Service and Maintenance Manual

Models
X17JP - X500AJ
X20JP - X600AJ
X26JP - X770AJ

3121623

June 29, 2018 - Rev E

ANSI

CE

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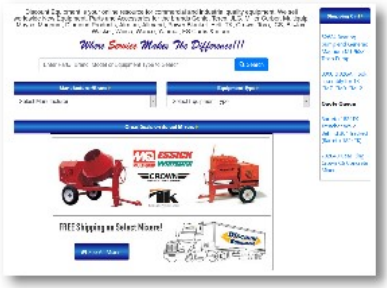

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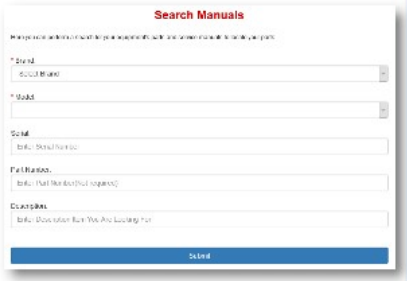

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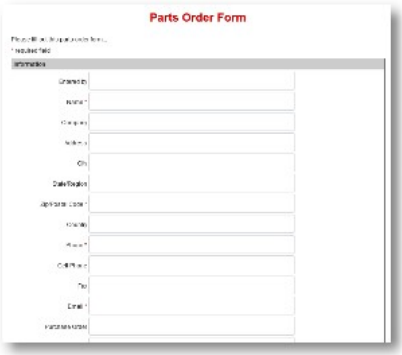

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INTRODUCTION - MAINTENANCE SAFETY PRECAUTIONS

GENERAL

This section contains the general safety precautions which must be observed during maintenance of the 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 DISCONNECTEDDURING REPLACEMENT OF ELECTRICAL COMPONENTS.
- KEEP ALL SUPPORT EQUIPMENT AND ATTACHMENTS STOWED IN THEIR PROPER PLACE.
- USE ONLY APPROVED, NONFLAMMABLE CLEANING SOLVENTS.

REVISON LOG

Original Issue	A - October 21, 2013
Revised	B - November 3, 2016
Revised	C - March 29, 2017
Revised	D - March 27, 2018
Revised	E - June 29, 2018 - Revised Covers

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SECTION 5 - HYDRAULICS

SECTION 7 - GENERAL ELECTRICAL INFORMATION & SCHEMATICS

SECTION 1. SPECIFICATIONS

1.1 CAPACITIES

Table 1-1. Drive Hub Capacities

Machine	Type Drive Hub	Drive	Capacities
X17JP / X500AJ	BONFIGLIOLI 700C2K I:32 + MAG12 VP	AUTO 2 SPEED	0.10 gal (0,4 L)
X20JP / X600AJ	BONFIGLIOLI 700-2 C2K+ MAG16VP	AUTO 2 SPEED	0,09 gal (0,35 L)
X26JP / X770AJ	BONFIGLIOLI 701 C2K + MAG18VP	AUTO 2 SPEED	0.16 gal (0,6 L)

Table 1-2. Hydraulic & Fuel Tank Capacities

MACHINE	HYDRAULIC OIL TANK CAPACITY	FUEL TANK (To S/N- C170000892)		FUEL TANK (S/N-C170000893 to Present)	
		GASOLINE	DIESEL	GASOLINE	DIESEL
X17JP / X500AJ	10.56 gal (40L)	1.55 gal (5,9L)	1.3 gal (5L)	1.6 gal (6,1L)	1.3 gal (5L)
X20JP / X600AJ	10.56 gal (40L)	1.55 gal (5,9L)	2.6 gal (10L)	1.6 gal (6,1L)	2.6 gal (10L)
X26JP / X770AJ	15.85 gal (60L)	—	10.56 gal (25L)	—	10.56 gal (25L)

1.2 TRACK SPECIFICATIONS

Table 1-3. Track Specifications

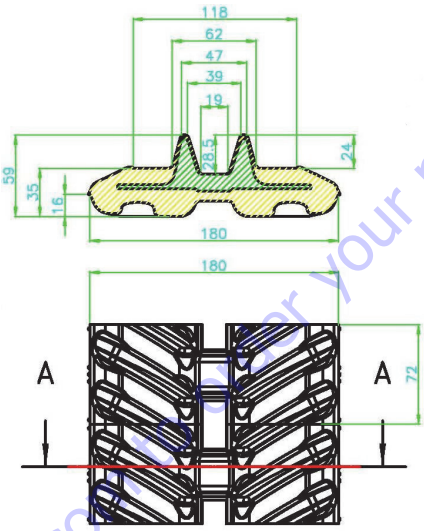
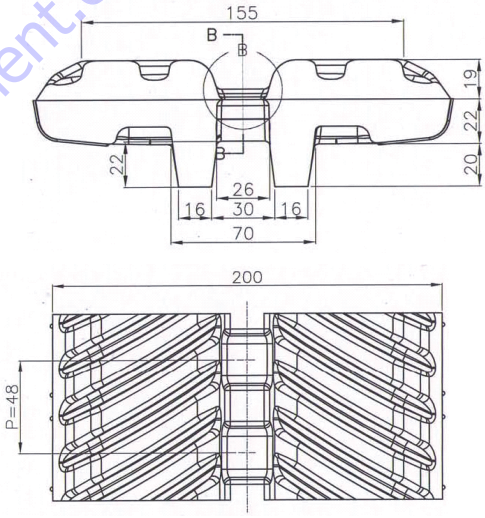
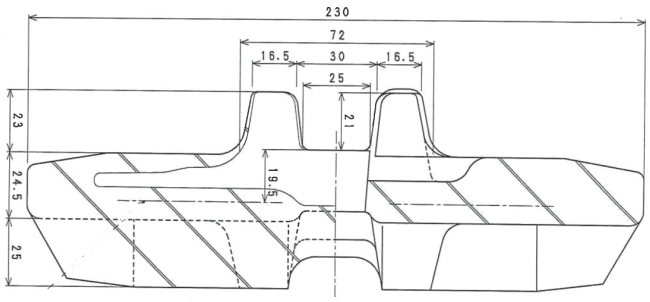
MACHINE MODEL	RUBBER BELT TRACK			
	TYPE	PART NUMBER	DIMENSIONS	DRAWING
X17JP X500AJ	LOW PROFILE BLACK COLOR	053715L0	Cm 180 X 37 X 72	
	LOW PROFILE NON-MARK-ING	053715LB		
X20JP X600AJ	LOW PROFILE BLACK COLOR	257215L0	Cm 200 X 48 X 66	
	LOW PROFILE NON- MARK-ING	257215LB		
X26JP X770AJ	HI PROFILE BLACK COLOR	27589900	Cm 230 X 26 X 96	
	HI PROFILE NON-MARK-ING	2758990B		

Table 1-4. Ground Bearing Pressure

MODEL	PRESSURES AND REACTIONS TO THE GROUND					
	ON TRACKS		ON OUTRIGGER			
	*Ground Bearing Pressure [daN/cm^2] - [PSI] * Average values on hard surface		Maximum Ground Bearing Pressure On Each Pad [daN] - [lbf]		Maximum Ground Bearing Pressure [daN/cm^2] - [PSI]	
X17JP-X500AJ	0,67 daN/cm^2	9.7 PSI	1731 daN	3892 lbf	2,45 daN/cm^2	35.5 PSI
X20JP-X600AJ	0,64 daN/cm^2	9.2 PSI	2150 daN	4833 lbf	3,04 daN/cm^2	45 PSI
X26JP-X770AJ	0,53 daN/cm^2	7.6 PSI	3124 daN	7023 lbf	4,42 daN/cm2	65 PSI

1.3 POWER SOURCE

Table 1-5. Power Configurations

	X17JP - X500AJ	X20JP - X600AJ	X26JP - X770AJ
Gasoline Engine (up to C170000892)	Honda iGX440 12.7 hp (9,5 kW) / 3600 RPM		N/A
Gasoline Engine (from C170000893)	Honda iGX390 11,7 hp (8,7 kW) / 3600 rpm	Honda iGX440 12.7 hp (9,5 kW) / 3600 RPM	N/A
Diesel Engine	Hatz 1B40 10 hp (7.46 kW)	Perkins 402.05 14 hp (10.44 Kw)	Kubota D902 21.6 hp (16,1 Kw)
Lithium	90 or 100Ah 72V	90 or 100Ah 72V	100 Ah 83V
AC Electric Motor	110V 50 Hz (2,2 KW) 120V 60 Hz (1.2 kW) 230V 50 Hz (2.2 kW) 230V 60 Hz (2.2 kW)		

NOTE: *RPM Tolerances are ± 50.*

Honda Engine iGX390 Specifications

Table 1-6. Specifications Honda Engine iGX390

Model	iGX390
Engine type	Air cooled 4-stroke OHV petrol engine, 25° inclined cylinder, horizontal shaft, cast iron sleeve
Bore x stroke	88 x 64 mm
Displacement	389 cm3
Compression ratio	8.2 : 1
Net power	6.4 kW (8,6 HP) / 3 000 rpm 7.0 kW (9.4 HP) / 3 600 rpm
Max. net torque	26.5 Nm / 2.7 kgfm / 2 500 rpm
Ignition system	Digital CDI with variable ignition timing
Starting system	Recoil starter, Electric starter
Choke	Automatic
Fuel tank capacity	6.1 l
Fuel cons. at cont. rated power	3.5 L/hr - 3 600 rpm
Engine oil capacity	1.1 l
Dimensions (L x W x H)	409 x 484 x 448 mm
Dry weight	37,0 kg

Honda Engine iGX440 Specifications

Table 1-7. Specifications Honda Engine iGX440

Model	iGX440U
Description code	GCAWK
Type	4-stroke, overhead camshaft, single cylinder, inclined by 15°
Displacement	438 cm^3 (26.7cu-in)
Bore x stroke	88.0 x 72.1 mm (3.46 x 2.84 in)
Maximum horsepower	11.2 kW (15.2 HP) / 3,600 min^{-1} (rpm)
Recommended maximum operation bhp	8.0 kW (10.8 HP) / 3,600 min^{-1} (rpm)
Maximum torque	29.8 N·m (3.0 kgf·m, 22 lbf·ft)/2,500 min^{-1} (rpm)
Compression ratio	8.1 : 1
Minimum fuel consumption	328 g/kW·h (241 g/HP·h, 0.53 lb/HP·h)
Ignition system	CDI
Ignition timing (at no load)	10° B.T.D.C./1,400 min^{-1} (rpm) 13° B.T.D.C./3,600 min^{-1} (rpm)
Spark plug	BKR7E-E (NGK), K22PR-UR (DENSO)
Lubrication system	Forced splash type
Oil capacity	1.10 l (1.16 US qt, 0.97 lmp qt)
Cooling system	Forced air
Starting system	Recoil and starter motor
Stopping system	Ignition primary circuit open
Carburetor	Horizontal type batter fly valve

Table 1-7. Specifications Honda Engine iGX440

Model	iGX440U
Air cleaner	Dual element type
Governor	STR (Self Tuning Regulator) governor
Fuel used	Unleaded gasoline with a pump octane rating 86 or higher

Hatz Engine 1B40 Specifications

Table 1-8. Specifications Hatz Engine 1B40

Type	1B40
Design	Air-cooled four-stroke diesel engine
Combustion system	Direct injection
Number of cylinders	1
Bore / stroke	88 / 76 mm
Displacement	462 cm^3
Lubricating oil capacity without oil sump: with oil sump:	1.5 [1] l, approx. 3.2 [1] l, approx.
Difference between “max” and “min” levels without oil sump: with oil sump:	0.8 [1] l, approx. 2.2 [1] l, approx.
Lubricating oil consumption (after running in)	1% of fuel consumption at full load max.)
Lubricating oil pressure (oil temperature 100 °C)	2.5 bars at 3000 r.p.m. (approx.)
Direction of rotation, power take-off end	anti-clockwise
Valve clearance 10 - 30 ° C - Inlet and exhaust valve	0.10 mm
	or automatically [2]
Max. tilt angle in operation, in direction	Flywheel 25° down [3] all other directions 35°[3]
Weight (incl. fuel tank, air-cleaner, exhaust silencer, recoil starter and electric starter)	55 kg approx.
Battery capacity	max. 12 V / 60 Amp/h

Perkins Engine 402D Specifications

Table 1-9. Specifications Perkins Engine 402D

Type	402D-05 Engine
Maximum Operating Speed (rpm)	3600 rpm
Cylinders and Arrangement	In-Line two cylinder
Bore	67 mm (2.64 inch)
Stroke	72 mm (2.83 inch)
Displacement	0.507 L (30.939 in3)
Aspiration	NA[(1)]
Compression Ratio	23.5:1
Firing Order	1-2
Rotation that is viewed from the flywheel	Counterclockwise
Valve Lash Setting (Inlet)	0.20 mm (0.008 inch)
Valve Lash Setting (Exhaust)	0.20 mm (0.008 inch)
Injection	Indirect

Kubota Engine D902-E3B Specifications

Table 1-10. Specifications Kubota Engine D902-E3B

Model		D902-E3B
Emission Regulation		Tier 4
Type		Vertical 4-cycle Liquid Cooled Diesel
Number of Cylinders		3
Bore	mm (in)	72 (2,83)
Stroke	mm (in)	73,6 (2,9)
Displacement	L (cu.in)	0,898 (54,80)
Compustion System		IDI
Intake System		Naturally Aspirated
Maximum Speed	rpm	3200
Output: Gross Intermittent	KW	16.1
	hp	21.6
	ps	21.9
Direction of Rotation		Counterclockwise viewed on flywheel
Oil Pan Capacity	L (gal)	3,7 (0,98)
Starter Capacity	V-KW	12-1,2
Alternator Capacity	V-A	12-40
Lenght	mm (in)	467,1 (18,40)
Width	mm (in)	420,5 (16,6)
Height (1)	mm (in)	544,1 (21,42)
Height (2)	mm (in)	204,0 (8,03)
Dry Weight	KG (lb)	72,0 (158,8)

1.4 SPECIFICATIONS AND PERFORMANCE DATA

Reach Specifications

Table 1-11. Machine Reach Specifications

	X17JP CE	X500AJ ANSI	X20JP CE	X600AJ ANSI	X26JP CE	X770AJ ANSI
Working Height	17.06 m	N/A	20,15 m	N/A	25,70 m	N/A
Platform Height	14,96 m	49,08 ft	18,05 m	59,21 ft	23,60 m	77,42 ft
Horizontal Outreach	7,50 m	24,60 ft	9,70 m	31,82 ft	13,75 m	45,11 ft
Up & Over Height	7.80 m	25,59 ft	8,20 m	26,90 ft	10,1 m	33,13 ft
Swing (non - continuous)	360°					
Max gradeability allowed in drive	16° / 28,7%		16° / 28,7%		16° / 28,7%	
Max gradeability stabilization	12°		15°		16°	
Max Approach /Depart angles	20°/26°		20°/21°		22°	

Dimensional Data

Table 1-12. Machine Dimensional Data

	X17JP / X500AJ	X20JP / X600AJ	X26JP / X770AJ
Platform size (standard 2 persons)	27.16 in. x 52.56 in. (690 mm x 1335 mm)		
Stowed width (with std. 2P platform)	52.56 in. (1335 mm)		
Stowed width (without platform)	30.70 in. (780 mm)	30.70 in. (780 mm)	38.98 in. (990 mm)
Stowed height (on tracks)	76.66 in. (1998 mm)	76.66 in. (1998 mm)	78 in. (1981 mm)
Stowed length (on tracks)	178.3 in. (4529 mm)	197.28 in. (5011 mm)	250 in. (6347 mm)
Outrigger footprint (Between Center Plate)	113.54 in. x 113.74 in. (2884 x 2889 mm)	115 in. x 115.16 in. (2922 x 2925 mm)	160.59 in. x 156.61 in. (4079 x 3978 mm)
Outrigger footprint reduced stabilization area (Between Center Plate)	NA	NA	214.61 in. x 98.50 in. (5451 x 2502 mm)
Machine weight (with standard platform)			
Gasoline:	4916 lb. (2230 Kg)	6261 lb. (2840 Kg)	NA
Diesel:	4916 lb. (2230 Kg)	6482 lb. (2940 Kg)	9623 lb. (4365 Kg)
Lithium Battery:	5071 lb. (2300 Kg)	6504 lb. (2950 Kg)	9665 lb. (4384 Kg)

Function Speed Data

Table 1-13. Function Speed

FUNCTIONS SPEED RANGE						
MACHINE MODEL	X17JP / X500AJ		X20JP / X600AJ		X26JP / X770AJ	
POWER SYSTEM	Engine	Lithium	Engine	Lithium	Engine	Lithium
FUNCTION	TIME Sec		TIME Sec		TIME Sec	
TELESCOPE EXTEND	15'' - 20''	35'' - 45''	21'' - 28''	35'' - 41''	21'' - 30''	45'' - 60''
TELESCOPE RETRACT	16'' - 22''	35'' - 43''	16'' - 20''	21'' - 25''	21'' - 30''	40'' - 50''
TOWER BOOM UP	21'' - 24''	38'' - 46''	30'' - 35''	35'' - 43''	36'' - 42''	45'' - 60''
TOWER BOOM DOWN	19'' - 22''	41'' - 49''	30'' - 35''	37'' - 45''	36'' - 45''	50'' - 65''
UPPER BOOM UP	25'' - 29''	34'' - 42''	35'' - 40''	38'' - 48''	41'' - 52''	50'' - 70''
UPPER BOOM DOWN	24'' - 30''	35'' - 43''	35'' - 40''	38'' - 44''	41'' - 52''	50'' - 70''
BASKET ROTATE RIGHT	7'' - 10''	7,5'' - 11''	7'' - 10''	6,5'' - 11''	7'' - 15''	7'' - 15''
BASKET ROTATE LEFT	7'' - 10''	7,5'' - 11''	7'' - 10''	6,5'' - 11''	7'' - 15''	7'' - 15''
SWING LEFT	40'' - 45''	47'' - 57''	45'' - 50''	48'' - 59''	55'' - 65''	60'' - 80''
SWING RIGHT	40'' - 45''	47'' - 57''	45'' - 50''	48'' - 59''	55'' - 65''	60'' - 80''
JIB UP	7'' - 10''	17'' - 24''	7'' - 10''	13'' - 17''	7'' - 15''	10'' - 20''
JIB DOWN	7'' - 10''	11'' - 15''	7'' - 10''	9,5'' - 11''	7'' - 15''	10'' - 15''
BASKET LEVEL UP	40'' - 58''	41'' - 64''	33'' - 55''	29'' - 61''	33'' - 55''	33'' - 55''
BASKET LEVEL DOWN	35'' - 52''	40'' - 57''	37'' - 50''	34'' - 57''	37'' - 50''	40'' - 65''
DRIVE SPEED	0.43/1.12/2.24 mph (0,7/1,8/3,6 Km/h)	0.25/0.50/0.99 mph (0,4/0,8/1,6 Km/h)	0.31/0.81/1.55 mph (0,5/1,3/2,5 Km/h)	0.52/0.99 mph (0,83/1,6 Km/h)	0.68/1.24 mph (1,1/2 Km/h)	0.43/0.75 mph (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).

1.5 HYDRAULIC PRESSURE SETTINGS - PSI (BAR)

Table 1-14. Pressure Settings

MODEL	UNDERCARRIAGE Left and Right Control Valve		TOWER Control Valve	
	BAR	PSI	BAR	PSI
X17JP - X500AJ	165	2393	185	2045
X20JP - X600AJ	165	2393	210	3045
X26JP - X770AJ	200	2900	200	2900

Table 1-15. Reduction Drive Speed Pressure Settings

MODEL	AUTOMATIC REDUCTIONS DRIVE SPEED	
	BAR	PSI
X17JP - X500AJ	26	380
X20JP - X600AJ	NA	NA
X26JP - X770AJ	26	380

1.6 MAJOR COMPONENT WEIGHTS

Table 1-16. Major Component Weights

MACHINE	X17JP - X500AJ		X20JP - X600AJ		X26JP - X770AJ	
DESCRIPTION	KG	LBS	KG	LBS	KG	LBS
Basket with Remote Control	43	94.7	36	79.3	43.0	94.7
Basket A-Frame Assembled	33	72.7	31	68.3	31	68.3
Basket Level Cylinder	8	17.6	8	17.6	8	17.6
Basket Rotator	20	44	17	37.4	17	37.4
Cylinder JIB	12	26.4	12	26.4	12	26.4
Upper JIB Link	10	22	10	22	10	22
Lower JIB Link	15	33	15	33	15	33
Arms JIB	24	52.9	24	52.9	24	52.9
Upper Boom	92	202.8	158	348.3	218.3	481.2
Telescope Cylinder	52	114.6	61.5	135.5	94.8	209
Upper Upright	60	132.2	92	202.8	83.3	183.6
Master Cylinder	7	15.4	7	15.4	7	15.4
Upper Lift Cylinder	38	83.7	53.3	117.5	69.7	153.6
Upper Boom Link	61	134.4	128	282.1	204	449.7
Upper Tower Boom	105	231.4	149.5	329.5	283.1	624.1
Upper Tower Cylinder	38	83.7	53	116.8	89.4	197
Lower Boom Link	14	30.8	28.5	62.8	27	59.5
Lower Upright	57	125.6	84	185.1	126.3	278.4
Tower Link	35	77.1	86	189.5	141	310.8
Lower Tower Boom	71	156.5	98.5	217.1	194.3	428.3
Tower	218	480.6	268	590	217.9	480.3
Undercarriage Assembled	1119	2466.9	1271	2802	2137.2	4711.7

1.7 LUBRICATION

Hydraulic Oil

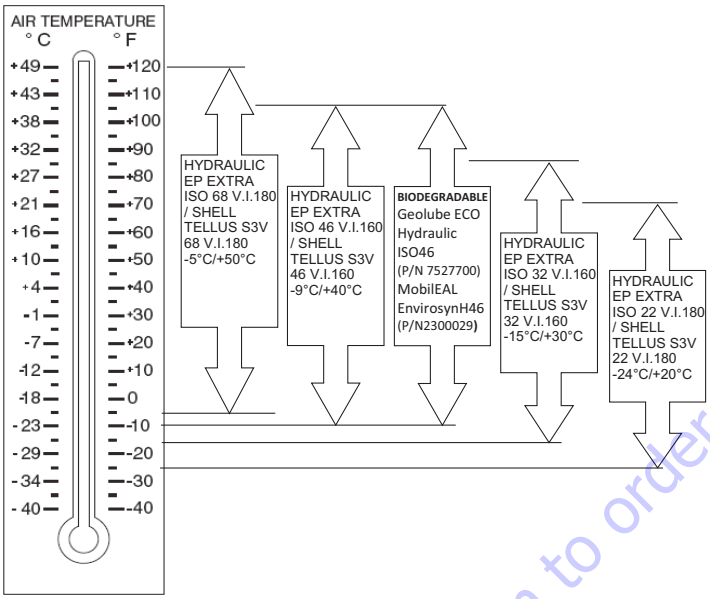


Figure 1-1. Hydraulic Oil Temperature Operating Range

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 HydraulicISO 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 1-17. 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

1.8 SERIAL NUMBER LOCATION

A serial number plate is affixed on to the frame a frame. The following illustration showing the position.

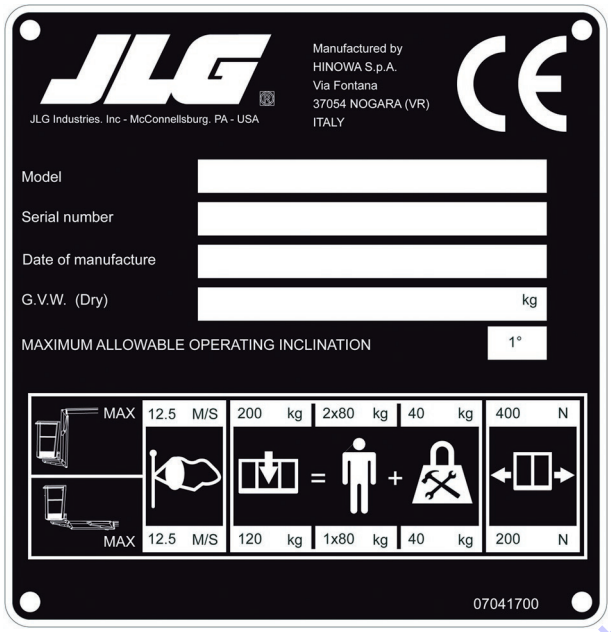


Figure 1-2. Serial Number Plate

Figure 1-3. X26JP / X770AJ Serial Number Plate Location
(on side of chassis rear compartment cover)

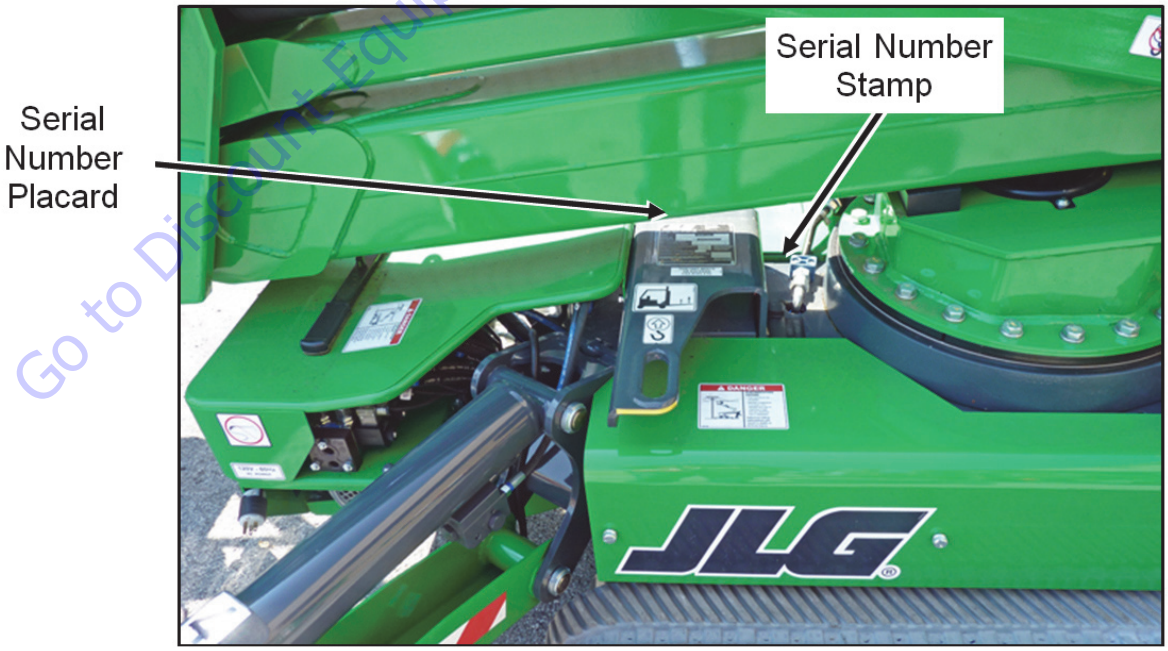


Figure 1-4. X17JP/X20JP - X500AJ/X600AJ - Serial Number Plate Location

1.9 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 (Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140)		Torque (Loctite® 262™ or Vibra-TITE™ 131)		Clamp Load	Torque (Dry or Loctite® 263) K= 0.20		Torque (Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140) K=.18		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604	380	8	0.9	6	0.7											
	48	0.1120	0.00661	420	9	1.0	7	0.8											
6	32	0.1380	0.00909	580	16	1.8	12	1.4											
	40	0.1380	0.01015	610	18	2.0	13	1.5											
8	32	0.1640	0.01400	900	30	3.4	22	2.5											
	36	0.1640	0.01474	940	31	3.5	23	2.6					1320	43	5				
10	24	0.1900	0.01750	1120	43	4.8	32	3.5					1580	60	7				
	32	0.1900	0.02000	1285	49	5.5	36	4					1800	68	8				
1/4	20	0.2500	0.0318	2020	96	10.8	75	9	105	12			2860	143	16	129	15		
	28	0.2500	0.0364	2320	120	13.5	86	10	135	15			3280	164	19	148	17		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	3340	17	23	13	18	19	26	16	22	4720	25	35	20	25	20	25
	24	0.3125	0.0580	3700	19	26	14	19	21	29	17	23	5220	25	35	25	35	20	25
3/8	16	0.3750	0.0775	4940	30	41	23	31	35	48	28	38	7000	45	60	40	55	35	50
	24	0.3750	0.0878	5600	35	47	25	34	40	54	32	43	7900	50	70	45	60	35	50
7/16	14	0.4375	0.1063	6800	50	68	35	47	55	75	45	61	9550	70	95	65	90	50	70
	20	0.4375	0.1187	7550	55	75	40	54	60	82	50	68	10700	80	110	70	95	60	80
1/2	13	0.5000	0.1419	9050	75	102	55	75	85	116	68	92	12750	105	145	95	130	80	110
	20	0.5000	0.1599	10700	90	122	65	88	100	136	80	108	14400	120	165	110	150	90	120
9/16	12	0.5625	0.1820	11600	110	149	80	108	120	163	98	133	16400	155	210	140	190	115	155
	18	0.5625	0.2030	12950	120	163	90	122	135	184	109	148	18250	170	230	155	210	130	175
5/8	11	0.6250	0.2260	14400	150	203	110	149	165	224	135	183	20350	210	285	190	260	160	220
	18	0.6250	0.2560	16300	170	230	130	176	190	258	153	207	23000	240	325	215	290	180	245
3/4	10	0.7500	0.3340	21300	260	353	200		285	388	240	325	30100	375	510	340	460	280	380
	16	0.7500	0.3730	23800	300	407	220	298	330	449	268	363	33600	420	570	380	515	315	430
7/8	9	0.8750	0.4620	29400	430	583	320	434	475	646	386	523	41600	605	825	545	740	455	620
	14	0.8750	0.5090	32400	470	637	350	475	520	707	425	576	45800	670	910	600	815	500	680
1	8	1.0000	0.6060	38600	640	868	480	651	675	918	579	785	51500	860	1170	770	1045	645	875
	12	1.0000	0.6630	42200	700	949	530	719	735	1000	633	858	59700	995	1355	895	1215	745	1015
1 1/8	7	1.1250	0.7630	42300	800	1085	600	813	840	1142	714	968	68700	1290	1755	1160	1580	965	1310
	12	1.1250	0.8560	47500	880	1193	660	895	925	1258	802	1087	77000	1445	1965	1300	1770	1085	1475
1 1/4	7	1.2500	0.9690	53800	1120	1518	840	1139	1175	1598	1009	1368	87200	1815	2470	1635	2225	1365	1855
	12	1.2500	1.0730	59600	1240	1681	920	1247	1300	1768	1118	1516	96600	2015	2740	1810	2460	1510	2055
1 3/8	6	1.3750	1.1550	64100	1460	1979	1100	1491	1525	2074	1322	1792	104000	2385	3245	2145	2915	1785	2430
	12	1.3750	1.3150	73000	1680	2278	1260	1708	1750	2380	1506	2042	118100	2705	3680	2435	3310	2030	2760
1 1/2	6	1.5000	1.4050	78000	1940	2630	1460	1979	2025	2754	1755	2379	126500	3165	4305	2845	3870	2370	3225
	12	1.5000	1.5800	87700	2200	2983	1640	2224	2300	3128	1974	2676	142200	3555	4835	3200	4350	2665	3625

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS
2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
3. * ASSEMBLY USES HARDENED WASHER

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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 (Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140) K=0.16		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15		Clamp Load	Torque (Dry or Loctite® 263) K= 0.17		Torque (Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140) K=.16		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604	380	7	0.8											
	48	0.1120	0.00661	420	8	0.9											
6	32	0.1380	0.00909	580	14	1.5											
	40	0.1380	0.01015	610	14	1.6											
8	32	0.1640	0.01400	900	25	2.8											
	36	0.1640	0.01474	940	26	2.9					1320	37	4				
10	24	0.1900	0.01750	1120	36	4.1					1580	51	6				
	32	0.1900	0.02000	1285	42	4.7					1800	58	7				
1/4	20	0.2500	0.0318	2020	86	9.7	80	9			2860	122	14	114	13		
	28	0.2500	0.0364	2320	99	11.1	95	11			3280	139	16	131	15		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	3340	15	20	14	19	15	20	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	48	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	0.1599	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	563	765	530	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	755	1025	713	969	670	911	77000	1225	1665	1155	1570	1085	1475
1 1/4	7	1.2500	0.9690	53800	955	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	2665	3625

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS
2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
3. * ASSEMBLY USES HARDENED WASHER

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

SOCKET HEAD CAP SCREWS																	
				Magni Coating (Ref 4150701)*							Zinc Yellow Chromate Fasteners (Ref 4150707)*						
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load See Note 4	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]	IN-LB	[N.m]	IN-LB	[N.m]	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604														
	48	0.1120	0.00661														
6	32	0.1380	0.00909														
	40	0.1380	0.01015														
8	32	0.1640	0.01400														
	36	0.1640	0.01474														
10	24	0.1900	0.01750														
	32	0.1900	0.02000														
1/4	20	0.2500	0.0318	2860	122	14	114	13			2860	143	16	129	15		
	28	0.2500	0.0364	3280	139	16	131	15			3280	164	19	148	17		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	4720	20	25	20	25	20	25	4720	25	35	20	25	20	25
	24	0.3125	0.0580	5220	25	35	20	25	20	25	5220	25	35	25	35	20	25
3/8	16	0.3750	0.0775	7000	35	50	35	50	35	50	7000	45	60	40	55	35	50
	24	0.3750	0.0878	7900	40	55	40	55	35	50	7900	50	70	45	60	35	50
7/16	14	0.4375	0.1063	9550	60	80	55	75	50	70	9550	70	95	65	90	50	70
	20	0.4375	0.1187	10700	65	90	60	80	60	80	10700	80	110	70	95	60	80
1/2	13	0.5000	0.1419	12750	90	120	85	115	80	110	12750	105	145	95	130	80	110
	20	0.5000	0.1599	14400	100	135	95	130	90	120	14400	120	165	110	150	90	120
9/16	12	0.5625	0.1820	16400	130	175	125	170	115	155	16400	155	210	140	190	115	155
	18	0.5625	0.2030	18250	145	195	135	185	130	175	18250	170	230	155	210	130	175
5/8	11	0.6250	0.2260	20350	180	245	170	230	160	220	20350	210	285	190	260	160	220
	18	0.6250	0.2560	23000	205	280	190	260	180	245	23000	240	325	215	290	180	245
3/4	10	0.7500	0.3340	30100	320	435	300		280	380	30100	375	510	340	460	280	380
	16	0.7500	0.3730	33600	355	485	335	455	315	430	33600	420	570	380	515	315	430
7/8	9	0.8750	0.4620	41600	515	700	485	660	455	620	41600	605	825	545	740	455	620
	14	0.8750	0.5090	45800	570	775	535	730	500	680	45800	670	910	600	815	500	680
1	8	1.0000	0.6060	51500	730	995	685	930	645	875	51500	860	1170	775	1055	645	875
	12	1.0000	0.6630	59700	845	1150	795	1080	745	1015	59700	995	1355	895	1215	745	1015
1 1/8	7	1.1250	0.7630	68700	1095	1490	1030	1400	965	1310	68700	1290	1755	1160	1580	965	1310
	12	1.1250	0.8560	77000	1225	1665	1155	1570	1085	1475	77000	1445	1965	1300	1770	1085	1475
1 1/4	7	1.2500	0.9690	87200	1545	2100	1455	1980	1365	1855	87200	1815	2470	1635	2225	1365	1855
	12	1.2500	1.0730	96600	1710	2325	1610	2190	1510	2055	96600	2015	2740	1810	2460	1510	2055
1 3/8	6	1.3750	1.1550	104000	2025	2755	1905	2590	1785	2430	104000	2385	3245	2145	2915	1785	2430
	12	1.3750	1.3150	118100	2300	3130	2165	2945	2030	2760	118100	2705	3680	2435	3310	2030	2760
1 1/2	6	1.5000	1.4050	126500	2690	3660	2530	3440	2370	3225	126500	3165	4305	2845	3870	2370	3225
	12	1.5000	1.5800	142200	3020	4105	2845	3870	2665	3625	142200	3555	4835	3200	4350	2665	3625

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS
2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
*3. ASSEMBLY USES HARDENED WASHER 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.

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

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)

Size	PITCH	Tensile Stress Area	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*			
			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	5865	5275	4395

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS
2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
*3. ASSEMBLY USES HARDENED WASHER 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. 5000059 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

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. 5000059 REV. K

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

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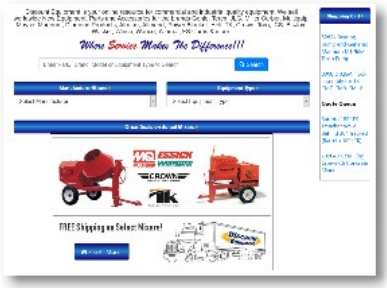

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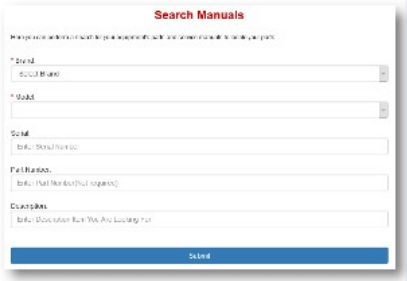

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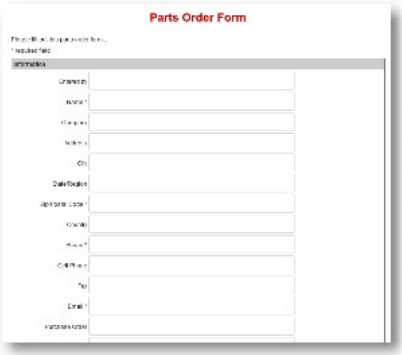

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We sell worldwide for the brands: Genie, Terex, JLG, MultiQuip, Mikasa, Essick, Whiteman, Mayco, Toro Stone, Diamond Products, Generac Magnum, Airman, Haulotte, Barreto, Power Blanket, Nifty Lift, Atlas Copco, Chicago Pneumatic, Allmand, Miller Curber,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

SECTION 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.

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

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

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

Preventative Maintenance

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

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

Table 2-1. Inspection and Maintenance

TYPE	FREQUENCY	PRIMARY RESPONSIBILITY	SERVICE QUALIFICATION	REFERENCE
Pre-Start Inspection	Prior to use each day; or At each Operator change.	User or Operator	User or Operator	Operator and Safety Manual
Pre-Delivery Inspection	Prior to each sale, lease, or rental delivery.	Owner, Dealer, or User	Qualified JLG Mechanic	Service and Maintenance Manual and applicable JLG inspection form.
Frequent Inspection	In service for 3 months or 150 hours, whichever comes first; or Out of service for a period of more than 3 months; or Purchased used.	Owner, Dealer, or User	Qualified JLG Mechanic	Service and Maintenance Manual and applicable JLG inspection form.
Annual Machine Inspection	Annually, no later than 13 months from the date of the prior inspection.	Owner, Dealer, or User	Factory-Certified Service Technician	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, pealing, scoring, or scratches on the pin surface.
   c. Rusting of the pin in the bearing area.
4. Re-assembly of pinned joints using filament wound bearings.
   a. Housing should be blown out to remove all dirt and debris...bearings and bearing housings must be free of all contamination.
   b. Bearing / pins should be cleaned with a solvent to remove all grease and oil...filament wound bearing are a dry joint and should not be lubricated unless otherwise instructed (i.e. sheave pins).
   c. Pins should be inspected to ensure it is free of burrs, nicks, and scratches which would damage the bearing during installation and operation.

2.6 WELDING ON JLG EQUIPMENT

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

Do the Following When Welding on JLG Equipment

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

Do NOT Do the Following When Welding on JLG Equipment

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

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

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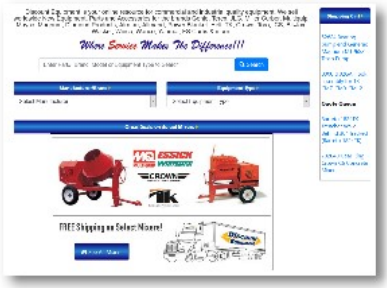

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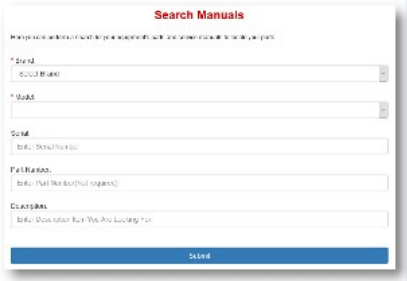

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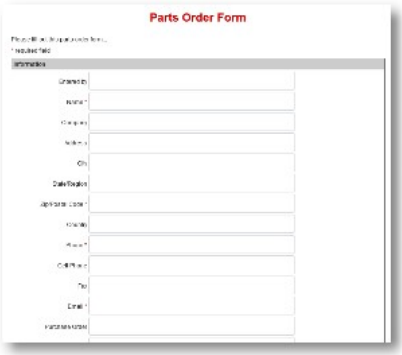

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SECTION 3. CHASSIS & TURNTABLE

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 taught, follow the procedures illustrated in the paragraph below.

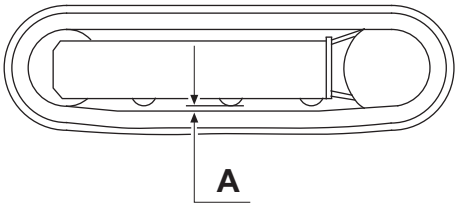


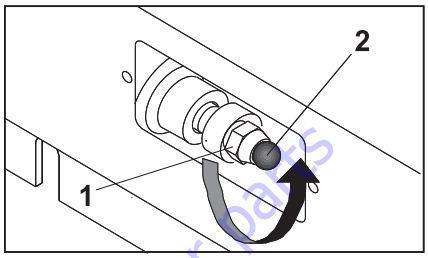
Figure 3-1.

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.



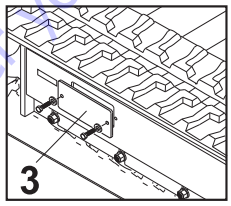


Figure 3-2.

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

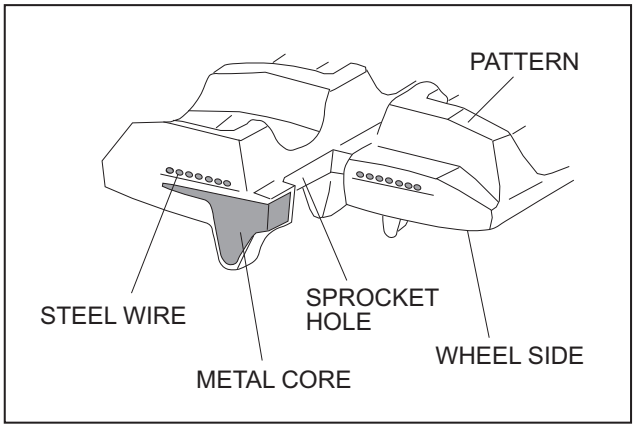


Figure 3-3. Rubber Track Structure

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.

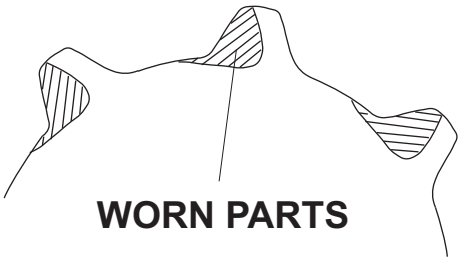


Figure 3-4.

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.

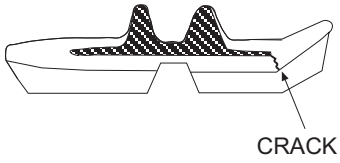


Figure 3-5.

   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.

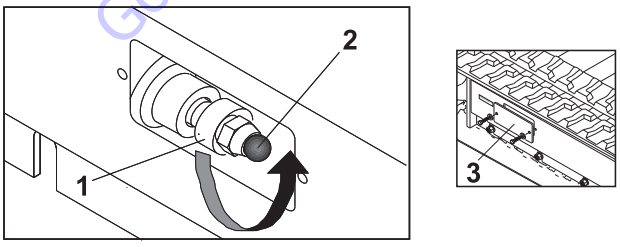


Figure 3-6.

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.

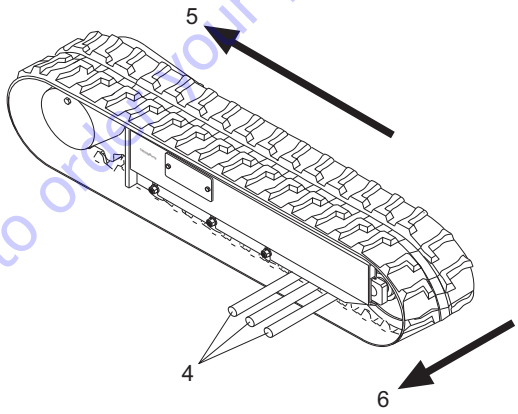


Figure 3-7.

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.

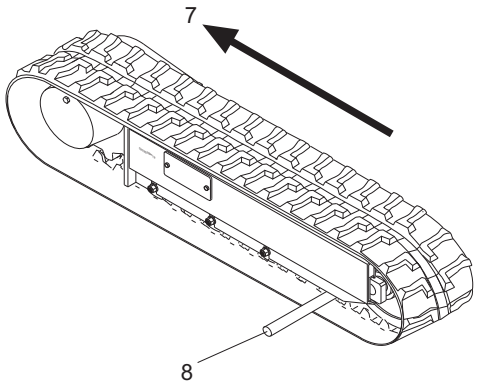


Figure 3-8.

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.

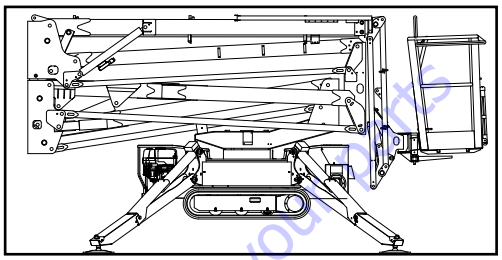


Figure 3-9.

Replacement roller lower wheel and tracks adjuster

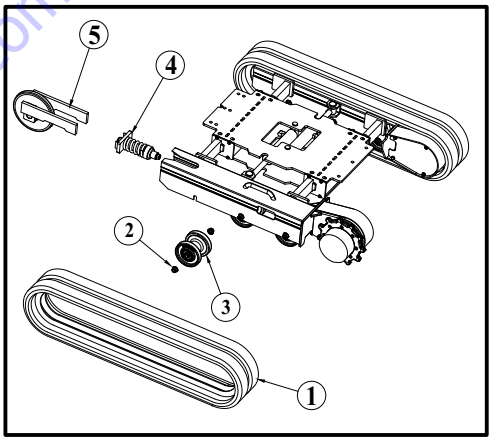


Figure 3-10.

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

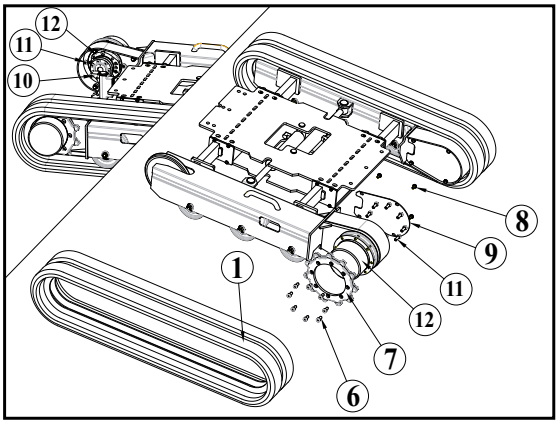


Figure 3-11.

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.

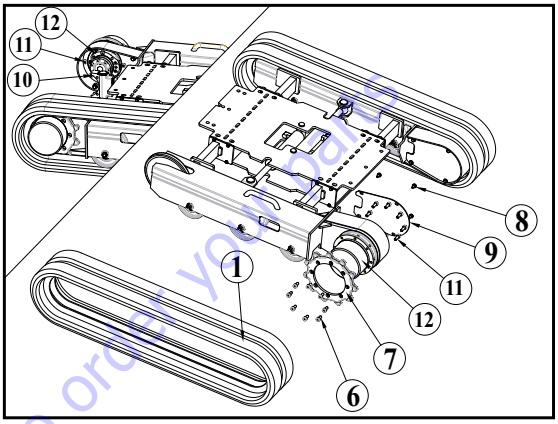


Figure 3-12.

Sprocket installation

1. Instal the sprocket
2. Instal the screws 6

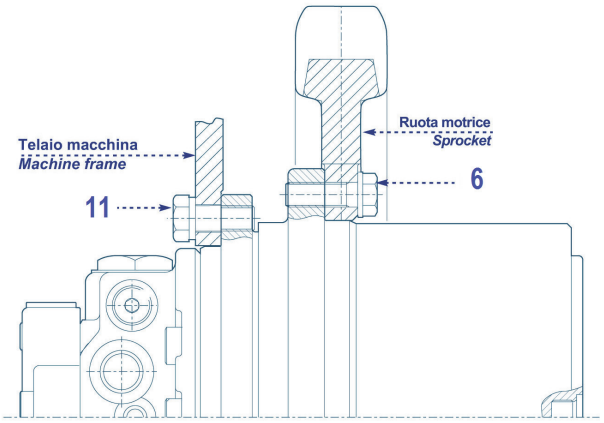


Table 3-1. Final Drive Torque Valves

MACHINE MODEL	SPROCKET SCREW N. 6 TORQUE VALUES	FINAL DRIVE SCREW N. 11 TORQUE VALUES
X17JP - X500AJ	M10x18 - Nm 50	M10x25 - Nm 50
X20JP - X600AJ	M10x25 - Nm 70	M10x30 - Nm 70
X26JP - X770AJ	M12x18 - Nm 86	M12x30 - Nm 86

3.3 AXLE EXTENSION REMOVAL

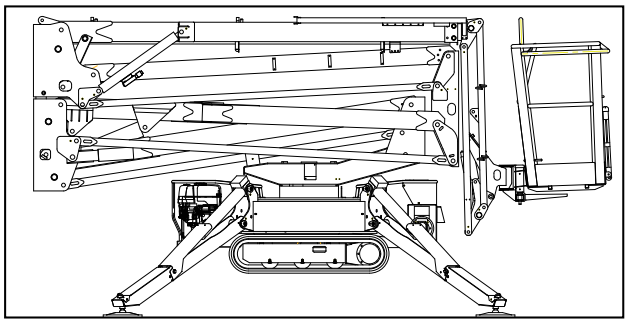


Figure 3-13.

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.

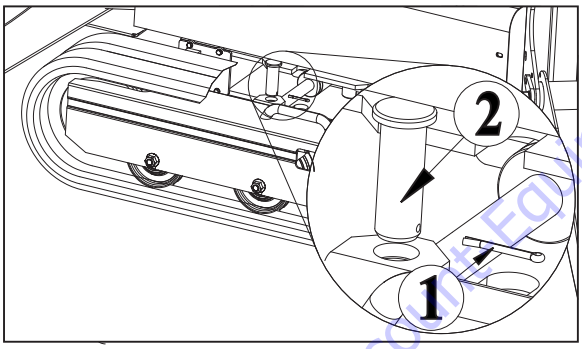


Figure 3-14.

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

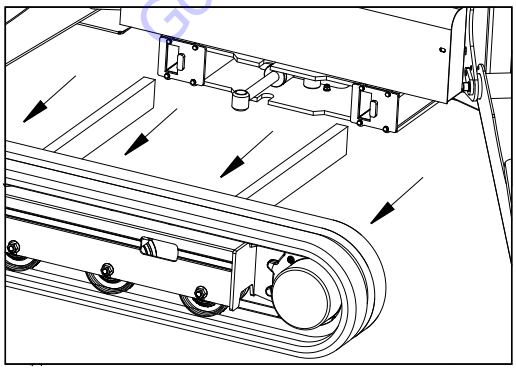


Figure 3-15.

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

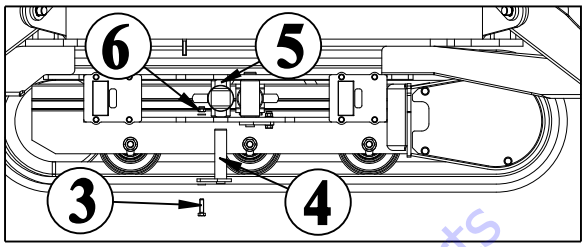


Figure 3-16.

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.

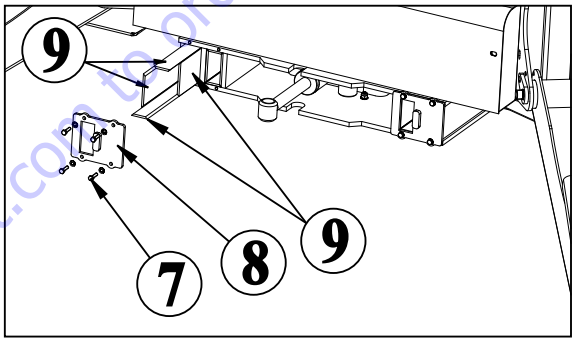


Figure 3-17.

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
X17JP - X500AJ	700C2K I:32 + MAG12	AUTO TWO SPEED
X20JP - X600AJ	700-2C2K MAG16VP	AUTO TWO SPEED
X26JP - X770AJ	701C2K+MAG18	AUTO TWO SPEED

Product Identification

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

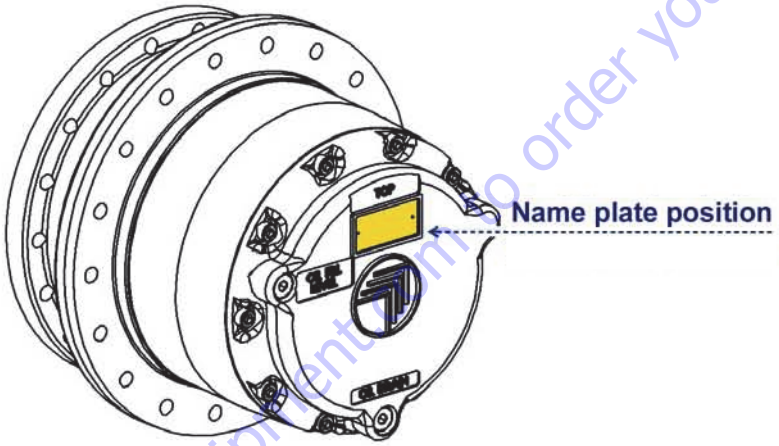
Information

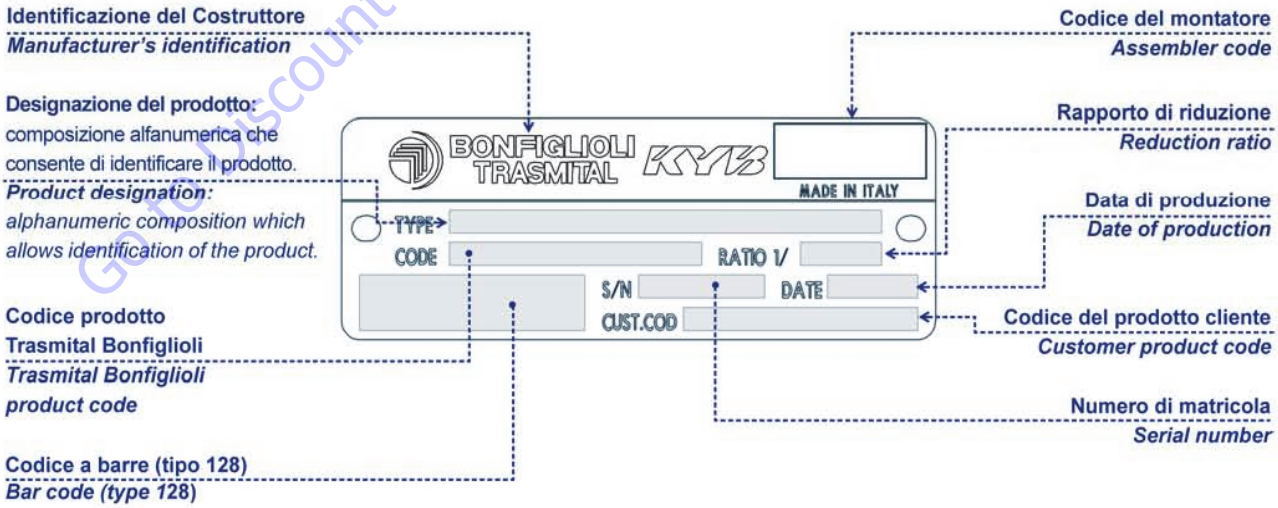
For all enquiries regarding general information on the product, spare parts, assistance etc, always give the identification data stamped on the ID plate.

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.

NOTE: *Note Refer to the supplier final drive applicable Service Manual - Bonfiglioli Trasmital MAN_serie 700CK_IS.doc. Rev17*





3.5 SWING DRIVE (IMO)

Technical Data – Type Plate

Figure 3-18. 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.

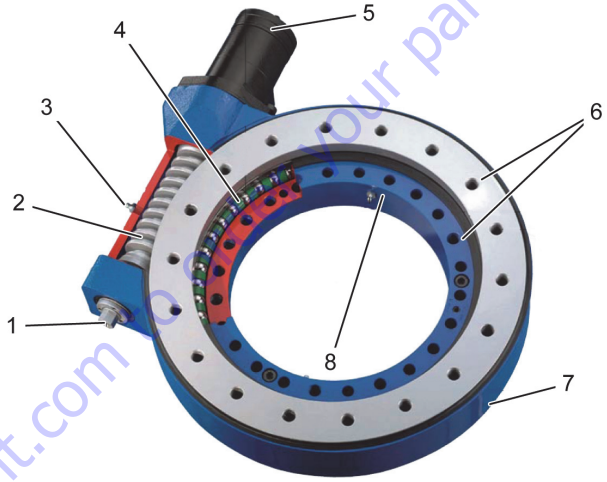


Figure 3-19. Slew drive WD-L

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

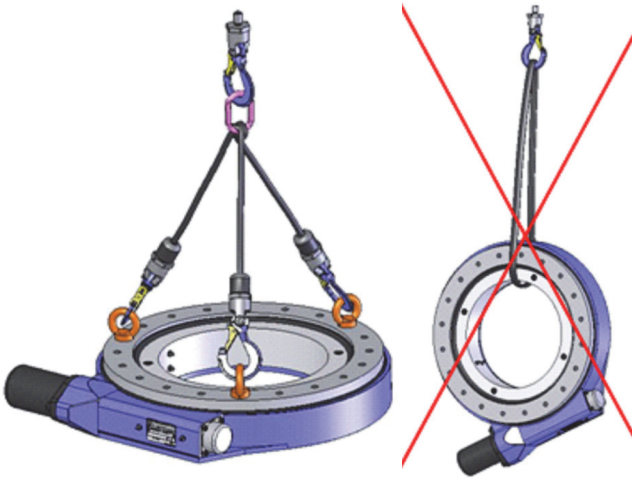


Figure 3-20. Use suitable lifting gear/never transport product vertically

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.

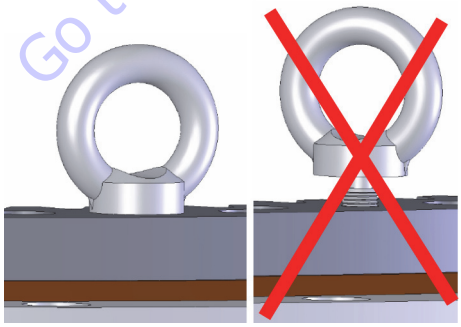


Figure 3-21. Always use the full length of the thread

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.

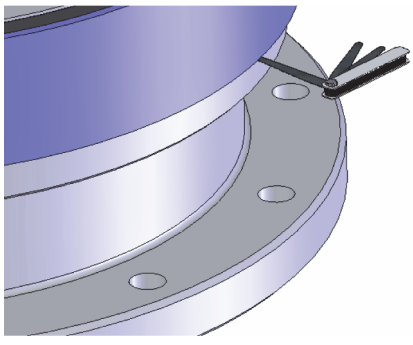


Figure 3-22. Check the support surface

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.

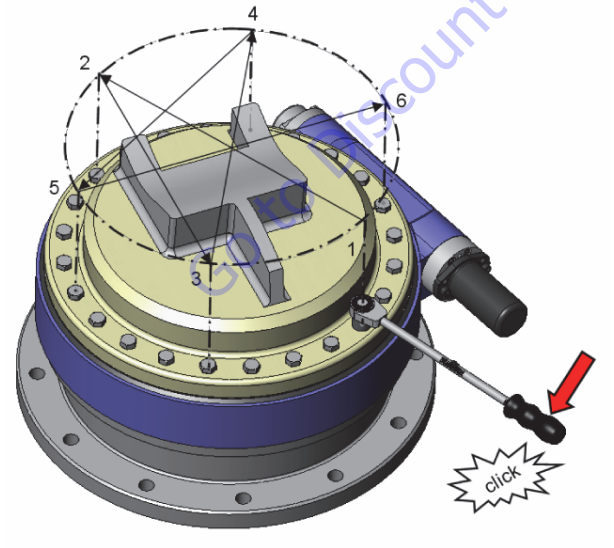


Figure 3-23. Tighten crosswise

Table 3-3.

MOUNTING BOLT DIMENSIONS	MOUNTING PRETENSION FORCE F_M [1] 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

[1] F_M for hydraulic bolt-tensioning cylinder pretension to 85% of yield strength.

Table 3-4.

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

[1] 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.

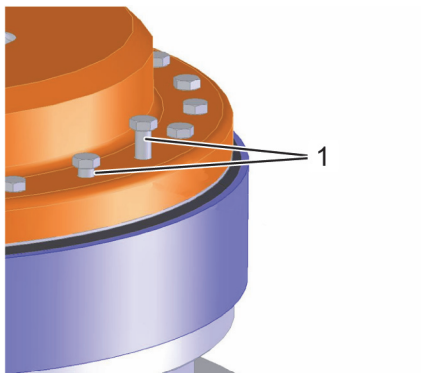


Figure 3-24. Inspecting the mounting bolts

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 PD0" 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.

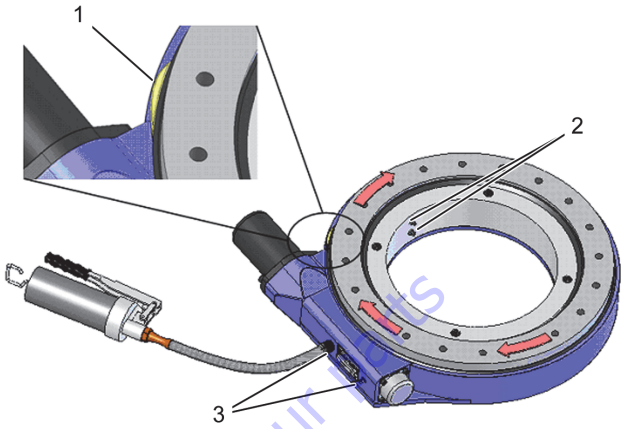


Figure 3-25. Lubricating the slew drive

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.

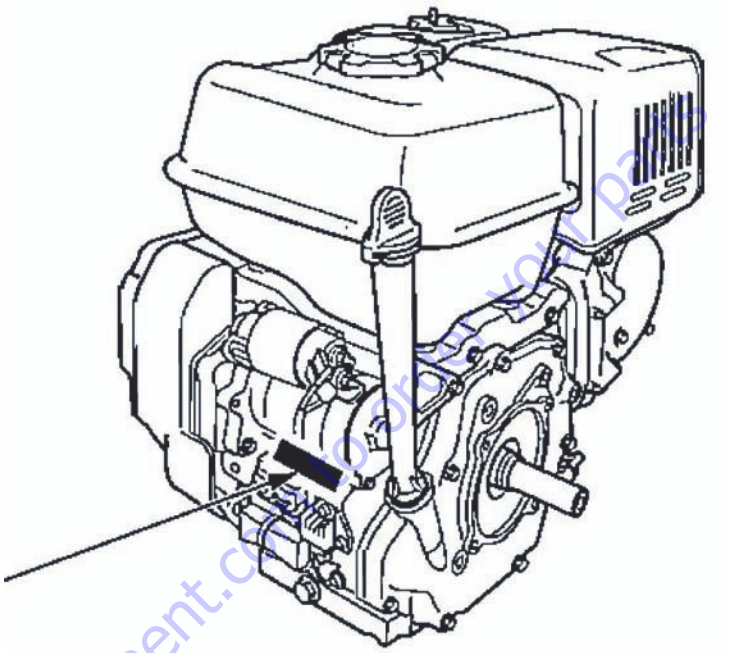
If damage is detected on a seal, contact the customer service organization without delay.

3.6 HONDA ENGINE IGX440

NOTE: *Refer to the supplier Engine applicable Honda Service Manual.*

Serial Number Location

The engine serial number is stamped on the cylinder barrel. Refer to this when ordering parts or making technical inquiries.



ENGINE SERIAL NUMBER

Specifications

Dimensions And Weight

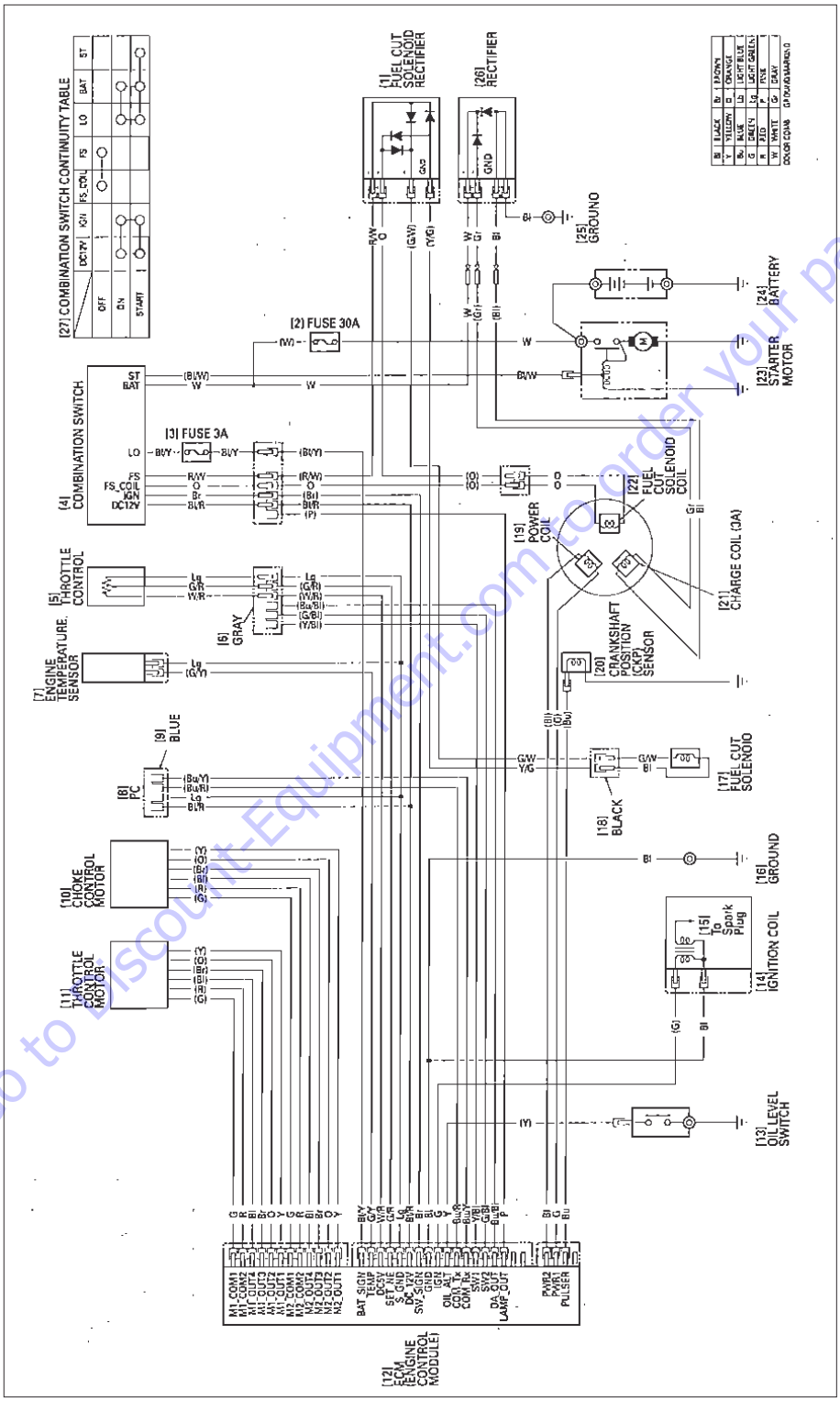
MODEL	iGX440U		
PTO types	S	Q	V
Overall length	407 mm (16.0 in)	433 mm (17.0 in)	450 mm (17.7 in)
Overall width	505 mm (19.9 in)		
Overall height	454 mm (17.9 in)		
Maximum angle of inclination	20°		
Dry weight	39 kg (86 lbs)		
Operating weight	45 kg (99 lbs)		

Engine

MODEL	iGX440U
Description code	GCAWK
Type	4-stroke, overhead camshaft, single cylinder, inclined by 15°
Displacement	438 cm^3 (26.7cu-in)
Bore x stroke	88.0 x 72.1 mm (3.46 x 2.84 in)
Maximum horsepower	11.2 kW (15.2 PS) / 3,600 min^{-1} (rpm)
Recommended maximum operation bhp	8.0 kW (10.8 PS) / 3,600 min^{-1} (rpm)
Maximum torque	29.8 N·m (3.0 kgf·m, 22 lbf·ft)/2,500 min^{-1} (rpm)
Compression ratio	8.1 : 1
Minimum fuel consumption	328 g/kW·h (241 g/PS·h, 0.53 lb/PS·h)
Ignition system	CDI
Ignition timing (at no load)	10° B.T.D.C./1,400 min^{-1} (rpm) 13° B.T.D.C./3,600 min^{-1} (rpm)
Spark plug	BKR7E-E (NGK), K22PR-UR (DENSO)
Lubrication system	Forced splash type
Oil capacity	1.10 l (1.16 US qt, 0.97 lmp qt)
Cooling system	Forced air
Starting system	Recoil and starter motor
Stopping system	Ignition primary circuit open
Carburetor	Horizontal type batter fly valve
Air cleaner	Dual element type
Governor	STR (Self Tuning Regulator) governor
Fuel used	Unleaded gasoline with a pump octane rating 86 or higher
Fuel tank capacity	6.5 l (1.72 US gal, 1.43 lmp gal)

Wiring Diagrams

With starter motor and charge coil (20A) type



Engines & Controls Adjustments And Troubleshooting

Experience of engine doesn't start or not run correctly, following this procedure to recognize an engine trouble, or a machine control system problem.

The electrical test requires disconnecting the engine harness from the machine harness system and then start the engine isolate from the machine.

As well if the engine starts then need inspecting the machine system, otherwise refer to the Engine Service manual for the troubleshooting or contact the local engine service.

Other than further the suggestion of the engine controls.

These instructions are valid for engines with and with no key start switch.

If the engine is not cranking, go to the instructions "Engine Harness By-Pass".

Figure 3-26.
Check the status of the LED on the carburetor control unit.

Figure 3-27.
Led on ECM carburetor

- **LED OFF**
  Battery or key switch malfunction
  Fuse 3A or 30A blown
  Wires harness failure
  ECM failure.
- **LED ON**
  Fuel; or Spark issue
  (See Fuel or Spark Plug Check procedure).
- **LED 2 Flashes**
  Not enough oil
  Oil level switch or wire harness short circuit
  ECM Failure.
- **LED 4 Flashes**
  Engine temperature sensor or harness short circuit;
  ECM Failure.
- **LED 6 Flashes**
  Power coil or harness short circuit
  ECM Failure.
- **LED 8 Flashes**
  ECM Software failure

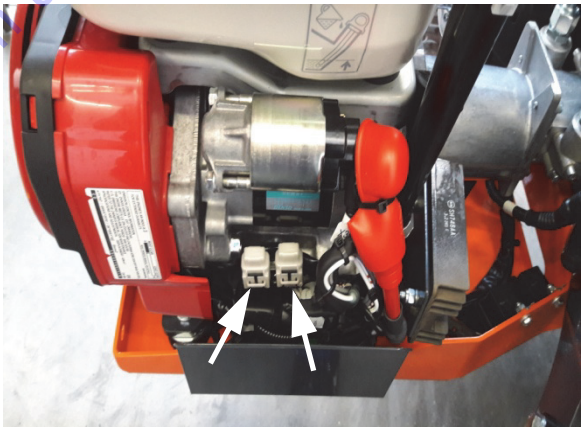


Figure 3-28.
Position of the Fuses 3Amp and 30Amp

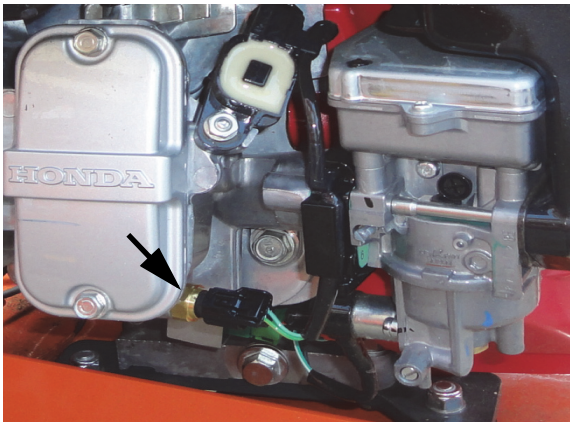


Figure 3-29.
Location of the Engine temperature sensor

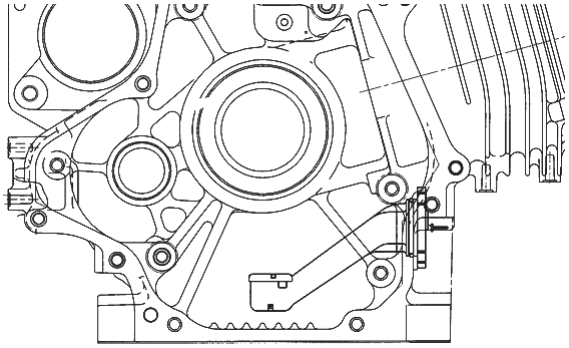


Figure 3-30.
Location of the Engine oil level sensor

For additional instruction refer to the Engine Service Manual for a complete troubleshooting.

Engine Harness By-Pass

With these Instructions the engine harness is disconnected from the machine harness.

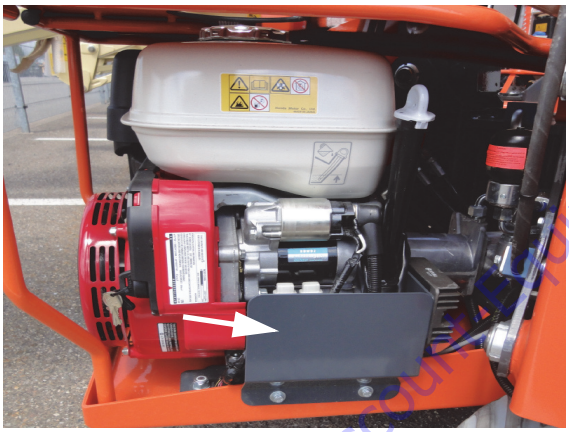


Figure 3-31.

On engine left side removes the two bolts and the gray plate to access to the harness, and recognize the wires with white plug connectors.

Figure 3-32.

Disconnect the white plugs of the engine harness from the machine harness.

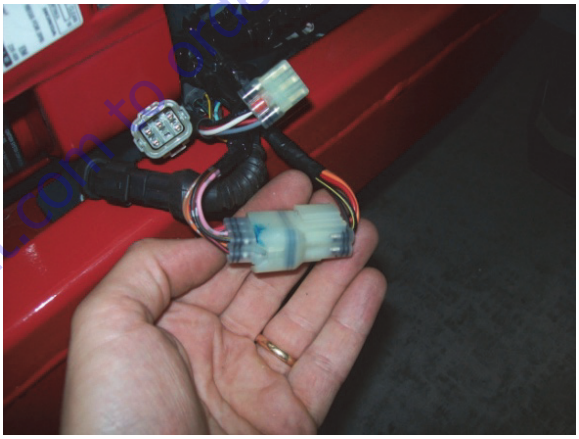


Figure 3-33.

Connect together the two white plugs of engine harness.

Figure 3-34.

Start the engine with the manual rope recoil starter.

Figure 3-35.

On engines with the key switch, it should be possible to try and start also by the key switch.

Figure 3-36.

To shut down the engine with no key switch, disconnect the white plugs

Fuel System Check

Follow these Instructions to check the fuel flow into the carburetor float bowl.

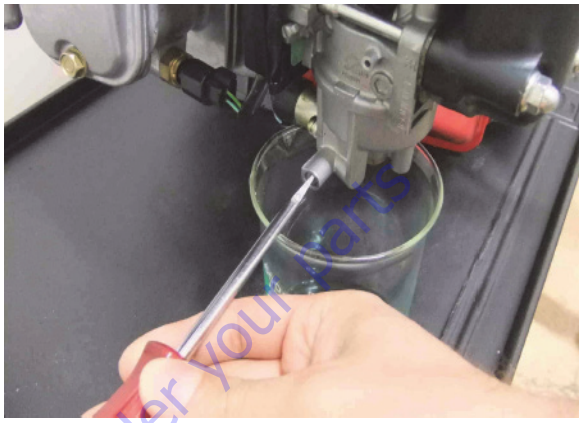


Figure 3-37.

a. Place a container below the carburetor.

b. Unscrew the drain tap and check if gasoline flows out.

In the event that gasoline does not flow out proceed with the test below.

Figure 3-38.

With the drain tap unscrewed pull the manual rope recoil starter at least 3 times , and check if gasoline flows out.

In gasoline does not flow out; replace the filter in the fuel tank, if gasoline does flow out, proceed with the spark test.

Fuel Tank Inspection

Replace the fuel filter if not dirt free.

Figure 3-39.

Unscrew the four bolts and lift the tank

Figure 3-40.

Unscrew the two lock nuts and remove the bottom plate

Figure 3-41.

Disconnect the hose

Figure 3-42.

Unscrew and remove and clean or replace the filter.

Spark Test

Use these Instructions to check the condition of the spark plug and if spark occurs.

Figure 3-43.

Pull the wire plug from the spark plug and with a tool unlock the spark plug

Figure 3-44.

Gently and carefully remove the spark plug.

Figure 3-45.

Connect the wire plug to the spark plug.

Keeping the spark plug against the engine, pull the manual rope recoil starter to see if a spark occurs.

In the event of no or pour spark, with a spark plug in a good condition, refer to the OEM SM for the troubleshooting or contact the local Honda service.

Replacement Of Engine ECU

The engine ECU has specific software for the machine arrangement. Install or replace ECM programmed only, orderable on JLG spare part system, otherwise contact Honda servicers.

Figure 3-46.

Unscrew and remove the air filter support

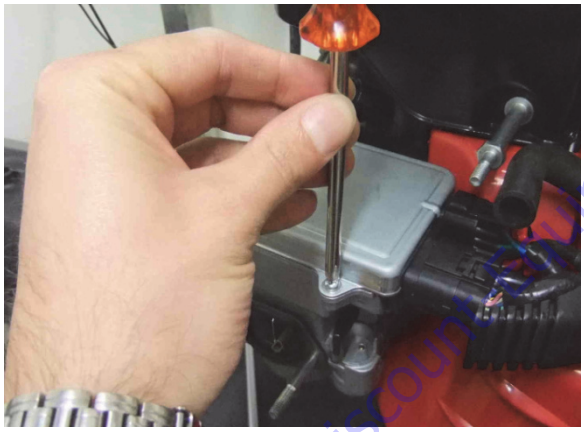


Figure 3-47.

Unscrew the three screws on top of the ECM

Figure 3-48.

Gently take out the ECM and disconnect the two plugs harness.

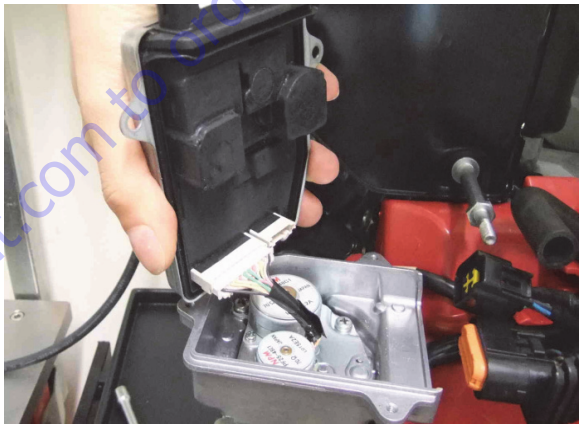


Figure 3-49.

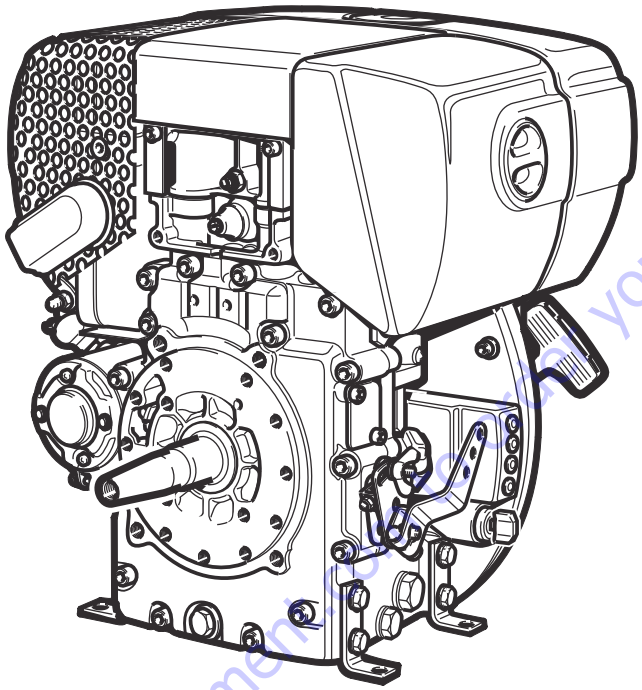
Gently disconnect the white connector on the ECM

Figure 3-50.

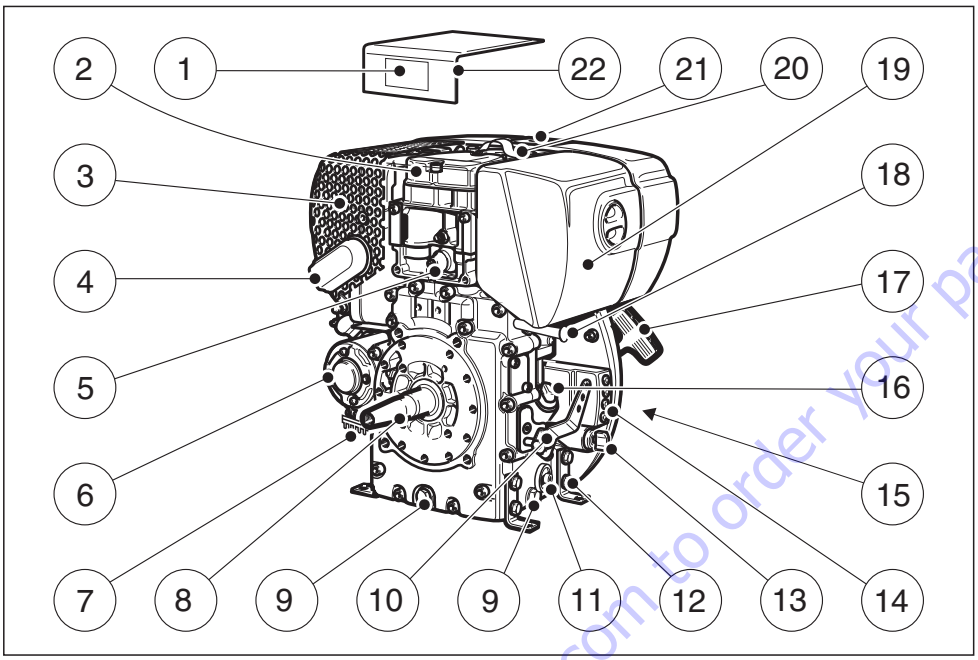
Replace the carburator ECM. Install the ECM following the steps of the procedure on the contrary.

3.7 HATZ ENGINE

Model: HATZ 1B40



Description Of The Engine



1. Type plate
2. Cylinder head cover
3. Exhaust silencer
4. Exhaust mesh insert
5. Oil pressure switch
6. Starter motor
7. Voltage regulator
8. Crankshaft - power take-off
9. Oil drain plug
10. Speed adjustment lever
11. Oil filter
12. Engine mountings
13. Ignition key
14. LED display
15. Intake opening for cooling and combustion air
16. Oil filler pipe and dipstick
17. Recoil starter
18. Engine shutdown pin
19. Dry-type air cleaner
20. Lifting lug
21. Fuel tank cap
22. Noise insulating hood

Technical data

Type	1B40	
Design	Air-cooled four-stroke diesel engine	
Combustion system	Direct injection	
Number of cylinders	1	
Bore / stroke	mm	88 / 76
Displacement	cm3	462
Lubricating oil capacity without oil sump with oil sump	l, approx. l, approx.	1.5 [1)] 3.2 [1)]
Difference between “max” and “min” levels without oil sump with oil sump	l, approx. l, approx.	0.8 [1)] 2.2 [1)]
Lubricating oil consumption (after running in)	max.	1% of fuel consumption at full load
Lubricating oil pressure (oil temperature 100 °C)	approx.	2.5 bars at 3000 r.p.m.
Direction of rotation, power take-off end		anti-clockwise
Valve clearance 10 - 30 °C Inlet and exhaust valve	mm	0.10
		or automatically [2)]
Max. tilt angle in operation, in direction	Flywheel 25° down [3)] all other directions 35° [3)]	
Weight (incl. fuel tank, air-cleaner, exhaust silencer, recoil starter and electric starter)	kg, approx.	55
Battery capacity	Amp/h	max. 12 V / 60 Amp/h

[1)] These values are intended as an approximate guide. The max. marking on the dipstick is the deter-mining factor.

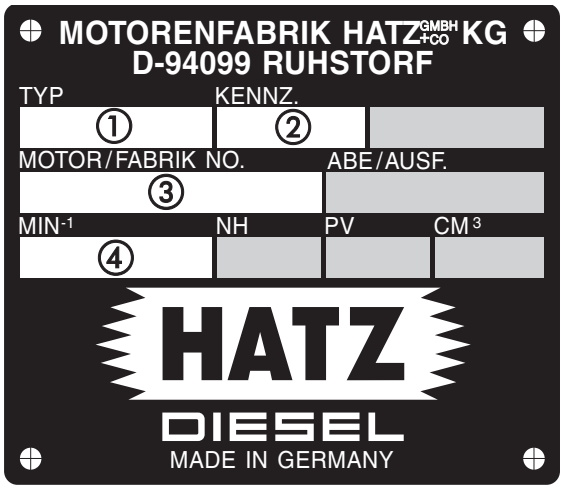
[2)] Depending on model (see maintenance charts).

[3)] Exceeding these limits causes engine breakdown.

Tightening torques

Item	Nm
Oil drain plug	50

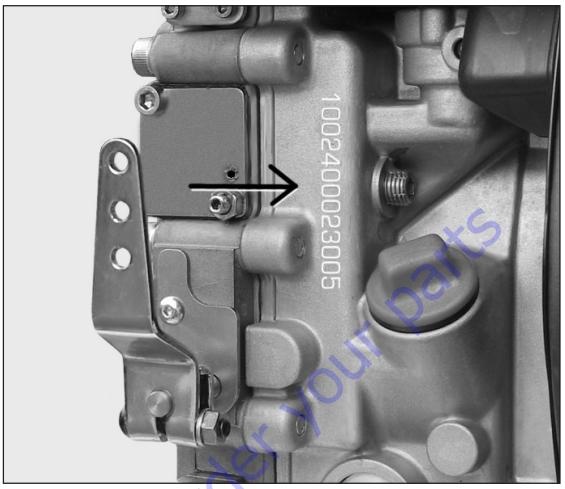
Engine Type Plate



The type plate is placed on the noise insulating hood and includes the following engine information:

1. engine type
2. code (only for special equipment)
3. engine number (also stamped on crankcase)
4. max. engine speed

For any offer as well as spare parts orders it is necessary to mention these data (also see spare parts list).



Engine serial number on crankcase

Operation

Engine Oil - Oil Quality

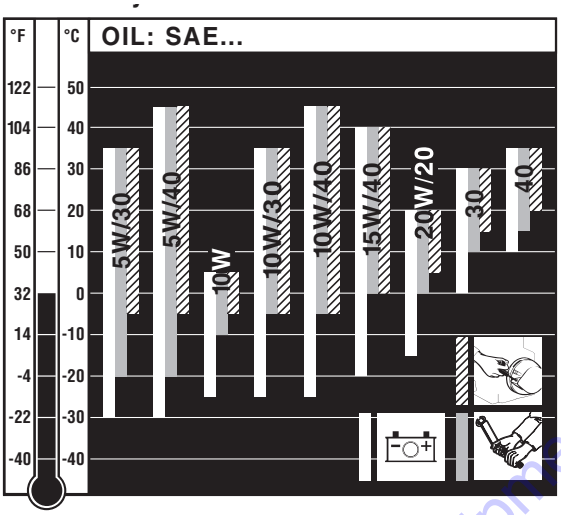
Qualified are all trademark oils which fulfil at least one of the following specifications:

ACEA – B2 / E2 or more significant

API – CD / CE / CF / CF-4 / CG-4or more significant.

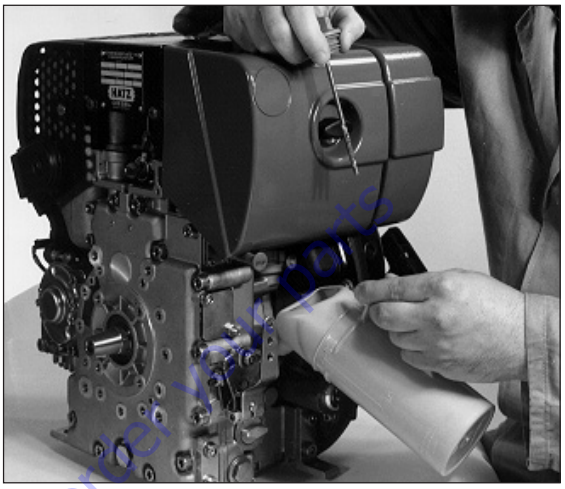
If engine oil of a poorer quality is used, reduce oil change intervals to 150 hours of operation.

Oil Viscosity



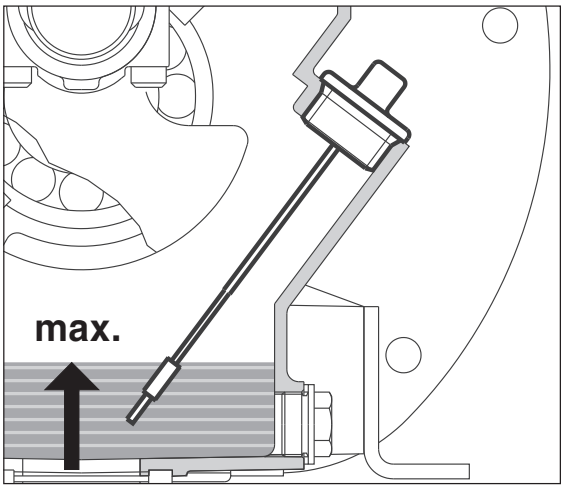
Select the viscosity class according to the ambient temperature for cold starts.

When adding oil or checking the oil level, the engine must be horizontal.



Remove oil filler screw and add engine oil.

Lubricating oil capacity: see Chapter Technical data.



To check the oil level, remove the dipstick, clean it - then screw it back in and finally remove it again.

Check the oil level on the dipstick and, if necessary, top up to the max.level.

Troubleshooting

***These instructions are valid for engines with the key start switch* only.**

Figure 3-51.

Identify behind the engine the harness plug that connecting the engine and the machine system.

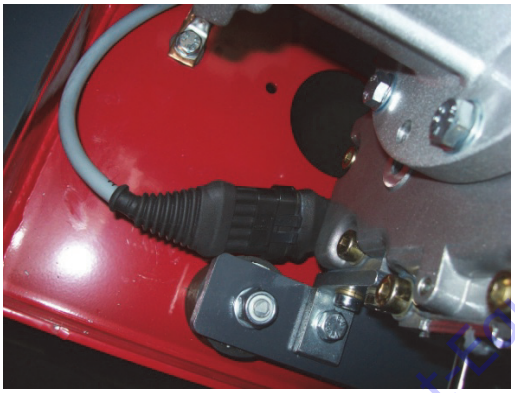


Figure 3-52.

Disconnect the plug **X51.**

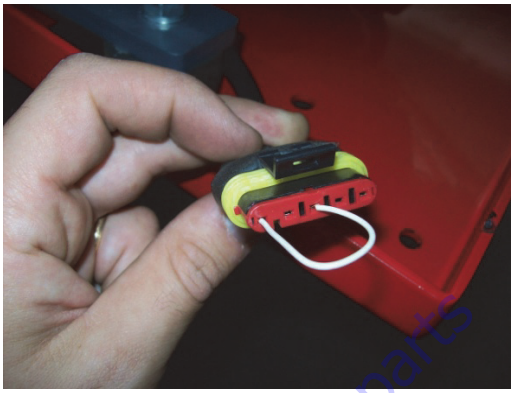


Figure 3-53.

On engine harness plug connector make a bridge between PIN 1 and PIN 2.

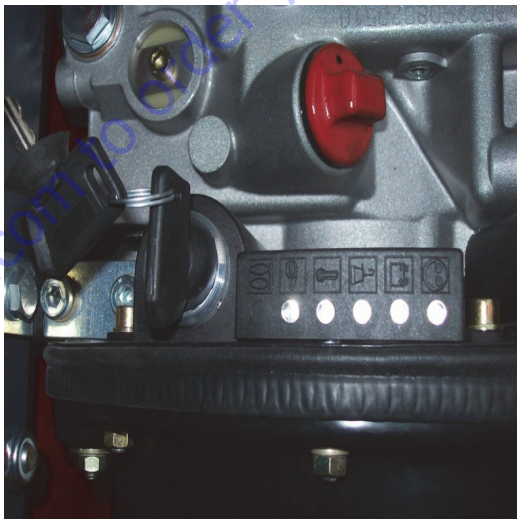


Figure 3-54.

Attempt to start the engine by key switch

Those instructions are valid for engines with no key switch.

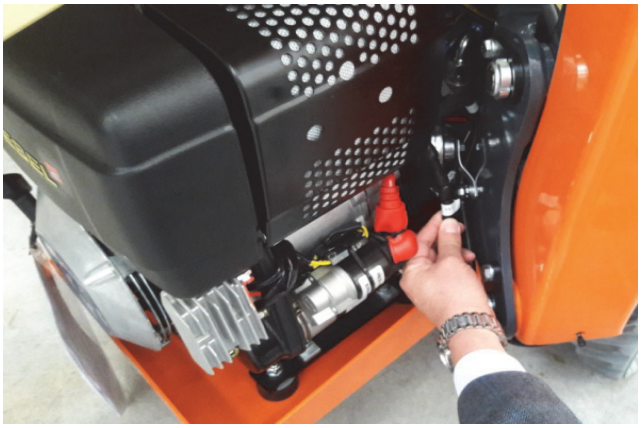


Figure 3-55.

On engine right side access to the harness, and disconnect the engine harness plug.

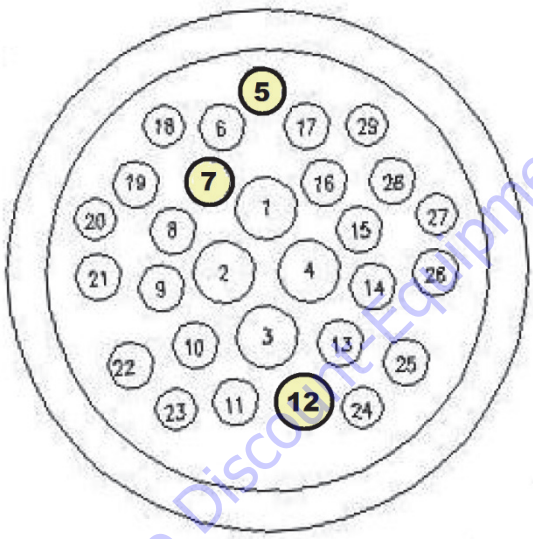


Figure 3-56.

On female connector jump the following wires:

- Pin12 (12 Volt supply) battery positive terminal.
- Pin 5 (Starter) for a moment utilize hook up this pin as key starter.

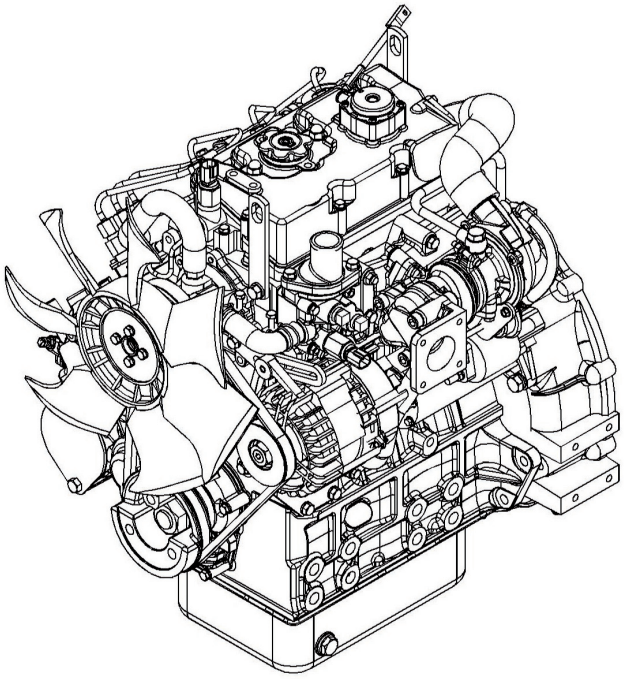
Figure 3-57.

LED's On when Pin 12 feed with 12 Volt.

To turn off the engine remove the supply voltage to Pin 12

3.8 PERKINS ENGINE

Model: 402D



Specifications

Table 3-5.

402D-05 Engine	
Maximum Operating Speed (rpm)	3600 rpm
Cylinders and Arrangement	In-Line two cylinder
Bore	67 mm (2.64 inch)
Stroke	72 mm (2.83 inch)
Displacement	0.507 L (30.939 in3)
Aspiration	Naturally Aspirated
Compression Ratio	23.5:1
Firing Order	1-2
Rotation that is viewed from the flywheel	Counterclockwise
Valve Lash Setting (Inlet)	0.20 mm (0.008 inch)
Valve Lash Setting (Exhaust)	0.20 mm (0.008 inch)
Injection	Indirect

Engine Identification

Perkins engines are identified by a serial number. This number is shown on a serial number plate that is mounted above the fuel injection pump on the right hand side of the engine block.

An example of an engine number is

GP*****U000001M.

GP _____Type of engine

U _____Built in the United Kingdom

*****_____ The list number of the engine

000001 _____ _____Engine Serial Number

M _____ Year of Manufacture

Perkins dealers or Perkins distributors need all of these numbers in order to determine the components that were included with the engine. This permits accurate identification of replacement part numbers.

Serial Number Plate

Fuel Filter Base - Remove and Install

Removal Procedure

NOTICE

DO NOT ALLOW DIRT TO ENTER THE FUEL SYSTEM. THOROUGHLY CLEAN THE AREA AROUND A FUEL SYSTEM COMPONENT THAT WILL BE DISCONNECTED. FIT A SUITABLE COVER OVER DISCONNECTED FUEL SYSTEM COMPONENT.

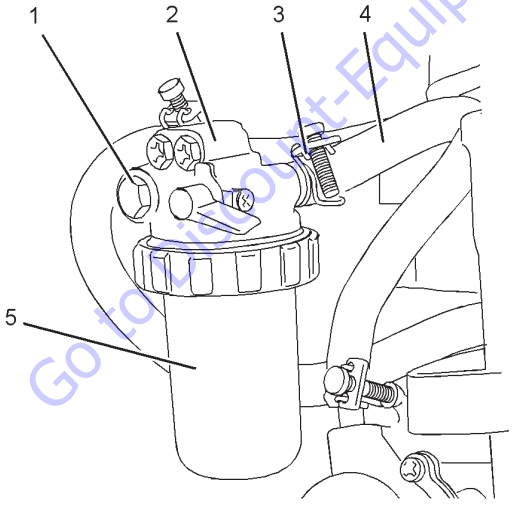
NOTICE

CARE MUST BE TAKEN TO ENSURE THAT FLUIDS ARE CONTAINED DURING PERFORMANCE OF INSPECTION, MAINTENANCE, TESTING, ADJUSTING AND REPAIR OF THE PRODUCT. BE PREPARED TO COLLECT THE FLUID WITH SUITABLE CONTAINERS BEFORE OPENING ANY COMPARTMENT OR DISASSEMBLING ANY COMPONENT CONTAINING FLUIDS. DISPOSE OF ALL FLUIDS ACCORDING TO LOCAL REGULATIONS AND MANDATES.

NOTICE

KEEP ALL PARTS CLEAN FROM CONTAMINANTS. CONTAMINANTS MAY CAUSE RAPID WEAR AND SHORTENED COMPONENT LIFE.

NOTE: *Place identification marks on all hoses for installation purposes. Plug all hoses and all the ports in the fuel filter base. This helps prevent fluid loss, and this helps to keep contaminants from entering the system.*

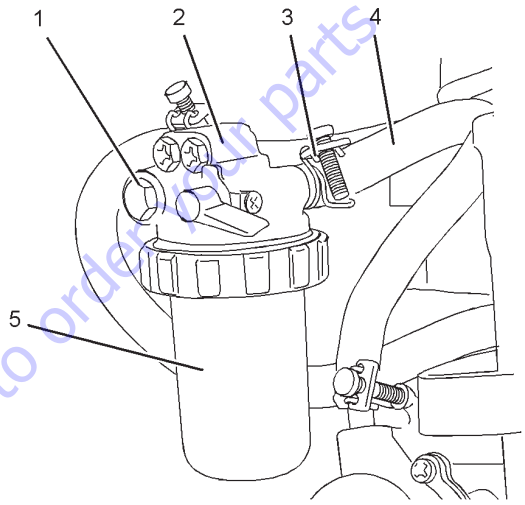


1. Turn the fuel supply to the OFF position.
2. Loosen hose clamps (3) and disconnect hoses (4).
3. If necessary, remove fuel filter element (5). Refer to Operations and Maintenance Manual, “Fuel System Filter - Replace”.
4. Remove bolt (1) and remove fuel filter base (2) from the mounting bracket.

Installation Procedure

NOTICE

KEEP ALL PARTS CLEAN FROM CONTAMINANTS. CONTAMINANTS MAY CAUSE RAPID WEAR AND SHORTENED COMPONENT LIFE.



1. Ensure that the fuel filter base is clean and free from damage. If necessary, replace the fuel filter base.
2. Align fuel filter base (2) with the mounting bracket. Install bolt (1). Tighten the bolt to a torque of 25 N·m (18 lb ft).
3. If necessary, install a new fuel filter element (6) to fuel filter base (2). Refer to Operation and Maintenance Manual, “Fuel System Filter - Replace”.
4. Connect hoses (4) and tighten hose clamps (3).

NOTE: *Ensure that the hoses do not contact any other engine components.*

5. Turn the fuel supply to the ON position.
6. Remove the air from the fuel system. Refer to Operation and Maintenance Manual, “Fuel System - Prime”.

Troubleshooting

These Instructions are valid for machines with the engine the key switch.

Figure 3-58.

Identify the plug X-51 that feed the fuel pump shutoff to the machine system.

Figure 3-59.

Disconnect the plug X-51.

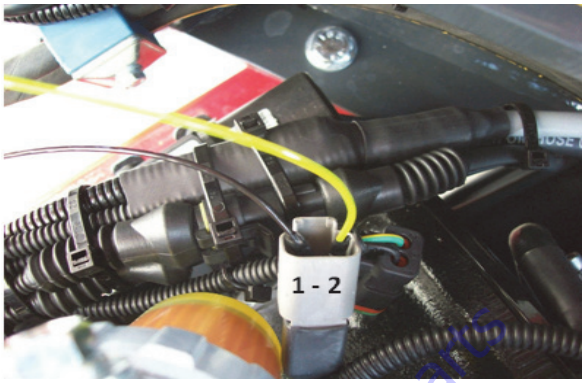


Figure 3-60.

On grey connector make a wire to connect the pin 1 to the positive terminal of the battery and another at pin 2 to ground or battery.

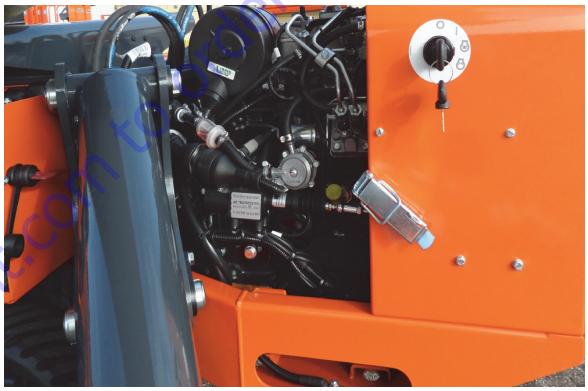


Figure 3-61.

Attempt to start the engine by key switch

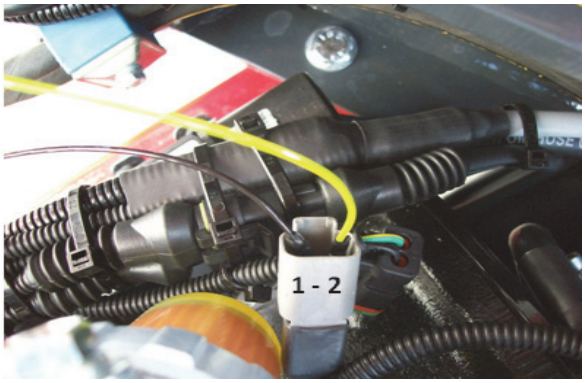


Figure 3-62.

To shutdown the engine disconnect the wires.

These Instructions are valid for machines with no engine key switch.

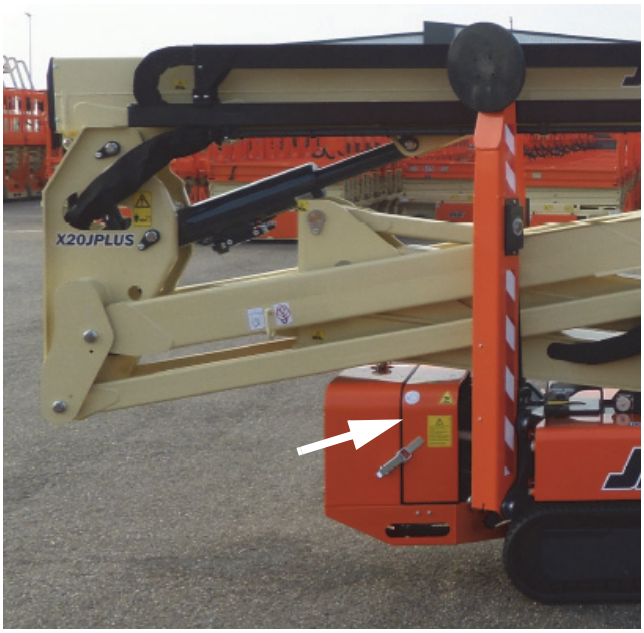


Figure 3-63.

Remove the engine hood to access to the harness and engine left side, to identify the wires with plug connectors.

Figure 3-64.

Disconnect the plug circled.

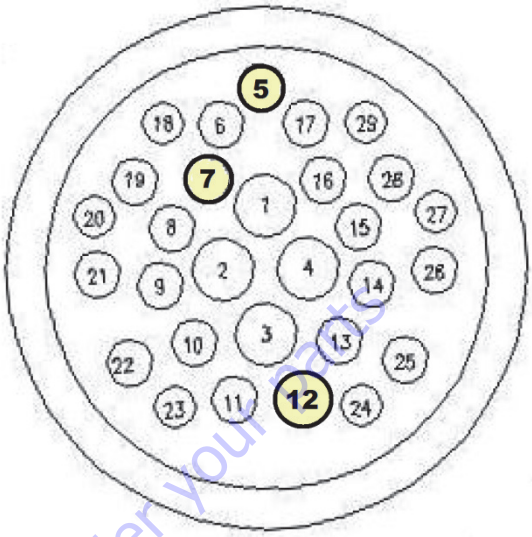
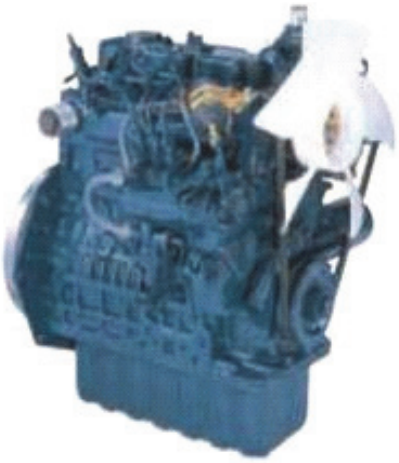


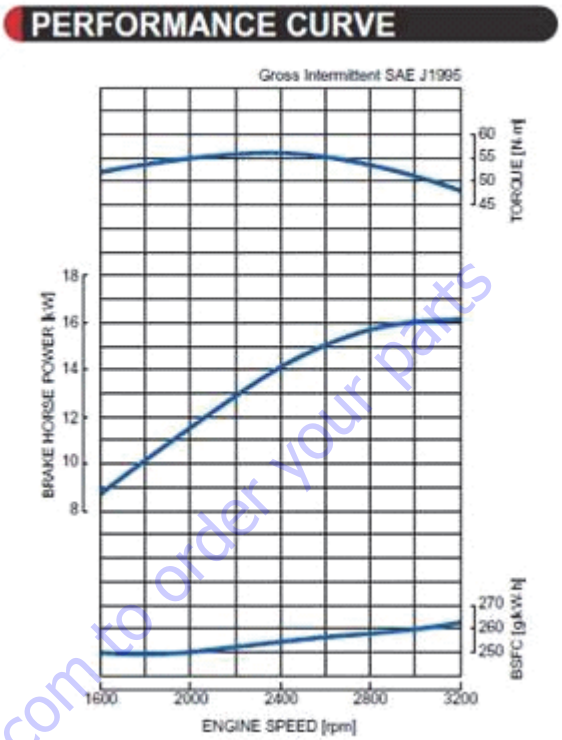
Figure 3-65.

On Female connector jump the follows wires:

- Pin12 (12 Volt supply) battery positive terminal.
- Pin 7 (Glow plugs) hook up if necessary for few second only.
- Pin 5
- (Starter) for a moment utilize hook up this pin as key starter.

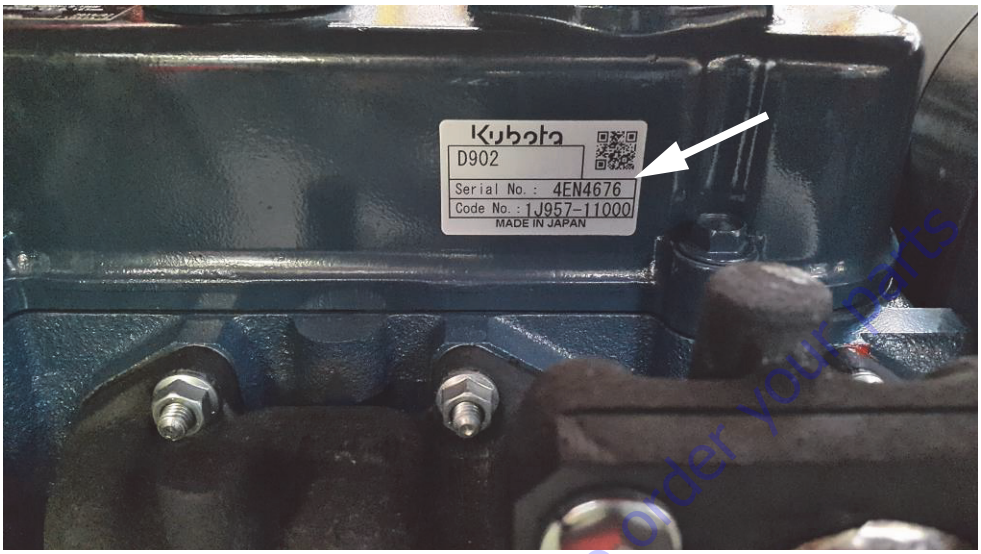
3.9 KUBOTA DIESEL ENGINE MODEL D902





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^3
Bore	72 mm (2,83 in)
Stroke	73,6 mm (2,9 in)
Fuel tank capacity	40 litres
Emission Regulation	Tier 4 F
Dry Weight (according to Kubota's standards)	72 Kg (158,8 Lbs)

Engine Plate

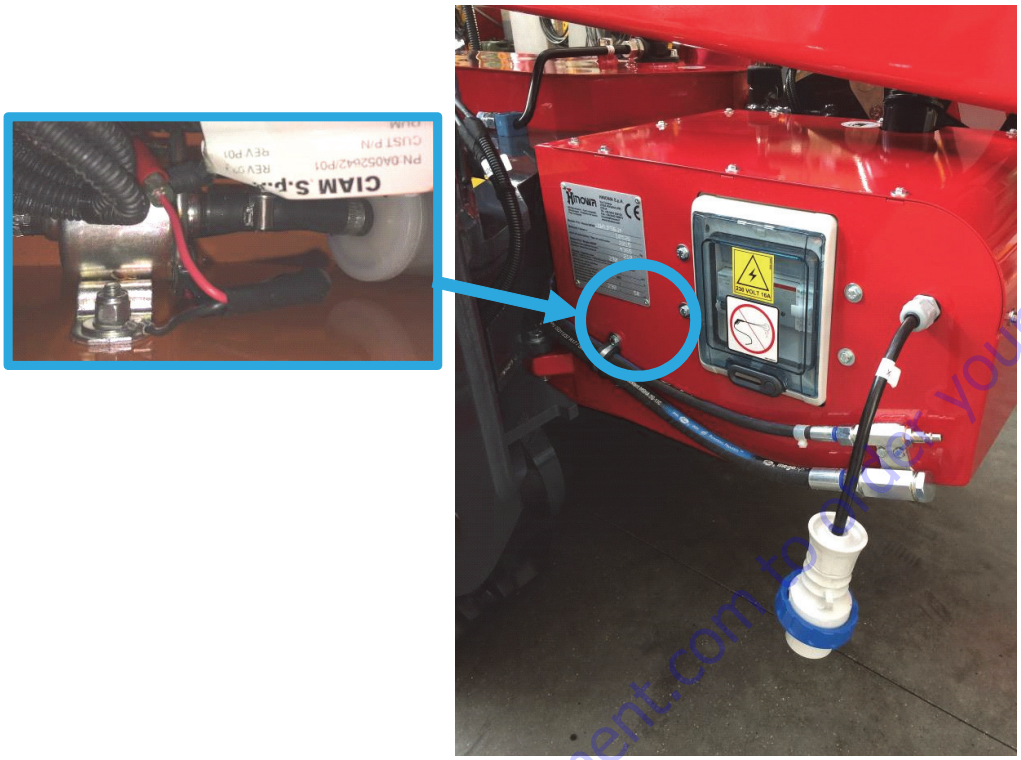


The engine plate with serial number is placed on the engine head close to muffler collector and includes the following engine information:

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.

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

Figure 3-66.

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

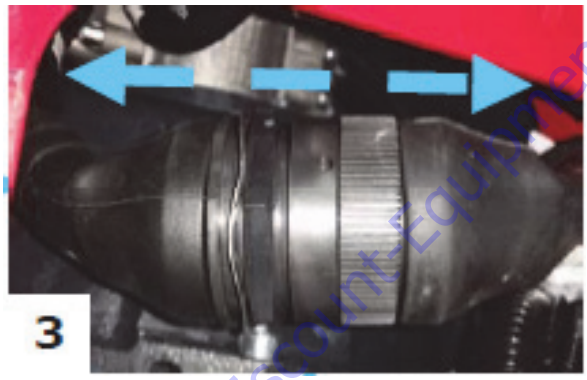


Figure 3-67.

Disconnect the plug harness

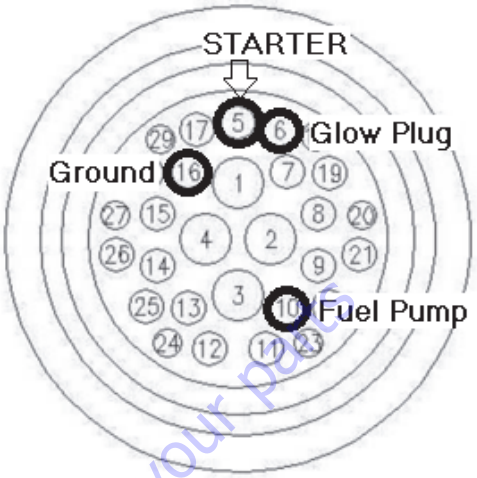


Figure 3-68. Female Connector

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 .

To shutdown the engine disconnect wire of Pin 10. The engine wills contimue to run for a while untile 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 3-69.

Speed Sensor Hatz 1B40

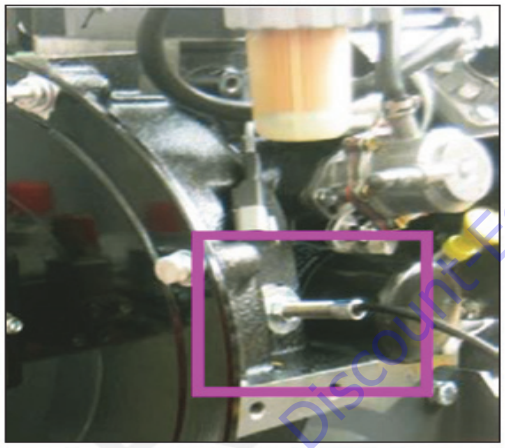


Figure 3-70.

Speed Sensor on Perkins 402.05

Figure 3-71.

Speed Sensor on Kubota D902

Speed Sensor Installation and Adjustment

Figure 3-72.

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.

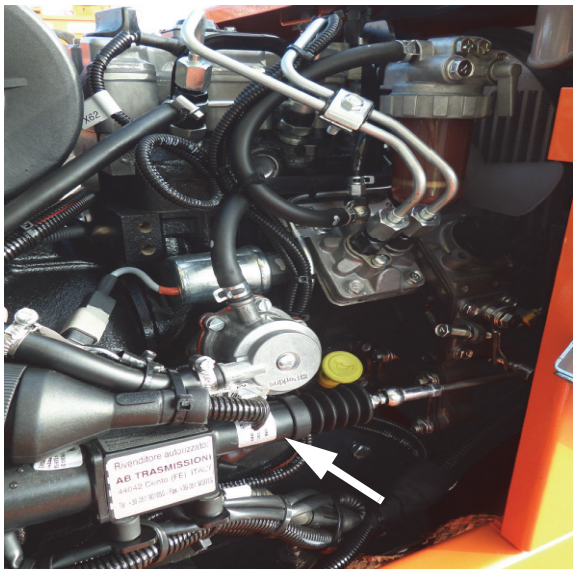


Figure 3-73.

Throttle actuator on Perkins 402.05

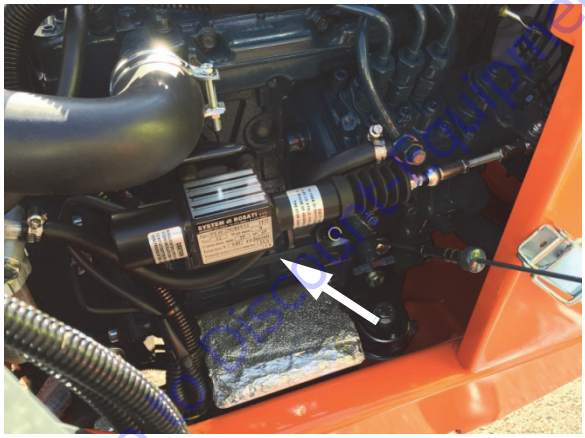


Figure 3-74.

Throttle actuator on Kubota D902

Figure 3-75.

Speed Sensor Hatz 1B40

All Diesel Actuator Rod Travel Adjustment

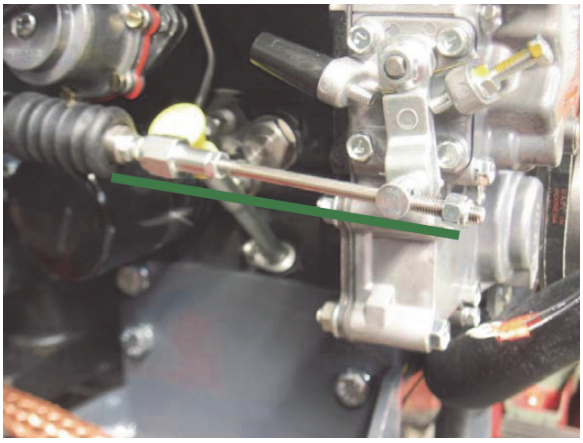


Figure 3-76.

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

3.10 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.

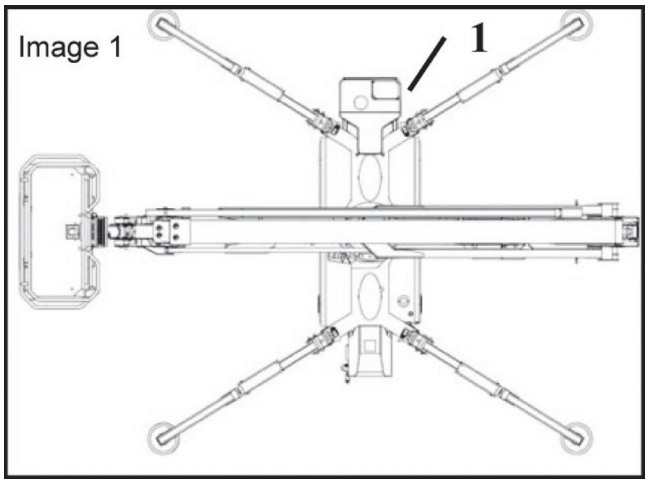


Figure 3-77. Engine cover

4. Disconnect, tag and isolate the wires from the engine.

NOTE: *On X20JP-X600AJ – X26JP-X770AJ diesel, disconnect the oil pipes and cooling lines, then drain the 2 circuities.*

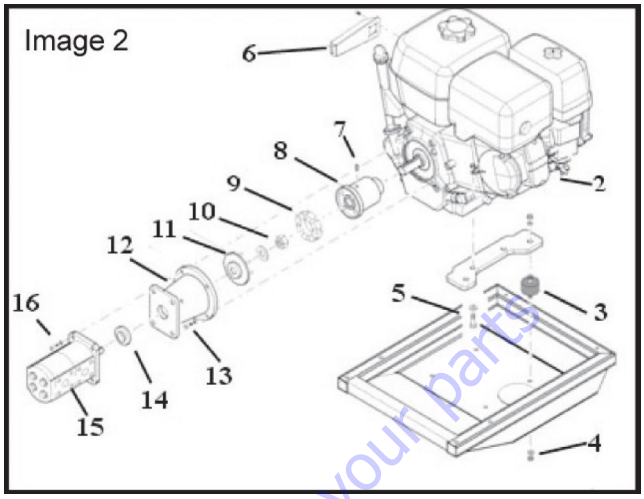


Figure 3-78. Image 2

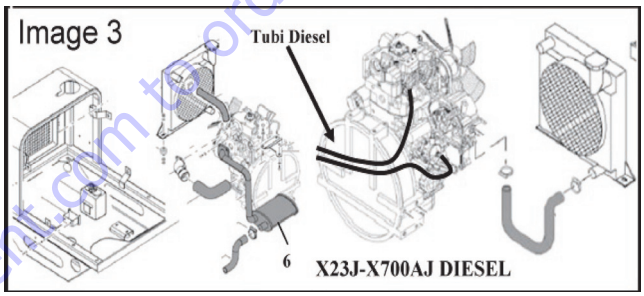


Figure 3-79. Image 3

1. Remove the screws (items 13 and 5 - image 2).
2. Remove the engine, remove the joint (items 8 and 9 - Image 2) .
3. Remove the muffler (item 6 - Image 2).
4. Replace the engine and tighten the screws (items 13 and 5 - Image 2). Torque screws to 16.2 ft. lb. (22N-m) and 18.5 ft. lb. (25Nm) respectively.
5. Connect the wires to the motor.
6. Replace guard on motor (1) and test the machine.

3.11 ELECTRIC MOTOR REPLACEMENT

1. Place and stabilize the machine on a flat and level surface; for the models X17JP/X500AJ and X20JP/X600AJ rotate the turret 90° (Figure 3-80.), while for X26JP and X770AJ, keep the machine in stowed position
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.

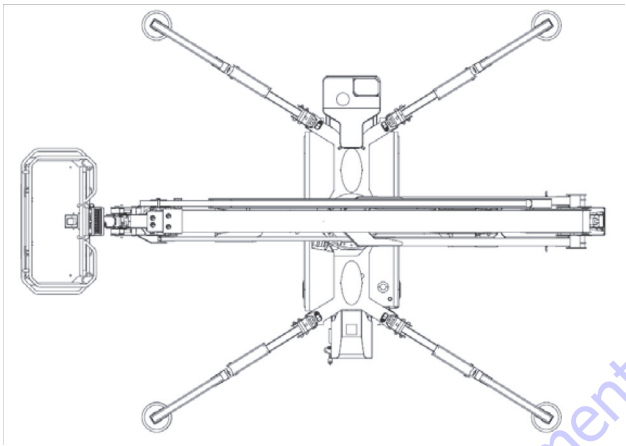


Figure 3-80. Cover position engine X17JP/X500AJ X20JP/X600AJ

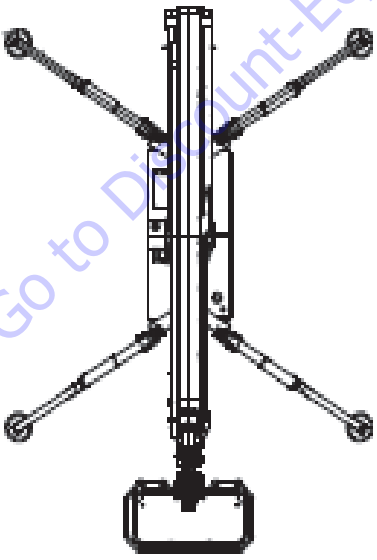


Figure 3-81. Cover position engine X26JP/X770AJ

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)

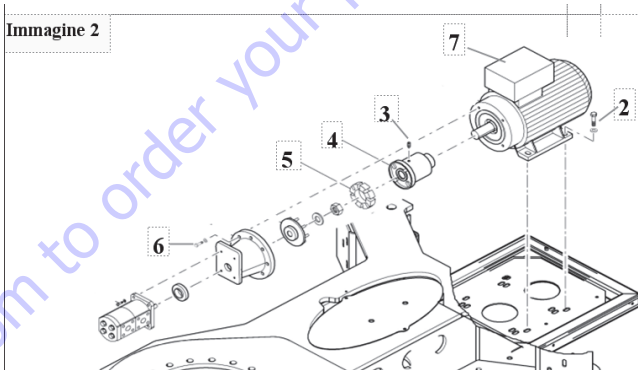


Figure 3-82.

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).

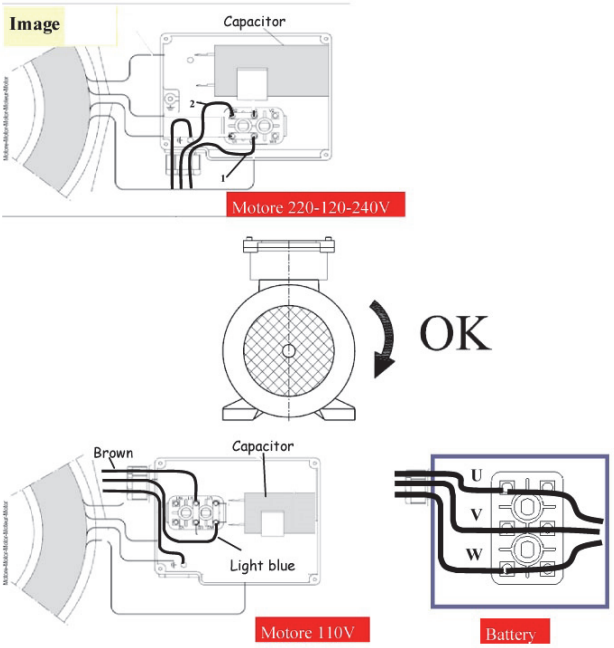


Figure 3-83.

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 3-84.).

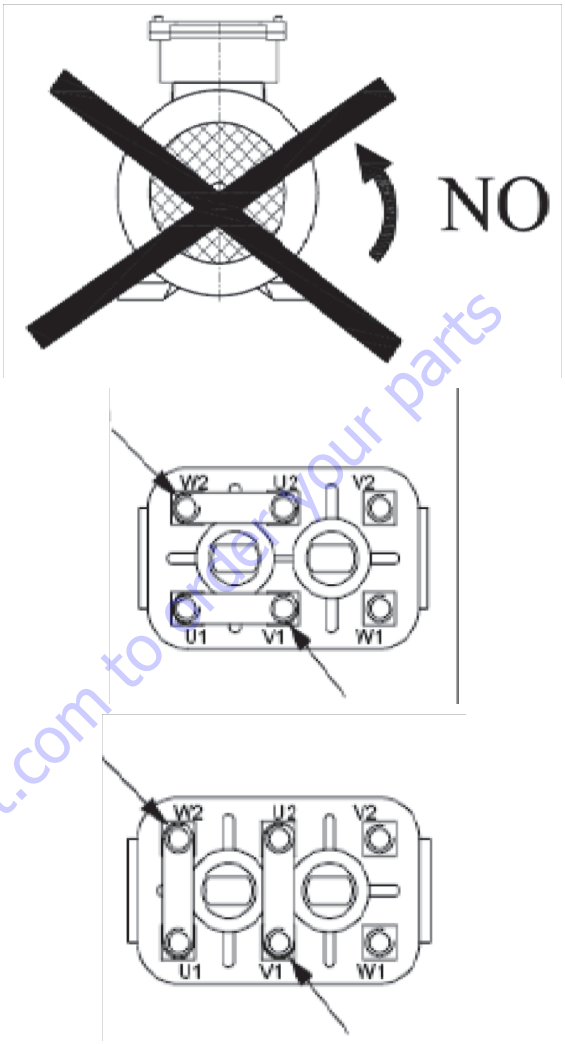


Figure 3-84.

14. Install cover and test the machine.

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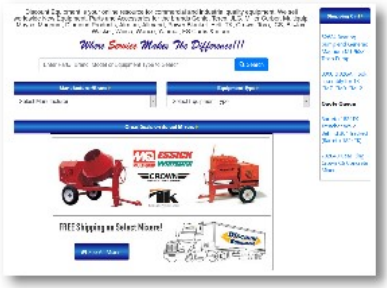

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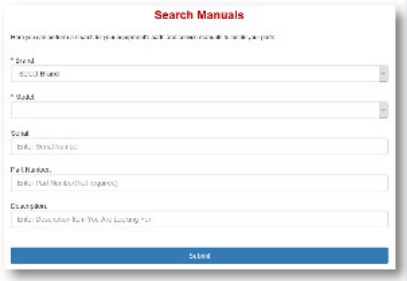

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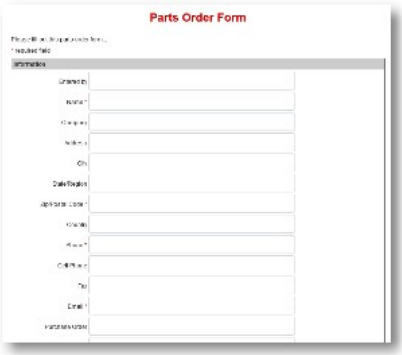

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SECTION 4. BOOM & PLATFORM

4.1 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.

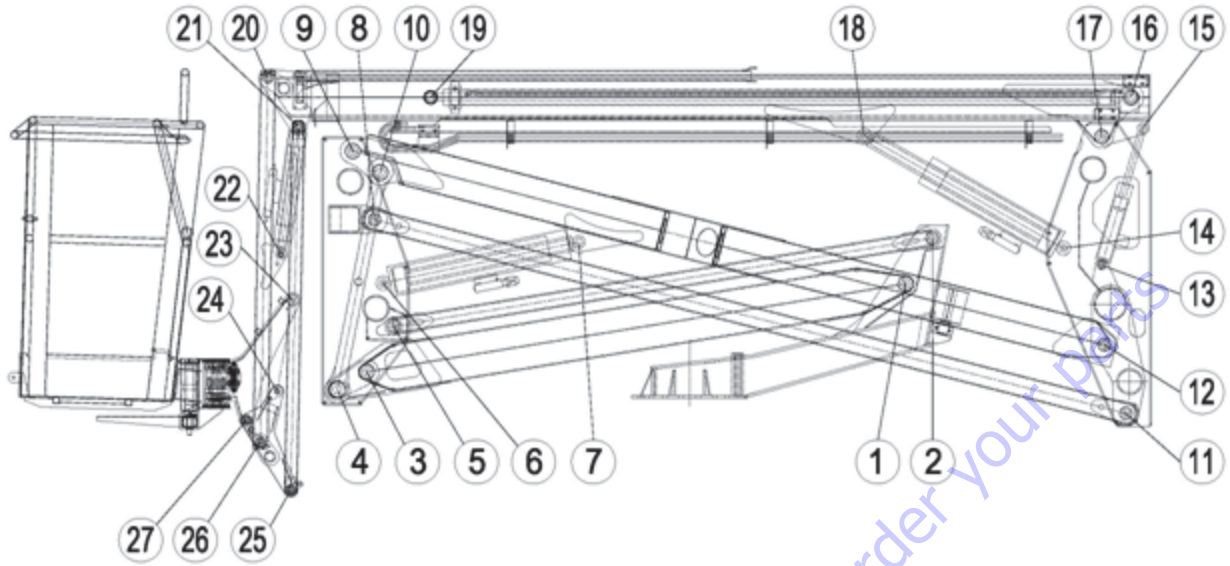


Figure 4-1. Position pins X17JP - X500AJ

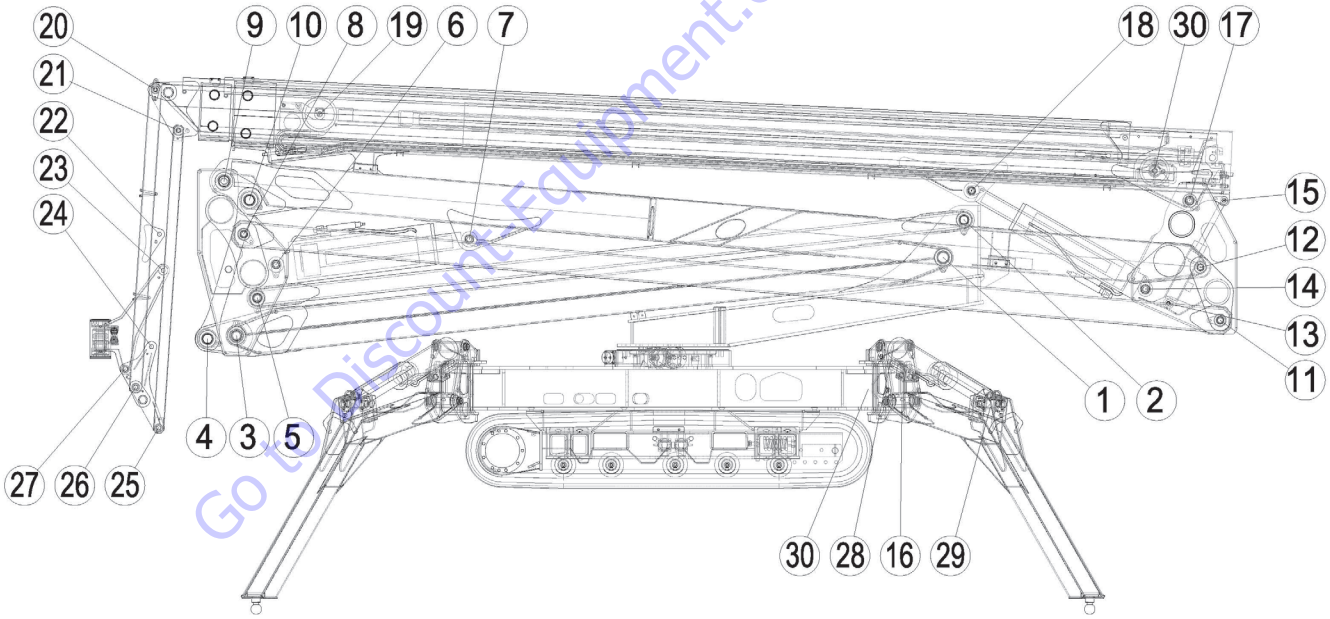


Figure 4-2. Position pins X20JP - X600AJ

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.

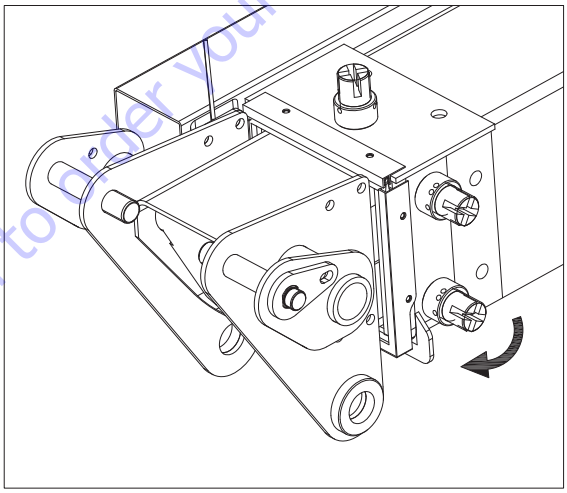
Assembly of the Main Boom

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.

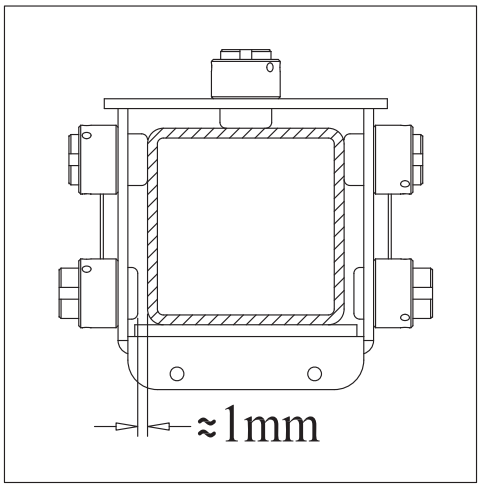
NOTICE

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

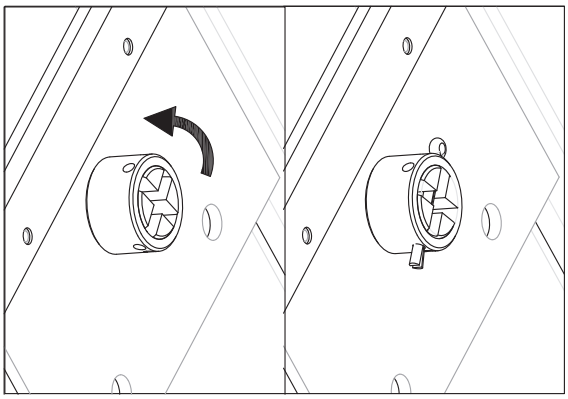
11. Slowly slide the telescope cylinder into boom assembly, align rod end with attach point in fly section. Insert pin and secure with retaining ring.
12. Slowly slide the telescope cylinder into boom assembly, align barrel end with attach point in fly section. Insert pin and secure with retaining ring.
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.

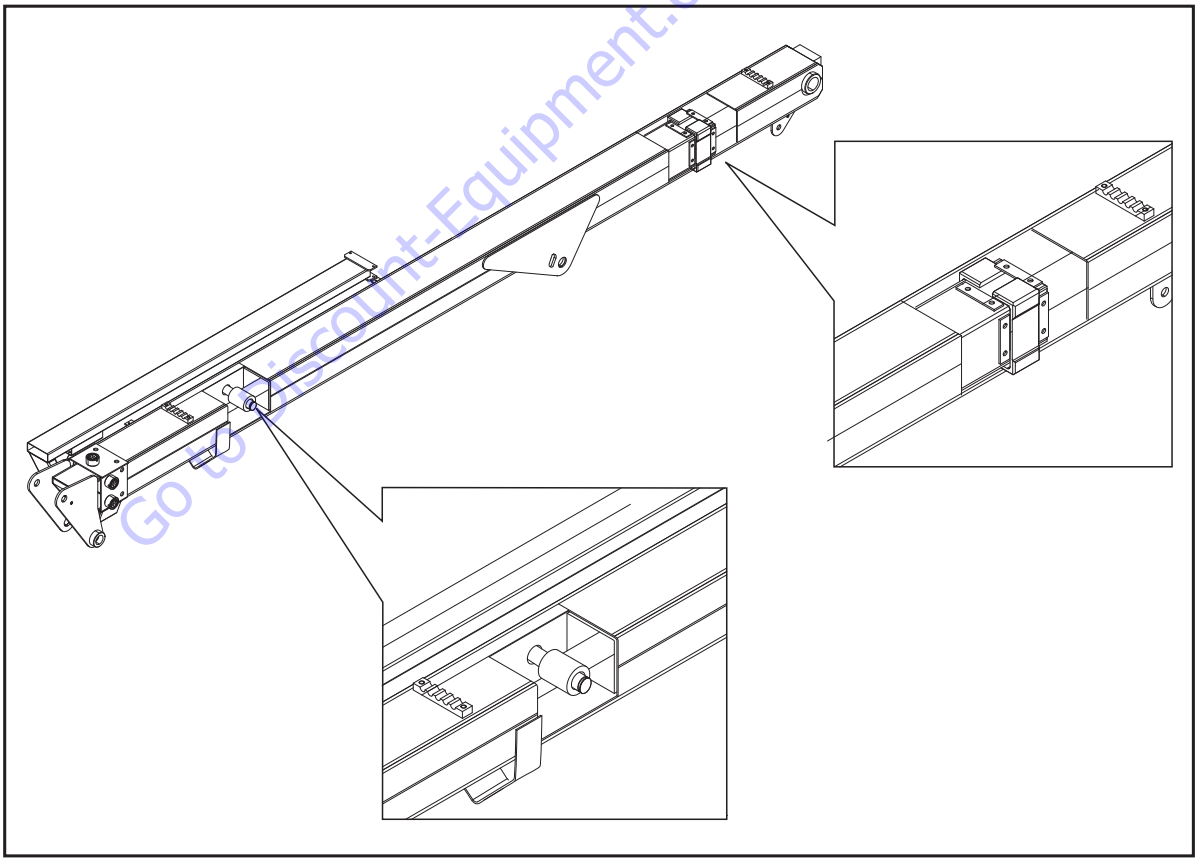


Figure 4-3.

4.2 BOOM DISASSEMBLY X20JP - X600AJ

NOTE: *The following procedure assumes the boom is removed from the machine.*

1. Extend the boom approximately 2 feet (0.6 m). This will enable access to the bolts that secure the cable mount block to the boom fly section.
2. Remove hardware securing the telescope cylinder.

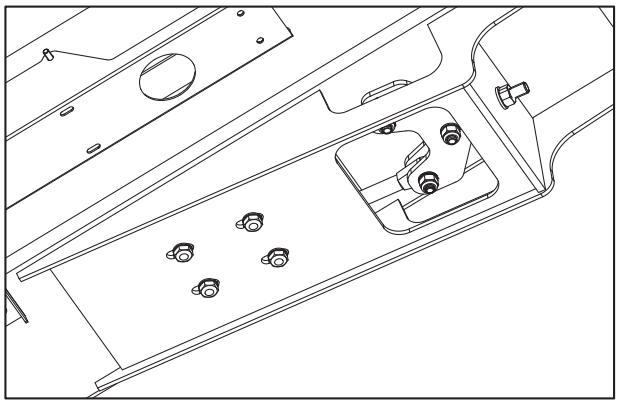


Figure 4-4.

NOTE: *Do not allow wire rope to rotate. This may damage the wire rope.*

3. Clamp both threaded ends of wire rope to prevent rotation. Note: Do not clamp on threads. Remove jam nuts and nuts which secure the wire rope adjustments to the bottom front of the base boom section.
4. Using a M6 drive extension approximately 4 feet (1.2 m) long, remove the bolts and washers securing the cable mount block to the boom fly section.

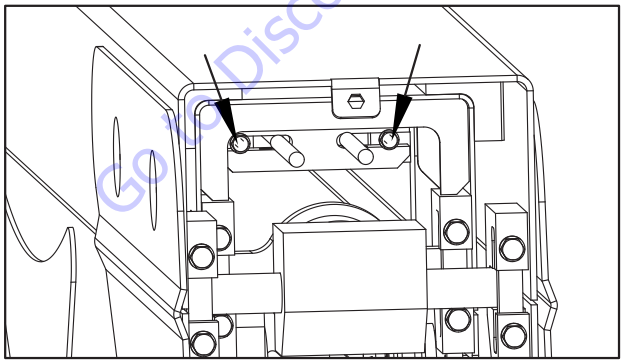


Figure 4-5.

5. Remove the four bolts, shims, and attachment blocks that secure the telescope cylinder barrel to the boom mid section.

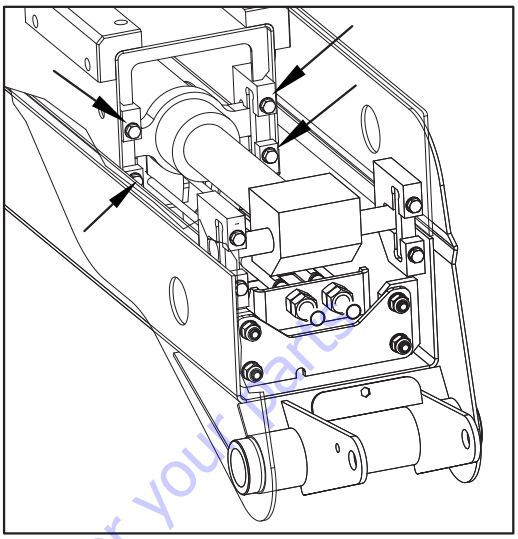


Figure 4-6.

6. Remove the four bolts, shims, and mounting blocks that secure the telescope cylinder rod to the boom base section.

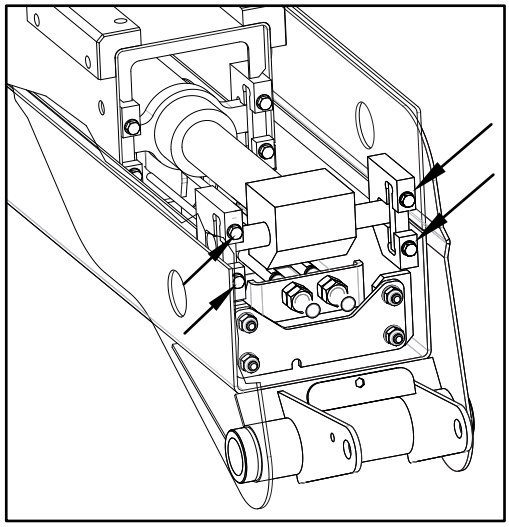


Figure 4-7.

NOTICE

WHEN REMOVING THE TELESCOPE CYLINDER FROM THE BOOM, IT MAY BE NECESSARY AT SOME POINT TO TURN THE CYLINDER SLIGHTLY IN ORDER TO CLEAR ASSEMBLIES MOUNTED WITHIN THE BOOM. CARE MUST BE TAKEN TO MOVE THE CYLINDER SLOWLY FROM THE BOOM. DAMAGE TO COMPONENTS MAY RESULT FROM FORCIBLE IMPACT WITH THESE ASSEMBLIES.

NOTE: *The telescope cylinder weighs approximately 600 lbs. (275 kg).*

1. Using overhead cranes or other suitable lifting/supporting devices, carefully pull the telescope cylinder out from the back of the boom. At the same time, also pull the cable mount block out so the extension cables come out with the telescope cylinder and do not bind. The lifting/supporting devices will have to be repositioned to support the weight of the cylinder as it is drawn out of the boom.

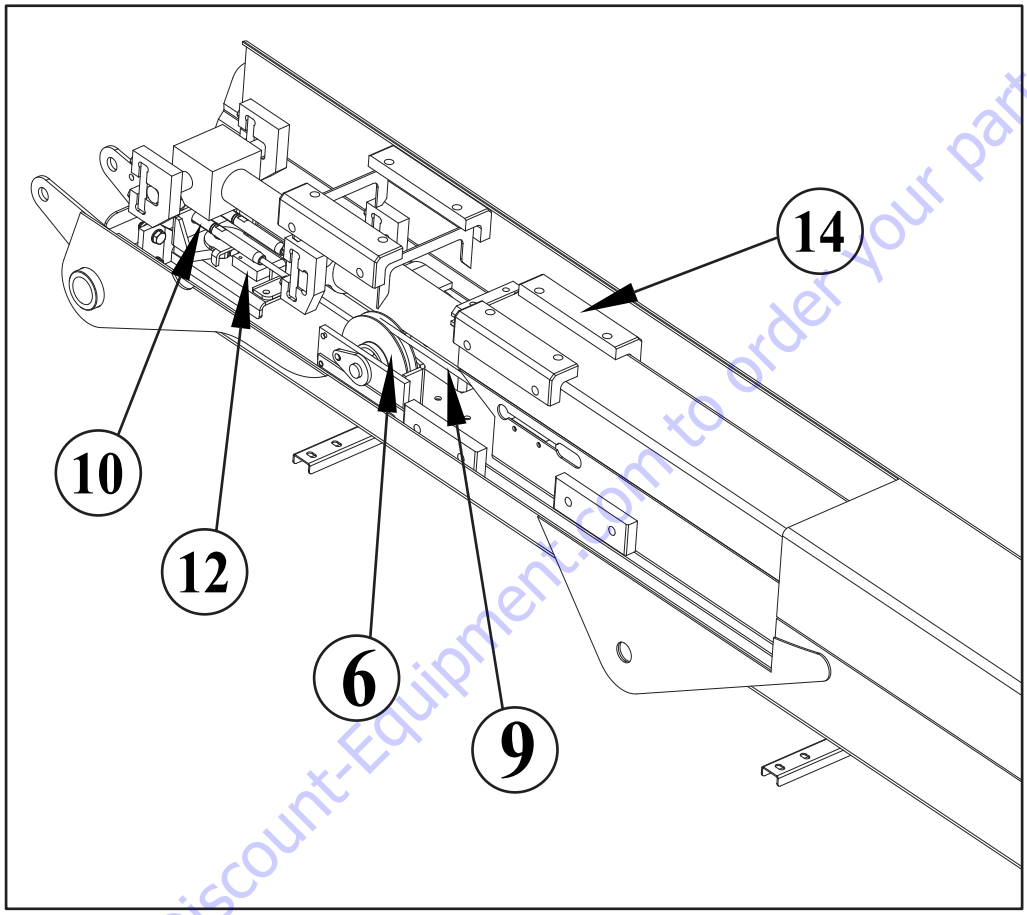


Figure 4-8.

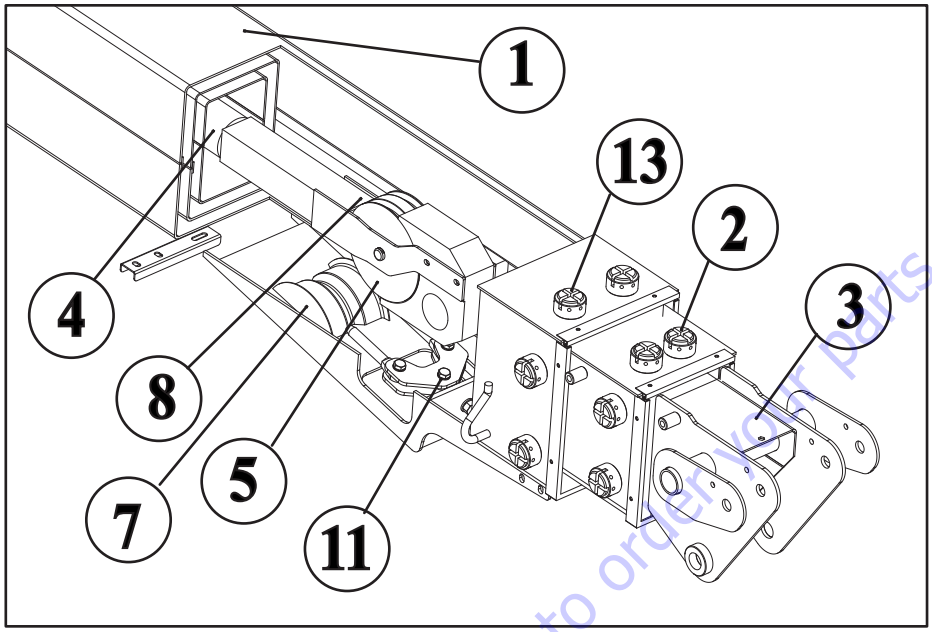


Figure 4-9.

1. Base Boom
2. Mid Boom
3. Fly Boom
4. Telescope Cylinder
5. Extend Sheave
6. Retract Sheave
7. Sheave Block
8. ExTend Cable
9. Retract Cable
10. Extend Cable Adjustment
11. Retract Cable Adjustment
12. Proximity Switch
13. Wear Pad
14. Wear Pad

8. Carefully remove the telescope cylinder and sheave assembly. Place telescope cylinder on a suitable trestle.
   a. Remove hardware from the wear pads; remove wear pads from cylinder.
   b. Remove hardware from the wire rope guard; remove guard from cylinder.
   c. Remove hardware from the sheave pin; remove pin and sheave from cylinder.

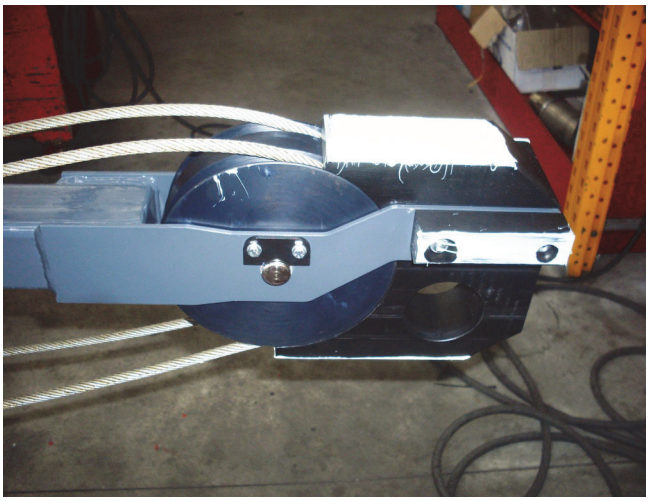


Figure 4-10.

9. Remove hardware which secures the wear pads to the front of base boom section; remove wear

pads from the top, sides and bottom of the base boom section.

10. Using an overhead crane or suitable lifting device, remove mid and fly boom sections from base section. Note: When removing mid and fly boom sections from base boom section, retract wire rope must be dragged along with boom sections.
11. Remove hardware which secures the wear pads to the rear end of mid boom section; remove the wear pads from the top, sides and bottom of the mid boom section.
12. Remove hardware which secures the sheave guards and sheave assemblies to mid boom section, remove sheave assemblies from mid boom section.
13. Remove hardware which secures the wear pads to the front of mid boom section; remove wear pads from the top, sides and bottom of the mid boom section.
14. Using an overhead crane or suitable lifting device, remove fly boom section from mid section. Note: When removing fly boom section from mid boom section, retract wire rope must be dragged along with fly boom section.
15. Remove hardware which secures the wear pads to the rear end of fly boom section; remove wear pads from the top, sides and bottom of the fly boom section.
16. When removing wire rope from fly boom section, push the cable into fly boom. Route wire rope back through holes in the side of the fly boom section.

Figure 4-11.

4.3 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.

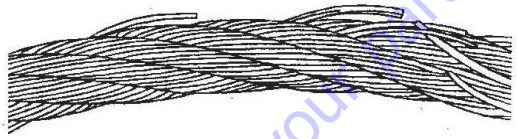


Figure 4-12.

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.

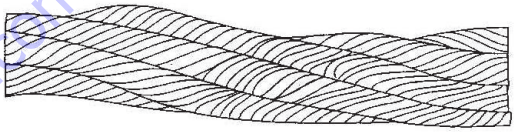


Figure 4-13.

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.

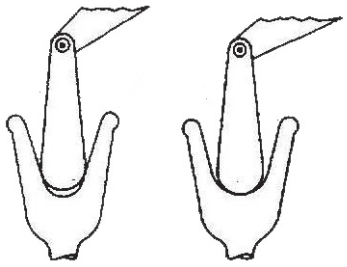


Figure 4-14.

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

Assembly

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

1. Measure inside dimensions of the base and mid sections to determine the number of shims required for proper lift.
2. Measure inside dimensions of the mid section to determine the number of shims required for proper lift.
3. Install side, top and bottom wear pads to the rear end of fly section; shim evenly to the measurements of the inside of mid section.
4. Install retract wire ropes into rear end of fly section, route wire ropes thru holes in side of fly boom section and pull into slot.

Figure 4-15.

5. Install side, top and bottom wear pads to the rear end of mid section.

NOTICE

WHEN ASSEMBLING BOOM SECTIONS, ENSURE THAT THE BOOM SLIDING TRAJECTORIES HAVE BEEN CLEARED OF CHAINS, TOOLS, AND OTHER OBSTRUCTIONS.

6. Slid fly boom section into the mid boom section. Adjust boom, if necessary, for a total of 1/16 inch (0.062) clearance.
7. Install wear pads into the forward position of the mid boom section. Adjust boom, if necessary, for a total of 2/10 inch (5.08mm) clearance.
8. Properly position the retraction wire rope sheaves assemblies at the rear end of the mid boom section; ensure all sheave-to-mounting block attachment holes align. Install the sheave pins and secure them with mounting hardware. Position retract wire ropes onto the sheaves.
9. Install sheave guards to rear end of mid boom section and secure with mounting hardware.
10. Slide mid boom section into the base boom section. Allow the retraction wire ropes to trail between the bottom surfaces of boom sections. Adjust boom, if necessary, for a total of 1/16 inch (0.062) clearance.
11. Install wear pads into the forward position of the base boom section. Adjust boom, if necessary, for a total of 2/10 inch (0.20) clearance.
12. Install sheave block to bottom of base boom section and adjust block so that retract wire ropes do not come into contact with boom surfaces.
13. Install wire rope threaded ends thru attachment holes in the bottom of base boom section. Loosely install nuts and jam nuts onto the threaded ends of wire ropes.
14. Pull the boom sections out to approximately where they were extended to for telescope cylinder removal.
15. Install a new extend sheave on the end of the telescope cylinder.
16. Route new extend cables around the telescope cylinder. Loosely fasten the threaded end of the cables to the rod end of the telescope cylinder with the adjusting nuts and lock nuts. Install the opposite end of the cables in the cable mount block.
17. Use tape or tie straps to fasten the cables to the telescope cylinder assembly. It is important that the tape or straps be strong enough to hold the cable in place yet weak enough to break and fall away when the cables are adjusted.

NOTICE

WHEN PUSHING THE TELESCOPE CYLINDER INTO THE BOOM, IT MAY BE NECESSARY AT SOME POINT TO TURN THE CYLINDER SLIGHTLY IN ORDER TO CLEAR ASSEMBLIES MOUNTED WITHIN THE BOOM. CARE MUST BE TAKEN TO MOVE THE CYLINDER SLOWLY INTO THE BOOM. DAMAGE TO COMPONENTS MAY RESULT FROM FORCIBLE IMPACT WITH THESE ASSEMBLIES.

NOTE: *The telescope cylinder weighs approximately 600 lbs. (275 kg).*

18. Using adequate lifting equipment, carefully push the telescope cylinder assembly and cables back into the boom.

19. Apply Loctite #242 to the bolts and fasten the telescope cylinder rod to the boom base section with the bolts, shims, mounting blocks.

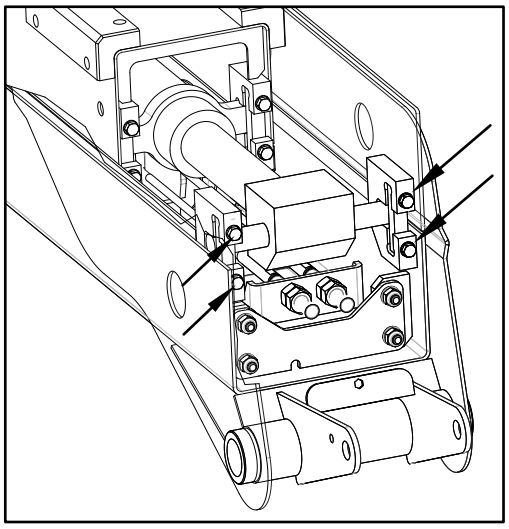


Figure 4-16.

20. Apply Loctite #242 to the bolts and fasten the telescope cylinder barrel to the boom mid section with the bolts, shims, mounting blocks.

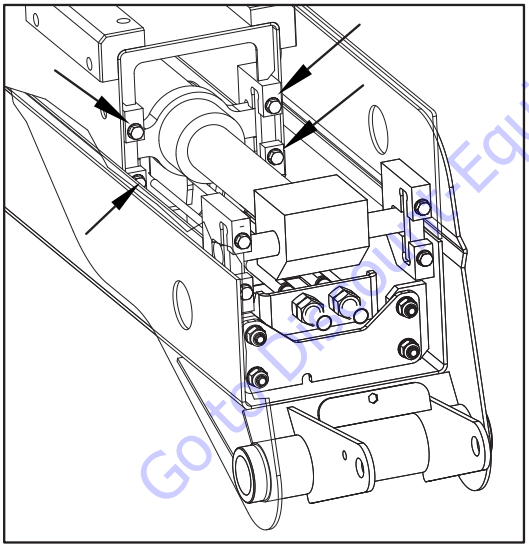


Figure 4-17.

21. Using a 3/8 drive extension approximately 4 feet (1.2 m) long, install the bolts and washers securing the cable mount block to the boom fly section. Tape the bolts to the socket at the end of the extension to prevent it from coming out of the socket before it engages the mounting threads.

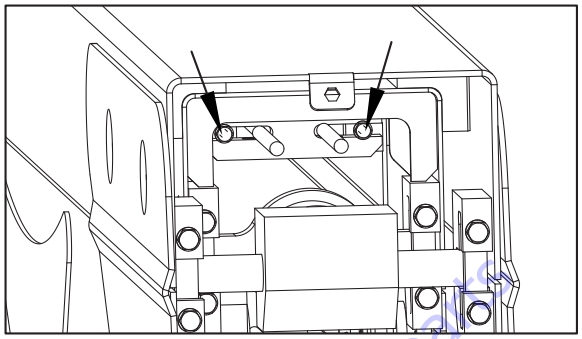


Figure 4-18.

22. Connect all the hydraulic lines to the cylinder as tagged during the removal procedure.
23. Adjust the boom cables as outlined under Section 4.4, ROPES TENSION ADJUSTMENT PROCEDURE.

Installation To Machine

1. Using a suitable lifting device, position boom assembly on upright so that the pivot holes in both boom and upright are aligned.
2. Install boom pivot pin, ensuring that location of hole in pin is aligned with attach point on upright.
3. If necessary, gently tap pin into position with soft headed mallet. Secure pin mounting hardware.
4. Connect all wiring to the ground control box.
5. Connect all hydraulic lines running along side of boom assembly.
6. Using all applicable safety precautions, operate lifting device in order to position boom lift cylinder so that holes in the cylinder rod end and boom structure are aligned. Insert the lift cylinder pin, ensuring that location of hole in pin is aligned with attach point on boom.
7. Align holes in boom structure with hole in master cylinder. Insert the master cylinder pin, ensuring that location of hole in pin is aligned with attach point on boom.
8. Adjust retract and extend cables to the proper torque. Refer to Section 4.4, ROPES TENSION ADJUSTMENT PROCEDURE.
9. Using all applicable safety precautions, operate machine systems and raise and extend boom fully, noting the performance of the extension cycle.
10. Retract and lower boom, noting the performance of the retraction cycle.

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 al 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.

4.4 WIRE ROPE TENSION ADJUSTMENT PROCEDURE

NOTE: *Do not clamp on threads.*

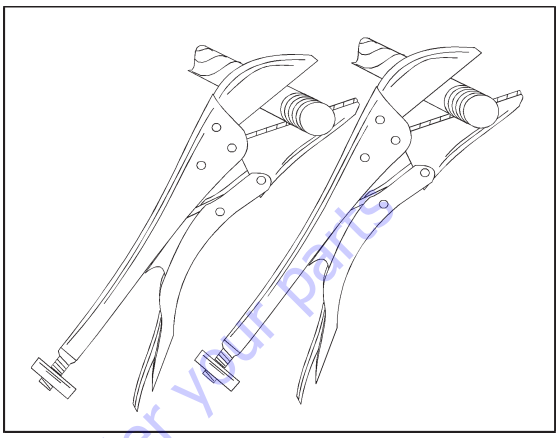


Figure 4-19. Clamping Wire Ropes

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.

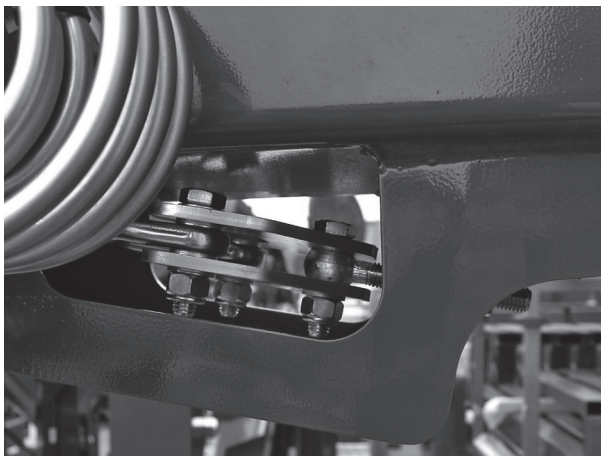


Figure 4-20. Return ropes fixing rocker arm

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±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.

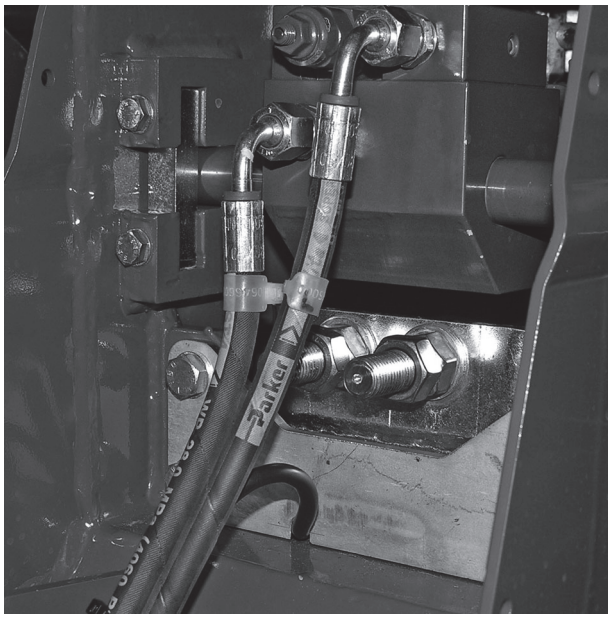


Figure 4-21. Nuts for exit cables stop

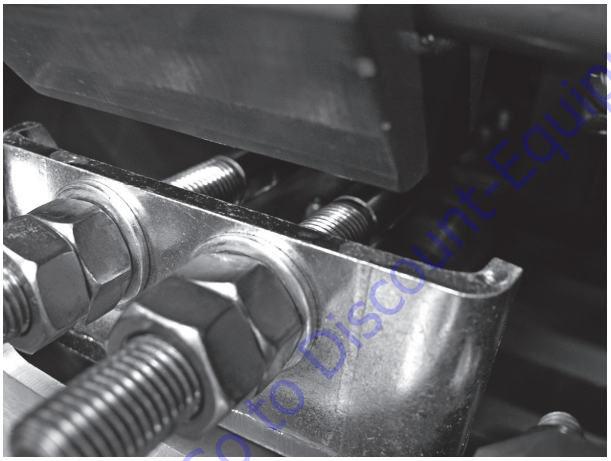


Figure 4-22. Terminal with seat for anti-rotation key

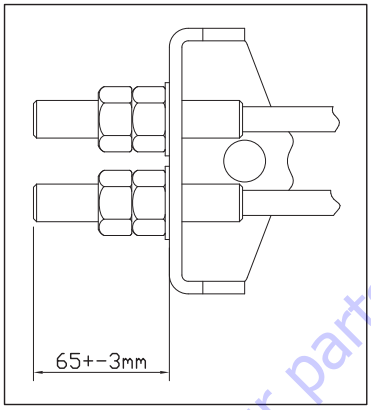


Figure 4-23.

6. Activate the movement of the extendible arms several times and check that the residual loads on the ropes are 10Nm.
7. This procedure could require several attempts before it is completed correctly.
8. The adjustment is correct when the ropes do not emit any noise during extension or return and the torque value prescribed is reached on all of the ropes.
9. Once calibration has been concluded, tighten the counter-nuts and re-mount the sump.

4.5 ROTARY ACTUATOR

ARP Series

Technical Data

- **a.** Rotary actuator model.
- **b.** Construction year.
- **c.** Serial number. Please refer to this number in order to obtain every further details from our technical department.
- **d.** Max working pressure.

Technical Data	Actuator Model
	RP.17/L25H1D2VPH
Rotation Angle	124°
Displacement (cm^3)	~ 81
Weight (kg)	~ 16
Ports	¼ G
Working temperature (°C)	- 20 / + 80
Max. torque at 210bar (Nm)	505
Max. working pressure (bar)	210
Max. Capacity straddle mount / cantile-ver mount (Nm)	2800 / 1400
Max. capacity: thrust / radial (N)	5000 / 14000

For more information and other details see technical drawing.

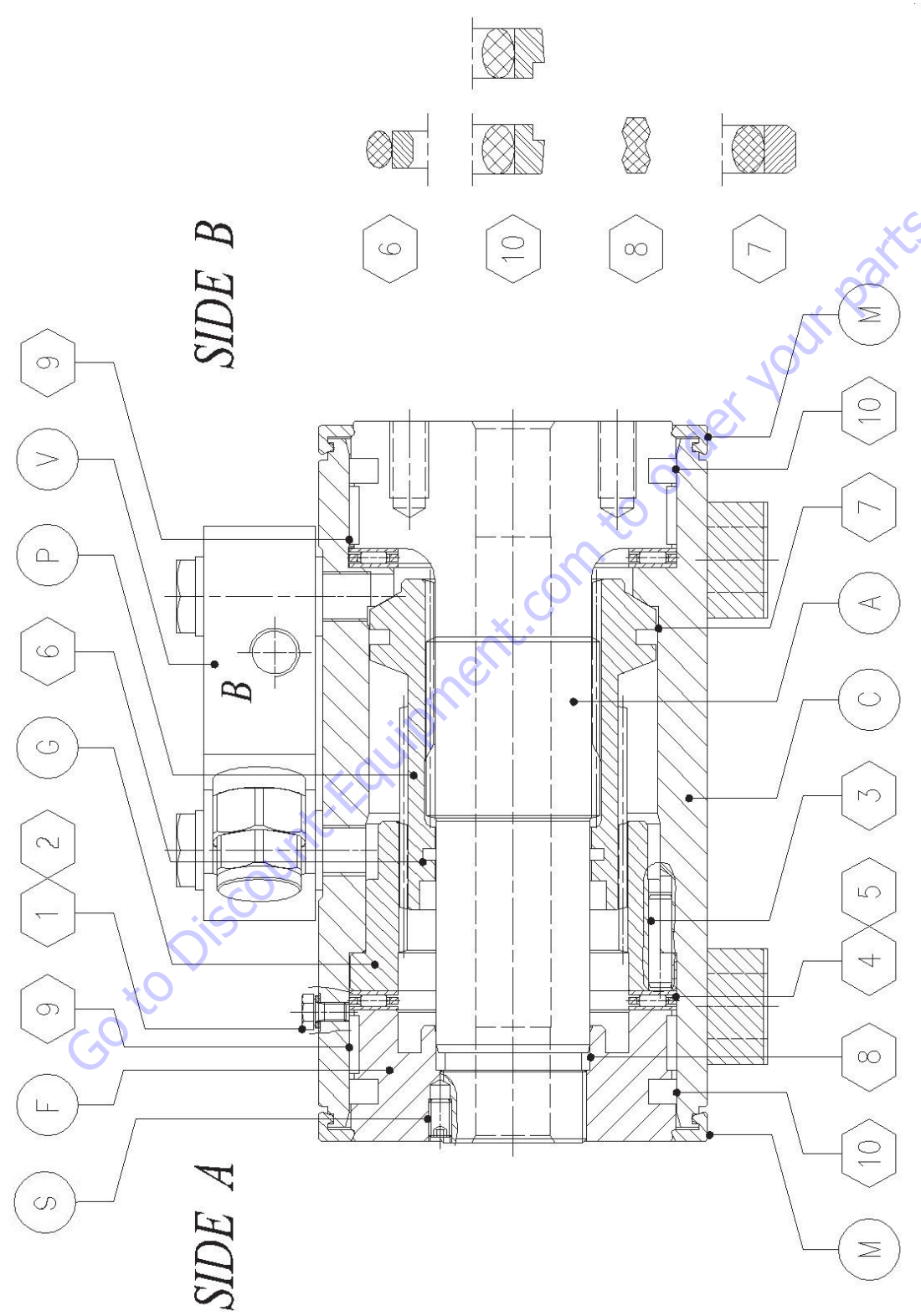


Figure 4-24.

H.987/124DC01/C – H.987/124DC07/C		
POS.	**QTY**	**DEFINITION**
SPECIAL INTERNAL PRODUCTION MOVECO		
A	1	TOOTHED SHAFT D85/D40X187,5 THROUGH HOLE
C	1	WELDED BODY CYLINDER ASSEMBLY X ...DC01/C
	1	WELDED BODY CYLINDER ASSEMBLY X ...DC07/C
	2	BUSHING D28XD20X40 X H.987/124DC01/C
	2	BOX SUPPORT
	4	HEX.HEAD SCREW M6X20
	4	FLAT WASHER D6XD18X2
	4	SELF LOCKING NUT M6
F	1	REAR FLANGE D84,4X35,5-124°
G	1	TOOTHED GEAR RING
M*	2	WIPER RING D101XD81X7,5
P	1	TOOTH PISTON D75XD40X86
S*	3	PIN D6X12
V	1	DOUBLE OVERCENTER VALVE
SEALS KIT (includes the particulars marked by *)		
NOTE: Units (A, C, F, P) are exchangeable only by MOVECO		
SPARE-PARTS		
1*	2	BONDED SEAL D5
2	2	HEX.HEAD SCREW M5X8
3	4	PIN D6X24 - UNI 6364 A
4	4	THRUST RING D60XD85X1
5	2	THRUST BEARING D60XD85X3
6*	1	INT.PTFE SEAL D40
7*	1	EXT.PTFE SEAL D75 - 0750/A
8*	1	SEAL RING OP D40XD35,5X4,5
9*	2	GUIDE RING I 80/E85X14.8 RF
10*	2	EXT.PTFE SEAL D85 PROF. B

Disassembly

⚠ CAUTION

THE SEALS MUST BE REMOVED USING APPOSITE TOOLS, SEALING SURFACES MUST NOT BE DAMAGED.

1. After disassembly all parts must be cleaned and degreased.
2. Clean all parts with compressed air.
3. Lubricate all sealing surfaces.
4. Make sure that the seals are not damaged during disassembly and assembly.

NOTICE

REMOVE ONLY WHEN THE ACTUATOR IS UNINSTALLED FROM THE MACHINE/EQUIPMENT.

5. Fix the actuator to the bench.
6. Remove valve V, plugs and any bleeder screws on the body (eg 1, 2).

NOTE: *Place a suitable container below the actuator to collect oil.*

7. Remove protection ring M.
8. Remove the locking pins S.
9. Loosen flange F from shaft A using hole Ø6 and using an appropriate wrench. We recommend make equipment to facilitate the operation.

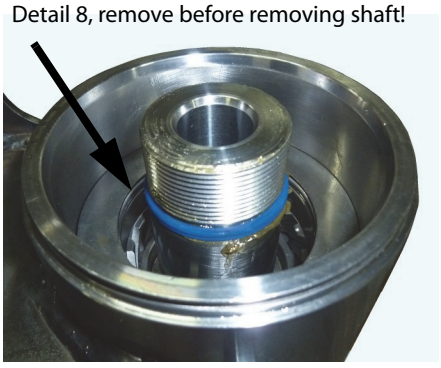
NOTE: *Before unscrewing, make a reference between shaft and flange and measure the gap between them on side A.*

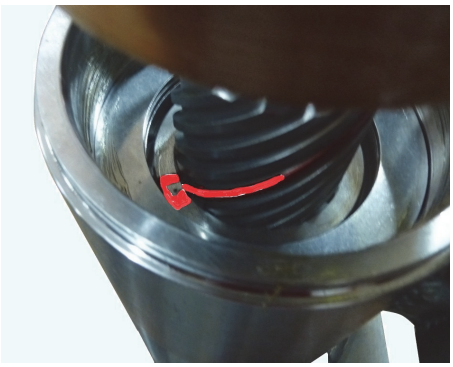
10. Now carefully remove bearing 5 and thrust ring 4 .

11. Using holes Ø6 on the head of shaft and using a proper wrench, rotate shaft A clockwise to bring piston P to touche against the stop on body C.
12. With the piston stop, rotate the shaft anti-clockwise and this will march by the body.

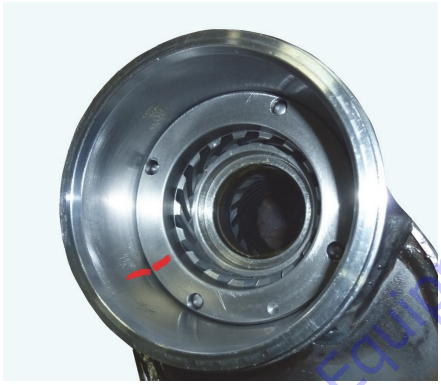
NOTE: *On gear teeth of shaft and piston (before disengaging the same) make a reference, marking a tooth for every detail on which engages with reciprocal.*

Detail 8, remove before removing shaft!



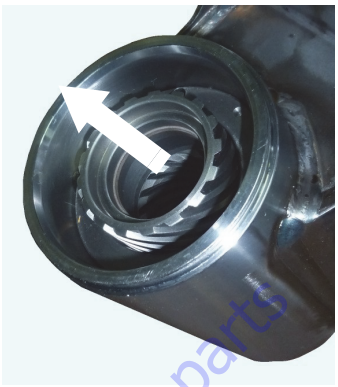


13. Now carefully remove shaft A,bearing 5 and thrust ring 4.
14. Make a reference between actuator body C and gear ring G (on side A), so as to reposition it properly during assembly.



15. Push piston toward the side A, when it is stopping on gear ring G, make an effort to remove it from mounting pins 3, push out the two details from actuator body and remove pins.

NOTE: *On gear teeth of piston and gear ring (before disengaging the same) make a reference, marking a tooth for every detail on which engages with reciprocal.*



16. Remove all elements sealing by the particular.

⚠ CAUTION

THE SEALS MUST BE REMOVED USING APPOSITE TOOLS, SEALING SURFACES MUST NOT BE DAMAGED.

17. After disassembly all parts must be cleaned and degreased.
18. Clean all parts with compressed air.
19. Lubricate all sealing surfaces.
20. Make sure that the seals are not damaged during disassembly and assembly.

Assembly

1. Fix the actuator in a proper way to the bench
2. Reinstall all sealing elements on their particulars paying attention to mounting direction (see drawing). If you have difficulty use appropriate bushings cone.

NOTE: *For easy mounting, it is recommended to heat up the elements of PTFE details 6, 7 and 10 in hot water at 70/80 ° C.*

3. Put piston P, complete with seals 6 and 7 in actuator body C.
4. Engage gear ring G with piston P referring to the previously marked position.
5. Turn gear ring G and match references between this and body (made during removal) and insert mounting pins 3 until it is under the level of gear ring.
6. Place bearing 5 and thrust ring 4 (4+5+4) on side B.

NOTE: *Lubricate with grease the bearing and thrust ring. Use grease EP 0 (NLGI consistency 0; soap type Lithium; base oil Mineral).*

7. Insert shaft A from side B, complete with seals 8 and 10 and guide ring 9, engage it with piston P by referring to previously marked tooth.

NOTE: *During this operation pay attention to the sealing elements between the shaft A and piston P.*

8. Place bearing 5 and thrust ring 4 (4+5+4) on side A.
9. Screw flange F, with seal 10 and guide rings 9, until the reference and the gap between shaft and flange do not match (clamp the shaft using the holes Ø6 on the head).
10. Put the pins S.
11. Install any plugs and bleeder screws on the body (eg: 1, 2).
12. Install valve V and details M.
13. Check that there isn't air inside the actuator. To get out any internal air put the actuator in horizontal position with the axis of rotation, with the attacks facing up and make several rotations (10/20).
14. To assure the oil exchange within the system during the work the volume of the connecting pipes must be lower than the actuator displacement.
15. Align the fixing holes of structure/machine to those of structure/actuator flange and lock this position by pins/screws of suitable torque.
16. Connect the rotary actuator as per layout on the drawing.

Installing Counterbalance Valve

Refer to Figure 4-25., 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).

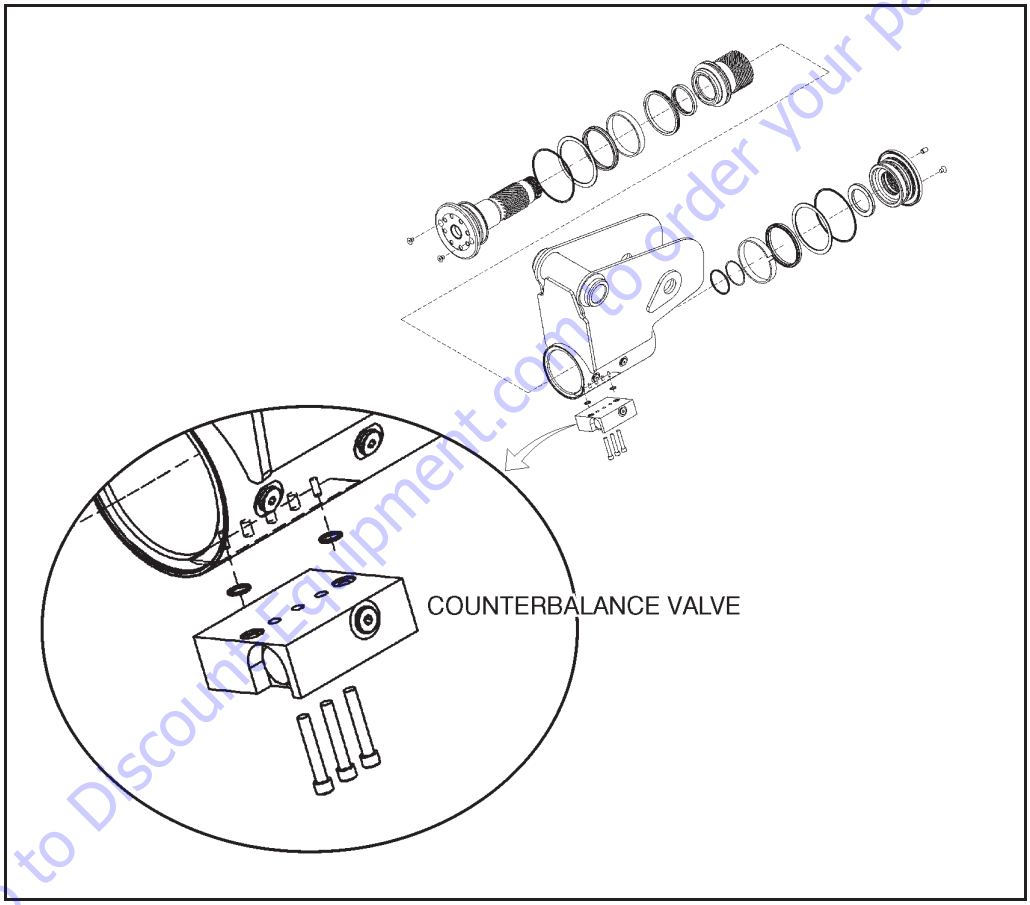


Figure 4-25. Rotator Counterbalance Valve

4.6 BOOM ROTATION SENSOR ASSEMBLY - X23JP - X700AJ

1. Assemble the end couplings (p/n-26741500) using the hex galvanized screws (p/n-BV013000) to the extension pipe (p/n-06745900).

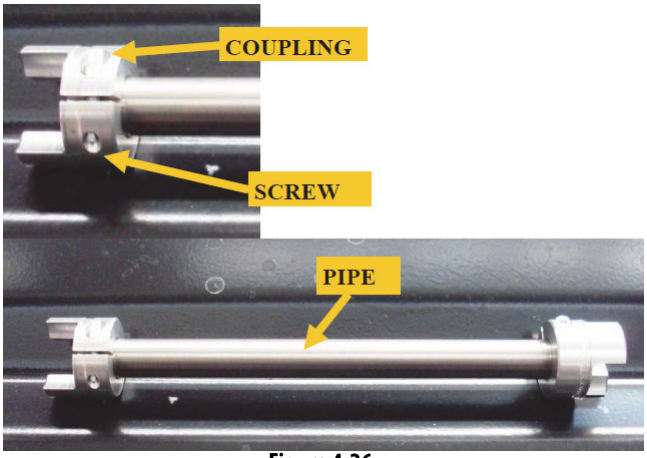


Figure 4-26.

2. Locate the rotation sensor (encoder) (p/n-0660400) and encoder coupling (p/n-26741500).

Figure 4-27.

3. Mount the rotation sensor (encoder) to the crossmember under the turntable bearing using 3 - 6 x 12M screws with threadlocker. Connect the rotation sensor electrical connector to the connector coming from the electrical box. *See Figure 4-28.*

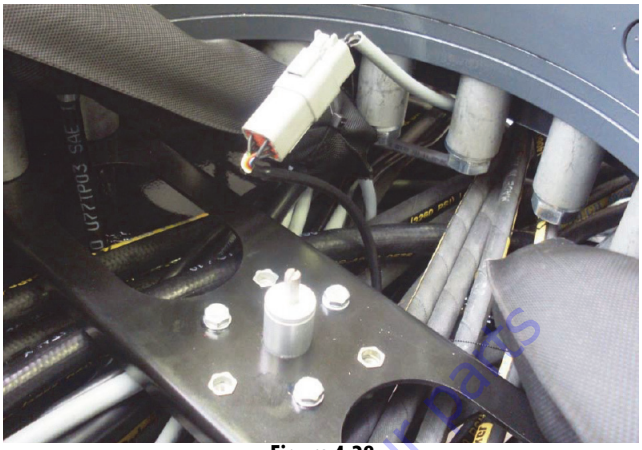


Figure 4-28.

4. Route the rotation sensor electrical cable inside the frame as shown below.

Figure 4-29.

5. Install a coupling onto the rotation sensor shaft using 1 - 3x12M screw (p/n-BV013000).

Figure 4-30.

6. Install the protective cover over the rotation sensor assembly using 3-6x16M TE screws and washers. Install cover with the open slot facing the engine end of the machine. *See Figure 4-31.*

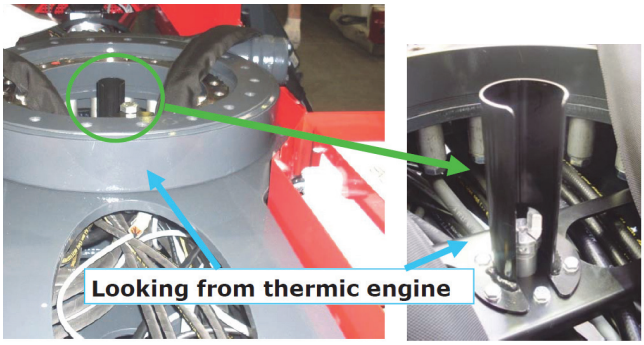


Figure 4-31.

7. Install the sensor extension pipe with couplings assembled in step 1, onto the sensor coupling at the bottom of the protective cover. Install a rubber coupling *(blue arrow)* into the metal coupling *(red arrow)* at each end of the extension pipe *(green arrow)* before installing.

Figure 4-32.

8. Measure with a caliber the distance between the coupling top and the surface of the first boom support where the rotation marker will be mounted. *See Figure 4-33.*

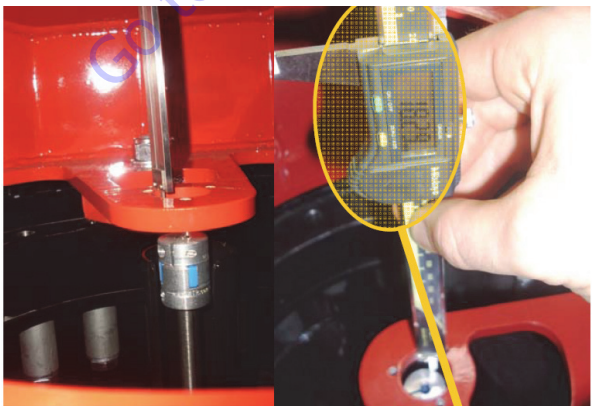


Figure 4-33.

9. Make the difference between this distance and the rotation marker size (15mm), then add at least 0.02 in. (0,5mm) to have an interference fit (but not more than 0.06 in. (1,5mm). Adjust to the right measure shifting the two couplings on the pipe to achieve 0.63 in. (16mm).
(Example 18,29-16= 2,29mm)
In this case it's necessary to elongate the distance between the two couplings to 0.09 in. (2,29mm).

Figure 4-34.

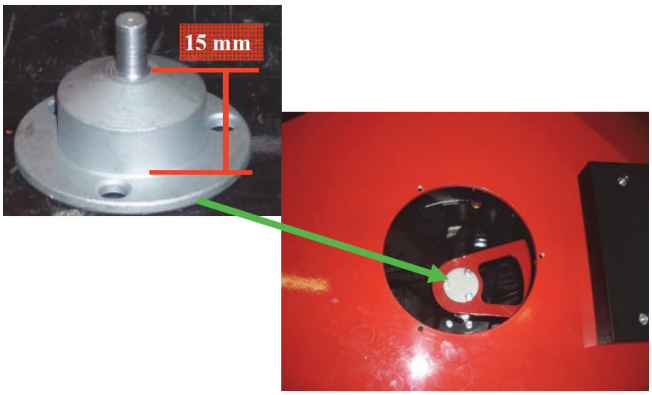


Figure 4-35.

4.7 PROXIMITY SENSOR ADJUSTMENT (X17JP-X500AJ – X20JP-X600AJ)

Adjust the proximity sensor in order to obtain a gap of 2 mm between the sensor and the undercarriage ring plate.

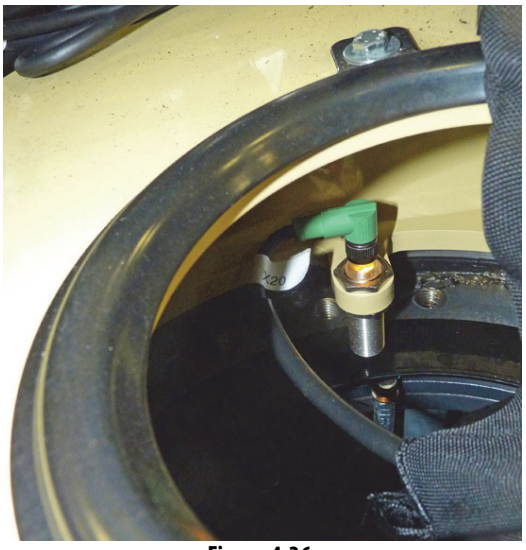


Figure 4-36.

4.8 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.

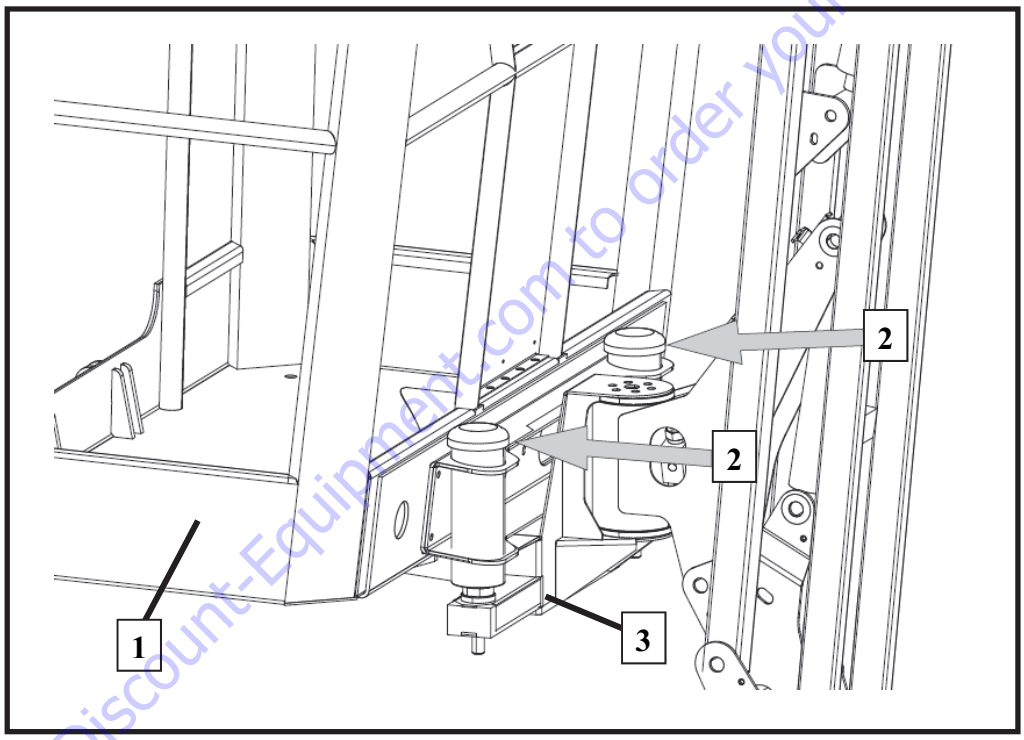


Figure 4-37.

4.9 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)

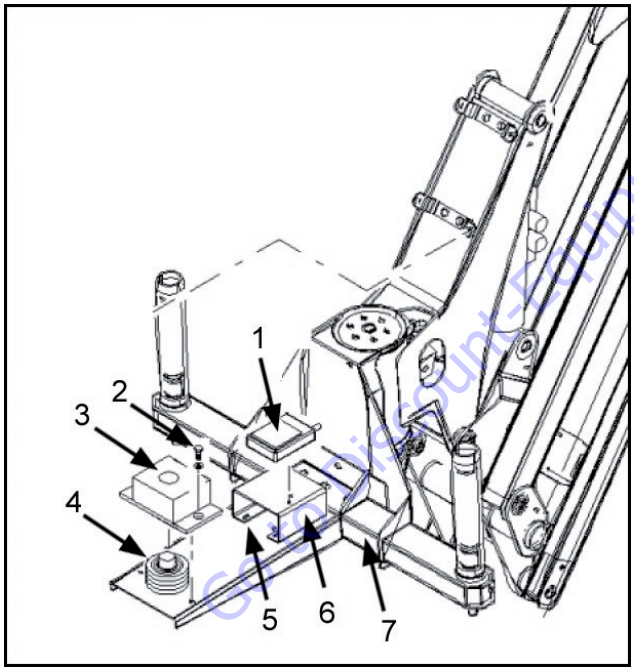


Figure 4-38.

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).

4.10 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.

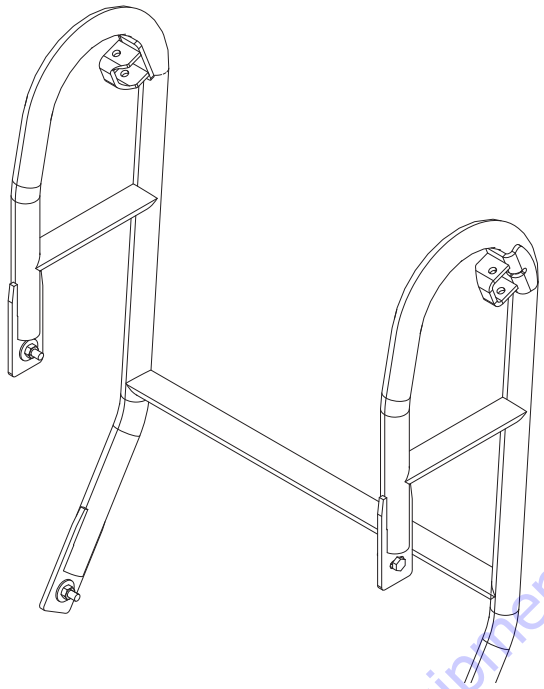


Figure 4-39. SkyGuard Bracket with Mount

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.

Models Affected:

NOTE: *This can only be installed in machines after S/N C170000893 "With a single person basket".*

- X500AJ
- X600AJ
- X770AJ
- X17J Plus
- X20J Plus
- X26J Plus

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, 1/4-20 x 1 3/4 LG	2
2	0700812	Bolt (Metric), 8 x 25 LG	4
3	3290801	Nut, M8 x 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	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:

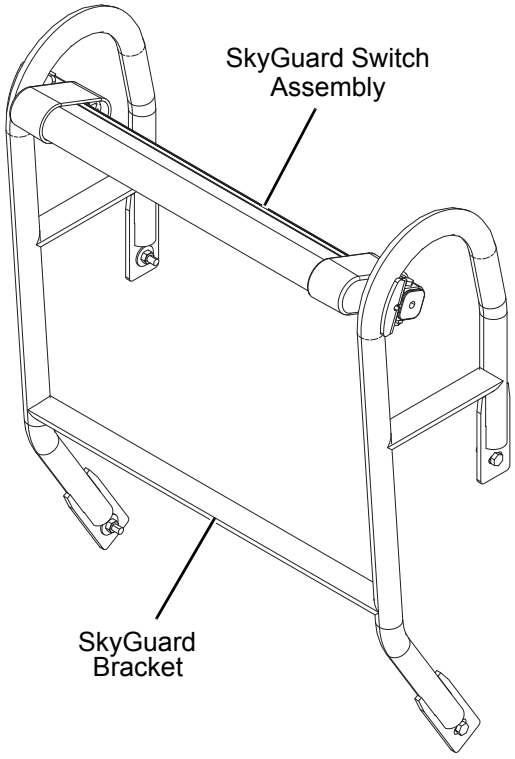


Figure 4-40. SkyGuard Bracket with SkyGuard

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 4-41.*

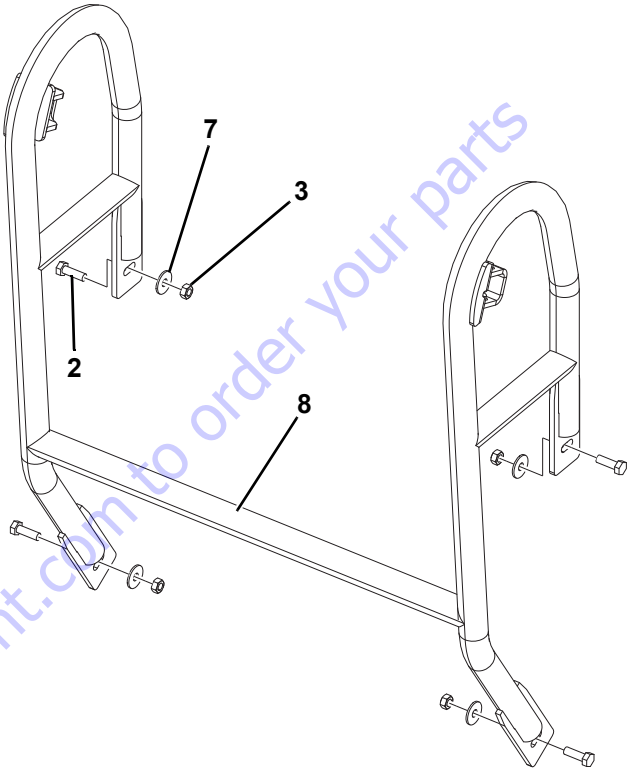


Figure 4-41.

2. Align and attach Platform Sensor Mount **(12)** onto the SkyGuard Switch **(11)** as shown in *Figure 4-42.*
3. Attach Platform Sensor Covers **(9)** to SkyGuard switch assembly at both ends. *See Figure 4-42.*

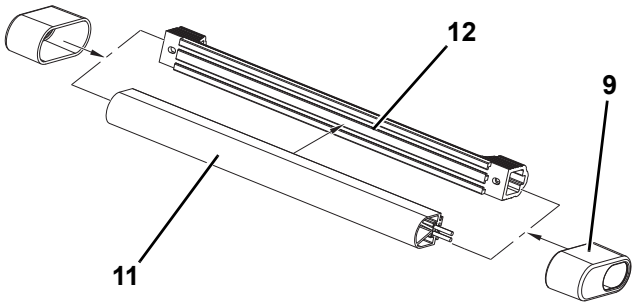


Figure 4-42.

4. Position SkyGuard switch assembly with sensor cover onto the SkyGuard Support Bracket **(8)** as shown in *Figure 4-43.*.

5. Insert a Shear Block Support **(10)** through shear block housing on the SkyGuard support bracket and into the platform sensor mount. *See Figure 4-43.*

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

6. Secure the shear block on welded mount of Sky-Guard support bracket using Bolt **(1)**, relevant Washer **(6)** and Acorn Nut **(4)** as shown in *Figure 4-43.*
7. Secure the SkyGuard switch assembly using Bolt **(5)** and relevant Washer **(6)** on platform sensor mount. *See Figure 4-43.*

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 Sky-Guard support bracket ensuring correct position of the shear block support before installation.

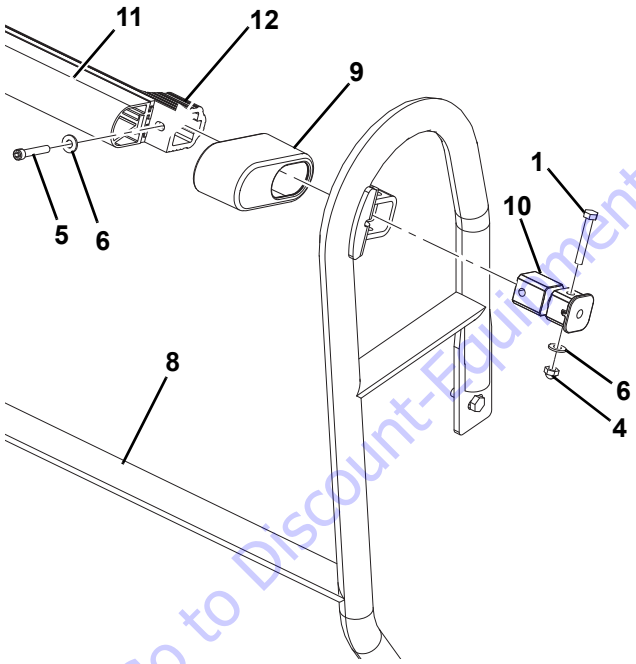


Figure 4-43.

9. Route the SkyGuard switch harness along Sky-Guard support bracket (right side) and under the platform control box. Secure the harness using tie straps. *See Figure 4-44.*

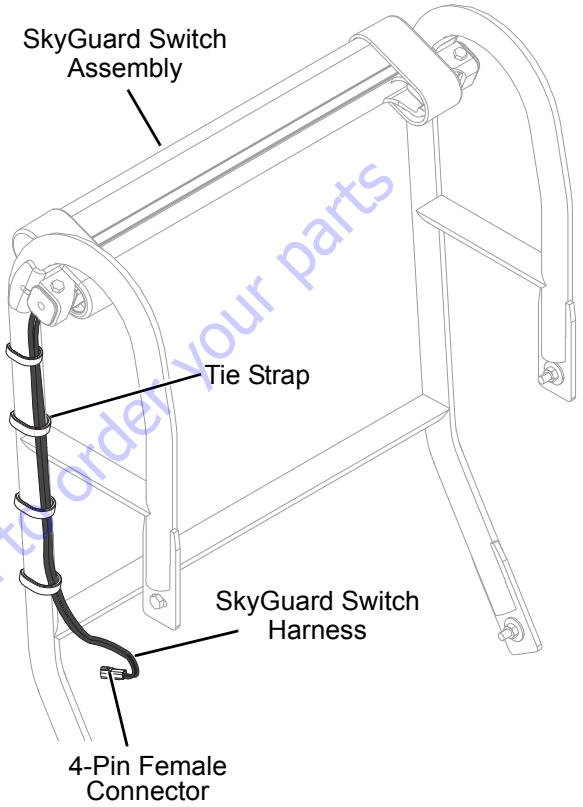


Figure 4-44.

10. Connect Sky Guard connector to the one on the machine located under load cell box. *See Figure 4-45..*

Figure 4-45.

11. Open load cell board (ECM3) box, locate connectors X604 and X603, then disconnect them. *See Figure 4-46.*

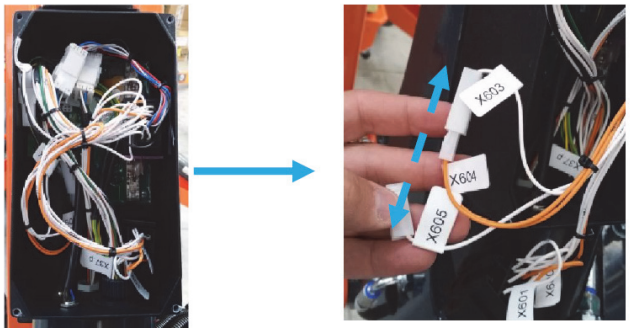


Figure 4-46.

12. Connect connector X603 to connector X605. *See Figure 4-47.*

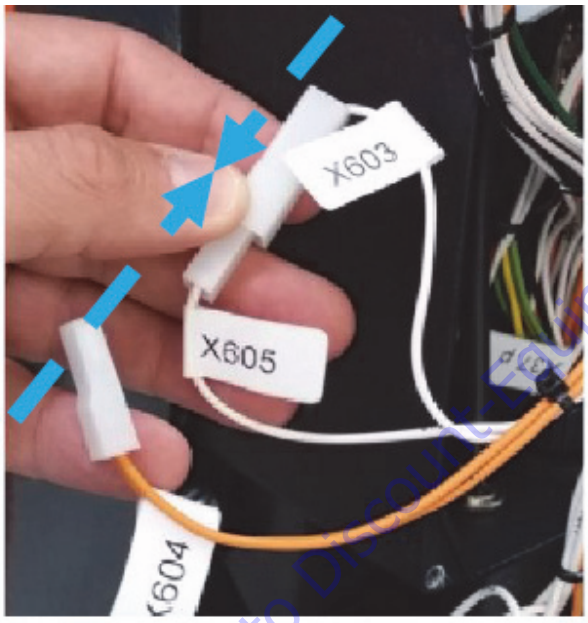


Figure 4-47.

⚠ CAUTION

WHEN THE SKYGUARD IS PUSHED WITH EXCESSIVE FORCE THE SENSOR SUPPORTS *(ITEM 10 - FIGURE 4-43.)* 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 4-48.

- 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 4-49.

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

Skyguard Anti-Trapping 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 (3 Boom) Up	Main Tele (Extension) In	Main Tele (Extension) Out	Main Swing	Drive Forward	Drive Reverse	Tower Lift (1 Boom) Up	Tower Lift (1 Boom) Down	Basket Level	Basket Rotate	Jib Lift
R	C	R	R	C	C	R	C	C	C	C
R= Indicates Reversal is Activated										
C= Indicates Cutout is Activated										

Figure 4-50. SkyGuard Function Table

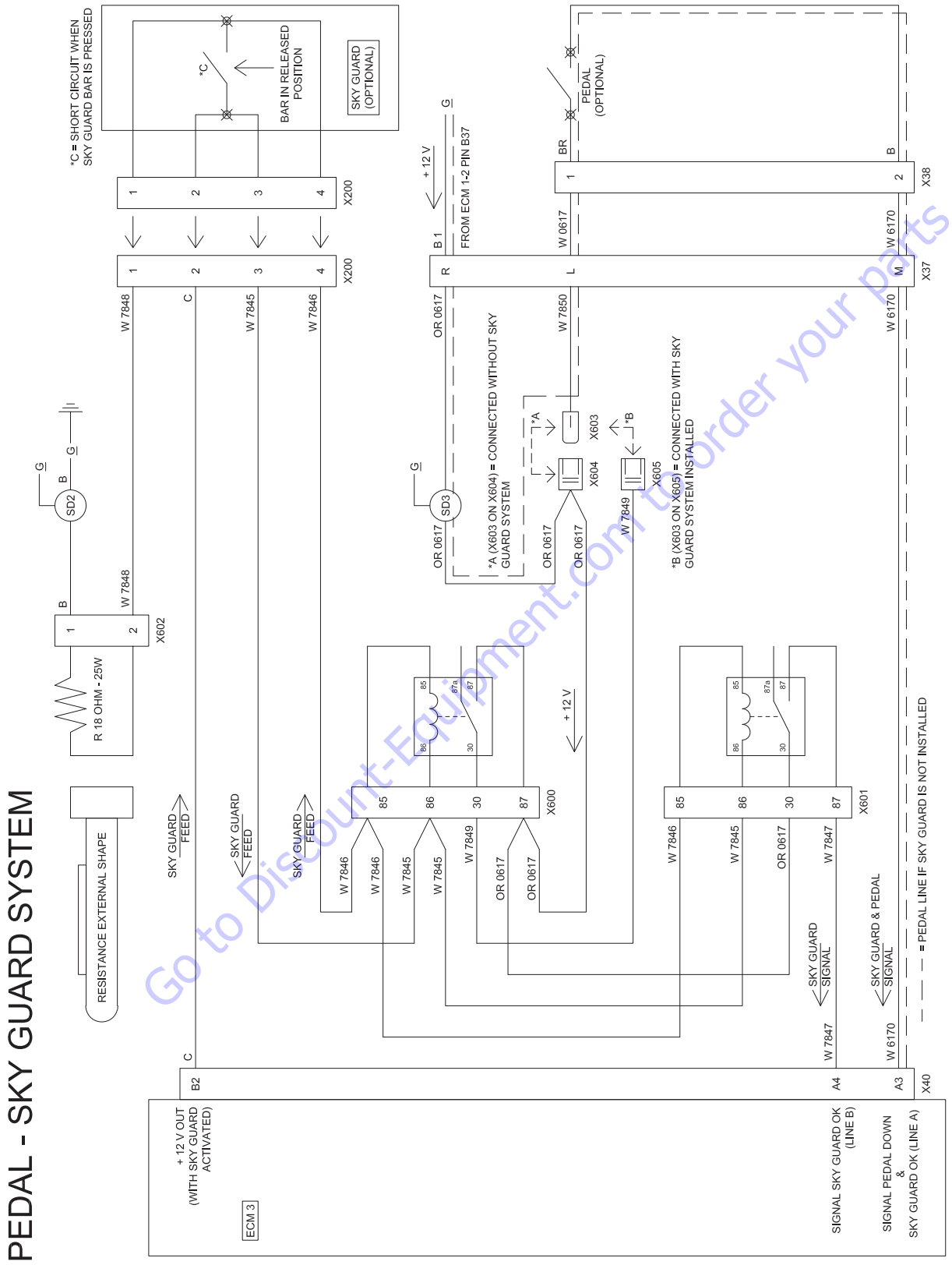


Figure 4-51. Pedal - Sky Guard System Schematic

4.11 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.

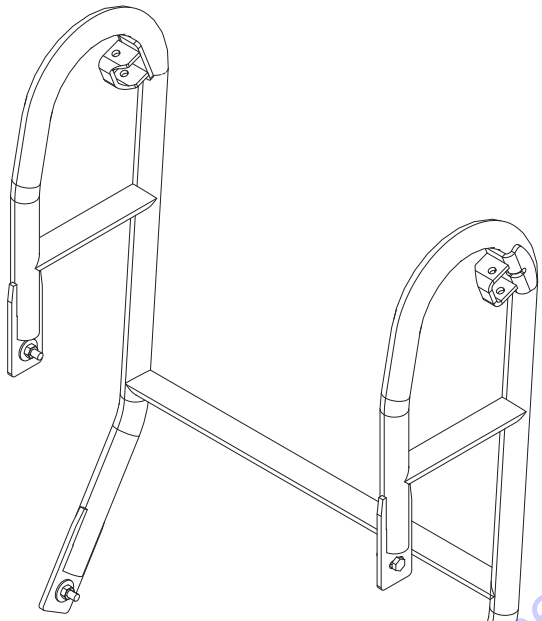


Figure 4-52. : SkyGuard Bracket with Mount

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.

Models Affected:

NOTE: *This can only be installed on machines after S/N C170000893 "With a two person basket".*

- X500AJ
- X600AJ
- X770AJ
- X17J Plus
- X20J Plus
- X26J Plus

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, 1/4-20 x 1 3/4 LG	2
2	0700812	Bolt (Metric), 8 x 25 LG	4
3	3290801	Nut, M8 x 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.

For Reference:

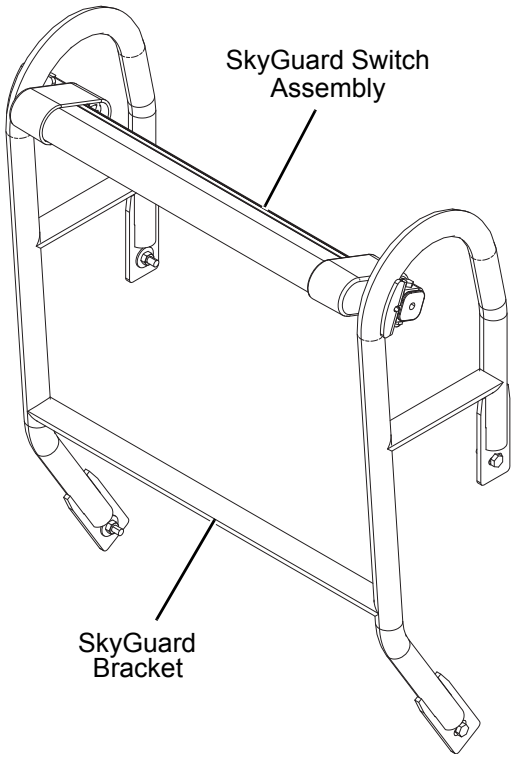


Figure 4-53. SkyGuard Bracket with SkyGuard

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 4-54.*

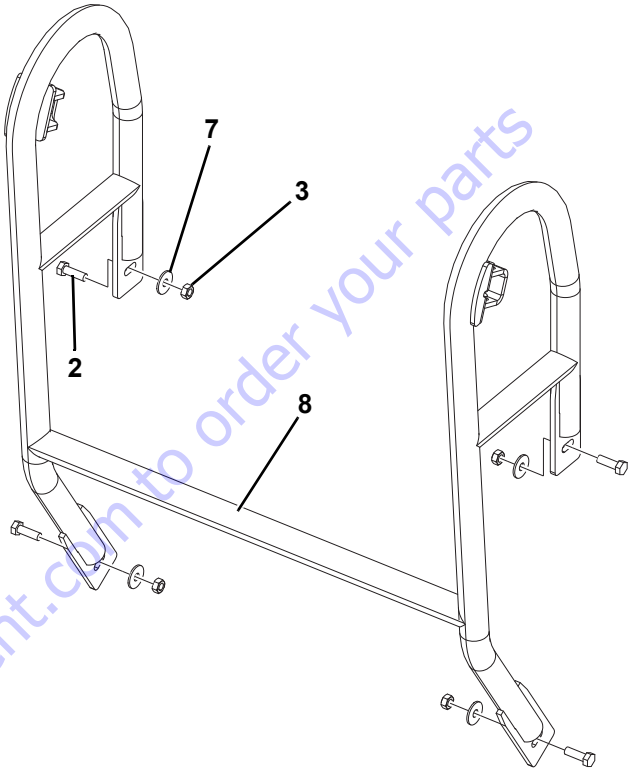


Figure 4-54.

2. Align and attach Platform Sensor Mount **(12)** onto the SkyGuard Switch **(11)** as shown in *Figure 4-55.*
3. Attach Platform Sensor Covers **(9)** to SkyGuard switch assembly at both ends. *See Figure 4-55.*

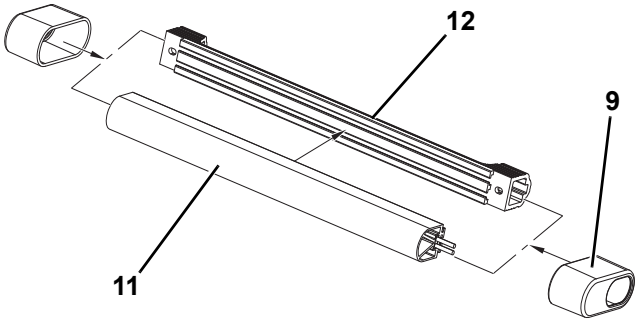


Figure 4-55.

4. Position SkyGuard switch assembly with sensor cover onto the SkyGuard Support Bracket **(8)** as shown in *Figure 4-54.*

5. Insert a Shear Block Support **(10)** through shear block housing on the SkyGuard support bracket and into the platform sensor mount. *See Figure 4-56.*

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

6. Secure the shear block on welded mount of Sky-Guard support bracket using Bolt **(1)**, relevant Washer **(6)** and Acorn Nut **(4)** as shown in *Figure 4-56.*
7. Secure the SkyGuard switch assembly using Bolt **(5)** and relevant Washer **(6)** on platform sensor mount. *See Figure 4-56.*

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 Sky-Guard support bracket ensuring correct position of the shear block support before installation.

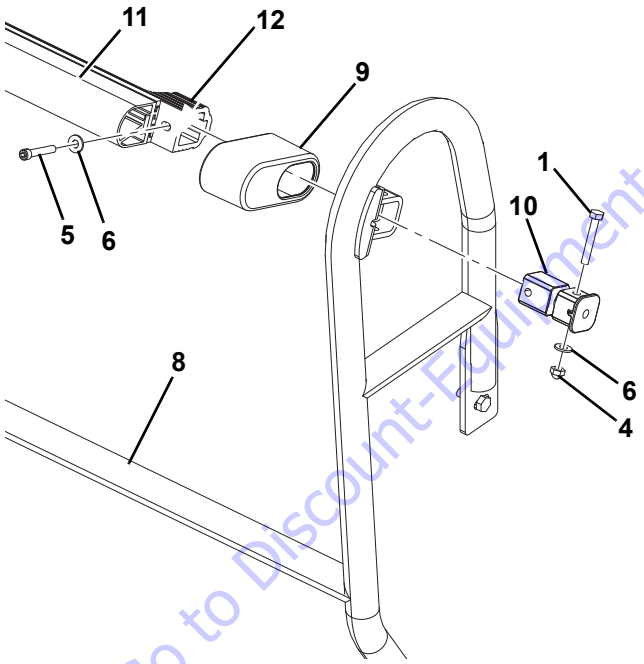


Figure 4-56.

9. Route the SkyGuard switch harness along Sky-Guard support bracket (right side) and under the platform control box. Secure the harness using tie straps. *See Figure 4-57.*

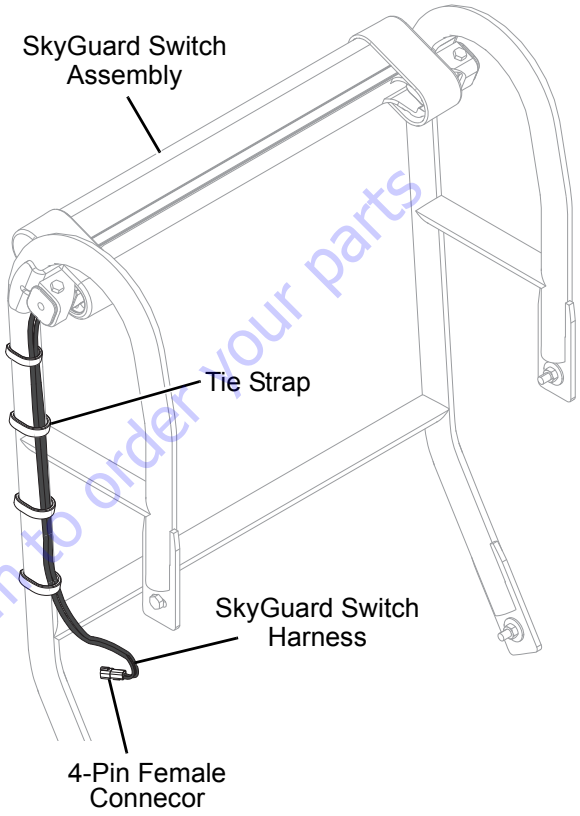


Figure 4-57.

10. Connect Sky Guard connector to the one on the machine located under load cell box. *See Figure 4-58.*

Figure 4-58.

11. Open load cell board (ECM3) box, locate connectors X604 and X603, then disconnect them. *See Figure 4-59.*

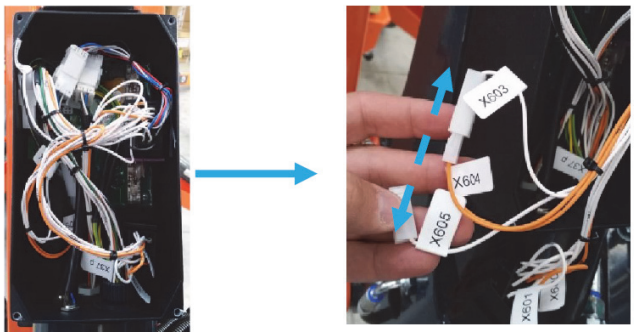


Figure 4-59.

12. Connect connector X603 to connector X605. *See Figure 4-60.*

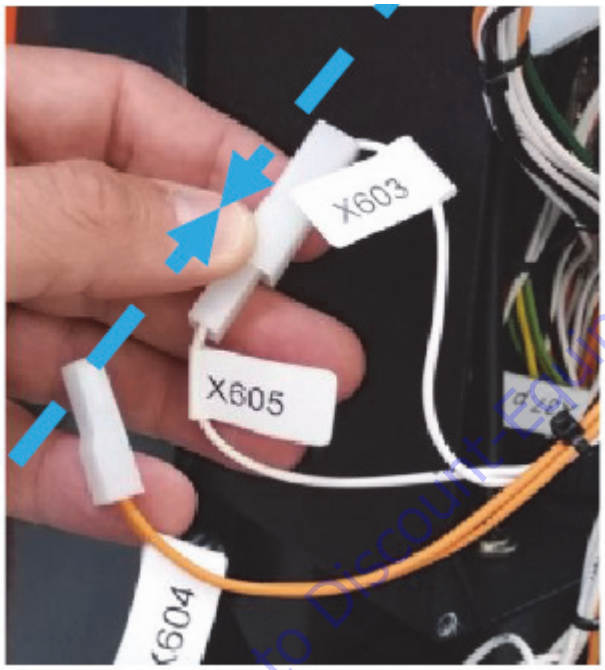


Figure 4-60.

⚠ CAUTION

WHEN THE SKYGUARD IS PUSHED WITH EXCESSIVE FORCE THE SENSOR SUPPORTS *(ITEM 10 - FIGURE 4-56.)* 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 4-61.

- 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 4-62.

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

Skyguard Anti-Trapping 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 (3 Boom) Up	Main Tele (Extension) In	Main Tele (Extension) Out	Main Swing	Drive Forward	Drive Reverse	Tower Lift (1 Boom) Up	Tower Lift (1 Boom) Down	Basket Level	Basket Rotate	Jib Lift
R	C	R	R	C	C	R	C	C	C	C
R= Indicates Reversal is Activated										
C= Indicates Cutout is Activated										

Figure 4-63. SkyGuard Function Table

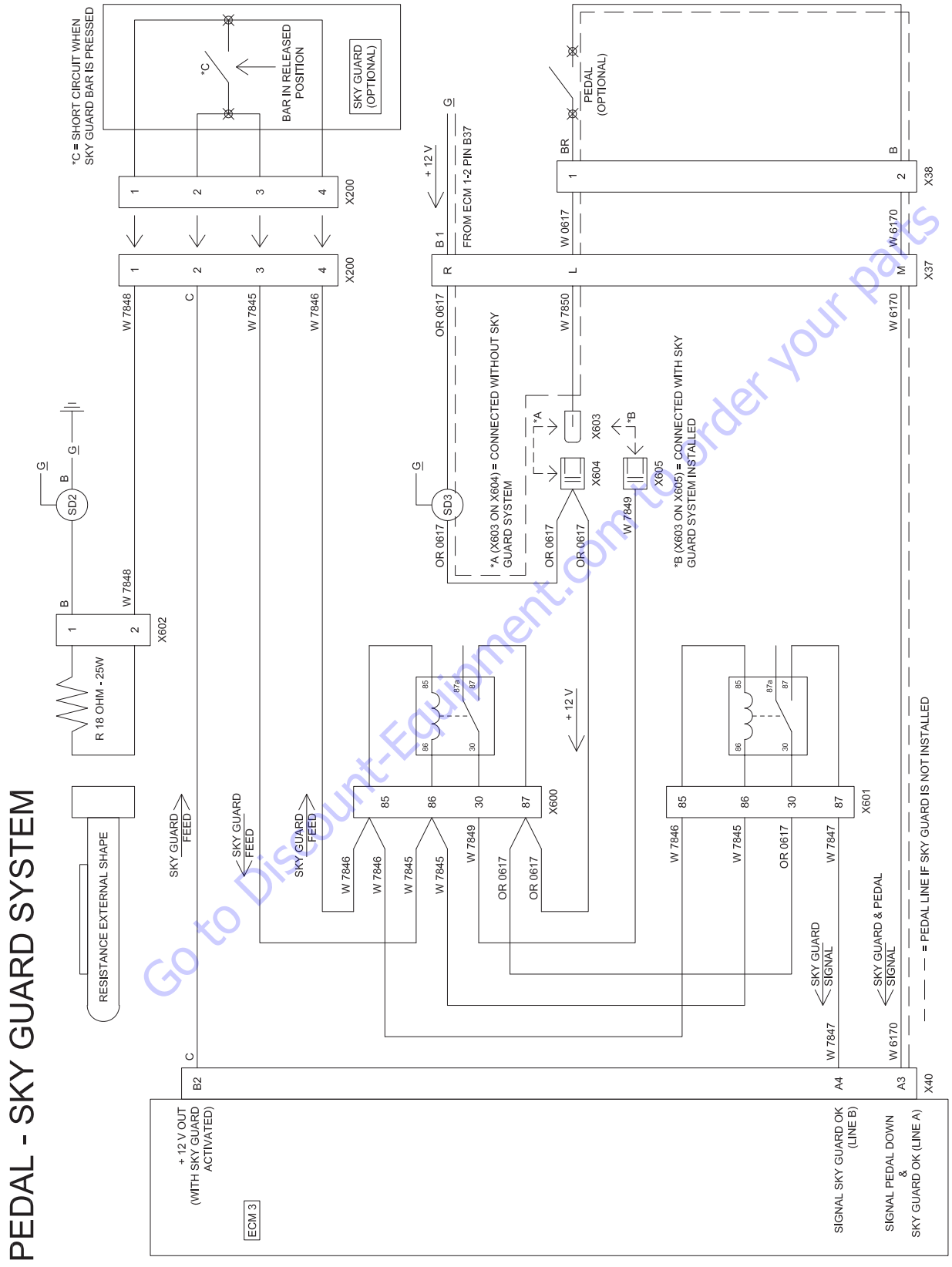


Figure 4-64. Pedal - Sky Guard System Schematic

PARTS FINDER

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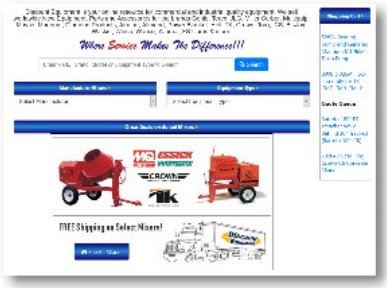

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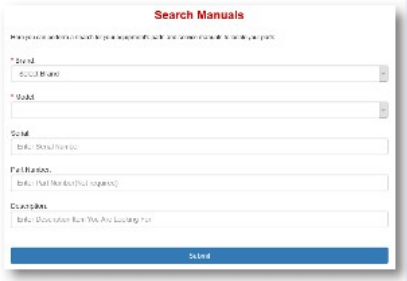

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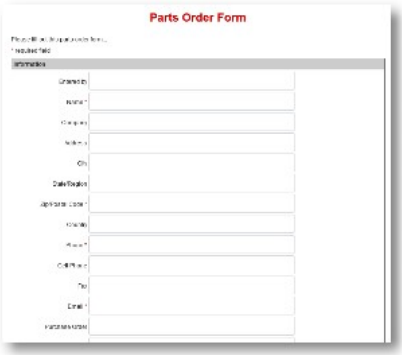

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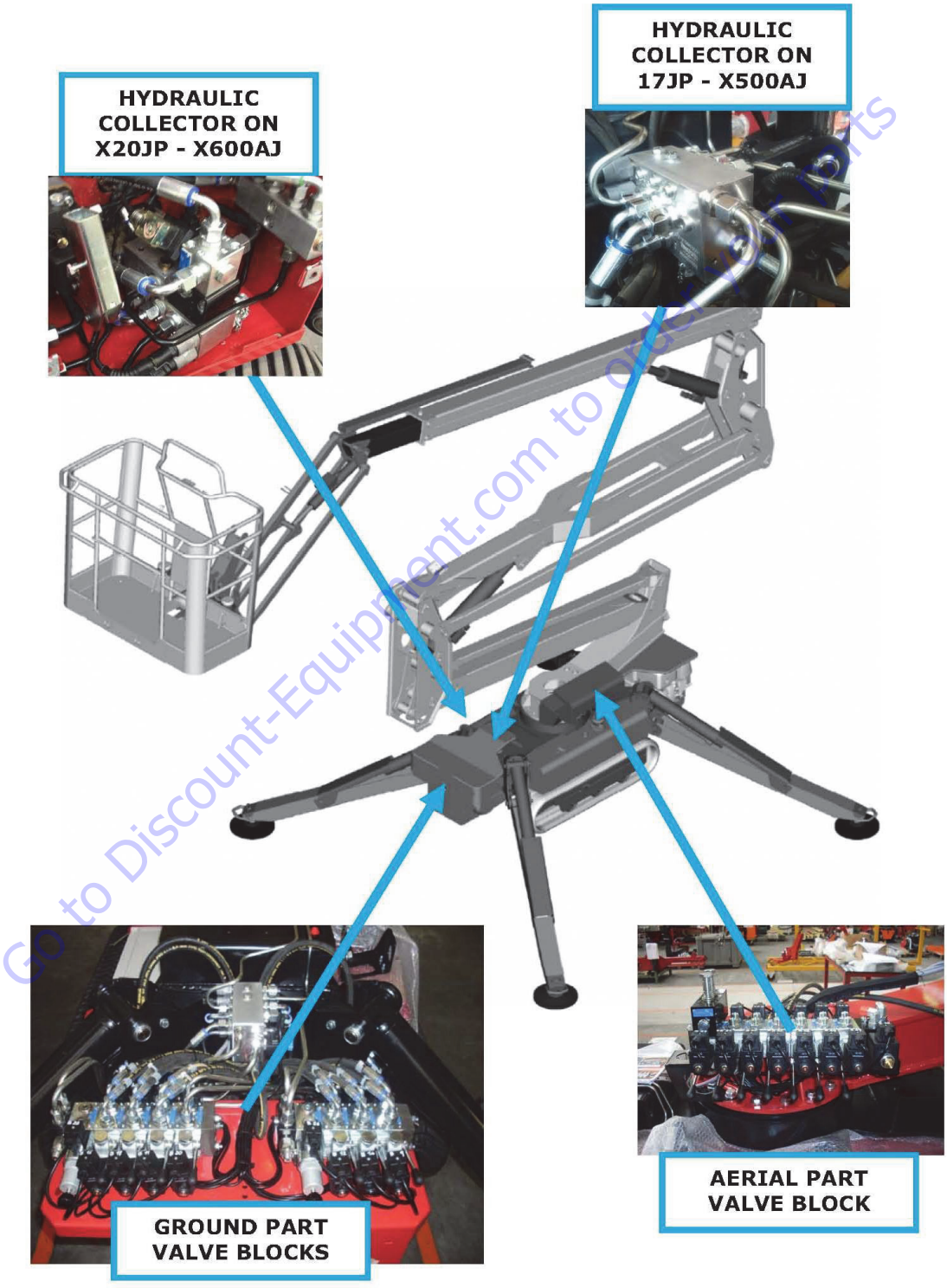
SECTION 5. HYDRAULICS

5.1 MAIN COMPONENTS IDENTIFICATION AND LOCATION

X17JP-X500AJ and X20JP-X600AJ

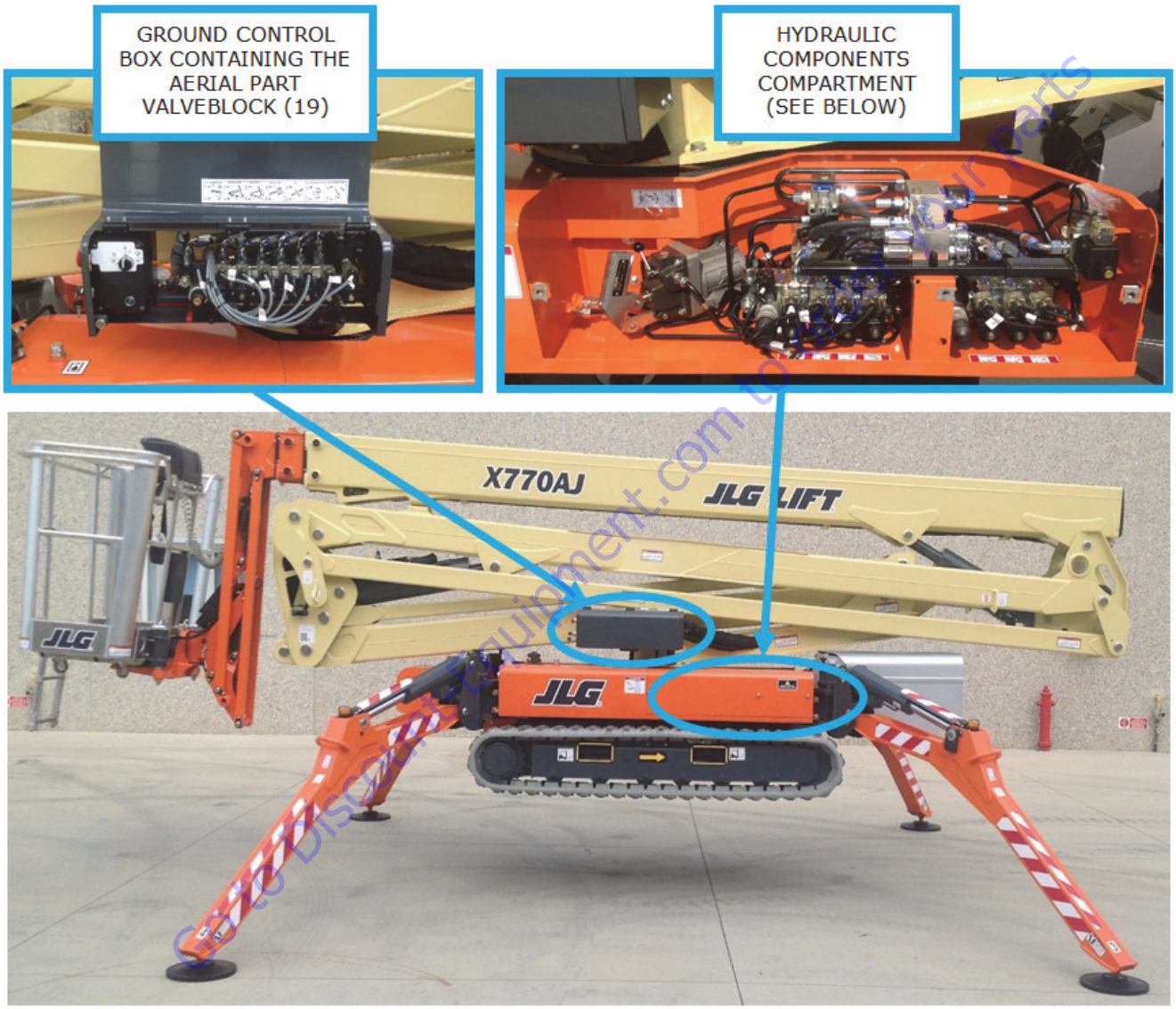


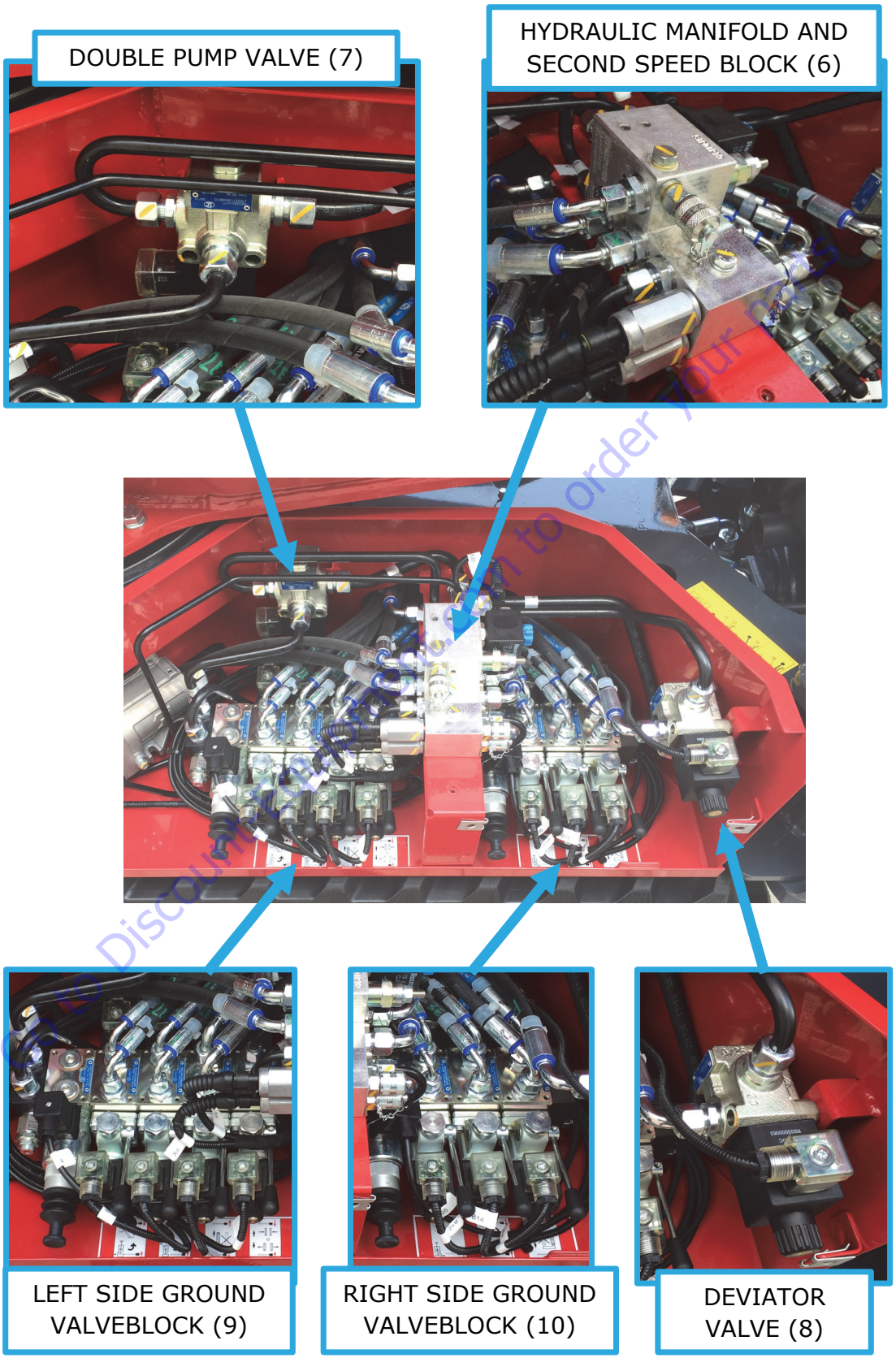
X26JP-X770AJ

The ground control box located on the right side of the machine contains the aerial part valveblock.

The hydraulic components compartment on the right side inside the bonnet contains the ground valveblocks, the hydraulic manifold, the deviator valve, the double pump valve and the hand pump.

Together with hydraulic components is indicated in brackets the relevant number on hydraulic diagram.





5.2 HYDRAULIC SYSTEM PUMP AND PRESSURE LINES

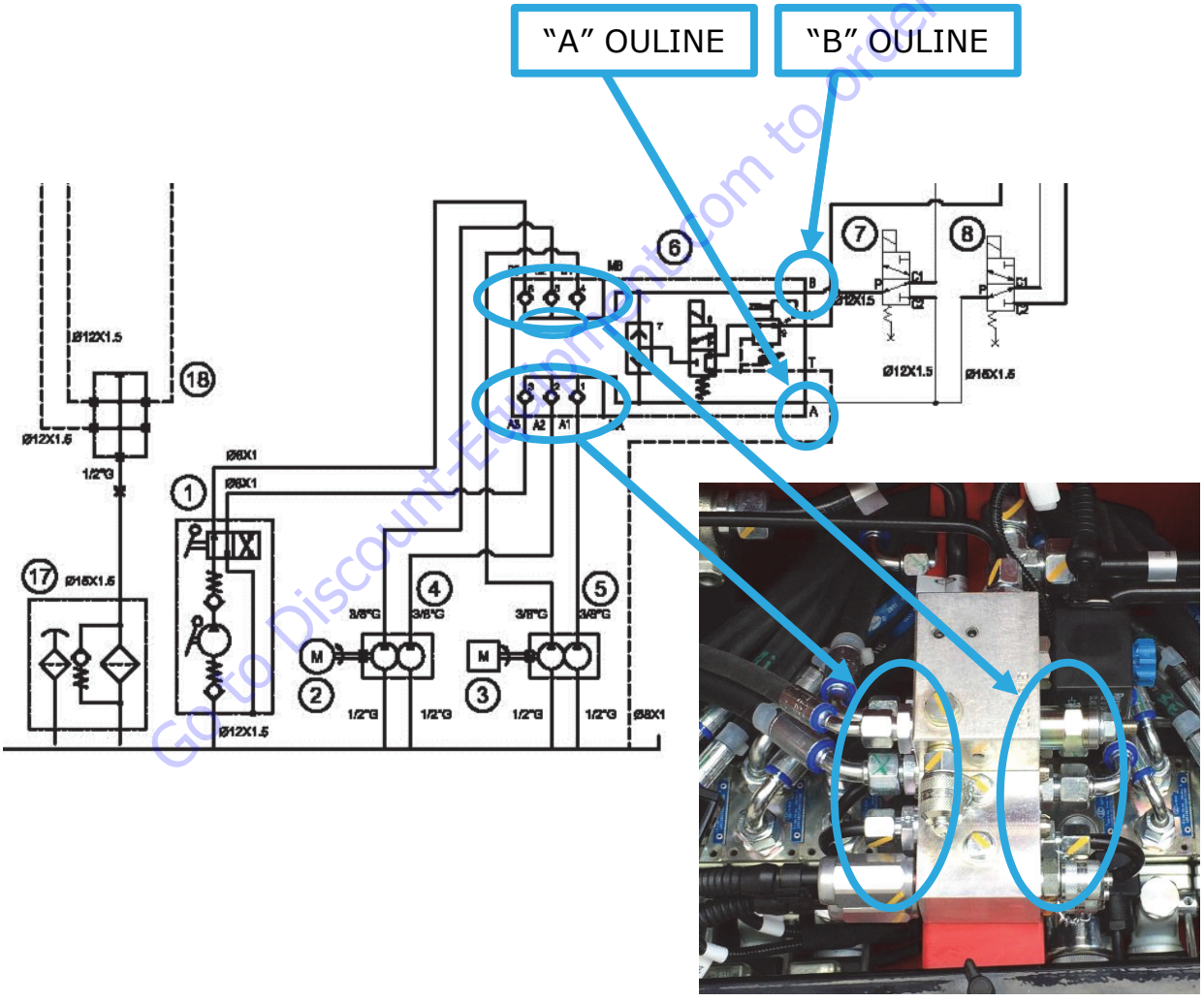
The machine hydraulic system is powered by n.3 pumps units:

- Pumps unit connected to the diesel engine, n.2 pumps 6,67cc/rev each, diesel engine is calibrated at maximum 3200 rpm
- Pumps unit connected to the electric motor, n.2 pumps 2,15 cc/rev each, electric motor is calibrated at 1500 rpm
- Emergency hand pump, this has only one outlet line but it's equipped with a deviator to select which one of the two lines should be fed

NOTE: *Lithium machine are equipped only with n.2 pumps unit, one connected to the electric motor with n.2 pumps 3,15 cc/rev each and the hand 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.

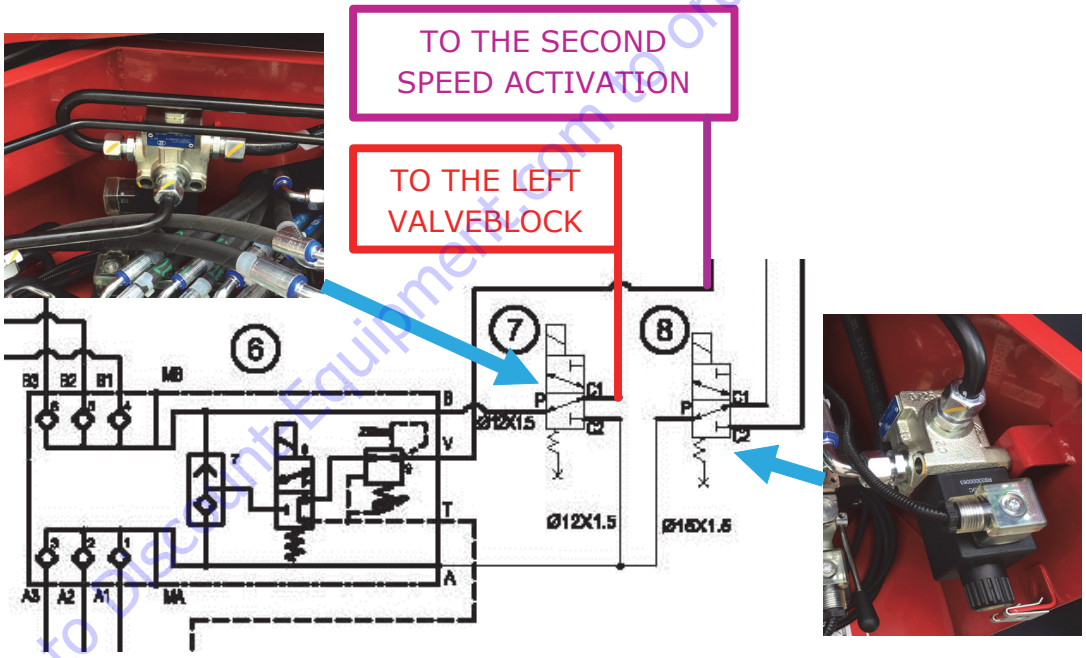
"B" pressure line sends oil under pressure to the double pump valve that normally feeds the left side ground valve-block.

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".

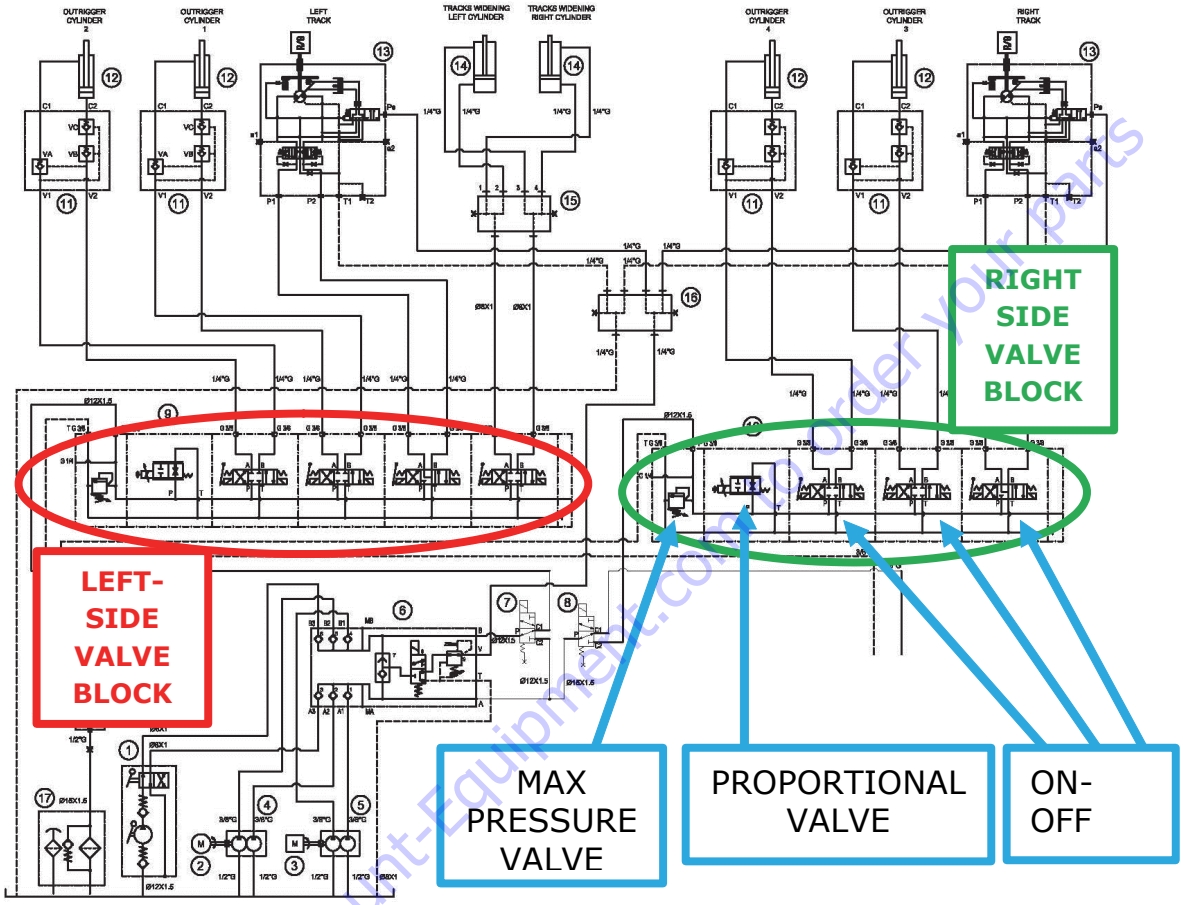


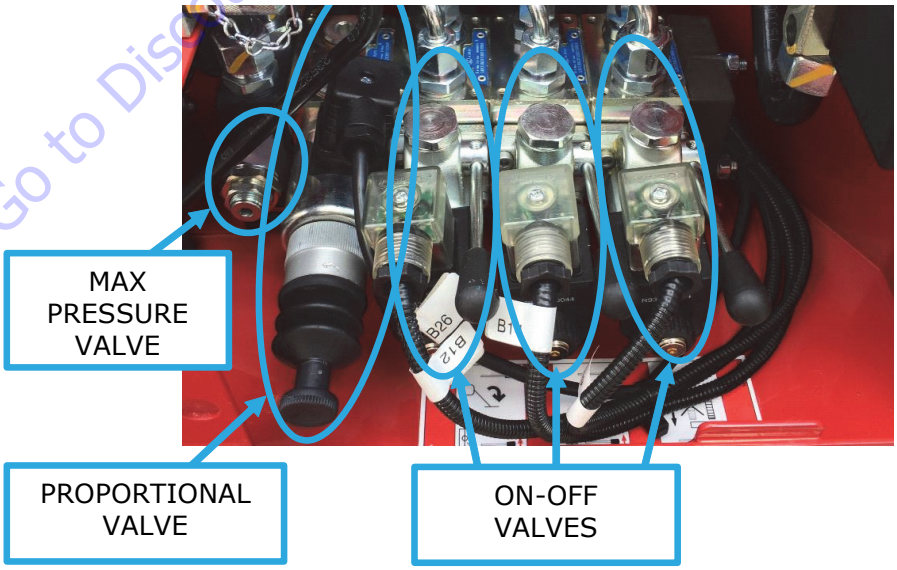
From the three valve-blocks the outgoing oil is collected by the blow-off manifold to the tank filter.

5.3 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 two hydraulic valve-blocks (right side and left side), both equipped with one maximum pressure valve, one proportional valve and an ON-OFF valve for each 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.

Left side ground valve-block controls the two left side outriggers (n.1 and n.2), the left track drive gear motor and the tracks widening cylinders.

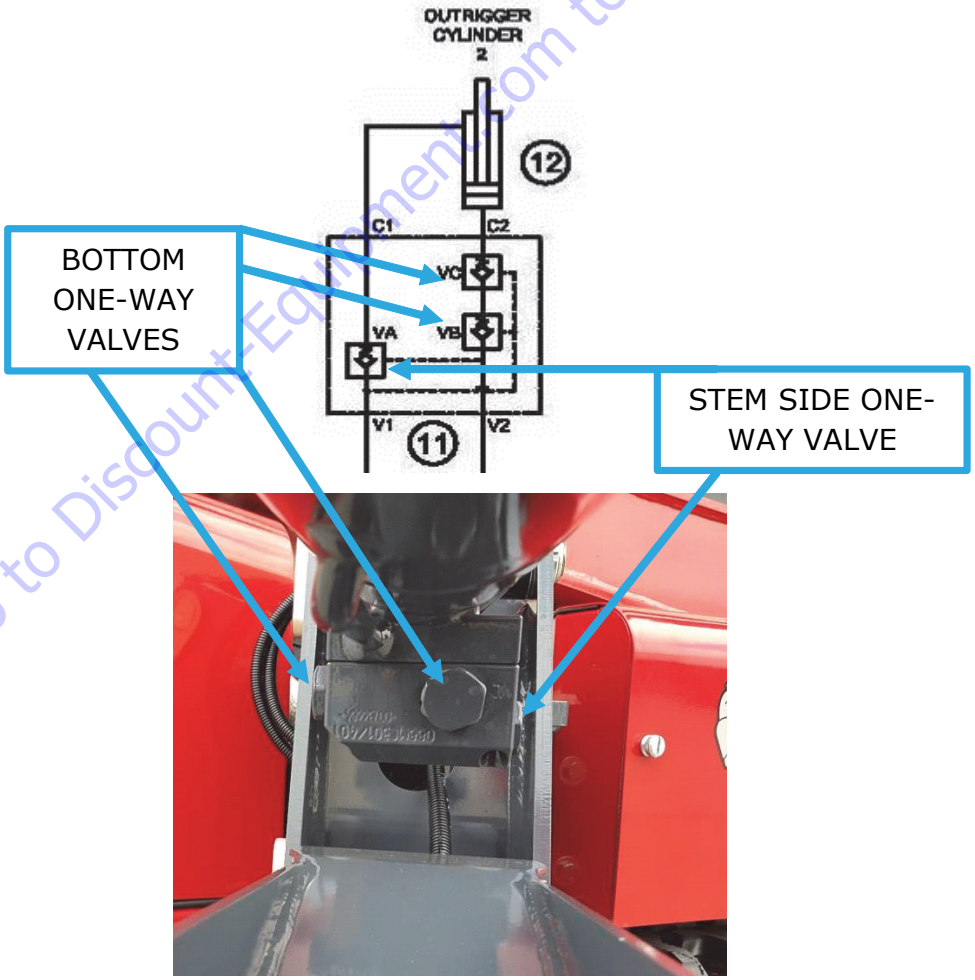
Right side ground valve-block controls the two right side outriggers (n.3 and n.4) and the right track drive gear motor.

5.4 OUTRIGGERS

Outrigger cylinders are controlled by the cylinder valves block that is screwed on the cylinder. When machine is setup on outriggers, oil is kept under pressure on the cylinder bottom side, against machine weight, by two 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.



5.5 DRIVE GEAR MOTORS

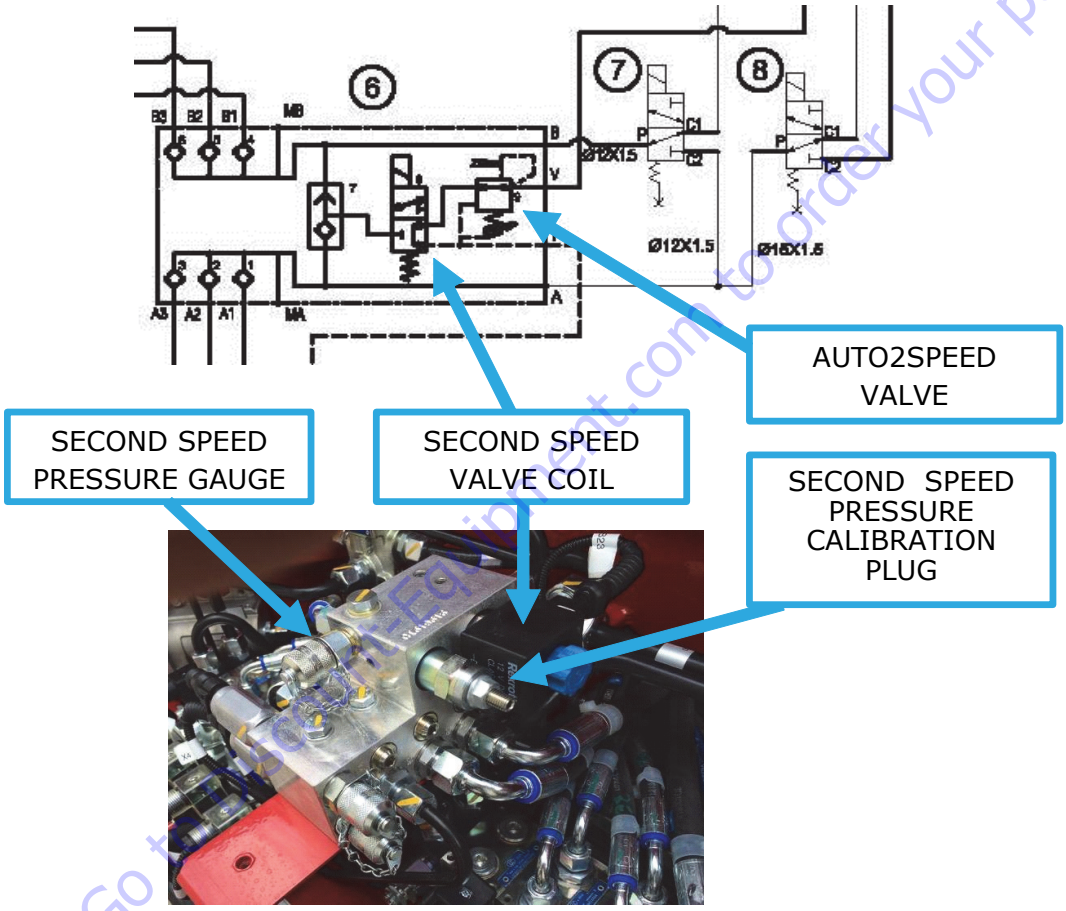
Each drive gear motors runs forward or backward independently, it's so possible to turn the machine. Drive gear motors are controlled by the ground valve-blocks and each one is equipped with an automatic brake that is hydraulically deactivated only while it runs.

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.

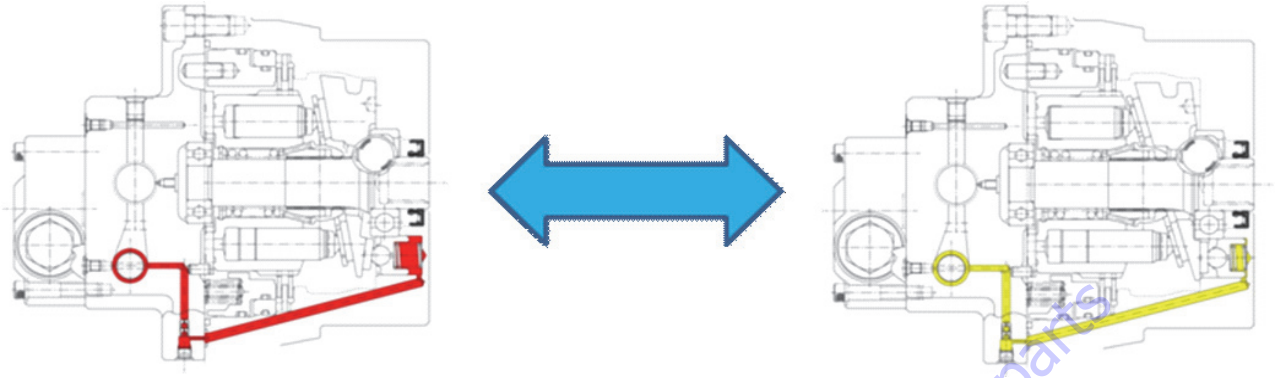
The second speed block contains the coil in charge to activate the second speed, selecting RABBIT from remote control button the control module will energize that coil.

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.



SMALLER CHAMBER:

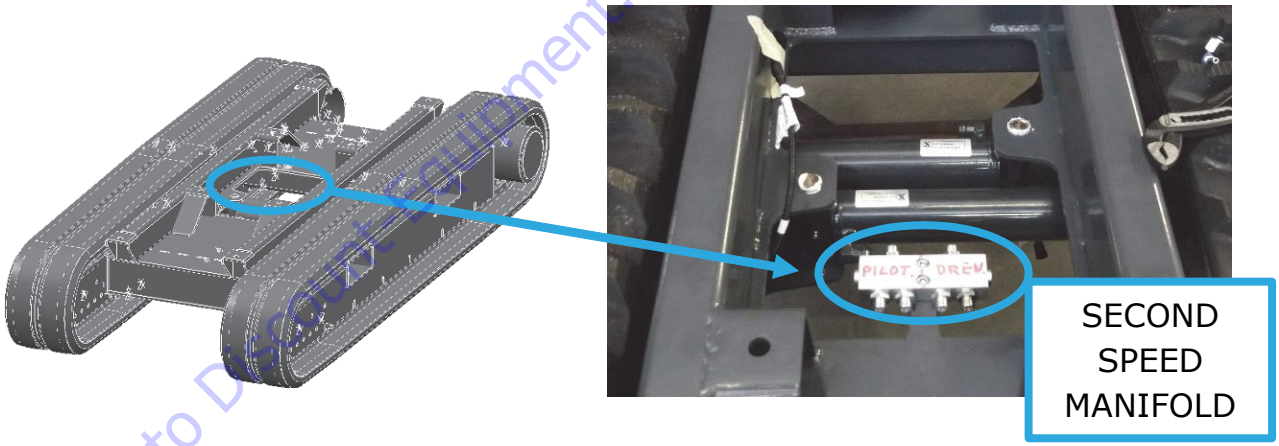
- FASTER SPEED
- SMALLER TORQUE

BIGGER CHAMBER:

- SLOWER SPEED
- HIGHER TORQUE

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).

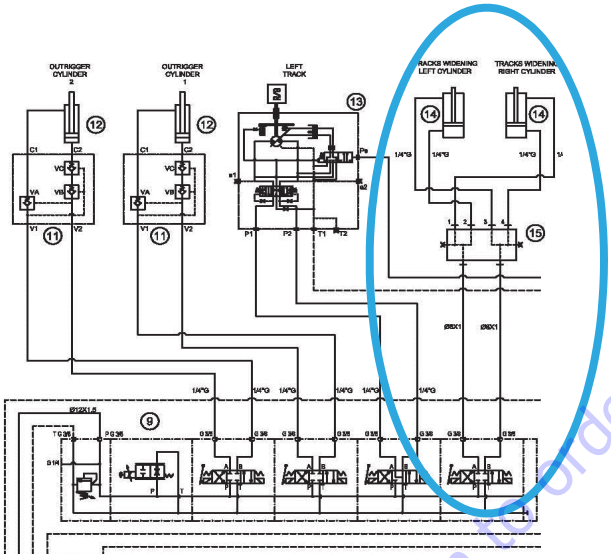
Second speed activation oil, coming from second speed valve coil, is sent to both drive gear motors through the second speed manifold.



SECOND SPEED MANIFOLD

5.6 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.

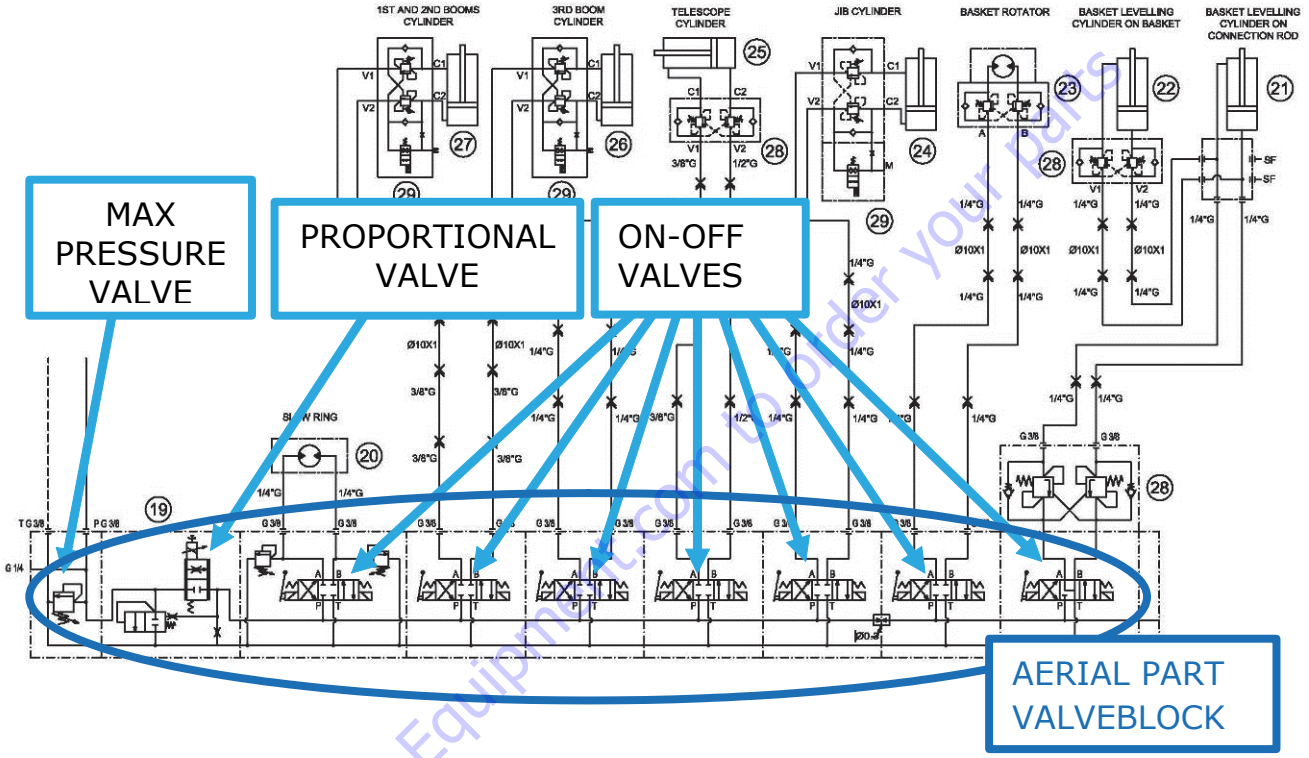


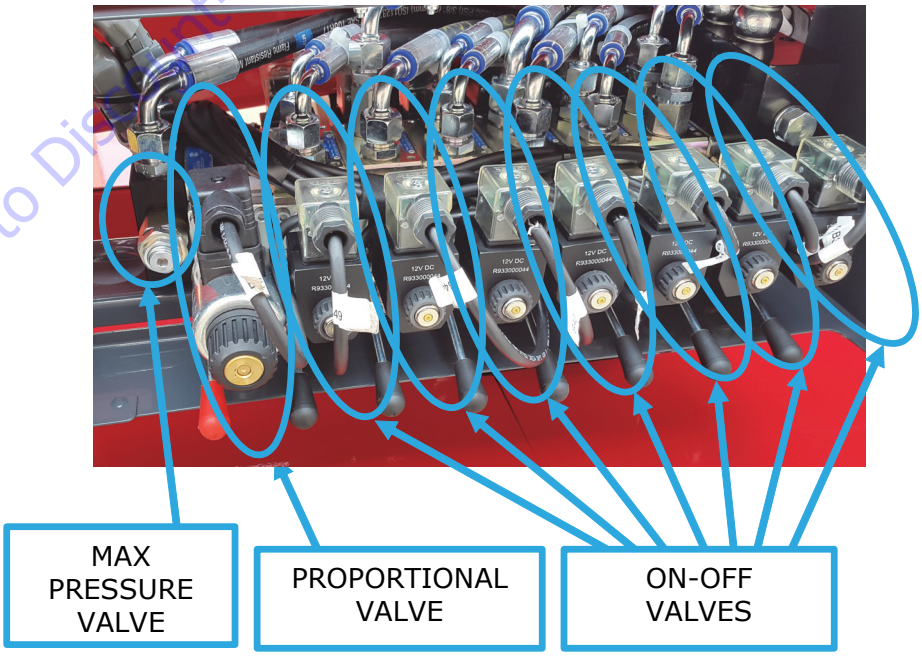
Track widening system oil is sent to both cylinders through the track widening manifold that is installed on hydraulic components compartment just below the hydraulic manifold close to blow-off manifold.

5.7 BOOM COMPONENT HYDRAULIC SYSTEM

The boom components controlled by the boom control manifold valve are, 1st/2nd boom cylinder, 3rd boom cylinder, telescope cylinder, jib cylinder, platform rotator, and platform leveling cylinders.

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





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.

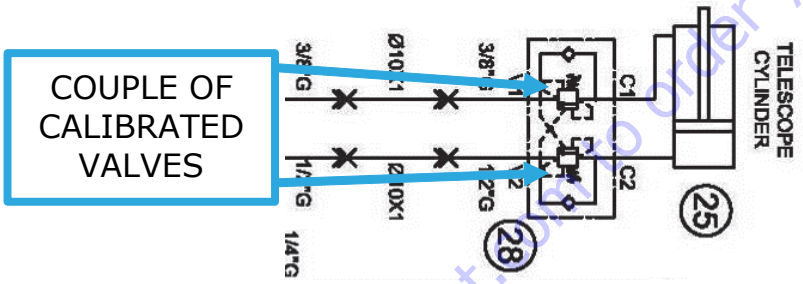
When the proportional valve coil is not fed, oil is sent to the drainage and then to the tank.

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).

Through boom component manifold valves feed the turret rotation motor, the cylinder for moving 1st and 2nd booms, the cylinder for moving the 3rd boom, the telescope cylinder, the jib cylinder, the basket rotation actuator and the basket levelling circuit.

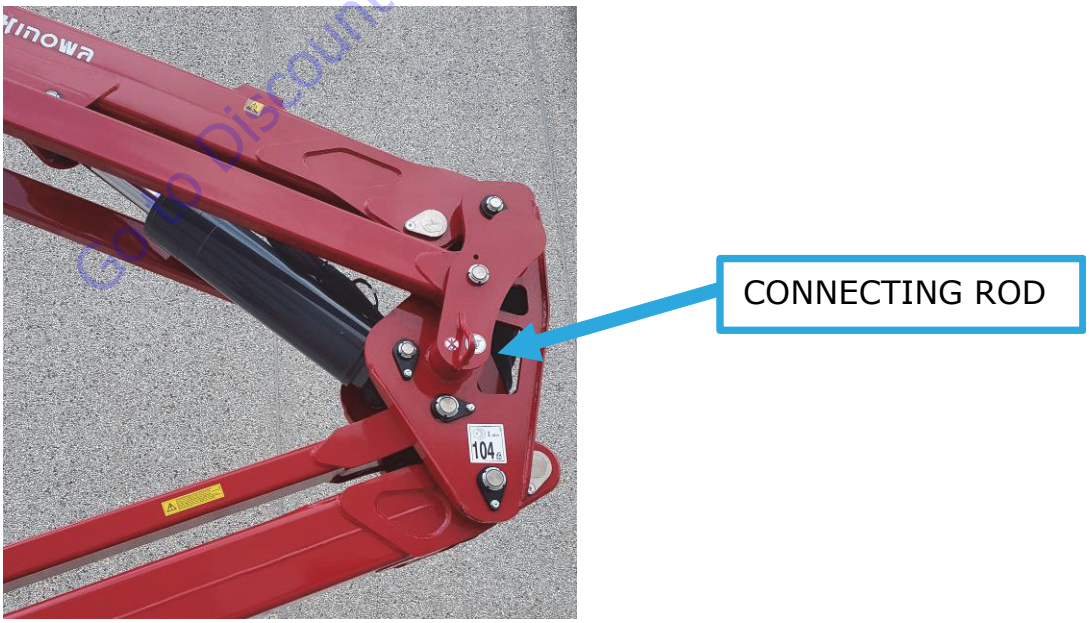
On each cylinder an actuator is installed a couple of calibrated valves, one each direction, when movement is in progress on one direction the opposite valve is piloted to open letting oil flow back to the manifold valve block.

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.



First And Second Booms

1st and 2nd booms are moved together by one cylinder through the connection rod designed to obtain a double parallelogram system, this cylinder is equipped with an internal sensor that measures its opening position.



Third Boom

Third boom is moved by one cylinder, this cylinder is equipped with an internal sensor that measures its opening position.

While lifting third boom, when it's going to reach its end of the stroke, in order to achieve a smoother machine handling, movement is automatically hydraulically decelerate by reducing the opening of proportional valve.

Telescope

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

A microswitch is in charge to detect an eventual anomalies about the ropes positions.

More details about ropes system and their maintenance are indicate on use and maintenance manual.

Jib

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

Basket Leveling

Basket levelling close circuit is composed by two cylinders, one on the basket and one on the third boom connection rod, basket is automatically kept levelled while third boom is moving because of the basket cylinder is moved by connection rod cylinder.

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

Of course is possible to adjust basket levelling acting on its joystick.

Basket Rotation

Basket rotation is carried out by the basket 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 basket aligned position.

Turret 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.

Emergency Gravity Descent System

Cylinders for 1st and 2nd booms, 3rd boom and jib are equipped with a coil valve for gravity emergency descent, they are controlled by the control module when the remote control button "gravity emergency descent" is pressed.

When they are fed they open a calibrated passage and under the gravity effect (weight) they will allow oil to get out from the bottom of the cylinder flowing back to the tank (through the ON-OFF valves), so that booms will slow down.

The coil valve for gravity emergency descent has a blue cap.

Hydraulic System Sections

The hoses that start from the boom component manifold valves and go through the booms are sectionized with fittings inside the second boom where is indicated by the blue arrow here below.

Other sectioning points are on the catenary, at the beginning and at the end of the rigid pipes and are attached to the hoses coming from the lower booms and the hoses going to the jib arm.

5.8 CYLINDER REPAIR

Specification - Cylinders Overview

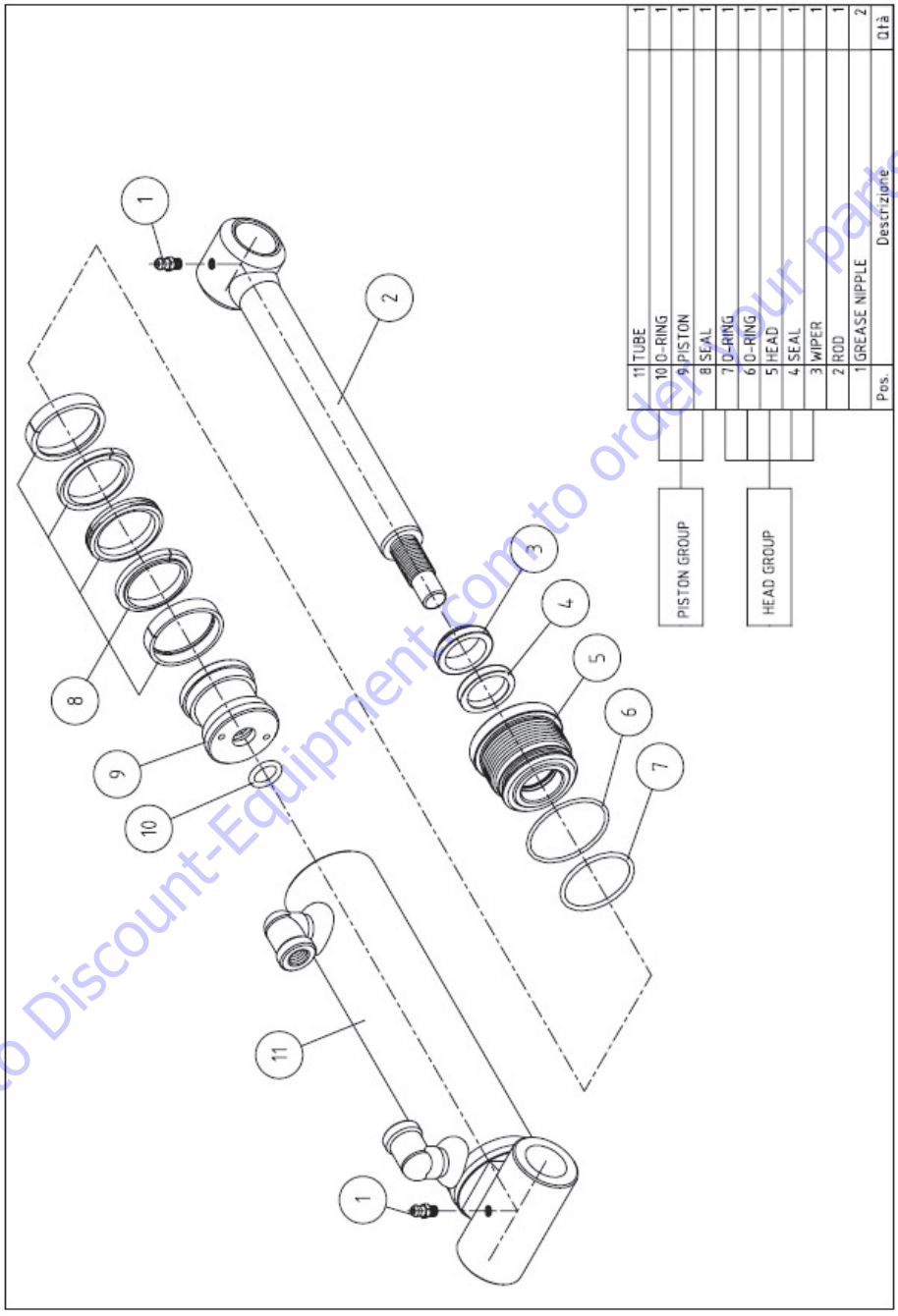


Figure 5-1. Piston Thread