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# Service and Maintenance Manual

## Models **X33JP - X1000AJ**

**3121784 Rev A**

April 1, 2019

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## INTRODUCTION - MAINTENANCE SAFETY PRECAUTIONS

### NOTICE

This machine is powered by an 76VDC (nominal) electrical system. Based on employer, local, and governmental regulations as they pertain to this machine, specific electrical training and certifications may be required before servicing or troubleshooting.

### GENERAL

This section contains the general safety precautions which must be observed during maintenance of the aerial 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 AN AERIAL 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 IS THE RESPONSIBILITY OF THE OWNER/OPERATOR.**

### HYDRAULIC SYSTEM SAFETY

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

of the system.



### MAINTENANCE

### ⚠ WARNING

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

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

## **INTRODUCTION - MAINTENANCE SAFETY PRECAUTIONS**

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- KEEP ALL SUPPORT EQUIPMENT AND ATTACHMENTS STOWED IN THEIR PROPER PLACE.
- USE ONLY APPROVED, NONFLAMMABLE CLEANING SOLVENTS.

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## **REVISION LOG**

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## SECTION 1. SPECIFICATIONS

## 1.1 OPERATING SPECIFICATIONS

Model	X1000AJ/X33JP
Maximum work load (capacity)	500 lbs (230 kg)
Max. Vertical Platform Height	100 ft (30,5 m)
Max. Vertical Working Height	108 ft (33 m)
Max. Horizontal Platform Reach	52.5 ft (16 m)

## 1.2 DIMENSIONAL DATA

Model	X1000AJ/X33JP
Overall Width	without Platform: 3.92 ft (1,19 m) with Platform: 5.25 ft (1,6 m)
Outriggers Deployed Full Width	15.1 ft x 20.7 ft (4.6 m x 6.3 m)
Stowed Height	6.5 ft (1.99m)
Stowed Length	21.3 ft (6.5 m)
Approach angle	Front: 18° Rear: 16°

## 1.3 CHASSIS DATA

Model	X1000AJ/X33JP
Maximum Travel Grade w/ boom in stowed position (gradeability)	16°
Maximum Travel Side Slope w/ boom in stowed position	16° (29%)
Turning radius	360°
Maximum ground pressure per outrigger	58 psi (4 daN/cm <sup>2</sup> )
Maximum outrigger pad load	11,240 lb (5000 daN)
Outrigger pad diameter	14.7 in (400 mm)
Max drive speed (with std. 2nd speed)	Diesel Engine: 1.1 mph (1,8 km/h) (Lithium) Electric Engine: 0.8 mph (1,3 km/h)
Max hydraulic system pressure	3,046 psi (210 bar)
Maximum wind speed	28 mph (12,5m/s)
Maximum manual force	90 lb (400N)
Electrical system voltage	12V
Lithium-Ion system voltage	76V
Gross machine weight (platform empty)	Diesel: 16,865 lb (7650 kg) Lithium: 16,975 lb (7700 kg)

## 1.4 CAPACITIES

Model	X1000AJ/X33JP
Hydraulic Tank	21.1 gal (80L)
Fuel Tank	Diesel: 6.6 gal (25L)
Engine Oil	Diesel: 0.98 gal (3.71L)
Platform Capacity	2 occupants 500 lb (230 Kg)

## 1.5 ENGINE DATA

Model	D902-E3B
Emission Regulation	Tier 4
Type	Vertical 4-cycle Liquid Cooled Diesel
Number of Cylinders	3
Bore	2.83 in (72 mm)
Stroke	2.9 in (73,6 mm)
Displacement	54.80 cu. in(0,898 L)
Compustion System	IDI
Intake System	Naturally Aspirated
Maximum Speed	3200 rpm
Output: Gross Intermittent	16.1 KW 21.6 hp 21.9 ps
Direction of Rotation	Counterclockwise viewed on fly-wheel
Oil Pan Capacity	0.98 gal (3,7 L)
Starter Capacity	12 V (1,2 KW)
Alternator Capacity	12 V 40 A
Lenght	18.40 in (467,1 mm)
Width	16.6 in (420,5 mm)
Height (1)	21.42 in (544,1 mm)
Height (2)	8.03 in (204,0 mm)
Dry Weight	158.8 lb (72,0Kg)

## 1.6 ELECTRIC MOTOR DATA

Model	X1000AJ/X33JP
Rated Input Voltage	380V
Rated Frequency	50Hz
Rated Power	11 Kw

## SECTION 1 - SPECIFICATIONS

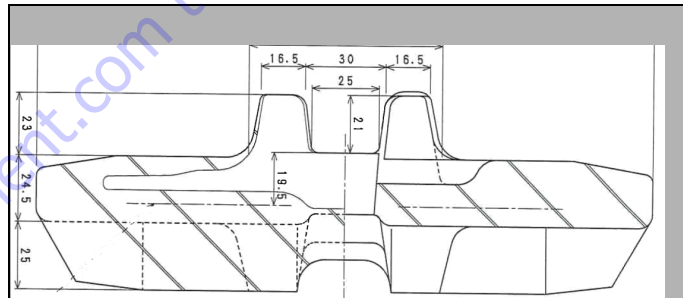
### 1.7 LITHIUM ION SPECIFICATIONS

Model	X1000AJ/X33JP
<b>Battery Pack</b>	
No. of cells in the battery pack:	72 cells
Rated voltage of each cell:	3.2 volt
Max. cell voltage:	3.65 volt
Min. cell voltage:	2.5 volt
Features of complete pack:	76 volt - 150 ampere/h
*Charge cycles:	3000 cycles
Cathode:	Lithium Ion Phosphate (LiFePO4)
Anode:	Graphite
Memory effect:	NO
<b>Battery Charger</b>	
Type:	120 V (+/- 30V) - 50/60 Hz
Necessary time to recharge:	4 hrs to 80% of recharge
<b>Electric System</b>	76 volt for the Lithium battery pack - 12 volt lead battery
<b>Electric Motor</b>	76 volt - three phase - 2000 watt
*The charge cycles have to be considered based on the fact that there is not memory effect in the lithium batteries, i.e. 2000 charges at 100% or 4000 charges at 50%, etc.	

### 1.8 MAJOR COMPONENT WEIGHTS

Model	X1000AJ/X33JP
Engine (Dry Weight)	Kubota D902 Diesel: 158 lb. (72 kg)
Boom Sections Combined	4,916 lb. (2,230 kg)
Lift Cylinders	
Level Cylinder:	16.5 lb. (7.5 kg)
Jib Cylinder:	26.5 lb. (12 kg)
3rd boom level cylinder:	16.5 lb. (7.5 kg)
Lift cylinder:	198.4 lb. (90 kg)
Upper lift cylinder:	154.3 lb. (70 kg)
Swing Actuator:	44 lb. (20 kg)
Telescope cylinder:	209.4 lb. (95 kg)
Platform	1 - occupants: 77.2 lb. (35 kg) 2 - occupants: 110.2 lb (50 kg)
Chassis	Diesel: 4,718 lb (2140 kg) Lithium: 4,828 lb (2190 kg)

### 1.9 TRACK SPECIFICATIONS



TYPE	PART NUMBER	DIMENSIONS
HI PROFILE BLACK COLOR	27589900	Cm 230 X 26 X 96
HI PROFILE NON-MARKING	2758990B	

## 1.10 FUNCTIONS SPEED RANGE

MACHINE MODEL	X33JP / X1000AJ	
POWER SYSTEM	Engine	Lithium
FUNCTION	TIME Sec	
TELESCOPE EXTEND	21" - 30"	45" - 60"
TELESCOPE RETRACT	21" - 30"	40" - 50"
TOWER BOOM UP	36" - 42"	45" - 60"
TOWER BOOM DOWN	36" - 45"	50" - 65"
UPPER BOOM UP	41" - 52"	50" - 70"
UPPER BOOM DOWN	41" - 52"	50" - 70"
BASKET ROTATE RIGHT	7" - 15"	7" - 15"
BASKET ROTATE LEFT	7" - 15"	7" - 15"
SWING LEFT	55" - 65"	60" - 80"
SWING RIGHT	55" - 65"	60" - 80"
JIB UP	7" - 15"	10" - 20"
JIB DOWN	7" - 15"	10" - 15"
BASKET LEVEL UP	33" - 55"	33" - 55"
BASKET LEVEL DOWN	37" - 50"	40" - 65"
DRIVE SPEED	0.68/1.24 mph 0.99/1.82 fps (1,1/2 Km/h)	0.43/0.75 mph 0.63/1.1 fps (0,7/1,2 Km/h)

### Machine Orientation When Performing Speed Tests

- **Lift:** Boom Retracted. Telescope Retracted. Lift Up, Record Time, Lift Down, Record Time.
- **Swing:** Machine stabilized, upper Boom at Full Elevation. Telescope Retracted. Swing the Turntable to the end stop. Swing the Opposite Direction, Record Time.
- **Telescope:** Boom at Full Elevation; Telescope Retracted; Telescope Out, Record Time. Telescope In, Record Time.
- **Drive:** Test to be done on a smooth level surface. Drive Select Switch should be set at 2WD High Engine. Start approximately 25 ft (7.62 m) from starting point so that the unit is at maximum speed when starting the test.
- **Platform Rotate:** Platform level and completely rotated one direction. Rotate the opposite direction, Record Time. Rotate the other direction, Record Time.
- **Articulating Jib:** Platform level and centered with the boom. Start with the Jib down. Jib Up, Record Time. Jib Down, Record Time.
- **Lower Lift:** Upper Boom horizontal. Telescoped In. Lower Lift Up, Record Time. Lower Lift Down, Record Time.

### Test Notes:

1. Stop watch should be started with the function, not with the controller or switch.
2. All speed tests are run from ground with remote control connected on the basket.
3. Function speeds may vary due to cold, thick hydraulic oil. Test should be run with the oil temperature above 100° F (38° C).

## 1.11 HYDRAULIC PRESSURE SETTINGS - PSI (BAR)

Table 1-1. Pressure Settings

MODEL	UNDERCARRIAGE Left and Right Control Valve		TOWER Control Valve	
	BAR	PSI	BAR	PSI
X33JP - X1000AJ	200	2900	200	2900

Table 1-2. Reduction Drive Speed Pressure Settings

MODEL	AUTOMATIC REDUCTIONS DRIVE SPEED	
	BAR	PSI
X33JP - X1000AJ	26	380

1.12 COMPONENT MAINTENANCE INTERVALS

Diesel maintenance intervals


Component	Operation	Hours					
		50	100	250	500	1000	2000
Dry Air Filter(Diesel Engine)	Check/Clean						
	Replace				•		
Engine Oil (Diesel Engine)	Check Level						
	Replace	•*	•				
Engine Oil Filter (Diesel Engine)	Check/Clean	•					
	Replace			•			
Fuel Filter (Diesel Engine)	Clean						
	Replace				•		
Cooling System (Diesel Engine)	Check Level						
	Liquid Add and Replacement					•	
Water Separator (Diesel Engine)	Clean and Drain Water	•*		•			
Hydraulic Oil	Check Level						
	Replace					•	
Hydraulic Oil Filter	Replace Cartridge	•*		•			
Articulated Joint Points	Grease	•*	•				
Battery	Check						
Reduction Gear Oil	Check Level		•				
	Replace	•*				•	
Machine	General Periodic Check					•	•*
Extension Arm Internal Sliding Ring (if equipped)	Check Wear			•			
	Replace					•	
Turntable Bolt Tightening	Check			•*	•		
Platform Mount Pin Nuts	Check torque 148 ft. lb. (200 Nm)					•****	
Extension Ropes and pulleys (if equipped)	Check Wear					•**	•*
	Replace						•***



\* 1st time interval then per chart thereafter  
 \*\* At least every 3 months or 1000 hrs. of operation  
 \*\*\* At lease every 5 years or 2000 hrs of operation. Check every year.  
 If torque is not correct, replace the nuts with new nuts of same specification.  
 Install dry without using grease or oil to specified torque.  
 \*\*\*\* At least once a year. Replace nuts if not properly torqued.

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**Lithium maintenance intervals**

Component	Operation	Hours					
		50	100	250	500	1000	2000
Hydraulic Oil	Check Level						
	Replace					.	
Hydraulic Oil Filter	Replace Cartridge	.*		.			
Articulated Joint Points	Grease	.*	.				
Battery (Auxiliary)	Check						
Reduction Gear Oil	Check Level		.				
	Replace	.*				.	
Machine	General Periodic Check					.	.*
Extension Arm Internal Sliding Ring (if equipped)	Check Wear			.			
	Replace					.	
Turntable Bolt Tightening	Check			.*	.		
Platform Mount Pin Nuts	Check torque 148 ft. lb. (200 Nm)					.****	
Extension Ropes and pulleys (if equipped)	Check Wear					.***	.*
	Replace						.****
* 1st time interval then per chart thereafter ** At least every 3 months or 1000 hrs. of operation *** At least every 5 years or 2000 hrs of operation. If torque is not correct, replace the nuts with new nuts of same specification. Install dry without using grease or oil to specified torque. **** At least once a year. Replace nuts if not properly torqued.							

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1.13 LUBRICATION

Hydraulic Oil

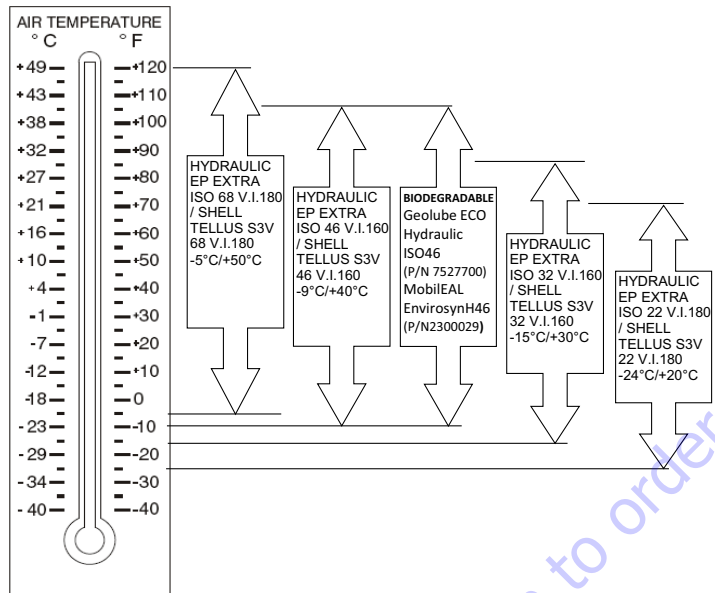


Figure 1-1. Hydraulic Oil Temperature Operating Range

FLUID	PROPERTIES		TYPE				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***
Pakelo Hydraulic EP Extra ISO 68	68	180	X							
Pakelo Hydraulic EP Extra ISO 46	46	160	X							
GeolubeECO Hydraulic ISO 46 (P/N 17527700)	47.3	144				X	X			
Pakelo Hydraulic EP Extra ISO 32	32	160	X							
Pakelo Hydraulic EP Extra ISO 22	22	180	X							
SHELL TELLUS S3V 68	68	180	X							
SHELL TELLUS S3V 46	46	160	X							
MobilEAL EnviroSynH46 (P/N2300029)						X	X			
SHELL TELLUS S3V 32	32	160	X							
SHELL TELLUS S3V 22	22	180	X							

Table 1-3. Hydraulic Oil Specifications

\* 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 per OECD 203

\*\*\* Fire Resistant classification indicates Factory Mutual Research Corp. (FMRC) Approval  
Flash point (C.O.C) for 68-46-32-22: 210°C

### 1.14 SERIAL NUMBER LOCATION

A serial number plate is affixed to the right side of the turn table frame. The following illustration showing the position.

<b>JLG</b>	Manufactured by HINOWA S.p.A. Via Fontana 37054 NOGARA (VR) ITALY																	
	DESIGNATION: TYPE <b>1</b> GROUP <b>B</b> MEWP's																	
JLG Industries, Inc - McConnellsburg, PA - USA																		
Model	<input type="text"/>																	
Serial number	<input type="text"/>																	
Year of manufacture	<input type="text"/>																	
G.V.W. (Dry)	<input type="text"/>	lbs/kg																
MAXIMUM ALLOWABLE OPERATING INCLINATION		<input type="text" value="1°"/>																
<table border="1"> <tr> <td>FT M</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>FT M</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>	FT M						FT M						<table border="1"> <tr> <td>28 MPH 12.5 M/S</td> <td>500 lbs 230 kg</td> <td>2x176 lbs 2x80 kg</td> <td>154 lbs 70 kg</td> <td>90 lbs 400 N</td> </tr> </table>	28 MPH 12.5 M/S	500 lbs 230 kg	2x176 lbs 2x80 kg	154 lbs 70 kg	90 lbs 400 N
FT M																		
FT M																		
28 MPH 12.5 M/S	500 lbs 230 kg	2x176 lbs 2x80 kg	154 lbs 70 kg	90 lbs 400 N														
THIS MACHINE MEETS OR EXCEEDS APPLICABLE REQUIREMENTS OF ANSI A92.20 - 2018 AND CAN/CSA-B354.6:17 ASORIGINALLY MANUFACTURED FOR INTENDED PURPOSE																		
08106200																		

Figure 1-2. Serial Number Plate



ML00530

Figure 1-3. X33JP / X1000AJ Serial Number Plate Location (on side of turn table frame)

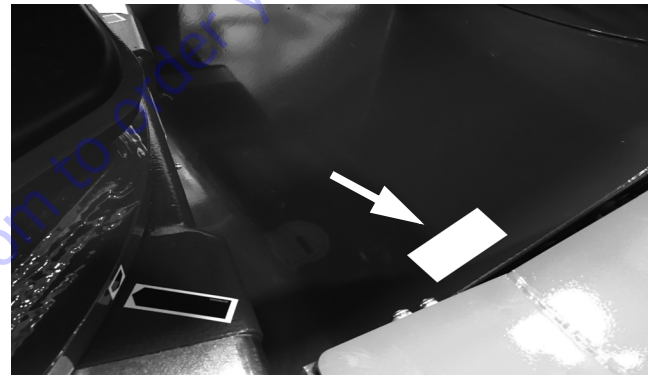


Figure 1-4. X33JP / X1000AJ Serial Number Stamp Location (Serial number stamped on chassis)

1.15 FASTENER TORQUE CHARTS

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)												
SAE GRADE 5 BOLTS & GRADE 2 NUTS						SAE GRADE 8 (HEX HD) BOLTS & GRADE 8 NUTS*						
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry)		Torque Lubricated		Torque (Locite® 242™ or 271™ OR Vibra-TITE™ 111 or 140)		Torque (Locite® 262™ or Vibra-TITE™ 131)	
					IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB
4	40	0.1120	0.00604	360	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	IN-M	FT-LB	IN-M	FT-LB	IN-M	FT-LB	IN-M
5/16	18	0.3125	0.0524	3340	17	23	13	18	26	22	16	
	24	0.3125	0.0580	3700	19	26	14	19	29	23	17	
3/8	16	0.3750	0.0775	4940	30	41	23	31	48	38	28	
	24	0.3750	0.0878	5600	35	47	25	34	54	43	32	
7/16	14	0.4375	0.1063	6800	50	68	35	47	55	45	34	
	20	0.4375	0.1187	7550	55	75	40	54	60	50	38	
1/2	13	0.5000	0.1419	9050	75	102	55	75	85	68	52	
	20	0.5000	0.1599	10700	90	122	65	88	100	80	62	
9/16	12	0.5625	0.1820	11600	110	149	80	108	120	98	75	
	18	0.5625	0.2030	12950	120	163	88	119	135	109	83	
5/8	11	0.6250	0.2260	14400	150	203	110	149	165	135	103	
	18	0.6250	0.2560	16300	170	230	130	176	190	158	120	
3/4	10	0.7500	0.3340	21300	280	353	200	298	338	240	183	
	16	0.7500	0.3730	23600	300	407	220	330	388	268	207	
7/8	9	0.8750	0.4620	29400	430	583	320	434	475	336	252	
	14	0.8750	0.5090	32400	470	637	350	475	520	370	285	
1	8	1.0000	0.6060	38600	640	868	480	651	718	518	396	
	12	1.0000	0.6630	42200	700	949	530	719	795	580	440	
1 1/8	7	1.1250	0.7630	42300	800	1085	600	813	900	668	500	
	12	1.1250	0.8560	47500	880	1193	660	895	925	725	550	
1 1/4	7	1.2500	0.9630	53600	1120	1518	840	1139	1175	880	660	
	12	1.2500	1.0730	59600	1240	1681	920	1247	1300	1000	750	
1 3/8	6	1.3750	1.1550	64100	1460	1979	1100	1491	1525	1118	840	
	12	1.3750	1.3150	73000	1680	2278	1260	1708	1750	1322	980	
1 1/2	6	1.5000	1.4050	78000	1940	2630	1460	1979	2025	1506	1120	
	12	1.5000	1.5900	87700	2200	2963	1640	2224	2300	1714	1280	

NO. 5000059 REV. K

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

Figure 1-5. Torque Chart - Sheet 1 of 5 - (SAE Fasteners)

Values for Magni Coating Fasteners (Ref 4150701)																	
SAE GRADE 5 BOLTS & GRADE 2 NUTS						SAE GRADE 8 (HEX HD) BOLTS & GRADE 8 NUTS*											
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry) K=0.17	Torque (Locitite® 242™ or 271™ OR Vibra-TITE™ 111 or 140) K=0.16		Torque (Locitite® 262™ or TITE™ 131) K=0.15		Clamp Load	Torque (Dry or Locitite® 263) K=0.17		Torque (Locitite® 242™ or 271™ OR Vibra-TITE™ 111 or 140) K=0.16		Torque (Locitite® 262™ or TITE™ 131) K=0.15		
						IN-LB	FT-LB	IN-LB	FT-LB		IN-LB	FT-LB	IN-LB	FT-LB	IN-LB	FT-LB	IN-LB
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									
							FT-LB	IN-LB									
5/16	18	0.3125	0.0524	3340	15	20	14	19	15	20	4720	20	25	20	25	20	25
	24	0.3125	0.0580	3700	15	20	15	21	15	20	5220	25	35	20	25	20	25
3/8	16	0.3750	0.0775	4940	25	35	25	34	25	34	7000	35	50	35	50	35	50
	24	0.3750	0.0878	5600	30	40	28	38	25	34	7900	40	55	40	55	35	50
7/16	14	0.4375	0.1063	6800	40	55	40	54	35	54	9550	60	80	55	75	50	70
	20	0.4375	0.1187	7550	45	60	44	60	40	54	10700	65	90	60	80	60	80
1/2	13	0.5000	0.1419	9050	65	90	60	82	55	75	12750	90	120	85	115	80	110
	20	0.5000	0.1589	10700	75	100	71	97	65	88	14400	100	135	95	130	90	120
9/16	12	0.5625	0.1820	11600	90	120	87	118	80	109	16400	130	175	125	170	115	155
	18	0.5625	0.2030	12950	105	145	97	132	90	122	18250	145	195	135	185	130	175
5/8	11	0.6250	0.2260	14400	130	175	120	163	115	156	20350	180	245	170	230	160	220
	18	0.6250	0.2560	16300	145	195	136	185	125	170	23000	205	280	190	260	180	245
3/4	10	0.7500	0.3340	21300	225	305	213	290	200	272	30100	320	435	300	410	280	380
	16	0.7500	0.3730	23800	255	345	238	324	225	306	33600	355	485	335	455	315	430
7/8	9	0.8750	0.4620	29400	365	495	343	466	320	435	41600	515	700	485	660	455	620
	14	0.8750	0.5090	32400	400	545	378	514	355	483	45800	570	775	535	730	500	680
1	8	1.0000	0.6060	38600	545	740	515	700	480	653	51500	730	995	685	930	645	875
	12	1.0000	0.6630	42200	600	815	600	815	563	721	59700	845	1150	795	1080	745	1015
1 1/8	7	1.1250	0.7630	42300	675	920	635	863	595	809	68700	1095	1490	1030	1400	965	1310
	12	1.1250	0.8560	47500	765	1025	713	969	670	911	77000	1225	1665	1155	1570	1085	1475
1 1/4	7	1.2500	0.9690	53800	965	1300	897	1219	840	1142	87200	1545	2100	1455	1980	1365	1855
	12	1.2500	1.0730	59600	1055	1435	993	1351	930	1265	96600	1710	2325	1610	2190	1510	2055
1 3/8	6	1.3750	1.1550	64100	1250	1700	1175	1598	1100	1496	104000	2025	2755	1905	2590	1785	2430
	12	1.3750	1.3150	73000	1420	1930	1338	1820	1255	1707	118100	2300	3130	2165	2945	2030	2760
1 1/2	6	1.5000	1.4050	78000	1660	2260	1560	2122	1465	1992	126500	2690	3660	2530	3440	2370	3225
	12	1.5000	1.5800	87700	1865	2535	1754	2385	1645	2237	142200	3020	4105	2845	3870	2685	3625

NO. 5000059 REV. K

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

Figure 1-6. Torque Chart - Sheet 2 of 5 - (SAE Fasteners)

SOCKET HEAD CAP SCREWS												
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load See Note 4	Magni Coating (Ref 4150701)*			Zinc Yellow Chromate Fasteners (Ref 4150707)*				
					Torque (Dry) K = .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	Clamp Load See Note 4	Torque (Dry) K = .20	Torque (Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140 OR Precoat 85®) K=0.18	Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	LB	IN-LB [N.m]	FT-LB [N.m]	IN-LB [N.m]	IN-LB [N.m]	IN-LB [N.m]	FT-LB [N.m]	IN-LB [N.m]	IN-LB [N.m]
4	40	0.1120	0.00604		122	14	114	13				
	48	0.1120	0.00661		139	16	131	15				
6	32	0.1380	0.00909		20	25	20	25				
	40	0.1380	0.01015		25	35	20	25				
8	32	0.1640	0.01400		35	50	35	50				
	36	0.1640	0.01474		40	55	40	55				
10	24	0.1900	0.01750		60	80	55	70				
	32	0.1900	0.02000		65	90	60	80				
1/4	20	0.2500	0.0318	2860	122	14	114	13	2860	143	16	129
	28	0.2500	0.0364	3280	139	16	131	15	3280	164	19	148
		In	Sq In	LB	FT-LB [N.m]		FT-LB [N.m]		LB	FT-LB [N.m]		FT-LB [N.m]
5/16	18	0.3125	0.0624	4720	20	25	20	25	4720	25	35	20
	24	0.3125	0.0680	5220	25	35	20	25	5220	25	35	25
3/8	16	0.3750	0.0775	7000	35	50	35	50	7000	45	60	40
	24	0.3750	0.0878	7900	40	55	40	55	7900	50	70	50
7/16	14	0.4375	0.1063	9550	60	80	55	70	9550	70	95	60
	20	0.4375	0.1187	10700	65	90	60	80	10700	80	110	70
1/2	13	0.5000	0.1419	12750	90	120	85	110	12750	105	145	95
	20	0.5000	0.1599	14400	100	135	95	120	14400	120	165	110
9/16	12	0.5625	0.1820	16400	130	175	125	155	16400	155	210	140
	18	0.5625	0.2030	18250	145	195	135	175	18250	170	230	155
5/8	11	0.6250	0.2260	20350	180	245	170	230	20350	210	285	190
	18	0.6250	0.2560	23000	205	280	190	260	23000	240	325	215
3/4	10	0.7500	0.3340	30100	320	435	300	380	30100	375	510	340
	16	0.7500	0.3730	33600	355	485	335	455	33600	420	570	380
7/8	9	0.8750	0.4620	41600	515	700	485	660	41600	605	825	545
	14	0.8750	0.5090	45800	570	775	535	730	45800	670	910	600
1	8	1.0000	0.6060	51500	730	995	685	930	51500	860	1170	775
	12	1.0000	0.6630	59700	845	1150	795	1080	59700	995	1355	895
1 1/8	7	1.1250	0.7630	68700	1095	1490	1030	1400	68700	1290	1755	1160
	12	1.1250	0.8560	77000	1225	1665	1155	1570	77000	1445	1965	1300
1 1/4	7	1.2500	0.9690	87200	1545	2100	1455	1980	87200	1815	2470	1635
	12	1.2500	1.0730	96600	1710	2325	1610	2190	96600	2015	2740	1810
1 3/8	6	1.3750	1.1550	104000	2025	2755	1905	2590	104000	2365	3245	2145
	12	1.3750	1.3150	118100	2300	3130	2165	2945	118100	2705	3680	2435
1 1/2	6	1.5000	1.4050	126500	2690	3660	2530	3440	126500	3165	4305	2845
	12	1.5000	1.5800	142200	3020	4105	2845	3870	142200	3555	4835	3200

NO. 5000059 REV. K

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 OR FASTENER IS PLACED AGAINST PLATED STEEL OR RAW ALUMINUM  
 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.

Figure 1-7. Torque Chart - Sheet 3 of 5 - (SAE Fasteners)

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)											
CLASS 8.8 METRIC (HEX/SOCKET HEAD) BOLTS CLASS 8 METRIC NUTS					CLASS 10.9 METRIC (HEX HEAD) BOLTS CLASS 10 METRIC NUTS CLASS 12.9 SOCKET HEAD CAP SCREWS M3 - M5*						
Size	PITCH	Tensile Stress Area	Clamp Load	Torque (Dry or Loctite® 263™)	Torque (Lub)	Torque (Loctite® 262™ OR VIBRA-TITE™ 131)	Torque (Loctite® 242™ or 271™ OR VIBRA-TITE™ 111 or 140)	Clamp Load	Torque (Dry or Loctite® 263™) K = 0.20	Torque (Lub 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]	[N.m]	KN	[N.m]	[N.m]	[N.m]
3	0.5	5.03	2.19	1.3	1.0	1.2	1.4	3.13			
3.5	0.6	6.78	2.95	2.1	1.6	1.9	2.3	4.22			
4	0.7	8.78	3.82	3.1	2.3	2.8	3.4	5.47			
5	0.8	14.20	6.18	6.2	4.6	5.6	6.8	8.85			
6	1	20.10	8.74	11	7.9	9.4	12	12.5			
7	1	28.90	12.6	18	13	16	19	18.0	25	23	19
8	1.25	36.60	15.9	26	19	23	28	22.8	37	33	27
10	1.5	58.00	25.2	50	38	45	55	36.1	70	65	55
12	1.75	84.30	36.7	88	66	79	97	52.5	125	115	95
14	2	115	50.0	140	105	126	154	71.6	200	180	150
16	2	157	68.3	219	164	197	241	97.8	315	280	235
18	2.5	192	83.5	301	226	271	331	119.5	430	385	325
20	2.5	245	106.5	426	320	383	469	152.5	610	550	460
22	2.5	303	132.0	581	436	523	639	189.0	830	750	625
24	3	353	153.5	737	553	663	811	222.0	1065	960	800
27	3	459	199.5	1080	810	970	1130	286.0	1545	1390	1160
30	3.5	561	244.0	1460	1100	1320	1530	349.5	2095	1885	1575
33	3.5	694	302.0	1990	1490	1790	2090	432.5	2855	2570	2140
36	4	817	355.5	2560	1920	2300	2690	509.0	3665	3300	2750
42	4.5	1120	487.0	4090	3070	3680	4290	698.0	5665	5275	4395

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS  
 2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%  
 \*3. ASSEMBLY USES HARDENED WASHER OR FASTENER IS PLACED AGAINST PLATED STEEL OR RAW ALUMINUM  
 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.

NO. 500059 REV. K

Figure 1-8. Torque Chart - Sheet 4 of 5 - (METRIC Fasteners)

Values for Magni Coated Fasteners (Ref 4150701)										
CLASS 8.8 METRIC (HEX/SOCKET HEAD) BOLTS CLASS 8 METRIC NUTS					CLASS 10.9 METRIC (HEX HEAD) BOLTS CLASS 10 METRIC NUTS CLASS 12.9 SOCKET HEAD CAP SCREWS M6 AND ABOVE*					
Size	PITCH	Tensile Stress Area	Clamp Load	Torque (Dry or Loctite® 263™) K=0.17	Torque (Loctite® 262™ OR Vibra-TITE™ 131) K=0.16	Torque (Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140) K=0.15	Clamp Load	Torque (Dry or Loctite® 263™) K = 0.17	Torque (Lub 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]	KN	[N.m]	[N.m]	[N.m]
3	0.5	5.03	2.19	1.1	1.1	1.0	3.13			
3.5	0.6	6.78	2.95	1.8	1.7	1.5	4.22			
4	0.7	8.78	3.82	2.6	2.4	2.3	5.47			
5	0.8	14.20	6.18	5.3	4.9	4.6	8.85			
6	1	20.10	8.74	9	8.4	7.9	12.5	13	12	11
7	1	28.90	12.6	15	14	13	18.0	21	20	19
8	1.25	36.60	15.9	22	20	19	22.8	31	29	27
10	1.5	58.00	25.2	43	40	38	36.1	61	58	55
12	1.75	84.30	36.7	75	70	66	52.5	105	100	95
14	2	115	50.0	119	110	105	71.6	170	160	150
16	2	157	68.3	186	175	165	97.8	265	250	235
18	2.5	192	83.5	256	240	225	119.5	365	345	325
20	2.5	245	106.5	362	340	320	152.5	520	490	460
22	2.5	303	132.0	494	465	435	189.0	705	665	625
24	3	353	153.5	627	590	555	222.0	905	850	800
27	3	459	199.5	916	860	810	286.0	1315	1235	1160
30	3.5	561	244.0	1245	1170	1100	349.5	1780	1680	1575
33	3.5	694	302.0	1694	1595	1495	432.5	2425	2285	2140
36	4	817	355.5	2176	2050	1920	509.0	3115	2930	2750
42	4.5	1120	487.0	3477	3275	3070	698.0	4985	4690	4395

NO. 500059 REV. K

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 OR FASTENER IS PLACED AGAINST PLATED STEEL OR RAW ALUMINUM

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.

Figure 1-9. Torque Chart - Sheet 5 of 5 - (METRIC Fasteners)

# PARTS FINDER

**Search Website  
by Part Number**



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

**Search Manuals**

Enter your information to search for parts manuals and lookup part numbers.

\* Brand:

\* Model:

\* Serial:

\* Part Number:

SEARCH

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

**Parts Order Form**

Please fill in the following information to request help finding a part or manual.

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Model:

Description:

Quantity:

Part Number:

Part Name:

Part Location:

Part Condition:

Part Material:

Part Color:

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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 2. GENERAL

### 2.1 MACHINE PREPARATION, INSPECTION, AND MAINTENANCE

#### General

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

#### Preparation, Inspection, and Maintenance

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

#### Pre-Start Inspection

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

#### Pre-Delivery Inspection and Frequent Inspection

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

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

this inspection must be increased as environment, severity and frequency of usage requires.

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

#### Annual Machine Inspection

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

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

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

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

**Table 2-1. Inspection and Maintenance**

TYPE	FREQUENCY	PRIMARY RESPONSIBILITY	SERVICE QUALIFICATION	REFERENCE
Pre-Start Inspection	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.
Preventative Maintenance	At intervals as specified in the Service and Maintenance Manual.	Owner, Dealer, or User	Qualified JLG Mechanic	Service and Maintenance Manual

## 2.2 SERVICE AND GUIDELINES

### General

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

### Safety and Workmanship

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

### Cleanliness

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

them clean. Be sure all parts are clean before they are installed. New parts should remain in their containers until they are ready to be used.

### Components Removal and Installation

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

### Component Disassembly and Reassembly

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

### Pressure-Fit Parts

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

## Bearings

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

## Gaskets

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

## Bolt Usage and Torque Application

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

## Hydraulic Lines and Electrical Wiring

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

## Hydraulic System

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

## Lubrication

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

## Battery

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

## Lubrication and Servicing

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

## 2.3 LUBRICATION AND INFORMATION

### Hydraulic System

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

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

**Hydraulic Oil**

Refer to Section 1 for recommendations for viscosity ranges.

**Changing Hydraulic Oil**

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

**Lubrication Specifications**

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

**2.4 CYLINDER DRIFT TEST**

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

**Cylinder Drift**

**Table 2-2. Cylinder Drift**

CYLINDER BORE DIAMETER		MAX ACCEPTABLE DRIFT IN 1 MINUTE	
INCHES	MM	INCHES	MM
2.1	55	0.02	0.53
2.3	60	0.021	0.54
2.5	65	0.013	0.35
2.7	70	0.026	0.68
2.9	75	0.013	0.35
3.1	80	0.011	0.29
3.7	95	0.009	0.23
3.9	100	0.007	0.2
4.5	115	0.005	0.15
4.9	125	0.004	0.12
6.1	155	0.002	0.07

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

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

If the cylinder passes this test, it is acceptable.

## 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.)**



## SECTION 3. CHASSIS &amp; TURNTABLE

## 3.1 RUBBER TRACK MAINTENANCE

## Checking Track Tension

Stop the machine on firm, level surface. Lift the machine into safe conditions and place stable supports under the under-carriage frame for total support. Parallel with the central roller of the under-carriage, measure distance (A) from the bottom of the roller to the rigid inside of the rubber belt. Track tension is normal if measurement (A) is between 10 and 15 mm.

If track tension is not within the measurements specified above, loose or too tight, follow the procedures illustrated in the paragraph below.

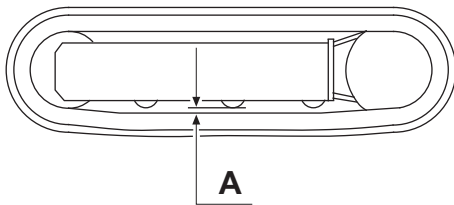


Figure 3-1.

## Operations For Loosening/tightening The Track

The grease contained in the hydraulic track is pressurised. For this reason, do not loosen the greasing valve (1) by more than 1 turn; if the valve is loosened too much, it risks being expelled under the effect of the pressure of the grease, putting the safety of the operator at risk. Never loosen greaser (2).

When gravel or mud are blocked between the toothed wheel and the track links, remove it before loosening.

1. Remove the screws and take of adjustment access lid 3.
2. To loosen the track, slowly unscrew valve 1 in an anti-clockwise direction for no more than one turn. One turn of valve 1 is sufficient to loosen the track.
3. If the grease does not start to drain, turn the track slowly.

4. When correct track tension has been obtained, turn valve (1) in a clockwise direction and tighten it. Clean all traces of grease.

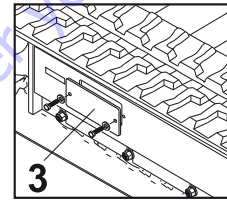
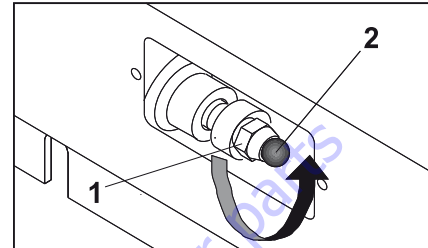


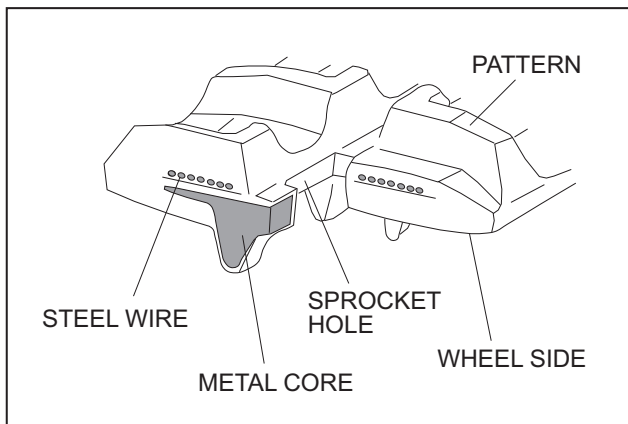
Figure 3-2.

5. To tighten the track, connect a grease gun to greaser (2) and add grease until belt tension is within the specified values.

**⚠ DANGER**

**IT IS NOT NORMAL IF THE TRACK REMAINS TAUGHT AFTER HAVING TURNED VALVE (1) IN AN ANTI-CLOCKWISE DIRECTION OR IF THE TRACK IS STILL LOOSE AFTER HAVING PUT GREASE INTO GREASER (2). NEVER TRY TO REMOVE THE TRACKS OR DISASSEMBLE THE TRACK-TENSIONED CYLINDER BECAUSE THE GREASE PRESSURE INSIDE THE TRACK IS VERY DANGEROUS.**

## Checking The Rubber Tracks



**Figure 3-3. Rubber Track Structure**

The structure of the rubber track is illustrated in Figure 3-3. The steel ropes and the metal core are imbedded into the rubber. The carved profiles are used to give traction when moving over loose land. They are situated in the lower part resting on the ground, while the wheel guides situated inside the track, prevent the track from escaping from the guide rollers.

### CAUSES OF DAMAGE

#### 1. Breakage of the steel ropes

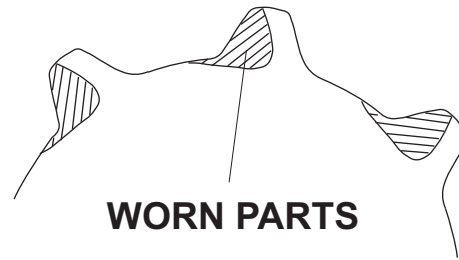
Excessive tension causes the steel ropes to break in the following conditions:

- a. when stones or foreign bodies accumulate between the track and the under-carriage frame;
- b. when the track escapes from its guide;
- c. in the case of strong friction such as rapid direction changes.

#### 2. Wear and breakage of the metal cores

As for breakage of the steel ropes, stated above, excessive tension may cause the metal cores to bend or break, as may the following causes:

- a. incorrect contact between toothed wheel and track;
- b. breakage of internal rollers;
- c. functioning on sandy land.



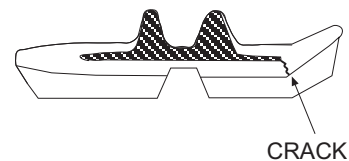
**Figure 3-4.**

#### 3. Separation of the metal cores

- a. The metal core acts as a type of adhesive of the rubber between the core itself and the steel ropes. Separation may be caused by excessive tension as breakage of the ropes for the following reasons:
  - b. The metal cores have been wound by the worn toothed wheel as indicated in the figure. When this wear and abrasion is detected, the toothed wheel must be replaced as soon as possible.
  - c. If it breaks, as stated in item 2, "Wear and breakage of the metal cores", the track must be replaced because this damage leads to a complete loss of functions.

#### 4. Abrasion and fatigue cracks

- a. The cracks at the base of the carved profile occur due to bending fatigue of the rubber caused by the toothed wheel and the track-tensioning wheel.
- b. The cracks and bends on the edge of the rubber are due to manoeuvres with the track in presence of cement kerbs and edges.



**Figure 3-5.**

- c. The cracks and abrasions in the rubber on the tracks of the roller guide originate from fatigue from the compression of the rubber by the weight of the wheel, together with functioning on sandy land, or repeated and abrupt changes of direction.
- d. Abrasion of the carved profiles may occur especially if slewing on concrete surfaces or on gravel or hard surfaces are carried out.



- e. The damage indicated in paragraphs a, b, and c above, must not be considered fatal for the track and, even if in presence of gradual and progressive damage, they allow the track to continue working. The development of the damage indicated in point 3 leads to the exposure of the metal cores and if they are exposed for more than half of the track circumference, it means that it is time to replace them. It can however still be used.
5. Cracks due to external factors

Cracks on external track surfaces (those in contact with the ground) are often due to contact with gravel, sharp stones, sharp materials, nails, glass, which cause cuts. From the rubber properties point of view, this is inevitable although it does depend on service conditions. Cracks on the internal surface of the circumference and on the edge of the rubber originate from contact of the belt with the structure of the undercarriage or with sharp concrete edges. The increase in cracks is relatively small. Even if it does not appear to be in good condition the track can be used in heavy duty conditions.

## Replacing The Rubber Tracks

### **⚠ DANGER**

THE GREASE CONTAINED IN THE HYDRAULIC TRACK IS PRESSURISED. FOR THIS REASON, DO NOT LOOSEN THE GREASING VALVE (1) BY MORE THAN 1 TURN; IF THE VALVE IS LOOSENED TOO MUCH, IT RISKS BEING EXPELLED UNDER THE EFFECT OF THE PRESSURE OF THE GREASE, PUTTING THE SAFETY OF THE OPERATOR AT RISK. NEVER LOOSEN GREASER (2).

When gravel or mud are blocked between the toothed wheel and the track links, remove it before loosening.

### Removing The Rubber Track

1. Stop the machine on solid, level land, lift it and support it in safe conditions, using the outriggers.

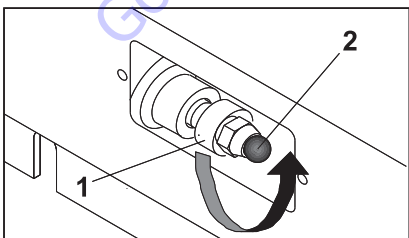
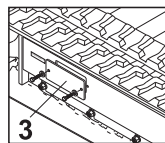


Figure 3-6.

2. Remove the screws and take of adjustment access lid 3.



3. To loosen the track, slowly unscrew valve 1 in an anti-clockwise direction for no more than one turn. One turn of valve 1 is sufficient to loosen the track.
4. If the grease does not start to drain, turn the track slowly.
5. Insert three steel pipes (4) inside the track in the space between the rollers. Turn the driving wheel backwards (5) in a way that the steel pipes proceed with the track and engage on the track-tensioning wheel. Apply force (6) laterally to allow the track to run and lift it from the track-tensioning wheel.

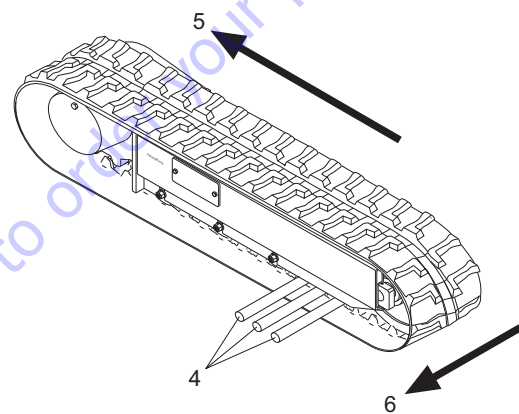


Figure 3-7.

## Installing The Rubber Track

### **⚠ DANGER**

ENSURE SAFE CONDITIONS WITH THE MACHINE LIFTED TO PROCEED WITH MOUNTING THE TRACKS.

1. Check that the grease contained in the hydraulic cylinder has been removed.
2. Engage the track links with the toothed wheel and position the other end of the track on the track-tensioning wheel.
3. Turn the driving wheel in reverse (7) pushing the track plate inside the frame (8).
4. Position the track using a steel pipe and turn the driving wheel again.
5. Ensure that the track links are correctly engaged in the toothed wheel and in the track-tensioning wheel.
6. Adjust track tension (see paragraph -Operations for loosening/tightening the track).
7. Rest the tracked under-carriage on the ground.

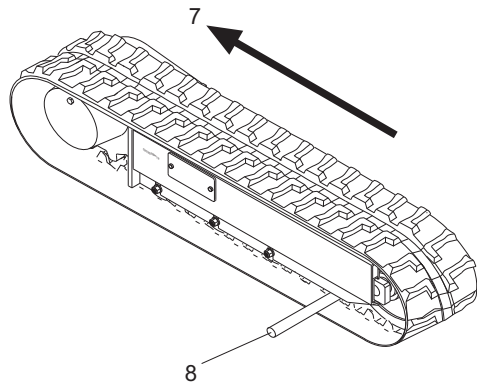


Figure 3-8.

### Checking tightness of nuts and bolts

Depending on the use of the platform, it is indispensable to check the parts and the nuts and bolts in general, which are subject to loosening.

Pay particular attention to the frame components, such as track-tensioning wheels, traversing geared motors, driving wheels and guide rollers. Check that they are tightened sufficiently as indicated in the following table.

The values indicated are to be applied unless otherwise stated in this manual.

ilize the machine on level ground.

## 3.2 UNDERCARRIGE COMPONENTS

- a. Fully extend the undercarriage.
- b. Remove the tracks (see sub-section 3.1).
- c. Remove the key ignition, and a tag with warning do not start the machine.

### Replacement roller lower wheel and tracks adjuster

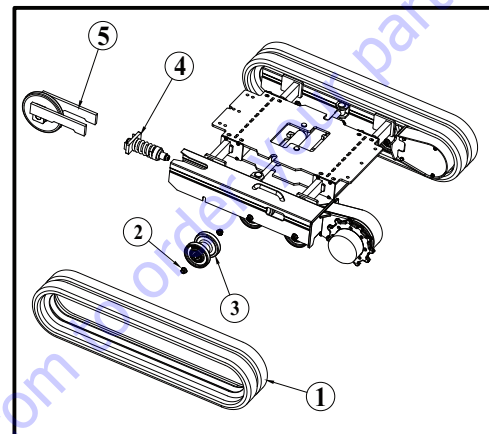


Figure 3-9.

### Disassembly

1. Remove the nuts 2 on the lower roller.
2. Remove the lower roller 3.
3. Remove the front idler 5.
4. Remove the tracks adjuster 4.

### Assembly

1. Fit the tracks adjuster 4.
2. Instal the front idler 5.
3. Instal the lower roller 3.
4. Apply loctite 243 and torque the nuts 2 on the lower roller at 125Nm.

### Replacement sprocket and Gear Motor

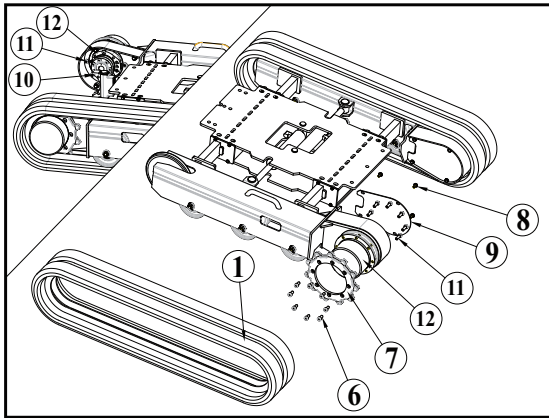


Figure 3-10.

### Sprocket remove

1. Fully extend the undercarriage.
2. Remove the tracks (see paragraph 3.1).
3. Remove the key ignition, and a tag with warning do not start the machine.
4. Remove screws 6.
5. Remove the sprocket 7.

### Gear motor remove

1. Remove cover 9.
2. Disconnect and tag the hydraulic hoses from the gearmotor.
3. Remove the valve 10 to access all the screws 11 (on single speed versions only).
4. Remove the screws 11.
5. Remove the gearmotor 12.

### Gear motor installation

1. Fix the screws 11.
2. Instal the valve 10.
3. Connect the Hydraulic hoses
4. Instal the cover 9.

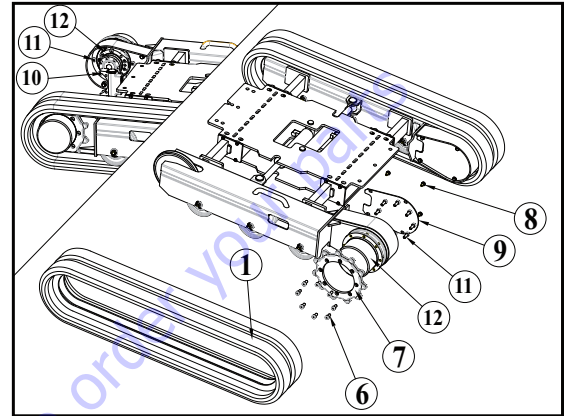


Figure 3-11.

### Sprocket installation

1. Instal the sprocket
2. Instal the screws 6

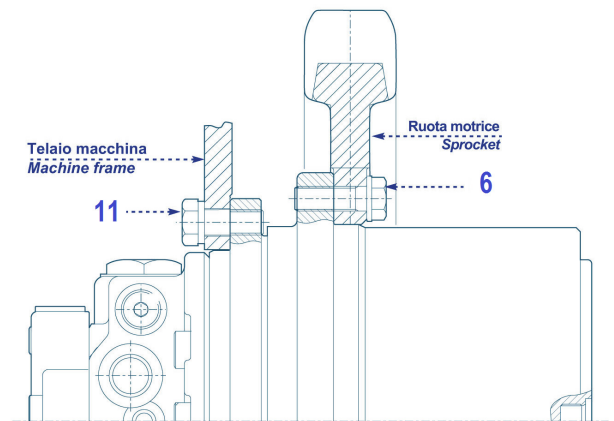


Table 3-1. Final Drive Torque Valves

MACHINE MODEL	SPROCKET SCREW N. 6 TORQUE VALUES	FINAL DRIVE SCREW N. 11 TORQUE VALUES
X33JP - X1000AJ	M12x18 - Nm 86	M12x30 - Nm 86

### 3.3 AXLE EXTENSION REMOVAL

1. Stabilize the machine on level surface.
2. Extend the undercarriage.
3. Turn engine and key off.
4. Remove the key ignition, and a tag with warning do not start the machine.
5. Open the hydraulic cap, and operate the function undercarriage extend/retract to discharge any residual pressure in the system.

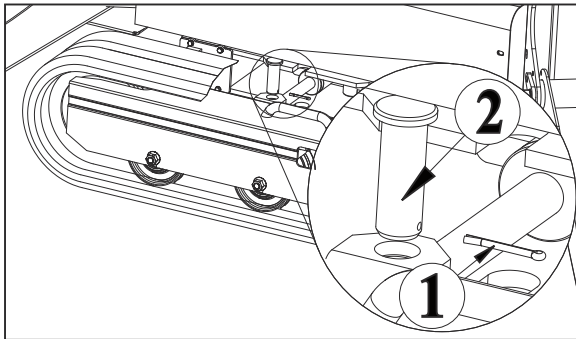


Figure 3-12.

6. Remove the cotter pin 1 - (figure 3-13)
7. Remove the pin 2

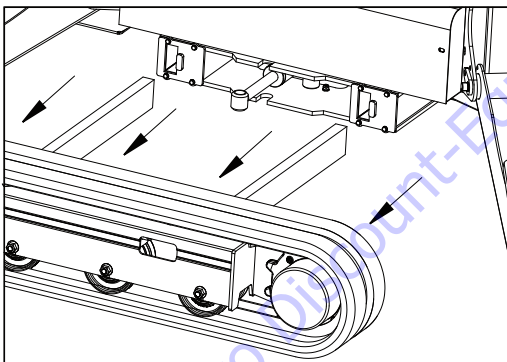


Figure 3-13.

8. Using a suitable lifting device (minimum 441 lb. (200kg) capacity) to remove the track frame.

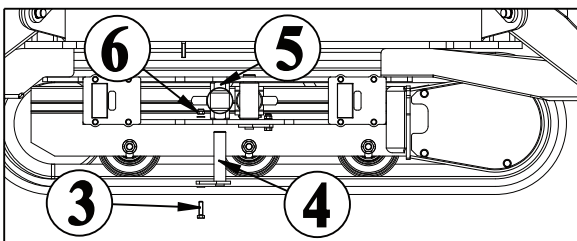


Figure 3-14.

9. Remove screw and nut 3 and 6.
10. Remove the pin 4.
11. Disconnect, tag and plug the hydraulic hoses from the cylinder extension.

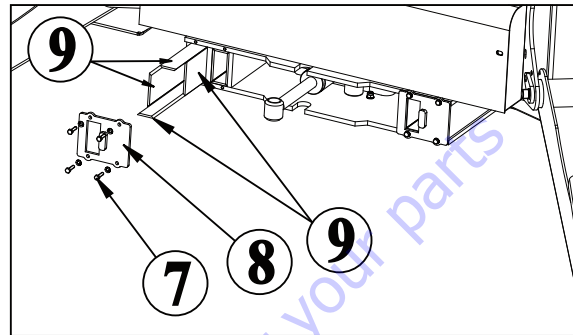


Figure 3-15.

12. Remove the cylinder.

**NOTE:** Before to install the undercarriage frame inspect the slide guides 9.

- a. Unscrew the screws 7.
- b. Remove the stop slide guides 8.
- c. Remove the slide guides 9.
- d. Check the thickness of slide guides, if less than 3.5 mm, damage, with deep scratches or with deformation, replace its. Otherwise clean them and install by adding Grease GR MU EP1 before to install the track guides.
- e. Use medium strength Loctite (Loctite 243) on screws 7 and tightening torque of 10 Nm.

### 3.4 FINAL DRIVE

Table 3-2. Final Drive Models

MACHINE	TYPE	SPEED
X33JP-X1000AJ	701C2K+MAG18	AUTOTWOSPEED

#### Product Identification

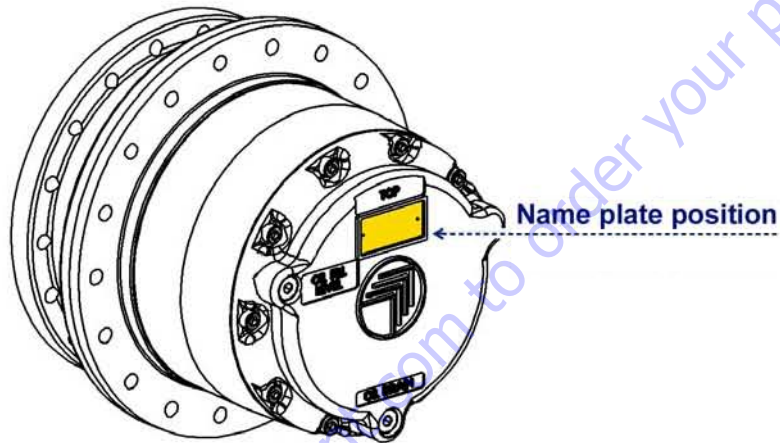
The data to identify the product are shown on the identification plate attached to it.

#### Information

For all enquiries regarding general information on the product, spare parts, assistance etc, always give the identification data stamped on the ID plate.

The gearmotor has two ID plates, one gives data on the gearbox and the other data on the hydraulic motor.

The plates must not be removed or damaged during the life of the product. The following illustration shows how the data is set out.

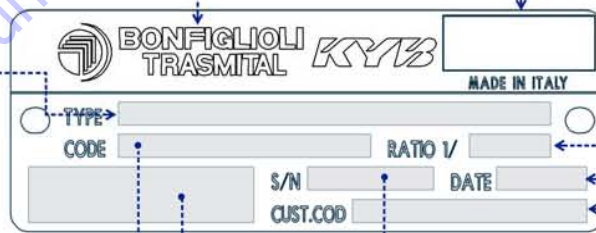


Identificazione del Costruttore  
Manufacturer's identification

Designazione del prodotto:  
composizione alfanumerica che consente di identificare il prodotto.  
Product designation:  
alphanumeric composition which allows identification of the product.

Codice prodotto  
Trasmital Bonfiglioli  
Trasmital Bonfiglioli  
product code

Codice a barre (tipo 128)  
Bar code (type 128)



Codice del montatore  
Assembler code

Rapporto di riduzione  
Reduction ratio

Data di produzione  
Date of production

Codice del prodotto cliente  
Customer product code

Numero di matricola  
Serial number

### 3.5 SWING DRIVE (IMO)

#### Technical Data – Type Plate

**IMO ANTRIEBSEINHEIT**

Drawing No. \_\_\_\_\_

Identification - Code \_\_\_\_\_ Module \_\_\_\_\_

[www.imo.de](http://www.imo.de)

Figure 3-16. Type plate

The type plate is on the housing and contains the following information:

- Manufacturer
- Drawing no./type
- Identification code consisting of:
  - Order number, year of manufacture and consecutive number
- Module
- Web address

#### Structure and function

##### Brief description

Slew drives are used for concurrent transmission of axial and radial forces, as well as transmission of tilting moments. Slew drives consist of a ball or roller slewing ring, hydraulic or electric drives, and a completely enclosing housing. Force is transmitted to the mounting structure through bolts. For this purpose through holes or threads are provided in the inner and outer ring.

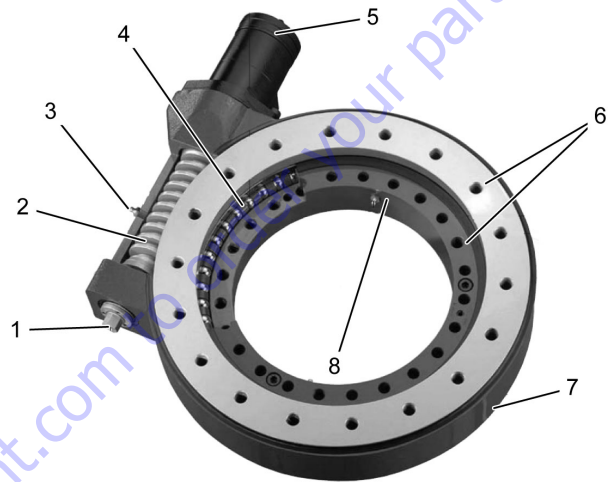
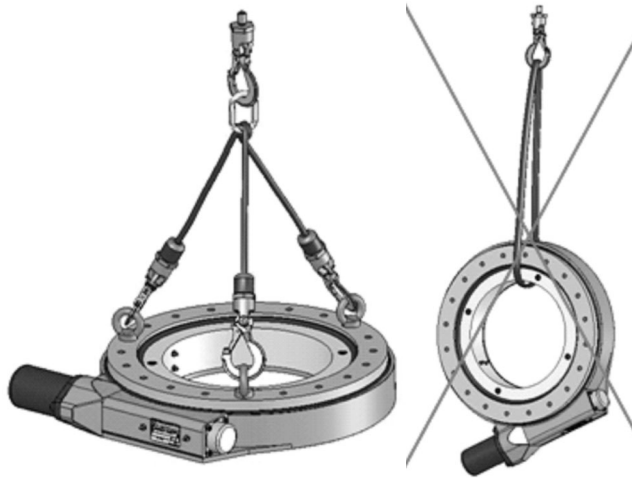


Figure 3-17. Slew drive WD-L

1. Connection for options: Potentiometer, permanent brake or front-end brake
2. Worm shaft
3. Lubricating nipple
4. Ball slewing ring
5. Option: Drive motor
6. Bolted unions for the mounting structure
7. Housing
8. Lubricating nipple

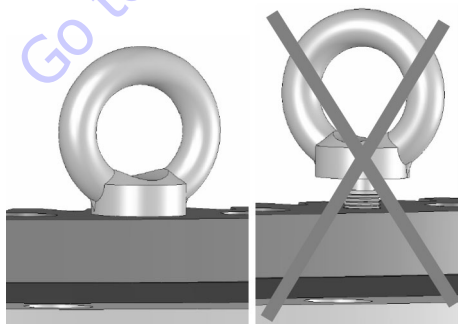
## Transporting Unpacked Slew Drives



**Figure 3-18. Use suitable lifting gear/never transport product vertically**

Unpacked slew drives can be transported with lifting gear when using eye bolts under the following conditions

- The lifting gear must be configured appropriately for the weight of the transport units.
- The ring bolts must be configured appropriately for the weight of the transport unit.
- The slew drive shall only be transported by itself, without attached parts.
- Maintain the insertion depth prescribed by the manufacturer.
- If insertion depth is not prescribed, then a minimum insertion depth of 1.5 x the bolt diameter must be selected.
- Transport within the company shall only be executed horizontally.



**Figure 3-19. Always use the full length of the thread**

### Attachment:

1. Screw the 3 eye bolts into the 3 threads that are distributed uniformly on the circumference of the slew drive.

### **⚠ WARNING**

**SCREW IN THE EYE BOLTS TO THE FULL THREAD LENGTH! IMPROPERLY ATTACHED, UNSUITABLE, OR DAMAGED EYE BOLTS MAY CAUSE THE SLEW DRIVE TO FALL AND CAUSE LIFE-THREATENING INJURIES.**

2. Attach lifting gear to the eye bolts.
3. Start the transport.

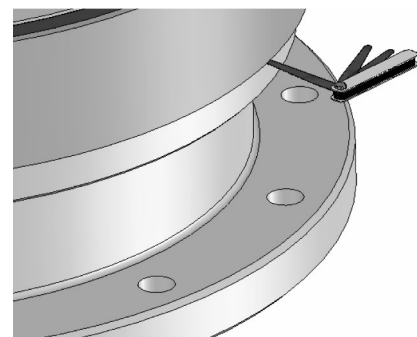
### Positioning The Swing Drive

1. Determine the main load-carrying zone. The main load-carrying zone is that area of the slewing ring that is subject to the highest load, taking all aggressive forces and torques, and all occurring load cases into account.
2. Arrange the hardness gap of the bearing ring charged with point load so that it is offset by 90° relative to the main load-carrying zone. The main load-carrying zone is in the main slewing range.

### **⚠ CAUTION**

**THE HARDNESS GAP OR THE FILLING PLUG IN A SLEWING RING CONSTITUTE A ZONE OF DECREASED LOAD-CARRYING CAPACITY. THE SERVICE-LIFE OF THE SLEW DRIVE WILL BE REDUCED SIGNIFICANTLY, IF THE HARDNESS GAP IS IN THE MAIN SLEWING RANGE. FRACTURE OF BEARING RING FOR EXAMPLE MAY CAUSE SLEW DRIVE FAILURE. CONSEQUENTLY PLACE THIS MARKED POINT IN A REDUCED LOAD ZONE IF POSSIBLE.**

3. Use a feeler gauge to check whether the support surface of the slew drive is completely supported by the mounting structure. If this is not the case, the support surface of the mounting structure must be reworked.



**Figure 3-20. Check the support surface**

### Bolting The Slew Drive

**⚠ WARNING**

DO NOT USE IMPACT SCREWDRIVERS. USING AN IMPACT SCREWDRIVER MAY CAUSE IMPERMISSIBLE DEVIATIONS BETWEEN THE BOLT TIGHTENING FORCES. FAILURE OF THE BOLTED UNION WITH THE MOUNTING STRUCTURE MAY CAUSE SEVERE PERSONAL INJURY OR MATERIAL DAMAGE.

**NOTICE**

MOUNT THE SLEW DRIVE IN UNSTRESSED STATE.

Strictly comply with the procedure specified below to avoid impermissible deviations between the bolt tightening forces:

**NOTICE**

FIRST FASTEN THE HOUSING, THEN FASTEN THE TOOTHED BEARING RING!

1. Use medium strength Loctite (Loctite 243) on screws.
2. Pretension the bolts, with washers if required, crosswise in 3 steps, 30%, 80%, and 100% of the tightening torque, or the hydraulically applied pretension force.
3. In this process turn the unscrewed ring several times. Repeat the procedure for the bearing ring that has not yet been bolted.

If using a hydraulic bolt-tensioning cylinder the tensioning forces for the bolt pretension should not exceed 90% of yield strength.

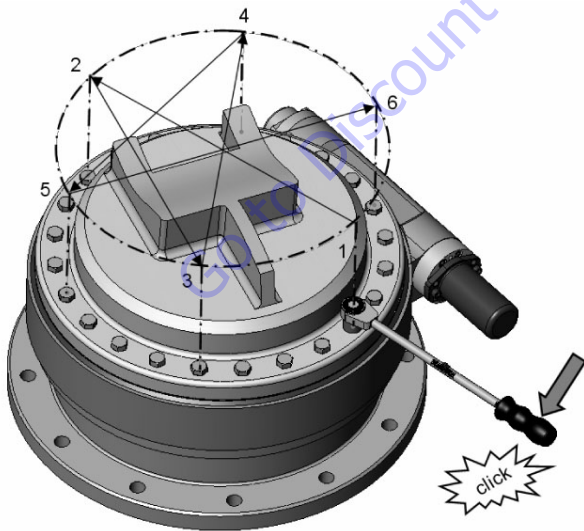


Figure 3-21. Tighten crosswise

Table 3-3.

MOUNTING BOLT DIMENSIONS	MOUNTING PRETENSION FORCE $F_M$ <sup>1)</sup> STRENGTH CLASS 10.9 in	
	kN	lbs
M24	282	63396
M27	367	82505
M30	448	100714
M33	554	124544
M36	653	146800
M42	896	201429
M45	1043	234476
M48	1177	264600
M52	1405	315857
M56	1622	364640
M60	1887	424215
M64	2138	480642
M68	2441	548759

<sup>1)</sup>  $F_M$  for hydraulic bolt-tensioning cylinder pretension to 85% of yield strength.

Table 3-4.

MOUNTING BOLT DIMENSIONS	MOUNTING PRETENSION FORCE $F_M$ <sup>1)</sup> STRENGTH CLASS 10.9 in	
	kN	lbs
1-8UNC	301	67668
1 1/8-7UNC	379	85203
1 1/4-7UNC	481	108133
1 3/8-6UNC	573	128816
1 1/2-6UNC	697	156692
1 5/8-6UNC	832	187041
1 3/4-5UNC	942	211770

<sup>1)</sup>  $F_M$  for hydraulic bolt-tensioning cylinder pretension to 85% of yield strength.



### Maintenance Schedule

Maintenance tasks are described in the sections below that are required for optimal and trouble-free operation.

If increased wear is detected during regular inspections, then reduce the required maintenance intervals according to the actual indications of wear.

If you have questions concerning maintenance tasks and intervals, please contact our customer service.

INTERVAL	MAINTENANCE TASK	TO BE EXECUTED BY
Weekly	Check seal	Qualified person
After 250 Operating Hours	Check tighten bolts	Qualified person
	Check tilting clearance	Qualified person
After Every Additional 500 Operating Hours Or At Least Every 6 Months	Check tighten bolts Reduce the inspection interval if there is heavy wear or continuous operation.	Qualified person
	Check tilting clearance Reduce the inspection interval to 200 operating hours if the detected increase in tilting clearance is approximately 75% of the permissible tilting clearance increase. After further increase reduce the interval between inspections to 50 - 100 hours.	Qualified person
	Check circumferential backlash Reduce the inspection interval to 200 operating hours if the detected increase in circumferential backlash is approximately 75% of the permissible circumferential backlash increase. After further increase reduce the interval between inspections to 50 - 100 hours.	Qualified person

### Lubrication

General re-lubrication of slew drives:

- After each cleaning
- Before and after longer periods of standstill, e.g. for cranes and construction machines during the winter months.

**NOTICE**

**THE MAIN CAUSE FOR SLEWING RING FAILURE IS INADEQUATE LUBRICATION. THE LUBRICATION INTERVALS ESSENTIALLY DEPEND ON EXISTING WORKING AND ENVIRONMENTAL CONDITIONS, AS WELL AS THE VERSION OF THE SLEW DRIVE. PRECISE LUBRICATION INTERVALS CAN ONLY BE DETERMINED BY TESTS UNDER NORMAL OPERATING CONDITIONS.**

The specified values are valid for the following conditions:

- Operating temperature on the slew drive < 70° C (158° F).
- Circumferential speed < 0.5 m/s (1.64 ft/sec) for SP slew drives.
- Output speed < 5 rpm for WD slew drives.
- Low to moderate load.

**NOTICE**

**COMPLY WITH THE INSTRUCTIONS IN THE OPERATING MANUAL PROVIDED BY THE MANUFACTURER, FOR LUBRICATION OF OPTIONAL INTERMEDIATE GEAR UNITS, BRAKES, AND MOTORS.**

**NOTICE**

**IF NECESSARY RE-LUBRICATE PERMANENT BRAKES. FOR THIS ONLY USE THE SPECIAL GREASE SHELL RETINAX HDX2.**

If comparable results are not available, the following table can be used as a guide value:

WORK CONDITIONS	LUBRICATING INTERVAL	TO BE EXECUTED BY
Dry and clean workshop hall (rotary tables, robots, etc.)	Approx. every 300 operating hours, at least every 6 months	Specialist
Severe conditions on open terrain (cranes, excavators, etc.)	Approx. every 100 to 200 operating hours, at least every 4 months	Specialist
Aggressive climatic conditions, (ocean, desert, arctic climate, extremely polluted environment, ≥70 operating hours per week	Every 50 operating hours, at least every 2 months	Specialist
Extreme conditions (tunnel boring machines, steel works, wind turbines)	Continuous lubrication (through central lubrication or grease cups)	Specialist

## Maintenance Tasks

### Inspecting The Mounting Bolts

#### NOTICE

TO COMPENSATE FOR SETTLING, THE BOLTS MUST BE RETIGHTENED WITH THE PRESCRIBED TIGHTENING TORQUE. RETIGHTENING MUST BE EXECUTED WITHOUT EXERTING ADDITIONAL EXTERNAL STRESS ON THE BOLTED UNION.

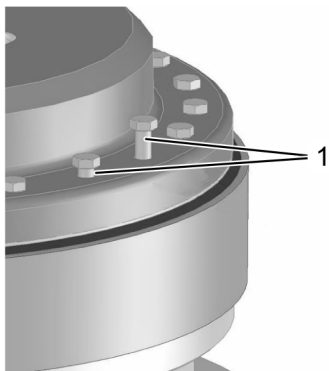


Figure 3-22. Inspecting the mounting bolts

#### 1. Detached bolt

Execution only by a specialist.

- Special tools required:
  - Torque wrench
  - Hydraulic clamping fixture
- Replace loose and detached bolts or nuts and washers with new bolts, nuts and washers.
- Use the same bolt size and bolt quality.

#### NOTICE

IF A HYDRAULIC CLAMPING FIXTURE WAS USED TO TIGHTEN THE BOLTS, THEN A HYDRAULIC CLAMPING FIXTURE MUST ALSO BE USED TO CHECK THE BOLT PRETENSION. ALWAYS USE THE SAME TIGHTENING PROCEDURE AS SPECIFIED FOR INSTALLATION OF THE SLEW DRIVE WHEN CHECKING THE BOLTED UNION.

## Lubricating The Slew Drive

### NOTICE

REGULARLY LUBRICATE THE SLEW DRIVES TO PROLONG THEIR SERVICE LIFE AND ENSURE SAFE OPERATION.

### NOTICE

ALWAYS USE THE LUBRICANTS SPECIFIED IN THE ORDER DRAWING. IF USING OTHER LUBRICANTS PAY ATTENTION TO THE RELATIVE MIX ABILITY OF THE SUBSTANCES. THE STANDARD LUBRICANTS USED ARE "R.TECC NORPLEX LKP2" FROM RHENUS, OR THE GREASE "OPTIMOL LONGTIME PDO" FROM CASTROL. IF IN DOUBT, OR IF THERE IS NO SPECIFICATION ON THE DRAWING, CONSULT WITH OUR CUSTOMER SERVICE. USING THE WRONG LUBRICANT MAY CAUSE DAMAGE TO THE SLEW DRIVES AND REDUCE THE SERVICE LIFE. IN THIS CASE, ANY WARRANTY SHALL BE EXCLUDED. COMPLY WITH THE INSTRUCTIONS PROVIDED BY THE LUBRICANT MANUFACTURER!

- If possible use a central lubrication system to lubricate the raceway system. In this regard ensure that the hoses are filled with grease at commissioning and that the storage tanks are regularly topped up with grease.
- An automatic re-lubricating system significantly facilitates re-lubrication for the raceway system and the toothing. Functional safety as well as wear behavior are improved.
- Comply with the instructions in the operating manual provided by the respective manufacturer for lubrication of optional intermediate gear units, brakes, and motors.
- If it is evident that moisture has penetrated into the slew drive, or has been absorbed by the grease, you must re-lubricate more intensively.

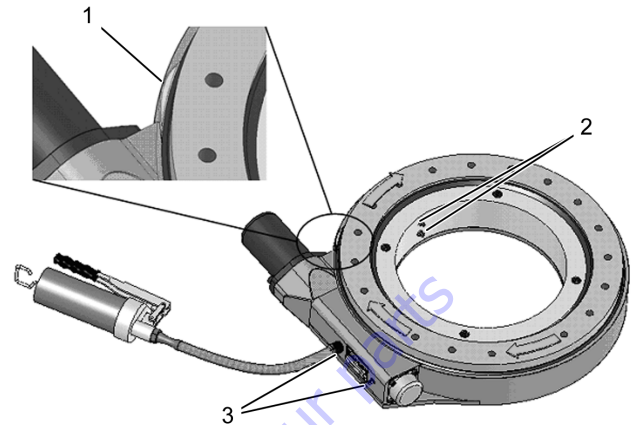


Figure 3-23. Lubricating the slew drive

1. Fresh lubricant
2. Lubricating nipple, bearing ring
3. Lubricating ring housing
4. In succession, press grease into all lubricating nipples while simultaneously turning the slew drive all the way through, until a continuous collar of grease forms under at least one seal.
5. Ensure that old lubricant can escape without obstruction.

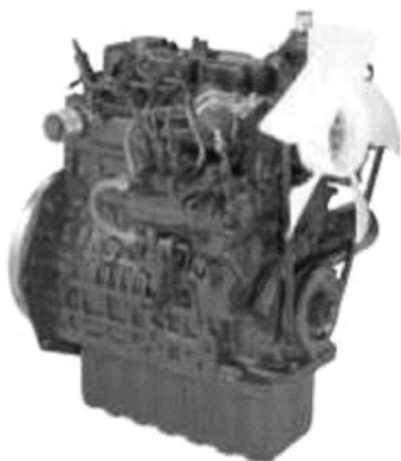
## Inspecting The Seals

### NOTICE

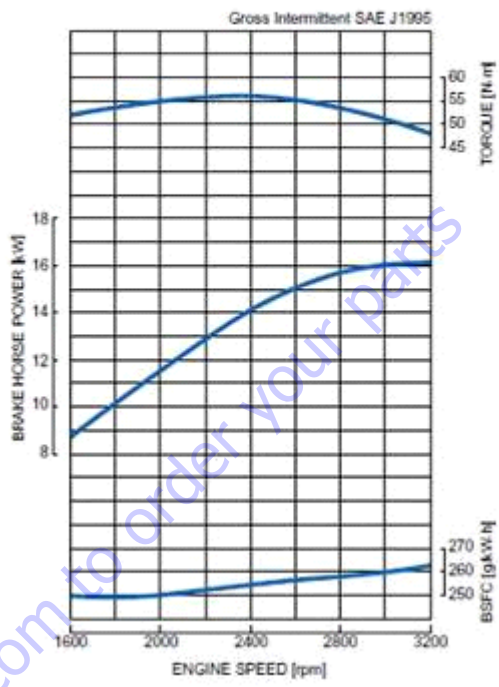
DAMAGED SEALS MUST BE REPLACED IMMEDIATELY. IF THERE IS CORROSION DAMAGE OR FUNCTIONAL IMPAIRMENT A CONSEQUENCE OF DAMAGED SEALS NOT BEING REPLACED AT THE PROPER TIME, ANY WARRANTY SHALL BE EXCLUDED. PENETRATING MOISTURE MAY QUICKLY CAUSE CORROSION IN THE BEARING RING AND IMPAIRS SAFE OPERATION. NOTE THAT THE FACTORY-INSTALLED SEAL ONLY OFFERS PROTECTION AGAINST DUST AND SPLASHING WATER.

If damage is detected on a seal, contact the customer service organization without delay.

3.6 KUBOTA DIESEL ENGINE MODEL D902



**PERFORMANCE CURVE**



Type	Vertical 4-Cycle Liquid Cooled Diesel
Combustion System	IDI
Intake System	Naturally Aspirated
Diesel fuel intake system	Electric Pump
Number of cylinders	3
Power	16,1 Kw (21,6 Hp) / 3200 rpm
Max rpm	3200 rpm
Direction of rotation	Counter clockwise Viewed on Flywheel
Max torque	56 Nm / 2400 rpm
Displacement	898 cm <sup>3</sup>
Bore	72 mm (2,83 in)
Stroke	73,6 mm (2,9 in)
Fuel tank capacity	40 litres
Emission Regulation	Tier 4F
Dry Weight (according to Kubota's standards)	72 Kg (158,8 Lbs)

## Engine Plate



The engine plate with serial number is placed on the engine head close to muffler collector and includes the following engine information:

1. Engine model
2. Engine serial number
3. Engine code No

The information shown above is necessary for any engine spare parts or information required.

### SECTION 3 - CHASSIS & TURNTABLE

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The fuel system of the diesel engine is fed by an electric fuel pump mounted beside the fuel tank as indicated by picture below.



### Troubleshooting

*Those Instructions valid for all machines serial number*

On engine left side remove the engine hood and cut the strap to access to the harness, plug.



**Figure 3-24.**  
Disconnect the plug harness

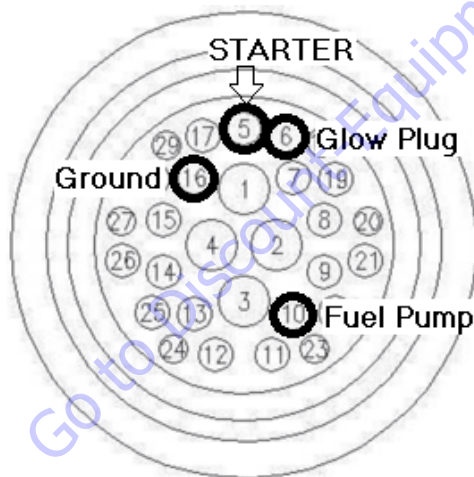
To shutdown the engine disconnect wire of Pin 10. The engine will continue to run for a while until it ends the fuel on the line.

### Engine Speed Sensor

A sensor in the diesel engine detects the engine rpm's and communicates this data to the master controller.



**Figure 3-26.**  
Speed Sensor on Kubota D902



**Figure 3-25. Female Connector**

On Female connector jump the follows wires:

- Pin 16 (Ground) to battery negative terminal.
- Pin 10 (fuel pump) to battery positive terminal.
- Pin 6 (Glow plugs) hook up if necessary for few second only.
- Pin 5 (Starter) For a moment utilize hook up this pin for as key starter.

### Speed Sensor Installation and Adjustment



**Figure 3-27.**

1. Install the speed sensor into the housing until it contacts the flywheel.
2. Back the sensor out 1 turn.
3. Tight the nut.

### Diesel Engine RPM control

On Diesel powered units a throttle actuator controls the fuel to manage the engine speed based on operating conditions.



Figure 3-28.

Throttle actuator on Kubota D902

### Diesel Actuator Rod Travel Adjustment

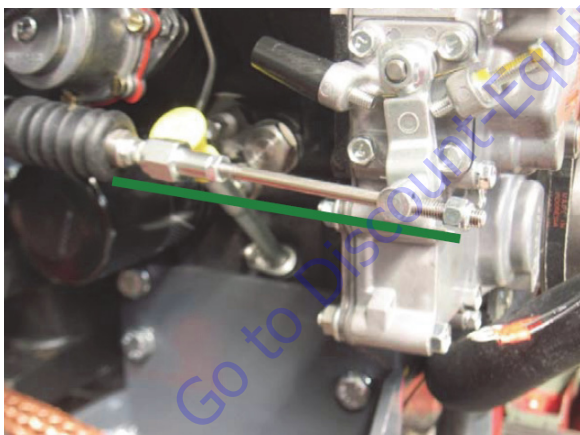


Figure 3-29.

With the control linkage pushed against the idle stop, adjust the lock nut.

### 3.7 THERMIC ENGINE REPLACEMENT

1. Place and stabilize the machine on a flat and level surface.
2. Turn machine OFF and remove the key ignition, and a tag with warning do not start the machine.
3. Remove the cover 1.

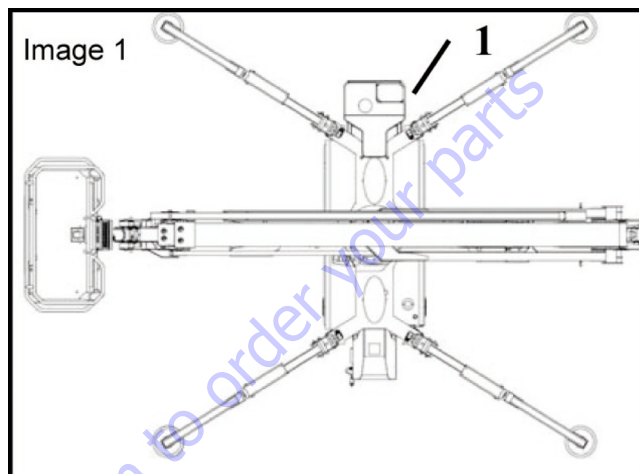


Figure 3-30. Engine cover

4. Disconnect, tag and isolate the wires from the engine.
5. Disconnect the oil pipes and cooling lines, then drain the 2 circuits.

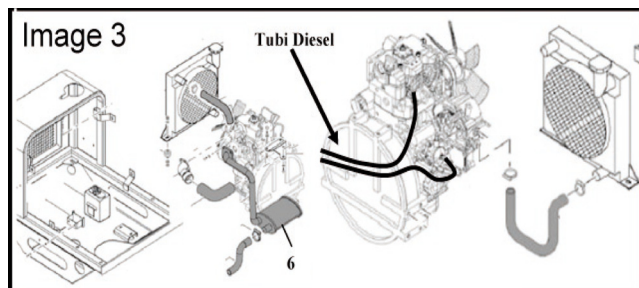


Figure 3-31. Image 3

1. Replace the engine and tighten the screws  
Torque screws to 16.2 ft. lb. (22N-m) and 18.5 ft. lb. (25Nm) respectively.
2. Connect the wires to the motor.
3. Replace guard on motor (1) and test the machine.



### 3.8 ELECTRIC MOTOR REPLACEMENT

1. Place and stabilize the machine on a flat and level surface, rotate the turret 90° (Figure 3-32.).
2. Turn machine OFF and remove the Key switch, make sure that plug connector is disconnect, and the machine is isolate from any electrical power supply.
3. Remove the cover.

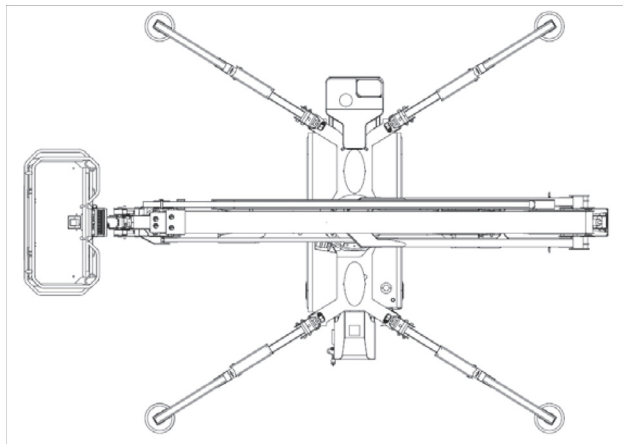


Figure 3-32. Cover position engine

4. Open the cover of the electrical box (7), label and disconnect the wires attached to the electrical motor and isolate the wires end
5. Remove the four bolts that attach the pumps adapter to the electrical motor.
6. Remove the four mounts bolts (2) that attach the electrical motor to the frame.
7. Carefully lift, remove the electrical motor and separate from the pumps adapter.
8. After the electrical motor has been removed, loosen the screw (3) and pull off the coupler (4).

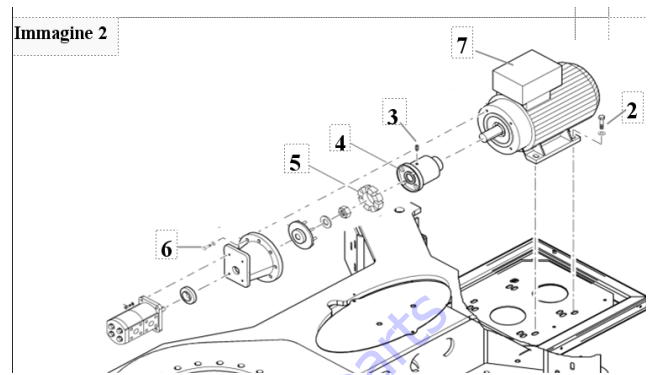


Figure 3-33.

9. For the electrical motor installation follow the procedure in opposite order from step 5 to step 8.
10. After mounting the electrical motor, tighten four mounts bolts (item 2) to 29.5 ft. lb. (40N-m) while the bolts (6) of the pumps adapter to 16.23 ft. lb. (22N-m).
11. Reattach the previously labelled electrical wires to the electrical motor and close the cover of the electrical box (item 7).

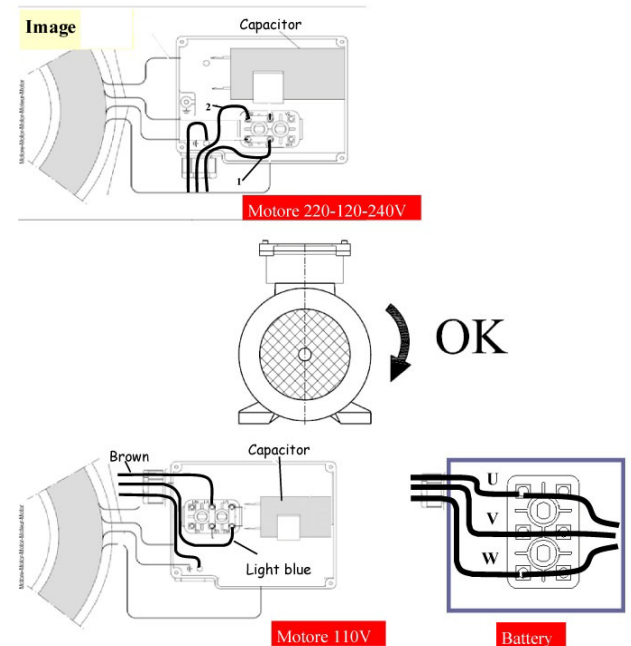


Figure 3-34.

12. Energize the system and start the electrical motor
13. Check from the fan side, if the electrical motor run in correct CW direction, otherwise swap the wires connected as shown on (Figure 3-35.).

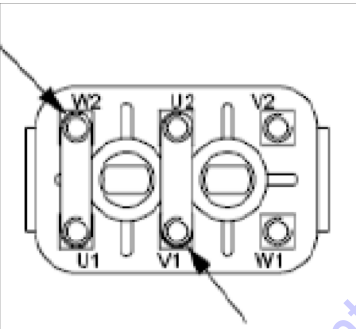
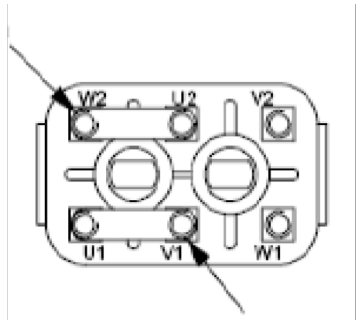
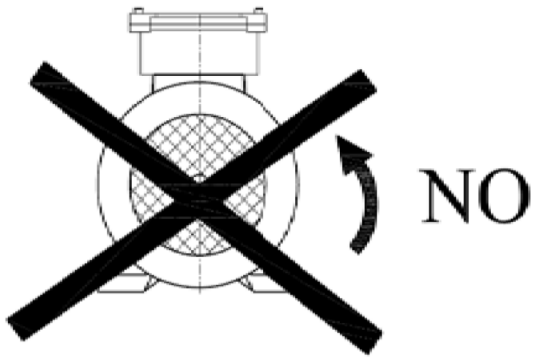


Figure 3-35.

14. Install cover and test the machine.

### 3.9 LITHIUM MACHINE WITH 83V LITHIUM BATTERY SYSTEM

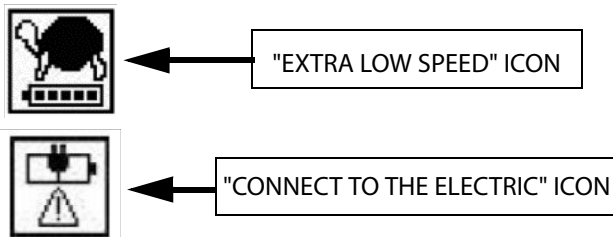
#### Charge Information

The level of charge of the lithium pack is shown by the icon on the right lower corner of the display, or more in detail by the input SOC (State Of Charge).

When Lithium pack State of Charge (SOC) is lower than 21%, remote control beeper is activated to inform the operator that machine need to be charged.

When SOC is lower than 11%, inverter feeds electric motor with an half of the standard speed.

When SOC is lower than 6%, inverter feeds electric motor with an extra low speed, and the following icon are displayed.



When SOC is 0%, machine could not be moved and the icon "CONNECT TO THE ELECTRIC NETWORK" is displayed in the middle of the display.

#### Lithium Cells

Number of cells in the battery pack	72 cells, 24 groups of cells connected in series
Nominal voltage of each cell	3.2 Volt
Capacity of one cell	50 Amps/h
Nominal features of the complete pack	76 Volt –150 Amps/h
Max cell nominal voltage	3.65 Volt
Min cell operating voltage	2.5 Volt
DOD	90%
Charge cycles	3000 full cycles
Memory effect	NO

Lithium cells are managed by BMS (Battery Management System) that continuously manages charge and discharge operations, monitors cells parameters including their tensions and their temperatures, and in case of failure opens the internal contactor insulating the Lithium pack.

#### Battery Charger

The on-board battery charged is activated when its plugged, if present it has to be used the plug fitted on the lithium pack, otherwise the one close to the magneto-thermic switch.

#### DC-DC Transformer

Apart for Lithium system that works at 76 nominal Volt, the rest of the machine electronic boards and components still work at 12 / 5 Volt, so Lithium system includes a DC-DC transformer that convert the 76 Volt into 13.5 Volt.

Machine is equipped with 12 Volt battery necessary to switch ON Lithium system.

#### Electric Motor

Type	Three-phase
Nominal tension	803Volt
Nominal Power	3500 Watt

Electric motor is fed through an inverter that convert the lithium pack direct current (DC) into alternative three-phase current.

#### RPM Regulation System

RPM regulation is carried out by the following components:

- Master board (ECM1)
- Inverter
- Electric motor

Inverter is parameterized to feed the electric motor with a pre-determinate selection of frequencies, corresponding to a nominal rpm configurations, in case of inverter replacement is required a new parameterization.

**NOTE:** The set-point rpm could be different from the nominal rpm configuration depending on the electric load.

#### RPM Setting

ECM1 through its internal contacts communicates the required rpm selection to the inverter, which will feed the electric motor with the relevant frequency in order to achieve the nominal rpm selected, the actual rpm depends also on the machine working conditions.

## SECTION 3 - CHASSIS & TURNTABLE

Here below is listed the rpm setting according to the movement required and to the speed selected.

LITHIUM SYSTEM RPM SETTING		
TURTLE	NORMAL/ HARE	MOVEMENT (*)
1500	1500 + double pump	1st and 2nd booms UP
900	1950	1st and 2nd booms DOWN
900	1950	3rd boom UP
900	1500	3rd boom DOWN
1500	1950 + double pump	Telescope OUT
1500	1950	Telescope IN
900	1050	Turret rotation
900	900	Basket rotation
900	900	Basket levelling
900	1050	Jib UP
900	900	Jib DOWN
1500	3000	Tracks forward or backward
1500	3000	Tracks opening or closing
3000	3000	Auto stabilization with maximum one outrigger on the ground
1500	1500	Auto stabilization with two or three outriggers on the ground
3000	3000	Auto stabilization with all outrigger on the ground
3000	3000	Outriggers Auto retraction with all outrigger lifted from the ground
1500	1500	Outriggers Auto retraction with at least one outrigger on the ground

**NOTE:** Outriggers rpm depends on the machine condition.

**NOTE:** Tracks opposite rotation is carry out with lower speed.

**NOTE:** Aerial contemporary movements including jib, basket leveling or rotation are carry ion at minimum rpm.

**NOTE:** Double pump valve is not activated with movements together.

### Temperature Ongoings (Heaters And Fans)

Lithium battery pack discharge and/or recharge, with positive lithium battery level (SOC>0), is possible over 14°F (-10°C).

In cold environmental temperature (not lower than -13°F (-25°C), the on-board electric heaters automatically warm up the cells, they are activated by the BMS when the minimum cell temperature goes down 32°F (0°C), they are automatically switched off when the minimum cell temperature raises over the 35.6°F (2°C).

In case of battery charger is connected, till 32°F (0°C) it supplies only 5A in order to surely feeds only the heaters, waiting positive temperatures to recharge the cells.

In cold environmental temperature (from -13°F (-25°C) to 32°F (0°C), with null lithium battery level (SOC = 0), the heaters work only while the cable is plugged to the electric network (battery charger activated).

While heaters are working on the display will appear the icon batteries cold, and machine could be moved only in lower speed (turtle).



"BATTERY COLD/HEATER ACTIVATED" ICON

In hot environmental temperature, the fans system automatically cool down the cells, they are automatically activated by the BMS when cells temperature raises over 98.6°F (37°C), they are automatically switched off when cells temperature goes down the 95°F (35°C).

### Diagnostics And Fault Codes

The main devices composing the lithium batteries system are able to carry out self-diagnosis informing the operator by the remote control display, in particular they eventually display informative icons and provide fault codes.

Self-diagnosis is carry out by:

- BMS (Battery Management System)
- Battery charger
- Inverter

Further information about Lithium system, fault codes and diagnose are detailed by Lithium system specific training.

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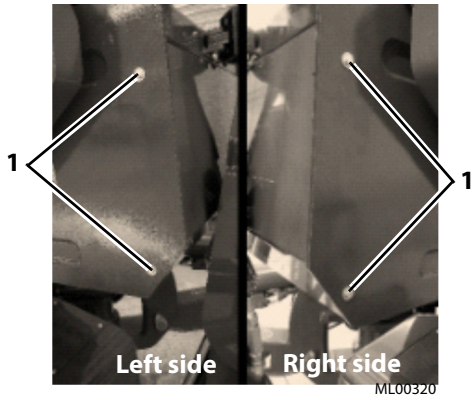
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Click on this link: <http://www.discount-equipment.com/category/5443-parts/> and choose one of the options to help get the right parts and equipment you are looking for. Please have the machine model and serial number available in order to help us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

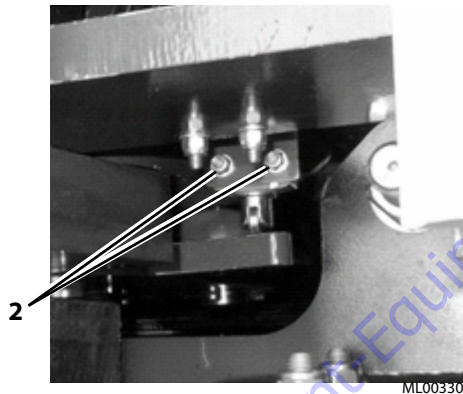
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SECTION 4. BOOM & PLATFORM

4.1 TOWER BOOM MICROSWITCH REPLACEMENT



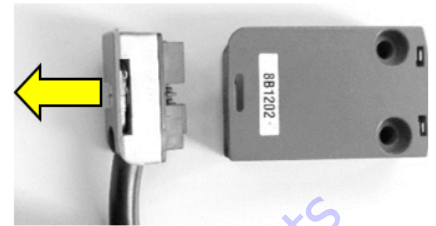
1. Stabilize machine on flat level ground.
2. Lift up JIB to allow access to cover.
3. Remove cover on tower boom by unscrewing screws (1).



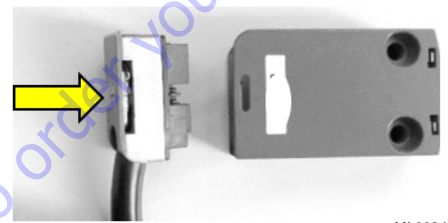
4. Remove nuts (2) securing microswitch and remove microswitch.



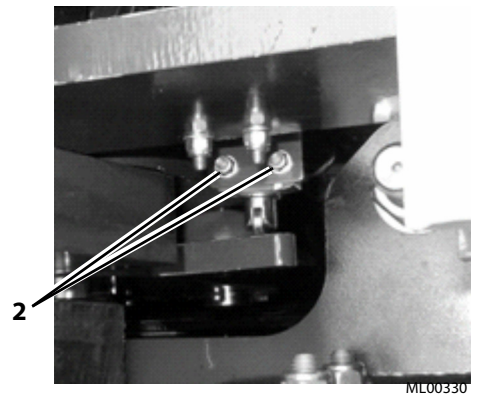
5. Turn screw counter-clockwise to unlock contact from microswitch.



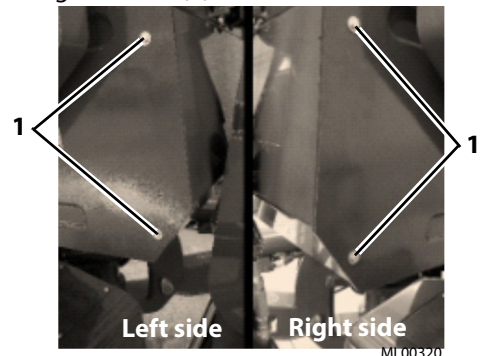
6. Pull the bottom of microswitch (wire side) to disconnect it.



7. Push contact in to microswitch and secure by turning screw clockwise 90°.



8. Place the microswitch on bracket. Hand tighten nuts (2).
9. Adjust microswitch to the ropes balancer tooth. Microswitch must be pressed.
10. Tighten nuts (2).



11. Place cover on tower boom and secure with screws (1).

## 4.2 MAIN BOOM MICROSWITCH REPLACEMENT

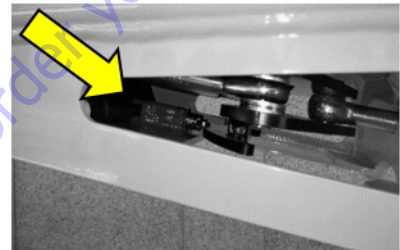
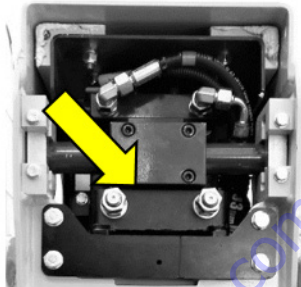
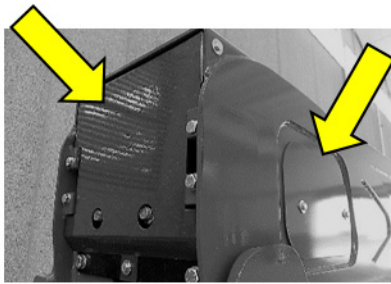
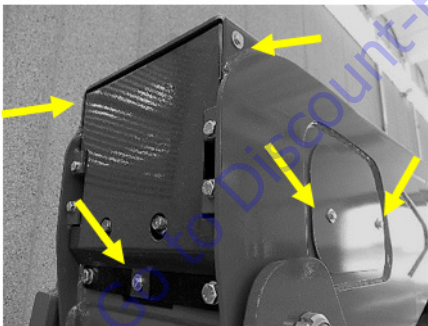


Figure 4-1. Main Boom Microswitch Locations

ML00370

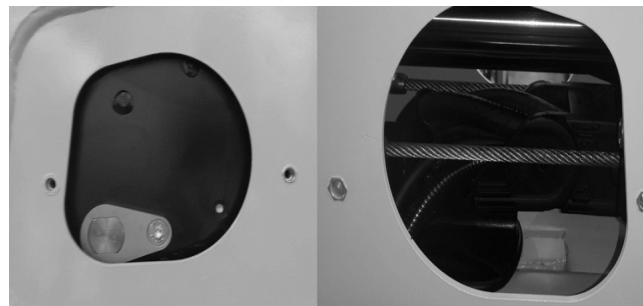
### Front side microswitch replacement

1. Stabilize machine on flat level ground.



ML00380

2. Remove screws from boom cover and remove cover.

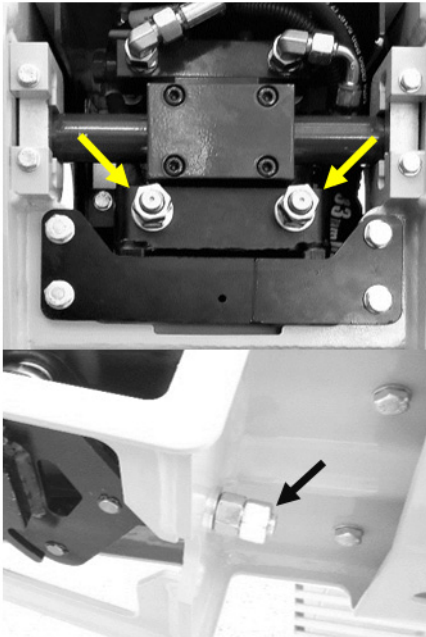


ML00390

3. Extend main boom until side window is uncovered by internal boom section.

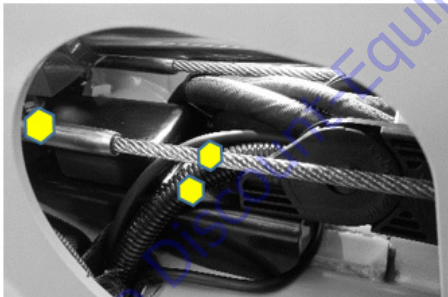
### **⚠ WARNING**

**DURING THE MAIN BOOM EXTENSION, MACHINE WILL OPEN THE JIB AND TOWER BOOM AUTOMATICALLY.**



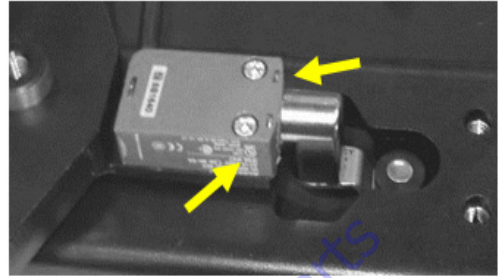
ML00400

4. Unscrew all ropes locknuts. There re two in front side and one in back side.
5. Loosen both tensioner nuts from front side. Do not remove.
6. Remove the tensioner nut from the back side and extract the ropes balancer.



ML00410

7. Unscrew all three bolts from microswitch cover.
8. Remove microswitch cover.



ML00420

9. Unscrew screws and remove microswitch.



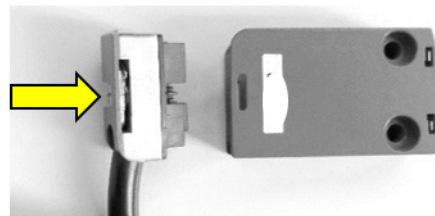
ML00340

10. Turn screw counter-clockwise to unlock contact from microswitch.



ML00350

6. Pull the bottom of microswith (wire side) to disconnect it.

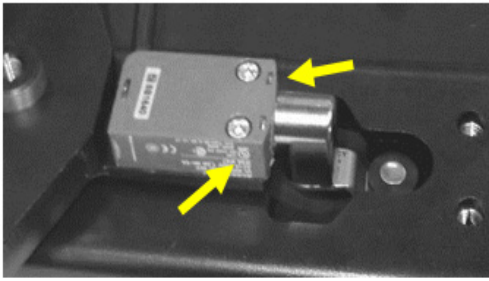


ML00360

7. Push contact in to microswitch and secure by turning screw clockwise 90°.

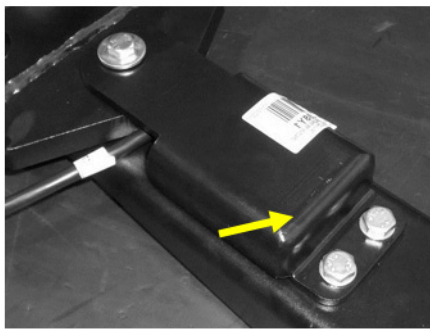


## SECTION 4 - BOOM & PLATFORM



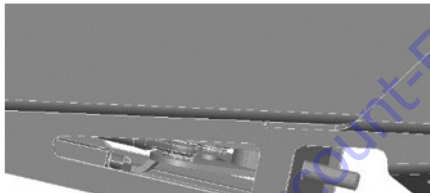
ML00420

8. Place microswitch on bracket and secure with screws.



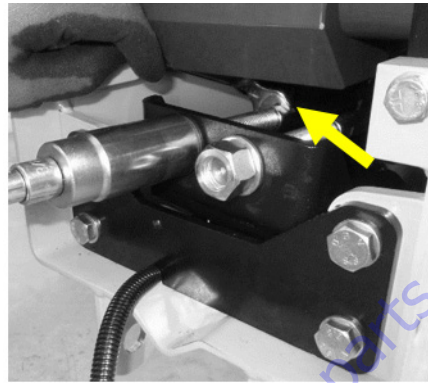
ML00430

9. Place cover on microswitch. Make sure to place screws in original locations.
10. Use threadlock medium and tighten screws by hand.



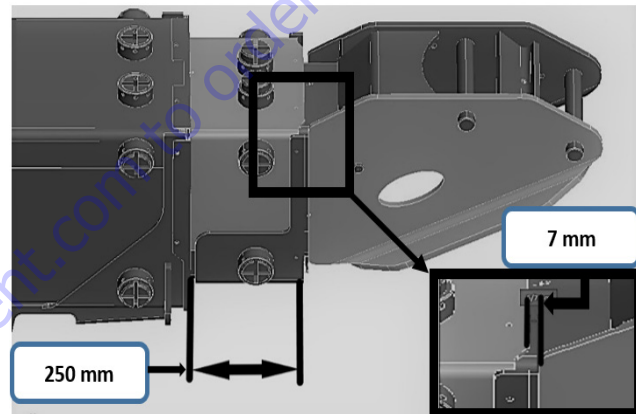
ML00440

11. Insert balancer screw in hole and secure with n°1 washer  $\text{\O}16$  and M16 tensioner nut.
12. Tighten nut to 44.25 in lbs (5 Nm).



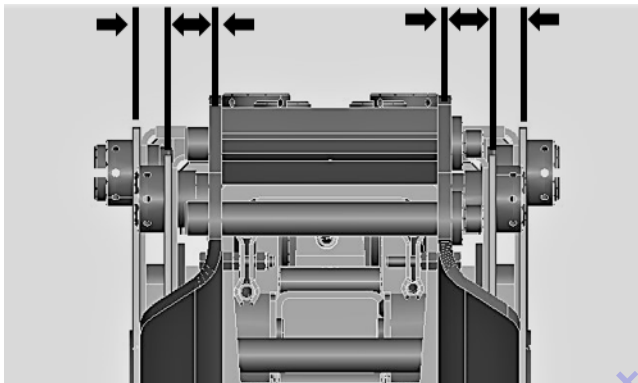
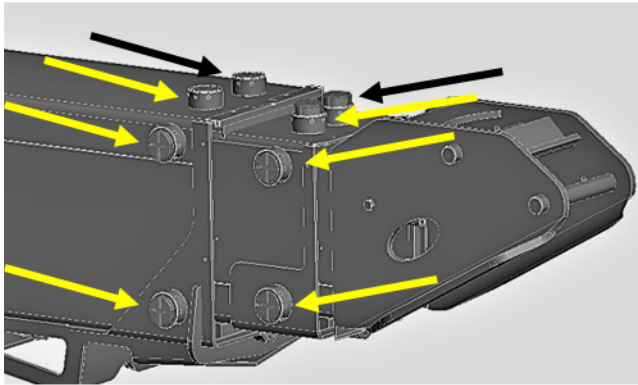
ML00450

13. Tighten front side nuts to 44.25 in lbs (5 Nm). Keep ropes from rotating using a 14 mm wrench while tightening front side nuts.



ML00460

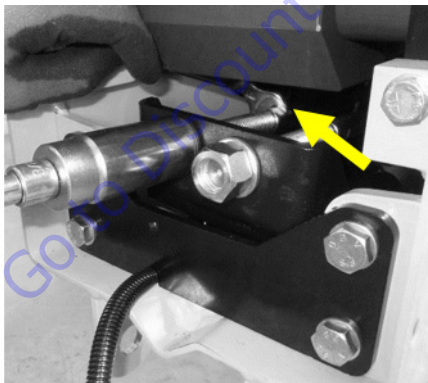
14. Switch on the machine and retract the main boom until end of stroke is reached.



15. Remove all cotter pins to the slide adjuster screws and tighten to avoid boom movement during rope tensioning.

**⚠ WARNING**

**DURING SLIDE ADJUSTER TIGHTENING, THE BOOMS MUST BE CENTERED.**



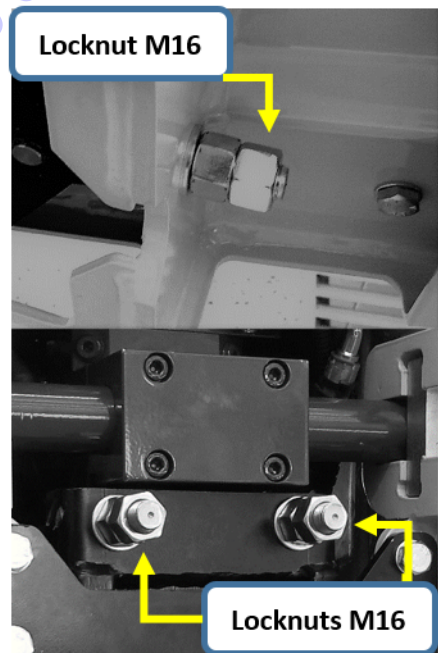
ML00480

16. Loosen tensioner nuts (previously at 44.25 in lbs (5 Nm)). Tighten again to 44.25 in lbs (5 Nm), backside first. Keep ropes from rotating using a 14 mm wrench while tightening front side nuts.
17. Once tensioner nuts are torqued to 44.25 in lbs (5 Nm) torque to 88.5 in lbs (10 Nm).



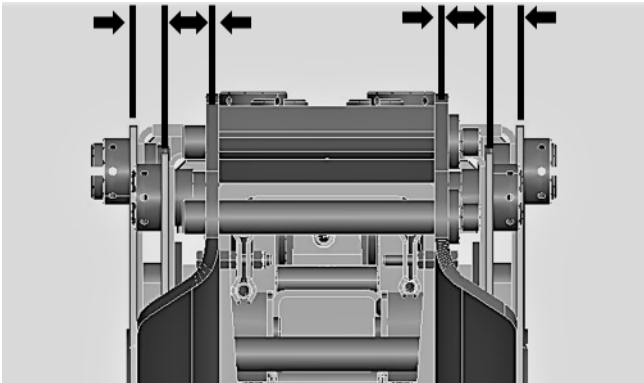
ML00490

18. Loosen all slide adjusters two to three turns.
19. Switch on the machine, extend and retract the main boom two to three times. Verify correct functionality.
20. Tighten slide adjusters.
21. Verify proper rope tensioner nut torque value.

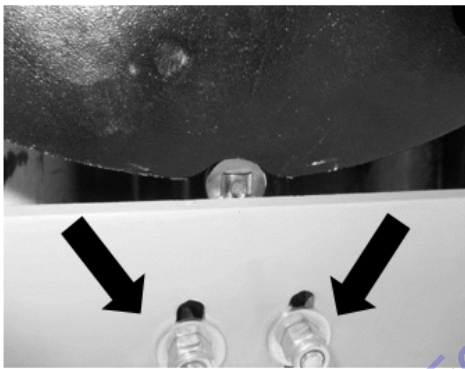


ML00500

22. Tighten a second nut unto the rope tensioner nuts.

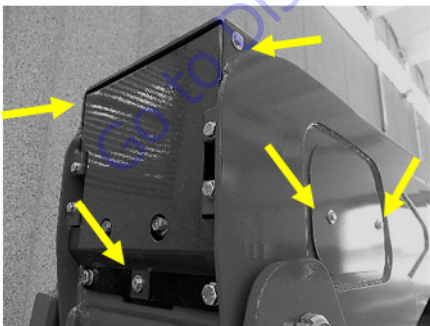


- 23. Tighten the adjuster slides. Gap must be no larger than 0.04 in (1 mm) in every boom section. Boom sections must be centered on longitudinal axis.
- 24. Install new cotter pins.



ML00510

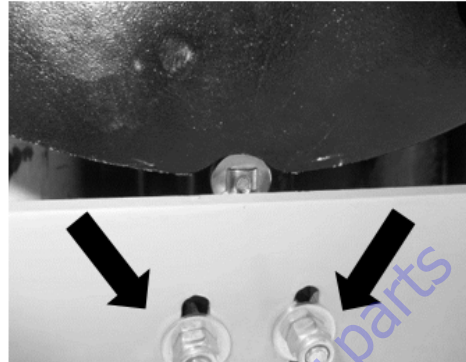
- 25. Verify microswitch clearance on back side. Microswitch should be just touching rope balancer cam.
- 26. Tighten screws to secure microswitch.



ML00380

- 27. Install cover and secure with screws.

### Back side microswitch replacement



ML00510

- 1. Unscrew screws and remove microswitch.



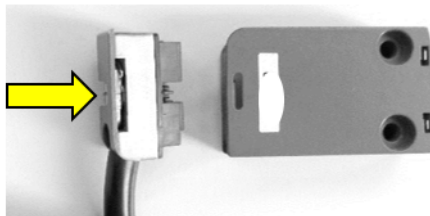
ML00340

- 2. Turn screw counter-clockwise to unlock contact from microswitch.



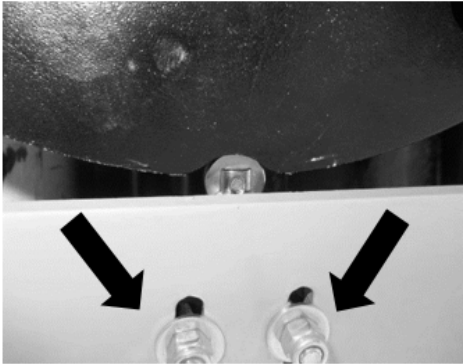
ML00350

- 6. Pull the bottom of microswitch (wire side) to disconnect it.



ML00360

7. Push contact in to microswitch and secure by turning screw clockwise 90°.



ML00510

8. Verify microswitch clearance on back side. Microswitch should be just touching rope balancer cam.
9. Tighten screws to secure microswitch.

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### 4.3 BOOM MAINTENANCE

#### NOTICE

IF PERFORMING MAINTENANCE ON THE BOOM, DO NOT USE A LIFTING DEVICE TO LIFT THE BOOMS UNLESS THE HOLDING VALVES HAVE BEEN REMOVED FIRST. FAILURE TO DO SO WILL RESULT IN SEVERE DAMAGE TO THE BOOM.

#### Removal of the Boom Assembly

1. Remove the platform and platform support as follows:
  - a. Disconnect electrical cable from control console.
  - b. Tag and disconnect the hydraulic lines running to the rotate cylinders. Cap the hydraulic lines and ports.
  - c. Using an overhead crane or suitable lifting device, use nylon support straps to support the platform/support.

**NOTE:** When removing the retaining pin from the rod end of the level cylinder, make sure the cylinder is properly supported.

- d. Remove bolts and keeper pins that secures the retaining pins. Using a suitable brass drift and hammer, remove the retaining pins from the platform support.
2. Remove the boom from the turntable as follows:
  - a. Disconnect wiring harness from ground control harness connector.

#### NOTICE

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

- b. Tag and disconnect hydraulic lines from boom to control valve. Use a suitable container to retain any residual hydraulic fluid. Cap all hydraulic lines and ports.
  - c. Using a suitable lifting equipment, adequately support boom weight along entire length.
  - d. Remove the bolts and keeper pins securing the lift cylinder pivot pin. Using a suitable brass drift and hammer, remove the pivot pin from the lower boom.
  - e. Remove hardware securing the level link pivot pin. Using a suitable brass drift and hammer, remove the pin from the level link and turntable.
  - f. Remove hardware securing the lower boom pivot pin. Using a suitable brass drift and hammer, remove pin from the turntable.

- g. Using all applicable safety precautions, carefully lift boom assembly clear of turntable and lower to ground or suitable supported work surface.

#### Disassembly of the Main Boom

1. Loosen jam nuts on aft end of fly boom wear pad adjustment and loosen adjustments.
2. Using a portable power source, attach hose to telescope cylinder port block. Using all applicable safety precautions, activate hydraulic system and extend cylinder to gain access to cylinder rod retaining pin. Shut down hydraulic system.
3. Carefully disconnect hydraulic hose from retract port of cylinder. There will be initial weeping of hydraulic fluid which can be caught in a suitable container. After initial discharge, there should be no further leakage from the retract port.
4. Remove hardware securing telescope cylinder to the fly boom section, then remove pin from fly.
5. Remove hardware securing telescope cylinder to the base boom section.

#### NOTICE

WHEN REMOVING TELESCOPE CYLINDER FROM BOOM SECTIONS, CARE SHOULD BE TAKEN NOT TO LEAVE CYLINDER REST ON POWERTRACK WHICH COULD CAUSE DAMAGE TO POWERTRACK.

6. Using a suitable lifting device, remove telescope cylinder from boom sections.
7. Using a piece of tape, mark the length of hoses and wires from front of fly boom and bottom of base boom for reassembly.
8. Remove hardware securing the front wear pads on base boom section, remove wear pads.
9. Remove hardware securing the powertrack to the aft end of the fly boom section.
10. Using a suitable lifting device, remove fly boom from boom section.
11. Remove hydraulic lines and electrical cables from powertrack.
12. Remove hardware securing powertrack to the base boom section. Remove powertrack.

## Inspection

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

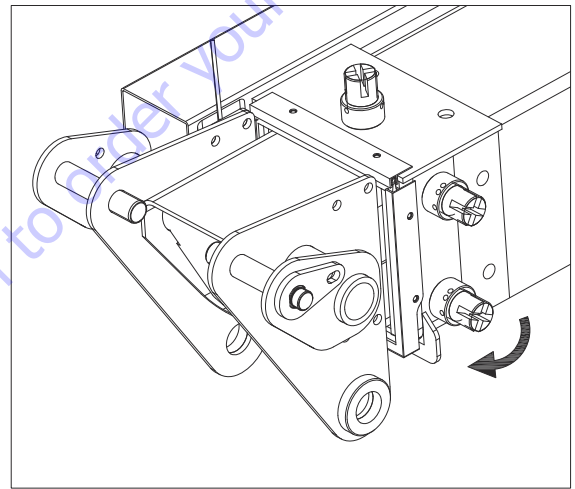
## Assembly of the Main Boom

1. Install power track to the attach point on the base boom section. Secure power track with the attaching hardware.
2. Install hydraulic lines and electrical cables into the power track.
3. Install wear pads to the aft end of the fly section.
4. Using suitable lifting equipment, slide fly section into the base section until power track attach point aligns with holes in side of base section.
5. Attach the power track to the aft end of fly boom section. Secure power track with the attaching hardware.
6. Using suitable lifting equipment, slide fly boom section out to gain access to telescope cylinder attach pin hole.
7. Measure the distance between the telescope cylinder port block attach point on base boom section and the attach point on fly boom section.
8. Connect a suitable auxiliary hydraulic power source to the telescope cylinder port block.
9. Extend the telescope cylinder the distance of the two attach points.
10. Secure the sling and lifting device at the telescope cylinder's approximate center of gravity, and lift the cylinder to the aft end of the boom assembly.

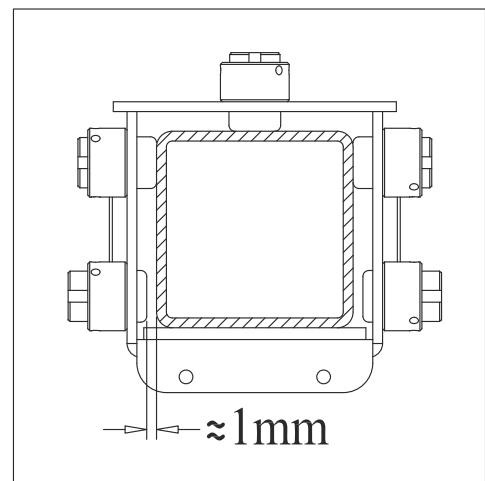
### NOTICE

**WHEN INSERTING THE TELESCOPE CYLINDER INTO THE BOOM, CARE MUST BE TAKEN NOT TO DAMAGE THE POWER TRACK ASSEMBLY.**

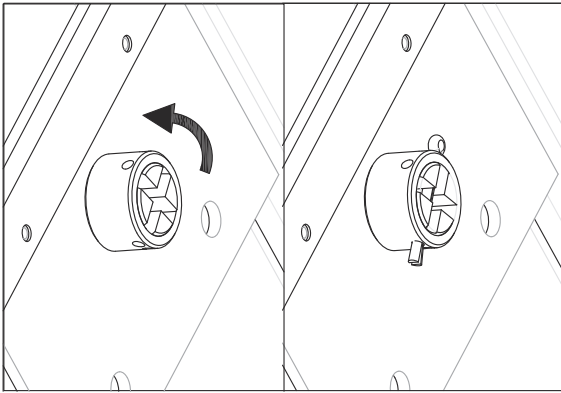
11. Slowly slide the telescope cylinder into boom assembly, align rod end with attach point in fly section. Insert pin and secure with retaining ring.
12. Slowly slide the telescope cylinder into boom assembly, align barrel end with attach point in fly section. Insert pin and secure with retaining ring.
13. Install wear pads at front of base boom section. Adjust the wear pads to zero clearance.



14. Adjust pads alternately side to side, so that fly boom section is centered in base boom section (lower wear pad with 1 mm gap).



15. Turn the wear pad to expose the groove on the head to insert the cotter.



16. Disconnect auxiliary power source from telescope cylinder.

**Installation of the Boom Assembly**

1. Using suitable lifting equipment, position boom assembly on turntable so that boom pivot holes in both boom and turntable are aligned.

2. Install boom pivot pin, ensuring that location of the hole in pivot pin aligns with attach point on upright.
3. Using all applicable safety precautions, operate lifting equipment in order to position boom lift cylinder and level link so that holes in cylinder rod end and level link are aligned with the one in the turntable. Insert cylinder pins.
4. If necessary, gently tap pins into position with a soft headed mallet, ensuring that attach holes in pins are aligned with attach holes in boom structure. Secure with hardware.
5. Connect all hosing and wiring.
6. Install the platform to the boom assembly.
7. Connect all hosing and wiring at platform control station.
8. Using all safety precautions, operate machine systems and extend and retract boom for four or five cycles.
9. Shut down machine systems and check for leakage.

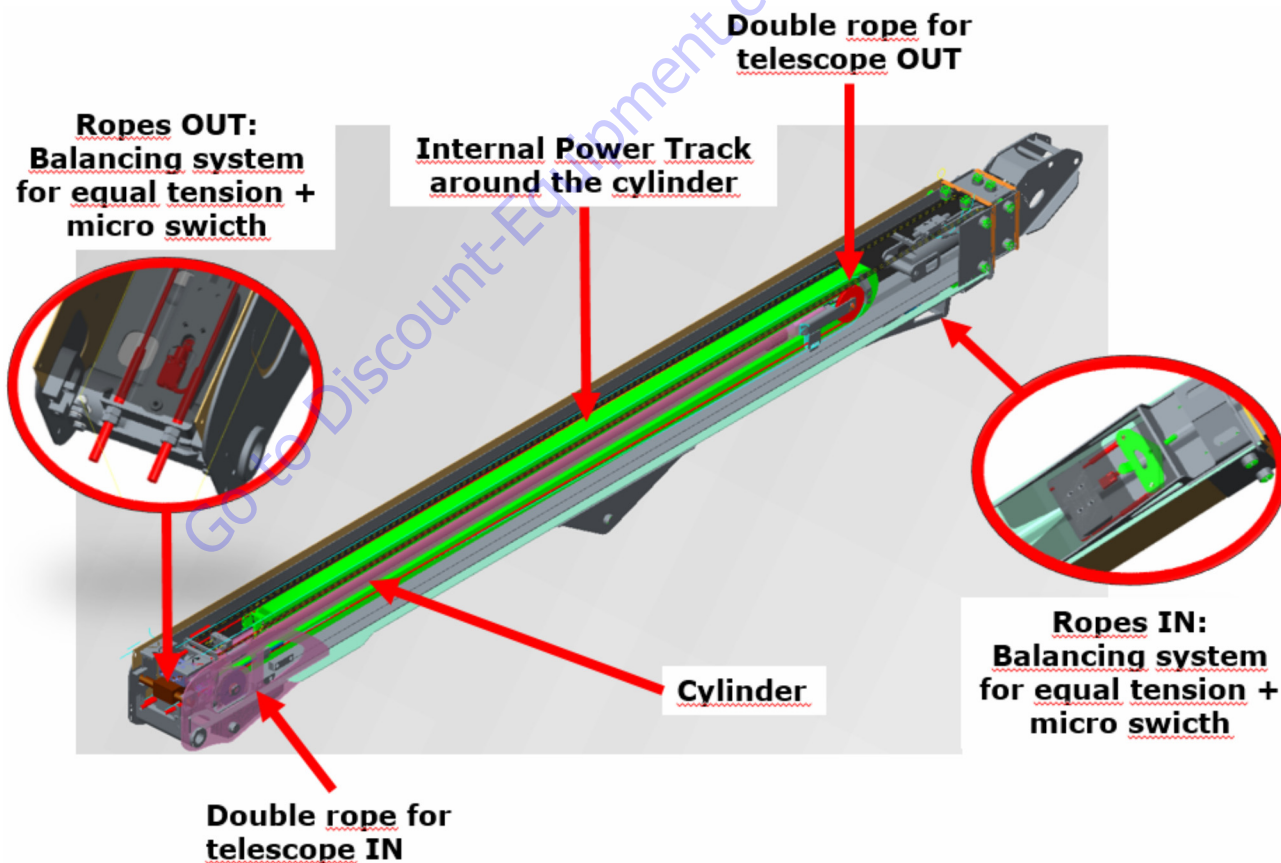


Figure 4-2.

## 4.4 INSPECTION

### Checking Wear And Deformation Of Ropes And Pulleys

If only one of the following situations is detected the ropes or pulleys must be replaced.

1. Check that there are no broken threads on the surface of the rope, in the internal area or in correspondence with the cable socket.

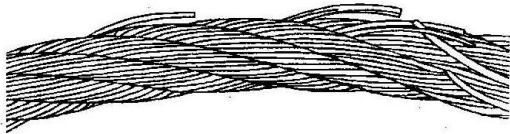


Figure 4-3.

2. Check that there are no signs of corrosion on the rope.
3. Check that there are no signs of kinking, crushing or deformations of any type on the rope.

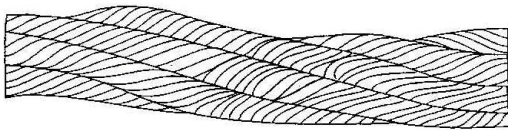


Figure 4-4.

4. Check the condition of the fixing pins of the outlet pulley and extensions return.
5. Check the wear of the pulley grooving using a profile comparator. As indicated in the figure it is necessary to check that the outline of the comparator corresponds with the base of the grooving.

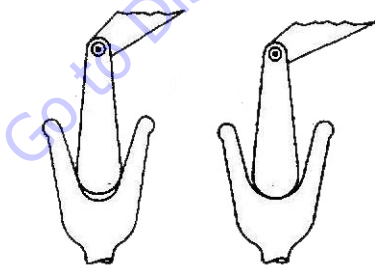


Figure 4-5.

6. Check that there are no signs of ovalisation, wear or any other type of deformation on the pulleys.
- 7.

### Three month inspection

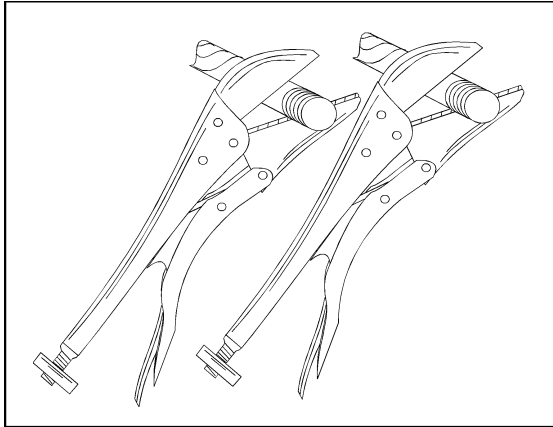
1. Remove all protection sumps from the third arm and the two extensions. Use a flashlight torch to visually check the state of the ropes and the extension pulleys.
2. Check the correct rope tension, trying to bend them manually. If they are pulled correctly they should not be able to move more than a few millimeters.
3. Check that in the extension arms exit phase the return ropes are sufficiently in traction in a way not to allow relative contact with the third arm.
4. Vice versa in the extension return phase, check that the outlet ropes are subject to a tension that allows them not to come into contact with the second extension or the cylinder.
5. Use a torque wrench to check the correct torque of all rope fixing nuts and the respective rocker arms; recommended torque 10 Nm.

If the tension of the ropes should not be adequate the conditions for use must be restored by scrupulously following the Ropes Tension Adjustment procedure reported following.



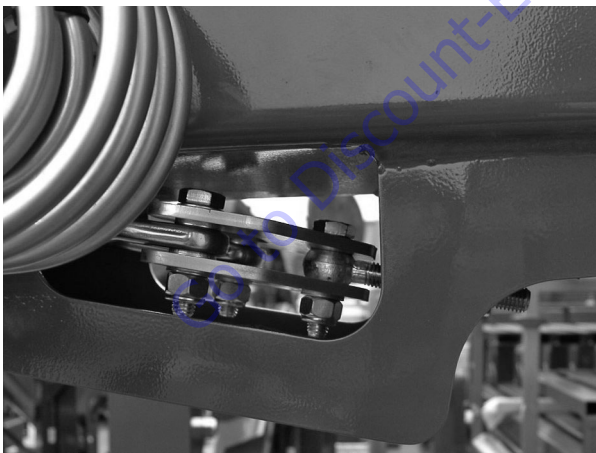
## 4.5 ROPES TENSION ADJUSTMENT PROCEDURE

**NOTE:** Do not clamp on threads.



**Figure 4-6. Clamping Wire Ropes**

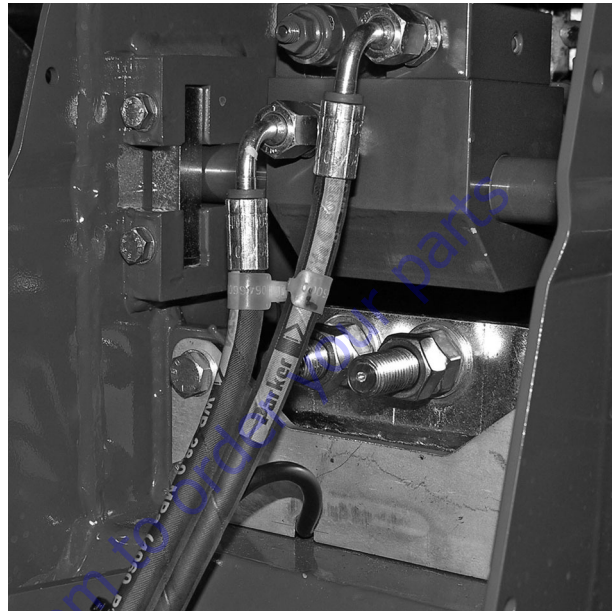
1. Loosen the register counter-nuts by a few turns, position them in a way to access the adjustment nuts in order to make the adjustment. (two nuts with relative counter-nut for extend ropes and one nut with relative counter-nut for retract ropes rocker arm).
2. Completely retract both extendible arms and make them escape for about 30-40cm.
3. Tighten the nut for the traction of the fixing rocker arm of the return ropes to a torque of 10Nm.



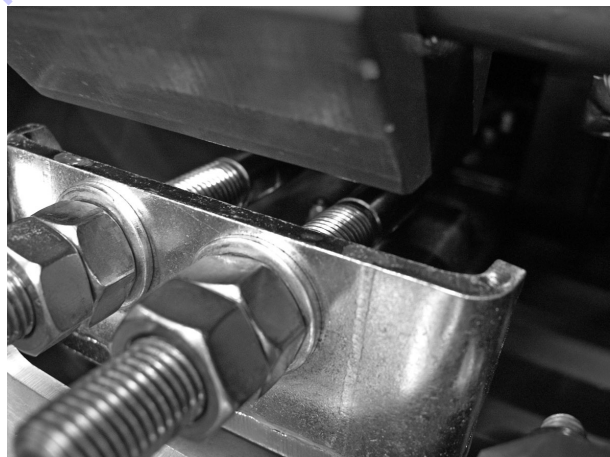
**Figure 4-7. Return ropes fixing rocker arm**

4. Completely extend the extensions and retract them by about 30-40cm.
5. Tighten the bolts of the two output cables so that the threaded terminals come out of  $65 \pm 3$  mm from the rocker arm. During adjustment

keep the ropes blocked to prevent them turning with the nuts. Make use of the relevant seat for the wrench on the cable socket.



**Figure 4-8. Nuts for exit cables stop**



**Figure 4-9. Terminal with seat for anti-rotation key**

### Counterbalance Valve

Refer to Figure 4-10., Rotator Counterbalance Valve.

1. Make sure the surface of the actuator is clean, free of any contamination and foreign debris including old Loctite.
2. Make sure the new valve has the O-rings in the counter bores of the valve to seal it to the actuator housing.
3. The bolts that come with the valve are grade 8 bolts. New bolts should be installed with a new valve. Loctite #242 should be applied to the shank of the three bolts at the time of installation.
4. Torque the 1/4-inch bolts 110 to 120 inch pounds (12.4 to 13.5 Nm). Do not torque over 125 inch pounds (14.1 Nm). Torque the 5/16-inch bolts 140 inch pounds (15.8 Nm). Do not torque over 145 inch pounds (16.3 Nm).

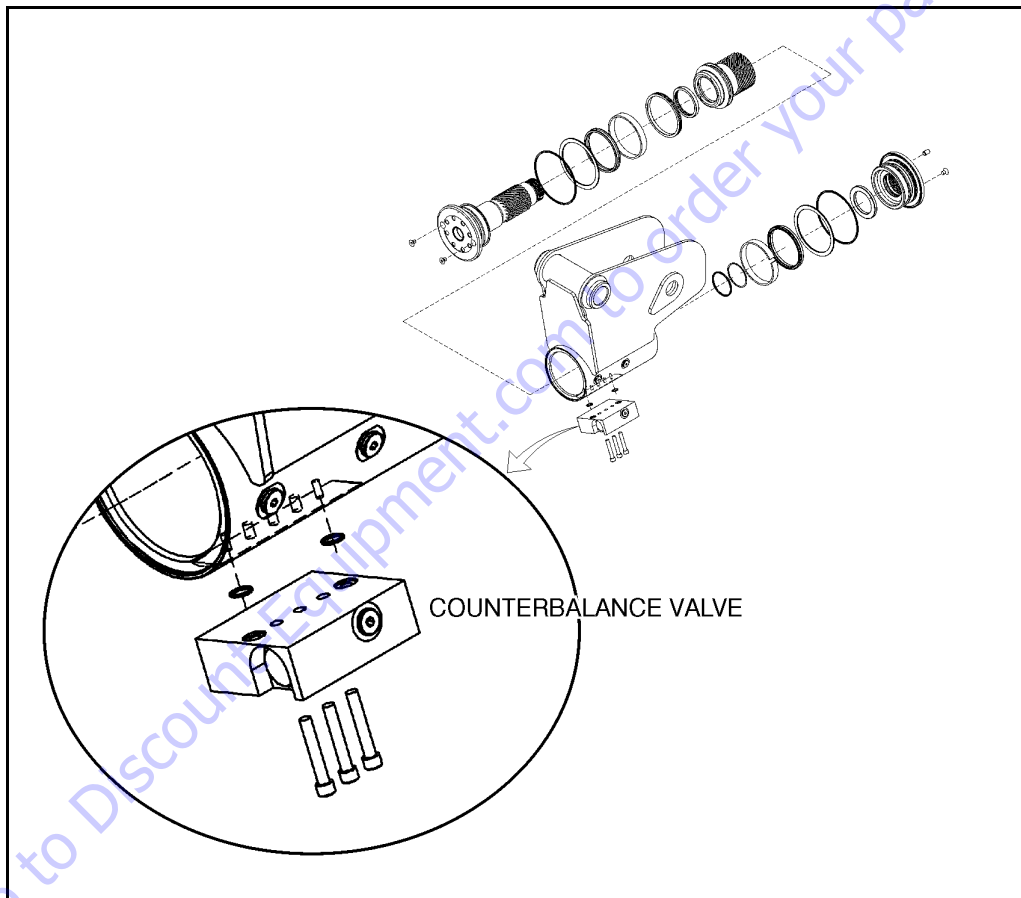


Figure 4-10. Rotator Counterbalance Valve

#### 4.6 PLATFORM REMOVAL/INSTALLATION

**NOTE:** If the platform is removed only track movement is allowed.

1. Remove the platform/remote control box from the mounting support.
2. Loosen and remove the aluminium caps that secure the platform to the jib platform mounting posts.
3. Lift the platform off the mounting posts in an upward direction. Place platform aside for later installation.

#### Platform Installation

1. Lift the platform and align the platform mounts with the jib mounting posts and lower until seated.
2. Secure the platform to the jib mounting posts with the aluminum threaded caps. Do not over-tighten.
3. Re-install the platform/remote control box into the mounting support on the platform.

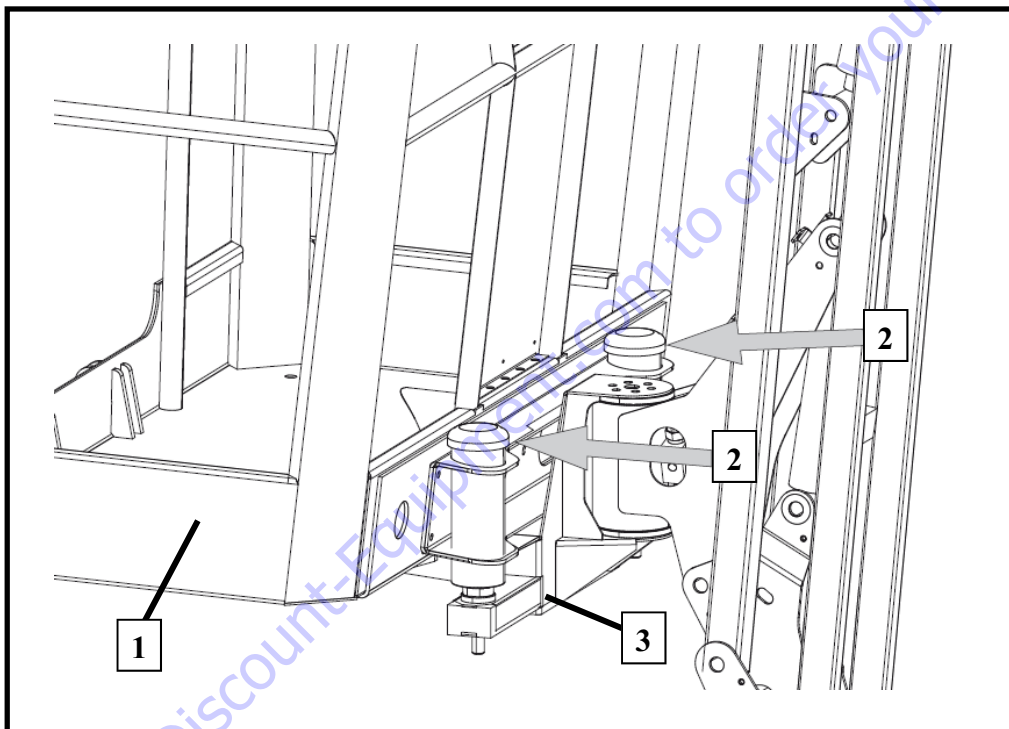


Figure 4-11.

## 4.7 LOAD CELL AND FOOTSWITCH REMOVAL/ INSTALLATION

### Removing Load Cell

1. Turn the machine off and unplugged from the power supply.
2. Remove the basket of the machine (see dismantling basket).
3. Remove screws (2) and remove cover (3).
4. Remove the load cell (4) by disconnecting the wiring from ECM3.

### Installing Load Cell

1. Install the load cell (4) and stop with cover (3) and secure with screws (2).
2. Remount the load cell (4) connecting the electrical wiring to ECM3.
3. Reinstall the basket. (See section basket installation)

### Removing Footswitch

1. Turn the machine off and unplugged from the power supply.
2. Remove the basket of the machine. (See paragraph basket removal).
3. Remove screws (5) securing support footswitch (6).
4. Loosen the fixing screw foot (1).
5. Remove the footswitch (1) disconnecting the wiring from ECM3.

### Installing Footswitch

1. Fit and secure with screw the the footswitch (1) to the support footswitch (6).
2. Secure with screws (5) footswitch support (6) to the basket support(7).
3. Connect the wiring to ECM3.
4. Reinstall the basket. (See paragraph basket installation).

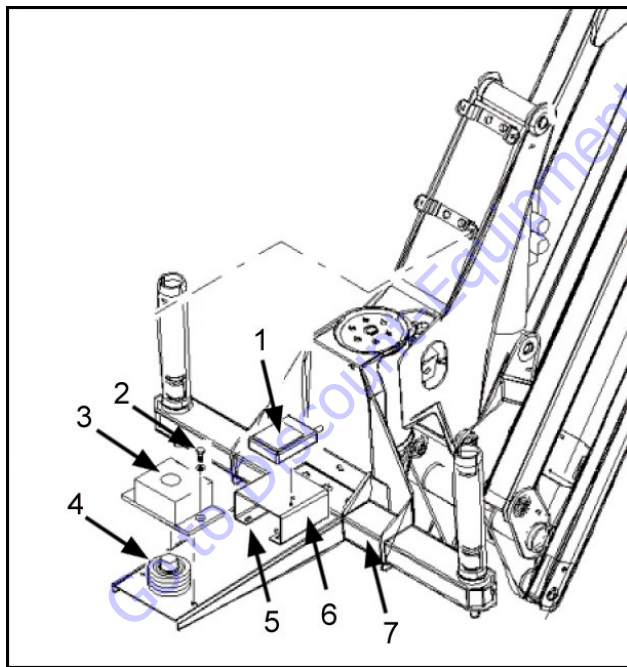


Figure 4-12.

#### 4.8 SKYGUARD INSTALLATION - ONE PERSON PLATFORM

The purpose of this instruction is to install a SkyGuard system on JLG Compact Crawler Boom (platform capacity of one person) models listed below and with below pictured SkyGuard Bracket.

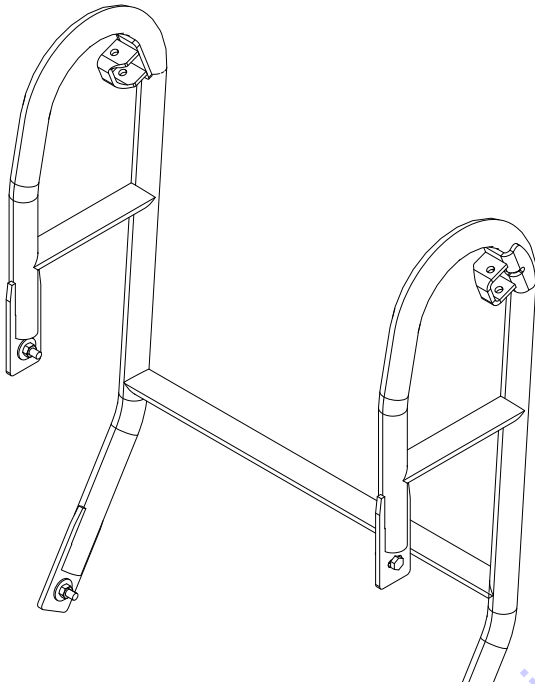


Figure 4-13. SkyGuard Bracket with Mount

It is recommended that you read and thoroughly understand these instructions before starting this procedure.

**NOTICE**

Use all applicable Safety precautions while working on, around or under any machinery.

**Options/Accessories Prohibited When Installing This Kit:**

- None

**Tools & Equipment Required:**

- Standard mechanic tools including 5/16" & 7/32" Allen Wrenches
- Tie Straps

**Personnel Required:**

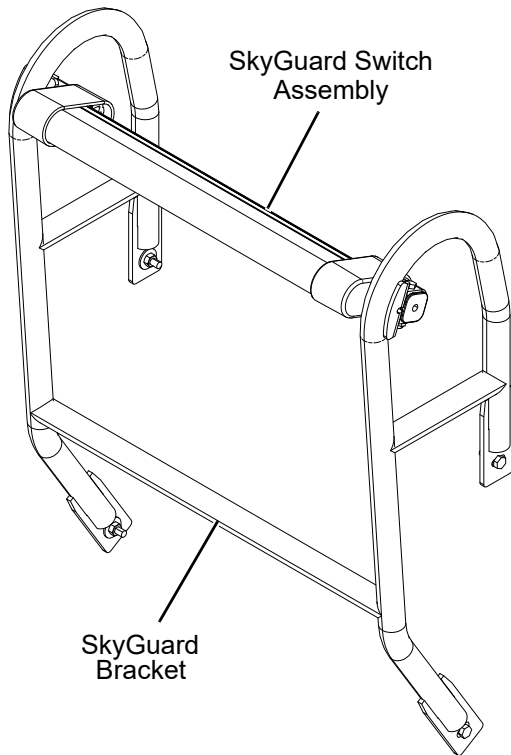
- Qualified JLG equipment mechanic

**Parts List:**

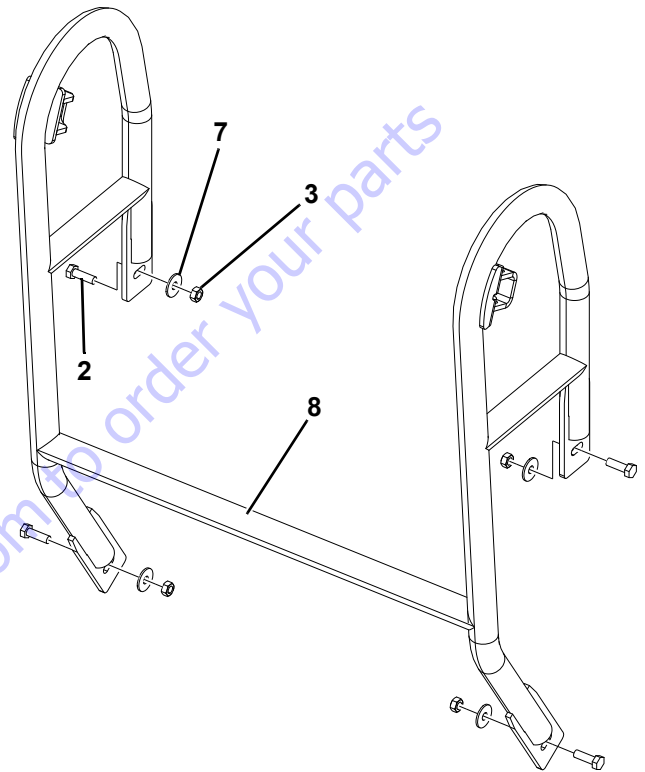
ITEM	PART NUMBER	DESCRIPTION	QTY
1	0641414	Bolt, 1/4-20x 1 3/4 LG	2
2	0700812	Bolt (Metric), 8x25 LG	4
3	3290801	Nut, M8x1.25	4
4	3300430	Nut, Acorn 1/4- 20	2
5	3931424	Bolt, 1/4-20x1 1/2 LG	2
6	4711400	Washer, 1/4 DIA Plain Steel, Narrow	4
7	4811902	Washer, 8mm LGOD	4
8	37675400	Bracket, Skyguard Support	1
9	1001186517	Cover, Platform Sensor	2
10	1001188889	Support, Shear Block	2
11	1001213890	Switch, Skyguard	1
12	1001213891	Mount, Platform Sensor	1

**Procedure:**

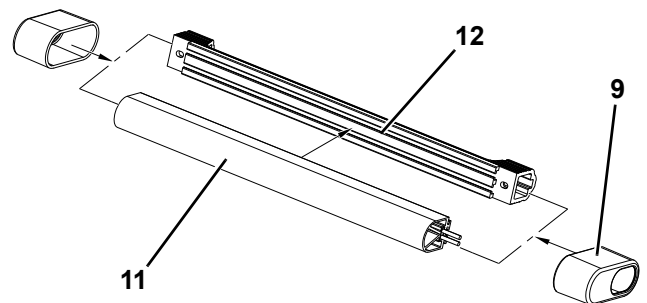
1. Park the machine on the firm level surface, fully retract & lower the boom.
2. Extend all the four outriggers, set them to the auto levelling mode and set the machine to rest position.
3. Remove the key and shut the engine OFF.
4. Allow the machine and system fluids to cool.
5. Disconnect the battery power from the machine.

**For Reference:****Figure 4-14. SkyGuard Bracket with SkyGuard****Installation:**

1. Install the SkyGuard Support Bracket (8) onto the welded mounts on platform rails. Secure the support bracket using four Bolts (2), relevant Washers (7) and Nuts (3). See Figure 4-15.

**Figure 4-15.**

2. Align and attach Platform Sensor Mount (12) onto the SkyGuard Switch (11) as shown in Figure 4-16.
3. Attach Platform Sensor Covers (9) to SkyGuard switch assembly at both ends. See Figure 4-16.

**Figure 4-16.**

4. Position SkyGuard switch assembly with sensor cover onto the SkyGuard Support Bracket (8) as shown in Figure 4-17..

## SECTION 4 - BOOM & PLATFORM

5. Insert a Shear Block Support (10) through shear block housing on the SkyGuard support bracket and into the platform sensor mount. See Figure 4-17.

**NOTE:** Ensure the correct position of Shear Block Support (10) before installation.

6. Secure the shear block on welded mount of SkyGuard support bracket using Bolt (1), relevant Washer (6) and Acorn Nut (4) as shown in Figure 4-17.
7. Secure the SkyGuard switch assembly using Bolt (5) and relevant Washer (6) on platform sensor mount. See Figure 4-17.

**NOTE:** Tighten the Bolt (5) using appropriate allen wrench.

8. Repeat Steps 4 through 7 to secure SkyGuard switch assembly on the other side of the SkyGuard support bracket ensuring correct position of the shear block support before installation.

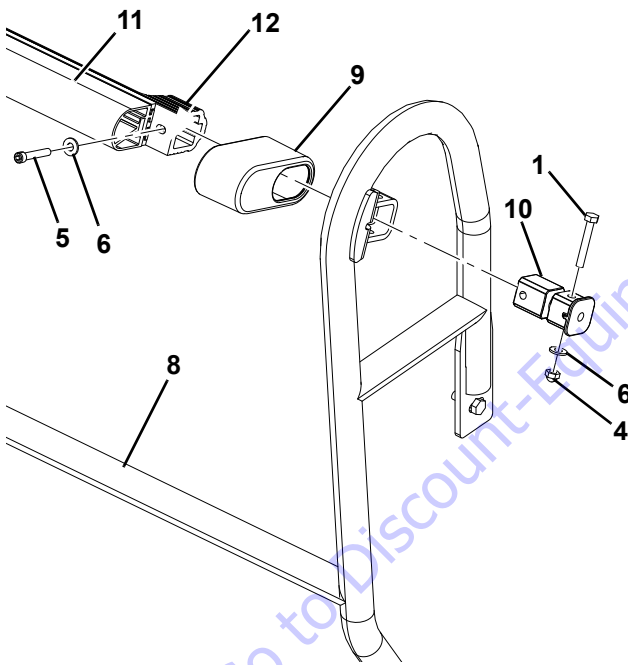


Figure 4-17.

9. Route the SkyGuard switch harness along SkyGuard support bracket (right side) and under the platform control box. Secure the harness using tie straps. See Figure 4-18.

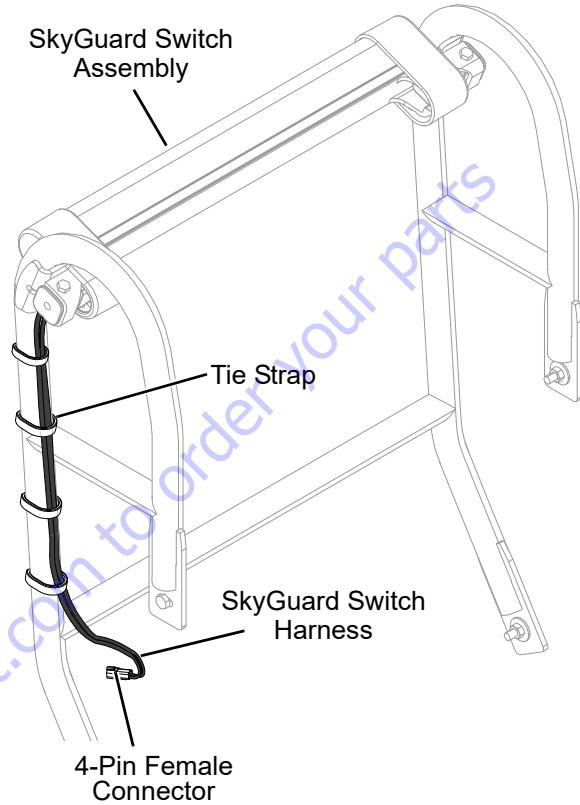


Figure 4-18.

10. Connect Sky Guard connector to the one on the machine located under load cell box. See Figure 4-19.



Figure 4-19.

11. Open load cell board (ECM3) box, locate connectors X604 and X603, then disconnect them. See Figure 4-20.

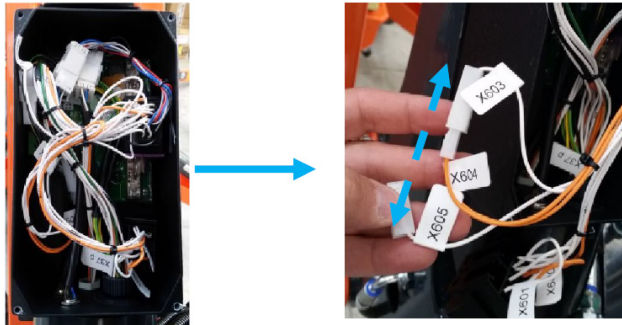


Figure 4-20.

12. Connect connector X603 to connector X605. See Figure 4-21.

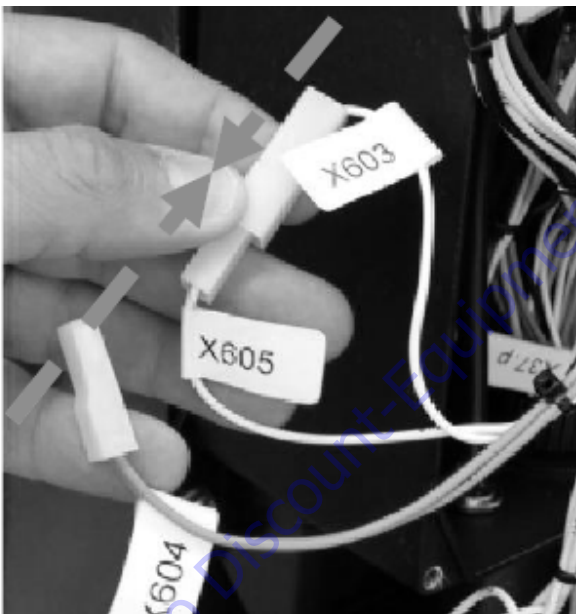


Figure 4-21.

**⚠ CAUTION**

WHEN THE SKYGUARD IS PUSHED WITH EXCESSIVE FORCE THE SENSOR SUPPORTS (ITEM 10 - FIGURE 4-17.) WILL BREAK. REPLACE WITH NEW SENSOR SUPPORTS BEFORE CONTINUING OPERATION OF THE MACHINE.

13. Reconnect the battery power to the machine.
14. Check for the proper functioning of SkyGuard system.

15. POWER ON the machine.
  - Press button 6 (service) on the remote control
  - Press button 7 (set up)
  - Press button 5 (password)
  - Enter password "4 7 7 1" then press button 9 (OK)
  - Press button 3 (extra)
  - Press button 1 (optional)
  - Press button 8 (next)
  - Press button 4 (skyguard)
  - Press Button 1 (ON)



Asterisk must show next to the ON position

Figure 4-22.

- Press button 9 (esc)
- Press button 9 (esc)
- Press button 9 (esc)
- Press button 9 (esc)
- Remote control screen should be on main icon page

**NOTICE**

IF PLATFORM REMOVAL WILL BE NECESSARY, SKY GUARD EXTERNAL CONNECTOR HAS TO BE DISCONNECTED. THEN RECONNECTED WHEN THE PLATFORM IS INSTALLED ON THE MACHINE.

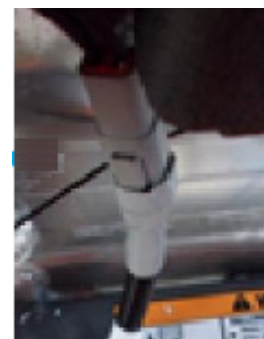


Figure 4-23.



## SECTION 4 - BOOM & PLATFORM

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**NOTE:** If further information is required, please contact the JLG Service Department.

### Skyguard System

When the SkyGuard sensor is activated, functions that were in use at the time of actuation will reverse or cutout. The table below outlines these functions.

Main Lift Up	Main Lift Dn	Main Tele In	Main Tele Out	Swing	Drive Forward	Drive Reverse	Tower Lift Up	Tower Lift Down	Platform Level	Platform Rotate	Jib Lift	Go Home (All Functions)
R	C	C	R	C	C	C	R	C	C	C	C	C
R= Indicates Reversal is Activated												
C= Indicates Cutout is Activated												
N/A Indicates the function does not exist for this model												

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# PEDAL - SKY GUARD SYSTEM

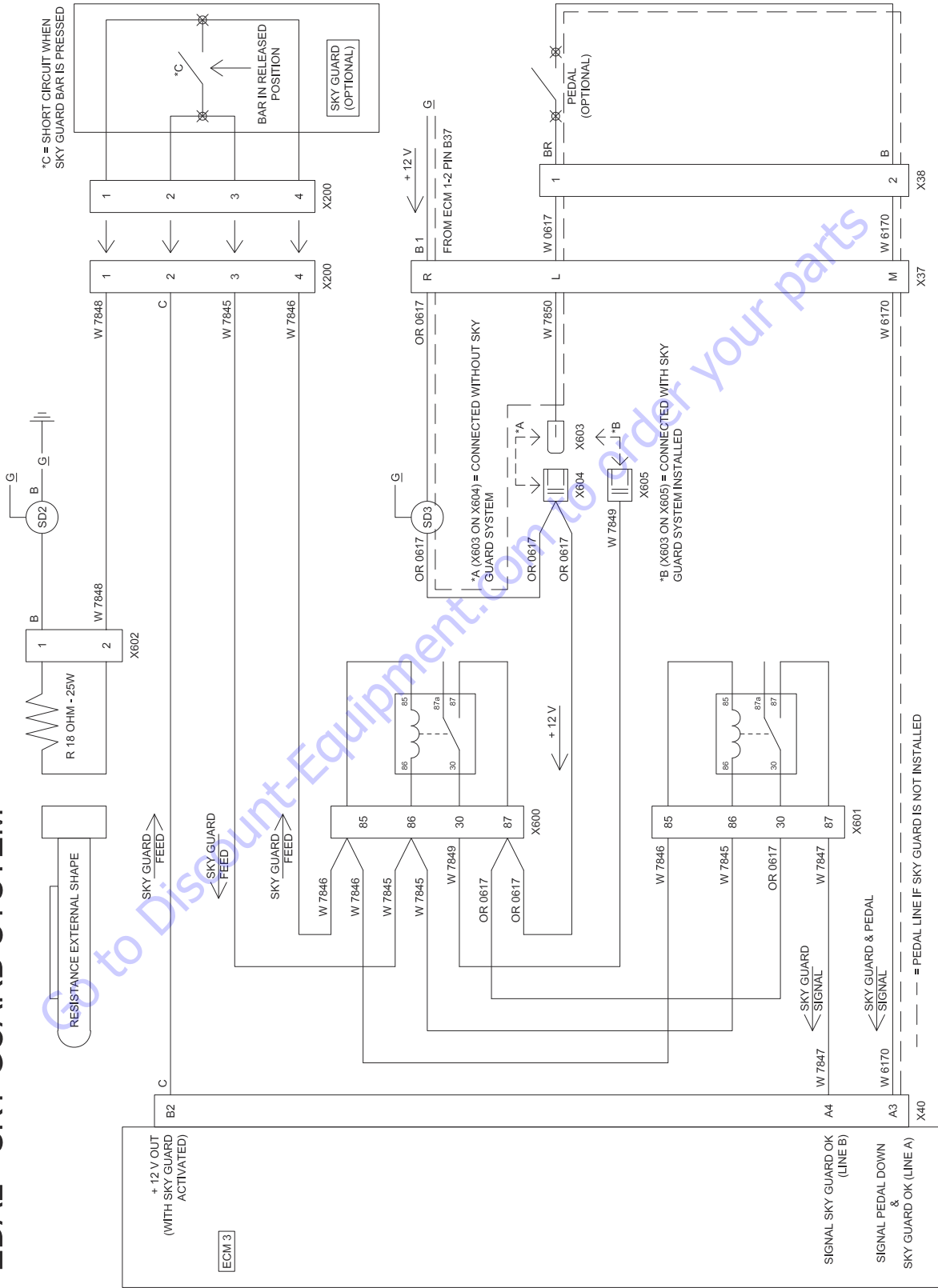
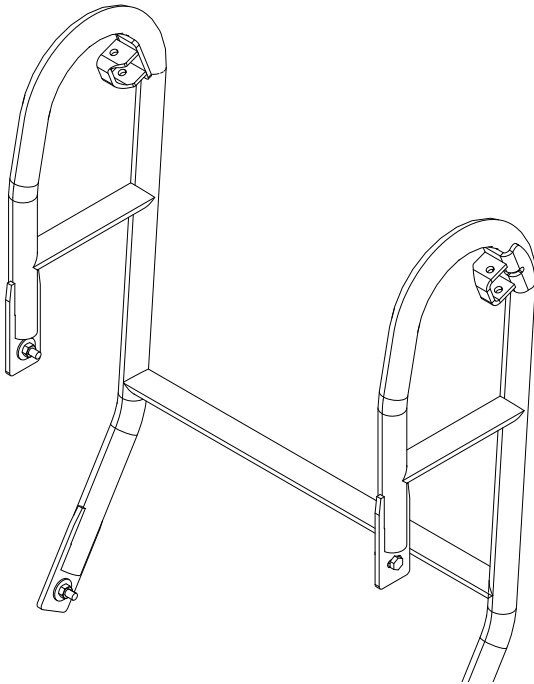


Figure 4-24. Pedal - Sky Guard System Schematic

**4.9 SKYGUARD INSTALLATION - 2 PERSON PLATFORM**

The purpose of this instruction is to install a SkyGuard system on JLG Compact Crawler Boom (capacity of two person) models listed below and with below pictured SkyGuard Bracket.



**Figure 4-25. : SkyGuard Bracket with Mount**

It is recommended that you read and thoroughly understand these instructions before starting this procedure.

**NOTICE**

**USE ALL APPLICABLE SAFETY PRECAUTIONS WHILE WORKING ON, AROUND OR UNDER ANY MACHINERY.**

**Options/Accessories Prohibited When Installing This Kit:**

- None

**Tools & Equipment Required:**

- Standard mechanic tools including 5/16" & 7/32" Allen wrenches
- Tie Straps

**Personnel Required:**

- Qualified JLG equipment mechanic

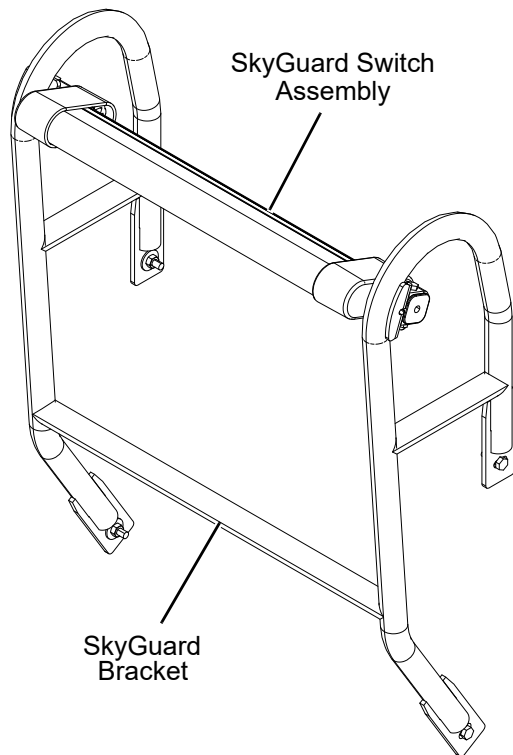
**Parts List:**

1	0641414	Bolt, 1/4-20x1 3/4 LG	2
2	0700812	Bolt (Metric), 8x25 LG	4
3	3290801	Nut, M8x 1.25	4
4	3300430	Nut, Acorn 1/4- 20	2
5	3931424	Bolt, 1/4-20x1 1/2 LG	2
6	4711400	Washer, 1/4 DIA Plain Steel, Narrow	4
7	4811902	Washer, 8mm LG OD	4
8	37609800	Bracket, Skyguard Support	1
9	1001186517	Cover, Platform Sensor	2
10	1001188889	Support, Shear Block	2
11	1001213890	Switch, Skyguard	1
12	1001213891	Mount, Platform Sensor	1

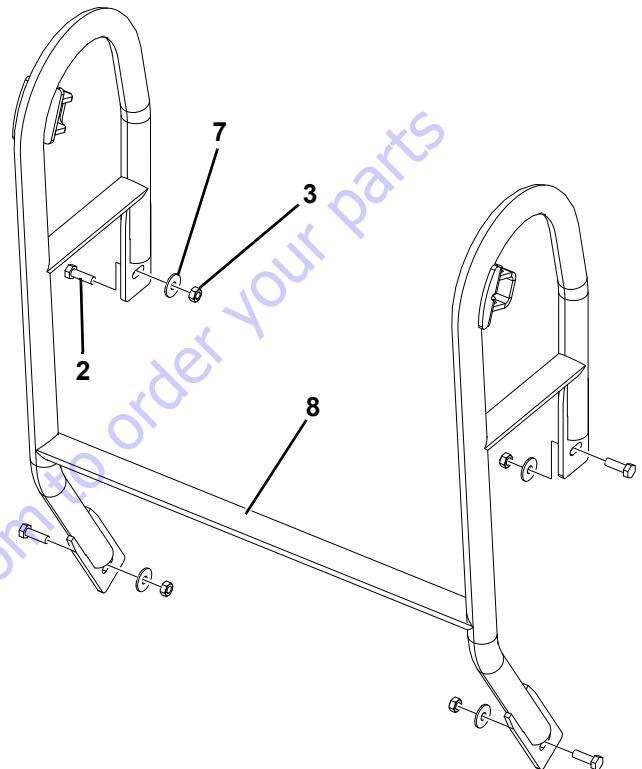
**Procedure:**

1. Park the machine on the firm level surface, fully retract & lower the boom.
2. Extend all the four outriggers, set them to the auto levelling mode and set the machine to rest position.
3. Remove the key and shut the engine OFF.
4. Allow the machine and system fluids to cool.
5. Disconnect the battery power from the machine.

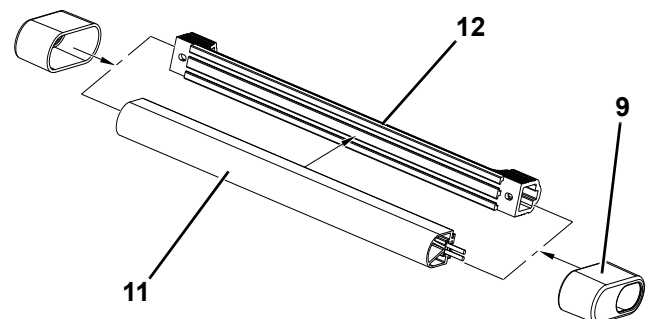
ITEM	PART NUMBER	DESCRIPTION	QTY
------	-------------	-------------	-----

**For Reference:****Figure 4-26. SkyGuard Bracket with SkyGuard****Installation:**

1. Install the SkyGuard Support Bracket (**8**) onto the welded mounts on platform rails, secure the support bracket using four Bolts (**2**), relevant Washers (**7**) and Nuts (**3**). See Figure 4-27.

**Figure 4-27.**

2. Align and attach Platform Sensor Mount (**12**) onto the SkyGuard Switch (**11**) as shown in Figure 4-28.
3. Attach Platform Sensor Covers (**9**) to SkyGuard switch assembly at both ends. See Figure 4-28.

**Figure 4-28.**

4. Position SkyGuard switch assembly with sensor cover onto the SkyGuard Support Bracket (**8**) as shown in Figure 4-27.

## SECTION 4 - BOOM & PLATFORM

5. Insert a Shear Block Support (10) through shear block housing on the SkyGuard support bracket and into the platform sensor mount. See Figure 4-29.

**NOTE:** Ensure the correct position of Shear Block Support (10) before installation.

6. Secure the shear block on welded mount of SkyGuard support bracket using Bolt (1), relevant Washer (6) and Acorn Nut (4) as shown in Figure 4-29.
7. Secure the SkyGuard switch assembly using Bolt (5) and relevant Washer (6) on platform sensor mount. See Figure 4-29.

**NOTE:** Tighten the Bolt (5) using appropriate allen wrench.

8. Repeat Steps 4 through 7 to secure SkyGuard switch assembly on the other side of the SkyGuard support bracket ensuring correct position of the shear block support before installation.

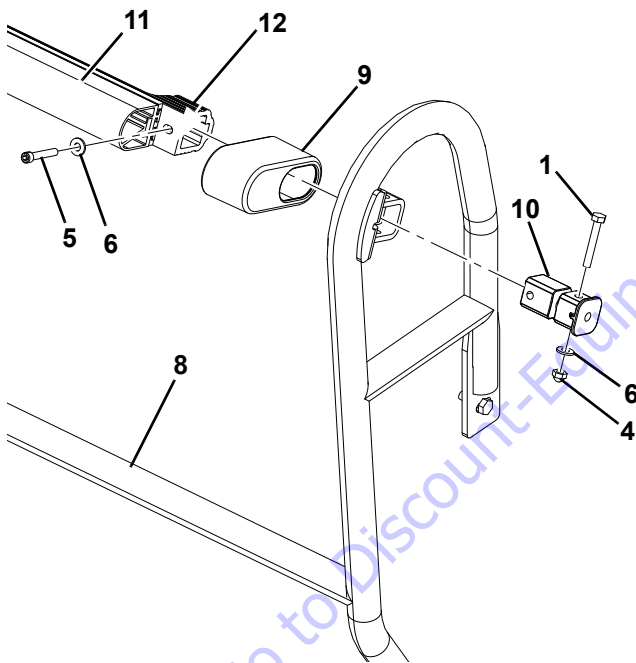


Figure 4-29.

9. Route the SkyGuard switch harness along SkyGuard support bracket (right side) and under the platform control box. Secure the harness using tie straps. See Figure 4-30.

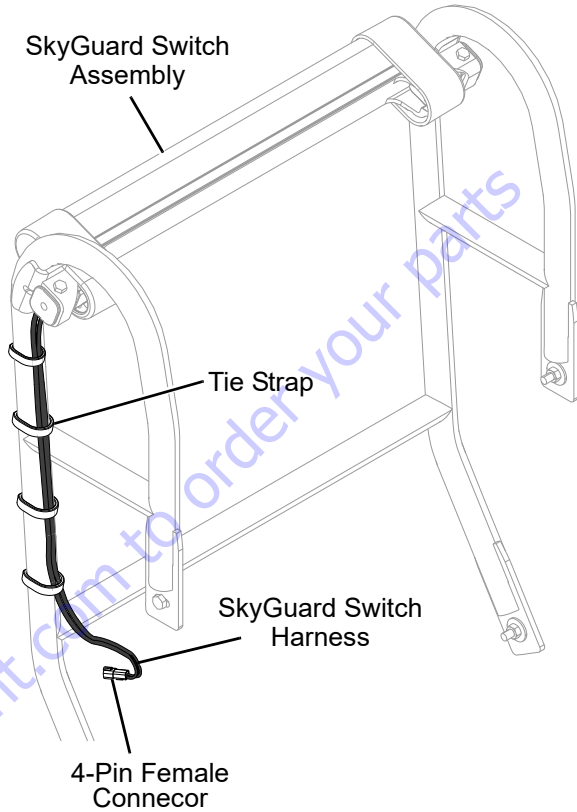


Figure 4-30.

10. Connect Sky Guard connector to the one on the machine located under load cell box. See Figure 4-31.



Figure 4-31.

11. Open load cell board (ECM3) box, locate connectors X604 and X603, then disconnect them. See Figure 4-32.

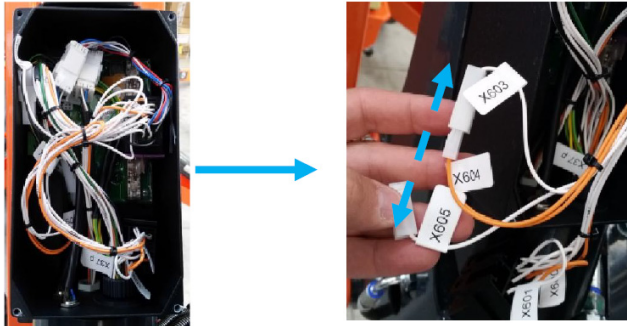


Figure 4-32.

12. Connect connector X603 to connector X605. See Figure 4-33.

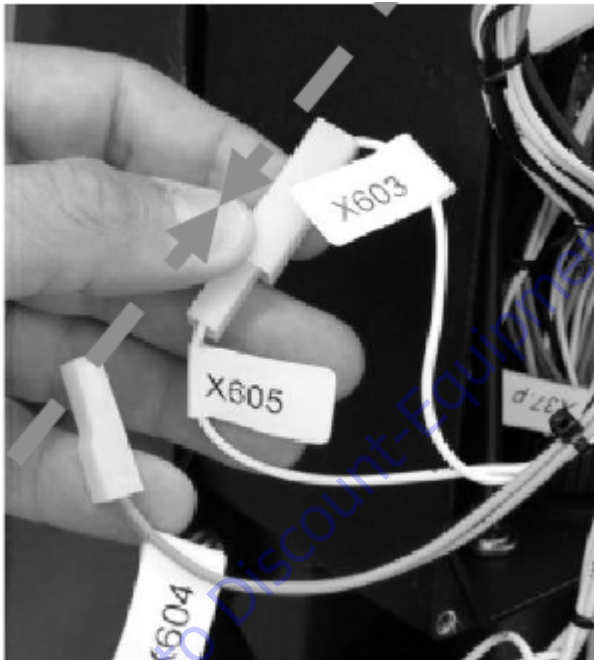


Figure 4-33.

**⚠ CAUTION**

WHEN THE SKYGUARD IS PUSHED WITH EXCESSIVE FORCE THE SENSOR SUPPORTS (ITEM 10 - FIGURE 4-29.) WILL BREAK. REPLACE WITH NEW SENSOR SUPPORTS BEFORE CONTINUING OPERATION OF THE MACHINE.

13. Reconnect the battery power to the machine.
14. Check for the proper functioning of SkyGuard system.

15. POWER ON the machine.
  - Press button 6 (service) on the remote control
  - Press button 7 (set up)
  - Press button 5 (password)
  - Enter password "4 7 7 1" then press button 9 (OK)
  - Press button 3 (extra)
  - Press button 1 (optional)
  - Press button 8 (next)
  - Press button 4 (skyguard)
  - Press Button 1 (ON)



Asterisk must show next to the ON position

Figure 4-34.

- Press button 9 (esc)
- Press button 9 (esc)
- Press button 9 (esc)
- Press button 9 (esc)
- Remote control screen should be on main icon page

**NOTICE**

IF PLATFORM REMOVAL WILL BE NECESSARY, SKY GUARD EXTERNAL CONNECTOR HAS TO BE DISCONNECTED. THEN RECONNECTED WHEN THE PLATFORM IS INSTALLED ON THE MACHINE.

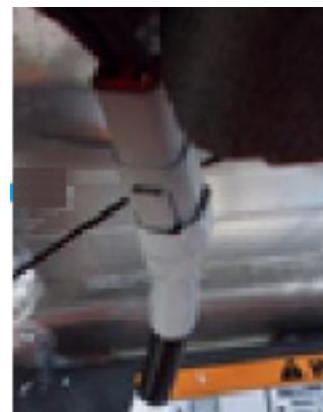


Figure 4-35.

## SECTION 4 - BOOM & PLATFORM

---

**NOTE:** If further information is required, please contact the JLG Service Department.

### Skyguard System

When the SkyGuard sensor is activated, functions that were in use at the time of actuation will reverse or cutout. The table below outlines these functions.

Main Lift Up	Main Lift Dn	Main Tele In	Main Tele Out	Swing	Drive Forward	Drive Reverse	Tower Lift Up	Tower Lift Down	Platform Level	Platform Rotate	Jib Lift	Go Home (All Functions)
R	C	C	R	C	C	C	R	C	C	C	C	C
R= Indicates Reversal is Activated												
C= Indicates Cutout is Activated												
N/A Indicates the function does not exist for this model												

PEDAL - SKY GUARD SYSTEM

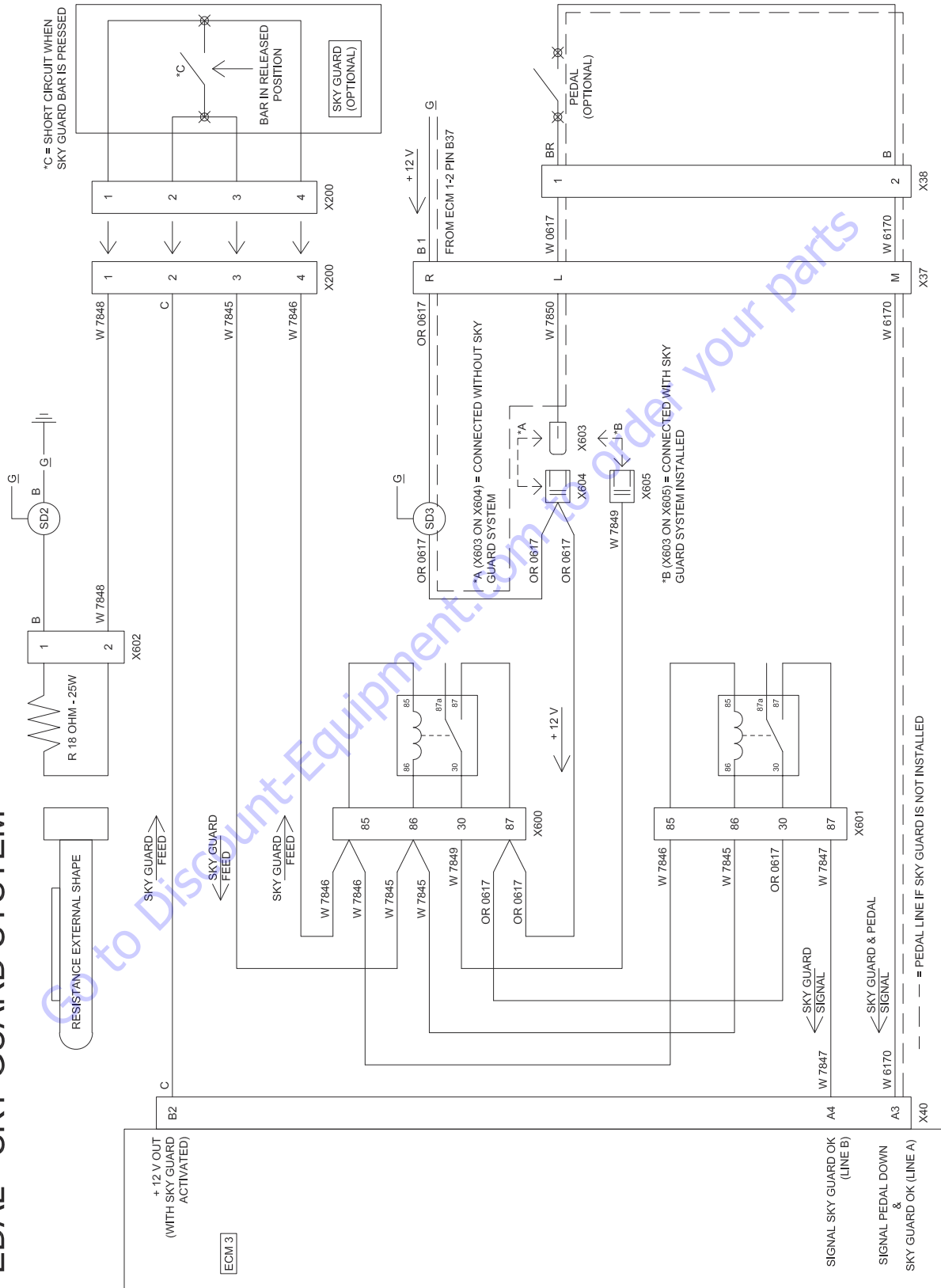


Figure 4-36. Pedal - Sky Guard System Schematic



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SECTION 5. HYDRAULICS

5.1 MAIN HYDRAULIC VALVE BLOCK IDENTIFICATION AND LOCATIONS



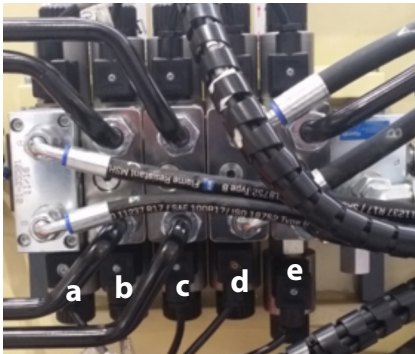
1. Ground Valve Block



ML00050

- a. Left track
- b. Right track
- c. Front left outrigger
- d. Rear left outrigger
- e. Front right outrigger
- f. Rear right outrigger
- g. Widening system

2. Aerial Valve Block



ML00060

- a. Tower extension
- b. Tower boom
- c. Main extension
- d. Main boom
- e. Turn table rotation

3. Platform Valve Block

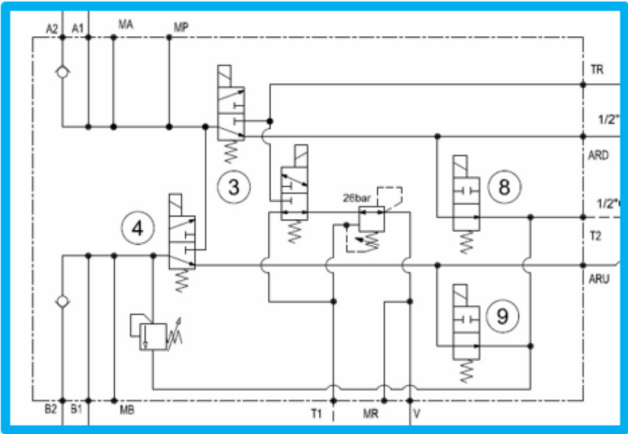


- a. Jib cylinder
- b. Platform leveling
- c. Platform rotation

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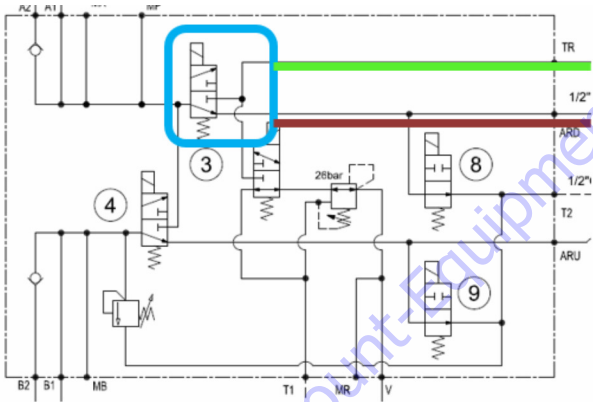
5.2 COMPONENTS

Safety Valve Block

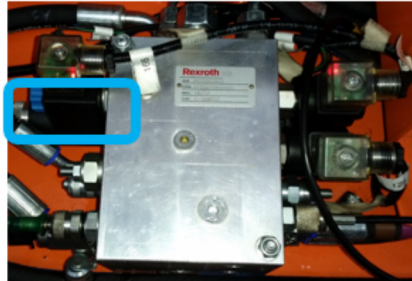
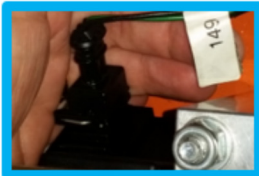


ML00080

Aerial/Ground Electric Valve Deviator (X153)



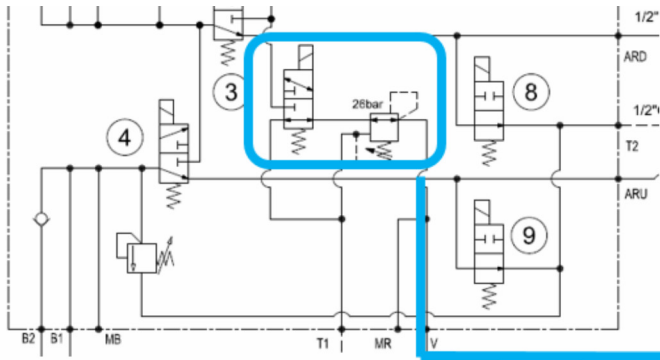
Ground Valve Block  
Aerial Valve Block  
(at the ground)



ML00090

The aerial/ground deviator sends oil to the ground valve block or to the aerial valve block.

**Second Speed Electric Valve (X150)**



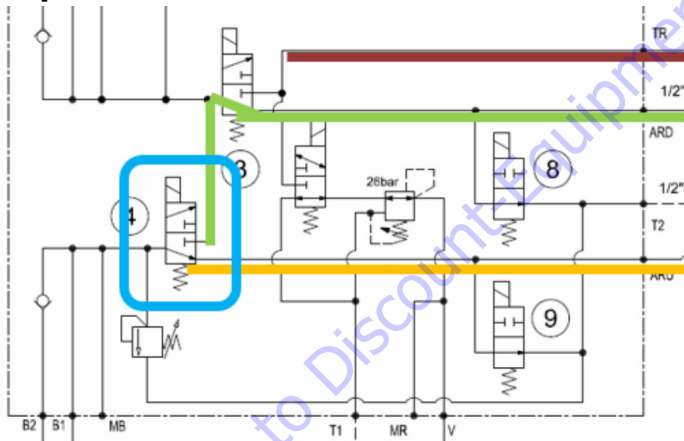
**Second drive speed  
command for motor gears**



ML00100

The second speed electric valve engages the second chamber on the motor gear. Maximum pressure valve is set during production (auto-two speed system).

**Pumps Electric Valve (X125)**



**Ground Part Valve Block**

**Aerial part Valve Block (at the ground)**

**Aerial part valve block  
(on the Jib)**

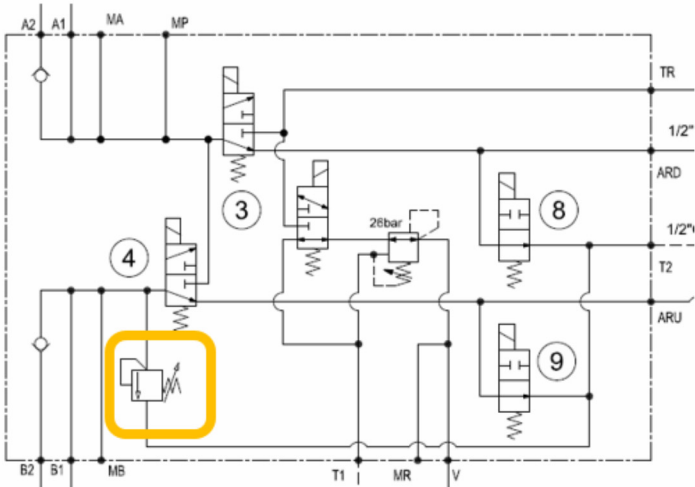


ML00110

The pumps electric valve sends the second pump's oil to the ground pump valve block or the aerial valve block (at the ground) to improve the movement speeds.

**NOTE:** Platform leveling always has priority.

**Second Pump Pressure Sensor (X141)**



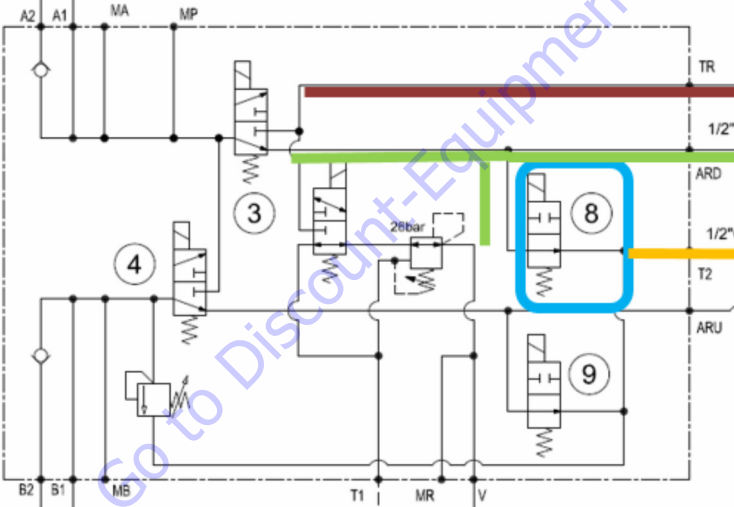
**MAX PRESSURE VALVE**  
It protect the little pump, for example in case of oil tubes squeezed



ML00120

The second pump pressure sensor disengages the little pump (used to improve movement speeds) if oil pressure exceeds 2175 psi (150 bar).

**Aerial Dump Valve-Ground (X166)**



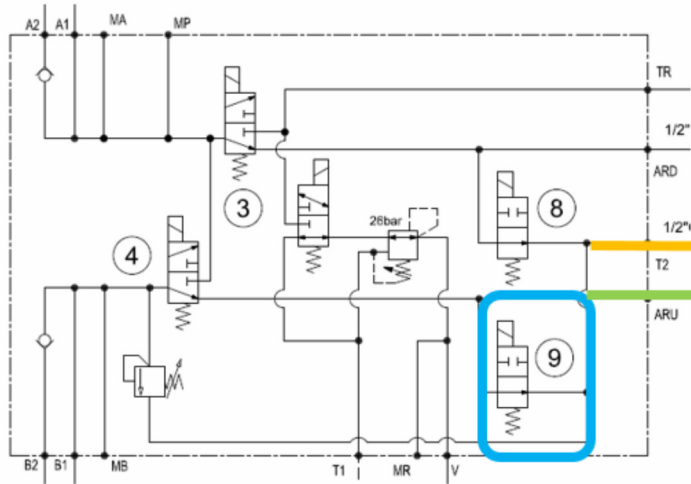
**Ground Valve Block**  
**Aerial Valve Block (at the ground)**  
**Tank line**



ML00130

The aerial dump valve is a second safety valve for the aerial system (on the ground).

**Aerial Dump Valve-Jib (X190)**



Tank line

Aerial part Valve Block  
(on the jib)

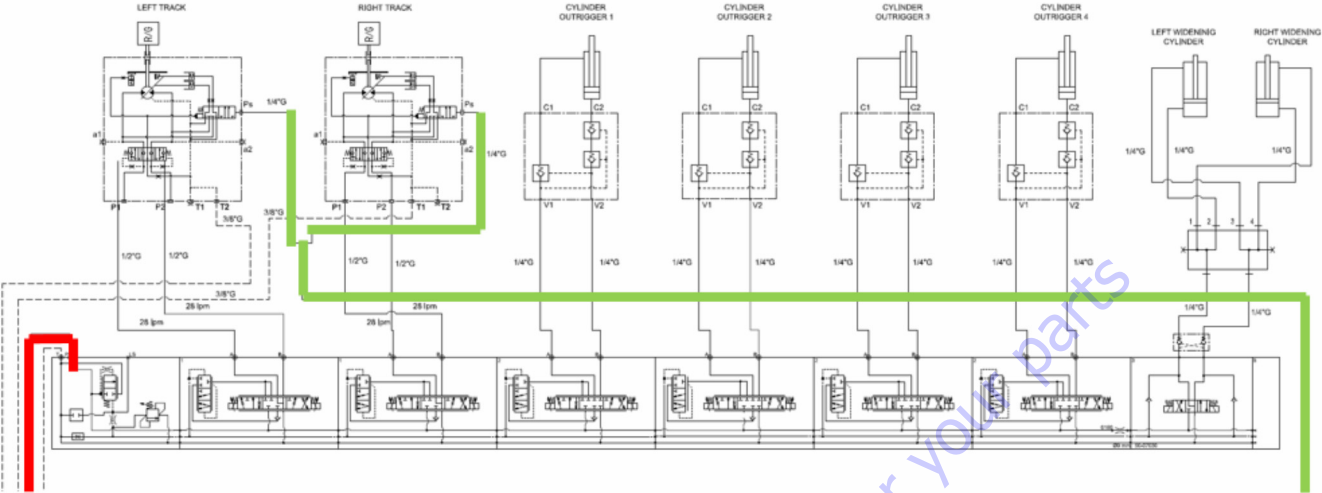


ML00140

The aerial dump valve is a second safety valve for the aerial system (on the jib).

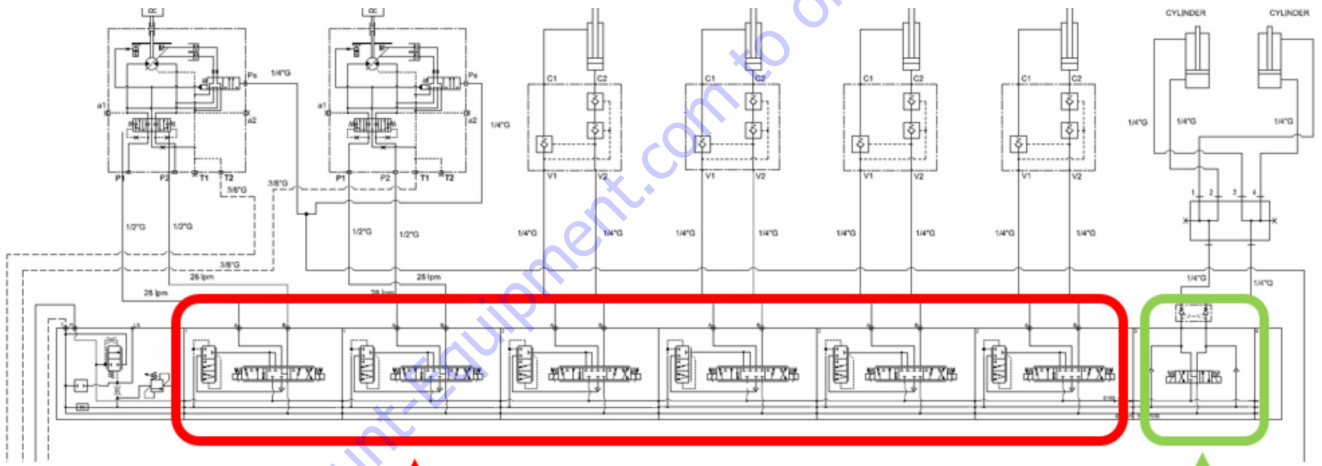
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Ground Valve Block



Pressure Line

Second Speed Line



Proportional Valves with post compensated elements

On-Off Valve

ML00150

ML00160



5.3 SCHEMATIC

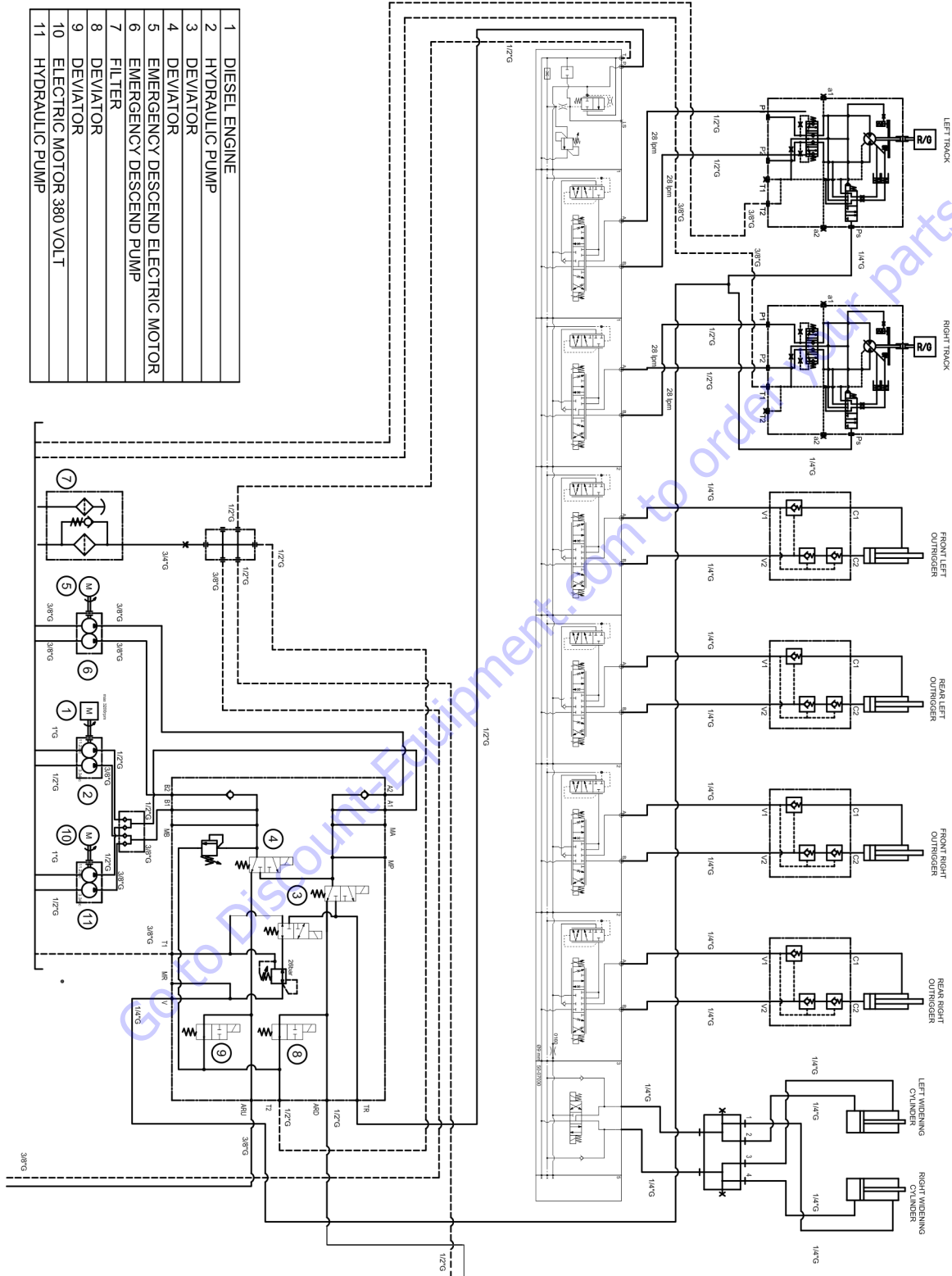
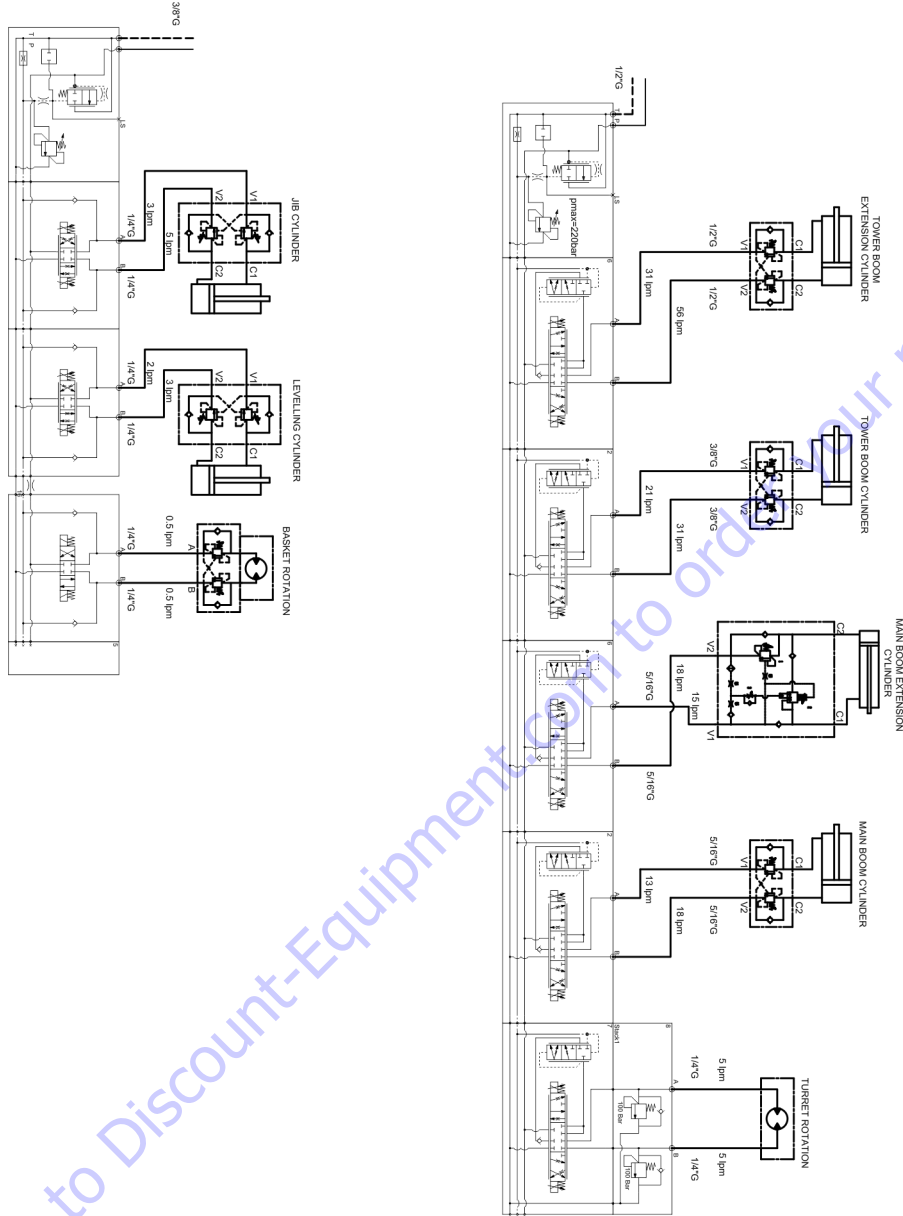


Figure 5-1. Hydraulic Schematic-Sheet 1 of 2

ML00020



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Figure 5-2. Hydraulic Schematic-Sheet 2 of 2

M100030

### 5.4 HYDRAULIC SYSTEM PUMP AND PRESSURE LINES

The machine hydraulic system is powered by two pump units:

- Pump unit connected to the diesel engine, two pumps 6,67cc/rev each, diesel engine is calibrated at maximum 3200 rpm
- Pump unit connected to the electric 12V motor, two pumps 2,15 cc/rev each, electric motor is calibrated at 1500 rpm

**NOTE:** *Lithium machine are equipped with two pump units, one connected to the electric motor with two pumps 3,15 cc/rev each and the emergency 12V pump.*

All of the pump unit pressure lines are conveyed through the hydraulic manifold into two pressure lines A and B. Six one-way valves avoid oil under pressure to flow back to the tank through an unused pump unit.

Every time that hydraulic oil tank is opened (depressurized), such as in case of hydr. oil filter replacement, it must be pressurized again (with cork screwed) at minimum rpm, to avoid cavitation.

"A" pressure line sends oil under pressure to the deviator valve, this valve is commanded directly by the control module to feed right side ground valve-block or to aerial part valve-block. Deviator valve normally (when not fed) send oil to aerial part valve-block, so that it feeds right side ground valve-block only when its coil is energized.

Its coil is not energized (oil to the aerial part) only when machine is OFF or when machine is stabilized.

"B" pressure line sends oil under pressure to the double pump valve that normally feeds the left side ground valve-block.

Double pump valve normally (when not fed) sends oil to left side ground valve-block, so that it send oil to the deviator only when its coil is energized.

While "N" or "RABBIT" speed are selected, when some boom manifold movement is in progress, double pump valve is fed by the control module in order to feed also with the second pump the boom manifold valve-block, increasing the movement speed even without increasing the RPM.

Which movement are speed up by this way depends on which power system is used on that moment, diesel engine, electric motor or lithium electric motor for lithium machines, they are those movements that are better performed with an higher oil rate, for instance telescope opening is always carried out with both the pumps.

Double pump valve is not fed with contemporaneously movements and is not fed at minimum speed "TURTLE".

### 5.5 GROUND COMPONENT HYDRAULIC SYSTEM

The ground control manifold valves control, outriggers, left and right track drive, and track widening.

The ground control valves are controlled by a hydraulic valve-block equipped with one maximum pressure valve, six proportional valves and an ON-OFF valve for ground control movement.

On each ground manifold oil rate is controlled through the proportional valve managed by the control module.

Depending on the movement required, proportional valve will open accordingly regulating the oil rate, at the same time the relevant ON-OFF valves (one each movement) will open feeding the relevant cylinder or drive gear motor.

Ground manifold maximum pressure valve has to be calibrated as indicated on use and maintenance manual, at 200 bar with Diesel engine or 180 bar with electric motor (185 bar for lithium machine).

When the proportional valve coil is not energized, oil flows back to the tank.

### 5.6 OUTRIGGERS

Outrigger cylinders are controlled by the ground valve block. When machine is setup on outriggers, oil is kept under pressure on the cylinder bottom side, against machine weight, by four piloted one-way valves installed in series on the cylinder valves block.

Another piloted one-way valve is installed on the stem side.

While cylinder movements are in progress the opposite/s one-way valves is/are piloted to open letting oil flow back to the valveblock.

### 5.7 DRIVE GEAR MOTORS

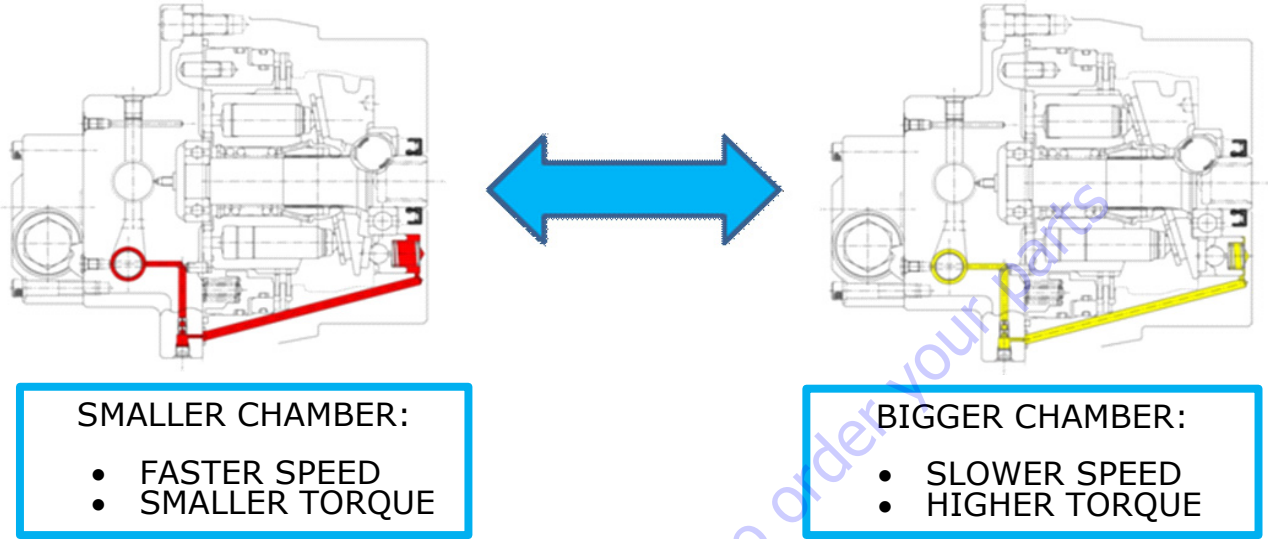
Each drive gear motors runs forward or backward independently. Drive gear motors are controlled by the ground valve-block and each one is equipped with an automatic brake that is hydraulically deactivated only while it runs.

Drive gear motors are equipped with a second speed system, indeed they are variable capacity so that they can perform two different hydraulic speeds in order to change tracks speeds further that rpm regulation.

The second speed block contains the coil in charge to activate the second speed, selecting RABBIT from remote control button the control module will energize that coil.

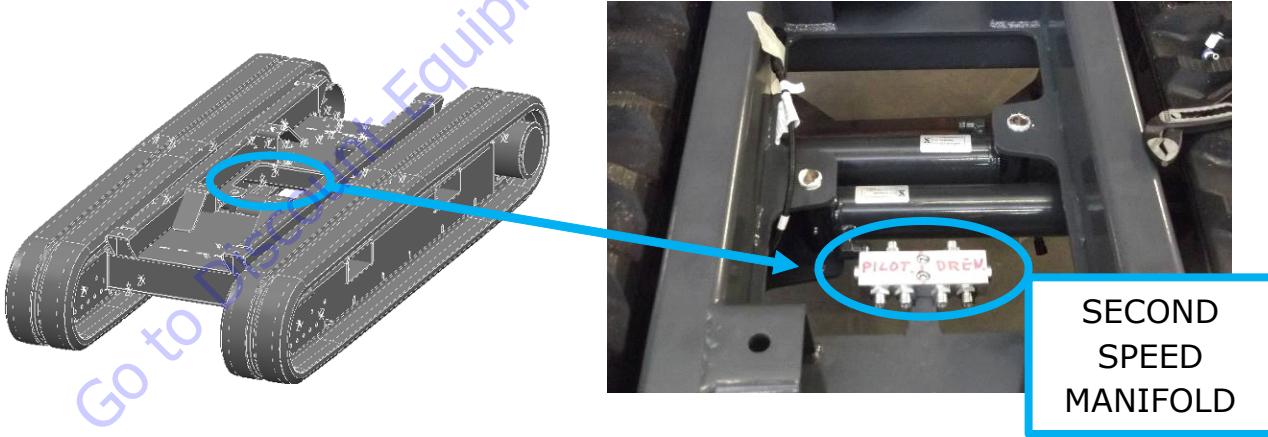
When that coil is energized oil is sent to both drive gear motors to move their plate so that their chamber capacity will be reduce. With reduced capacity the gear rate is increased so that the tracks speed is increased too.

This second speed system is also controlled by an auto2speed valve, in case of an higher torque is required to the drive gear motors, such as driving uphill, the second speed line pressure will raise and if it overcomes the calibrated maximum pressure (26 bar) it will automatically open the auto2speed valve reducing the gear rate and the tracks speed.



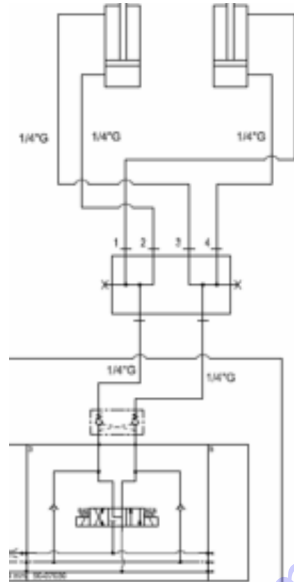
Auto2speed allows to manage automatically the available power, providing on demand an higher torque (with a slower speed) or an faster speed (with a lower torque).

Second speed activation oil, coming from second speed valve coil, is sent to both drive gear motors through the second speed manifold.



### 5.8 TRACKS WIDENING

Tracks widening or narrowing is carried out by two cylinders controlled together in parallel by the same valve-block element on the left side valve-block.



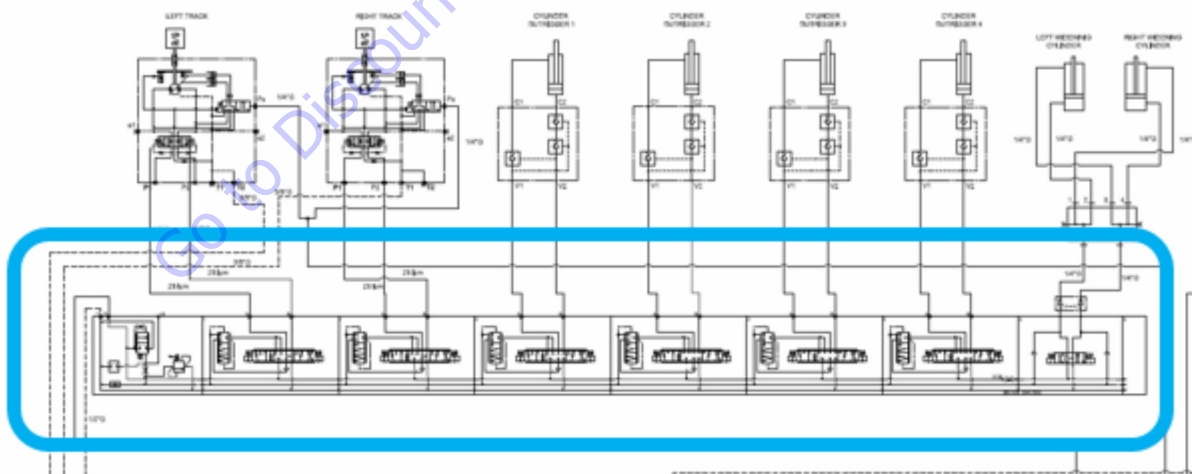
ML00170

Track widening system oil is sent to both cylinders through the track widening manifold that is installed on hydraulic components compartment just below the hydraulic manifold close to blow-off manifold.

### 5.9 BOOM COMPONENT HYDRAULIC SYSTEM

The boom components controlled by the aerial valve block are tower extension, tower boom, main extension, main boom and turn table rotation.

The boom components are controlled by an hydraulic manifold valve equipped with proportional valve and an ON-OFF valve for each aerial part movement.



ML00180

Boom component manifold valves are fed by pressure line "A" through deviator valve and oil rate is controlled through the proportional valve managed by the control module.

Depending on the movement required, proportional valve will open accordingly regulating the proper oil rate, than the relevant ON-OFF valves (one each movement) will open addressing the oil to the relevant cylinder or actuator.

When the proportional valve coil is not fed, oil is sent to the drainage and then to the tank.

The maximum pressure valve has to be calibrated as indicated on use and maintenance manual at 200 bar with Diesel engine or 180 bar with electric motor (185 bar for lithium machine).

On each cylinder an actuator is installed a couple of calibrated valves, one each direction, when movement is in progress on one direction the opposite valve is piloted to open letting oil flow back to the manifold valve block.

When these valves are not piloted oil flow is avoided so that they keep the cylinder and actuator position against external forces or in case of an hose damage.

### **Tower Boom**

The tower boom is moved by one cylinder. This cylinder is equipped with an internal sensor that measures its opening position.

### **Main Boom**

The main boom is moved by one cylinder. This cylinder is equipped with an internal sensor that measures its opening position.

### **Telescope**

Telescope system is composed by two parts, the tower boom that contains the first telescope and the main boom that contains the second telescope. They are all opened or closed together by an unique internal cylinder and a system of ropes and pulleys.

Microswitches detect the ropes positions within the boom sections.

### **Jib**

Jib is moved by one cylinder, while moving jib the platform is kept level thanks to the parallelogram system.

### **Platform Leveling**

Platform levelling close circuit is composed by two cylinders, one on the platform and one on the jib. The platform is automatically kept levelled while the boom is moving because of the platform cylinder is moved by connection rod cylinder.

In particular, while boom is opening, the connection rod cylinder will be closing so that its oil will be send to the platform cylinder achieving the automatic basket levelling.

### **Platform Rotation**

Platform rotation is carried out by the platform rotation actuator composed by two chambers, the maximum rotation possible is 62° on both directions achieving a total of 124°.

Two black arrows show the platform aligned position.

### **Turn Table Rotation**

Turret rotation is carried out by a rotation hydraulic motor moved by a worm screw on a bearing ring.

Turret could be rotated 180° each side till a mechanical block, achieving a total rotation.

5.10 CYLINDER REPAIR

Specification - Cylinders Overview

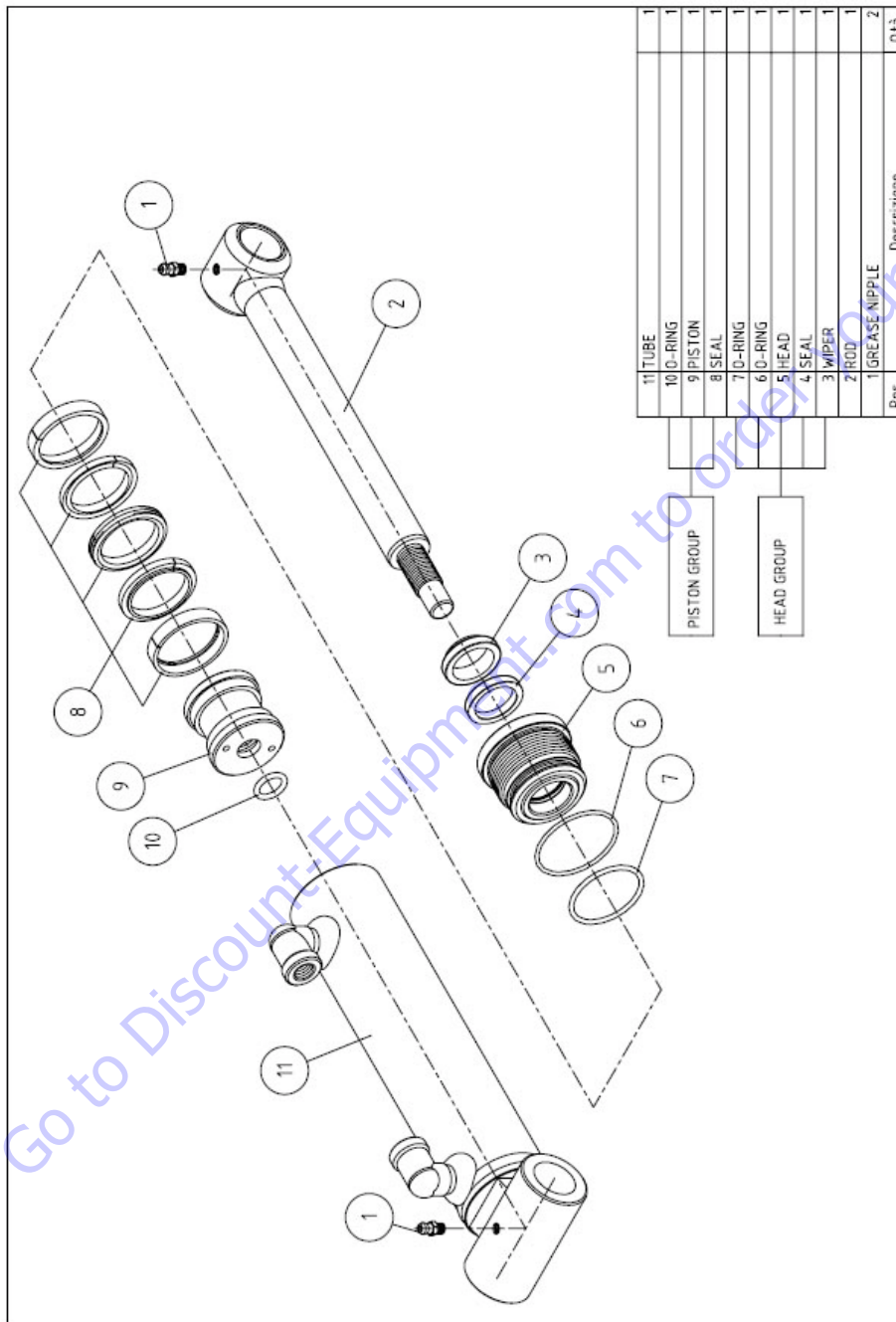


Figure 5-3. Piston Thread

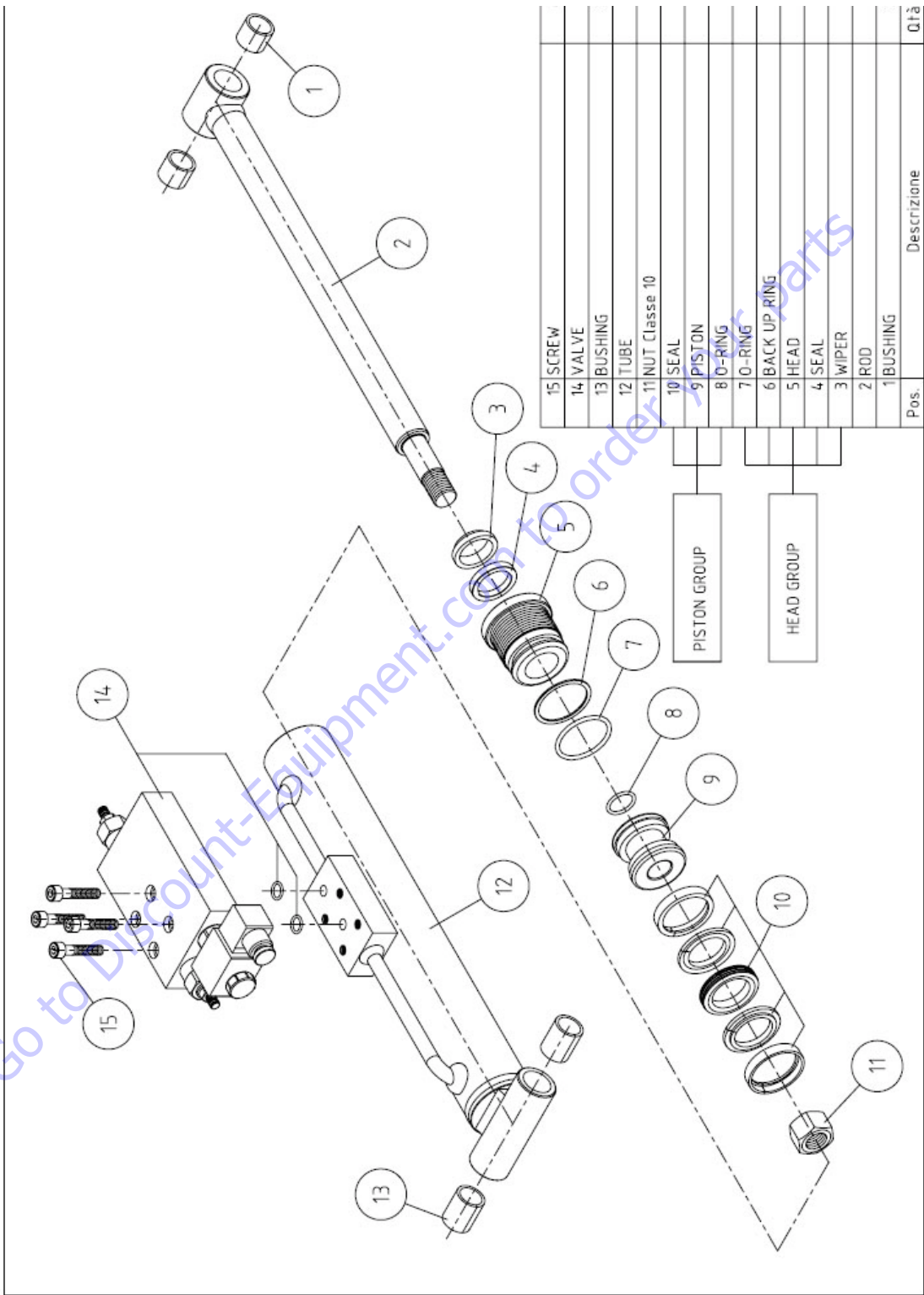


Figure 5-4. Piston With Nut Thread



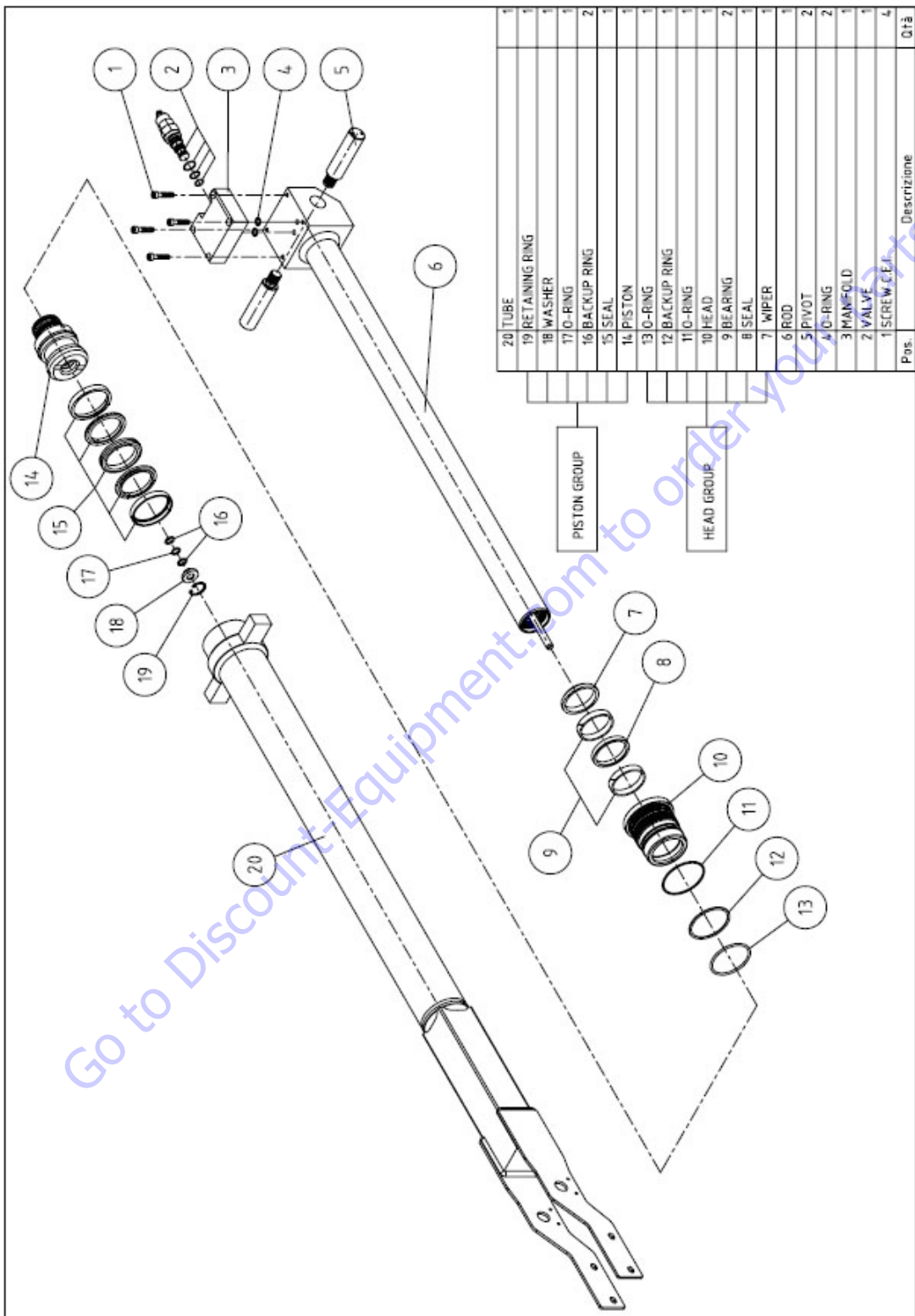


Figure 5-5. Telescope Cylinder

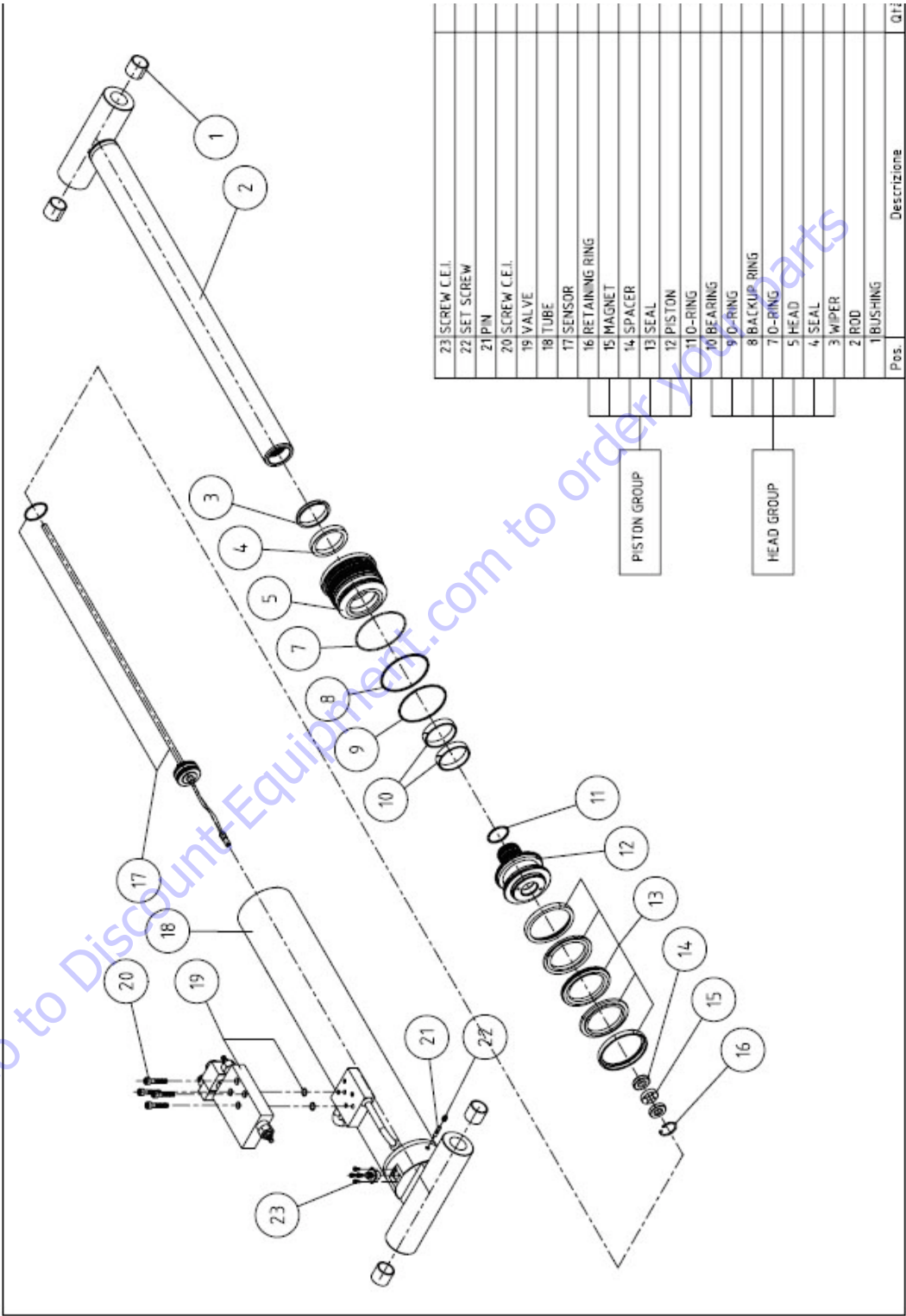


Figure 5-6. Cylinder With Sensor

**Hydraulic Cylinders Torque Specifications**

**Screws Torque Specifications**

CYLINDER SCREWS	TORQUE VALUE
DRILLED SCREW 3/8"	70N/m
SCREW M8	25N/m
SCREW M6	11N/m
SCREW M4	3N/m
CAP 1/4"	30N/m
PURGE SCREW	8N/m
GREASE NIPPLE	2N/m
SENSOR SETSCREW	0.5N/m

**Hose Connections Torque Specifications**

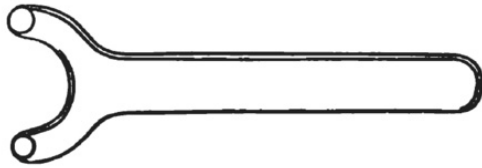
JUNCTION		
Ø HOSE	METRIC THREAD	TORQUE VALUE (N/m)
6	M12x1.5	20
8	M14x1.5	25
10	M16x1.5	30
12	M18x1.5	40
15	M22x1.5	60
18	M26x1.5	90
22	M30x2	170
28	M36x2	210
35	M45x2	360
42	M52x2	490

**Cylinders Head Torque Specification**

TIGHTENING TORQUE HEAD		
HEAD DIAMETER (mm)	TORQUE [Nm]	
	MIN	MAX
30	50	100
35	50	100
40	100	150
45	100	150
50	150	200
55	150	200
60	200	250
65	200	250
70	250	300
75	250	300
80	300	350
90	350	400
100	400	450
110	450	500
120	500	550
130	500	550
140	500	550
150	500	550
160	550	600
170	550	600
180	550	600
190	550	600
200	600	650
210	600	650
220	600	650
230	600	650
240	600	650
250	700	750

## Equipment And Product List

- Spanner Wrench



**NOTE:** The following are general procedures that apply to all of the cylinders with sensor. Procedures that apply to a specific cylinder will be so noted.

## Cylinder With Sensor - General Cylinder Disassembly



1. Clean the cylinder with a suitable cleaner before disassembly. Remove all dirt, debris and grease from the cylinder.
2. Clamp the barrel end of the cylinder in a soft-jawed vise or other acceptable holding equipment if possible.

### NOTICE

**AVOID USING EXCESSIVE FORCE WHEN CLAMPING THE CYLINDER IN A VISE. APPLY ONLY ENOUGH FORCE TO HOLD THE CYLINDER SECURELY. EXCESSIVE FORCE CAN DAMAGE THE CYLINDER TUBE.**

3. Remove the counterbalance valve from the side of the cylinder barrel.

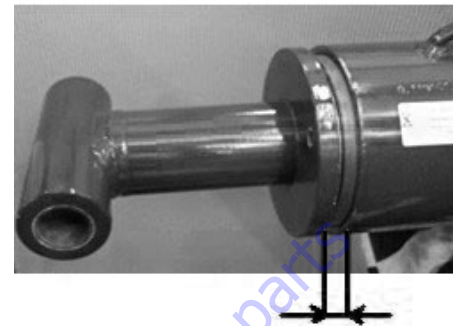
### NOTICE

**CYLINDER ARE UNDER PRESSURE.**

### NOTICE

**DO NOT TAMPER WITH OR ATTEMPT TO ADJUST THE COUNTERBALANCE VALVE CARTRIDGE. IF ADJUSTMENT IS NECESSARY, REPLACE THE COUNTERBALANCE VALVE WITH A *NEW PART*.**

4. Partially extend the rod ~ 15mm and unscrew the head about ~ 15mm.



5. Remove 4 screws of the sensor



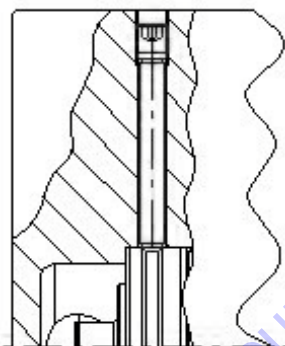
6. Unhook the connector from the base making pressure on 2 wing signed in the picture.



7. Push the connector inside the hole and fix the plate again.



8. Unscrew the setscrew and remove the pin. Use a magnet to pull out the pin.



9. Secure the setscrew in order to keep the air pressure.



10. Blow pressurized air with caution on the connection in order to push the sensor out of the housing.

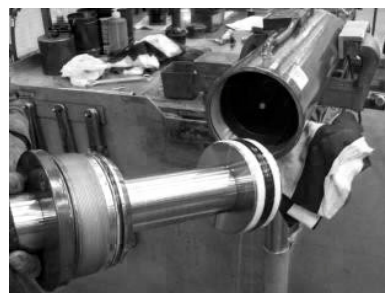
**NOTICE**

WHEN SLIDING THE ROD AND PISTON ASSEMBLY OUT OF THE TUBE, PREVENT THE THREADED END OF THE TUBE FROM DAMAGING THE PISTON. KEEP THE ROD CENTERED WITHIN THE TUBE TO HELP PREVENT BINDING.



**NOTICE**

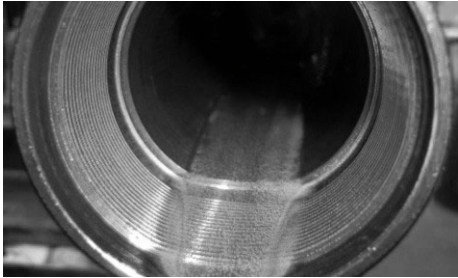
BE CAREFUL IN THIS OPERATION IN ORDER TO AVOID TO BREAK THE WIRE OR DAMAGE THE SENSOR.



## Cleanness And Inspection

### Cylinder Cleaning Instructions

1. Discard all seals, back-up rings and o-rings. Replace with new items from complete seal kits to help ensure proper cylinder function.



2. Clean all metal parts with an approved cleaning solvent such as trichlorethylene. Carefully clean cavities, grooves, threads, etc.



**NOTE:** *If a white powdery residue is present on threads and parts, it can be removed. Clean the residue away with a soft brass wire brush prior to reassembly, and wipe clean before reinstallation.*

3. Blow pressurized air on the connection of the manifold for cleaning.

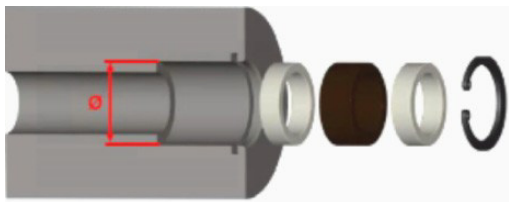


4. Verify the integrity of the tube checking that the surface doesn't present scratches.



### Magnetic Sensor Removal

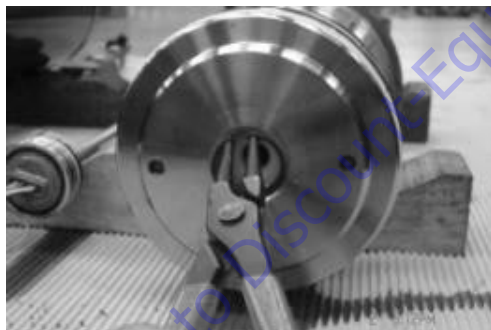
1. Pull out retain clip with pliers.



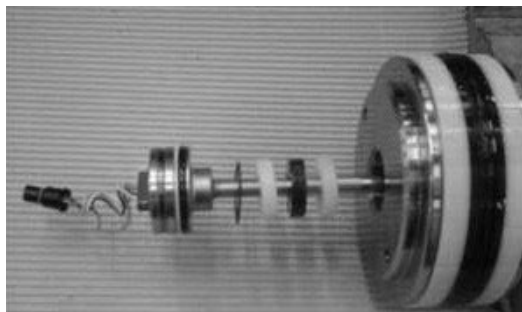
2. Pull out the spacer.



3. Pull out the magnet.



4. Pull out the other spacer.



### Threaded Piston Disassembly

#### NOTICE

**PROTECT THE FINISH ON THE ROD AT ALL TIMES. DAMAGE TO THE SURFACE OF THE ROD CAN CAUSE SEAL FAILURE.**

Fix the rod into the vice.

**NOTE:** Before attempting to disassemble the piston remove any accessible seals.



**NOTE:** Apply heat to break the bond of the sealant between the piston and the rod before the piston can be removed.

#### CAUTION

**WARM THE SURFACE INDICATED MAX 300°C**

Avoid overheating, or the parts may become distorted or damaged.



Apply sufficient torque for removal while the parts are still hot. The sealant often leaves a white, powdery residue on threads and other parts, which must be removed by brushing with a soft brass wire brush prior to reassembly.

### General Cylinder Assembly

1. Use the proper tools for specific installation tasks. Clean tools are required for assembly.
2. Install new seals, back-up rings and o-rings on the piston and the head.
3. Fasten the rod eye in a soft-jawed vise, and place a padded support under and near the threaded end of the rod to prevent any damage to the rod.
4. Lubricate and slide the head over the cylinder rod. Install the piston head on to the end of the cylinder rod. Loctite® 243TM and install the set screw in the piston head. Refer to "Hydraulic Cylinder Torque Specifications," for tightening guidelines for the piston, head and the set screws.

### Seals Head Replacing

Remove all seals, back-up rings and o-rings from the piston head and all seals, back-up rings and orings.



N°	DESCRIPTION	Qty.
1	O-RING	2
2	BEARING	2
3	BACKUPRING	1
4	SEAL	2

Install new seals, back-up rings and o-rings on the piston and the head using the proper tool.



### Cylinder Mounting

#### Cylinder Inspection

5. Inspect internal surfaces and all parts for wear, damage, etc. If the inner surface of the tube does not display a smooth finish, or is scored or damaged in any way, replace the tube.
6. Remove light scratches on the piston, rod or inner surface of the tube with a 400-600 grit emery cloth. Use the emery cloth in a rotary motion to polish out and blend the scratch(es) into the surrounding surface.
7. Check the piston rod assembly for run-out. If the rod is bent, it must be replaced.



8. Replace the seals on the piston. **DO NOT** attempt to salvage cylinder seals, sealing rings or o-rings. ALWAYS use a new, complete seal kit when rebuilding hydraulic components. Consult the parts manual for ordering information.

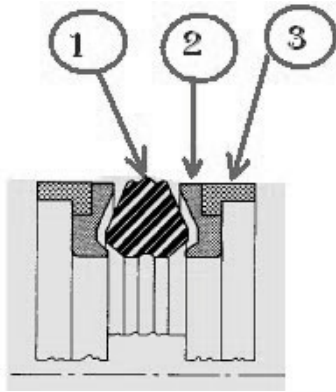




## SECTION 5 - HYDRAULICS

Mount the seals in the following order:

9. Seal
10. Support bearing
11. Bearing

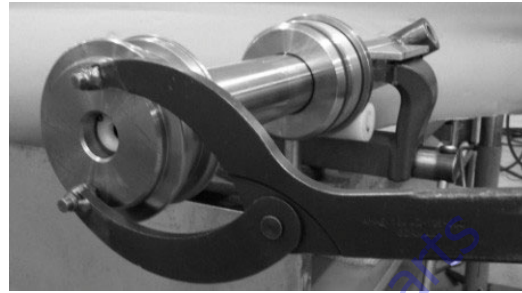


Install the piston on to the end of the cylinder rod. Loctite® 270TM

**NOTE:** If a white powdery residue is present on threads and parts, it can be removed. Clean the residue away with a soft brass wire brush prior to reassembly, and wipe clean before reinstallation.



Refer to "Hydraulic Cylinder Torque Specifications," for tightening guidelines for the piston.

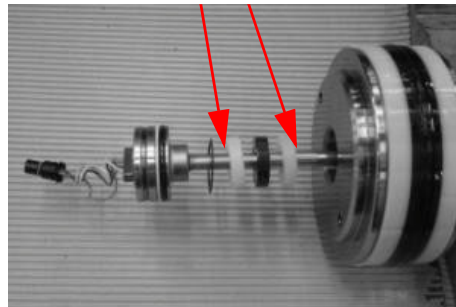


### Sensor Assembling

Spacer has chamfer.



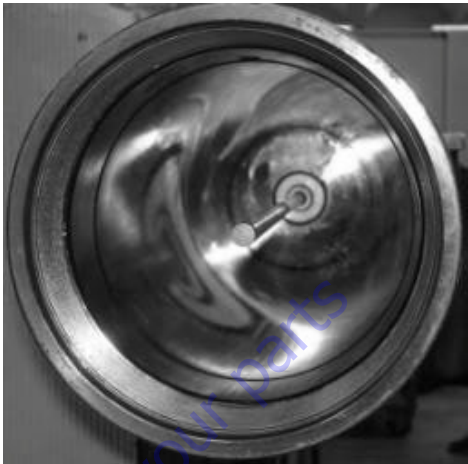
12. Mount spacer with chamfer face outside.



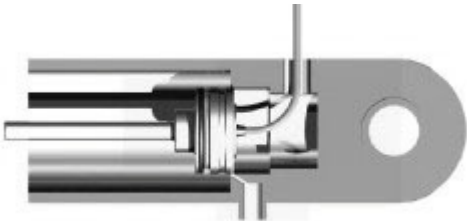
13. Lubricate the o-ring



14. Joint the sensor pin with a guidance cable.



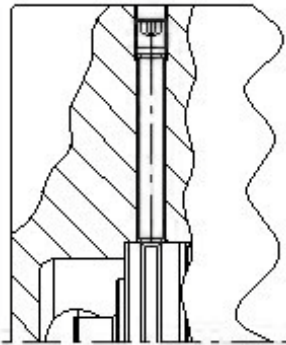
15. Insert sensor with a cable pass



18. Remove the set screw, insert the pin and then fix the set screw.

Pay attention do not overtighten the set screw because the sensor could be damaged.

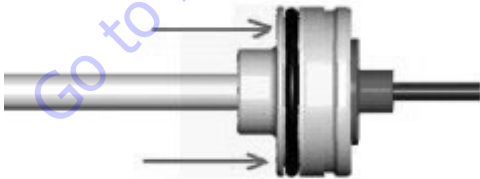
Tightening torque 5 Nm seal with AREXON 35A77.



16. Use plastic tool to insert the sensor



17. Push the tool carefully



## Cylinder Assembling

Pay attention to not damage the sensor



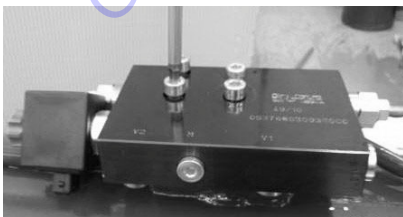
### NOTICE

WHEN SLIDING THE ROD AND PISTON ASSEMBLY OUT OF THE TUBE, PREVENT THE THREADED END OF THE TUBE FROM DAMAGING THE PISTON. KEEP THE ROD CENTERED WITHIN THE TUBE TO HELP PREVENT BINDING.

1. Screw the head into the cylinder barrel and tighten with a spanner wrench. Refer to "Hydraulic Cylinder Torque Specifications," for tightening guidelines for the head.



2. Thread the counterbalance valve into the block on the cylinder barrel. Refer to Section 3.2 "Hydraulic Cylinder Torque Specifications".



**NOTE:** The following are general procedures that apply to all of the cylinders without sensor. Procedures that apply to a specific cylinder will be so noted

## Cylinder Repair Without Sensor

### Rod Removal

General Cylinder Disassembly

1. Clean the cylinder with a suitable cleaner before disassembly. Remove all dirt, debris and grease from the cylinder.
2. Clamp the barrel end of the cylinder in a soft-jawed vise or other acceptable holding equipment if possible.



### NOTICE

AVOID USING EXCESSIVE FORCE WHEN CLAMPING THE CYLINDER IN A VISE. APPLY ONLY ENOUGH FORCE TO HOLD THE CYLINDER SECURELY. EXCESSIVE FORCE CAN DAMAGE THE CYLINDER TUBE.

3. Remove the counterbalance valve from the side of the cylinder barrel.

### NOTICE

DO NOT TAMPER WITH OR ATTEMPT TO ADJUST THE COUNTERBALANCE VALVE CARTRIDGE. IF ADJUSTMENT IS NECESSARY, REPLACE THE COUNTERBALANCE VALVE WITH A NEW PART.

**NOTE:** Cylinder can have residual pressure inside.

4. When the cylinder has been emptied pull out the rod ~ 15mm and loosen the head until ~ 15mm.



### NOTICE

WHEN SLIDING THE ROD AND PISTON ASSEMBLY OUT OF THE TUBE, PREVENT THE THREADED END OF THE TUBE FROM DAMAGING THE PISTON. KEEP THE ROD CENTERED WITHIN THE TUBE TO HELP PREVENT BINDING.

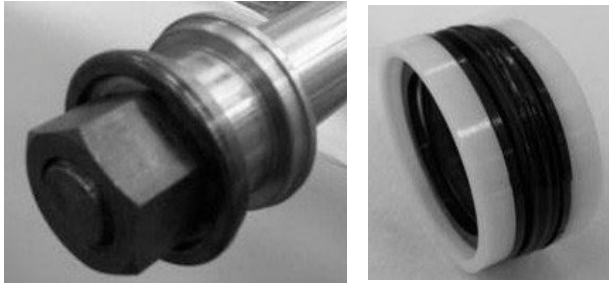
## Piston With Nut Disassembling

### NOTICE

**PROTECT THE FINISH ON THE ROD AT ALL TIMES. DAMAGE TO THE SURFACE OF THE ROD CAN CAUSE SEAL FAILURE.**

1. Fix the rod into the vice.

**NOTE:** Before attempting to disassemble the piston remove any accessible seals.



**NOTE:** Apply heat to break the bond of the sealant between the piston and the rod before the piston can be removed.

### CAUTION

**WARM THE SURFACE INDICATED MAX 300°C**

2. Avoid overheating, or the parts may become distorted or damaged.



Apply sufficient torque for removal while the parts are still hot. The sealant often leaves a white, powdery residue on threads and other parts, which must be removed by brushing with a soft brass wire brush prior to reassembly.

3. Remove the piston head from the rod and carefully slide the head gland off the end of the rod.



## Cylinder Assembly

### General Cylinder Assembly

1. Use the proper tools for specific installation tasks. Clean tools are required for assembly.
2. Install new seals, back-up rings and o-rings on the piston and the head.
3. Fasten the rod eye in a soft-jawed vise, and place a padded support under and near the threaded end of the rod to prevent any damage to the rod.
4. Lubricate and slide the head over the cylinder rod. Install the piston head on to the end of the cylinder rod. Loctite® 243TM and install the set screw in the piston head. Refer to "Hydraulic Cylinder Torque Specifications" for tightening guidelines for the piston, head and the set screws.

### Seals Head Replacing

1. Remove all seals, back-up rings and o-rings from the piston head and all seals, back-up rings and orings



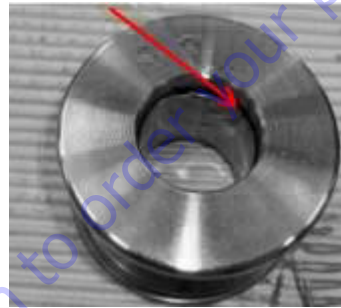
N°	DESCRIPTION	Qty.
1	O-RING	2
2	BEARING	2
3	BACK UP RING	1
4	SEAL	2

2. Install new seals, back-up rings and o-rings on the piston and the head using the proper tool.



### Cylinder Inspection

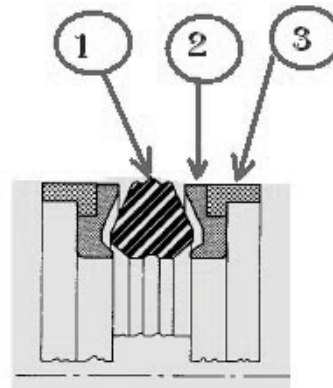
1. Inspect internal surfaces and all parts for wear, damage, etc. If the inner surface of the tube does not display a smooth finish, or is scored or damaged in any way, replace the tube.
2. Remove light scratches on the piston, rod or inner surface of the tube with a 400-600 grit emery cloth. Use the emery cloth in a rotary motion to polish out and blend the scratch(es) into the surrounding surface.
3. Check the piston rod assembly for run-out. If the rod is bent, it must be replaced.



Replace the seals on the piston. DO NOT attempt to salvage cylinder seals, sealing rings or o-rings. ALWAYS use a new, complete seal kit when rebuilding hydraulic components. Consult the parts manual for ordering information.

Mount the seals in the following order:

4. Seal
5. Support bearing
6. Bearing



**NOTICE**

**PROTECT THE FINISH ON THE ROD AT ALL TIMES. DAMAGE TO THE SURFACE OF THE ROD CAN CAUSE SEAL FAILURE.**

**Replace the seals on the piston. DO NOT** attempt to salvage cylinder seals, sealing rings or o-rings. ALWAYS use a new, complete seal kit when rebuilding hydraulic components. Consult the parts manual for ordering information.



7. Install the piston on to the end of the cylinder rod. Loctite® 270TM.

**NOTE:** If a white powdery residue is present on threads and parts, it can be removed. Clean the residue away with a soft brass wire brush prior to reassembly, and wipe clean before reinstallation.

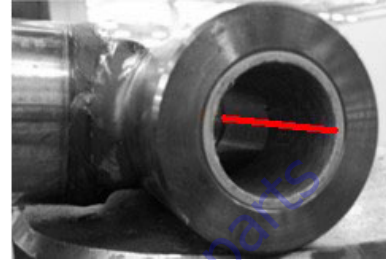


Refer to "Hydraulic Cylinder Torque Specifications," for tightening guidelines for the piston.



## Bushing Replacement

1. Carefully grind the bush with a milling cutter for plastic.



2. After that the bushing has been removed inspect the internal surface.



3. Replace the bush with a new one and put it inside with a press.

## Cylinders Bleeding

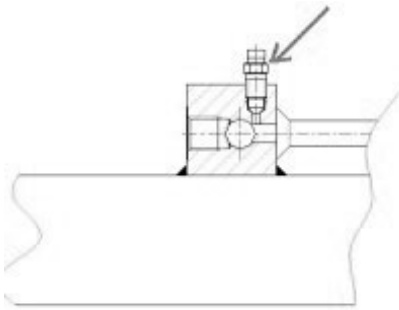
### Vent Valve

Air inside the circuit has to be removed in order to avoid vibration and irregular motion of the cylinder, vent valves are apply to make this kind of operation.

Failure to remove air from the circuit can cause diesel effect with consequent damage of the seals.

Be sure that there is no presence of air inside the cylinder before it start working.

### Bleeder screw



**⚠ CAUTION**

LOOSEN BLEEDER SCREW TO LET AIR ESCAPE RE-TIGHTENING TORQUE 6 FT. LB. (8 Nm).

## 5.11 REPLACEMENT HYDRAULIC PUMP

### Pump removal

1. Open the top cap of the hydraulic oil tank.
2. Tag & disconnect the hoses from the pump 15.
3. Loose screws 16.
4. Remove from the pump 15 from the adapter 12.
5. Loosen nut 10 and remove the coupling 11 and plate 14 from the pump shaft 15.
6. Move the new pump the particular 14.

### Pump installation

1. Install the plate 14, coupling 11, and the nut 10 on the pump.
2. Tighten the nut 10 at (15Nm).
3. Fit the pump 15 on the coupling 15 with screw 16.
4. Connect the hoses to the pump 15.

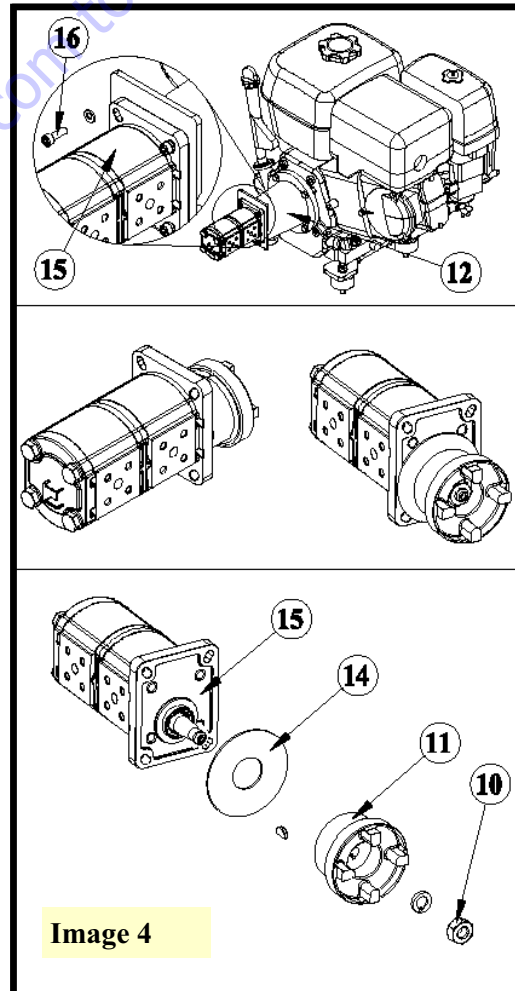
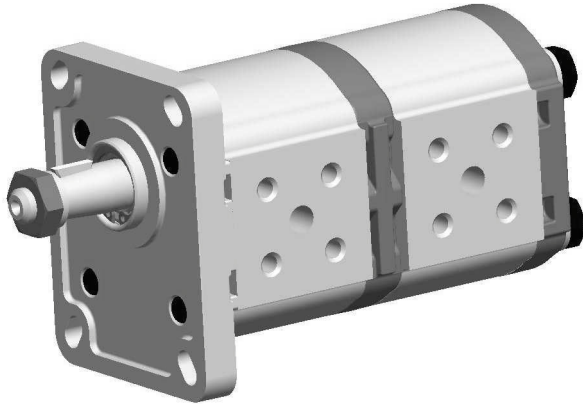


Image 4

## 5.12 HYDRAULIC PUMP REPAIR

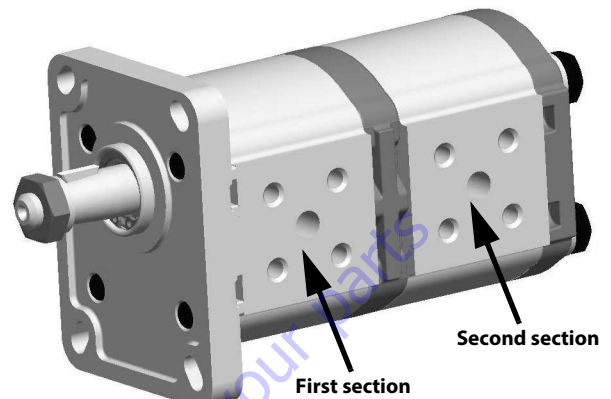
### Seal Kit Replacement Instruction



#### General Suggestions

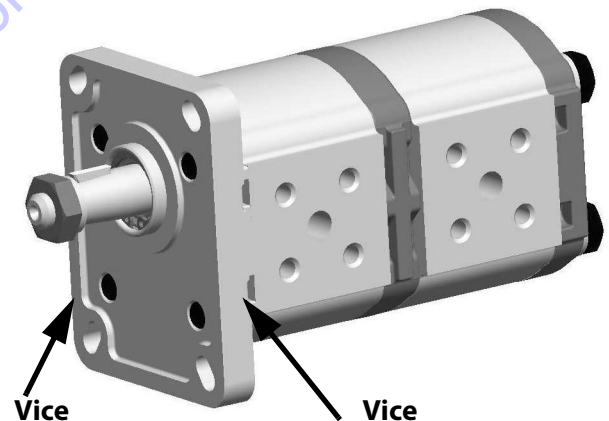
1. Check the parts have not been damaged during the shipment.
2. Work in a clean area.
3. Clean with solvent (except the seals) and air dry all components before assembling.
4. Pay attention not to damage the machined surfaces.
5. The components need to be fitted in place without forcing them. If too much force is required, it is due a bad clearances issues.
6. When hand pressure is not enough, use only mallet and never hammer.
7. Respect the tightening torque for bolts.

### External Components Disassembly



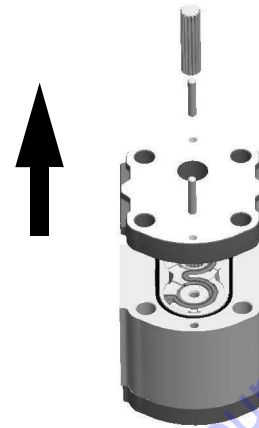
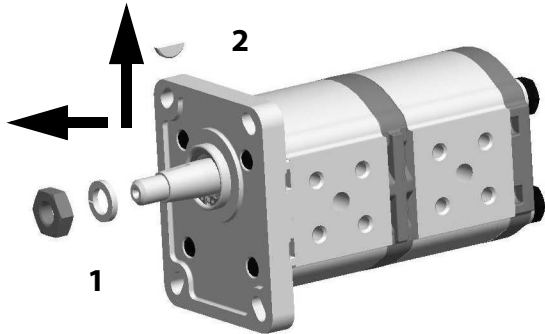
#### ⚠ CAUTION

USE SOME ALUMINIUM PROTECTION ON THE VICE TO NOT DAMAGE THE MACHINED SURFACES. PUT THE PUMP IN HORIZONTAL POSITION AND BLOCK THE COVER IN THE VICE'S JAWS. LOOSEN THE BOLTS.



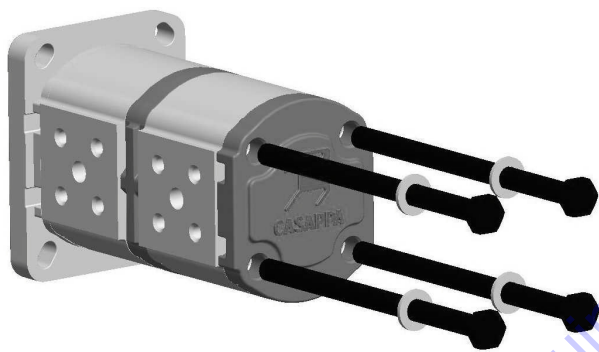


1. Unscrew the nut and remove the nut and washer (1).
2. Take out the shaft key (2).



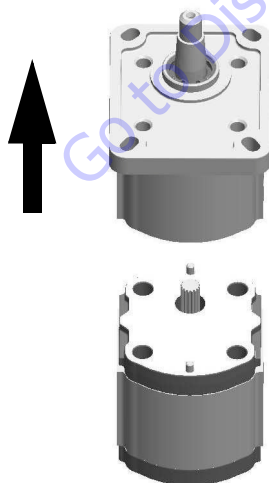
3. Put the pump on the work bench and remove the bolts and the washers.

3. Remove the rear cover.



**Components disassembly**

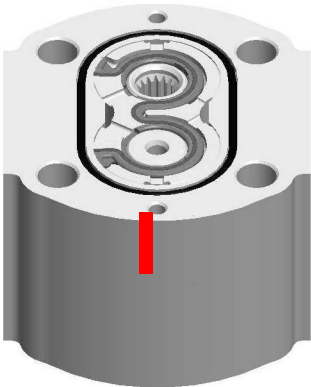
1. Remove the first section from the second section.



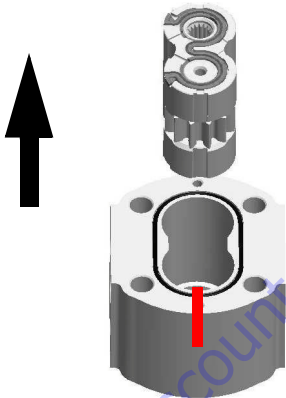
2. Remove the connecting hub and the dowel pins.

**Second Section Components Disassembly**

- 1. Using a marker draw a reference mark on the plate and the body. It will be used later during reassembly.

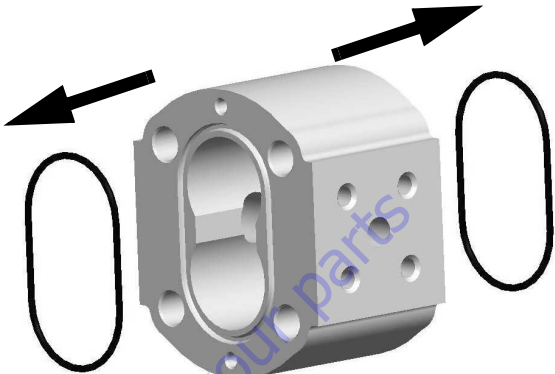


- 2. Remove the gears and the pressure plates.

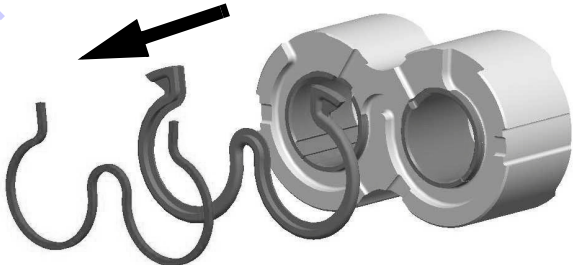


**Second Section Seals Disassembly**

- 1. Remove the seals from the body.

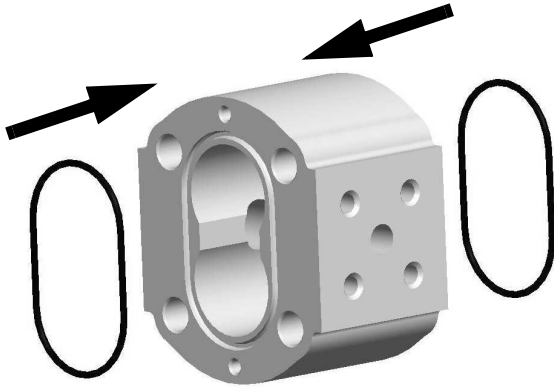


- 2. Remove from the plate the back-up ring (1) and the seal (2).

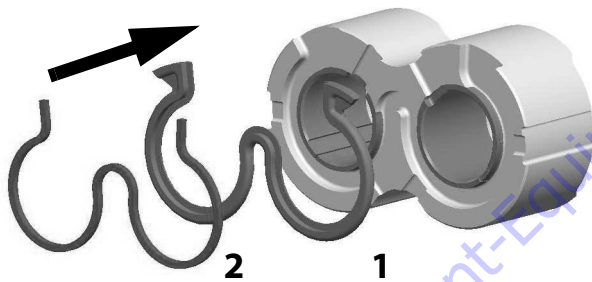


### Second Section Seals Replacement

1. Place on the body the new seals. Use clean grease to keep the seal in place.

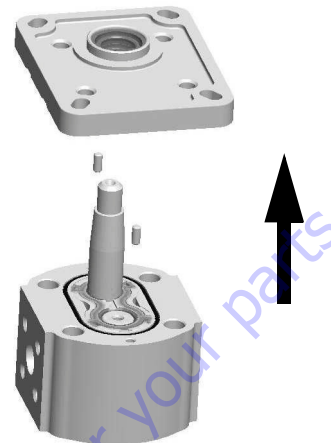


2. Fit the new seal (1) and back-up ring (2) on the plate.

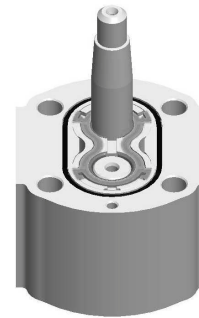


### First Section Seals Disassembly

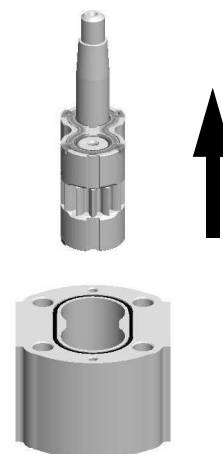
1. Remove the front cover.



2. Using a marker draw a reference mark on the plate and the body. It will be used later during reassembly.

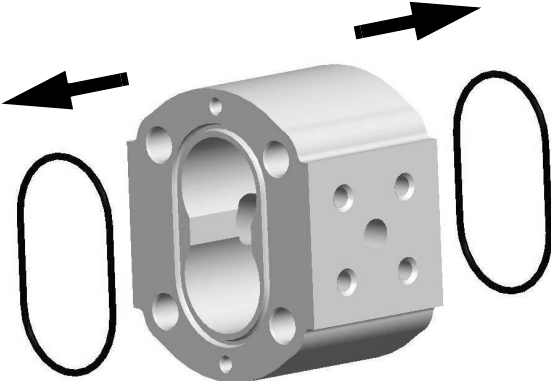


3. Remove the gears and the pressure plates.

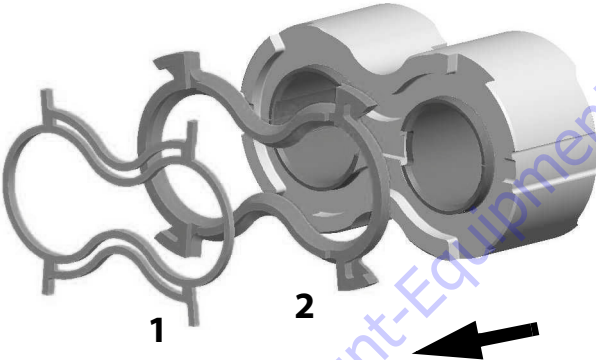


**First Section Seals Disassembly**

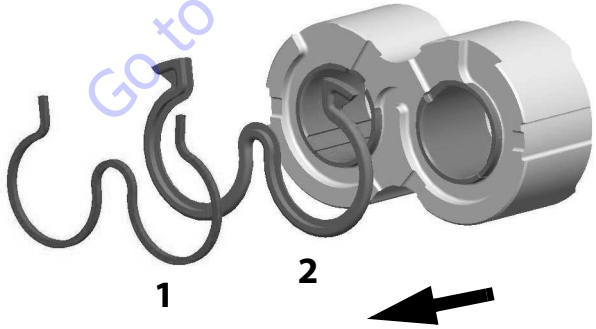
- 1. Remove the seals from the body.



- 2. Remove from the plate the back-up ring (1) and the seal (2).



- 3. Remove from the plate the back-up ring (1) and the seal (2).

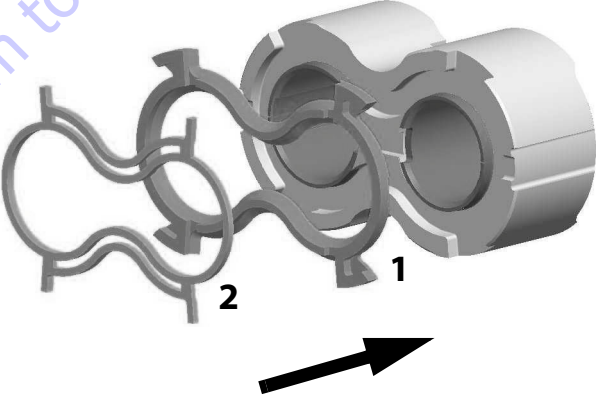


**First Section Seals Replacement**

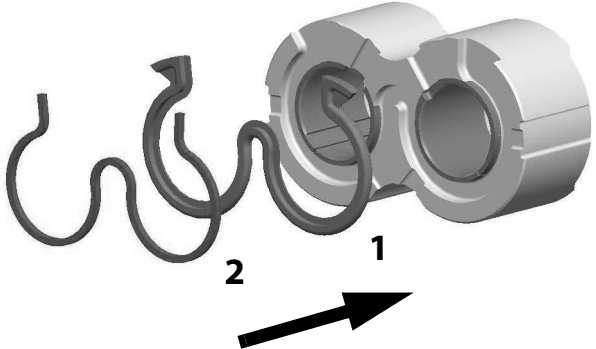
- 1. Use clean grease on the pressure plate to help the seals stay in place before fitting them.



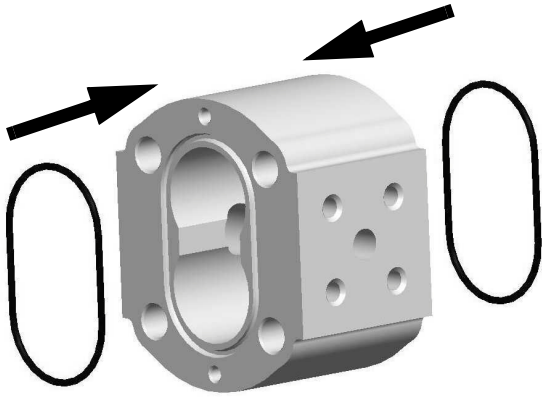
- 2. Fit the new seal (1) and back-up ring (2) on the plate.



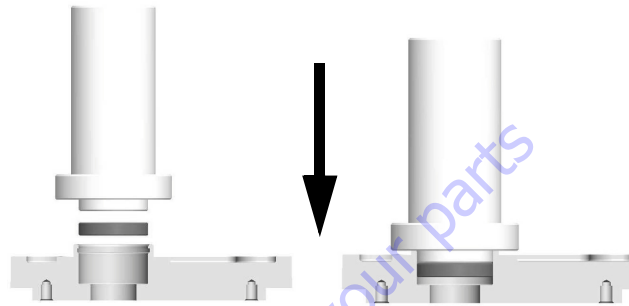
- 3. Fit the new seal (1) and back-up ring (2) on the plate.



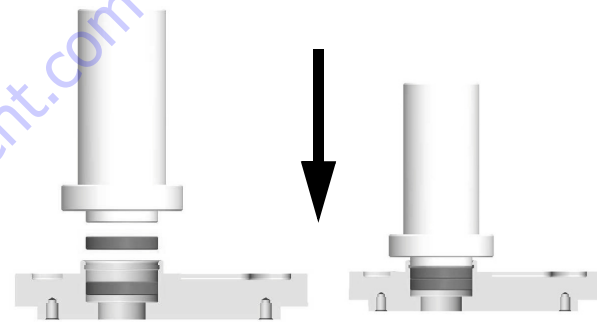
- Place on the body the new seals. Use clean grease to keep the seal in place.



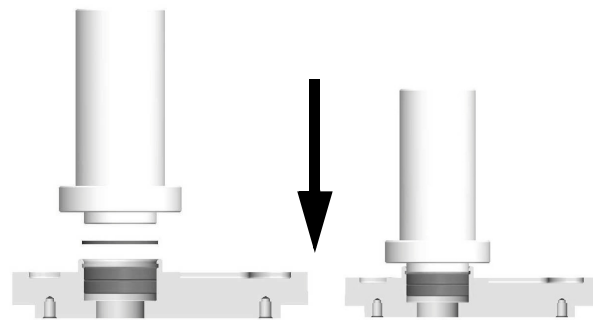
- Insert the shaft seal. Pay attention to the assembling direction of the shaft seal (see section). Using a mallet push all the way down the CASAPPA tool pn. 06100091.



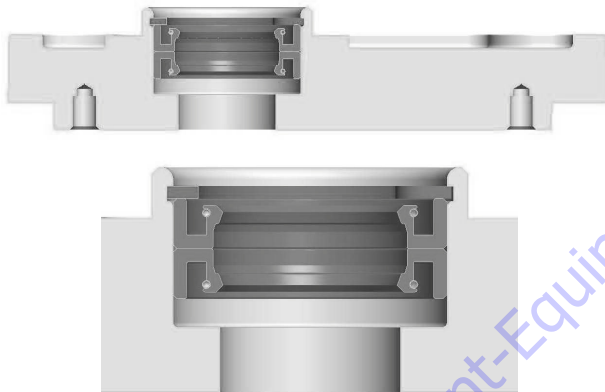
- Insert the second shaft seal. Pay attention to the assembling direction of the shaft seal (see section). Using a mallet push all the way down the CASAPPA tool pn.06100091



- Insert the back-up ring.
- Using a mallet push all the way down the CASAPPA tool pn. 06100091.



**Cover Seals Replacement**

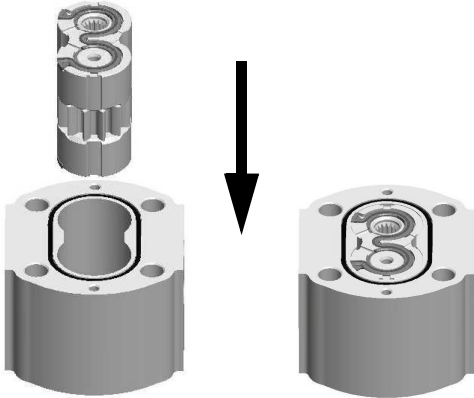


- Put the cover on the working bench.
- Remove the snap ring (1).
- Paying attention not to damage the seat remove with a screw driver (flat head) the shaft seals.(2 - 3)
- Put some clean grease into the seat seal.

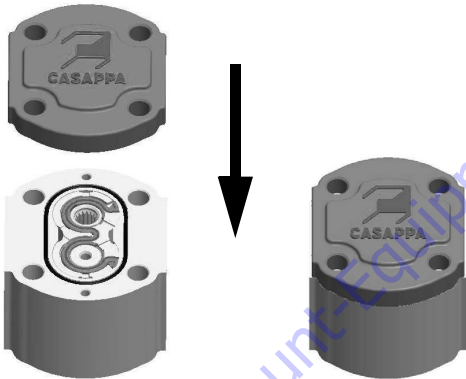


**Second Section Components Reassembly**

- 1. Reassemble the gears and the plates. Use as reference the mark made previously.

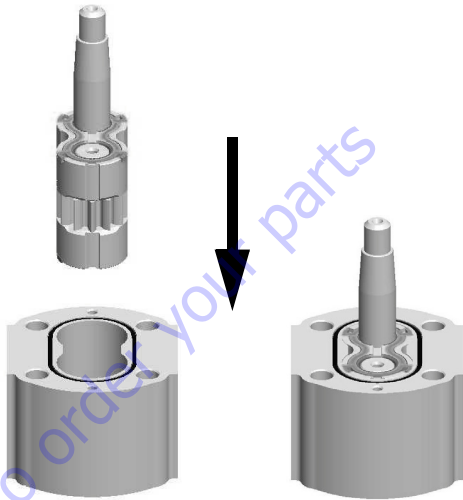


- 2. Reassemble the rear cover.



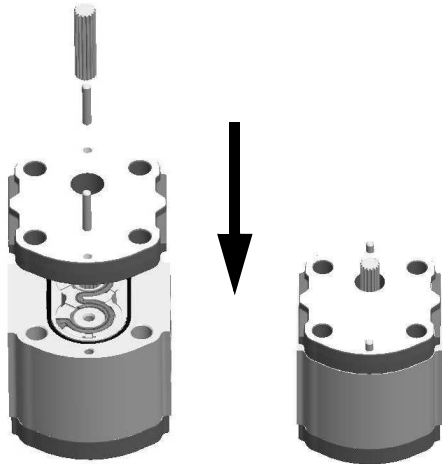
**First Section Components Reassembly**

Reassemble the gears and the plates. Use as reference the mark made previously.

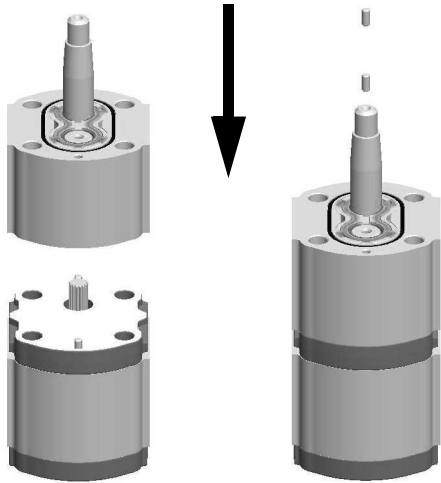


**Components Reassembly**

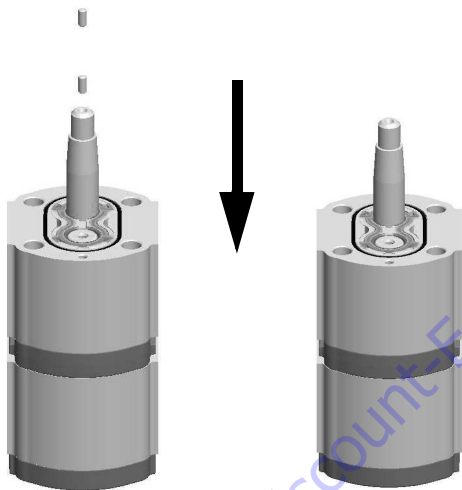
- 1. Put back the flange and the pins. Put the connecting hub into the second section shaft.



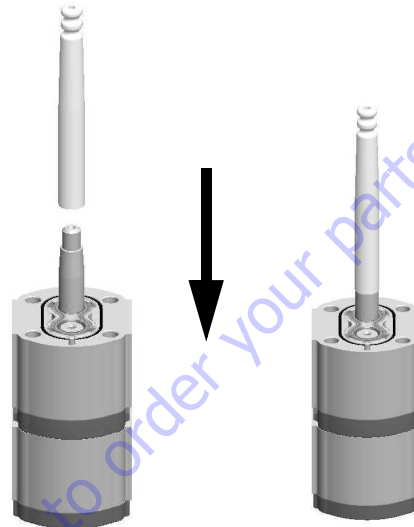
2. Put back the first section.



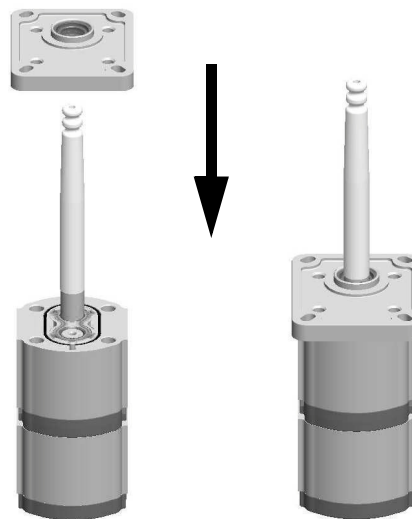
3. Put back the dowel pins.



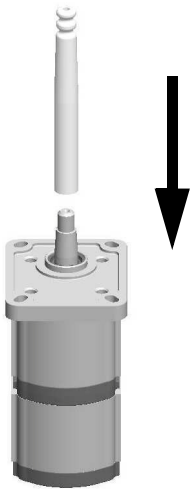
4. Put the appropriate CASAPPA tool pn 0610090 on the drive shaft or protect with adhesive tape to avoid damaging the shaft seal.



5. Use grease on the CASAPPA tool. Assemble the cover on the pump.

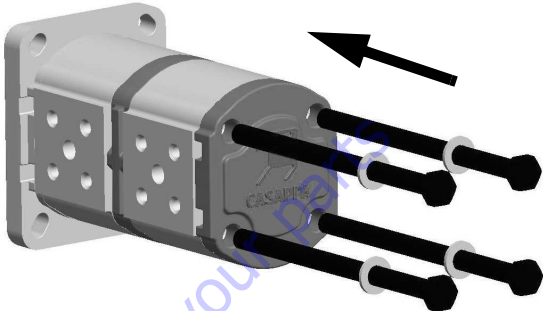


- 6. Remove the CASAPPA tool pn 06100090.



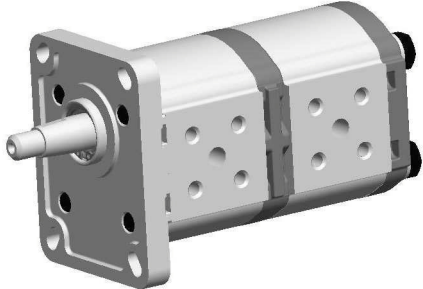
**Final Assembly And Check**

- 1. Put the pump in the vice and tighten the bolts with a torque wrench. Tightening torque 30 Nm.

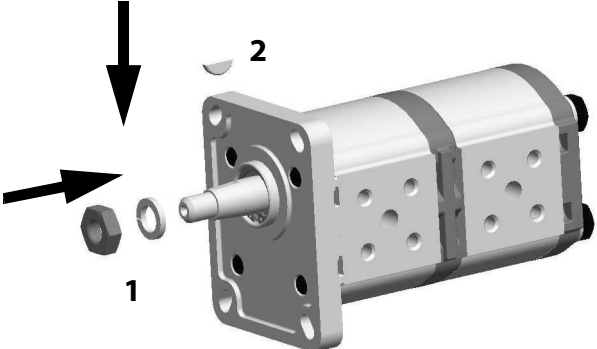


**NOTICE**

WITH A CLAMP VERIFY THAT THE SHAFT OF THE PUMP CAN ROTATE AFTER THE OPERATION IN BOTH DIRECTIONS. THE SHAFT MUST EASILY ROTATE. IF THE SHAFT IS LOCKED THIS MEANS THAT SOME OF THE SEALS HAVE COME OUT OF THEIR SEATS DURING ASSEMBLY. IF THIS HAPPENS THE WHOLE OPERATION MUST BE DONE AGAIN AND THE DAMAGED SEALS REPLACED.



- 2. Put back the shaft key (2). Insert the washer and tighten the nut (1). Tightening torque 10 Nm.





### 5.13 HYDRAULIC COMPONENT START-UP PROCEDURES AND RECOMMENDATIONS

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

#### **⚠ WARNING**

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

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

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

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

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

**NOTE:** *In most cases, the reservoir is above the pump inlet so that the pressure head created by the higher oil level helps to keep the inlet pressures within an acceptable range and prevent high vacuum levels. However, due to hose routing or low reservoir locations, there may be air trapped within this line. It is important to assure that the air is bled from this line. This can be accomplished by loosening the hose at the fitting closest the pump. When oil begins to flow, the line is full, the air has been purged, and the fitting can be retightened to its specified torque. If the tank needs to be pressurized in order to start the flow of oil, a vacuum reading should be taken at the inlet of the pump during operation in order to verify*

*that the pump is not being asked to draw an inlet vacuum higher than it is capable of.*

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

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

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

**NOTE:** *Make certain that the oil being used to fill the component housing is as clean as possible, and store the fill container in such a way as to prevent it from becoming contaminated.*

4. Install a 60 bar (or 1000 psi) pressure gauge in the charge pressure gauge port in order to monitor the charge pressure during start-up.
5. It is recommended that the external control input signal, (electrical connections for EDC), be disconnected at the pump control until after initial start-up. This will ensure that the pump remains in its neutral position.

#### **⚠ WARNING**

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

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

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

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

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

8. Shut down the engine and connect the external control input signal. Also reconnect the machine function(s), if disconnected earlier.
9. Start the engine, checking to be certain the pump remains in neutral. With the engine at normal operating RPM, slowly check for forward and reverse machine operation.
10. Charge pressure may slightly decrease during forward or reverse operation. Continue to cycle slowly between forward and reverse for at least five minutes.

**5.14 OUTRIGGERS AUTO-RETRACTION**

To be able to automatically retract the outriggers the machine must be closed and aligned and outriggers must be all opened as the previous paragraph describes.

To automatically retract the outriggers you have to press and hold remote control button n.1 "AUTOMATIC OUTRIGGERS RETRACTION", the display will shows "DEST".



Figure 5-7. Outriggers Auto-Retraction In Progress

It's possible to keep automatic outriggers retraction running till outriggers are completely lifted up.

To achieve the stowed condition outriggers must be completely lifted up till the end of their stroke and have to be manually rotated while unlocked with their pivot.

The machine is equipped with two pressure switches on the hydraulic manifold, one for the right side and one for the left side. When both the same side outriggers are at end of the stroke, the hydraulic oil pressure reaches the maximum value so that the pressure switch informs the ECM1 that outriggers are completely lifted up. When ECM1 senses that all the four outriggers are completely lifted up starts to feed one side outriggers at a time, this will help when outriggers need more power to be lifted up, for instance in case of cold hydraulic oil.

**NOTE:** *During the intermediate steps of auto-stabilization and outriggers auto-retraction, while two or three outriggers are touching the ground, the engine automatically runs at minimum RPM to ensure smooth movements.*

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## SECTION 6. JLG CONTROL SYSTEM

### 6.1 INTRODUCTION

#### NOTICE

THIS MACHINE IS POWERED BY AN 76VDC (NOMINAL) ELECTRICAL SYSTEM. BASED ON EMPLOYER, LOCAL, AND GOVERNMENTAL REGULATIONS AS THEY PERTAIN TO THIS MACHINE, SPECIFIC ELECTRICAL TRAINING AND CERTIFICATIONS MAY BE REQUIRED BEFORE SERVICING OR TROUBLESHOOTING.

#### NOTICE

WHEN INSTALLING ANY NEW MODULE CONTROLLER ON THE MACHINE, IT WILL BE NECESSARY TO PROGRAM THE CONTROLLER FOR THE PROPER MACHINE CONFIGURATION, INCLUDING OPTIONS AND PROPERLY CALIBRATE THE TILT SENSOR.

IT IS A GOOD PRACTICE TO AVOID PRESSURE-WASHING ELECTRICAL/ELECTRONIC COMPONENTS. SHOULD PRESSUREWASHING BE UTILIZED TO WASH AREAS CONTAINING ELECTRICAL/ELECTRONIC COMPONENTS, JLG INDUSTRIES, INC. RECOMMENDS A MAXIMUM PRESSURE OF 750 PSI (52 BAR) AT A MINIMUM DISTANCE OF 12 INCHES (30.5 CM) AWAY FROM THESE COMPONENTS. IF ELECTRICAL/ELECTRONIC COMPONENTS ARE SPRAYED, SPRAYING MUST NOT BE DIRECT AND BE FOR BRIEF TIME PERIODS TO AVOID HEAVY SATURATION.

The JLG Control System is a 12 volt based control unit installed on the compact crawlers boom lift.

The JLG Control System has reduced the need for exposed terminal strips, diodes and trim pots and provides simplicity in viewing and adjusting the various personality

Settings for smooth control of: acceleration, deceleration, creep, min speed, and max. speed for all boom, and drive functions.

The main lift, swing, and drive are controlled by individual Joysticks. To activate Drive, Lift, and Swing move the joystick into the direction desired.

The control system will control the voltage output to the valves, as programmed for smooth operation and maximum cycle time.

The JLG Remote Control has a built in Display and by a push buttons, could show any present faults.

The Remote Control is connected by cable on the following models:

CE - X33JP

ANSI -X1000AJ

The system can be accessed for troubleshooting even by the analyzer RamHino; kit JLG part no.17162400.

6.2 PLATFORM - REMOTE CONTROL STATION

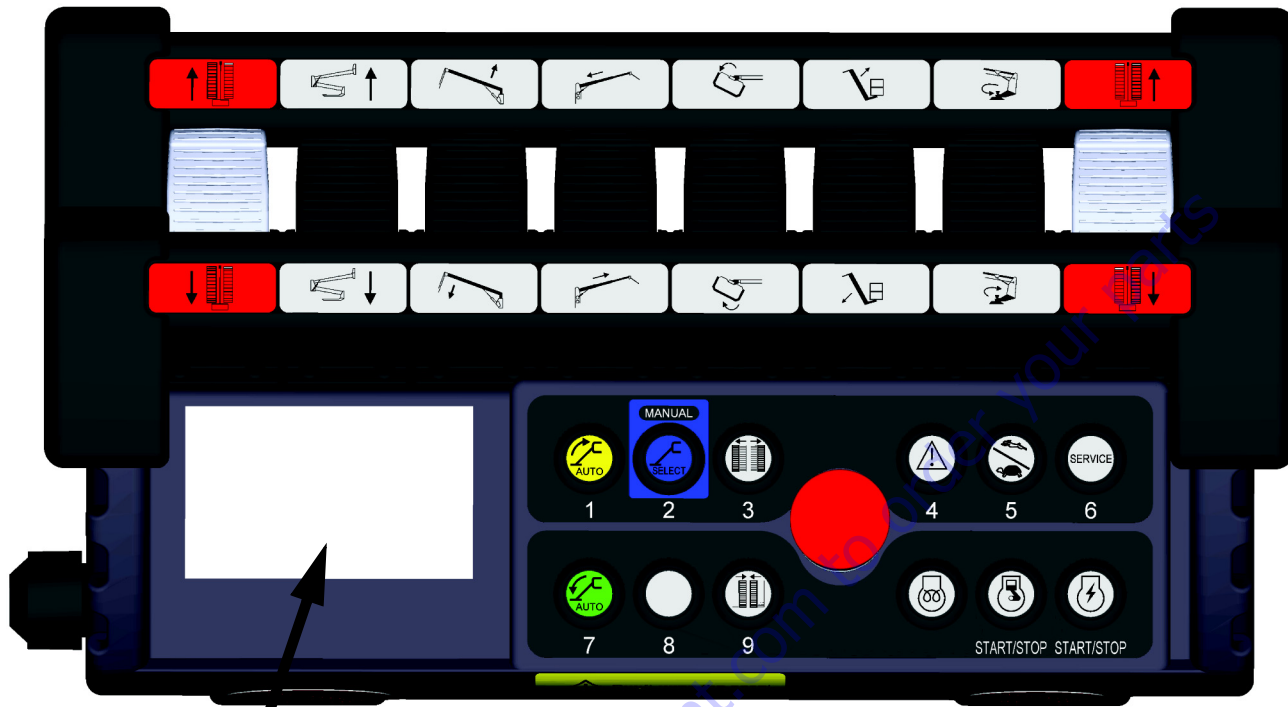


Figure 6-1. Remote Control

1	3	5	7
2	4	6	8

At machine start-up and during machine operation the main LCD display screen (Figure 6.1) is activated. There are eight (8) display positions which indicate machine status during various stages of operation.

The remote control is made up of buttons, joysticks, a key selector switch and a display.

When the machine's main control board is powered via the engine key, the information to be shown on the display is sent to the remote control.

This operation has a variable duration. Normally a few seconds are sufficient, however the following screen may appear on the display:

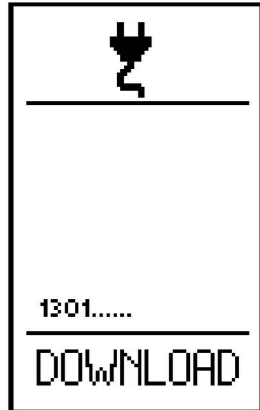


Figure 6-2.

In this case about 5-10 minutes are needed to send all the information from the main board to the remote control.

The machine cannot operate within this period.

Do not stop the machine or operate it during this period.

**NOTE:** The numbers shown above DOWNLOAD are the data transferred. The Download will be completed when about more than 29000 steps are transferred.

**LCD Display Screen**

At machine start-up and during machine operation the main LCD display screen is activated. There are eight (8) display positions which indicate machine status during various stages of operation.

1	3	5	7
2	4	6	8

Figure 6-3.

POSITION 1:

Reduced operating area if all outriggers are not fully deployed.

1	3	5	7
2	4	6	8



Figure 6-4.

POSITION 2:

Currently unused

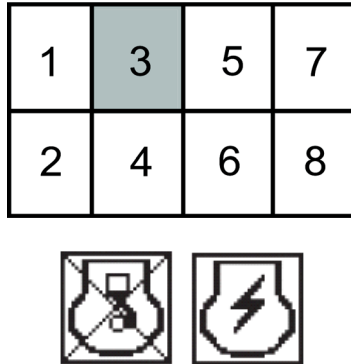
1	3	5	7
2	4	6	8

Figure 6-5.

**SECTION 6 - JLG CONTROL SYSTEM**

**POSITION 3:**

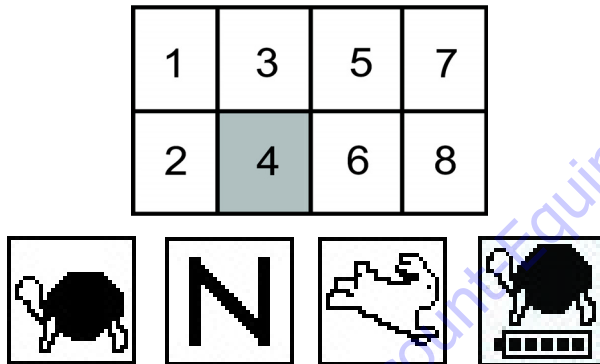
Displays if selected engine (diesel or electric) is on or off. The X on the icon indicates the engine is off.



**Figure 6-6.**

**POSITION 4:**

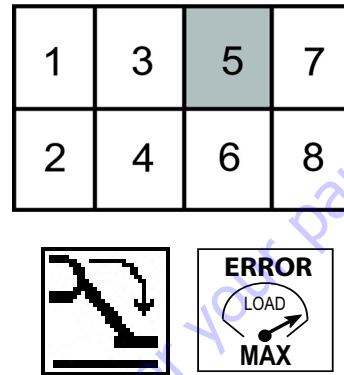
Displays selected engine speed.



**Figure 6-7.**

**POSITION 5:**

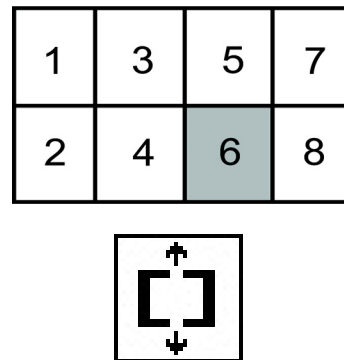
Displays outriggers are properly set and boom functions are allowed. No display indicates outriggers are not properly set and boom functions are not allowed.



**Figure 6-8.**

**POSITION 6:**

Indicates boom, jib, turntable, and base are aligned. Drive, steer, track width adjustment and outrigger functions are operational if this symbol below is present. No symbol indicates these functions are not operational. Drive and steer are operational if all 4 outriggers are not contacting the ground.



**Figure 6-9.**

POSITION 7:

Can indicate any of the following situations:

- An emergency stop is pushed in (off).
- A low battery. Batteries need charging by running the gas/diesel engine or connecting to a power source.
- Tower boom sensor is faulty.
- Main boom sensor is faulty. Boom functions are cut out.
- Swing sensor is faulty.
- CANBUS communication is faulty.
- Electronic fault.
- Lithium ION - Signals an error in the BMS - Battery Management System
- Skyguard™ - System Enabled.
- Battery cold/heater activated system is enabled.
- Safety by-pass activated
- Service Interval

1	3	5	7
2	4	6	8

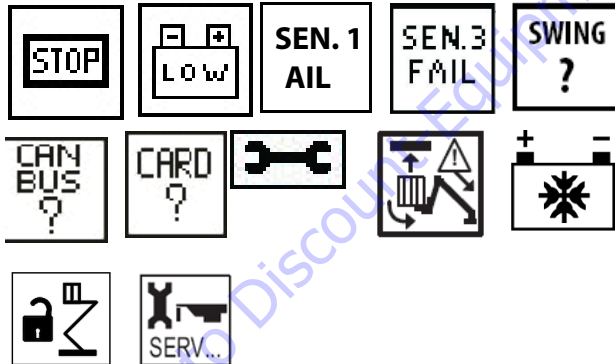


Figure 6-10.

POSITION 8:

- Indicates emergency lowering has been selected.
- Lithium ION - Battery Charge Status and Battery Charger Plugged In.

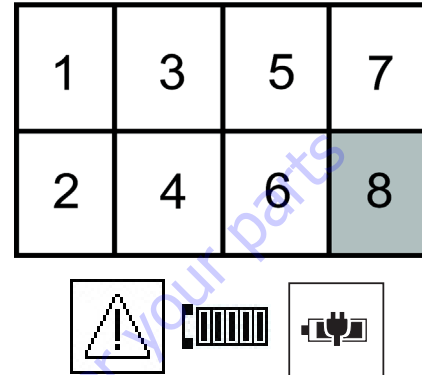


Figure 6-11.



### LCD Display Icon Description

The display indicates machine conditions and eventual errors occurred in order to help operator and to have a quick diagnose, here follows icons meanings:



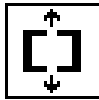










































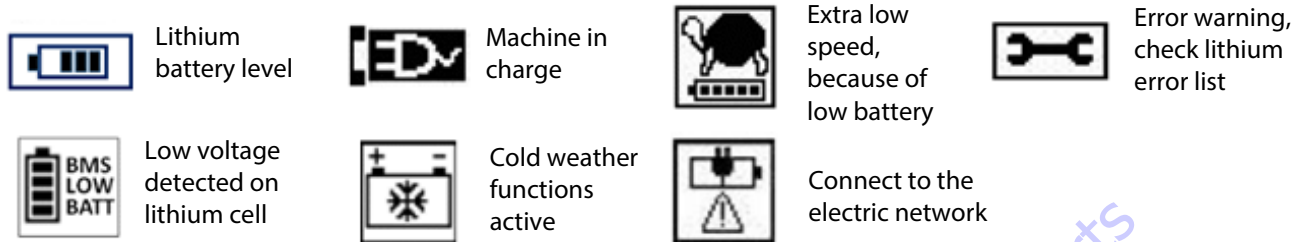
	Safety state, press and release the remote control stop		Both motors not running		Machine closed and aligned		Close and align the machine
	Engine running		Electric motor running		Lift outrigger from the round		Max tilt angle reached while driving
	Rotate aerial part on the opposite side		Lift 1 <sup>st</sup> -2 <sup>nd</sup> booms		Machine stabilized		Max tilt angle reached while stabilizing
	Minimum speed		Standard speed		Maximum speed for tracks		Select which outrigger to move
	Stop button pressed		Unload the basket from its support		Only jib movement allowed		Engine preheating active
	Basket overload		Basket underload		Gravity emergency descent		Movement not allowed by gravity emergency descent
	Machine stabilize error list (*)		12V battery voltage low		Press pedal		Double line sensor error, check error menu
	Error on board input or output, check CODE menu		Software updating in progress		CAN BUS error, check CAN TIME CUT menu		12V battery down or 3 <sup>rd</sup> boom cable sensor anomaly
	Safeties by-pass activated		Aerial part movements safeties by-pass activated		Undercarriage part movement safeties by-pass activated		Machine fully rotated, rotate few degrees back
	Remote connection in progress		Software updates available		Automatic periodical service reminder		Main key off
	Tilt sensor calibration required		Load cell sensor calibration required		SkyGuard bar pressed		Wrong remote control connection on the basket, at the ground)
	Wrong model elected, the aerial part is not fed						

Figure 6-12. LCD Display Icon Description

## Only Lithium Icons

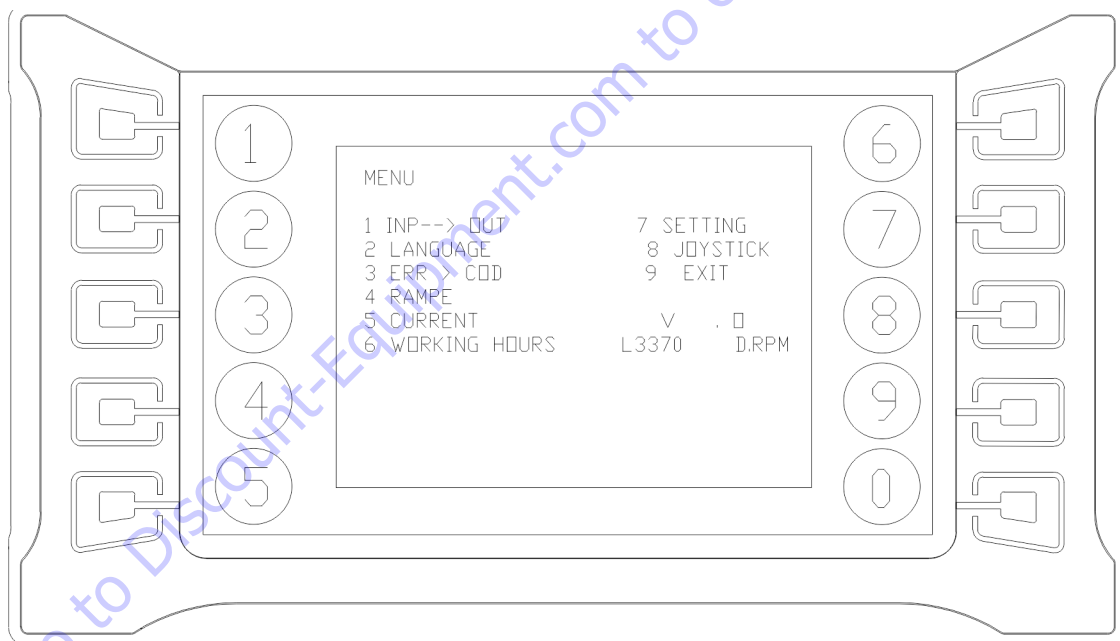


### 6.3 DIAGNOSTIC BY SERVICE MENU

Further that the icons by the display it's possible to get into diagnostic menus. It's possible to select several languages, the indication here following are for English language.

By diagnostic menus it's only possible to visualize the machine condition, it's not possible to carry out operations such as to modify calibrations or safety parameters of the machine if not after having insert the relevant password.

Pressing button no.6 one time display will show the SERVICE menu.



The here above picture shows the SERVICE menu main display, by the lower row it's possible to identify the installed software version and the machine model settled (Diesel or Lithium).

From SERVICE menu pressing button from n.1 to n.8 it's possible to enter into several menus as for instance pressing button n.1 display will show the INPUT menu. Pressing button n.9 (ESC) brings back to the main display.

From SERVICE menu it's possible to enter into other menu and under menus.

**NOTE:** While into the SERVICE menu it's possible to use all of the joysticks and motors buttons, it's not possible to use outriggers and tracks widening buttons.

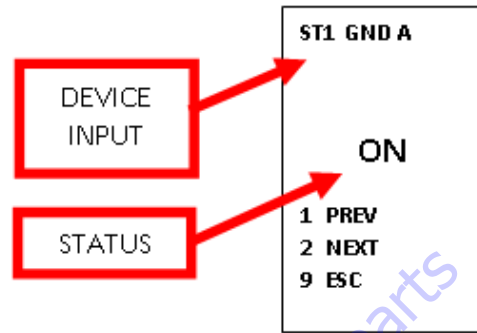
OL00440

**Menu Input**

This menu visualizes the current status of all the devices giving an input signal to the ECM1, it's so possible to check eventual changes of status.

The device status visualized depends on the signal received by the ECM1 so that it depends on the device itself but also on the connections.

The picture aside shows for instance the status of the first device of INPUT menu. Pressing button n.1 (PREV) brings back to the previous device of the list, pressing button n.2 (NEXT) brings to the next one. Pressing button n.9 (ESC) brings back to the SERVICE menu main display.



Here follows the INPUT list with their meanings.

ST1GND AB	DOWN DOWN	Outrigger n.1 on the ground - the switch is released, line A is open and line B is closed
	UP UP	Outrigger n.1 lifted - the switch is pressed, line A is closed and line B is open
ST1 OPEN AB	ON ON	Outrigger n.1 in restricted position - the switch is released and lines A and B are closed
	OFF OFF	Outrigger n.1 in transport position - the switch is pressed and lines A and B are open
ST1 POS	ON ON	Outrigger n.1 fully open position - the switch is pressed and line A is open and line B is closed
	OFF OFF	Outrigger n.1 in transport position - the switch is released and lines A and B are open
ST2GND AB	DOWN DOWN	Outrigger n.2 on the ground - the switch is released, line A is open and line B is closed
	UP UP	Outrigger n.2 lifted - the switch is pressed, line A is closed and line B is open
ST2 OPEN AB	ON ON	Outrigger n.2 in restricted position - the switch is released and lines A and B are closed
	OFF OFF	Outrigger n.2 in transport position - the switch is pressed and lines A and B are open
ST2 POS	ON ON	Outrigger n.2 fully open position - the switch is pressed and line A is open and line B is closed
	OFF OFF	Outrigger n.2 in transport position - the switch is released and lines A and B are open
ST3GND AB	DOWN DOWN	Outrigger n.3 on the ground - the switch is released, line A is open and line B is closed
	UP UP	Outrigger n.3 lifted - the switch is pressed, line A is closed and line B is open
ST3 OPEN AB	ON ON	Outrigger n.3 in restricted position - the switch is released and lines A and B are closed
	OFF OFF	Outrigger n.3 in transport position - the switch is pressed and lines A and B are open

ST3 POS	ON ON	Outrigger n.3 fully open position - the switch is pressed and line A is open and line B is closed
	OFF OFF	Outrigger n.3 in transport position - the switch is released and lines A and B are open
ST4GND AB	DOWN DOWN	Outrigger n.4 on the ground - the switch is released, line A is open and line B is closed
	UP UP	Outrigger n.4 lifted - the switch is pressed, line A is closed and line B is open
ST4 OPEN AB	ON ON	Outrigger n.4 in restricted position - the switch is released and lines A and B are closed
	OFF OFF	Outrigger n.4 in transport position - the switch is pressed and lines A and B are open
ST4 POS	ON ON	Outrigger n.4 fully open position - the switch is pressed and line A is open and line B is closed
	OFF OFF	Outrigger n.4 in transport position - the switch is released and lines A and B are open
BYPASAE AB	OFF OFF	Aerial ground switch in normal working condition - line A is open and line B is closed
	ON ON	The aerial ground switch is activated (emergency condition) - line A is closed and line B is open
BYPASTR AB	OFF OFF	Drive ground switch in normal working condition - line A is open and line B is closed
	ON ON	Drive ground switch is activated (emergency condition) - line A is closed and line B is open
STOP GND AB	ON ON	Ground power/stop red button is pressed - line A is closed and line B is open
	OFF OFF	Ground power/stop red button is released - line A is open and line B is closed
STOP RC DW	ON ON	IGNORE
	OFF OFF	IGNORE
STOP RD UP	ON ON	Remote control power/stop red button is pressed - lines A and B are open
	OFF OFF	Remote control power/stop red button is released - lines A and B are closed
ST12 CLOSED	ON	IGNORE
	OFF	IGNORE
ST34 CLOSED	ON	IGNORE
	OFF	IGNORE
TEMP.ALARMA	ON	IGNORE
	OFF	IGNORE

## SECTION 6 - JLG CONTROL SYSTEM

GND CTRL	ON	IGNORE
	OFF	IGNORE
ENGINE ON	ON	Engine is running
	OFF	Engine is not running
ELE MOT ON	ON	The ground button for electric motor start is pressed
	OFF	The ground button for electric motor start is released
RC UP CTRL	ON	Remote control level basket switch
	OFF	Ground control level basket switch
PEDAL AB	ON ON	Foot pedal pressed - line A is open and line B is closed
	OFF OFF	Foot pedal released - line A is closed and line B is open
TOWERCLOSE	ON ON	Tower boom extended/retracted switch - retracted
	OFF OFF	Tower boom extended/retracted switch - extended
FUNI TOWER	ON ON	Tower boom ropes switch - ropes OK
	OFF OFF	Tower boom ropes switch - ropes not well tensioned or broken
PRES POMPE	ON	Hydraulic pressure switch - pressure above 2176 PSI (150 BAR)
	OFF	Hydraulic pressure switch - pressure below 2176 PSI (150 BAR)
PROX FUNI A	ON	Left telescope ropes prox switch 4° section - ropes OK
	OFF	Left telescope ropes prox switch 4° section - ropes not well tensioned or broken
PROX FUNI B	ON	Right telescope ropes prox switch 4° section - ropes OK
	OFF	Right telescope ropes prox switch 4° section - ropes not well tensioned or broken
FUNI MAIN	ON ON	Telescope extension ropes prox switch main boom - ropes not well tensioned or broken
	OFF OFF	Telescope extension ropes prox switch main boom - ropes OK
FUNI MAIN	ON	Telescope retract ropes prox switch main boom - ropes OK
	OFF	Telescope retract ropes prox switch main boom - ropes not well tensioned or broken
RC BASKET	ON	The remote control is in the holder basket
	OFF	The remote control is not in the holder basket
TR OPEN L	ON	Left track fully extended - widening cylinder switch contact of left track is closed
	OFF	Left track fully extended - widening cylinder switch contact of left track is open
TR OPEN R	ON	Right track fully extended - widening cylinder switch contact of right track is closed
	OFF	Right track fully extended - widening cylinder switch contact of right track is open

INCL X-Y	0.09 0.08	Machine tilt values - X and Y axis in degrees
INCL B X-Y	0.63 0.02	Platform tilt values - Y axis in degrees
LOAD AB	68 65	Indicates the weight of the platform (about 110 lbs (50 kg) plus the weight in the platform measured in kg by line A and line B. Function cut out with a disagreement of more than 4lbs (20 kg) between line A and line B.
CYL JIB	0 - 305	Indicates how far the JIB cylinder is extended - 0 mm is fully retracted and 305 mm is fully extended
CYL TOWER	0 - 311	Indicates how far the tower cylinder is extended - 0 mm is fully retracted and 311 mm is fully extended
CYL MAIN	0 - 335	Indicates how far the main cylinder is extended - 0 mm is fully retracted and 335 mm is fully extended
CYL EXT TW	0 - 392	Indicates how far the telescope tower cylinder is extended - 0 mm is fully retracted and 392 mm is fully extended
CYL EXT MN	0 - 343	Indicates how far the telescope main cylinder is extended - 0 mm is fully retracted and 343 mm is fully extended
ROTAT AB	0 - 360	360/0 = Machine closed and aligned
ROT BAS AB	24-3755	Left end of stroke - 679 - 2920
SKYGUARD	ON	Indicates that SkyGuard bar has been pressed
	OFF	Indicates that SkyGuard bar has not been pressed
TEMPERAT	37 - 62	Indicates the temperature of ECM1 in Celsius degrees
SUPPLY (V)	12 - 15	Indicates the battery voltage, or the output voltage from the battery charger

### Only Lithium Input

V HIGH CELL	3317	Indicates the voltage of the highest cell. When cells are not under charge or discharge, it tends to be a nominal value around 3300 mVolt.
	5	Indicates number of highest cell
V AVG CELL	3316	Indicates the voltage average of the cells. When cells are not under charge or discharge, it tends to be a nominal value around 3300 mVolt.
V LOW CELL	3308	Indicates the voltage of the lowest cell. When cells are not under charge or discharge, it tends to be a nominal value around 3300 mVolt.
	12	Indicates number of lowest cell
CHG SETUP	35	Indicates the maximum current (Amp) that BMS required by the battery charger (lithium pack not fully charged)
T HIGH CELL	23	Indicates the highest temperature (Celsius degrees) detected among the cells
	1	Indicates the number of the temperature sensor with the highest temperature detected

## SECTION 6 - JLG CONTROL SYSTEM

T AVG CELL	23	Indicates the average temperature (Celsius degrees) detected among the cells
LOW T CELL	28	Indicates the lowest temperature (Celsius degrees) detected among the cells
	1	Indicates the number of the temperature sensor with the lowest temperature detected
T BMS	37	Indicates the temperature (Celsius degrees) detected in the BMS
REM CAP AH	27	Indicates the charge level of the battery pack - 100% is maximum, 0% is minimum. Same meaning of SOC
R HIGH CELL	1	Indicates the highest resistance (mOhm) of cells
	1	Indicates the number of the cell with the highest resistance
R AVG CELL	1	Indicates the average resistance (mOhm) of cells
R LOW CELL	0	Indicates the highest resistance (mOhm) of cells
	0	Indicates the number of the cell with the lowest resistance
HOURS INV	27	It counts the working hours of electric motor running
RPM INV	0	Indicates the electrical motor rpm read by the speed sensor. At a certain rpm setting, the rpm read also depends on the electrical load.
CONTACTOR	ON	State of the internal contactor normally ON
HEATER	OFF	
COOLING	OFF	
SOC%	21	Indicates the charge level of battery pack - SOC (%) depends on the status of all cells
BAT PACK V	80	Battery pack cell voltage

**Output**

CURRENT A	16	Indicates the amount of current in (within the charge) or out within machine operation (discharge) of battery pack
BMS STATUS	1	Indicates the BMS status or fault code if present
PIN 101	-3, 73	
PIN 102	-0, 32	
PIN 238	- 94, 99	
PIN 241	- 95, 32	
PIN 126	0	
PIN 125	0	

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### Language Menu

Through this page it is possible to select the visualization language among ITALIAN, GERMAN, ENGLISH, FRENCH and SPANISH. To change the language has to be press the relevant button number and button n.9 to come back to the SERVICE menu main display



ERROR menu is composed by the following 5 different pages selectable by buttons n.1 and n.2, it's always possible to come back to the SERVICE menu main display pressing button n.9.

When a device reference is marked with a "NO" that means there's an error and that device has one line signal not coherent with the other.

### PAGE 1

ERRORS	
ST1 GND	OK
ST1 POS	OK
ST2 GND	OK
ST2 POS	OK
ST3 GND	OK
ST3 POS	OK
ST4 GND	OK
ST4 POS	OK
1 PREV	
2 NEXT	
9 ESC	

### Error Menu

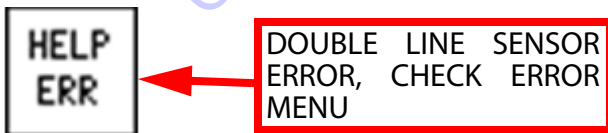
By ERROR menu pages are displayed the eventual current errors, an error occurs when a double line device has one line signal not coherent with the other.

The most of the machine double line devices, all except remote control emergency stop button have one line closed (NC) and one line opened (NO).

A part for the remote control emergency stop button, when the two lines are both opened or both closed, there's an error in progress and the icon HELP ERROR will appear on the display.

In that case into the ERROR menu the involved device reference will be marked aside with a "NO" instead of an "OK".

ST1 GND	Outrigger n.1 on the ground switch
ST1 POS	
ST2 GND	Outrigger n.2 on the ground switch
ST2 POS	
ST3 GND	Outrigger n.3 on the ground switch
ST2 POS	
ST4 GND	Outrigger n.4 on the ground switch
ST4 POS	



PAGE 2

ERRORS	
BYPAS AE	OK
BYPAS TR	OK
STOP GND	OK
STOP RC UP	OK
PEDAL	OK
SKYGUARD	OK
1 PREV	
2 NEXT	
9 ESC	

<b>BYPAS AE</b>	Aerial part safeties by-pass switch
<b>BYPAS TR</b>	Ground part safeties by-pass switch
<b>STOP GRN</b>	Stop button on the ground
<b>STOP RC UP</b>	Remote control stop button on the platform
<b>PEDAL</b>	Pedal
<b>SKYGUARD</b>	SkyGuard system

PAGE 3

ERRORS	
ST1 POSM	OK
ST2 POSM	OK
ST3 POMS	OK
ST4 POMS	OK
INCL.G	OK
LOAD	OK
ROTATION	OK
CODE	OK
1 PREV	
2 NEXT	
9 ESC	

<b>ST1 POMS</b>	Outrigger n.1 position
<b>ST2 POMS</b>	Outrigger n.2 position
<b>ST3 POMS</b>	Outrigger n.3 position
<b>ST4 POMS</b>	Outrigger n.4 position
<b>INCL. G</b>	Frame tilt sensor
<b>ROTATION</b>	Turret swing sensor
<b>CODE</b>	System recognize correct module installation by ECM3

PAGE 4

The fourth and fifth pages inform about an eventual error on CAN BUS system indicating the component involved. All of the components should be marked with an "OK", in case of a "NO" it means that component it's not properly communicating through CAN BUS.

CAN TIMOUT	
RC BASK	OK
MODEM	OK
ECM3	OK
ECM4	OK
BMS	OK
BAT CHARG.	OK
INVERT.	OK
1 PREV	
2 NEXT	
9 ESC	

<b>RC BASK</b>	Remote control
<b>MODEM</b>	Modem
<b>ECM3</b>	Module ECM3
<b>ECM4</b>	Module ECM4
<b>BMS</b>	Lithium battery management system
<b>BAT CHARG</b>	Lithium battery charger
<b>INVERT</b>	Lithium motor inverter

PAGE 5

LITH ERR	
BMS:	0
INVER:	0
BAT CHARG:	0
1 PREV	
2 NEXT	
9 ESC	

The fifth page has to be considered only for Lithium machines, BATT, INVER and BAT CHARG are indicated as "0" otherwise it means there's a Lithium error in progress.

More information about this data, see Lithium Supplement Manual.

ERRORS	
INC.BAS	OK
ROT.BAS	OK
JIB	OK
TOWER	OK
MAIN	OK
SFMAIN	OK
SFTOWER	OK
1 PREV	
2 NEXT	
9 ESC	

<b>INC. BAS</b>	Platform level sensor
<b>ROT. BAS</b>	Platform rotate sensor
<b>JIB</b>	Jib sensor
<b>TOWER</b>	Tower cylinder long sensor
<b>MAIN</b>	Main cylinder long sensor
<b>SFMAIN</b>	Telescope main cylinder long sensor
<b>SFTOWER</b>	Telescope tower cylinder long sensor

ERRORS	
MICTOW	OK
FUNITW	OK
PROXYTW	OK
FUNIM	OK
MICTWSEN	OK
1 PREV	
2 NEXT	
9 ESC	

<b>MICTWO</b>	Ropes switch telescope main
<b>FUNITW</b>	Platform rotate sensor
<b>PROXYTW</b>	Ropes Prox telescope main
<b>FUNIM</b>	Ropes switch telescope main boom
<b>MICTWSEN</b>	Telescope main cylinder long sensor
	Telescope tower cylinder long sensor

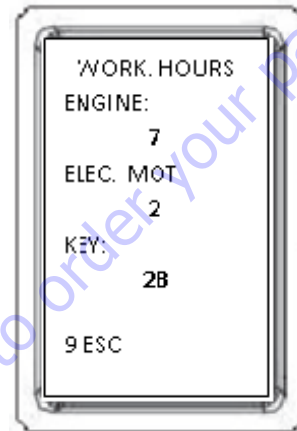
### Working Hours Menu

This page indicates the machine working hours displaying engine working hours and electric motor working hours.

On Lithium machines have to be considered only the electric motor hours.

For both models "KEY" indicates the hours with main key switched ON.

Press button 6 "W.HOURS".



#### Working hours to reset/modify:

1. Press button 7 "SETUP".
2. Press button 5 "PASSWORD".

Using the remote control buttons to enter the password 7385.

**NOTE:** Passwords allow changing the Working Hours of Engine and Electrical Motor.

Once the correct password is accepted the display showed "OK".

3. Press button 9 "ESC" two times.

**NOTE:** Repeat the above steps if "NO" appear on the display.

4. Press button 6 "W:HOURS".

KEEPING PRESSED the button 6 use the button 1 "T+" to increase and button 2 "T-" to decrease the working hours of the ENGINE.

KEEPING PRESSED the button 6 use the button 7 "E+" to increase and button 8 "E-" to decrease the working hours of the Electric Motor.

KEEPING PRESSED the button 6 and then button 3 to set zero the working hours of Engine and Motor.

5. Press button 9 ESC 3 times to escape.

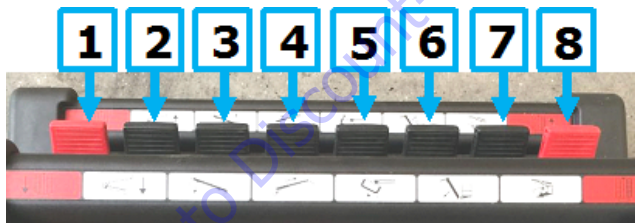
On Lithium models the Engine working HOURS will stay always 0.

The procedure to view or change the working Hours of the electrical motor are the same as per double powered models.

### Joystick Menu

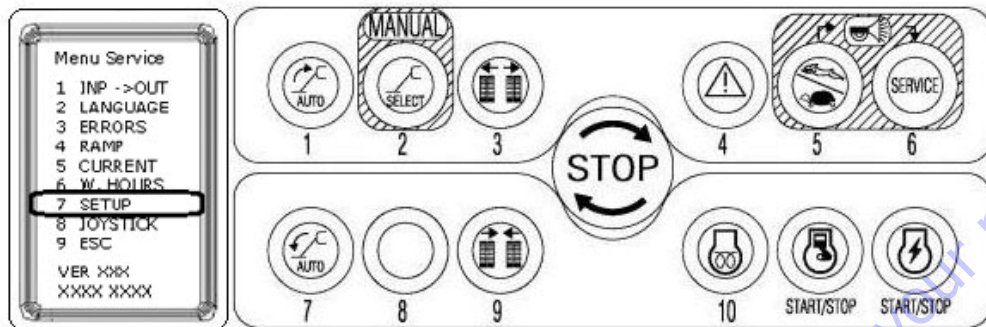
By this page it's possible to verify the proper functioning of the joysticks, once selected one joystick by buttons n.1 and n.2, joystick enumeration is indicated here below, the display will show its position, expressed in step from 0 (rest position) to 127 (joystick fully pressed up or down).

Moving the selected joystick it's so possible to check its proportionality and its end of the stroke (about 127 steps) both forward and backward.



### 6.4 MACHINE SETUP MENU

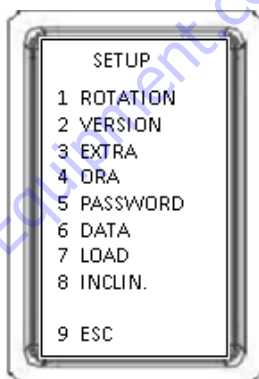
From the SERVICE menu, pressing button 7 "SETUP" accesses the menu SETUP to adjust the parameter settings in order to achieved proper machine performance.



When selection the machine model to match the size of the machine, the personality settings will all default to the factory recommended setting.

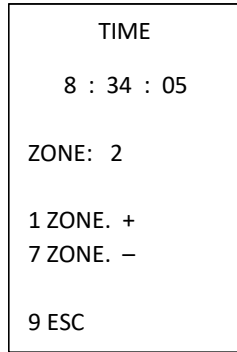
**NOTE:** Passwords will give you access to level, which will permit you to change all machine settings.

**NOTE:** Refer to the following steps in this Service Manual for the recommended factory settings.



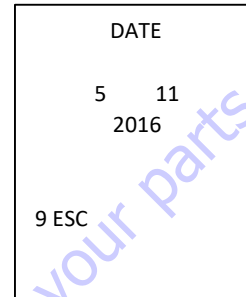
**Setup - Time**

By this page is visualized the settled time, after having inserted the relevant password "8262" it's possible to choose the time-zone pressing buttons n.1 or n.2, ZONE: 0 is the time in meridian "0".



**Setup - Date**

By this page is visualized the settled time, after having inserted the relevant password "1468" it's possible to adjust it, pressing buttons n.1 to modify the day, buttons n.2 to modify the month and n.3 or n.4 to modify the year.



**Setup - Password**

Some setting requires a password, some passwords are relevant to more than one setting, some other passwords are dedicated to only one setting.

By PASSWORD page it's possible to insert the password required pressing the keyboard buttons, password are composed by 4 numbers, if password is accepted display will visualize an "OK".



### Setup - Turn Table Sensor

1. Turn ON the main key and stabilize the machine.
2. Rotate the turntable until boom is aligned.
3. Raise outrigger to transport position.
4. Press button n.6 (SERVICE) and then press button n.7 (SETUP).
5. Press button n.5 (PASSWORD). The display will ask for the password.
6. Inserting password 2857 the display will confirm with "OK".
7. Press button n.9 (EXIT) and then button n.1 (ROT GROUND), the display will then visualize the page here below:

```

ROT SETUP
MACHINE 3 SET

READY 9 ESC
    
```

8. Press button n.3 (SET).

**NOTE:** Outriggers must be in transport position.

9. Switch off the machine, then switch it on again and check the turn table sensor calibration by the relevant input menu voice.

```

ROTAT AB
0
360

1 PREV
2 NEXT
9 ESC
    
```

10. Line <A> must be set at 360; line <B> must be set at 0.

**NOTE:** Turn table can be set from transport position, if the alignment is already perfect.

### Setup - Platform Rotation Sensor

1. Turn ON the main key and stabilize the machine.
2. Align platform with boom.
3. Press button n.6 (SERVICE) and then press button n.7 (SETUP).
4. Press button n.5 (PASSWORD). The display will ask for the password.
5. Inserting password 2857 the display will confirm with "OK".
6. Press button n.9 (EXIT) and then button n.2 (ROT BASKET), the display will then visualize the page here below:

```

ROT SETUP
MACHINE 3 SET

READY 9 ESC
    
```

7. Press button n.3 (SET).
8. Switch off the machine, then switch it on again and check the platform rotation sensor calibration by the relevant input menu voice.

```

ROT BAS AB
24
357,5

1 PREV
2 NEXT
9 ESC
    
```

9. Line <A> must be set at 24°; line <B> must be set at 357,5°.

### Setup - Load Cell Board (ECM3) Calibration

After having replaced the master board (ECM1) or the load cell board (ECM3) or having replaced the load cell sensor it's necessary to calibrate the "0" of the load cell system, by this procedure the calibration parameters relevant to the load cell sensor installed will be memorized on the ECM1.

Being possible difference between one load cell sensor and another it's necessary to calibrate ECM1 with the load cell sensor installed on the machine and not with another.

The load sensor system reset must be done with the basket removed.

The reset the load sensor system consist into saving the value "0", done without the basket, here follows the calibration procedure:

1. Turn ON the main key and stabilize the machine. Stay out from the basket with remote control on hands.
2. Press button n.6 (SERVICE) and then press button n.7 (SETUP).
3. Press button n.5 (PASSWORD). The display will ask for the password.
4. Inserting password 6138 the display will confirm with "OK".
5. Press button n.9 (EXIT) and then button n.7 (LOAD SENS), the display will than visualize the page here below:



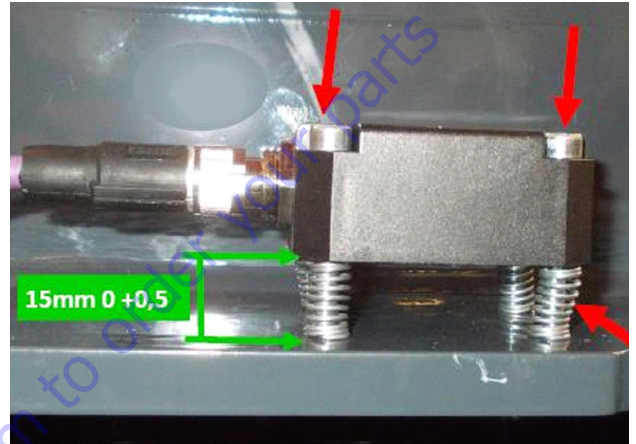
6. With the basket removed, press button n.3 (CALIB) and verify that display indicates "OK". In case of the basket is still loaded on its support this page will display "NOT READY" instead of "READY" and reset will not be possible.
7. Press button n.9 (ESC) and then turn OFF the main key.
8. Turn ON again the main key and verify by INPUT "LOAD A" and "LOAD B" that calibration is correct by checking the variation at several basket loading condition, the difference between LOAD A and LOAD B values should be less than a certain value.

### Setup - ACCELER (Calibrating Tilt Sensor)

This menu allows the calibration of the tilt sensor.

After replaced the master board (ECM1) or the tilt sensor it's necessary to calibrate the tilt levelling system.

**NOTE:** Ensure the tilt switch is mounted at distance of 0.59 in (15 mm) and securely attached on the bracket plate, with the screws 5x45 TCEI and Loctite.



#### NOTICE

A NEW TILT MODULE WILL ACT AS IF IT IS TILTED ALL OF THE TIME UNTIL THE FOLLOWING PROCEDURE IS PERFORMED.

#### ⚠ WARNING

DO NOT CALIBRATE THE LEVEL SENSOR EXCEPT WITH A MACHINE LEVELLED. PLACE THE MACHINE ON OUTRIGGERS, WITH BOOMS IN STOWED POSITION AND ALIGNED WITH THE BASKET EMPTY. ENGINE AND ELECTRICAL MOTOR MUST BE SWITCHED OFF (AVOIDING VIBRATIONS).

Start of the calibration procedure:

1. Turn ON the main key and stabilize the machine.
2. Place a level on the slew ring and ensure machine is level.
3. Press button n.6 (SERVICE) and then press button n.7 (SETUP).
4. Press button n.5 (PASSWORD). The display will ask for the password.
5. Inserting password 1883 the display will confirm with "OK".
6. Press button n.9 (EXIT) and then button n.8 (INCLIN.), the display will than visualize the page here below.



```

INCLINATION
SENS. CA
LIBRATION

MACCHINA: NOT
READY

3 CALIB.

9 ESC
    
```

Press button n.3 (CALIB) and verify that display indicates "OK". In case of outriggers are not touching the ground, or photocells are not aligned, engine or electrical motor is switched on, this display will show "NOT READY" instead of "READY" and reset will not be possible.

7. Press button n.9 (ESC) and then turn OFF the main key.
8. Turn ON again the main key and verify at INPUT "INCLIN. X" and "INCLIN. Y".  
To verify the calibration is accurate, test out the values at different machine gradient position.

**Setup - Extra**

EXTRA menu gives the access to other settings and under menus.

The here aside picture shows the EXTRA menu display, from EXTRA menu pressing button from n.1 to n.6 it's possible to enter into further pages. Pressing button n.9 (ESC) brings back to the SETUP menu.

```

EXTRA

1 OPTIONAL
2 FIRMWARE
3 CARDS
4 MODEM
5 GPS

9 ESC
    
```

**Setup - Extra - Modem**

This page could be used in case of RAHM difficult connection; the meanings of the parameters shown by this page are the followings.

- STATUS: INIT. --> Initialization, modem is not ready to communicate.  
READY --> Modem is ready to communicate
- SIM: NO --> SIM CARD not present (STATUS will be INIT.)  
OK --> SIM CARD present
- OPERATOR: Shows the network operator, for instance TIM
- RSSI: 0 - 100 --> SIM CARD operator signals, need to be over 50 to have a good connection
- BER: 0 - 100 --> network line signals
- GPRS: Ok --> GPRS signal available

```

MODEM

STATUS :
READY
SIM OK
OPERATOR
I TIM
RSSI : 75
BER : 70
GPRS: Ok

9 ESC
    
```

**Setup - Extra - GPS**

This page shows RAHM references, the position availability, latitude and longitude, date and hours references

```

GPS

FIX: OK
LATIT.:
45,20
LONGI.:
11,03

9 ESC
    
```

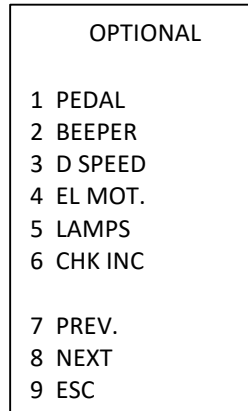
**Optional (Page1)**

OPTIONAL menu gives the access to other settings.

The here aside picture shows the OPTIONAL menu first page display, from which pressing button from n.1 to n.6 it's possible to enter some settings.

Pressing button n.8 it's possible to enter into a second page of settings, shown below.

Pressing button n.9 (ESC) brings back to the EXTRA menu.



**Beeper**

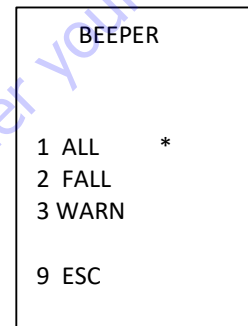
By this page, if is installed the optional warning buzzer, it's possible to set the motion alarm, after having inserted the relevant password "8365".

The motion alarm is activated depending on the BEEPER menu setting.

If it's selected ALL the warning buzzer is activated at all the machine movements, both aerial part and ground part.

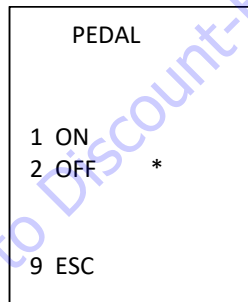
If it's selected FALL the warning buzzer is activated at the aerial part lowering moment and telescope retraction.

If it's selected WARN the warning buzzer is activated in the same condition or the remote control beeper.



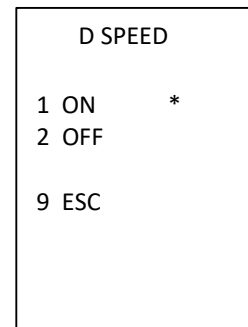
**Pedal**

By this page it's possible to set the pedal, after having inserted the relevant password "4771", pressing button n.1 "ON" pedal will be activated, pressing button n.2 "OFF" pedal will be deactivated.



**Second Speed**

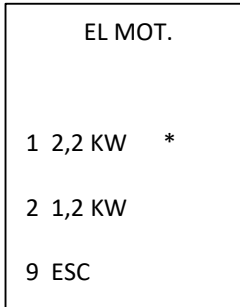
By this page it's possible to set the second speed (Hare), after having inserted the relevant password "5216", pressing button n.1 "ON" second speed will be activated, pressing button n.2 "OFF" second speed will be deactivated.



**Electric Motor**

By this page it's possible to set the electric motor power setting, after having inserted the relevant password "3522", pressing button n.1 "2.2 KW" machine will be set for 2.2 KW electric motor, pressing button n.2 "1.2 KW" it will be set for 1.2 KW electric motor.

The main difference between the two settings is in the auto-stabilization procedure steps timing.

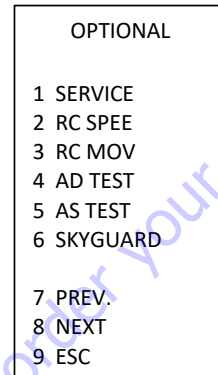


**Optional (Page 2)**

The here aside picture shows the OPTIONAL menu second page display.

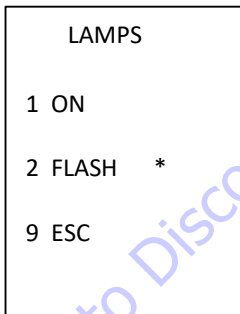
Pressing button n.7 it's possible to come back to the first page of settings.

Pressing button n.9 (ESC) brings back to the EXTRA menu.



**Lamps**

By this page it's possible to set the outriggers lights, after having inserted the relevant password "6661", pressing button n.1 "ON" outriggers lights will be steady on while they are touching the ground, pressing button n.2 "FLASH" outriggers lights will be flashing while they are touching the ground.

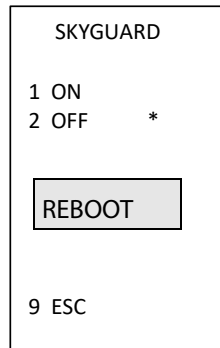


### Skyguard

By this page it's possible to set the Skyguard function, when it is activated, by pressing on Skyguard bar it stops certain movements.

After having inserted the relevant password "4771", pressing button n.1 "ON" and restarting by the main key it will be activated, pressing button n.2 "OFF" and restarting by the main key it will be deactivated.

"REBOOT" indication means that the machine has to be restarted by the main key to activate the function.

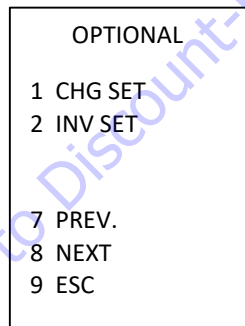


### Optional (Page 3)

The here aside picture shows the OPTIONAL menu third page display.

Pressing button n.7 it's possible to come back to the second page of settings.

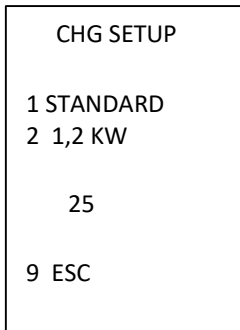
Pressing button n.9 (ESC) brings back to the EXTRA menu.



### CHG Set

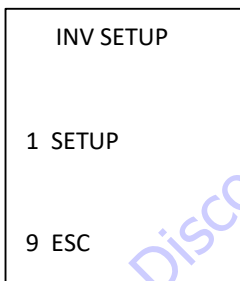
For a lithium machine, by this page it's possible to set the maximum charging current, after having inserted the relevant password "1138", pressing button n.1 it will be settled 25 Amp, pressing button n.2 it will be settled 18 Amp.

This setting, considering the transformation rate, has to respect the maximum current available on local electric plug.



### INV Set

For a lithium machine, by this page it's possible to setup the rpm setting for a new inverter, pressing button n.1 the rpm setting will be settled according to the machine model settled by the relevant menu, check chapter 10.1.9.2.



**NOTE:** Some pages are not accessible, or could not show same information, if not after having inserted the relevant password.

## 6.5 MASTER BOARD (ECM1) REPLACEMENT AND SETTING

Machine software contains the software for all the TTC JLG machine models produced till that moment, so that when a new master board (ECM1) is installed on a machine, the machine model need to be selected.

### New Master Board

When a new master board (never used) is fitted on the machine, the remote control need to be connected to its ground cable and the control position selected accordingly by the control position selector switch.

Then, turning on the main key, it will require the setting of the machine model and version, as indicated by the here below procedure.

To set the master board, machine must be closed and aligned, it has to be make sure that battery is charged enough or machine need to be plugged to the electric network.

Here follows the calibration procedure:

1. Connect the remote control at its ground cable and select the control position accordingly by the control position selector switch.



2. Turn ON the main key and select the correct machine model with button n.1 (VERSION), the display shows the machine model selected. If it appears "MOD.CODE FAIL!", it means that the machine model selected is not correct, even if that alarm does not appear on the display the machine model selected needs to be check.

Here below the example shows on the image A the case of machine model selected is wrong, and on image B the case of machine model selected is the right one.

**A**

VERSION  
MODEL:  
LL1570  
ENGINE  
D.RPM

MOD. CODE  
FAIL!

1 VERSION  
7 MOTOR  
3 SAVE  
9 ESC

MACHINE MODEL  
SELECTED IS WRONG

**B**

VERSION  
MODEL:  
LL1570  
ENGINE  
D.RPM

1 VERSION  
7 MOTOR  
3 SAVE  
9 ESC

MACHINE MODEL  
SELECTED IS OK

3. In case of the engine model selected is not correct with button n.7 (MOTOR) select the correct one (for instance "D.RPM" is the diesel Hatz 1B40 and "G.13L" is the gasoline Honda iGX390).
4. Press button n.3 (SAVE) to save the setting.
5. Switch the main key OFF and ON again to restart it.
6. Press and release the remote control emergency button to esc the SAFETY STATE.
7. The display will show "LOAD CAL" and "INCL CAL", following the procedures of appendixes 2 and 1 calibrate the load cell system and the tilt sensor.
8. Following the relevant procedures set the other settings, as ramps and currents.

PERSONALITY SETTING		
MACHINE	MODEL	ENGINE
X13JP X370AJ	LL1370	D.RPM
		B.13I
		LITH.
X15JP X430AJ	LL1570	D.RPM
		B.13I
		LITH.

### Already Initialized Master Board

The machine system in some cases, specifically for machine models different on a safety point of view, is able to recognize if the machine model selected is not correct.

This verification is possible because on the load cell board (ECM3) a series of contacts input depends on the machine model.

As soon as another master board, already initialized on another machine, is connected to its connectors, as well as when the contacts on the load cell board (ECM3) have been changed, machine will check if the machine model selected on the master board corresponds to the machine model where it is fitted on.

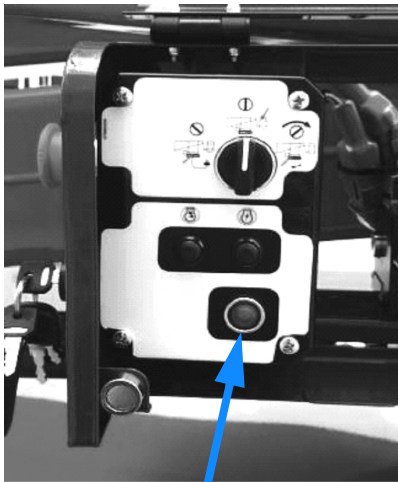
If the machine model selected on the master board does not correspond to the machine model, the correct machine model must be selected by the VERSION menu.

### Software Recovery By Modem

In case of main machine software in the master board software is corrupted or missing, if the modem contains the main machine software it is able to install the software in the master board.

When the modem installs the main machine software on the master board, the first part of the installing process is the erasing of the eventual software on master board, so that the remote control display will show wrong images.

While the installing process is in progress the machine must be left switched on for 10-15 minutes, till the ground green light comes on flashing.



GREEN LIGHT

### 6.6 CODE MENU

The machine diagnostic system identify faulty as short circuits and missing connections to the valve coils, furthermore monitoring the circuit load.

For some faulty affecting on aerial part valve coils, which include the gravity emergency descent valves, the summing oil pump valve, the functions could be prevented.

To restart the functions have to turn OFF (ground key OFF) and then ON the machine, as a result all the function are then active with exception the faulty one.

For some faulty affecting on ground part valve coils, which include outrigger movements, track widening, the functions could be prevented.

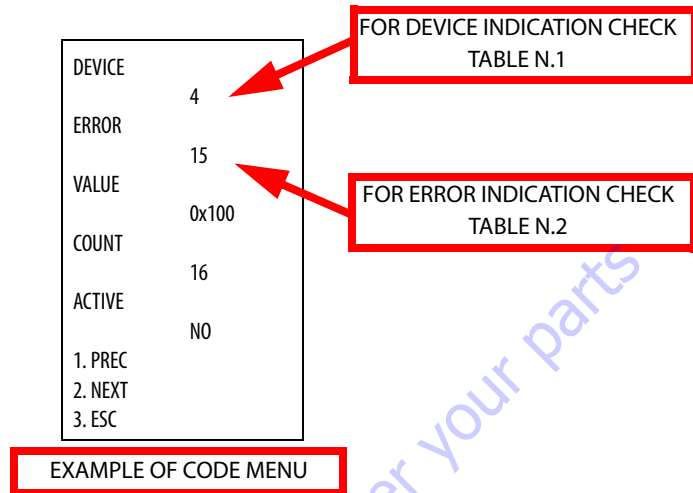
To restart the functions have to turn OFF (ground key OFF) and then ON the machine, as a result all the function are then active with exception the faulty one.

In case of the display shows the icon FAIL INPUT OUT, as shows here below, it means a faulty issue present on the electric connection.



ELECTRIC CONNECTION ANOMALY IN PROGRESS

By the remote control, pressing button 6 - SERVICE and then keeping pressed button 3 - ERR --> COD, it will be displayed the CODE MENU, that is a list of DEVICE with potentially anomalous signal.



**NOTE:** By CODE MENU, not all the DEVICES signed with an ERROR and "ACTIVE YES" have to be considered as an anomaly, only in case of the icon FAIL INPUT OUTPUT is displayed there's an anomaly in progress.

Here follows the list of the main DEVICES that could be affected by that kind of anomalies, not all the DEVICES are listed.

**Table 6-1. DEVICES**

DEVICE CODE	DEVICE DESCRIPTION
22	Ground part right side proportional valve coil
23	Ground part left side proportional valve coil
24	Right track forward valve coil
25	Left track forward valve coil
26	Right track backward valve coil
27	Left track backward valve coil
28	Outrigger n.1 lowering valve coil
29	Outrigger n.2 lowering valve coil
30	Outrigger n.3 lowering valve coil
31	Outrigger n.4 lowering valve coil
32	Outrigger n.1 lifting valve coil
33	Outrigger n.2 lifting valve coil
34	Outrigger n.3 lifting valve coil
35	Outrigger n.4 lifting valve coil
36	1-2 booms lifting valve coil
37	3 boom lifting valve coil
38	1-2 booms lowering valve coil
39	3 boom lowering valve coil
40	Telescope extraction valve coil
41	Telescope retraction valve coil



**Table 6-1. DEVICES**

DEVICE CODE	DEVICE DESCRIPTION
42	Jib opening valve coil
43	Jib closing valve coil
44	Basket levelling up valve coil
45	Basket levelling down valve coil
46	Turntable right rotation valve coil
47	Turntable left rotation valve coil
48	Basket right rotation valve coil
49	Basket left rotation valve coil
50	Aerial part proportional valve coil
51	Pumps sum valve coil
52	Tracks second speed valve coil
53	Tracks widening valve coil
54	Tracks closing valve coil
55	1-2 booms gravity descent valve coil
56	3 boom gravity descent valve coil
57	Deviator (aerial part/ground part) valve coil

Here follows the list of the main ERRORS, not all the ERRORS are listed.

**Table 6-2. ERRORS**

ERROR CODE	ERROR DESCRIPTION
0	No error
1	Initialization error
2	Open load error (charge disconnected)
3	Open load error (short circuit)
4	Short circuit to ground
5	Short circuit to battery plus
7	Safety deactivation
8	Out of range error
9	Timeout error
12	Reading error
14	Selection error
15	Occupied
16	Default value not valid

**EXAMPLES**

Here follow some examples of what could be displayed on CODE menu.

EXAMPLE OF A CODE MENU INDICATION WITH NO ERROR IN PROGRESS

STOWED MACHINE WITH NO ERROR		
DEVICE CODE	ERROR CODE	ACTIVE
11	12	NO
12	9	YES
64	2	YES
65	9	NO
66	9	NO
67	4	YES
73	2	NO
89	12	YES
133	1	YES
145	2	YES
154	8	NO
155	8	NO
166	9	YES

**NOTE:** Some different indications on CODE menu could occur depending on the machine conditions (stabilized, aligned, etc.).

**EXAMPLE OF MACHINE WITH A COIL CONNECTION ERROR**

In case of the coil of the ON-OFF valve for third boom lifting is disconnected from its cabling or in case of its cable is ripped, when pushing one of the black joysticks, the aerial

part movement will not be carried out and the icon FAIL INPUT OUTPUT will be displayed.

On this case on the CODE MENU at the DEVICE 37 the ERROR 2 (Open load error) or ERROR 5 (Short circuit to battery plus), will be displayed as "ACTIVE YES", while some other DEVICE between the 36 and the 56 will be displayed with ERROR 7 (Safety deactivation).

COIL CONNECTION ERROR EXAMPLE			
DEVICE CODE	ERROR CODE	ACTIVE	
12	9	YES	
<b>36</b>	<b>7</b>	<b>YES</b>	1-2 booms lifting valve coil
<b>37</b>	<b>5</b>	<b>YES</b>	<u>3 boom lifting valve coil</u>
<b>38</b>	<b>7</b>	<b>YES</b>	1-2 booms lowering valve coil
<b>39</b>	<b>7</b>	<b>YES</b>	3 boom lowering valve coil
<b>40</b>	<b>7</b>	<b>YES</b>	Telescope extraction valve coil
<b>41</b>	<b>7</b>	<b>YES</b>	Telescope retraction valve coil
<b>42</b>	<b>7</b>	<b>YES</b>	Jib opening valve coil
<b>43</b>	<b>7</b>	<b>YES</b>	Jib closing valve coil
<b>44</b>	<b>7</b>	<b>YES</b>	Basket levelling up valve coil
<b>45</b>	<b>7</b>	<b>YES</b>	Basket levelling down valve coil
<b>46</b>	<b>7</b>	<b>YES</b>	Turntable right rotation valve coil
<b>47</b>	<b>7</b>	<b>YES</b>	Turntable left rotation valve coil
<b>48</b>	<b>7</b>	<b>YES</b>	Basket right rotation valve coil
<b>49</b>	<b>7</b>	<b>YES</b>	Basket left rotation valve coil
64	2	YES	
65	9	NO	
66	9	NO	

**SECTION 6 - JLG CONTROL SYSTEM**

COIL CONNECTION ERROR EXAMPLE		
DEVICE CODE	ERROR CODE	ACTIVE
67	4	YES
73	2	NO
89	12	YES
133	1	YES
145	2	YES
154	8	NO
155	8	NO

**EXAMPLE OF MACHINE WITH A COIL CONNECTION ERROR AFTER KEY RESET**

From the software release 2.0, resetting the machine by the main key the aerial part movements will be re-acti-

vated, except for the third boom lowering that will be re-activated only after its coil anomaly is restored.

COIL CONNECTION ERROR AFTER KEY RESET EXAMPLE		
DEVICE CODE	ERROR CODE	ACTIVE
12	9	YES
<b>37</b>	<b>2</b>	<b>YES</b>
64	2	YES
65	9	NO
66	9	NO
67	4	YES
73	2	NO
89	12	YES
133	1	YES
145	2	YES
154	8	NO
155	8	NO

3 boom lifting valve coil

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## SECTION 7. GENERAL ELECTRICAL INFORMATION & SCHEMATICS

### NOTICE

**THIS MACHINE IS POWERED BY AN 76VDC (NOMINAL) ELECTRICAL SYSTEM. BASED ON EMPLOYER, LOCAL, AND GOVERNMENTAL REGULATIONS AS THEY PERTAIN TO THIS MACHINE, SPECIFIC ELECTRICAL TRAINING AND CERTIFICATIONS MAY BE REQUIRED BEFORE SERVICING OR TROUBLESHOOTING.**

### NOTICE

**IT IS A GOOD PRACTICE TO AVOID PRESSURE-WASHING ELECTRICAL/ELECTRONIC COMPONENTS. SHOULD PRESSURE-WASHING BE UTILIZED TO WASH AREAS CONTAINING ELECTRICAL/ELECTRONIC COMPONENTS, JLG INDUSTRIES, INC. RECOMMENDS A MAXIMUM PRESSURE OF 750 PSI (52 BAR) AT A MINIMUM DISTANCE OF 12 INCHES (30.5 CM) AWAY FROM THESE COMPONENTS. IF ELECTRICAL/ELECTRONIC COMPONENTS ARE SPRAYED, SPRAYING MUST NOT BE DIRECT AND BE FOR BRIEF TIME PERIODS TO AVOID HEAVY SATURATION.**

avoid damaging the seal around the wire. It is best to use probes or probe tips specifically designed for this technique, especially on sealed connectors. Whenever possible insert probes into the side of the connector such that the test also checks both terminals of the connection. It is possible to inspect a connection within a closed connector by backprobing both sides of a connector terminal and measuring resistance. Do this after giving each wire a gentle pull to ensure the wires are still attached to the contact and contacts are seated in the connector.

### 7.1 GENERAL

This section contains schematics to be used for locating and correcting most of the operating problems which may develop. If a problem should develop which is not presented in this section or which is not corrected by listed corrective actions, technically qualified guidance should be obtained before proceeding with any maintenance.

### 7.2 MULTIMETER BASICS

A wide variety of multimeters or Volt Ohm Meters (VOM) can be used for troubleshooting your equipment. A digital meter with reasonable accuracy (within 7%) is recommended for the measurements in these procedures. This section shows diagrams of a common, digital VOM configured for several different circuit measurements. Instructions for your VOM may vary. Please consult the meter operator's manual for more information.

#### Grounding

"Grounding the meter" means to take the black lead (which is connected to the COM (common) or negative port) and touch it to a good path to the negative side of the voltage source.

#### Backprobing

To "backprobe" means to take the measurement by accessing a connector's contact on the same side as the wires, the back of the connector. Readings can be done while maintaining circuit continuity this way. If the connector is the sealed type, great care must be taken to

### Min/Max

Use of the "Min/Max" recording feature of some meters can help when taking measurements of intermittent conditions while alone. For example, you can read the voltage applied to a solenoid when it is only operational while a switch, far from the solenoid and meter, is held down.

### Polarity

Finding a negative voltage or current reading when expecting a positive reading frequently means the leads are reversed. Check what reading is expected, the location of the signal and that the leads are connected to

the device under test correctly. Also check that the lead on the "COM" port goes to the ground or negative side of the signal and the lead on the other port goes to the positive side of the signal.

### Scale

M = Mega = 1,000,000 \* (Displayed Number)

k = kilo = 1,000 \* (Displayed Number)

m = milli = (Displayed Number) / 1,000

$\mu$  = micro = (Displayed Number) / 1,000,000

Example: 1.2 k $\Omega$  = 1200  $\Omega$

Example: 50 mA = 0.05 A

### Voltage Measurement

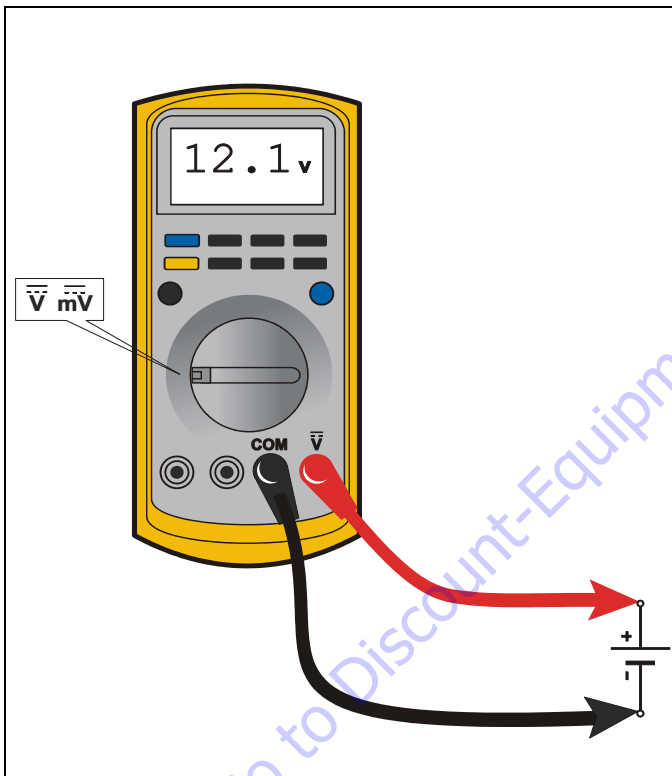


Figure 7-1. Voltage Measurement (DC)

- If meter is not auto ranging, set it to the correct range (See multimeter's operation manual)
- Use firm contact with meter leads

### Resistance Measurement

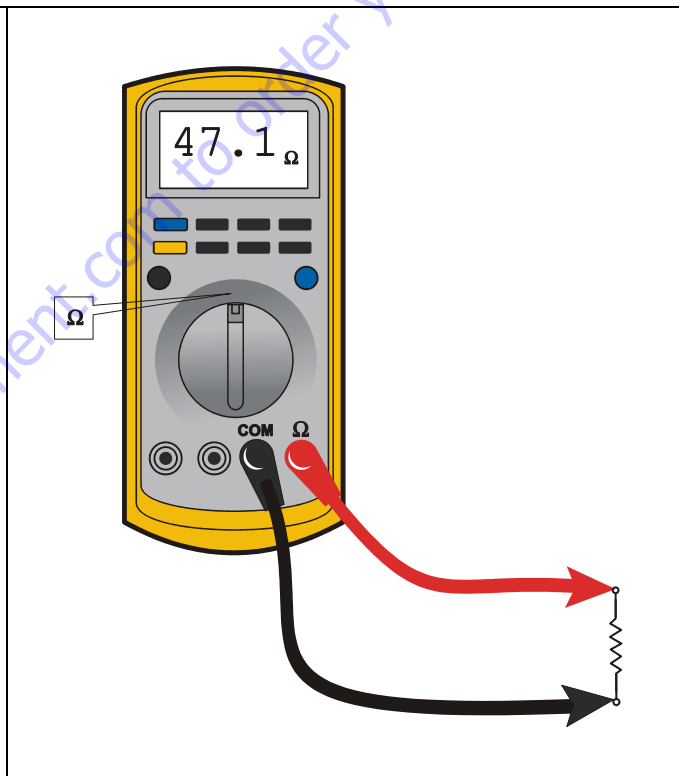
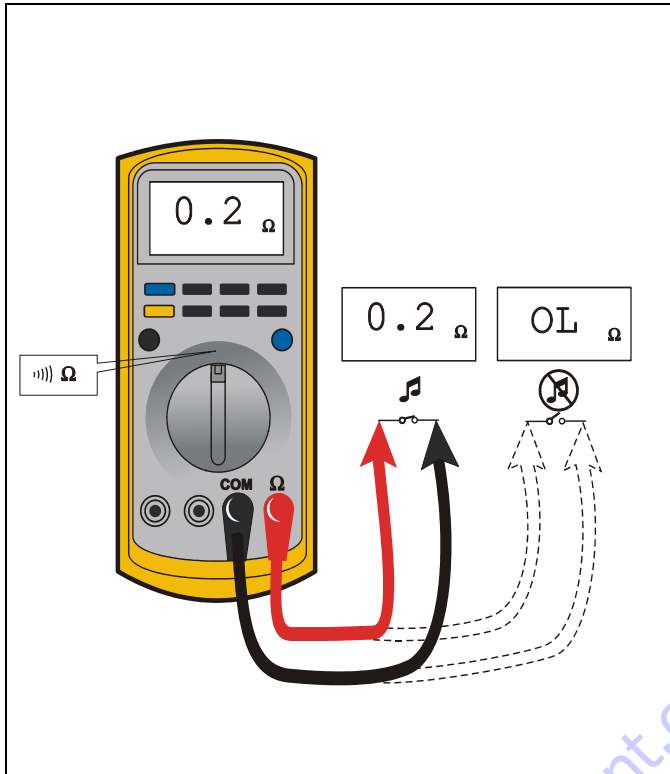
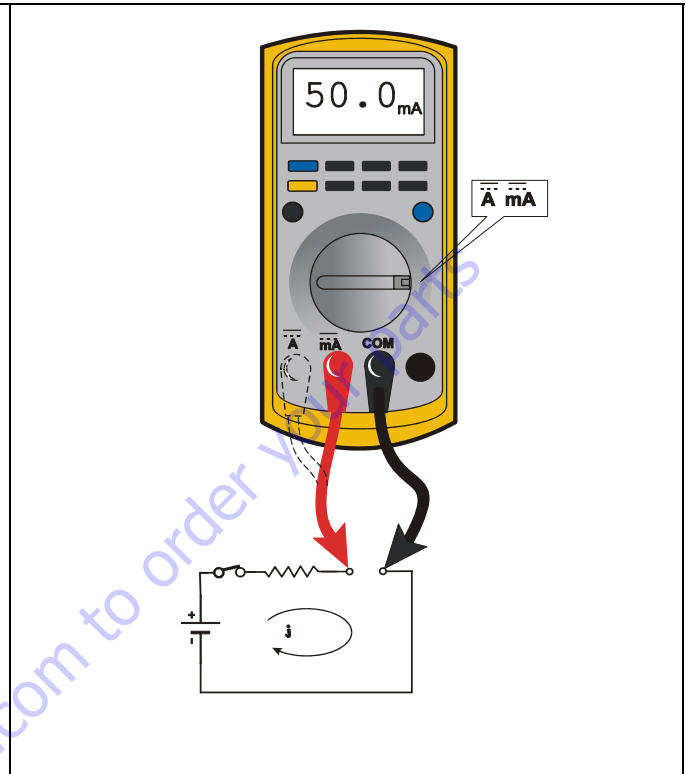


Figure 7-2. Resistance Measurement

- First test meter and leads by touching leads together. Resistance should read a short circuit (very low resistance)
- Circuit power must be turned OFF before testing resistance
- Disconnect component from circuit before testing
- If meter is not auto ranging, set it to the correct range (See multimeter's operation manual)
- Use firm contact with meter leads

**Continuity Measurement****Figure 7-3. Continuity Measurement**

- Some meters require a separate button press to enable audible continuity testing
- Circuit power must be turned OFF before testing continuity
- Disconnect component from circuit before testing
- Use firm contact with meter leads
- First test meter and leads by touching leads together. Meter should produce an audible alarm, indicating continuity

**Current Measurement****Figure 7-4. Current Measurement (DC)**

- Set up the meter for the expected current range
- Be sure to connect the meter leads to the correct jacks for the current range you have selected
- If meter is not auto ranging, set it to the correct range (See multi meter's operation manual)
- Use firm contact with meter leads

### Continuity Measurement Over Long Distances

When trying to determine continuity of a harness or wire, longer than the reach of standard instrument leads, is possible to perform the check without excessively long leads. Using the other wires in the harness one can determine the condition of a particular wire in the harness.

#### Requirements:

- Harness with at least three separate wires including the wire under test.
- These wires must be able to be isolated from other wires, etc.
- Jumper or method to connect contacts on one side of harness.
- Meter that can measure resistance or continuity.

#### Procedure

Test multimeter leads resistance. Subtract this value from the measured resistance of the wires to get a more accurate measurement.

Consult the circuit schematic to determine which wires to use in addition to wire under test, here called wire #1 and wire #2, and how to isolate these wires. These wires should appear in the same connectors as the wire under test or are within reach of the jumper.

1. Disconnect all connections associated with the wire under test and the two additional wires. If harness is not completely isolated disconnect battery terminals also, as a precaution.
2. Measure continuity between all three wires, the wire under test, wire #1 and wire #2. These should be open. If not, repair the shorted wires or replace the harness.

3. On one side, jumper from contact of wire #1 and wire #2.
4. Measure continuity between wire #1 and wire #2. If there is continuity, both wires are good and can be used for this test. If there is not continuity, either wire could be bad. Check connections and measurement setup. Redo measurement. If still no continuity, repair wires or consult schematic for other wires to use for test.
5. Jumper from wire under test to wire #1.
6. Measure continuity. If there is continuity, the wire under test is good. Resistance of a wire increases as the length increases and as the diameter decreases.

One can find the continuity of two wires, here #1 and #2, at once by following steps 1 through 4. If there is a problem the third wire is used to troubleshoot the other wires. To find the problem, start at step 1 and use the entire procedure.

### 7.3 ELECTRICAL SCHEMATICS MANUALS

The electrical schematics manuals are separate from this manual. They are available online (Online Express or [www.jlg.com](http://www.jlg.com) - Manuals) in the same folder where this Service Manual was found.



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