JLG®

An Oshkosh Corporation Company

Service and Maintenance Manual

Model 1250AJP

PVC 2001

31215058

November 04, 2019 - Rev A

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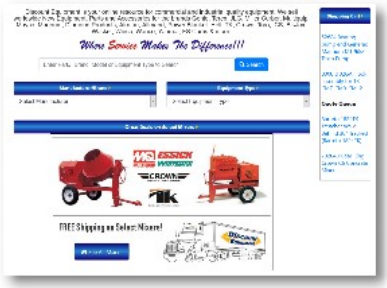

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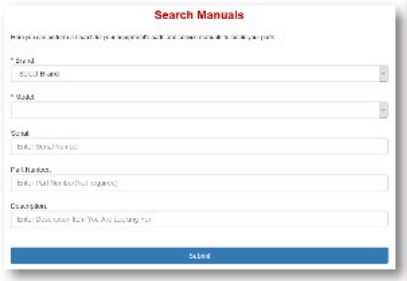

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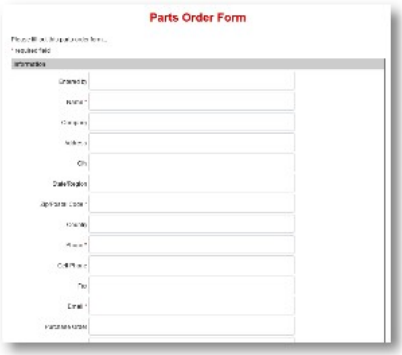

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SECTION A. INTRODUCTION - MAINTENANCE SAFETY PRECAUTIONS

A GENERAL

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

⚠ WARNING

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

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

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

⚠ WARNING

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

B HYDRAULIC SYSTEM SAFETY

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

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

C MAINTENANCE

⚠ WARNING

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

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

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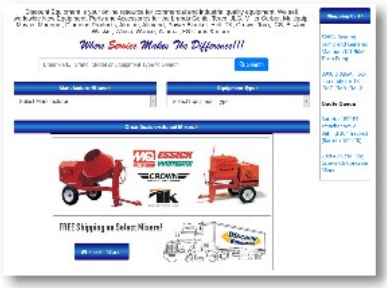

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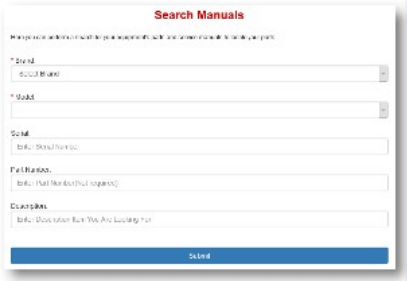

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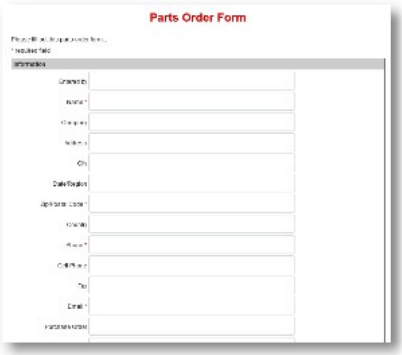

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SECTION 1. SPECIFICATIONS

1.1 OPERATING SPECIFICATIONS & PERFORMANCE DATA

Machine Specification

Maximum Work Load (Capacity) Unrestricted Restricted	 500 lb (230 kg) 1000 lb (450 kg)
Max. Vertical Platform Height (Unrestricted)	125 ft (38.1 m)
Max. Vertical Platform Height (Restricted)	125 ft (38.1 m)
Max. Horizontal Platform Reach (Unrestricted)	63 ft-2 in (19.3 m)
Max. Horizontal Platform Reach (Restricted)	53 ft-2 in (16.2 m)
Up and Over Height	60 ft-7 in (18.5 m)
Main Boom Range (At Maximum Up & Over)	+75° / -55°
Main Boom Range (At Maximum Left & Right)	+70° / -55°
Maximum Boom Swing	360° Continuous
JibPLUS Length Horizontal Motion Vertical Motion	 8 ft (2.44 m) 125° working, 210° stowed 130° (+75/-55)
Max. Hydraulic System Pressure	4600 psi (317 Bar)
Maximum Wind Speed	28 mph (12.5 m/s)
Maximum Manual Force	400 N
Electrical System Voltage	12 Volts
Max Tire Load	23,700 lb (10750 kg)
Maximum Platform Rotation	±90°

1.2 CAPACITIES

Hydraulic Tank	53.3 gal (201.7 L)
Fuel Tank	31 gal (117 L)
Hydraulic System	65.4 gal (247.5 L)
Drive Hub Bonfiglioli Reggiana Riduttori	 0.53 qt (0.5 L) ± 10% 1.59 qt (1.5 L) ± 10%

1.3 CHASSIS SPECIFICATIONS

Maximum Travel Grade With boom in stowed position (Gradeability)	45%
Maximum Travel Grade With boom in stowed position (Side Slope)	5°
Turning Radius (Axles Retracted) Outside Inside	 22 ft-6 in (6.8 m) 14 ft-5 in (4.4 m)
Turning Radius (Axles Extended) Inside Outside	 8 ft (2.4 m) 19 ft-4 in (5.9 m)
Max Tire Load	23700 lb (10750 kg)
Max Ground Bearing Pressure	100 psi (7.03 kg/cm^2)
Maximum Drive Speed Stowed Elevated	 3.25 mph (5.2 kph) 0.75 mph (1.2 kph)
Gross Machine Weight Platform Empty Platform Empty w/ Skypower	 44,000 lb (19,958 kg) 44,215 lb (20,056 kg)

1.4 TIRES

Size	445/50D710
Load Range	J
Ply Rating	18
Foam Fill	Polyurethane HD (55 Durometer) Foam
Diameter	46.45 in (117.9 cm)
Width	18 in (45.7 cm)
Rim Size	15x28
Tire & Wheel Weight	867 lb (393 kg)
Max Tire Load	23,700 lb (10750 kg)
Size	445/65-24
Type	Solid
Diameter	45.3 in (115.1 cm)
Width	17.3 in (43.9 cm)
Rim Size	12.00-24
Tire & Wheel Weight	960 lb (435.4 kg)
Max Tire Load	23,700 lb (10750 kg)

1.5 DIMENSIONAL DATA

Machine Dimensional Data

Overall Width Axles Retracted Axles Extended	 8 ft-2 in (2.49 m) 12 ft-6 in (3.8 m)
Stowed Height	10 ft (3.05 m)
Stowed Length (Transport Mode)	37 ft-7 in (11.46 m)
Stowed Length (Working Mode)	47 ft-6 in (14.48 m)
Wheelbase	12 ft-6 in (3.81 m)
Tailswing Tower Up Tower Down	 7 ft (2.13 m) 11 ft-3 in (3.43 m)
Oscillating Axle	±6 in (0.15 m)
Ground Clearance (Axle)	12 in (30.4 cm)
Ground Clearance (Chassis)	25.5 in (64.7 cm)

1.6 ENGINE DATA

Deutz TD2011L4

Type	Liquid Cooled
Number of Cylinders	4
Bore	3.7 in (94 mm)
Stroke	4.4 in (112 mm)
Total Displacement	190 cu. in (3108 cm^3)
Compression Ratio	17.5
Firing Order	1-3-4-2
Max Power Output	74.2 hp (55.4 kW) @ 2500 rpm
Max Torque Output	192 ft. lbs. (260 Nm) @ 1800 rpm
Oil Capacity Cooling System w/Filter Total Capacity	 5 qt (4.5 L) 11 qt (10.5 L) 16 qt (15 L)
Average Fuel Consumption	1.1 gph (4.1 Lph)
Low Engine RPM	1000
Mid Engine RPM	1800
High Engine RPM	2600

Deutz TCD2.9L4

Type	Liquid Cooled
Number of Cylinders	4
Bore	3.6 in (92 mm)
Stroke	4.3 in (110 mm)
Total Displacement	178 cu. in (2925 cm^3)
Firing Order	1-3-4-2
Max Power Output	74.2hp (55.4 kW) @ 2500 rpm
Max Torque Output	192 ft. lbs. (260 Nm) @ 1800 rpm
Oil Capacity	2.4 gal (8.9 L)
Coolant Capacity (System)	3.2 gal (12.1 L)
Average Fuel Consumption	1.2 gph (4.1 Lph)
Low Engine RPM	1200
Mid Engine RPM	1800
High Engine RPM	2500

1.7 TORQUE REQUIREMENTS

Description	Torque Value (Dry)	Interval Hours
Wheel Bolts	180 ft-lb (252 Nm)	150
Counterweight Bolts	400 ft-lb (542 Nm)	As required
Swing Bearing Bolts	190 ft-lb (260 Nm)	50/600*
Starter or Aux Pump Solenoid Contacts Coil	 95 in-lb (10.5 Nm) 40 in-lb (4.5 Nm)	 As required
*Check turntable bearing bolts for security after first 50 hours of operation and every 600 hours thereafter. (See Turntable Bearing in Section 3.)		
NOTE: *When maintenance becomes necessary or a fastener has loosened, refer to the Torque Chart for proper torque value.*		

1.8 MAJOR COMPONENT WEIGHTS

Component		LB	KG
Tire & Wheel	445/50D710, FF	867	393
	445/65-24, Solid	960	435.4
Drive Hub & Motor	BONFIGLIOLI	267	121
	REGGIANA RIDUTTORI	306	138
Engine Assembly	TD 2.9L4	550	249.5
Main Boom		5196	2357
Tower Boom		7147	3242
Tower Telescope Cylinder		915	415
Axle Oscillation Cylinder		74	34
Axle Extend Cylinder		92	42
Level Cylinder		89	40
Platform	36 x 96	245	111
	36 x 72	195	89
Counterweight *		3329	1574
* For actual weight, see stamping on counterweight			

1.9 PRESSURE SETTINGS

Function	PSI	Bar
Function Pump, High Press. Relief	3200	220.6
Function Pump Standby Pressure	450	31
Swing	1500	103.4
Main Telescope	2200	151.6
Axle, Extend & Retract	2500	172.3
Steer Left	2600	179
Steer Right	2000	138
Platform Level Up	3000	206.8
Platform Level Down	2500	172.3
Jib, Up & Down	2750	189.6

1.10 HYDRAULIC OIL

Table 1-1.Hydraulic Oil Specifications

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

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

NOTE: *If temperatures remain consistently below 20° F (-7° C), JLG Industries recommends using Premium Hydraulic Fluid.*

Table 1-2. Mobil DTE 10 Excel 32 Specs

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	33cSt
at 100° C	6.6 cSt
at 100° F	169 SUS
at 210° F	48 SUS
cp at -20° F	6,200
Viscosity Index	140

Table 1-3. UCon Hydrolube HP-5046

Type	Synthetic Biodegradable
Specific Gravity	1.082
Pour Point, Max	-58°F (-50°C)
pH	9.1
Viscosity	
at 0° C (32° F)	340 cSt (1600SUS)
at 40° C (104° F)	46 cSt (215SUS)
at 65° C (150° F)	22 cSt (106SUS)
Viscosity Index	170

Table 1-4. Mobil EAL H 46 Specs

Type	Synthetic Biodegradable
ISO Viscosity Grade	46
Density at 15° C	.874
Pour Point	-49°F (-45°C)
Flash Point	500°F (260°C)
Operating Temp.	-20 to 200°F (-29 to 93°C)
Weight	7.64 lb/gal (0.9 kg/L)
Viscosity	
at 40° C	48.8 cSt
at 100° C	7.8 cSt
Viscosity Index	145

Table 1-5. Mobil EAL 46 Specs

Type	Synthetic Biodegradable
ISO Viscosity Grade	46
Density at 15°C	.93
Pour Point	-27°F (-33°C)
Flash Point	568°F (298°C)
Operating Temp.	-20 to 200°F (-29 to 93°C)
Weight	7.64 lb/gal (0.9 kg/L)
Viscosity	
at 40° C	43.3 cSt
at 100° C	7.7 cSt
Viscosity Index	149

Table 1-6. Quintolubric 888-46

Density	0.92 @ 59°F (15°C)
Pour Point	<-22°F (<-30°C)
Flash Point	572°F (300°C)
Fire Point	680°F (360°C)
Autoignition Temperature	>842°F(>450°C)
Viscosity	
at 0° C (32° F)	320 cSt
at 20° C (104° F)	109 cSt
at 40° C (104° F)	47.5 cSt
at 100° C (150° F)	9.5 cSt
Viscosity Index	190

Table 1-7. Mobilfluid 424 Specs

SAE Grade	10W30
ISO	55
Gravity, API	29.0
Density, Lb/Gal. 60°F	7.35
Pour Point, Max	-46°F (-43°C)
Flash Point, Min.	442°F (228°C)
Viscosity	
Brookfield, cP at -18°C	2700
at 40° C	55 cSt
at 100° C	9.3 cSt
Viscosity Index	152

Table 1-8. Exxon Univis HVI 26 Specs

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

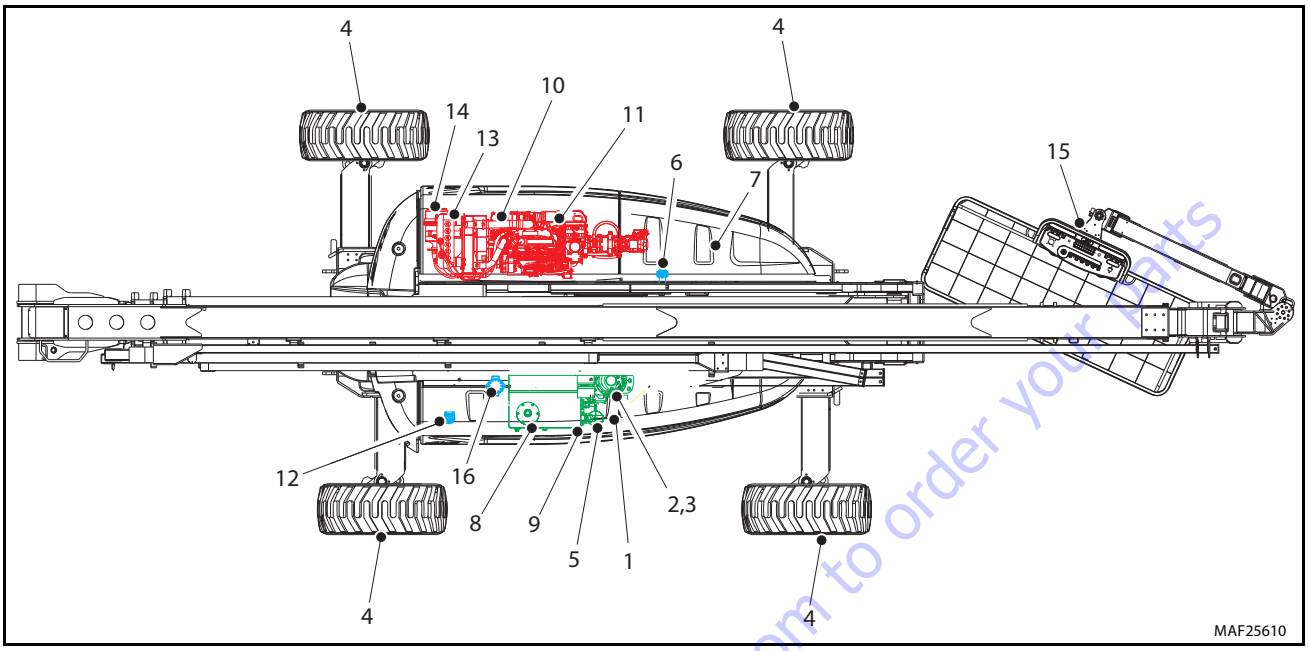


Figure 1-1. Lubrication & Operator Maintenance Diagram - Deutz 2.9 Engine

1.11 LUBRICATION & OPERATOR MAINTENANCE

Table 1-9. Lubrication Specifications

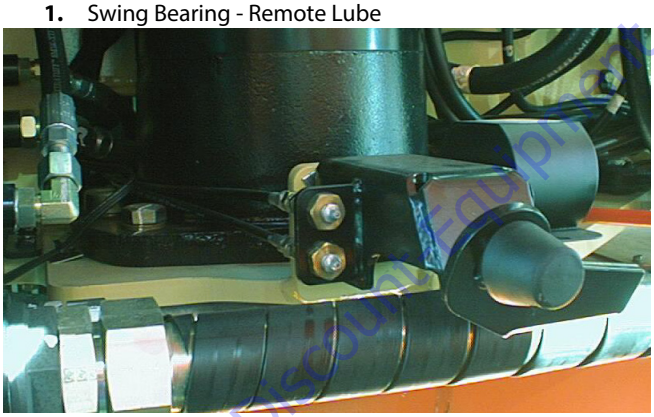
KEY	SPECIFICATIONS
MPG	Multipurpose Grease having a minimum dripping point of 350°F (177°C). Excellent water resistance and adhesive qualities, and being of extreme pressure type. (Timken OK 40 pounds minimum.)
EPGL	Extreme Pressure Gear Lube (oil) meeting API service classification GL-5 or MIL-Spec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

NOTICE

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

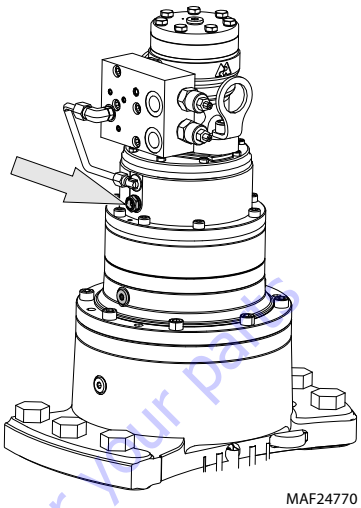
NOTE: *It is recommended as a good practice to replace all filters at the same time.*

1. Swing Bearing - Remote Lube



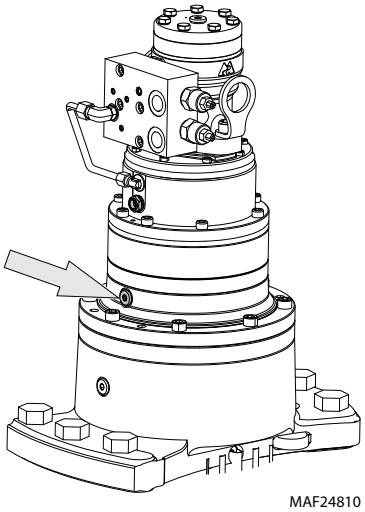
Lube Point(s) - 2 Grease Fitting
Capacity - A/R
Lube - MPG
Interval - Every 3 months or 150 hours of operation.

2. Swing Gearbox



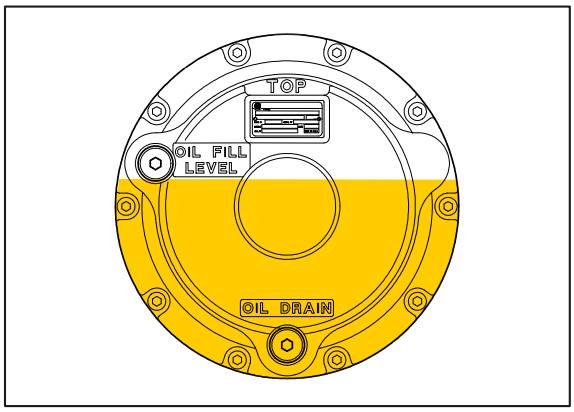
Lube Point(s) - Fill Plug
Capacity - 79 oz (2.3 L)
Lube - GL-5
Interval - Check level every 150 hours/Change every 1200 hours of operation. Fill to cover ring gear.

3. Swing Brake



Lube Point(s) - Fill Plug
Capacity - 2.7 oz (80 ml)
Lube - DTE24
Interval - Check level every 150 hours/Change every 1200 hours of operation.

4. A: Wheel Drive Hub - Bonfiglioli



Lube Point(s) - Level/Fill Plug
Capacity - 2.1 qt (2 L) ± 10%
Lube - EPGL
Interval - Change after first 150 hours then every1200 hours of operation
Comments - Place Fill port at 12 o'clock position and Check port at 8 o'clock position. Pour lubricant into fill port until it just starts to flow out of check port.

B: Wheel Drive Hub - Reggiana Riduttori)

Lube Point(s) - Level/Fill Plug
Capacity - 0.5 qt (0.5 L) ± 10%
Lube - EPGL
Interval - Change after first 150 hours then every 1200 hours of operation
Comments - Place Fill port at 12 o'clock position and Check port at 3 o'clock position. Pour lubricant into fill port until it just starts to flow out of check port.

5. Hydraulic Return Filter - (See Figure 1-2.)

Lube Point(s) - Replaceable Element
Interval - Change after first 50 hours and every 300 hours thereafter or as indicated by condition indicator.

Figure 1-2. Hydraulic Return Filter Condition Indicator

6. Hydraulic Charge Filter

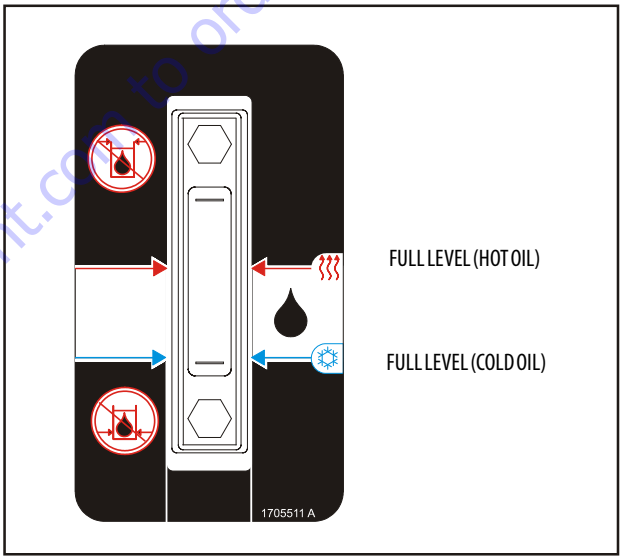
or

Lube Point(s) - Replaceable Element
Interval - Change after first 50 hours and every 300 hours thereafter or as indicated by condition indicator (if equipped).

7. Main Valve Filter

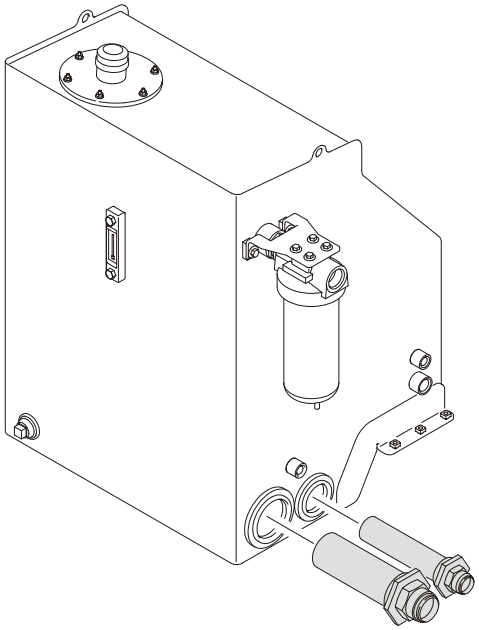
Lube Point(s) - Replaceable Element
Interval - Change after first 50 hours and every 300 hours thereafter.

8. Hydraulic Oil



Lube Point(s) - Fill Cap
Capacity - 55 gal (208 L) Tank
Lube - HO
Interval - Check level daily. Change every 2 years or 1200 hours of operation.

9. Suction Strainers (In Tank)

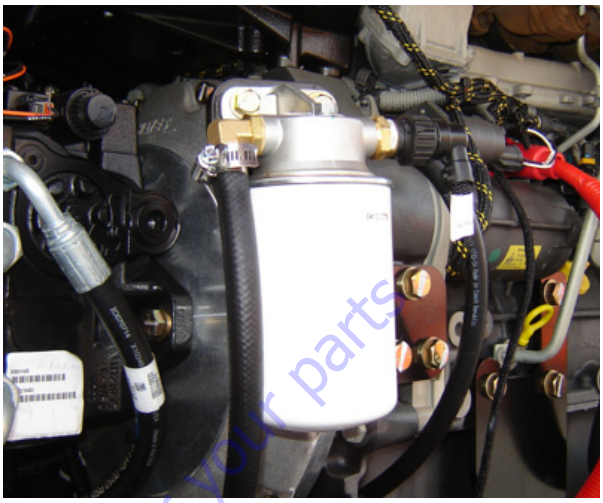


Lube Point(s) - 2
Interval - Every 2 years or 1200 hours of operation.
Remove and clean at time of hydraulic oil change.

10. Oil Change w/Filter - Deutz TCD2.9 L4

Lube Point(s) - Fill Cap/Spin-on Element
Capacity - 2.4 Gallon (8.9 L)
Lube - EO
Interval - Check level daily; change every 500 hours or six months, whichever comes first. Adjust final oil level by mark on dipstick.

11. Fuel Filter - Deutz TCD2.9

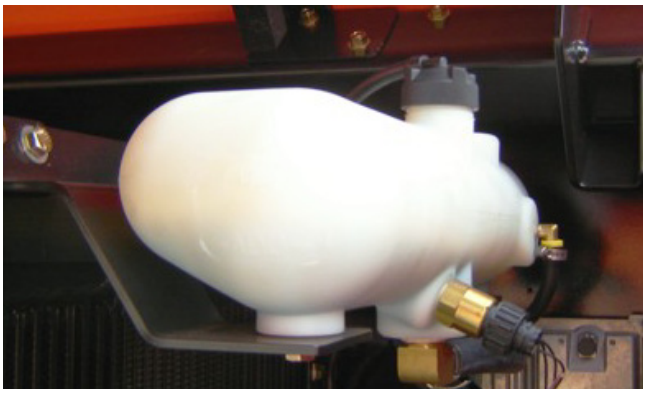


Lube Point(s) - Replaceable Element
Interval - Every year or 500 hours of operation.

12. Fuel Pre-Filter - Deutz TCD2.9

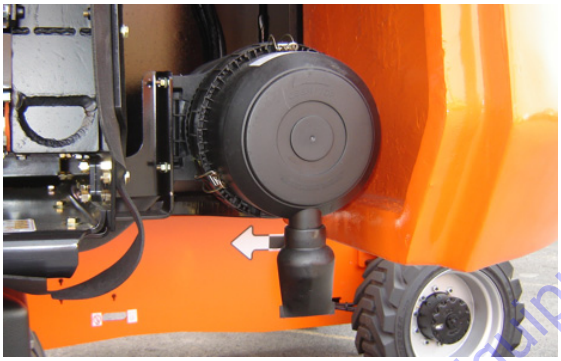
Lube Point(s) - Replaceable Element
Interval - Drain water daily; Change every year or 500 hours of operation.

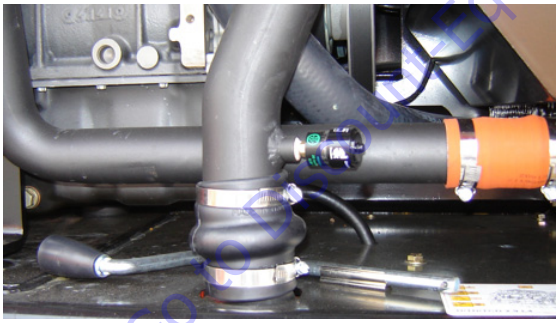
13. Radiator Coolant - Deutz TCD2.9



Lube Point(s) - Fill Cap
Capacity - 3.2 Gallon (12.1 L)
Lube - Anti-Freeze
Interval - Check level daily; change every 1000 hours or 2 years, whichever comes first.

14. Air Filter - Deutz TCD2.9



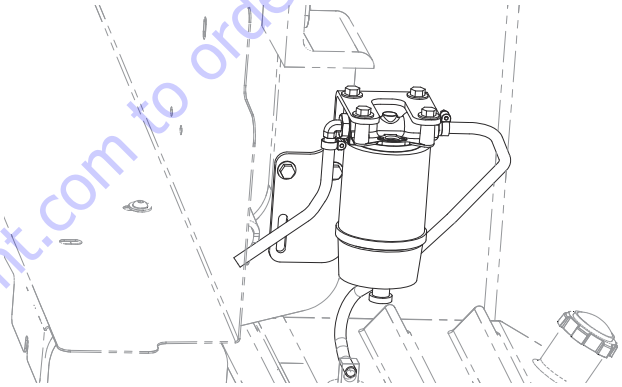


Lube Point(s) - Replaceable Element
Interval - Every 6 months or 300 hours of operation or as indicated by the condition indicator
Comments - Check Dust Valve daily.

15. Platform Filter

Lube Point(s) - Replaceable Element
Interval - Change after first 50 hours and then every year or 600 hours of operation thereafter.

16. Optional Fuel Filter/Water Separator



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

1.12 THREADLOCKING COMPOUND

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

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

1.13 TORQUE CHARTS

SAE Fastener Torque Chart

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

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

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

3. * ASSEMBLY USES HARDENED WASHER

SAE Fastener Torque Chart (Continued)

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

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

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

3. * ASSEMBLY USES HARDENED WASHER

5000059K

SAE Fastener Torque Chart (Continued)

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

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

5000059K

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

3. * ASSEMBLY USES HARDENED WASHER

SAE Fastener Torque Chart (Continued)

Values for Magni Coating Fasteners (Ref 4150701)										
SAE GRADE 8 (HEX HD) BOLTS & GRADE 8 NUTS*										
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry or Loctite® 263) K=0.17		Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.16		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604							
	48	0.1120	0.00661							
6	32	0.1380	0.00909							
	40	0.1380	0.01015							
8	32	0.1640	0.01400							
	36	0.1640	0.01474	1320	37	4				
10	24	0.1900	0.01750	1580	51	6				
	32	0.1900	0.02000	1800	58	7				
1/4	20	0.2500	0.0318	2860	122	14	114	13		
	28	0.2500	0.0364	3280	139	16	131	15		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	4720	20	25	20	25	20	25
	24	0.3125	0.0580	5220	25	35	20	25	20	25
3/8	16	0.3750	0.0775	7000	35	50	35	50	35	50
	24	0.3750	0.0878	7900	40	55	40	55	35	50
7/16	14	0.4375	0.1063	9550	60	80	55	75	50	70
	20	0.4375	0.1187	10700	65	90	60	80	60	80
1/2	13	0.5000	0.1419	12750	90	120	85	115	80	110
	20	0.5000	0.1599	14400	100	135	95	130	90	120
9/16	12	0.5625	0.1820	16400	130	175	125	170	115	155
	18	0.5625	0.2030	18250	145	195	135	185	130	175
5/8	11	0.6250	0.2260	20350	180	245	170	230	160	220
	18	0.6250	0.2560	23000	205	280	190	260	180	245
3/4	10	0.7500	0.3340	30100	320	435	300	410	280	380
	16	0.7500	0.3730	33600	355	485	335	455	315	430
7/8	9	0.8750	0.4620	41600	515	700	485	660	455	620
	14	0.8750	0.5090	45800	570	775	535	730	500	680
1	8	1.0000	0.6060	51500	730	995	685	930	645	875
	12	1.0000	0.6630	59700	845	1150	795	1080	745	1015
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

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

3. * ASSEMBLY USES HARDENED WASHER

5000059K

SAE Fastener Torque Chart (Continued)

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

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

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

3. * ASSEMBLY USES HARDENED WASHER

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

SAE Fastener Torque Chart (Continued)

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

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

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 5000059K

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Metric Fastener Torque Chart (Continued)

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

NOTES:

1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS 5000059K
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Metric Fastener Torque Chart (Continued)

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

NOTES:

1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS 5000059K
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Metric Fastener Torque Chart (Continued)

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

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

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SECTION 2. GENERAL

2.1 MACHINE PREPARATION, INSPECTION, AND MAINTENANCE

General

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

Preparation, Inspection, and Maintenance

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

Pre-Start Inspection

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

Pre-Delivery Inspection and Frequent Inspection

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

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

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

Annual Machine Inspection

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

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

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

Preventative Maintenance

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

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

Table 2-1. Inspection and Maintenance

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

2.2 SERVICE AND GUIDELINES

General

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

Safety and Workmanship

Your safety, and that of others, is the first consideration when working on or around 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. Always provide adequate support when lifting 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 foreign materials out of vital components. Precautions have been taken to safeguard against this. Shields, covers, seals, and filters are provided to keep air, fuel, and oil supplies clean; however, these items must be maintained on a scheduled basis to function properly.

2. At any time when air, fuel, or oil lines are disconnected, clear adjacent areas as well as the openings and fittings themselves. As soon as a line or component is disconnected, cap or cover all openings to prevent entry of foreign matter.

3. Clean and inspect all parts during servicing or maintenance, and ensure all passages and openings are unobstructed. Cover all parts to keep them clean. Be sure all parts are clean before they are installed. New parts should remain in their containers until needed.

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. If a component must be removed on an angle, keep in mind the capacity of an eyebolt or similar bracket lessens, as the angle between the supporting structure and the component becomes less than 90 degrees.

3. If a part resists removal, check if all nuts, bolts, cables, brackets, wiring, etc., have been removed and that no adjacent parts are interfering.

Component Disassembly and Reassembly

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

Pressure-Fit Parts

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

Bearings

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

Gaskets

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

Bolt Usage and Torque Application

1. Use bolts of proper length. A bolt which is too long will bottom before the head is tight against its related part. If a bolt is too short, there will not be enough thread area to engage and hold the part properly. When replacing bolts, use only those having the same specifications of the original, or one which is equivalent.
2. Unless specific torque requirements are provided in this manual, use standard torque values on heat-treated bolts, studs, and steel nuts, in accordance with recommended shop practices. (See Torque Chart Section 1.)

Hydraulic Lines and Electrical Wiring

Clearly mark or tag hydraulic lines and electrical wiring, as well as their receptacles, when disconnecting or removing them from the unit. This will ensure correct reinstallation.

Hydraulic System

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

Lubrication

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

Battery

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

Lubrication and Servicing

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

2.3 LUBRICATION AND INFORMATION

Hydraulic System

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

2. Design and manufacturing tolerances of component working parts are very close, therefore, even the smallest amount of dirt or foreign matter entering a system can cause wear or damage to the components and cause faulty operation. Every precaution must be taken to keep hydraulic oil clean, including reserve oil in storage. Hydraulic system filters should be checked, cleaned, and/or replaced as necessary, at intervals specified in the Lubrication Chart in Section 1. Always examine filters for evidence of metal particles.

3. Cloudy oils indicate a high moisture content which permits organic growth, resulting in oxidation or corrosion. If this condition occurs, the system must be drained, flushed, and refilled with clean oil.

4. It is not advisable to mix oils of different brands or types, as they may not contain the same required additives or be of comparable viscosities. Good grade mineral oils, with viscosities suited to the ambient temperatures in which the machine is operating, are recommended for use.

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

Hydraulic Oil

1. Refer to Section 1 for recommendations for viscosity ranges.

2. JLG recommends Standard UTTO Fluid hydraulic oil, which has an SAE viscosity of 10W-30 and a viscosity index of 152.

NOTE: *Start-up of hydraulic system with oil temperatures below -15 degrees F (-26 degrees C) is not recommended. If it is necessary to start the system in a sub-zero environment, it will be necessary to heat the oil with a low density, 100VAC heater to a minimum temperature of -15 degrees F (-26 degrees C).*

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

Changing Hydraulic Oil

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

2. Use every precaution to keep the hydraulic oil clean. If the oil must be poured from the original container into another, be sure to clean all possible contaminants from the service container. Always clean the mesh element of the filter and replace the cartridge any time the system oil is changed.

3. While the unit is shut down, a good preventive maintenance measure is to make a thorough inspection of all hydraulic components, lines, fittings, etc., as well as a functional check of each system, before placing the machine back in service.

Lubrication Specifications

Lubricants specified 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 any question 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 appearing in the Lubrication Chart.

2.4 CYLINDER DRIFT TEST

NOTICE

THE TOWER BOOM LIFT CYLINDER HAS A SPECIFIC PROCEDURE FOR TESTING CYLINDER DRIFT. REFER TO SECTION 4 - BOOM & PLATFORM.

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

Theory

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

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

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

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

Cylinder Leakage Test

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

Measure drift at cylinder rod with a calibrated dial indicator.

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

Cylinder leakage is acceptable if it passes this test.

Table 2-2. Cylinder Drift

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

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

Cylinder Thermal Drift

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

2.5 PINS AND COMPOSITE BEARING REPAIR GUIDELINES

Filament wound bearings.

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

2.6 WELDING ON JLG EQUIPMENT

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

Do the Following When Welding on JLG Equipment

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

Do NOT Do the Following When Welding on JLG Equipment

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

NOTICE

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

Table 2-3. Inspection and Preventive Maintenance Schedule

AREA	INTERVAL	
	Pre-Delivery[1] or Frequent[2] (Quarterly) Inspection	Annual[3] (Yearly) Inspection
Boom Assembly		
Boom Weldments	1,2,4	1,2,4
Hose/Cable Carrier Installations	1,2,9,12	1,2,9,12
Pivot Pins and Pin Retainers	1,2	1,2
Sheaves, Sheave Pins	1,2	1,2
Bearings	1,2	1,2
Wear Pads	1,2	1,2
Covers or Shields	1,2	1,2
Extend/Retract Chain or Cable Systems	1,2,3	1,2,3
Platform Assembly		
Platform	1,2	1,2
Railing	1	1,2
Gate	1	1,5
Floor	1	1,2
Rotator	15	15
Lanyard Anchorage Point	1,2,10	1,2,10
Turntable Assembly		
Swing Bearing or Worm Gear	1,2,14	1,2,3,13,14
Oil Coupling	9,11,23	9,11,23
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	5,8
Outrigger or Extendable Axle Systems	5,8	5,8
Steer Components	1,2,3,4,15,16,20	1,2,3,4,15,16,20
Drive Motors	1,2,3,5	1,2,3,5
Drive Hubs	1,3,9,11,15,23	1,3,9,11,15,23
Functions/Controls		
Platform Controls	5,6	5,6

Table 2-3. Inspection and Preventive Maintenance Schedule

AREA	INTERVAL	
	Pre-Delivery[1] or Frequent[2] (Quarterly) Inspection	Annual[3] (Yearly) Inspection
Ground Controls	5,6	5,6
Function Control Locks, Guards, or Detents	1,5	1,5
Footswitch	1,5	1,5
Emergency Stop Switches (Ground & Platform)	5	5
Function Limit or Cutout Switch Systems	5	5
Capacity Indicator	1,3,5,15,21,22	1,3,5,15,21,22
Drive Brakes	5	5
Swing Brakes	5	5
Boom Synchronization/Sequencing Systems	5	5
Manual Descent or Auxiliary Power	5	5
Power System		
Engine Idle, Throttle, and RPM	3	3
Engine Fluids (Oil, Coolant, Fuel)	9,11	9,11
Air/Fuel Filter	1,7	1,7
Exhaust System	1,9	1,9
Batteries	1,3,9,11,15,19,23	1,3,9,11,15,19,23
Battery Fluid	11	11
Battery Charger	1,3,5,15	1,3,5,15
Fuel Reservoir, Cap, and Breather	1,5,9,11	1,5,9,11
Hydraulic/Electric System		
Hydraulic Pumps	1,2,9	1,2,9
Hydraulic Cylinders	1,2,7,9	1,2,7,9
Cylinder Attachment Pins and Pin Retainers	1,2,9	1,2,9
Hydraulic Hoses, Lines, and Fittings	1,2,9,12	1,2,9,12
Hydraulic Reservoir, Cap, and Breather	1,2.5,9,11	1,2.5,9,11,24
Hydraulic Filter	7	7
Hydraulic Fluid	7,11	7,11
Electrical Connections	1,20	1,20
Instruments, Gauges, Switches, Lights, Horn	5,23	5,23
General		
Operation and Safety Manuals in Storage Box	21	21
ANSI Manuals of Responsibilities and AEM Safety Manual in Storage Box (ANSI and ANSI Expert 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] (Quarterly) Inspection	Annual[3] (Yearly) Inspection
Annual Machine Inspection Due	21	21
No Unauthorized Modifications or Additions	21	21
All Relevant Safety Publications Incorporated	21	21
General Structural Condition and Welds	2,4	2,4
All Fasteners, Pins, Shields, and Covers	1,2	1,2
Grease and Lubricate to Specifications	22	22
Function Test of All Systems	21	21,22
Paint and Appearance	7	7
Stamp Inspection Date on Frame		22
Notify JLG of Machine Ownership		22

Footnotes:

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

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

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

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

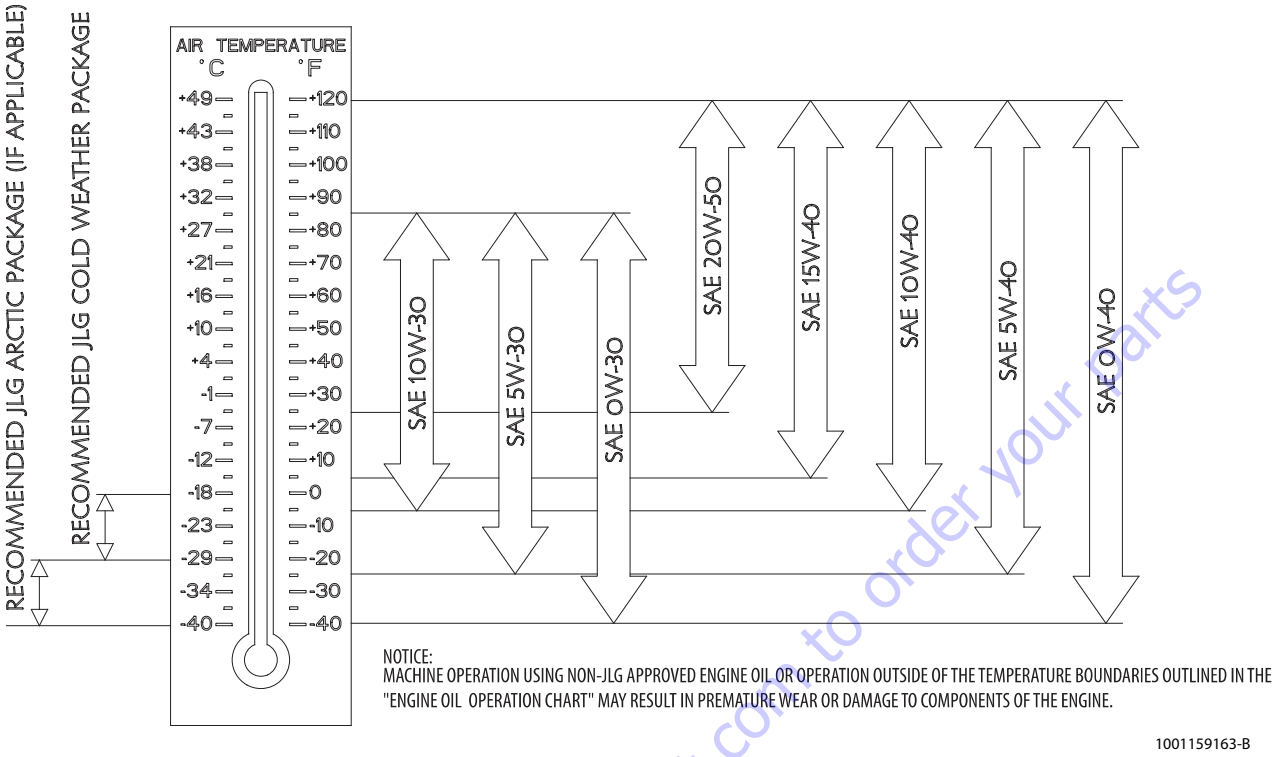
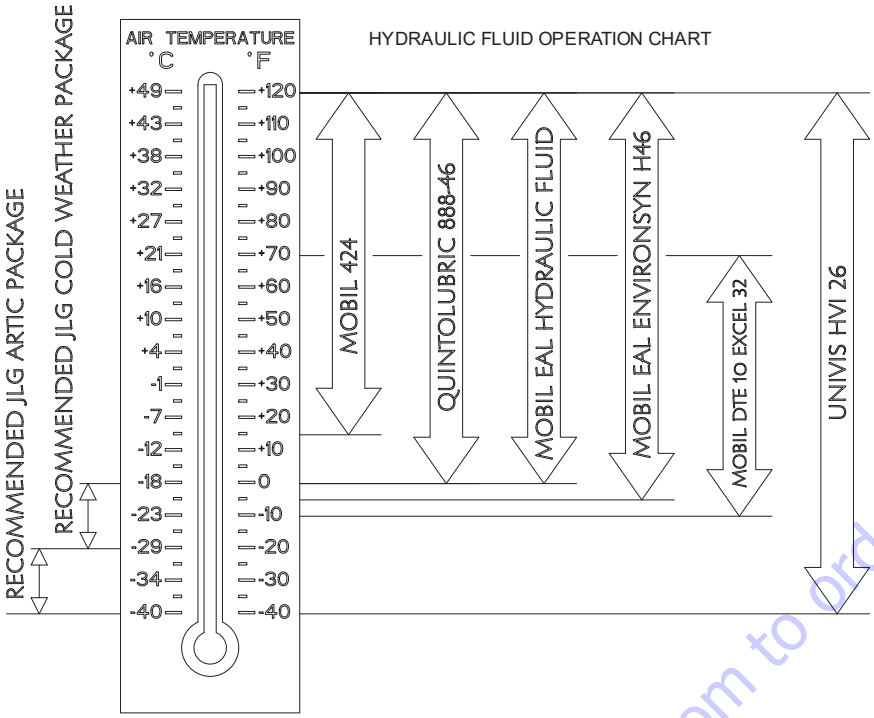


Figure 2-1. Engine Operating Temperature Specifications - Deutz



NOTICE:

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

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	164	X					X	
Univis HVI 26	26	376	X						
Mobil EAL Hydraulic Oil	47	176		X			X	X	
Mobil EAL 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

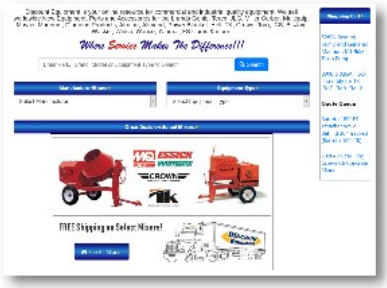
4150740-B

Figure 2-2. Hydraulic Oil Operating Temperature Specifications

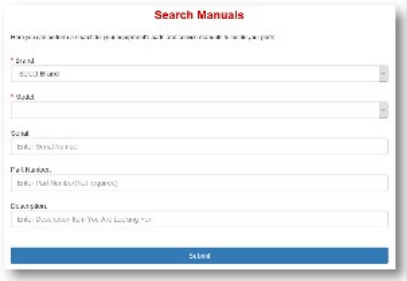
PARTS FINDER

Search Website by Part Number

Discount Equipment



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



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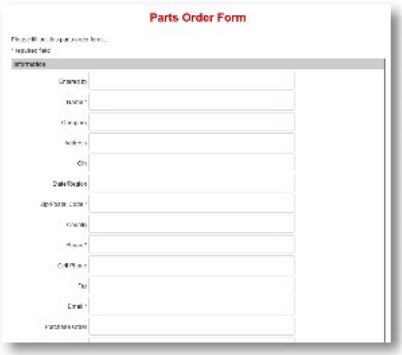

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We sell worldwide for the brands: Genie, Terex, JLG, MultiQuip, Mikasa, Essick, Whiteman, Mayco, Toro Stone, Diamond Products, Generac Magnum, Airman, Haulotte, Barreto, Power Blanket, Nifty Lift, Atlas Copco, Chicago Pneumatic, Allmand, Miller Curber,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

SECTION 3. CHASSIS & TURNTABLE

3.1 TIRES & WHEELS

Tire Damage

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

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

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

Tire Replacement

JLG recommends a replacement tire be the same size, ply and brand as originally installed on the machine. 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 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 original
- Approved for 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 and Tire Replacement

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

Wheel Installation

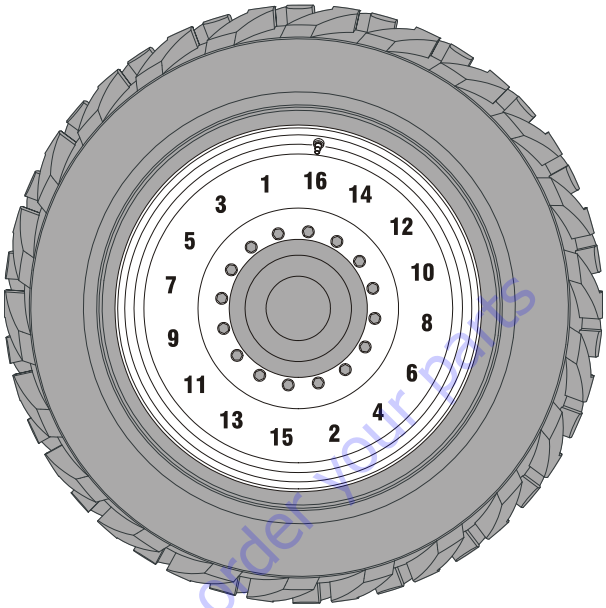
It is extremely important to apply and maintain proper wheel mounting torque.

⚠ WARNING

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

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



3. Tighten nuts 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
45 ft-lb (60 Nm)	100 ft-lb (140 Nm)	180 ft-lb (252 Nm)

4. Torque wheel nuts before first road use and after each wheel removal. Check and torque every 3 months or 150 hours of operation.

3.2 AXLE EXTENSION SYSTEM

The Axle Extension System allows each of the four axles to be extended and retracted together while maintaining full steering control as the machine is driven. The system allows the axles to extend or retract only while the boom is in the transport position (see Section 4.2, Transport Position Sensing System) and in order to minimize wheel scrubbing during axle movement, a minimum drive speed must be attained before axle extension/retraction will be permitted.

To extend/retract the axles, the user engages the axle extend/retract switch on the platform console and the drive control at the same time. The axle set indicator will be off when the axles are not fully extended and the axle extend/retract switch is not engaged. It will flash while the axles are extending or retracting and will be on constantly when the axles are fully extended.

The system uses four limit switches (one at each axle) to sense when the axles are fully extended. If any of the switches are not made, the control system considers the axles retracted.

With the axles not fully extended, the boom is restricted to operation within the transport position (see Section 4.2, Transport Position Sensing System). If a signal from any axle extend sensing switch is lost when the boom is beyond the transport position, the axle set indicator will flash and drive/steer functions will be disabled until the boom is brought back into the transport position. The steering angle will be automatically limited to ± 25 degrees anytime the axles are not fully extended. If the wheel angle is more than ± 25 degrees when the axle retract command is engaged, the control system will automatically reduce the wheel angle to 25 degrees during axle retraction.

NOTE: *For more detailed information concerning system adjustment and operation, refer to Section 6 - JLG Control System.*

3.3 AXLE LIMIT SWITCH ADJUSTMENT PROCEDURE

1. Fully extend axles.
2. Initially position the limit switch arm straight.
3. Select the mounting plate bolt pattern to position the switch roller within 0.125 inches (mm) from the edge of the axle cutout. It may be necessary to reposition the switch arm ±10° to accomplish this.
4. Ensure the arm will clear the axle (without bottoming out to 70° stroke of the switch) in the retracted position.
5. Check for proper operation. Axle set light is to deactivate when the axle is retracted 0.625 inches (16 mm) maximum from fully extended.

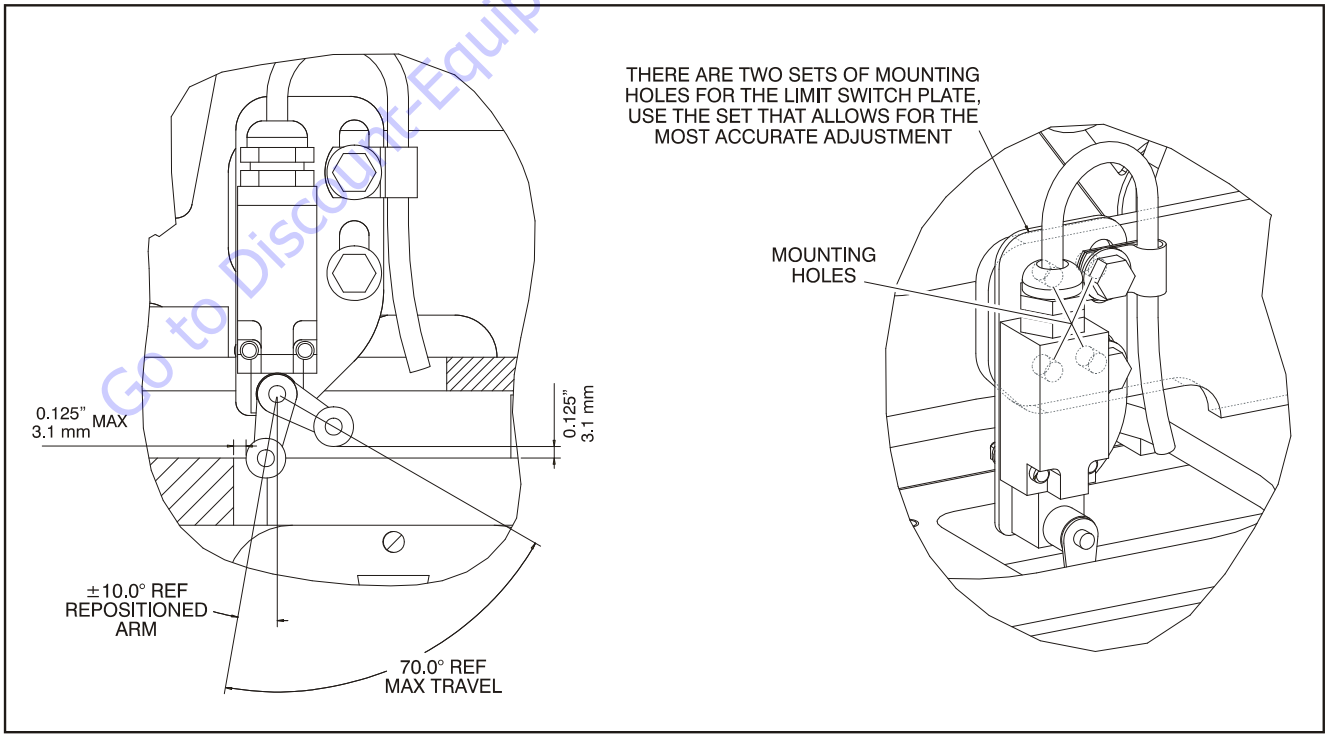


Figure 3-1. Axle Limit Switch Adjustment

3.4 DRIVE SYSTEM

The drive system utilizes 2 traction pumps so each side is powered individually. This produces maximum tractive effort to wheels by minimizing flow divider losses. The maximum drive speed is modulated with the steered angle of the wheels to eliminate the whiplash effect of driving at full speed and maximum steering lock.

3.5 STEERING CONTROL SYSTEM

Each wheel is individually steered by means of a closed circuit control system utilizing a steer sensor on each wheel, 4 steer cylinders, and proportional valves.

The control system senses the wheel position in relation to the steering command (direction and steering mode) and automatically synchronizes the movement of all 4 wheels to the desired position.

There are three different modes of steering selectable by the position of the steer select switch on the platform control panel: conventional two wheel steering, crab and coordinated. These are shown below.

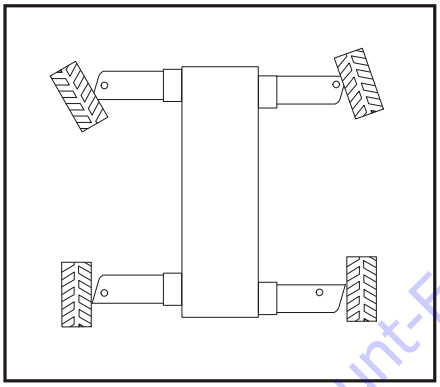


Figure 3-2. Conventional Two Wheel Steer Mode

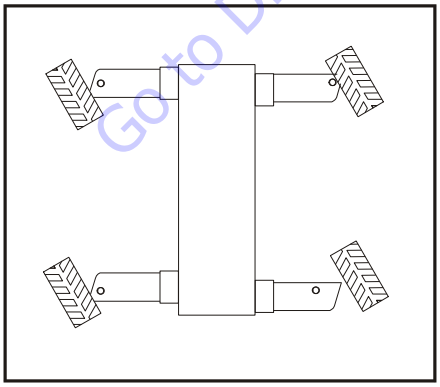


Figure 3-3. Crab Steer Mode

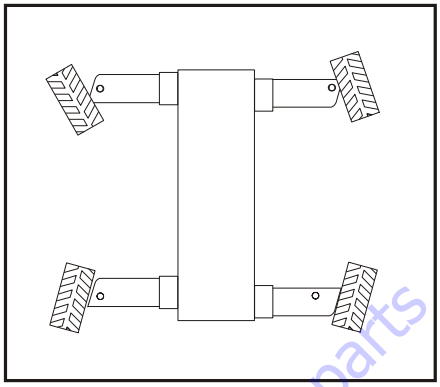


Figure 3-4. Coordinated Steer Mode

Each wheel has its own steer cylinder, wheel angle sensor, and proportional valve, allowing the control system to position each wheel to the ideal angle for all steering modes and all steering commands.

Changes in steering modes while the footswitch is depressed causes the wheels to automatically adjust to the appropriate angle for the selected steering mode based on the position of the inside front wheel. If the steer select switch is changed without the footswitch being depressed or when the EMS is off, the wheels will not move until the footswitch is depressed and a steering or drive command has been initiated.

The steering angles are limited to ±25 degrees anytime the axles are not fully extended. See the Axle Extension System (see Section 3.2, Axle Extension System) for interaction with the axle extension system.

If a wheel cannot achieve its commanded angle within a specified time, it is considered jammed. When a wheel is considered jammed during steering, a fault is reported and the remaining wheels will continue to their commanded position. The fault is cleared when the footswitch is cycled.

If a wheel is jammed making it significantly out of position, with regard to the other wheels, the drive motors are restricted to their maximum displacement (slow speed).

Wheel angle sensor failures will result in an approximated steering control logic that will allow the operator to move the machine until it can be repaired. The wheel at the failed sensor will be driven based on the information available from the other sensors. This wheel will not track perfectly and will become farther out of position over time. When the wheel becomes prohibitively out of position, the wheels can be resynchronized by fully steering against the mechanical stops.

NOTE: *For more detailed information concerning system adjustment and operation, refer to Section 6 - JLG Control System.*

3.6 DRIVE/STEERING SPEED CONTROL

The Drive/Steering Speed Control system uses the steering sensors from the steering control system (see Section 3.5, Steering Control System) to increase operator control and comfort by reducing the effect of turning the chassis and the resulting lateral platform speed. The system proportionally varies the drive speed based on the predicted turning radius of the chassis for both coordinated and conventional two wheel steer modes. The tighter the turn the slower the allowable drive speed. As crab steer does not steer on a radius, full drive speed is maintained regardless of steer angle.

NOTE: *For more detailed information concerning system adjustment and operation, refer to Section 6 - JLG Control System.*

3.7 TRACTION CONTROL SYSTEM

The Traction Control System uses the steering sensors from the steering control system (see Section 3.5, Steering Control System) to optimize the performance of the drive system. This is especially important due to the disparity of wheel speeds generated between the inside and outside wheels of the extended axle chassis with large steering angle capability.

The steering sensors are used to predict the rolling path and therefore the required wheel speed of each wheel as the steering angles change and steering modes change. The control system can then command the ideal flow from each of the two drive pumps, one for the right side of the machine and one for he left side. Two flow dividers, one for the right side front to back and one for the left side front to back absorb the variation in wheel speed front to back.

NOTE: *For more detailed information concerning system adjustment and operation, refer to Section 6 - JLG Control System.*

3.8 DRIVE ORIENTATION SYSTEM

The Drive Orientation System (DOS) is intended to indicate to the operator conditions that could make the direction of movement of the chassis different than the direction of movement of the drive/steer control handle. The system indicates to the operator the need to match the black and white directional arrows on the platform control panel to the arrows on the chassis. The system uses a 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 the last drive/steer command. If the timer expires, the DOS override switch must be re-engaged to enable drive/steer.

NOTE: *For more detailed information concerning system adjustment and operation, refer to Section 6 - JLG Control System.*

3.9 GROUND CONTROL ENABLE SYSTEM

The ground controls include the use of a function enable system for the operation of directional functions from the ground control panel. To operate any directional function, the function enable switch must be held in combination with the directional function switch. This switch doubles as the auxiliary power switch. When the engine is not running, activating this switch will operate auxiliary power. When the engine in running, activating this switch will enable directional functions. Releasing this switch during function commands will stop the function movement. Unlike the platform enable, no timer or sequence logic is imposed on the use of the function enable.

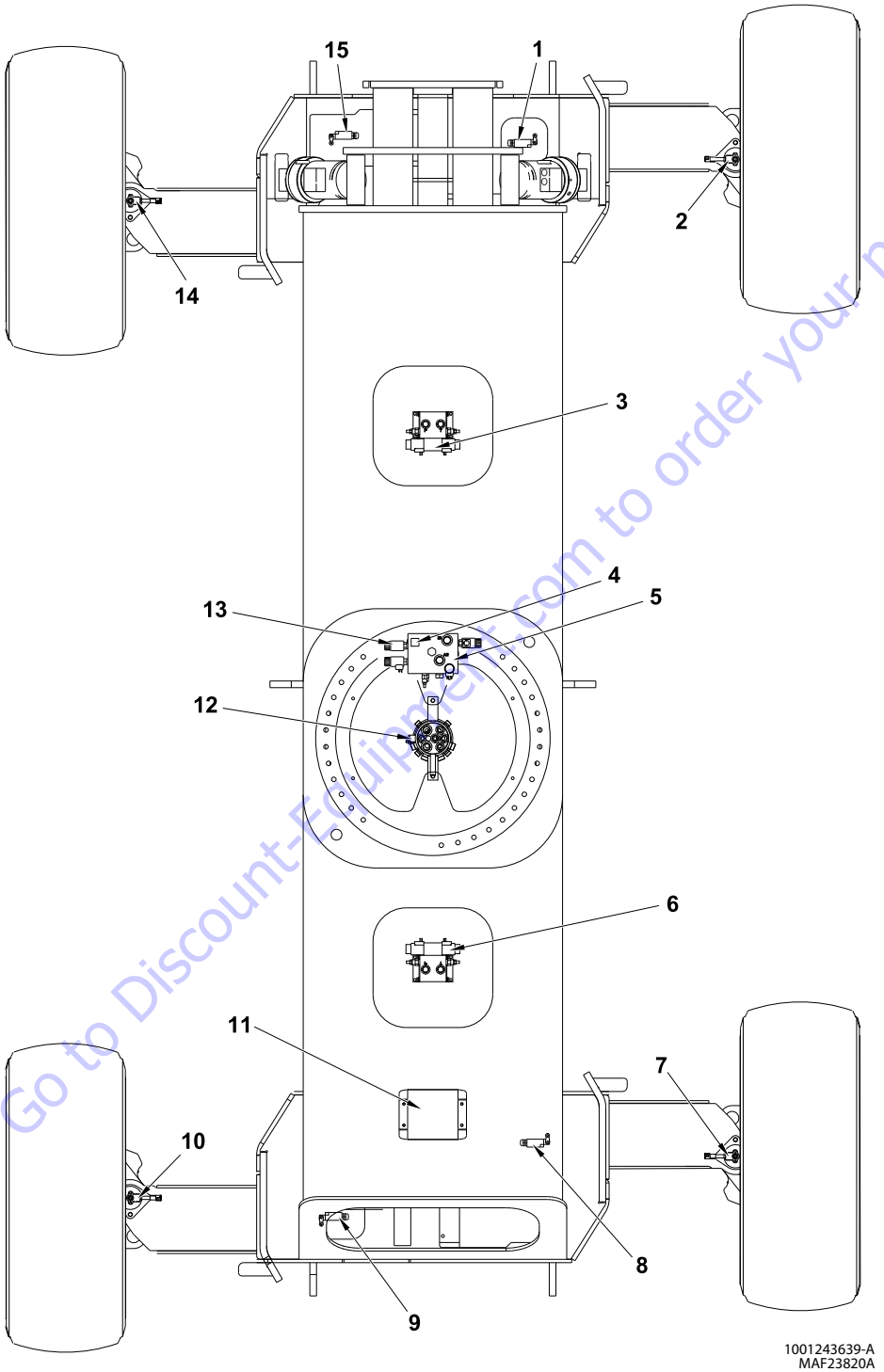


Figure 3-5. Chassis Component Location - Sheet 1 of 2

1. Axle Limit Switch (Right Front)
2. Steer Angle Sensor (Right Front)
3. Steer Valve (Front)
4. Axle Lockout Valve
5. Traction Valve
6. Steer Valve (Rear)
7. Steer Angle Sensor (Right Rear)
8. Axle Limit Switch (Right Rear)
9. Axle Limit Switch (Left Rear)
10. Steer Angle Sensor (Left Rear)
11. Chassis Module
12. Swivel/Collector Ring
13. Axle Lockout Pressure Switch
14. Steer Angle Sensor (Left Front)
15. Axle Limit Switch (Left Front)

Figure 3-6. Chassis Component Location - Sheet 2 of 2

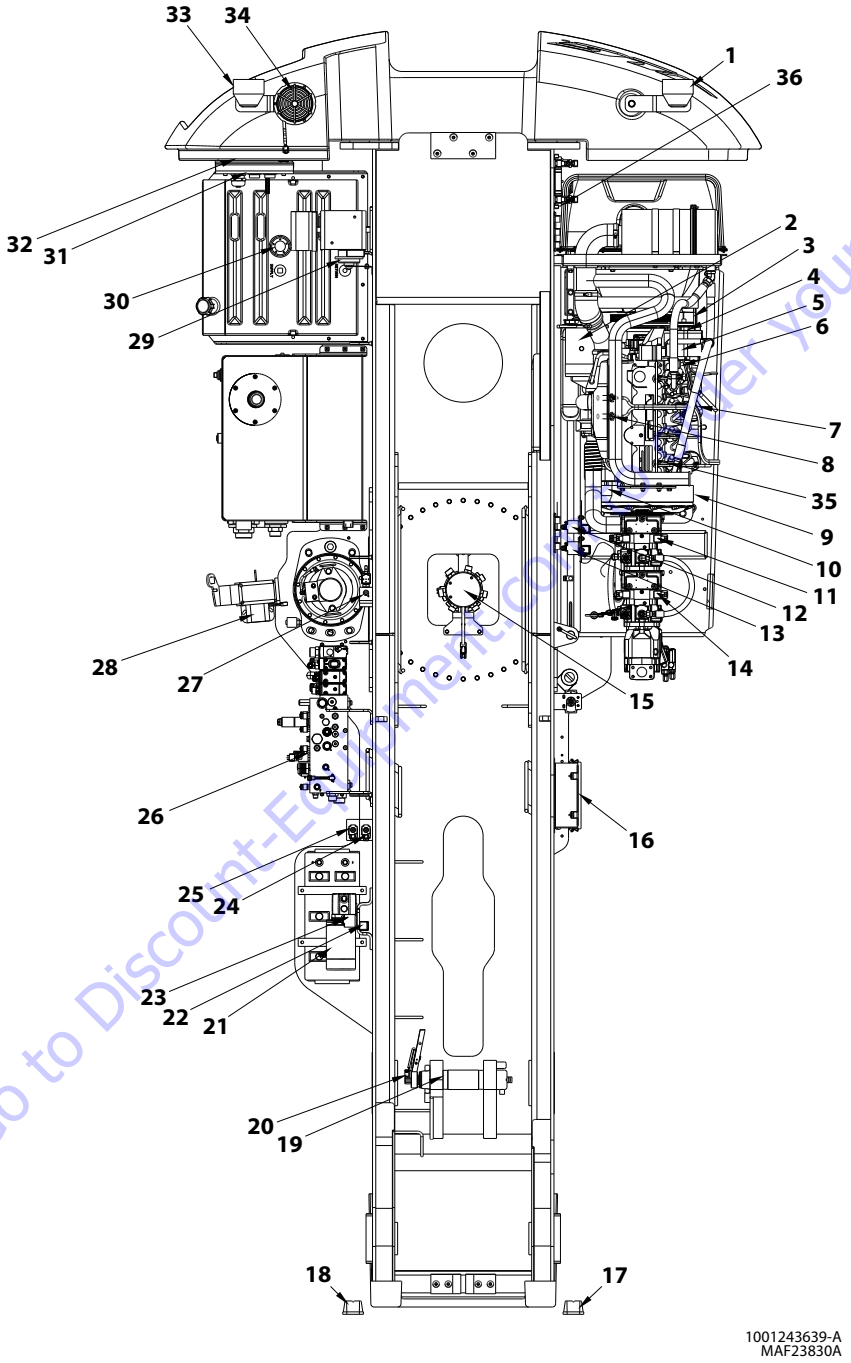


Figure 3-7. Turntable Component Location - Sheet 1 of 2

1. Headlight
2. 2500W Generator
3. 2500W Generator Control Box
4. Alternator
5. Throttle Actuator
6. Oil Temperature Switch
7. Oil Pressure Switch
8. Intake Heaters
9. Engine Speed Sensor
10. Starter
11. Drive Pump
12. Starter Relay
13. Glow Plug Relay
14. Drive Pump
15. Swivel
16. 7500W Generator Control Box
17. Taillight
18. Taillight
19. Tower Lift Cylinder Load Pin
20. Tower Lift Cylinder Angle Sensor
21. Auxiliary Power Unit
22. Headlight/Taillight Relay
23. Auxiliary Power Relay
24. Tower Lift Enable Valve
25. Tower Tele Enable Valve
26. Main Control Valve
27. Main Lift Enable Valve
28. Alarm
29. Horn
30. Fuel Level Sensor
31. Ground Control Box
32. BLAM Module
33. Headlight
34. Strobe Light
35. In Head Glow Plug
36. Deutz EMR2 Module

Figure 3-8. Turntable Component Location - Sheet 2 of 2

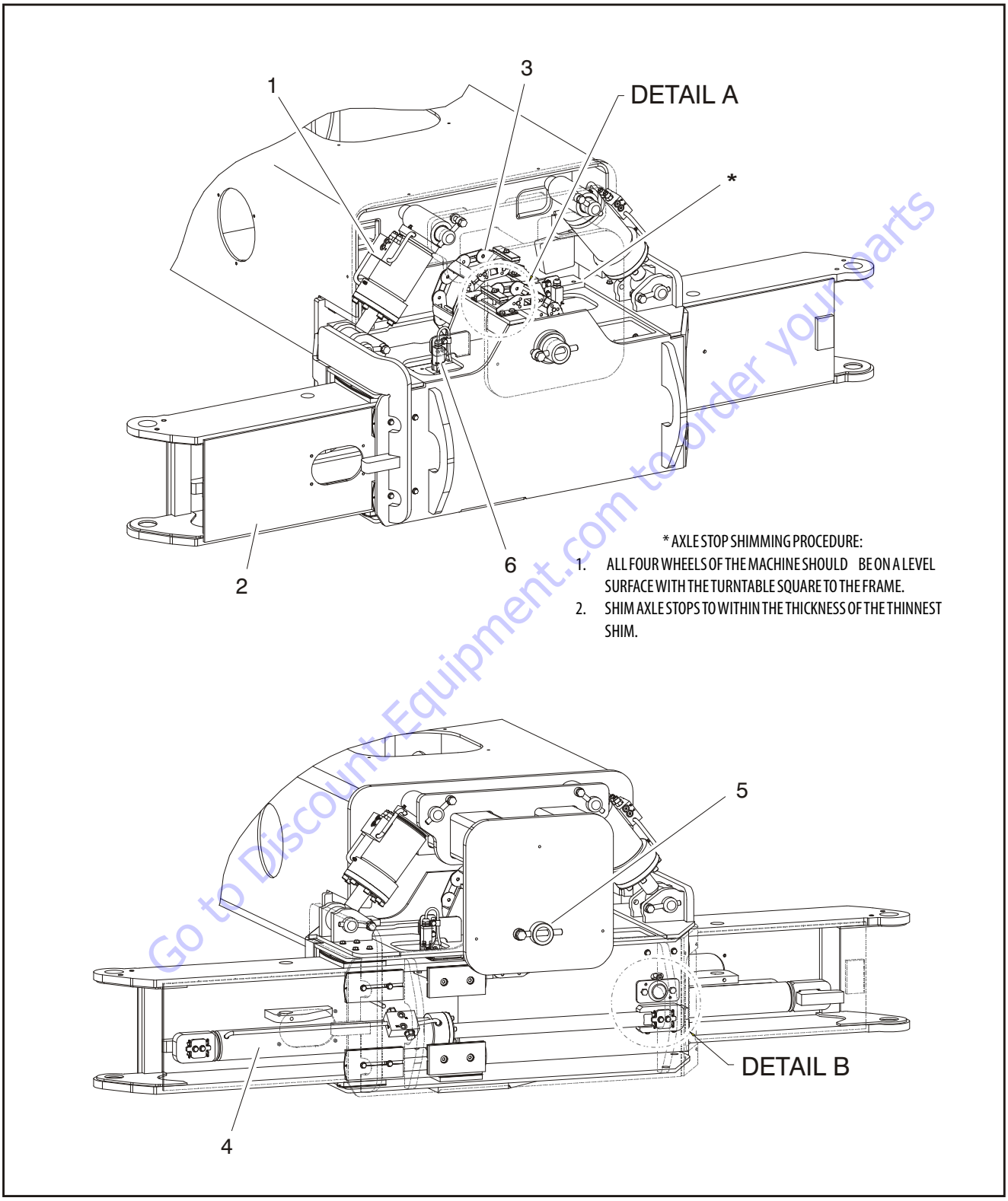
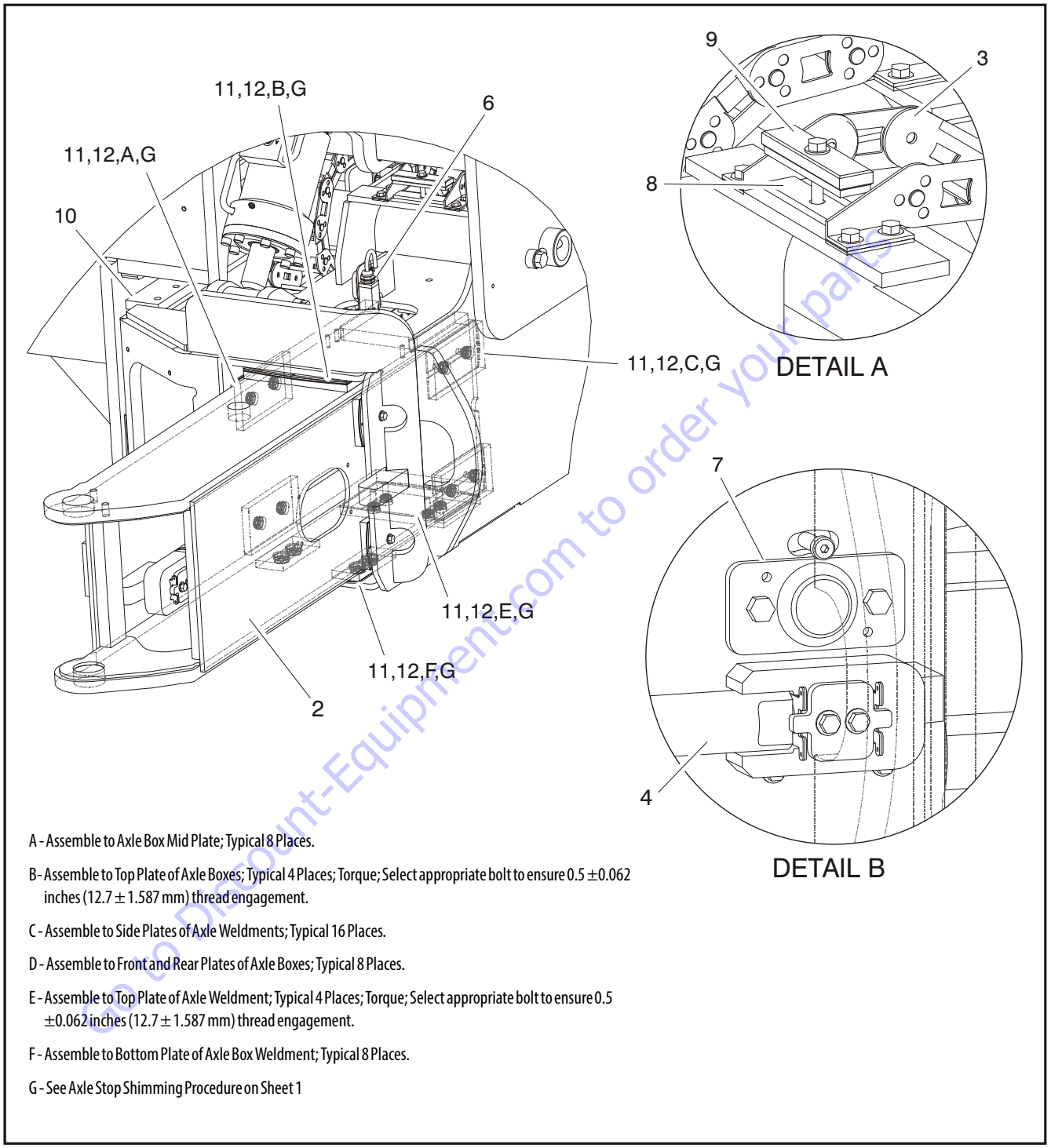


Figure 3-9. Oscillating Axle - Sheet 1 of 2



A - Assemble to Axle Box Mid Plate; Typical 8 Places.

B- Assemble to Top Plate of Axle Boxes; Typical 4 Places; Torque; Select appropriate bolt to ensure 0.5 ±0.062 inches (12.7 ± 1.587 mm) thread engagement.

C - Assemble to Side Plates of Axle Weldments; Typical 16 Places.

D - Assemble to Front and Rear Plates of Axle Boxes; Typical 8 Places.

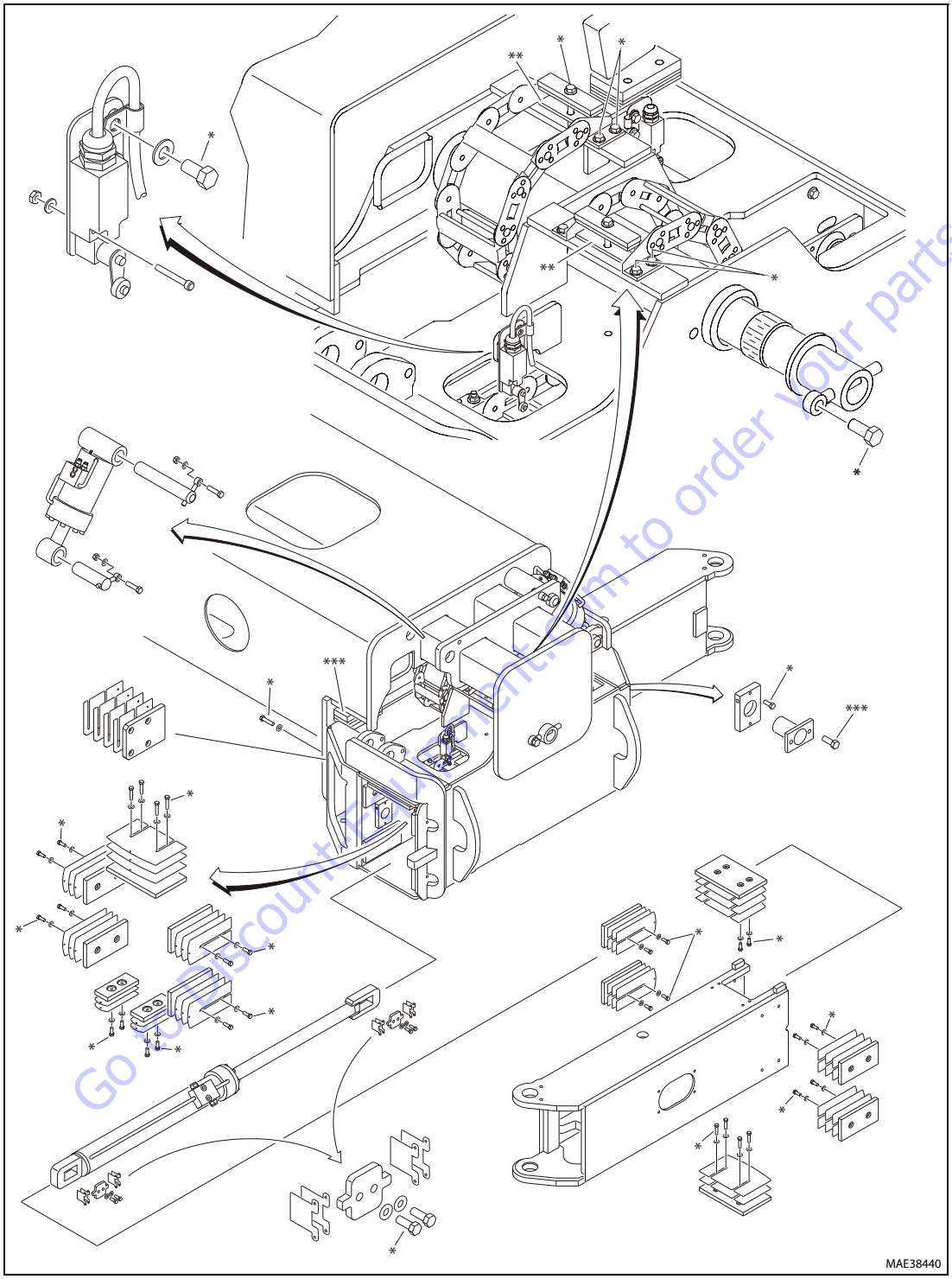
E - Assemble to Top Plate of Axle Weldment; Typical 4 Places; Torque; Select appropriate bolt to ensure 0.5 ±0.062 inches (12.7 ± 1.587 mm) thread engagement.

F - Assemble to Bottom Plate of Axle Box Weldment; Typical 8 Places.

G - See Axle Stop Shimming Procedure on Sheet 1

1. Axle Oscillation Cylinder
2. Axle
3. Axle Powertrack
4. Extension Cylinder
5. Axle Pivot Pin
6. Axle Limit Switch
7. Axle Stop Pin
8. Rubber Pad
9. Hose Clamp
10. Stop Block
11. Wear Pad
12. Shim

Figure 3-10. Oscillating Axle - Sheet 2 of 2

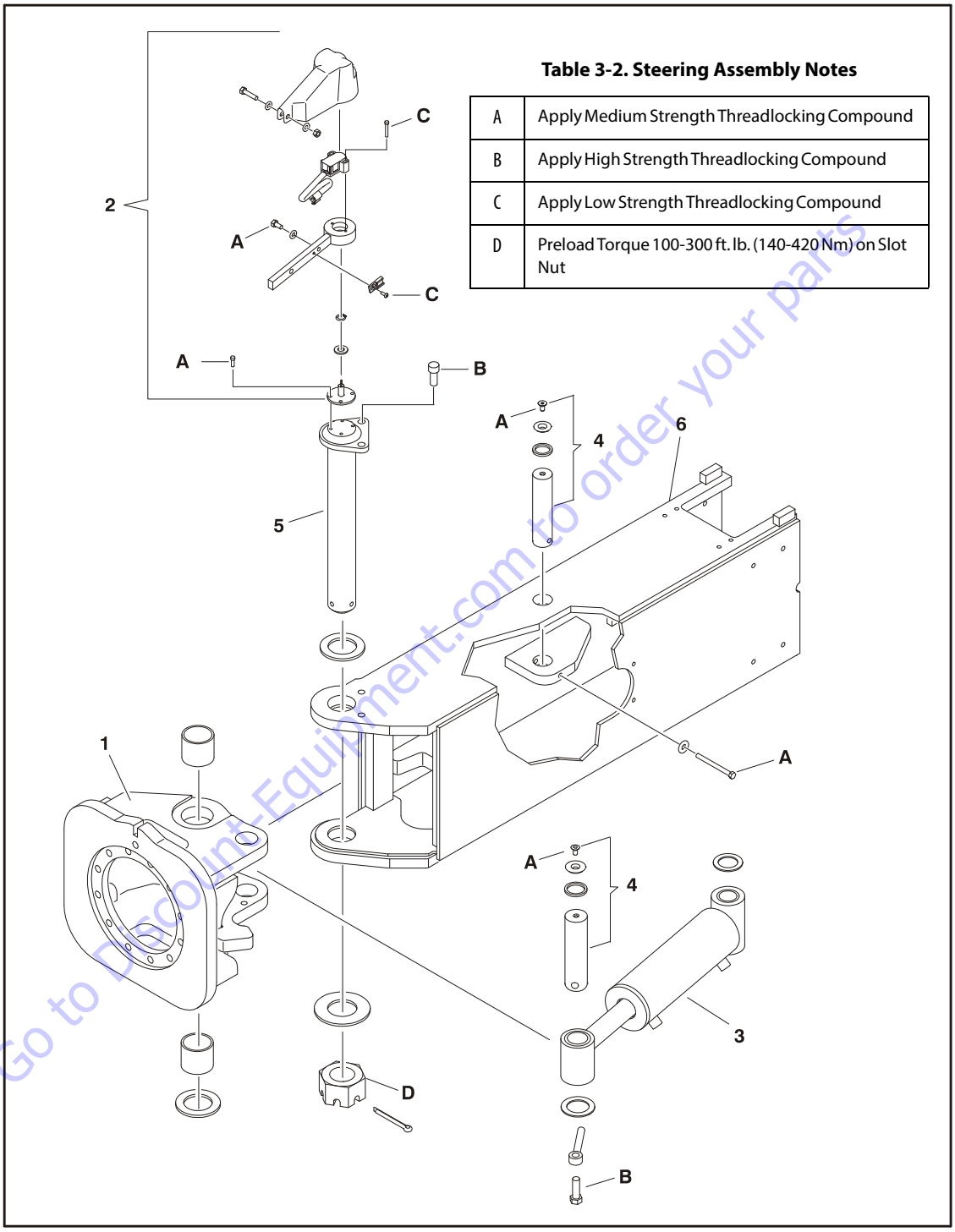


* - Medium Strength Threadlocking Compound

** - Medium Strength Threadlocking Compound

*** - High Strength Threadlocking Compound

Figure 3-11. Axle JLG Threadlocker Application



1. Spindle
2. Angle Sensor Assembly
3. Steer Cylinder
4. Steer Cylinder Pivot Pin
5. King Pin
6. Axle

Figure 3-12. Steering Installation

3.10 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 the transport position (see Section 4.2, Transport Position Sensing System) and drive is commanded.

Lockout cylinders lock and hold the axle when drive is not commanded or when the boom is outside the transport position. Cylinders unlock when pilot pressure is applied to the holding valves mounted on the cylinders and lock when pilot pressure is removed. Pilot pressure is available from brake pressure and is controlled by a solenoid operated lockout valve mounted in the frame. To ensure the lockout valve is functioning correctly, a NO pressure switch is mounted between the lockout valve and the holding valves. The system is "healthy" when pressure trips the pressure switch when the lockout valve is energized and conversely is healthy when the lack of pressure resets the pressure switch when the lockout valve is de-energized.

Failures in the oscillating axle system will cause the control system to disallow main boom lift up and telescope out, and tower boom lift up when both booms are within the transport position and will disallow drive/steer, lift up and telescope out when either boom is beyond the transport position.

NOTE: *For more detailed information concerning system adjustment and operation, refer to Section 6 - JLG Control System.*

3.11 OSCILLATING AXLE BLEEDING PROCEDURE AND LOCKOUT TEST

Lockout Cylinder Bleeding

To start the test, the axle must be fully oscillated in one direction. Start with oscillating the axle so that the left lock-out cyl. is fully retracted (left front tire up), and the right lock-out cyl. Is fully extended (right front tire down).

NOTICE

ENSURE PLATFORM IS FULLY LOWERED AND BOOM IS CENTERED OVER REAR AXLE PRIOR TO BEGINNING BLEEDING PROCEDURE. MAKING SURE MACHINE IS ON A LEVEL SURFACE AND REAR WHEELS ARE BLOCKED, BRAKE WIRE IS DISCONNECTED.

1. Making sure machine is on a level surface and rear wheels are blocked, machine is in transport mode.
2. Disengage drive hubs.
3. Use suitable container to catch any residual hydraulic fluid, place container under the lockout cylinder.
4. With left lockout cylinder retracted, open bleeder on top of the cylinder, then have an operator from the platform (on high engine) feather drive. Activate drive fully.
5. Close bleeder when there is a steady stream of oil and not air.
6. With axle in the same position, go to right lockout cylinder and open bleeder at the rod end. Activate drive in the same manner and close when all air has been purged.
7. Close bleeder when there is a steady stream of oil and not air.
8. Oscillate axle the other direction, left lock-out cyl. extended (tire down), right lock-out cyl. retracted (tire up). Use the same procedure for the bleeder in the rod end of the left lock-out cyl., Then the piston end of the right lock-out cyl. then close.
9. Repeat process one more time to ensure all air has been purged from the system.
10. Perform oscillating axle lockout test.
11. If necessary, repeat steps 1 thru 9.

NOTE: *Bleeding oscillating axles is an infrequent operation performed after hydraulic line failure or lock-out cylinder repair.*

Oscillating Axle Lockout Test

The front axles will oscillate when the boom is in the transport position.

NOTE: *The machine is in transport mode until one of the following three factors are exceeded:*
Main boom extended more than 4 ft. (1.2 m)
OR
Main boom 6° above horizontal (w/tower stowed
OR
Tower above horizontal.

NOTICE

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

NOTE: *Ensure booms are fully retracted, lowered, and centered between drive wheels prior to beginning lockout cylinder test. The axles must also be fully extended.*

1. Place a 6 inch (15.2 cm) high block with ascension ramp in front of left front wheel.
2. From platform control station, activate machine hydraulic system.
3. Place FUNCTION SPEED CONTROL and DRIVE SPEED/ TORQUE SELECT control switches to their respective LOW positions.
4. Place DRIVE control lever to FORWARD position and carefully drive machine up ascension ramp until left front wheel is on top of block.
5. Telescope boom out of transport position.
6. Drive machine off of block and ramp back on level surface.
7. Have an assistant check left front wheel remains locked in position off ground.
8. Retract boom back in to transport position. Activate drive and the lockout cylinders should release.
9. Place the 6 inch (15.2 cm) high block with ascension ramp in front of right front wheel.
10. Place DRIVE control lever to FORWARD and carefully drive machine up ascension ramp until right front wheel is on top of block.
11. Telescope the boom out of the transport position.
12. Drive machine off of block and ramp back onto the level surface.
13. Have an assistant check to see that right front wheel remains locked in position off of ground.
14. Retract the boom back in to the transport position. Activate drive and the lockout cylinders should release.
15. If lockout cylinders do not function properly, have qualified personnel correct the malfunction prior to any further operation.

3.12 WHEEL DRIVE ASSEMBLY

Removal

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

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

NOTE: *The foam-filled tire & wheel assembly weighs approximately 867 lb (393 kg). The solid tire & wheel assembly weighs approximately 960 lb (435 kg).*

2. Remove hardware securing wheel and remove tire and wheel assembly. Using suitable lifting device lift the tire and wheel assembly and place in a suitable area.
3. Tag and disconnect the hydraulic lines running to the drive motor. Cap or plug all openings to ensure no dirt enters the hydraulic system.

NOTE: *The drive hub and drive motor assembly weighs approximately 267 lb (121 kg).*

4. Use a supporting device capable of handling the weight of the drive hub and drive motor, and unbolt the drive hub from the frame. Remove the entire assembly from the machine.
5. Remove the capscrews and washers that secure the drive motor to the drive hub and remove the drive motor. Remove and discard the brake gasket between the drive motor and drive hub.

Installation

1. Install a new brake gasket between the drive motor and drive hub. Apply a coat of Medium Strength Threadlocking Compound on capscrews. Install the washers and capscrews to secure the drive hub and drive motor, and torque to 178 ft. lbs. (241 Nm).
2. Place the drive hub flange against the mounting flange on the axle and fasten it in place with the bolts and washers. Torque the bolts to 180 ft. lbs. (244 Nm).
3. Using adequate support, install wheel into wheel assembly and secure with bolts and washers.

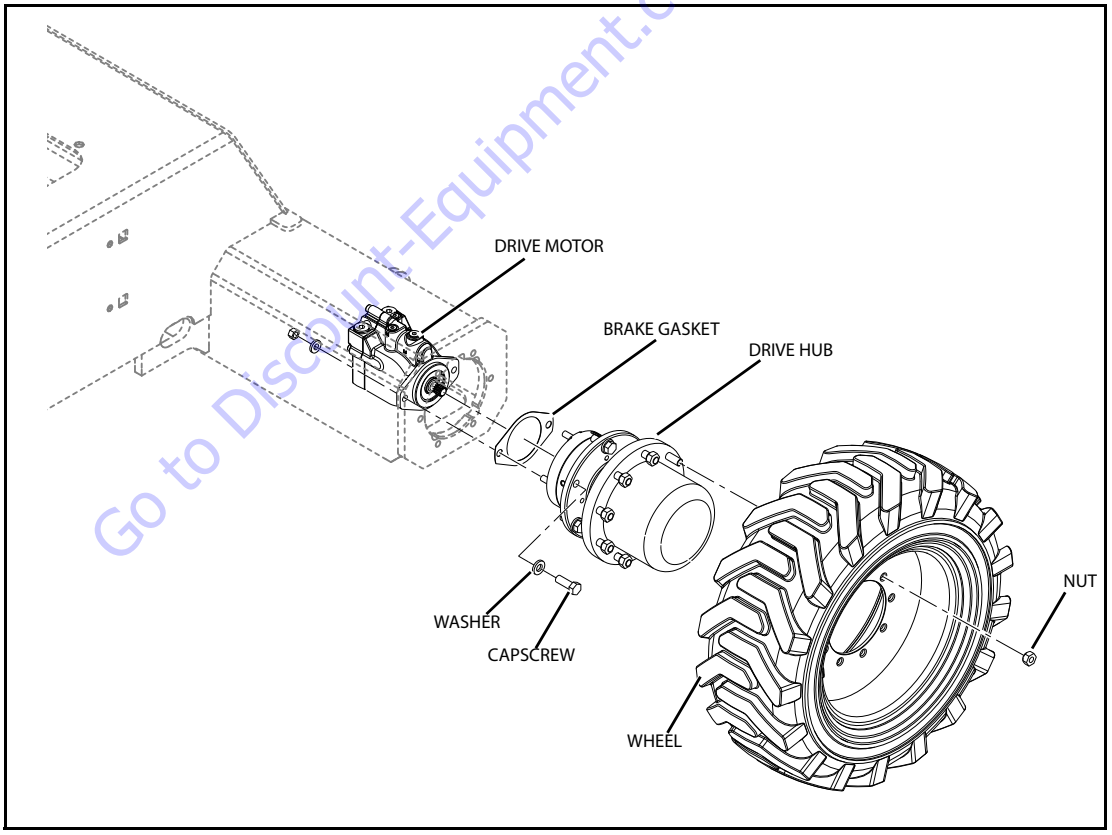


Figure 3-13. Wheel Drive Installation

3.13 DRIVE HUB - IF EQUIPPED WITH BONFIGLIOLI

Product Identification

The identification data of the hub is shown on a name plates on the hub. Figure 3-14., Drive Hub Identification Plate shows how the information is displayed.

The information stamped on the name plates must always be readable. Use the identification data (at least serial number) for spare part inquiries, information and service, etc.

Hydraulic Motor Installation

The mating areas and the pilot diameter of the gearbox where the motor is to be mounted must be clean and without burrs.

Before assembling the hydraulic motor, verify by a depth slide gauge the correct assembly of the unit checking the axial distance as shown in Figure 3-15.

1. Fit the O-ring seal, supplied with the gearbox, in its seat in the hydraulic motor, and assemble it to the gearbox being careful not to damage the seal already fitted.
2. Torque bolts to 63.5 ft-lbs. (86 Nm) torque.

Installation of the Wheel Drive on the Machine

1. Clean the mating surfaces from oils or paint and fit the wheel drive on the machine frame.
2. Attach the gearbox to the machine frame with the mounting bolts and torque to 178 ft.lbs. (241 Nm).

Start Up and Running In

If new hubs are being installed, it is advised to follow the measures given below:

1. Bleed air from every part of the hydraulic and add oil in the tank if necessary.

NOTICE

THE PRESENCE OF RESIDUAL AIR IN THE HYDRAULIC CIRCUIT WILL BE RECOGNIZED BY THE PRESENCE OF FOAM IN THE TANK AND WILL LEAD TO A JERKING OF THE MOTOR AS WELL AS EXCESSIVE NOISE COMING FROM THE MOTOR AND THE VALVES.

2. Start the gearmotor at a low speed and gradually increase it after having verified that it is functioning correctly without any noises or vibrations.

NOTICE

DO NOT REACH MAXIMUM PRESSURE UNLESS THE ENTIRE SYSTEM HAS BEEN FILTERED TO ELIMINATE ANY PARTICLES OF DIRT THAT MAY BE PRESENT.

NOTE: *During running-in stage follow steps below.*

3. Check correct revolution and direction of rotation.
4. Make sure functioning is regular and without any excessive noises and vibrations.
5. Make sure oil temperature does not exceed values listed previously.

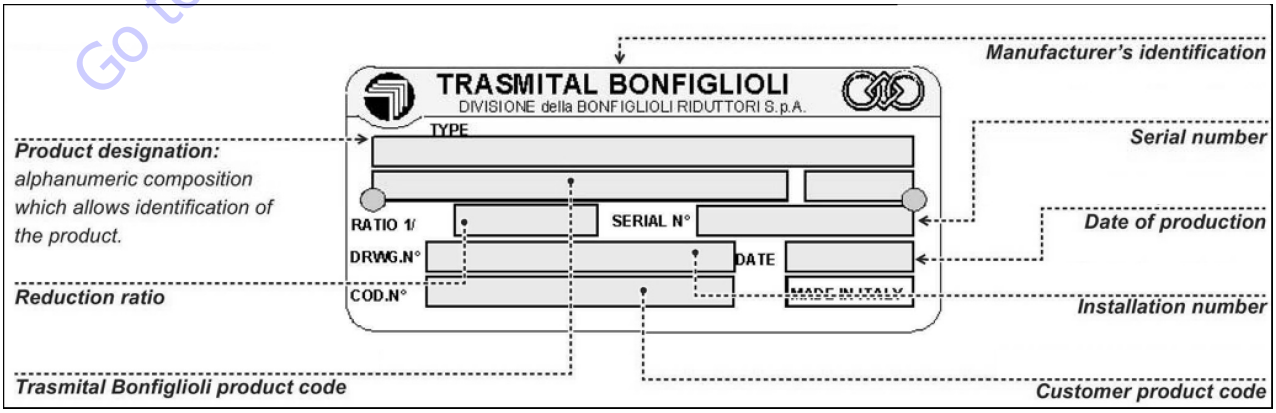


Figure 3-14. Drive Hub Identification Plate

After running-in the gearbox, follow steps below.

6. Check there are no oil leaks. If leaks are present, fix them before proceeding.
7. Check gearmotor oil level.
8. It possible the presence of air in the system during the first start up could cause application of the brake to be slowed down. It is advised to repeat the application and release functions of the brake to purge air from the brake.
9. Check there are no other problems in general.

General Information

The gearbox is designed and built for wheel drive.

The unit includes planetary gearbox, 3 stages, rotating housing type.

The illustrations show the parts and the main functions of the gearbox.

A strict and consistent compliance with the specifications of this technical manual ensure the minimum operating costs and a longer unit life.

Photographic documentation and drawings are supplied for educational purposes, so as to safely and properly carry out maintenance operations.

Minor deviations from pictures of this manual may appear on the actual gearbox. However, these discrepancies are not relevant to the main parameters, or maintenance functions.

CONNECTING THE BRAKE

The gearbox is fitted with a negative multi disk safety brake with hydraulic control release (parking brake). For information regarding the characteristics of the brake refer to the installation drawing.

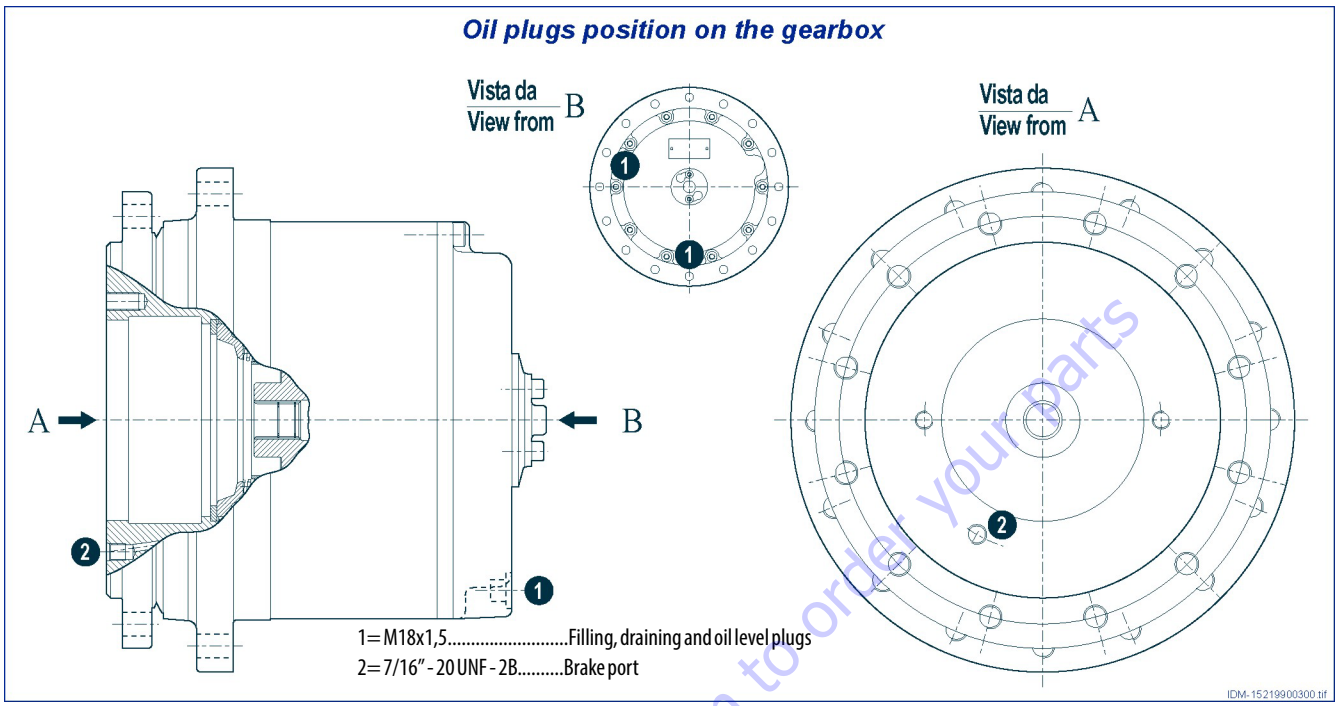
Table 3-2. Brake Technical Data

Brake Release Pressure	(16 bar)
Maximum Operating Pressure Brake	(50 bar)
Braking Torque	(265 ± 10% Nm)

FILLING GEARBOX WITH LUBRICATING OIL

The motor and the gearbox have separate lubrication. The gearbox is lubricated by oil splashing. The recommended type of oil is SAE 80W/90 or SAE 85W/140 with EP features complying with MIL-L-2105 C & API GL5. Refer to Table 3-3, Suggested Lubricants According SAE 80W/90 and SAE 85W/140 API GL5 Grade.

NOTE: *Oil temperature must not exceed 85-90° C intermittently during operation.*



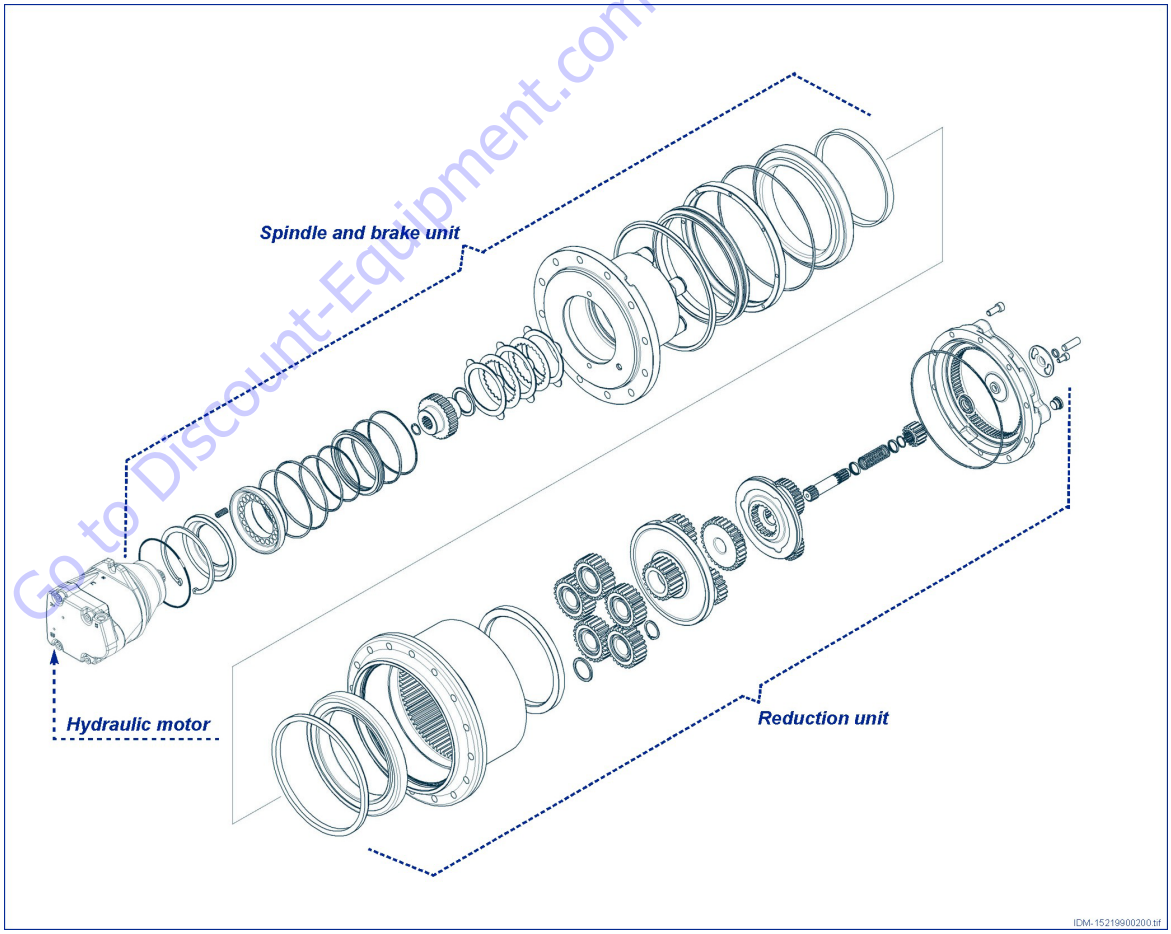


Figure 3-15. Hub Assembly

Table 3-3. Suggested Lubricants According SAE 80W/90 and SAE 85W/140 API GL5 Grade

Ambient temperature Oil viscosity		-20°C / +30°C SAE 80W/90	+10°C / +45°C SAE 85W/140
Manufacturer		Oil Brand	
	SHELL	SPIRAX HD	SPIRAX HD
	AGIP	ROTRA MP	ROTRA MP
	ARAL	GETRIEBEOL HYP	GETRIEBEOL HYP
	BP-MACH	HYPOGEAR EP	HYPOGEAR EP
	CASTROL	HYPOY	HYPOY
	CHEVRON	UNIVERSAL GEAR LUBRICANT	UNIVERSAL GEAR LUBRICANT
	ELF	TRANSELF B	TRANSELF B
	ESSO	GEAR OIL GX PONTONIC MP	GEAR OIL GX PONTONIC MP
	I.P.	PONTIAX HD	PONTIAX HD
	MOBIL	MOBILUBE HD	MOBILUBE HD
	TOTAL	TRASMISSION TM	TRASMISSION TM

NOTE: *Do not mix together oils of different brands or characteristics.*

NOTE: *The gearbox is supplied without oil; before putting the gearbox into operation, it is necessary to fill it with oil.*

This procedure is undertaken following the indications given below.

1. Check gearbox axis is horizontal. Rotate gearbox housing until drain plug (A) is on bottom of the vertical axis of the end cover.
2. Unscrew fill and level oil plug (B).
3. Fill from hole until the lubricant flows out.
4. Tighten fill and level oil plug (B) and let gearbox run. After a few minutes, stop and check the oil level.
5. If necessary, refill with lubricant oil. Approximate oil capacity = 2 L ±10%

Gearbox Disengagement

⚠ WARNING

THE DISENGAGEMENT OPTION MUST BE CONNECTED OR DISCONNECTED ONLY WHEN GEARBOX IS STOPPED ON FLAT GROUND.

NOTICE

MAXIMUM WHEEL SPEED WITH DISENGAGED GEARBOX MUST NOT EXCEED 25 REV/MIN.

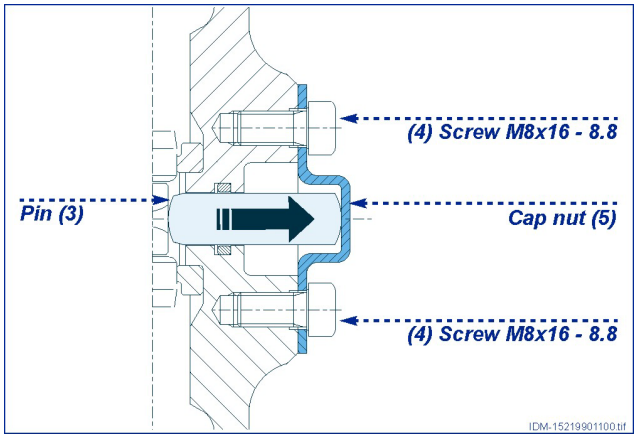
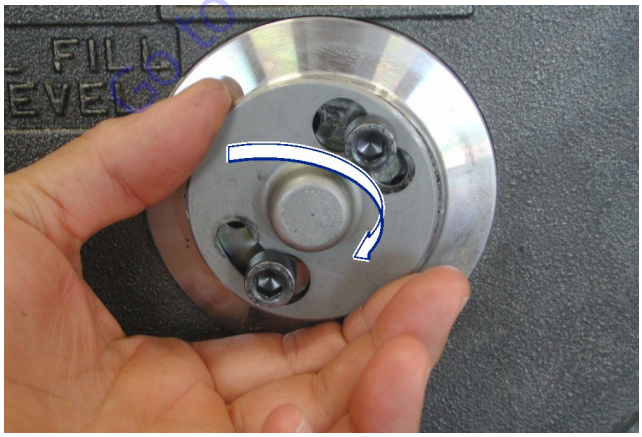


Figure 3-16. Gearbox engaged

1. Remove two socket head screws M8x16 (4) from the end cover (7) with a male hex head wrench.

2. Rotate cap nut (5).



3. Remove cap nut (5).

4. Turn cap nut (5) upside down. Pin (3) will be pushed inside to permit disengagement of the gearbox.

5. Rotate cap nut (5).

6. Tighten two socket head screws M8x16 (4) with a male hex head torque wrench to 18.4 ft-lb (25 Nm) torque.

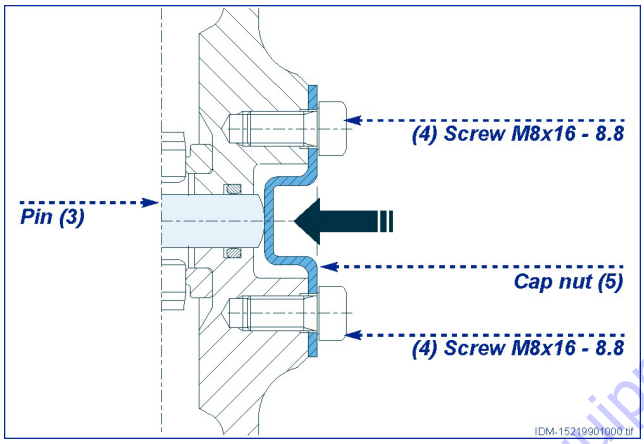


Figure 3-17. Gearbox Disengaged

7. Repeat the above steps to engage the gearbox again.

   Operation:

   a. Engaged gearbox

   At this condition the motion is transmitted from the hydraulic motor to the gearbox.

   b. Disengaged gearbox

⚠ CAUTION

AT THIS CONDITION THE HYDRAULIC MOTOR AND THE BRAKE ARE DISCONNECTED TO THE GEARBOX: THE WHEEL IS IDLE.

Maintenance Information

PERIODIC MAINTENANCE

The gearbox only requires the scheduled maintenance procedures set out by the manufacturer (see Table 3-4).

Good maintenance will ensure an ongoing functioning in time as well as maximum reliability.

Should irregularities in function arise, it will be necessary to consult the troubleshooting checklist to find the most adequate solution.

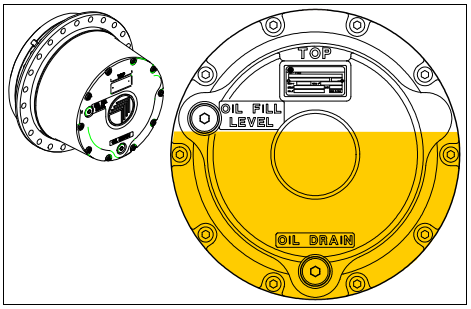
If unsuccessful, it may be necessary to partially or completely disassemble the gearbox.

Table 3-4. Drive Hub Maintenance Schedule

Inspection	Frequency	Action
Tightening bolts	After the first 50 operating hours of the gearbox	Bolt tightening torque check
Oil level	Every 150 operating hours of the gearbox	Refill oil if necessary
1st oil change	At 150 operating hours of the gearbox	Oil replacement
Next oil change	Every 1200 operating hours	Oil replacement

CHANGING THE LUBRICATING OIL

1. Check gearbox axis is horizontal. Rotate gearbox housing until drain plug is at bottom of the vertical axis of the end cover.



2. Unscrew both plugs (Fill and Drain) and let the oil flow in a large enough container. To facilitate draining, the oil must be warm.
3. Wait a few minutes until all the oil is drained and then proceed to screw on the plugs.
4. Proceed with the oil fill-up. Refer to Filling-up the Gearbox with Lubricating Oil.

NOTE: *Never mix mineral oils with synthetic oils and vice versa.*

⚠ CAUTION

DO NOT DISPOSE OF OIL IN THE NATURAL ENVIRONMENT. BE CAREFUL TO ELIMINATE IT IN COMPLIANCE WITH LOCAL RULES AND REGULATIONS.

TROUBLESHOOTING

The following table is provided to help locate problems in the gearbox.

Table 3-5. Troubleshooting

Symptom	Causes	Remedies
External oil leakage:		
From the lifetime seal	a) Lifetime seal damaged	a) Replace lifetime seal
From the end cover	a) O-ring seal damaged	a) Replace O-ring seals
From the plugs	a) Plug seal damaged	a) Replace plug seal
	b) Plugs or screws loose	b) Tighten the plugs/screws
Too much noise:		
Hydraulic noise (during the slowing down of the motor speed)	a) Hydraulic circuit malfunctioning	a) Verify hydraulic circuit
Inside the gearmotor (reductions)	a) Internal damage	a) Check the gearbox
Other:		
Overheating	a) Insufficient oil level	a) Check the oil level and refill if necessary
	b) Hydraulic oil too warm	b) Check the hydraulic circuit
	c) Brake not fully released	c) Check brake release pressure
Parking brake malfunctioning		
Insufficient braking torque	a) Brake discs worn	a) Replace brake disc pack
	b) Damaged parts	b) Check brake components
Wheel Locked	a) Parking brake locked	a) Check the complete brake release
	b) Mechanical components damaged	b) Replace damaged parts

Disassembly Information

It is also important this procedure is performed in a workshop equipped with the proper tools. As well as normal workshop tools, it is necessary to use special tools that can be made (see special tools attachment) or may be requested from the manufacturer.

Special Tools:

Puller.....Code/: 6689960240

Tool for lifetime seal assembly.....Code/: 6689960300

Puller for brake disassembly.....Code/: 6689960310

Torque multiplier.....Code/: ATZ.09.016.0

To be able to produce these special tools refer to Figure 3-19. thru Figure 3-22.

It is important to strictly adhere to all procedures for disassembling and reassembling the gearbox. Proceed with these instructions using all necessary safety measures, for example:

1. Plug all gearbox hydraulic ports to prevent contaminating the circuit and gearbox.
2. Do not damage coupling surfaces.
3. Handle with care to ensure personnel safety and guarantee reliability of the gearbox.
4. Provide a work area that meets Work and Health Safety in the Workplace guidelines.

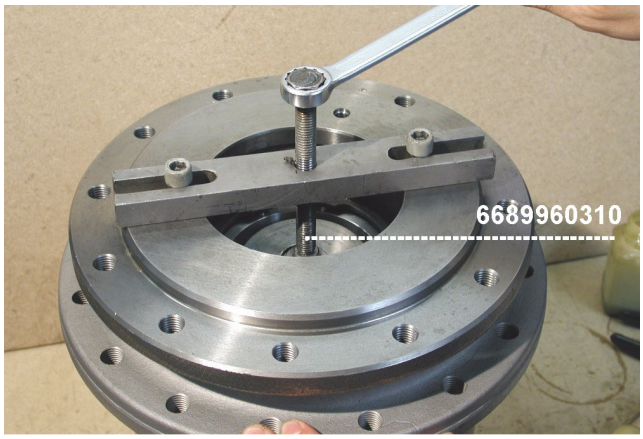
Disassembly

NOTE: *Below are all the steps to follow during Disassembly and Assembly. Numbers in brackets in the text correspond to the references in the exploded view.*

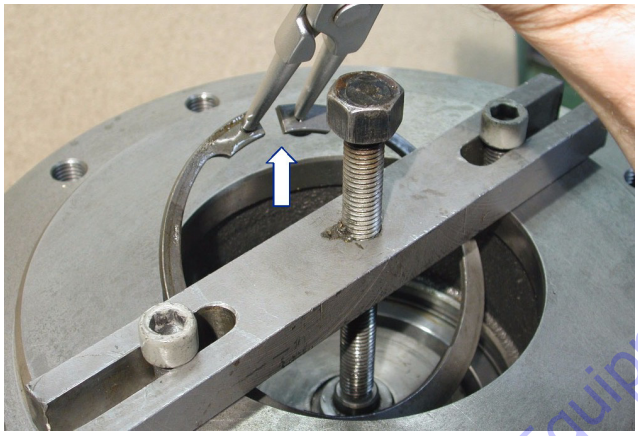
Initial inspection can be made without disassembling the hub from the machine. Before wheel drive disassembling, make sure that the oil is drained from the hub.

Unscrew and remove the nos. 2 screws M12, grade 8,8, and remove the hydraulic motor and its O-ring seal (48).

1. Install special tool (6689960310) on the flanged hub (31). Turn screw until it compresses springs (45).

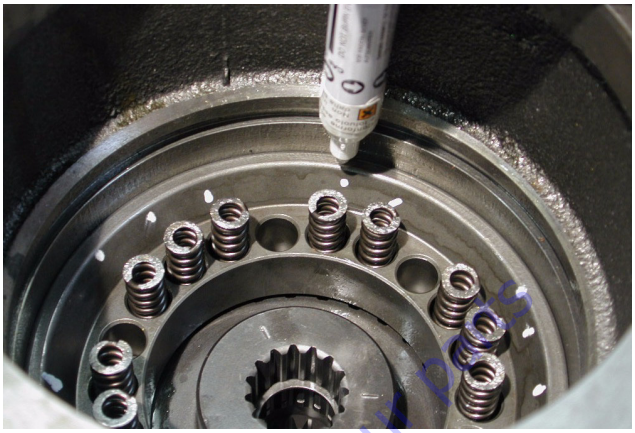


2. Remove circlip (47). Remove the special tool.

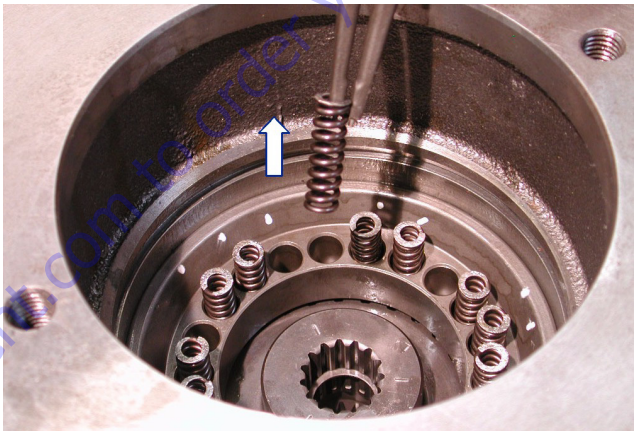


3. Remove spring retainer disc (46).

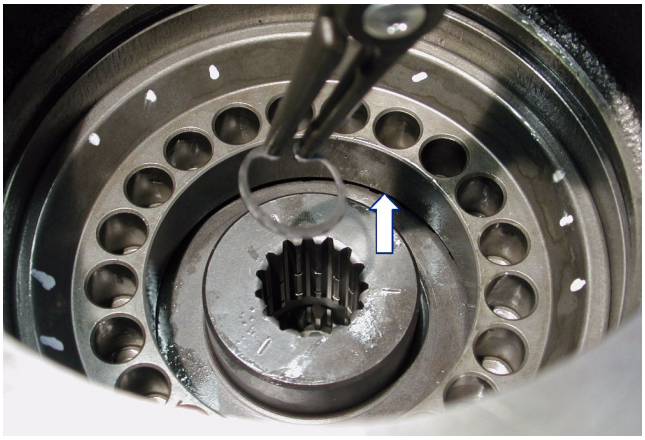
4. Mark position of springs (45) for reassembly.

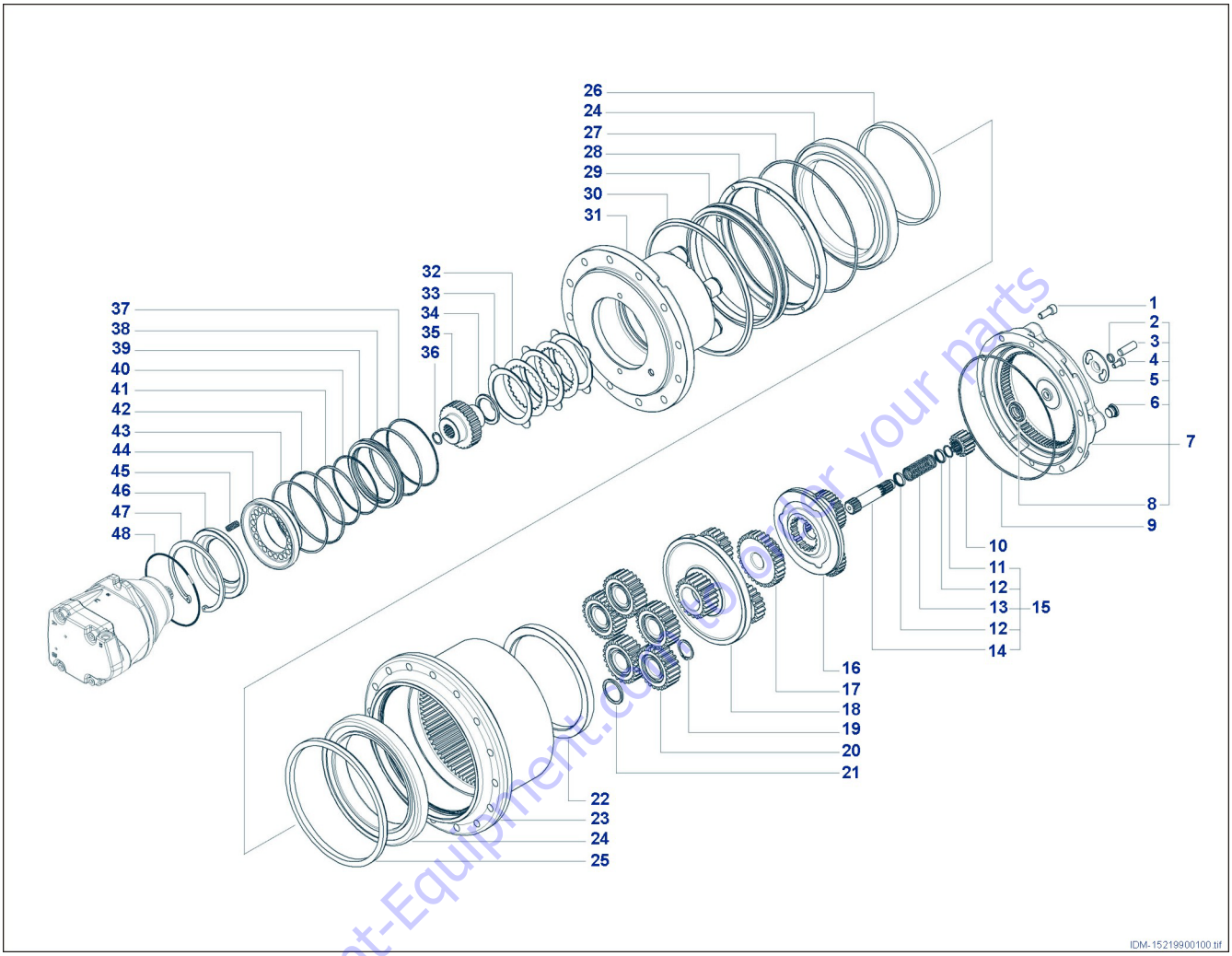


5. Remove springs (45) from brake piston seats (44).



6. Using pliers, remove circlip (36) from its seat in the brake shaft (35).

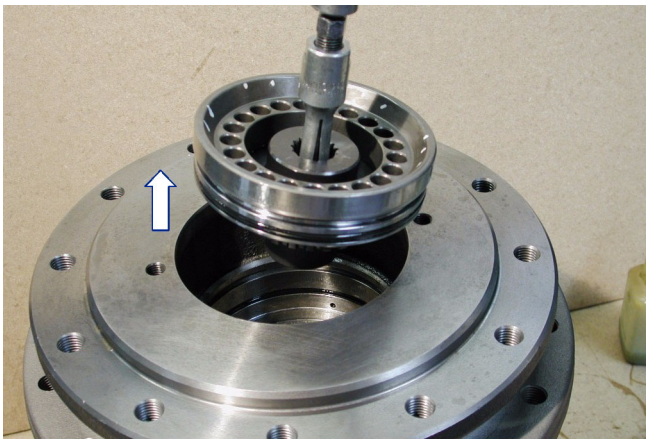




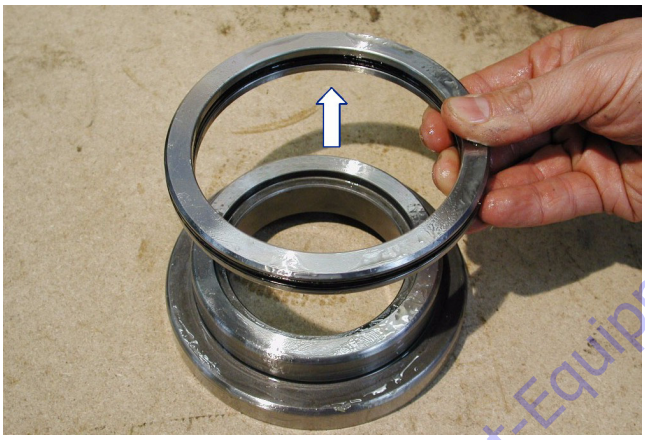
1. Screw
2. O-ring
3. Pin
4. Screw
5. Cap Nut
6. Oil Plug
7. End Cover
8. Pad
9. O-ring
10. 1st Stage Sun Gear
11. Elastic Ring
12. Washers
13. Spring
14. Splined Shaft
15. Disengagement Shaft
16. 1st Reduction Assembly
17. 2nd Stage Sun Gear
18. 2nd Reduction Assembly
19. Circlip
20. 3rd Reduction Assembly
21. Spacer
22. Ring Nut
23. Gearbox Housing
24. Bearing
25. Spacer
26. Spacer
27. O-ring
28. Spacer
29. Half Seal
30. Seal Ring
31. Flanged Hub
32. Disc (Internal Teeth
33. Disc (External Teeth)
34. Spacer
35. Brake Shaft
36. Circlip
37. Backup Ring
38. O-ring
39. Spacer
40. Backup Ring
41. O-ring
42. O-ring
43. Backup Ring
44. Brake Piston
45. Springs
46. Retainer Disc
47. Circlip

Figure 3-18. Drive Hub - If Equipped with Bonfiglioli

7. Using a puller, remove at the same time, the brake piston (44), spacer (39) and brake shaft (35).



8. Remove spacer (39) from brake piston (44).

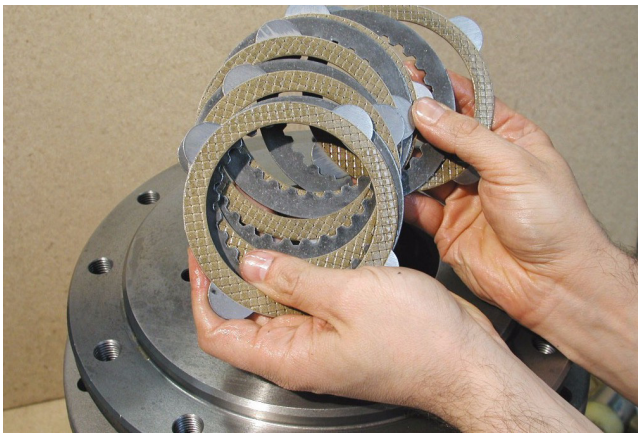


9. Remove internal O-Ring seal (41) and backup ring (40) from their seat in the spacer (39).

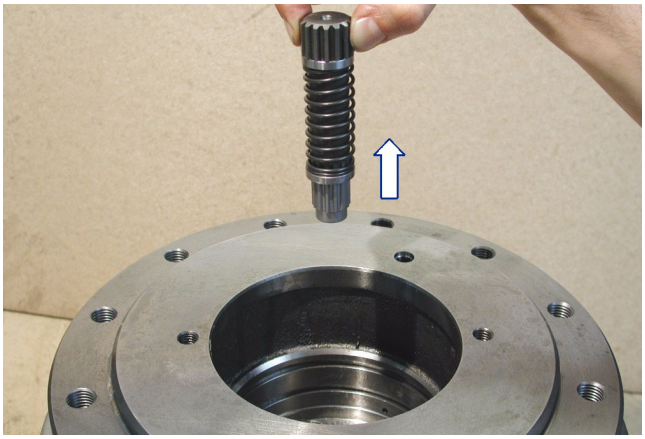
10. Remove external O-Ring seal (38) and backup ring (37) from their seat in the spacer (39).

11. Remove O-ring seal (42) and backup ring (43) from their seats in the flanged hub (31).

12. Remove brake discs pack (32-33).

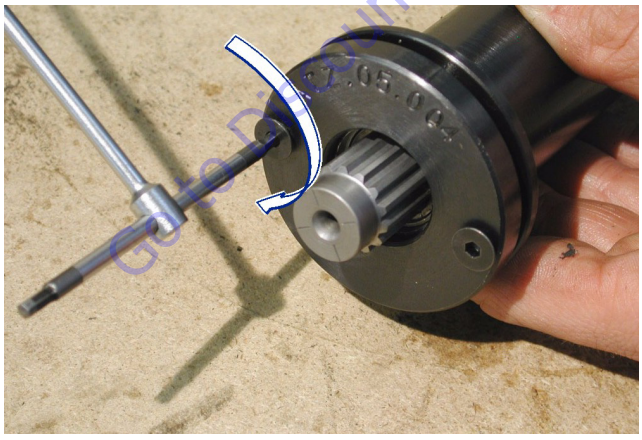


13. Remove disengagement shaft kit (15).

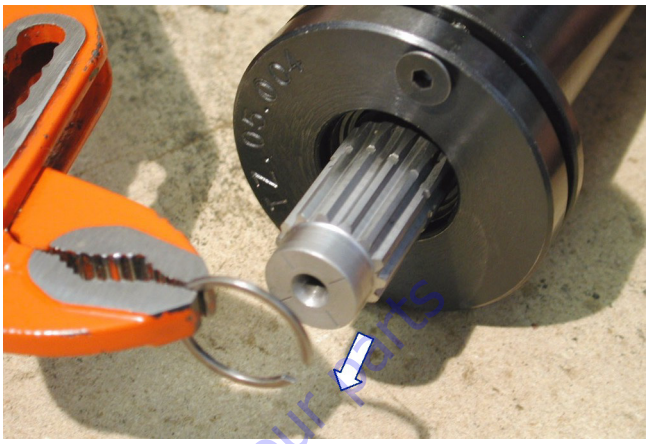


14. Place the disengagement shaft kit (15) inside the special tool (6689960240).

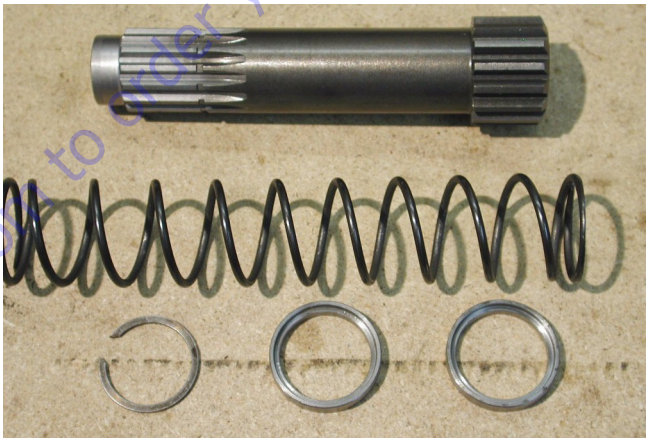
15. Tighten two screws M5x16, grade 8.8, in cover with a torque wrench to 18.4 ft-lb (25 Nm).



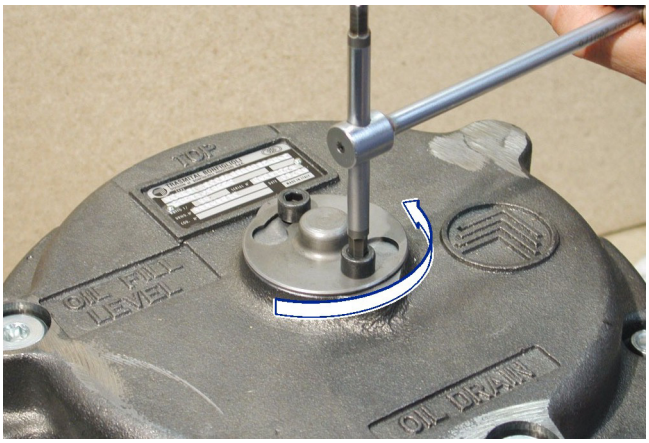
16. Use pliers to remove elastic ring (11) from splined shaft (14).



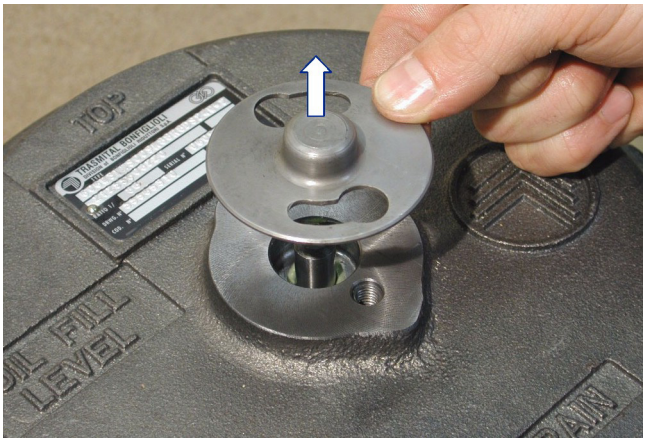
17. Remove special tool, spring (13), and washers (12).



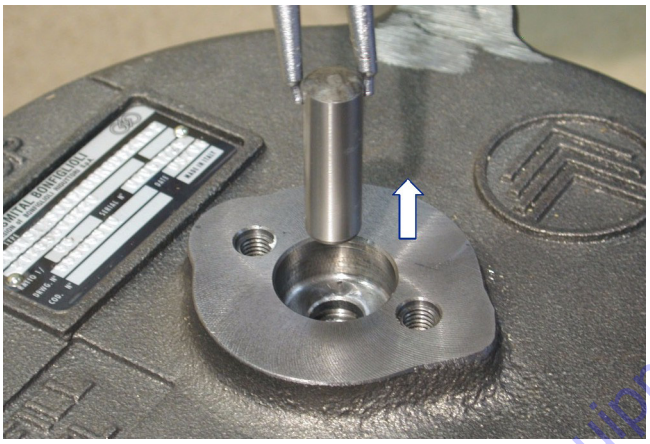
18. Turn gearbox upside down. Remove two screws M8x16 (4), grade 8.8, from end cover (7).



19. Remove cap nut (5).



20. Remove pin (3).



21. Remove O-ring seal (2) from its seat in the end cover (7).

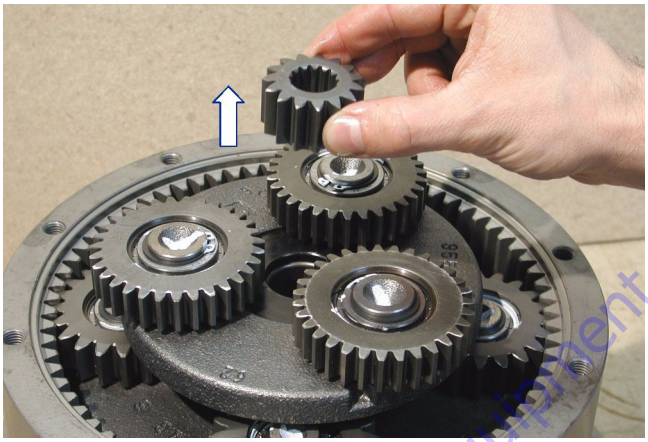
22. Remove draining-filling-level oil plugs (6) using a male hex head wrench.

23. Remove 10 screws M10X25 (1) from end cover (7).

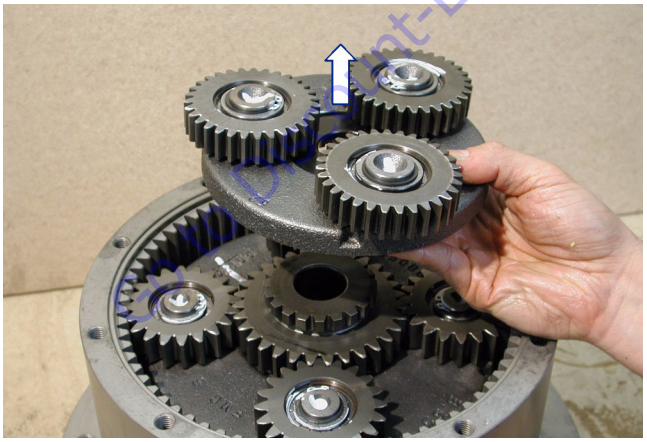
24. Remove end cover (7).

25. Remove O-ring seal (9) from its seat in the end cover (7).

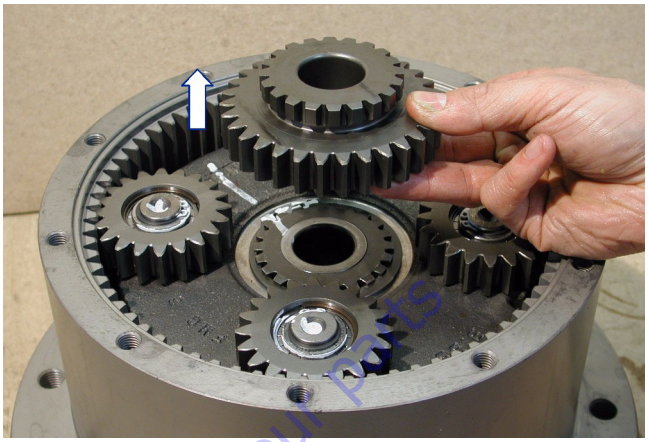
26. Remove 1st stage sun gear (10).



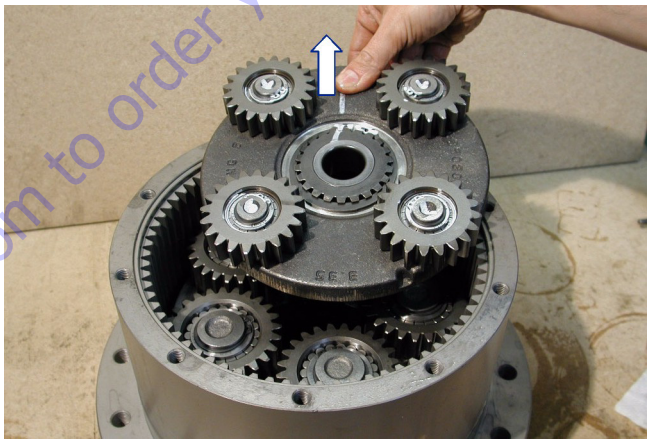
27. Remove 1st reduction assembly (16).



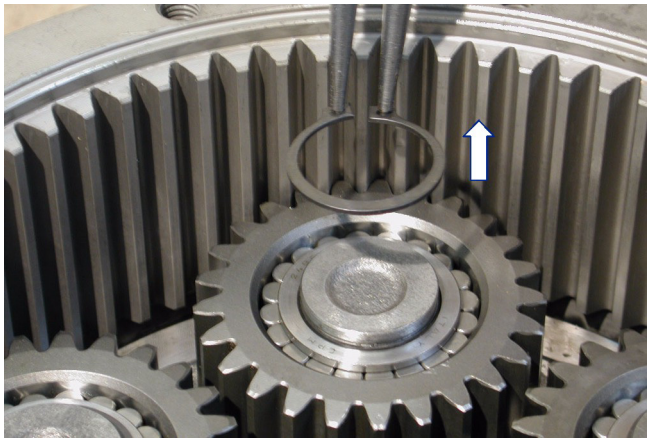
28. Remove 2nd stage sun gear (17).



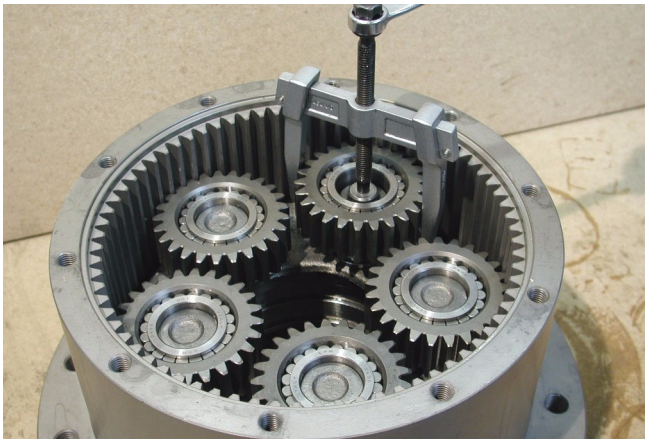
29. Remove 2nd reduction assembly (18).



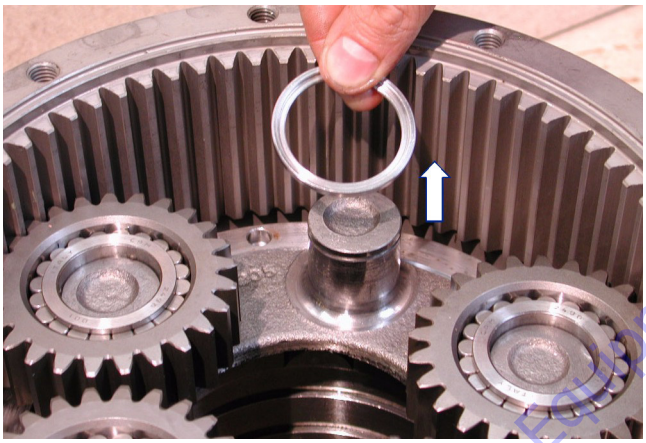
30. Using pliers, remove circlips (19) from their seats in the flanged hub's pins (31).



31. Using a puller, remove planet assemblies of the 3rd reduction (20).



32. Remove spacer (21) from their seats in the pins of the flanged hub (31).



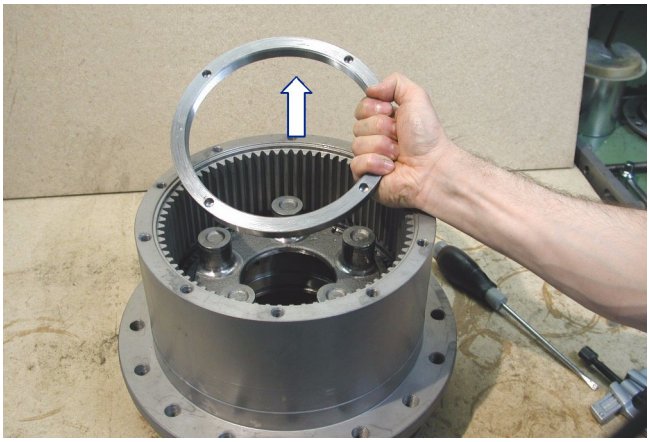
NOTE: *To proceed with gearbox disassembly, remove it from machine and bring it to a properly equipped workshop.*

33. Use a drill remove caulking on the ring nut (22).

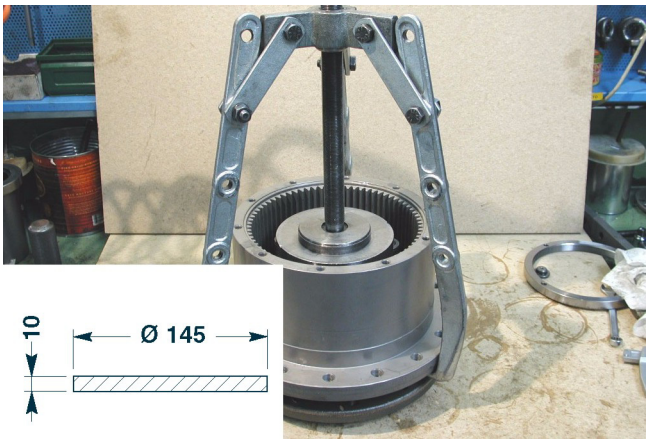
34. Using a tackle, place torque multiplier (ATZ.09.016.0) on ring nut (22).

35. Using the torque multiplier (ATZ.09.016.0), loosen ring nut (22).

36. Remove ring nut (22).



37. Using a puller and a metal stopper, remove the flanged hub (31) from the gearbox housing (23).



38. Using a tackle, remove gearbox housing (23) from flanged hub (31).

39. Remove seal ring (30) from flanged hub (31).

NOTE: *In case of oil leaks, it may be necessary to check and replace the lifetime seal (29), which means metal rings parts and O-ring seals.*

40. Using a screwdriver, remove 1st half-seal (29) from the flanged hub (31).

41. Using a screwdriver, remove 2nd half-seal (29) from gearbox housing (23).

NOTE: *Gearbox disassembly ends with the above operation. All items are now available for inspection.*

Inspection of Parts

Pieces that are subject to general wear and tear are:

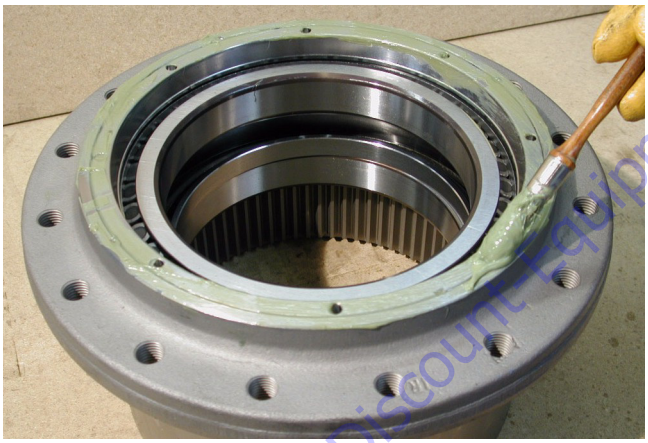
- Gears.
- Bearings.
- All the seals

Replace used or irregular parts using the following steps:

1. Remove dirt and properly clean seals, bearings, and locking rings seating.
2. Lubricate parts before installing.
3. In case of damaged gears, for example a planetary, do not replace the individual gear but entire reduction assembly.
4. When reassembling a part, replace all seals. Apply grease on the seats and on new seals to make reassembly easier.
5. Replace all damaged parts with original spare parts.

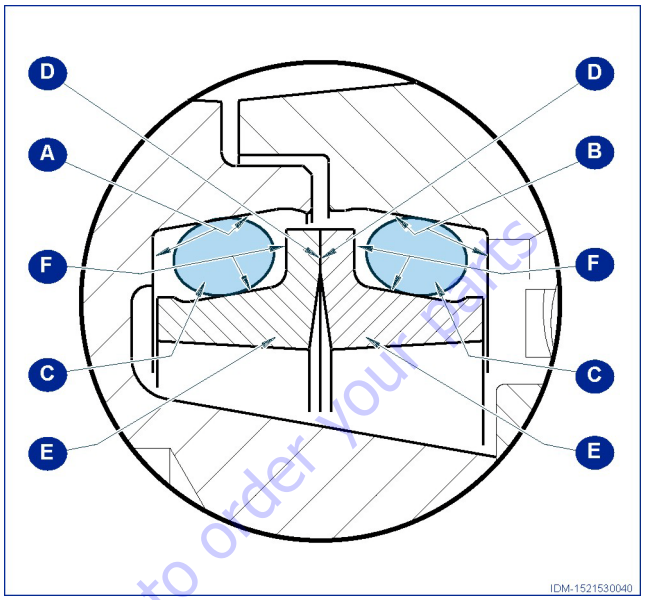
Assembly

Apply grease TECNOLUBE SEAL GS730 on gearbox housing (23).



1. Follow steps below to prepare the lifetime seal for assembly:

   a. Carefully clean seats (A and B) using, if necessary, metallic brushes or solvent (surfaces in contact with or (C) must be perfectly clean and dry).



   b. Make sure sealing surfaces (D) of metal rings (E) are free from scratches, dings, or foreign substances; metallic ring surfaces must be perfectly clean and dry. We suggest to dip the metallic rings in volatile solvent or industrial degreasing alcohol.

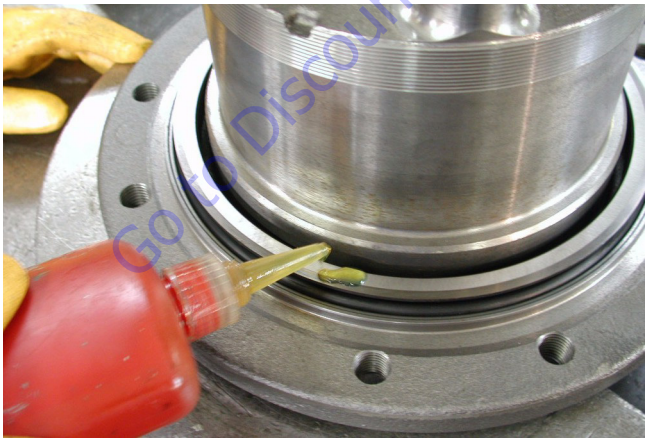
   c. Carefully clean lapped surface (D) of metal rings (E) and remove dust or fingerprints. Lubricate them with a thin oil film. Do not oil other components.

2. Assemble half seal (29) on tool (6689960300).

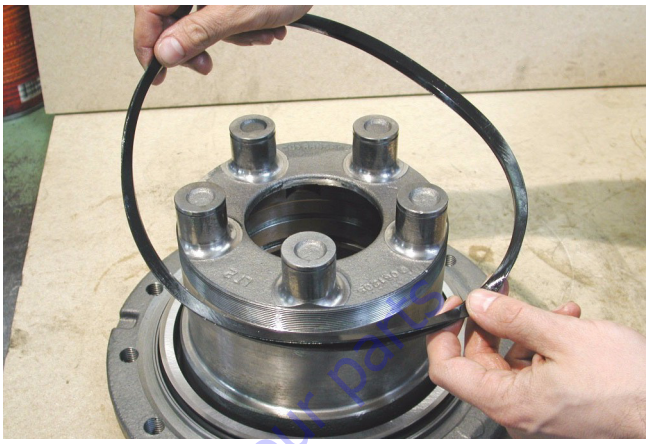
3. Assemble 1st half seal (29) on gearbox housing (23).

4. Using the same tool (6689960300), assemble 2nd half seal (29) on the flanged hub (31).

5. Carefully clean metallic faces of the lifetime seal (29) and lubricate surfaces with oil.



6. Insert seal ring (30) in its seat in the flanged hub (31).

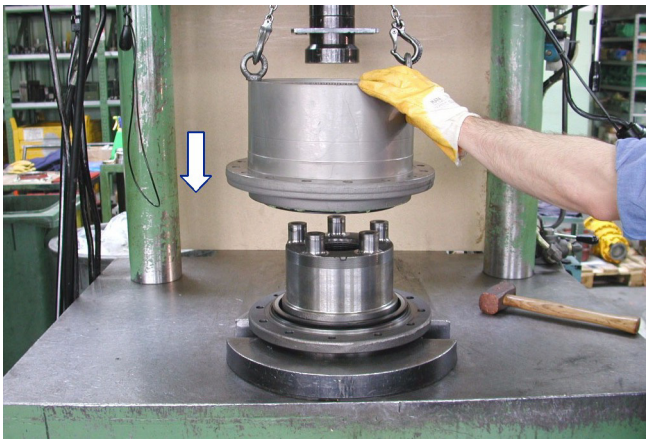


7. Apply grease TECNOLUBE SEAL GS730 on seal ring (30).

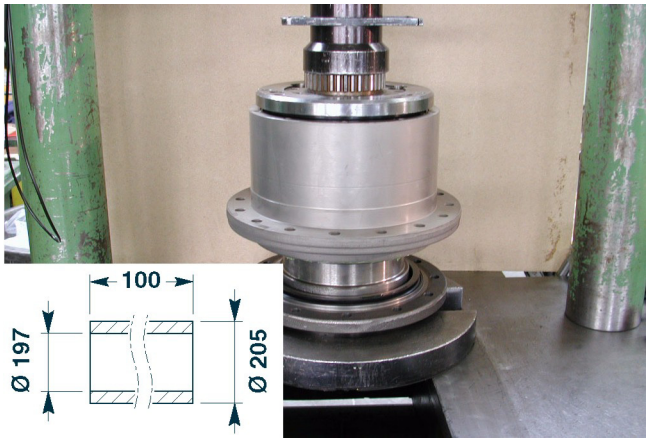
NOTICE

AVOID GETTING GREASE IN CONTACT WITH THE LIFETIME SEAL (29)

8. Using a hoist, place gearbox housing (23) on flanged hub (31).

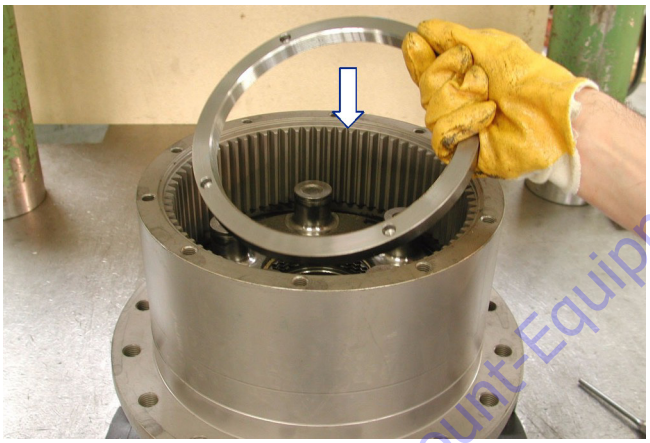


9. Using a press and a metallic stopper, push gearbox housing (23) against shoulder on flanged hub (31) until assembling of unit is complete.



NOTICE

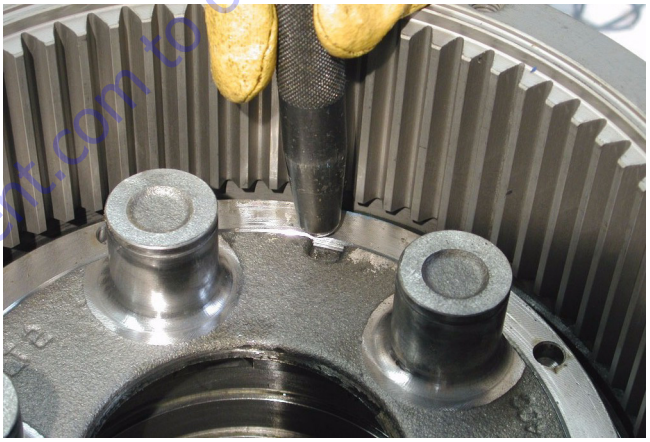
SCREW NUT (22) PARTIALLY IN TO PREVENT FLANGED HUB (31) FROM COMING OUT OF GEARBOX HOUSING (23) DURING THE FOLLOWING STEPS.



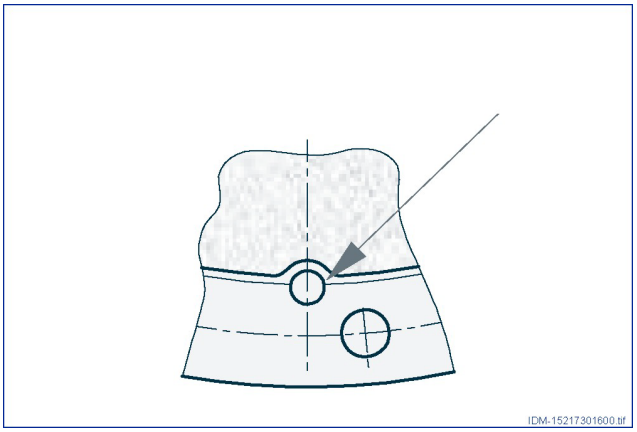
10. Use a hoist to place the torque multiplier (ATZ.09.016.0) on the ring nut (22).

11. Using multiplier (ATZ.09.016.0), tighten ring nut (22), using a torque wrench with an input multiplier torque of 71 ± 3 ft-lb (96,5 ± 4, 5 Nm) corresponding to an output multiplier torque of 3688 ± 184 ft-lb (5000 ± 250 Nm).

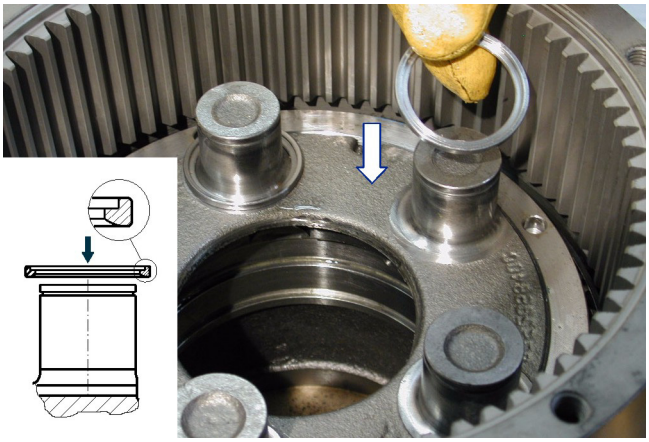
12. Stake ring nut (22) near two seats at 180° of flanged hub (31) on the right side.



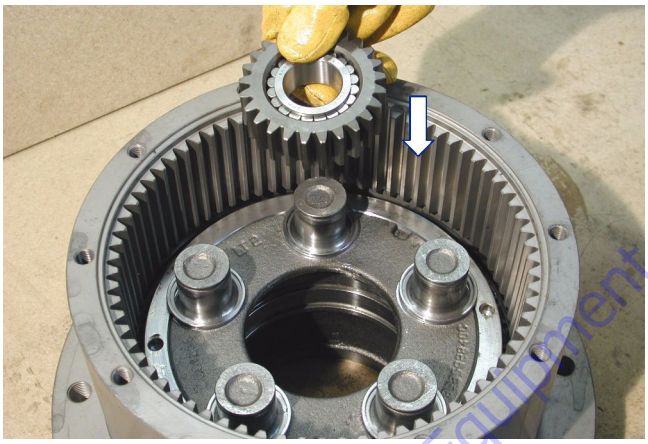
NOTE: *Stake Ø 4+5 mm (depth 1+1,5 mm).*



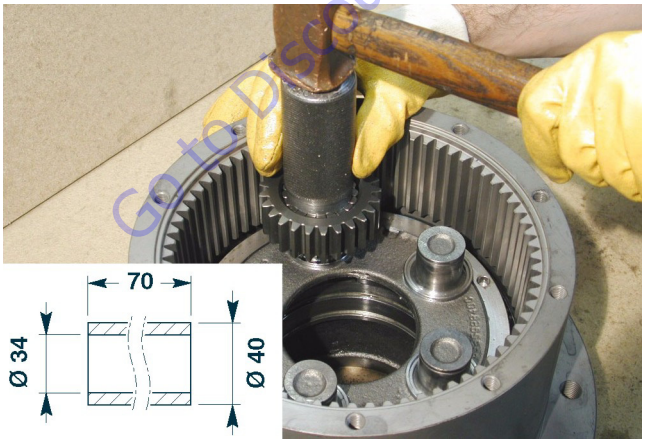
13. Install spacers (21) on flanged hub (31)pins.



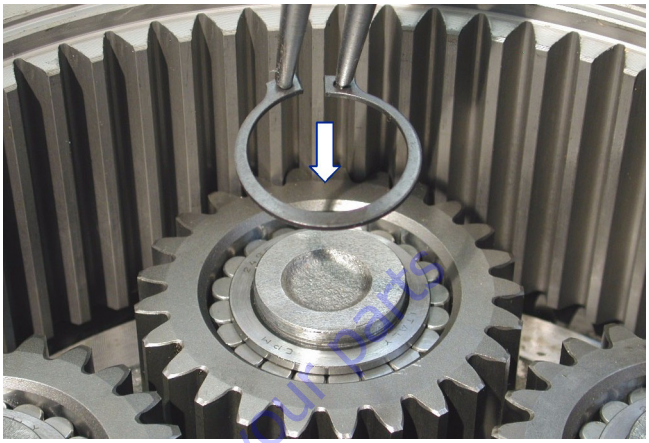
14. Place five planet assemblies of the 3rd reduction (20) on flanged hub's pins (31).



15. Using a rubber hammer and a metal stopper, push planet assemblies of the 3rd reduction (20) against the shoulder until assembly is complete.

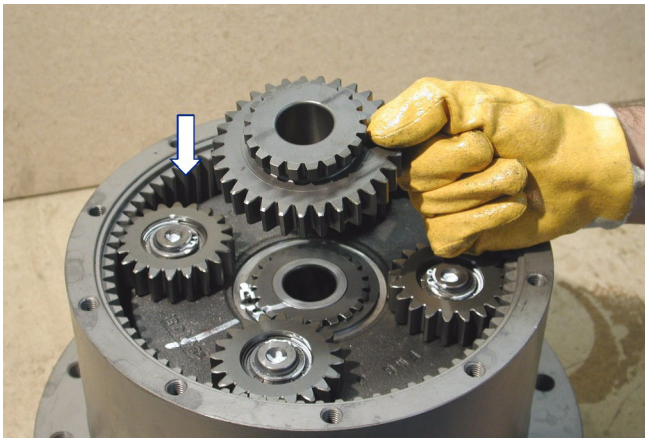


16. Using pliers, assemble circlips (19) in flanged hub pin seats (31).

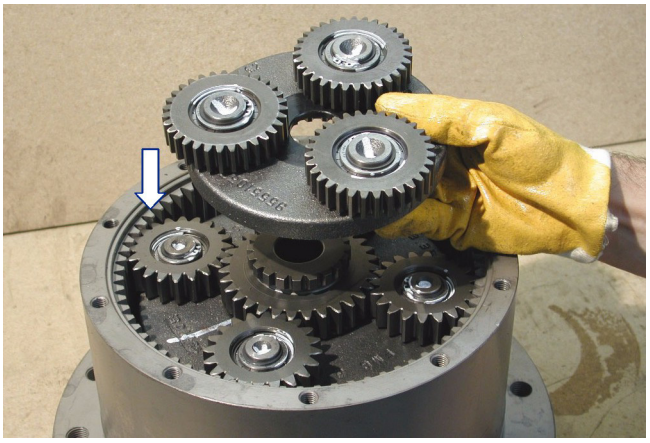


17. Assemble 2nd reduction assembly (18).

18. Install 2nd stage sun gear (17).



19. Assemble 1st reduction assembly (16).



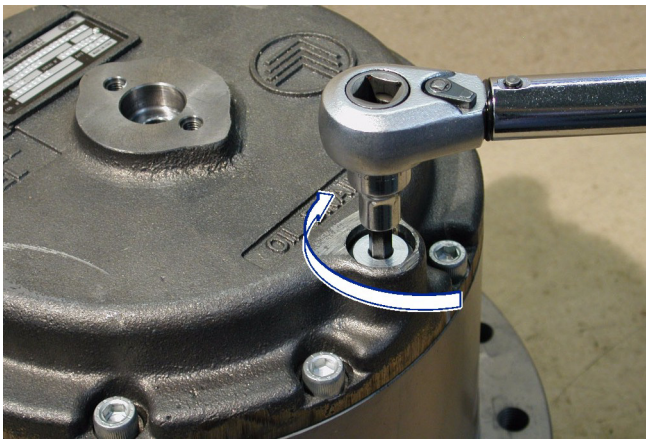
20. Install 1st stage sun gear (10).

21. Install O-ring seal (9) into its seat in the end cover (7).

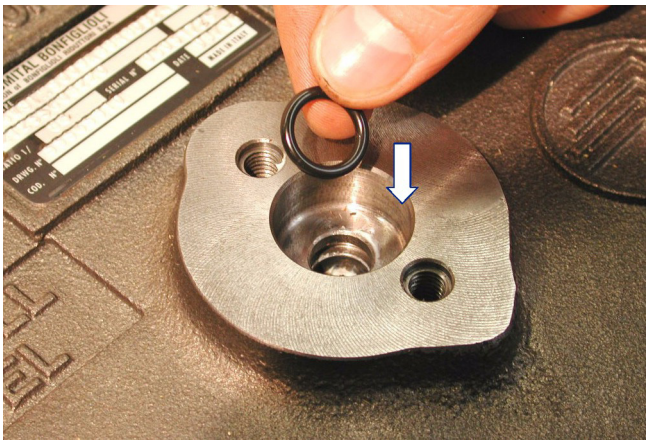
22. Place end cover (7) on gearbox housing (23).

23. Tighten 10 socket head screws M10x25 (1),grade 12,9, by a torque wrench to 62.7 ft-lb torque (85 Nm).

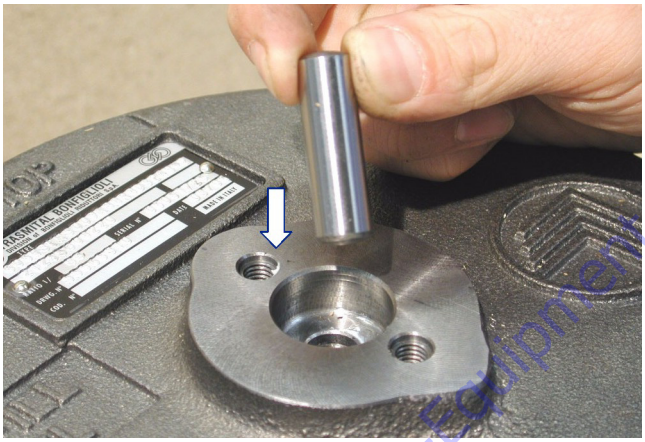
24. Install plugs (6) in oil drain-fill holes of the end cover (7). Torque plugs to 52 ± 7 ft-lb (70±10 Nm).



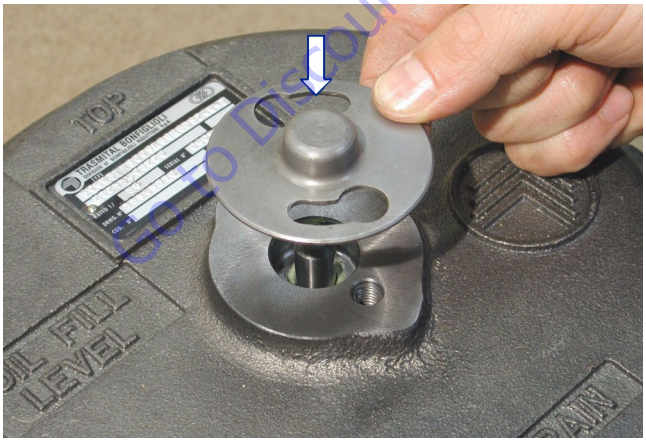
25. Install O-ring (2) into its seat in the end cover (7).



26. Protect seat and pin (3) with grease type MOLYKOTE G6000. Wait 15 minutes for it to completely dry. Insert pin (3) in its seat in the end cover (7).

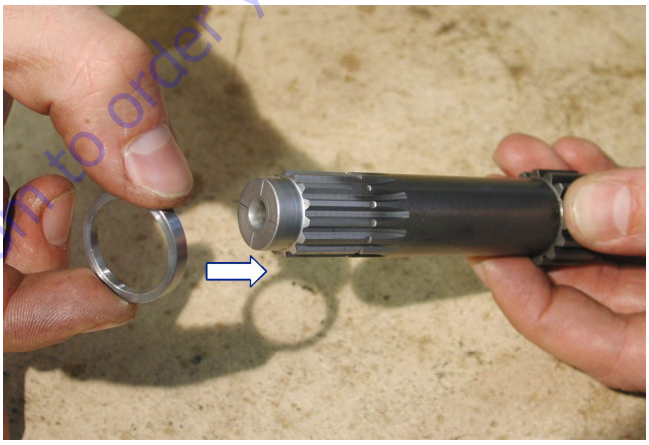


27. Install cap nut (5).



28. Torque two screws M8x16 (4) to 18.4 ft-lb (25 Nm).

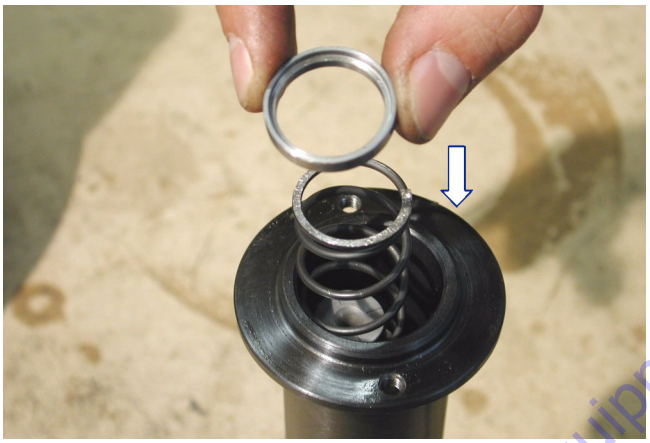
29. Install 1st washer (12) on splined shaft (14).



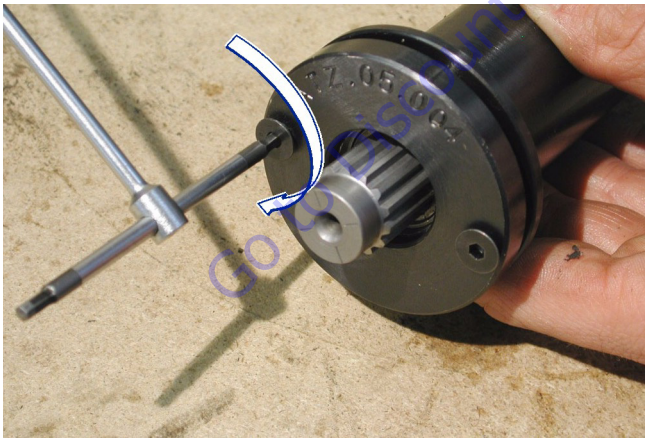
30. Install spring (13) on splined shaft (14).

31. Insert splined shaft (14) in special tool (6689960240).

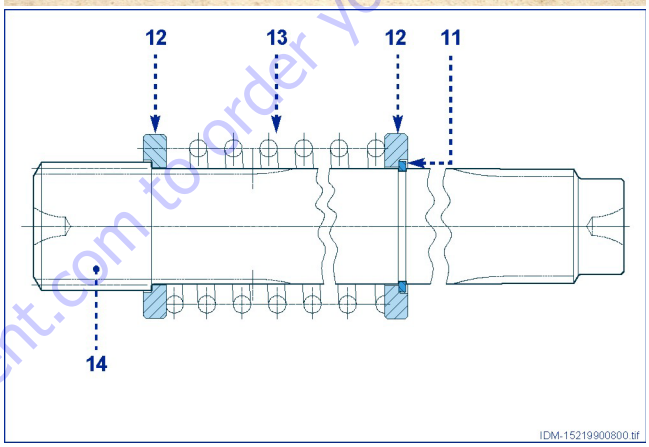
32. Insert 2nd washer (12) correctly in the splined shaft (14).



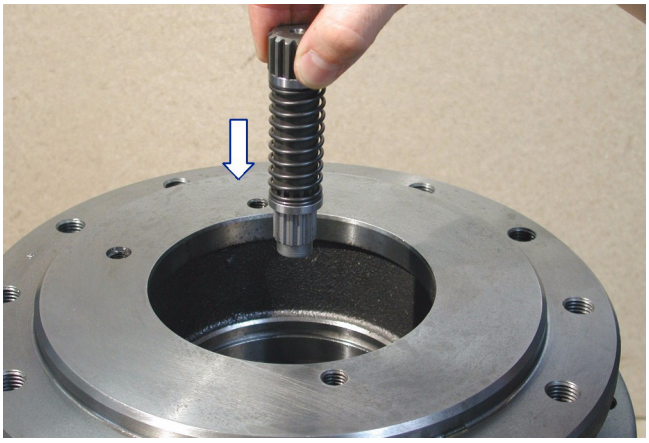
33. Torque two screws M5x16, grade 8.8, of the cover to 18.4 ft-lb (25 Nm).



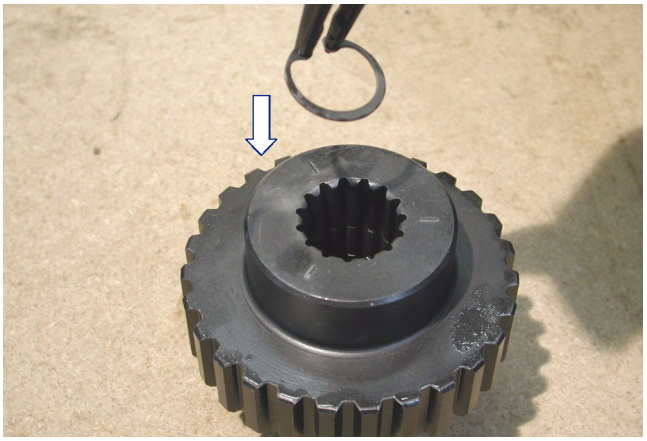
34. Using pliers, assemble elastic ring (11) into its seat in the splined shaft (14).



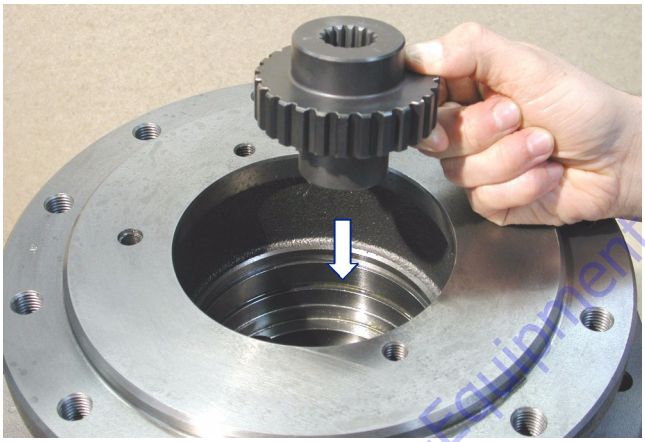
35. Insert disengagement shaft kit (15) in flanged hub (31).



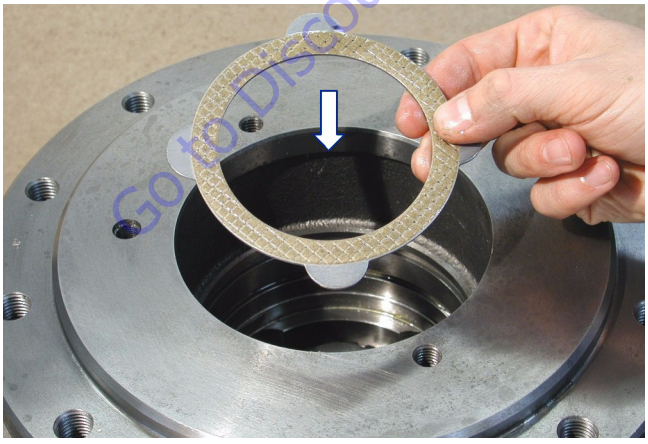
36. Using pliers, install circlip (36) into its seat in the brake shaft (35).



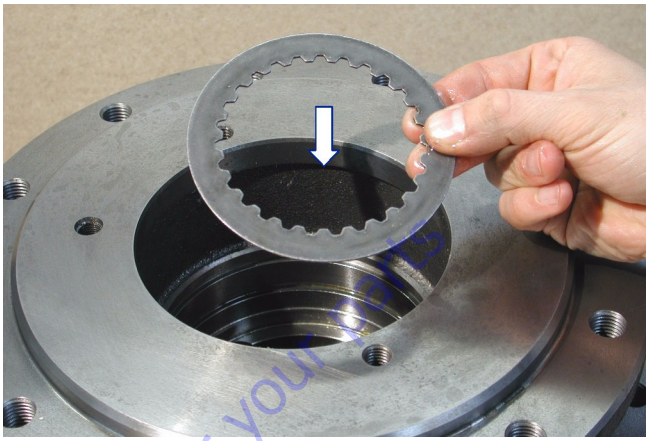
37. Turn gearbox upside down. Install brake shaft (35) inside flanged hub (31).



38. Assemble brake discs in the following order: first, insert one sintered bronze disc with external teeth (33).



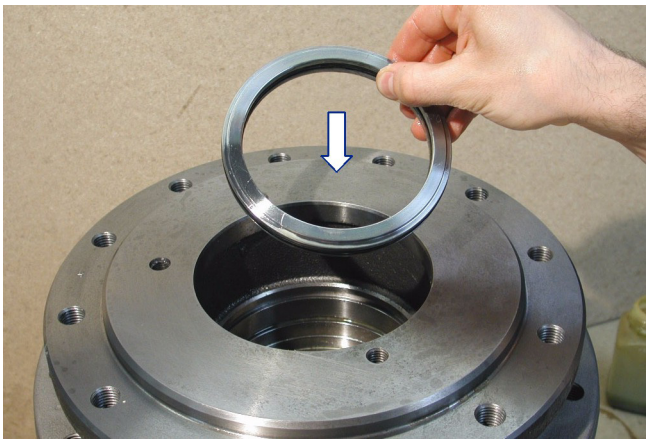
39. Insert an internally toothed steel disc (32). Repeat operation until all five sintered bronze discs and four steel discs are installed.



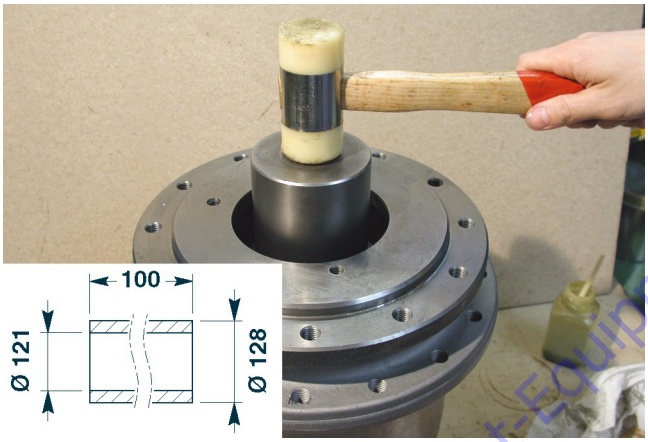
40. Fit internal O-ring seal (41) and backup ring (40) into their seats in the spacer (39).

41. Fit external O-ring seal (38) and backup ring (37) into their seats in the spacer (39).

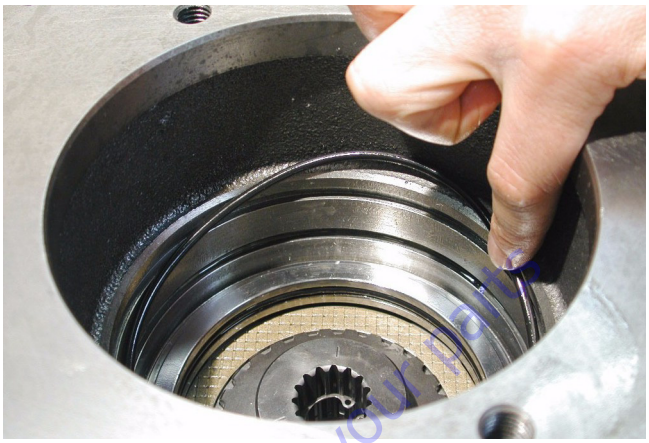
42. Insert spacer (39) inside flanged hub (31). Do not damage seals already installed.



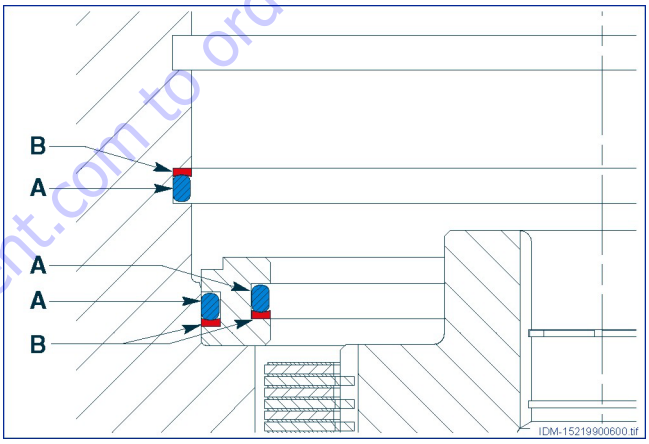
43. Using a rubber hammer and a metal stopper, push spacer (39) against flanged hub (31). Do not damage seals already installed.



44. Lube seal seats into flanged hub (31) and assemble the O-ring seal (42) and the backup ring (43).

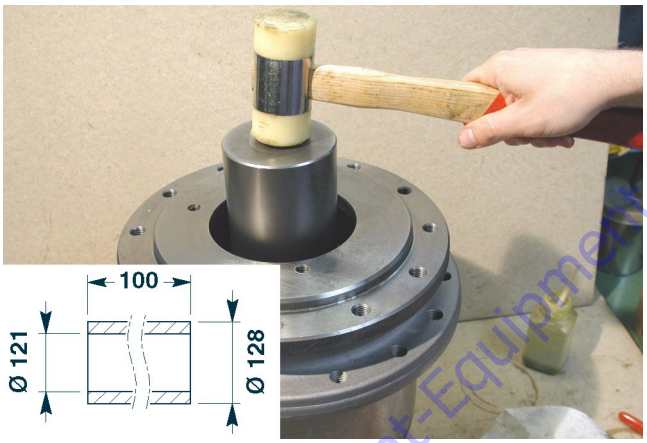


NOTE: *O-ring seals (A) and backup rings (B) must be fitted in seats according mutual position shown below.*

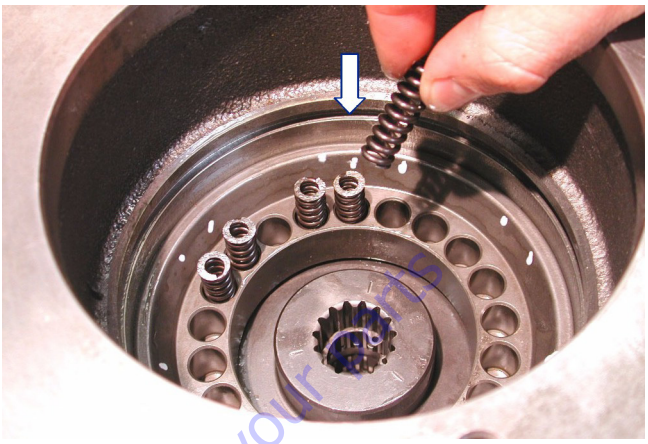


45. Insert brake piston (44) inside flanged hub (31). Do not damage seals already fitted.

46. Using a rubber hammer and a metal stopper, push brake piston (44) against flanged hub (31). Do not damage seals already installed.

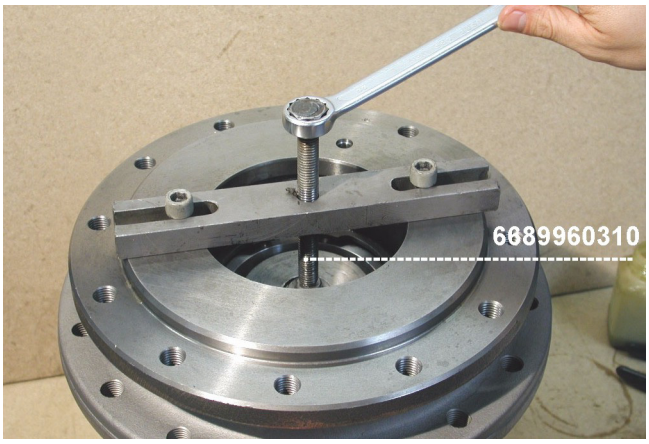


47. Insert springs (45) in previously marked brake piston (44) holes.

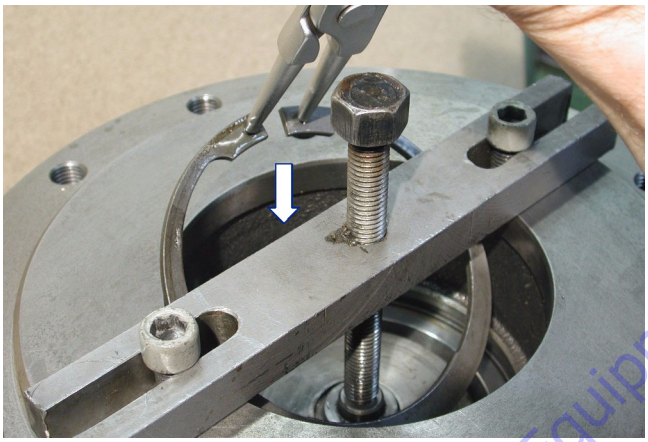


48. Install spring retainer disc (46).

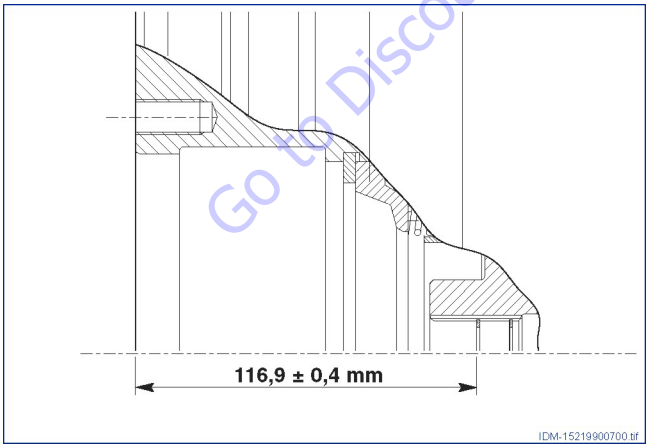
49. Install special tool (6689960310) on flanged hub (31). Turn screw until it compresses springs (45).



50. Install circlip (47) in its seat and remove special tool.



NOTE: *Before assembling hydraulic motor, verify by a depth slide gauge the correct assembly of the unit checking the axial distance as shown below.*



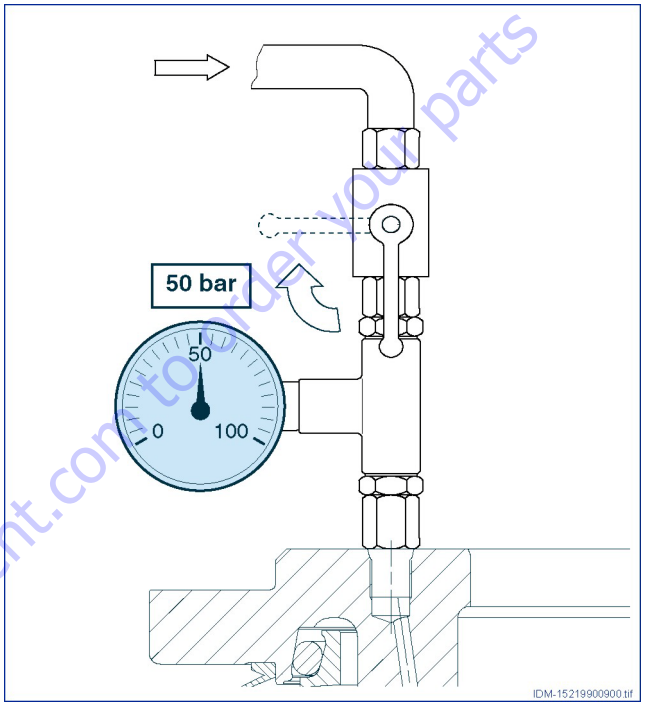
Final Test and Reinstallation

Check product by remounting it to the machine.

Check function of drive hub following all checks shown in Startup and Running In.

If work on the brake was performed, check for oil leaks. Follow procedure below:

1. Connect pressure pilot line with manometer (with a base scale of 100 bars) to the brake release port.



2. Open flow valve and release brake with pilot pressure of 50 bar.

3. Close flow valve and keep brake released 3 minutes or longer.

4. Using a manometer, check pressure remains constant.

NOTE: *If pressure drops, it may mean brake seals are not tight and must be replaced, or reassembling was not completed properly.*

5. After reassembling gearbox, install hydraulic motor.

6. Fill gearmotor with lubricant oil.

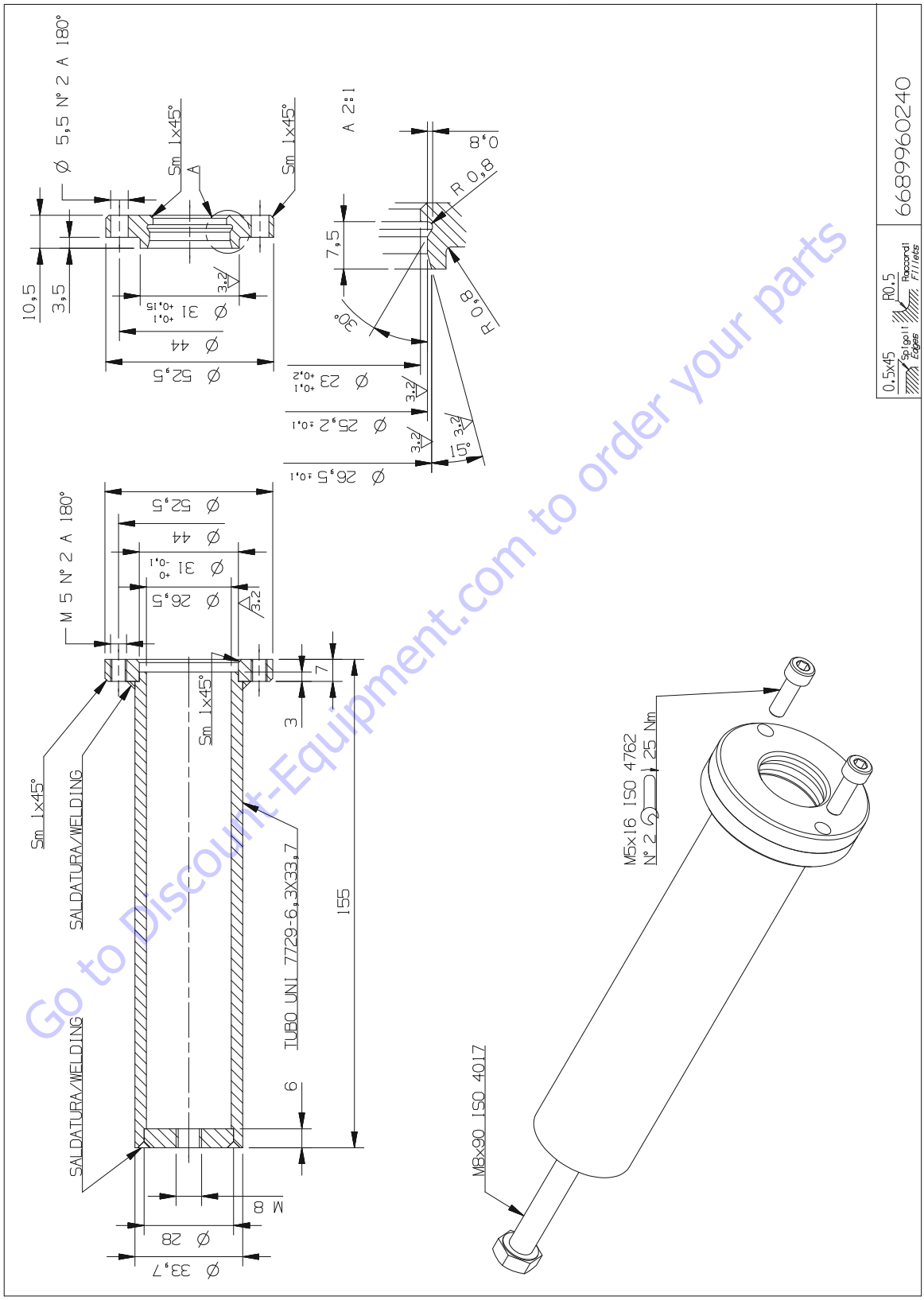


Figure 3-19. Drive Hub Special Tools - Sheet 1 of 4

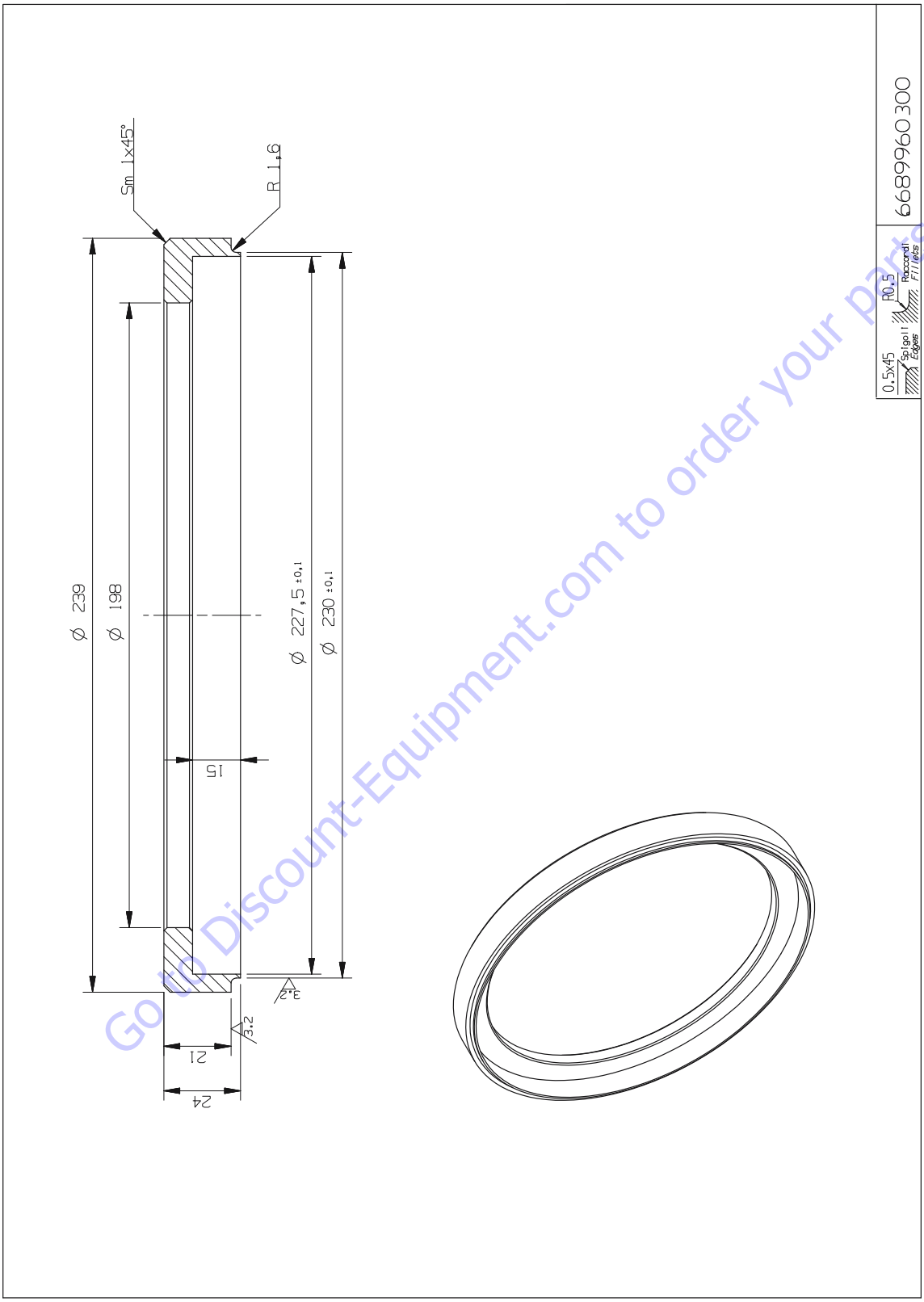


Figure 3-20. Drive Hub Special Tools - Sheet 2 of 4

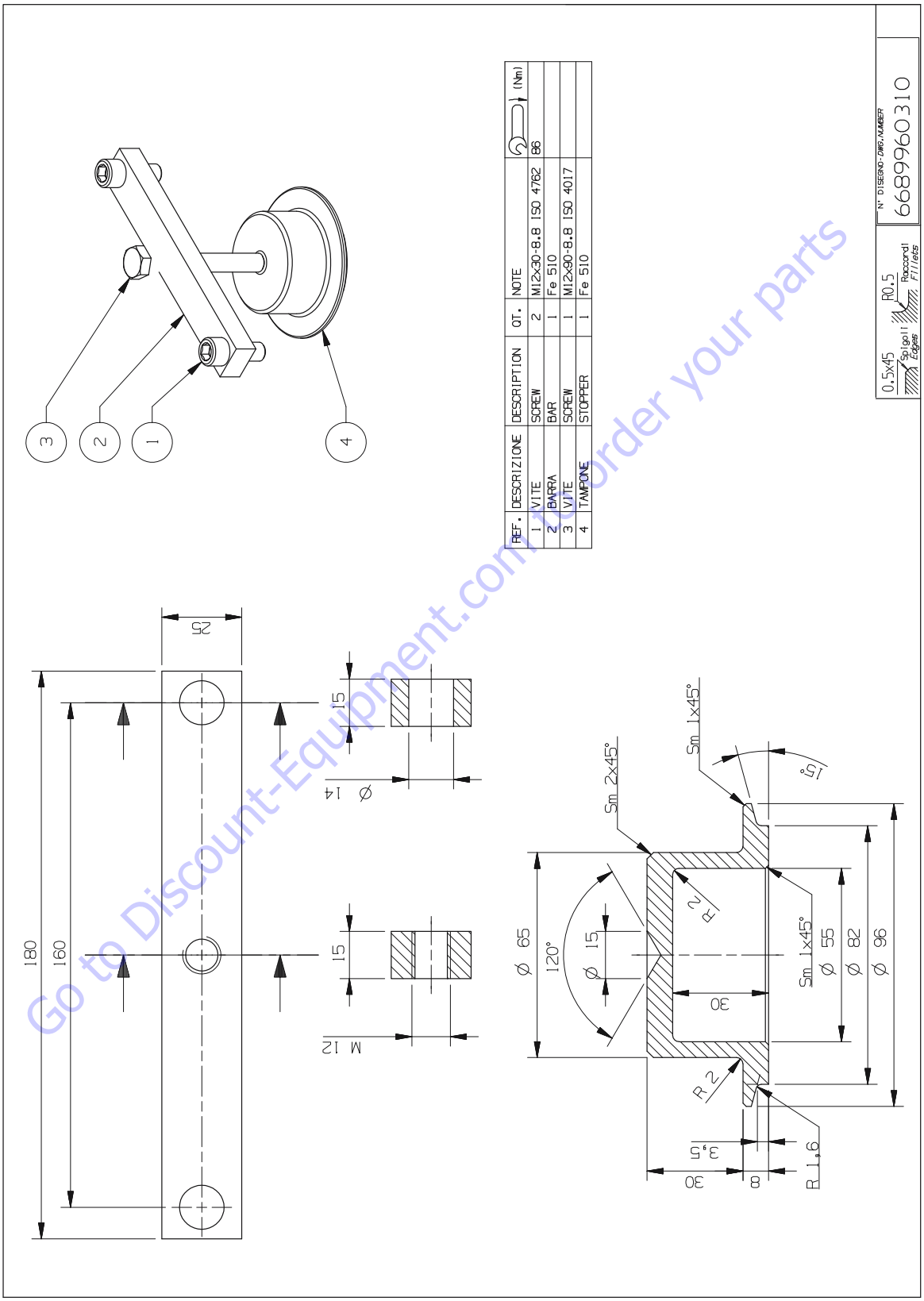


Figure 3-21. Drive Hub Special Tools - Sheet 3 of 4

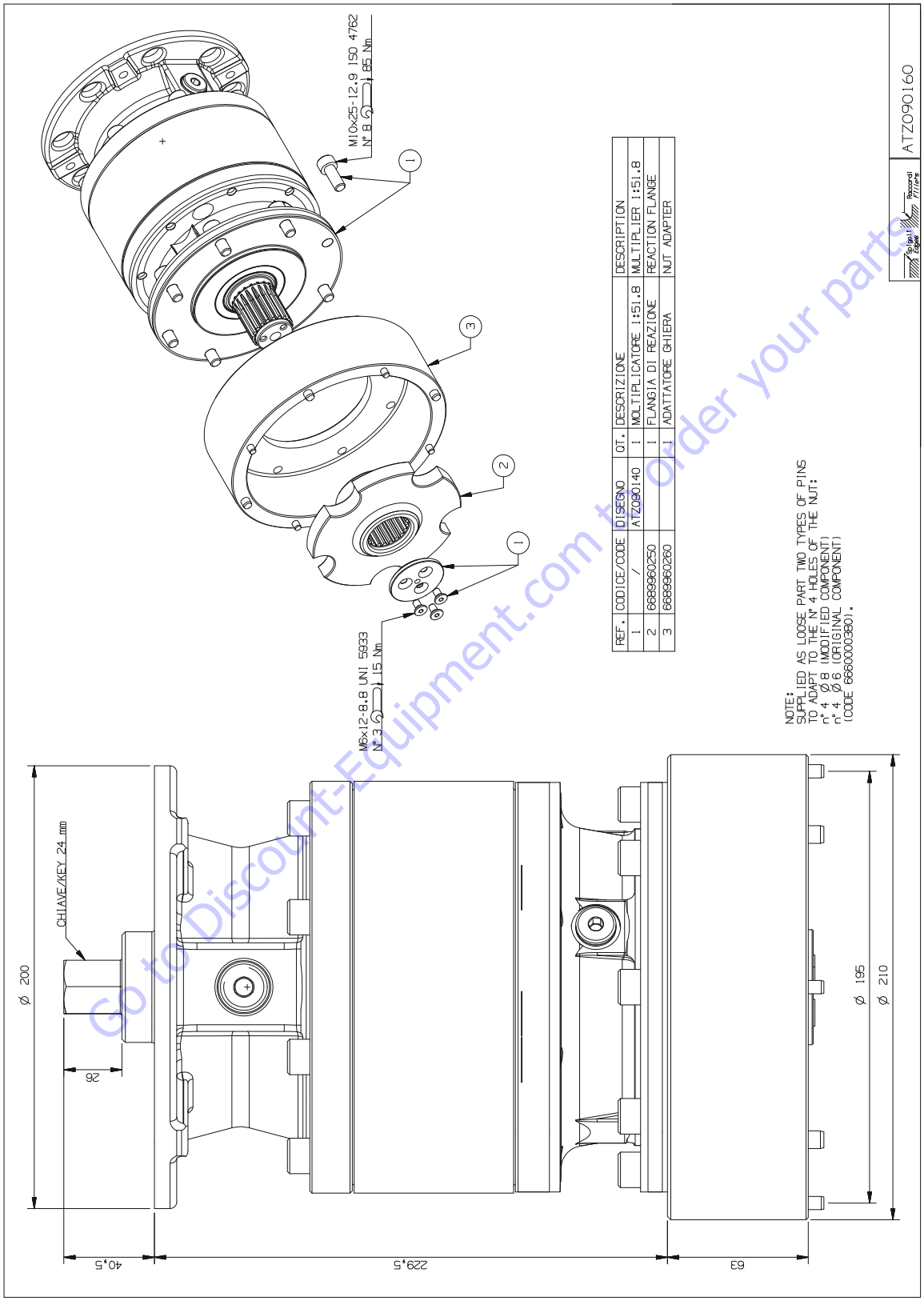


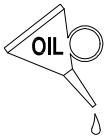
Figure 3-22. Drive Hub Special Tools - Sheet 4 of 4

3.14 DRIVE HUB - IF EQUIPPED WITH REGGIANA RIDUTTORI

NOTE: *Machines may be built with either Bonfiglioli or Reggiana Riduttori wheel drive hubs. See Section 3.13, Drive Hub - If Equipped With Bonfiglioli. Do not use different hubs on the same machine.*

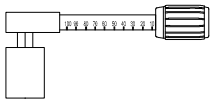
Symbol Nomenclature

= ADHESIVE



= LUBRICANT

= GREASE



= TORQUE WRENCH

= DISPOSAL

Tools

Tools required for assembling and disassembling the wheel gear RRTD1701TB

1. Hammer;
2. Clamps for inner retention rings;
3. Clamps for outer retention rings;
4. Electric or pneumatic screwdriver;
5. Special spacer mounting;
6. Torque wrench;
7. Hydraulic press;
8. Wrench for M6, M8, M10 socket head screws and 1/4"G plug.
9. Socket wrench for M6 hexagonal screw.

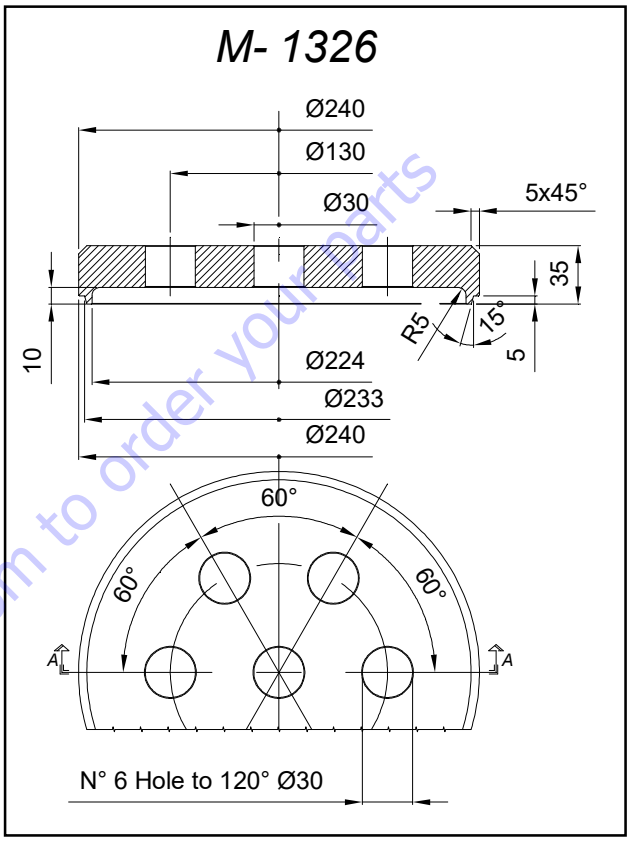


Figure 3-23. Bearing Track Spacer Mounting C016117

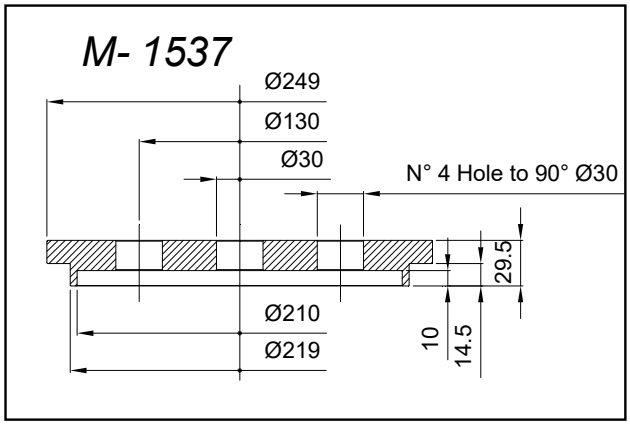


Figure 3-24. Oil Seal Spacer Mounting C125049

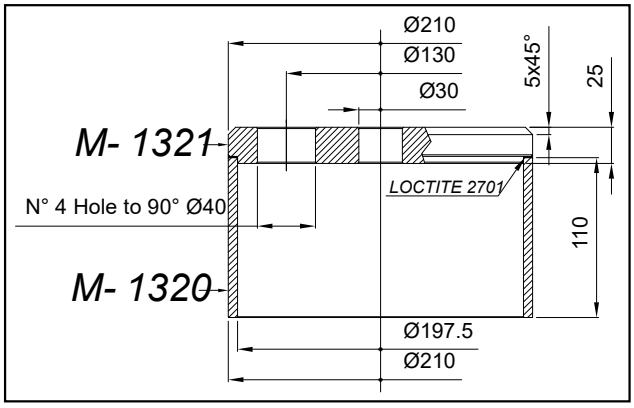


Figure 3-25. Bearing Spacer Mounting CO16117

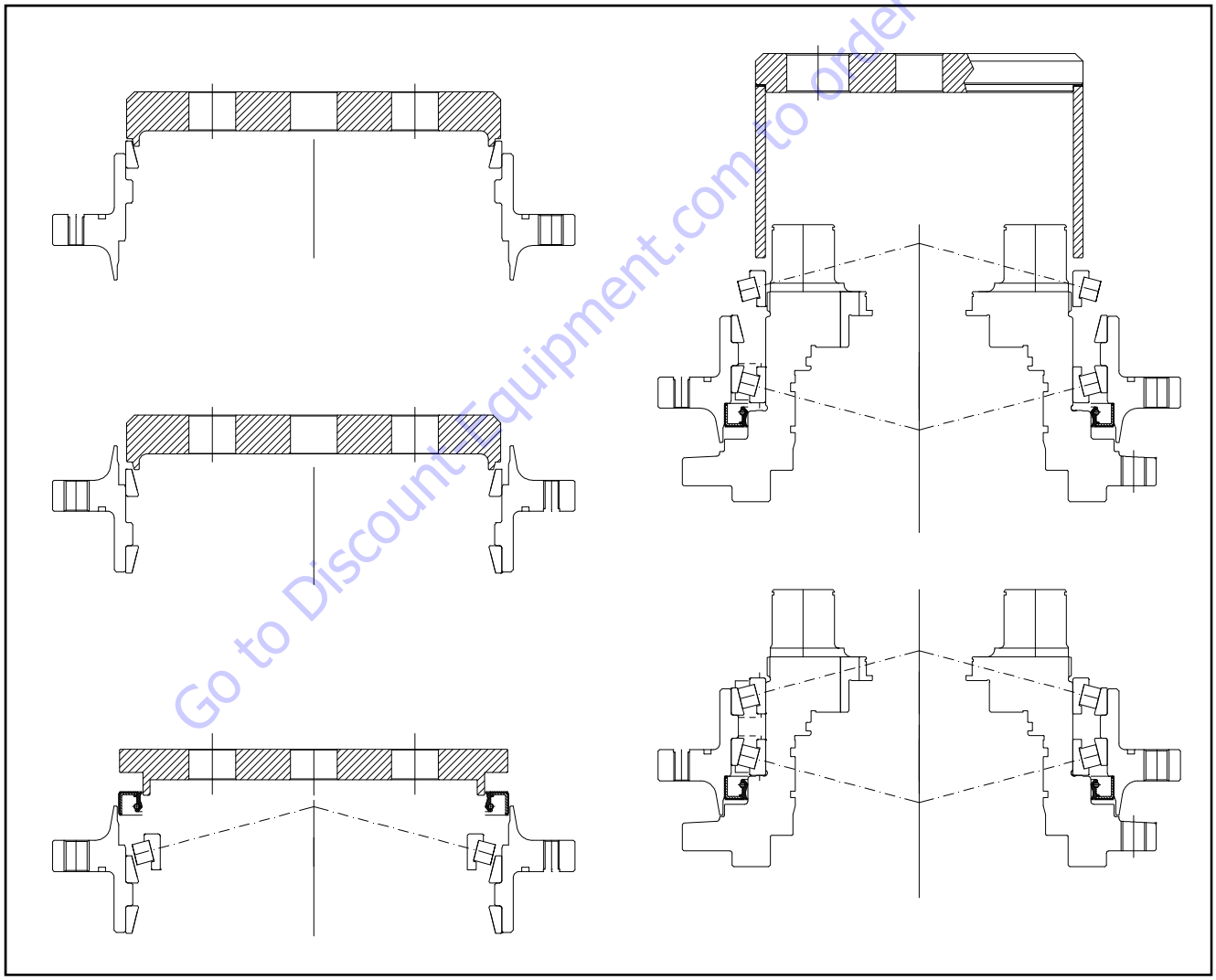


Figure 3-26. Assembly Diagram 1

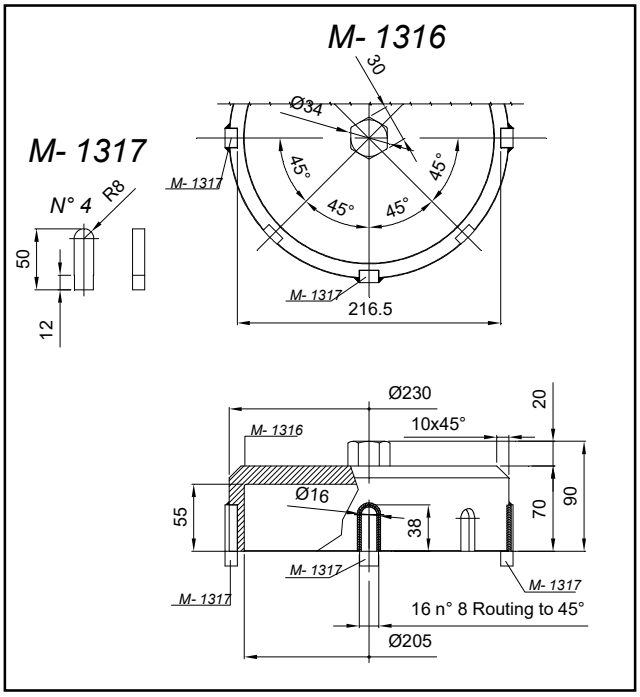


Figure 3-27. Wrench For Ring Nut

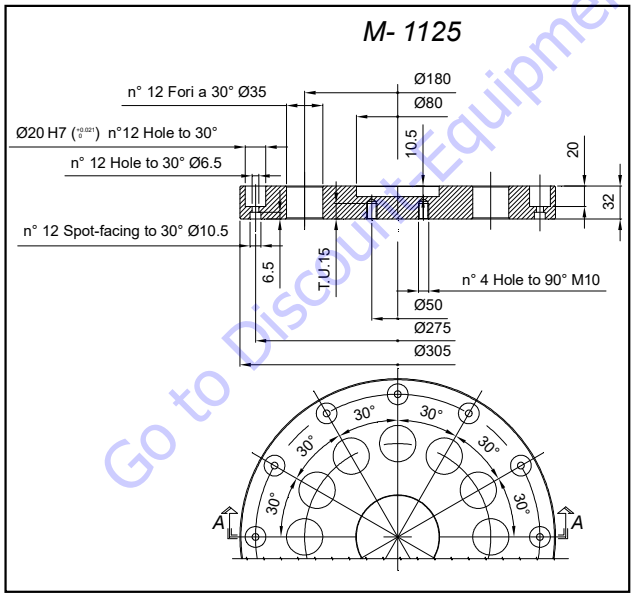


Figure 3-28. Anti-rotation Flange

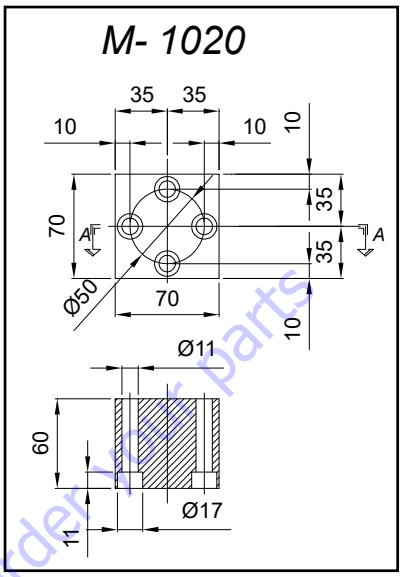


Figure 3-29. Anti-rotation Block

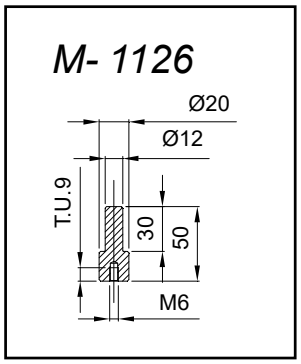


Figure 3-30. Anti-rotation Pin

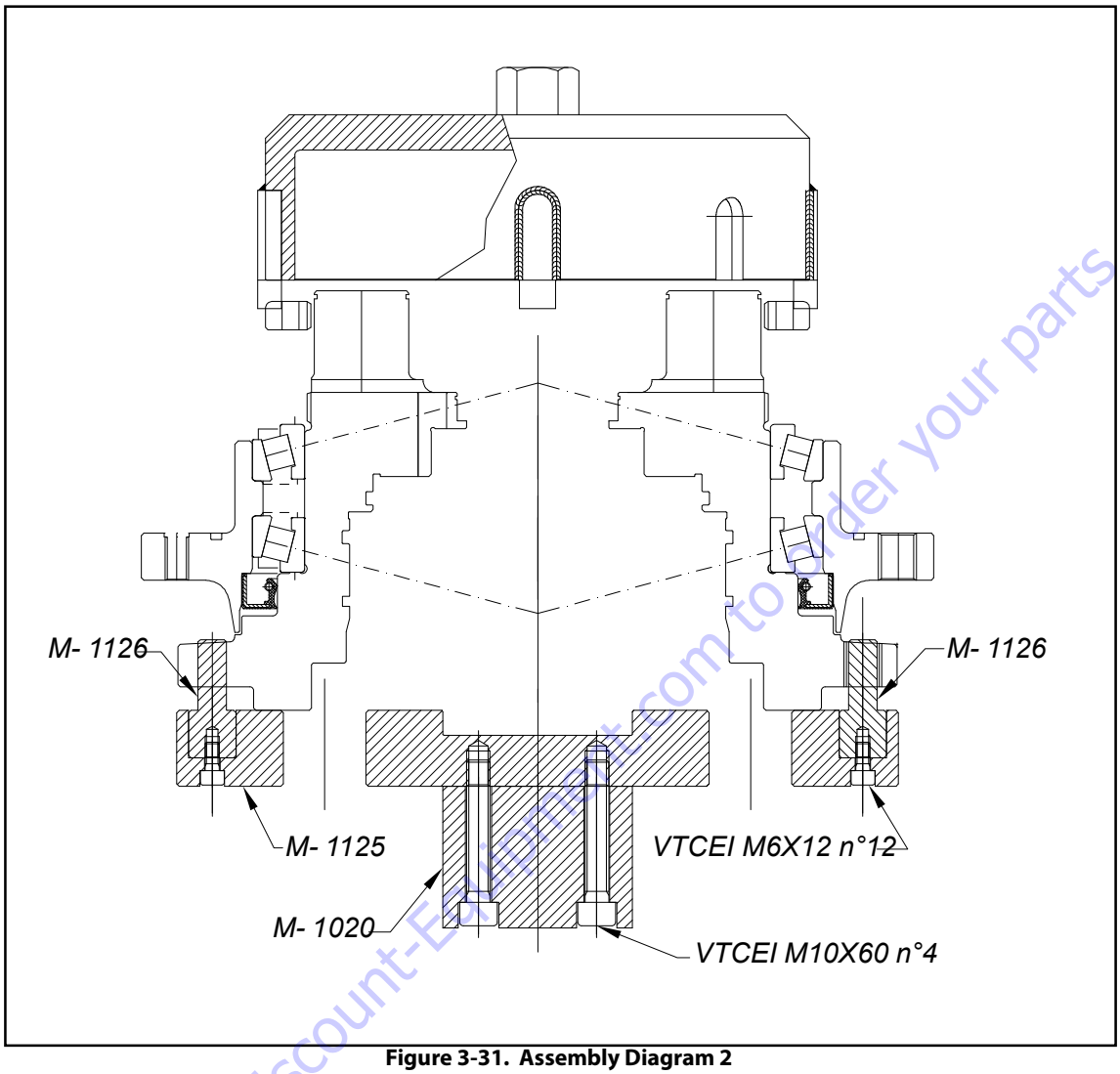


Figure 3-31. Assembly Diagram 2

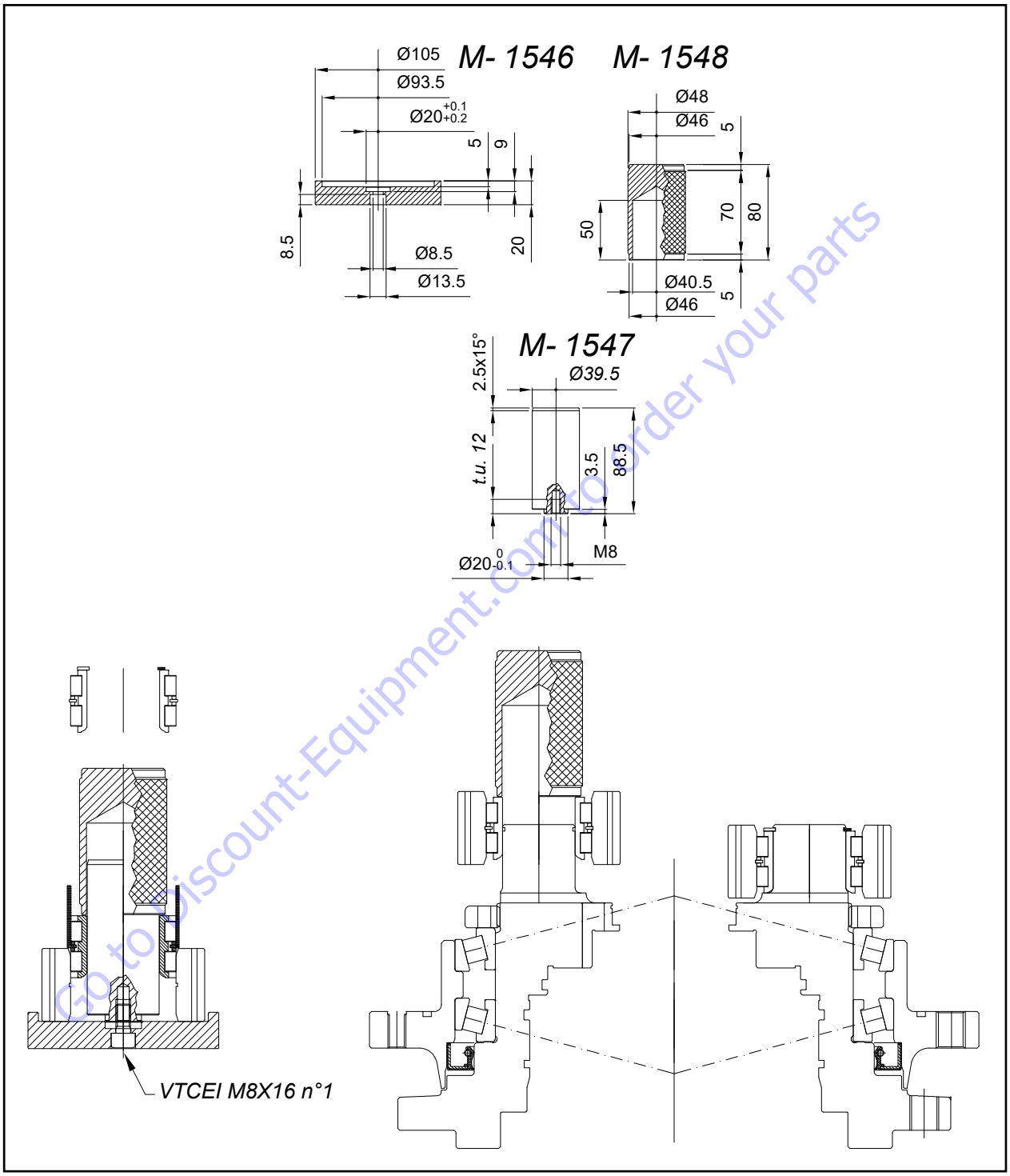
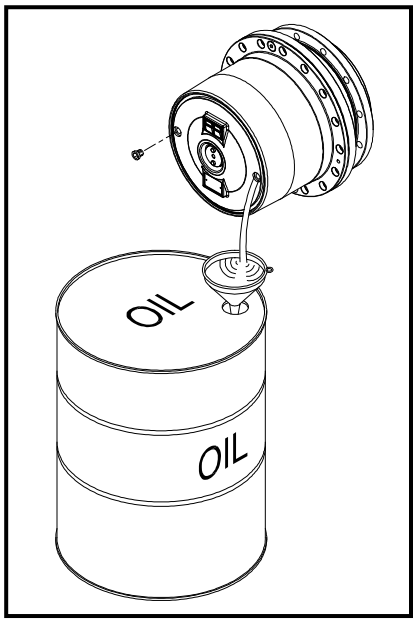


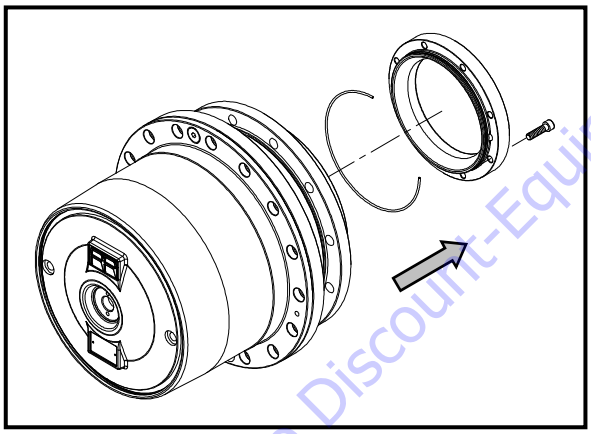
Figure 3-32. Tools For Assembling Bearing 3rd Stage Planetary Gear Assembly Diagram

Disassembly

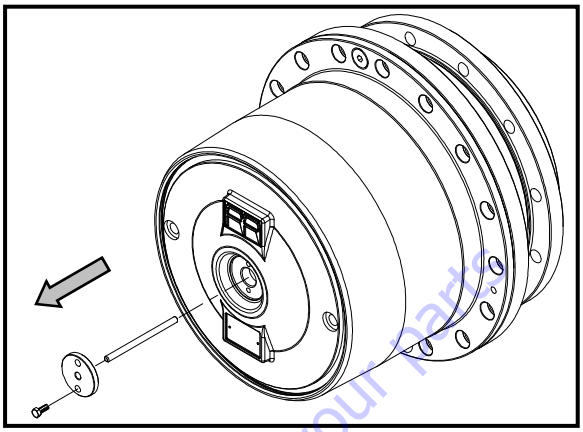
1. Remove plugs and pour lubricant in a container.



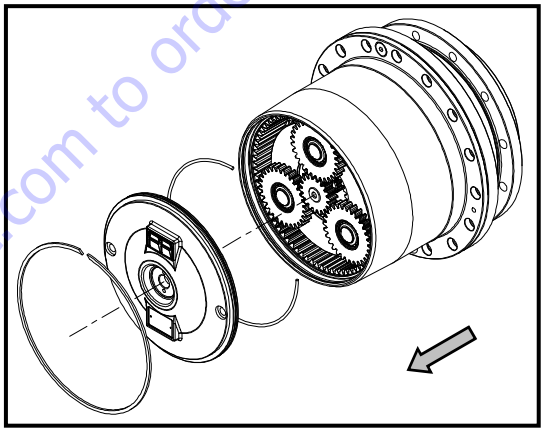
2. Release screws to disassemble the motor flange. Do not damage O-Ring.



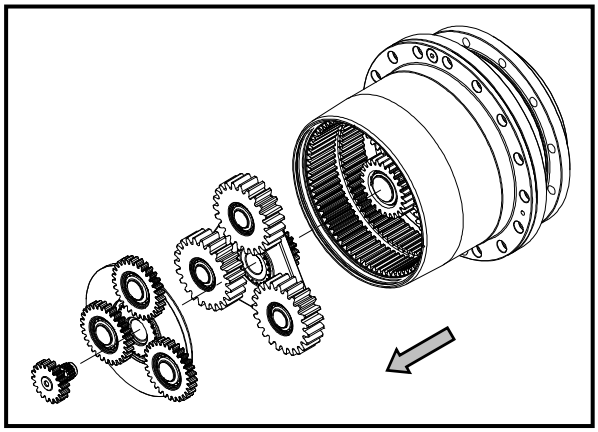
3. Release the screws from the release cover and pull the pin out.



4. Remove the BR250 ring and pull cover out. Do not damage O-Ring.



5. Pull reduction gears out.



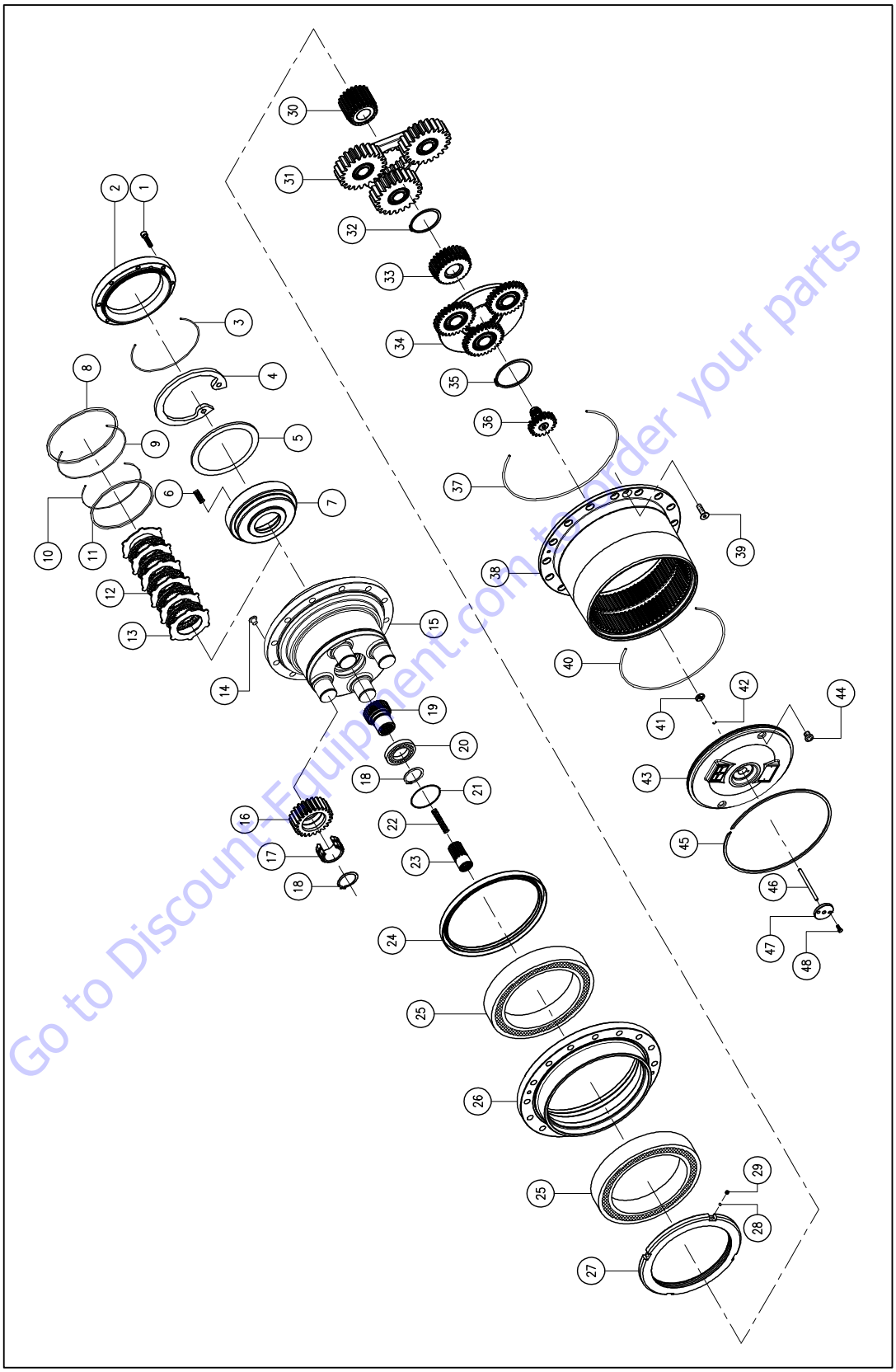
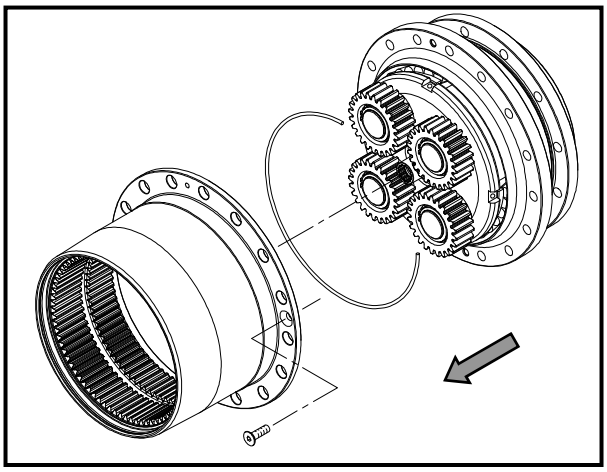


Figure 3-33. Reggiana Riduttori Hub - Sheet 1 of 2

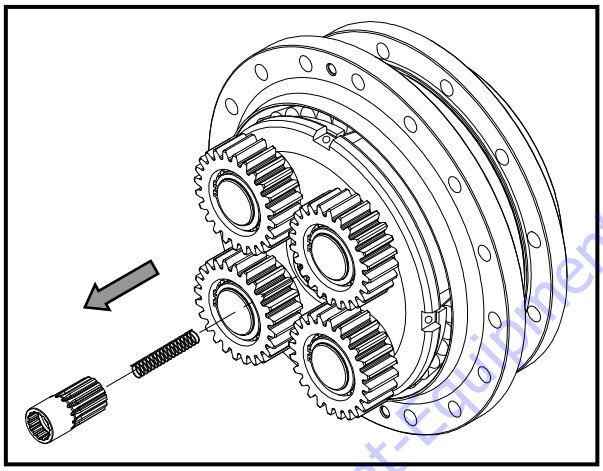
1. Screw
2. Motor Support
3. O-ring
4. Inner Retention Ring
5. Brake Spring Spacer
6. Brake Spring
7. Brake Piston
8. Parbak
9. O-ring
10. O-ring
11. Parbak
12. Sintered Brake Disc
13. Iron Brake Disc
14. Plastic Plug
15. Spindle
16. Planet Wheel
17. Bearing
18. Outer Retention Ring
19. Input Shaft
20. Input Shaft Bearing
21. Ring
22. Disengagement Spring
23. Disengagement Shaft
24. Spindle Oil Seal
25. Tapered Roller Bearing
26. Bearing Support
27. Ring Nut
28. Sphere
29. Screw
30. Pinion
31. Reduction Gears
32. Outer Retention Ring
33. Pinion
34. Reduction Gears
35. Outer Retention Ring
36. Pinion
37. O-ring
38. Crown Gear
39. Crown Gear Screw
40. O-ring
41. Support Tablet
42. O-ring
43. Cover
44. Steel Plug
45. Cover Retaining Ring
46. Disengagement Stud
47. Disengagement Cap
48. Disengagement Screw

Figure 3-34. Reggiana Riduttori Hub - Sheet 2 of 2

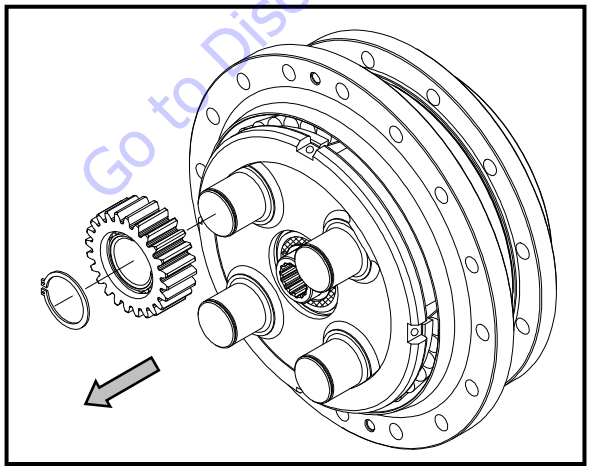
6. Loosen the M10x25 flathead socket screws. Remove planetary ring. Do not damage O-Ring.



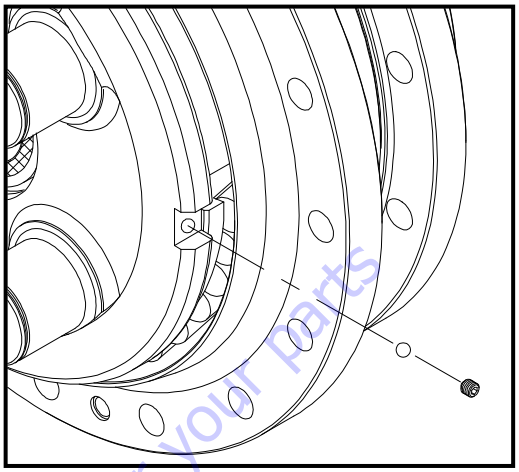
7. Remove release joint together with the spring.



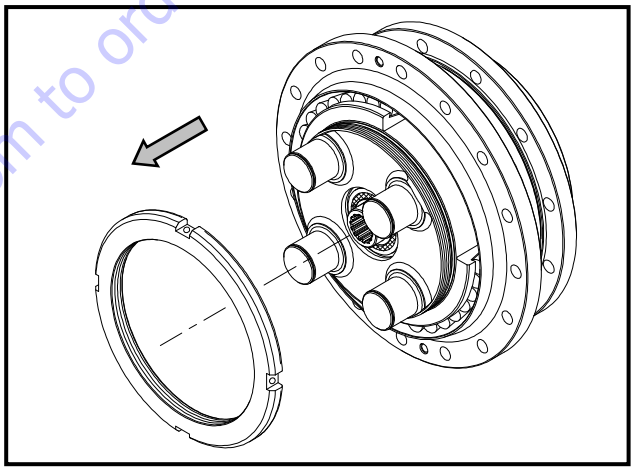
8. Disassemble the Ø40 outer snap rings. Using an extractor, remove planetary gears from spindle pins.



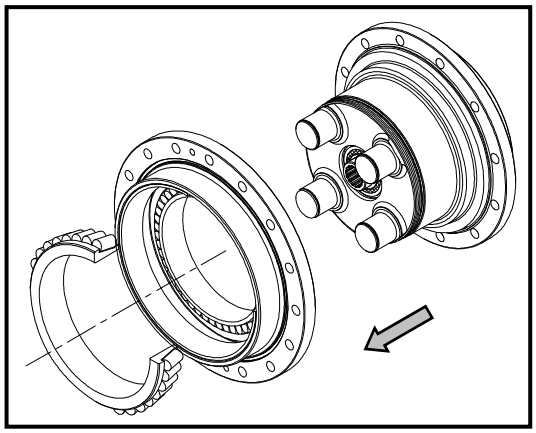
9. Loosen the M6x6 socket headless screws and remove the 3/16" balls.



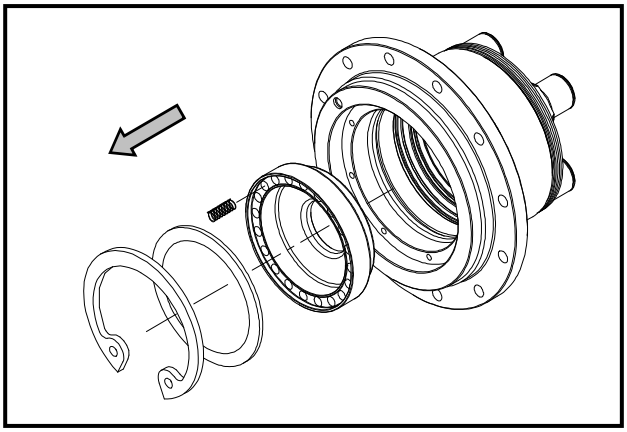
10. Loosen the ring nut using the special wrench.



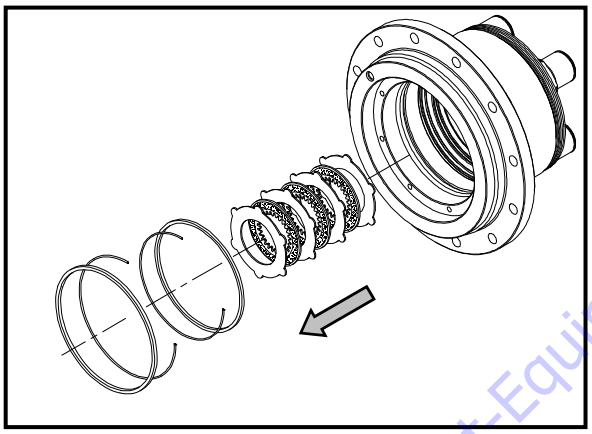
11. Remove hub support with roller bearing inner track.



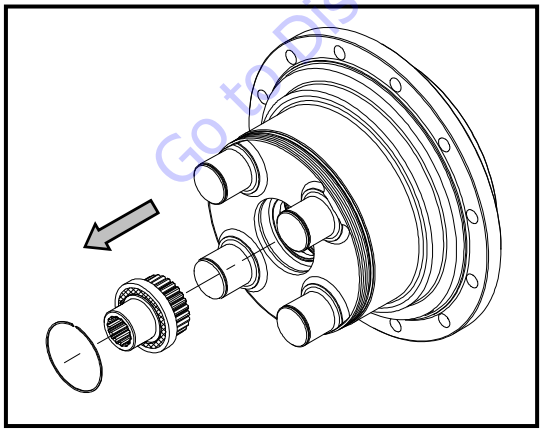
12. Disassemble the Ø160 inner snap ring and pull the spring holder spacer out. Remove springs. Using a compressed air jet in the brake control hole, pull piston out of the spindle.



13. Remove brake discs and seals.

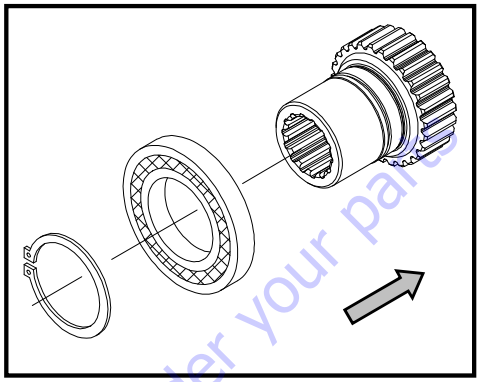


14. Fit ball bearing into input shaft and lock it with a Ø40 outer snap ring. Install motor shaft in spindle and lock with a BR68 ring. Lubricate bearing.

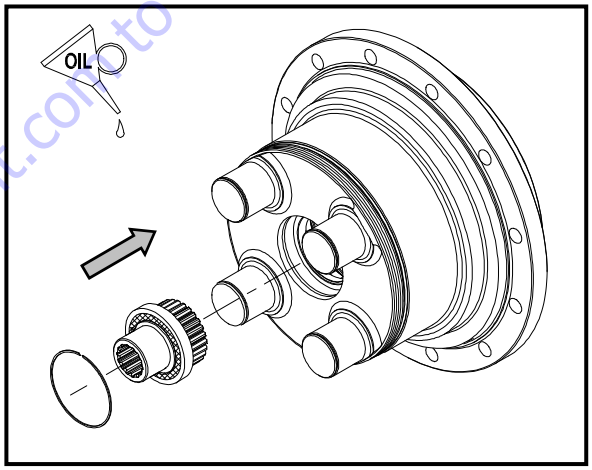


Assembly

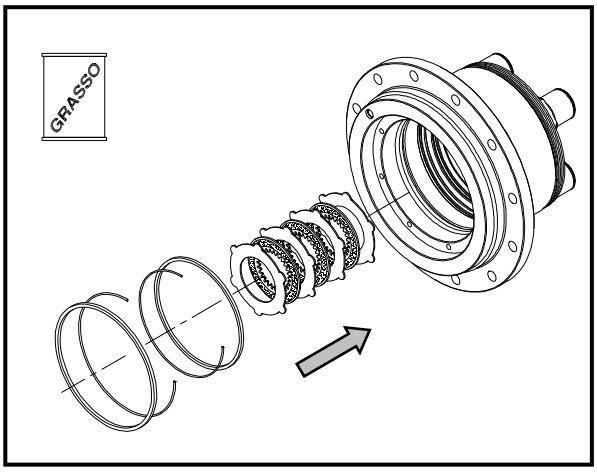
1. Make sure all wheel gear components are devoid of burrs, machining residues, and are correctly washed.
2. Fit ball bearing in input shaft. Lock with a Ø40 outer snap ring.



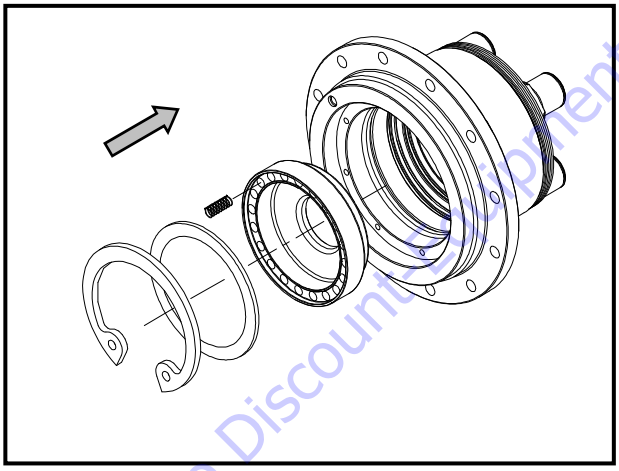
3. Install motor shaft in spindle and lock with BR68 ring. Lubricate bearing.



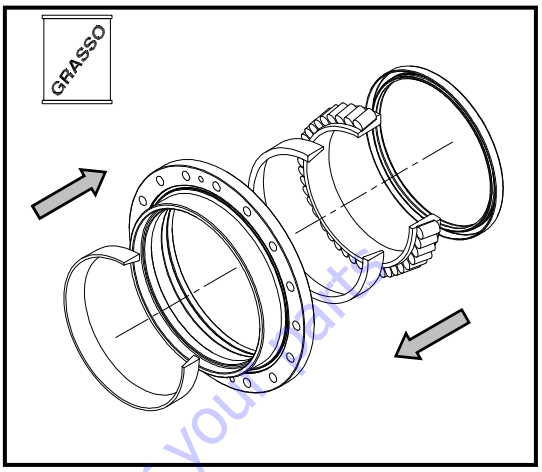
4. Fit brake sealing rings O-Ring and PARBAK (lubricated with grease) in the respective spindle seats. Place the brake discs making sure to center them on the spindle and on the input shaft.



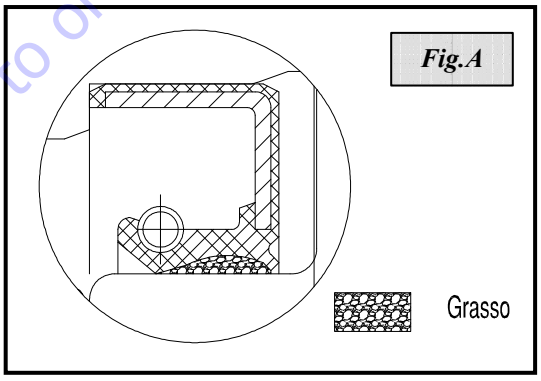
5. Insert brake piston and place springs into the piston holes. Close brake fitting spring holder plate, then lock with the Ø160 inner snap ring. Check brake leakage, if any, as well as the static torque and minimum opening pressure.



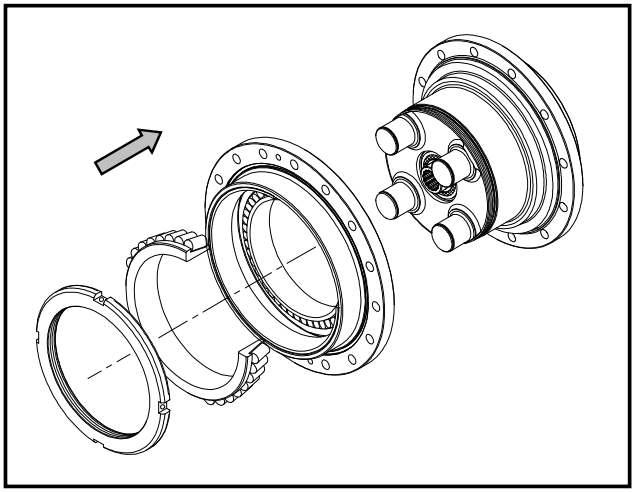
6. Prepare hub support, mounting on it the two roller bearing outer tracks. Place first roller bearing inner track.



7. Install oil seal lubricated with grease on support with special spacer mounting (see figure A).

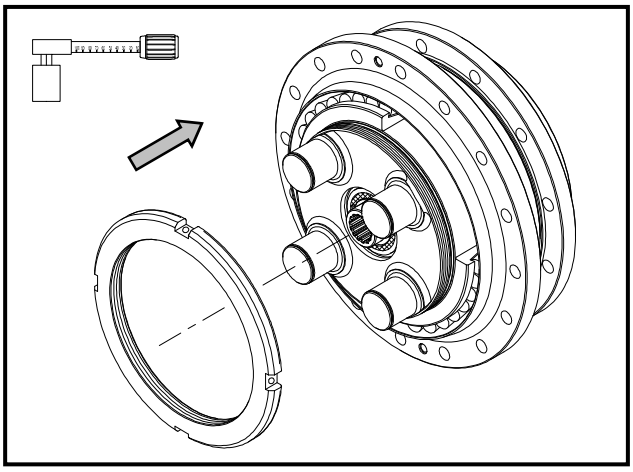


8. Place hub support already assembled on spindle making sure that the first roller bearing inner track goes correctly against it; then fit the second roller bearing inner track by means of spacer mounting. Tighten ring nut.

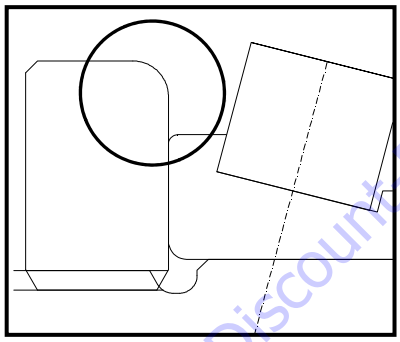


9. Check unit roll torque and proceed in the following order:

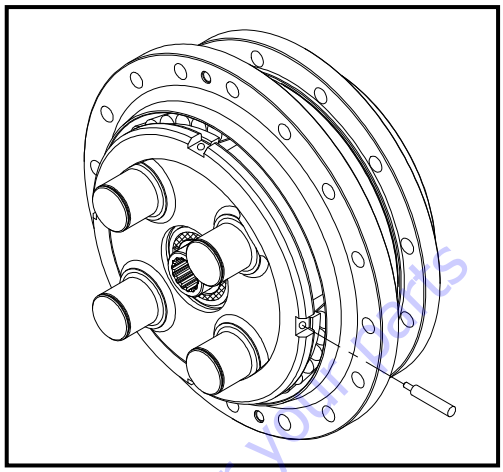
10. Keeping spindle locked, apply a setting preload by tightening ring nut at 40daNm, turn completely the hub support twice using the special wrench to recover any bearing cage misalignments. Release and tighten the ring nut at the final torque of 30daNm (alternate tightening and some setting turns). Check roll torque with seal which must be within 1÷1,5 daNm.



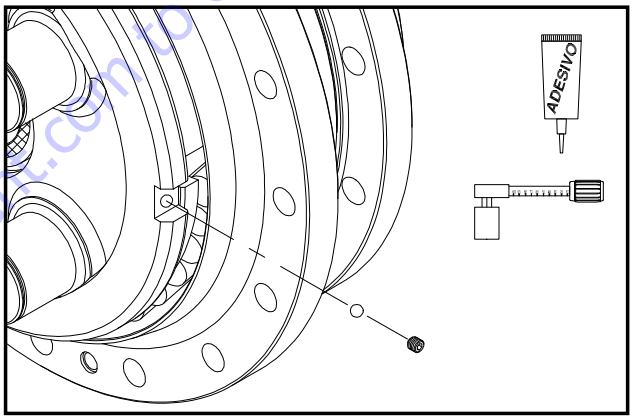
NOTE: *Place ring nut with convex part facing the roller bearing as shown below.*



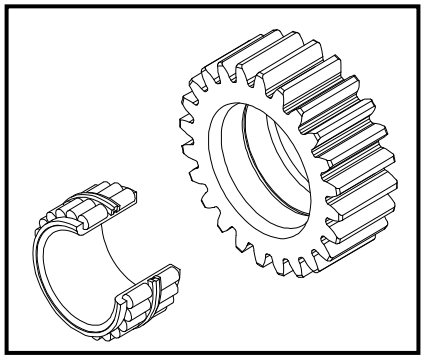
11. Using special tool and hammer, make four dents on the spindle thread by the M6 holes of the ring nut.

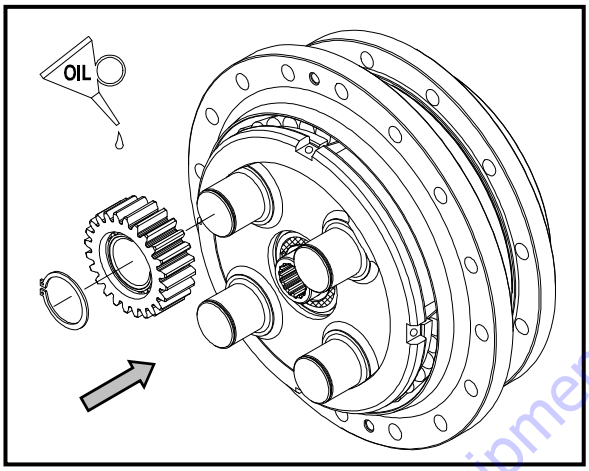


12. Fit the 4 3/16" balls and tighten with Medium Strength Threadlocking Compound the 4 M6x6 socket headless screws at the torque of 1daNm.

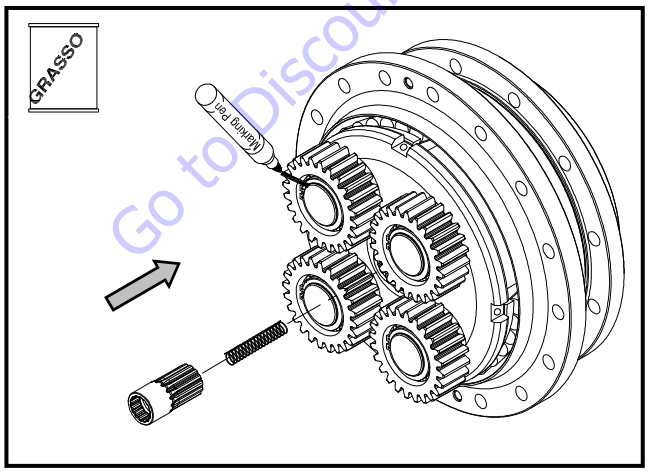


13. Fit bearings on 3rd stage planetary gears and using a spacer mounting mount everything on the spindle pins. Lock with an outer snap ring. Lubricate bearings.

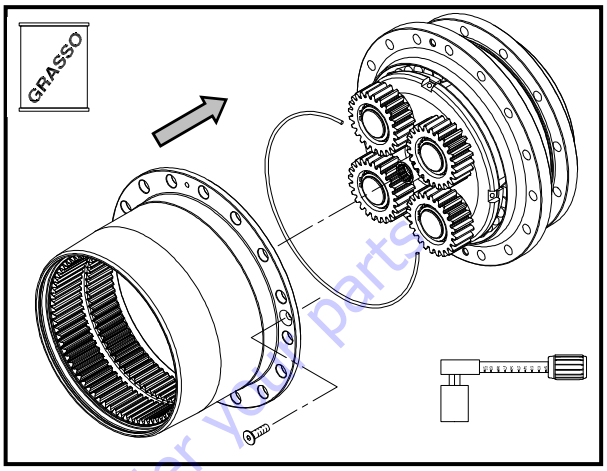




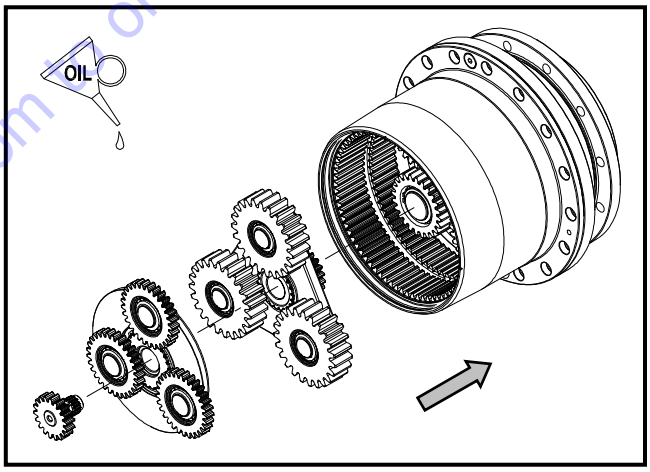
14. Using a marking pen, make a mark between the snap ring and the bearing. Fit the greased spring and the release joint. Use grease to fit the O-Ring 2-275 in the hub support seat.



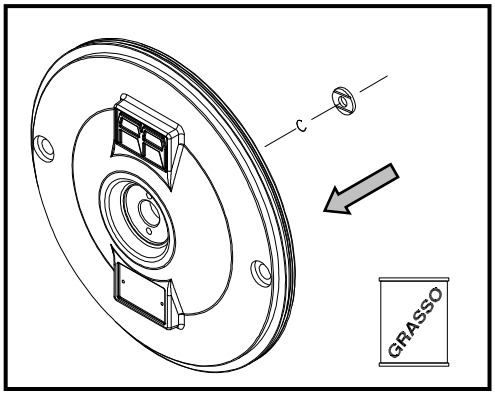
15. Place hub on support making the two holes coincide for tightening the M10x25 flathead socket screws at the torque of 5daNm.



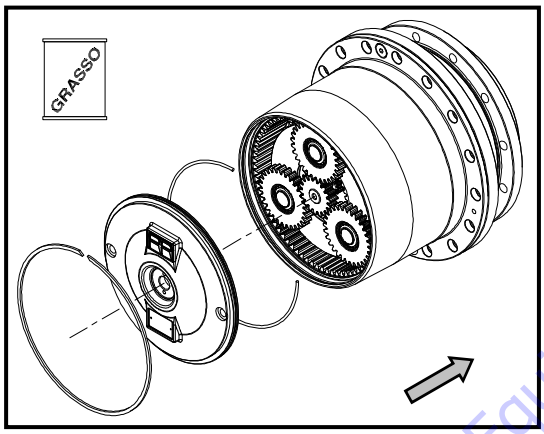
16. Fit the reduction gears and the pinion in the unit.



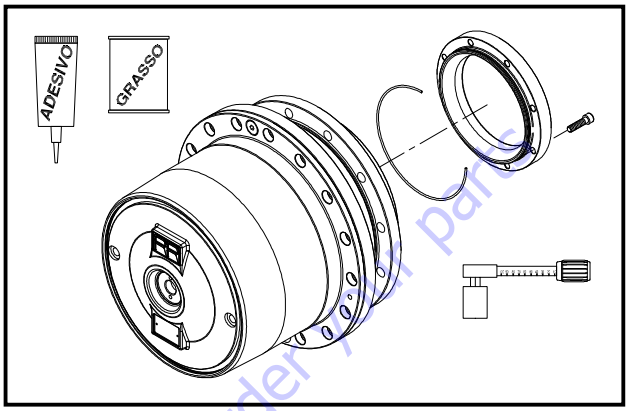
17. Prepare the closing cover fitting the O-ring 5-582 suitably greased and lock it with the shimming ring. Lubricate the bearings.



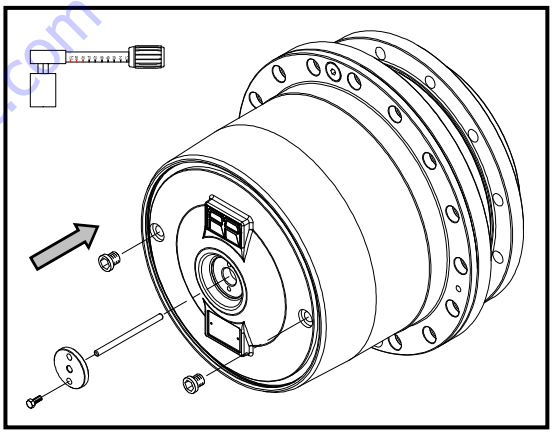
18. Fit O-Ring 2-177 suitably greased, mount the cover locking it with the BR250 ring.

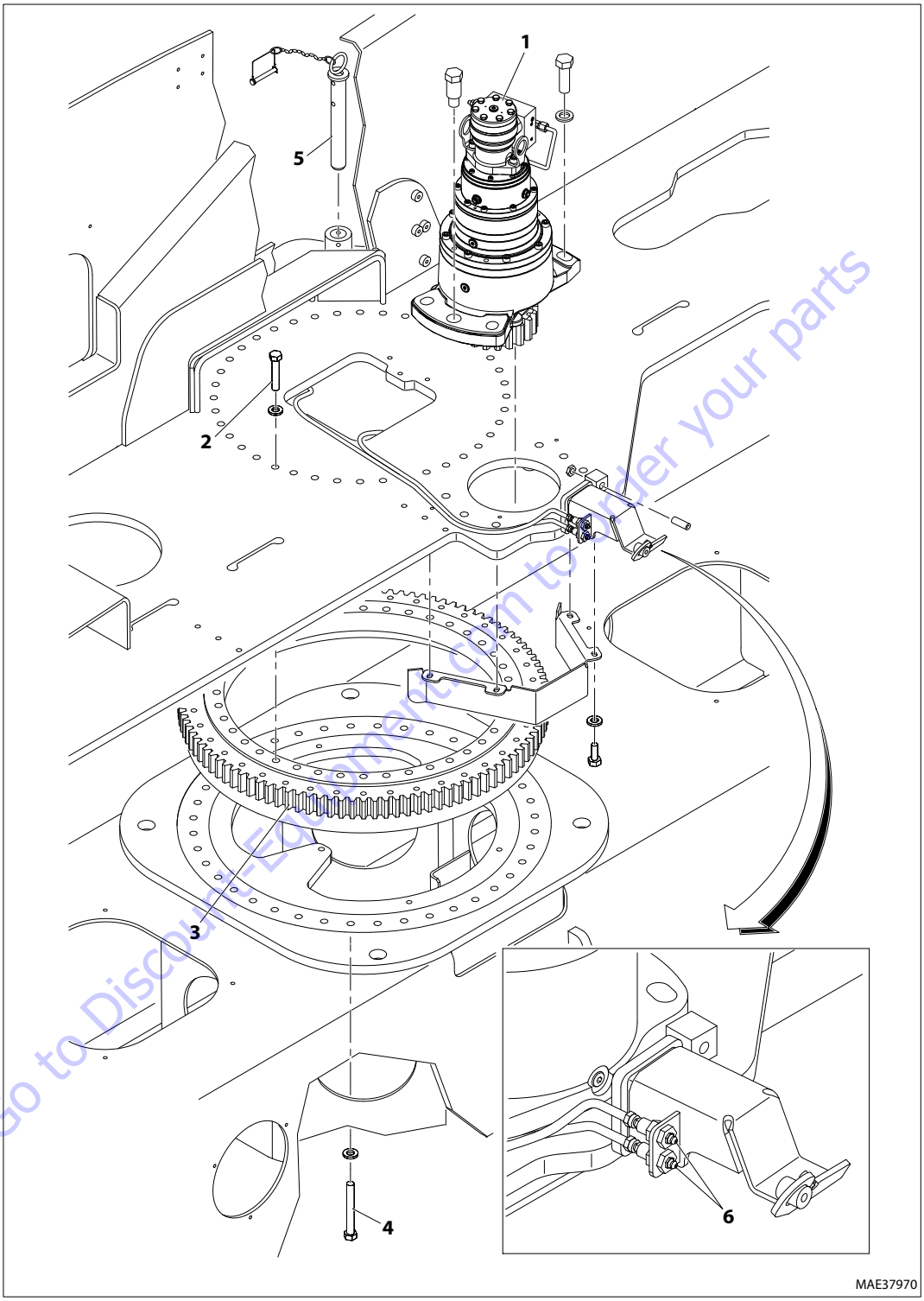


19. Fit O-Ring 2-163 suitably greased, on motor coupling flange S-D LC/KC. Mount flange on spindle with 6 M8x25 socket capscrews at the torque of 2.4daNm with Medium strength threadlocking compound. Insert pin and perform rotation test according to PGQ-22 standard.



20. Mount release cover fastening it with 2 M6x20 hexagonal screws at the torque of 1daNm. Mount the 1/4"GAS plugs on the cover at the torque of 1daNm.





1. Swing Drive
2. Inner Race Bearing Bolt
3. Swing Bearing
4. Outer Race Bearing Bolt
5. Turntable Lock Pin
6. Remote Bearing Lubrication Fittings

Figure 3-35. Swing System

3.15 SWING DRIVE HUB

Removal

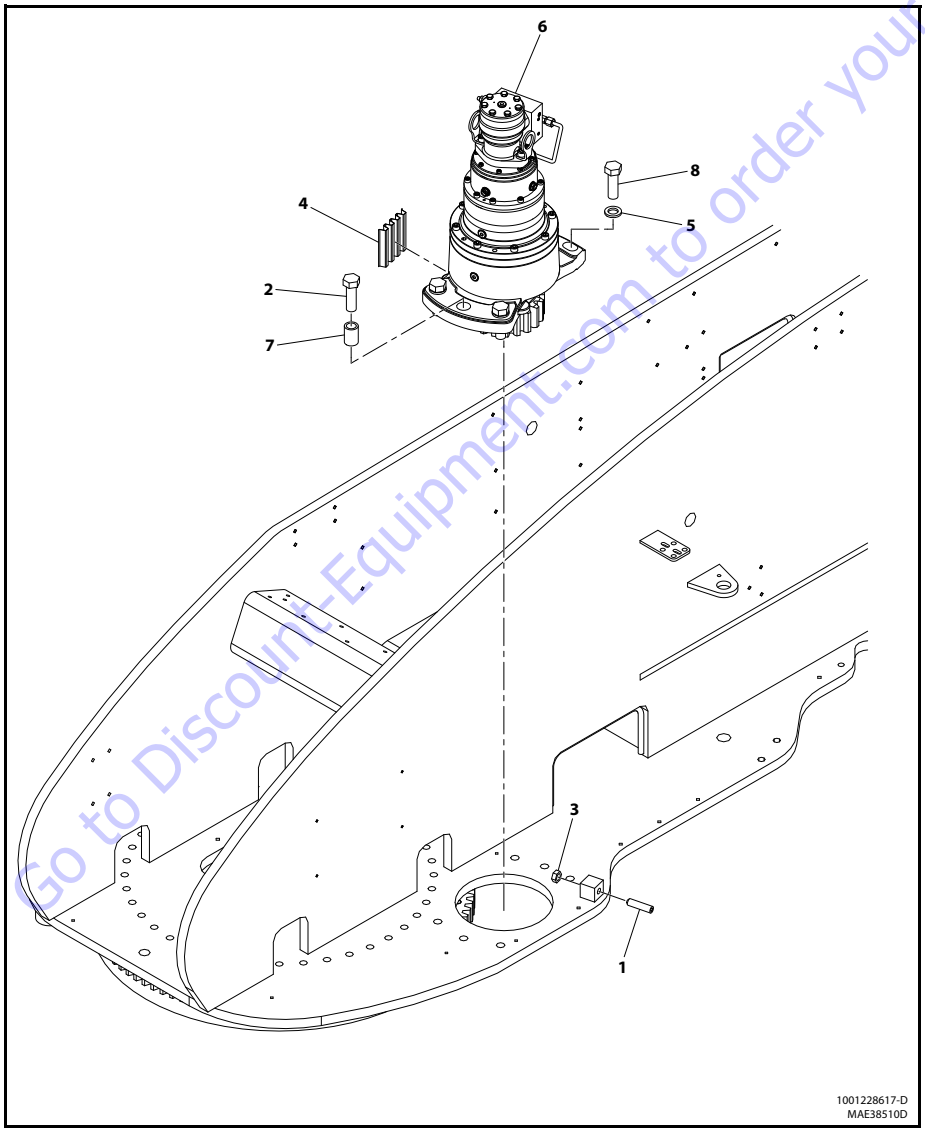
1. Gently loosen the setscrew (1). Do not remove.
2. Remove the bolt (2).
3. Remove the mounting bolts (8) securing swing drive hub to the turntable.
4. Using the suitable lifting device, remove the swing drive hub from mounting plate without damaging the swing gear.
5. Place swing drive hub in the clean area.
6. Refer to Figure 3-36., Swing Drive Installation, for swing drive maintenance.

Assembly/Disassembly

For detail assembly/disassembly instructions, Refer Swing Drive Hub Manual or contact JLG service for more details..

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. Setscrew
2. Bolt
3. Nut
4. Shim
5. Washer
6. Swing Hub Assembly
7. Sleeve
8. Mounting Bolt

Figure 3-36. Swing Drive Installation

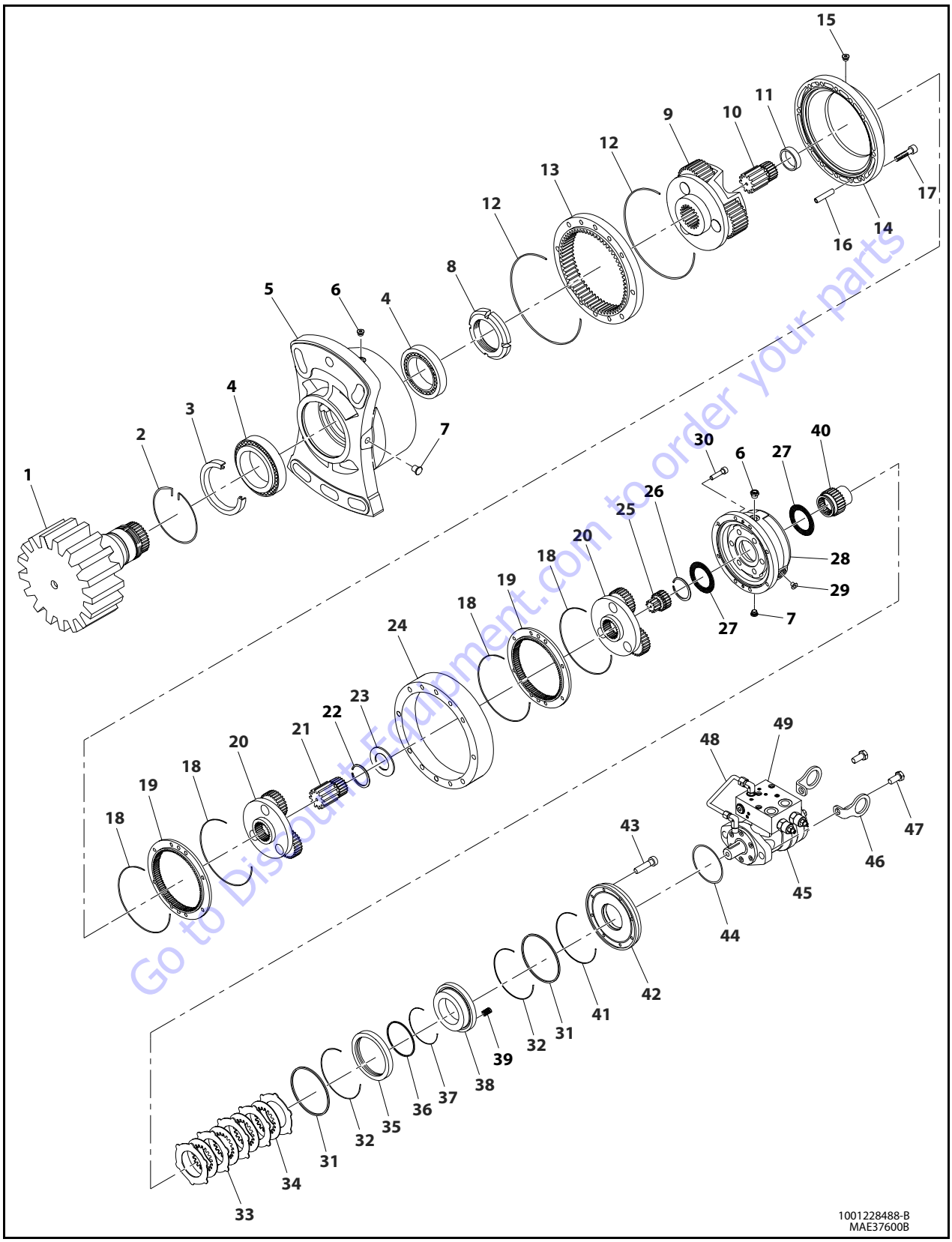


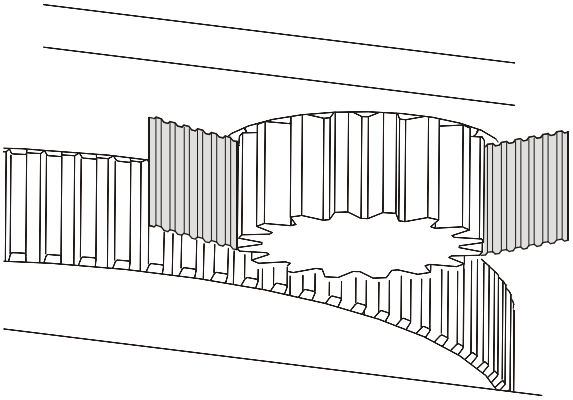
Figure 3-37. Swing Motor - Sheet 1 of 2

1. Shaft
2. Ring
3. Oil Seal
4. Bearing
5. Support
6. O-ring Plug
7. O- ring Plug
8. Nut Ring
9. Reduction Gear
10. Pinion
11. Spacer
12. O-Ring
13. Planetory Gear
14. Spacer
15. O-Ring Plug
16. Spring
17. Capscrew
18. O-ring
19. Planetory Ring
20. Reduction Gear
21. Pinion
22. Ring
23. Spacer
24. Spacer
25. Pinion
26. Ring
27. Washer
28. Brake Housing
29. Plug
30. Capscrew
31. Seal
32. O-Ring
33. Steel Disc
34. Disc
35. Disc
36. Seal
37. O-ring
38. Piston Brake
39. Spring Brake
40. Shaft Input
41. O-ring
42. Cover
43. Screw
44. O-ring
45. Motor
46. Lung Lifting
47. Capscrew
48. Brake valve adapter
49. Valve

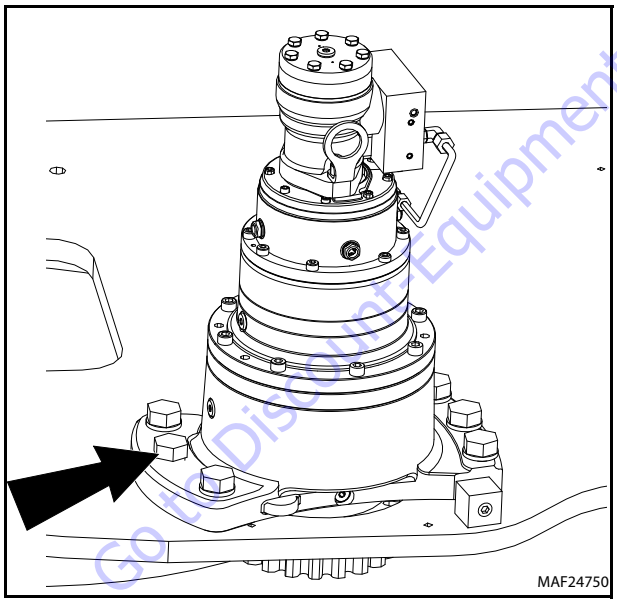
Figure 3-38. Swing Motor - Sheet 2 of 2

3.18 PROCEDURE FOR SETTING GEAR BACKLASH

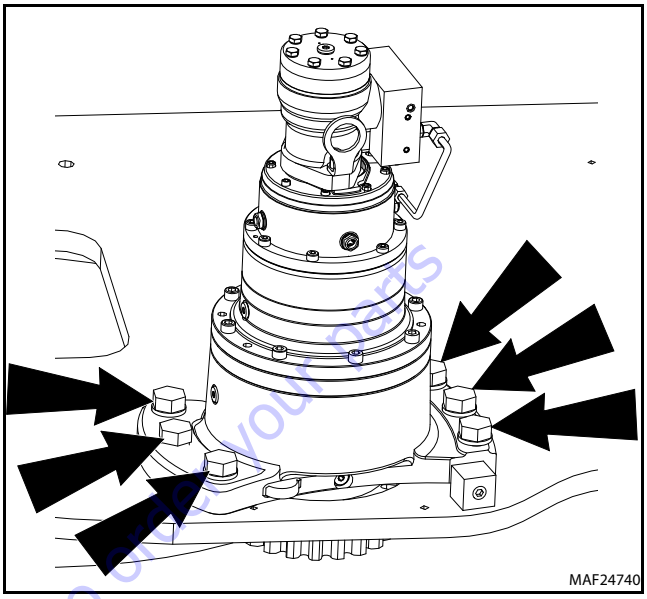
1. Set backlash to 0.010 to 0.015" using the following procedure.
2. Place shim (JLG PN 4071041) between pinion and bearing on bearing high spot. The bearing high spot should be stamped with an "X" on the surface below the teeth and marked with yellow paint in the tooth space.



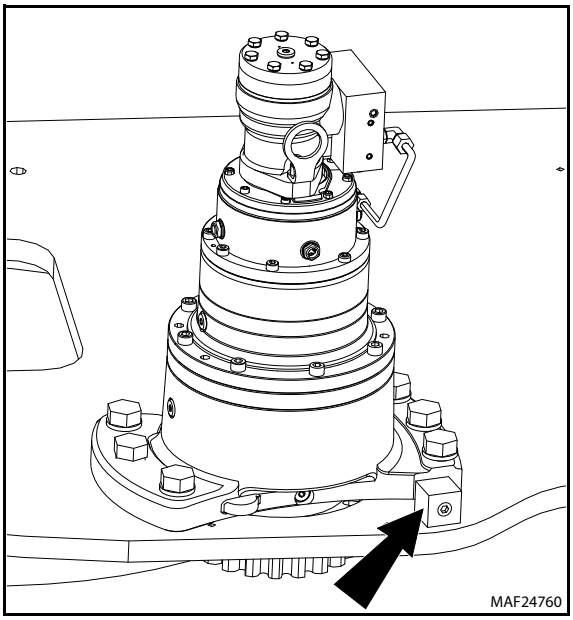
3. Torque pivot bolt (shown below) to 205 ft-lb (280 Nm) with High Strength Threadlocking Compound.



4. Remove turntable lock pin.
5. Pre-torque capscrews (shown below) to 90 ft-lb (122 Nm) with High Strength Threadlocking Compound.

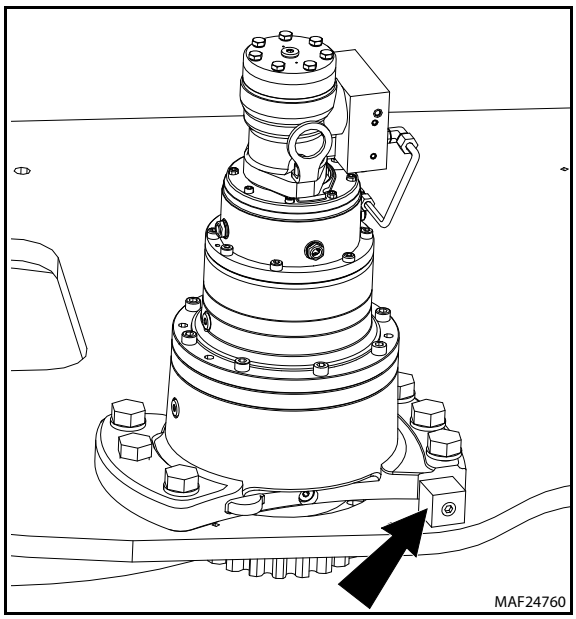


6. Tighten setscrew (shown below) until pinion is completely snug against shim and bearing, then back off the setscrew.



7. Torque setscrew to 50 ft-lb (68 Nm).

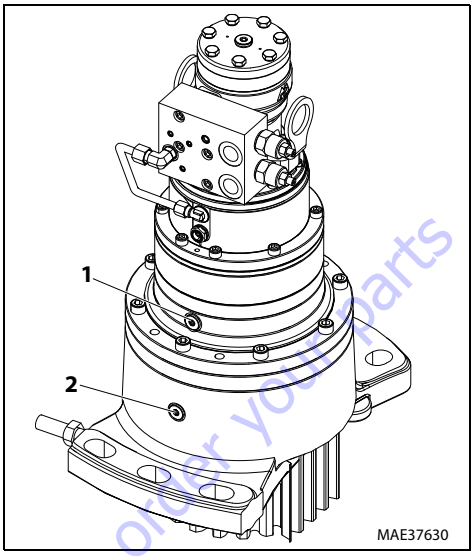
8. Tighten jam nut (shown below) wit High Strength Threadlocking Compound.



9. Torque capscrews shown in step 5 to 660 ft-lb (896 Nm).

10. Remove shim and discard.

3.19 SWING DRIVE LUBRICATION



1 Swing Gearbox/Brake Fill Port
2 Swing Gearbox/Brake Drain Port

Figure 3-39. Swing Drive Ports

The brake on swing drive uses same oil cavity as gearbox. Remove the swing gearbox/brake fill plug and fill the unit with 105 ounces (3.1 L) of ISO VG 150 oil, until oil reaches halfway of the plug opening. Close the swing gearbox/brake fill port (1) immediately. Drain oil through the swing gearbox/brake drain port (2).

3.20 TURNTABLE BEARING

Turntable Bearing Mounting Bolts Condition Check

NOTICE

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

NOTE: *This check must be performed after first 50 hours of machine operation and every 600 hours of machine operation thereafter. If any bolts are missing or loose, replace with new bolts. Apply High Strength Threadlocking Compound to the bolt threads and torque to 190 ft-lb (260 Nm). Check all bolts for looseness after replacing or re-torquing any bolt.*

1. Check frame side bearing bolts as follows:
   - **a.** Raise main boom to be fully elevated and retracted. Stow tower boom. Raise jib to be fully elevated and centered. Center platform and keep it unloaded. (See Figure 3-48.)
   - **b.** At position indicated on Figure 3-48., try to insert a 0.0015 in (0.038 mm) feeler gauge between frame side bearing bolt and hardened washer.

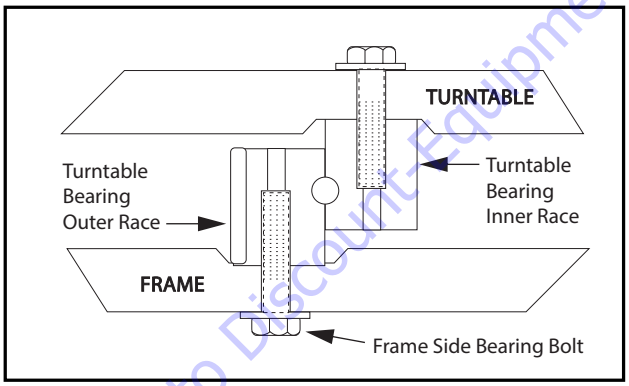


Figure 3-40. Frame Side Bearing Bolt Location

   - **c.** Ensure 0.0015 in (0.038 mm) feeler gauge will not fit under bolt head to bolt shank as shown in Figure 3-41.

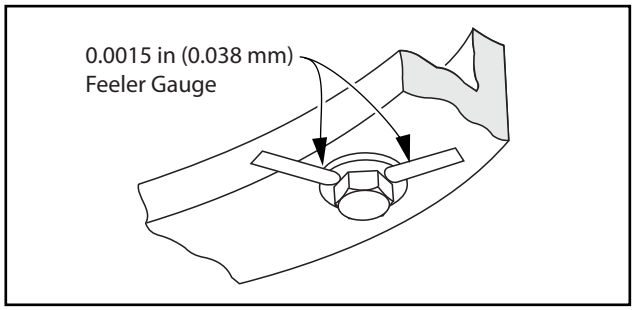


Figure 3-41. Frame Side Bearing Bolt Feeler Gauge Check

   - **d.** Check a sample of bolts in this 90° quadrant (45° left and right of indicated position) of the bolt circle.
   - **e.** Swing turntable 90 degrees and check selected bolts at the new position.
   - **f.** Continue rotating turntable at 90 degree intervals until a sampling of bolts have been checked in all quadrants.
2. Check turntable side bearing bolts as follows:
   - **a.** Raise main boom to be fully elevated and retracted. Raise Tower boom 10° or enough to gain access to bearing bolts. Raise jib to be fully elevated and centered. Center platform and keep it unloaded. (See Figure 3-49.)

⚠ WARNING

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

   - **b.** At position indicated on Figure 3-49., try to insert a 0.0015 in (0.038 mm) feeler gauge between turntable side bearing bolt and hardened washer.

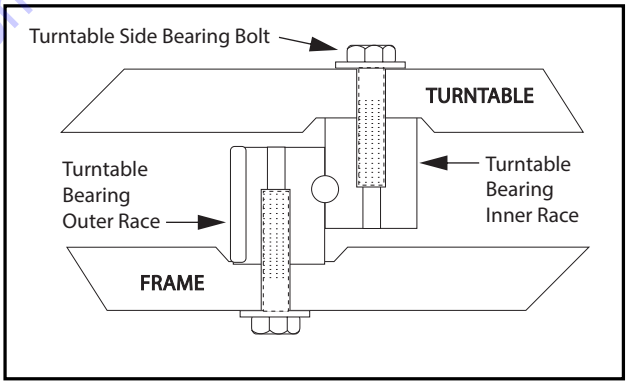


Figure 3-42. Turntable Side Bearing Bolt Location

   - **c.** Ensure 0.0015 in (0.038 mm) feeler gauge will not fit under bolt head to bolt shank as shown in Figure 3-43.

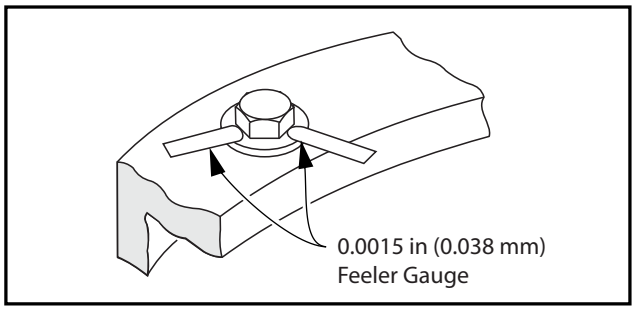


Figure 3-43. Turntable Side Bearing Bolt Feeler Gauge Check

   - **d.** Check a sample of bolts in this 90° quadrant of the bolt circle (45° left and right of indicated position).

e. Fully raise the tower boom. Lower main boom to be horizontal and fully extended. Position jib and platform to be horizontal and centered. (See Figure 3-50.)

f. At position indicated in Figure 3-50., try and insert a 0.0015 in (0.038 mm) feeler gauge between bolt head and hardened washer.

g. Ensure 0.0015 in (0.038 mm) feeler gauge will not fit under bolt head to bolt shank as shown in Figure 3-43.

h. Check a sample of bolts in this 90° quadrant of the bolt circle (45° left and right of indicated position).

Turntable Bearing Wear Measurement

1. Position machine as follows and as shown in Figure 3-48.
   - **a.** Rotate turntable 90° so counterweight is over right side of frame.
   - **b.** Stow tower boom.
   - **c.** Raise main boom to be fully elevated and retracted
   - **d.** Raise jib to be fully elevated and centered
   - **e.** Center platform and keep it unloaded
2. Set up dial indicator as follows:
   - **a.** Locate dial indicator at rear center of machine, next to bearing, and opposite counterweight.
   - **b.** Position magnetic base of the indicator on vertical member of frame as shown in Figure 3-44.

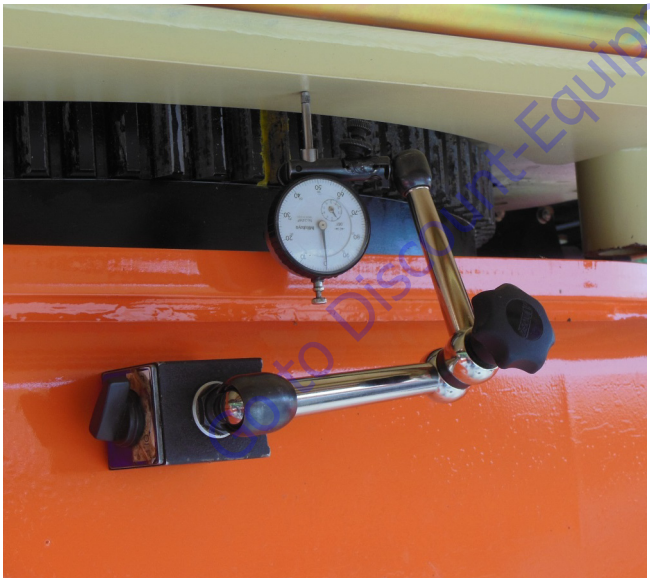


Figure 3-44. Dial Indicator General Location

c. Position indicator point to measure turntable base plate (on doubling plate) 3.5 in (88.9 mm) from gear tooth root as shown in Figure 3-45. and Figure 3-46.

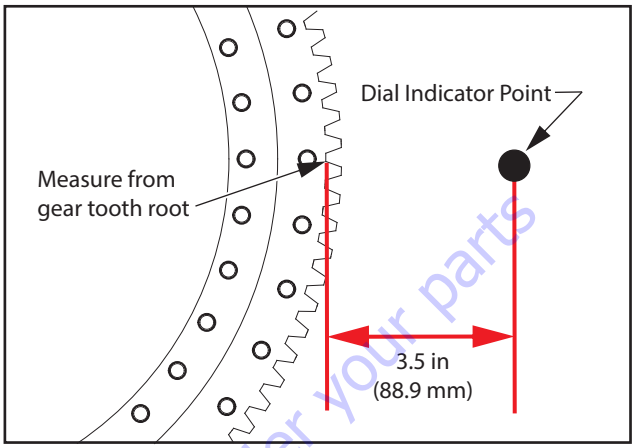


Figure 3-45. Turntable Bearing Measurement Point

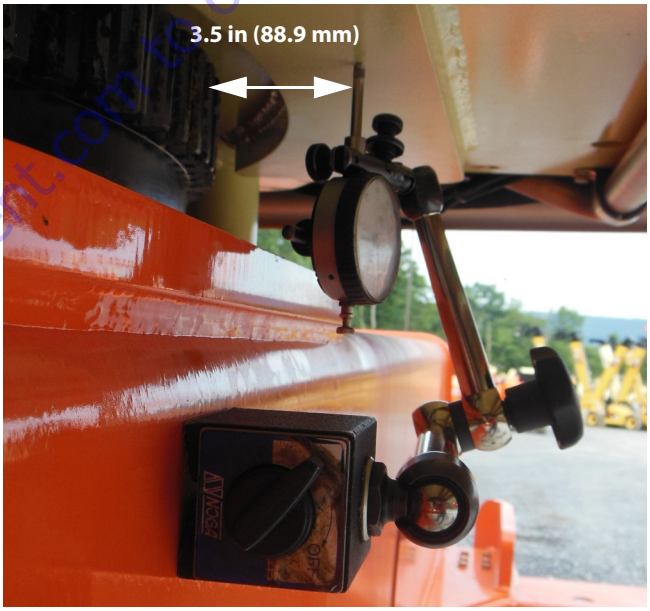


Figure 3-46. Dial Indicator Measurement Location

4. Zero dial indicator.
5. Position machine as follows and as shown in Figure 3-50.
   - **a.** Do not rotate turntable
   - **b.** Fully elevate tower boom
   - **c.** Lower main boom until horizontal
   - **d.** Fully extend main boom
   - **e.** Lower jib to horizontal
   - **f.** Keep jib and platform centered and unloaded
   - **g.** Verify dial indicator has not shifted. Record bearing wear value.

6. Position machine back to the first position as outlined in Step 1 and shown in Figure 3-48. The dial indicator should return to zero. If dial indicator does not return to zero, determine corrective action and repeat test.

7. Determine which model turntable bearing is installed by checking location shown in Figure 3-47. and comparing with markings in Table 3-6.

NOTE: *JLG Boom Lifts may utilize multiple model bearings.*

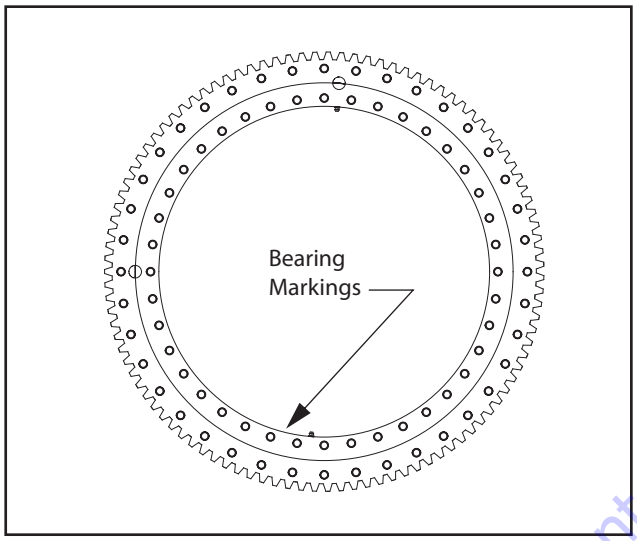


Figure 3-47. Bearing Marking Location

Table 3-6. Bearing Model Marking Identification

Model	Marking
1	1234567, XXXXX, XXXXX
2	JLG 1234567 A XX 0001 11 04
3	V 12 3456 789 01 23 4567 SERIAL NR. 08/_ _ _ _ YEAR _ _ _ _ PAG/POS. _ _ _ _ _ _/_ _ _ _ WEIGHT _ _ _ Kg. JLG PART #1234567
4	D123456

Determine turntable bearing wear measurement allowance by bearing model as shown in Figure 3-7.

Table 3-7. Turntable Bearing Wear by Bearing Model

Bearing Model	Wear Measurement
1	0.179 in (4.54 mm)
2	0.205 in (5.214 mm)
3	0.255 in (6.47 mm)
4	0.197 in (5 mm)

9. Replace turntable bearing if any of the following conditions exist:

   a. Bearing wear measurement is greater than allowed in Table 3-7.

NOTE: *If bearing markings are illegible, use 0.179 in (4.54 mm) as the wear measurement.*

   b. Increased swing power required.

   c. Noise is present when turntable is rotated.

   d. Rough operation when turntable is rotated.

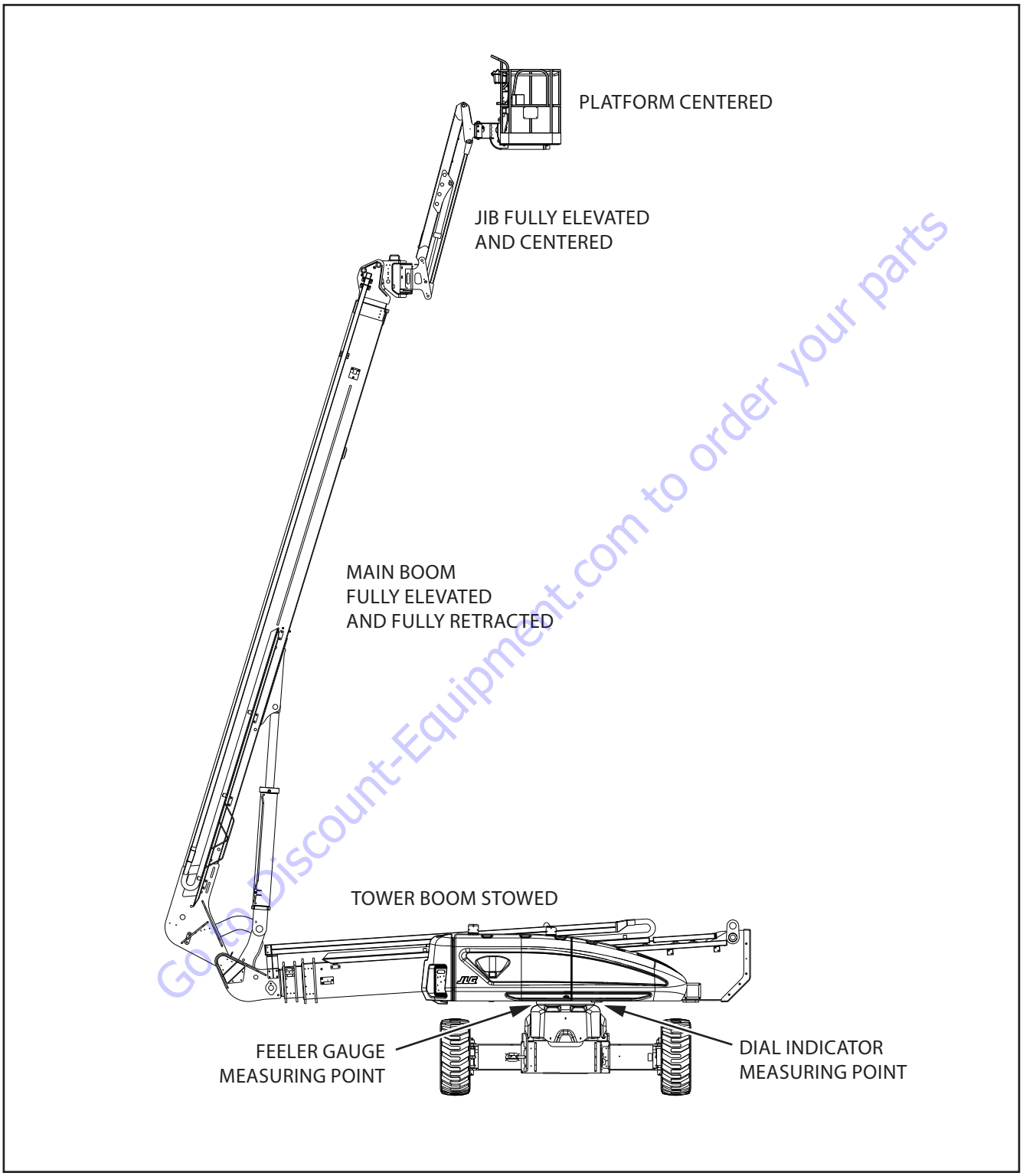


Figure 3-48. Turntable Bearing Service Boom Placement - 1

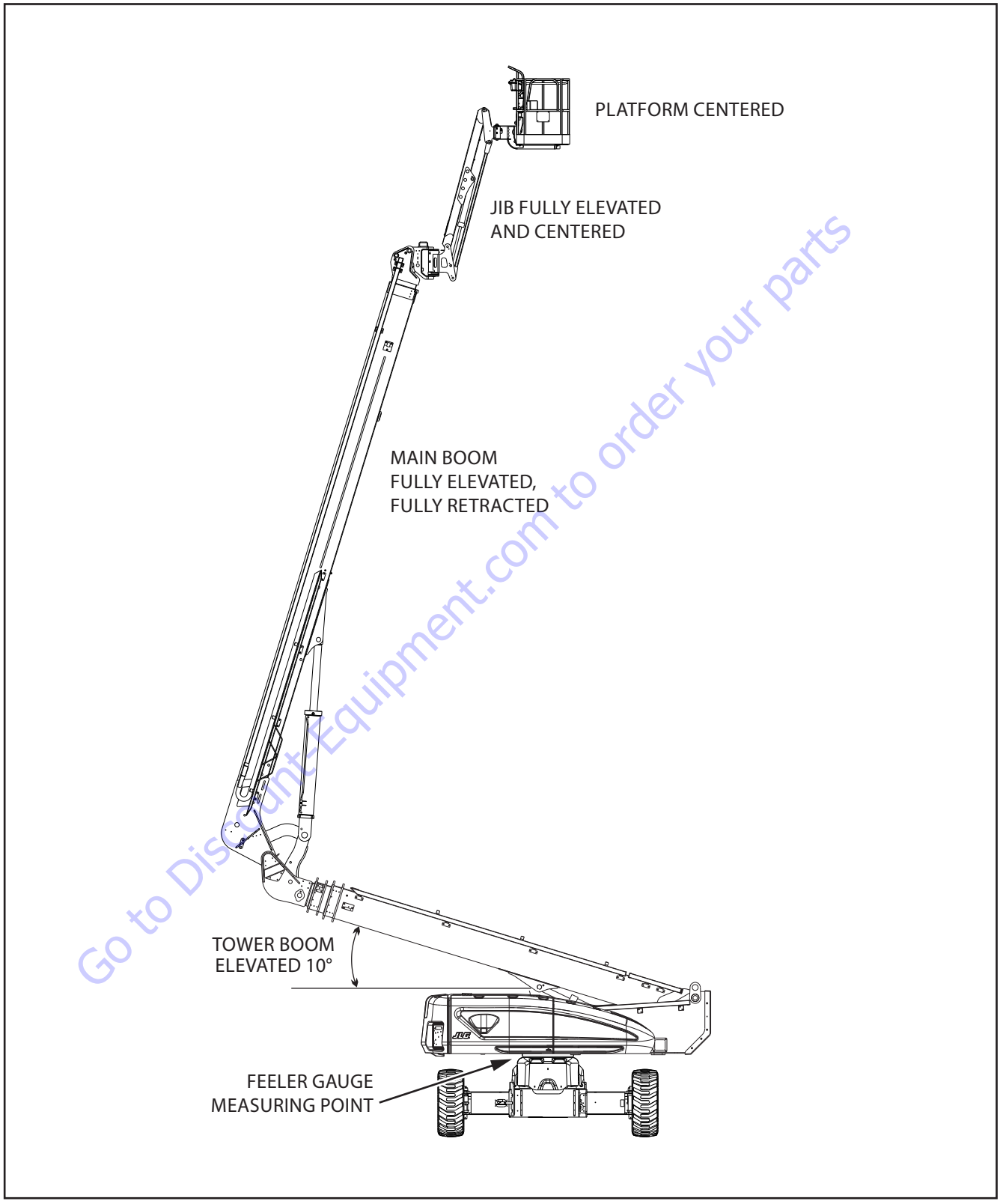


Figure 3-49. Turntable Bearing Service Boom Placement - 2

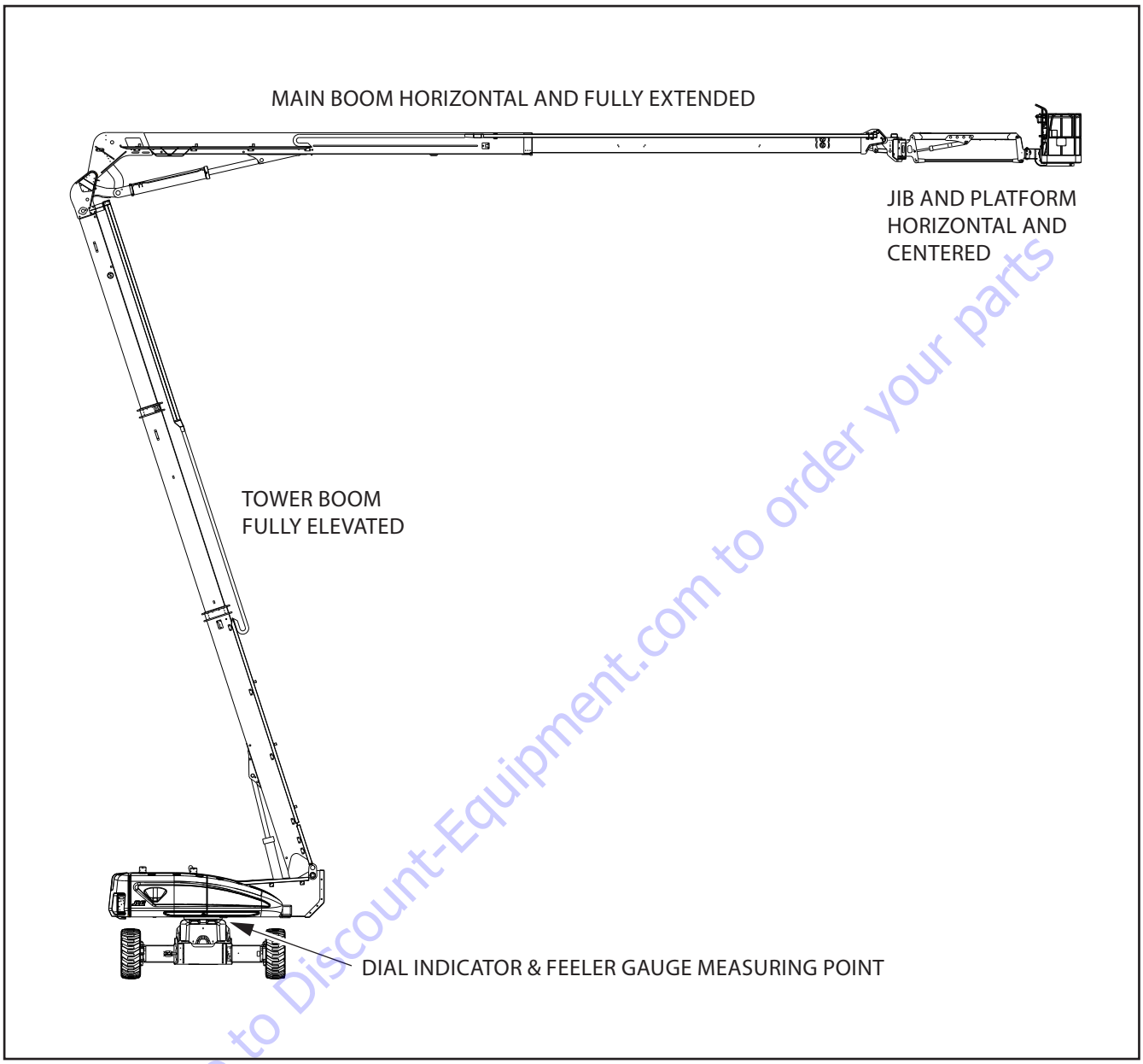


Figure 3-50. Turntable Bearing Service Boom Placement - 3

Turntable Bearing Removal

1. From Ground Control Station, elevate tower boom to about 10° or enough to gain access to bearing bolts. Set main boom horizontal and fully retracted. Raise and center jib and platform. (See Figure 3-51.)

⚠ WARNING

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

2. Attach an adequate support sling to the boom. Remove all slack from sling. Prop or block boom if possible.
3. 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 ENTRY OF CONTAMINANTS INTO THE SYSTEM.

4. Tag and disconnect hydraulic lines from fittings on top of rotary coupling. Use a suitable container to retain any residual hydraulic fluid. Immediately cap lines and ports.
5. Attach suitable overhead lifting equipment to base of turntable.
6. Scribe a line on the turntable bearing inner race and underside of turntable. This will aid in aligning the bearing during re-installation. Remove bolts and washers attaching turntable to bearing inner race. Discard bolts.
7. Carefully lift complete turntable assembly from bearing. Ensure no damage occurs to turntable, bearing, or frame-mounted components. Refer to Figure 3-51., Turntable Bearing Removal.
8. Carefully place turntable on a suitably supported trestle.
9. Scribe a line on turntable bearing outer race and frame. This helps align the bearing during re-installation. Remove bolts and washers attaching bearing outer race to the frame. Discard bolts.
10. Use suitable lifting equipment to remove bearing from frame. Move bearing to a clean, suitably supported work area.

Turntable Bearing Installation

1. Using suitable lifting equipment, carefully lower turntable bearing into position on frame. Ensure scribed line of bearing outer race aligns with scribed line on frame. If a new turntable bearing is used, ensure spot with minimum gear backlash (stamped with an “X” or marked with yellow paint) is towards centerline of the swing drive (as close as bolt pattern allows).

⚠ CAUTION

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

2. Spray a light coat of Safety Solvent 13 on new bearing bolts.
3. Apply a light coating of High Strength Threadlocking Compound to new bearing bolts. Loosely install bolts and washers to frame and bearing outer race.

NOTICE

IF COMPRESSED AIR OR ELECTRICALLY OPERATED IMPACT WRENCH IS USED FOR TIGHTENING BEARING ATTACHMENT BOLTS, CHECK TOOL TORQUE SETTING ACCURACY BEFORE USE.

4. Torque bolts to 190 ft-lb (260 Nm) in sequence shown in Figure 3-52., Turntable Bearing Torque Sequence.
5. Remove lifting equipment from bearing.
6. Using suitable lifting equipment, carefully position turntable assembly above machine frame.
7. Carefully lower turntable onto turntable bearing, ensuring scribed line on bearing inner race aligns with scribed line on turntable. If a new turntable bearing is used, ensure filler plug fitting is at 90 degrees from fore and aft center line of turntable.
8. Spray a light coat of Safety Solvent 13 on new bearing bolts.
9. Apply a light coating of High Strength Threadlocking Compound to new bearing bolts. Install bolts and washers to turntable and bearing inner race.

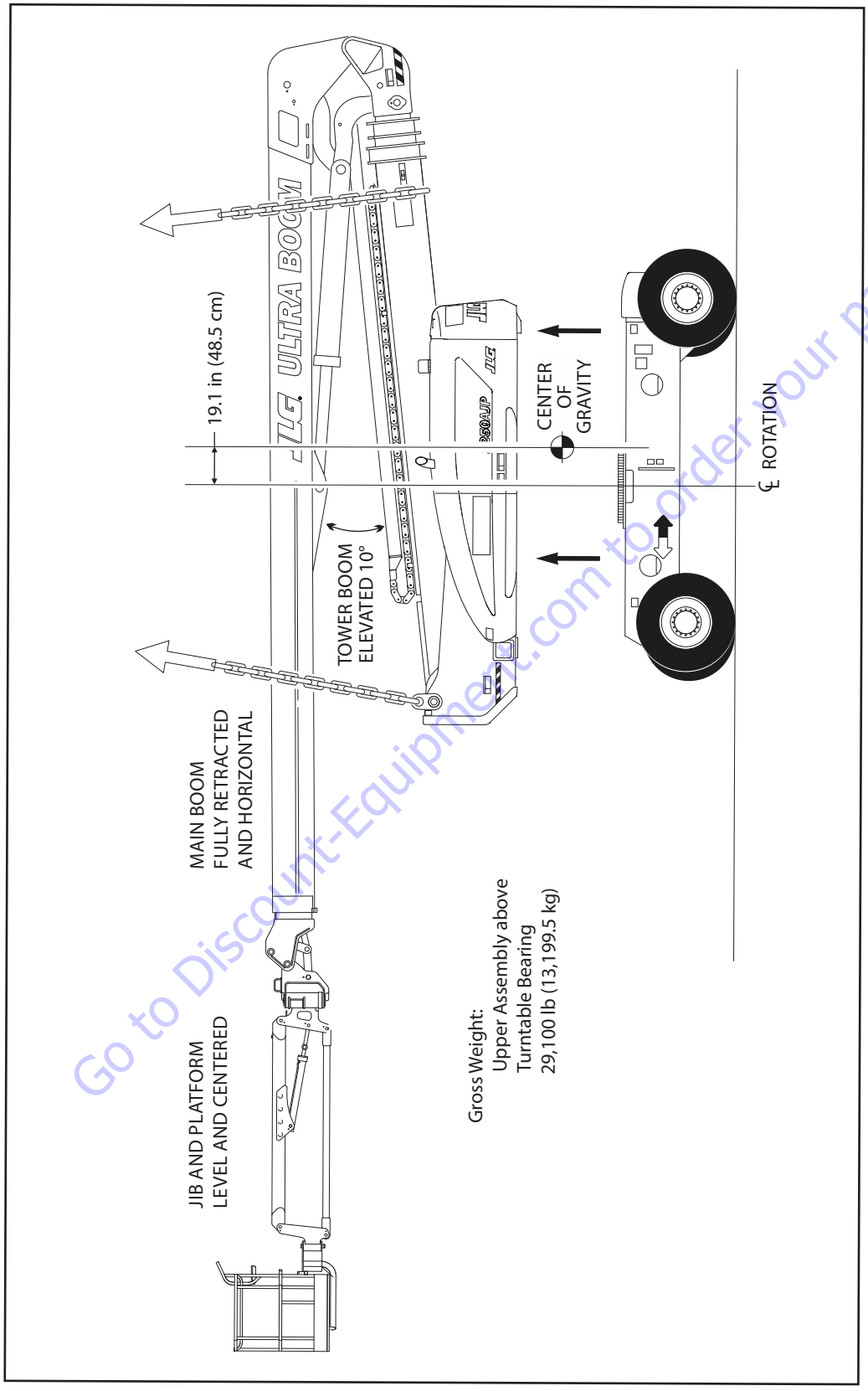
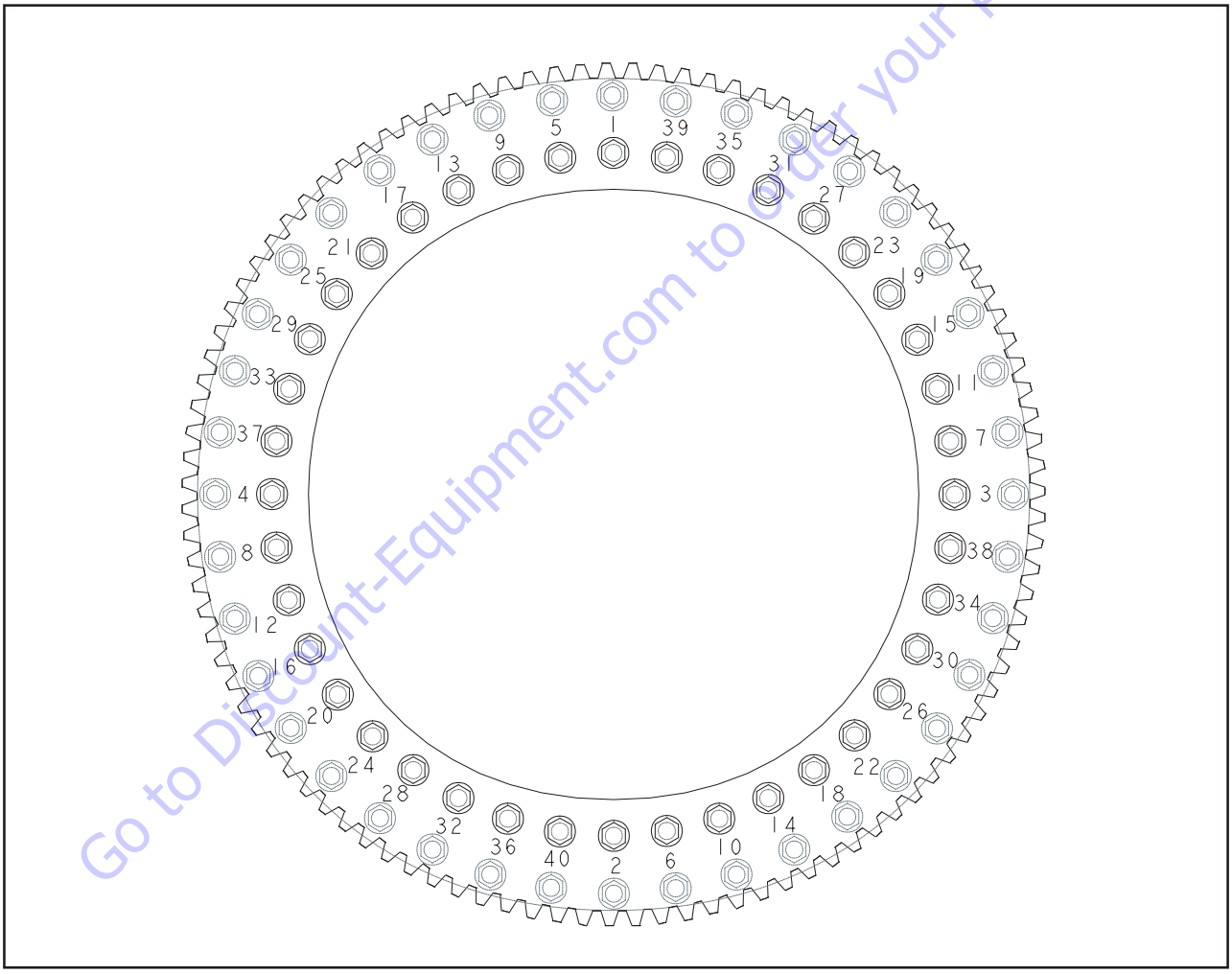


Figure 3-51. Turntable Bearing Removal

10. Torque bolts to 190 ft-lb (260 Nm) following sequence shown in Figure 3-52., Turntable Bearing Torque Sequence.
11. Remove lifting equipment.
12. Install rotary coupling retaining yoke brackets. Apply a light coating of Medium Strength Threadlocking Compound to the attaching bolts and secure yoke to turntable with mounting hardware.
13. Connect hydraulic lines to rotary coupling as tagged before removal.
14. At ground control station, use boom lift control to lower boom to stowed position.
15. Using all applicable safety precautions, activate hydraulic system and check swing system for proper and safe operation.

⚠ WARNING

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



NOTE: *Turntable Bearing Torque Sequence is identical for both inner and outer races. Torque all bolts to 190 ft-lb (260 Nm).*

Figure 3-52. Turntable Bearing Torque Sequence

3.21 SWING SPEED PROPORTIONING

Swing Speed Proportioning uses main boom length switches and envelope control sensors to improve comfort, speed, and control of the turntable swing function.

Turntable swing speed is increased as distance of the platform to center of rotation is decreased and when the tower boom is lowered in angle. This results in approximately constant platform speeds regardless of boom position.

Swing speed proportioning is disabled with any envelope sensors failure. Disabling of swing speed proportioning will default to the slowest swing speed setting.

NOTE: *For detailed information concerning system adjustment and operation, refer to Section 6 - JLG Control System.*

3.22 CHASSIS TILT INDICATOR SYSTEM

The Chassis Tilt Indicator System measures turntable angle in comparison to level ground. The tilt sensor (which is an integral part of the ground module) has three settings; 3.0° side tilt, 5.0° omni directional tilt, and 8.0° omni directional tilt.

The 5.0° omni directional angle setting is used to warn the operator by using the chassis tilt light in the platform display panel. When used with the Beyond Transport - Drive Speed Cutback System (Section 4.3, Beyond Transport - Drive Speed Cutback System), the tilt sensor will cause an alarm to sound and Drive function will be disabled.

The 3.0° side tilt setting is used in combination with boom position and when exceeded, imposes the same functionality as the 5.0° omni directional setting. The side tilt setting is ignored when the tower boom is less than 60° regardless of main boom position, and is proportionally increased in value up to 5.0° as the main boom is lowered from high angles to horizontal when the tower is above 60°.

The 8.0° angle is used only for automatically shifting the drive motors to the maximum displacement position (slow speed). The control system responds to indicated angle readings 0.5 degree smaller than the required angles to account for calibration and sensor variation.

NOTE: *For detailed information concerning system adjustment and operation, refer to Section 6 - JLG Control System.*

3.23 ROTARY COUPLING

Use the following procedure to for installing the seal kit.

1. Remove snap ring from end.
2. Remove thrust ring from same end.
3. Remove center body from housing.
4. Cut off old seals.
5. Assemble lip seals in direction shown in Figure 3-53., Rotary Coupling Seal Installation.
6. Reassemble O-ring.
7. Heat cap seals in hydraulic oil for 5 minutes at 300° F (149° C).
8. Assemble cap seals over O-rings
9. Reinsert center body into housing (lube with hydraulic oil).
10. Replace thrust ring and snap ring.

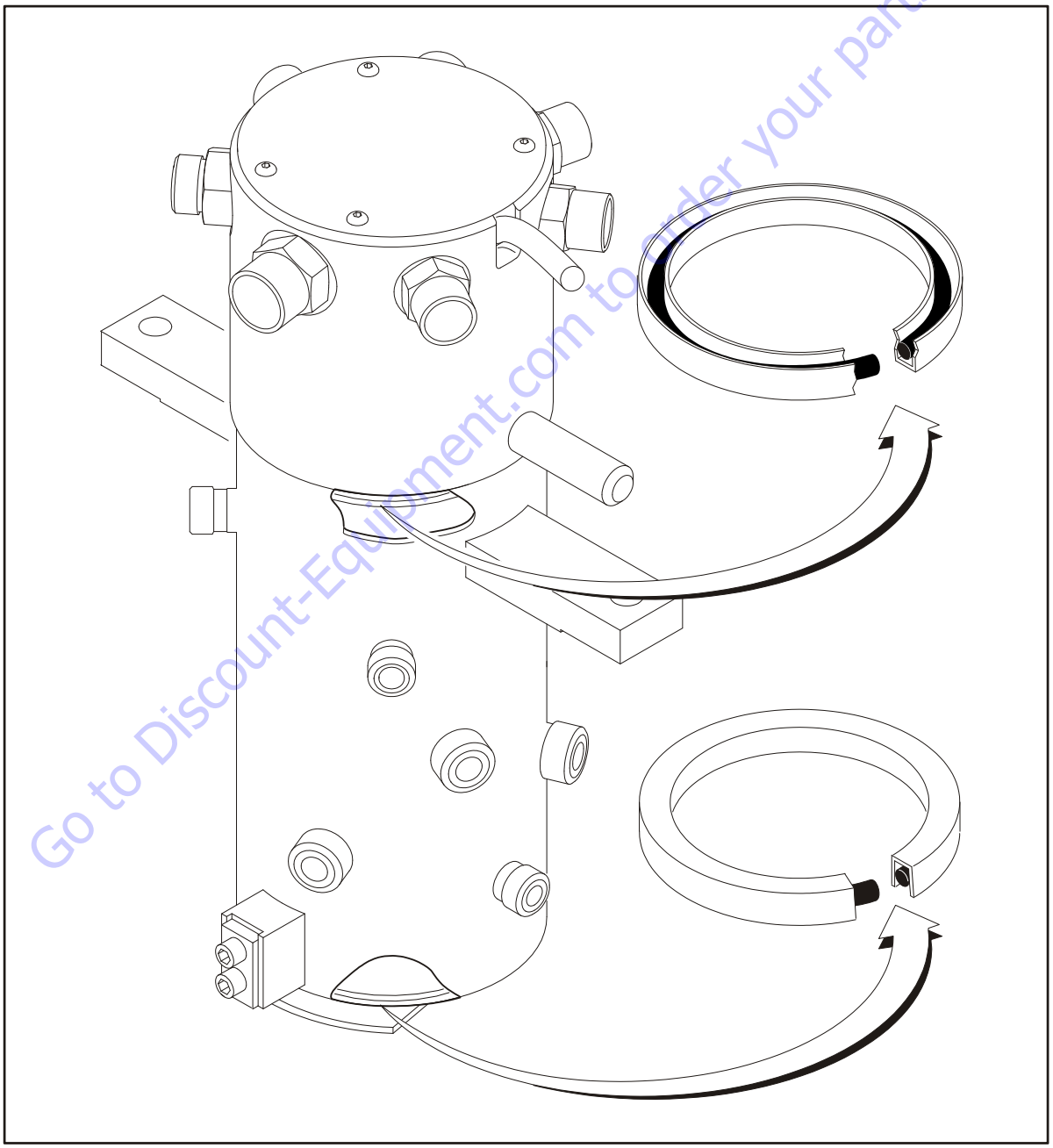
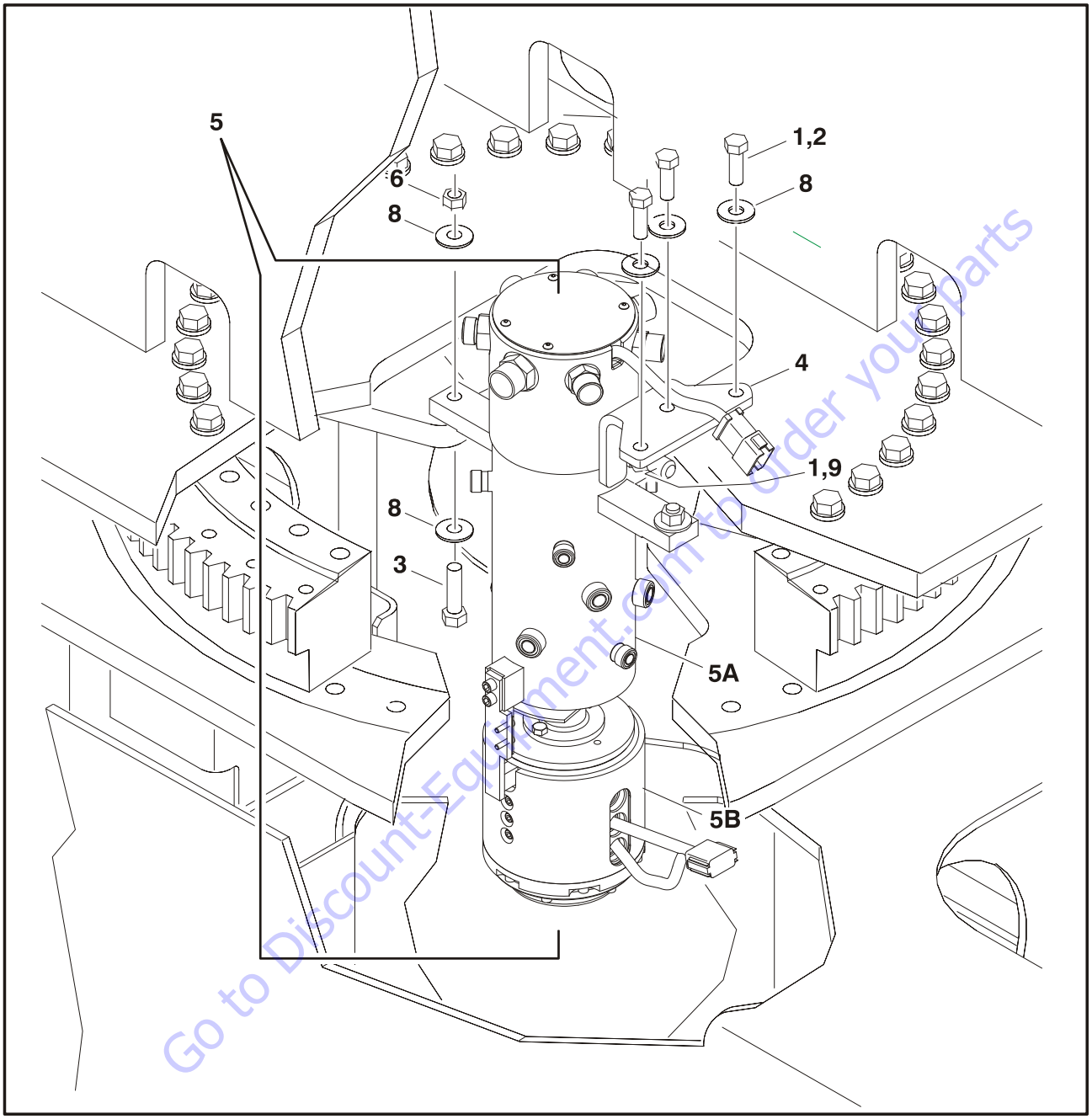


Figure 3-53. Rotary Coupling Seal Installation



1. Medium Strength Threadlocking Compound
2. Bolt
3. Bolt
4. Swivel Bracket
5. Rotary Coupling & Collector Ring Assembly

5A. Rotary Coupling

5B. Rotary Circuit Contactor
6. Locknut
7. Not Used
8. Flatwasher
9. Nut

Figure 3-54. Rotary Coupling Installation

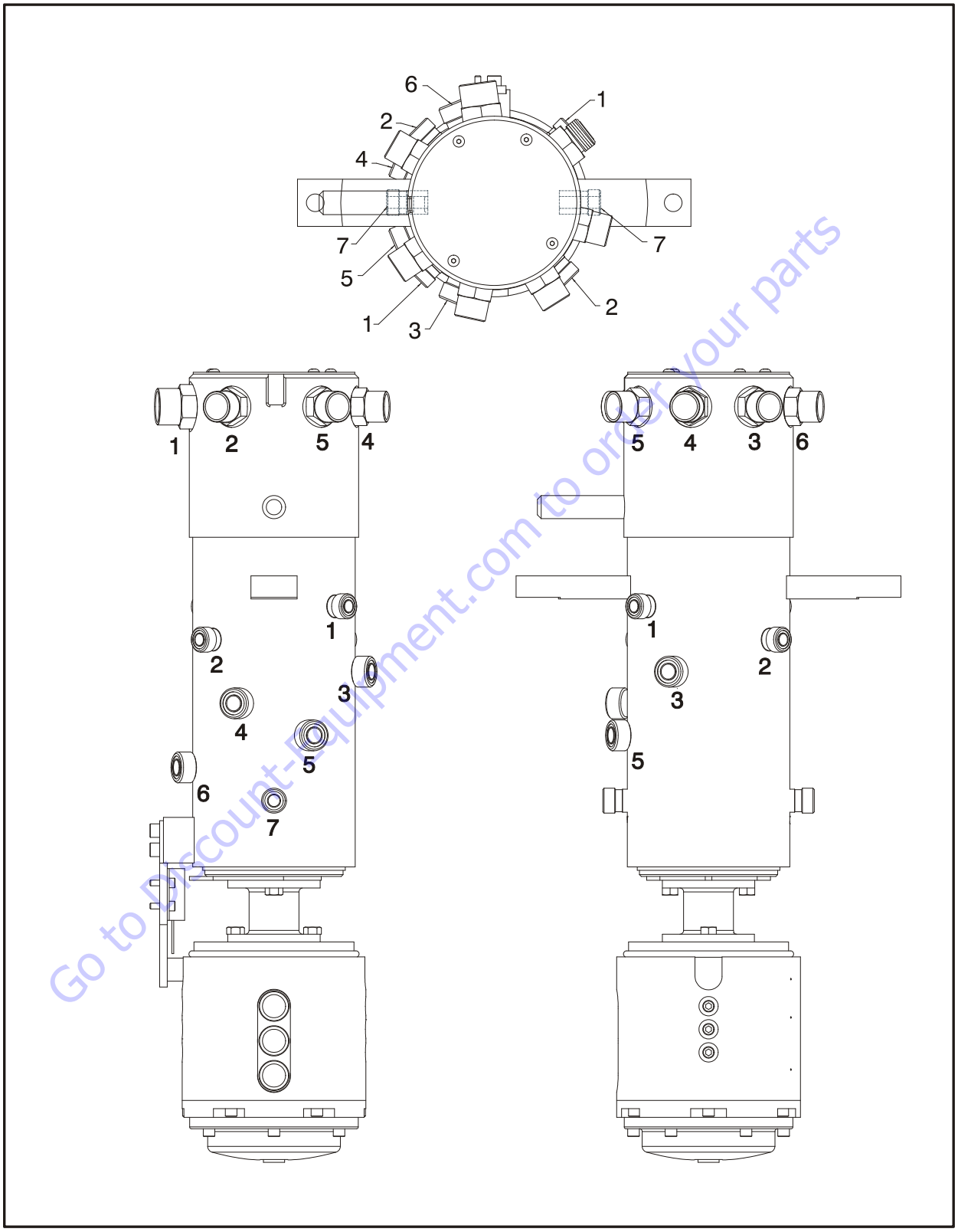


Figure 3-55. Rotary Coupling Port Location

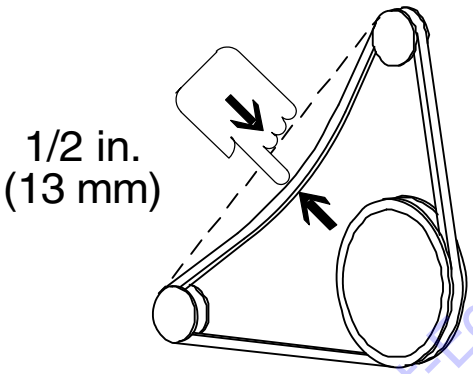
Table 3-8. Coupling Port Information Table

Port No.	Port Size	Description	Operating Pressure PSI (Bar)	Proof Pressure PSI (Bar)
1	-12	Return	250 (17)	375 (26)
2	-10	Steer/Axle Extend (Pressure)	3000 (207)	4500 (310)
3	-10	Drive A	5000 (345)	7500 (517)
4	-10	Drive B	5000 (345)	7500 (517)
5	-10	Drive A (Osc. Axle Lock)	5000 (345)	7500 (517)
6	-10	Drive B (Osc. Axle Lock)	5000 (345)	7500 (517)
7	-12	Case Drain	250 (17)	375 (26)

3.24 GENERATOR

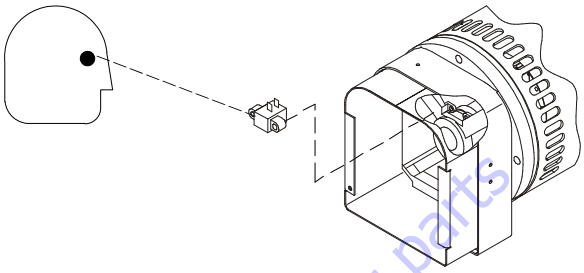
Every 250 hours

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

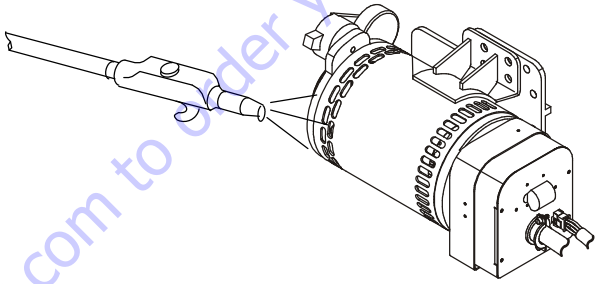


Every 500 hours

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



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

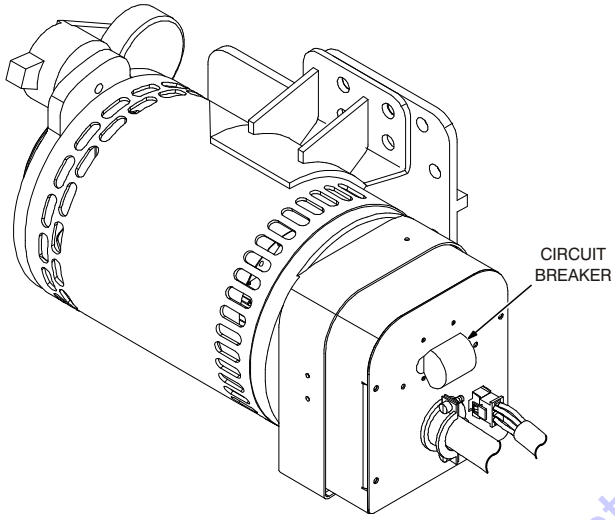


Overload Protection

⚠ CAUTION

STOP ENGINE WHENEVER CHECKING OR INSPECTING THE CIRCUIT BREAKER.

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



Inspecting Brushes, Replacing Brushes, and Cleaning Slip Rings

Refer to Figure 3-56., Inspecting Generator Brushes, Replacing Brushes, and Cleaning Slip Rings.

INSPECTING BRUSH POSITION

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

INSPECTING BRUSHES

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

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

CLEANING SLIP RINGS

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

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

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.

Reinstall belt, brush holder assembly, and end panel.

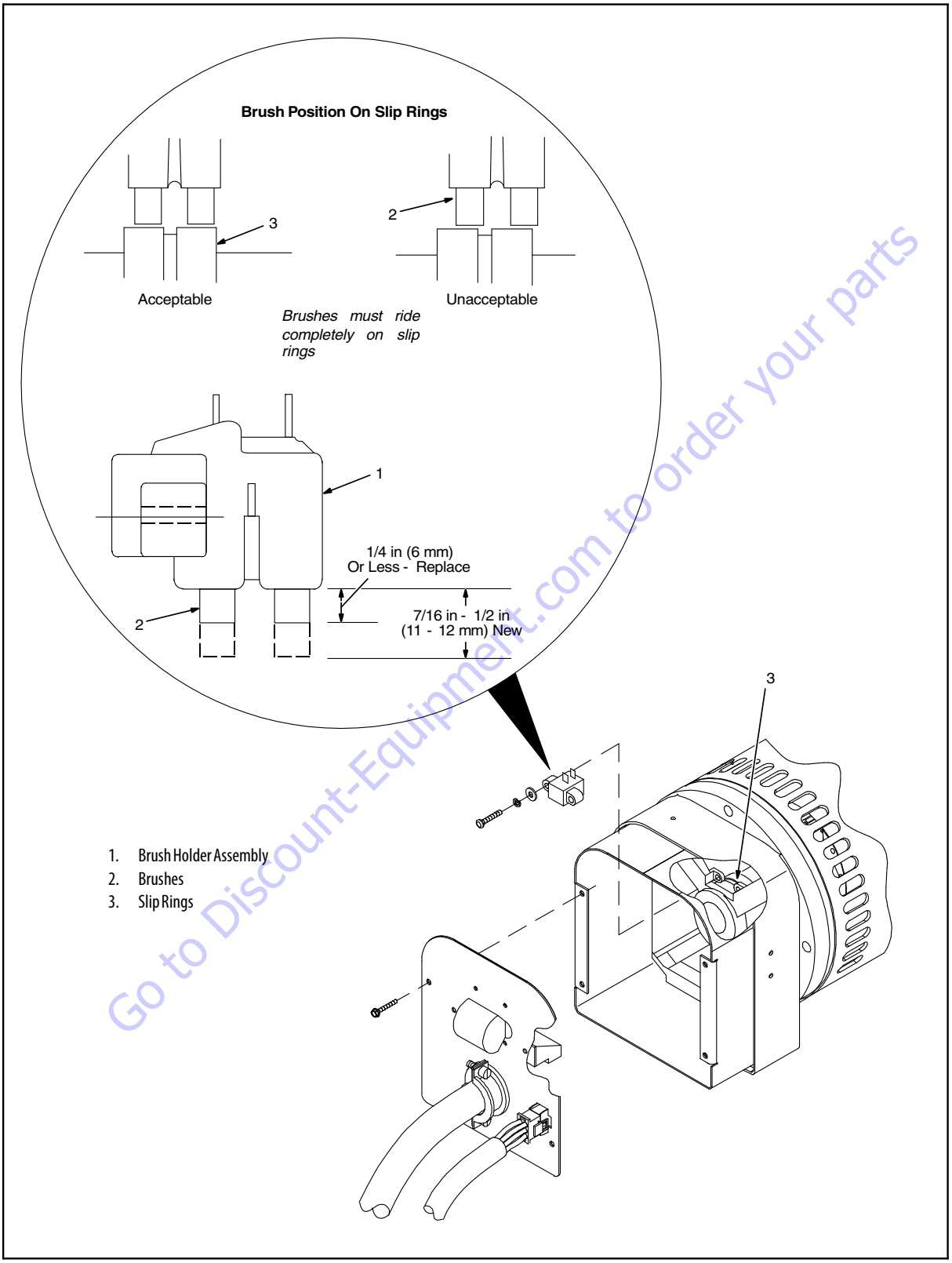


Figure 3-56. Inspecting Generator Brushes, Replacing Brushes, and Cleaning Slip Rings

3.25 COLD WEATHER PACKAGE

As an option, a cold weather package is available to allow the machine to be operated in lower temperatures. The package consists of battery heaters, a hydraulic tank heater, Exxon Univis hydraulic oil, and diesel fuel conditioner. See Figure 3-59., Cold Weather Package.

3.26 ENGINE

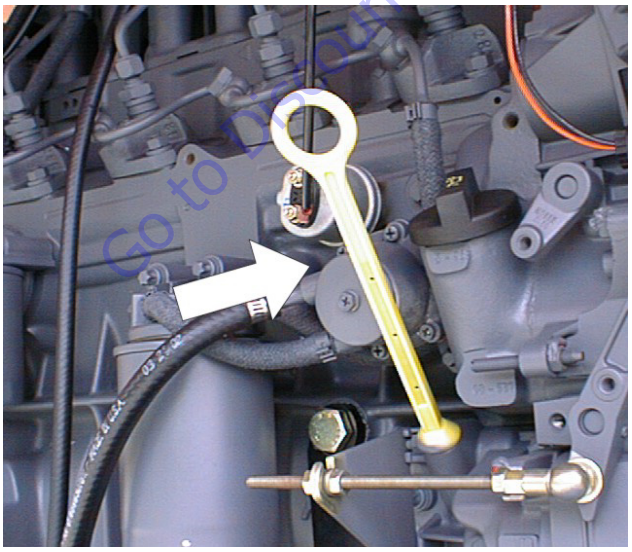
NOTE: *Refer to the engine manufacturer's manual for detailed operating and maintenance instructions.*

Glow Plugs

If the glow plug option is enabled in the JLG Control System, the glow plug and indicator lamp will be energized when the Power/Emergency Stop switch is pulled on if the 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. The lamp and glow plugs remain energized for the period of time specified by the setting in the JLG Control System. Engine start shall be disabled during this period. On Deutz engines, glow plugs will continue (post glow) after engine has started for three times the machine digit setting.

Checking Oil Level

1. Switch engine off before checking oil level.
2. Make sure machine and engine are level.
3. Remove dipstick.
4. Wipe dipstick with non-fibrous, clean cloth.
5. Insert dipstick to the stop and remove again.



6. Check oil level, and if necessary, top oil level up to MAX mark with an approved grade and type of oil as outlined in the engine manufacturer's operator's manual. Refer to Figure 3-57., Deutz Engine Dipstick.

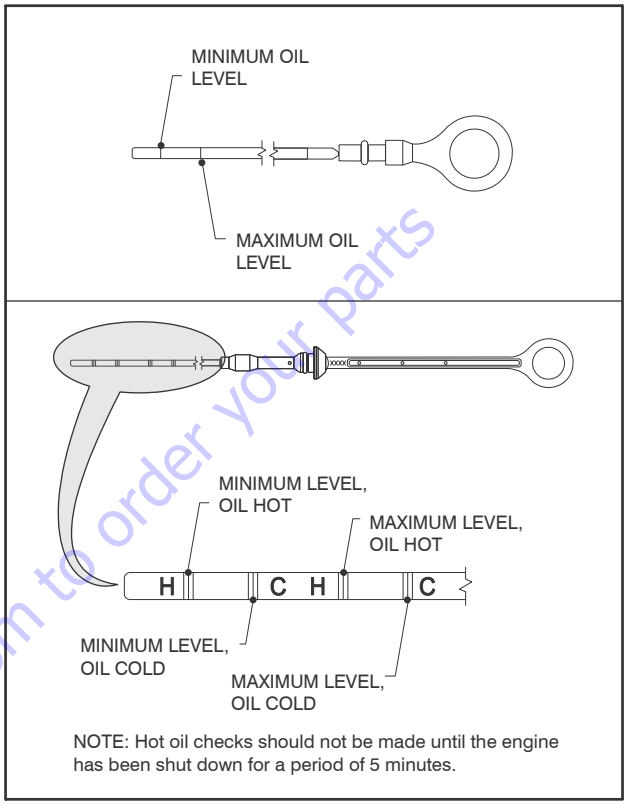
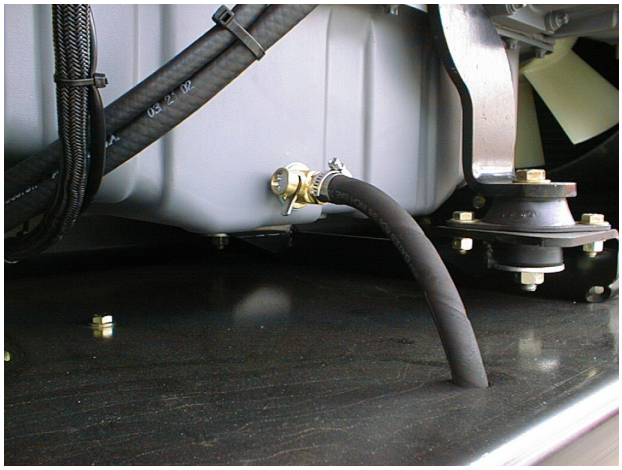


Figure 3-57. Deutz Engine Dipstick

7. Replace dipstick. Make sure it is fully seated in the dipstick tube to seal off the crankcase.

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.
3. Switch off engine.
4. Place an oil tray under the engine.
5. Open oil drain valve.



⚠ WARNING

WHEN DRAINING HOT ENGINE OIL THERE IS A RISK OF SCALDING.

⚠ CAUTION

DO NOT LET USED OIL RUN INTO SOIL; COLLECT USED OIL IN A CONTAINER SUITABLE FOR DISPOSAL OR RECYCLING. DISPOSE OF USED ENGINE OIL IN ACCORDANCE WITH ENVIRONMENTAL REGULATIONS.

6. Drain oil.
7. Close oil drain valve.
8. Pour in new engine oil. Refer to Section 1 for capacity and refer to Figure 3-58., Engine Oil Viscosity for the proper grade.

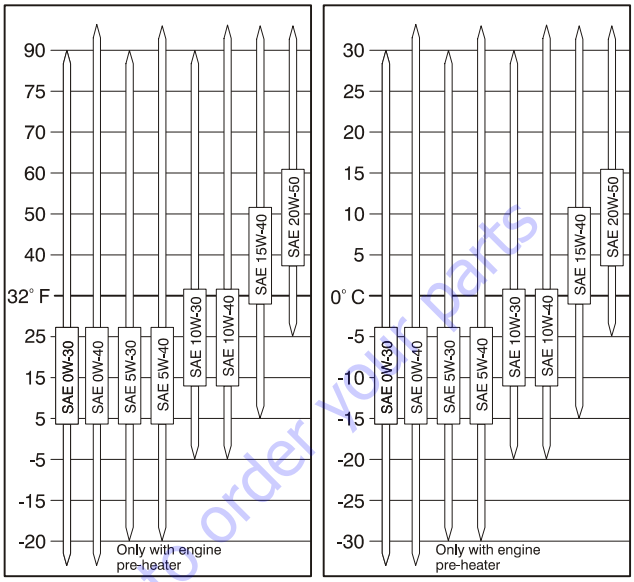
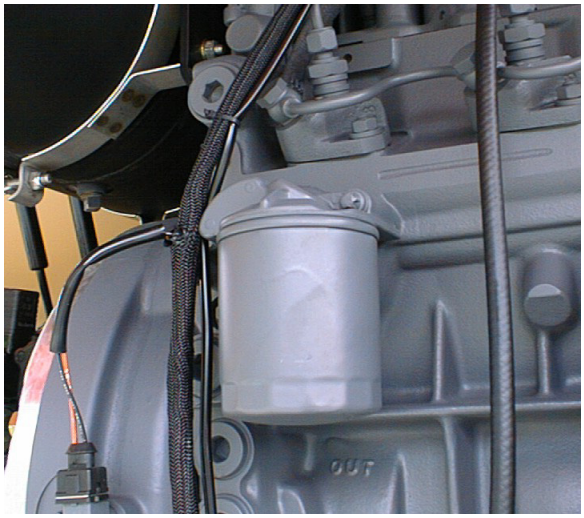


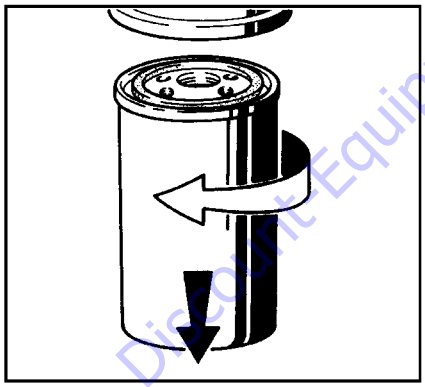
Figure 3-58. Engine Oil Viscosity

Changing Oil Filter

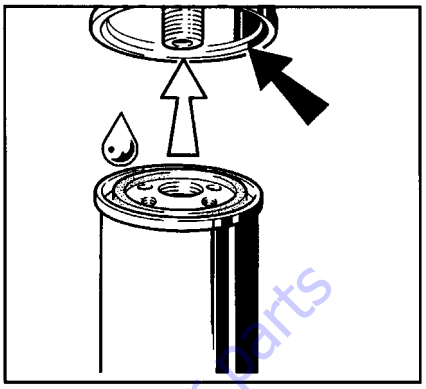
Most engine oil filters are mounted vertically. Tier 4 engine oil filters are mounted horizontally. Removal and installation is identical.



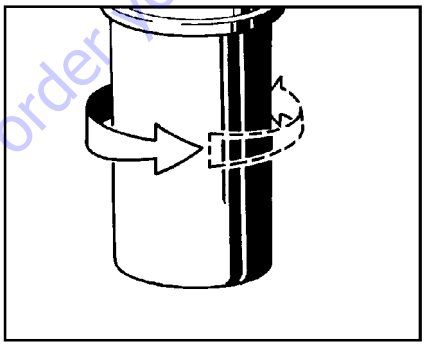
1. Wipe area around filter to remove dirt and other contaminants.
2. Using a suitable oil filter removal tool, loosen the lube oil filter cartridge and spin off.



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

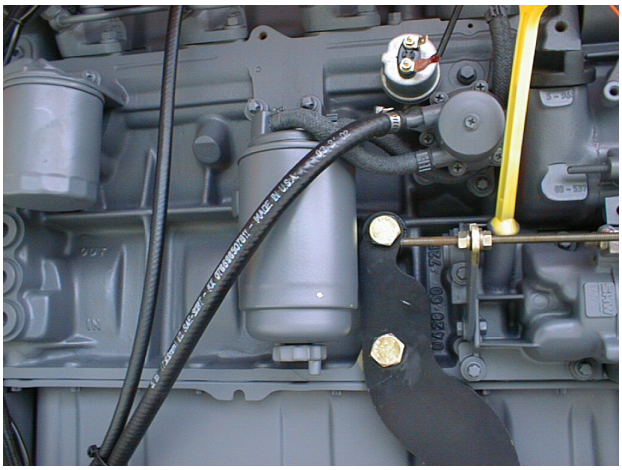


6. Manually screw in new filter until gasket is flush.



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

Replacing Fuel Filter or Pre-Filter



⚠ WARNING

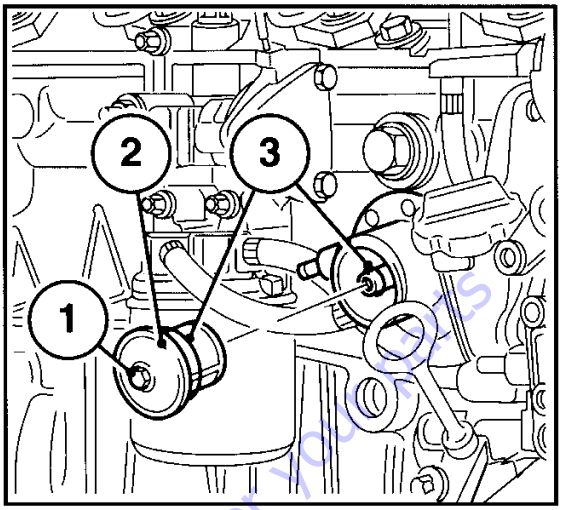
WHEN WORKING ON FUEL SYSTEM, MAKE SURE THERE ARE NO OPEN FLAMES OR SPARKS IN THE AREA. DO NOT SMOKE WHEN WORKING ON FUEL SYSTEM.

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

⚠ WARNING

WHEN WORKING ON FUEL SYSTEM, MAKE SURE THERE ARE NO OPEN FLAMES OR SPARKS IN THE AREA. 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, replace if necessary.
4. Place seal (3) in position.
5. Install fuel strainer cover (2) in position and tighten the hexagonal screw (1).
6. Check for leaks.

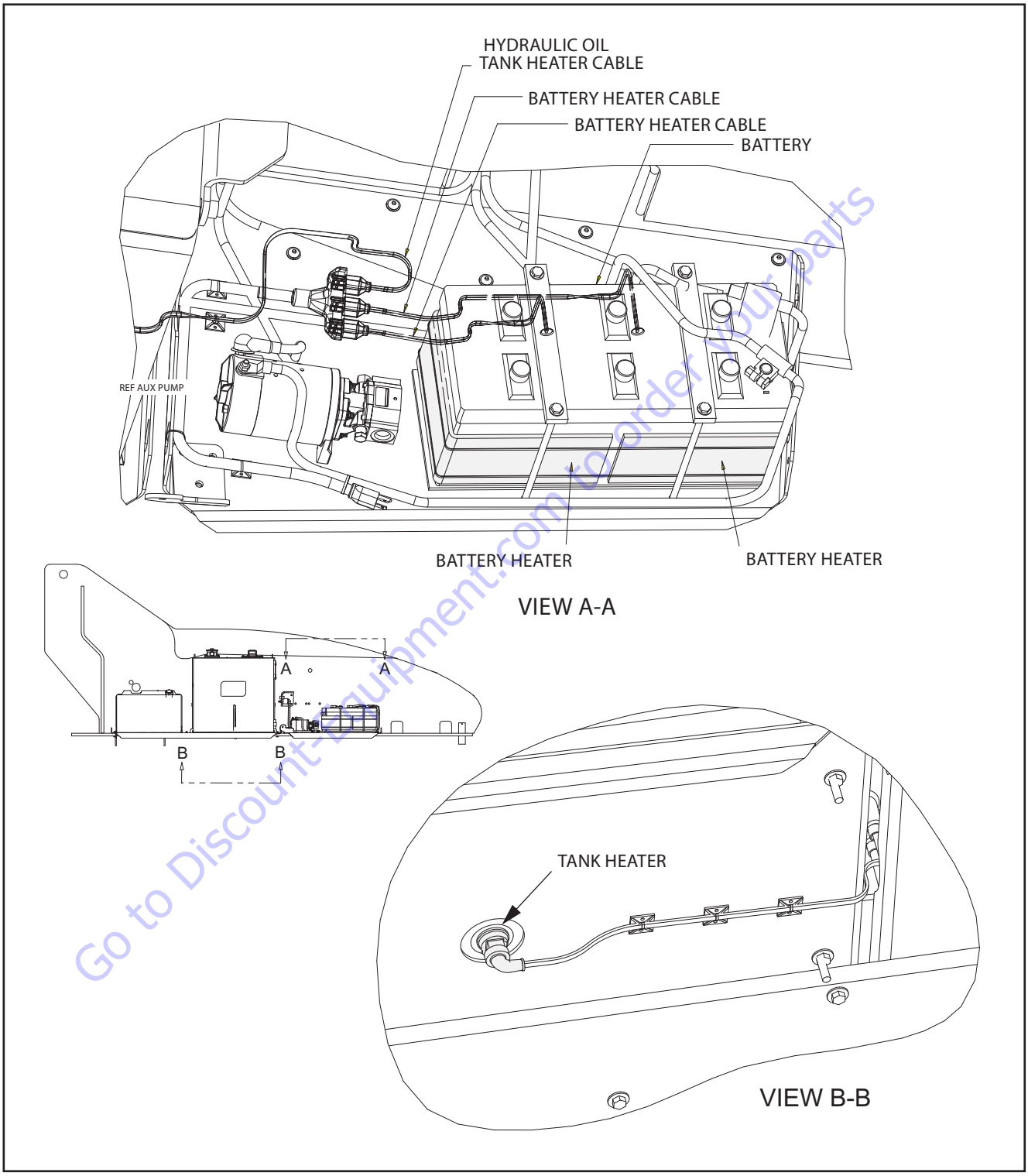


Figure 3-59. Cold Weather Package

Removal

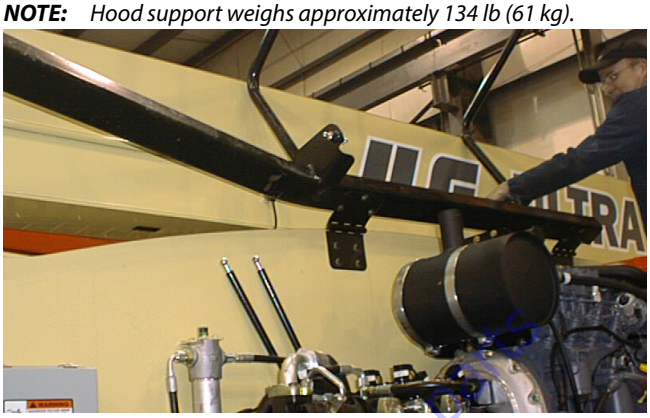
1. Disconnect battery.
2. Use a tie strap as shown below to secure hood support while hood is being removed.

3. Remove bolts and clamps that secure engine hood assembly to hood support.
4. Carefully lift engine hood assembly away from machine.

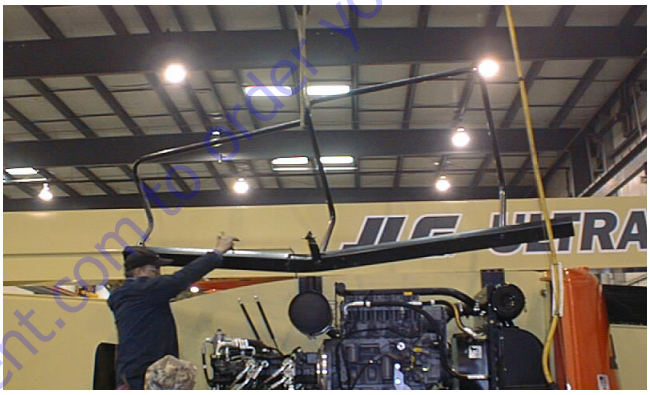
NOTE: *Engine hood assembly weighs approximately 84 lb (38 kg).*

5. Using an adequate lifting device, support weight of hood support. Disconnect gas springs and remove bolts and washers that secure hood support to hinges.

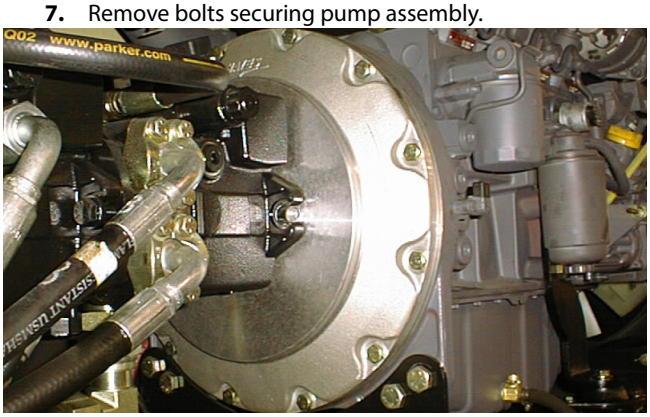
NOTE: *Hood support weighs approximately 134 lb (61 kg).*

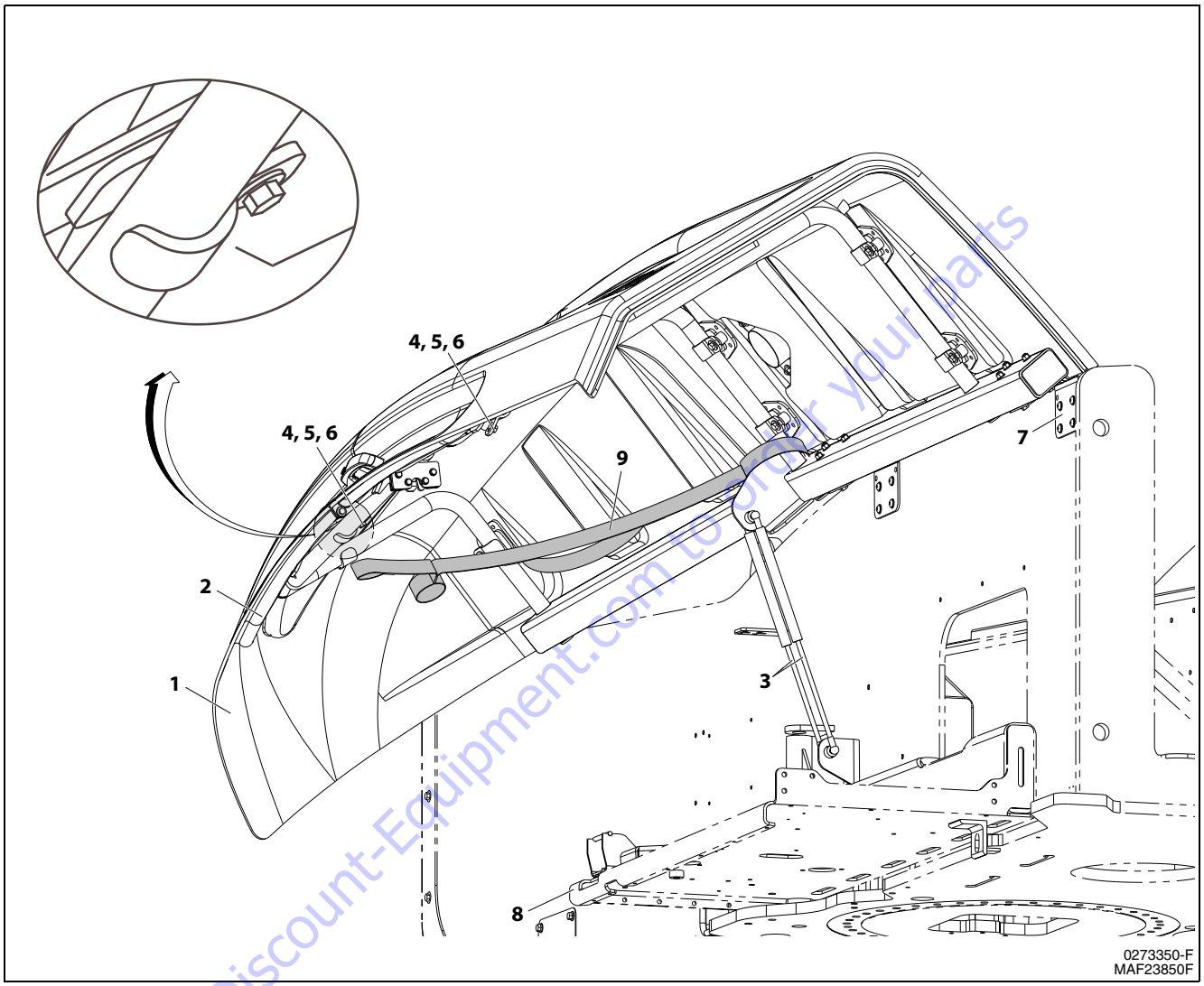


6. When all bolts are removed, lift hood support away from machine.



7. Remove bolts securing pump assembly.

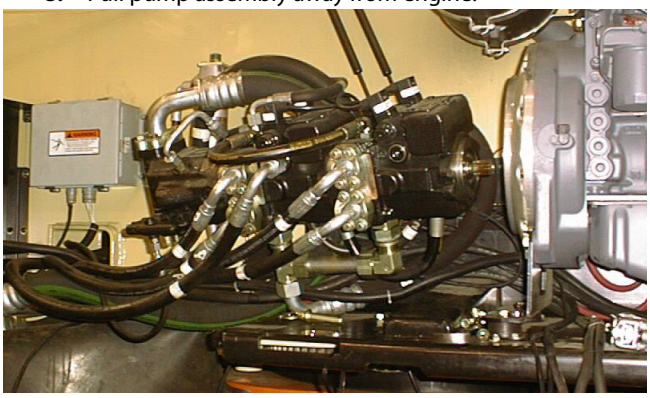




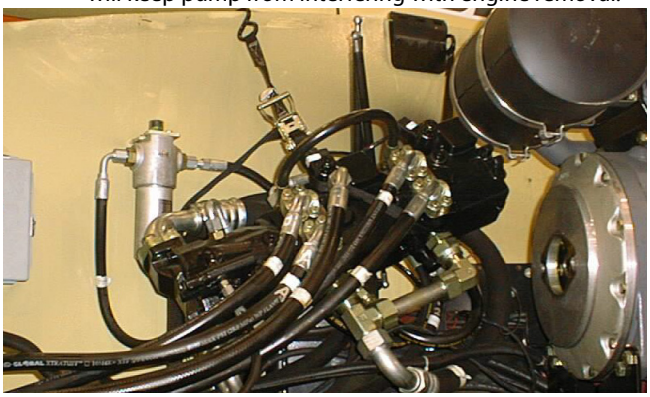
1. Hood
2. Hood Support
3. Gas Spring
4. Bolt
5. Washer
6. Clamp
7. Hinge
8. Engine Tray
9. Hand Pull Strap

Figure 3-60. Engine Hood

8. Pull pump assembly away from engine.

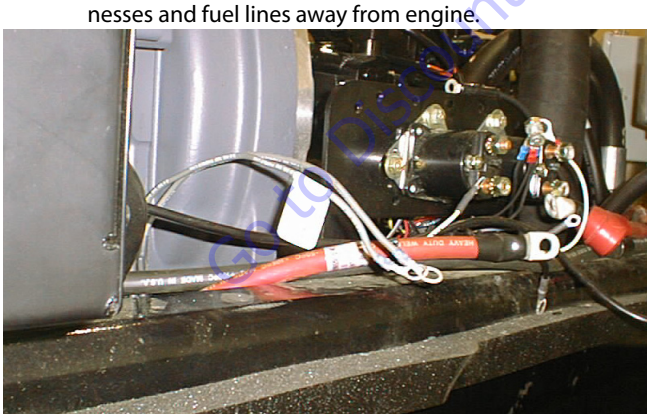


9. Using a ratchet strap, support pump in a position that will keep pump from interfering with engine removal.



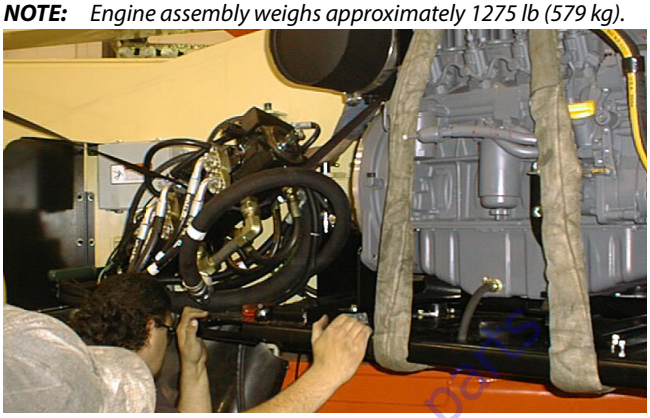
10. Disconnect all fuel lines from engine. Cap all open hoses to prevent fuel leakage.

11. Swing engine out to gain access to the back of the engine, and tag and disconnect all electrical wiring from relays, switches, etc. Carefully pull disconnected harnesses and fuel lines away from engine.

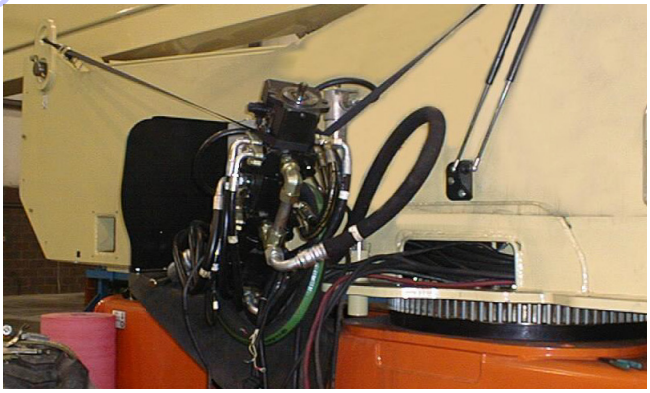


12. Using an adequate lifting device, support weight of the engine assembly. Remove pivot pin.

NOTE: *Engine assembly weighs approximately 1275 lb (579 kg).*



13. Carefully lift engine assembly away from machine.



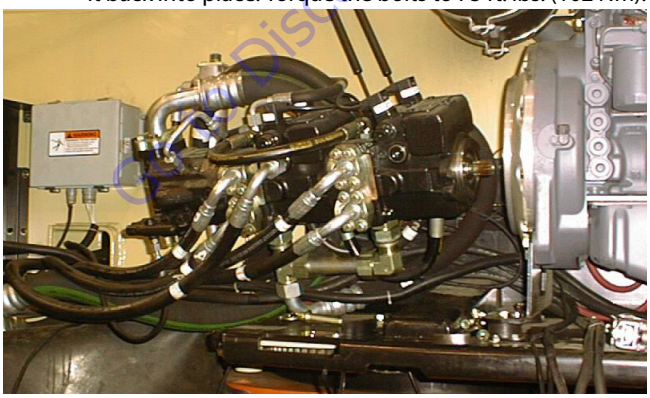
14. If installing a new engine, transfer any necessary components from the old engine assembly onto the new Engine Assembly.

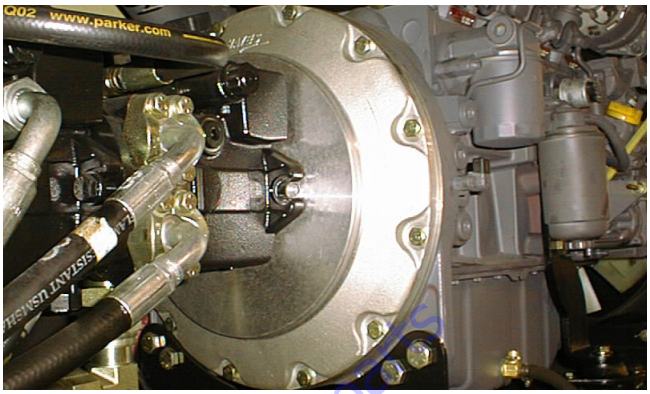
Installation

1. Using an adequate lifting device, support weight of the engine assembly and position it in place on the machine. Install engine pivot pin.

NOTE: *Engine assembly weighs approximately 1275 lb (579 kg)*

2. Route all wiring and fuel lines and connect them as tagged during removal.
3. Unstrap the pump, re-connect it to the engine and bolt it back into place. Torque the bolts to 75 ft. lbs. (102 Nm).

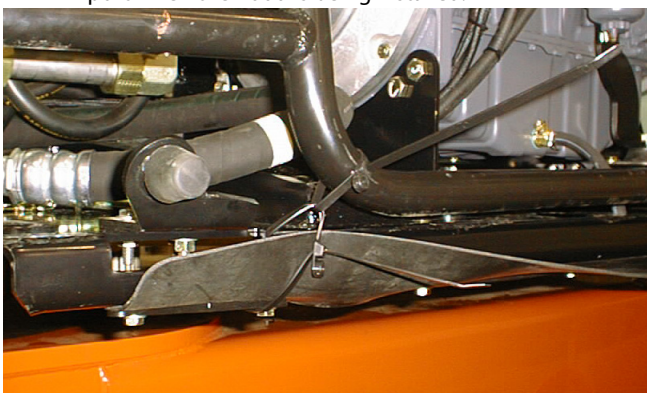




4. Lift hood support back into position. Install bolts and washers that secure hood support to hinges. Re-connect gas springs to hood support

NOTE: *Hood support weighs approximately 134 lb (61 kg)*

5. Use a tie strap as shown below to secure the hood support when the hood is being installed.



6. Carefully lift engine hood assembly onto hood support.

NOTE: *Engine hood assembly weighs approximately 84 lb (38 kg).*

7. Install bolts and clamps that secure engine hood assembly to hood support.

8. Start engine and check for proper operation and any leakage. If engine does not start immediately, fuel lines may need primed.

NOTE: *The delay in starting the engine can be reduced by removing the fuel filter, pre-filling the filter with fuel, and reinstalling the filter before attempting to start engine.*

3.27 DEUTZ EMR 2

The EMR2 consists of the sensors, the control unit and the actuator. Engine-side controls as well as the JLG Control System are connected by means of separate cable harnesses to the EMR control unit.

The sensors attached to the engine provide the electronics in the control unit with all the relevant physical parameters In accordance with the information of the current condition of the engine and the preconditions (throttle position etc.), the EMR2 controls an actuator that operates the control rod of the injection pump and thus doses the fuel quantity in accordance with the performance requirements.

The exact position of the regulating rod is reported back and, if necessary, is corrected, by means of the control rod travel sensor, situated together with the rotation magnets in a housing of the actuator.

The EMR2 is equipped with safety devices and measures in the hardware and software in order to ensure emergency running (Limp home) functions.

In order to switch the engine off, the EMR2 is switched in a de-energized fashion over the ignition switch. A strong spring in the actuator presses the control rod in the de-energized condition into the zero position. As a redundancy measure, an additional solenoid serves for switching off and this, independently of the actuator, also moves the control rod in the de-energized condition into the zero position.

After programming, carried out over the ISO9141 interface, the EMR2 is possesses a motor-specific data set and this is then fixedly assigned to the engine. Included in this are the various application cases as well as the customer's wishes regarding a particular scope of function.

Each EMR2 module is matched by serial number to the engine. Modules cannot be swapped between engines.

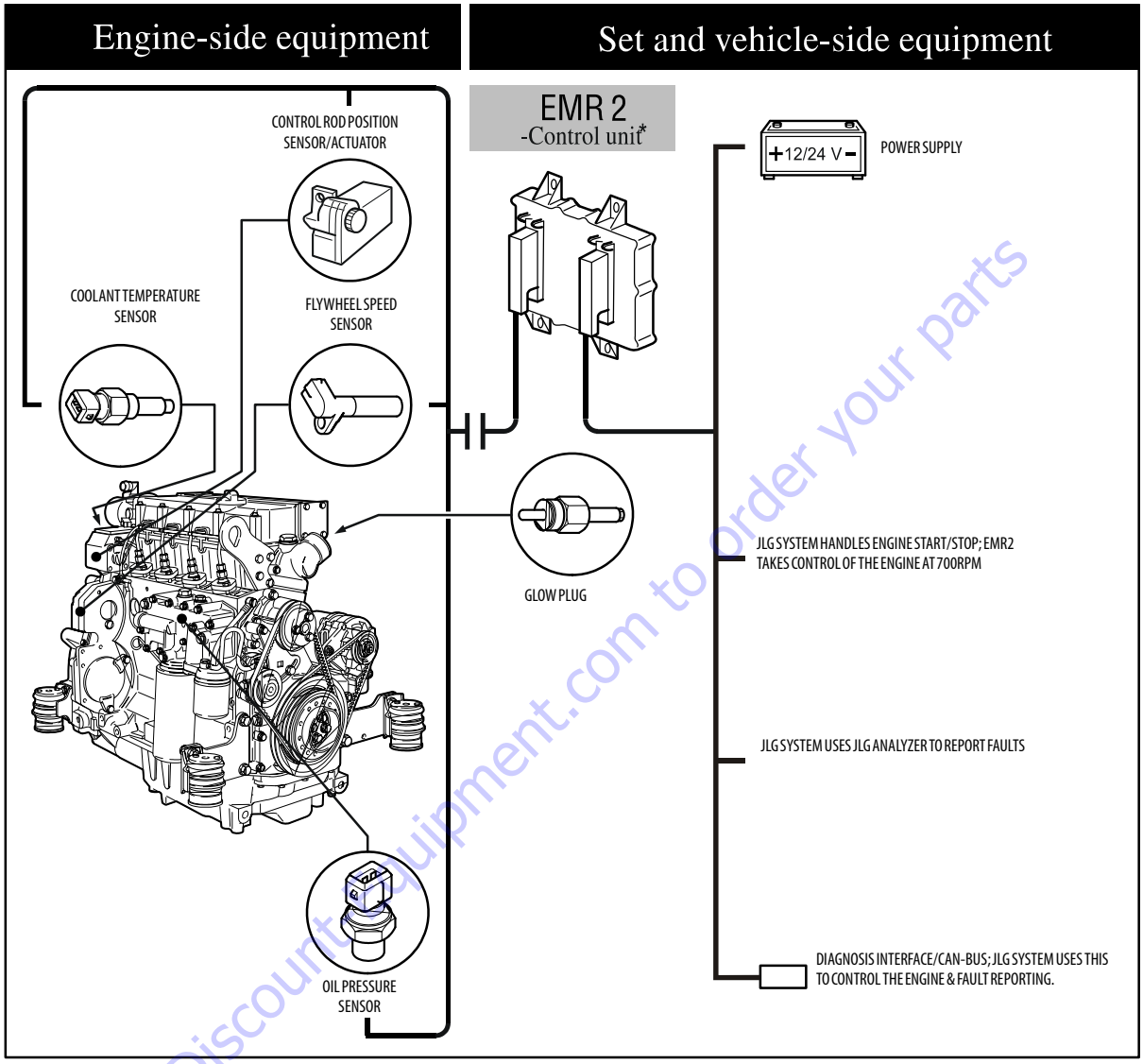


Figure 3-61. EMR 2 Engine Side Equipment

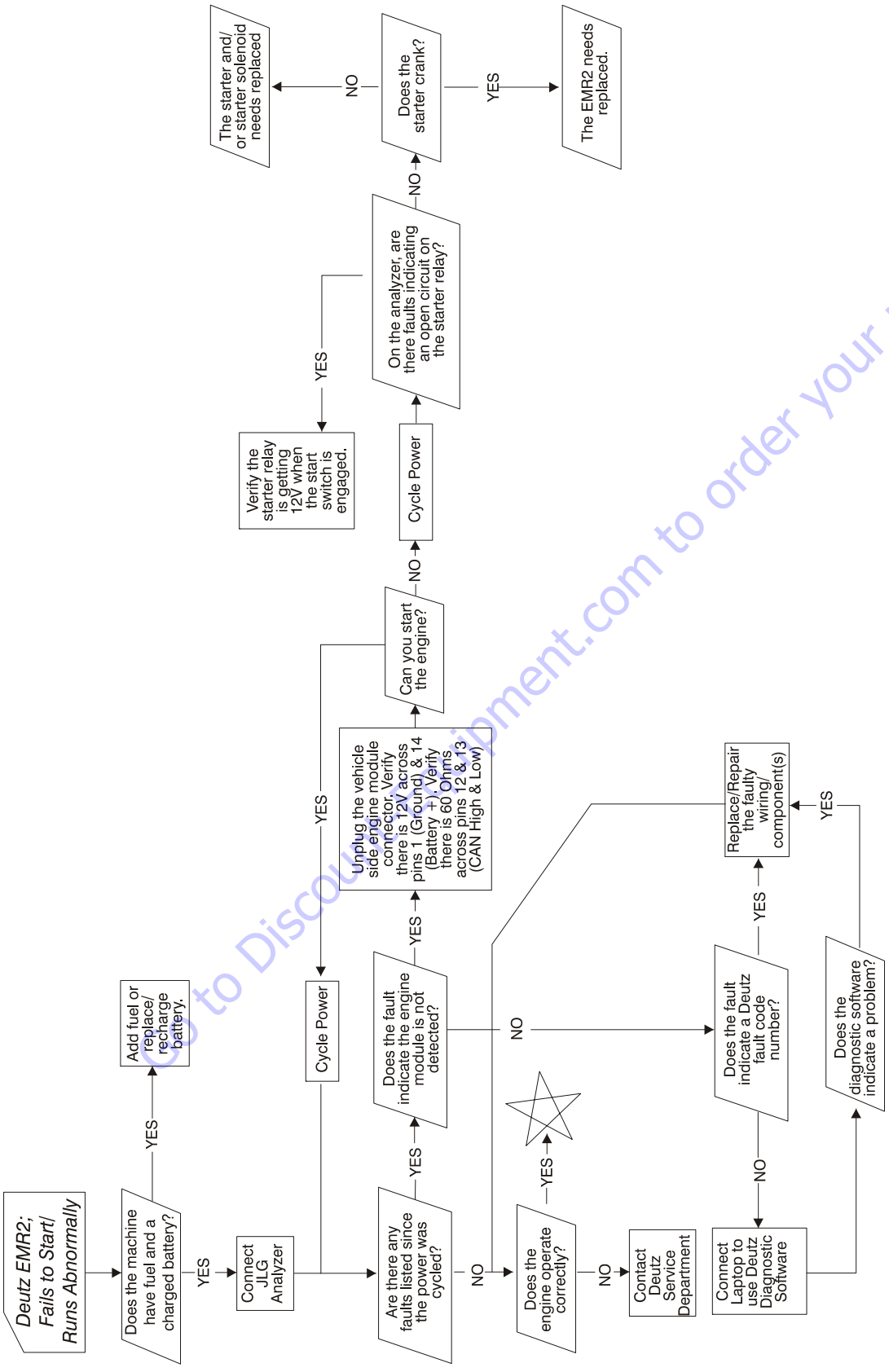


Figure 3-62. Deutz EMR 2 Troubleshooting Flow Chart

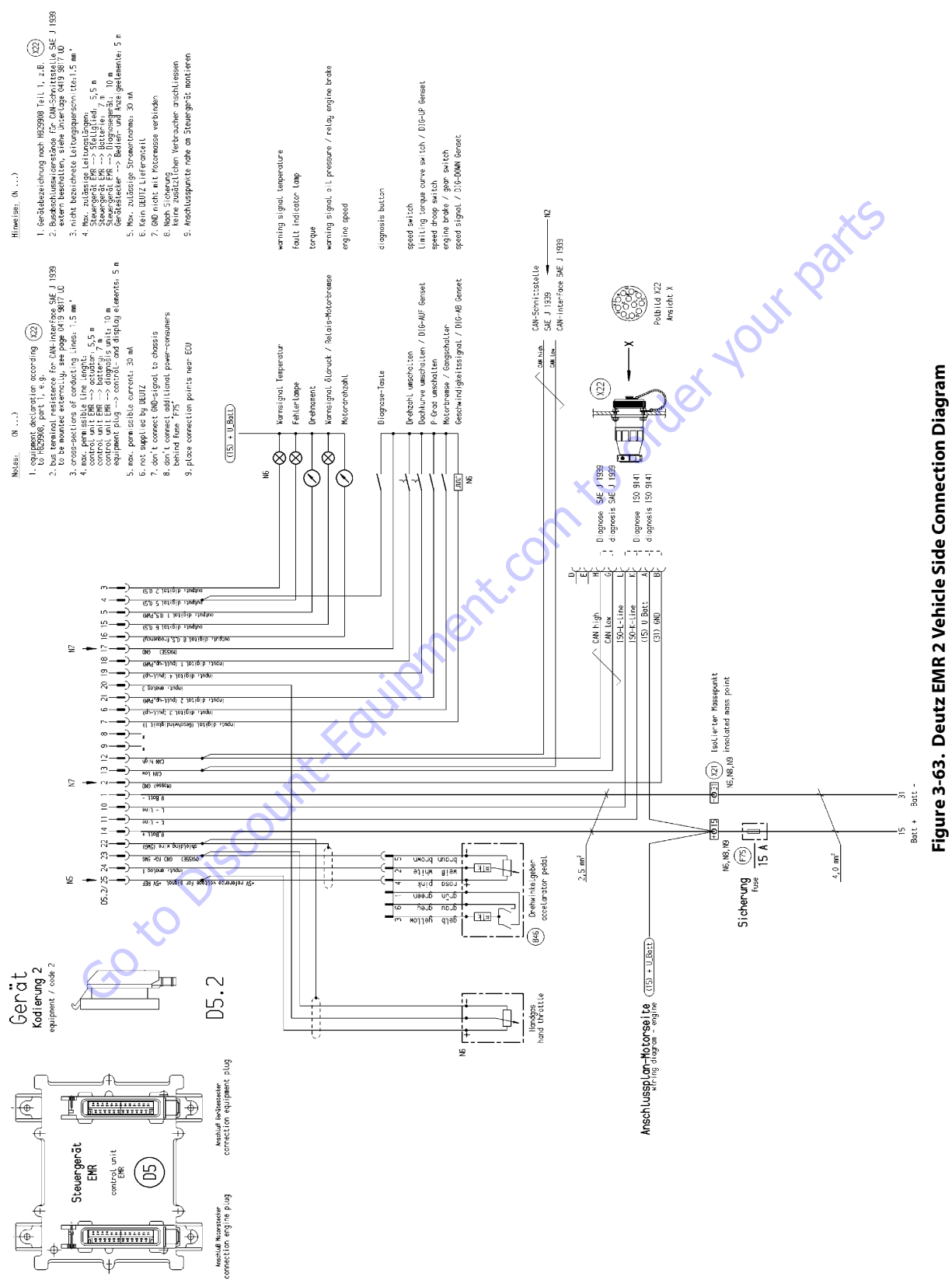


Figure 3-63. Deutz EMR 2 Vehicle Side Connection Diagram

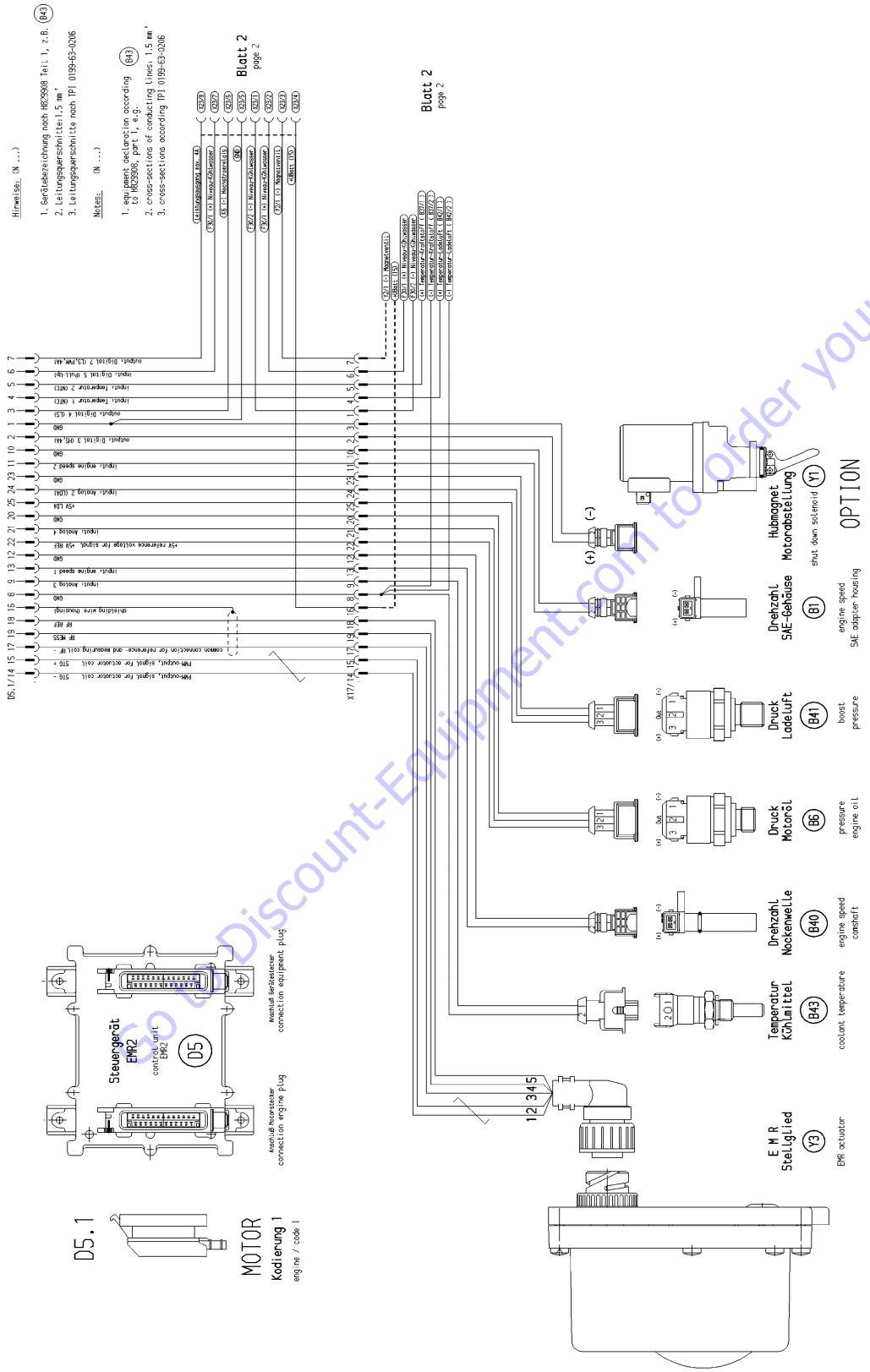


Figure 3-64. Deutz EMR 2 Engine Side Connection Diagram - Sheet 1 of 2

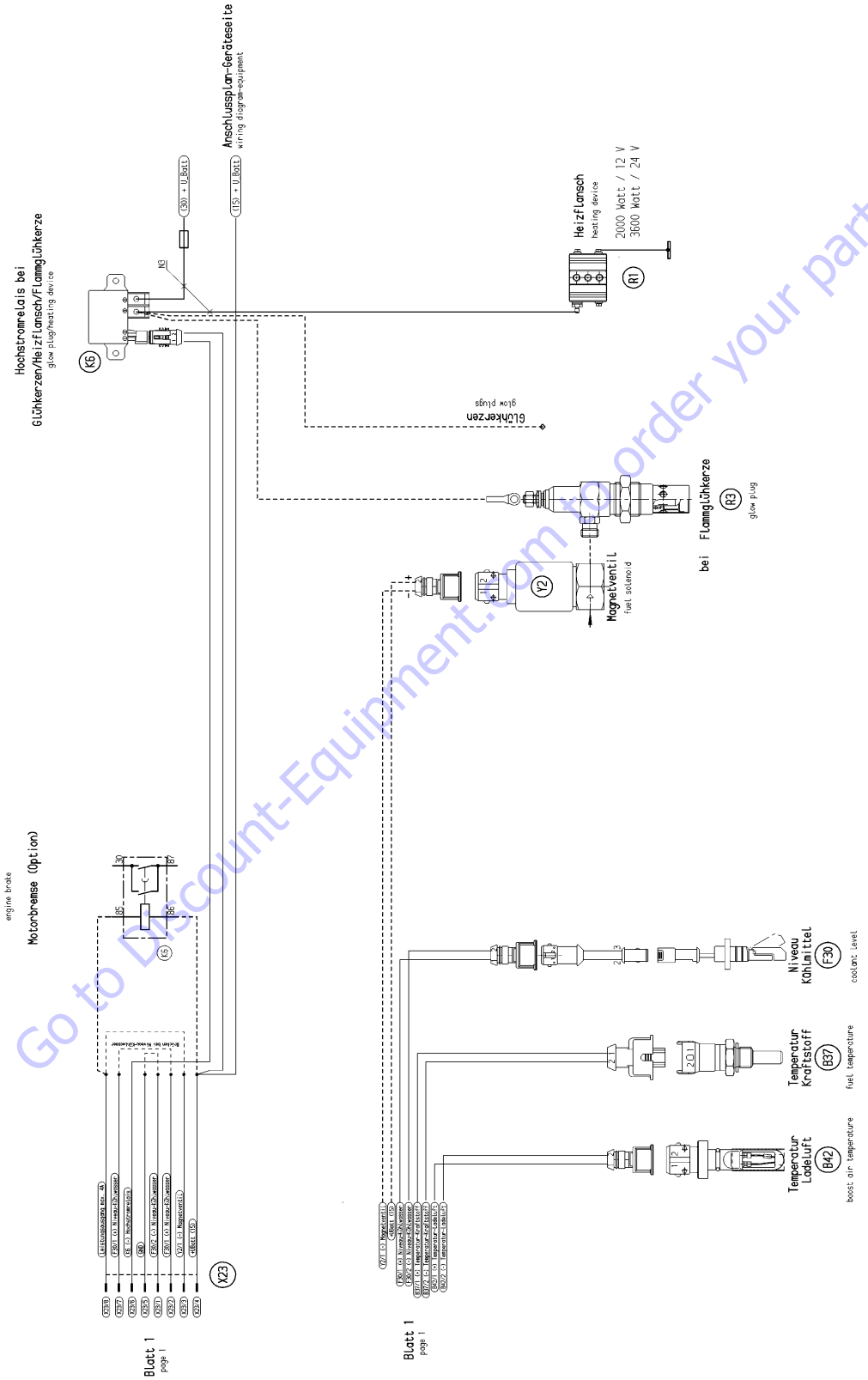
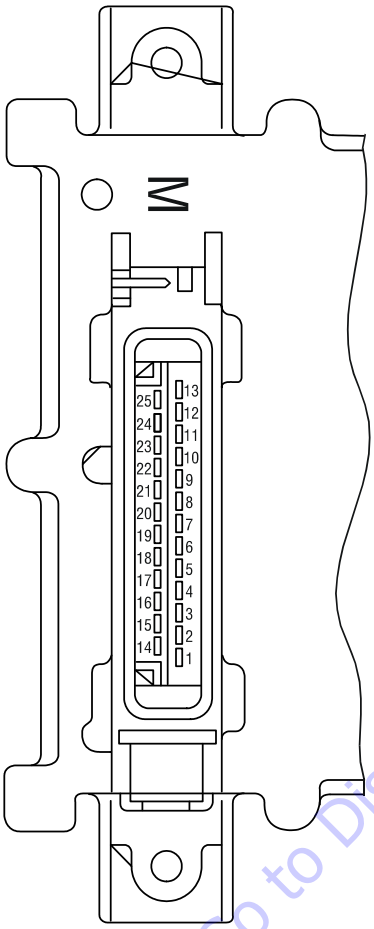


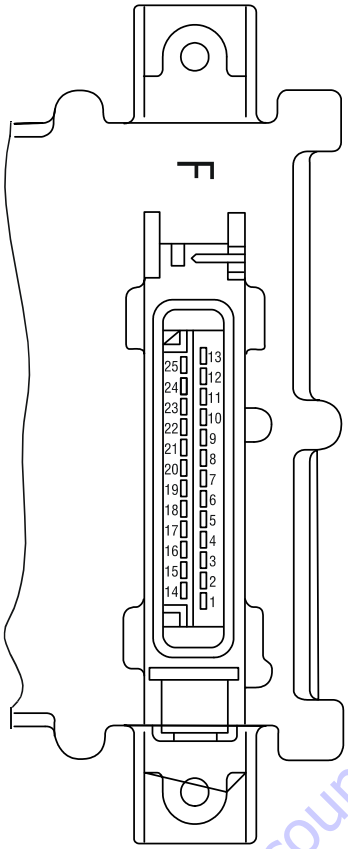
Figure 3-65. Deutz EMR 2 Engine Side Connection Diagram - Sheet 2 of 2



Pin No.	Designation	Description
1	Reserve	Reserve
2	Output: digital 3	Digital output for solenoid [1)]
3	Output: digital 4	For heating flange (optional)/ glow plug (optional)
4	Input (optional) Temp 1	Fuel temperature [2)]
5	Input (optional) Temp 2	Charge air temperature
6	Input (optional) DigIn 5	Coolant level / oil level
7	Output: PWM2/digital 6	
8	GND	Reference potential for analog signal at pin 9
9	Input: analog 7	Analog input for Coolant temperature sensor (NTC)
10	GND	Reference potential for analog signal at pin 11
11	Multi-function input: speed 2/DigIn 2	Digital input second engine speed (crankshaft) (optional) and speed signal (optional)
12	GND	Reference potential for analog signal at pin 13
13	Input: speed 1	Digital input first engine speed (camshaft)
14	STG -	PWM output, signal for actuator coil
15	STG +	PWM output, signal for actuator coil
16	Screen	Screening regulating rod travel sensor (for lines 17, 18, 19)
17	RF -	General connection for reference and measuring coil
18	RF REF	Analog input, reference signal of the reference coil
19	RF MESS	Analog input, measuring signal of the measuring coil
20	GND	Reference potential for signal at pin 21
21	Input: analog 4/digital 9	Analog input 4 (sensor signal oil pressure sensor) or digital input 9
22	+5 V REF	+5 V Reference voltage for signal at pin 21 (max. 15 mA)
23	GND	Reference potential for signal at pin 24
24	Input: analog 2/digital 7	Analog input 2 (sensor signal charge air) or digital input 7
25	+5 V LDA	+5 V Reference potential for signal at pin 24 (max. 15 mA)

1) For continuous power: < 4 A
2) Corresponds to special function"fuel temperature compensation at the EMR (0211 2571)

Figure 3-66. EMR 2 Engine Plug Pin Identification



Pin-No.	Designation	Description
1	U Batt -	Negative pole at battery (clamp 31)
2	GND	Reference potential for signal
3	Output: digital 2	PWM or digital output, various functions
4	Input / output: DigInOut	Fault lamp and diagnostic button
5	Output: PWM 1/Dig 1	PWM or digital output, various functions
6	Multi-function input: DigIn 3	Genset applications/gear shift/motor brake
7	Input: digital 10/velocity	Speed signal (tacho input)
8	NC	Not occupied
9	NC	Not occupied
10	L-line	Serial ISO 9141 interface
11	K-line	Serial ISO 9141 interface
12	CAN high	Interface for CAN-Bus
13	CAN low	Interface for CAN-Bus
14	U Batt +	Positive pole for battery (clamp 15)
15	Output: digital 5	Digital output, various functions
16	Output: digital 7/Frequency	Frequency, PWM or digital output, various functions
17	Ground	Reference potential for signal at pins 18, 19 and 21
18	Input: digital 1 / PWM 1	PWM 1 or digital input 1, various functions
19	Multi-function input: DigIn 4	Performance curve switching/genset applications
20	Multi-function input: digital 8 / analog 3	Hand hand throttle/genset applications, Digital (8) or analog input (3)
21	Input: digital 2 / PWM 2	PWM 2 or digital input 2, various functions
22	Screen	Screening (e.g. for lines hand throttle or PWG)
23	GND	Reference potential for signal at pin 24
24	Input: analog 1 / digital 6	Analog input 1 (pedal value sensor, PWG) or digital input 6
25	+5 V REF	+5 V Reference voltage for signal at pin 24

Figure 3-67. EMR 2 Vehicle Plug Pin Identification

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). Governor in emergency operation (with sensor 1) Emergency switch-off (if sensor 1 not available or failed).	Check distance. Check cable connection. Check sensor and replace if required.
	03	Speed sensor	84	8	Tacho failed. Additional fault impulses. Cable connection interrupted.	Governor in emergency operation.	Check cable connection and Tacho. Replace if required.
	04	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			

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.

Figure 3-68. EMR2 Fault Codes - Sheet 1 of 5

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.

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.

Figure 3-69. EMR2 Fault Codes - Sheet 2 of 5

Fault group	Fault no. (in SERDIA)	Fault locality/ Fault description	SPN	FMI	Cause	Remarks	Help
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.
Actuator	50	Feedback	SID 24	12	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	SID 24	13			Check actuator, replace if required. Check cable, check fault limits for “Rifeness confirmation”.
	53	Control travel difference	SID 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	SID 23	13	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.

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.

Figure 3-70. EMR2 Fault Codes - Sheet 3 of 5

Fault group	Fault no. (in SERDIA)	Fault locality/ Fault description	SPN	FMI	Cause	Remarks	Help
Hardware inputs/ outputs	60	Digital output 3 (Switch-off solenoid, pin M 2)	SID 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	SID 60	2		Fault message.	
	63	Excess voltage switch-off solenoid	SID 51	6			
	67	Error Hand Setp1	91	11			
	68	Error CAN Setp1	898	2			
Communi-cation	70	CAN-Bus controller	SID 231	12	CAN-controller for CAN-bus is faulty. Fault removal despite re-initialising continuously not possible	Application-dependent.	Check CAN connection, terminating resistor (see Chapter 12.4), Check control unit.
	71	CAN interface SAE J 1939	SID 231	9	Overflow in input buffer or a transmission cannot be placed on the bus.		
	74	Cable break, short circuit or bus-error	SID 231	14			Check CAN connection, cable connection. Check sensor and replace if required.
Memory	76	Parameter programming (write EEPROM)	SID 253	12	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
	77	Cyclic program test	SID 240	12	Constant monitoring of program memory shows error (so-called “Flash-test”).		
	78	Cyclic RAM test	SID 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.

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.

Figure 3-71. EMR2 Fault Codes - Sheet 4 of 5

Fault group	Fault no. (in SERDIA)	Fault locality/ Fault description	SPN	FMI	Cause	Remarks	Help
Control unit hardware	80	Power supply (Actuator)	SID 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	SID 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	SID 254	2			
	85	Reference voltage 4	SID 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	108	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).	SID 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	SID 240	2	Internal calculation fault (so-called “Stack overflow” 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 fault	SID 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.

Figure 3-72. EMR2 Fault Codes - Sheet 5 of 5

3.28 BIO FUEL IN DEUTZ ENGINES

General

Use of bio fuels is permitted for the compact engines made by DEUTZ.

Distillate fuels with residue oil percentages or mixed fuels may not be used in DEUTZ compact engines.

The DEUTZ vehicle engines are designed for diesel fuels in accordance with EN 590 with a cetane number of at least 51. DEUTZ engines for mobile machinery are designed for a cetane number of at least 45. When using fuels of a low cetane number, disturbing white smoke and ignition misfires are to be expected under some circumstances.

A cetane number of at least 40 is permissible for the US market, therefore special engine models have been developed to avoid starting difficulties, extreme white smoke or increased hydrocarbon emissions (EPA specification - US EPA REGULATIONS FOR LARGE NONROAD COMPRESSION-IGNITION ENGINES).

If the white smoke behavior is unacceptable when using a very low cetane number, the use of ignition improvers is to be recommended as a later remedial measure.

The certification measurements for compliance with the legal emission limits are carried out with the test fuels prescribed by law. These correspond to the diesel fuels in accordance with EN 590 and ASTM D 975. No emission values are guaranteed with the other fuels described. It is the obligation of the owner to check the permission for use of the fuels in accordance with regional regulations.

Bio Fuel

PERMITTED BIO-DIESEL FUELS

Originally only rape seed oil methylester (RME) was sold as a bio-diesel fuel in Europe but fatty acid methylester (FAME) based on other oils have come onto the market increasingly in recent years. However, with the latter there is a risk that the limit values of EN 14214 are not kept in the field. Anyone who uses bio-diesel fuel in DEUTZ engines must therefore choose his supplier very carefully and have him guarantee compliance with the EN 14214 limit values. Since experience has shown that rape seed oil methylester (RME) exceeds the limit values less often that other esters, it is expressly recommended to use only rape seed oil methyester. DEUTZ customers in Germany can additionally ensure the quality by buying bio-diesel fuel with an AGQM certificate (Arbeitsgemeinschaft Qualitäts-Management Biodiesel e.V.).

The use of US bio-diesel based on soy oil methylester is only permissible in mixtures with diesel fuel with a bio-diesel part of a max. 20 weight-%. The US bio-diesel used for the mixture must comply with the ASTM D6751-07a (B100) standard.

APPROVED ENGINES

The 912, 913, 914, 1011, 2011, 1012, 2012, 1013, 2013, 413 and 513 series are approved for bio-diesel from year of manufacture 1993 under compliance with the basic conditions specified below.

BASIC CONDITIONS TO BE OBSERVED

- A power loss of 5-9% in relation to diesel fuel in accordance with EN 590 is possible due to the lower heating value. Blocking of the fuel injector is not allowed.
- The lubricating oil quality must correspond to TR 0199-99-3002. The lubricating oil change interval must be halved in relation to operation with diesel fuel in accordance with EN 590.
- Standstills of longer than 4 to 6 weeks must be avoided with bio-diesel. Otherwise the engine must be started and stopped with diesel fuel.
- Bio-diesels can be mixed with normal diesel fuel but the basic conditions described in this subsection apply for mixtures. Mixtures with up to 5% (m/m) bio-diesel (B5) which have recently been on sale at European fuel stations are excepted. These fuels must be treated like normal diesel fuels because EN 590 expressly permits adding up to 5% (m/m) bio-diesel in accordance with EN 14214.
- Approx. 30-50 hours after changing over from diesel fuel to bio-diesel, the fuel filter should be changed as a preventive measure to avoid a drop in performance due to clogged fuel filters. Deposited fuel ageing products are dissolved by bio-diesel and transported into the fuel filter. They should not be changed immediately but after approx. 30 to 50 hours because the dissolving of dirt takes a certain amount of time.

PLANT OIL

NOTICE

PURE PLANT OILS (E.G. RAPE SEED OIL, SOY OIL, PALM OIL) ARE NOT CLASSIFIED AS BIO-DIESEL AND EXHIBIT PROBLEMATICAL PROPERTIES FOR DIESEL ENGINE OPERATION (STRONG TENDENCY TO COKE, RISK OF PISTON SEIZURE, EXTREMELY HIGH VISCOSITY, POOR EVAPORATION BEHAVIOR.

Conversion of DEUTZ engines to rape seed oil fuel operation with conversion kits and modified tanks systems of various manufacturers is not allowed and leads to loss of warranty rights.

Biological Contamination In Fuels

SYMPTOMS

The following symptoms may indicate a fuel tank is contaminated by micro-organisms:

- Internal tank corrosion,
- Filter blockage and the associated loss of power due to gel-like deposits on the fuel filter (especially after long stand-stills)

CAUSE

Micro-organisms (bacteria, yeasts, funguses) can form bio-sludge under unfavorable conditions (favored particularly by heat and water).

Penetration by water is usually caused by condensation of the water in the air. Water does not dissolve in fuel so that the penetrating water collects at the bottom of the tank. The bacteria and funguses grow in the watery phase, at the phase boundary to the fuel phase, from which they draw their nutrition. There is an increased risk especially with bio-diesel (FAME).

PREVENTIVE MEASURES

- Keep storage tank clean, regular cleaning of the tank by specialist companies
- Installation of fuel pre-filters with water traps, especially in countries with frequently fluctuating fuel qualities and high percentage of water.

If the fuel system and storage tank have already been attacked by micro-organisms. The biocide must be dosed according to the manufacturer's specifications.

- Avoid direct exposure of the storage tank to sunlight
- Use smaller storage tanks with corresponding low dwell times of the stored fuel

FUEL ADDITIVES

Use of fuel additives is not permitted. The flow improvers mentioned above are an exception. Use of unsuitable additives will result in loss of warranty.

3.29 DEUTZ TURBOCHARGER OPERATION

Good engine operating procedures are essential to prolong turbocharger life.

Particular attention to oil system and air system will eliminate the two main causes of turbocharger failure. To prevent this Operators/Owners must ensure that :-

1. Air and oil filters are checked regularly to the manufacturer's specifications.
2. Engine maintenance intervals are adhered to.
3. Engine and equipment are operated in such a way that is not harmful to the life of the turbocharger.

Operating Practices

Operators and owners can get maximum service life from their turbochargers if a few good practices are followed:

START UP

When starting the engine use minimum throttle and run in idle mode for approximately one minute. Full working oil pressure builds up within seconds but it is useful to allow the turbocharger moving parts to warm up under good lubricating conditions. Revving the engine within the first few seconds of start up causes the turbocharger to rotate at high speeds with marginal lubrication which can lead to early failure of the turbocharger.

AFTER SERVICING

After servicing the engine or turbocharger, ensure the turbocharger is pre-lubed by adding clean engine oil into the turbocharger oil inlet until full. After pre-lubing, crank the engine without firing (engine/fuel pump stop out) to allow oil to circulate through the full system under pressure. On starting the engine, run at idle for a few minutes to ensure the oil and bearing systems are operating satisfactorily.

LOW AIR TEMPERATURES & INACTIVE OPERATION

If the engine has been inactive for some time or the air temperature is very low, crank the engine first and then run at idle. This allows the oil to circulate throughout the full system before high loads and speeds are applied to engine and turbocharger.

SHUT DOWN

Before shutting the engine down, let the turbocharger cool down. When an engine runs at maximum power/high torque, the turbocharger is operating at very high temperatures and speeds. Hot shut down can cause reduced service life which is avoidable by a minute or two of idling. Most mobile equipment applications include an adequate cooling period during parking or mooring procedures.

Allow the engine to idle for 1-5 minutes to allow the high temperatures and speed to reduce and thus prolong the life of the turbocharger.

ENGINE IDLE

Avoid running the engine for long periods in idle mode (greater than 20-30 minutes). Under idling conditions low pressures are generated in the turbocharger which can cause oil mist to leak past seals into the two end housings. Although no real harm is done to the turbocharger, as load is applied temperatures increase and the oil will start to burn off and cause blue smoke emission problems.

If the engine is allowed to Idle for a period of time, lube oil will continue to flow cooling the turbine shaft.

You can also see spots on the turbo where grooves have been "worn" in to the turbine shaft at the point where the radial bearing sits. Dirty oil/contaminates in the oil can become trapped in between the radial bearing and the surface of the shaft becoming abrasive and ultimately grinding away the material.

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
978	1-2-6	29	2	Diagnostic fault check of synchronism of hand throttle and Low idle switch(LIS).	Plausibility error between sensor and idle switch	Threshold for error detection is an internal ECU threshold. The accelerator pedal must have detected full load and idle plausibility at least once.
932	1-2-6	29	3	Diagnostic fault check of short circuit to supply voltage (signal range check high) of acceleration pedal signal.	The signal exceeds the applicatable threshold; signal range violation	If the signal is below the applicatable threshold APP_uRawSRCHiHTLIS_C, the signal range violation is reset after the healing debouncing. In case when the CCP is active (CCP_stActive = 1)and the reading from the EEPROM memory is successful, the signal is below the threshold APP_uHTLISCCPHi[1], a signal range violation is reset after debouncing.
937	1-2-6	29	4	Diagnostic fault check of short circuit to ground (signal range check low) of acceleration pedal signal	The signal is below the applicatable threshold; signal range violation	If the signal exceeds the applicatable threshold APP_uRawSRCLoHTLIS_C, the signal range violation is reset after the healing debouncing. In case when the CCP is active (CCP_stActive = 1)and the reading from the EEPROM memory is successful, the signal exceeds the threshold APP_uHTLISCCPLo[1], a signal range violation is reset after debouncing.
935	2-2-6	91	3	Analog accelerator pedal sensor 1 or double accelerator pedal sensor: the voltage measured by ECU is out of the target range or the calculated pedal position is implausible compared with the position of the second pedal	Sensor defect. Short cut to battery or open loop.	Check cabling, check accelerator pedal sensor and if necessary replace it, check connection cable and if necessary repair or replace it. If the signal is below the applicatable threshold APP_uRaw1SRCHigh_C, the signal range violation is reset after the healing debouncing.
940	2-2-6	91	4	Analog accelerator pedal sensor 1 or double accelerator pedal sensor: the voltage measured by ECU is out of the target range or the calculated pedal position is implausible compared with the position of the second pedal	Short circuit to ground.	Check cabling, check accelerator pedal sensor and if necessary replace it, check connection cable and if necessary repair or replace it If the signal exceeds the applicatable threshold APP_uRaw1SRCLow_C, the signal range violation is reset after the healing
976	2-2-6	91	11	Diagnostic fault check of synchronism of single potentiometer and Low idle switch(LIS).	Measured voltage of accelerator pedal 1 is out of plausible range.	Threshold for error detection is an internal ECU threshold. Check cabling, check accelerator pedal and pedal sensor and if necessary replace it, check connection cable and if necessary repair or replace it. When the PWM period APP_tiPWMPer is in between APP_tiSRCLoPWMPer_C and APP_tiSRCHiPWMPer_C.

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
474	216	94	1	Low fuel pressure: the low fuel pressure calculated by ECU is underneath the target range; the ECU activates a system reaction	Fuel pressure below warning threshold	Check low fuel pressure system (fuel feed pump, relay , fuse, wiring, sensor) and if necessary repair or replace it.
472	216	94	3	Low fuel pressure sensor: the voltage of sensor measured by ECU is out of the target range	cable break or short circuit, sensor defective, connection cable damaged Short cut to battery or open loop	Check cabling, if sensor not working, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it
473	216	94	4	Low fuel pressure sensor: the voltage of sensor measured by ECU is out of the target range	cable break or short circuit, sensor defective, connection cable damaged short cut to ground	Check cabling, if sensor not working, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it
464	228	97	3	Fuel filter water level sensor: the voltage of sensor measured by ECU is out of the target range	Sensor not connected or sensor defect.	Check of wiring and water in fuel sensor. Check cabling, if charge Water in Fuel sensor is not working, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it.
465	228	97	4	Fuel filter water level sensor: the voltage of sensor measured by ECU is out of the target range.	cable break or short circuit, sensor defective, connection cable damaged. Short cut to ground.	Check sensor and if necessary replace it, check connection cable and if necessary repair or replace it.
1157	228	97	12	Fuel filter water level sensor: the maximum level is exceeded	Water level in fuel pre-filter reservoir over limit (bad fuel quality)	Measure Voltage at Water in Fuel Sensor and renew harness if needed.
736	231	100	1	Oil pressure is below the target range (warning threshold)	Oilpressure too low (pressure below warning threshold)	Threshold for error detection is an internal ECU threshold. Check oil level, check engine for oil leckage, measure oil pressure external to evaluate sensor value
737	231	100	1	Oil pressure is below the target range (shut off threshold)	Oilpressure too low (pressure below shut off threshold).	Threshold for error detection is an internal ECU threshold. Check oil level, check engine for oil leckage, measure oil pressure external to evaluate sensor value.
732	224	100	3	Oil pressure sensor: the voltage of sensor measured by ECU is out of the target range	short circuit to battery or cable break	check battery and wiring Check cabling. If sensor not working, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it.
733	224	100	4	Oil pressure sensor: the voltage of sensor measured by ECU is out of the target range	Short circuit to ground	The sensed raw voltage value Oil_uRawPSwmp is above Oil_SRCPSwmp.uMin_C Check cabling, if sensor not working, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it No detail informationen!
774	223	102	1	charge air pressure below lower limit	measured charge air pressure below the threshold.	Check complete air system of engine for massive leakage, especially from compressor to intake air manifold. Check air filter. Exchange charge air presure sensor.

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
88	223	102	2	Charge air pressure messured by sensor is above the shut off threshold.	Charged air cooler pressure below threshold.	Check waste gate system if necessary replace TC, check CAC if all channels are clean,check charge air piping if nececery.
89	223	102	2	Charge air pressure messured by sensor is above the warning threshold	Charge air pressure above shut off threshold	Check waste gate system if necessary replace TC, check CAC if all channels are clean, check charge air piping if necessery.
772	223	102	2	Deviation between sensed intake manifold pressure is not plausible compared to environment pressure. Which sensor is not okay can not be said.	deviation between ambient pressure sensor and charge air pressure sensor at not running engine to high	1) Exchange boost pressure sensor 2) Exchange ECU
776	223	102	3	Charge air pressure sensor: the measured voltage of sensor by ECU is out of the target range	The Sensor Voltage is above the Threshold.	Check cabling, if charge air pressure/temperature sensor is not working, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it.
777	223	102	4	Charge air pressure sensor: the measured voltage of sensor by ECU is out of the target range	The Sensor Voltage is below the Threshold.	Check cabling, if charge air pressure/temperature sensor is not working, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it
996	233	105	0	Charge air temperature downstream calculated by ECU is above the target range. The ECU activates a system reaction.	Charge air temperature (downstream) over warning threshold.	Check CAC system and clean it. Check fan functionality. Check cooling perfomance with temperature measurement.
997	233	105	0	Charge air temperature downstream calculated by ECU is under the shut down threshold. The ECU activates a system reaction.	Charge air temperature (downstream) over the low threshold.	Check CAC system and clean it. Check fan functionality. Check cooling perfomance with temperature measurement.
992	128	105	1	Charged Air cooler down stream temperature. Temperature below lower physical threshold.	Sensed temperature within intake air manifold < threshold.	actual temperature below -40°C? exchange sensor
994	128	105	3	Charge air temperature sensor: the voltage of sensor measured by ECU is out of the target range.	Short circuit to battery. sensor voltage > limit	The sensor raw signal Air_uRawTCACDs (voltage) > Air_SRCTCACDs.uMin_C. Check CAC-sensor and if necessary replace it, check connection cable and if necessary repair or replace it.
995	128	105	4	Charge air temperature sensor: the voltage of sensor measured by ECU is out of the target range.	Short circuit to ground or open load. sensor voltage < limit.	The sensor raw signal Air_uRawTCACDs (voltage) is below Air_SRCTCACDs.uMin_C. Check CAC-sensor and if necessary replace it, check connection cable and if necessary repair or replace it
752	136	107	0	Air filter differential pressure: the pressure difference of the intake air between the filter inlet and outlet calculated by ECU is above the target range and the ECU activates a system reaction	Pressure loss above target range with system reaction, air filter clogged or defective, sensor not working, connection cable damaged Pressure value above warning threshold	Check air filter and if necessary clean or renew it, check cabling, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it
98	232	110	0	Coolant temperature: the coolant temperature calculated by ECU is above the target range; the ECU activates a system reaction	Cooling temperature too high. Coolant temperature above warning threshold	Clean radiator, check fan drive, check coolant level, check cooling system in general, check thermostat function, check water pump

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
99	232	110	0	Coolant temperature: the coolant temperature calculated by ECU is above the target range. The ECU activates a system reaction	Coolant temperature above shut off threshold.	Clean radiator, check fan drive, check coolant level, check cooling system in general, check thermostat function, check water pump
93	225	110	1	Coolant temperature sensor: the voltage of the sensor measured by ECU is out of the target range.	Suspected components:wiring harness, coolant temperature sensor.	Check wiring harness and connected Coolant Temp Sens.
96	225	110	3	Coolant temperature sensor: the voltage of the sensor measured by ECU is out of the target range	Short cut to battery or open load.	Check sensor and if necessary replace it, check connection cable and if necessary repair or replace it.
97	225	110	4	Coolant temperature sensor: the voltage of the sensor measured by ECU is out of the target range	Voltage Surveillance has found shortcut to Ground at Coolant Temperature Sensor.	Check sensor and if necessary replace it, check connection cable and if necessary repair or replace it Measure Voltage at Coolant Temperature Sensor and renew harness if needed.
101	235	111	1	Coolant level: the coolant level calculated by ECU is underneath the allowed minimum.	Coolant level too low, leakage in cooling system, sensor defective, wiring damaged.	Check coolant level, inspect cooling system for leakage and if necessary repair it, check sensor and wiring
877	147	157	3	Rail pressure sensor: the voltage of sensor measured by ECU is out of the target range.	Short cut to battery. Damaged rail pressure sensor.	Check cabling, check rail pressure sensor and if necessary replace it, check connection cable and if necessary repair or replace it.
878	147	157	4	Rail pressure sensor: the voltage of sensor measured by ECU is out of the target range.	Check cabling, check rail pressure sensor and if necessary replace it, check connection cable and if necessary repair or replace it.	Check cabling, check rail pressure sensor and if necessary replace it, check connection cable and if necessary repair or replace it.
1381	839	164	2	Rail pressure safety function is not executed correctly	Rail pressure is still above threshold.	Threshold for error detection is an internal ECU threshold. Reset the fault and at reappearance check ECU and injection system
1180	318	168	0	Battery voltage: the voltage measured by ECU is out of the target range	Battery voltage over limit	Check alternator, regulator of alternator and if necessary replace it, check wiring and voltage of alternator
1181	318	168	1	Battery voltage: the voltage measured by ECU is out of the target range	Battery voltage below limit	Check alternator, cabling, contact resistance, safety fuses, too high load in energy system, check battery and if necessary replace it
47	318	168	2	Battery voltage: the voltage measured by ECU is out of the target range, system reaction is initiated	If Batteryvoltage (Ubatt_U) > 17V or 31V for mor than =0.5sec a warning is generated Battery voltage above warning threshold	Check wiring harness and connected alternator.
45	318	168	3	Battery voltage: the voltage measured by ECU is out of the target range, system reaction is initiated	Battery voltage above warning threshold (~38,9Volt), Short cut to battery possible.	Check wiring harness and connected alternator.
46	318	168	4	Battery voltage: the voltage measured by ECU is out of the target range, system reaction is initiated	Battery voltage below warning threshold, Short cut to ground	Check wiring harness and connected alternator.
417	312	171	3	Sensor error SCR-System environment temperature; DPF-System air inlet temperature; signal range check high	open loop to sensor	Check cabling, if environment temperature sensor is not working, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it.

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
418	312	171	4	Sensor error SCR-System environment temperature; DPF-System air inlet temperature; signal range check low	short circuit to Ground	Check cabling, if environment temperature sensor is not working, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it
1425	226	172	0	sensed intake air temperature at air filter > physical high limit	sensed intake air temperature at air filter > physical high limit	Check outside conditions: Temperature > Threshold within the intake air system of the engine? E.G: engine sucks in air from hot asphalt out of paver bucket Sensor positioned within black air filter housing above engine lid at hot environmental conditions and idling or similar? => if yes check with application team to adapt limits if not check sensor and wiring harness exchange sensor
1183	226	172	1	sensed air temperature within air intake path of engine below physical low limit	sensed air temperature within air intake path of engine below physical low limit	Cold start and ambient temperature < threshold Check wiring harness to AFST-sensor Exchange AFST-sensor
389	214	190	0	Engine speed: the engine speed calculated by ECU is above the target range; the ECU activates a system reaction	Overspeed monitoring during 1 level of FOC (Failure overrun condition) if engine speed was over Limit.	check powertrain settings regarding overspeed
421	213	190	2	ECU measures a deviation between camshaft and crankshaft angle to target.	Offset error between crankshaft and camshaft.	Threshold for error detection is an internal ECU threshold, occurs by offset between crankshaft and camshaft. Check increment wheel position, clean and adjust if necessary, check sensor postition. Check Camshaft and Crankshaft senor or wiring.
419	212	190	8	Camshaft speed sensor: the ECU receives no signal and uses the signal from crankshaft speed sensor as alternative to calculate the engine speed	When disturbed camshaft signal detected. Error in sensor or wiring.	Threshold for error detection is an internal ECU threshold, occurs by disturbed camshaft signal. Check increment wheel position, clean and adjust if necessary, check sensor postition. Check Camshaft Sensor or wiring.
422	212	190	8	Sensor crankshaft speed; disturbed signal	Error in sensor or wiring. Crankshaft sensor defect.	Threshold for error detection is an internal ECU threshold, occurs by disturbed crankshaft signal. Check increment wheel position, clean and adjust if necessary, check sensor postition. Check Crankshaft Sensor or wiring.
390	214	190	11	Engine speed: the engine speed calculated by ECU is above the target range; the ECU activates a system reaction	Overspeed monitoring during 2 level of FOC (Failure overrun condition) if engine speed was over limit.	check powertrain O settings regarding overspeed
420	212	190	12	Camshaft speed sensor: the ECU receives no signal and uses the signal from camshaft speed sensor as alternative to calculate the engine speed Threshold:	Error in sensor or wiring.	Threshold for error detection is an internal ECU threshold, occurs by disturbed or no camshaft signal. Check increment wheel position, clean and adjust if necessary, check sensor postition. Check Camshaft Sensor or wiring.

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
423	212	190	12	Crankshaft speed sensor: the ECU receives no signal and uses the signal from camshaft speed sensor as alternative to calculate the engine speed.	Error in sensor or wiring.	Threshold for error detection is an internal ECU threshold, occurs by disturbed or no Crankshaft signal. Check increment wheel position, clean and adjust if necessary, check Crankshaft sensor postition or wiring.
391	214	190	14	Engine speed: the engine speed calculated by ECU is above the target range; the ECU activates a system reaction	Overspeed monitoring during ORC (Override conditions) if engine speed was over 2900rpm	check powertrain settings regarding overspeed
1222	2-1-2	190	14	Camshaft- and Crankshaft speed sensor signal not available on CAN or defect.	Sensors for engine speed are defect.	Threshold for error detection is an internal ECU threshold. Check wiring, check cabels and repair or replace if necessary.
791	693	411	0	delta pressure across venturi in EGR line above physical high limit	sensed value of venturi difference pressure > high limit	Threshold for error detection is an internal ECU threshold. EGR-Valve blocked open EGR-Valve actuator defect EGR-cooler defect (check for coolant water) Reed Valve defect Intake throttle blocked in closed position => Check intake throttle Exhaust pressure too high => Check Exhaust pressure Check Nox-sensor upstream SCR catalyst dp venturi sensor defect
792	693	411	1	delta pressure across venturi in EGR line below physical low limit	sensed value of venturi difference pressure < low limit	Threshold for error detection is an internal ECU threshold. Check correct mounting of difference pressure sensor at venturi tube Exchange difference pressure sensor broken
795	693	411	3	The sensed raw voltage Air_uRawPEGRDeltaP is above the maximum threshold.	EGR Delta pressure Sensor defect	Check cabling, if charge EGR Delta pressure sensor is not working, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it.
381	693	411	4	Range check cannot be done or interrupted.	EGR or wiring defect	Check wiring harness and connected EGR.
796	693	411	4	The sensed raw voltage value Air_uRawPEGRDeltaP is above the minimum threshold.	EGR Delta pressure Sensor defect	Check cabling. If charge EGR Delta pressure sensor is not working, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it.

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
793	693	411	11	DFC is stored in EEPROM and status kept until check is allowed to be carried out again DFC can be reset by service routine 216	deviation between desired O2 concentration in intake air manifold and the real 02-concentration within intake air manifold > limit	Threshold for error detection is an internal ECU threshold. EGR-Valve mechanically blocked open or closed EGR-pipe blocked with metall plate instead sealing downstream EGR-Valve EGR-Valve actuator defect EGR-cooler defect (check for coolant water) Reed Valve defect Intake throttle blocked in closed position => Check intake throttle Exhaust pressure too high => Check Exhaust pressure Check Nox-sensor upstream SCR catalyst dp venturi sensor defect
1007	682	412	3	EGR downstream temperature sensor: the voltage of sensor measured by ECU is out of the target range.	Short circuit to battery. sensor voltage > limit	Check wiring harness to TEGR-sensor. Exchange TEGR-sensor.
1008	682	412	4	EGR downstream temperature sensor: the voltage of sensor measured by ECU is out of the target range.	Short circuit to ground or open load. sensor voltage < limit	Check wiring harness to TEGR-sensor. Exchange TEGR-sensor.
376	281	630	12	Internal hardware monitoring: the ECU finds an error during the access to its EEPROM memory or works with an alternative value	Section could not be erased	Threshold for error detection is an internal ECU threshold. There is no healing possible for the error. In the every new initialization phase, the debounce level is set to zero. If not programmed, EEPROM is defect --> ECU is defect, reprogramm ECU and if necessary replace it.
377	281	630	12	Internal hardware monitoring: the ECU finds an error during the access to its EEPROM memory or works with an alternative value	Minimum 3 blocks could not be readed, EEPROM has Checksum Error	There is no healing possible for the error. In the every new initialization phase, the debounce level is set to zero. If not programmed, EEPROM is defect -->ECU is defect, reprogramm ECU and if necessary replace it
378	281	630	12	Internal hardware monitoring: the ECU finds an error during the access to it's EEPROM memory or works with an alternative value	Block could not be written for minimum 3 times	Threshold for error detection is an internal ECU threshold. If not programmed, EEPROM is defect --> ECU is defect, reprogramm ECU and if necessary replace it.
84	271	639	14	CAN bus 0: the ECU is not allowed to send messages, because the status "BusOff" is detected.	CAN BusOff error; CAN 0 (Customer CAN)	Threshold for error detection is an internal ECU threshold. BusOff bit for CAN A node is set. Check wiring of CAN bus and if necessary repair it, check connection cable and if necessary repair or replace it, check resistance in CAN lines (120 Ohm)
580	154	651	3	Injector cyl. 1: the current drop measured by ECU is above the target range	Suspected Components: injector cylinder 1 wiring harness, cable break or short circuit, sensor defective, connection cable damaged	Threshold for error detection is an internal ECU threshold. Check wiring harness, injectors and if necessary repair/replace it. Use SerDia Injector test for diagnosis.

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
568	154	651	5	Injector cyl. 1: interruption of electrical connection	Interruption of electronic connection Injector cyl. 1	Threshold for error detection is an internal ECU threshold. Check wiring harness, injectors and if necessary repair/replace it.
581	155	652	3	Injector cyl. 2: the current drop measured by ECU is above the target range	Suspected Components: injector cylinder 2 wiring harness, cable break or short circuit, sensor defective, connection cable damaged	Threshold for error detection is an internal ECU threshold. Check wiring harness, injectors and if necessary repair/replace it. Use SerDia Injector test for diagnosis.
569	155	652	5	Injector cyl. 2: interruption of electrical connection	Interruption of electronic connection Injector cyl. 2	Threshold for error detection is an internal ECU threshold. Check wiring harness, injectors and if necessary repair/replace it.
582	156	653	3	Injector cyl. 3: the current drop measured by ECU is above the target range	Suspected Components: injector cylinder 3 wiring harness, cable break or short circuit, sensor defective, connection cable damaged	Threshold for error detection is an internal ECU threshold. Check wiring harness, injectors and if necessary repair/replace it. Use SerDia Injector test for diagnosis.
570	156	653	5	Injector cyl. 3: interruption of electrical connection	Interruption of electronic connection Injector cyl. 3	Threshold for error detection is an internal ECU threshold. Check wiring harness, injectors and if necessary repair/replace it.
583	161	654	3	Injector cyl. 4: the current drop measured by ECU is above the target range	Suspected Components: injector cylinder 4 wiring harness, cable break or short circuit, sensor defective, connection cable	Threshold for error detection is an internal ECU threshold. Check wiring harness, injectors and if necessary repair/replace it. Use SerDia Injector test for diagnosis.
571	161	654	5	Injector cyl. 4: interruption of electrical connection	Interruption of electronic connection Injector cyl. 4	Threshold for error detection is an internal ECU threshold. Check wiring harness, injectors and if necessary repair/replace it.
584	162	655	3	Injector cyl. 5: the current drop measured by ECU is above the target range	Suspected Components: injector cylinder 5 wiring harness, cable break or short circuit, sensor defective, connection cable	Threshold for error detection is an internal ECU threshold. Check wiring harness, injectors and if necessary repair/replace it. Use SerDia Injector test for diagnosis.
572	162	655	5	Injector cyl. 5: interruption of electrical connection	Interruption of electronic connection Injector cyl. 5	Threshold for error detection is an internal ECU threshold. Check wiring harness, injectors and if necessary repair/replace it.
585	163	656	3	Injector cyl. 6: the current drop measured by ECU is above the target range	Suspected Components: injector cylinder 6 wiring harness, cable break or short circuit, sensor defective, connection cable	Threshold for error detection is an internal ECU threshold. Check wiring harness, injectors and if necessary repair/replace it. Use SerDia Injector test for diagnosis.
573	163	656	5	Injector cyl. 6: interruption of electrical connection	Interruption of electronic connection Injector cyl. 6	Threshold for error detection is an internal ECU threshold. Check wiring harness, injectors and if necessary repair/replace it.

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
543	263	676	11	Cold start aid relay error.	Relay defect or wire harness problem	Threshold for error detection is an internal ECU threshold. check wire harness, replace relay
544	263	676	11	Cold start aid relay open load	Relay or wire harness	Threshold for error detection is an internal threshold. check wire harness, replace relay
956	512	677	3	Start relay (high side power stage): the current drop measured by ECU is above the target range.	Short cut HighSide-output to battery.	Threshold for error detection is an internal ECU threshold. Check cabling and start relay and if necessary replace it, check connection cable and if necessary repair or replace it.
960	512	677	3	Start relay (low side power stage): the current drain measured by ECU is above the target range.	Shortcut LowSide-Output to battery.	Threshold for error detection is an internal ECU threshold. Check cabling and start relay and if necessary replace it, check connection cable and if necessary repair or replace it.
957	512	677	4	Start relay (high side power stage): the current drain measured by ECU is above the target range.	Shortcut HighSide-output to ground.	Threshold for error detection is an internal ECU threshold. Check cabling and start relay and if necessary replace it, check connection cable and if necessary repair or replace it.
961	512	677	4	Start relay (low side power stage): the current drop measured by ECU is above the target range.	Shortcut LowSide-Output to ground.	Threshold for error detection is an internal ECU threshold. Check cabling and start relay and if necessary replace it, check connection cable of terminal 50 and if necessary repair or replace it.
958	512	677	5	Start relay (low side power stage): the current drop measured by ECU is above the target range	Open circuit/disconnection LowSide-Output.	Threshold for error detection is an internal ECU threshold. Check cabling and start relay and if necessary replace it, check connection cable and if necessary repair or replace it.
959	512	677	12	Start relay (low side power stage): the current drop measured by ECU is above the target range.	Temperature over limit.	Threshold for error detection is an internal ECU threshold. Check cabling and start relay and if necessary replace it, check connection cable and if necessary repair or replace it.
928	928	691	8	Supply module heater: PWM time periode out of valid range.	PWM signal for temperature readout from supply module to the control unit is out of range. Supply modul defect, fault in the wiring.	The Time period of the received PWM signal SCR_tiSMPerPwm is within the specified range of150ms to 250ms Supply module check and replace if necessary. Check the wiring.
549	263	729	3	wiring to the intake air heater device is faulty.	Intake Air Heater Device: overload, short-circuit	Threshold for error detection is an internal ECU threshold. Electrical error, Check wiring to the intake air heater device.

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
551	263	729	4	wiring to the air intake heater is faulty	Relay (for cold start aid) cable break or short to ground:	Threshold for error detection is an internal ECU threshold. Electrical error, check wiring to the air intake heater.
545	263	729	5	The cold start aid relay is according to wiring faulty.	Relay defect or wire harness problem	Threshold for error detection is an internal ECU threshold. Electrical error, check wires
547	263	729	12	The cold start aid relay is overheated, which causes this error	High temperature around the cold start relay.	Check the functionality of relay and replace it if needed. Check the temperature around the cold start relay during worst case operation.
305	118	898	9	Timeout Error of CAN-Receive-Frame TSC1TE - active	Timeout Error (Missing CAN Bus message)	Check CAN Bus cabling (Bus sheduling, polarity, short circuit, power interrupt), test protocol of receiver, check CAN functional range.
946	282	1079	13	Internal hardware monitoring: the ECU detects a deviation of the target range of the power supply voltage of sensor output 1.	Suspected components EDC17cv52 Pin A19: DEF press / Exh.PressBeforeTurb (P3) / Air Pump Press /BrnFuelPressAfterDV2 Pin K19: Fan Speed Sensor Pin A21: LDF6T / OilPress / LowFuelPress Pin A17: Rail Pressure Sensor Suspected components EDC17cv54 Pin A21: CAM speed Pin K44: Delta Press Venturi / Poti EGR or Inlet Throttle Pin A24: LDF6T / OilPress / LowFuelPressPin K43: Reserve 5V Sensor Supply Pin A09: second footpedal Suspected components EDC17cv56 Pin A21: Cam speed Pin K44: DEF press / Air FilterDiffPress Pin A24: LDF6T / OilPress / LowFuelPress Pin K43: second footpedal Pin A09: Delta Press Venturi	Check cabling of external components, check working voltage and if necessary correct it, check connection cable and if necessary repair or replace it, if error is not removable, change ECU.
947	282	1080	13	Internal hardware monitoring: the ECU detects a deviation of the target range of the power supply voltage of sensor output 2.	Suspected components EDC17cv52 Pin K16: second footpedal Pin A20: Exh.PressAfterTurb/DPFDiffPress/ BrnDV1Press/HClPressDV1DV2 Suspected components EDC17cv54 Pin K45: DPF Diff Press / Exh. Press After Turb / Fan Speed Sensor Pin A46: first footpedal Suspected components EDC17cv56 Pin A22: Fan Speed Sensor Pin K45: Position EGR or Intake throttle flap Pin K46: First footpedal	Check cabling of external components, check working voltage and if necessary correct it, check connection cable and if necessary repair or replace it, if error is not removable, change ECU.
121	341	1109	2	Request of engine shut off: the operator ignores the engine shut off request within an allowed period.	Engine Shut Off demand has been ignored by the user	Depending on error requested a shut off.
1398	681	1136	0	ECU internal temperature; temperature measured by ECU is out of the target range	Short-Circuit in ECU, ECU heated by hot air	Close warm air circuits, replace ECU

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
85	271	1231	14	CAN bus 1: the ECU is not allowed to send messages, because the status "BusOff" is detected Warning, no diagnostic with SERDIA2010 possible	CAN BusOff error; CAN 1 (Diagnostic CAN)	Threshold for error detection is an internal ECU threshold. BusOff bit for CAN B node is set. Check wiring of CAN bus and if necessary repair it, check connection cable and if necessary repair or replace it, check resistance in CAN lines (120 Ohm)
86	271	1235	14	CAN bus 2: the ECU is not allowed to send messages, because the status "BusOff" is detected. Warning, depends on engine, EAT.	CAN BusOff error; CAN 2 (Engine CAN)	Threshold for error detection is an internal ECU threshold. BusOff bit for CAN C node is set. Check wiring of CAN bus and if necessary repair it, check connection cable and if necessary repair or replace it, check resistance in CAN lines (120 Ohm)
747	145	1237	2	Override switch switch: the ECU receives a permanent signal.	Switch is blocked, taster locked, connection cable damaged plausbility error "override switch > 250ms pressed".	If the Block Button is pressed shorter than the Maximum Plausible pressing Time. Check cabling, if sensor is not working, check switch and if necessary replace it, check connection cable and if necessary repair or replace it.
1593	129	1761	0	The urea tank level sensor detects a value higher than the maximum allowed thresh-old	Suspected components: Urea Quality Sensor defect mechanical defect at the float gauge	Check level sensor and float gauge
1594	129	1761	1	The DEF tank level sensor detects a value lower than the minimum allowed threshold	Suspected components: Urea Quality Sensor defect mechanical defect at the float gauge	Check level sensor and float gauge
1655	138	1761	14	The urea tank volume ratio is below the threshold of <5%	actual urea tank level SCRUTnk_rVol_mp [%] is below applicable threshold 5%	Check urea level => if empty, then fill in urea Check DEF level sensor. If there is urea in the tank, then move the floater of the level sensor. The floater must be free. If you lift the sensor body, then SCRUTnk_rVol_mp must change. Exchange DEF level sensor, if no change of value or it's implausible.
1656	138	1761	14	The urea tank volume ratio is below the threshold of <2.5%	actual urea tank level SCRUTnk_rVol_mp [%] is below 2.5%	Check urea level => if empty, then fill in urea Check DEF level sensor. If there is urea in the tank, then move the floater of the level sensor. The floater must be free. If you lift the sensor body, then SCRUTnk_rVol_mp must change. Exchange DEF level sensor, if no change of value or it's implausible.

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
1880	138	1761	14	The DEF tank level is below the threshold.	actual DEF tank level SCRUTnk_rVol_mp [%] is below the threshold	Check DEF level => if empty, refill Check DEF level sensor. If there is urea in the tank loose the sensor and move it. The floater must be free and move if you lift the sensor body. SCRUTnk_rVol_mp must change. Compare SCRUTnk_rVol_mp to: 1 = SCR_rawUTnkLvl 2 = SCR_rAdapUtnkLvl 3 = SCRUTnk_rActTnkVol *SCRUTnk_facVolPer_mp In case of malfunction, exchange DEF level sensor.
1763	415	2791	0	Internal actuator temperature is above threshold.	Overheating of EGR actuator during operation.	Let EGR actuator cool down and check heat accumulation during worst case operation.
1753	415	2791	2	corrupted CAN communication with actuator.	CAN bus error or faulty EGR actuator.	Threshold for error detection is an internal ECU threshold. Check other CAN bus components. If no message is sent, fix the wiring. If o.k. exchange EGR actuaror.
1758	415	2791	3	Overvoltage at EGR actuator.	High voltage from the battery	Check battery voltage.
1759	415	2791	4	Undervoltage at EGR actuator.	Low voltage from the battery.	Check battery voltage.
1757	415	2791	6	Overcurrent to EGR actuator.	High voltage from battery. EGR actuator is blocked or moving very hard.	Check battery voltage. Check if EGR is blocked or not running smoothly. If everything is o.k. change EGR actuator.
1752	415	2791	7	EGR actuator is mechanically blocked.	EGR actuator faulty or blocked.	Threshold for error detection is an internal ECU threshold. Check the EGR actuator and EGR valve to mechanical blockage / clean. Check for free movement of the valve. If it'S blocked, then exchange the EGR valve.
1761	415	2791	7	EGR actuator spring broken.	mechanical damage of spring due to overstress.	Threshold for error detection is an internal ECU threshold. Exchange EGR actuator.
1755	415	2791	12	Internal electrical fault of EGR actuator.	Internal damage of EGR actuator due to high temperature or electrical wiring issue.	Threshold for error detection is an internal ECU threshold. Exchange EGR actuator.
1754	415	2791	13	EGR actuator can not learn stop positions. Possibly only second failure if other EGRTV failures occure.	Error detection during the learning process.	Threshold for error detection is an internal ECU threshold. Start Serdia Usecase to reset EGR actuator. Check EGR valve and mounting situation. If o.k. change EGR actuator.
1756	415	2791	13	EGR actuator can not learn stop positions because procedure was interrupted.	Interruption of learning process due to mechanical damage.	Threshold for error detection is an internal ECU threshold. Start Serdia Usecase to reset EGR actuator.
1760	415	2791	13	Stop positions of EGR valve not o.k.	Mechanical damage of EGR actuator. EGR valve is blocked or moving very hard.	Threshold for error detection is an internal ECU threshold. Start Serdia Usecase to reset EGR actuator.
1762	415	2791	16	Internal actuator temperature above threshold.	overheating of EGR actuator	Let EGR actuator cool down, check heat accumulation during worst case operation.

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
1337	565	2797	4	Injector diagnosis: Timeout of Injetor detection cylinder bank 0	Short-Circuit to ground on component wiring	Threshold for error detection is an internal ECU threshold. Check wiring, component, ECU Note: affected injector has to be evaluated according to firing order
1339	565	2797	4	Injector test: Short cut to ground on cylinder bank 0	Short-Circuit to ground on component wiring	Check wiring, component, ECU Note: affected injector has to be evaluated according to firing order
1338	566	2798	4	Injector diagnosis: Timeout of Injetor detection cylinder bank 1	Short-Circuit to ground on component wiring	Threshold for error detection is an internal ECU threshold. Check wiring, component, ECU Note: affected injector has to be evaluated according to firing order
1340	566	2798	4	Injector test: Short cut to ground on cylinder bank 1	Short-Circuit to ground on component wiring	Check wiring, component, ECU Note: affected injector has to be evaluated according to firing order
1135	669	3031	0	The urea tank temperature sensor detects a value above the maximum allowed threshold	Sensed urea tank temperature > physical range high limit	Case "CANBUS sensor": Check urea tank temperature: really hot? Check CANBus-message of DEF sensor urea tank temperature Com_dRxSCR2Byt2 Compare it to Com_dRxSCR1Byt1 (urea temperature at quality sensor) identical? Tank heater permantly on? Check wiring of DEF-quality sensor Case "analog DEF T & Level sensor": Check urea tank temperature: really hot? Check urea tank temperature SCR_tSensUTnkT Compare urea tank temperature to EnvT_t or to SCR_tSMT (the urea temperature inside the supply module) identical? Tank heater permantly on? Check wiring of analog DEF T & Level sensor
1136	669	3031	1	The urea tank temperature sensor detects a value lower than the minimum allowed threshold.	sensed urea tank temperature < physical range low limit	Case "CANBUS sensor": Check ambient temperature EnvT_t => About -40 °C? If yes Error could be plausible Check CANBus-message of DEF sensor urea tank temperature Com_dRxSCR2Byt2 Compare it to Com_dRxSCR1Byt1 (urea temperature at quality sensor) identical? Check wiring of DEF-quality sensor Check quality sensor Case "analog DEF T & Level sensor": Check urea tank temperature: really that cold? Check ambient temperature EnvT_t => About -40 °C? If yes Error could be plausible Check urea tank temperature SCR_tSensUTnkT Check wiring of analog DEF T & Level sensor Check analog DEF T & Level sensor
129	596	3224	2	DLC Error of CAN-Receive-Frame AT1IG1Vol NOX Sensor (SCR-system upstream cat; DPF-system downstream cat); length of frame incorrect	Not Used	Threshold for error detection is an internal ECU threshold. Check Nox-Sensor and the wiring from CAN-BUS.

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
130	597	3224	9	Timeout Error of CAN-Receive-Frame AT1IG1Vol; NOX sensor (SCR-system upstream cat; DPF-system downstream cat)	Failure of the CAN Bus message	NOX sensor and sensor connection check
138	114	3234	2	DLC Error of CAN-Receive-Frame AT1O1Vol NOX Sensor (SCR-system downstream cat; DPF-system downstream cat); length of frame incorrect	Failure of the CAN Bus message	NOX downstream sensor and sensor connection check
139	117	3234	9	Timeout Error of CAN-Receive-Frame AT1OG1Vol; NOX sensor (SCR-system downstream cat; DPF-system downstream cat)	Failure of the CAN Bus message	NOX downstream sensor and sensor connection check
1077	677	3361	3	Urea dosing valve (low side power stage): the current drain measured by ECU is above the target range	Fault in the wiring	Threshold for error detection is an internal ECU threshold See substitute function Check the wiring
1078	677	3361	3	Urea dosing valve (high side power stage): the current drain measured by ECU is above the target range	Fault in the wiring	Threshold for error detection is an internal ECU threshold Check the wiring
1079	677	3361	4	Urea dosing valve (low side power stage): the current drain measured by ECU is above the target range	Fault in the wiring	Check the wiring
1080	677	3361	4	Urea dosing valve (high side power stage): the current drain measured by ECU is above the target range	Fault in the wiring	Threshold for error detection is an internal ECU threshold Check the wiring
1075	677	3361	6	Urea dosing valve: the current measured value by ECU at the end of the injection is too high	Fault in the wiriing Defect urea dosing injection valve	Check wiring Check the urea dosing injection valve
1898	277	3519	3	The integrated diagnostic of the temperature sensor of the Urea Quality Sensor recognized a short circuit to battery. The UQS Sensor is an combined sensor of tank temperature, filling grade and DEF quality and it is also an CAN sensor --> no PIN	Wrong diagnostic of the short circuits logic inside the temperature sensor of the UQS CAN Communication corrupted	Check the wiring to the suction unit in the DEF tank. Check the CAN bus communication of the suction unit. In case the communication is corrupt, exchange the suction unit.
1899	277	3519	4	The integrated diagnostic of the temperature sensor of the Urea Quality Sensor recognized a short circuit to ground	DEF quality sensor in the suction unit of the DEF tank is defect CAN Communication corrupted	Check the wiring to the suction unit of the DEF tank. Check the CAN bus communication from the suction unit. In case the signal is corrupt, exchange the suction unit in the DEF tank.

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
1895	277	3519	12	The integrated temperature sensor of the Urea Quality Sensor measures higher temperature than threshold	Temperature sensor inside the UQS defect. CAN Communication corrupted. Overheating of the DEF tank due to malfunction of the heating valve. Flow direction is of coolant is wrong due to mixed up the hoses routed to the heating valve. Overheating of the DEF tank due to heat transfer from neighbor parts.	Check the temperature sensor signal for plausibility. In case of improper signal, exchange the suction unit in the tank. Check CAN bus communication for proper signal. In case of improper signal, exchange the suction unit in the tank. Check the function of heating valve and routing of the hoses. The coolant flow through the heating valve must be observed according to the shown arrow. In case all actions above are OK, check the real temperature in the DEF tank during worst case condition and improve the installation of the DEF tank.
1908	277	3519	13	Temperature at UQS out of range the specified thresholds; invalid quality of the temperature	Suspected Components Tank heater DEF sensor	Check temperature system and/or DEF quality sensor
1904	2-7-8	3520	2	Measured DEF Quality from UQS is too low. Quality value received from UQS is < 22 % for a certain time and a certain number or for measuring conditions not observed for a certain time.	Suspected components: Urea quality sensor defect Wrong installation (measuring air) Urea level sensor defect Non urea filled in tank CANBUS problems Evaluation conditions for new quality check not fulfilled after one previous mal detection	Check that there is liquid urea of known quality in the tank first Check urea tank level. Add urea until level is at least 10 cm above sensor. Ensure that urea is not frozen / sufficient urea is liquid Check Sensor: Are urea tank temperature and level displayed? Changes the level if you refill urea? Check electrical connection Check CANBus New quality detection is carried out if urea refill is detected or if an quality evaluation was triggered and was not finished successfully: To provoke a quality measurement: refill urea, at least 10 % of tank volume Wait until quality evaluation was carried out, can take up to 30 minutes => check value. It should be about 33 % Exchange quality sensor
1896	278	3520	3	The integrated diagnostic of the Urea Quality Sensor recognized a short circuit to battery	wiring harness of UQS corrupted CAN Communication corrupted	Threshold for error detection is an internal ECU threshold. Check the wiring harness from the ECU to the suction unit of the DEF tank Check the CAN bus communication. If the signal is corrupt, then exchange the suction unit.
1897	278	3520	4	The integrated diagnostic of the Urea Quality Sensor recognized a short circuit to ground.	wiring harness to the suction unit in the DEF tank is corrupted CAN Communication corrupted	Threshold for error detection is an internal ECU threshold. Check the wiring to the suction unit in the DEF tank. Check the CAN bus communication. In case the communication is corrupt, exchange the suction unit in the DEF tank.

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
1907	278	3520	13	Urea quality at UQS out of range the specified thresholds; invalid quality of the urea qualiy	Suspected components DEF quality sensor DEF	Check DEF quality and/or DEF quality sensor
1911	127	3532	3	The urea quality value from the sensor is greater than the maximum physical range threshold Comment: tank temperature is measured by the UQS sensor	Suspected Components: UQS defect	Check DEF quality and/or sensor.
1912	127	3532	4	The urea quality value from the sensor is lower than the minimum physical range threshold.	Suspected Components: UQS defect	Check DEF quality and/or Sensor.
1455	711	3711	12	Temperature Phy_tPfWgh, the weighted DPF temperature < Threshold 1 Temperature Phy_tPfWgh, the weighted DPF temperature > Threshold 2 towards the end of the stand-still main phase.	temperature Phy_tPfWgh, the weighted DPF temperature, is below or above the target temperature towards the end of the stand-still main phase.	Check temperature upstream DOC Exh_tSensOxiCatUs within Stand-still: > 450 °C? If not: => Check air path of engine: EGR-Valve, Intake-Throttle, Turbocharger and Piping each for leakage and correct function Check temperature difference across DOC by Exh_tSensOxiCatDs - Exh_tSensOxiCatUs within Stand-still: < 100°C? If not: Check exhaust pipe downstream turbo charger for oil? check injectors: is an injector got stuck? Too many hydrocarbons in exhaust? White smoke (at hot EAT system, not at cold start)? Check air path of engine: EGR-Valve, Intake-Throttle, Turbocharger and Piping each for leakage and correct function Check exhaust gas temperature sensors within EAT-system: T upstream DOCC, T downstream DOC & T upstream SCR catalyst all three of them can influence Phy_tPfWgh
1917	2-8-6	3936	14	Standstill escalation by time. In case the standstill request will not be released within 50 h by the driver this fault code will be set.	Stand-still request ignored by the operator. Display / stand-still request lamp broken.	Perform Stand-still. If soot load level of DPF has increased too high already call service to perform stand-still. In case the DPF soot load level remove DPF => Exchange DPF.
1122	665	4334	0	The absolute pressure value of the urea pump is greater than an applicable maximal filtered pressure threshold	Suspected Components: Urea pump defect Supply module pressure sensor defect Pump contains dirty parts	Check the urea pump Check the supply module pressure sensor Clean the urea pump (filter)
1123	665	4334	1	Urea supply module pressure sensor: The absolute pressure value of the urea pump is less than an applicable minimal filtered pressure threshold	Check the urea pump Check the supply module pressure sensor Clean the urea pump (filter)	Check the urea pump Check the supply module pressure sensor Clean the urea pump (filter)

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
1866	665	4334	2	absolute difference of sensed urea pump pressure (SCR_pAbsSensUPmpP) and ambient pressure (EnvP_p) > limit abs(UPmpP_pDiffPmpEnv_mp) > UPmpP_pDiffPmpEnv_C (250 hPa)	absolute difference of sensed urea pump pressure (SCR_pAbsSensUPmpP) and ambient pressure (EnvP_p) > limit abs(UPmpP_pDiffPmpEnv_mp) > UPmpP_pDiffPmpEnv_C	Check environment pressure sensor (EnvP_p) => plausible value? Engine shut-off and immediately re-started? => Shut-off again. Wait until afterun of ECU has finished, re-Start engine Back-flow line free? Does the urea pump pressure show values < 1000 hPa in SCR state emptying (64)? Check revision valve => Does the urea pump pressure show values < 1000 hPa in SCR state emptying (64)? => exchange supply module Supply module pressure sensor defect => exchange supply module
1104	675	4341	3	Urea heater supply line: the current drain measured by ECU is above the target range	electrical error	Threshold for error detection is an internal ECU threshold Check wire harness Check supply line
1105	675	4341	4	Urea heater supply line: the current drain measured by ECU is above the target range	electrical error	Threshold for error detection is an internal ECU threshold Check wire harness Check supply line
1102	675	4341	5	Urea heater supply line: the current drain measured by ECU is above the target range	electrical error	Threshold for error detection is an internal ECU threshold Check wire harness Check supply line
1096	673	4343	3	Urea pressure line heater: the current drain measured by ECU is above the target range	shortcut to battery If this error detected during the heating phase is a result error: KWP 1089 broken heating element in pressure line	Threshold for error detection is an internal ECU threshold Check wiring Check heating element
1097	673	4343	4	Urea pressure line heater: the current drain measured by ECU is above the target range	Shortcut to ground If this error detected during the heating phase is a result error: KWP 1089 Short cut to ground or broken wiring, broken heating element in pressure line	Threshold for error detection is an internal ECU threshold Check wiring Check heating element
1094	673	4343	5	Urea pressure line heater: the current drain measured by ECU is above the target range	Open load If this error detected during the heating phase is a result error: KWP 1089 Broken wiring, broken heating element in pressure line	Threshold for error detection is an internal ECU threshold Check wiring Check heating element
1092	674	4345	3	Urea backflow line heater: the current drain measured by ECU is above the target range	Shortcut to battery If this error detected during the heating phase is a result error: KWP 1089 Short cut to battery or broken wiring, broken heating element in backflow line	Threshold for error detection is an internal ECU threshold Check wiring Check heating element
1093	674	4345	4	Urea backflow line heater: the current drain measured by ECU is above the target range	Shortcut to ground If this error detected during the heating phase is a result error: KWP 1089 Short cut to ground or broken wiring, broken heating element in backflow line	Threshold for error detection is an internal ECU threshold Check wiring Check heating element

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
1090	674	4345	5	Urea backflow line heater: the current drain measured by ECU is above the target range	Open load If this error detected during the heating phase is a result error: KWP 1089 Broken wiring, broken heating element in back-flow line	Threshold for error detection is an internal ECU threshold Check wiring Check heating element
1069	668	4360	0	The filtered urea cat upstream temperature is greater than an applicable maximum temperature threshold	Sensed temperature upstream SCR > physical high limit	Check temperature difference across DOC (Exh_tOxiCatDs-Exh_TOxiCatUs) at higher engine load => high difference > 100 K? If yes, the engine emitts too many Hydrocarbons => check injectors: is an injector got stuck? => Check EGR Valve If difference normal the exhaust out of the engie itself is too hot: => Check air path of engine: EGR-Valve, Intake-Throttle, Turbocharger and Piping each for leakage and correct function If that error was set while stand-still operation the error source could be exothermal soot burn off in DPF (which should not happen) => Dismount DPF and check it visually exchange temperature sensor upstream SCR
1070	668	4360	1	The filtered temperature before urea cat is less than an applicable minimum temperature threshold	Sensed temperature upstream SCR catalyst < than physical low limit	Cold start and ambient temperature < Threshold? Missdetection? Check wiring harness to UCatUsT-sensor Exchange UCatUsT-sensor
1865	668	4360	2	Error at static plausibility check: absolut temperature difference of sensed temperature upstream SCR catalyst and ambient temperature > as static plausibility limit at engine cold start (engine was off for at least 8 h), temperature upstream of SCR catalyst is expected to be identical to ambient temperature => see enable conditions for details. Error at dynamic plausibility check: temperature difference of sensed temperature upstream SCR catalyst and ambient temperature < as dynamic plausibility limit dynamic check is blocked if static plausibility check is already faulty => Temperature upstream SCR catalyst must be by 40°C higher than ambient temperature if engine runs and a certain delay time has expired.	Error at static plausibility check: absolut temperature difference of sensed temperature upstream SCR catalyst and ambient temperature > as static plausibility limit at engine cold start (engine was off for at least 8 h), temperature upstream of SCR catalyst is expected to be identical to ambient temperature => see enable conditions for details. Error at dynamic plausibility check: temperature difference of sensed temperature upstream SCR catalyst and ambient temperature < as dynamic plausibility limit dynamic check is blocked if static plausibility check is already faulty => Temperature upstream SCR catalyst must be by 40°C higher than ambient temperature if engine runs and a certain delay time has expired.	Check whether temperature sensor upstream of SCR catalyst is physically mounted within exhaust pipe If cold start condition can be made sure (engine was off for at least 8 h) compare values of EnvT_t, EngDa_tEng, Exh_TOxiCatUs, Exh_tOxiCatDs and SCR_tSensUCatUsT at ignition on, without starting the engine. All identical? Compare values of Exh_TOxiCatUs, Exh_tOxiCatDs and SCR_tSensUCatUsT after 15 min in constant operation point: show all similar values (30 K tolerance width). Are ambient temperature and (EnvT_t), cooling water temperature (EngDa_tEng) plausible? Sensor coated with urea crystalls? Dismount urea injector and inspect temperature sensor upstream SCR catalyst visually Check wiring of sensor Replace sensor
1072	668	4361	3	Urea catalyst upstream temperature sensor: the voltage of sensor measured by ECU is out of the target range	Voltage of temperature sensor upstream SCR catalyst > maximum limit Short circuit to battery	Check sensor Check wiring Replace UCatUsT-sensor
1073	668	4361	4	Urea catalyst upstream temperature sensor: the voltage of sensor measured by ECU is out of the target range	Voltage of temperature sensor upstream SCR catalyst < minimum limit Short circuit to ground	Check sensor Check wiring Replace UCatUsT-sensor

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
1137	6-6-9	4365	2	Signal error in case of Urea tank temperature trnasmitted via CAN-signal Com_tUTnkT.	CAN message is not send properly.	Check sensor connector Check CANbus
1138	6-6-9	4365	3	Urea tank temperature sensor: he current drain measured by ECU is above the target range.	Shortcut or open load.	Threshold for error detection is an internal ECU threshold. The Sensed raw voltage value SCR_uRawUTnkT is below SCR_SRCUTnkT.uMax_C. Check wiring.
1914	669	4365	3	Internal error of DEF qualitysensor.	Suspected componentes: DEF qualitysensor Wiring harness	Check wiring harness and DEF qualitysensor
1139	6-6-9	4365	4	Urea tank temperature sensor: he current drain measured by ECU is above the target range.	Shortcut or open load.	Threshold for error detection is an internal ECU threshold. The sensed raw voltage value SCR_uRawUTnkT is above SCR_SRCUTnkT.uMin_C. Check wiring.
1915	6-6-9	4365	4	Internal error of DEF qualitysensor.	Suspected componentes: DEF qualitysensor Wiring harness	Check wiring harness and DEF qualitysensor
1112	671	4366	3	Urea tank heating valve: the current drain measured by ECU is above the target range	Shortcut to battery If this error detected during the heating phase is a result error: KWP 1089 Broken wiring Urea tank heating valve defect	Threshold for error detection is an internal ECU threshold Check wiring Check urea tank heating valve
1113	671	4366	4	Urea tank heating valve: the current drain measured by ECU is above the target range	Shortcut to ground If this error detected during the heating phase is a result error: KWP 1089 Broken wiring Urea tank heating valve defect	Threshold for error detection is an internal ECU threshold Check wiring Check urea tank heating valve
1110	671	4366	5	Urea tank heating valve: the current drain measured by ECU is above the target range	Open load If this error detected during the heating phase is a result error: KWP 1089 Broken wiring Urea tank heating valve defect	Threshold for error detection is an internal ECU threshold Check wiring Check urea tank heating valve
1120	666	4375	3	Urea supply module pump: the current drain measured by ECU is above the target range	Shortcut to battery If this error detected during the heating phase is a result error: KWP 1089 Broken wiring Pump in urea supply module defect	Threshold for error detection is an internal ECU threshold The hardware detects absence of any short circuit to battery on the PWM output power stage for the urea pump module actuator Check wiring Check pump in the urea supply module
1121	666	4375	4	Urea supply module pump: the current drain measured by ECU is above the target range	Shortcut to ground If this error detected during the heating phase is a result error: KWP 1089 Broken wiring Pump in urea supply module defect	Threshold for error detection is an internal ECU threshold The hardware detects a short circuit to ground error on the PWM output power stage for the UreaPump Module Motor Actuator. The error is updated by setting bit 1 of measuring point UPmp-Mot_stPrevTstRslt_mp Check wiring Check pump in the urea supply module

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
1118	666	4375	5	Urea supply module pump: the ECU can not measure any reaction during pump control	Open load Broken wiring Pump in urea supply module defect	Threshold for error detection is an internal ECU threshold The hardware detects the presence of load on the PWM output power stage for the urea pump module actuator. Check wiring Check pump in the urea supply module
1131	667	4376	3	Urea supply module reversal valve: the current drain measured by ECU is above the target range	Shortcut to battery Fault in the wiring Reversal valve in the urea supply module defect	Threshold for error detection is an internal ECU threshold Check wiring Check urea supply modul
1132	667	4376	4	Urea supply module reversal valve: the current drain measured by ECU is above the target range	Shortcut to ground Fault in the wiring Reversal valve in the urea supply module defect	Threshold for error detection is an internal ECU threshold Check wiring Check urea supply modul
1129	667	4376	5	Urea supply module reversal valve: the current drain measured by ECU is above the target range	Open load Fault in the wiring Reversal valve in the urea supply module defect	Threshold for error detection is an internal ECU threshold Check wiring Check urea supply modul
1039	683	4765	0	The exhaust temperature value from the sensor befor DOC is above an applicable upper shutoff threshold TOxiCatUs_tShOffThresHiAds_C = Threshold 1 in Normal and Heatmodes (TOxiCatUs_tShOffThresHiRgn_C = Threshold 2 in stand-still)	sensed temperature upstream DOC > shut-off limit	Check air path of engine: EGR-Valve, Intake-Throttle, Check Turbocharger and Piping each for leakage and correct function Check injectors: is an injector got stuck? Exchange temperature sensor upstream DOC
1040	683	4765	0	The exhaust temperature value from the sensor befor DOC is above an applicable upper warning threshold TOxiCatUs_tWarnThresHi_C = Threshold	Sensed temperature upstream DOC > warning limit	Check air path of engine: EGR-Valve, Intake-Throttle, Turbocharger and Piping each for leakage and correct function Check injectors: is an injector got stuck? Exchange temperature sensor upstream DOC

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
1036	683	4768	2	Static plausibility check: The exhaust temperature value from the sensor before DOC, the exhaust temperature value from the sensor after DOC, the temperature value from the sensor before SCR-Cat, the environment temperature and the coolant engine temperature their ratios to each other exceed their related thresholds. Dynamic plausibility check with environment temperature sensor value: The exhaust temperature value from the sensor before DOC is lower than an applicable environment temperature threshold	Static plausibility check: The exhaust temperature value from the sensor before DOC, the exhaust temperature value from the sensor after DOC, the temperature value from the sensor before SCR-Cat, the environment temperature and the coolant engine temperature their ratios to each other exceed their related thresholds. (difference between temperature after DOC and temperature before DOC > Threshold 1 difference between temperature befor DOC and before SCR > Threshold 2 difference between temperature after DOC and before SCR < Threshold 3 difference between temperature after DOC and ambinet temperature < Threshold 4 differnece between temperatur ambient temperature and engine temperature < Threshold 5) Dynamic plausibility check with environment temperature sensor value: The exhaust temperature value from the sensor before DOC is lower than an applicable environment temperature threshold (< environmental temperature + Threshold 6)	Check ambient temperature => value plausible? upstream DOC sensor mounted within exhaust line? T upstream DOC sensor physically mounted in correct position upstream DOC? (not upstream SCR or downstream DOC?) Check T upstream DOC sensor Check other T-sensors within EAT-system (Exh_tOxiCatDs & UCatUsT_tFlt_mp show plausible values? No errors on them?
1881	683	4768	2	At engine cold start conditions the sensed exhaust gas temperature downstream DOC (Exh_tSensTOxiCatDs) has exceeded the sum of ambient temperature (EnvT_t) + offset (40°C) earlier than the sensed exhaust gas temperature upstream of DOC (Exh_tSensTOxiCatUs). The check is only performed once each ignition cycle and only if the start is judged a cold start. Error status is frozen for that ignition cycle. No healing possible.	Difference temperature of exhaust gas temperature downstream DOC and fixed ambient temperature at ignition on exceeds a certain limit earlier than the difference temperature of exhaust gas temperature upstream DOC and fixed ambient temperature at ignition on.	Check whether all exhaust gas temperature sensors within the EAT system are mounted properly: Within the exhaust line and at correct positions. Check the position of the sensor upstream SCR which might be physically mounted in the wrong position. If cold start condition can be made sure (engine was off for at least 8 h) compare values of EnvT_t, EngDa_tEng, Exh_TOxiCatUs, Exh_tOxiCatDs and SCR_tSensUCatUsT at ignition on, without starting the engine. All identical? Then the sensors itself are okay. Check exhaust piping for leakage. Check wiring of sensors Replace sensors Check DOC => physicallly intact?
1044	683	4768	3	Oxidation catalyst upstream temperature sensor: the voltage of sensor measured by ECU is out of the target range	The sensed raw voltage value Exh_uRawTOxiCatUs is above Exh_SRCTOxiCatUs.uMax_C Shortcut to battery	Check wiring harness to temperature sensor upstream DOC Exchange temperature sensor upstream DOC
1045	683	4768	4	Oxidation catalyst upstream temperature sensor: the voltage of sensor measured by ECU is out of the target range	The sensed raw voltage value Exh_uRawTOxiCatUs is below Exh_SRCTOxiCatUs.uMin_C Shortcut to ground	Check wiring harness to temperature sensor upstream DOC Exchange temperature sensor upstream DOC

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
1024	594	5763	3	Actuator of the external EGR valve: the ECU detects a short circuit to battery or open load.	Short cut to battery or open loop.	Check cabling, actuator defect, check actuator and if necessary replace it, check connection cable and if necessary repair or replace it.
1226	594	5763	3	Actuator EGR-valve: short cut to battery is detected	Short-Circuit to battery on component wiring	Threshold for error detection is an internal ECU threshold. Check wiring, component, ECU Check repair with SerDia 2010 use case
1227	594	5763	3	Actuator EGR-valve: short cut to battery on ECU pin is detected	Short-Circuit to battery on component wiring	Threshold for error detection is an internal ECU threshold. Check wiring, component, ECU Check repair with SerDia 2010 use case
1025	594	5763	4	Actuator of the external EGR valve: the ECU detects a short circuit to ground.	Short cut to ground	Check cabling, actuator defect, check actuator and if necessary replace it, check connection cable and if necessary repair or replace it.
1228	594	5763	4	Actuator EGR-valve: short cut to ground on ECU pin is detected	Short-Circuit to ground on component wiring	Threshold for error detection is an internal ECU threshold. Check wiring, component, ECU Check repair with SerDia 2010 use case
1229	594	5763	4	Actuator EGR-valve: short cut to battery on ECU pin is detected	Short-Circuit to ground on component	Threshold for error detection is an internal ECU threshold. Check wiring, component, ECU Check repair with SerDia 2010 use case
1232	5-9-4	5763	4	Actuator error EGR-Valve (2.9;3.6) or Throt-tle-Valve (4.1;6.1;7.8); Voltage below threshold 3.6) Drosselklappe (4.1;6.1;7.8); Voltage below threshold;	Monitoring for CY146 Under Voltage.	Threshold for error detection is an internal ECU threshold. Check wiring, component
1023	5-9-4	5763	5	Actuator error EGR-Valve; signal range check low, measured current is below target	Short circuit to ground.	Check wiring, check cabels and repair or replace if necessary, check actuator with SERDIA 2010 test for EGR and if necessary replace it.
1014	594	5763	6	Actuator error EGR-Valve. Signal range check high.	Short cut to batterie.	Check wiring and repair or replace if necessary, check actuator with SERDIA test for EGR and if necessary replace it.
1022	5-9-4	5763	6	Actuator error EGR-Valve; signal range check high, measured current by ECU is over target	Short circuit to battery or open circuit.	Check cabling, actuator defect, check actuator and if necessary replace it, check connection cable and if necessary repair or replace it.
1223	594	5763	6	Actuator EGR-Valve: Open load on ECU out-put is detected	Open circuit on component wiring	Threshold for error detection is an internal ECU threshold. Check wiring, component, ECU Check repair with SerDia 2010 use case
1224	594	5763	6	Actuator EGR-valve: too high curent is going into the actuator. Output is switched off	Overload on component wiring	Threshold for error detection is an internal ECU threshold. Check wiring, component, ECU Check repair with SerDia 2010 use case

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
1230	5-9-4	5763	6	Actuator error EGR-valve; Overload by short-circuit	Short Circuit over Load	Threshold for error detection is an internal ECU threshold. Check wiring, component
1016	594	5763	7	Actuator position for EGR valve is not plausible, internal error, angular misalignement of the flap.	Position error of throttle flap (deviation > 7%).	Threshold for error detection is an internal ECU threshold. Threshold for error detection, deviation from setpoint > 7%. Troubleshooting with SERDIA 2010 Use Case "EGR Diagnostic".
1231	5-9-4	5763	11	Power stage overtemperature due to high current.	Temperature dependent Over Current	Threshold for error detection is an internal ECU threshold. Check wiring, component
1015	594	520521	5	Actuator error EGR-Valve. Signal range check low.	Short cut to ground.	Check wiring and repair or replace if necessary, check actuator with SERDIA test for EGR and if necessary replace it.
825	253	523009	9	The pressure relief valve (PRV) has reached the number of allowed activations.	Rail pressure has exceeded the trigger threshold of the pressure limiting valve.	Replace pressure relief valve (PRV) and reset fault with Serdia.
833	2-5-3	523009	10	The pressure relief valve (PRV) has reached the allowed opening time.	Rail pressure has exceeded the trigger threshold of the pressure limiting valve.	Replace pressure relief valve (PRV) and reset fault with Serdia.
171	3-3-3	523212	9	Timeout Error of CAN-Receive-Frame ComEngPrt; Engine Protection	Timeout Error (Missing CAN Bus message)	Check wiring harness and customer devices
179	527	523240	9	Timeout CAN-message FunModCtl; Function Mode Control	Timeout Error (Missing CAN Bus message)	Check CAN Bus cabling (Bus sheduling, polarity, short circuit, power interrupt), test protocol of receiver, check CAN functional range.
565	151	523350	4	Injector cylinder bank 1: the current drop measured by ECU is above the target range	Short circuit injection bank 1 (all injectors of this bank can be affected)	Threshold for error detection is an internal ECU threshold. Check wiring harness, injectors and if necessary repair/replace it.
566	152	523352	4	Injector cylinder bank 2: the current drop measured by ECU is above the target range	Short circuit injection bank 2 (all injectors of this bank can be affected)	Threshold for error detection is an internal ECU threshold. Check wiring harness, injectors and if necessary repair/replace it.
567	153	523354	12	Internal hardware monitoring: the ECU detects an error of its injector high current output. Chip of CY33x defect power stage components	Defective powerstage in ECU	Threshold for error detection is an internal ECU threshold. If error is not removable, change ECU.
839	1-4-3	523450	4	Diagnostic fault check for min error of COM message.	The sensed raw value is less than the threshold.	Check cabling, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it.
826	146	523470	2	The pressure relief valve (PRV) has been opened due to excessive pressure.	Rail pressure has exceeded the trigger threshold of the pressure limiting valve.	Threshold for error detection is an internal ECU threshold. Reset the fault and at reappearance check injection system.
827	146	523470	2	The pressure relief valve (PRV) has been opened due to excessive pressure.	Rail pressure has exceeded the trigger threshold of the pressure limiting valve.	Threshold for error detection is an internal ECU threshold. Reset the fault and at reappearance check injection system.

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
876	146	523470	7	Rail pressure is out of the expected average range.	Rail pressure is out of the expected average range. PRV can not be opened.	(A) Check railpressure relief valve and replace if necessary. (B) Check high pressure pumps, pressure relief valve and metering unit. (C) Change components if necessary
831	146	523470	11	Rail pressure relief valve can not be opened due to the railpressure.	Railpressure out of tolerance range (PRV can not be opened by a pressure peak in this operating point)	Threshold for error detection is an internal ECU threshold. Check railpressure, check rail pressure sensor for plausibility, check FCU.
832	146	523470	11	Rail pressure is out of the expected average range. The PRV can not be opened at this operating point with a pressure shock.	Averaged rail pressure is outside the expected tolerance range.	Threshold for error detection is an internal ECU threshold. Check PRV and replace if necessary.
828	146	523470	12	Rail pressure relief valve: is open. Shutoff conditions.	Shut Off after PRV Open	Threshold for error detection is an internal ECU threshold. Check PRV opening counter and if necessary replace PRV, check rail-pressure sensor for plausibility and if necessary replace it, check FCU and if necessary replace it.
829	146	523470	12	Rail pressure relief valve is open. Warning conditions.	Warning PRV open	Threshold for error detection is an internal ECU threshold. Check PRV opening counter and if necessary replace PRV, check rail-pressure sensor for plausibility and if necessary replace it, check FCU and if necessary replace it.
830	146	523470	14	Rail pressure relief valve is open. (PRV)	Open PRV	Threshold for error detection is an internal ECU threshold. Only after ECU reset. Check PRV opening counter and if necessary replace it, check rail-pressure sensor for plausibility and if necessary replace it, check FCU and if necessary replace it.
980	515	523550	12	Terminal 50 was operated for more than 2 minutes. This may happen due to short to battery or wrong usage of Terminal 50. Starter control is disabled until this error is healed.	Startinformation to Starter (T50-switch) erratic/defect.	Threshold for error detection is an internal ECU threshold. Check cabling, if sensor not working, check start switch and if necessary replace it, check connection cable and if necessary repair or replace it.
948	282	523601	13	Internal hardware monitoring: the ECU detects a deviation of the target range of the power supply voltage of sensor output 3.	Suspected components EDC17cv52 Pin A18: DeltaPressVenturi / Position intake throttle flap Pin K20: First footpedal Pin K21: Air FilterDiffPress Suspected components EDC17cv54 and cv56 Pin A07: Rail pressure	Check cabling of external components, check working voltage and if necessary correct it, check connection cable and if necessary repair or replace it, if error is not removable, change ECU.
644	555	523612	3	supply voltage too high	not used	Threshold for error detection is an internal ECU threshold.

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
646	555	523612	4	supply voltage too low	not used	Threshold for error detection is an internal ECU threshold.
387	555	523612	12	Internal hardware monitoring: the CPU of the ECU is reset and the cause is logged internally; no item will be created in error memory	Injector shut off demand for the ICO coordinator System responses: not	Threshold for error detection is an internal ECU threshold. Caution ! Sequence error, check error memory for other errors.
612	555	523612	12	Internal hardware monitoring: the CPU of the ECU is reset and the cause is logged internally; no item will be created in error memory.	Plausibility check failed (MoCADC_uNTP_mp is higher than MoCADC_uNTPMax_C).	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
613	555	523612	12	Internal hardware monitoring: the CPU of the ECU is reset and the cause is logged internally; no item will be created in error memory	Analysis of test voltage (Value is out of the target -> ECU internal error)	Threshold for error detection is an internal ECU threshold. Check wiring, check connected sensors actuators. If error is still present, exchange ECU.
614	555	523612	12	Internal hardware monitoring: the CPU of the ECU is reset and the cause is logged internally; no item will be created in error memory	Analysis of the ratiometric correction (Value is out of the target -> ECU internal error)	Threshold for error detection is an internal ECU threshold. Check wiring, check connected sensors actuators. If error is still present, exchange ECU.
615	555	523612	12	Internal hardware monitoring: the CPU of the ECU is reset and the cause is logged internally; no item will be created in error memory	Error report due to an error in the plausbility of Function Coordination(FC) and Monitoring Modul(MM)(ECU internal error)	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
616	555	523612	12	Internal hardware monitoring: the CPU of the ECU is reset and the cause is logged internally; no item will be created in error memory	Error report due to an interrupted SPI communication (ECU internal error)	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
617	555	523612	12	Internal hardware monitoring: the CPU of the ECU is reset and the cause is logged internally; no item will be created in error memory	multiple error in complete ROM-test during postdrive detected (ECU internal error)	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
618	555	523612	12	Internal hardware monitoring: the CPU of the ECU is reset and the cause is logged internally; no item will be created in error memory	Too less bytes received by monitoring memory from CPU as response (ECU internal error). Loss of synchronization sending bytes to the monitoring memory from CPU	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
619	555	523612	12	Internal hardware monitoring: the CPU of the ECU is reset and the cause is logged internally; no item will be created in error memory	Suspected components: Injector ECU wiring harness/connector	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
620	555	523612	12	Internal hardware monitoring: the CPU of the ECU is reset and the cause is logged internally; no item will be created in error memory	Error trying to set MM Response time (ECU internal error)	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
621	555	523612	12	Internal hardware monitoring: the CPU of the ECU is reset and the cause is logged internally; no item will be created in error memory	Error detected in the internal ECU communication, Too many SPI errors during MoCSOP execution	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
623	555	523612	12	Internal hardware monitoring: the CPU of the ECU is reset and the cause is logged internally; no item will be created in error memory	Error in the check of the shut-off path test of the under voltage detection (ECU internal error). Diagnostic fault check to report the error in undervoltage monitoring	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
624	555	523612	12	Internal hardware monitoring: the CPU of the ECU is reset and the cause is logged internally; no item will be created in error memory	Error in the check of the shut-off path of the monitoring module (ECU internal error).	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
625	555	523612	12	Internal hardware monitoring: the CPU of the ECU is reset and the cause is logged internally; no item will be created in error memory	Time out error trying to set or cancelling the alarm task (ECU internal error). Failure setting the alarm task period	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
627	555	523612	12	Internal hardware monitoring: the CPU of the ECU is reset and the cause is logged internally; no item will be created in error memory	Error in time monitoring of the shut-off path test (ECU internal error). Diagnostic fault check to report the timeout in the shut off path test	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
628	555	523612	12	Internal hardware monitoring: the CPU of the ECU is reset and the cause is logged internally; no item will be created in error memory	Error in the check of the shut-off path test of the over voltage detection (ECU internal error). Diagnostic fault check to report the error in overvoltage monitoring	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
629	555	523612	12	The two voltage values (ADC_VAL1, ADC_VAL2), detected by the accelerator pedal, are not plausible to each other.	Defect pedal or wiring	Threshold for error detection is an internal ECU threshold. Check Pedal, repair or exchange the Pedal. Check wiring. If error is still present, exchange ECU.
630	555	523612	12	Impermissible offset between the engine speed of level 2 and level 1	Calculated engine speed in level 1/2 implausible (-> ECU internal error).	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
631	555	523612	12	Diagnostic fault check to report the plausibility error between level 1 energizing time and level 2 information	Implausible injection energizing time for either PiIx or MI1 or PoIx.	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
632	555	523612	12	Error in the plausibility of the start of energising angles	Implausible start of energising of either PiIx or MI1 or PoIx.	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
633	555	523612	12	Error in the plausibility of the energising times of the zero fuel quantity calibration	The energising times of the zero fuel quantity calibration ZFC is out of the target. (-> ECU internal error)	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
634	555	523612	12	Error in the plausibility of PoI2 efficiency.	Error in the plausibility of PoI2 efficiency.	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
635	555	523612	12	Error in the PoI2 shut-off.	Error in the PoI2 shut-off.	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
636	555	523612	12	Error in the plausibility of PoI3 efficiency.	Error in the plausibility of PoI3 efficiency.	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
637	555	523612	12	Engine speed: the engine speed calculated by ECU is above the target range; the ECU activates a system reaction	Error in the plausibility of current energising time with maximum permitted energising time. Diagnostic fault check to report the error due to Over Run	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
638	555	523612	12	Error in the plausibility of the wave correction parts	Error in the plausibility of the wave correction parts	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
639	555	523612	12	Plausibility error of the Rail pressure sensor	In case the gradient of rail pressure is larger than the max threshold or lesser than the min threshold. Rail metering unit defect. Leakge in the Rail System.	Threshold for error detection is an internal ECU threshold. Check metering unit or cable. Check Rail pressure. Check the Rail System of leakage.
640	555	523612	12	Error in the torque comparison between permissible engine torque and current actual torque	Error in the torque comparison between the permissible inner engine torque and the current plausible actual torque.	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
641	555	523612	12	Diagnosis of curr path limitation forced by ECU monitoring level 2	The torque comparison is not plausible with the torque monitoring.	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
642	555	523612	12	Diagnosis of lead path limitation forced by ECU monitoring level 2	The setpoint path of the air system is limited by the limitation torque of the functional control unit monitoring.	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
643	555	523612	12	Diagnosis of set path limitation forced by ECU monitoring level 2.	If the quantity setpoint is exceeds the limit of the torque function.	Threshold for error detection is an internal ECU threshold. If error is still present, exchange ECU.
714	555	523612	12	Error report "WDA wire is active" due to a defect query/response communication	Error detection by monitoring module	Threshold for error detection is an internal ECU threshold. Software reset.
715	555	523612	12	Error report "ABE wire is active" due to undervoltage detection	The reason is that a slow dropping of the vehicle electrical system voltage (defective autobattery) should not lead the ECU OCWDA's diagnose to enter an error in the fault memory due to an undervoltage recognition.	Threshold for error detection is an internal ECU threshold. Software reset.
716	555	523612	12	Error report "ABE wire is active" due to overvoltage detection	If the ABE/WDA powerstage shut-off is active due to an overvoltage detection.	Threshold for error detection is an internal ECU threshold. software reset.
717	555	523612	12	Error report "ABE/WDA active" due to an unknown reason	The reason is that a slow dropping of the vehicle electrical system voltage (defective autobattery) should not lead the ECU OCWDA's diagnose to enter an error in the fault memory due to an undervoltage recognition.	Threshold for error detection is an internal ECU threshold. Software reset.
1170	555	523612	12	Internal hardware monitoring: the CPU of the ECU is reset and the cause is logged internally; no item will be created in error memory	Error during positive test (ECU internal error). Diagnostic fault check to report that the positive test failed	Threshold for error detection is an internal ECU threshold. Reflash ECU. If error is still activ replace ECU.

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
1857	555	523612	12	Fault in the monitoring during the engine start. Start requested in level 1, but not released in level 2 which leads to no fuel injection.	wiring is not according DEUTZ requirements engine start conditions are not observed low battery voltage during start malfunction of starter	Threshold for error detection is an internal ECU threshold. check other active errors and fix them. check all needed engine start conditions, e.g. neutral switch. check the engine speed during starting of the engine. If it's too low, then check the battery voltage and then check the starter for malfunction.
973	555	523612	14	Internal hardware monitoring: the CPU of the ECU is reset and the cause is logged internally; no item will be created in error memory.	Visibility of Softwareresets in DSM	Threshold for error detection is an internal ECU threshold.
974	555	523612	14	Internal hardware monitoring: the CPU of the ECU is reset and the cause is logged internally; no item will be created in error memory.	Visibility of Softwareresets in DSM	Threshold for error detection is an internal ECU threshold.
975	555	523612	14	Internal hardware monitoring: the CPU of the ECU is reset and the cause is logged internally; no item will be created in error memory	Visibility of SoftwareResets in DSM	Threshold for error detection is an internal ECU threshold. If possible the software update has to be done. Replace the ECU.
856	134	523613	0	Rail pressure: the fuel pressure in rail calculated by ECU is below the target range which is dependant on the engine speed.	Pressure governor deviation exceeds the limiting value based on the engine speed.	Threshold for error detection is an internal ECU threshold. (A) Check for leakage (B) Check fuel-primary pressure (C) Change components, check sensor and if necessary replace it, check fuel system and if necessary repair it
857	134	523613	0	Rail pressure: the fuel pressure in rail calculated by ECU is below the target range which is dependant on the engine speed.	maximum positive deviation of rail pressure exceeded concerning set flow of fuel.	Threshold for error detection is an internal ECU threshold. (A) Check for leakage (B) Check fuel-primary pressure (C) Change components, check sensor and if necessary replace it, check fuel system and if necessary repair it
858	134	523613	0	Rail pressure: the fuel pressure in rail calculated by ECU is above the target range which is dependant on the engine speed.	leakage is detected based on fuel quantity balance.	Threshold for error detection is an internal ECU threshold. (A) Check backflow pressure (B) Check Injector function with SerDia (C) Change components (metering unit, injector) if necessary
859	134	523613	0	Rail pressure: the fuel pressure in rail calculated by ECU is above the target range which is dependant on the engine speed.	Maximum negative rail pressure deviation with metering unit on lower limit is exceeded.	Threshold for error detection is an internal ECU threshold. (A) Check backflow pressure (B) Check Injector function with SerDia (C) Change components (metering unit, injector) if necessary
862	134	523613	0	Rail pressure: the fuel pressure in rail calculated by ECU is above the target range.	Rail pressure exceeds the limiting value.	(A) Check backflow pressure (B) Check pressure relief valve and metering unit. (C) Change components if necessary

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
861	134	523613	1	Rail pressure: the fuel pressure in rail calculated by ECU is below the target range which is dependant on the engine speed.	Rail pressure falls below the limiting value based on the engine speed.	Threshold for error detection is an internal ECU threshold. (A) Check backflow pressure (B) Check Injector function with SerDia (C) Change components (metering unit, injector) if necessary
864	134	523613	2	Rail pressure metering unit, Setpoint of metering unit in overrun mode not plausible.	Pressure pump delivery quantity in overrun exceeds the threshold based on the pressure.	Threshold for detection is an internal ECU threshold. (A) Check backflow pressure (B) Check pressure relief valve and metering unit. (C) Change components if necessary
594	135	523615	3	Fuel metering unit: the current drain measured by ECU is above the target range	short circuit to battery high side	Threshold for error detection is an internal ECU threshold. Check wiring harness and metering unit if necessary repair/replace it.
596	135	523615	3	Fuel metering unit: the current drain measured by ECU is above the target range	short circuit to battery low side	Threshold for error detection is an internal ECU threshold. Check wiring harness and metering unit if necessary repair/replace it.
595	135	523615	4	Fuel metering unit: the current drain measured by ECU is above the target range	short circuit to ground high side	Threshold for error detection is an internal ECU threshold. Check wiring harness and metering unit if necessary repair/replace it.
597	135	523615	4	Fuel metering unit: the current drain measured by ECU is above the target range	short circuit to ground low side	Threshold for error detection is an internal ECU threshold. Check wiring harness and metering unit if necessary repair/replace it.
592	135	523615	5	Detecting an open load fault in the metering unit	wiring harness defective, cable break	Threshold for error detection is an internal ECU threshold. Check wiring harness and metering unit if necessary repair/replace it.
593	135	523615	12	powerstage of metering unit is overheated	over temperature	Threshold for error detection is an internal ECU threshold. Check functionality of metering unit and replace it if needed. Check temperature of metering unit and improve the installation in case of overheating.
1127	665	523632	3	Urea supply module pressure sensor: the current drain measured by ECU is above the target range	Shortcut to battery Broken wiring Pressure sensor in urea supply module defect	Check wiring Check pressure sensor in urea supply module
1128	665	523632	4	Urea supply module pressure sensor: the current drain measured by ECU is above the target range The sensed raw voltage value SCR_uRawUPmpP is above SCR_SRCUPmpP.uMin_C	Shortcut to ground Broken wiring Pressure sensor in urea supply module defect	Check wiring Check pressure sensor in urea supply module
1117	666	523632	11	Urea supply module pump: the current drain measured by ECU is above the target range	When the pump motor does not switch to pump actuation mode after temperature measurement has been carried out.	Threshold for error is an internal ECU threshold

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
122	591	523698	11	Shut off request from supervisory monitoring function	Engine Shut Off due to supervisory function	Threshold for error detection is an internal ECU threshold. Check error memory for additional errorcode to find root cause. Depending on additional error follow the documented "Take action for repair".
1100	676	523718	3	Urea heater relay: the current drain measured by ECU is above the target range	Shortcut to battery If this error detected during the heating phase it is a result error: KWP 1089 Broken wiring, broken relay	Threshold for error detection is an internal ECU threshold Check wiring Check SCR main relay
1101	676	523718	4	Urea heater relay: the current drain measured by ECU is above the target range	Shortcut to ground If this error detected during the heating phase it is a result error: KWP 1089 Broken wiring, broken relay	Threshold for error detection is an internal ECU threshold Check wiring Check SCR main relay
1098	676	523718	5	Urea heater relay: the current drain measured by ECU is above the target range	Open load If this error detected during the heating phase it is a result error: KWP 1089 Broken wiring broken relay	Threshold for error detection is an internal ECU threshold Test SCR main relay Check cabling, if necessary replace relay.
1109	672	523719	4	Urea supply module heater: the current drain measured by ECU is above the target range	Shortcut to ground If this error detected during the heating phase it is a result error: KWP 1089 Broken wiring Heating element in supply module defect	Threshold for error detection is an internal ECU threshold Check wiring Check cabling, if necessary replace supply module
1106	672	523719	5	Urea supply module heater: the current drain measured by ECU is above the target range	Open load If this error detected during the heating phase is a result error: KWP 1089 Broken wiring Heating element in supply module defect	Threshold for error detection is an internal ECU threshold Check wiring Check cabling, if necessary replace supply module
925	148	523720	8	Supply module heater: Duration of switch on is too long.	uty cycle for temperature readout from supply module heater to the control unit is out of range; Supply modul defect, fault in the wiring.	When the received supply module heater temperature duty cycle SCR_rSMT is out of the failurerange (SCR_rSMFailMax_C < SCR_rSMHtrT < SCR_rSMFailMin_C) Supply module check and replace if necessary. Check the wiring.
926	148	523720	8	Supply module heater: Dutycycle timing over error threshold.	Duty cycle for temperature readout from supply module heater to the control unit is not valid. Supply modul defect, fault in the wiring.	When the received supply module heater duty cycle SCR_rSMHtrT is in the valid range (SCR_r- Supply module check and replace if necessary. Check the wiring.
930	689	523721	8	Supply module heater: Dutycycle timing over error threshold.	Duty cycle for temperature readout from supply module to the control unit is out of range. Supply modul defect, fault in the wiring.	Supply module check and replace if necessary. Check the wiring.

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
931	689	523721	8	Supply module heater: Dutycycle timing out of valid range.	Duty cycle for temperature readout from supply module to the control unit is not valid. Supply modul defect, fault in the wiring.	When the received supply module duty cycle SCR_rSMT is in the valid range (SCR_rSMTVld-Min_C <= SCR_rSMT <= SCR_rSMTVldMax_C), OR in the failure range (SCR_rSMFailMin_C <=SCR_rSMT <= SCR_rSMFailMax_C) Supply module check and replace if necessary. Check wiring.
927	689	523721	11	Supply module heater: temperature measurement not available.	Duty cycle for temperature readout from supply module heater to the control unit is not available. Supply modul defect, fault in the wiring.	Threshold for detection is an internal ECU threshold. No erasing in the current driving cycle. Supply module check and replace if necessary. Check the wiring.
929	691	523722	8	Supply module heater: Faulty PWM signal from supply module.	PWM Signal for temperature readout from supply module to the control unit is not valid. Supply modul defect, fault in the wiring.	Threshold for error detection is an internal ECU threshold. When valid Sync followed by temperature information signal is received AND valid sync and temperaturesignal for both information is received one after the other. Supply module check and replace if necessary. Check the wiring.
291	119	523776	9	Timeout Error of CAN-Receive-Frame TSC1TE - active	Timeout Error (Missing CAN Bus message)	Threshold for error detection is an internal ECU threshold. Check CAN Bus cabling (Bus sheduling, polarity, short circuit, power interrupt), test protocol of receiver, check CAN functional range.
292	119	523777	9	Message TSC1-TE has been missing (passive)	Passive timeout Error (Missing CAN Bus message)	Check CAN Bus cabling (Bus scheduling, polarity, short circuit, power interrupt), test protocol of receiver, check CAN functional range, check actuator
559	1-5-8	523895	13	Missing or wrong injector adjustment value programming (IMA) injector 1 (in firing order).	Missing or wrong injector adjustment value for cyl. 1.	Threshold for error detection is an internal ECU threshold. Check correct injector adjustment value (IMA). Use SERDIA UseCase to check it.
560	1-5-8	523896	13	Missing or wrong injector adjustment value programming (IMA) injector 2 (in firing order).	Missing or wrong injector adjustment value for cyl. 2	Threshold for error detection is an internal ECU threshold. check dataset and flash correct injector adjustement value (IMA). Use SERDIA UseCase to check it.
561	1-5-8	523897	13	Missing or wrong injector adjustment value programming (IMA) injector 3 (in firing order).	Missing or wrong parametrisation of injector adjustment cyl. 3.	Threshold for error detection is an internal ECU threshold. Check correct injector adjustment value (IMA).
562	1-5-8	523898	13	Missing or wrong injector adjustment value programming (IMA) injector 4 (in firing order).	Missing or wrong injector adjustment value for cyl. 4.	Threshold for error detection is an internal ECU threshold. Check correct injector adjustment value (IMA).
563	1-5-8	523899	13	Missing or wrong injector adjustment value programming (IMA) injector 5 (in firing order).	Missing or wrong injector adjustment value for cyl. 5.	Threshold for error detection is an internal ECU threshold. Check correct injector adjustment value (IMA).

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
564	1-5-8	523900	13	Missing or wrong injector adjustment value programming (IMA) injector 6 (in firing order).	Missing or wrong injector adjustment value for cyl. 6.	Threshold for error detection is an internal ECU threshold. Check correct injector adjustment value (IMA).
73	7-2-2	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	The sensed raw voltage value is below the minimum threshold.	The sensed raw voltage value DPM_uRawBrnDVDsP is above the minimum threshold DPM_SRCBrnDVDsP.uMin_C @ CRT < 4l: check throttle valve @ engines with Burner T4i: check back-pressure valve
42	167	523924	4	Overload at Pins O_V_RH2x: A01, K74, K91. Components on A01, K74, K91 cannot be activated. Internal ECU power stage switched off.	Suspected components: 1- Pin K91: Clutch switch, Brake switch, Engine brake demand, Regeneration activation, Parking brake, Gearbox N, Fan control 1 2- Pin K74: Boost air cooler bypass or electrical fuel pump relay, Fan control 2/fuel valve for flame star	Threshold for error detection is an internal ECU threshold. Check wiring harness and connected loads on pins A01, K74, K91 and/or reflash ECU. If error is still present, exchange ECU.
38	731	523925	3	Short circuit to battery error of actuator relay 2. Components on Pin A88, K57 cannot be activated. Internal ECU power stage switched off.	Suspected Components: 1- Lamps K57: Warn Ash Charge, Diagnostic, Warn Coolant Temp/Level, Warn Oil, Warn Boost Air, Warn Air Filter, Warn Water in Fuel, SCR, Regeneration, Engine Running. 2- Relay Preheat A88 3- Exhaust Flap A88	Check wiring harness and connected loads on pins A88, K57.
43	731	523925	4	Short circuit to ground actuator relais 3 Overload at Pins O_V_RH3x: A88, K57	Suspected components: 1- Pin A88: Preheat relay, Exhaust flap 2- Pin K 57: - control lamps: - OBD, preheat lamp, warning temp., warning oil, maintenance lamp, regeneration indicator, alternator management, engine running, diagnostic	Threshold for error detection is an internal ECU threshold. Check wiring harness and connected loads on pinsA88, K57. If error is still present, exchange ECU.
44	732	523926	4	Short circuit to ground aktuator relais 4. Overload at Pins O_V_PCV: A90	Suspected components:Fan, Wiring harness	Threshold for error detection is an internal ECU threshold. Check wiring harness and connected loads on pin A90. If error is still present, exchange ECU.
40	733	523927	3	Short circuit to battery error of actuator relay 2. Components on Pin A04, A05 cannot be activated. Internal ECU power stage switched off.	Suspected Components: 1- Urea Pump A04 2- SCR Heater A05	Check wiring harness and connected loads on pins A04, A05.
168	763	523935	12	Timeout Error of CAN-Transmit-Frame EEC3VOL1; Engine send messages	Fault is detected if a TimeOut of the EEC3VOL1 frame has occured.	Check wiring harness and customer nodes
169	764	523936	12	Timeout Error of CAN-Transmit-Frame EEC3VOL2; Engine send messages	Timeout Error (Missing CAN Bus message)	Check wiring harness and customer nodes

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
133	766	523938	9	Timeout Error (BAM to packet) for CAN-Receive-Frame AT1IGCVol1 information; factors & Sensorcalibration for NOX Sensor (SCR-system upstream cat; DPF-system downstream cat)	Failure of the CAN Bus message	NOX sensor and sensor connection check
134	766	523939	9	Broadcast Announce Message of the calibration message of the upstream catalytic NOx sensor has failed. Timeout Error (BAM to BAM) for CAN-Receive-Frame AT1IGCVol1 information. factors & Sensorcalibration for NOX Sensor (SCR-system upstream cat, DPF-system downstream cat).	Defective Nox sensor, faulty parameterization	NOX sensor and sensor connection check
135	766	523940	9	Timeout Error (PCK2PCK) for CAN-Receive-Frame AT1IGCVol1 information; factors & Sensorcalibration for NOX Sensor (SCR-system upstream cat; DPF-system downstream cat)	Failure of the CAN Bus message	NOX sensor and sensor connection check
140	767	523941	9	Timeout Error (BAM to packet) for CAN-Receive-Frame AT1OGCVol2 information; factors & Sensorcalibration for NOX Sensor (SCR-system downstream cat; DPF-system downstream cat)	Timeout Error (Missing CAN Bus message)	NOX downstream sensor and sensor connection check
141	767	523942	9	Timeout Error (BAM to BAM) for CAN-Receive-Frame AT1OGCVol2 information, Calibration message 1 of the after catalyst NOx sensor has failed. Factors & Sensorcalibration for NOX Sensor (SCR-system downstream cat, DPF-system downstream cat)	Defective Nox sensor, faulty parameterization.	NOX downstream sensor and sensor connection check.
142	767	523943	9	Timeout Error (PCK2PCK) for CAN-Receive-Frame AT1OGCVol2 information; factors & Sensorcalibration for NOX Sensor (SCR-system downstream cat; DPF-system downstream cat)	The fault is detected when a timeout error in packet 2 of NOxSenVol2Rx frame occurs.	NOX downstream sensor and sensor connection check
1011	771	523960	0	Physical range check high for EGR cooler downstream temperature.	Sensed temperature downstream EGR-cooler > limit.	EGR-Valve blocked open EGR-Valve actuator defect EGR-cooler defect (check for coolant water) Reed Valve defect Intake throttle blocked in closed position Exhaust pressure too high Check Nox-sensor upstream SCR catalyst dp venturi sensor defect
1012	771	523960	1	Physical range check low for EGR cooler downstream temperature.	sensor voltage > lower limit	EGR-Valve blocked open EGR-Valve actuator defect EGR-cooler defect (check for coolant water) Reed Valve defect Intake throttle blocked in closed position Exhaust pressure too high Check Nox-sensor upstream SCR catalyst dp venturi sensor defect

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
360	737	523982	0	Powerstage diagnosis disabled; Indicating that battery voltage is not high.	Powerstage diagnostic can be deactivated due to too high battery voltage.	Check wiring, check alternator, check cables and repair or replace if necessary.
361	737	523982	1	Powerstage diagnosis disabled; Indicating that battery voltage is not low.	Powerstage diagnostic can be deactivated due to too low battery voltage.	Check wiring, check alternator, check cables and repair or replace if necessary.
1239	788	523984	3	Actuator relay 5: the voltage measured by ECU is out of the target range	Short-Circuit to battery to component	Threshold for error detection is an internal ECU threshold. Check wiring, component, ECU
1241	176	523986	4	Actuator relay 4: the voltage measured by ECU is out of the target range	Short-Circuit to ground to component	Threshold for error detection is an internal ECU threshold. Check wiring, component, ECU
1242	791	523987	4	Actuator relay 5: the voltage measured by ECU is out of the target range	Short-Circuit to ground to component	Threshold for error detection is an internal ECU threshold. Check wiring, component, ECU
1434	8-3-6	524050	11	CAN; not used	not used	not used
1435	8-3-7	524051	11	CAN; not used	not used	not used
1505	8-4-3	524057	2	Low fuel pressure: the low fuel pressure calculated by ECU is underneath the target range; the ECU activates a system reaction	Fuel pressure below warning threshold	Threshold for error detection is an internal ECU threshold. Check low fuel pressure system (fuel feed pump, relay , fuse, wiring, sensor) and if necessary repair or replace it.
1558	869	524063	3	SCR heater mainrelay; short circuit to battery Threshold 1 < SCRHtr_rUHtrMeasRatio_mp < Threshold 2	Short-Circuit to battery on wiring to component	Check wiring, component
1559	869	524063	4	Connection between heating valve (Y31) on the control unit Pin A:92 and Load side SCR heater main relay (K31) is a short cut to ground. Threshold 1 < SCRHtr_rUHtrMeasRatio_mp < Threshold 2	Faulty wiring, faulty heater relay (K27-K31), defective heating valve (Y31), broken element in heating.	Disconnect plug from heating valve (Y31) and reset fault. If fault is still present you have to look in the wiring of Y31 to the control unit Pin A:92. If error is no longer present, you have to check the wiring of Y31 via relay K31 and possibly the heating cables and relay (K27-K30).
1555	869	524063	5	Urea backflow line heater: broken wiring detected Threshold 1 < SCRHtr_rUHtrMeasRatio_mp < Threshold 2	Open Load on wiring to component	Check wiring, component
1556	869	524063	5	Urea main relay: broken wiring detected Threshold 1 < SCRHtr_rUHtrMeasRatio_mp < Threshold 2	relay defect relay not connected wiring harness broken problems with supply voltage	Check wiring, component
1557	869	524063	5	Urea pressure line heater: broken wiring detected Threshold 1 < SCRHtr_rUHtrMeasRatio_mp < Threshold 2	Open load on wiring to component	Check wiring, component
1560	869	524063	5	SCR relay for suction line not connected Threshold 1 < SCRHtr_rUHtrMeasRatio_mp < Threshold 2	relay defect relay not connected wiring harness broken problems with supply voltage	Check wiring, component

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
1561	869	524063	5	Open load on wiring to component Threshold 1 < SCRHtr_rUHtrMeasRatio_mp < Threshold 2	Open load on wiring to component	Check wiring, component
1562	869	524063	5	SCR heater tank; open load	Open load on wiring to component	Check wiring, component
1646	869	524063	12	SCR supply module temperature is not reaching a threshold before a calibratable time is exceeded. Corresponding to the environmental Temperature a specific defrosting time is given. After starting the defrosting a clock counter is starting. Does the counter reach the given defrosting time limit, an error will be detected. Is the temperature reached in time the clock counter will be reset Example: by using the calibrated temperature/time curve --> environmental temperature 0°C --> defrosting time limit 6000s --> if the clock counter reaches 6000s the error will be detected	Suspected components: Enviroment temperature sensor defect SCR supply module temperature sensor defect SCR supply module electrical heater defect	Check Environment temperature sensor SCR supply module temperature sensor SCR supply module electrical heater
1565	892	524065	0	The relativ pressure value of the exhaust gas from the urea cat upstream sensor is greater than an applicable maximum pressure threshold	sensed presure upstream SCR catalyst > physical high range limit f(exhaust volume flow) UCatUsP_pRelFlt_mp > UCatUsP_pMax_mp	Check for crystallisation in exhaust line upstream SCR and dwnstream of urea injector Check correct connection from exhaust line to pressure sensor upstream SCR catalyst: syphons?, water in tube?, water in sensor? Check that exhaust pipe outlet is free (downstream SCR catalyst) Check wiring of pressure sensor upstream SCR catalyst Check pressure sensor upstream SCR catalyst: sensor has no connection to vehicle body? => Ensure that sensor is free Does sensor oscillate heavely at engine low idle / high idle? => try to supress the oscillating Exchange pressure sensor upstream SCR catalyst Check calculated exhaust volume flow of engine within EDC: SCR_dvolSCRUs pausible? If not: Check T sensor upstream SCR catalyst, check complete engine air path: EGR-Valve, Intake throttle, turbocharger, piping for leakage and function Check SCR catalyst: Broken? Exchange SCR-Catalyst

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
1566	892	524065	1	The relativ pressure value of the exhaust gas from the urea cat upstream sensor is less than an applicable minimum pressure threshold	sensed presure upstream SCR catalyst > physical high range limit f(exhaust volume flow) UCatUsP_pRelFlt_mp < UCatUsP_pMin_mp	Check correct connection from exhaust line to pressure sensor upstream SCR catalyst: leakage? Check electric connector: 4h pin open / new connector type used? pressure exchange from inside electrical connector with the environemt possible Check exhaust line: any leakages upstream of SCR catalyst? Check wiring of pressure sensor upstream SCR catalyst Exchange pressure sensor upstream SCR catalyst Check calculated exhaust volume flow of engine within EDC: SCR_dvolSCRUs pausible? If not: Check T sensor upstream SCR catalyst, check complete engine air path: EGR-Valve, Intake throttle, turbocharger, piping for leakage and function Check SCR catalyst: Broken? Exchange SCR-Catalyst
1598	892	524065	2	Comparison of urea cat upstream exhaust gas- and environment pressure, the difference should not exceed a certain limit abs(UCatUsP_pDiffEnvCat_mp) > Threshold	absolut value of difference between sensed pressure upstream SCR catalyst and environmental pressure > limit abs(UCatUsP_pDiffEnvCat_mp) > Threshold	Check electric connector: 4h pin open / new connector type used? pressure exchange from inside electrical connector with the environemt possible? water in sensor? sensor frozen? Check wiring of pressure sensor upstream SCR catalyst Exchange pressure sensor upstream SCR catalyst Check intake manifold pressure sensor (Air_pCACDs) Check ambient pressure sensor (EnvP_p)
1569	892	524065	3	voltage of pressure sensor upstream SCR > voltage high limit	voltage of pressure sensor upstream SCR > voltage high limit	Check wiring of pressure sensor upstream SCR catalyst Check pressure sensor upstream SCR catalyst Exchange pressure sensor upstream SCR catalyst
1570	892	524065	4	voltage of pressure sensor upstream SCR < voltage low limit	voltage of pressure sensor upstream SCR < voltage low limit	Check wiring of pressure sensor upstream SCR catalyst. Check pressure sensor upstream SCR catalyst. Exchange pressure sensor upstream SCR catalyst

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
1581	894	524067	0	Filtered urea supply module heater temperature value is above an applicable maximum heater temperature threshold of the supply module The temperature is read out via the PWM signal of the urea pump. That is only possible in status init of the SCR-system short after ignition was switched on. When that state is left the sensed temperature value is frozen.	sensed temperature of supply module heater > physical high range limit	Compare SCR_tSMT with SCR_tSMHtrT. Both show the same value? Check urea tank temperature (SCR_tAdapUTnkT). Very hot (> 70°C), urea tank heater permanet on? Does the pump never stop working? Check wiring to supply module Compare SCR_tSMT with SCR_tSMHtrT. Both show different values or urea tank temperature (SCR_tAdapUTnkT) is cold: exchange urea pump unit Supply module heater temperature sensor defect Supply module heater defect Supply module defect
1585	894	524067	0	Filtered urea supply module temperature value (SCR_tSMT) is above an applicable maximum temperature threshold of the supply module The temperature is read out via the PWM signal of the urea pump. That is only possible in status init of the SCR-system short after ignition was switched on. When that state is left the sensed temperature value is frozen.	sensed temperature of urea within supply module > physical high range limit	Compare SCR_tSMT with SCR_tSMHtrT. Both show the same value? Check urea tank temperature (SCR_tAdapUTnkT). Very hot (> 70°C), ure tank heater permanet on? Does the pump never stop working? Check wiring to supply module Compare SCR_tSMT with SCR_tSMHtrT. Both show different values or urea tank temperature (SCR_tAdapUTnkT) is cold: exchange urea pump unit Supply module temperature sensor defect Supply module heater defect Supply module defect
1582	894	524067	1	Filtered urea supply module heater temperature value is below an applicable minimum heater temperature threshold of the supply module The temperature is read out via the PWM signal of the urea pump. That is only possible in status init of the SCR-system short after ignition was switched on. When that state is left the sensed temperature value is frozen.	sensed temperature of supply module heater < threshold	Check ambient temperature EnvT_t < Threshold? Compare SCR_tSMT with SCR_tSMHtrT Check wiring with regard to supply modul heater exchange urea pump unit Supply module heater temperature sensor defect Supply module defect
1586	894	524067	1	Filtered urea supply module temperature (SCR_tSMT) value is below an applicable minimum temperature threshold of the supply module The temperature is read out via the PWM signal of the urea pump. That is only possible in status init of the SCR-system short after ignition was switched on. When that state is left the sensed temperature value is frozen.	sensed temperature of urea within supply module < physical low range limit	Check ambient temperature EnvT_t < threshold? Compare SCR_tSMT with SCR_tSMHtrT Check wiring with regard to supply modul heater exchange urea pump unit Supply module temperature sensor defect Supply module defect

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
1867	894	524067	2	absolute diference of sensed temperature of supply module heater temperature and ambient temperature UPmpT_tDiffPmpHtrAmb_mp > threshold	absolute diference of sensed temperature of supply module heater temperature and ambient temperature UPmpT_tDiffPmpHtrAmb_mp > threshold	Compare SCR_tSMT with SCR_tSMHtrT, EnvT_t and CEngTds_t and SCR_tAdapUTnkT => All identical? If not: Has the machine been brought from cold environment into a warm one or vice versa without engine running, e.g. at workshop? Environment temperature sensor defect Coolant temperature sensor defect Supply module temperature sensor defect Problem at Supply module unit (broken?) => exchange supply module
1868	894	524067	2	absolute diference of sensed temperature of supply module temperature and ambient temperature > threshold	absolute diference of sensed temperature of supply module temperature and ambient temperature UPmpT_tDiffPmpAmb_mp > threshold	Compare SCR_tSMT with SCR_tSMHtrT, EnvT_t and CEngTds_t and SCR_tAdapUTnkT => All identical? If not: Has the machine been brought from cold environment into a warm one or vice versa without engine running, e.g. at workshop? Environment temperature sensor defect Coolant temperature sensor defect Supply module temperature sensor defect Problem at Supply module unit (broken?) => exchange supply module
1533	246	524074	9	Open load sensor internally at NOx-sensor downstream SCR	Open load sensor internally at NOx-sensor downstream SCR	Threshold for error detection is an internal ECU threshold. Check NOx-Sensor downstream SCR catalyst: water inside? Shake out sensor after dismounting. => If water inside, replace sensor. Check mounting position of sensor and judge it regarding condense water formation / agglomeration. Check wiring harness Exchange sensor
1534	247	524075	11	Short circuit sensor internally at NOx-sensor downstream SCR	Short circuit sensor internally at NOx-sensor downstream SCR	Threshold for error detection is an internal ECU threshold. Check NOx-Sensor downstream SCR catalyst: water inside? Shake out sensor after dismounting. => If water inside, replace sensor. Check mounting position of sensor and judge it regarding condense water formation / agglomeration? Rearrange if critical and possible Check wiring harness Exchange sensor

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
1535	248	524076	9	Open line sensor internally at NOx-sensor downstream SCR NOx Sensors are CAN Sensors --> no HW Pin on the ECU	Open line sensor internally at NOx-sensor downstream SCR	Threshold for error detection is an internal ECU threshold. Check NOx-Sensor upstream SCR catalyst: water inside? Shake out sensor after dismounting. => If water inside, replace sensor. Check mounting position of sensor and judge it regarding condense water formation / agglomeration. Check wiring harness Exchange sensor
1536	249	524077	11	Short circuit sensor internally at NOx-sensor downstream SCR NOx Sensors are CAN Sensors --> no HW Pin on the ECU	Short circuit sensor internally at NOx-sensor downstream SCR	Threshold for error detection is an internal ECU threshold. Check NOx-Sensor upstream SCR catalyst: water inside? Shake out sensor after dismounting. => If water inside, replace sensor. Check mounting position of sensor and judge it regarding condense water formation / agglomeration. Check wiring harness Exchange sensor
1537	255	524078	9	Lambda value of NOx-Sensor downstream SCR is out of range. When the filtered Lambda concentration value at the sensor (ComRxSCR_rFltLamDs_mp) is greater than the physical range check max. lambda threshold	sensed lambda value of Nox-sensor downstream SCR catalyst is > physical high limit ComRxSCR_rCanLamDs_mp > threshold	Check whether NOx-sensor downstream SCR catalyst is physically mounted within the exhaust line Check Lambda values of NOx-sensor downstream SCR catalystat at idle conditions, ComRxSCR_rCanLamDs_mp > threshold? Compare to ComRxSCR_rCanLamUs_mp. Values must be almost identical Check CANBus of NOx-sensor downstream SCR catalyst Check NOx-sensor downstream SCR catalyst wiring Check NOx-sensor downstream SCR catalyst itself Replace NOx-sensor downstream SCR catalyst

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
1538	256	524079	9	sensed lambda value of NOx-sensor downstream SCR catalyst is < physical low limit ComRxSCR_rCanLamDs_mp < threshold	sensed lambda value of NOx-sensor downstream SCR catalyst is < physical low limit ComRxSCR_rCanLamDs_mp < threshold	Compare to ComRxSCR_rCanLamUs_mp. ComRxSCR_rCanLamDs_mp must be almost identical! If almost identical, Check air path of engine: EGR-Valve, Intake-Throttle, Turbocharger and Piping each for leakage and correct function Check injection system of engine. Injector stuck? if sensed lambda upstream SCR higher (ComRxSCR_rCanLamUs_mp) : Diesel in Urea-tank? Check CANBus of NOx-sensor downstream SCR catalyst Check NOx-sensor downstream SCR catalyst wiring Check NOx-sensor downstream SCR catalyst itself Replace NOx-sensor downstream SCR catalyst
1539	257	524080	9	sensed lambda value of Nox-sensor upstream SCR catalyst is > physical high limit ComRxSCR_rCanLamUs_mp > Threshold	sensed lambda value of Nox-sensor upstream SCR catalyst is > physical high limit ComRxSCR_rCanLamUs_mp > Threshold	Check whether NOx-sensor upstream SCR catalyst is physically mounted within the exhaust line Check Lambda values of NOx-sensor upstream SCR catalystat at idle conditions, ComRxSCR_rCanLamUs_mp < Threshold? Compare to ComRxSCR_rCanLamDs_mp. Must be almost identical Check CANBus of NOx-sensor upstream SCR catalyst Check NOx-sensor upstream SCR catalyst wiring Check NOx-sensor upstream SCR catalyst itself Replace NOx-sensor upstream SCR catalyst
1540	258	524081	9	sensed lambda value of Nox-sensor upstream SCR catalyst is < physical low limit ComRxSCR_rCanLamUs_mp < Threshold	sensed lambda value of Nox-sensor upstream SCR catalyst is < physical low limit ComRxSCR_rCanLamUs_mp < Threshold	Check air path of engine: EGR-Valve, Intake-Throttle, Turbocharger and Piping each for leakage and correct function Check injection system of engine. Injector stuck? Check CANBus of NOx-sensor upstream SCR catalyst Check NOx-sensor upstream SCR catalyst wiring Check NOx-sensor upstream SCR catalyst itself Replace NOx-sensor upstream SCR catalyst
1542	261	524083	9	sensed NOx-value of NOx-sensor downstream SCR catalyst < Threshold	sensed Nox-value of Nox-sensor downstream SCR catalyst < physical low limit	Check CANBus of NOx-sensor downstream SCR catalyst Check NOx-sensor downstream SCR catalyst wiring Check NOx-sensor downstream SCR catalyst itself Replace NOx-sensor downstream SCR catalyst

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
1544	912	524085	9	sensed Nox-value of Nox-sensor upstream SCR catalyst < Threshold	sensed Nox-value of Nox-sensor upstream SCR catalyst < physical low limit	Check CANBus of NOx-sensor upstream SCR catalyst Check NOx-sensor upstream SCR catalyst wiring Check NOx-sensor upstream SCR catalyst itself Replace NOx-sensor upstream SCR catalyst
1666	924	524100	9	Timeout error of CAN-Transmit-Frame Com-DPFHisDat.	Open load on CANBUS wiring.	Check wiring, component.
1676	928	524104	9	Timeout error of CAN-Receive-Frame Com-RxDPFCtl. CM1 Module Customer Recieve Message.	Time out of Check CANBUS EAT Control Receive Message, PGN65348. The message is not received.	Threshold for error detection is an internal ECU threshold. Check CANBUS EAT Control Receive Message, PGN65348. CM1 Module Customer Recieve Message.
1672	9-4-2	524118	9	Timeout error of CAN-Receive-Frame ComRxCM1	If the frame CM1 message is not transmitted successfully	Check CAN Bus cabling (Bus sheduling, polarity, short circuit, power interrupt), test protocol of receiver, check CAN functional range.
1683	9-4-5	524121	9	Timeout error of CAN-Receive-Frame Com-RxTrbChActr	Timeout Error (Missing CAN Bus message)	Check CAN Bus cabling (Bus sheduling, polarity, short circuit, power interrupt), test protocol of receiver, check CAN functional range.
1687	9-4-9	524125	9	Timeout error of CAN-Receive-Frame Com-TxTrbChActr	Timeout Error (Missing CAN Bus message)	Check CAN Bus cabling (Bus sheduling, polarity, short circuit, power interrupt), test protocol of receiver, check CAN functional range.
1827	192	524141	7	DEF dosing valve is blocked with crystalized urea or other deposits.	While SCR system is starting up and fter urea pressure reaches 10000 hPa, the DEF dosing module is tested. Expectation is that urea pressure drops below 1500 hPa if injector works properly. The test is repeated up to 3 times before an error is set. SCRSysPresMon_stPresDropDet_mp = 0 while SCRCo_stStatus_mp = 16. Suspected component: wiring harness DEF dosing valve The error is stored into the EEPROM of the ECU and status at ECU shut down is regained at ignition on.	Check electrical connection of urea injector: - wiring harness - connector Conduct SERDIA use-case "injection test". If it is faulty: - remove urea injector from exhaust line: - check for crystallisation direct on injector nozzle / plate - rinse it thoroughly in water - remount urea injector and conduct SERDIA use-case "injection test" If the error is still active, then exchange urea injector.
1858	192	524141	7	DEF dosing valve is blocked with crystalized urea or other deposits.	While SCR system is starting up and fter urea pressure reaches 10000 hPa, the DEF dosing module is tested. Expectation is that urea pressure drops below 1500 hPa if injector works properly. The test is repeated up to 3 times before an error is set. SCRSysPresMon_stPresDropDet_mp = 0 while SCRCo_stStatus_mp = 16. Suspected component: wiring harness DEF dosing valve The error is stored into the EEPROM of the ECU and status at ECU shut down is regained at ignition on.	Check electrical connection of urea injector: - wiring harness - connector Conduct SERDIA use-case "injection test". If it is faulty: - remove urea injector from exhaust line: - check for crystallisation direct on injector nozzle / plate - rinse it thoroughly in water - remount urea injector and conduct SERDIA use-case "injection test" If the error is still active, then exchange urea injector.

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
1639	966	524147	13	No proper urea pressure level could be build up within the SCR system state "Fill Lines" => SCRCo_stStatus_mp = 1 within some miuntes	This error shows up, if no proper urea pressure level could be build up within the SCR system state "Fill Lines" => SCRCo_stStatus_mp = 1 within some minutes Once the urea pump pressure has exceeded the threshold the error is declared as okay. Suspected components: Suction line blocked PWM Powerstage has a defect and a default value which leads not to a rising pressure Pump Pressure sensor defect pump filter contains dirty parts reverting valve continously open	Make sure that frozen lines, pump or tank can be excluded! Check whether there is urea in the urea tank Check urea lines: All lines connected? The right lines connected to the correct places? Suction line blocked? No leakage? Not also urea to the outside but also air into the lines, especially in the suction line! Perform service routine "pressure test": Does the urea pump work? => check wiring harness & PWM signal for pump Does the urea pressure rise? DFC already healed? If all unsuccessful so far: Check urea pressure sensor: At ignition on and SCR system state = 0 ("Init check"), SCR_pAbsAdapUPmpP shall be identical to EnvP_p. Fulfilled: Sensor okay! Check reverting valve => see DFC_SCRCoRevVlvBlk Check pump filter: dirt inside? Suspected components: Urea pump broken Reverting valve continously open Urea suction line, backflow line broken or connection swapped PWM Powerstage has a defect Pump Pressure sensor broken
1874	971	524152	2	CAN message is not received fora definite time => error is set. As soon as the message is received the error heals.	CAN message is not received for a definite time => error is set. As soon as the message is received the error heals.	Check eletrical connection oif urea quality sensor Check engine CAN bus Check urea quality sensor itself Exchange urea quality sensor
1875	997	524153	2	CAN message is not reseived for a definite time => error is set. As soon as the message is received the error heals.	CAN message is not reseived for a definite time => error is set. As soon as the message is received the error heals.	Check eletrical connection of suction unit sensor (combined sensor with tank level and tank temperature) Check engine CAN bus Check level sensor itself Exchange suction unit
1705	972	524156	9	Timeout error of CAN-Receive-Frame ComRxEBC2 from wheel speed sensor.	Timeout Error (Missing CAN Bus message) Defect on wheel speed sensor.	Check CAN Bus cabling (Bus scheduling, polarity, short circuit, power interrupt), test protocol of receiver, check CAN functional range. Replace the wheel speed sensor.

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
1863	995	524177	7	The error shows up, if no proper urea presure could be build up within the SCR system state "Fill Lines" => SCRCo_stStatus_mp = 1.	This error shows up, if no proper urea presure could be build up within the SCR system state "Fill Lines" => SCRCo_stStatus_mp = 1. 3 cases can lead to the error: Case A: increasing pressure is detected within 15s the check has passed => no error Case B: The pressure threshold was not reached within the 60s but case A was not positiv. Case C: The minimum pressure of 3000 hPa was not reached within the 60s.	Make sure that DEF lines, pump and tank are not frozen. Check for DEF level in the tank. Check DEF lines: Are all DEF lines connected? Is the suction line blocked? Is ther any leakage? Not only urea to the outside but also air into the lines, especially in the suction line! Perform SERDIA usecase "pressure test": Does the DEF pump work? => check wiring harness & PWM signal for pump. Does the urea pressure increase? All errors are already healed? If still unsuccessful so far: Check urea pressure sensor: At ignition on and SCR system state = 0 ("Init check"), SCR_pAbsAdapUPmpP shall be identical to EnvP_p. Fulfilled: Sensor okay! Check DEF pump filter: Is any dirt inside? Suspected components: Suction line PWM Powerstage has a defect and a default value which leads not to a rising pressure DEF pump pressure sensor defect DEF pump filter contains dirty parts

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
1864	996	524178	7	The urea pump is not able to control the urea pressure between 9bar and 11 bar.	The urea pump controller is not able to control the urea pressure between 9bar and 11 bar due to malfunction in the SCR system. Suspected components: - DEF pump broken - Reverting valve continously open - Urea suction line, backflow line broken or connection swapped - PWM Powerstage has a defect - Pump Pressure sensor broken	Make sure that DEF lines, pump and tank are not frozen. Check for DEF level in the tank Check DEF lines: All lines connected? The right lines connected to the correct places? Suction line blocked? Is there any leakage? Not also urea to the outside but also air into the lines, especially in the suction line! Perform SERDIA usecase "pressure test": Does the DEF pump work properly? => check wiring harness & PWM signal for pump Does the DEF pressure rise? Is the error healed? If still unsuccessful so far: - Check DEF pressure sensor: At ignition on and SCR system state = 0 ("Init check"), SCR_pAbsAdapUPmpP shall be identical to EnvP_p. Fulfilled: Sensor okay! - Check reverting valve - Check DEF pump filter: dirt inside? Suspected components: DEF pump broken Reverting valve continously open DEF suction line, backflow line broken or connection swapped PWM Powerstage has a defect DEF pump pressure sensor broken
1891	272	524190	14	Not enough urea in tank or low urea quality or hardware tampering failure is detected or hardware failure is detected	Low DEF tank level Low DEF quality Hardware Tampering is active Hardware Failure is active	Check DEF level in tank. If there is no DEF, refill up to volume above the warning threshold. Check the DEF quality in the tank. If wrong fluid is filled, refill with proper DEF. Check other errors based on hardware malfunctions.
1892	273	524191	14	A low DEF tank level or a low DEF quality is detected or hardware tampering(system components are pinched off) or hardware failures as shortcut to battery, shortcut to ground etc. are detected.	Low DEF tank level Low DEF quality Hardware Tampering is active Hardware Failure is active	Threshold for error detection is an internal ECU threshold. Check the DEF level in tank. If there is no DEF, refill up above the warning level. Check DEF quality filled in the tank. Check other errors based on hardware tampering or failure.

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
1893	275	524193	8	The total time in standstill-regeneration mode exceeds the long-limit threshold within last 500h total engine run time. The error is activated if the engine runs to many times in Standstill regeneartion.	Stand-still mode is very often aborted by the operator. Stand-still mode does not reach required temperature level and regeneration level is therefore reached after a short time again	Read out stand-still statistics => see service manual: Stand-still operation finished or often interrupted by driver / engine shut-off? => Run stand-still and instruct operator Stand-still operation required often by soot load => Check dp DPF pressure sensor Stand-still mode does not reach required temperature level: Check engine air path: Intake Trottle, EGR-Valve and turbocharger okay? Any leakage in engine air intake sytem or exhaust gas system? Check temperature sensors within exhaust system: upstream DOC, downstream DOC If soot load level of DPF allow it: Perform Stand-still and check reached temperature level upstream and downstream DOC: T upstream DOC in the range of 480-550°C? Downstream DOC after 25 min stand-still main phase 590°C are reached? Temerature traces are steady and even? Temperature downstream DOC higher than upstream DOC but difference does not exceed 100 K? Very small difference (< 10 K after 25 min stand-still main phase, 590 °C downstream DOC are not reached) => exchange DOC Very big difference (>100 K after 25 min stand-still main phase, 590 °C downstream DOC exceeded) => check injection system of engine & engine air path

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
1894	276	524194	8	The total time in standstill-regeneration mode exceeds the long-limit threshold: 2,5h stand-still operation within 50h total motor run time. The error is activated if the engine runs to much time in short Standstill regeneartion.	Stand-still mode is aborted / interrupted too often by the operator Stand-still is required too often due to miscalculation in the soot model Stand-still mode does not reache temperature level and regeneration level is therefore reached after a short time again.	Read out stand-still statistics => see service manual: Stand-still operation finished or often interrupted by driver / engine shut-off? => Run stand-still and instruct operator Stand-still operation required often by soot load => Check dp DPF pressure sensor Stand-still mode does not reach required temperature level: Check engine air path: Intake Trottle, EGR-Valve and turbocharger okay? Any leakage in engine air intake sytem or exhaust gas system? Check temperature sensors within exhaust system: upstream DOC, downstream DOC If soot load level of DPF allows it: Perform Stand-still and check reached temperature level upstream and downstream DOC: T upstream DOC in the range of 480-550°C? Downstream DOC after 25 min stand-still main phase 590°C are reached? Temerature traces are steady and even? Temperature downstream DOC higher than upstream DOC but difference does not exceed 100 K? Very small difference (< 10 K after 25 min stand-still main phase, 590 °C downstream DOC are not reached) => exchange DOC Very big difference (>100 K after 25 min stand-still main phase, 590 °C downstream DOC exceeded) => check injection system of engine & engine air path

Table 3-9. Engine Fault Codes

Deutz Code	Blink Code	SPN	FMI	Description	Possible Cause	Action
1900	279	524195	14	The standstill request of detected crystallization is ignored for more than 5h(>300min) This will be activated if there is a standstill request activated by Crystalisation Monitoring.	Back pressure upstream SCR catalyst has reached a level which indicates crystallisation inside of exhaust line. The error detection depends on the sensed pressure upstream of the SCR catalyst and the calculated exhaust volume flow through the mixer pipe. In case of error is set, but no crystallisation can be found in the mixing pipe, a possible reason can be the defect sensors: - exhaust pressure & temperature upstream of the SCR catalyst, - the ambient pressure - the exhaust mass flow => Check air path system at the engine.	Dismount urea injector from exhaust line and inspect visually the injector and the exhaust line for urea crystallisation upstream of SCR catalyst: If crystallisation can be clearly seen, then stand-still must be processed. Has the engine been operated in low load for longer time? If yes, then it could be the reaoson for crystallisation. Does the NOx-Sensors work properly? Compare ComRxSCR_rNOxUs to ComRxSCR_rNOxDs, when ComRxSCR_stNOxRdyUs = 1 & ComRxSCR_stNOxRdyDs = 1 (Warm engine and EAT-system, SCRT_tCatAvrgExhGs_mp > 250°C, SCR_stStatus = "Dosing" = 8): sensed NOx upstream of SCR catalyst must be higher than downstream of SCR catalyst. Go to idle and wait until SCR system enters status "stand-by" (no dosing), SCRT_tCatAvrgExhGs_mp < 225°C: ComRxSCR_rNOxUs = ComRxSCR_rNOxDs Clean urea injector: rinse it thourougly under water Check EGR-Path: difference pressure sensor at venturi tube, EGR cooler, EGR-Valve, Reed-Valve, Intake throttle regarding function and leakage. Does the EGR-cooler leak water in the exhaust? Check air path for leakage Check turbocharger No crystallisation can be seen in the mixing pipe: Check exhaust pressure sensor upstream of SCR catalyst (SCR_pSensUCatUsP): tube, water in sensor? Check environmental pressure sensor (EnvP_p): plausible? Check exhaust temperature sensor upstream of SCR-catalyst (SCR_tSensUCatUsT): plausible compared to Exh_tOxiCatUs & Exh_tOxiCatDs e.g. when engine has idled for 20 minutes? => Run stand-still to remove crystallisation and to reset the DFC
1108	672	5232719	3	Urea supply module heater: the current drain measured by ECU is above the target range	Short circuit to battery If this error detected during the heating phase it is a result error:KWP 1089 Broken wiring Heating element in supply module defect	Threshold for error detection is an internal ECU threshold Check wiring Check cabling, if necessary replace supply module

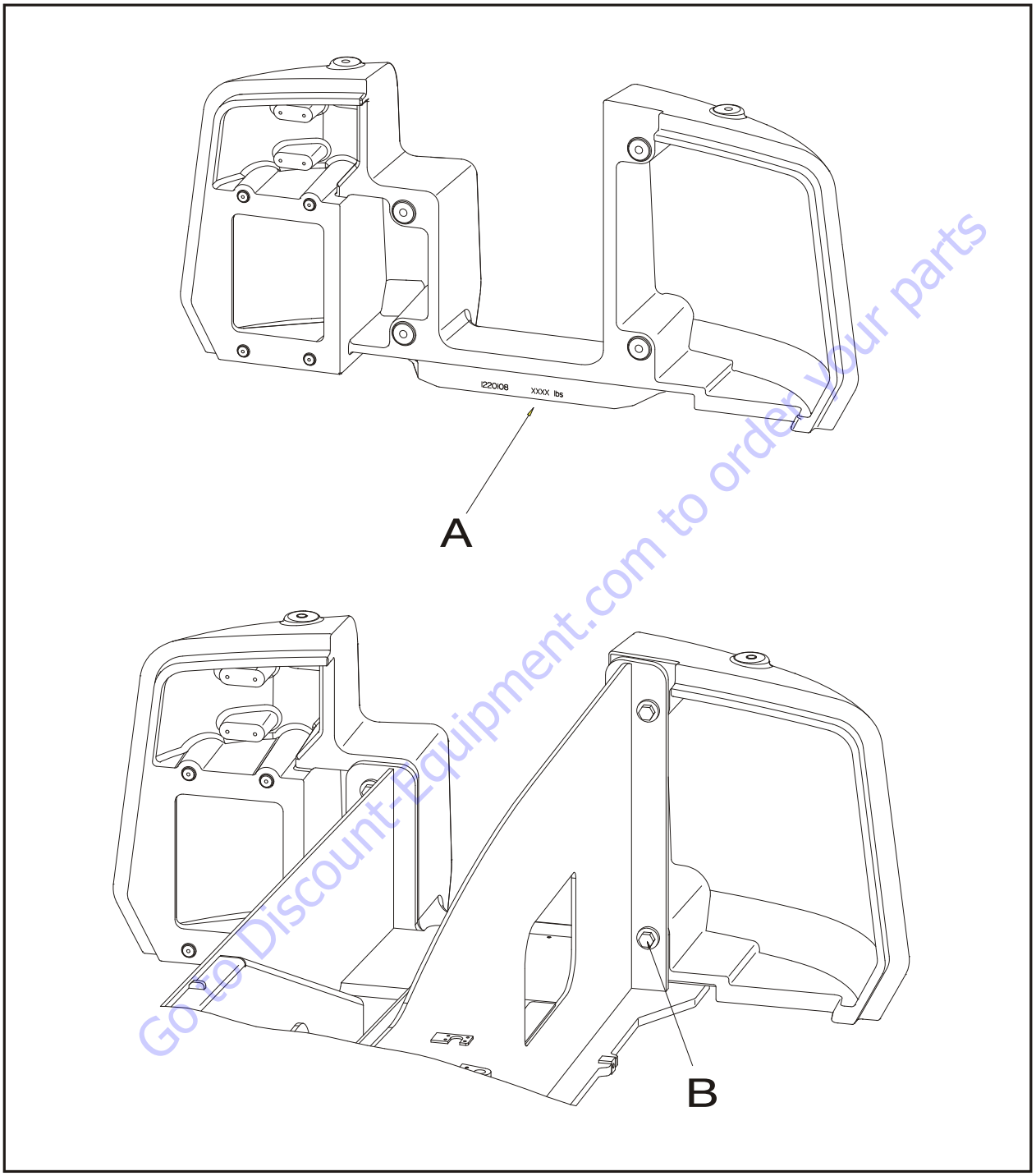
3.30 AUXILIARY POWER SYSTEM

The Auxiliary Power System is intended as a secondary means of moving the boom in the event of primary power loss. This system uses an electric motor/pump unit powered by a 12V battery capable of operating all functions except drive and controlled boom angle (see Section 4.11, Controlled Boom Angle System). To reduce the demand on the battery and therefore extend the run time of the system, the auxiliary power functionality differs from the primary power functionality. When commanded, the control system will attempt to use the force of gravity to operate main lift down, tower lift down, and tower telescope in by supplying pilot pressure to the respective cylinders. If appropriate movement is not detected by the boom sensors, the auxiliary power system will supply the hydraulic flow to power the movement conventionally.

The envelope control system (see Section 4.6, Envelope Control System) remains active during auxiliary power operation, however, functionality of tower lift or main lift only approximates the normal tower path control (see Section 4.7, Tower Path Control System) or main boom control (see Section 4.8, Automatic Main Boom Control System) functionality. Rather than the normal combined movements of tower lift, tower telescope, and main lift, these movements will automatically alternate during commands for tower lift or main lift to approximate the movements made under normal engine power.

3.31 COUNTERWEIGHT

If counterweight has been removed, ensure retaining bolts are torqued to the proper value as shown in Figure 3-73., Counterweight Bolt Torque.



A. Part Number\Actual Weight Stamping

B. Apply High Strength Threadlocking Compound to Bolt Threads and to Threads in Counterweight. Torque to 400 ft. lb (542 Nm). Typical Four Places.

Figure 3-73. Counterweight Bolt Torque

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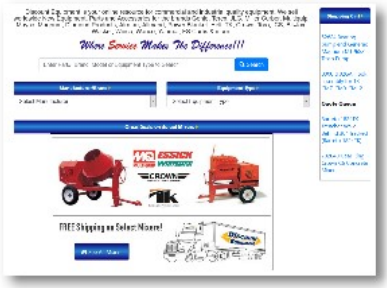

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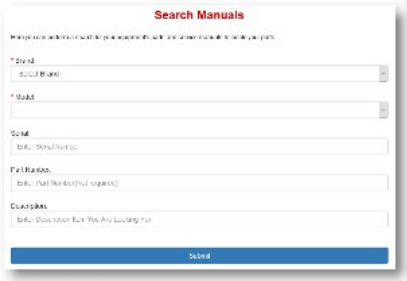

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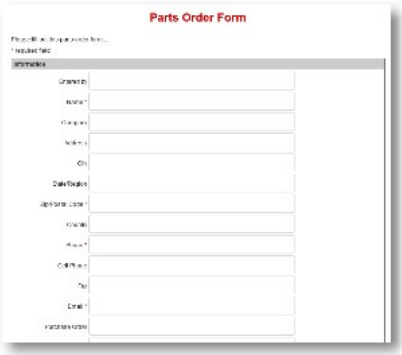

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SECTION 4. BOOM & PLATFORM

4.1 PLATFORM CONTROL ENABLE SYSTEM

Platform controls use a time dependent enable circuit to limit the time availability of “live” or enabled controls. To operate any directional function, the footswitch must be depressed before activation of the function. When the footswitch is depressed, the controls are enabled and the operator has 7 seconds to operate any function. 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 enable light will be illuminated in the platform display panel. When the time limit has been reached, the enable light will turn off and the controls will be “dead” or disabled. To continue use of the machine the controls must be re-enabled to start the timer system over again. This is done by releasing all functions, then releasing and re-depressing the footswitch.

NOTE: *For more detailed information concerning system adjustment and operation, refer to Section 6 - JLG Control System.*

4.2 TRANSPORT POSITION SENSING SYSTEM

The Transport Position Sensing System uses the following sensors to sense when the boom is in the position associated with high speed travel.

- Main boom angle sensors (mounted at the tower to main boom pivot pin).
- The main boom angle limit switch will be used in the event of a main boom angle sensor fault.
- Four main boom length limit switches (mounted on the main base boom).
- Tower lift cylinder angle sensor (mounted at the tower lift cylinder pivot to the turntable).
- The tower angle sensors in conjunction with the chassis tilt sensor will be used in the event of a tower lift cylinder angle sensor fault.
- Tower boom length sensors (mounted in the pivot end of the tower base boom).
- The tower length switch will be used in the event of a tower length sensor fault.
- The position of the articulated jib is not considered.

This system is used in the control of the following systems:

- Beyond Transport - Drive Speed Cutback System.
- Drive/Steer - Boom Function Interlock System - CE Only
- Jib Stow System
- Electrical Retrieval System
- Swing Speed Proportioning System
- Axle Extension System
- Oscillating Axle System

NOTE: *For more detailed information concerning system adjustment and operation, refer to Section 6 - JLG Control System.*

4.3 BEYOND TRANSPORT - DRIVE SPEED CUTBACK SYSTEM

When boom is positioned beyond the transport position as described in Section 4.2, Transport Position Sensing System, the drive motors are automatically restricted to their maximum displacement position (slow speed). See Section 3.22, Chassis Tilt Indicator System for interaction with the tilt sensor.

NOTE: *For more detailed information concerning system adjustment and operation, refer to Section 6 - JLG Control System.*

4.4 DRIVE/STEER – BOOM FUNCTION INTERLOCK SYSTEM (CE ONLY)

The Drive/Steer – Boom Function Interlock System 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.

NOTE: *For more detailed information concerning system adjustment and operation, refer to Section 6 - JLG Control System.*

4.5 JIB STOW SYSTEM

This machine is equipped with a full function side swing rotator that is mechanically limited to 55 degree rotation to the left and electrically limited to 70 degrees to the right through the use of a positive action limit switch mounted on the rotator assembly. The machines stowed length can be reduced to facilitate transportation on standard trailers by swinging the jib further to the right using the hydraulic power of the side swing rotator. The control system will prevent swinging the jib past the 70 degree position unless the axles are retracted, the boom is in the transport position (see Section 4.2, Transport Position Sensing System), and the jib stow override button on the platform control panel is held in combination with the jib swing function switch. When the jib is stowed, automatic platform leveling is disabled, the boom is restricted to the transport position, and axle extension is disabled. This system is functional only in the 500# (230 kg) mode of the Dual Capacity System (see Section 4.13, Dual Capacity System).

NOTE: *For more detailed information concerning system adjustment and operation, refer to Section 6 - JLG Control System.*

4.6 ENVELOPE CONTROL SYSTEM

The Envelope Control System is the primary means of controlling the working positions of the tower and main boom within the stability and structural requirements of the machine. Although the machine includes a load pin capable of measuring the changing forces on the boom, it is used exclusively for boom retrieval as described in the electrical retrieval system (see Section 4.9, Electrical Retrieval System) and is not used for controlling the stability of the machine until a fault is detected within the primary envelope control system. The control system is therefore not considering the load on the machine but rather the measured position of the boom within the envelope.

The main boom must be controlled in maximum angle and minimum angle to avoid entering a position that could compromise backward stability and avoid main boom to tower boom interference. The tower boom must be controlled by permitting only specific combinations of tower length and tower angle to avoid entering a position that could compromise forward and backward stability (see Section 4.7, Tower Path Control System).

This system uses two gravitationally based angle sensors and two length sensors to continuously measure the position of the tower boom in addition to two rotary angle sensors to continuously measure the position of the main boom. Each pair of sensors are continuously monitored for mutual agreement, proper response to command, and for correlation to a main boom angle limit switch, a tower boom length limit switch, and a tower rotary angle sensor. Recognized faults within this system will result in control by the Electrical Retrieval System (Section 4.9, Electrical Retrieval System), reduced function speeds, and BCS warning light illumination. After retrieval the boom will be restricted from leaving the transport position (see Section 4.2, Transport Position Sensing System) until the fault is resolved.

Boom position violations outside of the allowable envelope will result in reduced function speeds, BCS warning light illumination, restriction of functions, and sounding of the platform alarm and the flashing of the BCS light with attempts to operate restricted functions.

Normally, the tower lift function switch on the ground and platform control panels automatically activates both tower lift and tower telescope as described in the tower path control system (see Section 4.7, Tower Path Control System). Violations of the tower envelope will result in the suspension of this automatic feature. In an otherwise healthy control system, violations of the tower envelope can be corrected by actuating either of the tower lift up or tower lift down directions of the tower lift switch regardless of the direction of the violation. The control system will telescope or lift the tower in a singular manner to correct the tower position.

The restricted functions due to backward tower envelope violations are disallowing automatic tower lift down with tower lift down commands, automatic tower telescope out with tower lift up commands, main lift up and down, main telescope in, jib, swing, drive and steer.

The restricted functions due to forward tower envelope violations are disallowing automatic tower lift up with tower lift up commands, automatic tower telescope in with tower lift down commands, main lift up and down, main telescope out, jib, swing, drive and steer.

The restricted functions due to maximum main boom envelope violations are disallowing tower lift up and down, main lift up, main telescope in, jib, swing and drive.

The restricted functions due to minimum main boom envelope violations are disallowing main lift down, swing and drive.

NOTE: *For more detailed information concerning system adjustment and operation, refer to Section 6 - JLG Control System.*

4.7 TOWER PATH CONTROL SYSTEM

(see Figure 4-1., Tower Path vs. Main Boom Angle)

The Tower Path Control System uses the envelope control sensors to enhance the control of the tower boom for increased user efficiency and is used as an integral part of the envelope control system (see Section 4.6, Envelope Control System). Both the ground and platform control panels use one function switch to control the tower. User commands for tower lift up or tower lift down causes the control system to automatically introduce the correct combination of tower telescope and tower lift for the tower boom to follow a pre-described path or trajectory of the tower nose.

The tower path is a fixed relationship of tower length and tower angle (relative to gravity) and is variable only by the angle of the main boom. With main boom angles below +15°, the tower boom will reach maximum angles of 68° (at full tower boom extension) and with main boom angles above +65° the tower boom will reach maximum angles of 72° (at full tower boom extension).

Movement of the main boom will cause the control system to adjust the tower path accordingly. A fully raised tower boom will automatically vary in angle from 72° to 68° as the main boom is lowered from its maximum angle to the ground and conversely be raised from 68° to 72° as the main boom is raised from the ground to maximum angle. The amount of tower angle variation during main boom movements diminishes as the tower is lowered.

NOTE: *For more detailed information concerning system adjustment and operation, refer to Section 6 - JLG Control System.*

4.8 AUTOMATIC MAIN BOOM CONTROL SYSTEM

The Automatic Main Boom Control System uses the envelope control sensors to enhance the control of the main boom during tower lift functions. Due to the mechanical joining of the main and tower booms, changes in tower boom angle would normally have an opposite effect on the main boom angle. To compensate for this, when the tower is raised the control system automatically introduces main lift up. Similarly, when the tower is lowered the control system automatically introduces main lift down. This is done to keep the platform moving in the same direction as the user command and to increase user efficiency during tower lift functions.

The interaction of the main boom and the tower boom is slightly different when the main boom is above or below 60° relative to gravity.

During tower lift up or tower lift down movements with the main boom below 60°, the control system will maintain the angle of the main boom (relative to gravity) read at the start of the tower lift command or as read at the conclusion of main lift during combined tower and main lift commands.

During tower lift down movements with the main boom initially above 60°, the control system will lower the main boom to approximately 60° before initiating tower movement. The control system will then control the main boom to 60° for the remainder of the tower lift down command.

During tower lift up movements with the main boom initially above 60°, the control system will delay automatic compensation of the main boom angle during the tower lift movement until the main boom reaches approximately 60°. The control system will then control the main boom to 60° until the tower boom has reached its maximum height. Continuing to operate the tower lift up function when the tower reaches its maximum height, will cause the control system to automatically raise the main boom to its original angle.

NOTE: *For more detailed information concerning system adjustment and operation, refer to Section 6 - JLG Control System.*

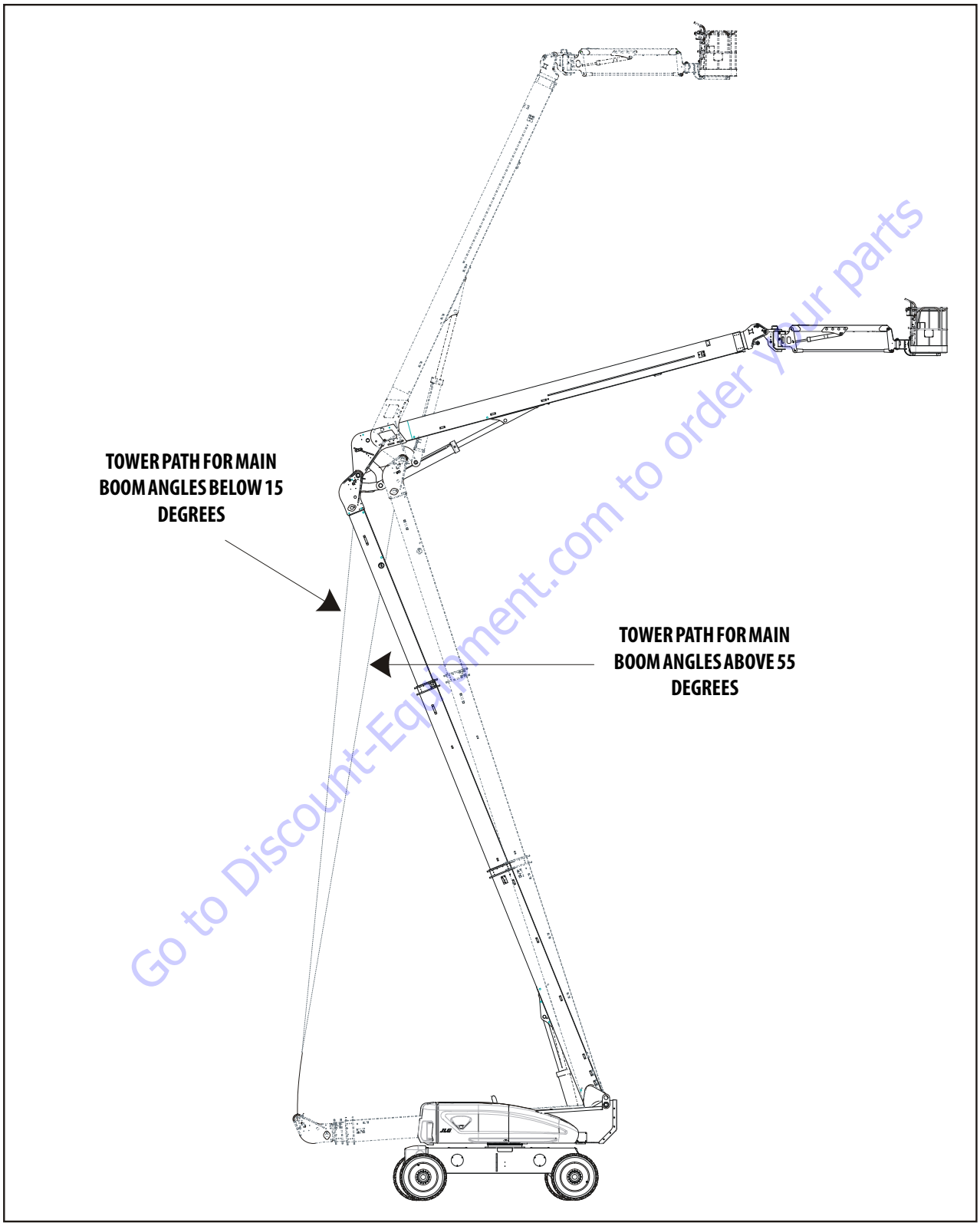


Figure 4-1. Tower Path vs. Main Boom Angle

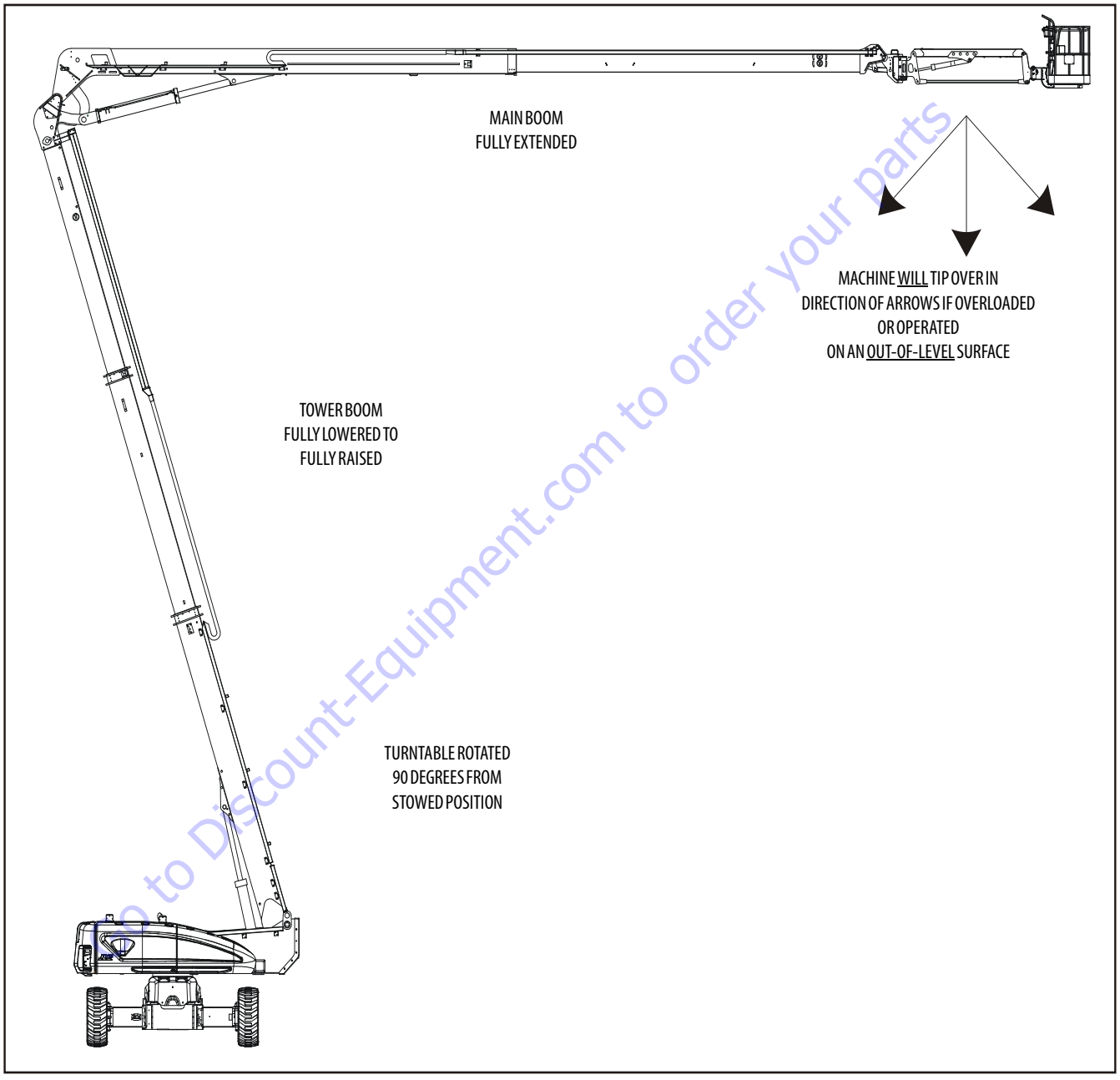


Figure 4-2. Position of Least Forward Stability

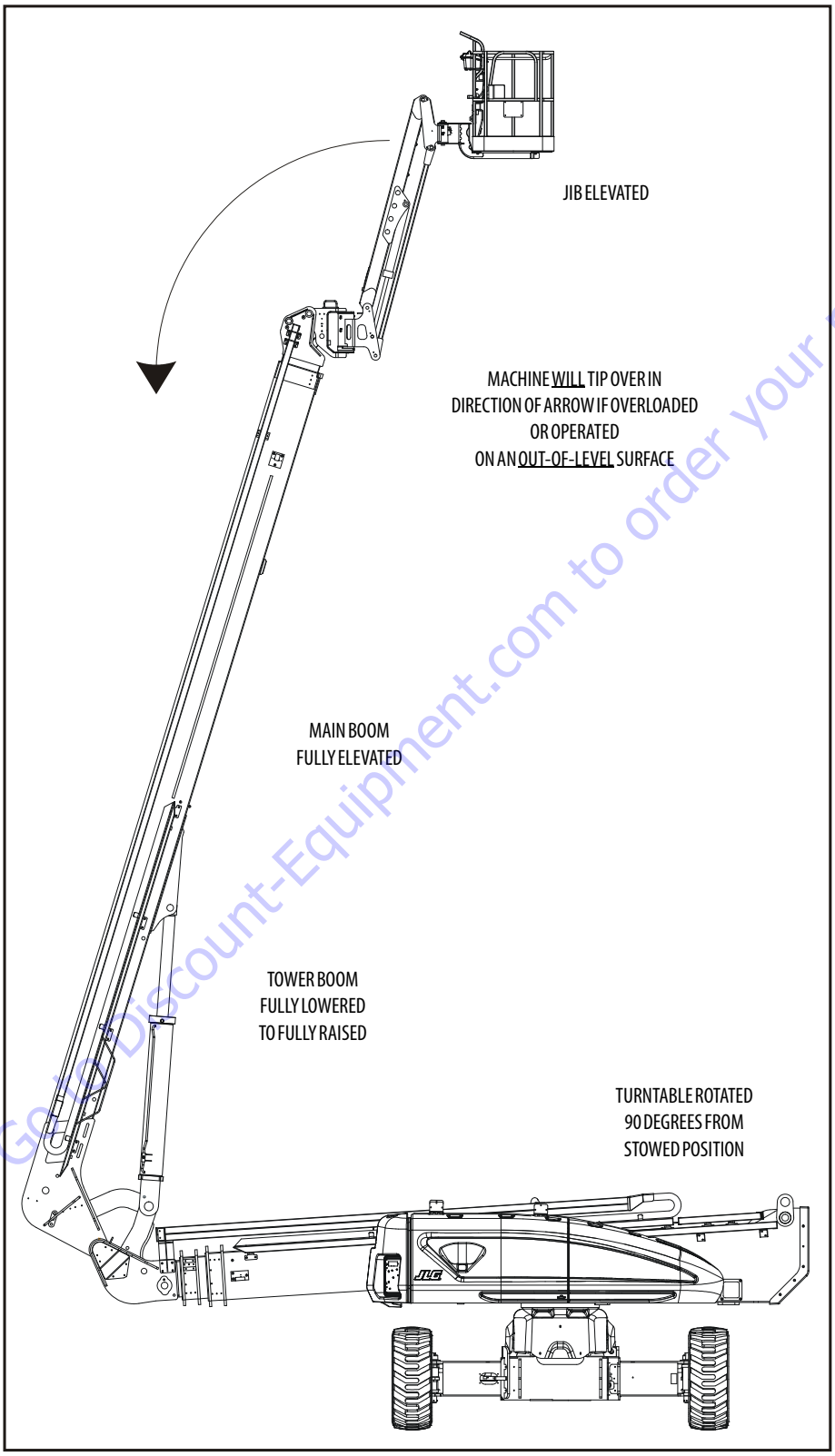


Figure 4-3. Position of Least Backward Stability - Sheet 1 of 2

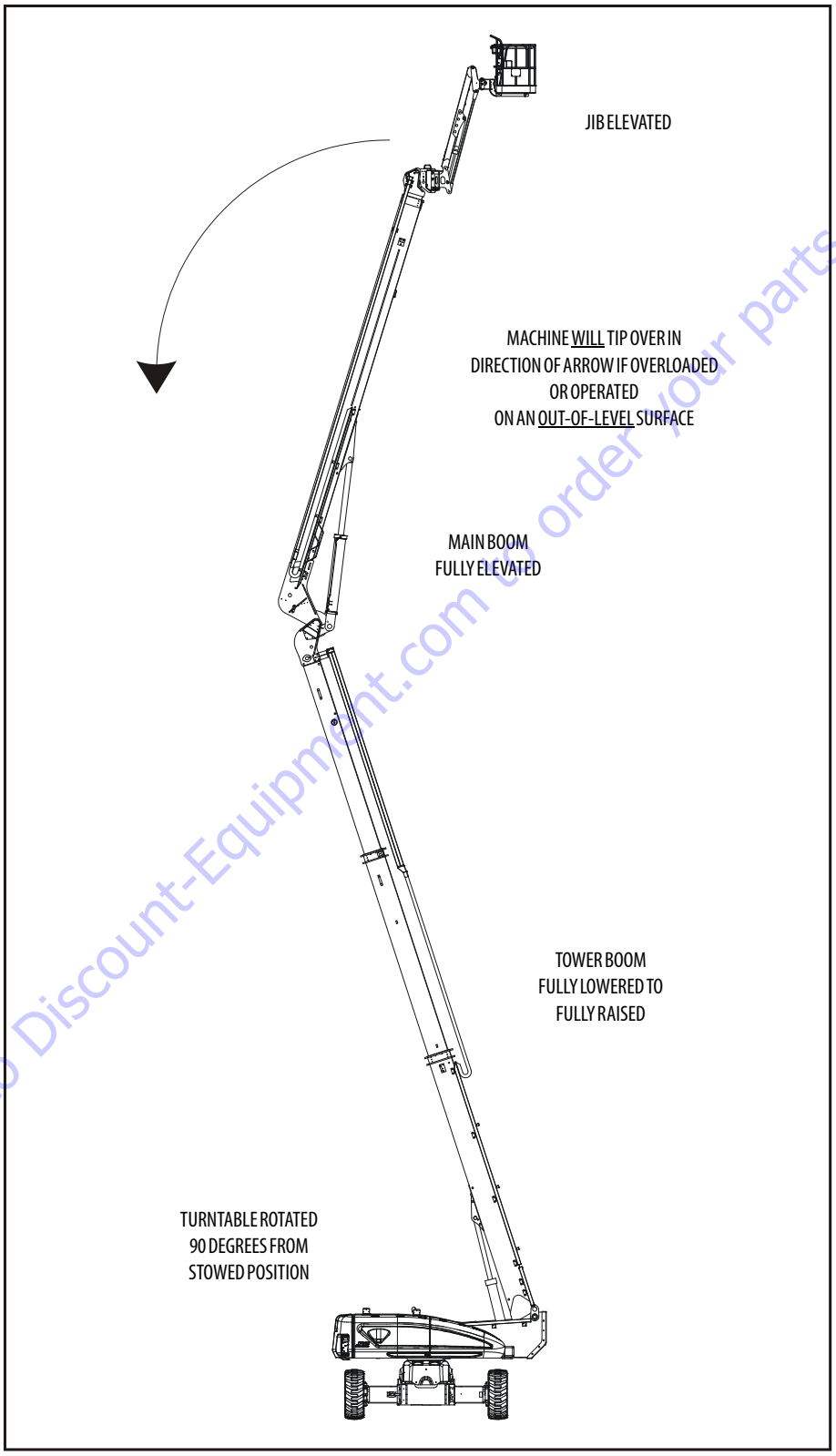


Figure 4-4. Position of Least Backward Stability - Sheet 2 of 2

4.9 ELECTRICAL RETRIEVAL SYSTEM

The Electrical Retrieval System provides a backup means of retrieving an elevated boom in the event of a failure of any sensor used in the envelope control system (see Section 4.6, Envelope Control System). Although the system is continuously monitored for its viability, it is not active until a failure of the envelope control system is detected.

The system uses a load cell pin to attach the tower lift cylinder to the turntable. This pin is instrumented with gauges allowing the forces in the pin to be monitored. The control system uses these force readings to select one of two sequences of retrieving the boom in a manner necessary to maintain the stability and structural integrity of the machine.

The two sequences of boom retrieval are determined based on the boom being closest to a position of forward stability concern or closest to a position of backward stability concern (See Figure 4-2., Figure 4-3., and Figure 4-4.). Regardless of the sequence selected by the control system, the control system must recognize successive positions of the main and tower booms before continuing with the sequence.

While operating in this mode, the positions of the booms are determined by sensors not used by the primary envelope control system. These include the tower length switch, tower cylinder angle sensor, main boom angle switch, and main boom length switches.

Operating in this mode will result in reduced function speeds, BCS warning light illumination, and restriction of functions. Attempts to operate restricted functions will flash the BCS light and sound the platform alarm.

NOTE: *For more detailed information concerning system adjustment and operation, refer to Section 6 - JLG Control System.*

4.10 HYDRAULIC RETRIEVAL SYSTEM

The Hydraulic Retrieval System provides a backup means of retrieving an elevated boom in the event of a recognized failure within the primary hydraulic control system related to the main lift, tower lift, and tower telescope functions. The control system monitors the primary hydraulic control system for short and open circuits, unexpected boom sensor response to command, control valve spool position faults, internal valve control module faults, and CAN BUS communication faults.

When a fault is detected, the control system automatically bypasses the appropriate hydraulic components and using alternative valves and control logic allows the operator to return the boom to the ground. In some cases the boom will be allowed to move only to the extent gravity is capable of assisting and in other cases the boom will be powered to allow complete retrieval to the transport position.

Although the envelope control system (see Section 4.6, Envelope Control System) remains active during the hydraulic retrieval, the tower lift functionality will follow the tower path (see Section 4.7, Tower Path Control System) in an approximated fashion. Rather than the normal combined movements of tower lift, tower telescope, and main lift, the tower lift movements will move in an alternating sequence between tower lift and tower telescope with the automatic main lift system (see Section 4.8, Automatic Main Boom Control System) disabled.

Operating in this mode will result in reduced function speeds, and restriction of functions. Attempts to operate restricted functions will flash the BCS light and sound the platform alarm.

NOTE: *For more detailed information concerning system adjustment and operation, refer to Section 6 - JLG Control System.*

4.11 CONTROLLED BOOM ANGLE SYSTEM

The Controlled Boom Angle System uses the envelope control sensors to enhance the control of the boom by minimizing the interaction of swing and drive functions with the envelope edges. This interaction is due to two factors. First, the envelope is controlled relative to gravity regardless of ground slope and second, the turntable/boom mounting is effected by swing and drive functions when the ground slope varies. This can cause the boom position to vary within the envelope or even violate the envelope edges when swinging or driving without intentionally moving the boom. The controlled boom angle system minimizes this effect by automatically introducing either the tower or main boom lift up or down during swing and drive commands to maintain a constant boom angle relative to gravity.

When the tower is below the tower transport angle and the main boom is 25 degrees above the tower boom, the angle of the main boom is controlled. When the tower is above the tower transport angle, the angle of the tower is controlled regardless of main boom position.

Just as the booms are controlled during swing and drive functions, the tower angle is also controlled during main boom lift and main boom telescope functions.

Controlled boom angle is disabled with any envelope violation or failure.

NOTE: *For more detailed information concerning system adjustment and operation, refer to Section 6 - JLG Control System.*

4.12 SLOW DOWN SYSTEM

To reduce the machine dynamics and improve operator control, the control system uses the envelope control sensors to automatically slow down the tower lift up, main lift up, and main lift down function speeds as the minimum and maximum angles of the working envelope are approached. The control system indicates to the operator this automatic introduction of slow down by flashing the creep light on the platform display panel. This feature applies to both platform and ground controls, however, no indication is made on the ground control panel.

NOTE: *For more detailed information concerning system adjustment and operation, refer to Section 6 - JLG Control System.*

4.13 DUAL CAPACITY SYSTEM

The Dual Capacity System is a multiple envelope control system as opposed to a capacity indication system. The control system changes the allowable working envelope to match the capacity select mode to either the 500# (230 kg) mode or the 1000# (450 kg) mode. It then displays the capacity mode on the platform and ground display panel and controls the positions of the main boom within the allowable envelope for that mode. This mode is selectable by the operator with the dual capacity select switch on the platform control panel.

The 500# (230 kg) mode has the largest envelope and allows the use of the side swing jib. The 1000# (450 kg) mode has a smaller envelope and requires the jib to be fixed in the centered position.

The control system uses the envelope control sensors (item16) in addition to the 4 limit switches and cams mounted on the main base and fly booms to restrict the main boom length between the main boom angles of +55° and –45° for the 1000# envelope.

To select the 1000# (450 kg) mode the boom must already be in the smaller 1000# (450 kg) envelope and the jib must be centered (+/-10 degrees) verified to the control system by the jib centered limit switch mounted on the side swing rotator.

When the operator selects the 1000# (450 kg) mode and these conditions are met, the capacity light changes from 500# (230 kg) to 1000# (450 kg), jib swing is disallowed, and the envelope is changed accordingly.

When the operator selects the 1000# mode and these conditions are not met, both capacity lights will flash, the platform alarm will sound, and all functions except jib swing will be disabled until the capacity select switch is put back into the 500# (230 kg) position. Operation of jib swing in this condition can be used to find the center position of the jib as the jib swing function will stop when the center position is reached.

When in the 1000# (450 kg) mode, attempts to telescope, lift or lower the main boom into the restricted area will cause that function to be prevented.

NOTE: *For more detailed information concerning system adjustment and operation, refer to Section 6 - JLG Control System.*

4.14 HYDRAULIC SYSTEM WARM UP

For optimal life and performance of the hydraulic system in extremely cold temperatures, the control system monitors the hydraulic system temperature and automatically limits the function speeds of the high demand functions.

While the system is cold and in the warm up mode, the tower lift, main lift, and main telescope functions are limited to creep speeds and is indicated to the operator by flashing the creep light on the platform control panel.

Operating the machine while in the warm up mode will generate sufficient heat to bring the hydraulic temperature up to allowable temperatures and the warm up mode will be automatically turned off. Although operating any function will generate heat, the tower lift function will warm the hydraulic system temperature the fastest as this function will operate tower lift, tower telescope, and main lift function automatically.

Functions being operated when the warm up mode turns off will remain in the creep speed until the function is re-initiated.

NOTE: *For more detailed information concerning system adjustment and operation, refer to Section 6 - JLG Control System.*

4.15 REDUCED PLATFORM HEIGHTS

The control system allows the maximum platform height of the machine to be restricted to a selectable reduced height to allow increased versatility in the rental market. The selection of 125, 100, and 80 ft maximum platform heights are available in the dealer mode - machine set up menu on the analyzer. The reduced platform heights are implemented by restricting the travel of the tower boom up the tower path (see Section 4.7, Tower Path Control System) while maintaining all other aspects of the envelope control system (see Section 4.6, Envelope Control System). The limits and functionality of the main boom are unaffected by the selection.

4.16 ELECTRONIC PLATFORM LEVELING

The Electronic Platform Leveling System uses two tilt sensors (mounted on either side of the pivot weldment), a control valve (mounted to the platform support), a level cylinder, and the platform control module (mounted in the platform control box) to automatically measure and control the incline of the platform with respect to gravity. This system is active while operating drive, telescope, lift or swing. It is not active while operating any other function (e.g. rotate, jib, or steer). The system controls the platform angle relative to gravity using a set point established during power-up (cycling of the EMS) or at the conclusion of a manual platform level override by the operator using the platform level override switch from either the platform or the ground control. In other words the operator can chose a platform incline other than level with gravity and the system will maintain that incline automatically.

If a fault occurs in the platform leveling system the following will occur:

- Automatic platform leveling will stop (except when there is a fault in only one sensor)
- The platform level fault indicator will flash
- The platform alarm will sound
- All functions will default to creep speed if in platform mode and the boom is out of the transport position (see Section 4.2, Transport Position Sensing System)

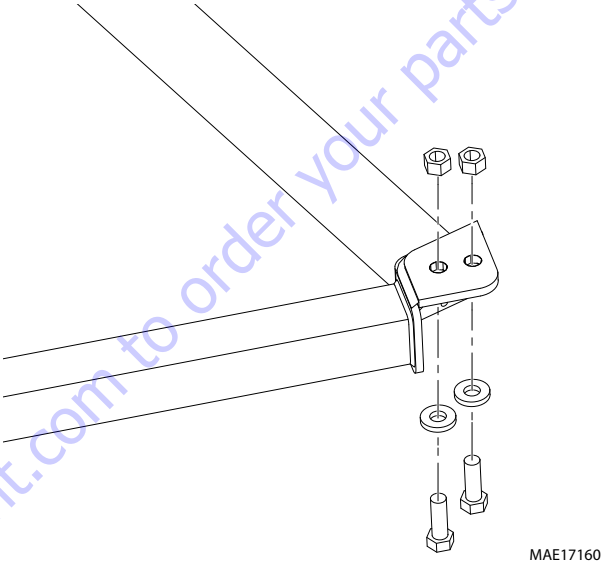
To reset a platform leveling fault, the emergency stop switch should be recycled.

NOTE: *For more detailed information concerning system adjustment and operation, refer to Section 6 - JLG Control System.*

4.17 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.



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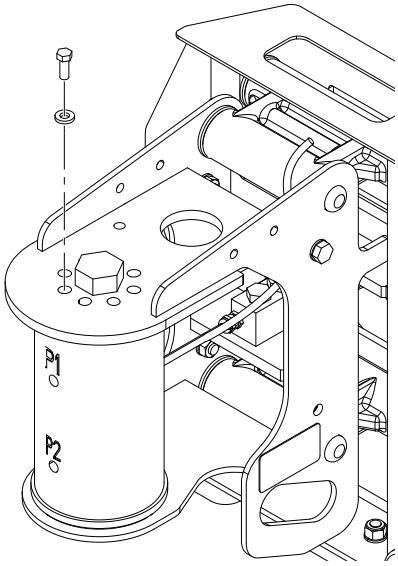
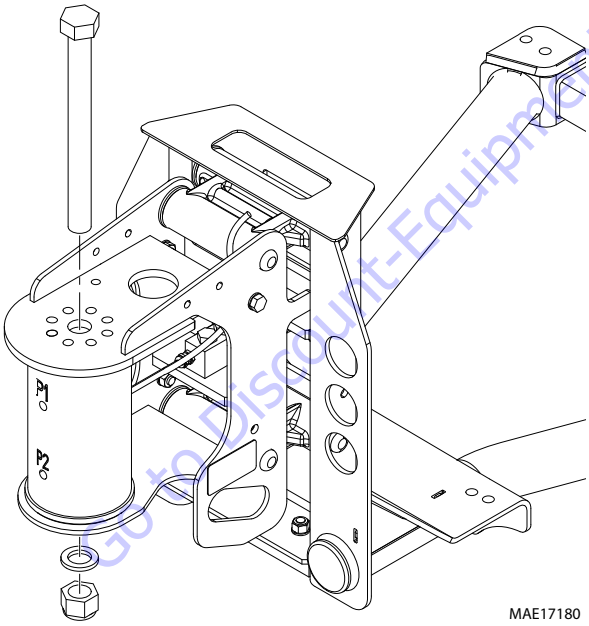
4. Using a suitable lifting device, support the platform support.

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

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



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

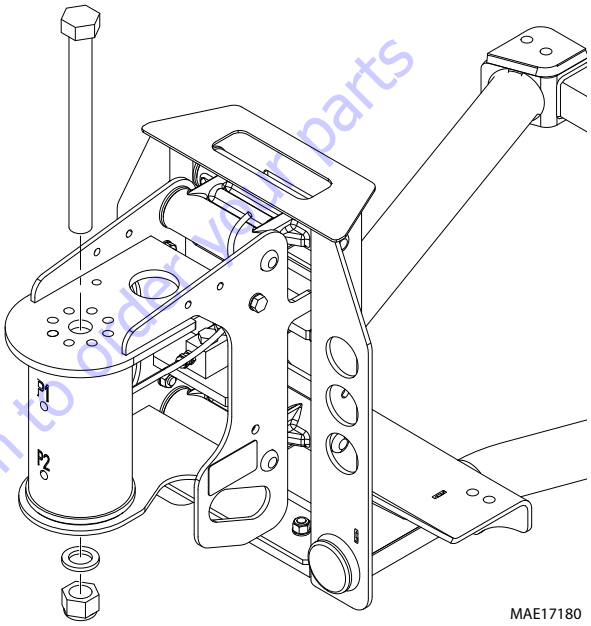


Support Installation

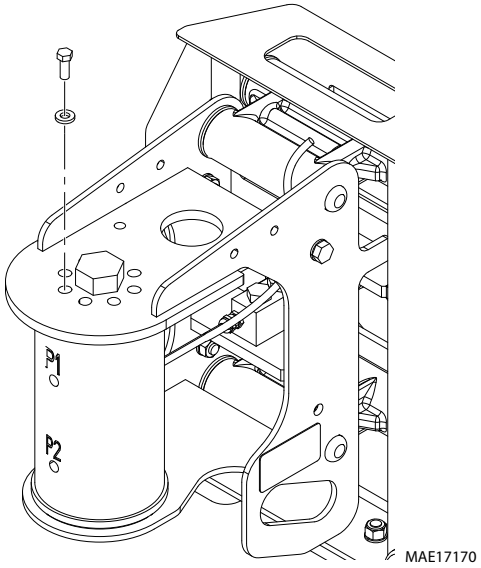
1. Using a suitable lifting device, support the platform support and position it on the rotator.

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

2. Install the rotator center bolt.

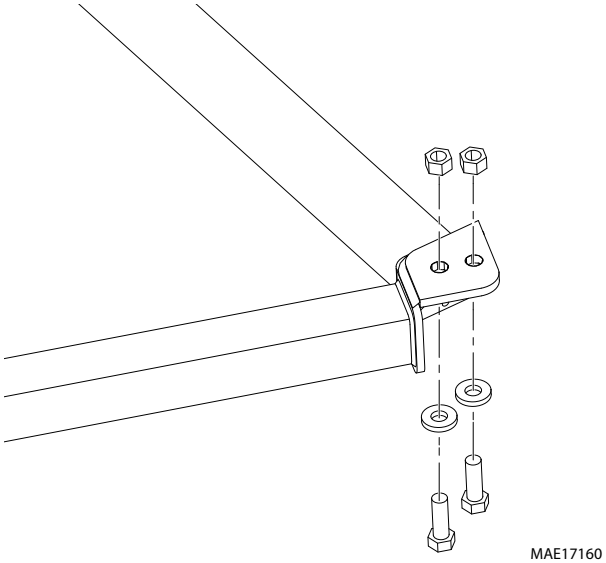


3. Apply Medium Strength Threadlocking Compound to the bolts and washers securing the support to the rotator and install the bolts and washers.

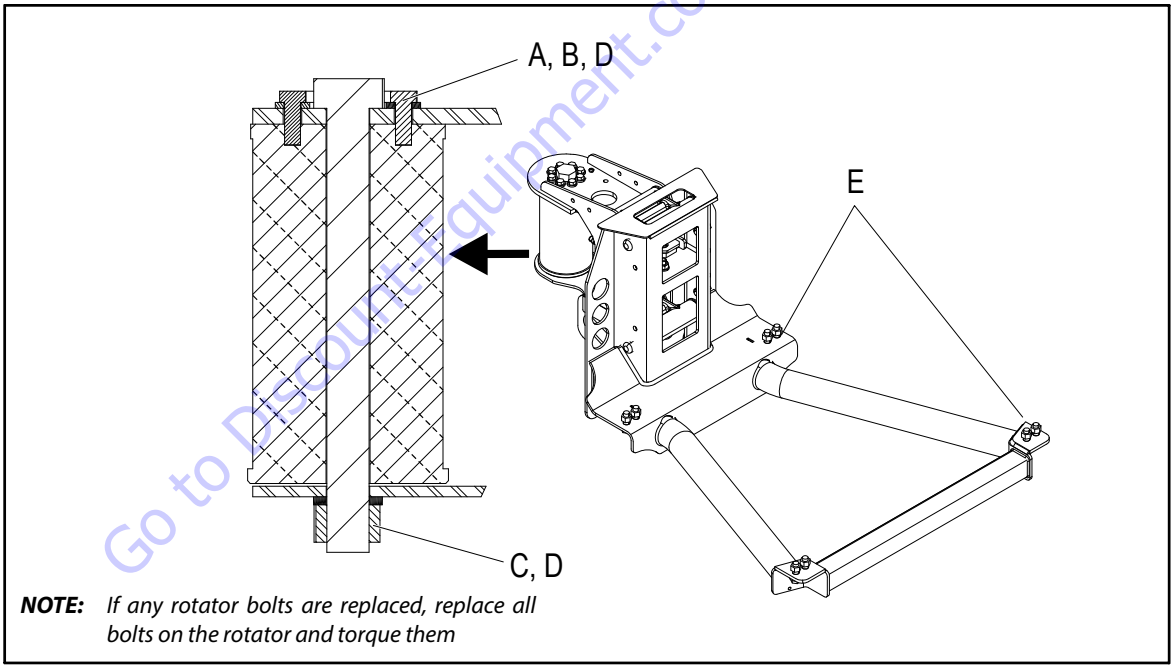


4. Torque the nut on the rotator center bolt to 586 ft. lbs. (795 Nm). Torque the retaining bolts to 40 ft. lbs. (55 Nm).

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



6. Remove tag and reconnect the hydraulic lines to the rotator.
7. Connect the electrical cables to the platform control console.



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

A	Torque to 40 ft.lbs. (55 Nm)
B	Medium Strength Threadlocking Compound
C	Torque 586ft. lb s. (795 Nm)
D	Check torque every 150 hours of operation
E	Torque 105 ft. lbs. (145 Nm)

Figure 4-5. Platform Support Torque Values