An Oshkosh Corporation Company

Service and Maintenance Manual

Models
X14J - X390AJ
X17J
X19J - X550AJ
X23J - X700AJ

PN 3121448

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ANSI

CE

An Oshkosh Corporation Company

SECTION 1. INTRODUCTION - MAINTENANCE SAFETY PRECAUTIONS

1.1 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.

A 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.

B 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

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SECTION 1. SPECIFICATIONS

1.1 CAPACITIES

Table 1-1. DRIVE HUB CAPACITIES

TYPE DRIVE HUB	SPEED	MACHINE	CAPACITIES
BOGFIGIOLI 7C 00 1 G 40 HC0 5.25 065RT01P3WHLZ	1V	X14JH X14J-X390AJ	0,340 kg (0,75 lbs)
BOGFIGIOLI 7C 00 1 G 40 HC0 5.25 080RT01P3WILA	1V	X17J X19J-X550AJ	0,340 kg (0,75 lbs)
BOGFIGIOLI 7C 00 1 G 40 HC0 5.25 080RT01P3WILA	2V	X23J-X700AJ	0,620 kg (1,37 lbs)
EATON	2V	X14JH X17J X14J-X390AJ X19J-X550AJ	NO OIL

Table 1-2. HYDRAULIC & FUEL TANK CAPACITIES

MACHINE	HYDRAULIC OIL TANK CAPACITY	FUEL TANK	
		GASOLINE	DIESEL
X14JH	5,49 gal (25L)	1.4 gal (5L)	1.3 gal (5L)
X14J-X390AJ	5,49 gal (25L)	1.4 gal (5L)	1.3 gal (5L)
X17J	5,49 gal (25L)	1.5 gal (5.9L)	1.3 gal (5L)
X19J-X550AJ	5,49 gal (25L)	1.5 gal (5.9L)	1.3 gal (5L)
X19J-X550AJ	10,55 gal (48L)	1.5 gal (5.9L)	3.4 gal (13L)

1.2 TRACKS

Table 1-3. Track Specifications

MODEL MACHINE	TRACK DIMENSIONS
X14JH	180x37x72
X14J-X390AJ	
X17J	
X19J-X550AJ	
X23J-X700AJ	230x39x96

Table 1-4. Ground bearing pressure

PRESSURES AND REACTIONS TO THE GROUND								
MODEL	ON TRACKS				ON OUTRIGGER			
	Reaction [daN] - [lbf]		Pressure [daN/cm^2] - [PSI]		Reaction [daN] - [lbf]		Pressure [daN/cm^2] - [PSI]	
X14J-H	1670 daN	3754 lbf	0,5 daN/cm^2	7,11 PSI	1330 daN	2898 lbf	1,9 daN/cm^2	27 PSI
X14J	1400 daN	3147 lbf	0,4 daN/cm^2	5,69 PSI	1200 daN	2697 lbf	1,7 daN/cm^2	24.1 PSI
X390AJ	1658 daN	3727 lbf	0,5 daN/cm^2	7,11 PSI	1200 daN	2697 lbf	1,7 daN/cm^2	24.1 PSI
X17J	2100 daN	4720 lbf	0,62 daN/cm^2	8,82 PSI	1450 daN	3259 lbf	2,0 daN/cm^2	28.4 PSI
X19J - X550AJ	2100 daN	4720 lbf	0,62 daN/cm^2	8,82 PSI	1330 daN	2989 lbf	1,9 daN/cm^2	27 PSI
X23J - X700AJ	3000 daN	6744 lbf	0,48 daN/cm^2	6,83 PSI	2100 daN	4720 lbf	3 daN/cm^2	42,6 PSI

1.3 ENGINE DATA

NOTE: *RPM Tolerances are ± 50.*

HONDA ENGINE GX270 - GX390

Table 1-5. SPECIFICATIONS HONDA ENGINE GX270-GX390

Model	GX270	GX390UT2
Description code		GCBCT
Type	4 stroke, overhead valve, single cylinder, inclined by 25°	
Displacement	270 cm^3 (16.5 cu–in)	389 cm^3 (23.7 cu–in)
Bore x stroke	77.0 x 58.0 mm (3.0 x 2.3 in)	88.0 x 64.0 mm (3.5 x 2.5 in)
Net power (SAE J1349)*1	6.7 kW (9 HP) / 3,600 min-1 (rpm)	8.7 kW (11.7 HP) / 3,600 min-1 (rpm)
Continuous rated power		7.0 kW (9.4 HP) / 3,600 min-1 (rpm)
Maximum net torque (SAE J1349)*1	19.5 N·m (1.95 kg·m, 14ft·lb) / 2,500 min-1 (rpm)	26.5 N·m (2.7 kgf·m, 19.5 lbf·ft) / 2,500 min-1 (rpm)
Compression ratio	8.2 : 1	8.2 ± 0.2: 1
Fuel consumption (at continuous rat-ed power)	313 g/kWh (230 g/HPh, 0,51 lb/HPh)	3.5 Liters (0.92 US gal, 0.77 Imp gal) / h
Ignition system	C.D.I.(Capacitor Discharge Ignition) type magneto ignition	
Ignition timing	B.T.D.C. 20° (fixed)	B.T.D.C. 10° / 1,400min-1 (rpm)
Spark advancer performance		B.T.D.C. 10°- 22°
Spark plug	BPR6ES (NGK) / W20EPR-U (DENSO)	
Lubrication system	Forced splash	
Oil capacity	1.1 Liters (1.16 US qt, 0.97 Imp qt)	
Recommended oil	SAE 10W-30 API service classification SE or later	
Cooling system	Forced air	
Starting system	Ignition exciter coil circuit open	
Carburetor	Horizontal type, butterfly valve	
Air cleaner	Dual element type, Cyclone type, Oil bath type, Low profile type	
Governor	Mechanical centrifugal	
Breather system	Reed valve type	
Fuel used	Unleaded gasoline with a pump octane rating 86 or higher	

HONDA ENGINE IGX440

Table 1-6. 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 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)

HATZ ENGINE 1B30 - 1B40

Table 1-7. SPECIFICATIONS HATZ ENGINE 1B30-1B40

Type		1B30	1B40
Design		Air-cooled four-stroke diesel engine	
Combustion system		Direct injection	
Number of cylinders		1	1
Bore / stroke	mm	80 / 69	88 / 76
Displacement	cm3	347	462
Lubricating oil capacity without oil sump with oil sump	l, approx. l, approx.	1.1 [1)] 2.8 [1)]	1.5 [1)] 3.2 [1)]
Difference between “max” and “min” levels without oil sump with oil sump	l, approx. l, approx.	0.5 [1)] 1.8 [1)]	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	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.	40	55
Battery capacity	Amp/h	max. 12 V / 60 Amp/h	

PERKINS ENGINE 402D

Table 1-8. SPECIFICATIONS PERKINS ENGINE 402D

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

1.4 SPECIFICATIONS AND PERFORMANCE DATA

Reach Specifications

Table 1-9. Reach Specifications

	X14J	X14J-H	X17J	X19J	X23J
Platform Height w 120 kg capacity	11.80 m	11.90 m	14.81 m	16.67 m	21.10 m
Platform Height w 200 kg capacity	10.15 m	10.58 m	13.12 m	14.96 m	19.70 m
Horizontal Outreach (Std Platform w 120kg)	6.26 m	6.50 m	7.68 m	5.90 m	11.13 m
Horizontal Outreach (Std Platform w 200kg)	5.42 m	5.16 m	6.45 m	4.30 m	9.75 m
Up & Over Height w 120 kg	5.58 m	5.84 m	6.08 m	7.66 m	9.38 m
Up & Over Height w 200 kg	5.52 m	4.56 m	5.86 m	6.23 m	7.96 m
Swing (non continuous)	361°	300°	361°	361°	361°
Jib - overall length	1.56 m	1.30 m	1.43 m	1.43 m	1.43 m
Jib - range of articulation (+/-)	83° (+0° / -83°)	80° (+0°/-80°)	88° (-2° / -90°)	83° (+0° / -83°)	85° (-1° / -86°)

Dimensional Data

Table 1-10. Dimensional data

	X14J	X14J-H	X17J	X19J	X23J
Platform size (standard 2 persons)	0.69 m x 1.30 m	0.62 m x 1.30 m	0.62 m x 1.30 m	0.69 m x 1.30 m	0.69 m x 1.30 m
Platform size (narrow one person)	0.59 m x 0.79 m	0.69 m x 0.79 m	0.62 m x 0.79 m	0.59 m x 0.79 m	0.59 m x 0.79 m
Stowed width (with std. 2P platform)	1.48 m	1.46 m	1.31 m	1.48 m	1.48 m
Stowed width (without platform)	0.79 m	0.79 m	0.79 m	0.79 m	0.79 m
Stowed height (on tracks)	2.07 m	1.98 m	1.99 m	1.98 m	1.99 m
Stowed length (on tracks)	4.02 m	3.97 m	4.53 m	4.47 m	6 m
Outrigger footprint	2.87 m x 2.91 m	2.70 m x 2.70 m	2.89 m x 2.88 m	2.89 m x 2.88 m	3.98 m x 3.98 m
Machine weight (with standard platform)	1,398 kg	1,700 kg	2,100 kg	2,080 kg	2,990 kg
Operating weight (with petrol engine)	1,430 kg	1,740 kg	2,152 kg	2,106 kg	3,100 Kg
Maximum ground bearing pressure (on outriggers)	1.73 kg/cm^2	1.94 kg/cm^2	2.09 kg/cm^2	1.94 kg/cm^2	3.06 kg/cm^2
Maximum ground bearing pressure (on tracks)	0.41 kg/cm^2	0.51kg/cm^2	0.63 kg/cm^2	0.63 kg/cm^2	0,49 kg/cm^2
Maximum drive speed (single speed m/c) Petrol	1.4 km/h	1.4 km/h	1,7 Km/h	1,7 Km/h	
Maximum drive speed (two speed m/c) Petrol	2.8 km/h	2.8 km/h	3,3 Km/h	3,3 Km/h	1 / 1,7 Km/h

Chassis

Table 1-11. Chassis specifications

	X14J	X14J-H	X17J	X19J	X23J
Gradeability	36%	33.5%	36%	38%	40%
Maximum operating slope	10°	10°	11°	11°	13
Max. Approach / Depart angles	Front 20° / Rear 20°	Front 24.5° / Rear 18.5°	Front 20° / Rear 21°	Front 21° / Rear 21°	Front 22° / Rear 25°
Track size - McLaren low profile black rubber	1.24 m x 0.18 m x 0.30 m	1.24 m x 0.18 m x 0.30 m	1.24 m x 0.18 m x 0.30 m	1.24 m x 0.18 m x 0.30 m	
Track size - Bridgestone high profile black rubber					1.76 m x 0.23 m x 0.38 m
Width of Undercarriage (Retracted/ Extended)	0.79 m / 0.79 m	0.79 m / 1,09 m	0.79 m / 1,09 m	0.79 m / 1,09 m	0.99 m / 1,29 m
AC electric motor	110V or 220V, 50Hz, 2.2kW	110V or 220V, 50Hz, 2.2kW	110V or 220V, 50Hz, 2.2kW	110V or 220V, 50Hz, 2.2kW	110V or 220V, 50Hz, 2.2kW

1.5 FUNCTION SPEEDS

Table 1-12. Function Speed (in seconds)

FUNCTIONS SPEED RANGE				
FUNCTION	TIME Sec X14J X390AJ	TIME Sec X17J	TIME Sec X19J X550AJ	TIME Sec X23J X700AJ
TELESCOPE EXTEND	21″ - 23″	26″ - 30″	21″ - 23″	45″ - 46″
TELESCOPE RETRACT	13″ - 15″	16″ - 20″	16″ - 18″	29″ - 45″
TOWER BOOM UP	18″ - 21″	24″ - 28″	28″ - 30″	50″ - 60″
TOWER BOOM DOWN	16″ - 20″	24″ - 28″	27″ - 29″	56″ - 70″
UPPER BOOM UP	25″ - 27″	24″ - 28″	29″ - 31″	48″ - 57″
UPPER BOOM DOWN	25″ - 27″	24″ - 28″	31″ - 33″	60″ - 70″
BASKET ROTATE RIGHT	//	9″ - 13″	7″ - 9″	7″ - 9″
BASKET ROTATE LEFT	//	9″ - 13″	7″ - 9″	7″ - 9″
SWING LEFT	1.00″ - 1.06″	58″ - 62″	41″ - 47″	1.20″ - 1.40″
SWING RIGHT	1.00″ - 1.06″	58″ - 62″	41″ - 47″	1.20″ - 1.40″
JIB UP	8.5″ - 10″	6″ - 10″	16″ - 25″	14″ - 25″
JIB DOWN	8.5″ - 10″	7″ - 11″	11″ - 13″	10″ - 13″
BASKET LEVEL UP	7″ - 11″	11″ - 15″	37″ - 39″	37″ - 39″
BASKET LEVEL DOWN	10″ - 13″	9″ - 15″	27″ - 29″	27″ - 37″
Drive Forward/Reverse				
Low Speed m/s	0.39″	0.47″	0.47″	0.28″
High Speed m/s	0.78″	0.92″	0.92″	0.47″

Machine Orientation When Doing 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. Results should be recorded for a 100 ft. (30.96 m) course. Drive Forward, record time. Drive Reverse, Record Time.

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).

1.6 PRESSURE SETTINGS - PSI (BAR)

Table 1-13. Pressure Settings

Model	UNDERCARRIAGE Left / Right Control Valve		TOWER Control Valve		BASKET Control Valve		Automatic reductions drive speed	
	Bar	PSI	Bar	PSI	Bar	PSI	Bar	PSI
X14JH	175	2540	180	2610	210	3050		
X14JH - X390AJ	165	2400	165	2400				
X17J	165	2400	180	2610	210	3050		
X19J - X550AJ	165	2400	215	3120				
X23J - X700AJ	160	2320	185	2685			26	380

1.7 SERIAL NUMBER LOCATION

A serial number plate is affixed on to the frame or the basket A frame. The following illustrations showing the position on each model.

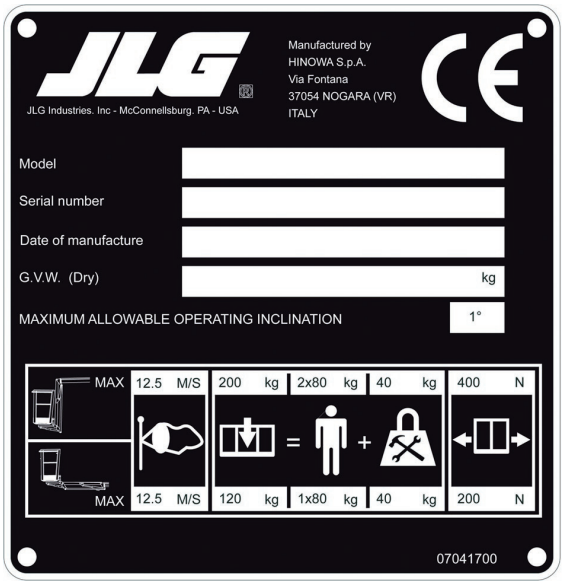


Figure 1-1. Plate...

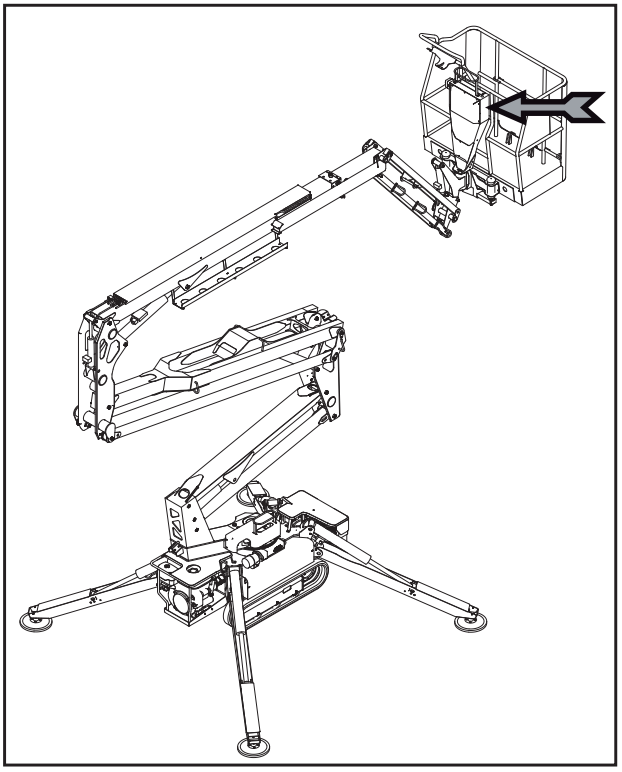


Figure 1-2. Plate location on X17J

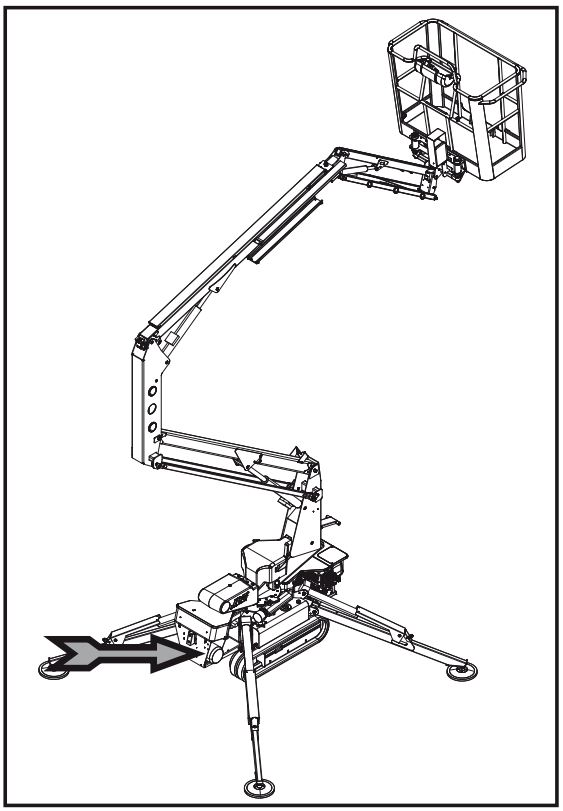


Figure 1-3. Plate location on X14J-X390AJ

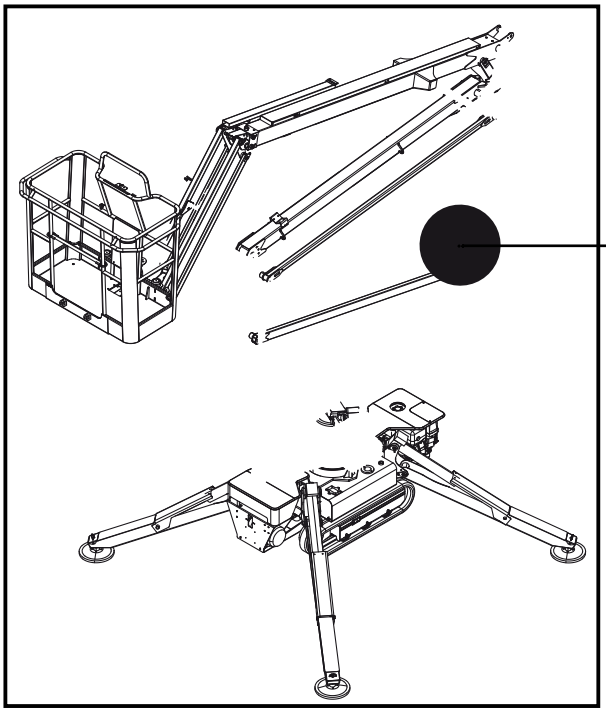


Figure 1-4. Plate location on X19J-X550AJ

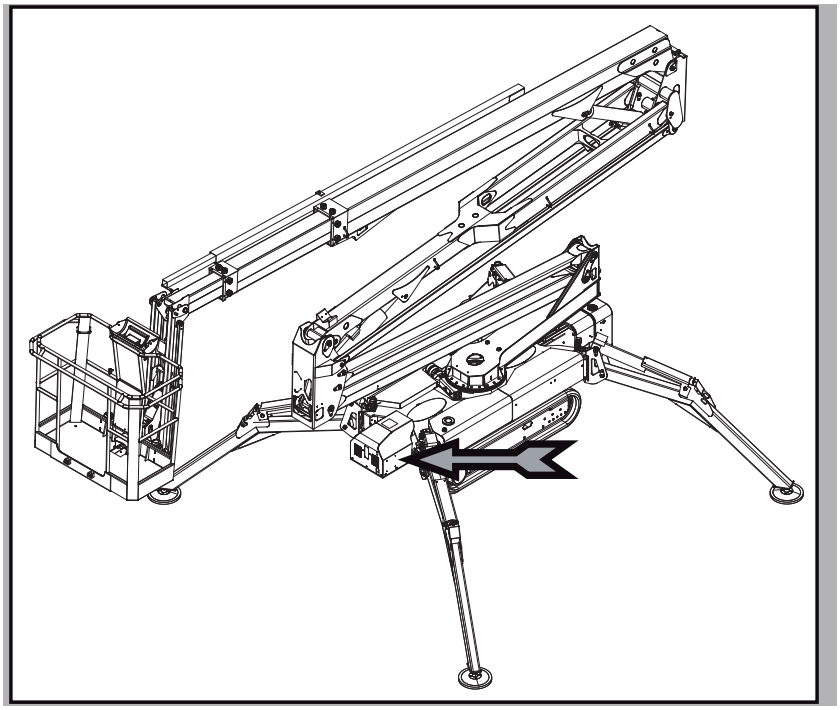


Figure 1-5. Plate location on X23J-X700AJ

NOTES:

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 10 Minutes	
inches	mm	inches	mm

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.

NOTICE

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

NOTES:

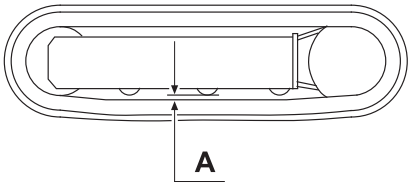
SECTION 3. CHASSIS & TURNTABLE

3.1 RUBBER TRACK MAINTENANCE

Checking track tension

Stop the machine on solid, level land. 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.

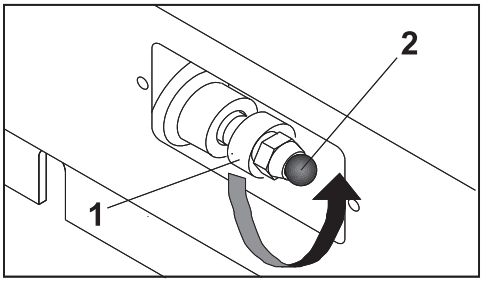


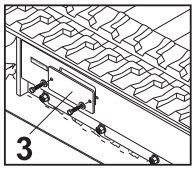
Operations for loosening/tightening the track

The grease contained in the hydraulic track is pressurized. 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.





DANGER

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-TENSIONER CYLINDER BECAUSE THE GREASE PRESSURE INSIDE THE TRACK IS VERY DANGEROUS.

Checking The Rubber Tracks

Figure A

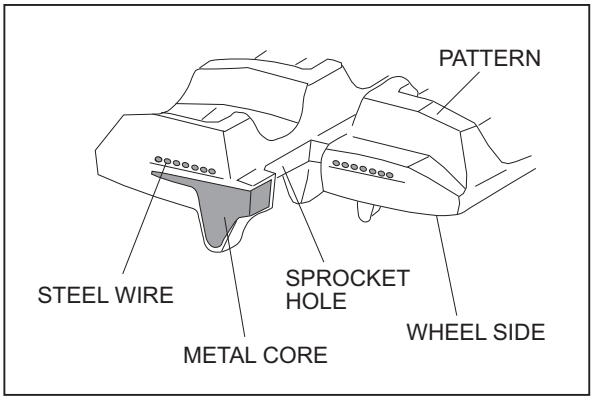


Figure 3-1. Rubber Track Structure

The structure of the rubber track is illustrated in Figure 3-1. The steel ropes and the metal core are sunk into the rubber. The carved profiles are used to give stability 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:

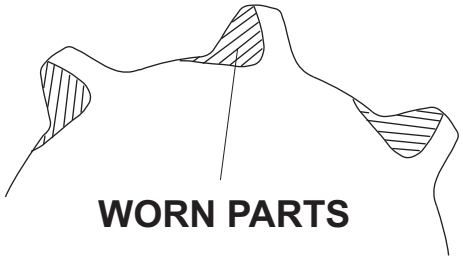
   - **a.** when stones or foreign bodies accumulate between the track and the under-carriage frame;
   - **b.** when the track escapes from its guide;
   - **c.** in the case of strong friction such as rapid direction changes.

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.

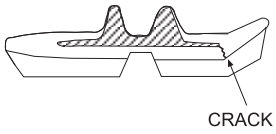
3. Separation of the metal cores



   - **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.



   - **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

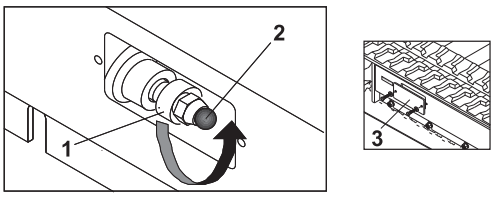
⚠ DANGER

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).

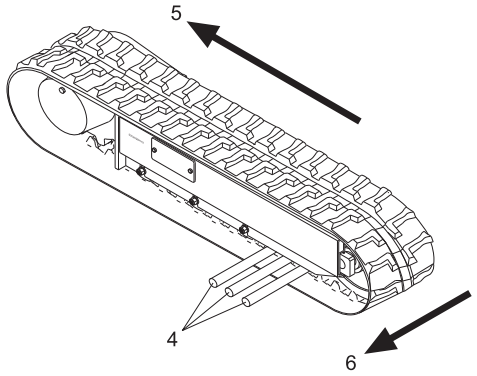
When gravel or mud are blocked between the toothed wheel and the track links, remove it before loosening.

Removing The Rubber Track

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



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.

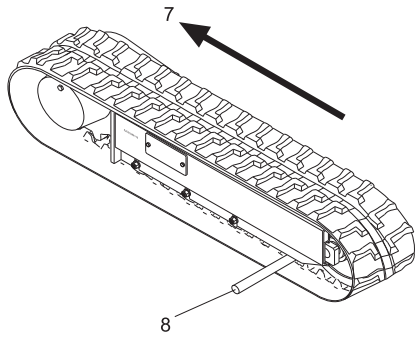


Installing The Rubber Track

⚠ 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.



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.

				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

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.

Torque Specs

			Values for Zinc Yellow Chromate Fasteners (Ref 4150707)									Spec #4150701			
			CLASS 8.8 METRIC (HEX 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*				CLASS 12.9 SOCKET HEAD CAP SCREWS M6 AND ABOVE*			
Size	PITCH	Tensile Stress Area	Clamp Load	Torque (Dry or Loctite® 263™)	Torque (Lub)	Torque (Loctite® 262™ OR Vibra-TITE™ 131)	Torque (Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140)	Clamp Load	Torque (Dry or Loctite® 263™) K = 0.20	Torque (Lub OR Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140) K= 0.18	Torque (Loctite® 262™ OR Vibra-TITE™ 131) K=0.15	Clamp Load See Note 4	Torque (Dry or Loctite® 263™) K = .17	Torque (Lub OR Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140) K = .16	Torque (Loctite® 262™ OR Vibra-TITE™ 131) K = .15
		Sq mm	KN	[N.m]	[N.m]	[N.m]	[N.m]	KN	[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				12,5	13	12	11
7	1	28,90	12,6	18	13	16	19	18,0	25	23	19	18,0	21	20	19
8	1,25	36,60	15,9	26	19	23	28	22,8	37	33	27	22,8	31	29	27
10	1,5	58,00	25,2	50	38	45	55	36,1	70	65	55	36,1	61	58	54
12	1,75	84,30	36,7	88	66	79	97	52,5	125	115	95	52,5	105	100	95
14	2	115	50,0	140	105	126	154	71,6	200	180	150	71,6	170	160	150
16	2	157	68,3	219	164	197	241	97,8	315	280	235	97,8	265	250	235
18	2,5	192	83,5	301	226	271	331	119,5	430	385	325	119,5	365	345	325
20	2,5	245	106,5	426	320	383	469	152,5	610	550	460	152,5	520	490	460
22	2,5	303	132,0	581	436	523	639	189,0	830	750	625	189,0	705	665	625
24	3	353	153,5	737	553	663	811	222,0	1065	960	800	220,0	900	845	790
27	3	459	199,5	1080	810	970	1130	286,0	1545	1390	1160	286,0	1315	1235	1160
30	3,5	561	244,0	1460	1100	1320	1530	349,5	2095	1885	1575	349,5	1780	1680	1575
33	3,5	694	302,0	1990	1490	1790	2090	432,5	2855	2570	2140	432,5	2425	2285	2140
36	4	817	355,5	2560	1920	2300	2690	509,0	3665	3300	2750	509,0	3115	2930	2750
42	4,5	1120	487,0	4090	3070	3680	4290	698,0	5865	5275	4395	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.

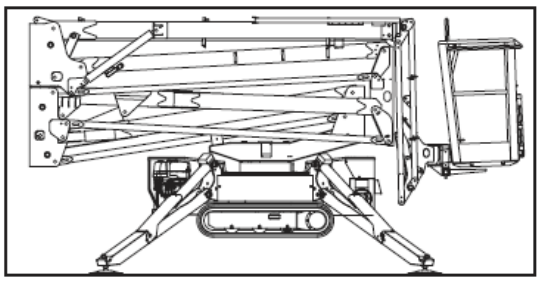
3.2 UNDERCARRIGE COMPONENTS

a. Stabilize the machine on level ground.

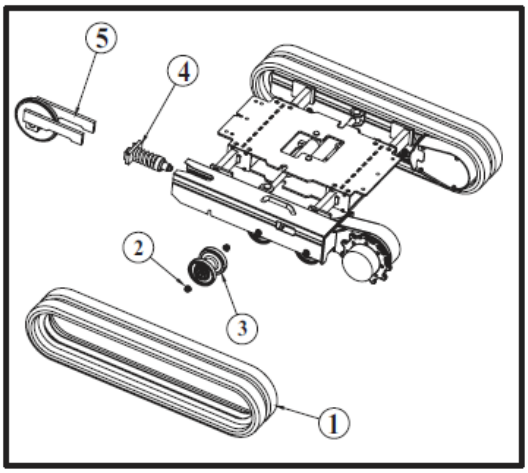
b. Fully extend the undercarriage.

c. Remove the tracks (see paragraph 3.1).

d. Remove the key ignition, and a tag with warning do not start the machine.

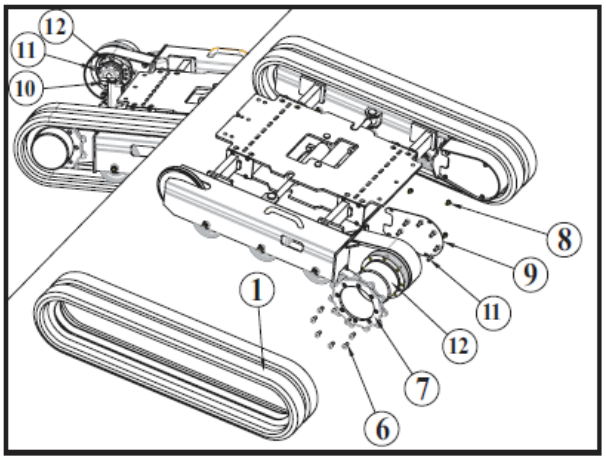


Replacement roller lower wheel and tracks adjuster



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.

Replacement wheel drive and Motor

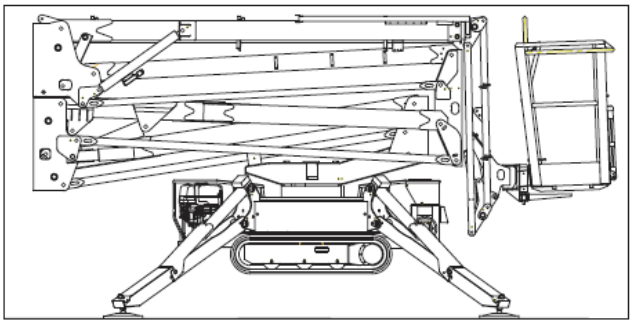


1. Stabilize the machine on level ground.
2. Fully extend the undercarriage.
3. Remove the tracks (see paragraph 3.1).
4. Remove the key ignition, and a tag with warning do not start the machine.
5. Remove screws 6.
6. Remove the sprocket 7.
7. To ensure a lifting system for the gearmotor 12 (30kg).
8. Disconnect and tag the hydraulic hoses from the gearmotor.
9. Remove the valve 10 to access all the screws 11 (on single speed versions only).
10. Remove the screws 11.
11. Remove the gearmotor 12.

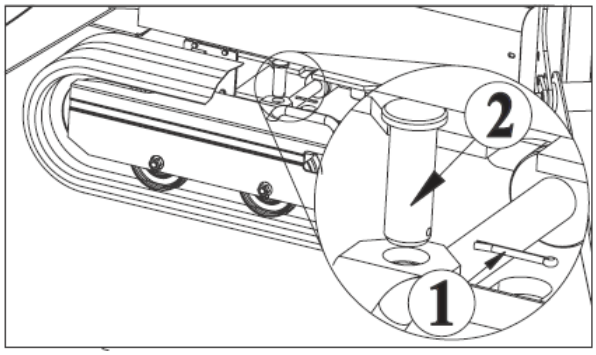
Table 3-1. Final drive torque valves

n.	Machine model	Description	Torque valve	Loctite type+
2	X14JH - X14J - X17J - X19J - X390AJ - X550AJ	Nut & pin thread M14	125 Nm	Loctite 52A43
	X23J - X700AJ	Nut AB M14	125 Nm	X
7	X14JH - X14J - X17J - X19J - X390AJ - X550AJ	Screw TECEI M 10X18 12,9	84 Nm	Loctite 52A43
	X23J - X700AJ	Screw TECEI M 12X18 10,9	119 Nm	Loctite 52A43
11	X14JH - X14J - X17J - X19J - X390AJ - X550AJ	Screw TECEI M 10X25 12,9	84 Nm	Loctite 52A43
	X23J - X700AJ	Screw TECEI M 12X30 10,9	119 Nm	Loctite 52A43

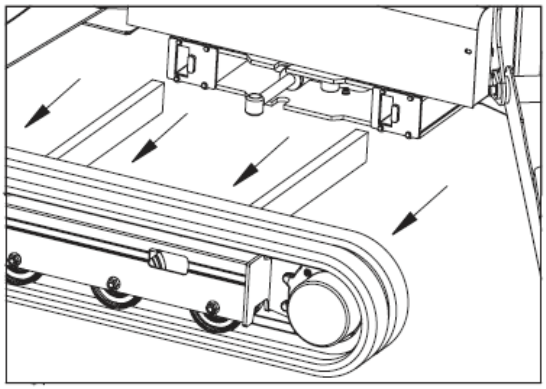
3.3 CYLINDERS AND ENLARGEMENT GUIDE



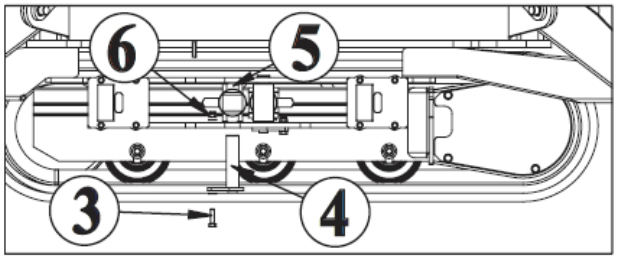
1. Stabilize the machine on level surface.
2. Extend the undercarriage.
3. Engine and key off.
4. Remove the key ignition, and a tag with warning do not start the machine.
5. Open the hydraulic cap, and operate the function undercarriage extend/retract to discharge any residual pressure in the system.



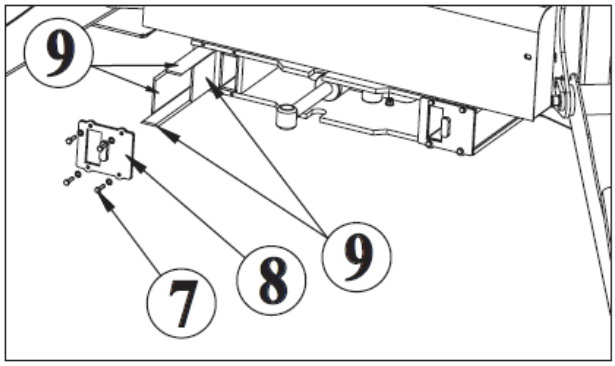
6. Remove the cotter pin 1.
7. Remove the pin 2.



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



9. Remove screw and nut 3-6.
10. Remove the pin 4.
11. Disconnect, tag and plug the hydraulic hoses from the cylinder extension.
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 52A43) on screws 7 and tightening torque of 10 Nm.

3.4 DRIVE GEAR MOTOR TABLE

SECTION	TYPE	SPEED	MACHINE	MOTOR
3.xx	BONFIGLIOLI 7C 00 1 G 40 HC0 5.25 065RT01 P 3WH LZ	1V	X14JH X14J-X390AJ	065
3.xx	BONFIGLIOLI 7C 00 1G 40 HC0 5.25 080RT01 P 3WI1 LA	1V	X17J X19J-X550AJ	080
3.xx	BONFIGLIOLI 7C 01 2 K A L 53 G018VP34 LA	2V	X23J-X700AJ	
3.xx	EATON	2V	X14JH X17J X14J-X390AJ X19J-X550AJ	

3.5 TRACK DRIVE - BONFIGLIOLI (MT700C077)

TYPE	SPEED	MACHINE	MOTOR
BONFIGLIOLI 7C 00 1 G 40 HC0 5.25 065RT01P 3WH LZ	1V	X14JH X14J-X390AJ	065
BONFIGLIOLI 7C 00 1G 40 HC0 5.25 080RT01P 3WI1 LA	1V	X17J -X500AJ X19J-X550AJ	080

Product Identification

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

INFORMATION

FOR ALL INQUIRIES REGARDING GENERAL INFORMATION ON THE PRODUCT, SPARE PARTS, ASSISTANCE ETC, ALWAYS GIVE THE IDENTIFICATION DATA STAMPED ON THE ID PLATE.

The gearmotor has two 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.

TECHNICAL INFORMATIONS

PRODUCT DESCRIPTION

The TRASMITAL BONFIGLIOLI gear motors of the series described in this manual are designed and built for application as track drive for crawled machines equipped with open loop hydraulic circuit.

The unit includes:

Hydraulic motor

Orbit fixed displacement motor including:

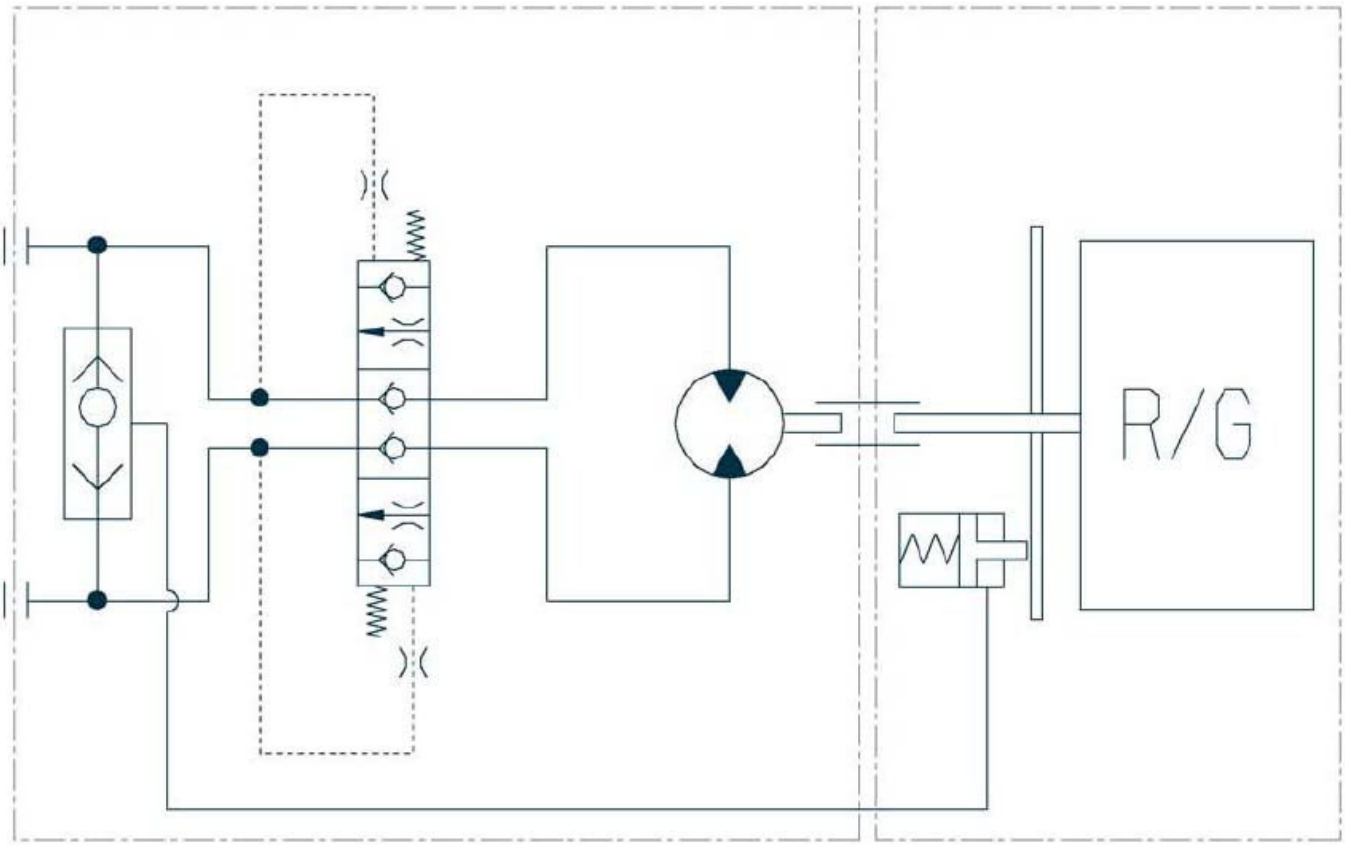
- Brake valve, this valve is installed for drive applications on tracked vehicles such as mini excavators and similar with open loop circuits; -Internal brake port directly controlled by the motor supply ports.

Planetary gearbox

Planetary gearbox, 1 stage, rotating housing type including:

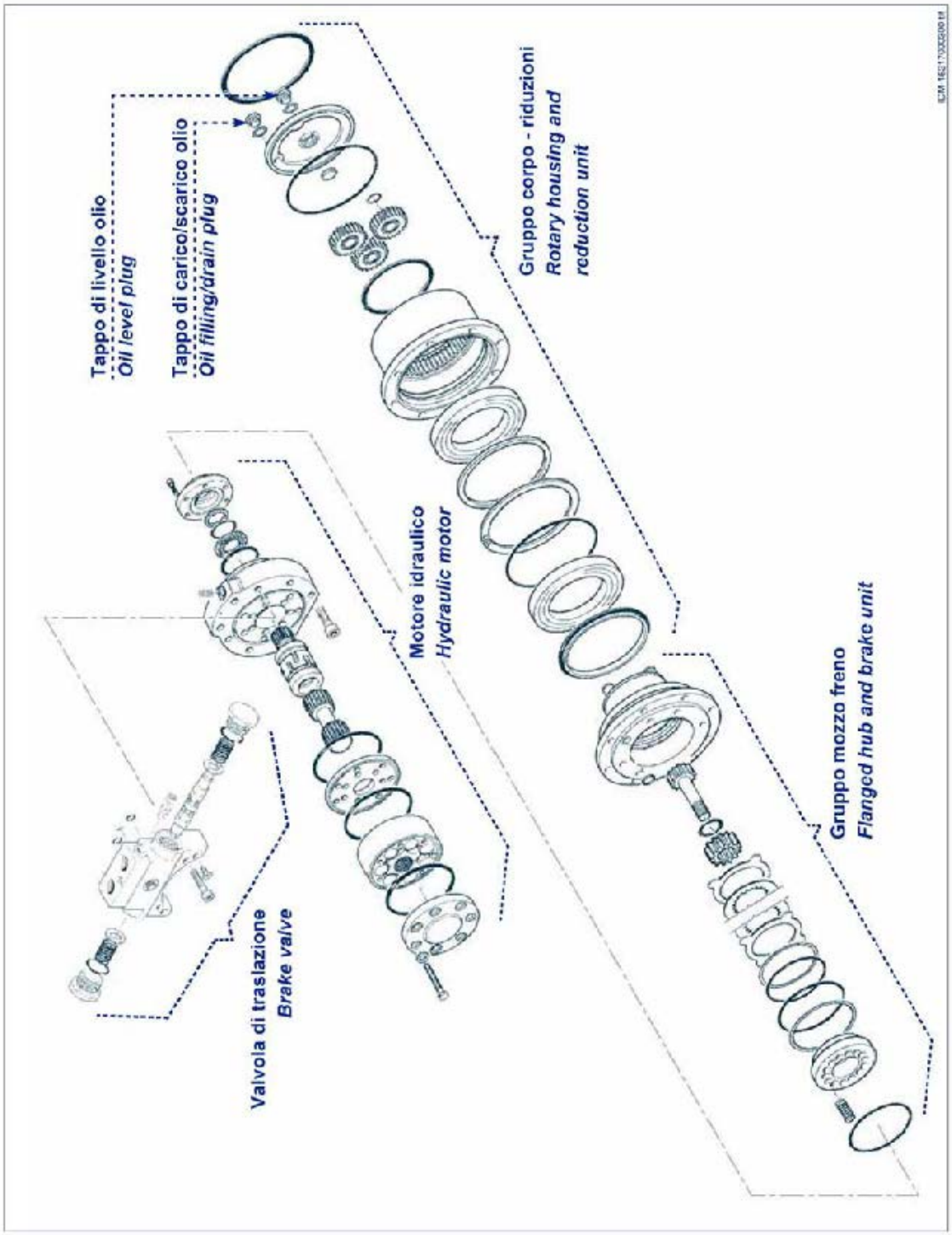
- Negative parking brake hydraulically actuated.

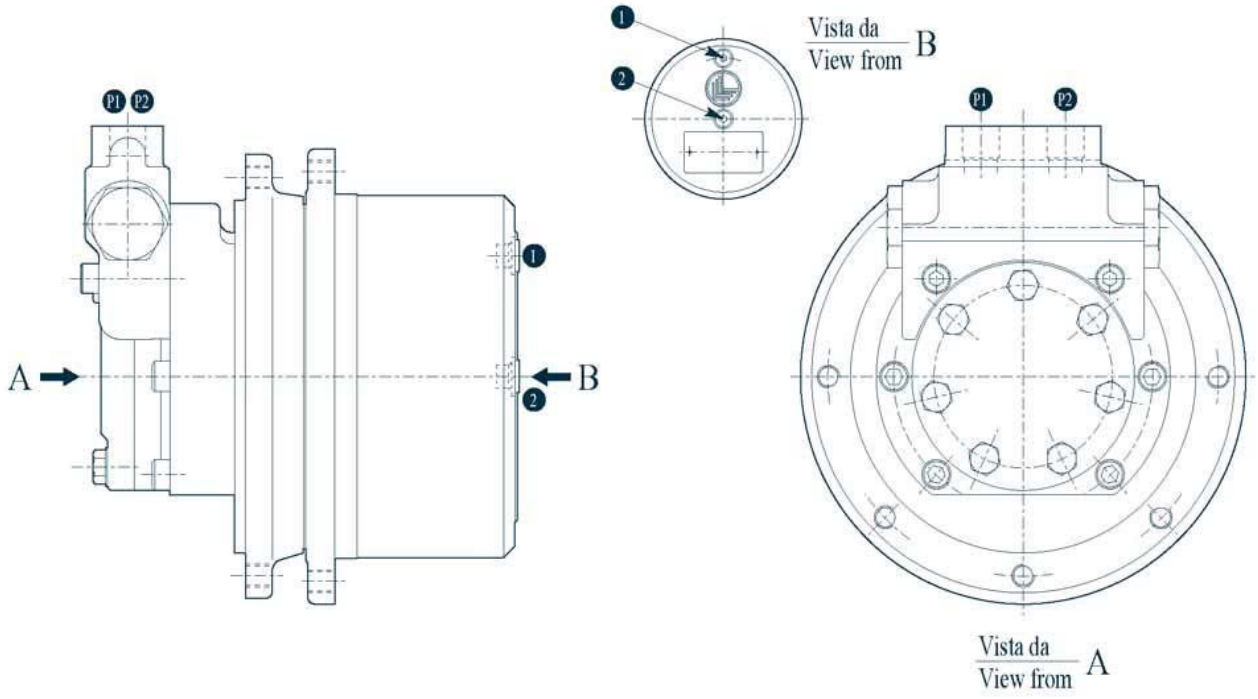
The track drive functional scheme is shown in the sketch below.



An important piece of advice given is “to perfectly“ design the main hydraulic system.

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





Legend:

1	M10x1	Filling and draining oil plug
2	M10x1	Level oil plug
P1 - P2	3/8“ G 19 TPI (depth 14 mm)	Motor port

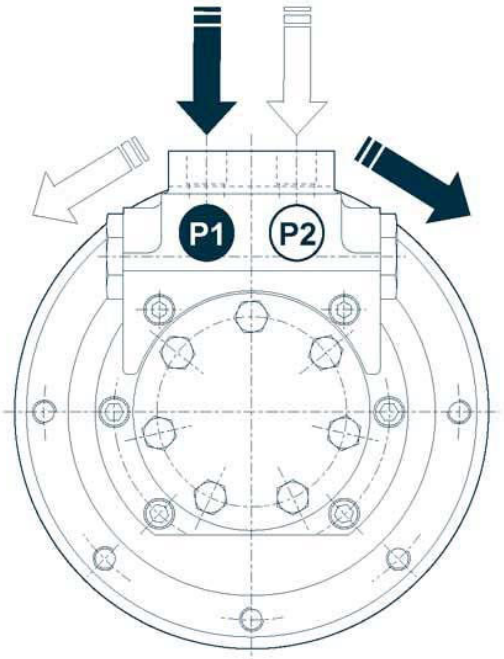
INSTALLATION INFORMATIONS

INSTALLATION PROCEDURE

Before proceeding with installation, follow the instructions given below.

1. Properly clean the product by removing packaging and all remains of protection padding.
2. Prepare the parts to be coupled using the installation drawing as a guide.

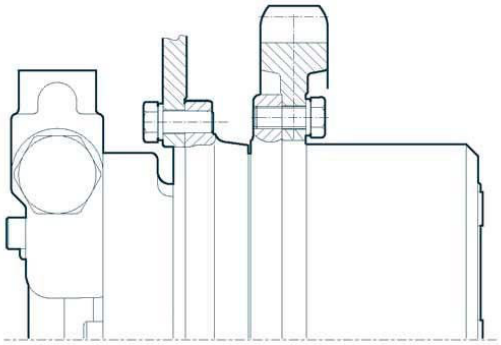
When assembling the track drive on the machine and connecting the hoses, follow instructions shown in below sketch for proper direction of rotation.



Oil port inlet	Oil port outlet	Direction of rotation (view from motor)
P1	P2	Clockwise
P2	P1	Counterclockwise

MOUNTING THE PRODUCT TO THE MACHINE

1. Move the gearmotor in the mounting area applying lifting methods.
2. Install the motor gearbox connecting it to the machine frame and to the sprocket using all screws as the thread holes on to the flanges. Lock the screws with the tightening torque shown in the following scheme.



CONNECTIONS TO THE HYDRAULIC SYSTEM

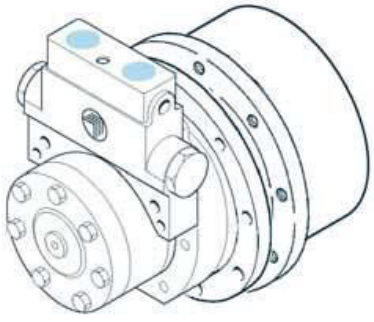
1. Make sure that the entire hydraulic system meets the cleaning standard as given in level 9 according NAS 1638 or 18/15 ISO/DIS 4406.
2. Clean the surface to be connected on the hydraulic motor.

INFORMATION

ONLY WHEN IT IS NECESSARY TO ATTACH PIPES, REMOVE THE PLASTIC CAPS PROTECTING THE CONNECTIONS, THIS WILL ENSURE THAT NO FOREIGN BODY GOES INSIDE THE HYDRAULIC MOTOR.

3. Pipe the hydraulic motor as shown below (for pipe sizes and dimensions refer to the installation drawing).

Main ports: P1-P2



FILLING-UP THE GEARBOX WITH LUBRICATING OIL

Before starting up the motor gearbox, check the level of lubricating oil in the gearbox. Check that the gearbox axis is horizontal. If necessary, refill with lubricant oil.

This procedure is undertaken following the indications given below.

Elenco olii consigliati a Norme SAE 80W/90 e SAE 85W/140 con caratteristiche API GL5
Lubricant oils suggested according SAE 80W/90 and SAE 85W/140 API GL5 grade

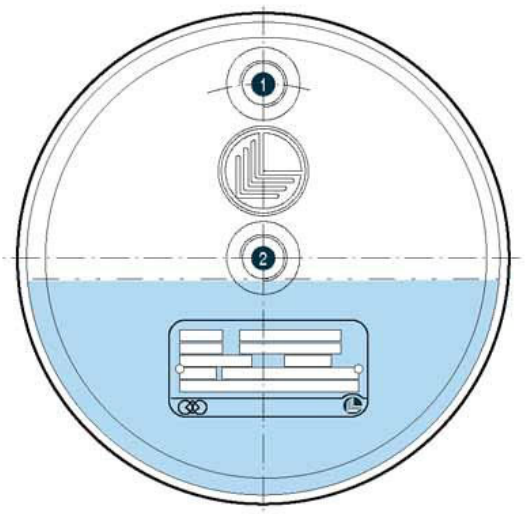
Temperatura ambiente ***Ambient temperature*** **Viscosità olio / *Oil viscosity***		**-10°C / +30°C SAE 80W/90**	**+20°C / +45°C SAE 85W/140**
Produttori / *Manufacturers*		**Tipo olio / *Oil Brand***	
	SHELL	**SPIRAX HD**	**SPIRAX HD**
	AGIP	ROTRA MP	ROTRA MP
	ARAL	GETRIEBEOL HYP	GETRIEBEOL HYP
	BP-MACH	HYPOGEAR EP	HYPOGEAR EP
	CASTROL	HYPOY	HYPOY
	CHEVRON	UNIVERSAL GEAR LUBRICANTE	UNIVERSAL GEAR LUBRICANTE
	ELF	TRANSELF8	TRANSELF8
	ESSO	GEAR OIL GX PONTONIC MP	GEAR OIL GX PONTONIC MP
	I.P.	PONTIAX HD	PONTIAX HD
	MOBIL	MOBILUBE HD	MOBILUBE HD
	TOTAL	TRASMISSION TM	TRASMISSION TM

INFORMATION

DO NOT MIX TOGETHER OILS OF DIFFERENT BRANDS OR CHARACTERISTICS.

1. Rotate the gearbox housing, so that the plug (1) is on the top of the cover.
2. Unscrew the two plugs (1-2) and fill from the upper hole until the oil flows out from the hole (2).
3. Tighten the oil plugs (1-2) and let the gearbox run. After a few minutes, stop and check the oil level.If necessary, refill.

Approximate oil capacity = 0,5 liters ±10%



CHARACTERISTICS OF THE HYDRAULIC SYSTEM

The oil in the hydraulic system (which also lubricates the hydraulic motor) must reflect the ISO VG 46 characteristics. It must be filtered with a maximum grade of 10 μm and with a level of contamination equal to or inferior to class 9 according to NAS 1638 or 18/15 as stated in ISO/DIS 4406.

It is advised not to mix together oils with different properties.

It is advised to use a filter with a led indicator that can be seen externally, with a flow control valve that blocks the flow of oil when the filter is clogged.

If it is necessary to work in low temperatures (artic climates) it is essential to use specific guidelines (contact the manufacturer).

Checking the temperature of the hydraulic oil is one of the most critical aspects of the hydraulic system.

High operational temperatures will cause a degradation of the oxidation resistance level and will accelerate the deterioration process of the hydraulic oil.

Therefore fl is important to follow the measures below.

- The temperature of the hydraulic oil during working conditions should remain between 30°C and 60°C.

- The temperature of oil should reach 20°C prior to start operation.

- During operation the oil temperature can rise to 90°C but this temperature is acceptable only for very short periods of time.

These temperatures have been set to take into consideration general degrading in viscosity as well as the wear respiting additives used in the oil.

The life of the motor will be shortened considerably if the operating temperature is constantly at a level that is hash er than 60°C.

FIRST START UP AND RUNNING IN

In this first stage it is advised to follow the measures given below.

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

INFORMATION

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

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

INFORMATION

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

During the running-in stage follow the steps given below.

1. Make sure that the speed and direction of rotation are correct.
2. Make sure that the functioning is regular and without any excessive noises and vibrations.
3. Make sure that the oil temperature does not exceed 60°C.

After having terminated this first running-in, follow the steps given below.

1. Check that there are no oil leakages. If present, proceed to remove them.
2. Check that there are no other problems in general.

MAINTENANCE INFORMATIONS

PERIODIC MAINTENANCE

The gearmotor only requires the scheduled maintenance procedures set out by the manufacturer (see Table below).

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

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

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

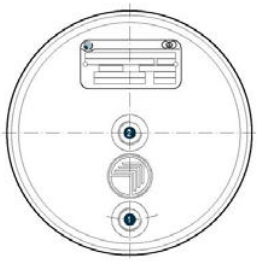
Inspection	Frequency	Action
Tightening screws	After the first 50 hours	Screws tightening torque check
Oil level	Every 100 hours	Refill oil
1st oil change	At 150 hours	Oil replacement
Following oil changes	Every 100 hours or 1year	Oil replacement

CHANGING THE LUBRICATING OIL

1. Place a large enough container (about 1 litre) under the oil drain plug.
2. Unscrew the plug (2).
3. Unscrew the oil drain plug (1) and allow the oil to drain. To facilitate the draining operation, it is better to work with hot oil.
4. Wait a few minutes until all the oil is drained and than proceed to screw on drain plugs (1-2).
5. Proceed with the oil fill-up following the procedures given.

⚠ CAUTION

DO NOT DISPOSE OF THE OIL IN THE NATURAL ENVIRONMENT BUT BE CAREFUL TO ELIMINATE IT IN COMPLIANCE WITH THE RELATIVE RULES AND REGULATIONS THAT GOVERN LOCALLY.



TROUBLESHOOTING

The following table is a guideline to identify the troubles in the track drive.

Anomalies	Causes	Remedies
External oil leakage :		
From the lifetime seal	a) Lifetime damaged	a) Replace lifetime seal
From the end cover	a) O-ring seal damaged	a) Replace O-ring seals
From the plugs of the cover	a) Plug seal damaged b) Plugs or screws loose	a) Replace plug seal b) Tighten the plugs/screws
From hydraulic motor	a) O-ring seals damaged b) Plugs or screws loose c) Internal motor parts damaged	a) Replace O-ring seals b) Tighten the plugs/screws c) Check the hydraulic motor
Too much noise :		
Inside the hydraulic motor (mechanical noise)	a) Internal motor parts damaged	a) Check the hydraulic motor
Hydraulic noise (during the slowing down of the motor speed)	a) Internal motor parts damaged b) Hydraulic circuit malfunctioning	a) Check the hydraulic motor b) Check the pressure to the motor ports is ≥ 3 bar Verify hydraulic circuit
Inside the gearmotor (reductions)	a) Internal damage	a) Check the gearbox
Other:		
Overheating	a) Insufficient oil level b) Hydraulic oil too warm c) Brake not fully released	a) Check the oil level and refill if necessary b) Check the hydraulic circuit
Insufficient power	a) Internal motor parts damaged b) Malfunctioning valves	a) Check the hydraulic motor b) Check valves
Insufficient braking torque	Parking brake malfunctioning a) Motor feed not correct b)Low volumetric efficiency	 a) Check the hydraulic circuit b) Check the hydraulic motor
Sprocket locked	a) Hydraulic motor locked b) Parking brake locked c) Mechanical components damaged	a) Check hydraulic motor b) Check the complete brake release c) Replace damaged parts

MOTORGEARBOX DISASSEMBLY

In the case that it was necessary to undergo a (partial or total) revision, it will be necessary to dismount the gearmotor from the machine. As this is known as an out of the ordinary maintenance procedure, it is important that only personnel with specific skills and experience undertake it.

It is also important that this procedure is undertaken in a workshop that is adequately tooled. As well as normal workshop tools it will be necessary to use special tools that can be made (see special tools attachment) or may be requested from the manufacturer.

Special Tools

Ring for lifetime..... Code / : ATZ.04.008.0

Puller.....Code / : ATZ.05.014.0

To be able to produce these equipment refer to the production drawings at the end of this manual.

In the following pages all the procedures for disassembling and reassembling the gearmotor are given, it is important to strictly adhere to them. Proceed with these operations using all the necessary safety measures, like for example:

1. Cutting off all the hydraulic system connections on the gearmotor to avoid the introduction of any foreign bodies in the circuit and the gearmotor.
2. Making sure that the coupling surfaces are not damaged.
3. Following the handling so as to be sure that there are no risks for human safety and to guarantee the reliability of the gearmotor.
4. Making available a work area that is in line with work and health safety in the workplace guidelines.

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

Bonfiglioli
Trasmital
Prodotto tipo / Product type:
7 00 C 1 G 40 HC0 5.25 065RT01P
3WH LZ
Comp./sign.: Cignani
Sostituisce / Replacing:
Sostituito dall'/Replaced by:
Data/Date: 17/01/2012
Da matr./From serial nbr:
A matricola/To serial nbr:
Lista ricambi n°:
Spare part list No.:
1.700C1G005038
Rev: 0
RAPPORTO TOTALE / TOTAL RATIO: 1:5,25
COPPIA FRENANTE / BRAKING TORQUE 191 Nm
MOTORE TIPO / MOTOR TYPE: TRASMITAL MG 065 SD R-T01P (DIN 5482 z14)
CODICE DI ORDINAZIONE PRODOTTO/PRODUCT ORDERING CODE: 2T700C1G005038
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Bonfiglioli Trasmital

Prodotto tipo / Product type:
MG 065 SD R 11076963 T01P

Compilatore / Signature: Cignani P
Data / Date: 17/01/2012
Sostituisce il / Replacing
Sost. tutto dal / Replaced by

Lista ricambi n°:
Spare part list No.:
1.11067001
Rev.: 0

Motore idraulico orbitale con valvola controllo traslazione con valvola a satellite per comando freno
Hydraulic orbital motor with counterbalance valve and brake pilot valve

Codice di ordinazione prodotto / Product ordering code: 17211207001

Bonfiglioli
Trasmital
Prodotto tipo / Product type:
7 00 C 1 G 40 HC0 5.25 080RT01P
3WI1 LA
Compilatore / Signature:
C.grandi P.
Data / Date:
17/01/2012
Sostituisce il / Replacing
Sostituito dal / Replaced by
Lista ricambi n°
Spare part list No.:
1.700C1G005048
Rev: 0
Rapporto totale / Total ratio: 1:5.25
Coppia frenante / Braking torque: 206 Nm
Codice di composizione prodotto / Product ordering code: 2T700C1G005048
Motore / Motor: TRASMITAL MG 080 SD R-T01P (DIN5482 26x22 z14)
Vedere sezione 3.1
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Bonfiglioli Trasmital

Prodotto tipo / Product type:
MG 080 SD R 11059988 T01P

Compilatore / Signature:
Data / Date: 17/01/2012
Sostituisce il / Replacing
Sostituito dal / Replaced by

Cigniani

Lista ricambi n°:
Spare part list No.:
1.11087004

Rev: 0

Motore idraulico orbitale con valvola controllo trasla zione con valvola selettrice per comando freno
Hydraulic orbital motor with counterbalance valve and brake pilot valve

Codice di ordinazione prodotto / Product ordering code 1T2110087004

DISASSEMBLING METHOD

Initial inspection can be made without disassembling the sprocket and the track drive from the machine.Before track drive disassembling, make sure that the oil is discharge.

Gearbox disassembly

1. Unscrew the 4 socket head screws M8x45 (29), grade 12.9, and the 2 socket head screws M8x75 (54), grade 12.9, which fix the hydraulic motor to the gearbox.

2. Remove the hydraulic motor from the flanged hub (15).

3. Remove the O-ring seal (28) from the hydraulic motor seat.

4. Remove the O-ring seal (16) from the brake port seat on the flanged hub (15).

5. Mark the position of the springs (27) as a reference for the reassembling step.

6. Take out the springs (27).

NOTICE

TIGHTEN NOS.2 SOCKET HEAD SCREWS M8X15 AND TWO SAFETY WASHERS INTO THE THREAD HOLES OF THE FLANGED HUB (15) BY A MALE HEX HEAD WRENCH. THIS STEP IS NECESSARY TO PREVENT THAT THE BRAKE PISTON (26) COMES OUT DANGEROUSLY DURING THE DISASSEMBLING PROCEDURE INDICATED AT THE FOLLOWING STEP.

7. Inflate compressed air into the brake port until the brake piston (26) comes out.

8. Remove the brake piston (26).

9. Remove the O-ring seals (23-24) and the backup rings (22-25) from their seats in the flanged hub (15).

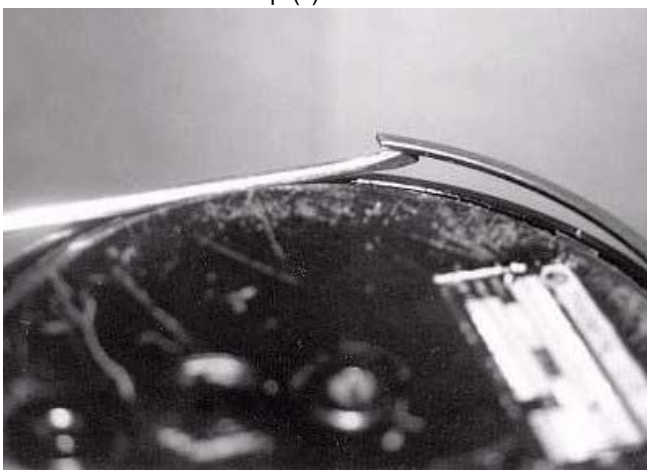
10. Take out the brake shaft (19).

11. Remove the circlip (18) from the brake shaft (19).

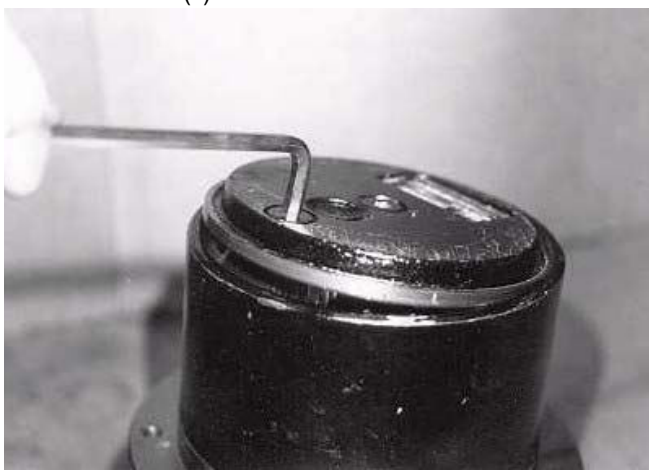
12. Take out the brake disc unit (20-21).

13. Take out the sun gear (17).

14. Turn the gearbox upside down and by using a screwdriver remove the circlip (1).



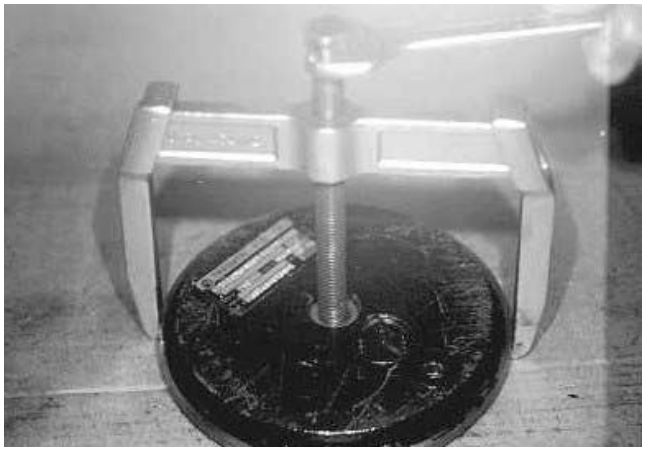
15. Place the wrench into the plug (2), jack and remove the end cover (4).



16. By using a puller remove the pad (3) from the end cover (4).

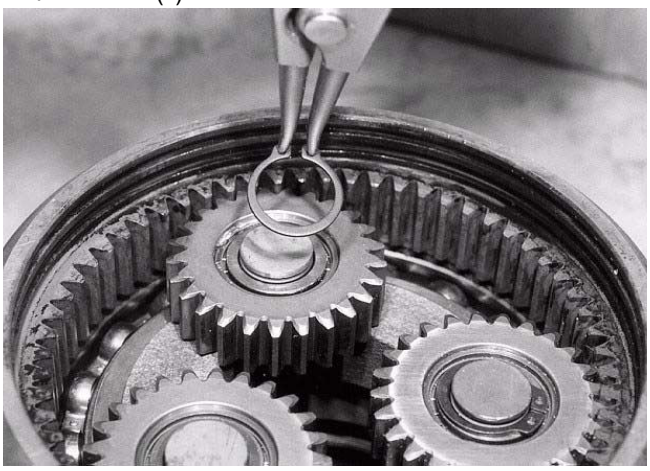
INFORMATION

THE ABOVE OPERATION MUST BE EXECUTE ONLY IN CASE OF REPLACEMENT OF THE PAD.

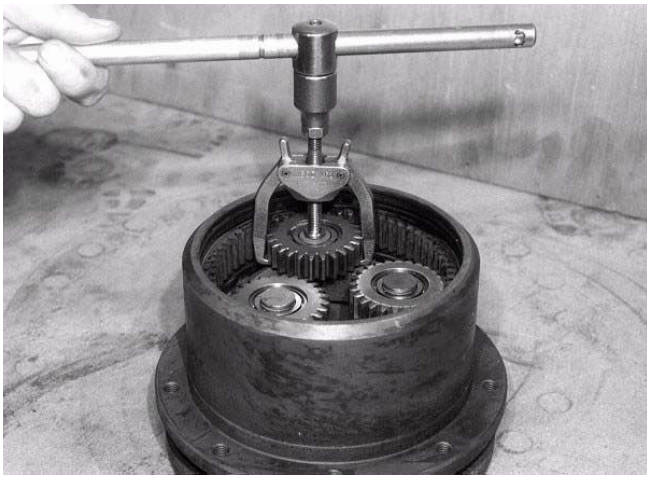


17. Remove the O-ring seal (5) from its seat in the gearbox housing (9).

18. By using pliers remove the circlips (6) from the planet assemblies (7).

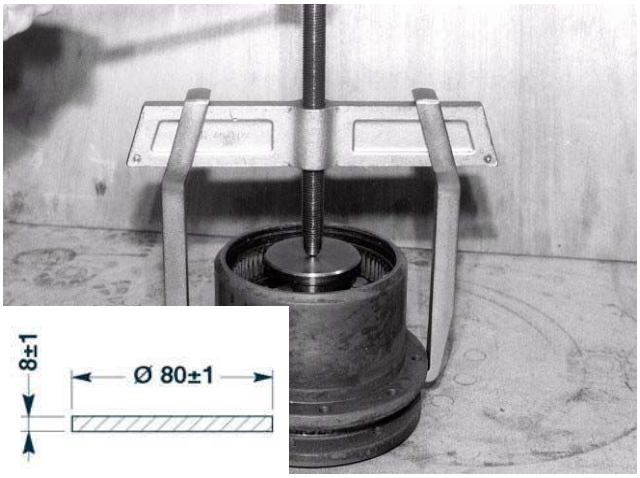


19. By using a puller remove the planet assemblies (7).

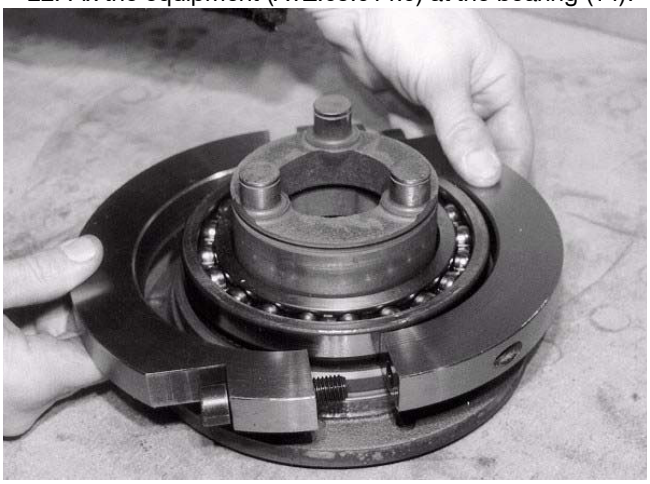


20. By using pliers remove the circlip (8) from its seat in the flanged hub (15).

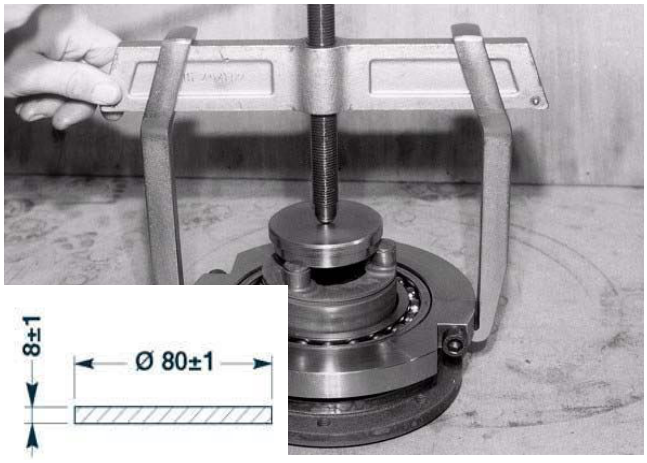
NOTE: *In order to proceed with the gearbox disassembly, it is now necessary to remove it from the ma-chine and bring it to a properly equipped workshop. By using a puller, push on the metal stopper and remove the flanged hub (15) from the gearbox housing (9).*



22. Fix the equipment (ATZ.05.014.0) at the bearing (14).



23. By using a puller remove the bearing (14) remaining on the flanged hub (15).



INFORMATION

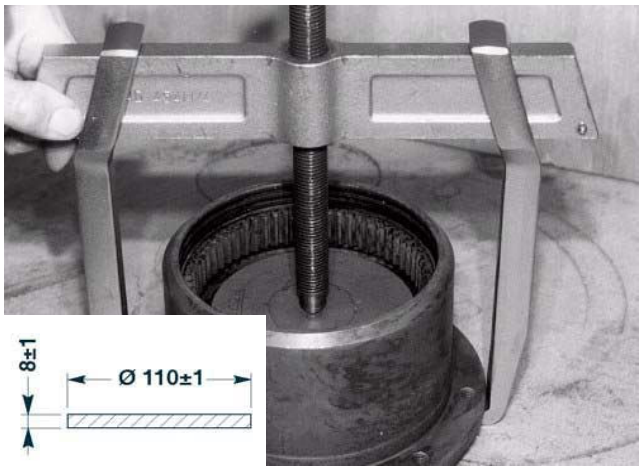
IN CASE OF OIL LEAKAGES, IT MIGHT BE NECESSARY TO CHECK AND EVENTUALLY REPLACE THE LIFETIME SEALS (14), WHICH MEANS BOTH THE METAL RINGS PARTS AND THE O-RING SEALS.

24. By using a screwdriver remove the half seal (14) from the flanged hub (15).

25. Remove the O-Ring seal (13) from its seat in the gearbox housing (9).

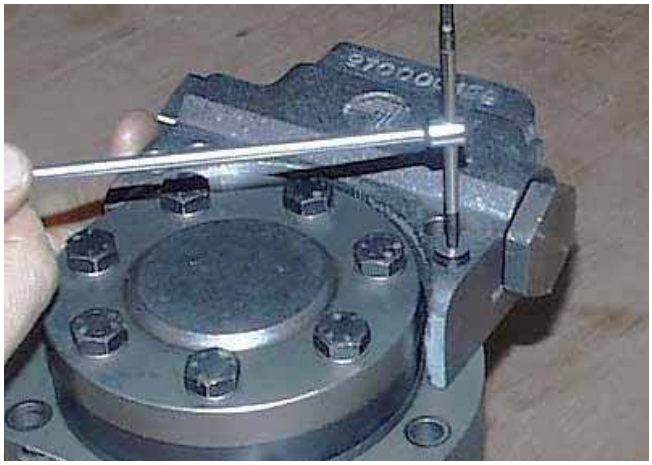
26. By using pliers remove the circlip (12) from its seat in the gearbox housing (9).

27. By using a puller, push on the metal stopper and remove in the same time the spacer (11) and the bearing (10) from the gearbox housing (9).



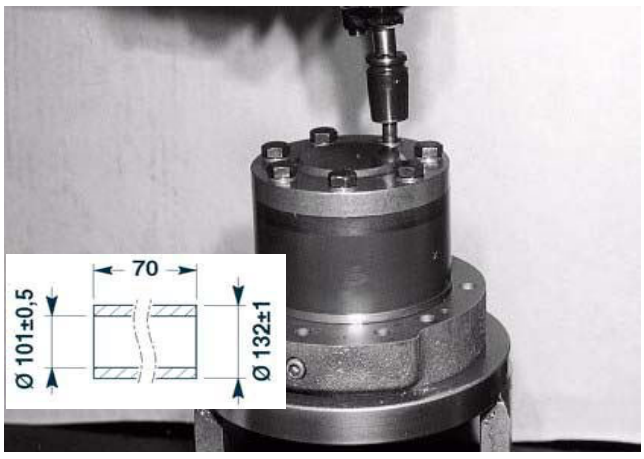
Hydraulic motor disassembly

1. Unscrew the 2 socket head screws M5x40 (55) grade 10.9, which fix the counterbalance valve to the hydraulic motor.

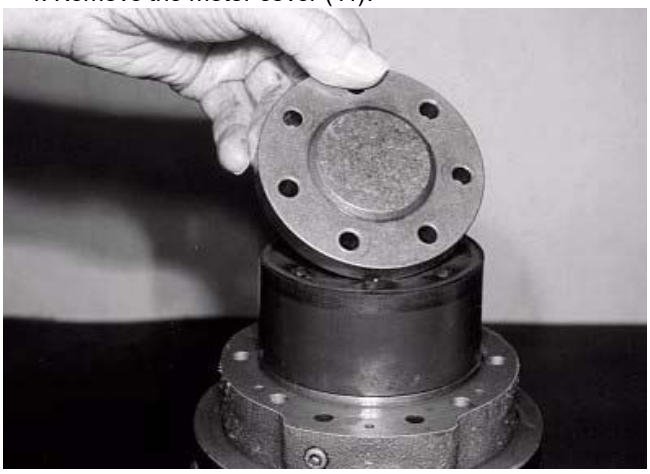


2. Remove the counterbalance valve.

3. Place the hydraulic motor on the support with the output side downwards. Unscrew the 7 hexagonal head screws M8 (43), grade 10.9, and remove the washers (42).

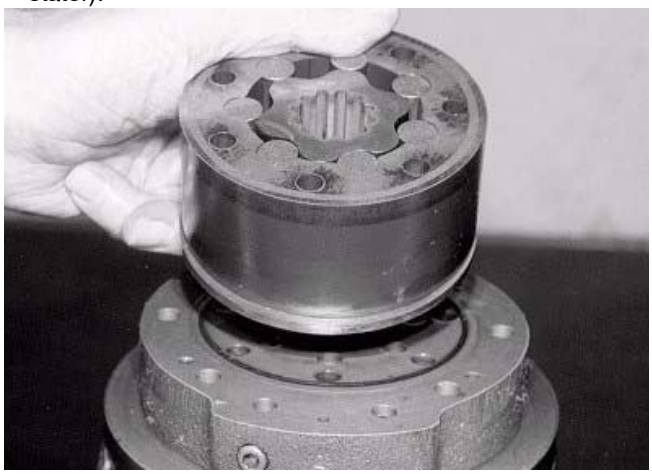


4. Remove the motor cover (41).



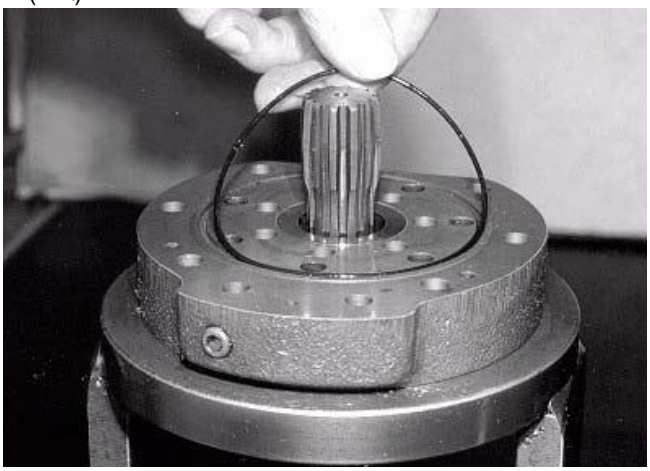
5. Remove the O-ring seal (38) from the motor cover (41).

6. Remove the roller gerotor (40) together with the distibutor plate (39) to prevent the parts from falling out (rolls ans stator).



7. Split the distributor plate (39) from the roller gerotor (40). From this one, remove the O-ring seal (38) from its seat.

8. Remove the O-ring seal (38) from the motor housing (36a).



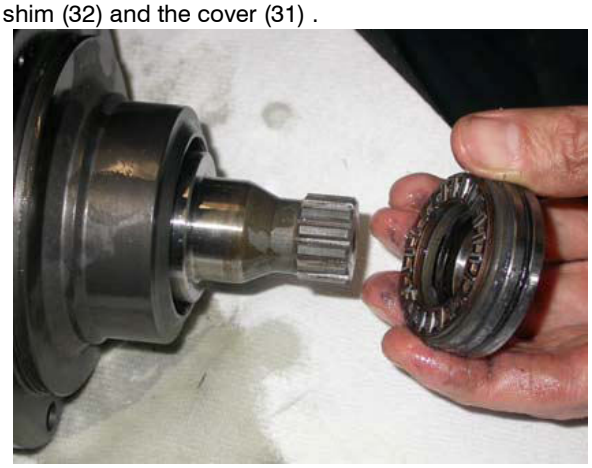
9. Remove the 2 ball.

10. Remove the Seeger (30).

11. Reverse the hydraulic motor body (36a) and hammer on the shaft 36b.

12. You must present the case.

13. Remove distributor shaft bearing (34) the fifth wheel shim (32) and the cover (31) .



14. Remove the joint float (37) and remove the tree distributor (36b).

15. Decompose the cover (31), the thrust bearing shim (32) and the cover (31).

16. Remove O-Ring (35) from cover (31).

Counterbalance valve disassembly

1. Remove the O-Ring seals (49-50) from their seat in the valve housing (56).

2. Fix the valve (56) without damaging the motor matching surface and unscrew the valve plugs (48).

3. Remove the O-Ring seals (45) from valve plugs (48).

4. Remove the springs (46) from their seats in the valve housing (56).

5. Remove the spool (53) by sliding it and remove the spring seat (47).

6. Remove the other spring seat (47).

7. View of the loose valve components.

INFORMATION

THE DISASSEMBLY ENDS WITH THE ABOVE OPERATION. ALL ITEMS ARE NOW AVAILABLE FOR THE NECESSARY INSPECTIONS.

EVALUATION OF THE PIECES TO BE REPLACED

The pieces that are subject to general wear and tear are the following.

Gears

Bearings

All the seals

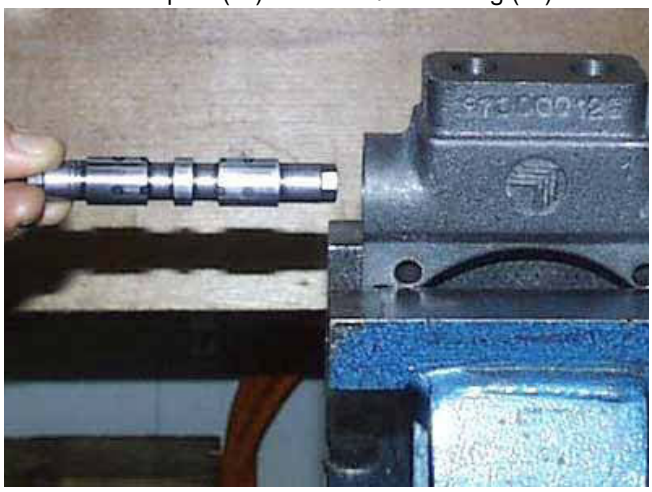
Replace the used or irregular parts respecting the following steps.

1. Accurately remove dirt, and in particular properly clean the seals, bearings and locking rings seating.
2. Lubricate the parts before connecting them.
3. In the case of damaged gears, for example a planetary, do not proceed to replace the individual gear but the entire reduction assembly.
4. When reassembling a part always replace all the seals involved.
5. Replace all the damages parts with originals spare parts and doing so follow all the steps given by the manufacturer in section 4.7.

REASSEMBLING METHOD

Counterbalance valve reassembly

1. Slide the spool (53) into the valve housing (56).



2.

Insert the spring seats (47) into the valve housing (56).

3. Insert the springs (46) into the valve housing (56).

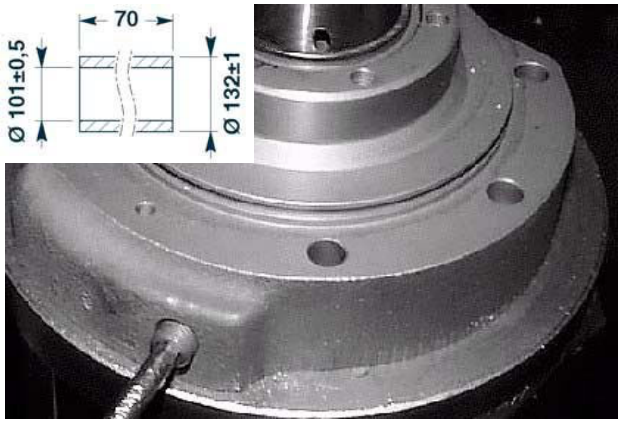
4. Assemble the O-ring seals (45) on the valve plugs (48).

5. Insert the valve plugs (48) and tighten them by a torque wrench at 100 Nm torque.

6. Assemble the O-ring seals (49-50) in their seats in the valve housing (56).

Hydraulic motor reassembly

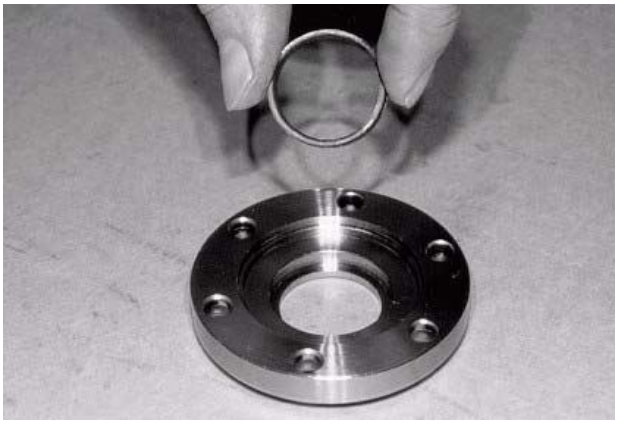
7. Place the motor housing (36a) on the support with the output side upwards. If removed, apply Loctite 542 on the plug (44) and tighten, by a torque wrench, at 50 Nm torque.



8. Place in the internal cover (31) the back-up ring (32) and the O-ring seal (33).

INFORMATION

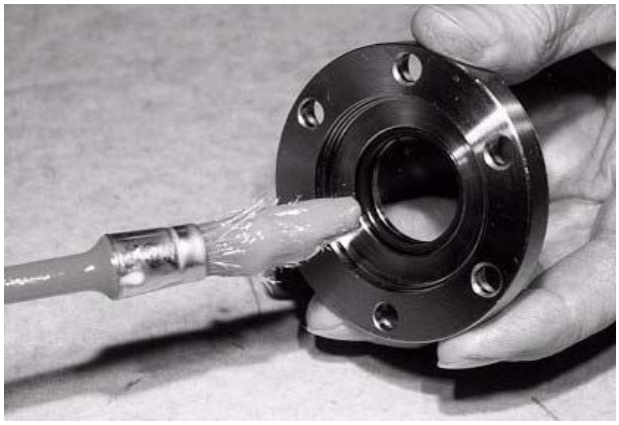
BE CAREFUL TO THE CORRECT DIRECTION OF ASSEMBLY.



9. Apply a slight coat of grease all over the internal diameter.

⚠ CAUTION

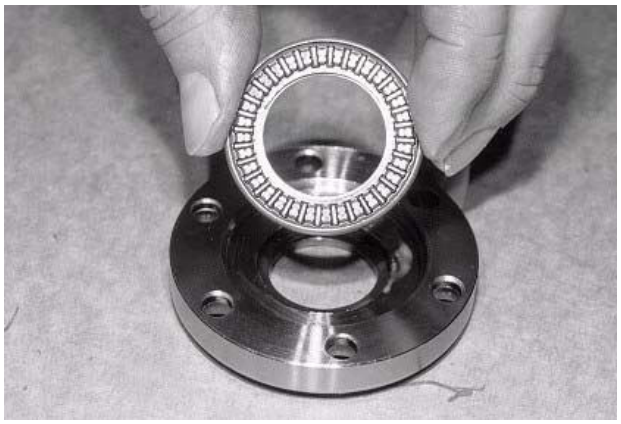
TO AVOID ROTATION OF THE O-RING (33) INTO THE SEAT, DO NOT APPLY GREASE ON THE EXTERNAL DIAMETER.



10. Place the axial bearing (34).

INFORMATION

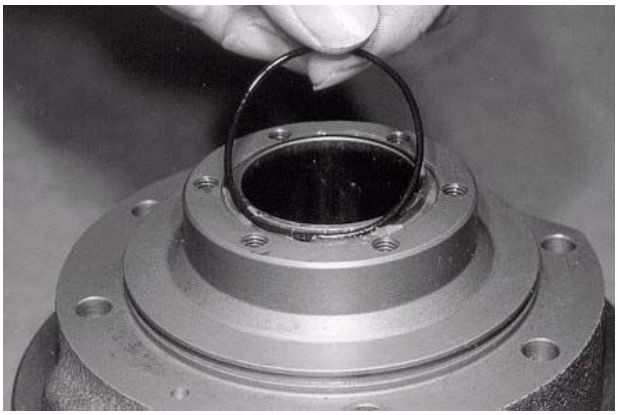
BE CAREFUL TO THE CORRECT DIRECTION OF ASSEMBLY.



11. Insert the internal cover (31) sub assembly on the timing shaft (36b) being careful that the axial bearing (34) is properly placed on its seat.

12. Apply a slight coat of grease on the O-ring seat on the motor housing (36a).

13. Place the O-ring seal (35) into its seat in the motor housing (36a).

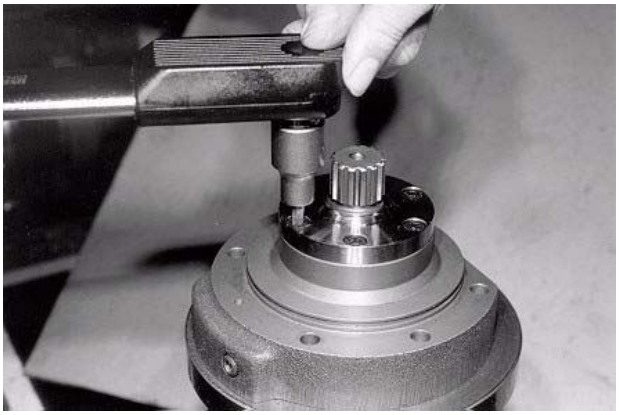


14. Slide into the motor housing (36a) the timing shaft +bearing + cover sub assembly.

⚠ CAUTION

BECAUSE OF THE VERY TIGHT CLEARANCE, CLEAN THE PARTS VERY WELL AND GUIDE THE SHAFT CAREFULLY INTO THE MOTOR HOUSING TO PREVENT IT FROM TILTING.

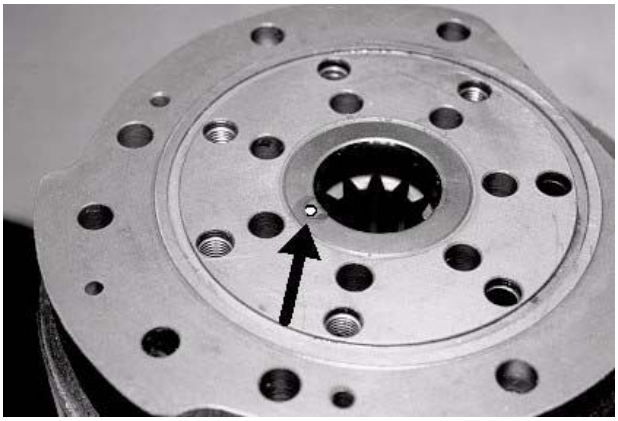
15. Insert the 6 socket head screws M6x12 (30), grade 8.8 and tighten by a torque wrench, at 10 Nm torque.



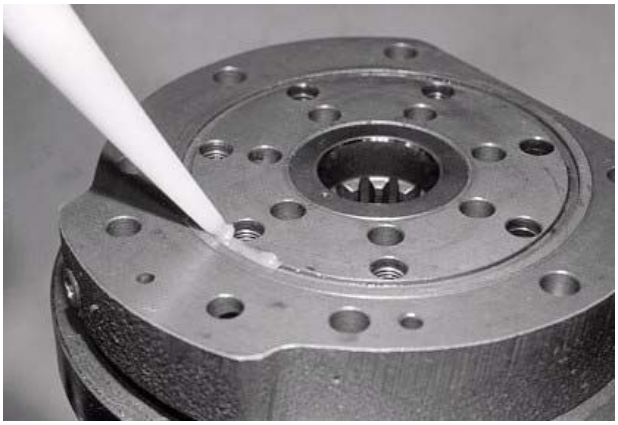
16. Turn the sub assembly upside down on the support.

⚠ CAUTION

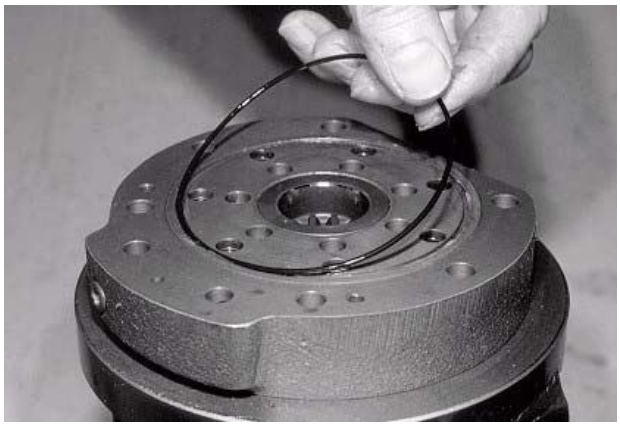
ROTATE THE TIMING SHAFT (36B) UNTIL THE MARK IS PLACED ON THE MOTOR AXIS OF SYMMETRY, OIL PORT SIDE.



17. Apply a slight coat of grease on the O-ring seat on the motor housing (36a).

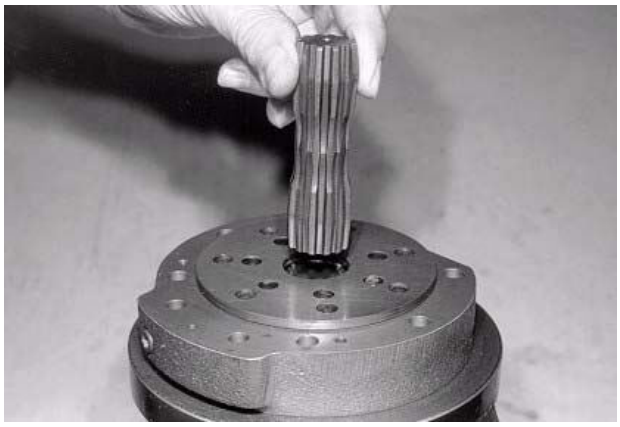


18. Place the O-ring seal (38) into its seat.

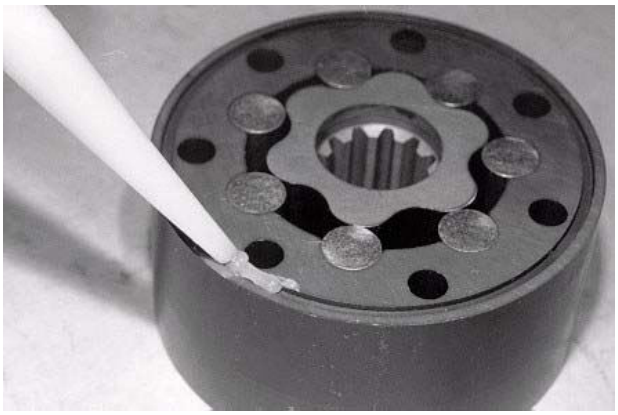


19. Place the distributor plate (39) onto the motor housing (36a) with the holes lined up.

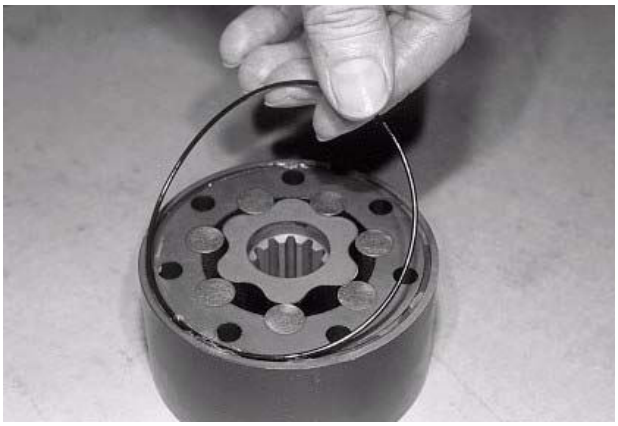
20. Insert the cardan shaft (37).



21. Apply a slight coat of grease on the O-ring seat of the gerotor (40).



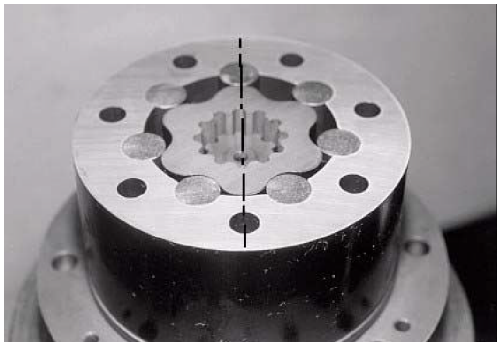
22. Place the O-ring seal (38) into its seat.



⚠ CAUTION

FIND THE AXIS OF SYMMETRY OF THE ROLLER GEROTOR (40) AND DEFINE THE POSITION WHERE A TOOTH OF THE ROTOR IS THE MOST INSIDE TWO ROLLS (CALLED "MINIMUM VOLUME CHAMBER").

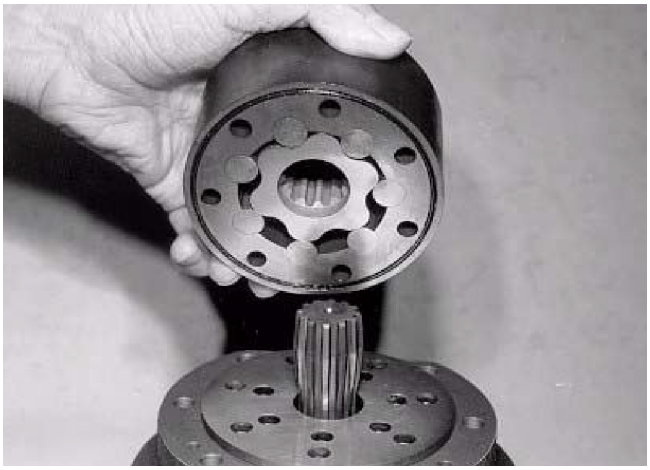
THE MOST INSIDE TWO ROLLS (CALLED "MINIMUM VOLUME CHAMBER").



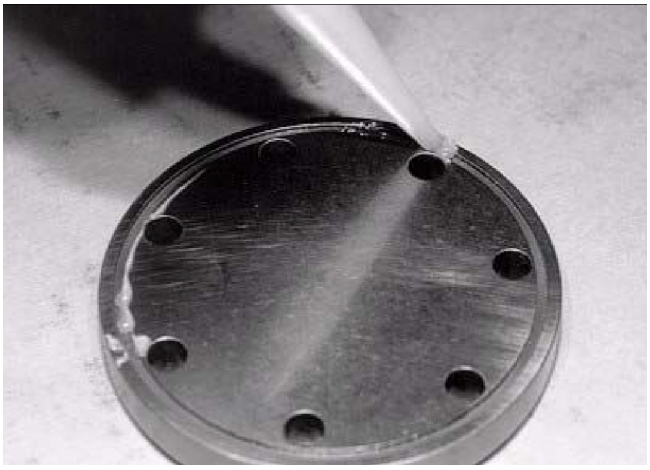
23. Place the roller gerotor (40) on the cardan shaft with the O-ring seal (38) faced down towards the distributor plate.

⚠ CAUTION

THE ROLLER GEROTOR (40) MUST BE ASSEMBLED WITH THEMINIMUM VOLUME CHAMBER ON THE MOTOR AXIS OF SYMMETRY, OIL PORT SIDE (SAME AS FOR TIMING SHAFT).



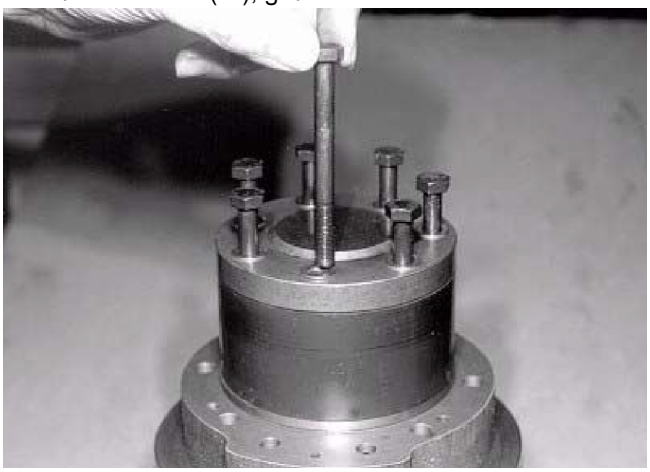
24. Apply a slight coat of grease on the O-ring seat of the motor cover (41).



25. Place the O-ring seal (38) into its seat.

26. Place the motor cover (41) with the O-ring seal (38) faced down towards the roller gerotor and the screw holes lined up.

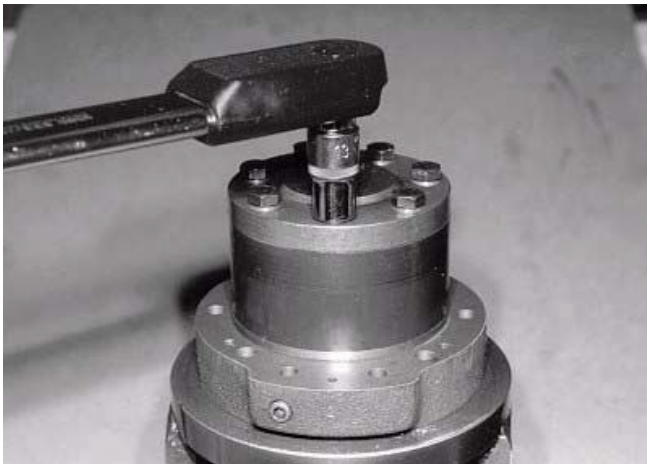
27. Place the 7 washers (42) and insert the 7 hexagonal head screws M8 (43), grade 10.9.



28. Tighten the 7 hexagonal head screws M8 (43) grade 12.9, by a torque wrench at 25 Nm torque.

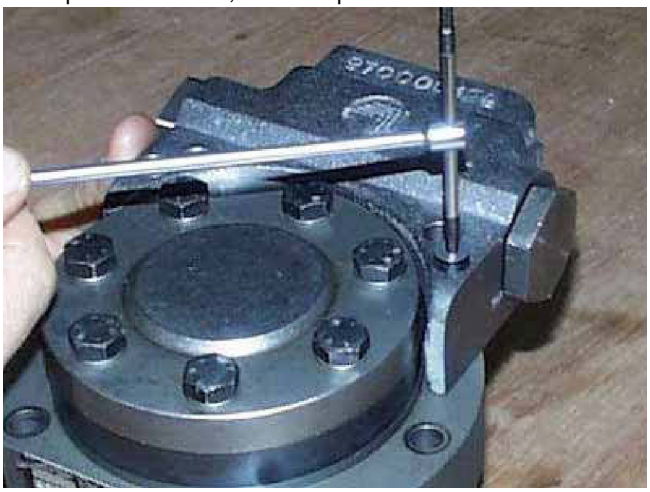
INFORMATION

THIS IS ONLY A FIRST STEP TIGHTENING.

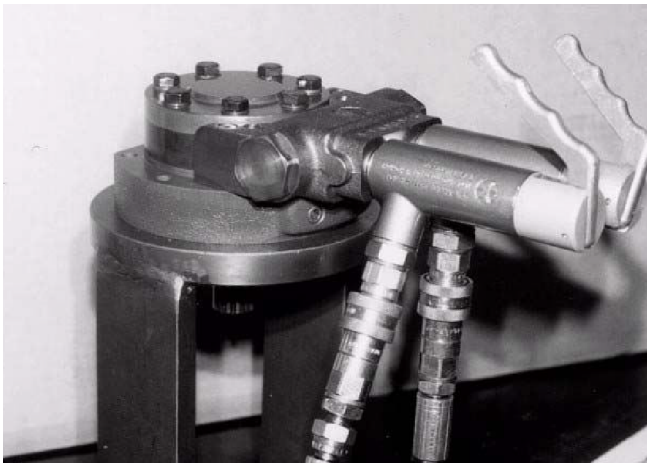


29. Place the counterbalance valve on the hydraulic motor.

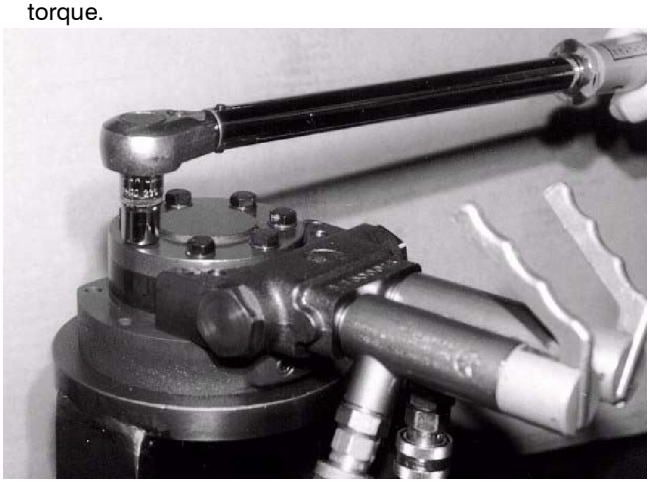
30. Fix the counterbalance valve to the hydraulic motor by 2 flathead screws M5x45 (55) grade 10.9, tightened by a torque wrench at 7,5 Nm torque.



31. Connect P1 and P2 ports to an hydraulic power unit with 10 l/min oil flow and run the motor unloaded.

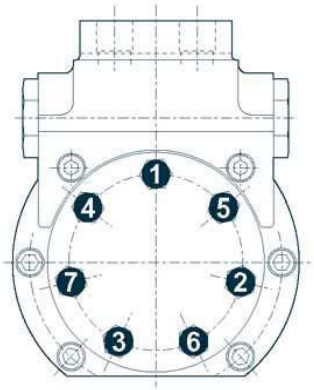


32. Tighten the screw (43) by a torque wrench, at 38 Nm torque.



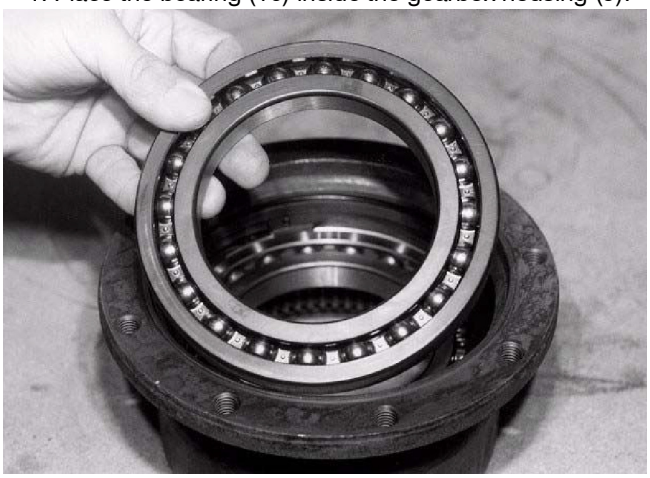
INFORMATION

WHILE THE MOTOR IS RUNNING UNLOADED, COMPLETE THE TIGHTENING OF THE HEXAGONAL HEAD SCREWS M8 (43), GRADE 10.9 FOLLOWING THE INDICATED ORDER.

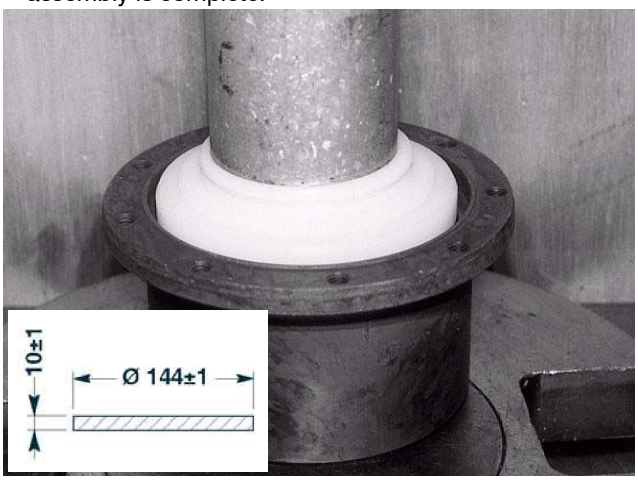


Reassembly of the gearbox

1. Place the bearing (10) inside the gearbox housing (9).



2. By using a press and a metal stopper, push the bearing (10) against the shoulder on the gearbox housing (9) until assembly is complete.



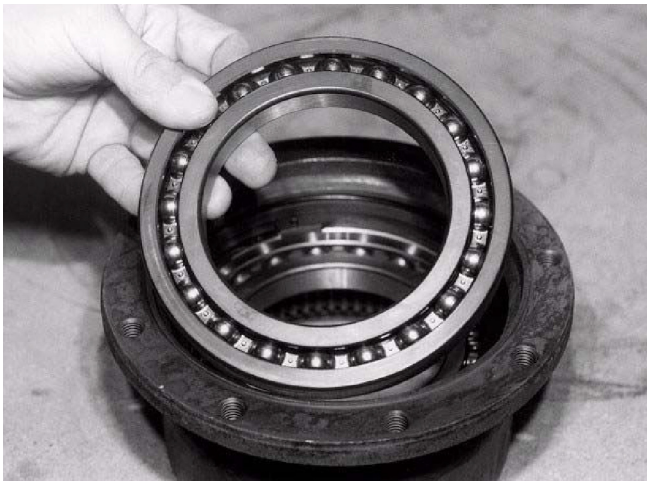
3. Assemble the spacer (11) on the gearbox housing (9).

4. By using pliers fit the circlip (12) into its seat in the gearbox housing (9).

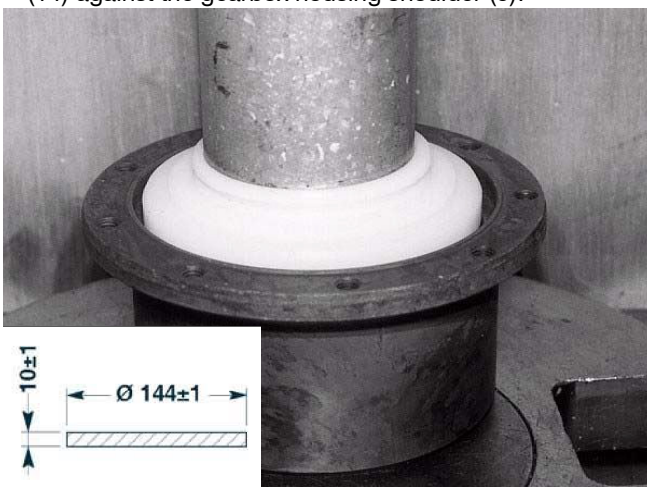
5. Assemble the O-ring seal (13) into its seat in the gearbox housing (9).

⚠ CAUTION

PLACE THE BEARING (14) IN THE GEARBOX HOUSING (9) WITH THE LAPPED SIDE UPWARDS.

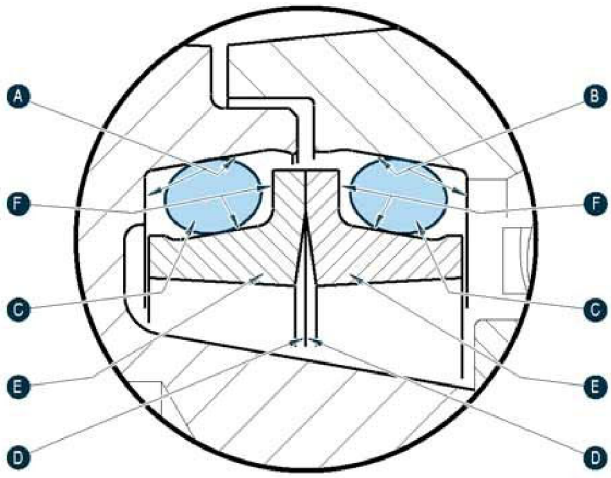


6. By using a press and a metal stopper, push the bearing (14) against the gearbox housing shoulder (9).

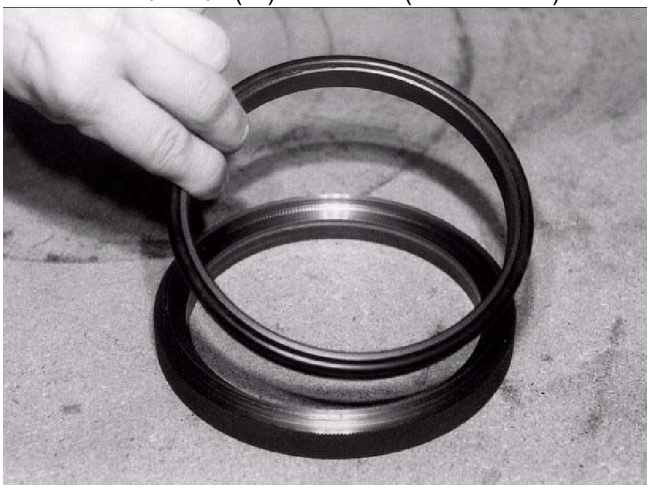


Make ready of the lifetime seal:

1. Carefully clean the seats ("A" and "B") using, if necessary, metal brushes or solvent (surfaces in contact with or ("C") must be perfectly clean and dry).
2. Make sure that sealing surfaces "D" of metal rings "E" are free from scratches, dings or foreign substances; metal ring surfaces must be perfectly clean and dry.
3. Carefully clean the lapped surface "D" of metal rings "E" and remove dust or finger prints. Then lubricate them with a thin oil film, taking care not to oil the other components.

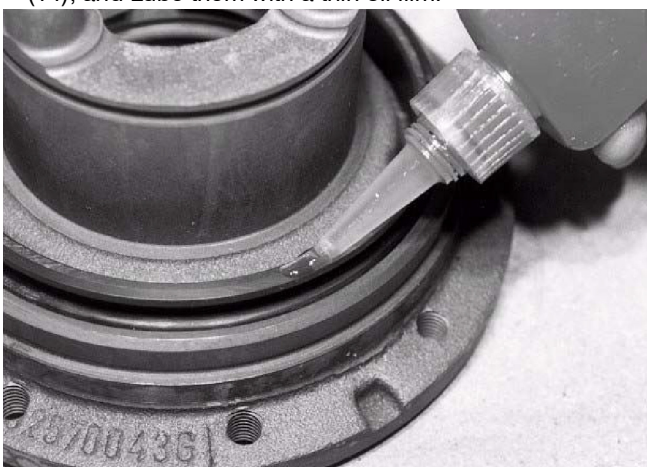


7. Fit the half seals (14) on the tool (ATZ.04.008.0).



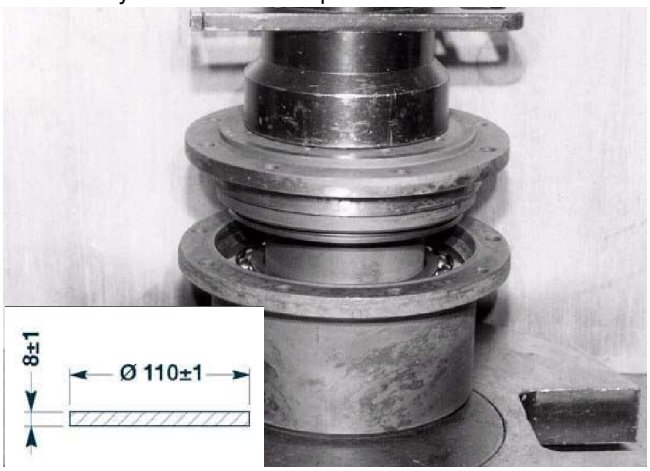
8. By means of the tool (ATZ.04.008.0), carry out the assembly of the half seal (14) on the flanged hub (15).

9. Clean carefully the metallic faces of the lifetime seal (14), and Lube them with a thin oil film.

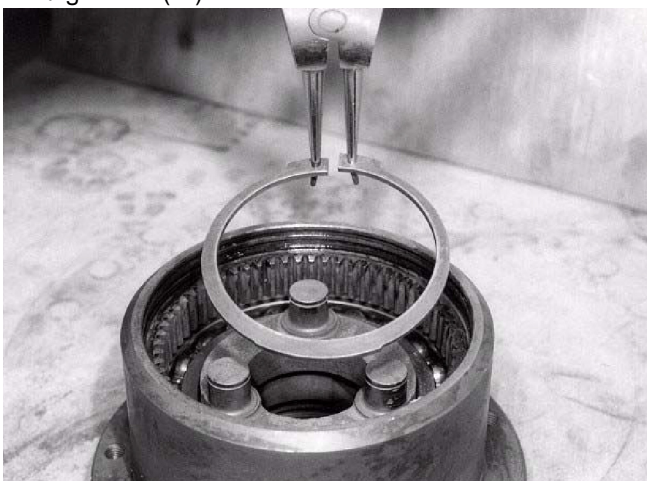


10. Place the flanged hub (15) inside the gearbox housing (9).

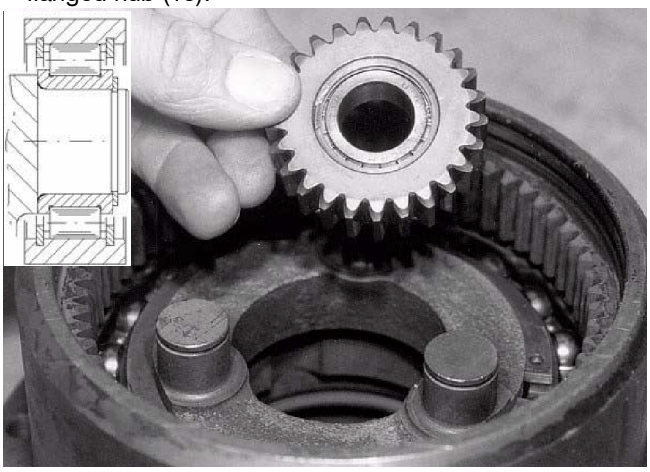
11. By using a press and a metal stopper push the flanged hub (15) against the gearbox housing shoulder (9) until assembly of the unit is complete.



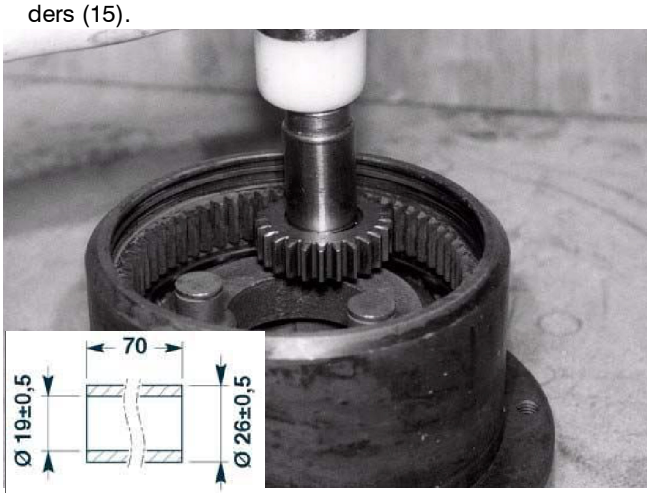
12. By using pliers, place the circlip (8) into its seat in the flanged hub (15).



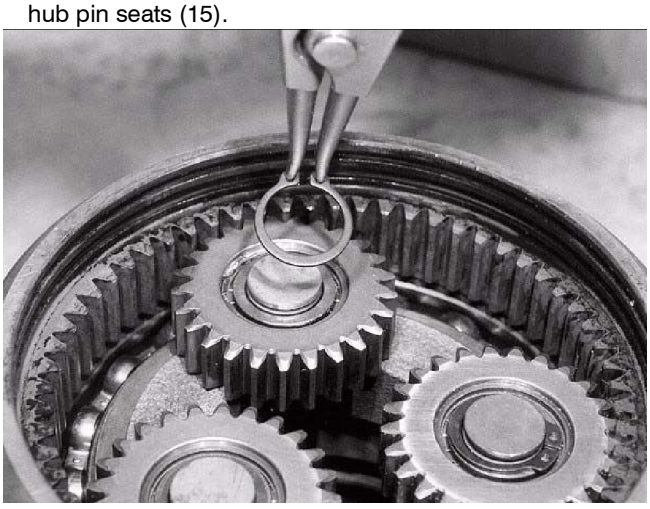
13. Place correctly the planet assemblies (7) on the flanged hub (15).



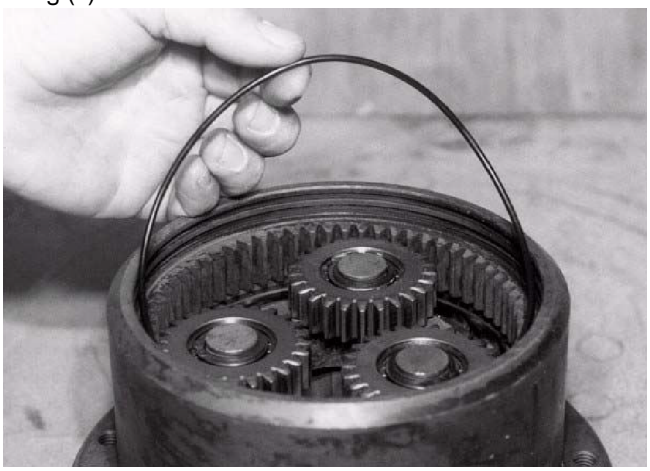
14. By using a rubber hammer and a stopper, push the planet assemblies (7) against the flanged hub pin shoulders (15).



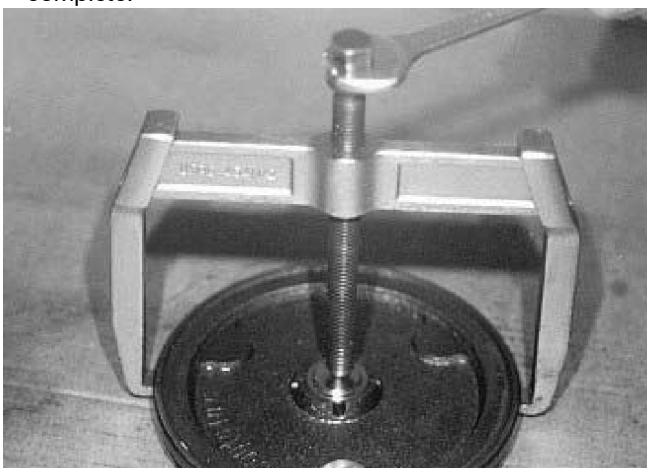
15. By using pliers, assemble the circlips (6) in the flanged hub pin seats (15).



16. Fit the O-ring seal (5) into its seat in the gearbox housing (9).



17. Place the pad (3) on the end cover (4) and by using a puller push it against the shoulder until assembling is complete.



18. Place the end cover (4) on the gearbox housing (9).

19. By using pliers, place the circlip (1) into its seat in the gearbox housing (9).

20. Turn the gearbox upside down and insert the sun gear (17).

21. By using pliers, assemble the cir clip (18) into its seat in the brake shaft (19).

22. Assemble the brake shaft (19).

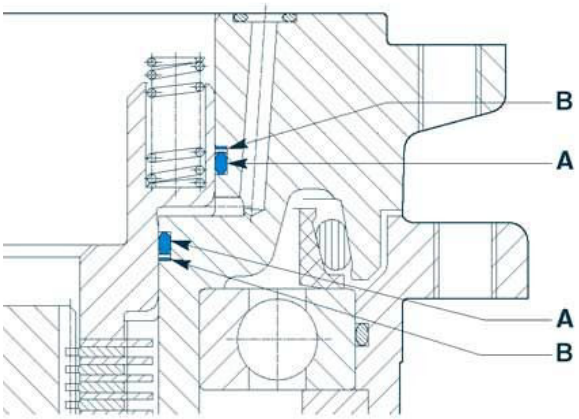
23. Assemble the brake discs package according to the following order: firstly, insert one steel disc with external teeth (21).

24. Then insert, an internally toothed sintered bronze disc (20). Repeat the operation until all 7 sintered bronze discs and 8 steel discs have been assembled.

25. Apply in the seals' seats, inside the flanged hub (15) a thin oil film and assemble the O-ring seals (23-24) and the back-rings (22-25).

INFORMATION

THE O-RING SEALS (A) AND A THE BACKUP RINGS (B) MUST BE FITTED IN THE SEATS ACCORDING THE MUTUAL POSITION AS SHOWN IN THE SCHEME



26. Insert the brake piston (26) inside the flanged hub (15), being careful not to damage the seals already fitted.

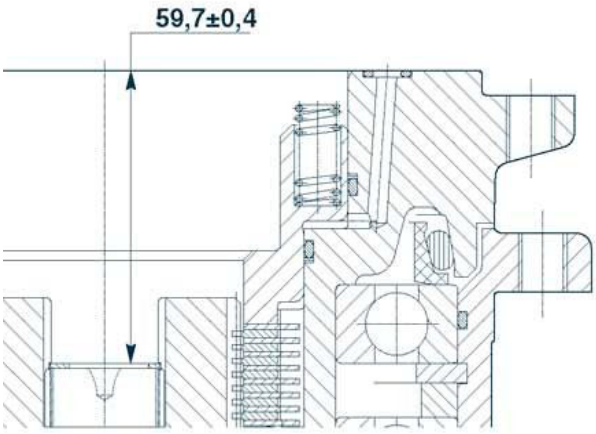
27. By using a stopper and a rubber hammer push the brake piston (26) against the seat shoulder (15).

28. Insert the springs (27) into the holes of the brake piston (26) marked previously.

29. Assemble the O-ring seal (16) in the brake port seat on the flanged hub (15).

INFORMATION

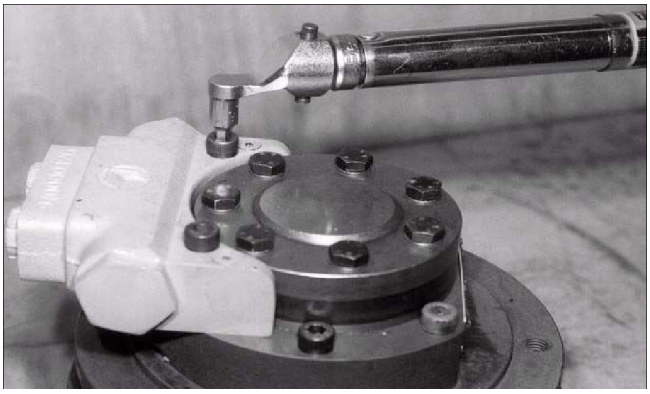
BEFORE MOUNTING THE HYDRAULIC MOTOR, VERIFY, BY USING DEPTH SLIDE GAUGE, THE CORRECT ASSEMBLY OF THE UNIT CHECKING THE AXIAL DISTANCE AS SHOWN ON THE SCHEME.



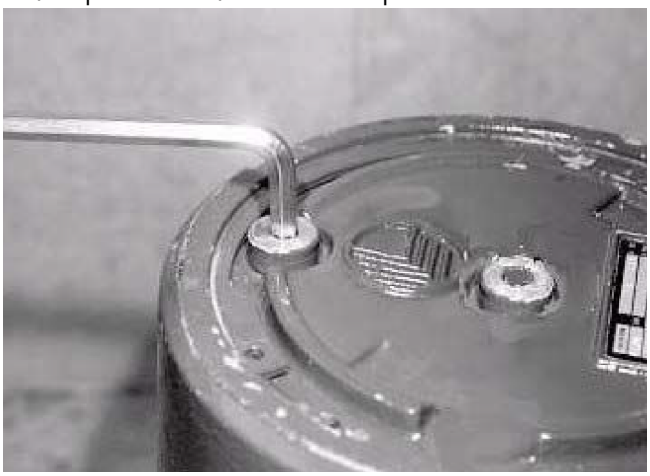
30. Assemble the O-ring seal (28) into the hydraulic motor seat.

31. Place the hydraulic motor on the flanged hub (15).

32. Fix the hydraulic motor to the gearbox by 4 socket head screws M8x45 (29) grade 12.9, and by 2 socket head screws M8x75 (54) grade 12.9, tightened by a torque wrench at 42 Nm torque.



33. Fill the gearbox with the lubricant oil as shown in section 3.4. Insert the washers and the plugs (2) into the oil drain-filling holes of the end cover (4).Tighten the plugs by a torque wrench at 10±2 Nm torque.



DISMANTLING AND DESTROYING THE PRODUCT

When dismantling the gearmotor follow the indications given below.

1. Remove the gearbox from the machine frame and let the lubricant oil flow.
2. Completely dismount the gearbox and remove all oil and grease from its parts.
3. Send all dangerous and/or polluted parts to the authorized demolishing centers whilst keeping in line with respective local rules and regulations.

3.6 TRACK DRIVE - BONFIGLIOLI (2T701C2K042002)

TYPE	SPEED	MACHINE	MOTOR
BONFIGLIOLI 7C 01 2 K A L 53 G018VP34 LA	2V	X23J-X700AJ	

Product Identification

The identification data of the unit are shown on a name plates put on it.

INFORMATION

FOR ALL INQUIRIES REGARDING GENERAL INFORMATION ON THE PRODUCT, SPARE PARTS, ASSISTANCE ETC, ALWAYS GIVE THE IDENTIFICATION DATA STAMPED ON THE ID PLATE.

TECHNICAL INFORMATIONS

PRODUCT DESCRIPTION

The BONFIGLIOLI TRASMITAL motor gearboxes of the series described in this manual are designed and built for application as track drive for crawled machines equipped with open loop hydraulic circuit.

The unit includes:

Motor

Two speed hydraulic motor (axial piston swash plate type) containing:

– Integrated counterbalance valve

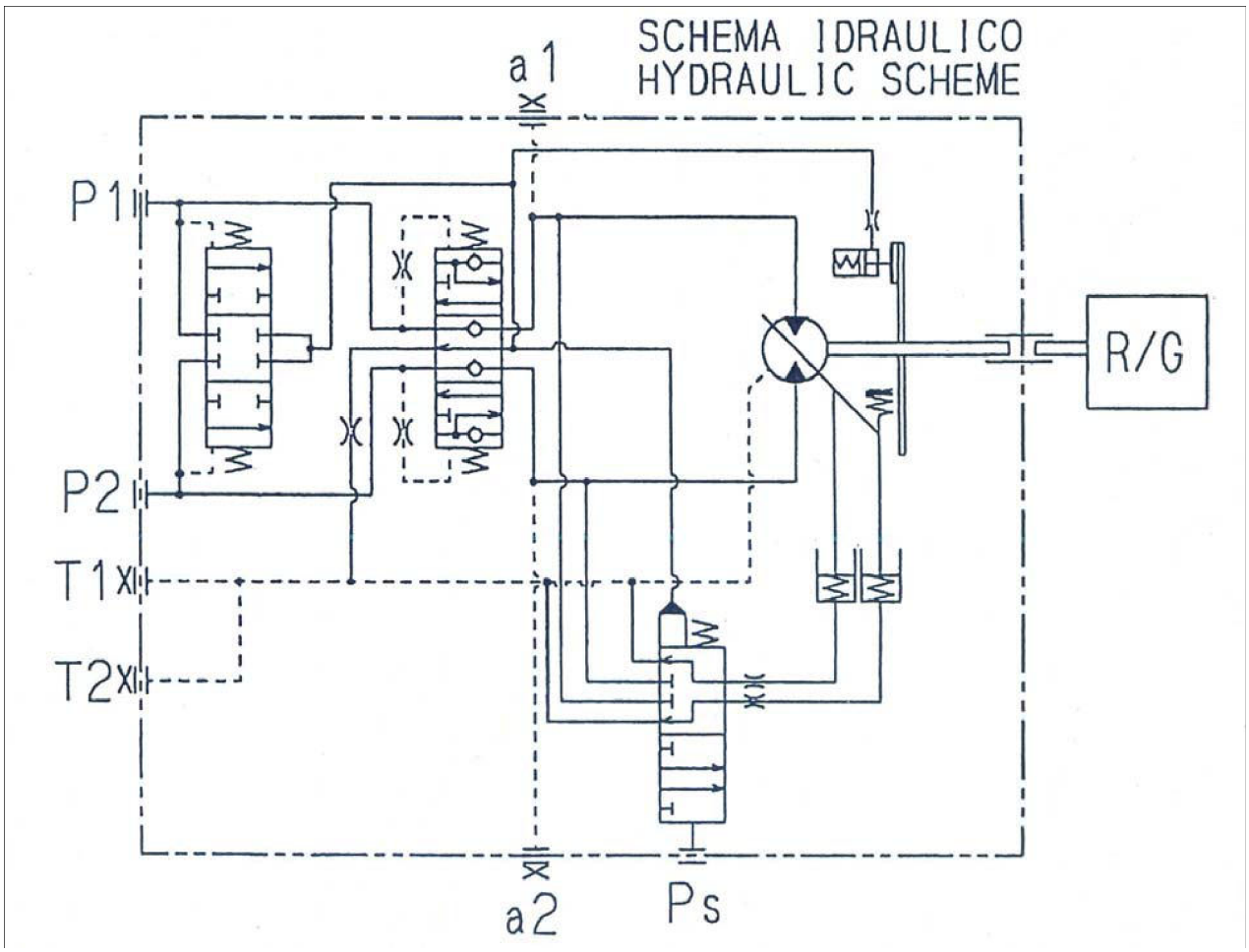
– Automatic speed shift device (auto 2 speed) according to the motor working pressure

– Anticavitation valve

Planetary gearbox

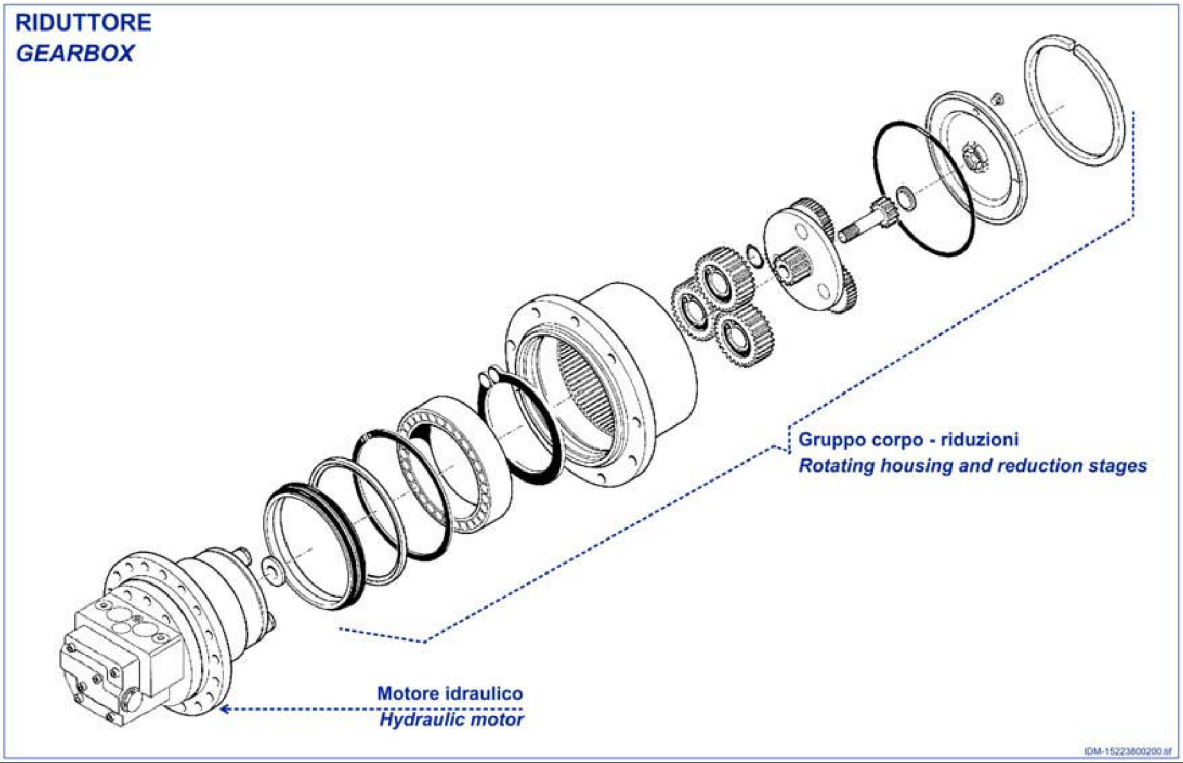
Planetary gearbox, 2 stages, rotating housing type.

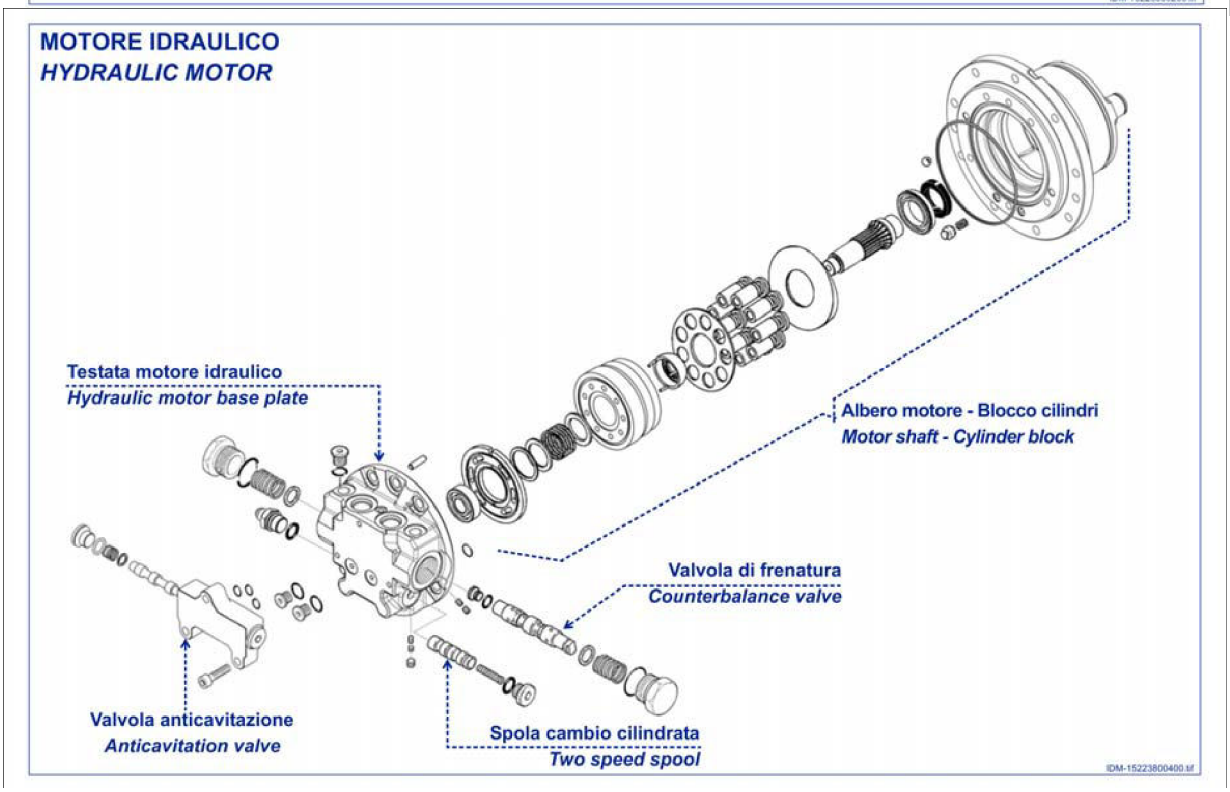
The track drive functional scheme shown in the sketch below.

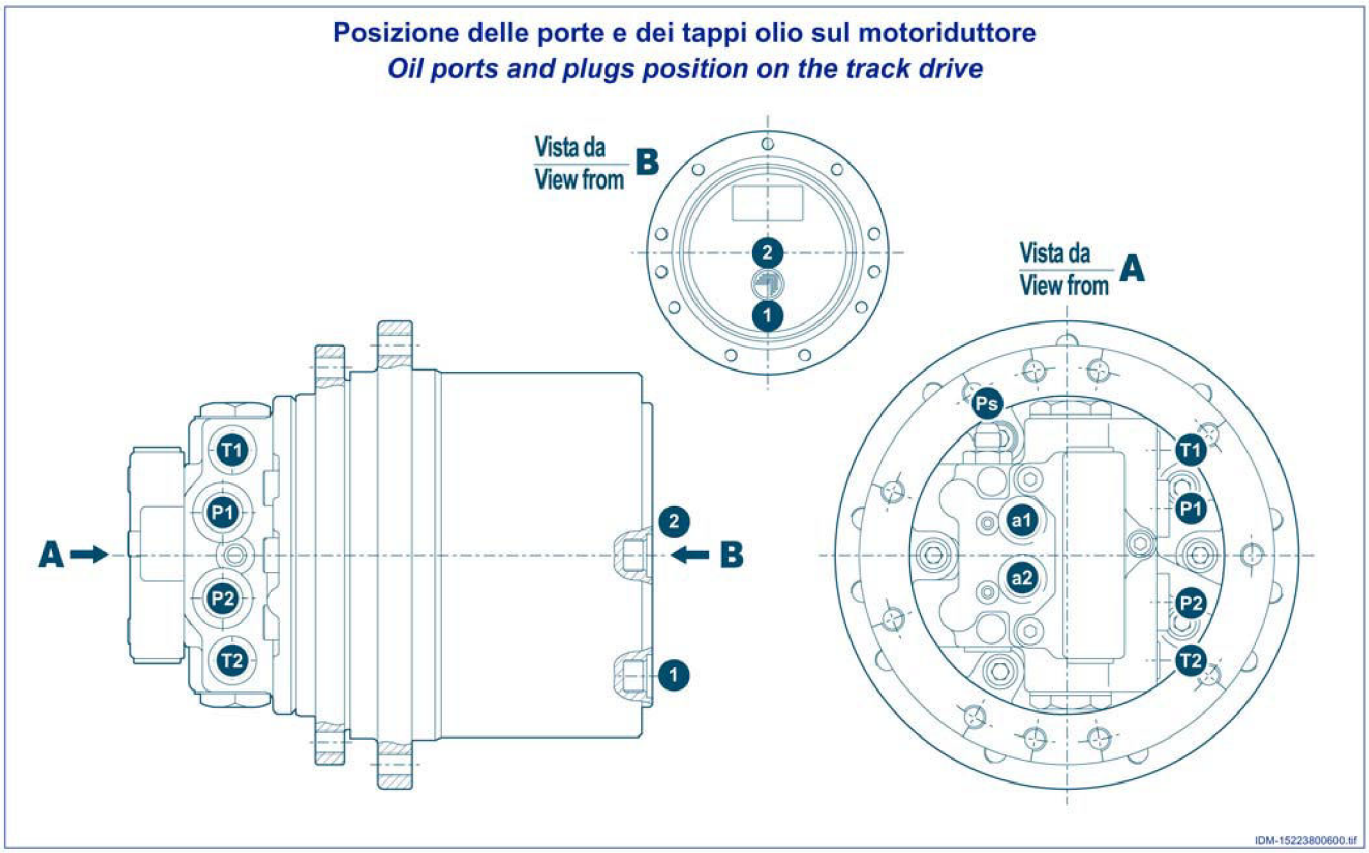


An important piece of advice given is “to perfectly” design the main hydraulic system.

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







Legend:

1	G 3/8”	Oil filling and draining plug
2	G 3/8”	Oil level plug
P1 - P2	3/4 - 16 UNF-2B	Service port
T1 - T2	9/16 - 18 UNF-2B	Drain port
Ps	9/16 - 18 UNF-2A 37°	2 speed control port
a1 - a2	9/16 - 18 UNF	Pressure gauge port

INSTALLATION INFORMATIONS

INSTALLATION PROCEDURE

Before proceeding with installation, follow the instructions given below.

1. Properly clean the product by removing packaging and all remains of protection padding.
2. Prepare the parts to be coupled using the installation drawing as a guide.

The main installation processes are given below. In the following sections, the procedures to follow are given in detail.

– Installation of the track drive on the machine.

– Sprocket fixing to the track drive.

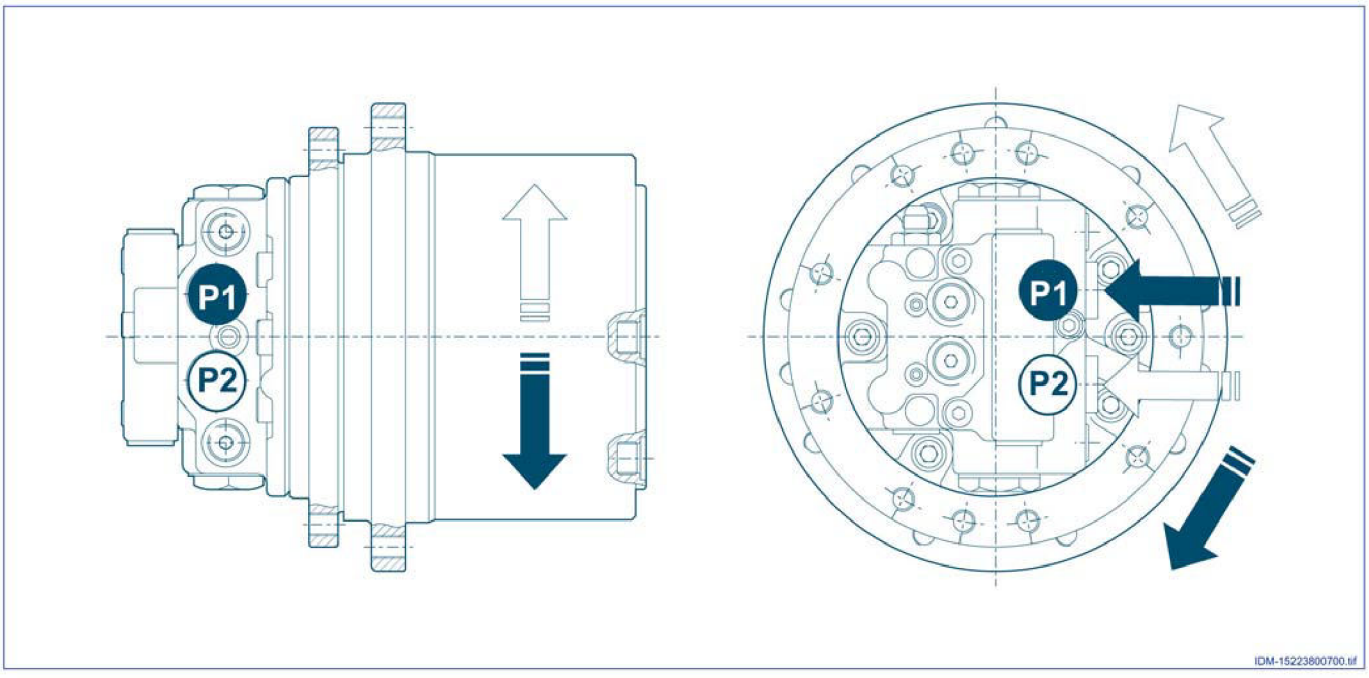
– Connecting the hydraulic system.

– Filling-up the gearmotor with lubricating oil and level of oil to maintain in the gearbox.

When assembling the track drive on the machine and connecting the hoses, follow instructions shown in below sketch for proper direction of rotation.

Direction of rotation

Oil port inlet	Oil port outlet	Direction of rotation (view from motor)
P1	P2	Clockwise
P2	P1	Counterclockwise



Installation of the track drive on the machine

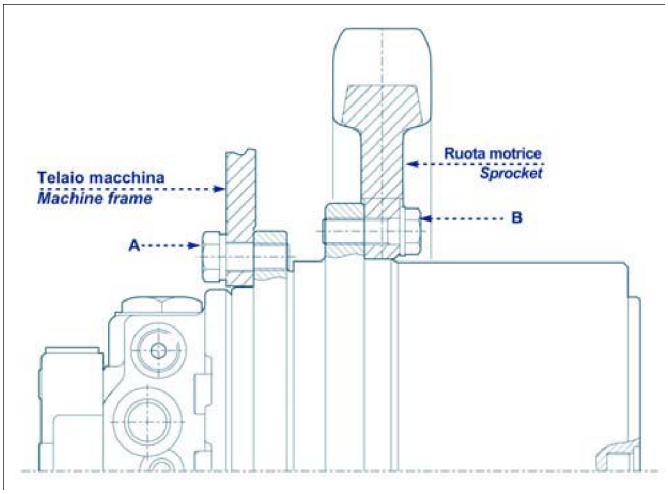
INFORMATION

THE ENTIRE INSTALLATION PROCESS MUST BE PLANNED AS EARLY AS THE GENERAL DESIGN PHASE OF THE MACHINE. THE PERSON AUTHORISED TO DO THE WORK MUST, IF NECESSARY, SET OUT A SAFETY PLAN TO PROTECT THE HEALTH AND SAFETY OF ALL PERSONS DIRECTLY INVOLVED AND APPLY ALL APPLICABLE LEGISLATION.

1. Ensure that the structure to which the gear unit is to be mounted is sufficiently robust and rigid to support its weight and operating stresses.
2. Check that the machine to which the gear unit is to be installed is switched and cannot be accidentally switched on again.
3. Make sure all mating surfaces are flat.
4. Make sure the shaft / shaft or shaft / bore are perfectly aligned for coupling.
5. Fit suitable guards to protect against the gear unit's external moving parts.
6. We recommend applying a protective paste to all gear/motor mating surfaces and other parts such as Klüberpaste 46 MR 401 or Tecnolube WRL 115 or similar product, to ensure optimal coupling and protection against fretting corrosion.
7. Move the track drive in the mounting area applying lifting methods.
8. Clean the mating surfaces from oils or paint and fit the track drive on the machine frame (for the correct orientation refer to the installation drawing).
9. Apply LOCTITE 270 on the thread screws (A). Fix the gearmotor to the machine frame tightening the screws (A) by a torque wrench at a torque shown on the following table.

Sprocket fixing to the track drive

1. Clean the mating surfaces from oils or paint and assemble the sprocket to the gearmotor.
2. Apply LOCTITE 270 on the thread screws (B). Fix the sprocket to the gearmotor tightening the screws (B) by a torque wrench at a torque shown on the following table.



Legend:

A

n° 11 screws ..... M12 grade 8.8 - 86 Nm

B

n° 11 screws ..... M12 grade 8.8 - 86 Nm

Hydraulic system connection

1. Make sure that the entire hydraulic system meets the cleaning standard as given in level 9 according NAS 1638 or 22/18/15 ISO/DIS 4406.

INFORMATION

CLEAN HOSES THOROUGHLY PRIOR TO CONNECTION AND REMOVE ANY INTERNAL OBSTRUCTIONS. PREVENT ANY FOREIGN PARTICLES FROM GETTING INTO THE HOSES BY REMOVING THE PLASTIC CAPS ONLY AT THE TIME OF THE ASSEMBLY. AFTER HOSES ARE CONNECTED TO THE MOTOR, FLOW THE HYDRAULIC CIRCUIT AND FILTER THE OIL FROM ALL THE PARTICLES THAT MAY HAVE CONTAMINED IT.

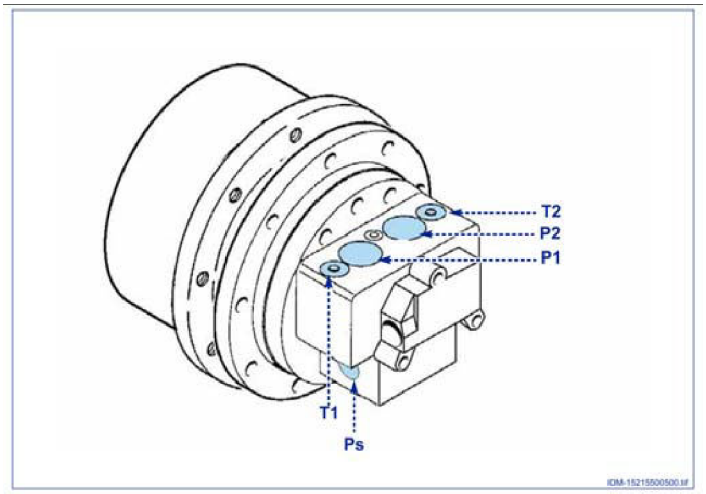
2. Clean the surface to be connected on the hydraulic motor.

INFORMATION

ONLY WHEN IT IS NECESSARY TO ATTACH PIPES, REMOVE THE PLASTIC CAPS PROTECTING THE CONNECTIONS, THIS WILL ENSURE THAT NO FOREIGN BODY GOES INSIDE THE HYDRAULIC MOTOR.

3. Pipe the hydraulic motor as shown below (for pipe sizes and dimensions refer to the installation drawing).

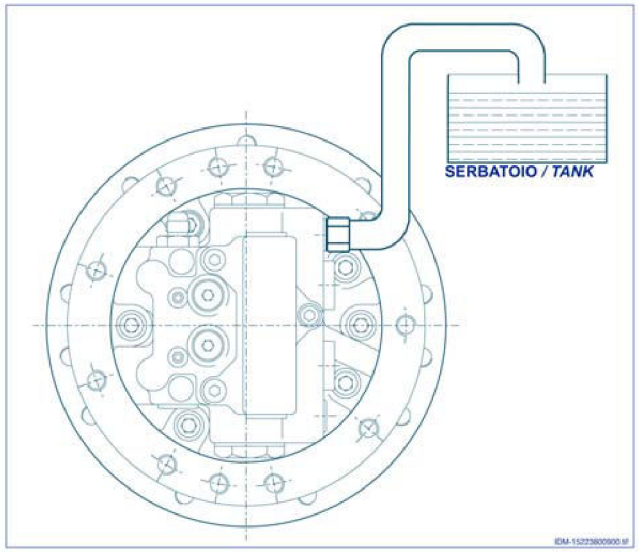
   - Main ports: P1-P2
   - Drain ports: T1-T2
   - Two speed control port: Ps



The drain pressure must be lower than the values shown below.

Motor drain pressure	
Continuous running	Less than 1 bar
Max. intermittent	Less than 5 bar

Drain pipe must be directly and independently connected to the tank. Drain port must be located on the upper side of the motor.



Gearbox lubrication

The motor and the gearbox have separate lubrication. The gearbox is lubricated by oil splashing.

The recommended oil type should have EP

characteristics according to MIL-L-2105 C & API GL5.

– For standard conditions, the recommended oil is:

1.Mineral oil SAE 80W/90.

2.Synthetic oil SAE 75W/90.

– For heavy duty conditions (high loads, high duty cycles or high ambient temperatures), the recommended oil is:

1.Mineral oil SAE 85W/140.

2.Synthetic oil SAE 80W/140.

In following table the most common brands of lubricant and the types recommended are shown.

INFORMATION

DURING OPERATION THE OIL TEMPERATURE MUST NOT EXCEED 85-90°C INTERMITTENT.

INFORMATION

USE ONLY SYNTHETIC OILS WITH PAO BASE IF NOT OTHERWISE SPECIFIED IN THE ORDER.

DO NOT MIX TOGETHER OILS OF DIFFERENT BRANDS OR CHARACTERISTICS.

Elenco olii consigliati a Norme SAE 80W/90 e SAE 85W/140 con caratteristiche API GL5
Lubricant oils suggested according SAE 80W/90 and SAE 85W/140 API GL5 grade

Temperatura ambiente *Ambient temperature* Viscosità olio / *Oil viscosity*		-20°C / +30°C SAE 80W/90	+10°C / +45°C SAE 85W/140
Produttori / *Manufacturers*		Tipo olio / *Oil Brand*	
	SHELL	SPIRAX A	SPIRAX A
	AGIP	ROTRA MP	ROTRA MP
	ARAL	GETRIEBEOL HYP	GETRIEBEOL HYP
	BP-MACH	HYPOGEAR EP	HYPOGEAR EP
Castrol	CASTROL	HYPOY	HYPOY
Chevron	CHEVRON	UNIVERSAL GEAR LUBRICANT	UNIVERSAL GEAR LUBRICANT
elf	ELF	TRANSELF B	TRANSELF B
	I.P.	PONTIAX HD	PONTIAX HD
Mobil	MOBIL	MOBILUBE HD	MOBILUBE HD
TOTAL	TOTAL	TRASMISSION TM	TRASMISSION TM

Oil filling

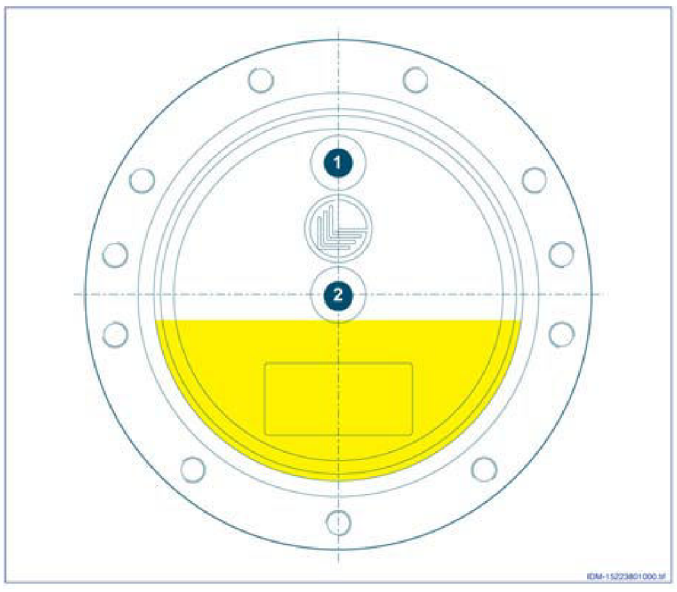
⚠ CAUTION

BEFORE THE STARTING UP, CHECK THE LEVEL OF LUBRICATING OIL. IF NECESSARY, REFILL WITH LUBRICANT OIL.

This procedure is undertaken following the indications given below.

1. Check that the gearbox axis is horizontal. Rotate the gearbox housing until the plug (1) is on the top on the vertical axis of the end cover.
2. Unscrew the oil plugs (1-2).
3. Fill from the hole (1) until the lubricant flows out from the hole (2).
4. Screw the oil plugs (1-2).
5. Run the gearbox, after a few minutes, stop and check the oil level.
6. If necessary, refill with lubricant oil (for plug orientation, size and dimension refer to the installation drawing).

Approximate oil capacity	**litres**	**0,6 ± 10%**



Characteristics of the hydraulic system

The oil in the hydraulic system (which also lubricates the hydraulic motor) must reflect the ISO VG 46 characteristics. It must be filtered with a maximum grade of 10 μm and with a level of contamination equal to or inferior to 22/18/15 ISO/DIS 4406 or level 9 according NAS 1638.

It is advised not to mix together oils with different properties.

It is advised to use a filter with a led indicator that can be seen externally, with a flow control valve that blocks the flow of oil when the filter is clogged.

If it is necessary to work in low temperatures (artic climates) it is essential to use specific guidelines (contact the manufacturer).

Checking the temperature of the hydraulic oil is one of the most critical aspects of the hydraulic system.

High operational temperatures will cause a degradation of the oxidation resistance level and will accelerate the deterioration process of the hydraulic oil.

Therefore it is important to follow the measures below.

– The temperature of the hydraulic oil during working conditions should remain between 25°C and 90°C.

– The temperature of oil should reach -20°C prior to start operation.

– During operation the oil temperature can rise to 90°C but this temperature is acceptable only for very short periods of time.

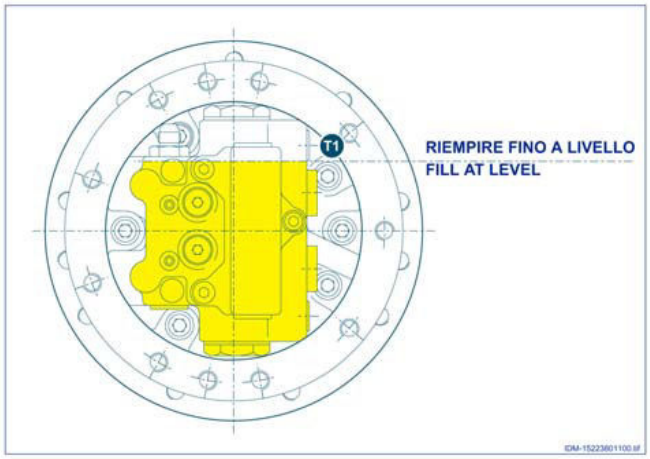
These temperatures have been set to take into consideration general degrading in viscosity as well as the wear resisting additives used in the oil.

The life of the motor will be shortened considerably if the operating temperature is constantly at a level that is higher than 90°C.

First start up and running in

In this first stage it is advised to follow the measures given below:

1. Check the correctly lubrication of the unit.
2. Fill the motor housing with hydraulic oil from the drain port (T1) (see the following picture).
3. Bleed air from every part of the hydraulic circuit and add oil in the tank if necessary.



INFORMATION

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

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

INFORMATION

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

During the running-in stage follow the steps given below.

1. Check the correct revolution and direction of rotation.
2. Make sure that the functioning is regular and without any excessive noises and vibrations.
3. Make sure that the oil temperature does not exceed 85-90°C intermittent.

After having terminated this first running-in follow the steps given below.

1. Check that there are no oil leakages. If present, proceed to remove them.
2. Check the level of lubricating oil in the gearmotor.
3. Check that there are no other problems in general.

MAINTENANCE INFORMATIONS

PERIODIC MAINTENANCE

The gearmotor only requires the scheduled maintenance procedures set out by the manufacturer (see table below).

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

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

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

Inspection	Frequency	Action
Tightening screws	After the first 50 operating hours of the gearbox	Screws tighening torque check
Oil level	Every 150 operating hours of the gearbox	Refill oil if necessary
1st oil change	At 150 operating hours of the gearbox	Oil replacement
Following oil changes		
Standard conditions	Every 1000 operating hours or at least one a year	Oil replacement
Heavy duty conditions	Every 250 operating hours or at least one a year	Oil replacement

OIL DRAINING AND REPLACEMENT

1. Check that the gearbox axis is horizontal. Rotate the gearbox housing until the plug (1) is on the bottom of the vertical axis of the end cover.

⚠ DANGER

REMOVE THE OIL PLUGS WITH CARE. WHEN THE GEARBOX IS WARM, THE AIR INSIDE CAN BE PRESSURIZED AND THIS CAN CAUSE THEIR STRONGLY EXPULSION TOWARDS THE WORKER.

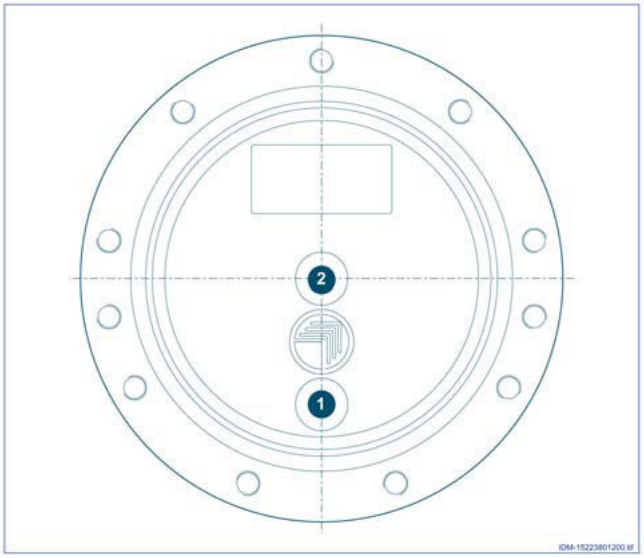
2. Unscrew the plugs (1-2) and let the oil flow in a large enough container; in order to facilitate the draining must be oil still warm.
3. Wait a few minutes until all the oil is drained and then proceed to screw on the plugs (1-2).
4. Proceed with the oil fill-up following the procedures given.

⚠ DANGER

NEVER MIX MINERAL OILS WITH SYNTHETIC OILS AND VICE VERSA.

⚠ CAUTION

DO NOT DISPOSE OF THE OIL IN THE NATURAL ENVIRONMENT BUT BE CAREFUL TO ELIMINATE IT IN COMPLIANCE WITH THE RELATIVE RULES AND REGULATIONS THAT GOVERN LOCALLY.



TROUBLE SHOOTINGS

The following table is a guideline to identify the troubles in the track drive.

Anomalies	Causes	Remedies
External oil leakage :		
From the lifetime seal	a) Lifetime damaged	a) Replace lifetime seal
From the end cover	a) O-ring seal damaged	a) Replace O-ring seals
From the plugs of the cover	a) Plug seal damaged b) Plugs or screws loose	a) Replace plug seal b) Tighten the plugs/screws
From hydraulic motor	a) O-ring seals damaged b) Plugs or screws loose c) Internal motor parts damaged	a) Replace O-ring seals b) Tighten the plugs/screws c) Check the hydraulic motor
Too much noise :		
Inside the hydraulic motor (mechanical noise)	a) Internal motor parts damaged	a) Check the hydraulic motor
Hydraulic noise (during the slowing down of the motor speed)	a) Internal motor parts damaged	a) Check the hydraulic motor
Inside the gearmotor (reductions)	a) Internal damage	a) Check the gearbox
Other:		
Overheating	a) Insufficient oil level b) Hydraulic oil too warm	a) Check the oil level and refill if necessary b) Check the hydraulic circuit
Insufficient torque	a) Internal motor parts damaged	a) Check the hydraulic motor
Insufficient speed	a) Motor feed not correct b) Low volumetric efficiency	a) Check the hydraulic circuit b) Check the hydraulic motor
Sprocket locked	a) Hydraulic motor locked b) Mechanical components damaged	a) Check hydraulic motor b) Replace damaged parts

DISASSEMBLY

In the case that it was necessary to undergo a (partial or total) revision, it will be necessary to dismount the gearmotor from the machine. As this is known as an out of the ordinary maintenance procedure, it is important that only personnel with specific skills and experience undertake it.

It is also important that this procedure is undertaken in a workshop that is adequately tooled. As well as normal workshop tools it will be necessary to use special tools that can be made (see special tools attachment) or may be requested from the manufacturer.

Special Tools

Puller ..... Code: 6689960740

Puller ..... Code: 6689962080

Puller ..... Code: 6689962090

Ring for lifetime

seal assembly..... Code: 6689962100

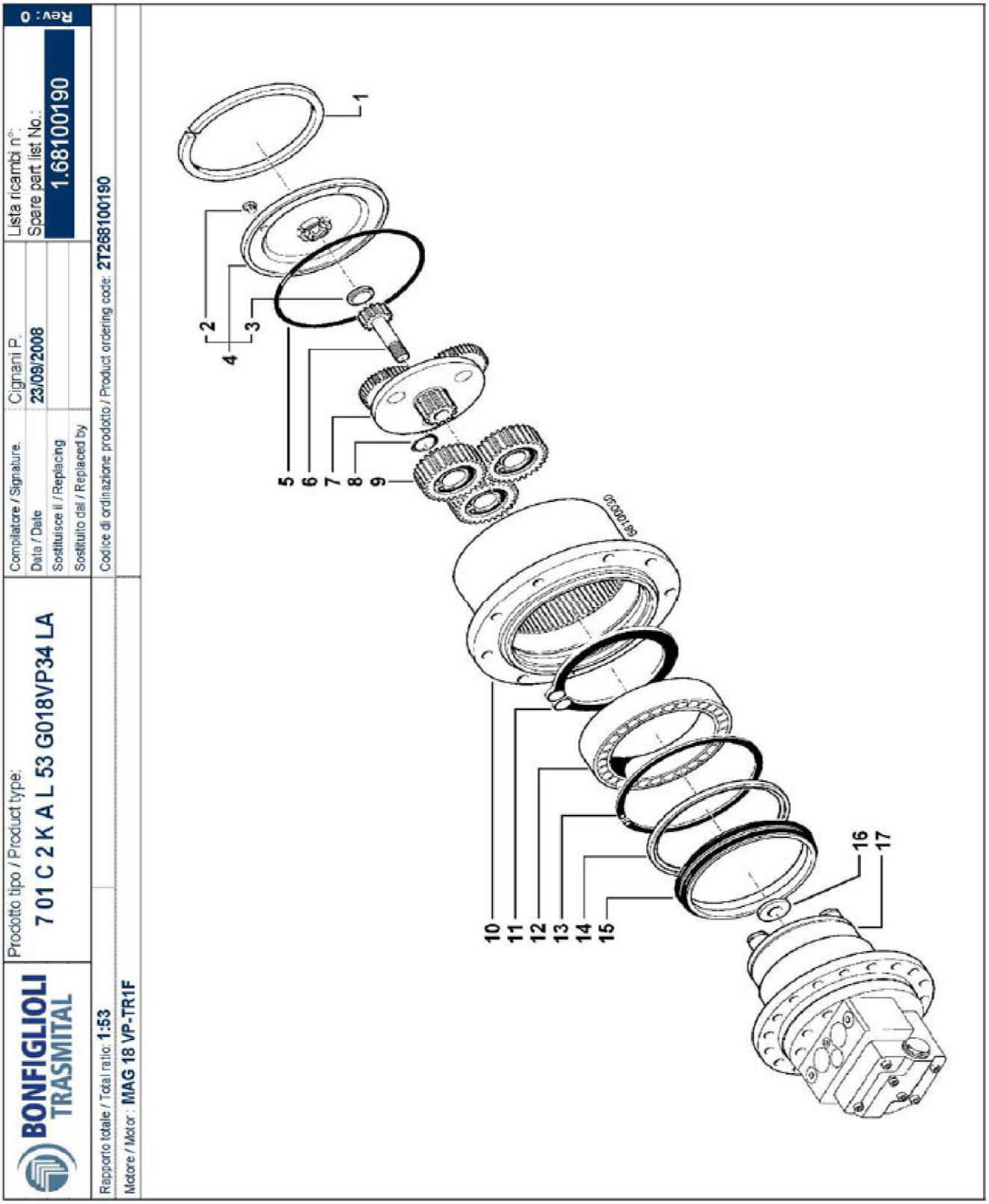
To be able to produce these equipments refer to the production drawings at the end of this manual.

In the following pages all the procedures for disassembling and reassembling the gearmotor are given, it is important to strictly adhere to them.

Proceed with these operations using all the necessary safety measures, like for example:

1. Cutting off all the hydraulic system connections on the gearmotor to avoid the introduction of any foreign bodies in the circuit and the gearmotor.
2. Making sure that the coupling surfaces are not damaged.
3. Following the handling so as to be sure that there are no risks for human safety and to guarantee the reliability of the gearmotor.
4. Making available a work area that is in line with work and health safety in the workplace guidelines.

NOTE: *below are all the steps to follow during these operations. Numbers in brackets in the text correspond to the references in the exploded view.*


BONFIGLIOLI TRASMITAL
Prodotto tipo / Product type:
7 01 C 2 K A L 53 G018VP34 LA
Compilatore / Signature: Cignani P.
Data / Date 23/09/2008
Sostituisce il / Replacing
Sostituito dal / Replaced by
Lista ricambi n°:
Spare part list No.:
1.68100190
Rev: 0
Rapporto totale / Total ratio: 1:53
Motore / Motor: MAG 18 VP-TR1F
Codice di ordinazione prodotto / Product ordering code: 2T2681001 90
1
2
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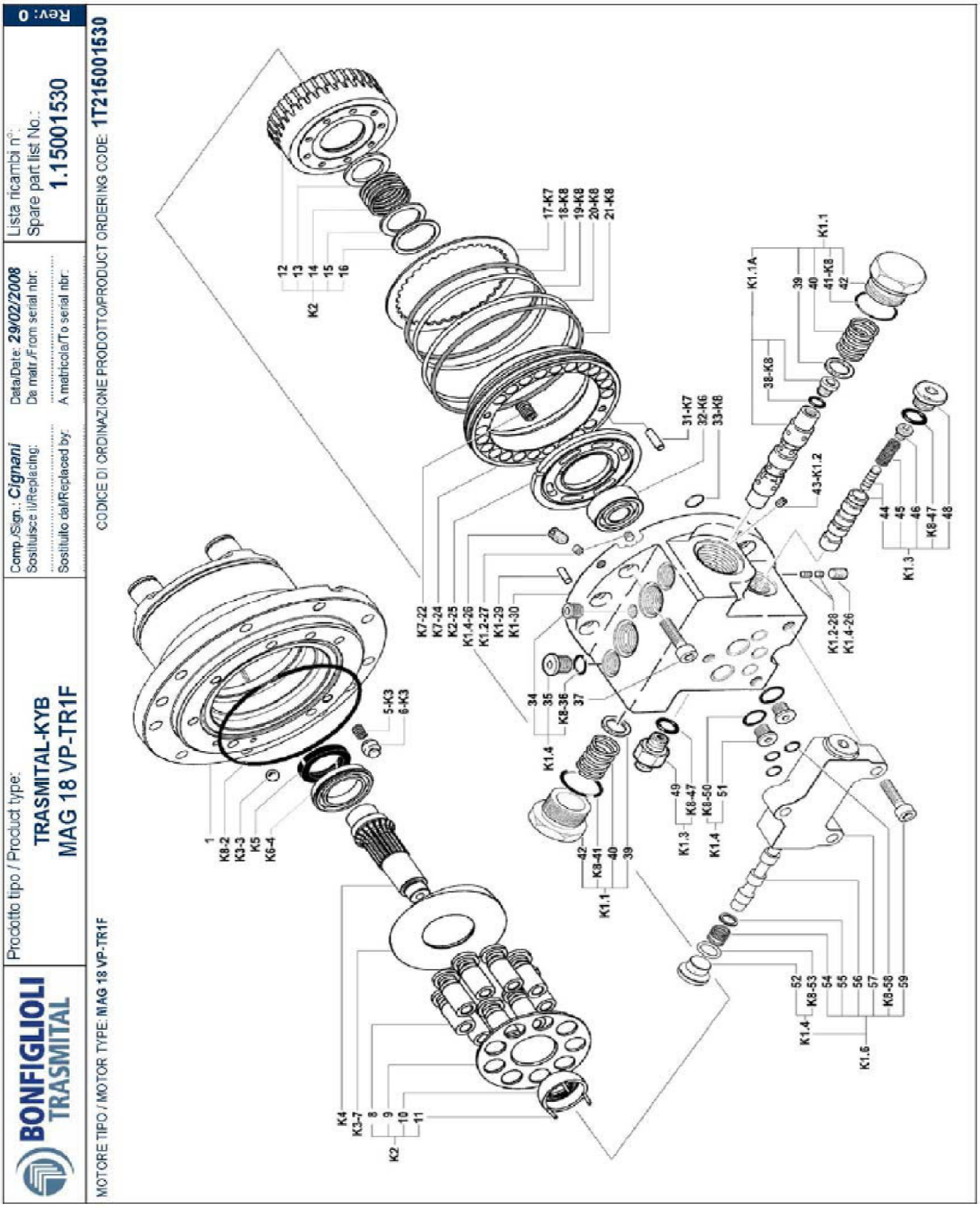

BONFIGLIOLI TRASMITAL
Prodotto tipo / Product type:
TRASMITAL-KYB
MAG 18 VP-TR1F
Comp./Sign.: Cignani
Sostituisce il/Replacing:
Sostituito dal/Replaced by:
Data/Date: 29/02/2008
Da matr./From serial nbr:
A matricola/To serial nbr:
Lista ricambi n°:
Spare part list No.:
1.15001530
Rev: 0
MOTORE TIPO / MOTOR TYPE: MAG 18 VP-TR1F
CODICE DI ORDINAZIONE PRODOTTO/PRODUCT ORDERING CODE: 1T215001530

Gearbox disassembly

Initial inspection of the gears, can be made without disassembling the track and the track drive from the machine.

INFORMATION

THE COMPONENTS CAN BE VERY HEAVY AND LARGE DIMENSIONS: PAY ATTENTION DURING THE HANDLING.

Before track drive disassembling, make sure that the oil is discharged according to instructions specified.

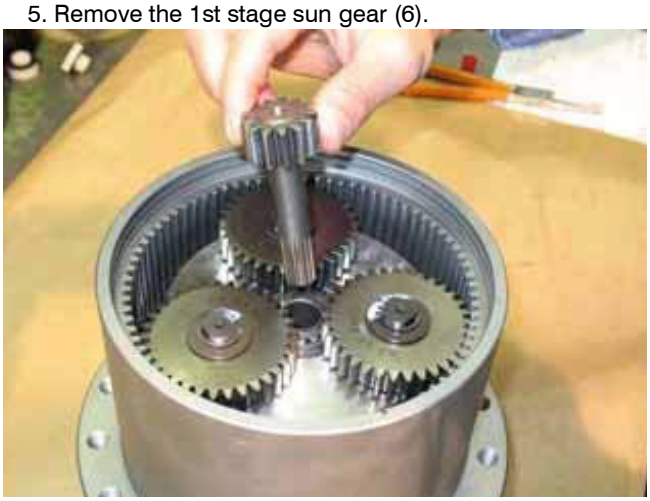
1. Unscrew the nos. 2 plugs (2) and the washers from the end cover (4).

2. By using a screwdriver remove the elastic ring (1).

3. Place the wrench into the plug (2), jack and remove the end cover (4).

4. Remove the O-ring seal (5) from its seat in the gearbox housing (10).

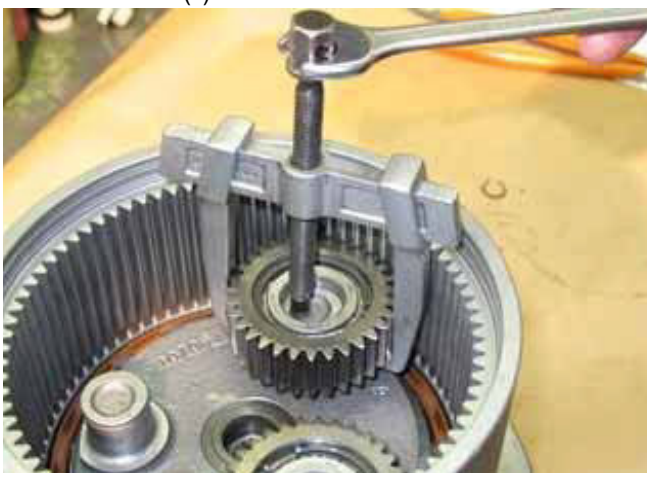
5. Remove the 1st stage sun gear (6).



6. Remove the 1st reduction assembly (7).

7. By using pliers remove the circlips (8) from their seats placed in the hydraulic motor's pins (17).

8. By using a puller remove the planet assemblies of the 2nd reduction (9).

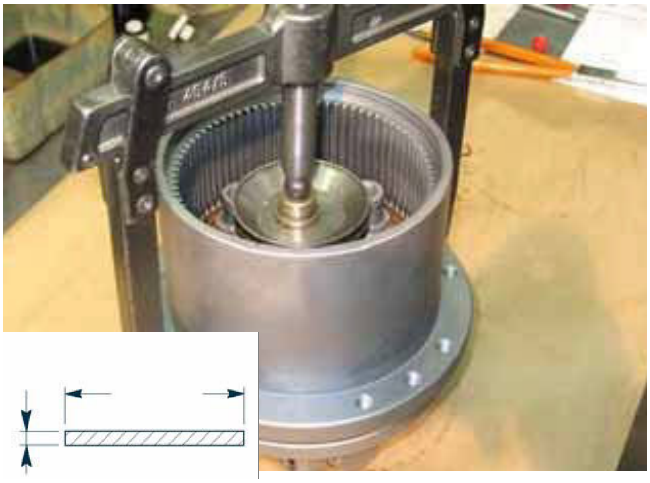


9. By using pliers remove the circlip (11) from its seat in the hydraulic motor (17).

INFORMATION

IN ORDER TO PROCEED WITH THE GEARBOX DISASSEMBLY, IT IS NOW NECESSARY TO REMOVE IT FROM THE MACHINE AND BRING IT TO A PROPERLY EQUIPPED WORKSHOP.

10. By using a puller, push on a metal stopper and remove the hydraulic motor (17) from the gearbox housing (10).



INFORMATION

IN CASE OF OIL LEAKAGES, IT MIGHT BE NECESSARY TO CHECK AND EVENTUALLY REPLACE THE LIFETIME SEALS (15), WHICH MEANS BOTH THE METAL RINGS PARTS AND THE O-RING SEALS.

11. Remove the 1st half seal (15) from the hydraulic motor (17).

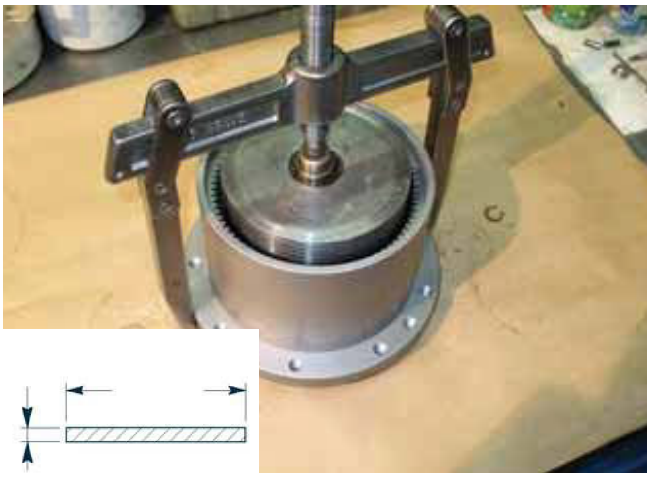
12. Remove the 2nd half seal (15) from the gearbox housing (10).

13. Remove the spacer (14) from the gearbox housing (10).

14. By using pliers remove the circlip (13) from its seat in the gearbox housing (10).

15. Turn the gearbox housing (10) upside down and place a metal stopper on the bearing (12).

16. By using a puller and a metal stopper, remove the bearing (12) from the gearbox housing (10).

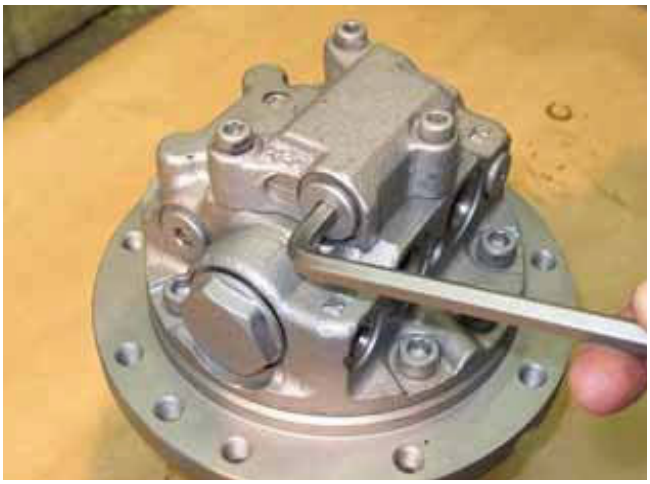


17. Remove the bearing (12) from the gearbox housing (10).

HYDRAULIC MOTOR DISASSEMBLY

Anticavitation valve disassembly

18. Loosen the plugs (61) of the relief valves from the valve housing (66).



19. Unscrew the nos. 3 socket head screws M8x35 (68), grade 10.9, of the valve housing (66) by a male hex head wrench.

20. Remove the valve housing (66).

21. Remove the O-ring seals (67) from their seats in the valve housing (66).

22. Remove the plugs (61) of the anticavitation valve from the valve housing (66) previously loosened.

23. Remove the O-ring seal (62) from each plug (61).

24. By using pliers remove the nos. 2 springs (63).

25. Remove the spool (65) from the anticavitation valve housing (66).

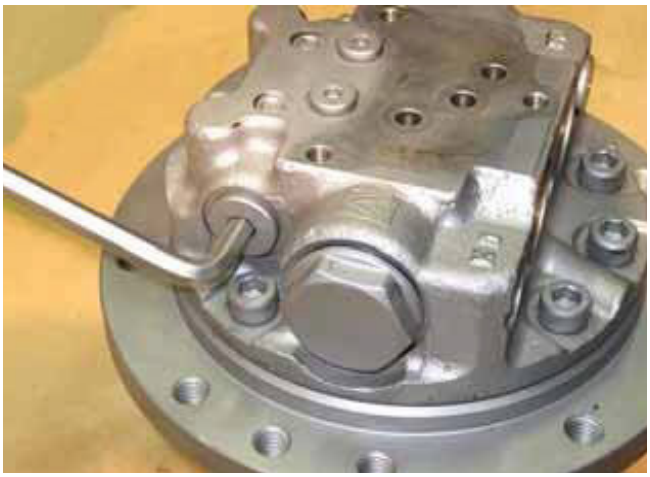
26. Take out the nos. 2 spring seats (64) from the anticavitation spool (65).

27. View of the loose parts.

Disassembly of the base plate

28. Loosen the counterbalance valve plugs (46) from the base plate (40) without remove them.

29. Loosen the plug (56) of the two speed control without remove it.



30. Unscrew the two speed control connector (57) from the base plate (40).

31. Remove the O-ring seal (55) from its seat in the two speed control connector (57).

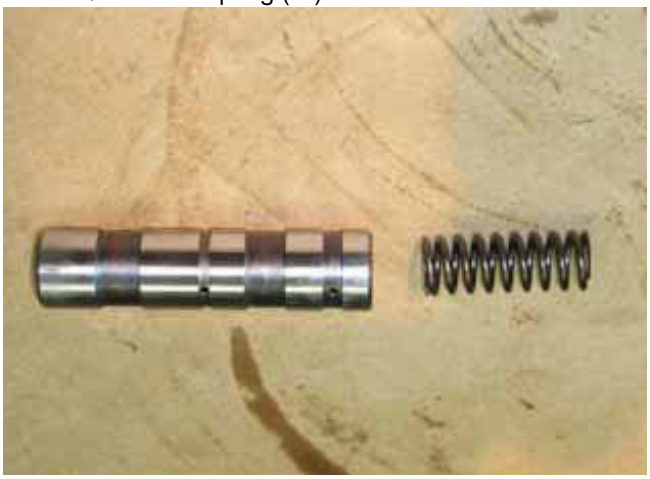
32. Unscrew the nos. 6 socket head screws M10x20 (58), grade 12.9, of the base plate (40) by a male hex head wrench.

⚠ DANGER

REMOVE CAREFULLY THE BASE PLATE (40) UNTIL PINS (39) ARE COMPLETELY OUT.

33. Take out the two speed spool (53).

34. Take out the spring (54).

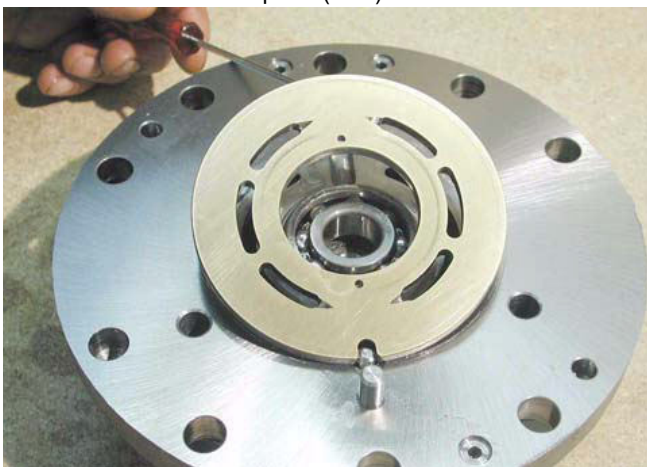


35. View of the loose parts.

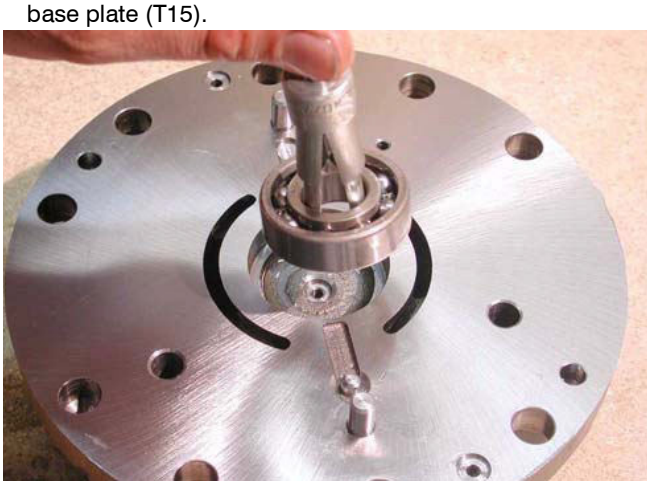
Disassembly of the counterbalance valve

36. Unscrew the counterbalance valve plugs (46), previously loosened, from the base plate (40).

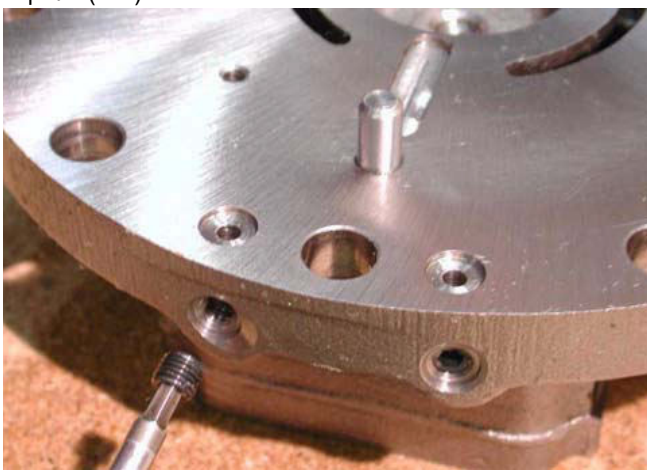
37. Remove the valve plate (M21).



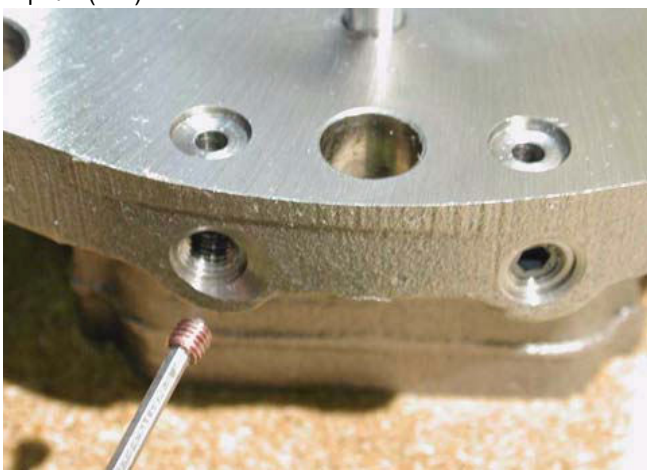
38. By using a puller, remove the bearing (M22) from the base plate (T15).



39. Unscrew and remove the plugs (T11) from the base plate (T15).



40. Unscrew and remove the orifices (T12) from the base plate (T15).



41. Unscrew the plugs (41) from the base plate (40).

42. Remove the O-ring seals (42) from its seat in the plugs (41).

Disassembly of the two speed control

43. Remove the plug (56) of the two speed control, previously loosened, from the base plate (40).

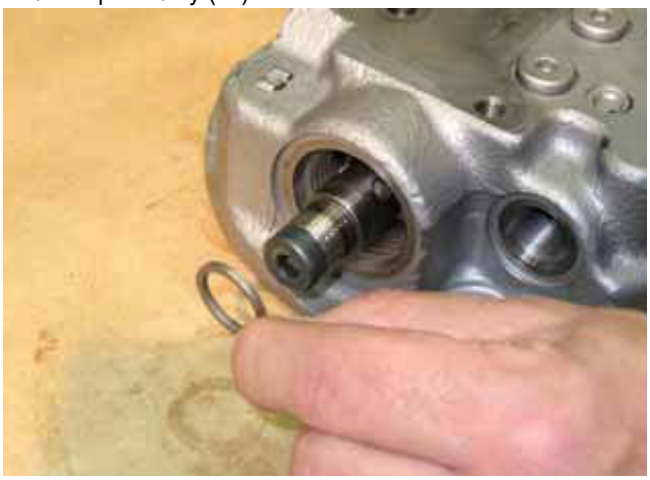
44. Remove the O-ring seal (55) from its seat in the plug (56).

45. Remove the O-ring seals (45) from its seat in the plugs (46).

46. Remove the nos. 2 springs (44).

47. Push right the counterbalance spool assy (47) to remove easily the spring seat (43).

48. Take out the 1st spring seat (43) from the counterbalance spool assy (47).



Disassembly of motor shaft and cylinder block

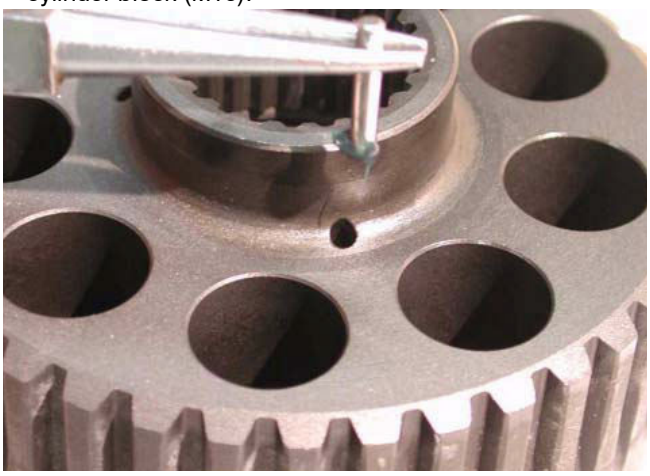
49. Remove the springs (M28) from the brake piston (M27).

50. Remove the O-ring seal (M6) from its seat in the flanged hub (M2).

51. Remove the cylinder block assy (M16).

52. Take out the spherical retainer plate holder (M13).

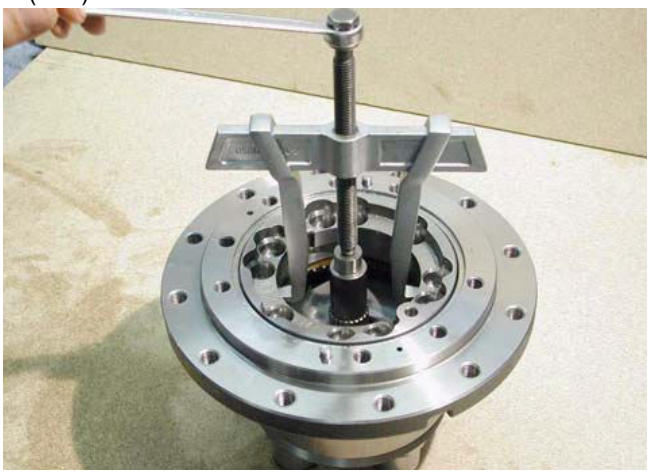
53. Take out the nos.3 pins (M15) from their seats in the cylinder block (M16).



54. Disassemble the pistons and the retainer plate (M11-M12).

55. Take out the pistons (M11) from the retainer plate (M12).

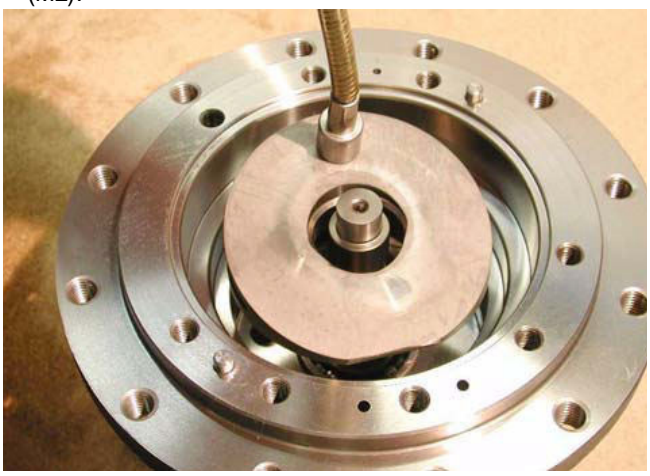
56. By using a puller, turn the screw until the brake piston (M27) comes out.



57. Remove the O-ring seals (M24-M25) and the backup rings (M23-M26) from their seats in the brake piston (M27).

58. Take out the brake disc (M14).

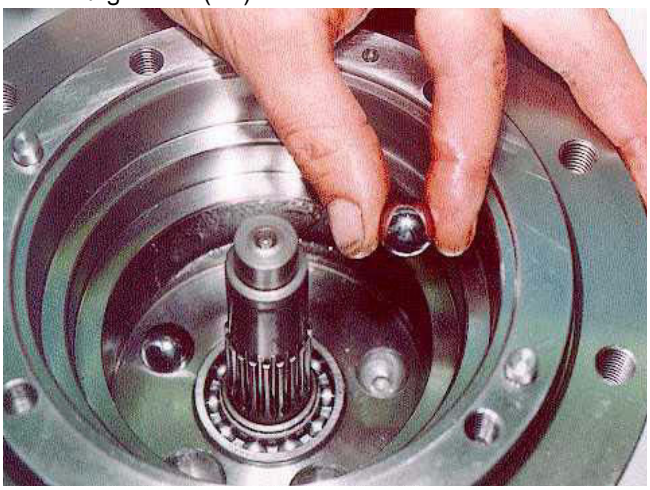
59. Remove the swash plate (M10) from the flenged hub (M2).



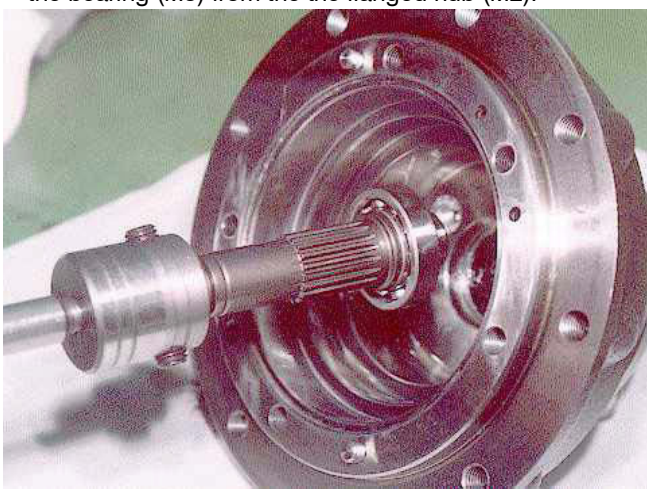
60. Take out the nos. 2 two speed control pistons (M5) from the flanged hub (M2).

61. Take out the nos.2 two speed control springs (M4) from their seats in the flanged hub (M2).

62. Take out the nos.2 steel balls (M3) from their seats in the flanged hub (M2).



63. By using a puller, take out the motor shaft (M9) and the bearing (M8) from the the flanged hub (M2).



64. By using a puller, take out the bearing (M8) from the motor shaft (M9).

65. By using a screwdriver remove the back-up ring (21) from its seat in the flanged hub (18).

INFORMATION

DISASSEMBLE THE BACK-UP RING (21) ONLY IN CASE OF REPLACEMENT, BECAUSE THIS WILL DAMAGE IT.

INFORMATION

THE DISASSEMBLY ENDS WITH THE ABOVE OPERATION. ALL ITEMS ARE NOW AVAILABLE FOR THE NECESSARY INSPECTIONS.

EVALUATION THAT PIECES TO REPLACE

The pieces that are subject to general wear and tear are the following:

- Gears
- Pinion shaft
- Bearings
- Seals

Replace the used or irregular parts respecting the following steps:

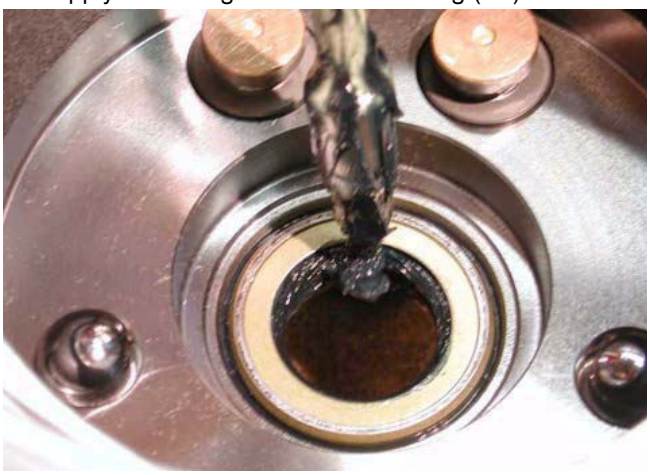
1. Accurately remove dirt, and in particular properly clean the seals, bearings and locking rings seating.
2. Lubricate the parts before connecting them.
3. In the case of damaged gears, for example a planetary, do not proceed to replace the individual gear but the entire reduction assembly.
4. When reconnecting a part always replace all the seals involved.
5. Replace all the damaged parts with original spare parts.

REASSEMBLING METHOT

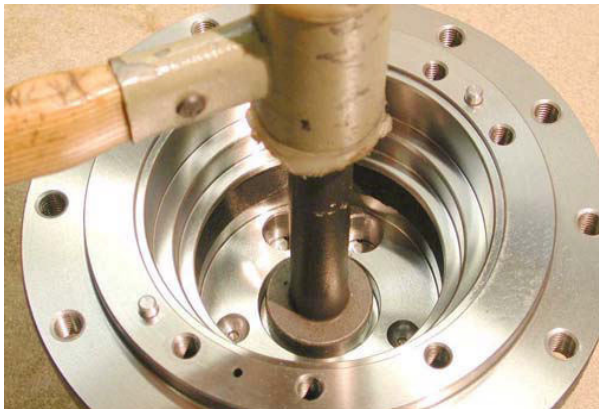
Reassembly of motor shaft and cylinder block

1. Place the seal ring (M7) into its seat in the flanged hub (M2).

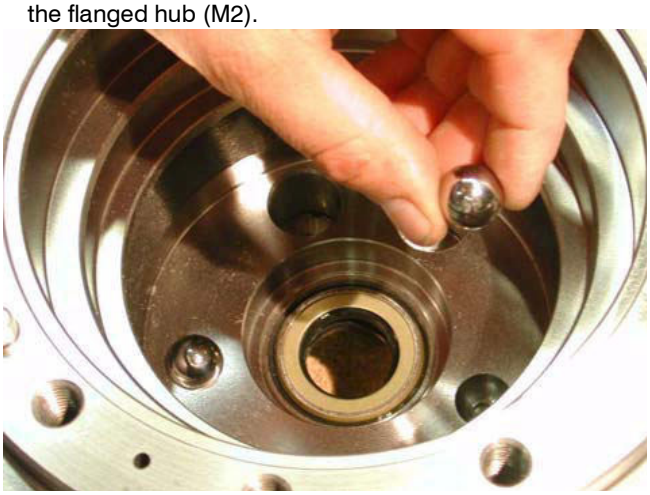
2. Apply a coat of grease on the seal ring (M7).



3. By using the tool (ATZ.06.027) and a rubber hammer push the seal ring (M7) against the seat shoulder.



4. Assemble the nos.2 steel balls (M3) into their seats in the flanged hub (M2).



5. Assemble the nos.2 two speed springs (M4) into their seats in the flanged hub (M2).

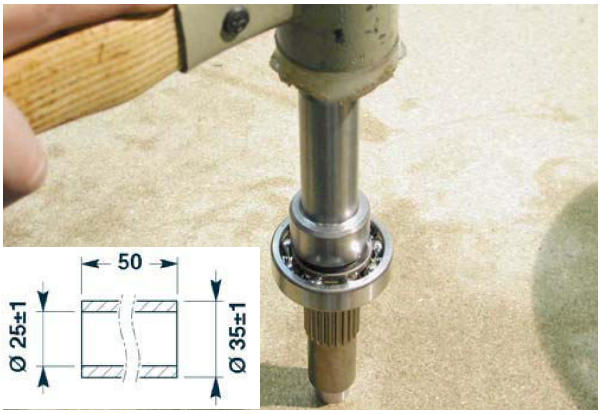
6. Assemble the nos.2 two speed pistons (M5) into their seats inside the flanged hub (M2).

⚠ DANGER

BE SURE THAT THE PISTONS CAN MOVE FREELY INTO THE SEATS.

7. Place the bearing (M8) on the motor shaft (M9).

8. By using a stopper and a rubber hammer push the bearing (M8) against the motor shaft shoulder (M9).

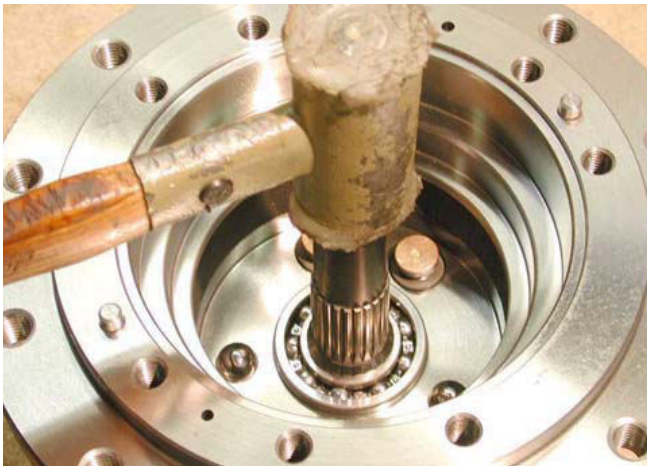


9. Place the bearing-motor shaft sub-assembly (M8-M9) in the seat inside the flanged hub (M2).

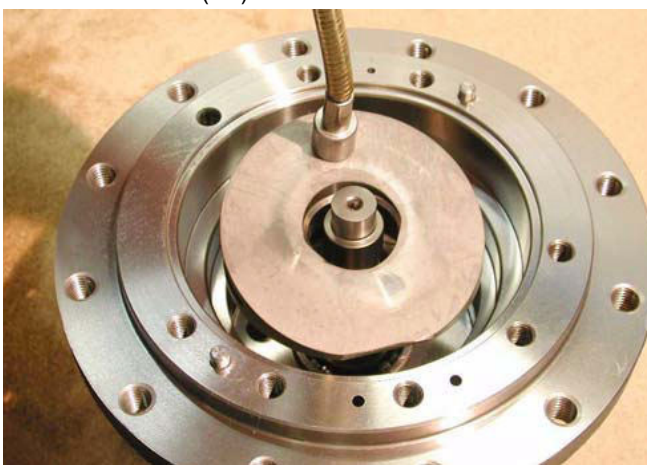
⚠ DANGER

BE CAREFUL WHEN INSERTING THE SHAFT INSIDE THE MOTOR SEAL, THAT MUST BE GREASED.

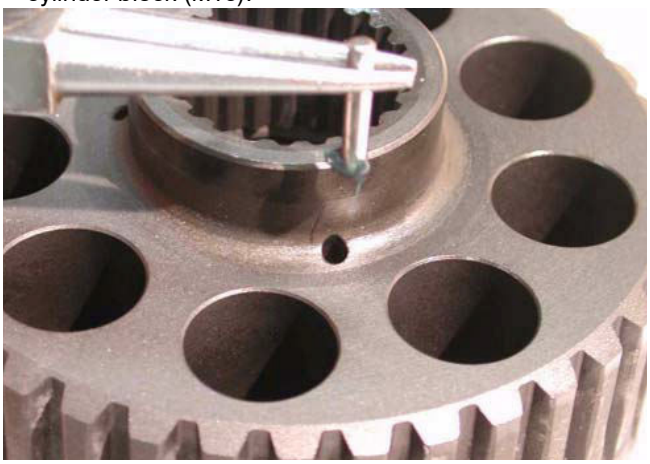
10. By using a plastic hammer push the bearing-motor shaft unit (M8-M9) against the flanged hub shoulder (M2).



11. Insert the swash plate (M10) inside the flanged hub (M2) being careful that spherical housings matches with the 2 steel balls (M3).



12. Assemble the nos.3 pins (M15) in their seats in the cylinder block (M16).



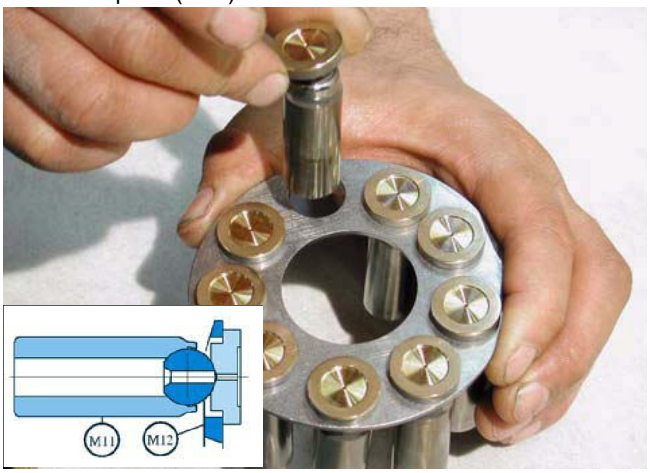
13. Assemble the spherical retainer holder (M13) on the cylinder block (M16).

⚠ CAUTION

THE TWO SPLINES MUST BE ALIGNED TOGETHER.

14. Piston orifice (M11) must be open and free of dust or dirt.

15. Assemble correctly the nos.9 pistons (M11) in the retainer plate (M12).



16. Assemble the pistons-retainer plate unit (M11M12) in the cylinder block (M16).

17. Insert the brake disc (M14) in the cylinder block (M16).

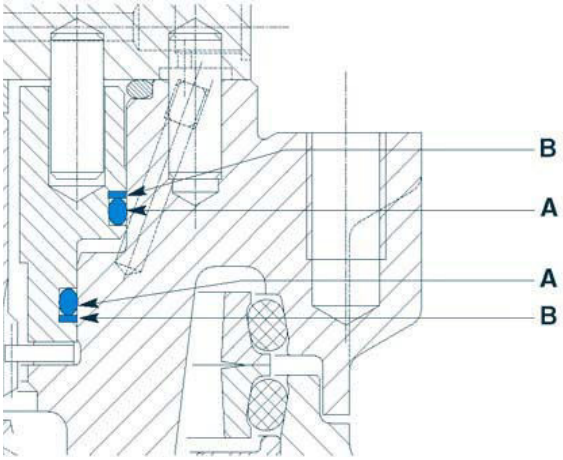
18. Assemble the cylinder block sub assembly (M16) into the flanged hub (M2) on the motor shaft spline (M9).

19. Assemble the backup ring (M26) into its seat in the brake piston (M27).

20. Assemble the O-ring seals (M25-M24) into its seat in the brake piston (M27). Assemble the backup ring (M23) into its seat as shown on the sketch below.

INFORMATION

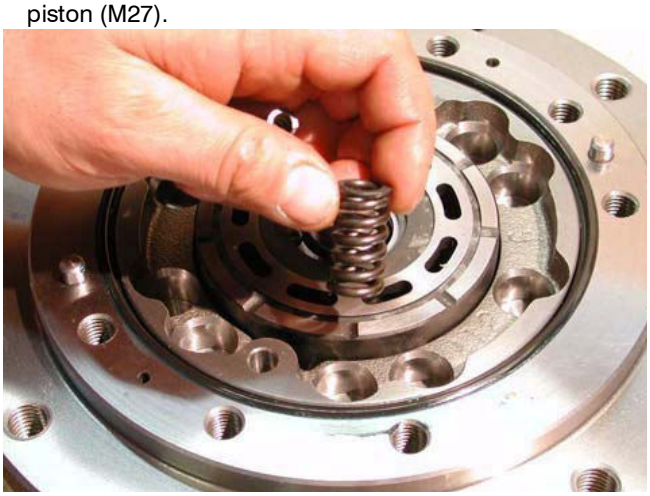
THE O-RING (A) AND A THE BACKUP (B) RING MUST BE FITTED IN THE SEAT ACCORDING THE MUTUAL POSITION AS SHOWN IN THE SCHEME.



21. Insert the brake piston (M27) inside the flanged hub (M2), being careful not to damage the seals already fitted.

22. Assemble the O-ring seal (M6) into its seat in the flanged hub (M2).

23. Insert the springs (M28) in their seats in the brake piston (M27).



Reassembly of the base plate

1. Insert the orifices (51) in the base plate (40) and tighten by a torque wrench at 2,5 ± 0,5 Nm torque.

2. Seal the thread of the plugs (52) by "Teflon" tape.

INFORMATION

BE SURE THAT THE TAPE IS CORRECTLY WINDED AROUND THE PLUGS (52).

3. Tighten the plugs (52) in the base plate (40) by a torque wrench at 5 ± 0,5 Nm torque.

4. Assemble the bearing (37) into its seat in the base plate (40).

5. Place the valve plate (36) on the base plate (40).

⚠ DANGER

BRONZE LAYER SURFACE MUST BE UPWARDS.

6. Place the base plate (40) on the flanged hub (18).

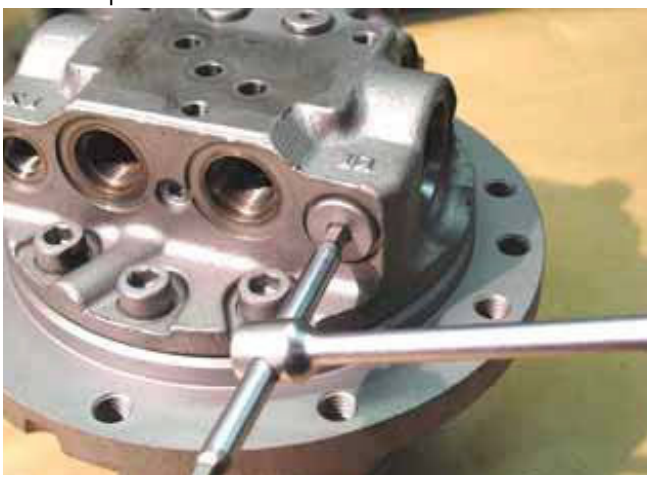
⚠ DANGER

THE BASE PLATE IS CENTERED BY TWO PINS (39) AND THE SECOND SPEED OIL PASSAGES MUST MATCH TOGETHER.

7. Fix the base plate (40) to flanged hub (18) by using nos. 8 socket head screws M10x20 (58), grade 12.9, tightened by a torque wrench at 64 ± 5 Nm torque.

8. By using the stopper (6689962090) assemble the O-ring (42) in its seat in the plug (41).

9. Tighten the plug (41) by a torque wrench at 23,5 ± 1 Nm torque.



Reassembly of the two speed control

10. By using the stopper (6689960740) assemble the O-ring (55) in its seat in the plug (56).

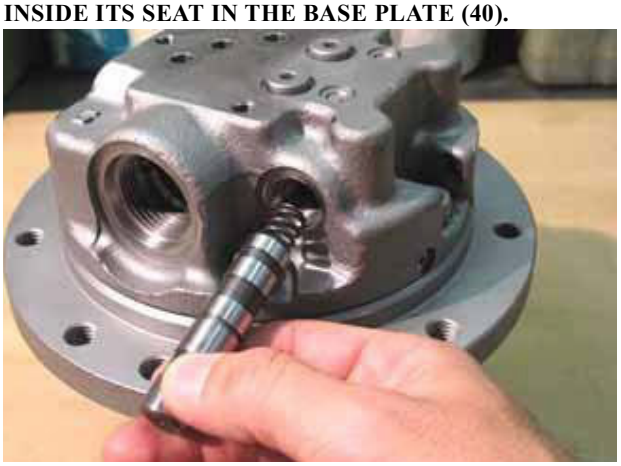
11. Tighten the plug (56) of the two speed control by a torque wrench at 54 ± 5 Nm torque.

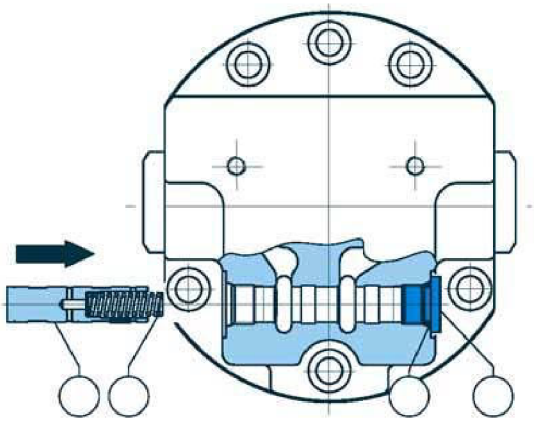
12. Insert the spring (54) in the two speed spool (53).

13. Insert the two speed spool (53) in the base plate (40).

⚠ DANGER

TWO SPEED SPOOL HAVE TO MOVE SMOOTHLY INSIDE ITS SEAT IN THE BASE PLATE (40).



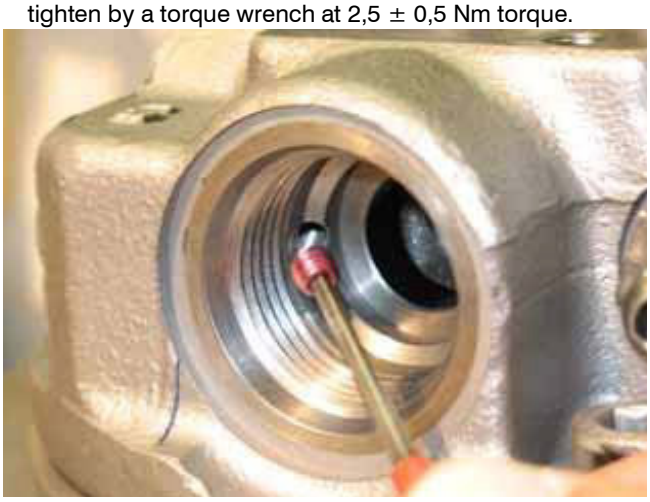


14. By using the stopper (6689960740) assemble the O-ring seal (55) in its seat in the two speed control connector (57).

15. Tighten the two speed control connector (57) by a torque wrench at 54 ± 5 Nm torque.

Reassembly of the counterbalance valve

16. Insert the orifices (50) in the base plate (40) and tighten by a torque wrench at 2,5 ± 0,5 Nm torque.



17. Slide the counterbalance valve spool (47) inside the base plate (40).

18. Insert the nos. 2 spring seats (43) on the counterbalance valve spool (47).

19. Insert the nos. 2 springs (44) on the counterbalance valve spool (47).

20. Fit the O-ring seals (45) into their seats in the plug (46).

21. Tighten the counterbalance valve plugs (46) by a torque wrench at 240 ± 5 Nm torque.

Anticavitation valve reassembly

22. Assemble the spool (65) into the anticavitation valve housing (66).

23. Insert the nos. 2 spring seats (64) on the spool (65).

24. Insert the nos. 2 springs (63) on the spool (65).

25. By using the stopper (6689960740) assemble the O-ring seals (62) in their seats in the plug (61).

26. Manually screw the nos. 2 plugs (61) in the valve housing (66).

27. Assemble the O-rings (67) into their seats in the valve housing (66).

28. Place the anticavitation valve (66) on the base plate (40).

29. Tighten the nos. 3 socket head screws M8x35 (68), grade 10.9, by a male hex head torque wrench at 37 ± 2 Nm torque.

30. Tighten the nos. 2 plugs (61) in the valve housing (66), by a torque wrench, at 54± 5 Nm torque.

GEARBOX REASSEMBLY

1. Place the bearing (12) inside the gearbox housing (10).

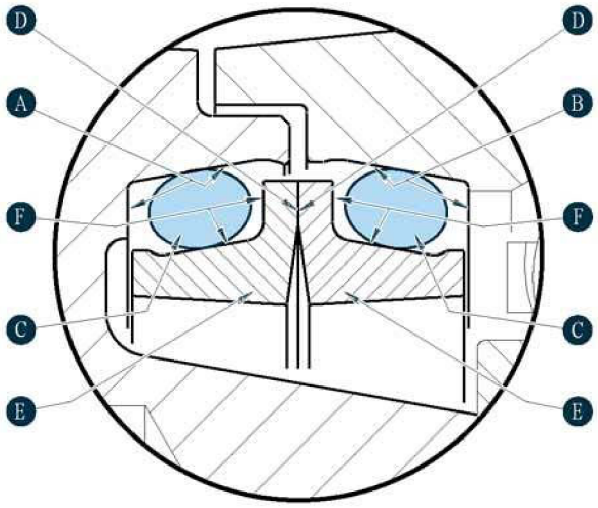
2. By using a press and a metal stopper, push the bearing (12) against the shoulder on the gearbox housing (10) until assembly is complete.

3. By using pliers fit the circlip (13) into its seat in the gearbox housing (10).

4. Place the spacer (14) inside the gearbox housing (10).

Make ready of the lifetime seal:

1. Carefully clean the seats (A and B) using, if necessary, metallic brushes or solvent (surfaces in contact with or (C) must be perfectly clean and dry).
2. Make sure that sealing surfaces (D) of metal rings (E) are free from scratches, dinges or foreign substances; metallic ring surfaces must be perfectly clean and dry. We suggest to dip the metallic rings in volatile solvent or industrial degreasing alcohol.
3. Carefully clean the lapped surface (D) of metal rings (E) and remove dust or fingerprints. Then lubrificate them with a thin oil film, taking care not to oil the other components.



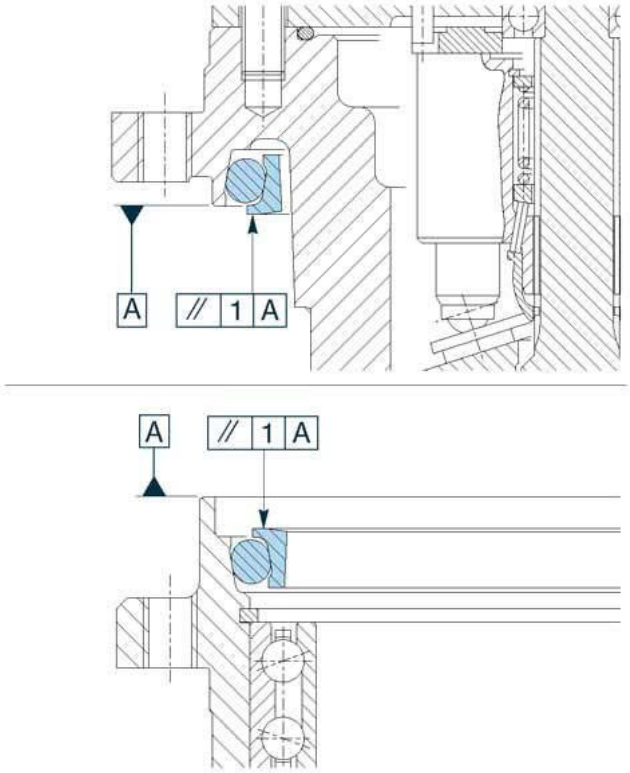
5. Assemble the half seal (15) on the tool (6689962100).

6. Assemble the 1st half seal (15) on the gearbox housing (10).

7. Assemble, by using the same tool (6689962100), the 2nd half seal (15) on the hydraulic motor (17).

INFORMATION

CORRECT LIFETIME SEAL ASSEMBLY CHECK (15).



8. Place the gearbox housing (10) putting the bearing (12) on the tool.

9. Clean carefully the seal faces (15).

⚠ CAUTION

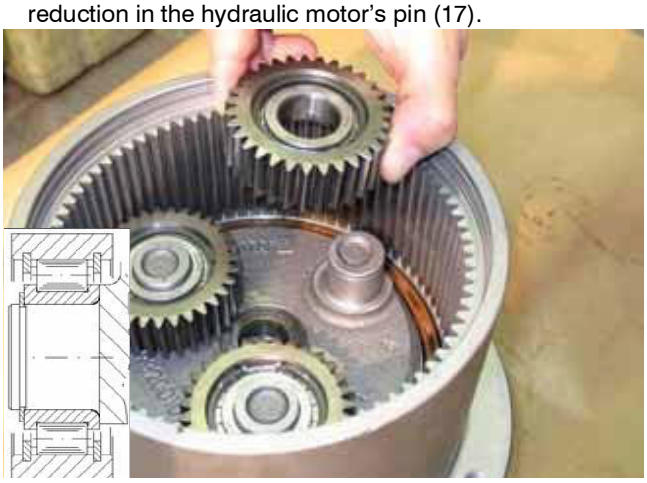
APPLY A THIN OIL FILM ON THE ENTIRE METALLIC FACE OF ONE OR BOTH SEALS. OIL MUST NOT CONTACT SURFACES OTHER THAN THE SEALING FACES.

10. Place the hydraulic motor (17) inside the gearbox housing (10).

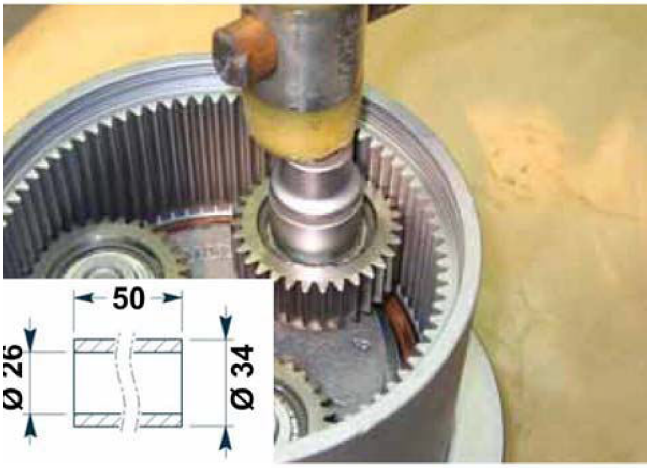
11. By using a press push the hydraulic motor (17) against the shoulder on the gearbox housing (10) until assembling of the unit is complete.

12. Turn the gearbox upside down and, by using pliers, place the circlip (11) into its seat in the hydraulic motor (17).

13. Place, correctly, the planet assemblies (9) of the 2nd reduction in the hydraulic motor's pin (17).



14. By using a rubber hammer and a metal stopper, push the planet assemblies of the 2nd reduction (9) against the hydraulic motor pin shoulders (17).

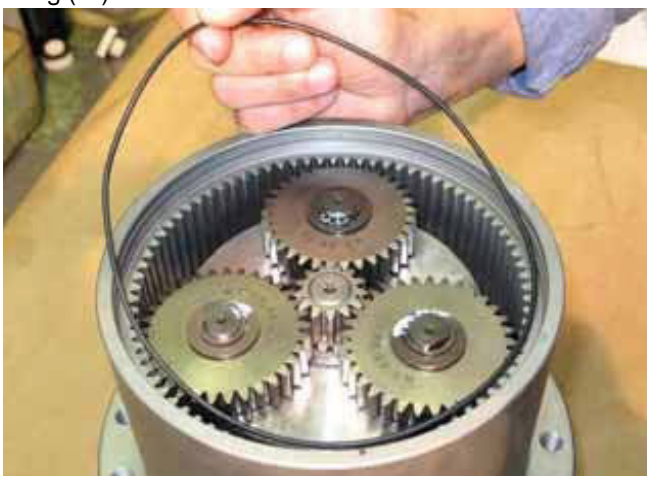


15. By using pliers, assemble the circlips (8) in the hydraulic motor pin seats (17).

16. Insert the 1st reduction assembly (7).

17. Insert the 1st reduction sun gear (6).

18. Fit the O-ring seal (5) into its seat in the gearbox housing (10).



19. Place the end cover (4) on the gearbox housing (10).

20. By using a rubber hammer push the cover (4) against the gearbox housing shoulder (10).

21. Fit the elastic ring (1) into its seat in the gearbox housing (10).

22. Fill the gearbox with the lubricant oil.

Insert the plugs (2) into the oil draining-filling holes of the end cover (4).Tighten the plugs by a torque wrench at 20 ÷ 30 Nm torque.

FINAL TEST AND REINSTALLATION

Check the product by remounting it to the machine. Check the function of the transmission.

3.7 DRIVE HUB - EATON

TYPE	SPEED	MACHINE	MOTOR
EATON	2V	X14JH X17J -X500AJ X14J-X390AJ X19J-X550AJ	

TR* series Orbit Motor Maintenance Manual

INTRODUCTION

This manual shows the way of disassembly and reassembly of TR* series ORBIT MOTOR . Please see the attached papers,

Assembly drawing: TRCV49C2204-A (AZ7663B)

Tools required for disassembly and reassembly

Tool name	Information
Torque wrench	Capacity 9.8~98Nm
Hexagon socket	6 mm 8 mm
Loctite	#242
Eyebolt	M8
Screw driver	

Disassembly

Cleanliness is extremely important when repairing a hydraulic motor. Work in a clean area.

Before disconnecting the lines, clean the port area of the motor thoroughly.

Use a wire brush to remove foreign material and debris from around the exterior joints of the motor.

Note: Don't disassembly the following

Parts if not necessary.

Spindle/wheel ass'y, End cover ass'y

Place the motor in a vise with the Geroler part.

Clamp across the End cover ass'y.

Remove the bolt (27) from the motor.

Remove the bolt (28) and Seal washer (30).

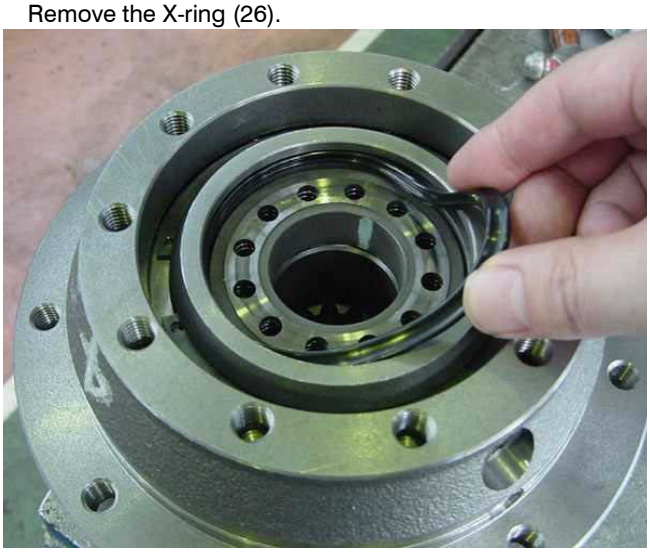
Remove the Geroler cover (16).

Remove the Geroler (1).

Remove Valve plate (15) from the motor used Eyebolt and Screw driver.

Remove the drive (24).

Remove the X-ring (26).



Remove the Valve ass'y (17).

Remove the bolt (29) and End cover ass'y (36).

Don't disassembly End cover ass'y if not necessary. Don't disassembly Spindle / wheel ass'y if not necessary.

If Bearing (11) and Floating seal (8) are broken, please replace whole the Spindle / wheel ass'y.

Reassembly

Check all mating surfaces.

Replace any parts that have scratches or burrs that could cause leakage. Clean all metal parts in clean solvent. Blow-dry with air.

Do not wipe dry with paper towel because lint or other matter can get in the hydraulic system and cause damage.

Do not file or grind motor parts.

Note: Please replace all old seals with new seals and lubricant all seals (prior to installation) with petroleum such as Vaseline.

Install the O-ring (31), (32).

Install the End cover ass'y (36), and the bolts (29). Align four holes the wheel ass'y with the End cover.

Torque all 4 bolts alternately to 35 N-m.

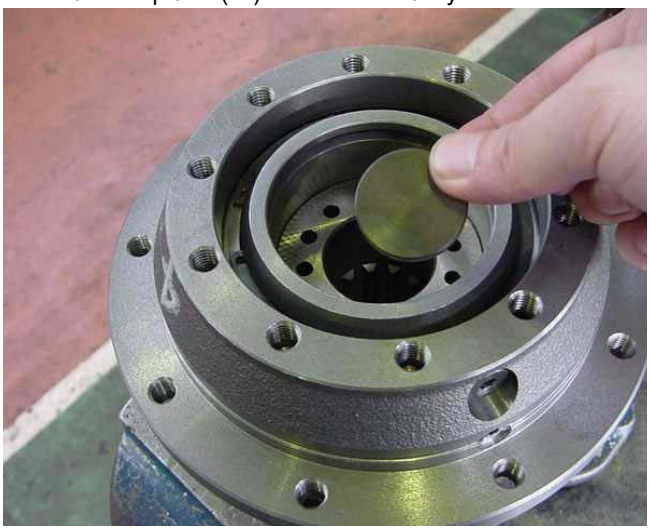
Pour the Gear oil into the Spindle / wheel ass'y (5).

Quantity TRC series: 100 cm3

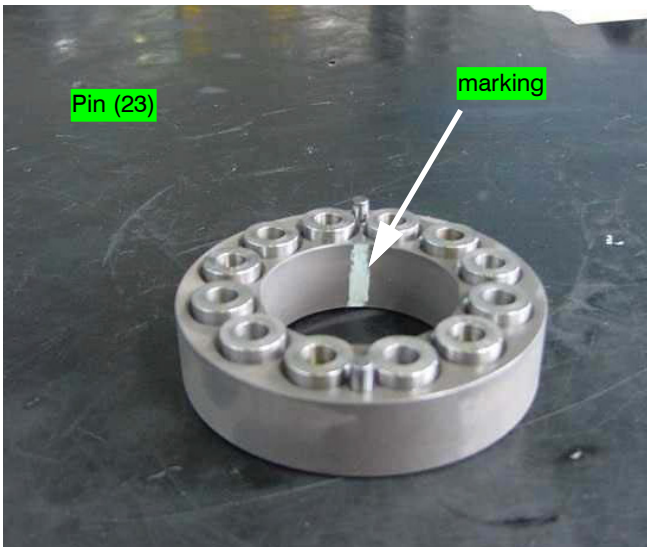
TRB series: 55 cm3

Gear oil: SHELL SPIRAX EP90

Install the Spacer (25) in the wheel ass'y.



Please mark to Valve ass'y(17).



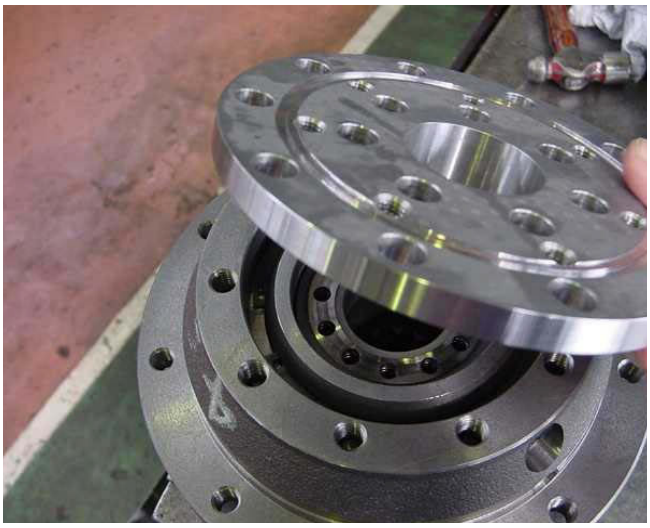
Install the Valve ass'y (17) in the wheel ass'y. Align the Pin (23) with the hole.

Install the X-ring (26) in the wheel ass'y.

Please attend these holes.

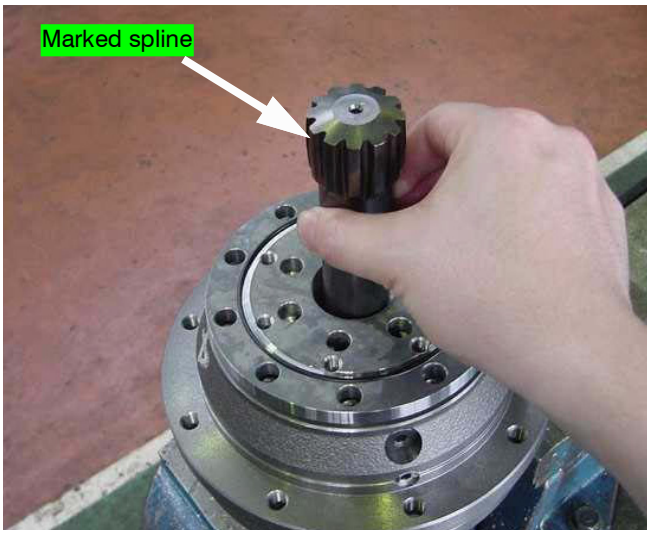
Install the O-ring (31) in the valve plate (15).

Install the Valve plate (15) on the wheel ass'y.

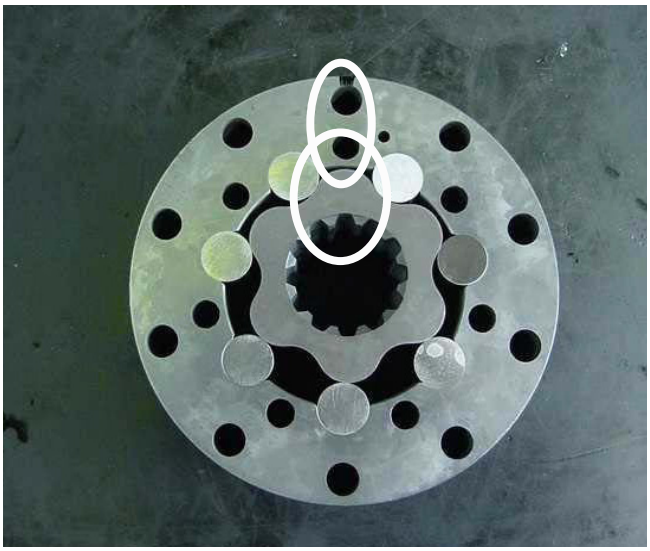


Install the Drive (24) into the motor.

Align the marked spline with the Valve's marking. Align the marked spline with the above Valve plate holes.



Please attend these holes and top of Star.



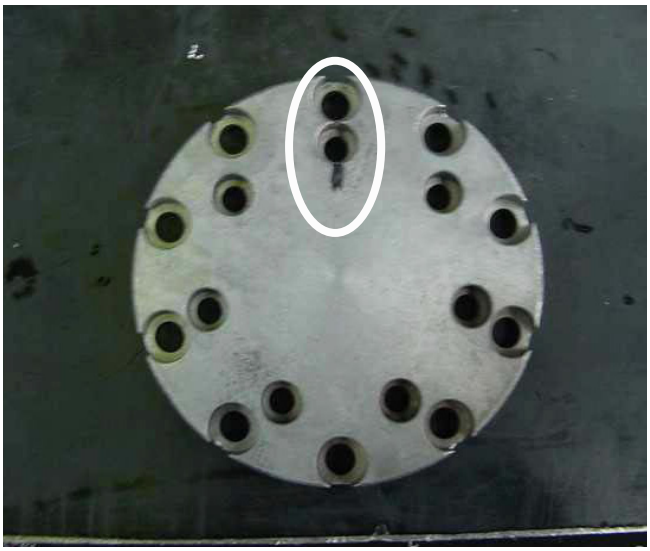
Install the O-ring (31) on the Valve plate (15). Install the Geroler (1) on the Valve plate (15).

Align top of Star with marked Drive spline.

⚠ WARNING

If you mistake the valve timing, motor turns in the opposite direction. Please be careful.

Please attend these holes.



Install the O-ring (31) on the Geroler cover (16). Install the Geroler cover (16) on the Geroler (1).

Align holes with the Geroler's holes.

Please daub Loctit #242 with the Bolt (28) Install the Bolt (28) and Seal washer (30). Torque all 7 bolts alternately to 30 N-m

Please daub Loctit #242 with the Bolt (27), Install the Bolt (27).

Torque all bolts alternately to 57 N-m

TRC and TRB-B type series have ten bolts. TRB-C type has seven bolts.

Trouble Shooting

Condition	Cause	Correction
Motor will not turn	No oil	Fill reservoir to proper oil level.
	Pomp broken	Replace pump.
	Relief valve stuck open or set too low	Clean and free relief valve spool and Adjust to proper setting.
Slow operation	Low oil viscosity	Use proper viscosity oil.
	Worm pomp	Repair or replace pump.
	Extremely high fluid temperatures	Increase reservoir size or add oil cooler.
	Relief setting too low	Set relief valve for proper pressure.
Erratic motor operation	Relief setting too low	Set relief valve for proper pressure.
	Air sucked in inlet side of pump	Tighten pipe fitting on pump inlet side.
Motor turns in wrong direction	Wrong piping	Reverse the piping
	The valve timing is incorrect due to a disassembling error.	Disassemble and reassemble the unit and correct valve timing.
Fluid leakage	Loose bolts or plugs.	Tighten bolts and plugs by the correct torque.
	Scratched or abraded O-ring	Replace the O-ring with a new one.
	Scratched or abraded X-ring	Replace the X-ring with a new one.
		Lower the drain pressure until it is within the allowable range.
	Scratched or abraded Floating seal	Replace whole the Spindle / wheel ass'y.
Abnormal sound	Air is remaining in the circuit and motor.	Bleed air completely.
	Pump cavitation.	Remove substance clogging the suction filter.
		Enlarge the dia. Of the suction pipe of the pump.
		Raise the boost pump pressure.
	Broken bearing	Replace whole the Spindle / wheel ass'y.
Bad changing Low speed ÍÎ High speed	Remained pressure in the pilot line	Bleed remained pressure or decrease remained pressure 0.5 MPa or below.
	The backpressure is high.	Lower the drain pressure 0.5 MPa or below.
	Orifice contaminated	Remove the contamination.
	Spool locked	Replace the Endcover ass'y.

3.8 SWING DRIVE (IMO)

TECHNICAL DATA – TYPE PLATE

Figure 3-2. 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.

OVERVIEW

Series WD slew drives are designed with worm gear. Series SP slew drives are designed with spur gear and straight toothing.

WD-L SERIES (LIGHT SERIES)

The lighter series is designated as the WD-L series. The drive motor (hydraulic/electric) is optional. Additional optional components are potentiometers, permanent brake or front-end brake.

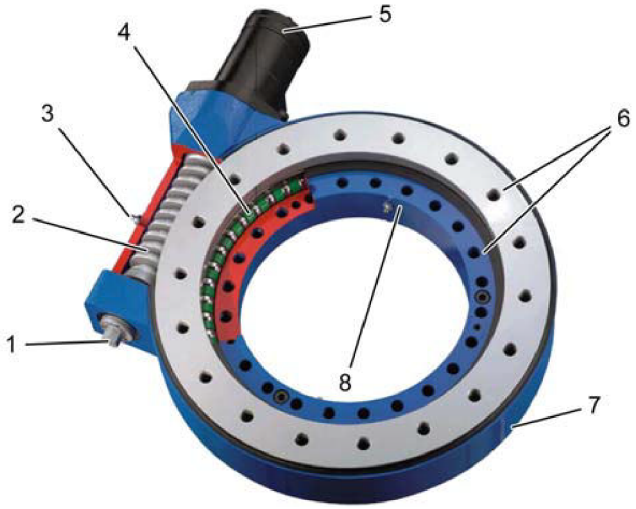


Figure 3-3. Slew drive WD-L

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

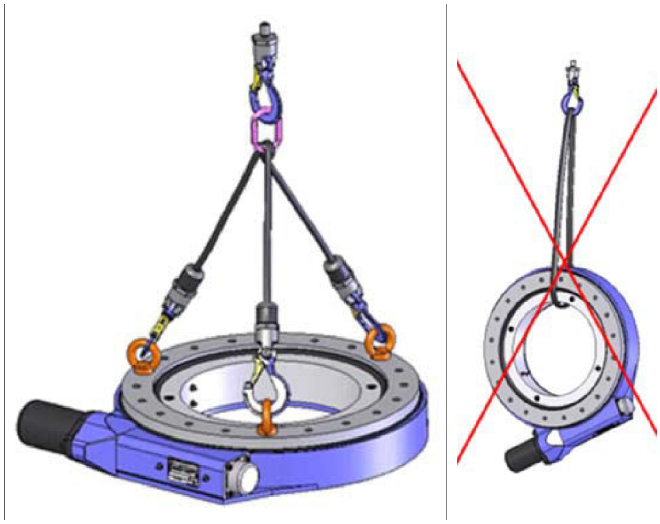


Figure 3-4. Use suitable lifting gear/never transport product vertically

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.

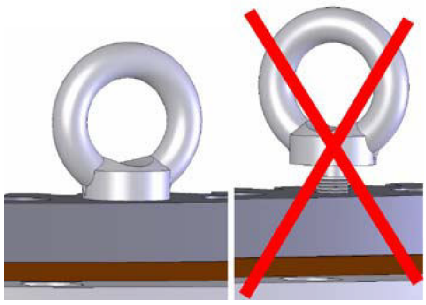


Figure 3-5. Always use the full length of the thread

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.

INSTALLATION AND COMMISSIONING

Preparation

Cleaning the slew drive and mounting structure

Wear the following additional protective equipment for cleaning work:

Face protection

to protect the eyes and face from solvents.

Chemical-resistant protective gloves

to protect hands from aggressive substances.

Check protective gloves for leaks prior to use. Clean the gloves before pulling them off, store them in a well-ventilated location.

Cleaning:

IMPORTANT! ONLY USE COLD SOLVENTS (E.G. WHITE SPIRIT, DIESEL OIL, KALTRYL KEV) THAT DO NOT CORRODE THE SEALING MATERIAL. ENSURE THAT THE CLEANING AGENT DOES NOT GET INTO THE SLEW DRIVE. DO NOT USE A HIGH-PRESSURE CLEANER TO CLEAN THE SLEW DRIVE. UNSUITABLE TRICHLOROETHYLENE-BASED OR PERCHLOROETHYLENE-BASED CLEANING AGENTS, OR OTHER AGGRESSIVE CLEANERS DAMAGE THE SEAL AND MAY CAUSE BEARING DAMAGE.

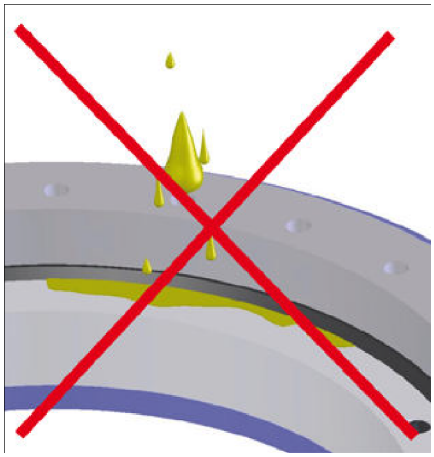


Figure 3-6. Do not let cleaning agents get into the slew drive

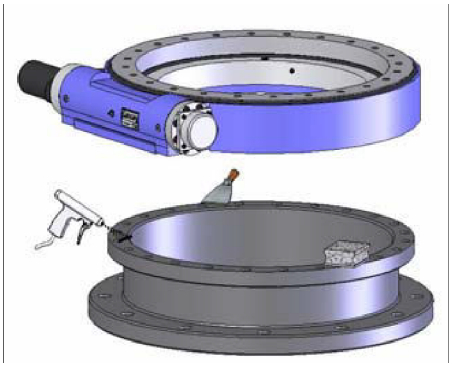


Figure 3-7. Cleaning

- When using cleaning agents, ensure adequate ventilation.
- Maintain a strict ban on smoking.
- Remove old grease, dust, and fouling with lint-free cloths.
- Remove foreign material from the support surface of the mounting structure (including paint residue, welding beads, burrs).
- If necessary clean the support surface of the slew drive.
- Strictly comply with industrial safety regulations.

DETERMINATION OF FLATNESS DEVIATION, AND PERPENDICULARITY DEVIATION AND DEFORMATION OF THE MOUNTING STRUCTURE

IMPORTANT

IF THERE ARE IMPERMISSIBLY HIGH DEVIATIONS IN FLATNESS AND PERPENDICULARITY IN THE MOUNTING STRUCTURE, THEN ROTATIONAL RESISTANCE OF THE SLEW DRIVE MAY SIGNIFICANTLY INCREASE AND DAMAGE THE ENTIRE SLEW DRIVE. IN THE WORST CASE THE SLEW DRIVE MAY BLOCK.

IF THE PERMISSIBLE VALUES FOR FLATNESS OR PERPENDICULARITY DEVIATION ARE EXCEEDED, THE MOUNTING STRUCTURE OF THE SLEW DRIVE SHALL BE REPLACED OR REWORKED.

Determination of flatness deviation, and perpendicularity deviation of the mounting structure

The mounting structure can be measured using a measuring plate and dial gauges.

Laser processes and measuring with 3D systems have also proven to be effective. These systems can be used without additional auxiliary material, and they can document the actual gradient of the mounting structure and process it accordingly.

Flatness deviation

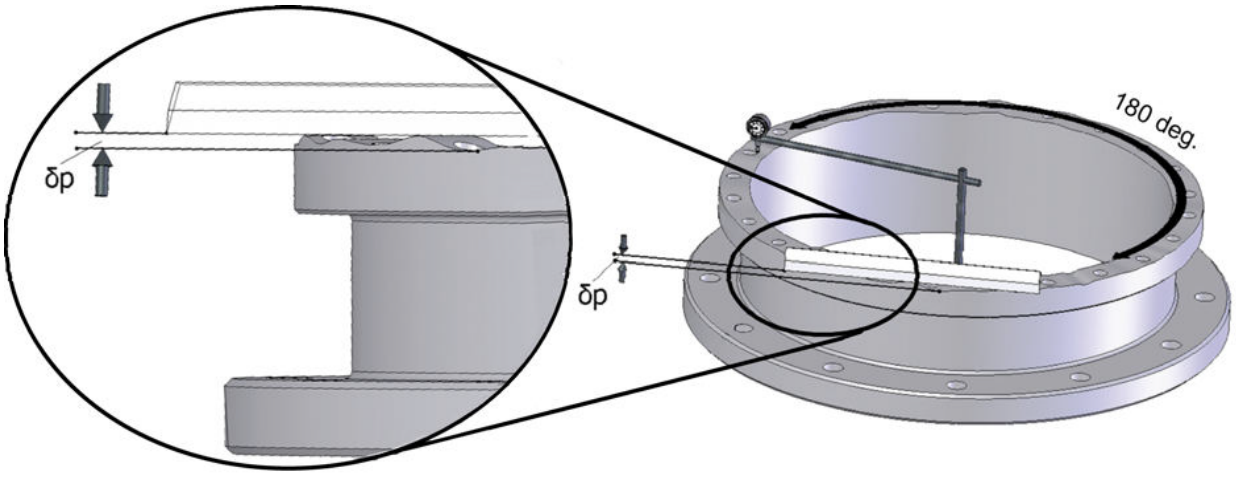


Figure 3-8. Flatness deviation

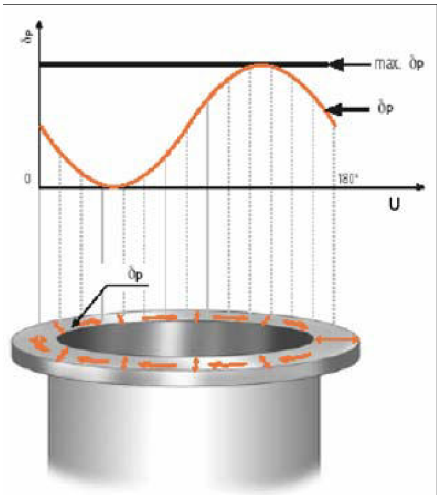


Figure 3-9. Permissible flatness deviation of the mounting structure

δp = flatness deviation

max. δp = maximum flatness deviation

U = circumference

- The maximum residual value for flatness deviation δp in the circumferential direction should only be reached once on half of the circumference. The gradient must look like a sinus curve that slowly rises or falls.

Perpendicularity deviation

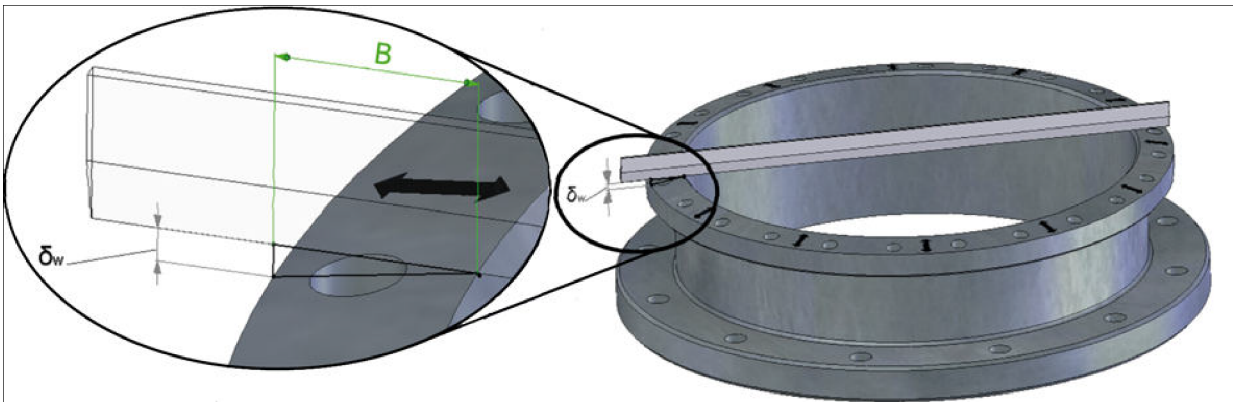


Figure 3-10. Perpendicularity deviation

δw = perpendicularity deviation

B = flange width

- The permissible perpendicular deviation dw (tilting) is based on the actual flange width and should only be half of the values from the tables below.

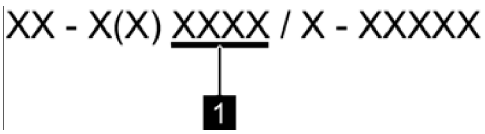


Figure 3-11. Drawing number

The size of the slew drive (WD-H) or of the running circle diameter D_L (WD-L/SP) is indicated in the drawing number at position (1) and is shown in all documents and the type plate.

FOR SLEW DRIVES THAT ARE BETWEEN THE SPECIFIED SIZES, ALWAYS ASSUME THE SMALLER VALUE. FOR SLEW DRIVES THAT ARE LARGER THAN THE LARGEST DIAMETER, USE THE LARGEST SPECIFIED VALUE.

THE SLEW DRIVE MUST BE SUPPORTED BY THE MOUNTING STRUCTURE UP TO THE DIAMETER SPECIFIED IN THE SLEW DRIVE DRAWING.

Permissible flatness and perpendicularity deviation for series WD-L and SP slew drives

Running circle diameter [mm]		≥ 100	≥ 250	≥ 500	≥ 750	≥ 1000	≥ 1250
Permissible flatness deviation including perpendicularity deviation per support surface	[mm]	0.04	0.06	0.08	0.09	0.10	0.11
	[in]	0.0016	0.0024	0.0032	0.0036	0.0040	0.0044

Permissible flatness and perpendicularity deviation for series WD-H slew drives

Size of the slew drive		≥ 146	≥ 220	≥ 300	≥ 373	≥ 490	≥ 625
Permissible flatness deviation including perpendicularity deviation per support surface	[mm]	0.06	0.06	0.07	0.07	0.08	0.09
	[in]	0.0024	0.0024	0.0028	0.0028	0.0032	0.0036

Determining the deformation of the mounting structure

Under maximum operating load an appropriate deformation of the mounting structure occurs. The dimensions can be detected via dial gauges, laser measurement processes, or 3D measuring systems.

Because in some cases measurement in operation is difficult, determination of deformation can also be executed mathematically, e.g. with the finite element method.

Alternatively you can also reference comparable measurements on test rigs.

FOR SLEW DRIVES THAT ARE BETWEEN THE SPECIFIED SIZES, ALWAYS ASSUME THE SMALLER VALUE. FOR SLEW DRIVES THAT ARE LARGER THAN THE LARGEST DIAMETER, USE THE LARGEST SPECIFIED VALUE.

THE SLEW DRIVE MUST BE SUPPORTED BY THE MOUNTING STRUCTURE UP TO THE DIAMETER SPECIFIED IN THE SLEW DRIVE DRAWING. ALL THE INSTALLED DIMENSIONS AS SPECIFIED IN THE DRAWING MUST BE COMPLIED WITH.

Permissible deformation of the mounting structure, under maximum load for series WD-L and SP slew drives

Running circle diameter [mm]		≥ 100	≥ 250	≥ 500	≥ 750	≥ 1000	≥ 1250
Permissible deformation of the mounting structure per support surface	[mm]	0.13	0.16	0.21	0.24	0.27	0.29
	[in]	0.0052	0.0063	0.0083	0.0095	0.0106	0.0114

Permissible deformation of the mounting structure, under maximum load for series WD-H slew drives

Size of the slew drive		≥ 146	≥ 220	≥ 300	≥ 373	≥ 490	≥ 625
Permissible deformation of the mounting structure per support surface	[mm]	0.10	0.11	0.12	0.13	0.15	0.16
	[in]	0.0040	0.0044	0.0048	0.0052	0.0059	0.0063

IMPORTANT

AXIAL DEFLECTION, TILTING, RADIAL EXTENSION (OR RADIAL CONTRACTION) OF THE MOUNTING STRUCTURE UNDER MAX. LOAD CAUSES DEFORMATION OF THE MOUNTING STRUCTURE.

SELECTING THE MOUNTING ELEMENTS

⚠ CAUTION

ONLY USE MOUNTING ELEMENTS OF THE CORRECT SIZE, NUMBER AND QUALITY. DO NOT REUSE BOLTS, NUTS, AND WASHERS. USING UNSUITABLE MOUNTING ELEMENTS MAY CAUSE THE BOLTED UNION TO FAIL AND THUS THE ENTIRE CONSTRUCTION TO FAIL.

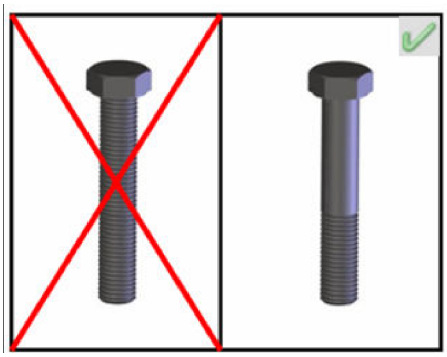


Figure 3-12. Do not use continuous thread

The function and service life, as well as the durability of the bolted union are highly dependent on grip ratio, the type of bolt, and the dimensions of the bolts. Consequently select the mounting elements on the basis of the following:

- Do not use any bolts with a fully threaded shaft.
- Only use new, quality class 10.9 (metric) bolts or SAE Grade 8.
- Maintain the grip ratio (grip length to the diameter of the bolt) of at least ≥ 5 to maximum ≤ 10.
- Select bolt length to ensure that the minimum insertion depth is reached.
- If the permissible interfacial pressure is exceeded use appropriate washers.

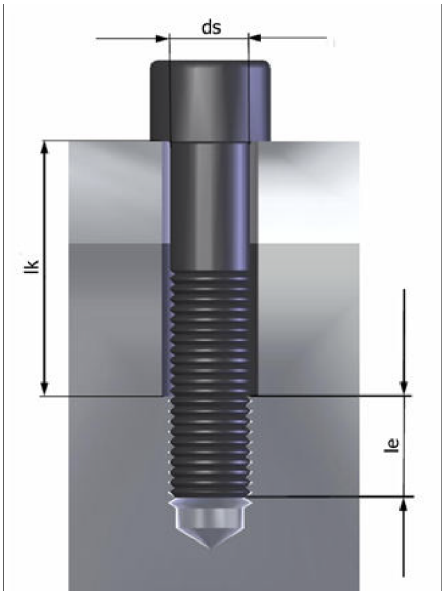


Figure 3-13. Mounting element

Minimum insertion depth depending on fracture strength of the mounting structure

Fracture strength Rm of the mounting structure		Minimum insertion depth (le)
in N/mm²	in lbf/in²	Strength class 10.9 / Grade 8
500 to 700	72520 to 101525	le = 1.4*ds
700 to 900	101525 to 130535	le = 1.1*ds
over 900	over 130535	le = 0.9*ds

MOUNTING STRUCTURES WITH FRACTURE STRENGTH UNDER 500 N/MM² OR 72520 LBS/IN² ARE PROHIBITED.

ds = bolt diameter

lk = grip length

le = insertion depth

Permissible interfacial pressure for various materials

Material	Max. surface pressure	
	in N/mm²	in lbs/in²
St52/C45N/46Cr2N	600	87023
46Cr4V/42CrMo4V	800	116030

TIGHTENING BOLTS WITH A TORQUE WRENCH

Normally the mounting bolts are adequately secured through correct pretension.

⚠ 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.

IMPORTANT

IF THERE ARE SHOCK LOADS OR VIBRATION ADDITIONAL SCREW- LOCKING DEVICES MAY BE NECESSARY. IN THIS CASE USE LOCTITE OR NORD-LOCK® BOLT LOCK WASHERS.

- Do not use split rings, spring washers, etc.
- Do not reuse bolts, nuts, and washers, etc.
- Only use hardened and tempered washers.
- Adjust the limit torque in accordance with bolt size and quality.
- Use a precisely indicating torque wrench.

Tightening torques and bolt tightening forces for metric coarse-pitched thread in accordance with DIN 13 when using a torque wrench:

Mounting bolt dimensions	Tightening torque M_A 1) Strength class 10.9 in		Mounting pretension force F_M 2) Strength class 10.9 in	
	Nm	ft-lbs	kN	lbs
M4	3.31	2.44	5.95	1338
M5	6.77	4.99	9.74	2190
M6	11.5	8.5	13.7	3080
M8	28.0	20.6	25.2	5665
M10	55.8	41.2	40.2	9037
M12	97.7	72.1	58.5	13151
M16	246	181	111	24954
M18	336	248	134	30124
M20	481	355	173	38892
M22	661	487	216	48559
M24	830	612	249	55977
M27	1230	907	328	73737
M30	1661	1225	398	89474

[1] M_A in accordance with VDI guideline 2230 (February 2003) for $\mu K=0.08$ and $\mu G=0.12$

[2] F_M in accordance with VDI guideline 2230 (February 2003) for $\mu G=0.1$

Tightening torques and bolt tightening forces for inch thread in accordance with ANSI B1.1 when using a torque wrench:

Mounting bolt dimensions	Tightening torque M_A [1] Strength class 8 in		Mounting pretension force F_M [2] Strength class 8 in	
	Nm	ft-lbs	kN	lbs
0.1900 – 24 UNC	4.80	3.54	7.15	1607
0.2160 – 24 UNC	7.69	5.67	10.1	2271
1/4 – 20 UNC	11.7	8.6	13.2	2967
5/16 – 18 UNC	24.4	18.0	22.1	4968
3/8 – 16 UNC	43.7	32.2	33.0	7419
7/16 – 14 UNC	70.1	51.7	45.4	10206
1/2 – 13 UNC	108	80	61.0	13713
9/16 – 12 UNC	156	115	78.6	17670
5/8 – 11 UNC	216	159	97.8	21986
3/4 – 10 UNC	386	285	146	32822
7/8 – 9 UNC	625	461	202	45411
1 – 8 UNC	938	692	266	59799
1 1/8 – 7 UNC	1328	979	334	75086
1 1/4 – 7 UNC	1889	1393	428	96218

[1] M_A in accordance with VDI guideline 2230 (February 2003) for $\mu K=0.08$ and $\mu G=0.12$

[2] F_M in accordance with VDI guideline 2230 (February 2003) for $\mu G=0.1$

POSITIONING THE SLEW 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.
4.

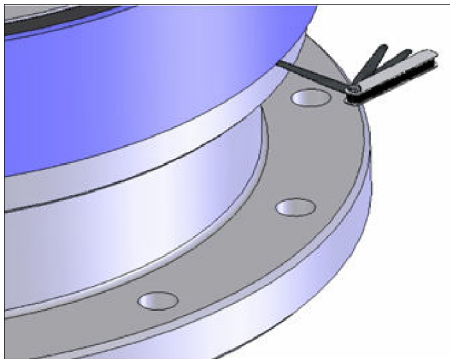


Figure 3-14. Check the support surface

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.

MOUNT THE SLEW DRIVE IN UNSTRESSED STATE.

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

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

1. Lightly oil the bolt thread (not when using bolt locking devices with adhesive).
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.

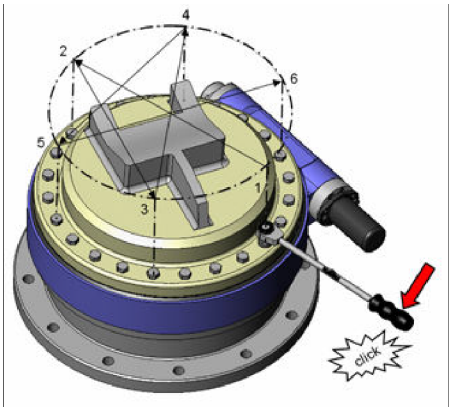


Figure 3-15. Tighten crosswise

Table 3-2.

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 ed to 85% of yield strength.

Table 3-3.

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 pretensioned to 85% of yield strength.

DETERMINING THE TILTING CLEARANCE

Tilting clearance increases as raceway system wear increases. To determine the increase in tilting clearance a basic measurement must be executed in installed status and prior to first-time operation. This is the only way to determine changes.

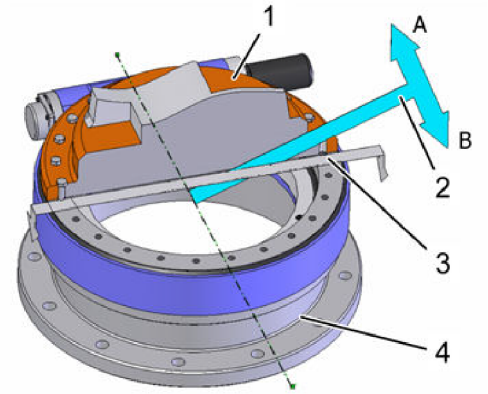


Figure 3-16. Determine tilting clearance

1. Upper mounting structure
2. Tilting direction
3. Main load-carrying zone
4. Lower mounting structure

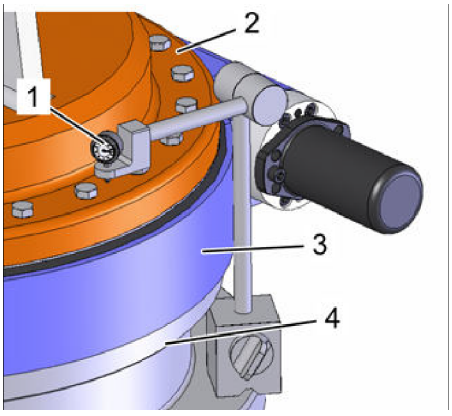


Figure 3-17. Measurement setup

1. Dial gauge
2. Upper mounting structure

3. Slew Drive
4. Lower mounting structure

Procedure:

Tilting clearance measurement

1. Switch off the system and safeguard it from being turned on again.
2. Permanently mark the measuring point in the main load direction on the housing and on the bearing ring.
3. Attach the dial gauge as shown in Fig. 24.
4. Apply defined tilt torque, at least 50% of max. operating load, in direction "A".
5. Set dial gauge to zero.
6. Apply defined tilt torque, at least 50% of max. operating load, in direction "B". The displayed measured value m1 corresponds to the existing tilting clearance and serves as the base value that will be used for comparison in later inspections.
7. Log and document all measured values.

- All inspections at a later point in time must be executed on the same measuring point, with the same loads, at the same relative position of the bearing rings, and in the same sequence.
- At pure axial or radial load check the tilting clearance by applying an additional tilting load.

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	Specialist
after 250 operating hours	Tighten bolts	Specialist
	Check tilting clearance	Specialist
after every additional 500 operating hours or at least every 6 months	Tighten bolts • Reduce the inspection interval if there is heavy wear or continuous operation.	Specialist
	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.	Specialist
	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.	Specialist

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.

IMPORTANT

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.

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

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.

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

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

MAINTENANCE TASKS

INSPECTING THE MOUNTING BOLTS

IMPORTANT

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.

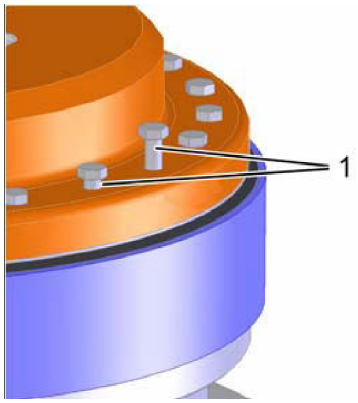


Figure 3-18. Inspecting the mounting bolts

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.

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.

CHECKING THE TILTING CLEARANCE

Wear in the raceway system results in an increase in tilting clearance. Consequently it is necessary to check the tilting clearance in accordance with the maintenance intervals.

⚠ CAUTION

IF THE MAXIMUM PERMISSIBLE TILTING CLEARANCE INCREASE IS REACHED, THEN THE SYSTEM MUST BE BROUGHT TO A STANDSTILL AND THE SLEW DRIVE MUST BE REPLACED IMMEDIATELY, AS SAFE OPERATION CAN NO LONGER BE ENSURED.

Checking the tilting clearance increase d_k directly on the slew drive

The measured value m1 determined at installation serves as the base value ("Determination of tilting clearance").

- Determine the value mx as described in the "Determining the tilting clearance".
- Subtract the base value m1 from the value mx determined in the inspection measurement:

  $d_k = mx - m1 \leq d_k perm$

  $d_k perm = 0.45$ mm

  $d_k perm = 0.0177$ in

Checking the tilting clearance increase dk but not directly on the slew drive

Proportionally convert the tilting clearance increase each time a measurement is taken (after the installation measurement) and compare with $d_k perm$.

LUBRICATING THE SLEW DRIVE

IMPORTANT

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

IMPORTANT

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.

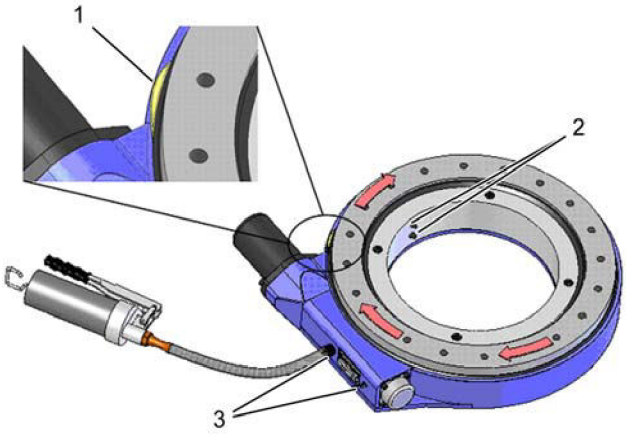


Figure 3-19. Lubricating the slew drive

1. Fresh lubricant
2. Lubricating nipple, bearing ring
3. Lubricating ring housing

1. 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.
2. Ensure that old lubricant can escape without obstruction.

Inspecting the seals

IMPORTANT

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.

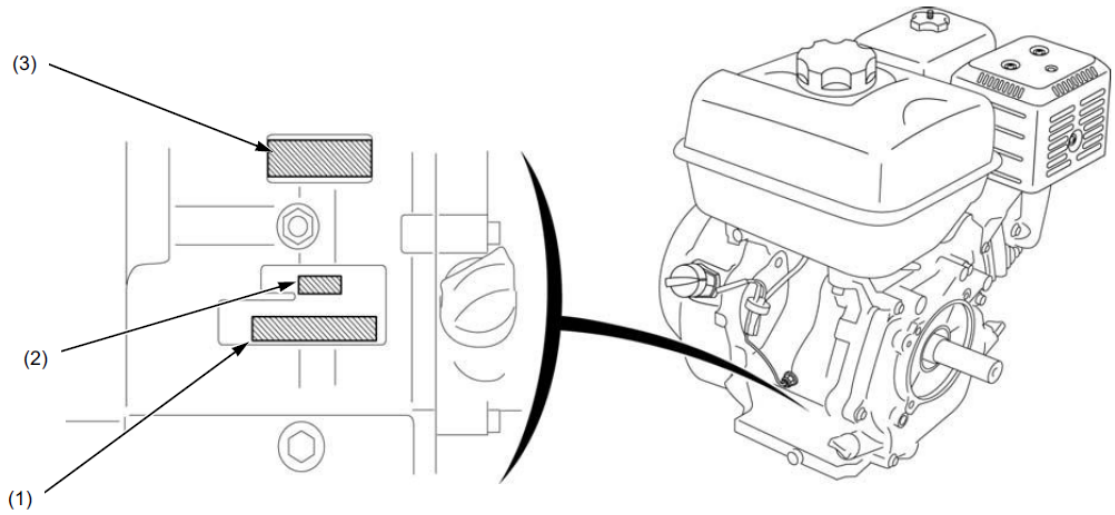
If damage is detected on a seal, contact the customer service organization without delay.

3.9 HONDA ENGINE GX270 - GX390

3.9.1 SPECIFICATIONS

SERIAL NUMBER LOCATION

The engine serial number (1), type (2) and model (3) is stamped on thecrankcase.Refer to it when ordering parts or making technical inquiries.



ENGINE SPECIFICATIONS

Table 3-4.

Model	**GX270**	**GX390UT2**
Description code		GCBCT
Type	4 stroke, overhead valve, single cylinder, inclined by 25°	
Displacement	270 cm^3 (16.5 cu–in)	389 cm^3 (23.7 cu–in)
Bore x stroke	77.0 x 58.0 mm (3.0 x 2.3 in)	88.0 x 64.0 mm (3.5 x 2.5 in)
Net power (SAE J1349)*1	6.7 kW (9 HP) / 3,600 min-1 (rpm)	8.7 kW (11.7 HP) / 3,600 min-1 (rpm)
Continuous rated power		7.0 kW (9.4 HP) / 3,600 min-1 (rpm)
Maximum net torque (SAE J1349)*1	19.5 N·m (1.95 kg·m, 14ft·lb) / 2,500 min-1 (rpm)	26.5 N·m (2.7 kgf·m, 19.5 lbf·ft) / 2,500 min-1 (rpm)
Compression ratio	8.2 : 1	8.2 ± 0.2: 1
Fuel consumption (at continuous rat-ed power)	313 g/kWh (230 g/HPh, 0,51 lb/HPh)	3.5 Liters (0.92 US gal, 0.77 Imp gal) / h
Ignition system	C.D.I.(Capacitor Discharge Ignition) type magneto ignition	
Ignition timing	B.T.D.C. 20° (fixed)	B.T.D.C. 10° / 1,400min-1 (rpm)
Spark advancer performance		B.T.D.C. 10°- 22°
Spark plug	BPR6ES (NGK) / W20EPR-U (DENSO)	
Lubrication system	Forced splash	
Oil capacity	1.1 Liters (1.16 US qt, 0.97 Imp qt)	
Recommended oil	SAE 10W-30 API service classification SE or later	
Cooling system	Forced air	
Starting system	Ignition exciter coil circuit open	
Carburetor	Horizontal type, butterfly valve	
Air cleaner	Dual element type, Cyclone type, Oil bath type, Low profile type	
Governor	Mechanical centrifugal	
Breather system	Reed valve type	
Fuel used	Unleaded gasoline with a pump octane rating 86 or higher	

*1: The power rating of the engine indicated in this document is the net power output tested on a production engine for the engine model and measured in accordance with SAE J1349 at 3,600 rpm (net power) and at 2,500 rpm (max net torque). Mass production engines may vary from this value. Actual power output for the engine installed in the final machine will vary depending on numerous factors, including the operating speed of the engine in application, environmental conditions, maintenance, and other variables.

SERVICE INFORMATION

TORQUE VALUES

ENGINE TORQUE VALUES

Item	Tread Dia. (mm)	Torque values		
		N·m	kgf·m	lbf·ft
Crankcase cover bolt	M8 x 1.25	24	2.4	17
Cylinder head bolt	M10 x 1.25	35	3.5	26
Oil drain plug bolt	M12 x 1.5	22.5	2.25	17
Connecting rod bolt	M8 x 1.25 (Special bolt)	14	1.4	10
Rocker arm pivot bolt	M8 x 1.25 (Special bolt)	24	2.4	17
Rocker arm pivot adjusting nut	M6 x 0.5	10	1.0	7
Oil level switch nut	M10 x 1.25	10	1.0	7
Flywheel nut	M16 x 1.5 (Special nut)	170	17.3	125
Fuel tank nut/bolt	M8 x 1.25	24	2.4	17
Fuel tank joint	M10 x 1.25	2	0.2	1.5
Air cleaner elbow nut	M6 x 1.0	9	0.9	6.6
Muffler nut	M8 x 1.25	24	2.4	17
Exhaust pipe nut	M8 x 1.25	24	2.4	17
Gear case cover bolt (With reduction)	M8 x 1.25	24	2.4	17
Primary drive gear bolt (With reduction)	M8 x 1.25	24	2.4	17
Engine stop switch tapping screw	M3 x 1.06	0.45	0.046	0.33
Recoil starter center screw	M5 x 0.8 (Special bolt)	3.9	0.40	2.9
Fuel strainer cup	M24 x 1.0	3.9	0.40	2.9

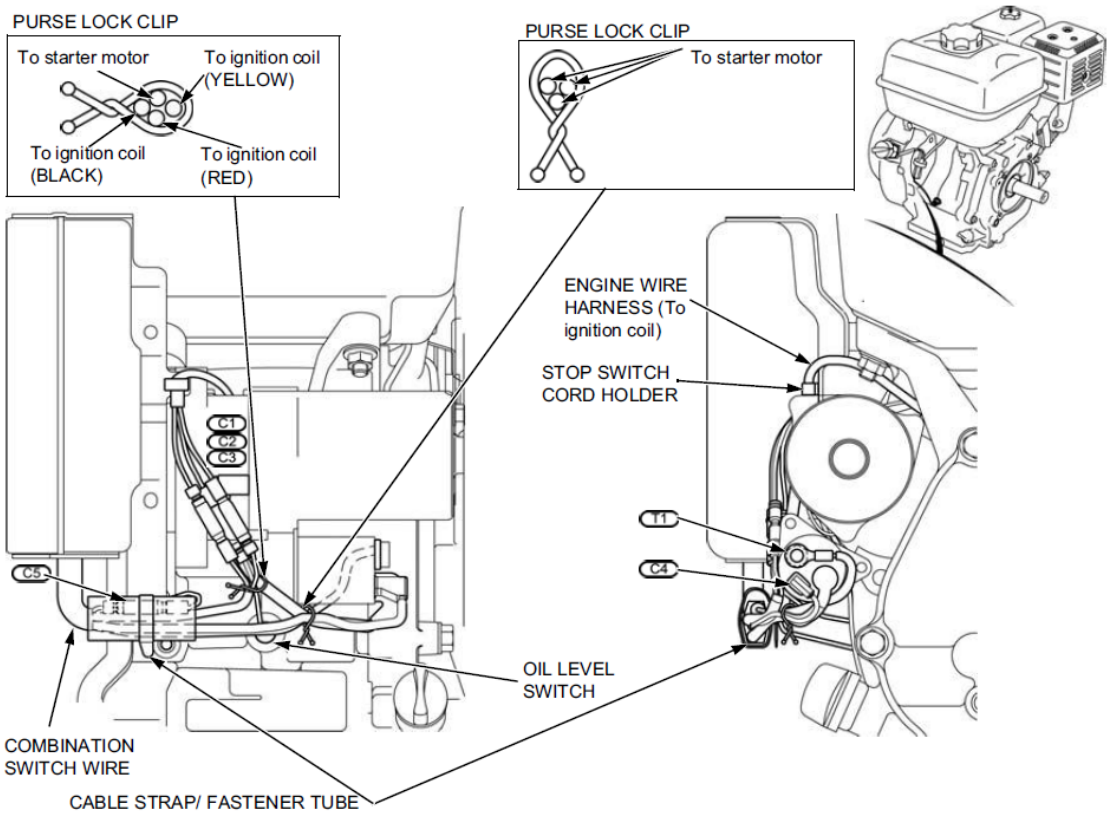
STANDARD TORQUE VALUES

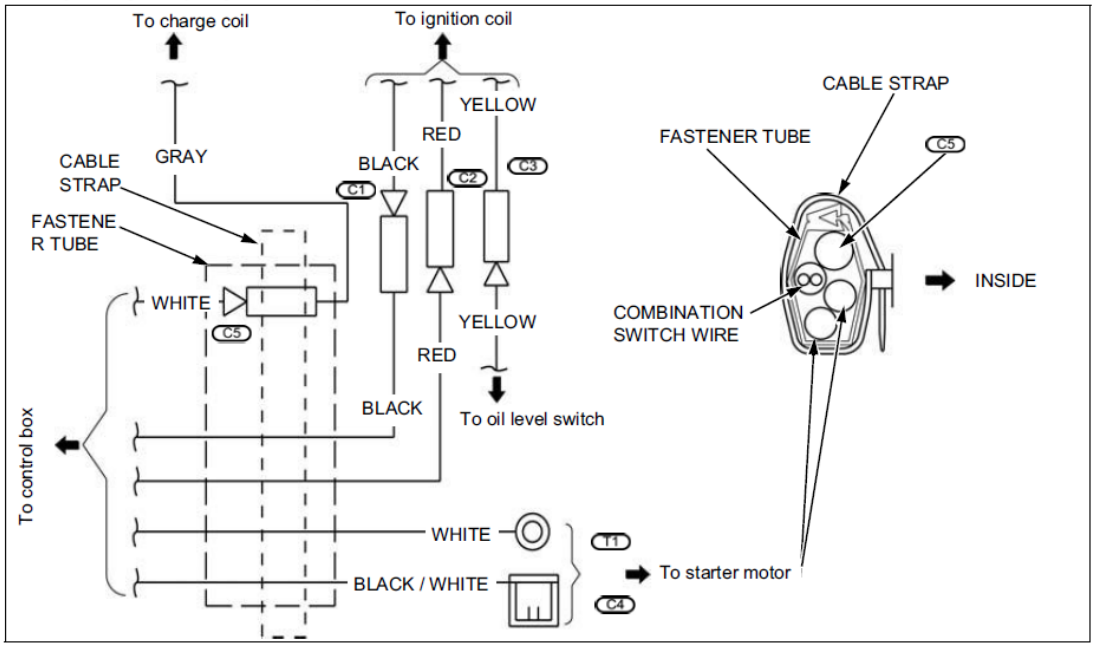
Item	Tread Dia. (mm)	Torque values		
		N·m	kgf·m	lbf·ft
Screw	4 mm	2.1	0.21	1.5
	5 mm	4.3	0.43	3.1
	6 mm	9.0	0.90	6.6
Bolt and nut	5 mm	5.3	0.53	3.9
	6 mm	10	1.0	7
	8 mm	22	2.2	16
	10 mm	34	3.5	25
	12 mm	54	5.5	40
Flange bolt and nut	5 mm	5.4	0.55	3.9
	6 mm	12	1.2	9
	8 mm	23	2.3	17
	10 mm	40	4.0	30
SH (Small head) flange bolt	6 mm	9.0	0.90	6.6
CT (Cutting threads) flange bolt (Retightening)	5 mm	5.4	0.55	4.0
	6 mm	12	1.2	9

HARNESS AND TUBE ROUTING

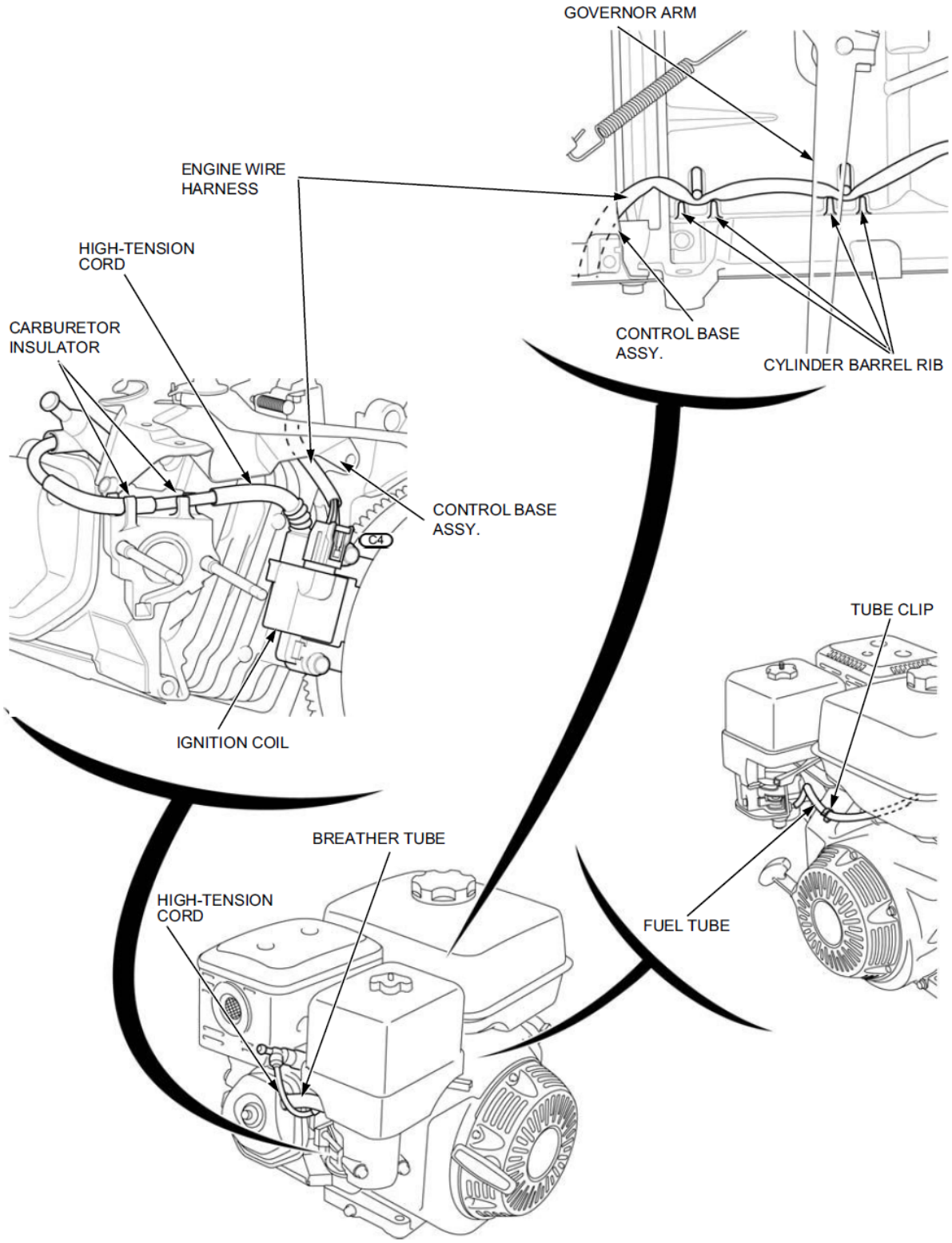
Connection of regulator/rectifier, charge/lamp coil, sub wire harness, and auto throttle solenoid are depending on the application of the engine, therefore, it does not indicate those parts in this manual.

COMBINATION SWITCH (CONTROL BOX) TYPE

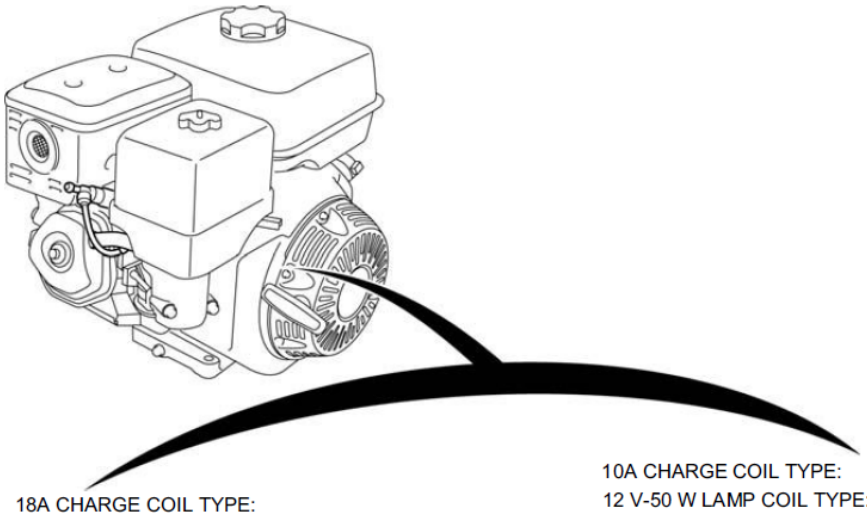




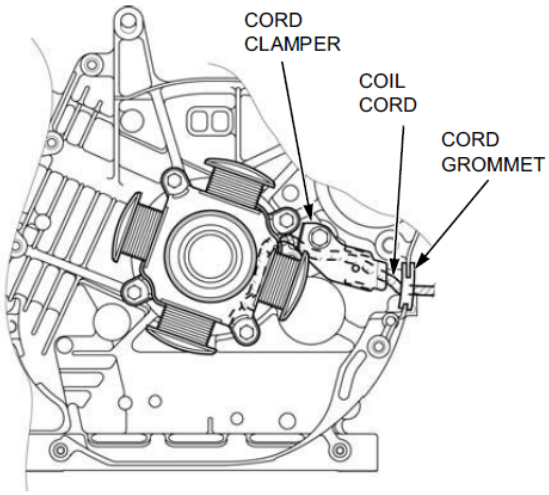
ALL TYPE


GOVERNOR ARM
ENGINE WIRE HARNESS
HIGH-TENSION CORD
CARBURETOR INSULATOR
CONTROL BASE ASSY.
CYLINDER BARREL RIB
CONTROL BASE ASSY.
C4
IGNITION COIL
TUBE CLIP
BREATHER TUBE
HIGH-TENSION CORD
FUEL TUBE

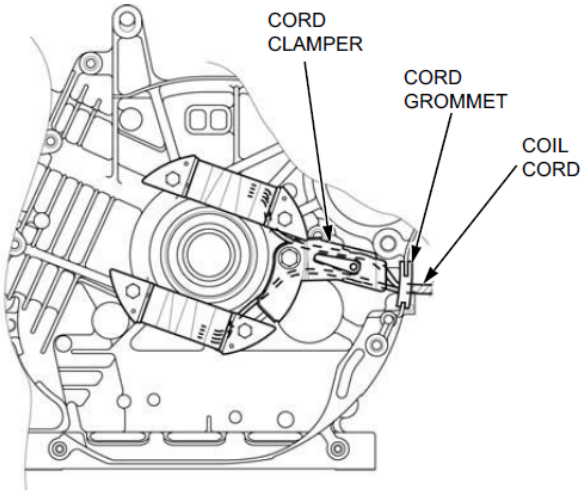
WITH CHARGE COIL / LAMP COIL



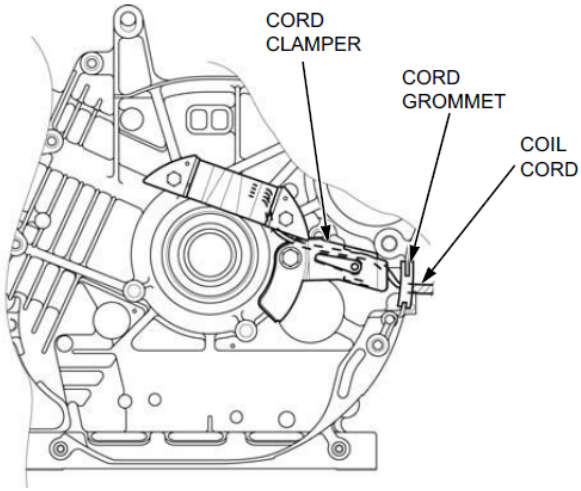
18A CHARGE COIL TYPE:



10A CHARGE COIL TYPE:
12 V-50 W LAMP COIL TYPE:



1 A / 3 A CHARGE COIL TYPE:
12 V - 15 W / 12 V-25 W LAMP COIL TYPE:



MAINTENANCE SCHEDULE

REGULAR SERVICE PERIOD (2) ITEM — Perform at every indicated month or operating hour interval, whichever comes first.		Each use	First month or 20 hrs.	Every 3 months or 50 hrs.	Every 6 months or 100 hrs.	Every year or 300 hrs.	Refer to page
Engine oil	Check level	O					3-3
	Change		O		O		3-3
Air cleaner	Check	O					3-4
	Clean			O (1)	O (*)(1)		3-4
		(Cyclone type) Every 6 months or 150 hours					3-4
	Replace					O(**)	3-4
		(Cyclone type) Every 2 years or 600 hours					3-4
Sediment cup	Clean				O		3-6
Spark plug	Check–adjust				O		3-7
	Replace					O	3-8
Spark arrester (If equipped)	Clean				O		3-8
Idle speed	Check–adjust					O	3-10
Valve clearance	Check–adjust					O	3-10
Combustion chamber	Clean	After every 500 hours					3-12
Fuel tank and filter	Clean				O		3-12
Fuel tube	Check	Every 2 years (Replace if necessary)					3-13

(1) Service more frequently when used in dusty areas.

(2) For commercial use, log hours of operation to determine proper maintenance intervals.

(*) Internal vent carburetor with dual element type only.

(**) Replace paper element type only.

ENGINE OIL LEVEL CHECK

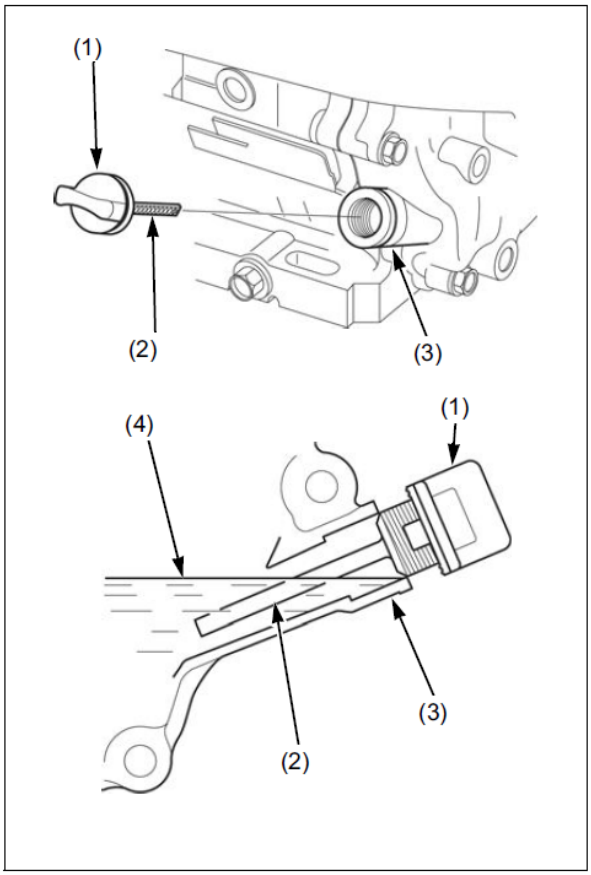
Place the engine on a level surface.

Remove the oil filler cap (1), and wipe the oil level gauge (2) clean.

Insert the oil filler cap without screwing it into the oil filler neck (3).

Remove the oil filler cap and check oil level shown on the oil level gauge.

If the oil level is low, fill with recommended oil to the upper level (4) of the oil filler neck.

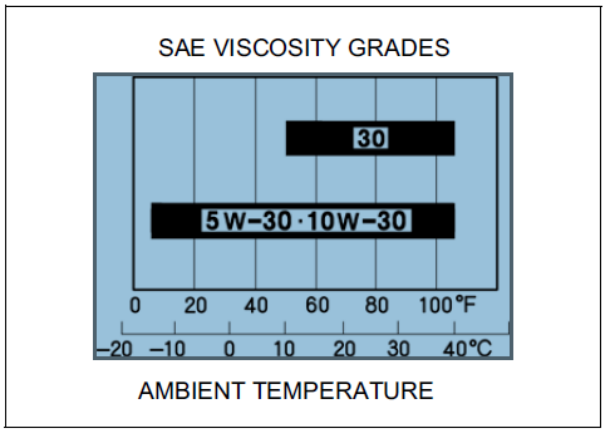


SAE 10W - 30 is recommended for general use. Other viscosities shown in the chart may be used when the average temperature in your area is within the recommended range.

RECOMMENDED OIL:

SAE 10W-30 API service classification SE or later

Tighten the oil filler cap securely.



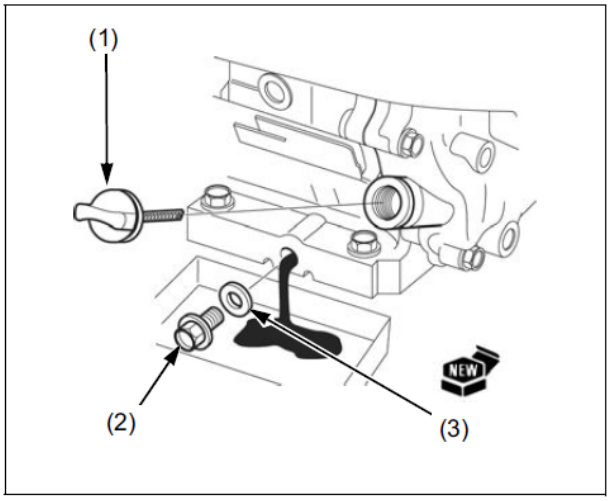
ENGINE OIL CHANGE

Drain the oil in the engine while the engine is warm. Warm oil drains quickly and completely.

Place the engine on a level surface, and place a suitable container under the drain plug bolt.

Remove the oil filler cap (1), drain plug bolt (2), and drain plug washer (3) to drain the oil into the suitable container.

Please dispose of used motor oil in a manner that is compatible with the environment. We suggest you take used oil in a sealed container to your local recycling center or service station for reclamation. Do not throw it in the trash, pour it on the ground, or pour it down a drain.



⚠ CAUTION

USED ENGINE OIL CONTAINS SUBSTANCES THAT HAVE BEEN IDENTIFIED AS CARCINOGENIC. IF REPEATEDLY LEFT IN CONTACT WITH THE SKIN FOR PROLONGED PERIODS, IT MAY CAUSE SKIN CANCER. WASH YOUR HANDS THOROUGHLY WITH SOAP AND WATER AS SOON AS POSSIBLE AFTER CONTACT WITH USED ENGINE OIL.

Install a new drain plug washer (3) and tighten the drain plug bolt (2) to the specified torque.

TORQUE:22.5 N·m (2.25 kgf·m, 17 lbf·ft)

Fill with recommended oil to the upper level mark of the oil level dipstick (page 3-3).

Engine oil capacity: 1.1 (1.16 US gal, 0.97 Imp gal)

Tighten the oil filler cap securely.

AIR CLEANER CHECK/CLEANING/ REPLACEMENT

DUAL ELEMENT TYPE:

A dirty air filter will restrict air flow to the carburetor, reducing engine performance. If the engine is operated in dusty areas, clean the air cleaner more often than specified in the MAINTENANCE SCHEDULE.

NOTICE

OPERATING THE ENGINE WITHOUT THE AIR FILTERS OR WITH THE FILTER INSTALLED LOOSELY WILL ALLOW DIRT TO ENTER THE ENGINE, CAUSING RAPID ENGINE WEAR. INSTALL THE AIR FILTERS SECURELY.

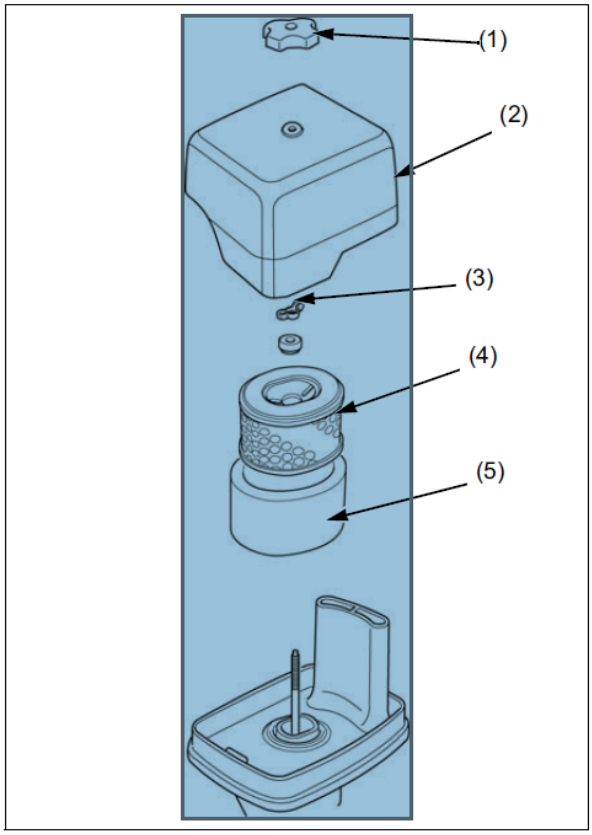
Remove the nut (1) and the air cleaner cover (2).

Remove the wing nut (3) and air filter assembly (4)(5).

Separate the inner filter (Paper) (4) from the outer filter (Foam) (5). Carefully check both filters for holes or tears and replace if damaged.

Clean the filters if they are to be reused.

Install the elements in the reverse order of removal.



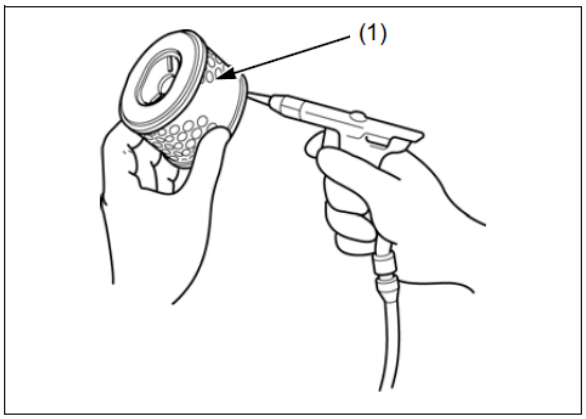
INNER FILTER (PAPER) TYPE:

Tap the inner filter (1) lightly several times on a hard surface to remove excess dirt, or blow compressed air lightly (207 kPa (2.11 kgf/cm2, 30 psi) or less) through the paper filter from the inside out. Never try to brush the dirt off; brushing will force dirt into the fibers.

Wipe dirt from the inside of the air cleaner case and the air cleaner cover, using a rag.

Check the air cleaner case packing for deterioration or damage. Make sure the air cleaner packing installed securely.

Install the cleaner in the reverse order of removal.



SEDIMENT CUP CLEANING

⚠ WARNING

GASOLINE IS HIGHLY FLAMMABLE AND EXPLOSIVE. YOU CAN BE BURNED OR SERIOUSLY INJURED WHEN HANDLING FUEL.

⚠ WARNING

- **KEEP HEAT, SPARKS, AND FLAME AWAY.**

⚠ WARNING

- **HANDLE FUEL ONLY OUTDOORS.**

⚠ WARNING

- **WIPE UP SPILLS IMMEDIATELY.**

Turn the fuel cock lever (1) to the OFF position.

Remove the sediment cup (2) and the O-ring (3).

Remove the cup filter (4) while releasing the tabs (5).

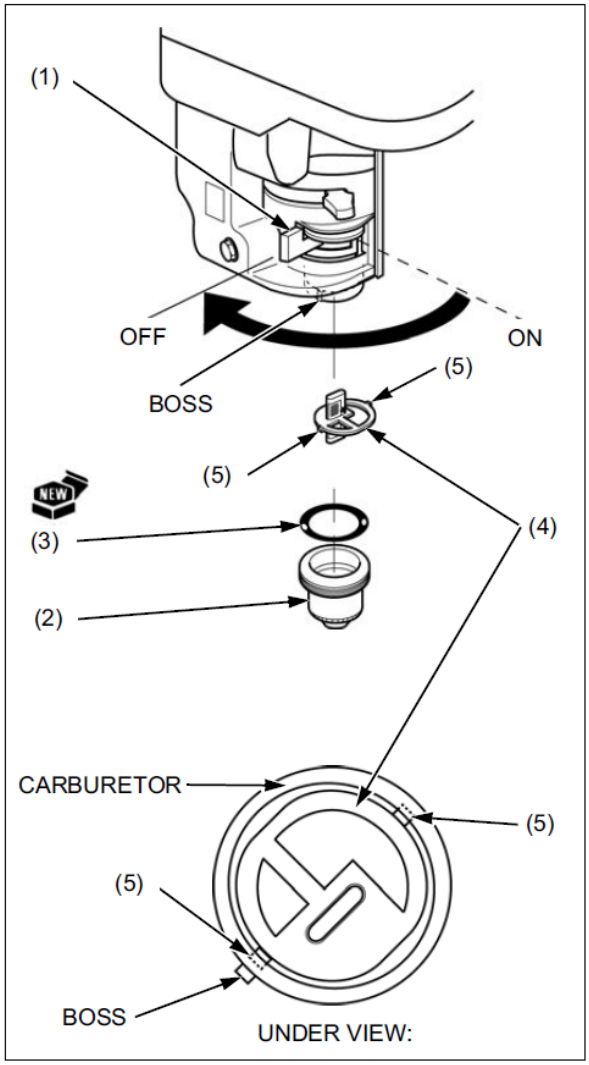
Clean the sediment cup and the cup filter with nonflammable solvent and allow them to dry thoroughly.

Install the cup filter as the direction shown in the illustration.

Install a new O-ring and tighten the sediment cup to the specified torque.

TORQUE:3.9 N·m (0.40 kgf·m, 2.9 lbf·ft)

Check the installation part of the sediment cup for any sign of fuel leakage.

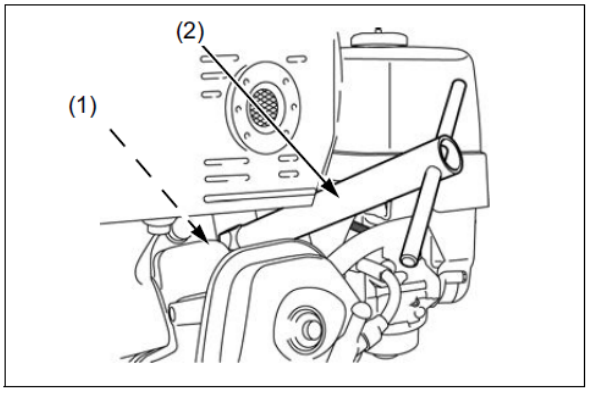


SPARK PLUG CHECK/ADJUSTMENT

⚠ CAUTION

IF THE ENGINE HAS BEEN RUNNING, THE ENGINE WILL BE VERY HOT. ALLOW IT TO COOL BEFORE PROCEEDING.

Remove the spark plug cap, and then remove the spark plug (1) using a spark plug wrench (2).

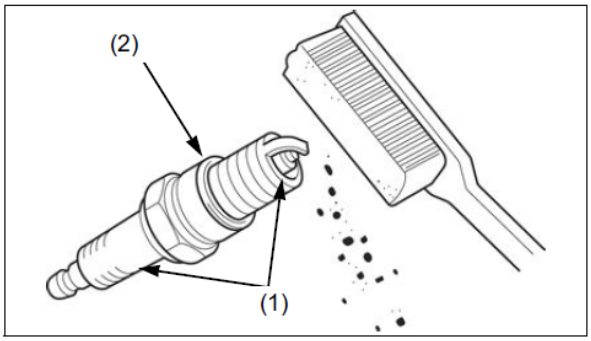


Visually check the spark plug. Replace the plug if the insulator (1) is cracked or chipped.

Check the sealing washer (2) for damage.

Replace the spark plug if the sealing washer is damaged (page 3-8).

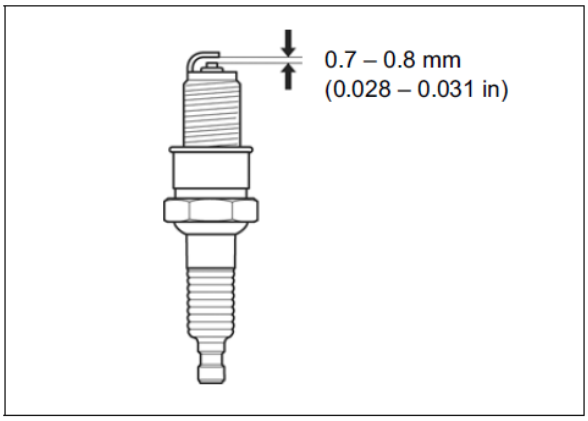
SPARK PLUG: BPR6ES (NGK) W20EPR-U(DENSO)



Measure the plug gap with a wire-type feeler gauge. If the measurement is out of the specification, adjust by bending the side electrode.

PLUG GAP: 0.7 – 0.8 mm (0.028 – 0.031 in)

Install the spark plug finger-tight to seat the washer, and then tighten 1/8 – 1/4 turn with a spark plug wrench.



NOTICE

A LOOSE SPARK PLUG CAN BECOME VERY HOT AND CAN DAMAGE THE ENGINE. OVERTIGHTENING CAN DAMAGE THE THREADS IN THE CYLINDER BLOCK. INSTALL THE SPARK PLUG CAP SECURELY.

SPARK PLUG REPLACEMENT

⚠ CAUTION

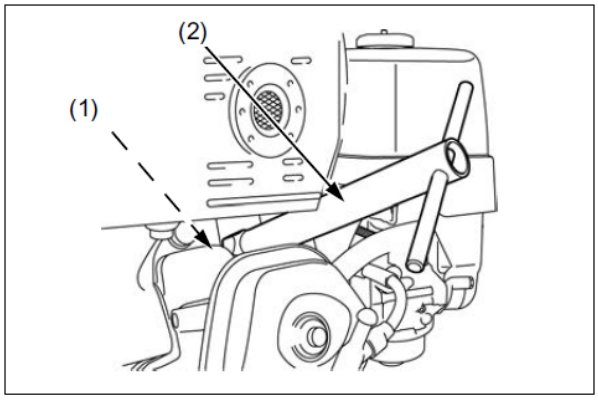
IF THE ENGINE HAS BEEN RUNNING, THE ENGINE WILL BE VERY HOT.ALLOW IT TO COOL BEFORE PROCEEDING.

Remove the spark plug cap, and then remove the spark plug (1) using a spark plug wrench (2).

Verify the new spark plug gap is correct (page 3-7).

Install a new spark plug finger-tight to seat the washer, and then tighten 1/2 turn with a spark plug wrench.

SPARK PLUG: BPR6ES (NGK)W20EPR-U(DENSO)



NOTICE

A LOOSE SPARK PLUG CAN BECOME VERY HOT AND CAN DAMAGE THE ENGINE. OVERTIGHTENING CAN DAMAGE THE THREADS IN THE CYLINDER BLOCK. INSTALL THE SPARK PLUG CAP SECURELY.

SPARK ARRESTER CLEANING

⚠ CAUTION

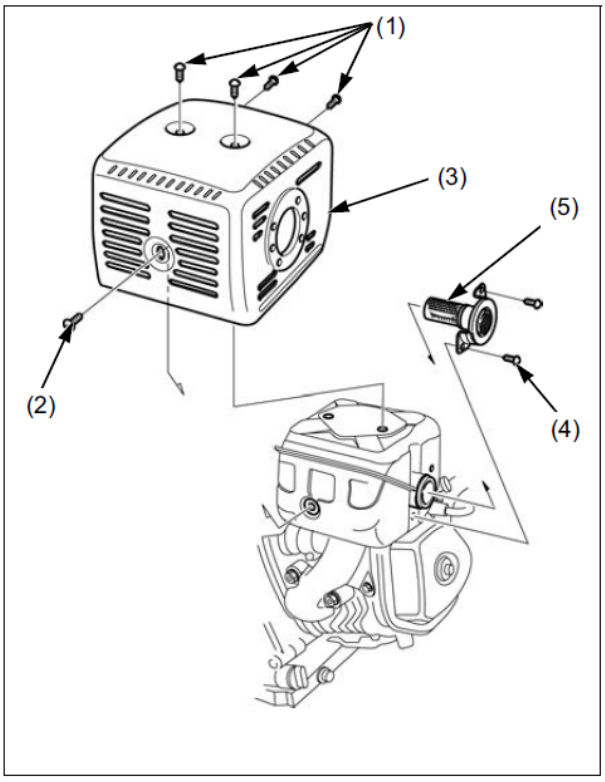
THE ENGINE AND THE MUFFLER BECOMES VERY HOT DURING OPERATION AND REMAINS HOT FOR A WHILE AFTER STOPPING THE ENGINE. BE CAREFUL NOT TO TOUCH THE MUFFLER WHILE IT IS HOT. ALLOW IT TO COOL BEFORE PROCEEDING.

SOLID PROTECTOR TYPE

Remove the muffler cover (page 12-6), If equipped.

Remove the 5 x 8 mm tapping screws (1), 6 x 10 mm tapping screw (2), and muffler protector (3).

Remove the 5 x 8 mm tapping screws (4) and spark arrester (5).

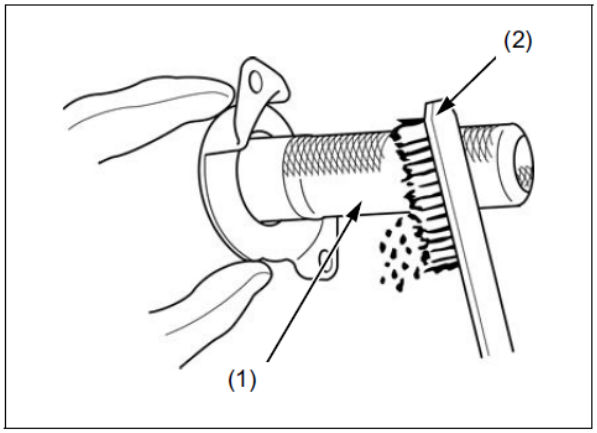


CLEANING

NOTICE

BE CAREFUL TO AVOID DAMAGING THE SCREEN.

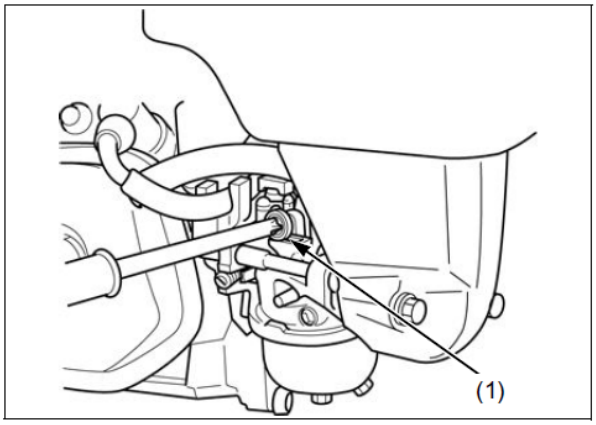
Clean the carbon deposits from the spark arrester screen (1) with a wire brush (2).Check the spark arrester screen for damage. If the screen is damaged, replace the spark arrester.Install the spark arrester in the reverse order of removal.



IDLE SPEED CHECK/ADJUSTMENT

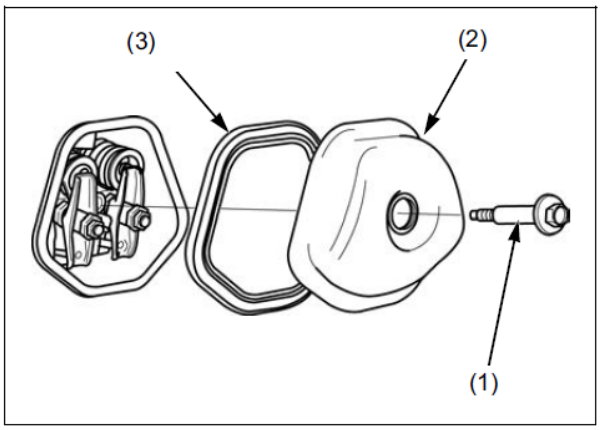
Start the engine and allow it to warm up to normal operating temperature.Turn the throttle stop screw (1) to obtain the specified idle speed.

IDLE SPEED:1,400 ± 150 min-1 (rpm)



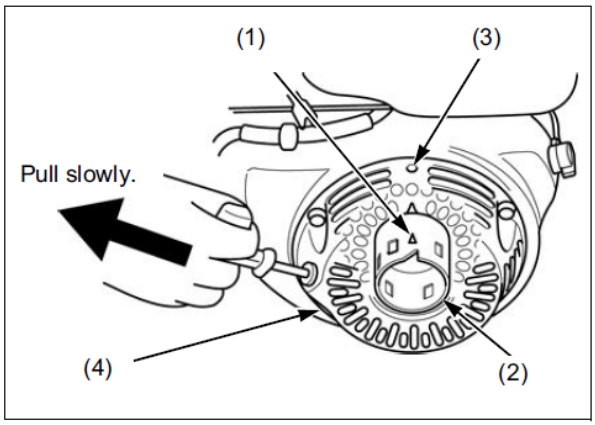
VALVE CLEARANCE CHECK/ADJUSTMENT

Remove the head cover bolt (1), the head cover (2),and the head cover packing (3).



Disconnect the spark plug cap from the spark plug.

Set the piston near top dead center of the cylinder compression stroke (both valves fully closed) by pulling the recoil starter slowly. When the piston is near top dead center of the compression stroke, the triangle mark (1) on the starter pulley (2) will align with the top hole (3) on the recoil starter case (4).If the exhaust valve is opened, use the recoil starter tot urn the crankshaft one additional turn and align the triangle mark on the starter pulley with the top hole on the recoil starter case again.



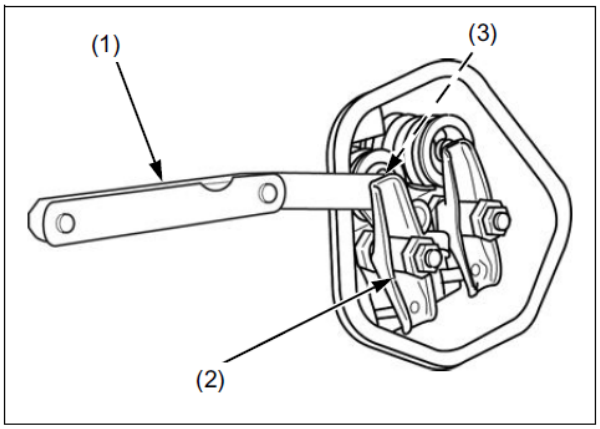
Insert a thickness gauge (1) between the valve rocker arm (2) and valve stem (3) to measure the valve clearance.

VALVE CLEARANCE:

IN: 0.15 ± 0.02 mm

EX: 0.20 ± 0.02 mm

If adjustment is necessary, proceed as follows.



Hold the rocker arm pivot (1) and loosen the pivot adjusting nut (2).

Turn the rocker arm pivot to obtain the specified clearance.

VALVE CLEARANCE:

IN: 0.15 ± 0.02 mm

EX: 0.20 ± 0.02 mm

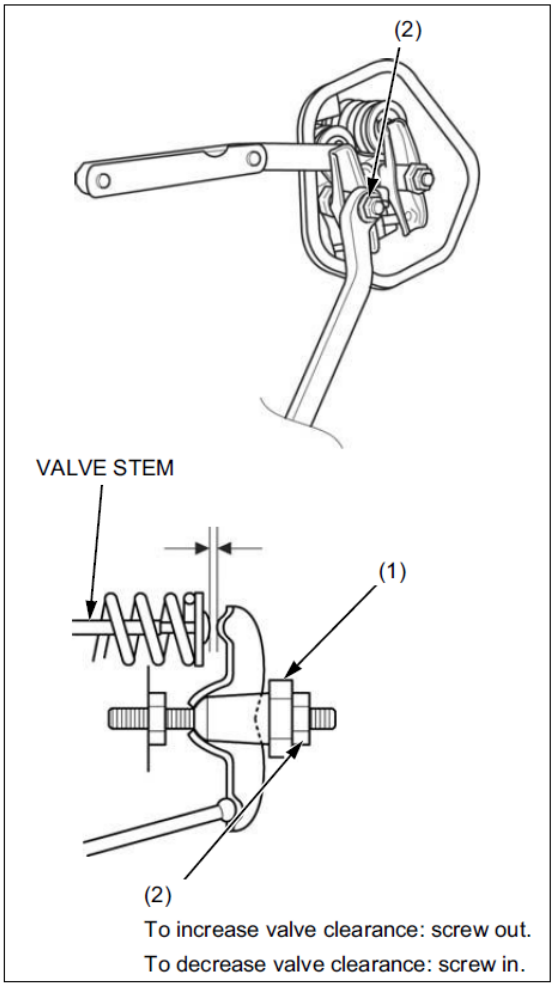
Hold the rocker arm pivot and retighten the pivot adjusting nut to the specified torque.

TORQUE:10 N·m (1.0 kgf·m, 7 lbf·ft)

Recheck the valve clearance, and if necessary, readjust the clearance.

Check the head cover packing for damage or deterioration, and install it to the head cover.

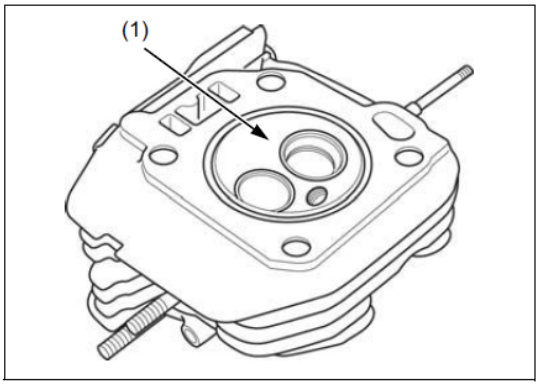
Attach the cylinder head cover to the cylinder head, and tighten the head cover bolt securely.



COMBUSTION CHAMBER CLEANING

Remove the cylinder head (page 13-3).

Clean any carbon deposits from the combustion chamber (1).



FUEL TANK AND FILTER CLEANING

⚠ WARNING

GASOLINE IS HIGHLY FLAMMABLE AND EXPLOSIVE. YOU CAN BE BURNED OR SERIOUSLY INJURED WHEN HANDLING FUEL.

⚠ WARNING

•KEEP HEAT, SPARKS, AND FLAME AWAY.

⚠ WARNING

•HANDLE FUEL ONLY OUTDOORS.

⚠ WARNING

•WIPE UP SPILLS IMMEDIATELY.

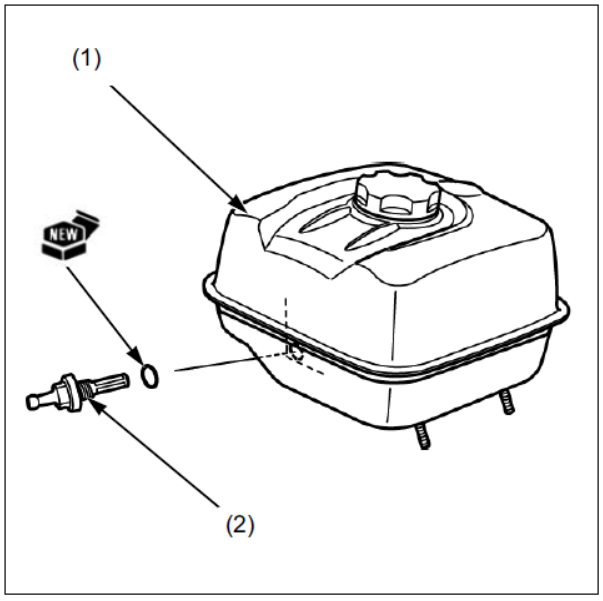
Drain the fuel into a suitable container.

Remove the fuel tank (1) and fuel tank joint (2).

Clean the fuel tank joint and fuel tank with non-flammable solvent, and allow them to dry thoroughly.

Install the fuel tank.

Check the installation part of the fuel tank for any sign of fuel leakage.

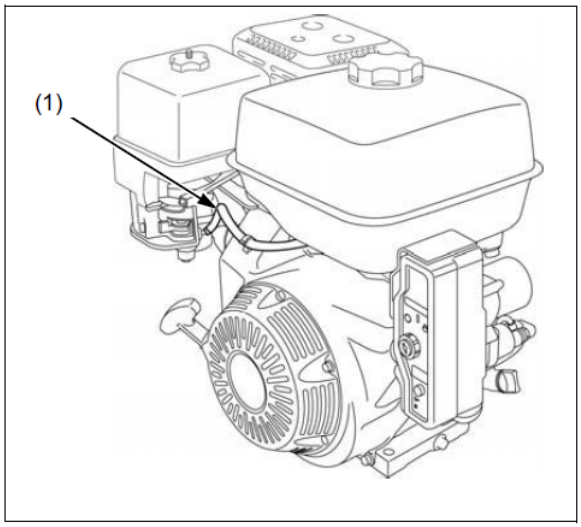


FUEL TUBE CHECK

⚠ WARNING

GASOLINE IS HIGHLY FLAMMABLE AND EXPLOSIVE. YOU CAN BE BURNED OR SERIOUSLY INJURED WHEN HANDLING FUEL. •KEEP HEAT, SPARKS, AND FLAME AWAY. •HANDLE FUEL ONLY OUTDOORS. •WIPE UP SPILLS IMMEDIATELY.

Check the fuel tube (1) for deterioration, cracks or signs of leakage.



TROUBLESHOOTING

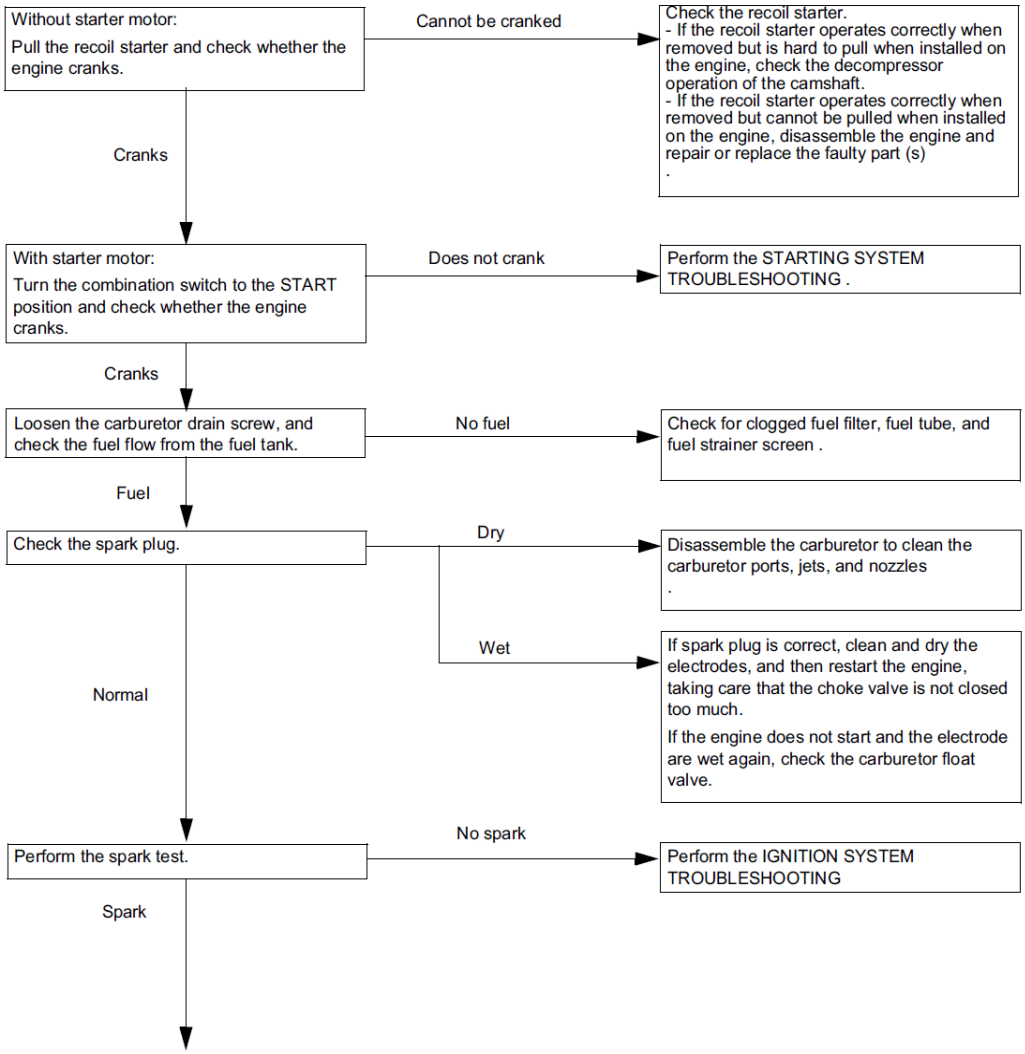
BEFORE TROUBLESHOOTING

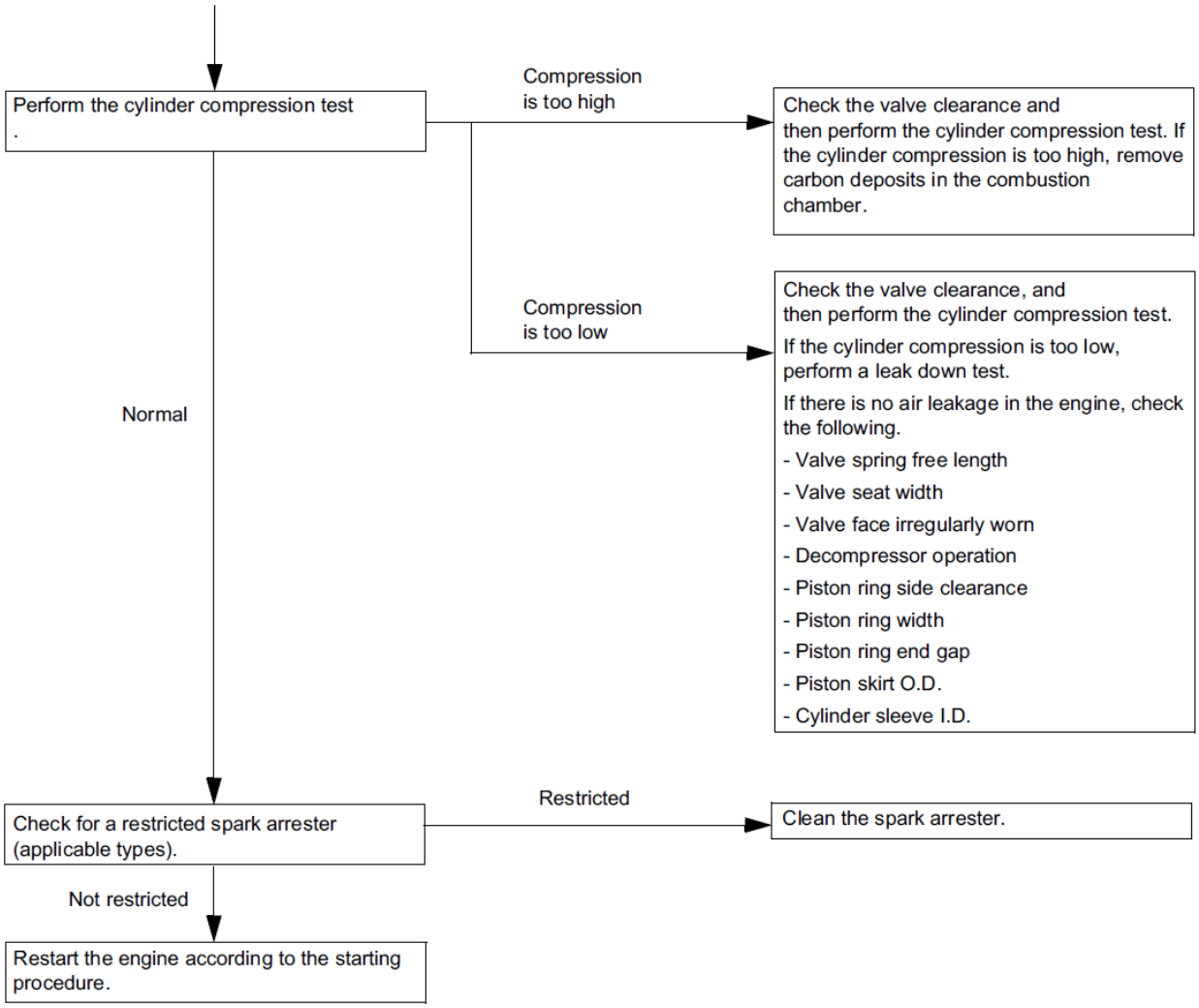
- Use a known-good battery for troubleshooting.
- Check that the connectors are connected securely.
- Check for sufficient fresh fuel in the fuel tank.
- Read the circuit tester's operation instructions carefully, and observe the instructions during inspection.
- Disconnect the battery cable before continuity inspection.

TROUBLESHOOTINGHARD

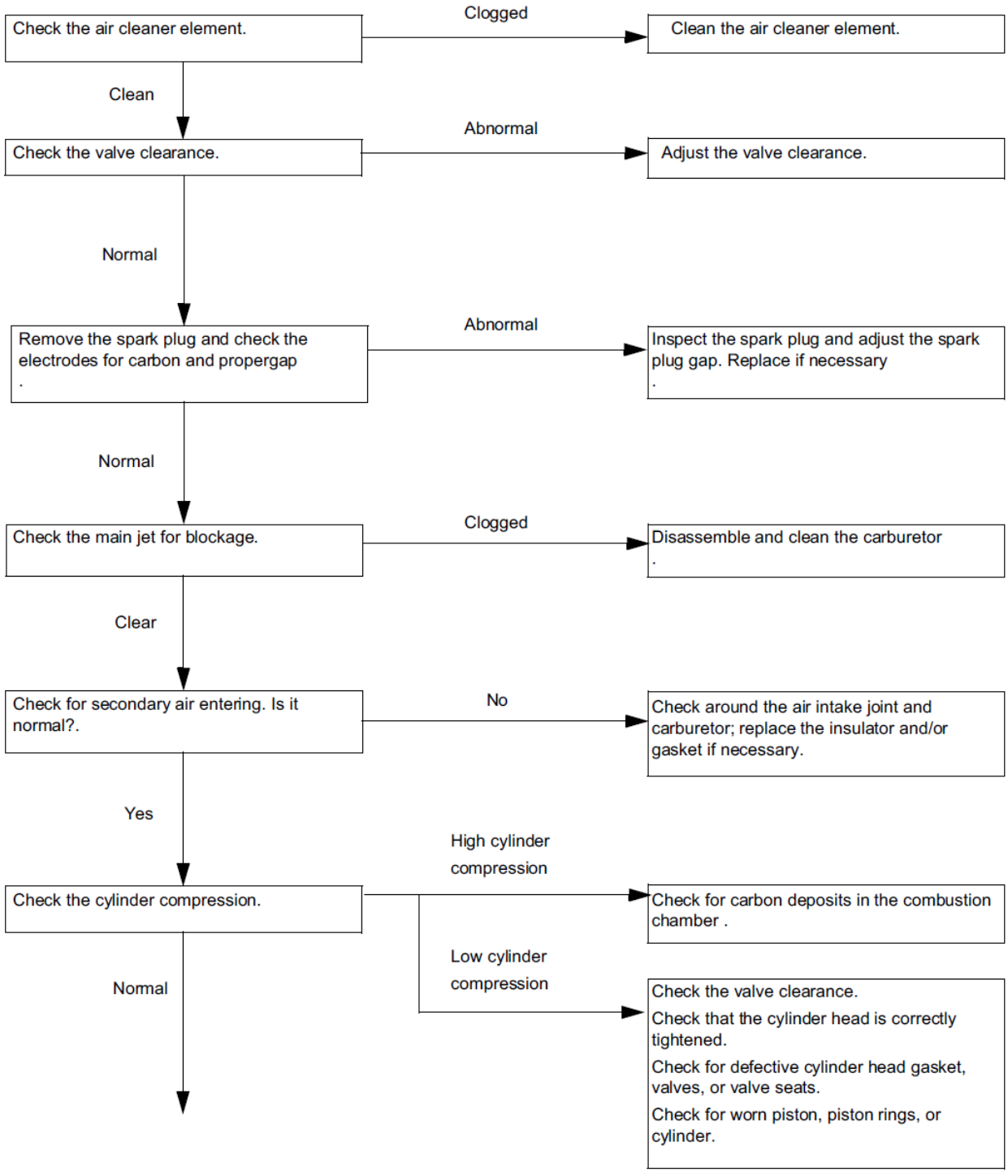
STARTING

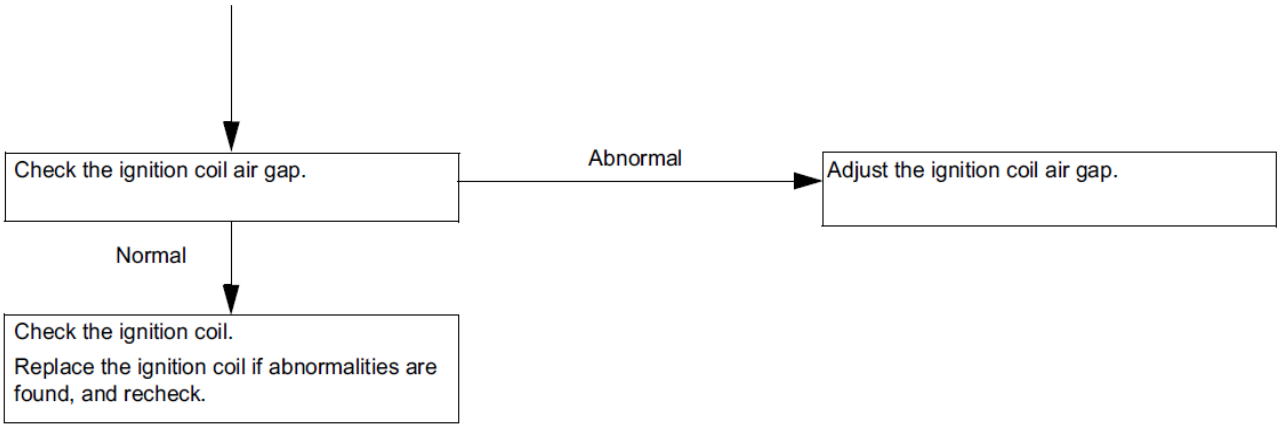
•Check the engine oil level before troubleshooting.




Perform the cylinder compression test
.
Compression
is too high
Check the valve clearance and
then perform the cylinder compression test. If the cylinder compression is too high, remove carbon deposits in the combustion chamber.
Compression
is too low
Check the valve clearance, and
then perform the cylinder compression test.
If the cylinder compression is too low, perform a leak down test.
If there is no air leakage in the engine, check the following.
- Valve spring free length
- Valve seat width
- Valve face irregularly worn
- Decompressor operation
- Piston ring side clearance
- Piston ring width
- Piston ring end gap
- Piston skirt O.D.
- Cylinder sleeve I.D.
Normal
Check for a restricted spark arrester (applicable types).
Restricted
Clean the spark arrester.
Not restricted
Restart the engine according to the starting procedure.

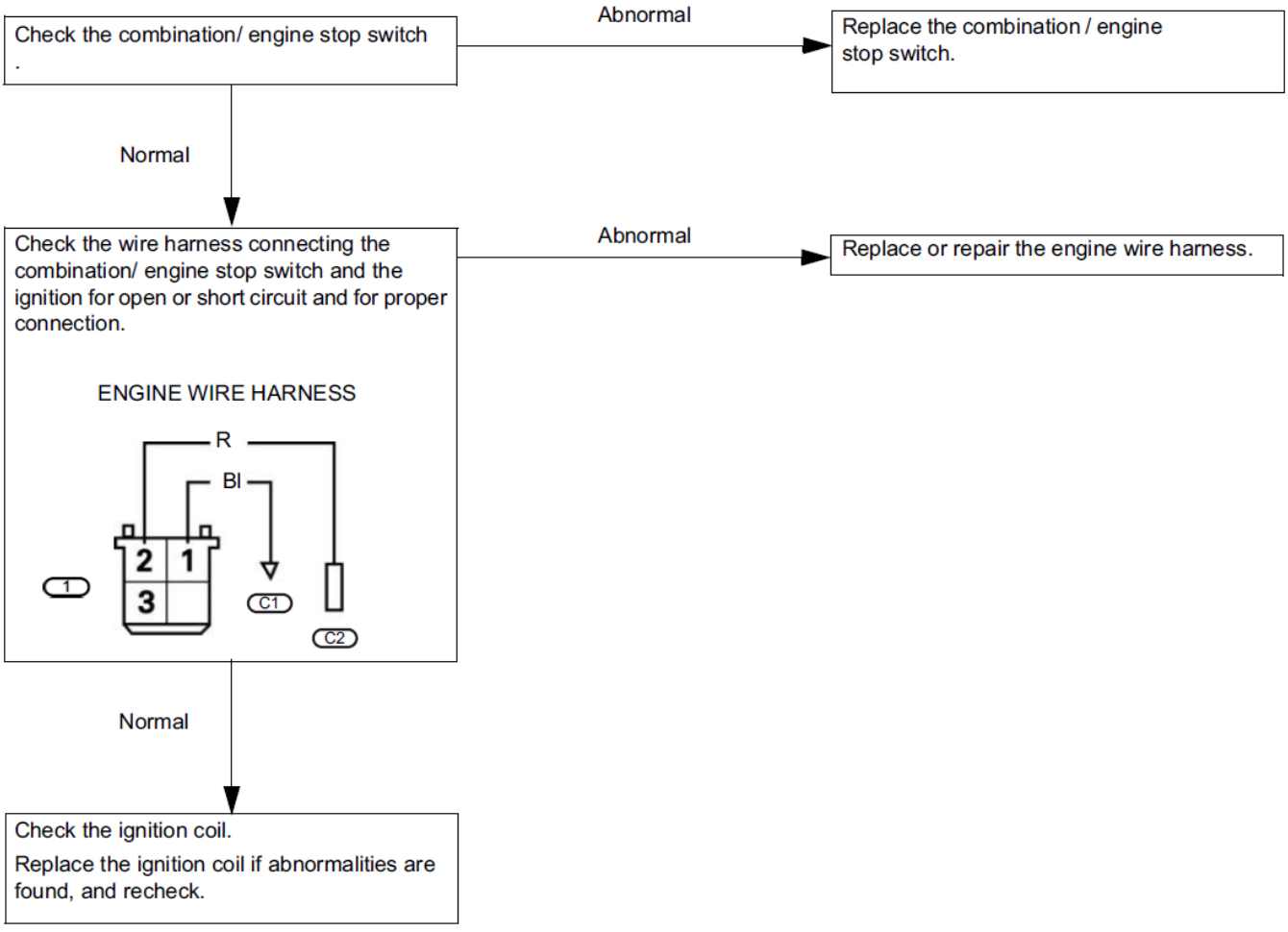
ENGINE SPEED DOES NOT INCREASE OR STABILIZE





ENGINE DOES NOT STOP WHEN COMBINATION/ ENGINE STOP SWITCH IS TURNED OFF

- Check the engine oil level before troubleshooting.



ENGINE DOES NOT STOP WHEN ENGINE OIL LEVEL IS SLOW

Check the oil level switch (If equipped) .
.

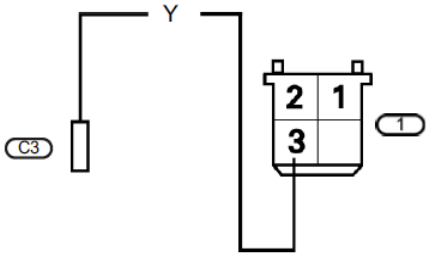
Abnormal → Replace the oil level switch.

Normal

Check the wire harness connecting the oil level switch and ignition coil for open or short circuit and proper connection.

No continuity → Replace or repair the engine wire harness.

ENGINE WIRE HARNESS



Continuity

Check the ignition coil.
Replace the ignition coil if abnormalities are found, and recheck.

COVER

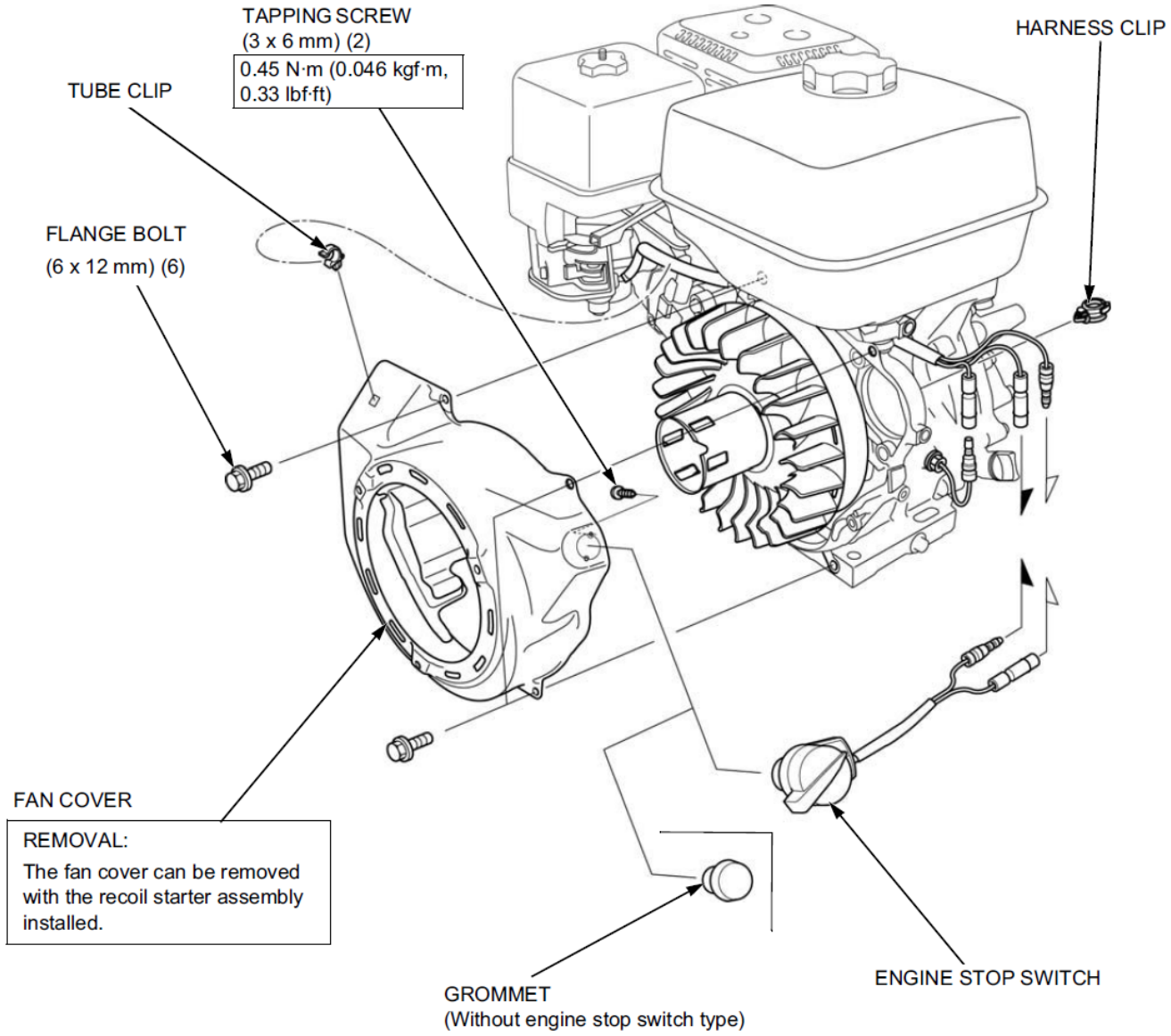
COVERFAN COVER REMOVAL/INSTALLATION

Remove the recoil starter.

Remove the auto throttle (If equipped).

Open the harness clip and disconnect the engine stop switch connector (Without control box type).

When installing, refer to the HARNESS ROUTING.



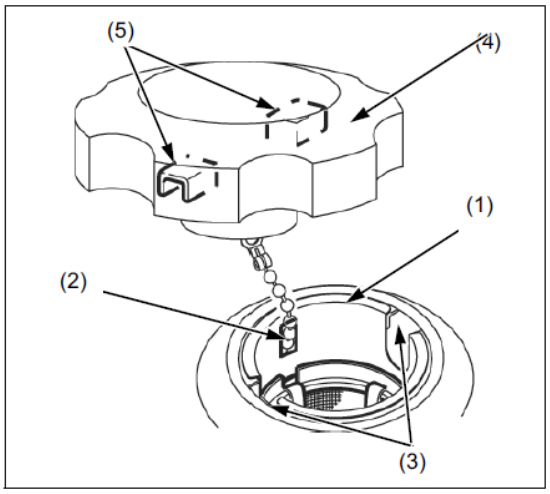
FUEL SYSTEM

FUEL FILLER CAP REMOVAL/INSTALLATION

Turn the fuel level gauge (1) to align the fuel filler capt ether hole (2) with the cutout (3) of the fuel filler neck, and then remove the fuel filler cap (4).

Before installing, check the air vent hole of the fuel filler cap for clogs. If necessary, clean it using low-pressure compressed air.

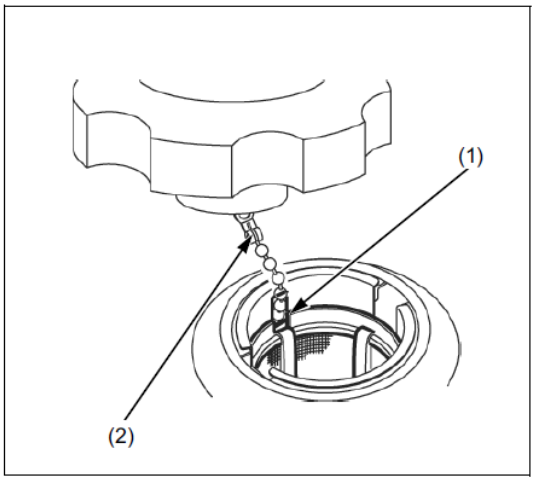
Set the fuel tank cap to the fuel filler neck by aligning the projections (5) of the cap with the cutouts of the fuel filler neck and fuel level gauge, and then turn the fuel tank cap clockwise 180 degrees to lock it.



FUEL FILTER REMOVAL/INSTALLATION

Remove or install the fuel filter by aligning the cutout (1)of the fuel filter with the fuel filler cap tether (2) as shown.

Before installing, check the screen of the fuel strainer for clogs or damage.



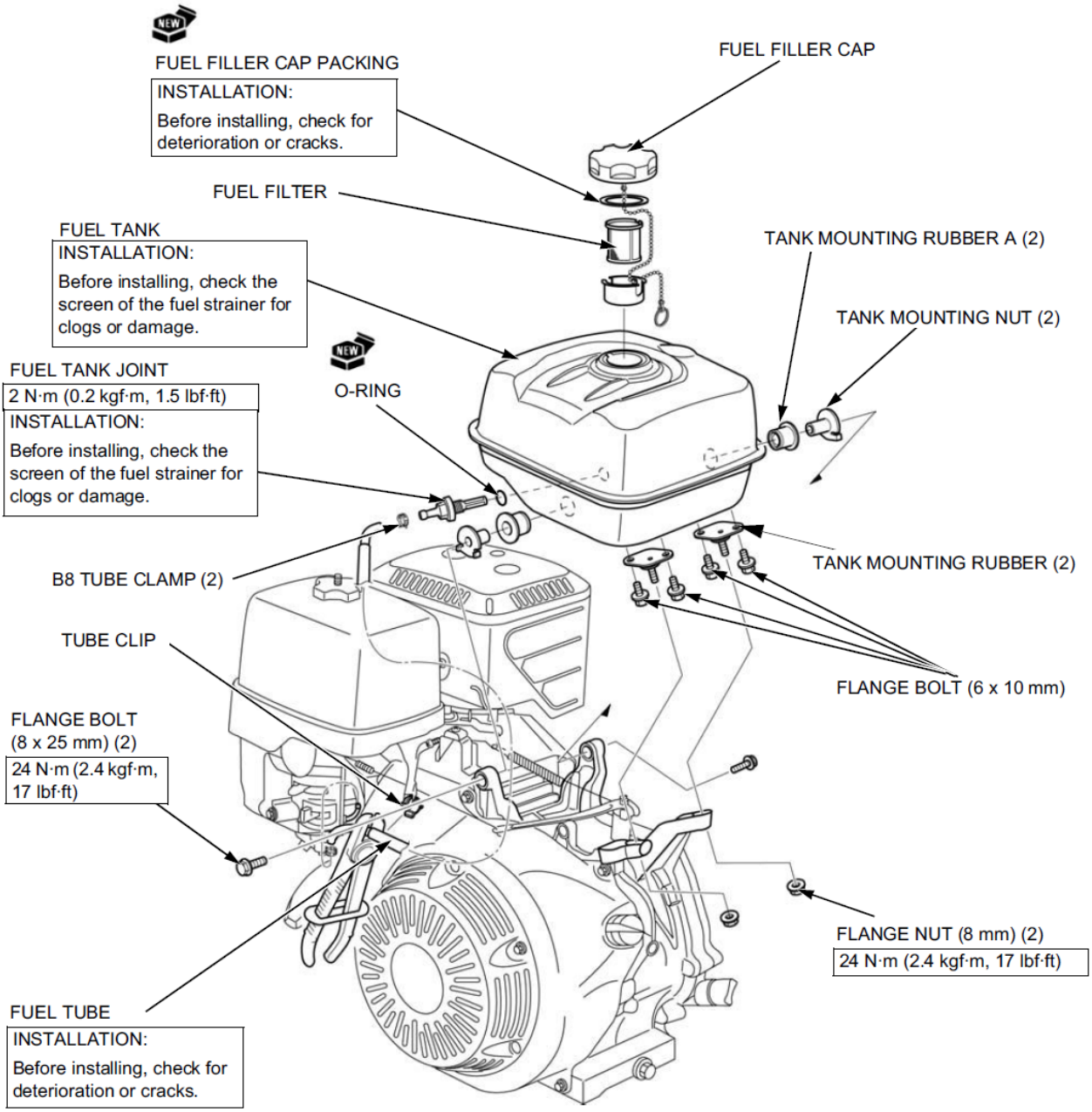
FUEL TANK REMOVAL/INSTALLATION (TYPE B)

⚠ WARNING

GASOLINE IS HIGHLY FLAMMABLE AND EXPLOSIVE.YOUCAN BE BURNED OR SERIOUSLY INJURED WHEN HANDLING FUEL. •KEEP HEAT, SPARKS, AND FLAME AWAY. •HANDLE FUEL ONLY OUTDOORS. •WIPE UP SPILLS IMMEDIATELY.

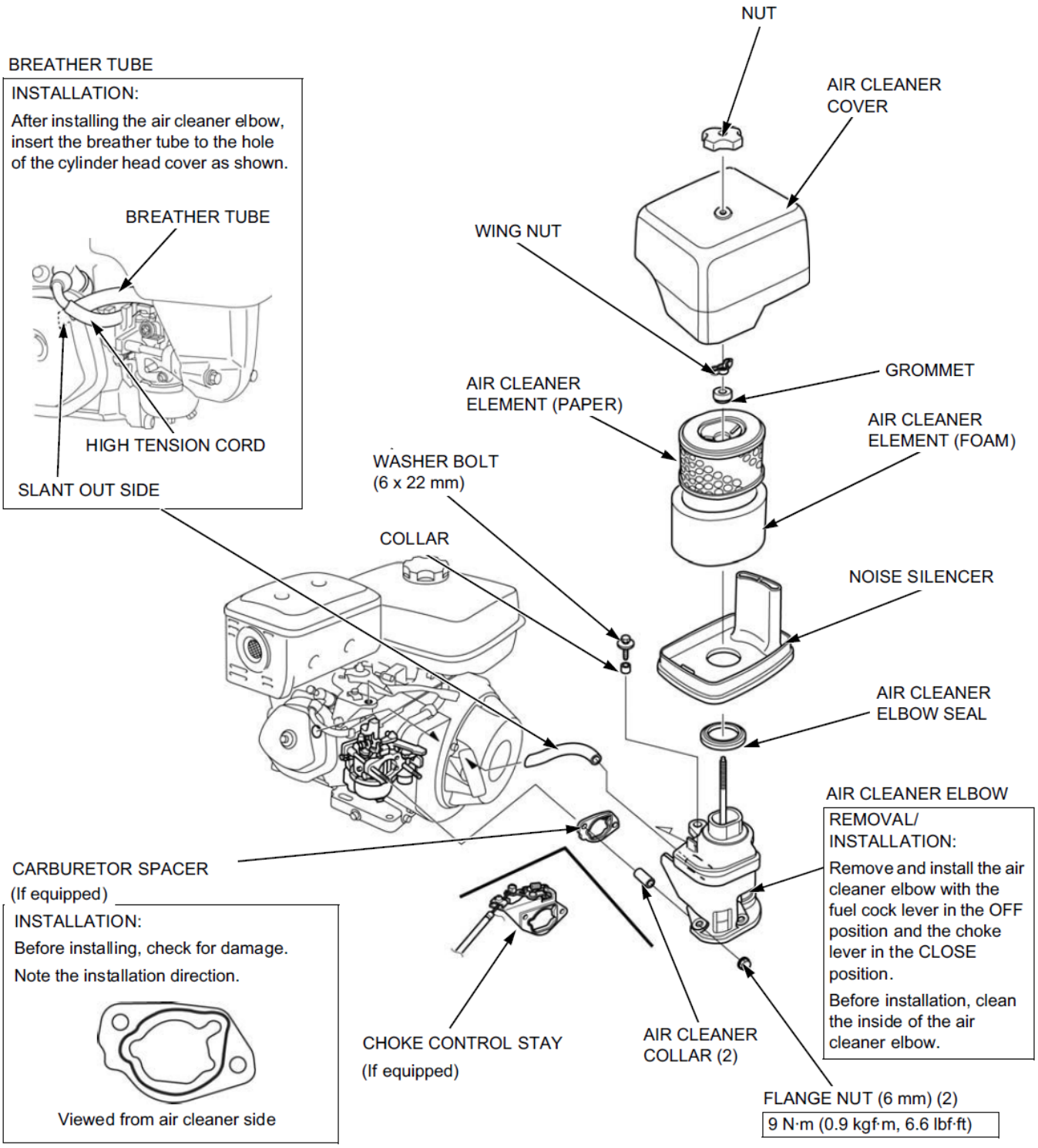
Turn the fuel valve lever to the OFF position.

Set a commercially available tube clip to the fuel tube.



AIR CLEANER REMOVAL/INSTALLATION

Dual element type:



CARBURETOR REMOVAL/INSTALLATION

Dual element or cyclone type air cleaner:

⚠ WARNING

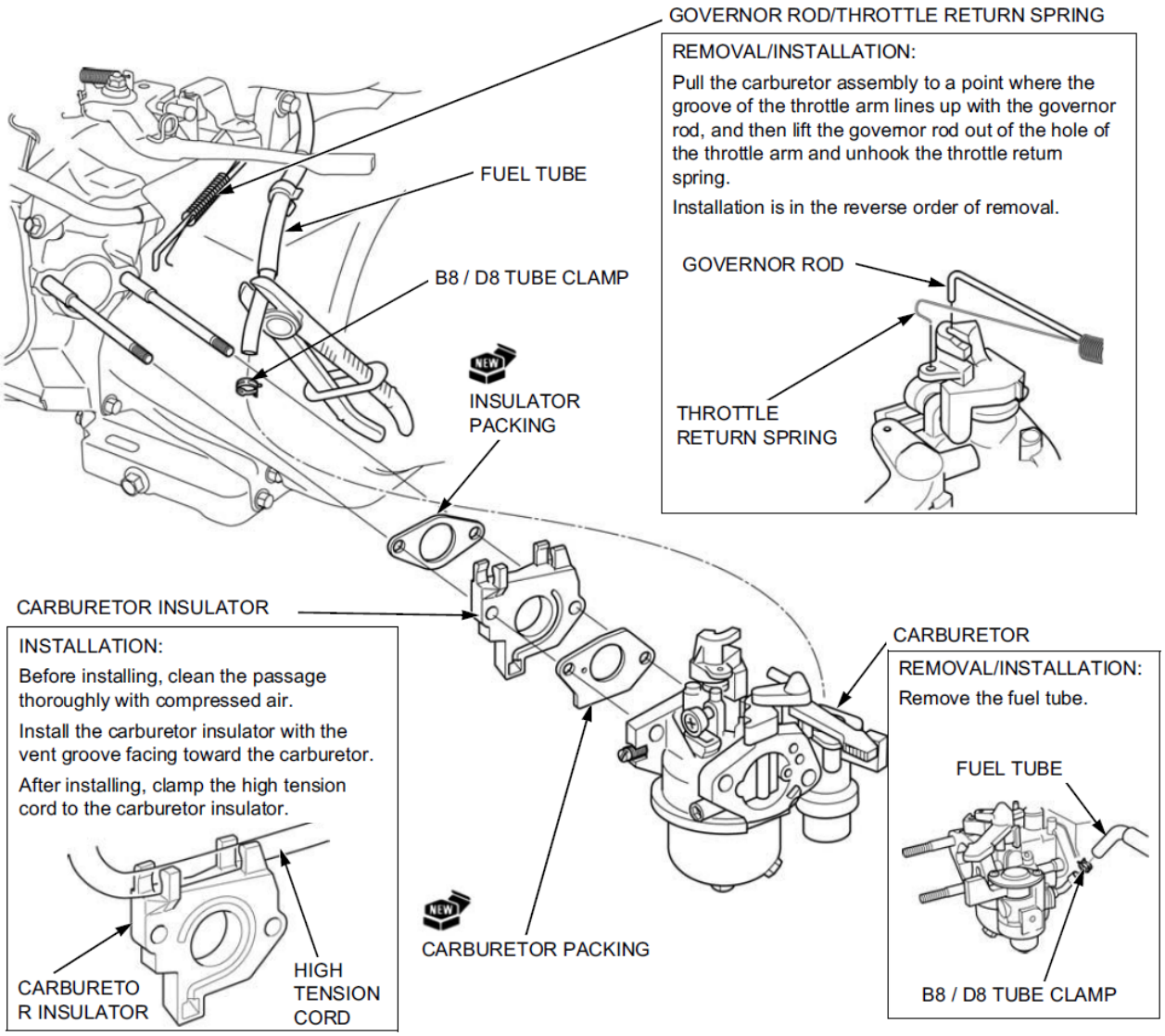
GASOLINE IS HIGHLY FLAMMABLE AND EXPLOSIVE.YOUCAN BE BURNED OR SERIOUSLY INJURED WHEN HANDLING FUEL. •KEEP HEAT, SPARKS, AND FLAME AWAY. •HANDLE FUEL ONLY OUTDOORS. •WIPE UP SPILLS IMMEDIATELY.

Turn the fuel valve lever to the OFF position.Remove the air cleaner.

Set a commercially available tube clip to the fuel tube.

Disconnect the fuel tube from the carburetor.

Remove the drain screw of the carburetor to drain completely.



CARBURETOR DISASSEMBLY/ASSEMBLY

Dual element or cyclone type air cleaner:

⚠ WARNING

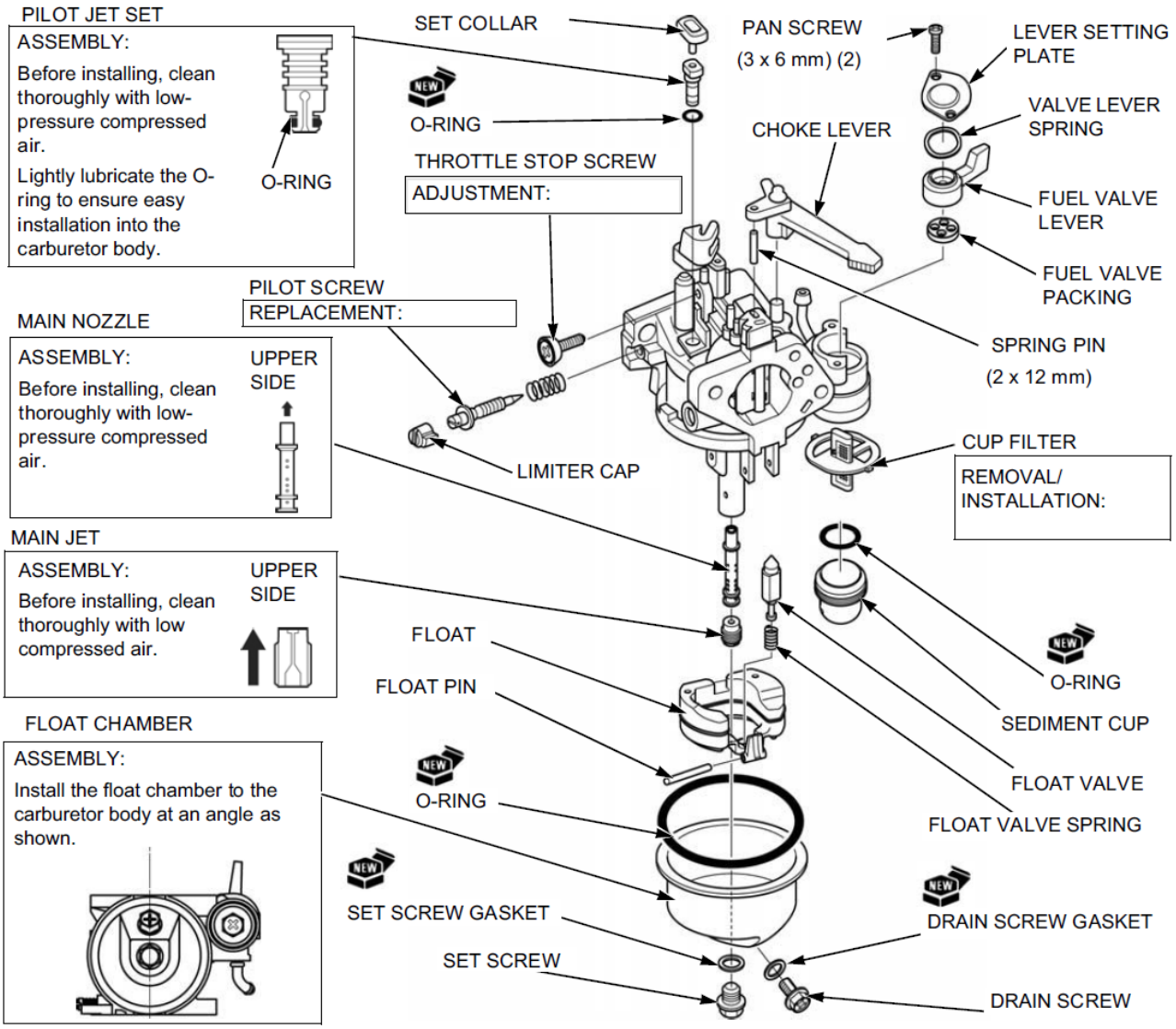
GASOLINE IS HIGHLY FLAMMABLE AND EXPLOSIVE.YOUCAN BE BURNED OR SERIOUSLY INJURED WHEN HANDLING FUEL. •KEEP HEAT, SPARKS, AND FLAME AWAY. •HANDLE FUEL ONLY OUTDOORS. •WIPE UP SPILLS IMMEDIATELY.

⚠ CAUTION

TO PREVENT SERIOUS EYE INJURY, ALWAYS WEAR SAFETY-GOGGLES OR OTHER EYE PROTECTION WHEN USING COMPRESSED AIR.

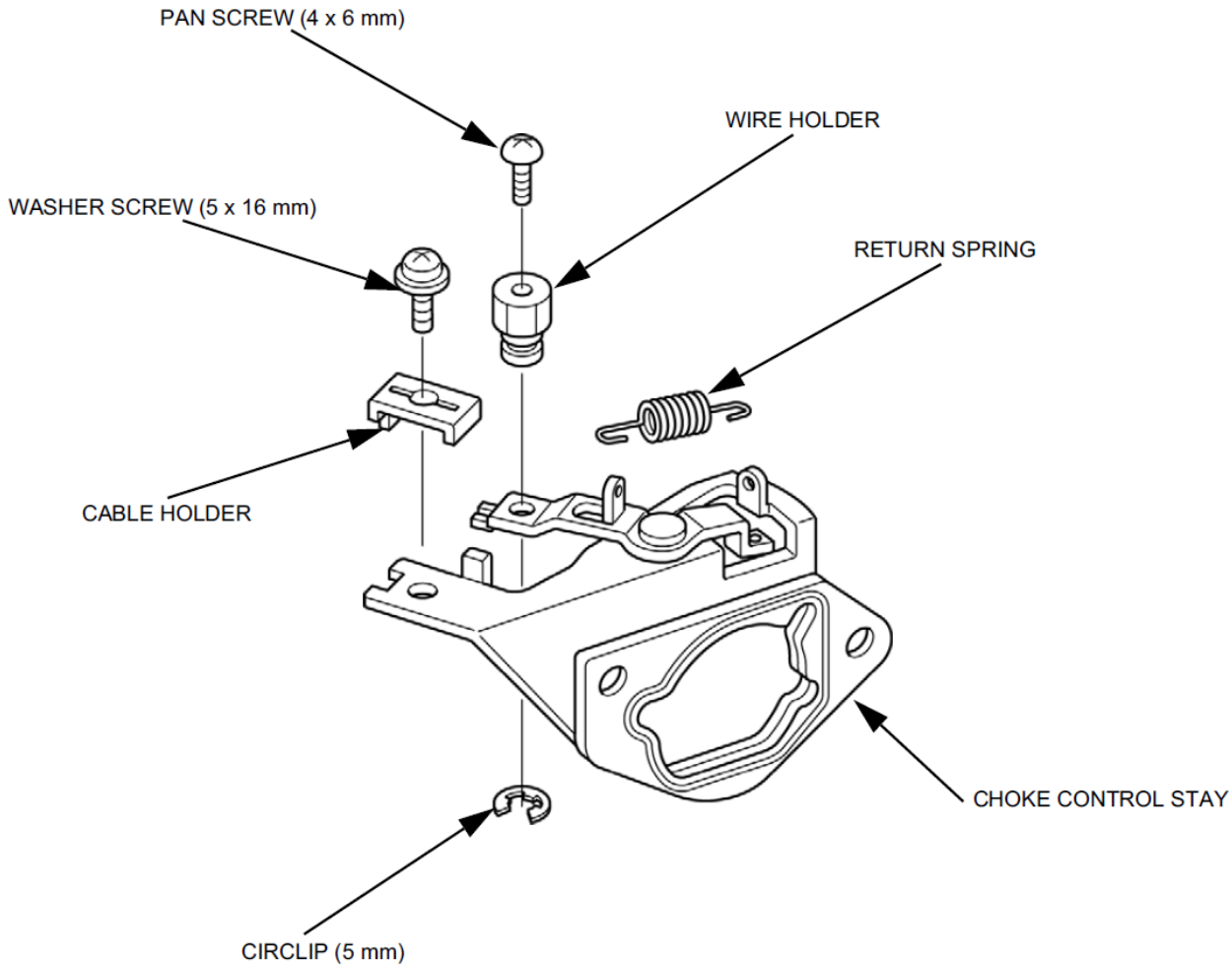
Remove the carburetor.

Before disassembly, clean the outside of the carburetor.

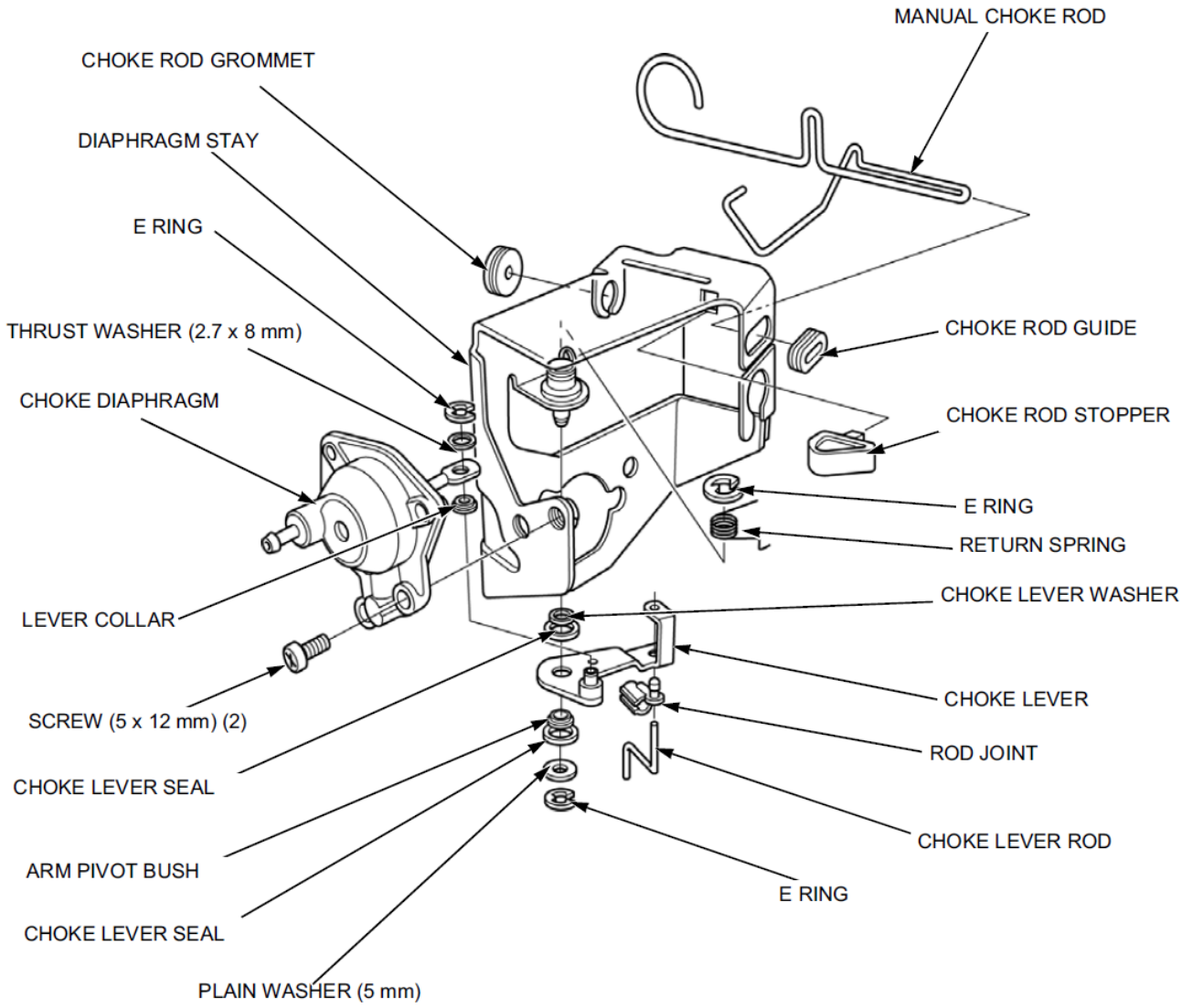


CHOKE CONTROL STAY DISASSEMBLY/ ASSEMBLY

Remove the choke diaphragm.



CHOKE DIAPHRAGM DISASSEMBLY/ASSEMBLY



CARBURETOR BODY CLEANING

⚠ CAUTION

TO PREVENT SERIOUS EYE INJURY, ALWAYS WEAR SAFETY GOGGLES OR OTHER EYE PROTECTION WHEN USING COMPRESSED AIR.

NOTICE

SOME COMMERCIALLY AVAILABLE CHEMICAL CLEANERS ARE VERY CAUSTIC. THESE CLEANERS MAY DAMAGE PLASTIC PARTS SUCH AS THE O-RING, THE FLOAT AND THE FLOAT SEAT OF THE CARBURETOR. CHECK THE CONTAINER FOR INSTRUCTIONS. IF YOU ARE IN DOUBT, DO NOT USE THE SE PRODUCTS TO CLEAN HONDA CARBURETORS.

NOTICE

HIGH AIR PRESSURE MAY DAMAGE THE CARBURETOR BODY.USE LOW AIR PRESSURE (30 PSI OR LESS) WHEN CLEANING PASSAGES AND PORTS.

Clean the carburetor body with non-flammable solvent.

Clean thoroughly the following passages and ports with-low-pressure compressed air.

Pilot screw hole (1)

Pilot jet hole (2)

Pilot air jet (3)

Main air jet (4)

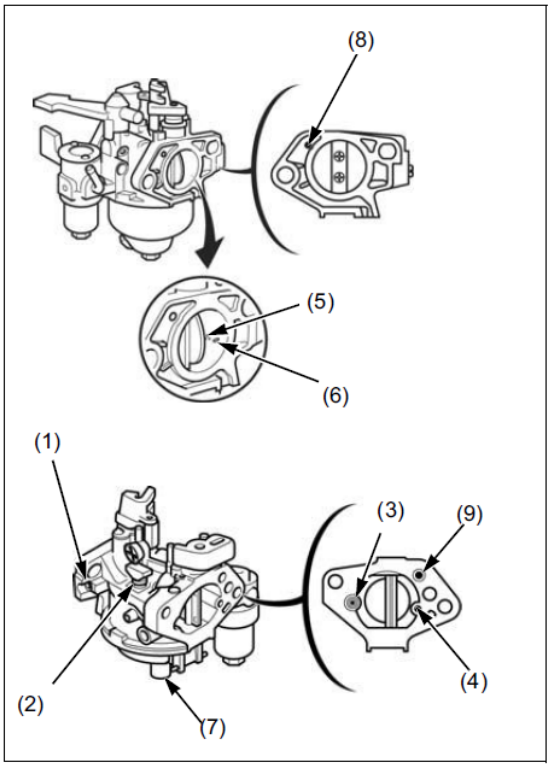
Transition ports (5)

Pilot outlet (6)

Main nozzle holder (7)

External vent port (8)

Internal vent port (9)



CARBURETOR INSPECTION

FLOAT LEVEL HEIGHT

Place the carburetor in the position as shown. Measure the distance between the float top and carburetor body when the float just contacts the seat without compressing the valve spring.

TOOL:

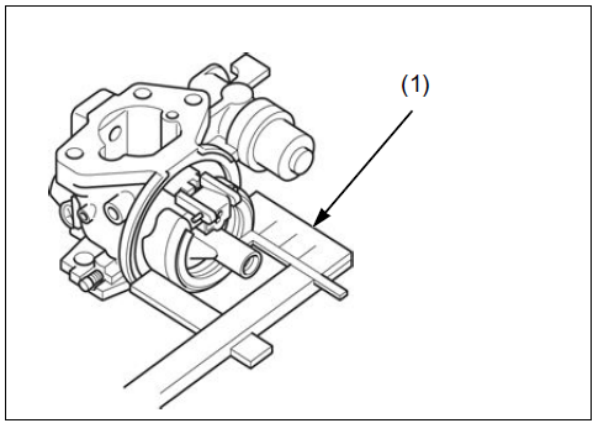
Float level gauge (1)07401-0010000

FLOAT HEIGHT:

13.2 mm (0.52 in)

If the measured float height is out of specification, check the float valve and the float valve spring.

If the float valve and the float valve spring are normal, replace the float.

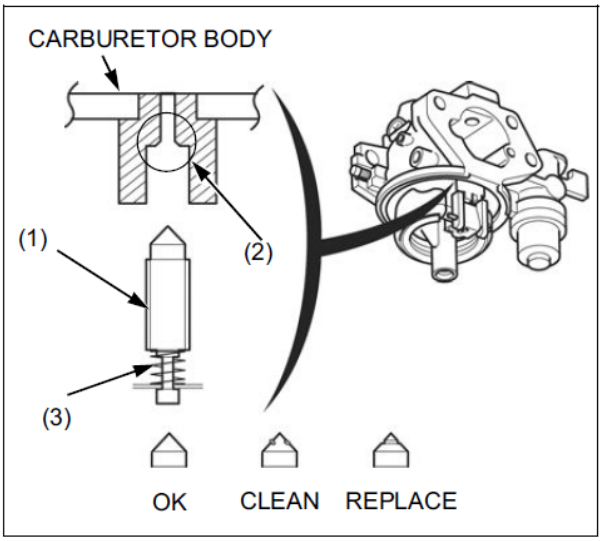


FLOAT VALVE

Check the float valve (1) and its seat (2) for wear or contamination.

Before installation, check for wear or a weak spring (3).

Check the operation of the float valve.

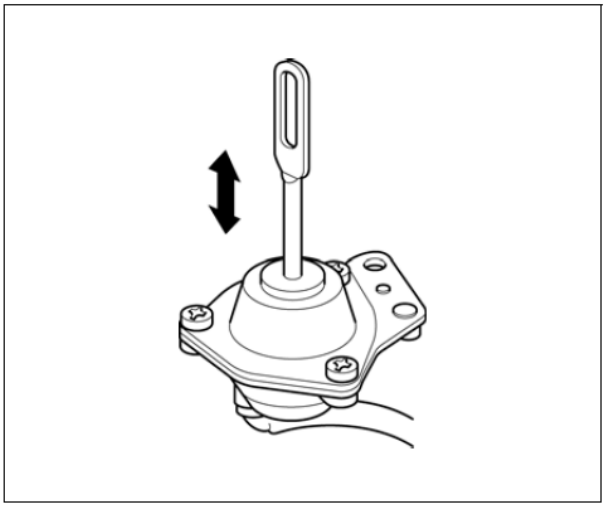


CHOKE DIAPHRAGM INSPECTION

Check for smooth operation by pressing the rod with a finger.

Connect a vacuum pump to the choke diaphragm and apply vacuum.

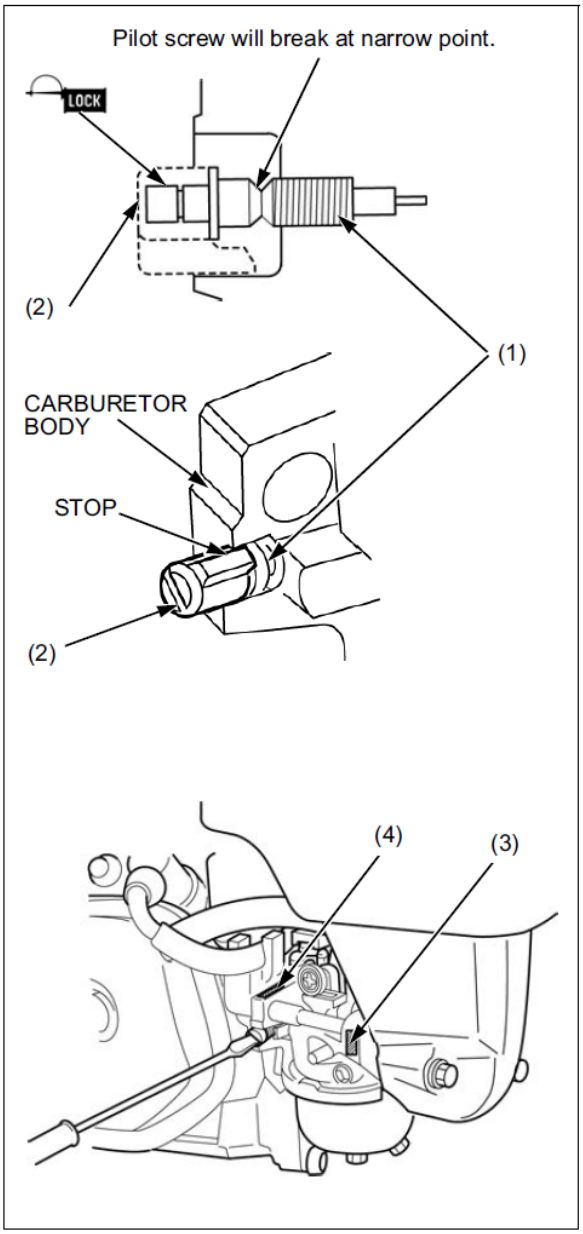
The diaphragm should hold.Replace the choke diaphragm if necessary.



PILOT SCREW REPLACEMENT

Leave the pilot screw(1) and limiter cap(2) in place during carburetor cleaning. Remove only if necessary for carburetor repair.Removal of the limiter cap requires breaking the pilot screw. A new pilot screw and limiter cap must be installed.

When the limiter cap has been broken off, remove the broken pilot screw.



GOVERNOR SYSTEM

GOVERNOR SYSTEMGOVERNOR ARM/ CONTROL BASE ASSY. REMOVAL/ INSTALLATION

MANUAL OPERATION TYPE

Remove the following parts.

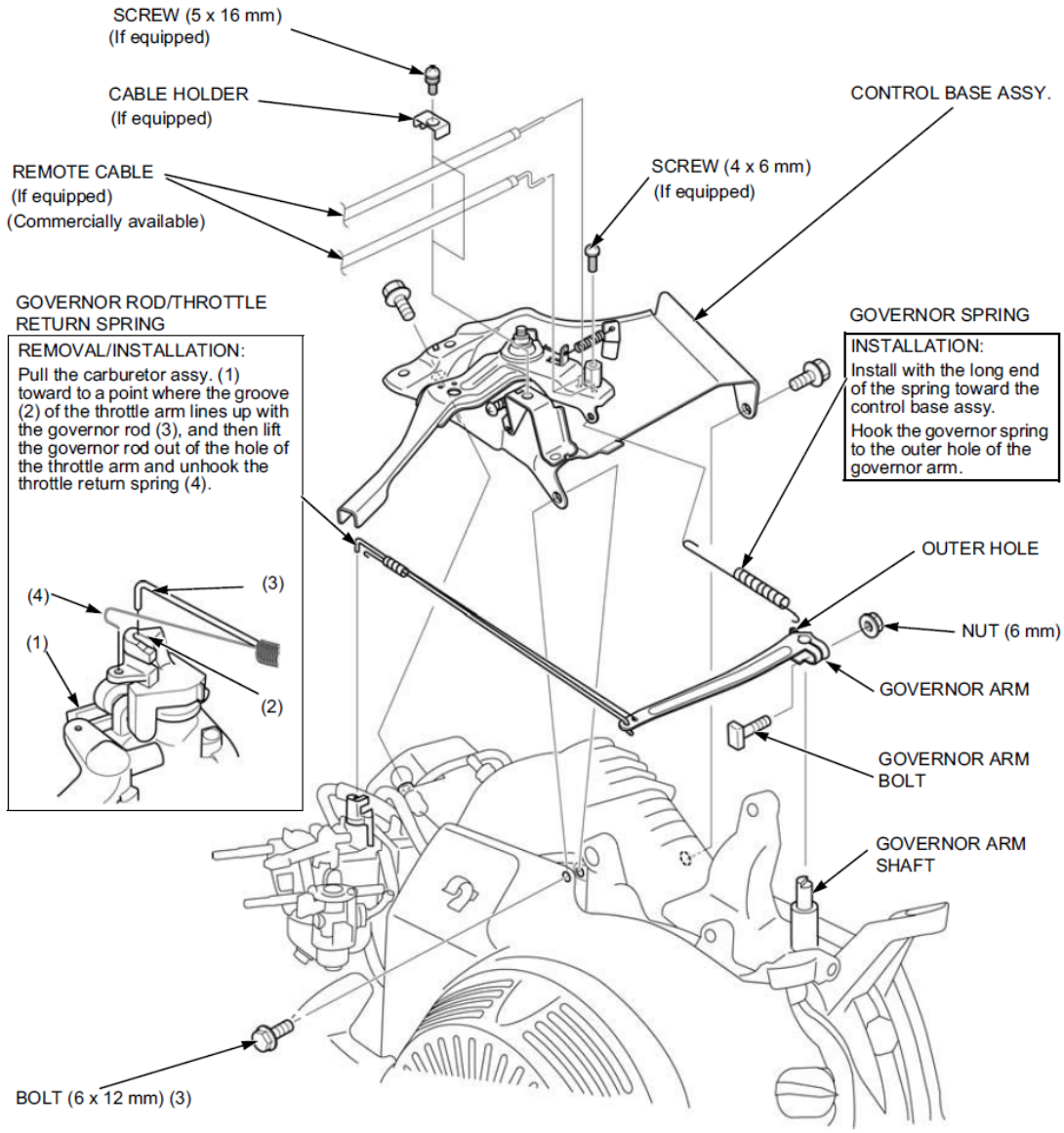
1.Air cleaner

2.Muffler

3.Fuel tank

4.Tube clamp

Installation is in the reverse of removal.Adjust the maximum speed.

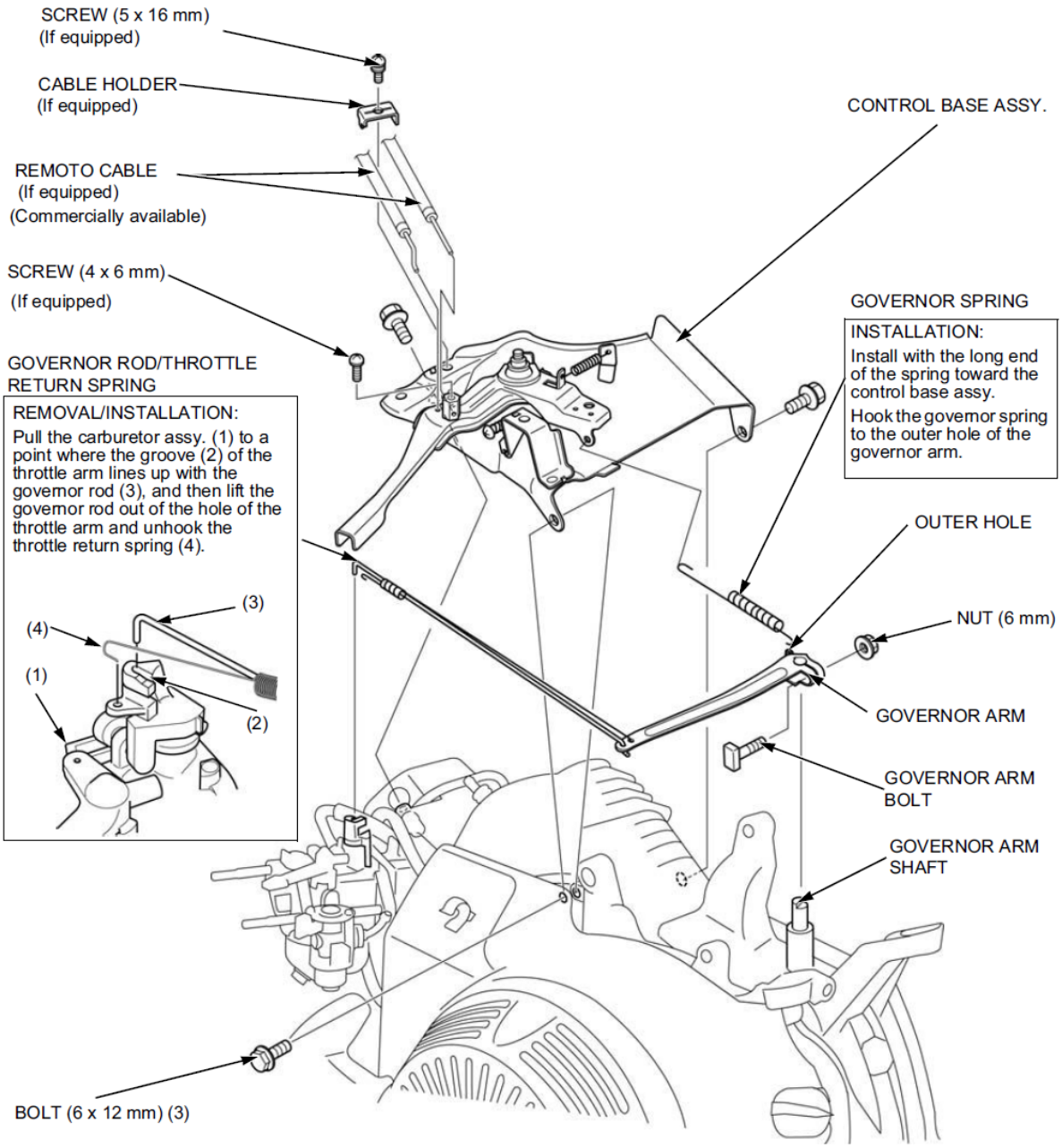


MANUAL OPERATION A TYPE

Remove the following parts.

1. Air cleaner
2. Muffler
3. Fuel tank
4. Tube clamp

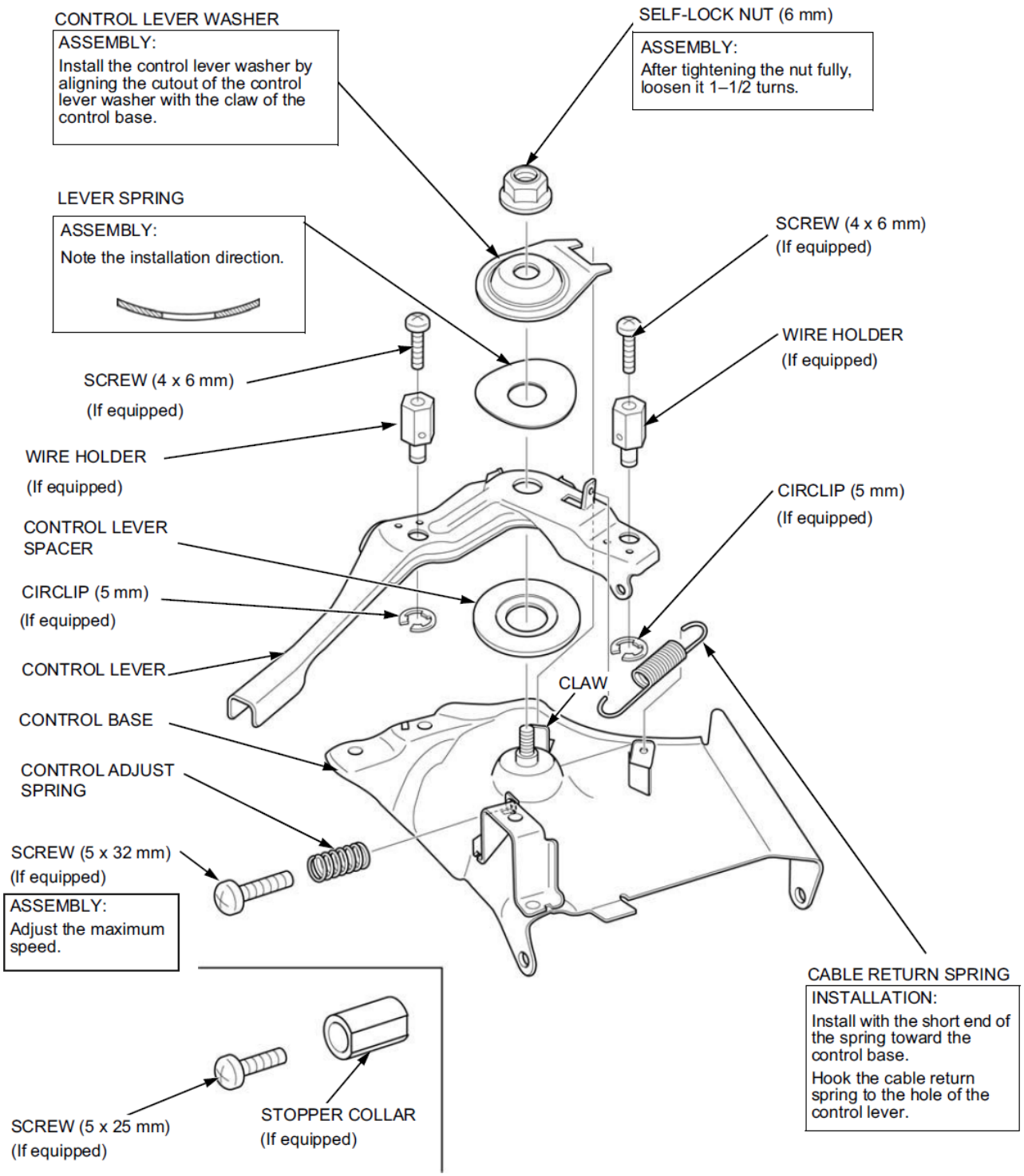
Installation is in the reverse of removal.Adjust the maximum speed.



CONTROL BASE ASSY. DISASSEMBLY/ ASSEMBLY

MANUAL OPERATION TYPE

Remove the control base assy.



MAXIMUM SPEED ADJUSTMENT

Remove the fuel tank.

Loosen the 6 mm nut (1) of the governor arm.

Turn the governor arm (2) counter clockwise to fully open the carburetor throttle valve (3).

Rotate the governor arm shaft (4) as far as it will go in the same direction the governor arm moved to open the throttle valve.

Tighten the 6 mm nut securely.

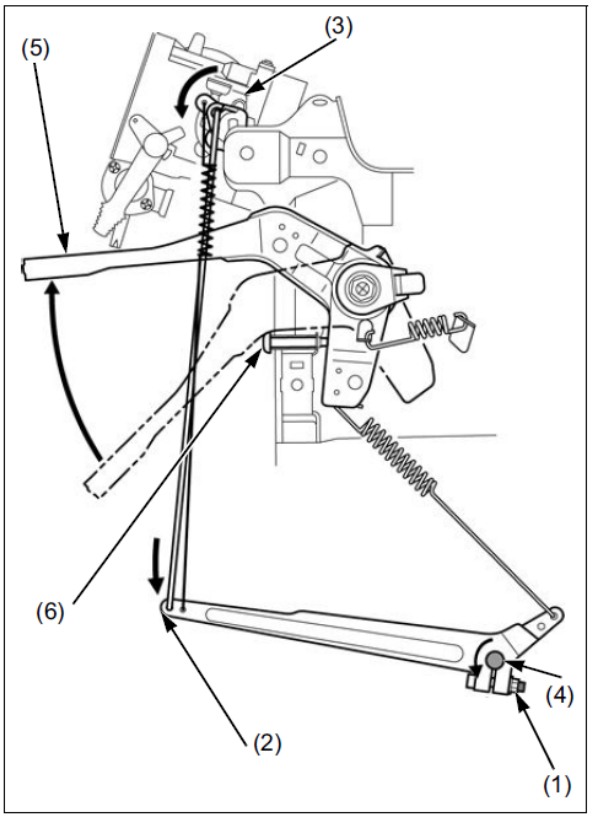
Install the fuel tank.

Start the engine and allow it to warm up to normal operating temperature.

Move the control lever (5) to run the engine at the specified maximum speed, and hold the control lever.

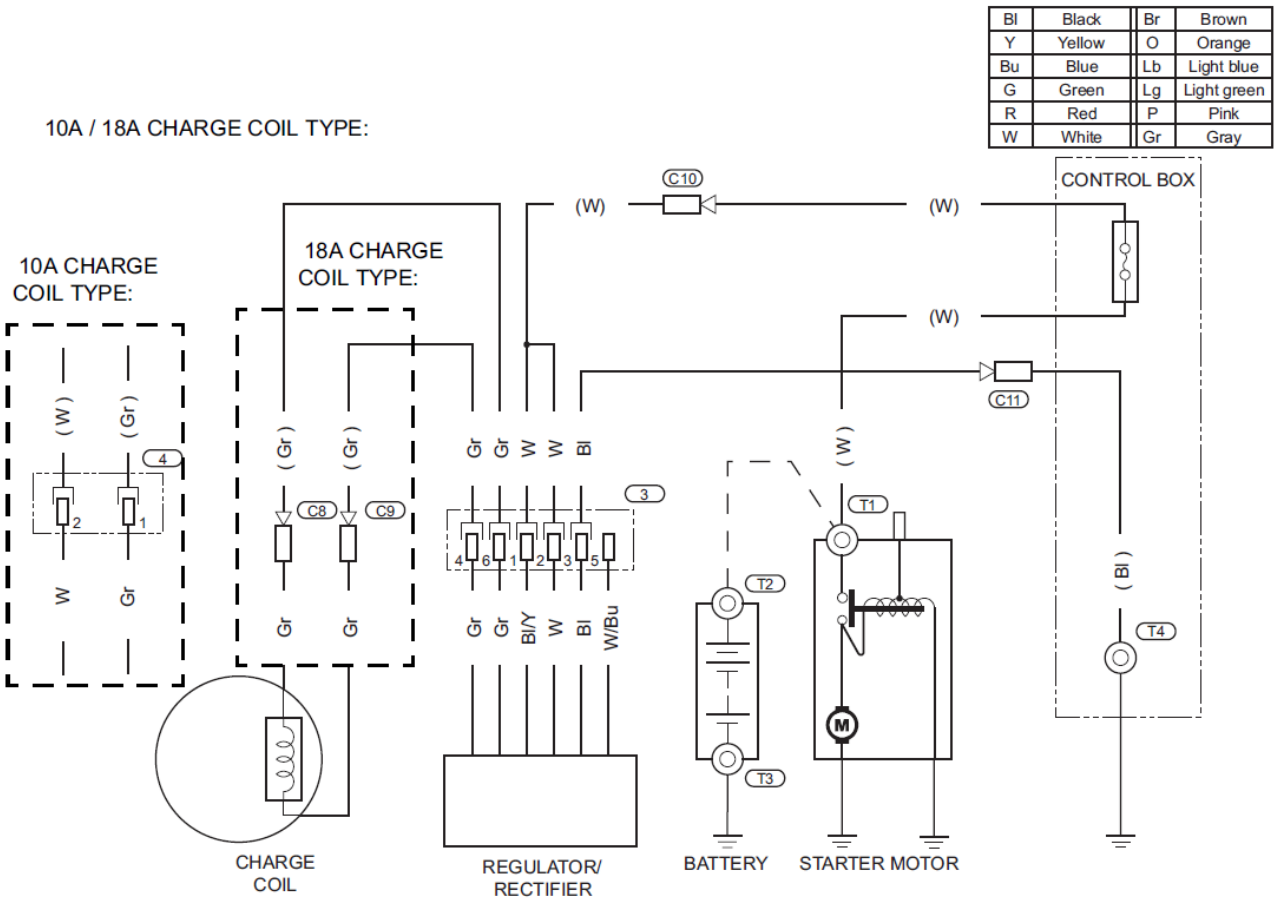
Turn the 5 x 32 mm screw or 5 x 25 mm (6) of the control to obtain the specified maximum speed.

MAXIMUM SPEED:3,850 ± 150 min-1 (rpm)



CHARGING SYSTEM

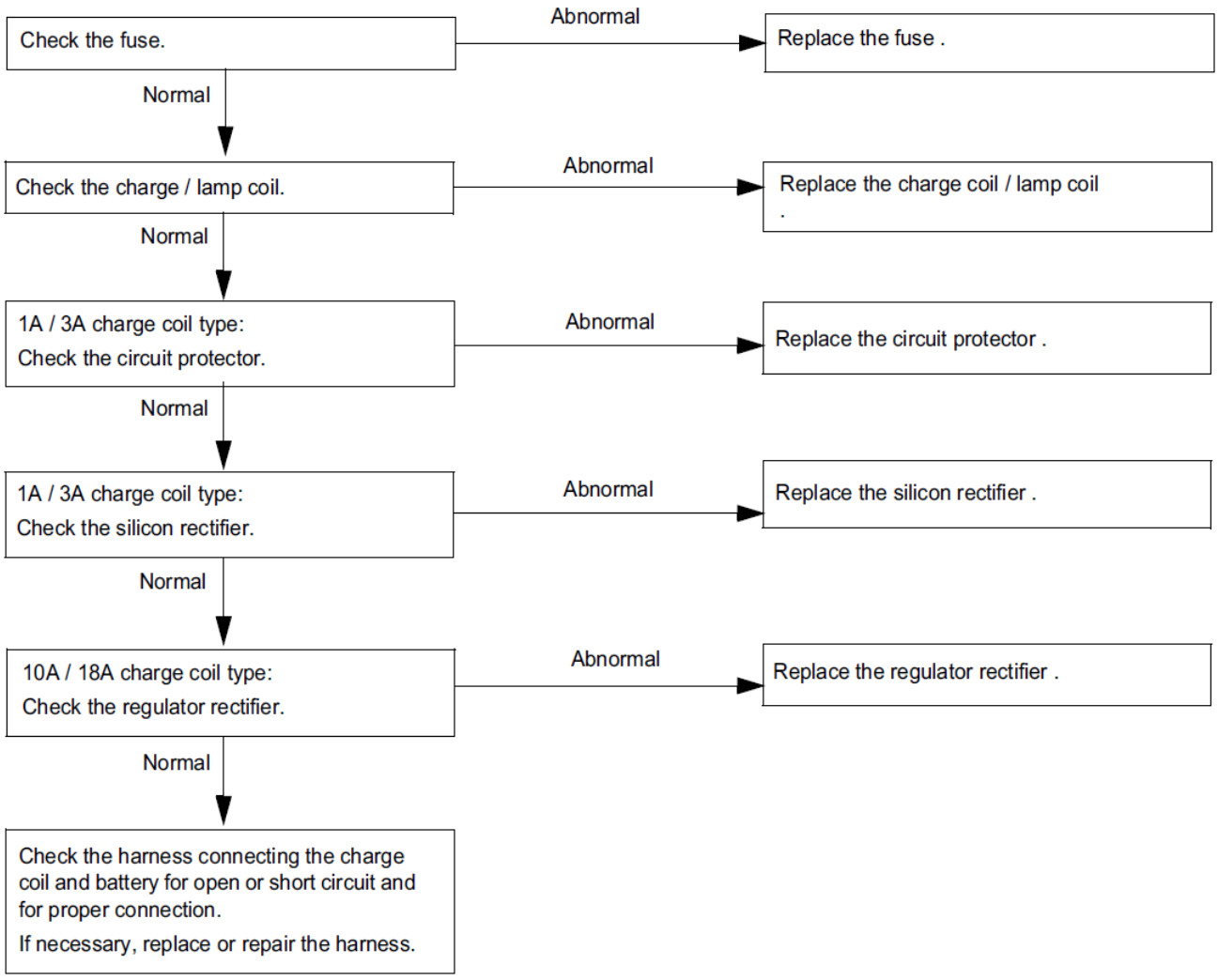
SYSTEM DIAGRAM



BEFORE TROUBLESHOOTING

- Use a known-good battery for troubleshooting.
- Check that the connectors are connected securely.
- Read the circuit tester's operation instructions carefully, and observe the instructions during inspection.
- Disconnect the battery cable before continuity inspection.

CHARGING SYSTEM TROUBLESHOOTING

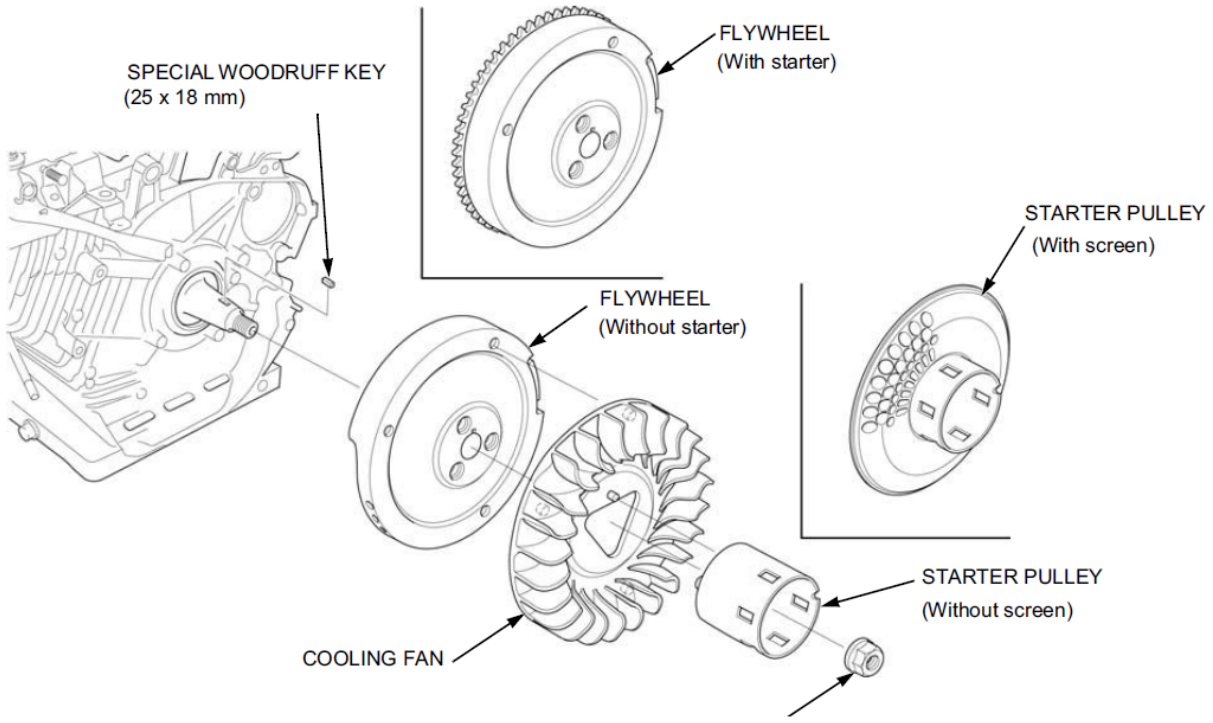


COOLING FAN/FLYWHEEL REMOVAL/ INSTALLATIONREMOVAL

Remove the following parts:

–Fan cover.

–Ignition coil.

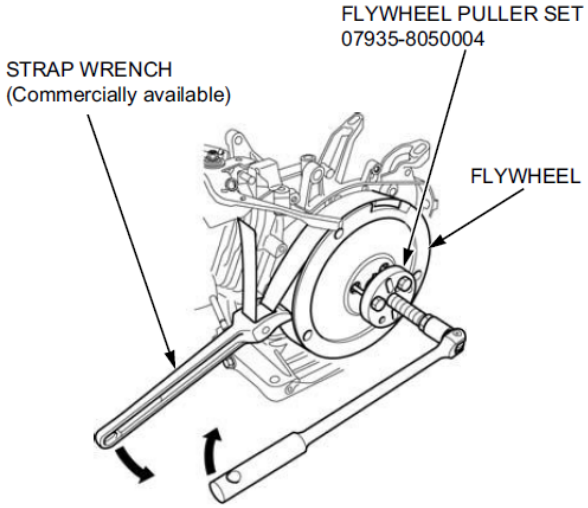


FLYWHEEL

REMOVAL:

Hold the flywheel with a commercially available strap wrench and use the special tool to remove the flywheel.

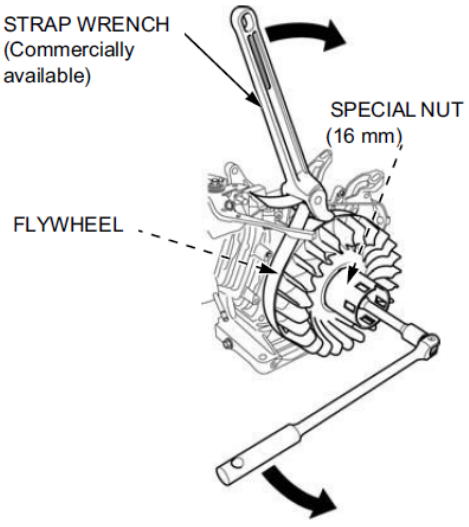
Do not hit the flywheel with a hammer.



REMOVAL:

Hold the flywheel with a commercially available strap wrench and remove the 16 mm special nut.

Take care not to damage the cooling fan.



INSTALLATION

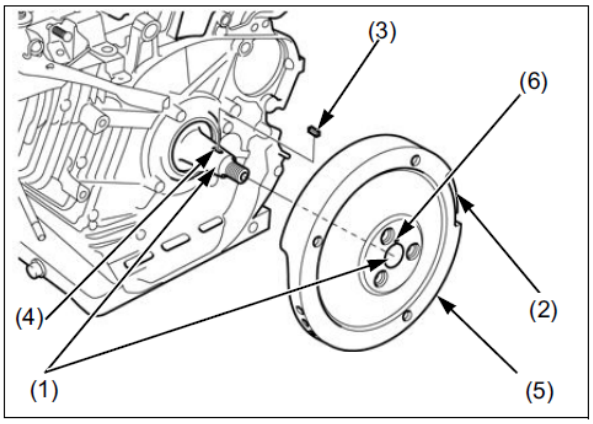
Clean the tapered parts (1) of dirt, oil, grease, and other foreign material before installation. Be sure there are nome tal parts or other foreign material on the magnet part(2) of the flywheel.

Set the 25 x 18 mm special woodruff key (3) in the key groove (4) of the crankshaft securely.

Set the flywheel (5) by aligning the key slot (6) with special woodruff key on the crankshaft.

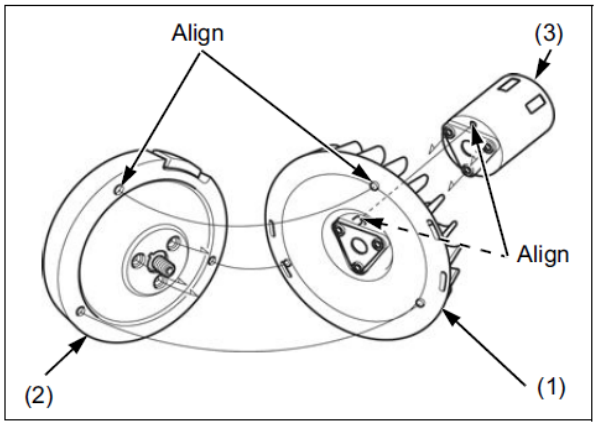
NOTICE

THE FLYWHEEL MAY PUSH THE 25 X 18 MM SPECIAL WOODRUFF KEY OUT OF ITS SLOT; CHECK AFTER INSTALLATION.



Attach the cooling fan (1) to the flywheel (2) by aligning the three projections of the cooling fan with the holes of the flywheel.

Attach the starter pulley (3) by aligning the hole of the pulley with the projection at the center of the cooling fan.



Apply a light coat of oil to the threads and the seating surface of the 16 mm special nut (1), and loosely tighten the nut.

Hold the flywheel (2) with a commercially available strap wrench (3), and tighten the 16 mm special nut to the specified torque.

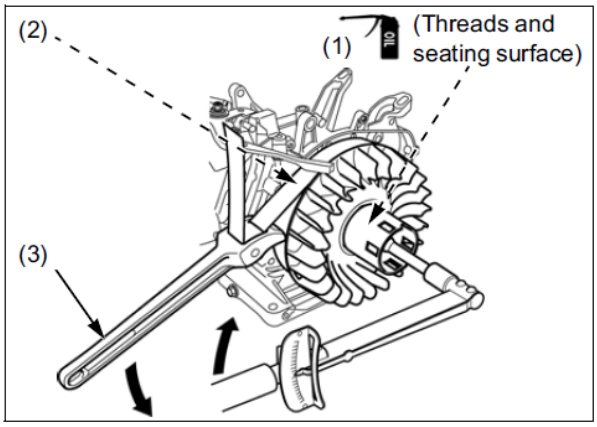
TORQUE:

170 N·m (17.3 kgf·m,125 lbf·ft)

Install the following parts:

–Ignition coil.

–Fan cover.



CHARGE / LAMP COIL (IF EQUIPPED)
REMOVAL/INSTALLATION

Remove the following parts:

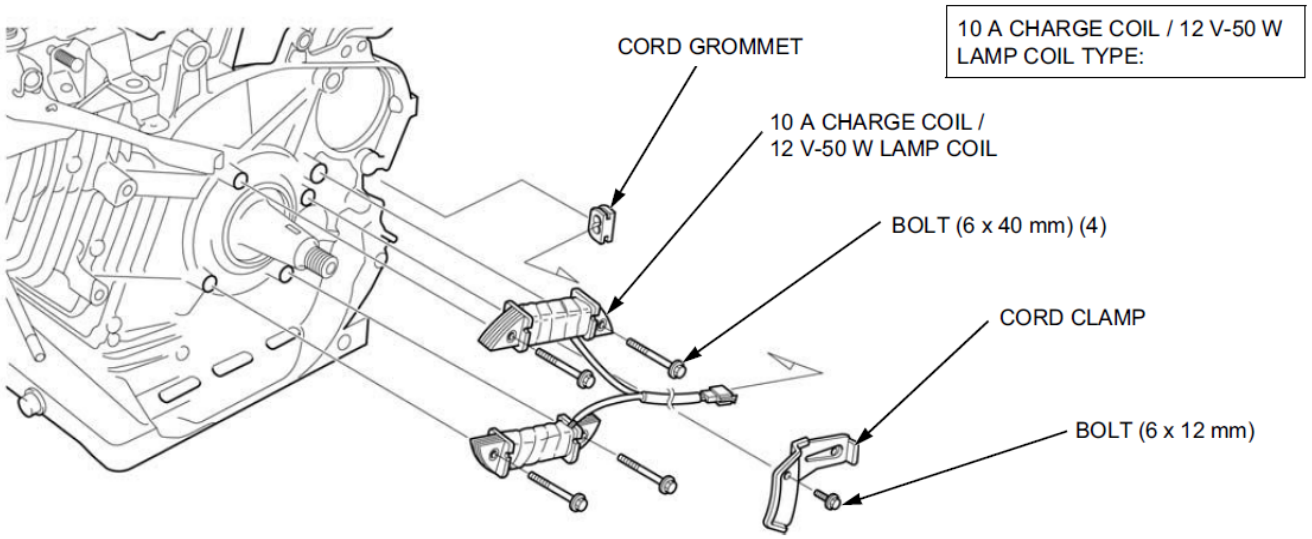
–Fan cover.

–Ignition coil.

–Remove the flywheel.

Remove the coil connector or connectors.Installation is in the reverse of removal.Install the cord clamp.

Adjust the governor.



CHARGE COIL INSPECTION

10 A / 18 A CHARGE COIL /12 V-15W /12 V-25 W LAMP COIL TYPE

Disconnect the charge/lamp coil connectors.

Measure the resistance between the terminals of the charge/lamp coil.

Resistance:

charge coil 10 A:0.16 - 0.24 .

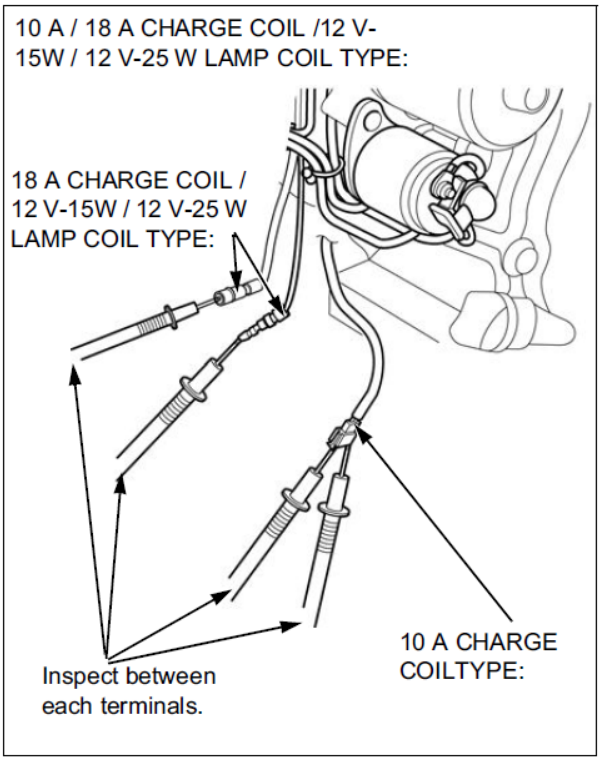
charge coil 18 A:0.10 - 0.30 .

lamp coil 12 V-15 W:1.04 - 1.56 .

lamp coil 12 V-25 W:0.30 - 0.46 .

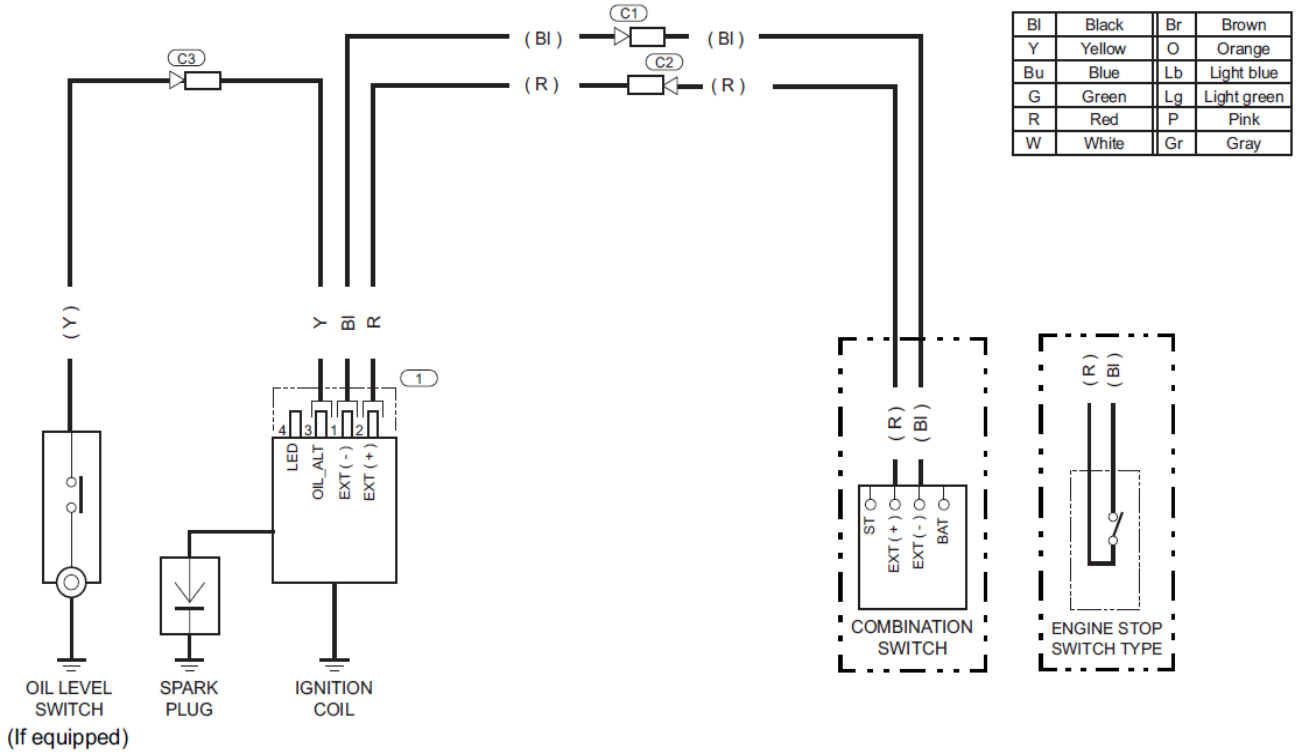
Check for continuity between each terminal and engine-ground.There should be no continuity.

- If the measured resistance is not within the range specification or if any wire has continuity to engine ground, replace the charge coil.
- If the resistance is good and the flywheel is ok, replace the charge coil and retest.



IGNITION SYSTEM

IGNITION SYSTEMSYSTEM DIAGRAM

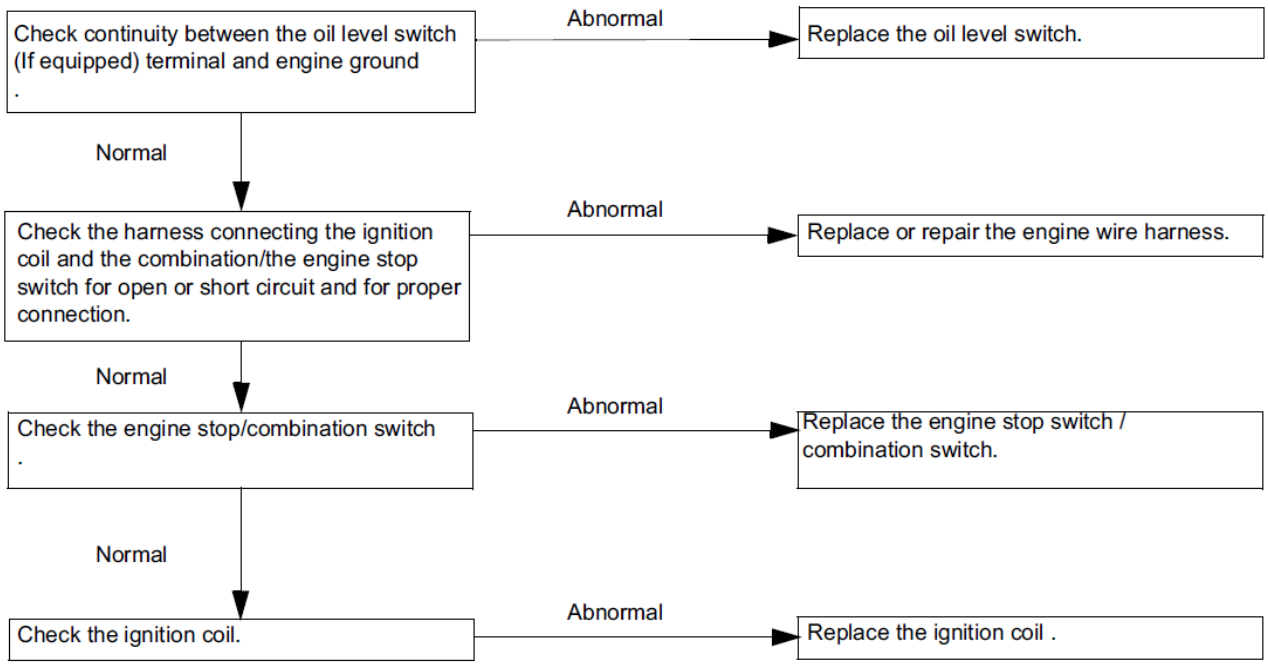


Bl	Black	Br	Brown
Y	Yellow	O	Orange
Bu	Blue	Lb	Light blue
G	Green	Lg	Light green
R	Red	P	Pink
W	White	Gr	Gray

IGNITION SYSTEM TROUBLESHOOTING

NO SPARK AT SPARK PLUG

- Check the engine oil level before troubleshooting.



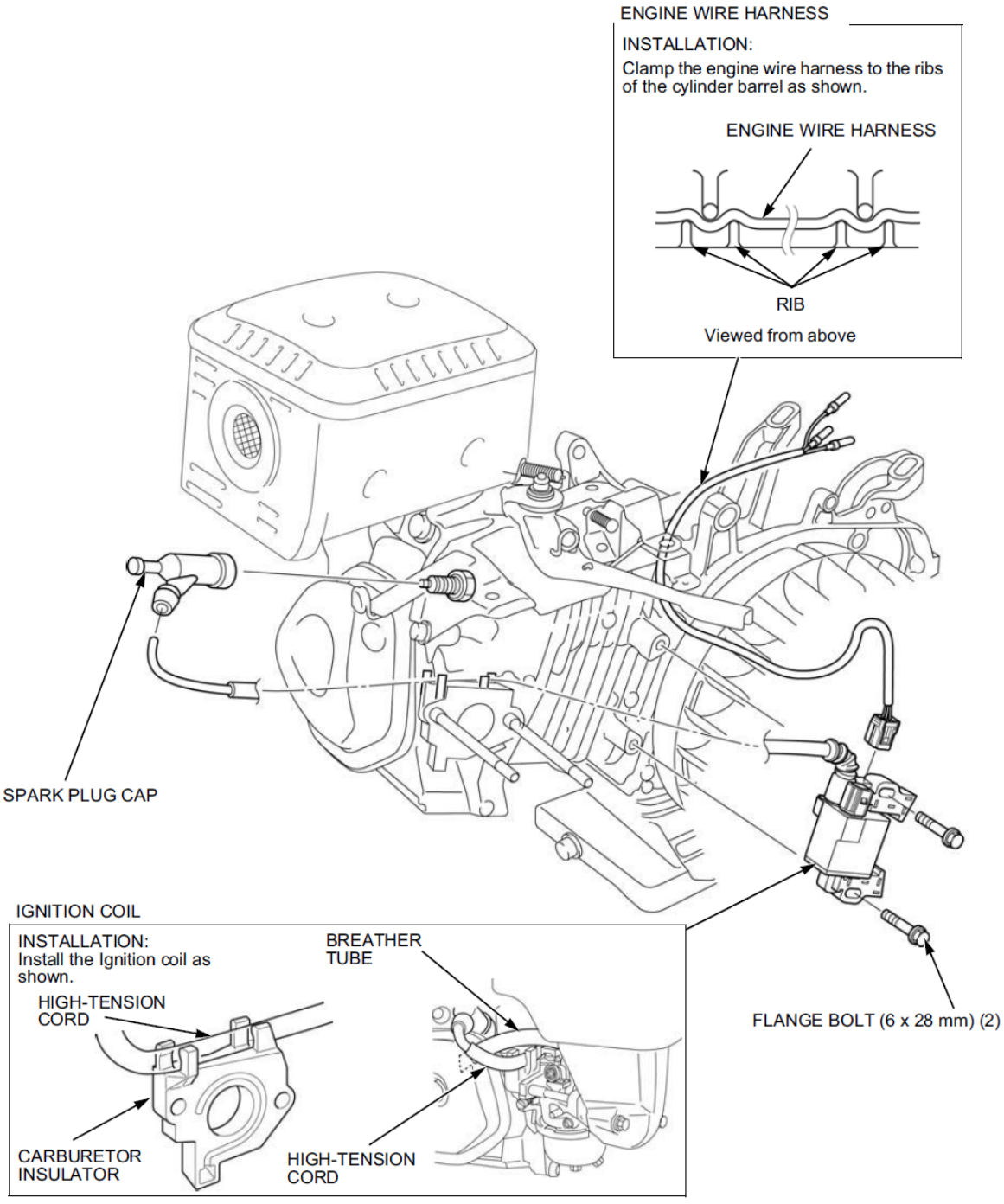
IGNITION COIL REMOVAL/INSTALLATION

Remove the following parts:

–Air cleaner

–Fuel tank

–Fan cover



IGNITION COIL INSTALLATION

Attach the ignition coil (1) and loosely tighten the two 6x 28 mm flange bolts (2).

Insert the thickness gauge (3) of proper thickness between the ignition coil and the flywheel.

IGNITION COIL AIR GAP:

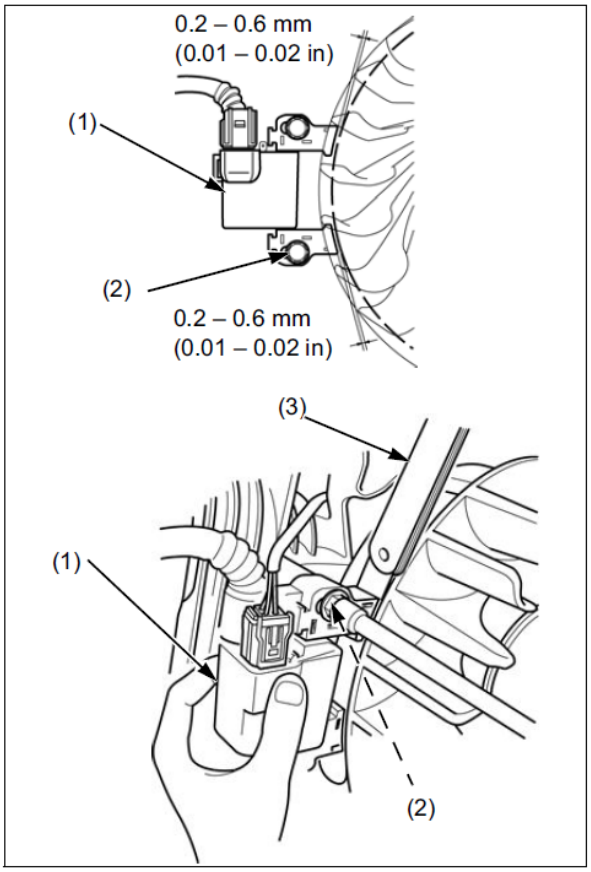
0.2 – 0.6 mm (0.01 – 0.02 in)

NOTICE

ADJUST THE IGNITION COIL AIR GAP EQUALLY ON BOTH SIDES.

Push the ignition coil firmly against the flywheel and tighten the 6 x 28 mm flange bolts securely.

Remove the thickness gauge.



SPARK TEST

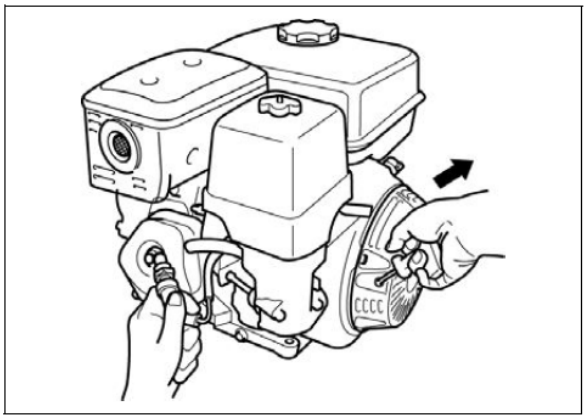
Inspect the following before spark test.

- Faulty spark plug
- Loose spark plug cap
- Water in the spark plug cap (Leaking the ignition coil secondary voltage)
- Loose ignition coil connector.

Disconnect the spark plug cap from the spark plug.

Connect a known-good spark plug to the spark plug cap and ground the spark plug to the cylinder head.

Crank the engine by pulling the recoil starter forcefully and check whether sparks jump across the electrode.

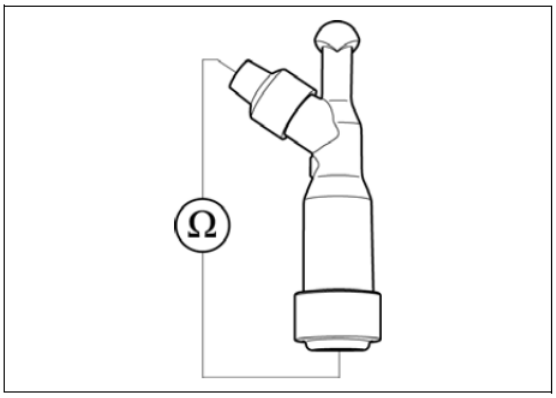


SPARK PLUG CAP INSPECTION

Remove the spark plug cap from the high tension cord.

Attach the tester probes to the terminal connected to the spark plug and terminal connected to the high-tension cord of the spark plug cap.

There should be a continuity between the terminals.If there is no continuity, replace the spark plug cap.

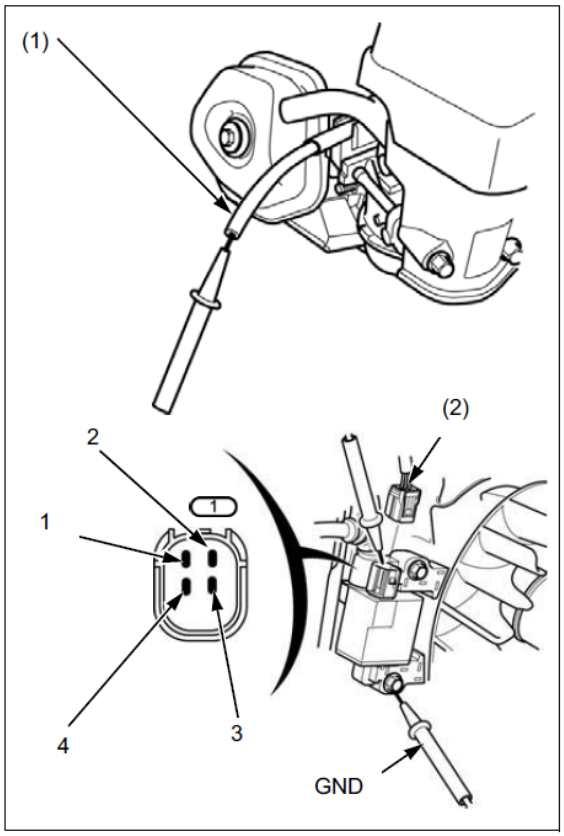


IGNITION COIL INSPECTION

Disconnect the spark plug cap from the spark plug.Remove the spark plug cap from the high tension cord(1).

Disconnect the engine wire harness connector (2) from the ignition coil.

Measure the resistance between the terminals and be sure that the measurements are within the specifications in the below.

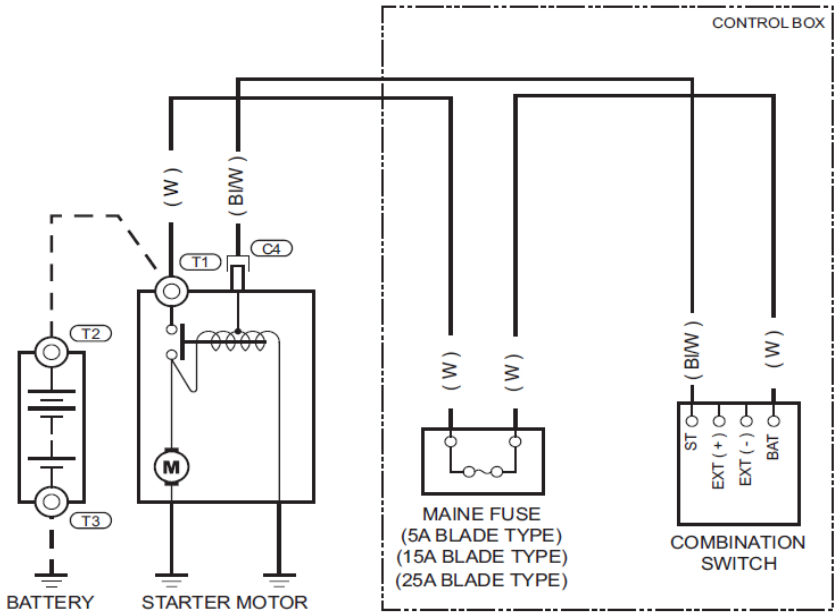


Unit: kΩ

			(+) Prove					
			GND	HIGH-TENSION CORD	Terminal number			
					EXT (+) 2	EXT (-) 1	LED 4	OIL ALT 3
(-) Probe	GND			6-11	1-10	∞	7-45	5-30
	HIGH-TENSION CORD		6-11		7-24	∞	14-72	12-47
	Terminal number	EXT (+) 2	5-14	10-26		∞	15-76	6-26
		EXT (-) 1	∞	∞	∞		∞	∞
		LED 4	∞	∞	∞	∞		∞
		OIL ALT 3	∞	∞	∞	∞	∞	

STARTING SYSTEM

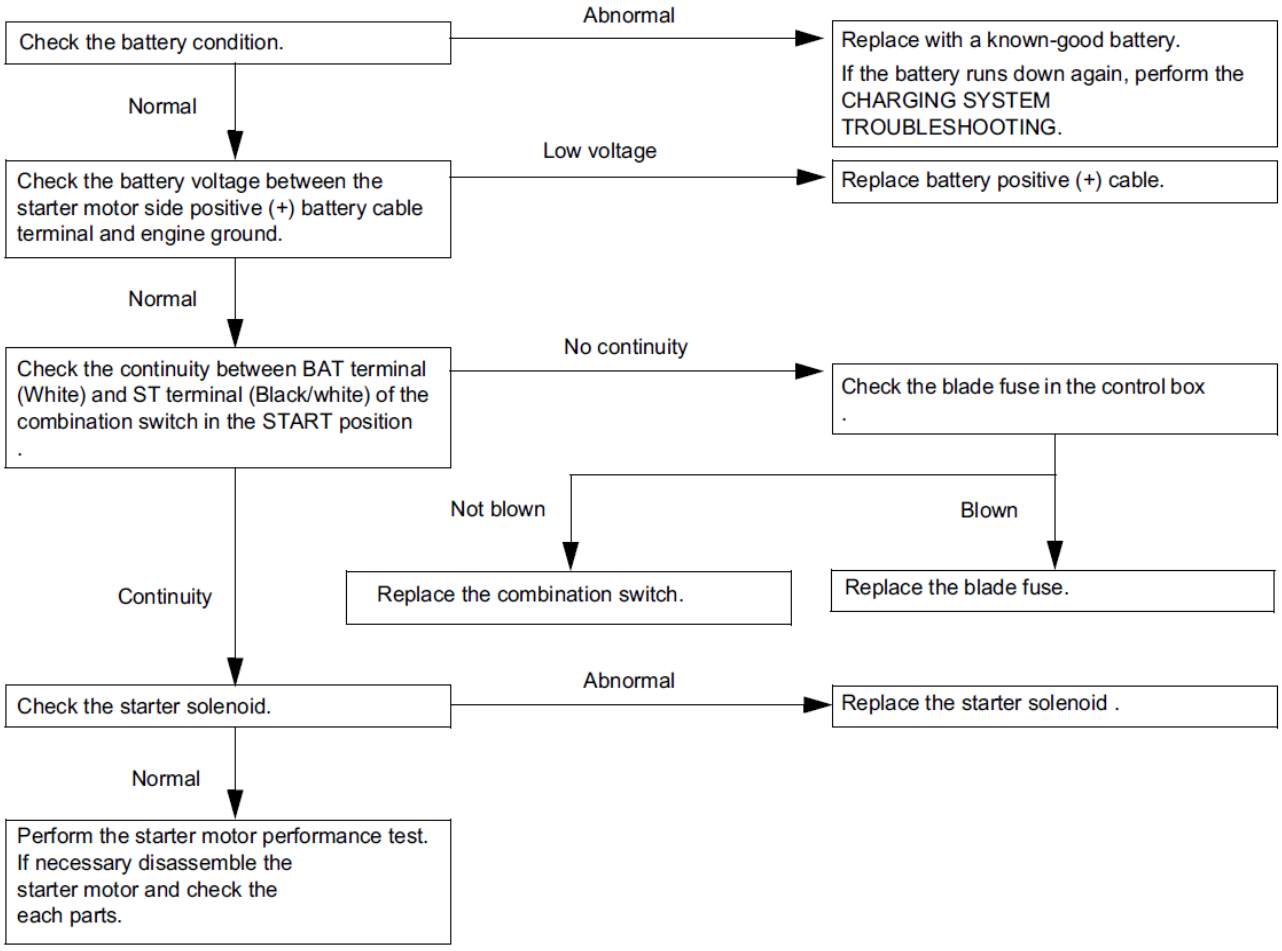
SYSTEM DIAGRAM



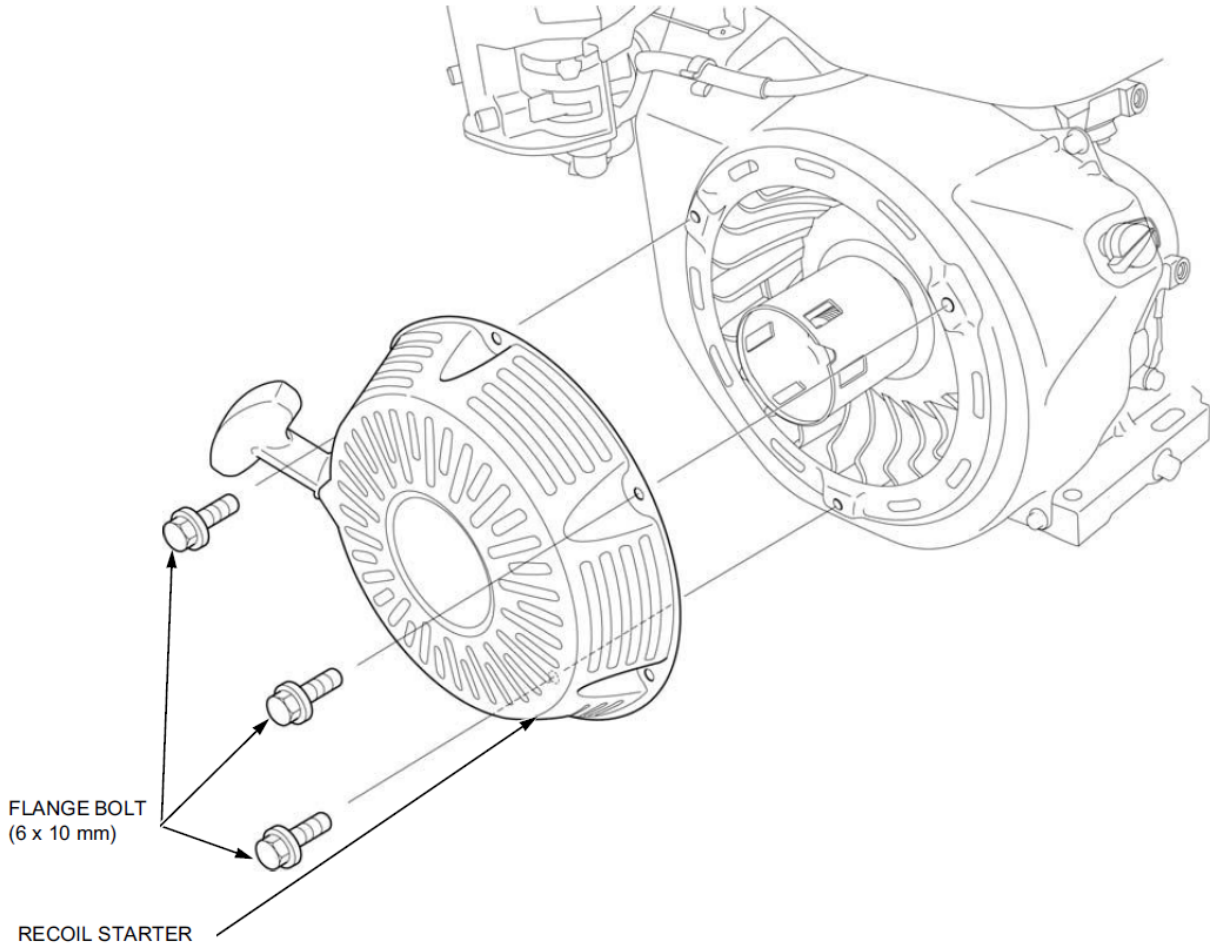
Bl	Black	Br	Brown
Y	Yellow	O	Orange
Bu	Blue	Lb	Light blue
G	Green	Lg	Light green
R	Red	P	Pink
W	White	Gr	Gray

STARTING SYSTEM TROUBLESHOOTING

STARTER MOTOR DOES NOT OPERATE

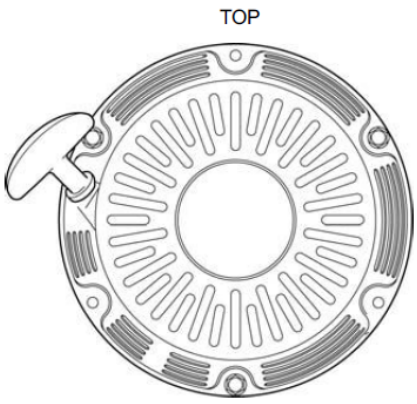


RECOIL STARTER REMOVAL/INSTALLATION

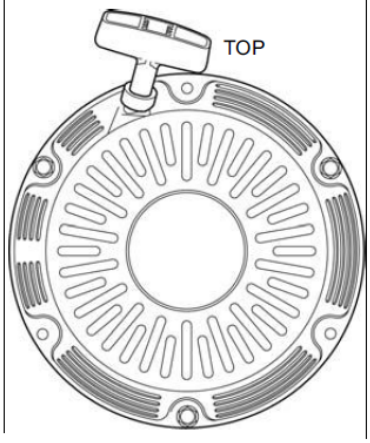


INSTALLATION:
Install the recoil starter as shown.

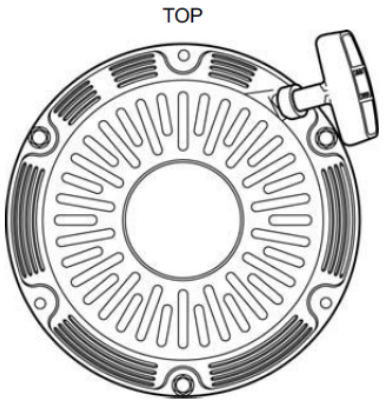
DUAL ELEMENT / CYCLONE AIR CLEANER TYPE:



LOW PROFILE AIR CLEANER TYPE:



QDW9 / QHB4 TYPE:

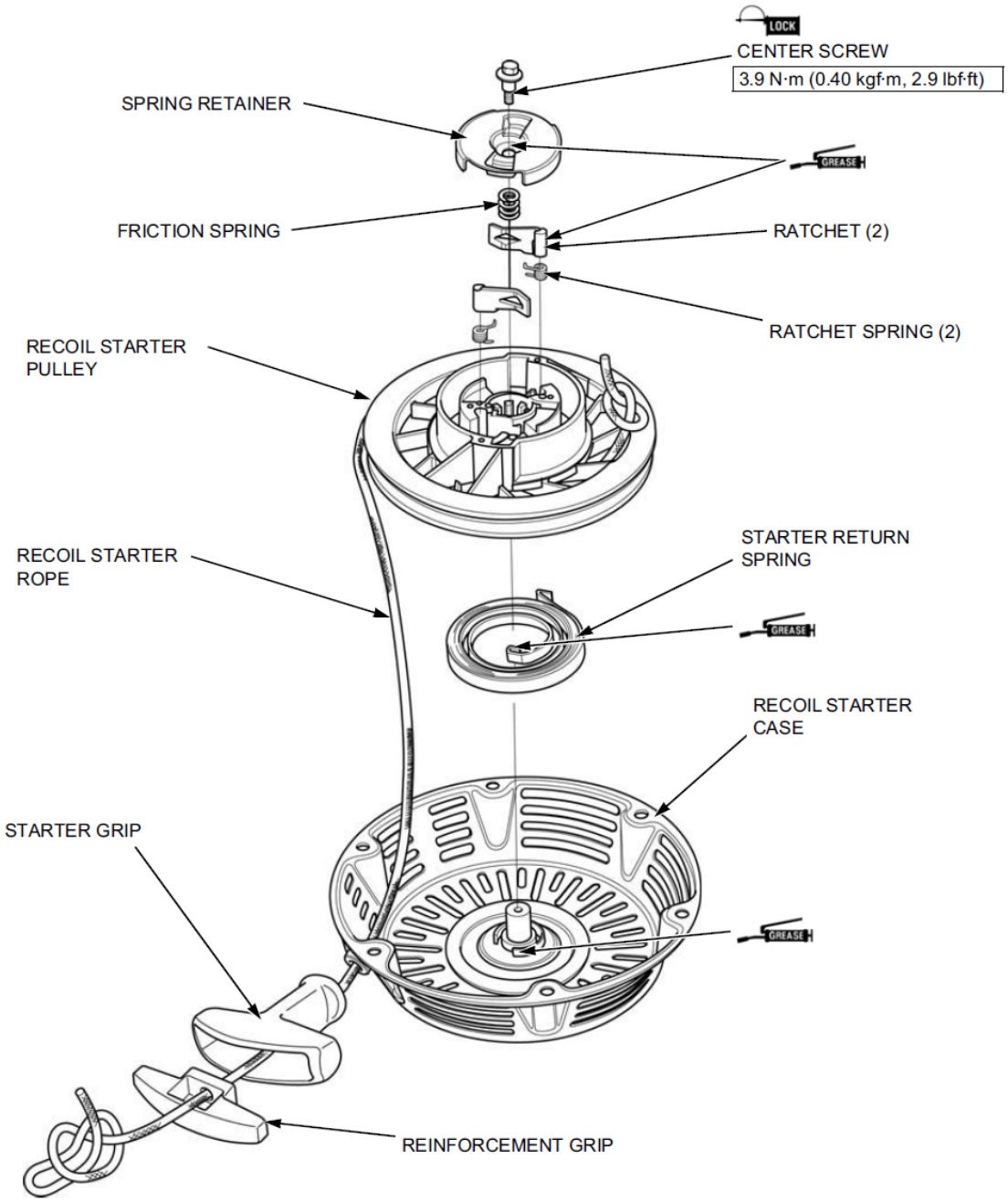


RECOIL STARTER DISASSEMBLY

⚠ CAUTION

TO PREVENT SERIOUS EYE INJURY, ALWAYS WEAR SAFETY GOGGLES OR OTHER EYE PROTECTION WHEN USING COMPRESSED AIR.

Remove the recoil starter.



RECOIL STARTER ASSEMBLY

⚠ CAUTION

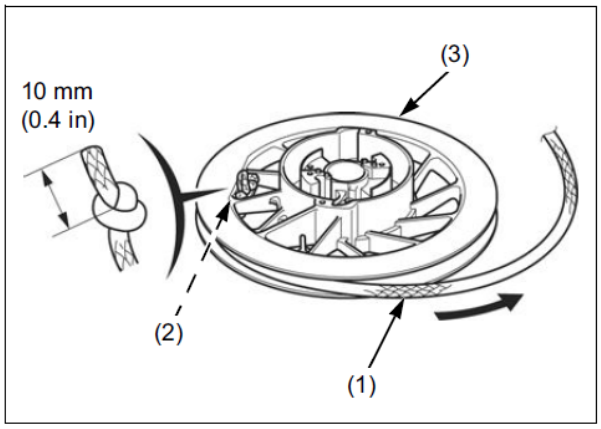
TO PREVENT SERIOUS EYE INJURY, ALWAYS WEAR SAFETY GOGGLES OR OTHER EYE PROTECTION WHEN USING COMPRESSED AIR.

Pass the recoil starter rope (1) through the hole (2) of the recoil starterpulley (3), and then tie the rope as shown.

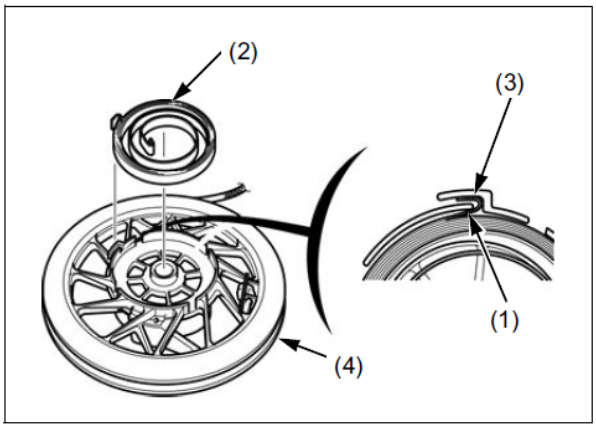
NOTICE

BEFORE INSTALLING THE RECOIL STARTER ROPE, CHECK FOR FRAY OR WEAR.

Wind the recoil starter rope onto the recoil starter pulley counterclockwise.

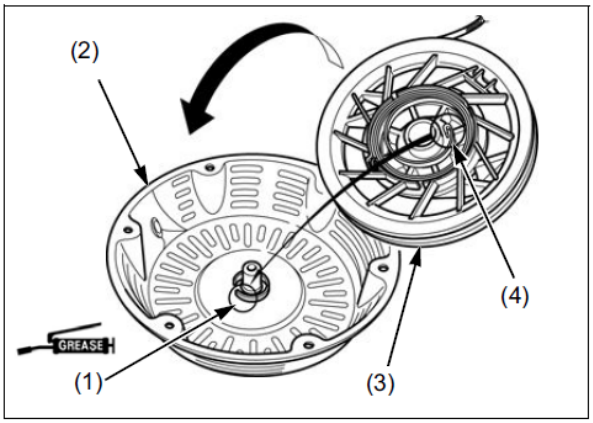


Hook the outer hook (1) of the starter return spring (2) to the groove (3) of the recoil starter pulley (4), and then install the starter return spring by winding it.



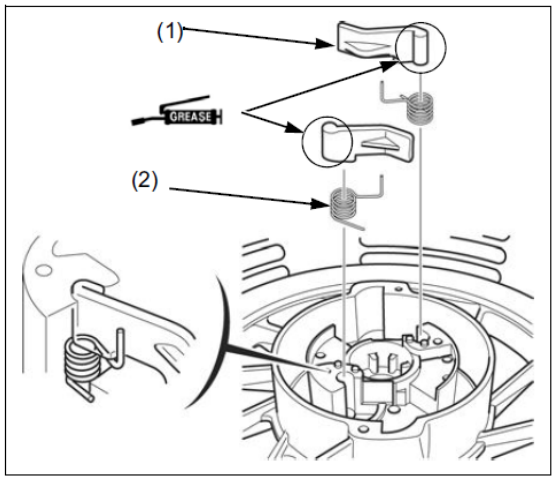
Apple grease to the cutout (1) of the recoil starter case (2).

Set the recoil starter pulley (3) to the recoil starter case by aligning the inner hook (4) of the starter return spring with the cutout of the recoil starter case.



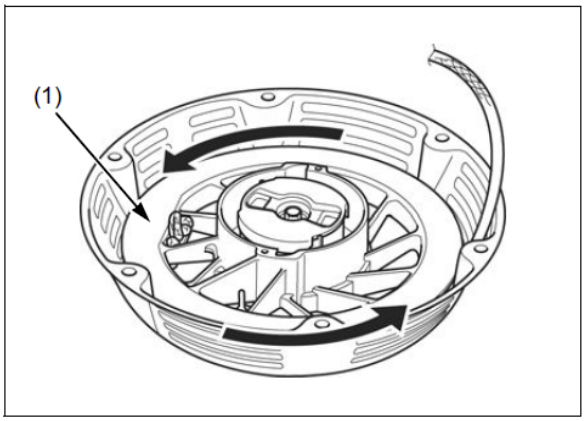
Apply grease to the two ratchets (1).

Install the two ratchets and the two ratchet springs (2)to the recoil starter pulley as shown.



Turn the recoil starter pulley (1) more than 2 turns counter-clockwise to preload the starter return spring.

Be sure to hold the recoil starter pulley.



Apply grease to the inside of the spring retainer (1).

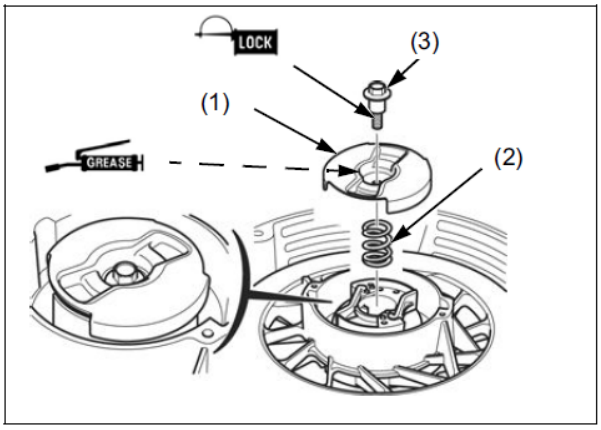
Set the friction spring (2) and the spring retainer to there coil starter pulley in the direction as shown.

Apply locking agent (Threebond® 2430 or equivalent) to the threads of the center screw (3).

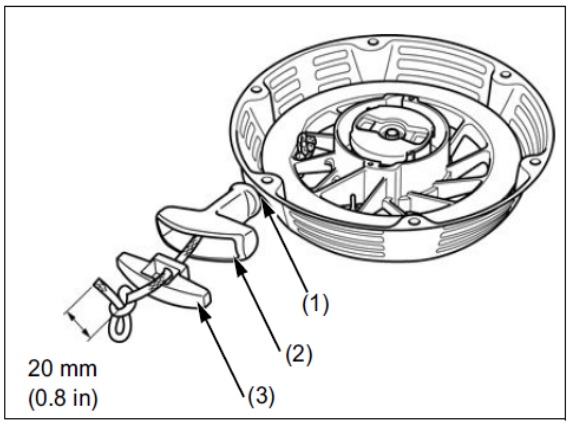
Hold the spring retainer and tighten the center screw tot he specified torque.

TORQUE:

3.9 N·m (0.40 kgf·m, 2.9 lbf·ft)



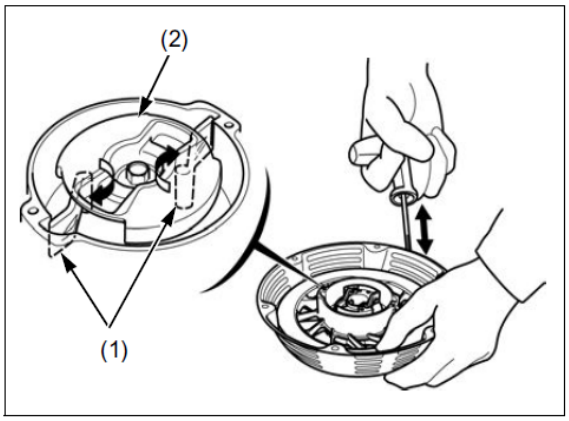
Pass the recoil starter rope through hole (1) of the recoils tarter case, the starter grip (2), and reinforcement grip(3), and then tie the rope as shown.Check the recoil starter operation.



RECOIL STARTER INSPECTION

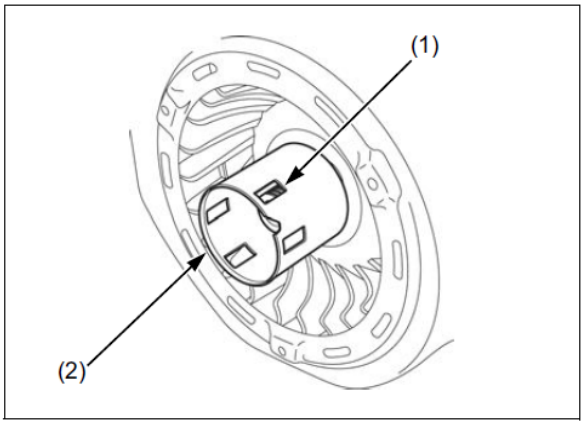
RECOIL STARTER OPERATION

Remove the recoil starter (page 10-3).Pull the starter grip several times to inspect that the ratchets (1) are operated properly (the ratchet ends come out from the spring retainer (2).



STARTER PULLEY

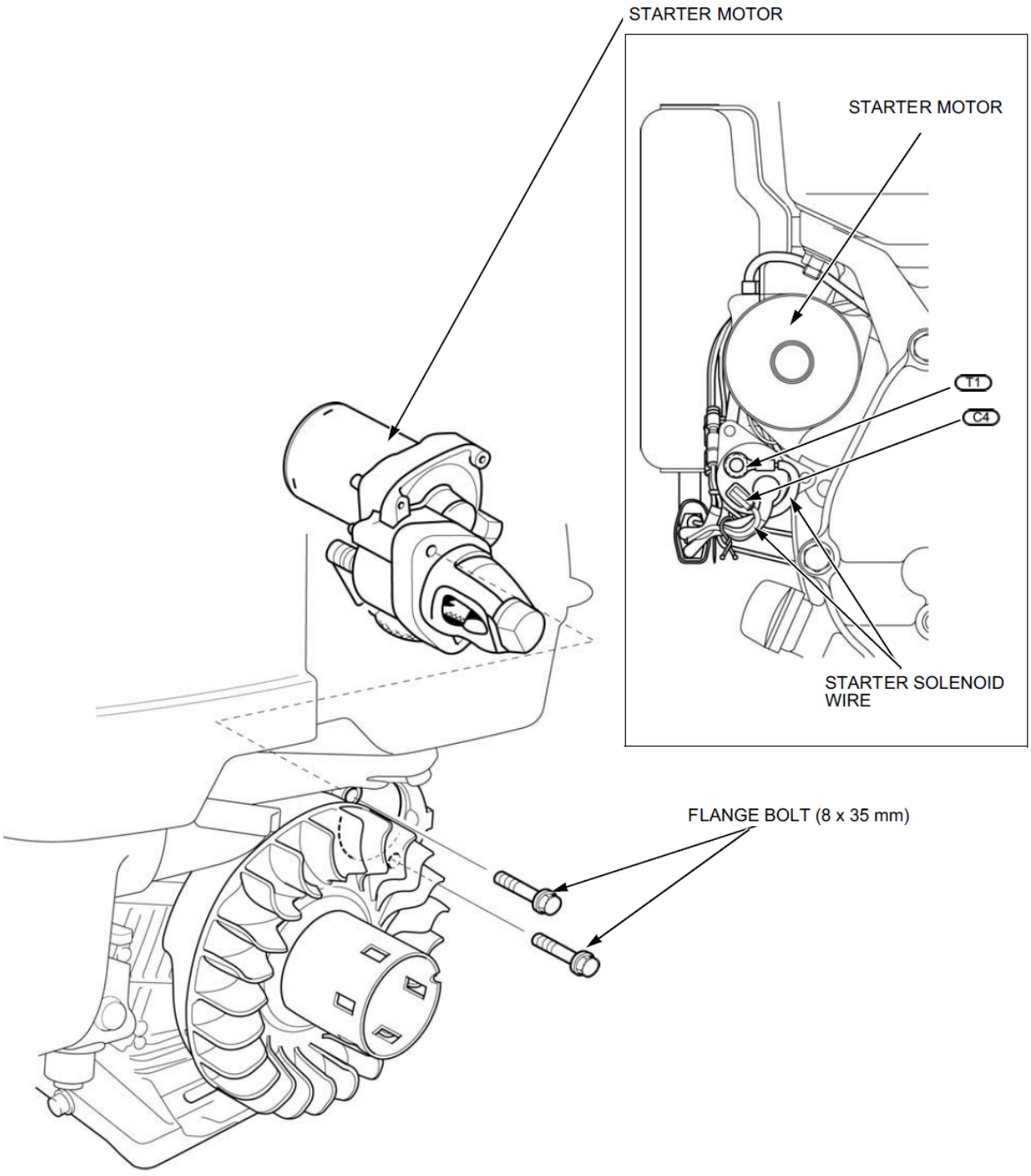
Remove the recoil starter (page 10-3).Inspect the square holes (1) of the starter pulley (2) for deformation.



STARTER MOTOR REMOVAL/INSTALLATION

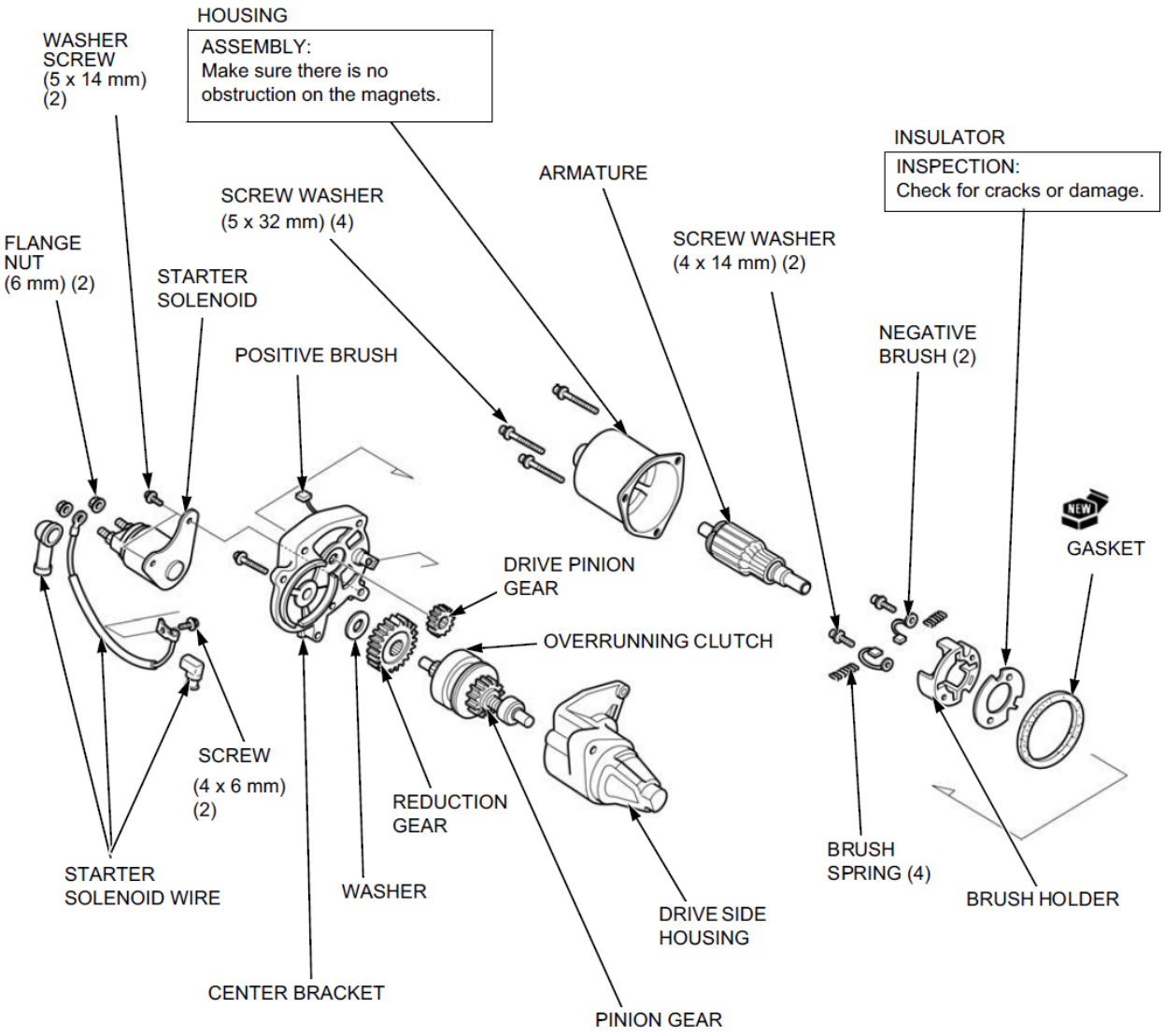
Disconnect the starter motor wires from the starter motor.

Remove the fan cover.



STARTER MOTOR DISASSEMBLY/ASSEMBLY

Remove the starter motor.

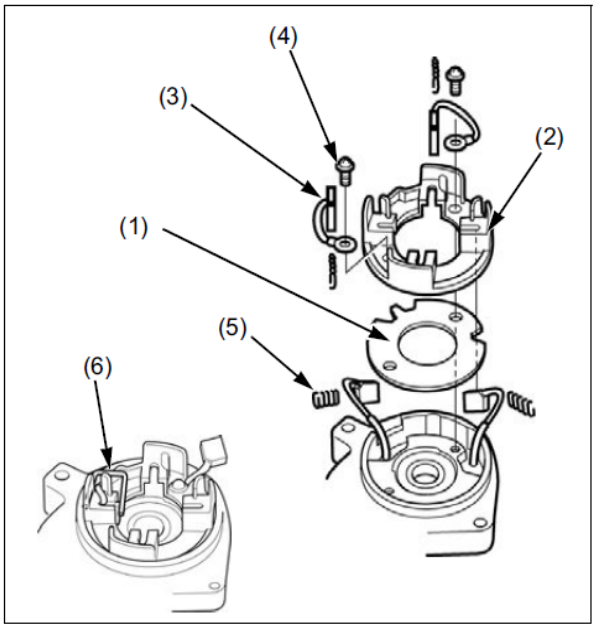


BRUSH HOLDER INSTALLATION

Note the installation direction.

Install the insulator (1), brush holder (2), negative brush terminals (3), and two 4 x 14 mm screws (4) to the center bracket as shown.

Install the brush springs (5) and brushes, and push the brushes in the holders with a suitable wire (6) so that they do not interfere with the commutator.



INSPECTION

PERFORMANCE TEST

Measure starter performance while cranking the engine.

STARTER MOTOR PERFORMANCE:

UNDER LOAD:CRANKING VOLTAGE:9.9 V

CRANKING CURRENT:103 A

ENGINE CRANKING SPEED:2,300 min-1 (rpm) min.

NO LOAD:CRANKING VOLTAGE:11.5 V

CRANKING CURRENT:31 A max.

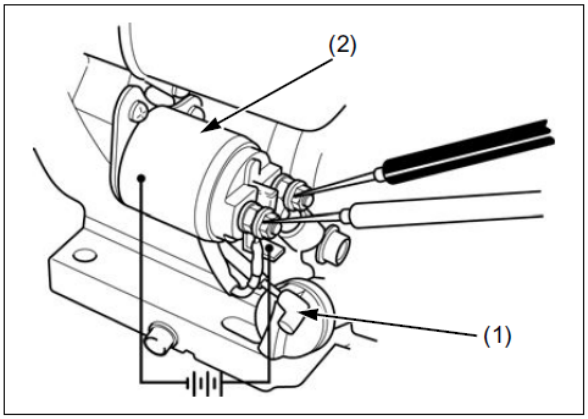
- To get accurate results, the test must be conducted in the normal ambient temperature.
- Battery: 55B24 (12 V 36 AH/5 HR)
- Battery cable: 15 sq. x 1.5 m (4.9 ft.) each for battery positive cable and battery negative cable.

If the measurement is out of specification, disassemble and inspect the starter motor.

STARTER SOLENOID

Remove the starter solenoid wire (1) from the starter solenoid (2).

Connect the positive (+) lead of a 12V battery to the solenoid terminal and the negative (-) lead to the solenoid body. Measure the resistance between the battery and starter motor terminals as shown.Continuity should exist when the battery is connected and not exist when the battery is disconnected.



BRUSH LENGTH

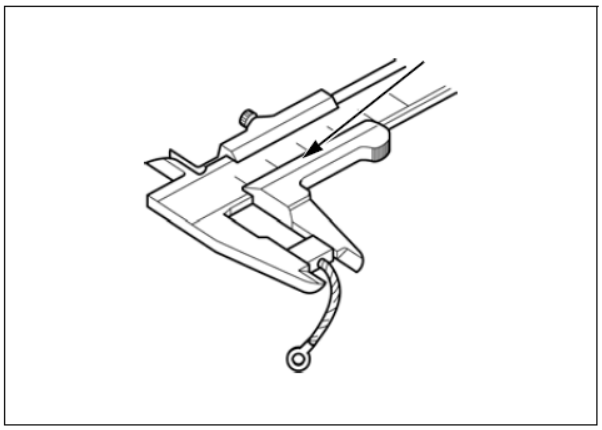
Measure the brush length.

If the negative brush length is less than the service limit, replace the brush and brush holder.

If the positive brush length is less than the service limit, replace the center bracket and brush holder.

STANDARD:7.0 mm (0.28 in)

SERVICE LIMIT:3.5 mm (0.14 in)



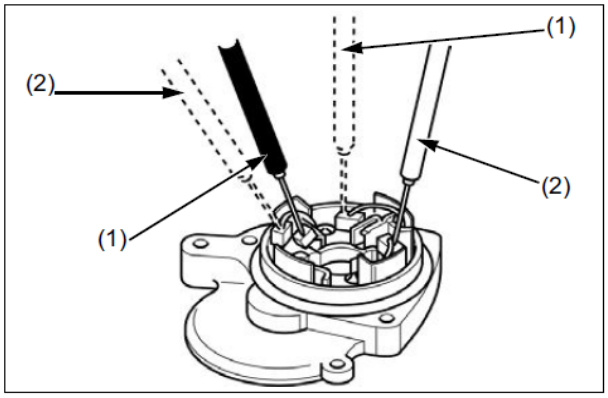
BRUSH CONTINUITY CHECK

Check for continuity between the positive (+) brushes(1) and negative (-) brushes (2).

There should be continuity between both the positive-brushes.There should be continuity between both the negativebrushes.There should be no continuity from either positive brush to either negative brush.

If the correct continuity of the positive (+) brushes is not obtained, replace the center bracket (page 10-9).

If the correct continuity of the negative (-) brushes is not obtain, replace the negative (-) brushes.



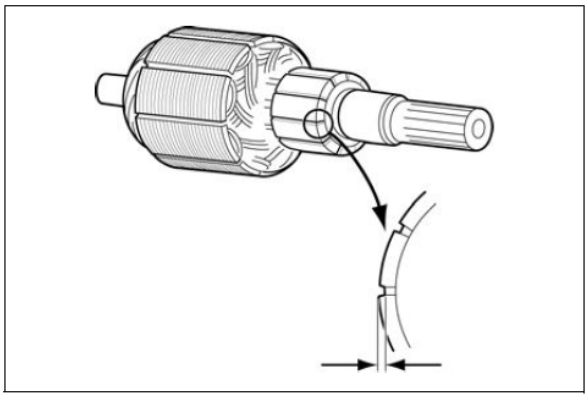
ARMATURE MICA DEPTH

Visually inspect the commutator surface for dust, rust, or other damage. If necessary, wipe it with a clean lint-free cloth. If rusted or damaged, dress with a fine emery cloth.

When the mica is clogged, or its depth is smaller than the service limit value, recut the grooves using a hacksaw blade or a small file.

STANDARD:1.0 mm (0.04 in)

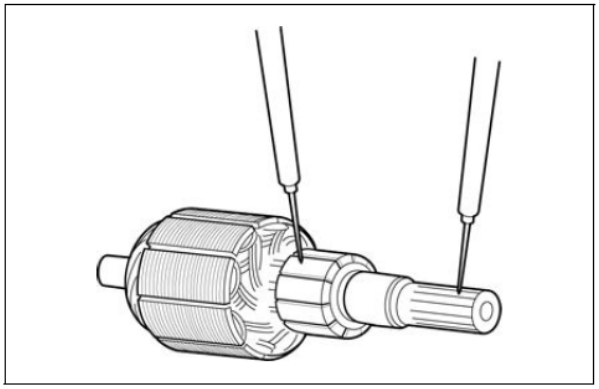
SERVICE LIMIT:0.2 mm (0.01 in)



ARMATURE CONTINUITY CHECK - COMMUTATOR TO SHAFT

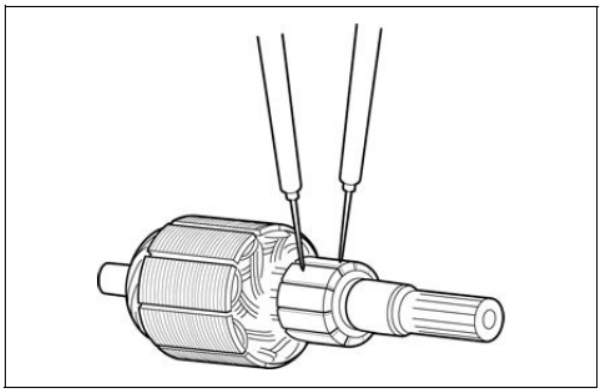
Check for continuity between the commutator and the armature shaft

Replace the armature if continuity exists between any of the commutator segments and the armature shaft.



ARMATURE CONTINUITY CHECK - COMMUTATOR SEGMENTS

Check for continuity between segments. If an open circuit (no continuity) exists between any two segments, replace the armature.



OVERRUNNING CLUTCH

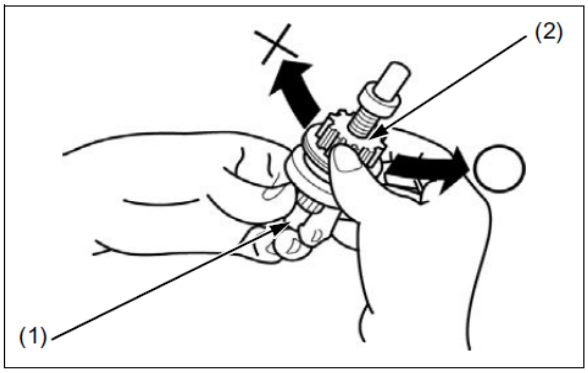
Check the pinion gear shaft (1) for smooth axial movement.

Apply oil or replace the overrunning clutch if necessary.

Check the pinion gear (2) operation by holding the pinion gear shaft and turning the pinion gear. The pinion gear should turn counterclockwise freely and should not turn clockwise.

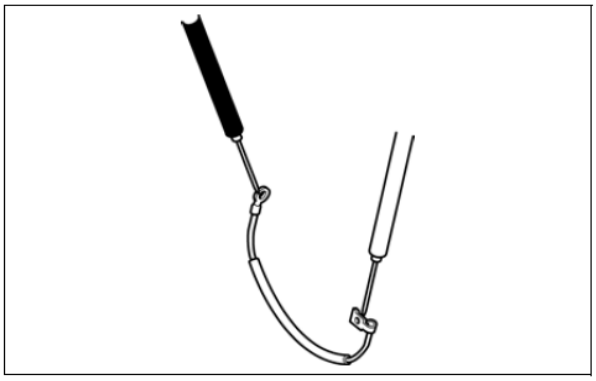
Check the pinion gear for wear or damage, and replace the overrunning clutch if necessary.

If the pinion gear is worn or damaged, the flywheel ring gear must be inspected.



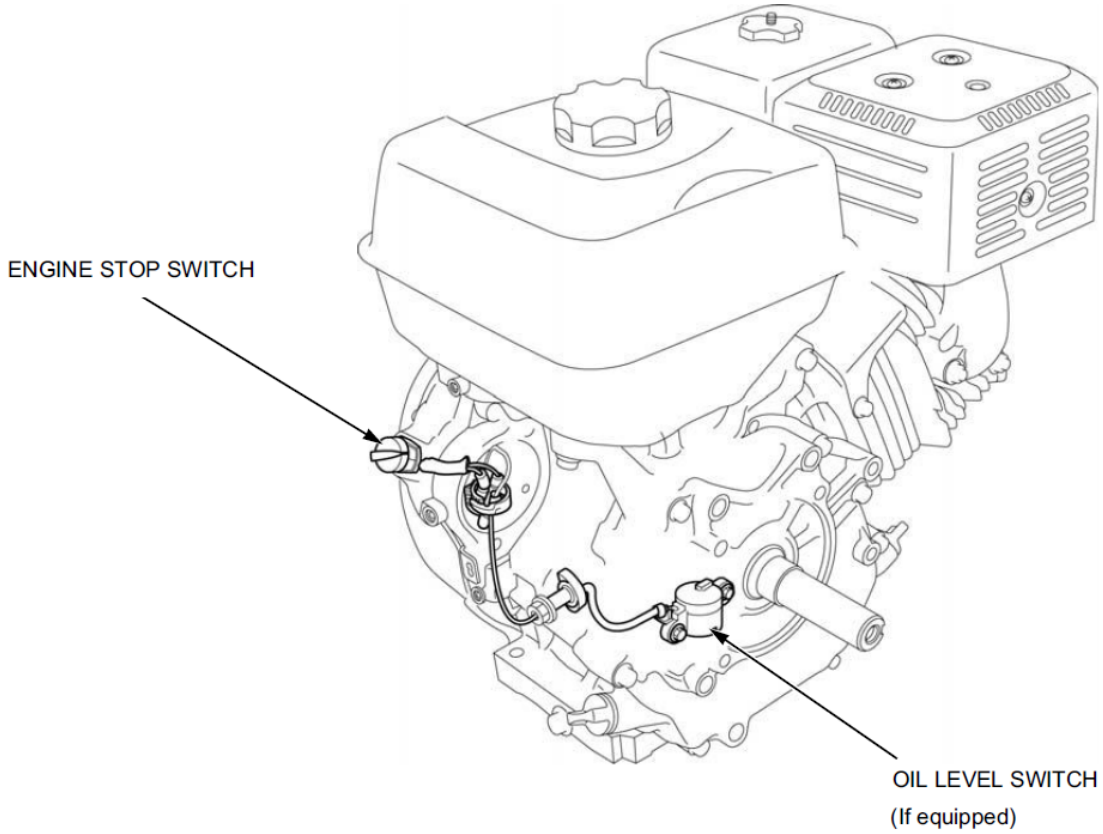
STARTER SOLENOID WIRE

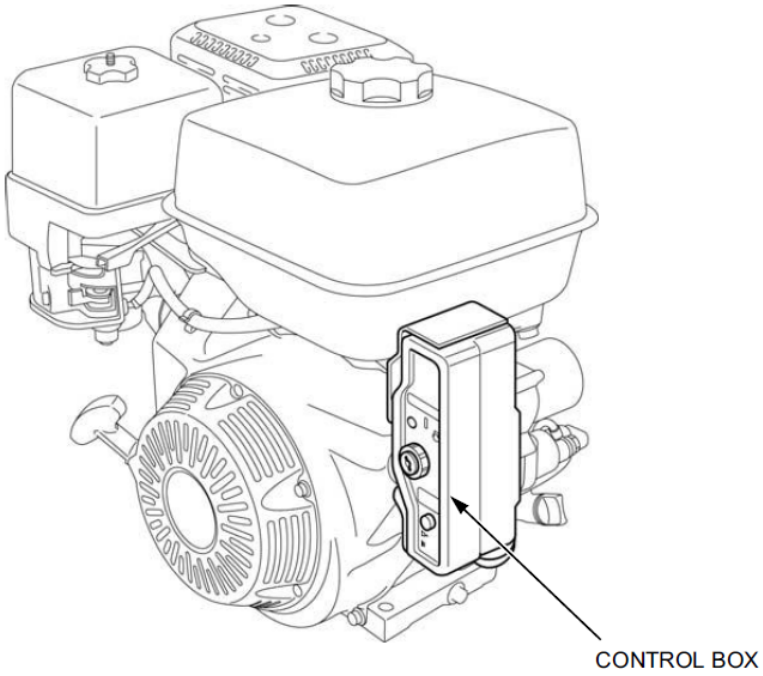
Check the starter solenoid wire for continuity.



OTHER ELECTRICAL

COMPONENT LOCATION

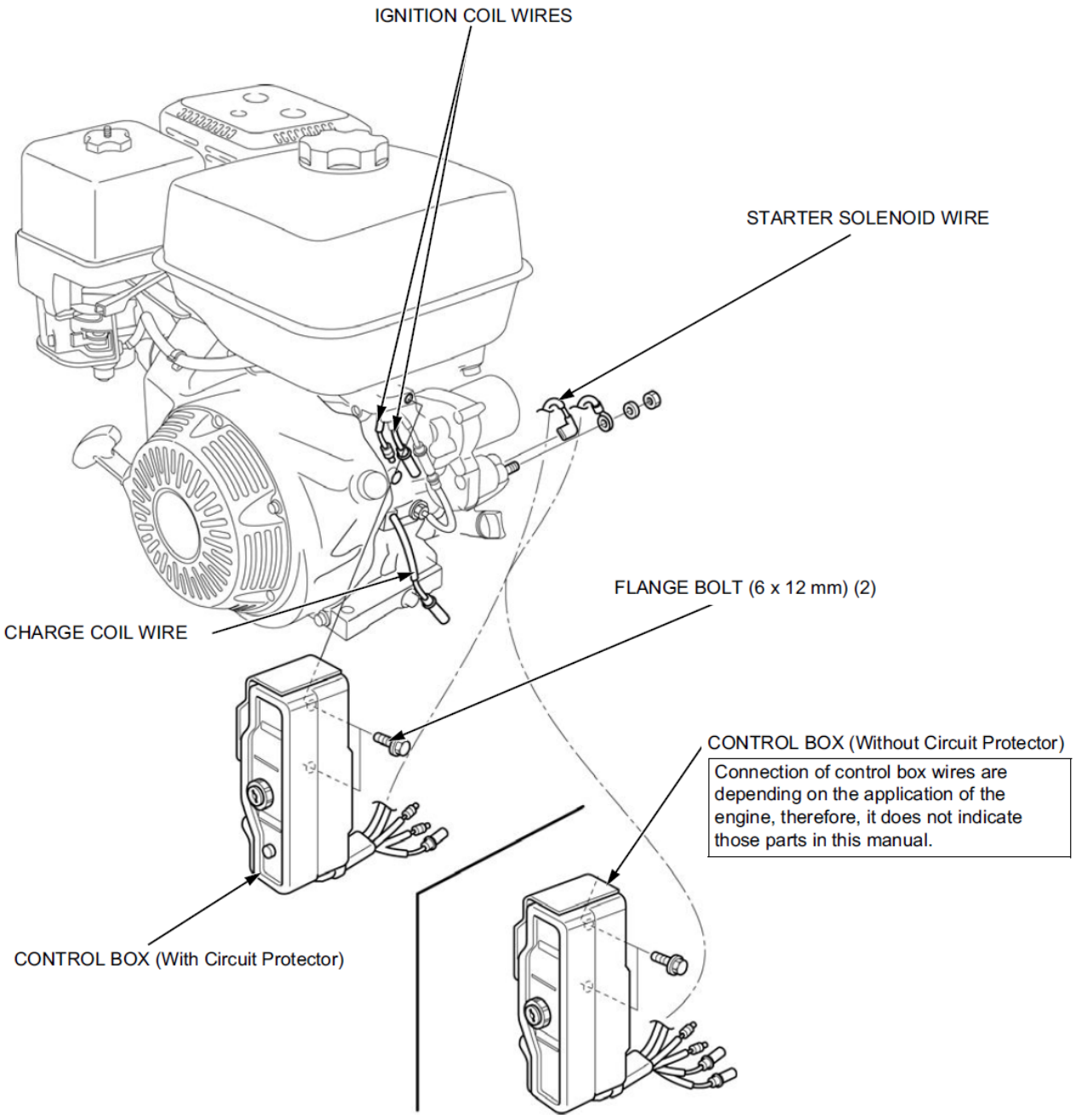




CONTROL BOX REMOVAL/INSTALLATION

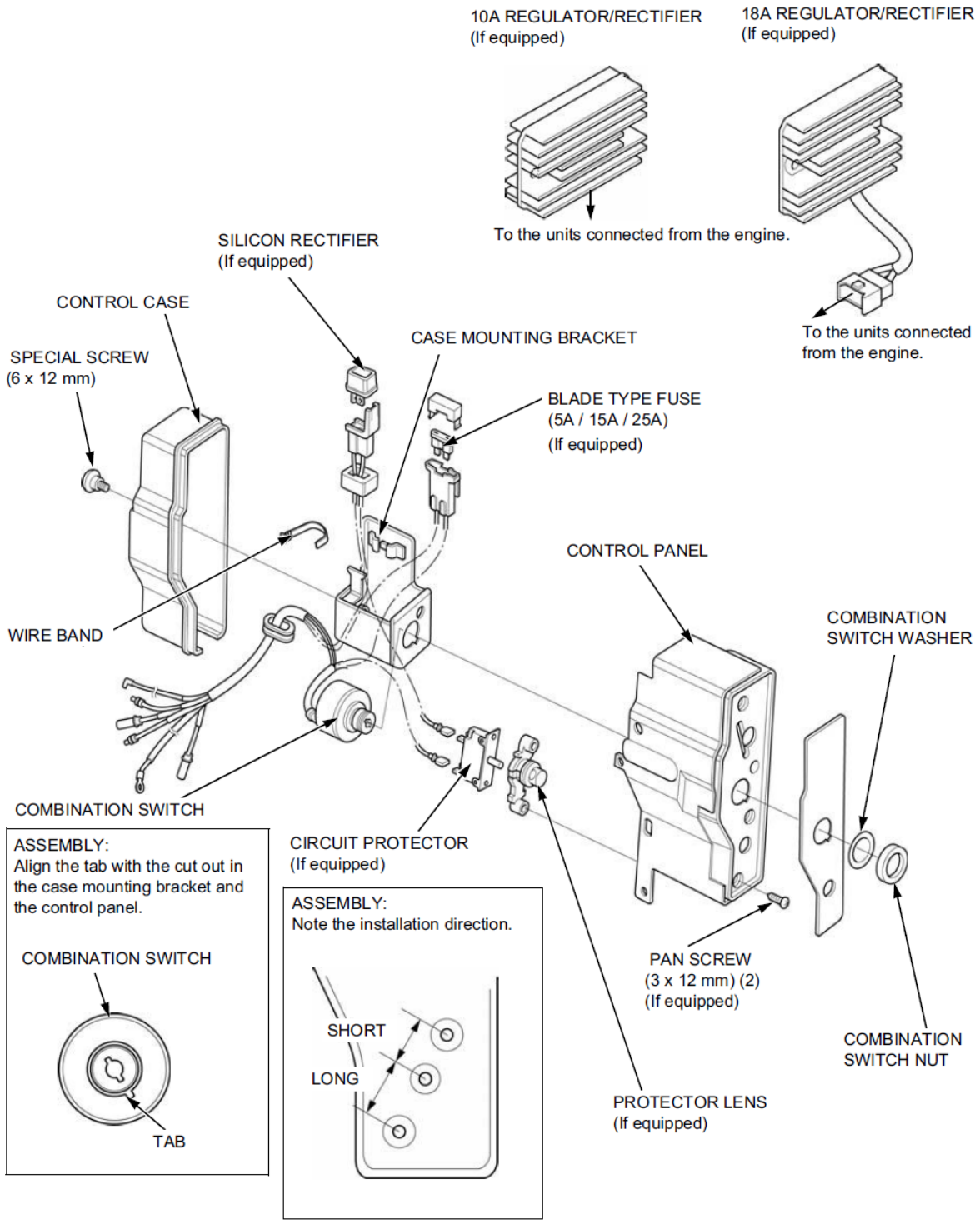
Disconnect the control box wires.

When installing, refer to the HARNESS AND TUBE ROUTING (with circuit protector).



CONTROL BOX DISASSEMBLY/ASSEMBLY

Remove the control box.



OIL LEVEL SWITCH INSPECTION

Disconnect the engine wire harness from the oil level switch.

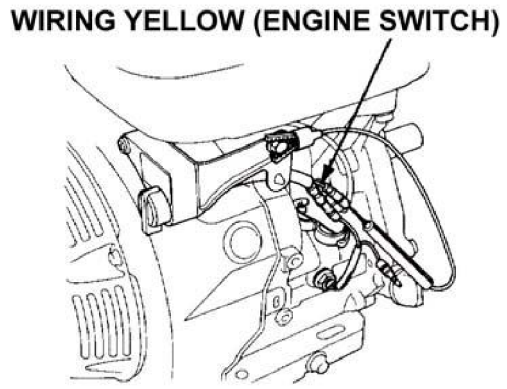
Check continuity between the switch terminal and engine ground.There should be no continuity when the engine is full of oil.

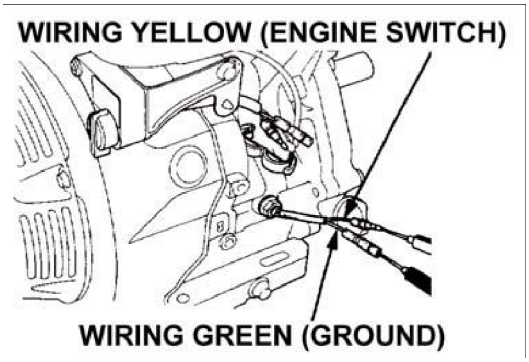
Drain the engine oil completely.

Check continuity between the switch terminal and engine ground.There should be continuity.

Check continuity between the switch terminals while filling the engine oil.The ohmmeter reading should go from continuity to no continuity as the oil is filled.

If the correct continuity is not obtained, replace the oil level switch.





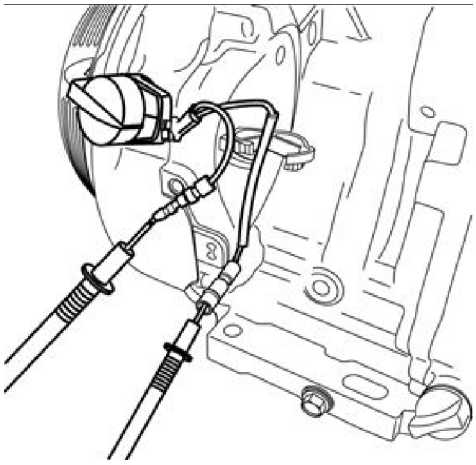
ENGINE STOP SWITCH INSPECTION

Remove the engine stop switch connectors.

Check continuity between the terminals at each switch position.

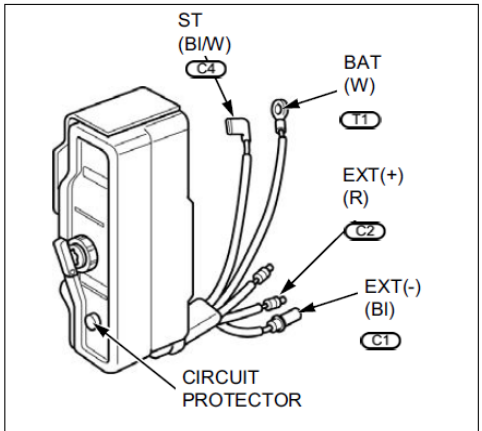
Switch position	Continuity
ON	Yes
OFF	No

If the correct continuity is not obtained, replace the engine stop switch.



COMBINATION SWITCH INSPECTION

With Circuit Protector Check continuity between the terminals at each switch position. If the correct continuity is not obtained, replace the combination switch.

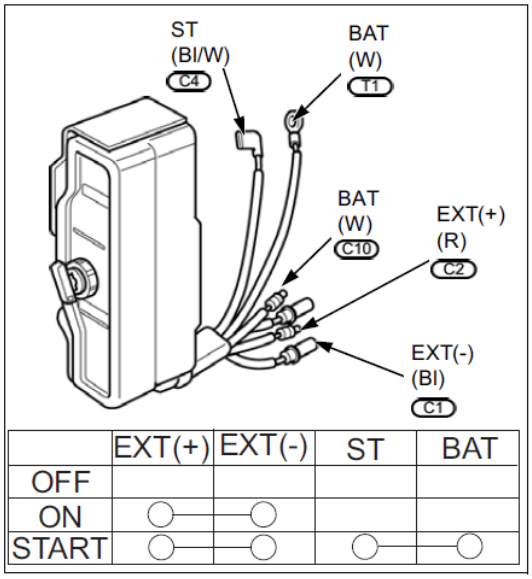


	EXT(+)	EXT(-)	ST	BAT
OFF				
ON	○	○		
START	○	○	○	○

Without Circuit Protector

Check continuity between the terminals at each switch position.

If the correct continuity is not obtained, replace the combination switch.

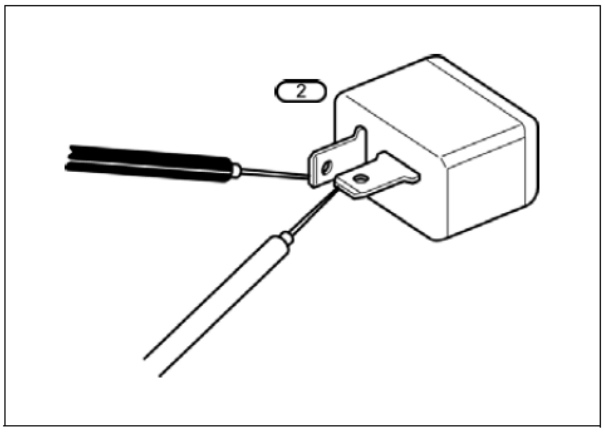


	EXT(+)	EXT(-)	ST	BAT
OFF				
ON	○	○		
START	○	○	○	○

SILICON RECTIFIER INSPECTION

Remove the silicon rectifier.

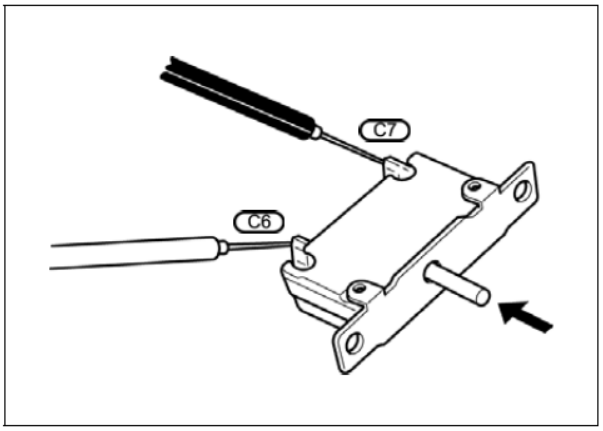
Check continuity between the terminals. There should be continuity in one direction only. Replace the rectifier if there is continuity in both directions or in neither direction.



CIRCUIT PROTECTOR INSPECTION

Remove the circuit protector.

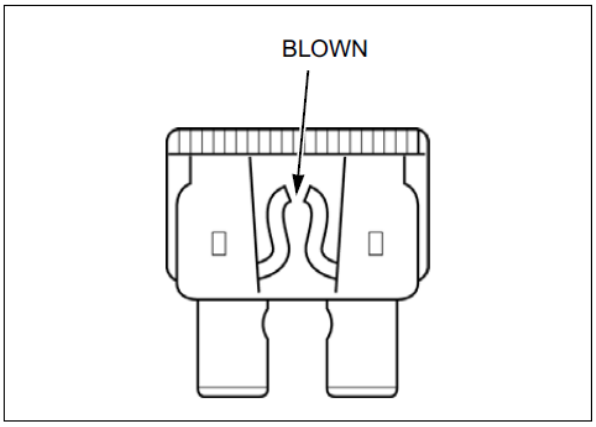
Check continuity between the terminals. There should be continuity in the ON position (button in) and no continuity in the OFF position (button out). Replace the circuit breaker if the correct continuity is not obtained.



FUSE INSPECTION

Remove the blade type fuse.

Visually inspect the fuse to see if it is blown. Check continuity across the two blades. Replace the fuse if it is blown or there is no continuity across the blades.



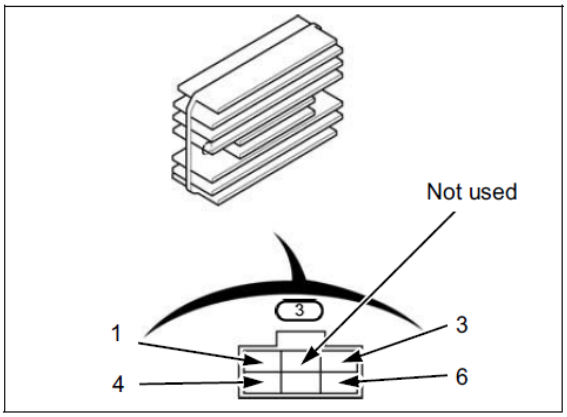
REGULATOR/RECTIFIER INSPECTION

Measure the resistance between the terminals and be sure that the measurements conform to the ranges shown in the table.

10A TYPE

Unit: kΩ

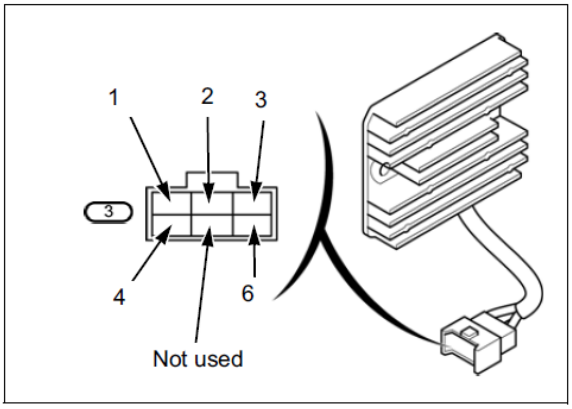
	4	6	1	3
4		∞	∞	∞
6	∞		∞	∞
1	1-200	1-200		0.5-100
3	0.1-50	0.1-50	∞	



18A TYPE

Unit: kΩ

	4	6	1	2	3
4		4 - 400	∞	∞	2 - 230
6	4 - 400		∞	∞	2 - 230
1	∞	∞		∞	∞
2	2 - 230	2 - 230	∞		1 - 600
3	0.09 - 400	0.09 - 400	∞	∞	



Use a tester that is equivalent to or higher than the performance specified, internal resistance: 20 k./VDC,9 k./VAC

Be careful not to touch the metallic part of the tester probe with your fingers; otherwise, the correct resistance value cannot be obtained.

Read the tester manufacturer‘s operation instructions carefully before operating the tester. Follow the instructions of the Service Manual. Be sure the tester‘s battery is fully charged, and check the meter before using the tester.

MUFFLER

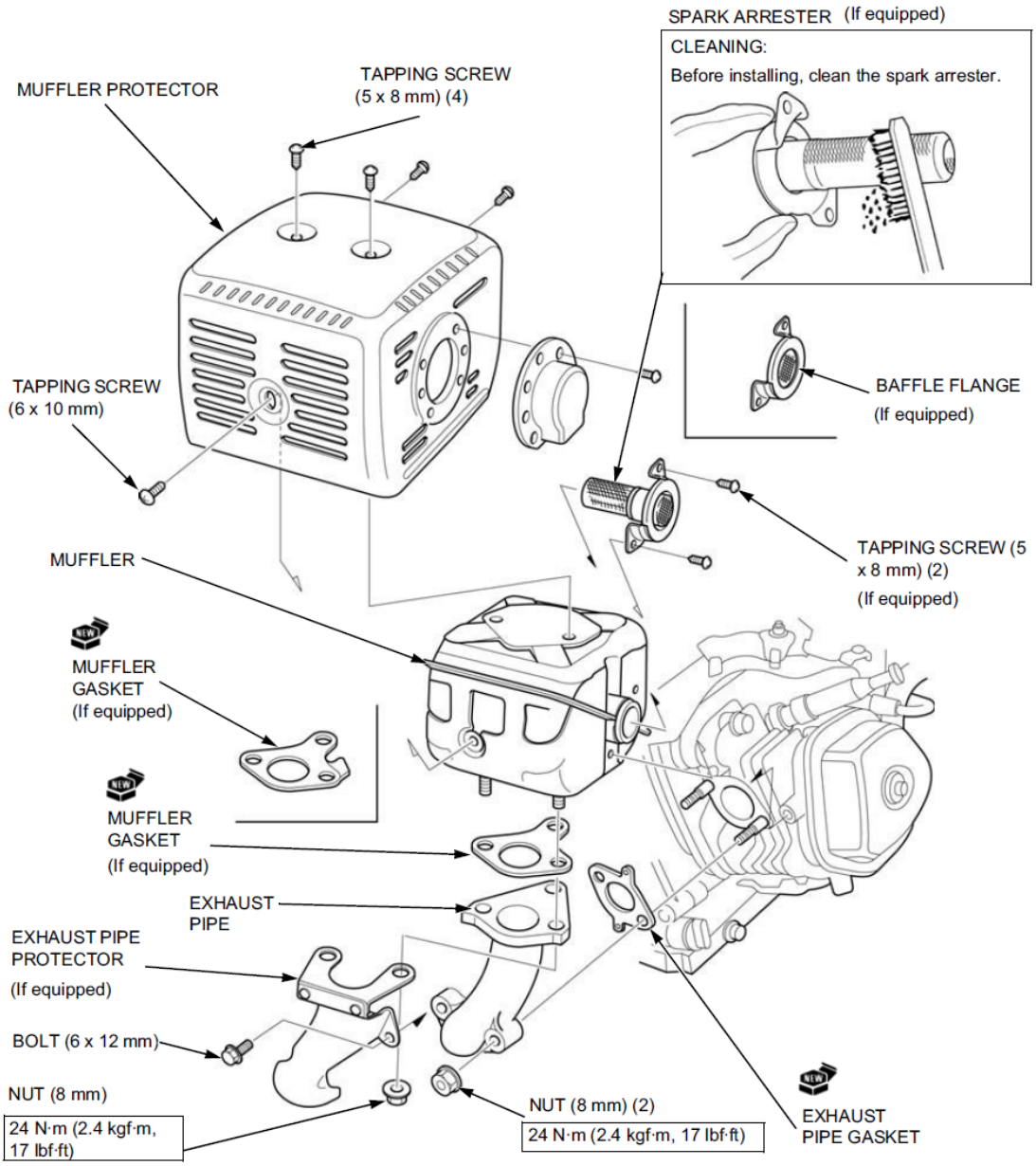
REMOVAL/INSTALLATION

⚠ CAUTION

THE MUFFLER BECOMES VERY HOT DURING OPERATION AND REMAINS HOT FOR A WHILE AFTER STOPPING THE ENGINE. BE CAREFUL NOT TO TOUCH THE MUFFLER WHILE IT IS HOT. ALLOW IT TO COOL BEFORE PROCEEDING.

SOLID PROTECTOR TYPE

Remove the muffler cover (if equipped).



CYLINDER HEAD/VALVES

CYLINDER HEAD/VALVES INSPECTION

CYLINDER COMPRESSION CHECK

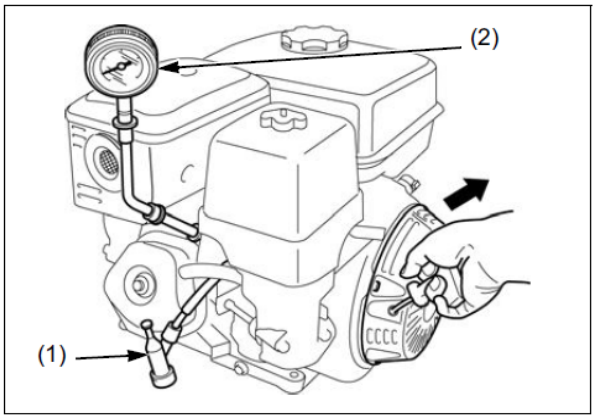
Start the engine and warm up to normal operatingtemperature.Turn the fuel valve lever to the OFF position, and then remove the drain screw to drain the carburetor.

Remove the spark plug cap (1) from the spark plug.Remove the spark plug using a spark plug wrench.

Pull the recoil starter several times to expel unburned-gas.Attach a commercially available compression gauge (2)to the spark plug hole.

Pull the recoil starter forcefully to measure stable cylinder compression.

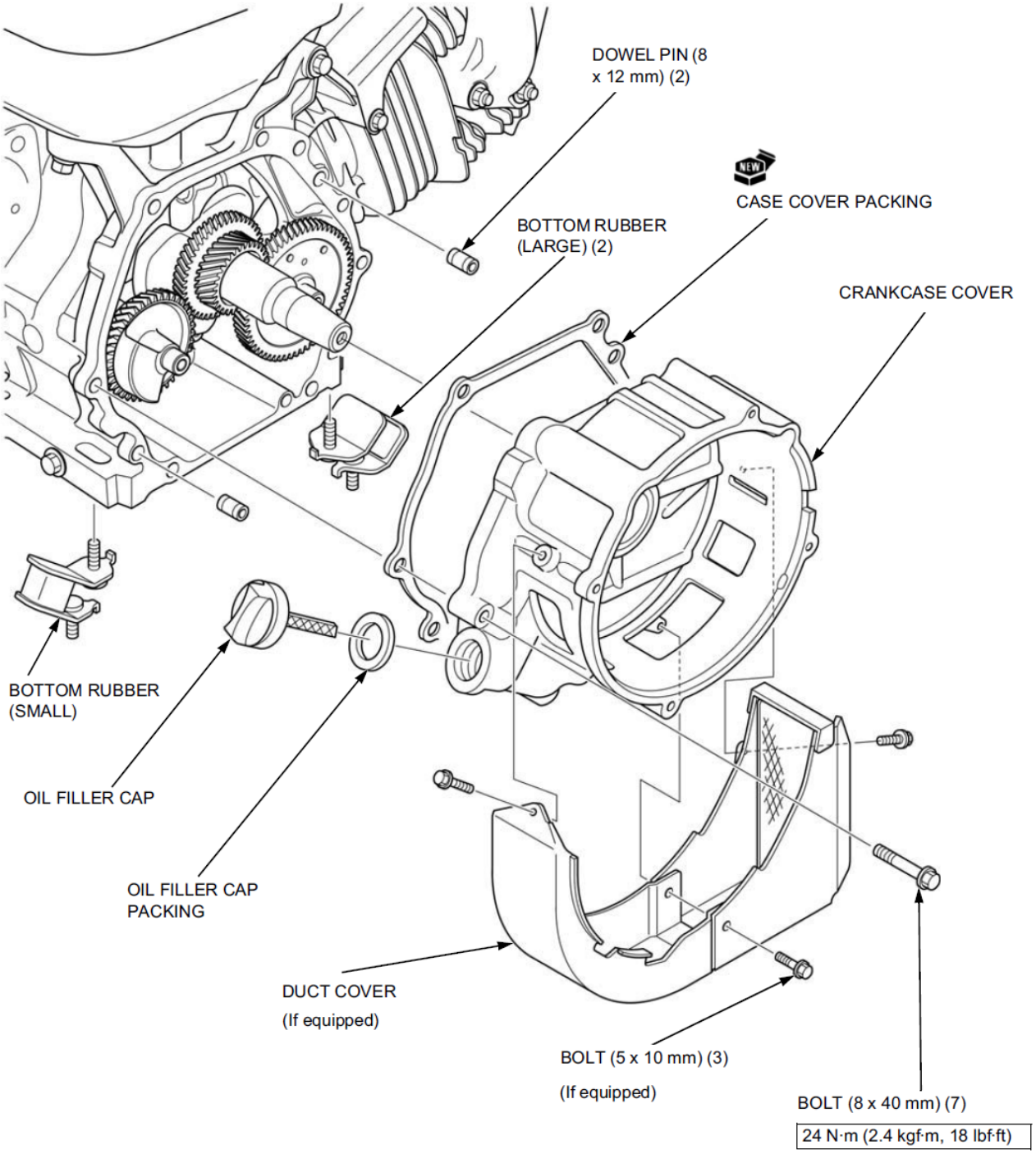
CYLINDER COMPRESSION:0.51 - 0.69 MPa (5.2 - 7.0 kgf/cm2, 74 - 100 psi) / 600 min-1 (rpm)



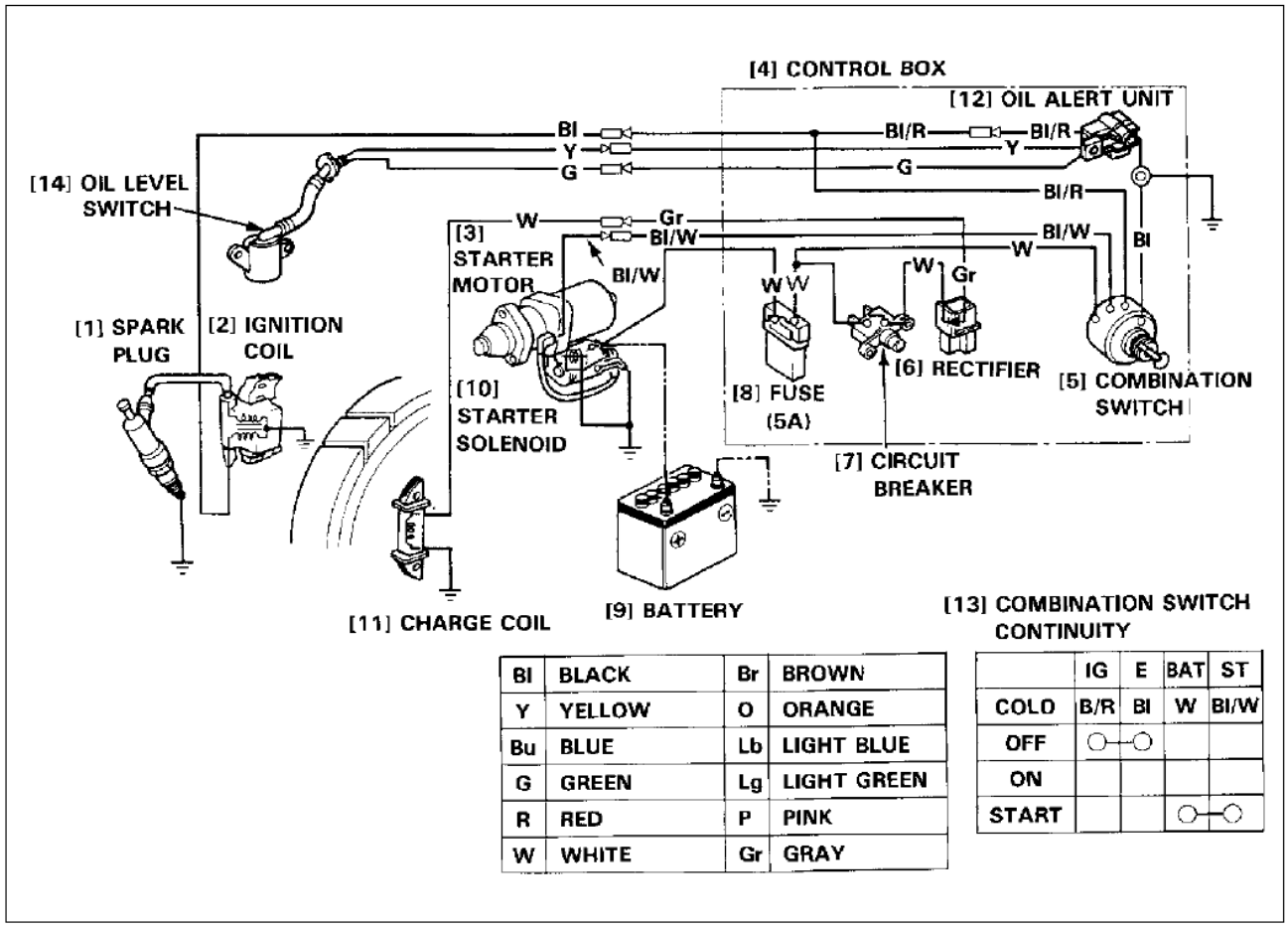
CRANKCASE COVER REMOVAL/ INSTALLATION

E TYPE

Drain the engine oil.



WIRING DIAGRAMS



Bl	BLACK	Br	BROWN
Y	YELLOW	O	ORANGE
Bu	BLUE	Lb	LIGHT BLUE
G	GREEN	Lg	LIGHT GREEN
R	RED	P	PINK
W	WHITE	Gr	GRAY

	IG	E	BAT	ST
COLO	B/R	Bl	W	Bl/W
OFF	○—○			
ON				
START			○—○	

WIRING DIAGRAMSHOW TO READ A WIRING DIAGRAM & RELATED INFORMATION

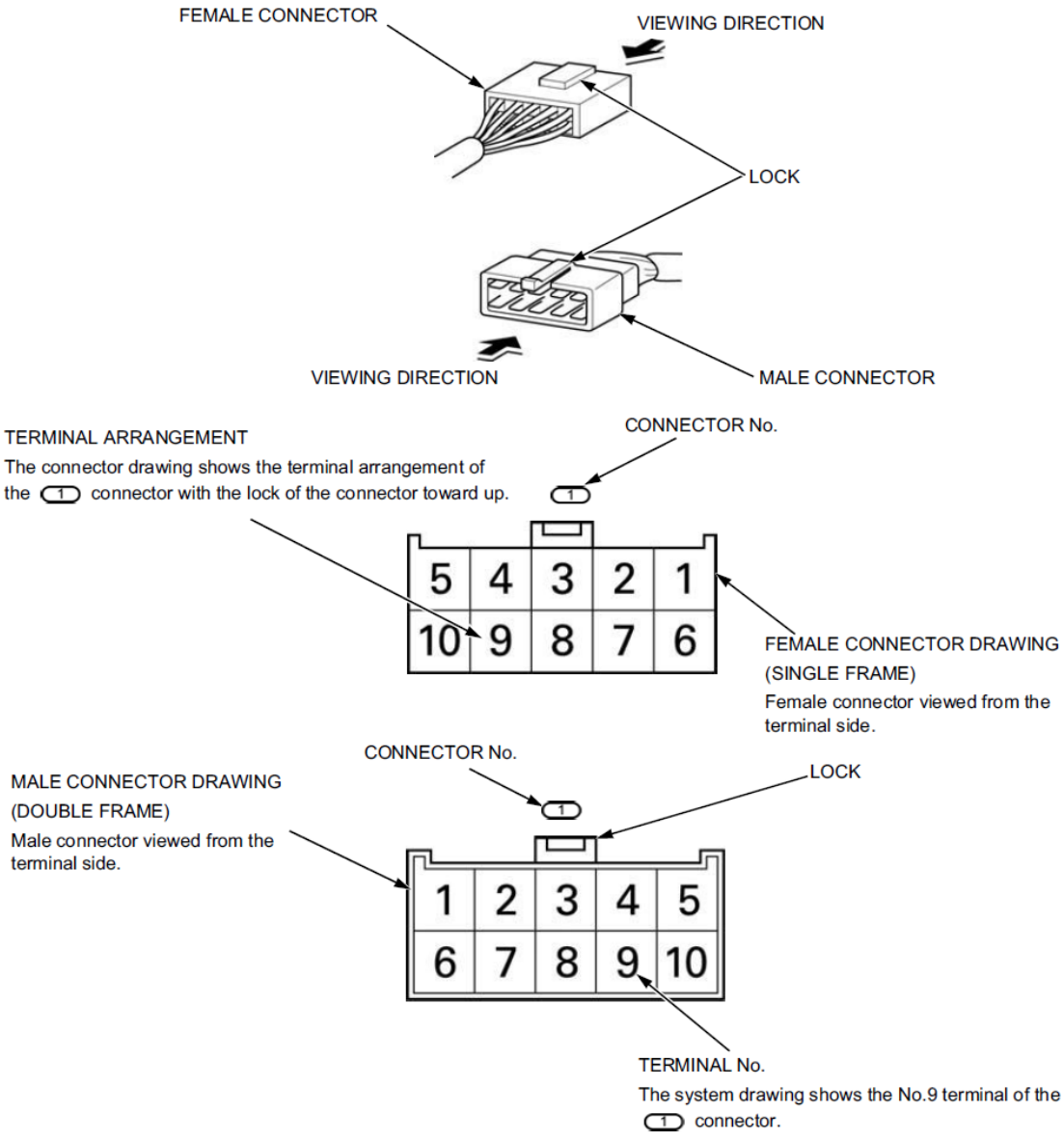
The wiring diagram, connector general layout drawing, connector drawings, and the symbols used in troubleshooting are explained in this section.

HOW TO READ CONNECTOR DRAWINGS

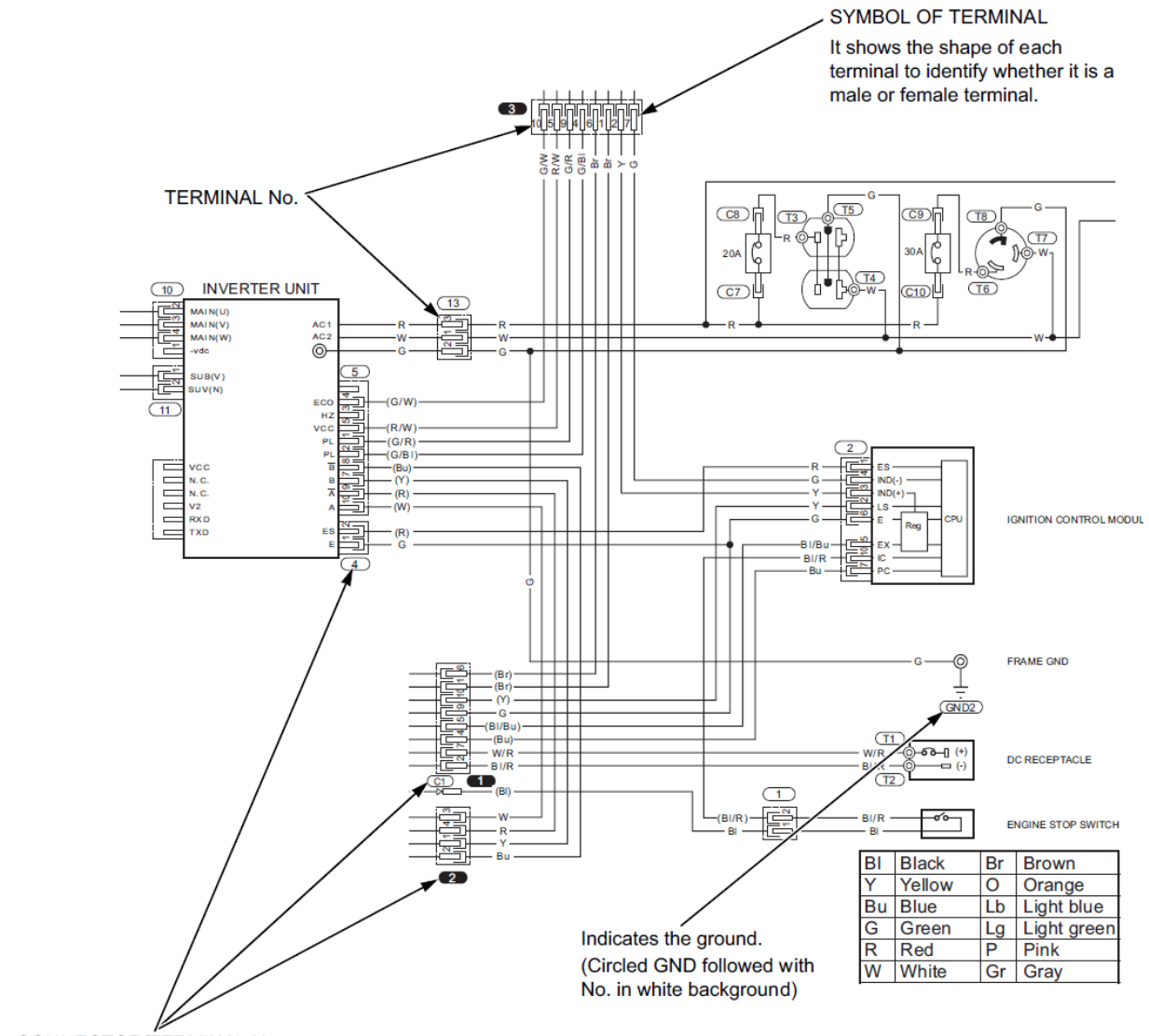
Connector drawings show the terminal arrangement, terminal No., number of pins, and the shape of terminal (male or female).

Both the male and female connectors are shown for the common connectors, while only the main wire harness side connectors are shown for the dedicated connectors.The double frame connectors represent the male connectors and the single frame connectors represent the female connectors.

Both the male and female connectors are shown by viewing them from the terminal side.



HOW TO READ WIRING DIAGRAM

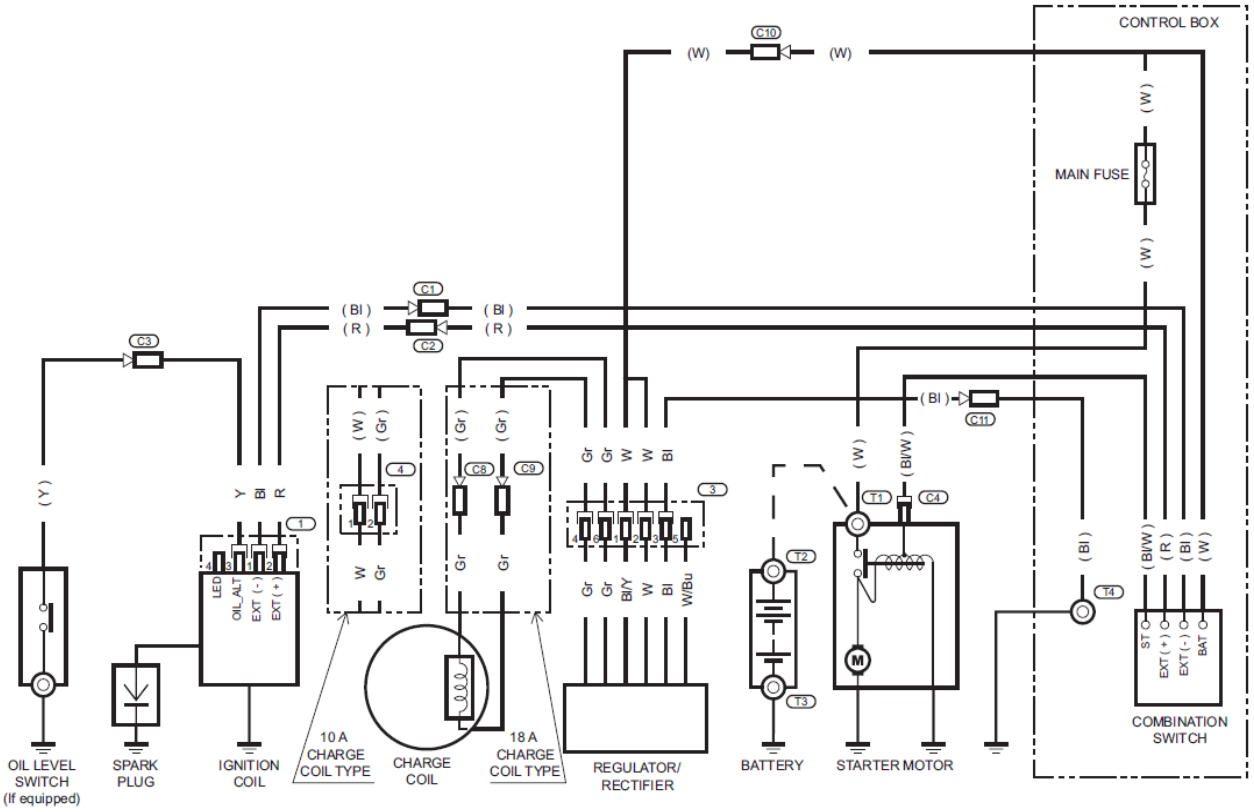


Bl	Black	Br	Brown
Y	Yellow	O	Orange
Bu	Blue	Lb	Light blue
G	Green	Lg	Light green
R	Red	P	Pink
W	White	Gr	Gray

Every connector and terminal has a number to help the users find the location and shape of the connector and the terminal arrangement by referring to the "Connector general layout drawing" and/or the "Connector drawing." All the connector/terminal numbers shown in this Service Manual are either of those shown in this section.

- (1) : Connector that relays from a harness to a harness (Circled No. in black background)
- (1) : Connector that connects to electrical equipment (Circled No. in white background)
- (C1) : Connector (Circled C followed with No. in white background)
- (T1) : Terminal (Circled T followed with No. in white background)
- (GND1) : Ground (Circled GND followed with No. in white background)

10A / 18A CHARGE COIL TYPE



COMBINATION SWITCH

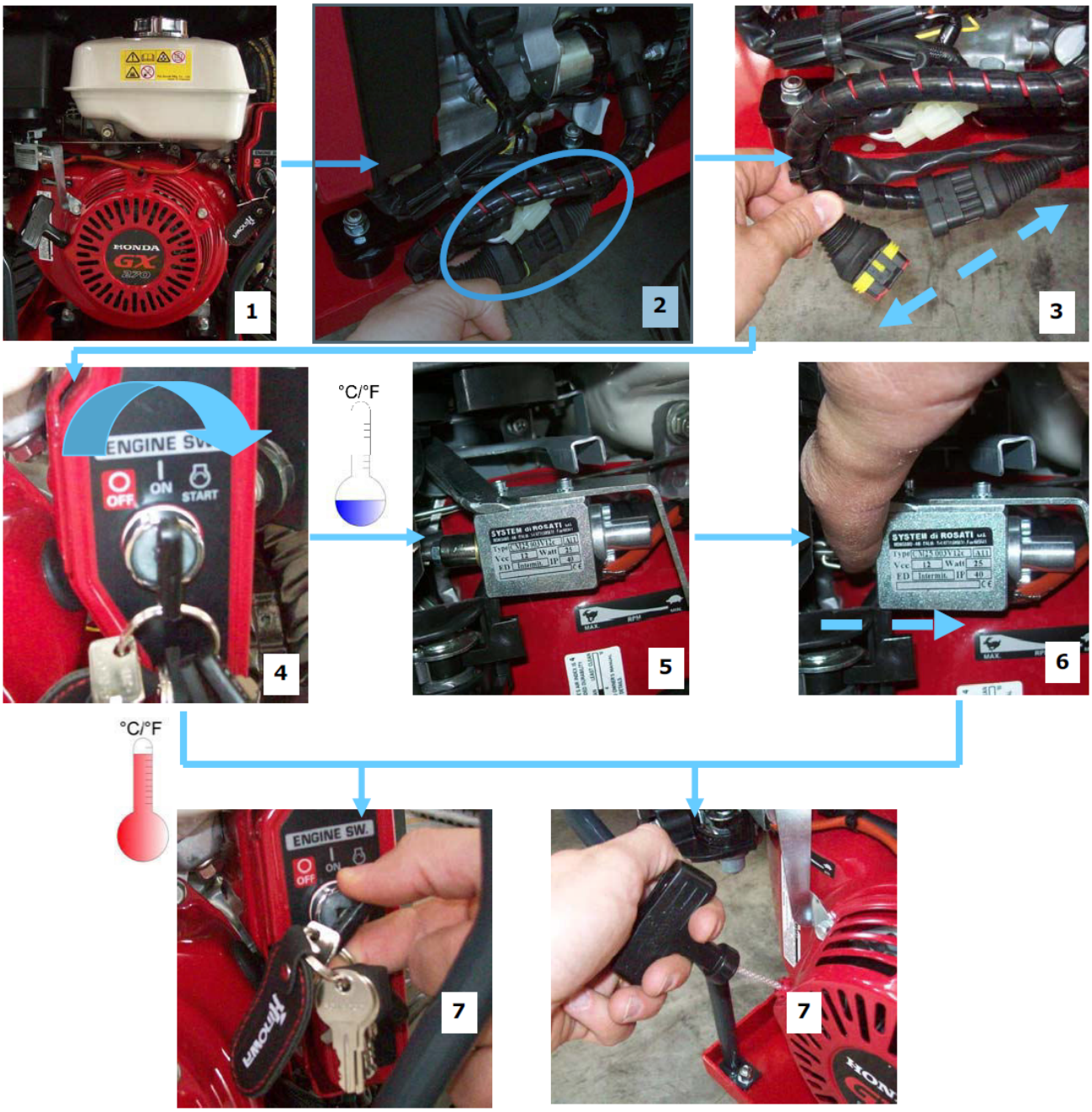
	EXT (+)	EXT (-)	ST	BAT
OFF				
ON	○—○	○—○		
START	○—○	○—○	○—○	○—○

Bl	Black	Br	Brown
Y	Yellow	O	Orange
Bu	Blue	Lb	Light blue
G	Green	Lg	Light green
R	Red	P	Pink
W	White	Gr	Gray

QUICK TROUBLESHOOTING

HONDA GX270 - GX390

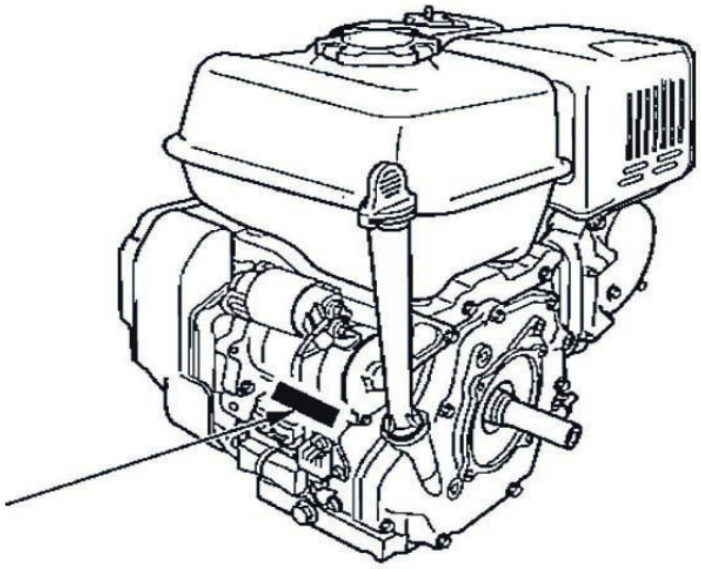
- HOW TO START ON THE THERMIC ENGINE WITH-OUT THE BOARD CONNEXION



3.10 HONDA ENGINE IGX440

SERIAL NUMBER LOCATION

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



SPECIFICATIONS

DIMENSIONS AND WEIGHT

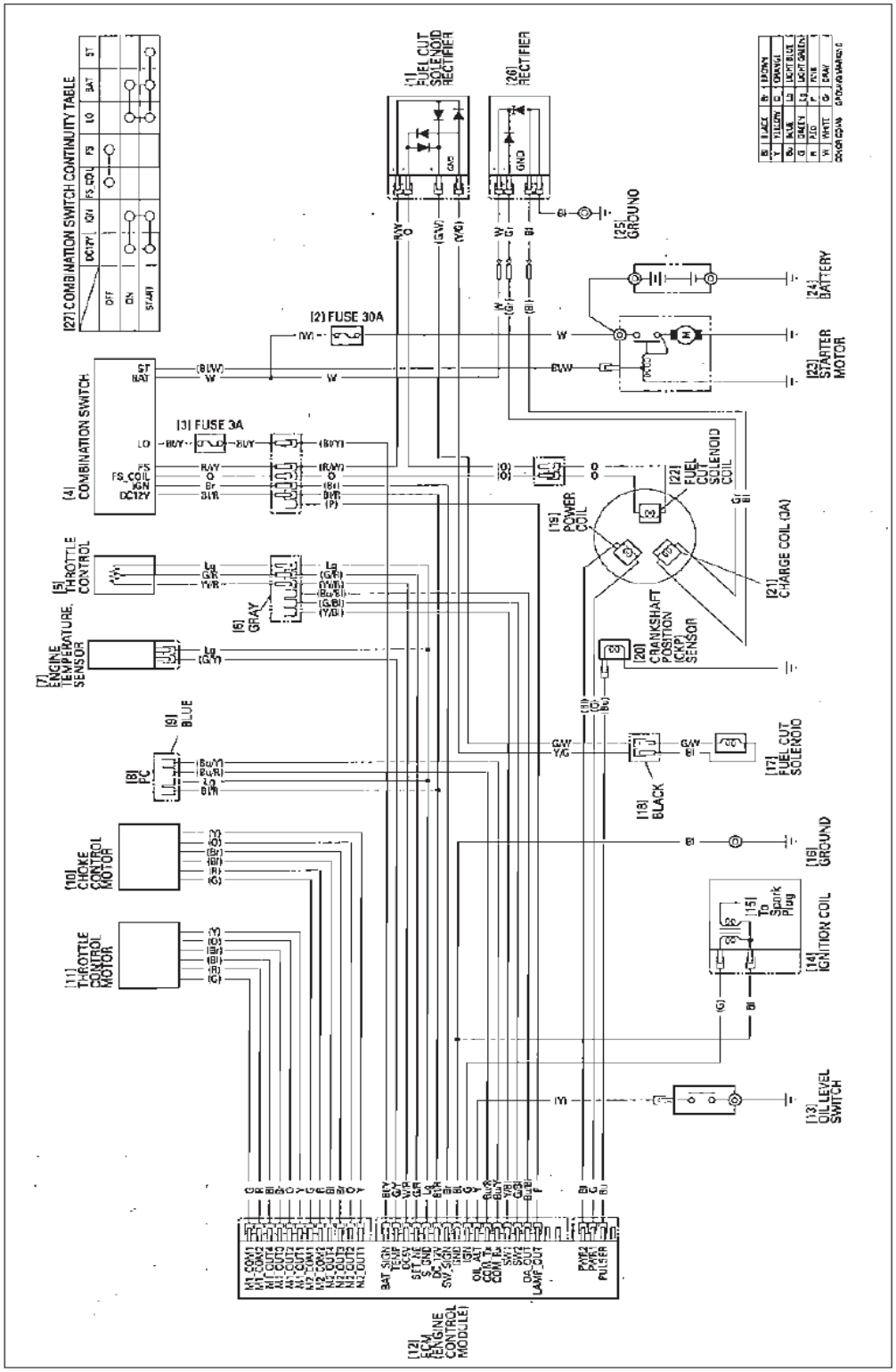
Model	iGX440U		
PTO types	S	Q	V
Overall length	407 mm (16.0 in)	433 mm (17.0 in)	450 mm (17.7 in)
Overall width	505 mm (19.9 in)		
Overall height	454 mm (17.9 in)		
Maximum angle of inclination	20°		
Dry weight	39 kg (86 lbs)		
Operating weight	45 kg (99 lbs)		

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 Imp 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 Imp gal)

WIRING DIAGRAMS

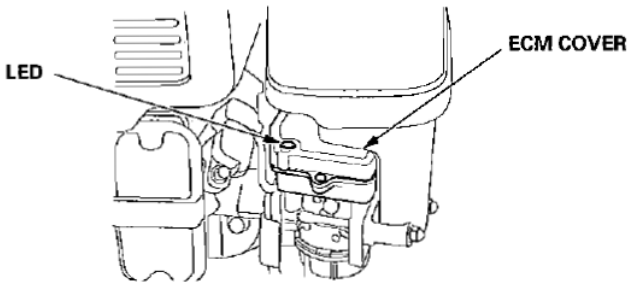
With starter motor and charge coil (20A) type



TROUBLESHOOTING

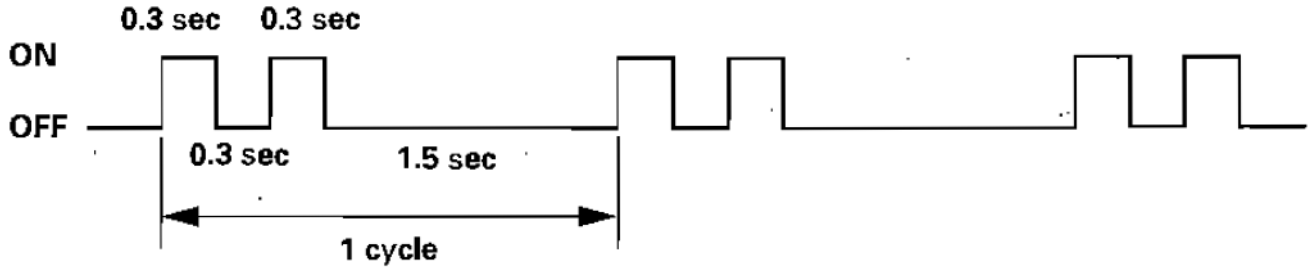
SELF-DIAGNOSIS AS INDICATED BY THE LED

When the battery is disconnected, self-diagnosis with the LED is not possible.



The LED for a failure flashes periodically, as shown in the following figure.

Example: in the case of "2 flashes" the sequence of 0.3 sec. on > 0.3 sec. off > 0.3 sec. on > 1.5 sec. off is repeated as a cycle.



LED status	Possible problems	Engine behavior
LED illuminates	None (Electrical system is normal)	Normal
2 flashes	• Insufficient oil • Oil level switch failure • Wire harness connecting oil level switch and ECM (Engine Control Module) failure • ECM failure	While engine is running: Engine stops. *1 At start up: Engine may or may not start. *1
4 flashes	• Engine temperature sensor failure • Wire harness connecting engine temperature sensor and ECM failure • ECM failure	While engine is running: The engine continues to run.*3 At start up: Engine does not start.
6 flashes	• Power coil failure • Wire harness connecting power coil and ECM failure • ECM failure	While engine is running: Engine stops. At engine start up: Engine does not start.
8 flashes	Program failure*2	While engine is running: Engine stops. At start up: Engine does not start.
LED does not light up	• Battery failure • 3A or 30A fuse blown • Combination switch failure • Wire harness failure • ECM failure	While engine is running: Engine stops. At start up: Engine does not start.

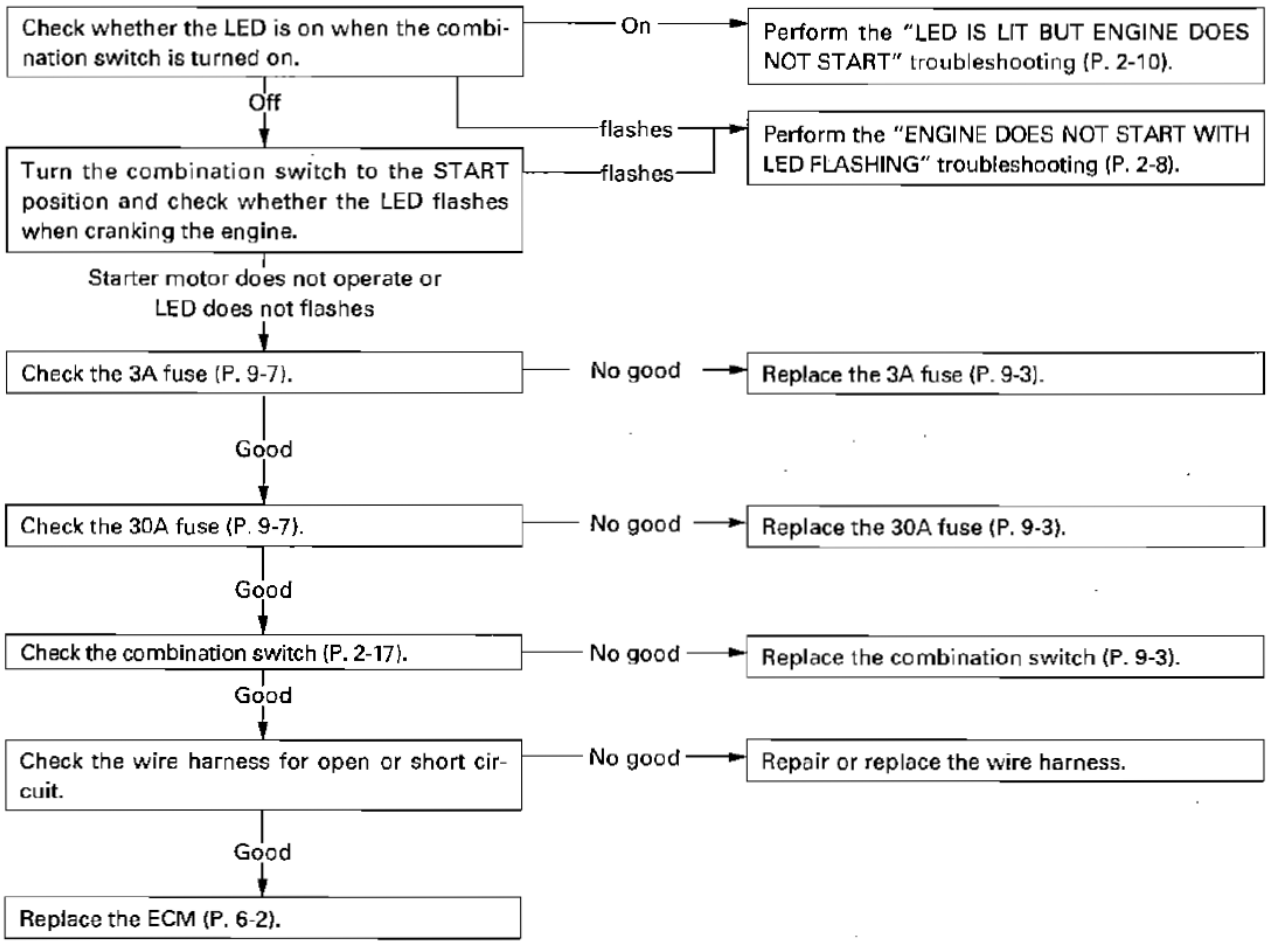
*1: The engine may or may not stop, depending on the program in the EDCM.

*2: Rewriting of the program is needed. Contact your Honda engine distributor.

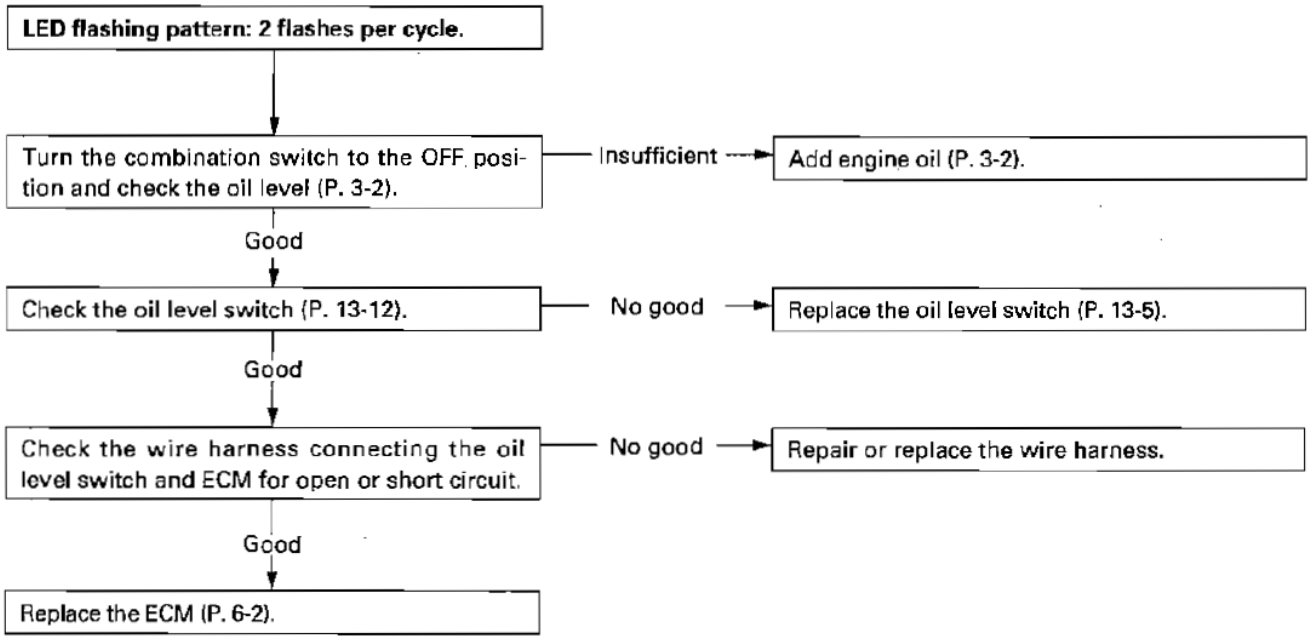
*3: If the faulty engine temperature sensor is detected while engine is running, the engine does not stop and the LED does not flash.

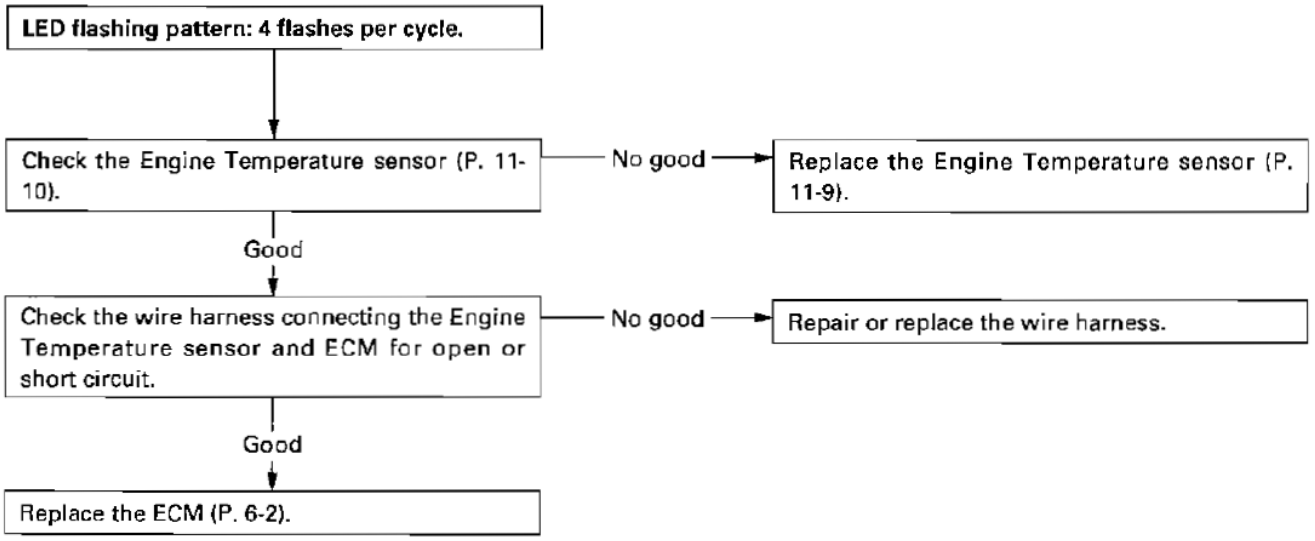
After the engine is stopped, the engine does not start until the faulty engine temperature sensor is solved.

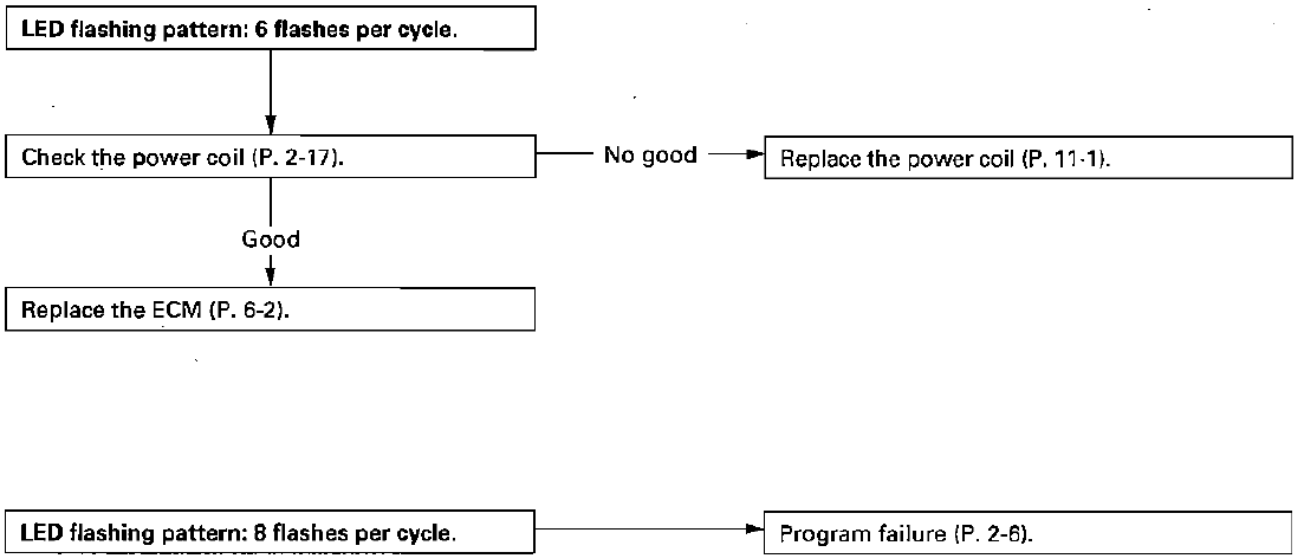
a. Engine does not start (starter motor equipped type).



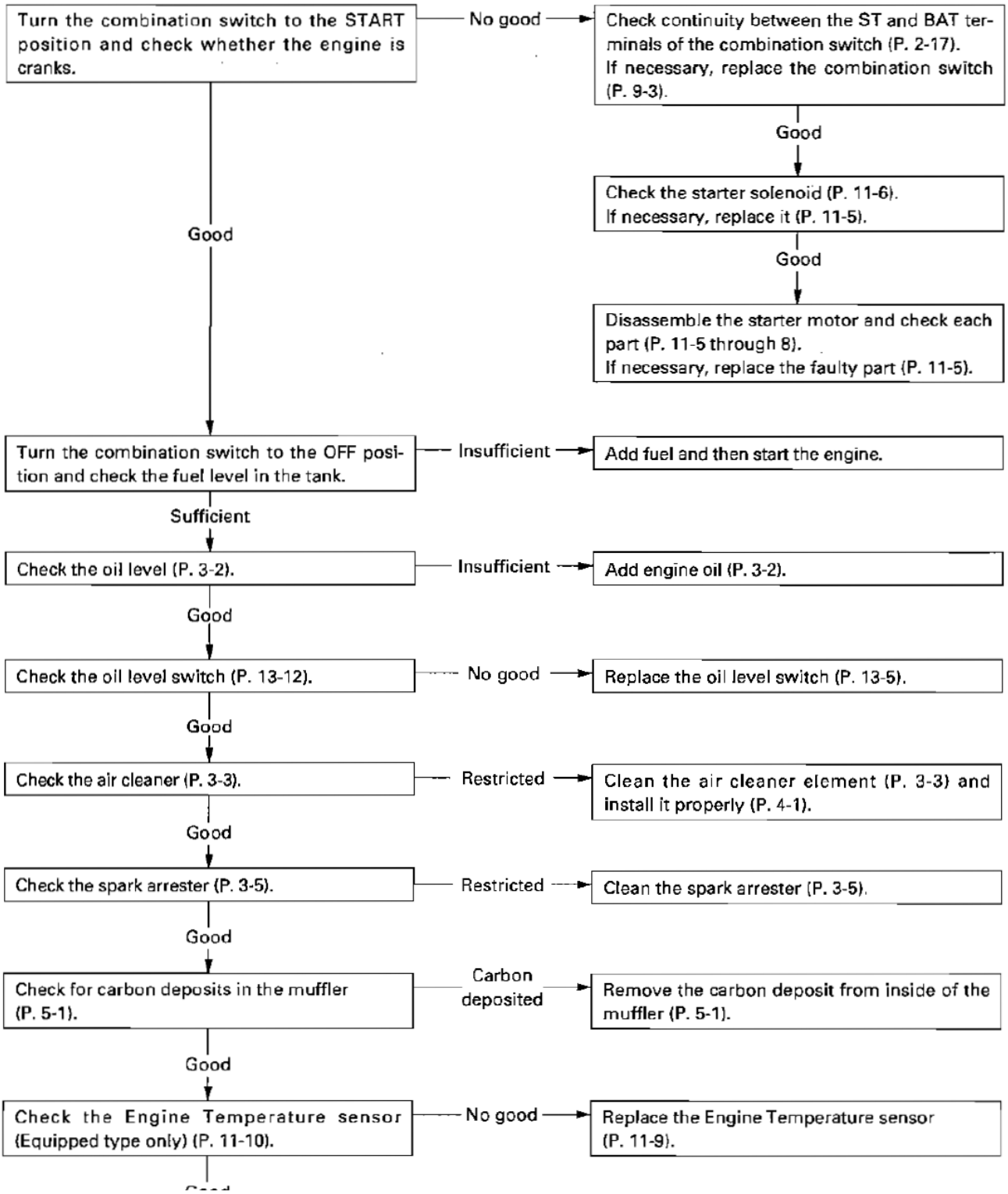
b. Engine does not start with LED flashing

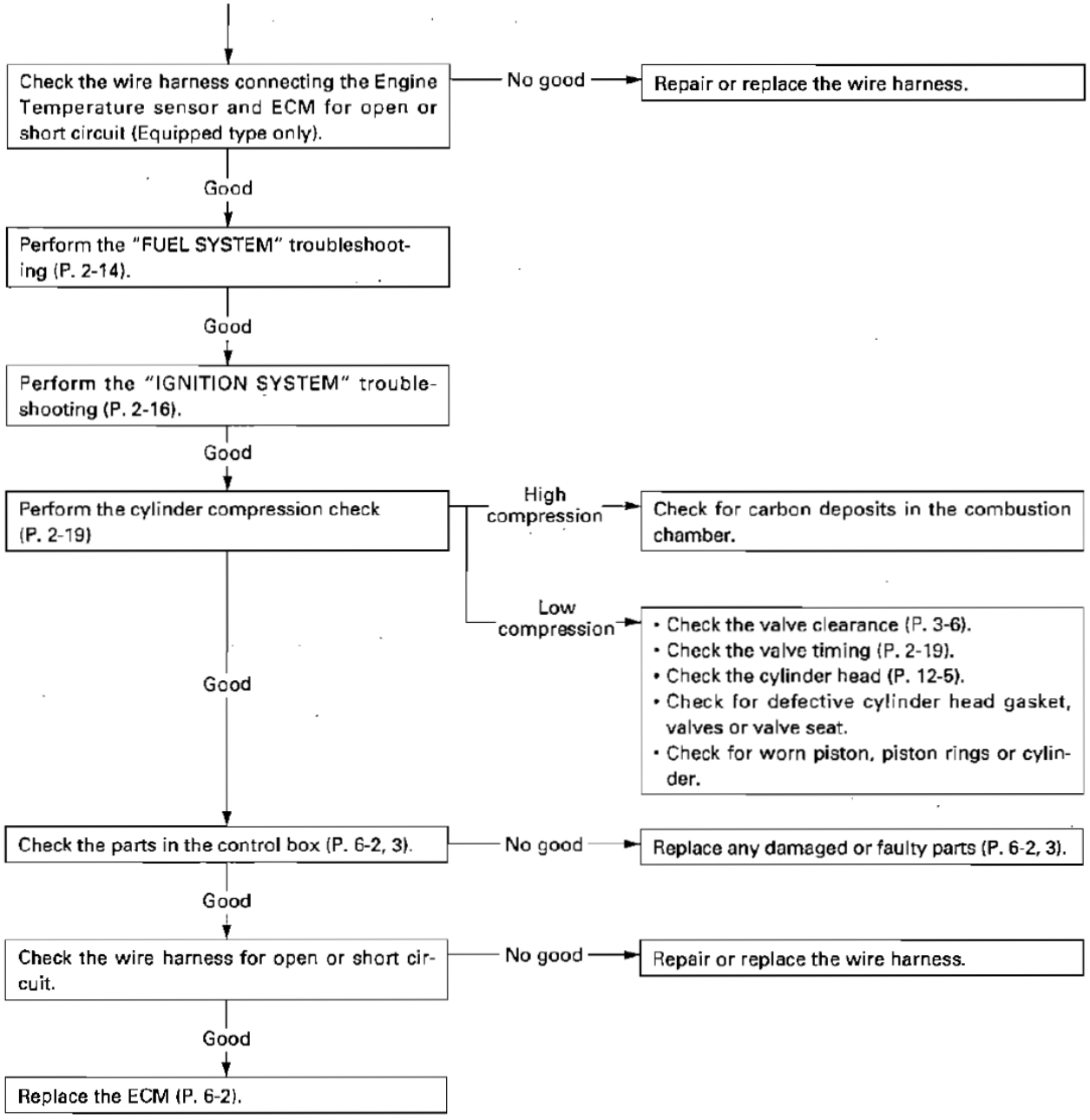




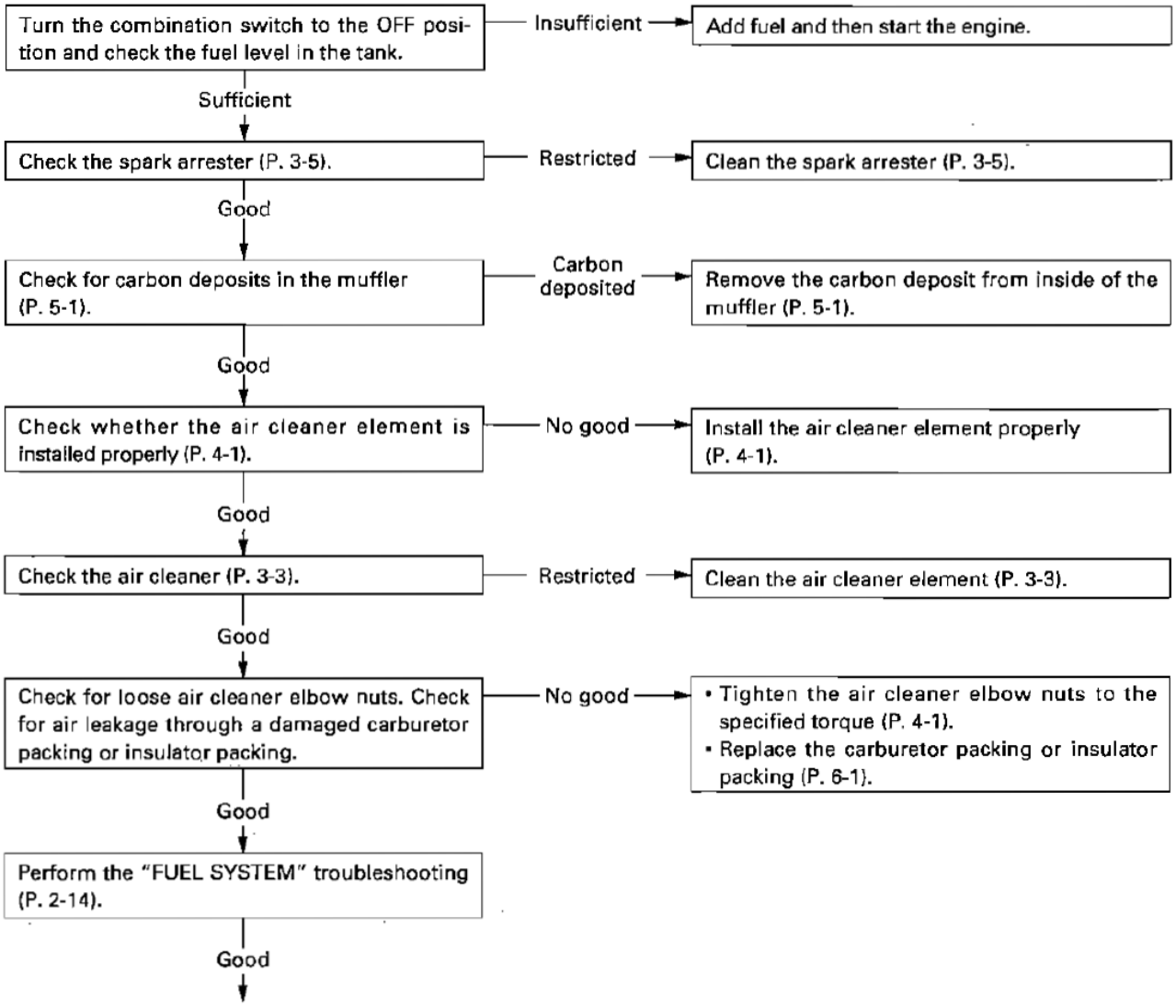

LED flashing pattern: 6 flashes per cycle.
Check the power coil (P. 2-17).
No good
Replace the power coil (P. 11-1).
Good
Replace the ECM (P. 6-2).
LED flashing pattern: 8 flashes per cycle.
Program failure (P. 2-6).

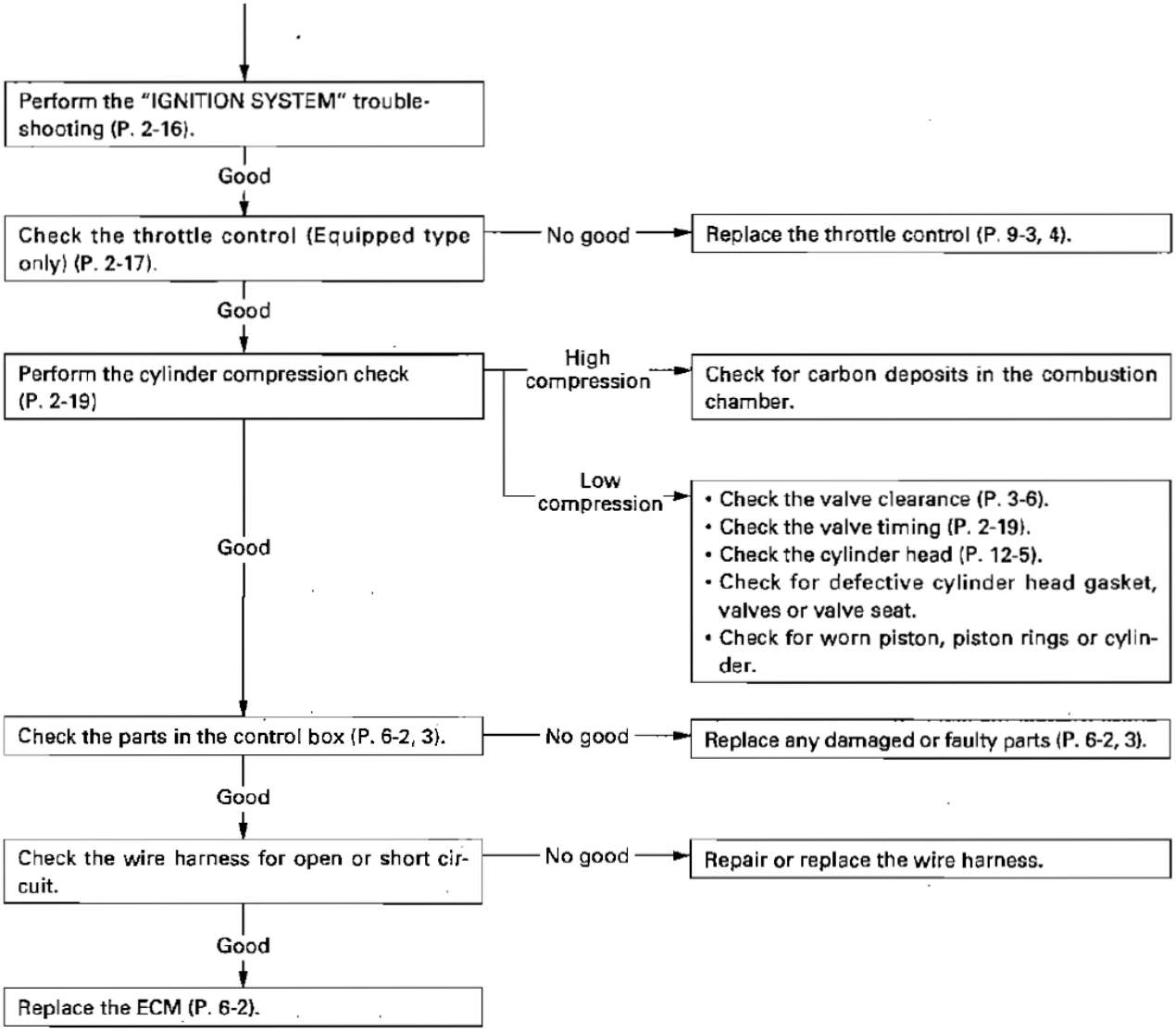
c. LED is lit but engine does not start (starter motor equipped type) / engine does not start (starter motor equipped type)



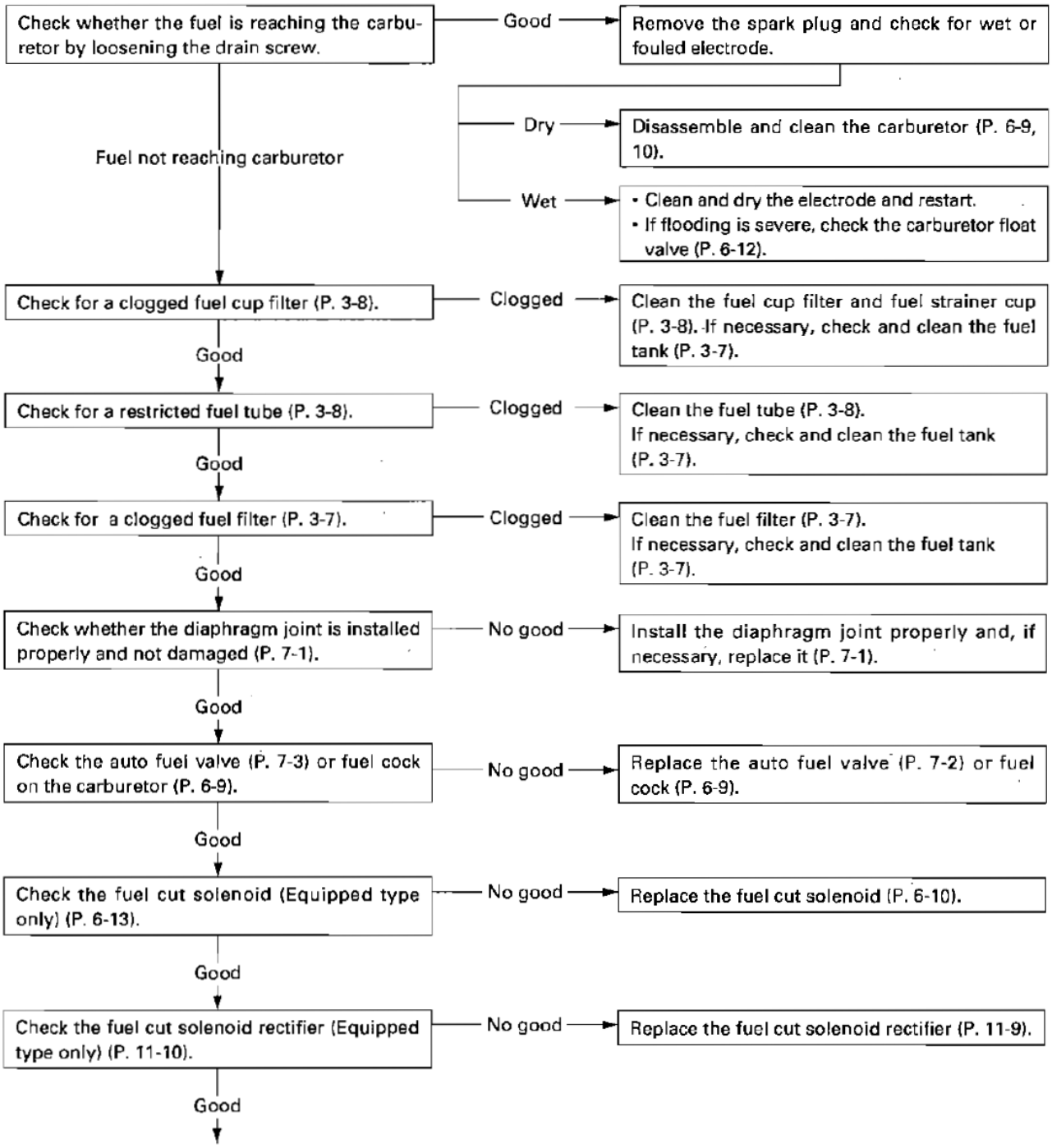

Check the wire harness connecting the Engine Temperature sensor and ECM for open or short circuit (Equipped type only).
No good
Repair or replace the wire harness.
Good
Perform the "FUEL SYSTEM" troubleshooting (P. 2-14).
Good
Perform the "IGNITION SYSTEM" troubleshooting (P. 2-16).
Good
Perform the cylinder compression check (P. 2-19)
High compression
Check for carbon deposits in the combustion chamber.
Low compression
• Check the valve clearance (P. 3-6).
• Check the valve timing (P. 2-19).
• Check the cylinder head (P. 12-5).
• Check for defective cylinder head gasket, valves or valve seat.
• Check for worn piston, piston rings or cylinder.
Good
Check the parts in the control box (P. 6-2, 3).
No good
Replace any damaged or faulty parts (P. 6-2, 3).
Good
Check the wire harness for open or short circuit.
No good
Repair or replace the wire harness.
Good
Replace the ECM (P. 6-2).

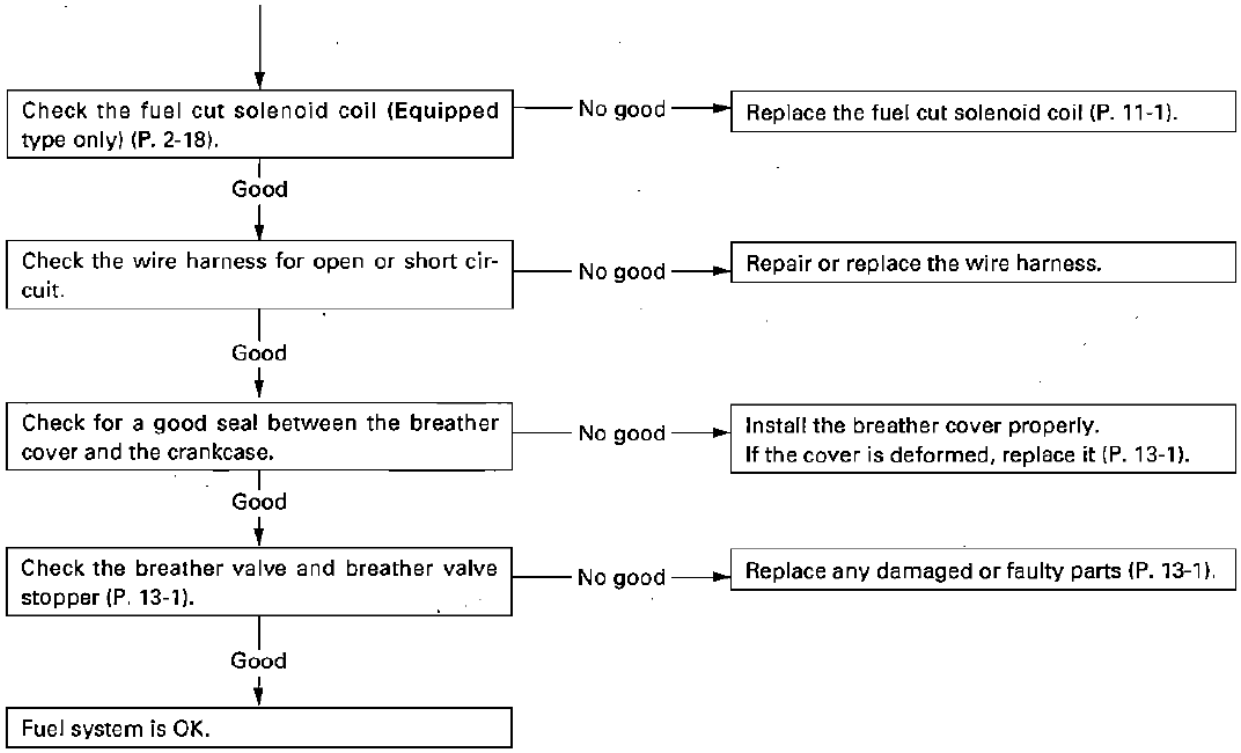
d. Engine speed does not increase or engine lacks power



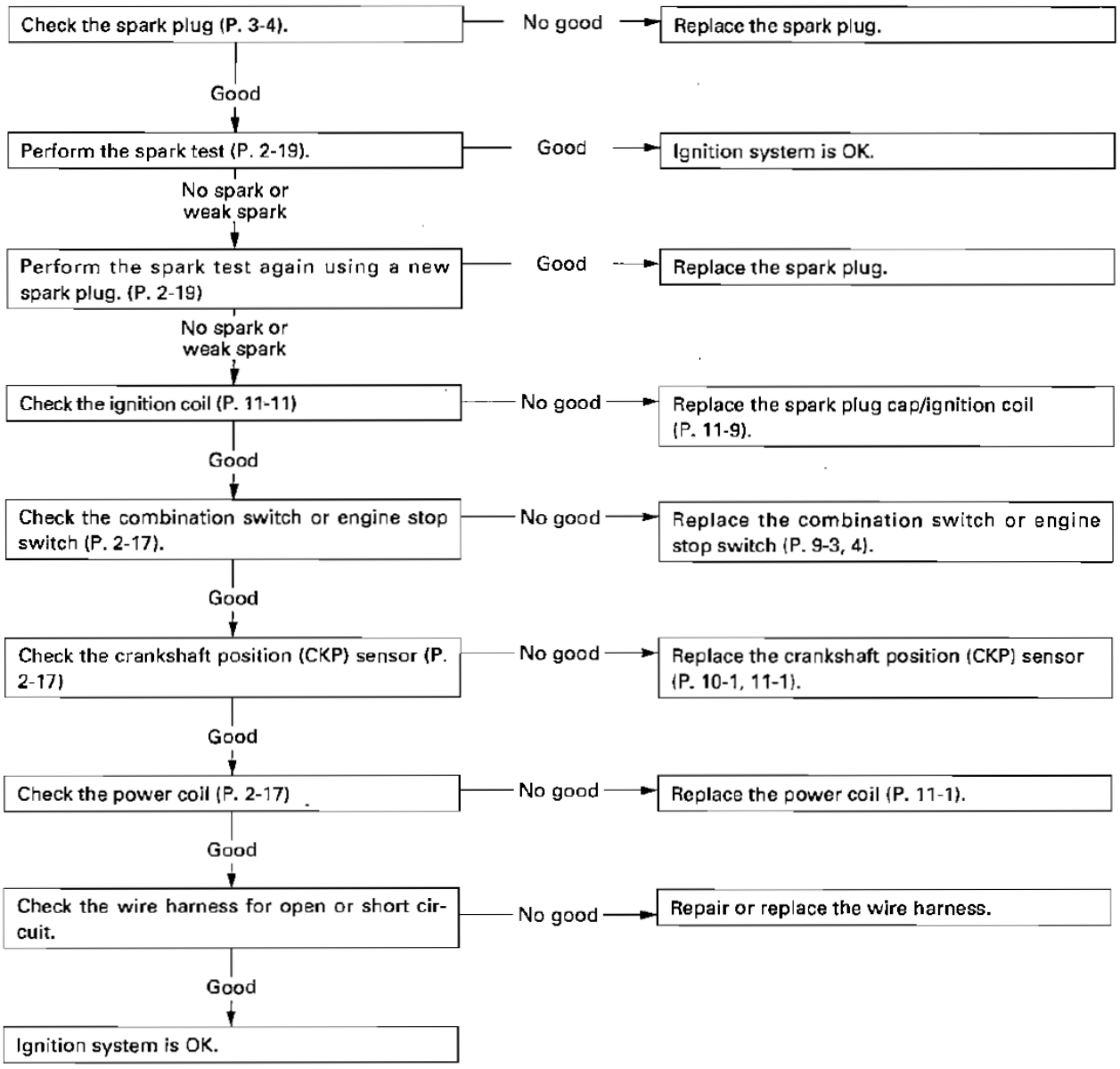

Perform the "IGNITION SYSTEM" trouble-shooting (P. 2-16).
Good
Check the throttle control (Equipped type only) (P. 2-17).
No good
Replace the throttle control (P. 9-3, 4).
Good
Perform the cylinder compression check (P. 2-19)
High compression
Check for carbon deposits in the combustion chamber.
Low compression
• Check the valve clearance (P. 3-6).
• Check the valve timing (P. 2-19).
• Check the cylinder head (P. 12-5).
• Check for defective cylinder head gasket, valves or valve seat.
• Check for worn piston, piston rings or cylinder.
Good
Check the parts in the control box (P. 6-2, 3).
No good
Replace any damaged or faulty parts (P. 6-2, 3).
Good
Check the wire harness for open or short circuit.
No good
Repair or replace the wire harness.
Good
Replace the ECM (P. 6-2).

e. Fuel system




Check the fuel cut solenoid coil (Equipped type only) (P. 2-18).
No good
Replace the fuel cut solenoid coil (P. 11-1).
Good
Check the wire harness for open or short circuit.
No good
Repair or replace the wire harness.
Good
Check for a good seal between the breather cover and the crankcase.
No good
Install the breather cover properly.
If the cover is deformed, replace it (P. 13-1).
Good
Check the breather valve and breather valve stopper (P. 13-1).
No good
Replace any damaged or faulty parts (P. 13-1).
Good
Fuel system is OK.

f. Ignition system



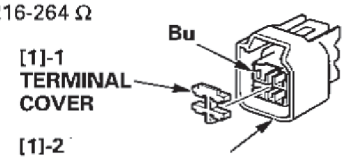
COILS AND IGNITION SWITCHES CHECK

• **COILS AND IGNITION SWITCHES CHECK**

[1] CRANKSHAFT POSITION (CKP) SENSOR INSPECTION

Measure the resistance between the terminal and engine ground (fan cover bolt).

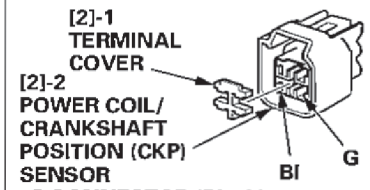
Bu-Ground
Specified resistance:
216-264 Ω



[2] POWER COIL INSPECTION

Measure the resistance between the terminals.

Bl-G
Specified resistance:
3.4-5.3 Ω

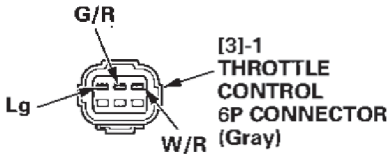


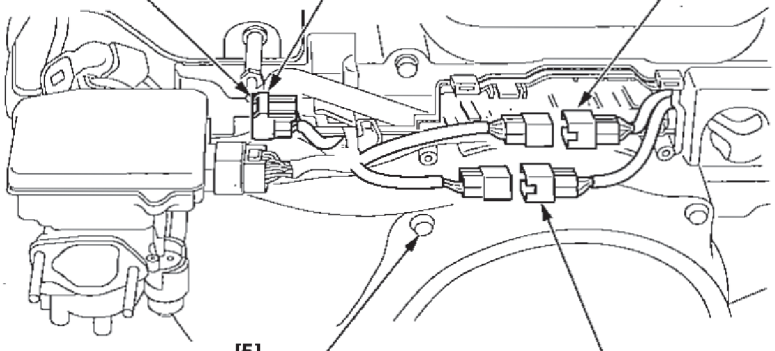
[3] THROTTLE CONTROL INSPECTION

Measure the resistance between the terminals when rotating the throttle control knob fully in the clockwise direction and when rotating it fully in the counterclockwise direction.

Lg-G/R
Specified resistance:
3-7 kΩ (Clockwise direction)
0-500 Ω (Counterclockwise direction)

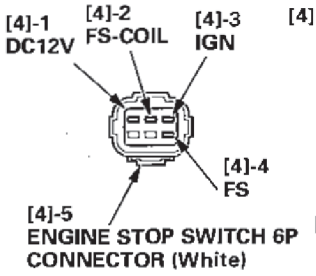
Lg-W/R
3-7 kΩ (Clockwise direction)
3-7 kΩ (Counterclockwise direction)





[5] FAN COVER BOLT (GROUND)

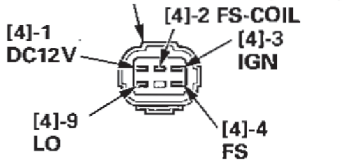
[4] COMBINATION SWITCH/ENGINE STOP SWITCH CHECK



[4]-6 ENGINE STOP SWITCH CONTINUITY TABLE (With fuel cut solenoid type)

Switch position	DC12V Bl/R	IGN Br	FS-COIL O	FS R/W
OFF			○	○
ON	○	○		

[4]-8 COMBINATION SWITCH 6P CONNECTOR (White)



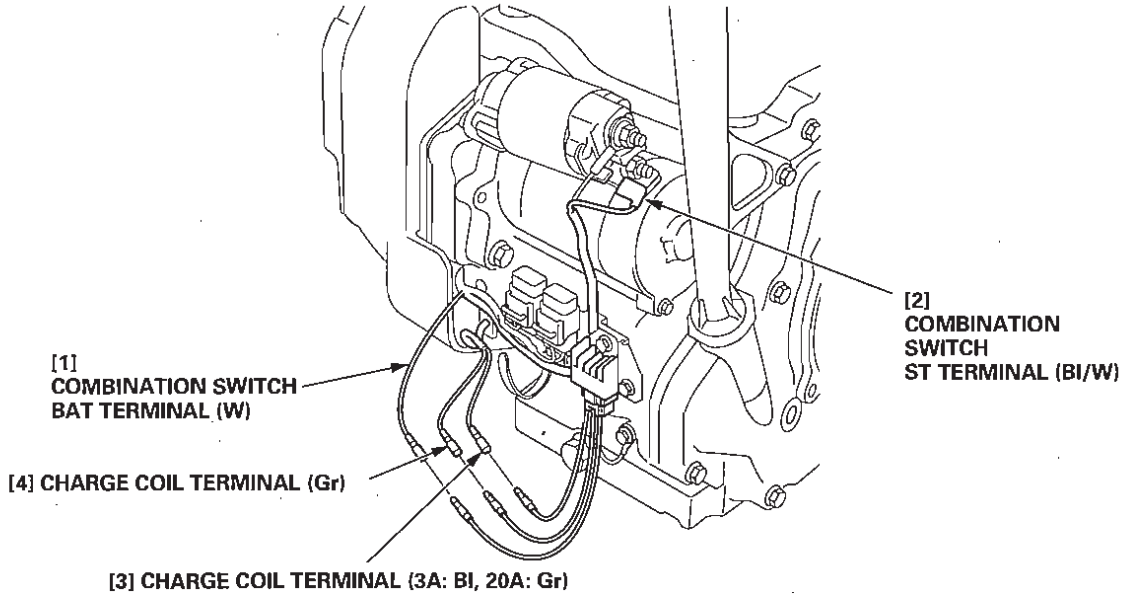
[4]-7 ENGINE STOP SWITCH CONTINUITY TABLE (Without fuel cut solenoid type)

Switch position	DC12V Bl/R	IGN Br
OFF		
ON	○	○

[4]-10 COMBINATION SWITCH CONTINUITY TABLE

Switch position	DC12V Bl/R	IGN Br	FS-COIL O	FS R/W	LO Bl/Y	BAT W	ST Bl/W
OFF			○	○			
ON	○	○			○	○	
START	○	○			○	○	○

BAT and ST terminal location: P. 2-18



[5]
CHARGE COIL INSPECTION

Measure the resistance between the terminals.

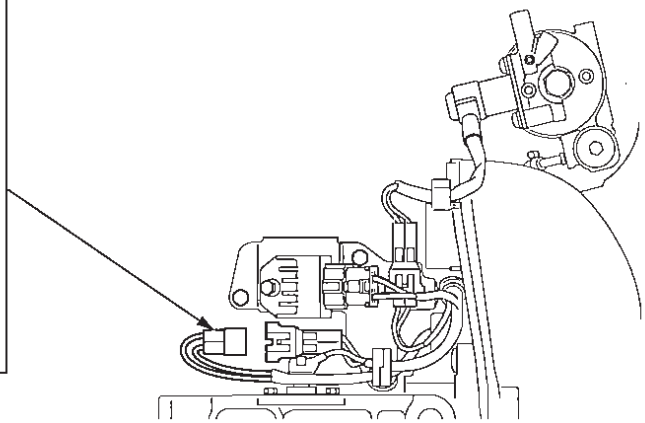
3A: Bl-Gr, 20A: Gr-Gr
Specified resistance:
1.8-2.8 Ω (3A)
0.1-0.3 Ω (20A)

[6]
FUEL CUT SOLENOID COIL INSPECTION

Measure the resistance between the terminals.

O-O
Specified resistance:
3.1-4.7 Ω

[6]-1
FUEL CUT SOLENOID COIL
2P CONNECTOR (White)



SPARK TEST

⚠ WARNING

GASOLINE IS HIGHLY FLAMMABLE AND EXPLOSIVE. YOU CAN BE BURNED OR SERIOUSLY INJURED WHEN HANDLING FUEL. KEEP HEAT, SPARKS AND FLAME AWAY. HANDLE FUEL ONLY OUTDOORS. WIPE UP SPILLS IMMEDIATELY.

NOTICE

DO NOT OPERATE THE STARTER MOTOR FOR MORE THAN 5 SECONDS AT ONE TRY. IF STABLE COMPRESSION IS NOT OBTAINED WITHIN 5 SECONDS, STOP THE STARTER MOTOR AND WAIT 10-20 SECONDS TO ALLOW THE STARTER MOTOR TO COOL, AND REPEAT THE OPERATION AGAIN.

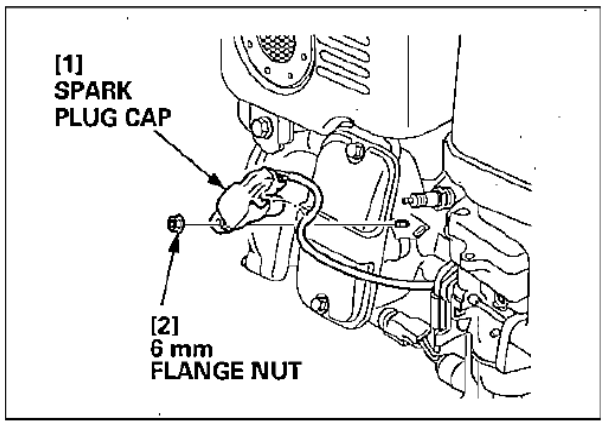
1. Loosen the carburetor drain screw to drain the carburetor througly.
2. Remove the spark plug cap from the spark plug.
3. Remove the spark plug from the cylinder.
4. Crank the engine several times to expel unburnt gas.
5. Attach the spark plug cap to the spark plug.
6. Ground negative (-) electrode (i. e. threaded part) of the spark plug against the cylinder side head cover bolt.

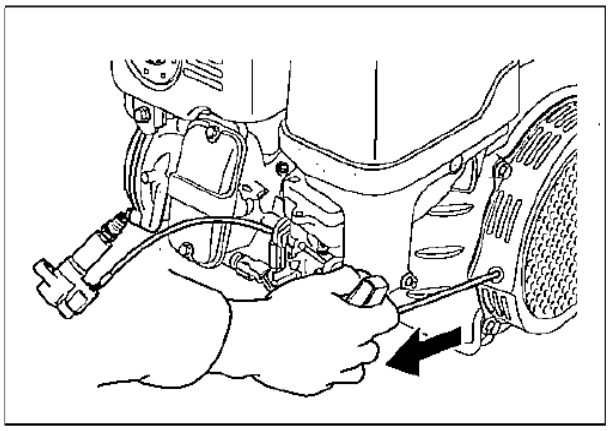
   With recoil starter type:

   Pull the recoil starter to check whether sparks jump across the electrodes.

   With starter motor type:

   Turn the combination switch to the "START" position to check whether sparks jump across the electrodes.





CYLINDER COMPRESSION CHECK

1. Remove the spark plug and spark plug.
2. Turn the throttle control to the HIGH position.
3. **With recoil starter type:**

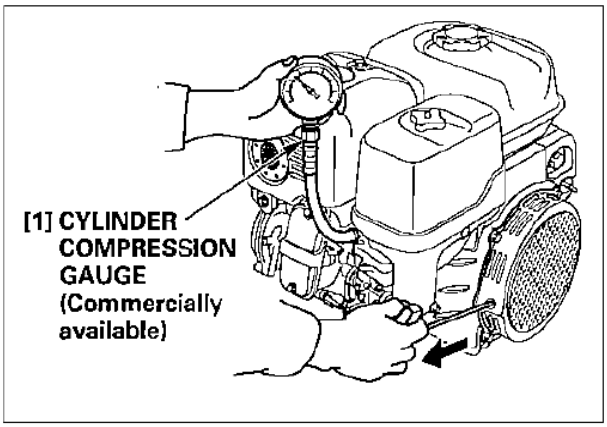
   Pull the recoil starter forcefully several times, and measure the cylinder compression.

Cylinder compression	**0.39-0.68 MPa (4-7 kgf/cm^2, 57-100 psi) at 600 min^{-1} (rpm)**

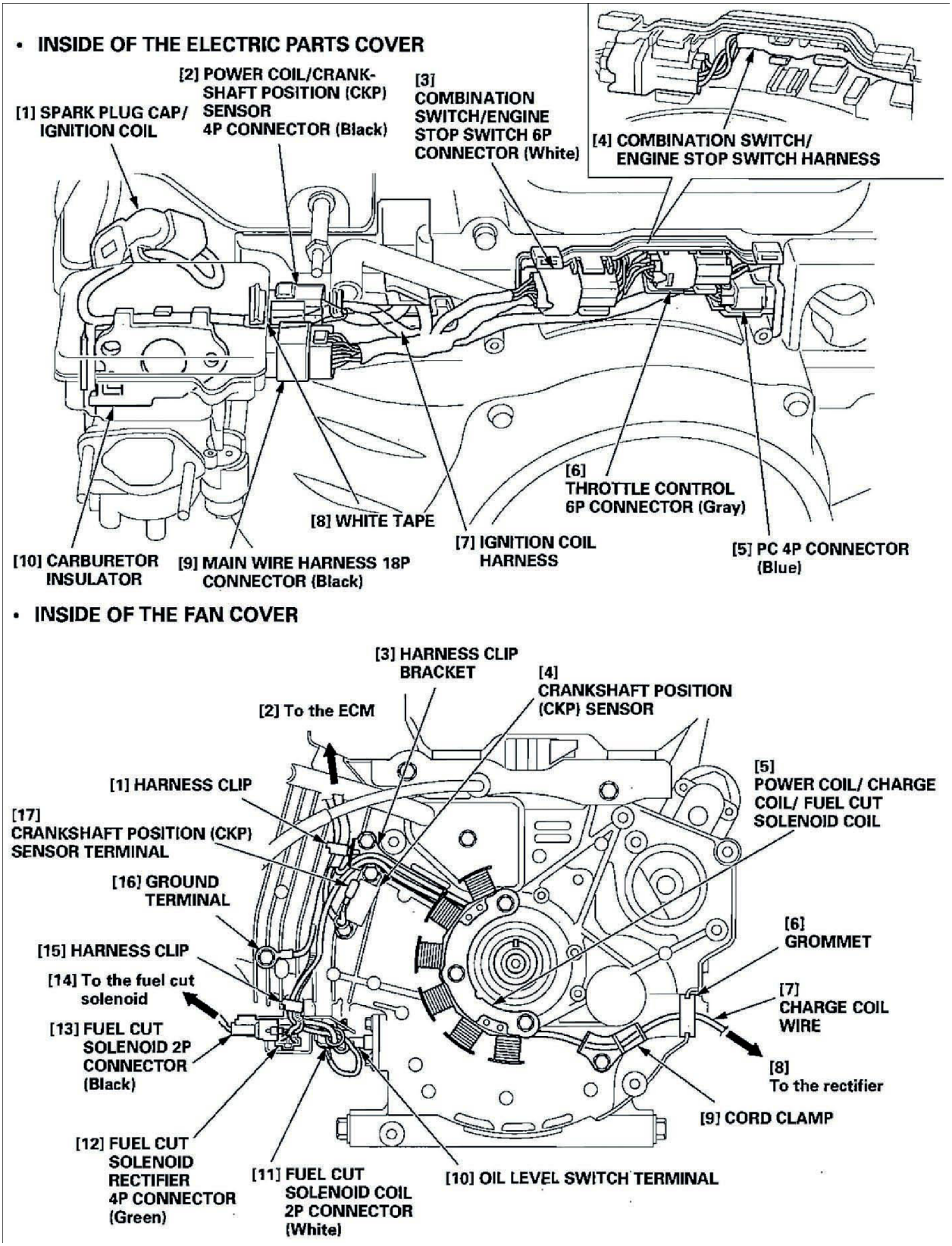
Without recoil starter type:

Turn the combination switch to the "START" position until stable compression is obtained.

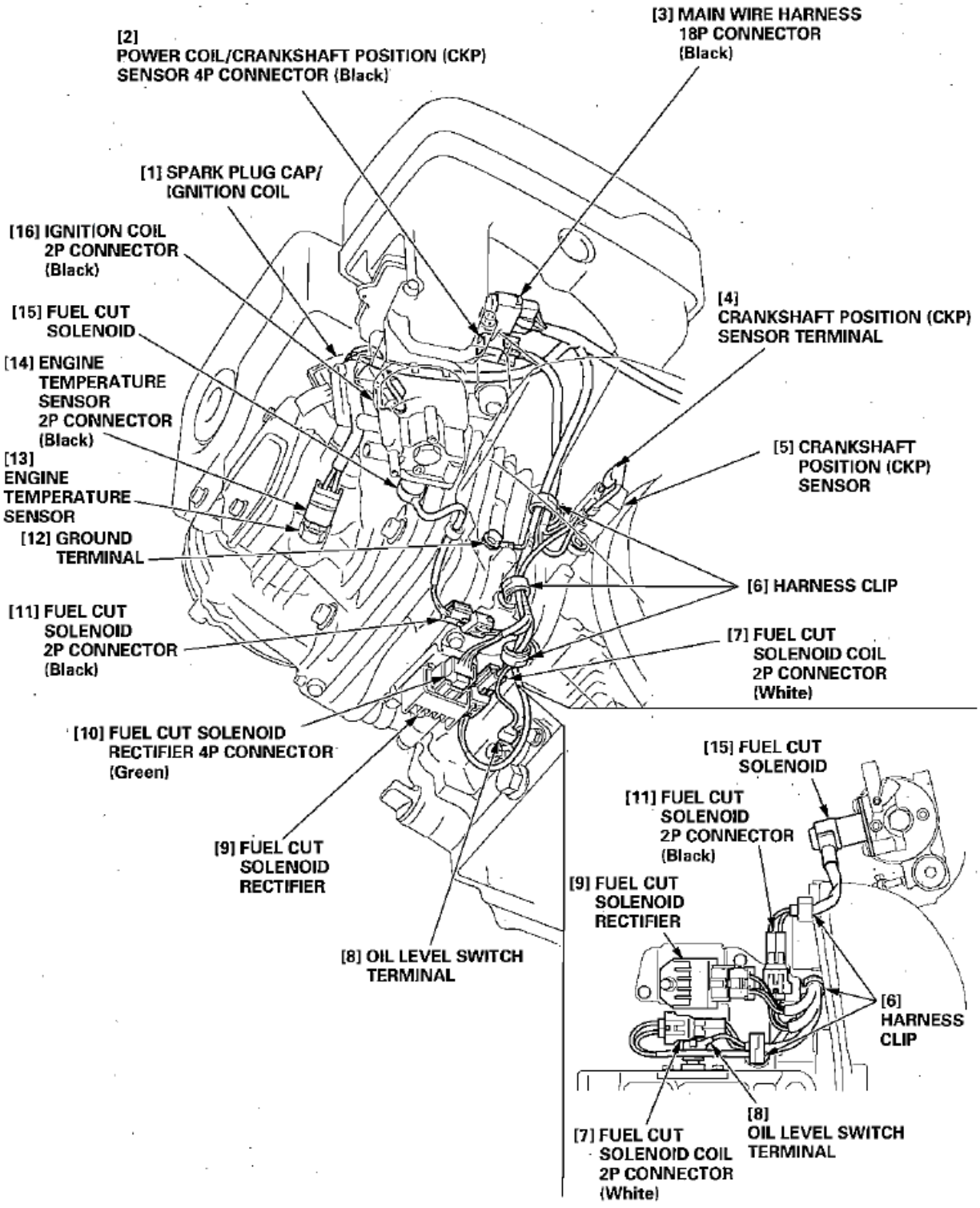
Cylinder compression	**0.39-0.68 MPa (4-7 kgf/cm^2, 57-100 psi) at 600 min^{-1} (rpm)**



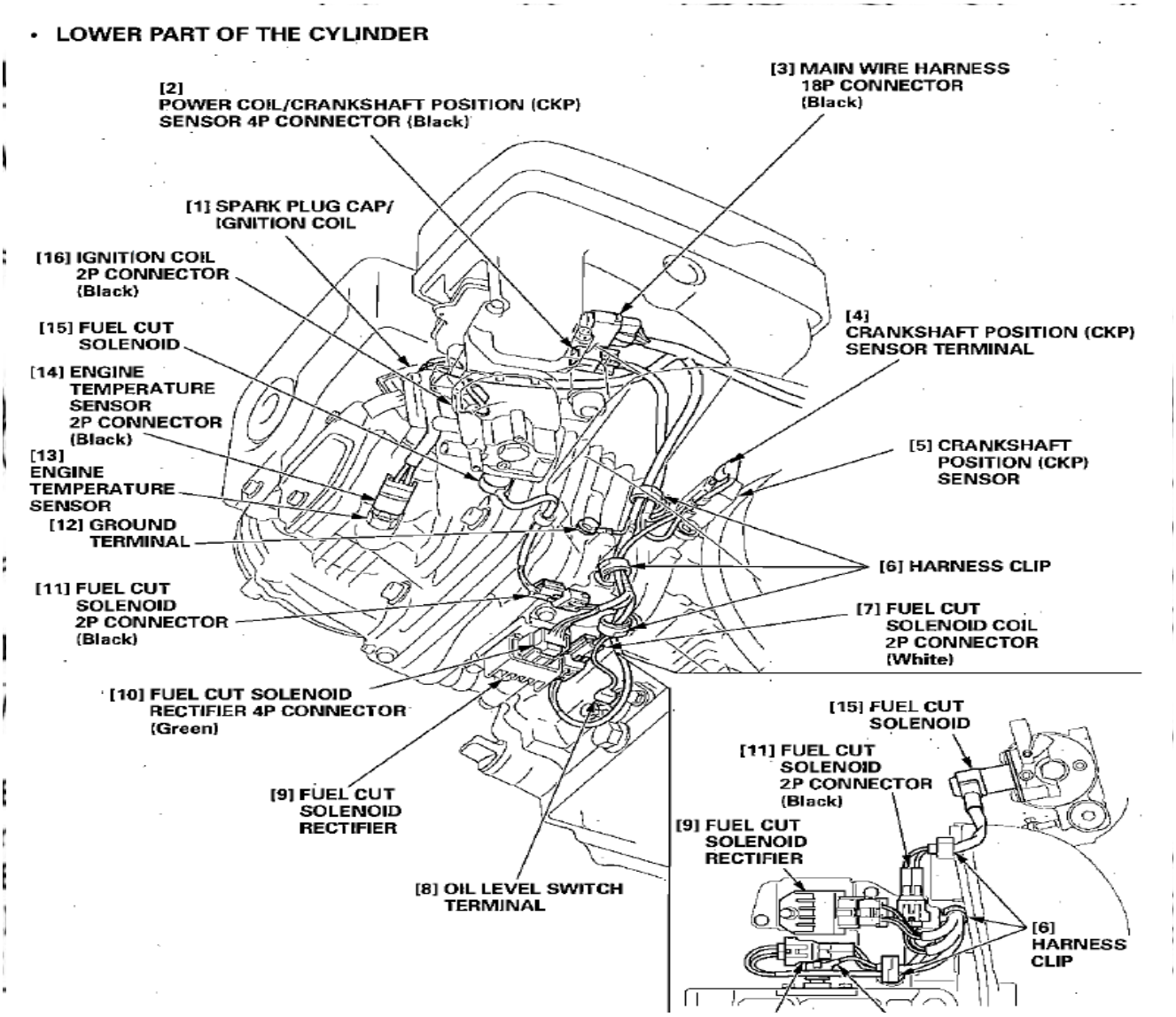
HARNESS ROUTING



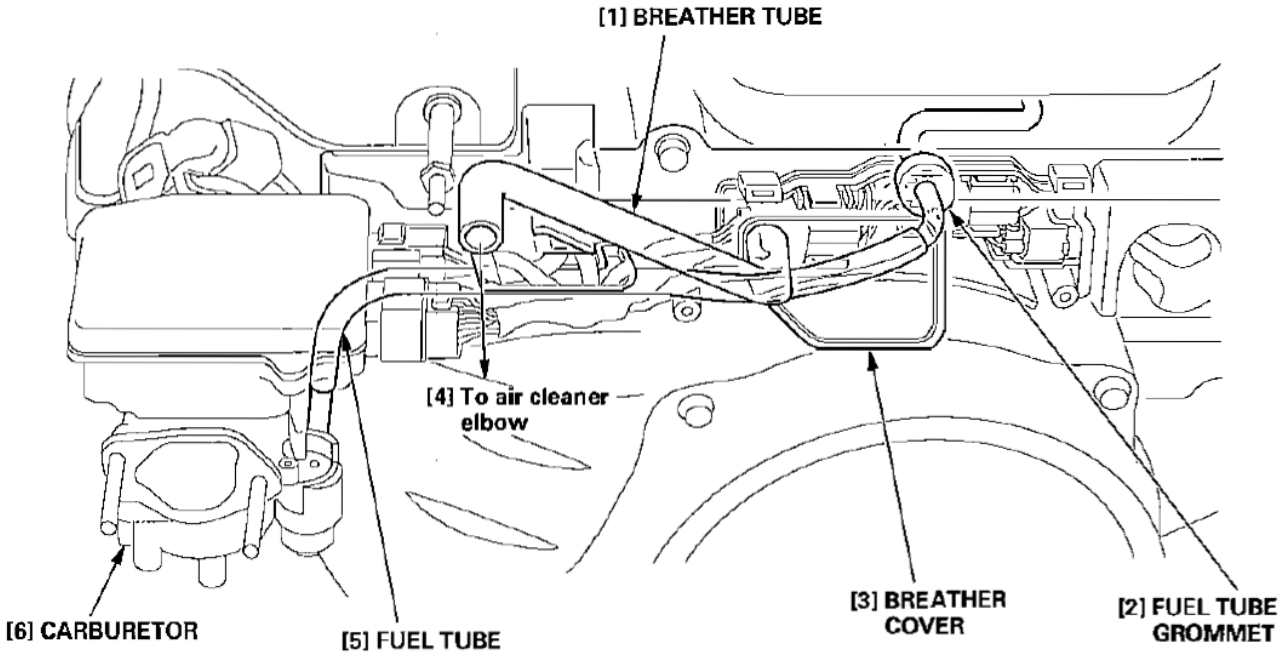
- LOWER PART OF THE CYLINDER



- LOWER PART OF THE CYLINDER



TUBE ROUTING



MAINTENANCE

MAINTENANCE SCHEDULE

	REGULAR SERVICE PERIOD (1) ITEM Perform at every indicated month or operating hour interval, whichever comes first.		Each use	First month or 20 Hrs.	Every 6 months or 100 Hrs.	Every year or 300 Hrs.	Every 2 years or 500 Hrs.	Refer to page
•	Engine oil	Check level	○					3-2
		Change		○	○			
•	Air cleaner	Check	○					3-3
		Clean			○ (2)			
		Replace					○	
•	Spark plug	Check-adjust			○			3-4
		Replace				○		
	Spark arrester	Check-clean			○			3-5
•	Valve clearance	Check-adjust				○		3-6
•	Fuel strainer cup	Clean			○			3-8
	Timing belt	Check	After every 500 Hrs (Replace if necessary) (3)					—
•	Combustion chamber	Clean	After every 500 Hrs					12-2
•	Fuel tank and filter	Clean			○			3-7
•	Fuel tube	Check	Every 2 years (Replace if necessary)					3-8

• Emission related items.

(1) For commercial use, log hours of operation to determine proper maintenance intervals.

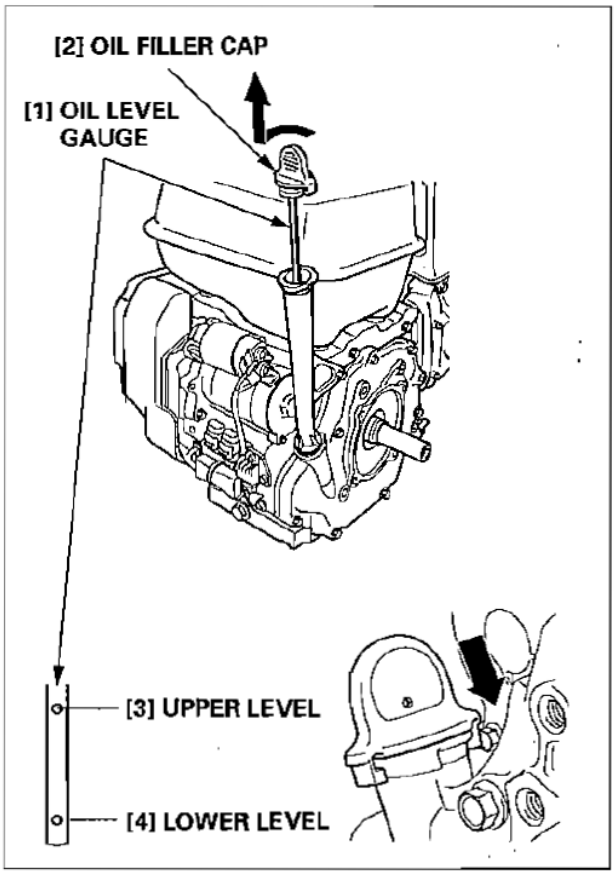
(2) Service more frequently when used in dusty areas.

(3) Check the belt for cracks or abnormal wear; replace if necessary.

ENGINE OIL

Oil level check:

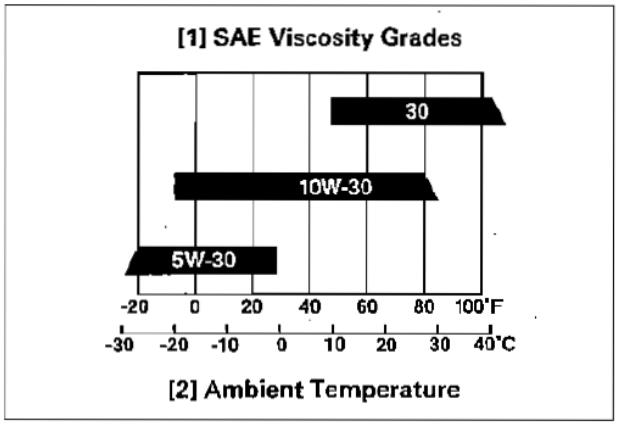
1. Place the engine on a level surface.
2. Turn the oil filler cap counterclockwise 90 degrees to unlock the cap and remove the oil level gauge from the oil filler neck. Wipe the oil level gauge clean.
3. Insert the oil level gauge without screwing it into the oil filler neck. Remove the oil filler cap and check the oil level shown on the oil level gauge.
4. If the oil level is near or below the lower level mark on the oil level gauge, fill with the recommended oil to the upper level mark.



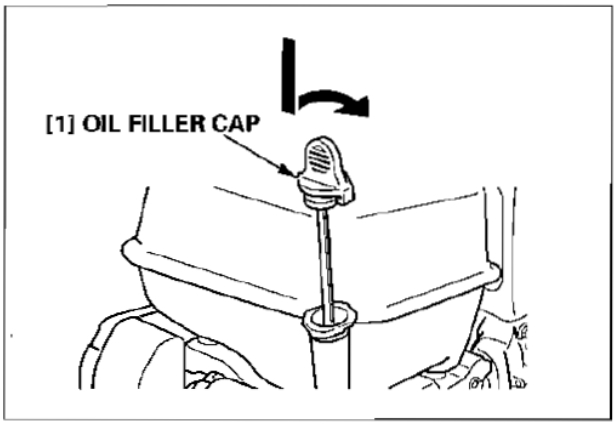
Recommended oil	**SAE 10W-30 API Service classification SE, SF or SG**

Oil is a major factor affecting performance and service life. Use 4-stroke automotive detergent oil.

SAE 10W-30 is recommended for general use. Other viscosities shown in the chart may be used when the average temperature in your area is within the recommended range.



Insert the oil level gauge into the oil filler neck and turn the oil filler cap clockwise 90 degrees to lock the cap.



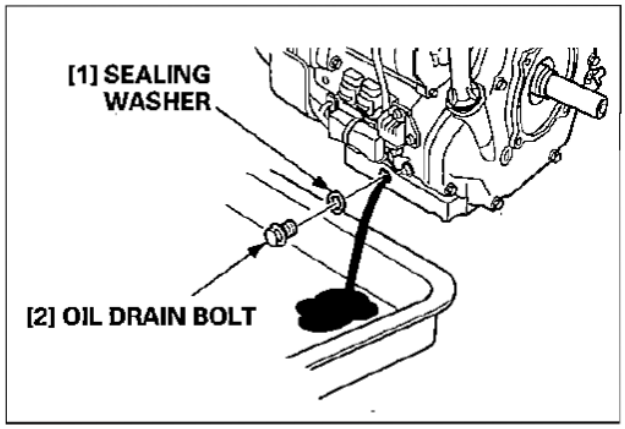
Oil change:

1. Check the engine on a level surface and remove the oil filler cap.
2. Remove the oil drain bolt and sealing washer. and drain the oil into a suitable container.

   Please dispose of used motor oil in a manner that is compatible with the environment. We suggest you take use oil In a sealed container to your local recycling center or service station for reclamation. Do not throw it in the trash. pour it into the ground, or down a drain.

⚠ CAUTION

USED ENGINE OIL CONTAINS SUBSTANCES THAT HAVE BEEN IDIOTIC AS CARCINOGENIC. IF REPEATEDLY LEFT IN CONTACT WITH THE SKIN FOR PROLONGED PERIODS, IT MAY CAUSE SKIN CANCER. WASH YOUR HANDS THOROUGHLY WITH SOAP AND WATER AS SOON AS POSSIBLE AFTER CONTACT WITH USED ENGINE OIL.



3. Tighten the oil drain bolt and a new sealing washer to the specified torque.

   TORQUE: 45 N·m (4.5 kgf·m, 33 lbf·ft)

4. Refill with the commended oil.

Engine oil capacity	**1.10 l (1.16 US qt, 0.97 Imp qt)**

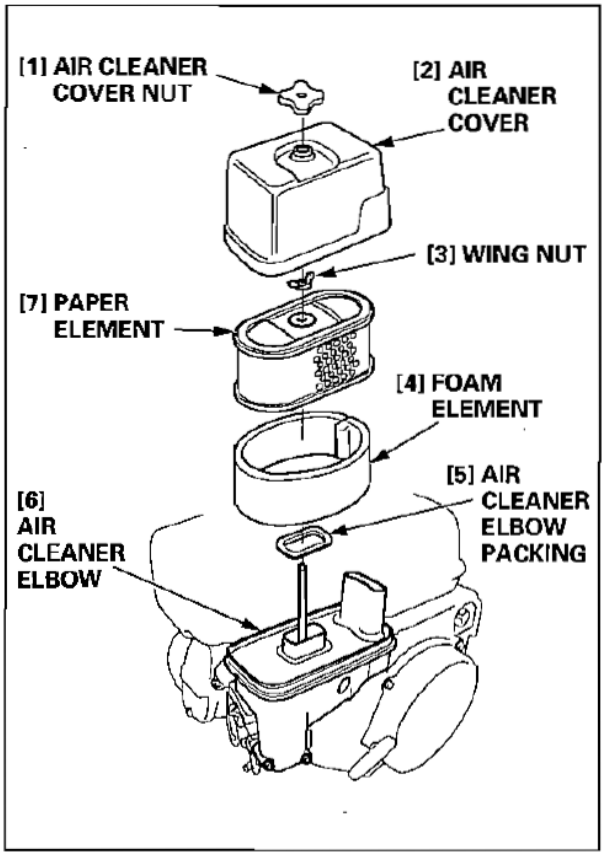
1. Check the oil level and, if the oil level is near or below the lower limit mark on the oil level gauge, fill with the recommended oil to the upper level mark.
2. Install the oil filler cap.

AIR CLEANER

Cleaning:

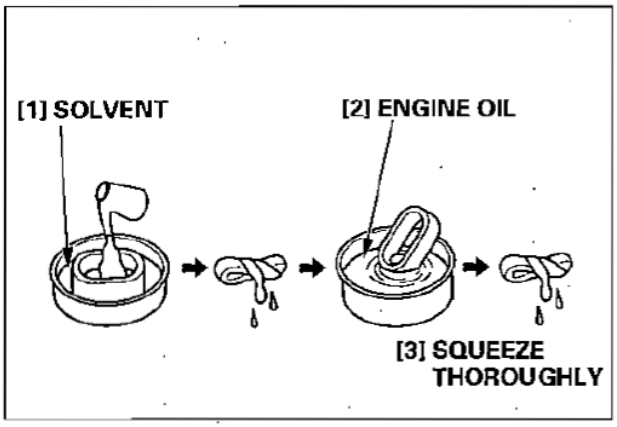
A dirty air cleaner will restrict air flow to the carburetor, reducing engine performance. If the engine is operated in dusty areas, clean the air cleaner more often than specified In the MAINTENANCE SCHEDULE.

1. Remove the air cleaner cover nut and air cleaner cover.
2. Remove the wing nut, air cleaner elements (paper element and foam element) and air cleaner elbow packing, and separate them. Carefully check both elements for hole, or tear: and replace if damaged. Check the air cleaner claw packing for deterioration or damage.

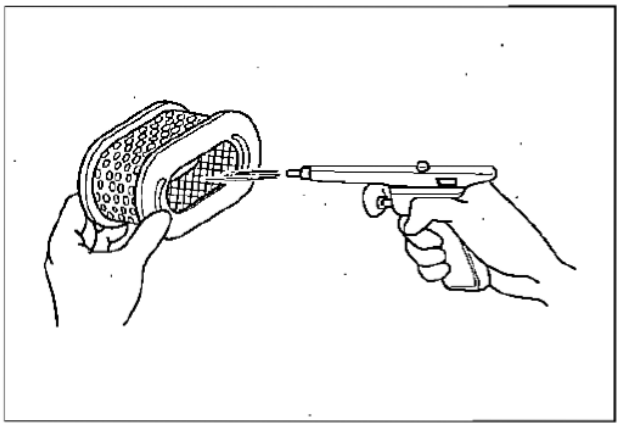


3. Foam element: Clean the element in warm soapy water, rinse and allow to dry thoroughly, or clean with a Nigh flash point solvent and allow to dry thoroughly. Dip the element in clear engine oil and squeeze out all the excess oil. Excess oil will restrict

air flow through the form element and may cause the engine to smoke at startup.



4. Paper element: Tap the element lightly several times on a hard surface to remove excess dirt or blow compressed air lightly 207 kPa (2.1 kgf/cm2, 30 psi) or less) through the falter from the inside out. Never try to brush the dirt off; brushing will force dirt into the fibers.



5. Wipe dirt from the inside of the air cleaner elbow and all cleaner cover, using a rag. Be careful to prevent dirt frond entering the air duct that leads to the carburetor.
6. Install the foam element to the paper element. Install the air cleaner elbow packing and air cleaner ale' mints, and tighten the wing nut securely.

   Install the air cleaned cover and tighten the air cleaned cover nut securely.

NOTICE

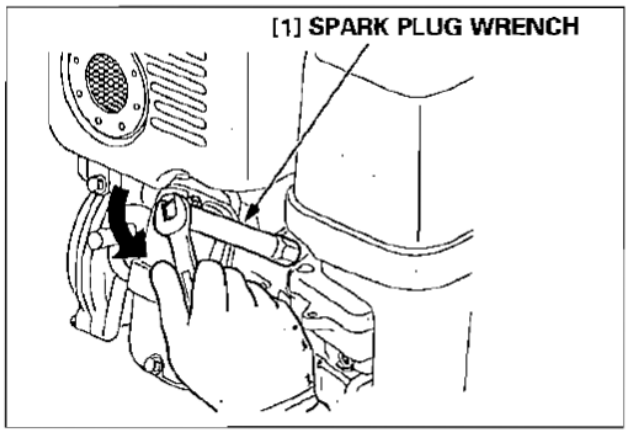
OPERATING THE ENGINE WITHOUT THE AIR CLEANER ELEMENT OR WILT THE ELEMENT INSTALLED LOOSELY WITH ALLOW DIRT TO ENTER THE ENGINE, CAUSING RAPID ENGINE WEAR. INSTALL THE AIR CLEANER ELEMENT SECURELY.

SPARK PLUG

Inspection/cleaning:

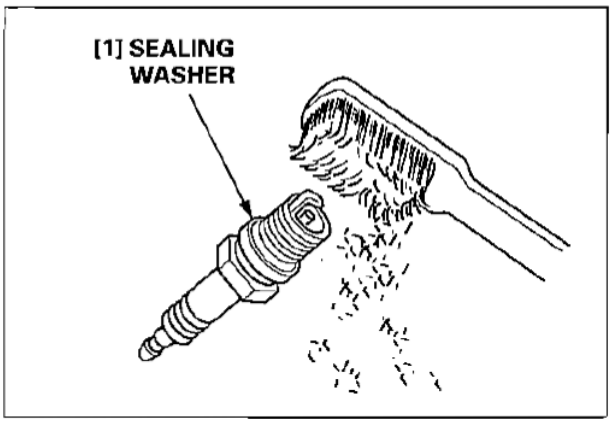
If the engine has been running, the engine will be very hot Allow it to coo! before proceeding.

1. Remove the spark plug cap and remove the spark plug using spark plug wrench.



2. Visually inspect the spark plug. Discard the plug if the insulator is cracked of chipped.
3. Remove carbon and other deposits with a plus cleaner or stiff wire brush. Check the sealing washer for damage.

Spark plug	BKR7E-E (NGK) K22PR-UR (DENSO)

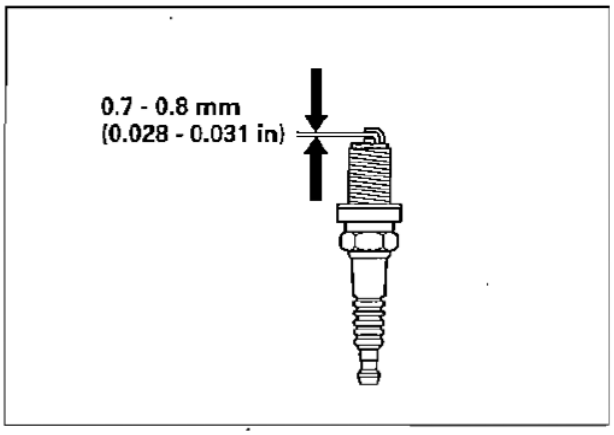


1. Measure the plug gag with a wire-type feeler gauge. If the measurement is outside the specification, adjust by bending the side electrode.

Plug gap	0.7 - 0.8 mm (0.028-0.031 in)

1. Install the spark plug fingerings to beat the washer, and then tighten with a plug wrench. If reinstalling the used spark plug, tighten 1/8-1/4 turf after the spark plug seats. If installing a new spark plug, tighten 1/2 turn after the spark plug seats.

   TORQUE: 18 N·m (1.8 Kgf·m, 13 lfb·ft)



NOTICE

A LOOSE SPARK PLUG OWN INCOME VET HOT AND CAN DALES, THE ENGINE. OVERTIGHTENING CAN DAMAGE THE THREADS IN THE CYLINDER BLOCK.

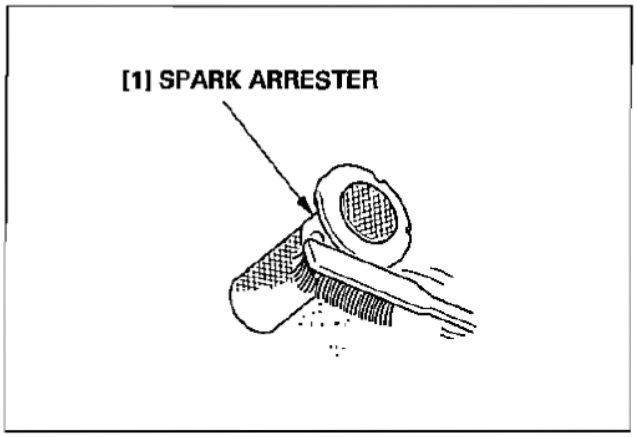
2. Install the spark plug cap securely.

SPARK ARRESTER

Cleaning:

⚠ CAUTION

THE ENGINE AND MUFFLER BECOME VERY HOT DURING OPERATION AND THEY REMAIN HOT FOR A WHILE AFTER OPERATION. BE SURE THAT THE ENGINE IS COOL BEFORE MUFFLER REMOVAL/INSTALLATION.



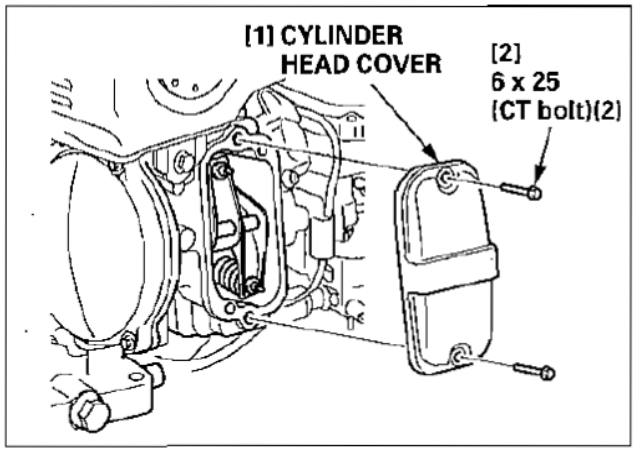
1. Remove the spark arrester from the muffler.
2. Clean the carbon deposits. from the spark arrester screed with a brush.
3. Check the spark arrester screen for damage. If the gnarl arrester is damaged, replace it.
4. Rainfall the spark arrester to the muffler.

VALVE CLEARANCE

Inspection/adjustment:

Valve clearance inspection and adjustment must be per formed with the engine cold.

1. Remove the cylinder head cover.

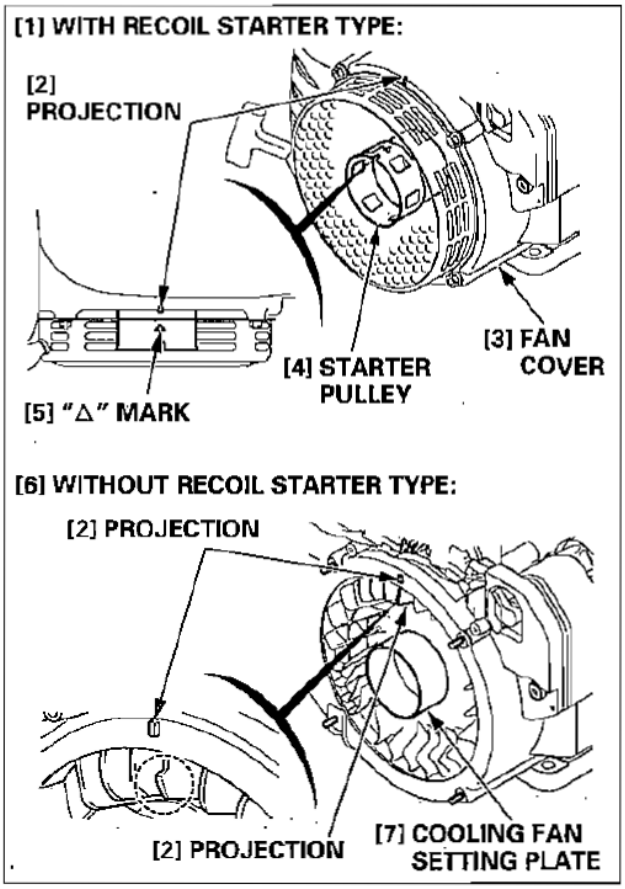


2. **With recoil starter type**:

   Set the piston at top dead center of the compression stroke (both' valves fully closed) by pulling the recti starter slowly. The "Δ" mark on the starter pulley wit align with the projection on the fan cover when the pastor is at top dead center of the compression stroke.

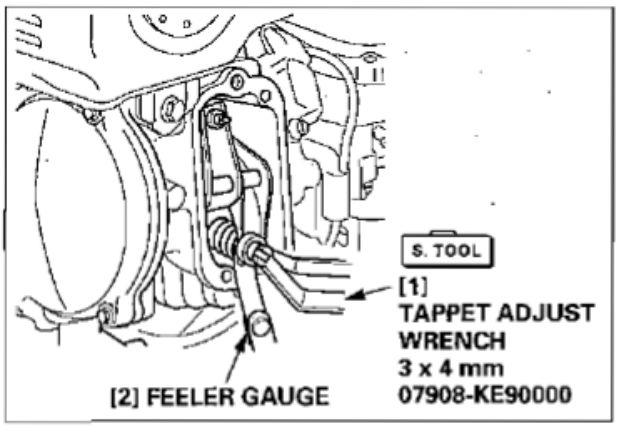
   Without retool starter type:

   sit the piston at top dead center of the compression stroke (both valves fully closed) by turning the cooling fan setting plate. The projection of the cooling fan will align with the projection on the fan cover when the piston is at top dead center of the compression stroke.



3. Insert a feeler gauge between the rocker arm and valve to measure valve clearance.

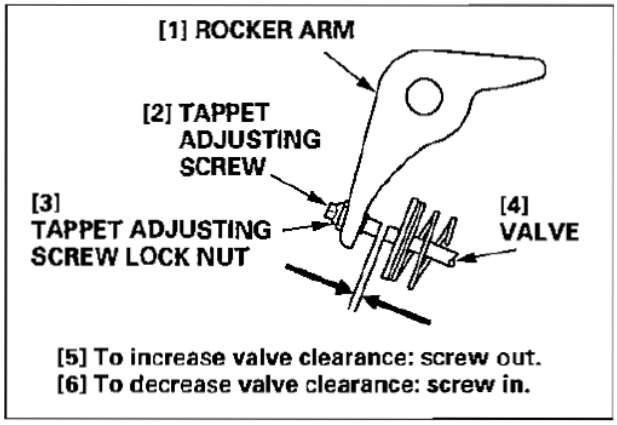
Valve clearance	IN	0.12 ±0.02 mm
	EX	0.15 ±0.02 mm



1. **If adjustment is necessary proceed is follows:**
   a. Hold the tappet adjusting screw using the special too and loosen the tappet adjusted screw lock nut.
   b. Turn the tappet adjusting screw to obtain the specifier clearance.
   c. Heighten the tappet adjusting screw lock nut while holding the rocker arm pivot.

   TORQUE: 7.5 N·m (0.75 kgf·m, 5.5 lbf·ft)

   Recheck valve clearance after tightening the tappet adjusting screw lock nut.
2. Install the cylinder head cover.



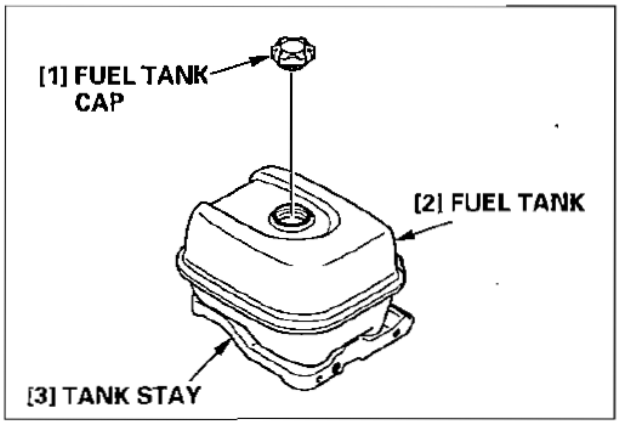
FUEL TANK

Cleaning:

⚠ WARNING

GASOLINE IS HIGHLY FLAMMABLE END EXPLOSIVE. YOU CAN RETURNED OR SERIOUSLY INJURED WHEN HANDLING FUEL. KEEP HEAT, SPARKS AND FLORAL AWAY. HANDLE FUEL ONLY OUTDOORS. WIPE UP SPILLS IMMEDIATELY.

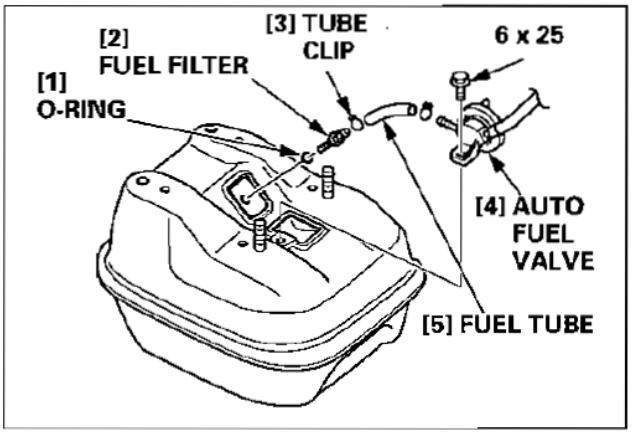
- After connecting the fuel tube. Check for any sign of fuel leakage.



1. Drain the fuel from the fuel tank into a suitable container.

   Manual fuel vales type:

   Drain tie fuel from the carburetor before removing the fuel tank, proceed as follows:
   a. Turn the fuel valve lever to the OFF position.
   b. Loosen the drain screw of the carburetor end drain tie fuel trio a suitable container.
2. Remove the fuel tank, tank stay and auto fuel valve and disconnect the fuel tube from the auto feel valve.
3. Disconnect the fuel lube end remove the fuel filter and oaring from the fuel lank. Wash the fuel filter in nonflammable or high flash point solvent. Inspect the fuel filter screen to be sure it is undamaged.
4. Clean the fuel lank with nonflammable or high flash point solvent and allow to dry thoroughly.
5. Install the fuel filter, O-ring, fuel valve, fuel tube and fuel tank cap. Connect the fuel tube to the fuel valve and install the fuel tank.
6. After reassembly check for fuel leaks.



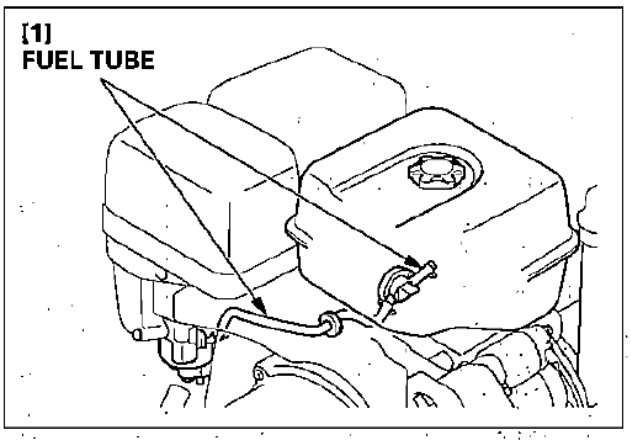
FUEL TUBE

Inspection:

⚠ WARNING

GASOLINE IS HIGHLY FLAMMABLE AND EXPLOSIVE. YOU CAN BE BURNED OR SERIOUSLY INJURED WHEN HANDLING FUEL. KEEP HEATH QUIRK: AND FLAME AWAY. HANDLE FULL ONLY OUTDOORS. WIPE UP SPILLS IMMEDIATELY.

- After connecting the fuel tube, check for any sign of fuel leakage.



Check the fuel line for deterioration, damage or leakage. Replace the fuel line if necessary.

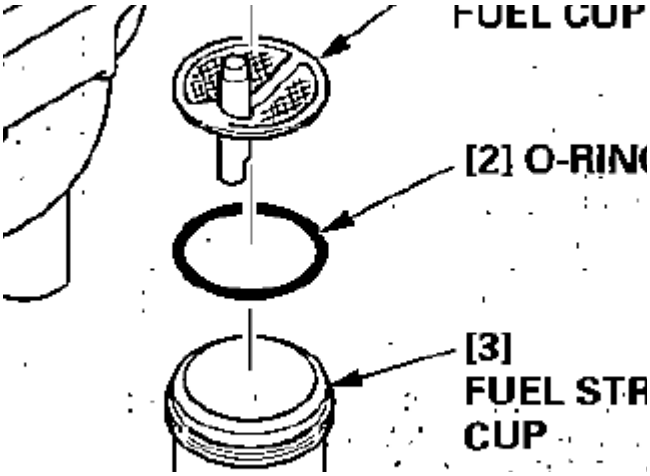
FUEL STRAINER CUP

Cleaning:

⚠ WARNING

GASOLINE IS HIGHLY FLAMMABLE AND EXPLOSIVE. YOU CAN BE BURNED OR SERIOUSLY INJURED WHEN HANDLING FUEL. KEEP HEAT, SPARK AND FLAME AWAY. HANDLE FUEL ONLY OUTDOORS. WIPE UP SPILLS IMMEDIATELY.

- After installing the fuel strainer cup, check for any sign of fuel leakage.

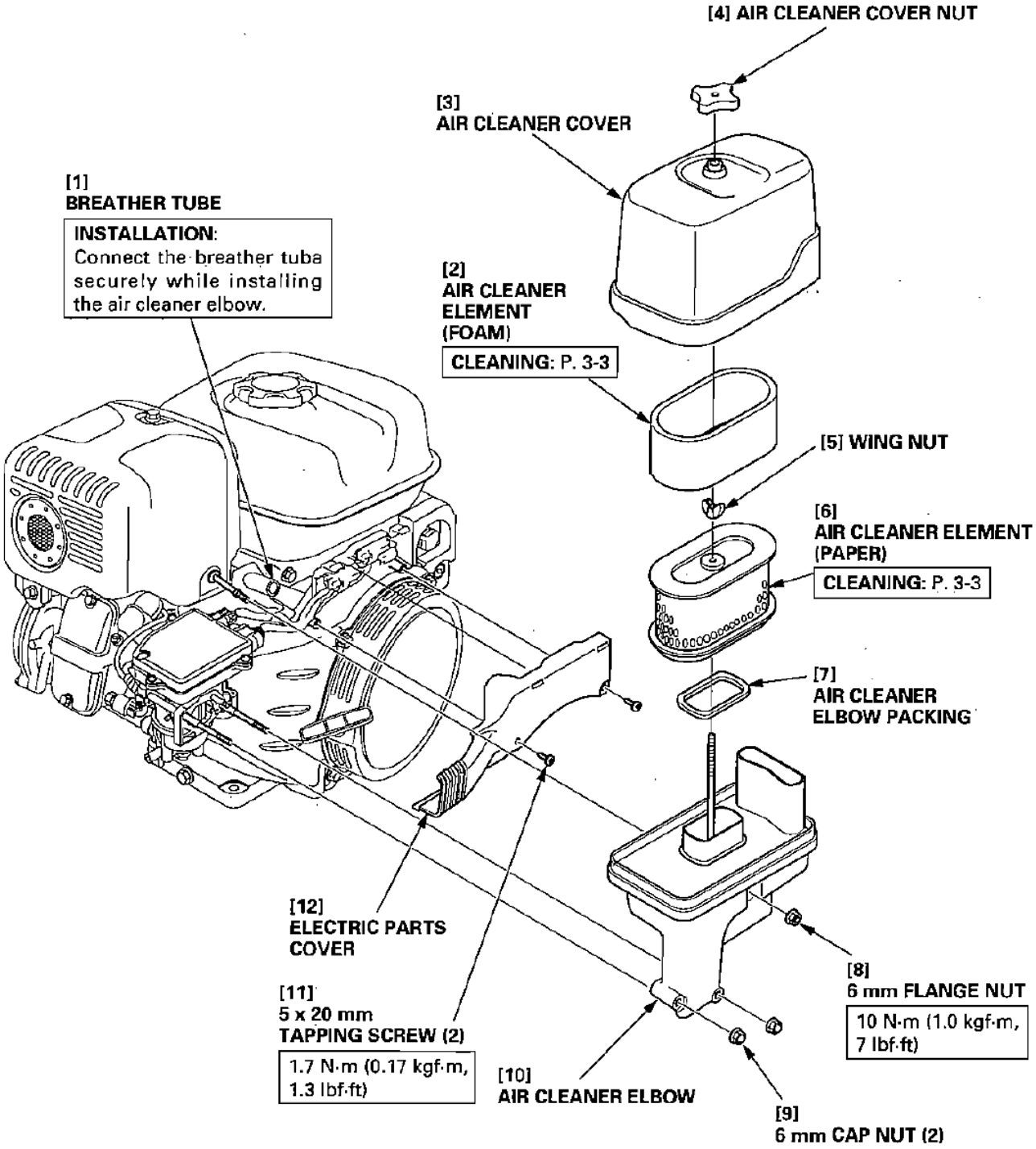


1. Remove the fuel strainer
2. Remove the fuel cup filter and clean it.
3. Install the fuel cup filter and tighten the fuel strainer cup to the specified torque.

   TORQUE: 3.9 N·m (0.4 kgf·m, 2.9 lbf·ft)

AIR CLEANER

REMOVAL/INSTALLATION



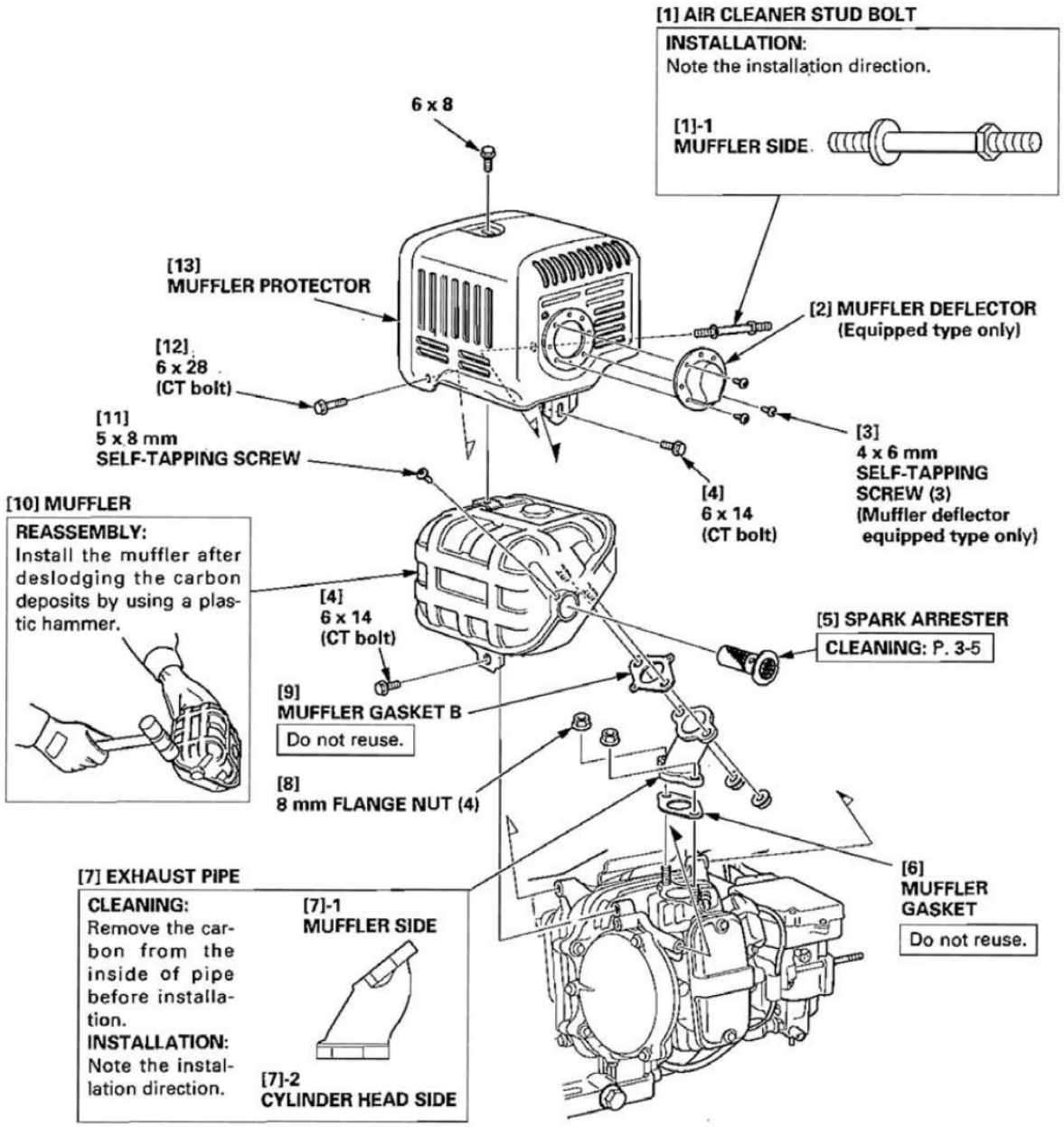
MUFFLER

REMOVAL/INSTALLATION

⚠ CAUTION

THE ENGINE AND MUFFLER BECOME VERY HOT DURING OPERATION AND THEY REMAIN HOT FOR A WHILE AFTER OPERATION. BE SURE THE ENGINE IS COOL BEFORE MUFFLER REMOVAL/INSTALLATION.

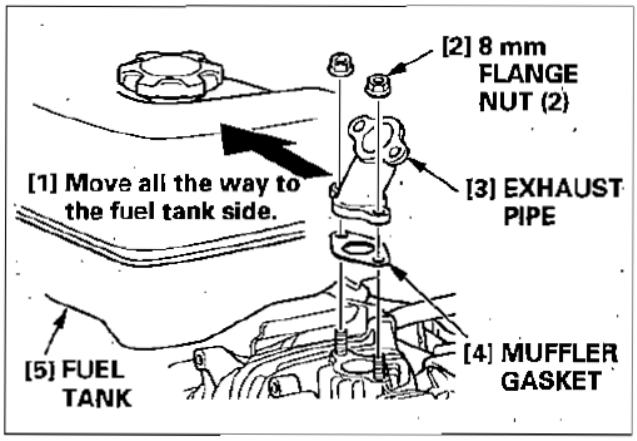
1. Remove the air cleaner.



EXHAUST PIPE/MUFFLER PROTECTOR

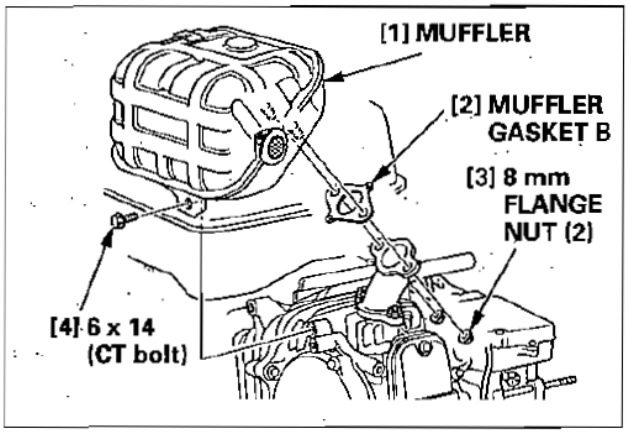
INSTALLATION:

1. Attach a new muffler basket and exhaust pipe to the cylinder head.
2. Move the exhaust pipe all the way to the fuel tank side and tighten the 8 mm flange nuts.

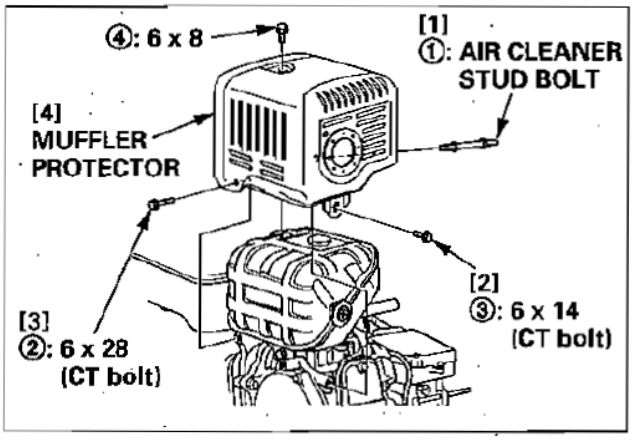


3. Attach a new muffler gasket B and muffler to the exhaust pipe. Tighten the I x 14 mm CT bolt on the muller stay.
4. Tighten the 8 mm flange nuts to install the muffler on the exhaust pipe.

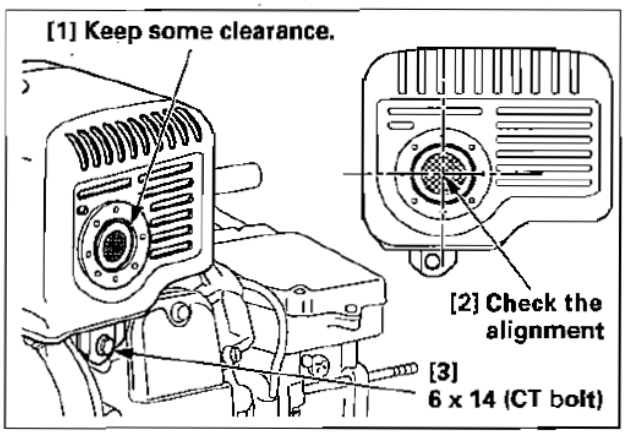
   After tightening the flange nuts. be sure the muffler gasket and exhaust pipe are closely attached together.



5. Put the muffler protector on the muffler and then loosely tighten the bolts in the numbered sequence as shown.



6. Align the center of the muffler' protector exhaust slot wit) the reenter of. the spark arrester, and tighten the 6 x 14 mm CT bolt under the echoed! slot securely.
7. Keep some clearance between the exhaust slot and the spark arrester, and tighten the other three bolts securely.



CARBURETOR

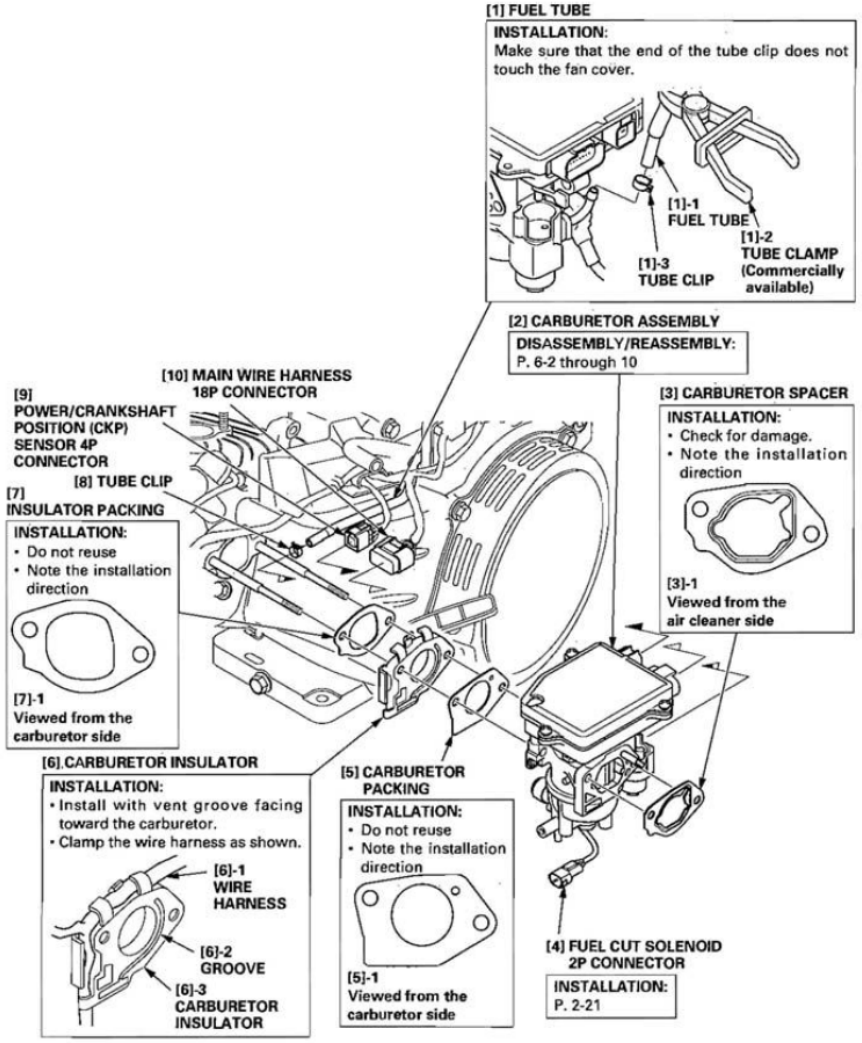
REMOVAL/INSTALLATION

⚠ WARNING

GASOLINE IS HIGH FLAMMABLE AND EXPLOSIVE. YOU CAN BE TURNED USURIOUSLY INJURED WHEN HANDLING FUEL. KEEP HEAT, SPARKS IND FLAME AWAY. HANDLE FUEL ONLY OUTDOORS. WIPE UP SPILLS IMMEDIATELY.

- Before removal, attach e commercially available tube clamp to the fuel lube and completely drain the carburetor.
- Turn the fuel VALVE to the OFF position, and then disconnect the fuel tube from the carburetor. (Manual fuel valve type only)
- Connect the fuel tube securely while installing the carburetor, or gasoline will drain when starting the engine.

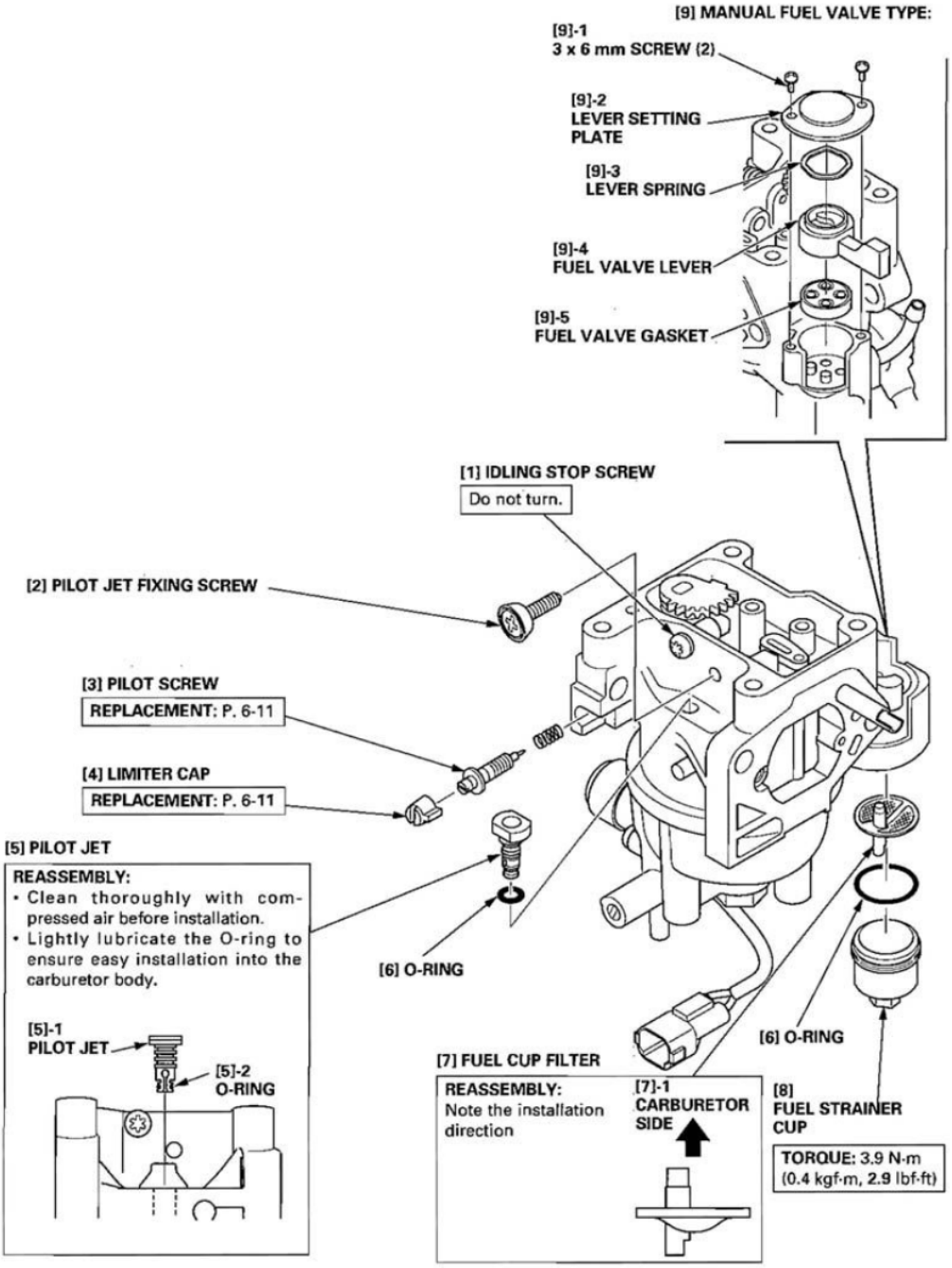
1. Remove the air cleaner.

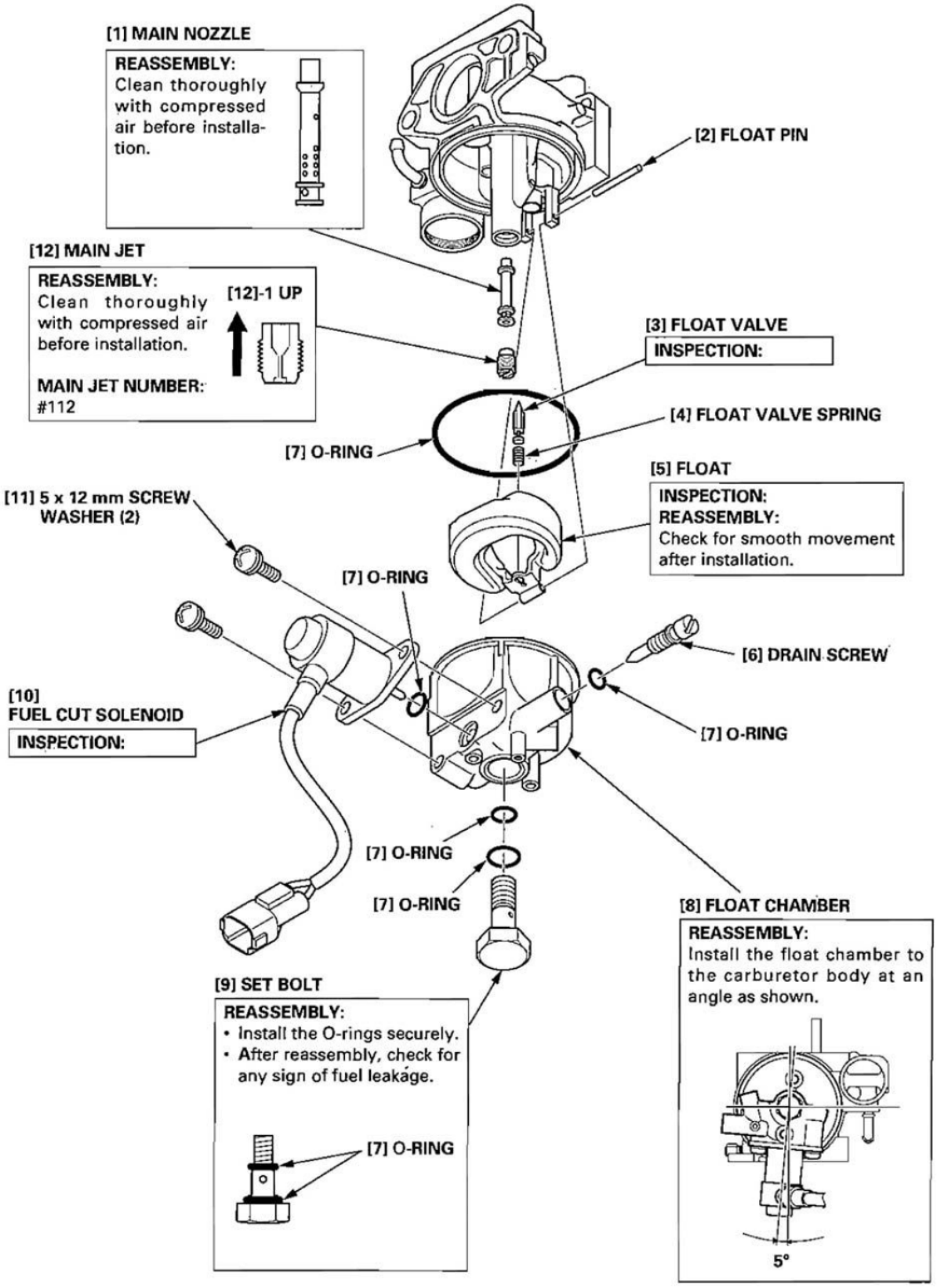


⚠ WARNING

GASOLINE IS HIGHLY FLAMMABLE AND EXPLOSIVE. YOU CAN BE BURNED OR SERIOUSLY INJURED WHEN HANDLING FUEL. KEEP HEAT, SPARKS AND FLAME AWAY. HANDLE FUEL ONLY OUTDOORS. WIPE UP SPILLS IMMEDIATELY.

- Before removal, completely drain the carburetor.
- Clean the outside of the carburetor before disassembly.

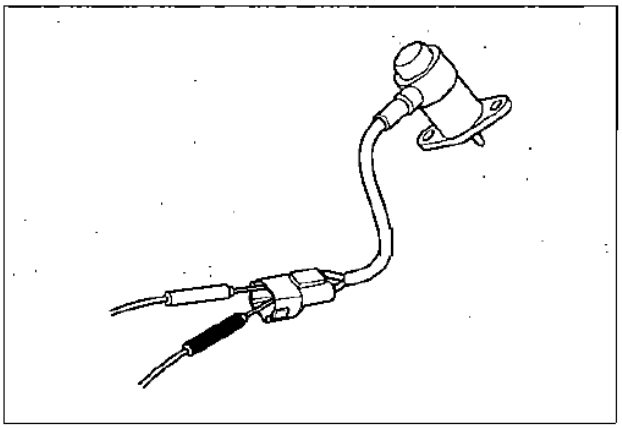



[1] MAIN NOZZLE
REASSEMBLY:
Clean thoroughly with compressed air before installation.
[2] FLOAT PIN
[12] MAIN JET
REASSEMBLY:
Clean thoroughly with compressed air before installation.
MAIN JET NUMBER:
#112
[12]-1 UP
[3] FLOAT VALVE
INSPECTION:
[4] FLOAT VALVE SPRING
[7] O-RING
[5] FLOAT
INSPECTION:
REASSEMBLY:
Check for smooth movement after installation.
[11] 5 x 12 mm SCREW WASHER (2)
[7] O-RING
[6] DRAIN SCREW
[7] O-RING
[10]
FUEL CUT SOLENOID
INSPECTION:
[7] O-RING
[7] O-RING
[8] FLOAT CHAMBER
REASSEMBLY:
Install the float chamber to the carburetor body at an angle as shown.
5°
[9] SET BOLT
REASSEMBLY:
• Install the O-rings securely.
• After reassembly, check for any sign of fuel leakage.
[7] O-RING

FUEL CUT SOLENOID

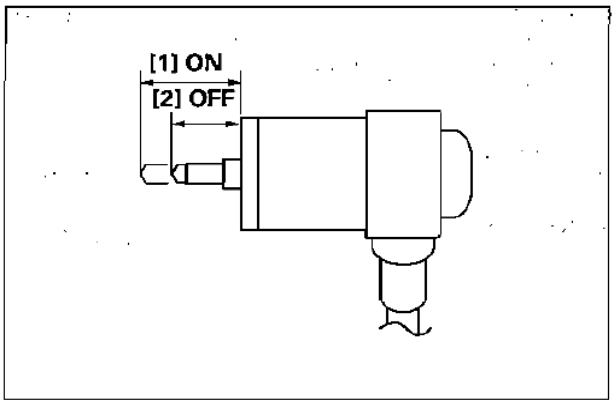
Measure the resistance between the terminals.

Specified resistance	**3.8 - 5.8 Ω**



When 12V battery voltage is applied, check that the fuel cut solenoid operates normally.

Check the extended length of the needle at ON (battery connected) position and OFF (battery removed) position.



FUEL TANK

REMOVAL/INSTALLATION

⚠ WARNING

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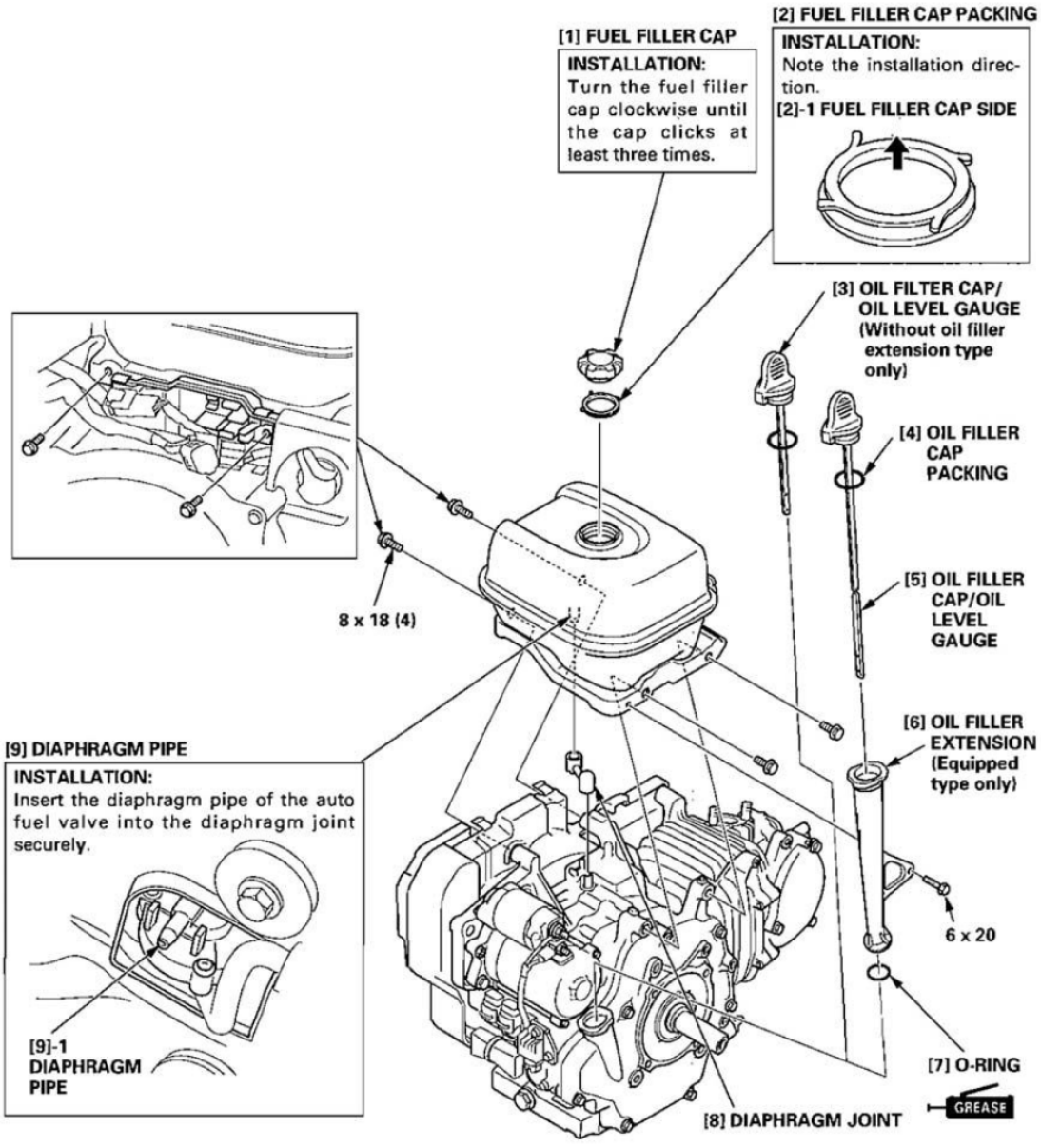
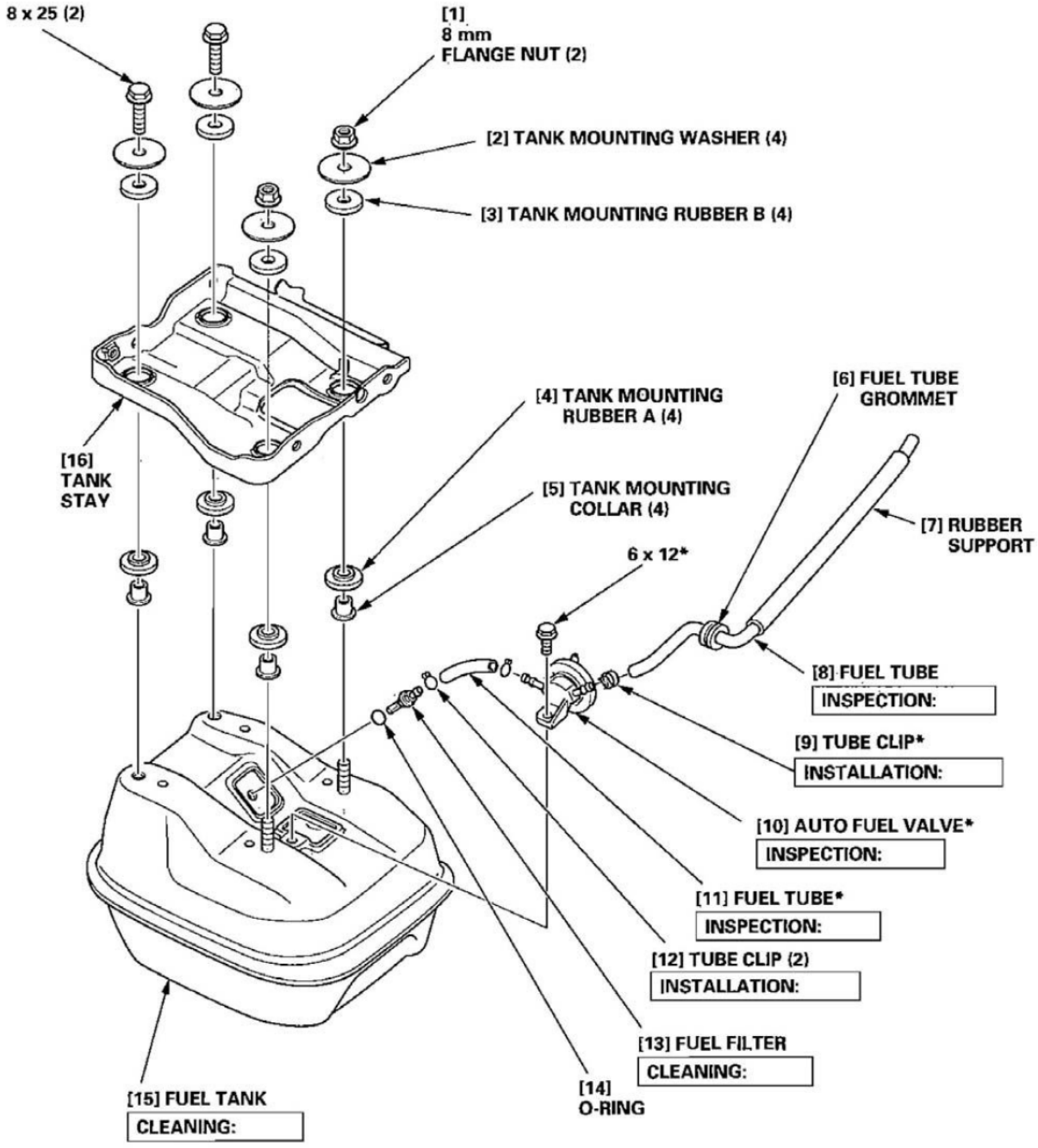
Before removal, drain the fuel tank and attach a commercially available tube clamp to the fuel tube.

1. Remove the electric parts cover.
2. Disconnect the fuel tube from the carburetor.



DISASSEMBLY/REASSEMBLY

Auto fuel valve type only.

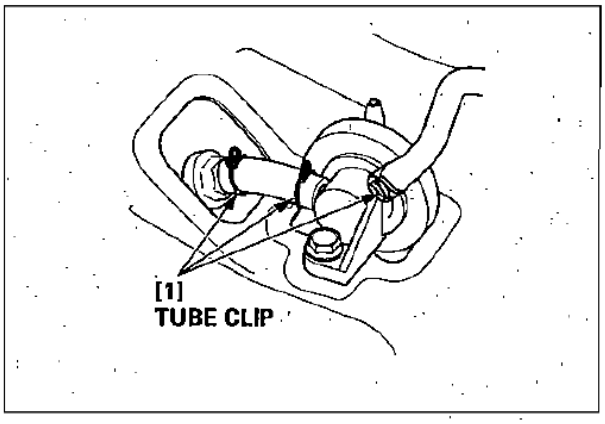


TUBE CLIP

INSTALLATION:

Install the tube clips as shown. Make sure that the clip and does not touch the auto fuel valve or fuel tank.

After installing the tank stay, check that the tube clip and does not touch the tank stay.

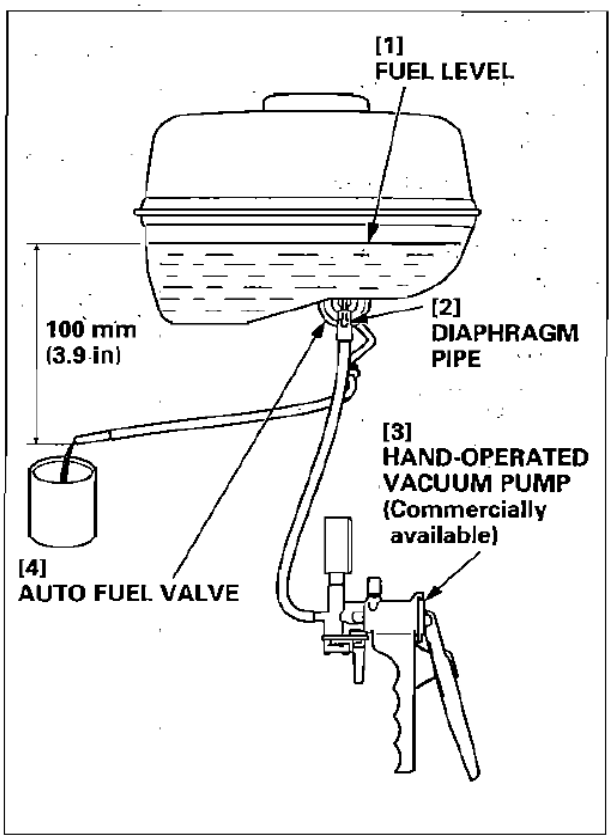


INSPECTION

AUTO FUEL VALVE

Measure the outlet flow of gasoline using a commercially available hand-operated vacuum pump as shown.

Specified outlet flow (At 4-6 kpa (0.04-0.06kgf/cm^2, 0.58-0.87 psi) of vacuum)	Approx. 200 cm^3 (12.2 cu-in)

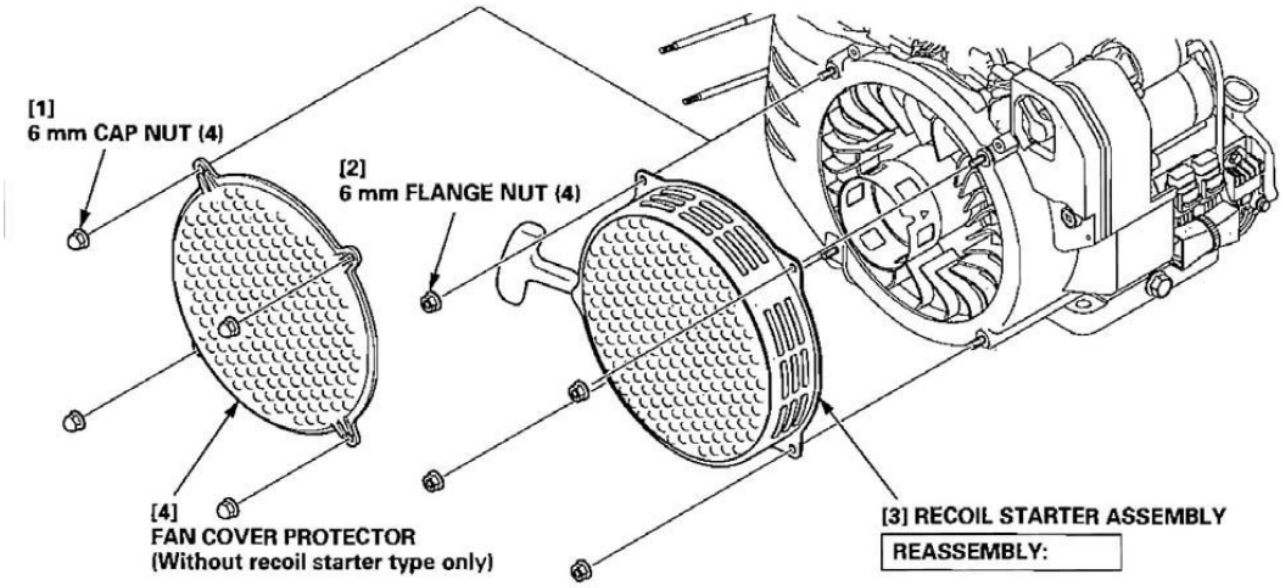


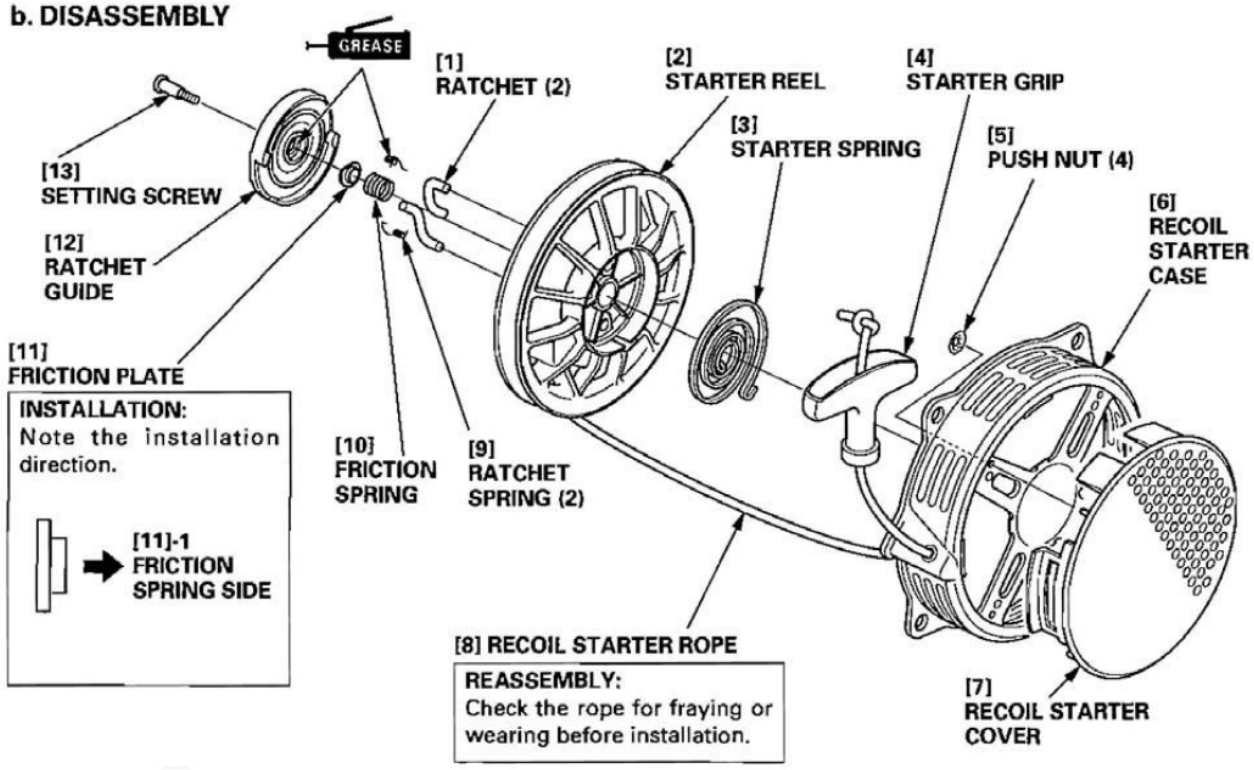
RECOIL STARTER

⚠ CAUTION

THE RETURN SPRING MAY BE EJECTED FROM THE HOLDER WITH ENOUGH FORCE TO INJURE YOU. BE SURE TO RELEASE THE TENSION ON THE RETURN SPRING BEFORE DISASSEMBLY.

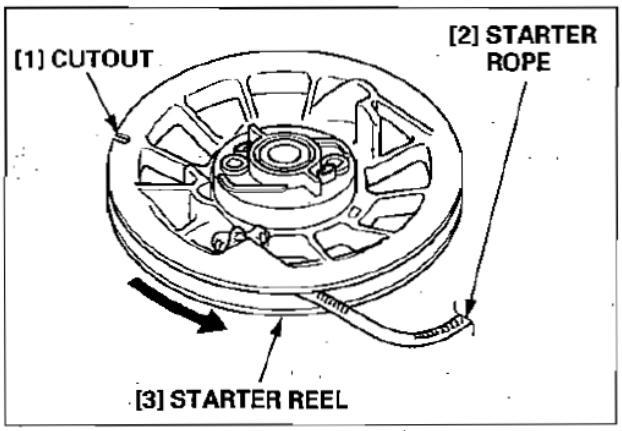
REMOVAL/INSTALLATION



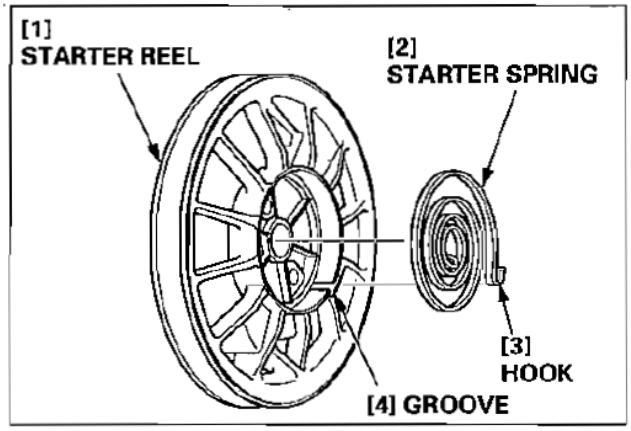


REASSEMBLY

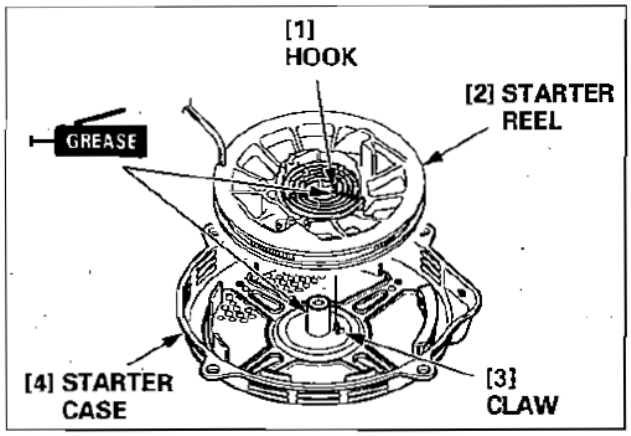
1. Insert the starter rope end into the. starter reel and tie the rope as shown.
2. Wind the rope onto the reel counterclockwise and hook the starter rope into the cutout of the starter reel.



3. Wind the starter spring and install it to the starter reel by aligning the outer hook to the groove of the reel.

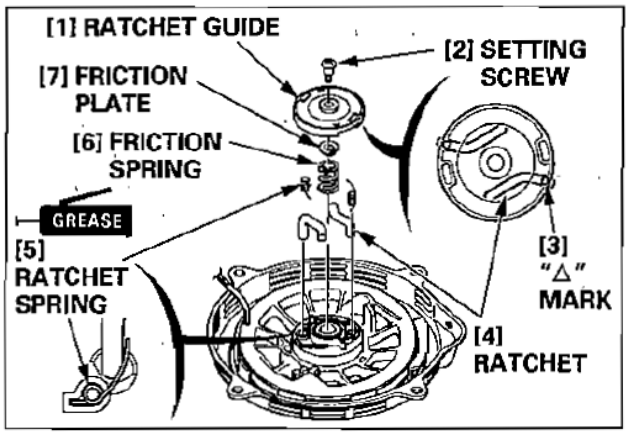


4. Apply grease to the spring hook and boss of the starter case. Align the spring inner hook to the case claw on the case by turning the reel counterclockwise.

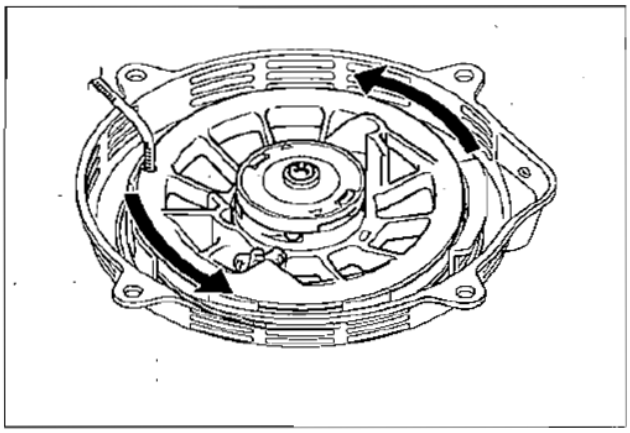


5. Install the ratchet spring and ratchet as shown.

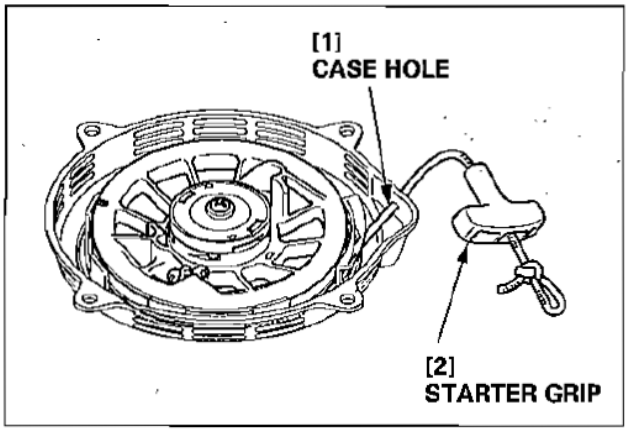
   Apply grease to the friction spring and inside of the ratchet guide. Install the spring end f friction plate, and then install the ratchet guide by aligning the "Δ" marks of the ratchet guide with the ratchets. Tighten the setting screw securely.



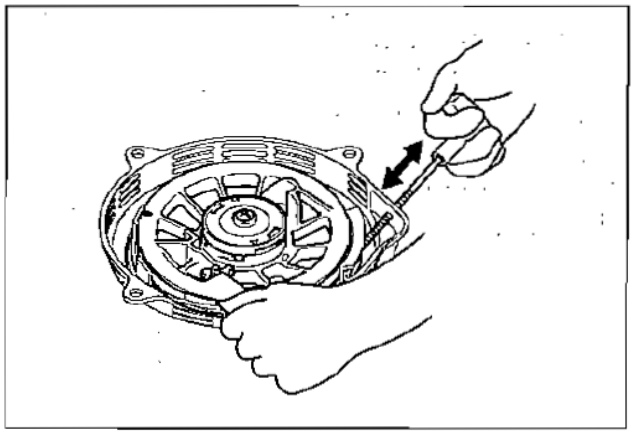
6. Turn the reel three full turns counterclockwise to pre-soak the starter spring.



7. Pass the rope through the starter case hole and started grip and knot the end of the rope as shown.



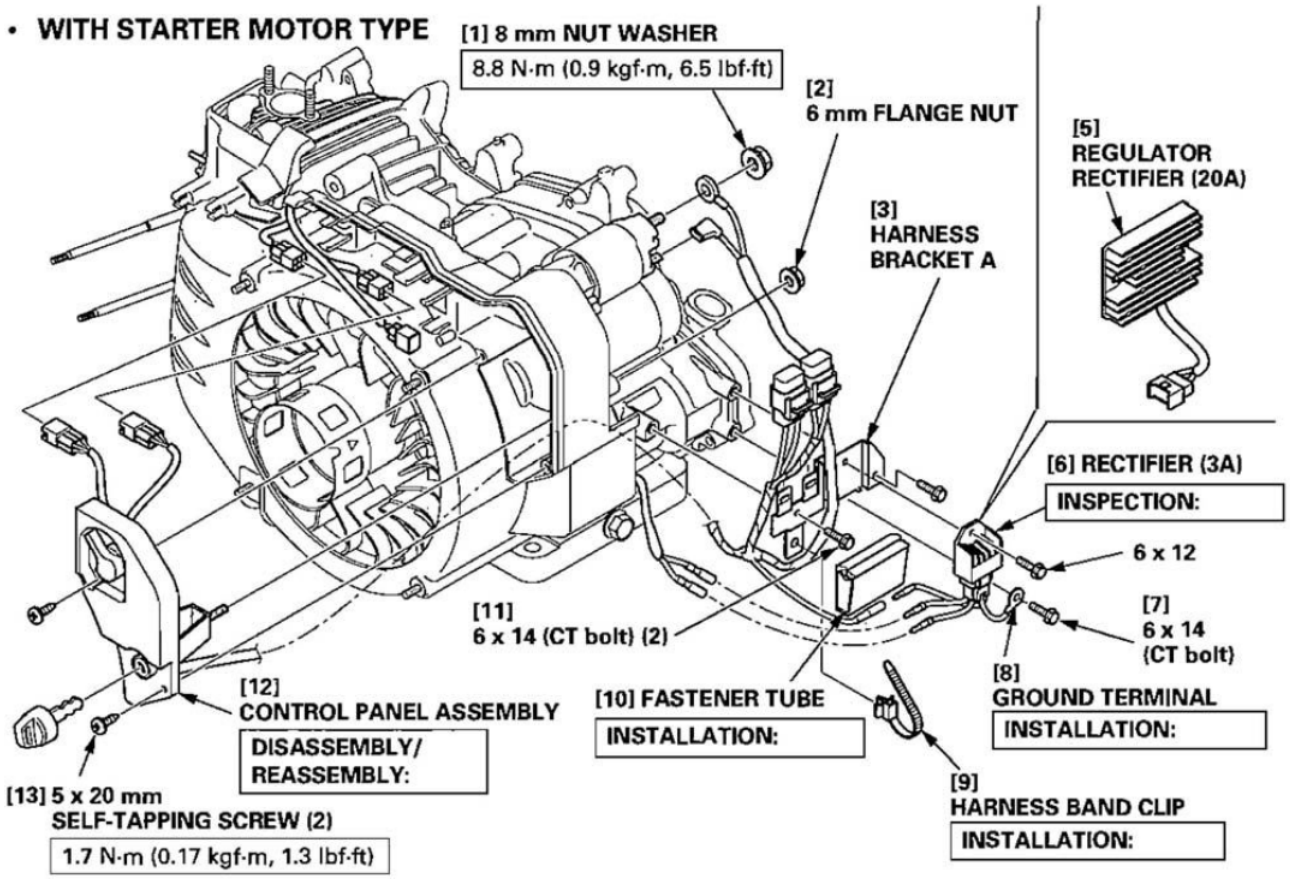
8. Check the operation of tile ratchet by pulling the started rope out several times.



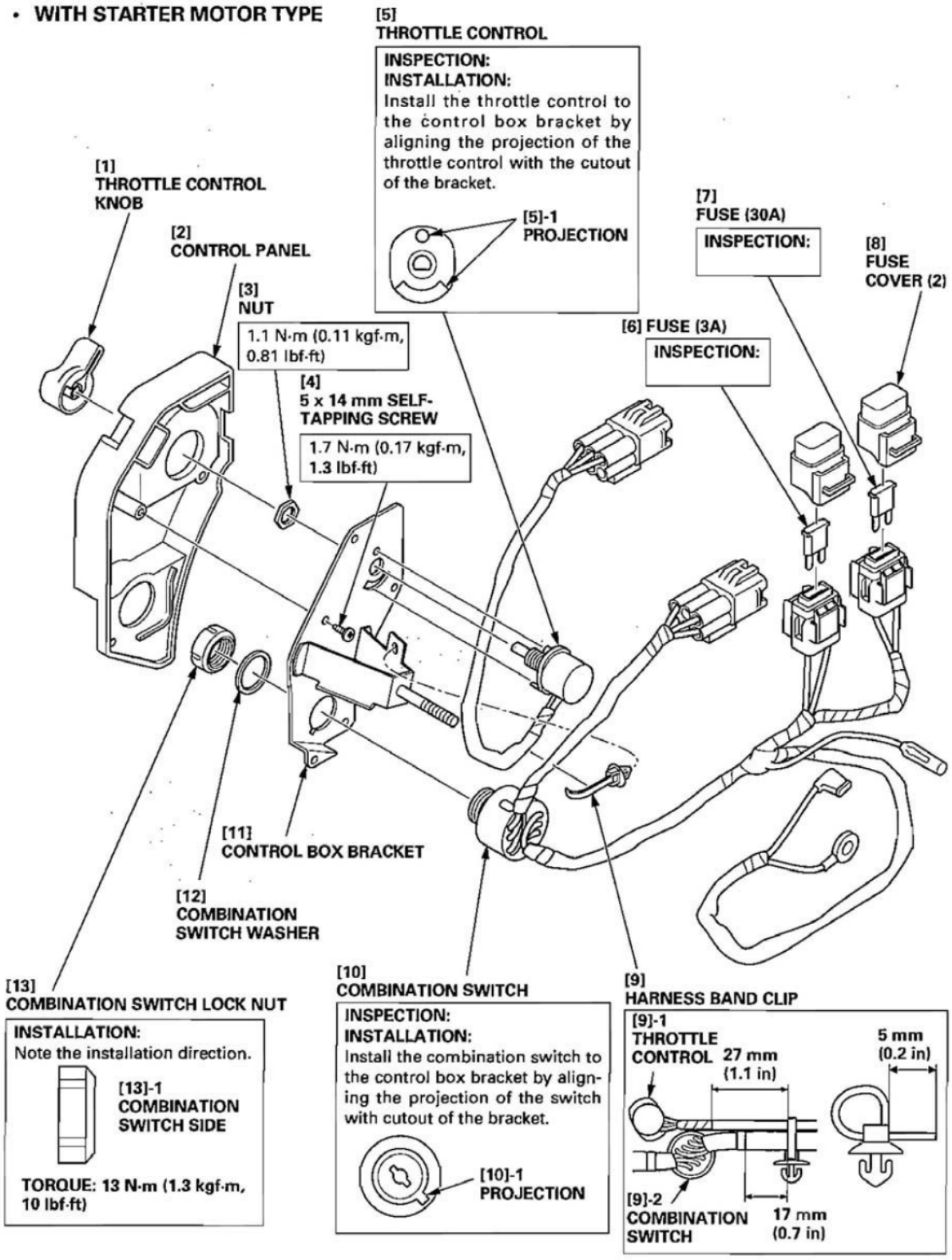
CONTROL PANEL

REMOVAL/INSTALLATION

Remove the electric parts cover.



DISASSEMBLY/REASSEMBLY



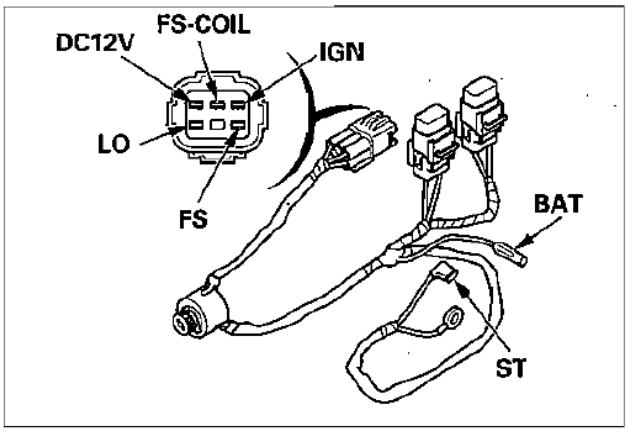
INSPECTION

COMBINATION SWITCH

Check continuity between the terminals at each switch position.

[1] Terminal/ Wire color / [2] Switch position	DC12V Bl/R	IGN Br	FS-COIL O	FS R/W	LO Bl/Y	BAT W	ST Bl/W
[3] OFF			○	○			
[4] ON	○	○			○	○	
[5] START	○	○			○	○	○

Perform this inspection with fuses installed in the switch harness.



ENGINE STOP SWITCH

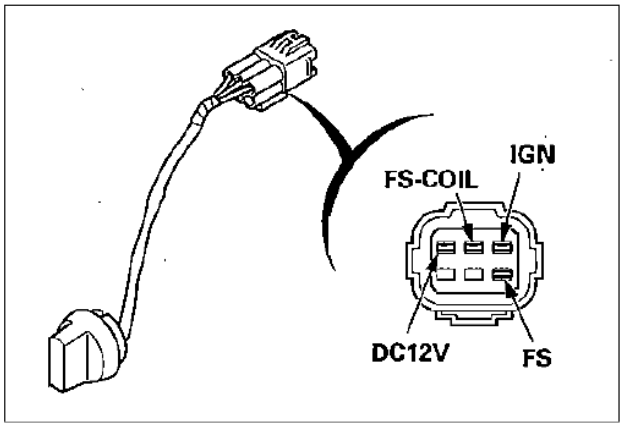
Check continuity between the terminals at each switch position.

With fuel cut solenoid type:

[1] Terminal/ Wire color / [2] Switch position	DC12V Bl/R	IGN Br	FS-COIL O	FS R/W
[3] OFF			○	○
[4] ON	○	○		

Without fuel cut solenoid type:

[1] Terminal/ Wire color / [2] Switch position	DC12V Bl/R	IGN Br
[3] OFF		
[4] ON	○	○



RECTIFIER/REGULATOR RECTIFIER

Measure the resistance between the terminals.

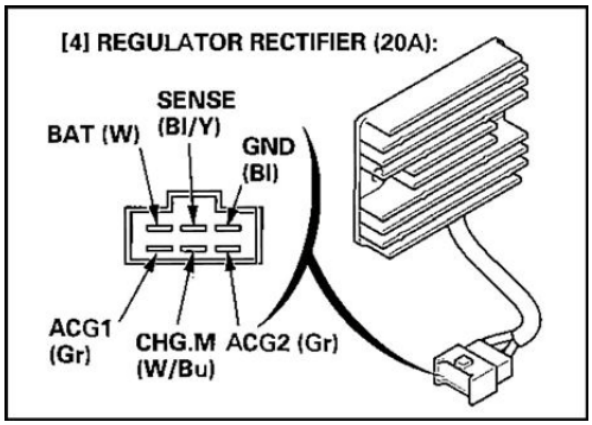
REGULATOR RECTIFIER (20A): Unit: Ω

[1] (+) probe / [2] (–) probe	ACG1 Gr	ACG2 Gr	BAT W	GND Bl	SENSE Bl/Y	CHG.M W/Bu
ACG1 Gr		∞	253-25 k	∞	∞	∞
ACG2 Gr	∞		253-25 k	∞	∞	∞
BAT W	∞	∞		∞	∞	∞
GND Bl	∞	∞	∞		∞	∞
SENSE Bl/Y	18 k-358 k	18 k-358 k	22 k-537 k	2.7 k-83 k		6.3 k-63 k
CHG.M W/Bu	27 k-626 k	27 k-626 k	49 k-∞	7 k-133 k	474-27 k	

- Use a tester that is equivalent to or higher than the performance specified:

  Internal resistance: 20 Ω/VDC, 9 Ω/VAC

- Be careful not to touch the metallic part of the tester probe with your fingers, otherwise correct resistance value cannot be obtained.
- Read the tester manufacturer's operation instructions carefully before operating the tester. Follow the instructions of the Service manual. Be sure the tester's battery is fully charged and check the meter before using the tester.
- Use the R x 1 scale of a commercially available millimeter that meter shows current flow from negative (-) to positive (+). If the meter shows current flow in one direction but not the other, the diode is goad.



FUSE

1. Check for. a blown fuse; replace if necessary.
2. If the replaced fuse blows out, check the following.

   30A FUSE:

   a. Check the combination switch.

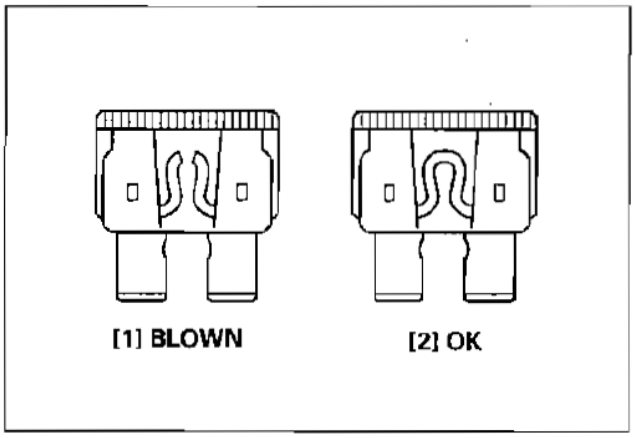
   b. Check the wire harness connecting the combination switch and ECM (Bl/Y) for open or short circuit.

   c. Check the rectifier or regulator rectifier.

   3A FUSE:

   d. Check the combination switch.

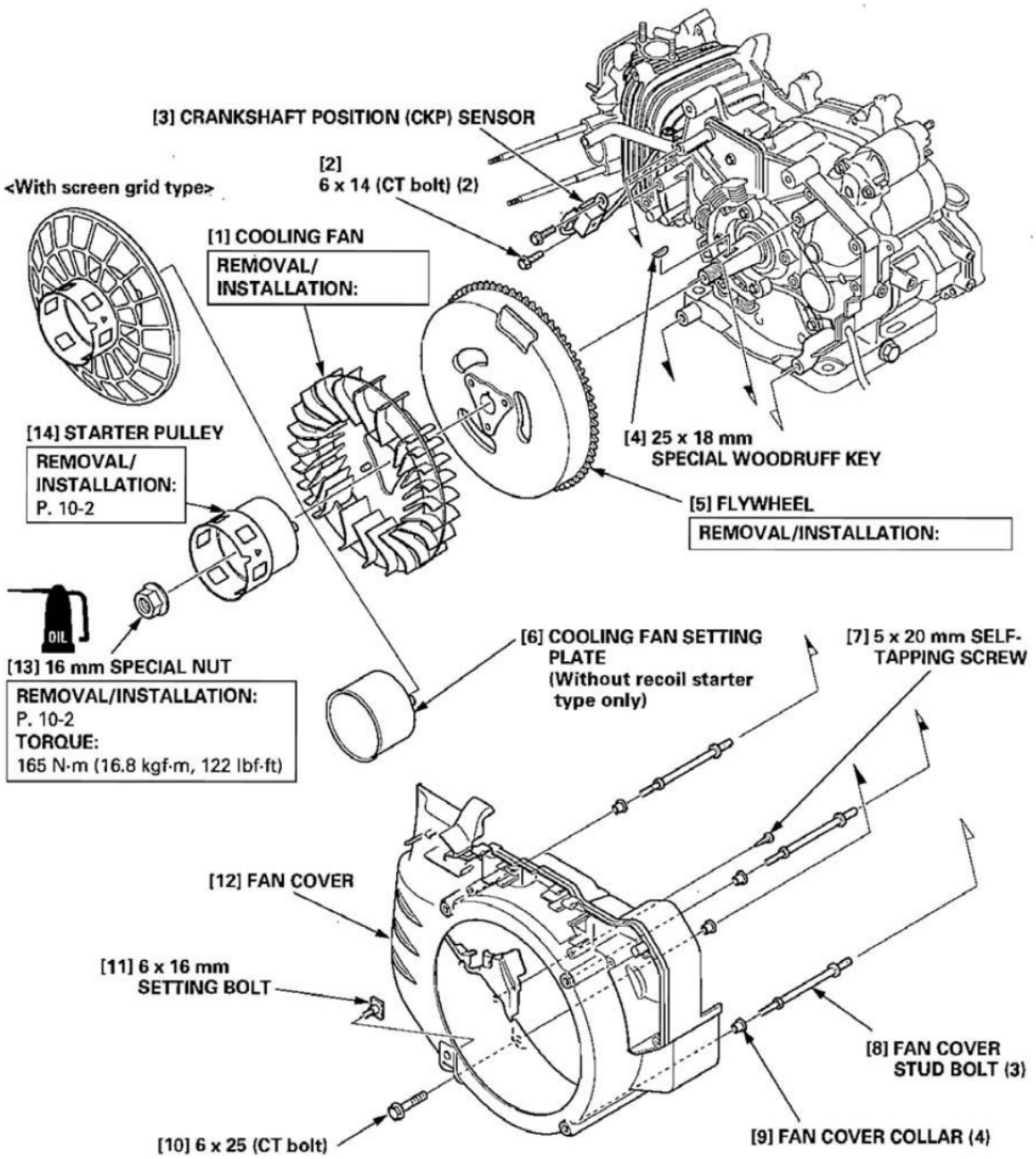
   e. Check the wire harness connecting the combination swatch and ECM (Bl/Y) for open or short circuit.



FAN COVER / FLYWHEEL

REMOVAL/INSTALLATION

1. Remove the air cleaner and electric parts cover.
2. Remove the recoil starter or fan cover protector.
3. Remove the control panel.
4. Remove the pulser coil.



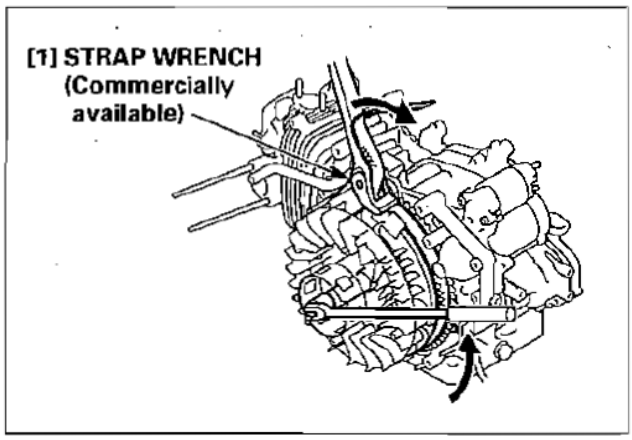
FLYWHEEL

REMOVAL

1. Hold the flywheel with a commercially available strap wrench, and remove the 16 mm special nut.

NOTICE

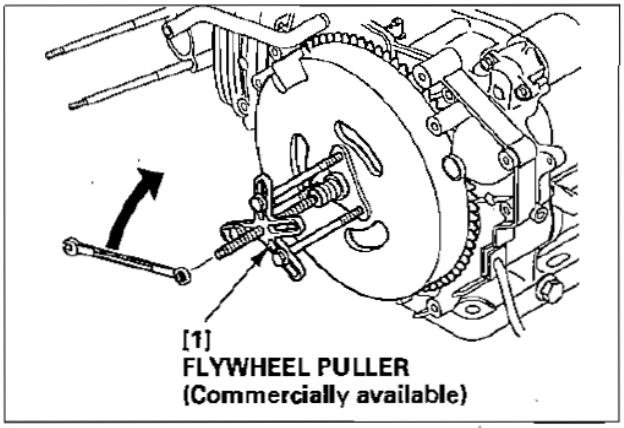
BEFORE ATTACHING THE STRAP WRENCH, REMOVE THE FAN COVER STUD BOLTS AND CRANKSHAFT COWGIRL (CKP) SENSOR. DO NOT POSITION THE STRAP WRENCH FULCRUM AT THE FLYWHEEL MAGNET PART.



2. Remove the starter pulley and cooping fan.
3. Remove the flywheel with a commercially available flywheel puller as shown.

NOTICE

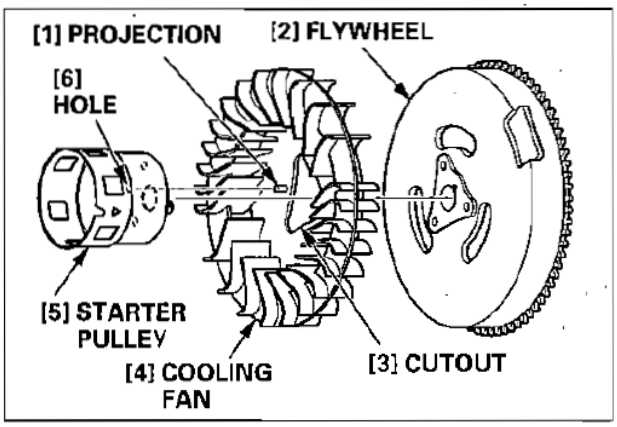
DO NOT HIT THE FLYWHEEL WITH A HAMMER.



INSTALLATION

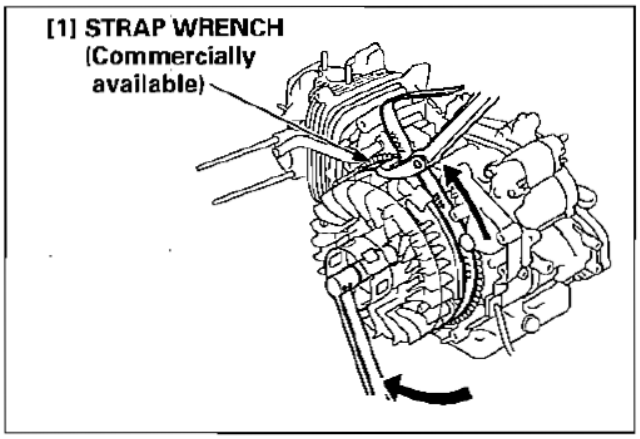
1. Clean the tapered part of dirt oil, grease and other foreign material before installation. Be sure there are no metal parts. or other foreign material on the magnet part of the flywheel.
2. Set the woodruff key in the key groove of the crankshaft securely.

   The flywheel may push the key out of its slot; check after installation.



3. Install the flywheel to the crankshaft.
4. Attach the cooling fan to the flywheel by aligning the cutout of the cooling fan with the projection of the flywheel. Attach the starter pulley by aligning the hole of the pulley with the projection at the center of the cooling fan.
5. Apply a light coat of oil to the threads once the seating surface of the 16 mm special nut, and loosely tighten the nut.
6. Hold the flywheel with a commercially available strep wrench, tighten the 16 mm special nut to tie specified torque.

   Torque: 165 N·m (16,8 Kgf·m, 122 lbf·ft)

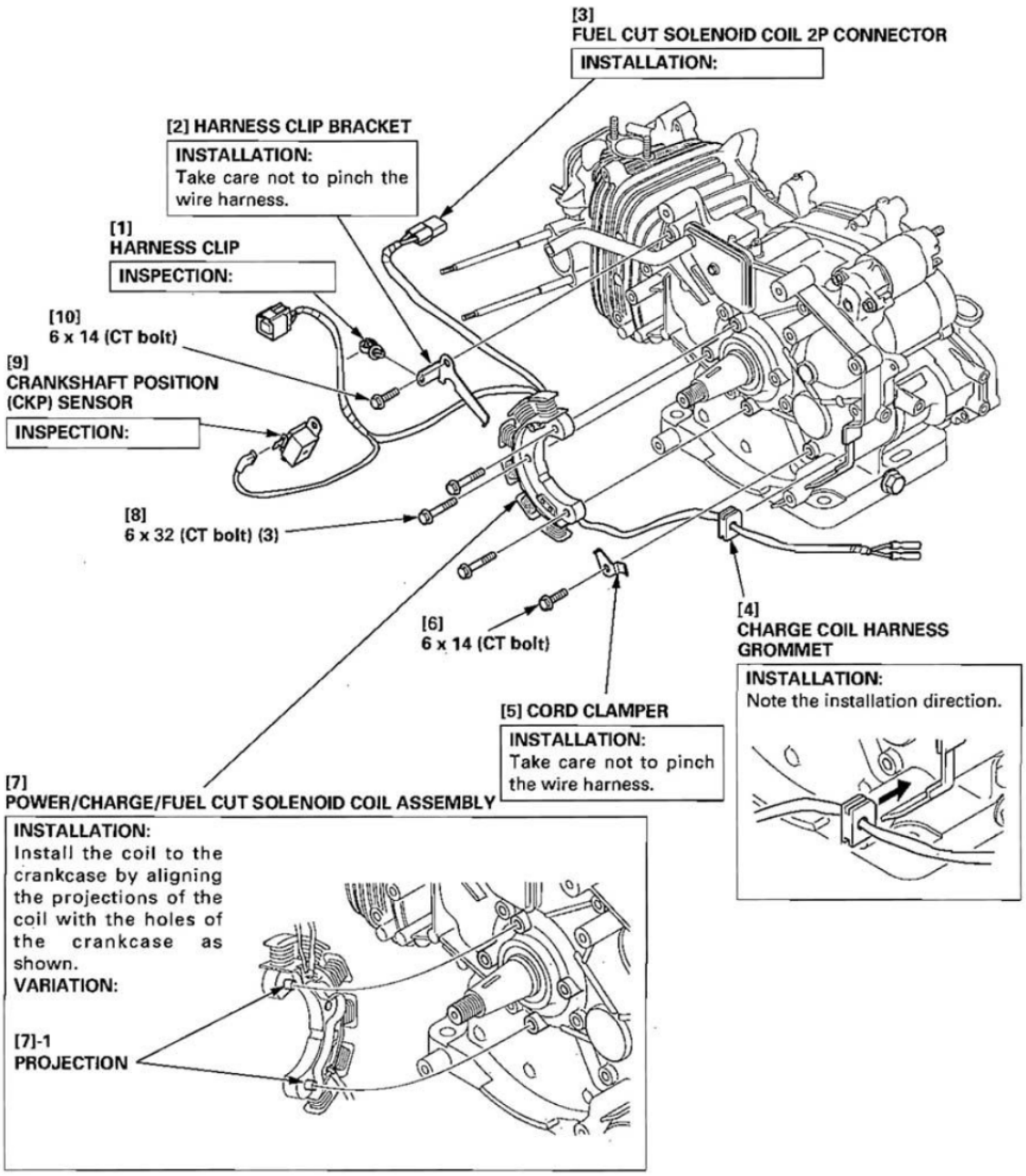


ELECTRIC EQUIPMENT

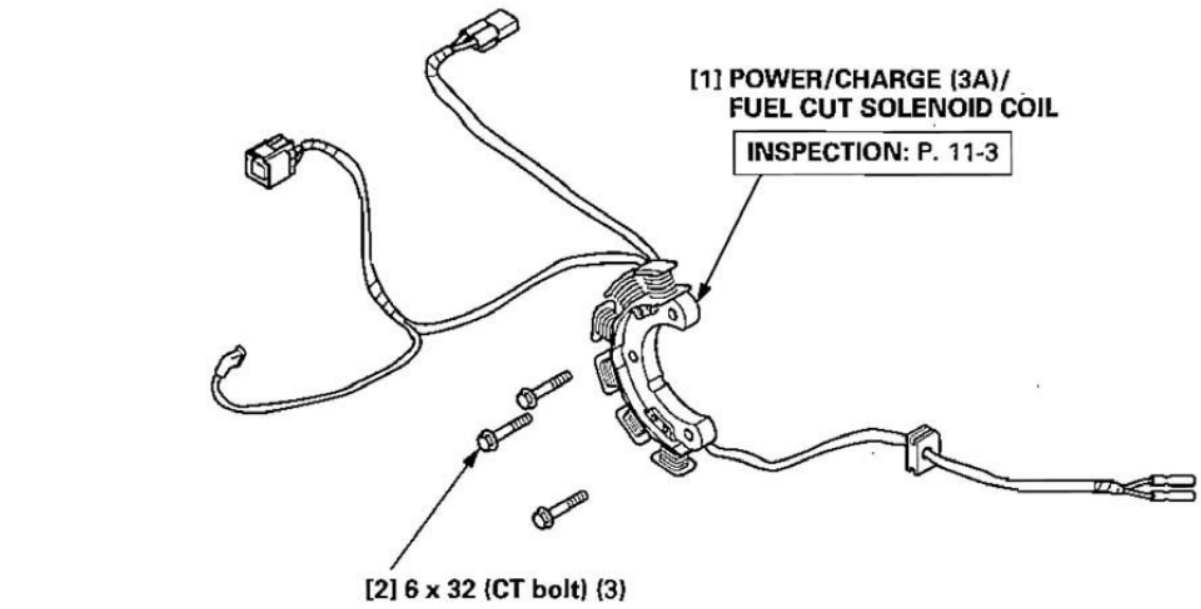
COILS

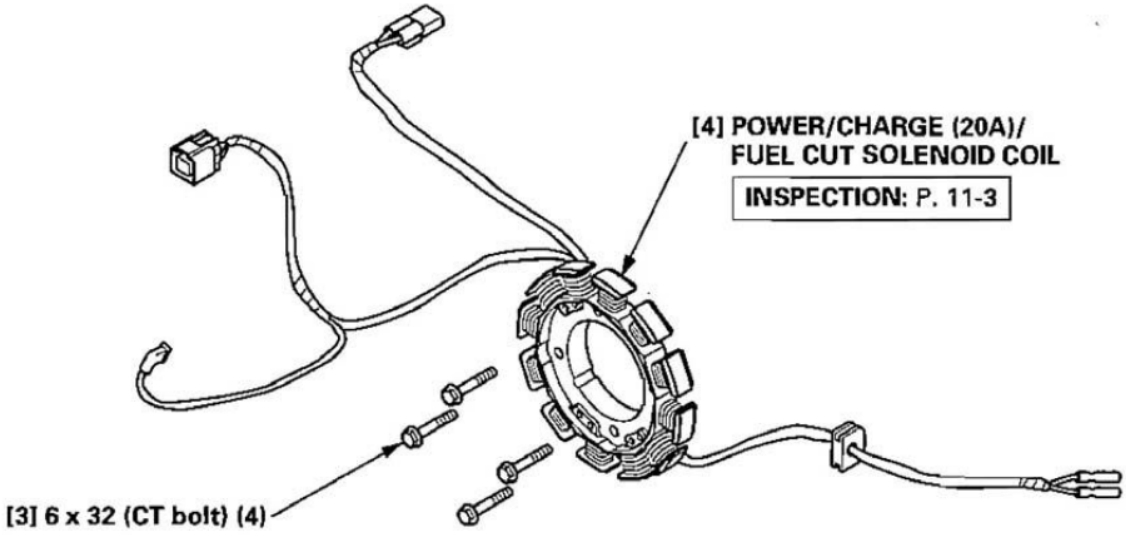
REMOVAL/INSTALLATION

7. Remove the air cleaner and electric party cover.
8. Remove the carburetor.
9. Remove the recoil sterner or fan cover protector.
10. Remove the control panel.



COINS


[1] POWER/CHARGE (3A)/
FUEL CUT SOLENOID COIL
INSPECTION: P. 11-3
[2] 6 x 32 (CT bolt) (3)

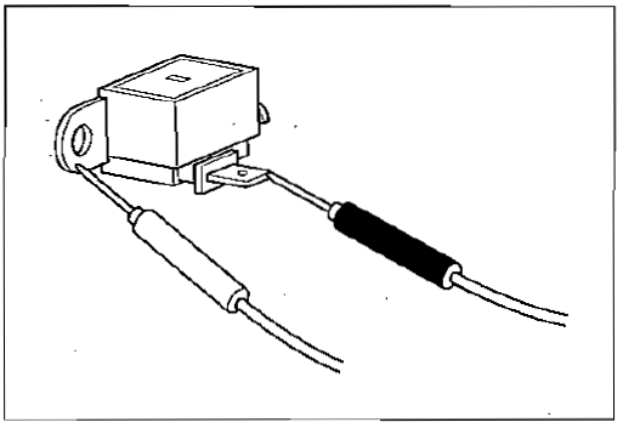

[4] POWER/CHARGE (20A)/
FUEL CUT SOLENOID COIL
INSPECTION: P. 11-3
[3] 6 x 32 (CT bolt) (4)

INSPECTION

- CRANKSHAFT POSITION (CKP) SENSOR

Measure the resistance between the terminal and the installation fitting.

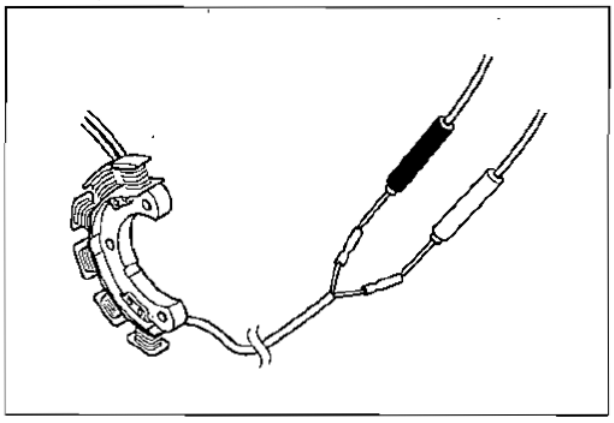
Specified resistance	216 - 264 Ω



- CHARGE COIL

Measure the resistance between the terminals.

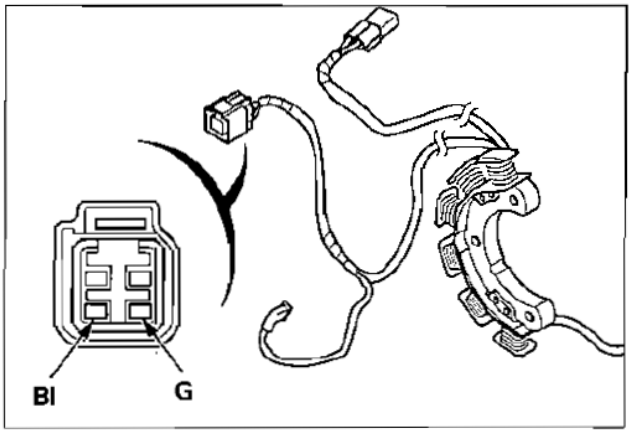
Specified resistance	3A	1.8 - 2.8 Ω
	20A	0.1 - 0.3 Ω



- POWER COIL

1. Remove the terminal cover from the connector using a flat-tip screwdriver.
2. Measure the resistance between the BI and G terminals.

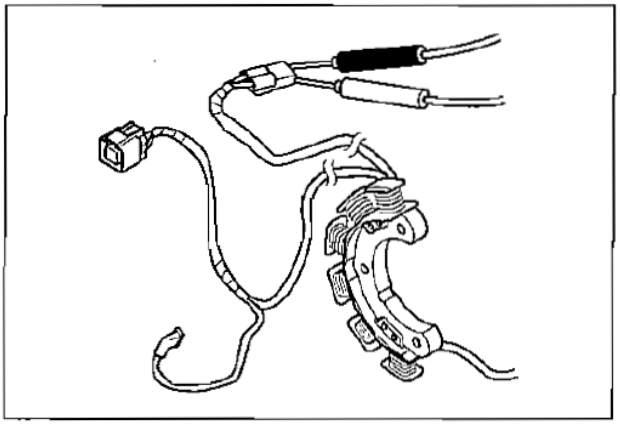
Specified resistance	3.5 - 5.3 Ω



- FUEL CUT SOLENOID COIL

Measure the resistance between the terminals.

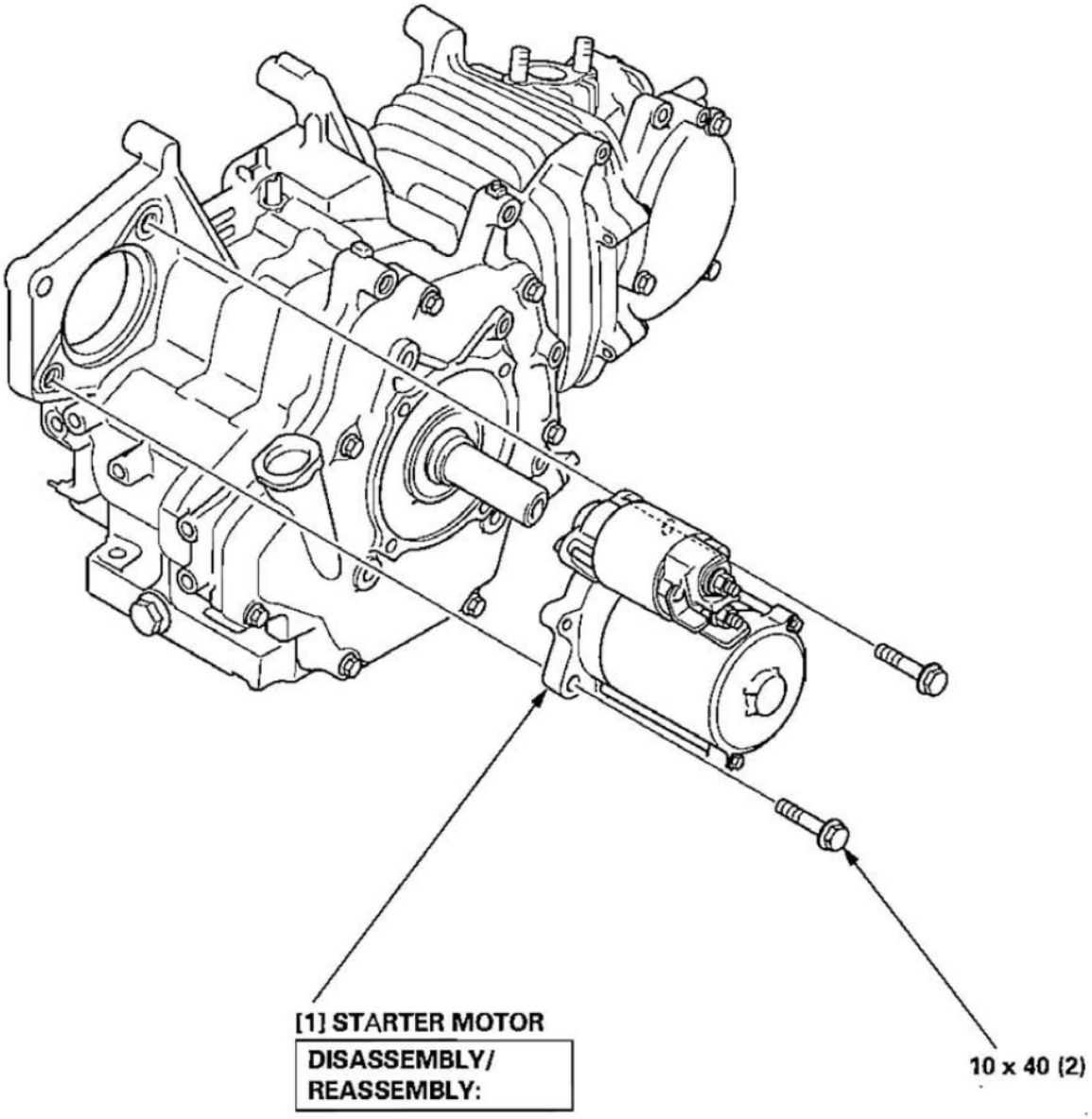
Specified resistance	3.1 - 4.7 Ω



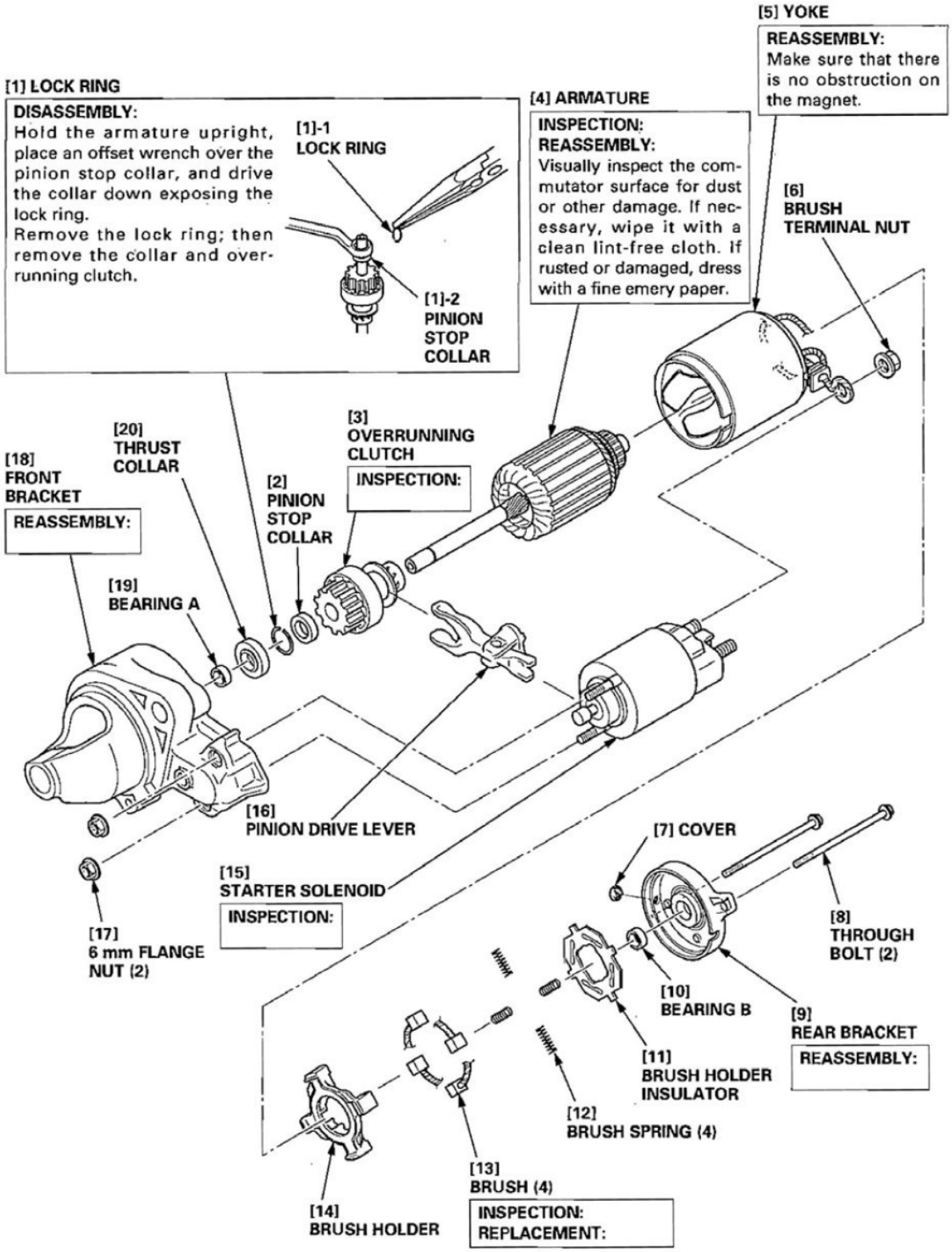
STARTER MOTOR

REMOVAL/INSTALLATION

1. Disconnect the starter motor terminal of the combination switch harness and starter motor battery terminal.
2. Remove the harness bracket A.
3. Remove the oil filler extension.

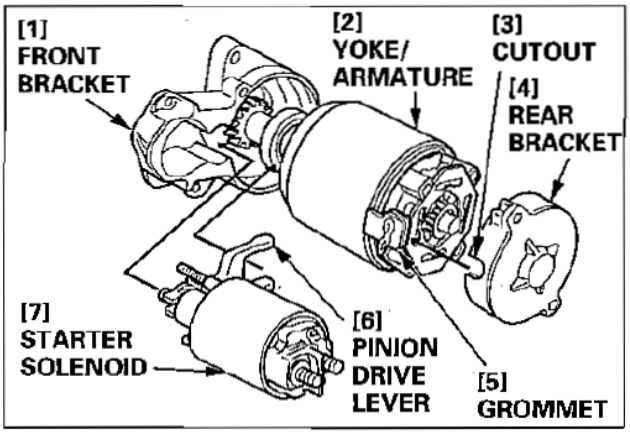


DISASSEMBLY/REASSEMBLY



FRONT BRACKET/REAR BRACKET ASSEMBLY

1. Install the rear bracket lo the armature/yoke by aligning the brush terminal grommet with the cutout of the rear bracket.
2. Attach the pinion drive lever to the starter solenoid. Set the pinion drive never to the overrunning clutch.
3. Hold the pinion drive lever. starter solenoid and yoke together and install the front bracket. Tighten the through bolts to secure the front bracket and rear bracket.

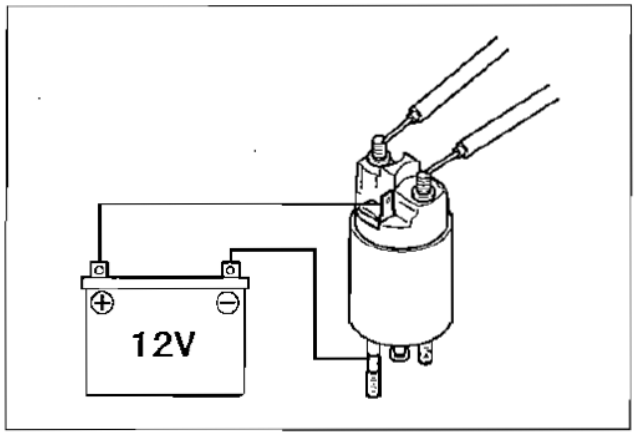


INSPECTION

STARTER SOLENOID

Connect a 12 V battery between the starter terminal and the switch body and check for continuity between the terminals.

Continuity should exist when the battery is connected and not exist when the battery is disconnected.



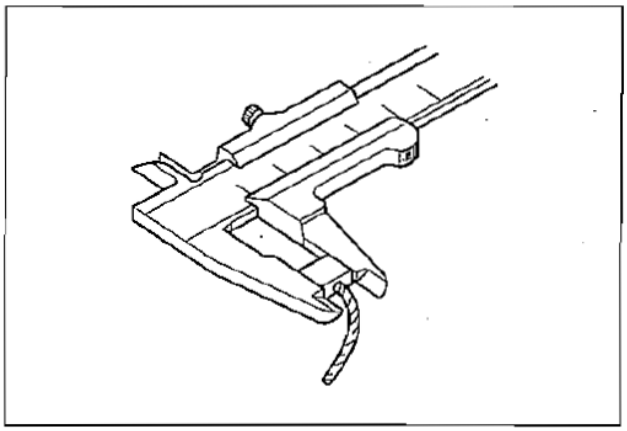
BRUSH

Brush length:

Measure the brush length.

If brush length is less than tile service limit, replace the brush.

Standard	Service limit
10.0 mm (0.39 in)	6.0 mm (0.24 in)



Continuity check-brusher:

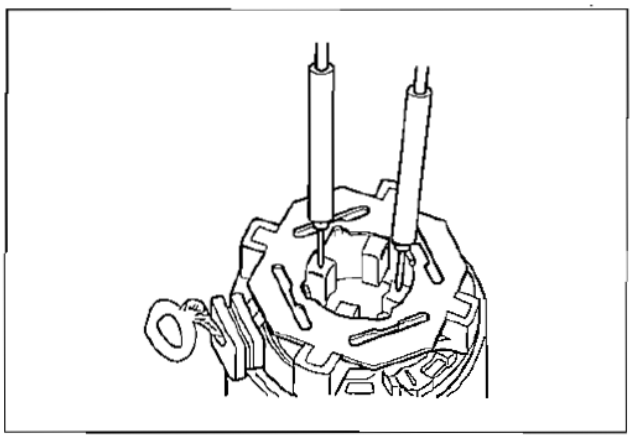
Check for continuity between the brushes.

There should be continuity between both the positive brushes.

There should be continuity between both the negative brushed.

There should be no continuity between both the positive and negative brushes.

If necessary, replace the broke assembly.



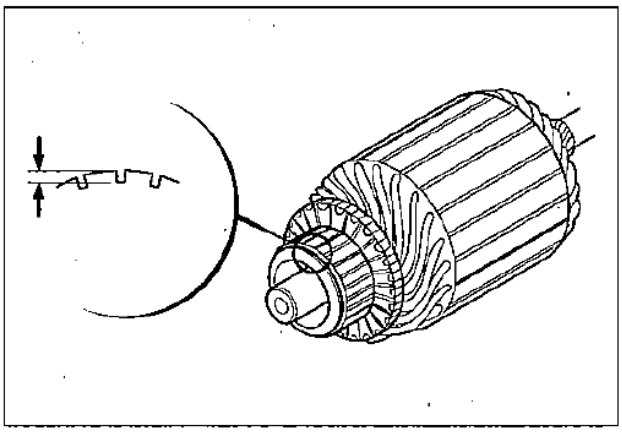
ARMATURE

Mica depth:

When the mica is fillers or its depth is smaller than the service limit value, recut the grooves using: a hacksaw blade or t small file.

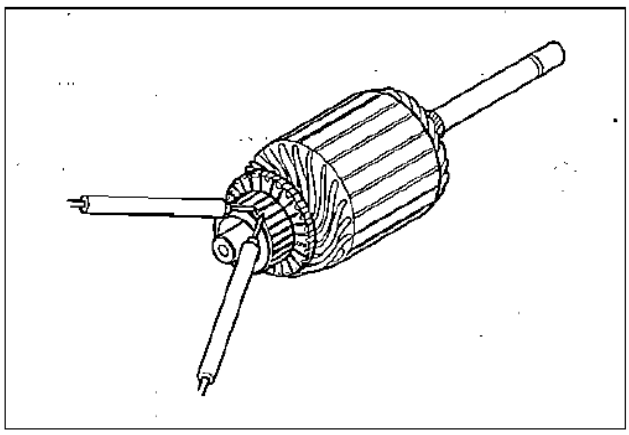
Service limit

0.2 mm (0,01 in)



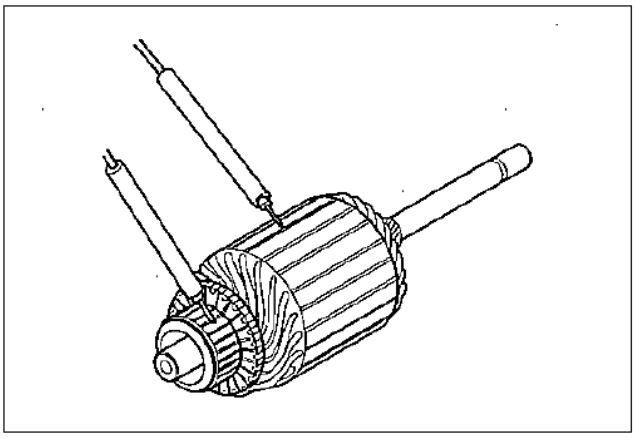
Continuity check-commutator segments:

Check for continuity between segments. If an open circuit (no continuity) exists between any two segments, replace the armature.



Continuity check-commutator to core:

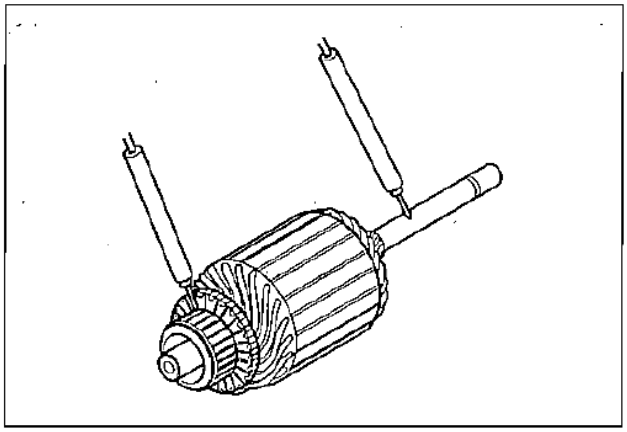
Check for continuity between the commutator segments and the a rapture coil core. Replace the armature if continuity exists.



Continuity check-commutator to shaft:

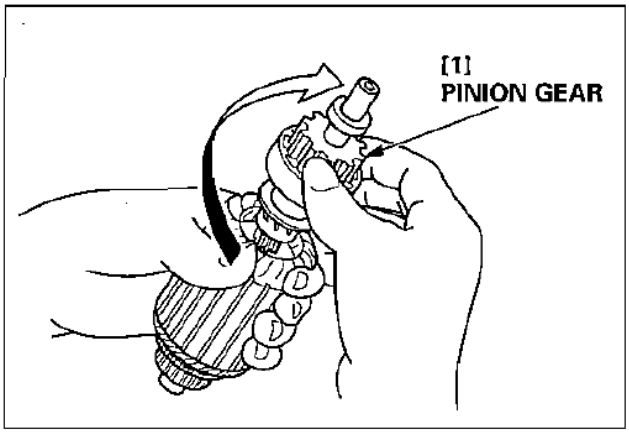
Check for continuity between the commutator and the armature shaft.

Replace the armature if continuity exists between any of the commutator segments end the armature shaft.



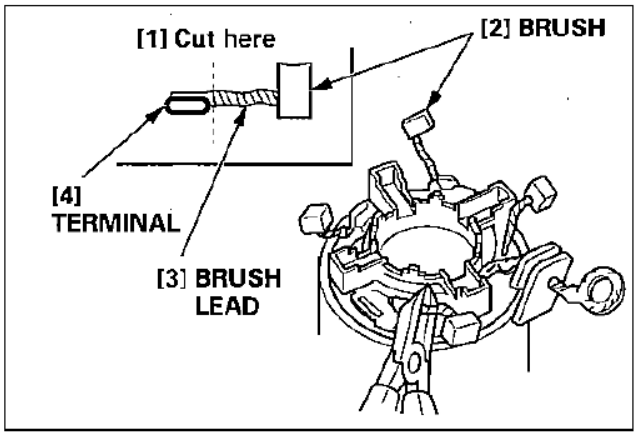
OVERRUNNING CLUTCH

1. Hold the pinion.gear.as shown and check that the gear turns clockwise and slides smoothly. If necessary, apply oil or replace the overrunning clutch.
2. Check the pinion gear for wear or damage and replace if necessary.
3. If the pinion ear is worn or damaged, the flywheel ring gear must be inspected.

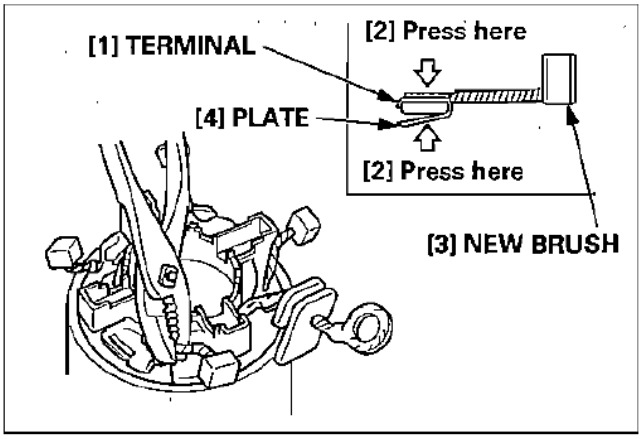


BRUSH REPLACEMENT

1. Cut off the brush lead at the point shown and remove the brush.
2. Remove the remaining brush lead and deposited solder from the terminal.



3. Hold a new brush in the same direction of the removed brush and put a new plate over the new brush and terminal and press it using a pair of pliers as shown.



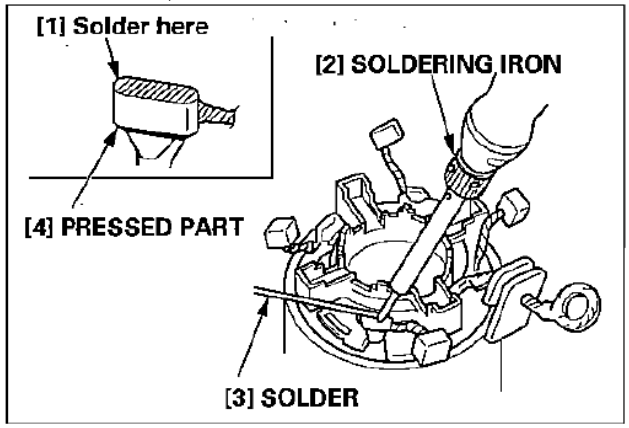
4. Solder the plate on the terminal.

   Before soldering heat the pressed part of the plate well to make sure solder reaches the end of the pressed part.

   Prevent solder from flowing down the brush lead.

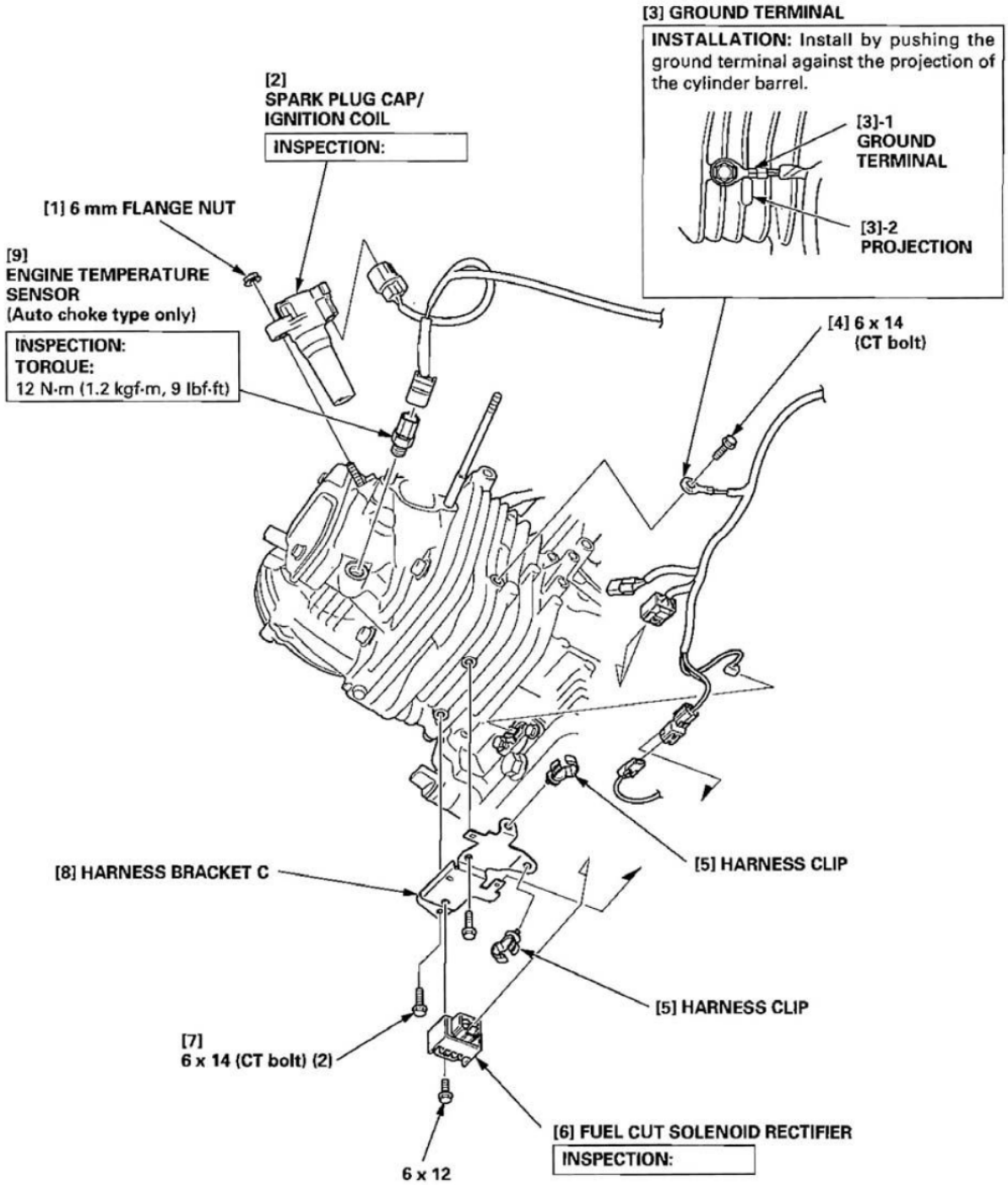
   Do not allow solder lo run down onto the field winding of the yoke.

   File the brush so that the brush and commutated can fit using an every paper #500 or #601.



IGNITION COIL/FUEL CUT SOLENOID RECTIFIER/ENGINE TEMPERATURE SENSOR

REMOVAL/INSTALLATION



INSPECTION

FUEL CUT SOLENOID RECTIFIER

Check continuity between the terminals.

[1] (+) probe / [2] (–) probe	①	②	③	④
①		∞	∞	∞
②	Continuity		Continuity	Continuity
③	Continuity	∞		∞
④	Continuity	∞	∞	

Use a tester that is equivalent to or higher than the performance specified:

Internal resistance: 20 DNDC, 9 Ω/VAC

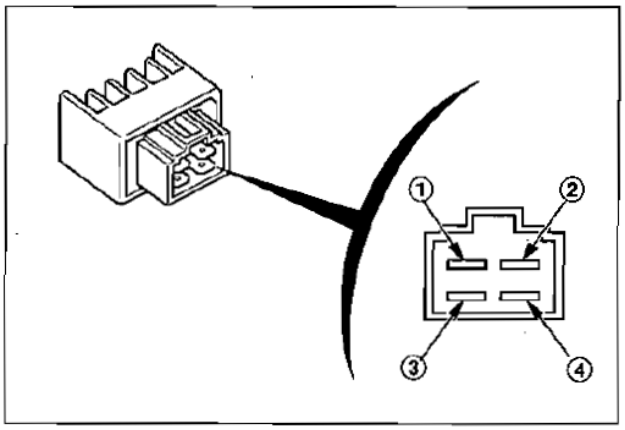
Be careful not to touch the metallic part of the tester probe with your fingers, otherwise correct resilience value cannot be obtained.

Read the tester manufacturer's operation instructions carefully before operating the tester.

Follow the instructions of the Service Manual.

Be sure the tester's battery is fully charged and check the meter before using the tester.

Use the R x 1 scale of a commercially available millimeter that shows current flow from negative (-) to position (+). If the mater shows current flow In one direction but not the other, the diode is good.

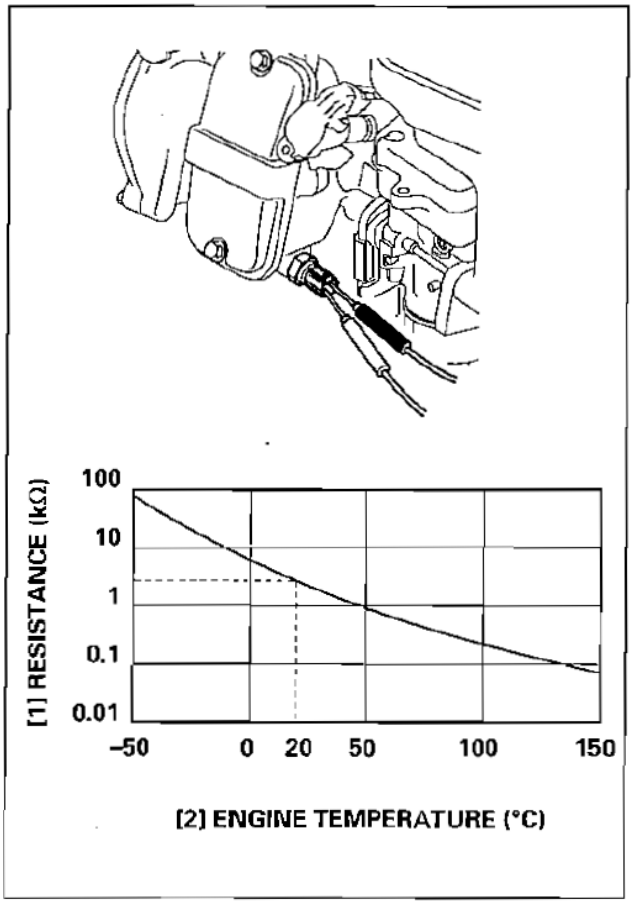


ENGINE TEMPERATURE SENSOR

Be sure the engine is cool before this inspection.

1. Measure the air temperature before inspecting the engine temperature sensor. For the specified resistance value that should be shown at the air temperature, refer to the graph in the figure.
2. Measure the resistance between the terminals of the engine temperature sensor, and make sure that it is consistent with the value shown in the graph.

Resistance at 20° C (Example)	2.3-3.0 kΩ

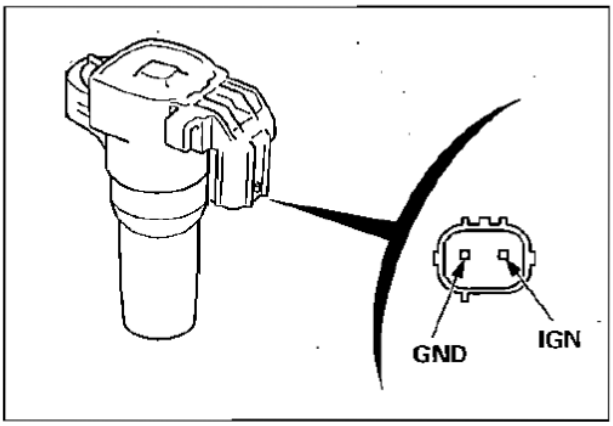


IGNITION COIL

Primary side

Measure the resistance between the GND and IGN terminals.

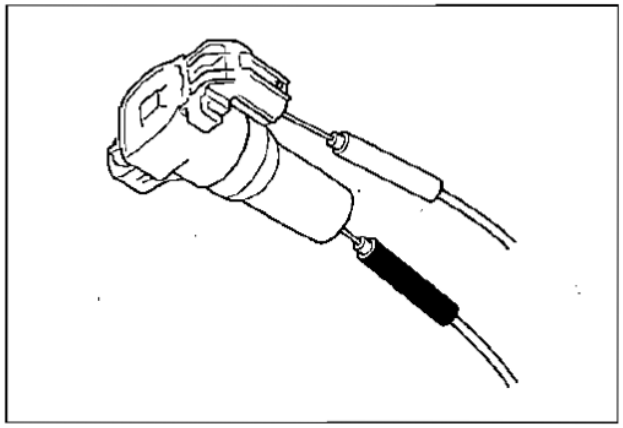
Specified resistance	0.16-0.21 Ω



Secondary side

Measure the resistance between the GND terminal and the sprig in the spark plug cap.

Specified resistance	3.74-4.58 kΩ



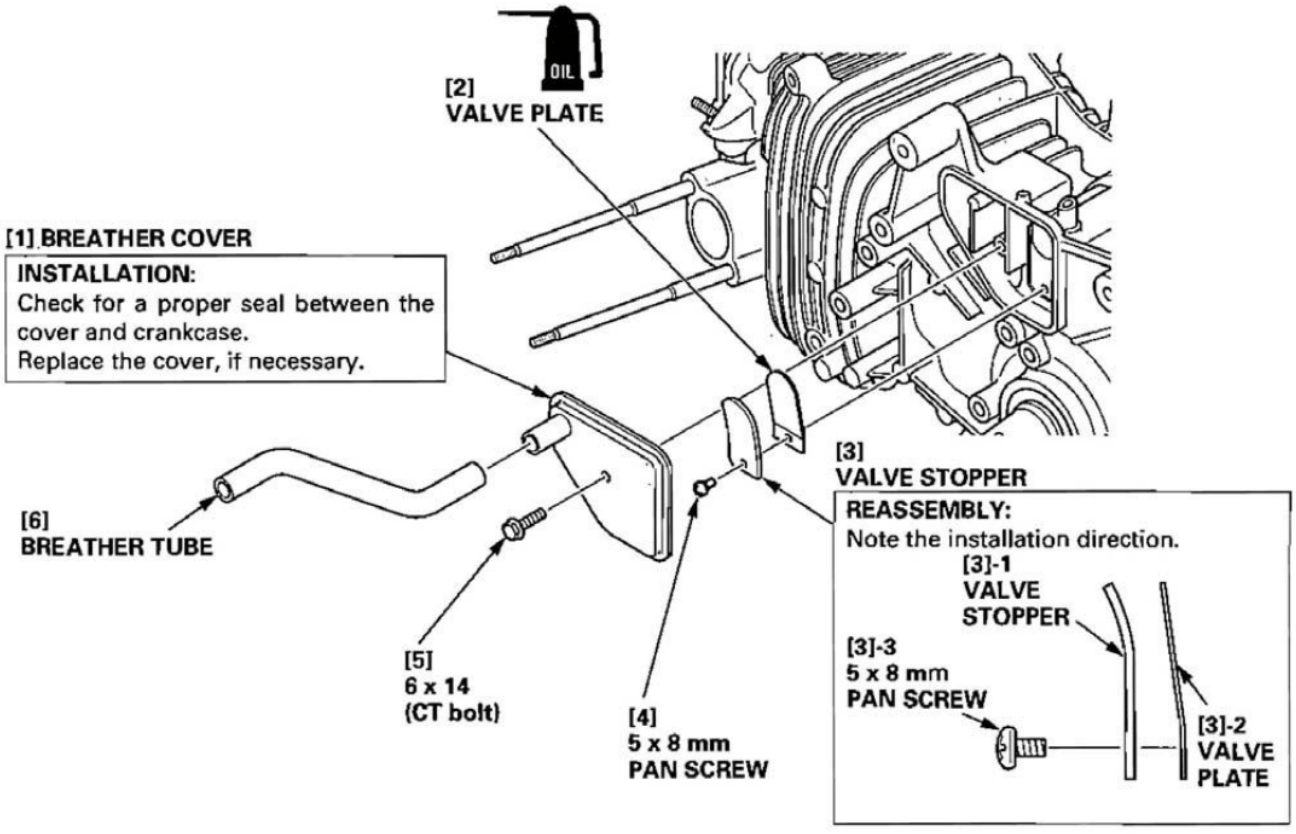
BREATHER VALVE/CRANKSHAFT/ BALANCER/PISTON

BREATHER VALVE

DISASSEMBLY/REASSEMBLY

Remove only if necessary for breather valve and breather cover repair.

1. Remove the air cleaner and electric parts cover.
2. Remove the carburetor.
3. Remove the recoil started or fan coyer protector.
4. Remove the control' panel.
5. Remove the fan cover and flywheel.

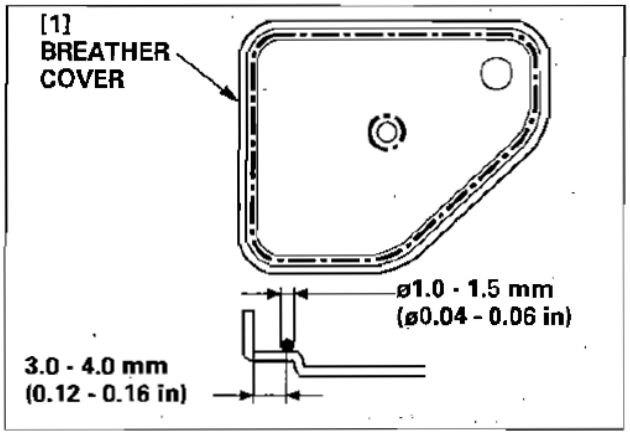


BREATHER COVER INSTALLATION

1. Clean the old liquid gasket, oil and contamination from the breather cover/crankcase mating surface.
2. Apply a bead (Ø1.0 - 1.5 mm (Ø 0.04-0.06 in)) of the liquid gasket (ThreeBond® 1207B) to the mating surface of the breather cover as shown.
3. Install the breather cover to the crankcase.

   Assemble the breather cover within 3 minutes after applying the liquid gasket.

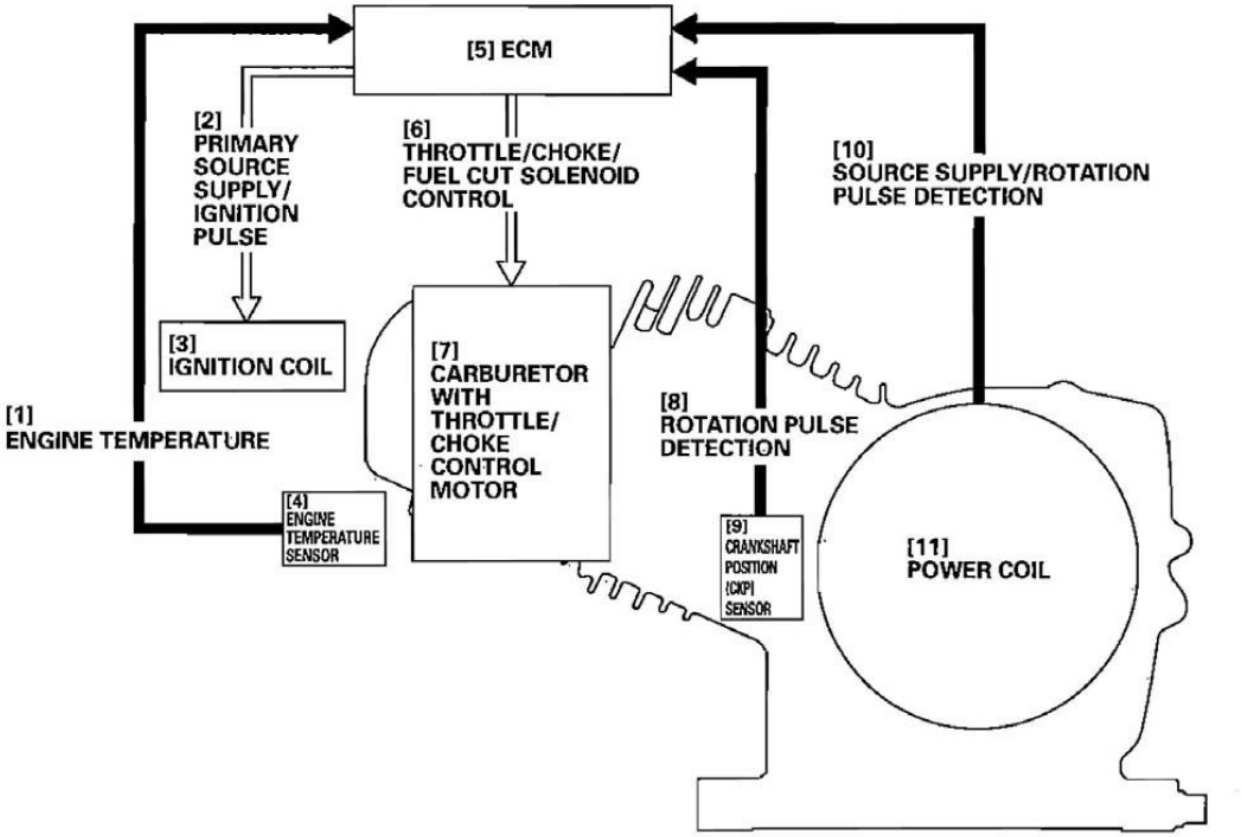
   Wait for 30 minutes after assembly before filling with oil and starting the engine.



OPERATION

STR (SELF TUNING REGULATOR) GOVERNOR

This engine uses an electronic control governor as opposed to the conventional mechanical governor.The ECM controls various functions to attain high power output and low fuel consumption.



FUNCTIONS

Engine speed control function

The ECM deters engine revolution pulse, controls the throttle position and constantly adjusts to the most appropriate engine speed. Moreover, setting the pattern of engine speed can be done by changing the program in the ECM, according to the required use.

AUTO CHOKE

The ECM automatically controls the choke so that the user does not have to perform this task. Since the ECM detects the engine temperature, the choke valve position in automatically adjusted to its most appropriate opening from the time the engine stars until the engine warms up.

ENGINE PROTECTION/SELF DIAGNOSIS FUNCTION

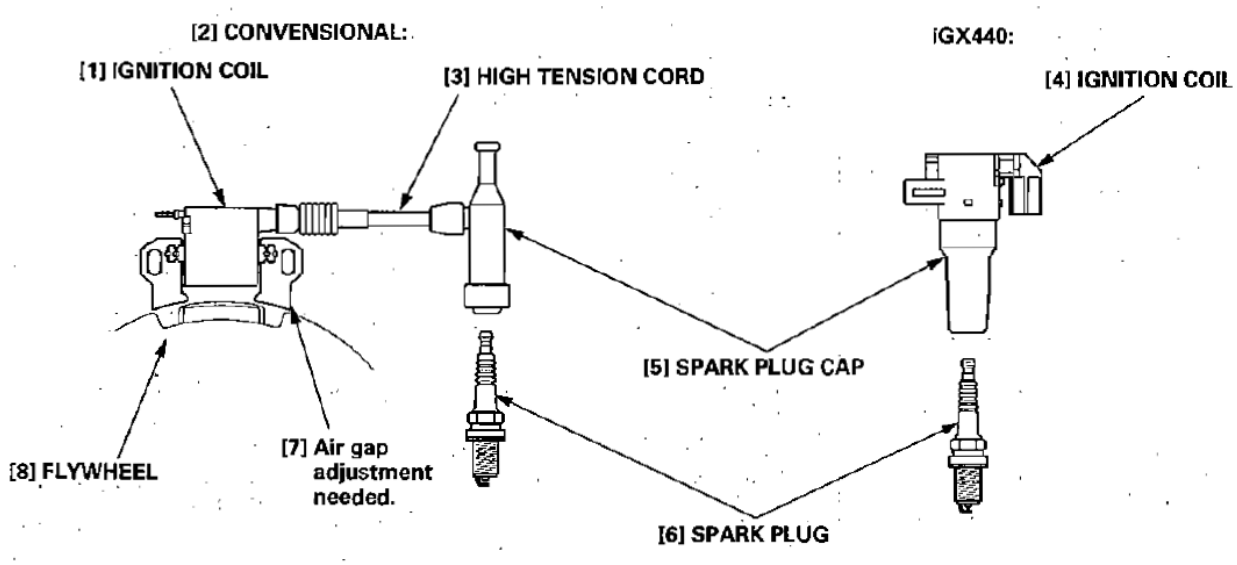
Should engine malfunctions occur, the engine stops or the malfunction indicator lamp illuminates to alert the user that a problem has occurred. Count the number of times the indicator lamp flashes to determine the cause of the problem.

IGNITION COIL WITH INTEGRATED SPARK PLUG CAP

Voltage produced by the power coil and signals produced by the crankshaft position (CKP) sensor are sent to the ECM. The ECM supplies primary voltage to the ignition coil. The ignition coil which is integrated into the spark plug cap, creates the secondary voltage to produce a spark at the spark plug.

This system has the following advantage over the conventional ignition system:

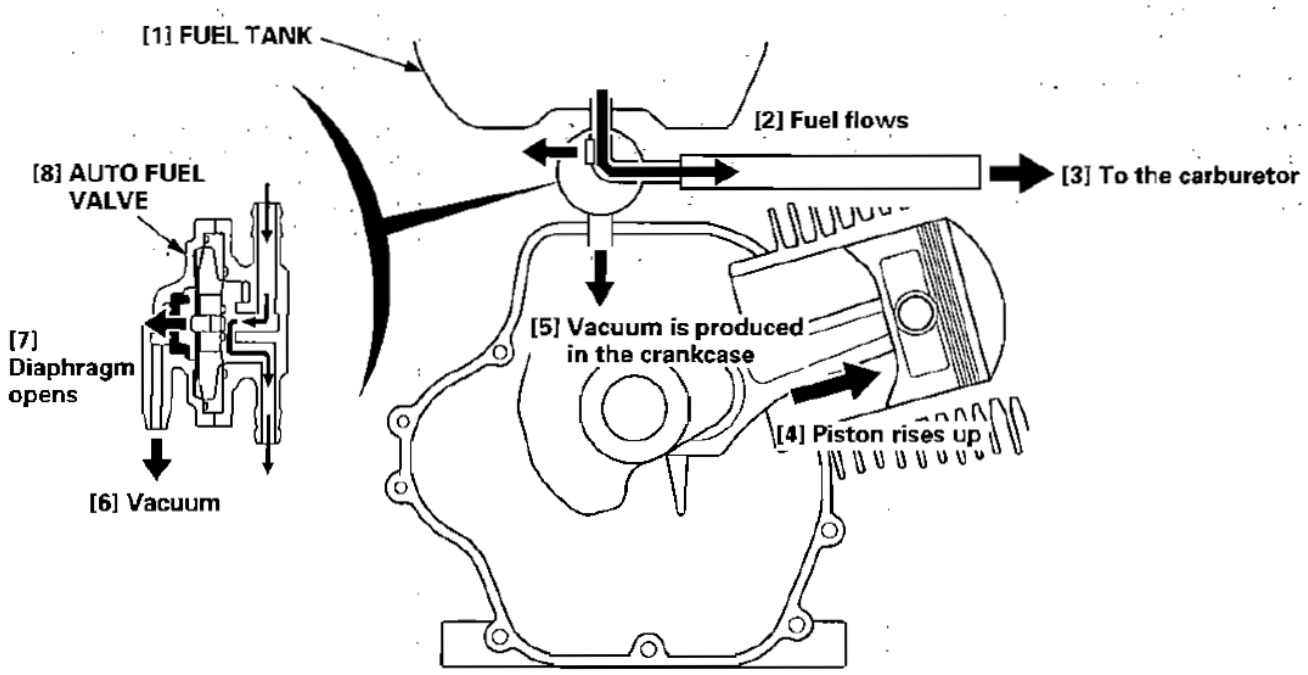
1. Since ECM controls the ignition timing, minute adjustments become possible, improving engine operation stability.
2. Voltage loss at high-tension cords is minimal.
3. Inspecting for broken connections at high-tension cords and adjusting air gap between the flywheel and ignition coil are not needed.



AUTO FUEL VALVE

The auto fuel valve and crankcase are connected. Vacuum produced by the movement of the piston and breather function while the engine operates opens the diaphragm inside the fuel valve, letting fuel flow from the fuel tube into the carburetor.

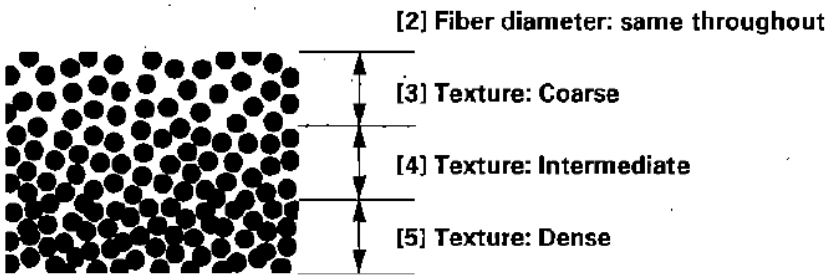
While the engine is stopped, the diaphragm closes, and fuel flow ceases.



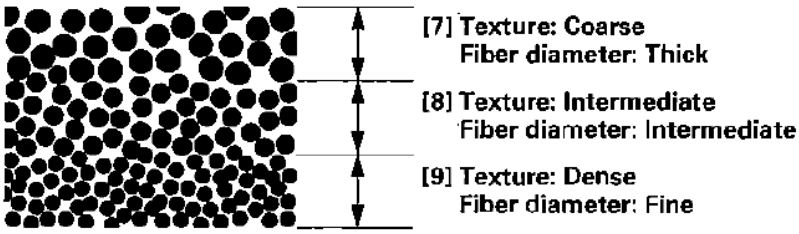
LONG MAINTENANCE INTERVAL AIR CLEANER ELEMENT

The air intake filter used a dense non-cloth material constructed of fiber arranged by grade. From the inflow until the outflow, the fiber in the element becomes denser and finer. Coarse is collected at the surface, while dirt and fine debris are collected throughout the filter. This allows a longer interval between filter changes.

[1] CONVENTIONAL: Single layered graded density type

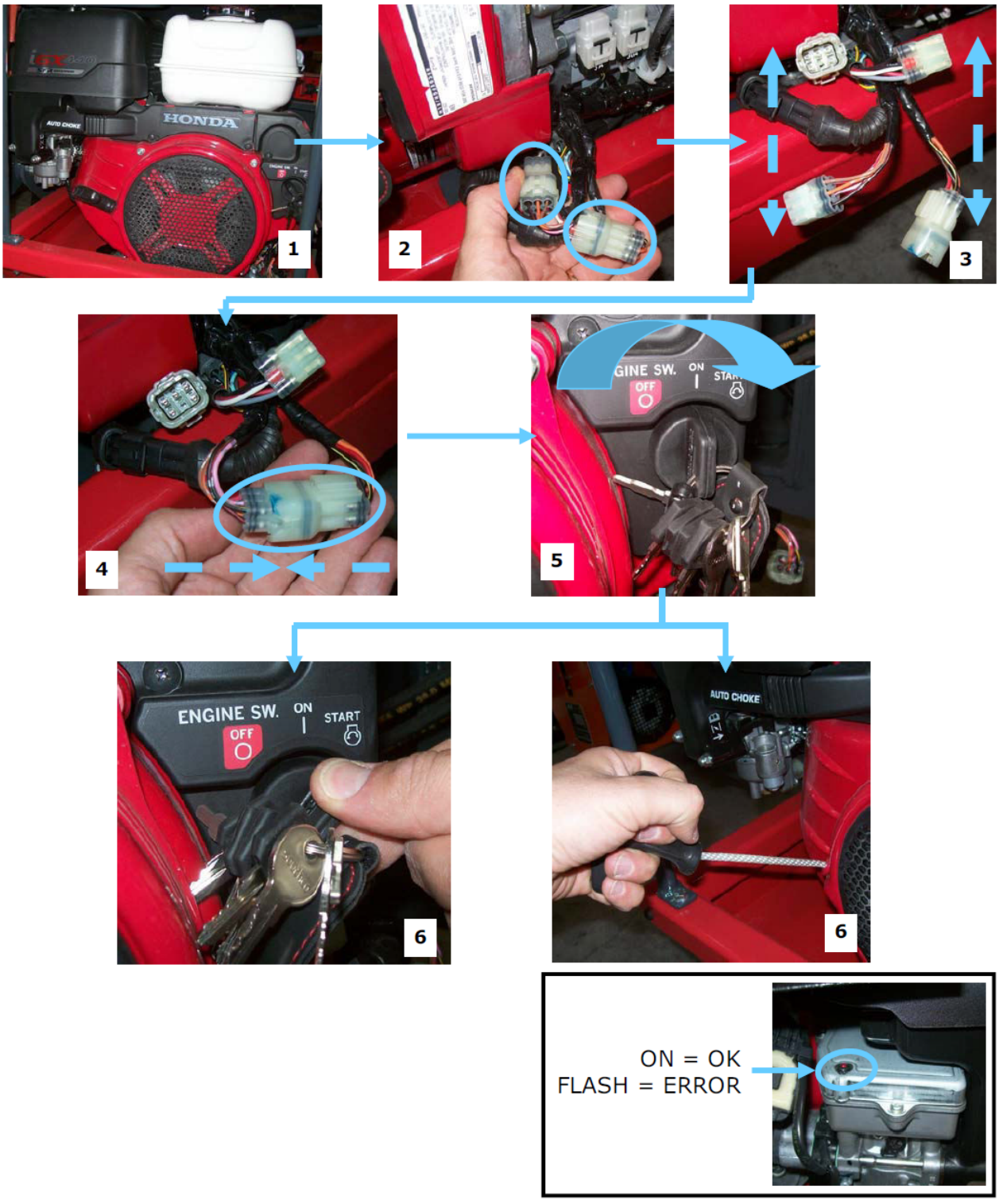


[6] iGX440: Multi layered graded density type



QUICK TROUBLESHOOTING

HONDA IGX440



FIRST OPERATION

Check fueling from fuel tank to carburetor.

Lose drain screw.

Let fuel drain.

Pull recoil 3 or 4 times.

Check fuel coming from fuel tank.

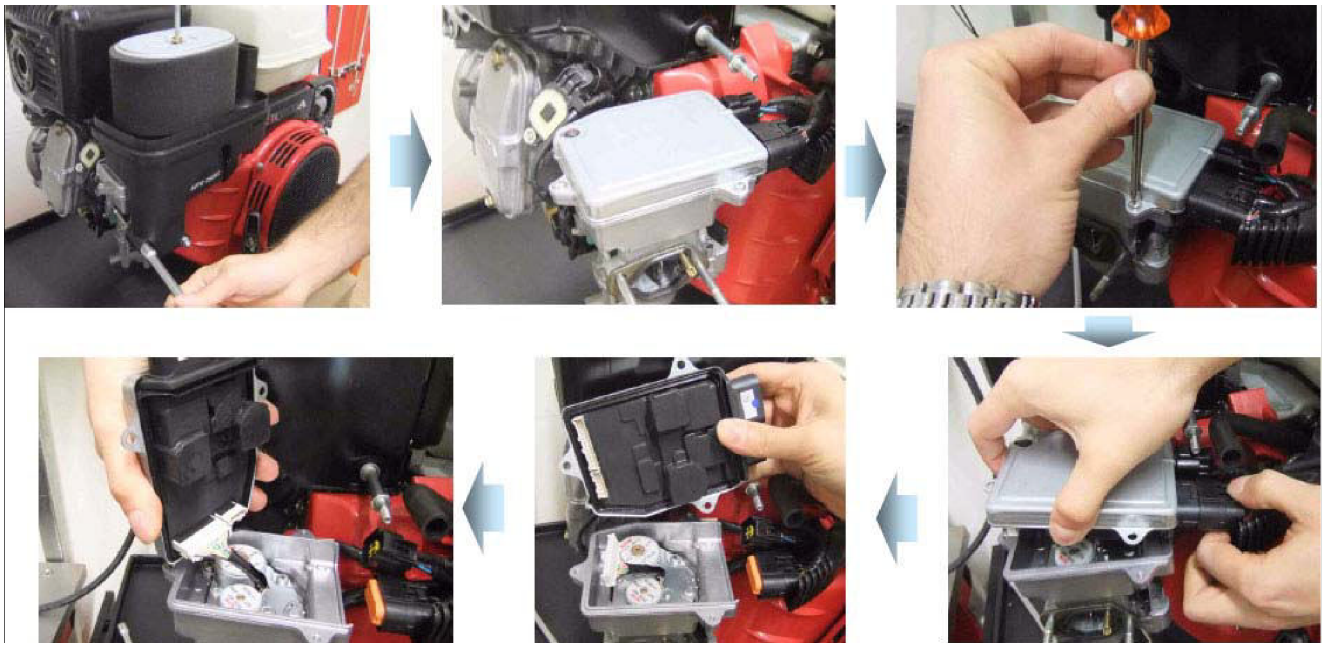
If fuel is not coming from fuel tank proceed to replace fuel filter in fuel tank.

Fuel filter replacement

SECOND OPERATION IF PROBLEM IS ON ENGINE

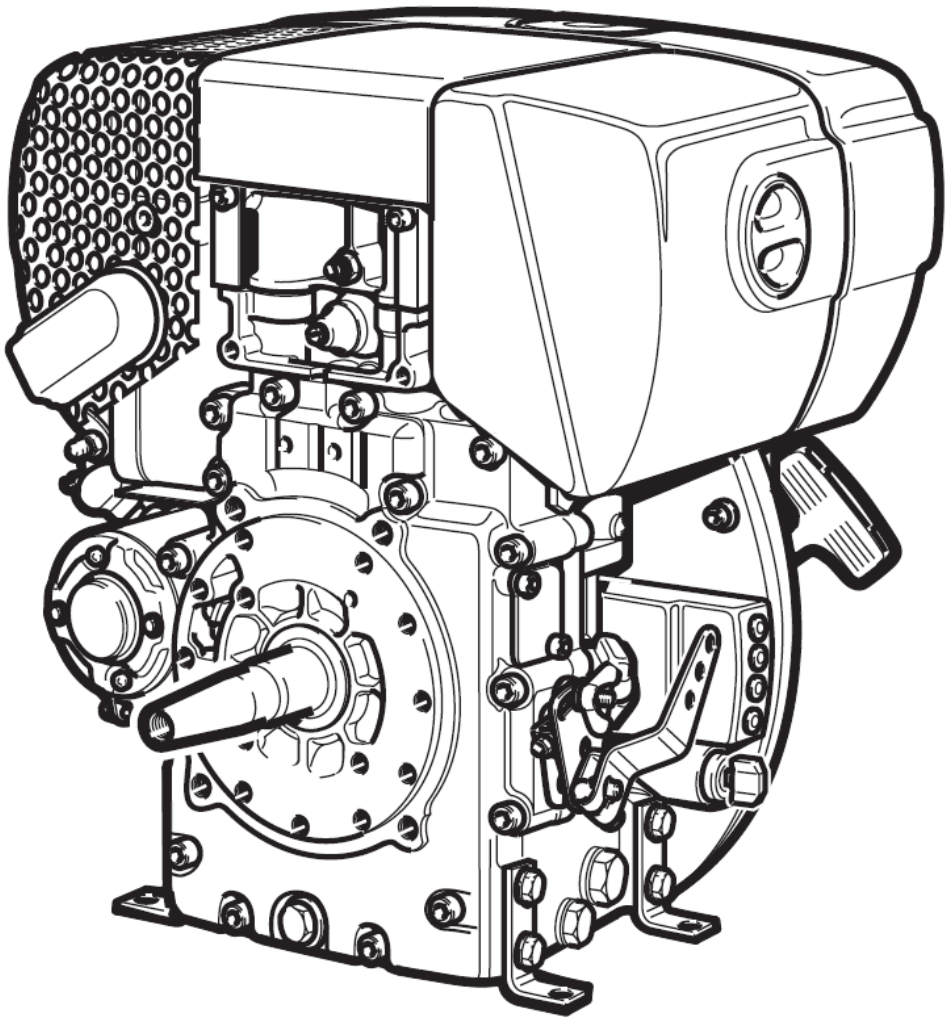
Spark checking

Changing the ECU.



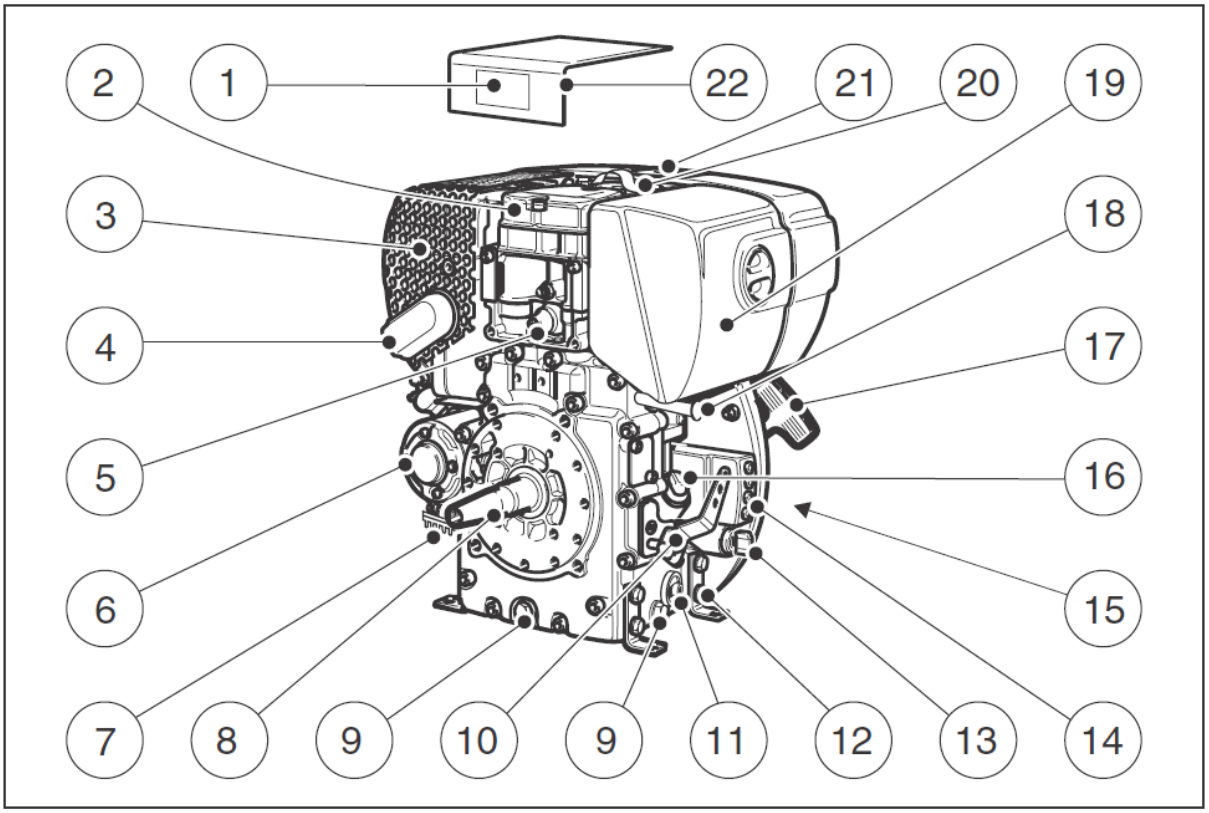
3.11 HATZ ENGINE

TYPE: HATZ 1B30 - 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



GENERAL NOTES

Technical data

Type		1B30	1B40
Design		Air-cooled four-stroke diesel engine	
Combustion system		Direct injection	
Number of cylinders		1	1
Bore / stroke	mm	80 / 69	88 / 76
Displacement	cm3	347	462
Lubricating oil capacity without oil sump with oil sump	l, approx. l, approx.	1.1 [1)] 2.8 [1)]	1.5 [1)] 3.2 [1)]
Difference between “max” and “min” levels without oil sump with oil sump	l, approx. l, approx.	0.5 [1)] 1.8 [1)]	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	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.	40	55
Battery capacity	Amp/h	max. 12 V / 60 Amp/h	

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

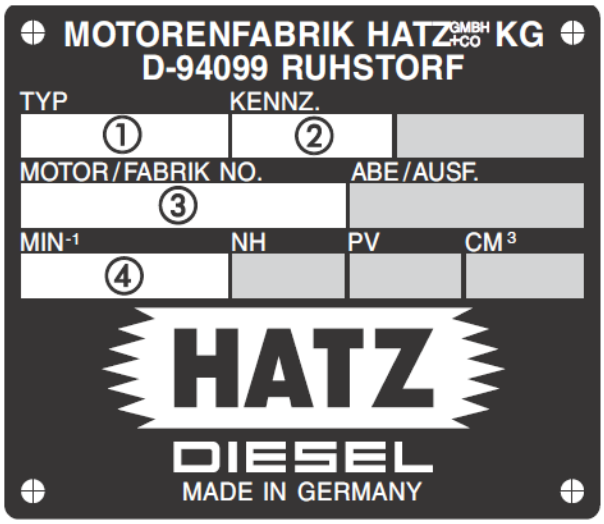
[2)] Depending on model (see maintenance charts).

[3)] Exceeding these limits causes engine breakdown.

Tightening torques

Item	Nm
Oil drain plug	50

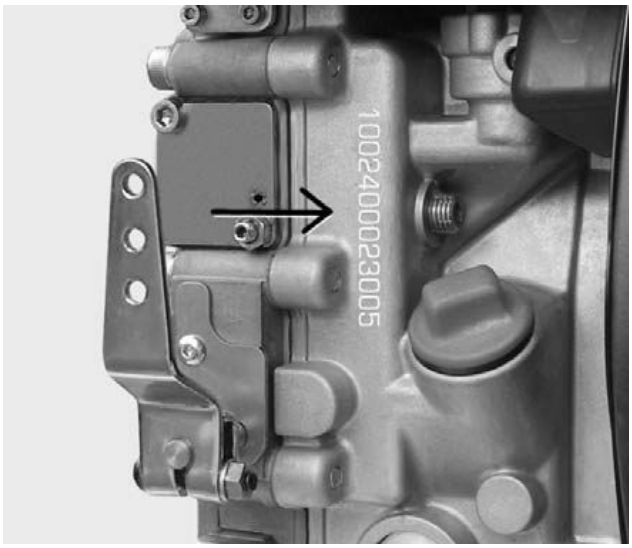
TYPE PLATE



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

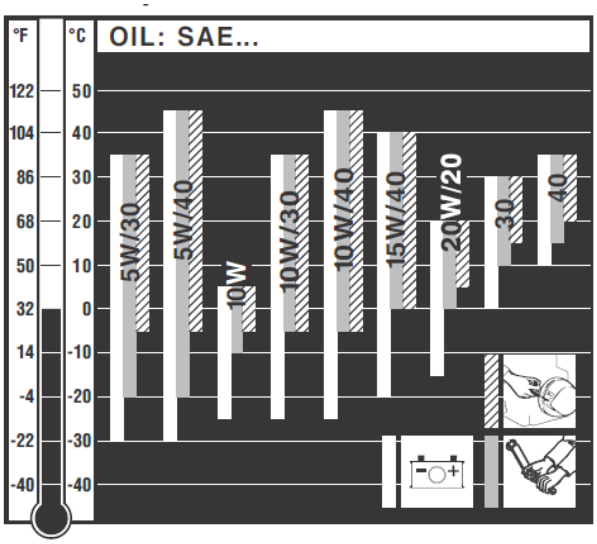
Qualified are all trademark oils which fulfil at least one of the following specifications:

ACEA – B2 / E2 or more significant

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

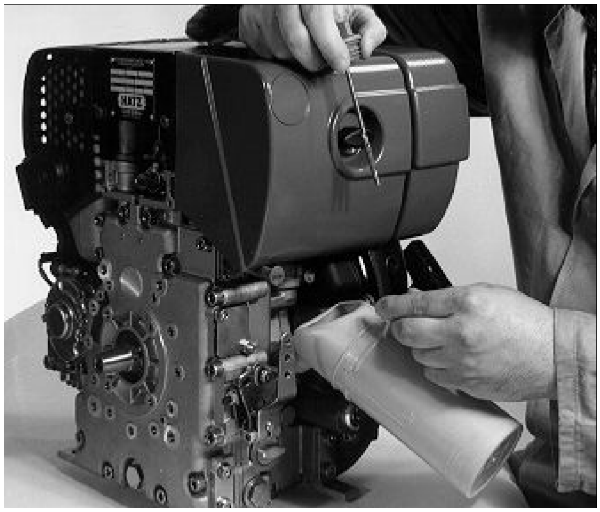
If engine oil of a poorer quality is used, reduce oil change intervals to 150 hours of operation.

Oil viscosity



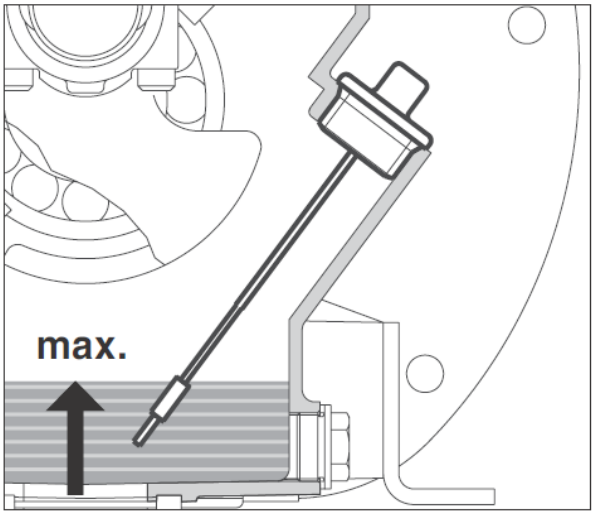
Select the viscosity class according to the ambient temperature for cold starts.

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.

Fuel

⚠ CAUTION

STOP THE ENGINE BEFORE REFILLING THE FUEL TANK. NEVER REFUEL NEAR A NAKED FLAME OR SPARKS WHICH COULD START A FIRE. DON'T SMOKE. USE ONLY PURE FUEL AND CLEAN FILLING EQUIPMENT. TAKE CARE NOT TO SPILL FUEL.

All diesel fuels which satisfy the following specifications are suitable:

EN 590 or BS 2869 A1 / A2 or ASTM D 975 - 1D / 2D

Remove fuel tank cap.

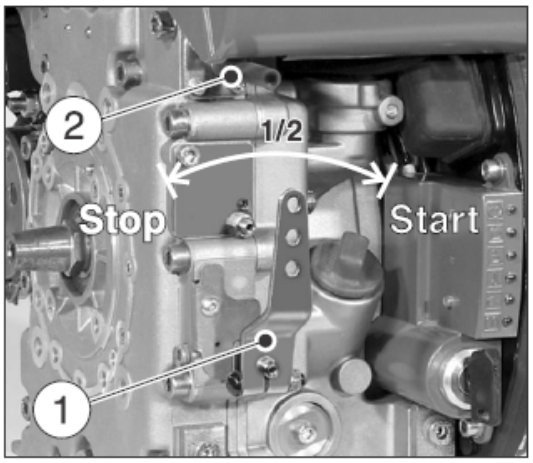
Before the first start or if the fuel tank has been run dry, completely fill the fuel tank with diesel. The bleeding of the fuel system is automatically.

NOTE: *If a **double fuel filter system** is provided, wait for a short time after replenishing fuel (approx. 1 to 2 minutes) for automatic bleeding to be completed.*

Close and fix fuel tank cap.

At temperatures below 0 °C, winter-grade fuel should be used or paraffin added to the fuel well in advance.

Lowest ambient temperature when starting, in °C	Paraffin content for:	
	Summer fuel	Winter fuel
0 up to–10	20%	–
–10 up to–15	30%	–
–15 up to–20	50%	20%
–20 up to–30	–	20%



Set speed adjustment lever „1“either to 1/2START or max. START position, as desired or necessary.

Starting at a lower speed will help to prevent exhaust smoke.

– Pull the starting cable out by the handle until you feel a slight resistance.

– Let the cable run back; in this way the entire length of the starting cable can be used to start the engine.

– Devices which are not securely fastened should be restrained with the foot.

– Grip the handle with both hands.

Recoil starter (down to –6 °C)

For starting preparations.

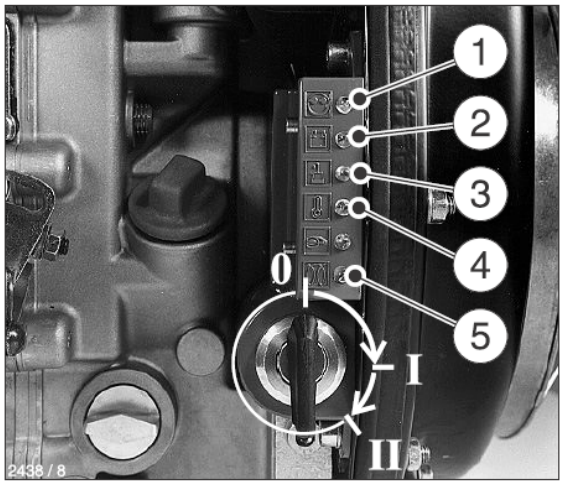
Starting procedure

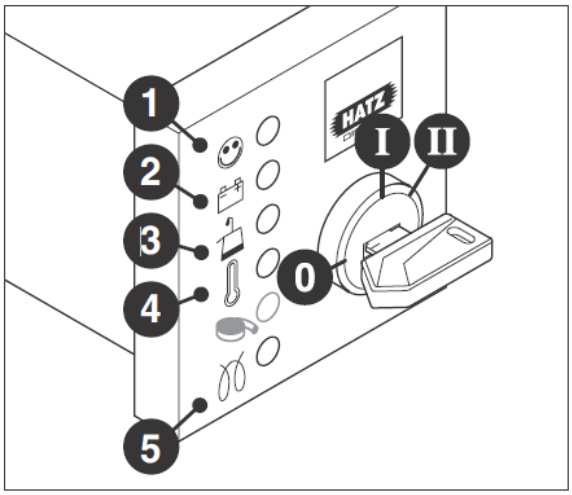
Commence pulling the starting cable vigorously and at an increasing speed (do not jerk it violently) until the engine starts.

NOTE: *If after several attempts of starting the exhaust begins to emit white smoke, move the speed adjustment lever to the STOP position and pull the starting cable out slowly 5 times. Repeat the starting procedure.*

Electric starter

– For starting preparations.





– Insert the key to its stop and turn it to position I.

Depending upon the model, the battery charge telltale „2“ and the oil pressure warning light „3“will come on.

The engine temperature display „4“(additionalequipment) lights up if the temperature at the cylinder head becomes too high.

Switch off the engine and trace and eliminate the cause of the problem.

– Turn the key to **position II**.

– Release the key as soon as the engine runs. The starting key must spring back to **position I** and remain there during engine operation.

– The battery charge and oil pressure lights should extinguish directly after the engine starts. The display lamp „1“ lights up to show that the engine is running.

– Prior to starting up again, the key has to be returned to **position 0**. When the engine is running the starter repeat lock in the ignition switch will prevent the starter from engaging and suffering damage.

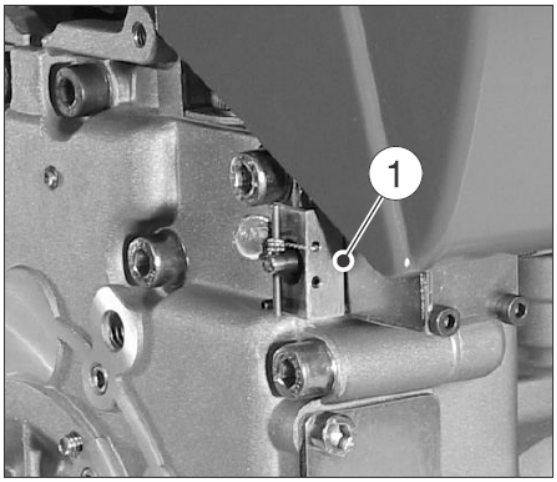
Preheat er system (optional extra)

When starting a cold engine, the preheat indica-tor „5“will light.

– Start the engine immediately after the light goes out.

Fuel shut-off valve, stop solenoid

(additional equipment)



As soon as the starting key is at **Position I**, **fuel shut-off valve** „1“is **electrically released**.

The fuel feed to the injection pump is then open and the engine is ready to start.

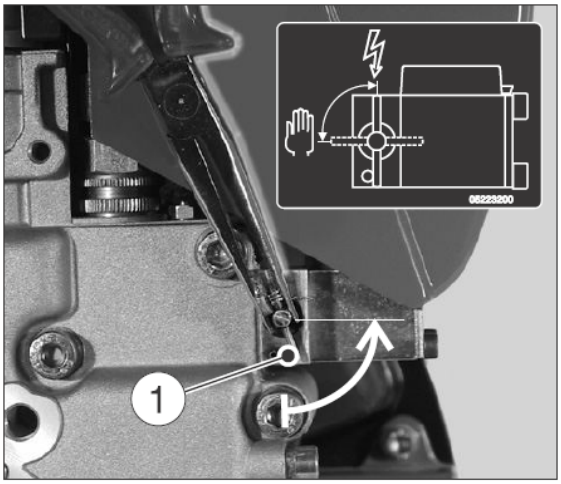
When the engine is running, turning the starting key to **position 0 closes** the cut-off valve and interrupts the fuel supply to the injection pump, so that the **engine stops**.

This shut-off valve is also used for the automatic electrical shutdown system.

Emergency start

If the **shut-off valve** is blocking the fuel supply as a result of an **electrical fault** and the **engine therefore cannot be started,** an emergency start can be attempted.

Proceed as follows for this:



– For emergency starting, turn the lever at fuel shut-off solenoid „1“anti-clockwise by at least 90° using suitable pliers. The lead seal wire will break off.

– As soon as the emergency start lever is in the starting position, the electric starter or recoil starter can be used. The oil level must always be checked before an emergency start, as insufficient oil pressure can lead to complete damage of the engine within a very short time.

⚠ CAUTION

AFTER THIS, THE ENGINE CAN ONLY BE STOPPED WITH THE STARTING KEY IN THE EMERGENCY OPERATING MODE IF THE EMERGENCY STARTING LEVER IS FIRST TURNED BACK CLOCKWISE TO THE STOP POSITION.

Immediately after a period of emergency running, ascertain the cause of the fault and have it rectified. Have the emergency-starting lever sealed once again by a **HATZ service point.**

When the automatic electrical shutdown system is used, the emergency start described above means that liability for risks must be accepted by the operator (**Motorenfabrik HATZ assumes no liability).**

In case of difficulty contact the nearest **HATZ service point.**

Automatic electrical shutdown system

Model with error memory

This is characterized by a brief flashing of all pilot lamps once the starter key has been turned to **position I**.

Important!

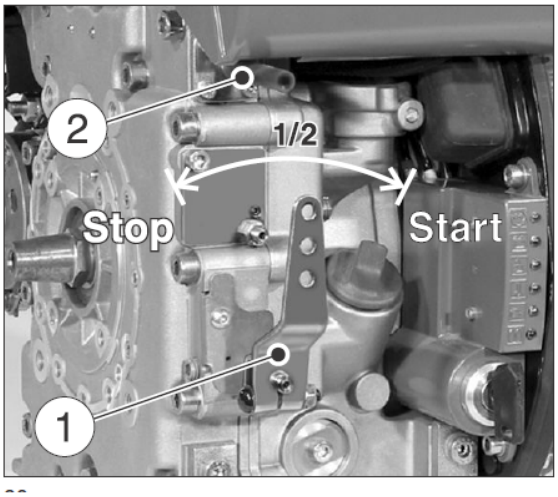
If the engine cuts out immediately after starting or switches off by itself during operation, a monitoring element in the automatic shutdown system has tripped. The corresponding indicator light will come on. After the engine has stopped, the display continues to glow for about 12 seconds. The electrical device then switches itself off automatically. The display lights up again after the start key has been turned back to **position 0** and then to **position I** again.

Trace and eliminate the cause of the operating fault before trying to restart the engine.

The display light goes out when the engine is next started.

Stopping the engine

Speed adjuster, standard version

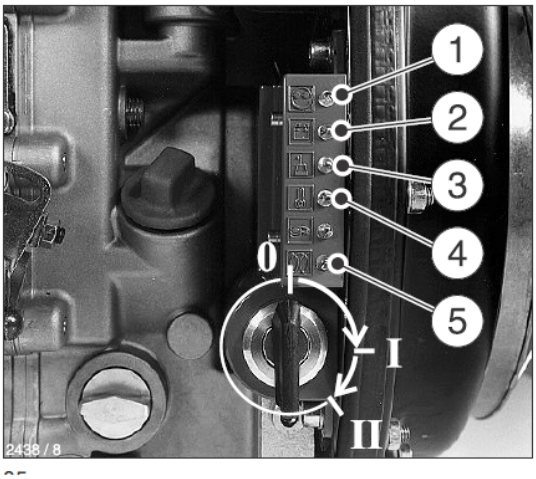


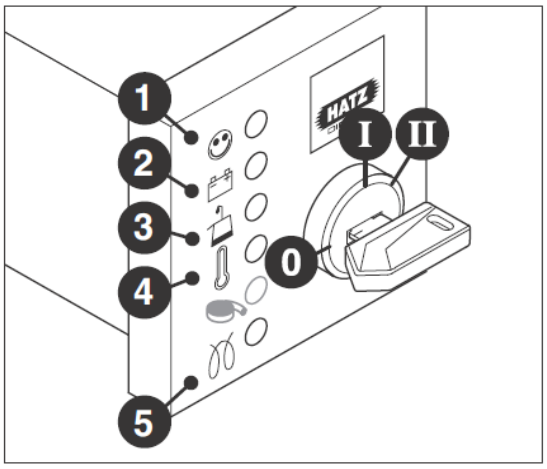
– Move the speed adjustment lever „1“back to the STOP position. The engine cuts out.

NOTE: *Engines with a fixed lower idling speed cannot be switched off using the speed adjustment lever. See the paragraph entitled „Other ways of switching off the engine“.*

Other ways of switching off the engine

1. Fuel shut-off valve, stop solenoid





Turn ignition key to the **0 position**.

The engine cuts out.

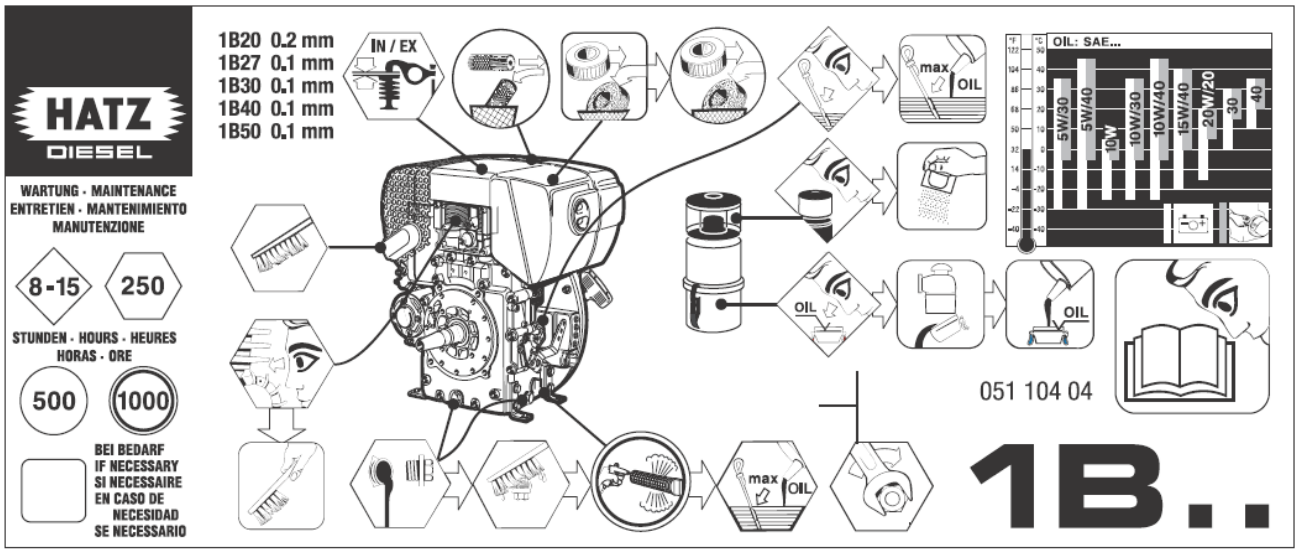
Maintenance

⚠ CAUTION

ONLY CARRY OUT MAINTENANCE WORK WITH THE ENGINE SWITCHED OFF.OBSERVE ALL RELEVANT LAWS AND REGULATIONS GOVERNING THE HANDLING AND DISPOSAL OF USED OIL, FILTERS AND CLEANING AGENTS. PROTECT THE STARTING KEY AGAINST UNAUTHORIZED USE. ON ENGINES WITH AN ELECTRIC STARTER, DISCONNECT THE BATTERY'S NEGATIVE TERMINAL. WHEN MAINTENANCE WORK HAS BEEN COMPLETED, CHECK THAT ALL TOOLS HAVE BEEN REMOVED FROM THE ENGINE AND ALL PROTECTIVE GUARDS FITTED AGAIN. BEFORE STARTING THE ENGINE, ENSURE THAT THERE ARE NO PERSONS IN THE DANGER AREA CLOSE TO THE ENGINE OR EQUIPMENT.

MAINTENANCE CHART

	Maintenance interval	Maintenance work required
8-15	Every 8 – 15 operating hours, or before each daily start-up	Check oil level. Examine the lower section of the oilbath air cleaner to ensure correct oil level and freedom from contamination; change the oil if it contains sludge. On version with cyclone-type dust trap, empty the dust collector. Check combustion and cooling air intake zone. Check air-cleaner maintenance indicator. Check the water trap.
250	Every 250 operating hours	Oilbath air cleaner maintenance. Change engine oil. Check and adjust valve clearances. (Not applicable with automatic self adjusting valve clearance models, see next page) Clean cooling air area. Check screw connections. Clean mesh insert for exhaust.
500	Every 500 operating hours	Change fuel filter element. Dry-type air cleaner maintenance.
1000	Every 1000 operating hours	Clean the oil filter.



On new or reconditioned engines, after the first 25 operating hours, always:

– Change engine oil.

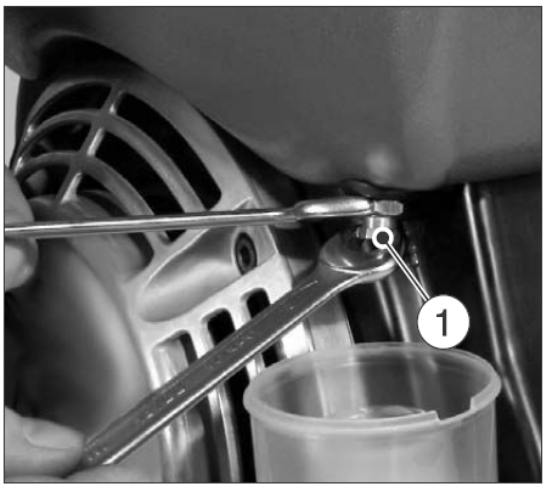
– Check valve clearances and adjust if necessary.

– Examine screw connections. **Do not tighten the cylinder head fastening.**

If the engine is not used frequently, change the engine oil after **12 months at the latest**, regard-less of the actual number of hours it has been inn operation.

CHECKING THE WATER TRAP

The intervals at which you should check the water trap depend entirely on the amount of water in the fuel and the care taken when re-fuelling. The normal interval is once a week.



- Loosen hexagon screw „1“with approx. 3-4 rotations.

– Trap the drops which emerge in a transparent vessel. Since water has a greater specific gravity than diesel fuel, the water emerges before the diesel fuel. The two substances separate at a clearly visible line.

– As soon as diesel only emerges at screw „1“,this can be tightened again.

If an external water trap is attached, check its water content every day, when the engine oil level is checked. The water which has collected is separated at a clearly visible line from the diesel fuel above it.

– Open drain plug „1“and drain the water out into a suitable vessel.

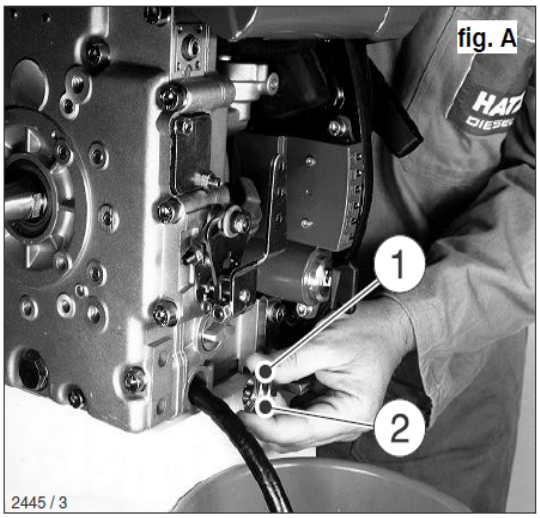
– If the drain plug is difficult to reach, an extension hose can be attached to it.

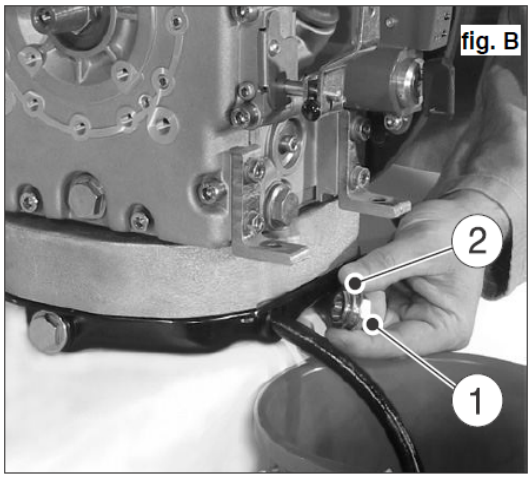
CHANGING ENGINE OIL

The engine must be standing level and be switched off. Only change the oil when the engine is warm.

⚠ CAUTION

DANGER OF SCALDING FROM HOT OIL! TRAP THE OLD OIL AND DISPOSE OF IT IN ACCORDANCE WITH LOCAL LEGISLATION.





– Take out oil drain plug „1“and allow the oil to drain out, Fig. A without oil sump, Fig. B with oil sump.

– Clean the oil drain plug „1“, fit a **new** washer „2“,insert and tighten. **Tightening torque: 50 Nm.**

–Add engine oil.

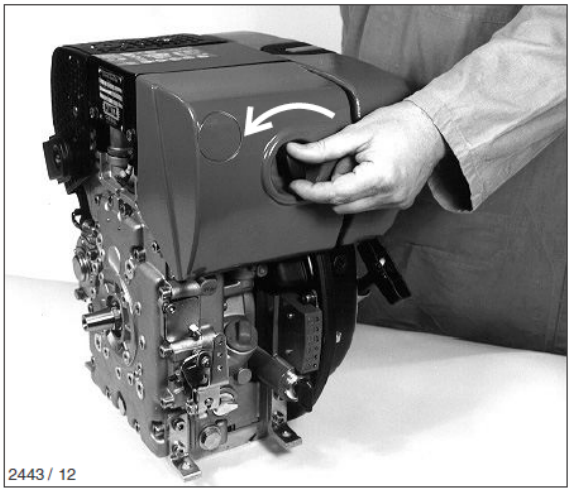
CHECKING AND ADJUSTING VALVE CLEARANCES

Remark:

Following steps are inapplicable in case equipment is with automatic tappet clearance compensation.

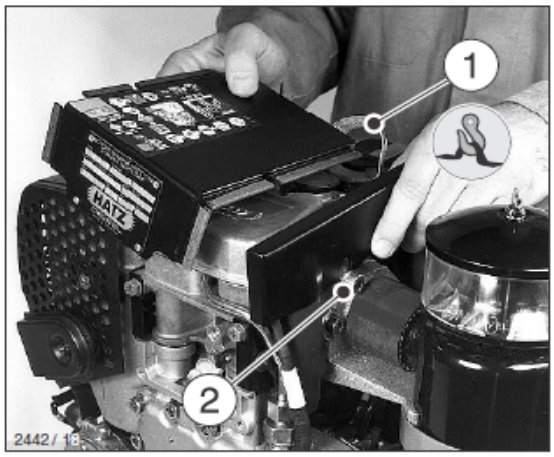
Identification characteristic is maintenance plan.

Only carry out adjustments when the engine is cold (10 - 30 °C).



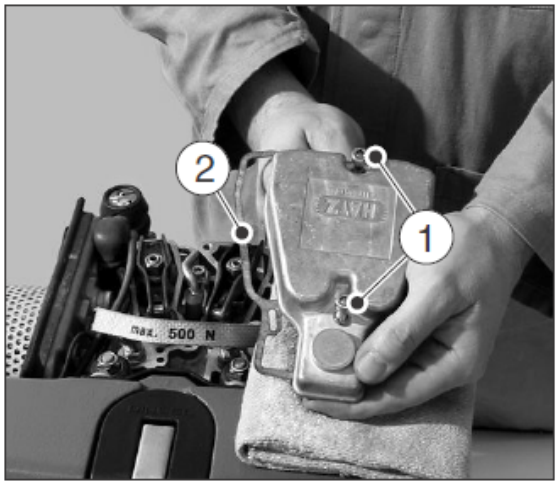
– Remove cover to air filter.

– Remove noise insulating hood.

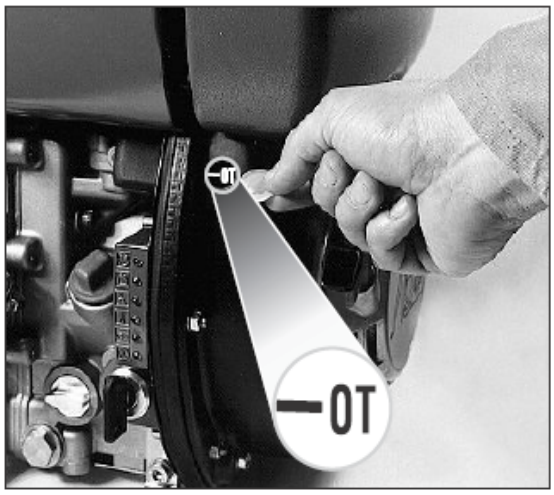


– On version with oil bath air cleaner, remove screw „2“ and take off cover plate with noise-insulating hood.

– Remove any contamination adhering to the cover for the cylinder head.



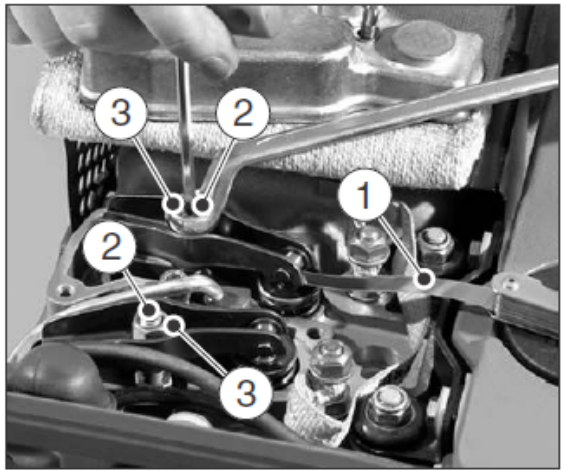
– Remove screws „1“and take off the cylinder head cover with gasket „2“.



– Remove rubber cap from the inspection hole cover.

– Turn the engine over in the normal direction of rotation until the valves are in the overlap position (exhaust valve not yet closed, inlet valve starts to open).

– Turn the crankshaft through 360° in the normal direction of rotation and align exactly to the OT-marking.



– Check valve clearances with feeler gauge „1“(0.10 mm).

– If valve clearances require adjusting, slacken off screw „2“and turn hex nut „3“until feeler gauge „1“can be pulled through with just slight resistance when screw „2“is retightened.

– Fit cover for cylinder head and tighten evenly, always using a new gasket.

– Re-attach parts previously removed from engine. Do not forget: replace the rubber cap at the inspection hole cover.

– Carry out a brief test run, then check the cover for leaks.

CLEANING COOLING AIR AREA

⚠ CAUTION

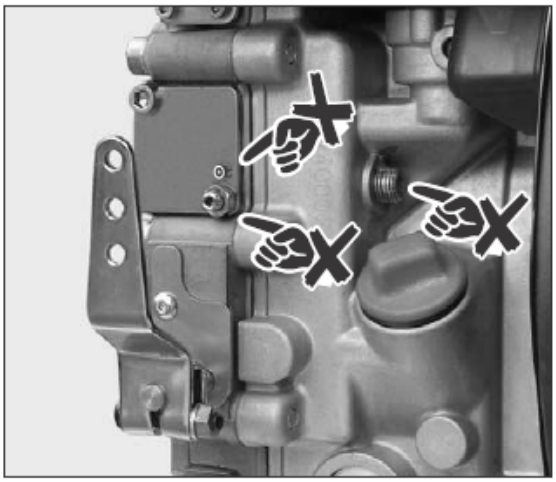
THE ENGINE MUST BE SWITCHED OFF AND COOLED DOWN BEFORE CLEANING!

– If severely contaminated, clean the cooling fins on the cylinder and cylinder head, and also the fan blades in the flywheel. If necessary, con-tact your local HATZ service station.

CHECKING SCREW CONNECTIONS

– Check the tightness of all threaded connections and take up slack if necessary, provided that these can be reached during maintenance work.

Do not tighten the cylinder head bolts.



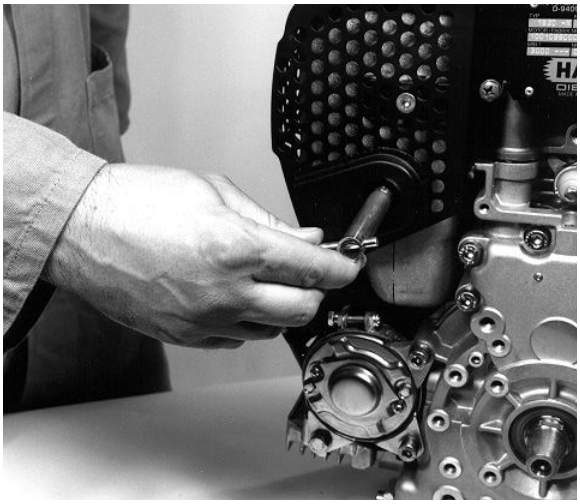
⚠ CAUTION

THE ADJUSTING SCREWS AT THE ENGINE GOVERNOR AND ON THE INJECTION SYSTEM ARE SEALED WITH LACQUER AND ARE NOT TO BE TIGHTENED OR ADJUSTED.

CLEANING THE EXHAUST MESH INLET

⚠ CAUTION

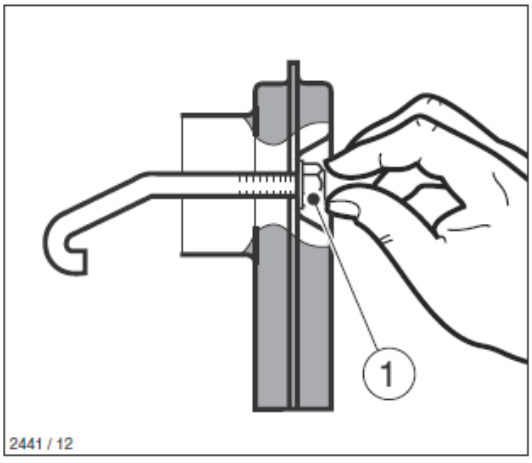
EXHAUST SYSTEM COMPONENTS WILL NATURALLY BE HOT AND MUST NOT BE TOUCHED WHILE THE ENGINE IS RUNNING OR UNTIL IT HAS COOLED DOWN AFTER BEING STOPPED.



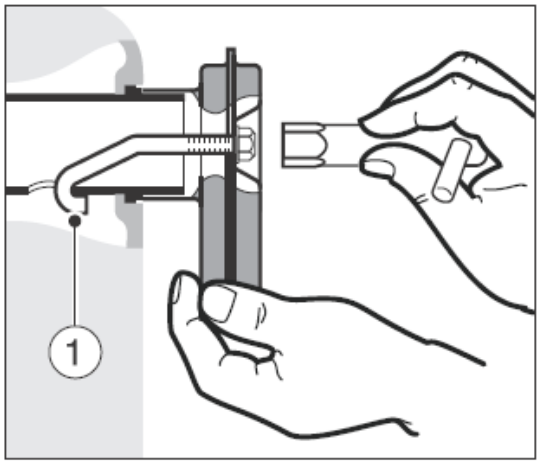
– Unscrew hex nut and remove the exhaust mesh insert.

– Remove any deposits in the mesh insert by means of a wire brush.

– Check the exhaust mesh insert for cracks or damage and, if necessary replace with a new one.



– Screw on hexagon nut „1“ by approx. 1 turn.



– Insert exhaust screen with hook „1“ into hole, them pull outwards again so that the hook is retained.

– Tighten the hexagon nut fully.

MAINTENANCE EVERY 500 OPERATING HOURS

Renewing fuel filter

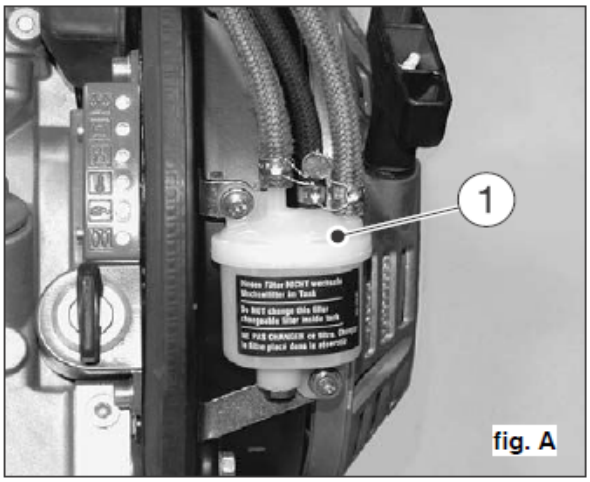
The maintenance intervals for the fuel filter are dependent upon the purity of the diesel oil being used and, if necessary, may have to be reduced to 250 hours.

⚠ CAUTION

WHEN WORKING ON THE FUEL SYSTEM, DO NOT EXPOSE IT TO NAKED FLAMES; DO NOT SMOKE.

IMPORTANT! KEEP THE ENTIRE AREA CLEAN SO THAT NO DIRT REACHES THE FUEL. FUEL PARTICLES MAY DAMAGE THE INJECTION SYSTEM.

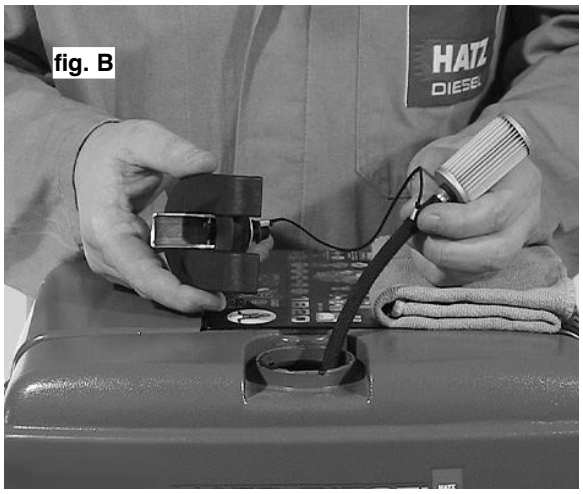
Model with double fuel filter system



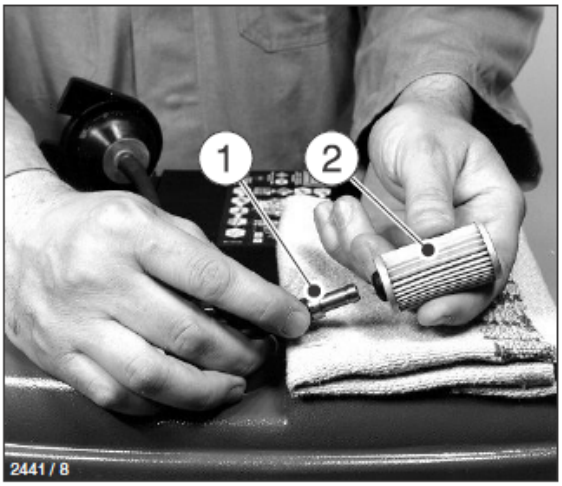
This system consists of a maintenance-free external filter „1“(Fig. A) and a replaceable-cartridge filter which is installed in the tank (Fig. B). The advantage of this system consists in retaining dirt particles which might get into the fuel system on filter replacement, upstream of the following external filter, so that they can-not endanger the injection system.

IMPORTANT! THIS EXTERNAL FILTER MUST NOT BE REPLACED. ONLY REPLACE THE FUEL FILTER INSTALLED IN THE TANK!

Model with fuel filter in fuel tank



– Open the tank cover and pull the fuel filter out of the tank by its cord.



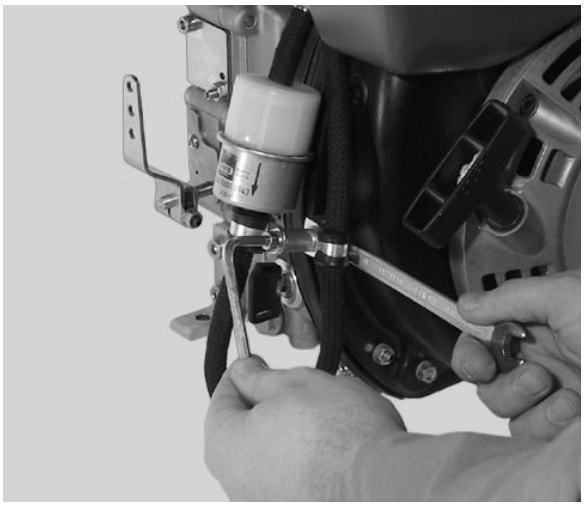
– Pull fuel supply line „1“off fuel filter „2“and insert a new filter.

– Fit the fuel filter again and close the tank cap. Bleeding of the fuel injection system takes place automatically.

MODEL WITH EXTERNAL FUEL FILTER

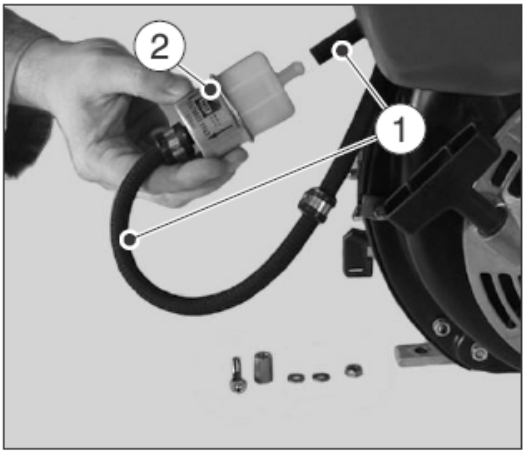
(no fuel filter in the tank)

– Empty the fuel tank by taking out screw „1“, (chapter Checking the water trap) and allow the fuel to drain into a clean vessel. This fuel can be reused later.



– Unscrew the fuel filter from its mount.

– Place a suitable vessel under the filter to trap the residual fuel.



– Pull off fuel supply line „1“at both ends of fuel filter „2“ and insert the new filter.

– Always renew the fuel filter. Note the arrows indicating the correct direction of flow.

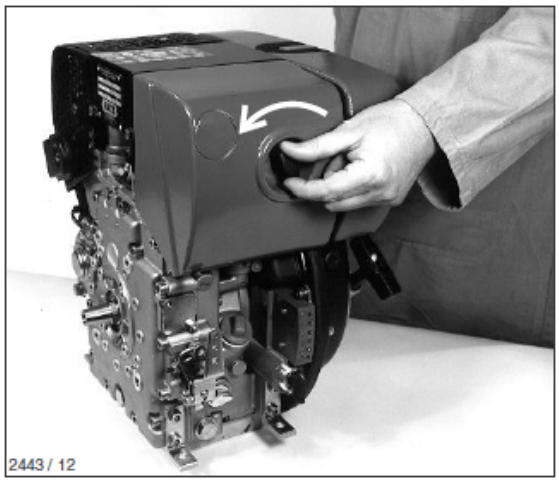
– Secure the filter to its mount.

– Fill the fuel tank with diesel oil. Air is vented from the fuel system automatically.

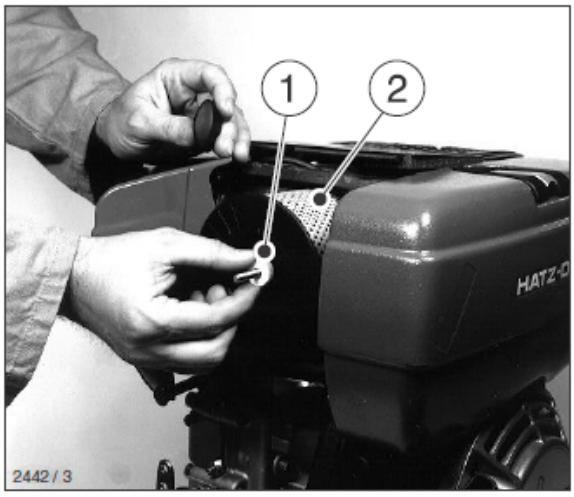
– Check the fuel filter and lines for leaks after a short test run.

AIR CLEANER MAINTENANCE

The filter cartridge should only be cleaned when the maintenance lamp lights at maximum speed.However, the filter cartridge should always be re-placed after 500 operating hours at the latest.

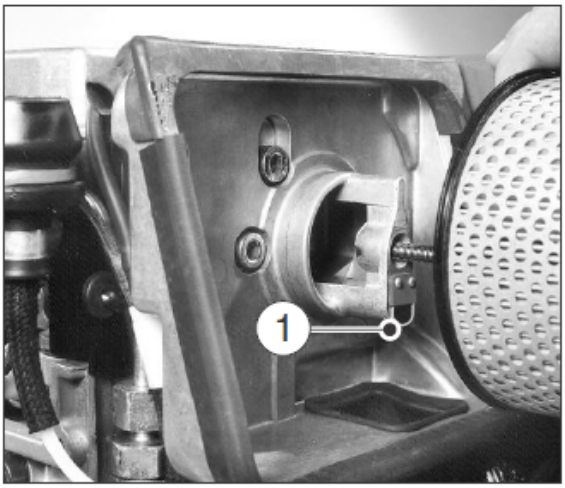


– Remove the air cleaner cover.



– Unscrew and remove knurled nut „1“and takeoff air cleaner element „2“.

– Clean the filter compartment and the cover. Dirt and other foreign bodies must not be allowed to enter the engine’s air inlet points.

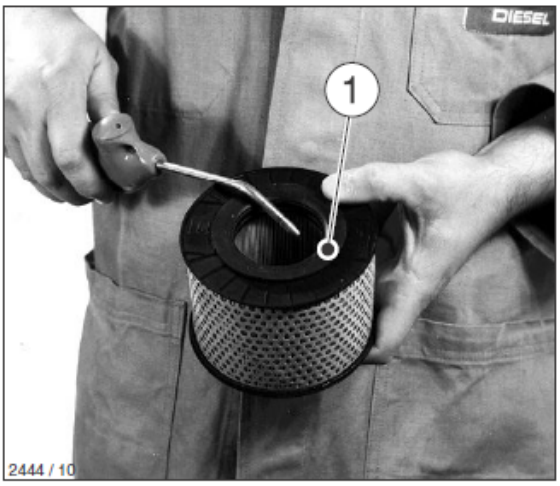


– On versions with a mechanical air cleaner service indicator, check the condition and cleanliness of valve plate „1“.

– The filter cartridge should either be renewed or, depending upon the degree of contamination, cleaned, or checked, as follows:

CLEANING THE FILTER CARTRIDGE

Dry contamination



Use compressed air to blow through the filter cartridge from the inside outwards, until no further dirt emerges.

IMPORTANT! THE PRESSURE MUST NOT EXCEED 5 BAR.

⚠ CAUTION

PERSONS HANDLING COMPRESSED AIR MUST WEAR PROTECTIVE GOGGLES.

Moist or oily contamination

Renew the filter cartridge.

CHECKING THE FILTER CARTRIDGE

– Check filter cartridge's gasket surface „1"for damage.

– Check the filter cartridge for cracks or any other type of damage to the paper filter by holding it inclined towards the light or by shining a light source through it.

IMPORTANT! THE SLIGHTEST DAMAGE TO THE PAPER FILTER RULES OUT IT BEING USED ANY LONGER.

– Re-assemble the filter cartridge in the reverse order of work.

MAINTENANCE EVERY 1000 OPERATING HOURS

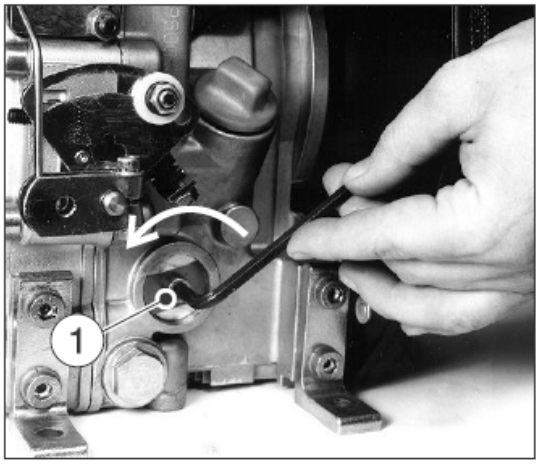
Cleaning the oil filter

The oil filter should be cleaned at the same time as the engine oil is changed, since oil escapes when the filter is removed.

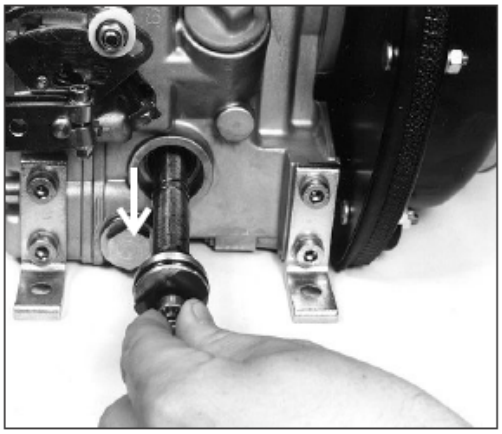
The engine must be standing horizontally and switched off.

⚠ CAUTION

DANGER OF SCALDING FROM HOT OIL! TRAP THE OLD OIL AND DISPOSE OF IT IN ACCORDANCE WITH LOCAL LEGISLATION.



– Loosen screw „1" with approx. 5 rotations.

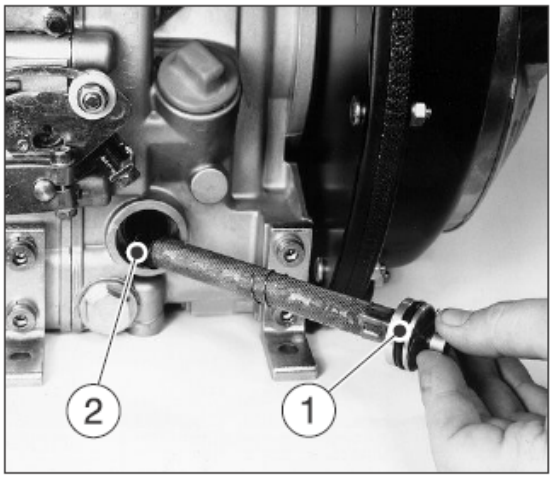


– Remove oil filter from housing.

– Use an air line to blow out oil filter dirt from the inside outwards.

⚠ CAUTION

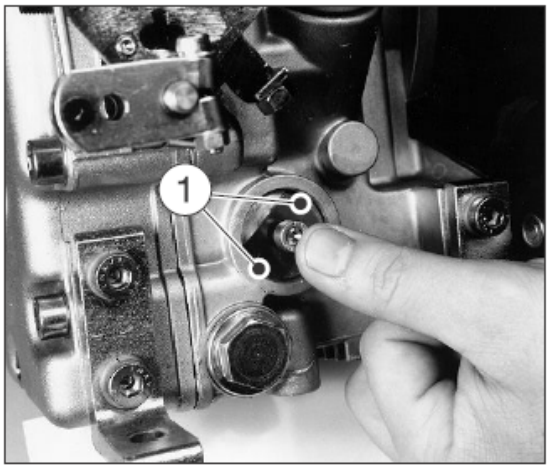
PERSONS HANDLING COMPRESSED AIR MUST WEAR PROTECTIVE GOGGLES.



– Check joint washer „1“whether it is damage; replacement if necessary.

– Check joint washer „2“whether it is damage and correctly fitted, replace oil filter if necessary.

– Lubricate joint washer before fitting.



– Put in oil filter and press until limit stop.

– Check whether tension springs sit close to oil filter with both ends „1“, before tightening screw.

– Check the oil level and restore to the **max.** level if required.

MALFUNCTIONS – CAUSES AND REMEDIES

Malfunctions	Possible causes	Remedy
1. Engine does not start, or not immediately, but can be turned over easily as usual.	Speed control lever in stop or idle position.	Move lever to START position.
	Engine shutdown pin in STOP position.	Move to operating position by pulling the pin gently.
	No fuel in the injection pump.	Add fuel. Systematically check the entire fuel supply system: If still no fault found, - check engine feed line - check fuel filter
	Insufficient compression: - Incorrect valve clearance.	Check valve clearances, adjust if necessary.
	- Cylinders and/or piston rings worn.	See workshop manual.
	Injector not functioning.	See workshop manual.
At low temperatures.	Below starting threshold temperature.	Operate preheater (optional extra).
	Equipment not disengaged.	Disengage engine from equipment, if possible.
	Preheating system faulty (optional extra).	See workshop manual.
	Fuel has inadequate resistance to low temperatures.	Check whether clear (not turbid) fuel emerges at the fuel line detached from the injection pump. If turbid or separated - either warm up the engine or drain the complete fuel supply system. Refill with winter-grade fuel to which paraffin has been added.

Malfunctions	Possible causes	Remedy
At low temperatures:	Starting speed below 400 min^{-1} - Viscosity of oil too high.	Change lubricating oil and add oil of the correct viscosity class.
	- Battery charge too low.	Check the battery, if necessary contact a service station.
If equipped with a stop solenoid or automatic electrical shutdown system (additional equipment)	Solenoid faulty and/or fault in the electrical system.	See workshop manual.
2. Engine fires but does not run.	Speed control lever not moved far enough towards „START".	Move lever to „START" position.
	Equipment not disengaged.	Disengage engine from equipment if possible.
	Fuel filter blocked.	Renew fuel filter.
Automatic electrical shut-off device (optional extra)	One of the automatic shutdown's monitoring elements has initiated a stop signal.	Localise the monitoring element responsible and clear the fault, or contact aHATZ service station.
3. Starter motor does not operate or engine does not turn over.	Fault in the electrical system: - Battery and/or other cables incorrectly connected up. - Cable connections loose and/or oxidised. - Battery faulty and/or flat. - Starter motor faulty. - Faulty relays, monitoring element.	Check electrical system and its component. See also the workshop manual.

Malfunctions	Possible causes	Remedy
4. Engine cuts out of its own accord during operation.	Fuel supply interrupted - Tank has run empty. - Fuel filter blocked. - Tank venting inadequate. - Air in the fuel system.	 Add fuel. Change fuel filter. Ensure adequte tank venting. Check fuel system for penetration of air. Check air vent valve.
	Mechanical faults.	Contact a HATZ service station.
Automatic electrical shut-off device (optional extra)	One of the automatic shutdown's monitoring elements has initiated a stop signal.	Localise the monitoring element responsible and clear the fault, or contact aHATZ service station.
	Monitoring element for: - oil pressure too low - engine temperature too high - defective alternator.	 Check oil lubrication. Check air cooling zone for contamination. See workshop manual.
5. Engine output and speed both drop.	Fuel supply interrupted: - Tank has run empty. - Fuel filter blocked. - Tank breathing inadequate. - Air in the fuel system. - Speed control lever does not remain in desired position.	 Add fuel. Change fuel filter. Provide adequate tank breathing. Check fuel system for penetration of air. Check air vent valve. Lock the lever into position.
6. Engine output and speed fall, black smoke from exhaust.	Air cleaner contaminated. Valve clearances incorrect. Injector not functioning.	Clean or renew the air cleaner. Adjust valve clearances. See workshop manual.

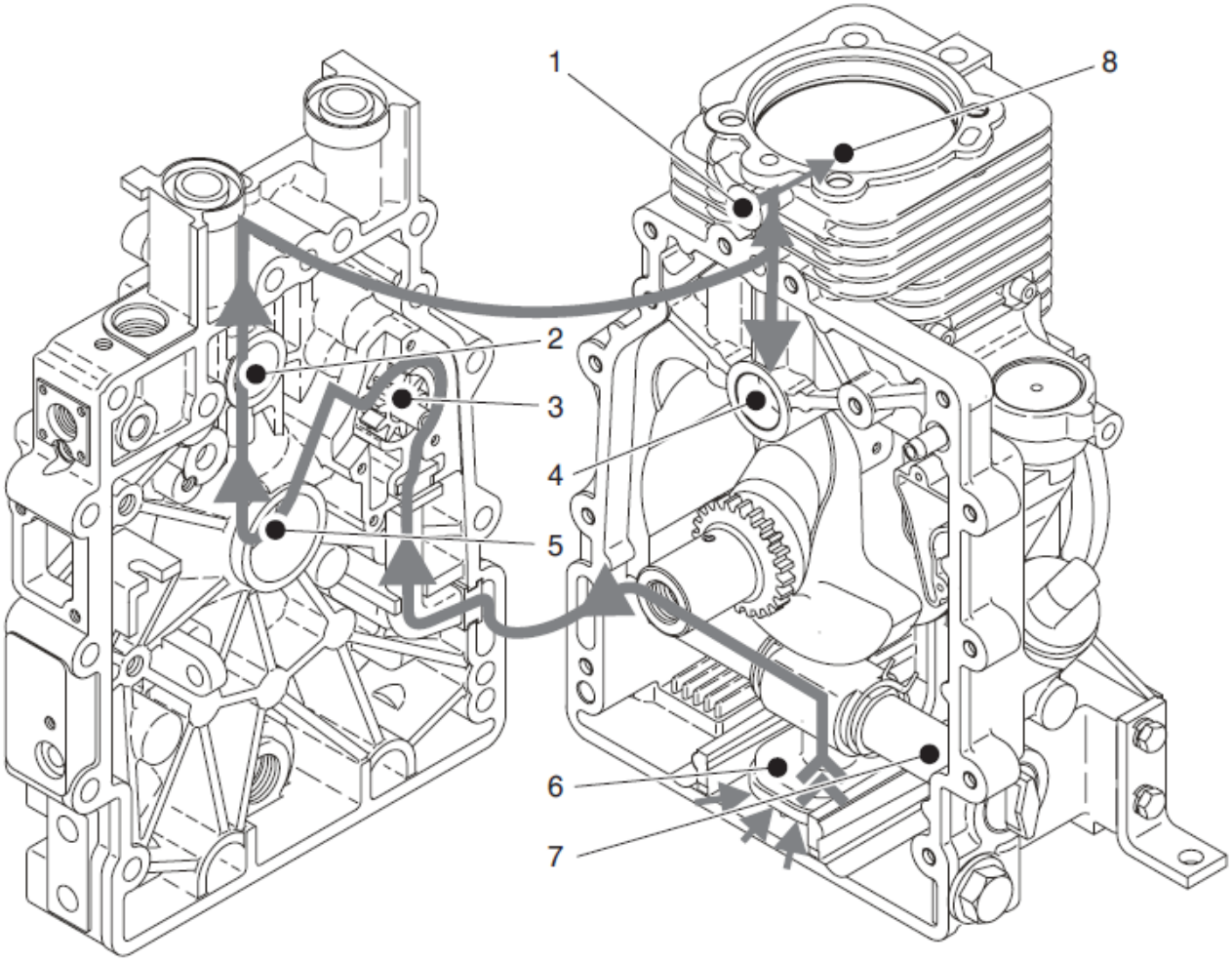
Malfunctions	Possible causes	Remedy
7. Engine becomes very hot. Indicator lamp for cylinder temperature (optional extra) comes on.	Too much lubricating oil in engine.	Drain off lubricating oil as far as upper mark on dipstick.
	Inadequate cooling: - Contamination of entire cooling air zone.	Clean cooling air zone.
	- Air duct panels not properly sealed.	Check cooling air deflector plates and shafts for completeness and airtight seal.
8. Moisture condensate emerging from exhaust.	Operation off load for a prolonged period.	Operate the machine at about 70 % load until moisture no longer emerges from the exhaust.

Technical data

Type		1 B 30	1 B 40
Description		air-cooled four-stroke diesel	
Fuel supply/combustion system		direct injection	
Number of cylinders		1	1
Bore / stroke	mm	80 / 69	88 / 76
Displacement	cc	347	462
Compression ratio		1:21.5	1:21.0
Max. lubricating oil content	app. l	1.1**	1.5**
Amount of oil between “max” und “min” marks	app. l	0.5**	0.8**
Engine oil consumption (after running in for approx. 50 hours)	max.	1 % of full-load fuel consumption	
Engine oil pressure at oil temperature 100 °C	app.	2.5 bar at 3000 rpm	
Direction of rotation (power take-off end)		counter-clockwise	
Weight (incl. tank, air cleaner, silencer, recoil starter and electric starter)	app. kg	38	55
Cooling air requirement at n = 3000 rpm	m^3 / min	6.0	7.3
Combustion air requirement at n = 3000 rpm	m^3 / min	0.52	0.69
Max. continuous operating angle – with flywheel end lower – in other directions		25° 35°	
Starter		12 V - 1.0 kW – 24 V - 1.6 kW	
Generator charging current at 3000/ 1500 rpm		12 V - 14 A / 7 A – 24 V - 10 A / 5 A	
Battery	min/max	12 V - 36 / 60 Ah – 24 V - 24 / 44 Ah	

** These values are to be understood as approximate.
Always refer to the max. mark on the dipstick.

Engine oil circuit



1. Oil pressure switch
2. Camshaft bearing, timing end
3. Oil pump
4. Camshaft bearing, flywheel end
5. Main and big-end bearings (crankshaft)
6. Intake screen
7. Oil mesh filter
8. Gap between crankcase and cylinder liner (for heat dissipation)

Additional equipment

FUEL TANK 1B 30, 1B 40

General information:

On 1B 30 / 40 engines from the start of series production, an injector with oil leak-off return line to the tank was introduced.

Retrofitting:

– Remove the edge at the angle for fuel tank 1 as illustrated.

– Drill an 8.3 - 8.5 mm diameter hole in the tank at the point shown, and deburr it.

– Insert the rubber grommet and hose nipple.

NOTE: *Only the new injector is available as a spare part. All the parts needed for retrofitting are supplied with it.*

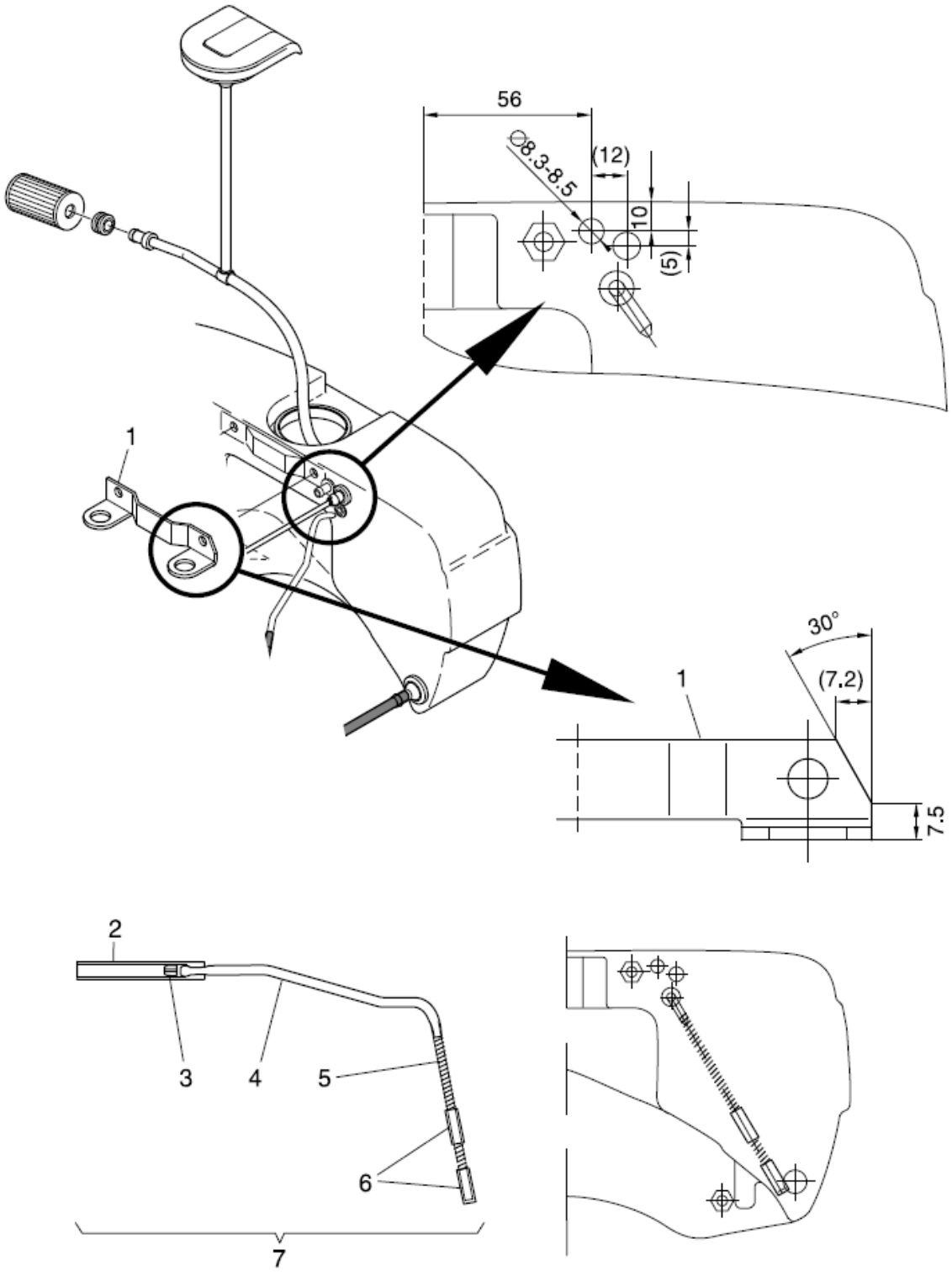
Fuel return line:

From the end of 1998 on, the fuel return line was modified again.It now consists of fuel line 2, restrictor 3, fuel pipe 4, coil spring 5 and fuel lines 6.The complete line 7 is supplied as a spare part.

NOTE: *The lines for 1B 30 and 1B 40 engines are of different lengths.*

Assembly instructions:

– Install return pipe 4 so that the end of the pipe in the tank faces towards the outlet nipple.


56
8.3-8.5
(12)
10
(5)
1
30°
(7.2)
7.5
2
3
4
5
6
7

DRY-TYPE AIR CLEANER

Preliminary work:

Dismantling:

– Take off the parts in the order 1 ... 4.

– Pull tank vent hose 8 off insulating flange 14.

– Loosen and remove machine screws 9 with spring washers 10 and shim washer 11.

– Extract air guide sleeve 15 out of air clean er housing 12.

– Take off air cleaner housing 12 with seals 13 and insulating flange 14.

Testing / **repair:**

– Check filter element 4 and sealing strips 5 / 6 on the housing and also rubber grommet 7 in the cover and plug 16.

– Renew damaged parts.

Assembly:

– Install the parrs by following the disman-tling procedure in the reverse order.

– Note the correct installed position of plug 16 :

without maintenance indicator:

Axial bore 17 faces the cylinder head

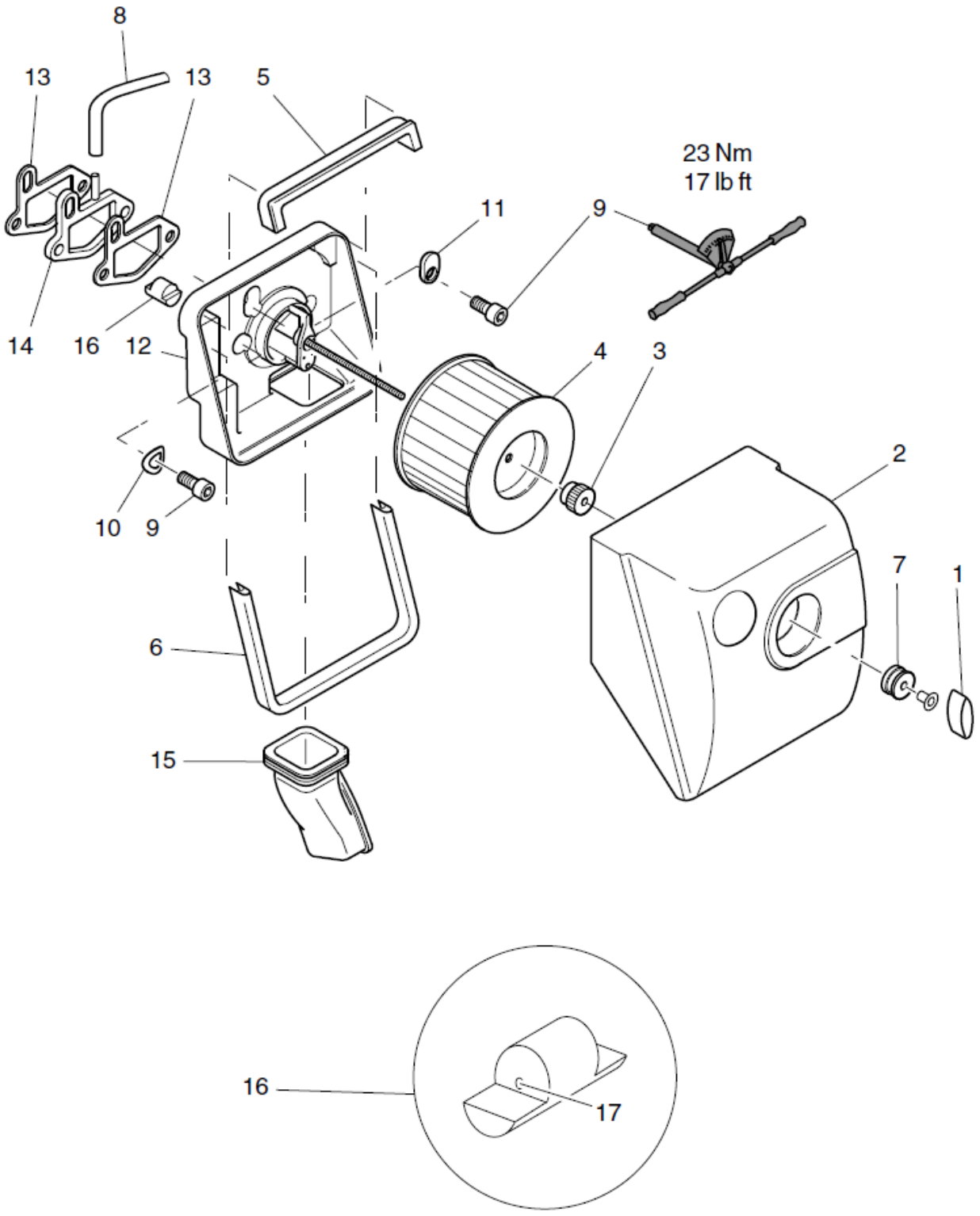
with maintenance indicator:

Axial bore 17 faces the air cleaner.

– Renew the seals.

– Note correct tightening value.

– Make sure that no lines are trapped be tween the air cleaner housing and the cylinder head.


8
13
13
5
23 Nm
17 lb ft
11
9
14
16
12
4
3
2
10
9
7
1
6
15
16
17

STARTER

Preliminary work:

– Disconnect the battery: negative pole first, positive pole second.

– Disconnect cables as far as necessary.

Dismantling:

– Take out screw 1 with washer 2 and nut 3.

– Unscrew nut 4 with spring washer 5 and washer 6.

– Take off regulator switch 7 and bushing 8.

– Remove machine screw 9 with spring washer 10 and washer 11; take off stirrup 12.

– Take out machine screws 13 with spring washers 14 and washers 15; take off starter 16.

Testing / repair:

– Examine bearings and pinion for signs of wear or damage.

– Check that pinion turns freely.

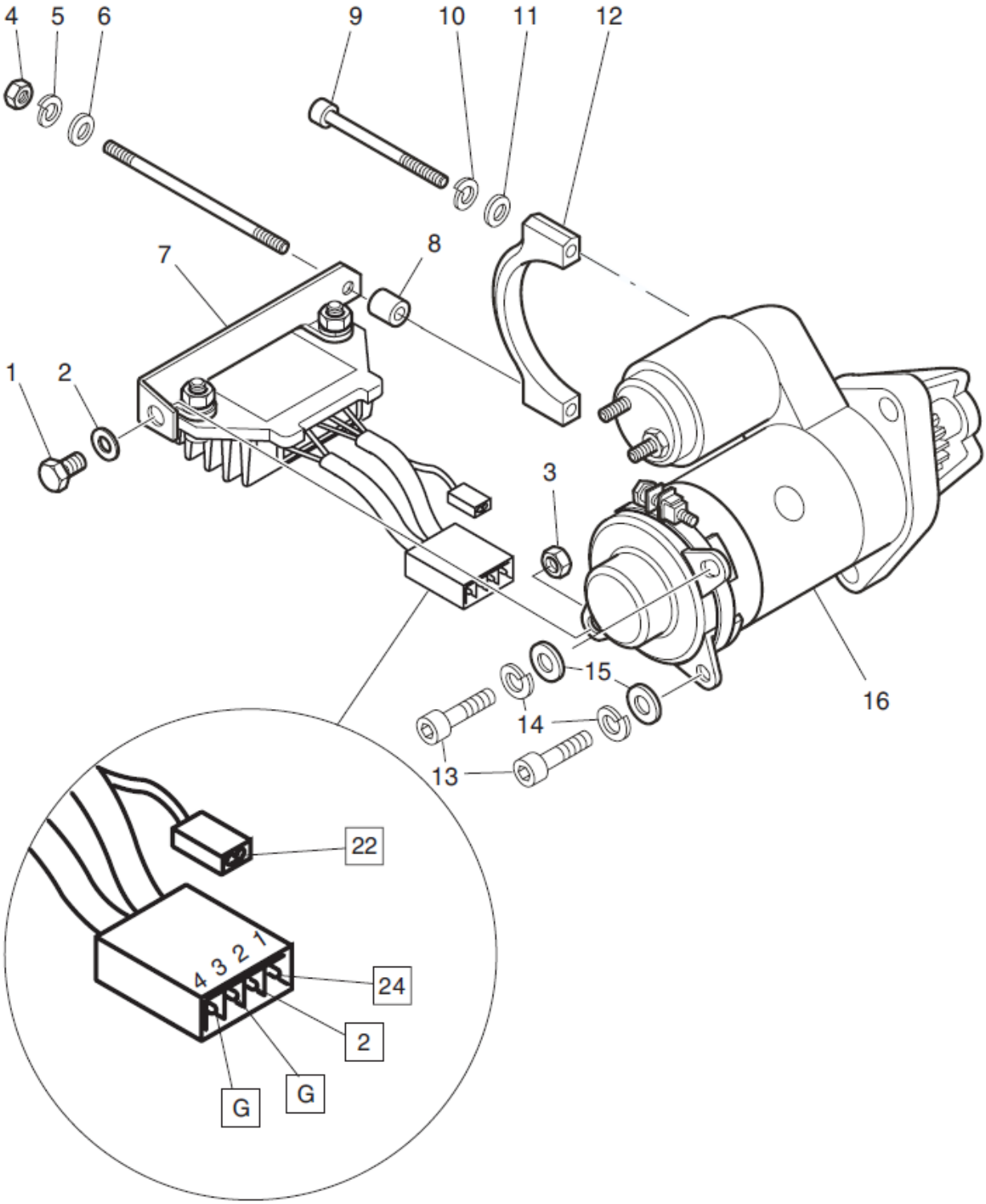
NOTE: *Repairs to the starter motor should only be performed by an authorized HATZ Service point.*

Assembly:

– Follow the dismantling instructions in the reverse order.

– Restore the electrical connections.

– Reconnect the battery: first the positive pole and then the negative pole.


4
5
6
9
10
11
12
7
8
1
2
3
15
16
14
13
22
4 3 2 1
24
2
G
G

GENERATOR

General information:

Before dismantling, check operation of the generator (measure off-load voltage).

Preliminary work:

– Disconnect the battery: negative pole first, positive pole second.

– Take off the fuel tank with the air guide housing.

– Take off the flywheel and the starter.

Testing / repair:

– Check parts for damage and renew if defective.

Dismantling:

– Take out machine screws 1 with spring washers 2; take off rotor 3.

– Unscrew the equipment box from the partition panel.

– Remove the partition panel.

– Detach the cable connector at the regulator switch.

– Open the plug and detach the two yellow wires in sockets 3 and 4 using tool - 4 -.

– Pull the generator cable out of the hole in the crankcase.

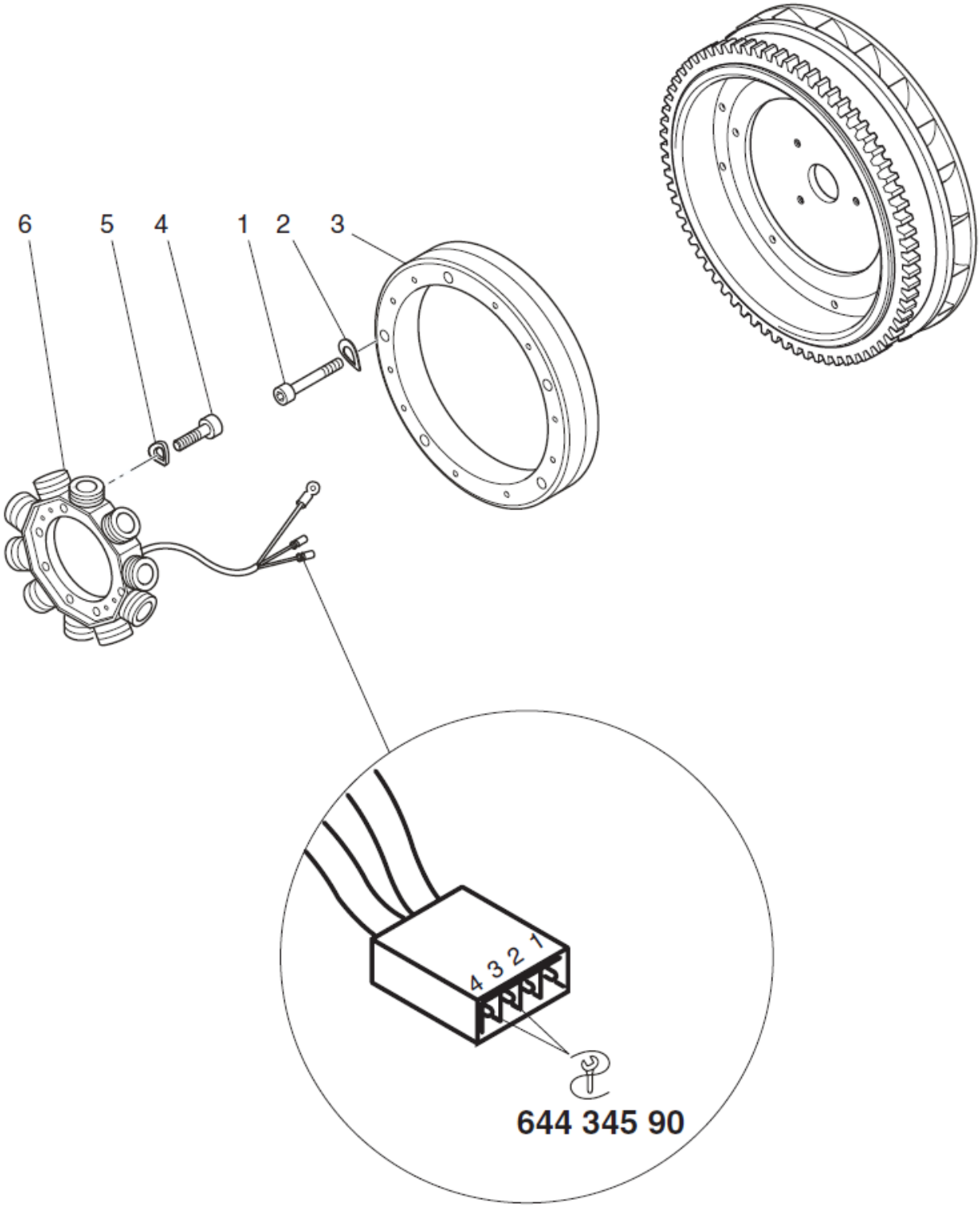
– Mark the position of the coil in relation to the crankcase with a scriber, so that it can be centred correctly.

– Take out machine screws 4 with spring washers 5 and take off coil 6.

Assembly:

– Follow the dismantling procedure in the reverse order.

– Before tightening coil 6, align it so that it is concentric with the crankshaft (scriber mark).


6
5
4
1
2
3
4 3 2 1
644 345 90

FITTINGS

Preliminary work:

– Disconnect the battery: first the nega tive pole, then the positive pole.

Dismantling:

– Take out machine screws 1 with washer 2.

– Detach cables and take off the electrical fitting.

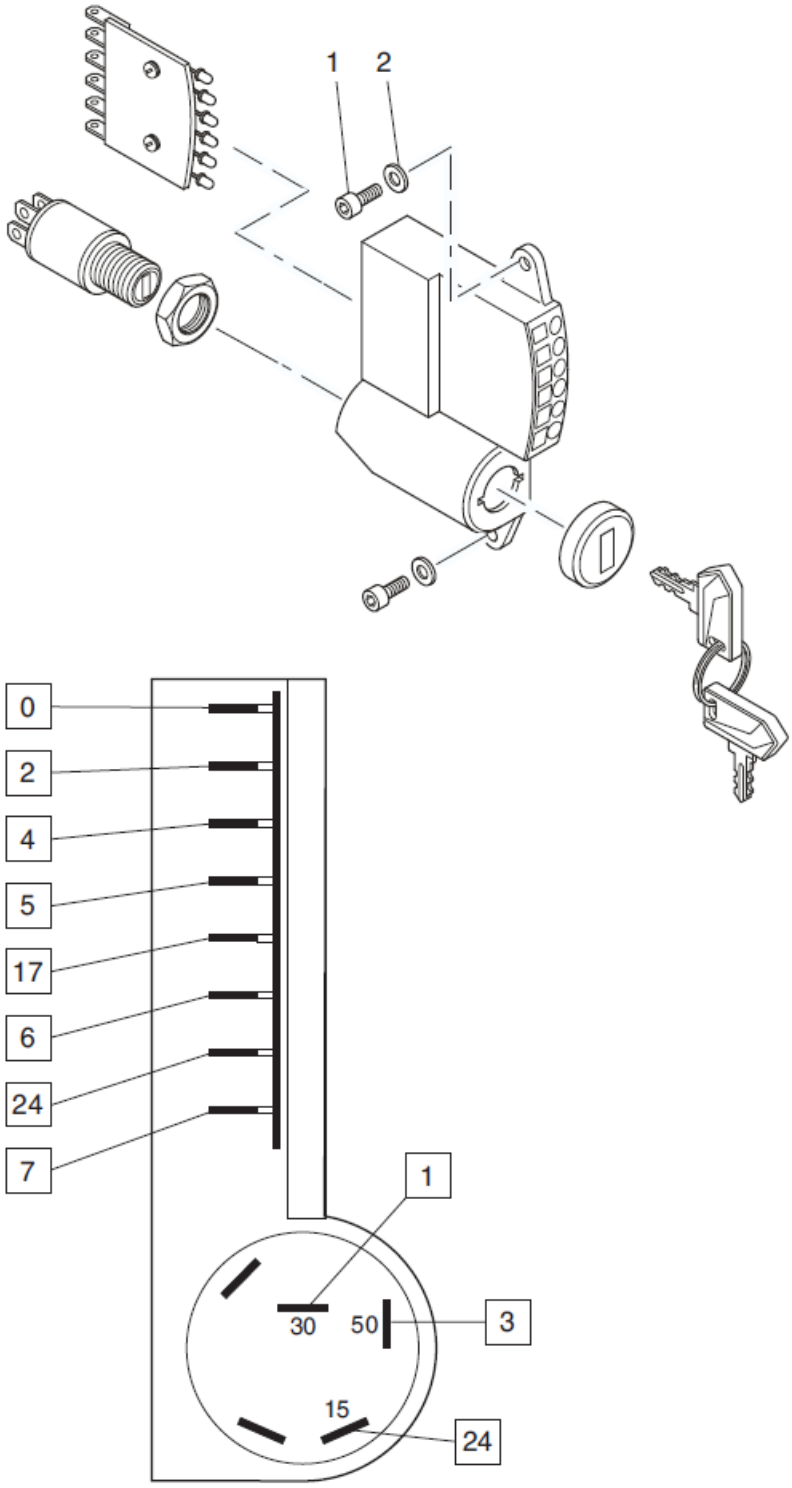
Testing / repair:

– Examine parts for damage and renew if necessary.

Assembly:

– Following the dismantling procedure in the reverse order.

– Make sure that the cables are reconnected correctly.


1
2
0
2
4
5
17
6
24
7
1
30
50
3
15
24

GEAR RING

Preliminary work:

– Take off the flywheel.

Testing / repair:

– Inspect the gear ring for broken teeth or other damage.

– If necessary, file the gear ring to shape or renew it.

Dismantling:

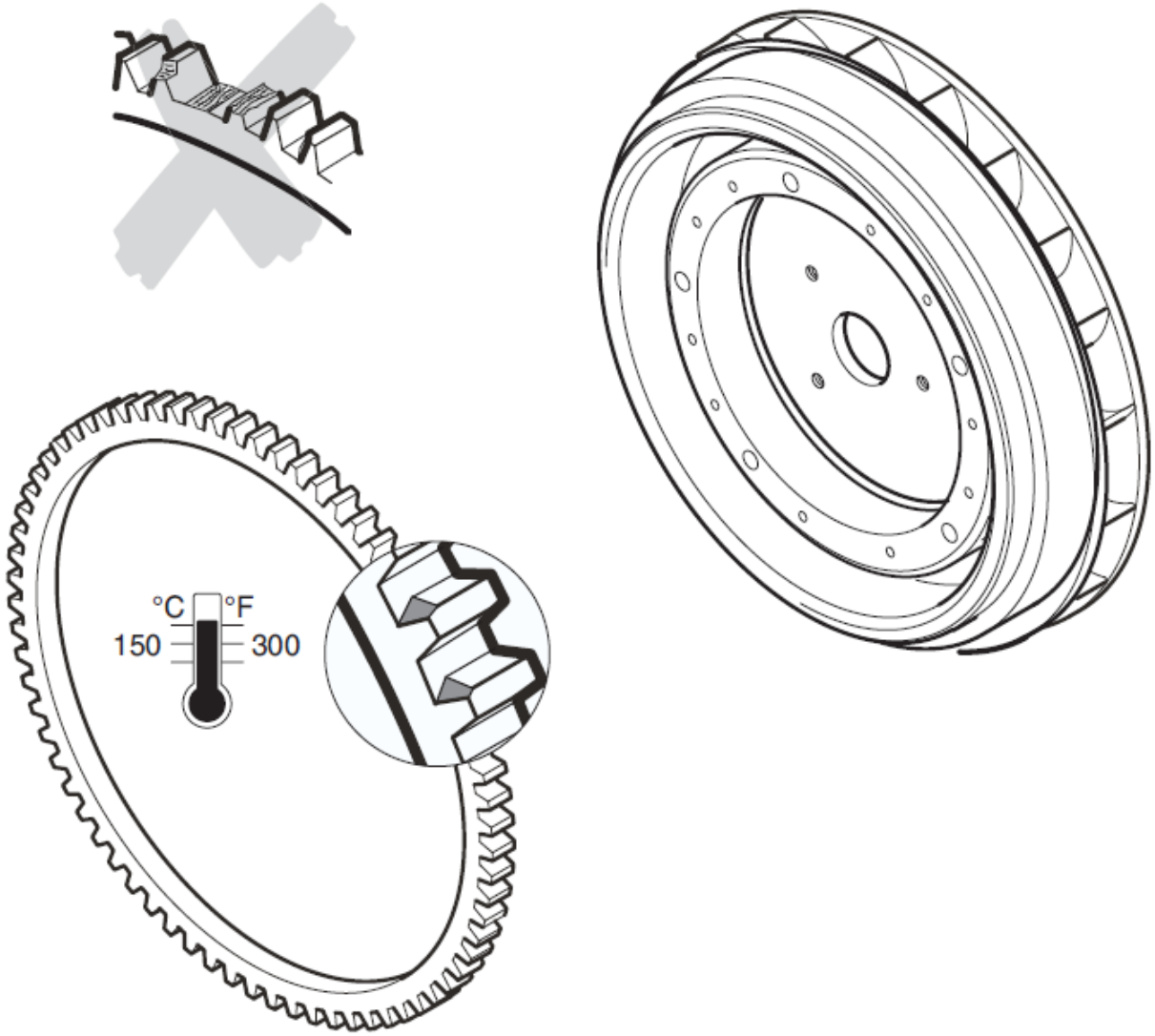
– Heat the gear ring carefully until it can be removed from the flywheel, or:

– Drill into the gear ring and chisel it open.

Assembly:

– Heat the gear ring to approx. 150°C and pull it on to the flywheel.

NOTE: *The chamfered side of the teeth must be towards the starter.*


°C
°F
150
300

Basic engine equipment

ADJUSTING LOWER IDLE SPEED

General information:

The lower idle speed must only be adjusted when the engine is warm and with power take-off components attached.

Initial adjustment with engine stopped:

– Turn adjusting screw 1 for the idle spring until the inner lever and the spring are aligned.

– Turn adjusting screw 2 for the stabilizing spring fully to the left.

Adjustment with engine running:

– Release friction brake 3 (speed control will then move freely).

– Start the engine and run it at a constant speed of approx. 1300 rpm by moving the speed control lever.

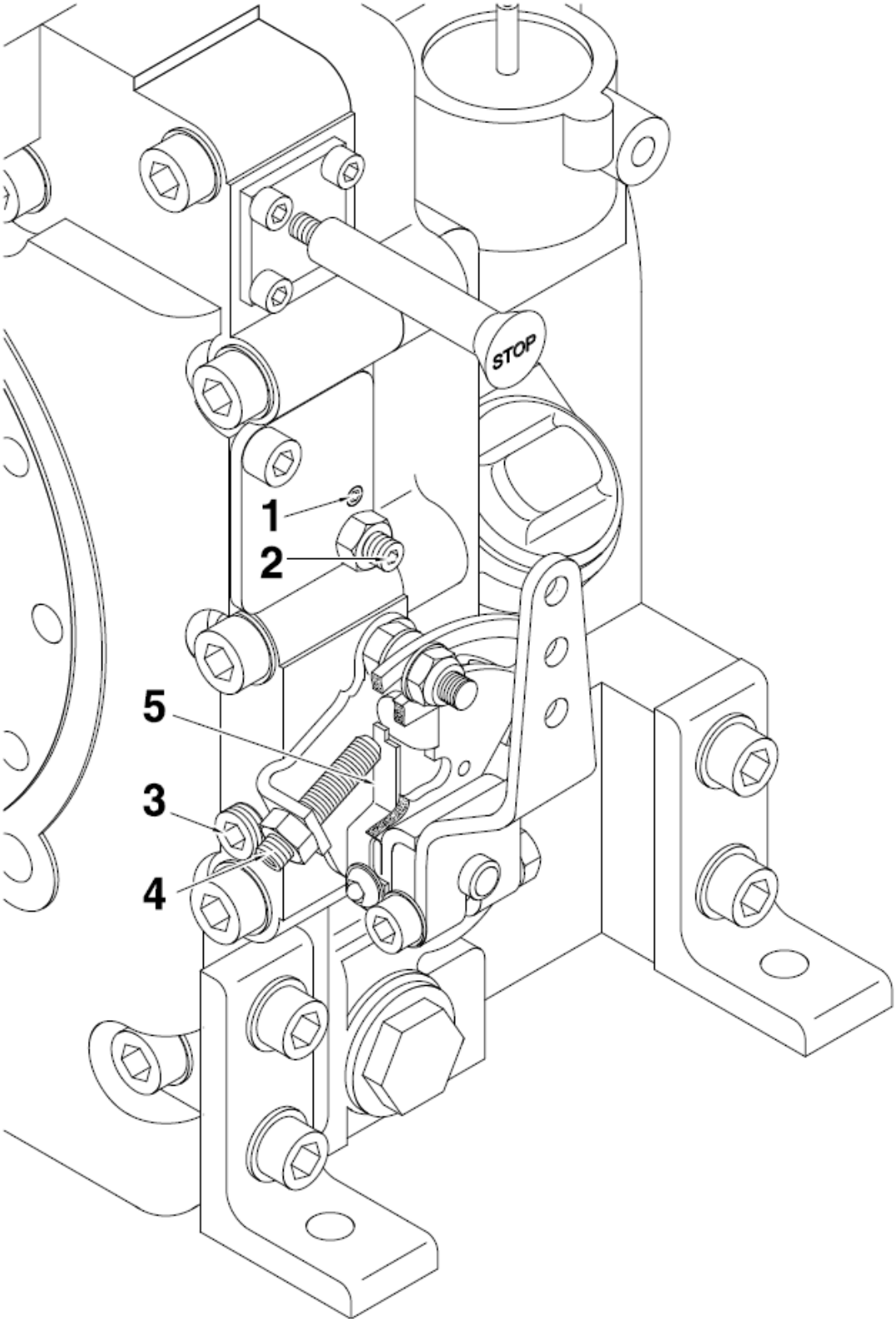
– Carefully turn adjusting screw 1 for the idle spring to the right until a speed of 1300 - 1400 rpm is maintained when the control lever is released.

– Reduce the speed carefully at the adjusting screw to 1100 - 1150 rpm.

– Move up idle speed stabilizing spring 2 carefully until engine speed rises by 8 - 10 rpm and there is no further tendency for the speed to vary.

– Check the upper idle speed and correct it if necessary.

– Ease off stop screw 4 for the lower idle speed until the lower idle speed does not change when the speed control lever makes contact, but the engine can still be stopped by pushing against leaf spring 5.


STOP
1
2
5
3
4

GENERATOR GOVERNOR, SPEED CONTROL

Dismantling:

– Remove parts in the order 1...10.

– Mark the position of retaining plate 13 in relation to the timing case cover with a scriber.

– Remove parts in the order 11...18.

Testing / repair:

– Check parts for wear and damage.

– Check the position of the bimetallic strip at the governor lever.

Assembly:

– Follow the dismantling instructions in the reverse order.

– Check that the positions of washers 17 (1.0 mm) and 16 (0.5 mm) are correct.

– Note correct position of retaining plate 13 (scriber mark).

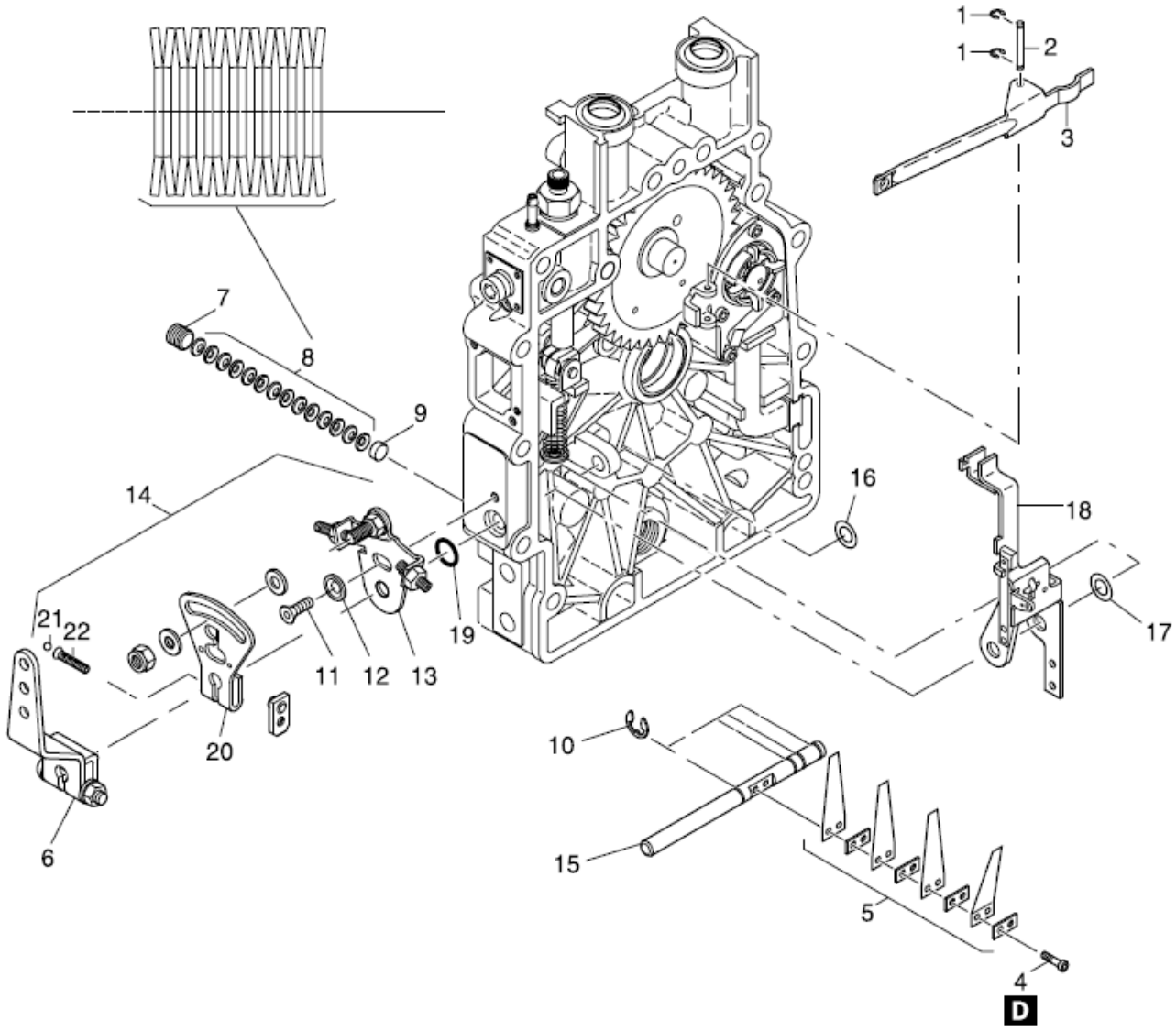
– Apply sealant D to screws 4 when installing.

– For correct governor springs, see Section Tables.

– Note correct assembly arrangement of cup springs 8 (14 springs). These were later replaced by a coil spring.

– Tighten screw 7, loosen again and retighten to 20 Nm, then adjust to the necessary friction value.

NOTE: *To prevent it from being moved accidentally, stop plate 20 is secured by ball 21 pressed into the head of screw 22. To remove, the screw head must be ground away.*


1
1
2
3
7
8
9
14
16
18
17
19
21
22
11
12
13
20
6
10
15
5
4
D

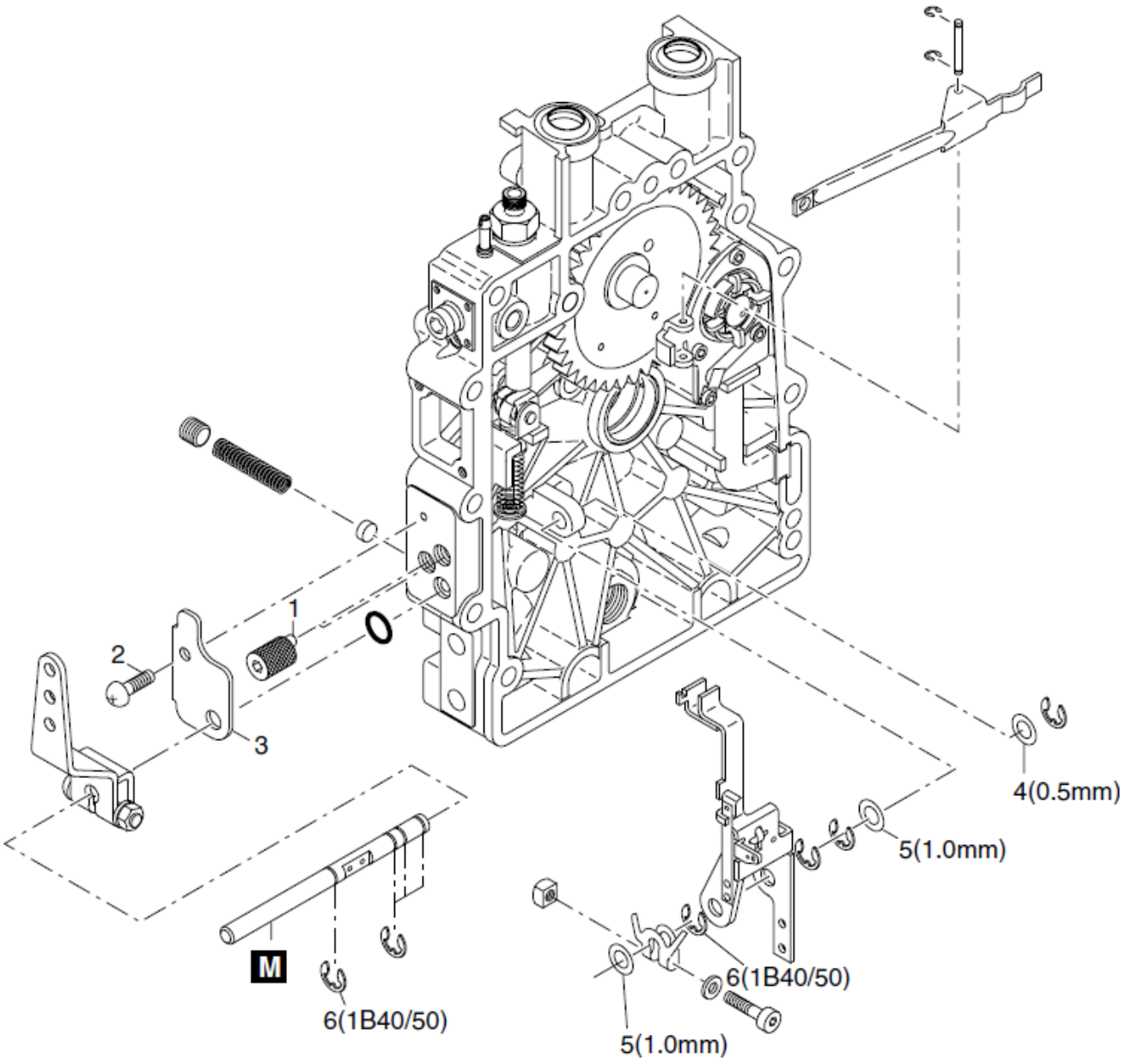
GOVERNOR, ENGINE SPEED ADJUSTMENT WITH INTERNAL STOP

General:

In connection with EPA certification, the engine speed adjustment screws together with stop were located inside the timing case cover. The rest of the governor is the same as the previous version. The adjustment screws 1 are protected by screw 2 and plate 3 against unauthorized adjustment.

Dismantling / assembly:

- Takes place as in the previous version.
- Make sure that washers 4 and 5 are in the right position.
- Circlip 6 is only installed on 1B40 engines.


1
2
3
M
6(1B40/50)
4(0.5mm)
5(1.0mm)
6(1B40/50)
5(1.0mm)

RECOIL STARTER

Preliminary work:

Dismantling:

– Take out retaining screws 1 and pull housing 2 off horizontally by hand.

– Pull starting cable 3 out of handgrip 4 and unfasten the knot.

– Turn cable pulley 5 back slowly until return spring 6 is relieved of load.

– Loosen screw 7 and take off spring washer 8 and brake disc 9.

– With return spring 6 entirely relieved of load, turn cable pulley 5 to and fro and lift it carefully out of housing 2.Turning to and fro is essential, or else return spring 6 will be pulled out of its seat in housing 2. However, it need not be removed unless damaged.

Warning: risk of injury!

– Take pawl 11 and torsion spring 12 off cable pulley 5.

Testing / repair:

– Perform a visual check.

– Check parts for wear or damage and renew if necessary.

Assembly:

– Apply a light coating of high-tempera-ture grease K to all moving metal parts.

– Wind return spring 6 back into housing 2 if it had to be removed, or insert a new wrapped spiral spring and remove its wrapping. The outer eye of the spring must engage in the milled cutout in housing 2. The inner spring eye must be about 4 mm from the shaft.

– Wind on starting cable 3 and place cable pulley 5 on the shaft in housing 2.

– Turn the cable pulley to and fro slightly until the projection on the cable pulley engages in the return spring eye.

– Insert the longer arm of torsion spring 12 into the hole on the cable pulley.

– Install pawl 11 and engage the shorter arm of the torsion spring in the cutout.

– Insert brake spring 10 as illustrated, and install brake disc 9.

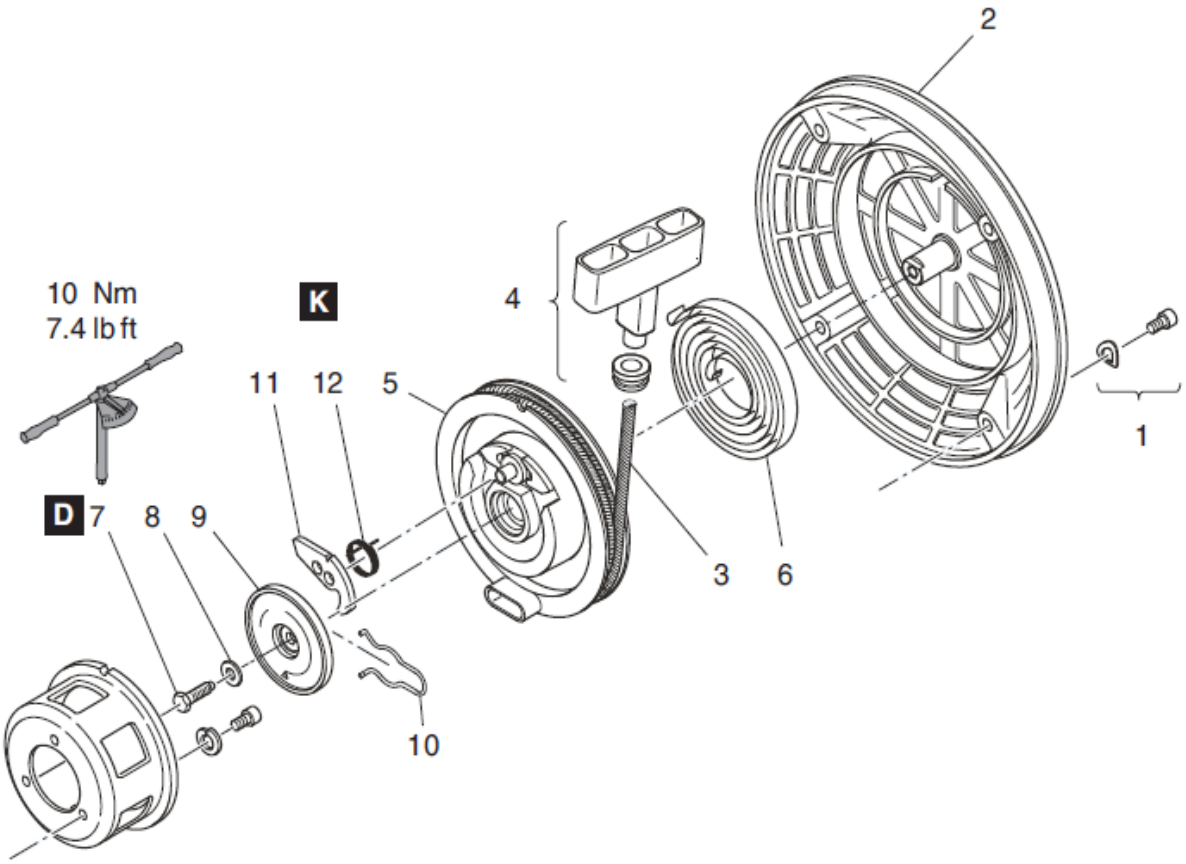
– Install spring washer 8 and screw 7. Use sealant D.Note correct tightening torque (10 Nm).

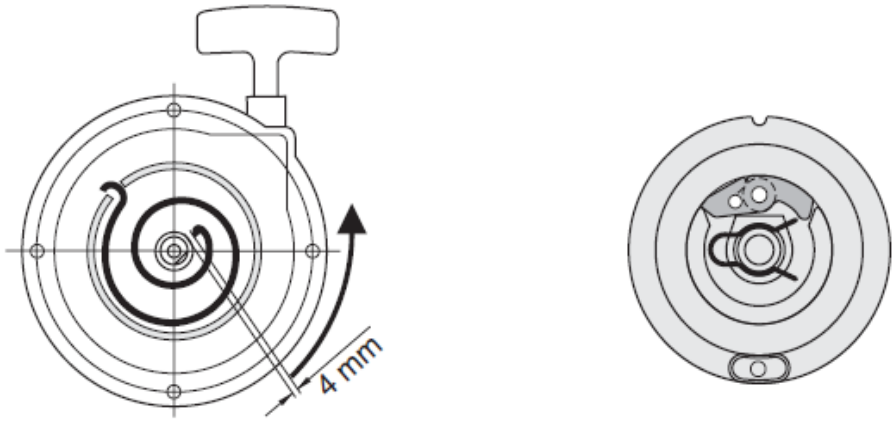
– Preload the cable pulley by giving it 4 1/2 turns in the engine's direction of rotation, and lock it in this position.

– Thread the cable through handgrip 4 and secure it with a knot.

– Check that the recoil starter operates correctly.

– Install remaining parts on engine.


2
10 Nm
7.4 lb ft
K
4
11
12
5
1
D
7
8
9
3
6
10


4 mm

AIR GUIDE

Preliminary work:

– Take off the fuel tank and air guide housing.

– Take off the flywheel.

Dismantling:

– Unscrew support bracket 2 from dividing plate 3.

– Take out cylinder screw 4, noting the presence of washer 5.

– Take off dividing sheet 3. Air guide sheets 6 and 7 can remain in position.

Testing / repair:

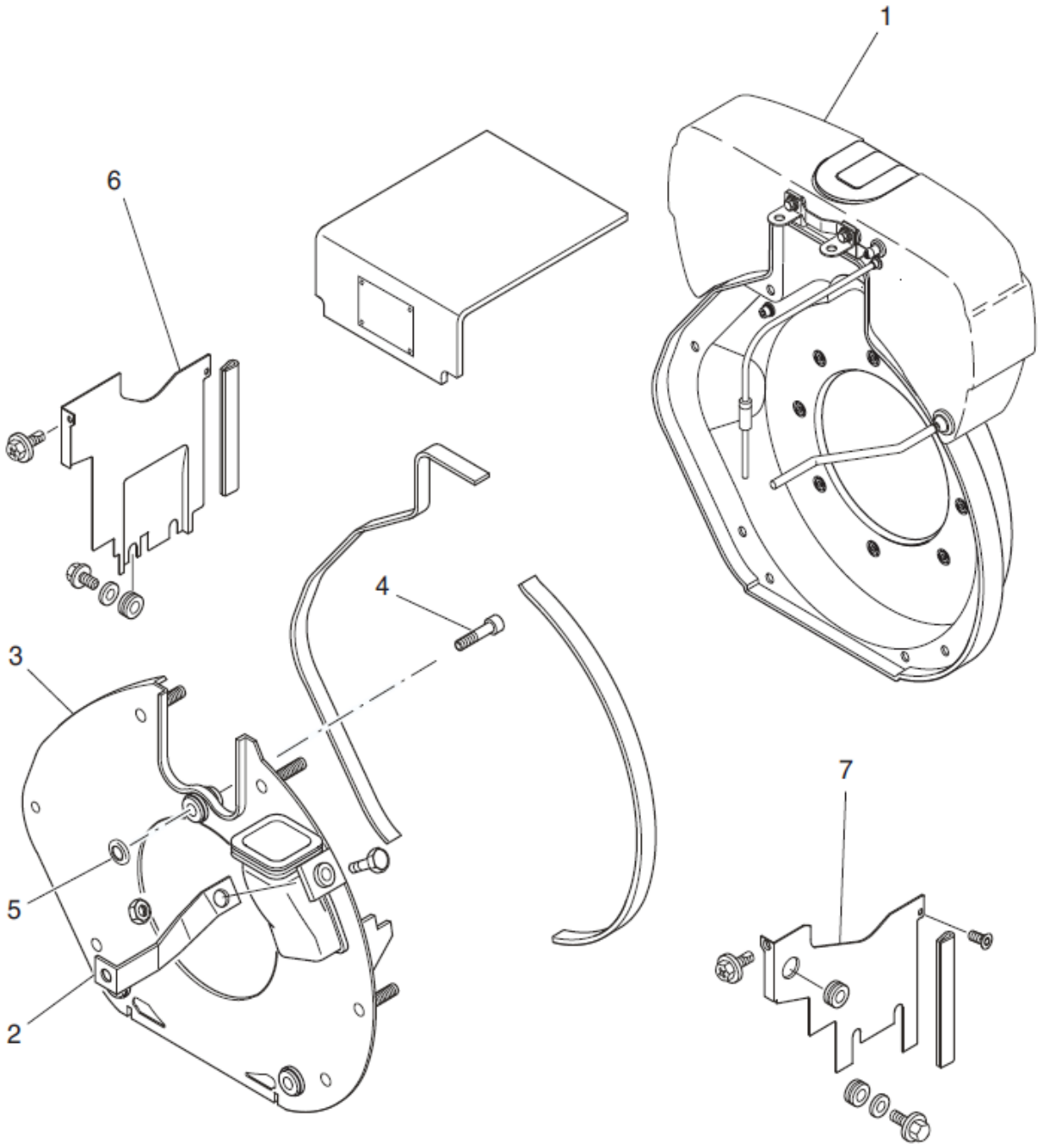
– Check the sealing strips for damage.

– Remove any foreign bodies.

Assembly:

– Follow the dismantling instructions in reverse.

– It is essential for all air guides to be installed completely and correctly so that the engine's thermal operating condition is not affected.


1
6
4
3
5
2
7

BREATHER

Preliminary work:

– Take off the air cleaner cover, the noise insulating hood and the air cleaner housing.

Dismantling:

– Pull oil trap 1 out of suction pipe 2 in the timing case cover, and take out of the crankcase complete with seal 3.

– Pull off hose 4, lever cover 5 out of the crankcase with a suitable drift and take out diaphragm 6.

Testing / repair:

– Check parts for damage.

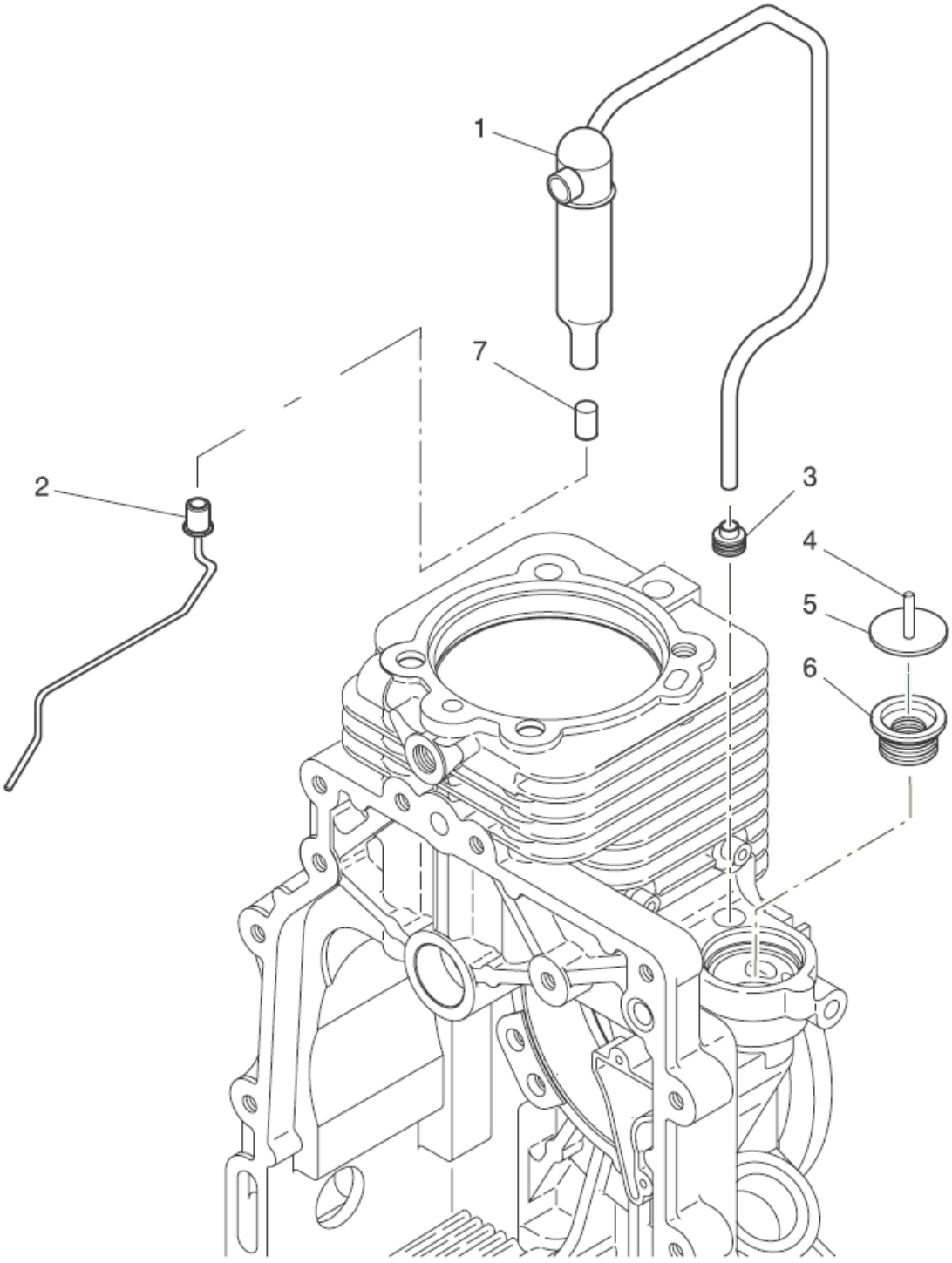
– If necessary, renew diaphragm 6 and filter insert 7.

Assembly:

– Follow the dismantling instructions in the reverse order.

– Drive cover 5 fully into the crankcase with a suitable drift.

– Re-attach parts removed from engine.


1
7
2
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4
5
6

Troubleshooting chart - electrical system

TROUBLESHOOTING AT THE BATTERY

Malfunction	Indication	Possible cause	Remedial action
Battery is not being charged sufficiently or at all, or is being discharged too rapidly.	Even shortly after charging, the terminal voltage drops rapidly to 7 V on systems with 12 V nominal voltage.	Poor connections, open circuit or contact resistance in charging circuit, short-circuit in line.	Eliminate open circuit, clean posts and clips, tighten loose terminals.
		Battery defective (internal short circuits).	Renew the battery.
		Battery capacity has dropped severely due to severe discharge for a lengthy period (grey-white coating on plates ("sulphatising").	Recharge battery at low current (app. 1/40 of nominal capacity in Amps) for about 50 hours. (Only possible if suplhatising not yet too far advanced.) Otherwise: renew battery.
		Charging rate too low (especially in winter).	Recharge the battery.
		Battery capacity too large.	Install a smaller battery.
		Defective voltage regulator (e.g. overheated/ overloaded).	Renew the voltage regulator.
Battery is overcharged.	Terminal voltage permanently above 16.5 V at 12 V nominal voltage, acid density above 1.285 kg/l, battery acid boils.	Charge voltage too high.	Check voltage regulator, renew if necessary.
		Battery capacity is too low.	Install a larger-capacity battery. As a temporary measure, discharge the battery at intervals, e.g. by switching on consumers without running the engine.
		Defective voltage regulator.	Check voltage regulator, renew if defective.
	Acid emerging at cell plugs.	Acid level too high.	Draw off excess acid with hygrometer.

Malfunction	Indication	Possible cause	Remedial action
Post terminals corroded.	Insufficient current transfer, “bloom” (white salt deposit).	Sulphuric acid attacks metals (except lead).	Wash the posts and terminals down with hot soda solution (but this must not enter the battery!), rinse with cold water and apply acid-resistant grease.
Acid level too low.	Acid level less than 10 mm (0.4 in) above top of cell plates.	Overloading, natural water loss caused by evaporation (esp. in summer).	Add distilled or demineralised water.
Battery life too low.		Battery was discharged too far or too frequently.	Check ratings of battery and generator, if necessary use a special “Z” or “HD” battery.
		Battery tends to over-heat.	Choose a better installed position.
		Excessive loads im-posed by vibration.	Choose a better installed position or use an “Rf” (vibration-proof) battery.
		Batterie is “sulphatising”.	Recharge battery at low current (app. 1/40 of nom. capacity in Amps) for app. 50 hours. Other-wise: renew battery
		Impurities in battery acid.	Renew the battery.

Malfunction	Indication	Possible cause	Remedial action
Battery output is too low.	Voltage drops severely when a load is applied.	Battery is flat (discharged).	Recharge battery.
		Charging voltage is too low: voltage regulator is defective.	Renew the voltage regulator.
		Connecting terminals loose or oxidised.	Clean connecting terminals, apply acid-resistant grease, tighten terminal clips.
		Battery capacity too low (too many consumers).	Install a larger battery.
		Battery discharged because of impurities in the acid..	Renew the battery.
		Battery is “sulphatising” (white deposit on cell plates).	Recharge the battery at low current for app. 50 hours, or renew the battery.
		Battery is exhausted; active material has failed.	Renew the battery.
		Acid level too low.	Add distilled water.
Long-term charging rate is insufficient.	Terminal voltage drops to 7 V nominal voltage (12 V circuit) even shortly after recharging.	Fault at generator, voltage regulator or cable connections.	Repair or renew the generator and voltage regulator, make sure that all line connections are tight.
		Too many consumers connected to the circuit, or generator is too small.	Choose more suitable battery - generator ratings.

TROUBLESHOOTING AT THE STARTING EQUIPMENT

Malfunction	Indication	Possible cause	Remedial action
Starter does not rotate when preheat - starting switch is operated.	Generator indicator lamp is not on.	Poor connection (loose or oxidised), break in cable or short to earth (ground).	Check battery cables and connections, clean battery posts and terminals, make sure that connections are tight.
		Battery flat or defective.	Recharge or renew the battery.
	Indicator lamp darkens slowly when preheat-starter switch is operated.	Battery is flat (discharged).	Recharge the battery.
	Indicator light remains on brightly. Bridge terminals 30 and 50 briefly at the starter. The starter then runs.	Break in line between terminal 50 and starting switch or in line between terminal 30 and battery, or defective starting switch.	Repair the break; if necessary, renew the starting switch.
	Indicator light remains on brightly, but no connection between terminal 30 and positive pole of battery.	Pull-in winding of starter has burned out.	Renew starter, ensure good connection between terminal 30 at starter and positive battery pole (main lead to starter).
	Indicator light remains on brightly, solenoid switch is energised; starter runs when solenoid switch is bridged.	Solenoid switch contacts worn or dirty.	Renew solenoid switch.

Malfunction	Indication	Possible cause	Remedial action
Starter turns too slowly or is unable to turn the engine over.	Lengthy period of use without maintenance or in severe conditions.	Carbon brushes sticking.	Renew carbon brushes and brush holder guides.
		Carbon brushes worn.	Renew carbon brushes.
		Brush springs too weak, brushes not making contact.	Renew springs.
		Commutator dirty.	Clean commutator.
		Commutator scored or burned.	Recondition or renew starter.
		Armature or field coils defective.	Recondition or renew starter.
Starter engages and is energised, but engine turns over jerkily or not at all.	Lengthy period of use without maintenance, neglect of electrical system.	Battery flat (discharged).	Charge the battery.
		Insufficient current flow because of loose or oxidised connections.	Clean battery posts and terminals, tighten connections.
		Carbon brushes sticking.	Renew carbon brushes and brush holder guides.
		Carbon brushes worn.	Renew carbon brushes.
		Commutator dirty.	Clean commutator.
		Commutator scored or burned.	Recondition or renew starter.
		Armature or field coils defective.	Recondition or renew starter.
Drive pinion does not engage or disengage.	Engine turns over jerkily or not at all.	Drive pinion or helical thread dirty or damaged.	Renew drive pinion, recondition starter.
		Damaged flywheel gear ring.	Remachine or renew gear ring.
		Faulty solenoid switch.	Renew solenoid switch.
		Return spring weak or broken.	Renew return spring.

Malfunction	Indication	Possible cause	Remedial action
Starter continues to turn after switch has been released.	Noise of starter turning.	Preheat/starting switch does not return automatically from position 2 to position 1.	Reset the preheat/starting switch to 0 by force if necessary and renew it. If this is not possible, disconnect the battery immediately. **Warning!** **If this action is not taken within 2 - 3 minutes, the starter will overheat and burn out.**
Engine starts reluctantly or not at all although starter turns quickly.		Defective preheat system (this is only of significance at temperatures below -10°C).	Check the preheat circuit, renew defective parts if necessary.

Code designations in circuit diagrams (DIN 40719)

Code	Designation of electrical component
A 1	Equipment box
A 2	Equipment panel
A 3	Automatic start-stop
A 4	Starter protection module
B 1	Temperature sensor
B 2	Speed pulse sensor
B 3	Oil pressure sensor
B 4	Horn
C1	Capacitor
E1	Heater for fuel filter
F1	Fuse
G1	Battery
G2	Generator (alternator)
G3	Flywheel generator
H 1	Indicator lamp, generator telltale
H 2	Indicator lamp, oil pressure
H 3	Indicator lamp, engine temperature
H 4	Indicator lamp, air cleaner (maintenance switch)
H 5	Indicator lamp, broken belt
H 6	Indicator lamp, preheat monitor
H 7	Indicator lamp, fan monitor
H 8	Remote display: engine on
K 1	Control relay 1 for start / start repeat interlock
K 2	Control relay 2 for preheat
K 3	Control relay 3 für speed control
K 4	Engine protection relay
K 5	Delay relay
K 6	Start interlock relay
K 7	Timer relay (impulse relay)
K 8	Power relay

Code	Designation of electrical component
M1	Starter motor
MG	Starter-generator
N 1	Regulator for starter-generator
N 2	Regulator for flywheel generator
N 3	Regulator for alternator (unless integrated)
N 4	Pulse sensor (additional for syncro-regulator)
P 1	Operating hours counter
P 2	Revolution counter
P 3	Pressure display
R 1	Preheat glowplug
R 2	Heating flange
R 3	Line resistor for preheat system
R 4	Resistor
R 5	Line resistor with thermal time switch
S 1	Preheat starter switch (5 positions)
S 2	Master switch
S 3	Preheat starter switch (3 positions)
S 4	Start-stop switch
S 5	Speed control switch
S 6	Engine temperature switch
S 7	Oil pressure switch
S 8	Pressure switch for air cleaner
S 9	Fan monitoring switch
S 10	Preheat temperature switch
S 11	Remote start switch
S 12	Remote stop switch
T1	Engine speed measurement transmitter
V 1	Decoupling diode
V 2	Freewheeling diode
V 3	Zener diode
V 4	Suppressor diode
W 1	Earth (ground), negative return line
W 2	Screened line at generator
X 1	Terminal strip on equipment box
X 2	Flat-plug distributor
X 3	Plug at emergency stop switch

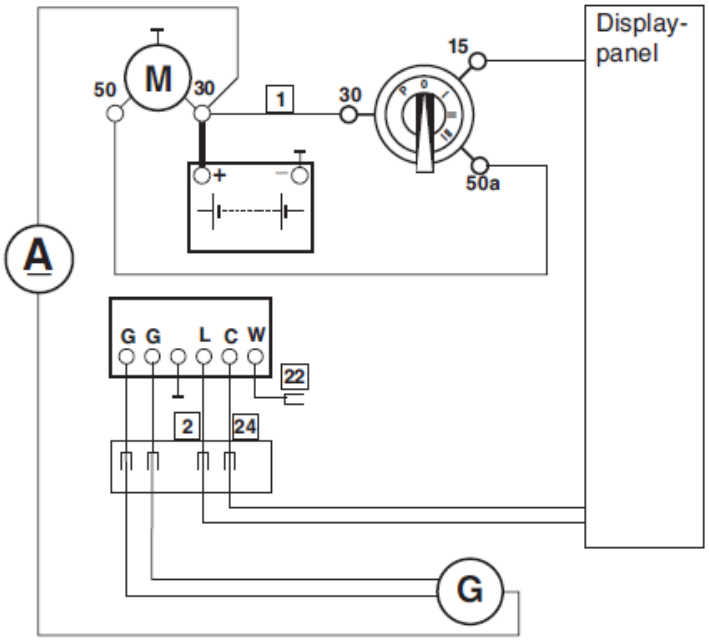
Code	Designation of electrical component
X4	Socket on emergency stop switch
X5	Terminal block on control box / terminal box
Y1	Speed control actuating solenoid
Y2	Engine shutdown actuating solenoid
Y3	Servo solenoid (= valve solenoid) for engine shutdown
Y4	Fuel shutoff valve
Y5	High-pressure shutdown valve
Z1	Suppressor choke
Z2	Suppressor capacitor

HATZ wiring designations

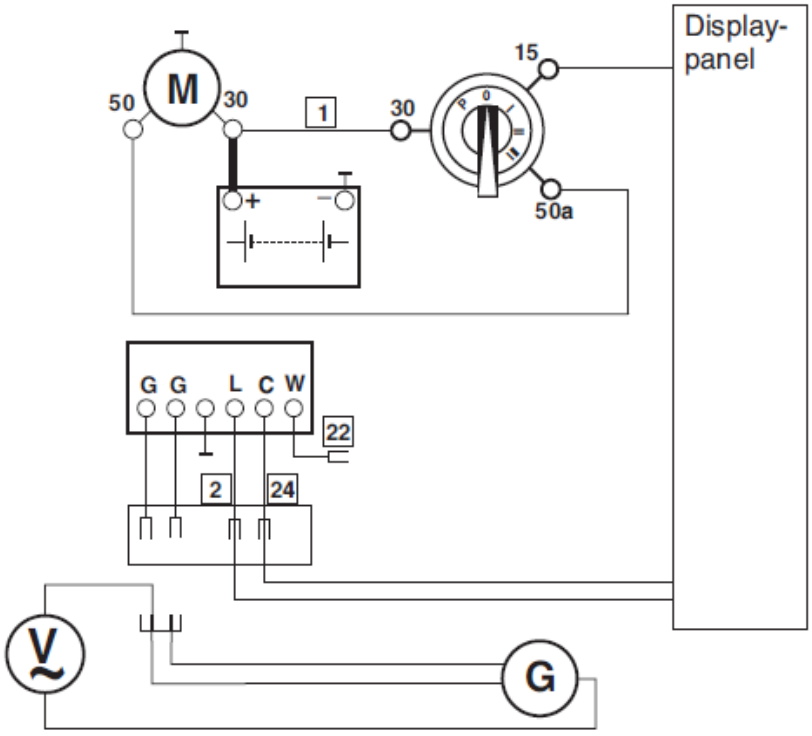
Terminal	Designation
0	Earth (ground)
1	Generator B+
2	With alternator: D+ With flywheel generator: Terminal L at regulator
3	Starter terminal 50
4	Oil pressure switch
5	Temperature switch on cylinder head
6	Preheat glowplug I
7	Engine shutdown solenoid
8	Preheat glowplug II
9	Start-stop input
10	Positive terminal for DC motor, precision speed control
11	Negative terminal for DC motor, precision speed control
12	Oil pressure sensor
13	* * * reserved for special applications * * *
14	Speed control solenoid - holding-on winding
15	* * * reserved for special applications * * *
16	Actuating solenoid for decompresser
17	Maintenance switch for air cleaner
18	Engine shutdown solenoid (energizing winding)
19	Temperature sensor at cylinder head
20	Oil temperature switch
21	Fan monitoring switch
22	Terminal W for engine-speed measurement
23	Starter 30 (with ammeter connection)
24	Terminal C with regulator on flywheel generator
25	Oil temperature sensor
26	Terminal 50f at starter protection module
27	* * * reserved * * *
28	Speed control solenoid (energizing winding)
29	* * * reserved * * *

Circuit diagram for current and voltage measurements

Measuring charge current:

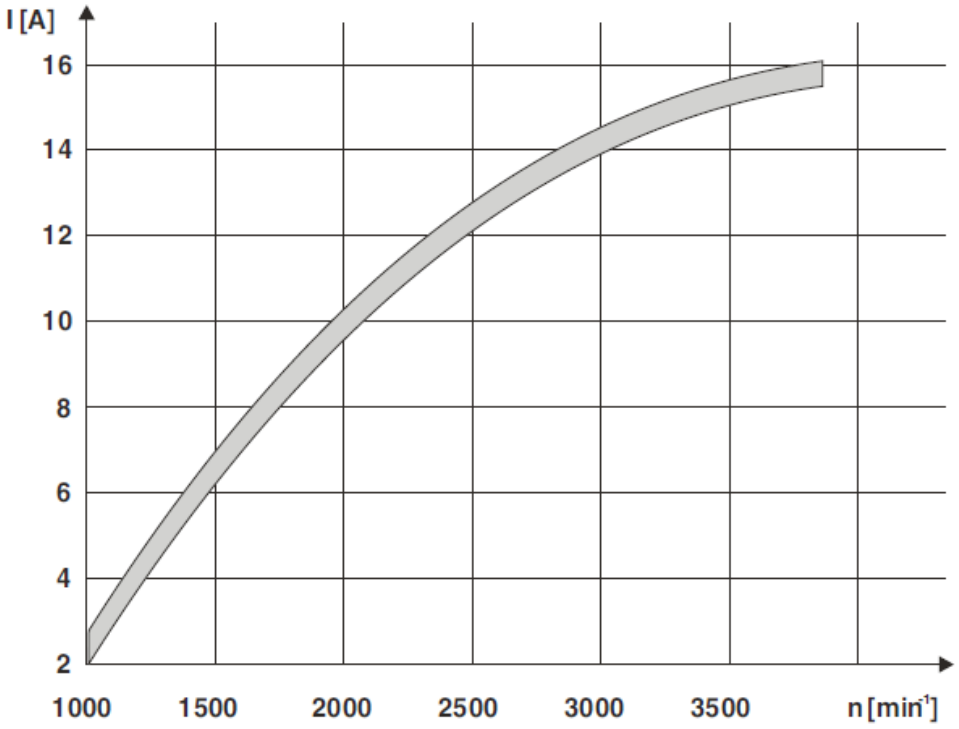


Measuring off-load voltage:



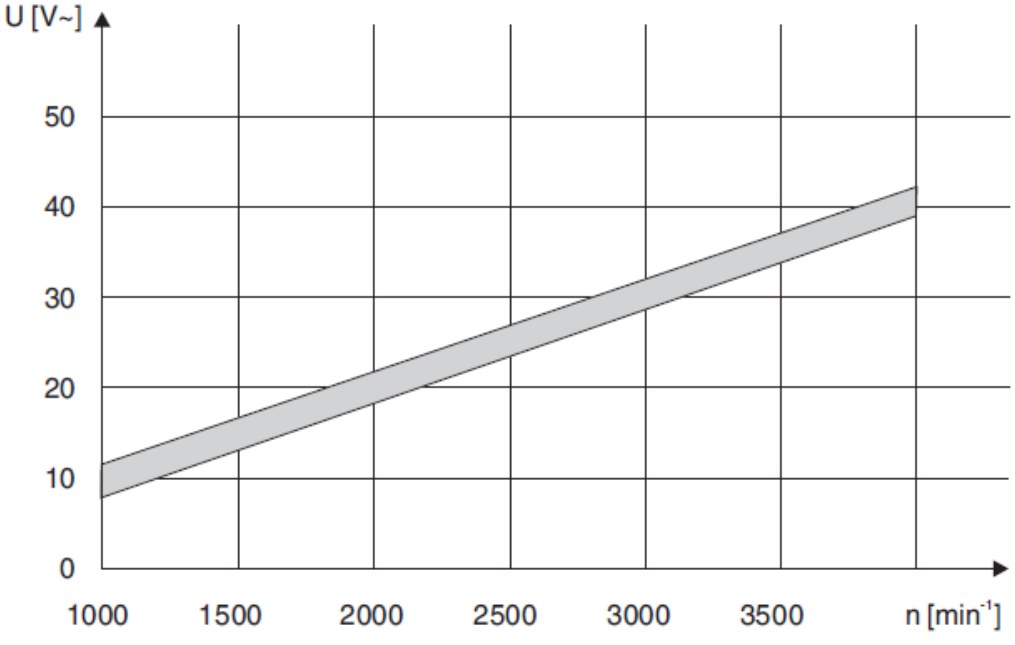
Charge current:

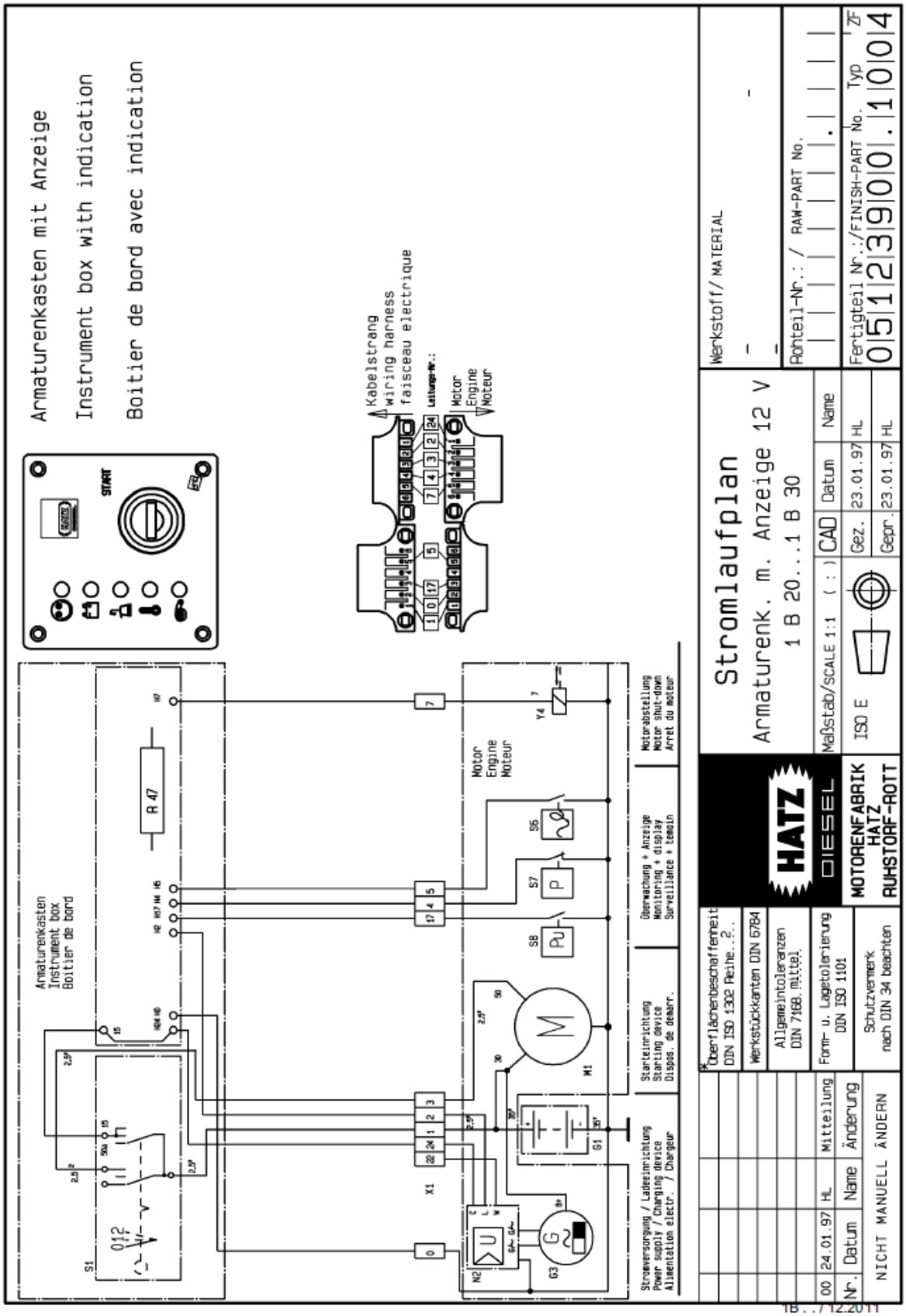
Battery voltage 12.5 V, normal operating temperature

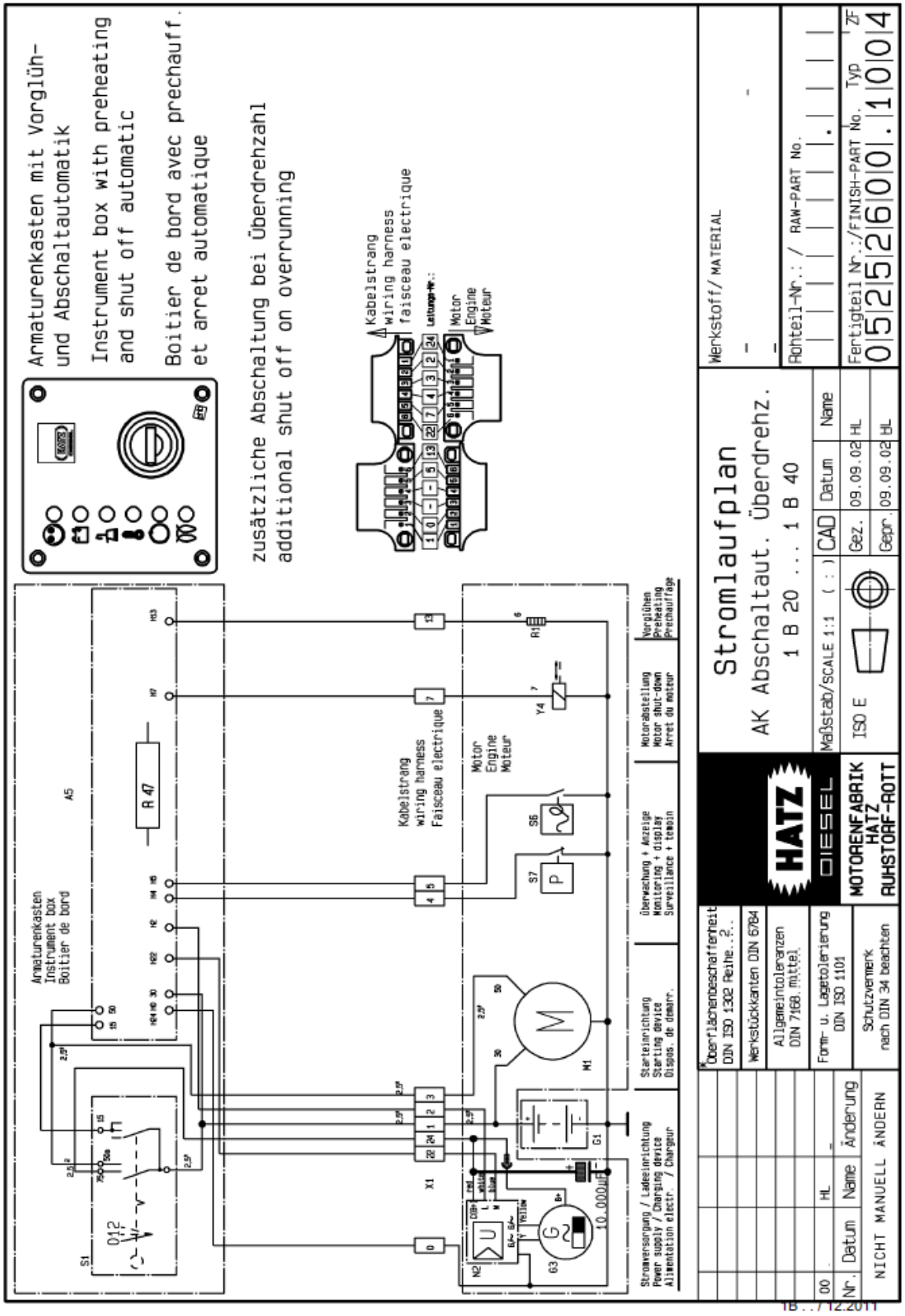


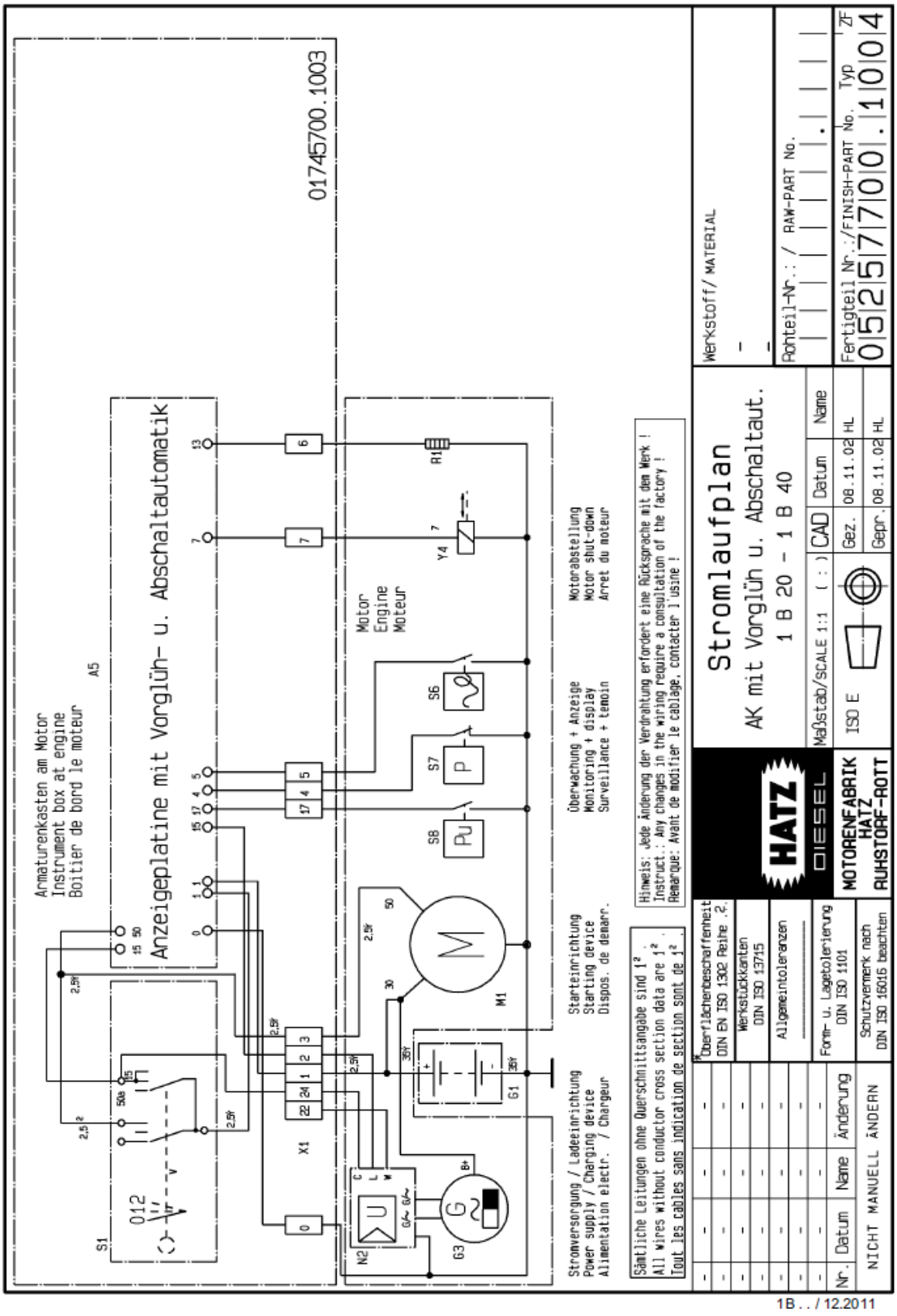
Off-load AC voltage:

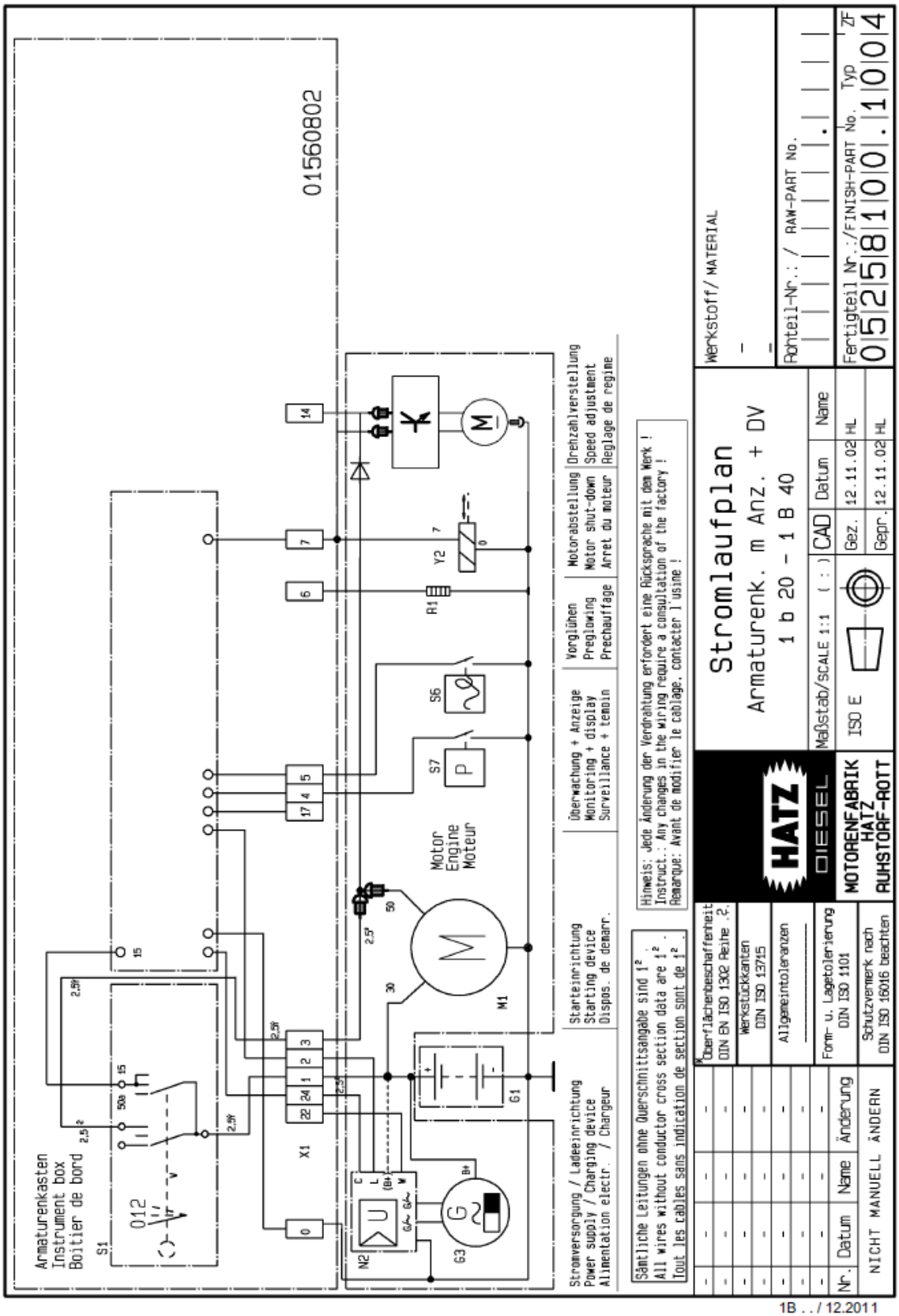
measured between a yellow and a red wire at the coil (without regulating switch)

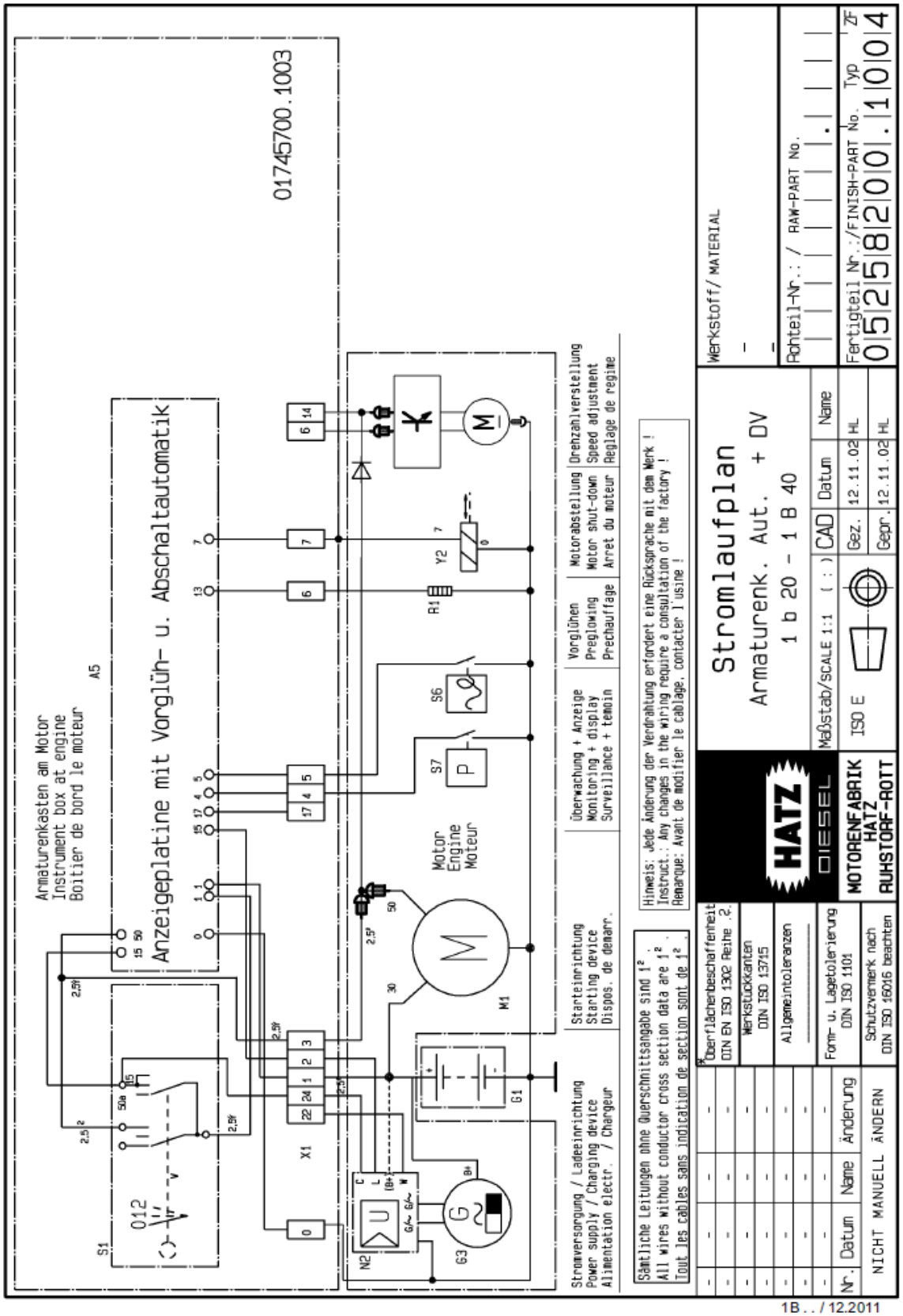



Armaturenkasten mit Anzeige
Instrument box with indication
Boitier de bord avec indication
Kabelstrang
wiring harness
faisceau electrique
Motor
Engine
Moteur
Stromlaufplan
Armaturenk. m. Anzeige 12 V
1 B 20...1 B 30
HATZ
DIESEL
MOTORENFABRIK
HATZ
RUHSTORF-ROTT
Werkstoff/ MATERIAL
Fertigteil Nr.:/FINISH-PART No.
Typ
05|12|39|00|.|10|04
Starteinrichtung
Starting device
Dispos. de demarr.
Überwachung + Anzeige
Monitoring + display
Surveillance + temoin
Motorabstellung
Motor shut-down
Arret du moteur
Stromversorgung / Ladeeinrichtung
Power supply / Charging device
Alimentation electr. / Chargeur
Schutzvermerk
nach DIN 34 beachten
NICHT MANUELL ÄNDERN


Armaturenkasten mit Vorglüh-
und Abschaltautomatik
Instrument box with preheating
and shut off automatic
Boitier de bord avec prechauff.
et arret automatique
zusätzliche Abschaltung bei Überdrehzahl
additional shut off on overrunning
Kabelstrang
wiring harness
faisceau electrique
Motor
Engine
Moteur
Armaturenkasten
Instrument box
Boitier de bord
A5
R 47
S1
Kabelstrang
wiring harness
Faisceau electrique
Motor
Engine
Moteur
S6
S7
Y4
R1
M1
G1
G3
N2
X1
10.000uF
Vorglühen
Preheating
Préchauffage
Motorabstellung
Motor shut-down
Arrêt du moteur
Überwachung + Anzeige
Monitoring + display
Surveillance + témoin
Starteinrichtung
Starting device
Dispos. de démarr.
Stromversorgung / Ladeeinrichtung
Power supply / Charging device
Alimentation electr. / Chargeur
Stromlaufplan
AK Abschaltaut. Überdrehz.
1 B 20 ... 1 B 40
HATZ
DIESEL
MOTORENFABRIK
HATZ
RUHSTORF-ROTT
ISO E
Maßstab/SCALE 1:1
CAD
Datum
Name
Gez.
09.09.02
HL
Gepr.
09.09.02
HL
Werkstoff/ MATERIAL
Rohteil-Nr.: / RAW-PART No.
Fertigteil Nr.:/FINISH-PART No.
Typ
ZF
0|5|2|5|2|6|0|0|1|.|1|0|0|4
Oberflächenbeschaffenheit
DIN ISO 1302 Reihe..2..
Werkstückkanten DIN 6784
Allgemeintoleranzen
DIN 7168 mittel
Form- u. Lagetolerierung
DIN ISO 1101
Schutzvermerk
nach DIN 34 beachten
Nr.
Datum
Name
Änderung
NICHT MANUELL ÄNDERN
1B . . / 12.2011

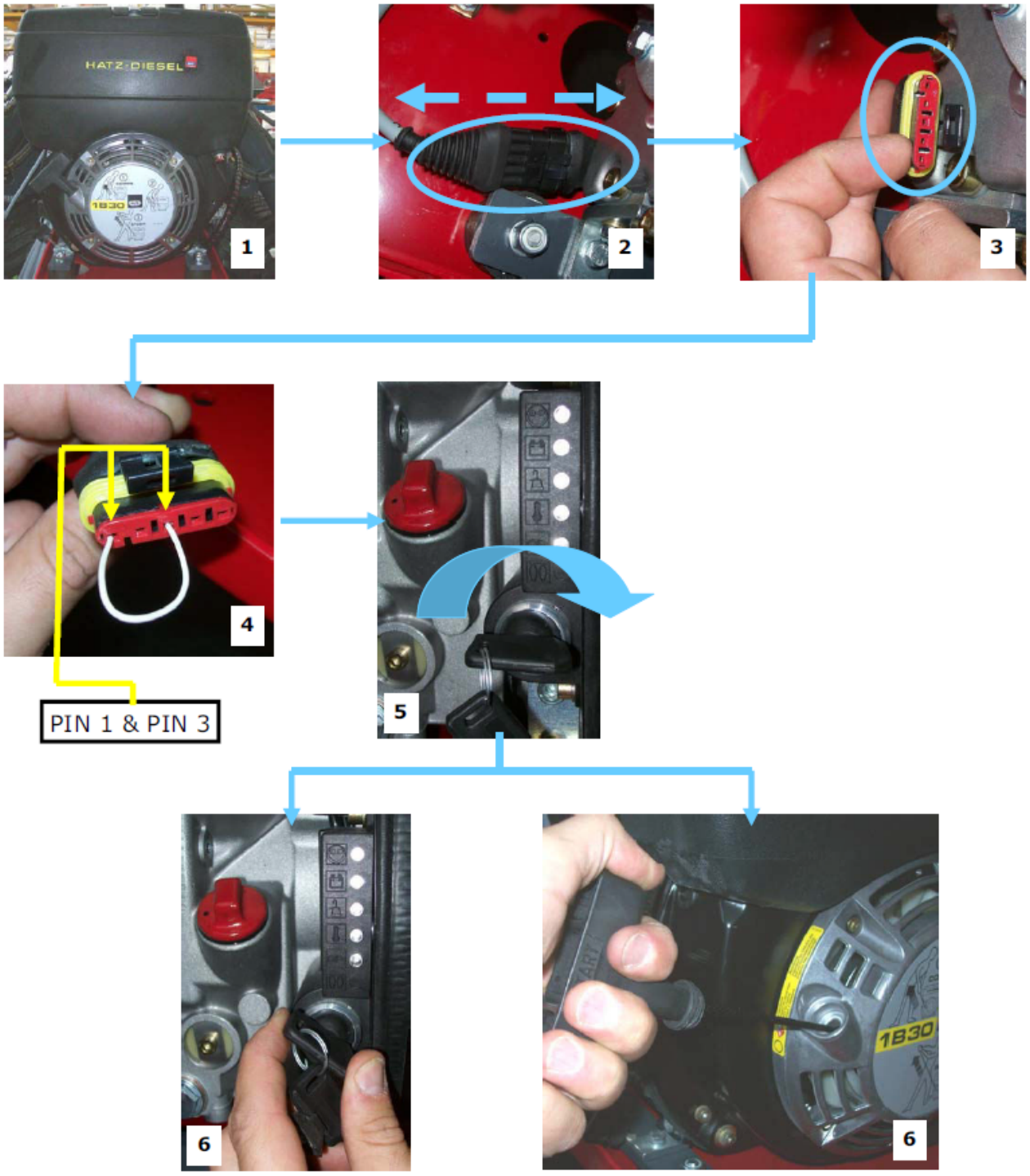

0174570.1003
Anzeigeplatine mit Vorglüh- u. Abschaltautomatik
Armaturenkasten am Motor
Instrument box at engine
Boitier de bord le moteur
A5
Motor
Engine
Moteur
Stromversorgung / Ladeeinrichtung
Power supply / Charging device
Alimentation electr. / Chargeur
Starteinrichtung
Starting device
Dispos. de demarr.
Überwachung + Anzeige
Monitoring + display
Surveillance + temoin
Motorabstellung
Motor shut-down
Arret du moteur
Hinweis: Jede Änderung der Verdrahtung erfordert eine Rücksprache mit dem Werk !
Instruct.: Any changes in the wiring require a consultation of the factory !
Remarque: Avant de modifier le cablage, contacter l'usine !
Sämtliche Leitungen ohne Querschnittsangabe sind 1².
All wires without conductor cross section data are 1².
Tout les cables sans indication de section sont de 1².
Stromlaufplan
AK mit Vorglüh u. Abschaltaut.
1 B 20 - 1 B 40
HATZ DIESEL
MOTORENFABRIK HATZ RUHSTORF-ROTT
Maßstab/SCALE 1:1
ISO E
CAD
Gez. 08.11.02 HL
Gepr. 08.11.02 HL
Name
Datum
Werkstoff/ MATERIAL
Rohteil-Nr.: / RAW-PART No.
Fertigteil Nr.:/FINISH-PART No. Typ ZF
0 5 2 5 7 7 0 0 1 . 1 0 0 4
Oberflächenbeschaffenheit DIN EN ISO 1302 Reihe .2.
Werkstückkanten DIN ISO 13715
Allgemeintoleranzen
Form- u. Lagetolerierung DIN ISO 1101
Schutzvermerk nach DIN ISO 16016 beachten
Änderung
NICHT MANUELL ÄNDERN
1B . . / 12.2011


01560802
Armaturenkasten
Instrument box
Boitier de bord
Stromlaufplan
Armaturenk. m Anz. + DV
1 b 20 - 1 B 40
HATZ
DIESEL
MOTORENFABRIK
HATZ
RUHSTORF-ROTT
ISO E
Maßstab/SCALE 1:1
CAD
Datum
Name
Gez. 12.11.02 HL
Gepr. 12.11.02 HL
Werkstoff/ MATERIAL
Rohteil-Nr.: / RAW-PART No.
Fertigteil Nr.:/FINISH-PART No. Typ
0525810010.1004
ZF
Motor
Engine
Moteur
Starteinrichtung
Starting device
Dispos. de demarr.
Überwachung + Anzeige
Monitoring + display
Surveillance + temoin
Vorglühen
Preglowing
Préchauffage
Motorabstellung
Motor shut-down
Arret du moteur
Drehzahlverstellung
Speed adjustment
Reglage de regime
Hinweis: Jede Änderung der Verdrahtung erfordert eine Rücksprache mit dem Werk !
Instruct.: Any changes in the wiring require a consultation of the factory !
Remarque: Avant de modifier le cablage, contacter l'usine !
Sämtliche Leitungen ohne Querschnittsangabe sind 1².
All wires without conductor cross section data are 1².
Tout les cables sans indication de section sont de 1².
Stromversorgung / Ladeeinrichtung
Power supply / Charging device
Alimentation electr. / Chargeur
Oberflächenbeschaffenheit
DIN EN ISO 1302 Reihe .2.
Werkstückkanten
DIN ISO 13715
Allgemeintoleranzen
Form- u. Lagetolerierung
DIN ISO 1101
Schutzvermerk nach
DIN ISO 16016 beachten
NICHT MANUELL ÄNDERN
Nr. Datum Name Änderung
1B . . / 12.2011


01745700.1003
Armaturenkasten am Motor
Instrument box at engine
Boitier de bord le moteur
A5
Anzeigeplatine mit Vorglün- u. Abschaltautomatik
Stromlaufplan
Armaturenk. Aut. + DV
1 b 20 - 1 B 40
HATZ
DIESEL
MOTORENFABRIK HATZ RUHSTORF-ROTT
Maßstab/SCALE 1:1
ISO E
Werkstoff/ MATERIAL
Rohteil-Nr.: / RAW-PART No.
Fertigteil Nr.:/FINISH-PART No.
0 5 2 5 8 2 0 0 1 . 1 0 0 4
Typ ZF
Motor Engine Moteur
Starteinrichtung Starting device Dispos. de demarr.
Überwachung + Anzeige Monitoring + display Surveillance + témoin
Vorglühen Preglowing Préchauffage
Motorabstellung Motor shut-down Arret du moteur
Drehzahlverstellung Speed adjustment Reglage de regime
Stromversorgung / Ladeeinrichtung Power supply / Charging device Alimentation electr. / Chargeur
Sämtliche Leitungen ohne Querschnittsangabe sind 1². All wires without conductor cross section data are 1². Tout les cables sans indication de section sont de 1².
Hinweis: Jede Änderung der Verdrahtung erfordert eine Rücksprache mit dem Werk ! Instruct.: Any changes in the wiring require a consultation of the factory ! Remarque: Avant de modifier le cablage, contacter l'usine !
Oberflächenbeschaffenheit DIN EN ISO 1302 Reihe 2
Werkstückkanten DIN ISO 13715
Allgemeintoleranzen
Form- u. Lagetolerierung DIN ISO 1101
Schutzvermerk nach DIN ISO 16016 beachten
Nr. Datum Name Änderung
NICHT MANUELL ÄNDERN
Gez. 12.11.02 HL
Gepr. 12.11.02 HL
CAD Datum Name
1B . . / 12.2011

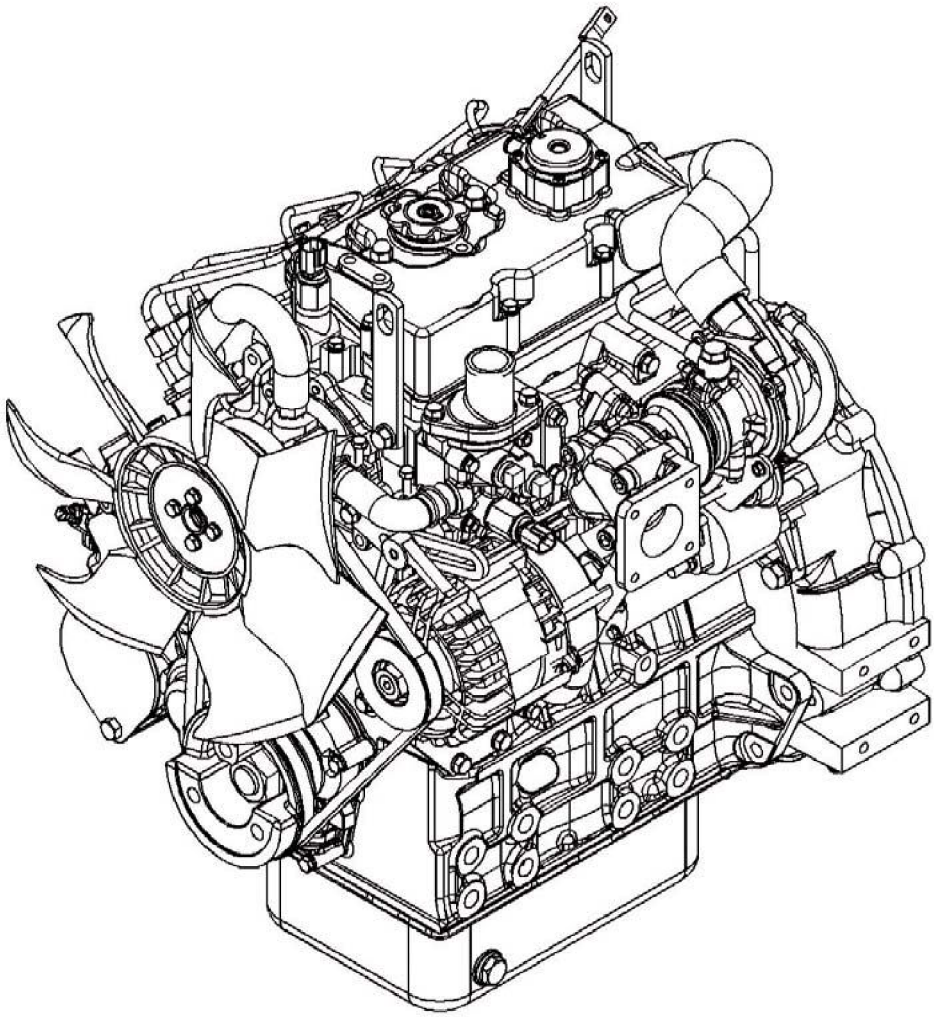
QUICK TROUBLESHOOTING

HATZ 1B30—1B40



3.12 PERKINS ENGINE

TYPE: 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	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

(1) Naturally Aspirated

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

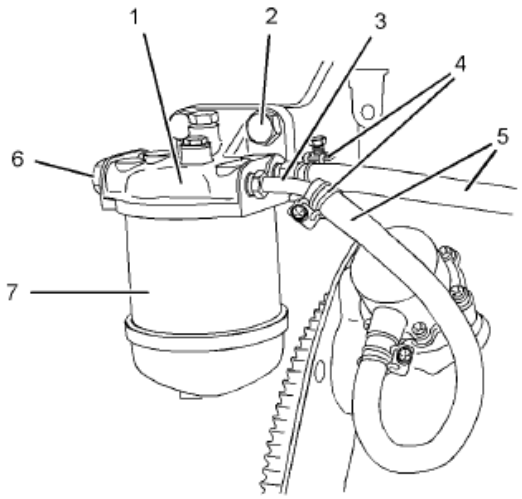
DISASSEMBLY AND ASSEMBLY

INSTALLATION PROCEDURE

NOTICE

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

NOTE: *If the engine is equipped with a hand priming pump, the hand priming pump is mounted on the fuel filter base. The assembly of the fuel filter base and the hand priming pump is not serviceable.*



1. Ensure that the fuel filter base is clean and free from damage. If necessary, replace the fuel filter base.
2. If necessary, install new rubber olives (not shown) onto tube assemblies (3). Install tube assemblies (3) to fuel filter base (1). Ensure the correct orientation of the tube assemblies. Tighten the nuts to a torque of 9 N·m (80 lb in).
3. Install washers (not shown) onto plugs (6). Install plugs (6) to fuel filter base (1). Tighten the plugs to a torque of 23 N·m (17 lb ft).
4. Align fuel filter base (1) with the mounting bracket. Install fasteners (2). Tighten the fasteners to a torque of 50 N·m (37 lb ft).
5. If necessary, install a new fuel filter element (7) to fuel filter base (1). Refer to Operation and Maintenance Manual, “Fuel System Filter - Replace”.
6. Connect hoses (5) and tighten hose clamps (4).

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

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

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.

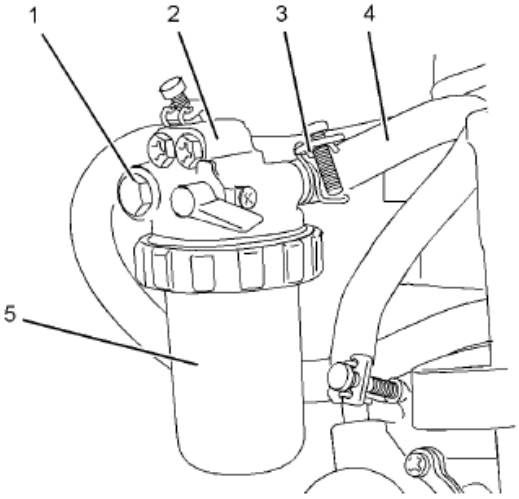
NOTICE

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.*

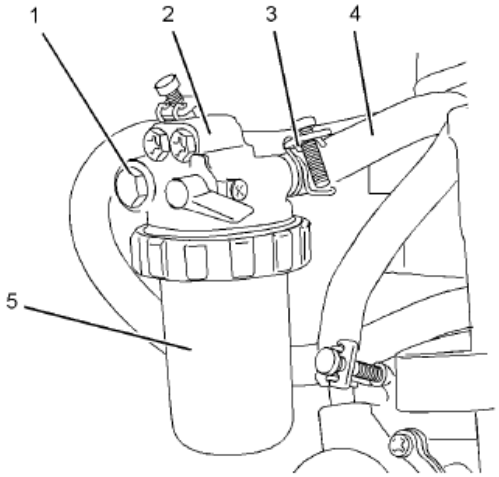


1. Turn the fuel supply to the OFF position.
2. Loosen hose clamps (3) and disconnect hoses (4).
3. If necessary, remove fuel filter element (5). Refer to Operations and Maintenance Manual, “Fuel System Filter - Replace”.
4. Remove bolt (1) and remove fuel filter base (2) from the mounting bracket.

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”.

FUEL TRANSFER PUMP - REMOVE AND INSTALL

(MECHANICAL FUEL TRANSFER PUMP)

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.

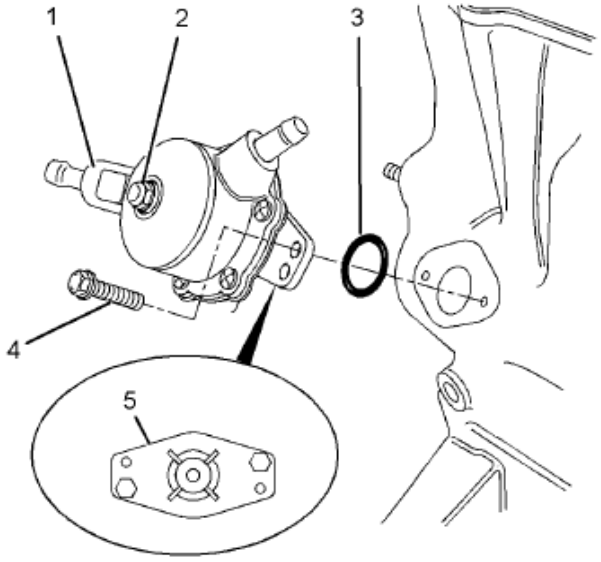
NOTICE

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 transfer pump. This helps prevent fluid loss, and this helps to keep contaminants from entering the system.*



1. Turn the fuel supply to the OFF position.

NOTE: *The fuel transfer pump can be oriented in two positions. Before removing the fuel transfer pump from the cylinder block, note the orientation of flange (5) on fuel transfer pump (1) for assembly.*

2. Loosen the hose clamps and disconnect the hoses (not shown) from fuel transfer pump (1).
3. Evenly loosen bolts (4) and remove fuel transfer pump (1) from the cylinder block.

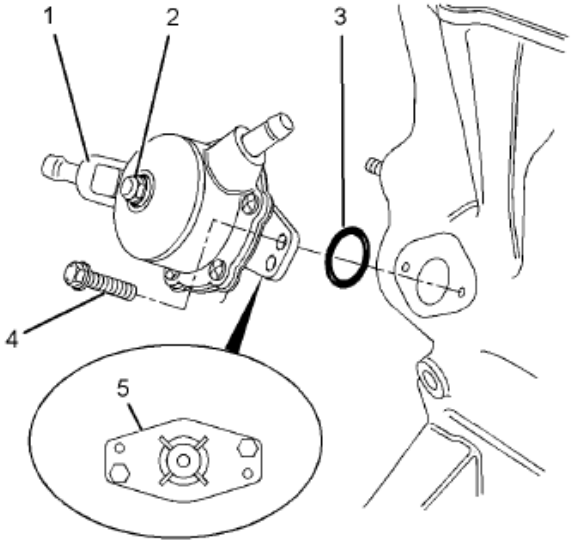
NOTE: *In order to remove the fuel transfer pump, it may be necessary to rotate the crankshaft until the operating plunger of the fuel transfer pump is not under pressure.*

4. Remove O-ring seal (3) from fuel transfer pump (1).

INSTALLATION PROCEDURE

NOTICE

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



1. Clean the mating surfaces of the cylinder block and flange (5) on the fuel transfer pump.

NOTE: *Ensure that the camshaft lobe for the fuel transfer pump is at minimum lift before the fuel transfer pump is installed. The fuel transfer pump can be oriented*

in two positions. Ensure that the fuel transfer pump is oriented in the correct position.

2. Install a new O-ring seal (3) to fuel transfer pump (1).
3. Lubricate the operating plunger of fuel transfer pump (1) with clean engine oil.
4. Position fuel transfer pump (1) on the cylinder block. Ensure that the operating plunger is positioned correctly on the camshaft lobe. Install bolts (4). Tighten the bolts to a torque of 6 N·m (53 lb in).
5. Connect the hoses (not shown) to fuel transfer pump (1). Tighten the hose clamps.

NOTE: *The inlet for the fuel transfer pump can be rotated 360 degrees by loosening bolt (2). The fuel inlet is adjustable in 15 degree increments. If adjustment is made to the position of the fuel inlet, tighten bolt (2) to a torque of 2.5 N·m (22 lb in).*

6. Turn the fuel supply to the ON position.
7. Prime the fuel system. Refer to Systems Operation, Testing and Adjusting, “Fuel System - Prime” for additional information.

FUEL TRANSFER PUMP - REMOVE AND INSTALL

(ELECTRICAL FUEL TRANSFER PUMP)

REMOVAL PROCEDURE

NOTICE

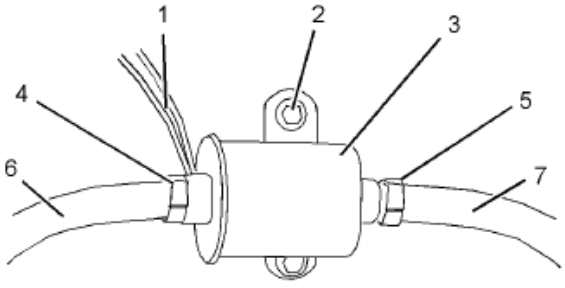
CARE MUST BE TAKEN TO ENSURE THAT FLUIDS ARE CONTAINED DURING PERFORMANCE OF INSPECTION, MAINTENANCE, TESTING, ADJUSTING AND REPAIR OF THE PRODUCT. BE PREPARED TO COLLECT THE FLUID WITH SUITABLE CONTAINERS BEFORE OPENING ANY COMPARTMENT OR DISASSEMBLING ANY COMPONENT CONTAINING FLUIDS. DISPOSE OF ALL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

NOTICE

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

NOTE: *Put identification marks on all hoses, on all hose assemblies, on wires and on all tube assemblies for installation purposes. Plug all hose assemblies and tube assemblies. This helps to prevent fluid loss and this helps to keep contaminants from entering the system.*

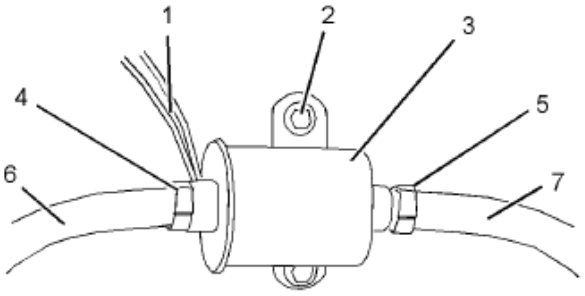
1. Turn the fuel supply to the OFF position.
2. Turn the battery disconnect switch to the OFF position.



3. Disconnect harness assembly (1).
4. Loosen hose clamps (4) and (5). Disconnect hoses (6) and (7).
5. Remove bolts (2) and remove electric transfer pump (3).

INSTALLATION PROCEDURE

1. Ensure that the electric transfer pump is clean and free from damage. If necessary, replace the electric transfer pump.



2. Position electric transfer pump (3) on the mounting and install bolts (2).
3. Tighten bolts (2) to a torque of 9 N·m (79 lb in).
4. Connect hoses (6) and (7). Tighten hose clamps (4) and (5).
5. Connect harness assembly (1).
6. Turn the fuel supply to the ON position.
7. Turn the battery disconnect switch to the ON position.
8. Remove the air from the fuel system. Refer to Operation and Maintenance Manual, “Fuel System - Prime”.

FUEL INJECTION LINES - REMOVE AND INSTALL

REMOVAL PROCEDURE

NOTICE

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

NOTICE

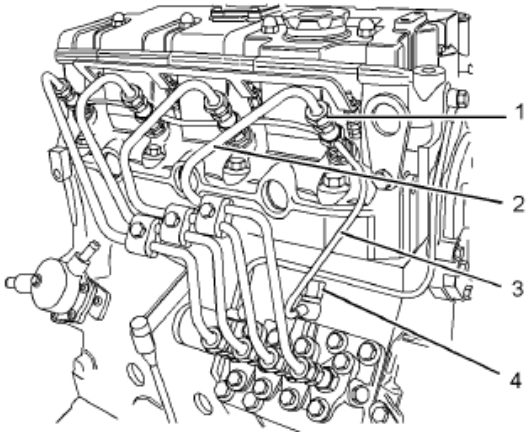
CARE MUST BE TAKEN TO ENSURE THAT FLUIDS ARE CONTAINED DURING PERFORMANCE OF INSPECTION, MAINTENANCE, TESTING, ADJUSTING AND REPAIR OF THE PRODUCT. BE PREPARED TO COLLECT THE FLUID WITH SUITABLE CONTAINERS BEFORE OPENING ANY COMPARTMENT OR DISASSEMBLING ANY COMPONENT CONTAINING FLUIDS. DISPOSE OF ALL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

NOTICE

DO NOT LET THE TOPS OF FUEL INJECTORS TURN WHEN THE FUEL LINE NUTS ARE LOOSENED OR TIGHTENED. THE FUEL INJECTORS WILL BE DAMAGED IF THE TOP OF THE INJECTOR TURNS IN THE BODY. THE ENGINE WILL BE DAMAGED IF A DEFECTIVE FUEL INJECTOR IS USED BECAUSE THE SHAPE OF FUEL (SPRAY PATTERN) THAT COMES OUT OF THE NOZZLE WILL NOT BE CORRECT.

NOTE: *Place identification marks on all tube assemblies for installation. Plug all lines and tube assemblies in order to prevent contamination.*

1. Turn the fuel supply to the OFF position.



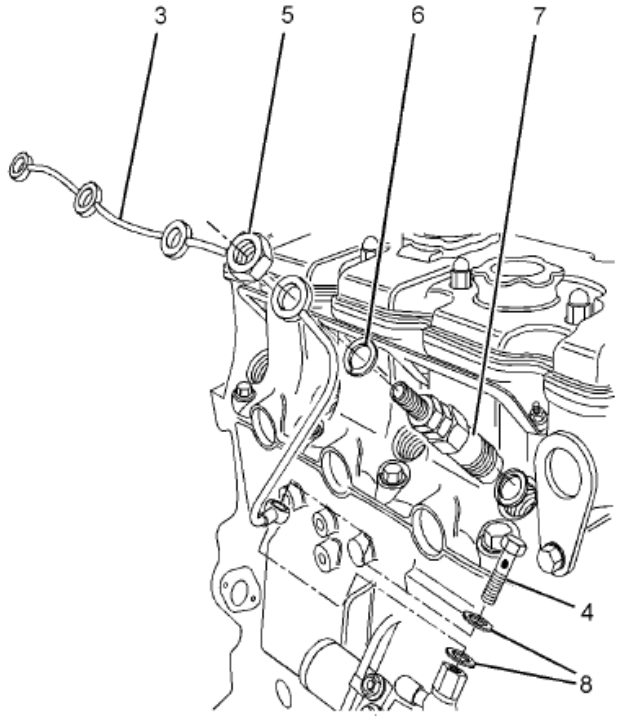
2. Disconnect nuts (1) for fuel injection lines (2) from the fuel injectors.

3. Disconnect nuts (1) for fuel injection lines (2) from the fuel injection pump.
4. Remove fuel injection lines (2) from the engine as a unit.
5. Use suitable caps in order to plug the open ports of the fuel injection pump immediately.

For engines with a rigid fuel return line, remove banjo bolt (4) from fuel return line (3). Remove washers (8).

The 402D-05, 403D-07, 403D-11 and 404D-15 engines have a flexible fuel return hose.

For engines with a flexible fuel return hose, disconnect the hose from the fuel injection pump.



1. Remove nuts (5) from fuel injectors (7).

NOTE: *For engines with a rigid fuel return line, ensure that the fuel return line is not distorted when the nuts are loosened.*

2. Remove fuel return line (3) and washers (6) from fuel injectors (7).
3. Use suitable caps in order to plug the fuel injectors immediately.

INSTALLATION PROCEDURE

Required Tools			
Tool	**Part Number**	**Part Name**	**Qty**
A	27610294	Injector Pipe Nut Tool	1

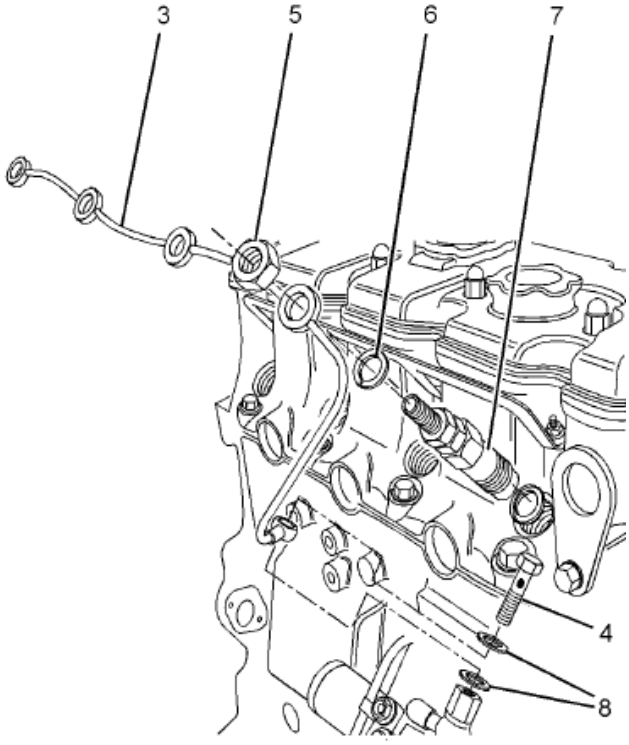
NOTICE

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

NOTICE

DO NOT LET THE TOPS OF FUEL INJECTORS TURN WHEN THE FUEL LINE NUTS ARE LOOSENED OR TIGHTENED. THE FUEL INJECTORS WILL BE DAMAGED IF THE TOP OF THE INJECTOR TURNS IN THE BODY. THE ENGINE WILL BE DAMAGED IF A DEFECTIVE FUEL INJECTOR IS USED BECAUSE THE SHAPE OF FUEL (SPRAY PATTERN) THAT COMES OUT OF THE NOZZLE WILL NOT BE CORRECT.

NOTE: *The installation procedure is similar for the two cylinder, the three cylinder and the four cylinder engines.*



1. Remove the caps from fuel injectors (7). Install new washers (6) and fuel return line (3) to fuel injectors (7).

NOTE: *The washers (6) have two small holes.*

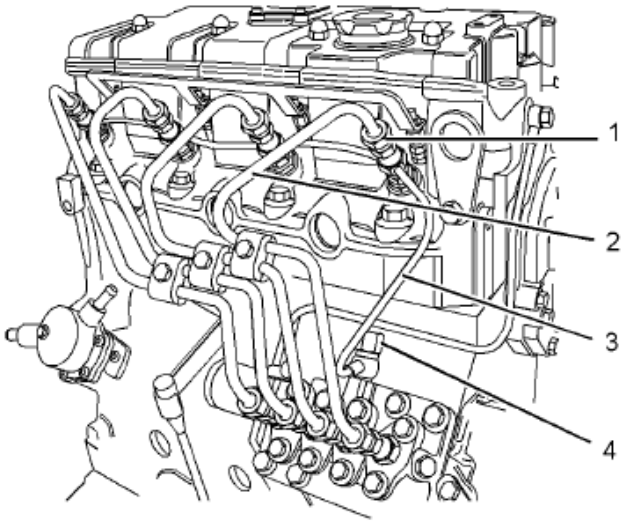
2. Install nuts (5) to fuel injectors (7).

For engines with a rigid fuel return line, install new washers (8) to fuel return line (3) and install banjo bolt (4) to the fuel injection pump. Tighten banjo bolt (4) to a torque of 7 N·m (62 lb in).

The 402D-05, 403D-07, 403D-11 and 404D-15 engines have a flexible fuel return hose.

For engines with a flexible fuel return hose, connect the fuel return hose to the fuel injection pump.

1. Tighten nuts (5) to a torque of 27 N·m (20 lb ft).



2. Remove the caps from the outlet connections of the fuel injection pump. Install the fuel injection lines to the engine as a unit.
3. Connect fuel injection lines (2) to fuel injectors (7). Tighten the union nuts (1) finger tight.
4. Use Tooling (A) to tighten union nuts (1) at the fuel injection pump.

For 402D-05 and 403D-07 engines, tighten union nuts (1) to a torque of 20 N·m (15 lb ft).

NOTE: *For the three cylinder and the four cylinder engines, tighten the center union nuts first.*

1. Use Tooling (A) to tighten union nuts (1) at the fuel injections.

For 402D-05 and 403D-07 engines, tighten union nuts (1) to a torque of 20 N·m (15 lb ft).

1. Turn the fuel supply to the ON position.
2. Prime the fuel system. Refer to Operation and Maintenance Manual, “Fuel System - Prime” for more information.

FUEL SHUTOFF SOLENOID - REMOVE AND INSTALL

REMOVAL PROCEDURE

NOTICE

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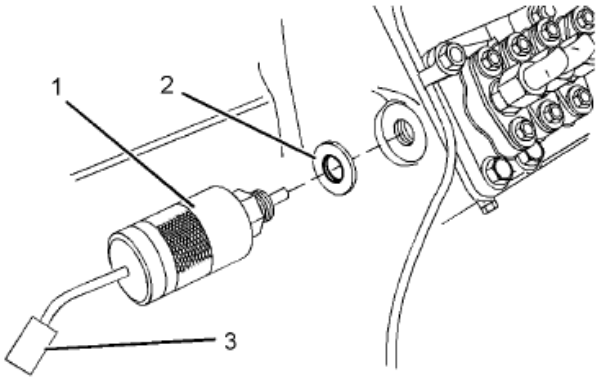
NOTICE

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

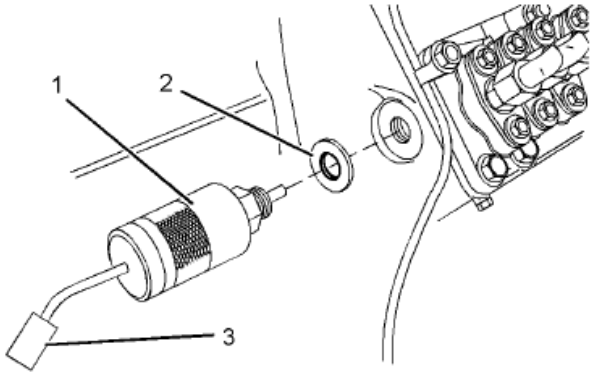


1. Turn the battery disconnect switch to the OFF position.
2. Disconnect electrical connection (3) from the harness assembly (not shown). Mark all connections for installation.
3. Remove fuel shutoff solenoid (1) from the fuel injection pump housing by rotating the fuel shutoff solenoid in a counterclockwise direction.
4. Remove sealing washer (2) from fuel shutoff solenoid (1).

INSTALLATION PROCEDURE

NOTICE

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



1. Install sealing washer (2) to fuel shutoff solenoid (1).
2. Install fuel shutoff solenoid (1) into the fuel injection pump housing by rotating the fuel shutoff solenoid in a clockwise direction. Tighten the fuel shutoff solenoid to a torque of 17 N·m (12 lb ft).
3. Connect electrical connection (3) to the harness assembly (not shown).
4. Turn the battery disconnect switch to the ON position.

FUEL INJECTOR - REMOVE AND INSTALL

REMOVAL PROCEDURE

Start By:

a. Remove the fuel injection lines. Refer to Disassembly and Assembly, “Fuel Injection Lines - Remove and Install”.

NOTICE

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NOTICE

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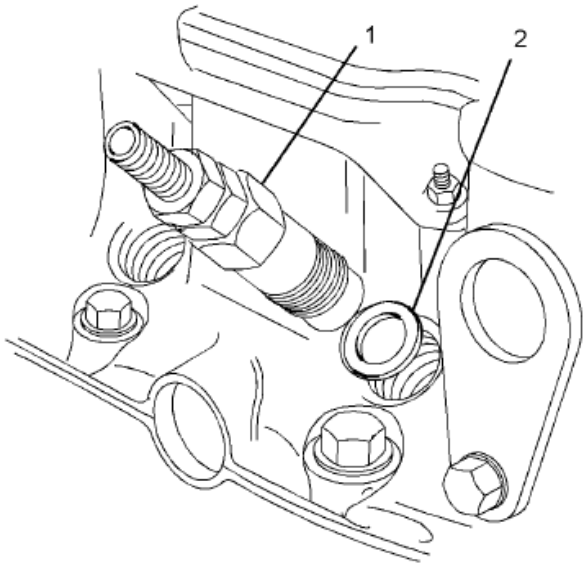


1. Use a deep socket to remove fuel injector (1) from the cylinder head.
2. Remove seat washers (2) from the cylinder head.

NOTE: *402D-05 and 403D-07 engines have two seat washers. The seat washers are different diameters.*

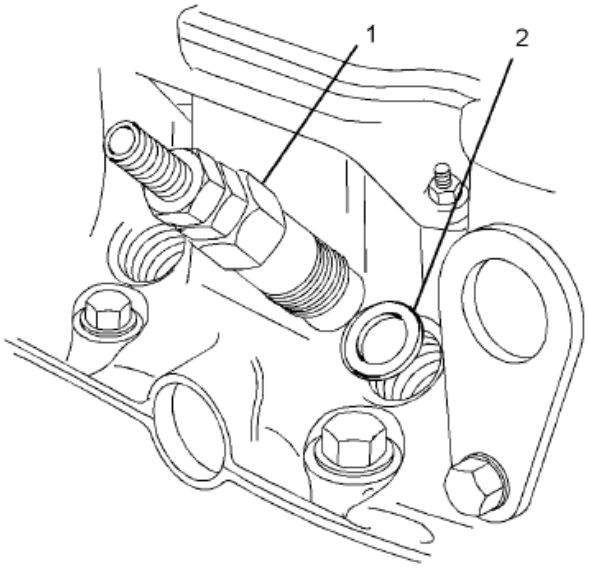
3. Cap all openings or plug all openings immediately.

INSTALLATION PROCEDURE

Required Tools			
Tool	Part Number	Part Description	Qty
A	1861117	POWERPART Universal Jointing Compound	1

NOTICE

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



1. Clean the bore for the fuel injector in the cylinder head. Ensure that no debris enters the cylinder. Clean the threads on the body of the fuel injector.
2. Install new seat washers (2) into the bore for the fuel injector in the cylinder head.

NOTE: *402D-05 and 403D-07 engines have two seat washers. The seat washers are different diameters.*

3. Apply a bead of Tooling (A) to the first two threads of the fuel injector that engage into the cylinder head. The bead should have a diameter of 2 mm (0.08 inch) and a length of 6 mm (0.25 inch).

NOTE: *Ensure that Tooling (A) does not cover the body of the fuel injector below the threads.*

4. Install fuel injector (1) into the cylinder head. Use a deep socket to tighten the fuel injector to a torque of 64 N·m (47 lb ft).

EXHAUST MANIFOLD - REMOVE AND INSTALL

REMOVAL PROCEDURE

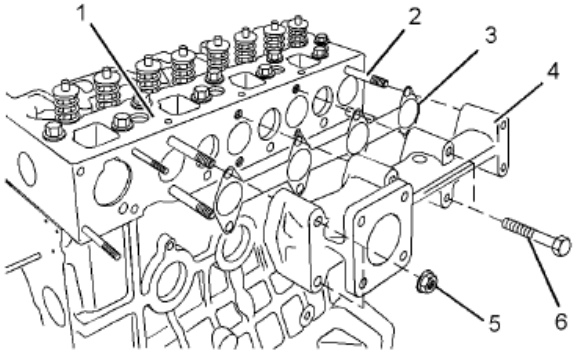
Start By:

a. If the engine is equipped with a turbocharger, remove the turbocharger. Refer to Disassembly and Assembly, “Turbocharger, Remove and Install”.

NOTICE

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

NOTE: *The two cylinder, the three cylinder and the four cylinder engines have different exhaust manifolds. The removal procedure is similar for all models.*



1. Loosen nuts (5) and bolts (6).

NOTE: *In order to prevent distortion of the exhaust manifold, loosen the outer fasteners first.*

2. Remove nuts (5) and bolts (6).

NOTE: *Identify bolts of different lengths so that the bolts can be installed in the correct positions.*

3. Remove exhaust manifold (4) from cylinder head (1). Note the orientation of the exhaust manifold for installation.
4. Remove gasket (3) from cylinder head (1).
5. If necessary, remove exhaust manifold studs (2) from cylinder head (1).

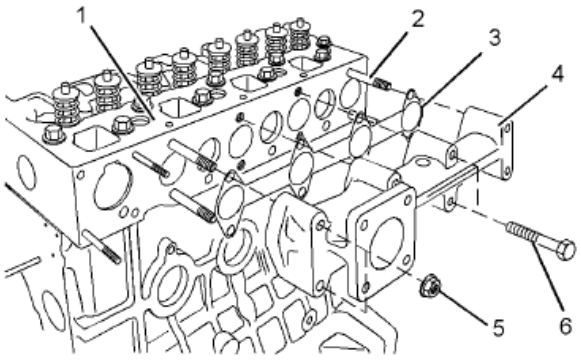
INSTALLATION PROCEDURE

NOTICE

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

NOTE: *The two cylinder, the three cylinder and the four cylinder engines have different exhaust manifolds. The installation procedure is similar for all models.*

1. Ensure that the mating surfaces of the cylinder head and the exhaust manifold are clean and free from damage.



2. If necessary, install exhaust manifold studs (2) to cylinder head (1).
3. Install a new exhaust manifold gasket (3) to cylinder head (1).
4. Align exhaust manifold (4) with studs (2) and install the exhaust manifold to cylinder head (1).

NOTE: *Note: Ensure that the exhaust manifold is installed in the correct orientation.*

5. Install nuts (5) and bolts (6) finger tight.

NOTE: *Note: Ensure that bolts of different lengths are installed in the correct positions.*

6. For 402D-05, 403D-07, 403D-11, 403D-15, 403D-15T, 403D-17, and 404D-15 engines, tighten nuts (5) and bolts (6) to a torque of 10 N·m (89 lb in).

NOTE: *On three cylinder engines and four cylinder engines, tighten the inner bolts first.*

End By:

a. If the engine is equipped with a turbocharger, install the turbocharger. Refer to Disassembly and Assembly, “Turbocharger, Remove and Install”.

ENGINE OIL LINE - REMOVE AND INSTALL

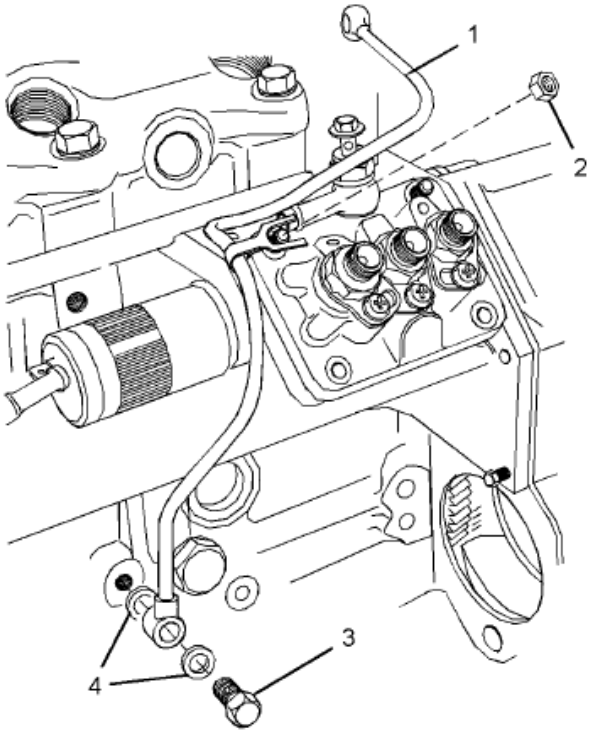
REMOVAL PROCEDURE

NOTICE

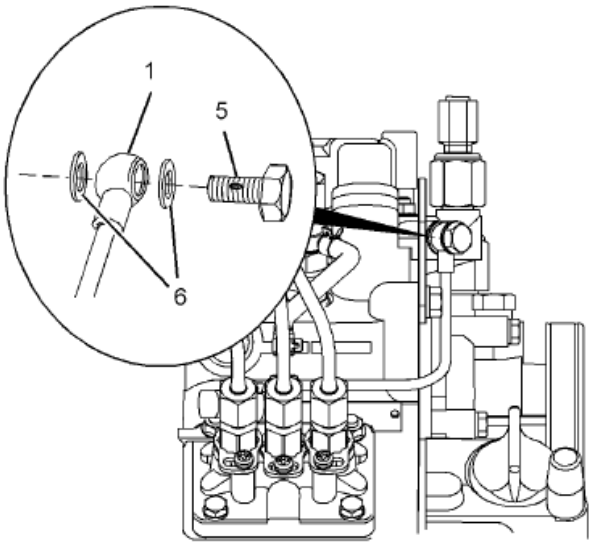
KEEP ALL PARTS CLEAN FROM CONTAMINANTS. CONTAMINANTS MAY CAUSE RAPID WEAR AND SHORTENED COMPONENT LIFE.

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.



1. Loosen nut (2) that attaches the clip on oil line (1) to the fuel injection pump.
2. Remove banjo bolt (3) and remove washers (4) from the cylinder block.

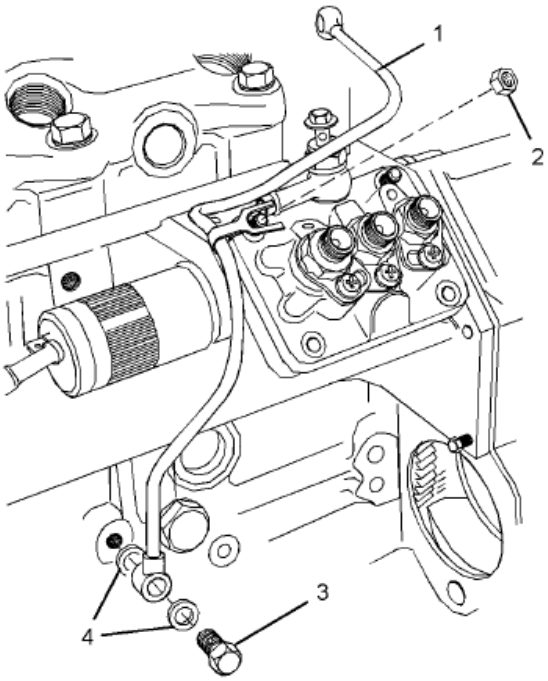


1. Remove banjo bolt (5) and remove washers (6) from the cylinder head.
2. Remove oil line (1) from the engine.

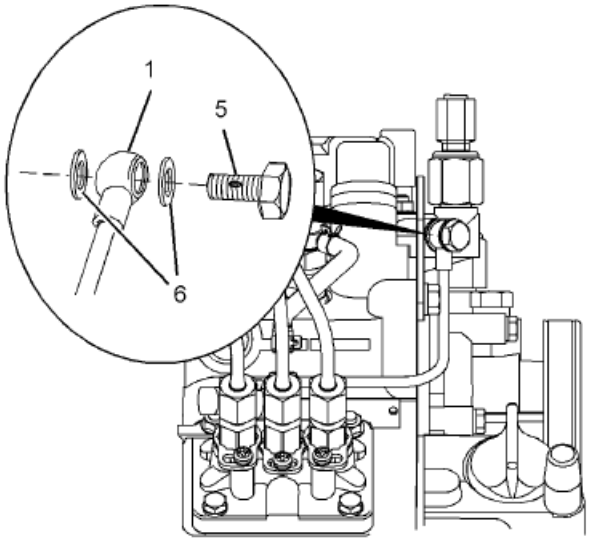
INSTALLATION PROCEDURE

NOTICE

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



1. Place oil line (1) on the engine. Ensure that the clip on the oil line is located below nut (2).
2. Position banjo bolt (3) and new washers (4) onto oil line (1). Install the banjo bolt and oil line to the cylinder block finger tight.



3. Position banjo bolt (5) and new washers (6) onto oil line (1). Install the banjo bolt and the oil line to the cylinder head finger tight.
4. Tighten nut (2) that attaches the clip on oil line (1) to the fuel injection pump.

NOTE: *For 402D-05, 403D-07, 403D-11 and 404D-15 engines, tighten nut (2) to a torque of 6 N·m (53 lb in).*

5. Tighten banjo bolts (3) and (5) to a torque of 12 N·m (106 lb in).

ENGINE OIL COOLER - REMOVE AND INSTALL

REMOVAL PROCEDURE

Required Tools			
Tool	**Part Number**	**Part Description**	**Qty**
A	-	Strap Wrench	1

NOTICE

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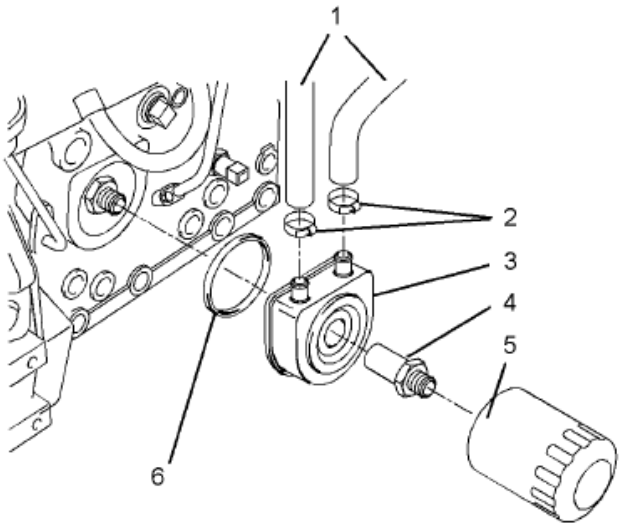
NOTICE

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

1. Drain the coolant from the cooling system into a suitable container. Refer to Operation and Maintenance Manual, “Cooling System Coolant - Drain” for the correct procedure.
2. Drain the engine lubricating oil into a suitable container. Refer to Operation and Maintenance Manual, “Engine Oil and Filter - Change” for the correct procedure.



3. Use Tooling (A) to remove oil filter element (5).
4. Loosen hose clamps (2) and disconnect hoses (1). Note the positions of the coolant inlet and the coolant outlet for installation.
5. Remove adapter (4) and remove oil cooler (3) from the cylinder block.

NOTE: *Make a temporary mark in order to show the orientation of the oil cooler for installation.*

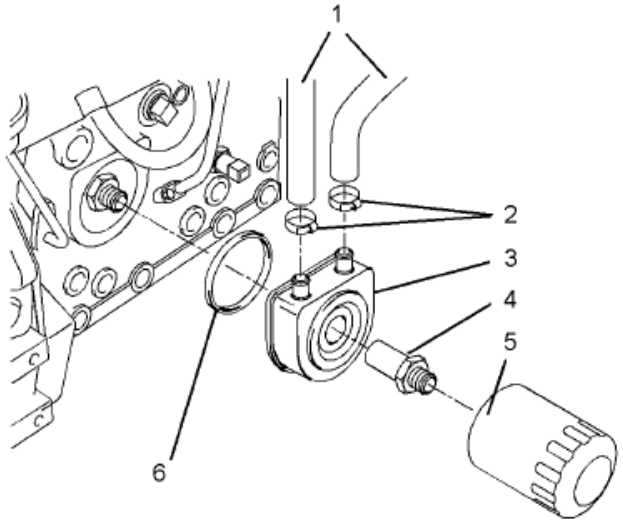
6. Remove O-ring seal (6) from oil cooler (3).

INSTALLATION PROCEDURE

NOTICE

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

1. Ensure that the oil cooler is clean and free from damage. Clean the mating surfaces of the cylinder block.



2. Install a new O-ring seal (6) to oil cooler (3). Position oil cooler (3) on the cylinder block and install adapter (4). Tighten adapter (4) to a torque of 34 N·m (25 lb ft).

NOTE: *Ensure that the oil cooler is correctly oriented.*

3. Connect hoses (1) to the coolant inlet and the coolant outlet on oil cooler (3). Tighten hose clamps (2).
4. Install a new oil filter element (5).
5. Fill the cooling system to the correct level. Refer to Operation and Maintenance Manual, “Cooling System Coolant - Fill” for the correct procedure.
6. Fill the engine oil pan to the correct level. Refer to Operation and Maintenance Manual, “Engine Oil Filter - Change” for the correct procedure.

ENGINE OIL RELIEF VALVE - REMOVE AND INSTALL

REMOVAL PROCEDURE

NOTICE

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NOTICE

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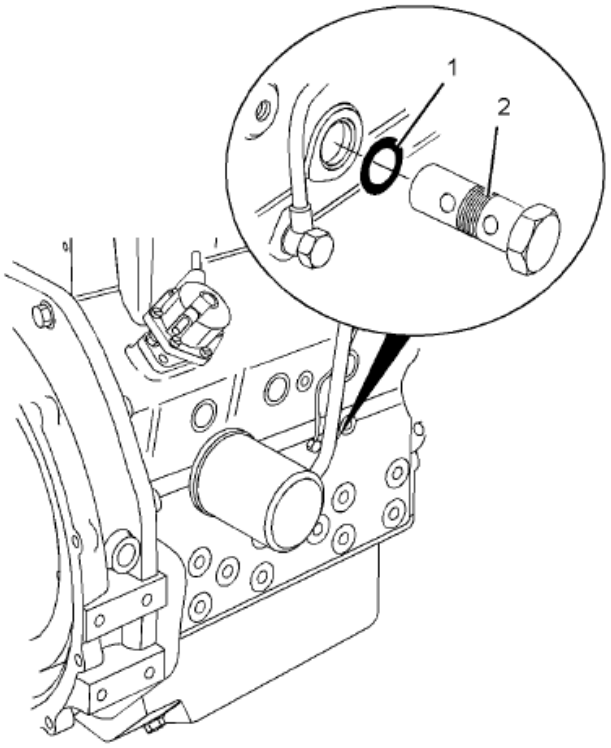
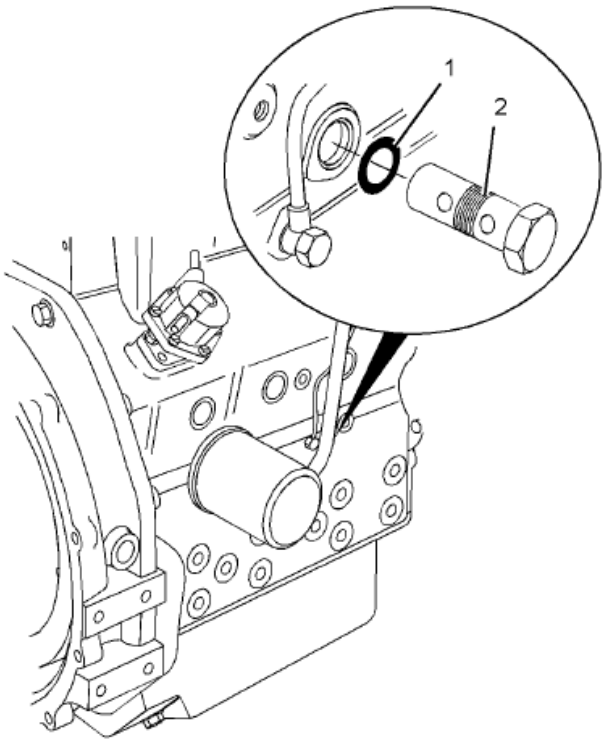


1. Remove engine oil relief valve (2) from the cylinder block.
2. Remove O-ring seal (1) from engine oil relief valve (2).

INSTALLATION PROCEDURE

NOTICE

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



1. Install a new O-ring seal (1) to engine oil relief valve (2).
2. Lubricate engine oil relief valve (2) with clean engine oil.
3. Install engine oil relief valve (2) into the cylinder block. Tighten the engine oil relief valve to a torque of 64 N·m (47 lb ft).

WATER PUMP - REMOVE AND INSTALL

REMOVAL PROCEDURE

Start By:

a. Remove the fan. Refer to Disassembly and Assembly, “Fan - Remove and Install”.

b. Remove the alternator. Refer to Disassembly and Assembly, “Alternator - Remove and Install”.

NOTICE

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

NOTICE

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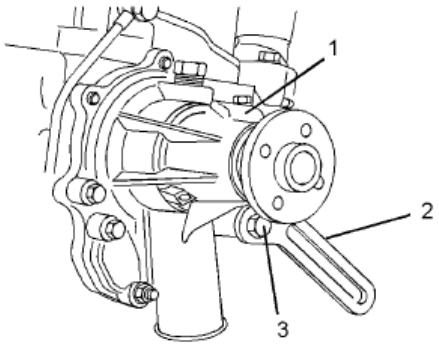
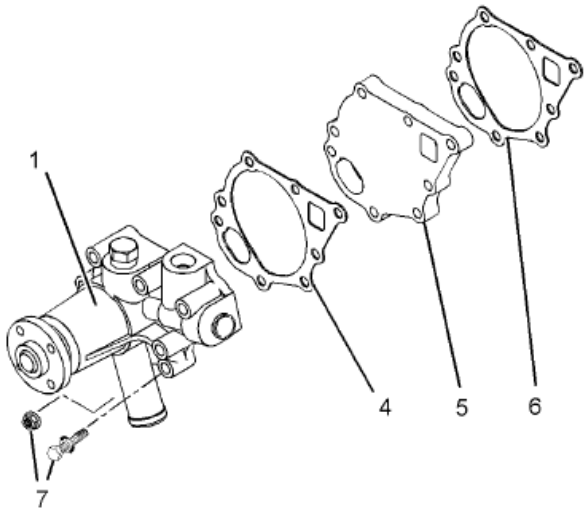
1. Drain the coolant from the cooling system into a suitable container for storage or disposal. Refer to Operation and Maintenance Manual, “Cooling System Coolant - Drain” for more information.
2. Loosen the hose clamp and disconnect the hose (not shown) from the water pump inlet.





1. Remove bolt (3) and remove adjusting link (2) for the alternator from water pump (1).

NOTE: *On some engines, the adjusting link for the alternator is secured by two bolts.*

2. Remove fasteners (7) and remove water pump (1).

NOTE: *If necessary, gently tap the water pump with a soft faced hammer in order to loosen the water pump.*

3. Remove joint (6) from the cylinder head.

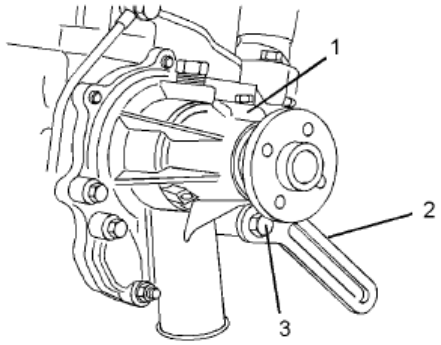
If the water pump has a spacer, remove spacer (5), and remove joint (4).

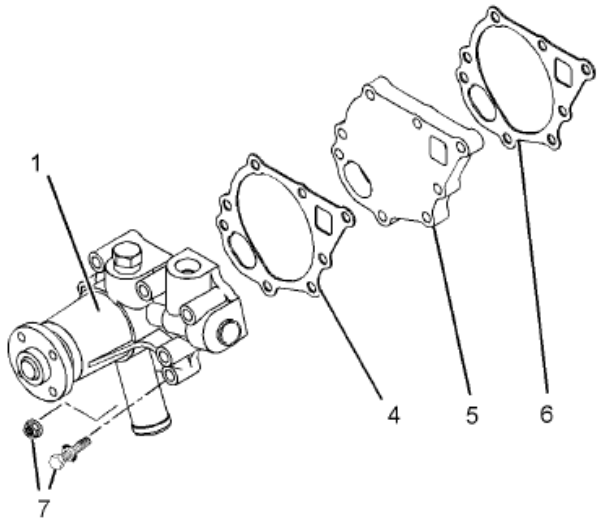
INSTALLATION PROCEDURE

NOTICE

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

1. Ensure that the mating surfaces of the water pump and the cylinder block are clean and free from damage. If the water pump has a spacer, ensure that the mating surfaces of the spacer are clean and free from damage.





1. Install a new joint (6) to the cylinder head.

   If the water pump has a spacer, install spacer (5) and install a new joint (4) to the cylinder head.

2. Place water pump (1) in position and install fasteners (7). Tighten the fasteners finger tight.

3. Position adjusting link (2) for the alternator on the water pump. Install bolt (3) finger tight.

NOTE: *On some engines, the adjusting link for the alternator is secured by two bolts.*

4. If the adjusting link for the alternator is secured by one bolt, tighten fasteners (7) to a torque of 10 N·m (89 lb in).

   If the adjusting link for the alternator is secured by two bolts, tighten fasteners (3) and (7) to a torque of 10 N·m (89 lb in).

5. Connect the hose (not shown) to the water pump inlet and tighten the hose clamp.

6. Fill the cooling system with coolant. Refer to Operation and Maintenance Manual, “Cooling System Coolant - Fill” for the correct procedure.

End By:

a. Install the alternator. Refer to Disassembly and Assembly, “Alternator - Remove and Install”.

b. Install the fan. Refer to Disassembly and Assembly, “Fan - Remove and Install”.

WATER TEMPERATURE REGULATOR - REMOVE AND INSTALL

REMOVAL PROCEDURE

NOTICE

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NOTICE

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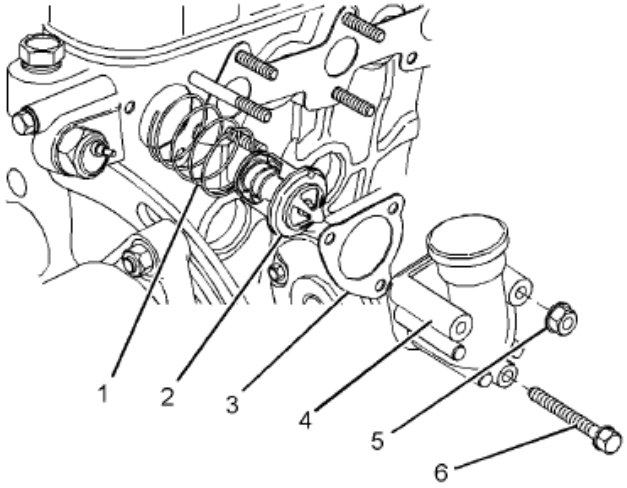
1. Drain the coolant from the cooling system into a suitable container for storage or disposal. Refer to Operation and Maintenance Manual, “Cooling System Coolant - Drain” for more information.



⚠ WARNING

PERSONAL INJURY CAN RESULT FROM PARTS AND/OR COVERS UNDER SPRING PRESSURE. SPRING FORCE WILL BE RELEASED WHEN COVERS ARE REMOVED. BE PREPARED TO HOLD SPRING LOADED COVERS AS THE BOLTS ARE LOOSENED.

2. Remove bolts (6) and nuts (5).

3. Remove outlet connection (4).

4. Remove joint (3).

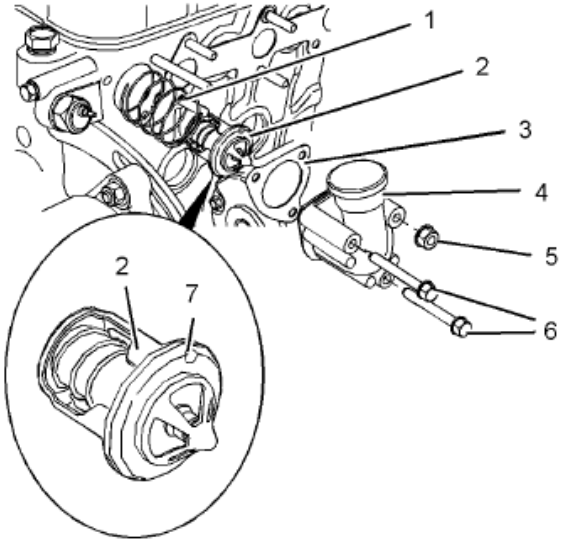
5. Remove water temperature regulator (2) and spring (1).

INSTALLATION PROCEDURE

NOTICE

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

6. Inspect the water temperature regulator for wear, damage and correct operation. Refer to Systems Operation, Testing and Adjusting, “Water Temperature Regulator - Test” for more information. If necessary, replace the water temperature regulator.
7. Ensure that the mating surfaces of the outlet connection and the cylinder head are clean and free from damage.



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8. Install spring (1) and water temperature regulator (2) to the cylinder head. Ensure that jiggle pin (7) on water temperature regulator (2) is in the vertically upward position.
9. Install a new joint (3) to the cylinder head.
10. Position outlet connection (4) onto the cylinder head. Install nut (5) and bolts (6) to outlet connection (4). Tighten the fasteners to a torque of 8 N·m (71 lb in).
11. Fill the cooling system with coolant to the correct level. Refer to Operation and Maintenance Manual, “Cooling System Coolant - Fill” for more information.

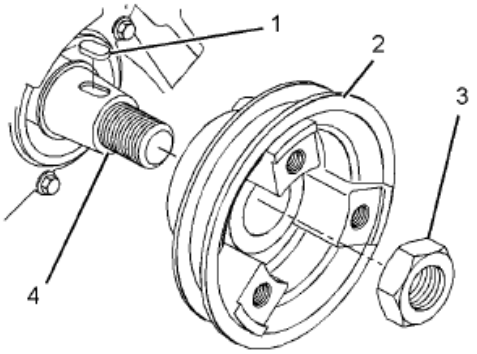
CRANKSHAFT PULLEY - REMOVE AND INSTALL

REMOVAL PROCEDURE

Start By:

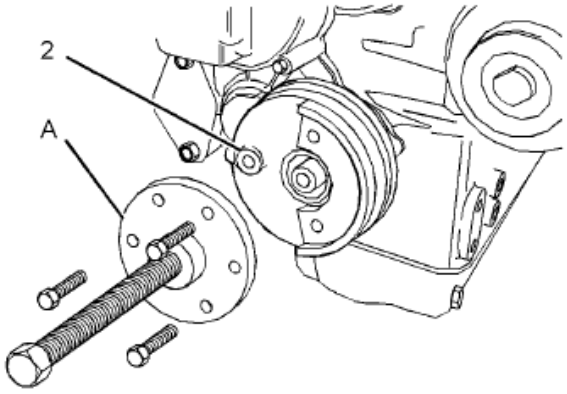
a. Remove the V-belt. Refer to Disassembly and Assembly, “V Belts Remove and Install” for more information.

Required Tools			
Tool	**Part Number**	**Part Description**	**Qty**
A	21825619	Puller	1
	-	Bolt	3



1. Loosen nut (3).

NOTE: *Do not remove the nut at this time.*

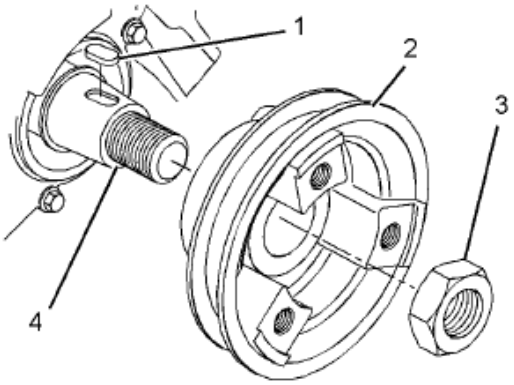


2. Install Tooling (A) to crankshaft pulley (2). Use Tooling (A) in order to remove crankshaft pulley (2) from crankshaft (4). Remove Tooling (A).
3. Remove nut (3).

4. Remove pulley (2) from crankshaft (4).
5. Remove woodruff key (1) from crankshaft (4).

INSTALLATION PROCEDURE

1. Ensure that the following components are clean and free from damage: the taper of the crankshaft, the woodruff key, and the bore of the crankshaft pulley. Replace any components that are damaged. Ensure that the taper of the crankshaft and the bore of the crankshaft pulley are clean and dry before assembly.



2. Install woodruff key (1) to crankshaft (4).
3. Install crankshaft pulley (2) to crankshaft (4).
4. Lubricate nut (3) with clean engine oil and install the nut.

   For 402D-05 and 403D-07 engines, tighten nut (5) to a torque of 93 N·m (69 lb ft).

End By:

a. Install the V-belt to the engine. Refer to Disassembly and Assembly, “V Belts Remove and Install”.

CRANKSHAFT FRONT SEAL - REMOVE AND INSTALL

REMOVAL PROCEDURE

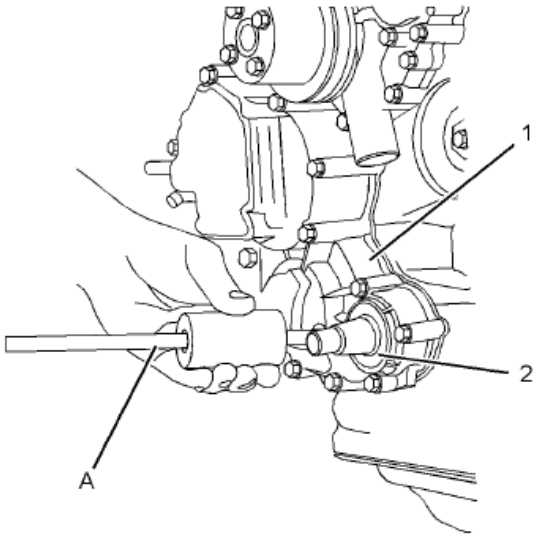
Required Tools			
Tool	**Part Number**	**Part Description**	**Qty**
A	27610311	Slide Hammer Puller	1

Start By:

a. Remove the crankshaft pulley. Refer to Disassembly and Assembly, “Crankshaft Pulley - Remove and Install”.

NOTICE

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



1. Use a 4 mm (0.158 inch) drill in order to make three holes in crankshaft front seal (2).

NOTICE

ENSURE THAT THE MAIN LIP IS USED IN ORDER TO REMOVE THE CRANKSHAFT FRONT SEAL. DO NOT DAMAGE THE EDGE OF THE HOUSING FOR THE CRANKSHAFT FRONT SEAL.

NOTE: *Do not damage the crankshaft during the removal process of the crankshaft front seal.*

2. Use Tooling (A) to carefully remove crankshaft front seal (2). Alternate the position of Tooling (A) from one hole to another hole. This will allow you to evenly remove the crankshaft front seal from front housing (1).

ALTERNATIVE REMOVAL PROCEDURE

Start By:

a. Remove the crankshaft pulley. Refer to Disassembly and Assembly, “Crankshaft Pulley - Remove and Install”.

b. Remove the front housing. Refer to Disassembly and Assembly, “Housing (Front) - Remove”.

NOTICE

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NOTE: *This is an alternative procedure to remove the crankshaft front oil seal. This procedure may be used if the front housing has been removed from the engine.*

1. Use a suitable mandrel and a press in order to remove the oil seal from the front cover. Ensure that the front cover is supported in order to prevent damage to the cover while the oil seal is being removed.

INSTALLATION PROCEDURE

NOTICE

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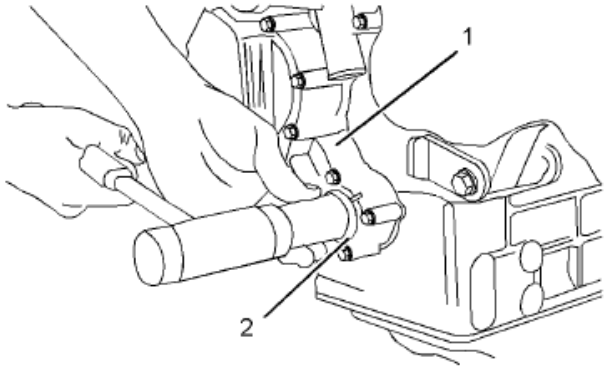

1. Ensure that the bore in front housing (1) and the nose of the crankshaft are clean and free from damage.
2. Lubricate the lip of a new crankshaft front seal (2) with clean engine oil.
3. Position crankshaft front seal (2) in the bore of front housing (1).

NOTICE

ENSURE THAT THE LIP OF THE CRANKSHAFT FRONT SEAL THAT IS SPRING LOADED IS FACING TOWARD THE INSIDE OF THE FRONT HOUSING AND THAT IT IS SQUARE WITH THE BORE OF THE HOUSING FOR THE CRANKSHAFT FRONT SEAL.

4. Use a suitable tool to install crankshaft front seal (2) to front housing (1).

End By:

a. Install the crankshaft pulley. Refer to Disassembly and Assembly, “Crankshaft Pulley - Remove and Install”.

HOUSING (FRONT) - REMOVE

REMOVAL PROCEDURE
Start By:

a. Remove the fuel injection pump. Refer to Disassembly and Assembly, “Fuel Injection Pump - Remove”.

b. Remove the crankshaft pulley. Refer to Disassembly and Assembly, “Crankshaft Pulley - Remove and Install”.

NOTICE

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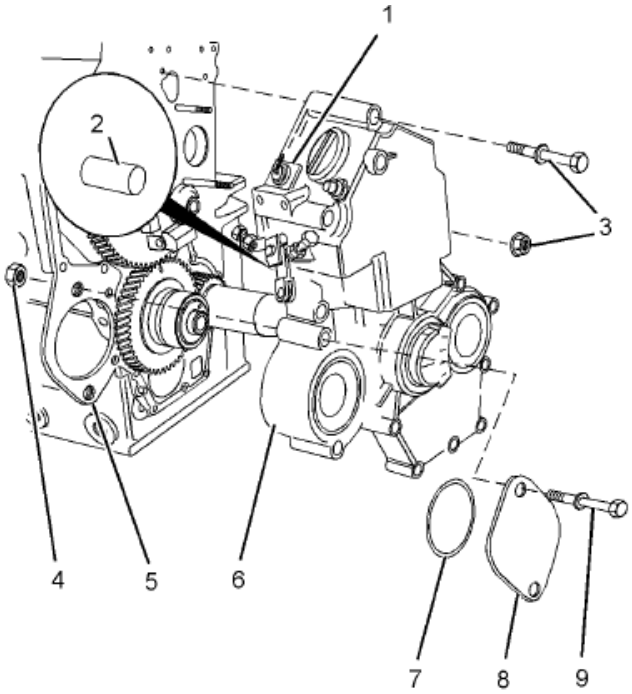

1. If the engine is equipped with a turbocharger, disconnect the hose from connection (1).

2. Remove nuts (4) and bolts (9).

3. Remove cover (8) and O-ring seal (7).

4. Remove fasteners (3). Identify the position of the different fasteners for installation.

5. Carefully remove front housing (6) from plate (5). Ensure that pin (2) remains in the front housing.

NOTE: *The front housing is aligned to the plate and to the cylinder block with dowels.*

6. Remove the joint (not shown).

CRANKCASE BREATHER - REMOVE AND INSTALL (NATURALLY ASPIRATED ENGINES)

REMOVAL PROCEDURE

NOTICE

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NOTICE

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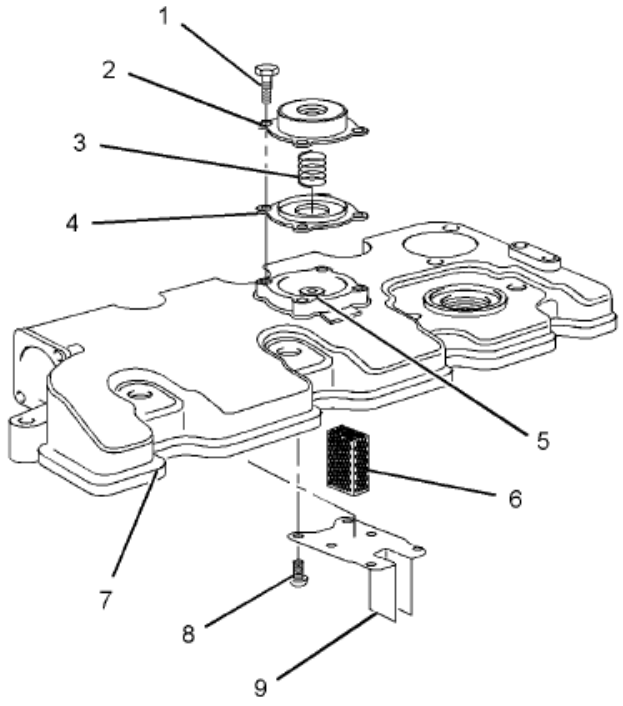
The two cylinder, the three cylinder and the four cylinder engines have different crankcase breathers. The removal procedure is similar for all models.



⚠ WARNING

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1. Remove bolts (1) and remove the assembly of cover (2), spring (3) and diaphragm (4). Note the orientation of cover (2).
2. Remove spring (3) and diaphragm (4) from cover (2).
3. If necessary, follow Steps 3.a through 3.c in order to remove the gauze for the breather.
   a. Remove valve mechanism cover (7). Refer to Disassembly and Assembly, “Valve Mechanism Cover - Remove and Install” for the correct procedure.
   b. Remove screws (8) and carefully remove plate (9).
   c. Remove gauze (6) from valve mechanism cover (7).

INSTALLATION PROCEDURE

Required Tools			
Tool	**Part Number**	**Part Description**	**Qty**
A	27610296	Torque Wrench	1

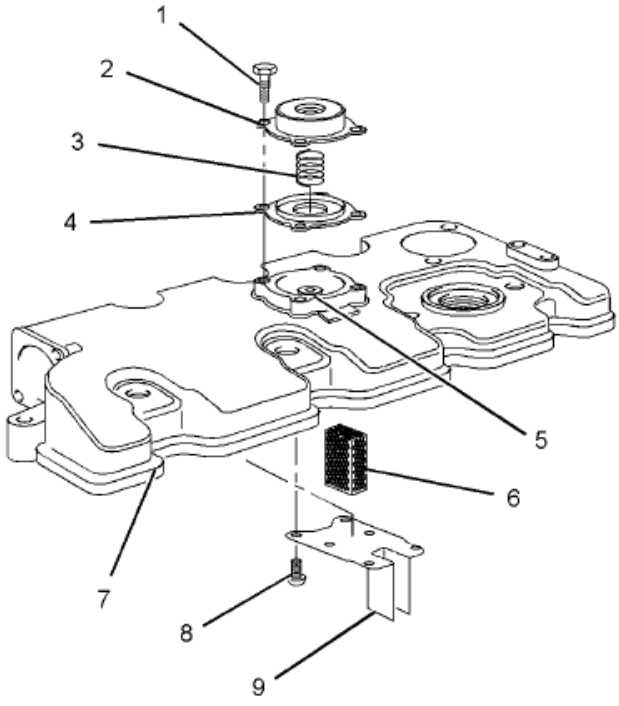
NOTICE

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

NOTICE

MAKE SURE THAT THE COMPONENTS OF THE BREATHER ASSEMBLY ARE INSTALLED CORRECTLY. ENGINE DAMAGE MAY OCCUR IF THE BREATHER ASSEMBLY IS NOT WORKING PROPERLY.

The two cylinder, the three cylinder and the four cylinder engines have different crankcase breathers. The installation procedure is similar for all models.



1. Clean all parts and inspect all parts. Replace any parts that are worn or damaged. Ensure that the cavity for the breather in the valve mechanism cover is clean. Ensure that vent hole (5) and the vent hole in cover (2) are free from restriction.
2. If necessary, follow Steps 2.a through 2.d in order to install the gauze for the breather.
   a. Install gauze (6) to valve mechanism cover (7).
   b. Position plate (9) on valve mechanism cover (7) and install screws (8).
   c. Tighten screws (8) to a torque of 1.5 N·m (13 lb in).
   d. Install valve mechanism cover (7). Refer to Disassembly and Assembly, “Valve Mechanism Cover - Remove and Install” for the correct procedure.

⚠ WARNING

PERSONAL INJURY CAN RESULT FROM BEING STRUCK BY PARTS PROPELLED BY A RELEASED SPRING FORCE. MAKE SURE TO WEAR ALL NECESSARY PROTECTIVE EQUIPMENT. FOLLOW THE RECOMMENDED PROCEDURE AND USE ALL RECOMMENDED TOOLING TO RELEASE THE SPRING FORCE.

3. Install diaphragm (4) and spring (3) to cover (2).
4. Position the assembly of cover (2), spring (3) and diaphragm (4) onto valve mechanism cover (7).

NOTE: *Ensure the correct orientation of the cover.*

5. Install bolts (1). Use Tooling (A) in order to tighten bolts to a torque of 3 N·m (27 lb in).

VALVE MECHANISM COVER - REMOVE AND INSTALL

REMOVAL PROCEDURE

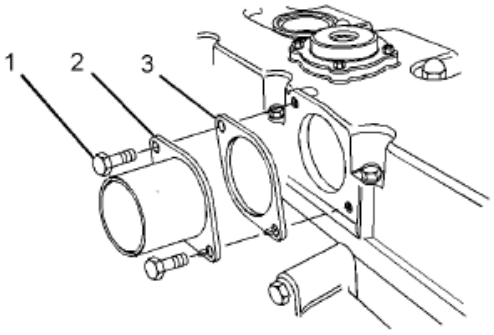
NOTICE

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

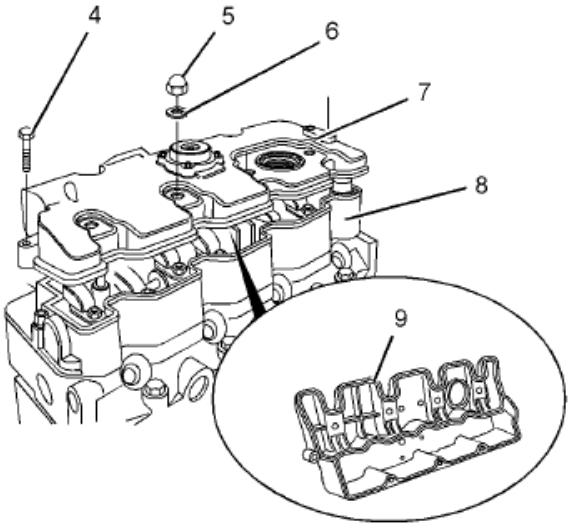
NOTICE

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.

NOTE: *The removal procedure is similar for the two cylinder, the three cylinder and the four cylinder engines. The illustrations show the four cylinder engine.*



1. Loosen the hose clamps and disconnect the hose (not shown) from connection (2).



2. Remove nuts (5) and washers (6) from valve mechanism cover (7).
3. Remove bolts (4) from valve mechanism cover (7).

NOTE: *Loosen the bolts evenly in order to avoid distortion of the valve mechanism cover.*

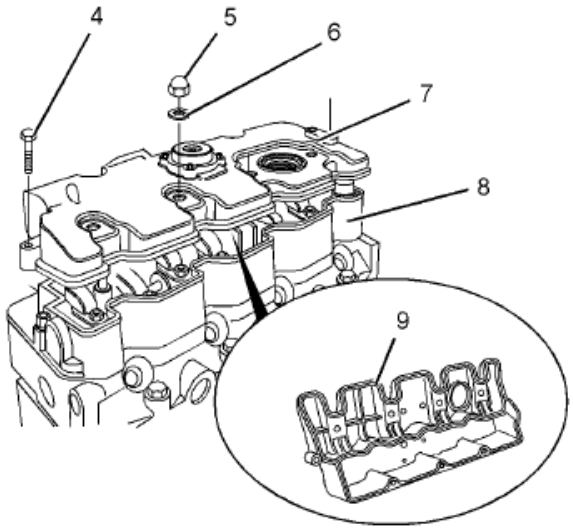
4. Remove valve mechanism cover (7) from base (8). Remove joint (9) from valve mechanism cover (7).
5. If necessary, remove bolts (1) and remove connection (2) from valve mechanism cover (7). Remove gasket (2).
6. If necessary, remove the crankcase breather. Refer to Disassembly and Assembly, “Crankcase Breather - Remove and Install” for more information.

INSTALLATION PROCEDURE

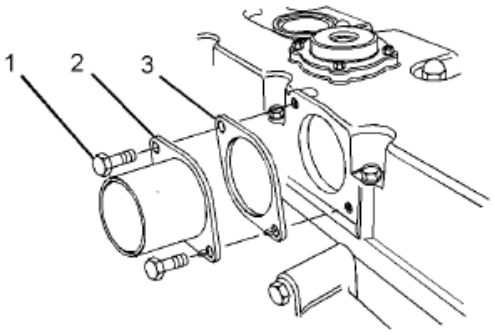
NOTICE

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

NOTE: *The installation procedure is similar for the two cylinder, the three cylinder and the four cylinder engines. The illustrations show the four cylinder engine.*



1. Ensure that the valve mechanism cover is clean and free from damage. Clean the mating surface of base (8).
2. If necessary, install the crankcase breather. Refer to Disassembly and Assembly, “Crankcase Breather - Remove and Install” for more information.
3. Install a new joint (9) to valve mechanism cover (7).
4. Position valve mechanism cover (7) onto housing (8) and install bolts (4) finger tight.
5. Install new washers (6) and nuts (5) finger tight.
6. For 402D-05, 403D-07, 403D-11 and 404D-15 engines, evenly tighten bolts (4) to a torque of 10 N·m (89 lb in). Tighten nuts (5) to a torque of 10 N·m (89 lb in).



7. If necessary, position a new gasket (3) onto valve mechanism cover (7) and install connection (2). Install bolts (1) and tighten to a torque of 14 N·m (124 lb in).
8. Connect the hose (not shown) to connection (2) and tighten the hose clamps.

COOLANT TEMPERATURE SWITCH - REMOVE AND INSTALL

REMOVAL PROCEDURE

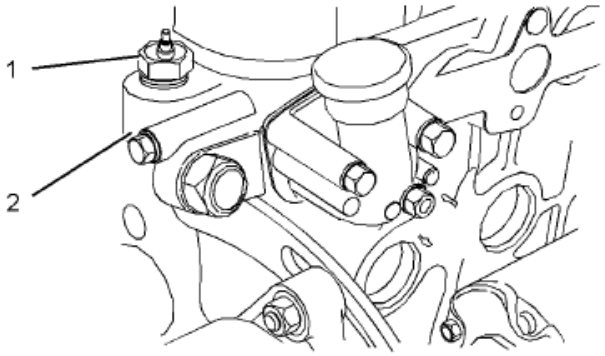
NOTICE

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

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.

1. Drain the coolant from the cooling system into a suitable container for storage or disposal. Refer to Operation and Maintenance Manual, “Cooling System Coolant - Drain” for more information.



2. Disconnect the harness assembly (not shown) from coolant temperature switch (1).
3. Remove coolant temperature switch (1) from water pump (2).

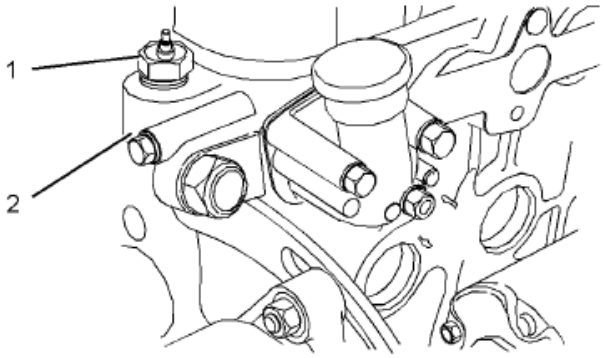
INSTALLATION PROCEDURE

Required Tools			
Tool	**Part Number**	**Part Description**	**Qty**
A	21820122	POWERPART Pipe Sealant	1

NOTICE

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

1. Inspect the coolant temperature switch for damage and correct operation. Refer to Systems Operation, Testing and Adjusting, “Coolant Temperature Switch - Test” for more information. If necessary, replace the coolant temperature switch.



2. Install coolant temperature switch (1) to water pump (2). Use a deep socket to tighten the coolant temperature switch to a torque of 27 N·m (20 lb ft).

NOTE: *If a used coolant temperature switch is installed, apply a thin layer of Tooling (A) to the threads of the coolant temperature switch.*

3. Connect the harness assembly (not shown) to coolant temperature switch (1).
4. Fill the cooling system with coolant to the correct level. Refer to Operation and Maintenance Manual, “Cooling System Coolant - Fill” for more information.

ENGINE OIL PRESSURE SWITCH - REMOVE AND INSTALL

REMOVAL PROCEDURE

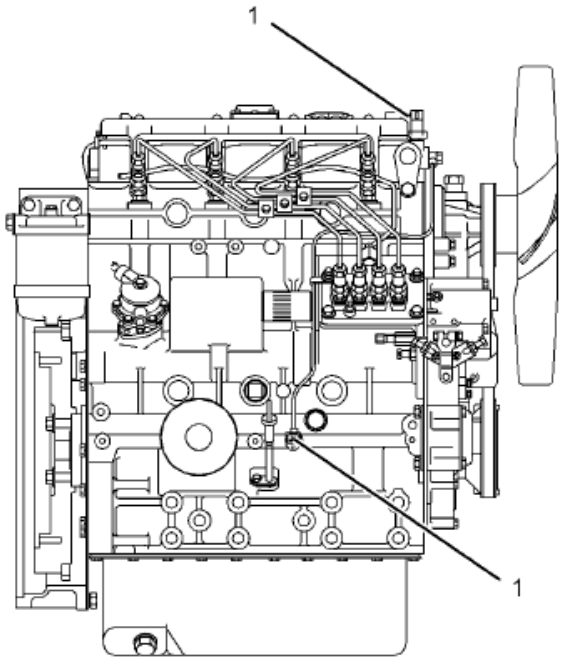
NOTICE

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

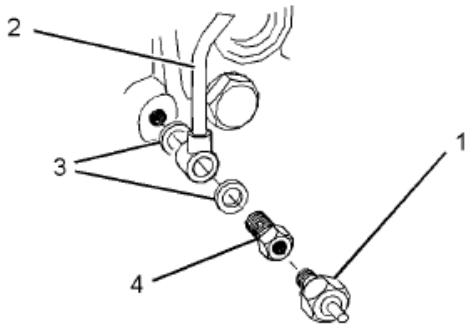
NOTICE

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.

NOTE: *The engine oil pressure switch may be located in the valve mechanism cover or in the cylinder block. Refer to Specifications, "Engine Oil Pressure Switch" for the correct location.*



1. Disconnect the harness assembly (not shown) from engine oil pressure switch (1).
2. If engine oil pressure switch (1) is located in the valve mechanism cover, remove the engine oil pressure switch from the valve mechanism cover.

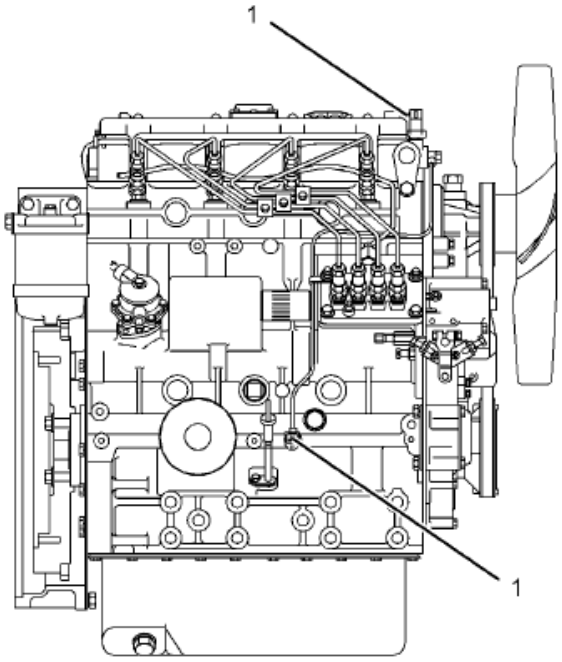


3. If engine oil pressure switch (1) is located in the cylinder block follow Steps 3.a through 3.c in order to remove the engine oil pressure switch.
   a. Remove engine oil pressure switch (1) and adapter (4) as an assembly from oil line (2).
   b. Remove washers (3).
   c. Remove engine oil pressure switch (1) from adapter (4).

INSTALLATION PROCEDURE

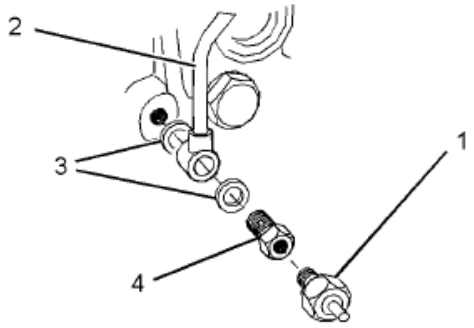
Required Tools			
Tool	**Part Number**	**Part Description**	**Qty**
A	21820122	POWERPART Pipe Sealant	1

NOTE: *The engine oil pressure switch may be located in the valve mechanism cover or in the cylinder block. Refer to Specifications, "Engine Oil Pressure Switch" for the correct location.*



NOTE: *If a used engine oil pressure switch is installed, apply a thin layer of Tooling (A) to the threads of the engine oil pressure switch.*

1. If engine oil pressure switch (1) is located in the valve mechanism cover, install the engine oil pressure switch and tighten to a torque of 11 N·m (97 lb in).



2. If engine oil pressure switch (1) is located in the cylinder block follow Steps 2.a through 2.c in order to install the engine oil pressure switch.
   a. Install engine oil pressure switch (1) to adapter (4). Tighten the engine oil pressure switch to a torque of 23 N·m (17 lb ft).

NOTE: *If a used engine oil pressure switch is installed, apply a thin layer of Tooling (A) to the threads of the engine oil pressure switch.*

   b. Position new washers (3) onto oil line (2) and install the assembly of engine oil pressure switch (1) and adapter (4) to the cylinder block.
   c. Tighten adapter (4) to a torque of 11 N·m (97 lb in).
3. Connect the harness assembly (not shown) to engine oil pressure switch (1).

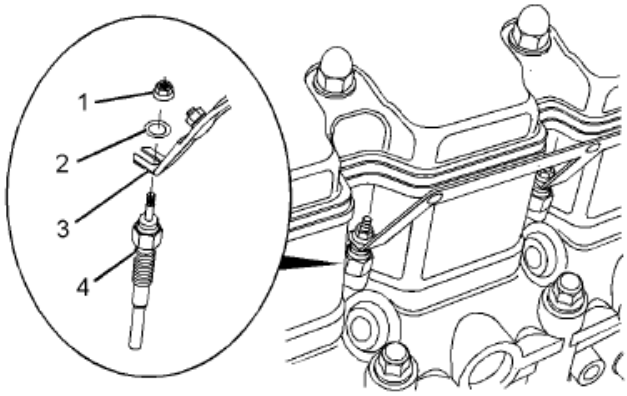
GLOW PLUGS - REMOVE AND INSTALL

REMOVAL PROCEDURE

1. Turn the battery disconnect switch to the OFF position.

NOTICE

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



2. Remove nuts (1) and washers (2) from bus bar (3).
3. Remove bus bar (3) from glow plugs (4).
4. Remove glow plugs (4) from the cylinder head.

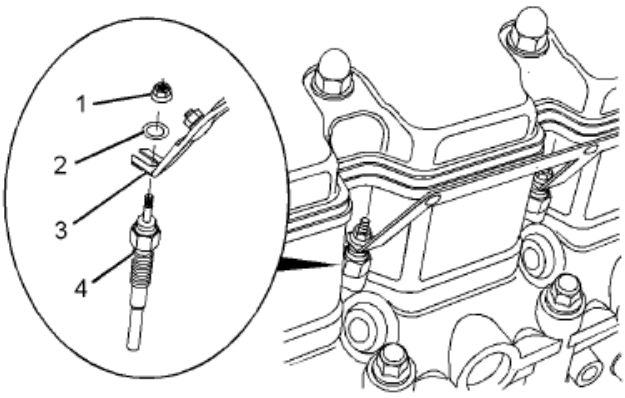
INSTALLATION PROCEDURE

Required Tools			
Tool	Part Number	Part Description	Qty
A	27610296	Torque Wrench	1

NOTICE

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

1. Ensure that the threads of the glow plugs are clean and free from damage. Replace any damaged glow plugs.



2. Install glow plugs (4) into the cylinder head.

   For 402D-05,403D-07,403D-11 and 404D-15 engines, tighten the glow plugs to a torque of 12 N·m (106 lb in).

3. Position bus bar (3) onto glow plugs (4).
4. Install washers (2) and nuts (1) to glow plugs (4). Use Tooling (A) to tighten the nuts to a torque of 1.2 N·m (10.6 lb in).
5. Turn the battery disconnect switch to the ON position.

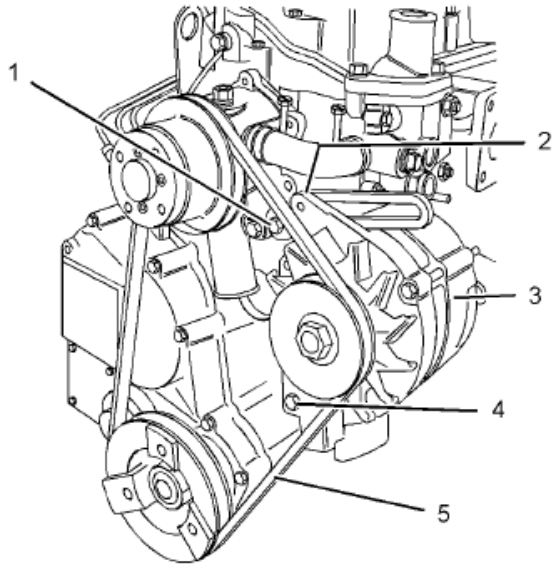
V-BELTS - REMOVE AND INSTALL

REMOVAL PROCEDURE

NOTICE

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

1. If the engine is equipped with fan guards, remove the fan guards.



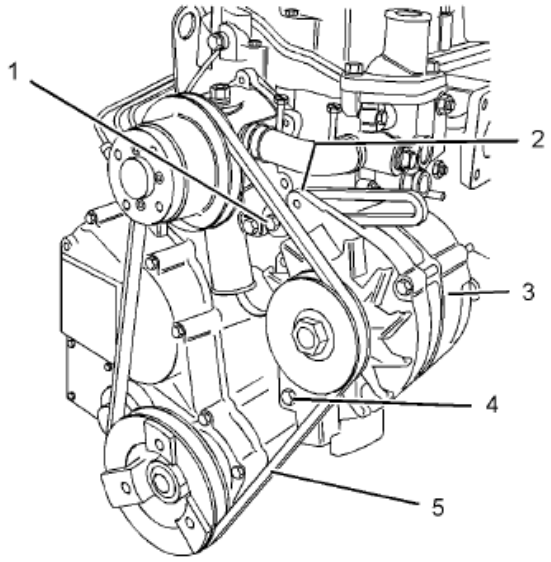
2. Loosen bolts (1), (2) and (4).
3. Push alternator (3) toward the engine and remove V-belt (5).

NOTE: *Mark the direction of rotation if the V-belt will be reused.*

INSTALLATION PROCEDURE

NOTICE

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



1. Check the condition of the V-belt. If the V-belt is worn or damaged, use a new V-belt for replacement.
2. Install V-belt (5) in position on the engine.

NOTE: *A used V-belt should be installed in the original direction of rotation.*

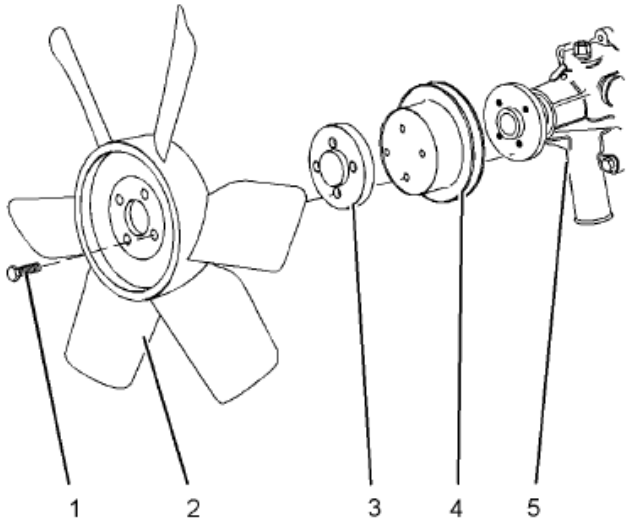
3. Slide alternator (3) away from the engine. Refer to Systems Operation, Testing and Adjusting, “Belt Tension Chart” for information on the correct belt tension. Tighten bolts (1), (2) and (4) to a torque of 25 N·m (18 lb ft).
4. If the engine is equipped with fan guards, install the fan guards.

FAN - REMOVE AND INSTALL

REMOVAL PROCEDURE

Start By:

a. Remove the V-Belt. Refer to Disassembly and Assembly, “V-Belts - Remove and Install”.



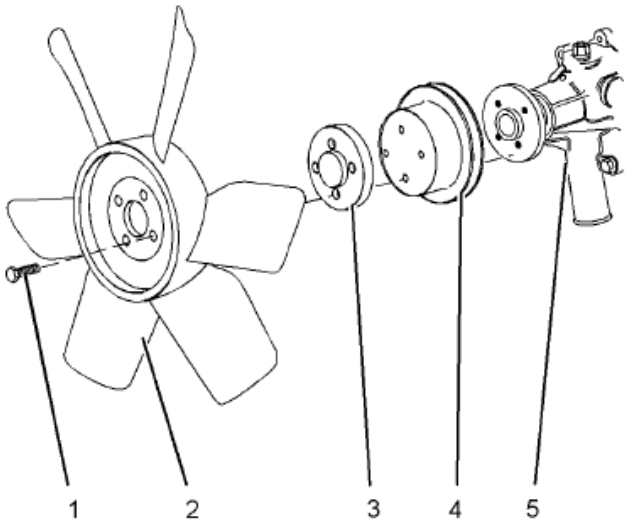
1. Remove bolts (1) and remove fan (2).

NOTE: *Mark the orientation of the fan for installation.*

2. Remove spacer (3) and pulley (4) from water pump (5).

INSTALLATION PROCEDURE

1. Ensure that all components are clean and free from damage. Replace any components that are worn or damaged.



2. Position pulley (4) and spacer (3) on water pump (5). Ensure that the bolt holes are aligned.
3. Install fan (2).

NOTE: *Ensure the correct orientation of the fan.*

4. Install bolts (1) and tighten to a torque of 11 N·m (97 lb in).

End By:

a. Install the V-Belt. Refer to Disassembly and Assembly, “V-Belts - Remove and Install”.

ALTERNATOR - REMOVE AND INSTALL (14 AMP AND 15 AMP ALTERNATORS)

REMOVAL PROCEDURE

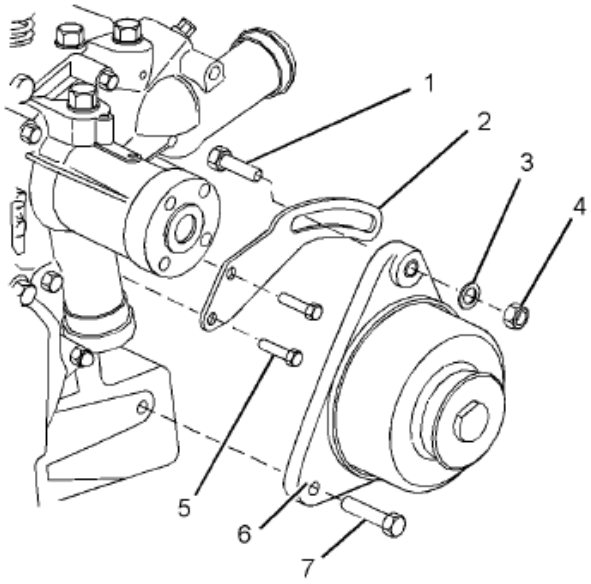
Start By:

a. Remove the V-Belt. Refer to Disassembly and Assembly, “V-Belts - Remove and Install”.

NOTICE

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

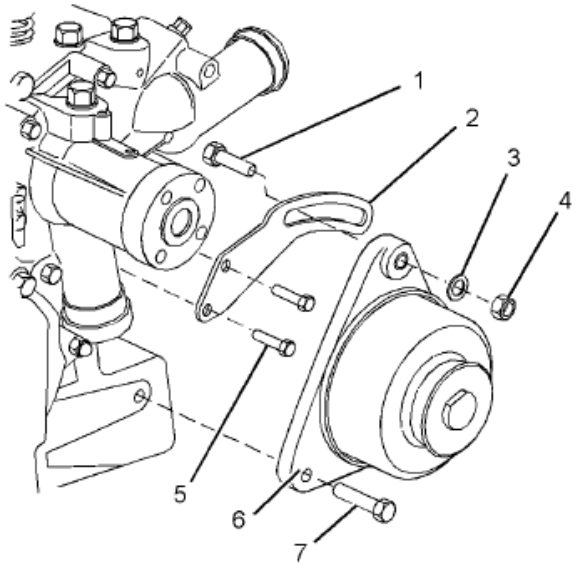
1. Turn the battery disconnect switch to the OFF position.
2. Make temporary identification marks on the connections of the harness assembly.



3. Disconnect the harness assembly (not shown) from alternator (6).
4. Remove bolt (1), washer (3) and nut (4) from alternator (6).
5. Remove bolt (7) and remove alternator (6) from the engine.
6. If necessary, remove bolts (5) and remove adjusting link (2).

NOTE: *The adjusting link on some engines is secured by one bolt.*

INSTALLATION PROCEDURE



1. If necessary, install adjusting link (2) and install bolts (5) finger tight.

NOTE: *The adjusting link on some engines is secured by one bolt.*

2. For engines that have an adjusting link that is secured by one bolt, leave bolt (5) loose.

   For engines that have an adjusting link that is secured by two bolts, tighten bolts (5) to a torque of 10 N·m (89 lb in).

3. Position alternator (6) on the engine and install bolt (7) finger tight.
4. Install bolt (1), washer (3) and nut (4) finger tight.
5. Install the V-Belt. Refer to Disassembly and Assembly, “V-Belts - Remove and Install”.

NOTE: *Ensure that the alternator pulley is in alignment with the crankshaft pulley. Ensure that all fasteners are tightened.*

6. Connect the harness assembly (not shown) to the alternator.
7. Turn the battery disconnect switch to the ON position.

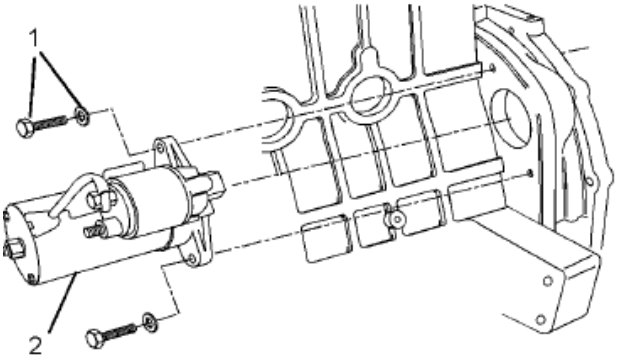
ELECTRIC STARTING MOTOR - REMOVE AND INSTALL

REMOVAL PROCEDURE

⚠ WARNING

ACCIDENTAL ENGINE STARTING CAN CAUSE INJURY OR DEATH TO PERSONNEL WORKING ON THE EQUIPMENT. TO AVOID ACCIDENTAL ENGINE STARTING, DISCONNECT THE BATTERY CABLE FROM THE NEGATIVE (–) BATTERY TERMINAL. COMPLETELY TAPE ALL METAL SURFACES OF THE DISCONNECTED BATTERY CABLE END IN ORDER TO PREVENT CONTACT WITH OTHER METAL SURFACES WHICH COULD ACTIVATE THE ENGINE ELECTRICAL SYSTEM. PLACE A DO NOT OPERATE TAG AT THE START/STOP SWITCH LOCATION TO INFORM PERSONNEL THAT THE EQUIPMENT IS BEING WORKED ON.

1. Disconnect the battery.
2. Make temporary identification marks on the harness assemblies that are connected to the electric starting motor.

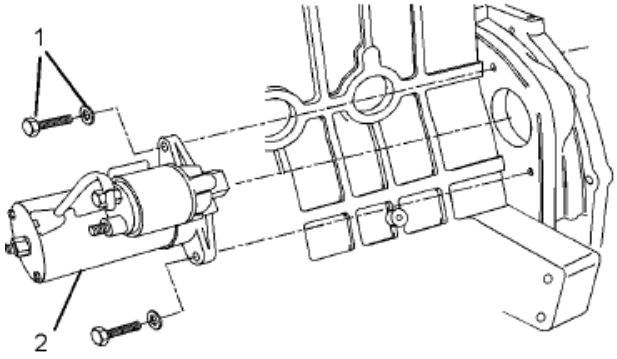


3. Disconnect the harness assemblies (not shown) from electric starting motor (2).
4. Remove fasteners (1) that secure electric starting motor (2).

NOTE: *Support the weight of the electric starting motor as the fasteners are removed.*

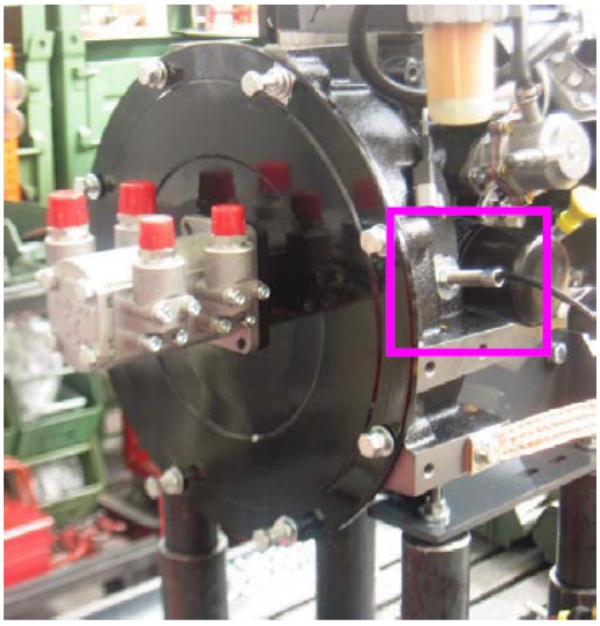
5. Remove electric starting motor (2) from the engine.

INSTALLATION PROCEDURE



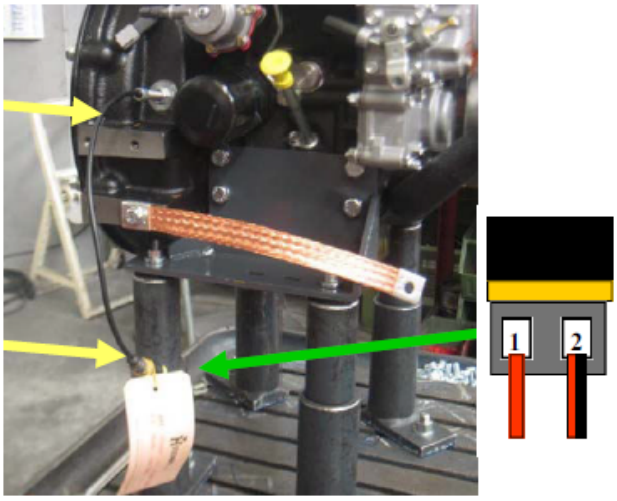
1. Install electric starting motor (2) in position on the engine.
2. Install fasteners (1) and tighten to a torque of 50 N·m (37 lb ft).
3. Connect the harness assemblies (not shown) to electric starting motor (2).
4. Connect the battery.

PERKINS RPM CONTROL SYSTEM



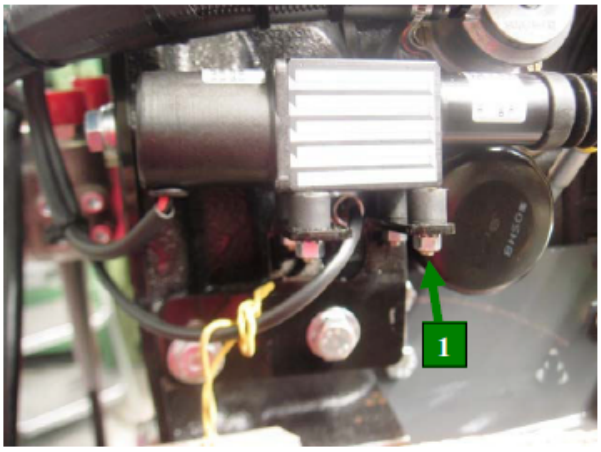
Mount the proximity cod.26514900 sure that inside see the hole on the reduction of the tooth crown, screw until you come into abutment with the sensor, make a mark and unscrew for a ride, then pull the nut to secure it.

Take the wire and cut proximity 350mm, thread a a sheath L = 300 and mount connector 2-way super seel female leads of the connector (1) red and black wire on the (2).



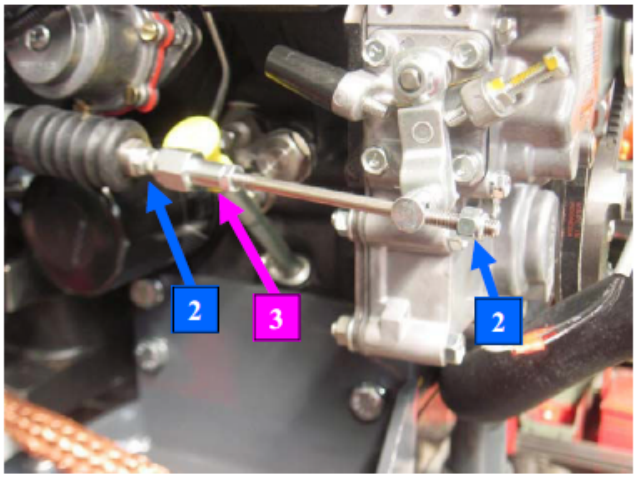
Take No. 1 throttle servo cod.26551500, No. 1 piston mounting bracket Electrical cod.06551300, n° 1 articulation, No. 4 vibration ø12, 5 H = 10 cod.06551400, n° 1 threaded rod accelerator cod.06471400, No. 1 stud for accelerator cod.06471500 and n ° 2 screws 5/16 X 3/4.

1. Slightly flared the 4 threaded holes of the servo command, cut one side of the fillets of vibration to about 5-6MM.



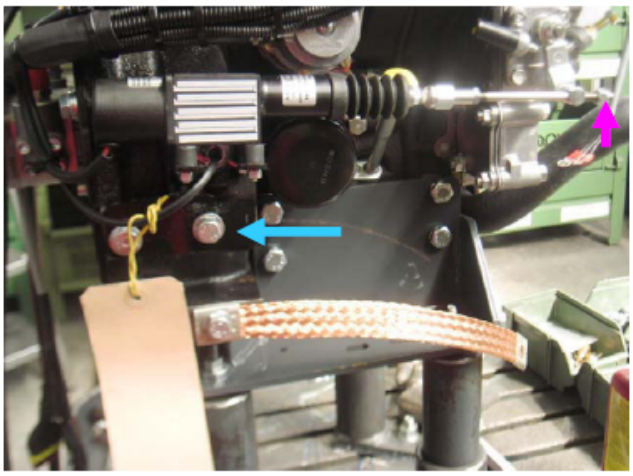
2. Put a little 'of fat on the joint where she works and a M6 nut low.

3. Mount it on the servo control and tighten until bottom.

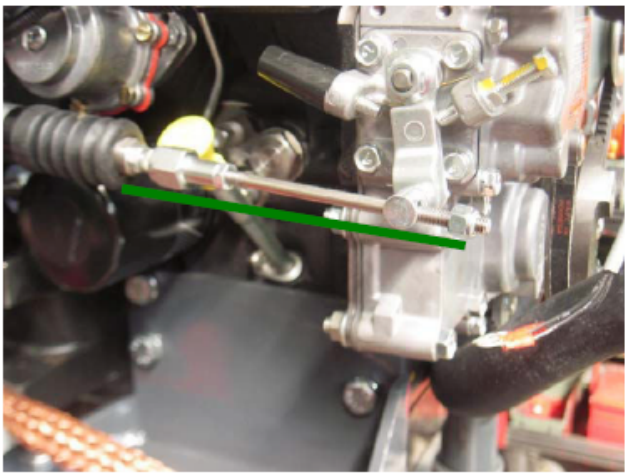


4. Cut to 10mm bolt for the throttle, tighten and tighten down with nut M6.

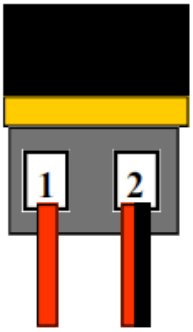
5. Orientate the bracket with 2 screws + washer 5/16X3/4 flat. Removing one at a time to put the thread lock and pull.



6. Mount the actuator and record it in line, check the operation with the help of a battery.

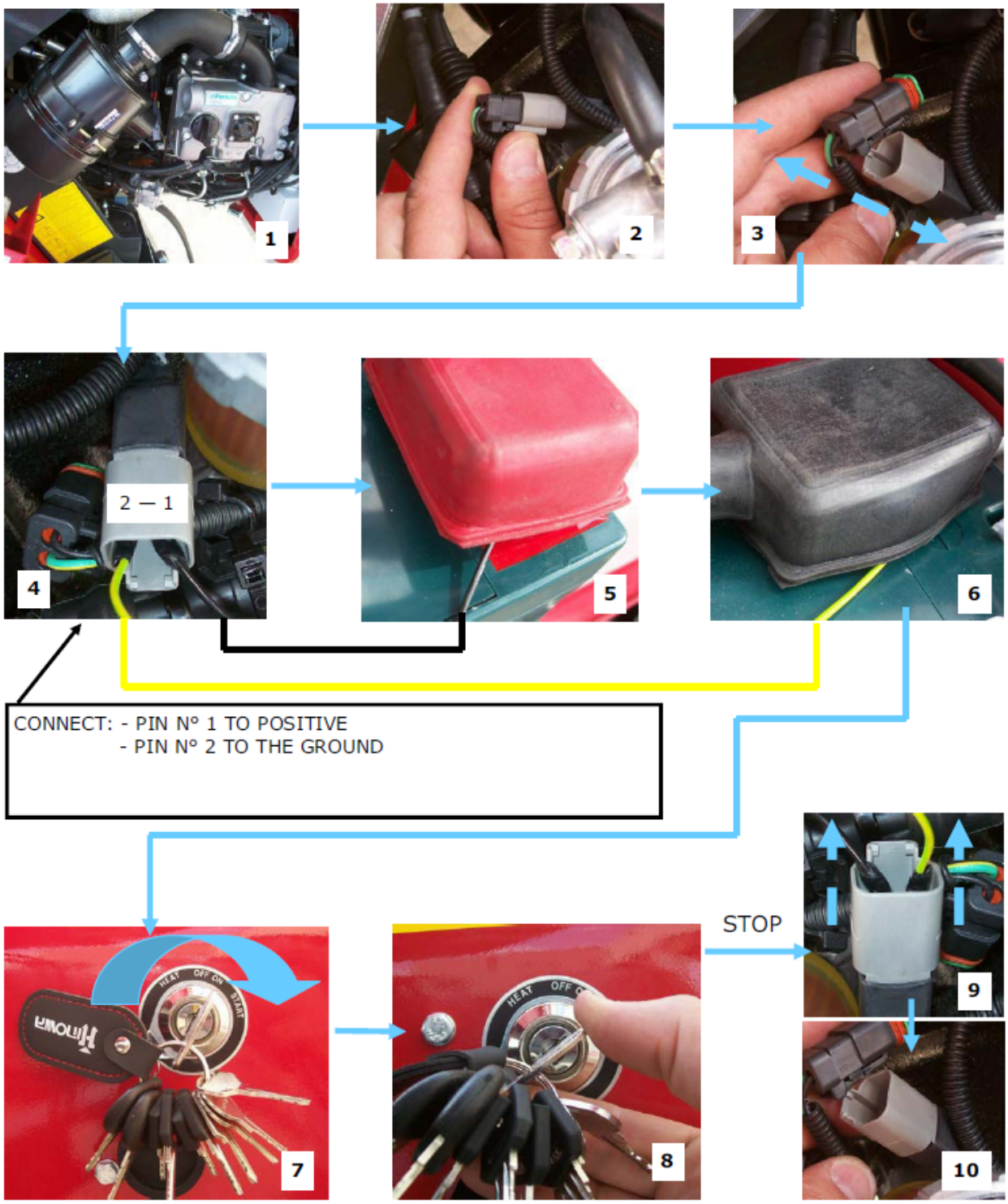


7. Wires 2 on the actuator to a sheath L = 250 and a connector with 2-way super-seel door males. The red wire on connector (2) and black wire on connector (1).



QUICK TROUBLESHOOTING

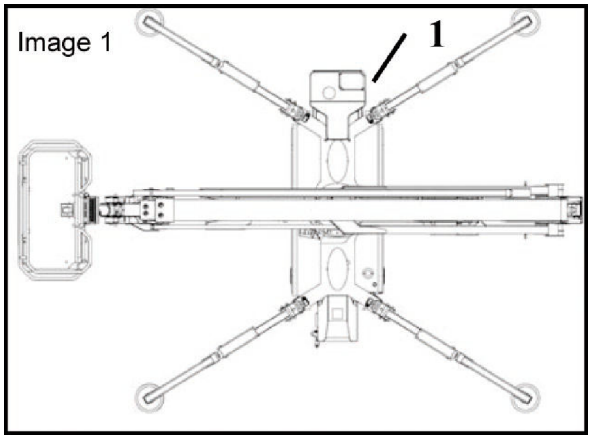
PERKINS 402.05



3.13 ENGINE REMOVAL

1. Stabilize and turn the machine on level surface at 90° (image 1).
2. Remove the key ignition, and a tag with warning do not start the machine.
3. Remove the cover 1.

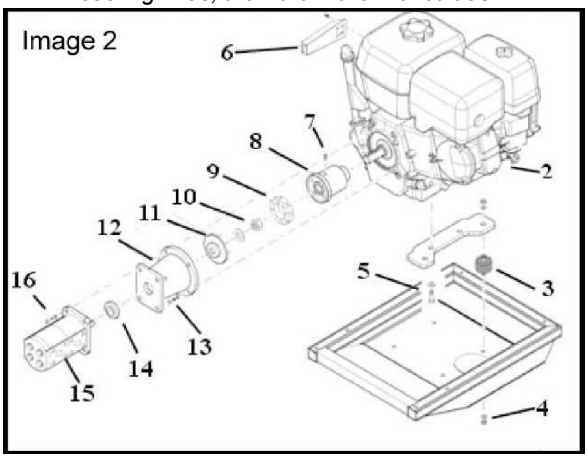
Image 1



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

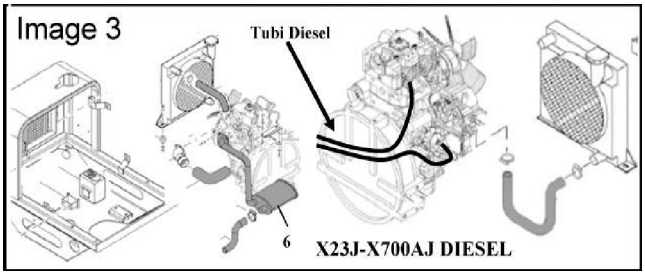
NOTE: *On X23J-X700AJ diesel disconnect the oil pipes and cooling lines, than drain the 2 circuities.*

Image 2



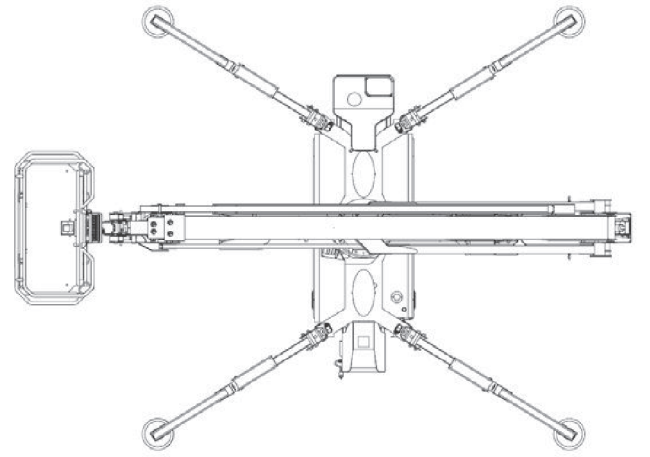
5. Unscrew the screws (13-5 image 2).
6. Remove the engine (Kg 70), remove the joint (8-9 Image 2) .
7. Remove the muffler (6 Image 2).
8. Replace the engine and tighten the screws (13-5 Image 2) respectively with the copies of tightening of 22Nm and 25Nm.
9. Connect the wires to the motor.
10. Replace guard on motor (1) and test the machine.

Image 3



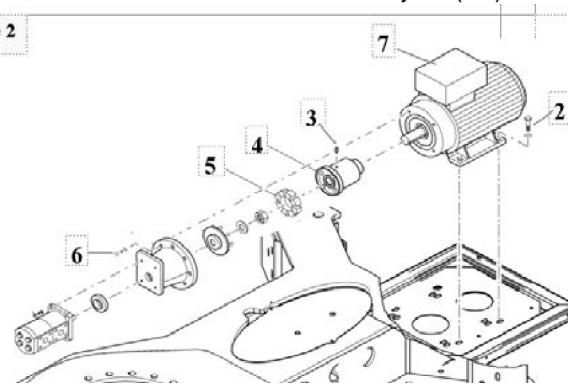
3.14 CHANGING THE ELECTRIC MOTOR

1. Stabilize and turn the machine on level ground at 90° (image 1).
2. Before beginning the maintenance check that the machine is disconnected from the mains and unplug the ignition key.
3. Remove casing (1).



4. Open cover engine wiring Electrical (7) mark the position of the wires then disconnect and isolate it.
5. Unscrew the screws (2-6).
6. Remove the electrical motor and the joint (4-5).

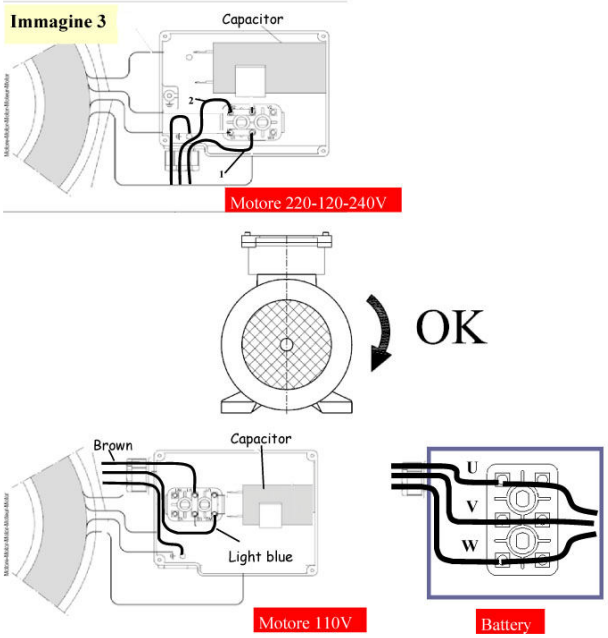
Immagine 2



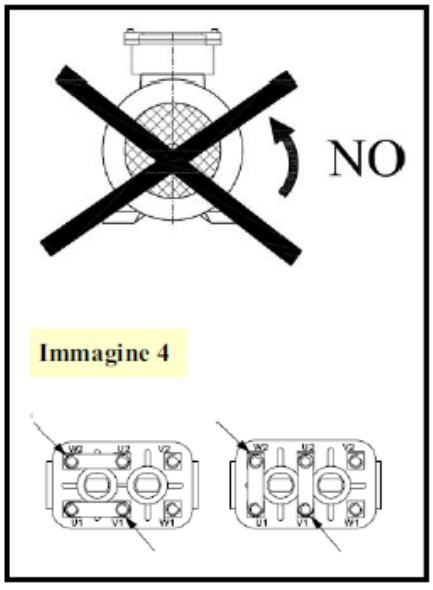
7. Install the electrical motor (40 kg), and connect the wires as shown in (image 3), screw the cover (7).
8. Tighten the screws (2-6), respectively, with copies of torque of 40Nm and 22Nm.

NOTE: *on lithium version to turn on the key.*

Immagine 3



9. Inspect from the fan side, the direction of the electrical motor. If the electrical motor turning in CCW change the position of the connectors as on (image 4).



10. Install cover (1) and test the machine.

NOTES:

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.*

   - **a.** 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.

1. 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.

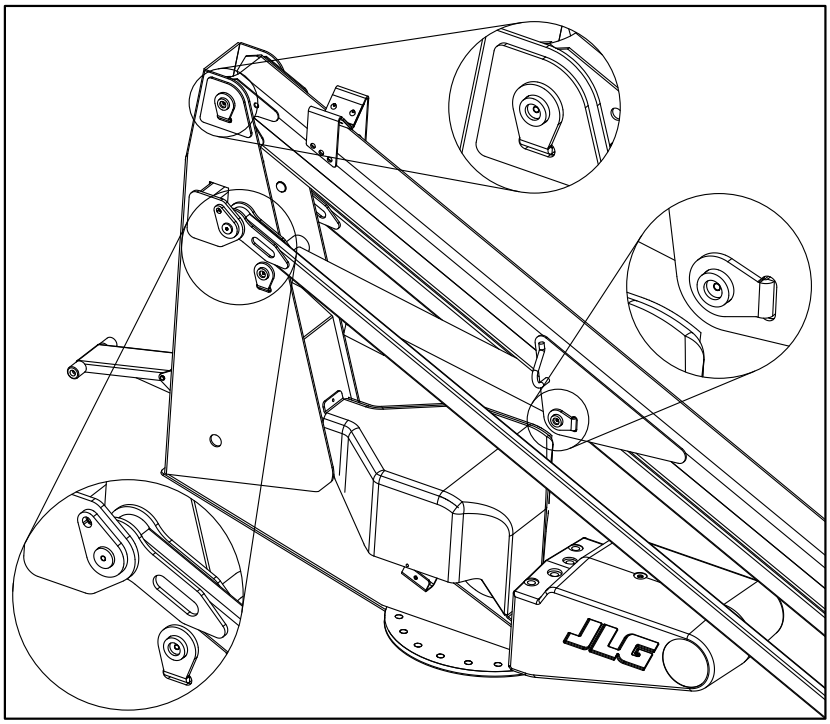


Figure 4-1.

a. **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.

b. **f.** Remove hardware securing the lower boom pivot pin. Using a suitable brass drift and hammer, remove pin from the turntable.

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

Disassembly of the Main Boom

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

NOTICE

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

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

Inspection

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

Assembly of the Main Boom

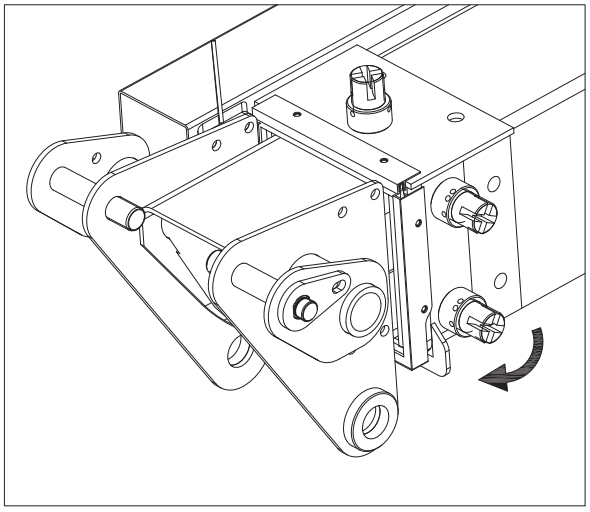
1. Install power track to the attach point on the base boom section. Secure power track with the attaching hardware.
2. Install hydraulic lines and electrical cables into the power track.
3. Install wear pads to the aft end of the fly section.
4. Using suitable lifting equipment, slide fly section into the base section until power track attach point aligns with holes in side of base section.
5. Attach the power track to the aft end of fly boom section. Secure power track with the attaching hardware.

6. Using suitable lifting equipment, slide fly boom section out to gain access to telescope cylinder attach pin hole.
7. Measure the distance between the telescope cylinder port block attach point on base boom section and the attach point on fly boom section.
8. Connect a suitable auxiliary hydraulic power source to the telescope cylinder port block.
9. Extend the telescope cylinder the distance of the two attach points.
10. Secure the sling and lifting device at the telescope cylinder's approximate center of gravity, and lift the cylinder to the aft end of the boom assembly.

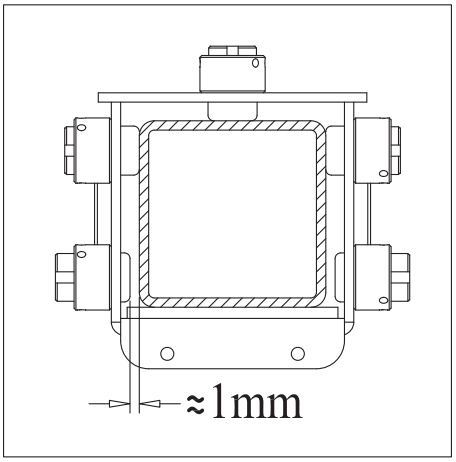
NOTICE

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

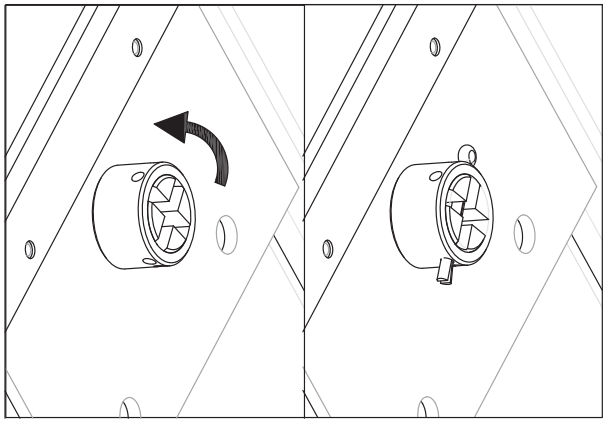
11. Slowly slide the telescope cylinder into boom assembly, align rod end with attach point in fly section. Insert pin and secure with retaining ring.
12. Slowly slide the telescope cylinder into boom assembly, align barrel end with attach point in fly section. Insert pin and secure with retaining ring.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



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



15. Turn the wear pad to dispose 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.

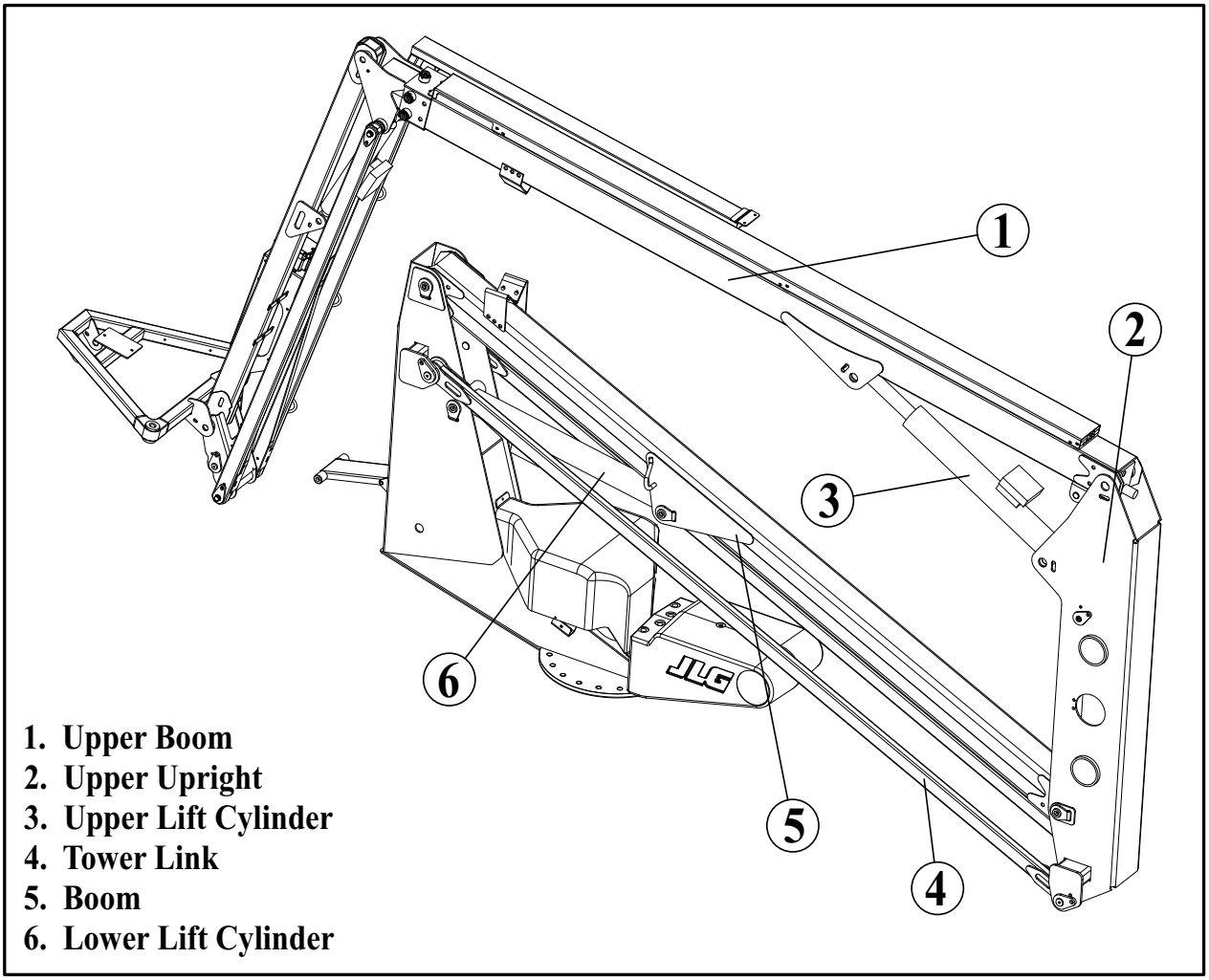

1
2
3
4
5
6
1. Upper Boom
2. Upper Upright
3. Upper Lift Cylinder
4. Tower Link
5. Boom
6. Lower Lift Cylinder

Figure 4-2.

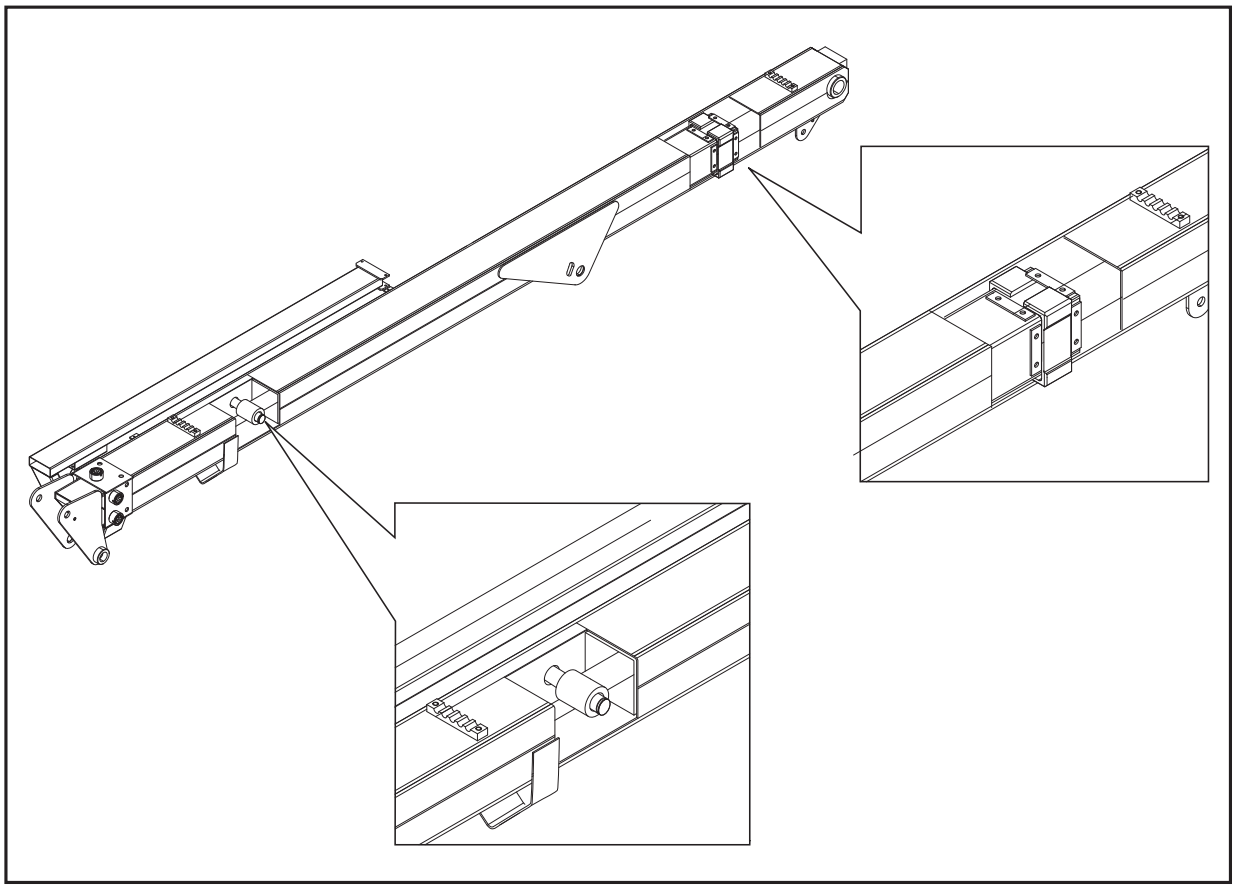


Figure 4-3.

4.2 BOOM DISASSEMBLY X23J - X700AJ

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.

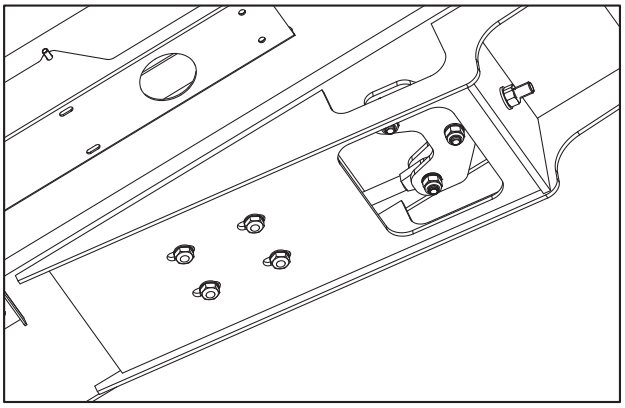


Figure 4-4.

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.

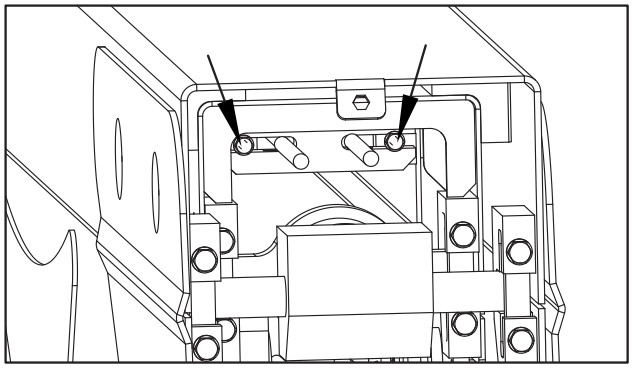


Figure 4-5.

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

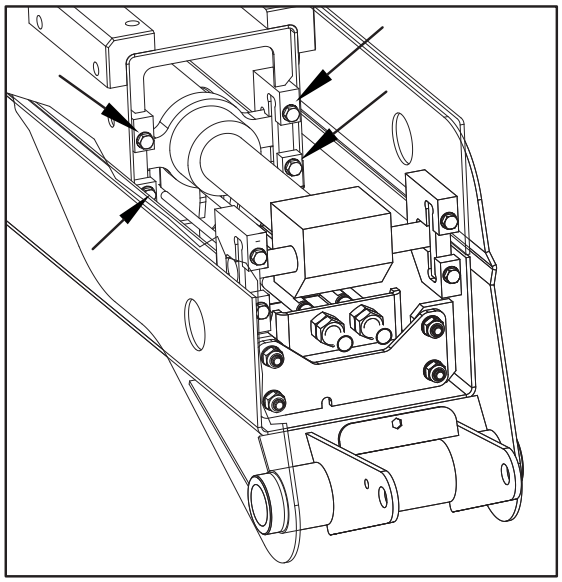


Figure 4-6.

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

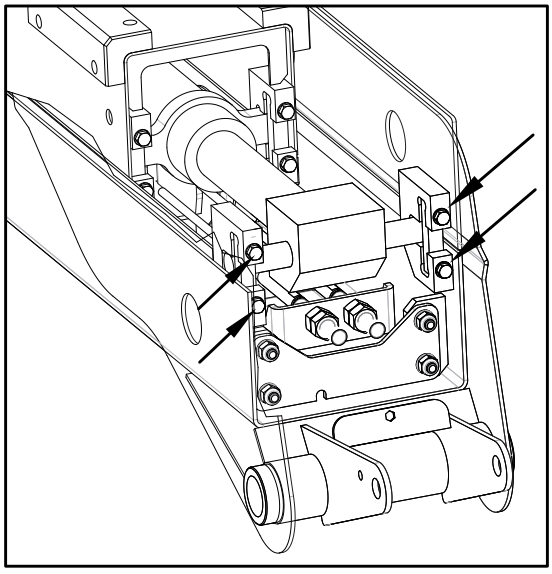


Figure 4-7.

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).*

7. 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.

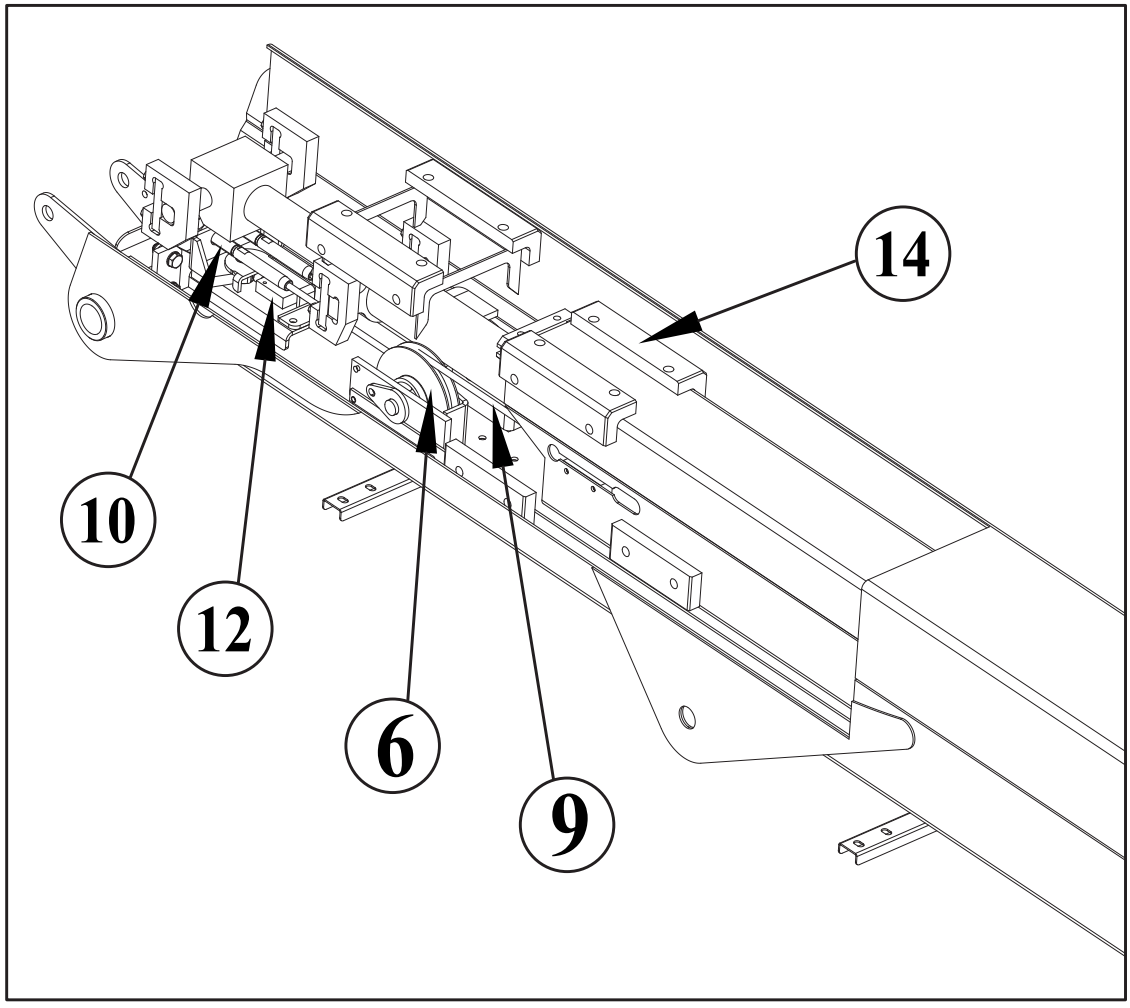


Figure 4-8.

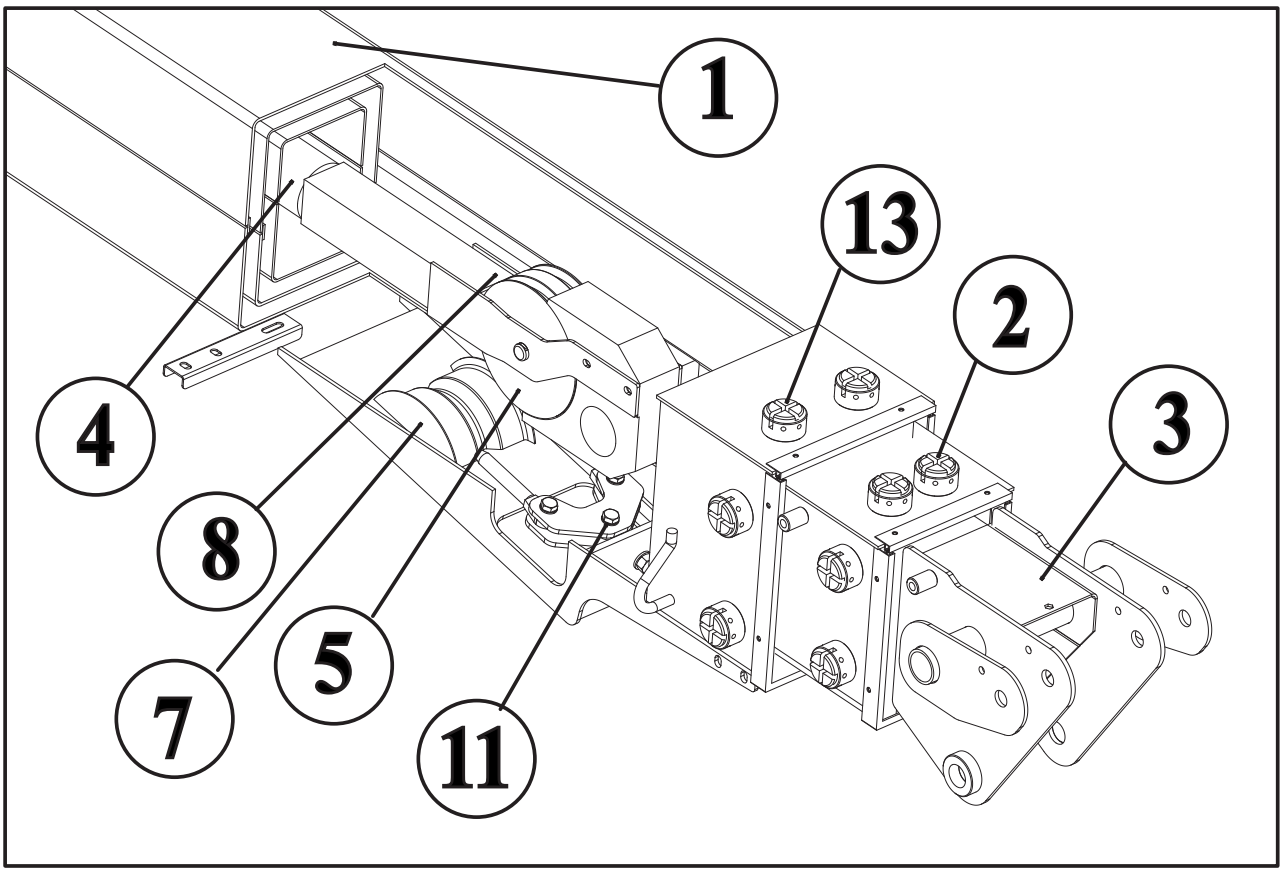


Figure 4-9.

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

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.

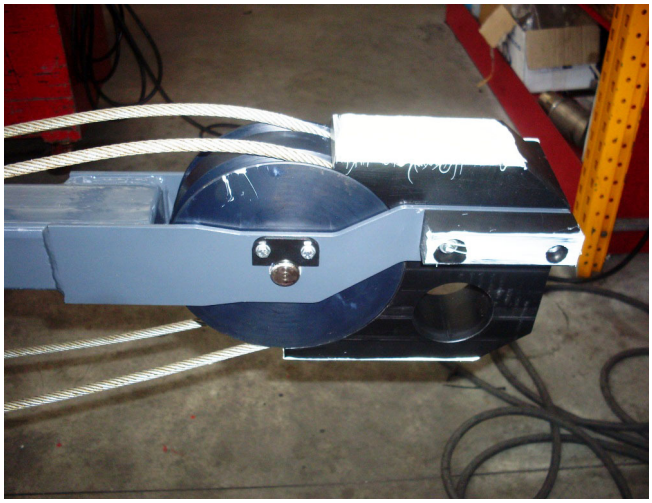


Figure 4-10.

1. 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.
2. 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.
3. 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.
4. 12. Remove hardware which secures the sheave guards and sheave assemblies to mid boom section, remove sheave assemblies from mid boom section.
5. 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.
6. 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.
7. 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.
8. 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.

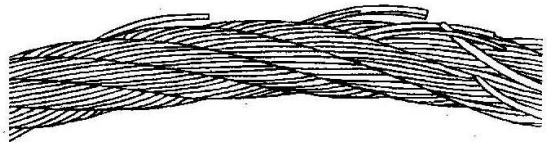


Figure 4-12.

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.

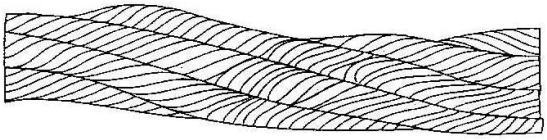


Figure 4-13.

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.

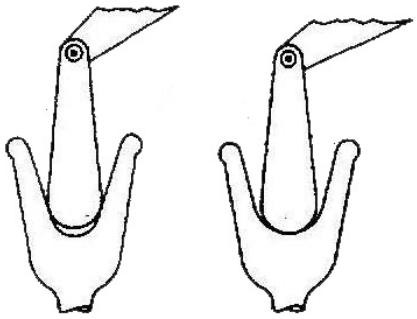


Figure 4-14.

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. Slide 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 (0.50) 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.

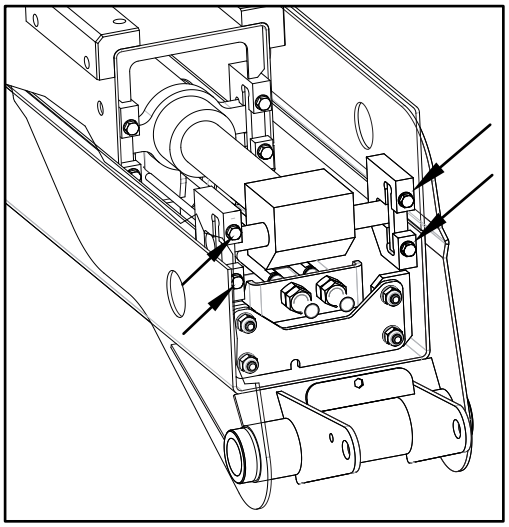


Figure 4-16.

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

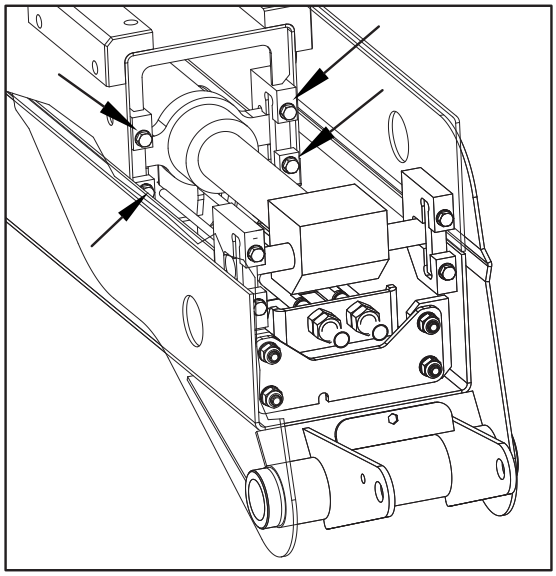


Figure 4-17.

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 pre-

vent it from coming out of the socket before it engages the mounting threads.

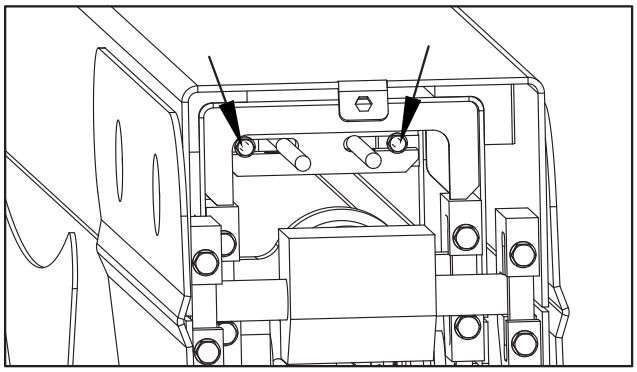


Figure 4-18.

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

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.

4.4 WIRE ROPE AND PULLEYS

⚠ CAUTION

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

Each day before using machine:

1. **Raise boom approximately horizontal.**
2. **Extend and retract all boom sections.**
3. **Check for delayed movement in any section which indicates loose wire ropes.**

⚠ WARNING

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

Inspection

NOTE: The pictures in this section are samples to show the replacement criteria of the rope.

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

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

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

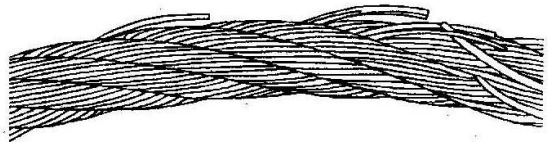


Figure 4-19.

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

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

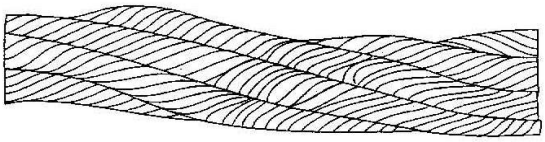


Figure 4-20.

4. **Inspect sheaves for condition of bearing/pins.**
5. **Inspect sheaves for condition of flanges.**
6. **Inspect sheaves with a groove wearout gauge for excessive wear.**

NOTE: Check groove so it may be clearly seen if the contour of the gauge matches the contour of the bottom of the groove.

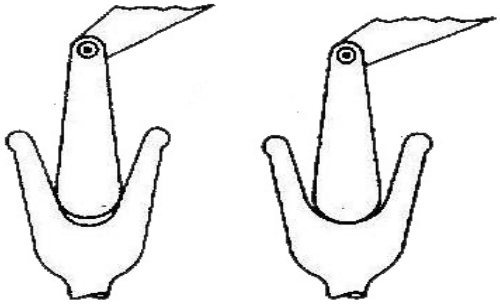


Figure 4-21.

7. **Wire ropes passing inspection should be lubricated with wire rope lubricant prior to assembly.**

Three Month Inspection

1. **Remove all protection sumps from the third arm and the two extensions. Use a flashlight to visually check the state of the ropes and the extension pulleys.**
2. **Check the correct rope tension, trying to bend them manually. If they are pulled correctly they should not be able to move more than a few millimeters.**
3. **Check that in the extension arms exit phase the return ropes are sufficiently in traction in a way not to allow relative contact with the third arm.**
4. **Vice versa in the extension return phase, check that the outlet ropes are subject to a tension that allows them not to come into contact with the second extension or the cylinder.**
5. **Use a torque wrench to check the correct torque of all rope fixing nuts and the respective rocker arms; recommended torque 7.4 ft-lbs (10 Nm).**

NOTE: If the tension of the ropes is not adequate, use the Ropes Tension Adjustment Procedure.

Seven Year or 3000 Hours Replacement

After seven years or 3000 hours of work, whichever comes first, all wire ropes, cables, and sheaves must be replaced completely.

4.5 ROPES TENSION ADJUSTMENT PROCEDURE

NOTE: *Do not clamp on threads.*

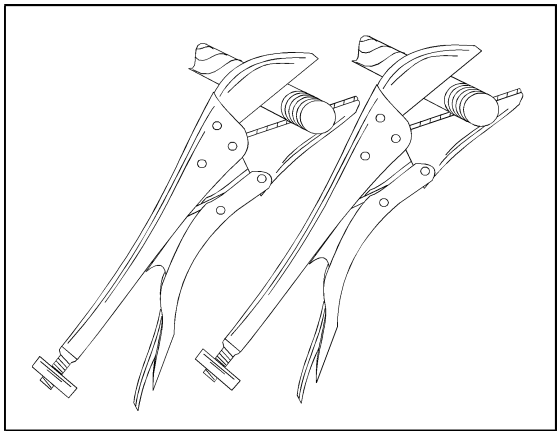


Figure 4-22. Clamping Wire Ropes

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. (2 nuts with relative counter-nut for outlet ropes and one nut with relative counter-nut for return 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.

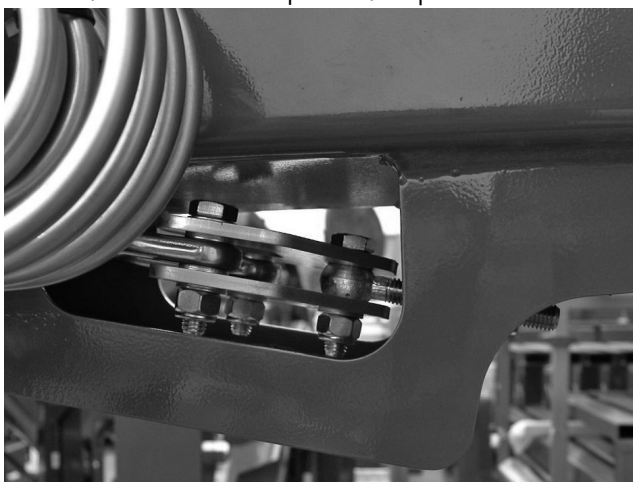


Figure 4-23. Return ropes fixing rocker arm

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.

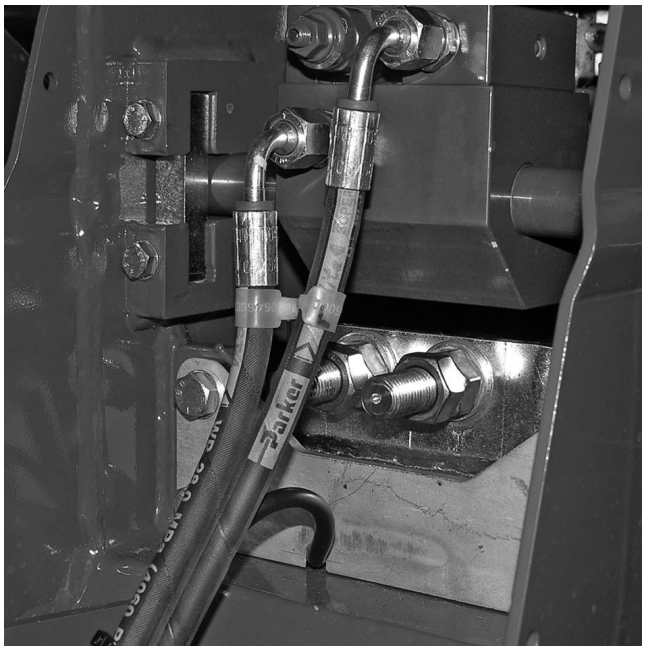


Figure 4-24. Nuts for exit cables stop

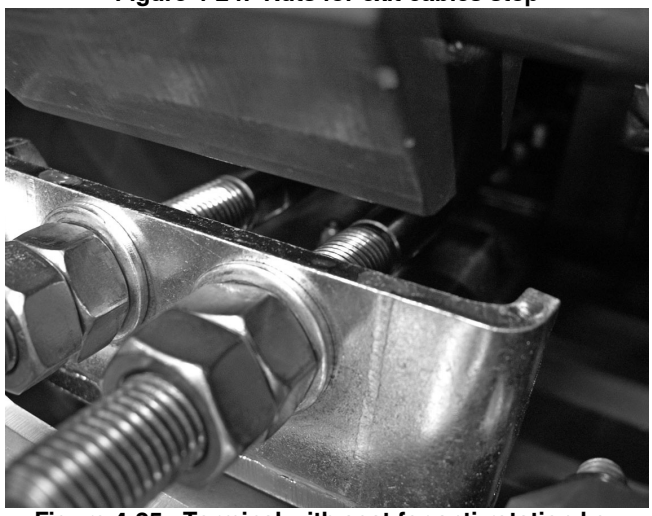


Figure 4-25. Terminal with seat for anti-rotation key

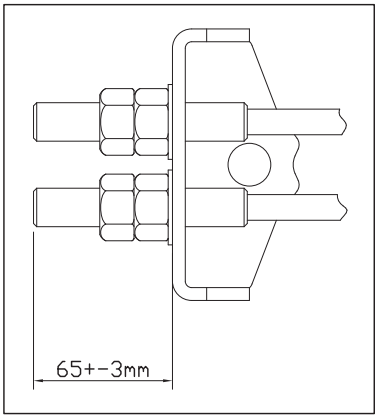


Figure 4-26.

1. Activate the movement of the extendible arms several times and check that the residual loads on the ropes are 10Nm.
2. This procedure could require several attempts before it is completed correctly.
3. 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.
4. Once calibration has been concluded, tighten the counter-nuts and re-mount the sump.

4.6 ROTARY ACTUATOR

ARP SERIES

Installation and maintenance manual

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	
	H.987/124DC01/C	H.987/124DC07/C
Rotation Angle	124°	124°
Displacement (cm^3)	~ 81	~ 81
Weight (kg)	~ 16	~ 15
Ports	¼ G	¼ G
Working temperature (°C)	- 20 / + 80	- 20 / + 80
Max. torque at 210bar (Nm)	505	505
Max. working pressure (bar)	210	210
Max. Capacity straddle mount / cantilever mount (Nm)	2800 / 1400	2800 / 1400
Max. capacity: thrust / radial (N)	5000 / 14000	5000 / 14000

For more information and other details see technical drawing.

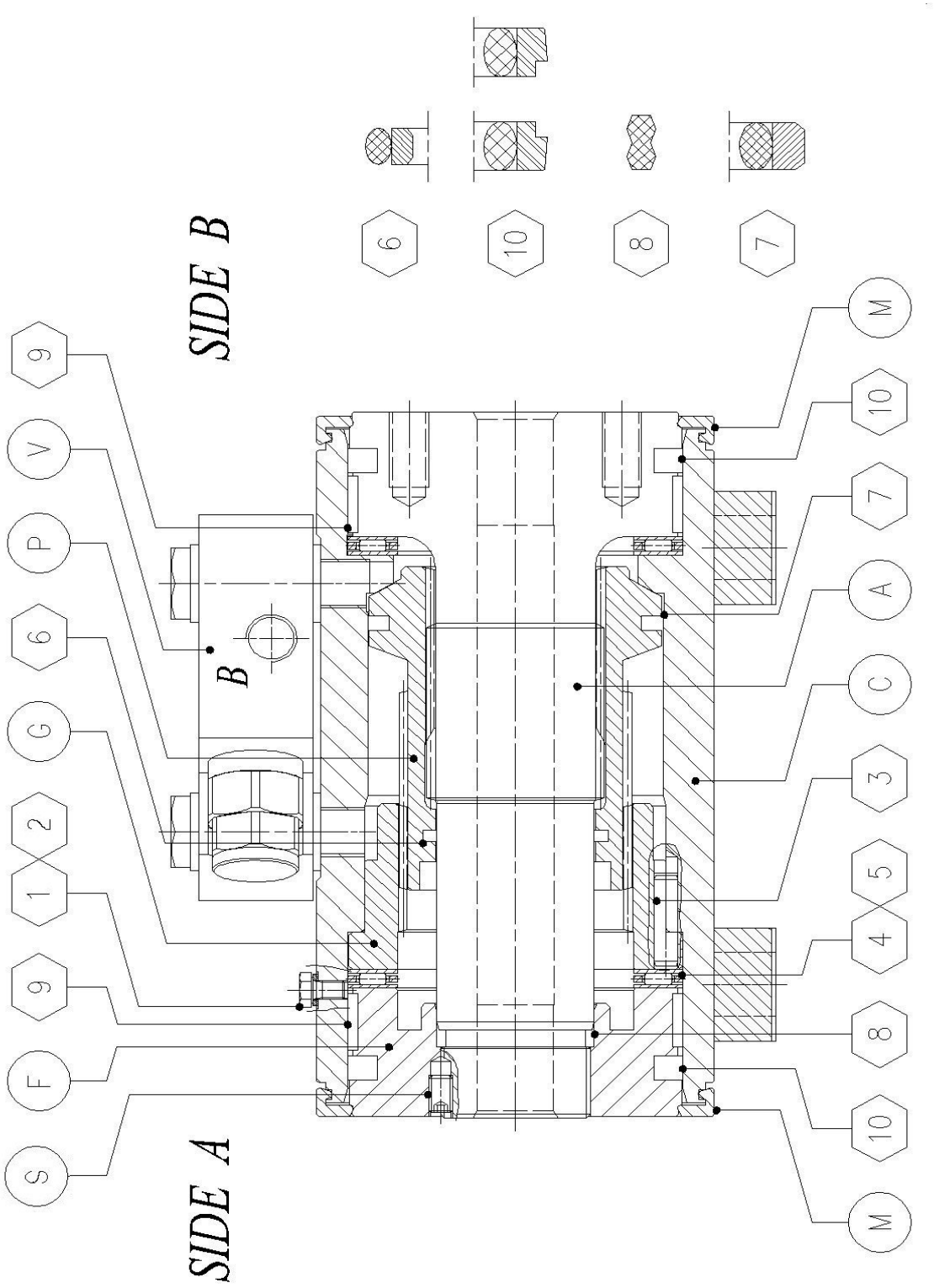


Table 4-1.

Figure 4-27.

H.987/124DC01/C – H.987/124DC07/C			
Pos.	**Q.ty**	**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.

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

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

- Fix the actuator to the bench.
- 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.*

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

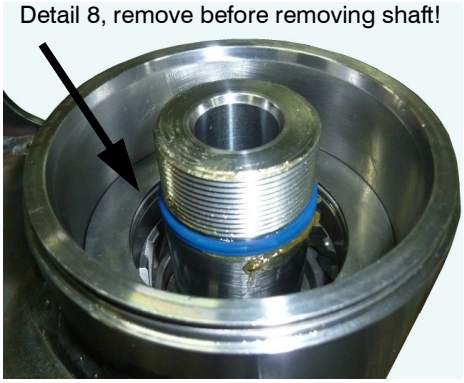
NOTE: *Before unscrewing, make a reference between shaft and flange and measure the gap between them on side A.*

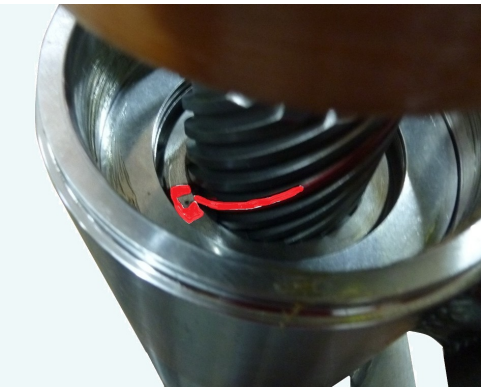
- Now carefully remove bearing 5 and thrust ring 4 .

- 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.
- With the piston stop, rotate the shaft anticlockwise and this will march by the body.

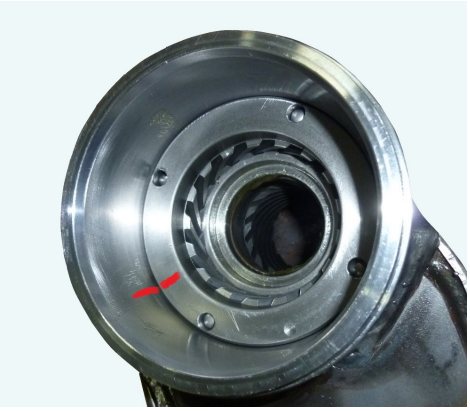
NOTE: *On gear teeth of shaft and piston (before disengaging the same) make a reference, marking a tooth for every detail on which engages with reciprocal.*

Detail 8, remove before removing shaft!





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



- 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.*

- Remove all elements sealing by the particular.

⚠ CAUTION

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

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

3 ASSEMBLY

- Fix the actuator in a proper way to the bench
- 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.*

- Put piston P, complete with seals 6 and 7 in actuator body C.
- Engage gear ring G with piston P referring to the previously marked position.
- 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.
- 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).*

- 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.*

- Place bearing 5 and thrust ring 4 (4+5+4) on side A.
- 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).
- Put the pins S.
- Install any plugs and bleeder screws on the body (eg: 1, 2).
- Install valve V and details M.
- 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).
- To assure the oil exchange within the system during the work the volume of the connecting pipes must be lower than the actuator displacement.
- Align the fixing holes of structure/machine to those of structure/actuator flange and lock this position by pins/screws of suitable torque.
- Connect the rotary actuator as per layout on the drawing.

Installing Counterbalance Valve

Refer to Figure 4-24, 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).

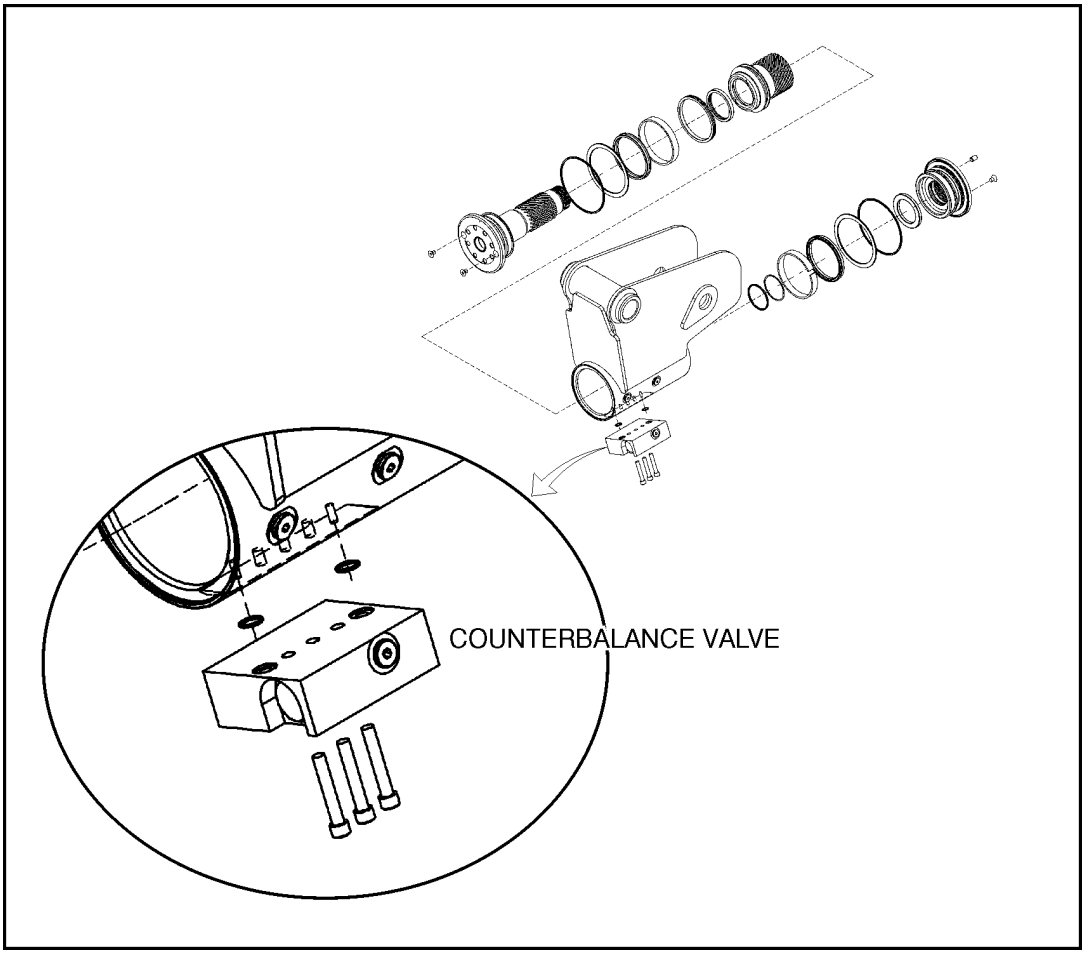


Figure 4-28.

4.7 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 overtighten.
3. Re-install the platform/remote control box into the mounting support on the platform.

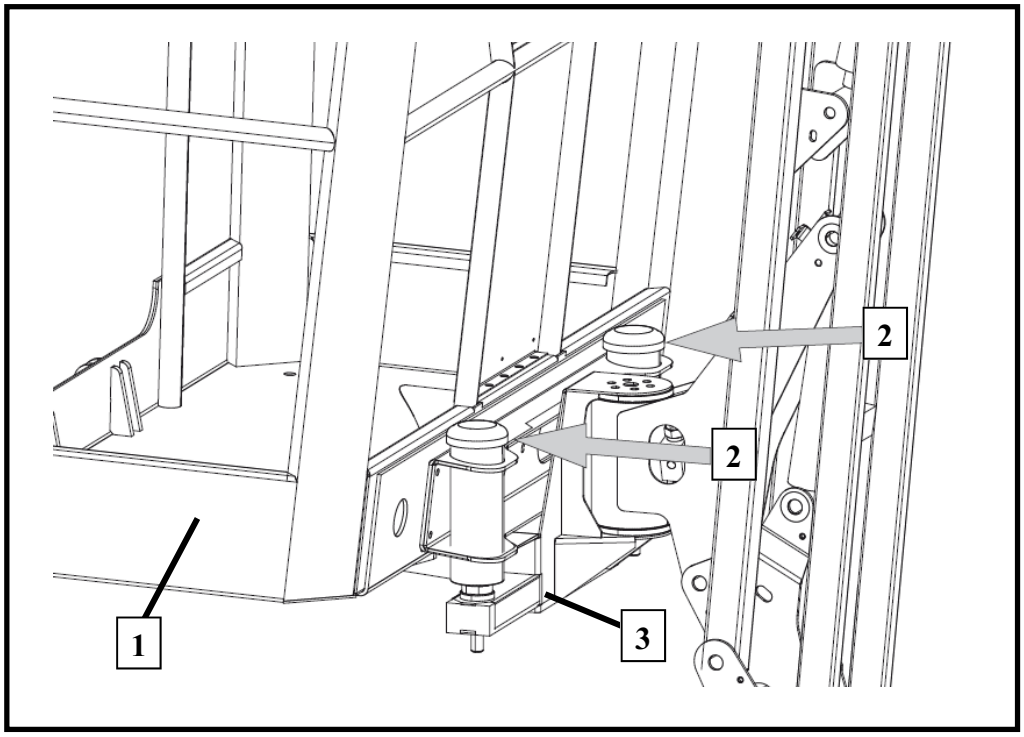


Figure 4-29.

4.8 LOAD CELL AND FOOTSWITCH REMOVAL/INSTALLATION

Removal 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.

Installation 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)

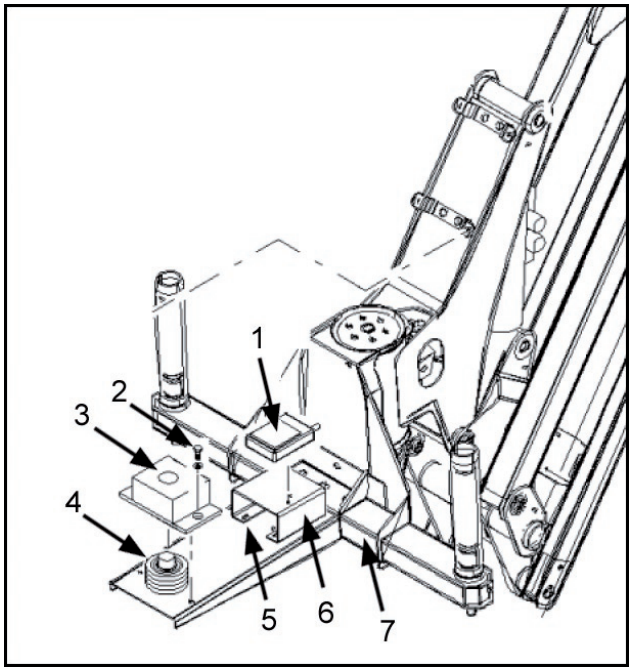


Figure 4-30.

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.

Installation footswitch

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

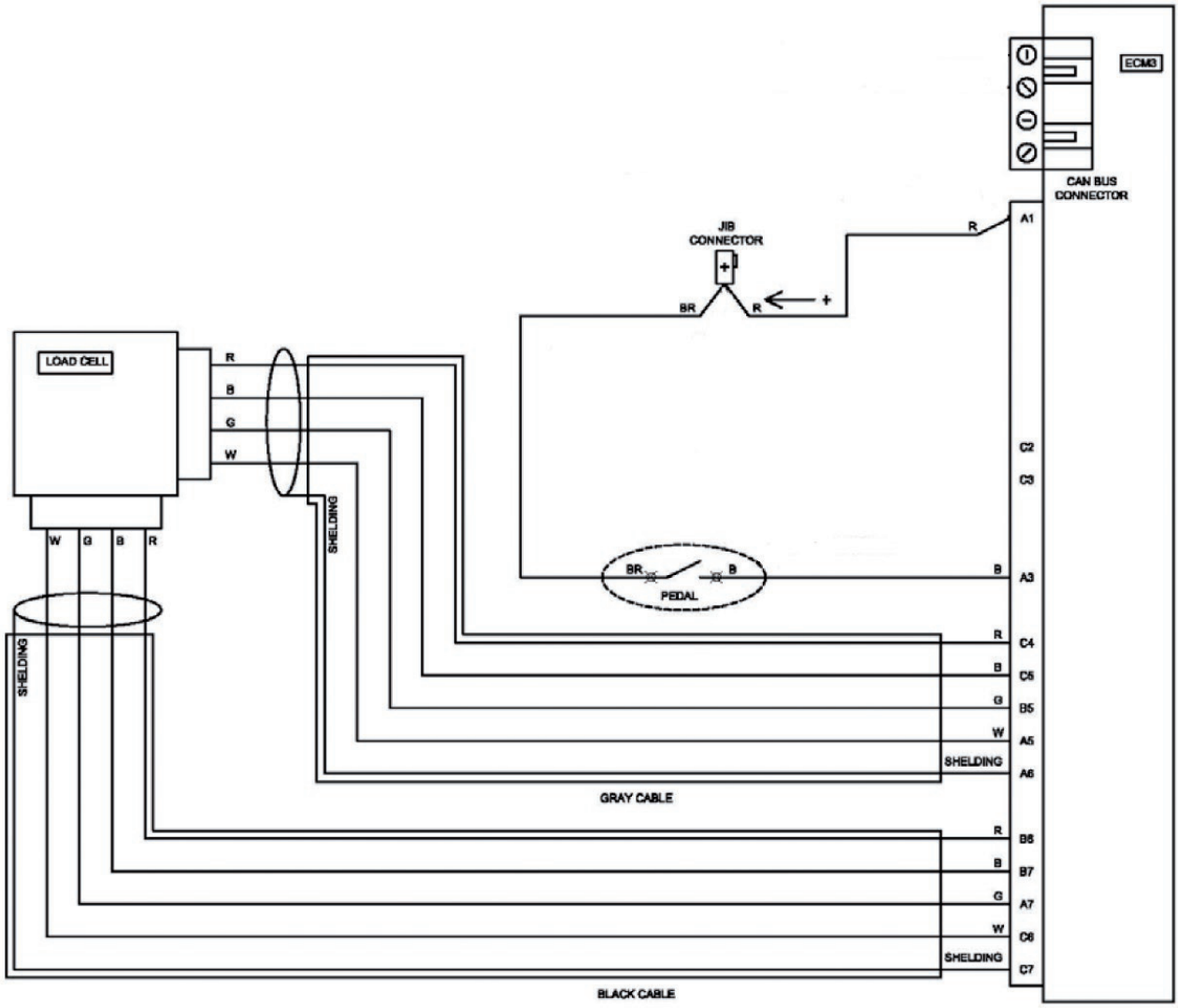


Figure 4-31. Electrical wiring ECM3

NOTES:

SECTION 5. HYDRAULICS

5.1 CYLINDER REPAIR

SPECIFICATION
Cylinders overview

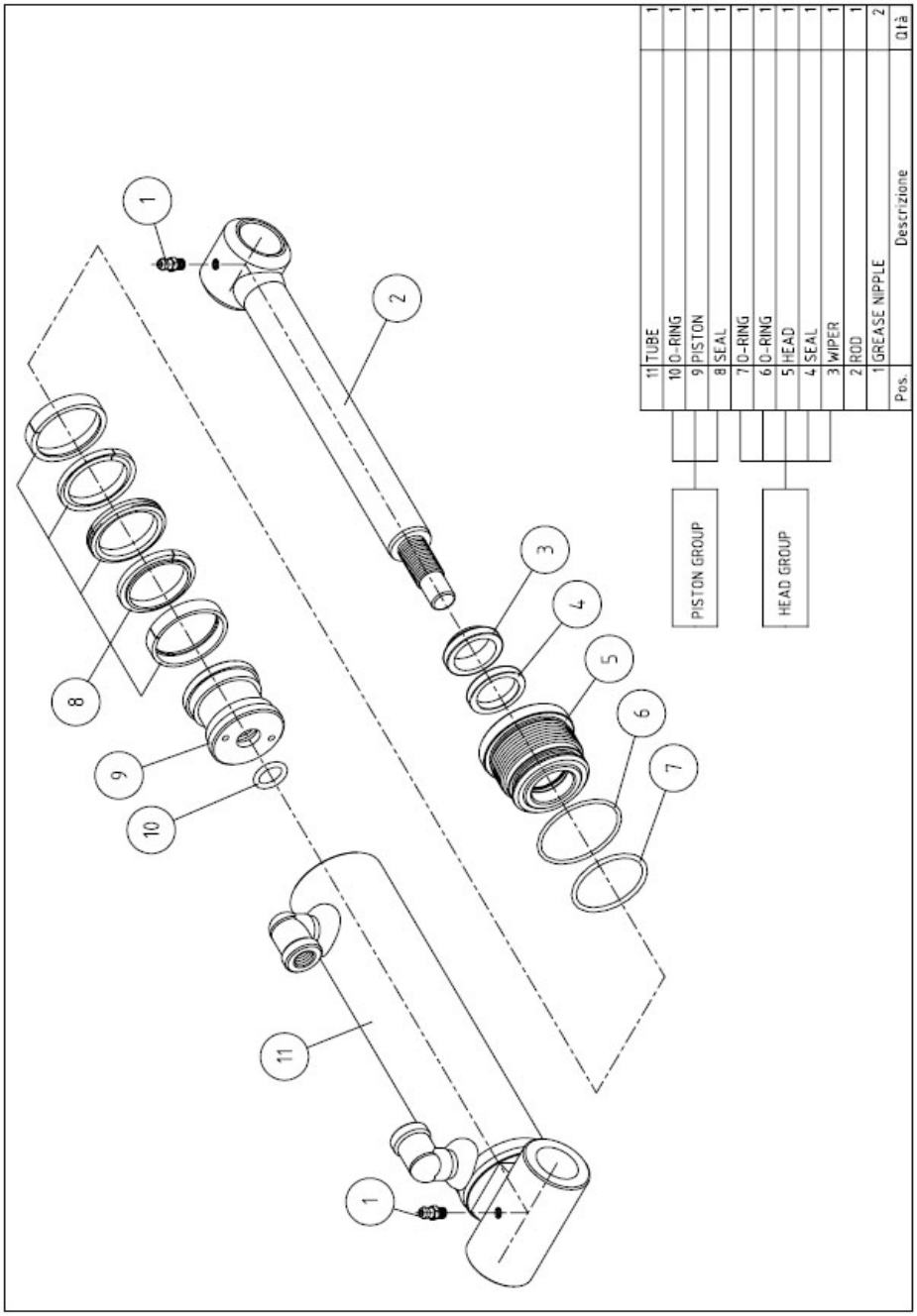


Figure 5-1. PISTON THREAD

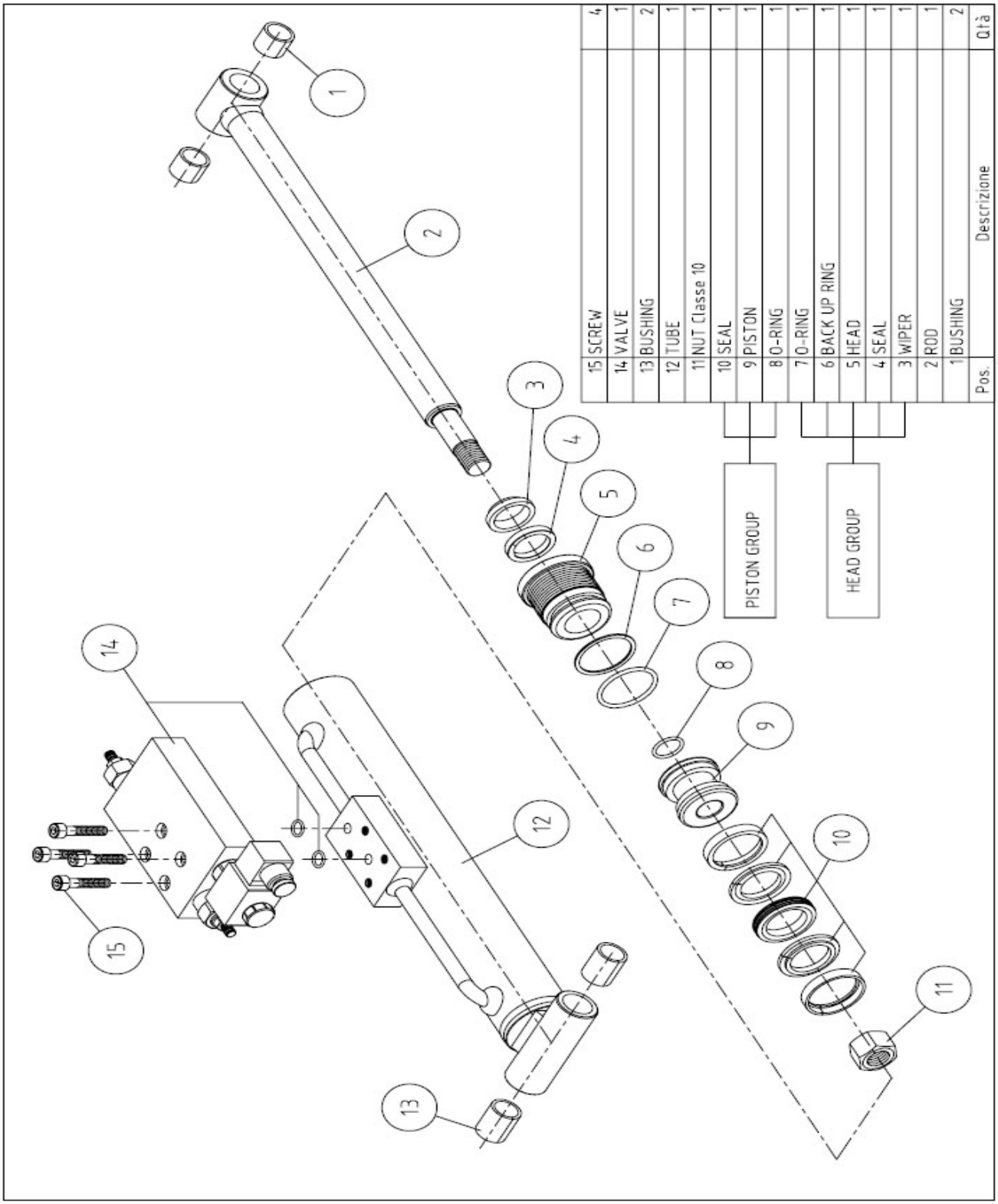


Figure 5-2. PISTON WITH NUT THREAD

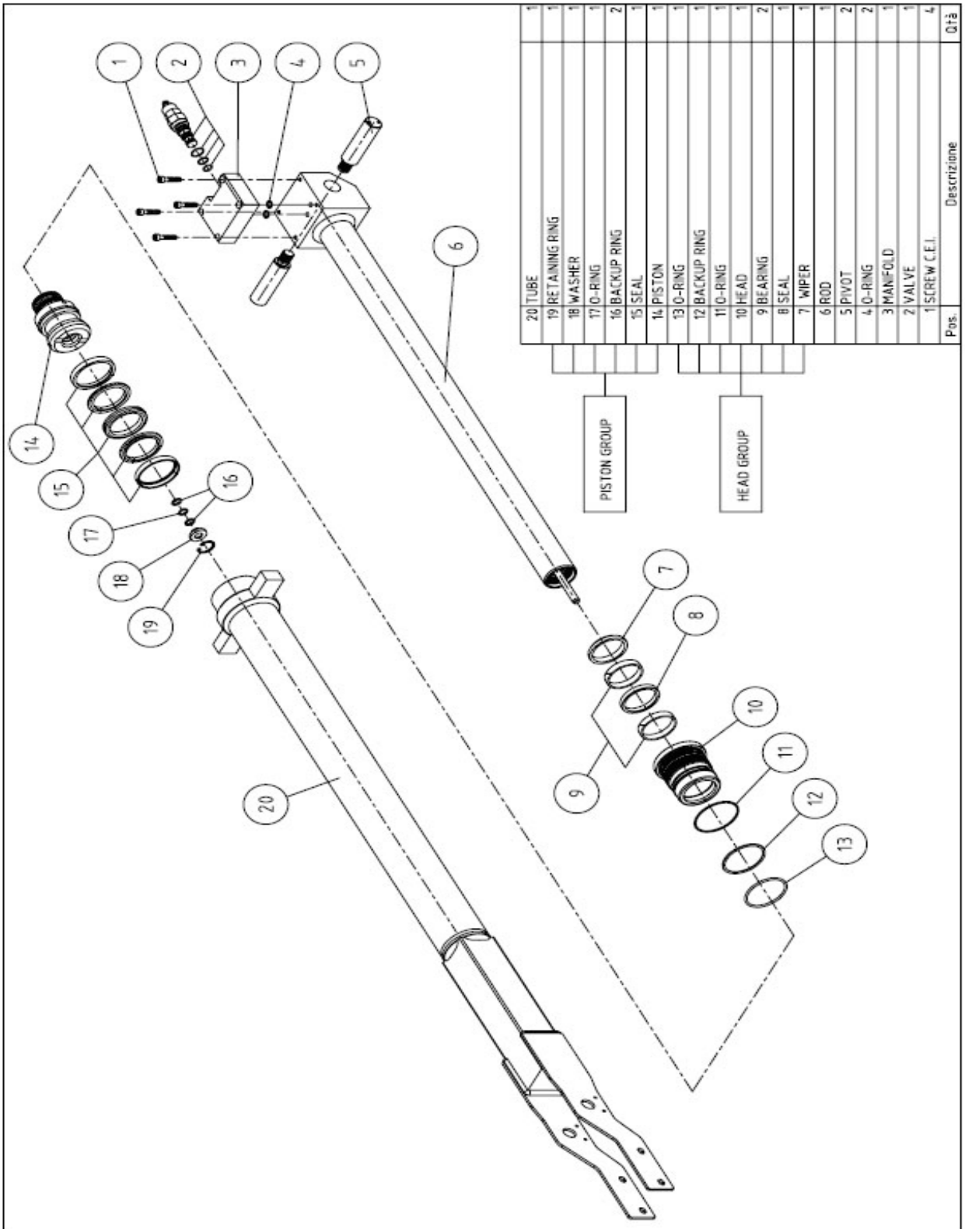


Figure 5-3. TELESCOPE CYLINDER

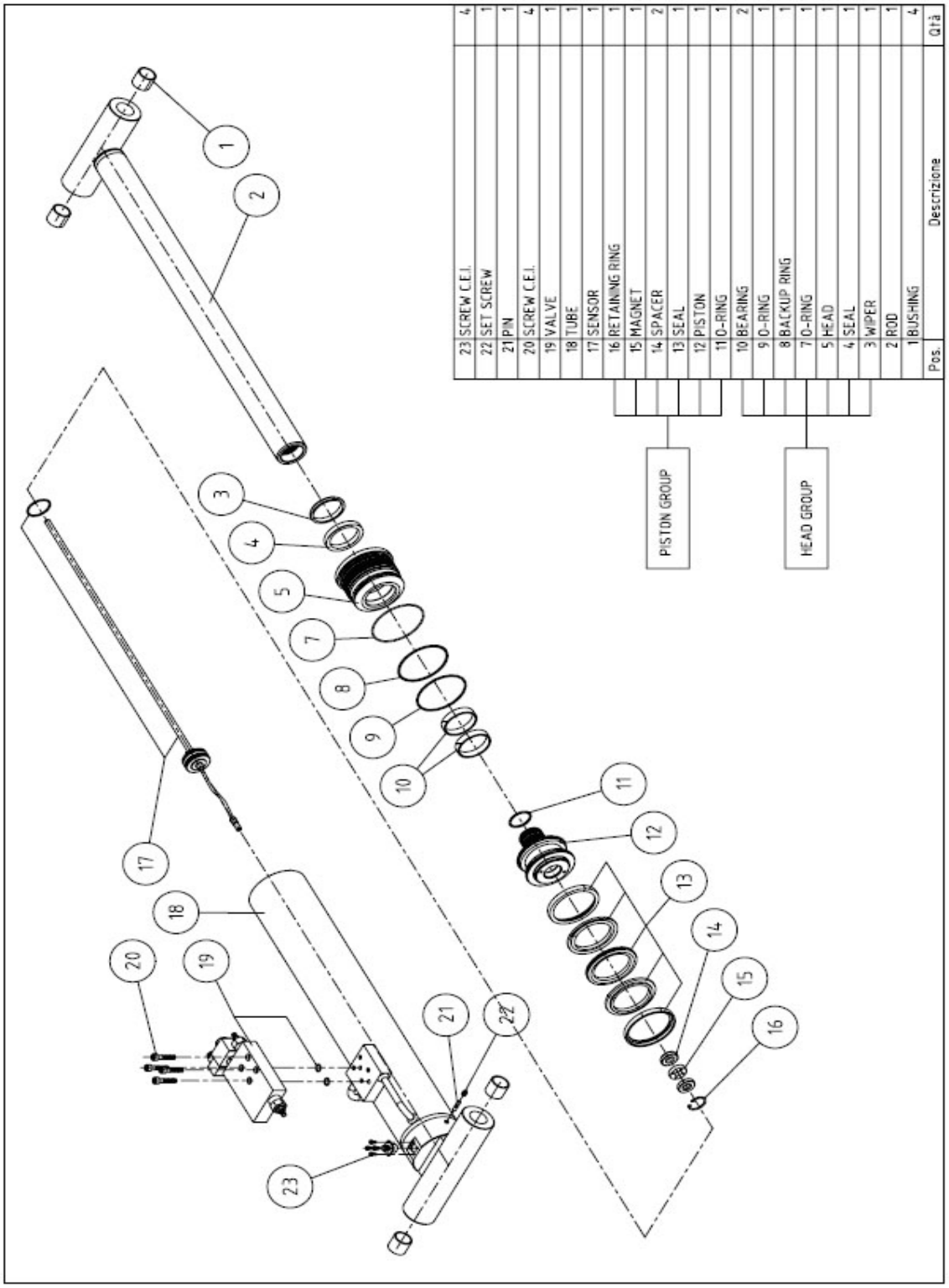


Figure 5-4. CYLINDER WITH SENSOR

HYDRAULIC CYLINDERS TORQUE SPECIFICATIONS

Piston nut thread torque specification

PISTON WITH NUT THREAD		NUT TORQUE VALUE
X14J-X390AJ	OUTRIGGER NUT M27X2	300N/m
X14J-X390AJ	JIB CYLINDER NUT M20X1.5	160N/m
X14J-X390AJ	LEVELING CYLINDER BASKET UP BASKET NUT M16X2	120N/m
X14J-X390AJ	FIRST ARM NUT M30X2	300N/m
X14J-X390AJ	SECOND ARM NUT M27X2	300N/m
X14J-X390AJ	LEVELING CYLINDER BASKET UP SENDING NUT M16X2	120N/m
X19J-X550AJ	LEVELING CYLINDER BASKET UP SENDING NUT M16X2	130N/m
X19J-X550AJ	LEVELING CYLINDER BASKET UP BASKET NUT M16X2	130N/m
X19J-X550AJ	THIRD- FOURTH ARM NUT M20X1.5	160N/m
X19J-X550AJ	JIB CYLINDER NUT M20X1.5	160N/m
X19J-X550AJ	OUTRIGGER NUT M30X2	300N/m
X19J-X550AJ	EXTRACTION CYLINDER NUT M20X1.5	160N/m
X23J-X700AJ	LEVELING CYLINDER BASKET UP SENDING NUT M16X2	130N/m
X23J-X700AJ	LEVELING CYLINDER BASKET UP BASKET NUT M16X2	130N/m
X23J-X700AJ	ENLARGMENT CYLINDER NUT M18X1.5	140N/m
X23J-X700AJ	JIB CYLINDER NUT M20X1.5	160N/m

Screws torque specifications

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

Hose connections torque specifications

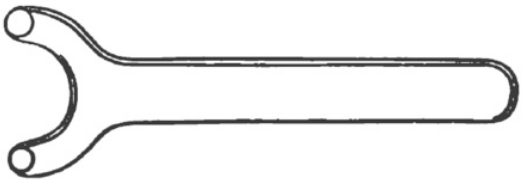
JUNCTION		
Ø HOSE	METRIC THREAD	TORQUE VALUE (N/m)
6	M12x1.5	20
8	M14x1.5	25
10	M16x1.5	30
12	M18x1.5	40
15	M22x1.5	60
18	M26x1.5	90
22	M30x2	170
28	M36x2	210
35	M45x2	360
42	M52x2	490

Cylinders head torque specification

Tightening torque head		
Head diameter (mm)	Torque [Nm]	
	Min	Max
30	50	100
35	50	100
40	100	150
45	100	150
50	150	200
55	150	200
60	200	250
65	200	250
70	250	300
75	250	300
80	300	350
90	350	400
100	400	450
110	450	500
120	500	550
130	500	550
140	500	550
150	500	550
160	550	600
170	550	600
180	550	600
190	550	600
200	600	650
210	600	650
220	600	650
230	600	650
240	600	650
250	700	750

EQUIPMENT AND PRODUCT LIST

- Spanner wrancher



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

CYLINDER WITH SENSOR

Disassembly

General Cylinder Disassembly

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

NOTICE

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

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

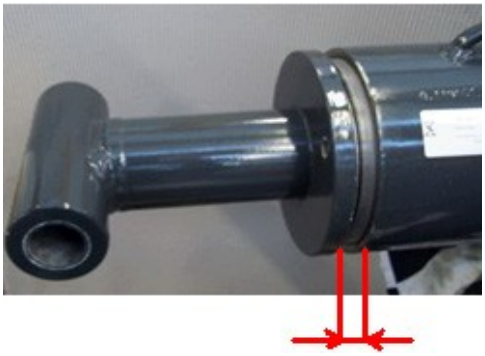
NOTICE

CYLINDER ARE IN PRESSURE.

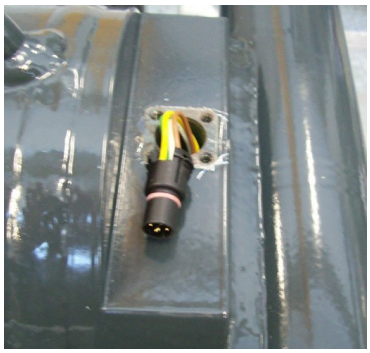
NOTICE

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

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



Remove 4 screws of the sensor

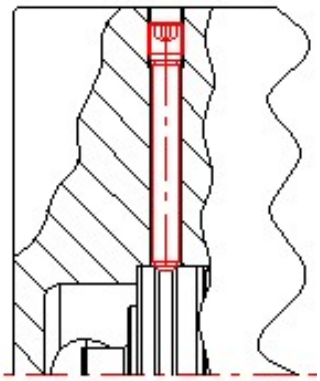


Unhook the connector from the base making pressure on 2 wing signed in the picture.

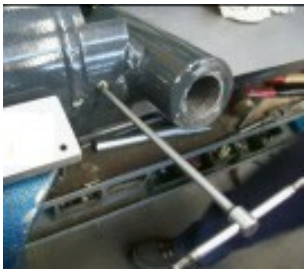
Push the connector inside the hole and fix the plate again.

Screw off the setscrew and remove the pin.

Use a magnet to pull out the pin.



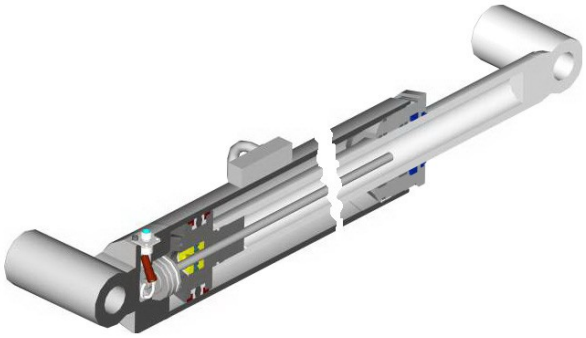
Fix the setscrew in order to keep the air pressure.



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

NOTICE

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



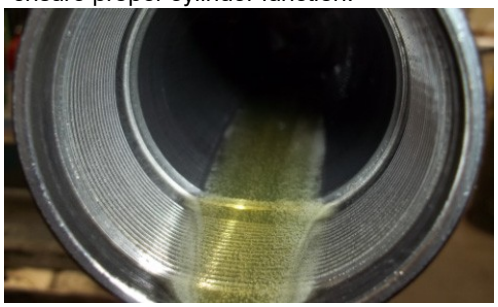
⚠ CAUTION

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

Cleanness and inspection

Cylinder Cleaning Instructions

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



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

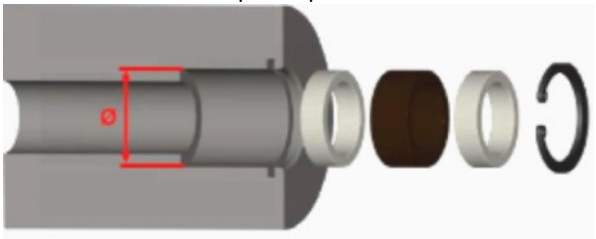
NOTE: *If a white powdery residue is present on threads and parts, it can be removed. Clean the residue away with a soft brass wire brush prior to reassembly, and wipe clean before reinstallation.*

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

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

Magnetic Sensor Removing

1. Pull out retain clip with pliers.



2. Pull out the spacer.

3. Pull out the magnet.

4. Pull out the other spacer.

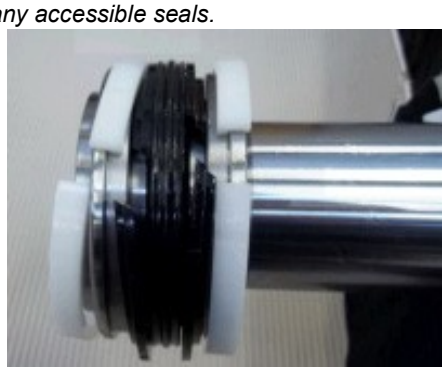
Threaded Piston Disassembling

NOTICE

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

Fix the rod into the vice.

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



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

⚠ CAUTION

WARM THE SURFACE INDICATED MAX 300°C

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

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

General Cylinder Assembly

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

Seals Head Replacing

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

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

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

Cylinder Mounting

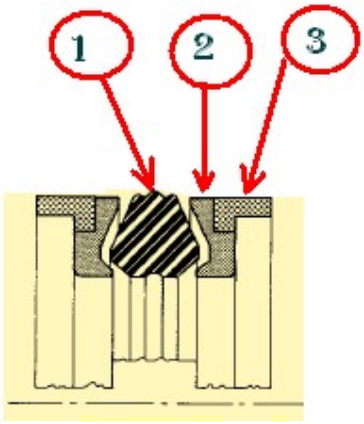
Cylinder Inspection

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

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

Mount the seals in the following order:

1. Seal
2. Support bearing
3. Bearing



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

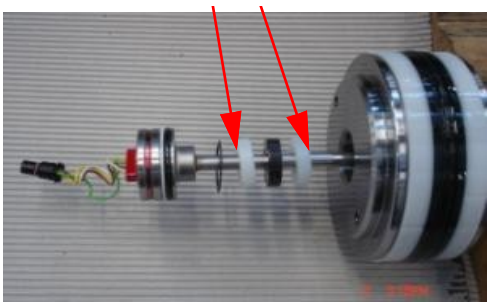
NOTE: *If a white powdery residue is present on threads and parts, it can be removed. Clean the residue away with a soft brass wire brush prior to reassembly, and wipe clean before reinstallation.*

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

Sensor Assembling

Spacer has chamfer.

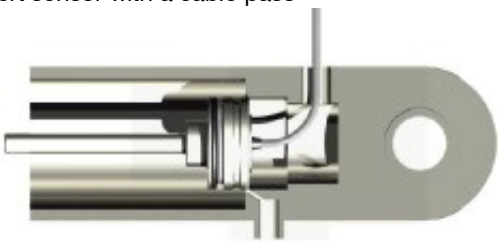
Mount spacer with chamfer face outside.



Lubricate the o-ring

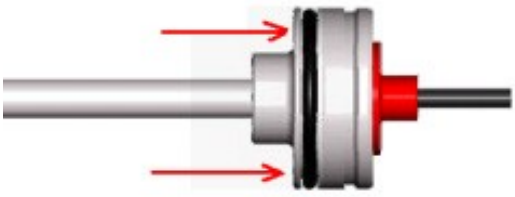
Joint the sensor pin with a guidance cable.

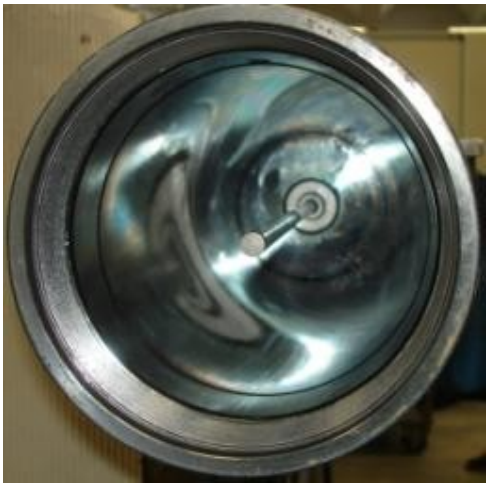
Insert sensor with a cable pass



Use plastic tool to insert the sensor

Push the tool carefully

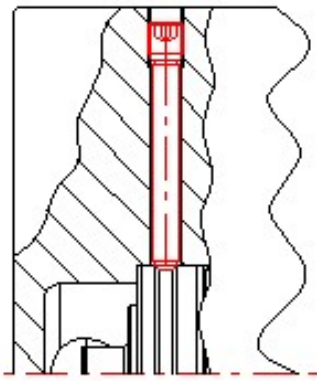


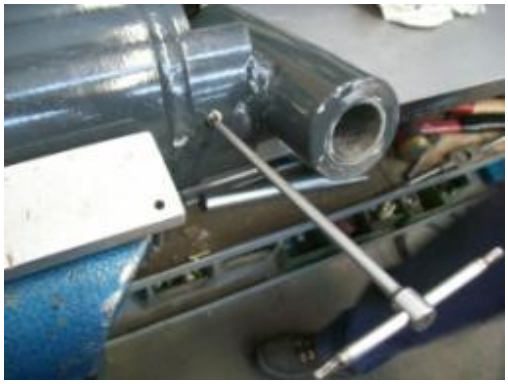


Remove the set screw, insert the pin and than fix the set screw.

Pay attention do not tight too much set screw because the sensor could be damaged.

Tightening torque 05N/m seal with AREXON 35A77.





Cylinder Assembling

Pay attention to not damage the sensor

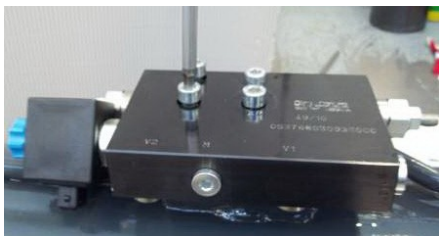
NOTICE

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

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

Thread the counterbalance valve into the block on the cylinder barrel.

Refer to Section 3.2 “Hydraulic Cylinder Torque Specifications”.



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

CYLINDER REPAIR WITHOUT SENSOR

Rod Removing

General Cylinder Disassembly

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

NOTICE

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

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

NOTICE

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

NOTE: *Cylinder can have residual pressure inside.*

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

NOTICE

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

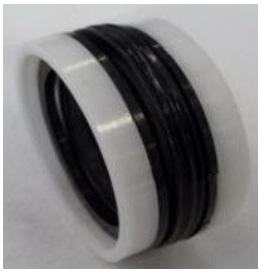
Piston with nut Disassembling

NOTICE

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

Fix the rod into the vice.

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



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

⚠ CAUTION

WARM THE SURFACE INDICATED MAX 300°C

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

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

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

Cylinder assembling

General Cylinder Assembly

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

Seals Head Replacing

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

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

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

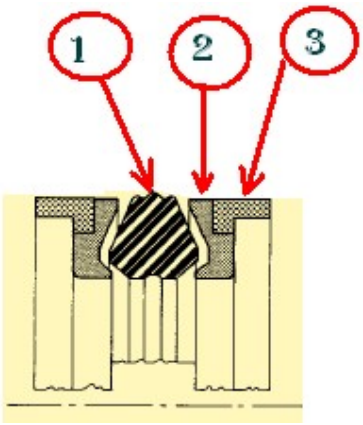
Cylinder Inspection

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

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

Mount the seals in the following order:

1. Seal
2. Support bearing
3. Bearing



NOTICE

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

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

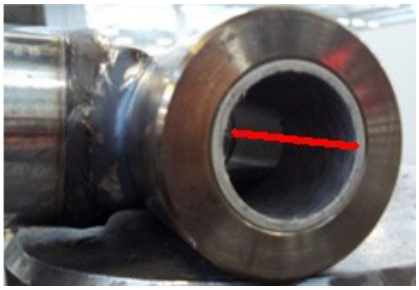
Install the piston on to the end of the cylinder rod. Loctite® 270TM.

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

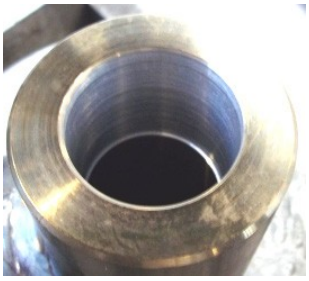
Refer to “Hydraulic Cylinder Torque Specifications,” for tightening guidelines for the piston.

BUSHES REPLACEMENT

Carefully grind the bush with a milling cutter for plastic.



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



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

EMPTYING OF THE CYLIDER

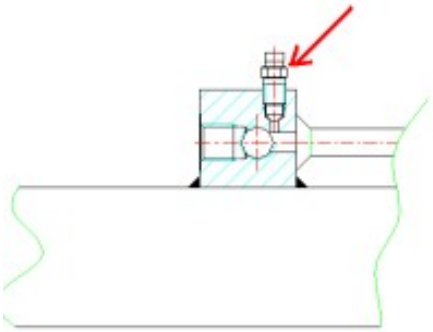
Vent Valve

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

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

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

Purge screw



⚠ CAUTION

LOOSEN PURGE SCREW TO LET AIR GOES OUT TIGHTENING TORQUE 8 N/M.

5.2 REPLACEMENT HYDRAULIC PUMP

Pump removal

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

Pump installation

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

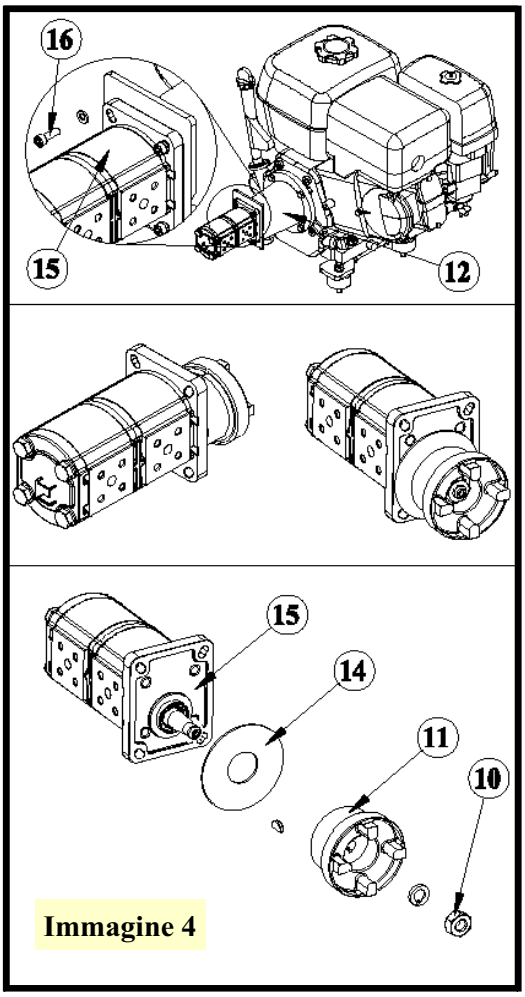


Immagine 4

5.3 FUNCTION PUMP

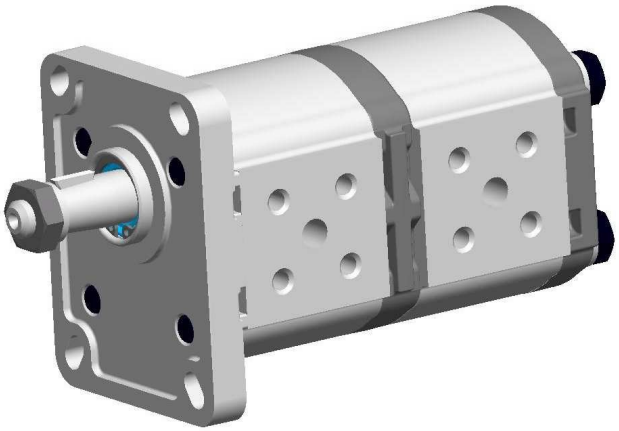
HYDRAULIC PUMP REPAIR

SEAL KIT REPLACEMENT INSTRUCTION

65602813 POMPA PLP10.4-86E1/10.4 D/FS-EL VZN

65602807 POMPA PLP10.3,15-86E1/10.3,15 D/ FS-EL-D VZN

CASAPPA

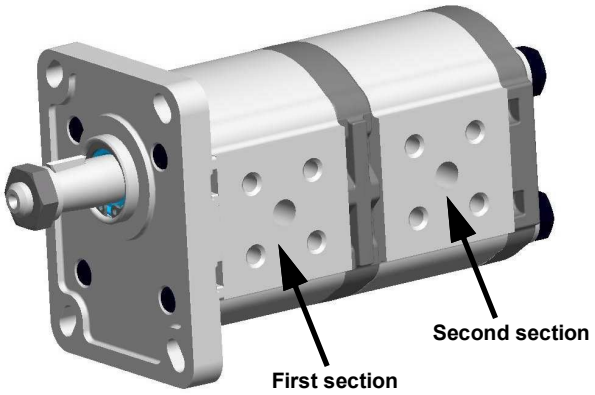


Main operations:

GENERAL SUGGESTION

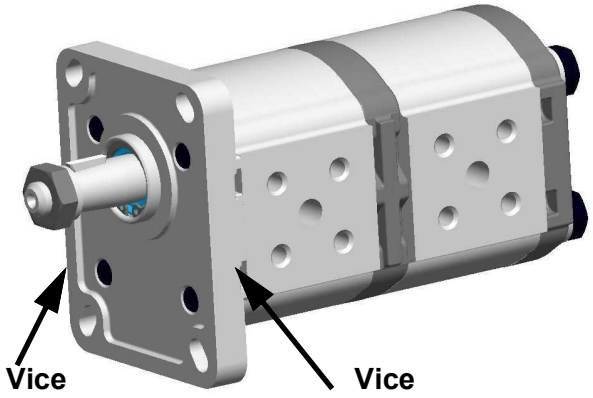
1. *Check the parts have not been damaged during the shipment.*
2. *Work in a clean area.*
3. *Clean with solvent (except the seals) and air dry all components before* assembling.
4. *Pay attention not to damage the machined surfaces.*
5. *The components need to be fitted in place without forcing them.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

External components disassembly



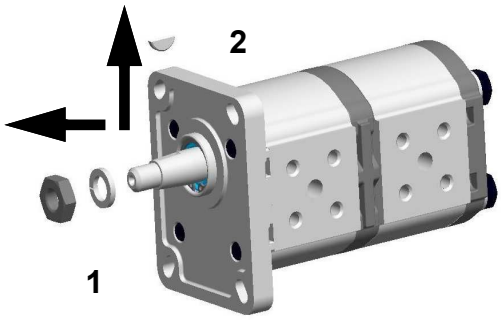
⚠ CAUTION

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

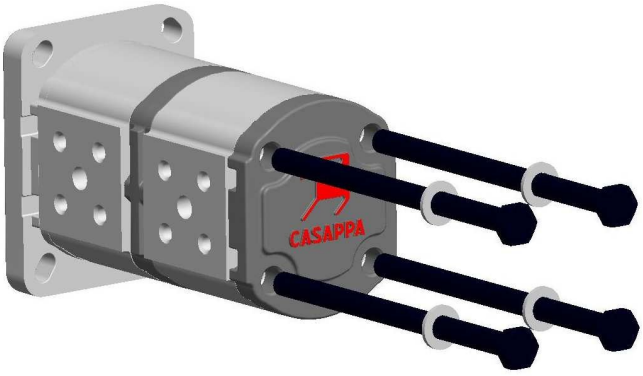


Unscrew the nut and remove the wash (1).

Take out the shaft key (2).

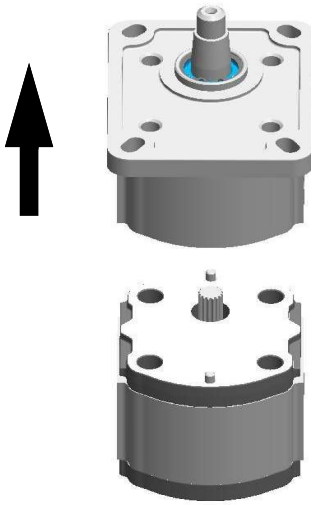


Put the pump on the work bench and remove the bolts and the washers.

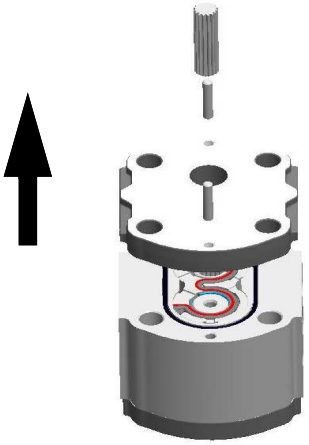


Components disassembly

Remove the first section from the second section.



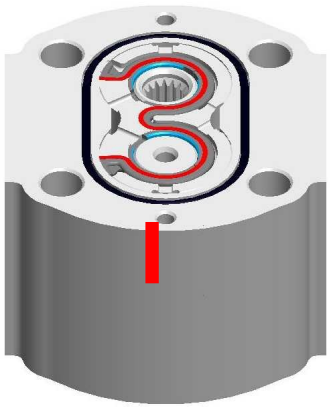
Remove the connecting hub and the dowel pins.



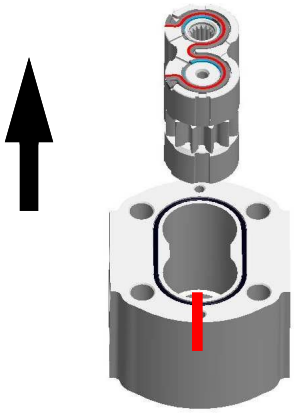
Remove the rear cover.

Second section components disassembly

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

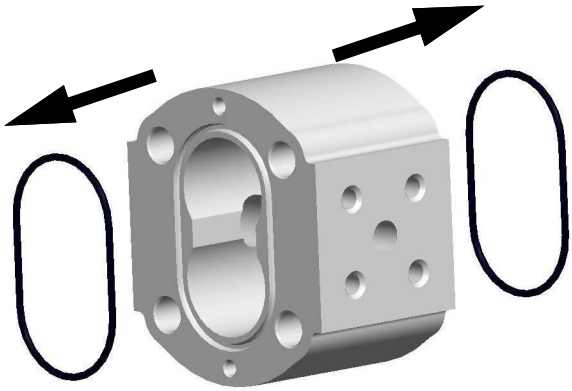


Remove the gears and the pressure plates.

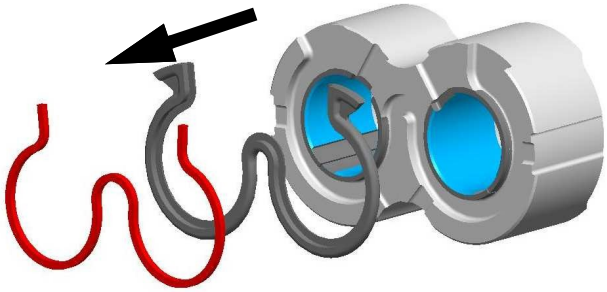


Second section seals disassembly

Remove the seals from the body.

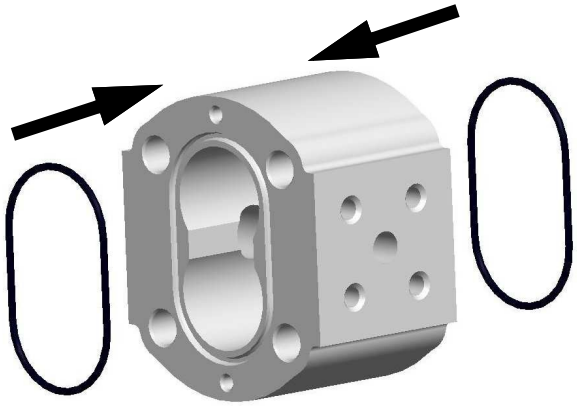


Remove from the plate the back-up ring (1) and the seal (2).

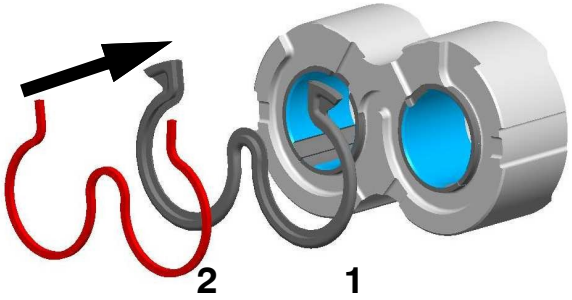


Second section seals replacement

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

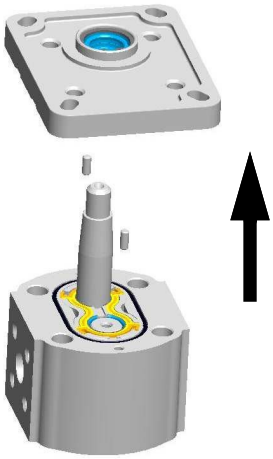


Fit the new seal (1) and back-up ring (2) on the plate.



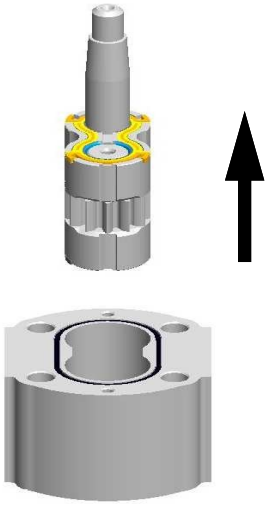
First section seals disassembly

Remove the front cover.



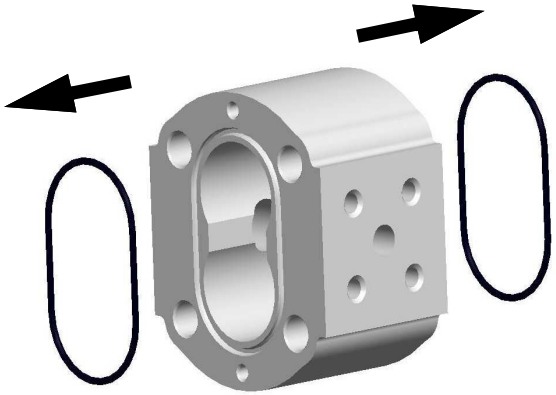
Using a marker draw a reference mark on the plate and the body. It will be used later during reassembly.

Remove the gears and the pressure plates.

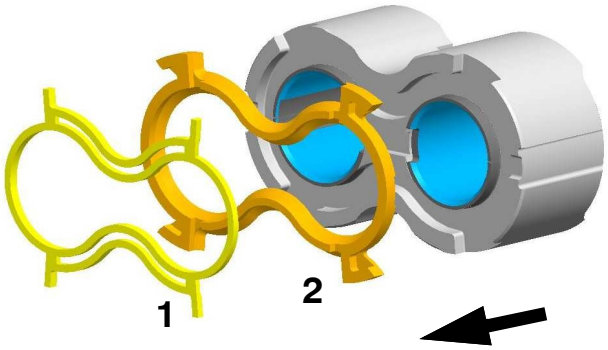


First section seals disassembly

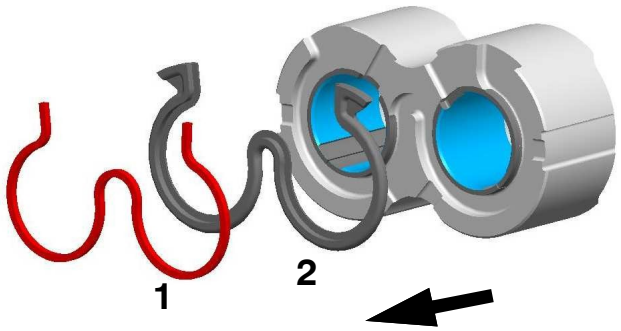
Remove the seals from the body.



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

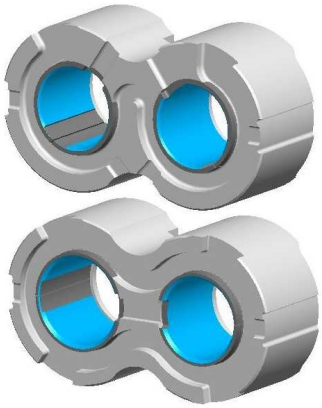


Remove from the plate the back-up ring (1) and the seal (2).

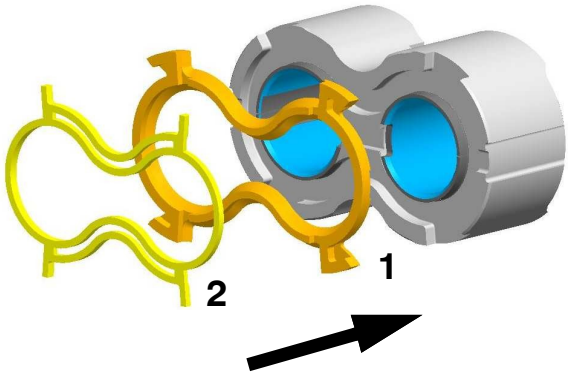


First section seals replacement

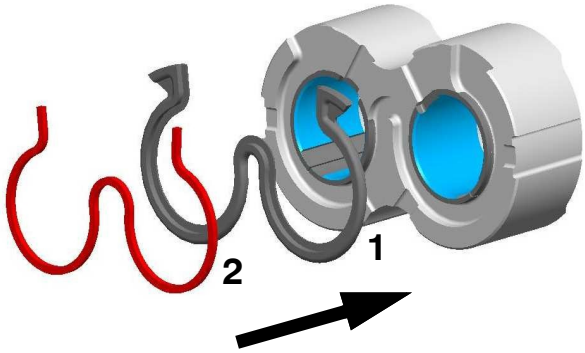
Use clean grease on the pressure plate to help the seals stay in place before fitting them.



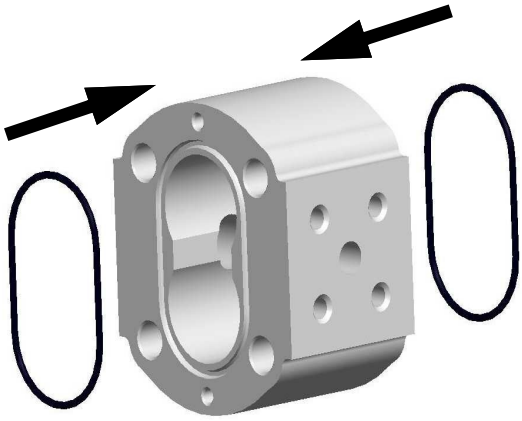
Fit the new seal (1) and back-up ring (2) on the plate.



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

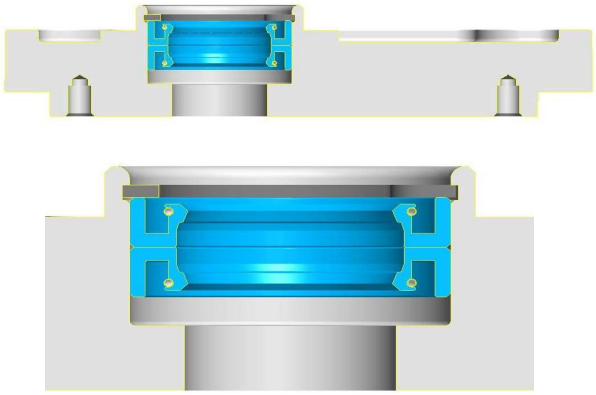


Place on the body the new seals. Use clean grease to keep the seal in place.



Cover seals replacement

Section

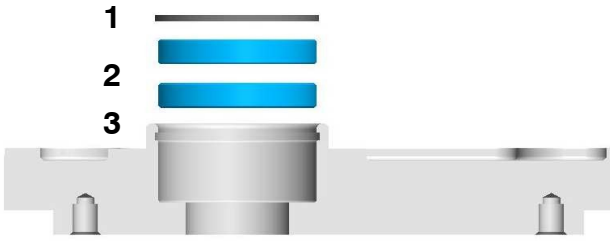


Put the cover on the working bench.

Remove the snap ring (1).

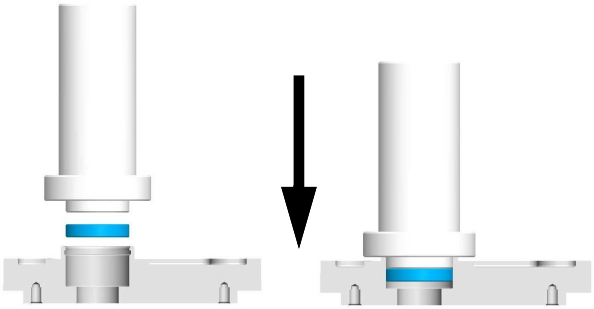
Paying attention not to damage the seat remove with a screw driver (flat head) the shaft seals.(2 - 3)

Put some clean grease into the seat seal.



⚠ CAUTION

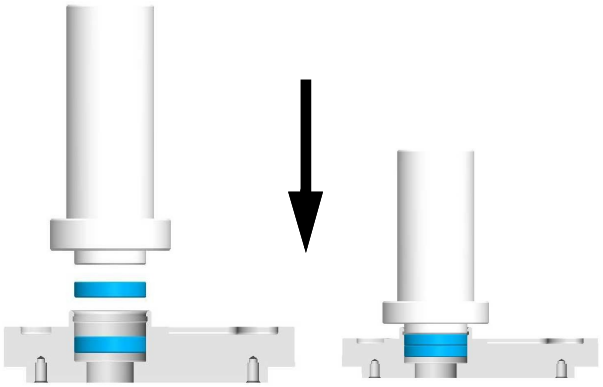
INSERT THE SHAFT SEAL. PAY ATTENTION TO THE ASSEMBLING DIRECTION OF THE SHAFT SEAL (SEE SECTION). USING A MALLET PUSH ALL THE WAY DOWN THE CASAPPA TOOL PN. 06100091.



Cover seals replacement

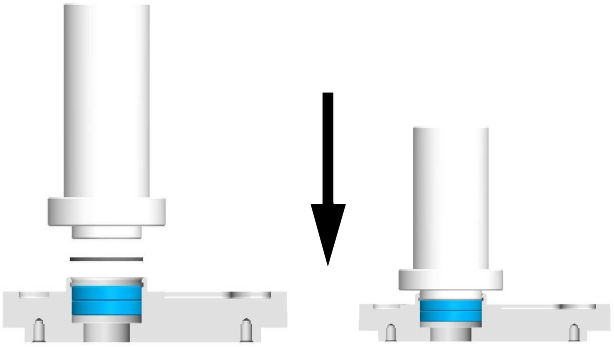
⚠ CAUTION

INSERT THE SECOND SHAFT SEAL. PAY ATTENTION TO THE ASSEMBLING DIRECTION OF THE SHAFT SEAL (SEE SECTION). USING A MALLET PUSH ALL THE WAY DOWN THE CASAPPA TOOL PN.06100091



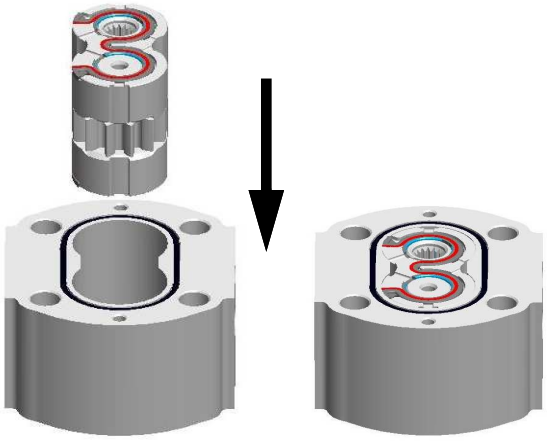
Insert the back-up ring.

Using a mallet push all the way down the CASAPPA tool pn. 06100091.

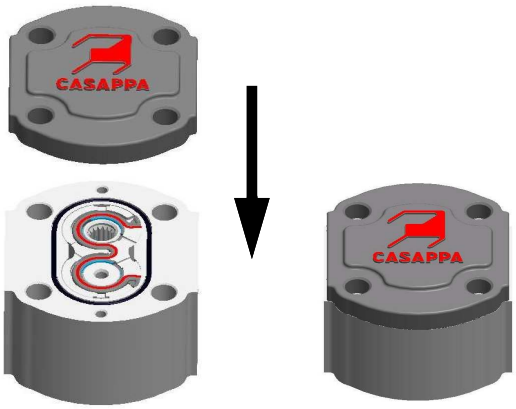


Second section components reassembly

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

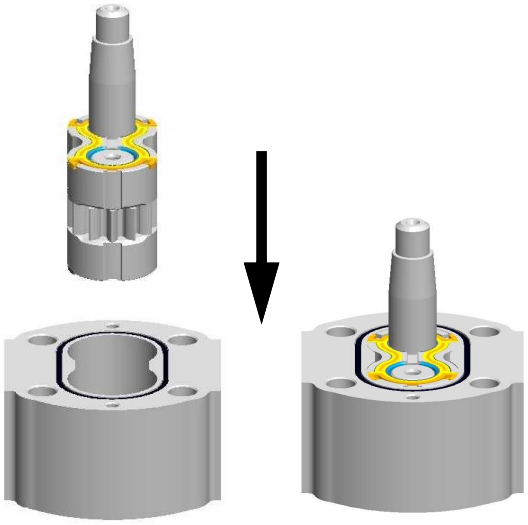


Reassemble the rear cover.

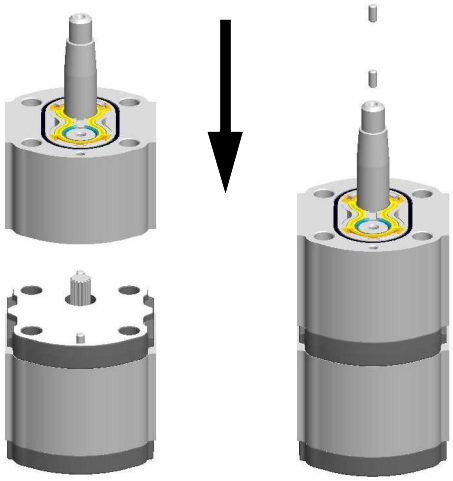


First section components reassembly

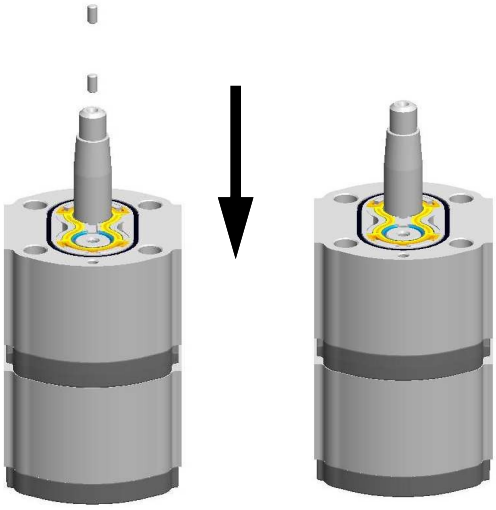
Reassemble the gears and the plates. Use as reference the mark made previously.



Put back the first section.

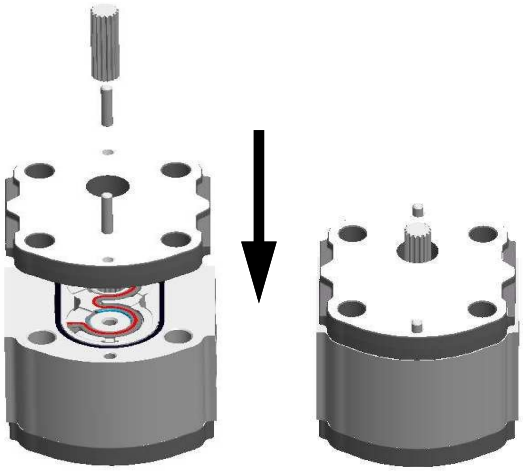


Put back the dowel pins.



Components reassembly

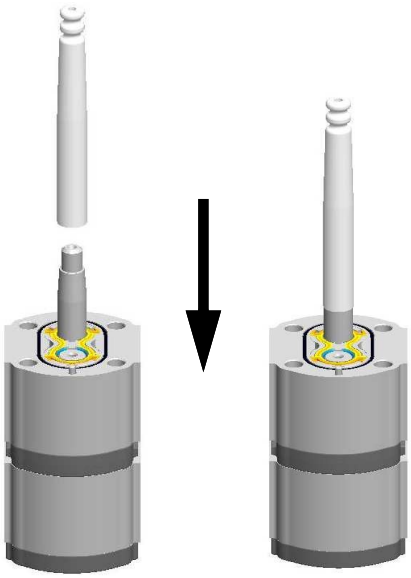
Put back the flange and the pins. Put the connecting hub into the second section shaft.



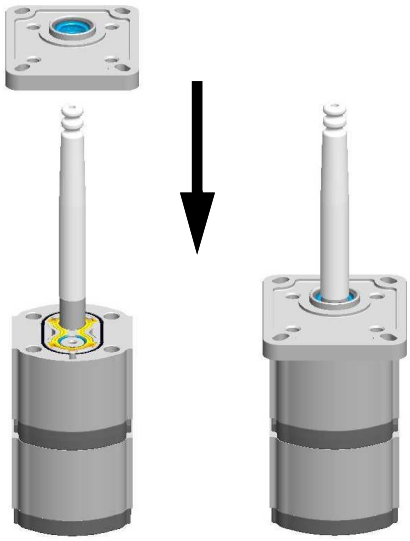
Components reassembly

⚠ CAUTION

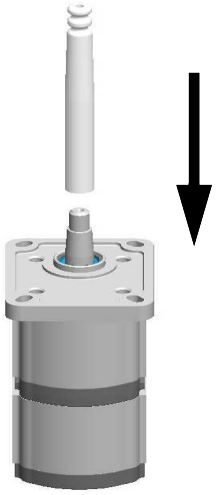
PUT THE APPROPRIATE CASAPPA TOOL PN 06100090 ON THE DRIVE SHAFT OR PROTECT WITH ADHESIVE TAPE TO AVOID DAMAGING THE SHAFT SEAL.



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



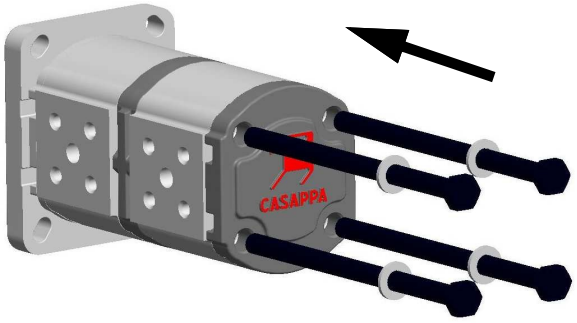
Remove the CASAPPA tool pn 06100090.



Final bolting and check

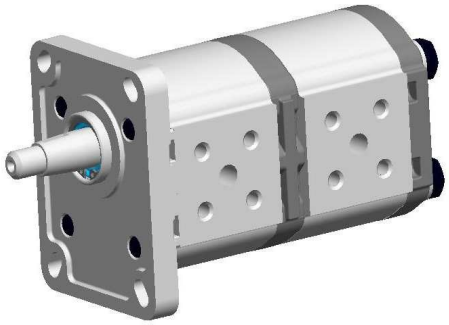
Put the pump in the vice and tighten the bolts with a torque wrench.

Tightening torque 30 Nm.

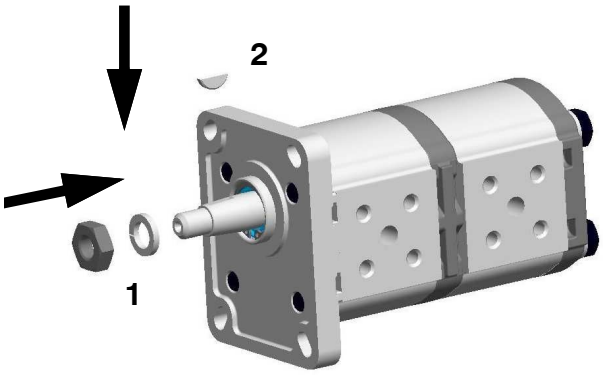


⚠ CAUTION

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



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



5.4 HYDRAULIC COMPONENT START-UP PROCEDURES AND RECOMMENDATIONS

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

⚠ WARNING

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

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

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

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

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

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

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

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

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

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

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

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

⚠ WARNING

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

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

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

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

⚠ WARNING

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

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

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

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

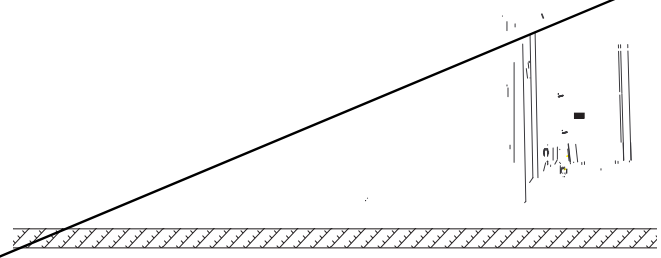
The machine is now ready for operation.

5.5 PRESSURE SETTING PROCEDURE

Cold temperatures have a significant impact on pressure readings. JLG Industries Inc. recommends operating the machine until the hydraulic system has warmed to normal operating temperatures prior to checking pressures. JLG Industries Inc. also recommends the use of a calibrated gauge. Pressure readings are acceptable if they are within ± 5% of specified pressures.

Control Valve Left Side (Chassis functions)

1. Machine completely closed.



2. Install the pressure gauge at the port marked MA Figure xx.
3. Activate the function outrigger IN on remote control.
4. Verify that the pressure is as on Table below.

Control Valve Left Side (Chassis functions)				
Model	**Pressure Port**	**Function Outrigger IN**	**Pressure setting**	
		Outrigger N°	Bar	PSI
X23J X700AJ	MA	3; 4	160	2320
X17J		1; 2	165	2400
X14JH		Stab. SX	175	2540
X19J X550AJ		3; 4	165	2400
X14J X390AJ		4; 2		

To adjust the relief valve, turn clockwise to increase, turn counterclockwise to decrease the pressure.

Control Valve Right Side (Chassis functions)

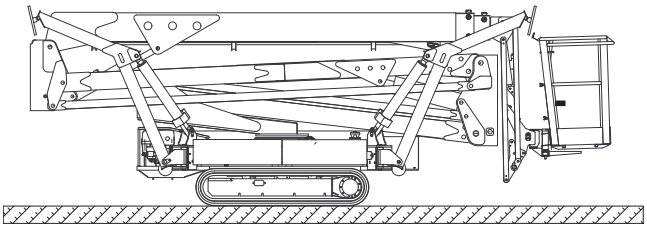
1. Install the pressure gauge at the port marked MB Figure xx.
2. Activate the function outrigger IN on remote control.
3. Verify that the pressure is as on Table below.

To adjust the relief valve, turn clockwise to increase, turn counterclockwise to decrease the pressure.

Automatic reductions drive speed (X23J-X700AJ only)

Adjust pressure reducing valve (only X23J-X700AJ)

1. Adjust the pressure when the machine is completely closed.

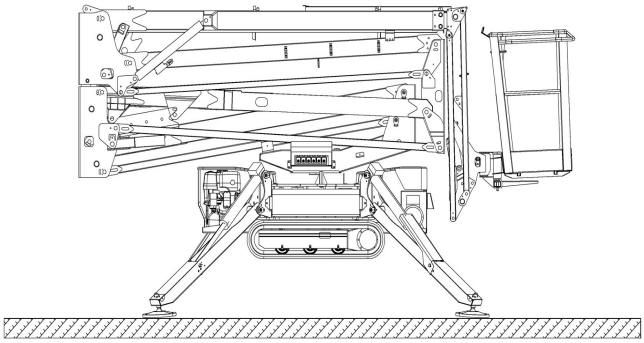


2. Install the pressure gauge at the port 5.
3. Activate the function outrigger IN on remote control 1.
4. Verify that the pressure is as on Table below.
5. Pressure adjust on relief valve point 6

Automatic reductions drive speed				
Model	**Pressure Port**	**Function**	**Pressure setting**	
			Bar	PSI
X23J X700AJ	Point 5	Function Outrigger IN	26	380

Control Valve Turntable Functions

1. Machine with outrigger fully extended.



2. Install the pressure gauge at the port marked MB Figure xx.
3. Activate the function Telescope IN on remote control.
4. Verify that the pressure is as on Table below.

Control Valve Turntable Functions				
Model	**Pressure Port**	**Function**	**Pressure setting**	
		Telescope IN	Bar	PSI
X17J	MB	Telescope IN Basket Control	210	3050
		Telescope IN Ground Control	180	2600
X14JH		Telescope IN Basket Control	210	3050
		Telescope IN Ground Control	180	2600
X23J X700AJ		Telescope IN	185	2680
X19J X550AJ			215	3120
X14J X390AJ			165	2400

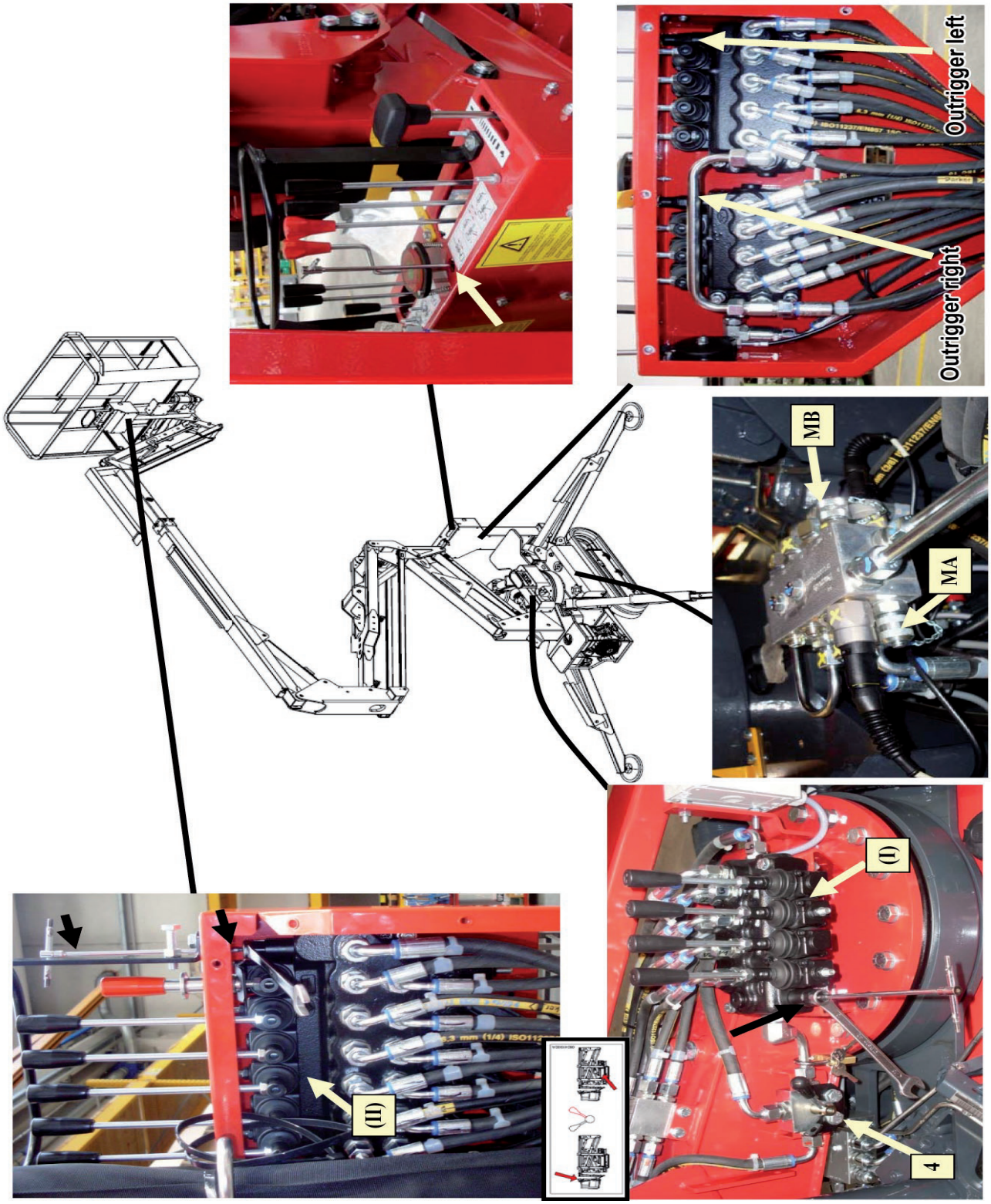


Figure 5-5. X14JH

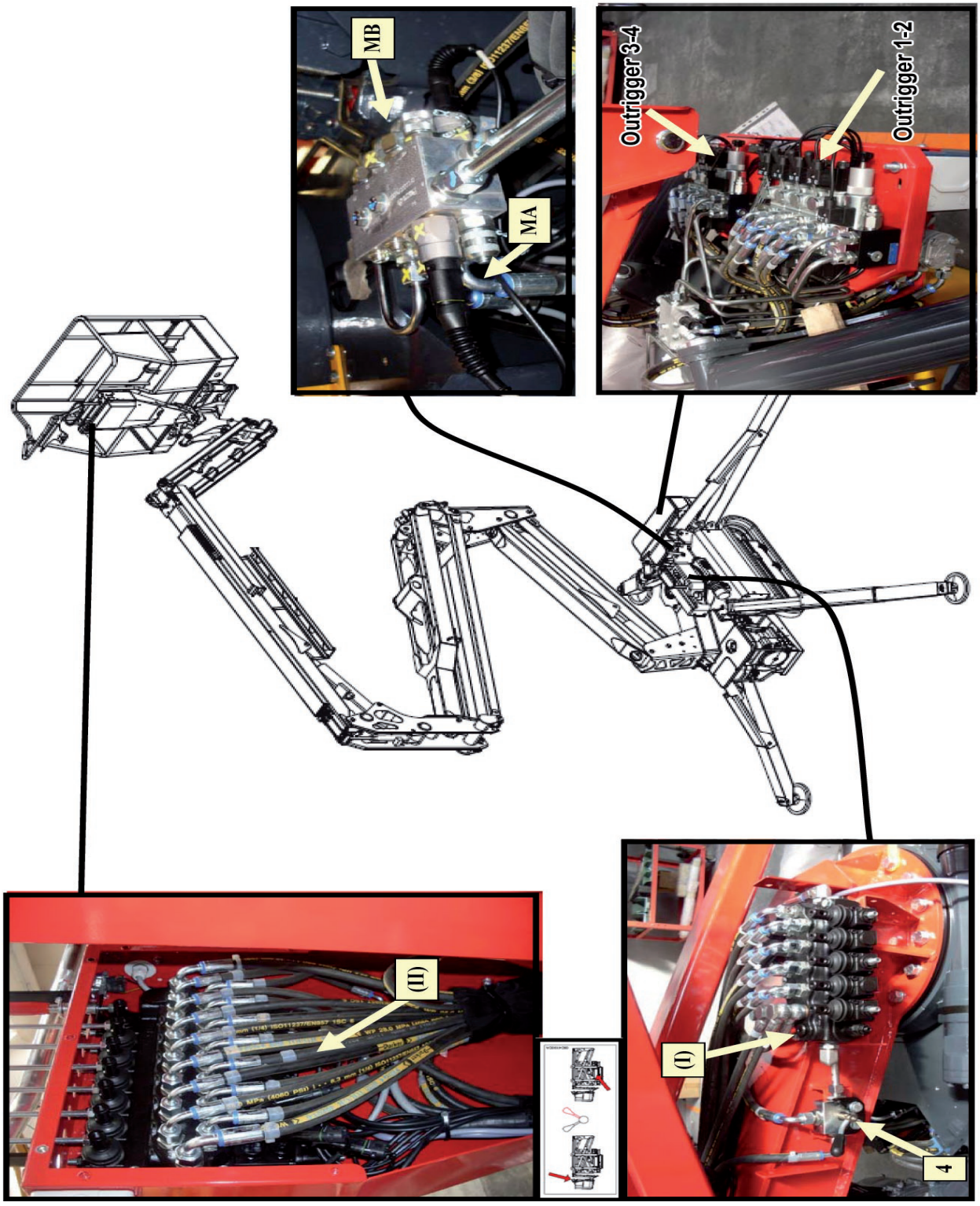


Figure 5-6. X17J

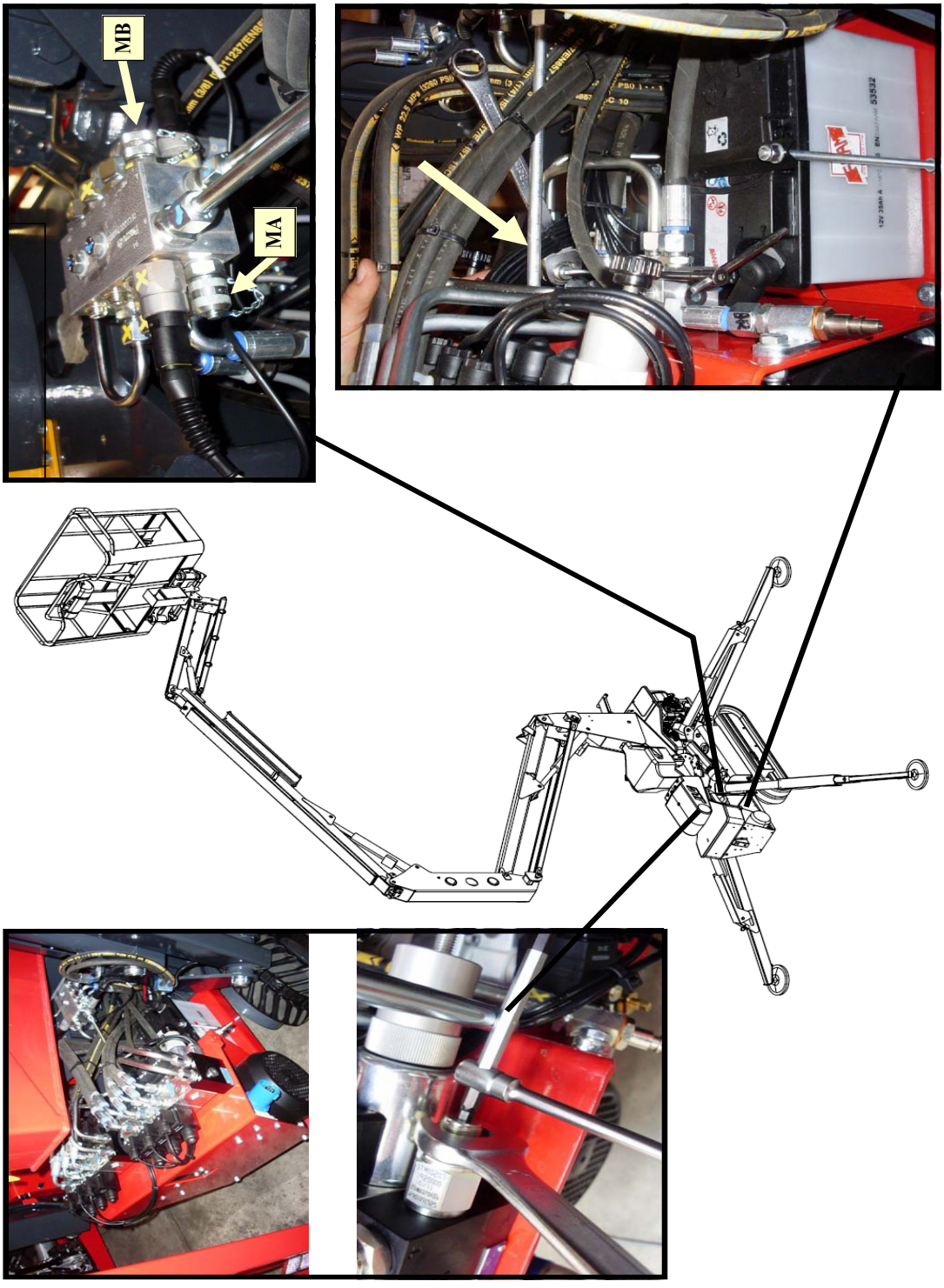


Figure 5-7. X14J-X19J-X390AJ-X550AJ

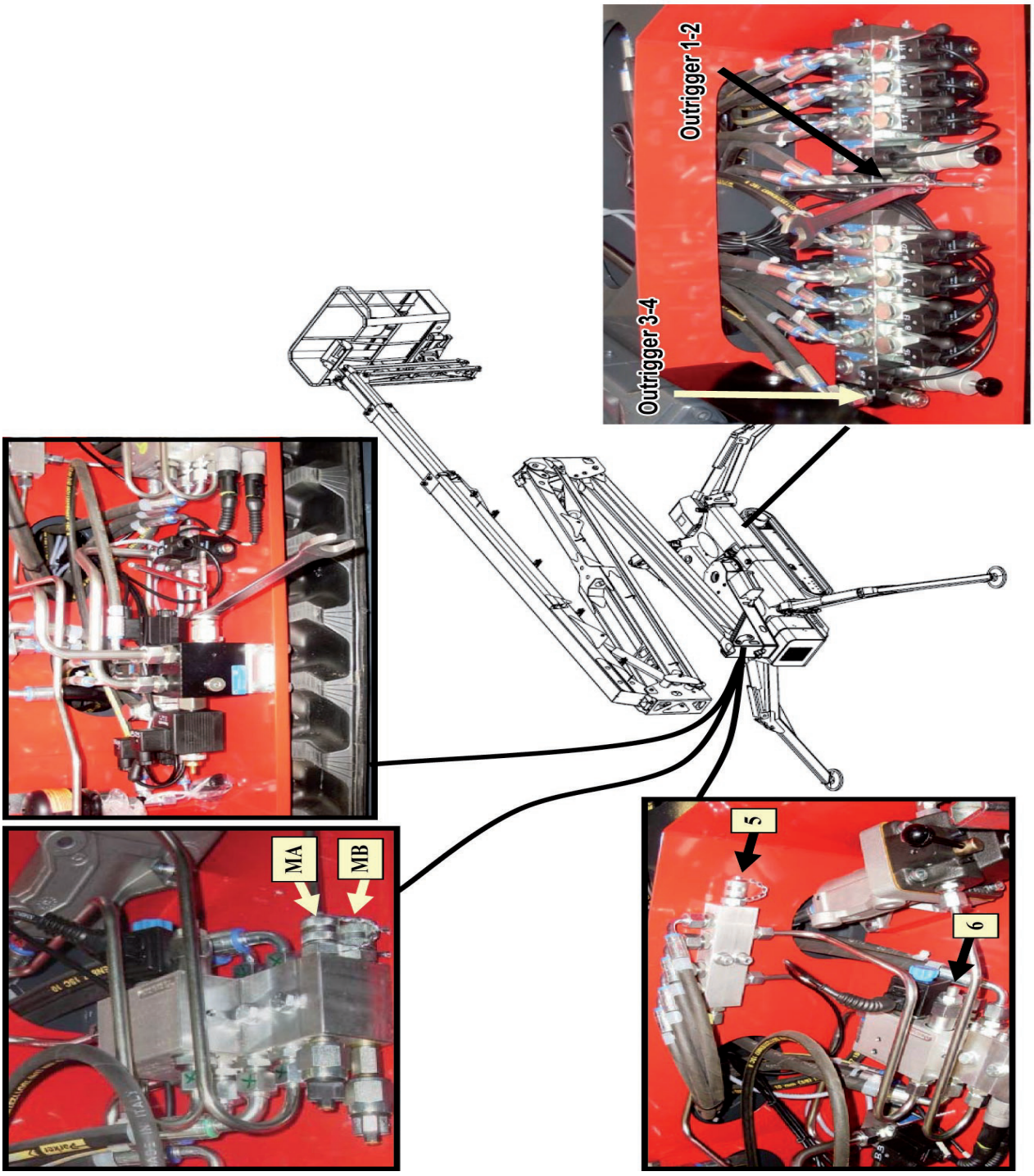


Figure 5-8. X23J-X700AJ

5.6 HYDRAULIC SCHEMATIC

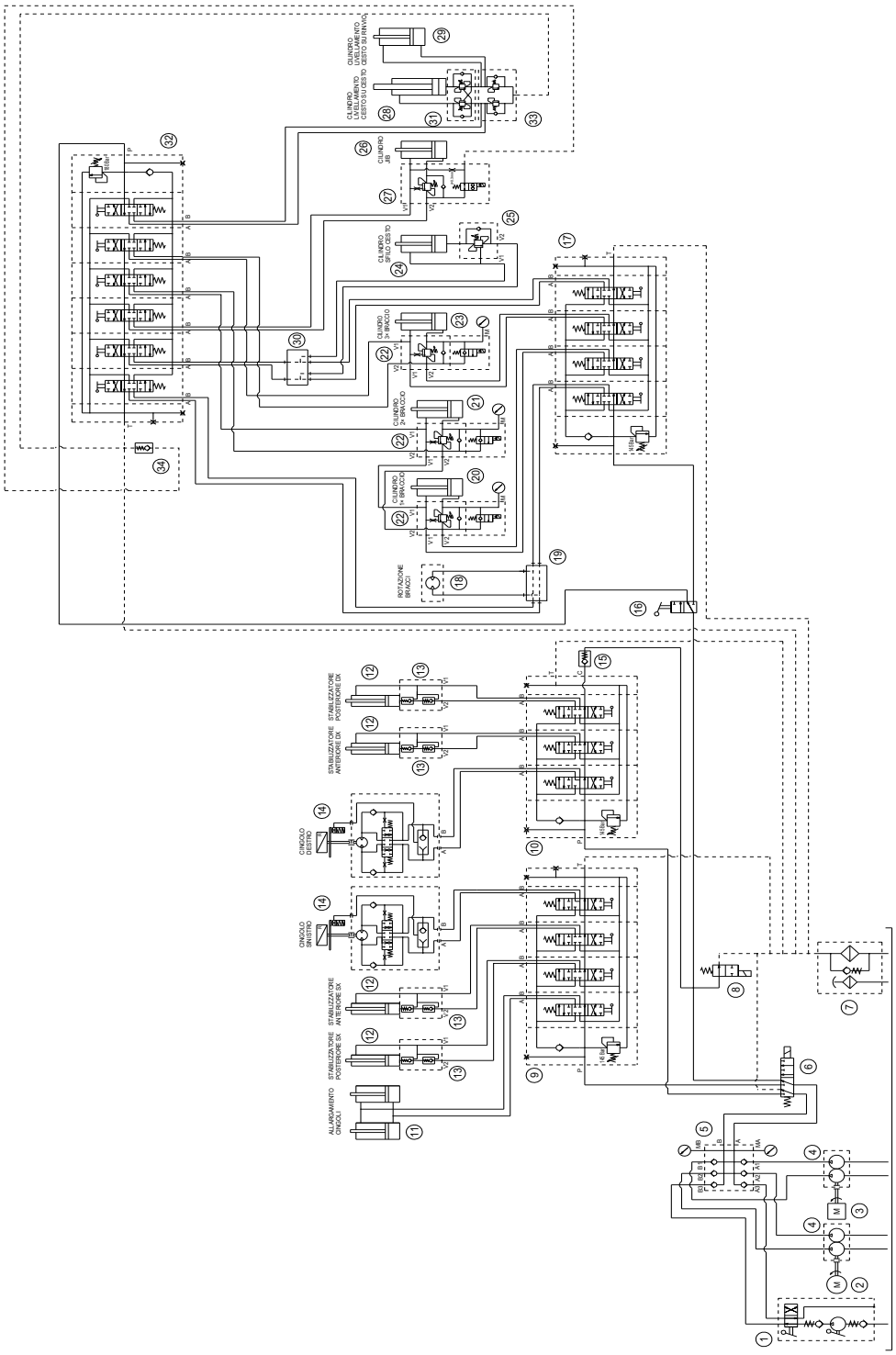


Figure 5-9. Hydraulic Schematic X14JH

LEGENDA HYDRAULIC SYSTEM X14JH

1. Hand pump
2. 2 2.2 W, 4 IP55 poles, electric engine
3. GX270 QME2 petrol engine

   1B30 Diesel engine
4. Double geared pump
5. Pump inlet manifold block
6. 6 way switch
7. Exhaust filter
8. Solenoid valve
9. Distributor
10. Distributor
11. Crawler widening cylinder
12. Stabilizer cylinder
13. Stabilizer locking valve
14. Gear motor
15. Non return valve
16. Switch
17. Distributor
18. Rotation engine
19. Manifold
20. First arm cylinder
21. Second arm cylinder
22. Arm balancing valve
23. Third arm cylinder
24. Withdraw cylinder
25. Withdraw balancing cylinder
26. Jib cylinder
27. Jib balancing valve
28. Basket levelling cylinder with jib
29. Basket levelling cylinder on transmission
30. Manifold
31. Double balancing valve
32. Distributor
33. Shock-proof valve with cartridge
34. Unidirectional valve with cartridge + cross joint

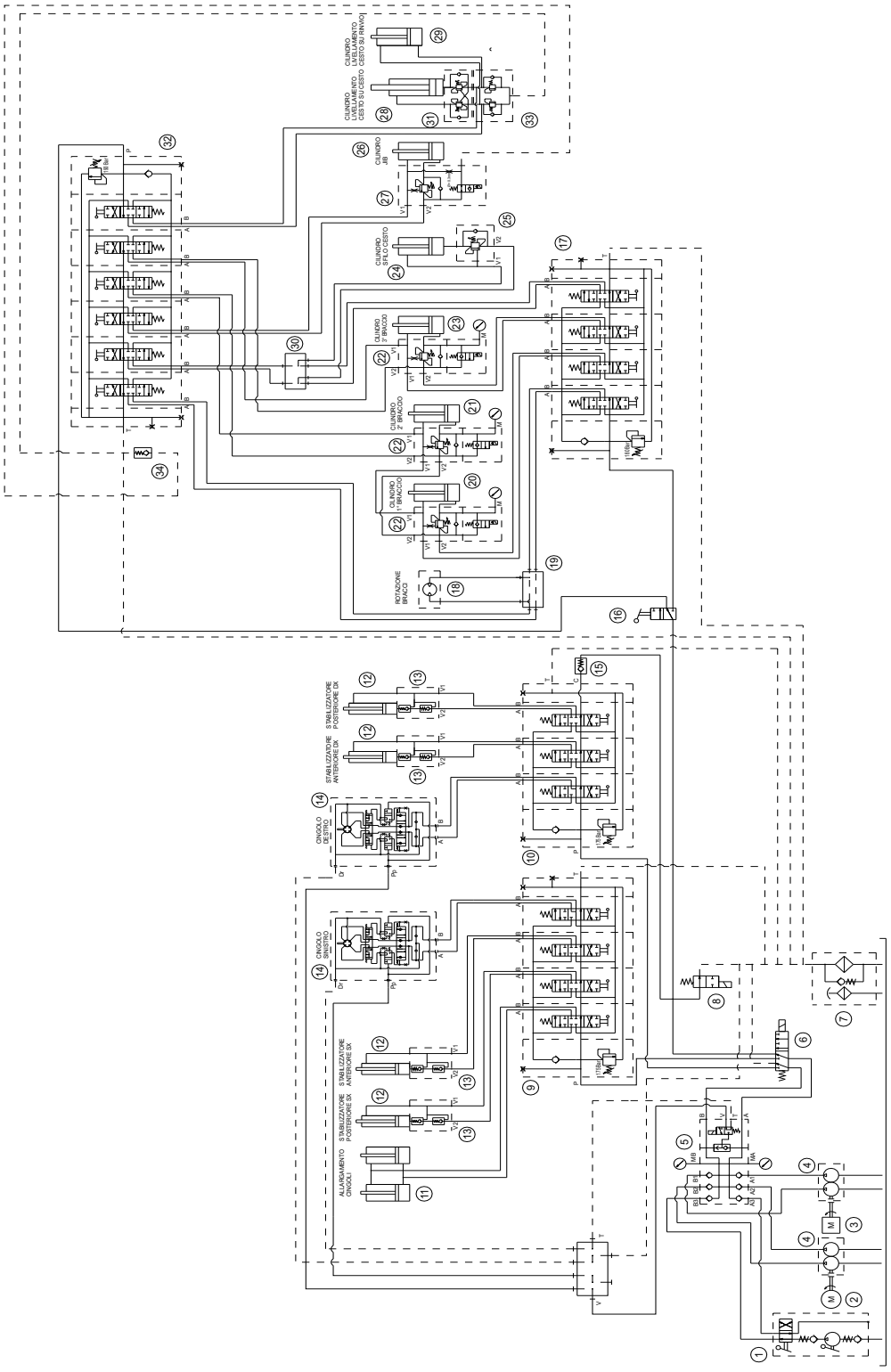


Figure 5-10. Hydraulic Schematic WITH 2ND SPEED X14JH

LEGENDA HYDRAULIC SYSTEM WITH 2ND SPEED X14JH

1. Hand pump
2. 2.2 W, 4 IP55 poles, electric engine
3. GX270 QME2 petrol engine
   1B30 Diesel engine
4. Double geared pump
5. Pump inlet manifold block
6. 6 way switch
7. Exhaust filter
8. Solenoid valve
9. Distributor
10. Distributor
11. Crawler widening cylinder
12. Stabilizer cylinder
13. Stabilizer locking valve
14. Gear motor
15. Non return valve
16. Switch
17. Distributor
18. Rotation engine
19. Manifold
20. First arm cylinder
21. Second arm cylinder
22. Arm balancing valve
23. Third arm cylinder
24. Withdraw cylinder
25. Withdraw balancing cylinder
26. Jib cylinder
27. Jib balancing valve
28. Basket levelling cylinder with jib
29. Basket levelling cylinder on transmission
30. Manifold
31. Double balancing valve
32. Distributor
33. Shock-proof valve with cartridge
34. Unidirectional valve with cartridge + cross joint

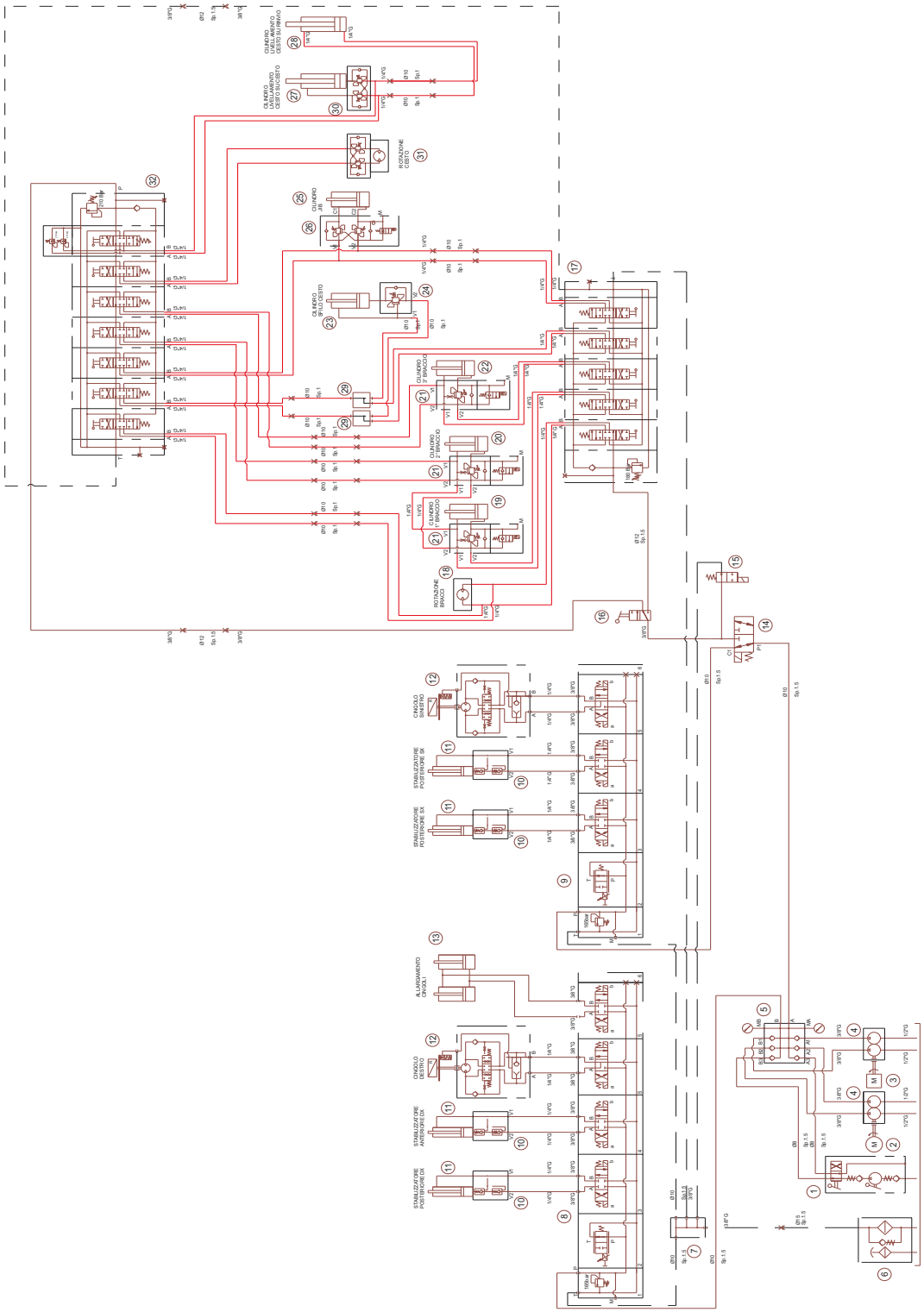


Figure 5-11. Hydraulic Schematic X17J

LEGENDA HYDRAULIC SYSTEM X17J

1. Hand pump
2. 2 kW 4 pole electric motor, IP55
3. Honda iGX440 petrol engine / Hatz 1B40 diesel engine
4. Double gear pump
5. Pump outlet manifold block
6. Discharge filter
7. Discharge manifold
8. Electroproportional distributor
9. Electroproportional distributor
10. Double stabilizer stop valve
11. Stabilizer cylinder
12. Gear motor
13. Track gauge extension cylinder
14. Directional solenoid valve
15. Aerial part safety device solenoid valve
16. Switch
17. Hydraulic distributor
18. Rotation motor
19. First arm cylinder
20. Second arm cylinder
21. Arm balance valve
22. Third arm cylinder
23. Extension arm cylinder
24. Extension arm balance valve
25. Jib arm cylinder
26. Double balance valve
27. Basket levelling cylinder on the basket
28. Basket levelling cylinder on the transmission
29. Extension arm pipe manifold
30. Double balance valve
31. Basket rotation actuator
32. Hydraulic distributor

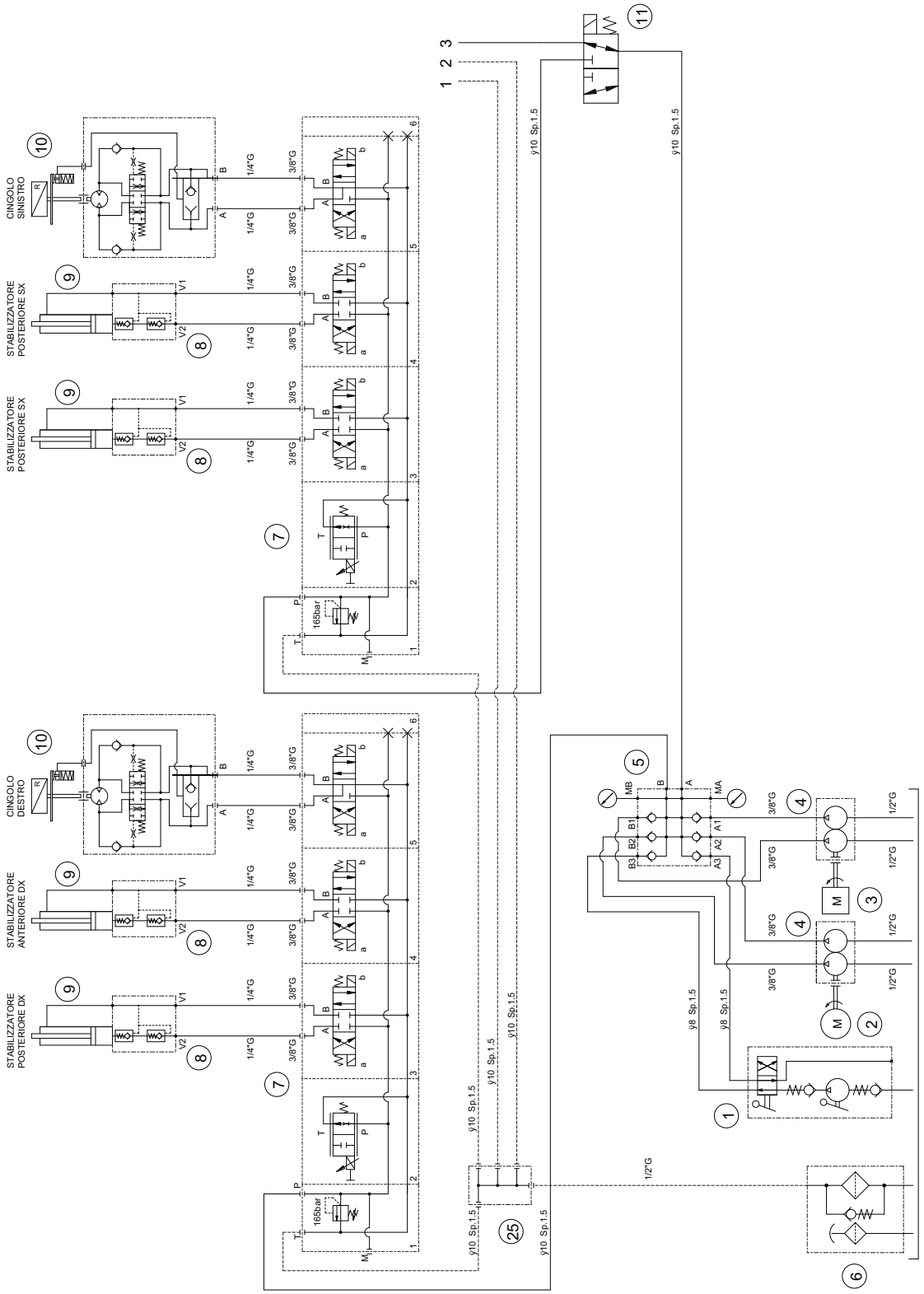


Figure 5-12. Hydraulic Schematic X14J-X390AJ Sheet 1 of 2

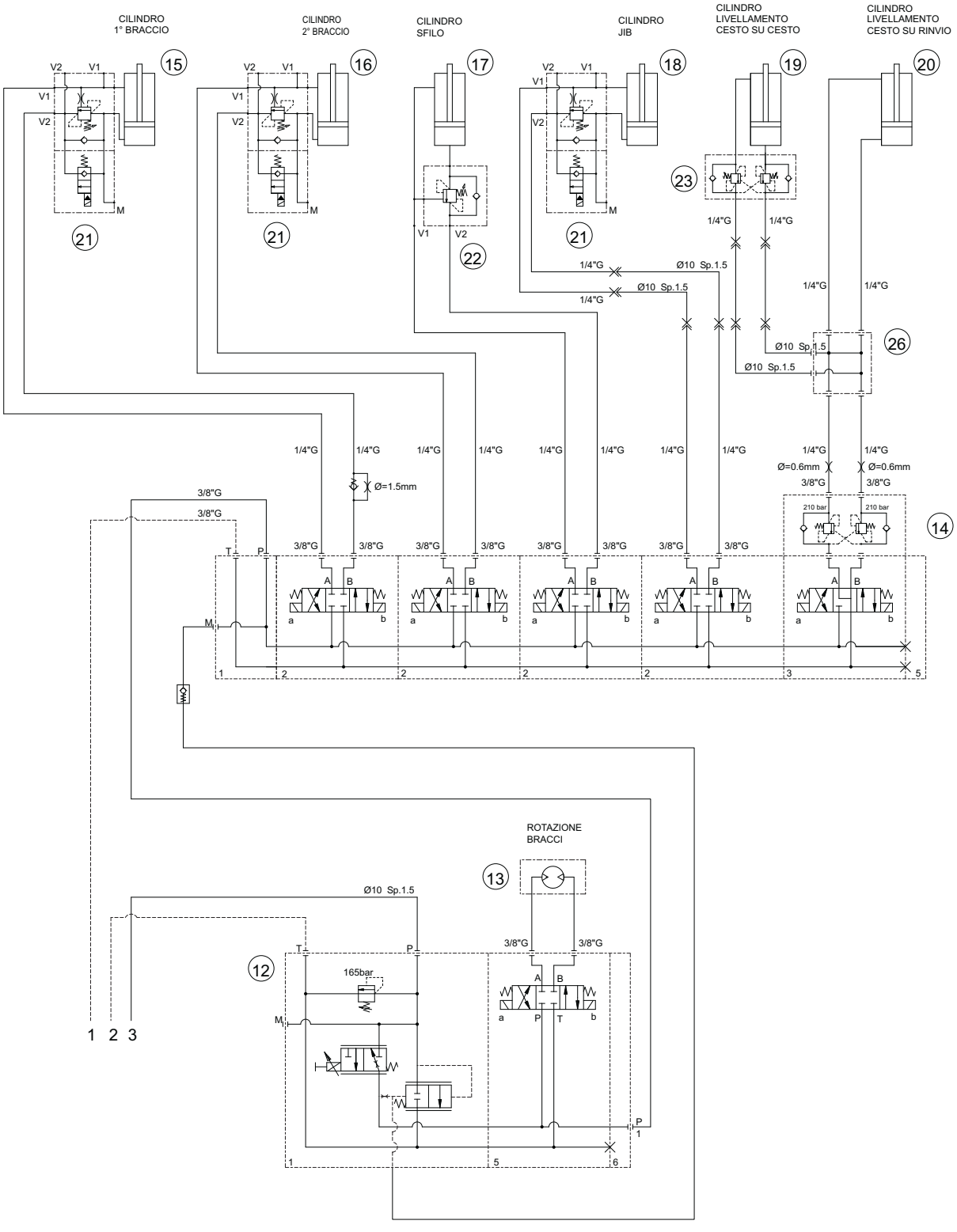


Figure 5-13. Hydraulic Schematic X14J-X390AJ Sheet 2 of 2

LEGENDA HYDRAULIC SYSTEM X14J-X390AJ

1. Hand pump
2. 2 kW 4 pole electric motor, IP55
3. GX270 QME2 petrol engine
   1B30 diesel engine
4. Double gear pump
5. Pump outlet manifold block
6. Discharge filter
7. Distributor
8. Stabilizer stop valve
9. Stabilizer cylinder
10. Gear motor
11. Directional solenoid valve
12. Rotation distributor
13. Rotation motor
14. Distributor
15. First arm cylinder
16. Second arm cylinder
17. Extension arm cylinder
18. Jib arm cylinder
19. Basket levelling cylinder on the basket
20. Basket levelling cylinder on the transmission
21. Arms balance valve
22. Extension arm balance valve
23. Double balance valve
24. Jib arm balance valve
25. Balance valve
26. Discharge collector
27. Collector

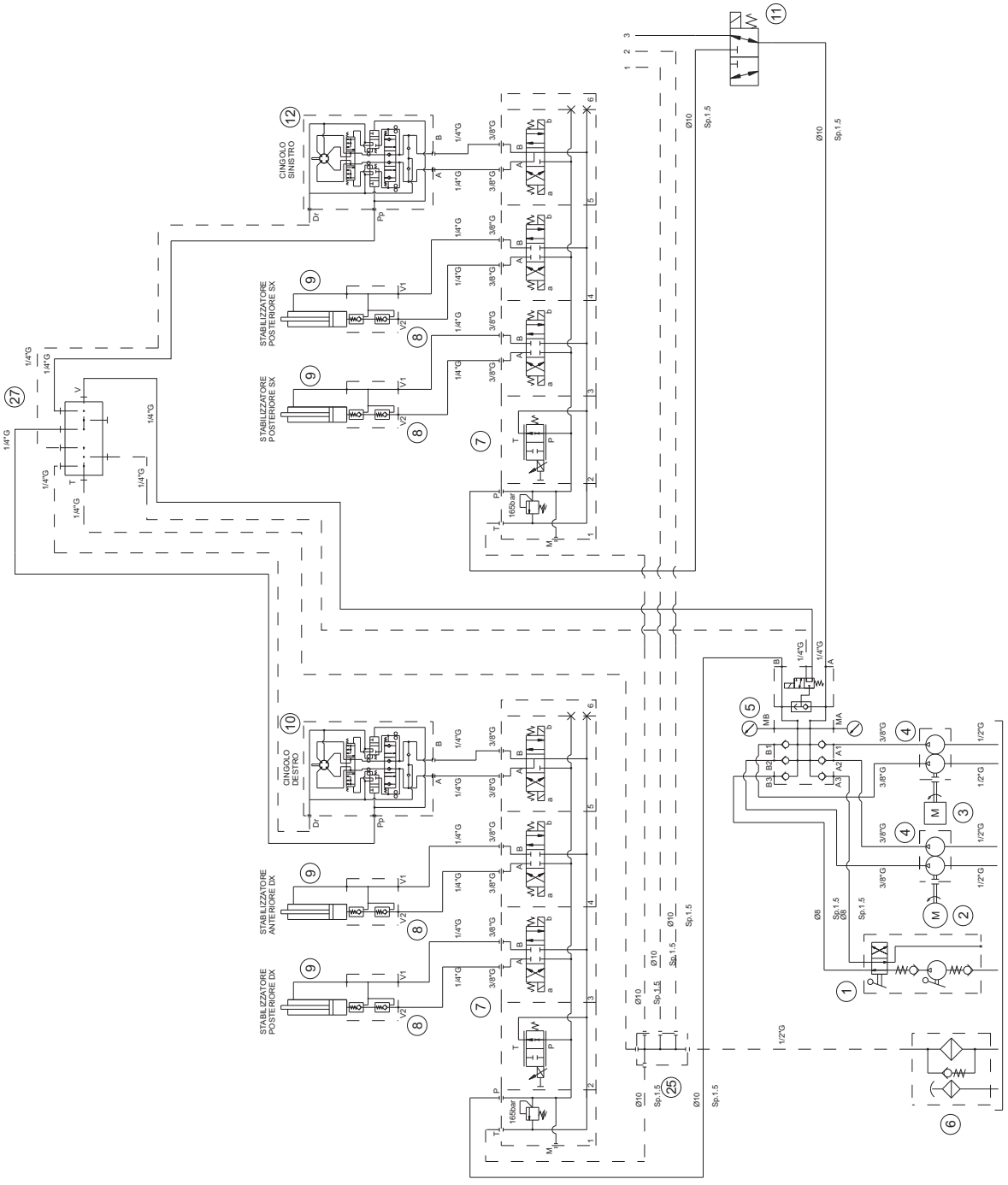


Figure 5-14. Hydraulic Schematic WITH 2ND SPEED X14J-X390AJ Sheet 1 of 2

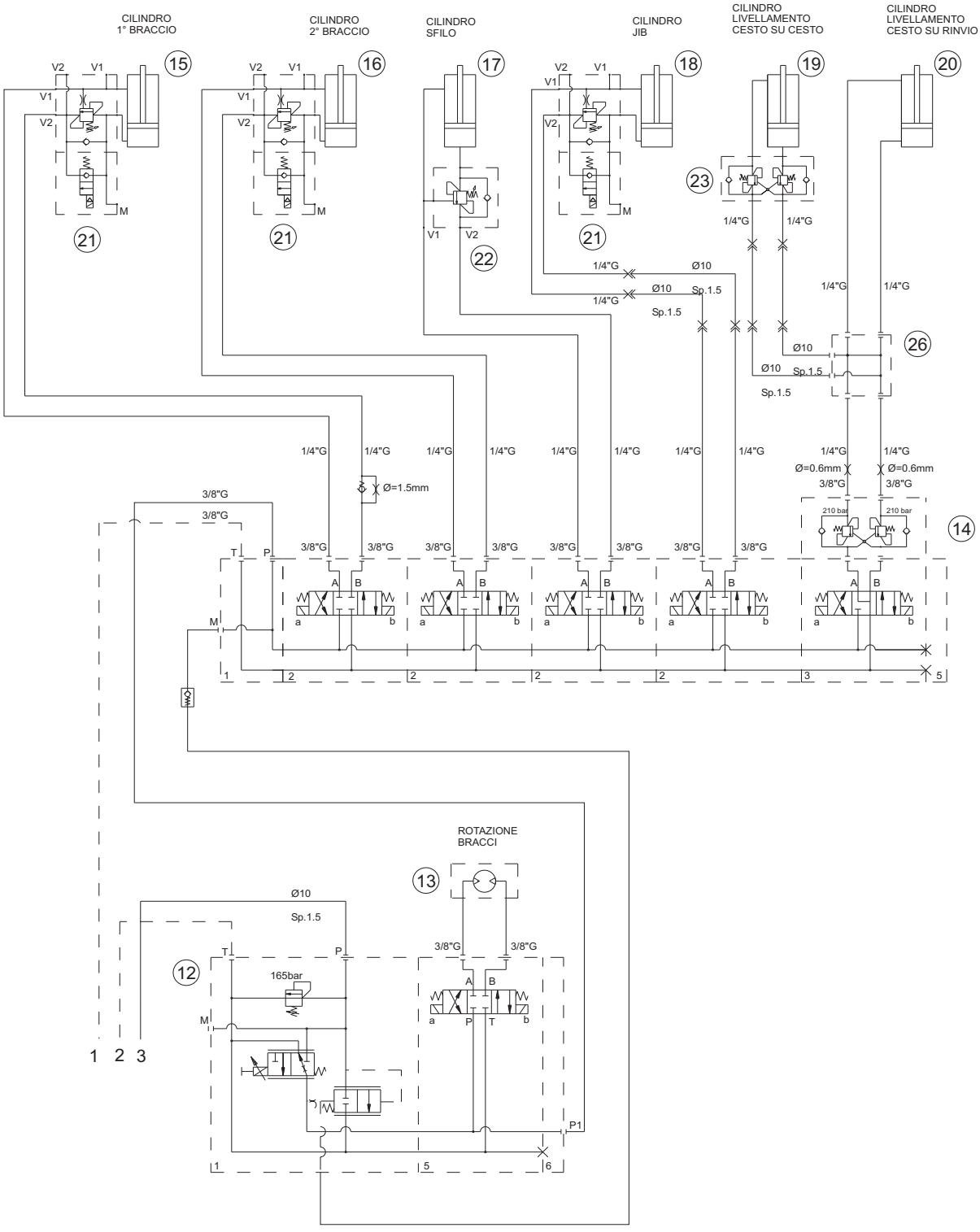


Figure 5-15. Hydraulic Schematic WITH 2ND SPEED X14J-X390AJ Sheet 2 of 2

LEGENDA HYDRAULIC SYSTEM WITH 2ND SPEED X14J-X390AJ

1. Hand pump
2. 2 kW 4 pole electric motor, IP55
3. GX270 QME2 petrol engine
   1B30 diesel engine
4. Double gear pump
5. Pump outlet manifold block
6. Discharge filter
7. Distributor
8. Stabilizer stop valve
9. Stabilizer cylinder
10. Gear motor
11. Directional solenoid valve
12. Rotation distributor
13. Rotation motor
14. Distributor
15. First arm cylinder
16. Second arm cylinder
17. Extension arm cylinder
18. Jib arm cylinder
19. Basket levelling cylinder on the basket
20. Basket levelling cylinder on the transmission
21. Balance valve of the arms
22. Balance valve extension arm
23. Double balance valve
24. Balance valves
25. Discharge collectors
26. Collector
27. Collector

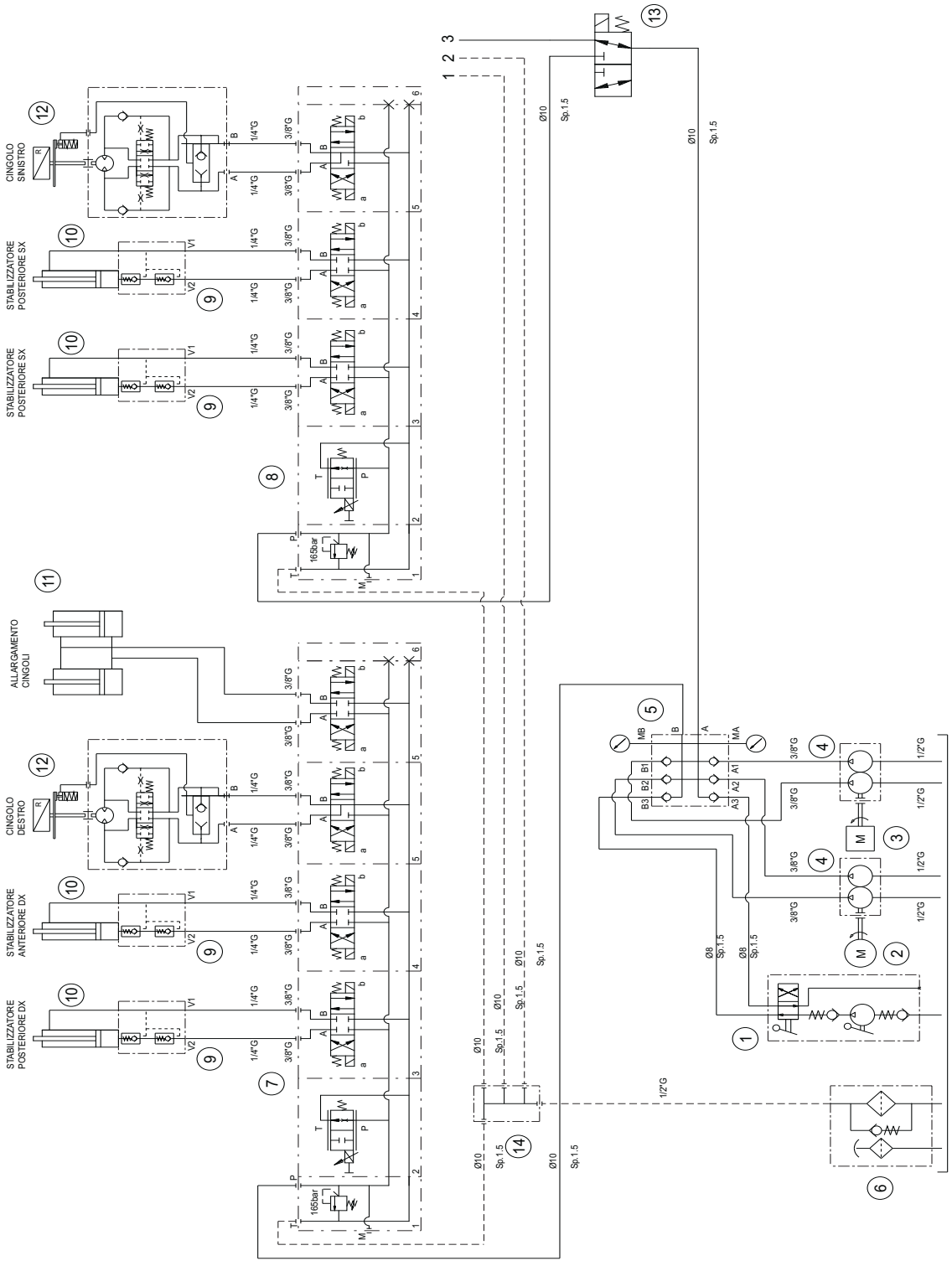


Figure 5-16. Hydraulic Schematic X19J-X550AJ Sheet 1 of 2

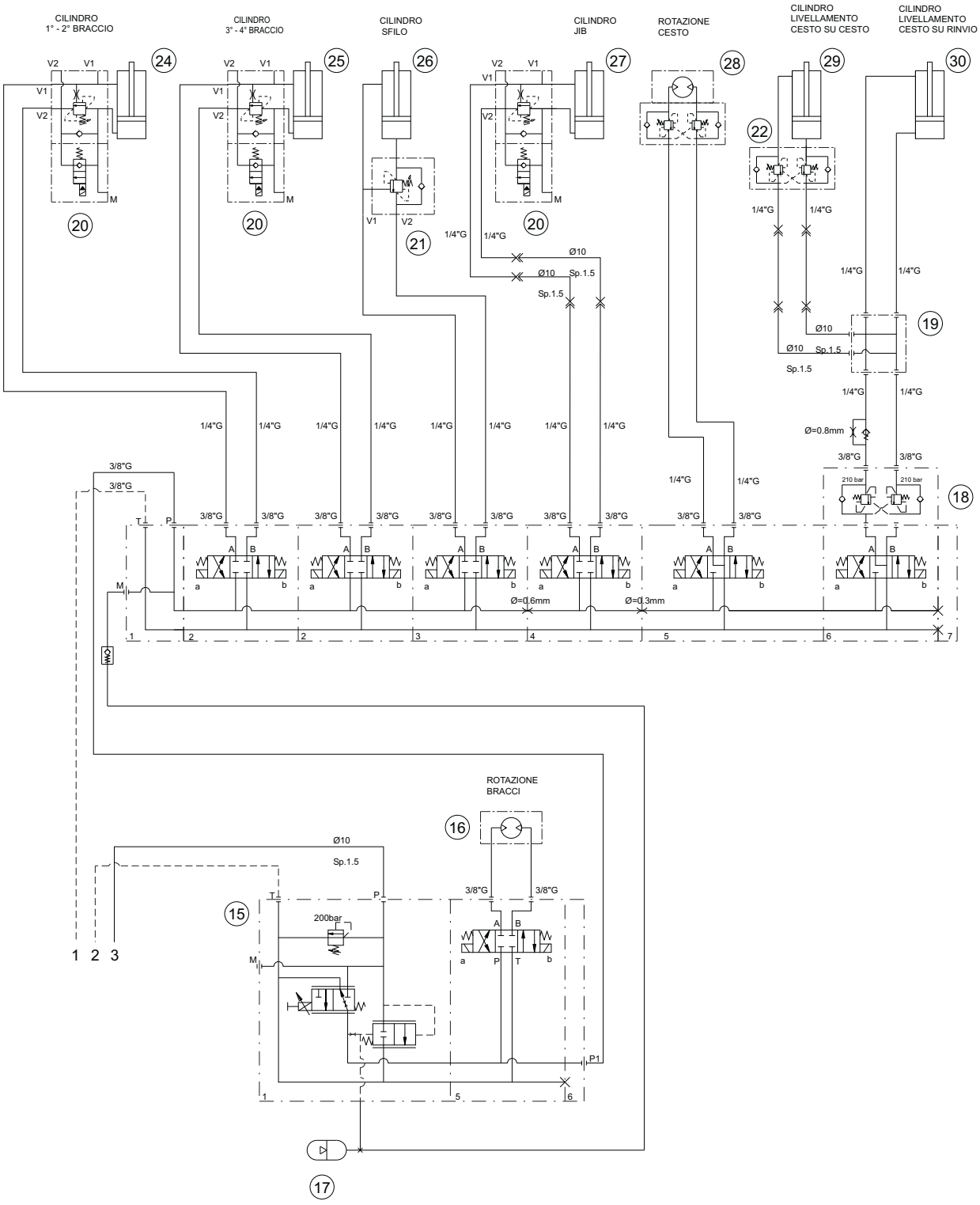


Figure 5-17. Hydraulic Schematic X19J-X550AJ Sheet 2 of 2

LEGENDA HYDRAULIC SYSTEM X19J-X550AJ

1. Hand pump
2. 2.2 kW 4 pole electric motor, IP55
3. Honda iGX440 petrol engine / Hatz 1B40 diesel engine
4. Double gear pump
5. Pump outlet manifold block
6. Discharge filter
7. Right-hand side + track gauge extension distributor
8. Left-hand side distributor
9. Stabilizer stop valve
10. Stabilizer cylinder
11. Track gauge extension cylinder
12. Gear motor
13. Directional solenoid valve
14. Discharge manifold
15. Rotation distributor
16. Rotation motor
17. Battery
18. Aerial part distributor
19. Manifold
20. Arm balance valve
21. Extension arm balance valve
22. Double balance valve
23. First-second arm cylinder
24. Third-fourth arm cylinder
25. Extension arm cylinder
26. Jib cylinder
27. Basket rotation actuator
28. Basket levelling cylinder on the basket
29. Basket levelling cylinder on the transmission

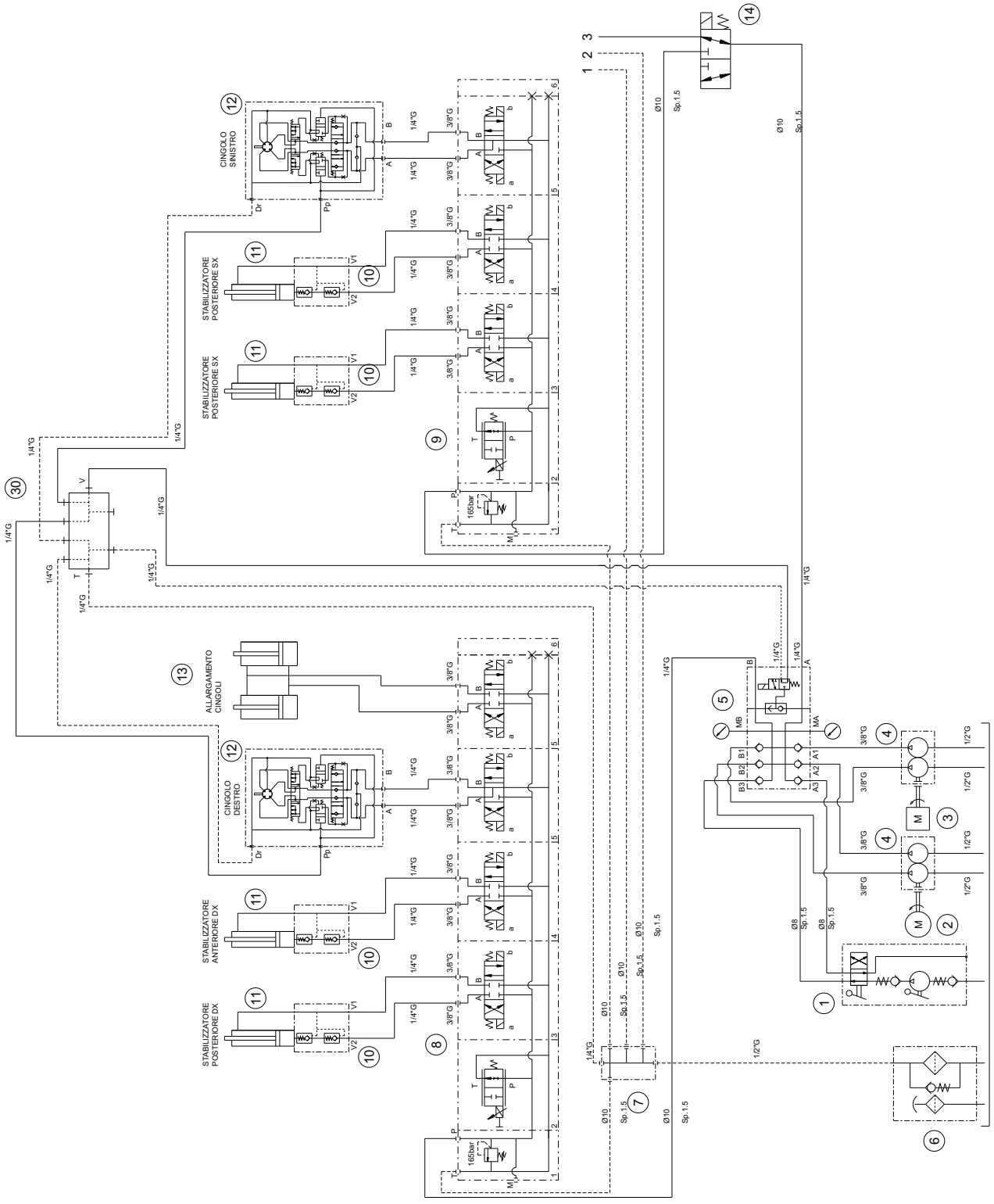


Figure 5-18. Hydraulic Schematic WITH 2ND SPEED X19J-X550AJ Sheet 1 of 2

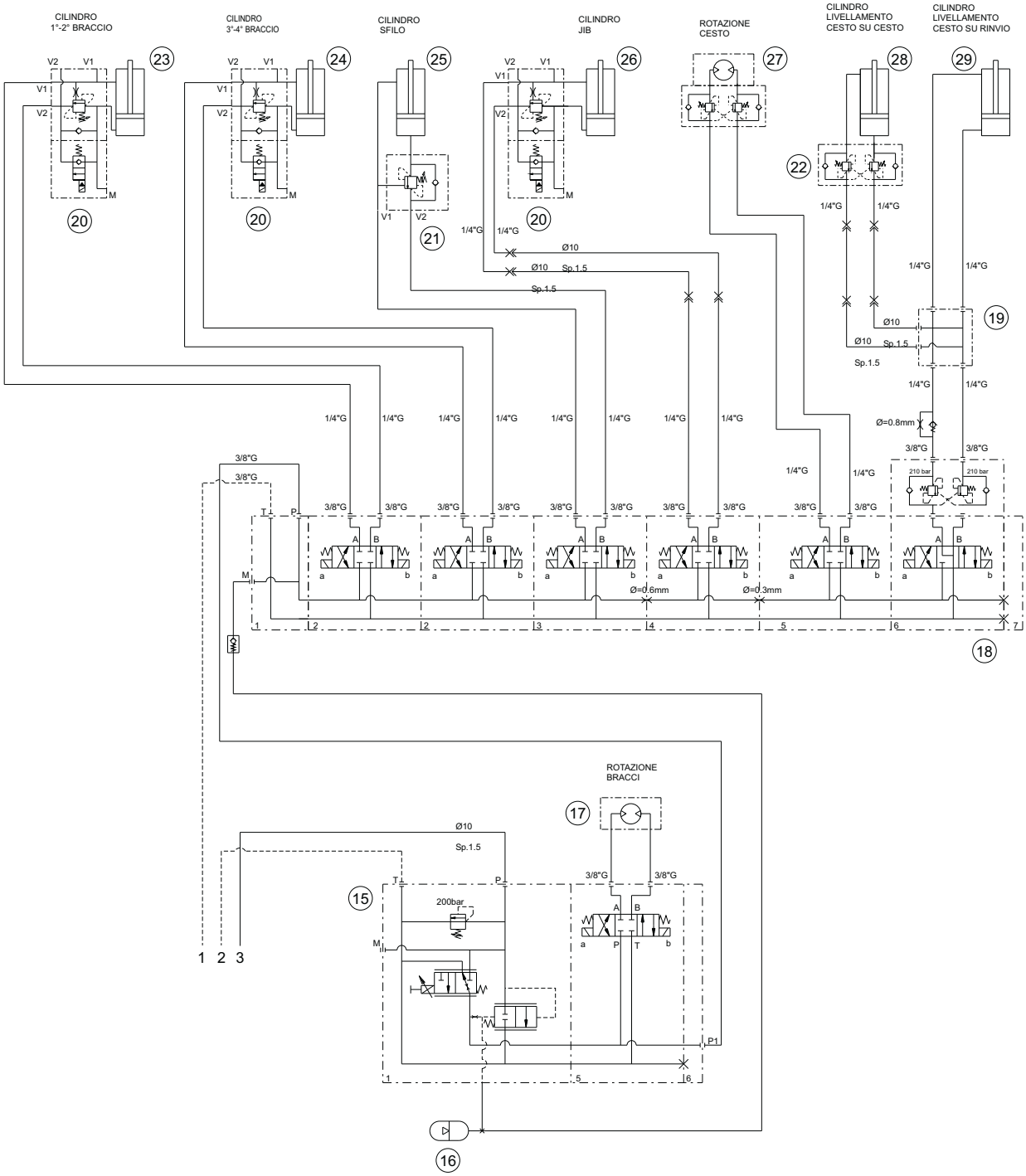


Figure 5-19. Hydraulic Schematic WITH 2ND SPEED X19J-X550AJ Sheet 2 of 2

LEGENDA HYDRAULIC SYSTEM WITH 2ND SPEED X19J-X550AJ

1. Hand pump
2. 2.2 kW 4 pole electric motor, IP55
3. iGX440 petrol engine

   1B40 10 HP diesel engine
4. Double gear pump
5. Pump outlet manifold block
6. Discharge filter
7. Discharge manifold
8. Distributor
9. Distributor
10. Stabilizer stop valve
11. Stabilizer cylinder
12. Gear motor
13. Track gauge extension cylinder
14. Directional solenoid valve
15. Rotation distributor
16. Battery
17. Rotation motor
18. Distributor
19. Manifold
20. Arm balance valve
21. Extension arm balance valve
22. Double balance valve
23. First-second arm cylinder
24. Third-fourth arm cylinder
25. Extension arm cylinder
26. Jib cylinder
27. Basket rotation actuator
28. Basket levelling cylinder on the basket
29. Basket levelling cylinder on the transmission
30. Manifold

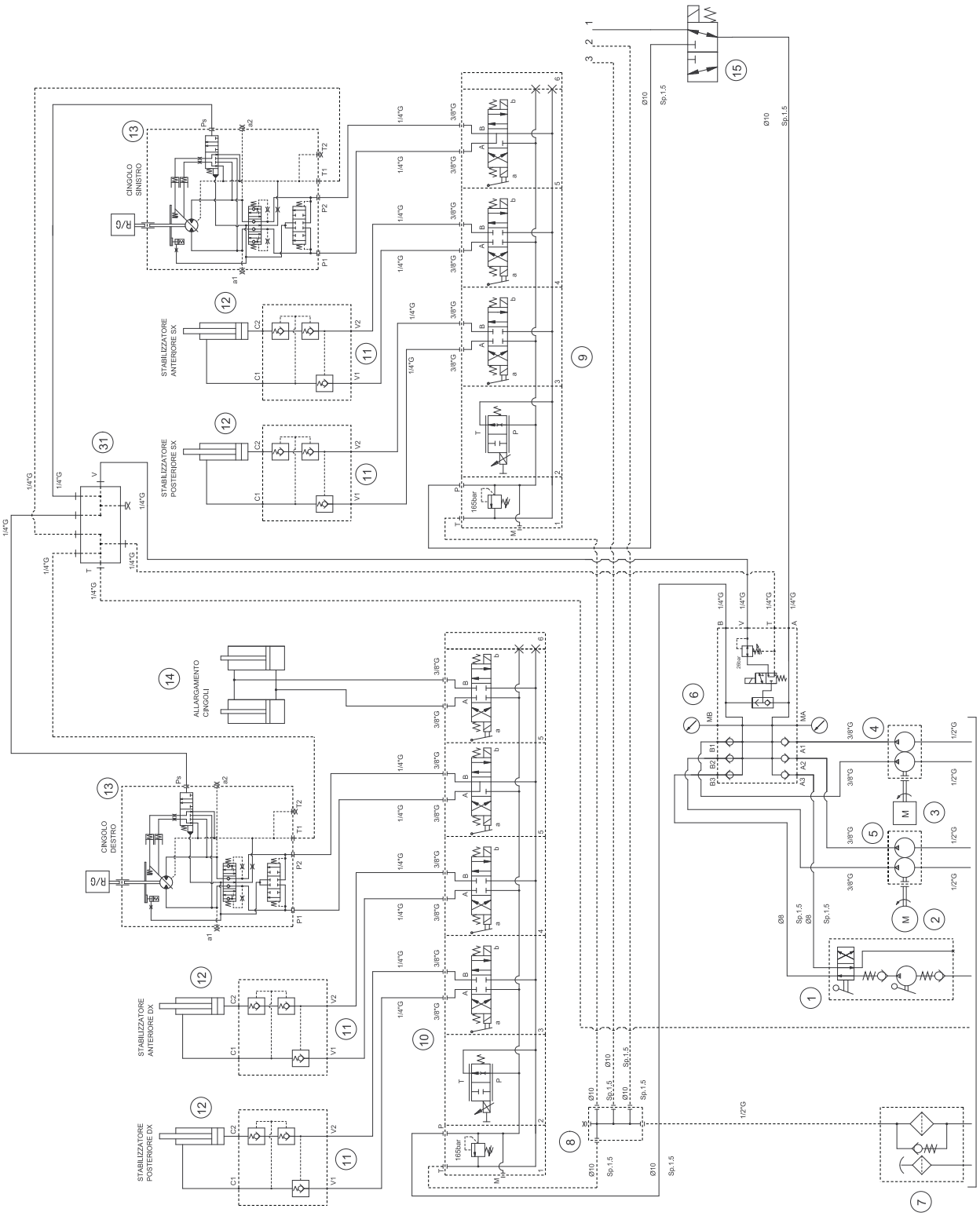


Figure 5-20. Hydraulic Schematic X23J-X700AJ Sheet 1 of 2

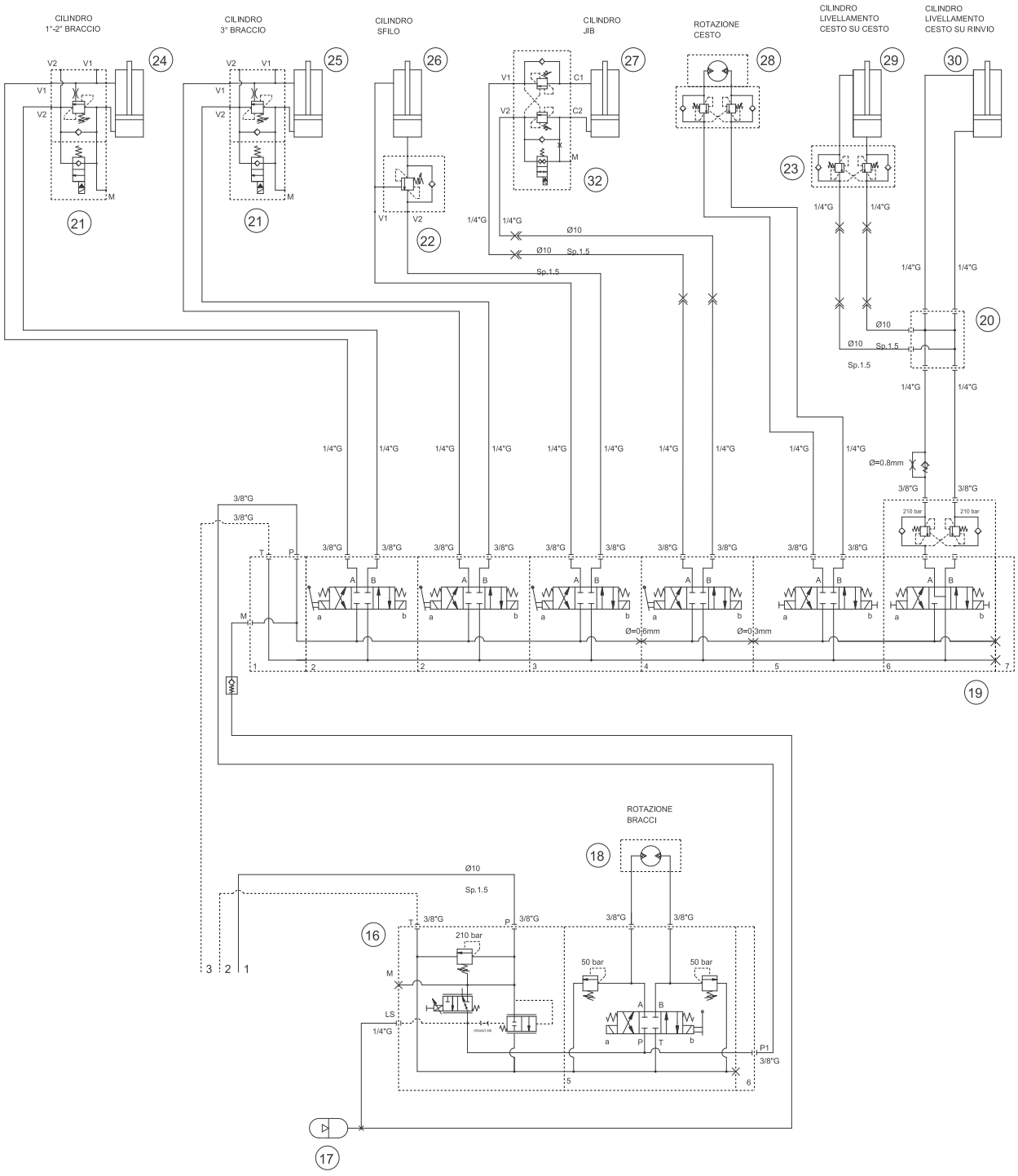


Figure 5-21. Hydraulic Schematic X23J-X700AJ Sheet 2 of 2

LEGENDA HYDRAULIC SYSTEM X23J-X700AJ

1. Hand pump
2. 2.2 kW 4 pole IP55 electric engine
3. Honda IGX440 petrol engine/Perkins 402-05 diesel engine
4. Double gear-type pump 4+4
5. Double gear-type pump 3.15+3.15
6. Delivery pump collector block
7. Discharge filter
8. Unloads collector
9. Distributor
10. Distributor
11. Outrigger lock valve
12. Outrigger cylinder
13. Geared motor
14. Cylinder for track widening
15. Directional electrovalve
16. Rotation distributor
17. Accumulator
18. Rotation engine
19. Distributor
20. Collector
21. Arm balancing valve
22. Extension balancing valve
23. Double balancing valve
24. First-second arm cylinder
25. Third arm cylinder
26. Extension cylinder
27. Jib cylinder
28. Basket rotation rotating actuator
29. Basket on basket levelling cylinder
30. Basket on connection levelling cylinder
31. Collector
32. Jib double balancing valve

NOTES:

SECTION 6. JLG CONTROL SYSTEM

6.1 INTRODUCTION

NOTICE

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

NOTICE

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

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

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

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

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

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

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

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

CE X14J X19J X23J

ANSI X390AJ X550AJ X700AJ

The Remote Control is connected by radio on the X17J.

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

6.2 PLATFORM/REMOTE CONTROL STATION LCD DISPLAY

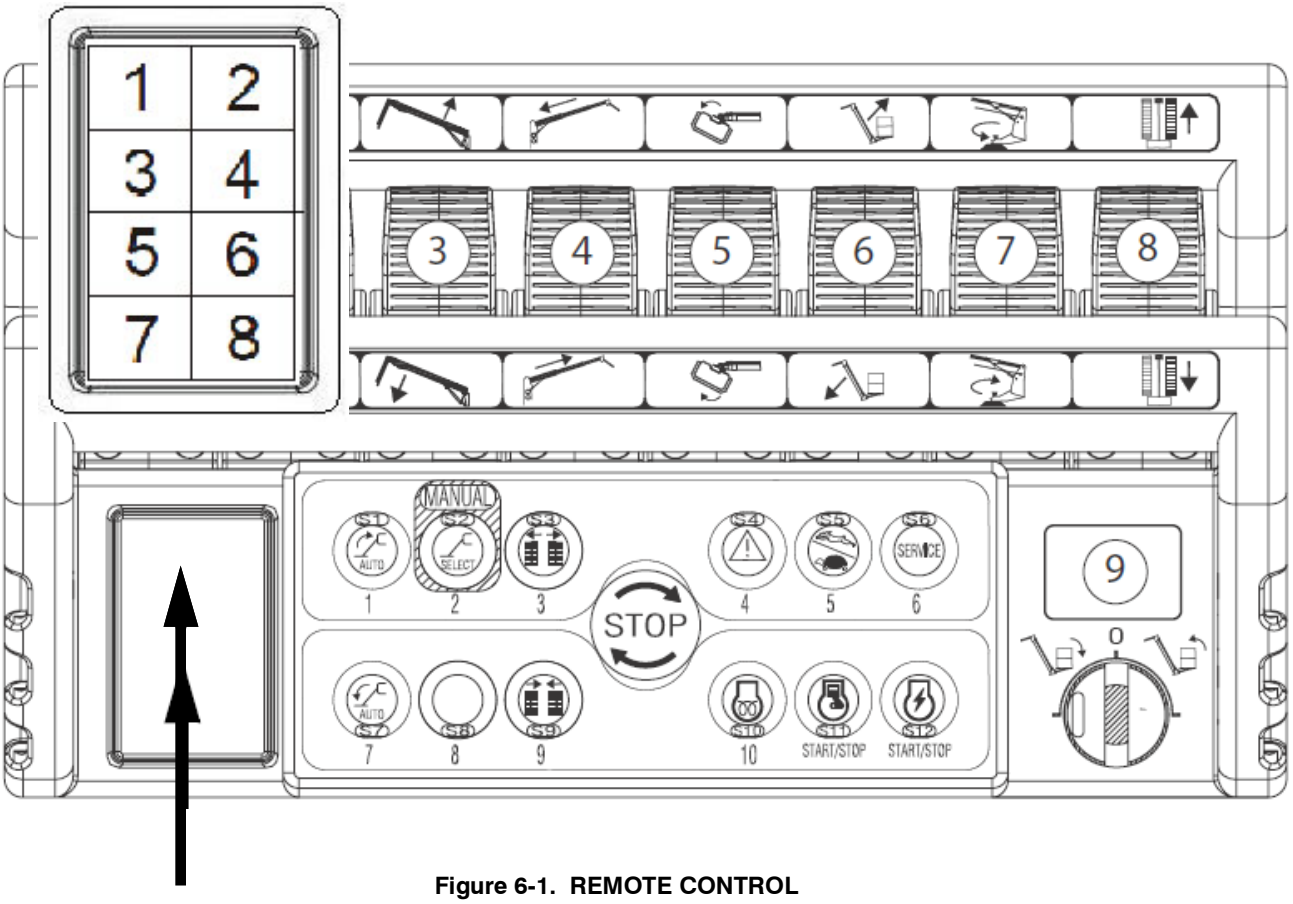


Figure 6-1. REMOTE CONTROL

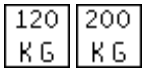
At machine start-up and during machine operation the main LCD display screen (Figure 6.1) is activated. There are eight (8) display positions which indicate machine status during various stages of operation.

NOTE: *J1 - J9 = Joysticks*

Position 1

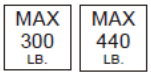
Reduced operating area if all outriggers are not fully deployed.

1	2
3	4
5	6
7	8



Position 2

Displays the capacity based on jib position.



1	2
3	4
5	6
7	8

Position 3

Displays the selected engine (gas/diesel or electric) and whether it is on or off. The X on the icon indicates the engine is off.

1	2
3	4
5	6
7	8

Position 4

Displays the selected engine speed.

1	2
3	4

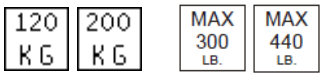
5	6
7	8

Position 5

Displays that the outriggers are properly set and boom functions are allowed.

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

1	2
3	4
5	6
7	8



If an overload occurs the main screen goes blank for 3 seconds followed by the overload error display and an alarm.

Position 6

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

Drive and steer are operational if all 4 outriggers are not contacting the ground.

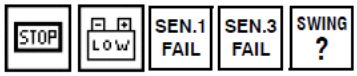
1	2
3	4
5	6
7	8

Position 7

Can indicate any of the following situations:

- An emergency stop is pushed in (off).
- A low battery. The batteries need charged by running the gas/diesel engine or connecting to a power source.
- Tower boom sensor is faulty.
- Main boom sensor is faulty. Boom functions are cut out.

- Swing sensor is faulty.
- CANBUS communication is faulty.



- Electronic fault.

1	2
3	4
5	6
7	8

Position 8

Indicates that emergency lowering has been selected.

1	2
3	4
5	6
7	8

DISPLAY ICONS

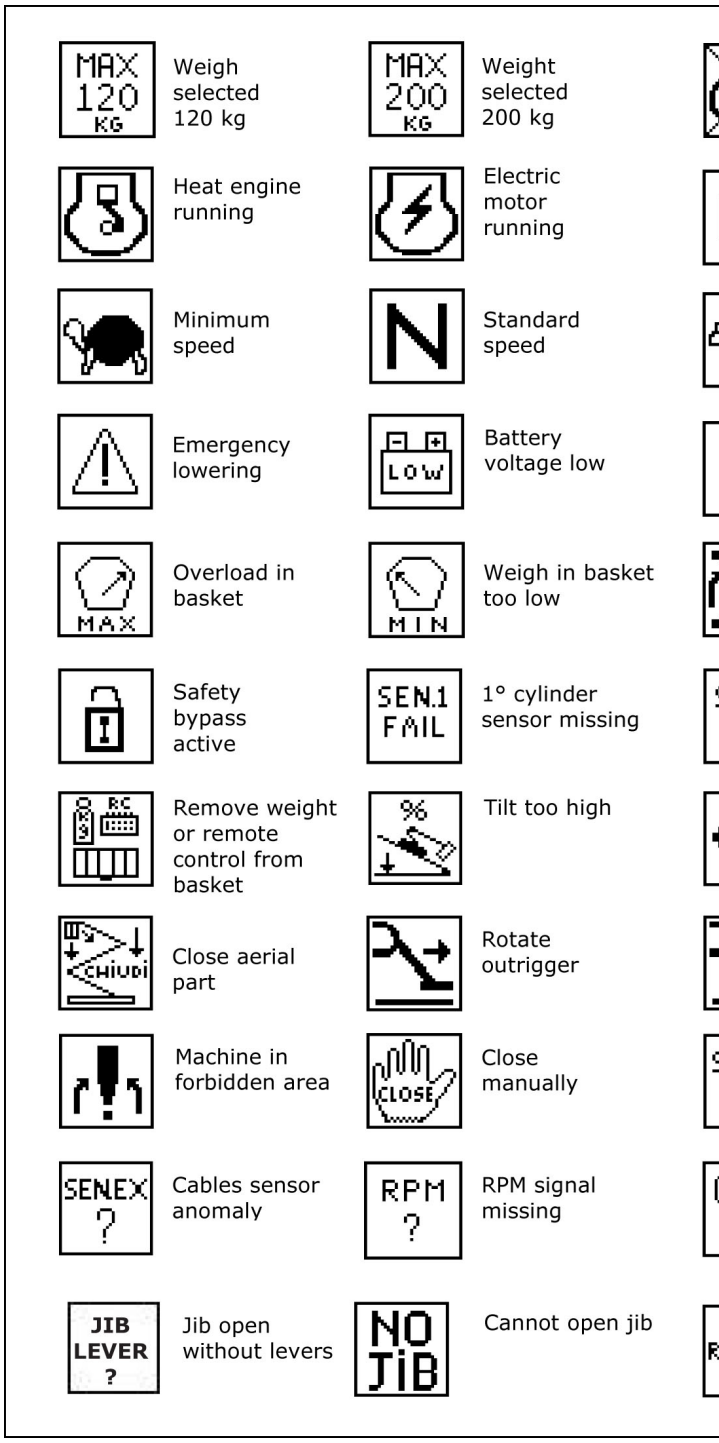


Figure 6-2. Display icons

6.3 CANBUS COMMUNICATIONS

The electrical system works with a CAN BUS system, where:

CAN = Control Area Network

BUS = Channels for peripherals

CANbus: CAN (Control Area Network) is a two wire differential serial link between the, Ground Module ECM1-2; the Remote Control (Or receiver); the LSS ECM3, the working area Module ECM4; the Cylinders position sensors and the Rham Modem Module providing bi-directional communications.

Two-wire: One wire (White; Black or Black with numbers) is driven high (5v) and the other low (Gray; Brown or Black with number) (0v) to send a signal; both wires"float" (2.5v) when no signal is being sent.

Differential: Any electrical line noise can affect the high or

The low wires but never both, so communications is not corrupted.

Serial Link: Messages are being sent bit by bit along the wires; the high bus speeds allow all modules to be constantly updated around 20 times per second. Typical traffic is 300 - 500 messages per second.

A complete CANbus circuit is approximately 60 ohms,

Each individual circuit from the modules is approximately 120 ohms.

The GROUND MODULE ECM1-2 is the master system controller.

Most functions are dispatched and coordinated from this module, all other system modules; Remote Control (Or receiver); LSS ECM3, working area Module ECM4; Cylinders position sensors; Rham Modem.

Fundamental characterized information (values) are stored into the ground module ECM 1-2 (i.e., Personalities or Calibrations), while on the LSS ECM3 the basket load setting and on the Module ECM4 the working area.

Lift, Tele, Swing & Drive:

The GROUND MODULE ECM1-2 stores default values, handles interlocks and calibration information.

Lift, Telescope Swing and Drive commands are dependent upon interlocks through out the machine that enables the power supply of the ON -OFF proportional coils after verification of the safety conditions by handles interlocks.

The safety control functioning ECM1 can be by - passed by the key selector switch (spring return) "safety device by-pass key".

The circuit board ECM1 stores any by-pass event by date, time and duration of the "safety device by-pass key" action.

Dual capacity and Load Sensing System

The module ECM3 control the max load on the basket and two different working area; jib open max 120 kg - jib closed max 200 kg.

When the maximum accepted load is reached, an icon appears on the remote control display.

Restricted Work Area Position

On the X23J and the X700AJ the working area Module ECM4, control if at least one of the outriggers is set in the restricted area position. The platform/remote control box LCD will display the symbol for restricted area operation which is always visible during the use of the machine in this set up.

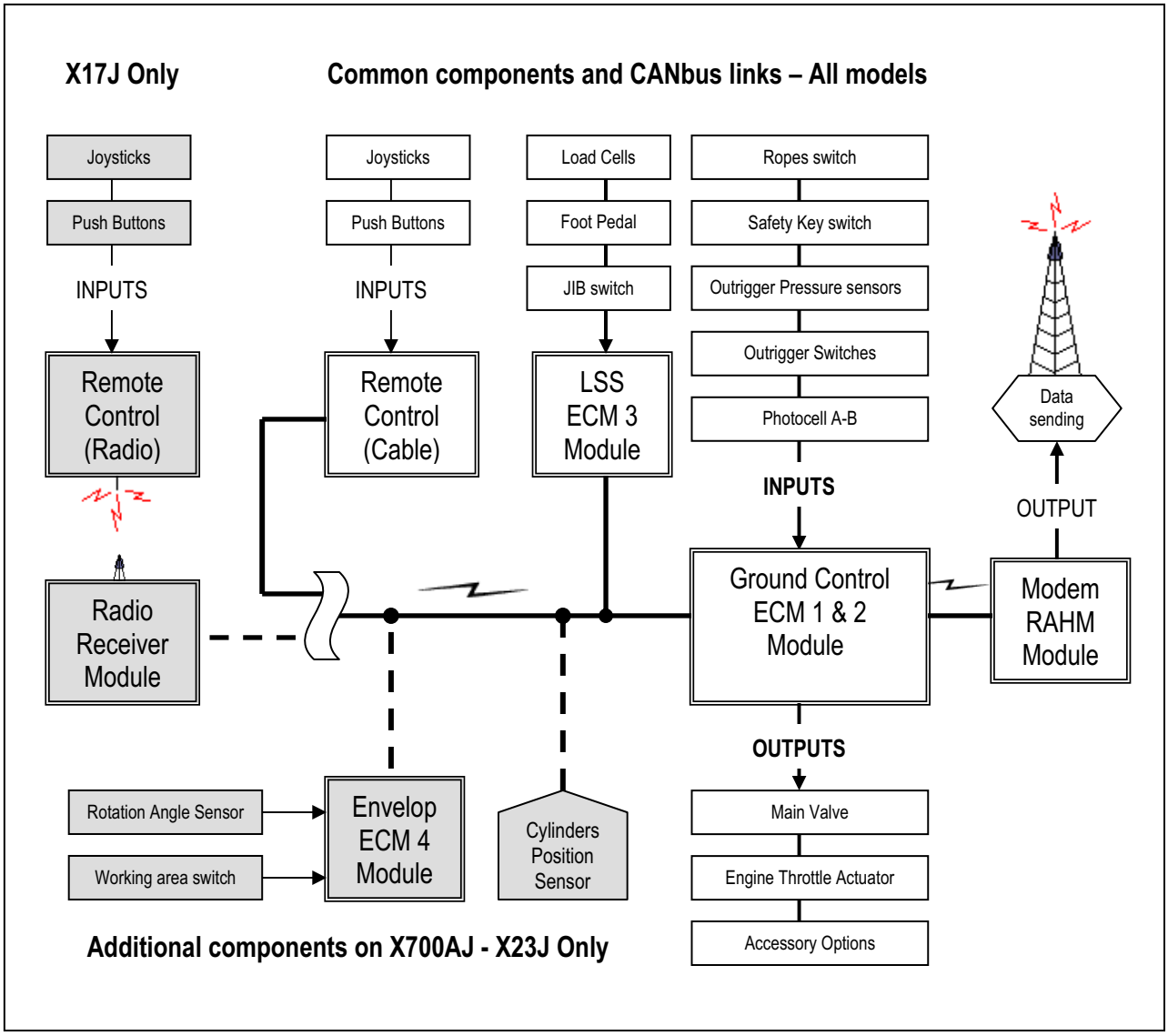


Figure 6-3. Control System Block Diagram

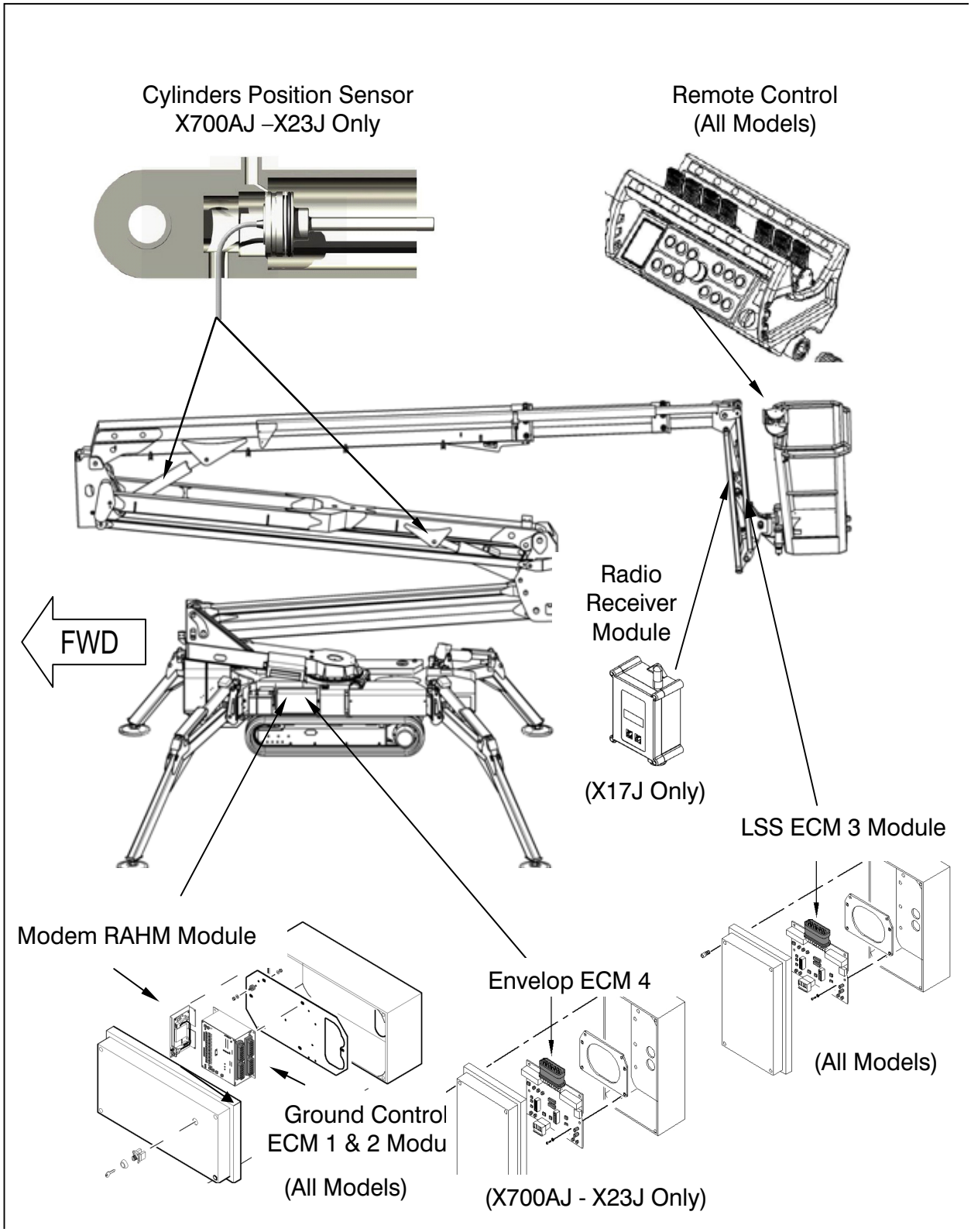


Figure 6-4. CONTROL MODULE LOCATION

MODULE FLASHING CODE

MODULE ECM 1

With Led's permanently ON:

DL1-GREEN

Power +5V to CPU

DL2- Yellow Power for aerial functions available

DL3-Yellow:

Power for drive functions available

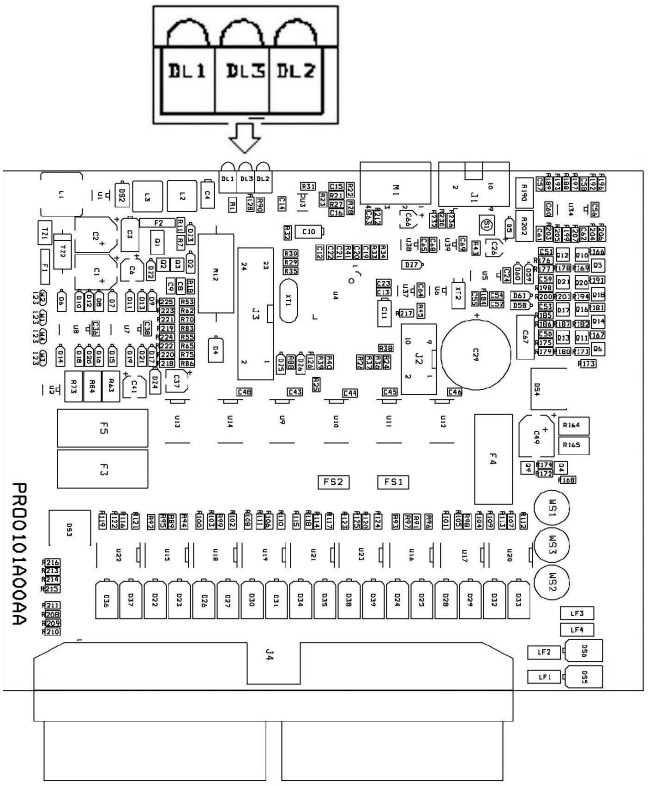


Figure 6-5. Module ECM 1

MODULE ECM 2

With Led's permanently ON

DL1-GREEN Power +5V to CPU A

DL2-GREEN Power +5V to CPU B

DL3 - Yellow Safety Relay for aerial functions CPU B closed

DL4 - Yellow Safety Relay for drive and Outriggers functions CPU B closed

DL3 - Yellow Safety Relay for aerial functions CPU A closed

DL4 - Yellow Safety Relay for drive and Outriggers functions CPU A closed

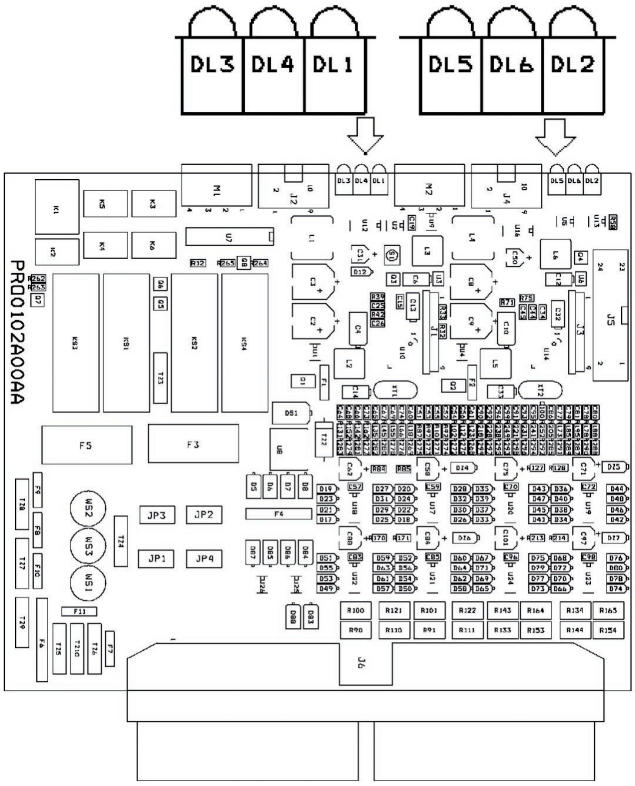


Figure 6-6. Module ECM 2

MODULE LOAD SENSING SYSTEM ECM3

With Led's DL1 –DL3 & DL2 –DL4 Blinking (green/red) Module LSS not calibrate.

With Led's DL1 DL2 green permanently ON, means LSS Module calibrate (even if out of range).

MODULE ENVELOPE ECM4 (X23J X700AJ ONLY)

With Led's DL1 –DL3 & DL2 –DL4 Blinking (green/red) Module Envelop not calibrate or out of the range.

With Led's DL1 DL2 green permanently ON, means calibration of the Envelope Module within the range.

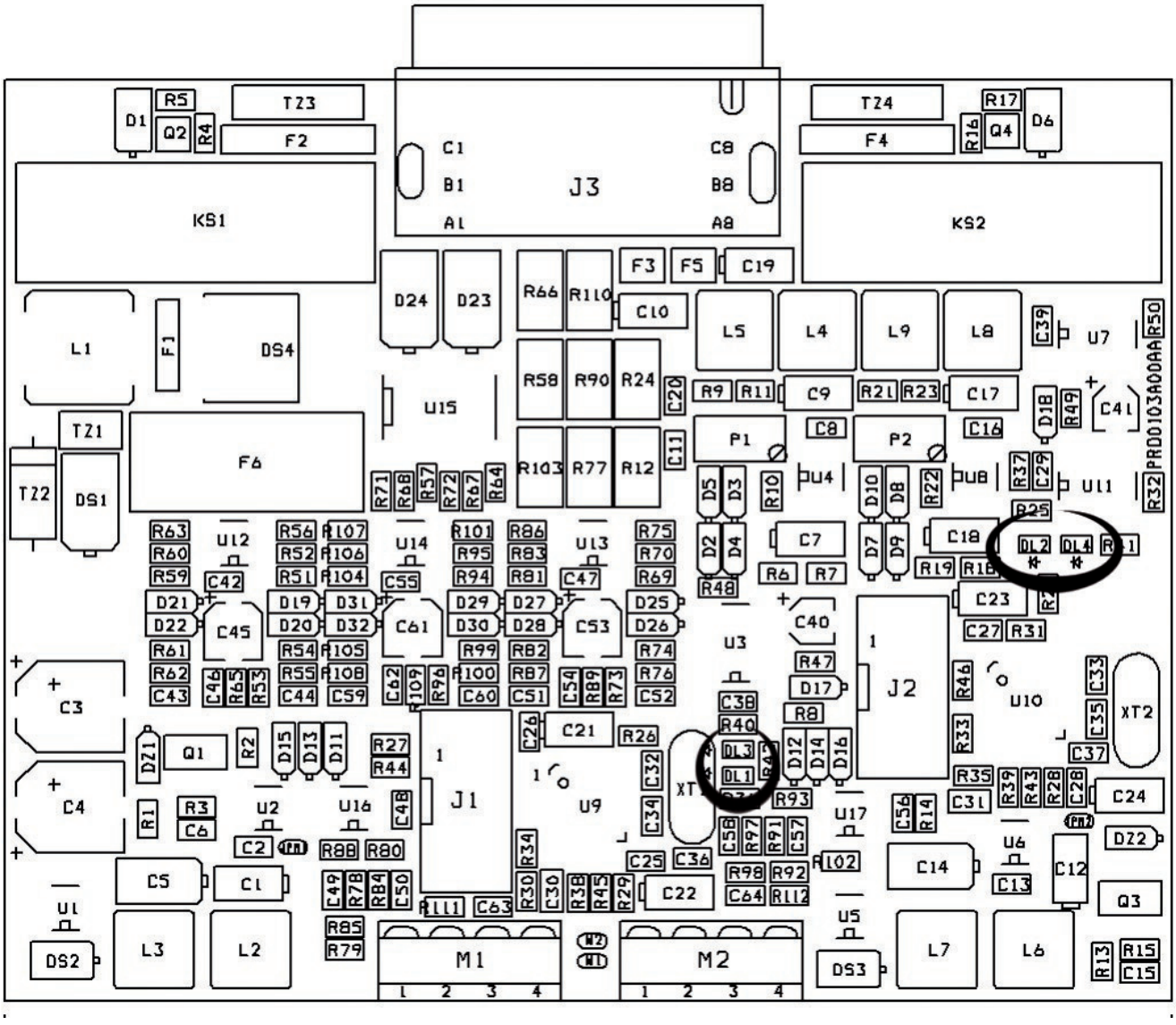


Figure 6-8. Module ECM3-ECM4

CHARGE BATTERY MODULE

With Green Led –DL3 ON Power ON

With Yellow Led –DL2 OFF End of Charging complete

With Red Led –DL1 ON

Electrical Motor ON

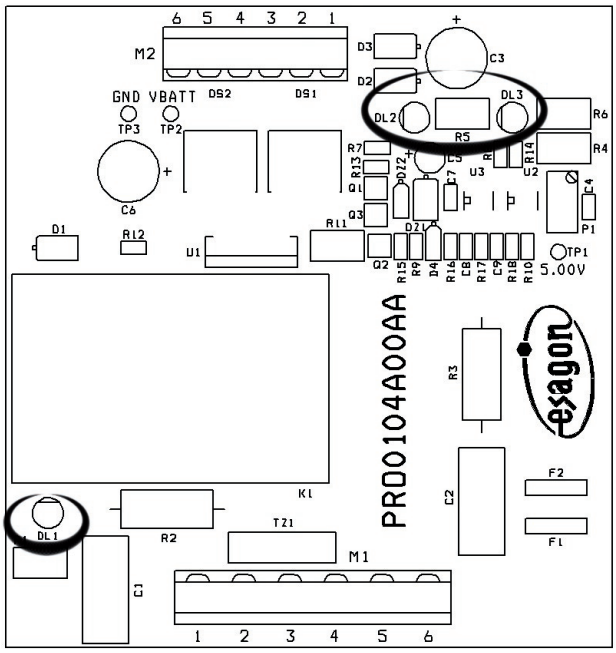


Figure 6-9. Charge Battery Module

MODEM MODULE

DL1- Green ON Power +5V to CPU

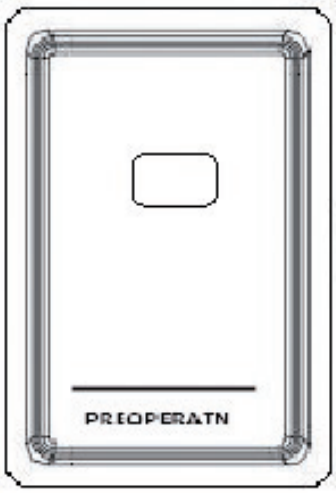
DL2-Red (see table below)

Table 6-1. Modem status

LED status	Blinking period	Time on	Device Status
permanently off	___	___	device off
fast blinking	1s	0,5s	Net search
slow blinking	3s	0,3s	Line ready

Remote Control Operation

On models with Remote Control connected by cable, if shown the message PREOPERATIN, that means an issue with CanBus link:

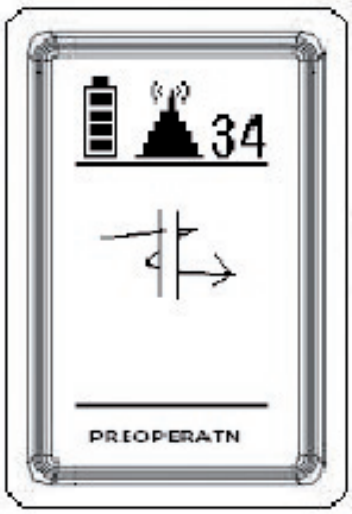


On models with Radio Remote Control shown the message of PREOPERATN, can be one of the following reasons:

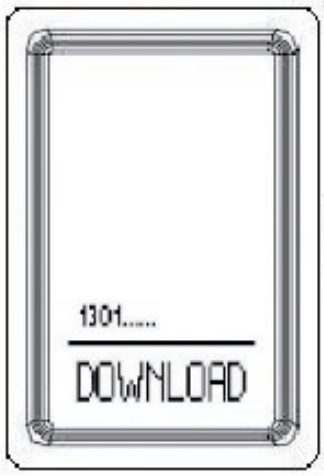
Just been switched ON

The receiver is off (ignition key OFF)

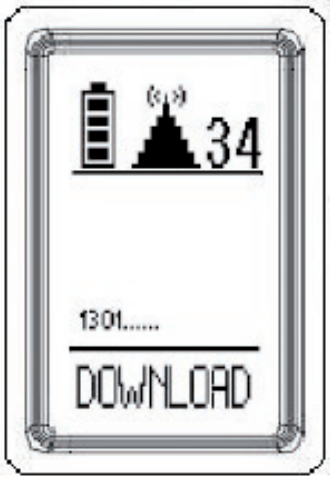
The receiver needs to be initialize the radio control/remote control an issue with CanBus link



On models with Remote Control connected by cable, if shown the message DOWNLOAD, that means a new modules have been installed.



Display on Radio Remote Control



When the procedure ends the display will show the screen with the icons.

NOTE: *The initialization procedure will be completed faster if the radio control/remote control cable is connected.*

NOTE: *The numbers shown above DOWNLOAD are the data transferred. The Download will be completed when about more that 18000 steps are transferred.*

6.4 CALIBRATION INSTRUCTIONS

This machine incorporates a variety of sensors and a high degree of function interaction. For safety and proper machine functionality, the calibration procedures must be repeated for any control module replacement, system calibration related fault, or removal or replacement of any sensors, valves, coils.

The chart below lists the calibrations required and potential reasons for recalibrating.

All calibration procedures are menu driven through the REMOTE CONTROL.

The user is prompted to exercise the machine in a specific order to use the machines physical properties to consistently establish sensor response and the interaction of valves, pumps, and motors.

Table 6-2. Calibration Instructions

Calibration Procedure	Reasons for Re-calibration
LOAD Cell Calibration	LSS Module ECM3 replacement LSS Sensor removal or replacement
Joystick Calibration	Joystick replacement
Chassis Tilt Calibration	Master Board ECM1- ECM2 removal or replacement Tilt indication inaccuracy
Rotator Sensors Calibration	X700AJ X23J Only Board ECM4 rotator sensor replacement Rotator sensor removal or replacement
Radio Control Calibration	X14HJ X17J Only Radio Control replacement

6.5 PLATFORM REMOTE CONTROL SERVICE

SERVICE BUTTON

A SERVICE button is present on the remote control which allows to view the status of the machine parameters and is an aid in the safety checks of the machine.

With machine power on, by pressing the SERVICE button a numerical menu is displayed on the LCD display, each of these menu items can be accessed by pressing the corresponding platform/remote control buttons.

Tu navigate through the menu use the Buttons Numbered 1 Thru 9.

The top level menus are as follows:

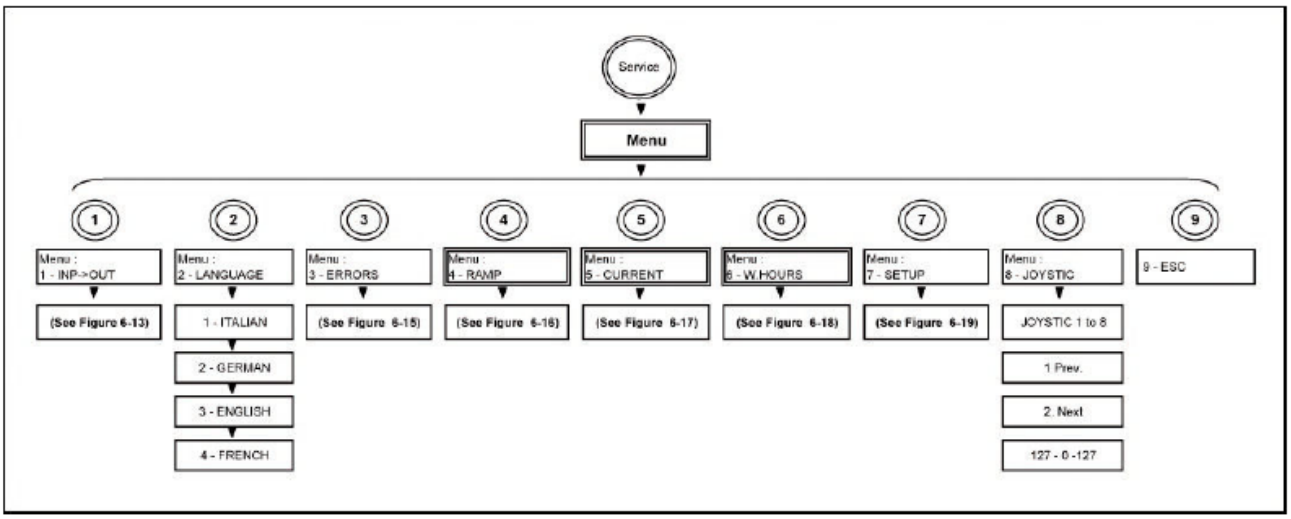


Figure 6-10. MENU SERVICE

NOTE: *The layout shown includes all possible analyzer screens. Please note that some screens may not be available or with different description depending upon machine configuration or language set-up.*

USING THE SERVICE PROGRAM

To select a displayed menu item, press button 6 **SERVICE**.

To cancel a selected menu item, press button 9 **ESC**, to escape.

From the SERVICE menu use the buttons 1-2-3-7-8 to navigate through the menu.

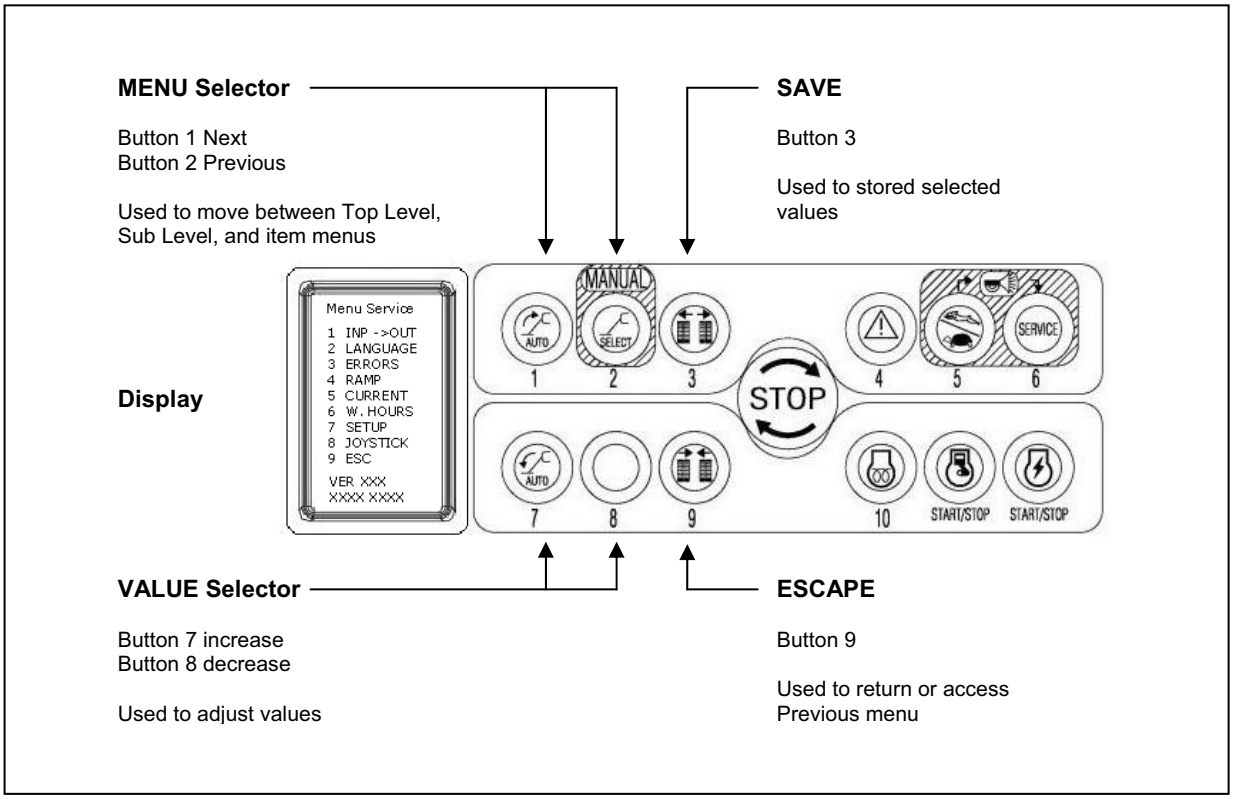


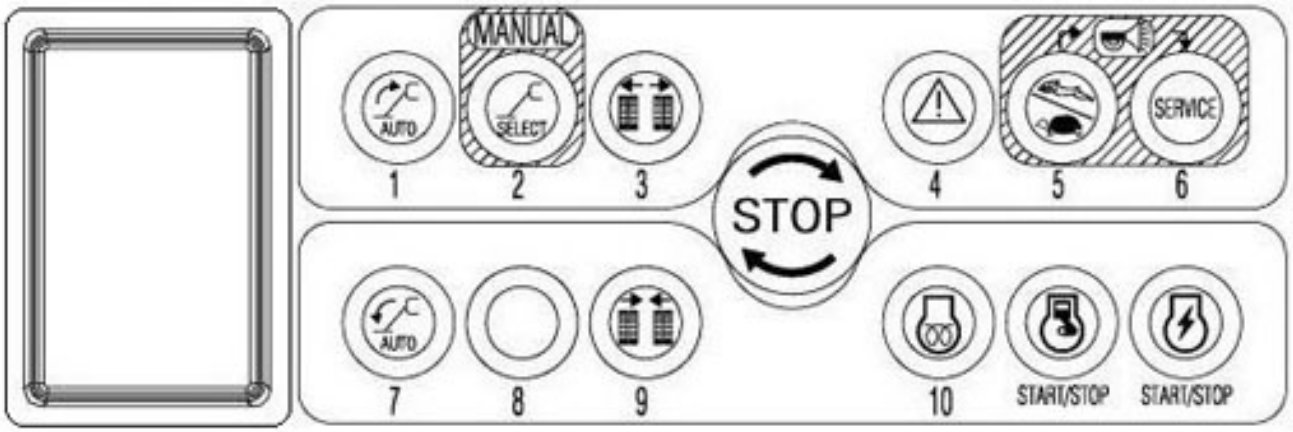
Figure 6-11. Buttons use

From the SERVICE menu, use button “7 Setup”, the button “5 Password” than enter a proper password (by using buttons 1 to 9) to advance to a lower level.

Once OK is displayed, press button “9 ESC”, MENU should display and than press the button for proper MENU, which will permit to change machine settings.

NOTE: ***if NO*** *is displayed, after digit the password, press button “9 Esc” to return to Menu, and do again the procedure.*

NOTE: *Password remain active all the time the Key Switch stay ON, even if escape from the menu service.*



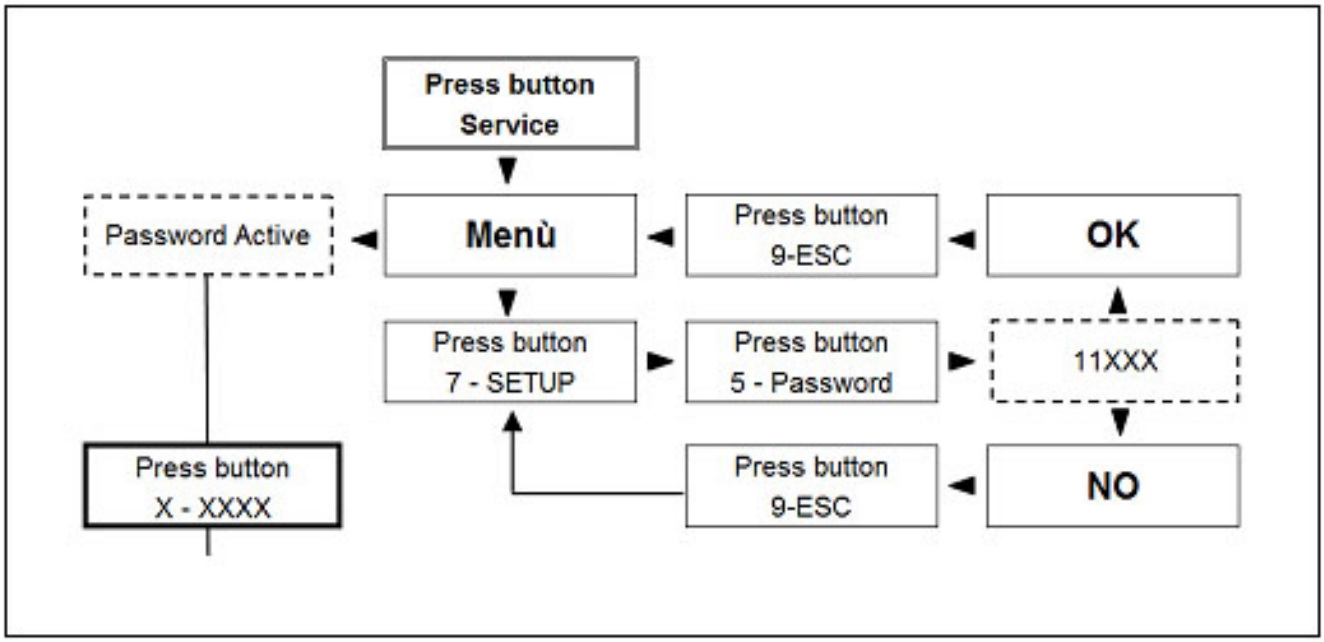


Figure 6-12. Password use

1 MENU INPUT

ANSI-SPEC **X390AJ - X550AJ - X700AJ**

CE-SPEC **X14J - X19J - X23J**

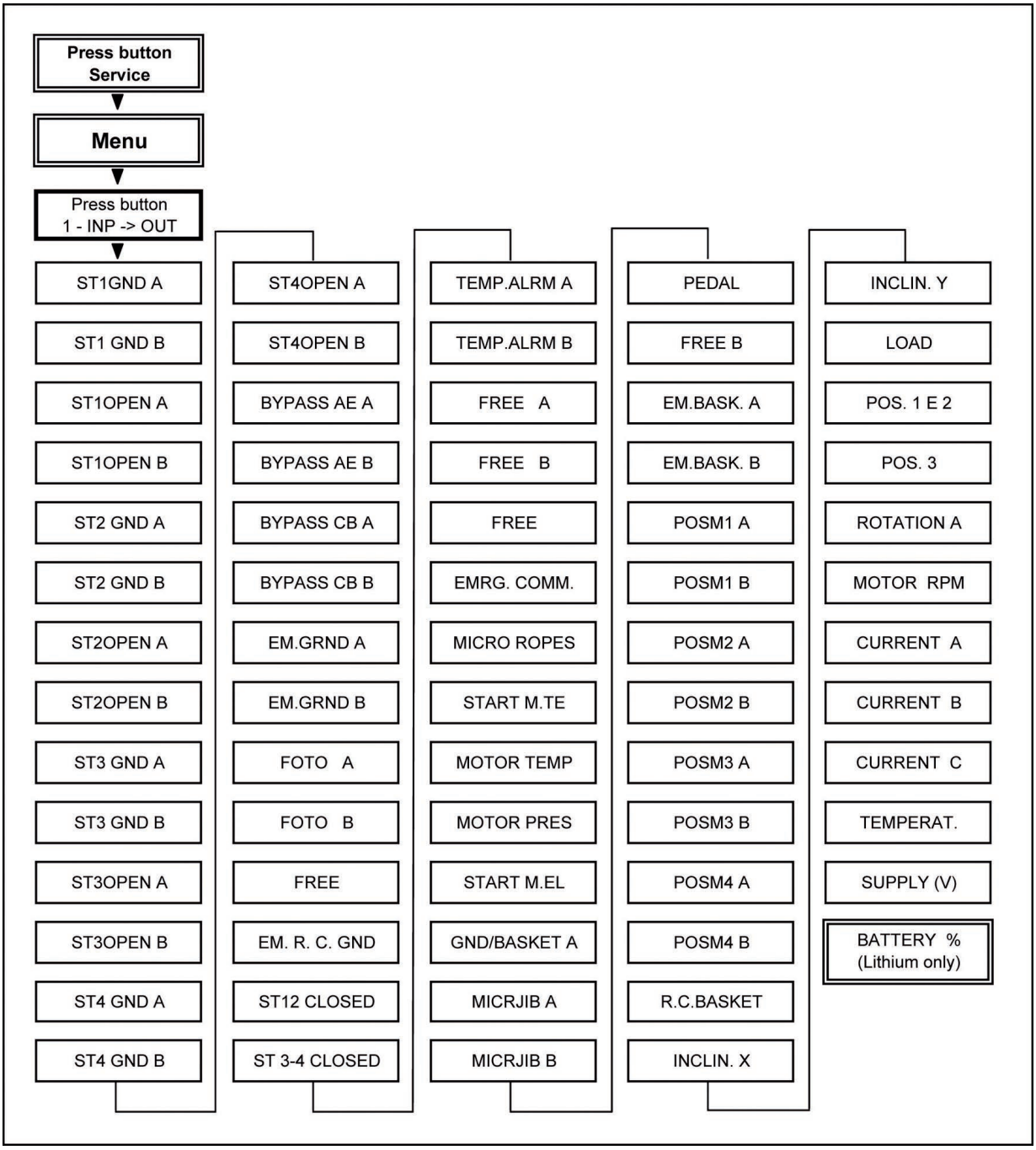


Figure 6-13. MENU INPUT 1-2

CE- SPEC X17J

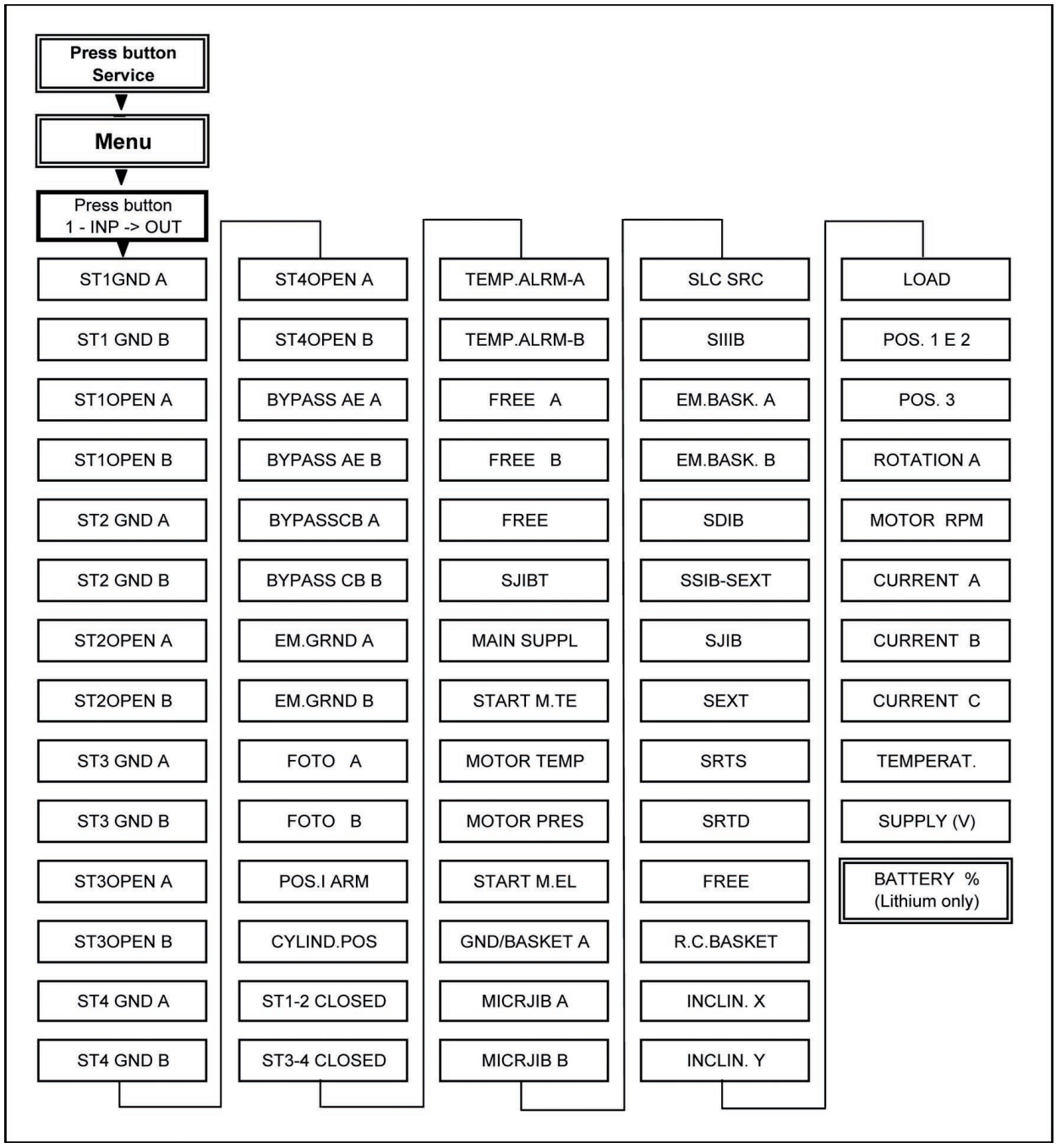


Figure 6-14. MENU INPUT 2-2

3 MENU ERRORS

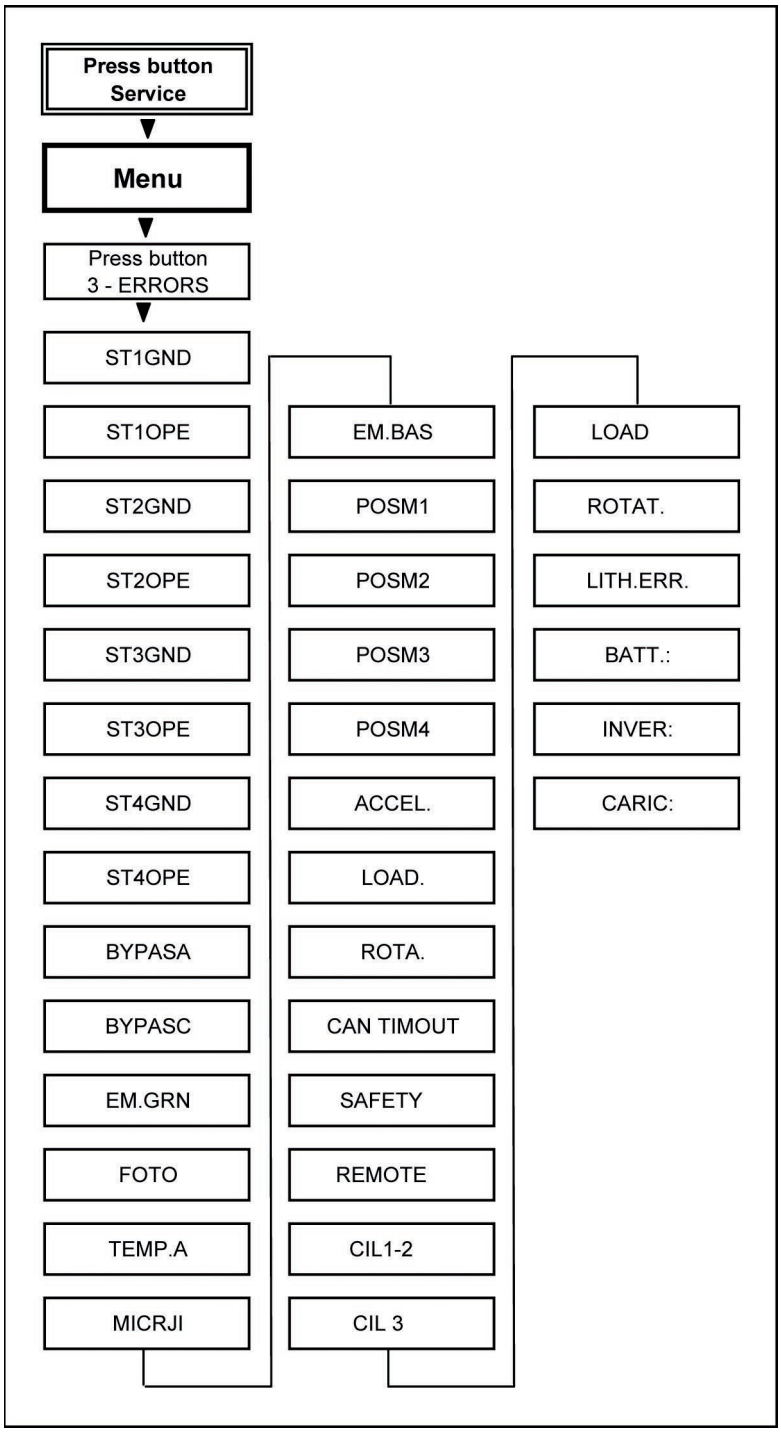


Figure 6-15. MENU ERRORS

4 MENU RAMPS

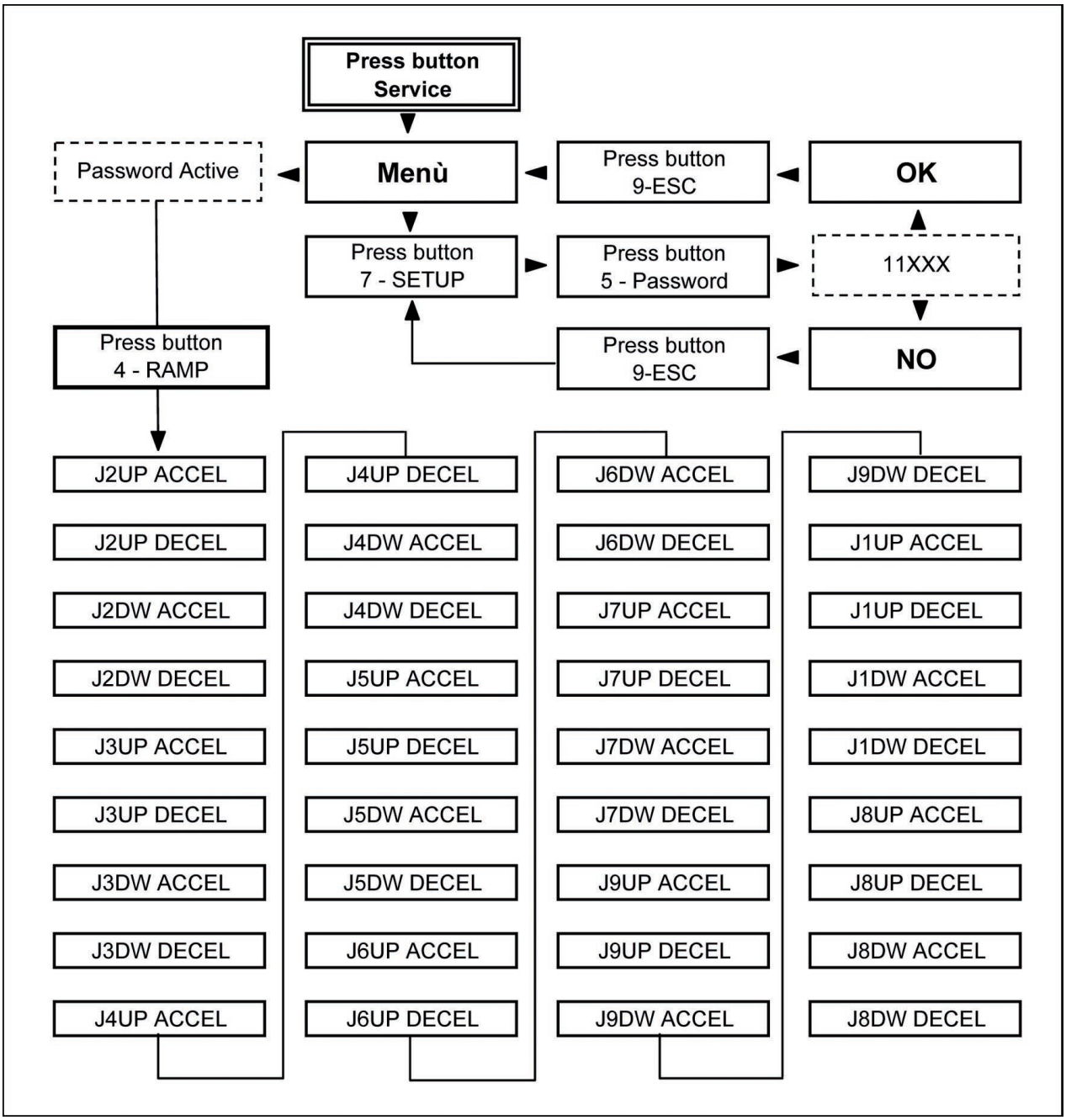


Figure 6-16. MENU RAMPS

5 MENU CURRENTS

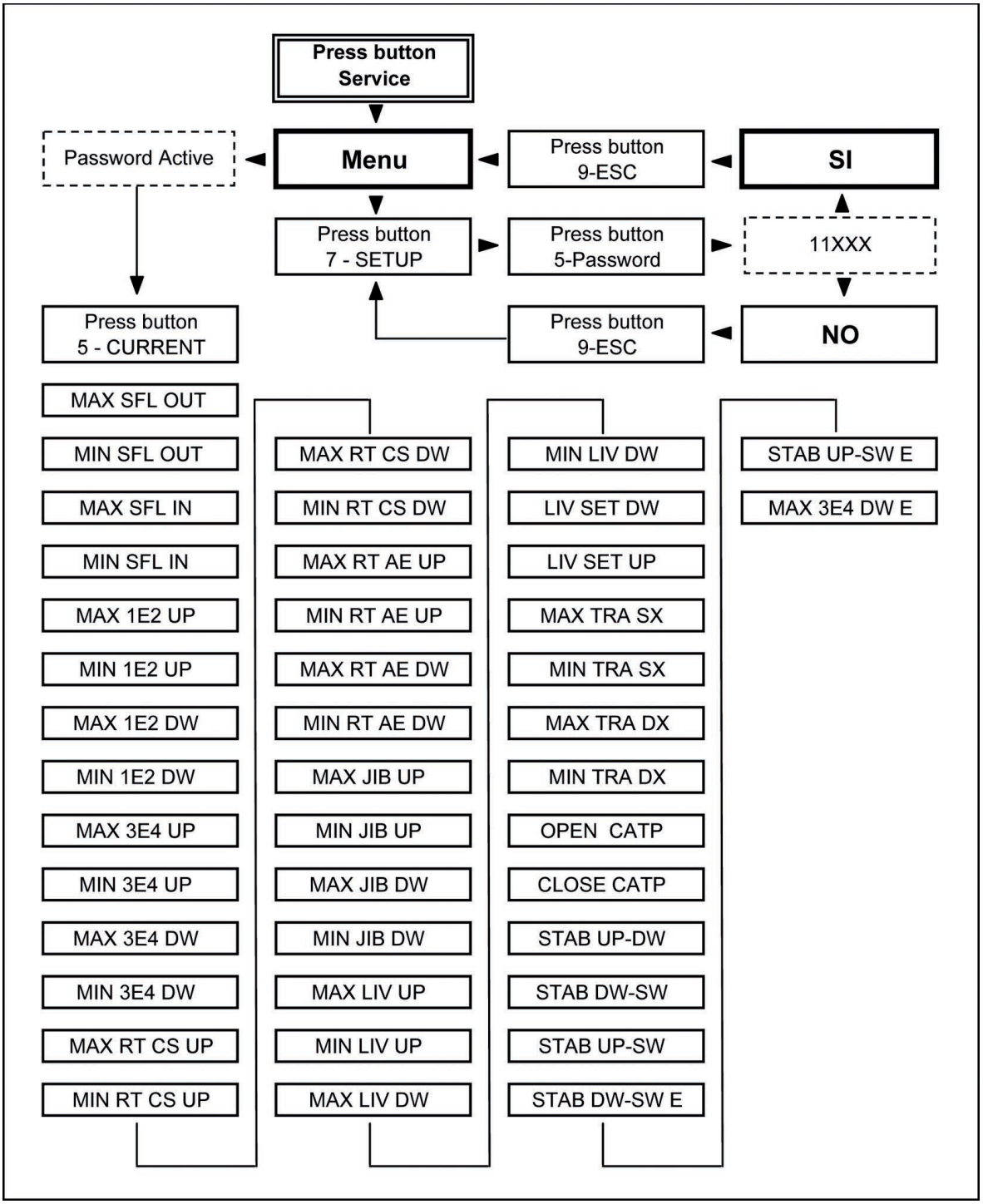


Figure 6-17. MENU CURRENTS

6 MENU WORKING HOURS

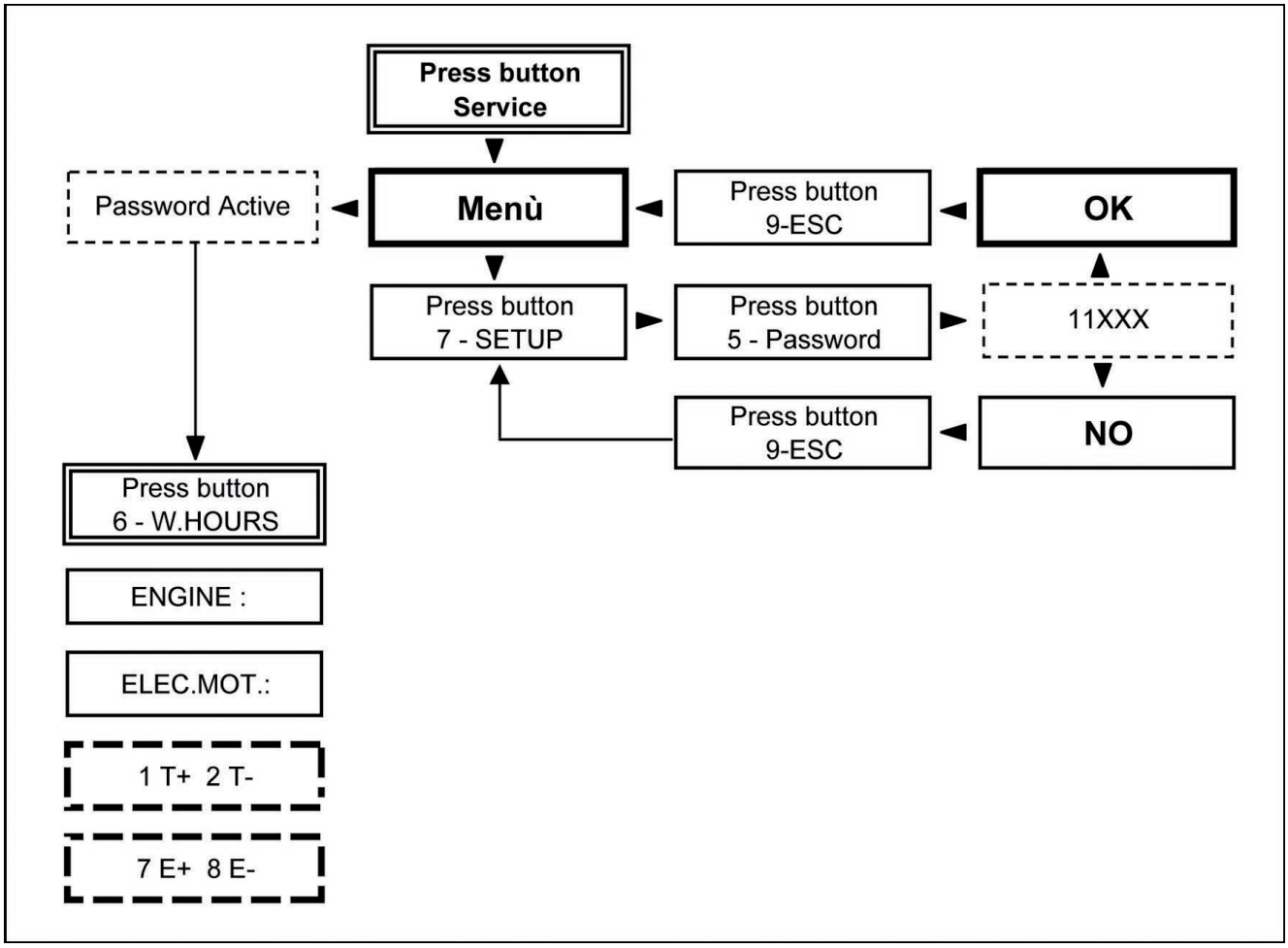


Figure 6-18. MENU WORKING HOURS

7 MENU SETUP

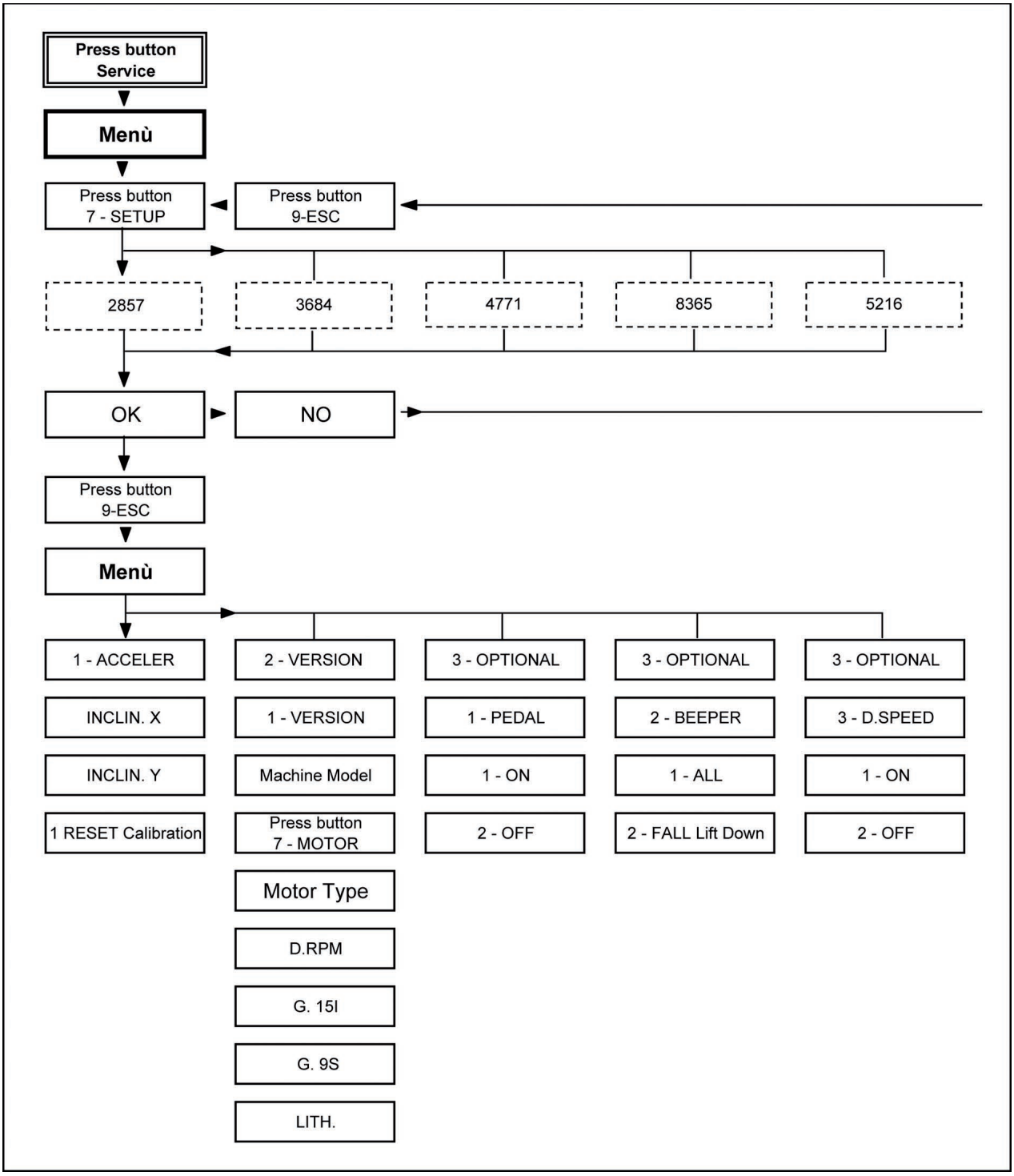


Figure 6-19. MENU SETUP 1-2

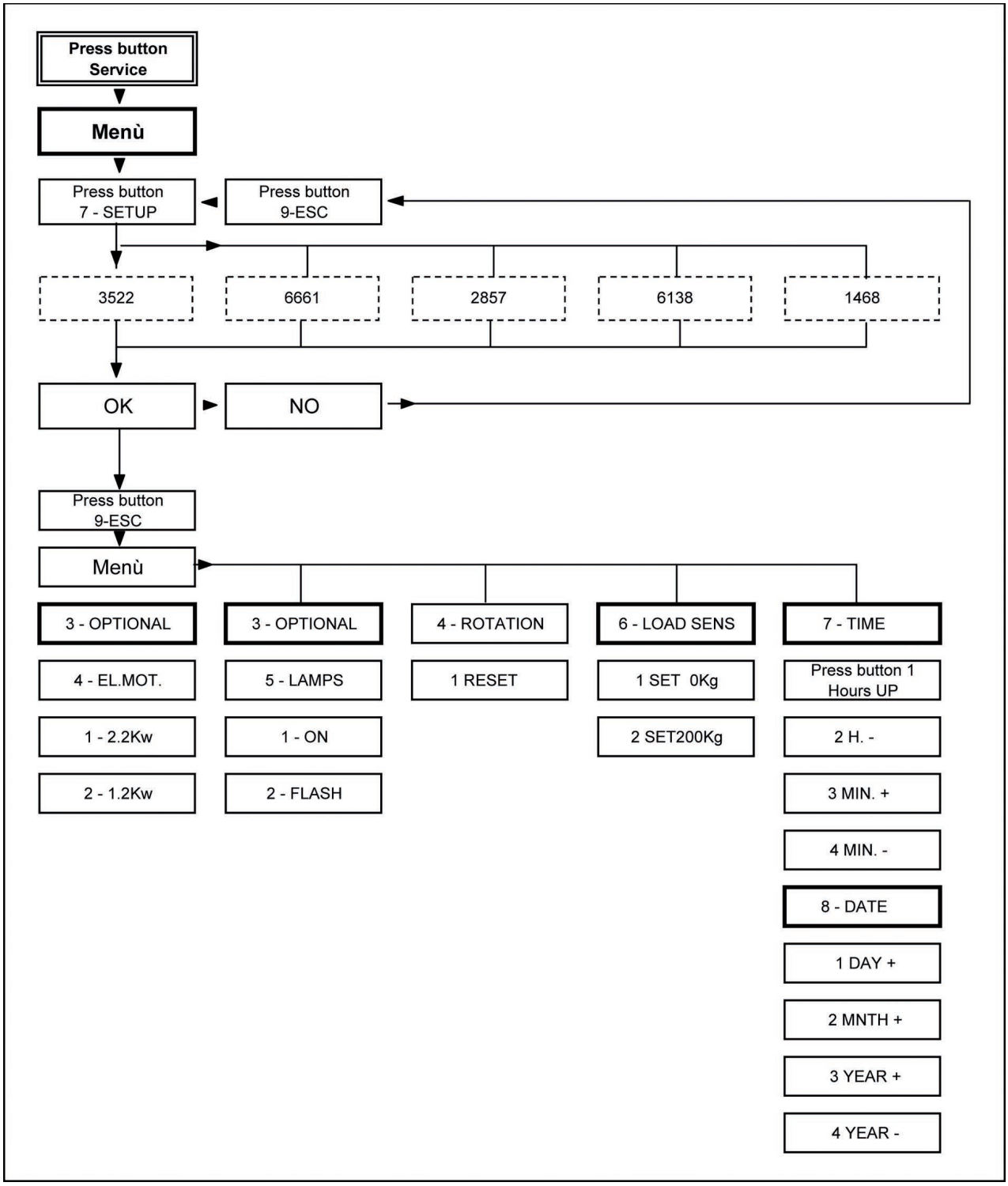
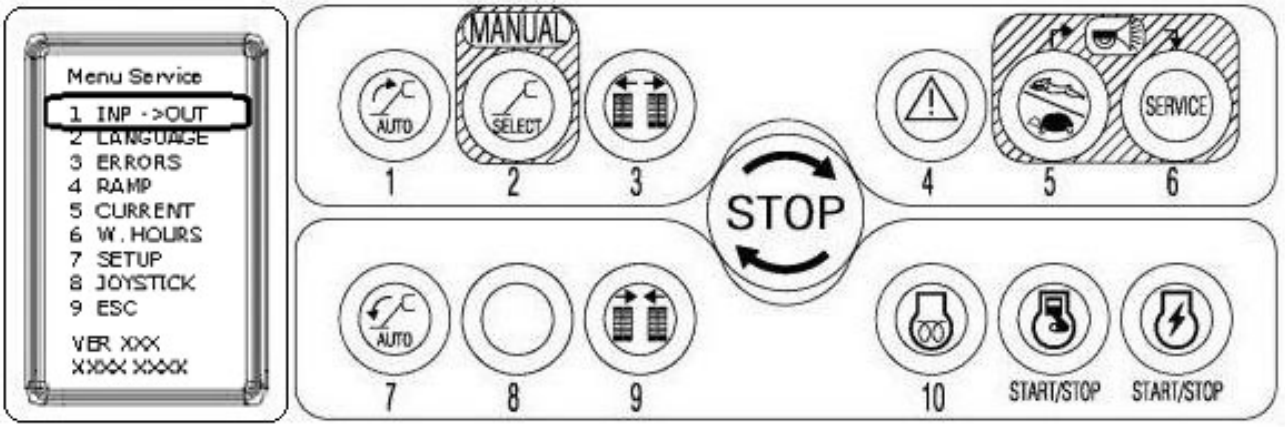


Figure 6-20. MENU SETUP 2-2

6.6 MENU INPUT

From the SERVICE menu, pressing button 1”INPUT” to accesses menu INPUT.



The menu INPUT visualize the status (or changes of status) of all the devices connected to the main control module.

Machine diagnostic devices status or values are shown on the display

Using the buttons 1”PREV.” and 2”NEXT” to choose the device.

Press button 9”ESC” to Esc.

Table 6-3. Menu Input

X14J - X19J - X23J - X390AJ - X550AJ - X700AJ

ST1A GND	**ON**	Outrigger N° 1 on the ground – the switch is released and A line is closed
	OFF	Outrigger N° 1 lifted – the switch is pressed and A line is opened
ST1B GND	**ON**	Outrigger N° 1 on the ground – the switch is released and B line is closed
	OFF	Outrigger N° 1 lifted – the switch is pressed and B line is opened
ST1A OPEN X23J - X700AJ Only	**ON**	Outrigger N° 1 completely opened – the switch is released and A line is closed
	OFF	Outrigger N° 1 closed or partially opened – the switch is pressed and A line is opened
ST1B OPEN X23J - X700AJ Only	**ON**	Outrigger N° 1 completely opened – the switch is released and B line is closed
	OFF	Outrigger N° 1 closed or partially opened – the switch is pressed and B line is opened
ST2A GND	**ON**	Outrigger N° 2 on the ground – the switch is released and A line is closed
	OFF	Outrigger N° 2 lifted – the switch is pressed and A line is opened
ST2B GND	**ON**	Outrigger N° 2 on the ground – the switch is released and B line is closed
	OFF	Outrigger N° 2 lifted – the switch is pressed and B line is opened
ST2A OPEN X23J - X700AJ Only	**ON**	Outrigger N° 2 completely opened – the switch is released and A line is closed
	OFF	Outrigger N° 2 closed or partially opened – the switch is pressed and A line is opened
ST2B OPEN X23J - X700AJ Only	**ON**	Outrigger N° 2 completely opened – the switch is released and B line is closed
	OFF	Outrigger N° 2 closed or partially opened – the switch is pressed and B line is opened
ST3A GND	**ON**	Outrigger N° 3 on the ground – the switch is released and A line is closed
	OFF	Outrigger N° 3 lifted – the switch is pressed and A line is opened
ST3B GND	**ON**	Outrigger N° 3 on the ground – the switch is released and B line is closed
	OFF	Outrigger N° 3 lifted – the switch is pressed and B line is opened
ST3A OPEN X23J - X700AJ Only	**ON**	Outrigger N° 3 completely opened – the switch is released and A line is closed
	OFF	Outrigger N° 3 closed or partially opened – the switch is pressed and A line is opened
ST3B OPEN X23J - X700AJ Only	**ON**	Outrigger N° 3 completely opened – the switch is released and B line is closed
	OFF	Outrigger N° 3 closed or partially opened – the switch is pressed and B line is opened
ST4A GND	**ON**	Outrigger N° 4 on the ground – the switch is released and A line is closed
	OFF	Outrigger N° 4 lifted – the switch is pressed and A line is opened
ST4B GND	**ON**	Outrigger N° 4 on the ground – the switch is released and B line is closed
	OFF	Outrigger N° 4 lifted – the switch is pressed and B line is opened

X14J - X19J - X23J - X390AJ - X550AJ - X700AJ

ST4A OPEN X23J - X700AJ Only	**ON**	Outrigger N° 4 completely opened – the switch is released and A line is closed
	OFF	Outrigger N° 4 closed or partially opened – the switch is pressed and A line is opened
ST4B OPEN X23J - X700AJ Only	**ON**	Outrigger N° 4 completely opened – the switch is released and B line is closed
	OFF	Outrigger N° 4 closed or partially opened – the switch is pressed and B line is opened
ESSICAE A	**ON**	The aerial part safeties are disconnected through the key button (emergency condition) – “A” line of the aerial part safeties by-pass button is closed.
	OFF	The aerial part safeties are connected (normal working condition) – “A” line of the aerial part safeties by-pass button is opened
ESSICAE B	**ON**	The aerial part safeties are disconnected through the key button (emergency condition) – “B” line of the aerial part safeties by-pass button is closed.
	OFF	The aerial part safeties are connected (normal working condition) – “B” line of the aerial part safeties by-pass button is opened
ESSICC A	**ON**	The ground part safeties are disconnected through the key button (emergency condition)– “A” line of the ground part safeties by-pass button is closed.
	OFF	The ground part safeties are connected (normal working condition) – “A” line of the ground part safeties by-pass button is opened
ESSICC B	**ON**	The ground part safeties are disconnected through the key button (emergency condition)– “B” line of the ground part safeties by-pass button is closed.
	OFF	The ground part safeties are connected (normal working condition) – “B” line of the ground part safeties by-pass button is opened
EM GND A	**ON**	Emergency stop on the ground is released –“A” line of the emergency stop is closed
	OFF	Emergency stop on the ground is pressed – “A” line of the emergency stop is opened
EM GND B	**ON**	Emergency stop on the ground is released –“B” line of the emergency stop is closed
	OFF	Emergency stop on the ground is pressed – “B” line of the emergency stop is opened
FOTO A	**ON**	Photocell A receives the signal from the reflector (Aerial part closed and aligned)
	OFF	Photocell A does not receive the signal from the reflector (Aerial part opened)
FOTO B	**ON**	Photocell B receives the signal from the reflector (Aerial part closed and aligned)
	OFF	Photocell B does not receive the signal from the reflector (Aerial part opened)
FREE	**ON**	Do not consider this signal
EM.R.C.GND	**ON**	The emergency stop on ground remote control is released.
	OFF	The emergency stop on ground remote control is pressed or the ground remote control is disconnected

X14J - X19J - X23J - X390AJ - X550AJ - X700AJ

ST12 CLOSED	**ON**	The thrust meter of outriggers 1 and 2 closes the contact – the outriggers are at end run and the max pressure valve is opened
	OFF	The thrust meter contact of outriggers 1 and 2 is opened – the outriggers are open, partially open or already closed
ST34 CLOSED	**ON**	The thrust meter of outriggers 3 and 4 closes the contact – the outriggers are at end run and the max pressure valve is opened
	OFF	The thrust meter contact of outriggers 3 and 4 is opened – the outriggers are open, partially open or already closed
TEMP ALRM A Option reserved for some markets	**ON**	The temperature external probe reached the maximum value – “A” line of the temperature probe is closed
	OFF	The temperature external probe hasn’t reached the maximum value – “A” line of the temperature probe is open
TEMP ALRM B Option reserved for some markets	**ON**	The temperature external probe reached the maximum value – “B” line of the temperature probe is closed
	OFF	The temperature external probe hasn’t reached the maximum value – “B” line of the temperature probe is open
FREE A		Do not consider this signal
FREE B		Do not consider this signal
GENERATOR	**ON**	The engine is ON – the control module receives the signal from the alternator
	OFF	The engine is OFF – the control module does not receive the signal from the alternator
EMRG. COMM	**ON**	The key button for aerial part manual operation from the ground is activated (emergency condition)
	OFF	The key button for aerial part manual operation is released (normal working condition)
MICROROPES X23J - X700AJ Only	**ON**	The cables of the extension are OK – the control switch of the cables on extension is released and the line is closed (normal working condition)
	OFF	A cable on the extension is out of order – the control switch of the cables on extension is pressed and the line is open (emergency condition)
START M.TE	**ON**	The ground button for engine start is pressed
	OFF	The ground button for engine start is released
MOTOR TEMP. X23J - X700AJ Diesel Only	**ON**	The engine reached the max functioning temperature (emergency condition – the engine remains at min)
	OFF	The engine maintains the correct functioning temperature (normal working condition)
MOTOR PRES. X23J - X700AJ Diesel Only	**ON**	The engine oil pressure is inadequate (emergency condition – engine turns off)
	OFF	The engine oil pressure is OK
START M.EL	**ON**	The ground button for electric motor start is pressed
	OFF	The ground button for electric motor start is released

X14J - X19J - X23J - X390AJ - X550AJ - X700AJ

GND/NAV A	**ON**	The remote control position selector is positioned on “basket”
	OFF	The remote control position selector is positioned on “ground”
MICROJIB A	**ON**	The JIB is closed – the control switch is released and “A” line is closed
	OFF	The JIB is open – the control switch is pressed and “A” line is open
MICROJIB B	**ON**	The JIB is closed – the control switch is released and “B” line is closed
	OFF	The JIB is open – the control switch is pressed and “B” line is open
PEDAL	**ON**	The pedal is pressed– the pedal electric line is closed
	OFF	The pedal is released – the pedal electric line is open
FREE B		Do not consider this signal
EMNAV A	**ON**	The emergency stop on remote control in basket is released – “A” line is closed
	OFF	The emergency stop on remote control in basket is pressed or the ground remote control is disconnected – “A” line is open
EMNAV B	**ON**	The emergency stop on remote control in basket is released – “B” line is closed
	OFF	The emergency stop on remote control in basket is pressed or the ground remote control is disconnected – “B” line is open
POSM1 A	**ON**	Outrigger no. 1 is in “reduced area” (or total) – the control switch is released and “A” line is closed
	OFF	Outrigger no. 1 is in “closed” position – the control switch is released and “A” line is open
POSM1 B	**ON**	Outrigger no. 1 is in “reduced area” (or total) – the control switch is released and “B” line is closed
	OFF	Outrigger no. 1 is in “closed” position – the control switch is released and “B” line is open
POSM2 A	**ON**	Outrigger no. 2 is in “reduced area” (or total) – the control switch is released and “A” line is closed
	OFF	Outrigger no. 2 is in “closed” position – the control switch is released and “A” line is open
POSM2 B	**ON**	Outrigger no. 2 is in “reduced area” (or total) – the control switch is released and “B” line is closed
	OFF	Outrigger no. 2 is in “closed” position – the control switch is released and “B” line is open
POSM3 A	**ON**	Outrigger no. 3 is in “reduced area” (or total) – the control switch is released and “A” line is closed
	OFF	Outrigger no. 3 is in “closed” position – the control switch is released and “A” line is open
POSM3 B	**ON**	Outrigger no. 3 is in “reduced area” (or total) – the control switch is released and “B” line is closed
	OFF	Outrigger no. 3 is in “closed” position – the control switch is released and “B” line is open

X14J - X19J - X23J - X390AJ - X550AJ - X700AJ

POSM4 A	**ON**	Outrigger no. 4 is in “reduced area” (or total) – the control switch is released and “A” line is closed
	OFF	Outrigger no. 4 is in “closed” position – the control switch is released and “A” line is open
POSM4 B	**ON**	Outrigger no. 4 is in “reduced area” (or total) – the control switch is released and “B” line is closed
	OFF	Outrigger no. 4 is in “closed” position – the control switch is released and “B” line is open
R.C. BASKET	**ON**	The remote control is in the support in basket
	OFF	The remote control is not in the support in basket
INCLIN. X	**1**	Indicates the inclination of the machine on the X axis in degrees
INCLIN. Y	**1**	Indicates the inclination of the machine on the Y axis in degrees
LOAD	**94**	Indicates the weight in Kg in the basket
POS. 1E2 X23J - X700AJ Only	**1423**	Indicates the opening of the 1 and 2 arms cylinder in tenths of a millimeter
POS. 3 X23J - X700AJ Only	**2398**	Indicates the opening of the 3 arm cylinder in tenths of a millimeter
ROTATION	**180**	Indicates the rotation angle of the aerial part in degrees
MOTOR RPM X23J - X700AJ Diesel Only	**2200**	Indicates the engine RPM
CURRENT A	**34,5**	Indicates the current sent to the aerial part proportional valve or to the left-side undercarriage proportional valve
CURRENT B	**45,3**	Indicates the current sent to the right-side proportional valve
CURRENT C		
TEMPERAT.	**37,6**	Indicates the temperature of the control module in C°
SUPPLY (V)	**12,1**	Indicates the batteries voltage, or the output voltage from the battery charger

Table 6-4. Menu Input

X17J

ST1 A GND	**ON**	Stabiliser 1 on the ground – The switch is released and line A is closed
	OFF	Stabiliser 1 raised – The switch is pressed and line A is open
ST1 B GND	**ON**	Stabiliser 1 on the ground – The switch is released and line B is closed
	OFF	Stabiliser 1 raised – The switch is pressed and line B is open
FREE		Ignore this signal
FREE		Ignore this signal
ST2 A GND	**ON**	Stabiliser 2 on the ground – The switch is released and line A is closed
	OFF	Stabiliser 2 raised – The switch is pressed and line A is open
ST2 B GND	**ON**	Stabiliser 2 on the ground – The switch is released and line B is closed
	OFF	Stabiliser 2 raised – The switch is pressed and line B is open
FREE		Ignore this signal
FREE		Ignore this signal
ST3 A GND	**ON**	Stabiliser 3 on the ground – The switch is released and line A is closed
	OFF	Stabiliser 3 raised – The switch is pressed and line A is open
ST3 B GND	**ON**	Stabiliser 3 on the ground – The switch is released and line B is closed
	OFF	Stabiliser 3 raised – The switch is pressed and line B is open
FREE		Ignore this signal
FREE		Ignore this signal
ST4 A GND	**ON**	Stabiliser 4 on the ground – The switch is released and line A is closed
	OFF	Stabiliser 4 raised – The switch is pressed and line A is open
ST4 B GND	**ON**	Stabiliser 4 on the ground – The switch is released and line B is closed
	OFF	Stabiliser 4 raised – The switch is pressed and line B is open
FREE		Ignore this signal
FREE		Ignore this signal
ESSICAE A	**ON**	The aerial part safety devices are deactivated by the key switch (emergency condition) – Line A of the aerial part safety bypass button is closed
	OFF	The aerial part safety devices are active (normal operating condition) – Line A of the aerial part safety bypass button is open

X17J

ESSICAE B	**ON**	The aerial part safety devices are deactivated by the key switch (emergency condition) – Line B of the aerial part safety bypass button is closed
	OFF	The aerial part safety devices are active (normal operating condition) – Line B of the aerial part safety bypass button is open
ESSICCA A	**ON**	The undercarriage safety devices are deactivated by the key switch (emergency condition) – Line A of the undercarriage safety bypass button is closed
	OFF	The undercarriage safety devices are active (normal operating condition) – Line A of the undercarriage safety bypass button is open
ESSICCA B	**ON**	The undercarriage safety devices are deactivated by the key switch (emergency condition) – Line B of the undercarriage safety bypass button is closed
	OFF	The undercarriage safety devices are active (normal operating condition) – Line B of the undercarriage safety bypass button is open
EM A GND	**ON**	The emergency stop on the ground is released – Line A of the emergency stop button is closed
	OFF	The emergency stop on the ground is pressed – Line A of the emergency stop button is open
EM B GND	**ON**	The emergency stop on the ground is released – Line B of the emergency stop button is closed
	OFF	The emergency stop on the ground is pressed – Line B of the emergency stop button is open
FOTO A	**ON**	Photocell A receives the signal from the retroreflector (aerial part closed and aligned)
	OFF	Photocell A doesn't receive the signal from the retroreflector (aerial part open)
FOTO B	**ON**	Photocell B receives the signal from the retroreflector (aerial part closed and aligned)
	OFF	Photocell B doesn't receive the signal from the retroreflector (aerial part open)
PROXPOS.IBR	**ON**	The aerial part does not have the first arm in area of impact with the engine *(X17J only)*
	OFF	The aerial part has the first arm in area of impact with the engine *(X17J only)*
POSCILIND	**ON**	The first arm is not sufficiently open to avoid impact with the engine and the control switch is pressed *(X17J only)*
	OFF	The first arm is sufficiently open to avoid impact with the engine and the control switch is released *(X17J only)*
ST12 CLOSED	**ON**	The contact on the pressure switch for stabilisers 1 and 2 closes – The stabilisers are at the end of travel and the maximum pressure valve is open
	OFF	The contact on the pressure switch for stabilisers 1 and 2 is open – The stabilisers are open, partially open or already closed
ST34 CLOSED	**ON**	The contact on the pressure switch for stabilisers 3 and 4 closes – The stabilisers are at the end of travel and the maximum pressure valve is open
	OFF	The contact on the pressure switch for stabilisers 3 and 4 is open – The stabilisers are open, partially open or already closed
TEMP ALRM A Option reserved for certain markets	**ON**	The external temperature probe has measured a critical value – Line A of the temperature probe is closed
	OFF	The external temperature probe has not measured a critical value – Line A of the temperature probe is open
TEMP ALRM B Option reserved for certain markets	**ON**	The external temperature probe has measured a critical value – Line B of the temperature probe is closed
	OFF	The external temperature probe has not measured a critical value – Line B of the temperature probe is open

X17J

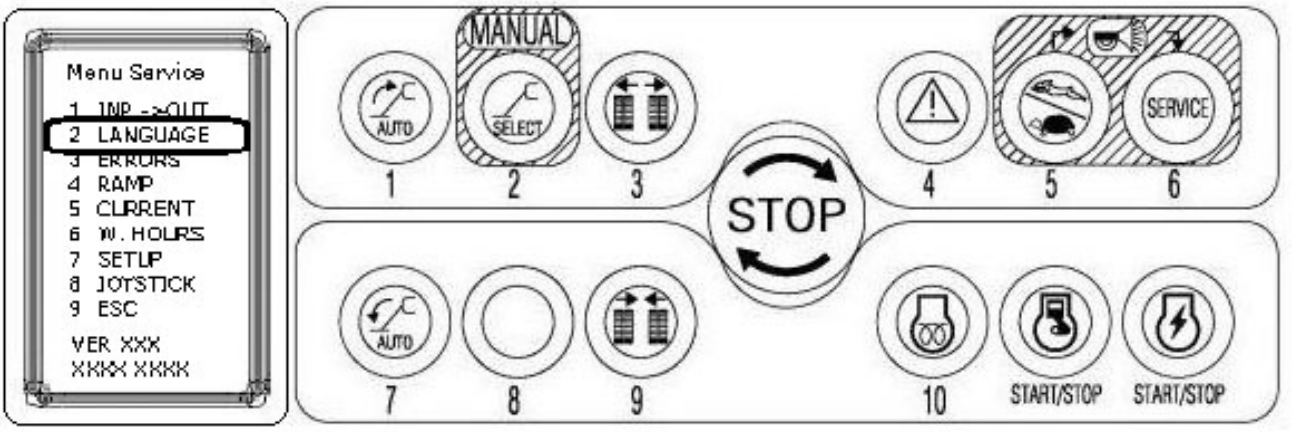
FREE A		Ignore this signal
FREE B		Ignore this signal
GENERATOR	**ON**	The engine is on – The control module receives the signal from the alternator
	OFF	The engine is off – The control module doesn't receive the signal from the alternator
SJIB GND	**ON**	The lever on the ground part distributor for moving the jib is activated *(X17J only)*
	OFF	The lever on the ground part distributor for moving the jib is deactivated *(X17J only)*
MAIN SUPPLY	**ON**	The mains power supply is connected – The radio control/remote control battery charger is active
	OFF	The mains power supply is not connected – The radio control/remote control battery charger is not active
START M.TE	**ON**	The start engine button on the ground is pressed
	OFF	The start engine button on the ground is released
TEMP. MOT	**ON**	Ignore this signal
PRESS. MOT	**ON**	Ignore this signal
START M.EL	**ON**	The start electric motor button on the ground is pressed
	OFF	The start electric motor button on the ground is released
TER/NAV A	**ON**	Ignore this signal
	OFF	Ignore this signal
MICROJIB A	**ON**	The jib is closed – The control switch is released and line A is closed
	OFF	The jib is open – The control switch is pressed and line A is open
MICROJIB B	**ON**	The jib is closed – The control switch is released and line B is closed
	OFF	The jib is open – The control switch is pressed and line B is open
SLC SRC	**ON**	The basket rotation lever or the basket levelling lever on the distributor in the basket are activated
	OFF	The basket rotation lever or the basket levelling lever on the distributor in the basket are not activated
SIIIB	**ON**	The third arm lever on the distributor in the basket is activated
	OFF	The third arm lever on the distributor in the basket isn't activated
EMNAV A	**ON**	The emergency stop in the basket is released – Line A is closed
	OFF	The emergency stop in the basket is pressed – Line A is open
EMNAV B	**ON**	The emergency stop in the basket is released – Line B is closed
	OFF	The emergency stop on the radio control/remote control is pressed – Line B is open

X17J

SDIB	**ON**	The first arm lever on the distributor in the basket is activated for lowering
	OFF	The first arm lever on the distributor in the basket isn't activated for lowering
SSIB	**ON**	The first arm lever on the distributor in the basket is activated for raising
	OFF	The first arm lever on the distributor in the basket isn't activated for raising
SJIB	**ON**	The jib lever on the distributor in the basket is activated
	OFF	The jib lever on the distributor in the basket isn't activated
SEXT	**ON**	The extension lever on the distributor in the basket is activated
	OFF	The extension lever on the distributor in the basket isn't activated
SRTS	**ON**	The rotation lever on the distributor in the basket is activated for rotation to the left
	OFF	The rotation lever on the distributor in the basket isn't activated for rotation to the left
SRTD	**ON**	The rotation lever on the distributor in the basket is activated for rotation to the right
	OFF	The rotation lever on the distributor in the basket isn't activated for rotation to the right
FREE A		Ignore this signal
FREE A		Ignore this signal
BASKET REM.	**ON**	The radio control/remote control is positioned on the support in the basket
	OFF	The radio control/remote control is positioned on the support in the basket
INCLIN. X	**1**	Indicates the slope of the machine on the X axis in degrees
INCLIN. Y	**1**	Indicates the slope of the machine on the Y axis in degrees
LOAD	**94**	Indicates the weight in the basket in kg
POS. 1E2		Ignore this signal
POS. 3		Ignore this signal
ROTAZ. A		Ignore this signal
MOTOR RPM		Ignore this signal
CURRENT A	**34,5**	Indicates the current sent to the L undercarriage proportional valve
CURRENT B	**45,3**	Indicates the current sent to the R proportional valve
CURRENT C		Ignore this signal
TEMPERAT.	**37,6**	Indicates the temperature of the control module in C°
ALIMENT (V)	**12,1**	Indicates the battery voltage, or alternatively the battery charger output voltage

6.7 LANGUAGE

From the SERVICE menu, pressing button 2”LANGUAGE” to accesses menu language.



Using the buttons 1 to 4 to select the language desired.

Press button 9”ESC” to save the change.

The languages available are:

Button 1-Italian

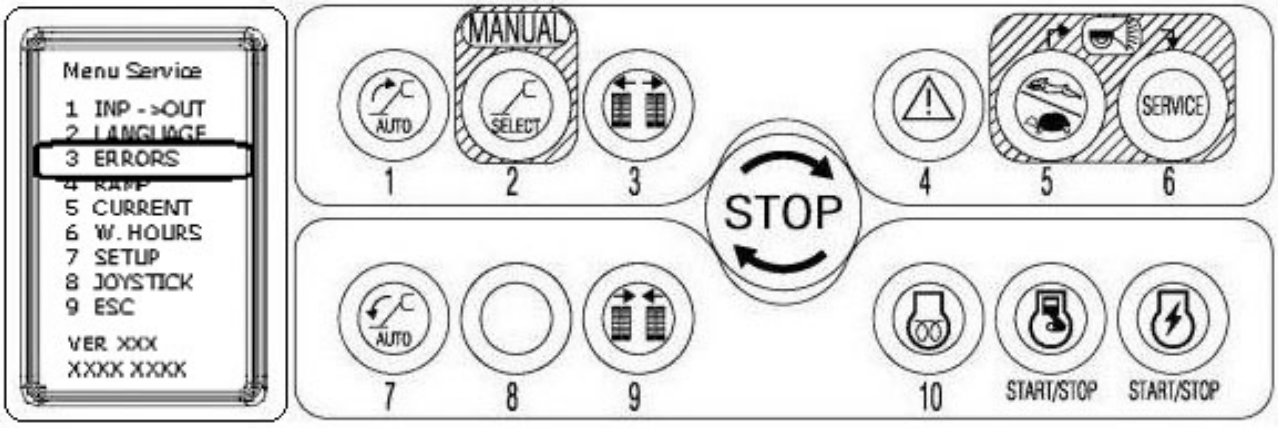
Button 2-German

Button 3-English

Button 4-French

6.8 MENU ERRORS

From the SERVICE menu, pressing button 3"ERROR" accesses the menu of errors to identification of malfunctioning of some devices.

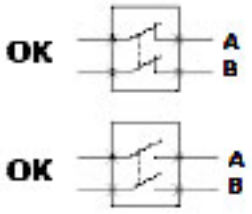


The faults highlighted by this list refer to devices with 2 safety lines, where the signal of the two lines is not coherent.

Errors menu underlines only the non-concordance between two safety lines (A and B) monitoring the same control, gives OK or NO in the errors menu.

- OK

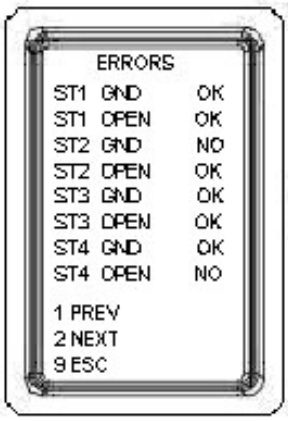
- Indication the signals agree.



- NO

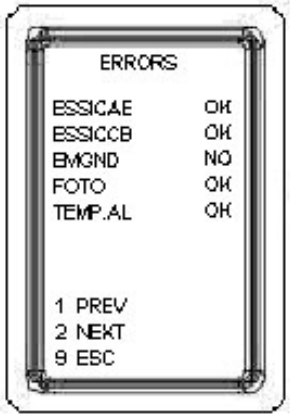
- Indication the signals have a discordant value, in this case the icon HELP ERROR may automatically appear on the display.

SCREEN ERRORS 1



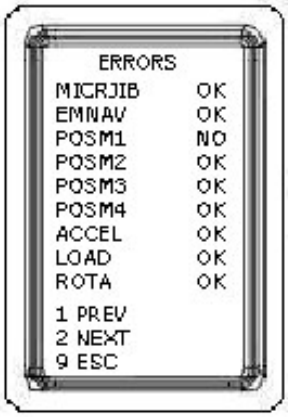
ST1 GND	Control switch if outrigger no. 1 is on the ground.
ST1 OPEN *700AJ – X23J only*	Control switch if outrigger no. 1 is open.
ST2 GND	Control switch if outrigger no. 2 is on the ground.
ST2 OPEN *700AJ – X23J only*	Control switch if outrigger no. 2 is open.
ST3 GND	Control switch if outrigger no. 3 is on the ground.
ST3 OPEN *700AJ - X23J only*	Control switch if outrigger no. 3 is open.
ST4 GND	Control switch if outrigger no. 4 is on the ground.
ST4 OPEN *700AJ - X23J only*	Control switch if outrigger no. 4 is open.

SCREEN ERRORS 2



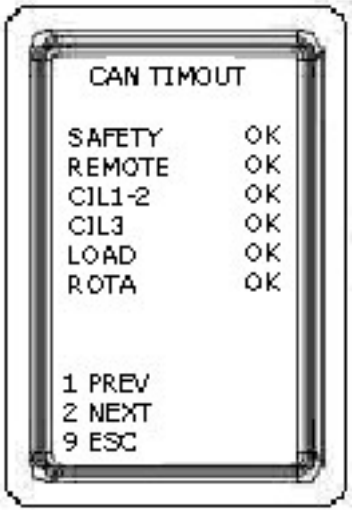
ESSICAE	Key button for aerial part safeties by-pass
ESSICCA	Key button for ground part safeties by-pass
EM GROUND	Emergency stop switch on the ground
PHOTO	Photocells – Indicates if the photocells have the same signal
ALL. TEMP *Option reserved for some markets*	External temperature sensor

SCREEN ERRORS 3



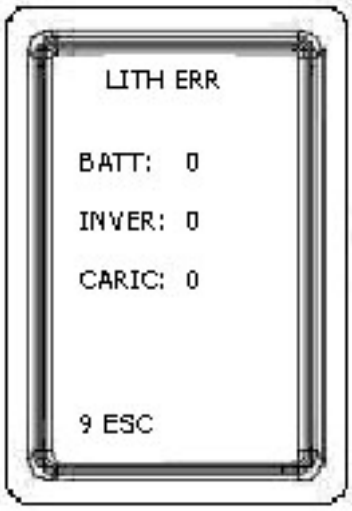
MICROJIB	Control switch if the JIB arm is perfectly closed
EMNAV	Emergency stop switch on remote control in basket
POSM1 *700AJ – X23J only*	Control switch if outrigger no. 1 is open in “reduced area” position
POSM2 *700AJ – X23J only*	Control switch if outrigger no. 2 is open in “reduced area” position
POSM3 *700AJ – X23J only*	Control switch if outrigger no. 3 is open in “reduced area” position
POSM4 *700AJ – X23J only*	Control switch if outrigger no. 4 is open in “reduced area” position
ACCEL	Accelerometers or inclination sensors in the board
LOAD	Load cell
ROTA *700AJ – X23J only*	Aerial part rotation sensor

SCREEN CAN MESSAGE



SAFETY	Safety lines
REMOTE	Remote control
CIL1-2 *700AJ – X23J only*	Position sensor for 1 and 2 arms cylinder
CIL3 *700AJ – X23J only*	Position sensor for 3 arm cylinder
LOAD	Controlling board of the Load cell
ROTA *700AJ – X23J only*	Aerial part rotation sensor

SCREEN FOR MODELS LITHIUM POWERED



The screen LITH ERR, present on all unities, provide indication for models powered with Lithium batteries only

On unities powered with Gasoline or Diesel engine, the value BATT; INVER and CARIC remain always O.

Batt = BMS (Battery Management System)

Inver = Inverter

Caric = Battery Charger

Table 6-5. BMS Diagnostic trouble code chart

CODE	ERROR TYPE
A99E01	System Configuration Error
A99E02	Unexpected voltage
A99E03	Unexpected temperature
A99E04	Over current Discharge
A99E05	Over current Charge
A99E06	Pre-Charge Error
A99E07	No 12V supply
A99E08	No -12V supply
A99E09	Battery Over temperature
A99E10	Electronics Over temperature
A99E11	Bad temp sensor auto shut off mode
A99E12	All temp sensors broken
A99E13	Broken temp sensor detected
A99E14	Grounding fault error
A99E01	System Configuration Error
A99E02	Unexpected voltage
A99E03	Unexpected temperature
A99E04	Over current Discharge
A99E05	Over current Charge
A99E06	Pre-Charge Error
A99E07	No 12V supply
A99E08	No -12V supply
A99E09	Battery Over temperature
A99E15	No boot loader error
A99E16	Second Protection
A99E17	Watchdog Error
A99E18	Power board alarm
A99E19	I2C Module not ready
A99E20	I2C TX Error
A99E21	I2C RX Error
A99E22	I2C RX Error 2
A99E23	AD error
A99E99	General Error

Table 6-6. INVERTER Diagnostic trouble code chart

CODE	MEANING
1	**Wrong Config** Cause: Eeprom memory not configured Solution: Contact JLG after sales dept.
8	**Watch Dog** Cause: The inverter is unable to activate or turn off the electric motor Solution: Control connections and continuity of the electric motor. If they are OK replace the inverter
13	**Eeprom KO** Cause: Hardware or Software problem in eeprom Solution: Replace the inverter
16	**Aux output KO** Cause: Electromechanical brake problem Solution: Usually it is a temporary anomaly due to a particular working condition. In case the anomaly persists replace the inverter.
17	**Logic failure #3** Cause: Activates in case of high peak of current in the inverter. Solution: Usually it is a temporary anomaly due to a particular working condition. In case the anomaly persists replace the inverter.
18	**Logic Failure #2** Cause: Fault in the inverter Solution: Replace the inverter
19	**Logic failure #1** Cause: An overvoltage or a sudden voltage drop occurred. Solution: Usually it is a temporary anomaly due to a particular working condition. In case the anomaly persists replace the inverter.
30	**VMN low** Cause: Inverter supply voltage is lower than the batteries' one, or the connection with the positive terminal of the battery is not correct. Solution: Control the connection with the positive terminal of the battery. If the anomaly persists replace the inverter.
31	**VMN High** Cause: One motor phase is not correctly connected or is broken. Solution: Control motor phases. If the anomaly persists replace the inverter.
37	**Contactor closed** Cause: The relay remains closed with power to the coil disconnected. Solution: Control the relay

Table 6-6. INVERTER Diagnostic trouble code chart

CODE	MEANING
38	**Contactor Open** Cause: The inverter feeds the relay's coil but the contact does not close. Solution: Control the relay and the power to the coil
49	**I=0 Ever** Cause: Feedback current from motor's sensor not constantly kept at 0 Solution: Control the connection with the motor
53	**STBY I high** Cause: Fault detected in the inverter Solution: Usually it is a temporary anomaly due to a particular working condition. In case the anomaly persists replace the inverter.
60	**Capacitor Charge** Cause: Problem in the inverter Solution: Control the connections and the motor phases
61	**High temperature** Cause: Temperature rise in the inverter. Solution: Allow a better cooling to the inverter. If the anomaly persists contact JLG after sales dept.
65	**Motor temper at** Cause: High motor temperature Solution: Stop the machine temporarily to enable motor cooling
67	**Can Bus KO** Cause: The inverter does not receive any information from Can Bus line Solution: Control the connections with the multi function tool
70	**Encoder Error** Cause: Anomaly detected on encoder (= engine rpm sensor) Solution: Control the rpm sensor connection. The anomaly may also be caused by a bearing fault.
73	**Therm is sensor KO** Cause: The signal from the temperature sensor is higher than 4,95 Volt or lower than 0,1 Volt Solution: Usually it is a temporary anomaly due to a particular working condition. In case the anomaly persists replace the inverter.
74	**Driver shorted** Cause: Anomaly to the relay supply. Solution: Control relay supply. Usually it is a temporary anomaly due to a particular working condition. In case the anomaly persists replace the inverter.
75	**Driver shorted** Cause: Anomaly to the relay supply. Solution: Control relay supply. Usually it is a temporary anomaly due to a particular working condition. In case the anomaly persists replace the inverter.

Table 6-6. INVERTER Diagnostic trouble code chart

CODE	MEANING
76	**Coil shorted** Cause: Anomaly detected in the relay coil Solution: Control the integrity of relay support.
78	**VACC not OK** Cause: Solution: Usually it is a temporary anomaly due to a particular working condition. In case the anomaly persists replace the inverter.
79	**Incorrect start** Cause: Starting procedure not correct Solution: Control the electric connections. Usually it is a temporary anomaly due to a particular working condition. In case the anomaly persists replace the inverter.
86	**Pedal wire KO** Cause: Solution: Usually it is a temporary anomaly due to a particular working condition. In case the anomaly persists replace the inverter.
93	**Wrong set batt** Cause: With supply ON, the control test detected batteries not in conformity. Solution: Replace the batteries with the original ones supplied by JLG.
94	**Current sensor KO** Cause: Max current setup procedure active. Solution: Contact JLG after sales dept.
99	**Check up needed** Cause: Solution: Contact JLG after sales dept.

Table 6-7. BATTERY CHARGER FAULT CODES

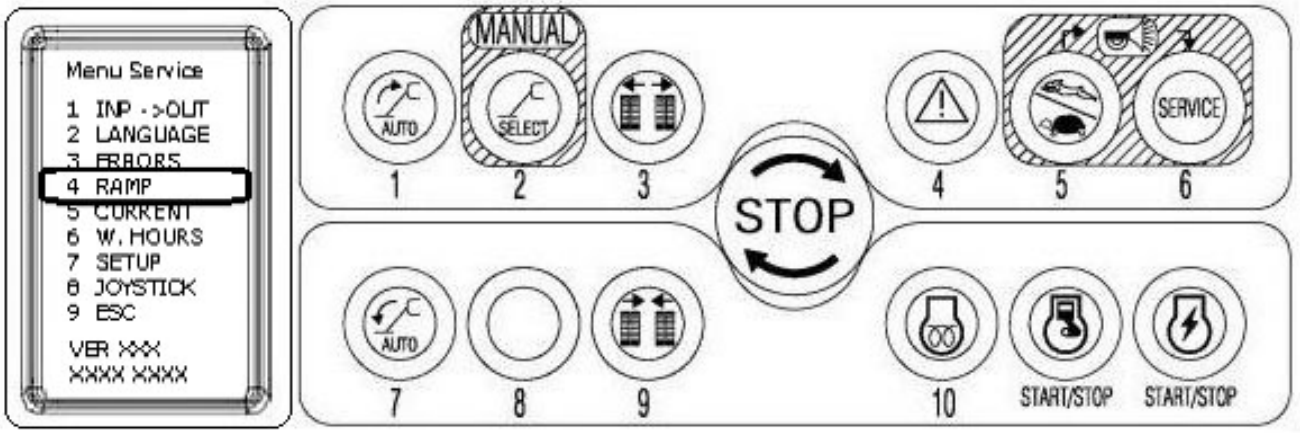
CODE	DESCRIPTION	STATUS	ACTION
8	Logic internal fault	The battery charger stops working	Call the assistance or change the product.
13	Communication problem with external memory	The battery charger stops working.	Call the assistance or change the product.
19	Logic internal fault	The battery charger stops working.	Call the assistance or change the product.
242	Error during the reading of the micro controller internal memory	The battery charger stops working.	Call the assistance or change the product.
252	Short circuit in the battery charger output.	The battery charger stops working	Turn the battery charger off and eliminate the output short circuit. If the problem persists call the service or change the product.
246	Phase 1 finished for timeout and not for natural reaching of the control voltage.	The battery charger stops working	Control that the battery capacity is compatible or control that the battery conforms to the battery charger purchased. If the battery is correct and the problem persists cal the service
241	Problem in CANBUS communication with other systems in the network	The managing may change according to the different product firmware.	Control the correct functioning of the CANBUS system
248	Too high temperature in the battery charger	if the internal temperature exceeds 80°C the battery charger reduces the power to the 80% while it stops working if the internal temperature exceeds 90°C. It restarts at full power if the internal temperature drops below 70°C	
249	Battery temperature too high.	The battery charger stops working if the temperature exceeds 55°C or drops below -20°C. When the battery temperature drops under 45°C or rises over -10°C the battery charger restarts working	
251	A network hole has been found	The battery charger stops the supply. It restarts once the alarm conditions disappear.	If the problem persists control supply of the battery charger network.
18	Stalling or very long network hole.	The battery charger stops the supply. It restarts once the alarm conditions disappear or after restarting.	If it is a network hole control the network supply of the battery charger.
245	Irregular current absorption	The battery charger stops the supply. It restarts once the alarm conditions disappear.	If the problem persists call the service or change the product.

Table 6-7. BATTERY CHARGER FAULT CODES

240	the digital input is open and is managed as start-stop hardware.	The battery charger stops the charge until the digital input is not reclosed.	Close the digital input.
253	Network voltage higher than the max value of the functioning window.	The battery charger does not charge until the network voltage re-enters the normal functioning window.	Control if the network voltage is in the correct functioning parameter
244	Network voltage lower than the min value of the functioning window.	The battery charger does not charge until the network voltage re-enters the normal functioning window.	Control if the network voltage is in the correct functioning parameter

6.9 RAMPS

From the SERVICE menu, pressing button 4"RAMP" accesses the menu RAMP to adjust the parameter settings in order to achieved optimum machine performance.



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

   Using the remote control buttons to enter the password 1883.

NOTE: *password permit to change all RAMP Settings.*

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

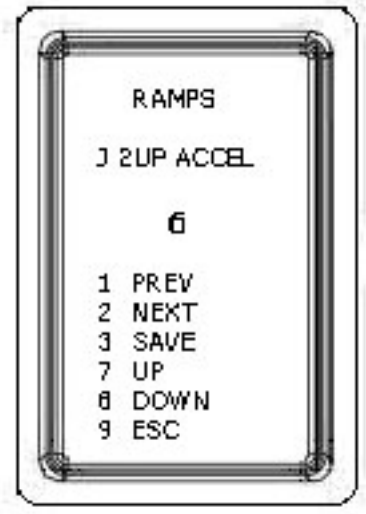
3. Press button 9 "ESC" two times.

   Repeat the above steps if "NO" appear on the display.

4. Press button 4 "RAMP" to enter in menu ramps setting.

   Use buttons 1"PREV." and 2"NEXT" to scroll the various functions.

5. Use buttons 7"UP" and 8"DOWN" to adjust the values.
6. Press button 3"SAVE" to save.

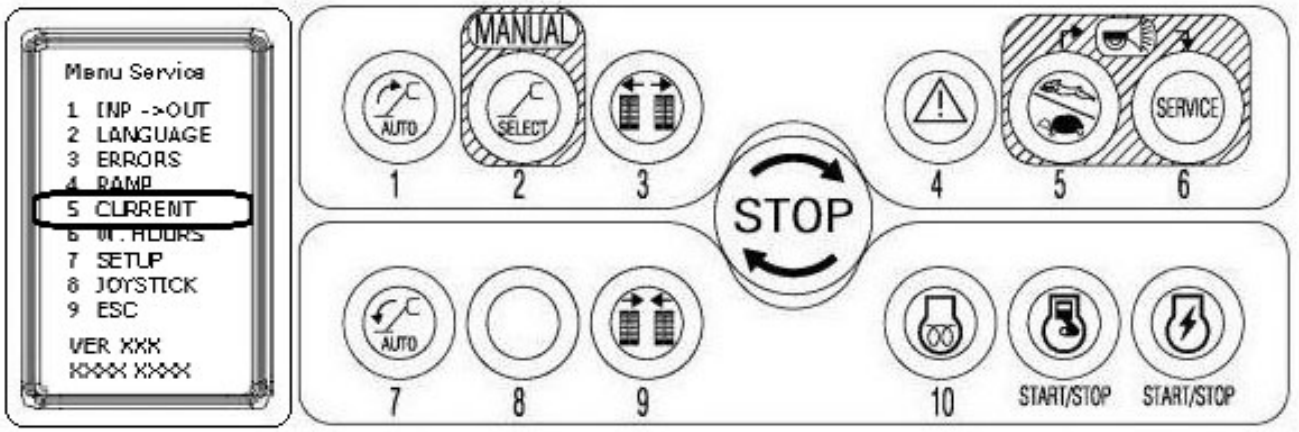


NOTE: *EVERY TIME THE RAMP VALUE GETS MODIFIED BUTTON 3 TO SAVE MUST BE PRESSED, OTHERWISE THE MODIFICATION IS NOT ACTIVATE.*

6.10 CURRENTS

From the SERVICE menu, pressing button 5"CURRENT" accesses the menu CURRENT to adjust the parameter settings in order to achieved optimum machine performance.

NOTE: *Personality settings can be adjusted within the adjustment range in order to achieve optimum machine performance.*



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

   Using the remote control buttons to enter the password 1883.

NOTE: *password permit to change all CURRENT Settings.*

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

3. Press button 9 "ESC" two times.

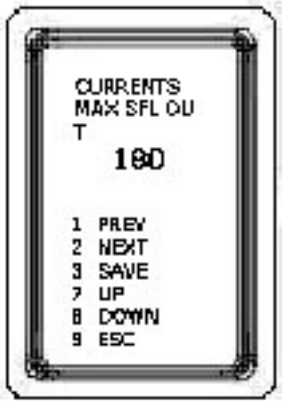
NOTE: *Repeat the above steps if "NO" appear on the display.*

4. Press button 5 "CURRENT" to enter in menu current setting.

   Use buttons 1 PREV. and 2 NEXT to scroll the various functions.

5. Use buttons 7 UP and 8 DOWN to adjust the values.
6. Press button 3 SAVE to save

NOTE: *EVERY TIME THE RAMP VALUE GETS MODIFIED BUTTON 3 TO SAVE MUST BE PRESSED; OTHERWISE THE MODIFICATION IS NOT ACTIVATE.*



NOTE: *Refer to Table 6.8, Time range (sec) for recommended settings.*

Table 6-8. Time range (sec)

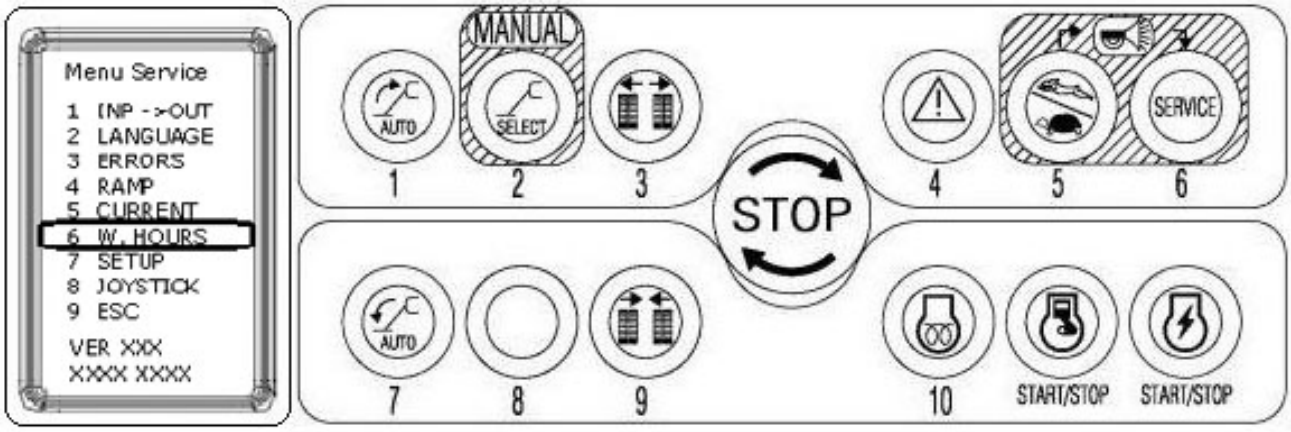
FUNCTIONS SPEED RANGE				
FUNCTION	**JOYSTICK N°**	**TIME Sec X14J X390AJ**	**TIME Sec X19J X550AJ**	**TIME Sec X23J X700AJ**
TELESCOPE EXTEND	J4	21" - 23"	21" - 23"	45" - 65"
ENGINE RPM		3000	3600	3600
TELESCOPE RETRACT	J4	13" - 15"	16" - 18"	29" - 45"
ENGINE RPM		3000	3600	2200
TOWER BOOM UP	J2	18" - 21"	28" - 30"	50" - 60"
ENGINE RPM		3000	2200	2200
TOWER BOOM DOWN	J2	16" - 20"	27" - 29"	56" - 70"
ENGINE RPM		3000	1500	1500
UPPER BOOM UP	J3	25" - 27"	29" - 31"	48" - 57"
ENGINE RPM		3000	2200	1500
UPPER BOOM DOWN	J3	25" - 27"	31" - 33"	60" - 70"
ENGINE RPM		3000	1500	1500
BASKET ROTATE RIGTH	J5	//	7" - 9"	7" - 9"
BASKET ROTATE LEFT	J5	//	7" - 9"	7" - 9"
ENGINE RPM		3000	1500	1500
SWING LEFT	J7	1':00" - 1.06"	41" - 47"	1':20" - 1.40"
SWING RIGTH	J7	1':00" - 1.06"	41" - 47"	1':20" - 1.40"
ENGINE RPM		3000	1500	1500
JIB UP	J6	8.5" - 10"	16" - 25"	14" - 25"
JIB DOWN	J6	8.5" - 10"	11" -13"	10" - 13"
ENGINE RPM		3000	1500	1500
BASKET LEVEL UP	J9	7" - 11"	37" - 39"	37" - 39"
BASKET LEVEL DOWN	J9	10" - 13"	27" - 29"	27" - 37"
ENGINE RPM		3000	1500	1500
Drive Forward /Reverse				
Low Speed m/s	J1	0.39"	0.47"	0.28"
High Speed m/s	J8	0.78"	0.92"	0.47"

6.11 WORKING HOURS

From the SERVICE menu, pressing button 6 ”W.HOURS” accesses the menu Working Hours.

This menu allows viewing the working hours of the thermic engine and the electrical motor.

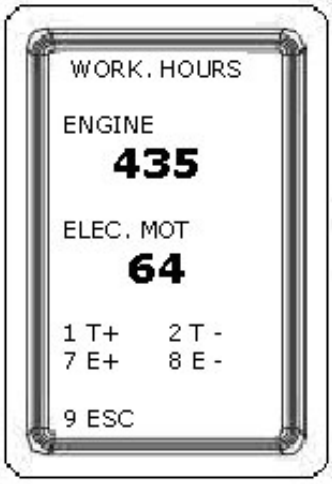
On lithium models, machine hours only.



To view the working hours of the Engine or Electrical motor.

Press button 6”W.HOURS”.

To change the working hours of the Engine or Electrical Motor.



1. Press button 7 “SETUP”.
2. Press button 5 “PASSWORD”.

   Using the remote control buttons to enter the password 7385.

NOTE: *password allow to change the Working Hours of Engine and Electrical Motor.*

Once the correct password is accepted the display shown “OK”.

3. Press button 9 “ESC” two times.

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

4. Press button 6“W:HOURS”.

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

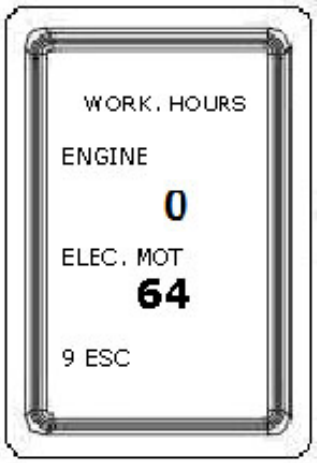
   KEEPING PRESSED the button 6 use the button 7” E +” to increase and button 8 ”E - “to decrease the working hours of the Electric Motor.

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

5. Press button 9 ESC 3 times to escape.

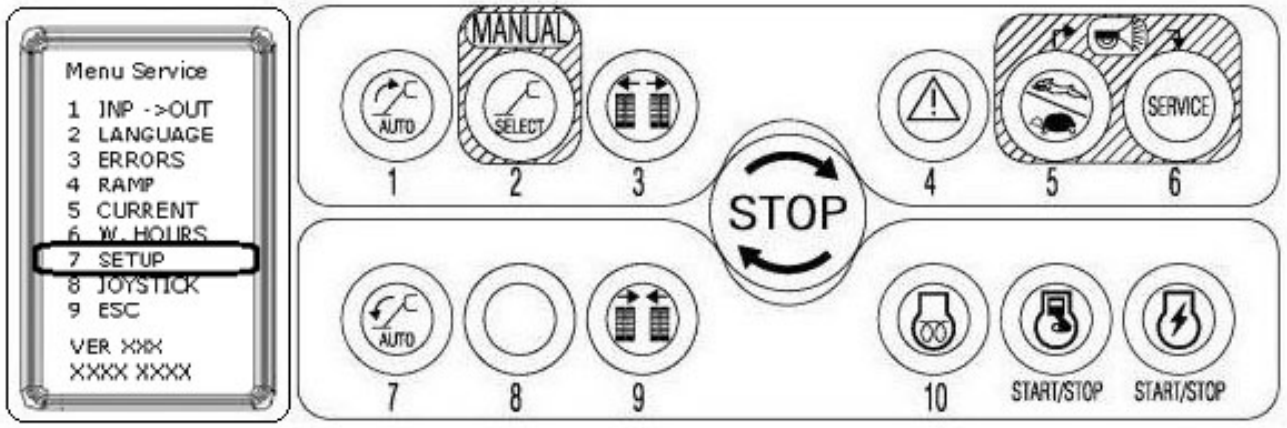
On Lithium models the Engine working HOURS will stay always **0**.

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



6.12 MACHINE SETUP

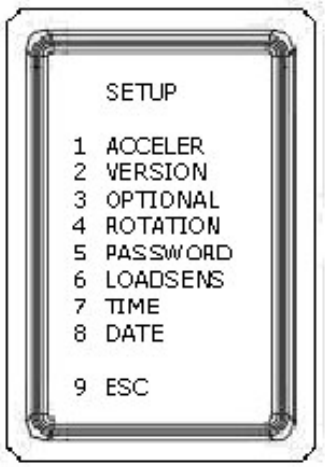
From the SERVICE menu, pressing button 7 ”SETUP ” accesses the menu SETUP to adjust the parameter settings in order to achieved proper machine performance.



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

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

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



SETUP 1 - ACCELER (CALIBRATING TILT SENSOR)

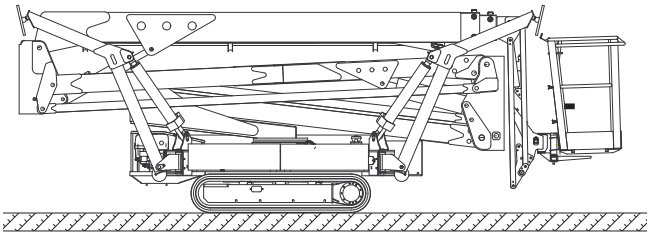
This menu allows the calibration of the tilt sensor.

NOTICE

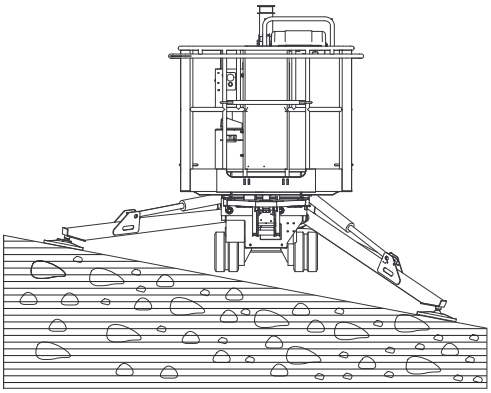
A NEW TILT MODULE WILL ACT AS IF IT IS TILTED ALL OF THE TIME UNTIL THE FOLLOWING PROCEDURE IS PERFORMED.

⚠ WARNING

CALIBRATE THE LEVEL SENSOR EXCEPT WITH THE UNITY LEVELED ON BOTH AXLE. CHECK THE BUBBLE LEVEL TO CONFIRM UNIT IS LEVEL (BUBBLE IS IN THE 1° GREEN *(CENTER)* AREA).



IF THE BUBBLE IN THE LEVEL IS NOT IN THE GREEN AREA, EXTEND THE SIDE OUTRIGGERS UNTIL UNIT IS LEVEL (BUBBLE IS IN THE 1° GREEN *(CENTER)* AREA).



1. Engine OFF.
2. Engine Key Switch ON.
3. Press button 7 SETUP “
4. Press button 5 “PASSWORD”

   Using the remote control buttons to enter the password 2857.

NOTE: *password above allow to calibrate the TILT SENSOR .*

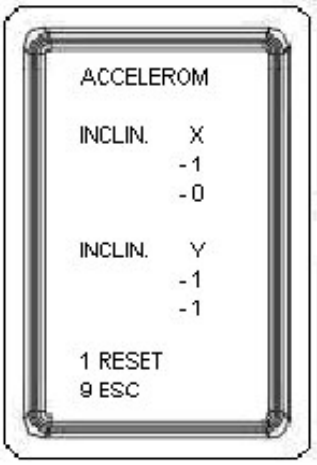
   Once the correct password is accepted the display shown “OK”.

5. Press button 9 “ESC”.

   Repeat the above steps if “NO” appear on the display.

6. Press button 1 “ACCELER” to enter in SETUP TILT SENSOR.
7. Press Button 1 to reset the TILT.

Check the values if both axle showed in the display become zero, otherwise press button 1 again until both values are zero.



Press 3 times button 9 to Esc to escape.

SETUP 2 - VERSION MODEL NUMBER ENGINE TYPE

This menu allows the setting of the machine model and the engine type.

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

   Using the remote control buttons to enter the password 3684.

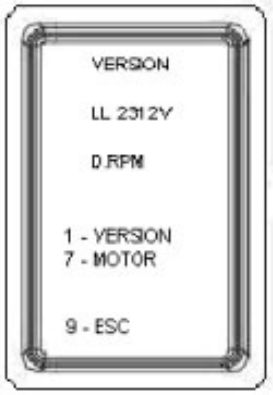
NOTE: *password above allow to choose machine number and engine type.*

Once the correct password is accepted the display shown “OK”.

3. Press button 9 “ESC”.

   Repeat the above steps if “NO” appear on the display.

4. Press button 2 “VERSION” to enter in VERSION SETUP.
5. Press Button 1 for machine number.
6. Press Button 7 for engine type.



Press button 9 ESC 3 times to escape.

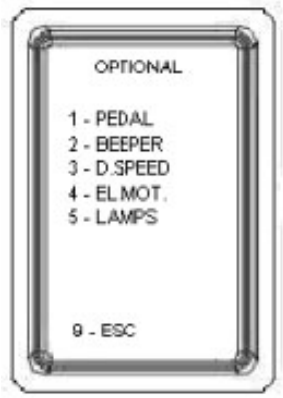
Personality Setting		
Model	Version	Engine
X14J X390AJ	LL1472	D. STD
		D.RPM
		B.9I
		B.13I
		B.9S
		B.13S
X17J X19J X500AJ	GL1780 LL1965	D. STD
		D.RPM
		B.15I
X23J X700AJ	LL2312	D.RPM
		B.15I

Engine Choice	EngineChoice Description
D. STD	Diesel RPM manual Adjustment
D.RPM	Diesel RPM Auto Adjustment
B.9I B.13I B.15I	Gasoline RPM Auto Adjustment
B.9S B13S	Gasoline RPM manual Adjustment

SETUP 3 - OPTIONAL

This menu allows the setting of those options:

1. Foot Pedal
2. Motion Alarm
3. Drive Speed
4. Power electrical Motor
5. Lamps on Outrigger



1 - FOOT PEDAL

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

   Using the remote control buttons to enter the password 4771.

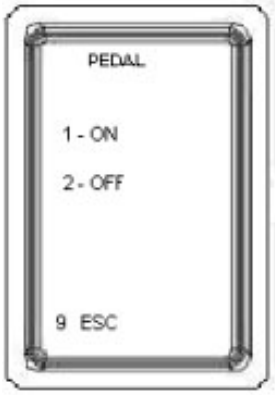
NOTE: *password above allow to choose the options shown on the screen.*

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

3. Press button 9 "ESC"

   Repeat the above steps if "NO" appear on the display.

4. Press button 3"OPTIONAL".
5. Press button 1 "PEDAL".
6. Press button 1 ON to actvate the "PEDAL".
7. Press button 2 "OFF to deactivate the Pedal".



Press 4 times button 9 to Esc to escape.

2 - MOTION ALARM

This menu allows the set ON or OFF of the motion alarm with upper fame and undercarriage movements, or for boom down only.

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

   Using the remote control buttons to enter the password 8365.

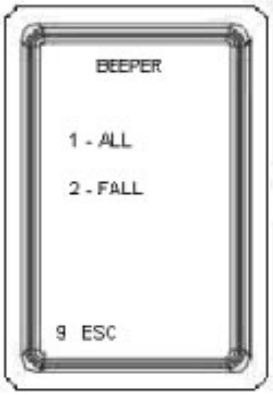
NOTE: *password above allow to choose the options shown on the screen.*

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

3. Press button 9 "ESC".

   Repeat the above steps if "NO" appear on the display.

4. Press button 3"OPTIONAL".
5. Press button 2 "BEEPER".



6. Press button 1 ALL to actvate all movements.
7. Press button 2 "FALL to activate the descent movements only".

Press 4 times button 9 to Esc to escape.

3 - 2ND DRIVE SPEED

This menu allows to set ON or OFF of the high drive speed on models with this option.

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

   Using the remote control buttons to enter the password 5216.

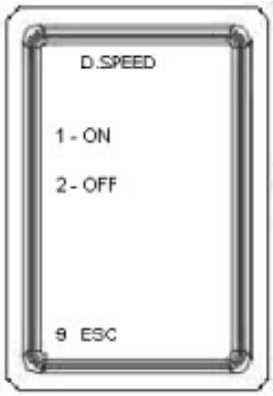
NOTE: *password above allow to choose the options shown on the screen.*

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

3. Press button 9 "ESC".

   Repeat the above steps if "NO" appear on the display.

4. Press button 3"OPTIONAL".
5. Press button 3"D.SPEED"2 ".



6. Press button 1 ON to activate 2ND DRIVE SPEED.
7. Press button 2 "OFF to deactivate the 2ND DRIVE SPEED.

Press 4 times button 9 to Esc to escape.

NOTICE

THE 2ND DRIVE SPEED STANDARD ON X23J AND X700AJ ONLY

4 - ELECTRICAL MOTOR

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

   Using the remote control buttons to enter the password 3522.

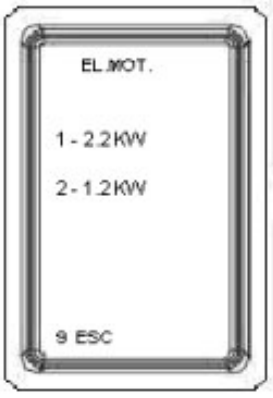
NOTE: *password above allow to choose the options shown on the screen.*

   Once the correct password is accepted the display shown “OK”.

3. Press button 9 “ESC”.

   Repeat the above steps if “NO” appear on the display.

4. Press button 3”OPTIONAL”.
5. Press button 4 “EL.MOT”.



6. Press button 1 2,2 KW for 220- 240 Volt 50HZ.
7. Press button 2 1;2 KW” for 110 Volt 60HZ.

Press 4 times button 9 to Esc to escape

5 - LAMP ON OUTRIGGER

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

   Using the remote control buttons to enter the password 6661.

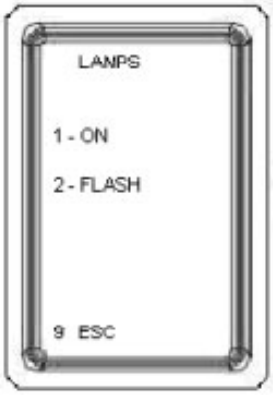
NOTE: *password above allow to choose the options shown on the screen.*

   Once the correct password is accepted the display shown “OK”.

3. Press button 9 “ESC”.

   Repeat the above steps if “NO” appear on the display.

4. Press button 3”OPTIONAL”.
5. Press button 5 “LAMPS”.



6. Press button 1 for Lamps continuously ON (With OUTRIGGER on the Ground CE /ANSI).
7. Press button 2 for Lamps Blinking (With OUTRIGGER on the Ground).

Press 4 times button 9 to Esc to escape

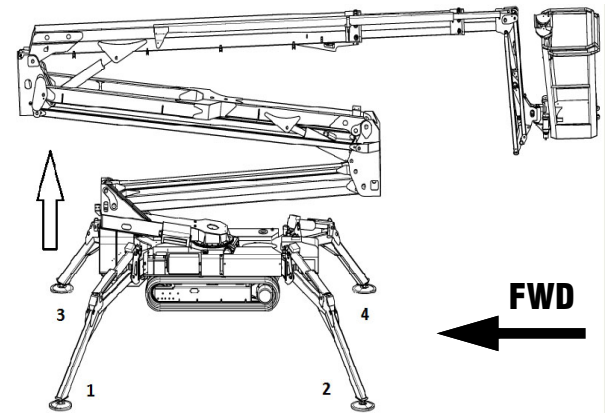
SETUP 4 - CALIBRATING SWING SENSOR (X23J –X700AJ Only)

NOTICE

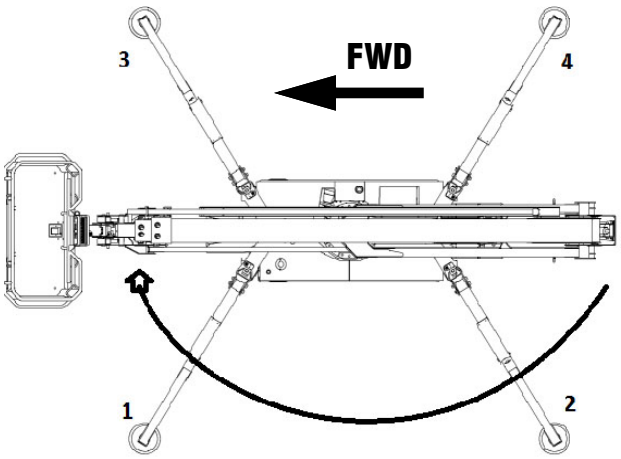
A NEW SWING SENSOR WILL ACT AS IF IT IS WITHOUT RESTRICTED AREA UNTIL THE FOLLOWING PROCEDURE IS PERFORMED. THE UPPER FRAME COULD INTERFER WITH THE OUTRIGGERS.

This menu allows calibrating the swing sensor for proper operating with outriggers on restricted work area.

1. Stabilize the machine.
2. Lift up the lower boom almost 1 mt (to avoid contacts with outrigger) for calibration position.

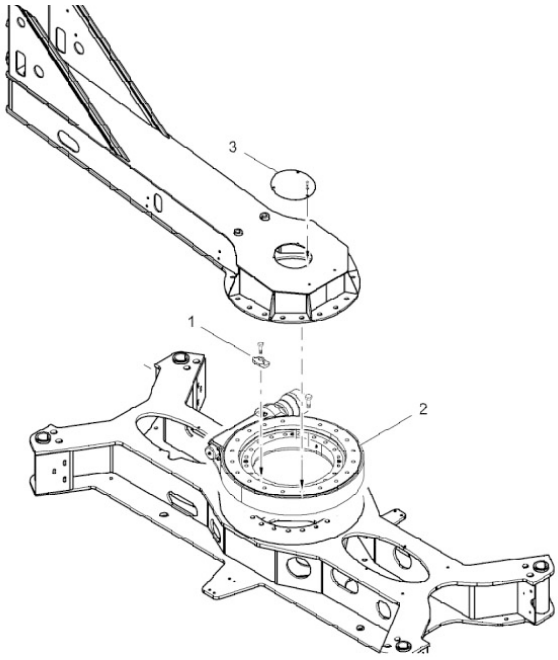


3. Swing CW 180 degrees (centered over opposite end of chassis) for Calibration Position.



NOTICE

TO ENSURING THE SUCCESS OF THE CALIBRATION IT IS ESSENTIAL SWING THE UPPER FRAME ON CW DIRECTION ONLY, AND THE ROTATION HAS BEEN CARRIED OUT AGAINST THE MECHANICAL STOP 1.



1. Press button 7 "SET-UP“.
2. Press button 5 “PASSWORD”.

   Using the remote control buttons to enter the password 2857.

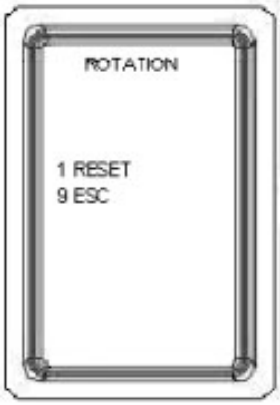
NOTE: *password above allow to choose machine number and engine type.*

   Once the correct password is accepted the display shown “OK”.

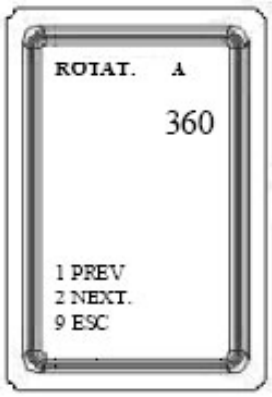
3. Press button 9 “ESC”.

   Repeat the above steps if “NO” appear on the display.

4. Press button 4 “ROTATION” to enter in ROTATION SETUP.
5. Press Button 1 for RESET .



6. Press 3 times button 9 to Esc to escape.
7. Press button 6 "SERVICE“.
8. Press button 1 INP OUT.
9. Press button 2 “SUCC” until shown “ROTATION”.
10. Check that the value is equal to 360 degrees.



If the value is different from 360 degrees repeat the procedure.

SETUP 6 - LOADSENS (CALIBRATING LSS LOAD SENSIG SYSTEM)

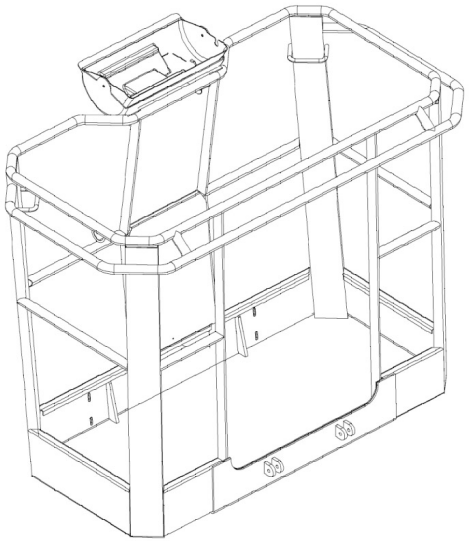
This menu allows the Calibration Menu is used with Platform weight.

NOTICE

A NEW LOAD CELL OR A NEW LSS MODULE WILL ACT AS IF IT IS WITHOUT AREA UNTIL THE FOLLOWING PROCEDURE IS PERFORMED. THE UPPER FRAME COULD INTERFER WITH THE OUTRIGGERS.

THE LOAD SENSING SYSTEM REQUIRES PERIODIC FUNCTION. VERIFICATION.

Empty the platform to allow the Load Sensing System to record its weight during calibration.



Remove the remote control from the basket and keep it on hand.

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

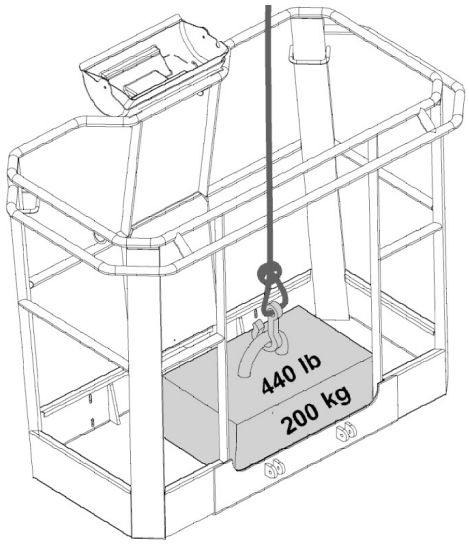
   Using the remote control buttons to enter the password 6138.

   Once the correct password is accepted the display shown “OK”.
3. Press button 9 “ESC”.

   Repeat the above steps if “NO” appear on the display.
4. Press button 6 “LOADSENS” to enter in LOADSENS SETUP.

5. Press button 1 “SET 0KG” and wait for about 5 seconds.

Add weight of 200 kg (CE) / 440 Lb (ANSI) in the basket.



Wait for about 5 seconds.

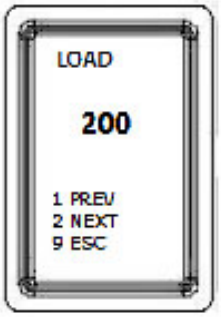
Press button 2 to SET 200KG.

Press 3 times button 9 to Esc to escape.

LSS VALIDATION

1. Stabilize the machine.
2. Press button 6 "SERVICE".
3. Press button 1 INP OUT.
4. Press button 2 “SUCC” until shown “LOAD”.

   Check that the value if is in reference to the weight on the basket.



If the values shown is almost greater than 10 kg, repeat the procedure.

SETUP 7 - TIME SETUP

This menu allows the setting of the clock.

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

   Using the remote control buttons to enter the password 1468.

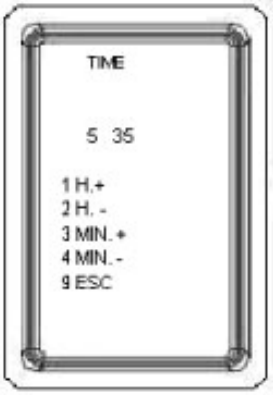
NOTE: *password above allow to change the time.*

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

3. Press button 9 "ESC".

   Repeat the above steps if "NO" appear on the display.

4. Press button 7 "TIME" to enter in TIME SETUP.



1. Press buttons 1 Hours UP
2. Press buttons 2 Hours Down
3. Press buttons 3 Minutes UP
4. Press buttons 4 Minutes Down

Press 3 times button 9 to escape.

SETUP 8 - DATE SETUP

This menu allows the setting of the data.

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

   Using the remote control buttons to enter the password 1468.

NOTE: *password above allow to change the date.*

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

3. Press button 9 "ESC".

   Repeat the above steps if "NO" appear on the display.

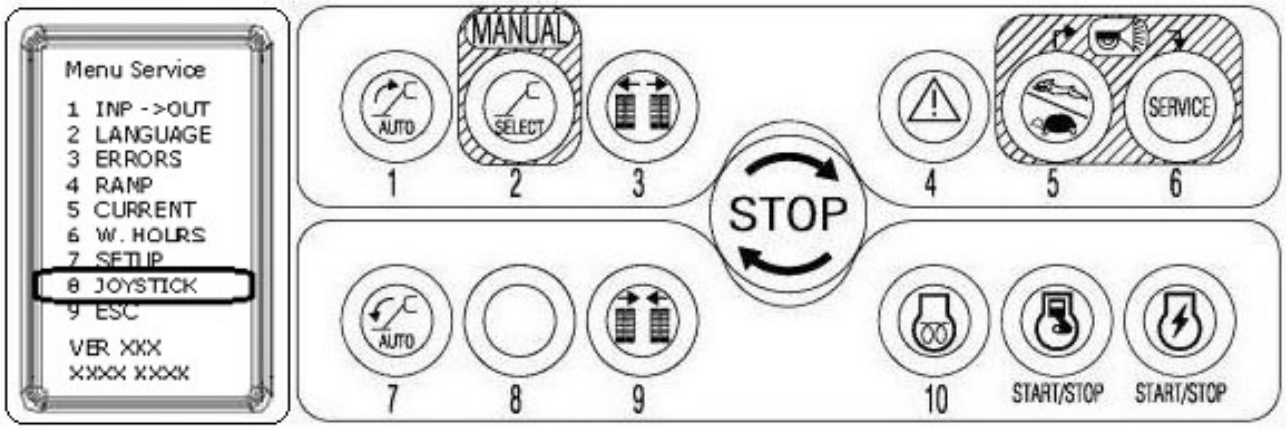
4. Press button 8 "DATE" to enter in DATE SETUP.

1. Press buttons 1 Day UP
2. Press buttons 2 Month Down
3. Press buttons 3 Year UP
4. Press buttons 4 Year Down

Press 3 times button 9 to escape.

6.13 JOYSTICK

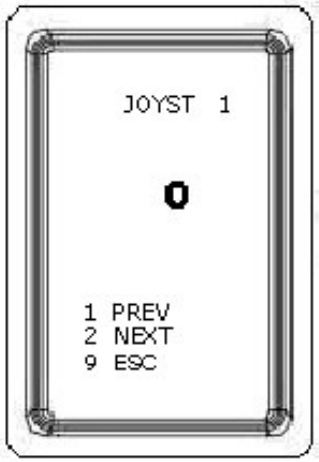
From the SERVICE menu, pressing button 8 ”JOYSTICK” accesses the menu JOYSTICK to visualize the numeric values.



USE Buttons 1 or 2 to choose the JOYSTICK.

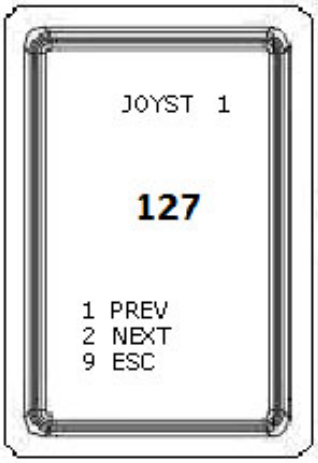
Joystick Neutral position

Value = 0



Joystick Fully stroking (both direction)

Value = 127

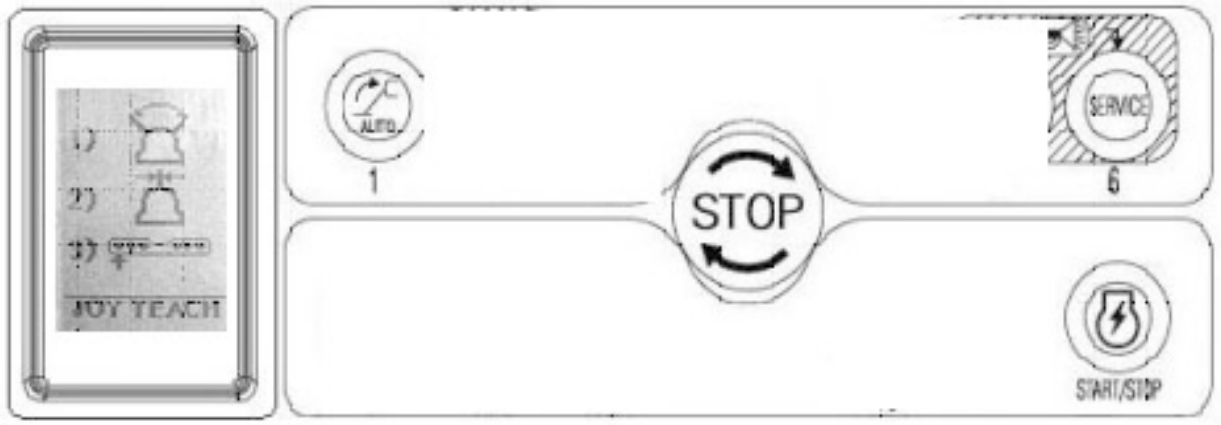


6.14 CALIBRATING JOYSTICK

This menu allows the calibration on Joystick replacement.

NOTICE

A NEW JOYSTIC WILL ACT AS IF IT IS AWATING FOLLOWING PROCEDURE IS PERFORMED.



1. Engine and Electrical Motor OFF.
2. Press at the same time the 3 buttons below for at least 7 seconds, until appear “JOY TEACH”.
3. Move each Joystick fully stroking on both direction.
4. Press Button 7 to escape.

6.15 CONFIGURATION SERIAL NUMBER RADIO REMOTE CONTROL (X17J ONLY)

This menu allows the configuration of the Radio Remote Control with the Radio Receiver Module.

1. Press Stop Button.

2. Keeping pressed buttons 9 & 10, while release the Stop Button.

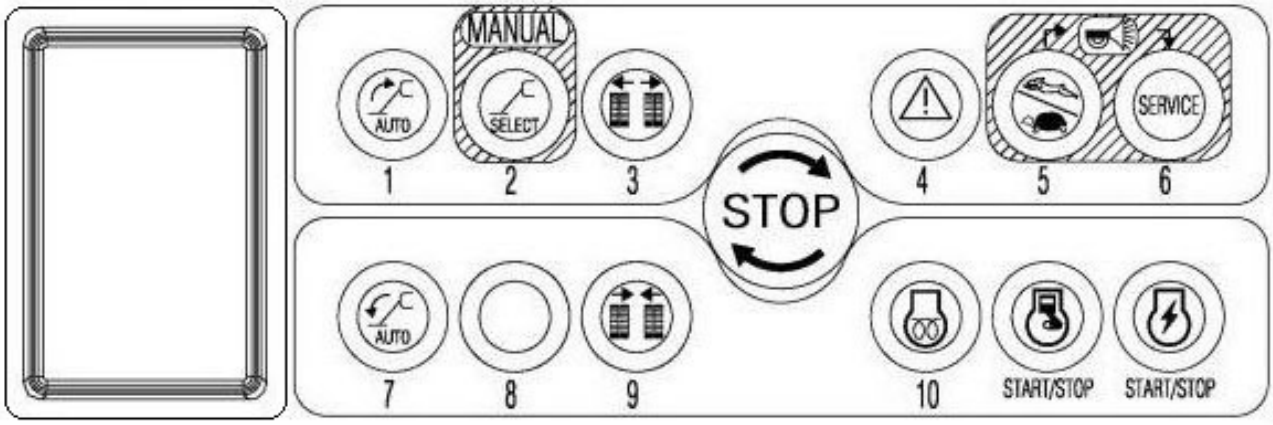
3. Display showing the last 5 digit code of the present remote control serial number.

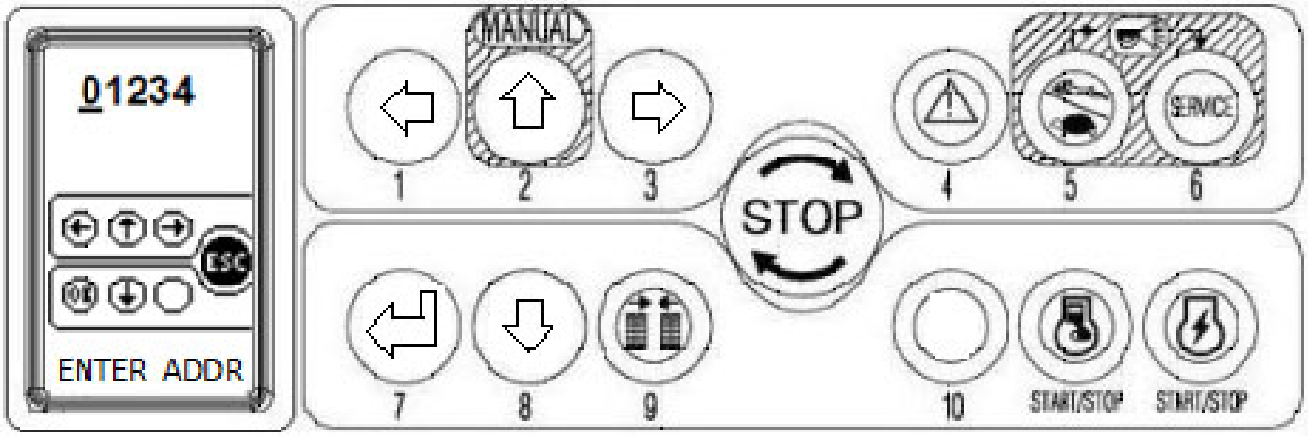
4. Make a note of the last 5 digit code, printed on back side of the remote control, that have to match with the radio receiver.

5. Using the arrows as indicated on the buttons 1; 2; 3; 7; 8 to enter the new code.

6. Press button 7 "Enter"/"OK" stores the value.

7. Press Stop Button.





NOTES:

SECTION 7. BASIC ELECTRICAL INFORMATION & SCHEMATICS

7.1 DESCRIPTION

Table 7-1. xxx

How to read the electric wiring diagrams	A
Photocells – Safety Exclusion – Slew proximity – Stabilizers pressure sensors	B
Aerial part safety chain: Outriggers aligned switches (only X23J-X700AJ)	C
Aerial part safety chain: Outriggers switches	D
Can Network - Cylinders position sensor – Remote control connector - Modem	E
Ropes switch - Jib position switch – Pedal – Load cell	F
Engine stop switches – Engine start push buttons (ground) – Aerial movement switch (ground)	G
Emergency descend electro valves - Optionals	H
Electric power supply	I
Ground part: Tracks – Undercarriage widening – 2° speed – Proportional electro valves	L
Ground part: Outriggers – Electric diverter	M
Aerial part: Basket levelling – Basket rotation – Jib – Proportional electro valve	N
Aerial part: 1° Cylinder - 2° cylinder – Extension - Rotation	O
Thermic engine connexion (gasoline) – X19J-X550AJ/X23J-X700AJ	P1
Thermic Engine connexion (diesel) – Diesel engine sensors – X23J-X700AJ	P2
Thermic Engine connexion (diesel) – X14J-X390AJ/X19J-X550AJ	P3
Thermic engine connexion (gasoline) – X14J-X390AJ	P4
220 Volt Electric power supply – Electric Engine	Q
Optional: double stabilization area with rotation sensor – X23J-X700AJ	R
Electric schedules layout	S
Components location	T

7.2 A - HOW TO READ THE WIRING DIAGRAMS

The wiring diagram is shown divided by individual application, in order to an easier and faster reading.

Some considerations are valid for all machines, unless otherwise specified. Specifically, the following should be remembered:

- Each component is identified by a code; the meaning of this code is shown in the key.
- Each component describes only the identification of the connector used and the pins corresponding to the application in question. The wiring references are shown on the outside of the connector.
- Each cable describes the color or the identifier number. When no color is indicated, the cable is black. Where the number is used, are shown two digits: the first identifies the wire and is also marked on the wire itself, the second identifies the number of wires in the cable (e.g.: 14/18=wire number 14 in an 18-wire cable).
- The Y/G or Y-G(= yellow and green) wires are always earth wires. The general earth connectors are located in the control panel, in the control board box and in the main power supply box.
- The simplest electronic schedules are always shown with a dashed perimeter. To make the system easier to understand, the wiring diagram is also shown inside these electronic schedule.
- The underlined letters show in what pages it is possible to find the same pin or connector
- The location of the connectors and the pins in the electronic schedules is shown in section “S”.
- The location of the electrical components is shown in section “T”.

COLOUR CODES

B = BLACK

BL = BLUE

BR = BROWN

G = GREEN

GR = GREY

OR = ORANGE

R = RED

W = WHITE

Y = YELLOW

7.3 B - PHOTOCELLS - SAFETY EXCLUSION - SLEW PROXIMITY - STABILIZERS PRESSURE SENSORS

NAME	DESCRIPTION
CONNECTOR	CONNECTOR
AE SAF ESC	AERIAL SAFETY EXCLUSION KEY SWITCH
ECM1	ELECTRONIC CONTROL MODULE 1
GR SAF ESC	GROUND SAFETY EXCLUSION KEY SWITCH
PHOTO A	PHOTOCELL A
PHOTO B	PHOTOCELL B
SLEW PROX	SLEW PROXIMITY (only X23J-X700AJ)
1-2 PRESSURE SENSOR	PRESSURE SENSORE STABILIZERS 1 AND 2
3-4 PRESSURE SENSOR	PRESSURE SENSORE STABILIZERS 3 AND 4

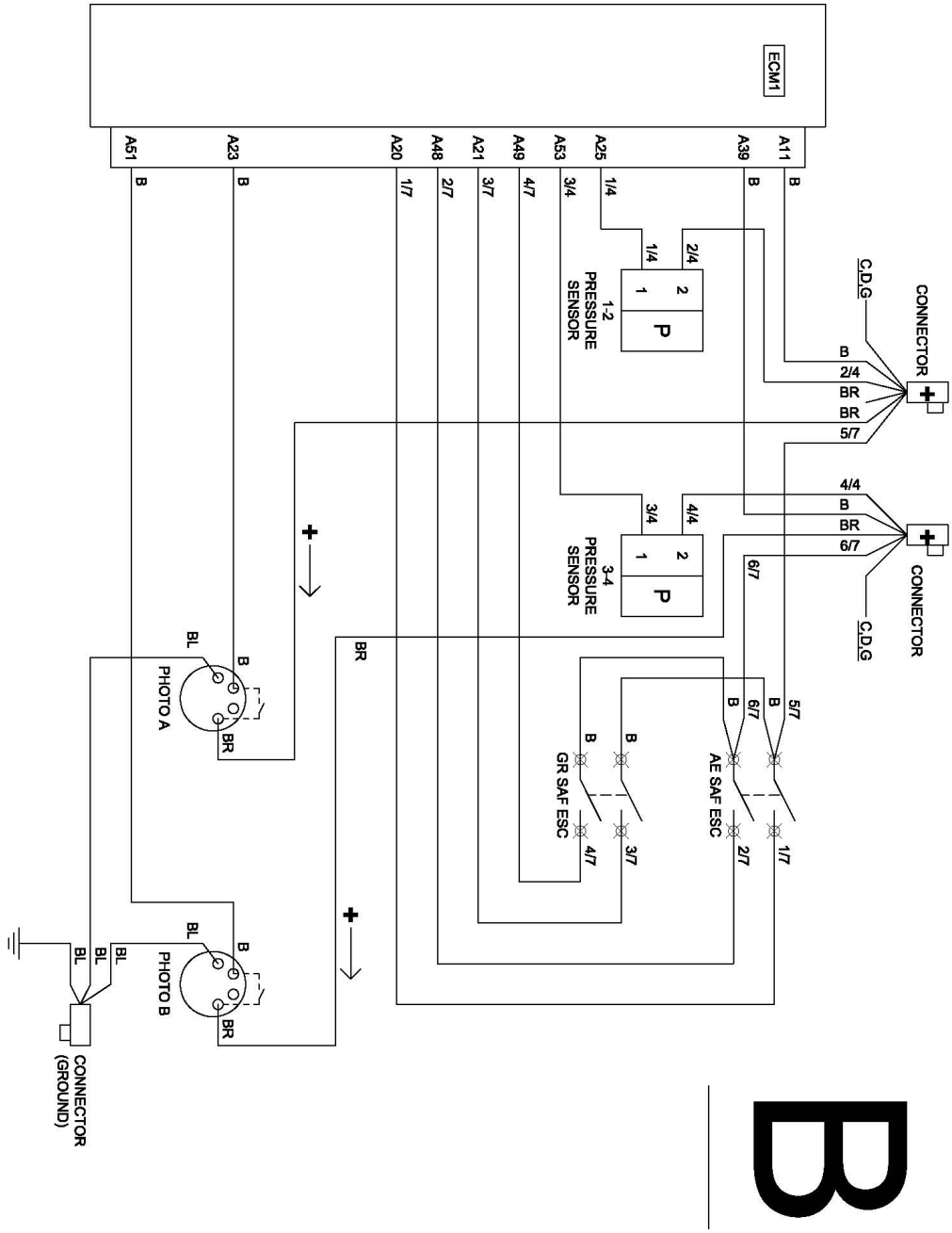

ECM1
A51
A23
A20
A48
A21
A49
A53
A25
A39
A11
1-2 PRESSURE SENSOR
3-4 PRESSURE SENSOR
C.D.G
CONNECTOR
PHOTO A
PHOTO B
CONNECTOR (GROUND)
GR SAF ESC
AE SAF ESC
B
BR
BL

Figure 7-1.

7.4 C - AERIAL PART SAFETY CHAIN: OUTRIGGERS ALIGNED SWITCHES (ONLY X23J-X700AJ)

NAME	DESCRIPTION
CONNECTOR	CONNECTOR
ECM1	ELECTRONIC CONTROL MODULE 1
SW POS STAB 1	FRONT LEFT OUTIGGER POSITION SWITCH
SW POS STAB 2	REAR LEFT OURIGGER POSITION SWITCH
SW POS STAB 3	FRONT RIGHT OUTRIGGER POSITION SWITCH
SW POS STAB 4	REAR RIGHT OUTRIGGER POSITION SWITCH

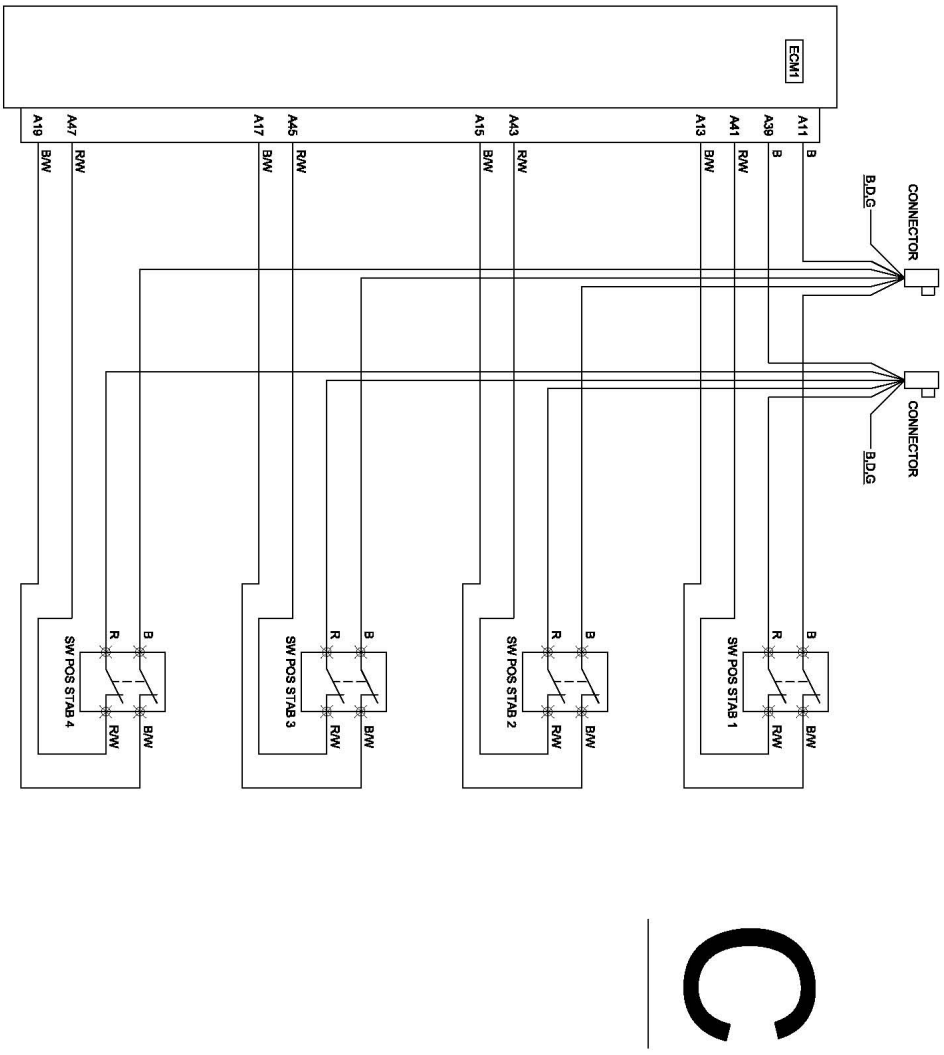

ECM1
A19
A47
A17
A45
A15
A43
A13
A41
A39
A11
B/W
R/W
B
B.D.G
CONNECTOR
CONNECTOR
B.D.G
SW POS STAB 4
SW POS STAB 3
SW POS STAB 2
SW POS STAB 1
R
B
R/W
B/W

Figure 7-2.

7.5 D - AERIAL PART SAFETY CHAIN: OUTRIGGERS SWITCHES

NAME	DESCRIPTION
CONNECTOR	CONNECTOR
CONNECTOR STAB 1	FRONT LEFT OUTIGGER CONNECTOR
CONNECTOR STAB 2	REAR LEFT OURIGGER CONNECTOR
CONNECTOR STAB 3	FRONT RIGHT OUTRIGGER CONNECTOR
CONNECTOR STAB 4	REAR RIGHT OUTRIGGER CONNECTOR
ECM1	ELECTRONIC CONTROL MODULE 1
LAMP STAB 1	FRONT LEFT OUTIGGER LAMP
LAMP STAB 2	REAR LEFT OURIGGER LAMP
LAMP STAB 3	FRONT RIGHT OUTRIGGER LAMP
LAMP STAB 4	REAR RIGHT OUTRIGGER LAMP
SW STAB 1	FRONT LEFT OUTIGGER SWITCH
SW STAB 2	REAR LEFT OURIGGER SWITCH
SW STAB 3	FRONT RIGHT OUTRIGGER SWITCH
SW STAB 4	REAR RIGHT OUTRIGGER SWITCH

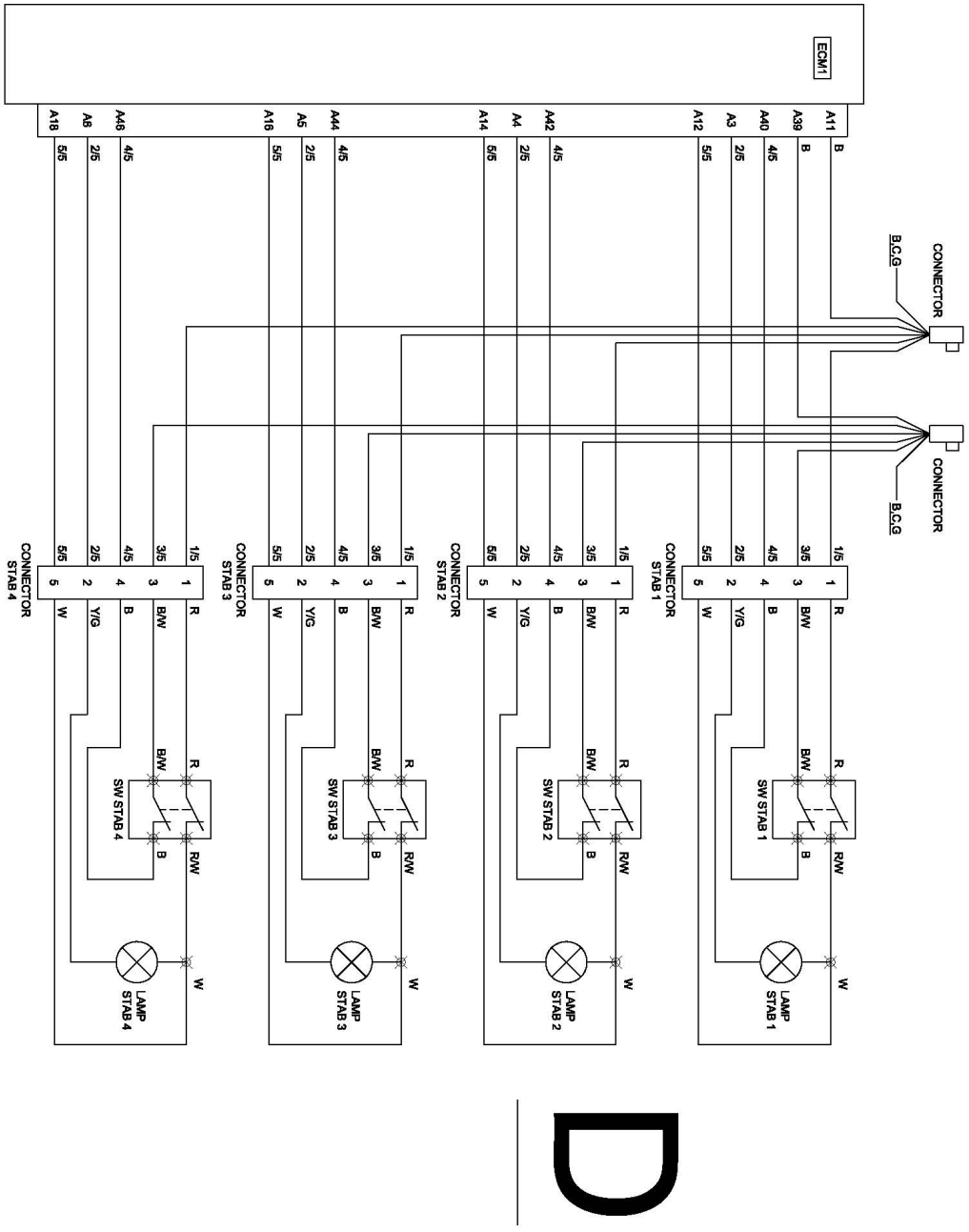

ECM1
A18
A8
A48
A16
A5
A44
A14
A4
A42
A12
A3
A40
A39
A11
B/G
CONNECTOR
CONNECTOR
B/G
CONNECTOR STAB 4
CONNECTOR STAB 3
CONNECTOR STAB 2
CONNECTOR STAB 1
SW STAB 4
SW STAB 3
SW STAB 2
SW STAB 1
LAMP STAB 4
LAMP STAB 3
LAMP STAB 2
LAMP STAB 1
B/W
R
R/W
Y/G
B
W

Figure 7-3.

7.6 E - CAN NETWORK - CYLINDERS POSITION SENSORS - REMOTE CONTROL CONNECTOR - MODEM

NAME	DESCRIPTION
ARM CONNECTOR	SECOND ARM CONNECTOR
ARM SCH	SECOND ARM SCHEDULE
CONNECTOR	CONNETTOR
ECM1	ELECTRONIC CONTROL MODULE 1
ECM2	ELECTRONIC CONTROL MODULE 2
ECM3	ELECTRONIC CONTROL MODULE 3
JIB CONNECTOR	CONNECTOR IN THE JIB
JIB SCH	JIB SCHEDULE
MAIN SWITCH	BATTERY CUTTER
MODEM	MODEM
OPTIONAL RC	OPTIONAL REMOTE CONTROL (EMERGENCY GROUND POSITION)
RC	REMOTE CONTROL
1° CYLINDER POSITION SENSOR	1° AND 2° ARMS POSITION SENSOR (only X23J-X700AJ)
2 CYLINDER POSITION SENSOR	3°° ARMS POSITION SENSOR (only X23J-X700AJ)

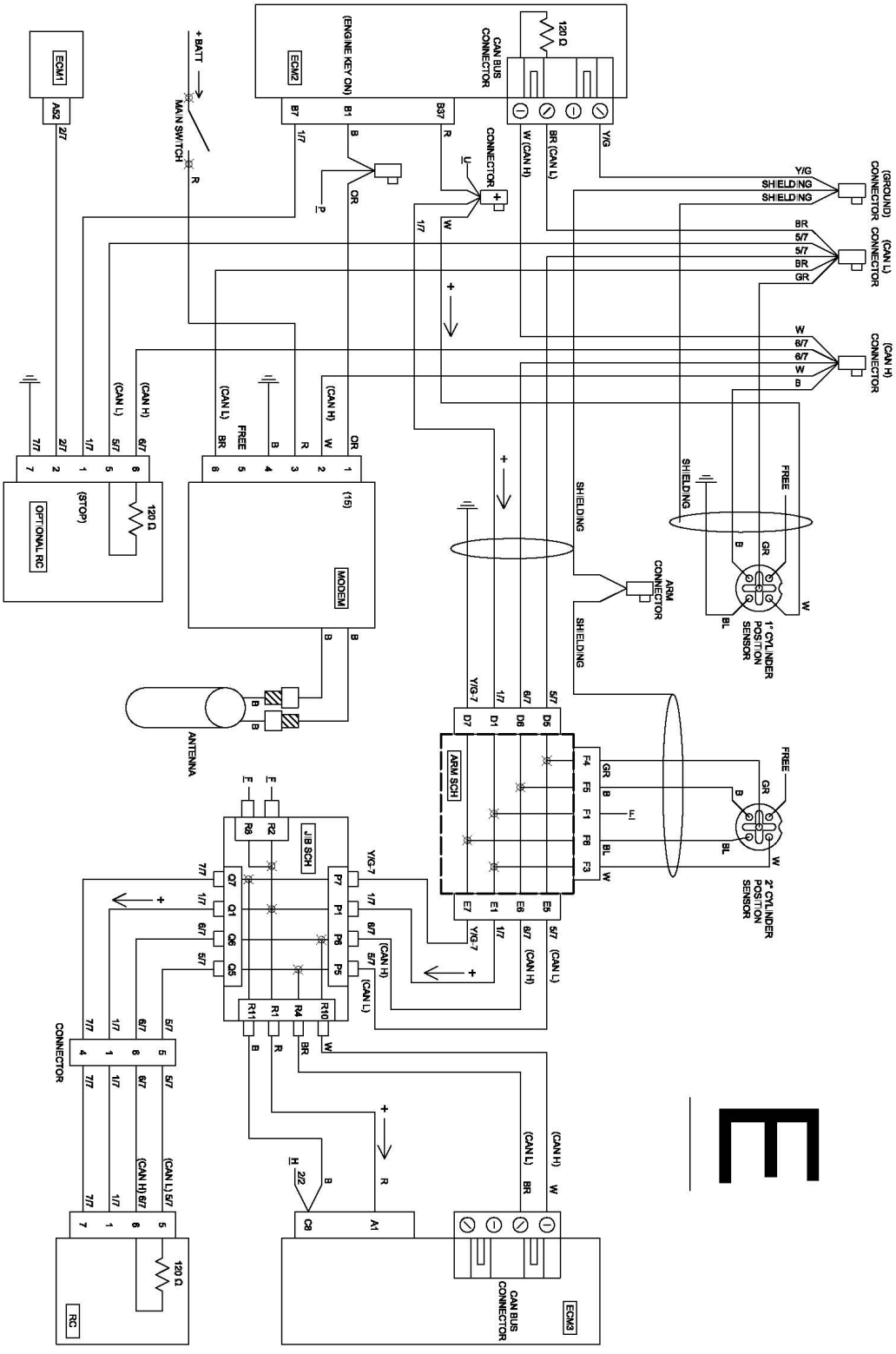

ECM1
ECM2
(ENGINE KEY ON)
CAN BUS CONNECTOR
120 Ω
+ BATT
MAIN SWITCH
CONNECTOR
W (CAN H)
BR (CAN L)
Y/G
(GROUND) CONNECTOR
(CAN L) CONNECTOR
(CAN H) CONNECTOR
SHIELDING
FREE
OPTIONAL RC
(STOP)
MODEM
ANTENNA
ARM CONNECTOR
1° CYLINDER POSITION SENSOR
2° CYLINDER POSITION SENSOR
ARM SCH
J1B SCH
CONNECTOR
RC
ECM3
CAN BUS CONNECTOR

Figure 7-4.

7.7 F - ROPES SWITCH - JIB POSITION SWITCH - PEDAL - LOAD CELL

NAME	DESCRIPTION
ARM SCH	SECOND ARM SCHEDULE
CONNECTOR	CONNETTOR
ECM2	ELECTRONIC CONTROL MODULE 2
ECM3	ELECTRONIC CONTROL MODULE 3
JIB CONNECTOR	CONNECTOR IN THE JIB
JIB SCH	JIB SCHEDULE
LOAD CELL	LOAD CELL
MICRO JIB	MICRO SWITCH JIB
PEDAL (optional)	PEDAL
ROPES SWITCH	ROPES SWITCH (only X23J-X700AJ)

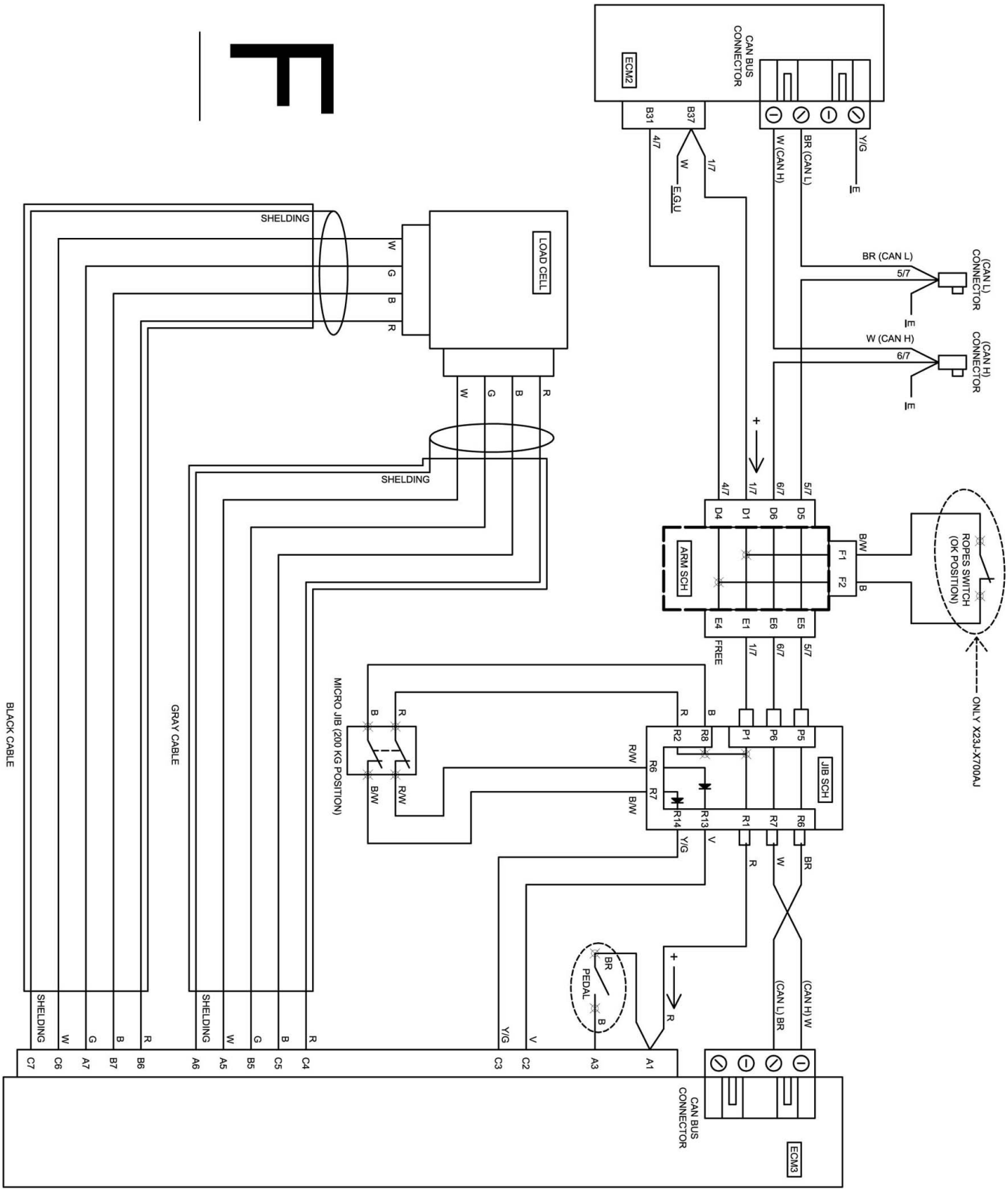

ECM2
CAN BUS CONNECTOR
B31
B37
4/7
1/7
W
E.G.U
W (CAN H)
BR (CAN L)
Y/G
E
BR (CAN L)
5/7
(CAN L) CONNECTOR
W (CAN H)
6/7
(CAN H) CONNECTOR
SHELDING
LOAD CELL
W
G
B
R
SHELDING
+
4/7
1/7
6/7
5/7
D4
D1
D6
D5
ARM SCH
F1
F2
B/W
B
ROPES SWITCH (OK POSITION)
E4
E1
E6
E5
FREE
1/7
6/7
5/7
ONLY X23J-X700AJ
MICRO JIB (200 KG POSITION)
R
B
R/W
B/W
R2
R8
P1
P6
P5
JIB SCH
R6
R7
R14
R13
R1
R7
R6
Y/G
V
R
W
BR
PEDAL
BR
B
+
R
(CAN L) BR
(CAN H) W
BLACK CABLE
GRAY CABLE
SHELDING
W
G
B
R
C7
C6
A7
B7
B6
A6
A5
B5
C5
C4
C3
C2
A3
A1
CAN BUS CONNECTOR
ECM3

Figure 7-5.

7.8 G - ENGINE STOP SWITCHES - ENGINE START PUSH BUTTONS (GROUND) - AERIAL MOVEMENTS ABILITATION SWITCH (GROUND)

NAME	DESCRIPTION
ARM SCH	SECOND ARM SCHEDULE
CONNECTOR	CONNECTOR
ECM1	ELECTRONIC CONTROL MODULE 1
ECM2	ELECTRONIC CONTROL MODULE 2
ECM3	ELECTRONIC CONTROL MODULE 3
ELECTRIC START	ELECTRIC ENGINE START PUSH BUTTON
GR STAB LAMP	MACHINE STABILIZED GROUND LAMP
GR STOP	ENGINE STOP SWITCH (GROUND)
GR STOP BOX	ENGINE STOP SWITCH BOX (GROUND)
JIB SCH	JIB SCHEDULE
KEY AE MOV	AERIAL MOVEMENT ABILITATION KEY SWITCH (GROUND)
OPTIONAL RC	OPTIONAL REMOTE CONTROL (EMERGENCY GROUND POSITION)
REM SELECTOR	REMOTE CONTROL SELECTOR - UP OR DOWN (OPTIONAL)
RC	REMOTE CONTROL
RB BYPASS BOX	REMOTE CONTROL BYPASS BOX
RC STOP	ENGINE STOP SWITCH IN THE REMOTE CONTROL
THERMIC START	THERMIC ENGINE START PUSH BUTTON

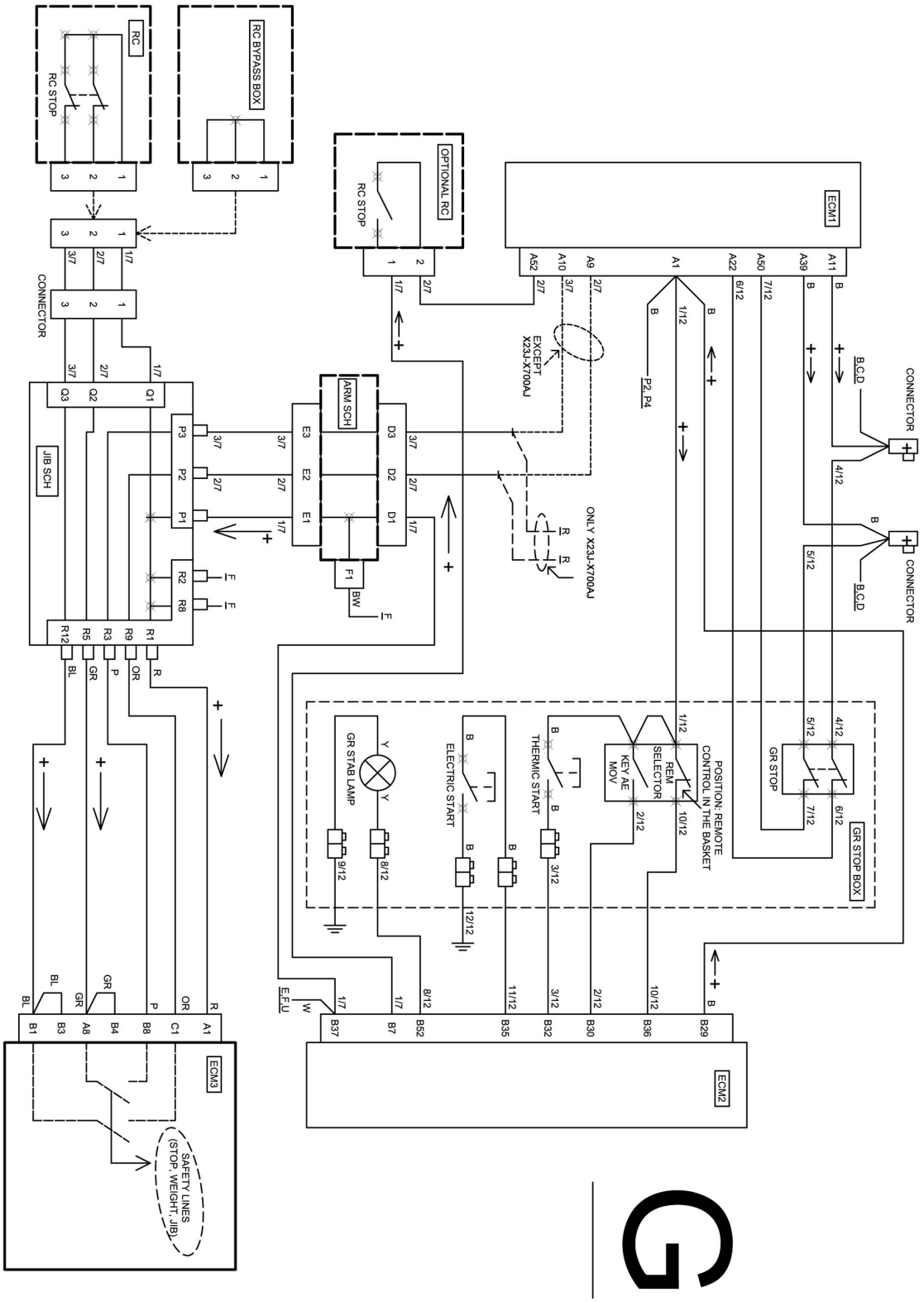

RC
RC STOP
RC BYPASS BOX
OPTIONAL RC
RC STOP
ECM1
CONNECTOR
JIB SCH
ARM SCH
EXCEPT X23J-X700AJ
ONLY X23J-X700AJ
P2, P4
B.C.D
CONNECTOR
CONNECTOR
B.C.D
GR STOP
GR STOP BOX
POSITION: REMOTE CONTROL IN THE BASKET
REM SELECTOR
KEY AE MOV
THERMIC START
ELECTRIC START
GR STAB LAMP
F1
BW
E.F.U
ECM2
ECM3
SAFETY LINES (STOP, WEIGHT, JIB)

Figure 7-6.

7.9 H - EMERGENCY DESCEND ELECTRO VALVES - OPTIONALS

NAME	DESCRIPTION
ARM SCH	SECOND ARM SCHEDULE
CLACSON	CLACSON
CONNECTOR	CONNETTOR
ECM1	ELECTRONIC CONTROL MODULE 1
ECM2	ELECTRONIC CONTROL MODULE 2
ECM3	ELECTRONIC CONTROL MODULE 3
EV - EM JIB	JIB EMERGENCY DESCEND ELECTRO VALVE
EV - EM 1° CYLINDER	1° CYLINDER EMERGENCY DESCEND ELECTRO VALVE
EV - EM 2° CYLINDER	2° CYLINDER EMERGENCY DESCEND ELECTRO VALVE
JIB SCH	JIB SCHEDULE
TEMPERATURE SENSOR (OPTIONAL)	TEMPERATURE SENSOR
WARNING BUZZER	WARNING BUZZER

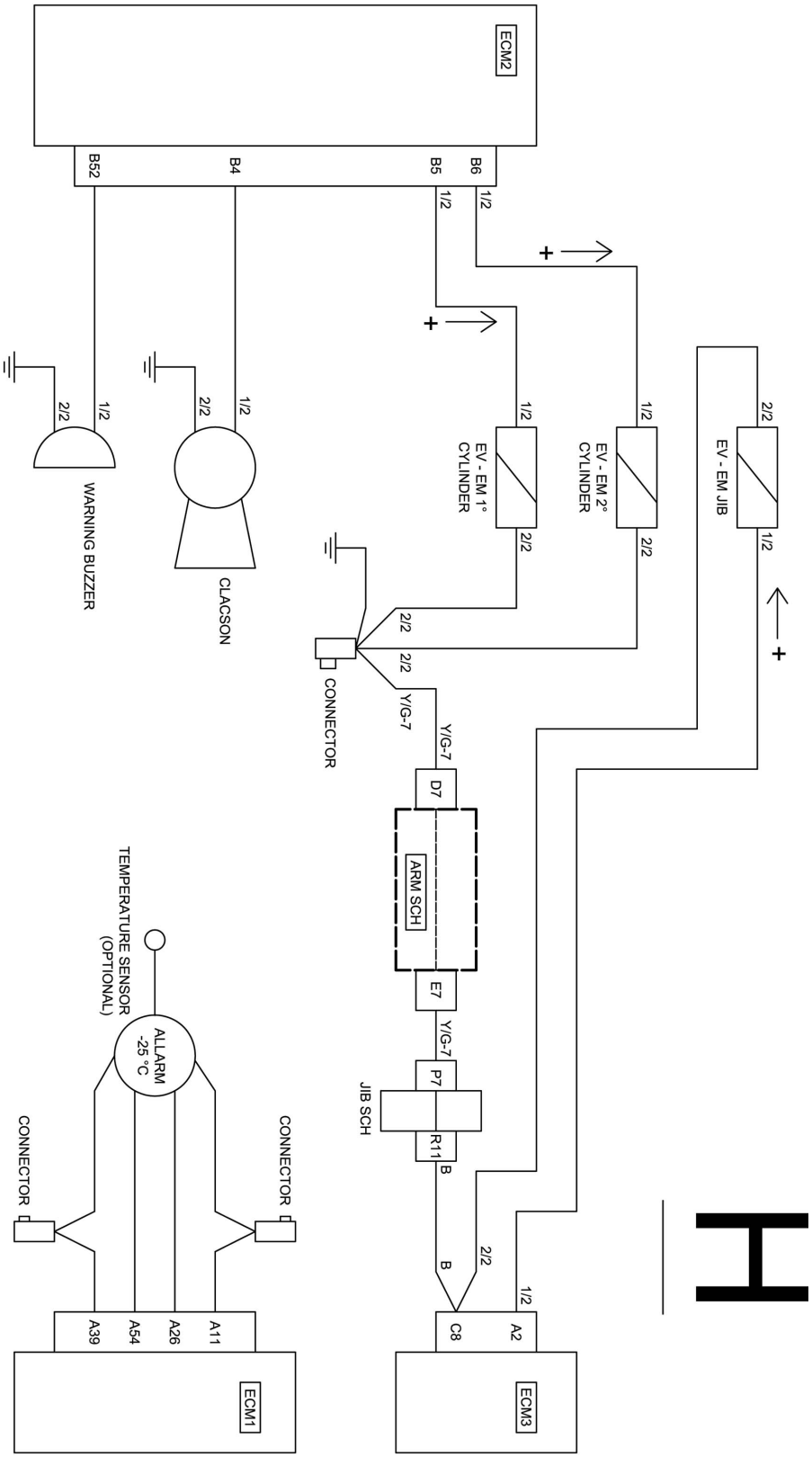

ECM2
B52
B4
B5
B6
1/2
1/2
+
+
2/2
1/2
WARNING BUZZER
2/2
1/2
CLACSON
1/2
EV - EM 1° CYLINDER
2/2
1/2
EV - EM 2° CYLINDER
2/2
2/2
EV - EM JIB
1/2
+
2/2
2/2
CONNECTOR
Y/G-7
Y/G-7
D7
ARM SCH
E7
Y/G-7
P7
JIB SCH
R11
B
B
2/2
1/2
C8
A2
ECM3
TEMPERATURE SENSOR (OPTIONAL)
ALLARM -25 °C
CONNECTOR
CONNECTOR
A39
A54
A26
A11
ECM1

Figure 7-7.

7.10 I - ELECTRIC POWER SUPPLY

NAME	DESCRIPTION
BATTERY	BATTERY
CONNECTOR	CONNETTOR
ECM1	ELECTRONIC CONTROL MODULE 1
ECM2	ELECTRONIC CONTROL MODULE 2
F 25 A	25 A FUSE (FLY)
GROUND CONNECTOR	GROUNDS CONNECTOR
MAIN SWITCH	BATTERY CUTTER
220V BOARD	220 VOLT BOARD (BATTERY CHARGE, ELECTRIC ENGINE CONTROLLER)

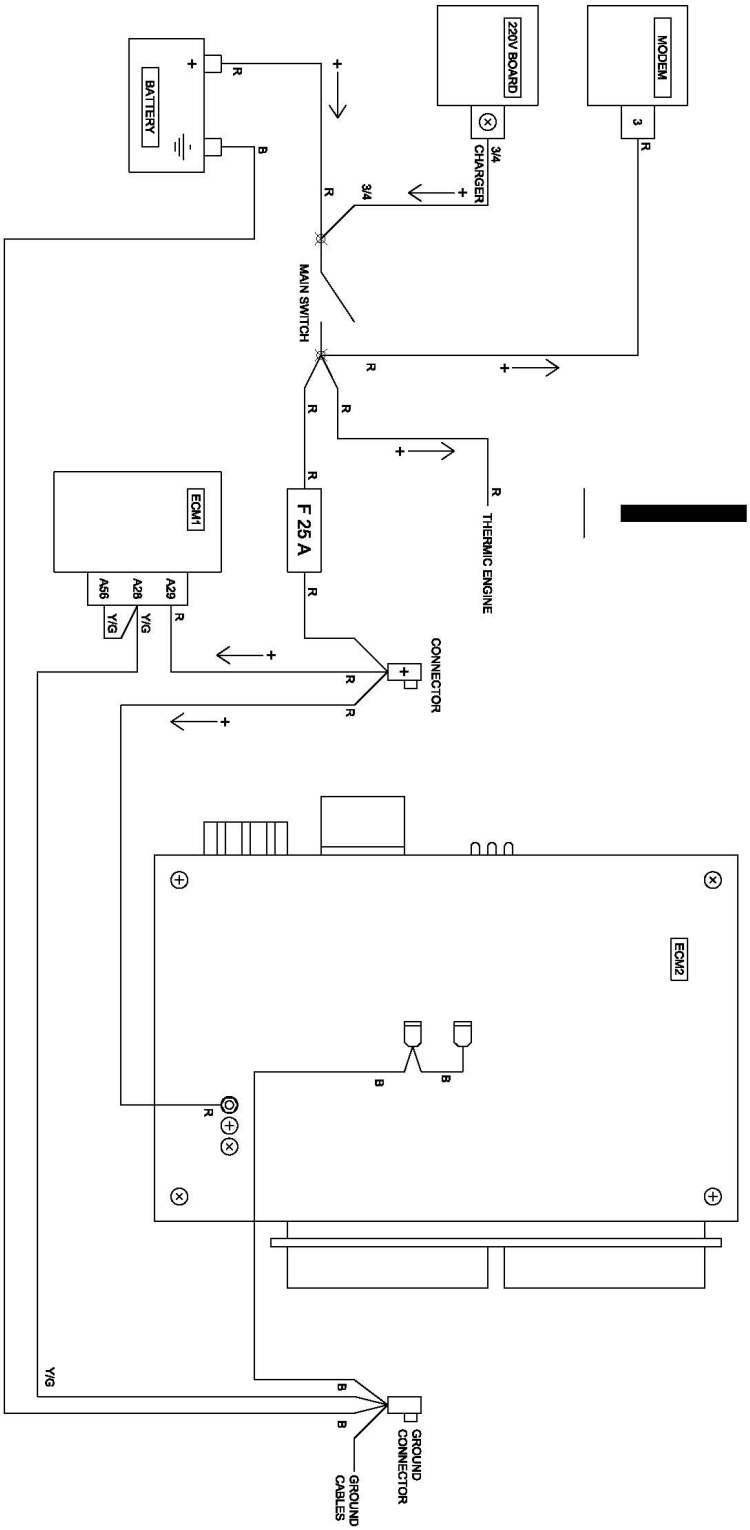

BATTERY
220V BOARD
MODEM
CHARGER
MAIN SWITCH
F 25 A
THERMIC ENGINE
ECM1
CONNECTOR
ECM2
GROUND CONNECTOR
GROUND CABLES
R
B
Y/G
3/4
3

Figure 7-8.

7.11 L - GROUND PART: TRACKS - UNDERCARRIAGE WIDENING - 2° SPEED - PROPORTIONAL ELECTRO VALVES

NAME	DESCRIPTION
ECM2	ELECTRONIC CONTROL MODULE 2
EV - TR L (F)	LEFT TRACK ON-OFF ELECTRO VALVE (FRONT)
EV - TR L (R)	LEFT TRACK ON-OFF ELECTRO VALVE (REAR)
EV - TR R (F)	RIGHT TRACK ON-OFF ELECTRO VALVE (FRONT)
EV - TR R (R)	RIGHT TRACK ON-OFF ELECTRO VALVE (REAR)
EV - TR OPENING (NO X14J-X390AJ)	UNDERCARRIAGE WIDENING ON-OFF ELECTRO VALVE (OPENING)
EV - TR CLOSING (NO X14J-X390AJ)	UNDERCARRIAGE WIDENING ON-OFF ELECTRO VALVE (CLOSING)
EV - 2° SPEED	TRACKS 2° SPEED ELECTRO VALVE
LEFT - PROP EV	LEFT SIDE PROPORTIONAL ELECTRO VALVE
RIGHT - PROP EV	RIGHT SIDE PROPORTIONAL ELECTRO VALVE
GR CONN	GROUND CONNECTOR

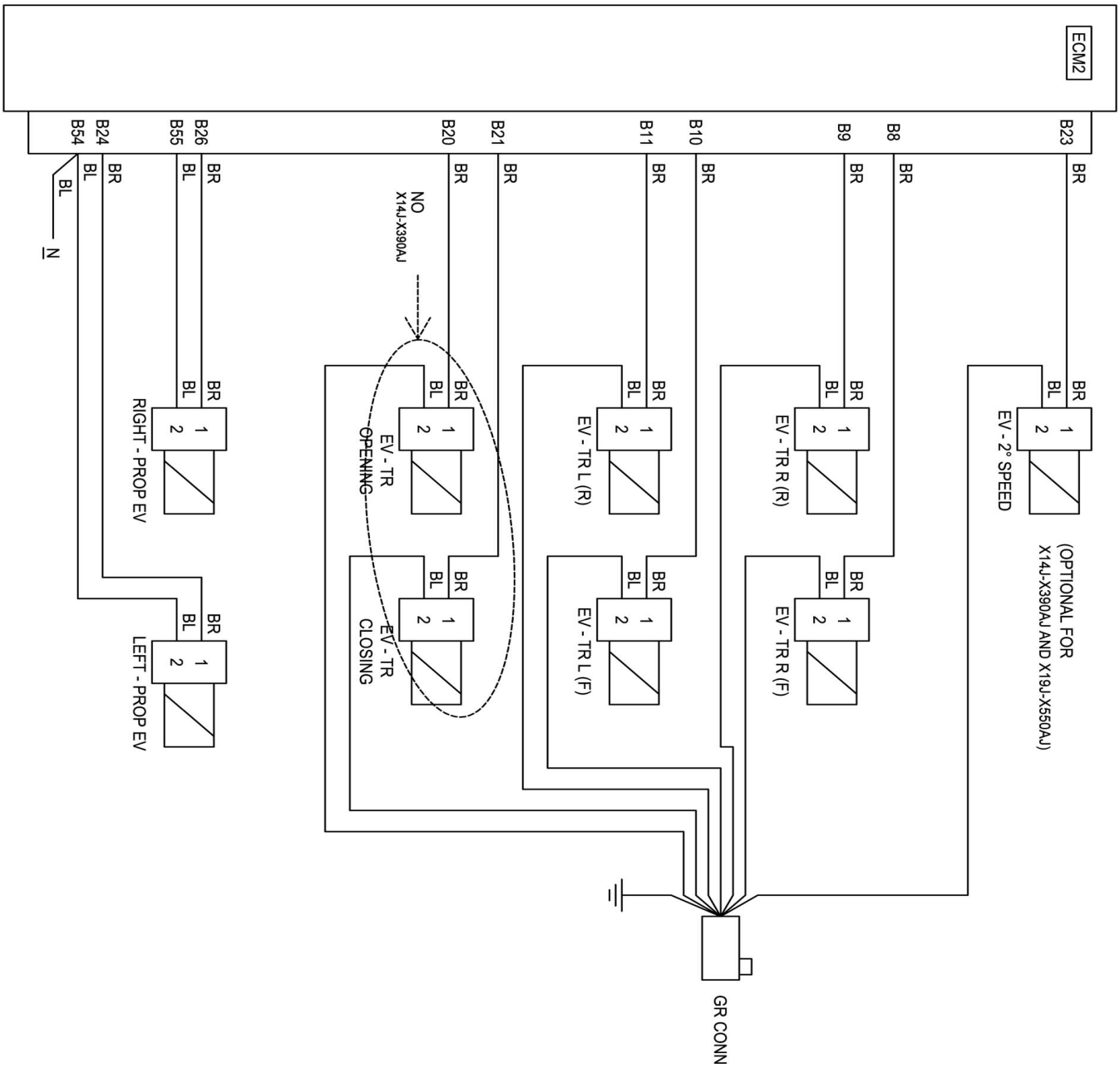

ECM2
B54
B24
B55
B26
B20
B21
B11
B10
B9
B8
B23
BR
BL
N
NO
X14J-X390AJ
RIGHT - PROP EV
LEFT - PROP EV
EV - TR
OPENING
EV - TR
CLOSING
EV - TR L (R)
EV - TR L (F)
EV - TR R (R)
EV - TR R (F)
EV - 2° SPEED
(OPTIONAL FOR
X14J-X390AJ AND X19J-X550AJ)
GR CONN

Figure 7-9.

7.12 M - GROUND PART: OUTRIGGERS - ELECTRIC DIVERTER

NAME	DESCRIPTION
ECM2	ELECTRONIC CONTROL MODULE 2
EV - DEV	ELECTRIC DIVERTER
EV - STAB 1 (F)	LEFT FRONT OUTRIGGER ON-OFF ELECTRO VALVE (OPENING)
EV - STAB 1 (R)	LEFT FRONT OUTRIGGER ON-OFF ELECTRO VALVE (CLOSING)
EV - STAB 2 (F)	LEFT REAR OUTRIGGER ON-OFF ELECTRO VALVE (OPENING)
EV - STAB 2 (R)	LEFT REAR OUTRIGGER ON-OFF ELECTRO VALVE (CLOSING)
EV - STAB 3 (F)	RIGHT FRONT OUTRIGGER ON-OFF ELECTRO VALVE (OPENING)
EV - STAB 3 (R)	RIGHT FRONT OUTRIGGER ON-OFF ELECTRO VALVE (CLOSING)
EV - STAB 4 (F)	RIGHT REAR OUTRIGGER ON-OFF ELECTRO VALVE (OPENING)
EV - STAB 4 (R)	RIGHT REAR OUTRIGGER ON-OFF ELECTRO VALVE (CLOSING)
GR CONN	GROUND CONNECTOR

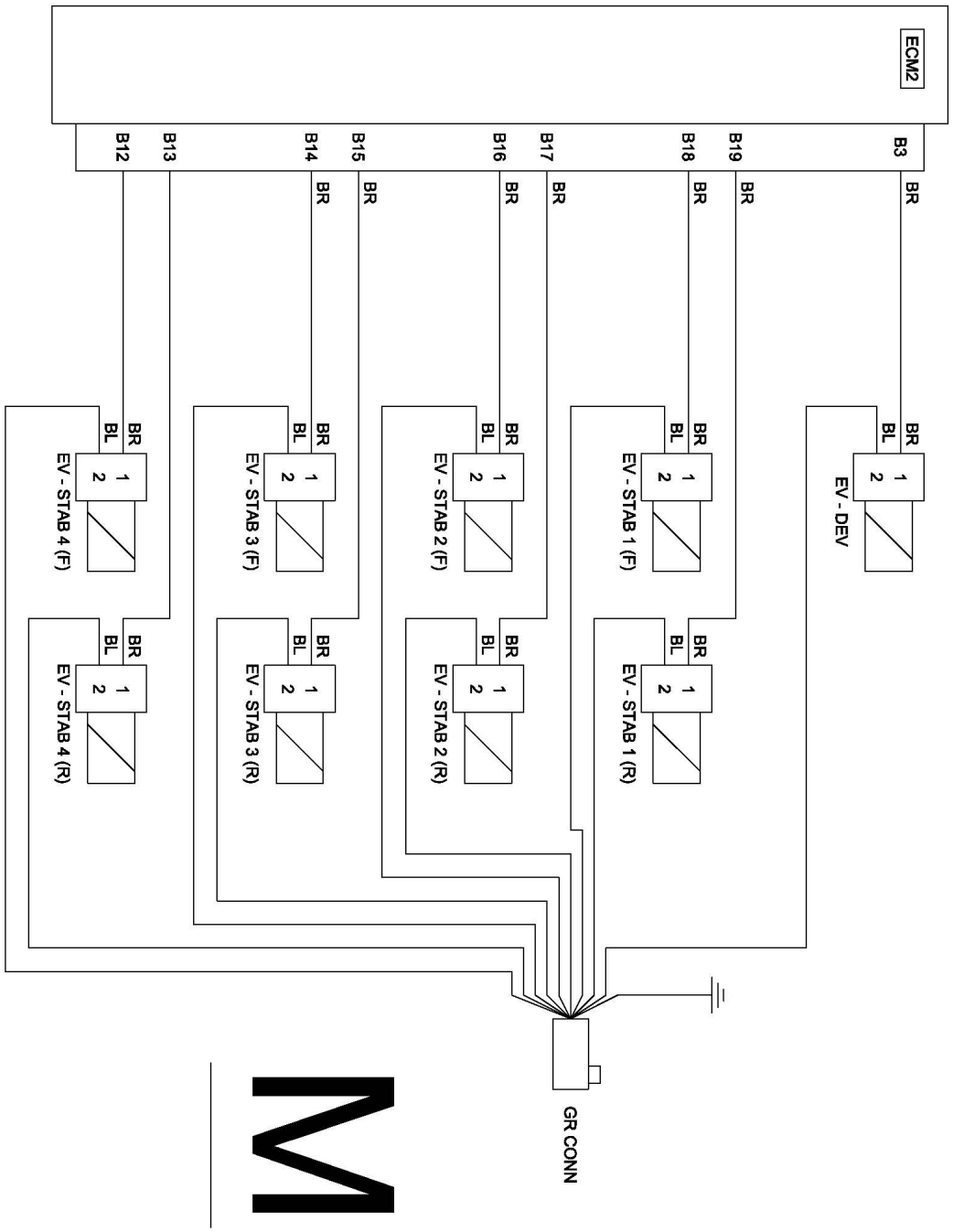

ECM2
B12
B13
B14
B15
B16
B17
B18
B19
B3
BR
BL
1
2
EV - STAB 4 (F)
EV - STAB 3 (F)
EV - STAB 2 (F)
EV - STAB 1 (F)
EV - DEV
EV - STAB 4 (R)
EV - STAB 3 (R)
EV - STAB 2 (R)
EV - STAB 1 (R)
GR CONN

Figure 7-10.

7.13 N - AERIAL PART: BASKET LEVELLING - BASKET ROTATION - JIB - PROPORTIONAL ELECTRO VALVE

NAME	DESCRIPTION
AE - PROP EV	AERIAL PART PROPORTIONAL ELECTRO VALVE
ECM2	ELECTRONIC CONTROL MODULE 2
EV - B LEV (F)	BASKET LEVELLING ON-OFF ELECTRO VALVE (OPENING)
EV - B LEV (R)	BASKET LEVELLING ON-OFF ELECTRO VALVE (CLOSING)
EV - B ROT (F)	BASKET ROTATION ON-OFF ELECTRO VALVE (ANTI CLOCKWISE)
EV - B ROT (R)	BASKET ROTATION ON-OFF ELECTRO VALVE (CLOCKWISE)
EV - JIB (F)	JIB ON-OFF ELECTRO VALVE (OPENING)
EV - JIB (R)	JIB ON-OFF ELECTRO VALVE (CLOSING)
GR CONN	GROUND CONNECTOR

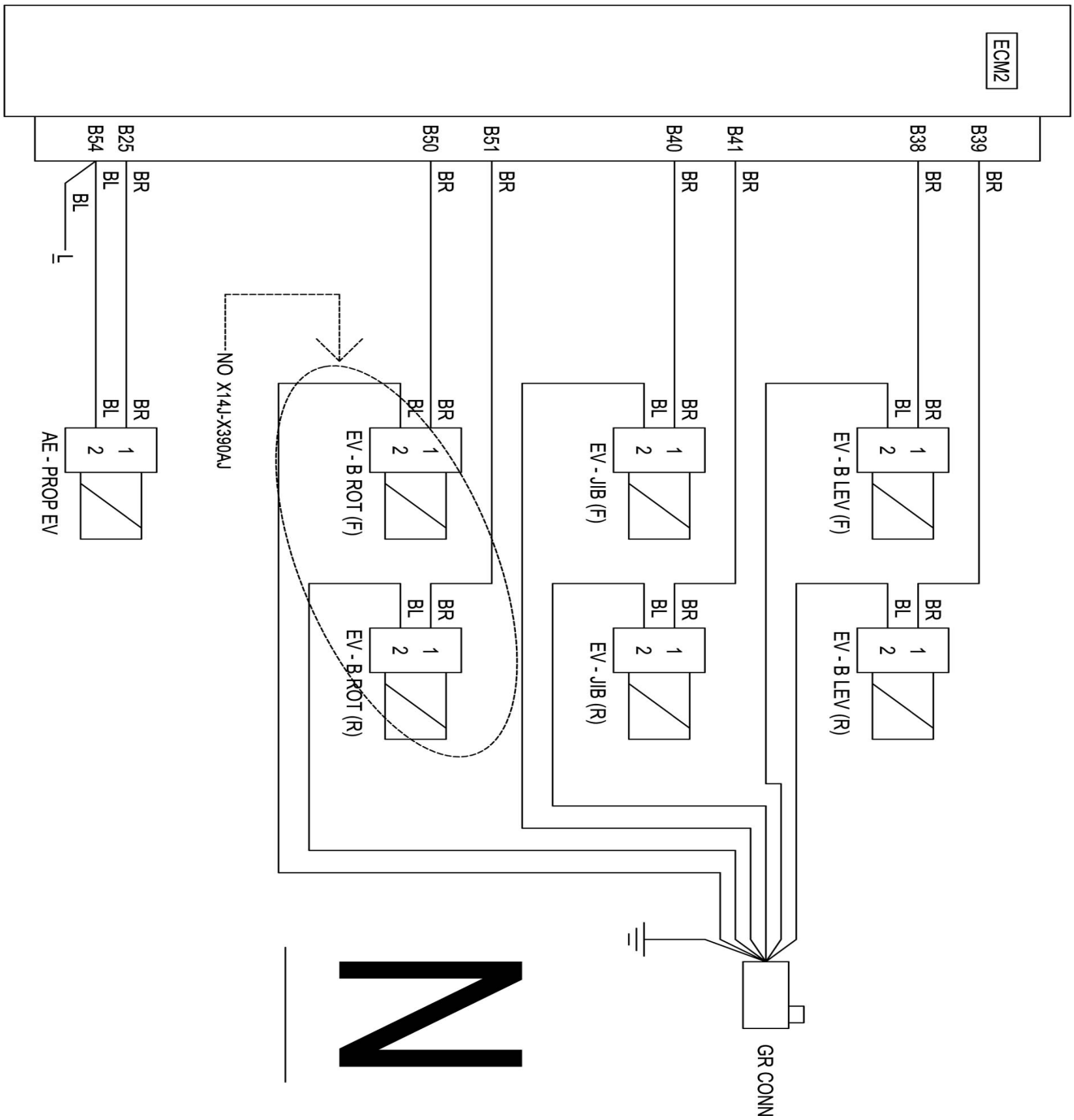

ECM2
B54
B25
B50
B51
B40
B41
B38
B39
BR
BL
L
NO X14J-X390AJ
AE - PROP EV
EV - B ROT (F)
EV - JIB (F)
EV - B LEV (F)
EV - B ROT (R)
EV - JIB (R)
EV - B LEV (R)
GR CONN
1
2

Figure 7-11.

7.14 O - AERIAL PART: 1° CYLINDER - 2° CYLINDER - EXTENSION - ROTATION

NAME	DESCRIPTION
ECM2	ELECTRONIC CONTROL MODULE 2
EV - EXT (F)	EXTENSION ON-OFF ELECTRO VALVE (OPENING)
EV - EXT (R)	EXTENSION ON-OFF ELECTRO VALVE (CLOSING)
EV - ROT (F)	ROTATION ON-OFF ELECTRO VALVE (ANTI CLOCKWISE)
EV - ROT (R)	ROTATION ON-OFF ELECTRO VALVE (CLOCKWISE)
EV - 1° CYLINDER (F)	1° CYLINDER ON-OFF ELECTRO VALVE (OPENING)
EV - 1° CYLINDER (R)	1° CYLINDER ON-OFF ELECTRO VALVE (CLOSING)
EV - 2° CYLINDER (F)	2° CYLINDER ON-OFF ELECTRO VALVE (OPENING)
EV - 2° CYLINDER (R)	2° CYLINDER ON-OFF ELECTRO VALVE (CLOSING)
GR CONN	GROUND CONNECTOR

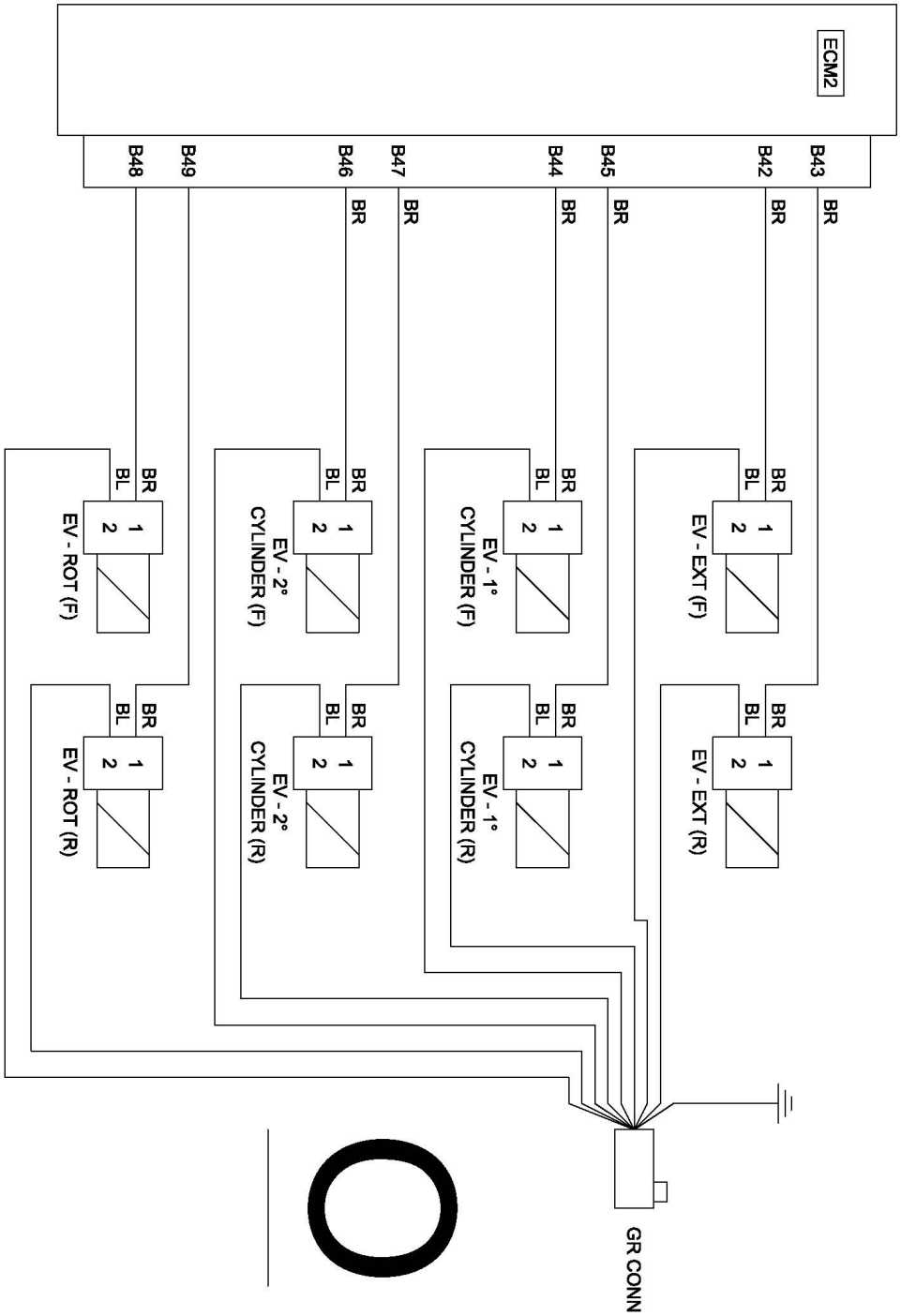

ECM2
B48
B49
B46
B47
B44
B45
B42
B43
BR
BL
1
2
EV - ROT (F)
EV - 2° CYLINDER (F)
EV - 1° CYLINDER (F)
EV - EXT (F)
EV - ROT (R)
EV - 2° CYLINDER (R)
EV - 1° CYLINDER (R)
EV - EXT (R)
GR CONN

Figure 7-12.

7.15 P1 - THERMIC ENGINE CONNEXION (GASOLINE) - X19J-X550AJ/X23J-X700AJ

NAME	DESCRIPTION
ECM1	ELECTRONIC CONTROL MODULE 1
ECM2	ELECTRONIC CONTROL MODULE 2
FASTON F	FASTON CONNECTOR FEMALE
FASTON M	FASTON CONNECTOR MALE
TEC1	GRAY ENGINE CONNECTOR
TEC1 - ES	GRAY ENGINE CONNECTOR (ENGINE SIDE)
TEC2	WHITE ENGINE CONNECTOR (MALE)
TEC2 - ES	WHITE ENGINE CONNECTOR (FEMALE - ENGINE SIDE)
TEC3	WHITE ENGINE CONNECTOR (FEMALE)
TEC3 - ES	WHITE ENGINE CONNECTOR ((MALE - ENGINE SIDE)

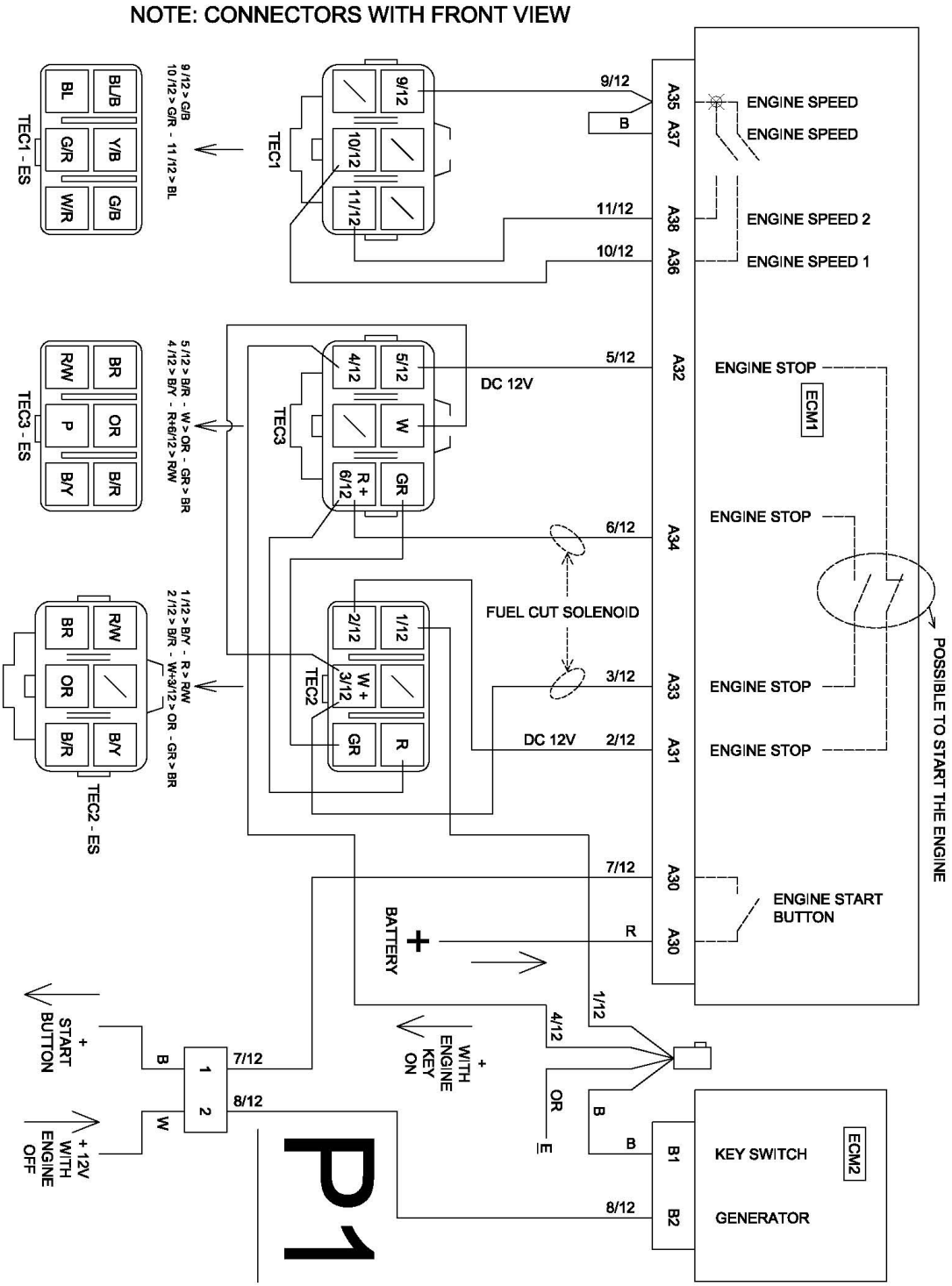

NOTE: CONNECTORS WITH FRONT VIEW
TEC1 - ES
BL
BL/B
G/R
Y/B
W/R
G/B
9/12 > G/B
10/12 > G/R - 11/12 > BL
TEC1
9/12
10/12
11/12
9/12
B
11/12
10/12
A35
A37
A38
A36
ENGINE SPEED
ENGINE SPEED
ENGINE SPEED 2
ENGINE SPEED 1
TEC3 - ES
R/W
BR
P
OR
B/Y
B/R
5/12 > B/R - W > OR - GR > BR
4/12 > B/Y - R+6/12 > R/W
TEC3
4/12
5/12
W
R + 6/12
GR
5/12
DC 12V
A32
ENGINE STOP
ECM1
6/12
A34
ENGINE STOP
FUEL CUT SOLENOID
TEC2 - ES
BR
R/W
OR
B/R
B/Y
1/12 > B/Y - R > R/W
2/12 > B/R - W+3/12 > OR - GR > BR
TEC2
2/12
1/12
W + 3/12
GR
R
3/12
A33
ENGINE STOP
DC 12V
2/12
A31
ENGINE STOP
POSSIBLE TO START THE ENGINE
7/12
A30
ENGINE START BUTTON
BATTERY
+
R
A30
1/12
4/12
START BUTTON
+
B
1
2
7/12
8/12
W
+ 12V WITH ENGINE OFF
WITH ENGINE KEY ON
+
OR
E
B
B
B1
B2
KEY SWITCH
GENERATOR
ECM2
8/12
P1

Figure 7-13.

7.16 P2 - THERMIC ENGINE CONNEXION (DIESEL) - DIESEL ENGINE SENSORS - X23J-X700AJ

NAME	DESCRIPTION
CONNECTOR	CONNETTOR
ECM1	ELECTRONIC CONTROL MODULE 1
ECM2	ELECTRONIC CONTROL MODULE 2
ELECTRO STOP	ELECTRO STOP
ENGINE CONNECTOR	ENGINE CONNECTOR
ENGINE GENERATOR	ENGINE GENERATOR
ENGINE GROUND	ENGINE GROUND
ENGINE RELE' ELECTRIC BOX	ENGINE RELE' ELECTRIC BOX
ENGINE REVOLUTION REGULATOR	ENGINE REVOLUTION REGULATOR
ENGINE REVOLUTION SCHEDULE	ENGINE REVOLUTION CONTROL SCHEDULE
ENGINE REVOLUTION SENSOR	ENGINE REVOLUTION SENSOR
ENGINE VOLTAGE REGULATOR	ENGINE VOLTAGE REGULATOR
OIL PRESSURE SENSOR	OIL PRESSURE SENSOR
PRE HEATING RELE'	PRE HEATING RELE'
PRE HEATING SPARKS	PRE HEATING SPARKS
STARTER	ELECTRIC ENGINE START
START RELE'	ENGINE START RELE'
VOLTAGE REGULATOR PLUG (FEMALE)	VOLTAGE REGULATOR PLUG (FEMALE)
VOLTAGE REGULATOR PLUG (MALE)	VOLTAGE REGULATOR PLUG (MALE)

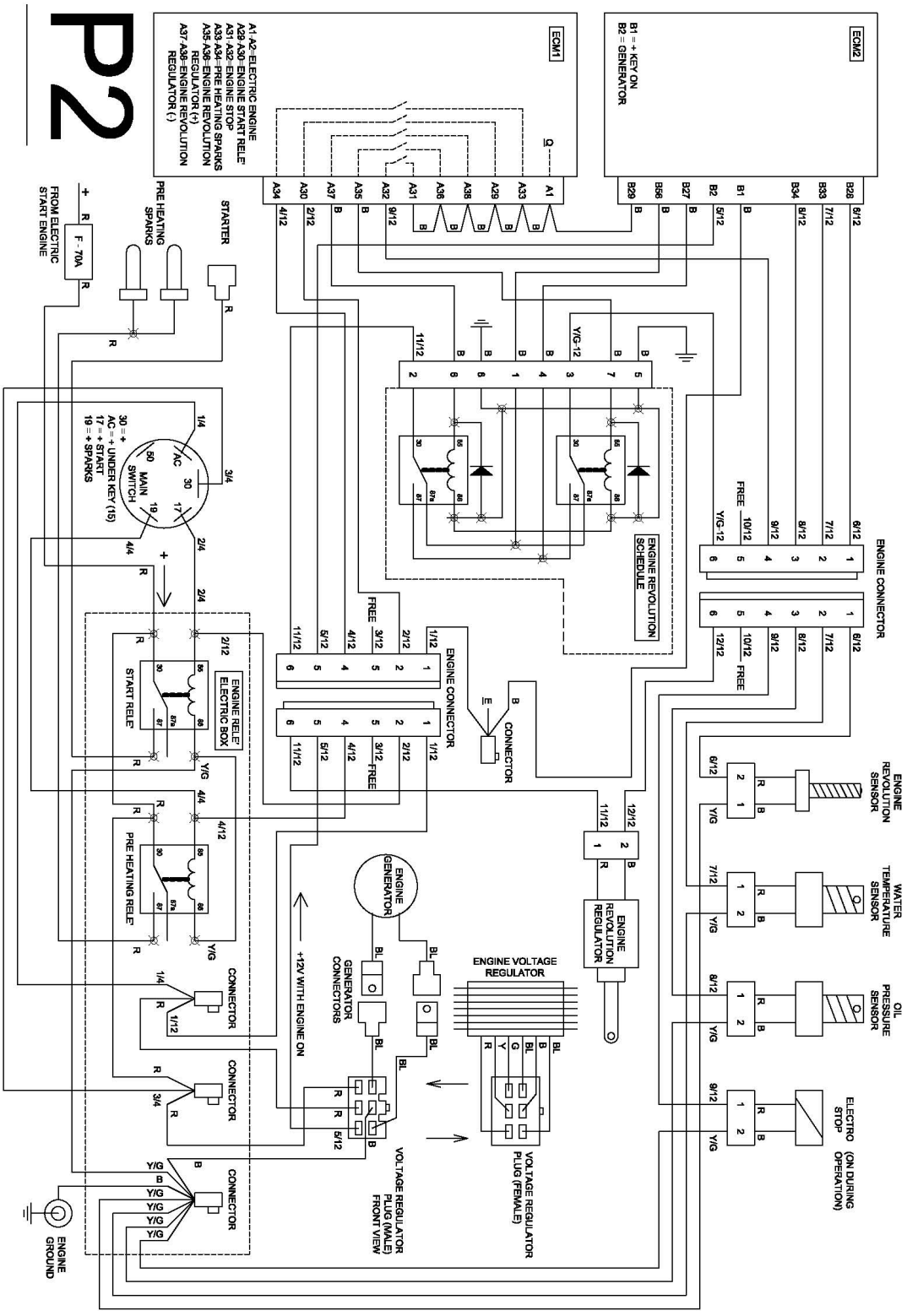

P2
ECM1
ECM2
A1-A2=ELECTRIC ENGINE START RELE'
A29-A30=ENGINE STOP
A31-A32=ENGINE STOP
A33-A34=PRE HEATING SPARKS
A35-A36=ENGINE REVOLUTION REGULATOR (+)
A37-A38=ENGINE REVOLUTION REGULATOR (-)
B1 = + KEY ON
B2 = GENERATOR
FROM ELECTRIC START ENGINE
F - 70A
PRE HEATING SPARKS
STARTER
30 = +
AC = + UNDER KEY (15)
17 = + START
19 = + SPARKS
MAIN SWITCH
ENGINE REVOLUTION SCHEDULE
ENGINE CONNECTOR
ENGINE REVOLUTION SENSOR
WATER TEMPERATURE SENSOR
OIL PRESSURE SENSOR
ELECTRO STOP (ON DURING OPERATION)
ENGINE RELE' ELECTRIC BOX
START RELE'
PRE HEATING RELE'
CONNECTOR
ENGINE GENERATOR
GENERATOR CONNECTORS
+12V WITH ENGINE ON
ENGINE VOLTAGE REGULATOR
ENGINE REVOLUTION REGULATOR
VOLTAGE REGULATOR PLUG (MALE) FRONT VIEW
VOLTAGE REGULATOR PLUG (FEMALE)
ENGINE GROUND

Figure 7-14.

7.17 P3 - THERMIC ENGINE CONNEXION (DIESEL) - X14J-X390AJ/X19J-X550AJ

NAME	DESCRIPTION
ECM1	ELECTRONIC CONTROL MODULE 1
ECM2	ELECTRONIC CONTROL MODULE 2
ENGINE REVOLUTION REGULATOR	ENGINE REVOLUTION REGULATOR
ENGINE REVOLUTION SCHEDULE	ENGINE REVOLUTION CONTROL SCHEDULE
ENGINE REVOLUTION SENSOR	ENGINE REVOLUTION SENSOR
ES HATZ	HATZ ELECTRONIC SCHEDULE
IS	IGNITION SWITCH
TEC	THERMIC ENGINE CONNECTOR

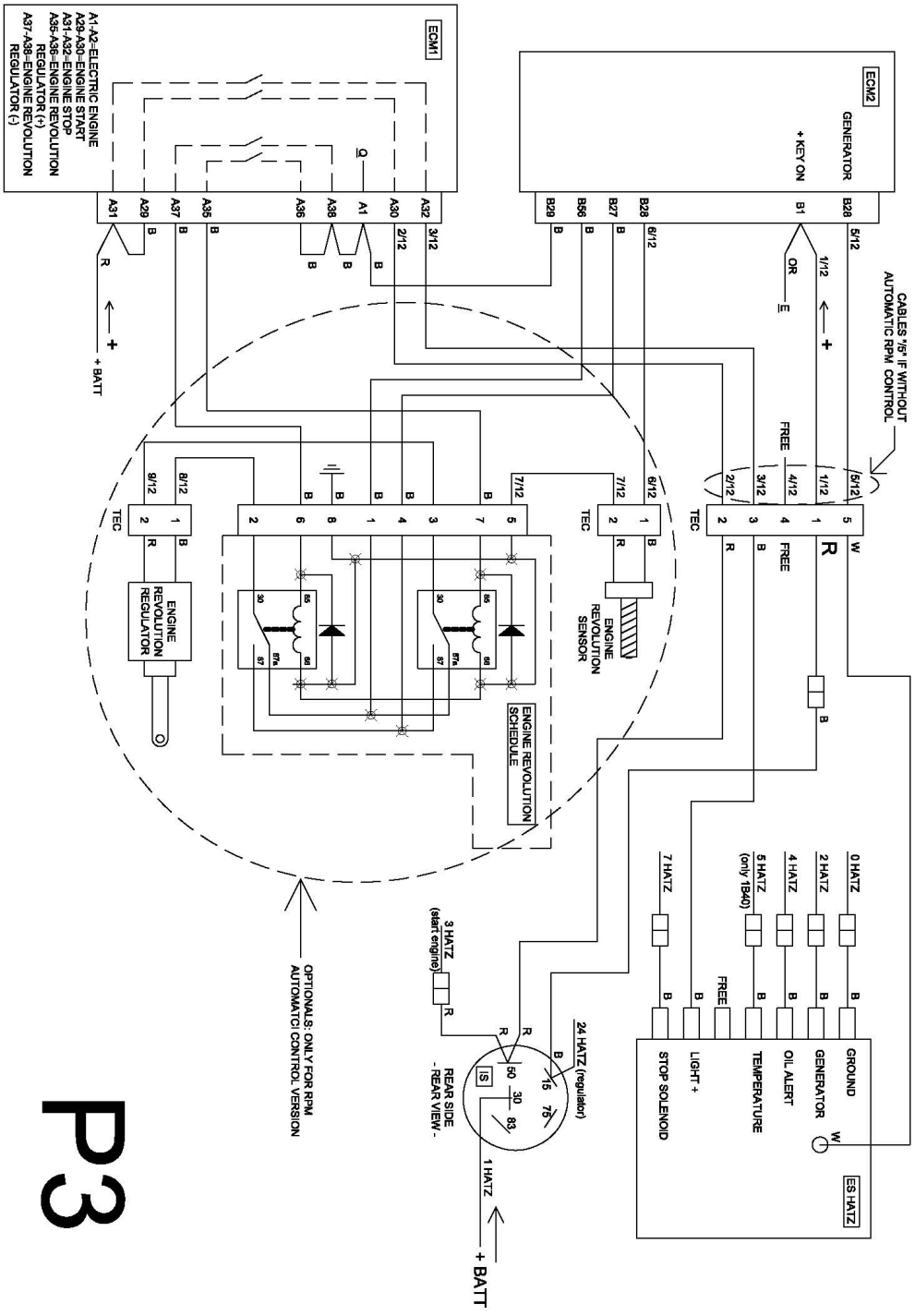

ECM1
A1-A2=ELECTRIC ENGINE
A29-A30=ENGINE START
A31-A32=ENGINE STOP
A35-A36=ENGINE REVOLUTION REGULATOR (+)
A37-A38=ENGINE REVOLUTION REGULATOR (-)
ECM2
GENERATOR
+ KEY ON
CABLES '15' IF WITHOUT AUTOMATIC RPM CONTROL
+ BATT
TEC
FREE
R
W
ENGINE REVOLUTION REGULATOR
ENGINE REVOLUTION SENSOR
ENGINE REVOLUTION SCHEDULE
OPTIONALS: ONLY FOR RPM AUTOMATIC CONTROL VERSION
3 HATZ (start engine)
24 HATZ (regulator)
REAR SIDE - REAR VIEW -
1 HATZ
0 HATZ
2 HATZ
4 HATZ
5 HATZ (only 1B40)
7 HATZ
GROUND
GENERATOR
OIL ALERT
TEMPERATURE
LIGHT +
STOP SOLENOID
ES HATZ
P3

Figure 7-15.

7.18 P4 - THERMIC ENGINE CONNEXION (GASOLINE) - X14J-X390AJ

NAME	DESCRIPTION
ECM1	ELECTRONIC CONTROL MODULE 1
ECM2	ELECTRONIC CONTROL MODULE 2
EV-CHOKE	CHOKE ELECTRO VALVE
F N°	FUSE NUMBER
IS	IGNITION SWITCH
TEC	ENGINE CONNECTOR
THERMIC ENGINE	THERMIC ENGINE
T FUSE 15 A	THERMIC ENGINE FUSE

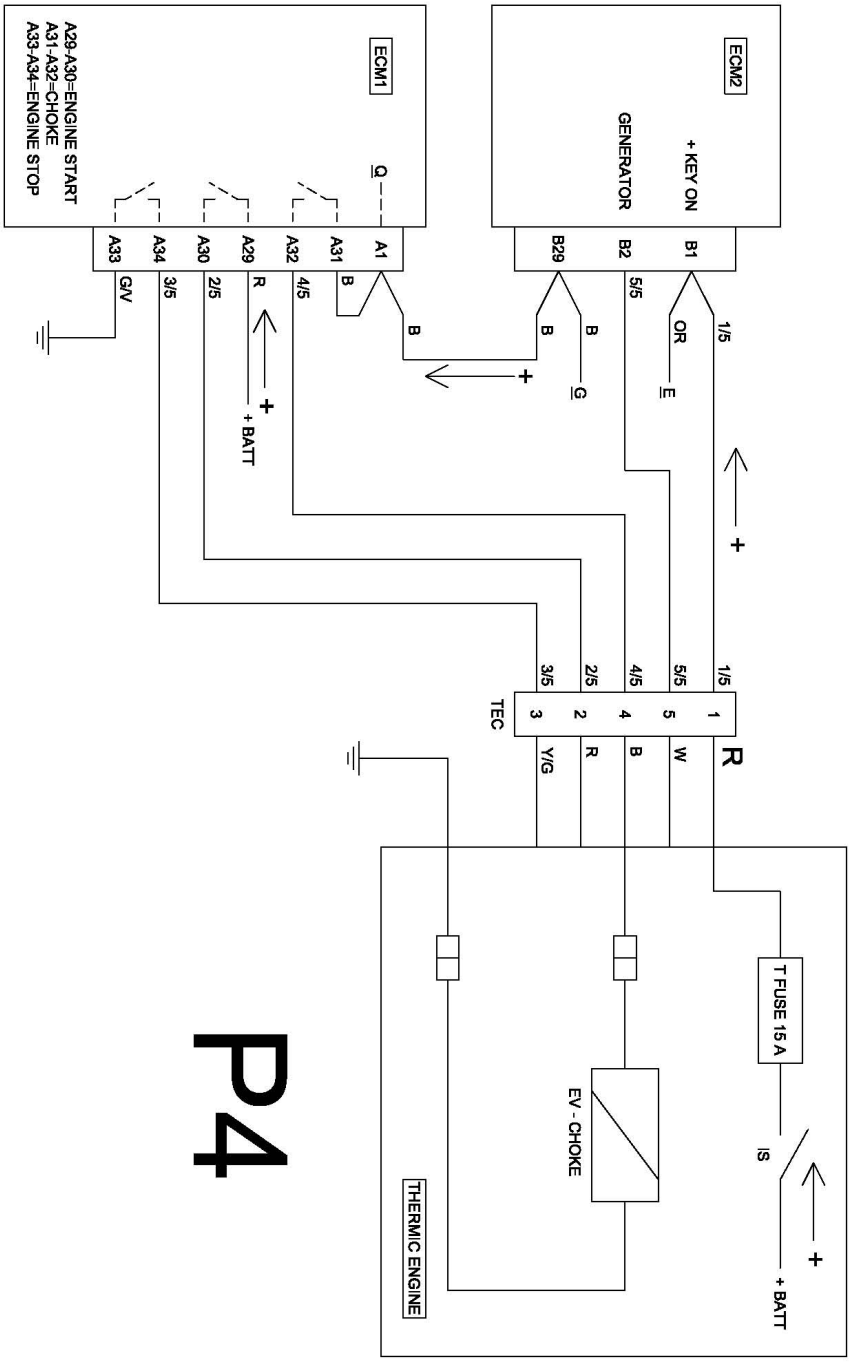

ECM1
A29-A30=ENGINE START
A31-A32=CHOKE
A33-A34=ENGINE STOP
A1
A31
A32
A30
A29
A34
A33
G
B
4/5
2/5
R
3/5
G/V
+ BATT
ECM2
GENERATOR
+ KEY ON
B1
B2
B29
5/5
1/5
OR
E
G
B
B
+
+
TEC
1
5
4
2
3
1/5
5/5
4/5
2/5
3/5
R
W
B
R
Y/G
P4
T FUSE 15 A
IS
+ BATT
+
EV - CHOKE
THERMIC ENGINE

Figure 7-16.

7.19 Q - 110-220 VOLT ELECTRIC POWER SUPPLY - ELECTRIC ENGINE

NAME	DESCRIPTION
ARM SCH	SECOND ARM SCHEDULE
CAPACITOR	CAPACITOR
CONNECTOR	CONNETTOR
ECM1	ELECTRONIC CONTROL MODULE 1
ELECTRIC ENGINE	ELECTRIC ENGINE
ELECTRIC TRANSFORMER	ELECTRIC TRANSFORMER
MS110-220V	THERMIC SWITCH
MS220V BOX	THERMIC SWITCH BOX
PLUG DW	110-220 VOLT BOARD CONNECTOR PLUG (DOWN)
PLUG UP	110-220 VOLT BOARD CONNECTOR PLUG (UP)
110-220V BASKET PLUG	110-220 VOLT PLUG IN THE BASKET
110-220V BOARD	110-220 VOLT BOARD (BATTERY CHARGE, ELECTRIC ENGINE CONTROLLER)
110-220V BOX	110-220 VOLT BOX
110-220V GROUND PLUG	110-220 VOLT PLUG AT THE GROUND

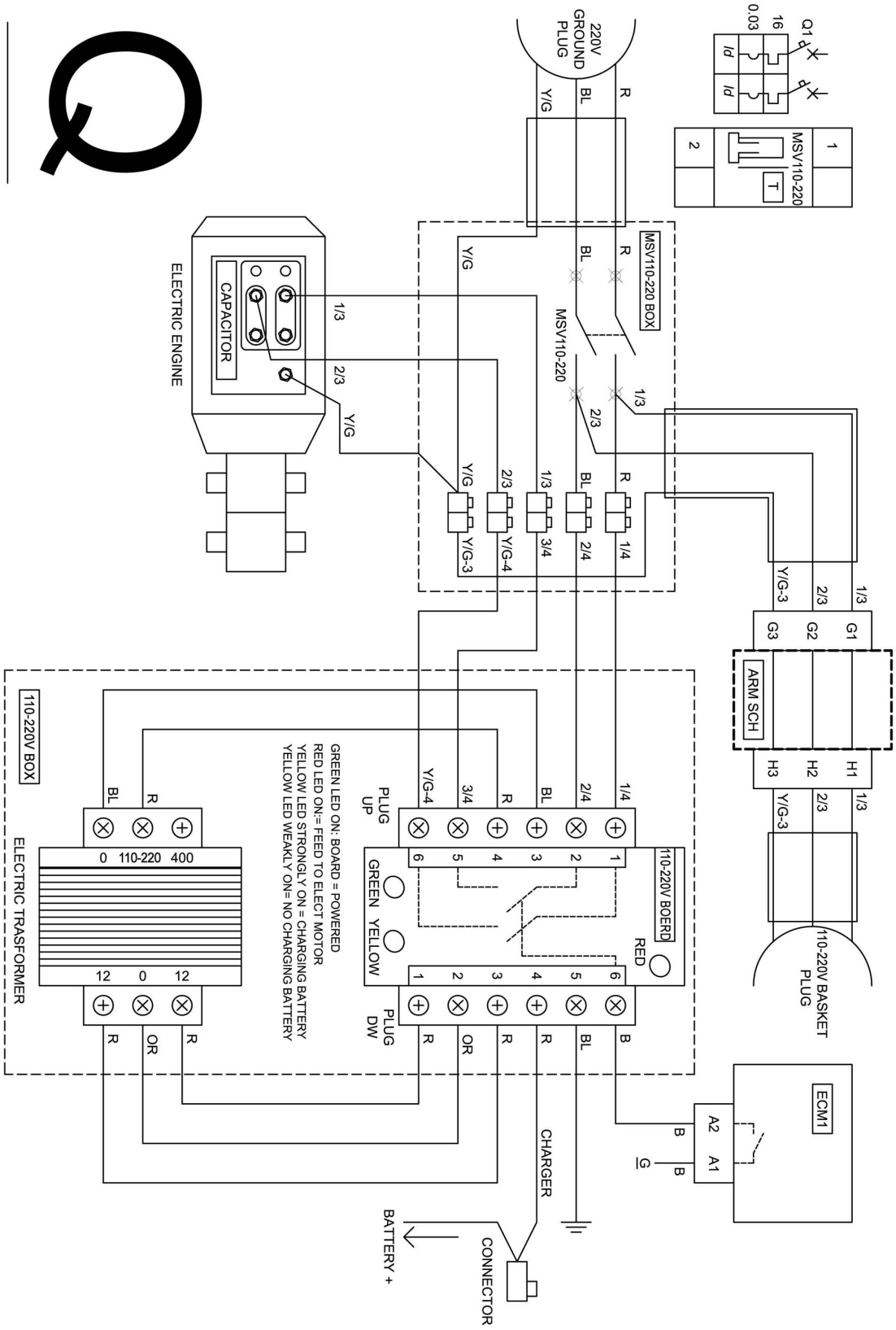

220V GROUND PLUG
Y/G
BL
R
0.03
16
Q1
Id
Id
MSV110-220
2
1
T
MSV110-220 BOX
MSV110-220
ELECTRIC ENGINE
CAPACITOR
1/3
2/3
Y/G
Y/G-3
Y/G-4
3/4
2/4
1/4
G3
G2
G1
ARM SCH
H3
H2
H1
110-220V BOX
ELECTRIC TRASFORMER
0 110-220 400
12 0 12
PLUG UP
PLUG DW
110-220V BOERD
GREEN
YELLOW
RED
GREEN LED ON: BOARD = POWERED
RED LED ON:= FEED TO ELECT MOTOR
YELLOW LED STRONGLY ON = CHARGING BATTERY
YELLOW LED WEAKLY ON= NO CHARGING BATTERY
110-220V BASKET PLUG
ECM1
A2
A1
B
G
OR
CHARGER
BATTERY +
CONNECTOR

Figure 7-17.

7.20 R - DOUBLE STABILIZATION AREA WITH ROTATION SENSOR - X23J-X700AJ

NAME	DESCRIPTION
ARM SCH	SECOND ARM CONNECTOR
CAN BUS CONNECTOR	GREEN CAN BUS CONNECTOR
CONNECTOR	CONNECTOR
ECM1	ELECTRONIC CONTROL MODULE 1
ECM2	ELECTRONIC CONTROL MODULE 2
ECM3	ELECTRONIC CONTROL MODULE 3
ECM4	ELECTRONIC CONTROL MODULE 4
ECM1-2 BOX	ELECTRONIC CONTROL MODULE 1-2 BOX
JIB SCH	JIB SCHEDULE
SW R-POS STAB 1	FRONT LEFT OUTIGGER REDUCED POSITION SWITCH
SW R-POS STAB 2	REAR LEFT OURIGGER REDUCED POSITION SWITCH
SW R-POS STAB 3	FRONT RIGHT OUTRIGGER REDUCED POSITION SWITCH
SW R-POS STAB 4	REAR RIGHT OUTRIGGER REDUCED POSITION SWITCH
ROTATION ANGLE SENSOR	ROTATION ANGLE SENSOR

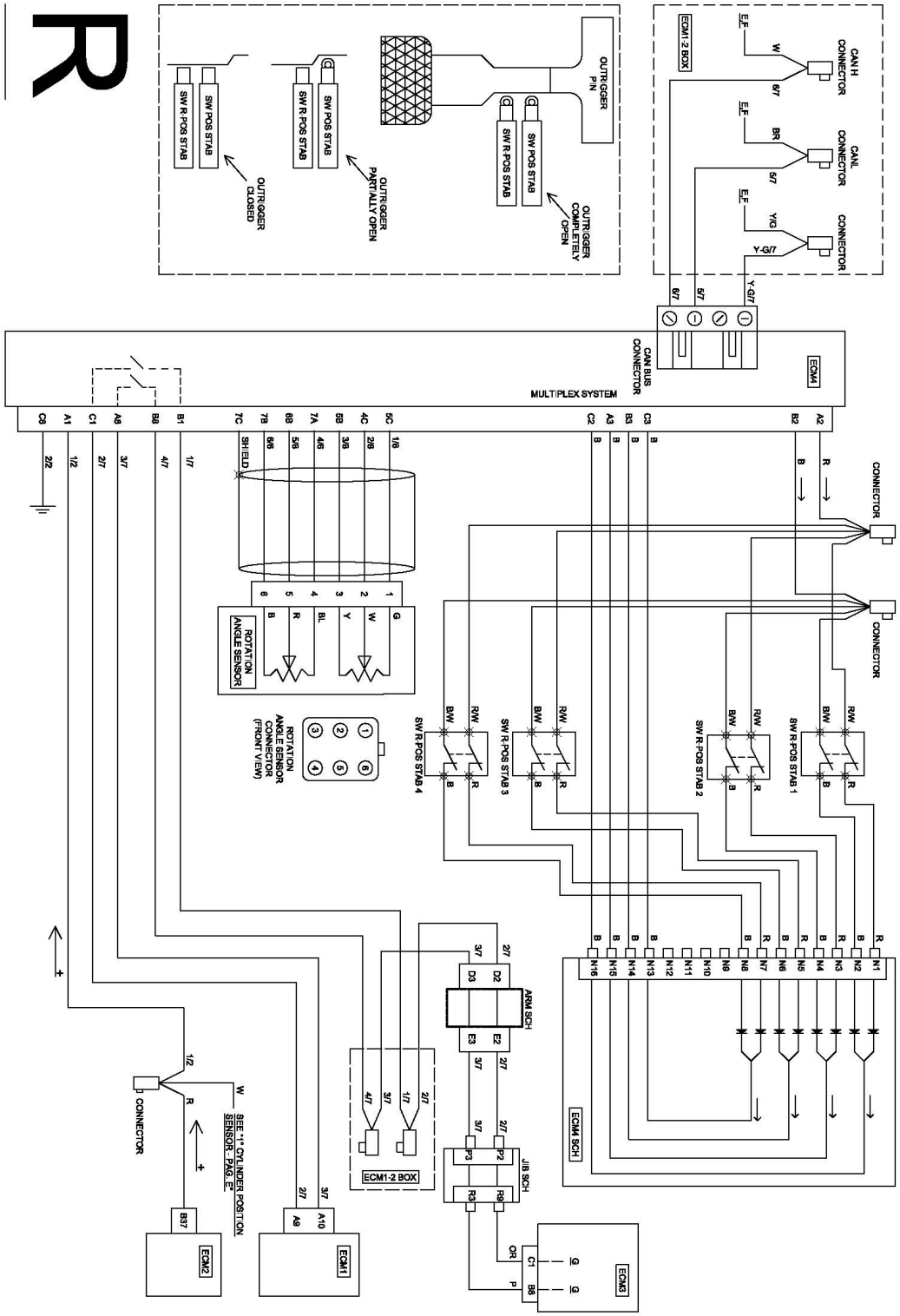

OUTRIGGER PIN
SW R POS STAB
SW POS STAB
OUTRIGGER CLOSED
OUTRIGGER PARTIALLY OPEN
OUTRIGGER COMPLETELY OPEN
ECM1-2 BOX
CAN H CONNECTOR
CAN L CONNECTOR
CONNECTOR
CAN BUS CONNECTOR
ECM1
MULTIPLEX SYSTEM
SHIELD
ROTATION ANGLE SENSOR
ROTATION ANGLE SENSOR CONNECTOR (FRONT VIEW)
SW R POS STAB 4
SW R POS STAB 3
SW R POS STAB 2
SW R POS STAB 1
ARM SCH
JIB SCH
ECM4 SCH
ECM3
ECM2
SEE "1" CYLINDER POSITION SENSOR - PAG. E"

Figure 7-18.

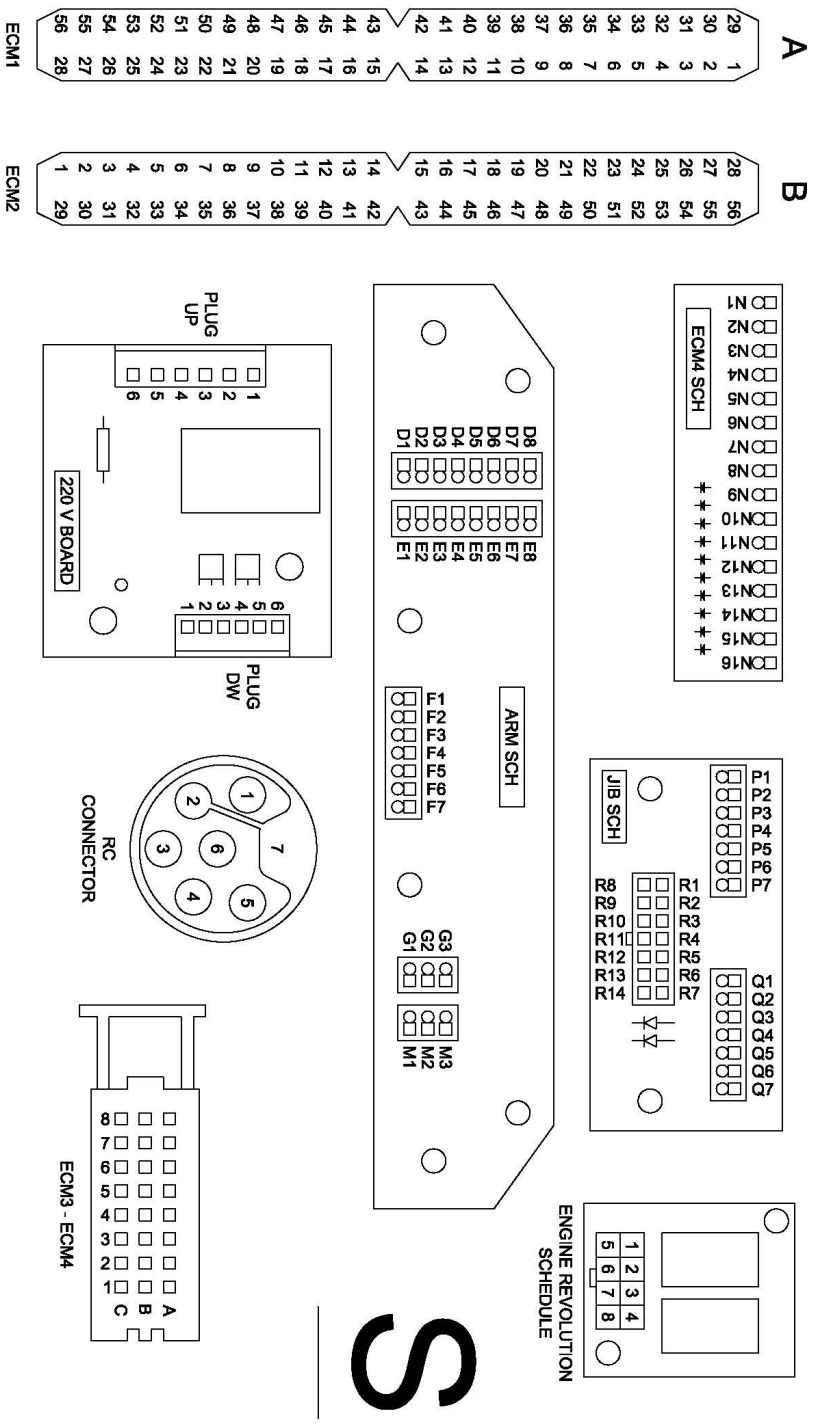

A
B
ECM1
ECM2
ECM4 SCH
N1
N2
N3
N4
N5
N6
N7
N8
N9
N10
N11
N12
N13
N14
N15
N16
PLUG UP
PLUG DW
220 V BOARD
ARM SCH
D1
D2
D3
D4
D5
D6
D7
D8
E1
E2
E3
E4
E5
E6
E7
E8
F1
F2
F3
F4
F5
F6
F7
G1
G2
G3
M1
M2
M3
JIB SCH
P1
P2
P3
P4
P5
P6
P7
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14
Q1
Q2
Q3
Q4
Q5
Q6
Q7
RC CONNECTOR
ECM3 - ECM4
ENGINE REVOLUTION SCHEDULE

Figure 7-19.

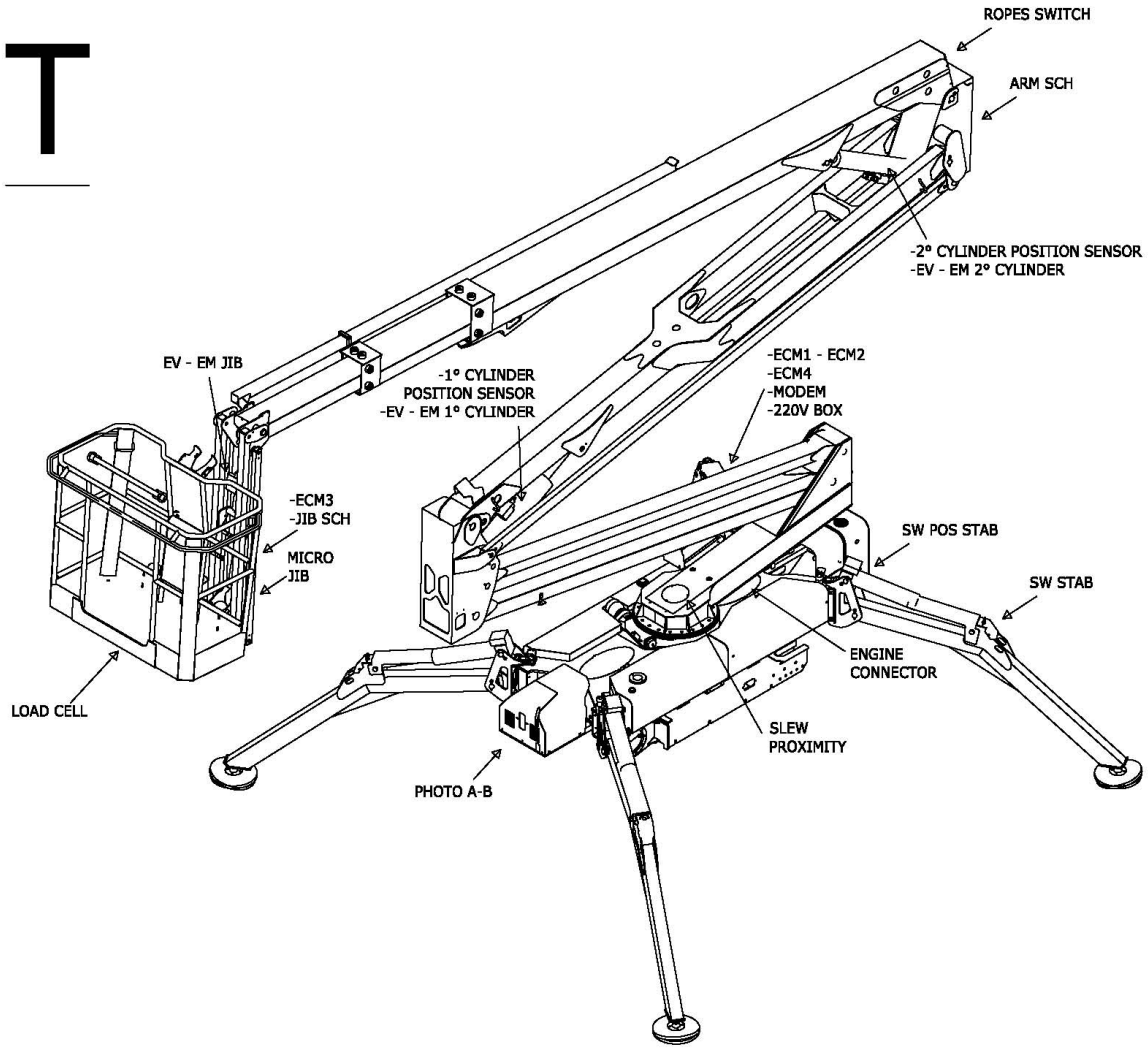

ROPES SWITCH
ARM SCH
-2° CYLINDER POSITION SENSOR
-EV - EM 2° CYLINDER
EV - EM JIB
-1° CYLINDER
POSITION SENSOR
-EV - EM 1° CYLINDER
-ECM1 - ECM2
-ECM4
-MODEM
-220V BOX
-ECM3
-JIB SCH
MICRO
JIB
SW POS STAB
SW STAB
ENGINE
CONNECTOR
LOAD CELL
SLEW
PROXIMITY
PHOTO A-B

Figure 7-20.

NOTES:

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