MD 700 series

ED. 5 - 10/2015

LUNGHEZZA - *Length* (1m=1000mm)

m	in	ft	yd
1	39.370	3.2808	1.0936
0.0254	1	0.08333	0.02778
0.3048	12	1	0.33333
0.9144	36	3	1

AREA ($1m^2=1000000mm^2$)

m^2	in^2	ft^2	yd^2
1	1550	10.764	1.1960
0.00065	1	0.00694	0.00077
0.0929	144	1	0.11111
0.83613	1296	9	1

VOLUME ($1dm^3=1000cm^3=1000000mm^3$)

m^3	dm^3, (liter)	in^3	ft^3	Imperial gallon	US gallon
1	1000	61024	35.315	219.97	264.17
0.001	1	61.024	0.03532	0.21997	0.26417
.	0.01639	1	0.00058	0.00360	0.00433
0.02832	28.317	1728	1	6.2288	7.4805
0.004546	4.546	277.420	0.16054	1	1.2010
0.003785	3.785	231	0.13368	0.83268	1

PESO - *Mass* (1kg=1000g)

kg	lb (pound)	oz (ounce)	stug, UK	ton, UK	short ton, US
1	2.2046	35.274	0.06852	0.00984	0.0011
0.45359	1	16	0.03108	0.00045	0.0005
0.02835	0.0625	1	0.00194	.	.
14.5939	32.174	514.78	1	0.01436	0.01609
1016	2240	35840	69.621	1	1.12
907.18	2000	32000	62.162	0.89286	1

POTENZA - *Output* (1kW=1000W)

kW, kNm/s, kJ/s	hk, metric hp	hp (PS), UK, US	ft x lbf/s
1	1.3596	1.3410	737.56
0.7355	1	0.98632	542.48
0.7457	1.0139	1	550
0.00136	0.00184	0.00182	1

FORZA LAVORO - *Energy work* (1kWs=1000Ws)

kWs, kJ, kNm	kWh	kpm	hkh (metric hph)	ft x lbf (foot pound-force)
1	0.00028	101.97	0.00038	737.56
3600	1	367100	1.3596	2655200
0.00981	.	1	.	7.2330
2631.6	0.7355	270000	1	1952910
0.00136	.	0.13826	.	1

COPPIA - *Torque*

Nm	kpm	lbf x in	lbf x ft
1	0.10197	8.8508	0.73756
9.8067	1	86.796	7.2330
0.11299	0.011521	1	0.08333
1.3558	0.13826	12	1

PRESSIONE - *Pressure stress*

N/m^2, Pa	bar (=1000 mbar)	mm Hg	kp/cm^2	kp/mm^2	lbf/in^2, psi
1	0.00001	0.0075	.	.	.
100000	1	750.062	1.0197	0.01097	14.503
133.32	0.00133	1	0.00136	.	0.01934
98066	0.98066	735.56	1	0.010	14.223
9806650	98.066	73556	100	1	1422.2
6894.76	0.06895	51.715	0.07031	.	1

DENSITA' - *Density*

kg/dm^3	g/mm^3	lb/in^3	lb/ft^3
1	0.001	0.03613	0.06243
1000	1	36.1273	62.428
27.679	0.02768	1	1728
0.01602	.	0.00058	1

TEMPERATURA - *Temperature*

°C	°F
Formula (1.8 x C)+32 = F	Formula (F-32) x 0.5556 = C
Example, 100°C (1.8 x 100)=180+32=212°F	*Example*, 100°F (100-32)=68 x 0.5556=38°C

SERVICE MANUAL COMMENTS

What errors(s) have you found?

In order for us to assist you, please include as much details as possible when reporting an error
Comments / Suggestions

☐ **DEALER**

Retail Customer ☐

Please poste this page using the envelope contained in this manual
or
write to below e-mail address:
sluciani@vmmotori.com

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FOREWORDS 0

WORKSHOP PROCEDURES

The models illustrated can be identified by the code indicating the bore, number of cylinders and aspiration type **(see Chap. 1 'Identification').**

In the event of a fault, check that the problem is not due to some external factor before proceeding to dismantle the engine.

If it is necessary to dismantle the engine, label all those parts which must be fitted in a certain position, so as to avoid problems and save time during reassembly.

DURING DISASSEMBLY AND REASSEMBLY, THE ENGINE MUST BE SUPPORTED ON A SUITABLE PURPOSE-BUILT STAND OF THE TYPE INDICATED IN ***CHAPS. 5 AND 7.***

Fix the engine to the stand using the bolts provided with the stand or similar.

WARNING: TO SUPPORT OR MOVE THE ENGINE, ALWAYS USE A COMMERCIAL PURPOSE-BUILT STAND OF THE TYPE INDICATED IN ***CHAPS. 5 AND 7.***

WARNING: RISK OF CRUSHING AND/OR SHEARING OF LIMBS DURING ENGINE ROTATION ON STAND.

WARNING: ALWAYS USE THE CORRECT TOOLS FOR THE TASK. DO NOT USE UNSUITABLE TOOLS TO AVOID RISK OF PERSONAL INJURY AND DAMAGING COMPONENTS.

If difficulty is encountered separating parts during disassembly, use only gentle blows with a synthetic rubber or wooden mallet or use a metal hammer and interpose soft material (synthetic resin, wood).

Keep the component parts of different assemblies separate and label any unmarked parts to facilitate reassembly.

If you use abrasive materials (emery cloth, etc.) to clean any parts, always clean the parts thoroughly afterwards using a suitable solvent to remove any abrasive particles **(see para. 3.7).**

Lubricate all moving parts with a suitable lubricant prior to reassembly **(see para. 3.5).**

When reassembling the engine, renew all seals, gaskets, spring washers, tab washers, and any parts which appear worn or defective.

DANGER: ALWAYS TAKE SUITABLE PRECAUTIONS WHEN HANDLING LUBRICANTS, THREAD-LOCKING COMPOUNDS, REFRIGERANTS, FUEL AND SOLVENTS ETC. AND AVOID INGESTION, INHALATION OF FUMES AND CONTACT WITH THE EYES AND SKIN.

USING THE WORKSHOP MANUAL

Importance of the manual

This workshop manual is published for use in **"VM"** Service Centers and contains instructions for the servicing, repair and overhaul of **MD700** engines.

We recommend that you follow all the instructions in this manual scrupulously, as the effectiveness of any servicing operation depends on the correct and methodical application of the information contained herein.

If you run into difficulties or setbacks, **VM MOTORI S.p.A. SERVICE DEPARTMENT** will be happy to provide you with the necessary advice and assistance.

VM MOTORI S.p.A. declines any liability for any injury or damage resulting from incorrect or unsuitable operations.

VM MOTORI S.p.A. reserves the right to make any modifications aimed at improving its products without prior notification.

Please ensure that any amendments or updates you may receive are kept with the original version of this manual.

Conserving the manual

When using the manual, take care not to damage or deface it.

Do not tear or remove pages from the manual, or overwrite any parts of the manual for any reason.

Keep the manual in safe place protected from excess heat and humidity.

Consulting the manual

This manual comprises:

- COVER PAGE IDENTIFYING THE TYPE OF ENGINE
- TABLE OF CONTENTS
- INSTRUCTIONS AND/OR NOTES ON THE PRODUCT

The **COVER PAGE** indicates the engine model dealt with in the manual.

The **TABLE OF CONTENTS** indicates the CHAPTER and PARAGRAPH to be consulted for information about a particular topic.

The **INSTRUCTIONS AND/OR NOTES ON THE PRODUCT** define the safe working practices, correct procedures and skills required to service the engine correctly.

Please note that some of the illustrations in the manual, which are included to help you identify the parts described in the text, show standard engines and therefore may differ in some respects from the engine in your possession.

Symbols used in the manual

The Safety symbols and notices shown below are used throughout this manual to draw the reader's attention to the hazards associated with particular procedures and operations which could result in damage to the engine or personal injury, or to indicate good working practices.

GENERAL OPERATIONAL NOTE

Safety notices (rectangular): you must use the protection shown in the notices when carrying out the operation in question to avoid risk of personal injury:

PROTECT YOUR HANDS (WEAR GLOVES)

PROTECT YOUR EYES (WEAR SAFETY GOGGLES)

PROTECT RESPIRATORY PASSAGES (WEAR A MASK)

Danger warning signs (triangular) (General warning of risk of personal injury or damage to the engine):

DANGER (GENERAL HAZARD - RISK OF PERSONAL INJURY OR DAMAGE TO THE ENGINE)

DANGER (ELECTRICAL HAZARD - RISK OF ELECTROCUTION OR DAMAGE TO THE ENGINE)

DANGER (HIGH TEMPERATURE HAZARD - RISK OF BURNS OR DAMAGE TO THE ENGINE)

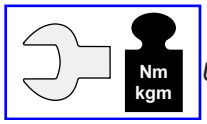
Prohibition notices (circular) denoting operations which are expressly prohibited to avoid risk of personal injury.

THE OPERATION INDICATED IN THE TEXT IS STRICTLY PROHIBITED

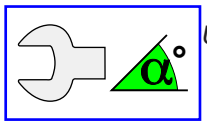
IT IS STRICTLY PROHIBITED TO CARRY OUT MAINTENANCE WORK IN THE PRESENCE OF MOVING PARTS.

IT IS STRICTLY PROHIBITED TO REMOVE OR TAMPER WITH THE SAFETY DEVICES.

PAY ATTENTION TO THE SYMBOLS AND ADHERE TO THE INSTRUCTIONS IN THE ADJACENT TEXT.



USE TORQUE WRENCH



USE ANGULAR TORQUE WRENCH

ORDERING ORIGINAL REPLACEMENT PARTS

To help us provide a fast and efficient service, always specify the following information when ordering replacement parts:

Engine type as indicated on nameplate;

Serial number as indicated on nameplate and stamped on crankcase;

Part number and drawing of component required

Quantity of each item required

Otherwise you can place your order through

INTERNET site:http://www.vm-motori.it

QUALITY SYSTEM CERTIFICATION ISO 9001 ; QS-9000 ; ISO 14001

VM MOTORI has obtained and maintains the official certification of its quality system in compliance with UNI EN ISO 9001 and in according with the prescriptions of Ford, Chrysler and GM car manufacturing association for the production of Diesel engines, set down in Quality System Standard QS 9000.
The company has also obtained the certification of its environmental management system, in accordance with ISO 14001 standards.
This is the result of an operating programme that has involved all levels of the company in a drive for constant structural improvement.
Quality policy and the environment, with particular reference to the principle of continuous improvement, are essential components of VM's top management functions in accordance with internationally accepted quality and environment management systems, in the full respect of the environment and the population.
Customer satisfaction, productivity and motivation of the employees as the sum of all services rendered outside and inside the company are the most important elements of VM's concept of quality.
All VM's employees are committed to the quality policy and the protection of the environment.
Regular training ensures that their qualifications are constantly brought up to date. VM regards quality as a dynamic process of continuous improvement in all activities in order to achieve the company's goals.

REFERENCE STANDARDS USED FOR DRAFTING

This manual has been drafted according to the following **"UNI STANDARD: 10653 and 10893"**

ISO 9001 - Cert. n° 0295/2
ISO\TS 16949- Cert. n°2920/0

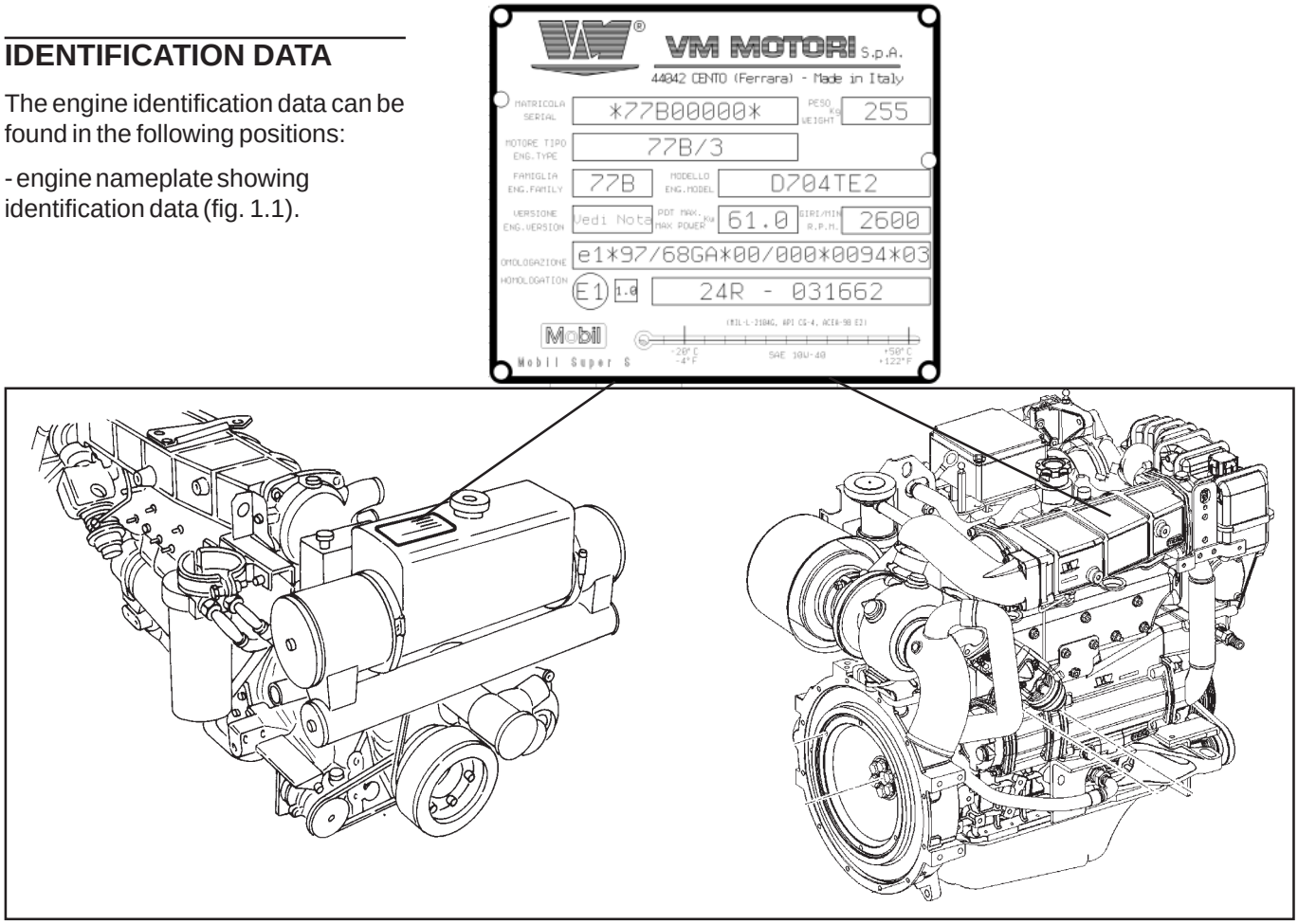
ISO 14001 - Cert. n° 0043A/0

IDENTIFICATION 1

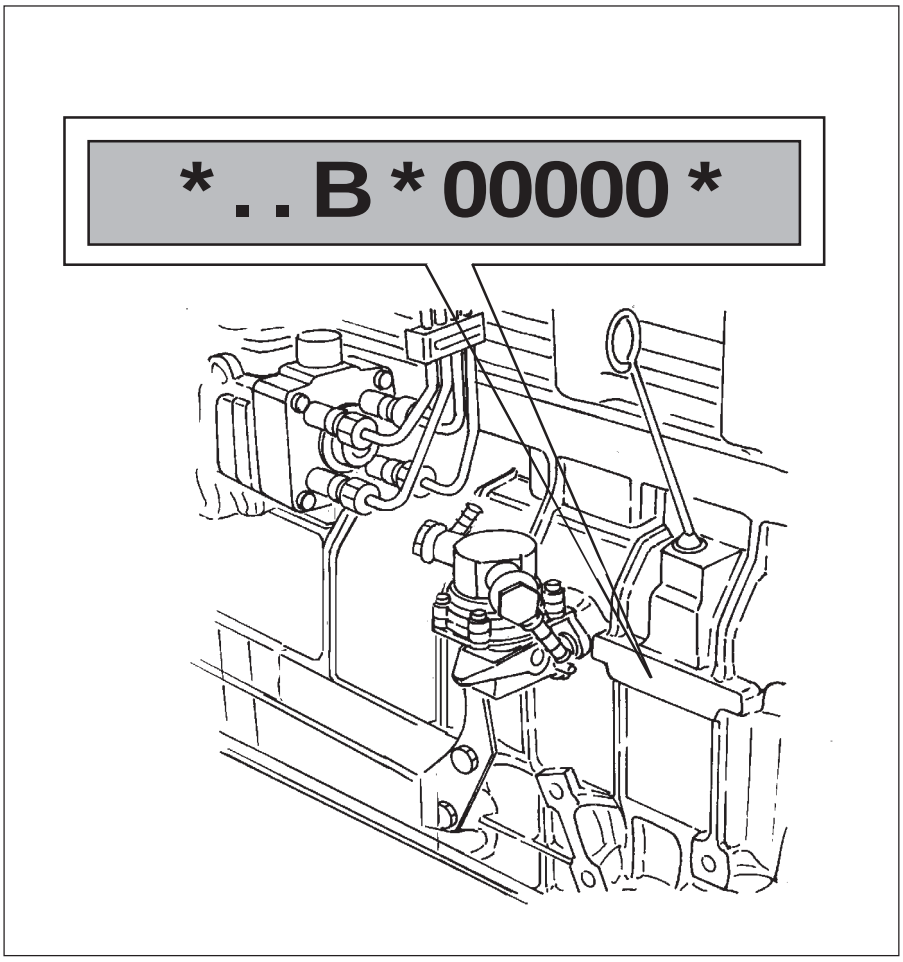
IDENTIFICATION DATA

The engine identification data can be found in the following positions:

- engine nameplate showing identification data (fig. 1.1).



- serial number stamped on the engine crankcase



ENGINE TYPE IDENTIFICATION

DENOMINAZIONE	CODICE
MD 704 LI	48B
MD 706 LI	49B
MD 706 MI	93B
MD 706 MH	97B
MD 706 LH	08C
MD 706 LS	35C
MD 704 LH	36C
MD 704 LS	37C
MD 706 LX	41C
MD 706 LB	42C
MD 706 MS	43C
MD 706 MX	44C

1° POSITION **M** = MARINE ENGINE

2° POSITION **D** = DIRECT INJECTION

3°-4° POSITION **70 =** UNITARY DISPLACEMENT DIVIDES FOR 10 (70=700cc.)

5° POSITION **0** = CYLINDER NUMBERS

6° POSITION **L** = ELECTRONIC INJECTION **M** = MECHANICAL INJECTION

7° POSITION **X** = ULTRA HIGH PERFORMANCES LEVEL
H = HIGH PERFORMANCES LEVEL
S = SOFT PERFORMANCES LEVEL
B = ULTRA SOFT PERFORMANCES LEVEL

8° POSITION NUMBER INDICATING EMISSION EPA/UE HOMOLOGATION

MANUFACTURER IDENTIFICATION

MANUFACTURER: VM MOTORI S.p.A.
Via Ferrarese, 29
44042 CENTO (FERRARA) ITALY
SERVICE TEL. +39 (051) 6837 608/609
SERVICE FAX. +39 (051) 6837 702
http://www.vmmotori.it

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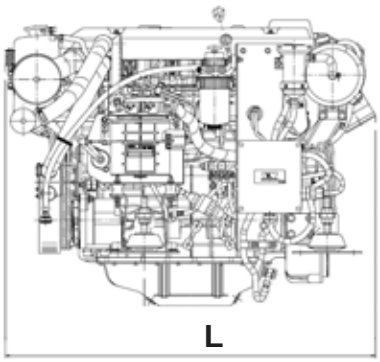
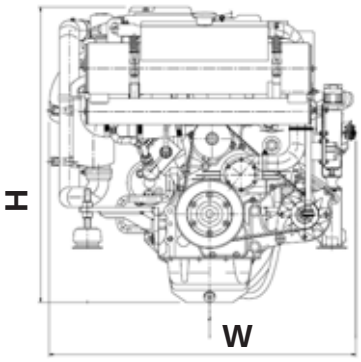
TECHINICAL SPECIFICATIONS 2

ENGINE DIMENSIONS (VM STANDARD ENGINE)

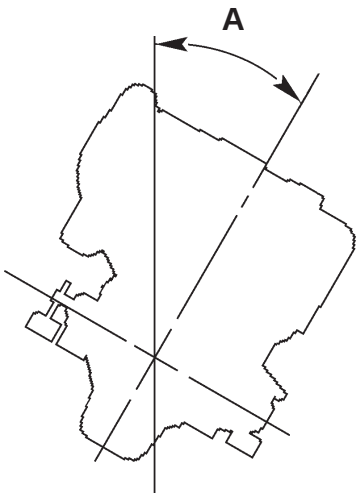
From flywheel housing to max front protrusion

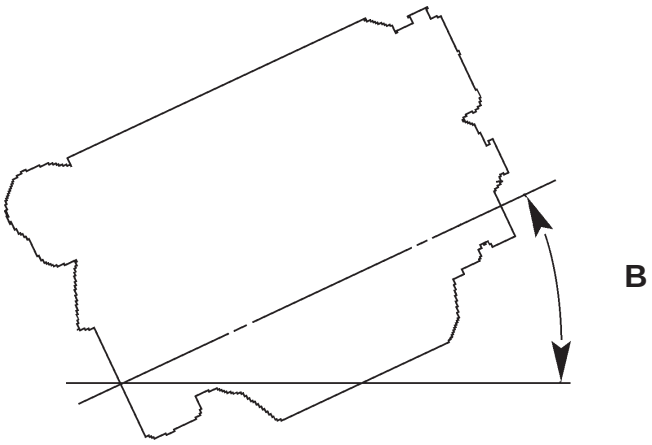




ENGINE TYPE	DIMENSIONS	L	W	H
MD 704 LI	mm	948	739	778
MD 704 LH-LS	mm	866	759	790
MD 706 LI-MI-MH	mm	1172	739	778
MD 706 LB-LS-LH-LX-MS-MX	mm	1191	730	784

Inclination max





ENGINE TYPE	MD704	MD706
Longitudinal inclination, continuous max.driving end down (B)	15°	10°
Longitudinal inclination, temporary max.driving end down (B)	25°	20°
Longitudinal inclination, continuous max.driving end up (B)	20°	15°
Longitudinal inclination, temporary max.driving end up (B)	30°	25°
Transverse inclination, continuous max. (A)	25°	25°
Transverse inclination, temporary max. (A)	45°	45°

TECHNICAL DATA (VM MOTORI STANDARD ENGINE)

	UNITS OF MEASURE	MD704LH	MD704LS
POWER AND TORQUE			
Engine rated speed	rpm	3800	
Power ISO 3046, max.	kW (CV)	147(200)	125 (170)
Torque, max.	Nm (kgm)	440 (44.8) @ 2200 rpm	345 (35.2) @ 2200 rpm
GENERAL TECHNICAL DATA			
Number of cylinders		4	
Bore	mm	94	
Stroke	mm	100	
Displacement, cylinder	liter	0.694	
Displacement, total	liter	2.776	
Compression ratio		17.0	
Number of inlet valves, per cylinder		1	
Number of exhaust valves, per cylinder		1	
Injection		Direct	
Intake		Turbocharged intercooled	
Cooling		Water	
Rotation (looking at the flywheel)		Anticlockwise	
Firing order		1-3-4-2	
Minimum idling speed (VM standard engine)	rpm	700 (800 possibilty)	
Normal Idle Speed variation	rpm	50	
High idling speed, max. (static)	rpm	4250	
Dry Weight	kg	335	
CONSUMPTIONS			
Specific fuel consumption	g/kWh (g/CVh)	217 (159)@2200 rpm	206 (151)@2200 rpm
Lubricating oil	g/kWh (g/CVh)	0.7 - 1.35 (0.5 - 1)	
INTAKE			
Intake air depression (new filter)	mbar	18	
Intake air depression, max.	mbar	40	
EXHAUST			
Exhaust back pressure	mbar	200	
Exhaust back pressure, max.	mbar	250	
Exhaust temperature after turbocharger	°C	550	500
WATER			
Coolant operating temperature, from	°C	80	
Coolant operating temperature, to	°C	95	
Coolant temperature after engine, alarm	°C	107	
Breather valve (expansion tank) opening pressure (excess pressure)	bar	1.0	
OIL			
Lube oil operating pressure (low idle)	bar	1 - 4	
Lube oil pressure before engine, alarm	bar	0.4	
INJECTION			
Opening injector pressure	bar	190 - 200	

CAPACITIES

see chapter 9 "Running tests and adjustments"

	UNITS OF MEASURE	MD704LI	MD706LI
POWER AND TORQUE			
Engine rated speed	rpm	3800	
Power ISO 3046, max.	kW (CV)	121(165)	184 (250)
Torque, max.	Nm (kgm)	345 (35.2) @ 2200 rpm	550 (56.1) @ 2400 rpm
GENERAL TECHNICAL DATA			
Number of cylinders		4	6
Bore	mm	94	
Stroke	mm	100	
Displacement, cylinder	liter	0.694	
Displacement, total	liter	2.776	4.164
Compression ratio		17.0	
Number of inlet valves, per cylinder		1	
Number of exhaust valves, per cylinder		1	
Injection		Direct	
Intake		Turbocharged intercooled	
Cooling		Water	
Rotation (looking at the flywheel)		Anticlockwise	
Firing order		1-3-4-2	1-5-3-6-2-4
Minimum idling speed (VM standard engine)	rpm	700 (possibility 600)	
Normal Idle Speed variation	rpm	50	
High idling speed, max. (static)	rpm	4250	
Dry Weight	kg	325	450
CONSUMPTIONS			
Specific fuel consumption	g/kWh (g/CVh)	228 (167)	233 (171)
Lubricating oil	g/kWh (g/CVh)	0.7 - 1.35 (0.5 - 1)	
INTAKE			
Intake air depression (new filter)	mbar	18	
Intake air depression, max.	mbar	40	
EXHAUST			
Exhaust back pressure	mbar	200	250
Exhaust back pressure, max.	mbar	250	270
Exhaust temperature after turbocharger	°C	500	450
WATER			
Coolant operating temperature, from	°C	72	
Coolant operating temperature, to	°C	95	
Coolant temperature after engine, alarm	°C	107	
Breather valve (expansion tank) opening pressure (excess pressure)	bar	1.0	
OIL			
Lube oil operating pressure (low idle)	bar	1 - 4	
Lube oil pressure before engine, alarm	bar	0.4	
INJECTION			
Opening injector pressure	bar	250 - 264	

CAPACITIES

see chapter 9 "Running tests and adjustments"

	UNITS OF MEASURE	MD706MI	MD706MH
POWER AND TORQUE			
Engine rated speed	rpm	3600	3800
Power ISO 3046, max.	kW (CV)	147(200)	169(230)
Torque, max.	Nm (kgm)	510 (52.2) @ 2200 rpm	571 (58.2) @ 2200 rpm
GENERAL TECHNICAL DATA			
Number of cylinders		6	
Bore	mm	94	
Stroke	mm	100	
Displacement, cylinder	liter	0.694	
Displacement, total	liter	4.164	
Compression ratio		17.0	
Number of inlet valves, per cylinder		1	
Number of exhaust valves, per cylinder		1	
Injection		Direct	
Intake		Turbocharged intercooled	
Cooling		Water	
Rotation (looking at the flywheel)		Anticlockwise	
Firing order		1-5-3-6-2-4	
Minimum idling speed			
(VM standard engine)	rpm	700	
Normal Idle Speed variation	rpm	50	
High idling speed, max. (static)	rpm	4000	4150
Dry Weight	kg	450	
CONSUMPTIONS			
Specific fuel consumption	g/kWh (g/CVh)	228 (167)	240 (176)
Lubricating oil	g/kWh (g/CVh)	0.7 - 1.35 (0.5 - 1)	
INTAKE			
Intake air depression (new filter)	mbar	18	
Intake air depression, max.	mbar	40	
EXHAUST			
Exhaust back pressure	mbar	250	
Exhaust back pressure, max.	mbar	270	
Exhaust temperature after turbocharger	°C	425	500
WATER			
Coolant operating temperature, from	°C	72	
Coolant operating temperature, to	°C	95	
Coolant temperature after engine, alarm	°C	107	
Breather valve (expansion tank)			
opening pressure (excess pressure)	bar	1.0	
OIL			
Lube oil operating pressure (low idle)	bar	1 - 4	
Lube oil pressure before engine, alarm	bar	0.4	
INJECTION			
Opening injector pressure	bar	250 - 264	

CAPACITIES

see chapter 9 "Running tests and adjustments"

	UNITS OF MEASURE	MD706MS	MD706MX
POWER AND TORQUE			
Engine rated speed	rpm	3600	3800
Power ISO 3046, max.	kW (CV)	147(200)	169 (230)
Torque, max.	Nm (kgm)	499 (50.9) @ 2000 rpm	557 (56.8) @ 2100 rpm
GENERAL TECHNICAL DATA			
Number of cylinders		6	
Bore	mm	94	
Stroke	mm	100	
Displacement, cylinder	liter	0.694	
Displacement, total	liter	4.164	
Compression ratio		17.0	
Number of inlet valves, per cylinder		1	
Number of exhaust valves, per cylinder		1	
Injection		Direct	
Intake		Turbocharged intercooled	
Cooling		Water	
Rotation (looking at the flywheel)		Anticlockwise	
Firing order		1-5-3-6-2-4	
Minimum idling speed			
(VM standard engine)	rpm	700	
Normal Idle Speed variation	rpm	50	
High idling speed, max. (static)	rpm	4000	4150
Dry Weight	kg	460	
CONSUMPTIONS			
Specific fuel consumption	g/kWh (g/CVh)	209 (154)@2400 rpm	214 (157)@2200 rpm
Lubricating oil	g/kWh (g/CVh)	0.7 - 1.35 (0.5 - 1)	
INTAKE			
Intake air depression (new filter)	mbar	18	
Intake air depression, max.	mbar	40	
EXHAUST			
Exhaust back pressure	mbar	250	
Exhaust back pressure, max.	mbar	270	
Exhaust temperature after turbocharger	°C	390	410
WATER			
Coolant operating temperature, from	°C	80	
Coolant operating temperature, to	°C	95	
Coolant temperature after engine, alarm	°C	107	
Breather valve (expansion tank)			
opening pressure (excess pressure)	bar	1.0	
OIL			
Lube oil operating pressure (low idle)	bar	1 - 4	
Lube oil pressure before engine, alarm	bar	0.4	
INJECTION			
Opening injector pressure	bar	250 - 264	

CAPACITIES

see chapter 9 "Running tests and adjustments"

	UNITS OF MEASURE	MD706LB	MD706LS
POWER AND TORQUE			
Engine rated speed	rpm	3800	
Power ISO 3046, max.	kW (CV)	184 (250)	199 (270)
Torque, max.	Nm (kgm)	572 (58.3) @ 2400 rpm	605 (61.7) @ 2600 rpm
GENERAL TECHNICAL DATA			
Number of cylinders		6	
Bore	mm	94	
Stroke	mm	100	
Displacement, cylinder	liter	0.694	
Displacement, total	liter	4.164	
Compression ratio		17.0	
Number of inlet valves, per cylinder		1	
Number of exhaust valves, per cylinder		1	
Injection		Direct	
Intake		Turbocharged intercooled	
Cooling		Water	
Rotation (looking at the flywheel)		Anticlockwise	
Firing order		1-5-3-6-2-4	
Minimum idling speed			
(VM standard engine)	rpm	700 (600 possibility)	
Normal Idle Speed variation	rpm	50	
High idling speed, max. (static)	rpm	4250	
Dry Weight	kg	460	
CONSUMPTIONS			
Specific fuel consumption	g/kWh (g/CVh)	208 (153)@2600 rpm	209 (154)@2400 rpm
Lubricating oil	g/kWh (g/CVh)	0.7 - 1.35 (0.5 - 1)	
INTAKE			
Intake air depression (new filter)	mbar	18	
Intake air depression, max.	mbar	40	
EXHAUST			
Exhaust back pressure	mbar	250	
Exhaust back pressure, max.	mbar	270	
Exhaust temperature after turbocharger	°C	510	530
WATER			
Coolant operating temperature, from	°C	80	
Coolant operating temperature, to	°C	95	
Coolant temperature after engine, alarm	°C	107	
Breather valve (expansion tank)			
opening pressure (excess pressure)	bar	1.0	
OIL			
Lube oil operating pressure (low idle)	bar	1 - 4	
Lube oil pressure before engine, alarm	bar	0.4	
INJECTION			
Opening injector pressure	bar	190 - 200	

CAPACITIES

see chapter 9 "Running tests and adjustments"

	UNITS OF MEASURE	MD706LH	MD706LX
POWER AND TORQUE			
Engine rated speed	rpm	3800	3900
Power ISO 3046, max.	kW (CV)	221 (300)	235 (320)
Torque, max.	Nm (kgm)	654 (66.66) @ 2800 rpm	660 (67.3) @ 2700 rpm
GENERAL TECHNICAL DATA			
Number of cylinders		6	
Bore	mm	94	
Stroke	mm	100	
Displacement, cylinder	liter	0.694	
Displacement, total	liter	4.164	
Compression ratio		17.0	
Number of inlet valves, per cylinder		1	
Number of exhaust valves, per cylinder		1	
Injection		Direct	
Intake		Turbocharged intercooled	
Cooling		Water	
Rotation (looking at the flywheel)		Anticlockwise	
Firing order		1-5-3-6-2-4	
Minimum idling speed (VM standard engine)	rpm	700 (600 possibility)	
Normal Idle Speed variation	rpm	50	
High idling speed, max. (static)	rpm	4250	
Dry Weight	kg	460	
CONSUMPTIONS			
Specific fuel consumption	g/kWh (g/CVh)	209 (154)@2400 rpm	214 (157)@2400 rpm
Lubricating oil	g/kWh (g/CVh)	0.7 - 1.35 (0.5 - 1)	
INTAKE			
Intake air depression (new filter)	mbar	18	
Intake air depression, max.	mbar	40	
EXHAUST			
Exhaust back pressure	mbar	250	
Exhaust back pressure, max.	mbar	270	
Exhaust temperature after turbocharger	°C	550	560
WATER			
Coolant operating temperature, from	°C	80	
Coolant operating temperature, to	°C	95	
Coolant temperature after engine, alarm	°C	107	
Breather valve (expansion tank) opening pressure (excess pressure)	bar	1.0	
OIL			
Lube oil operating pressure (low idle)	bar	1 - 4	
Lube oil pressure before engine, alarm	bar	0.4	
INJECTION			
Opening injector pressure	bar	190 - 200	

CAPACITIES

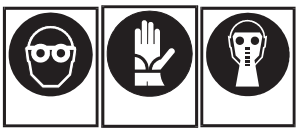
see chapter 9 "Running tests and adjustments"

MAINTENANCE 3

STORAGE

WARNING:
ALL ENGINES WHICH REMAIN IDLE ARE SUBJECT TO RUST AND CORROSION OF MACHINED SURFACES WHICH ARE NOT PROTECTED BY PAINT. THE DEGREE OF CORROSION DEPENDS ON THE CLIMATIC CONDITIONS TO WHICH THE ENGINE IS EXPOSED. THE INDICATIONS BELOW ARE THEREFORE INTENDED ONLY AS A GENERAL ONLY TO PROTECTING THE ENGINE FROM CORROSION.

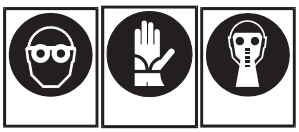
TEMPORARY PROTECTION (UP TO 6 MONTHS)



1) Prepare a container with a mixture of 10% **MOBILARMA 524** (ML-L-21269) and diesel fuel, disconnect the fuel feed and diesel fuel return lines from the fuel tank and connect them to this container.
2) Run the engine for about 10 minutes at a speed between ½ and ¾ of nominal rpm so that the pipelines, nozzles, pumps and filters are completely filled with the protective mixture.
3) Stop the engine and wait for it to cool down.
4) Reconnect the pipelines to the fuel tank.
5) Completely refill the diesel fuel service tank.
6) Spray the specific protective oil for electrical contacts into the non-protected contact points.

For disposal of used oils contact an authorised disposal company.

PERMANENT PROTECTION (6 MONTHS OR MORE)



1) Change engine oil and cartridge filter with new components.
2) Prepare a container with a mixture of protective oil **MOBILARMA 524** (MIL-L-21260) at 10% and diesel fuel. Disconnect the fuel supply and return lines from the fuel tank and immerse them in the mixture.
3) Run the engine at low speed for a few minutes.
4) Run the engine for about 10 minutes at a speed between ½ and ¾ of nominal rpm so that the pipelines, nozzles, pumps and filters are completely filled with the protective fluid.

   Before switching off the engine, connect the intake side of the sea-water pump to a tank containing a mixture of 40 % tap water and 60 % permanent anti-freeze MOBIL ANTICONGELANTE type and ched that the mixture outflows through the exhaust manifold.
5) To stop the engine and to wait that the engine is cooled.
6) Reconnect the lines to the fuel tank.
7) Loosen the vee belt.
8) Spray the specific protective into electrical contacts and belt grove pulley.

For disposal of used oils contact an authorized disposal company.

THREAD-LOCKING COMPOUNDS AND/OR SEALANTS

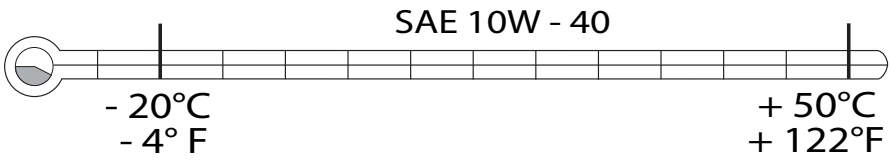
VM recommends use of the products as indicated below:

BRAND	FOR EUROPE	FOR USA
Loctite	222	222
Loctite	510	51
Loctite	573	510
Loctite	601	603
Loctite	986	586 - 620
Dow Corning	791	
Liquid teflon		

LUBRIFICANTS

Specifications

ACEA A2, B2, A3, B3
API SL, SJ, CF
MB 229.1
VW 505.00



VM preferers **MOBIL SUPER S**

NOTE DISPOSAL OF WASTE MATERIAL MUST BE CARRIED OUT IN CONFORMITY WITH ESTABLISHED LEGISLATION IN THE COUNTRY OF INSTALLATION.

IDENTIFICATION OF DANGERS

EFFECTS OF OVEREXPOSURE: No relevant effects expected.

FIRST AID MEASURES

CONTACT WITH EYES: Rinse immediately with copious amount of water and seek medical advice.

CONTACT WITH SKIN: Wash with soap and water.

INHALATION: No problems expected.

INGESTION: Not considered to be a problem. However, if more than 1/2 liter is swallowed or a feeling of discomfort is noted, administer 1 or 2 glasses of water and call a doctor or an ambulance. Do not induce vomit or administer substances orally to unconscious persons.

DISPOSAL

The product can be incinerated, according to standard regulations.

Wear protective gloves when handling the product.

Operate according to standard regulations in the country of use and in relation to the characteristics of the product at the moment of disposal.

HOW TO SELECT LUBRICATING OIL

Lubricant Selection in North America

The selection of the proper lubricating oil is important to achieve the long and trouble-free service which Detroit Diesel engines are designed to provide.

The proper lubricating oil for all Detroit Diesel engines is selected based on SAE viscosity grade and API (American Petroleum Istitute) service designation.

Only oils licensed to display the American Petroleum Institute (API) symbol shown should be used. See Figure B.

Lubricants meeting these criteria have provided maximum engine life when used in conjunction with specified oil drain and filter maintenance schedules.

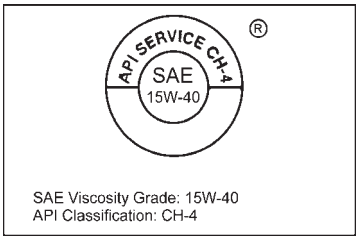
API CF-4 or CG-4 oil may be used when CH-4 oils are not available; however, their use may require a reduction in oil drain interval depending upon the application and the fuel sulfur level.

At ambient temperatures below -20°C (-4°F) when sufficient starter speed cannot be achieved with SAE 15W-40 oils, the use of 5W-XX and 10W-XXoils, where XX is 30 or 40, is allowed to improve startability, provided they are API CH-4 and have demonstrated field performance in DDC engines. These oils must possess a HT/HS of 3.7 cp minimum.

Monograde oils should not be used in DDC HR-HT2 engines regardless of API Service Classification.

Lubricant Requirements

Figure B. API Lubricant Service Mark



COOLANTS

Inhibited Ethylene Glycol

	TEMPERATURE		
% VOL	FREZZING POINT	BOILING POINT	DENSITY kg/dm3 a 15°C
10	-4	101	1.014
20	-10	102	1.028
30	-17	104	1.042
40	-27	106	1.056
50	-40	109	1.070
60	-47	114	1.084

To obtain the best operating conditions we recommend using a coolant mixture with a solution of 50% fresh demineralised water and 50% anti-rust anti-freeze liquid (inhibited ethylene glycol) that meets the reguirements of **ASTM standard D3306.**

Inhibited ethylene glycol is a special ethylene glycol liquid used for permanent type antifreeze mixture for use in internal combustion engine cooling circuits and for any other heat exchange circuit operating at low temperature.

The antifreeze also features efficient anti-rust and corrosion properties for cooling circuit metals. It does not contribute to temperature-related deterioration of the rubber hoses or couplings which connect the various circuit components.

HAZARDS

Ingestion of ethylene glycol can cause nausea, vomiting, stomach cramps, convulsions, pulmonary swelling, cardiopulmonary side-effects (metabolic acidosis), pneumonia and kidney defects which can be lethal.

The lethal single dose for humans is approximately 100 ml.

Inhalation over extended periods of time of high concentrations of vapours or mist is also harmful.

This product is harmful if swallowed.

FIRST AID

CONTACT WITH EYES: bathe thoroughly with water immediately. If irritation occurs, seek medical attention.

CONTACT WITH SKIN: wash with soap and water. Remove any contaminated clothing. Wash contaminated clothing before re-use.

INHALATION: Bring the person outside the exposed area. If irritation occurs in the respiratory system, or in the event of vertigo, nausea or unconsciousness, seek medical attention immediately. In the event of respiratory arrest, carry out artificial respiration immediately

INGESTION: induce vomiting immediately with ipecac syrup followed by 1 or 2 glasses of water and seek medical assistance. If ipecac syrup is not available, induce vomiting under the supervision of medical personnel. Never induce vomiting or attempt to put substances into the mouth if the person is unconscious.

DISPOSAL

WASTE DISPOSAL:

Wear impermeable gloves and drain the cooling circuit into a suitable receptacle. Dispose of coolant in conformity with established legislation and in accordance with the type of product.

SOLVENTS

VM Motori prescribes the following products or equivalents.

Pickling diluent

SUBSTANCE

Chemical composition
Mixture of aromatic hydrocarbons
ketones, dichloropropane, isobutyl alcohol.

Commercial name	Diluente Decapaggio 15
Formula	----
Kemler number	33
ONU number	1203

CHARACTERISTICS - INGREDIENTS

Acetone mixture	15% - 25%
Isopropyl alcohol mixture	10% - 20% Xn R 20
Dichloropropane mixture	15% - 25% Xn R 20
Totuol mixture	35% - 45% Xn R 20

Component identification numbers:

	n° CEE	n° CAS
Acetone	606-001-00-8	67-64-1
Isopropyl alcohol	603-003-00-0	67-63-0
Dichloropropane	602-020-00-0	78-87-5
Totuol	601-021-00-3	108-88-3

HAZARDS

Highly inflammable.

Harmful if inhaled and in contact with skin.

Injurious to health if ingested.

R 11 - Highly inflammable

R 20 - Harmful if inhaled.

Skin	irritant
Eyes	irritant
Ingestion	harmful
Inhalation	harmful

FIRST AID

CONTACT WITH SKIN

Remove contaminated clothing. Wash affected parts of the body with cold or tepid water immediately. Use neutral soap if available.

CONTACT WITH EYES

Rinse immediately with copious amounts of fresh water for at least 15 minutes. Seek medical advice.

INHALATION

Take patient away from the sources of fumes and keep outside in fresh air. Apply artificial respiration if the patient stops breathing.

Seek medical advice.

INGESTION

Rinse out mouth with water without swallowing. Do not induce vomiting. Seek medical advice.

EXPOSURE CONTROL - PERSONAL PROTECTION

Maximum exposure limit LV mg/mc. 491

According to DPR n° 303 19/03/65 medical examinations are required every three months.

RESPIRATORY PROTECTION

Full mask facepiece respirator with filter for highly concentrated organic vapor.

HAND PROTECTION

Solvent-resistant gloves.

EYE PROTECTION

Goggles providing splash and spray protection.

SKIN PROTECTION

Overalls and apron.

DO NOT EAT, DRINK OR SMOKE IN AREAS WHERE SOLVENTS ARE USED.

Trichloroethane

CHEMICAL NAME

1,1,1 - Trichloroethane

Synonyms: Tri-Ethane 377 - Tri-Ethane 348

EEC No.	602-013-00-2
Einecs No.	200-766
Cas No.	71-55-6

Contains:

< 5% Polymer stabilizer (the product does not contain significant concentrations of substances classified as hazardous for health).

HAZARDS

MAJOR HAZARDS

Harmful if inhaled

SPECIFIC HAZARDS

A concentration significantly higher than that permitted in the work area could cause damage to the central nervous system and collapse.

FIRST AID

General information

Show this safety sheet to the doctor in charge.

Avoid contact with solvents and adopt protective measures whenever possible in accordance with general standards of industrial hygiene.

INHALATION

Take patient outside in fresh air. Administer oxygen.

CONTACT WITH SKIN

Remove all contaminated clothing, shoes, etc.. Wash immediately with plenty of water and soap. Seek medical advice.

CONTACT WITH EYES

Rinse thoroughly with copious amounts of water for at least 15 minutes while keeping the patient's eyes wide open.

Seek medical advice.

INGESTION

Drink plenty of water. Do not induce vomiting.

Seek immediate medical advice.

Do not administer any substances whatsoever if the patient loses consciousness.

PROTECTION WHILE ADMINISTERING FIRST AID

Wear protective clothing to avoid contact with skin. Solvents can remove natural oils from skin.

EXPOSURE CONTROL - PERSONAL PROTECTION

WORK AREA DESIGN

Ensure that the work area is adequately ventilated, particularly if the area is enclosed.

CONTROL PARAMETERS

OSHA PEL 8 hr - TWA = 350 ppm

OSHA STEL 15 min = 450 ppm

PERSONAL PROTECTION

RESPIRATORY PROTECTION

If the work area is insufficiently ventilated, use a suitable respirator.

For emergency rescue operations and when working in storage tanks, use self-contained breathing apparatus.

HAND PROTECTION

Solvent-resistent gloves.

EYE PROTECTION

Safety goggles/faceshield visor

SKIN AND BODY PROTECTION

Protective clothing, solvent-resistent apron.

Remove and wash contaminated gloves and clothing before re-use.

HYGIENE

Avoid contact with eyes, skin and clothing.

DO NOT EAT, DRINK OR SMOKE DURING USE.

FUEL

Use diesel fuel conforming to the specifications given below.

When filling the fuel tank, use a funnel fitted with a metal mesh to filter out any solid impurities which could otherwise block the injector nozzles.

Do not use diesel fuel mixed with water and/or other substances.

ALWAYS USE A HIGH QUALITY DIESEL FUEL OF CERTIFIED ORIGIN WHICH MEETS ***CUNA STANDARDS (NC 630.01)****.*

WARNING:
THE USE OF DIESEL FUEL WHICH DOES NOT MEET THE ABOVE STANDARDS WILL CAUSE DAMAGE TO THE FUEL INJECTION SYSTEM AND CONSEQUENTLY TO THE ENGINE ITSELF AND WILL INVALIDATE THE WARRANTY.

POWER ADJUSTMENT FOR VARIATION OF FUEL PROPERTIES

FUEL PROPERTIES - Power output correction according to the properties of the fuel used.

The specified power output ratings are valid for fuel with the following properties:

Energy value 42 700 kJ/kg

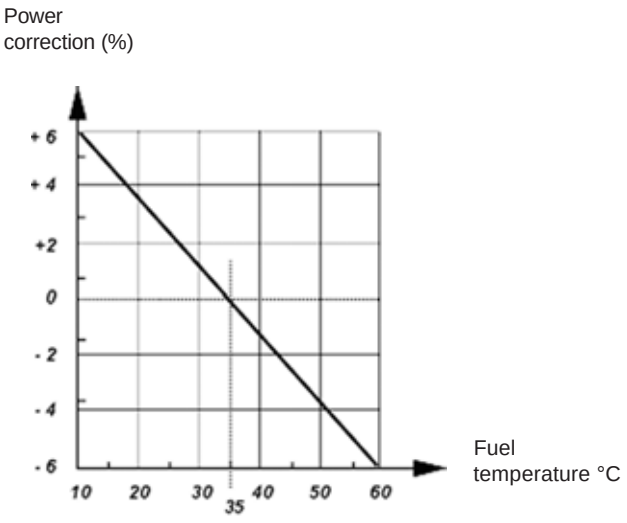
Temperature before fuel supply pump: 35 °C

Density 0.84 kg/dm³ at 15 °C

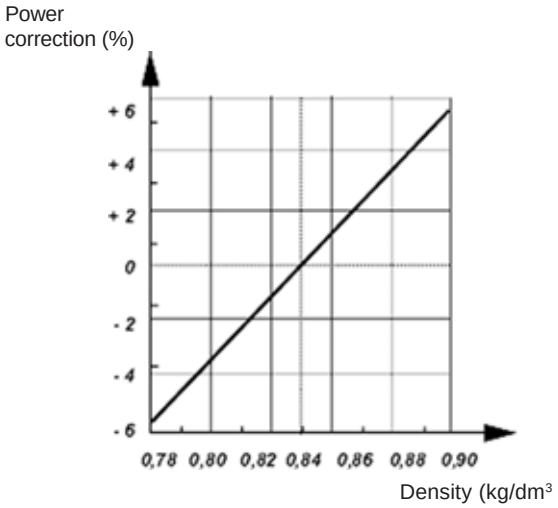
If the fuel deviates from these values, consult the graph below to determine the power correction factor (in %).

Apply these factors to calculate engine power.

Effect of fuel temperature on engine power with mechanicals injection pump.
The normal temperature is +35 (95) °C (°F) (0%).



Effect of fuel density on engine power.
Normal value 0.84 kg/dm³ at +15 (59) °C (°F) (0%).



POWER ADJUSTMENT FOR VARIATION OF COMBUSTION AIR PROPERTIES

AIR PROPERTIES - Power output correction according to air properties

The specified power ratings are valid for air with following properties (as per ISO 3046):

Air pressure 100kPa (1000 mbar)

Air temperature 25 °C

Humidity 30%, normally aspirated engines only (humidity is eliminated in the heat of turbochargers).

If the air deviates from these values, consult the graph below to determine the power correction factor.

Apply these factors to calculate the engine power.

- Note: <u>Engine with mechanicals injection pump only</u>

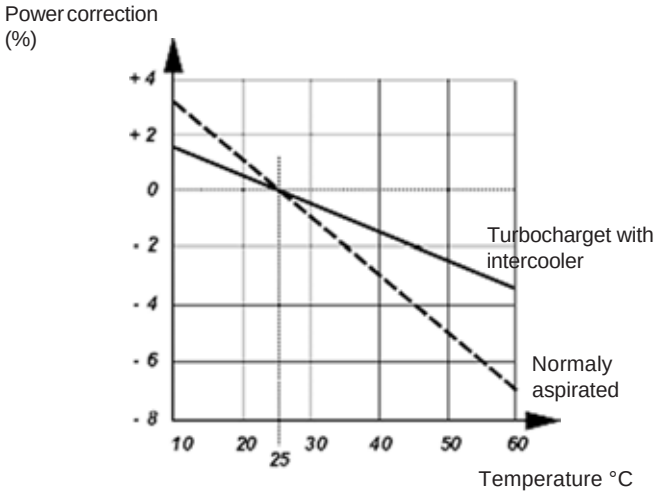
If the engine is used at air pressures (e.g. high altitudes) and/or temperatures exceeding the above standard values, the engine will have to be derated in order to compensate for the lower air pressure.

Reduced air density will negatively affect engine performance.

Incomplete combustion will result in black exhaust fumes and increased fuel consumption. There is also a risk of overrevving and overheating of the turbocharger.

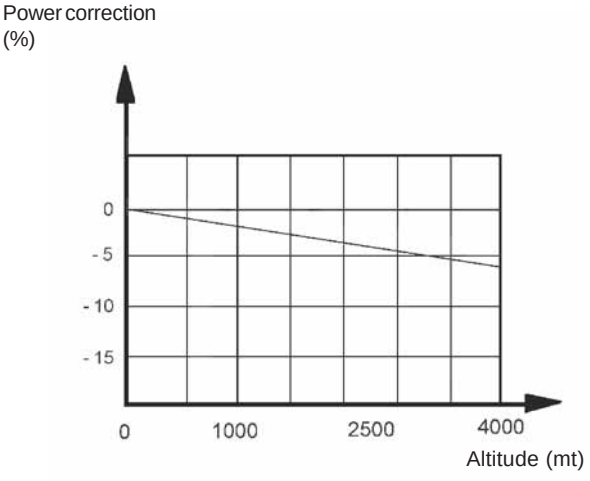
To avoid these problems, the engine must be derated in accordance with “Derating of engine”.

Effect of intake air temperature on engine performance
with mechanicals injection pump
Normal value: +25 (77) °C (°F) (0%).



Effect of intake air pressure on engine power

Normal value: 100 kPa (1000 mbar) (0%)



MAINTENANCE

CARRY OUT MAINTENANCE MORE FREQUENTLY WHEN THE ENGINE IS USED IN HARSH CONDITIONS (FREQUENT STOPS AND STARTS, DUSTY ENVIRONMENTS, LONG HARSH WINTERS, OPERATION UNDER NO-LOAD CONDITIONS).

ADHERE SCRUPULOUSLY TO MAINTENANCE INTERVALS REPORTED BELOW.

IF THERE IS NO HOUR-METER, TAKE 12 HOURS OF OPERATION AS ONE CALENDAR DAY. FOR VEHICLES WITH AN ODOMETER, TAKE 50 KM AS 1 HOUR OF OPERATION.

EVERY 10 HOURS

CHECK Engine oil level **(SEE CAP. 9)**

CHECK Coolant mixture level **(SEE CAP. 9)**

(IF NECESSARY IT MUST BE TOPPED UP WITH IDENTICAL MIXTURE. AVOID TO REFILL WITH DIFFERENT REFRIGERANT MIXTURE DIFFERENT FROM THE ONE WHICH IS ALREADY IN THE CIRCUIT).

*(THE COOLANT MIXTURE LIQUID MUST BE COMPLETELY REMOVED AT LEAST **EVERY 24 MONTHS**.)*

AFTER 50 HOURS

CHANGE Engine oil

*MUST BE PERFORMED AT LEAST ONCE **EVERY 12 MONTHS** IN ANY EVENT.*

CHANGE Oil filter cartridge

*MUST BE PERFORMED AT LEAST ONCE **EVERY 24 MONTHS** IN ANY EVENT.*

CHECK Trapezoidal belt tension model MD700LI - 706MI/MH/MS/MX - 706 LB/LS/LH/LX **(see chapter 6)**

THE ABOVE MAINTENANCE INTERVAL FOR CHANGING THE ENGINE OIL APPLIES TO THE FIRST OIL CHANGE ONLY. FAILURE TO PERFORM THIS OPERATION WILL INVALIDATE THE WARRANTY.
THE ABOVE MAINTENANCE INTERVAL FOR INSPECTING THE VEE BELT APPLIES TO THE FIRST INTERVAL ONLY.

EVERY 50 HOURS

CHECK (Integrity) Electrolytic zinc **(FOR REPLACING, SEE CAP. 9)**

EVERY 100 HOURS

CHECK (Integrity) sea water pump impeller **(see chapter 6)**

CHECK Trapezoidal belt tension model MD700LI - 706MI/MH/MS/MX - 706 LB/LS/LH/LX **(see chapter 6)**

EVERY 200 HOURS

CHANGE poly-vee belt / trapezoidal belt

*MUST BE PERFORMED AT LEAST ONCE **EVERY 24 MONTHS** IN ANY EVENT.*

CHANGE Impeller rotor water pump (see chapter 6)

*MUST BE PERFORMED AT LEAST ONCE **EVERY 12 MONTHS** IN ANY EVENT.*

CHANGE Engine oil

*MUST BE PERFORMED AT LEAST ONCE **EVERY 12 MONTHS** IN ANY EVENT.*

CHANGE Oil filter cartridge

CHANGE Air filter cartridge

CHANGE Fuel filter cartridge

TIGHTEN Fuel line union screws and nuts

*(THE AIR, OIL AND FUEL FILTER CARTRIDGE MUST BE RENEWED AT LEAST ONCE **EVERY 24 MONTHS**, REGARDLESS OF THE HOURS OF DUTY).*

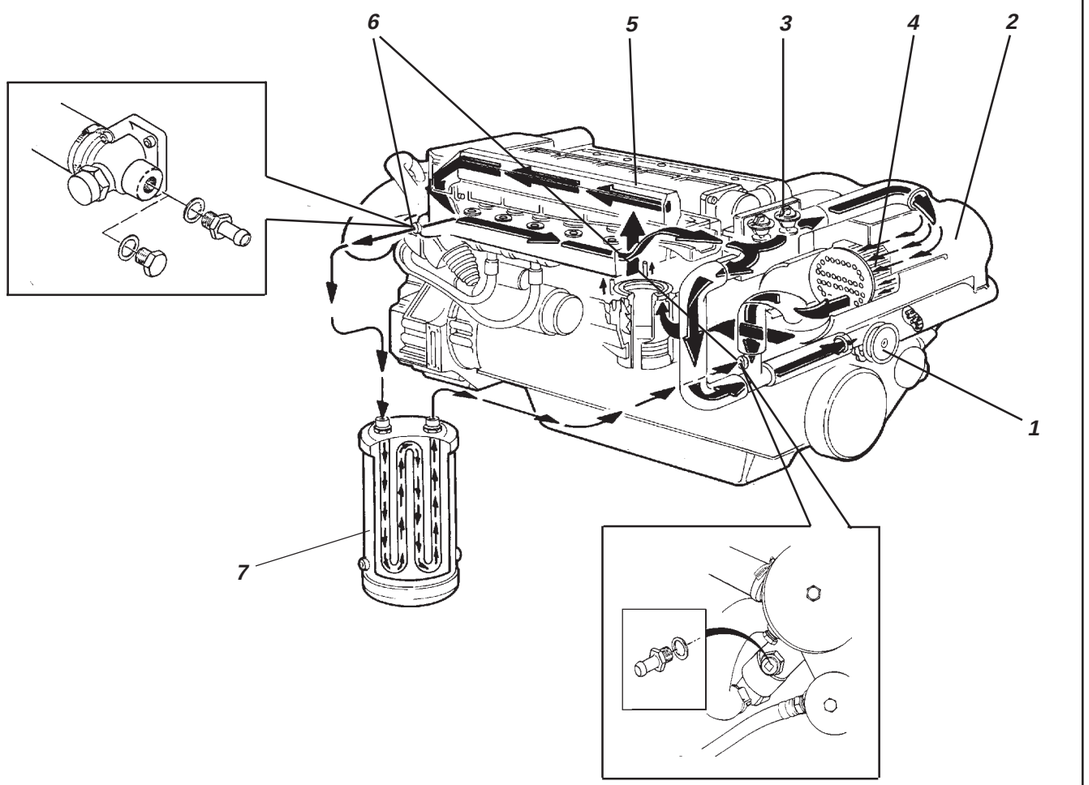
EVERY 600 HOURS

CHANGE Coolant mixture

*(MUST BE PERFORMED AT LEAST ONCE **EVERY 24 MONTHS** IN ANY EVENT).*

SYSTEM DIAGRAMS 4

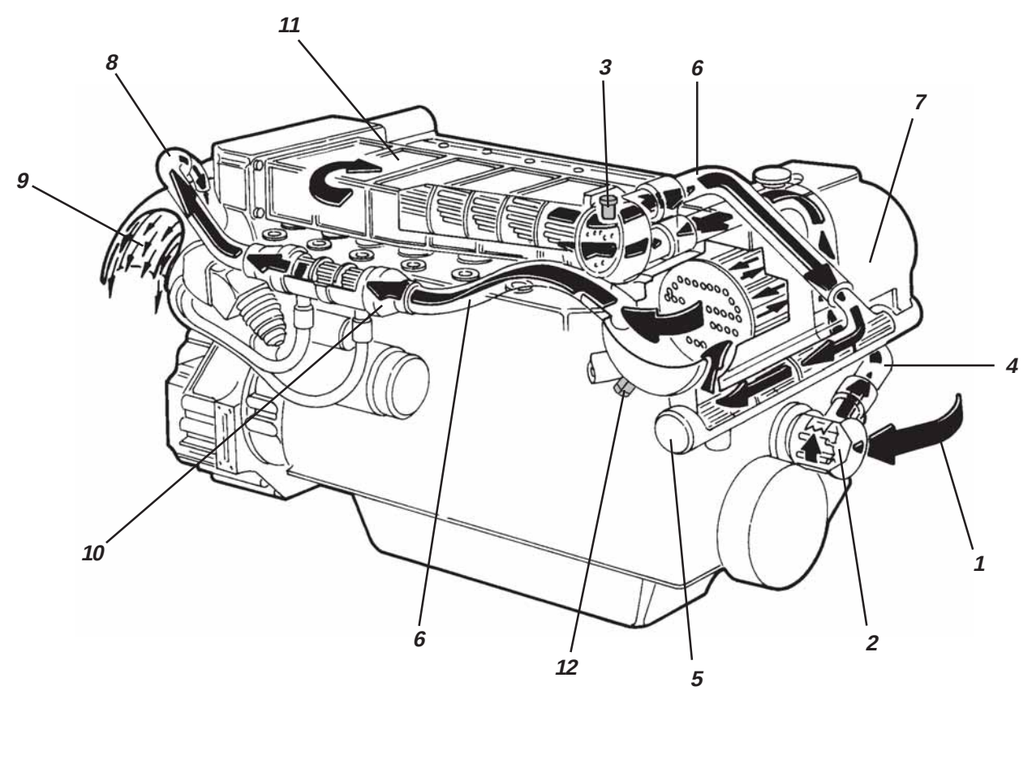
COOLING SYSTEM MD706MI/MH/MS/MX/ - 700LI - 706LB/LS/LH/LX



KEY:

1) Water pump
2) Water/water cooler
3) Thermostat valve
4) Header tank
5) Water recovery pipe
6) Boiler connctions
7) Boiler

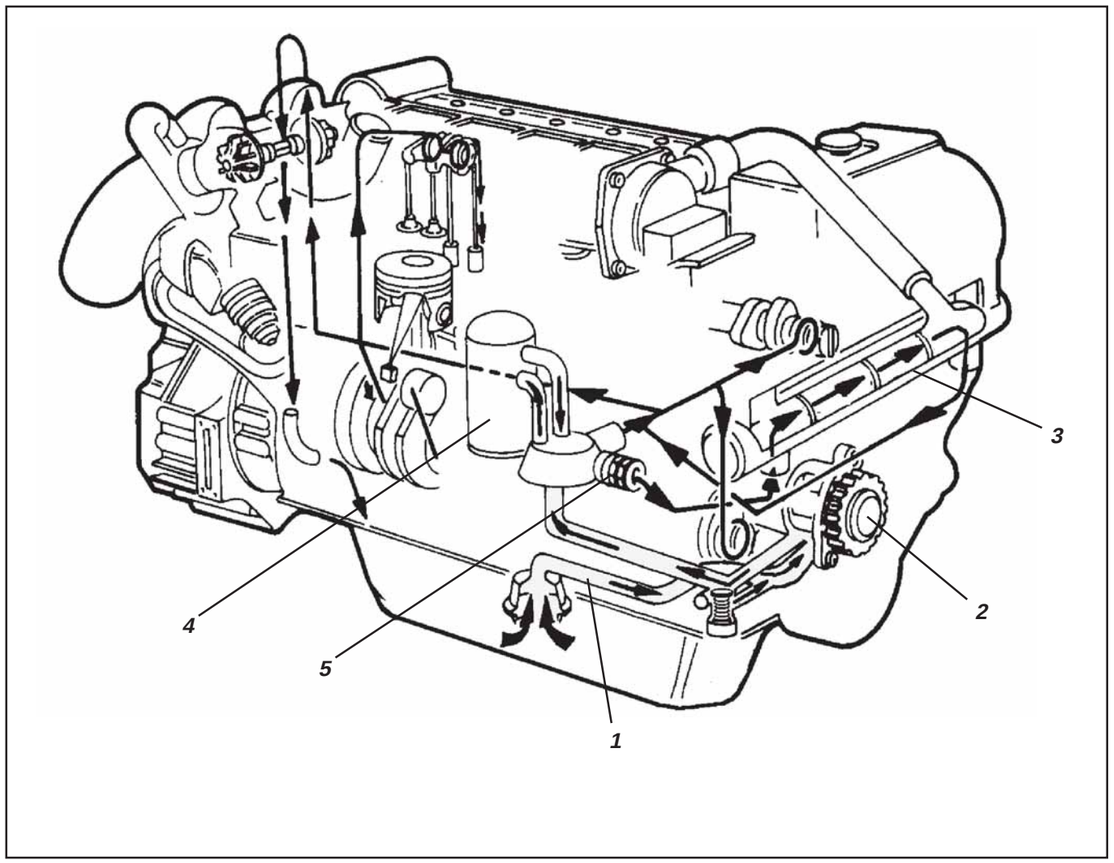
SEA WATER COOLING SYSTEM MD706MI/MH/MS/MX/ - 700LI - 706LB/LS/LH/LX



KEY:

1) Intake connection
2) Sea-water pump
3) Zinc anode
4) Pipe from water pump to intercooler
5) Water/oil cooler
6) Cooler connection pipes
7) Water/water cooler
8) Drain pipe
9) Humid gas discharge hose
10) Reverse gear oil cooler
11) Air/water cooler
12) Zinc anode

LUBRIFICATION SYSTEM

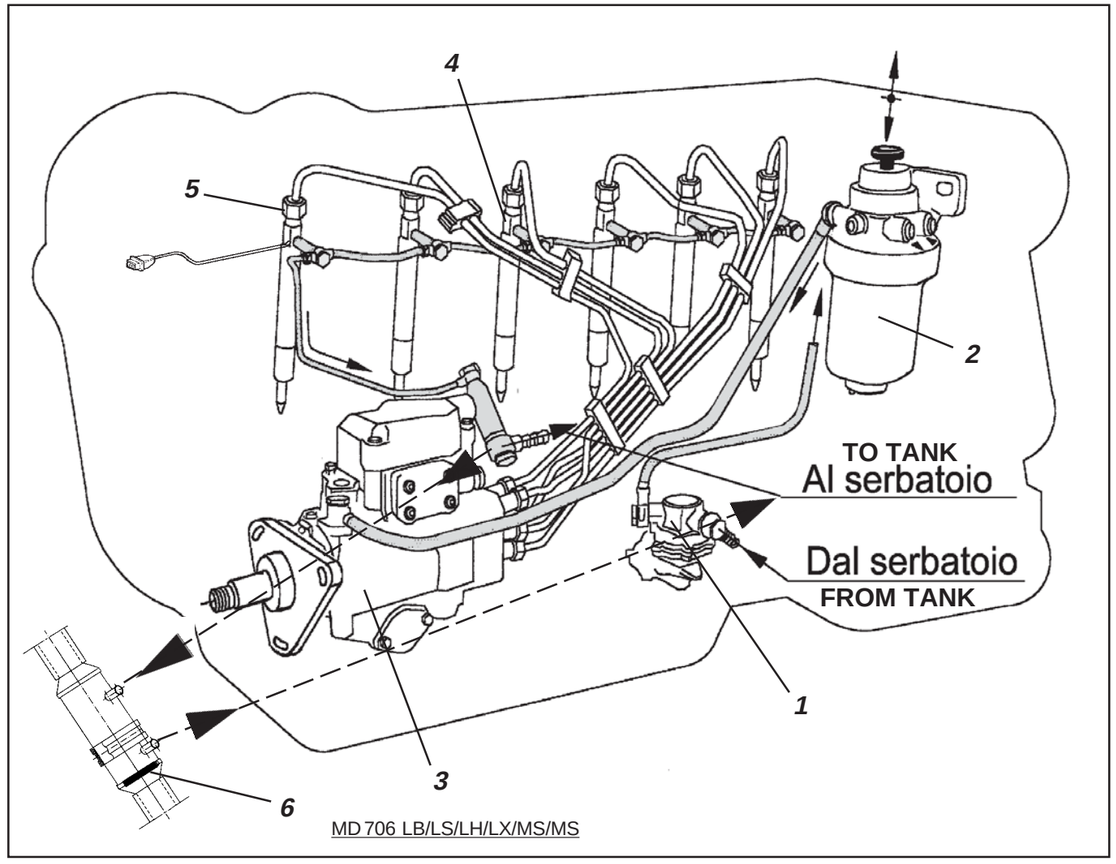


The lubricating oil is forced around the system by a rotor pump and filtered before being sent to the various points requiring lubrication. The oil from the pump is sent through a pressure regulating valve to the filter and then to the crankshaft main bearings, and through external pipes to the rocker arms and the turbocharger. A thermostatic valve in the circuit sends hot oil (90÷100 °C) (194÷212°F) to the water/oil cooler.

KEY:

1) Oil suction pipe
2) Oil pump
3) Oil/water heat exchanger
4) Cartridge
5) Thermostat

FUEL SYSTEM MD706 LB/LS/LH/LX/MS/MX

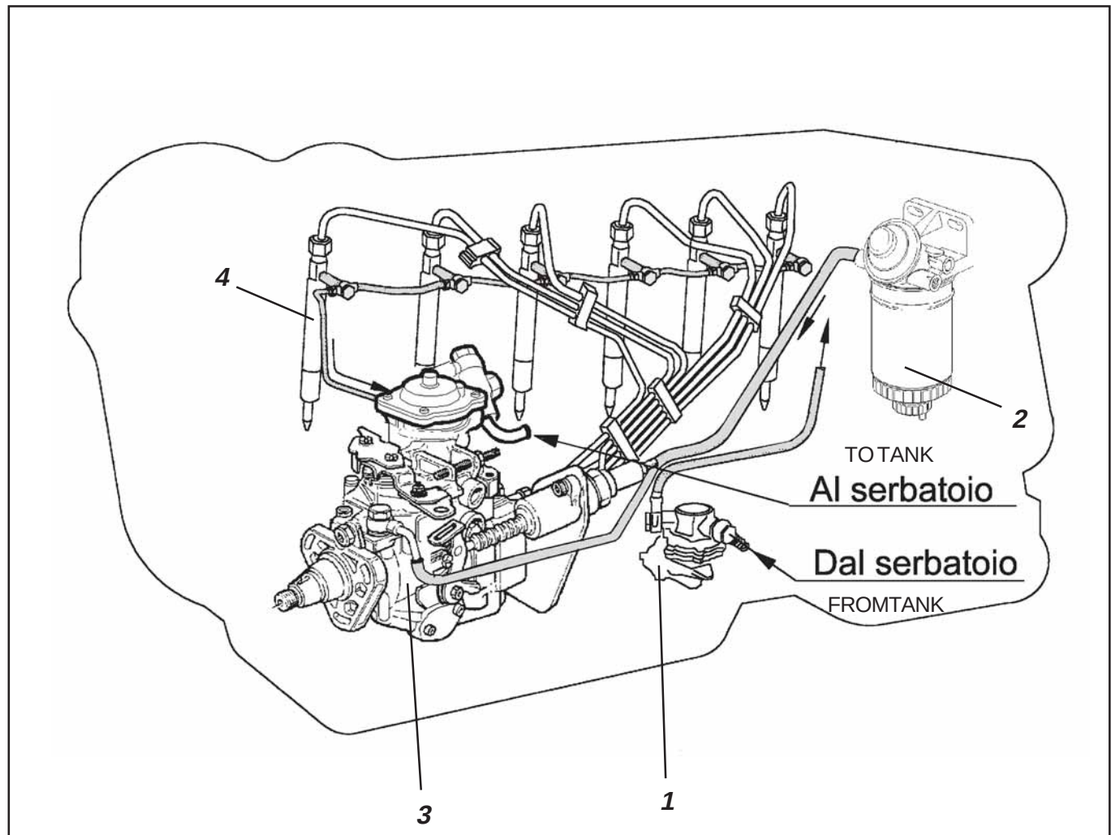


MD 706 LB/LS/LH/LX/MS/MS

KEY:

1) Fuel supply pump
2) Fuel filter
3) Injection pump
4) Std. injectors
5) Electrical injector
6) Fuel exchanger

FUEL SYSTEM (MD 706 MI/MH)



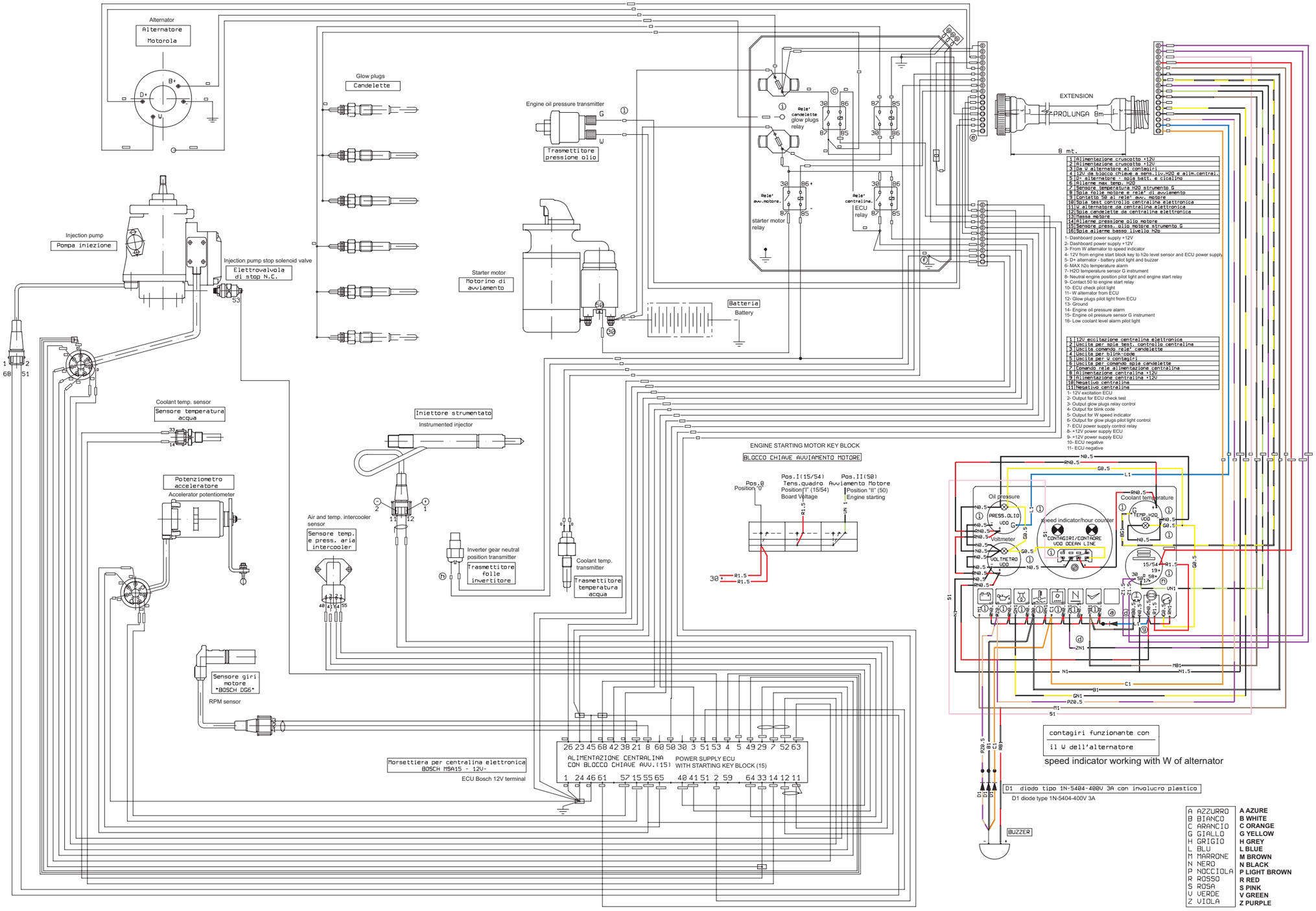
Key:

1) Fuel supply pump
2) Fuel filter
3) Injection pump
4) Standard injectors

OIL, FUEL, COOLANT MIXTURES, ETC. ARE HARMFUL IF INGESTED

ELECTRICAL DIAGRAM

Electrical diagram 12 V MD 700 LI



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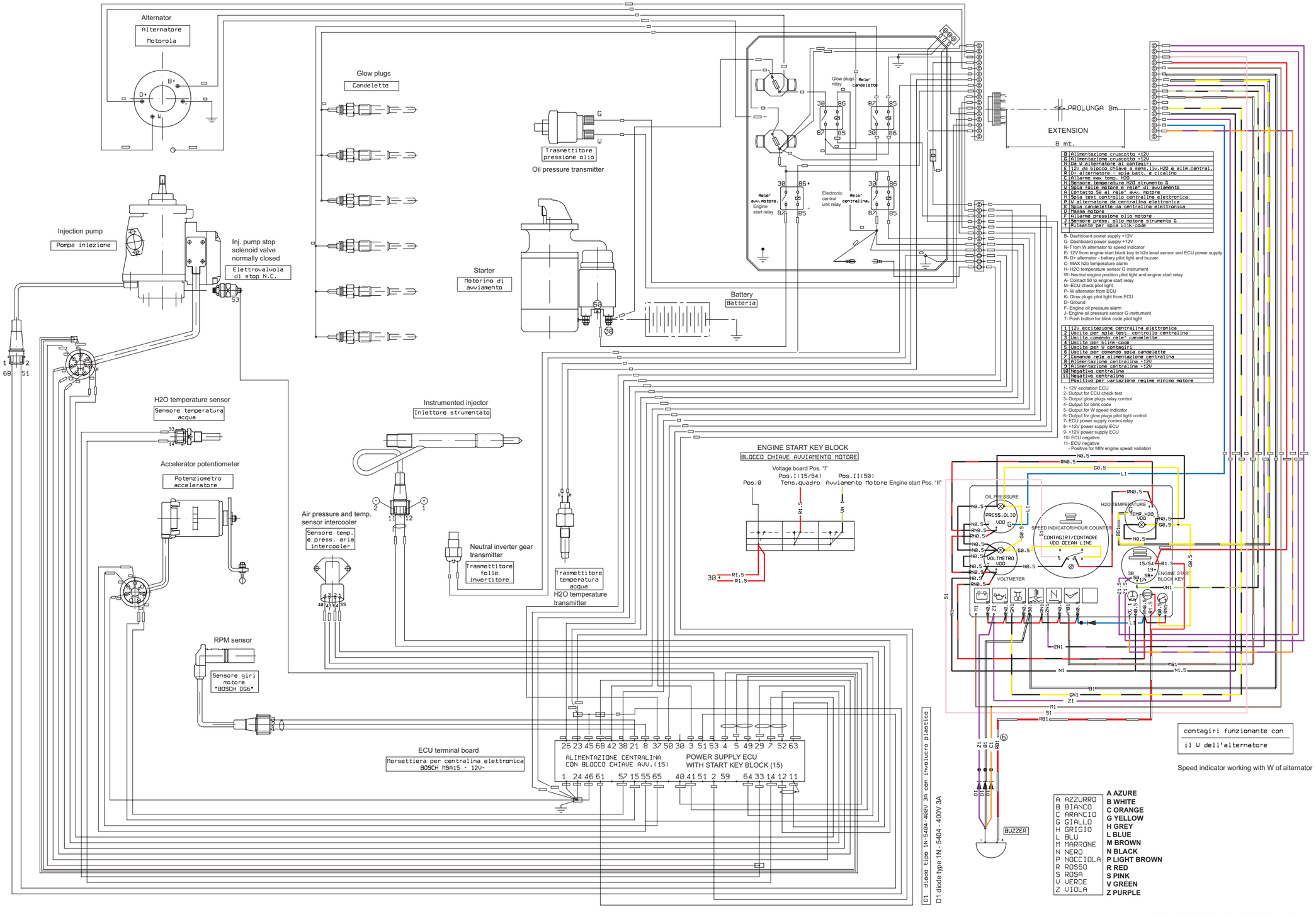
Electrical diagram 12 V MD 706 LB/LS/LH/LX



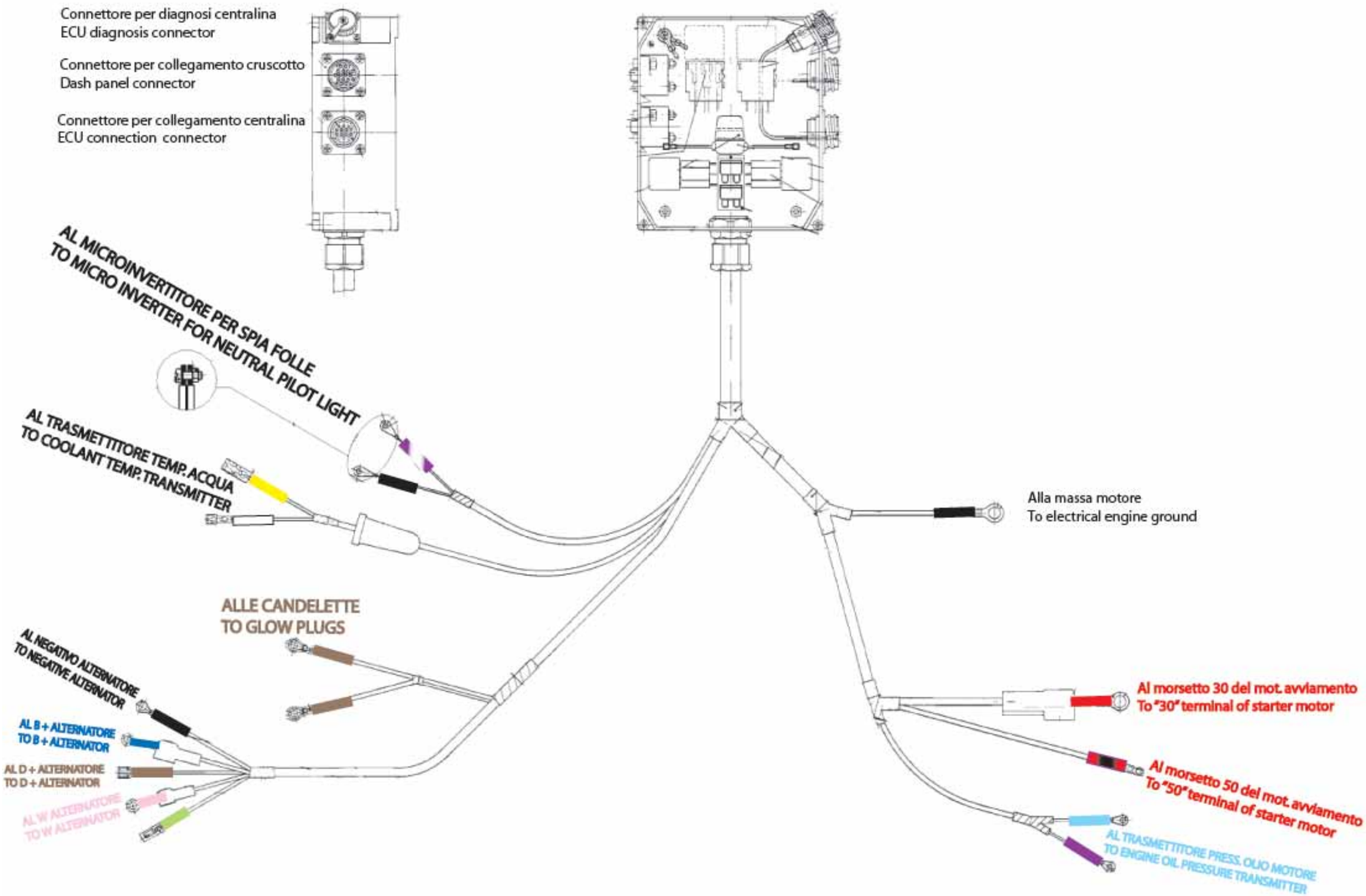
B	Alimentazione cruscotto +12V
G	Alimentazione cruscotto +12V
N	Da W alternatore al contagiri
E	12V da blocco chiave a sens.liv.H2O e alim.central.
R	D+ alternatore - spia batt. e cicalino
C	Allarme max temp. H2O
H	Sensore temperatura H2O strumento G
W	Spia folle motore e rele' di avviamento
A	Contatto 50 al rele' avv. motore
M	Spia test controllo centralina elettronica
P	W alternatore da centralina elettronica
K	Spia candelette da centralina elettronica
D	Massa motore
F	Allarme pressione olio motore
J	Sensore press. olio motore strumento G
T	Pulsante per spia blik-code

B- Dashboard power supply +12V
G- Dashboard power supply +12V
N- From W alternator to speed indicator
E- 12V from engine start block key to h2o level sensor and ECU power supply
R- D+ alternator - battery pilot light and buzzer
C- MAX h2o temperature alarm
H- H2O temperature sensor G instrument
W- Neutral engine position pilot light and engine start relay
A- Contact 50 to engine start relay
M- ECU check pilot light
P- W alternator from ECU
K- Glow plugs pilot light from ECU
D- Ground
F- Engine oil pressure alarm
J- Engine oil pressure sensor G instrument
T- Push button for blink code pilot light

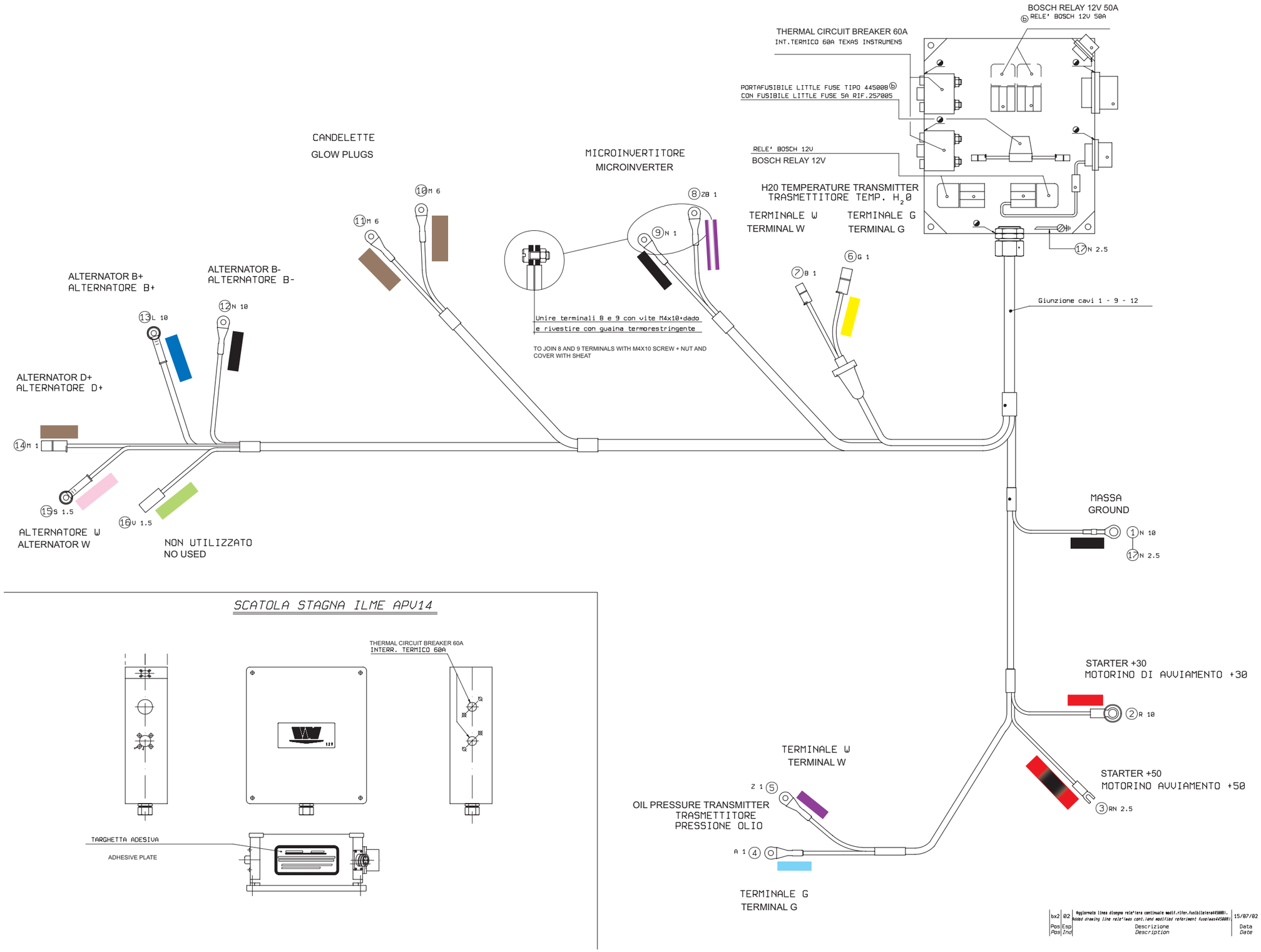
1	12V eccitazione centralina elettronica
2	Uscita per spia test. controllo centralina
3	Uscita comando rele' candelette
4	Uscita per blink-code
5	Uscita per W contagiri
6	Uscita per comando spia candelette
7	Comando rele alimentazione centralina
8	Alimentazione centralina +12V
9	Alimentazione centralina +12V
10	Negativo centralina
11	Negativo centralina - Positivo per variazione regime minimo motore

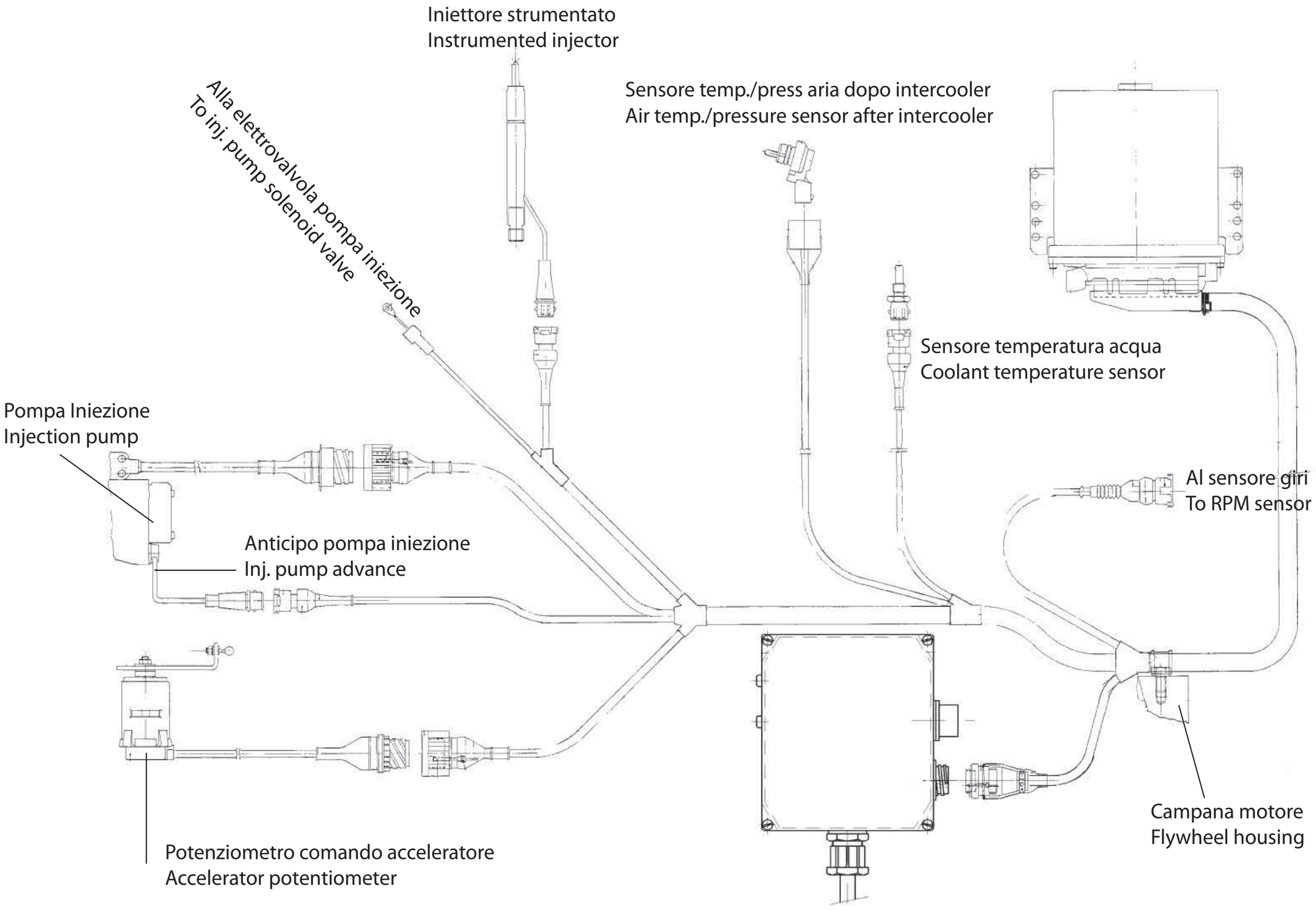
1- 12V excitation ECU
2- Output for ECU check test
3- Output glow plugs relay control
4- Output for blink code
5- Output for W speed indicator
6- Output for glow plugs pilot light control
7- ECU power supply control relay
8- +12V power supply ECU
9- +12V power supply ECU
10- ECU negative
11- ECU negative - Positive for MIN engine speed variation

Engine wiring harness MD 700 LI



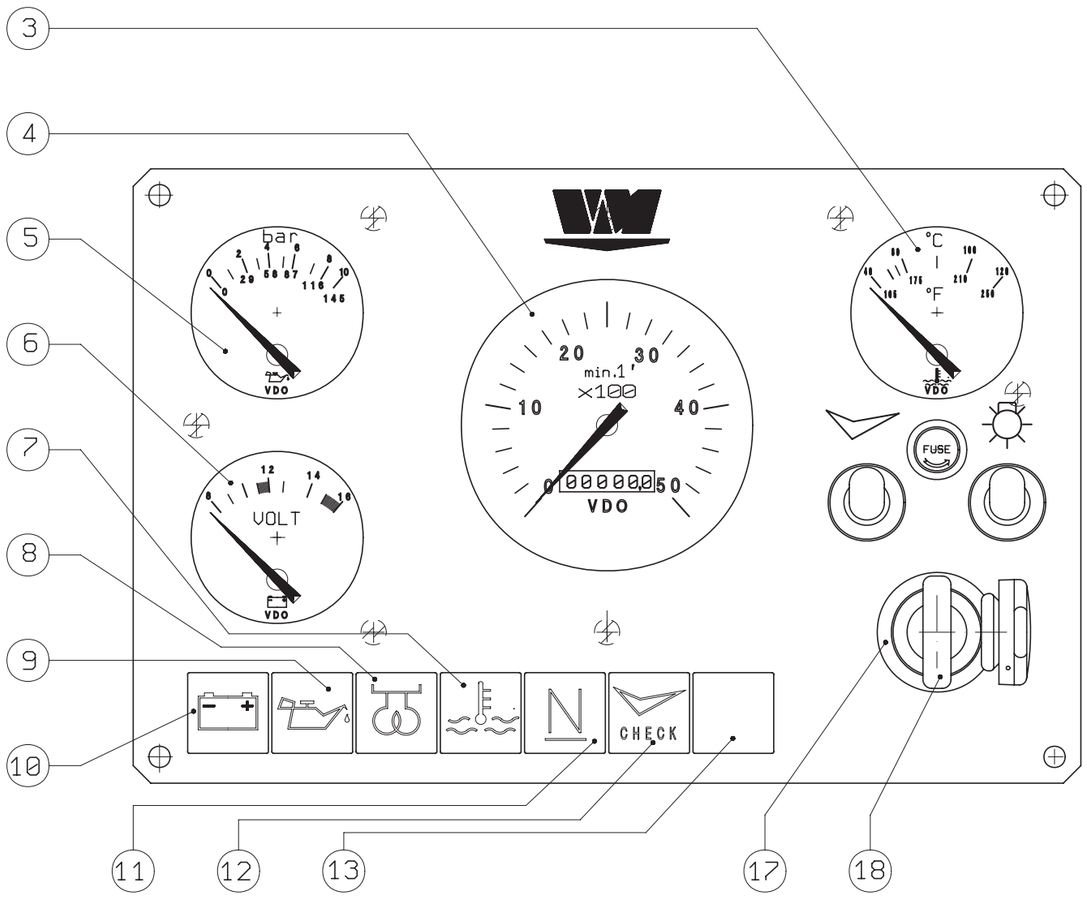
Engine wiring harness MD 706 LB/LS/LH/LX




Iniettore strumentato
Instrumented injector
Alla elettrovalvola pompa iniezione
To inj. pump solenoid valve
Sensore temp./press aria dopo intercooler
Air temp./pressure sensor after intercooler
Sensore temperatura acqua
Coolant temperature sensor
Pompa Iniezione
Injection pump
Anticipo pompa iniezione
Inj. pump advance
Al sensore giri
To RPM sensor
Potenziometro comando acceleratore
Accelerator potentiometer
Campana motore
Flywheel housing

Ed. 6 - 04-2002

Engine dashboard 12 V MD 700 LI - MD 706 LB/LH/LS/LX



CRUSCOTTO con nuovi strumenti V.D.O.
tipo:"OCEAN LINE"
Eletric panel complete with new V.D.O. instruments Type:"OCEAN LINE"

Cruscotto per impianti a 12V.
12V. dashboard

TARATURA STATICA CONTAGIRI
Con "FUNZIONE PULSE"
Impostare nel diplay il N°13.00

3 Termometro temp. H2O	3 Coolant temperature thermometer
4 Contagiri/Contaore	4 Speed indicator/Hour counter
5 Pressione olio motore	5 Engine oil pressure
6 Voltmetro	6 Voltmeter
7 Spia temp. H2O motore	7 Coolant temperature pilot light
8 Spia accensione candelette	8 Glow plugs pilot light
9 Spia MIN press. olio motore	9 MIN oil pressure pilot light
10 Spia carica batteria	10 Battery charge pilot light
11 Spia pos. folle invertitore	11 Neutral pos. inverter gear pilot light
12 Spia diagnosi centralina	12 Electric central unit diagnosis pilot light
13 Spia a disposizione	13 Pilot light available
17 Blocco chiave avviamento	17 Start key block
18 Chiave avviamento	18 Start key

01	Eliminata pellicola ant;modif.spess.4 mm (era 3mm).sigla HDS (era HDP); Aggiunto cod.VM ai part.n°48,24,16,13,12,11,10,9,8,7;Modif. colore nero al particol. n°2 (era grigio) e aggiunto rif. la Punta.Aggior. nota marcatura (era medinate fotoincis.);agg.tab. n° caratt.report e crit ed assegnato codice definitivo (era A0540049A).	23-05-02

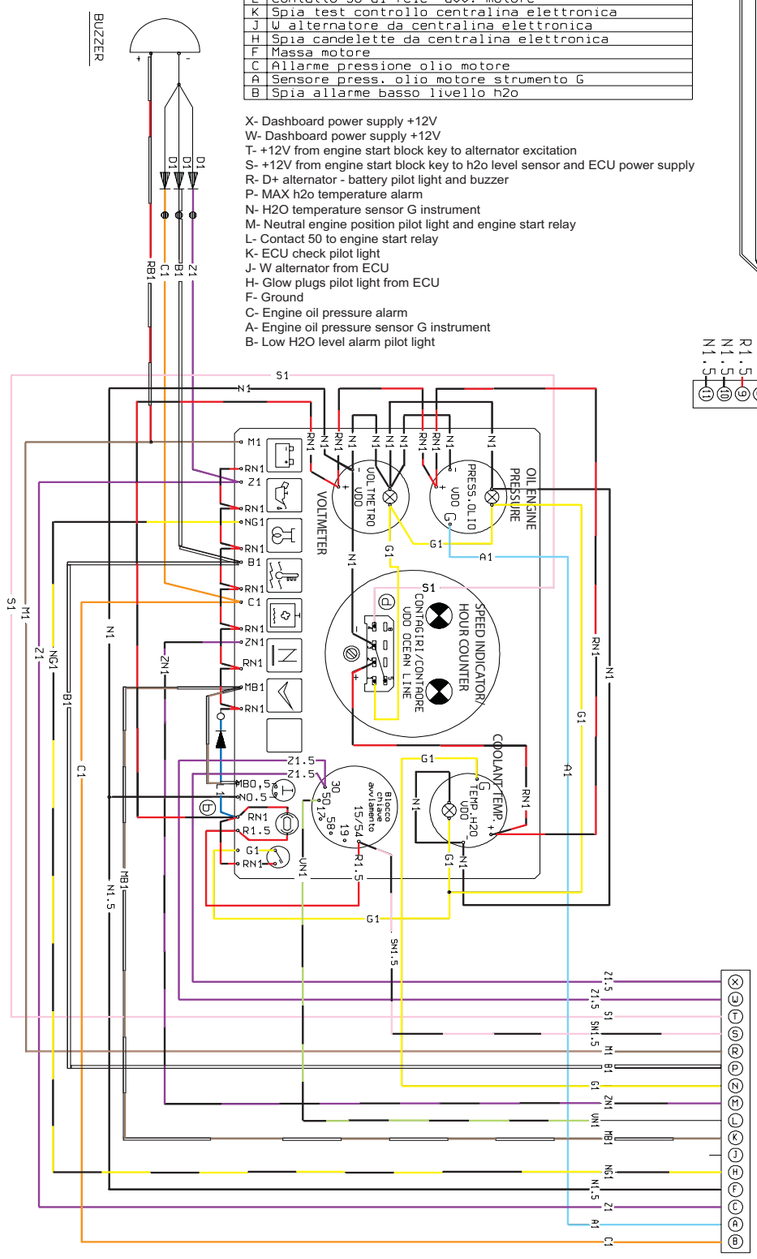
Flying bridge electrical diagram 12 V MD 700 LI

X	Alimentazione cruscotto +12V
W	Alimentazione cruscotto +12V
T	+12V da blocco chiave ad eccitazione alternatore
S	12V da blocco chiave a sens.liv.H2O e alim.central.
R	D+ alternatore - spia batt. e cicalino
P	Allarme max temp. H2O
N	Sensore temperatura H2O strumento G
M	Spia folle motore e rele' di avviamento
L	Contatto 50 al rele' avv. motore
K	Spia test controllo centralina elettronica
J	W alternatore da centralina elettronica
H	Spia candelette da centralina elettronica
F	Massa motore
C	Allarme pressione olio motore
A	Sensore press. olio motore strumento G
B	Spia allarme basso livello h2o

X- Dashboard power supply +12V
W- Dashboard power supply +12V
T- +12V from engine start block key to alternator excitation
S- +12V from engine start block key to h2o level sensor and ECU power supply
R- D+ alternator - battery pilot light and buzzer
P- MAX h2o temperature alarm
N- H2O temperature sensor G instrument
M- Neutral engine position pilot light and engine start relay
L- Contact 50 to engine start relay
K- ECU check pilot light
J- W alternator from ECU
H- Glow plugs pilot light from ECU
F- Ground
C- Engine oil pressure alarm
A- Engine oil pressure sensor G instrument
B- Low H2O level alarm pilot light

1	12V eccitazione centralina elettronica
2	Uscita per spia test. controllo centralina
3	Uscita comando rele' candelette
4	Uscita per blink-code
5	Uscita per W contagiri
6	Uscita per comando spia candelette
7	Comando rele alimentazione centralina
8	Alimentazione centralina +12V
9	Alimentazione centralina +12V
10	Negativo centralina
11	Negativo centralina

1- 12V excitation ECU
2- Output for ECU pilot light check test
3- Output glow plugs relay control
4- Output for blink code
5- Output for W speed indicator
6- Output for glow plugs pilot light control
7- ECU power supply control relay
8- +12V power supply ECU
9- +12V power supply ECU
10- ECU negative
11- ECU negative



Flying bridge electrical diagram 12 V MD 706 LB/LS/LH/LX - MD706MS/MX

B	Alimentazione cruscotto +12V
G	Alimentazione cruscotto +12V
N	+12V da blocco chiave ad eccitazione alternatore
E	12V da blocco chiave a sens.liv.H2O e alim.central.
R	D+ alternatore - spia batt. e cicalino
C	Allarme max temp. H2O
H	Sensore temperatura H2O strumento G
W	Spia folle motore e rele' di avviamento
A	Contatto 50 al rele' avv. motore
M	Spia test controllo centralina elettronica
P	W alternatore da centralina elettronica
K	Spia candelette da centralina elettronica
D	Massa motore
F	Allarme pressione olio motore
J	Sensore press. olio motore strumento G
T	Spia allarme basso livello H2O
S	Cavo disponibile nella prolunga

B- Dashboard power supply +12V
G- Dashboard power supply +12V
N- +12V from engine start block key to alternator excitation
E- +12V from engine start block key to h2o level sensor and ECU power supply
R- D+ alternator - battery pilot light and buzzer
C- MAX h2o temperature alarm
H- H2O temperature sensor G instrument
W- Neutral engine position pilot light and engine start relay
A- Contact 50 to engine start relay
M- ECU check pilot light
P- W alternator from ECU
K- Glow plugs pilot light from ECU
D- Ground
F- Engine oil pressure alarm
J- Engine oil pressure sensor G instrument
T- Low H2O level alarm pilot light
S- Available cable into extension

1	12V eccitazione centralina elettronica
2	Uscita per spia test. controllo centralina
3	Uscita comando rele' candelette
4	Uscita per blink-code
5	Uscita per W contagiri
6	Uscita per comando spia candelette
7	Comando rele alimentazione centralina
8	Alimentazione centralina +12V
9	Alimentazione centralina +12V
10	Negativo centralina
11	Negativo centralina
12	Positivo per variazione regime minimo motore

1- 12V excitation ECU
2- Output for ECU pilot light check test
3- Output glow plugs relay control
4- Output for blink code
5- Output for W speed indicator
6- Output for glow plugs pilot light control
7- ECU power supply control relay
8- +12V power supply ECU
9- +12V power supply ECU
10- ECU negative
11- ECU negative
12- Positive for MIN engine speed variation

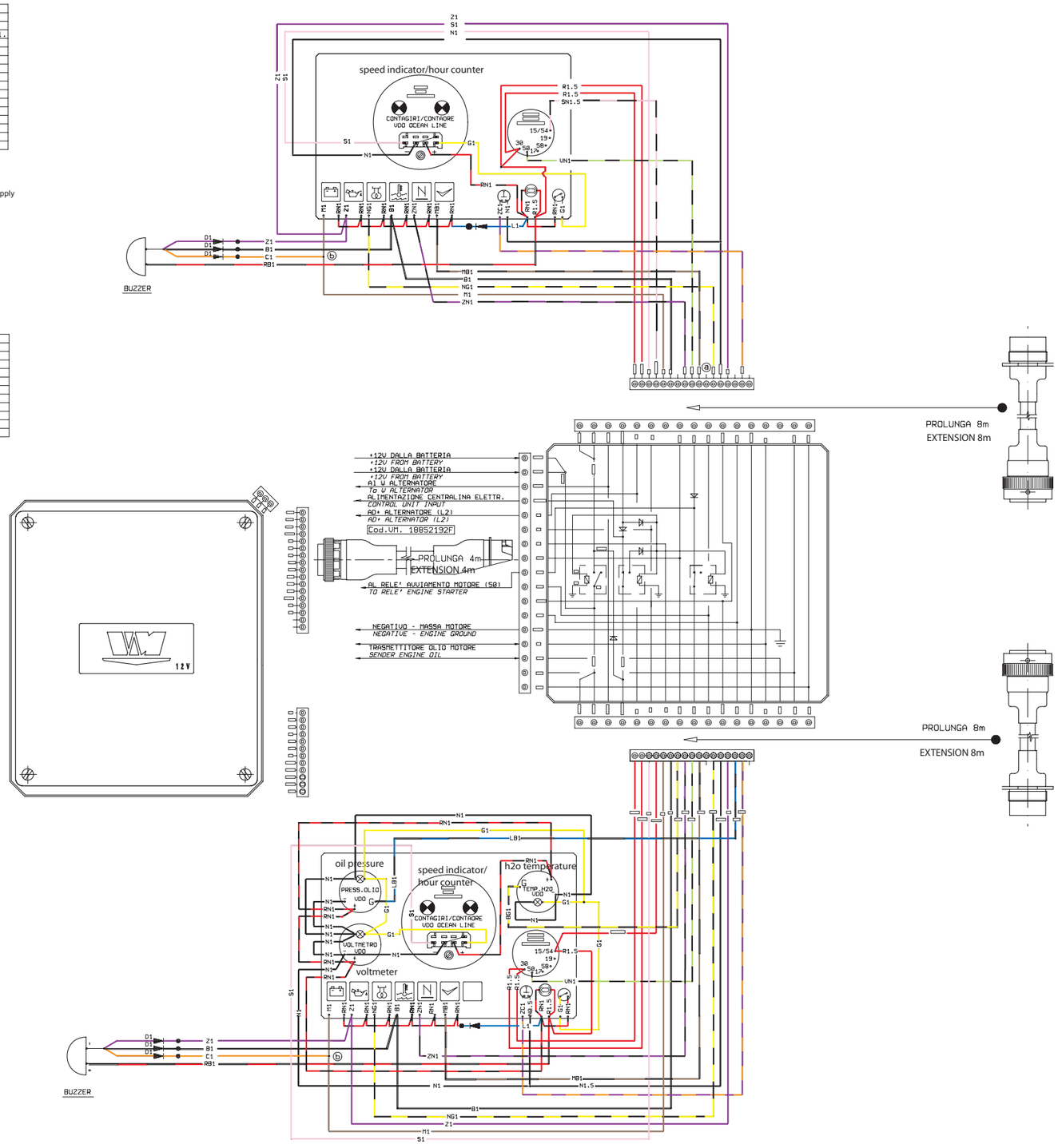


TABELLA COLORI
Color tablet

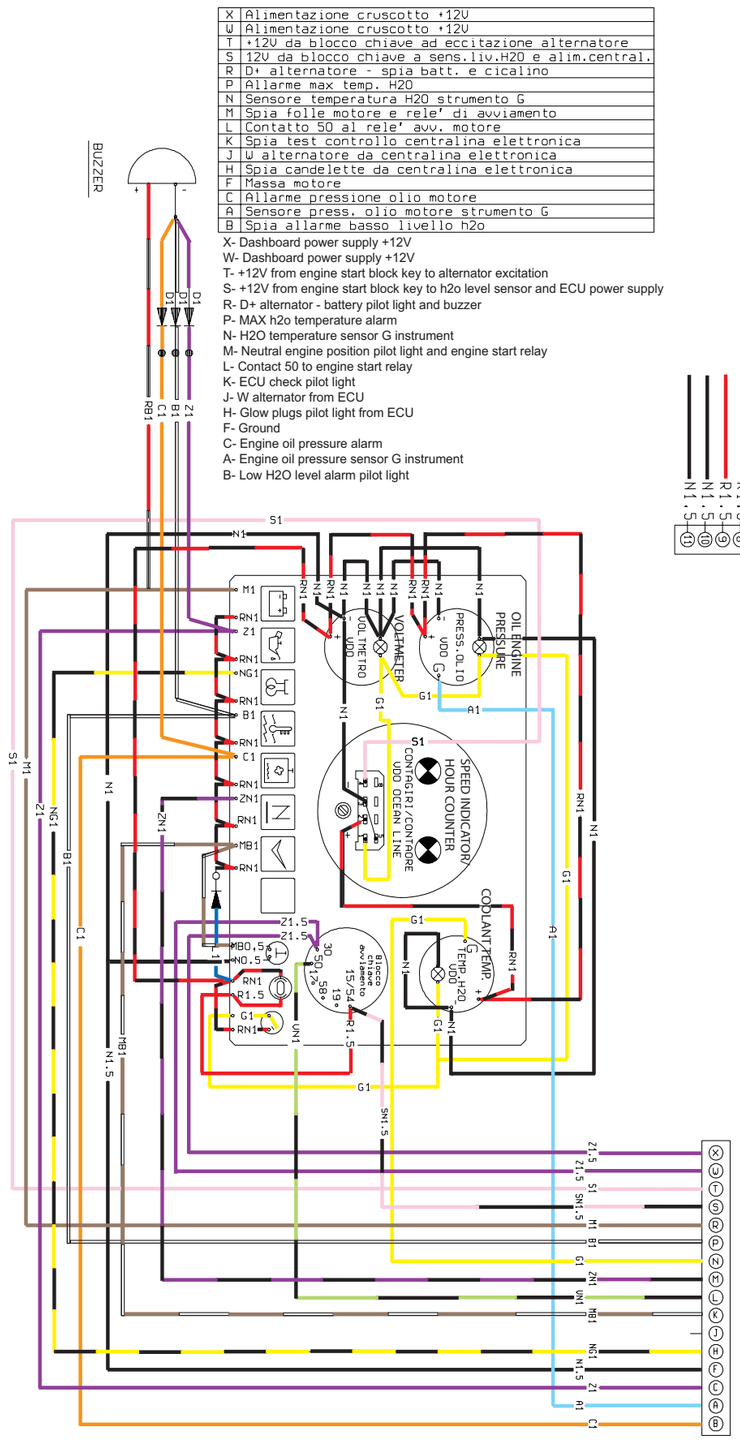
A AZZURRO	**A AZURE**
B BIANCO	**B WHITE**
C ARANCIO	**C ORANGE**
G GIALLO	**G YELLOW**
H GRIGIO	**H GREY**
L BLU	**L BLUE**
M MARRONE	**M BROWN**
N NERO	**N BLACK**
P NOCCIOLA	**P LIGHT BROWN**
R ROSSO	**R RED**
S ROSA	**S PINK**
V VERDE	**V GREEN**
Z VIOLA	**Z PURPLE**

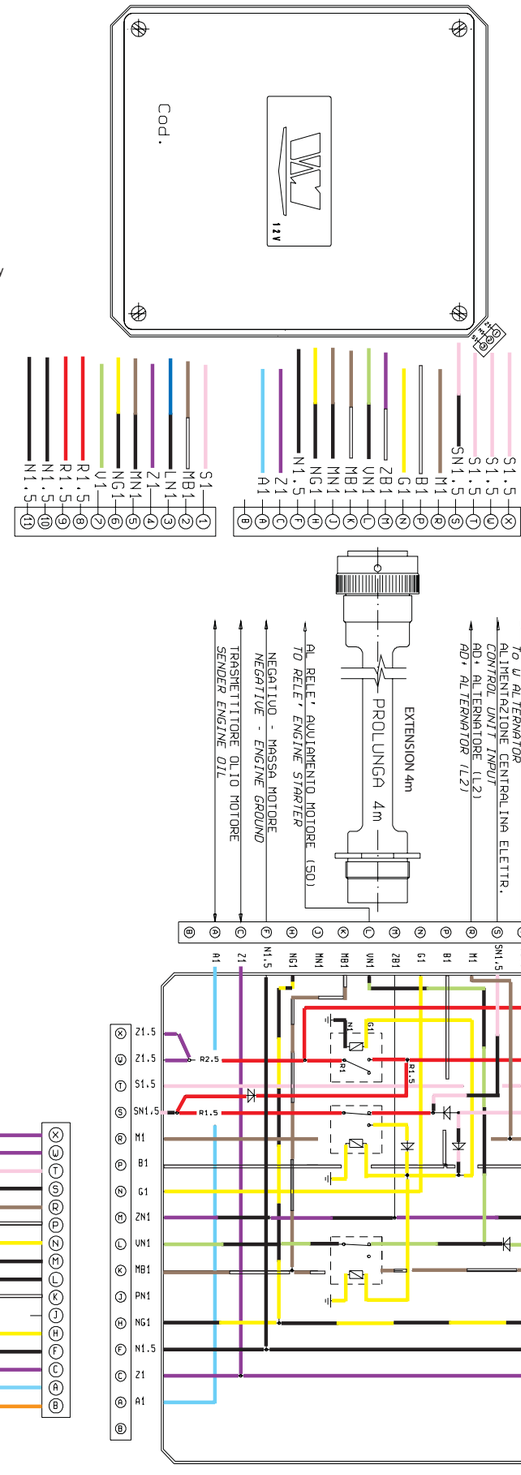
02	Aggiunto filo C1 da buzzer a filo M1	02/07/03
Esp *Ind*	Descrizione *Description*	Data *Date*

Flying bridge electrical diagram 12 V MD 706 MI/MH

X	Alimentazione cruscotto +12V
W	Alimentazione cruscotto +12V
T	+12V da blocco chiave ad eccitazione alternatore
S	12V da blocco chiave a sens.liv.H2O e alim.central.
R	D+ alternatore - spia batt. e cicalino
P	Allarme max temp. H2O
N	Sensore temperatura H2O strumento G
M	Spia folle motore e rele' di avviamento
L	Contatto 50 al rele' avv. motore
K	Spia test controllo centralina elettronica
J	W alternatore da centralina elettronica
H	Spia candelette da centralina elettronica
F	Massa motore
C	Allarme pressione olio motore
A	Sensore press. olio motore strumento G
B	Spia allarme basso livello h2o

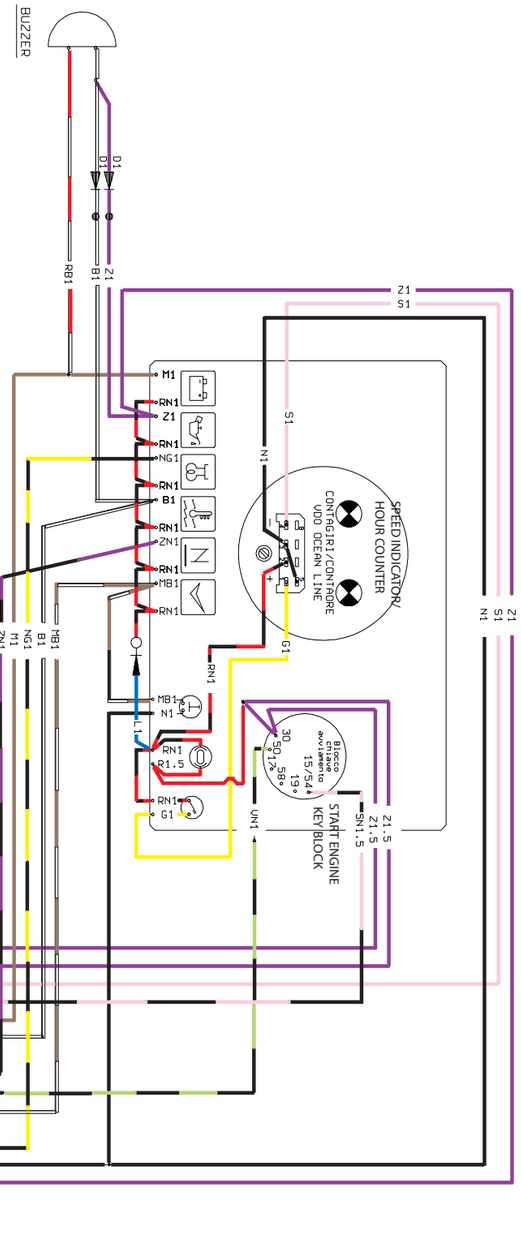
X- Dashboard power supply +12V
W- Dashboard power supply +12V
T- +12V from engine start block key to alternator excitation
S- +12V from engine start block key to h2o level sensor and ECU power supply
R- D+ alternator - battery pilot light and buzzer
P- MAX h2o temperature alarm
N- H2O temperature sensor G instrument
M- Neutral engine position pilot light and engine start relay
L- Contact 50 to engine start relay
K- ECU check pilot light
J- W alternator from ECU
H- Glow plugs pilot light from ECU
F- Ground
C- Engine oil pressure alarm
A- Engine oil pressure sensor G instrument
B- Low H2O level alarm pilot light





1	12V eccitazione centralina elettronica
2	Uscita per spia test. controllo centralina
3	Uscita comando rele' candelette
4	Uscita per blink-code
5	Uscita per W contagiri
6	Uscita per comando spia candelette
7	Comando rele alimentazione centralina
8	Alimentazione centralina +12V
9	Alimentazione centralina +12V
10	Negativo centralina
11	Negativo centralina

1- 12V excitation ECU
2- Output for ECU pilot light check test
3- Output glow plugs relay control
4- Output for blink code
5- Output for W speed indicator
6- Output for glow plugs pilot light control
7- ECU power supply control relay
8- +12V power supply ECU
9- +12V power supply ECU
10- ECU negative
11- ECU negative

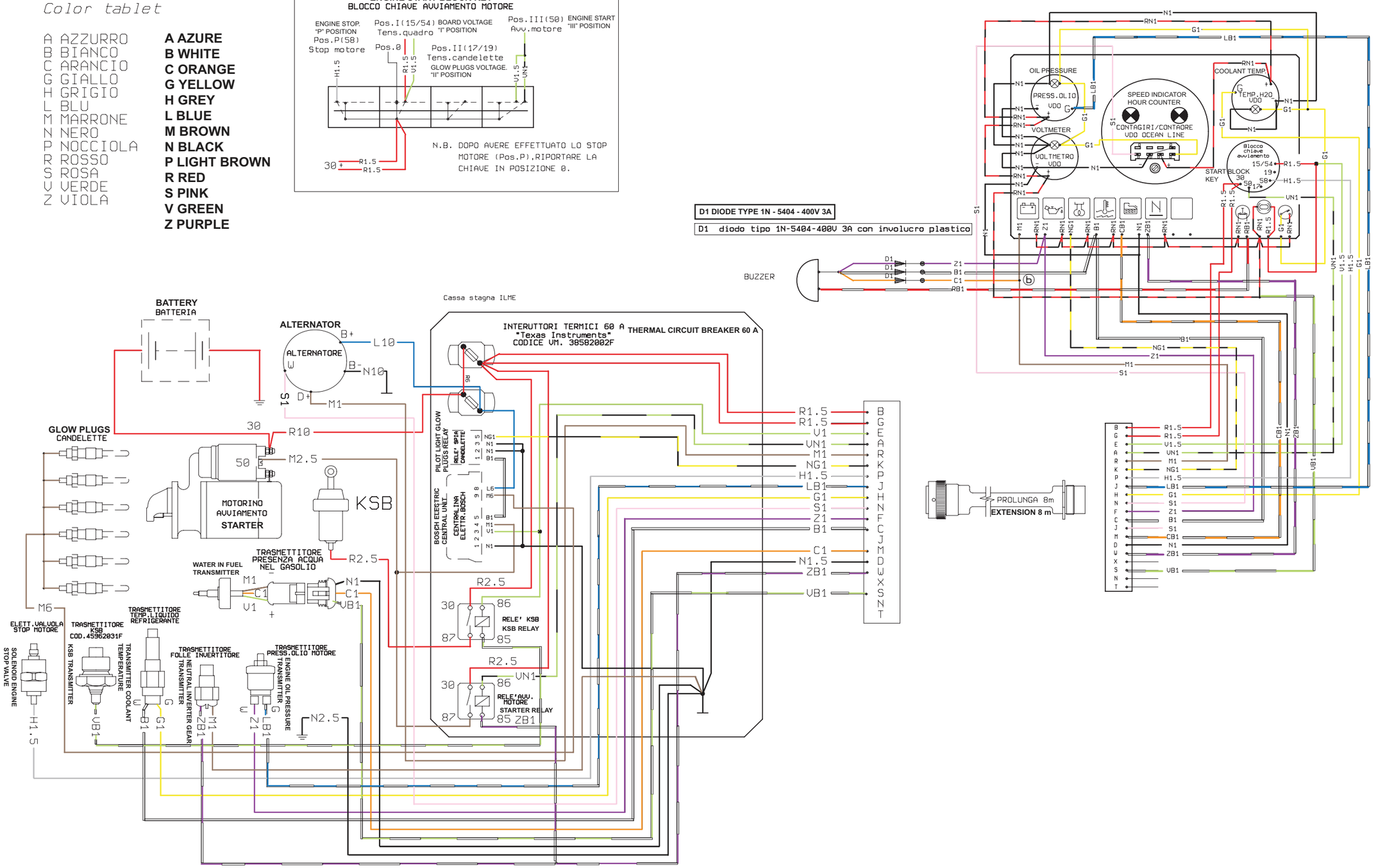


06-2001

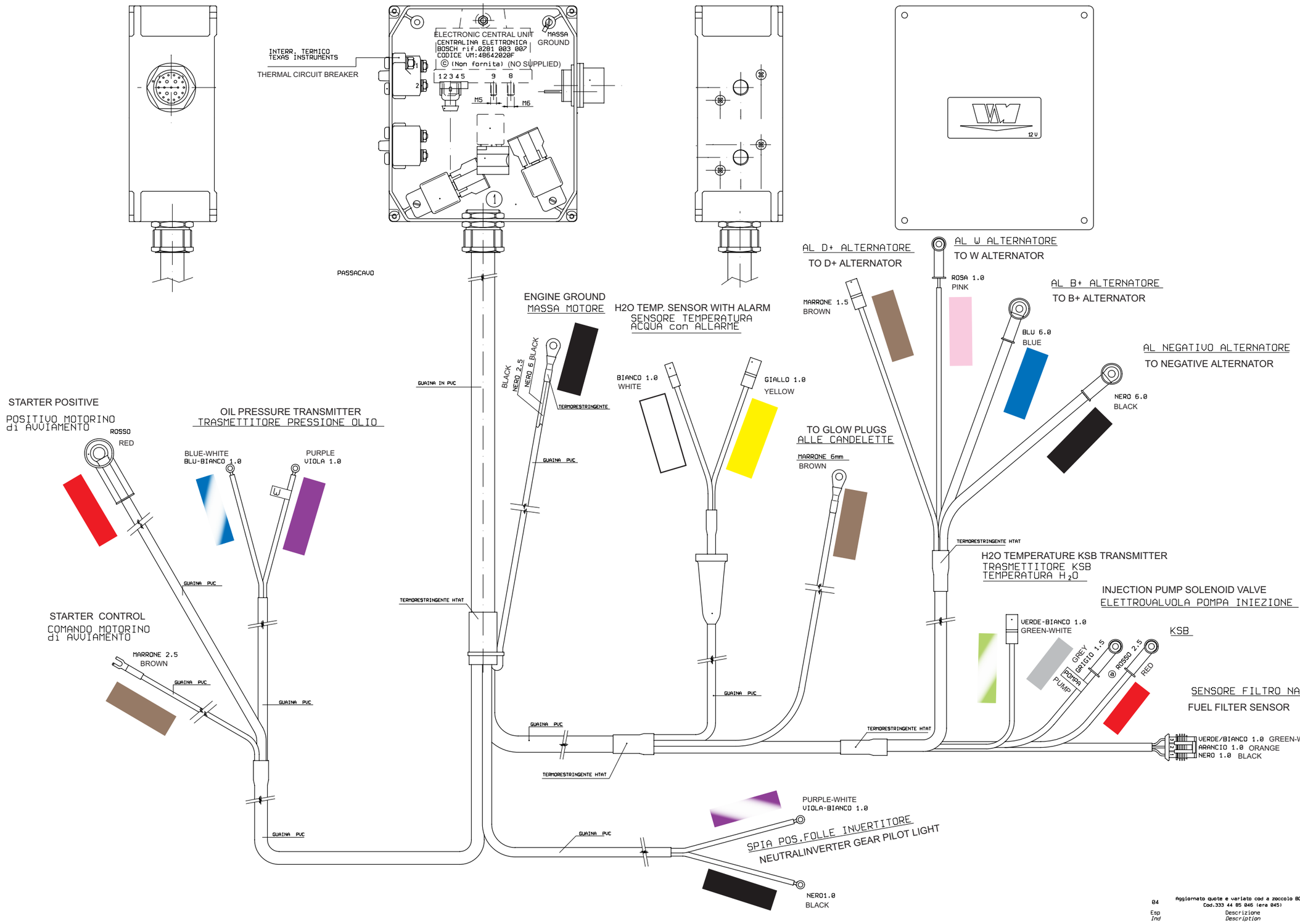
Electrical diagram 12 V MD 706 MI/MH/MS/MX

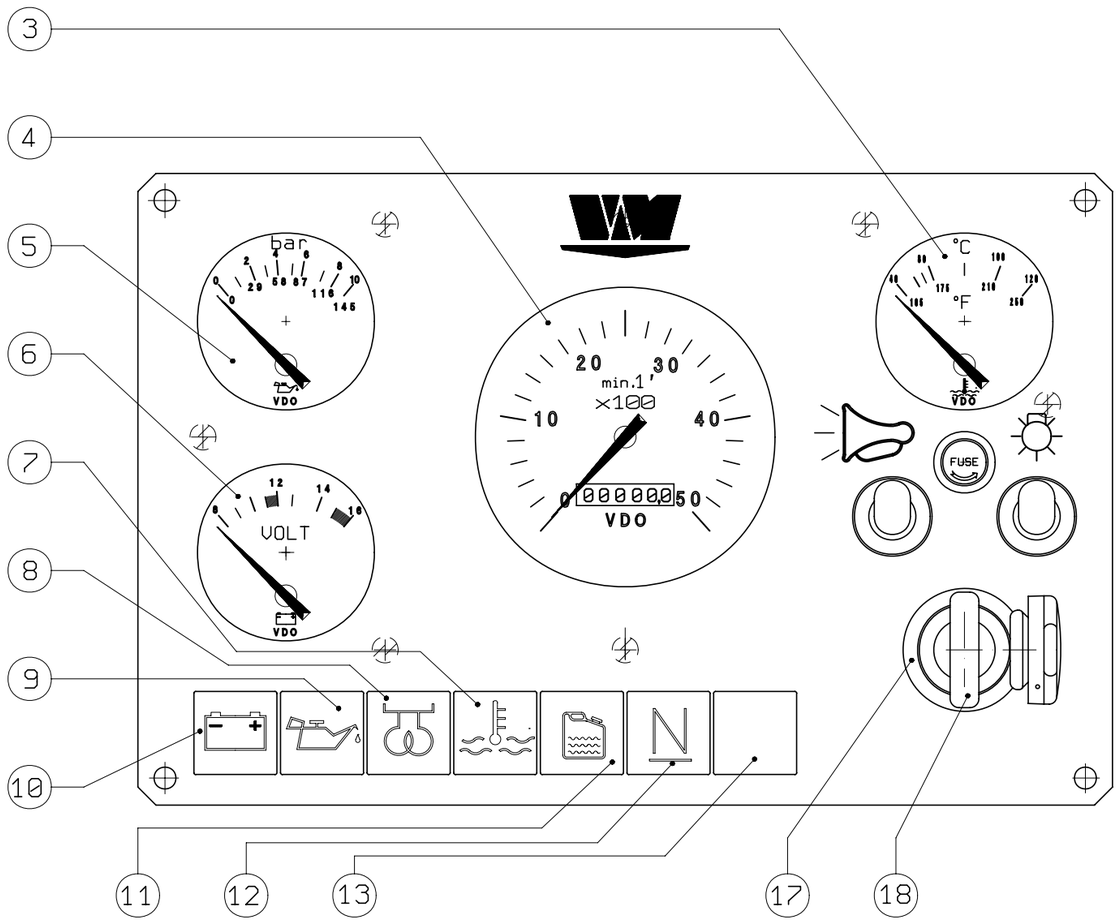
TABELLA COLORI
Color tablet

A AZZURRO	**A AZURE**
B BIANCO	**B WHITE**
C ARANCIO	**C ORANGE**
G GIALLO	**G YELLOW**
H GRIGIO	**H GREY**
L BLU	**L BLUE**
M MARRONE	**M BROWN**
N NERO	**N BLACK**
P NOCCIOLA	**P LIGHT BROWN**
R ROSSO	**R RED**
S ROSA	**S PINK**
V VERDE	**V GREEN**
Z VIOLA	**Z PURPLE**



Engine wiring harness 12 V MD 706 MI/MH/MS/MX





Cruscotto per impianti a 12V.

12V. dashboard

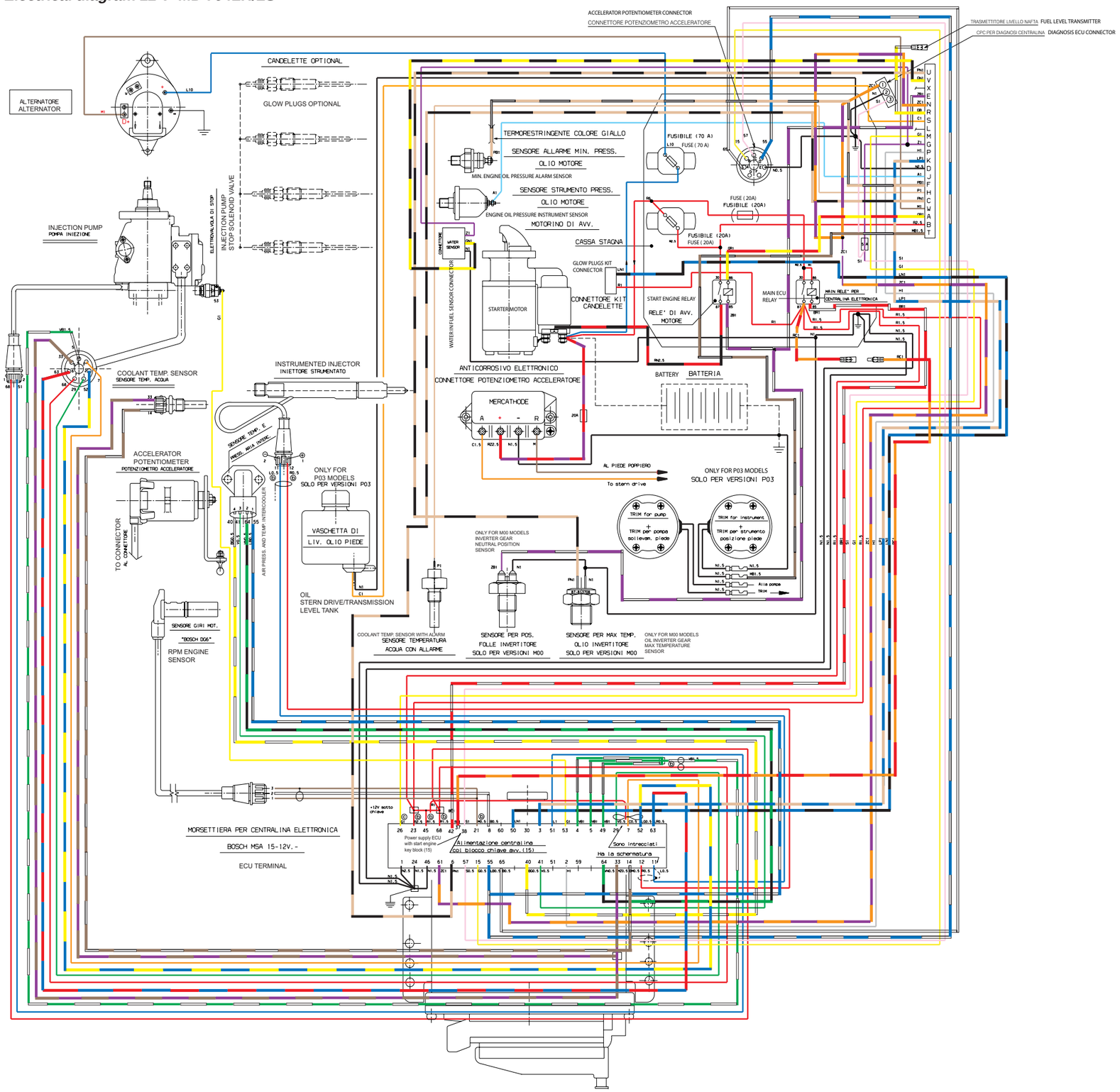
CRUSCOTTO con nuovi strumenti V.D.O.
tipo:"OCEAN LINE"

Eletric panel complete with new V.D.O. instruments Type:"OCEAN LINE"

3 Termometro temp. H2O	3 Coolant temperature thermometer
4 Contagiri/Contaore	4 Speed indicator/Hour counter
5 Pressione olio motore	5 Engine oil pressure
6 Voltmetro	6 Voltmeter
7 Spia temp. H2O motore	7 Coolant temperature pilot light
8 Spia accensione candelette	8 Glow plugs pilot light
9 Spia MIN press. olio motore	9 MIN oil pressure pilot light
10 Spia carica batteria	10 Battery charge pilot light
11 Spia presenza H2O in gasolio	11 Water in fuel pilot light
12 Spia pos. folle invertitore	12 Neutral pos. inverter gear pilot light
13 Spia a disposizione	13 Pilot light available
17 Blocco chiave avviamento	17 Start key block
18 Chiave avviamento	18 Start key

01	Assegnato codice definitivo (era A8850888A). *Assigned definitive code (was A8850888A).*	14/01/03
Esp *Ind*		Data *Date*

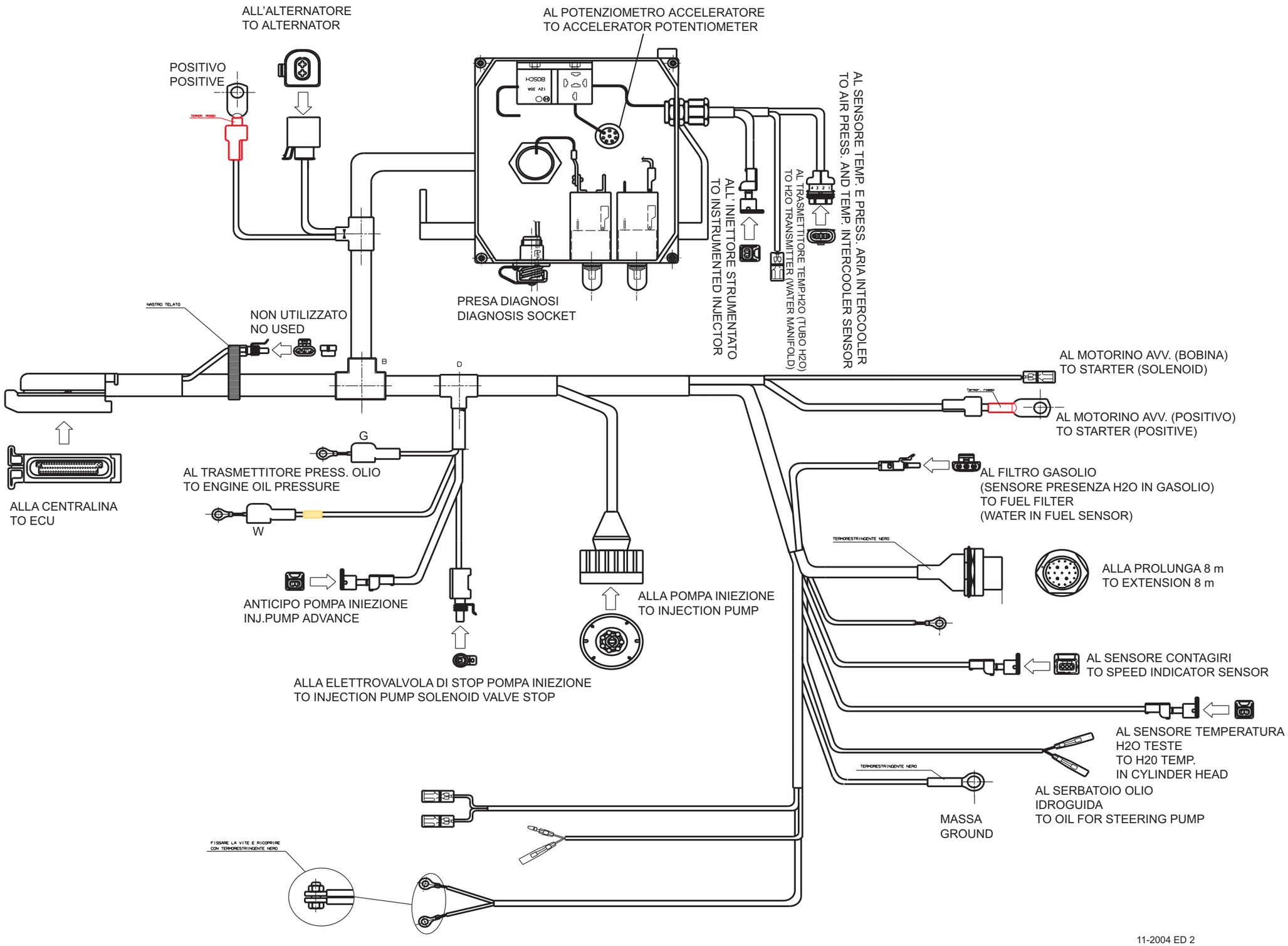
Electrical diagram 12 V MD 704LH/LS



LEGENDA COLORI Colours legend		
A	AZZURRO	Light/blue
B	BIANCO	White
C	ARANCIO	Orange
G	GIALLO	Yellow
H	GRIGIO	Gray
L	BLU	Blue
M	MARRONE	Brown
N	NERO	Black
P	NOCCIOLA	Tan
R	ROSSO	Red
S	ROSA	Pink
V	VERDE	Green
Z	VIOLA	Purple

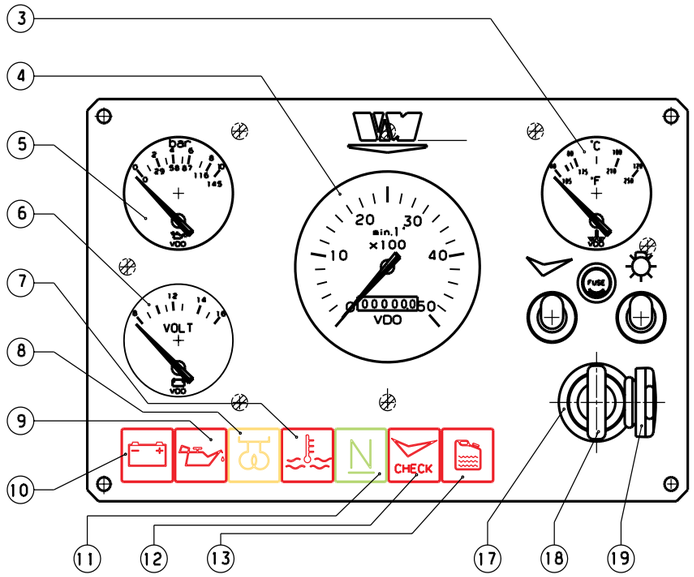
Ed. 4 - 06/2005

Engine wiring harness MD 704LH/LS



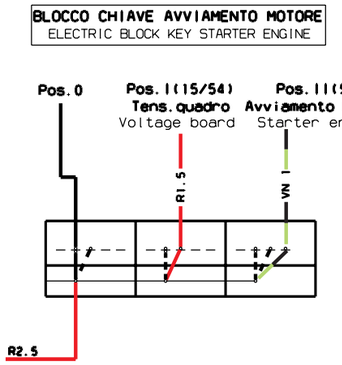
11-2004 ED 2

Engine dashboard MD 704LH/LS

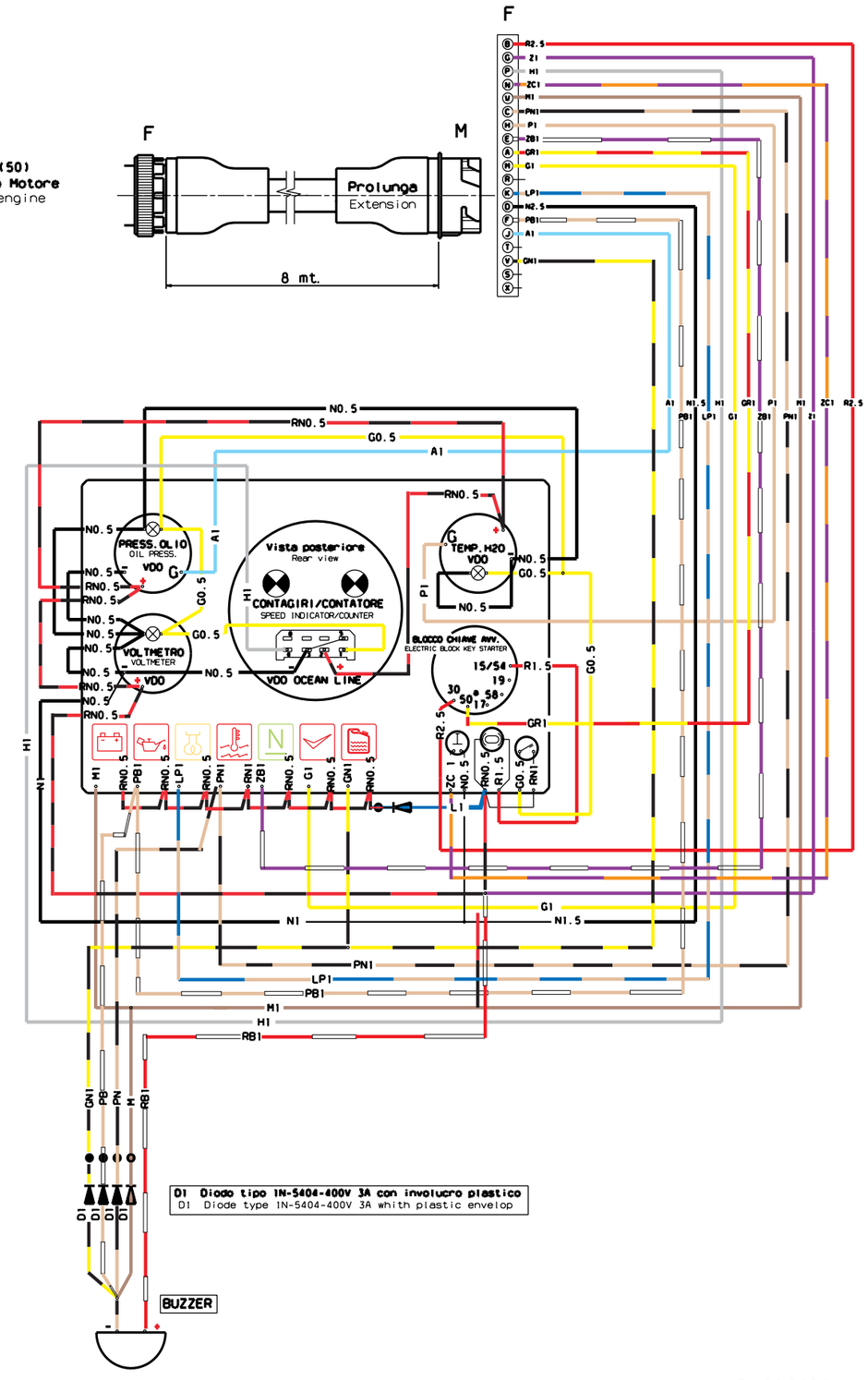


3 Termometro temp. H2O
4 Contagiri/Contaore
5 Pressione olio motore
6 Voltmetro
7 Spia temp. H2O motore
8 Spia accensione candelette
9 Spia MIN press. olio motore
10 Spia carica batteria
11 Spia pos. folle invertitore
12 Spia diagnosi centralina
13 Spia presenza H2O in gasolio
17 Blocco chiave avviamento
18 Chiave avviamento

3 Coolant temperature thermometer
4 Speed indicator/Hour counter
5 Engine oil pressure
6 Voltmeter
7 Coolant temperature pilot light
8 Glow plugs pilot light
9 MIN oil pressure pilot light
10 Battery charge pilot light
11 Neutral pos. inverter gear pilot light
12 ECU test diagnosis pilot light
13 Water in fuel pilot light
17 Start key block
18 Start key



A	AZZURRO	/	LIGHT BLUE
B	BIANCO	/	WHITE
C	ARANCIO	/	ORANGE
G	GIALLO	/	YELLOW
H	GRIGIO	/	GREY
L	BLU	/	BLUE
M	MARRONE	/	BROWN
N	NERO	/	BLACK
P	NOCCIOLA	/	HAZEL
R	ROSSO	/	RED
S	ROSA	/	PINK
V	VERDE	/	GREEN
Z	VIOLA	/	VIOLET



CRUSCOTTO PER IMPIANTI A 12V
12V Dashboard

TARATURA STATICA CONTAGIRI:
CON "FUNZIONE PULSE" IMPOSTARE NEL DISPLAY IL N° 13.00
SPEED METER STATIC SETTING:
With "FUNCTION PULSE" set on display N° 13.00

Contagiri funzionante con il W dell'alternatore

The speed indicator operating whith W alternator

CRUSCOTTO CON NUOVI STRUMENTI V.D.O. TIPO "OCEAN LINE"
Electric panel complete with new V.D.O. instruments type "OCEAN LINE"

Ed. 3 - 04-2004

WORKING FROM MAIN DASHBOARD

1) Insert engine starter key and position it in I; in this way the dashboard and flying-bridge are actived.
2) Position the key in II and start the engine.
3) At point 1 (key in pos. I) positioning also the key of flying-bridge in pos. I, comes cut out the dashboard.
4) For a good working the key of flying-bridge must always be in pos. 0.

WORKING FROM FLYING-BRIDGE

1) Insert engine starter key of main dashboard and position it in position I .
2) Insert engine starter key of flying-bridge and position it in I and successively in pos. II to start the engine. At this point also removing the key from main dashboard it is not possible to stop the engine.
3) For a good working the key of main dashboard must always be in pos. I.

DISASSEMBLY 5

INTRODUCTION

The following instructions refer to engine models available at the time of publication of this manual.

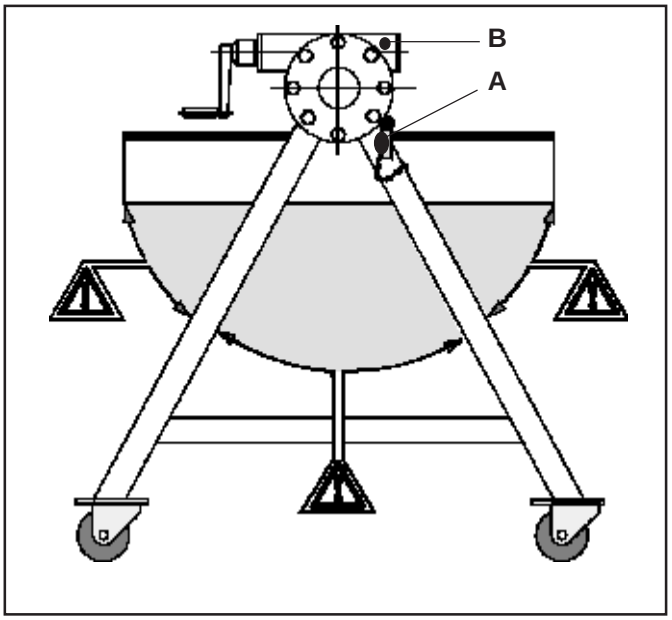
Before proceeding with the complete or partial disassembling of the engine, check that the problem is not due to some external cause.

WHERE VM SPECIAL TOOLS ARE NOT SPECIFIED IN THE DISASSEMBLY PROCEDURES, USE STANDARD COMMERCIAL TOOLS OF THE TYPE ILLUSTRATED.

Mounting the engine on the stand

Mount the engine on a commercial stand as shown in figure

Secure the engine by means of the assembling arms and bolts provided with the stand (or using mounting bolts of the same type).



WARNING: THE STAND MUST BE EQUIPPED WITH A REDUCTION GEAR AS SHOWN IN THE FIGURE TO SLOW DOWN ENGINE ROTATION AND CONTROL ROCKING.

WARNING: REMEMBER TO INSERT THE LOCK PIN (A) AND CHECK THAT IT EFFECTIVELY LOCKS T HE ENGINE IN POSITION.

WARNING: RISK OF CRUSHING AND/OR SHEARING OF LIMBS DURING ROTATION OF ENGINE ON STAND.

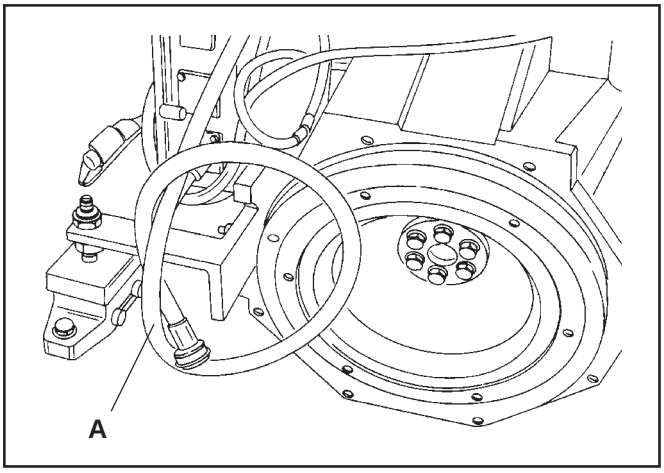
NEVER INTRODUCE PARTS OF THE BODY OR FOREIGN OBJECTS IN THE AREA SHADED GREY IN FIGURE

WE RECOMMEND THOROUGHLY CHECKING AND CLEANING THE COMPONENTS DISMANTLED, BEFORE REASSEMBLING THEM.

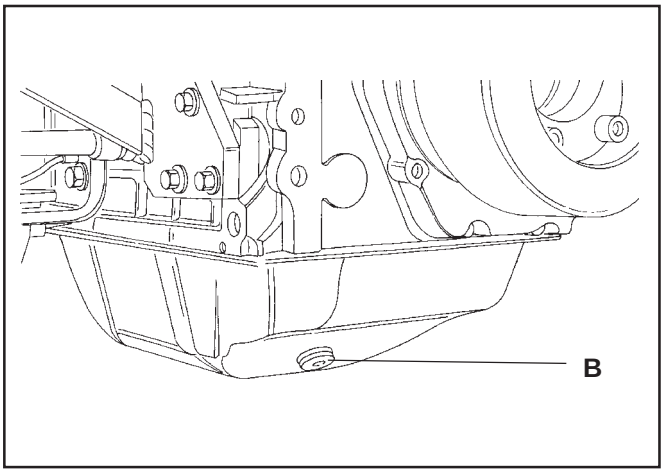
FOR THE CONTROLS TO CARRY OUT ON THE VARIOUS CASES IN QUESTION, SEE CHAPTER 6 (CONTROLS AND REPAIRS), FOR THE METHODS OF ASSEMBLY, SEE CHAPTER 7 (ASSEMBLY).

Draining MD700-MD704LH/LS

To drain the oil from the engine on the boat, use the special flexible pipe **(A)** with a fitting for the drain pump.



To drain the oil from the engine in the workshop, you can use the drain plug **(B)** in the sump.



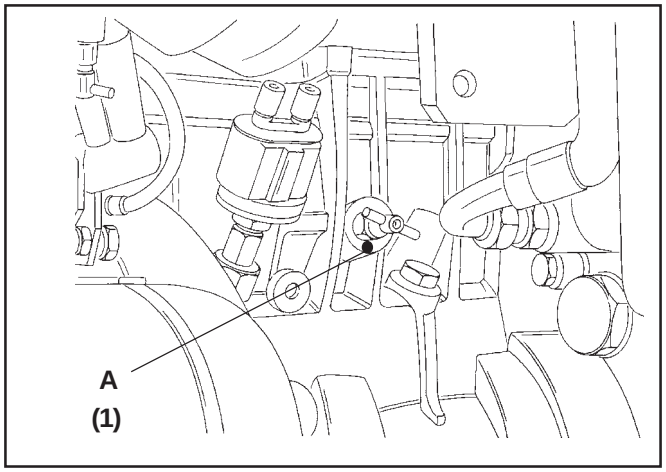
Draining the water (Coolant) MD700-MD704LH/LS

To drain the water, loosen taps **(A)**:

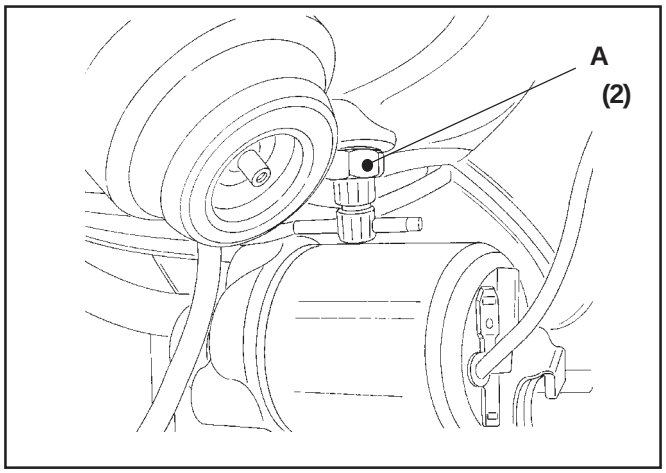
1) on the crankcase (injection side)

2) under the exhaust manifold

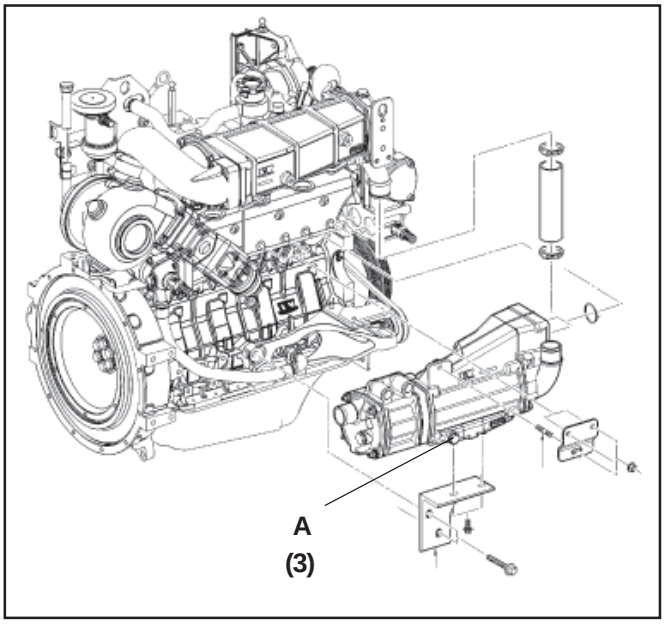
3) in the rear part of the exhaust manifold, on the side of the flywheel.



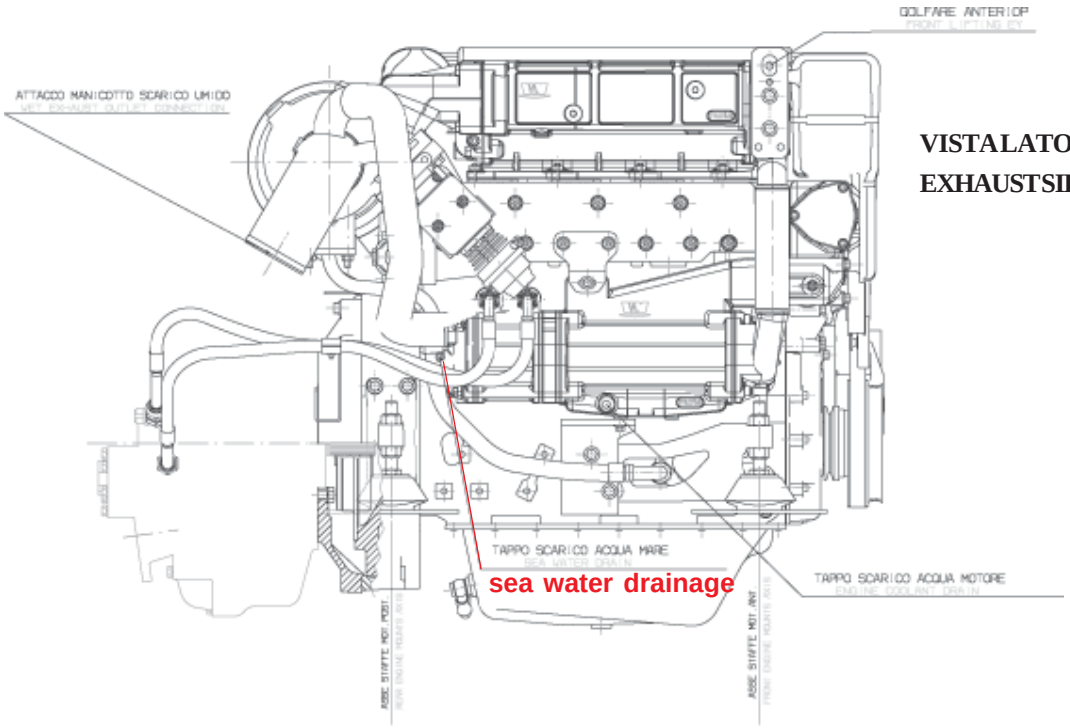
It is extremely important that the liquids drained aren't dispersed in the environment, but collected in the relevant containers and consigned to firms specialised in disposal.



MD704 LH/LS



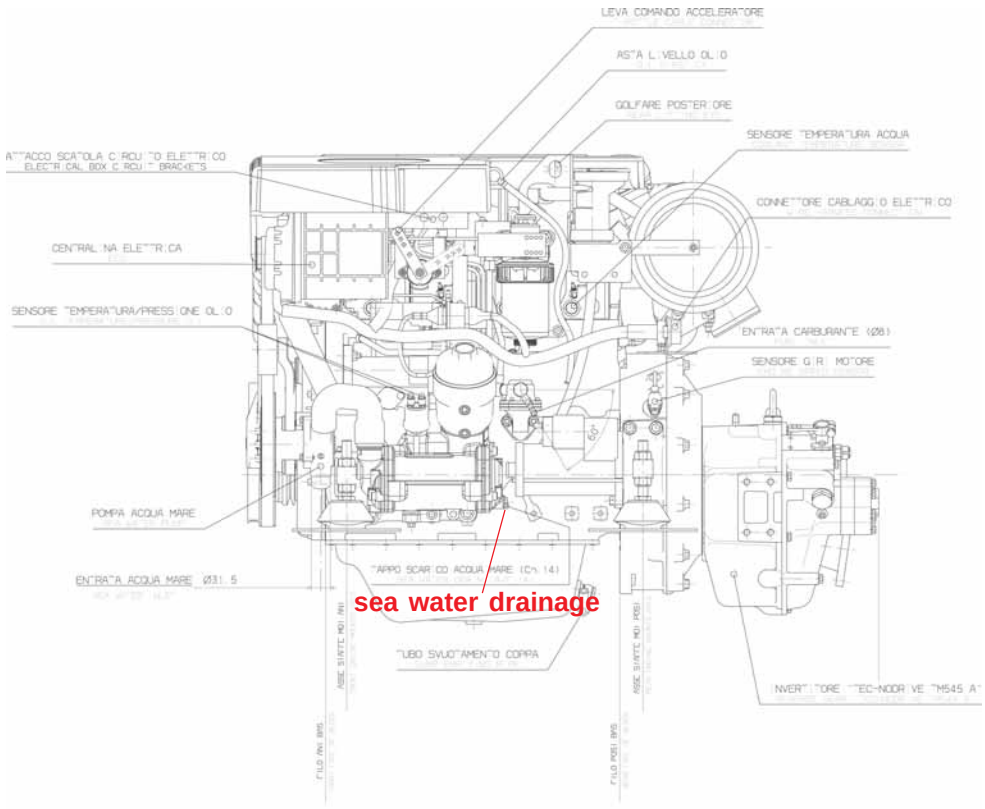
Draining the sea water MD704LH/LS



VISTA LATO SCARICO
EXHAUST SIDE VIEW

VISTA LATO SCARICO
EXHAUST SIDE VIEW

VISTA LATO INIEZIONE
INJECTION SIDE VIEW

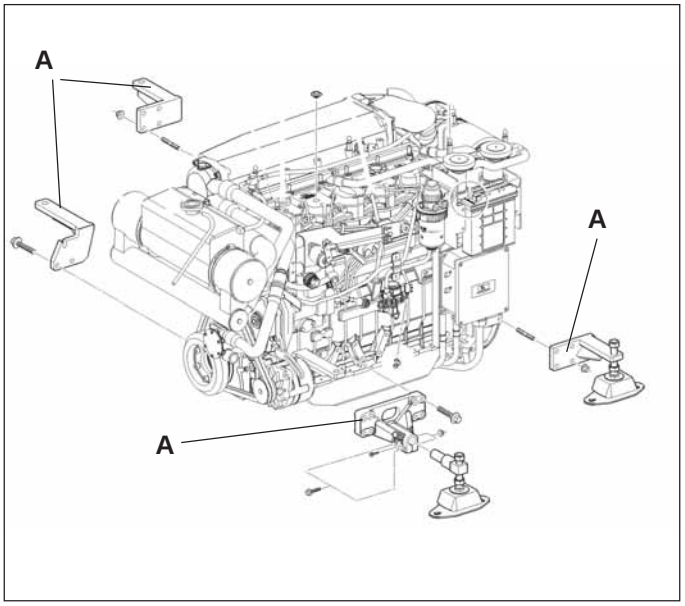


INJECTION SIDE VIEW

ENGINE MOUNTING REAR BRACKETS

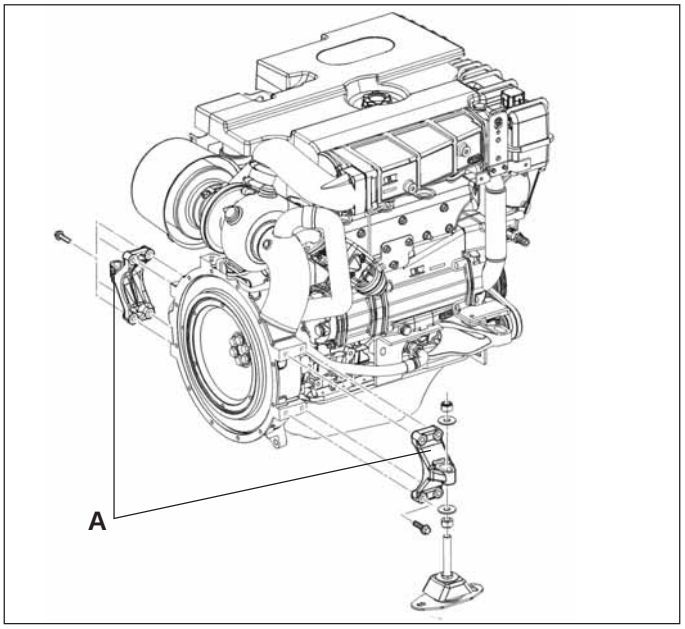
Rear bracket MD700

Unscrew the bolts as shown in the picture and remove rear brackets **A.**



Rear bracket MD704LH/LS

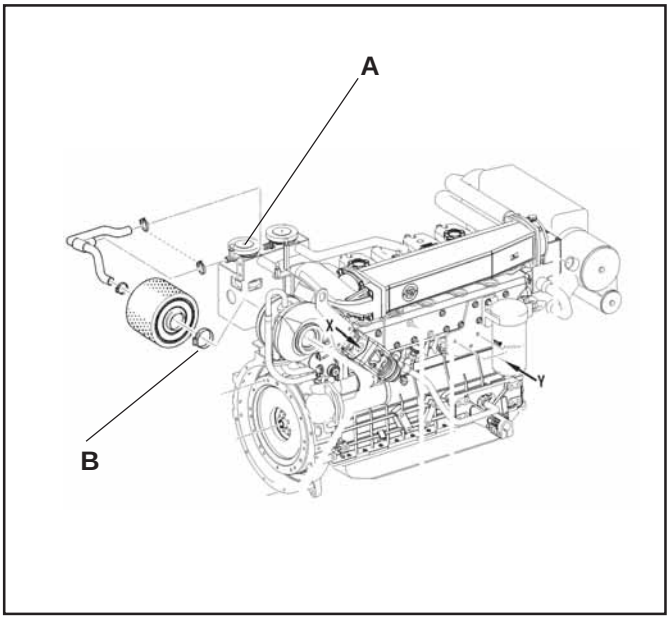
Unscrew the bolts as shown in the picture and remove rear brackets **A.**



AIR FILTER

Air suction filter MD700

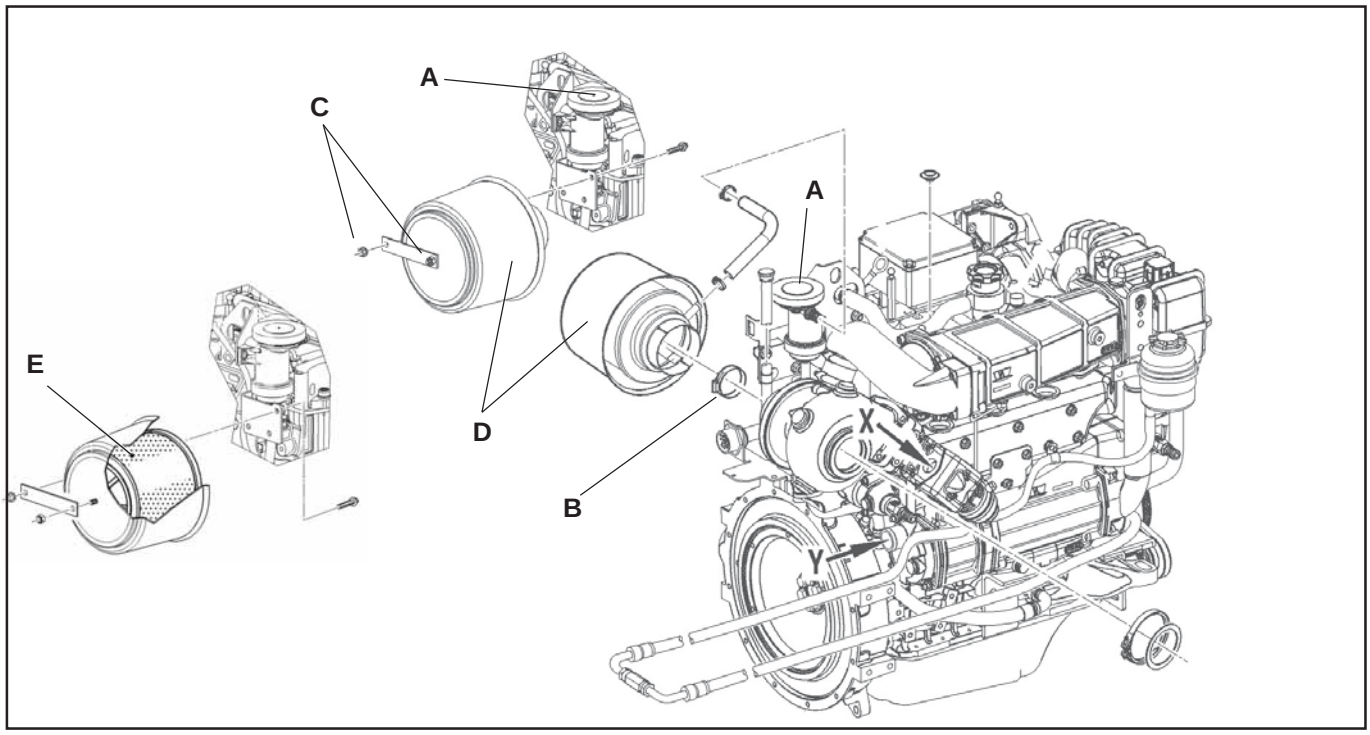
Disconnect the filter air from separator **(A).**
Loosen the clip fixing turbo **(B)** and pull the filter out.



Air suction filter MD704LH/LS

Remove nuts **C**.

Remove the protection **D** and remove the air filter element **E.**



RAISER

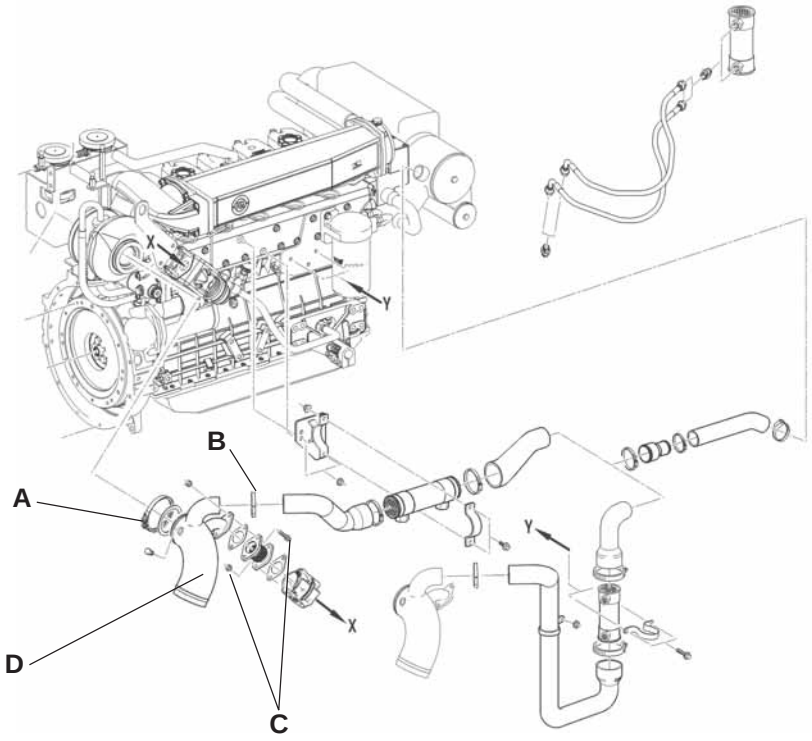
Raiser MD700

Loosen and remove clamp **A**.

Loosen clamp **B.**

Loosen and remove bolts **C**.

Remove raiser **D**.



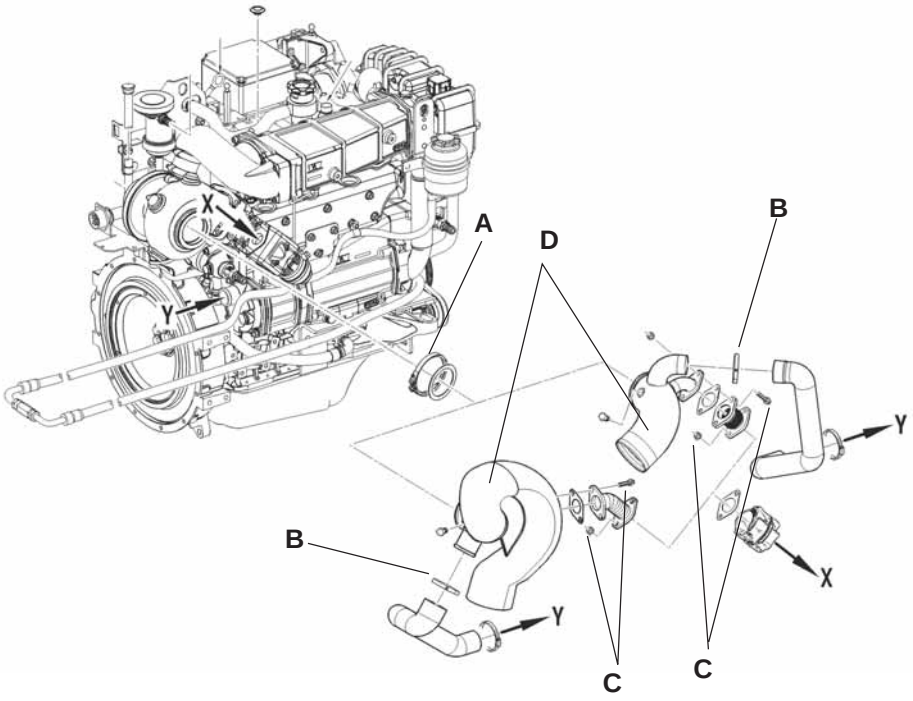
Raiser MD704LH/LS

Loosen and remove clamp **A**.

Loosen clamp **B.**

Loosen and remove bolts **C**.

Remove raiser **D**.



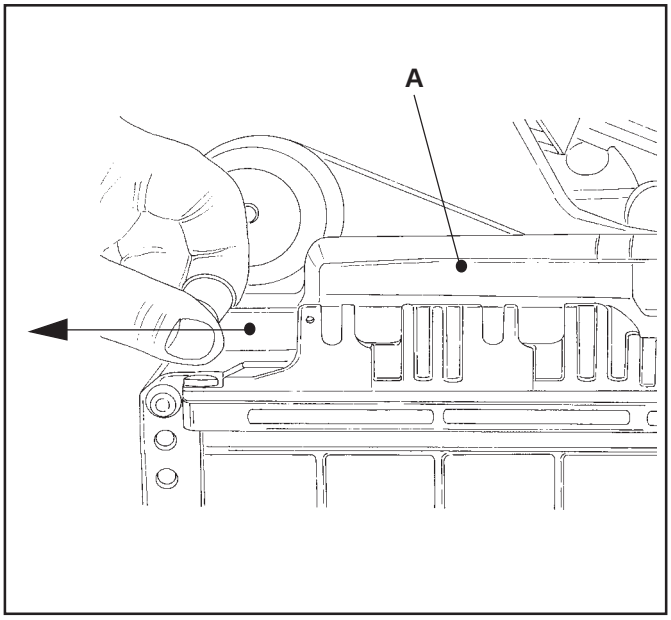
ELECTRONIC CENTRAL UNIT

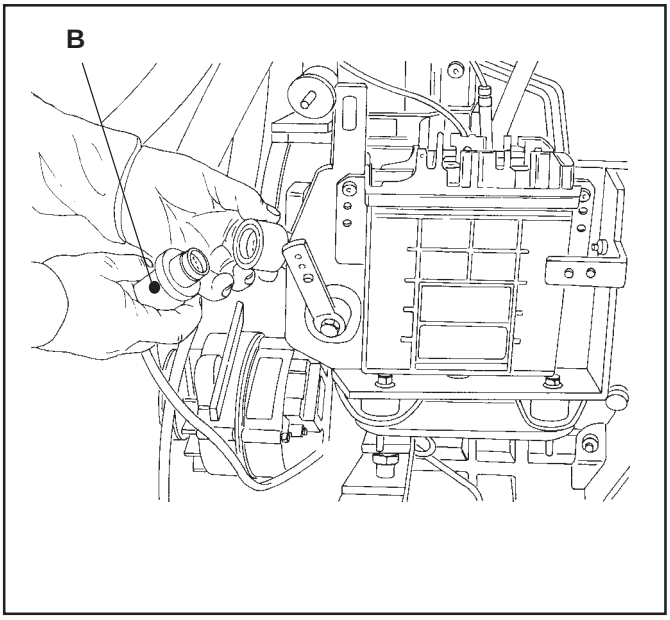
Electronic power plant

Release the device blocking the connector, that presses outwards as shown in the figure.

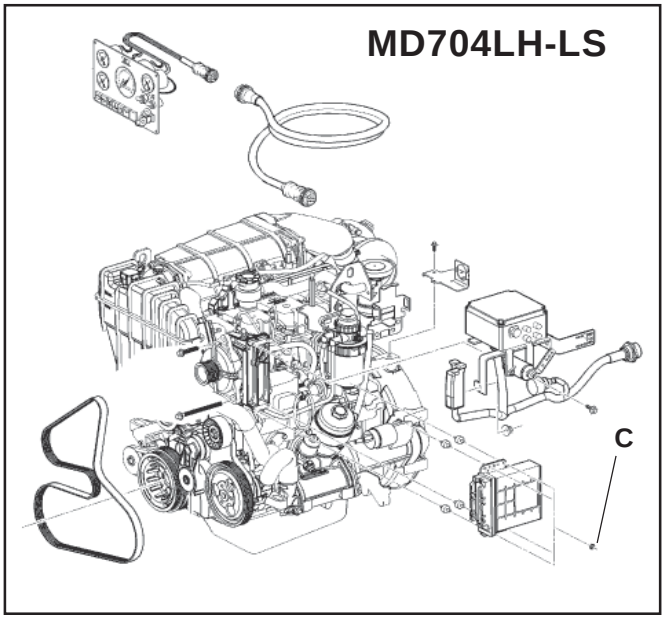
Remove connector **(A)** from the power plant.

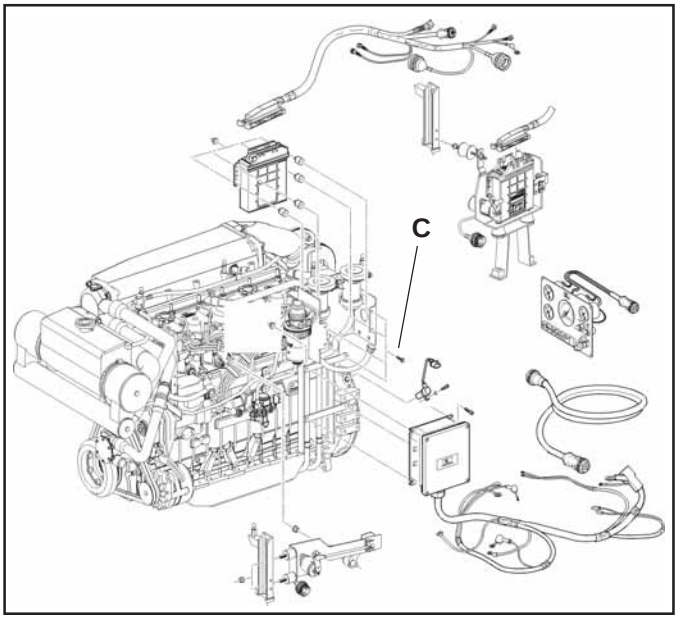
Release wiring connector **(B)**, loosen and remove the support fixing screws and remove the power plant.





To remove complety the electronic central unit, uncrews nuts **(C).**



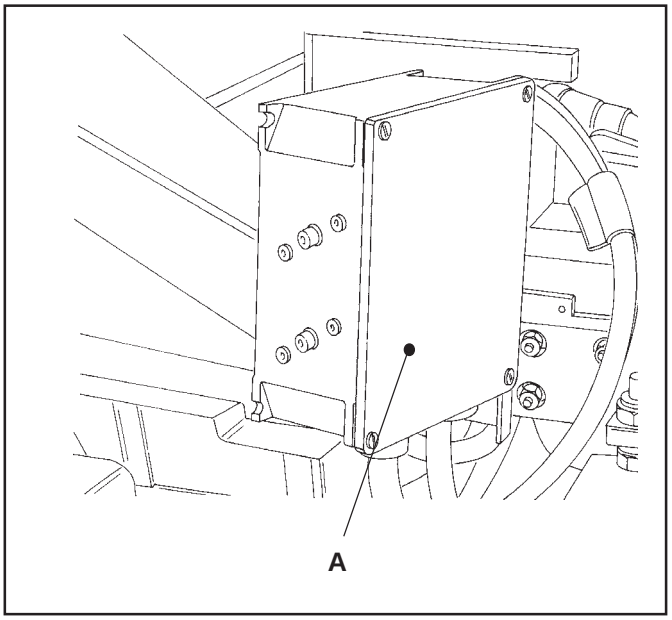


WIRING - POWER PLANT

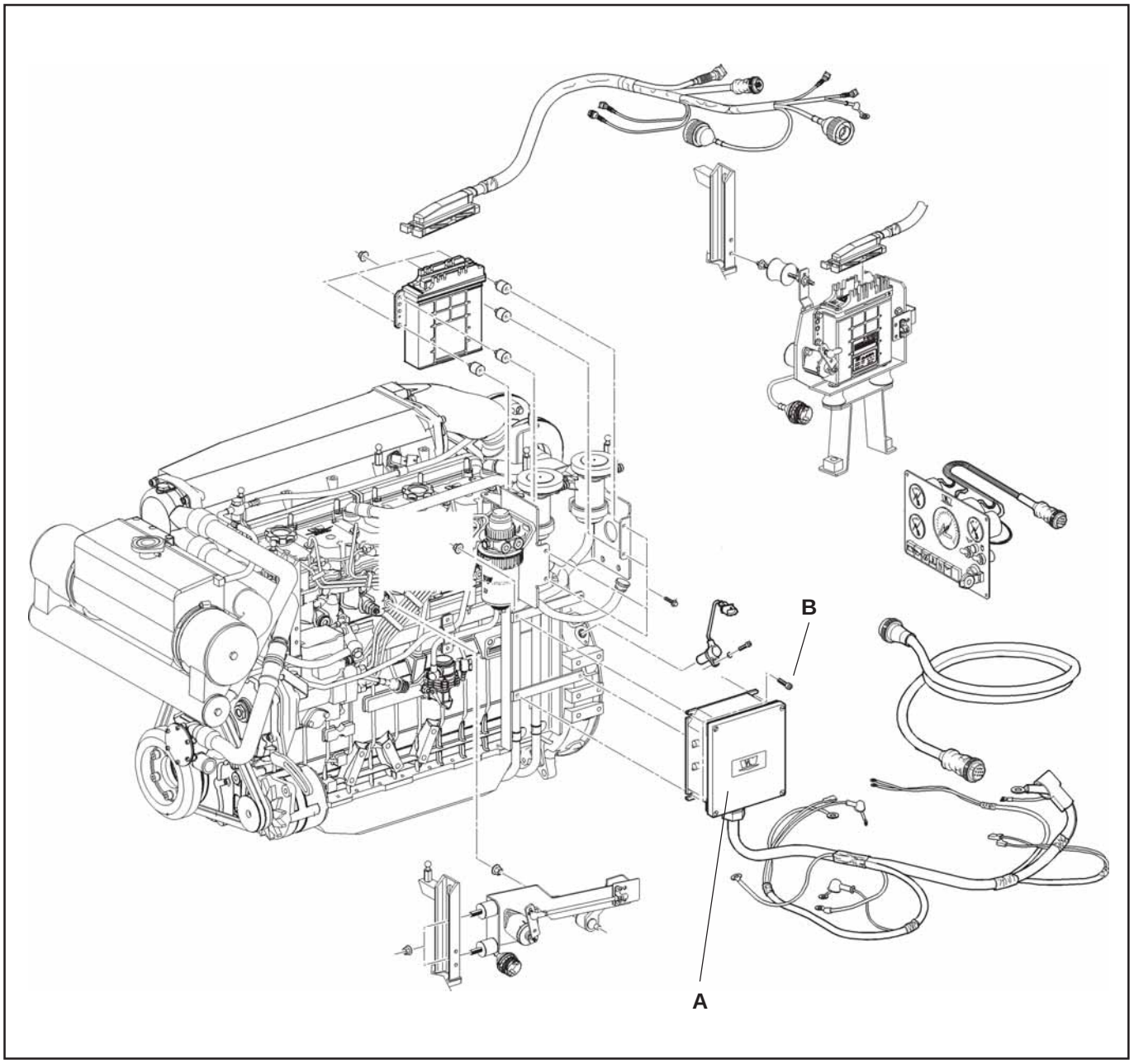
Wiring and the power plant MD700

Release the electrical connections of the various components, although these are differential connections, we recommend noting their position.

Remove the wiring and relevant power plant **(A).**



Remove screw and nut **B** as shown in the picture here below

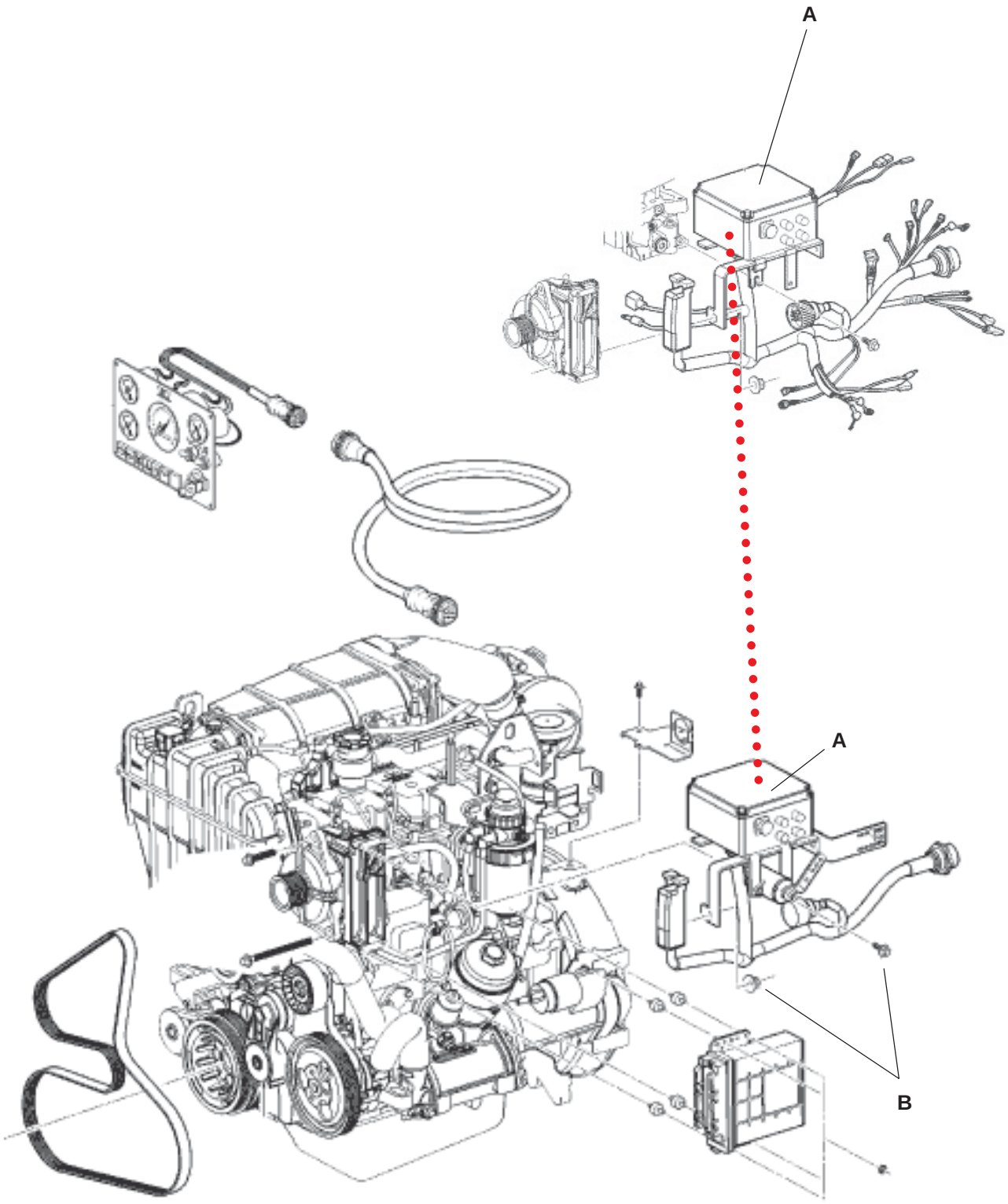


Wiring and the power plant MD 704 LH/LS

Release the electrical connections of the various components, although these are differential connections, we recommend noting their position.

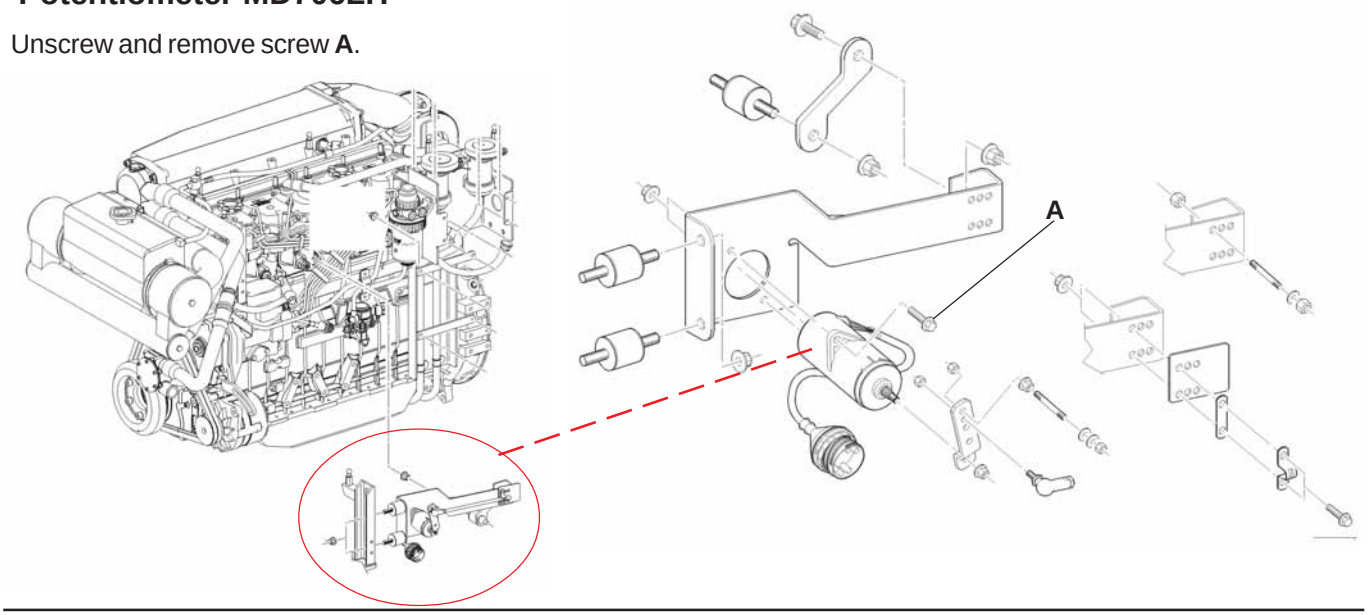
Remove the wiring and relevant power plant **(A).**

Remove screw and nut **B** as shown in the picture here below



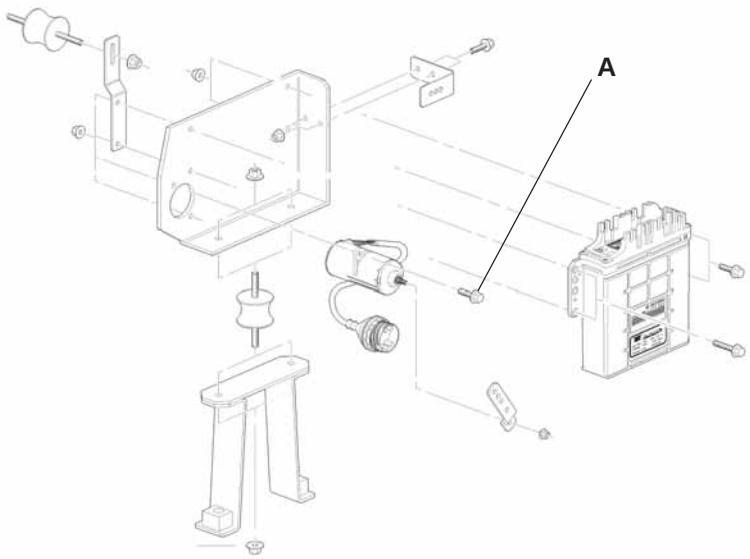
Potentiometer MD706LH

Unscrew and remove screw **A**.



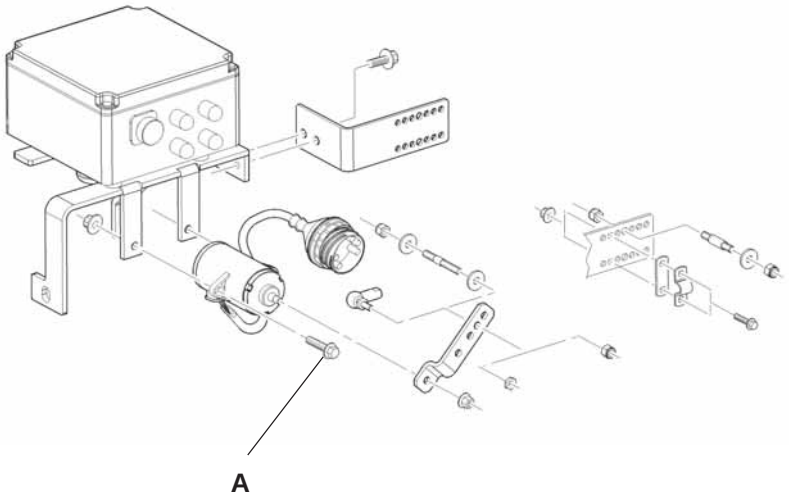
Potentiometer MD700LI

Unscrew and remove screw **A**.



Potentiometer MD704LH/LS

Unscrew and remove screw **A**.



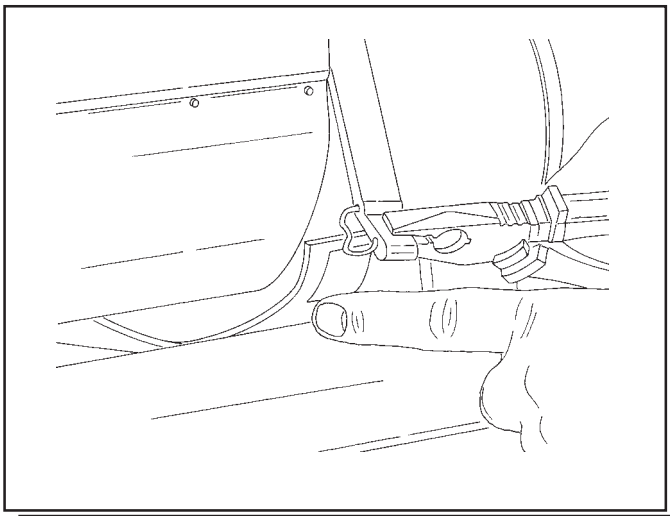
WATER HEAT EXCHANGER

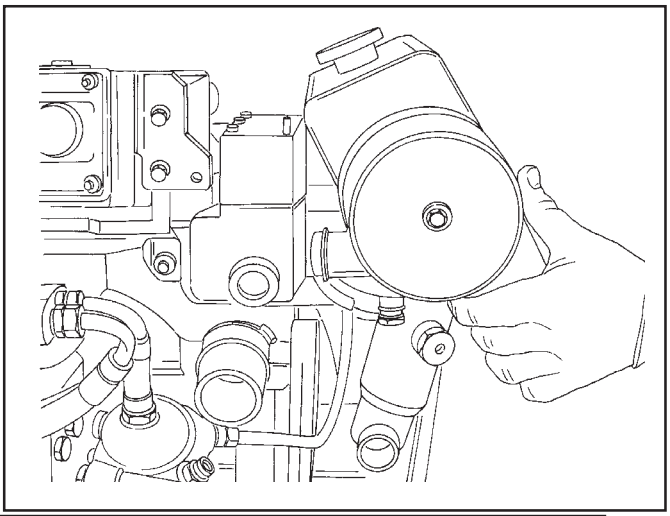
Water heat exchanger MD700LI/MI/MH

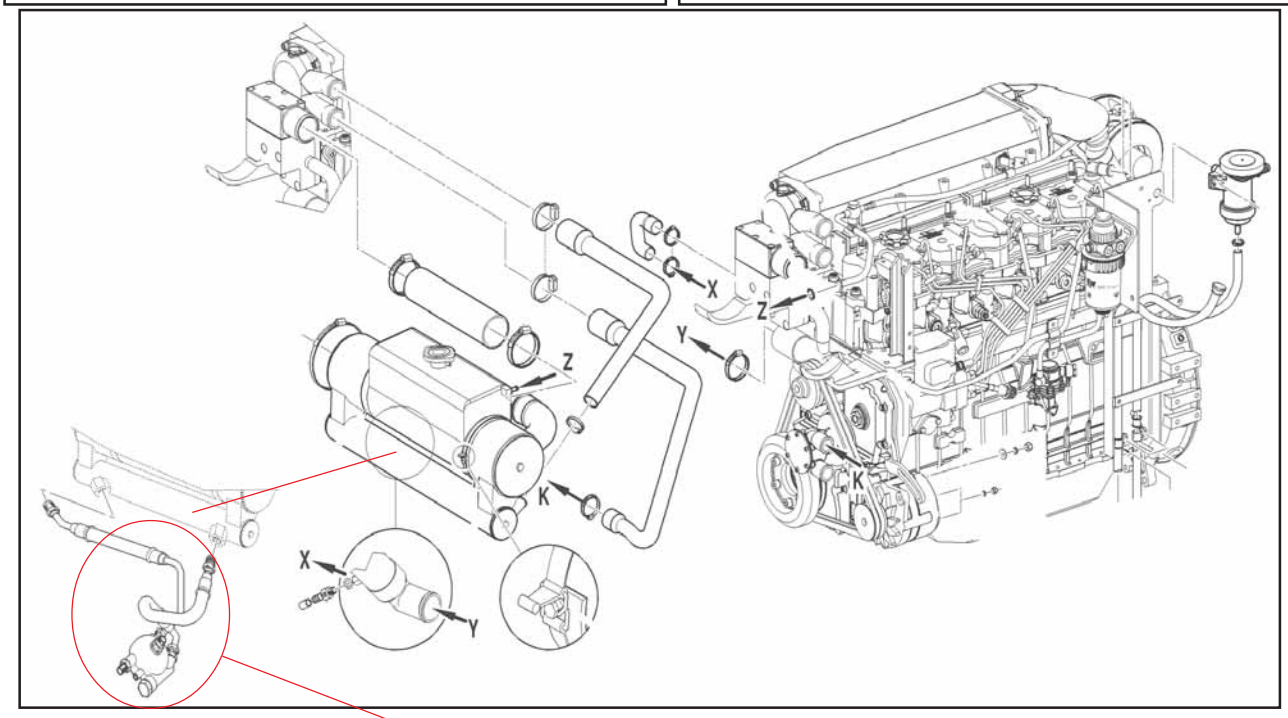
Unscrew and remove all of the pipes connecting the exchanger, water or oil pipes and any clamps.

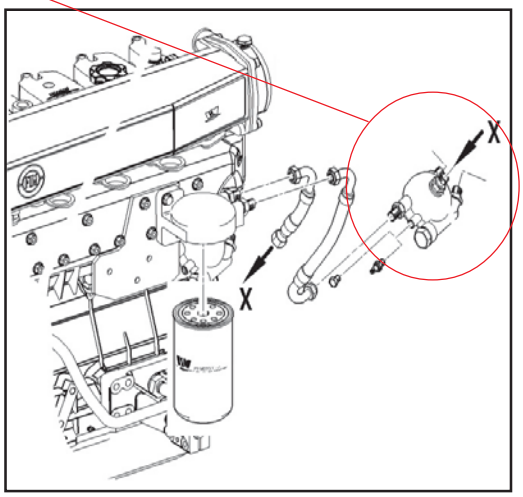
Pull the exchanger off the supporting brackets.

TO MAKE THE EXTRACTING THE PART EASIER, WE RECOMMEND STARTING WITH THE BOTTOM, AS SHOWN IN THE FIGURE.







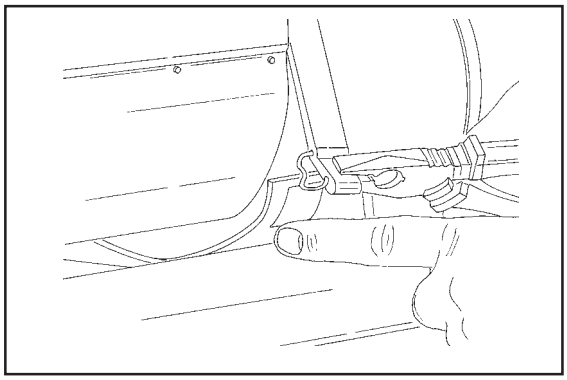


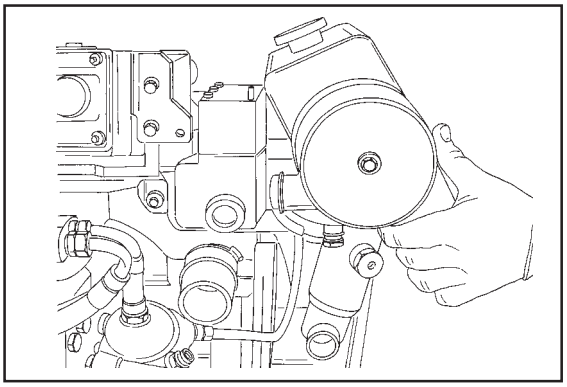
Water heat exchanger MD706 LB/S/H/X - 706 MS/X

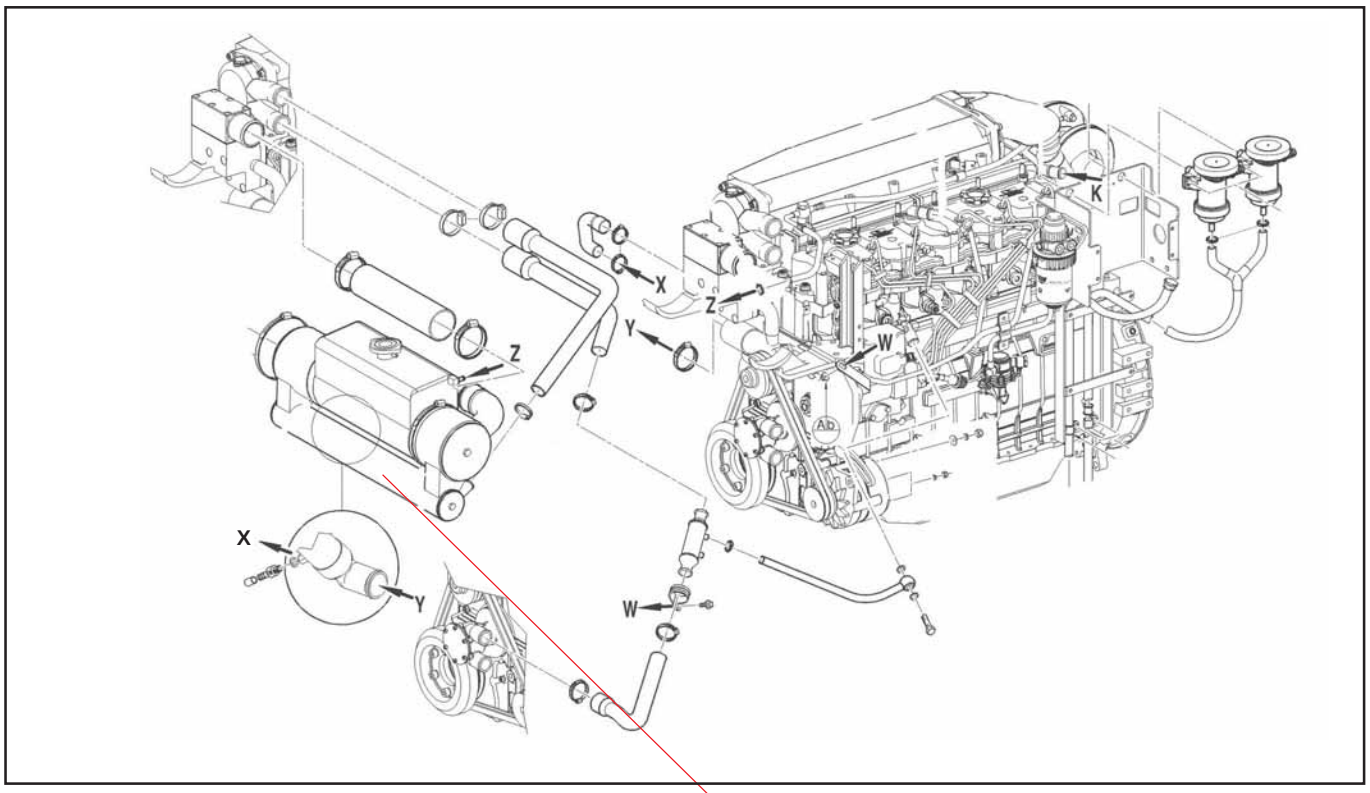
Unscrew and remove all of the pipes connecting the exchanger, water or oil pipes.

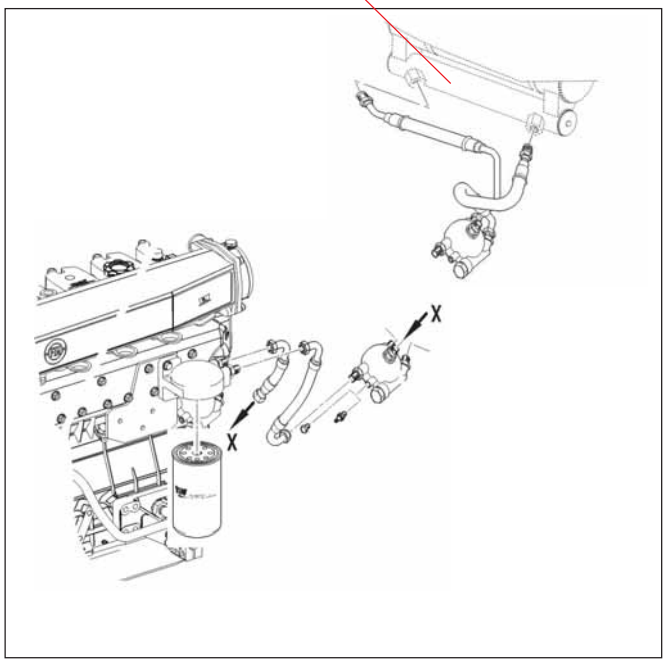
Pull the exchanger off the supporting brackets.

TO MAKE THE EXTRACTING THE PART EASIER, WE RECOMMEND STARTING WITH THE BOTTOM, AS SHOWN IN THE FIGURE.







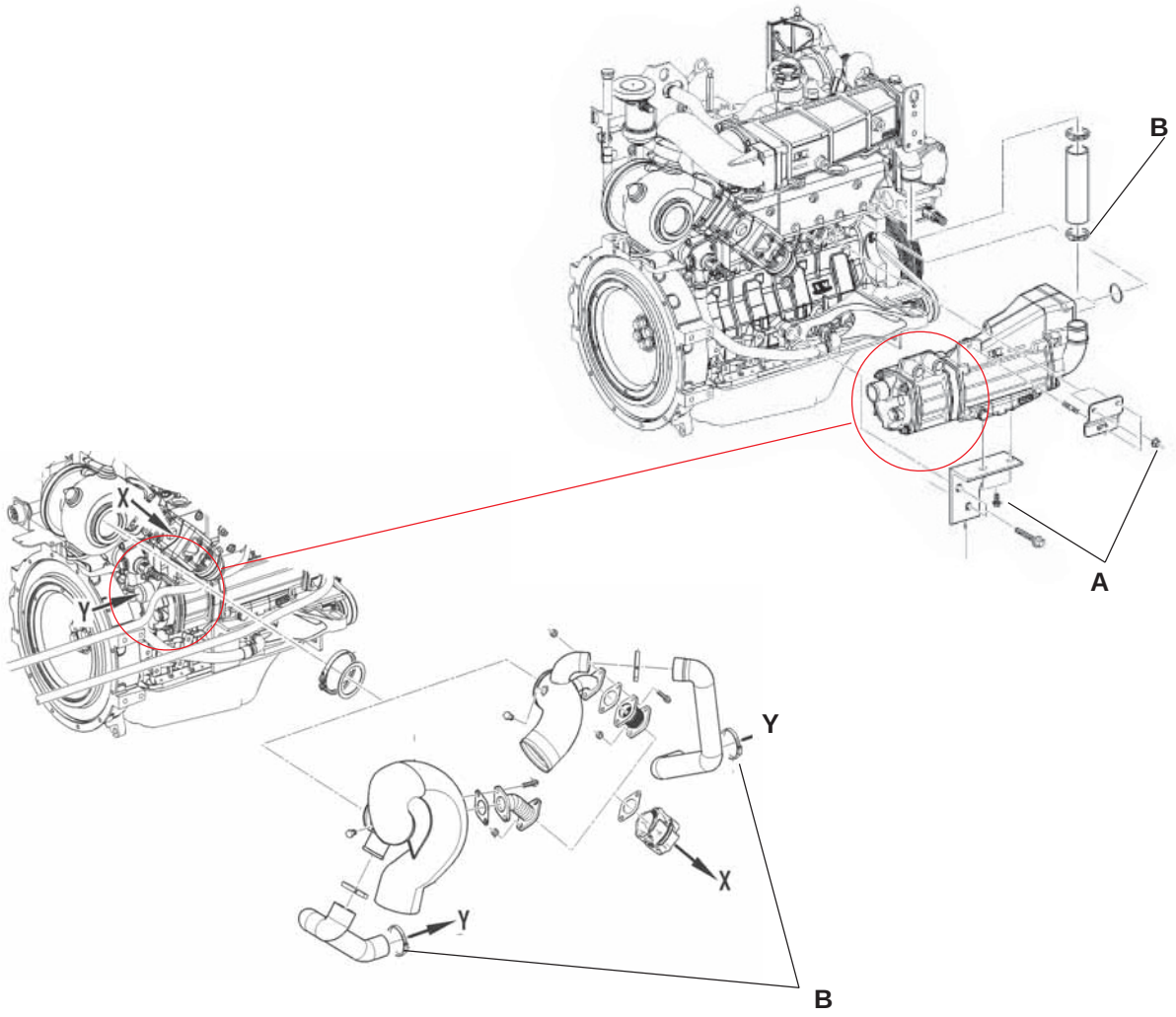


Water heat exchanger MD 704LH/LS

Loosening clamps **B**.

Remove nuts and screws **A**.

Remove oil pipes from water heat exchanger if provided.



BELT SYSTEM

Poly-V belt MD704LH/LS

Use a commercial tool to block the automatic tensioner **A**.

Remove the belt as shown in the picture.

EXPANSION COOLANT TANK

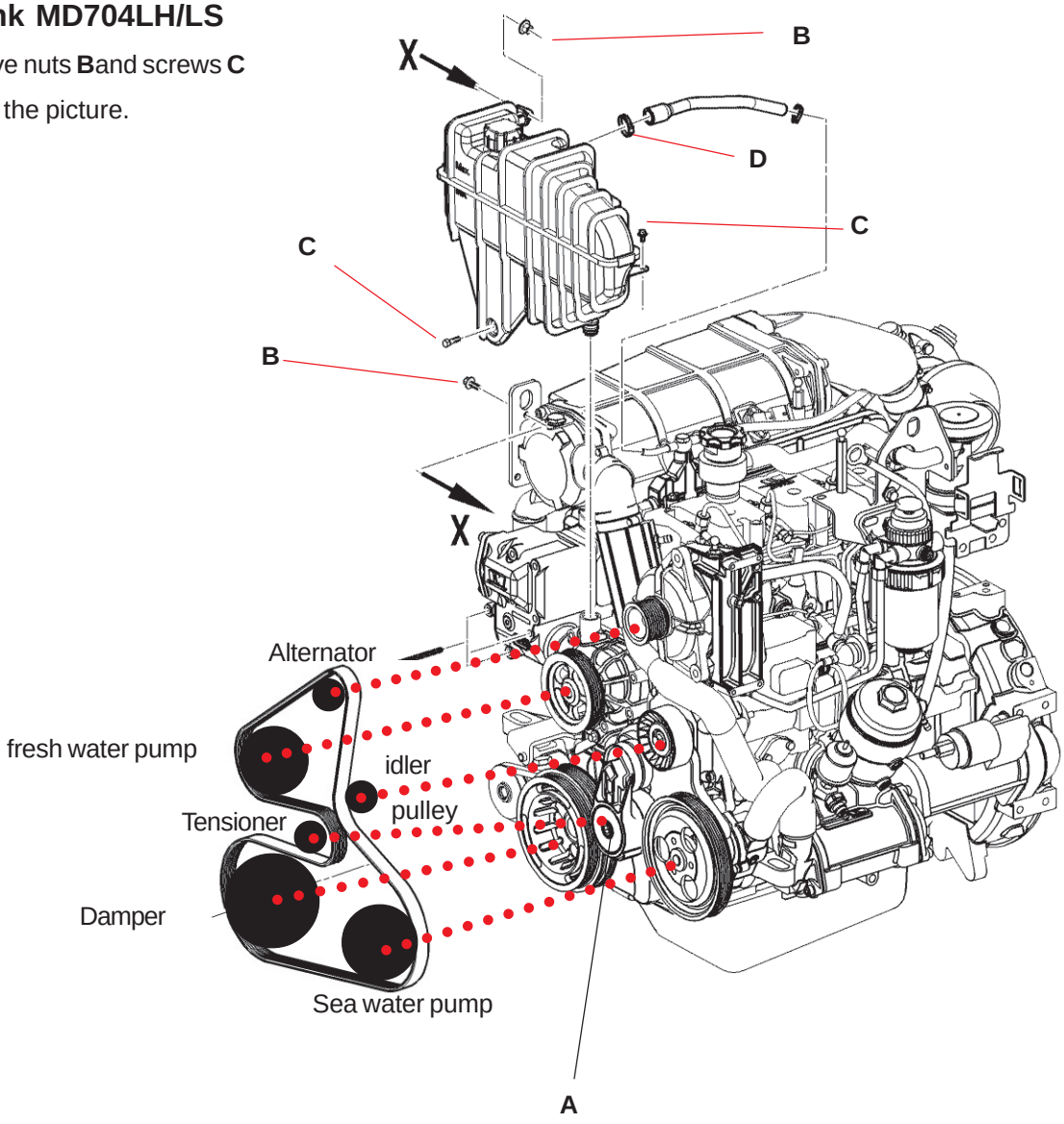
Expansion Tank MD704LH/LS

Unscrew and remove nuts **B**and screws **C**

as ashown in the in the picture.

Remove clamp **D**.

Pull the tank out-

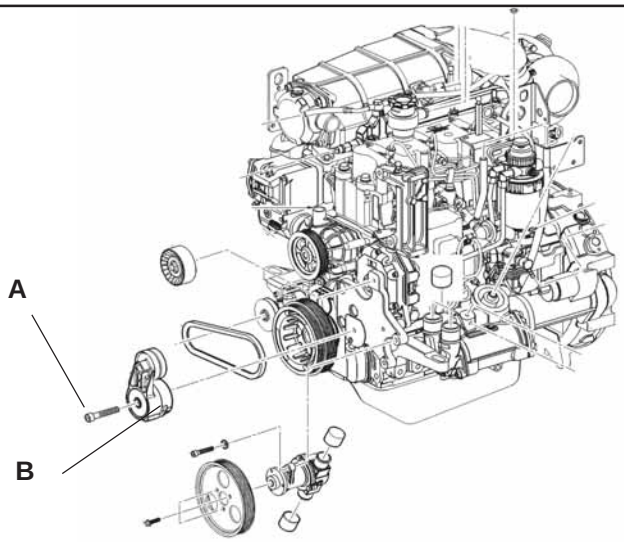


BELT TENSIONER

Automatic tensioner belt MD704LH/LS

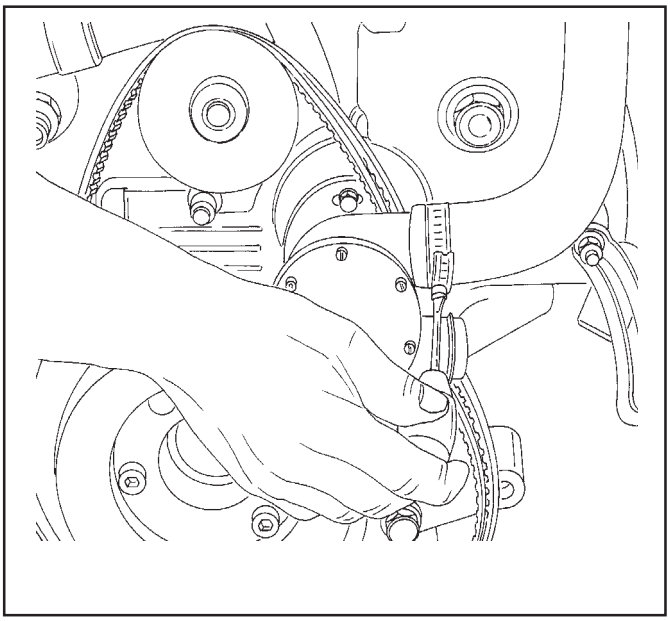
Remove poly-v belt.

Unscrew the screw **A** and pull the tensioner out (**B**).

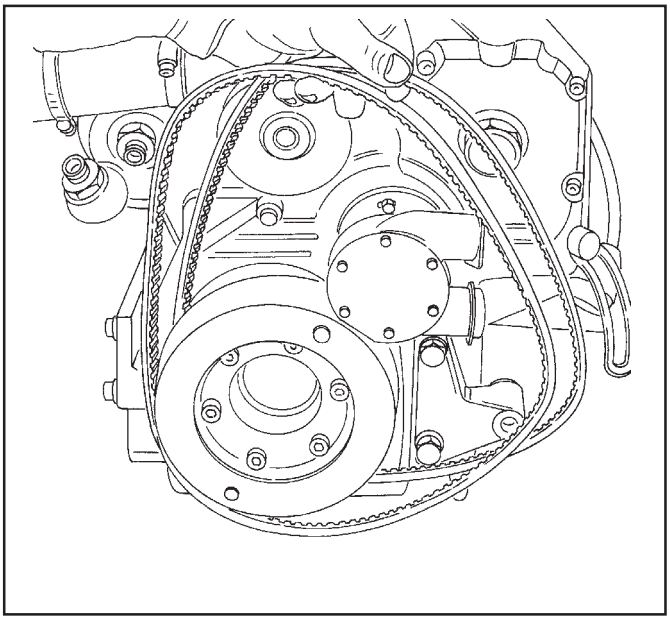


Trapezoidal belt MD700

Slacken the fixing clips and pull out the water hose connection to the exchanger.



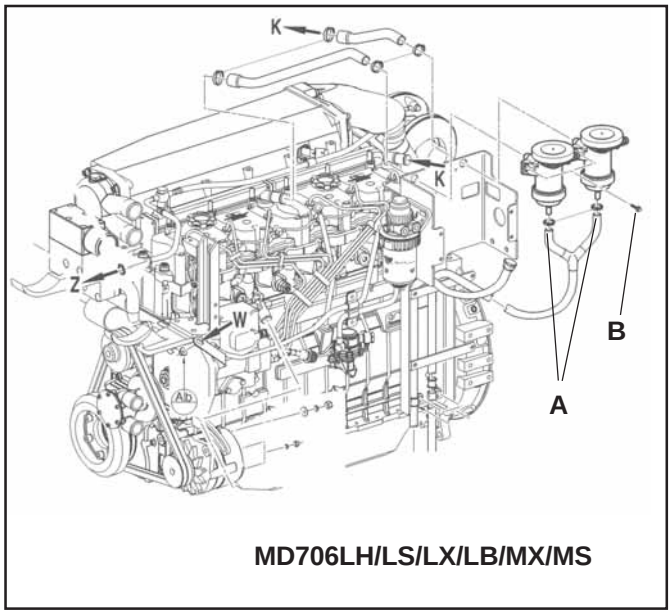
Pull out the transmission belts.



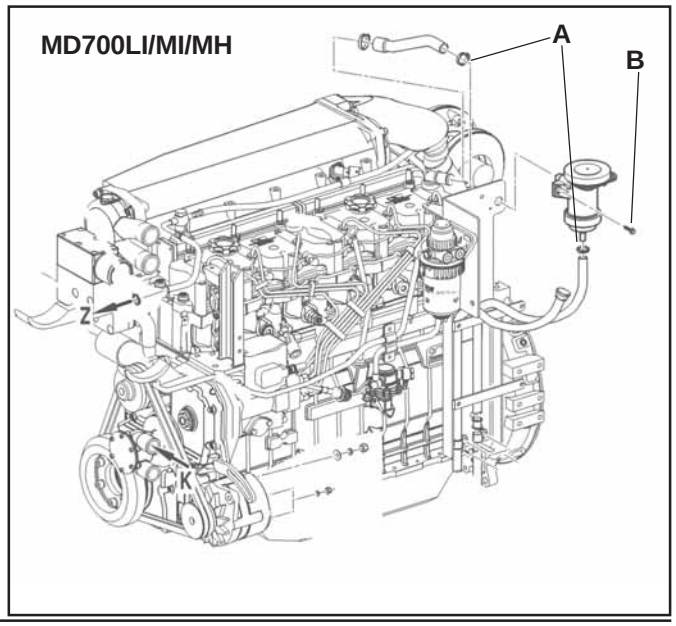
OIL SEPARATOR

Oil separator MD700

Loosen clip **(A)**
Unscrew the fixing screws **(B)** holding the bracket and remove separator.

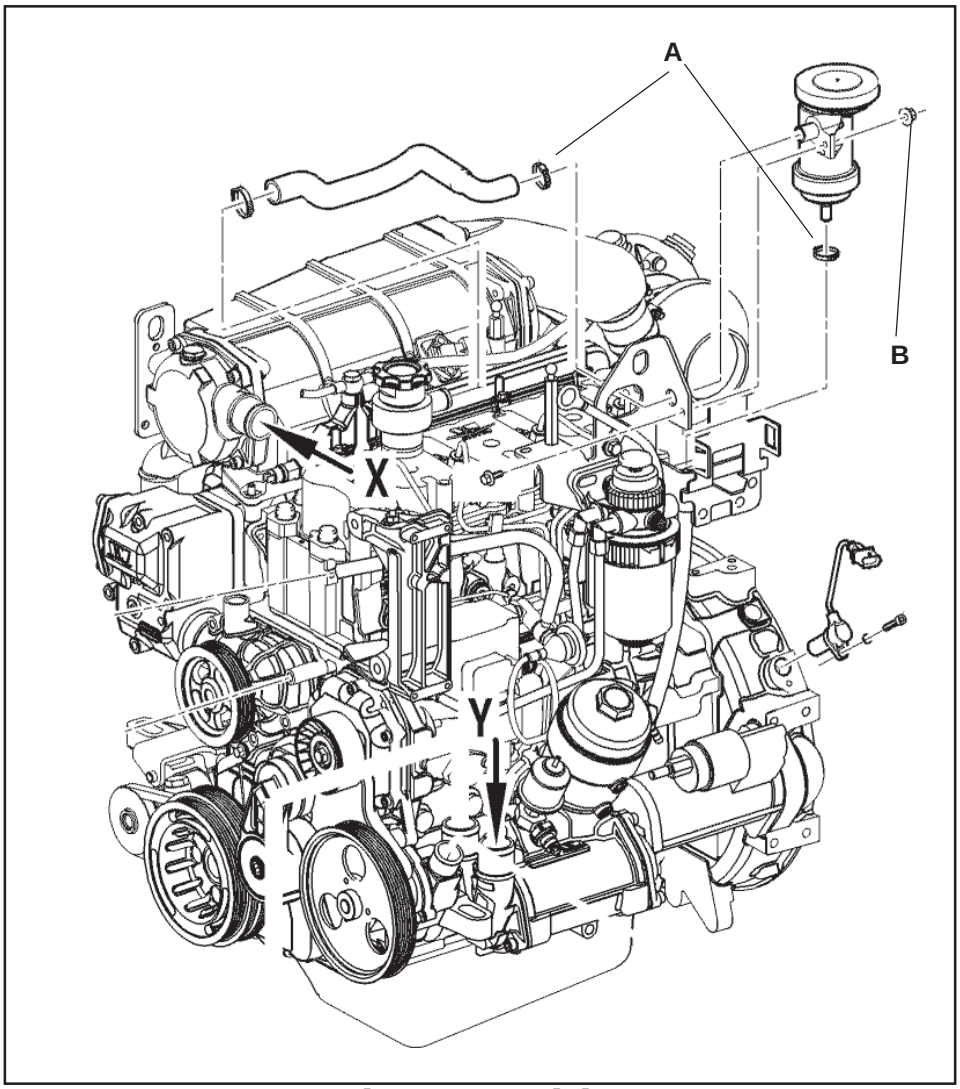


MD706LH/LS/LX/LB/MX/MS



Oil separator MD704LH/LS

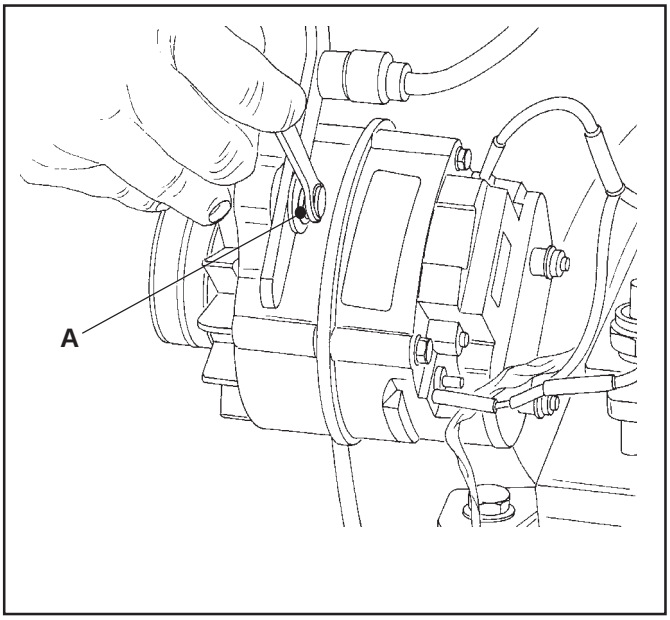
Loosen clip **(A)** and pull out the pipe that takes the oil back to the sump.
Unscrew the fixing screws **(B)** holding the bracket and remove separator.



ALTERNATOR

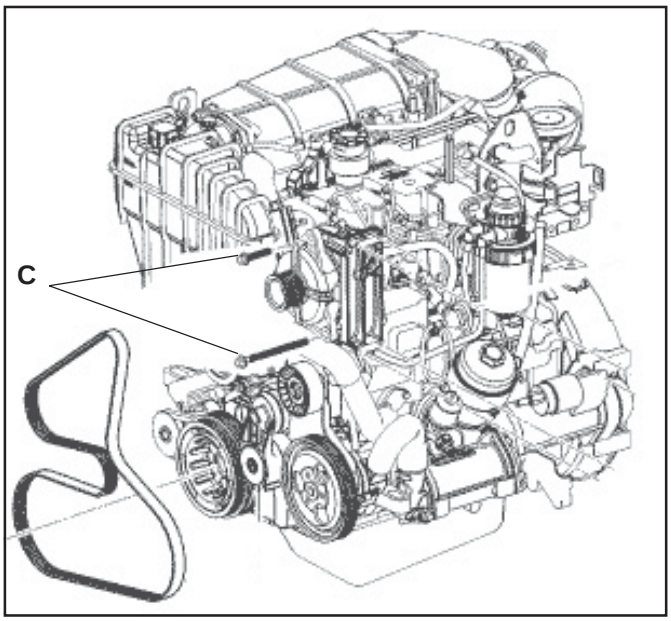
Alternator

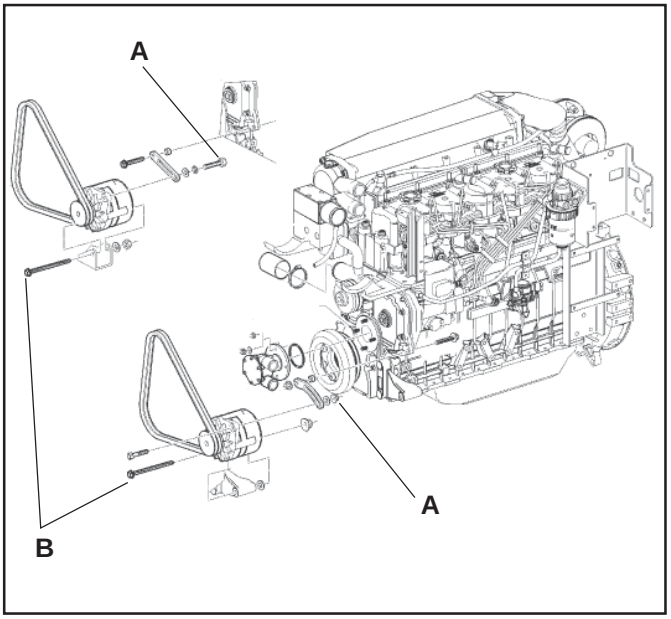
Release the electrical connections, although these are differential connections, we recommend noting their position.
Unscrew nut **(A)** completely, loosened previously, and also remove the bottom **(B)** screw to remove the alternator.



MD704LH-LS

Remove bolts **C** as shown in the picture here below



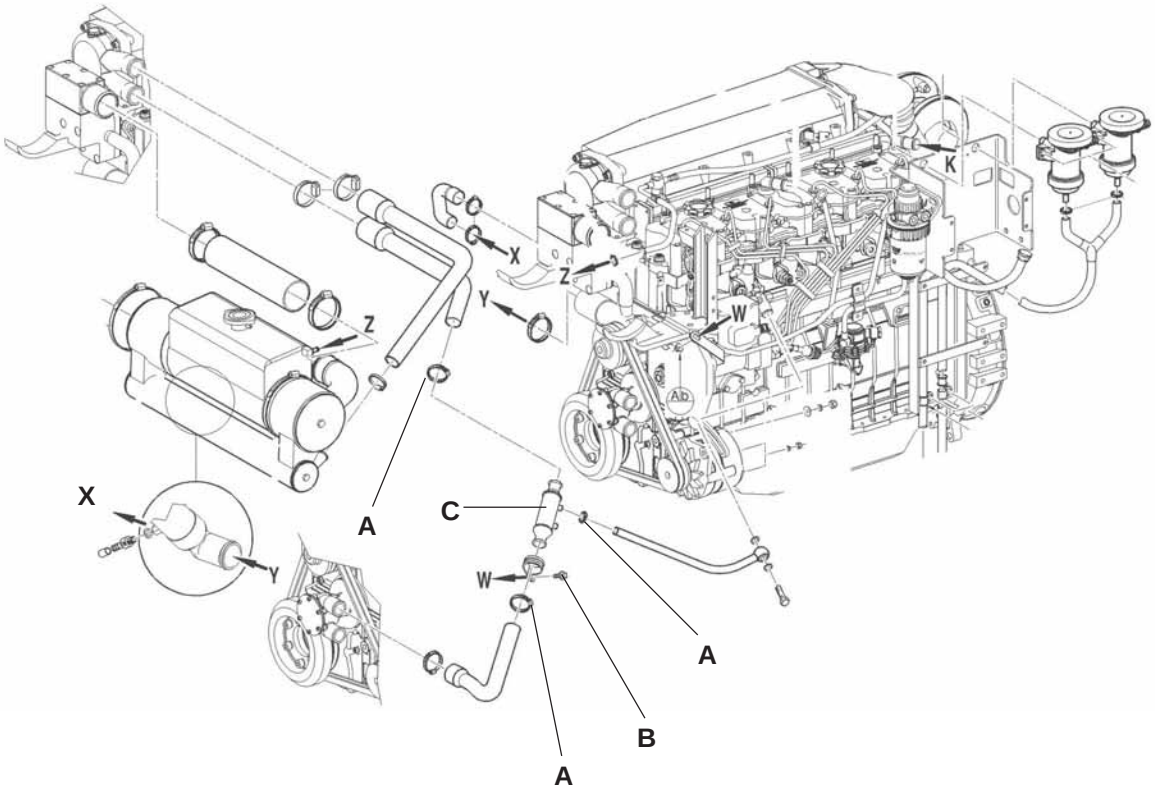


HEAT FUEL EXCHANGER

Fuel exchanger MD706LB/LS/LH/LX/MX/MS

Loosen clamps **A** and unscrew the screw **B**.

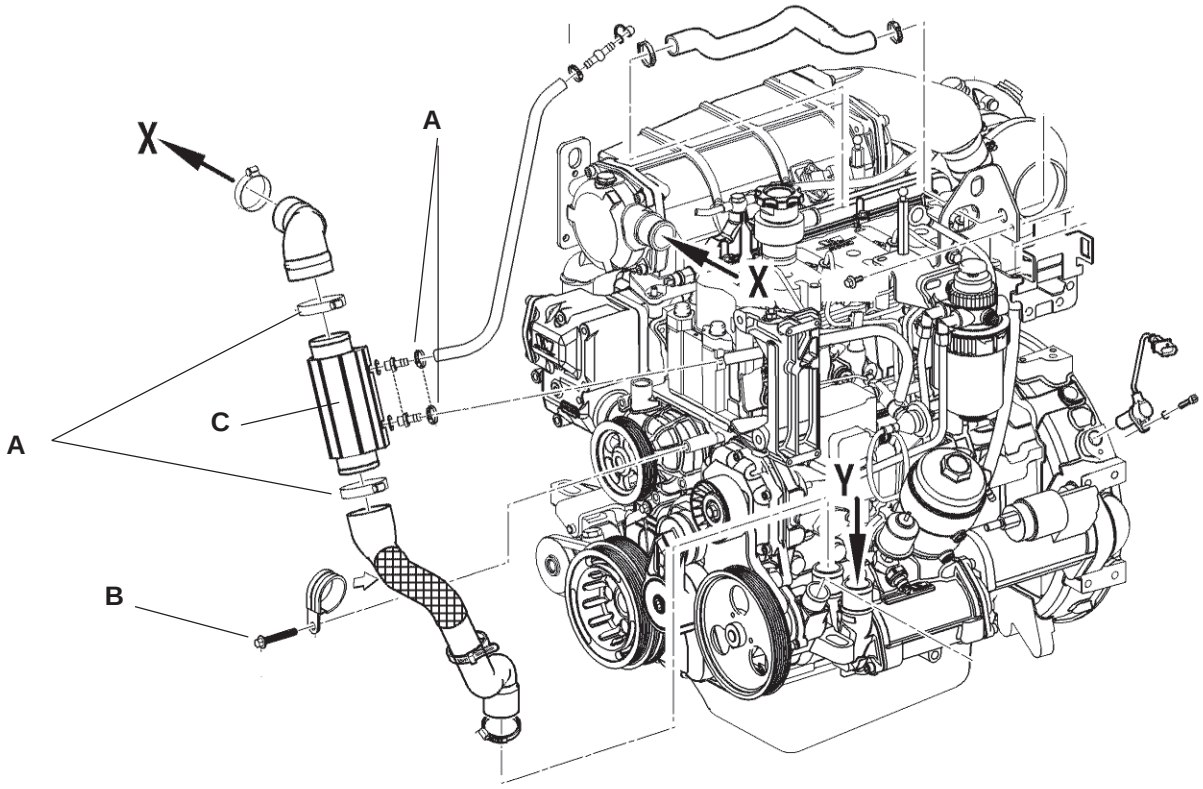
Pull the exchanger **C** out.



Fuel exchanger MD704LH/LS

Loosen clamps **A** and unscrew the screw **B**.

Pull the exchanger **C** out.

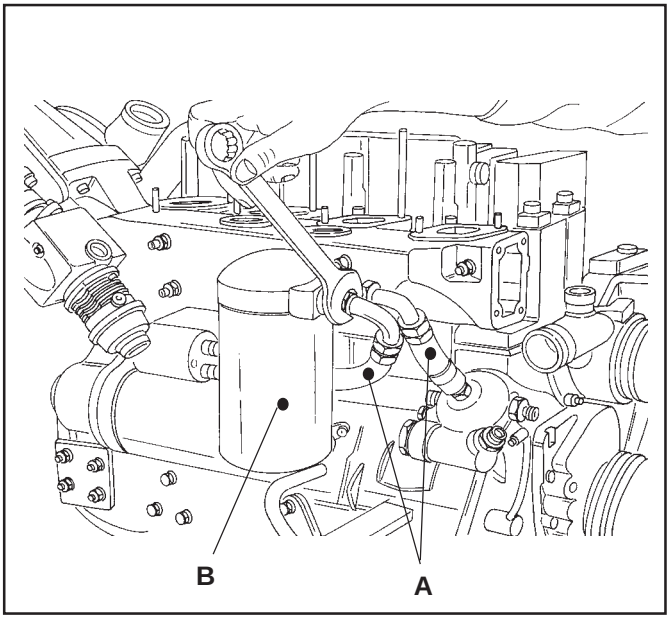


OIL FILTER/THERMOSTAT OIL VALVE

Oil filter MD700

Unscrew the fittings of pipes **A** connected to the filter support, remove the nuts that fix the support to the manifold and remove the group.

IF YOU HAVE TO REMOVE CARTRIDGE (B) WE RECOMMEND USING THE TYPICAL TOOL FOR REMOVING OIL FILTER CARTRIDGES.

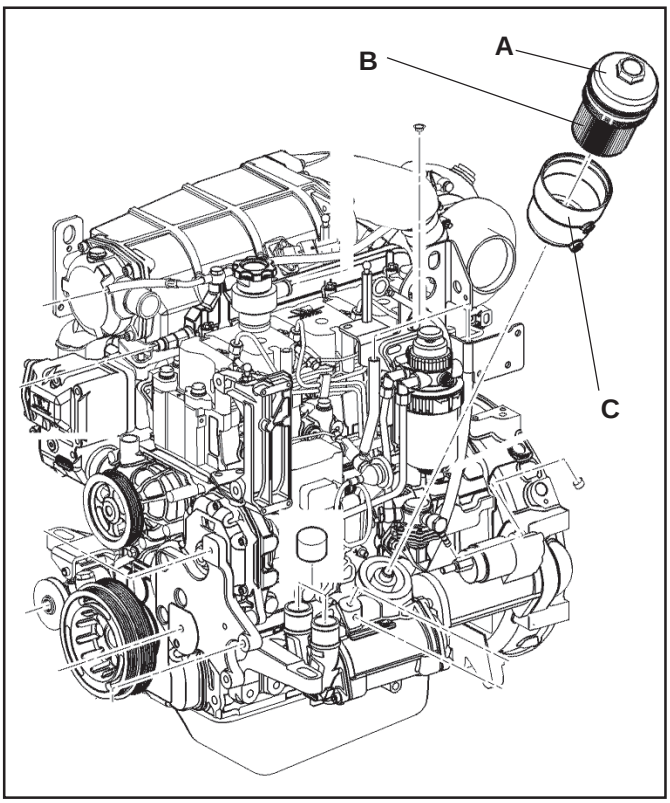


Oil filter MD704LH/LS

To remove oil filter cartridge **B**, use a commercial tool to unscrew the cap **A**.

Take care when unscrewing the cap: it is possible that the oil filter base **C** unscrews itself.

TO REMOVE CARTRIDGE (B) WE RECOMMEND USING THE TYPICAL TOOL FOR REMOVING OIL FILTER CARTRIDGES.

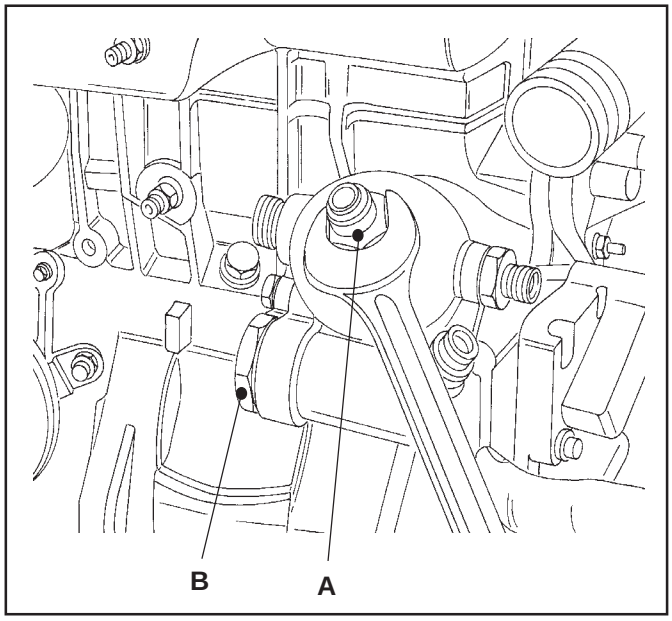


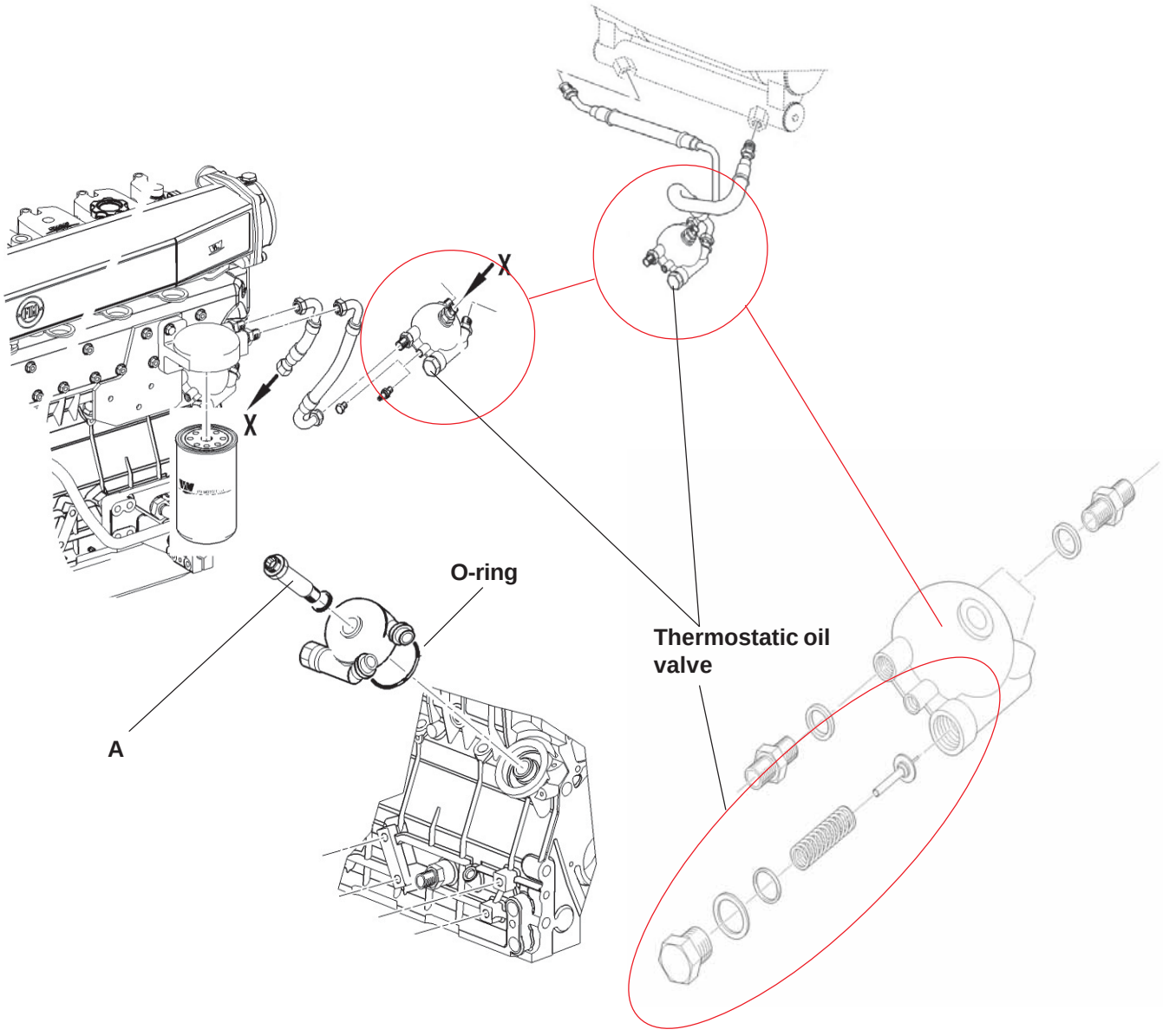
Oil thermostatic valve body MD700

Unscrew union **A** that fixes the crankcase and remove the valve body.

IF YOU HAVE TO REMOVE THERMOSTAT VALVE (B) WE RECOMMEND DOING THIS

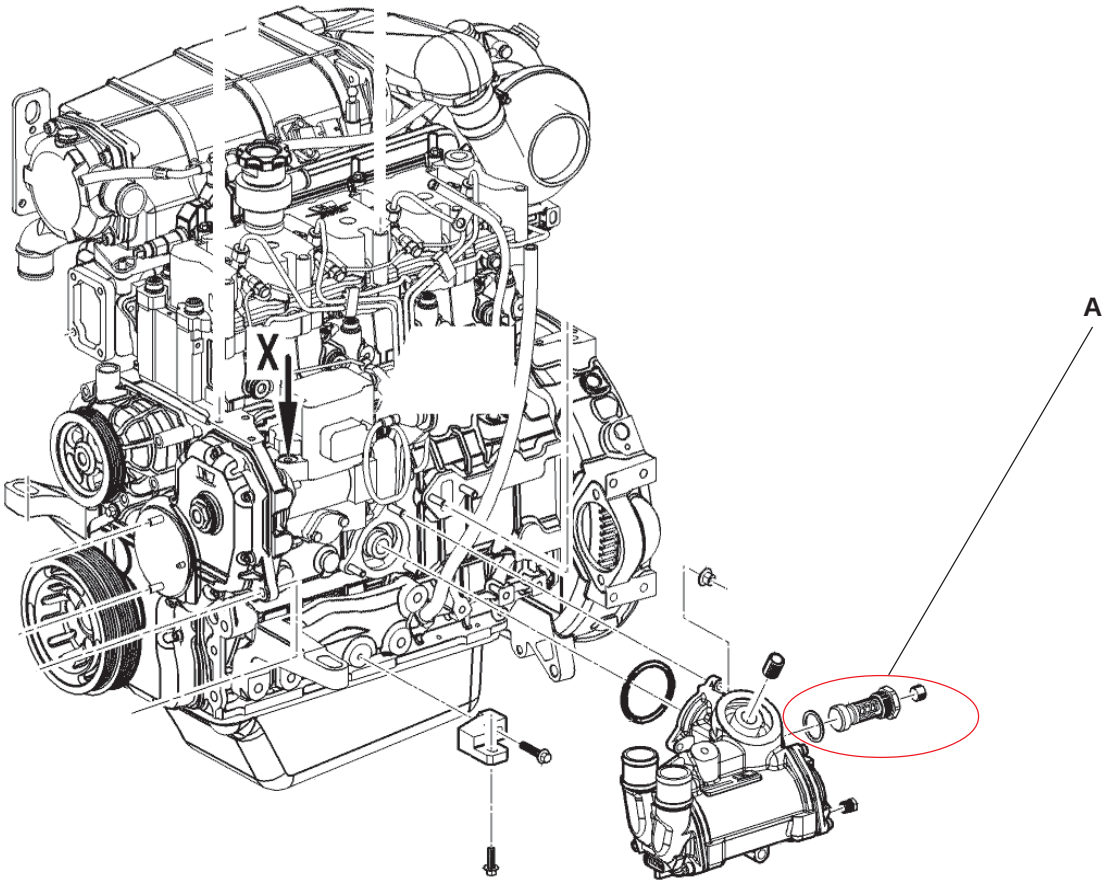
BEFORE REMOVING THE BODY OF THE CRANKCASE, WHICH MAKES THE OPERATION EASIER.





Oil thermostat valve body MD704LH/LS

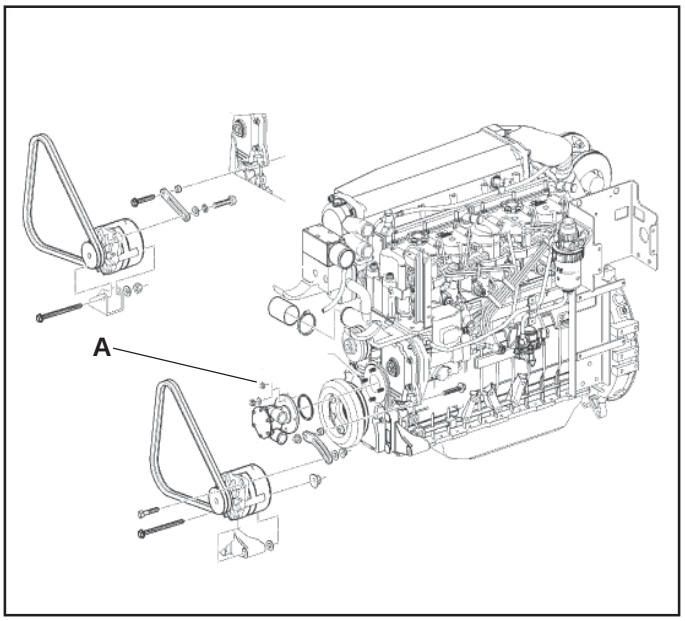
Unscrew valve **A** as shown in the picture.



SEA WATER PUMP

Sea water pump MD700

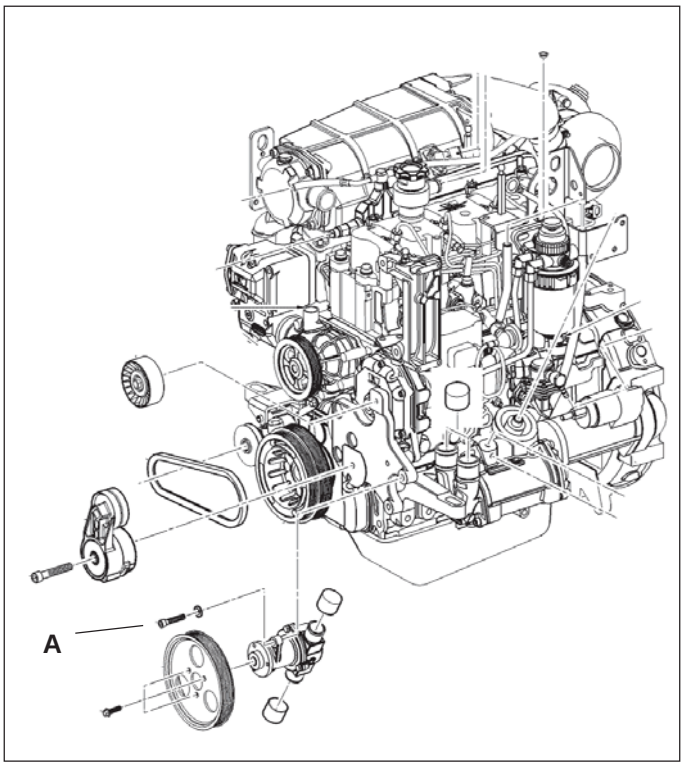
Unscrew fixing screws **(A)** and remove the pump.



Sea water pump MD704LH/LS

Remove Poly- V belt.

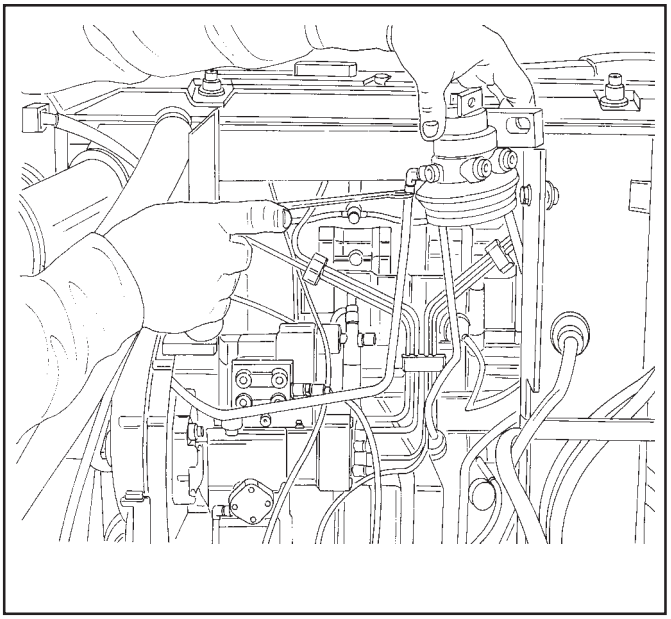
Remove screws **A**.



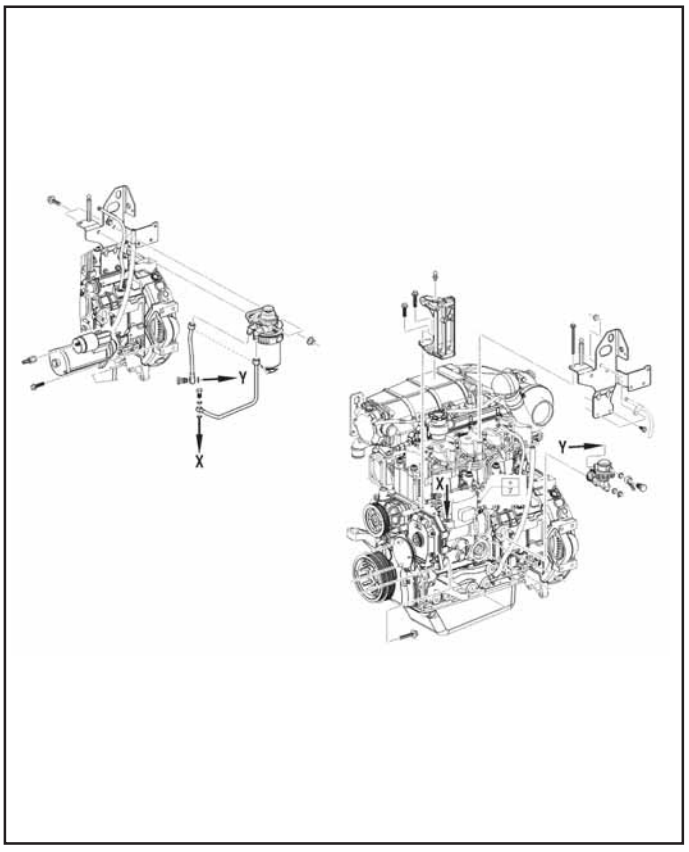
FUEL FILTER

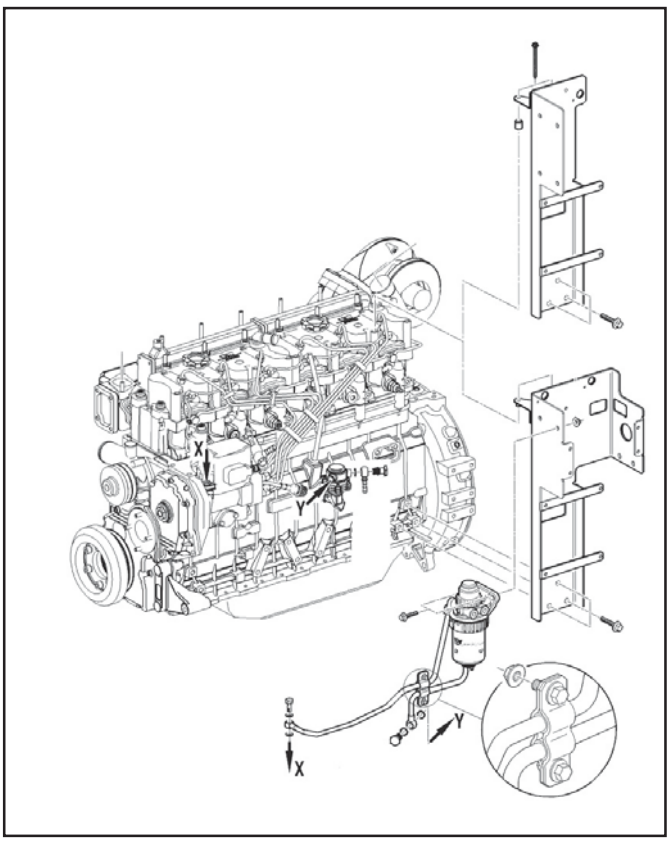
Fuel filter

Remove the diesel filter, the relevant support and the series of pipes connected to it.



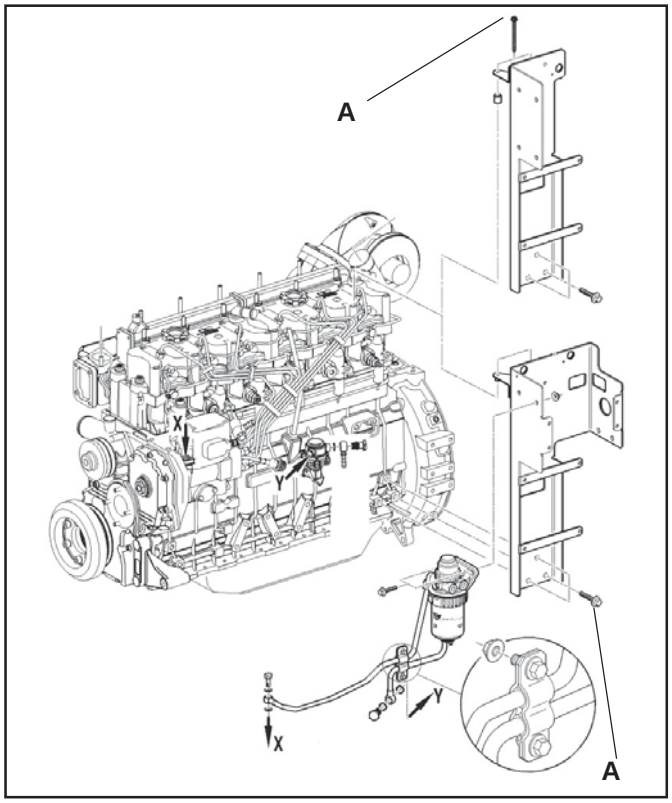
MD704LH-LS

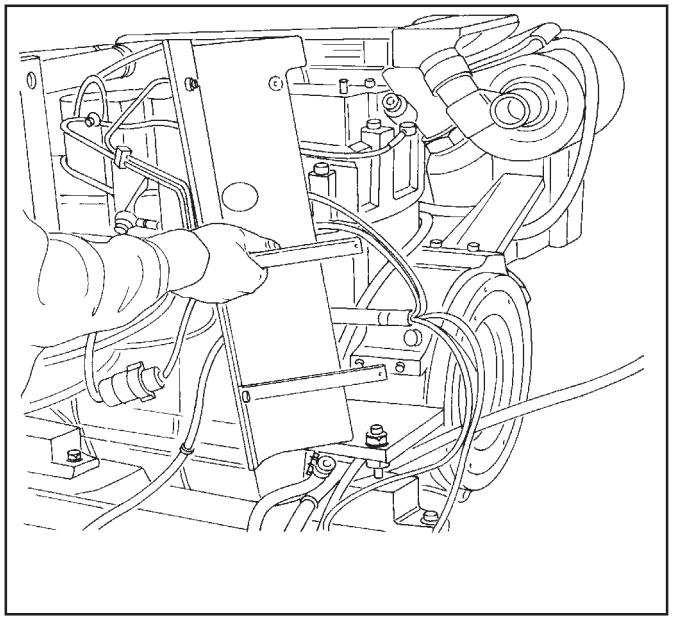




Fuel filter support MD700

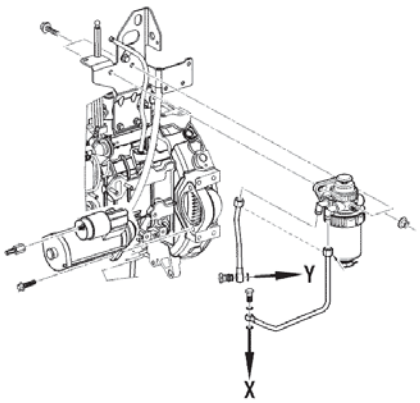
Unscrew the fixing screws **A** holding the bracket to the crankcase and remove it.

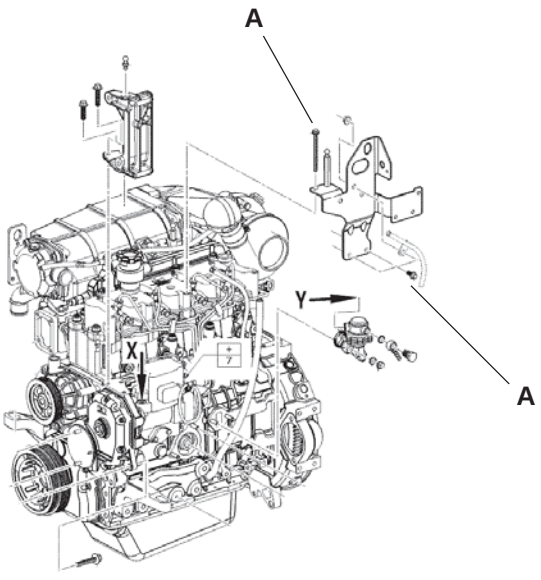




Fuel filter support MD704LH/LS

Unscrew the fixing screws **A** holding the bracket to the crankcase and remove it.

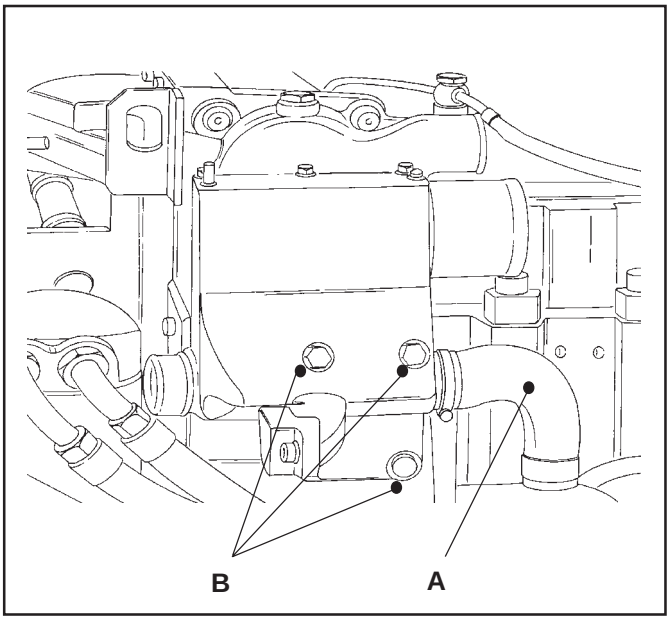


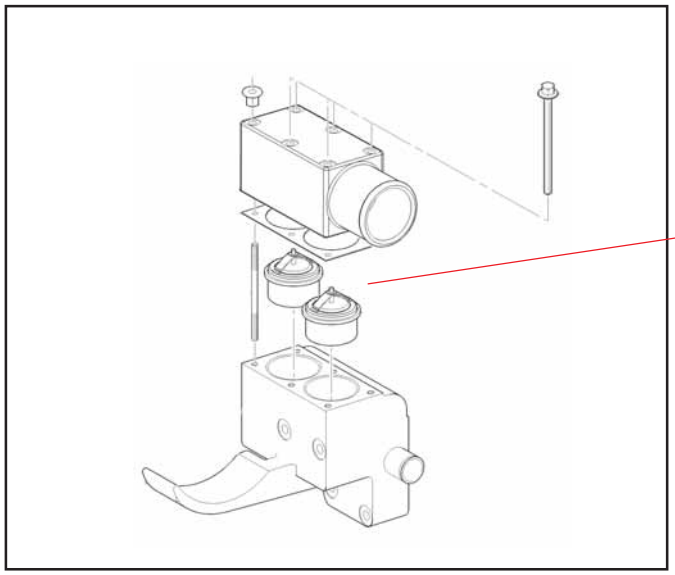


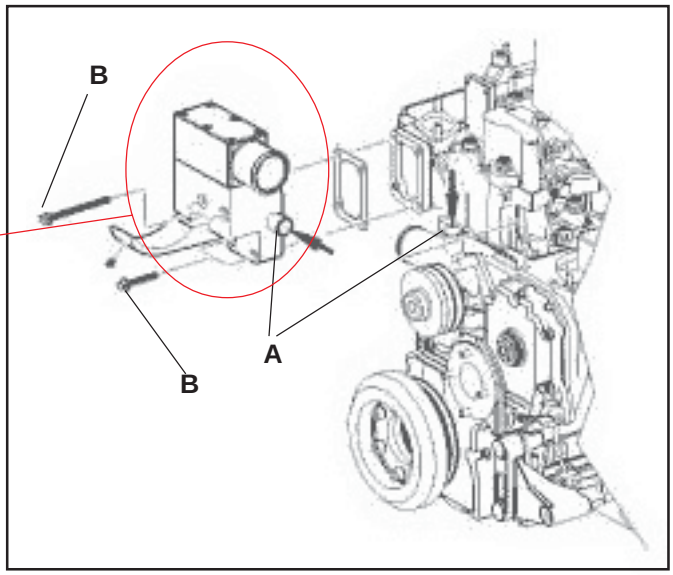
THERMOSTAT VALVE BODY

Thermostat valves body MD700

Remove the pipe connecting fresh water pump (**A**), unscrew the bolts that fix the body to the exhaust manifold (**B**) and remove it.

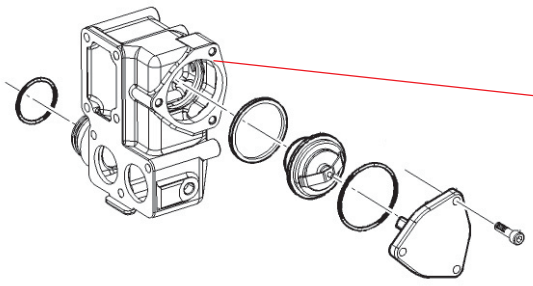


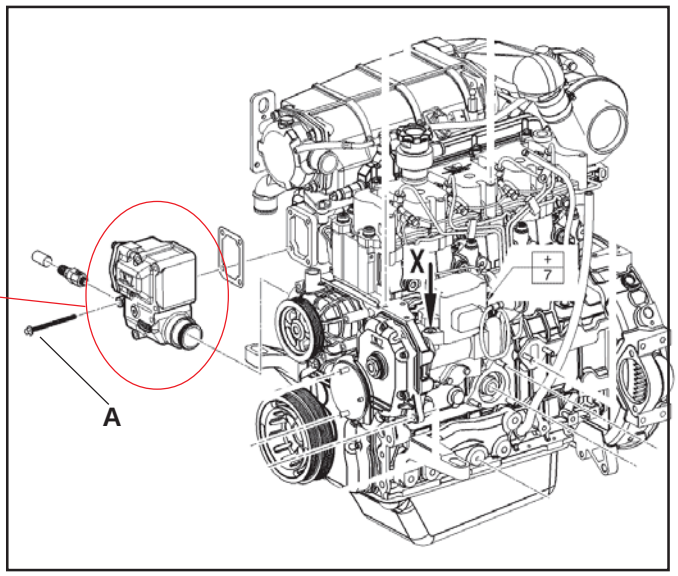




Thermostat valve body MD704LH/LS

Unscrew the screws **A**.



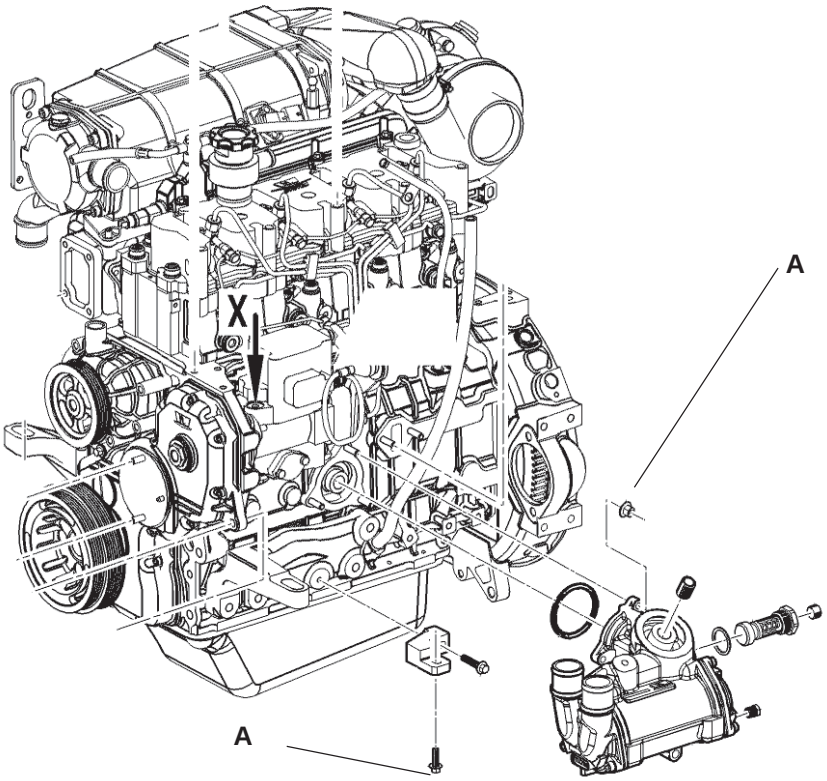


HEAT OIL EXCHANGER

Oil exchanger MD704LH/LS

Unscrew the screw **A**.

Remove heat oil exchanger.

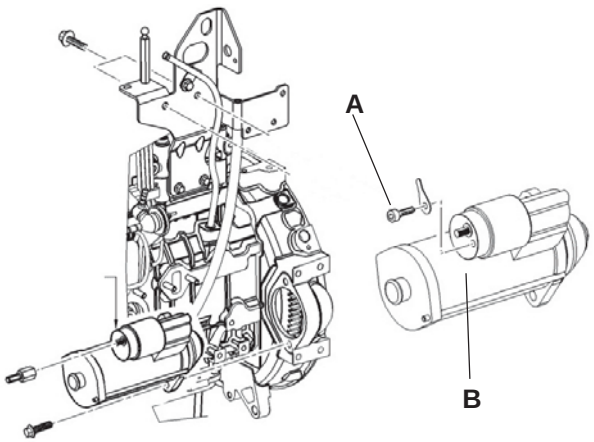


STARTER MOTOR

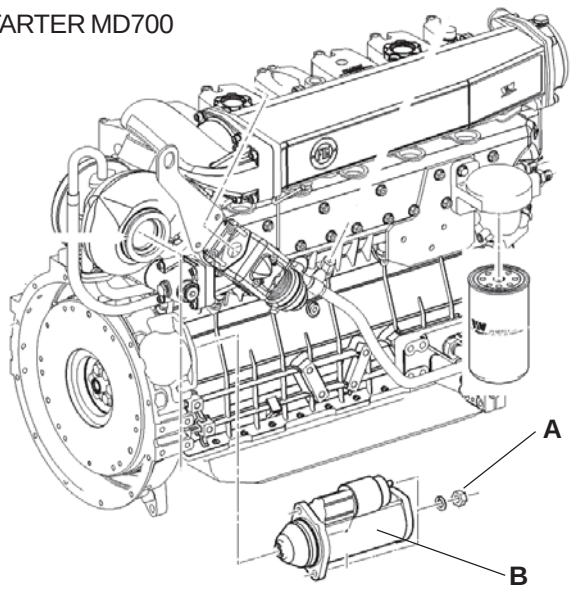
Unscrew and remove nuts **(A)** and dismantle starter motor **(B).**

TO UNSCREW THE TOP LOCKNUT AS SPACE IS RESTRICTED, WE RECOMMEND USING SPECIFIC TOOL (TAB. 11.1 ref. X)

STARTER MD704LH/LS



STARTER MD700

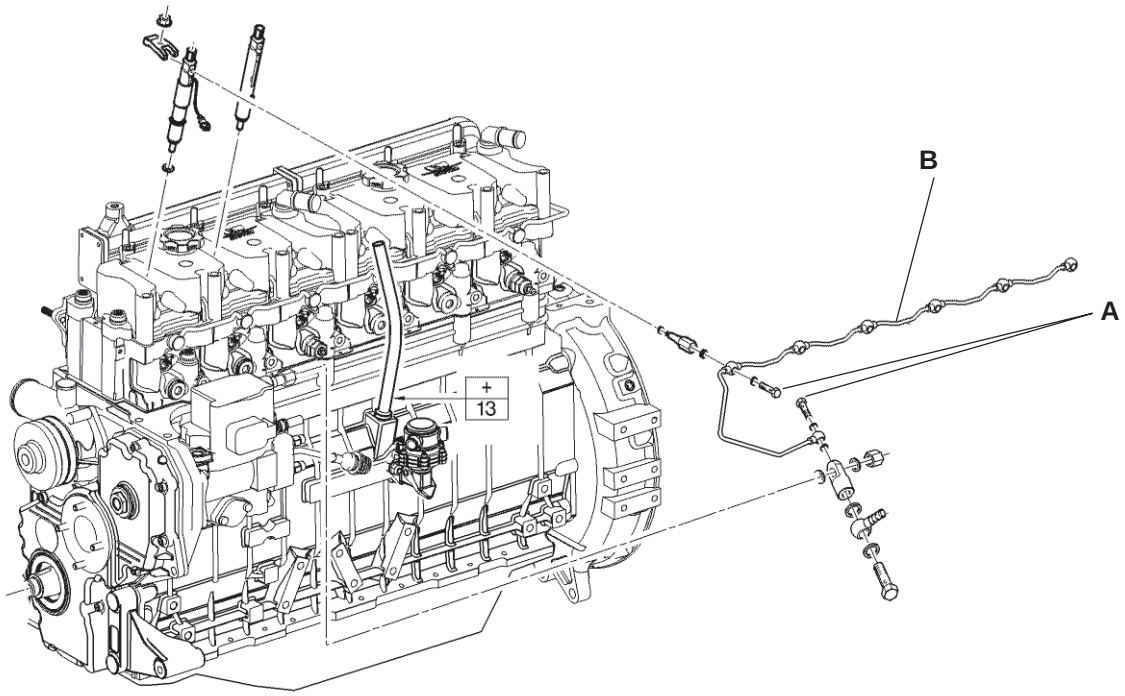


INJECTORS PIPES

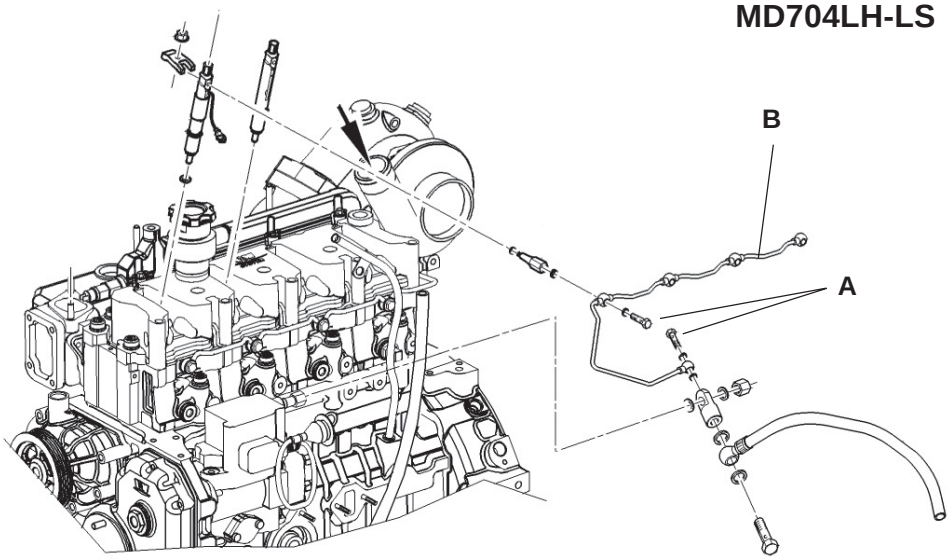
Waste diesel from injectors

Unscrew the unions fixing **A** the injectors and remove the diesel waste pipe **B**.

MD700

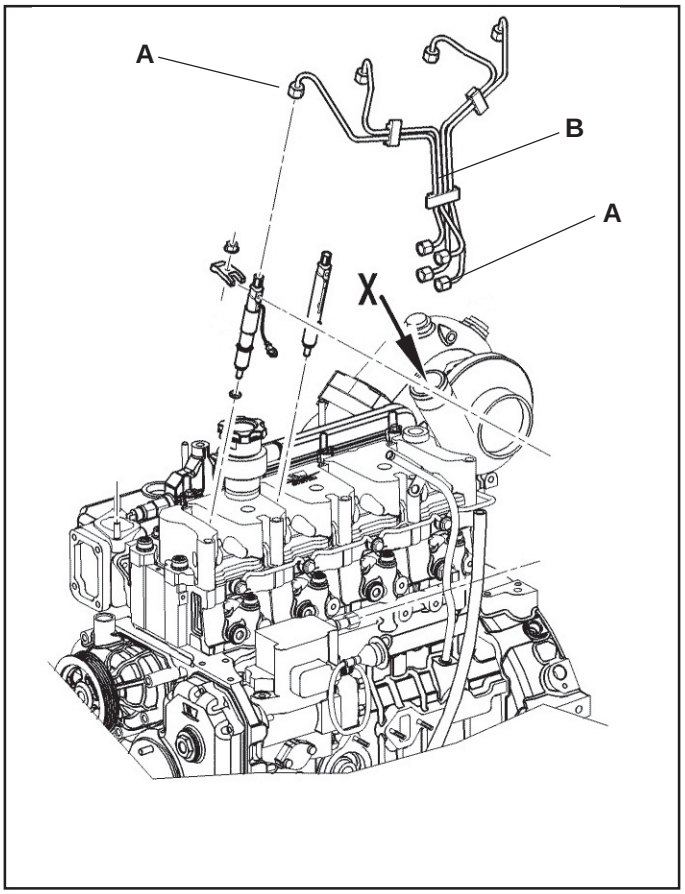


MD704LH-LS



Injectors delivery pipes

Unscrew the nuts **A** fixing the injectors and the pump and remove the pipes **B**.

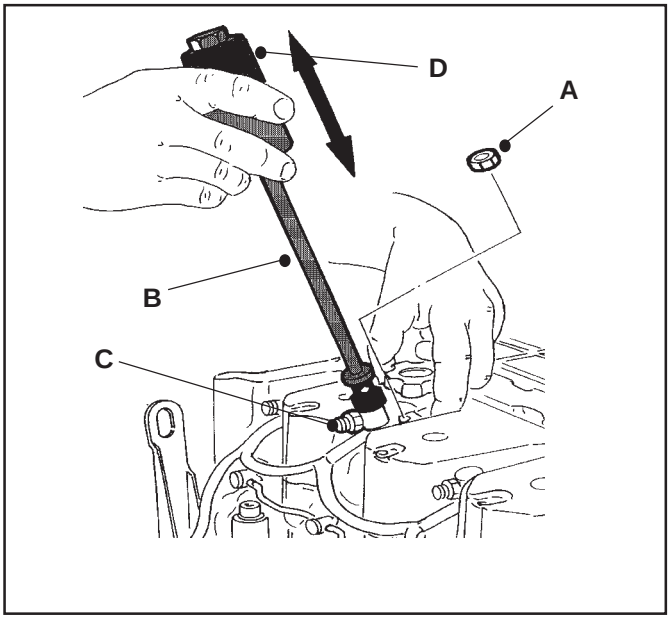


INJECTORS

Injectors

Unscrew fixing nut **A**. Insert special tool **B** **(TAB. 11.1 ref. B and adaptor AA)**, in injector **C** as indicated.
Proceed by dismantling, acting alternatively on the striker **D** in the direction indicated in the figure.

TO HELP FREE THE INJECTOR, IF NECESSARY, TURN THE INJECTOR BODY CLOCKWISE/ANTICLOCKWISE, HELPING TO REMOVE ANY EXCESS DRY PAINT.
REPEAT THE OPERATION FOR EACH INJECTOR ON THE ENGINE.

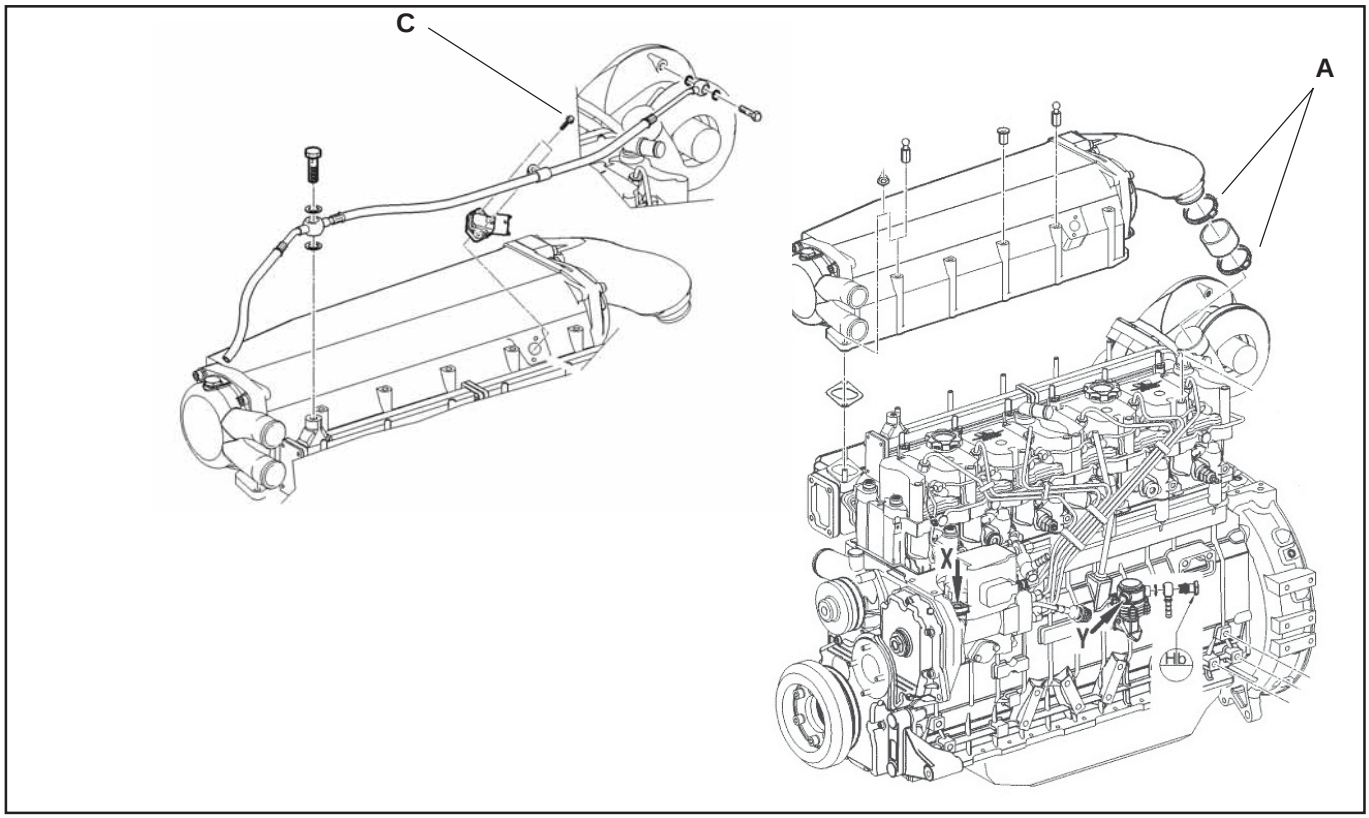


At the same time, keeping them parallel, pull out both the injector and the fixing bracket.

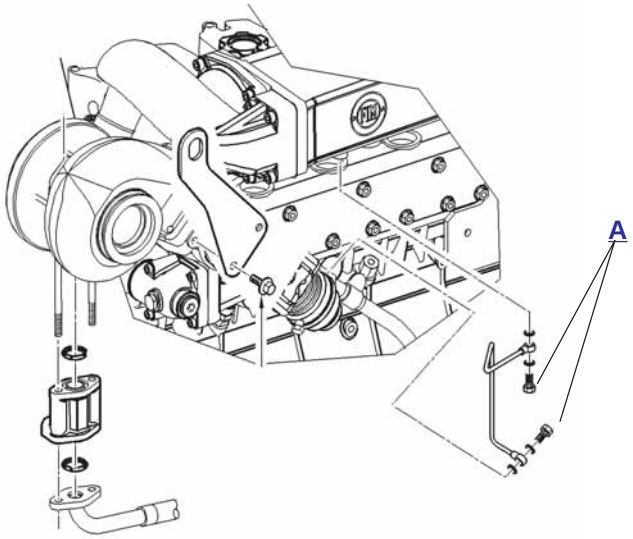
INTERCOOLER

Connection coupling turbo-intercooler MD700

Loosen clips (**A**) .
Remove screw (**C**).



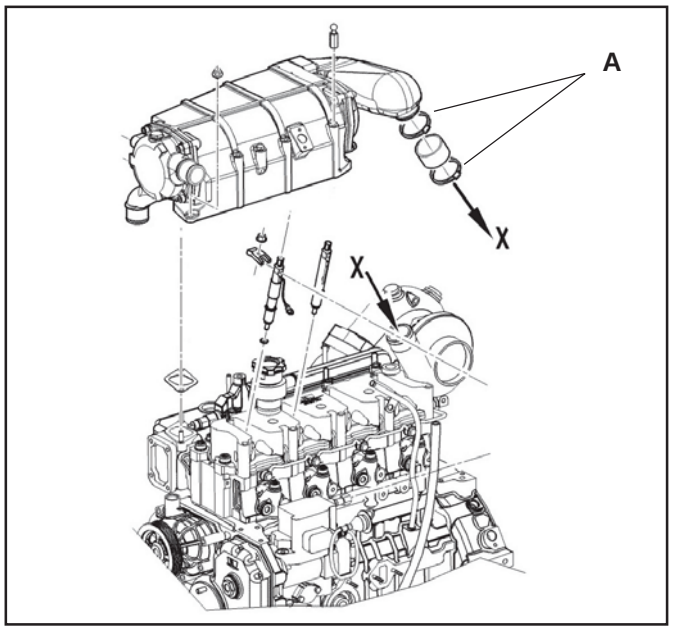
Remove pipe from waste gate and intercooler unscrewing the screws **A.**



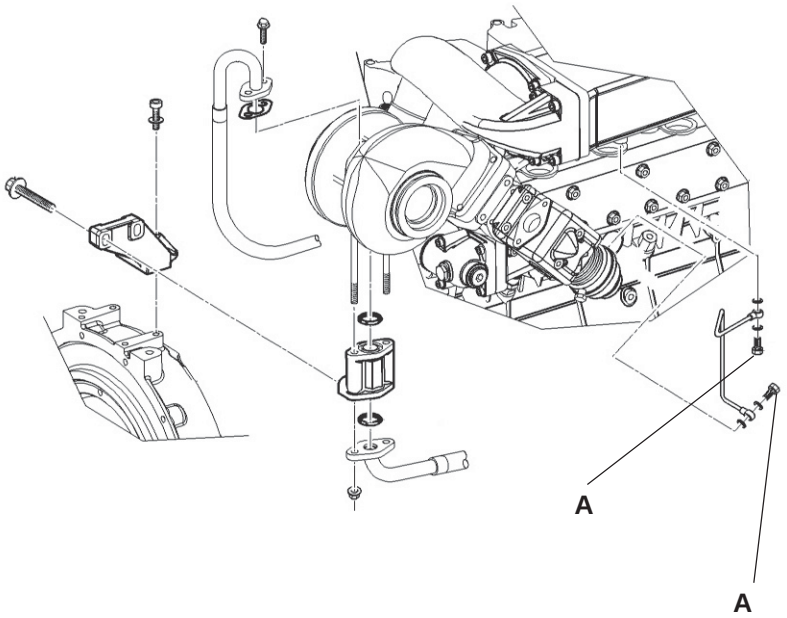
Connection coupling turbo-intercooler MD704LH-LS

Loosen clips (**A**) .

.

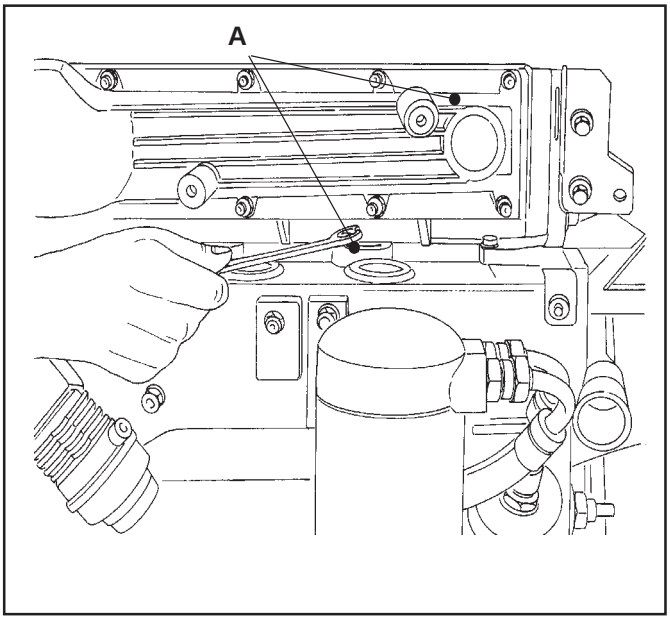


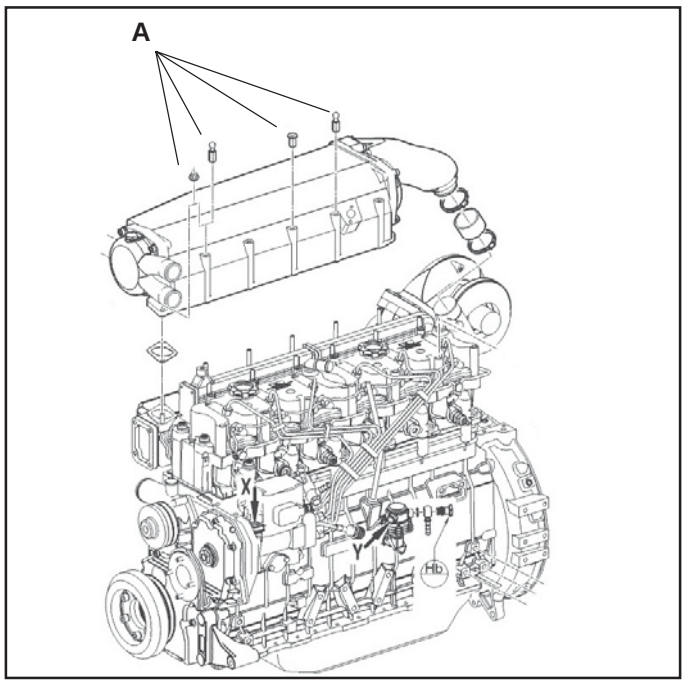
Remove pipe from waste gate and intercooler unscrewing the screws **A.**

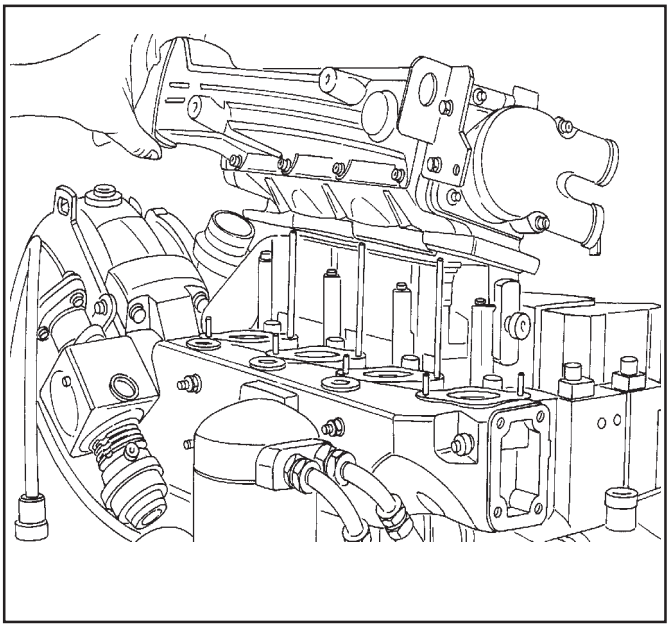


Intercooler MD700 (air / water exchanger)

Unscrew and remove nuts **A** from the fixing flange on the oil filter side and those on the top, with the long stud bolts.
Pull the intercooler off the stud bolts and remove it.

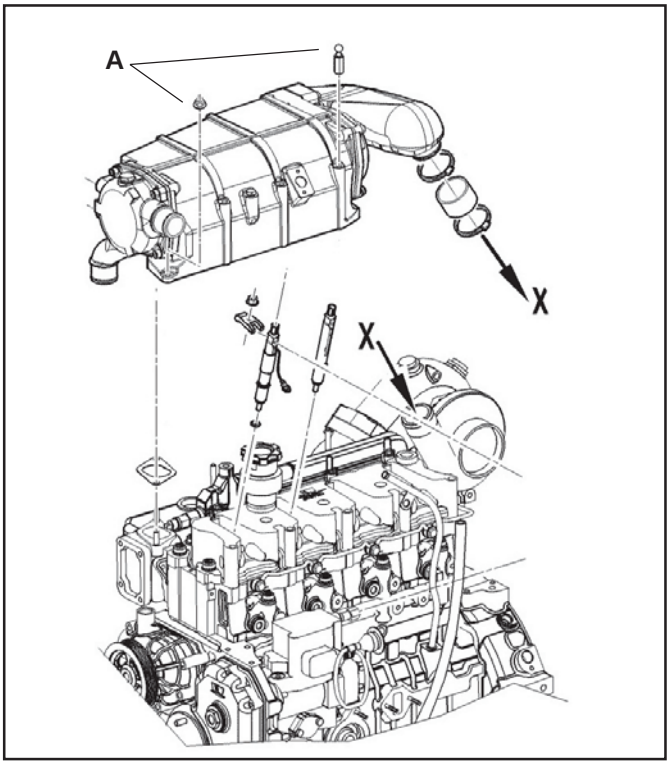






Intercooler MD704LH/LS (air / water exchanger)

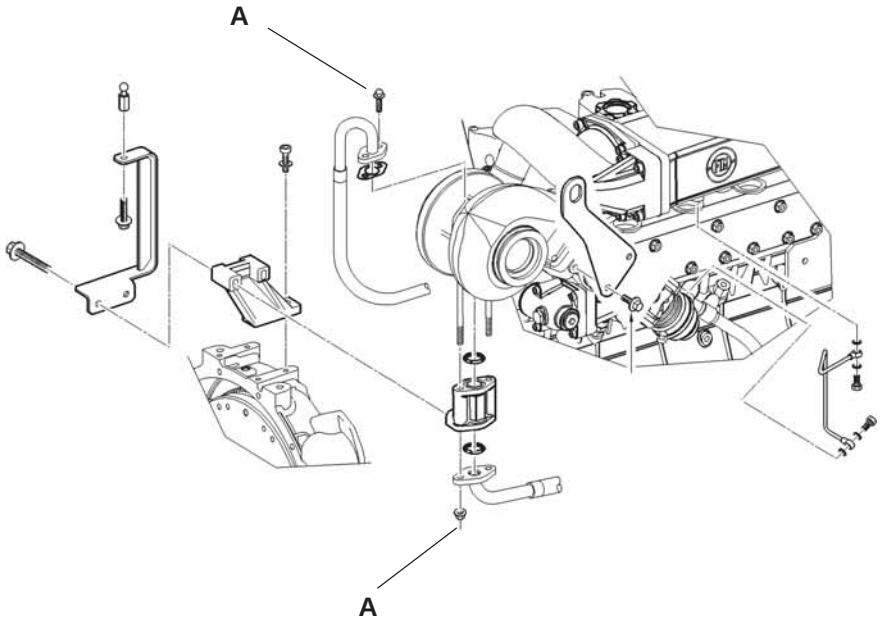
Unscrew and remove nuts **A** from exhaust side and those on the top, with the long stud bolts.
Pull the intercooler off the stud bolts and remove it.



TURBOCHARGER

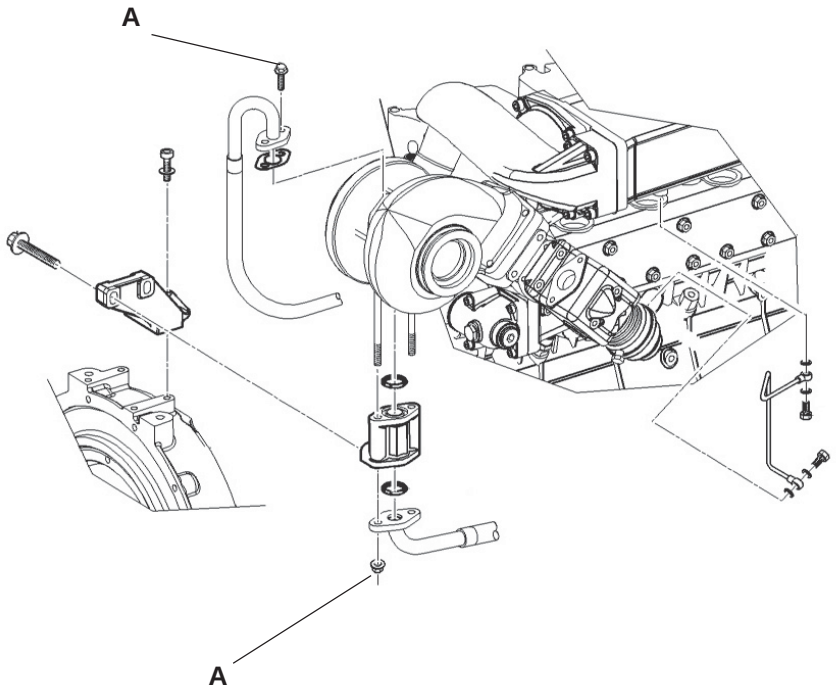
Oil pipes MD700

Remove the screws **A** as shown in the picture.



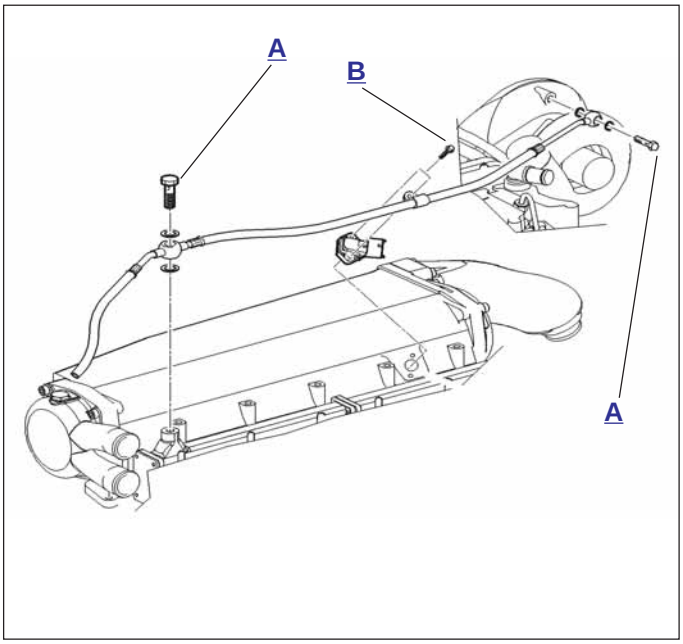
Oil pipes MD704LH/LS

Remove the screws **A** as shown in the picture.

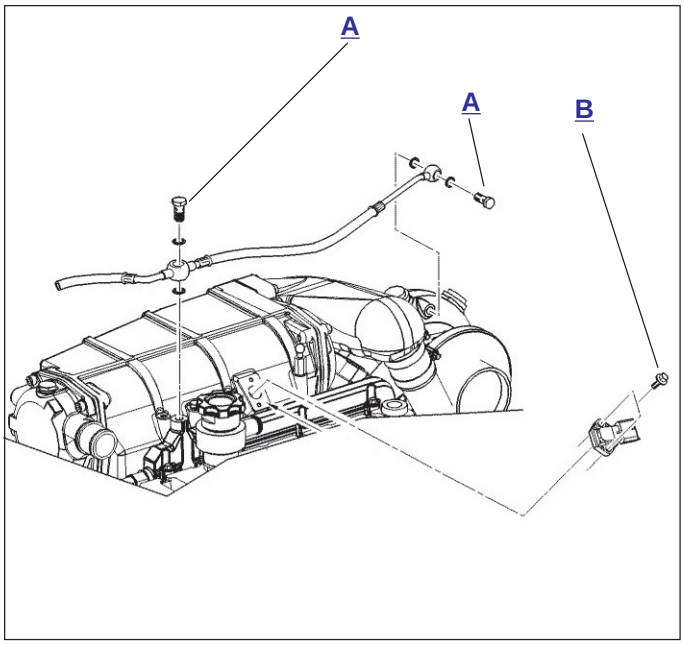


Water pipes MD700

Uncrew the connectors **A** and screw **B** as shown in the picture

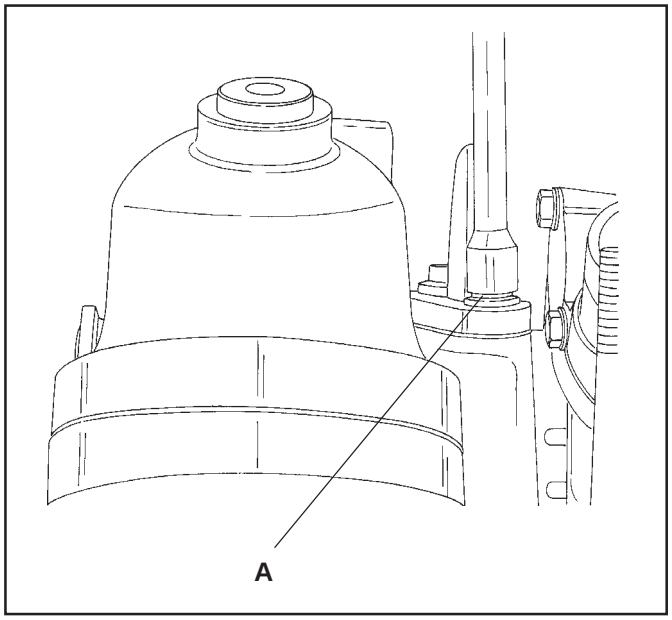


Water pipes MD704LH/LS

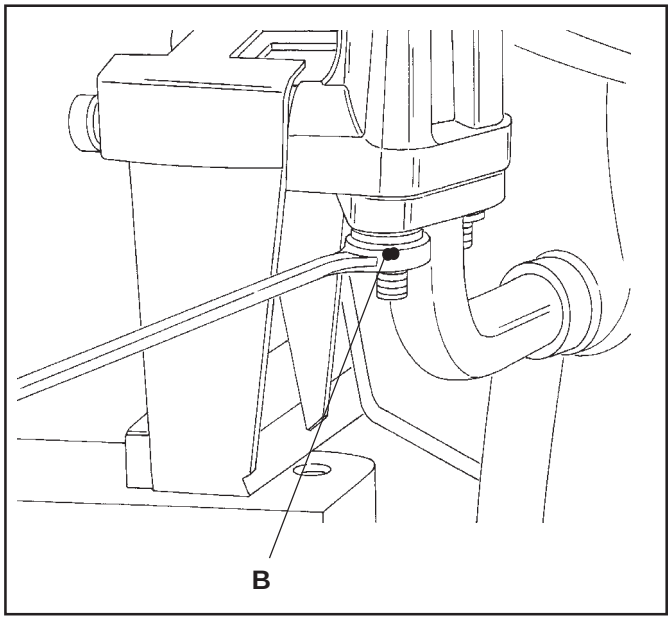


Turbocharger

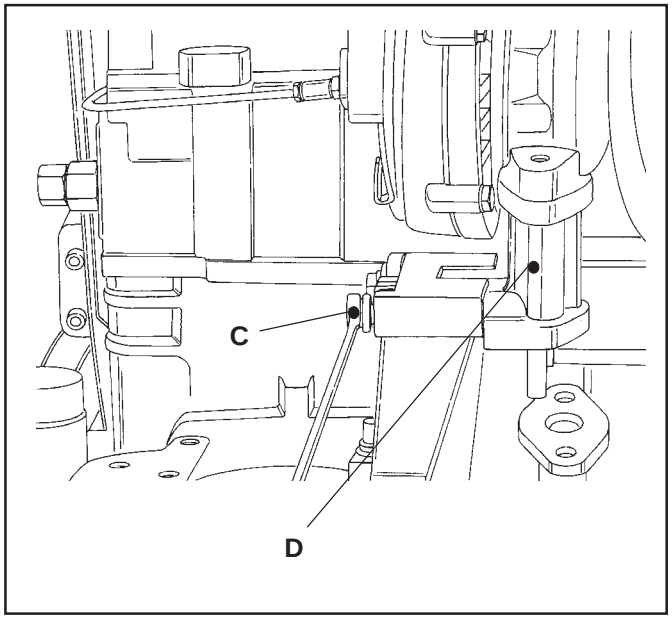
Unscrew and remove nuts **A** of the oil delivery pipe.



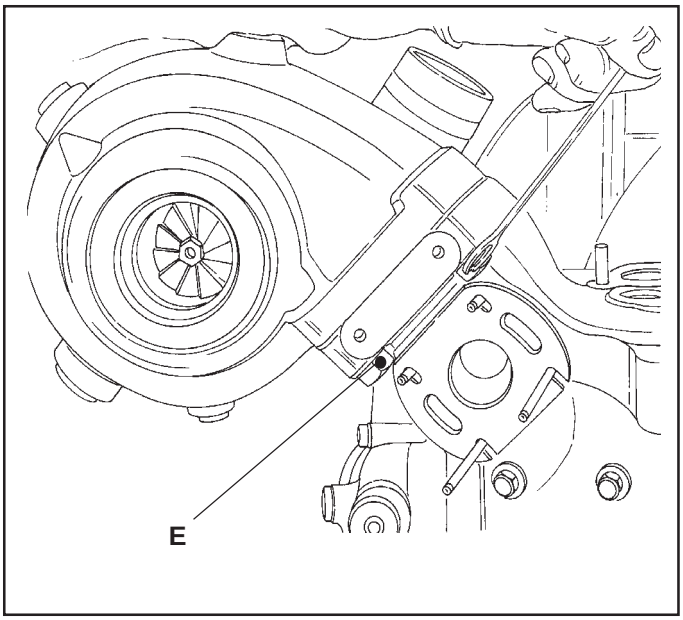
Unscrew and remove nuts **(A)** of the oil return pipe.

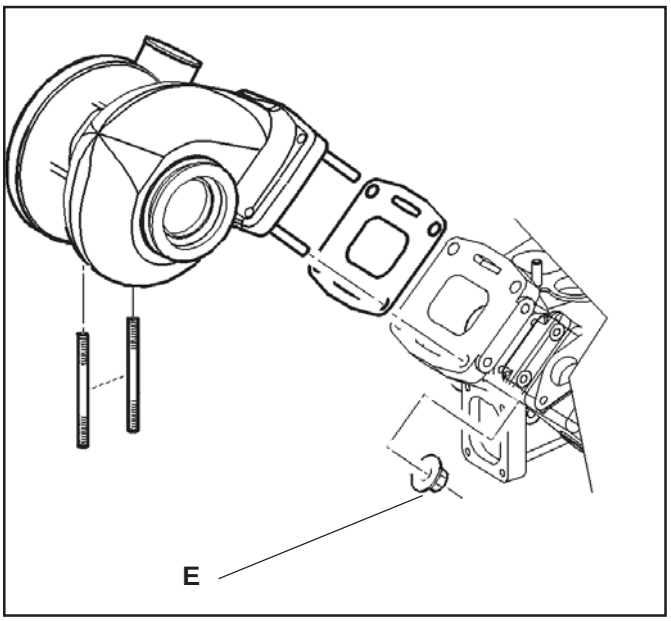


Unscrew and remove screws **(C)** from the support bracket and remove spacer **(D)**.



Unscrew and remove nuts **(E)** from the exhaust manifold, remove the turbo and the relevant gasket.

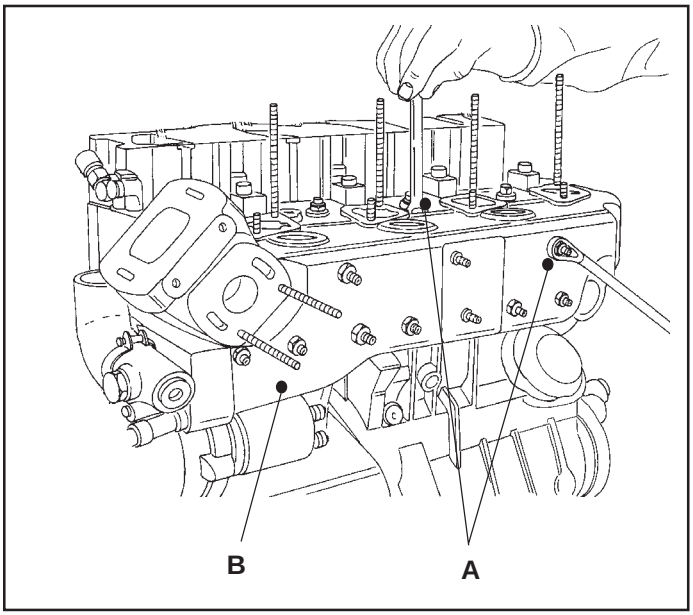


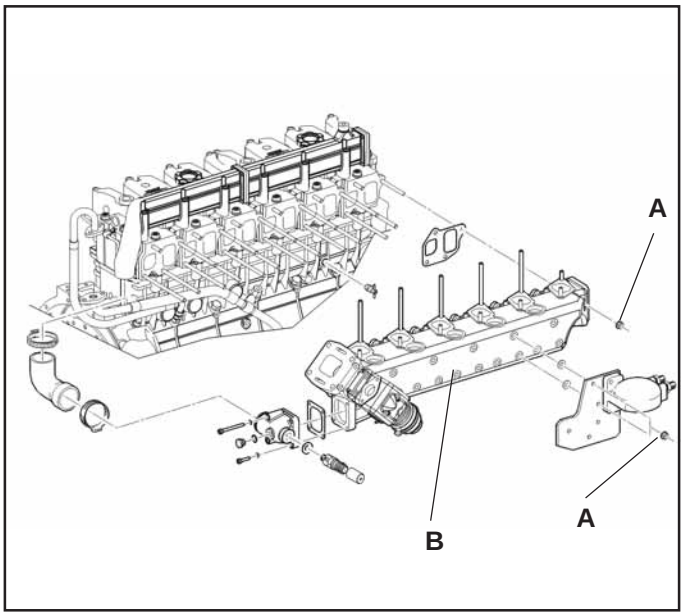


EXHAUST MANIFOLD

Exhaust manifold MD700

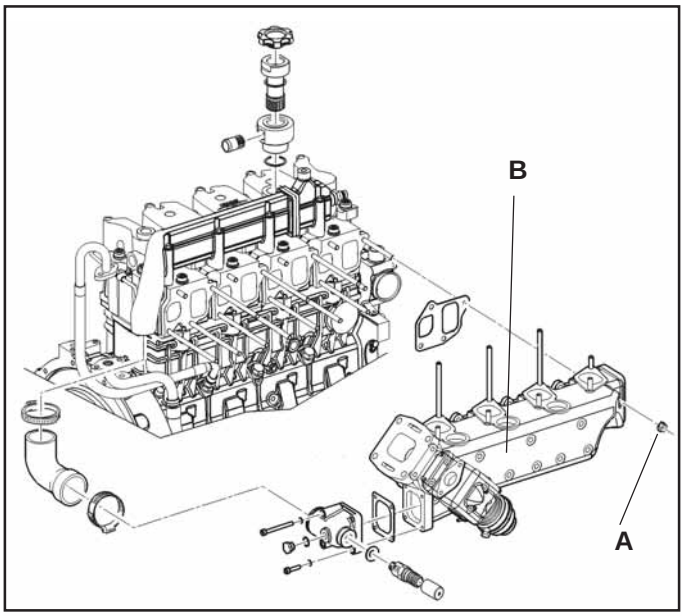
Unscrew and remove fixing nuts **(A)** and pull the manifold **(B)** off, outwards.



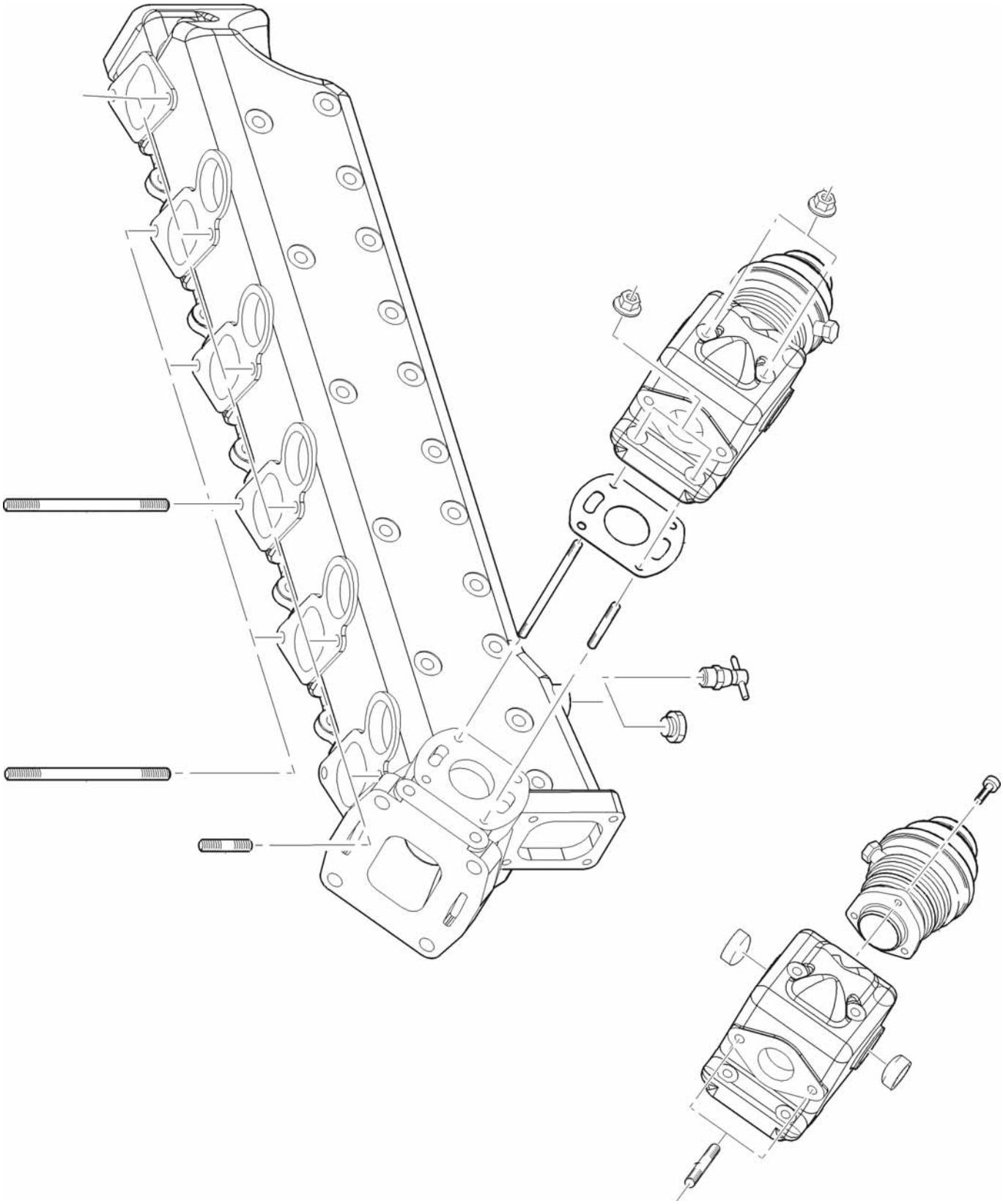


Exhaust manifold MD704LH/LS

Unscrew and remove fixing nuts **(A)** and pull the manifold **(B)** off, outwards.

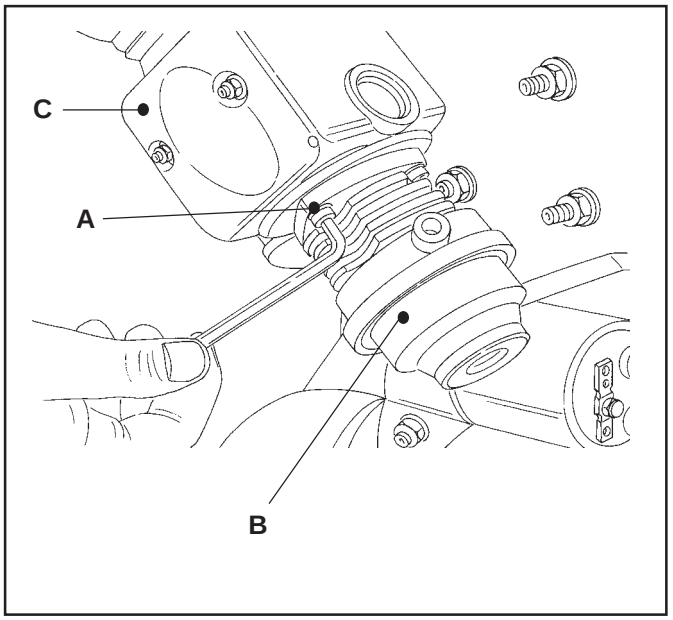


Exploded view (exhaust manifold MD700-MD704LH/LS)



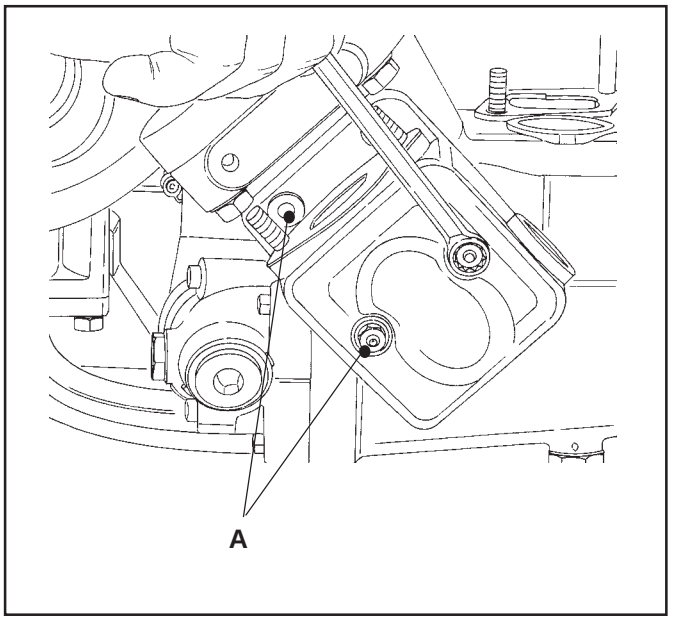
Waste gate valve

Unscrew fixing screws **A** and pull out valve **B** from body **C**.
If this operation is unnecessary, you can proceed by dismantling the complete body.



Waste gate body

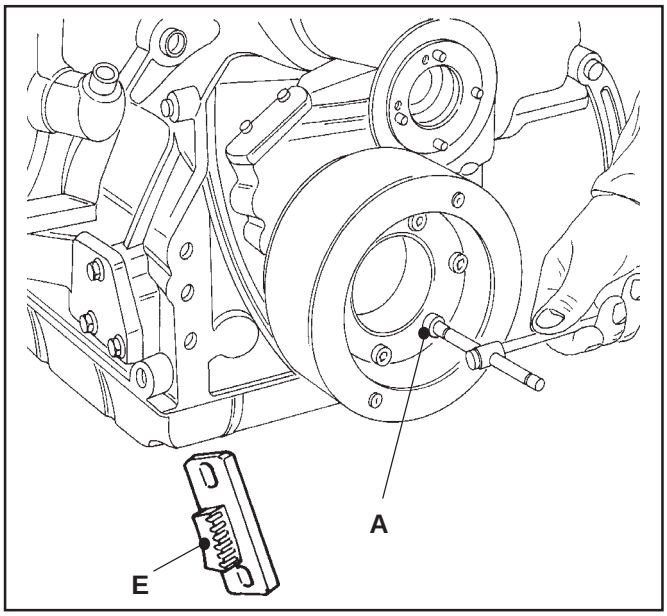
Unscrew the fixing nuts **A** and pull the body off the stud bolts.



FRONT PULLEY/DAMPER FLYWHEEL

Damper flywheel MD700

In place of the starter motor, insert special tool **(E)** **(TAB. 11.1 ref. T)** to block the rotation of the crankshaft.
Unscrew and remove screws **(A)** and dismantle the part.

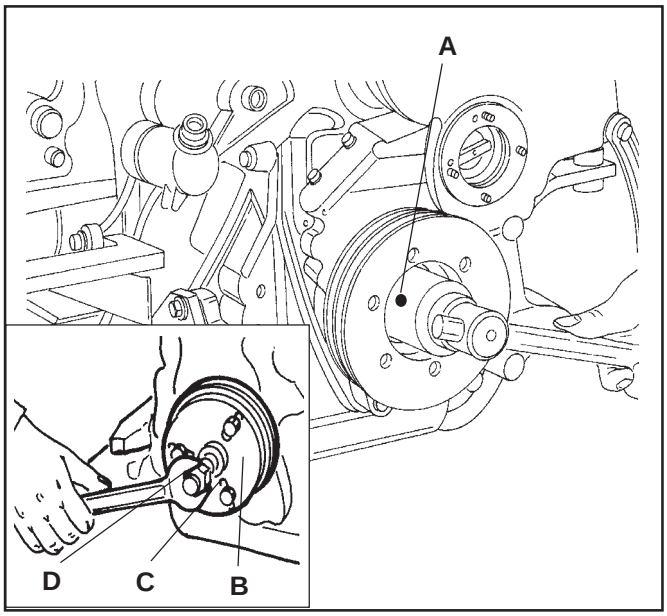


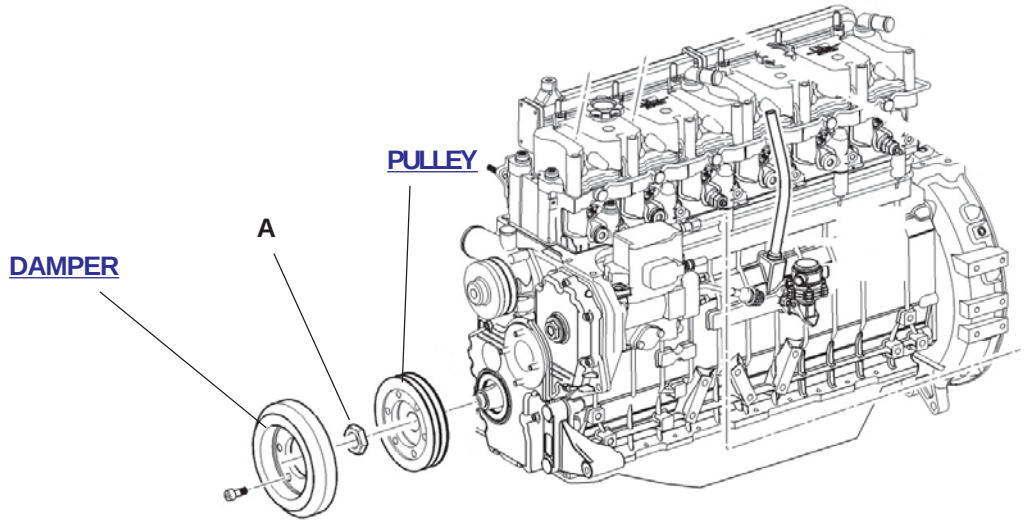
Front pulley MD700LI-MD706LB/LS/LH/LX/MS/MX

Unscrew locknut **(A)**.
Assemble special tool **(E)** **(TAB. 11.1 ref. A)** fixing body **(B)** to the pulley with normal screws **(C)**.
Screw in screw **(D)** until the pulley is free.

WARNING:

THE LOCKNUT OF THE PULLEY HAS A RIGHT HAND THREAD EXCEPT FOR ENGINE 706 LH/LS/LB/LX/MX/MS WHICH HAS A LEFT HAND THREAD.



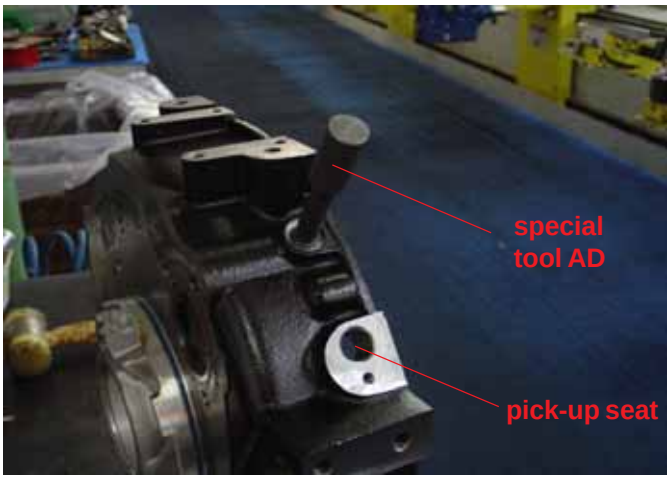


Damper flywheel MD704LH/LS

In place of the starter motor, insert special tool **(TAB. 11.1 ref. T)** or special tool **(TAB. 11.1 ref. AD)** to block the rotation of the crankshaft.

Insert special tool AD above pick-up seat when the 1st piston is at TDC

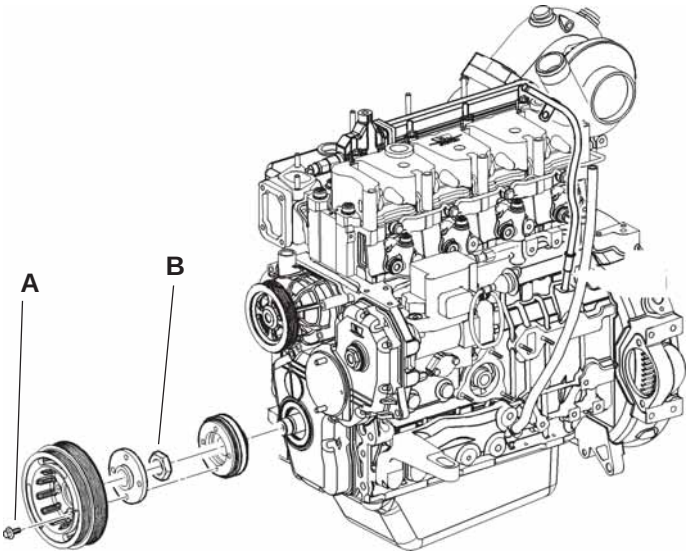
Unscrew and remove screws **(A)** and dismantle the part.



Front pulley MD704LH/LS

Remove the nut **B**.

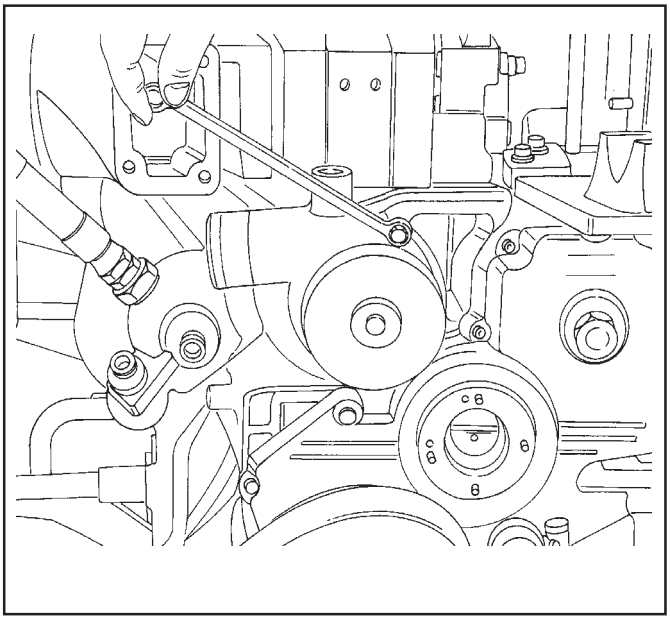
WARNING:
THE LOCKNUT OF THE PULLEY HAS A LEFT HAND THREAD.



FRESH WATER PUMP

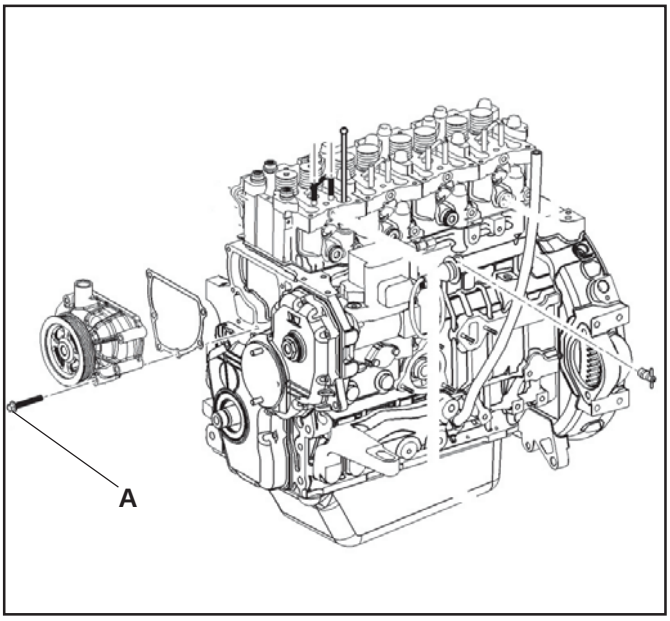
Fresh water pump MD700

Unscrew and remove the screws that fix the water pump to the crankcase and remove it.



Fresh water pump MD704LH/LS

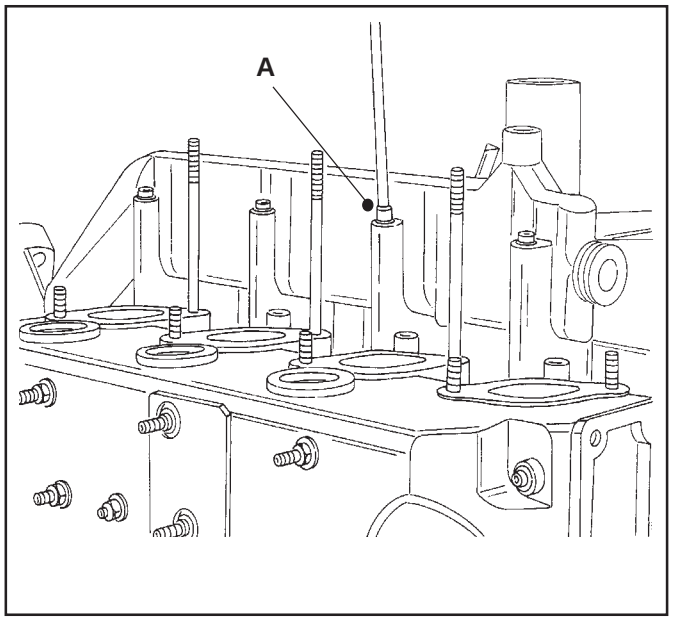
Remove screws **A**.



WATER MANIFOLD

Head water drain pipe

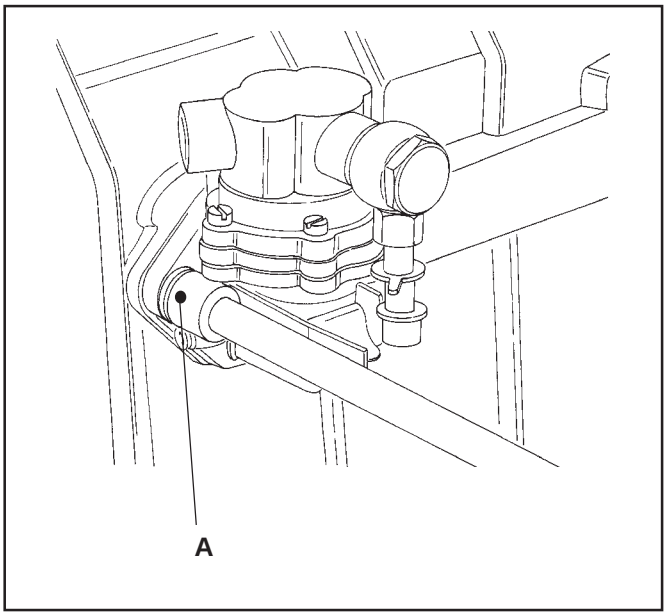
Unscrew and remove screws **(A)** and dismantle the part.



FUEL FEED PUMP

Fuel feed pump (AC)

Unscrew and remove screws **(A)** and dismantle the part.

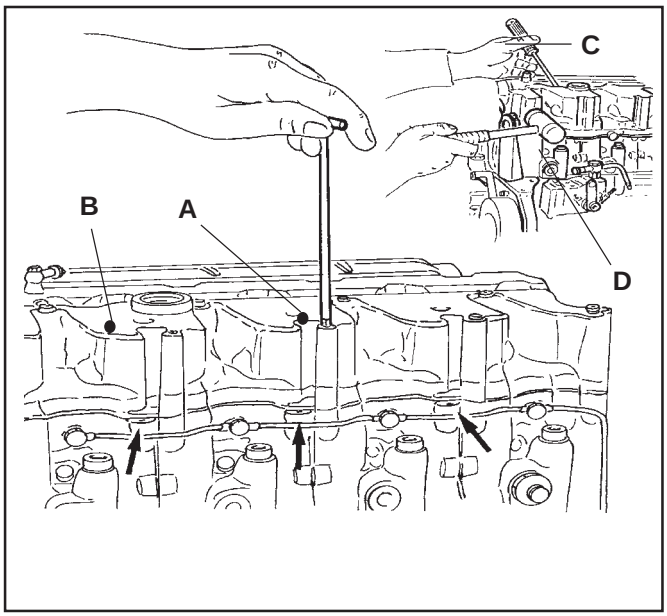


ROCKER ARM

Rocker arms cover

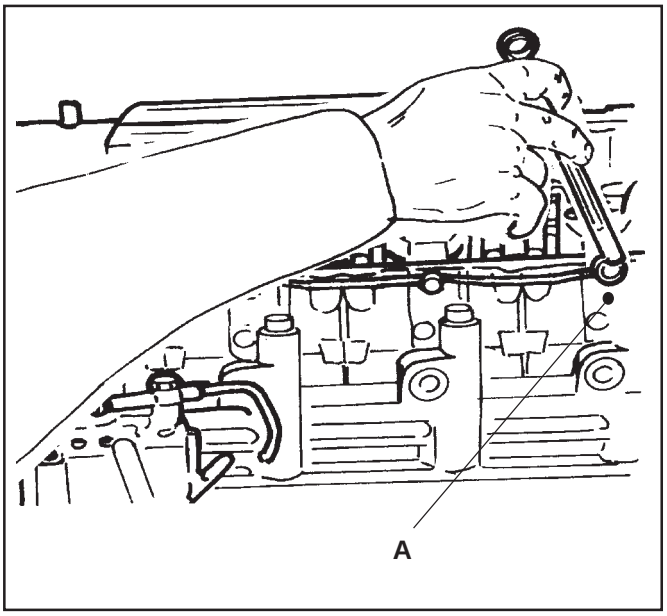
Remove fixing screws **(A)** of heads' cover **(B)**.
Proceed with dismantling the same.

IF NECESSARY, INSERT A SCREWDRIVER (C) IN THE SLOT AND WITH THE HELP OF A RUBBER MALLET (D) TAP THE CARTER LIGHTLY UNTIL THE GASKET PEELS OFF.



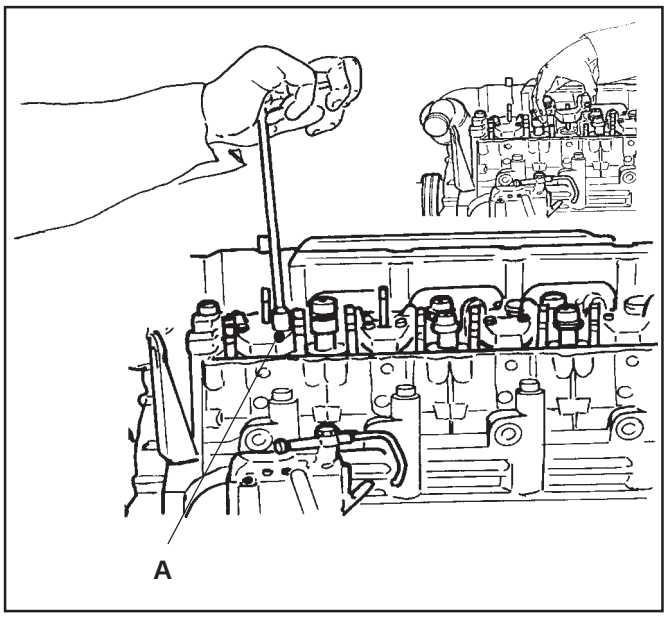
Rocker arms lubrification pipe

Unscrew fixing unions **(A)** of the heads, from the crankcase and remove the pipe.



Rocker arms

Unscrew nuts **(A)** to free the rocker arms.
Proceed by dismantling the rocker arms, pulling them off, upwards by hand.

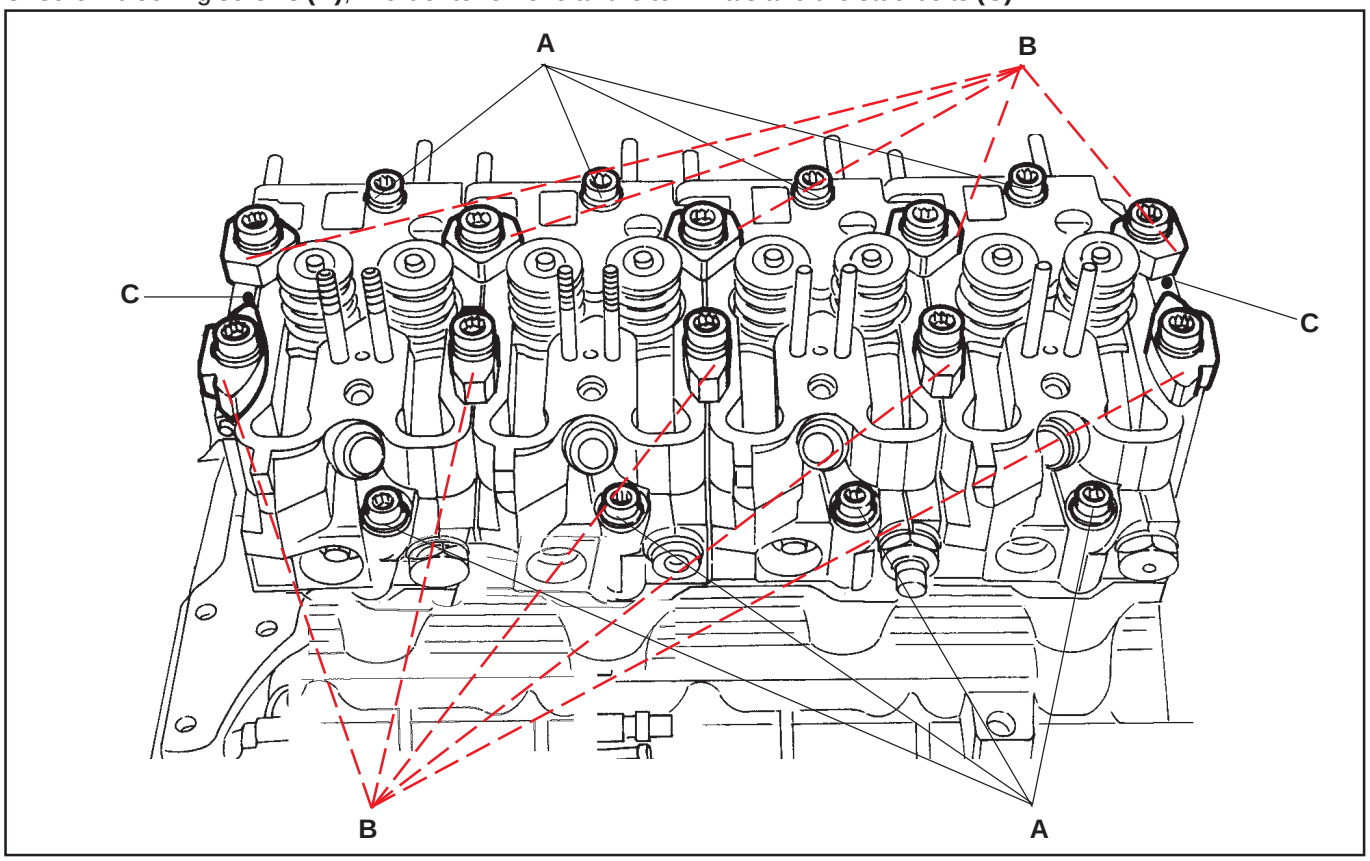


CYLINDER HEAD

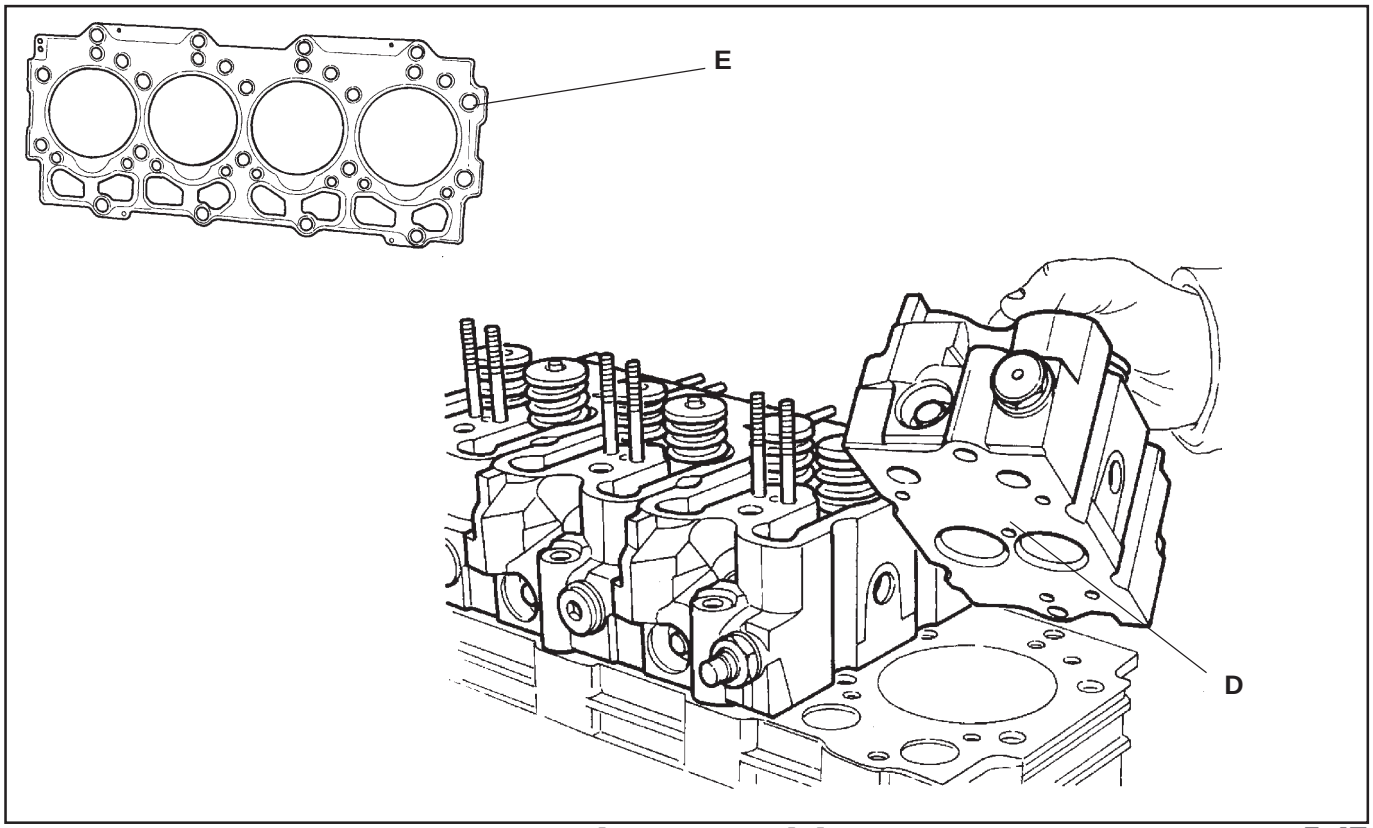
Head

Unscrew and remove the screws of head **(A)**.

Unscrew blocking screws **(B)**, in order to remove all the terminals and the stud bolts **(C)**.



By hand remove heads **(D)** and the relevant gasket **(E)** (4-cylinder engine in one piece, 6-cylinder engine in two pieces).

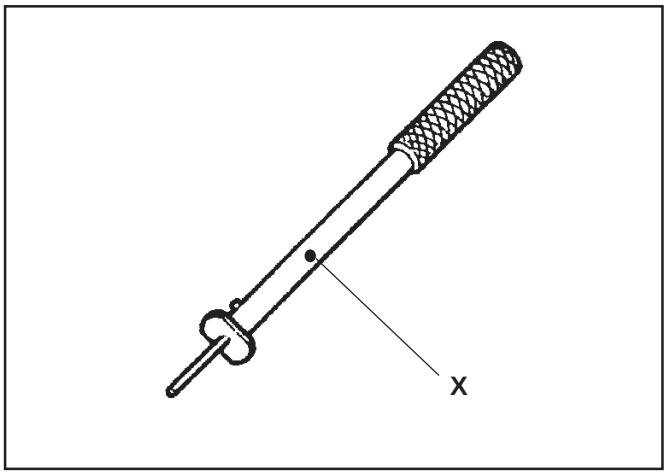


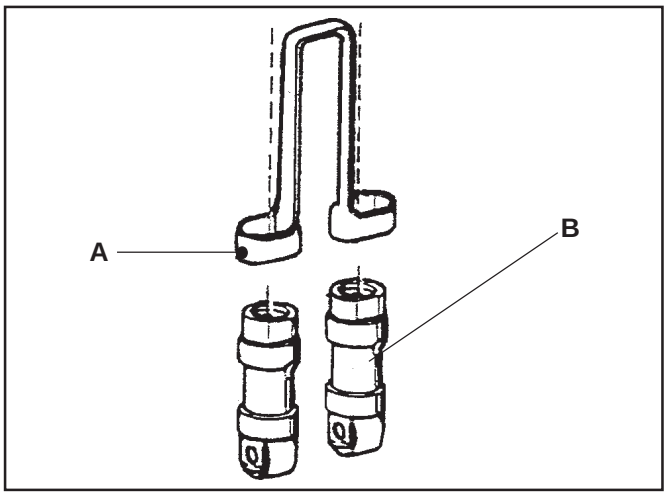
HYDRAULIC TAPPET

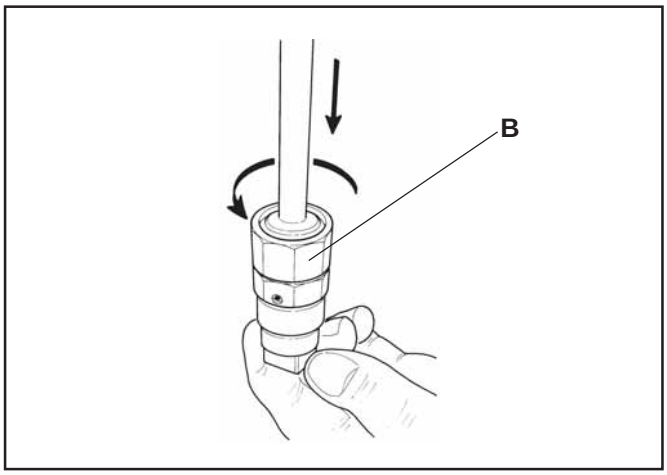
Hydraulic tappets

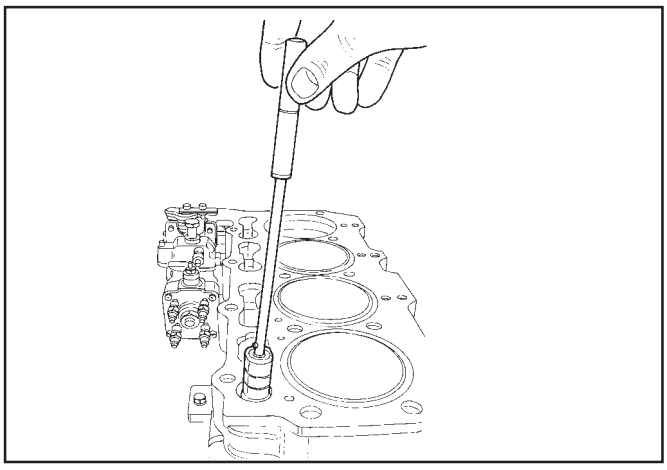
Remove the alignment brackets **A**.
Insert tool **X** **(Tab. 11.1 ref. L)** and fit it solidly on the tappet head **B** pressing the internal spring until the end on the tool is lower than the stop and turning the end of the tool 90° (degrees).
Removing the tappets from their seat.

WARNING: IN THE CASE OF WEAR OR DAMAGE, REPLACE THE COMPLETE TAPPETS.





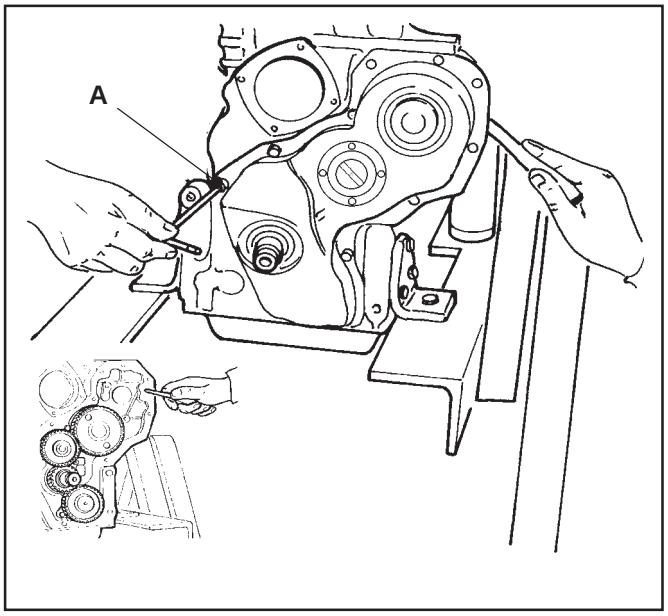




FRONT COVER

Front cover group

Unscrew screws **(A)** around the edge of the cover.
Remove the cover without using excessive or sudden force.
Clean the gasket residues on the contact surfaces of the crankcase cover.

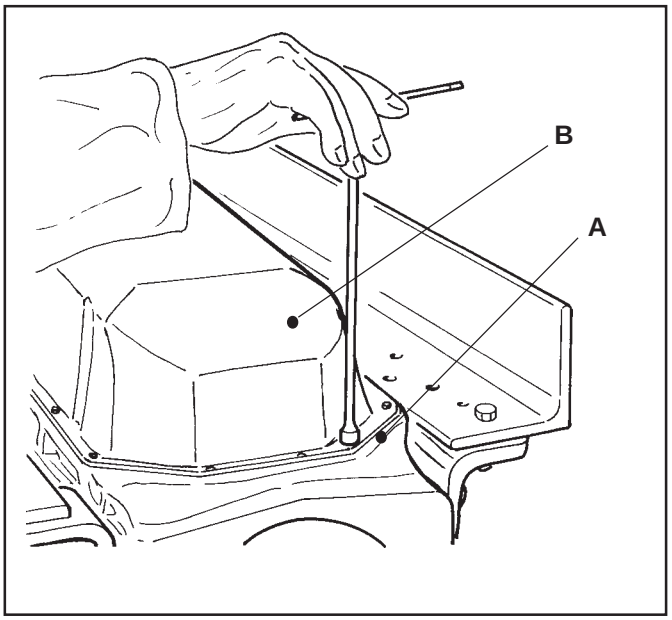


OIL SUMP

Oil sump

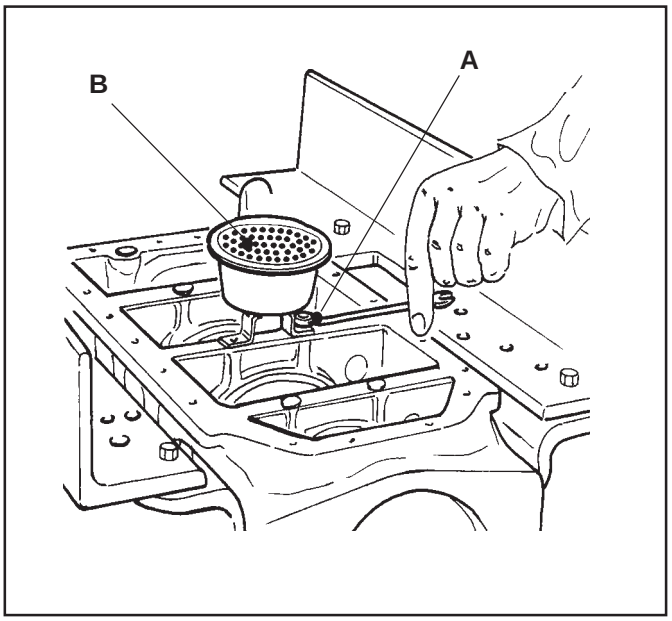
Unscrew screws **A** and remove sump **B**.
To avoid damaging the oil sump while separating it from the crankcase, as the silicone forms a seal between the two parts, we recommend inserting a metal spatula between the sump and the crankcase, and prising them apart at various points by exerting a slight pressure on the patula, without deforming the sump.

To remove the oil sump, do not overturn the engine in order to avoid possible debris drop down into the block.



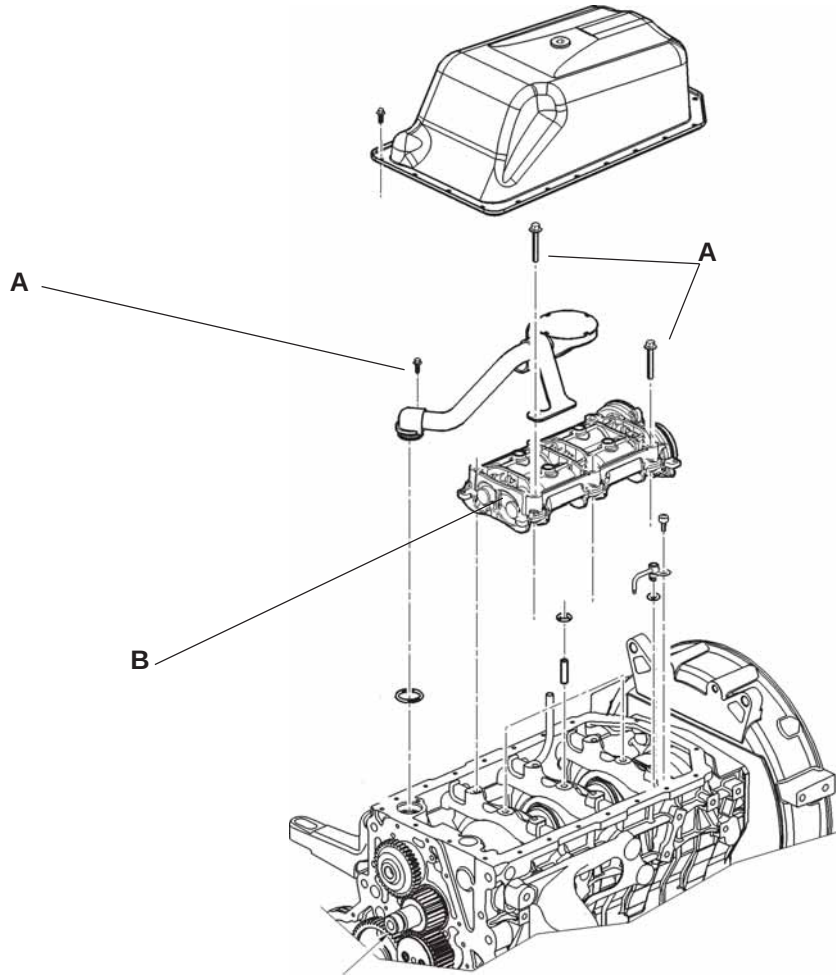
Oil pipe suction

Unscrew screws **(A)** and dismantle suction pipe **(B)**.

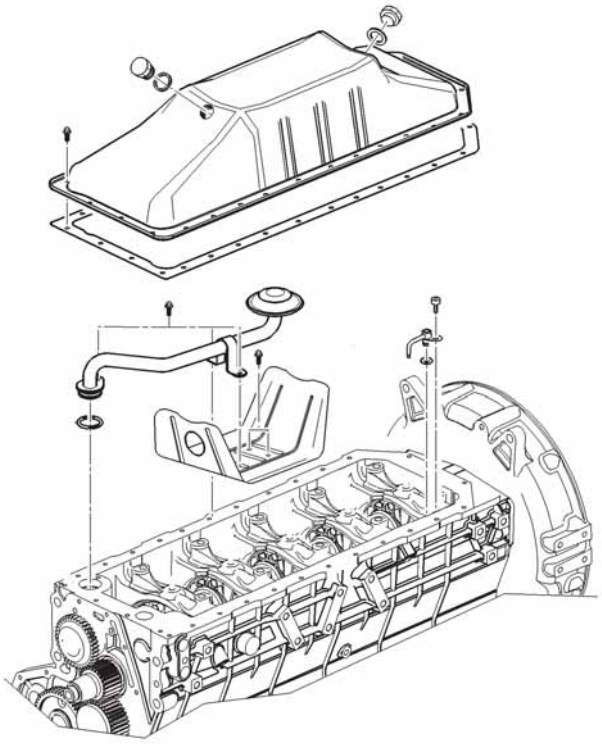


Counter balancing crankshaft MD704LH/LS

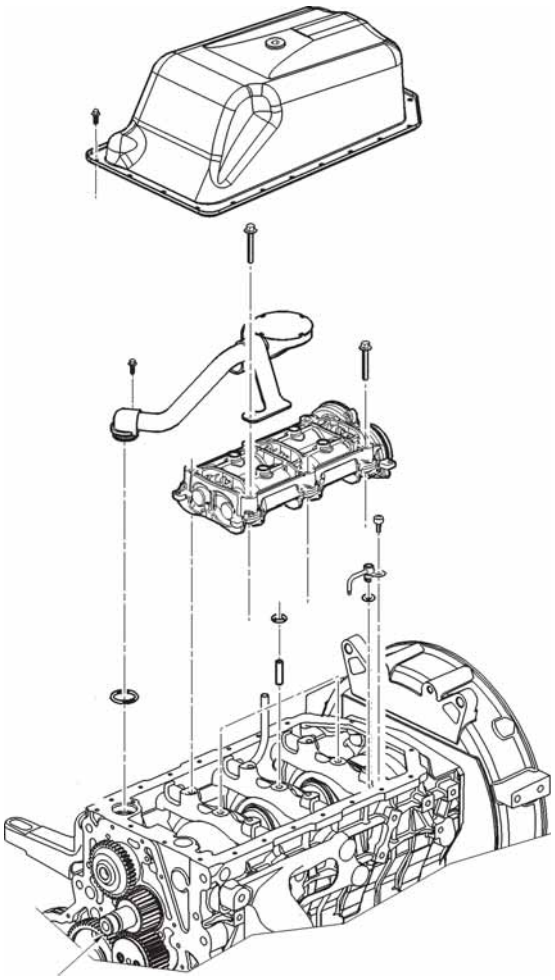
Unscrew the screws **A** and remove conter balancing shaft **B**.



Oil sump MD700 - exploded view



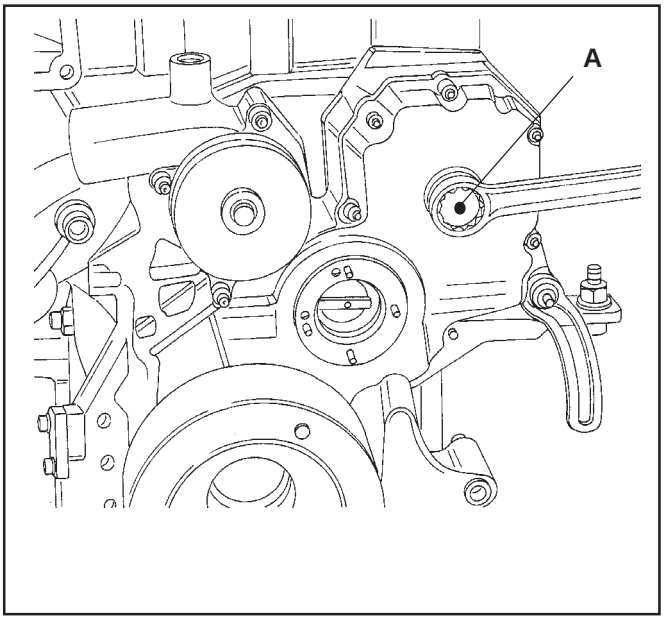
Oil sump MD704LH/LS - exploded view

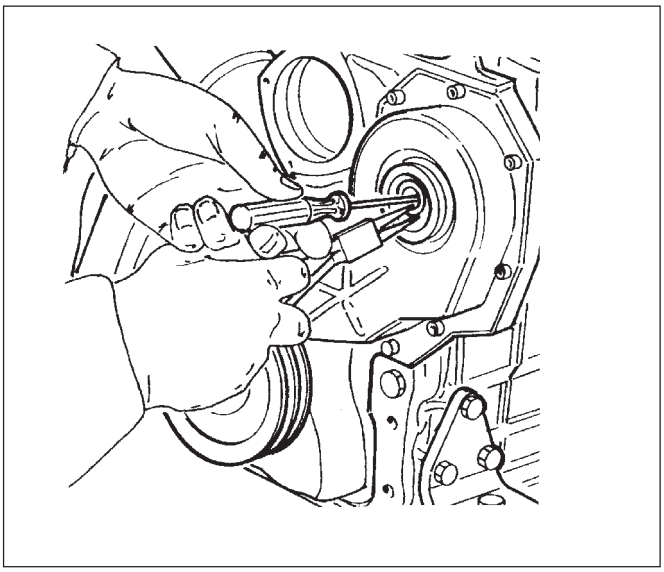


INJECTION PUMP

Injection pump

Unscrew threaded cap **A** on the front cover**.**
Unscrew the nut that holds the gear of the injection pump situated inside the cover and with using a pair of long-nose pliers, extract the washer under the nut, on the injection pump shaft.
Use a screwdriver to stop the washer falling inside the cover, as shown in figure.

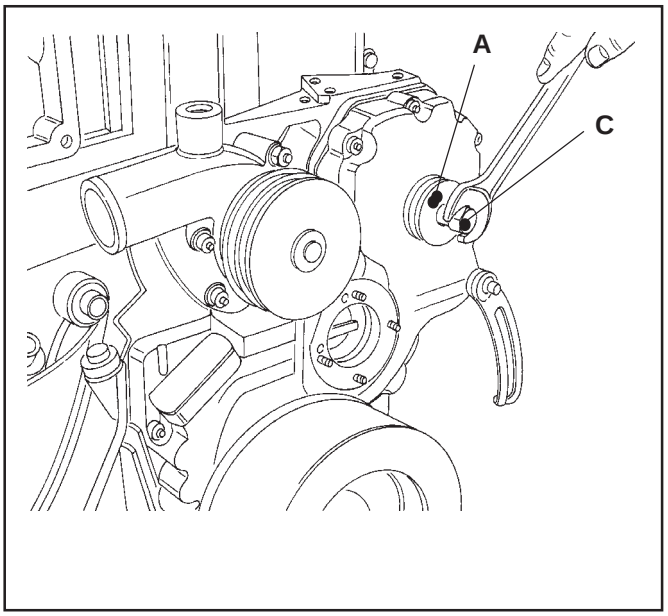


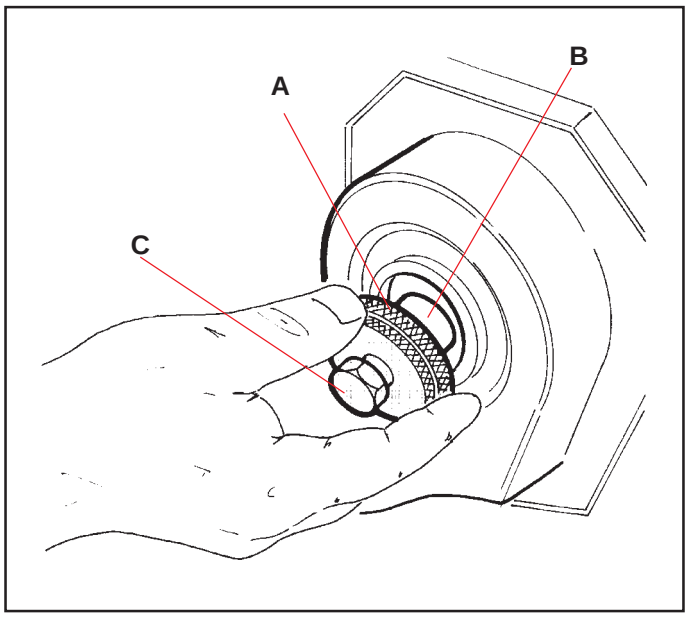


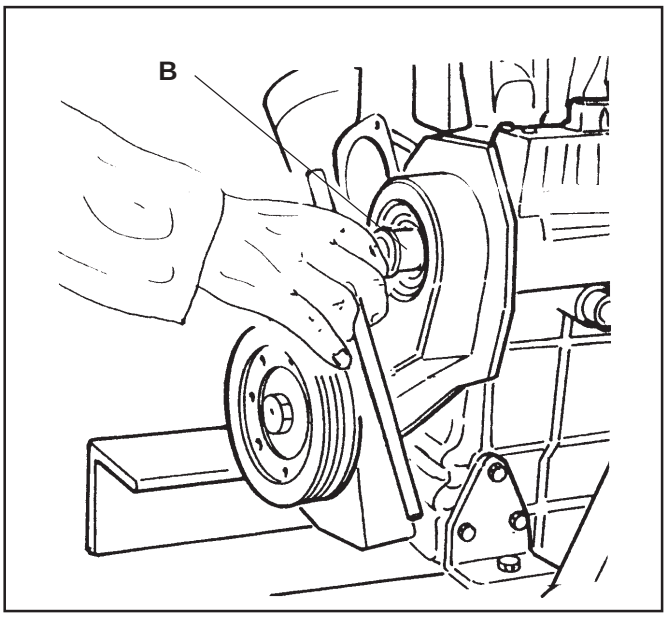
Assemble special tool **(A)** **(TAB. 11.1 ref. F or AE for MD704LH/LS)** as follows:

- screw the extractor aligner **A** onto the front cover
- screw the body **B** onto the injection pump drive gear.
- Unscrew nuts **(D)** by a few millimetres,

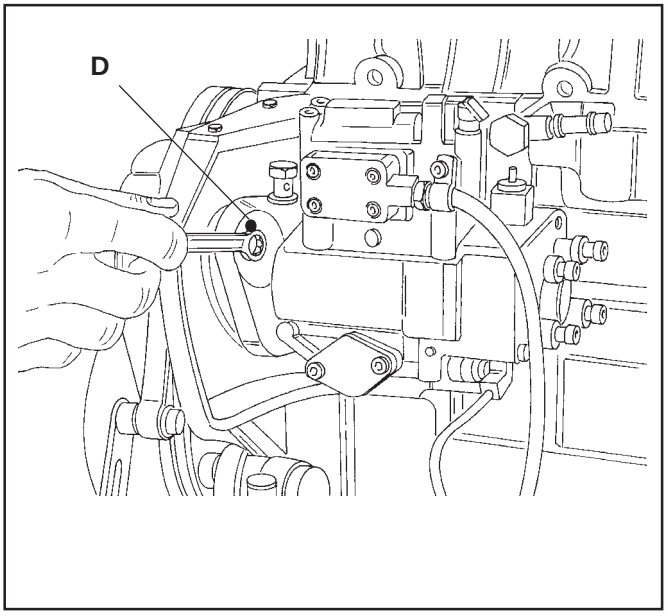
  so the injection pump can move back.
- Screw **(C)** until the injection pump comes out from own gear.
- Remove screws **(D)** and extract the pump.







IF YOU HAVE TO DISMANTLE ONLY THE INJECTION PUMP FROM THE REST OF THE ENGINE, THE SPECIAL TOOL (TAB. 11.1 ref. F or AE for engine model MD704LH/LS) IS ESSENTIAL FOR MAINTAINING THE INJECTION PHASE SETTINGS OF THE ENGINE, AS IT KEEPS THE INJECTION PUMP DRIVE GEAR ENGAGED.

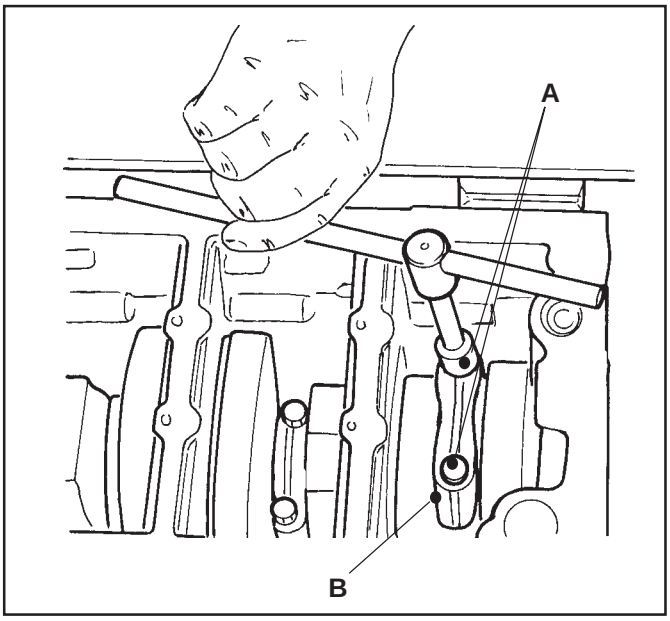


PISTON-CON ROD

Connecting rod - Piston complete with rings

Turn the crankshaft to bottom dead centre for the connecting rod you're working on.
Unscrew screws **(A)** and extract the bottom rod cap **(B)**.
Using a suitable block (nylon/Teflon/rubber) push the connecting rod - piston group downwards, until it drops out, we recommended holding a hand under the crankcase to prevent the group dropping on the floor.
Repeat the above operations for the other connecting rod - piston groups.

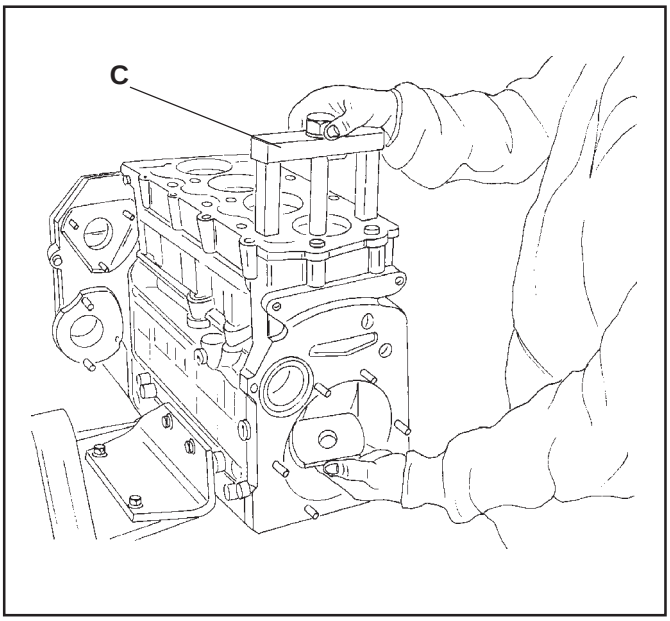
WE RECOMMEND REMOVING ANY CARBON DEPOSITS THAT CAN FORM IN THE TOP PART OF THE LINER SO IT IS EASIER TO GET THE PISTON OUT OF IT.



CYLINDER LINER

Liner

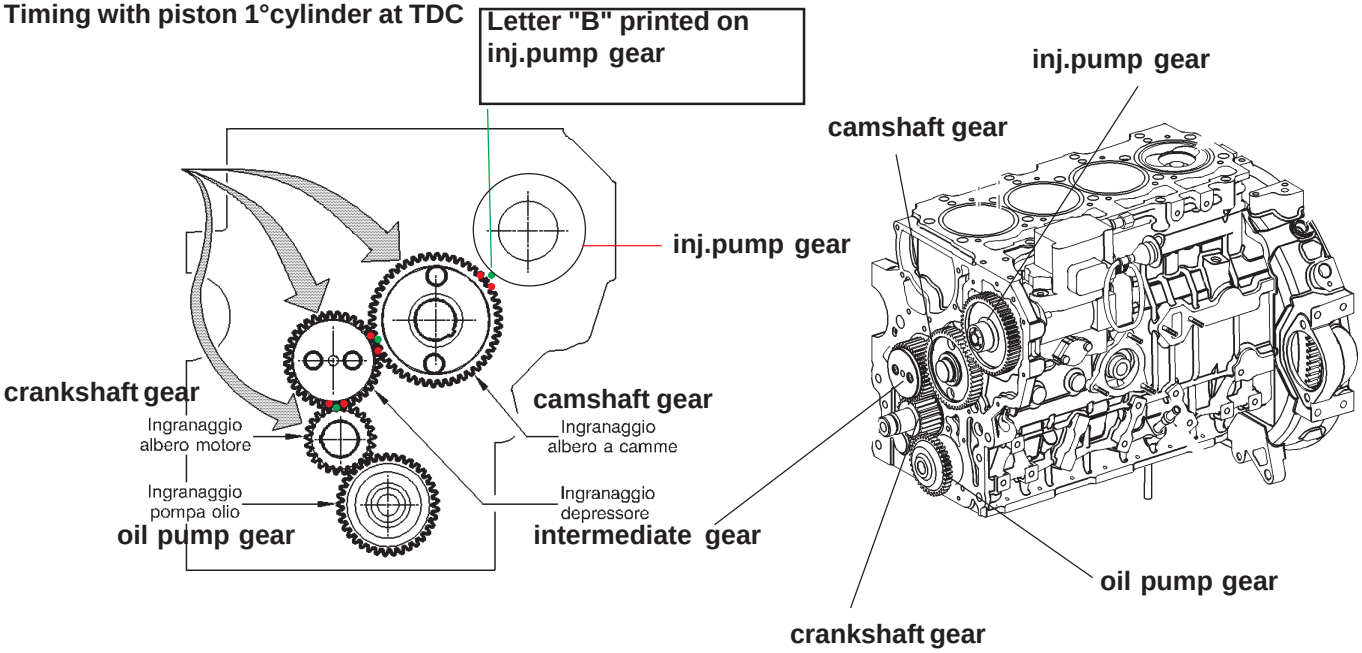
To remove the liner use the special tool **C** **(TAB. 11.1 rif. C)**.



TIMING

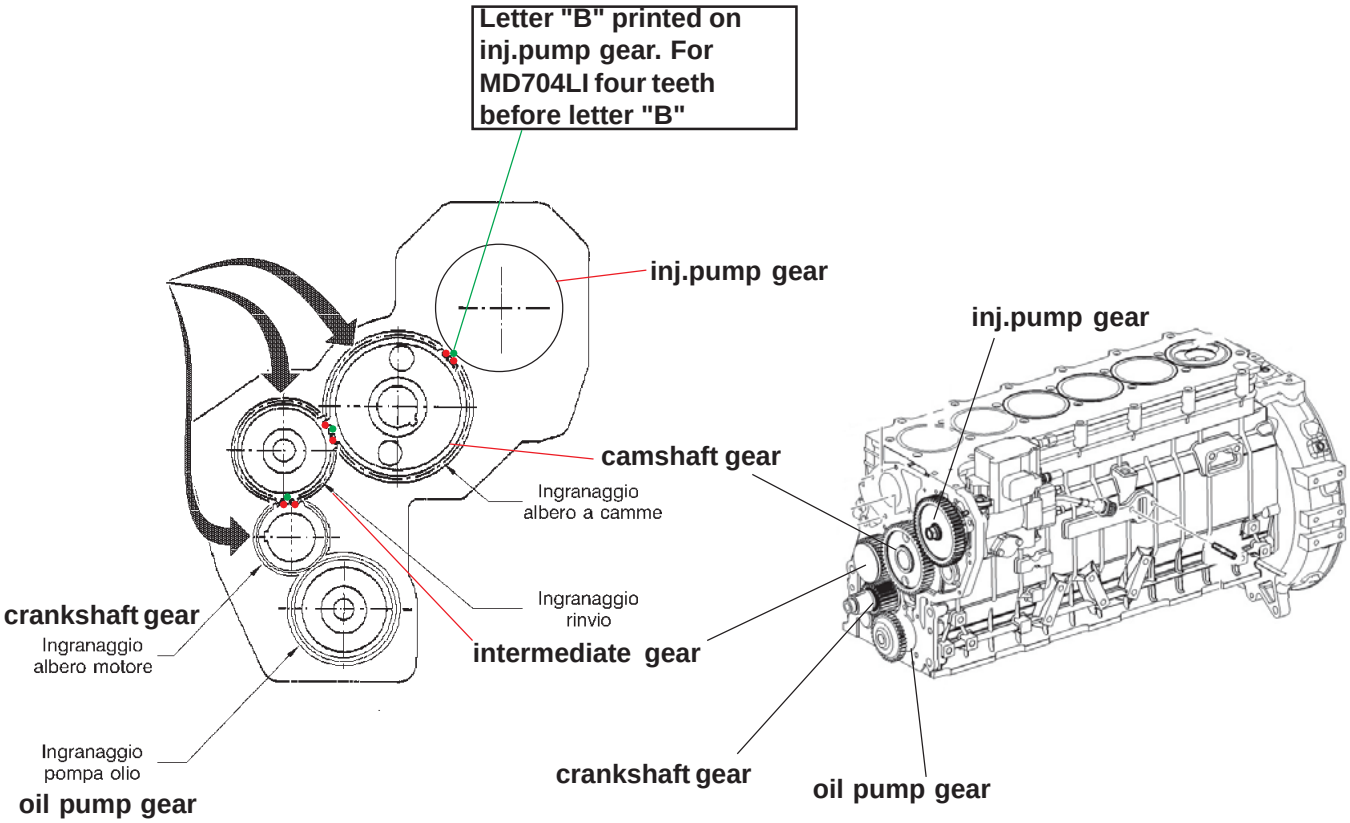
Timing MD704LH/LS

Timing with piston 1°cylinder at TDC



Timing MD700

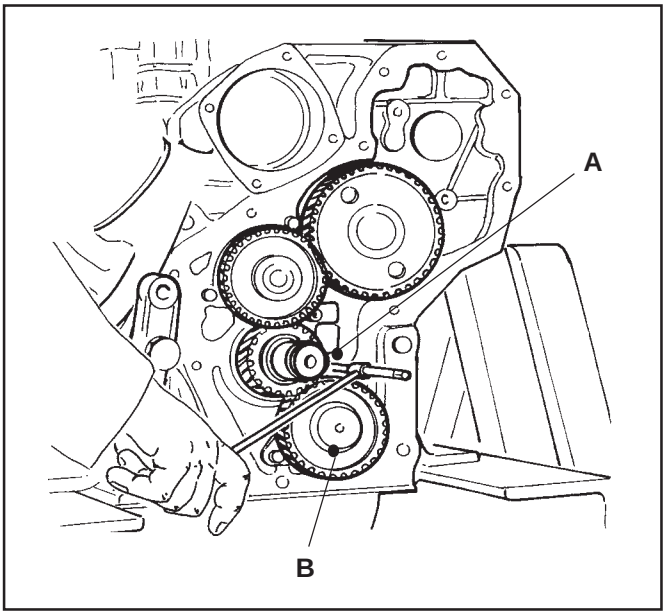
Timing with piston 1°cylinder at TDC



OIL PUMP

Oil pump

Unscrew fixing screws **(A)** and pull out valve **(B).**

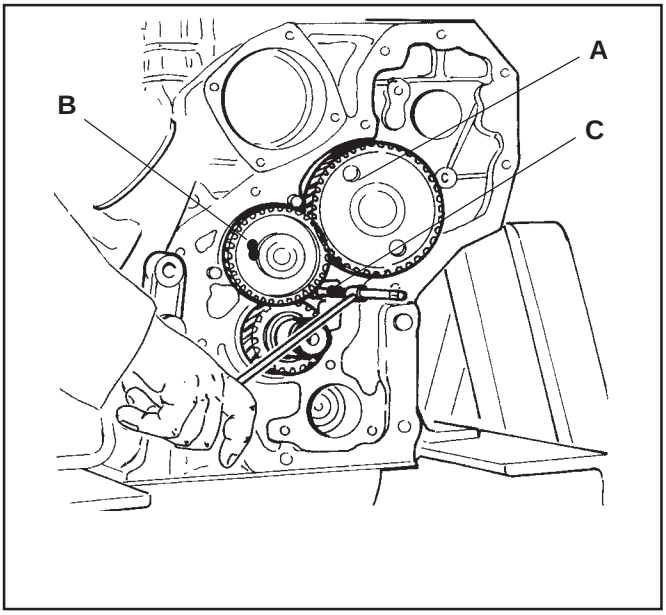


INTERMEDIATE GEAR

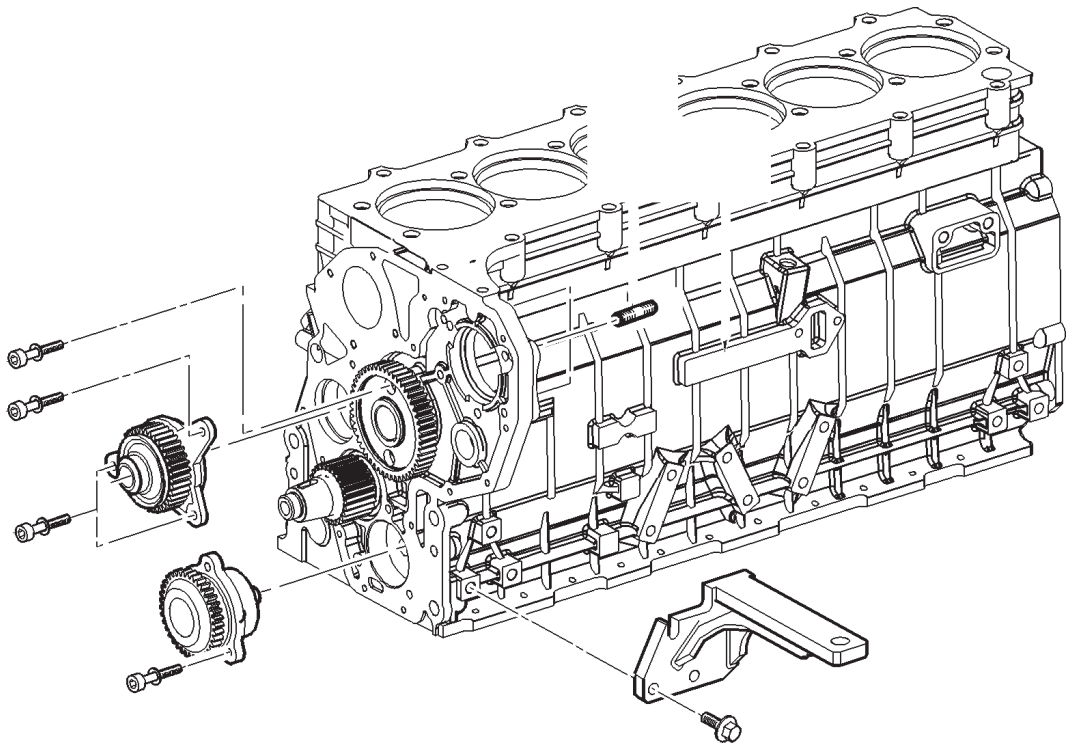
Intemediate gear

Unscrew and remove fixing screws **(A)** of the camshaft.
This operation is necessary so the camshaft can move.
Unscrew fixing screws **(C)** of the counter gear and remove the support complete with gear **(B)**.

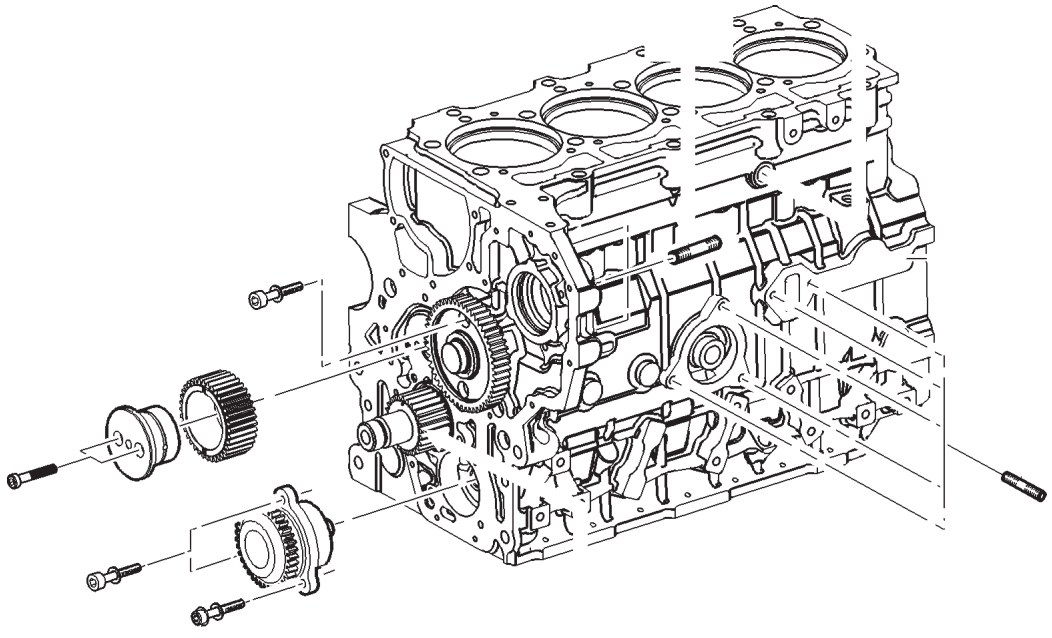
TO REMOVE THE COUNTER GEAR YOU HAVE TO MOVE THE CAMSHAFT OUTWARDS ENOUGH TO BE ABLE TO PULL THE SUPPORT OUT OF THE CRANKCASE.



Oil pump and intermediate gear MD700 - exploded view



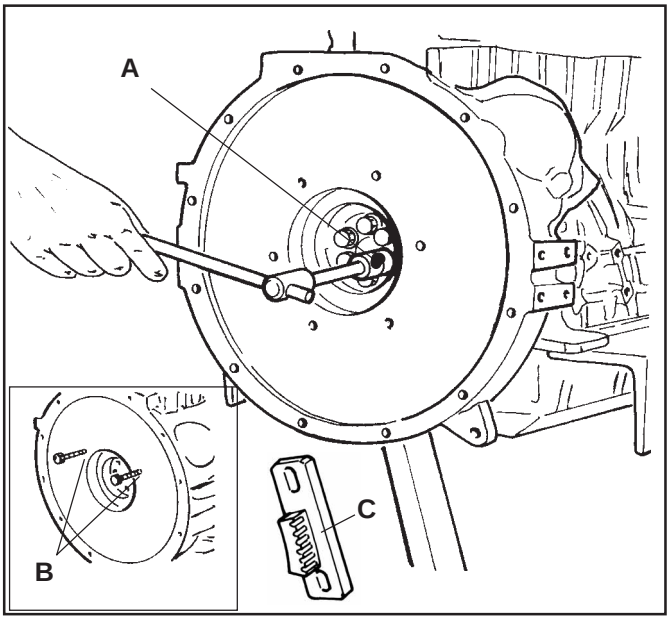
Oil pump and intermediate gear MD704LH/LS - exploded view



FLYWHEEL

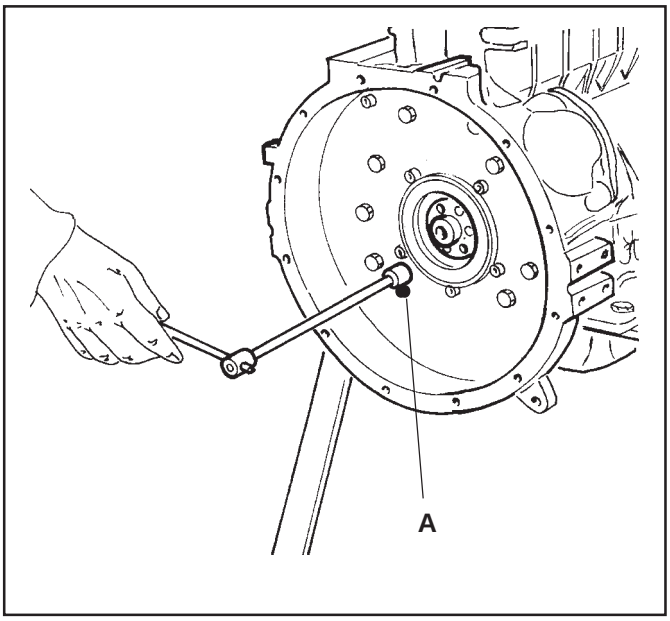
Flywheel

Keeping special tool **(C)** assembled **(TAB.11.1 ref. T or AD for MD704LH/LS when the 1st piston is at TDC)** unscrew fixing screws **(A)**.
To help the flywheel out, you can use two normal screws **(B)**.



Flywheel housing

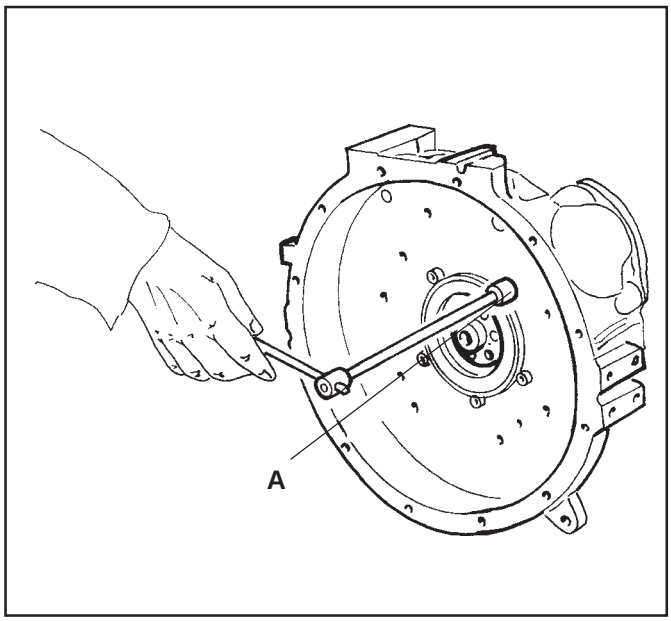
Unscrew screws **(A)** that hold the box on the crankcase and remove it.



Rear support

Unscrew nuts **(A)** and proceed by extracting the support without forcing it in a radial sense.

THE REAR SUPPORT CAN BE DISMANTLED WITH THE FLYWHEEL BOX.

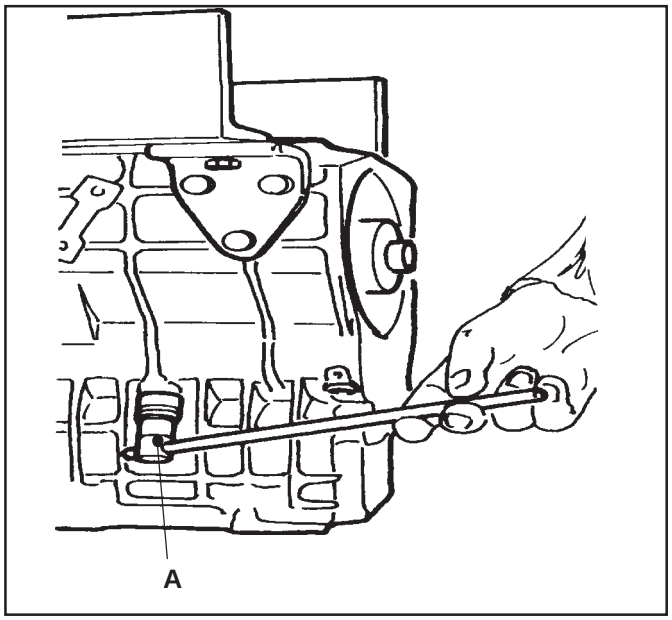


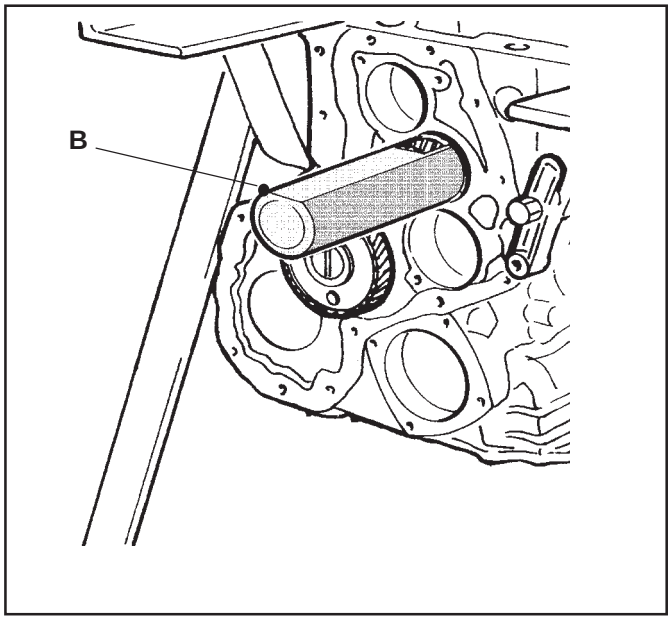
CENTER MAIN BEARING CARRIER

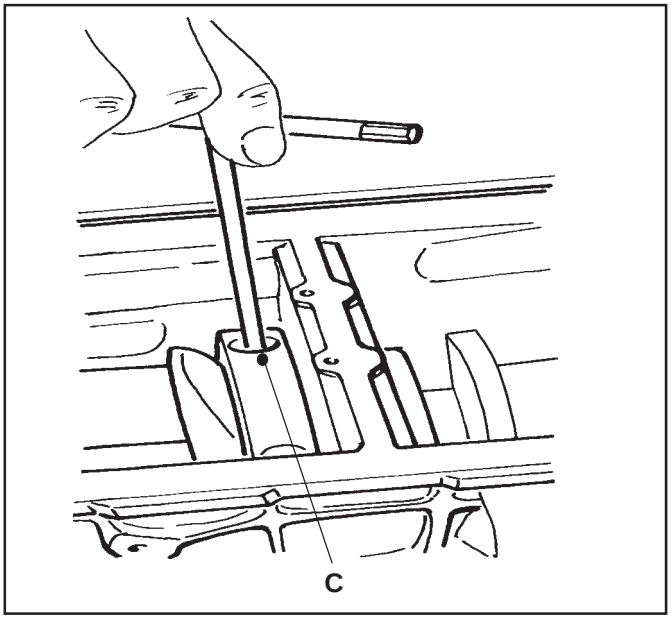
Center main carrier

Unscrew and remove unions **(A)**.
Using special tool **(B)** **(TAB. 11.1 ref. H)**, pull out the shaft until the bed supports come out of the tunnel resting the cheeks on the tunnel, so the whole weight of the crankshaft doesn't rest just on the front bush.
Unscrew the blocking screws of semi-supports **(C)**, open them and remove them from the crankcase.

IT IS A GOOD IDEA TO REASSEMBLE AND MARK THE SEMI-SUPPORTS WITH PROGRESSIVE ALPHANUMERIC INDICATIONS.



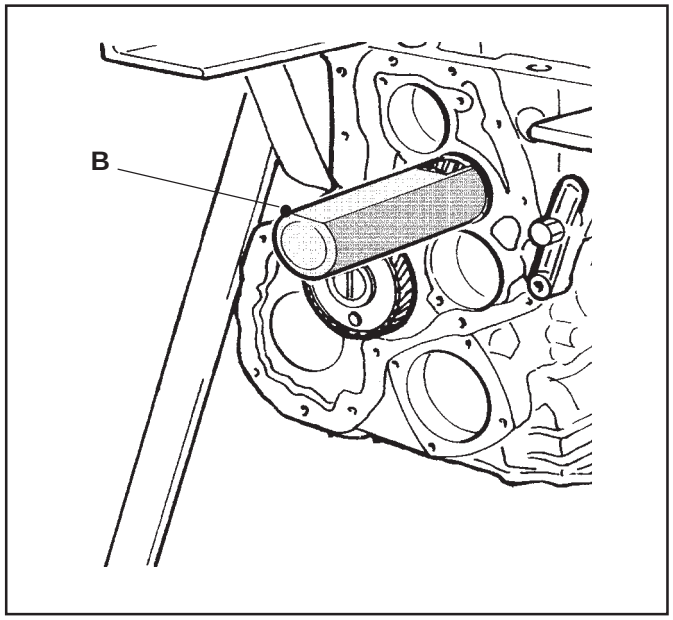




CRANCKSHAFT

Crankshaft

Using special tool **(C)** **(TAB. 11.1 ref. H)** proceed by pulling out the shaft. Using the special tool avoids scoring and/or abrasions on the front bearing.

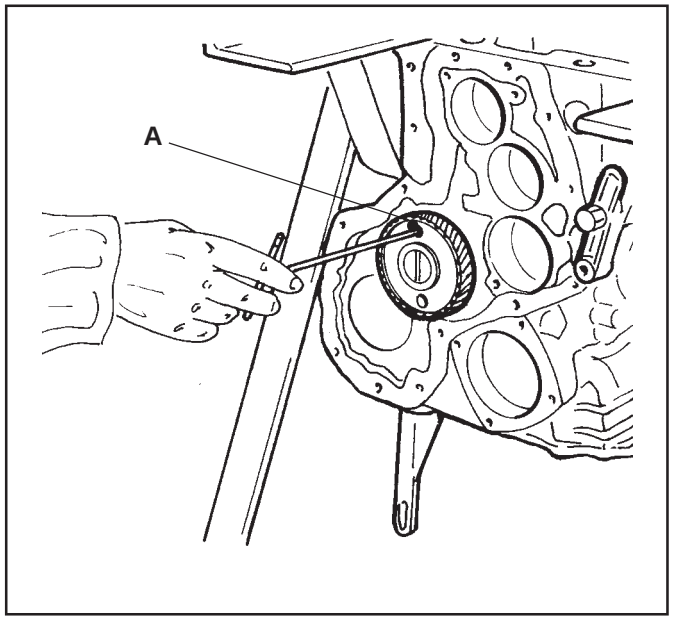


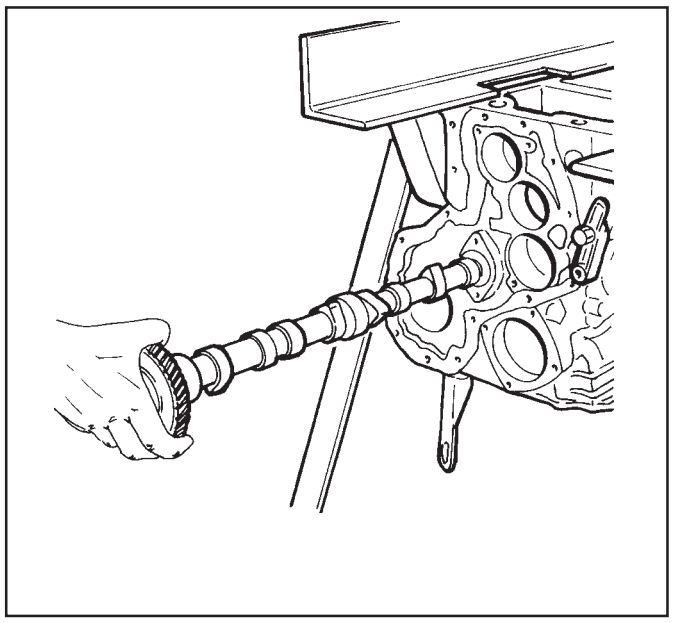
CAMSHAFT

Camshaft

Unscrew screws **(A)**.
Pull the camshaft out carefully, avoiding scoring it and/or abrasions on the supporting bearings.

BE CAREFUL WHEN PERFORMING THIS OPERATION AS WRONG MOVEMENTS CAN DAMAGE THE OIL LEVEL DIPSTICK.



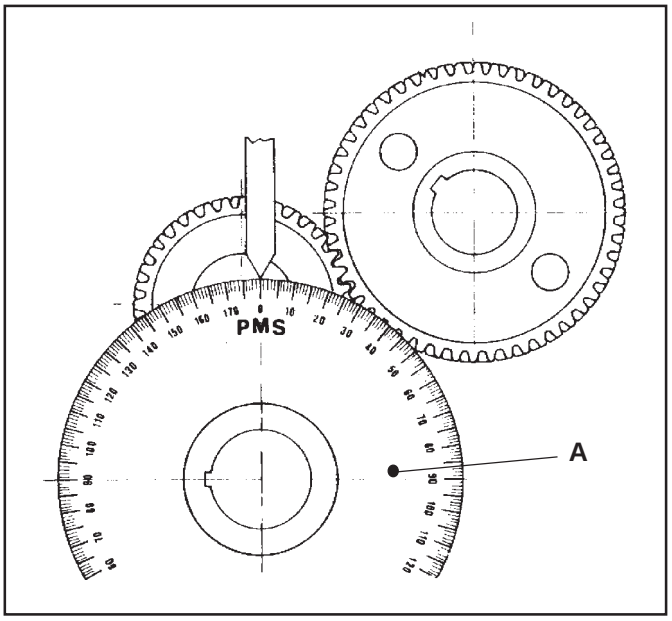


CHECK AND REPAIRS 6

FINDING TOP DEAD CENTRE "TDC"

FOR ALL ENGINE MODELS

1st PROCEDURE (without cyl.heads assembled)

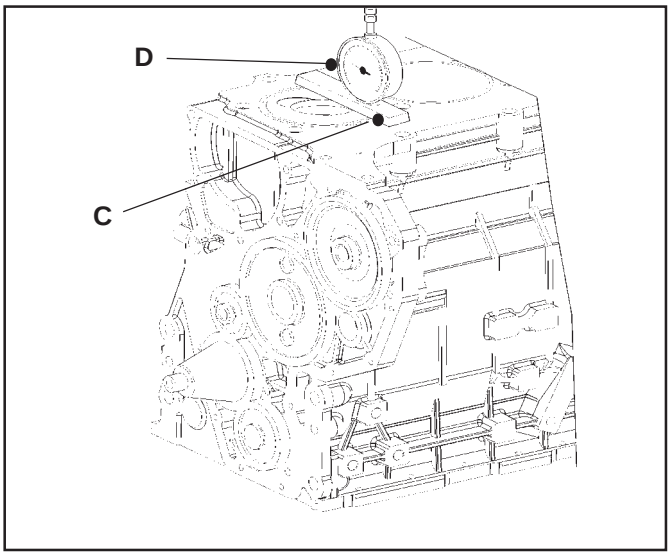


-1-Temporarily fit the front pulley on the crankshaft.

-2-Fix special tool **(A)** **(TABLE 11.1 ref. R)** on the front pulley and put a pointer at the numbered angle scale

-3-Fit a comparator with a centesimal scale on special tool **(C)** **(TABLE 11.1 ref. U)** and position it first on the liner.
Move the piston of the first cylinder to top dead centre.

-4-Position the feeler of the comparator **(D)** so it is in contact with the top surfaces of the piston.



-5-Turn the crankshaft in the direction of rotation (clockwise on the timing side) and stop when the pointer of the comparator inverts its direction of travel.

-6-Position the pointer at zero on the scale (TDC) on the special tool **(A)** **(TABLE 11.1 ref. R)**.
Refer to the pointer in this position every time the need occurs, for subsequent jobs, bringing it back to TDC.

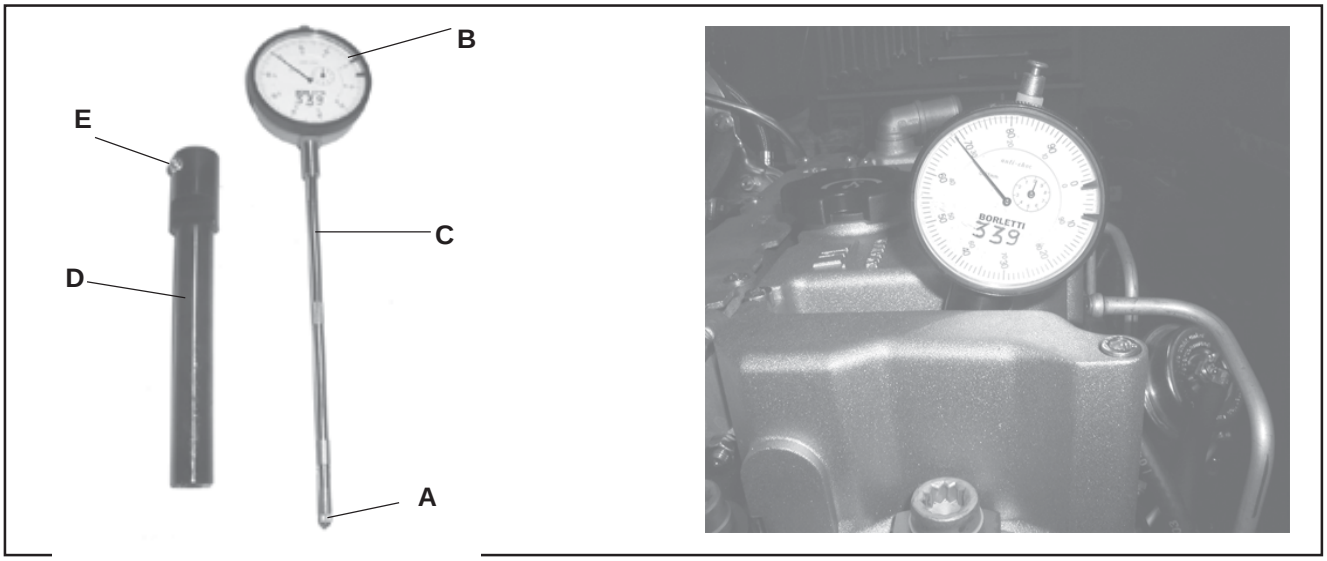
2nd PROCEDURE (with cyl.heads assembled)

It is possibile to determine the TDC using the special tool **(TAB.11.1 rif. AC);** this tool permits to determine the TDC with cylinder heads mounted on the block

For using this tool it is needed to take a comparator, remove the feeler **A** and screw it to extension **C** and then screw to comparator **B**.

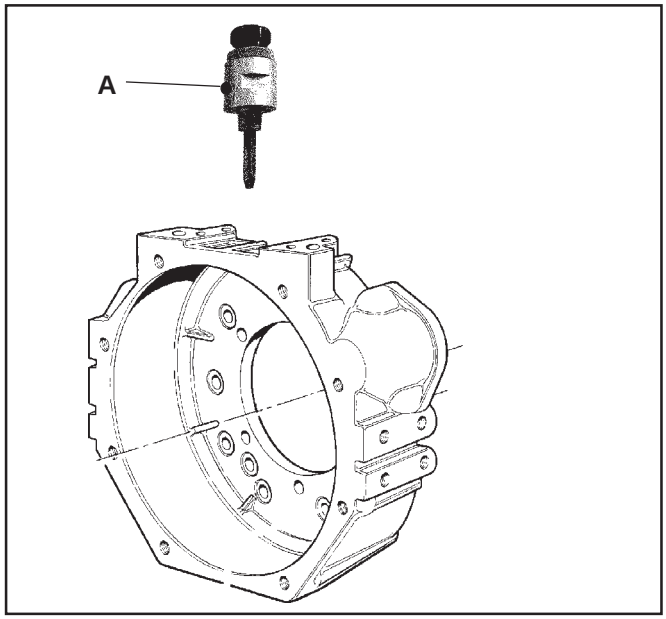
Take the comparator-extension and insert it into the body **D**. Insert the tool into 1st cylinder injector seat and apply previous methods 5 and 6 over described.

Screw **E** in the body **D**, blocks the comparator-extension one time find the right position



MD 706 LH/LS/LB/LX - MD 700 LI Engines

In this type of engine, TDC can be found by inserting special tool **(A)** **(TAB. 11.1 ref. Y)**, in the relevant seat on the flywheel box and so that the punch drops into the hole on the flywheel.



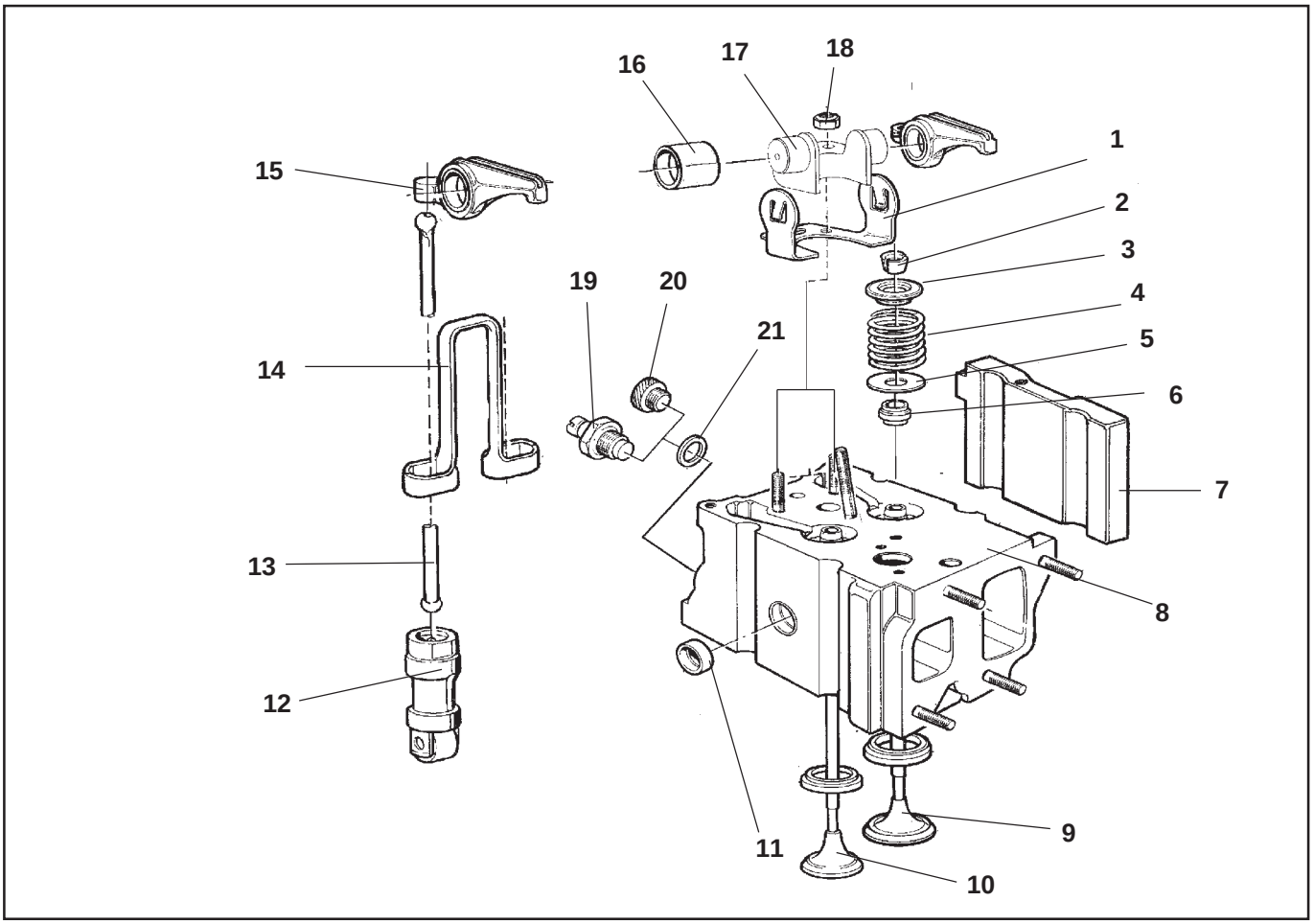
MD 704 LH/LS Engines

In this type of engine, TDC can be found by inserting special tool **(B)** **(TAB. 11.1 ref. AD)**, in the relevant seat on the flywheel box and so that the punch drops into the hole on the flywheel.

IN ORDER TO SCREW COMPLETELY THE TOOL INTO THE FLYWHEEL HOUSING AND BLOCK THE FLYWHEEL AT TDC, IT IS NEEDED TO TAKE THE PISTON OF 1ST CYLINDER HEAD AT TDC. (SEE PREVIOUS PROCEDURES TO GET THE TDC)

CYLINDER HEAD

Cylinder head



KEY:
1) Spring, **2)** Cotter, **3)** Top washer, **4)** Valve spring, **5)** Bottom washer, **6)** Oil seal, **7)** Stud bolt, **8)** Head, **9)** Inlet valve, **10)** Exhaust valve, **11)** Cap, **12)** Hydraulic tappets, **13)** Rod, **14)** Anti-rotation bracket, **15)** Rocker arm, **16)** Bearing, **17)** Rocker arm support, **18)** Nut, **19)** Water temperature sensor, **20)** Cap, **21)** Washer.

DON'T REMOVE OR DISMANTLE THE HEADS WHEN ARE HOT TO AVOID DEFORMATION.

Remove the valves using a commercial valve spring compressor and number them.

Remove carbon deposit from the heads and inspect the gasket matching surface.

If surfaces are distorted or pitted, regrind using a surface grinder only.

If the amount of metal to be removed exceeds **0.20 mm**, the head must be replaced.

Height cylinder head = 90 ± 0.5 mm

REMOVE THE SAME AMOUNT OF MATERIAL REMOVED FROM CYL. HEADS ALSO FROM CYLINDER HEAD LATERAL PIECES

Valve - Seat valve - Guide valve

If necessary, clean the valves with a wire brush or replace them if the heads are deformed, worn, cracked or rusty.

Check the diameter of the valve stems, value **(A)**

(fig. 6.2a), if they are worn, replace them.

Check that the inner surfaces of the guides show no signs of scoring or traces of seizing.

After replacing, to check if the valve guides are in the right position, check height **(A)** (fig. 6.2b).

Check the internal diameter of the valve guide, height **(B)** (fig. 6.2b) .

If there are any variations in the values, replace the head.

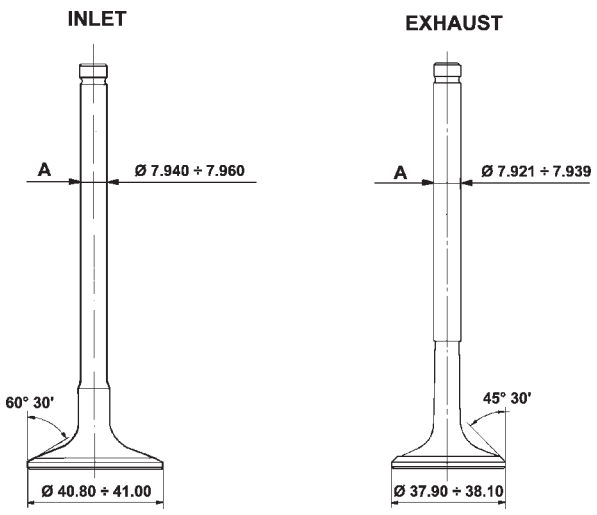


Fig. 6.2a

If value **(C) (valve downstad)** is lower than usual (fig. 6.2b), probably the seat has pulled through and at this point you will have to replace the head.

Dimens.	At installation	
	Inlet mm.	Exhaust mm.
A - Fig. 6.2b	2.00 ÷ 1.50	2.00 ÷ 1.50
B - Fig. 6.2b	8.000 ÷ 8.015	8.000 ÷ 8.015
C - Fig. 6.2b	0 ÷ 0.3	0 ÷ 0.3

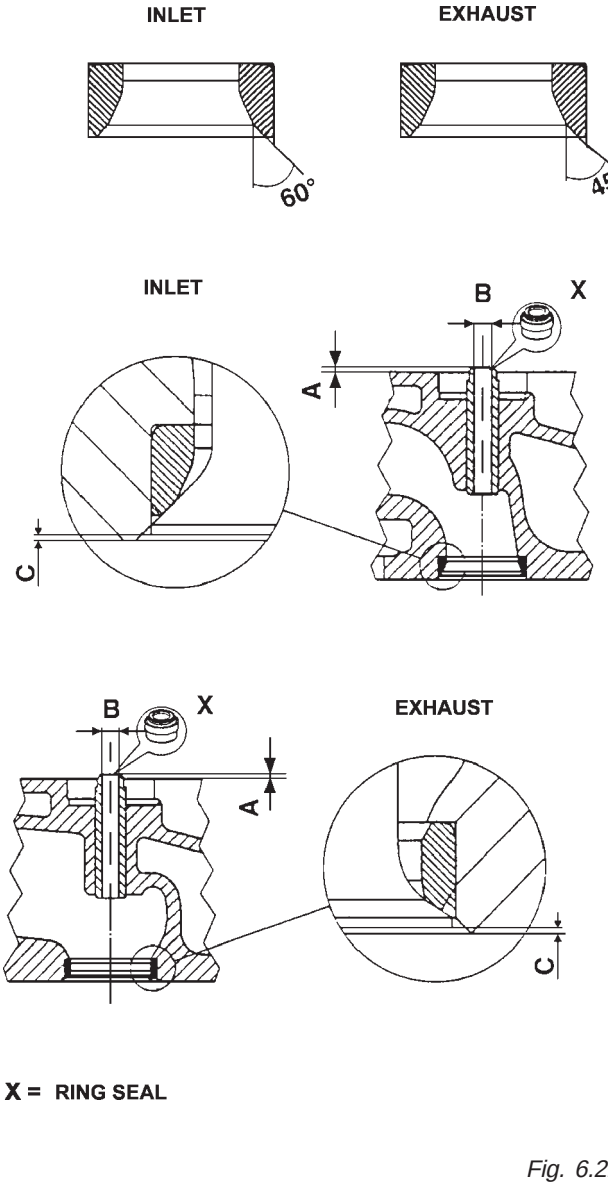
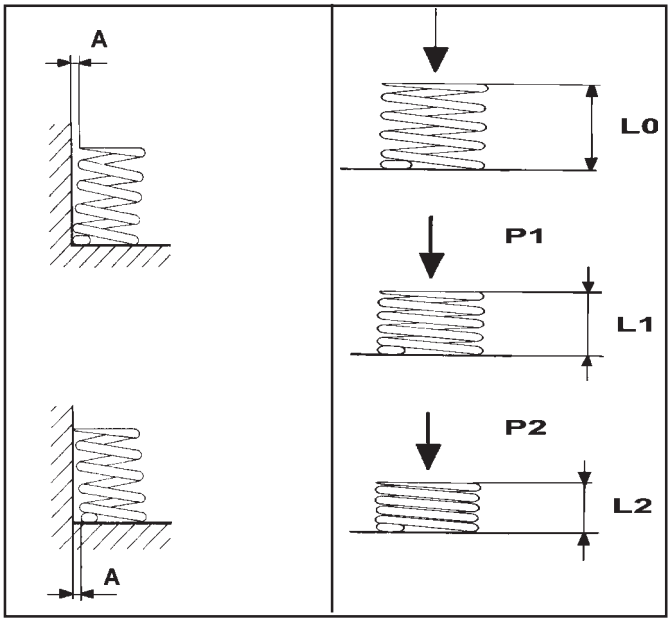


Fig. 6.2b

Valve springs

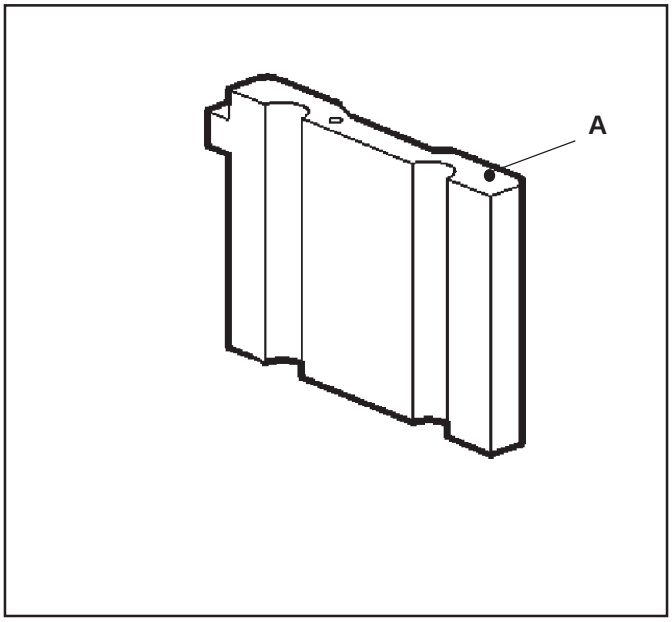
Check that the springs aren't damaged, rusty or have lost their spring.
Check the height of the springs under various loads.
Check that any out of square errors **"A"** are not over mm. **2**.

L 0 = 44.65 mm (free length)
L 1 = 38.6 mm **P 1** = 34 kg ± 6% (closed valve)
L 2 = 28.2 mm **P 2** = 92.5 Kg ± 4%(open valve)



Cylinder head lateral pieces

Check that the height of stud bolt **(A)** is **89.92 ÷ 90.00 mm** and that there are no deformations caused by the incorrect tightening of the clamps fixing the heads.

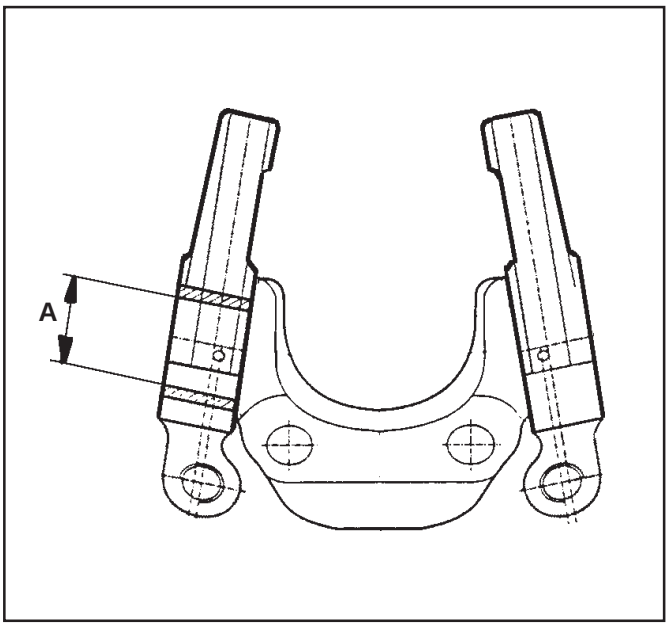


ROCKER ARMS

Clean the spindles and the rocker arms with solvent

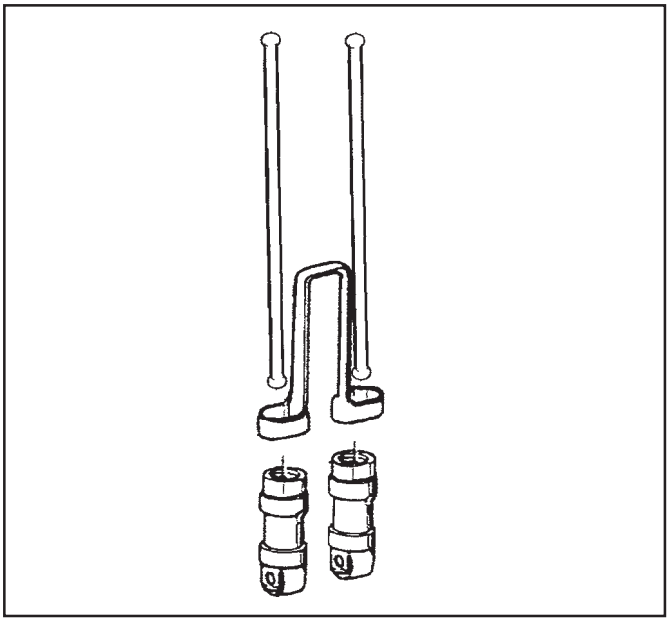
FREE THE OIL DUCTS OF ANY DIRT.

Check that there is no abnormal wear of the spindles, the supports and in the bushes of the rocker arms.
The indicated values are:
A = spindle diameter **24.979 ÷ 25.000 mm**
A = bush diameter **25.020 ÷ 25.041 mm**
If the values are different, replace the worn components.



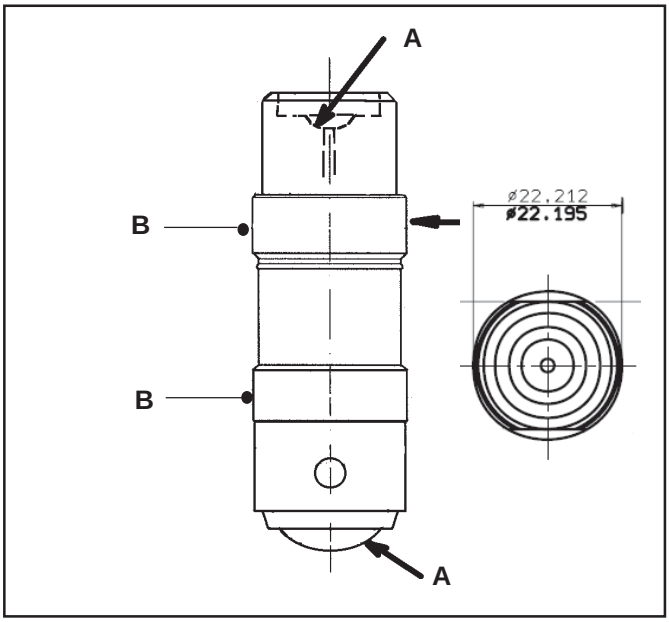
ROCKER ARM SPINDLES

Make sure the spindles are straight and the spherical surfaces at the ends are in a good condition.



TAPPETS

Check that surfaces **A** show no signs of dents, scoring and/or damage.
Check the values of the collets **B** which must be: **22.195 ÷ 22.212 mm**.
If worn, replace the tappets.

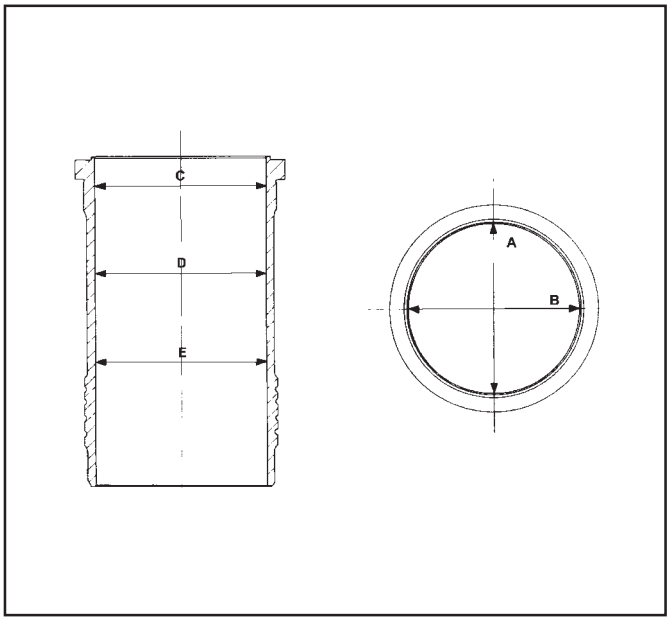


CYLINDER LINERS

Internal diameters of the liner D (mm) 93.995 ÷ 94.015, 108 from top edge.

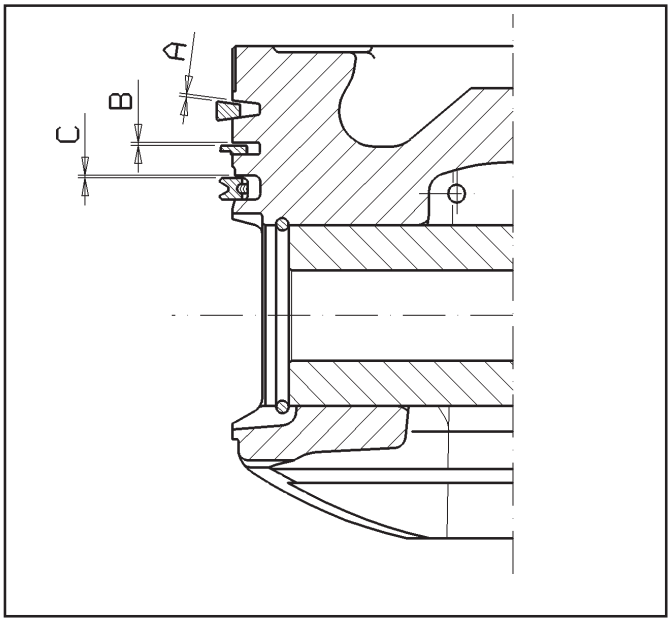
Max ovalization **A - B**: 0.100 mm
Max cone **E - C**: 0.100 mm

If the internal surfaces of the liner shows signs of scoring or wear not exceeding the nominal dimensions **D** by more than **0.10 mm**. it is possible to return to the initial roughness by grinding.
The roughness of the surfaces must be between **0.8 ÷ 1.2 µm**. If you find scoring or values of wear over **0.10 mm**, replace the liner.



PISTONS

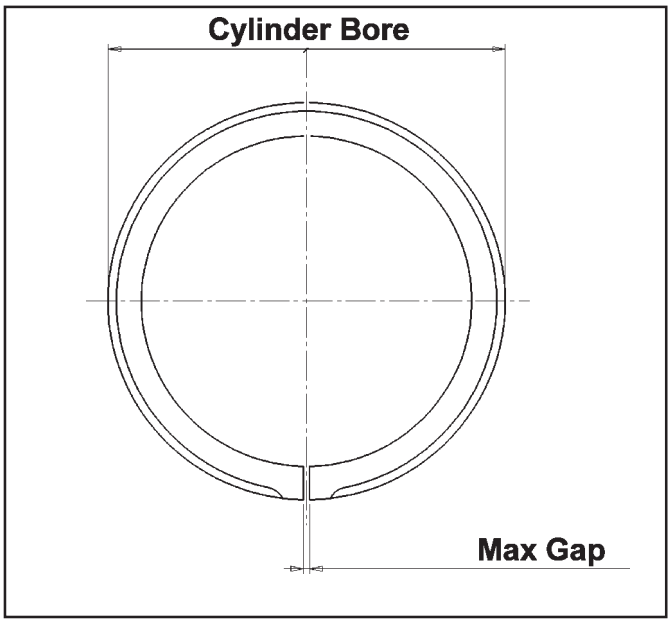
Check that the working surfaces have no nomalous wear, dents or signs of seizing.
In the case in which you notice any of the above problems, replace the part.
To check the play between rings and their seats, use a precision feeler gauge and the values measured mustn't exceed the limits indicated below:
compression ring **A**, can't be measured
step ring **B** max 0.10 mm
oil scraper ring **C** max 0.08 mm



Piston rings

Check that the rings move freely in their seats without any resistance or seizing and that they show no signs of damage. If you notice anomalies, replace the rings.
To measure the distance between the ends, as shown in the figure, insert the ring in the cylinder liner, positioned perfectly at right angles to the working surfaces and use a precision feeler gauge.

The measurements taken must not exceed the maximum values indicated below:
compression ring **A** max 0.5 mm
step ring **B** max 0.5 mm
oil scraper ring **C** max 0.6 mm



CRANKSHAFT

CLEANING:

Immerge the shaft in a solvent bath and remove the dirt from the lubrication ducts.

CONTROLS:

Make sure that the shaft shows no signs of cracking, seizing, overheating or abnormal wear.
Check that the centring pieces, the connecting surfaces and the threads show no signs of scoring, deformations or wear.
Check the wear and the ovalization of the gudgeon pins using a small precision micrometer, measuring around the entire diameter.

GRINDING:

If you have to grind down the shaft due to anomalies, to salvage the same, you can grind it down to the following values (**TAB. 8.2.1**).
Take great care not to create steps between the diameters of the gudgeon pins and the radiuses of the joint with the shoulders, as this is extremely dangerous and the incorrect joint of the radius can be a cause of breakage.

TESTING:

After grinding, check the shaft with a magnetoscope, there shouldn't be even the slightest trace of cracking.

HEAT TREATMENT:

Use the new "**SUR-SULF**" treatment for surface hardening with a hardness of at least **53 HRc**.

CLEANING:

After the hardening treatment, clean the lubrication holes.

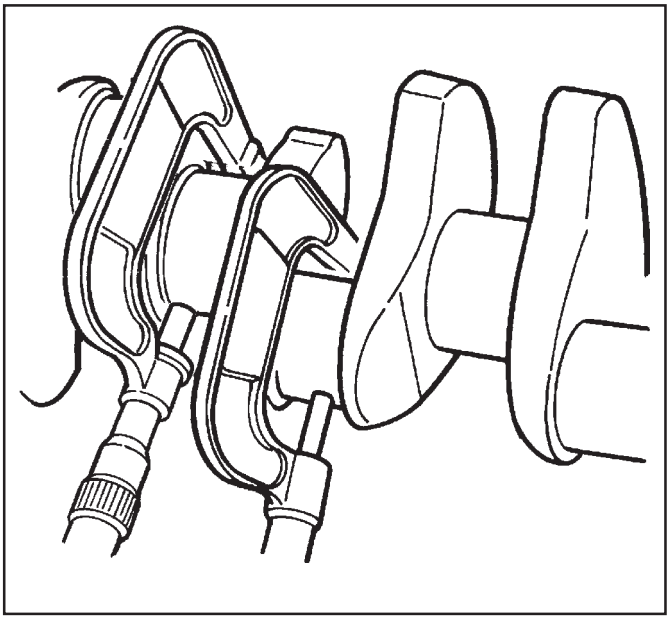
GEAR:

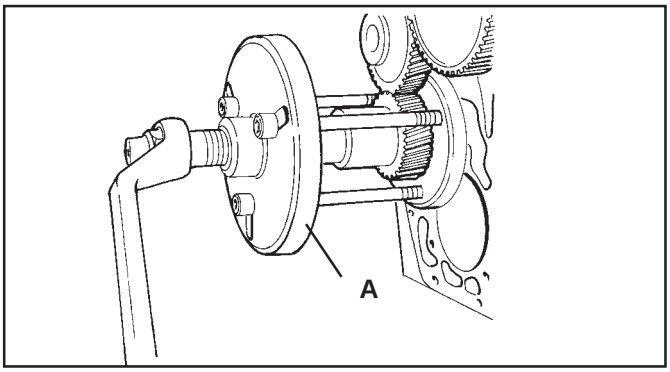
Check that the timing gears sprocket doesn't have any worn or damaged teeth.
Replace it if necessary, using tool **(A)** (**TAB. 11.1 ref. D or G for models MD700LI-MD706LH/LS/LX/LB/MI/MH/MS/MX and TAB 11.1 rif. AF for models MD704LH/LS**), to dismantle it.

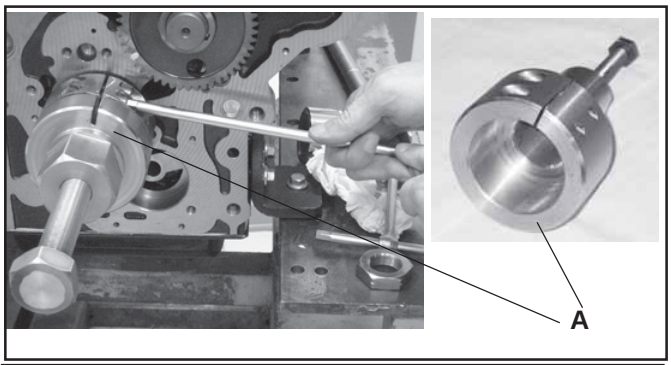
To fit a new sprocket, heat it in an oven at 180 °C ÷ 200 °C and assemble it making sure you centre the spline **(only for engine models MD700LI-MD706LH/LS/LX/LB/MI/MH/MS/MX**.)

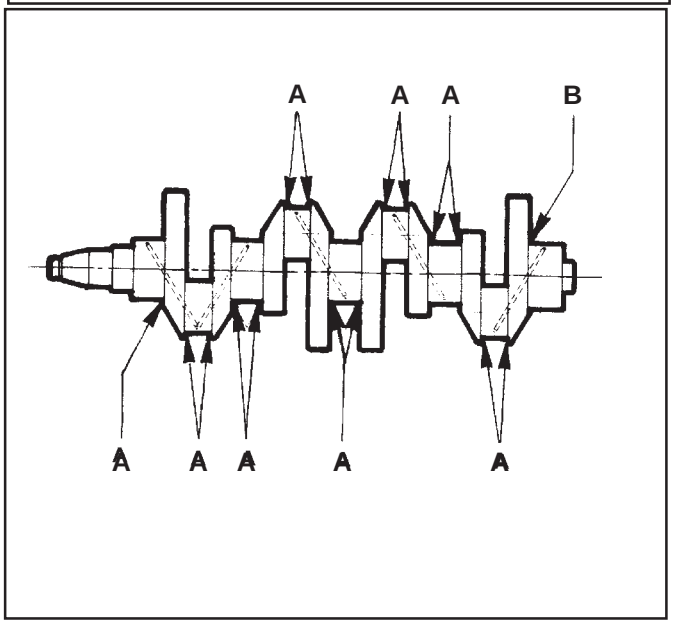
WHEN GRINDING, DON'T REMOVE MATERIAL FROM THE SIDE SHIM ADJUSTMENT.

RADIUSES A - B ON THE SHAFT MUST BE CONFORM TO THE VALUES INDICATED IN (TAB.8.2.1).









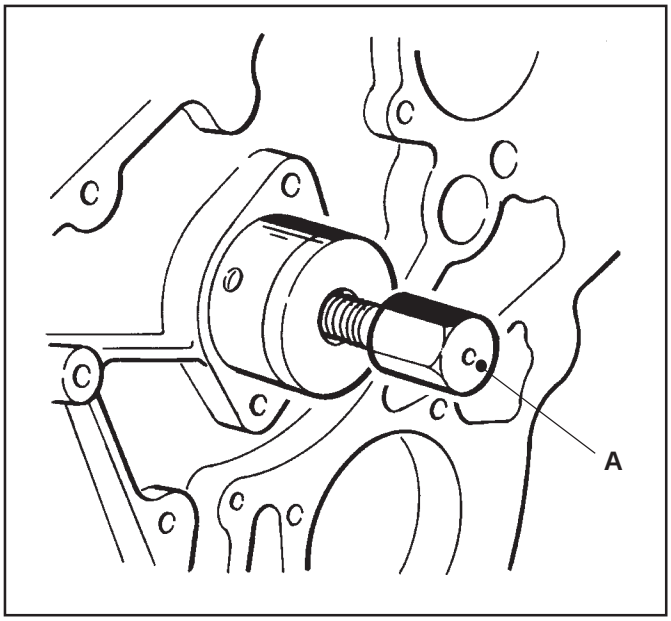
All of the bed and piston rod bushes, including the undersizes, are supplied to measure. Whenever you have to replace the front bush. For dismantling use tool **(A) (TAB. 11.1 ref. E)**.

Front bed pin diameter **(TAB. 8.2.1)**

Central bed pins diameters **(TAB. 8.2.1)**

Rear bed pin diameter **(TAB. 8.2.1)**

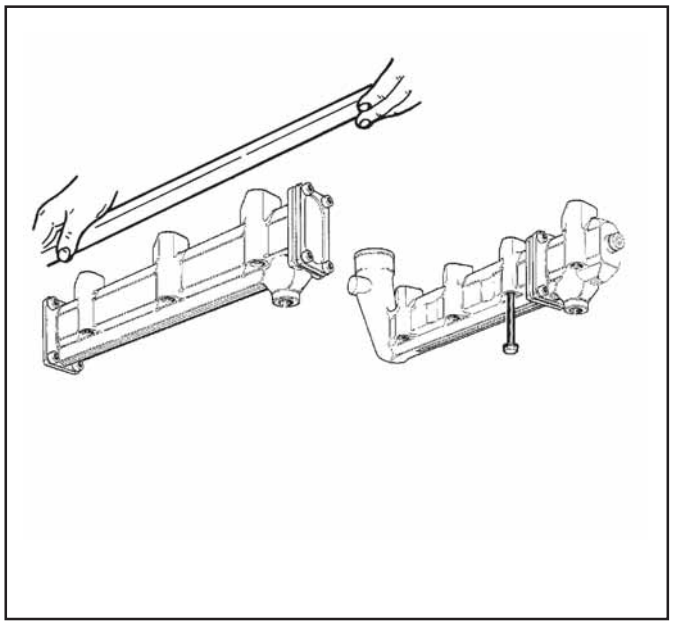
Piston rod gudgeon pins diameter **(TAB. 8.2.1)**



COOLANT MANIFOLD

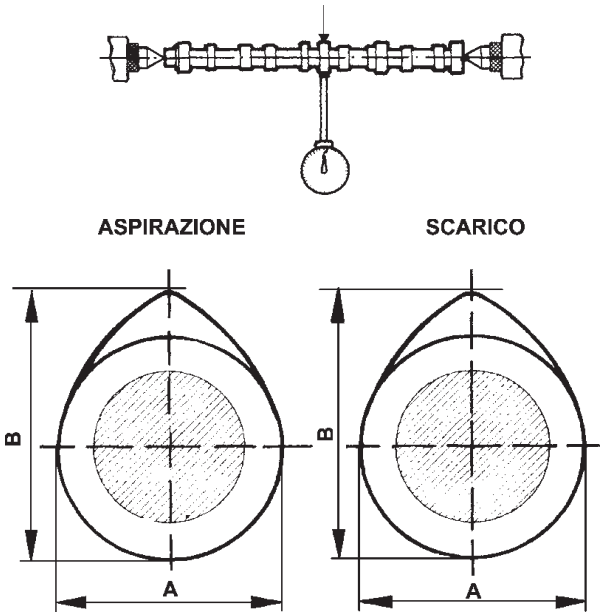
Check that the pipe isn't cracked or broken, which could cause leaks of liquid.
To check the tightness of any suspicious cracks, we recommend using penetrating liquids.

CONSIDERING THE TOXICITY OF THE PRODUCTS USED TO CHECK FOR LEAKS, WE RECOMMEND TAKING THE UTMOST CARE WHEN USING THESE PRODUCTS. FOR ANY FURTHER INFORMATION PLEASE REFER TO THE INSTRUCTIONS ON THE PRODUCT PACKAGING.



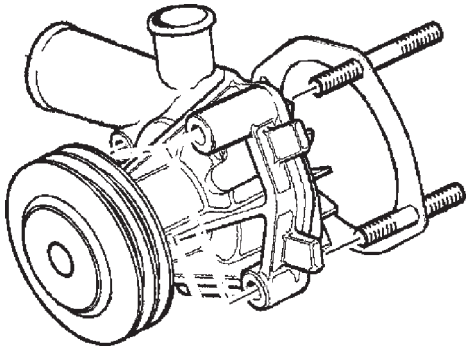
CAMSHAFT

Make sure that cams and gudgeon pins aren't worn. Check that the dimensions of the cams are no less than **0.05 mm**. with respect to the values in **(TAB. 8.2.2)**.



FRESH WATER PUMP

Make sure there are no signs of blow-by between the pump body and the crankcase or pulley, if you notice some leaks, replace the front gasket or seal.
If there are signs of blow-by or if the impeller or pump body are broken, replace the pump, consulting the general spare parts catalogue.

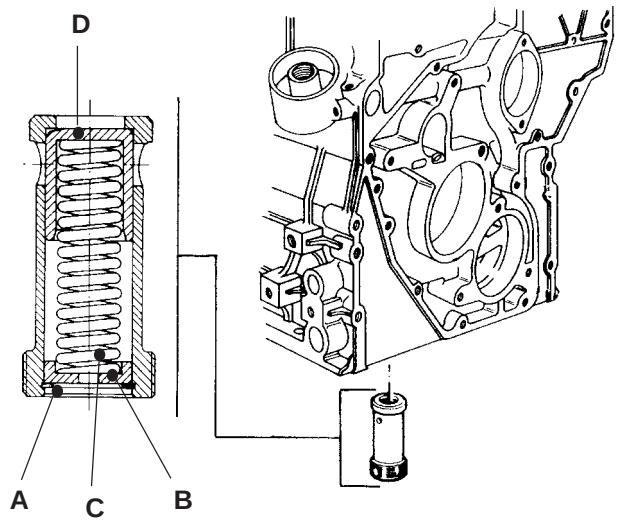


LUBRIFICATION CIRCUIT

The oil pressure adjustment valve is at the bottom of the crankcase, in a vertical position.
To reach it, you have to remove the oil sump.
If necessary wash with the relevant solvent see (par. 3.7).
If there are any anomalies in the functional character or the oil pressure is instable, we recommend replacing it.

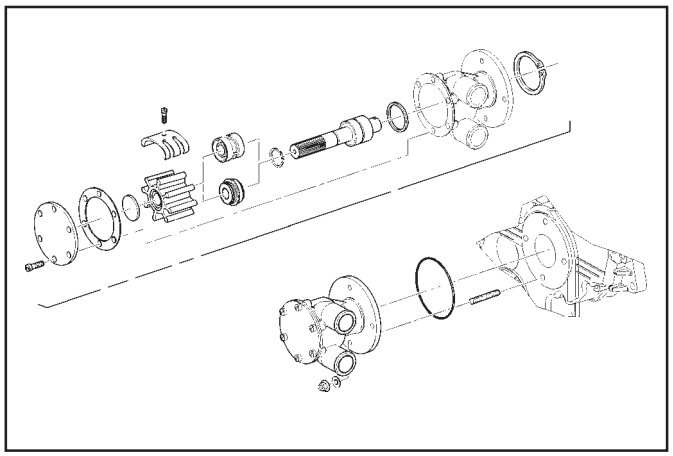
OIL PRESSURE REGULATING VALVE

To dismantle of the complete valve, we recommend heating the seat, but not too much, because the valve is assembled with LOCTITE, you can use various normal tools to unscrew it.
If you have to check the plunger or its seat, we recommend only dismantling the internal part, removing the snap ring **(A)**, removing washer **(B),** spring **(C)** and plunger **(D)**.

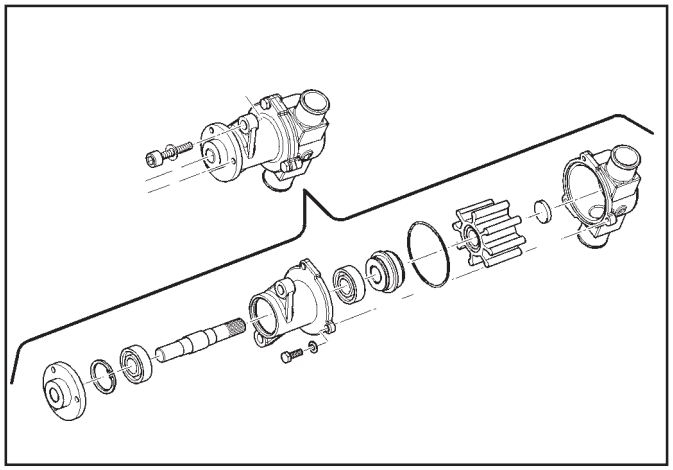


SEA WATER PUMP MD700

Make sure there are no signs of oil blow-by between the pump body and the front cover, if you do notice signs of a leak, replace the OR. If there are signs of blow-by or the pump body is broken, or there are signs of internal wear (rubber impeller) or the pump is unusually stiff to turn, replace the pump consulting the general spare parts catalogue.
If you notice sea water leaking from the body, check the internal seal, if necessary replace it.

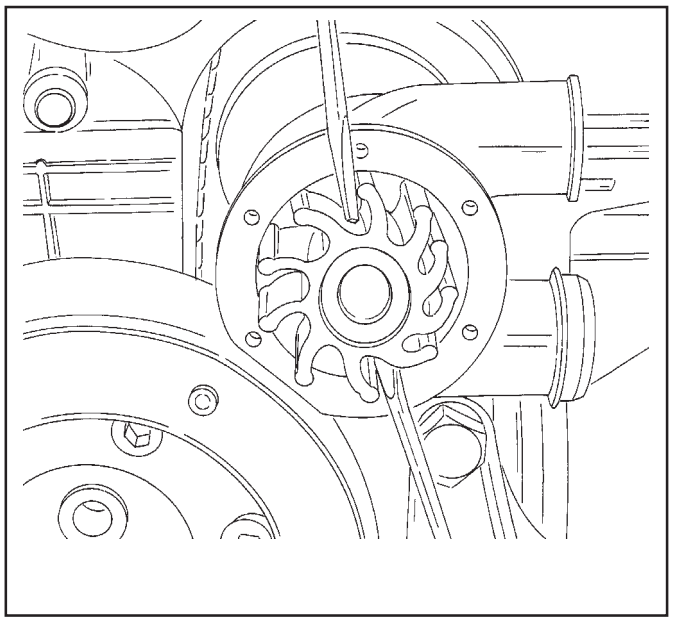


SEA WATER MD704LH/LS



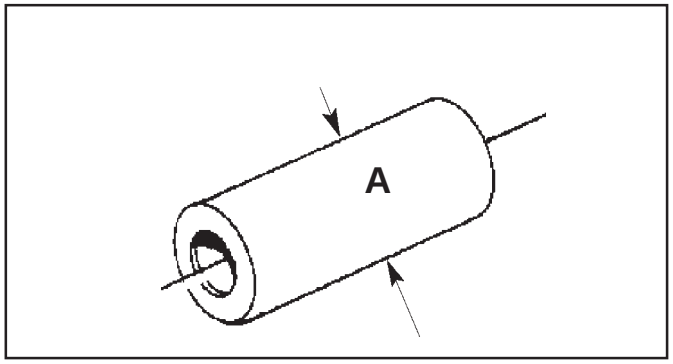
Sea water pump impeller

Check that the impeller shows no signs of wear or damage.
To pull the impeller off the spindle, prize it off outwards with two screwdrivers, being careful not to damage it (see figure).



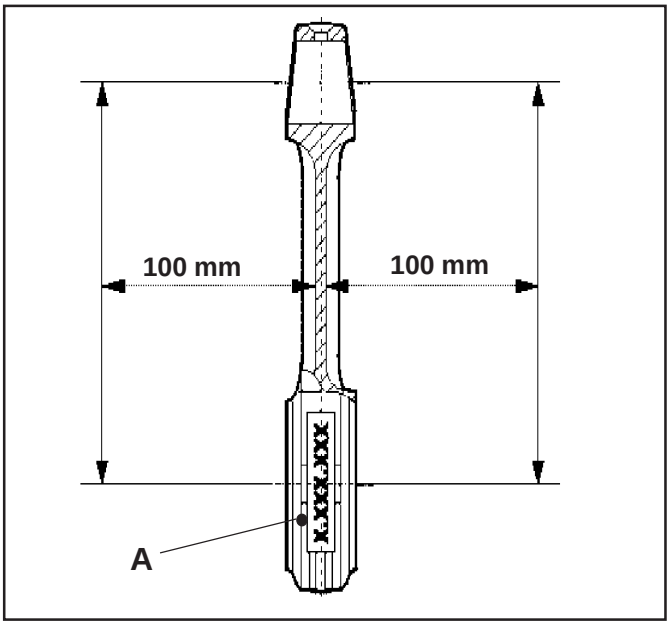
GUDGEON PINS

Make sure that the gudgeon pin shows no signs of scoring or traces of seizing or have been reduced from the nominal diameter (**A**), which should be:
Ø 31.990 ÷ 31.996 mm.
If you notice any anomalies, don't grind down or rectify the pin, which must be replaced.



PISTON RODS

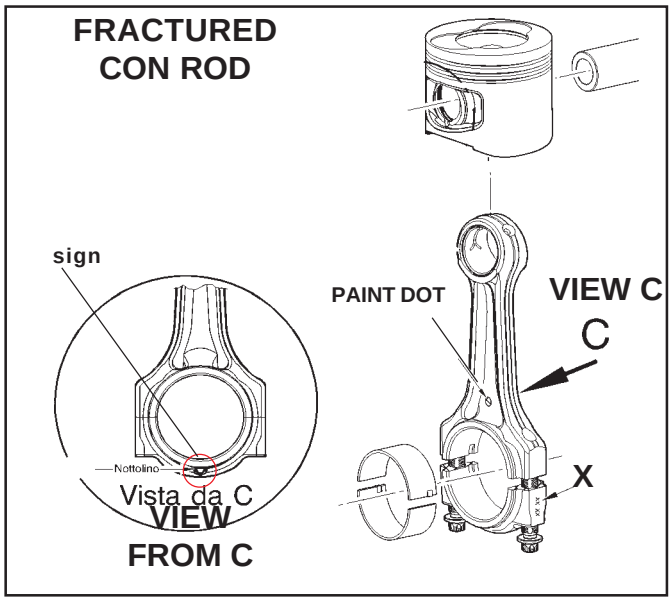
Make sure that the piston rod shows no traces of wear deformations or cracking.
When checking that small end-big end axes are parallel, the max difference mustn't be over **0.15 mm.** at a distance of **100 mm**. from the shaft axis.
Check that the small end bush shows no signs of scoring or evident traces of seizing.
If you do notice the above conditions, the piston rod must be replaced.



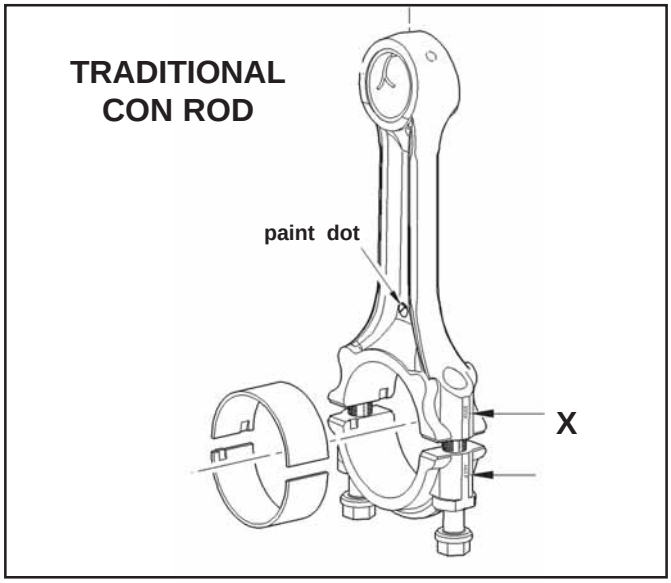
USE CON RODS WITH THE SAME WEIGHT IDENTIFIED BY A PAINT DONT AS SHOWN IN THE PICTURE

IDENTIFICAZIONE BIELLE IN FUNZIONE DELLA SELEZIONE PESI
Connecting rods identification in function of masses selection.

weight	≥978gr. ⇩ ≤992.9gr.	>992.9gr. ⇩ ≤1007.9gr.	>1007.9gr. ⇩ ≤1022.9gr.	>1022.9gr. ⇩ ≤1038gr.
colour paint dot	VERDE Green	BLU Blue	BIANCO White	GIALLO Yellow

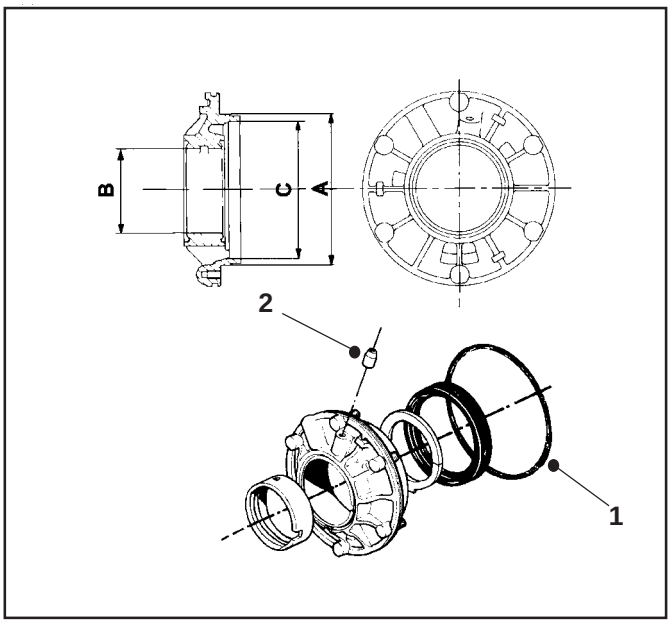


THE COMBUSTION CHAMBER MUST BE POSITIONED FROM PRINTED SIDE "X"PRESENT ON THE BACK CON ROD/CAP AS SHOWN IN THE PICTURE AND THAT (ONLY FOR FRACTURE CON RODS) SIGN IS POSITIONED AS FROM VIEW "C" WHEN ASSEMBLING CON ROD AND PISTON



ASSEMBLY BEARING CON RODS INTO OWN SEATS AS INDICATED IN THE PICTURES

REAR SUPPORT WITH JET INCORPORATED

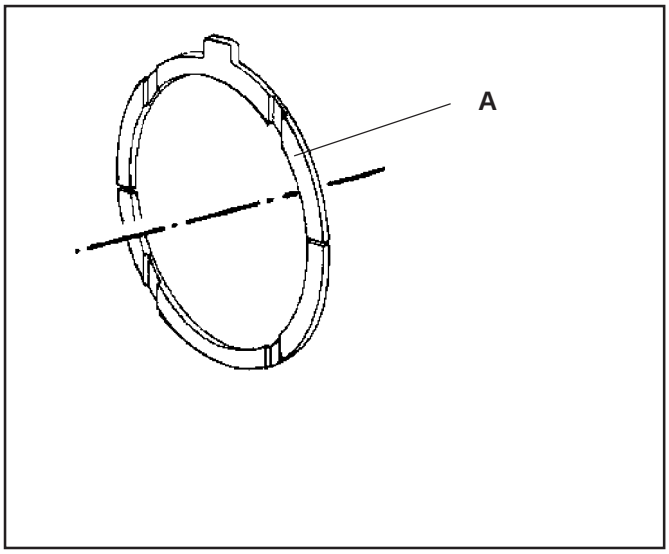


Make sure that the surfaces in contact with the scraper rings show no traces of uneven wear and that the error of measurement in a perpendicular direction of the seat of the crankshaft bearing doesn't exceed **0.03 mm**.
Check the following diameters:
A Centre pin diameter **131.930 ÷ 131.970 mm.**
B Bush seat diameter **85.985 ÷ 86.005 mm.**
C Oil seal seat diameter **120.000 ÷ 120.050 mm.**
Every time you dismantle the part replace seal ring **1**.
Check valve **2** works properly; if the opening values are different from **kPa 150 ÷ 200 (bar 1.5 ÷ 2.0)** replace the nozzle. Block it in the seat by caulking it at 120°.

REAR SUPPORT WITHOUT JET

For these controls, please follow the indications above.

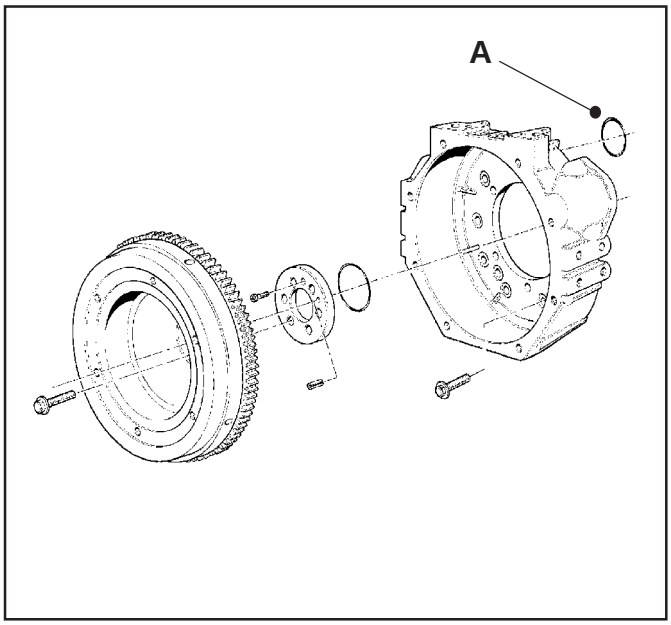
THRUSTWASHERS



To adjust the axial play use the supplied shims as shown in **table**.
The value of the oversize is stamped on the back of the shim (**A**) only for the two oversizes (0.10 and 0.20 mm).

REF.	DESCRIPTION	DIMENSION
	Standard	2.310 ÷ 2.360 mm
	1ST oversizer + 0.10	2.410 ÷ 2.460 mm
	2ST oversizer + 0.20	2.510 ÷ 2.560 mm

FLYWHEEL BELL-HOUSING

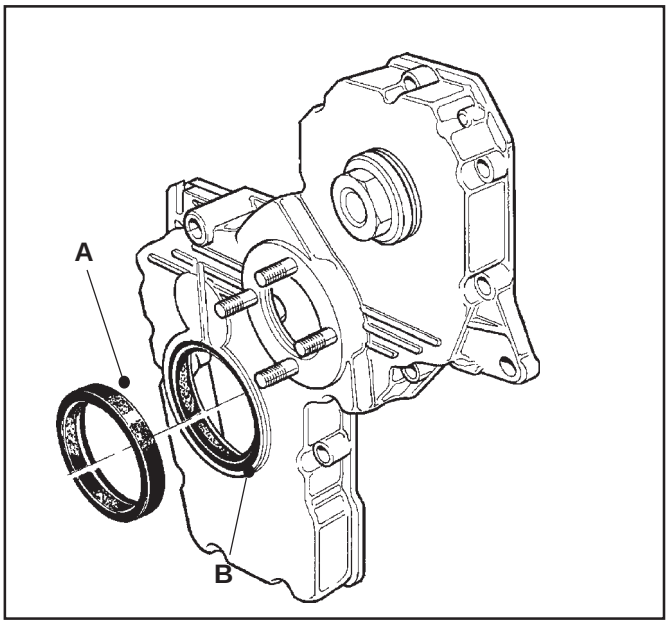


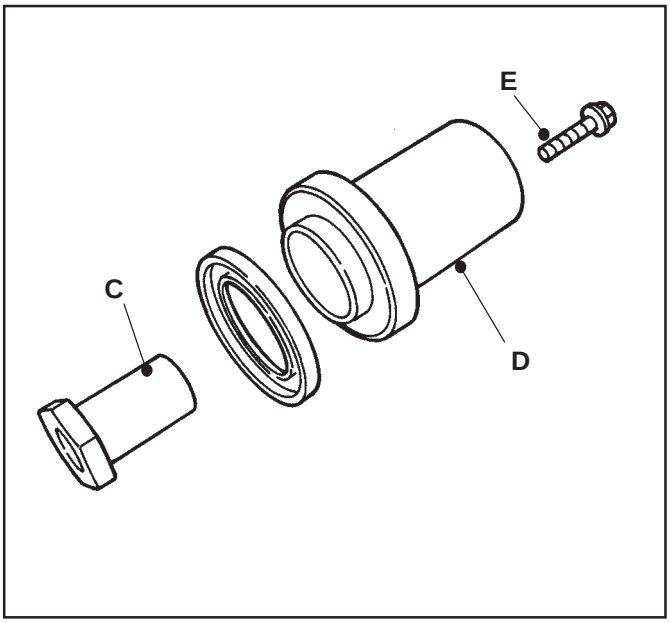
Check the integrity of the connecting surface of the holes and centring pins. If necessary, repair with the damaged threads with Helicoils. Every time you dismantle the parts, replace the seal ring **(A)** of the camshaft.

FRONT COVER

If you have to replace the seal ring **(A)** in the assembly phase you should use tool **(TAB. 11.1 ref. I)** , to avoid irreparably deforming the cover.
Carefully clean seat **B** on the cover, fit insert **C** screwing it on to the crankshaft until it is tight against the same.
Insert the new oil seal on support **D**.
Fit the support with the oil seal on the insert until the oil seal comes into contact with the cover.
Then put a M10x40 screw **E** in the back hole of the support and screw it into the insert until the two pieces are tight.
At this point the oil seal is correctly inserted.

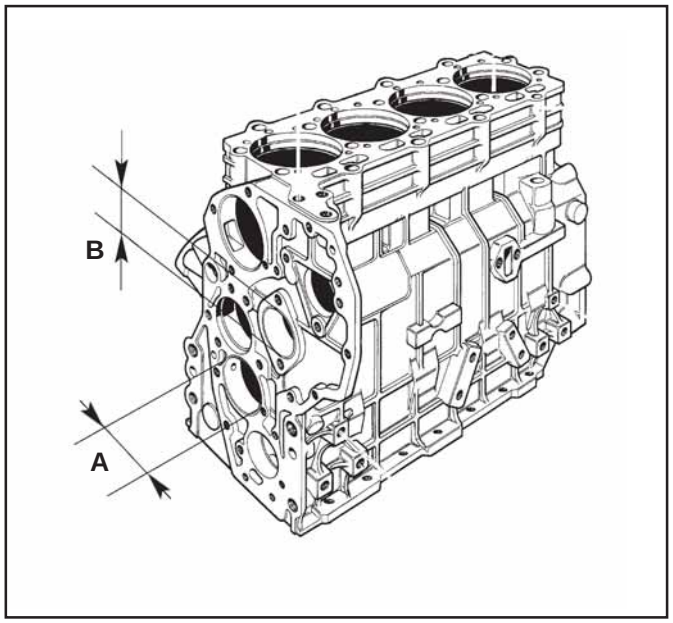
IMPORTANT: DON'T TOUCH THE LIP OF THE OIL SEAL YOU ARE CHANGING WITH YOUR BARE HANDS OR WITH DIRTY GLOVES, AS THE GREASE ON YOUR HANDS OR THE DIRT ON THE GLOVES CAN DAMAGE THE SEAL





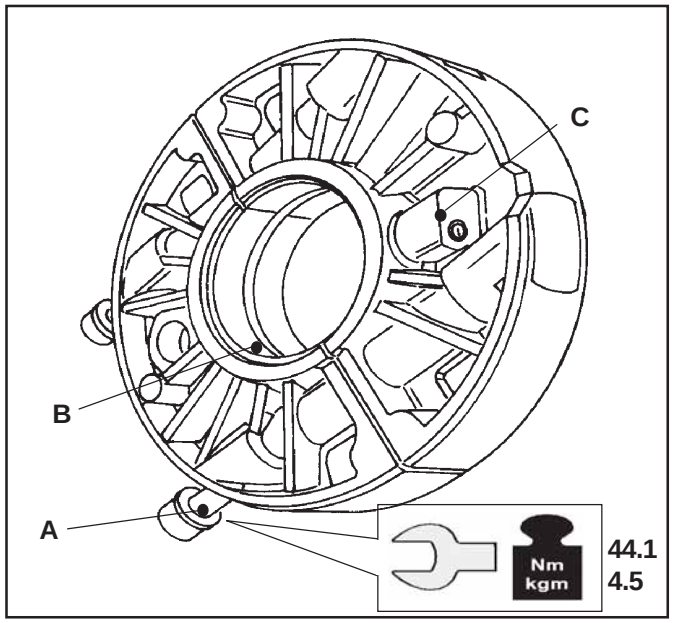
CRANKCASE

- Thoroughly wash the crankcase with solvent (par. 3.7)
- Check the integrity of the connecting surfaces of the heads.
- Check the integrity of the connecting surfaces of the liners.
- Check that the threaded holes are clean and show no signs of dents.
- Check that the oil ducts aren't obstructed.
- Check that the oil ducts show no signs of porosity or cracking.
- Check the diameter of the front bush seat **(A)**, which must be,: **(Ø 67.025 ÷ 67.050 mm.)**
- Check the diameter of the camshaft bush seats **(B)**, which must be: **(Ø 57.000 ÷ 57.030 mm.)**.



CENTRAL SUPPORT WITH JET VALVE

Tighten the support by tightening screws (**A**) to the value indicated.
Measure the seat of the bush (**B**) on two diameters that are perpendicular.
Seat diameter **(Ø 66.670 ÷ 66.697mm).**
If necessary replace valve (**C**), remove the half-bearing so you can pull out the body of the valve.
Insert the new valve in the seat with the oil jet hole pointing towards the piston.
Insert the new half-bearings.

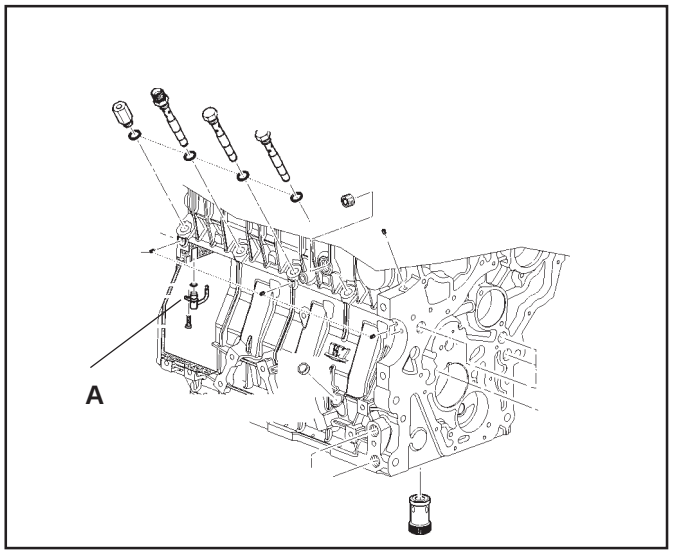


CENTRAL SUPPORT WITHOUT JET VALVE

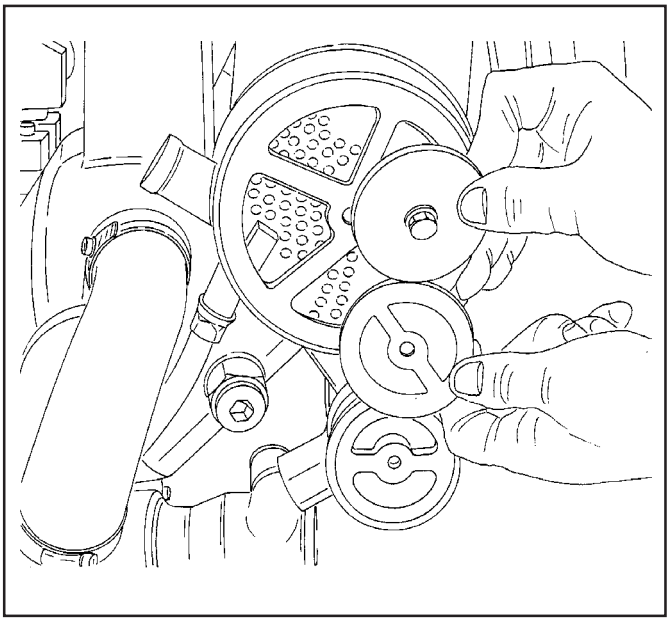
For this control, follow the instructions above.

Jet Valve MD706 LH/LS/LX/LB/MX/MS - MD704LH/LS

Check valve **A open at 1,8 - 2 bar.**

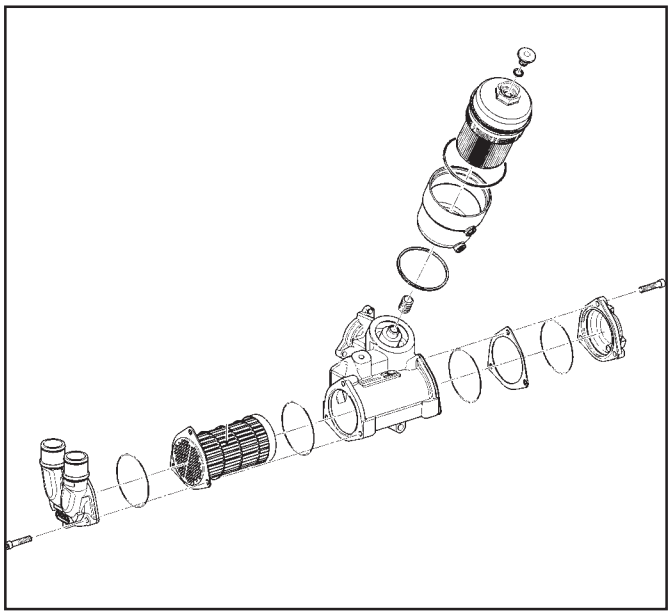


WATER/WATER-WATER/OIL EXCHANGER MD700LI - 706LH/LS/ LX/LB - 706 MI/MH/MX/MS

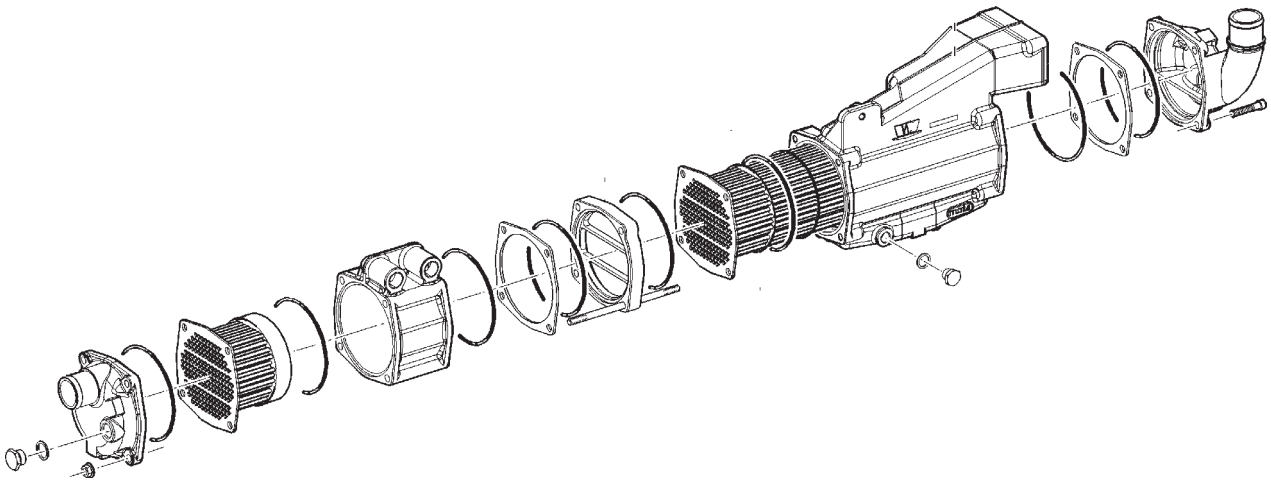


To check the internal cleanliness of the sea water circuit and if necessary wash the intercooler, you have to dismantle the covers situated in the two heads of the exchanger, a well as those of the water/water and those of the water/oil exchanger as shown in the figure, making sure you don't damage the gasket.
Then proceed by washing the inside of the exchanger with water and biodegradable detergent.
Fresh water circuit, to wash this sector, we recommend using water and biodegradable detergent, then filling it with a mix of 50% demineralised water and antioxidant/antifreeze fluid conform to **ASTM 3306**.

WATER/OIL EXCHANGER MD704LH/LS

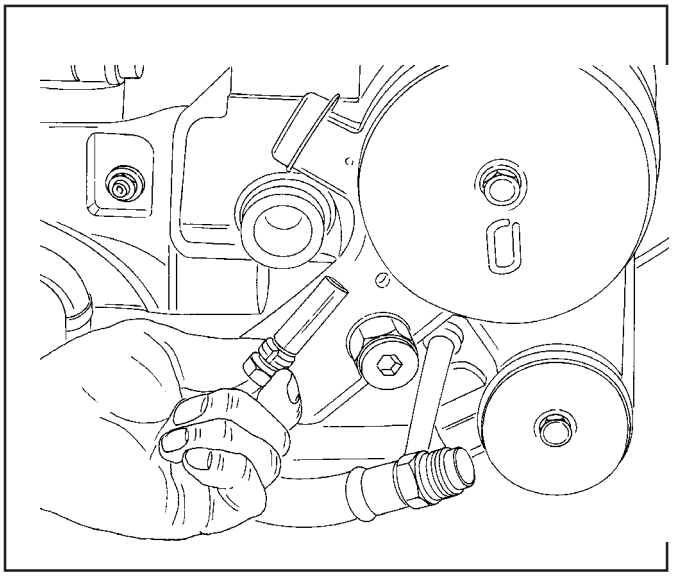


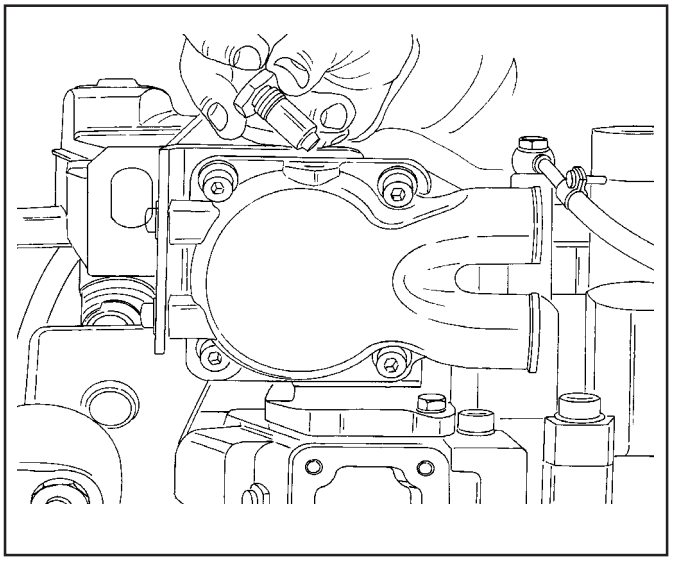
WATER/WATER EXCHANGER MD704LH/LS



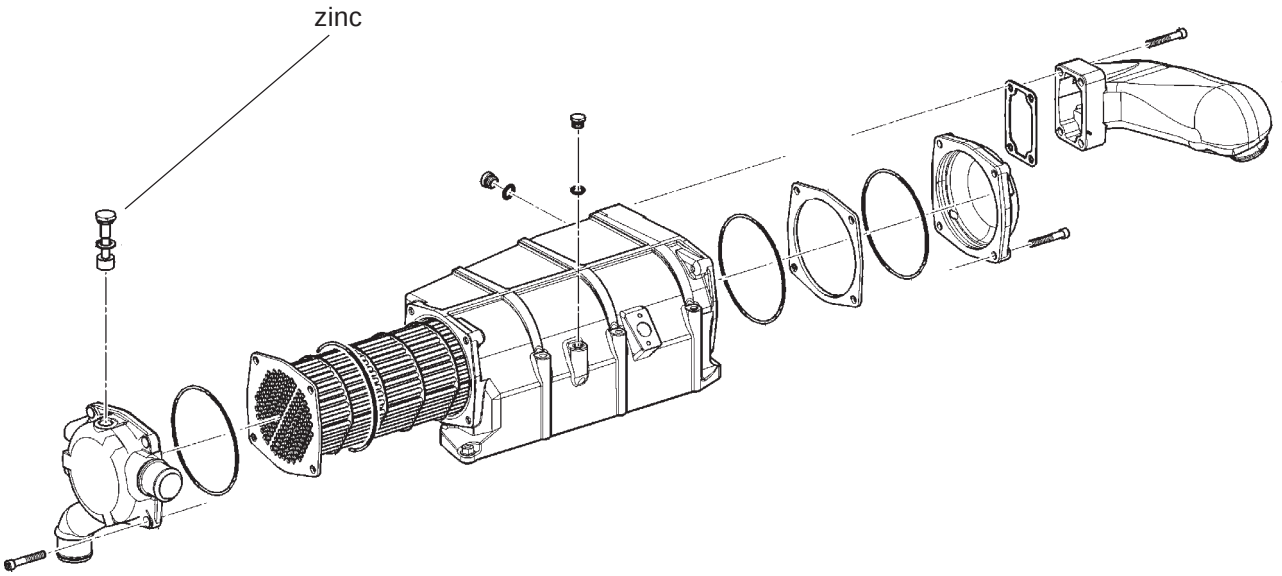
ELECTROLYTIC ZINC MD700

To check the state of the zincs, simply unscrew the zinc caps inserted, one on the water/water exchanger and one on the front of the intercooler , with the frequency indicated in the chapter “MAINTENANCE” .
If the check shows that they are excessively worn, we recommend reducing the time between checks.





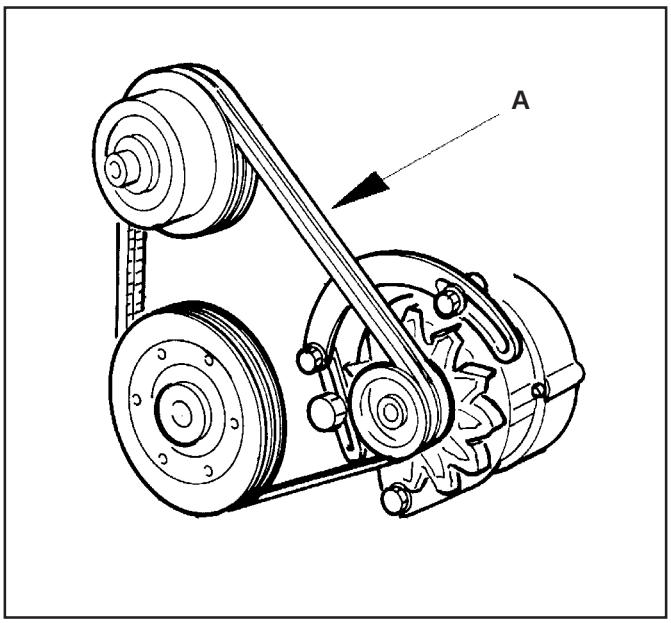
ELECTROLYTIC ZINC MD704LH/LS



BELT TENSION

TRAPEZOIDAL

You can check the tension of the belt in two ways.
By pressing on it from the longest side (position **(A)** in the figure) with roughly **7 ÷ 8 Kg**, it should flex by about **10 mm**.
Or, using an electronic tester (frequency analyser "Clavis").
To put it at the position side **L** to cap the belt for to read the frequency.



MD706

ALBERO MOTORE/P. ACQUA DOLCE/ ALTERNATORE

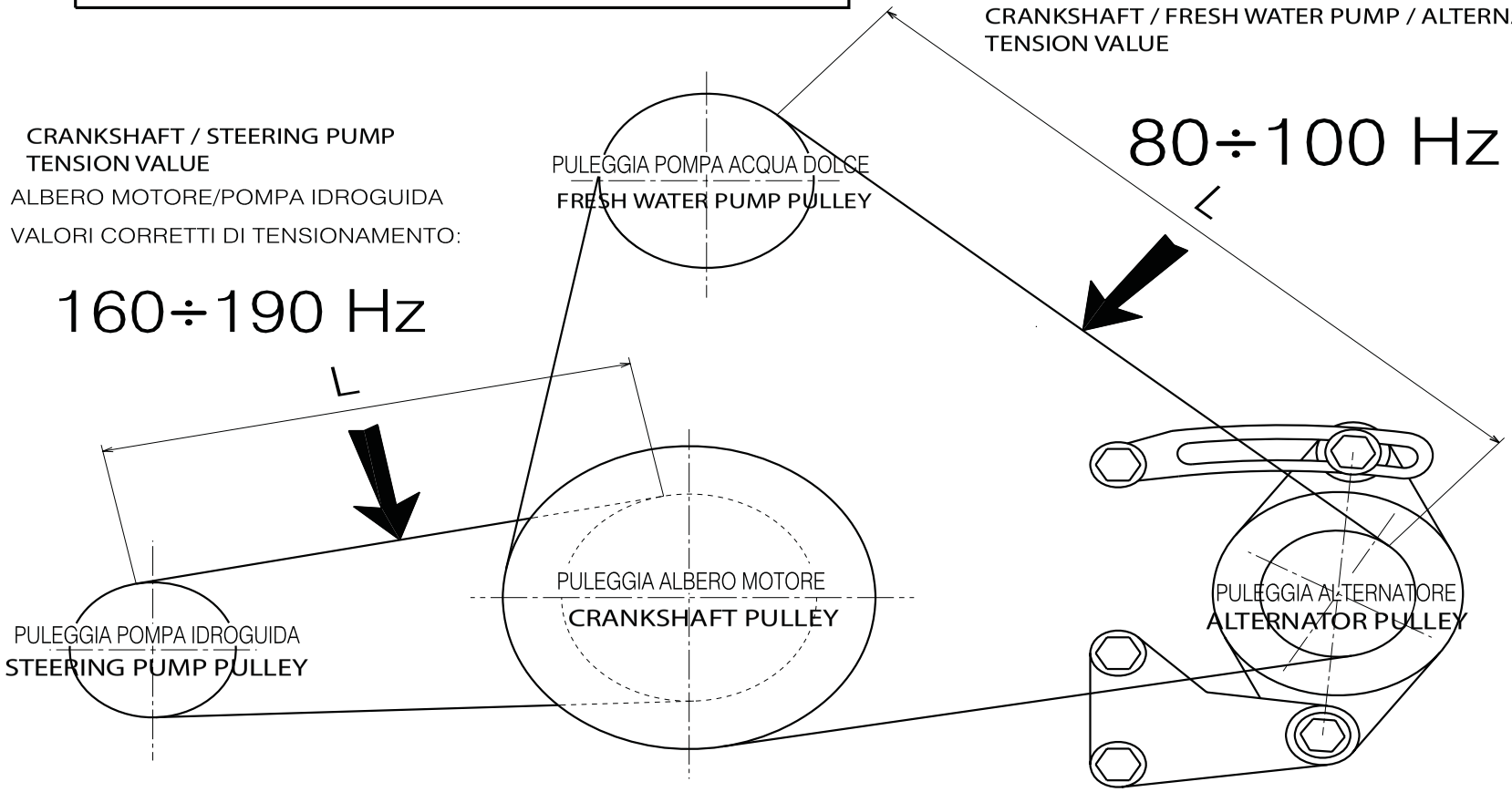
VALORI CORRETTI DI TENSIONAMENTO:

CRANKSHAFT / FRESH WATER PUMP / ALTERNATOR TENSION VALUE

CRANKSHAFT / STEERING PUMP TENSION VALUE

ALBERO MOTORE/POMPA IDROGUIDA

VALORI CORRETTI DI TENSIONAMENTO:



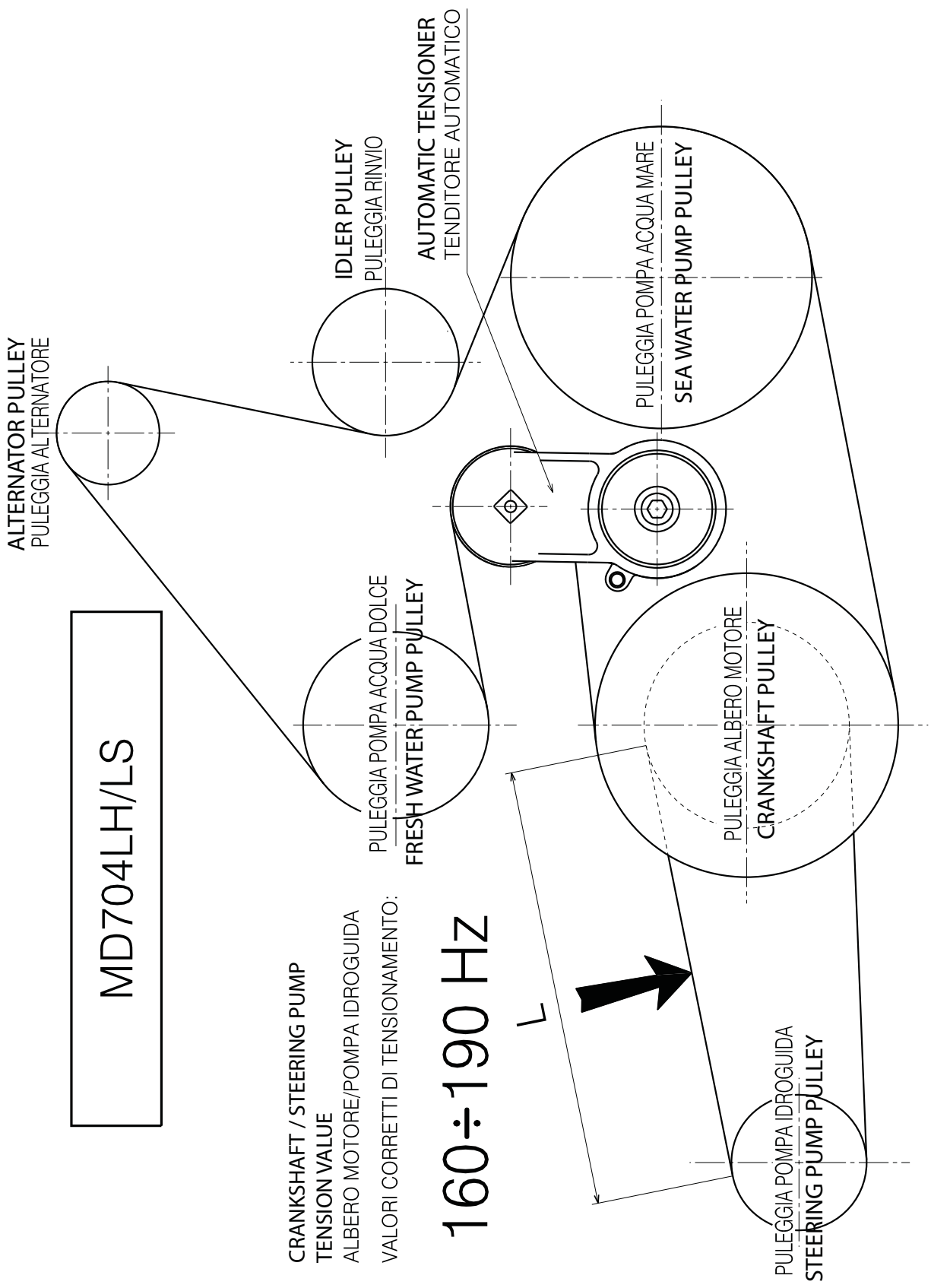
LA MISURA DEVE ESSERE RILEVATA NEI PUNTI INDICATI DALLE FRECCE

The measure must be surveyed in points indicate to arrows

I VALORI DI TENSIONAMENTO VANNO MISURATI CON STRUMENTO CLAVIS

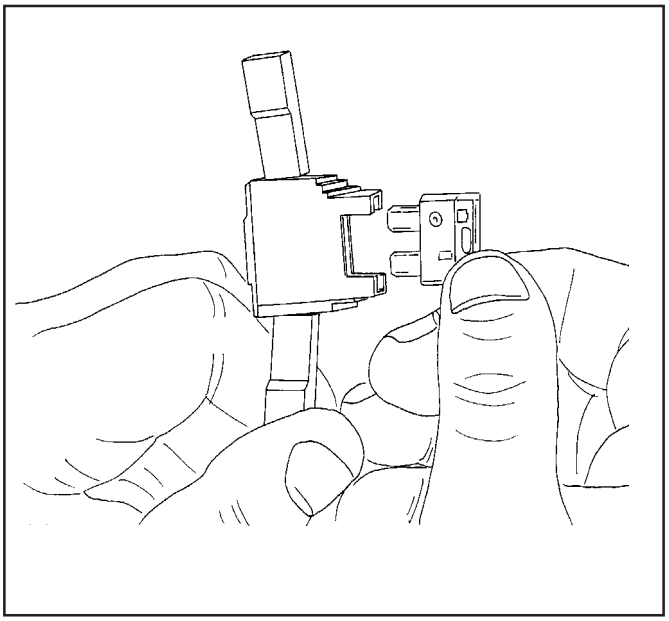
Belt tension reading must be measured with CLAVIS instrument

MD 704LH-LS STEERING BELT



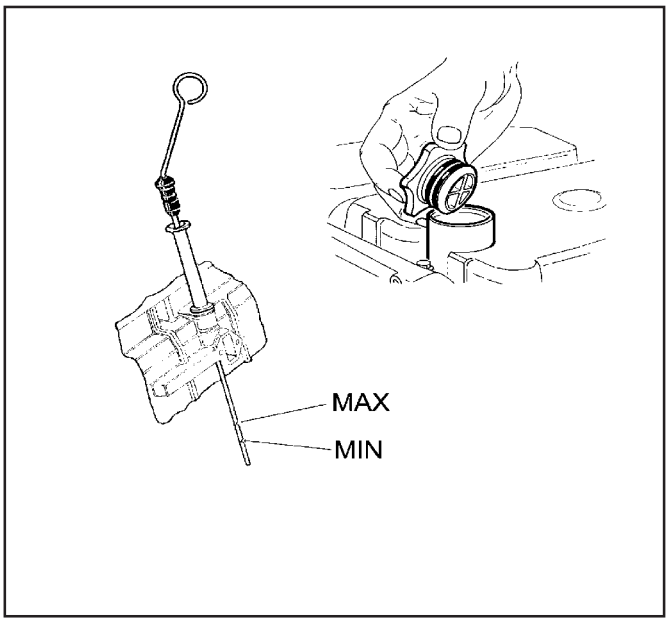
SAFETY FUSE FOR THE ELECTRONIC POWER PLANT

If the power to the power plant is cut off, check that the safety fuse is still intact.
The fuse can be found in the box with the watertight seal.



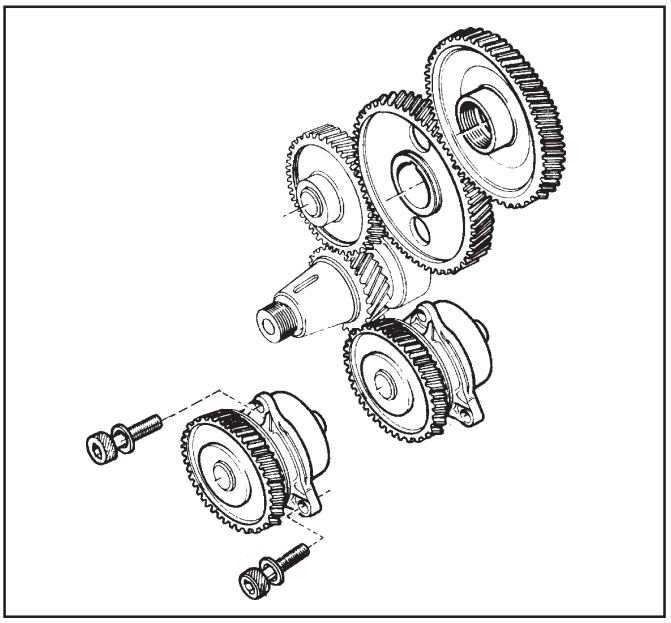
FILLING WITH OIL

Fill the engine with oil through the cap on the rocker arm box cover.
Pour the oil in until it reaches the top notch of the oil dipstick.
For the exact quantity see chapter 9 "running tests and adjustments



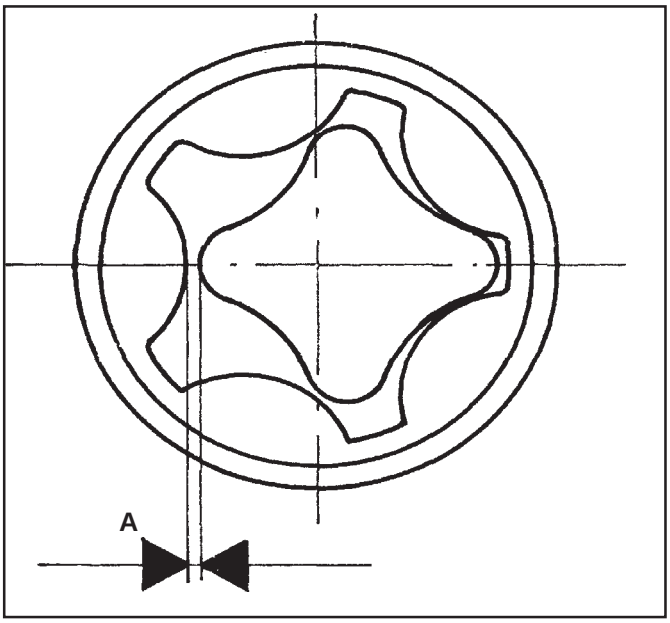
OIL PUMP

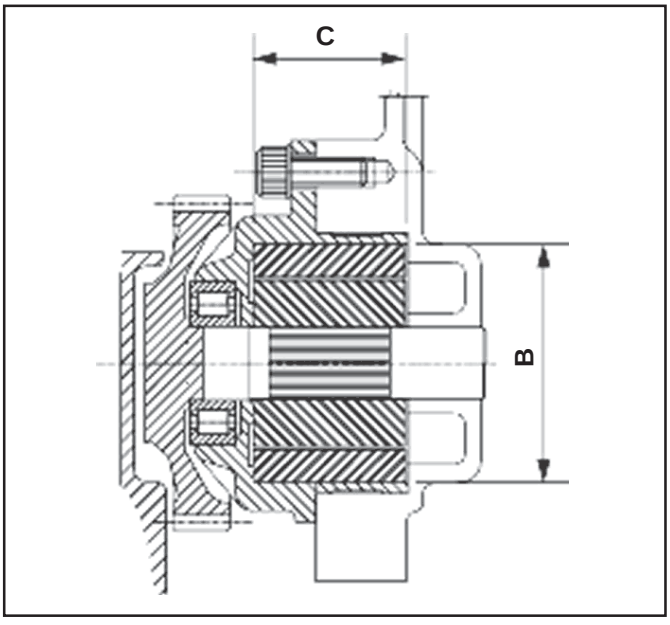
Ratio: engine rpm/pump rpm **1:0.666**
MD704LH/LS 1:0.676
Every time you dismantle the parts, wash the single parts and check for wear and deterioration.



Dimension and play
Impeller height mm. **32.487 ÷ 32.500.**
Play between impellers mm. **0.07-0.20**
Difference between the height of the impellers and their seat, mm. **0.081 ÷ 0.097**.
Axial play between gear and pump body mm. **0.150 ÷ 0.250**.
Impeller seat diameters mm. **(B) 58.105 ÷ 58.130**.
Impeller seat depths mm. **(C) 32.403 ÷ 32.406**.
Play between seat and external impeller mm. **0.105 ÷ 0.160** limit mm. **0.500**.

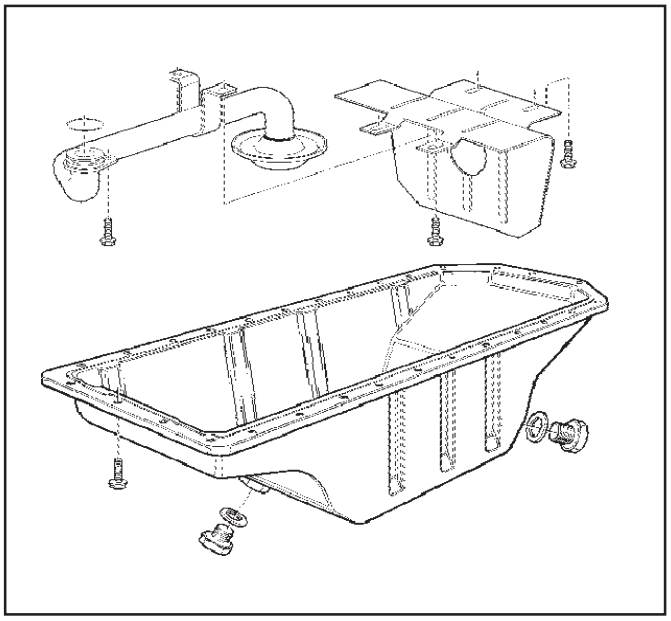
When re-assembling the parts, keep the chamfer of the external impeller pointing towards the gear and check that the block between impeller and gear resists a tightening torque of 9 Kgm (Nm 88.4).





OIL SUMP AND SUCTION PIPE

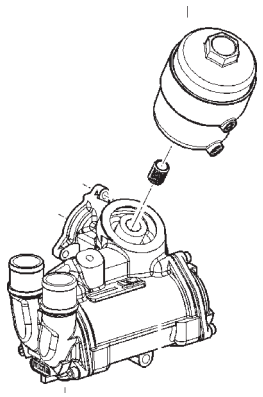
Check that the sump isn't cracked or cracking. Carefully check that all the welds are watertight and the integrity of the seal rings of the oil suction pipe.

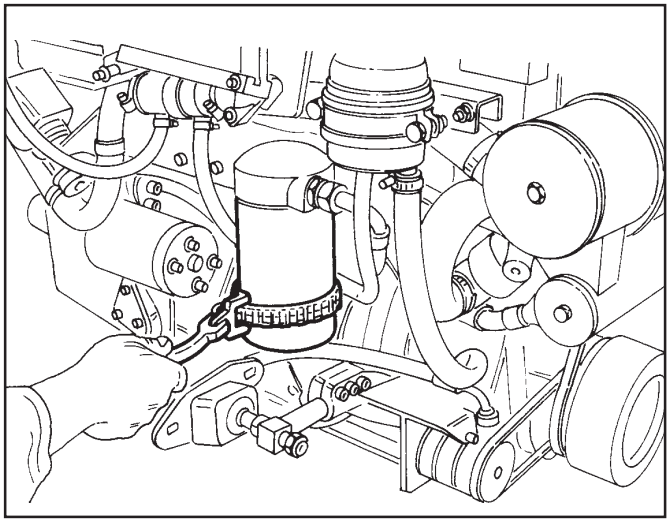


OIL FILTER

Replace the cartridge before the deadline in **chapter "Maintenance"**
Oil the gasket thoroughly before fitting.

MD704LH/LS



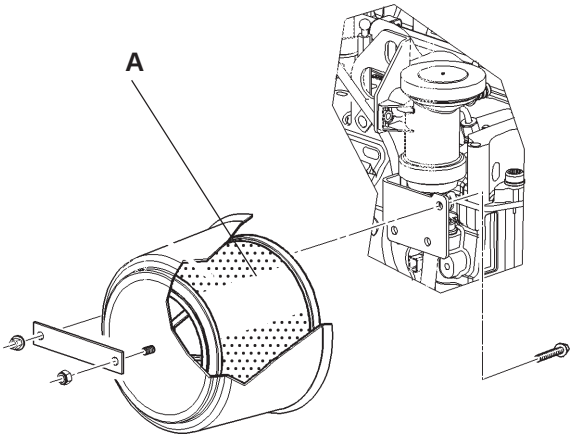


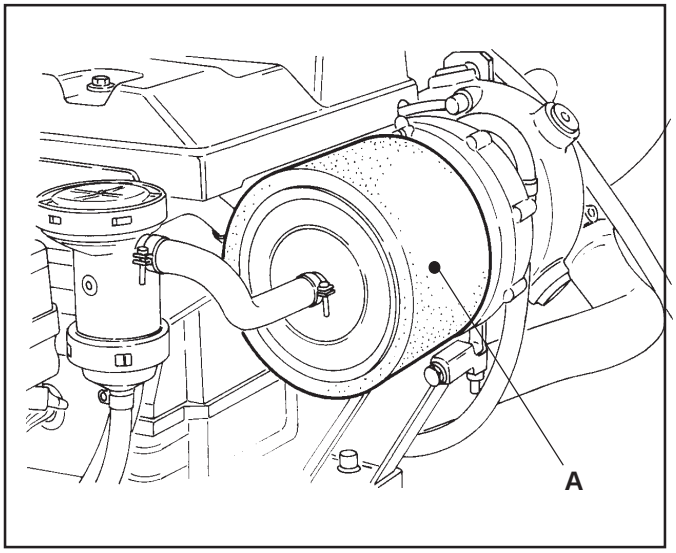
AIR FILTER

Remove the sponge filter **(A**) and rinse it in warm water and biodegradable degreasing product.

Replace the sponge filter if it is breaking up.

MD704LH/LS

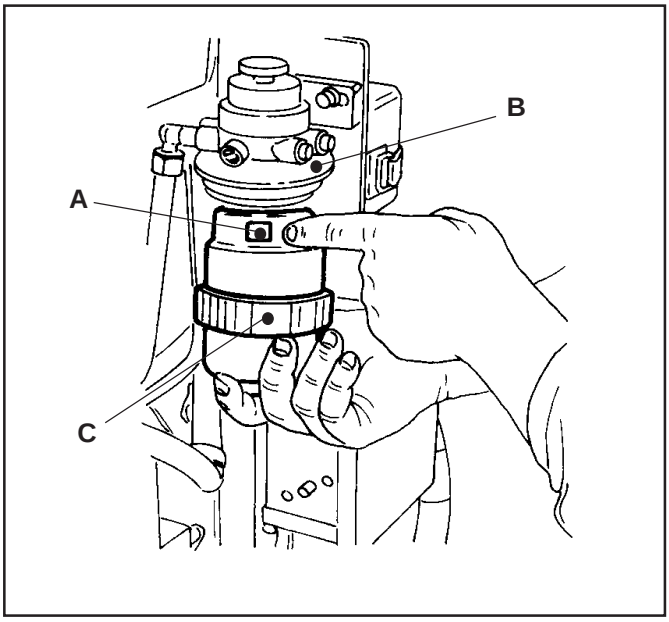




FUEL FILTER

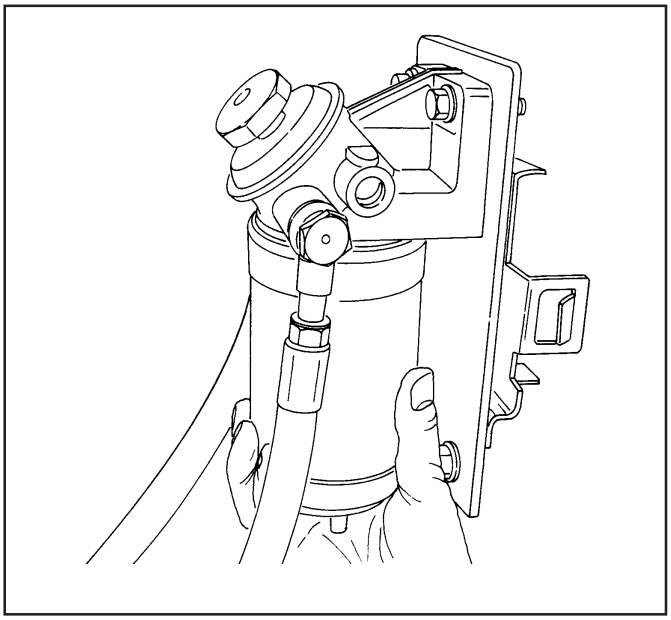
STANADYNE

Replace the cartridges by the deadline in **chapter 3 "Maintenance"**
To correctly replace the cartridge, proceed as follows:
Remove the cartridge complete with its holder from the support by loosening nut **(C)**.
Replace the cartridge and fit a new one, making sure that reference mark **(A)** lines up with the seat on the support **(B)**.
Proceed by bleeding the system as described on **chapter 9 "Running tests and adjustments"**



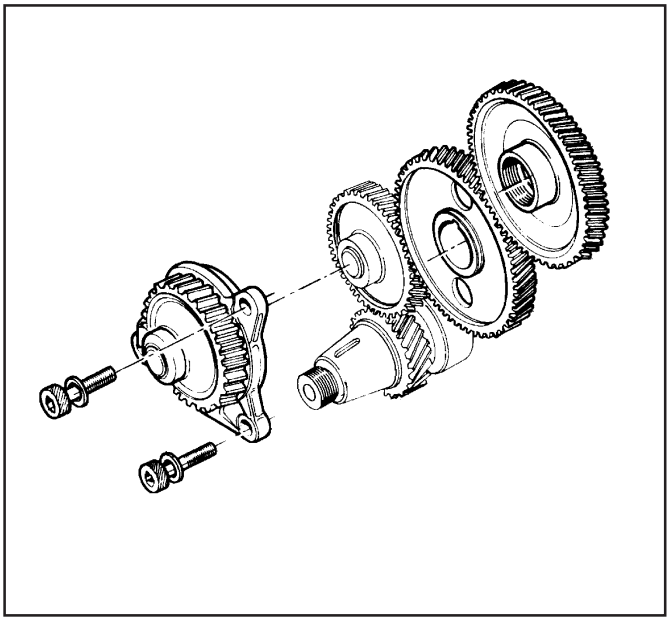
BOSCH

Remove the cartridge from the filter holder, loosening it and replacing it with a new one.
Proceed by bleeding the system as described on **chapter 9 "Running tests and adjustments"**



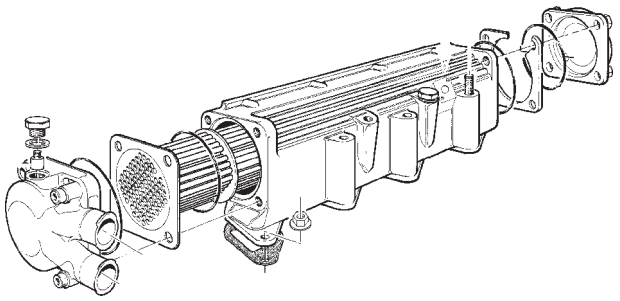
INTERMEDIATE GEAR

Check that the gear isn't broken or abnormally worn.
If you find any anomalies we recommend replacing the whole group. During assembly make sure that there is a play of **mm. 0.10 ÷ 0.20** between the gears.



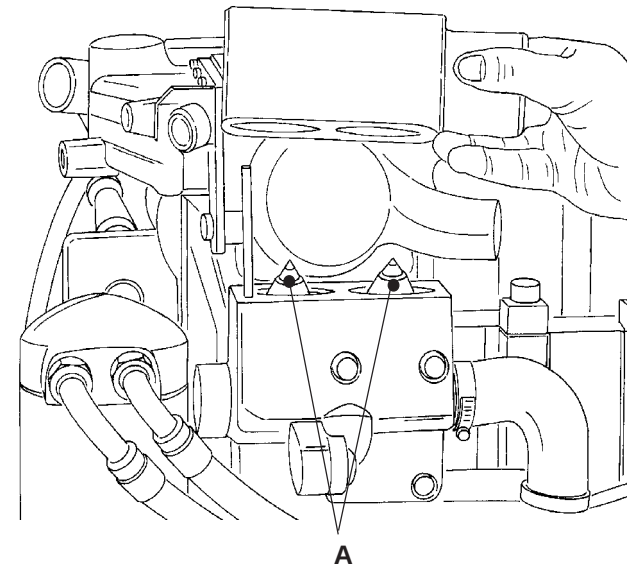
INTERCOOLER

Check that the intercooler is free of scale or impurities of any kind. If this is not the case clean the intercooler with biodegradable detergent.
The presence of dirt slows the airflow and reduces the performance of the engine.

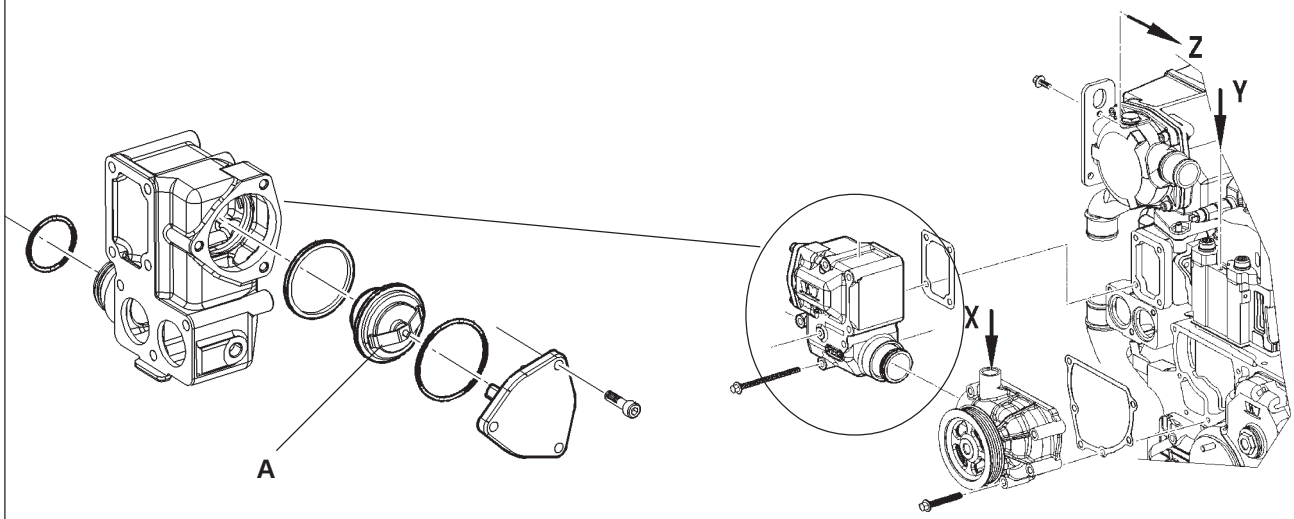


THERMOSTAT VALVES

The thermostat valves **(A**) are fitted in their holder situated in the front part of the engine, above the fresh water pump.
Replace them whenever you notice an irregular temperature of the engine water.
Although they have a differential degree of opening, they do not need to be in a specific position to be fitted, but it is important that they aren't installed upside down, the conical part should be positioned upwards (see figure).

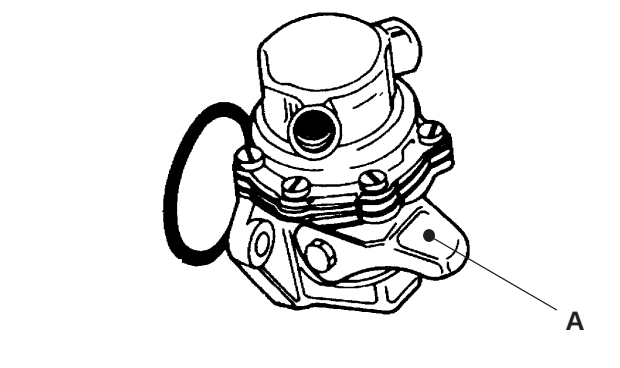


MD704LH/LS



FEED PUMP (AC)

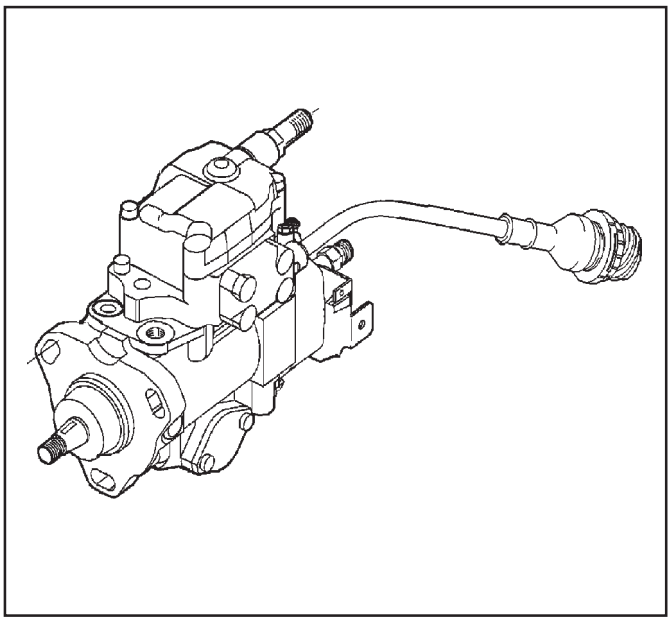
The feed pump is a membrane type pump, fixed on the crankcase and driven by a cam on the camshaft; it is triggered manually.
To check that it is working properly, detach the delivery pipe to the injection pump and put pressure on tongue **(A**). You should notice diesel pumped out.
If it isn't working properly replace it.



INJECTION PUMP

BOSCH ELECTRONIC TYPE

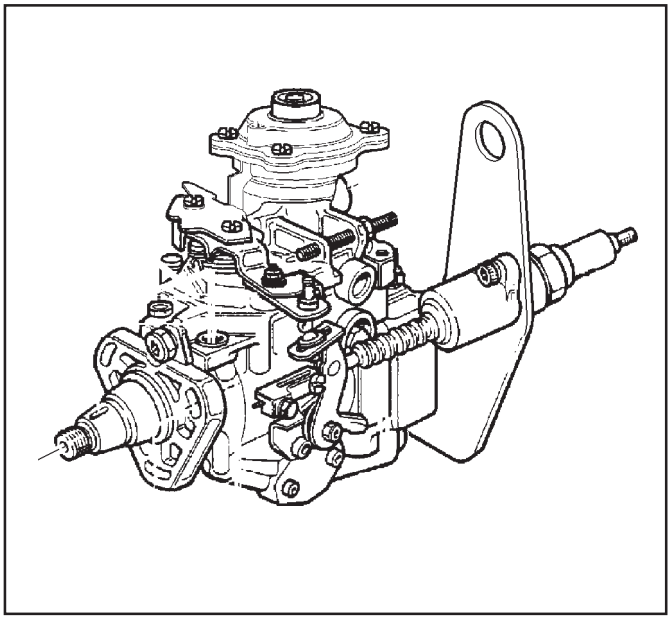
On the electronic pump there are no manual adjustments.



BOSCH MECHANICAL TYPE

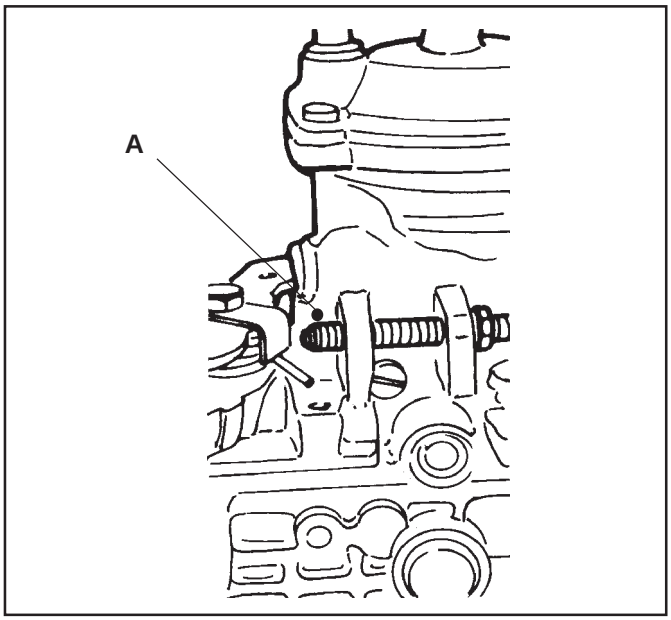
On the mechanical pump there are some manual adjustments, such as:
a) adjusting screw of the max idling engine speed
b) adjusting screw of the minimum engine speed
c) adjustment nut LDA , this part regulates the flow at low engine speeds.
d) fuel flow adjusting screw .

THE INTERVENTIONS IN POINTS (C) AND (D) SHOULD BE CARRIED OUT ONLY IN CASES OF ABSOLUTE NECESSITY AND ONLY BY A SPECIALIST EQUIPPED WITH A PUMP TEST BED.



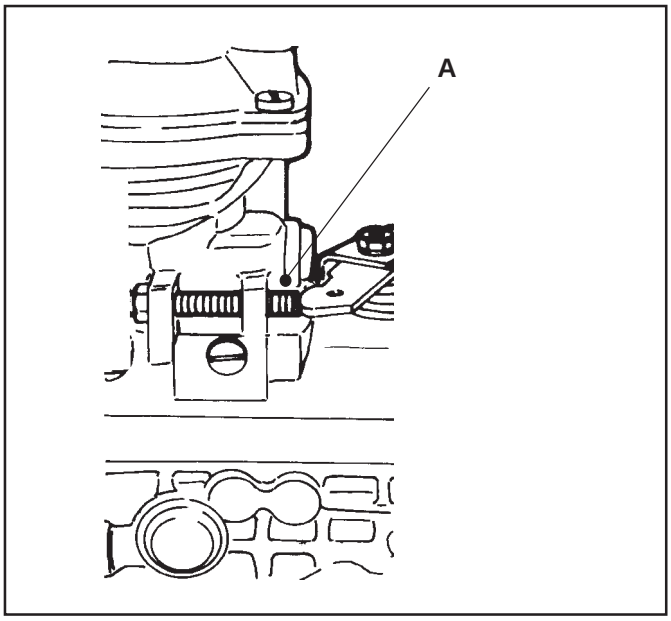
ADJUSTING SCREW OF THE MAX ENGINE IDLING SPEED

Turn screw **(A)** to adjust the engine idling speed to 400 ÷ 450 rpm/min. above that of the engine running at a working load.



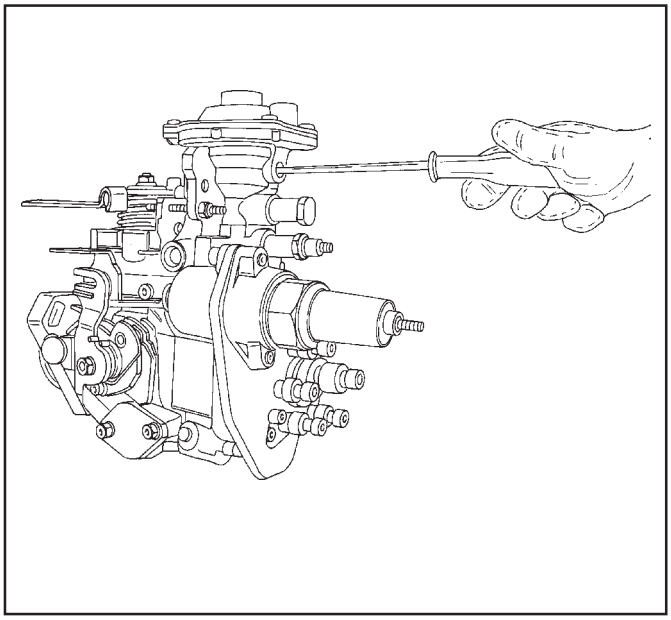
IDLING ADJUSTMENT SCREW

Turn screw **A** to adjust the engine speed to **670 ÷ 700** rpm/min.
The screw is at the side of the crankcase.



LDA ADJUSTMENT RING-NUT

The **LDA** adjustment ring-nut is inside the injection pump, in the top part.
The adjustments have an effect up to an engine speed of 1,800 ÷ 2,000 rpm.
Turning the nut clockwise diminishes the load of the spring and consequently at the same turbo pressure, increases the flow.
Turning the nut anticlockwise increases the load of the spring and at the same turbo pressure, the flow diminishes.

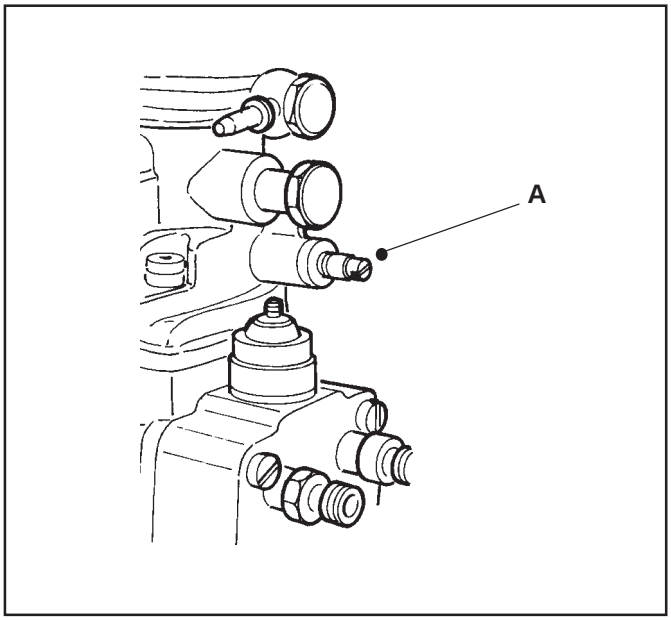


SCREW FOR ADJUSTING THE FUEL FLOW

Screwing in screw **A** increases the flow, unscrewing it diminishes the flow.

CALIBRATING

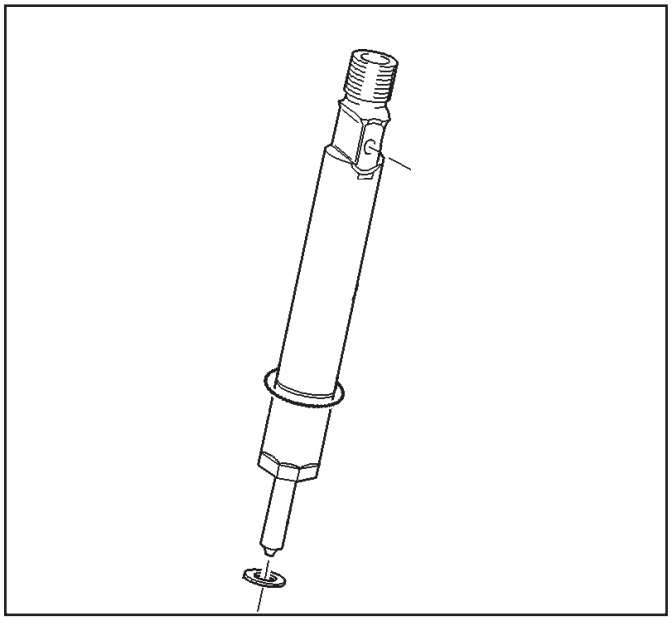
ALL THE READINGS AND ANY FLOW ADJUSTMENTS OF THE PUMP MUST BE DONE ON THE PUMP TEST BED OR WITH THE ENGINE ON A DYNAMOMETRIC BRAKE.



INJECTOR

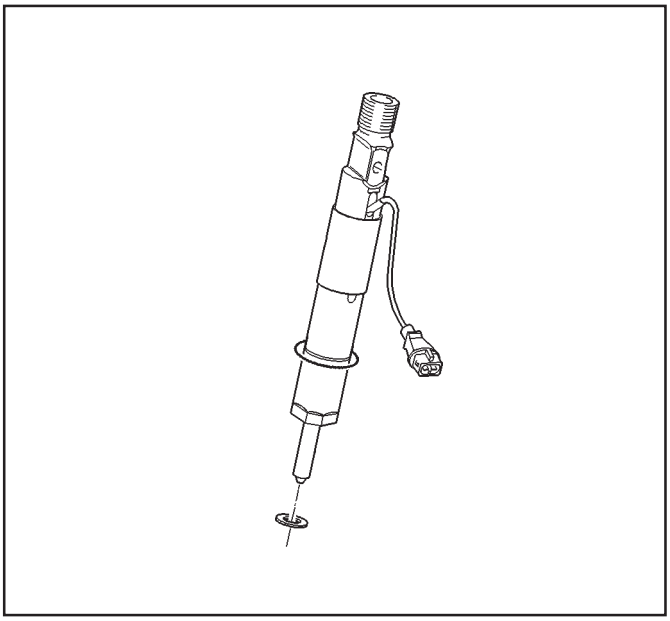
Fit the injector on the test bed, work the pump by hand and check that the injection pressure is up to the value in **chapter 2 "Technical specifications"** and that the injector doesn't drip. If this is not the case, replace the injector.

About engine models **MD 706 LX\LBLH\LS e MD 704 LH/LS** opening injector pressure check must be carried out by a service Bosch with specific test because **these type of injectors are twin effect**.



INSTRUMENT CABLED INJECTOR

Check that the connecting cable isn't damaged, worn or crushed, if the cable breaks this will reduce power.

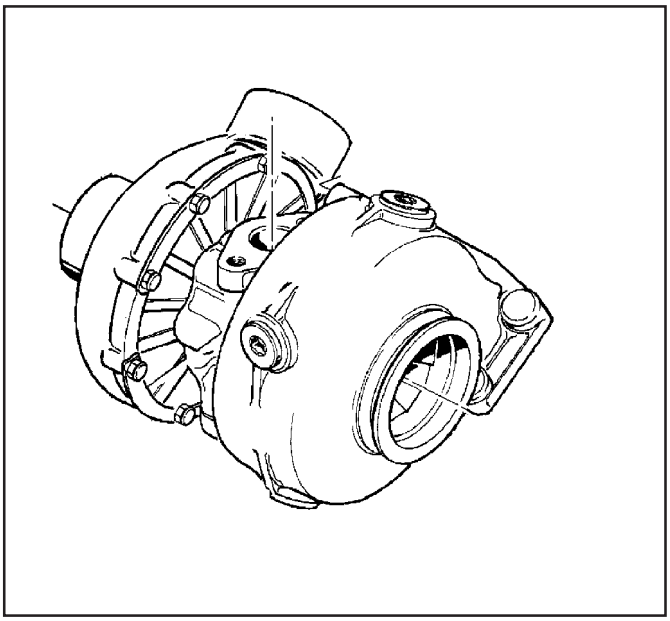


TURBOCHARGER

Check the impeller turns freely, there mustn't

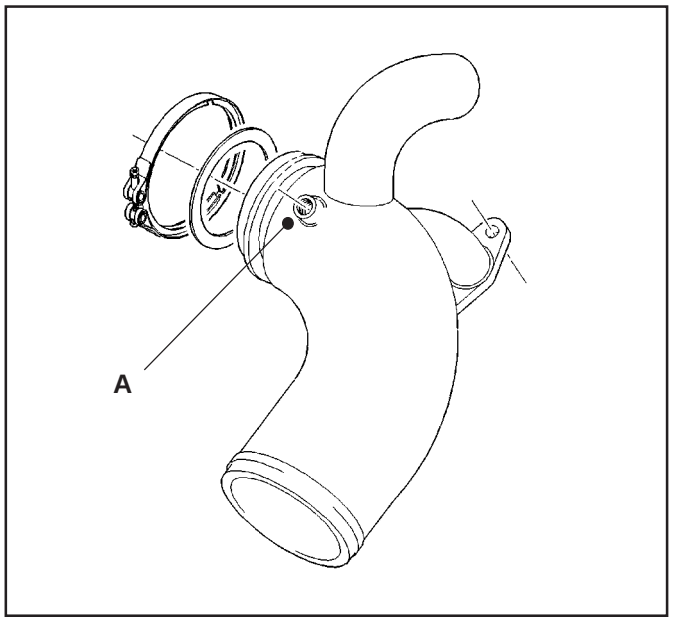
be any traces of sticking and the impeller shouldn't be hard to turn.

VM MOTORI FORBIDS CARRYING OUT ANY WORK OR TAMPERING WITH THE TURBOCHARGER, AS THIS MAKES THE GUARANTEE VOID.



DAMP GAS EXHAUST COUPLING "RAISER"

Check that there are no cracks or signs of breakage in the welds.
In point **A** you can insert a probe to read the the exhaust back pressure.
For the values and the method, please refer to **chapter 9 "running test and adjustments"**



ELECTRIC EQUIPMENT

Precautions

Don't disconnect the cables of the battery with the engine running to avoid tension peaks that could damage the diodes of the alternator and the rest of the electronic equipment.

If you have to do any welding disconnect the earth terminal of the battery.

STARTING

Turning the ignition key to position (1)

enables the control circuits and the pre-heated glow plugs (if present). In position (2) the key supplies power to the starter motor.

If the engine has pre-heated glow plugs, before switching the key to position (2), wait for the luminous indicator of the plugs to go out.

Once the engine starts, let the key return to position (1) disengaging the starter motor.

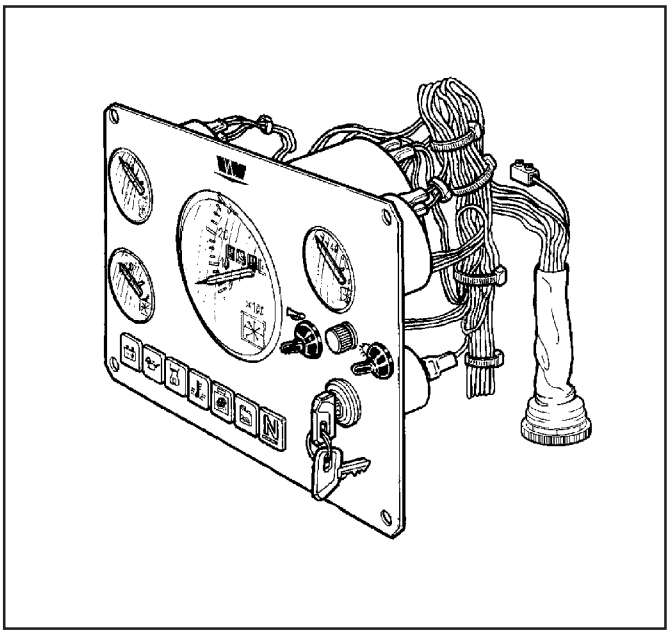
Don't try starting the engine for more than 15 seconds to avoid overheating the magnets.

After each time you try to start the engine, wait a few

seconds to give the battery the chance to recover.

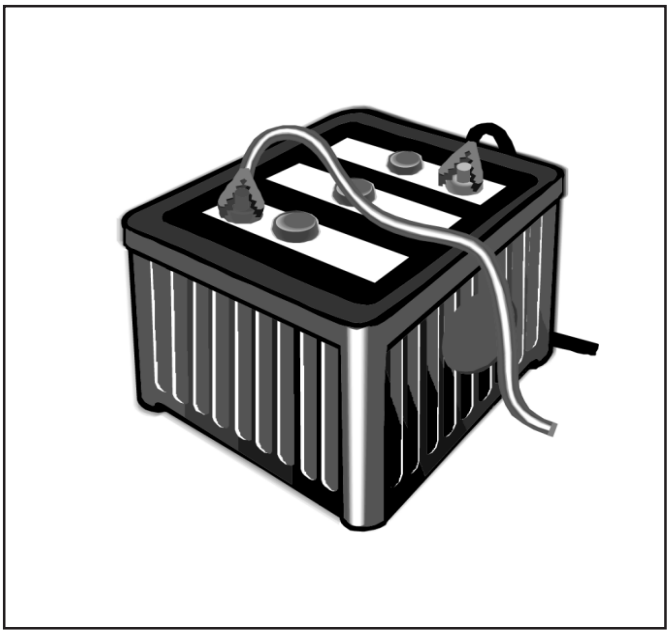
With the engine off leave the key in position (0) to

avoid draining the battery.



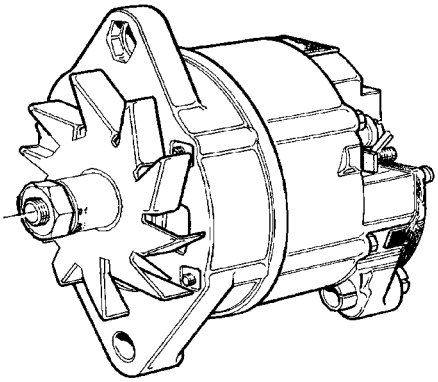
BATTERY

The battery is not supplied by VM.
For the correct size, respect the minimum values indicated in **chapter 10 (installation).**



ALTERNATOR

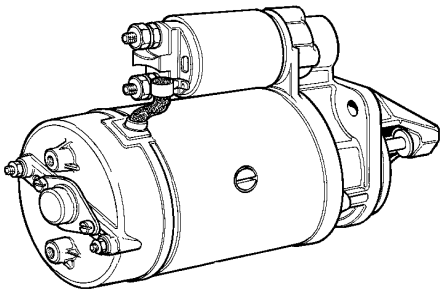
The alternator is a three-phase self-excited type with a diode rectifier incorporated.
Check:
- check the connections
For overhauls or repairs please contact the authorised VM service workshops.



ENGINE TYPE	ALTERNATOR SPEC.
MD704/6	14V - 70A
MD704LH/LS	14V - 90A

STARTER MOTOR

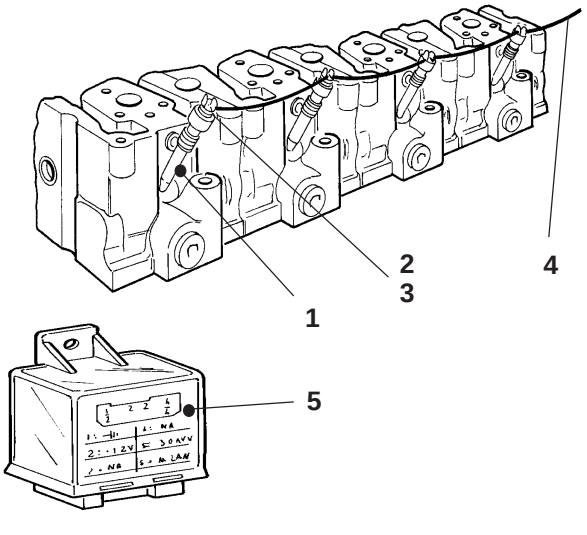
Replace the brushes by the envisaged deadline.
During the operation, check that the manifold doesn't show signs of scratching or traces of wear.
For overhauls or repairs please contact the authorised VM service workshops.



ENGINE MODEL	STARTER SPECIFICATION
MD704LI	12V - 2,4 KW
MD706	12V - 3 KW
MD704LH/LS	24V - 3,2 KW

PRE-HEATED POWER PLANT

For ambient temperatures below - 5 °C we recommended using pre-heated glow plugs with the relevant control unit.
For any other requirements, please consult VM Motori spa.



1 Glow plugs

2 Washer

3 Nut

4 Conductor

5 Control unit

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ASSEMBLY 7

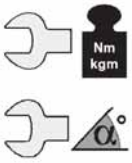
GENERAL WARNINGS

The following instructions refer to engine models available at the time of publication of this manual.

Assembly the engine components in the order indicated to save time and avoid damage.

Carefully check components before assembly following the instructions in **chapter 6 "CHECKS AND REPAIRS".**

USE TORQUE WRENCH



USE ANGULAR TORQUE WRENCH

WARNING: WHEN THE ABOVE SYMBOLS APPEAR TOGETHER, THE OPERATIONS ARE TO BE PERFORMED IN THE SEQUENCE INDICATED IN THE FIGURE.

WARNING: PRIOR TO ASSEMBLY, CLEAN PARTS WITH A SUITABLE SOLVENT (SEE PARAGRAPH 3.7).

WARNING: IT IS STRICTLY FORBIDDEN TO CLEAN THE ENGINE WITH COMPRESSED AIR.

WARNING: WHEN USING TORQUE WRENCHES, ALWAYS REFER TO THE "TORQUE WRENCH SETTINGS" INDICATED INTO PICTURE

WHERE THE USE OF VM SPECIAL TOOLS IS NOT SPECIFIED IN THE ASSEMBLY PROCEDURES, USE STANDARD COMMERCIAL TOOLS OF THE TYPE ILLUSTRATED.

Mounting the engine on the stand

Mount the engine on a commercial stand as shown in figure .

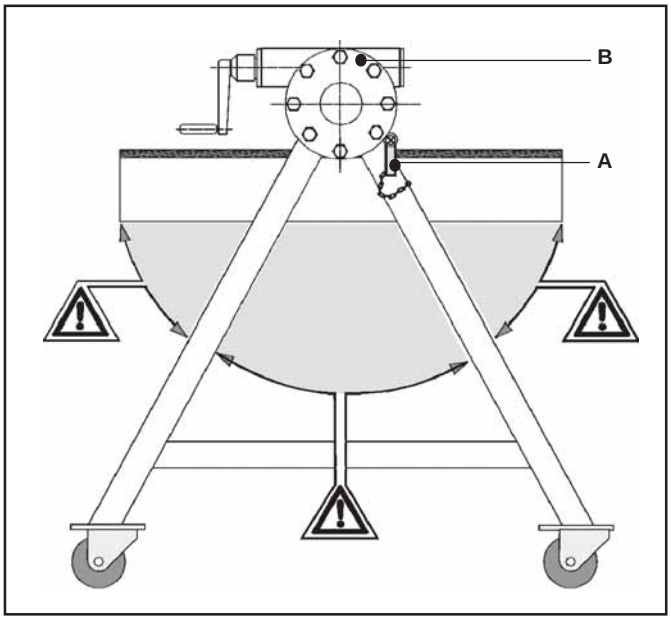
Secure the engine by means of the assembling arms and bolts provided with the stand (or using mounting bolts of the same type).

WARNING: REMEMBER TO INSERT THE LOCK PIN (A) AND CHECK THAT IT EFFECTIVELY LOCKS THE ENGINE IN POSITION.

WARNING: ALWAYS USE THE REDUCTION GEAR (B) TO ROTATE THE ENGINE.

WARNING: RISK OF CRUSHING AND/ OR SHEARING OF LIMBS DURING ROTATION OF ENGINE ON STAND.

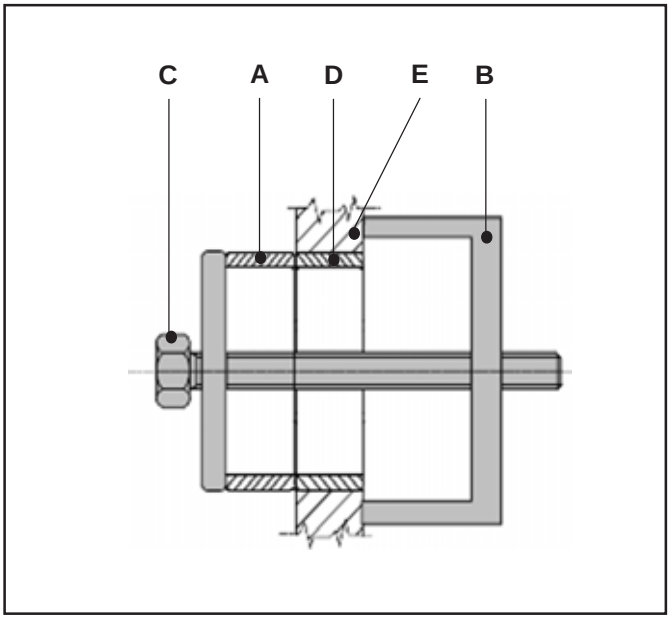
NEVER INTRODUCE PARTS OF THE BODY OR FOREIGN OBJECTS IN THE AREA SHADED GREY IN FIGURE .



CRANKCASE

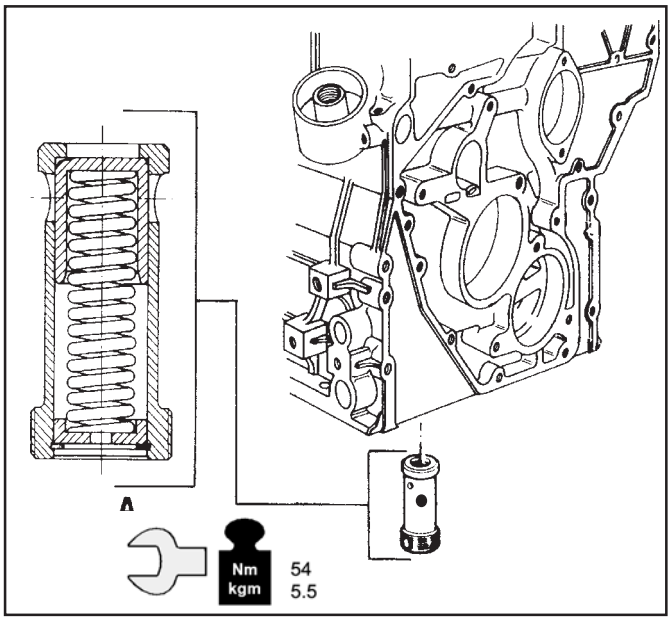
BED BEARINGS AND CAMSHAFT

Insert bearing **with LOCTITE 601 (A)** on special tool **(B)** **(TABLE 11.1 ref. E) as indicated in the figure.**
Turn screw **(C)** until you can pull out the old bearing **(D)** from crankcase **(E)** (and at the same time insert the new one in its seat).



OIL PRESSURE ADJUSTMENT VALVE

Thoroughly clean the seat of the valve in the crankcase. Fit the valve as shown in the figure, with the threaded part coated with **LOCTITE 510** and tighten suitably. Make sure you distribute the LOCTITE so that it doesn't drip into the plunger of the valve.

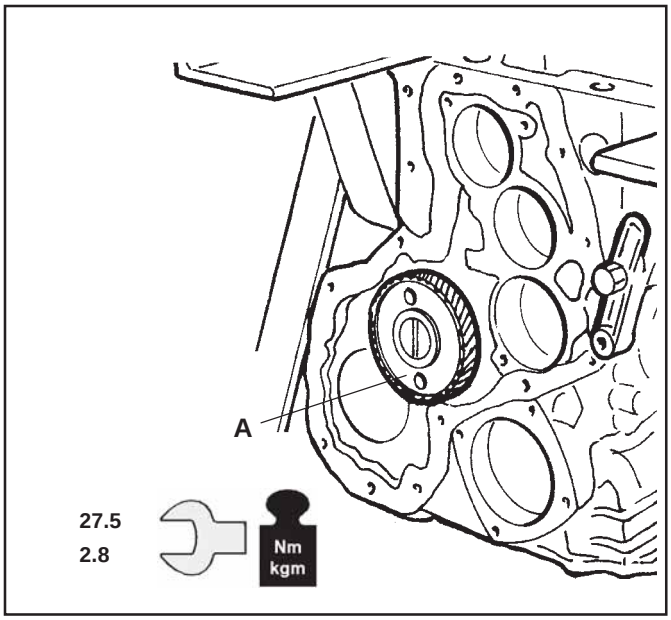


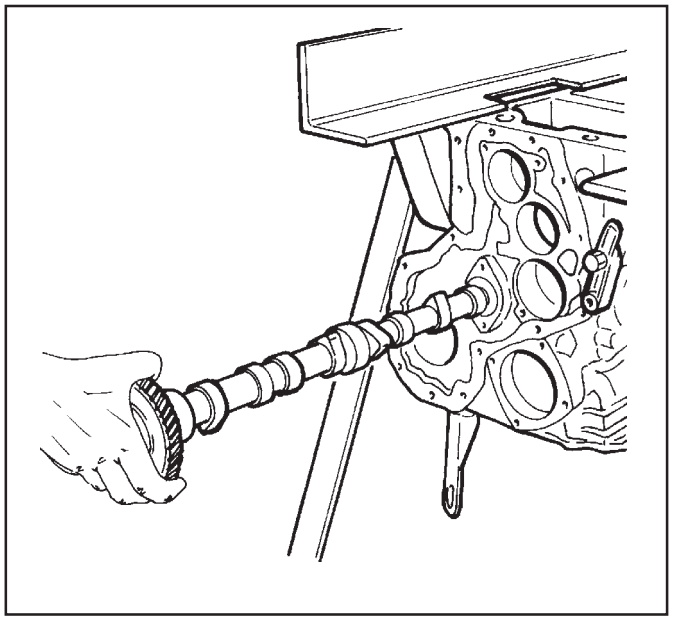
CAMSHAFT

Use engine oil to lubricate the surfaces of contact of the supporting bearings on the crankcase.

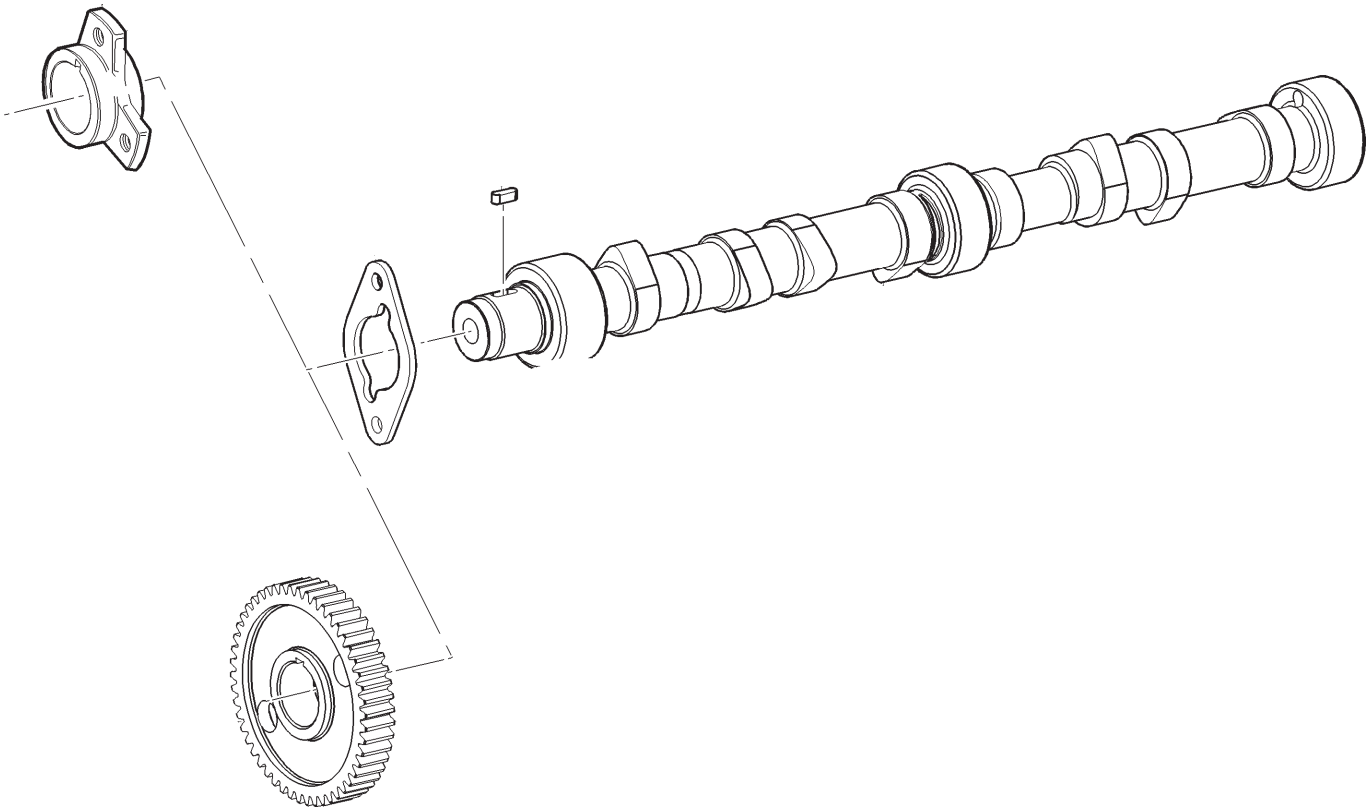
Introduce the shaft completely without damaging the supporting bearings.

Fix the flange and relevant gear tightening screws **(A).**





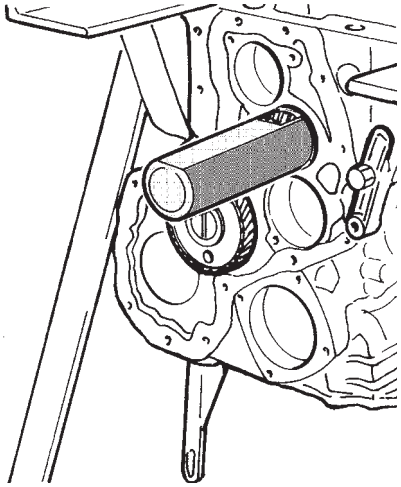
Exploded view Camshaft



CRANKSHAFT

Use engine oil to lubricate the connecting surfaces of the bed bearings and the connecting rod.

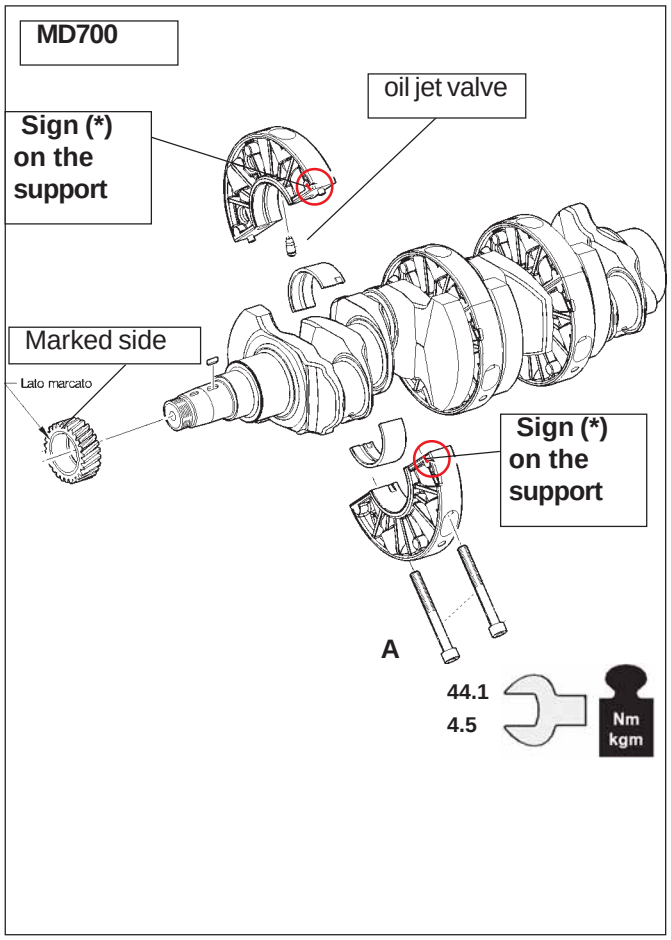
Introduce the crankshaft complete with its gear using the special tool **(TABLE 11.1 ref. H)** to make the operation easier and to avoid scoring and/or abrasions on the front bearing.

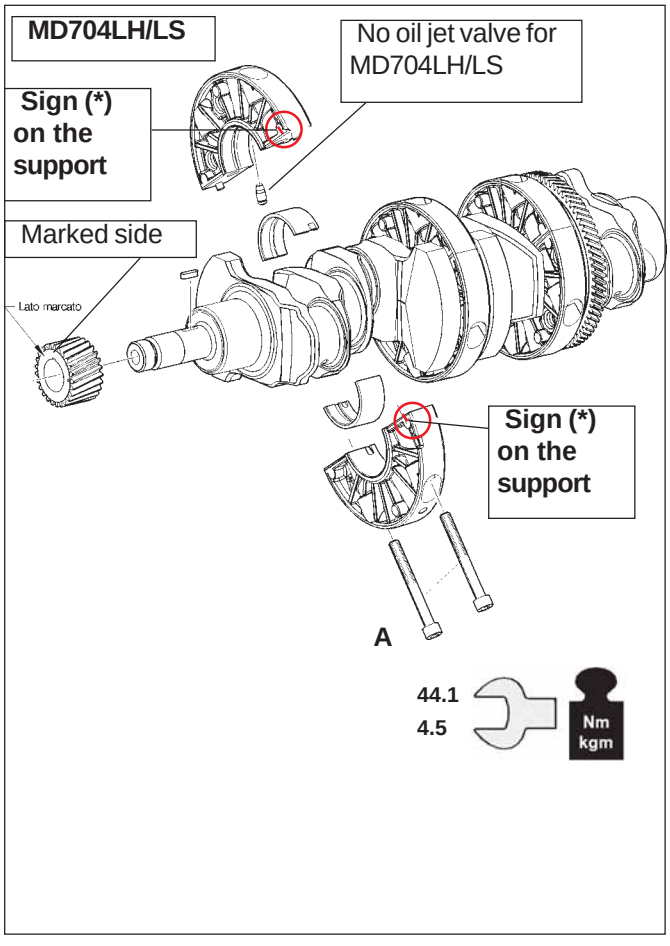


Central bed support

Make sure that each semi-support in the bed corresponds to the relevant semi-support, checking the alphanumeric marking described in the disassembly section or check the signs **(*)** are toward crankshaft gear.
Fit the relevant bed bearing.
Fit the central support on the relevant journal of the crankshaft, making sure that the oil jet valve for cooling the piston is pointing towards the front of the engine, on the side of the timing gear (for the engines with this type of lubrication).
Block the bed supports using the fixing screws **(A)**, lubricating them with engine oil, or alternatively MOLIGUARD type LPM-180, under the head and on the thread.

VERIFY THAT THE CRANKSHAFT GEAR MARKED SIDE, SHOWN IN THE PICTURE, IS POSITIONED OUTWARD OF CRANKSHAFT.

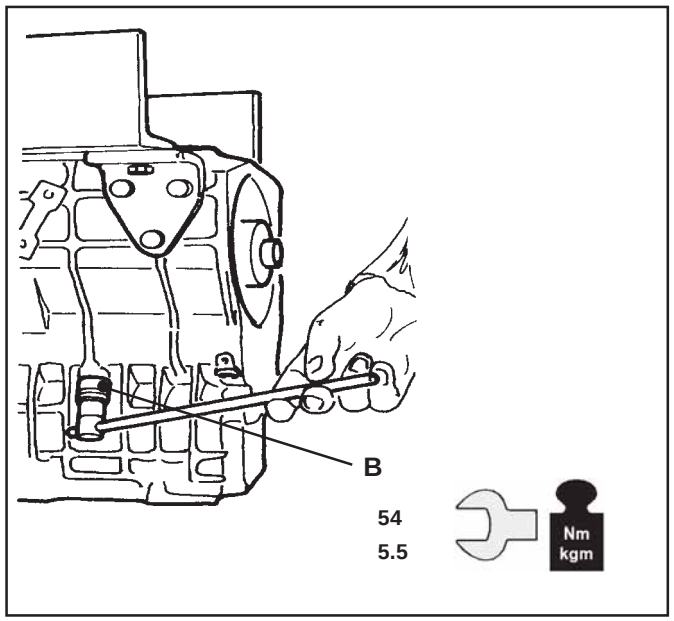


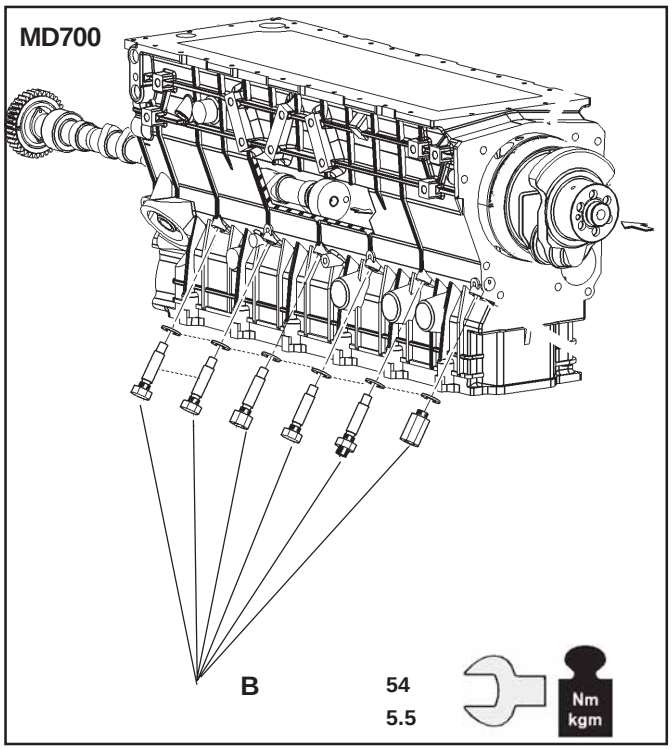


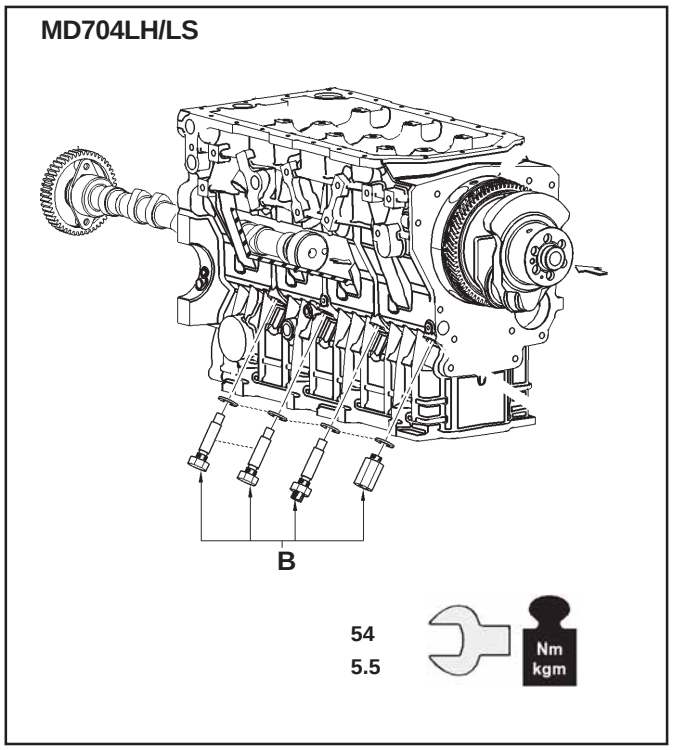
Then insert the supports in the seat on the crankcase.

Tighten fixing unions **(B)** inserting the bed semi-support.

Repeat the operations for each bed support.

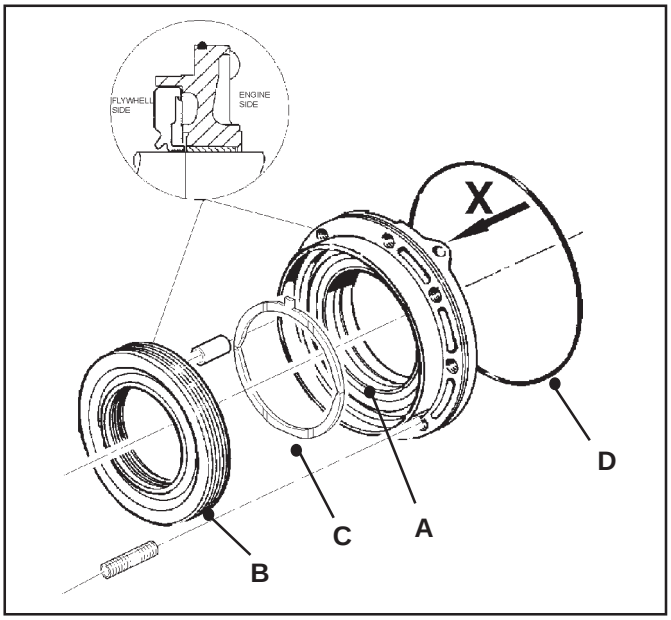






REAR SUPPORT

Fit bearing **(A)**.
Fit seal ring **(B)** using the special tool **(TABLE 11.1 ref K)**.
Fit scraper rings **(C)** of a standard size as in **chapter 6 "Check and repairs"**
To avoid oil leakage, apply DOW Corning silicon 7091 on the OR **D** and fit O-ring **(D)** on the rear support.
Insert the rear support in the crankcase housing so the oil ducts **(X)** line up.



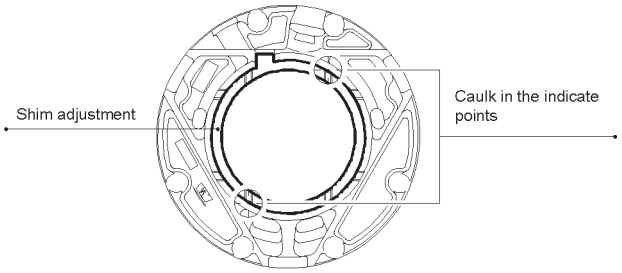
Assemly the trust-washer C with the grooves toward flywheel housing

CAULKING

Operation necessary to avoid that the scraper ring moves in its seat.

IMPORTANT: DON'T TOUCH THE LIP OF THE OIL SEAL YOU ARE REPLACING/ FITTING WITH YOUR BARE HANDS OR WITH DIRTY GLOVES , BECAUSE

THE GREASE ON YOUR HANDS OR THE DIRT ON THE GLOVES CAN DAMAGE THE SEAL.



SHIM ADJUSTMENT ASSEMBLY DIAGRAM MD700LI

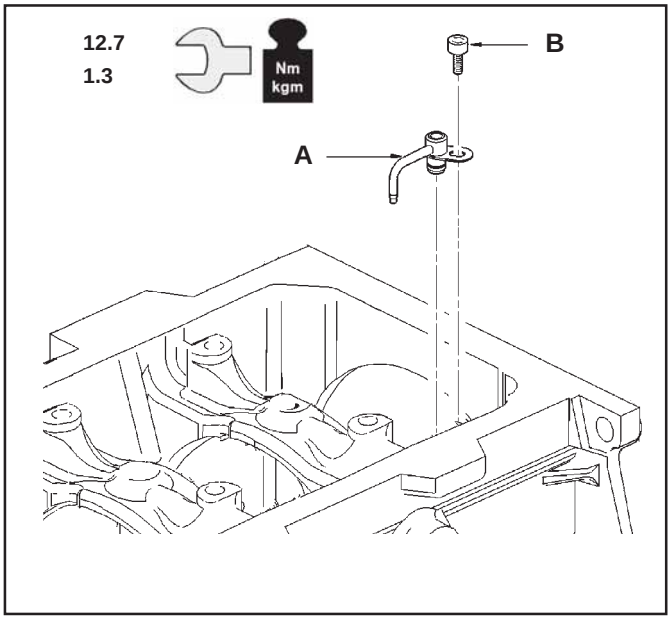
PISTONS' JET VALVE MD706 LH/ LS/LX/LB/MS/MX - MD704LH/LS

Insert the jet valves for lubricating the pistons **(A)** in the relevant seats on the crankcase, greasing the OR and tighten the relevant screws **(B)** to the indicated value.

This operation should be done on engines equipped with this type of lubrication.

TAKE GREAT CARE WHEN HANDLING

THIS PART AS EVEN SLIGHT DEFORMATION CAN LEAD TO THE PISTON SEIZING

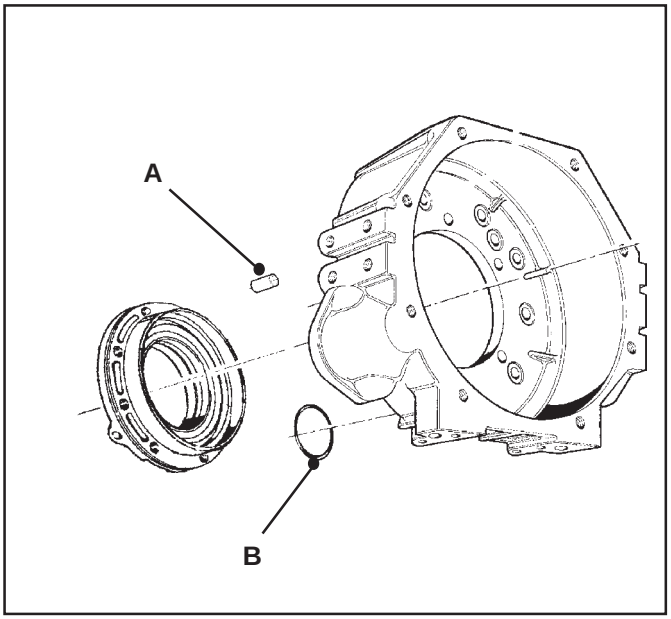


FLYWHELL BELL-HOUSING

Position the flywheel box on centring pin **(A)** on the rear support.

Insert the OR **(B)** in its seat on the box being careful not to nip it during assembly.

To avoid oil leakage, apply Dow Corning 7091 silicon on OR.

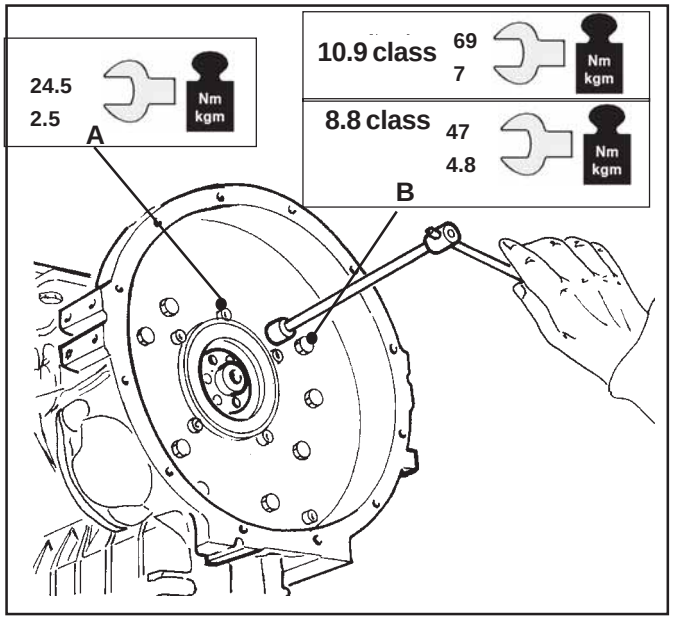


Tighten the screws fixing the rear support tobox **(A)** and the fixing screws of the box to crankcase **(B).**

Note for screws (B):

For screws with class 8.8 torque 4.8 Kgm

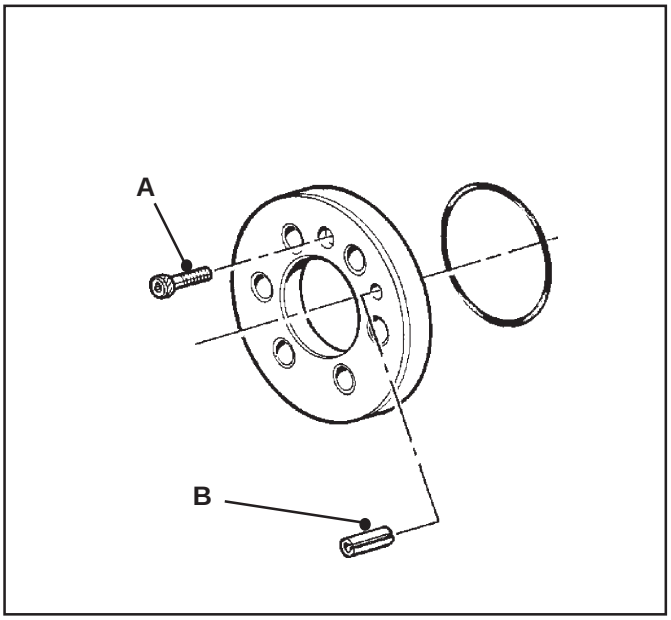
For screws with class 10.9 torque 7 kgm



SPACER RING

Assemble the spacer ring on the rear support in the oil seal, refer to centring pin **(B)**.

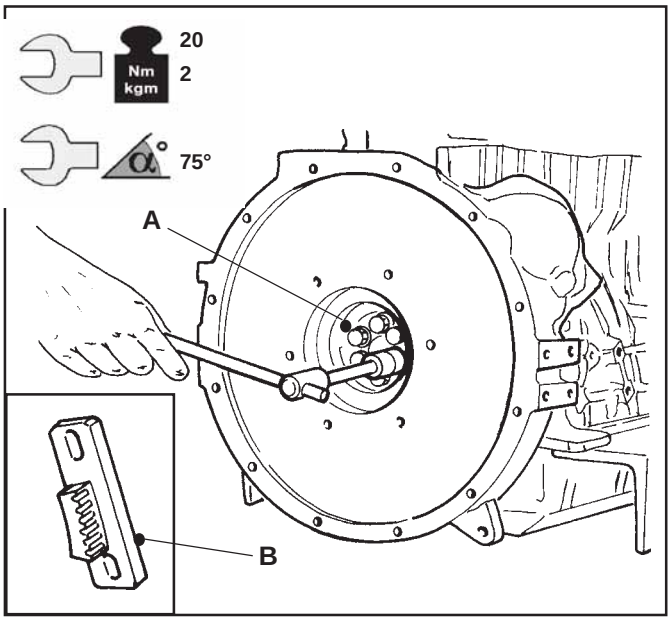
Make sure that the OR doesn't come out of its seat, to make the operation easier we recommend smearing a little grease **(Molykote 111)** between the seat and the OR.



FLYWHELL

Position the flywheel with the holes for the fixing screws lined up with the relevant threaded holes on the shank of the crankshaft.

You must fit the flywheel with the special pins **(TABLE 11.1 rif. AB)**.



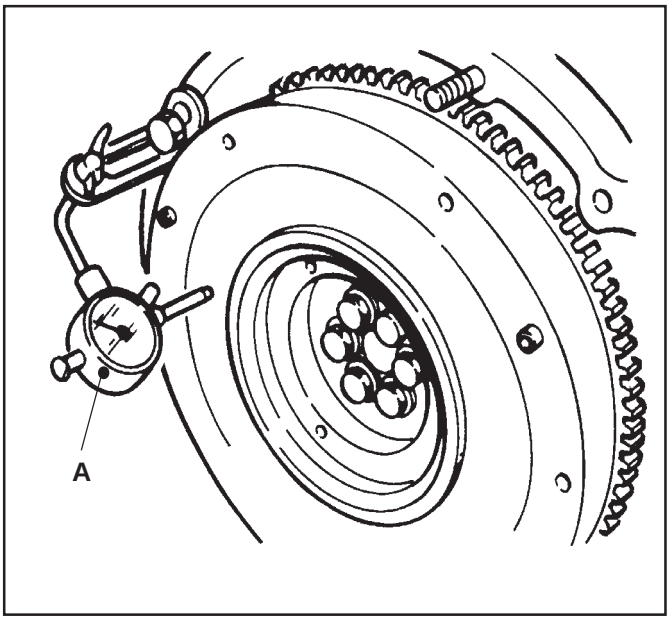
Lubricate the screws with engine oil, on the head, from the flywheel side and the thread, if you are using the screw again.
Screw in screws **(A)** moving them up to the surface.
Fit special tool **(B)** **(TABLE 11.1 ref. T or AD for MD704LH/LS)** to block the movement of the flywheel.
Tighten the six screws to a torque of **5.1 kgm (50 Nm)** starting with one screw and then the opposite one (cross tightening) until all the screws are tight, tightening them in a clockwise direction.

Using the dynamometric wrench fitted with a goniometer **(TABLE 11.1 ref. Q),** loosen one screw at a time and tighten it with a torque of **2.05 kgm (20 Nm)** (tolerance ± 5%) **+ an angle of 75°** (tolerance ± 5°), with the previous sequence.

WHEN FITTING NEW SCREWS DON'T LUBRICATE THEM AS THEY HAVE ALREADY BEEN TREATED WITH AN ANTI-FRICTION PRODUCT.
REUSE BOLTS ALWAYS UNLESS BOLTS ARE DAMAGED (STRETCHED THREAD, DAMAGED TOP OR BOTTOM HEAD OR ETC..) - IF REUSE BOLT, LUBRICATE THEM (THREAD AND BOTTOM HEAD WITH ENGINE OIL.

CRANKSHAFT AXIAL PLAY

Use a comparator **A** mounted on the crankcase support.
Move the crankshaft on its axis with a screwdriver to obtain the maximum movement of the flywheel.
Max. movement allowed:



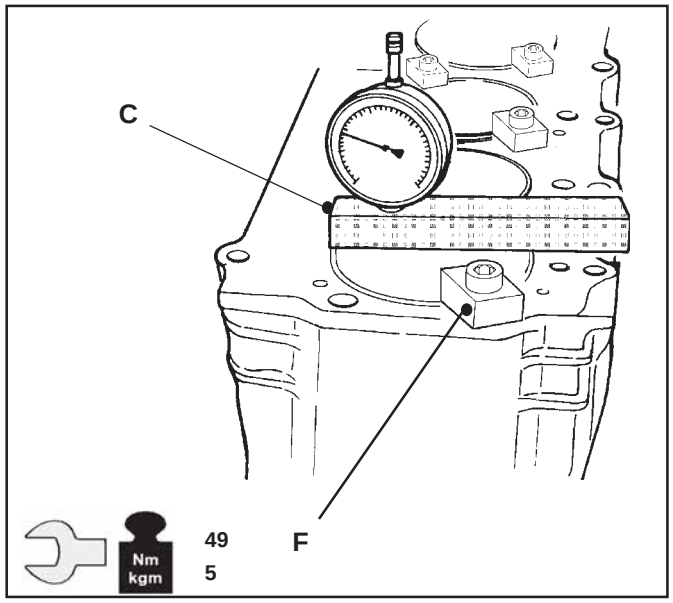
MD 700 (rear carrier ø 70mm) **0.153 ÷ 0.354** mm.

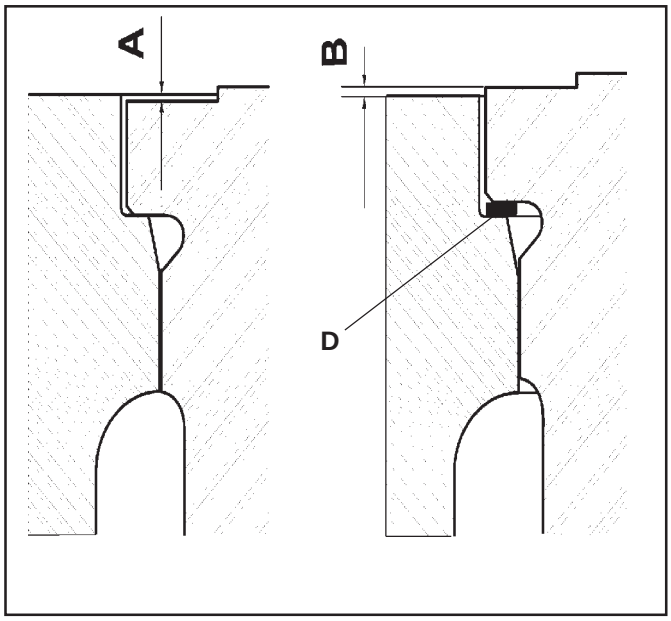
MD 700 (ø 80mm) - **0.080 ÷ 0.280** mm.

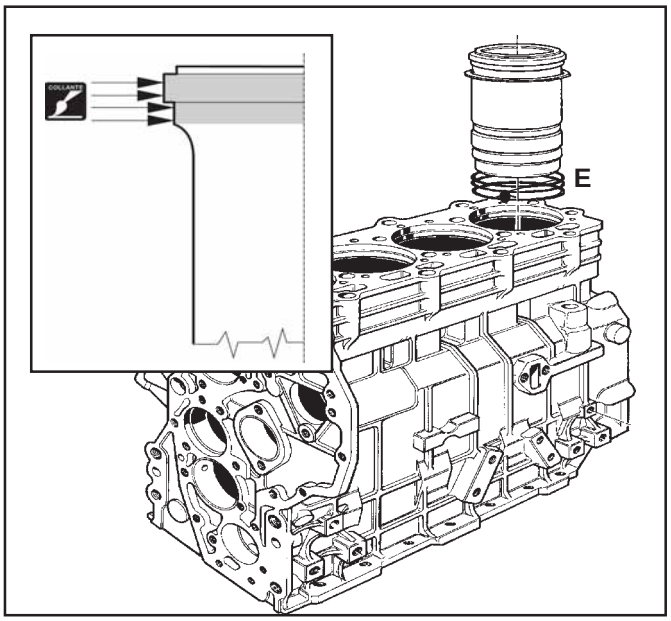
LINER

1) Insert the liner of the first cylinder into its seat in the crankcase.
2) Fit a comparator with a centesimal scale on special tool **C** **(TABLE 11.1 ref. U)**.
3) Place the block on the neck of the liner and reset the pointer of the comparator with the feeler in contact with the surface of the crankcase.
4) Move the feeler of the comparator on the neck of the liner (position **A**). The variation measured is useful for determining the value of the shim to insert under the neck of the liner (**D**), to obtain the right liner projection with respect to the level of the crankcase (**B**). **Liner projection value (0 ÷ 0.05 mm)**.
   To find the values of the liner shims, please refer to table here below.
5) Pull the liner out.
6) Fit the seal rings (**E**) : **n° 2 in the same colour and in the relevant slots first and n° 1 of a different colour at the bottom.**
7) Distribute a uniform layer of sealant **(Loctite 986)** on the top neck seal of the liner .
   Thoroughly clean any excess sealant.
   With grease (Polymer 400), lubricate the bottom centring pin of the liner in the crankcase.
8) Insert the chosen liner shim.
9) Reassemble the liner, prepared as described above, in the crankcase.
   To help the liner in, tap it in with a block (rubber or wood).
10) Block the liner in two opposite points using normal M14 screws and head clamp (**F**) and tighten to the indicated value .
    Check the value of the liner projection resetting the pointer of the comparator on the surface of the crankcase and then positioning it on the surface of the neck (**B**) .
    Make sure that the value measured is within the limits of those mentioned above.
11) Repeat the operations described from point 6 on, for each liner.

SELEZIONE DELLO SPESSORE DELLA GUARNIZIONE CANNA IN FUNZIONE DEL VALORE DI A *Selection of liner gasket thickness as A function of "A" value*			"B" SPORGENZA EFFETTIVA *Real protrusion*
VALORI DI "A" *"A" value* ⓐ	GUARNIZIONE CANNA *Gasket liner*		
	Spessore *Thickness*	N°Codice *Part #*	
0.10÷0.13	0.15	2 202 0130	ⓐ 0 ÷ 0.05
>0.13÷0.16	0.17	2 202 2049	
>0.16÷0.19	0.20	2 202 0153	
>0.19÷0.22	0.23	2 202 0165	
>0.22÷0.25	0.25	2 202 0154	







IF THE HEADS AREN'T FITTED WITHIN AN HOUR, THE LINERS MUST BE CLAMPED WITH THE RELEVANT CLAMPS FOR ROUGHLY 8 HOURS, SO THE LOCTITE CAN POLYMERISE, A THIS POINT THE CLAMPS CAN BE REMOVED AND THE THE HEADS ASSEMBLED.

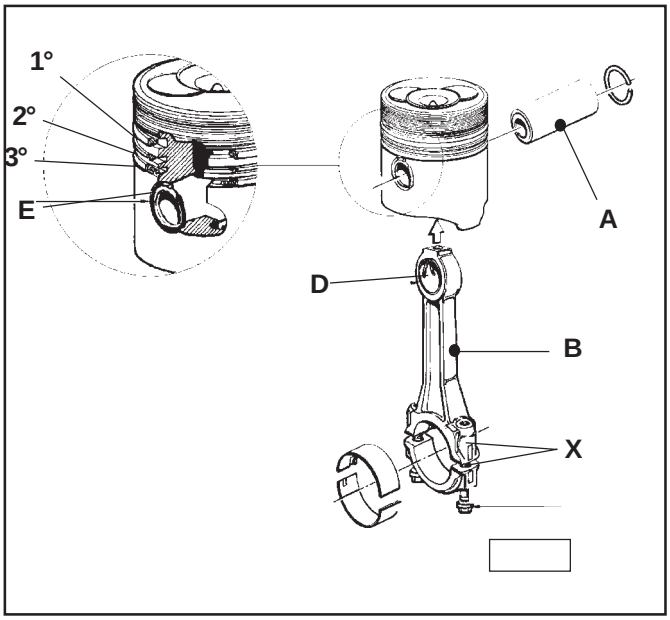
PISTON

Assemble the piston on the connecting rod drum **(B)** lining up the combustion chamber from the side of the connecting rod where the coupling numbers **(X)** are stamped and that reference (**N**) is positioned as by view C **(For fractured con-rod)**.

Oil the small end bush **(D)** and insert gudgeon pin **(A)**

blocking it with snap rings **(E)**.

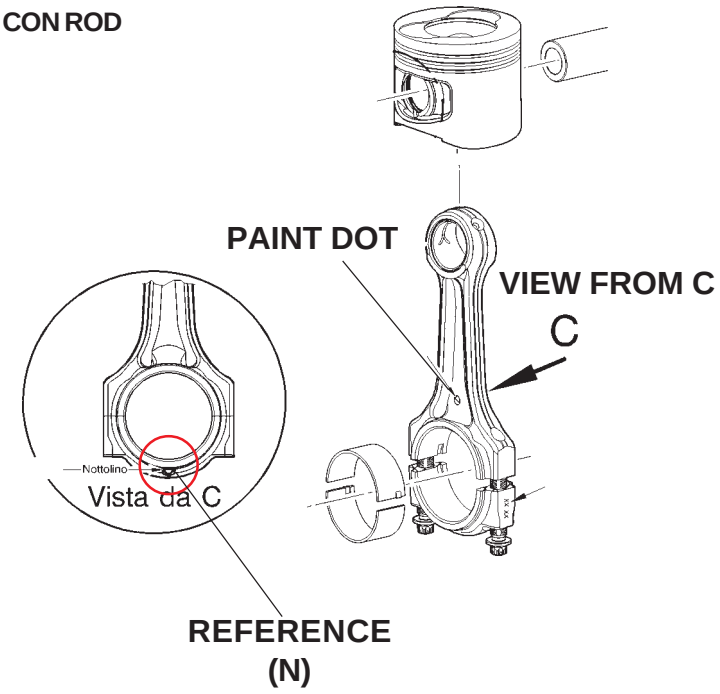
By eye check that the snap rings of the gudgeon pin are seated correctly.



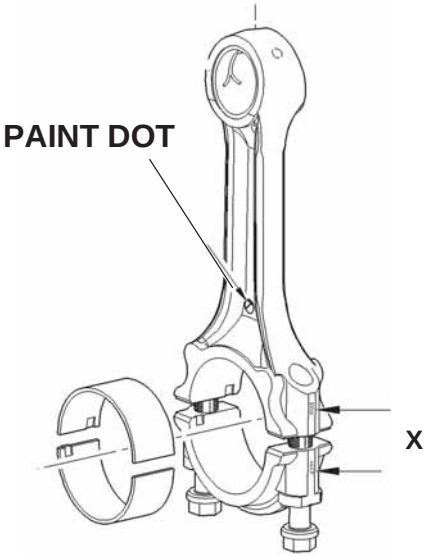
USE CON RODS WITH THE SAME WEIGHT IDENTIFIED BY A PAINT DONT AS SHOWN IN THE PICTURE

	IDENTIFICAZIONE BIELLE IN FUNZIONE DELLA SELEZIONE PESI Connecting rods identification in function of masses selection.			
weight	≥978gr. ⇩ ≤992.9gr.	>992.9gr. ⇩ ≤1007.9gr.	>1007.9gr. ⇩ ≤1022.9gr.	>1022.9gr. ⇩ ≤1038gr.
colour paint dot	VERDE Green	BLU Blue	BIANCO White	GIALLO Yellow

FRACTURED CON ROD

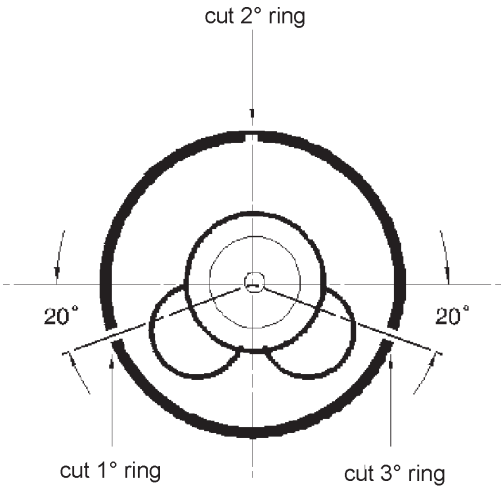


TRADITIONAL CON ROD

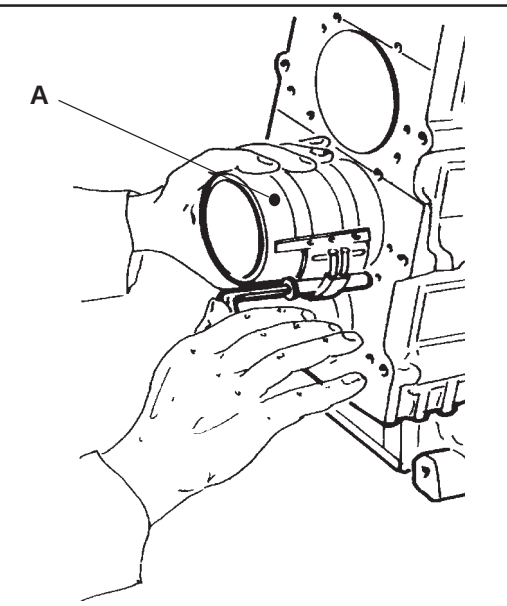


Fit the rings on the piston positioning them as shown in figure :

1st compression ring, with a trapezoidal shape.
2nd compression ring, with a stepped profile in the bottom part.
3rd oil scraper ring.
Point the combustion chamber, on the piston, towards injection side, consequently the number stamped on the connecting rod will point in the same direction.
Compress the rings with trade tool **(A)** and insert the piston in the liner pressing with a rubber, Teflon or nylon block or made of another suitable material on the top of the piston until it slides completely into the liner.
Don't use blocks of material that are harder than the piston and leave residues.



Ring orientation



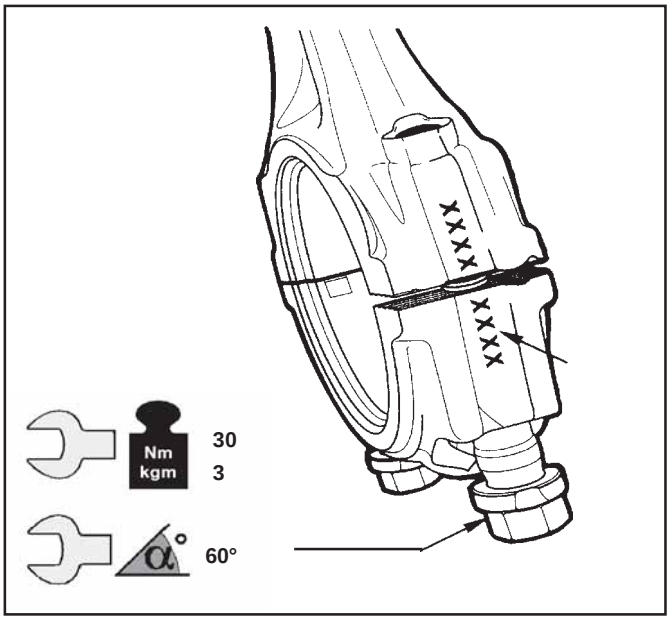
CONNECTING ROD

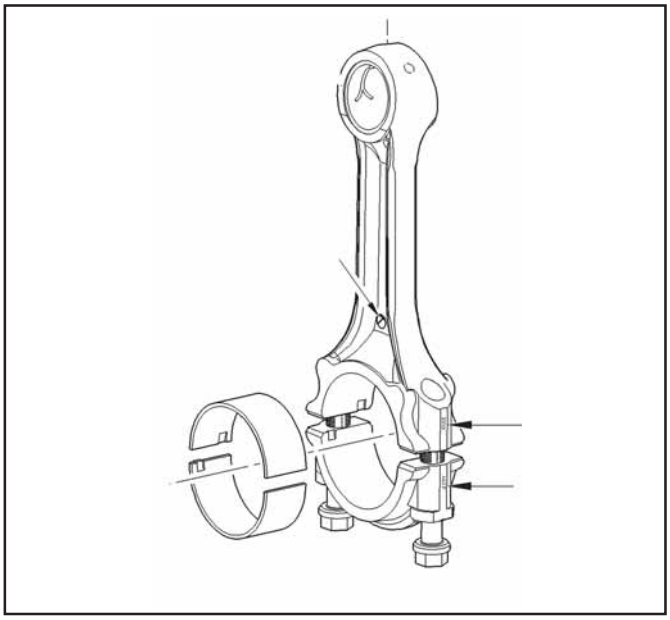
TRADITIONAL CON ROD

Assemble the bearing of the connecting rod and the cap lining up the numbers stamped on the drum and on the cap.

Tightening the screws for the connecting rod with teeth on the cap and drum:

- Lubricate the screws and the big end side of the connecting rod and the thread.
- Insert the screws and tighten them with the dynamometric wrench equipped with a goniometer **(TABLE 11.1 ref. Q)** one at a time, applying a torque of **3 kgm (30 Nm)** (tolerance ± 5%) and then, one at a time, apply an angle of **60°** (tolerance ± 5°). Tighten the screws, checking the correct operation by calibrating the dynamometric wrench to **9 Kgm (88 Nm)** and testing the screws.

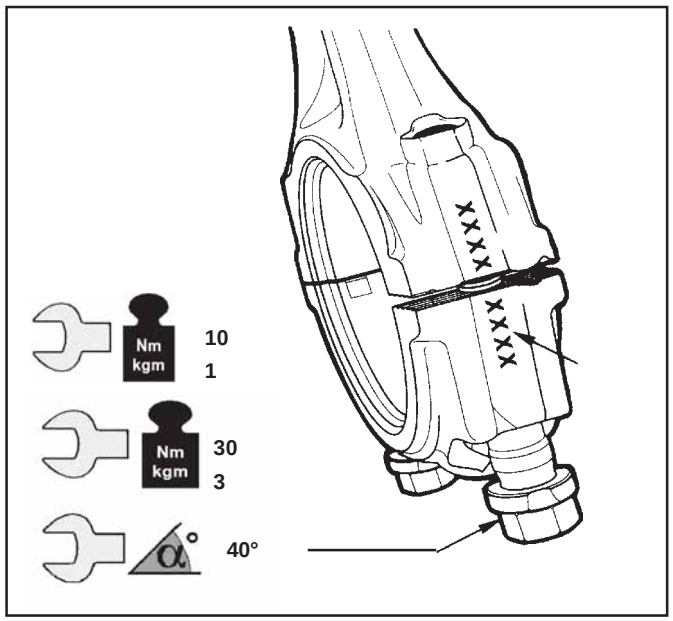




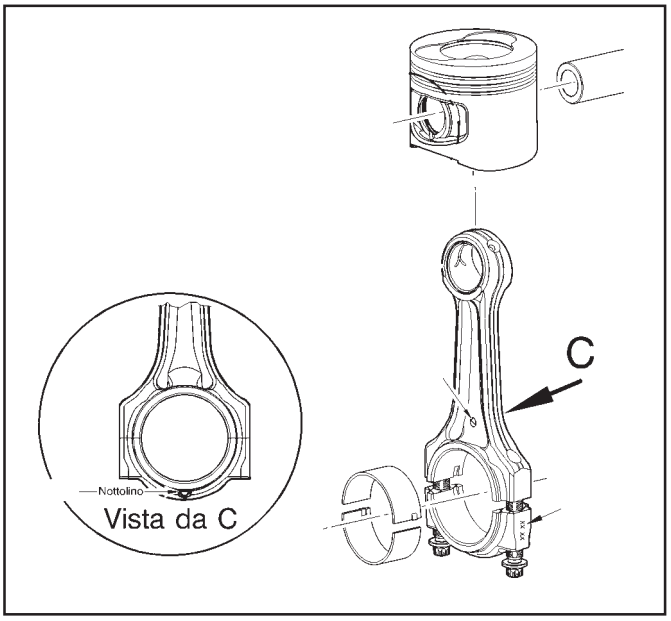
FRACTURED CON ROD

Tightening the screws of fractured connecting rods:

- Lubricate the screws and the big end side of the connecting rod and the thread.
- Insert the screws and tighten them with the dynamometric wrench equipped with a goniometer **(TABLE 11.1 ref. Q)** one at a time, applying a torque of **1 kgm (10 Nm)** (tolerance ± 5%), tighten the screws again one at a time applying a torque of **3 kgm (30 Nm)**.
  Check that the goniometer is reset and then, one at a time, apply an angle of **40°** (tolerance ± 5°).
  Tighten the screws, checking the correct operation by calibrating the dynamometric wrench to **9 Kgm (88 Nm)** and testing the screws.



WHEN FITTING NEW SCREWS DON'T LUBRICATE THEM AS THEY HAVE ALREADY BEEN BEEN TREATED WITH AN ANTI-FRICTION PRODUCT.
BOLTS CAN BE REUSED IF THEY DON'T SHOW STRETCHED THREAD, DAMAGED TOP/BOTTOM HEAD OR ANY DAMAGE.
WHEN REUSING BOLT, LUBRICATE THEM (THREAD, BOTTOM HEAD).

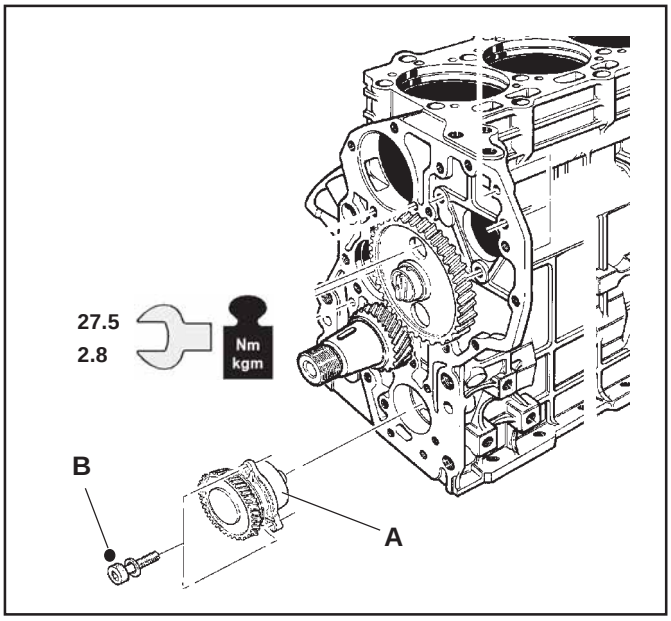


OIL PUMP

Make sure that the external rotor is assembled with

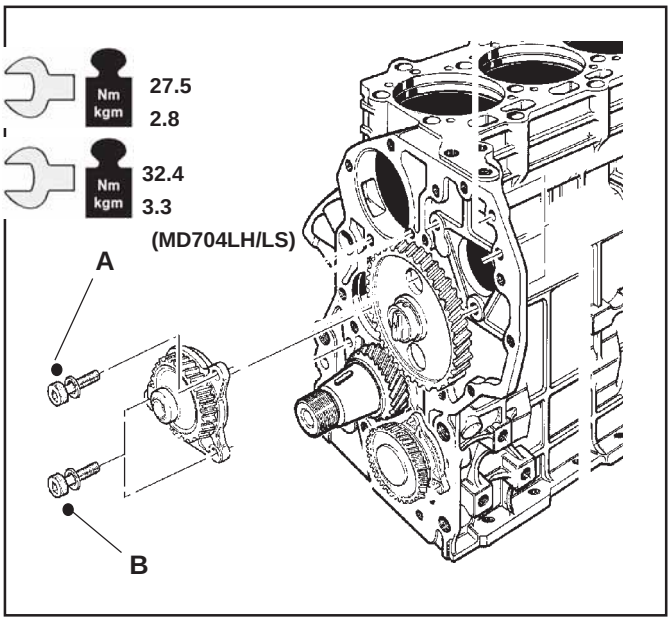
the chamfered part towards the seat in the pump body **(A)**.

Fit the oil pump engaging the gear with that of the crankshaft.
Tighten the three fixing screws **(B)** to the indicated value.
Check that there is a little play between the two gears.



INTERMEDIATE GEAR

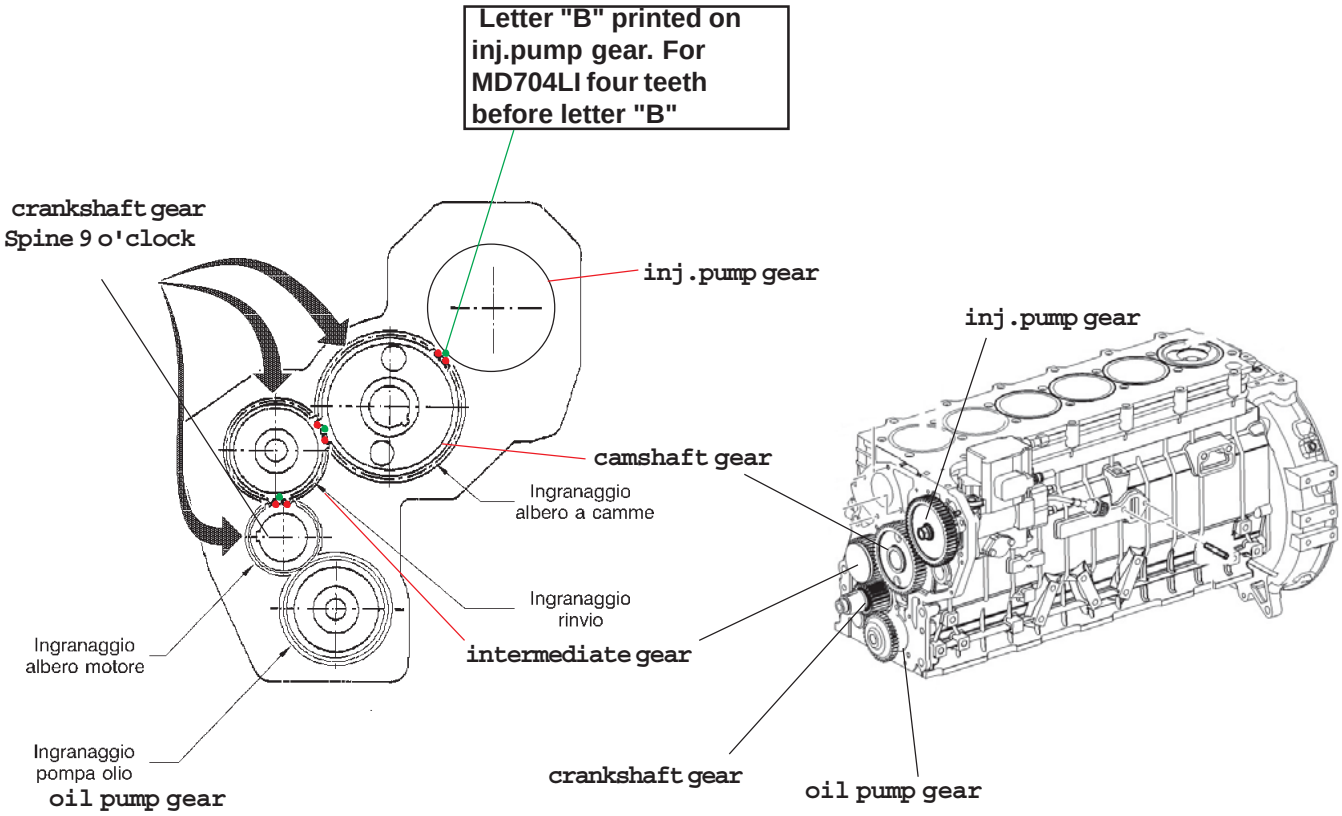
Insert the gear positioning it with the reference mark lined up with the marks on the crankshaft and the two marks, in line with that on the camshaft gear.
The crankshaft must be in a position with the first piston at top dead centre (TDC)and the spline at 9 o'clock, **see "Timing Phase"**
Screw in fixing screws (**A**) and (**B**) and tighten them to the torque indicated, making sure screw **(A)** is in the hole next to the gear of the camshaft.
This screw has the smallest head so it can pass between the two gears.



TIMING PHASE

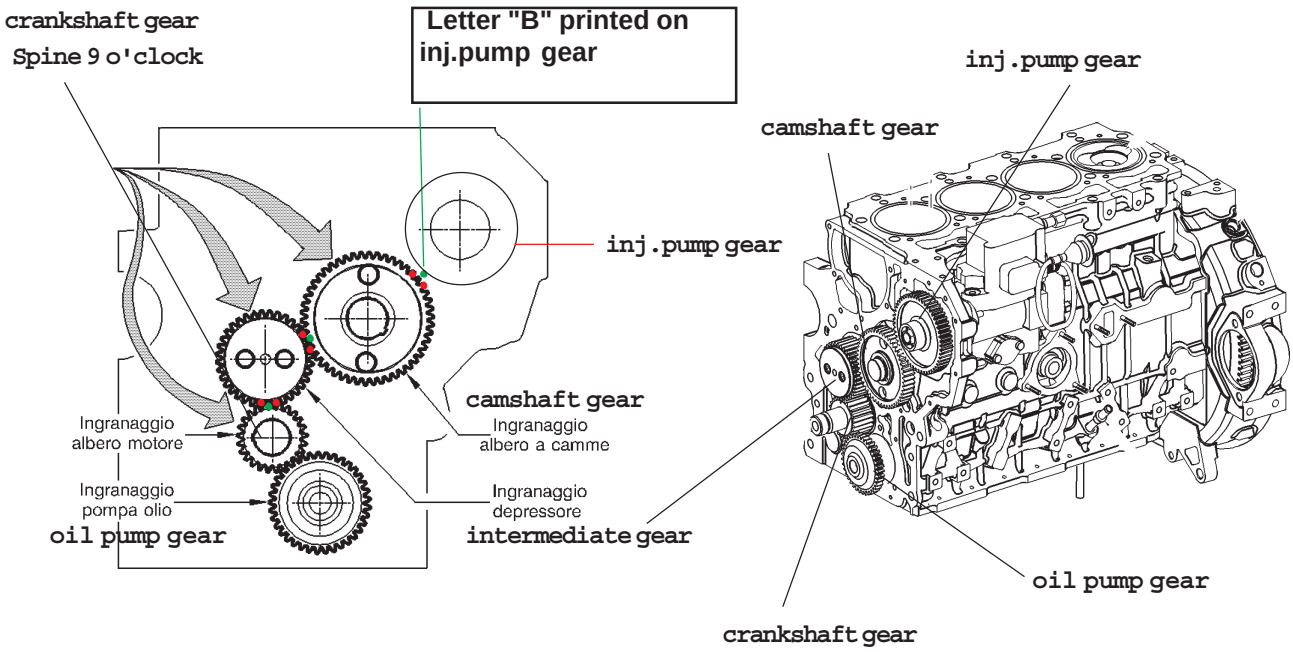
Timing MD700

Timing with piston 1°cylinder at TDC



Timing MD704LH/LS

Timing with piston 1°cylinder at TDC



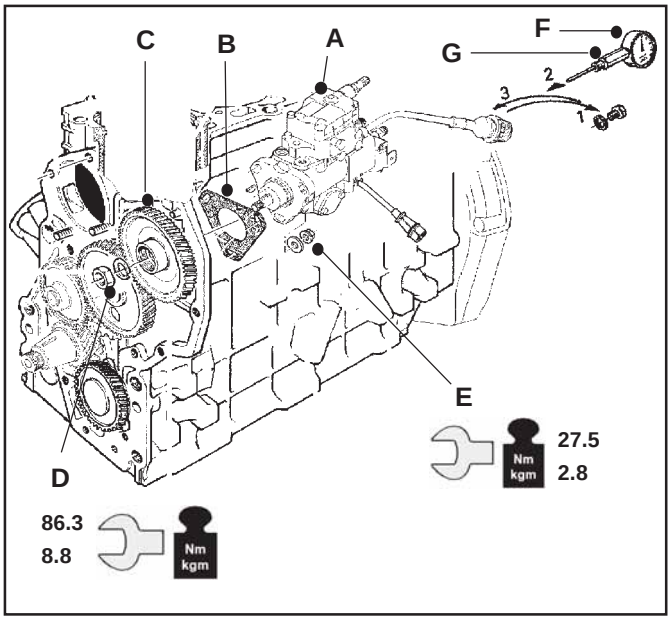
INJECTION PUMP

ELECTRONIC TYPE

Engine Model MD700 LH/LS/LX/LB

Assemble injection pump **(A)**, gasket **(B)** and gear **(C)**.

Turn the crankshaft anticlockwise roughly 25° ÷ 35° from TDC and fit special tool **(G)** **(TABLE 11.1 ref. V)** fitted with the centesimal comparator **(F)** on the injection pump.
Gear **(C)** must be assembled so that letter **"B"** marked on the same, coincides with the engraved mark on the gear of the camshaft **(see "Timing Phase).**
Tighten fixing nut **(D)** to the indicated value, accost and slightly tighten the pump fixing nuts **(E)**.
Turn the crankshaft clockwise and stop at (TDC), the value on the comparator, must correspond to the value indicated in the table here below.
If this is not the case, move the pump one way or the other until it corresponds to the specified values.
At this point you can tighten fixing nuts **(E)** of the pump to the indicated value.
We recommend checking the correct position of the injection pump again.



MECHANICAL TYPE

Engine Model MD700 MI/MH/MX/MS

The procedure is the same of electronic inj. pump.

Before performing inj. timing pump phase the KSB system must NOT be charged (working condition - fig. 2) but it must be free (fig.1).

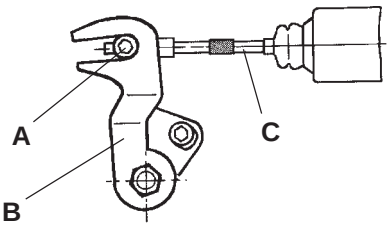


FIG.1

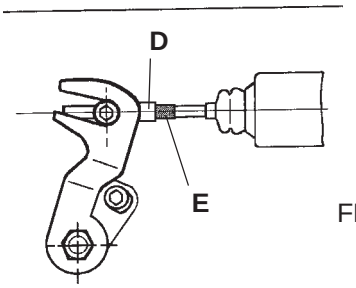


FIG.2

Adjusting the KSB

- Slacken screw A (Fig. 7.21b), turn lever **B** clockwise until it comes into contact with collar **D** with the black metal reference mark **E** on rod **C**.
- To turn lever B use a screwdriver or similar tool, these tools are necessary for compressing the spring inside the pump.
- Tighten screw **A**.
- **THE KSB SYSTEM IN THIS POSITION IS IN A WORKING CONDITION.**

Starting from this calibration, the KSB regulates the smoke grade on starting, working in a temperature range between 0 °C (electrical contact open) and a temperature near 30°C (electrical contact closed).

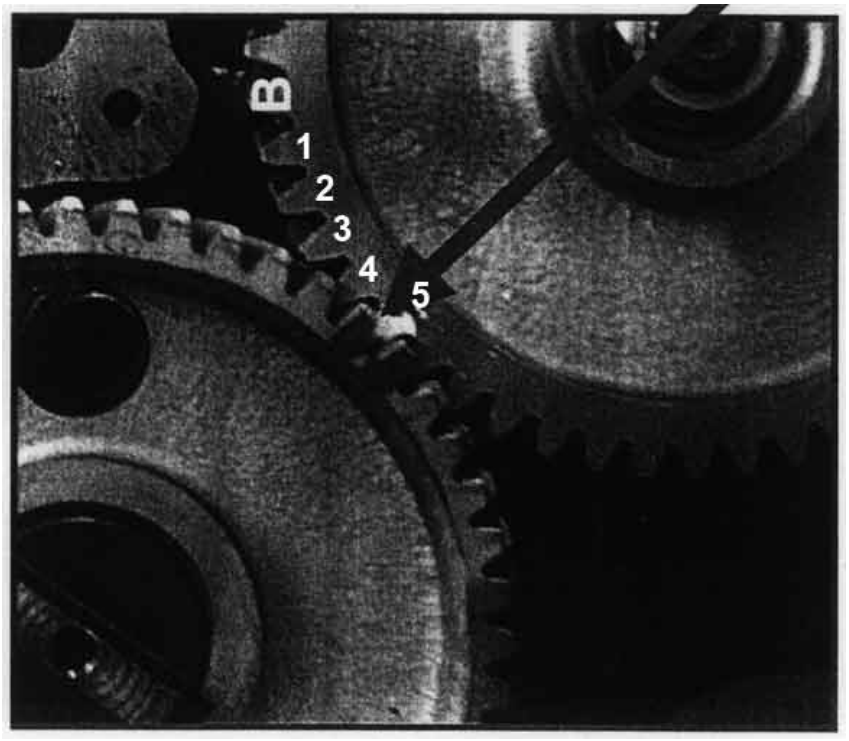
The KSB system is managed by a water temperature sensor, positioned on the heads.

Remember that the movement of the KSB rod is gradual and non instantaneous.

MODELLO MODEL	FASATURA (*) TIMING (*)	LETTERA "B" marcata sull'ingranaggio pompa iniezione LETTER "B" punched on inj.pump gear
MD704LI	0,60 - 0,65	4 teeth befor letter "B" anticlockwise (looking frontally the timing)
MD704LS MD704LH	0,48 - 0,51	"B"
MD706LI	1,74 - 1,76	"B"
MD706LB MD706LS MD706LX MD706LH	1,68	
MD706MI	1,70 - 1,72 (1,60 homolagation IMO)	"B"
MD706MS	1,60	
MD706MH MD706MX	1,70	
	(*) Corsa pompante in mm con cilindro n° 1 al PMS	
	(*) Prestroke in mm with 1st cylinder at TDC	

Example:

4 teeth befor letter "B" in anticlockwise (looking frontally the timing)



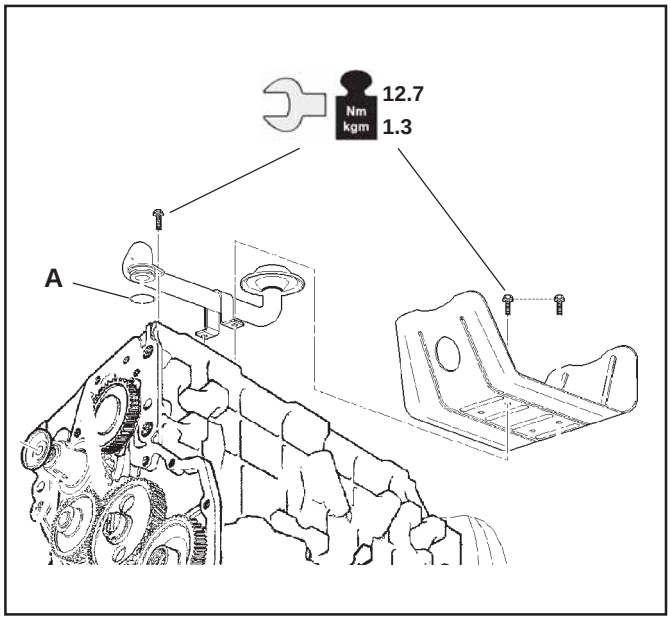
OIL SUMP

OIL SUCTION PIPE

Grease the OR **(A)** before fitting the oil suction pipe.

Insert the pipe in the hole of the partition and position the lot on the crankcase, inserting the mouth of the pipe in the specific seat in the crankcase.

Tighten fixing screws to the torque indicated.



OIL SUMP

Thoroughly clean the sealing surfaces of the sump and the crankcase.

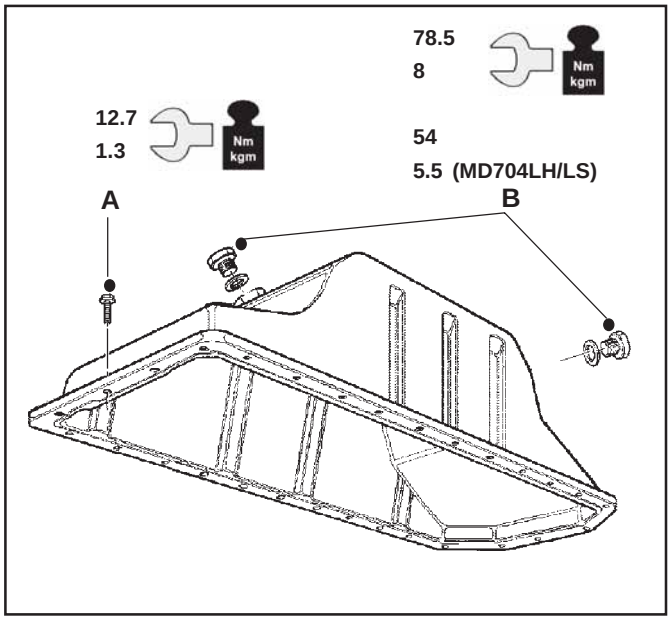
Distribute a uniform line on the sealing surface of the sump, being careful to go around the holes of the fixing screws, from the internal part of the sump, see picture.

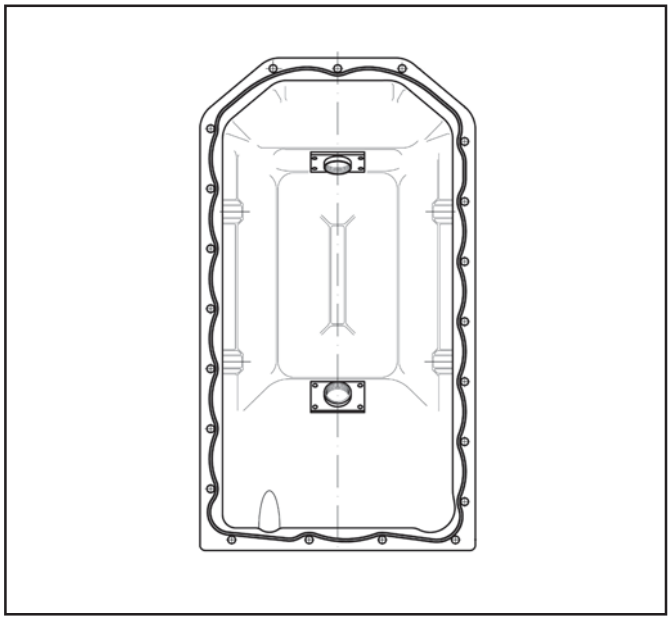
About oil sump with gasket, apply paste "Hycomar universal bleu" on the joints

Assemble the sump on the crankcase, insert fixing screws **(A)** and tighten them to the torque indicated.

Tighten caps **(B)** to the torque indicated.

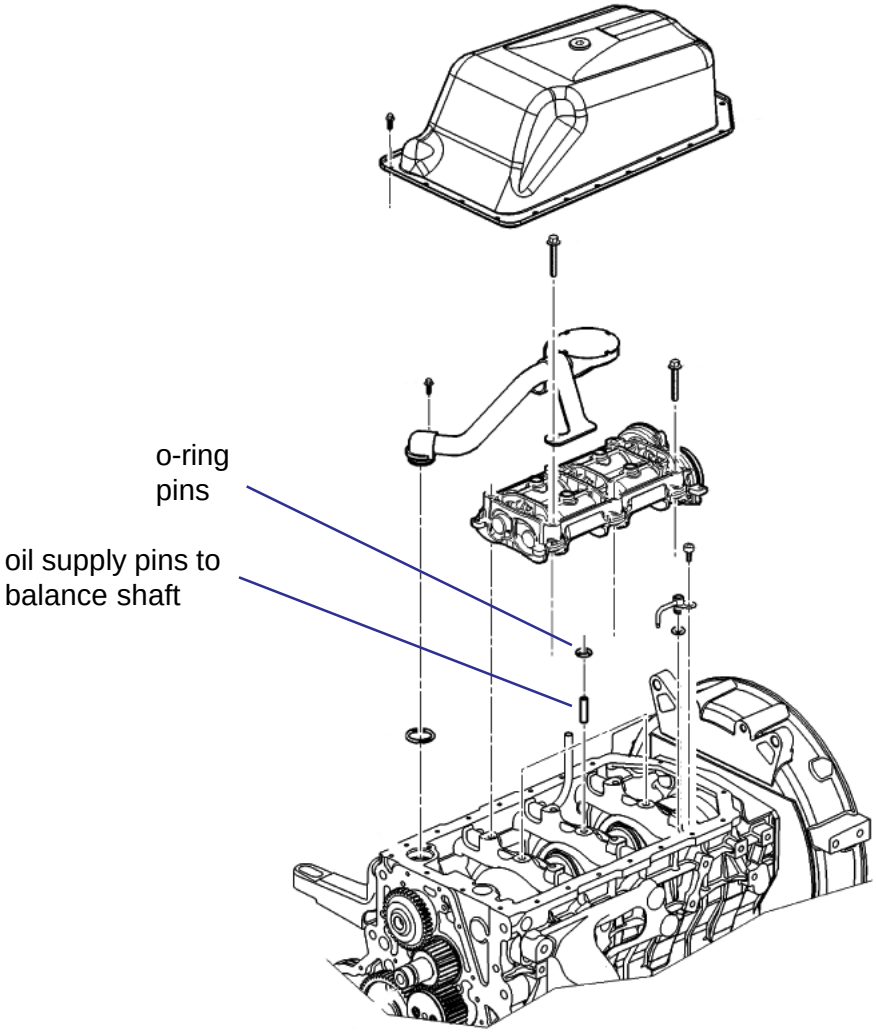
After tightening the sump, wait for at least 20 minutes before starting the engine.





COUNTER BALANCING CRANKSHAFT (MD704LH/LS)

Check the pins are installed correctly and o-ring pins are not worn.

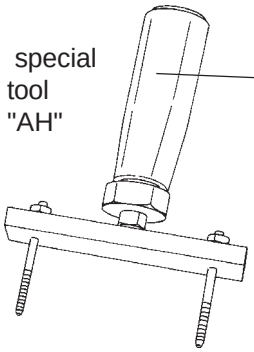


Align balance shaft counterweight as shown in the pics 1 (DO NOT ALIGN AS SHOWN in pics 2)
Insert special tool VM **(TAB. 11.1 rif AH)** into 2 holes to time the counter balancing shaft (as shown in pics 1-3.)

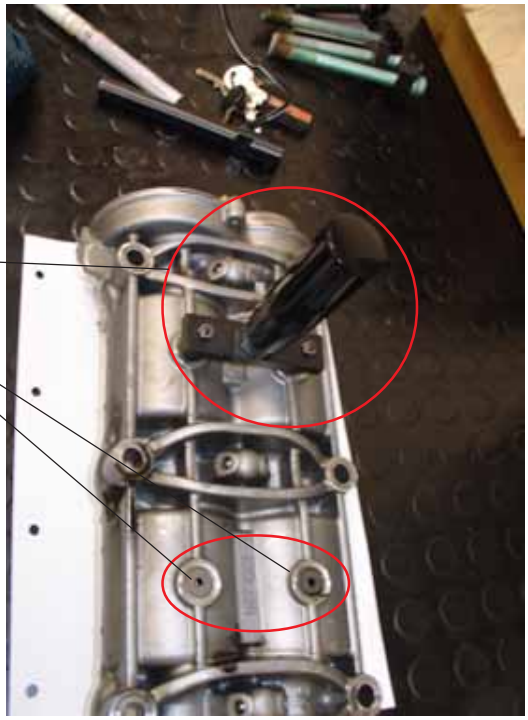
PICS 1

PICS 2

It is possible insert the tool into either couple of holes



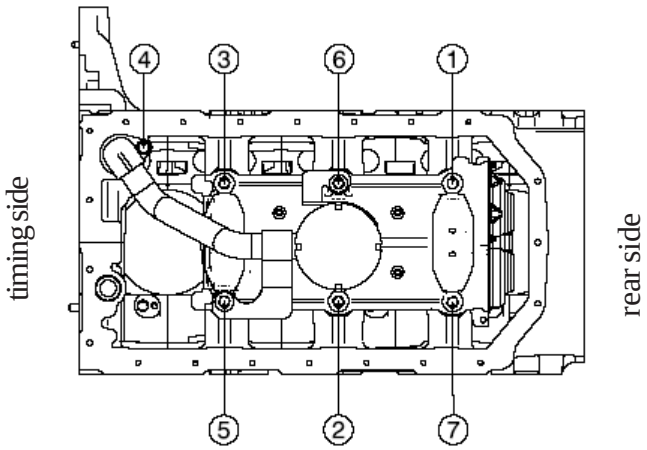
PICS 3



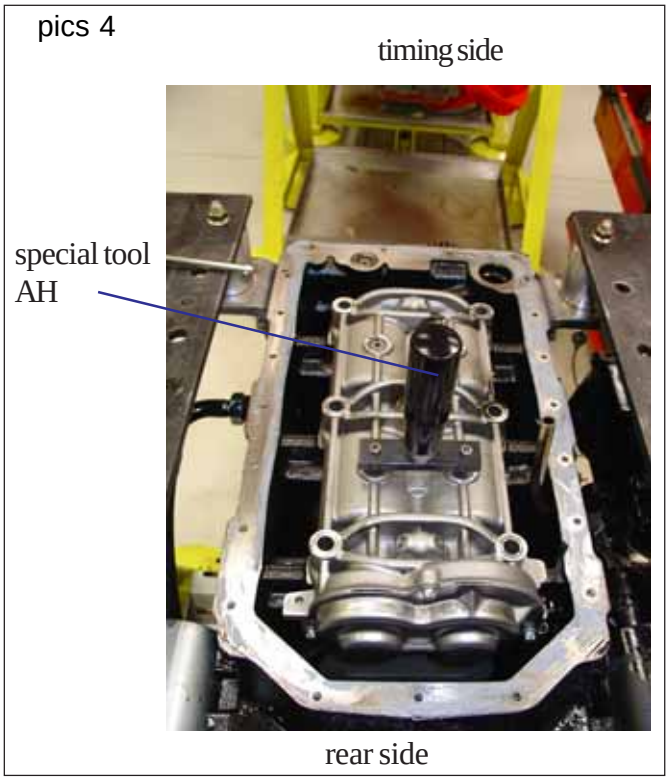
Take the 1st piston at TDC. To determine TDC **see (chapter 6 "Check and repairs")**
Lock the crankshaf rotation at TDC using special tool **(TAB. 11.1 AD).**
Install the balance shaft coupling balance gear with crankshaft gear as shown in pics 4
Remove the special tool VM **(TAB. 11.1 rif AH).**
Check o-rings oil pickup. If they are worn, replace them.
Install oil pickup.
Install bolt retaining oil pickup and balance shaft
Torque bolts following below procedure:

Torque bolts1-2-3 and bolts 4-5-6-7

Bolts 1-2-3-5-6-7 torque at 32.4 Nm - 3.3 kgm
Bolt 4 torque at 12.7 Nm - 1.3 Kgm



pics 4

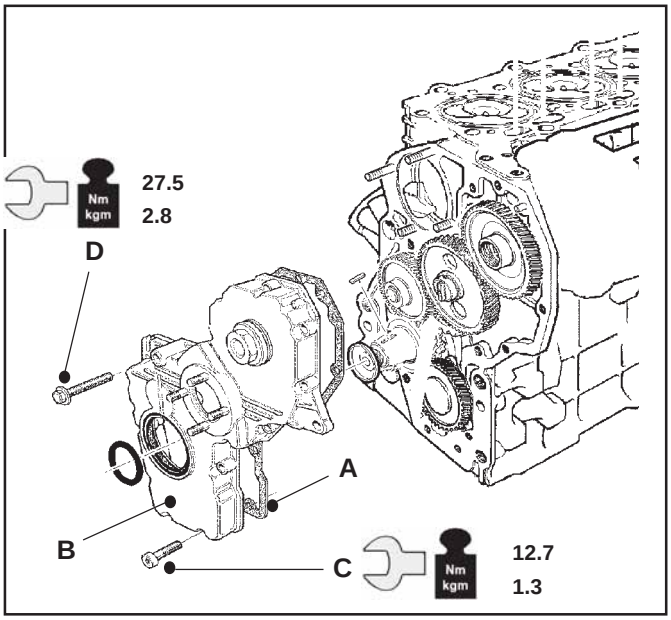


FRONT COVER

Thoroughly clean the contact surfaces.

Position sealing ring **(A)** on the crankcase, centring the reference pins.
Move cover **(B)** up to the gasket, on the reference pins.
Insert fixing screws **(C)** and **(D)**, making sure you have centred all the holes of the gasket, tighten them to the torque indicated.

Important: don't touch the lip of the oil seal you are replacing/fitting with your bare hands or with dirty gloves, because the grease on your hands or the dirt on the gloves can damage the seal.

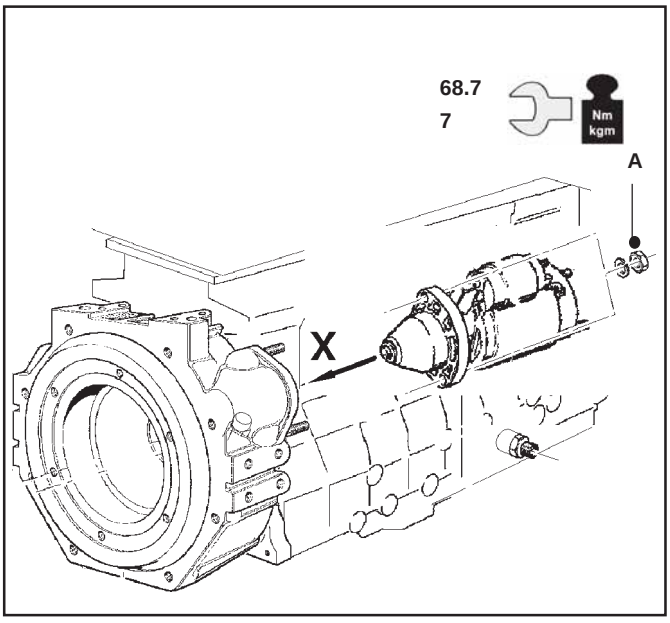


STARTER MOTOR

Insert the starter motor in the studs on the flywheel box.

Tighten nuts **(A)** to the indicated value.

To make tightening the nut from the heads easier, we recommend using the specific tool **(TABLE 11.1 ref. X).**

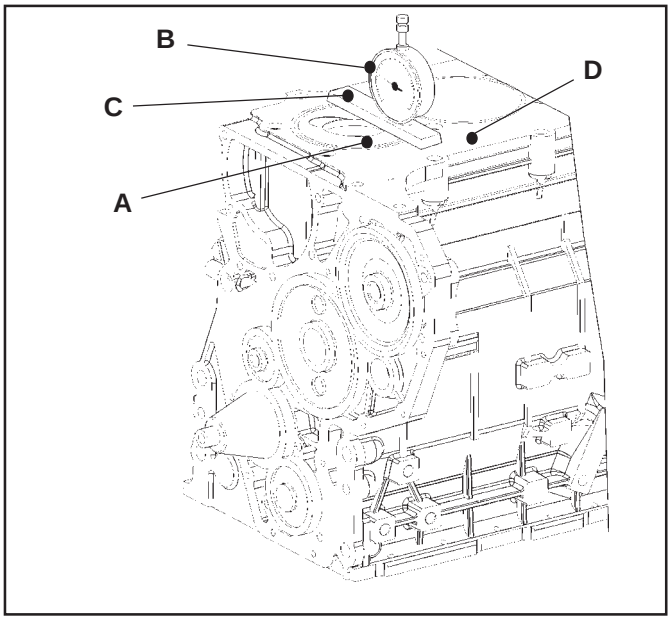


CYLINDER CLEARANCE-HEAD GASKETS

- Use special tool **(C)** **(TABLE 11.1 REF. U)** with comparator **(B)**.

- Turn the first piston **(A)**, timing side to TDC.
- Reset the pointer of the comparator **(B)** with reference to the surface of the crankcase **(D)**.
- Position the feeler of the comparator **(B)** on the piston **(A)** and note the reading.
- Choose the suitable head gasket following the table here below.

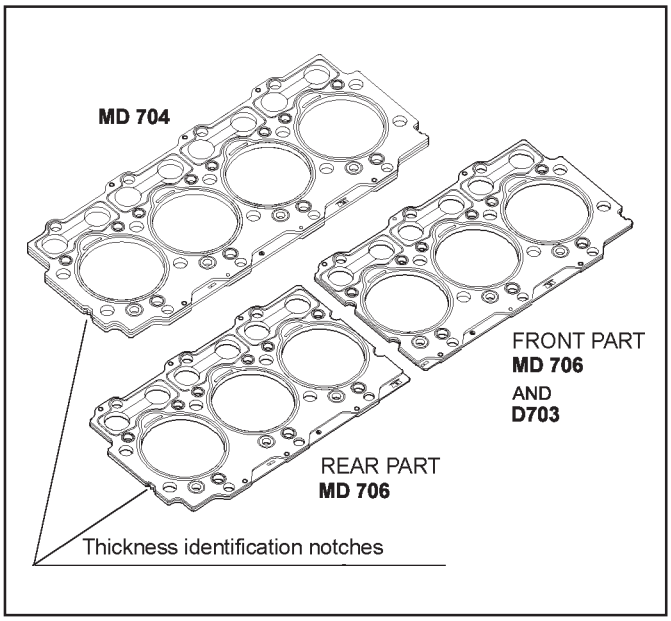
IN THE SERIES OF ENGINE GASKETS, AVAILABLE FROM OUR SPARE PARTS CENTRES, YOU WILL FIND A GASKET OF INTERMEDIATE THICKNESS WHICH CAN BE IDENTIFIED BY TWO MARKS ON THE EDGE.



Sporgenza pistone dal basam. *Piston protrusion from cranck.*	**0.60÷0.72**
Spessore guarnizione testa *Cylinder head gasket thickness*	1.42
Spazio nocivo al montaggio *Dead volume assembled*	**0.70÷0.82**
Sporgenza pistone dal basam. *Piston protrusion from cranck.*	**0.73÷0.82**
Spessore guarnizione testa *Cylinder head gasket thickness*	1.52
Spazio nocivo al montaggio *Dead volume assembled*	**0.70÷0.79**
Sporgenza pistone dal basam. *Piston protrusion from cranck.*	**0.83÷0.95**
Spessore guarnizione testa *Cylinder head gasket thickness*	1.62
Spazio nocivo al montaggio *Dead volume assembled*	**0.67÷0.79**

The head gaskets can have various thicknesses, and can be identified by the reference marks on the same.

The correct thickness to fit on the engine can be determined on the basis of the projection of the piston from the crankcase see above table, which in turn determine the cylinder clearance.



* RICONOSCIMENTO SPESSORE GUARNIZIONE IN FUNZIONE DEL FORNITORE * *Cylinder head gasket thickness identifi--cation according to different suppliers*		
SPESSORE *Thickness* (mm)	FORNITORE *Supplier* Goetze	Elring
1.42	**Senza tacche** *Without mark*	**Senza fori** *Hole less*
1.52	**N° 2 tacche** *N° 2 marks*	**N° 2 fori** *N° 2 holes*
1.62	**N° 1 tacca** *N° 1 mark*	**N° 1 foro** *N° 1 hole*

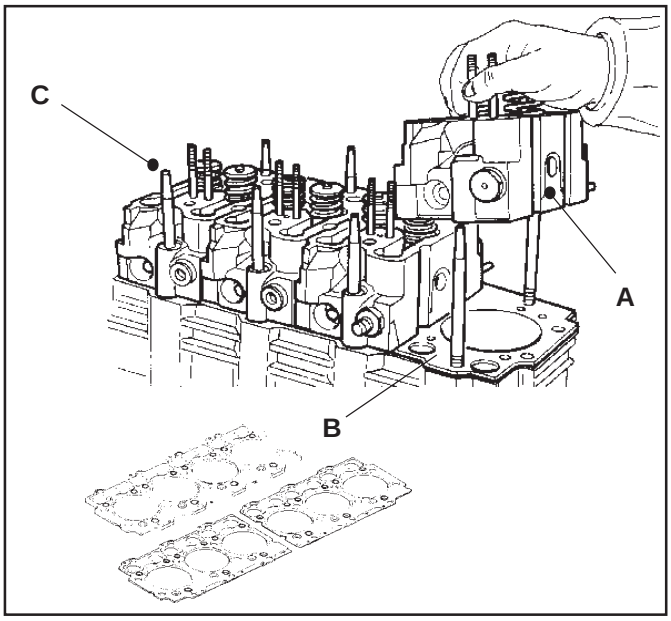
HEADS

Insert gasket (**B**) on the crankcase and position heads **(A)**.

To fit heads **(A)** and gasket **(B)** correctly use the specific tool **(C)** **(TABLE 11.1 ref. S)**.
Once you have fitted the heads, replace pins **(C)** with the fixing screws and relevant ends of the side stud bolts , move the screws up, tightening them by hand.
Fit the exhaust manifold with the relevant gaskets and tighten nuts **(A)** by hand, **an operation necessary for aligning the heads correctly.**

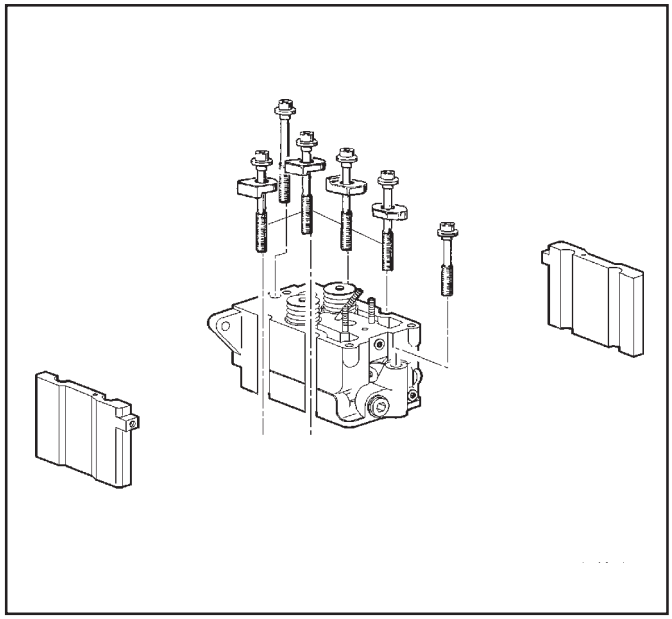
If you use the same head screws again:
lubricate all of the screws (thread and under the head), with molycote type GRAPID PLUS paste.

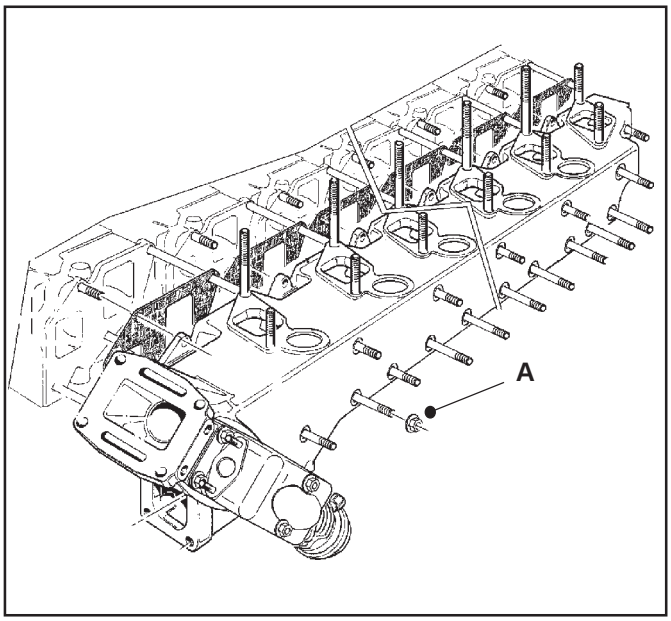
REPLACED BOLTS ONLY IN CASE OF DAMAGED BOLTS (TOP AND UNDER HEAD BOLT DAMAGE, STRETCHED THREAD, ETC...)



If you use new head screws:
these don't need to be lubricated as they are already coated with an anti-seizing material.
At this point tighten the heads following the specifications below.

TO TIGHTEN THE SCREWS, USE THE SPECIFIC TOOLS (TABLE 11.1 ref. M-N-O-P)





TIGHTENING THE HEADS

Phase 1°

Central screws (1-----14)

1) tighten to 30 Nm (3 kgm) in the following sequence:

   engine 4 cyl.: 3, 2, 1, 4, 5, 8, 9, 10, 7, 6 engine 6 cyl.: 11, 12, 13, 14, 10, 9, 8, 4, 3, 2, 1, 5, 6, 7

2) using the goniometer **(TAB. 11.1 rif. Q)** turn by 65° starting with number 1 and following ascending order, in other words:

   from 1 to 10 for engines with 4 cylinders from 1 to 14 for engines with 6 cylinders

3) repeat the second operation in the same way.

Lateral screws (M1, M2)

1) tighten all of the screws **M1** to 30 Nm (3 kgm)
2) turn all of the screws **M1** by 85°
3) tighten all of the screws **M2** to 30 Nm (3 kgm)
4) turn all of the screws **M2** by 85°

AFTER YOU HAVE FINISHED THIS OPERATION, RUN THE ENGINE AT WORKING SPEED FOR 20 MINUTES, THEN TURN THE ENGINE OFF.

Phase 2°

RE-TIGHTENING THE SCREWS AFTER RUNNING (RUN THE ENGINE AT WORKING SPEED FOR 20 MINUTES)

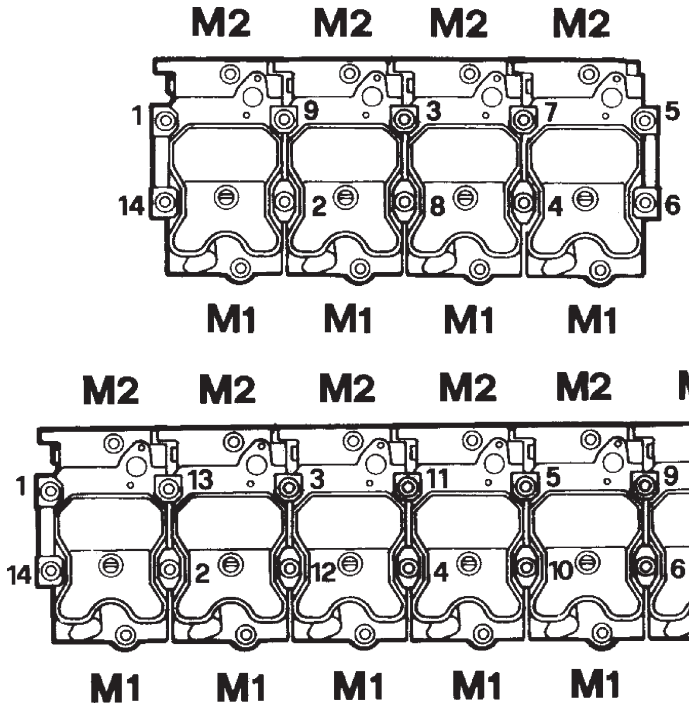
WARNING: CARRY OUT THIS OPERATION WITH THE ENGINE COLD (< 40° C)

Central screws (1-----14)

Following the sequence 1, 2, 3, 4, etc. etc., loosen one screw at a time completely then tighten it with a torque of 30 Nm (3 kgm) plus a turn of 120° (or 60° + 60°)

Lateral screws (M1, M2)

these don't need tightening again, if necessary check the screws with a dynamometric wrench set to 90 Nm (9.2 kgm).



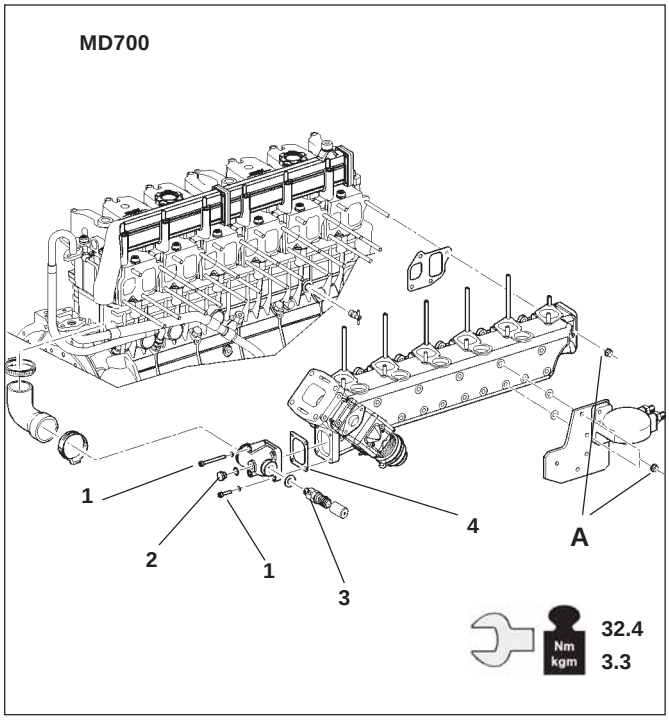
EXHAUST MANIFOLD

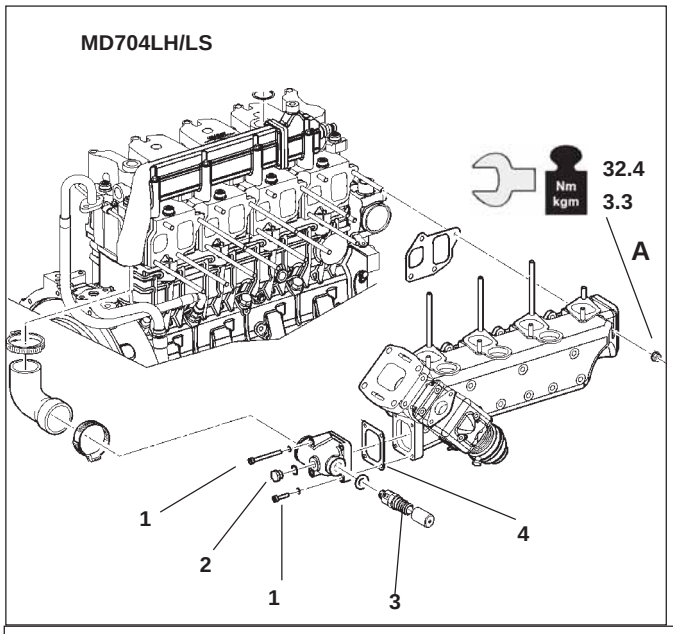
After tightening down the heads, tighten the fixing screws **(A)** to the correct torque.

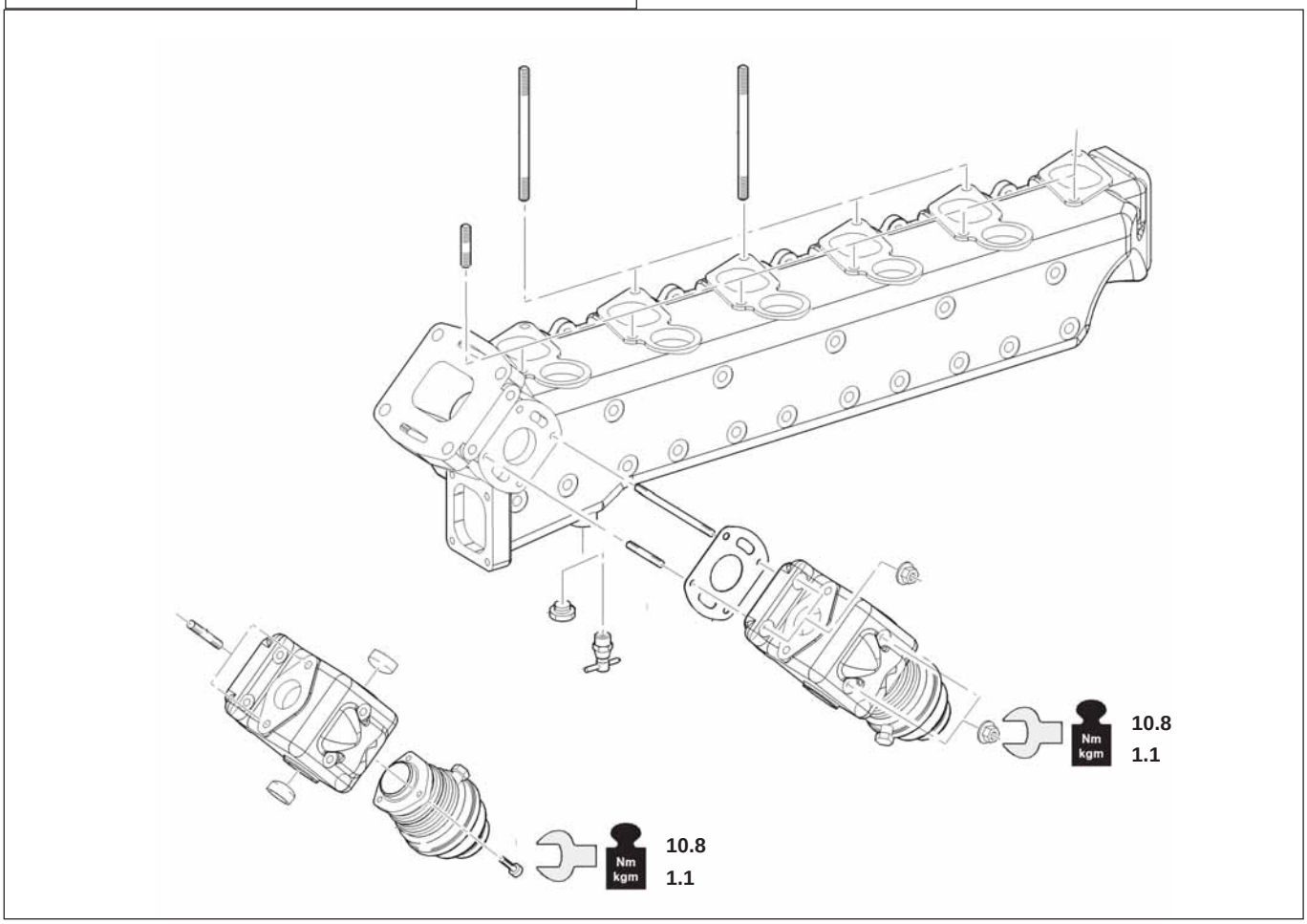
Torque screw **1** at 10.8 Nm - 1.1 kgm
Torque plug **2** at 37.3 Nm - 3.8 kgm using liquid teflon on thread.

Torque cock **3** at 24.5 Nm - 2.5 kgm using liquid teflon on thread.

Put Loctite 573 on both gasket **4** surfaces.





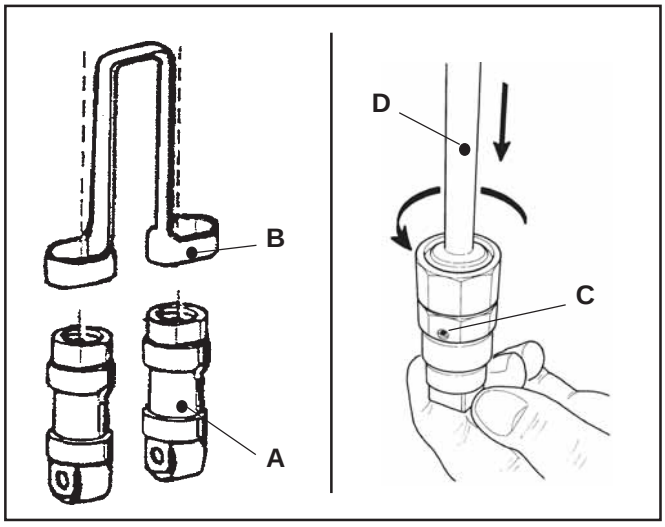


HYDRAULIC TAPPETS

First, drain all of the residual oil in the hydraulic tappets (drain hole **C**), compressing the spring inside with tool **(D)** **(TABLE 11.1 ref. L)**, in order to avoid problems with the rocker arm pusher rod at the first start.

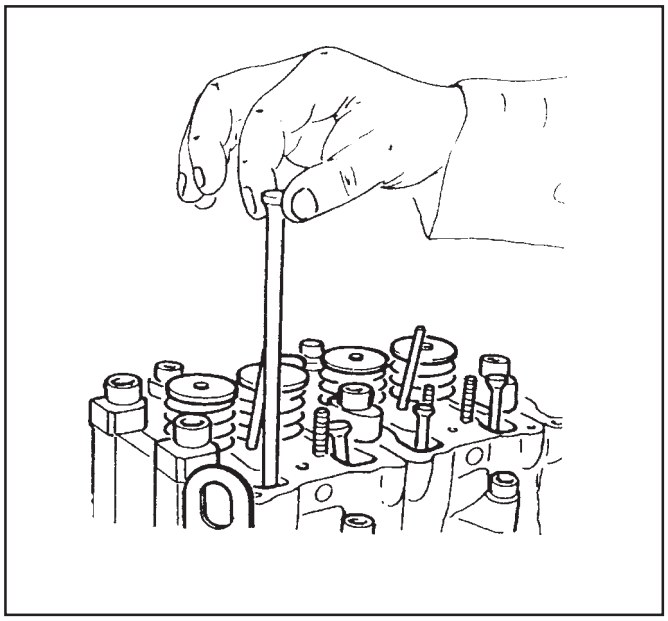
Fit tappets **(A)** in the crankcase with the help of tool **(D)** and then the alignment brackets **(B)**.

Drain hole **(C)** should be pointing towards the crankshaft.



PUSH ROD

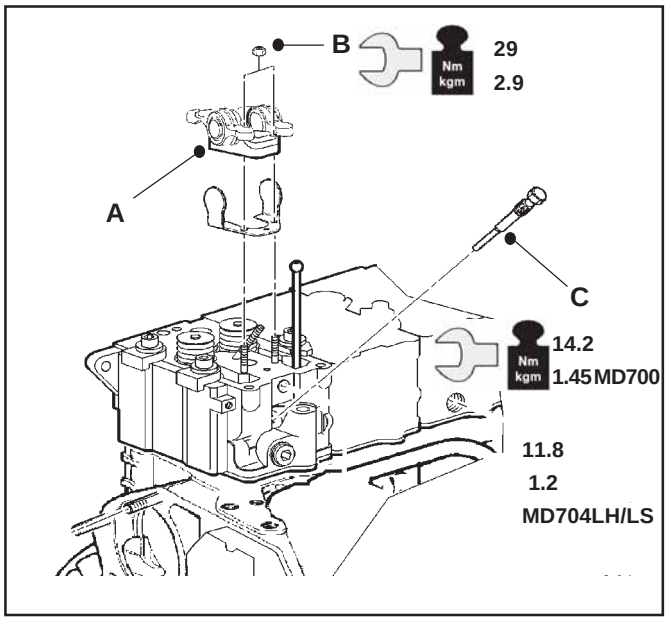
Assemble the rocker arm spindles making sure they are inserted correctly in the seat of the tappets.



ROCKER ARM

Insert the rocker arm groups **(A)** in the relevant studs

and tighten fixing nuts **(B)** to the right value.
To avoid damaging the rocker arm spindles, make sure you position the piston of the cylinder in question, at roughly 90° from TDC.
Alternatively simply turn the first pistons to roughly 40° ÷ 45°, before TDC.
Assemble and tighten the glow plug caps **(C)** to the value indicated, if pre-heated glow plugs are fitted, they should be tightened to the same torque.



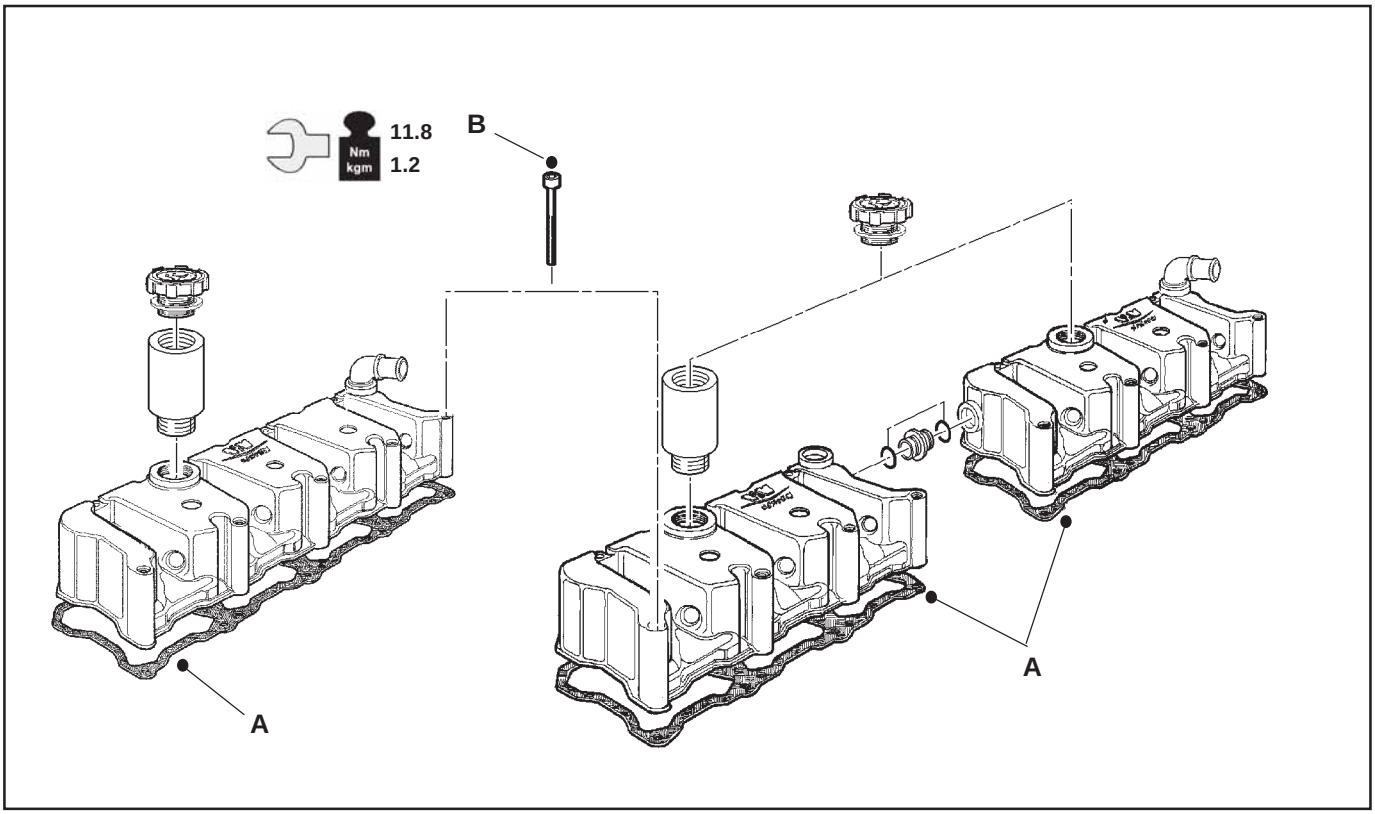
ROCKER ARM COVER

Position the gasket/s (**A**) on the heads so they adhere along the entire profile, with the text towards the heads.

Insert the cover/s, then the fixing screws **(B)** and tighten them to the indicated value.

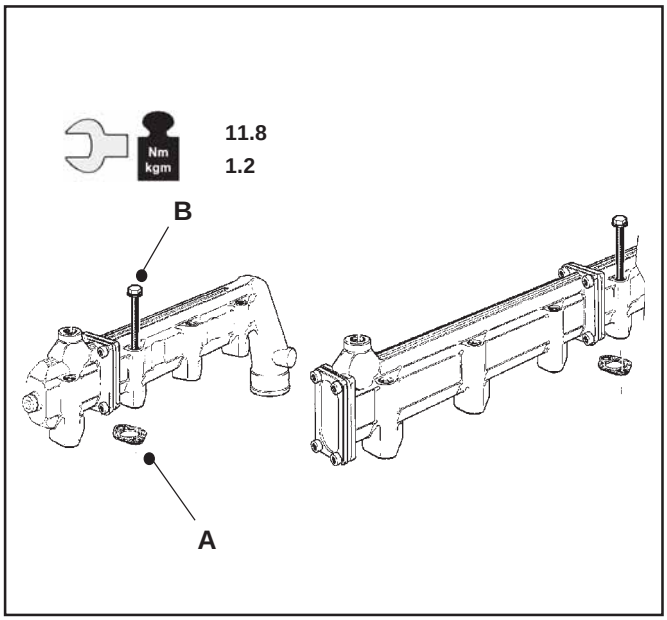
Fit the union oil and relevant cap.

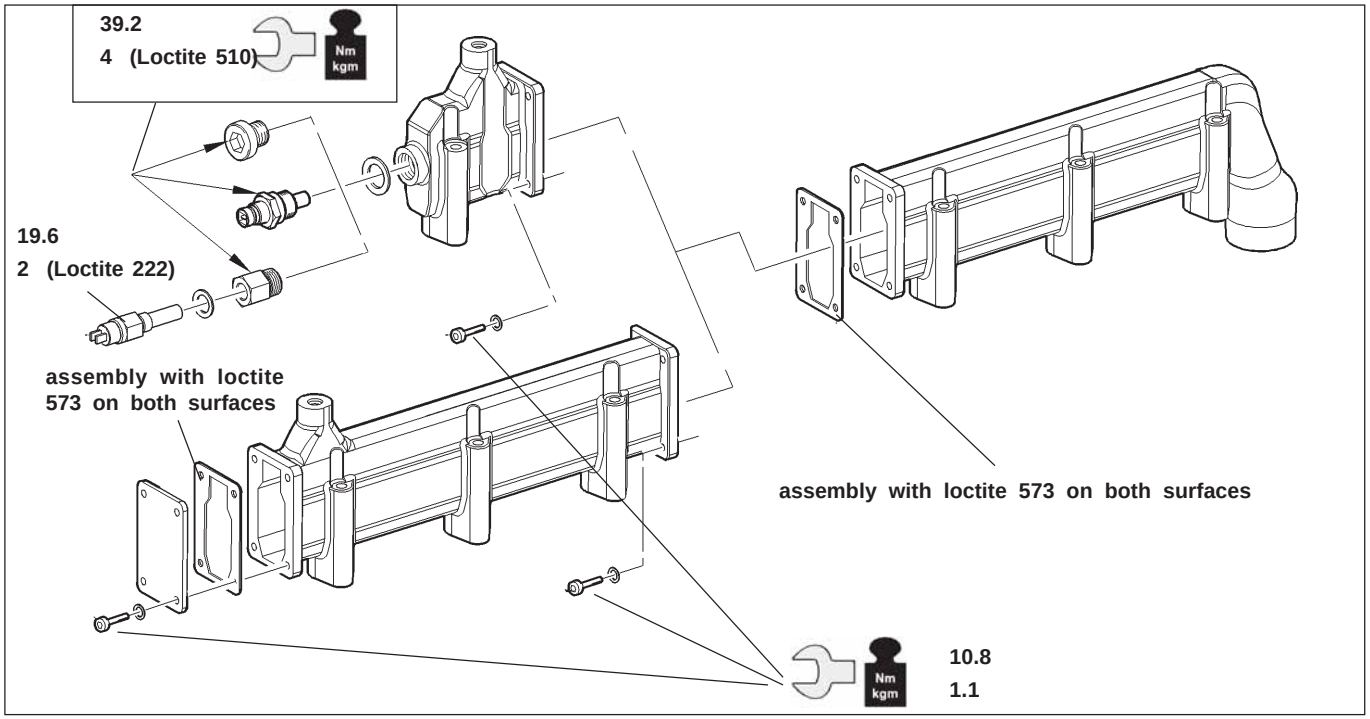
WHEN FITTING THE GASKET BE CAREFUL OF THE SPRINGS INSIDE IN CONTACT WITH THE ROCKER ARMS AS THEY COULD DAMAGE IT AND IF IT IS CUT OR FITS BADLY IT WON'T MAKE A GOOD SEAL.



HEAD WATER PIPE

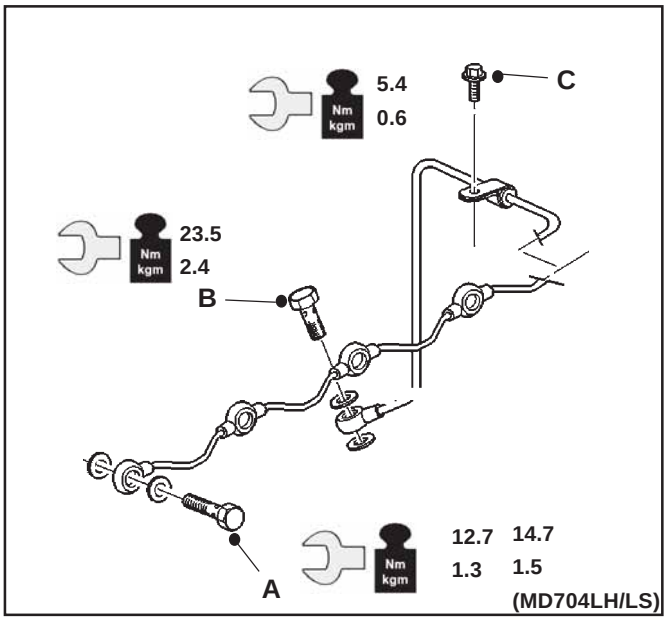
Position the pipe on the heads with sealing ring **(A)** between the two, then tighten fixing screws **(B)** to the indicated value, starting in the middle and proceeding in an alternate fashion outwards.
Take care when positioning the gaskets, if they are fit badly, they will leak.





ROCKER ARMS LUBRICATION PIPE

Position the pipe on the heads, insert unions **(A)** and the relevant gaskets, insert opening **(B)** on the crankcase on the rear support lubrication union with the relevant gaskets and the screw fixing the stabilising bracket (**C**).
Tighten the parts to the values indicated.



FRESH WATER PUMP

Position the sealing ring on the stud bolts in the crankcase, insert the water pump and the relevant fixing nuts.

Tighten nuts (**A**) to the indicated torque.

TIGHTENING PROCEDURE MD704LH/LS

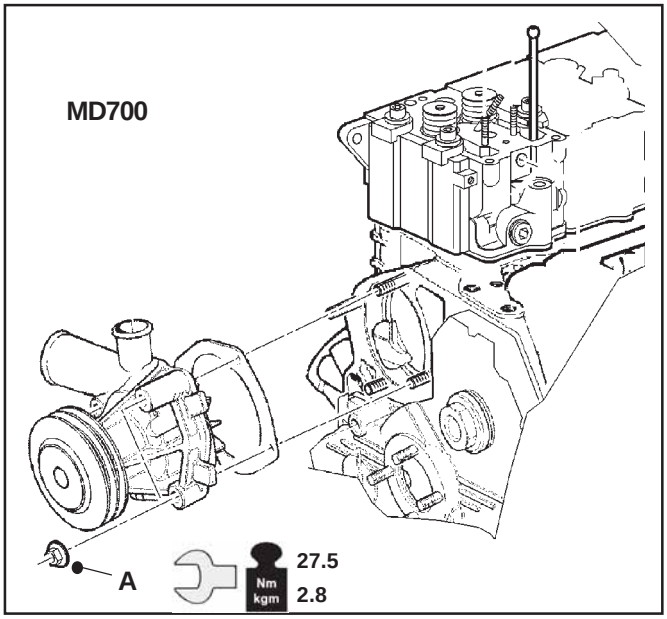
Insert the screws into holes 1-2-3-6.

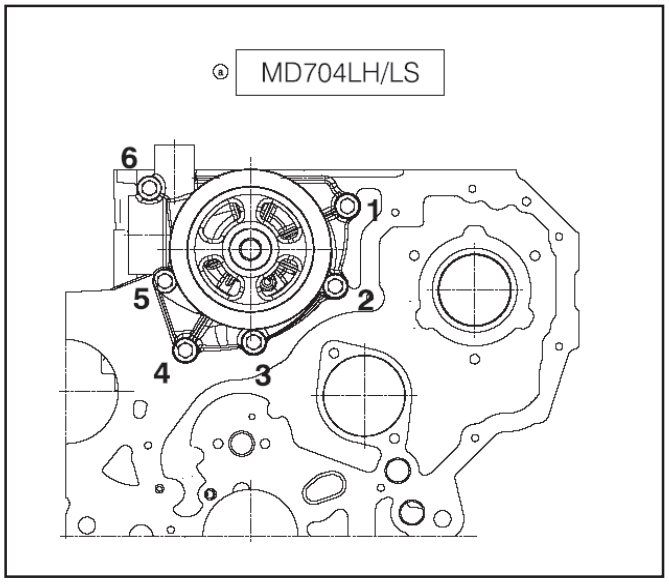
Approach the pump to crankcase torquing the screw 2 by hands.

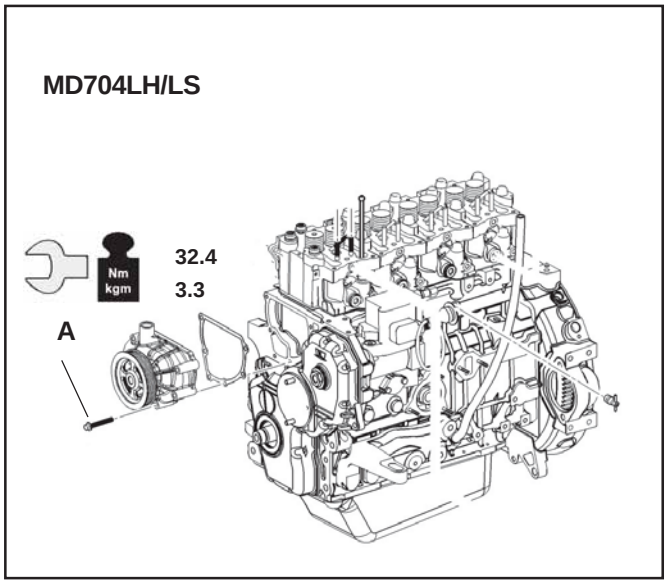
Approach the other screws (1-3-6) and torque them at indicated value in picture with sequence 6-3-1.

Torque other screws with sequence 4-2-5.

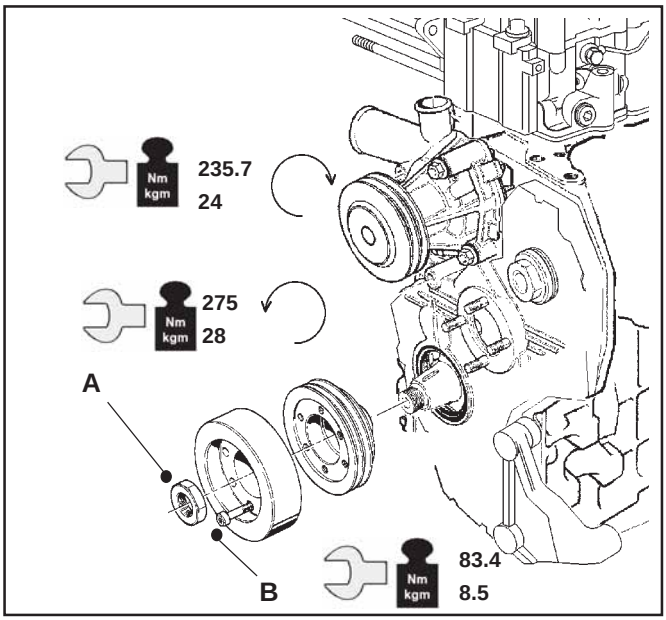
Retorque all screws with sequence 6-3-1-4-2-5.







FRONT PULLEY AND DAMPER FLYWHEEL



Make sure that the conical part of the shaft and the pulley are thoroughly degreased.

For Crankshaft end thread RIGHT-HAND (DX) (MD700LI - MD706MI/MH)

Check the cleaning of the crankshaft thread, crankshaft gear surface in contact with crankshaft pulley and crankshaft pulley surface in contact with crankshaft pulley nut.

Proceed by blocking it in the following way:

apply Loctite 222 on the nut thread and

tighten it to **108 Nm (11 kgm)** and unscrew the nut and retorque at **235.4 Nm (24 kgm).**

For Crankshaft end thread LEFT-HAND (SX) (MD706MS/MX/LB/LS/LH/LX)

The procedure is as previous models but the only difference is that it is needed to apply “Molykote G Rapid Plus Paste” grease on pulley nut thread and on the nut surface in contact with pulley and in the retorquing phase it is needed to torque **anticlockwise** at **274.7 Nm (28 kgm).**

TO CARRY OUT THIS OPERATION YOU SHOULD USE THE SPECIFIC TOOL (TABLE 11.1 T) TO STOP THE ROTATION OF THE CRANKSHAFT.

DAMPER

Move the damper flywheel up to the pulley, insert fixing screws **(B)** with the thread coated with **LOCTITE 510** and tighten them to the value indicated in the figure.

MD704LH/LS

Take the crankshaft at TDC using special tool **(TAB. 11.1 rif. AC).**

Block crankshaft rotation using special tool **(TAB. 11.1 rif. AD or T in place of starter).**

Disassembly crankshaft pulley nut (left thread).

Check the cleaning of the crankshaft thread, crankshaft gear surface in contact with crankshaft pulley and crankshaft pulley surface in contact with crankshaft pulley nut

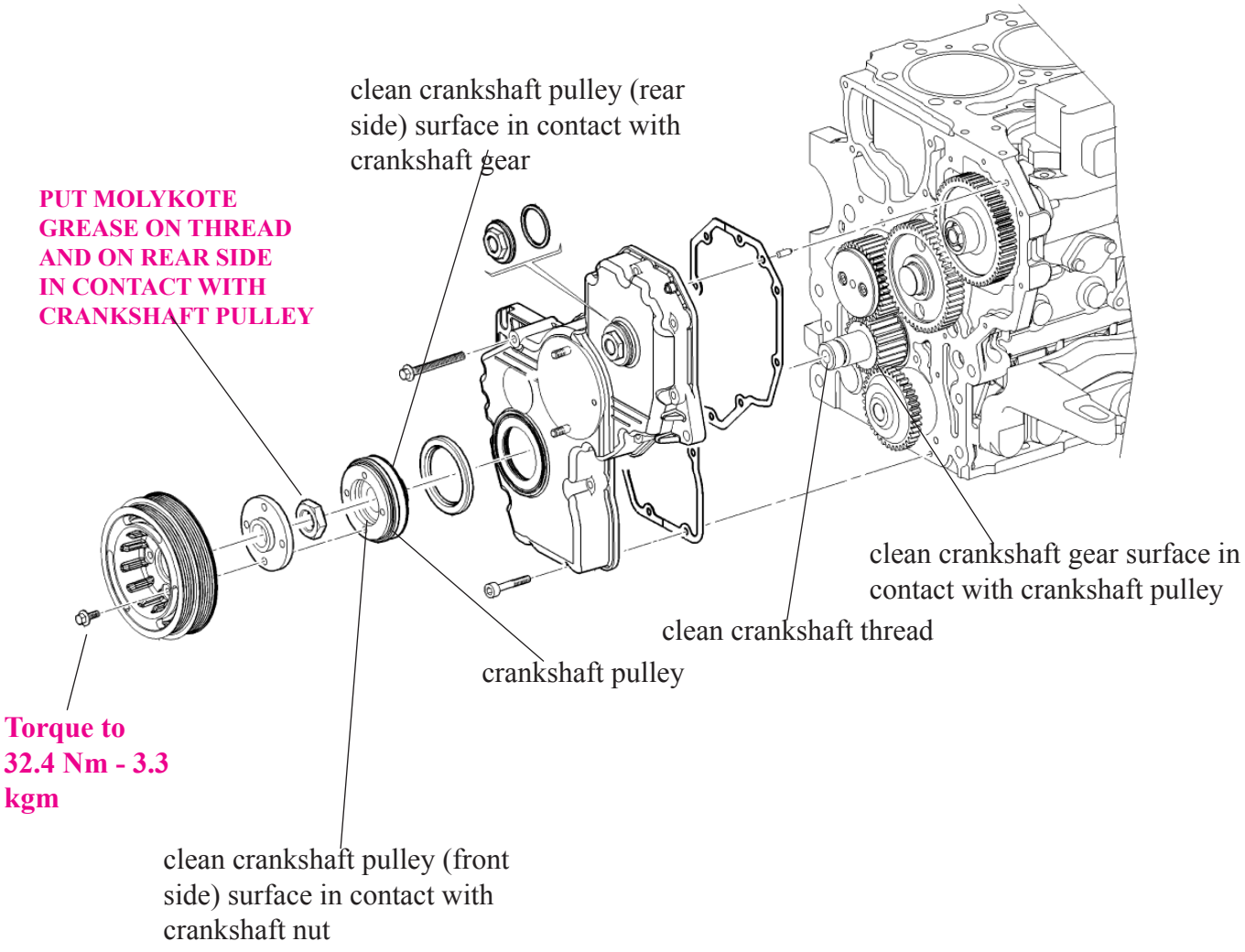
Apply “Molykote G Rapid Plus Paste” grease on pulley nut thread and on the nut surface in contact with pulley

Torque nut at **400 Nm - 41 Kgm**

Slacken the nut.

Torque againg the nut to 600 Nm - 61 Kgm

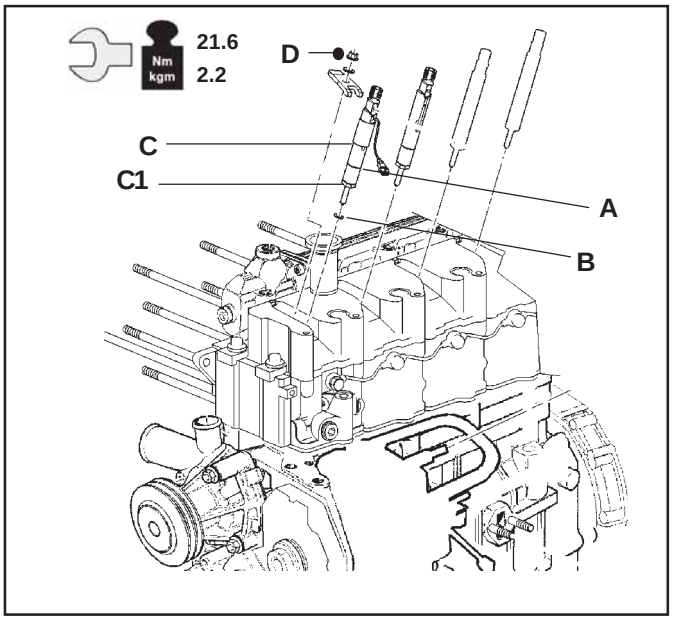
Remove special tools **(TAB. 11.1 rif. AD or T in place of starter) and (TAB. 11.1 rif. AC)**



INJECTORS

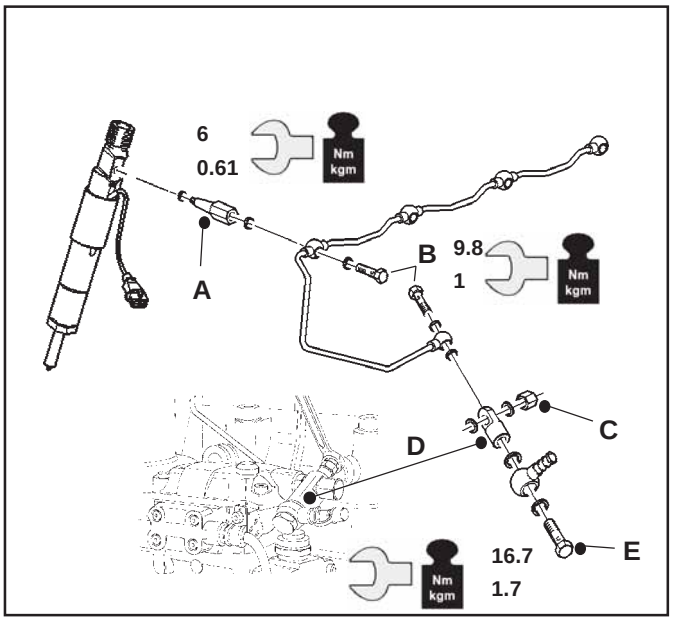
Before inserting the injector in its own seat, you should grease OR **(A)** and gasket **(B)**.

Apply **Molikote P 1500** grease on the zone indicated **beetwen(C) and (C1)**, insert the clamp on the injector and tighten nut **(D)** to the indicated value, lubricating with engine oil, or alternatively MOLIGUARD type LPM-180, on the thread.



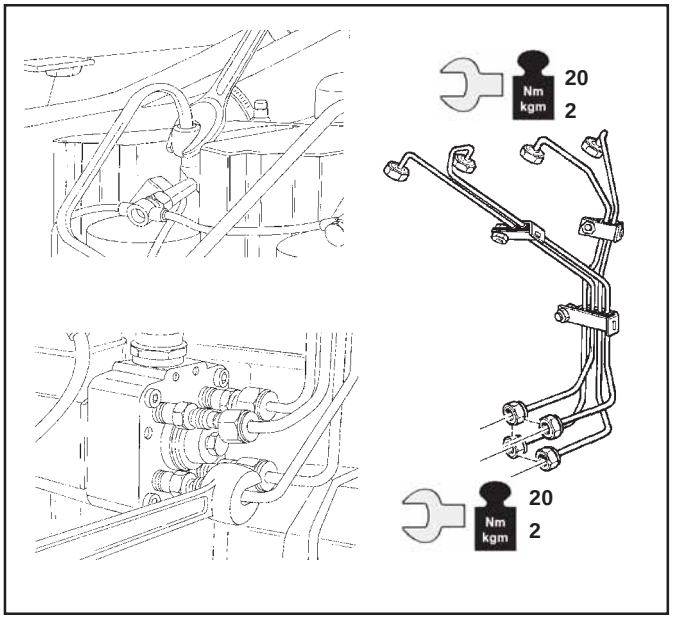
DIESEL DRAIN PIPE

Fix fittings **(A)** to the injectors puting liquid teflon on the thread, insert unions **(B)** and the relevant gaskets in the eyeholes of the pipe and tighten to the value indicated in the figure.
Screw in and tighten nut **(C)**, which fixes fitting **(D)** to the injection pump, with a torque of **17.5÷22.5 Nm (1.8÷2.3 kgm).**
Union (**E**) that clamps the diesel return fitting to the tank must be tightened to the value indicated in the figure.



INJECTORS DIESEL DELIVERY PIPE

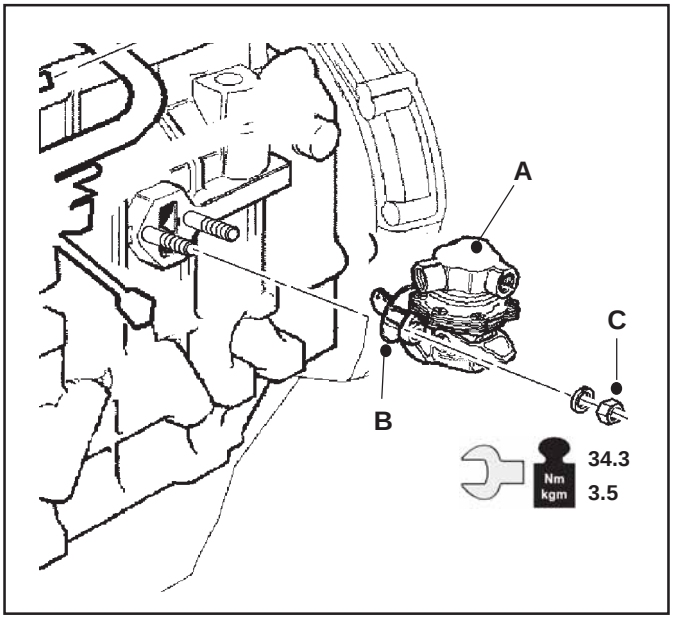
Screw in the nuts fixing the intercooler to the injectors and injection pump, tightening them to the value indicated in the figure.



FUEL FEED PUMP (AC)

Fit pump **(A)** on the crankcase, as indicated in the figure taking care not to pinch sealing ring **(B)**.
Tighten nuts **(C)** using a dynamometric wrench, set to the value indicated in the figure.

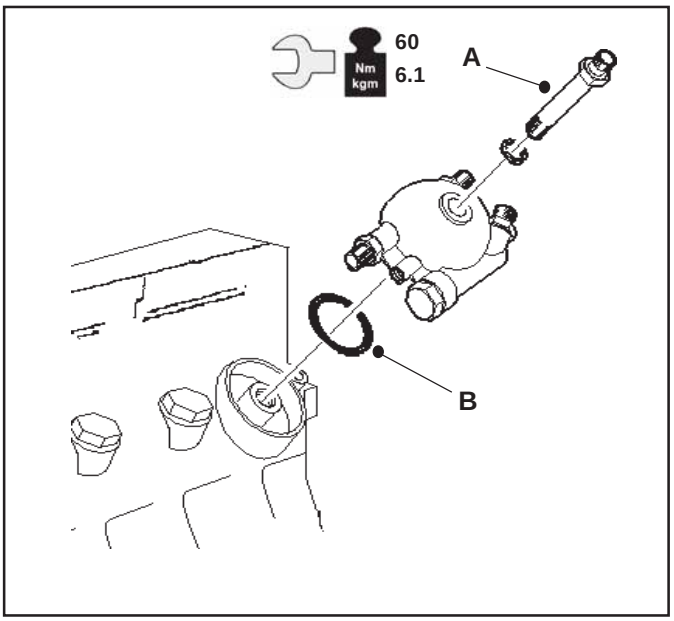
WARNING: BEFORE PROCEEDING WHEN FITTING THE PUMP (A), MAKE SURE THAT THE SEAL RING (O-RING) ISN'T DAMAGED REPLACE IT IF NECESSARY.



OIL THERMOSTAT BODY MD700

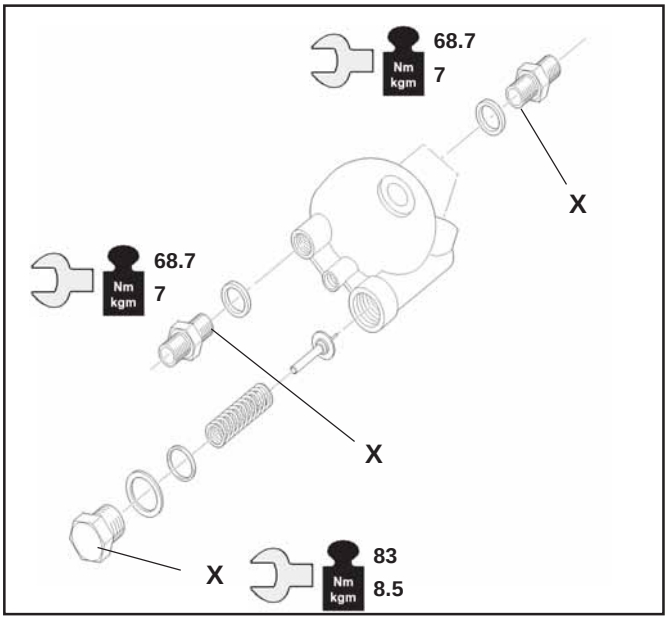
Insert the union **(A)** and relevant gasket on the thermostat body, as indicated in the figure.
Grease OR **(B)** so it sticks in the seat.
Place the body on the crankcase taking care not to pinch the OR seal.
Tighten the fitting to the value indicated in the figure.

WARNING: BEFORE PROCEEDING WITH THE ASSEMBLY OF THE BODY MAKE SURE THAT THE SEAL RING (O-RING) ISN'T DAMAGED REPLACE IF NECESSARY.



Exploded view oil thermostat body MD700

Put liquid teflon in thread **X**



OIL HEAT EXCHANGER - THERMOSTAT BODY MD704LH/LS

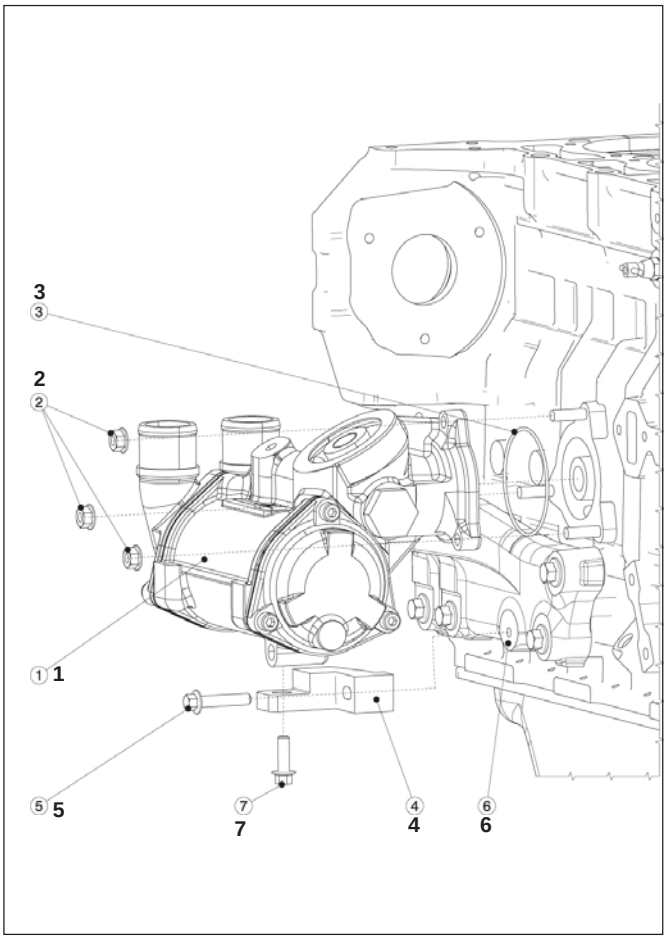
Fit the or **3**

Install the exchanger **1** and torque nuts **2 at 24.5 Nm (2.5 kgm).**

Approach the support **4** to exchanger **1**.

Torque screw **5 at 24.5 Nm (2.5 kgm)** supplying upward a light load to support **4**.

Torque screw **7 at 24.5 Nm (2.5 kgm)**

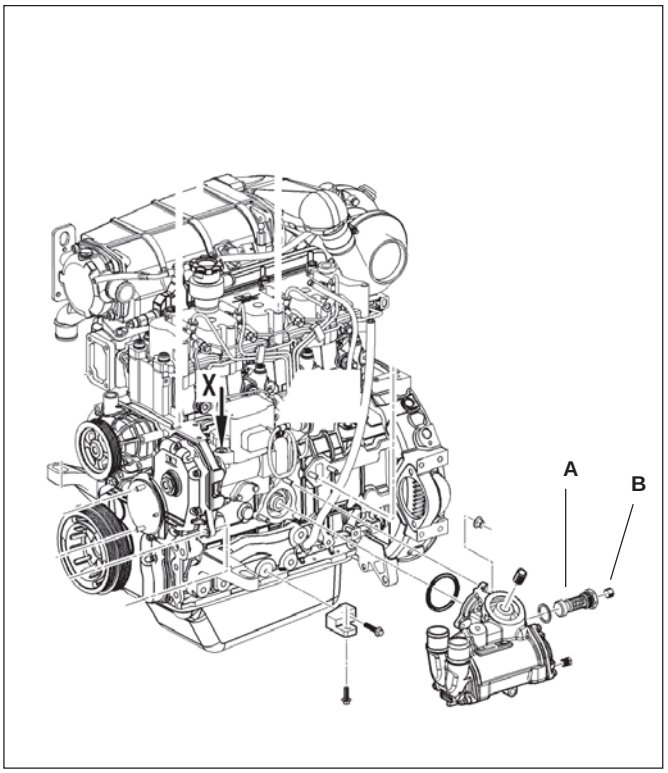


OIL THERMOSTAT BODY MD704LH/LS

Install body with liquid teflon

Torque body **A** at 88.3 Nm - 9 kgm.

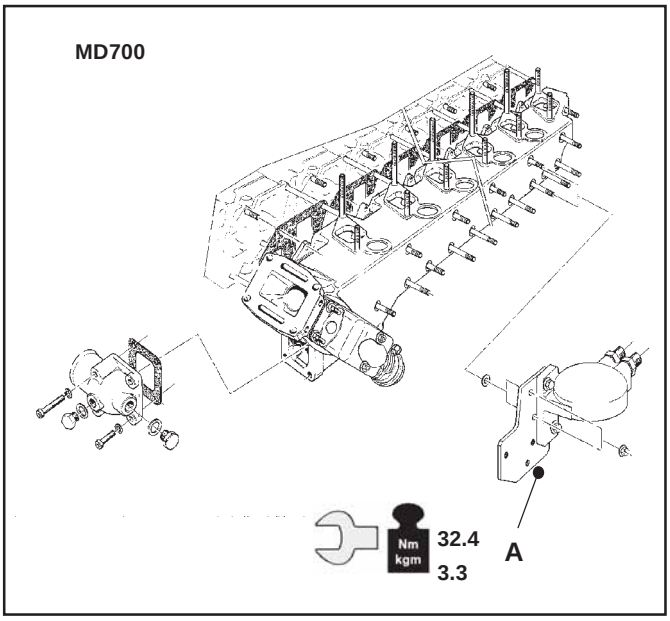
Torque plug **B** 19.6 Nm - 2 kgm



OIL FILTER

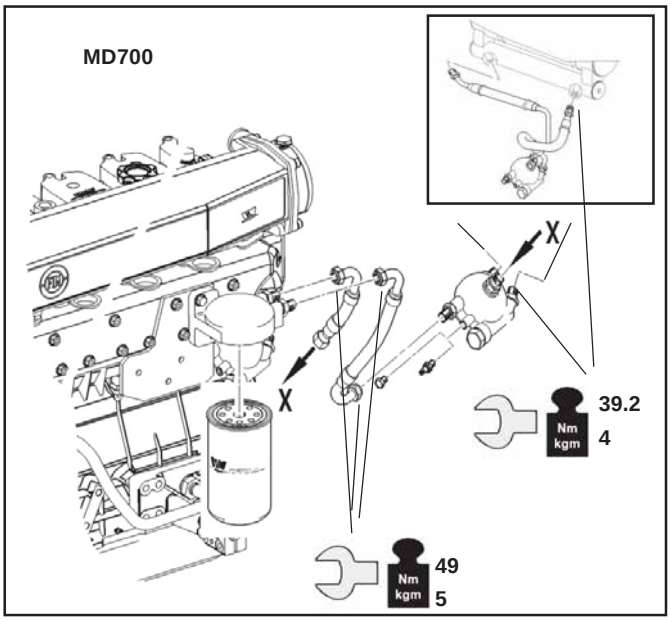
OIL FILTER SUPPORT

Insert the oil filter support **(A)** in the studs of the exhaust manifold and tighten the fixing nuts as shown in the figure.



OIL CARTRIDGE AND PIPES

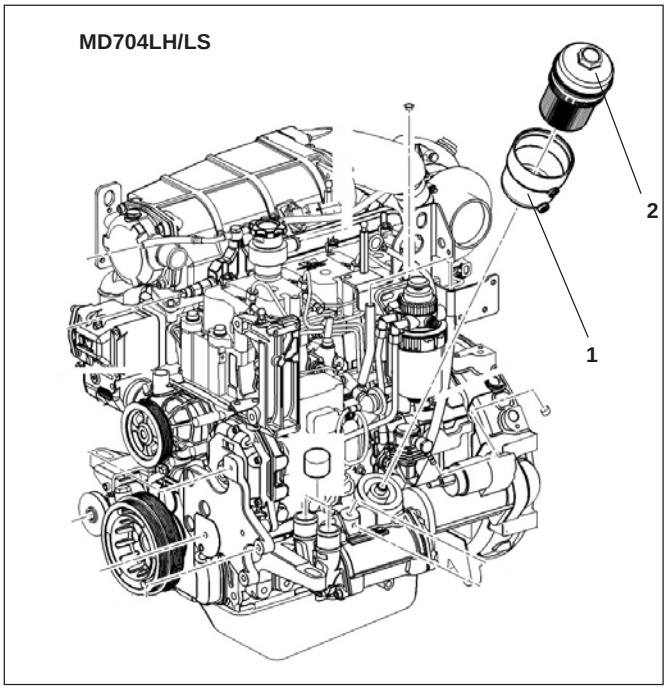
Assemble the pipes of the oil circuit distributing liquid teflon on the thread and tighten them to the value in the figure.
When tightening the nuts of the pipes that go to the water/oil exchanger, we recommend using a spanner on the fitting, to exert a reaction torque against the tightening torque, to avoid damaging the exchanger.
Screw in the oil filter cartridge by hand exerting a light tightening torque **(24.5 Nm - 2.5 kgm)**.
We recommend fitting the cartridge applying a thin layer of oil on the sealing ring.



MD704LH/LS

Torque component **1** at 35 Nm - 3.6 kgm.

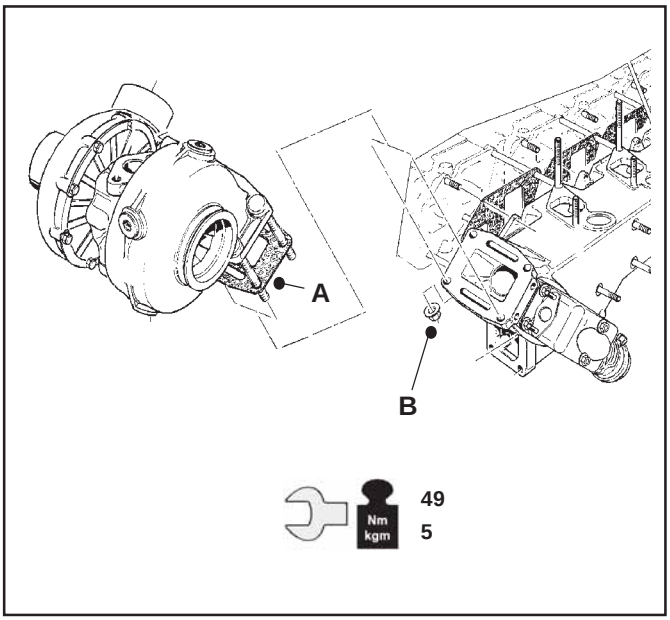
Torque oil cap cartridge **2** at 22.5 Nm - 2.3 kgm.



TURBO COMPRESSOR

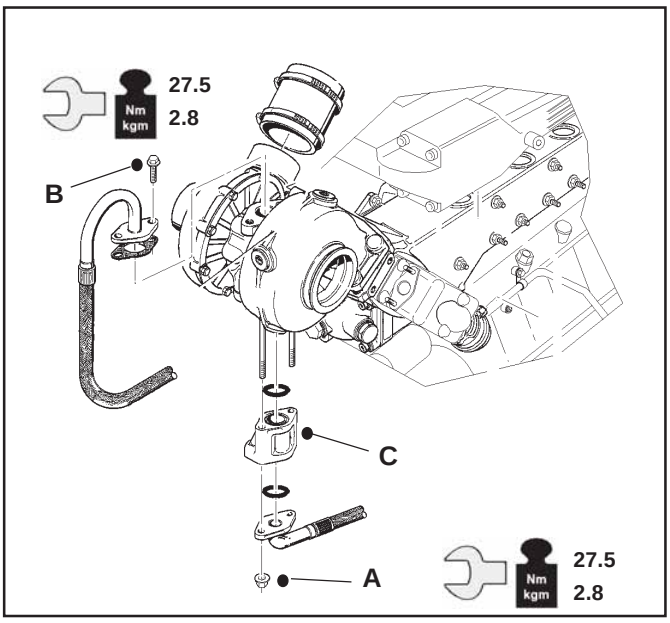
Insert gasket **(A)** on the studs of the turbo so the water holes match.
Screw in fixing nuts **(B)** and tighten them to the value indicated in the figure.

WARNING: TO GUARANTEE THE SEAL OF THE GASKET. THE TWO CONTACT SURFACES MUST BE PERFECTLY CLEAN.



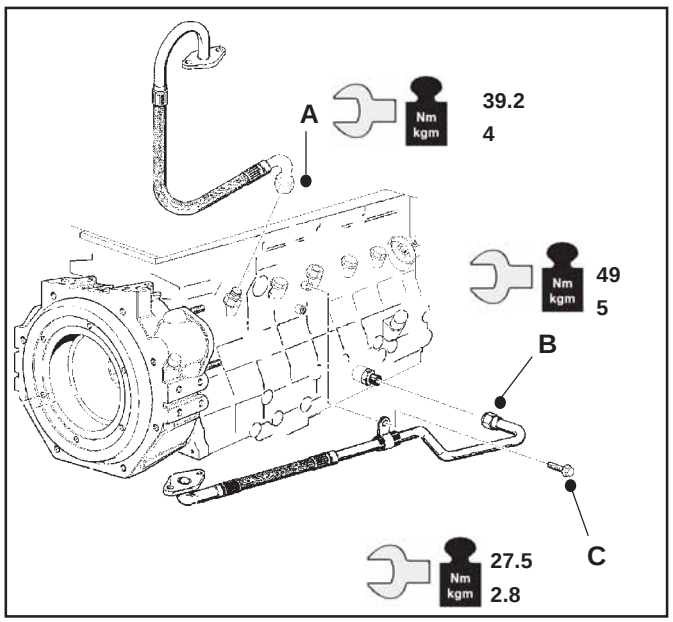
TURBO SUPPORT SPACER

Insert the OR in the seats of the spacer **(C)** using grease, insert the spacer in the studs of the turbo, insert the oil drain pipe, screw in fixing nuts **(A)** without tightening.
Before you tighten the fixing nuts, we recommend assembling the support bracket of the turbo , have all the screws in contact, once you have
taken up all the free movement, you can proceed by tightening it definitively, see value.
Place the oil delivery pipe and the relevant gasket on the turbo, insert fixing screws **(B)** and tighten them to the value indicated in the figure.



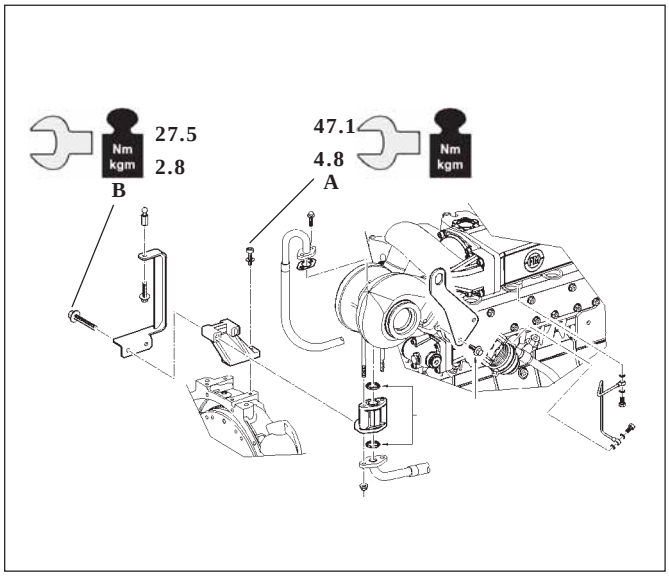
TURBO OIL DELIVERY AND RETURN PIPES

Put liquid Teflon on the threads of the unions, screw in the nuts of pipes **(A)** and **(B)** and tighten them to the torque values indicated.
Insert fixing screw **(C)** and tighten it to the indicated value.



TURBO SUPPORT

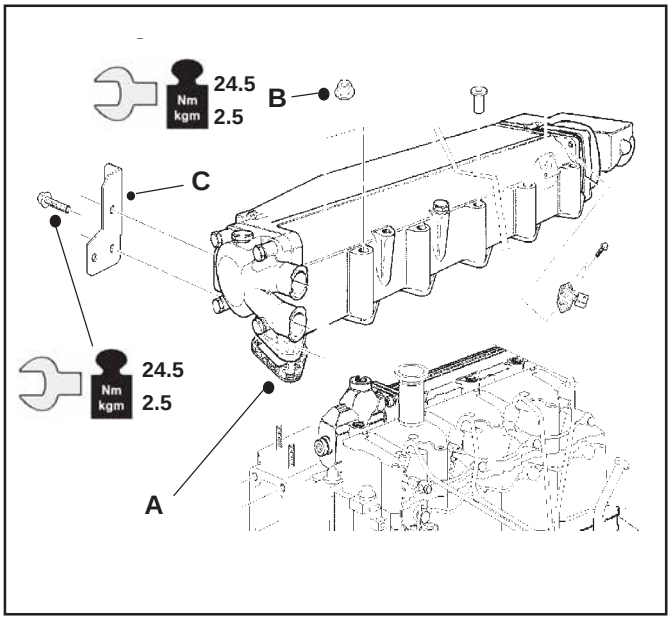
Insert screws **(A)** and the relevant washer in the box taking up the distance but without tightening them.
Insert screws **(B)** between the support and the spacer, taking up the distance, when the whole system (bracket and support) are in contact without generating tension, proceed by tightening to the torque values indicated.



INTERCOOLER

Position the intercooler on the exhaust manifold

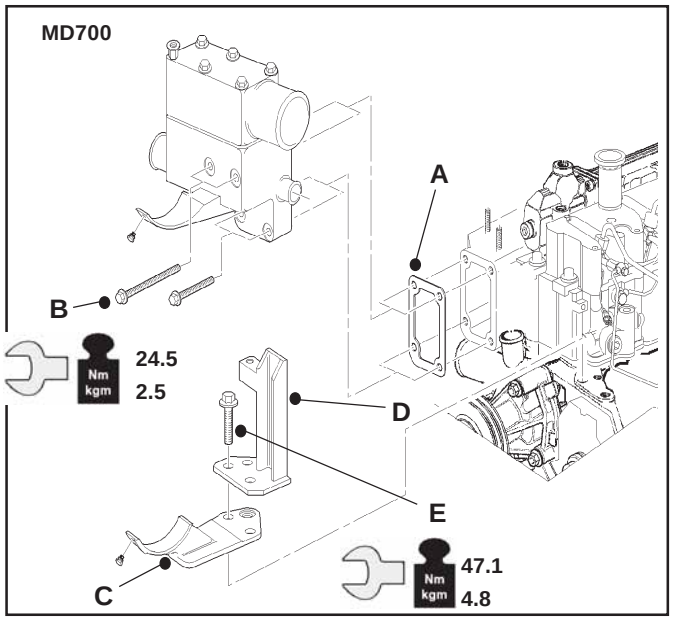
inserting gaskets **(A)** with LOCTITE 510 on both sides.
Tighten fixing nuts **(B)** to the value indicated in the figure.
Fit bracket **(C)**, insert the fixing screws and tighten them to the indicated value.

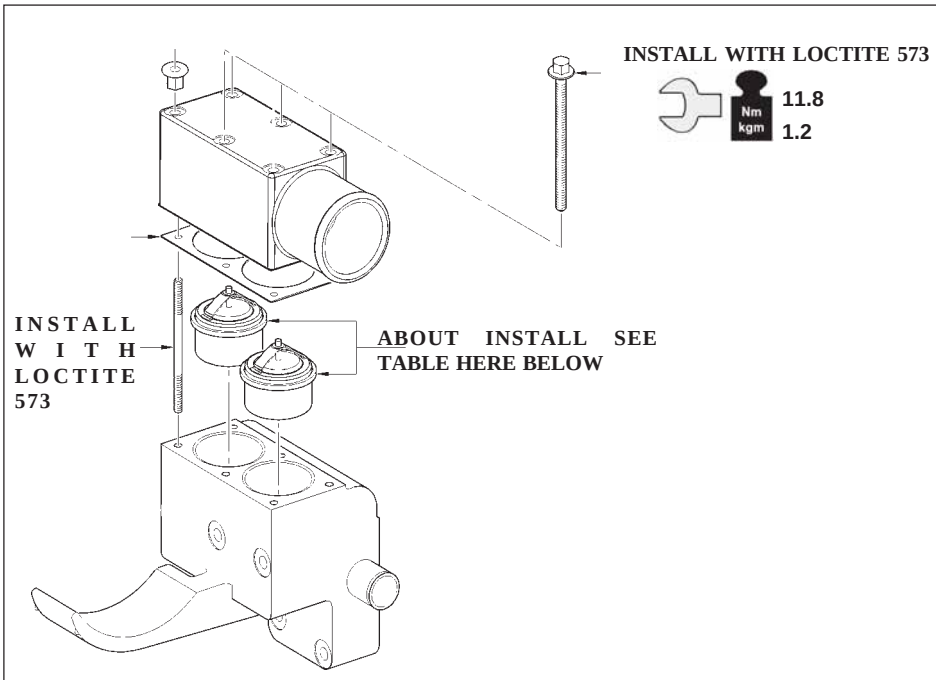


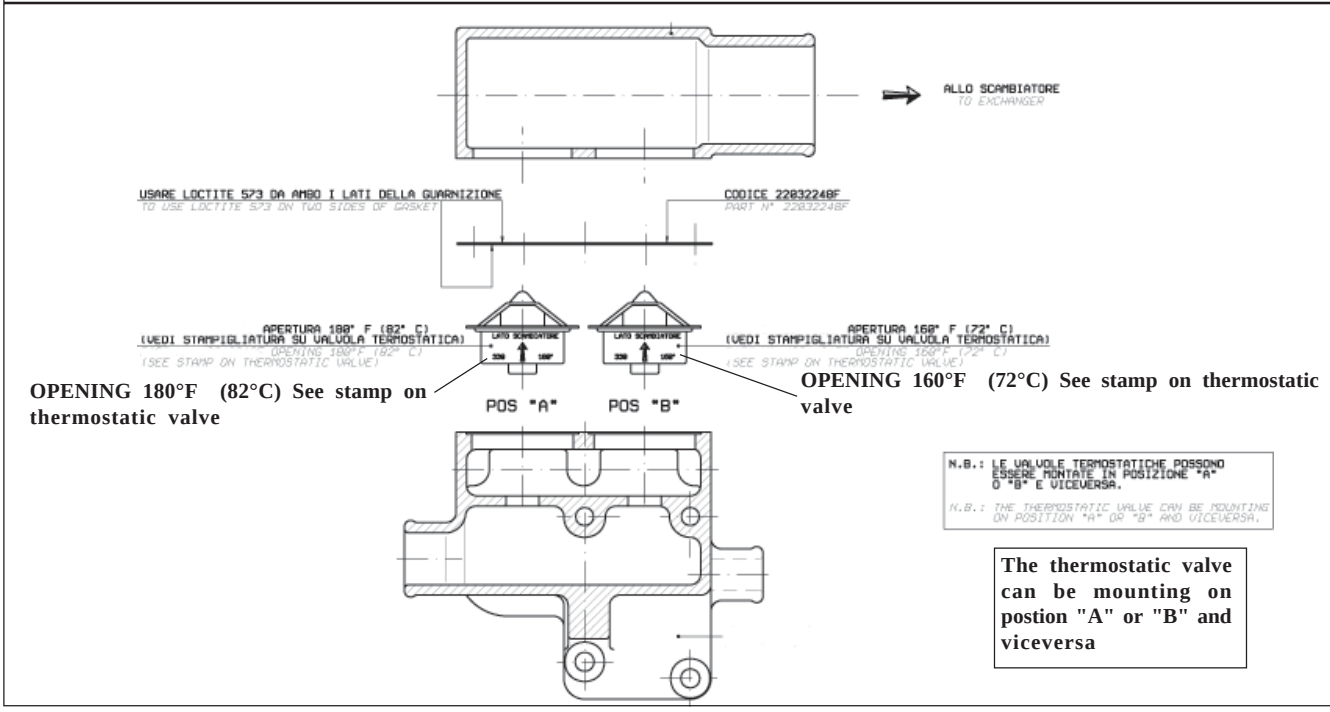
THERMOSTAT VALVE BODY MD700

THERMOSTAT VALVE SUPPORT BODY - WATER/WATER EXCHANGER SUPPORT AND EYEBOLT

Fit gasket **(A)** with LOCTITE 573 on both sides.
Make the valves support body adhere, insert the relevant fixing screws **(B)** and tighten them to the indicated value.
Position the exchanger support **(C)** on the crankcase, fit eyebolt **(D)** on the support, insert fixing screws **(E)** and tighten them to the value indicated.



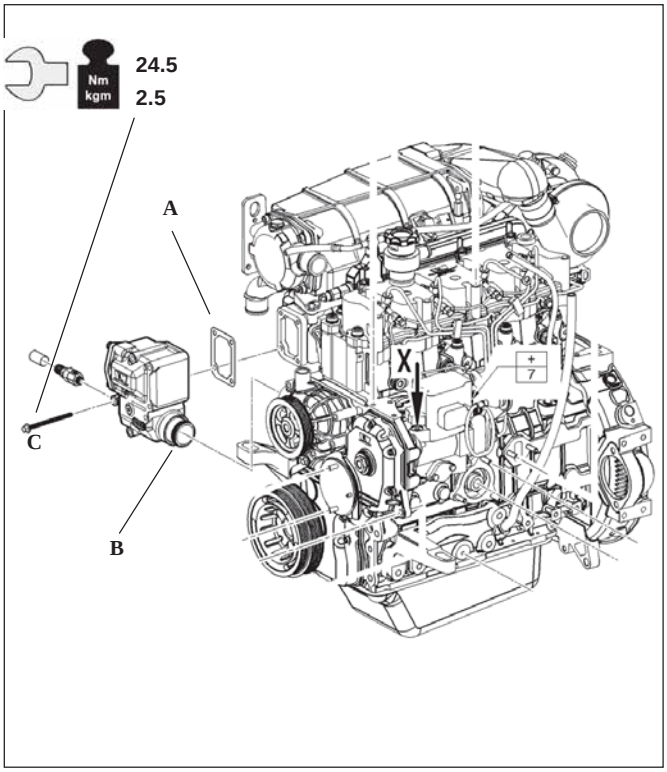




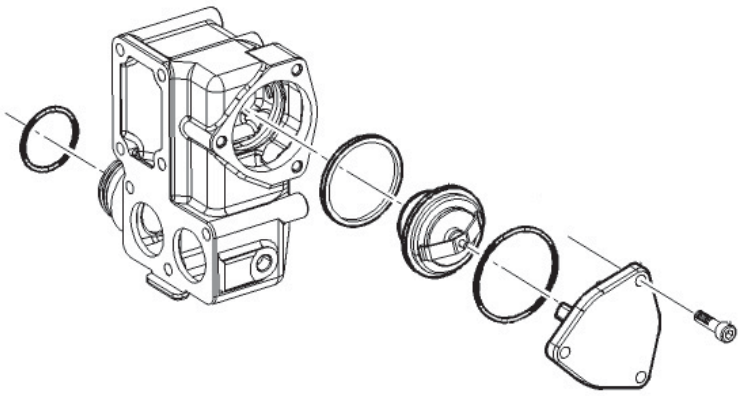
The thermostatic valve can be mounting on postion "A" or "B" and viceversa

THERMOSTAT VALVE BODY MD704LH/LS

Fit gasket **(A)** with LOCTITE 573 on both sides.
Lubricate OR **(B)** with grease.
Screw **(C)** at indicated value



Exploded view thermostat valve body MD704LH/LS

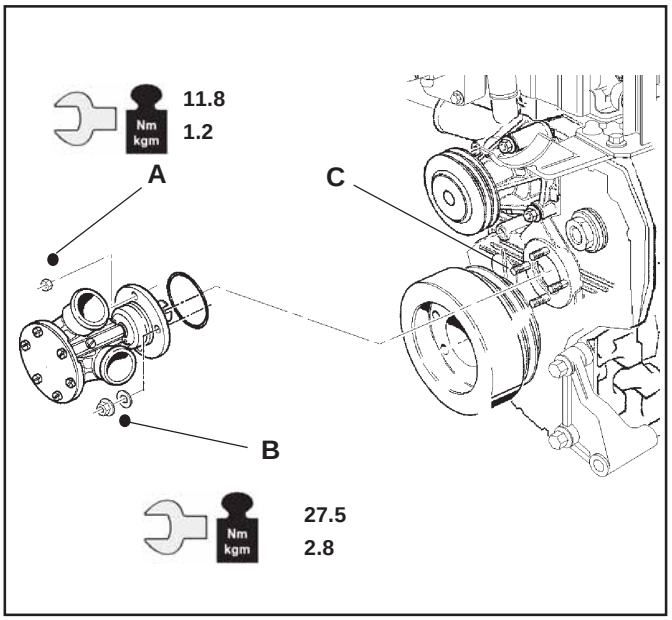


SEA WATER PUMP MD700

Engage the water pump shaft notch with camshaft key melted on it.

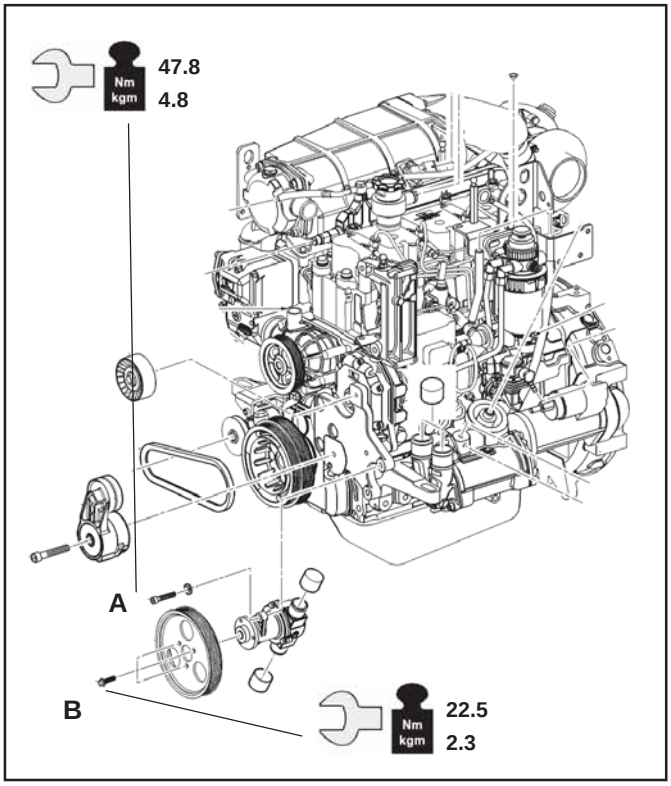
Put Loctite 222 on the stud bolts **C.**

Torque at indicated values.



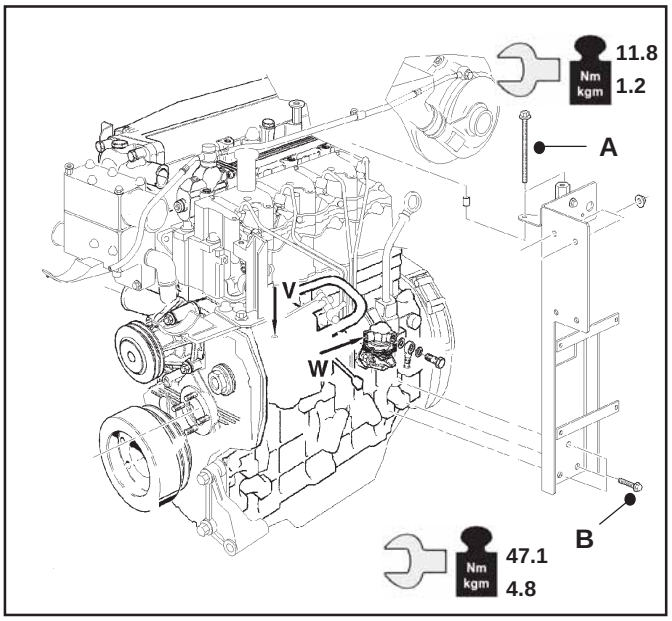
SEA WATER MD704LH/LS

Torque screws **A** and **B** at indicated values.



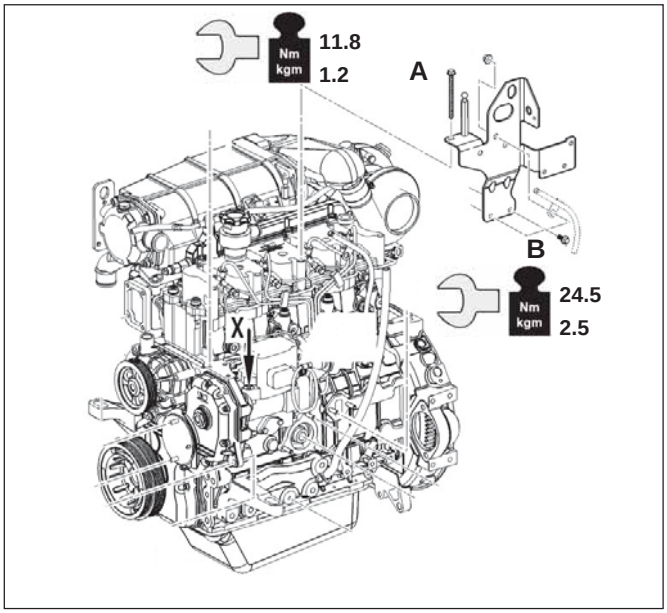
DIESEL FILTER SUPPORT BRACKET AND JUNCTION BOX (MD700)

Fit the bracket and tighten fixing screws **(A)** and **(B)** tightening them to the indicated value.



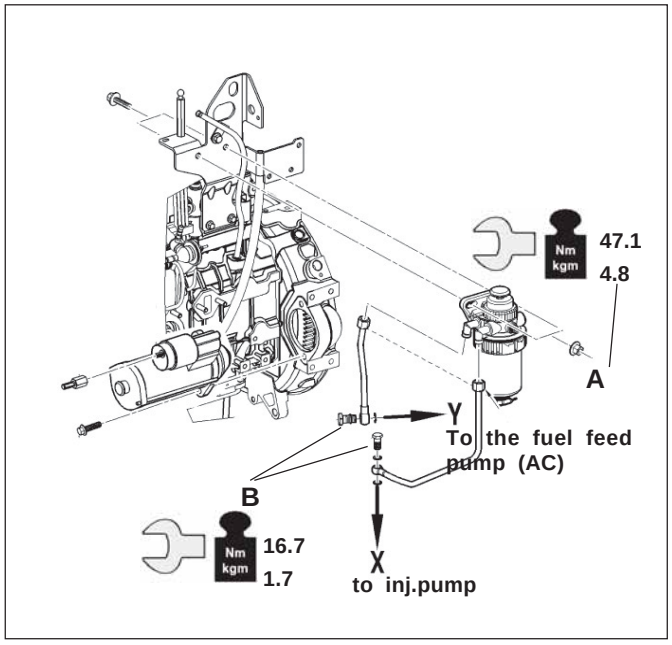
DIESEL FILTER SUPPORT BRACKET AND JUNCTION BOX (MD704LH/LS)

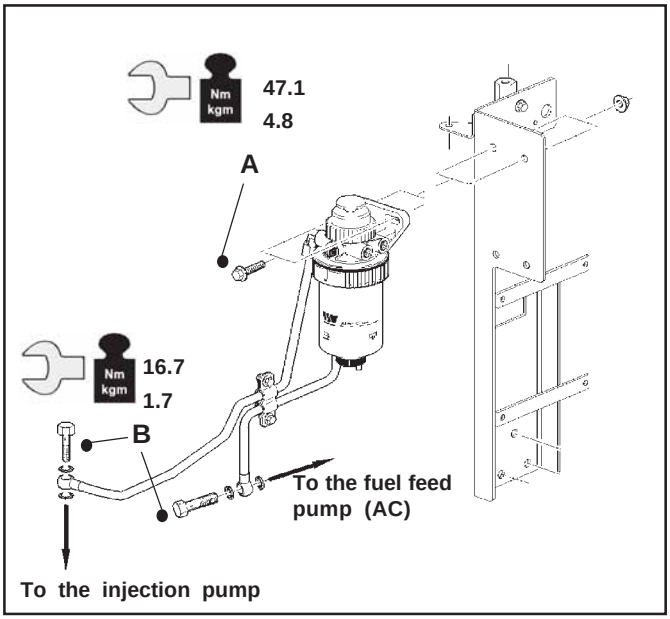
Fit the bracket and tighten fixing screws **(A)** and **(B)** tightening them to the indicated value.



DIESEL FILTER

Fit the diesel filter on the bracket, connect the relevant pipe, tighten fixing screws **(A)** and unions **(B)** to the indicated value.

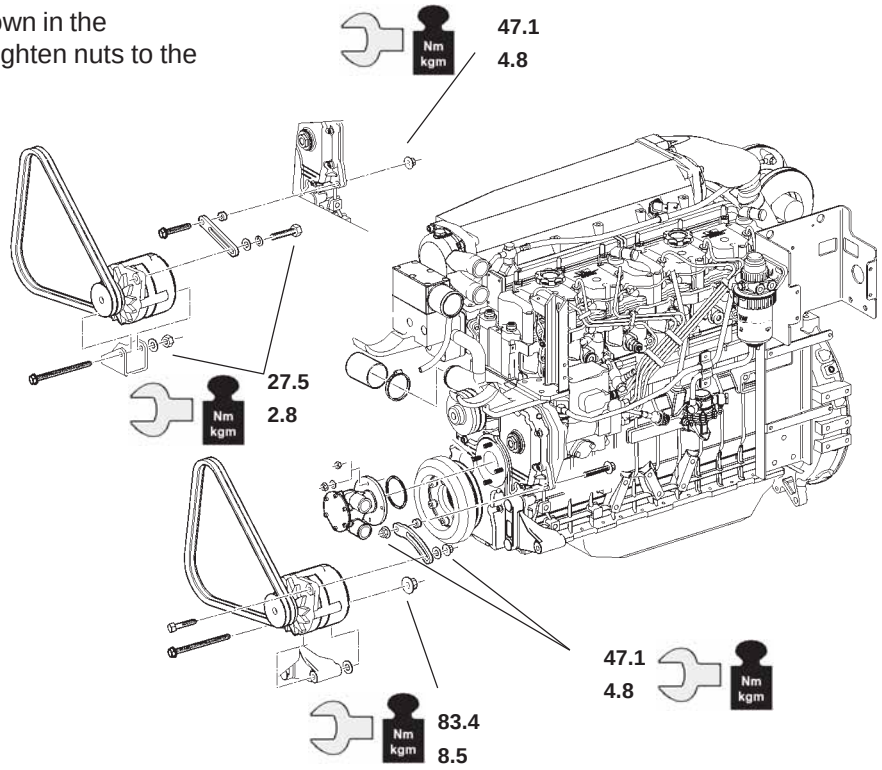




ALTERNATOR - TRAPEZOIDAL BELT SYSTEM (MD700)

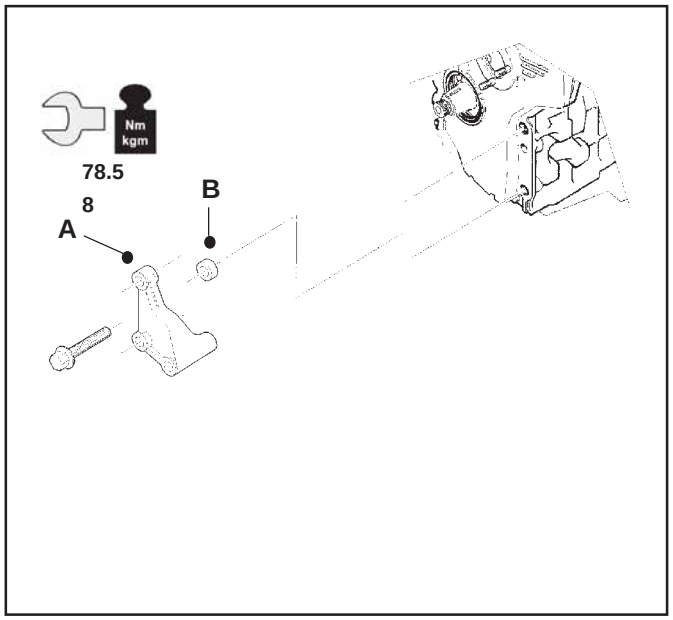
Fit the alternator on the support, insert the fixing screw, fit the tie rod and the relevant screws, fit the

belts supplied, tensioning them as shown in the **chapter 6 "Check and repairs"** and tighten nuts to the values indicated.



ALTERNATOR SUPPORT (MD700)

Insert the fixing screws on the support **(A)**, introduce spacers **(B)** and tighten the screws to the torque indicated in the figure.



ALTERNATOR - POLY-V BELT SYSTEM (MD704LH/LS)

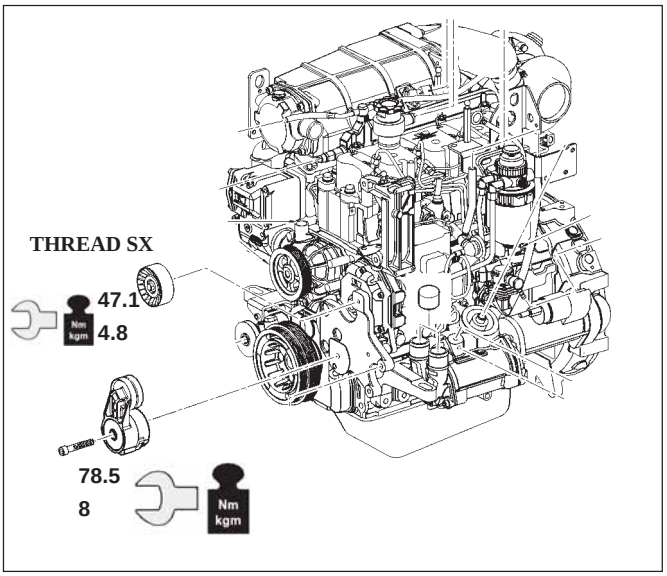
Install alternator bracket **A**.

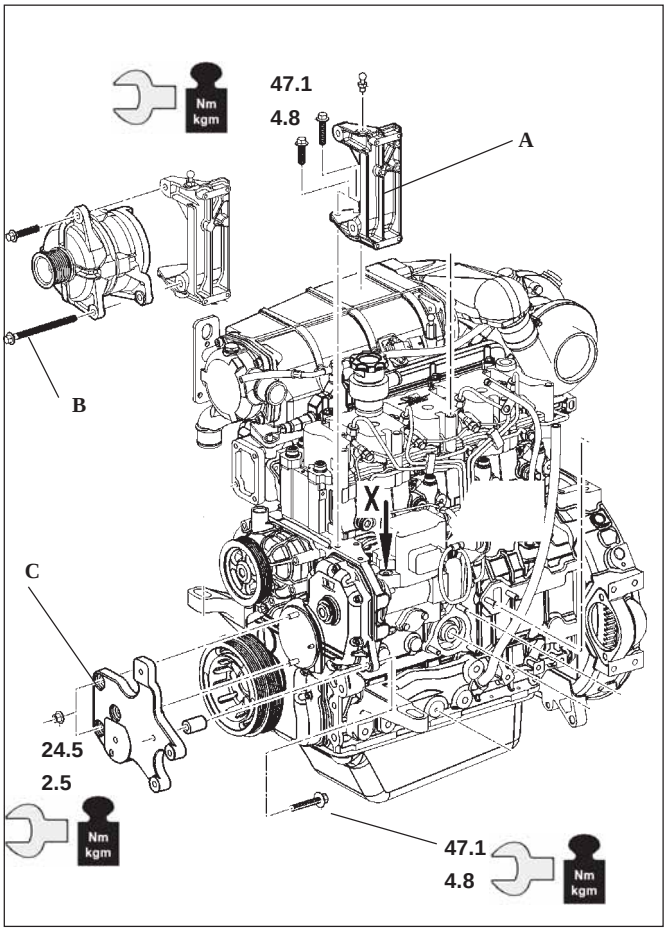
Install alternator and approach screws **B** without tightening .

Install support **C,** tensioner belt and idler pulley at indicated values.

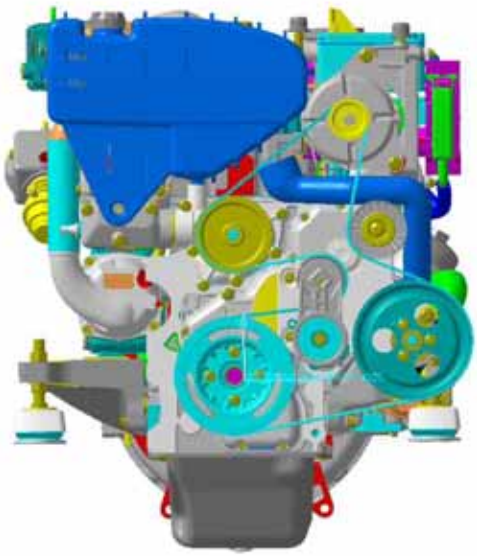
Install complete wiring harness with **D** and tighten alternator screws **B**.

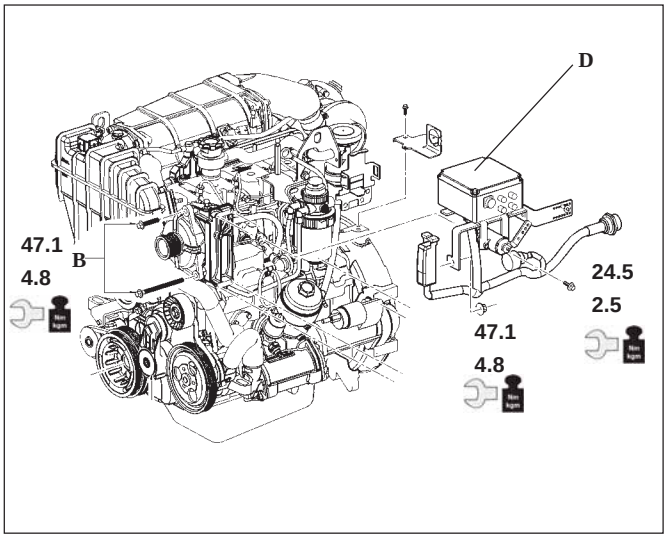
Install poly-V belt looking at the belt diagram here below.





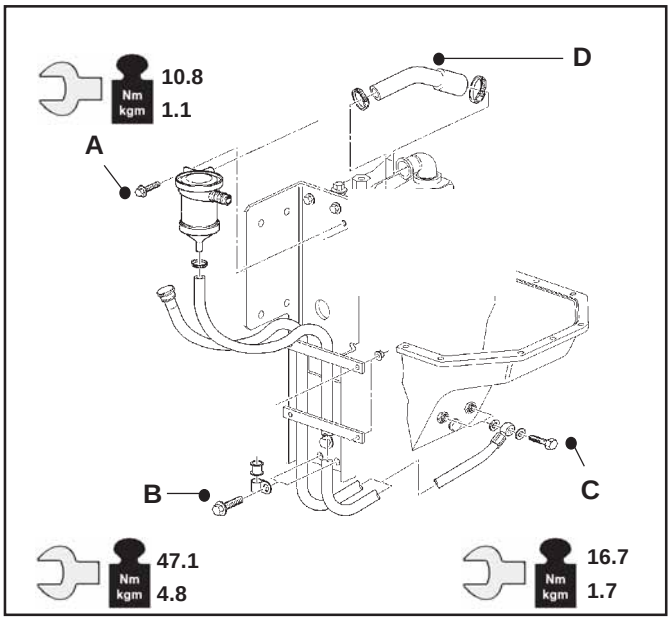
BELT SYSTEM DIAGRAM





OIL SEPARATOR AND RELEVANT PIPE

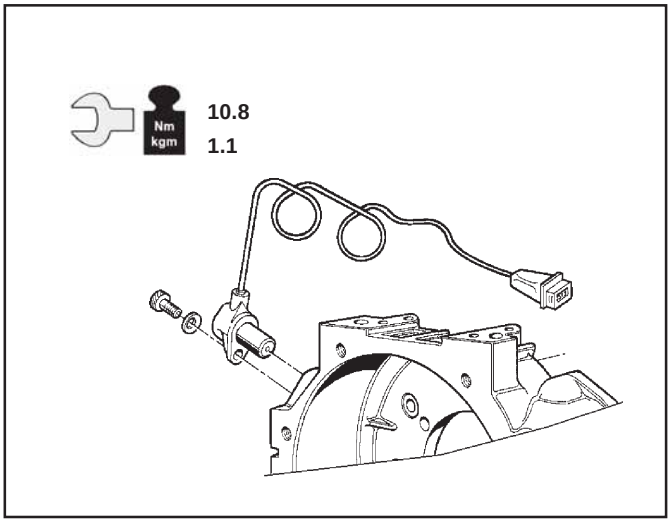
Fix the separator on the bracket using screw **(A)**, connect the pipe of the rocker arms cover **(D)**, tighten the fixing clips and the screw.
Connect the oil drain pipe from the separator to the sump, insert the U-bolt to the bracket with screw **(B)**, insert union **(C)** in the sump and tighten the components to the torque indicated.



TRANSMITTERS AND SENSOR

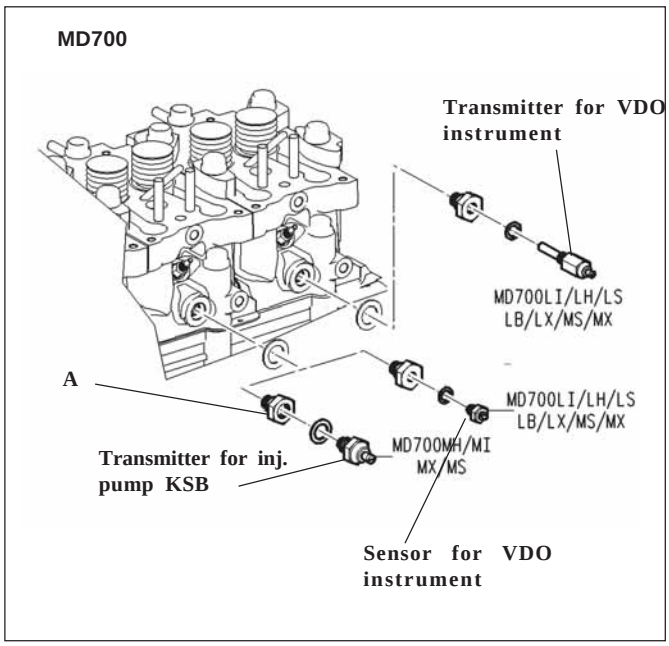
PICK-UP FOR ELECTRONIC POWER PLANT

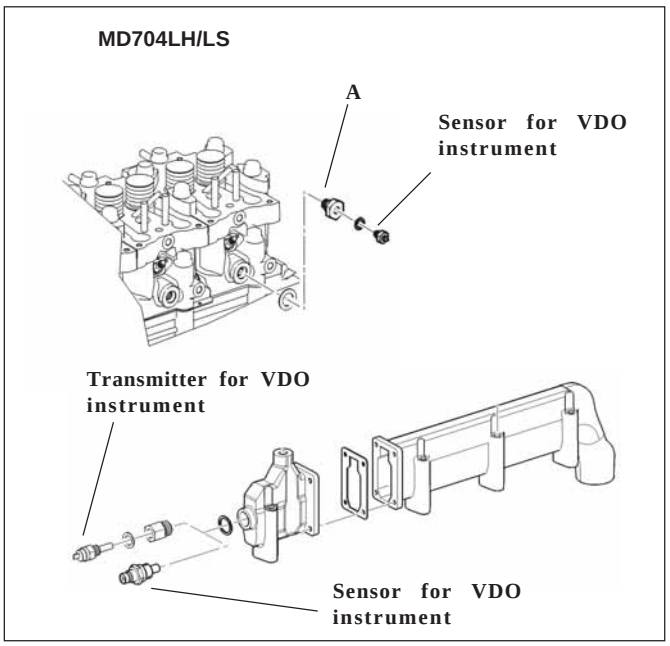
Introduce the PICK-UP in its seat in the flywheel box, introduce the fixing screw and tighten it to the indicated value.



WATER SENSOR AND TRANSMITTER

Install sensors and transmitter **(13.7 Nm - 1.4 kgm)** with loctite 222 and loctite 510 on the union thread **A** **(68.6 Nm - 7 kgm)**.

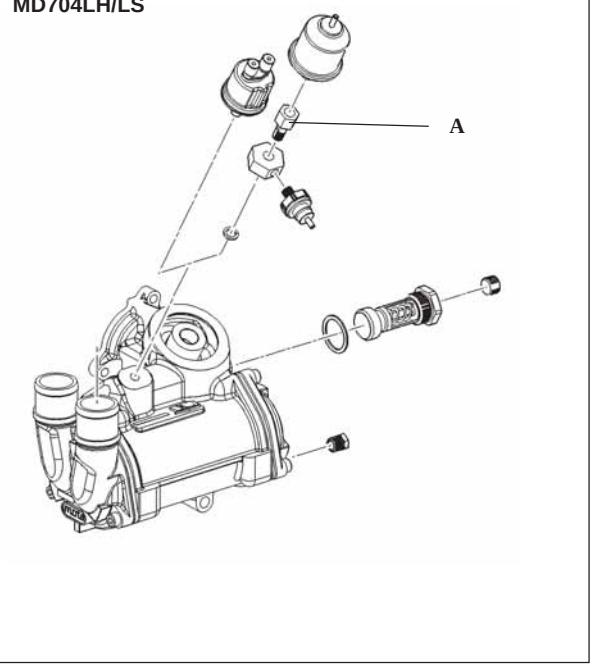




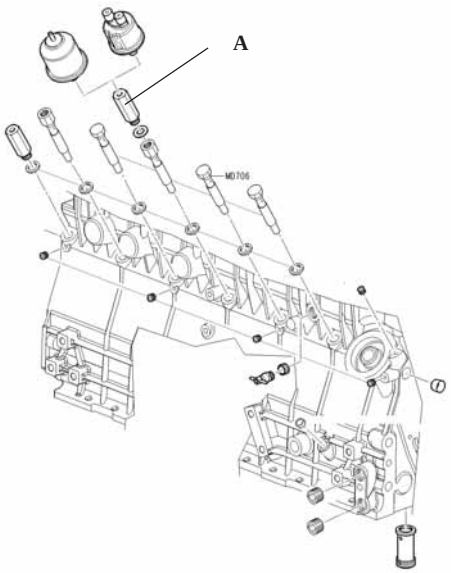
OIL SENSOR AND TRANSMITTER

Install sensors and transmitter **(10.8 Nm - 1.1 kgm)** with liquid teflon and loctite 510 on the union thread **A**.

MD704LH/LS

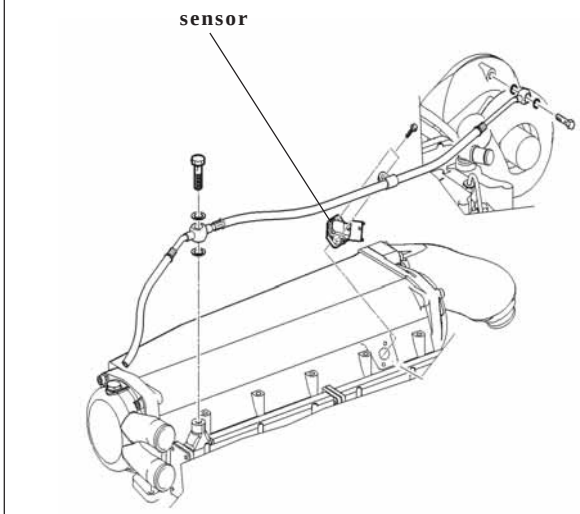


MD700



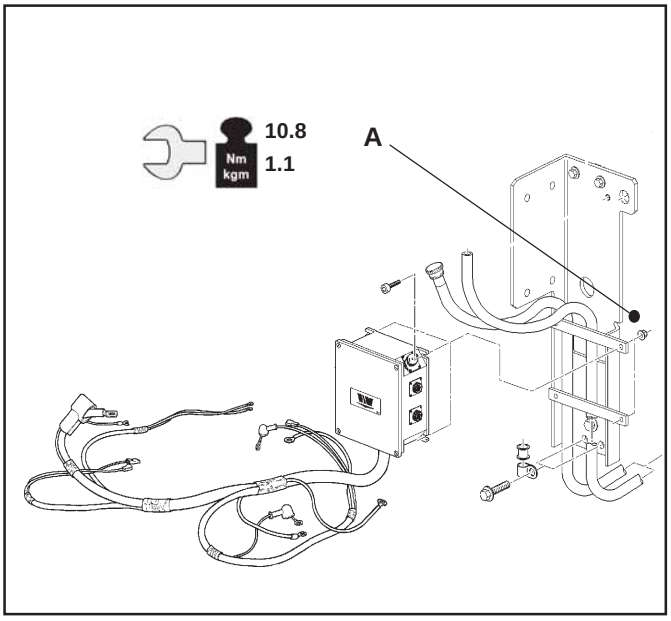
AIR TEMPERATURE AND PRESSURE SENSOR

Install sensors **(5.6 Nm - 0.57 kgm)** lubricating with grease the own seat



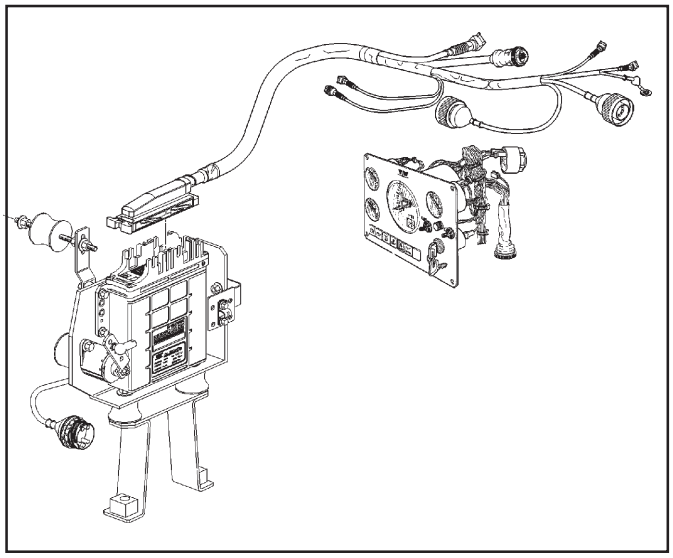
JUNCTION BOX (wiring harness) MD700

Fix the box to the bracket using the fixing screws and tighten them to the indicated value.



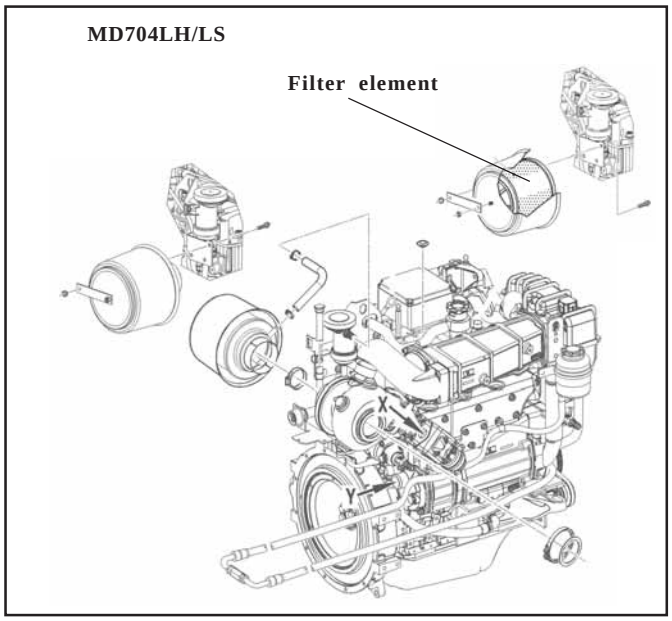
DASHBOARD ELECTRONIC POWER PLANT AND ELECTRONIC CENTRAL UNIT

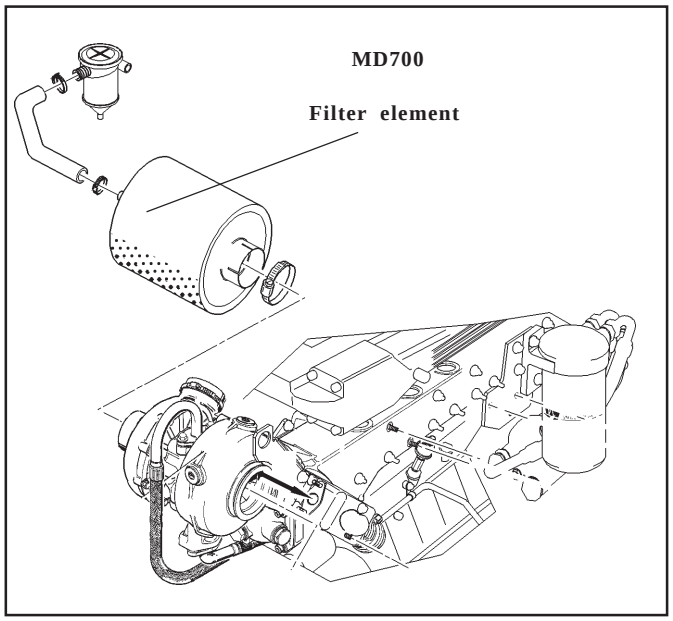
Fix the power plant using an anti-vibration system, to dampen the vibrations.
Torque anti-vibration nuts at **10.8 Nm - 1.1 Kgm.**



AIR FILTER

Fix the filter on the turbo compressor and connect it to the separator, using the fixing clips.



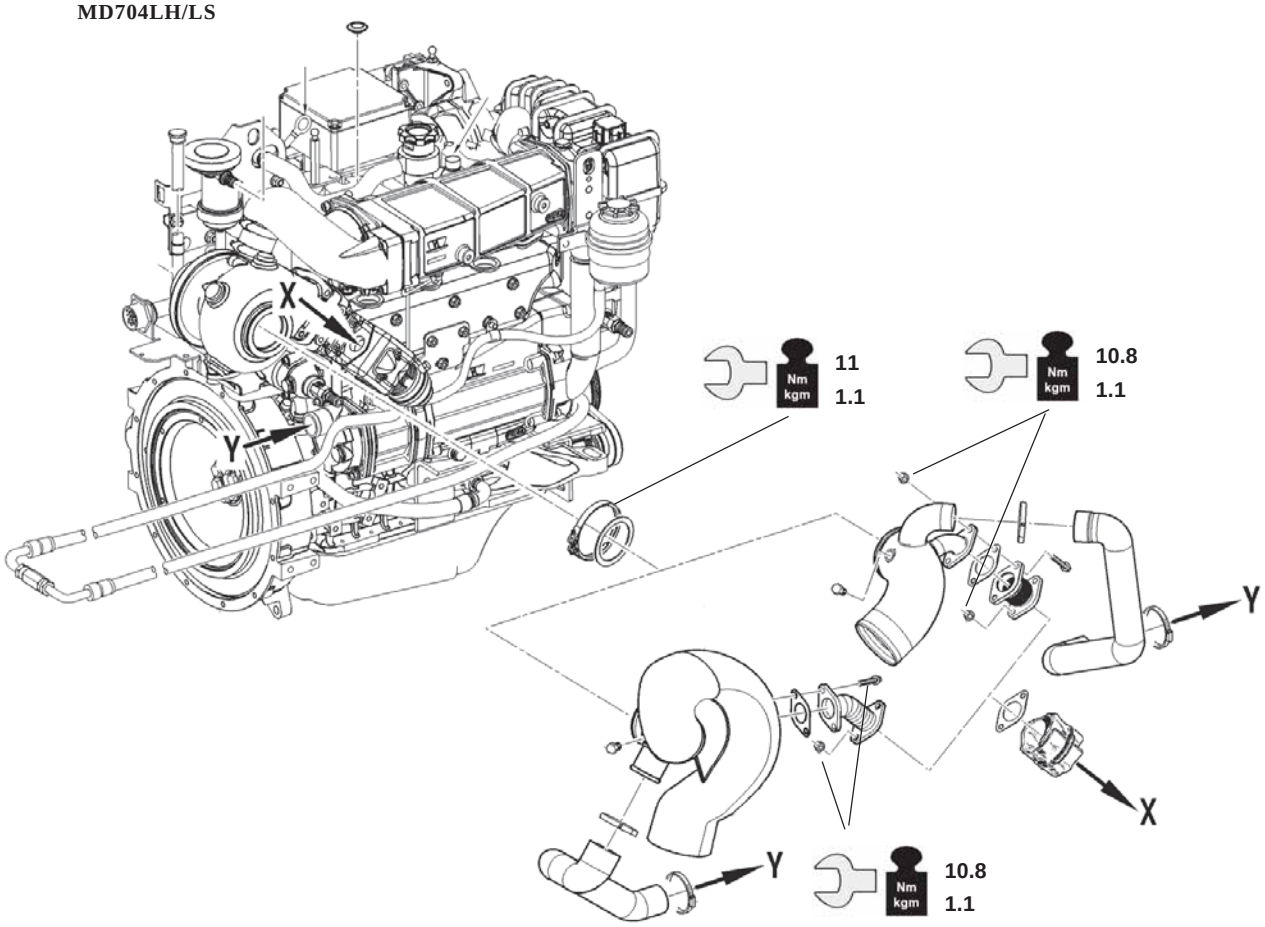


RAISER

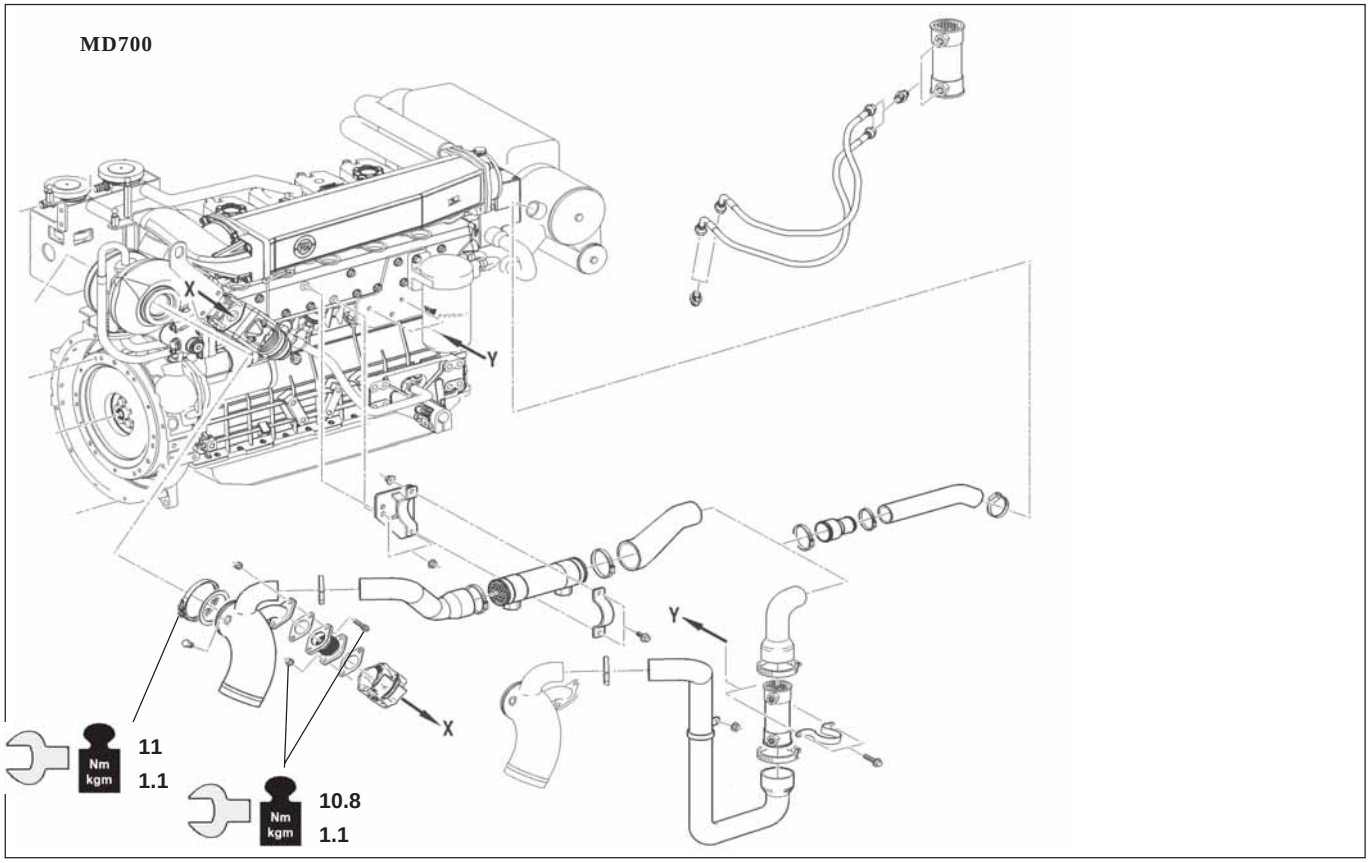
DAMP GAS EXHAUST COUPLING

Fix the coupling to the turbo compressor using the specific blocking clip, without tightening it and the relevant gasket. Insert the coupling connecting the waste gate valve body, inserting the sealing ring and tighten the fixing nuts to the indicated value. At this point you can tighten the fixing clip.

MD704LH/LS

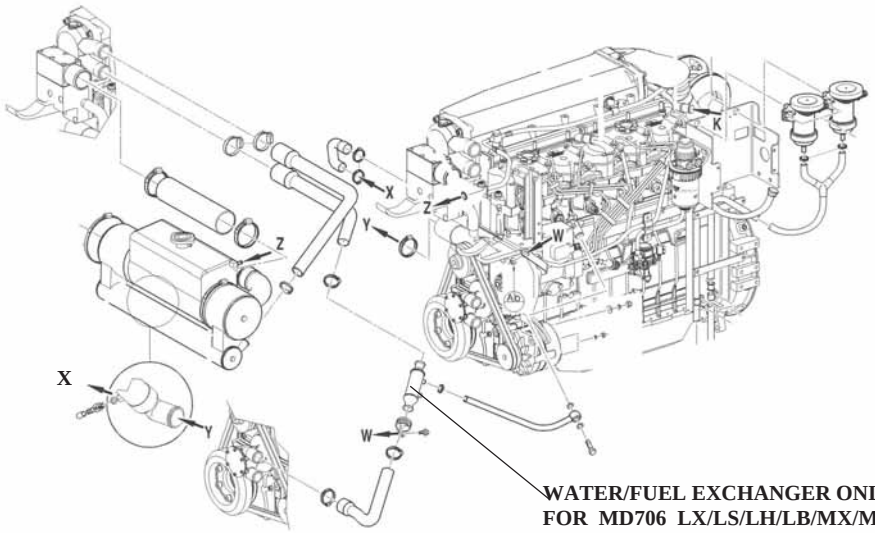


MD700



WATER/WATER - WATER/ENGINE OIL EXCHANGER (MD700)

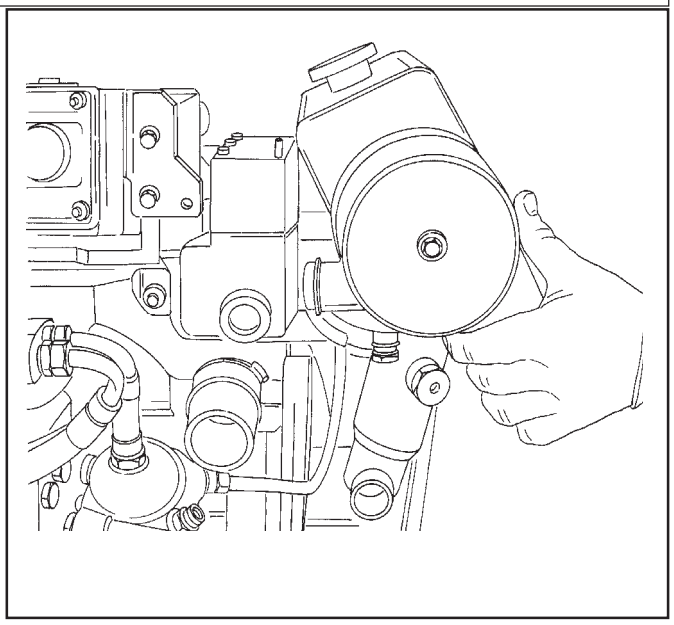
Position the exchanger on the cradles, block it with the relevant clips, connect the various pipes and tighten the fixing clips.



To make the inserting the part easier, we recommend operating as shown in the figure.

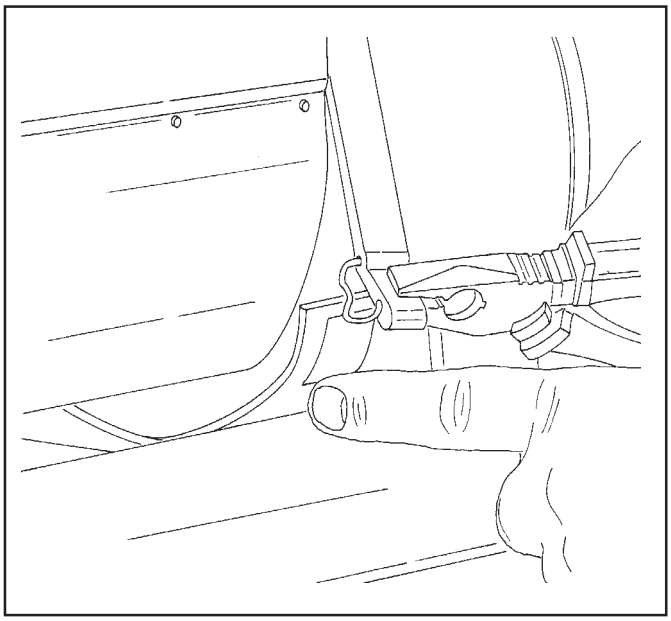
Move up to the supports holding the exchanger

slightly at an angle and then slide it on its cradle supports.



The best way to hook the rubber clips is to block one end and pass them behind the exchanger, then using a pair of pliers, pull them upwards, so they are long

enough to cover the diameter of the exchanger, then let it grip the surfaces and hook it as shown in the picture.



WATER/WATER HEAT EXCHANGER (MD704LH/LS)

Attention: The assembly of exchanger must be carried out after assembling of water thermostat body **6** on exhaust manifold.

Position the exchanger using the bracket **2**.

Approach the exchanger to water thermostat body **6** making care to maintain the exchanger lined up and supplying a light load upward.

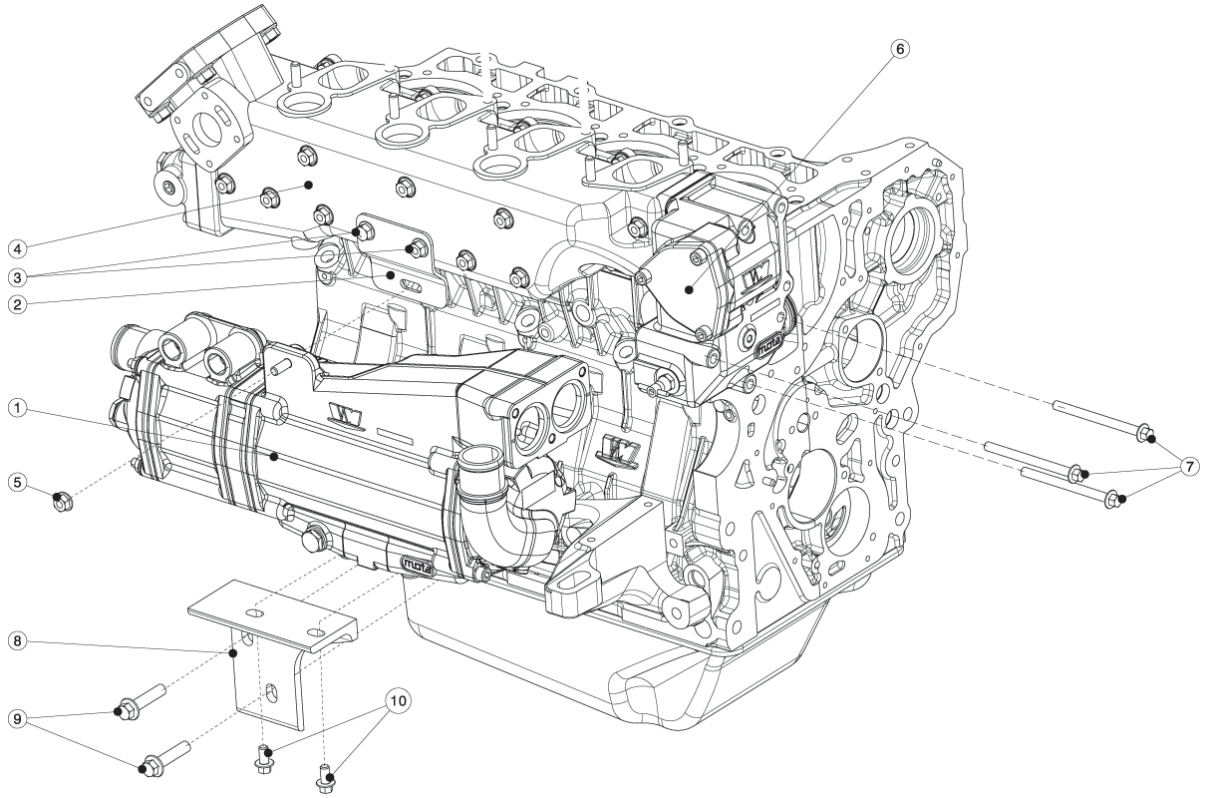
Install nut **5** without tightening.

Torque screws **7** at 24.5 Nm - 2.5 kgm.

Position bracket **8** supplying a light load toward exchanger and torque crews **9** at 86.3 Nm - 8.8 kgm.

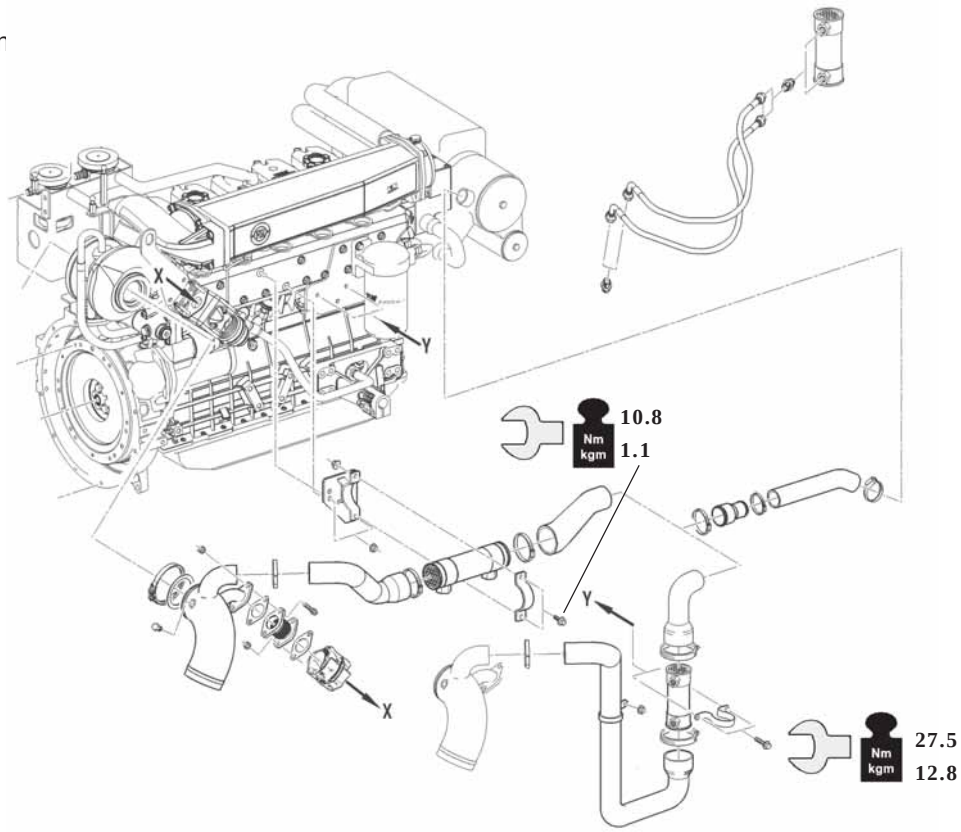
Torque screws **10** at 19.6 Nm - 2 kgm.

Torque nut **5** at 24.5 Nm - 2.5 kgm.



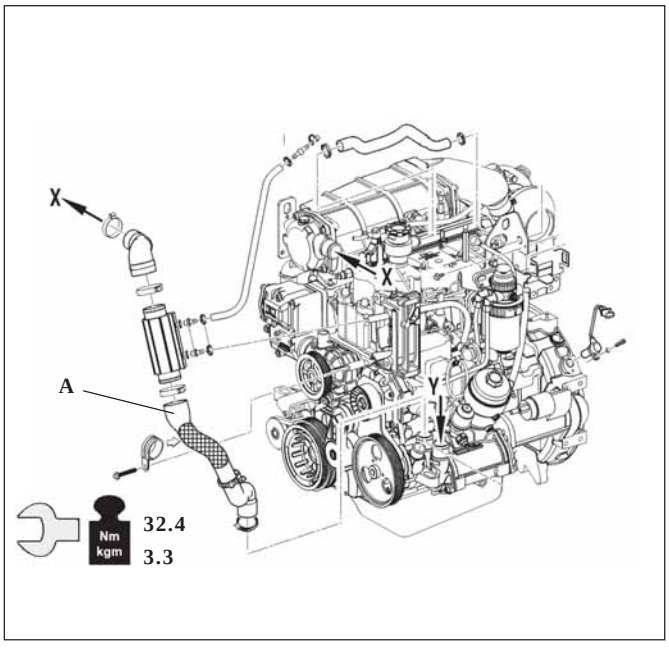
OIL INVERTER EXCHANGER (MD700)

Depending on the application of the exchanger it can be positioned horizontally or vertically, as shown in the figure.
The components that char
and the connecting pipes.



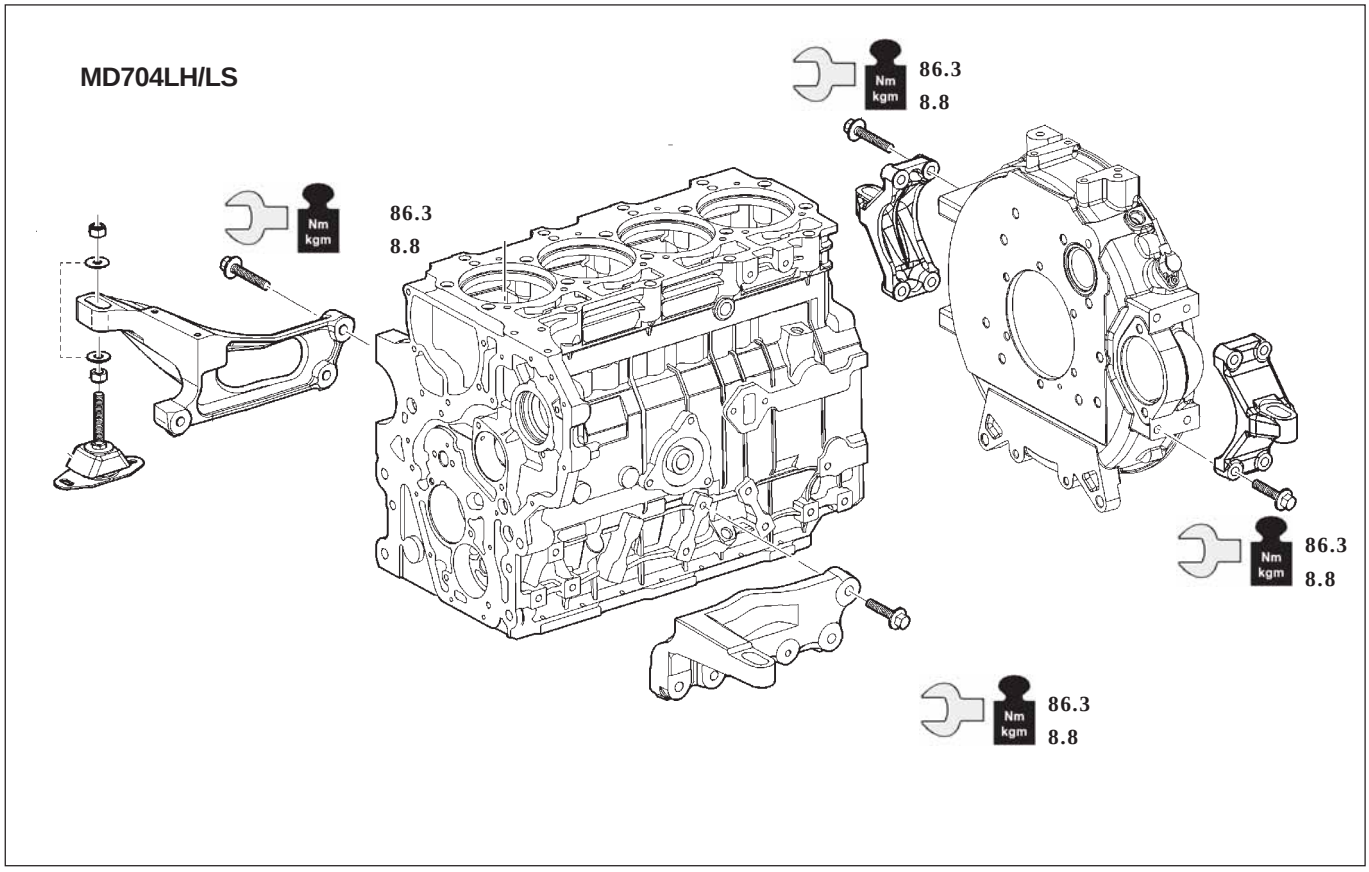
FUEL/WATER EXCHANGER (MD704LH/LS)

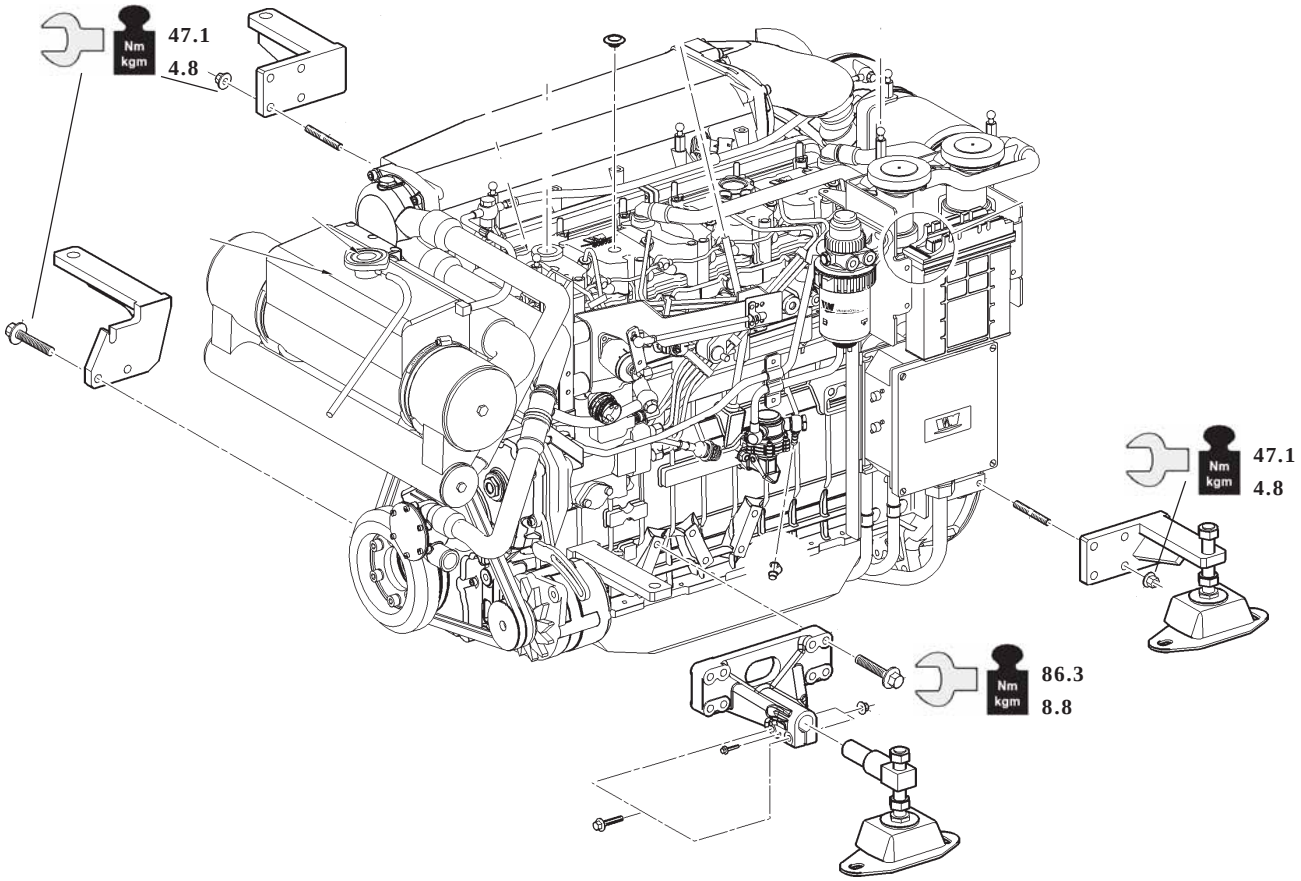
Install pipe **A** making care that it does not touch the system belt.



SUPPORTING BRACKETS

Before assembling the brackets make sure they are not deformed and none of the melds have broken.



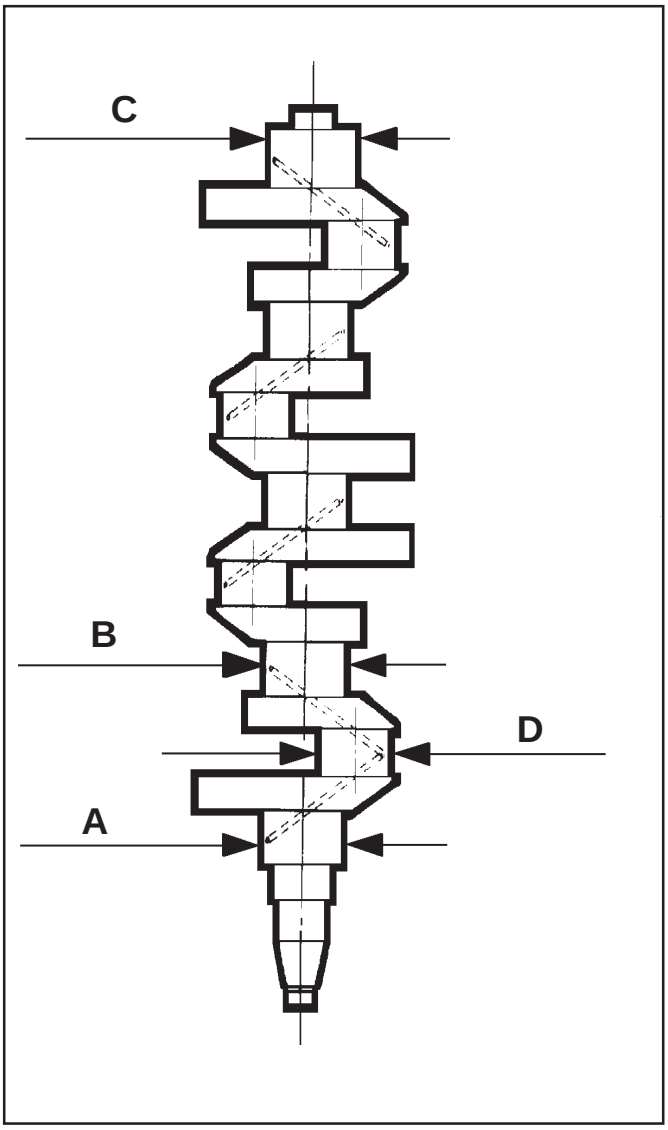


TABLES 8

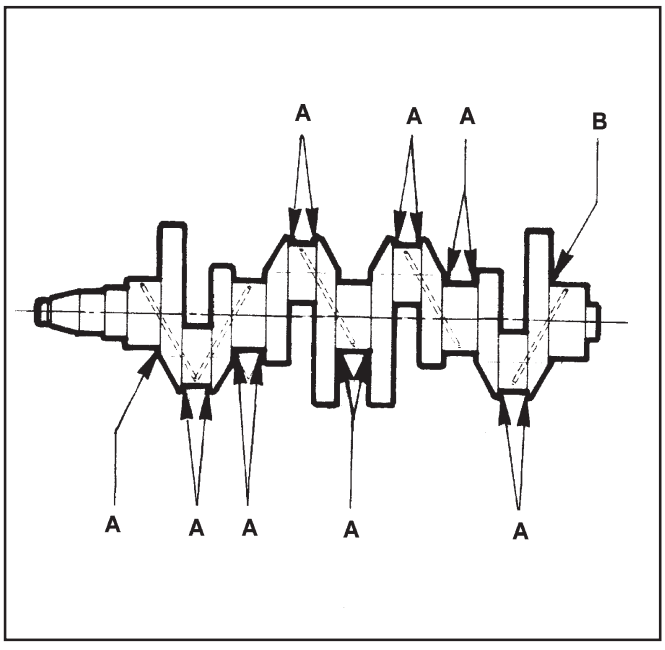
8.2 DIMENSION

8.2.1 Crankshaft

REF.	DESCRIPTION	DIMENSIONS
A	Diameter of front main bearing journal	62.985 ÷ 63.005 mm
B	Diameter of center main bearing journal	63.005 ÷ 63.020 mm
C	Diameter of rear main bearing journal	79.985 ÷ 80.000 mm
	Conicity of rear main bearing journal	0.015 ÷ 0.030 mm
D	Diameter of crankpin con rod	53.955 ÷ 53.940 mm
	Undersizer: **A-B-C-D**	0.250 mm
A-B-C	Roughness	0.22 µm
D	Roughness	0.18 µm

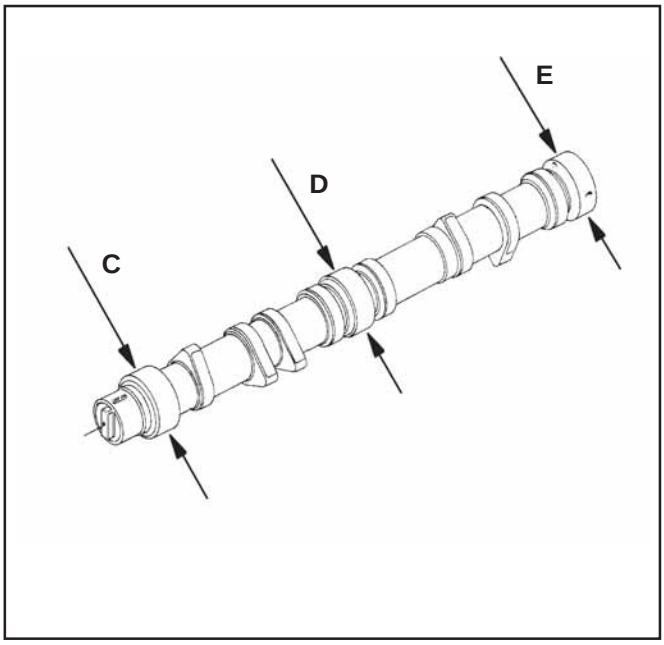


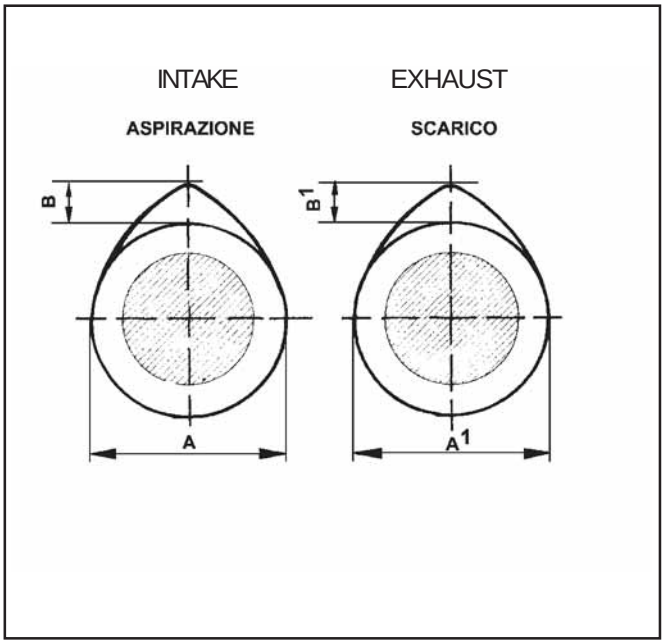
REF.	DESCRIPTION	DIMENSIONS
A	Radius	R = 3 0 /- 0.3 mm
B	Radius	R = 2.5 +/- 0.15 mm



8.2.2 Camshaft

REF.	DESCRIPTION	DIMENSION
A	Diameter inlet	39.450 ÷ 39.550 mm
A1	Diameter exaust	38.550 ÷ 38.650 mm
B	Lift inlet	6.850 mm
B1	Lift exaust	7.303 mm
C	Diameter front main journal	53.495 ÷ 53.510 mm
D	Diameter central main journal	53.450 ÷ 53.470 mm
E	Diameter rear main journal	53.480 ÷ 53.500 mm
	Undersizer **C-D-E**	0.250 mm
C-D-E	Roughness	0.8 µm





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RUNNING TESTS AND ADJUSTMENTS 9

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RUNNING TESTS AND ADJUSTMENTS

The instructions in the following chapter “Running tests and adjustments” apply to MD 700 series engines.

FILLING THE COOLING CIRCUIT

Fill the circuit from the coolant cap **(A)** with a mixture including 50 % fresh demineralised water and 50 % antioxidant antifreeze (inibited ethilene glicol) that meets the ASTM D 3306 requirements (available from specialized sales outlets).

CIRCUIT CAPACITY

MD 704: 13 Litri

MD 706: 13.8 Litri

WARNING: TAKE CARE WHEN HANDLING ANTIOXIDANT ANTIFREEZE AVOID CONTACT WITH EYES AND SKIN.

WARNING:
DO NOT INGEST ANY OF THE LIQUIDS USED IN THE ENGINE.

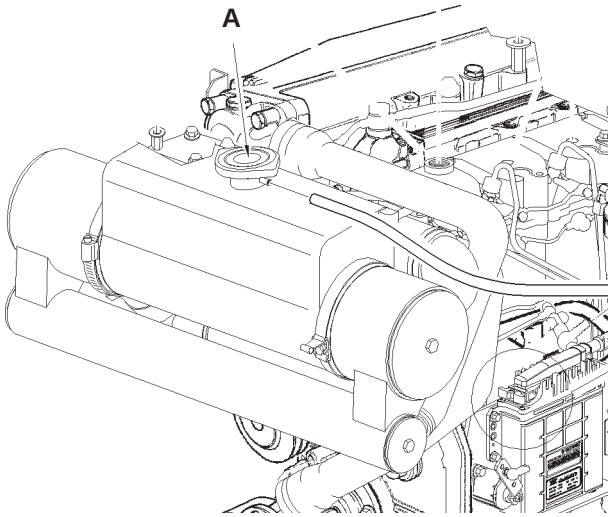
Run the engine for a few minutes until all parts of the system are full of coolant and free from air bubbles.

Check the level and top up if necessary.

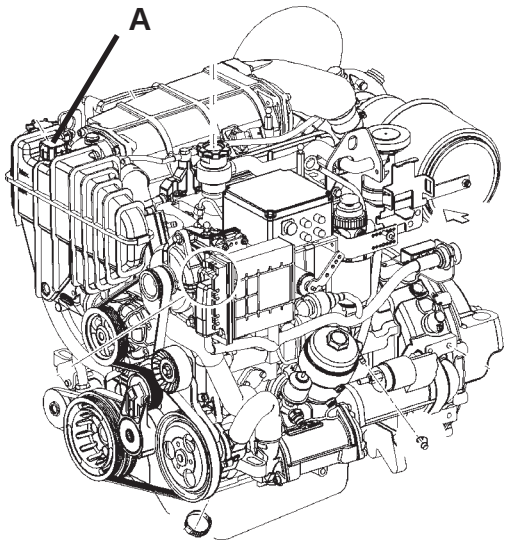
WARNING:
THE COOLANT LEVEL MUST BE CHECKED OUT EVERY DAY AND IF NECESSARY IT MUST BE TOPPED UP WITH IDENTICAL MIXTURE.
AVOID TO REFILL WITH DIFFERENT REFRIGERANT MIXTURE DIFFERENT FROM THE ONE WHICH IS ALREADY IN THE CIRCUIT.
THE COOLANT MIXTURE MUST BE TOTALLY DRAINED AND REPLACED AT LEAST EVERY 24 MONTHS.

WARNING:
THE USE OF A COOLANT WHICH DOES NOT COMPLY WITH THE ABOVE SPECIFICATIONS COULD CAUSE DAMAGE TO ENGINE COMPONENTS AND WILL INVALIDATE THE WARRANTY.

MD700



MD704LH/LS



FILLING WITH OIL

When delivered the engine is supplied complete with motor oil according to the quantities and specifications established by VM Motori.

Use oil that corresponds to the technical specifications in **chapter 3 "Maintenance"** .

Fill with oil through the filler hole on the top cover (**A**)

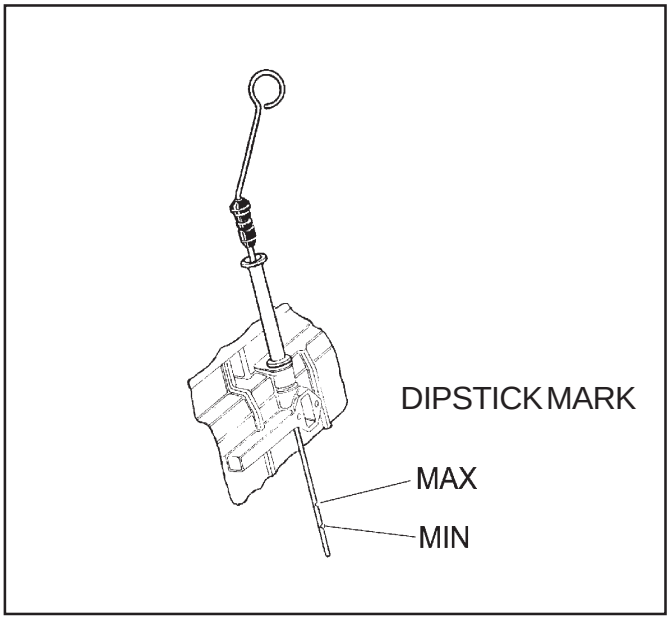
Pour in oil until it reaches the upper notch on the dipstick.

OIL CHANGE (WITH OIL FILTER)

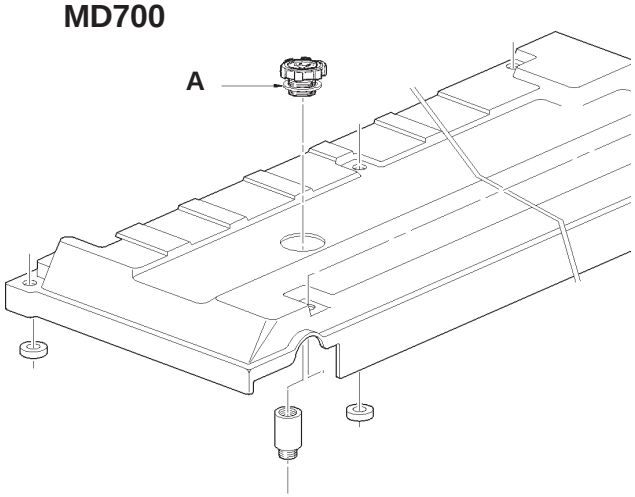
MD 704LI/LH/LS	6.8 kg - 8 l
MD 706	11 kg - 12.7 l

OIL PAN CAPACITY, DIPSTICK MARK

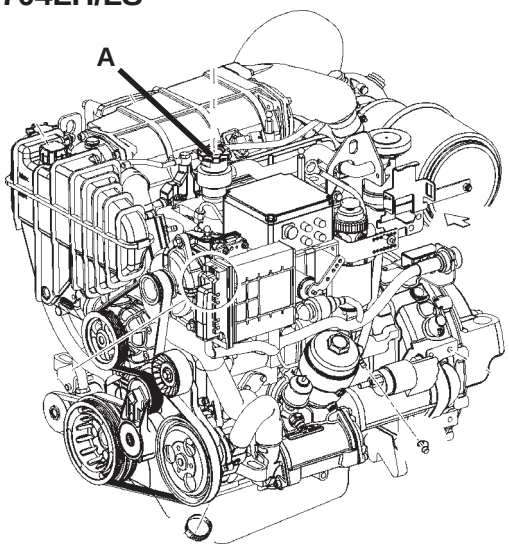
MD704	4.8 kg - 5.6 l (MIN) - 6.2 kg - 7.3 l (MAX)
MD706	7.7 kg - 9 l (MIN) - 10.5 kg - 12.3 l (MAX)



MD700



MD704LH/LS



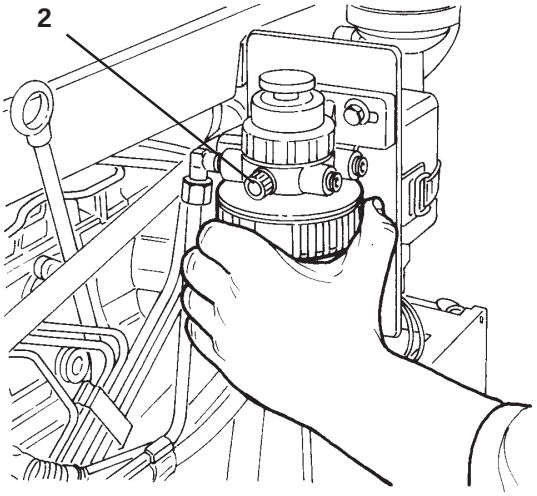
BLEEDING AIR FROM THE FUEL SYSTEM

- Before bleeding, loosen bleed screw **(2)** on the filter holder.
- Bleed the fuel filter by hand with lever **(1)** until you obtain a continuous flow of fuel from the screw.
- Tighten bleed screw.
- The injection pump is self-bleeding.
- Fully loosen the fittings of the delivery pipes to the injectors.
- Turn the engine with the starter motor until diesel comes out of the delivery pipes of the injectors, the flow mustn't have any traces of residual air.
- Tighten the fittings and start the engine.

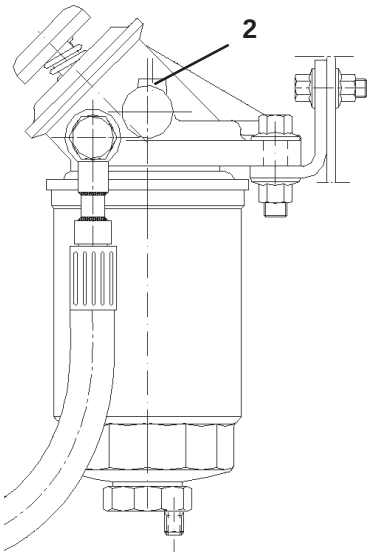
WEAR SAFETY GOGGLES TO PROTECT AGAINST RISK OF FUEL SPRAYING OUT UNDER PRESSURE.

WEAR GLOVES TO PROTECT SKIN FROM CONTACT WITH FUEL.

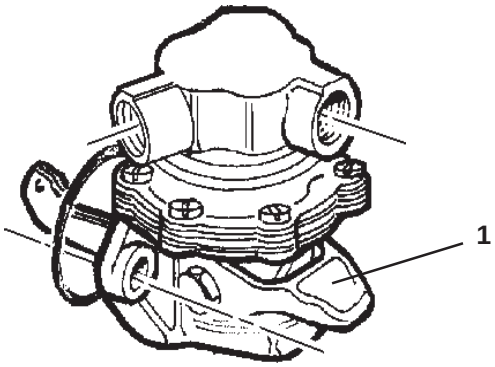
You will have to bleed the circuit:
- the first time you start the engine
- after the engine has been inactive for a long time.
- after dismantling the pipes, filters and injection pump.
- after replacing the fuel filter cartridge.



STANADYNE



BOSCH



IDLE RUNNING TEST

All adjustments are to be made with the engine hot and with the aid of a tachometer.

- Run the engine at low speed to warm it up to normal operating temperature.
- Connect a 1000 kPa (10 bar) pressure gauge to the last main bearing carrier oil line on the crankcase and check the oil pressure while the engine is running, for pressue value to see **chapter 2 "Technical specifications"**
- Check for possible oil or water leaks, abnormal noise or vibration.
- Check the electrical system.

RUNNING-IN

After replacing parts requiring running-in or after a full engine overhaul, do not exceed 70% of the maximum power rating for the first operating hours.

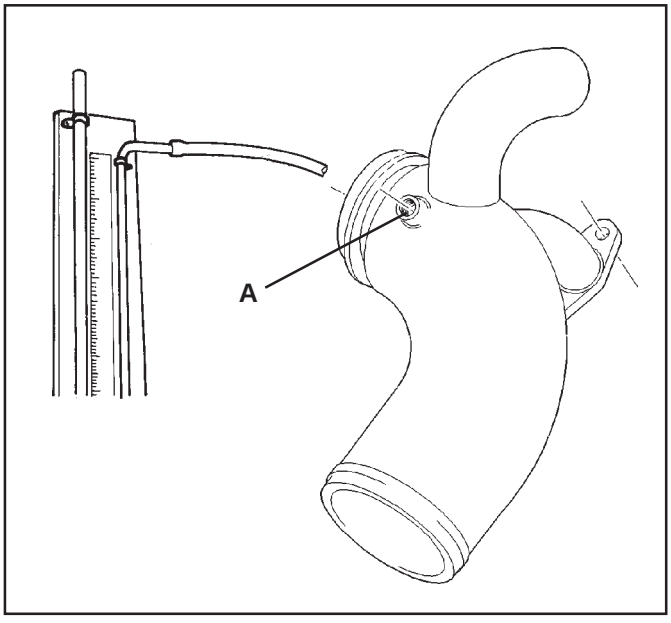
THE LONGER THE INITIAL RUNNING-IN PERIOD WITH REDUCED LOADS, THE LONGER THE WORKING LIFETIME OF THE VARIOUS PARTS OF THE ENGINE WITH CONSEQUENT SAVINGS IN TERMS OF MAINTENANCE AND RUNNING COSTS.

EXHAUST BACK PRESSURE

Attach a liquid U-tube pressure gauge to the exhaust in the point (**A**), to put the engine at max rpm and to note the back pressure value.

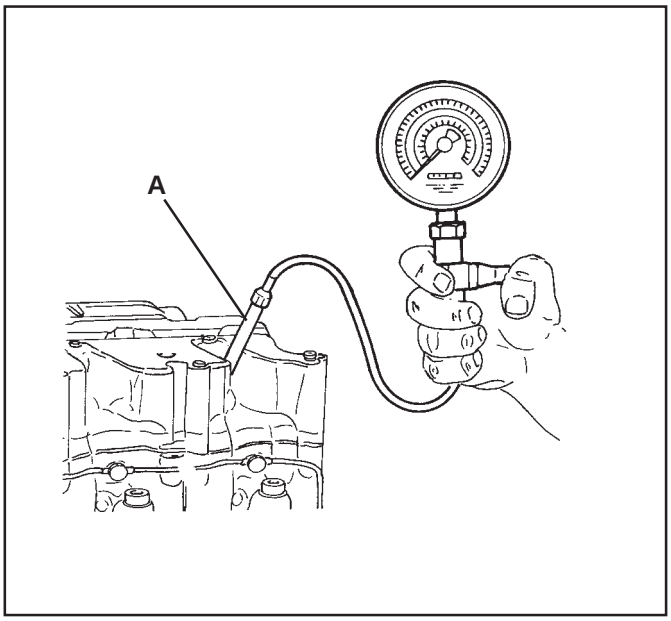
The max back pressure value must not be over 250 mbar (MD704) - 270 mbar (MD706).

If the back pressure is over check the exhaust pipe or muffler.



COMPRESSION TEST

Check the pressure developed in each cylinder. Insufficient compression will cause power loss, increased fuel and oil consumption, exhaust fumes, difficult starting and partial seizure.



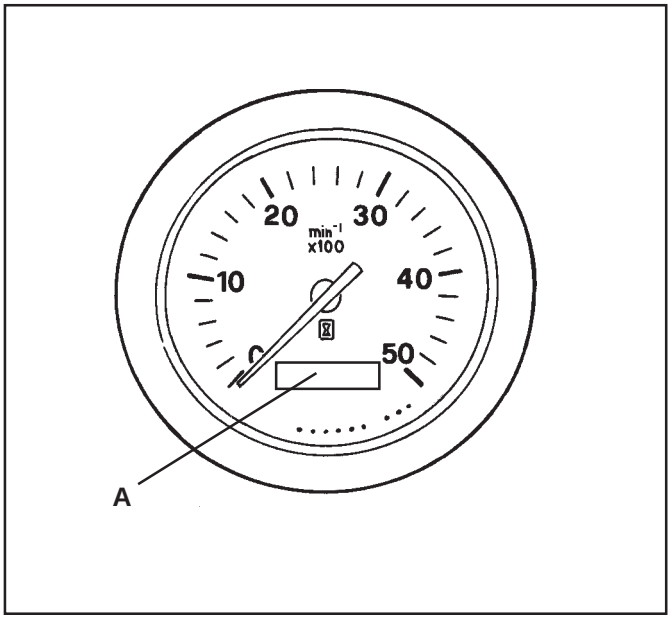
Test procedure

- To take away all the injctors.
- Clean the injector seat and install the compression tester (**A**) **(tab.11.1 ref. W).**
- Zeroset the dial and crank the engine with the starter motor .
- Repeat the operation with the other pistons.
- Check the battery conditions.

  During the test the battery must be in the optimal condition, because in different case there are several possibility to do a wrong test.
- If low readings are obtained or if the difference among different cylinders exceeds **500** kPa (5 bar)(72.5 psi), check piston rings, valves, cylinder liners and pistons.

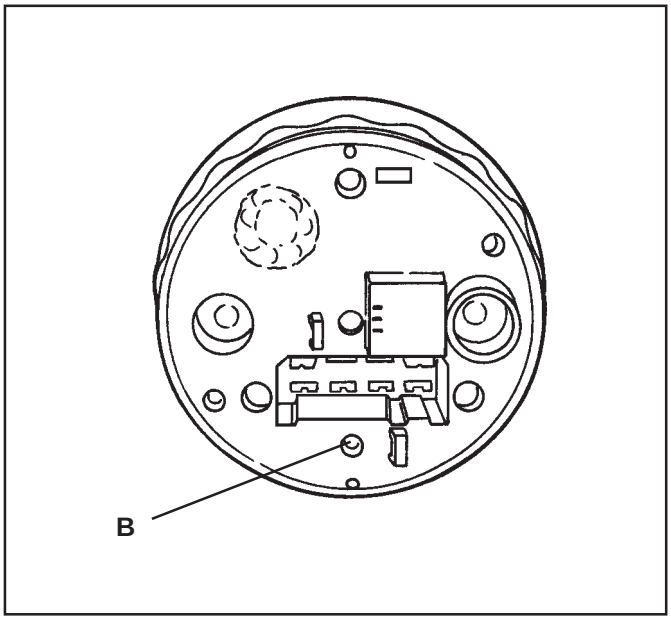
CALIBRATING THE REV/HOUR COUNTER

To calibrate the rev/hour counter correctly, there are two functions: **"PULSE"** and **"ADJUST"** visible and controlled from the display **(A)** .
To enable the first function, turn the power to the board off, press and hold down the button on the back of instrument **(B)** and turn the power on.
At this point the display of the instrument shows the text **"PULSE"** and **"ADJUST"** flashing every 2 seconds.
Release the button when the function **"PULSE"** appears.



ADJUSTING THE FUNCTION "PULSE" WITH THE engine off

After having selected this function, the letter "P" appears on the display (after 3 seconds), followed by three numbers, a comma and another two numbers ex.: (P012,50), when the first number on the right starts blinking slowly, don't do anything, simply wait for the second number to change. At this point press the button to change the number from 5 to 0, wait for the third number to change and set the number 3, the remaining figures and letter don't need changing, the final value will be **(P013,00)**, wait for the operation to finish when the hour counter appears.
At this point you can start the engine.

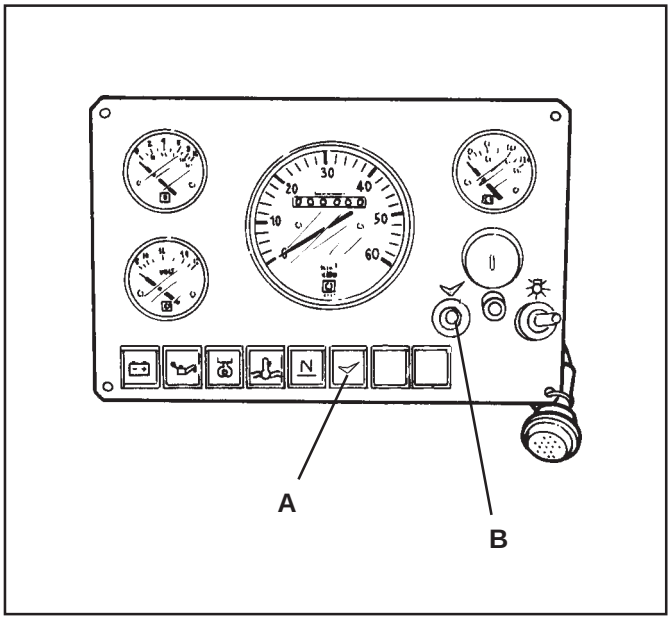


FINE ADJUSTMENT OF THE REV COUNTER "ADJUST" WITH THE ENGINE RUNNING

Run the engine at a certain speed and measure the value of the engine speed in rpm with a precision manual rev counter.
Pressing the rear button choose the "ADJUST" function, at this point the display shows the text "UP" and "DN" alternatively.
With the text "UP" you increase the engine rpm, with the text "DN" you decrease the engine rpm.
To correct the setting, simply hold the button of one of the two configurations down and the rpm changes.
To pass from one condition to another simply release the button and then press it again.
Act in this way until the engine speed and the engine rpm on the precision rev counter are the same.

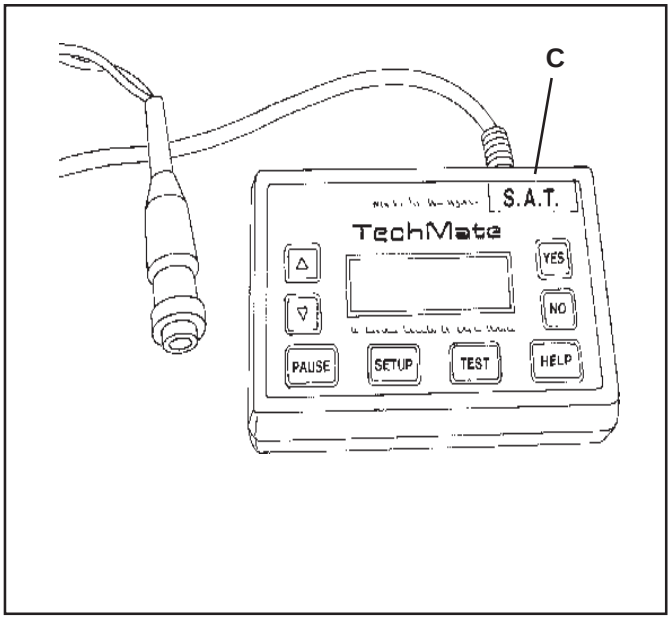
TROUBLE-SHOOTING PROCEDURE

The motors in the (**LI/LH/LX/LB/LS**) family have a system for the self-diagnosis of faults.
Some versions have a check light on the dashboard **(A)** which gives information regarding the type of fault by way of the flashing of a code, as described below.
For motors without the check light on the dashboard, faults can be diagnosed via the application of a device called (BLINK CODE), which provides the same function. This device can be purchased from the spare parts department at VM MOTORI.
In all circumstances, use of the **(C)** (RINDA TOOL) device, is required to delete the code of the fault found; we recommend contacting an authorised garage for this.



INTERPRETING FAULTS USING THE CHECK LIGHT or (BLINK CODE)

Start the BLINK CODE diagnosis procedure as follows:
-Turn the instrument panel on
-Press button **(B)** for at least 3 seconds and then release it. The light will start flashing.
-The diagnosis procedure starts with a flash lasting 2.5 seconds, preceded and followed by an equally long pause.
-Each diagnosis code is made up of groups of 4 short flashes, and each one represents a digit in the code.For each individual digit in the code, the light will remain on for 0.5 seconds and off for the same amount of time. There is a 2.5 second pause between the individual digits in the code.
-This code will continue to be displayed until a new request for diagnosis is made by pressing the button again for more than 3 seconds.



EXAMPLE:

If no faults are found, the code displayed is 4 4 4 4, and this will be shown as follows:
2.5-second pause
2.5-second flash (acceptance of diagnosis)
2.5-second pause
4 times 0.5-second flashes with 0.5-second pauses between them (1st digit in the code)
2.5 second pause
4 times 0.5-second flashes with 0.5-second pauses between them (2nd digit in the code)
2.5 second pause
4 times 0.5-second flashes with 0.5-second pauses between them (3rd digit in the code)
2.5 second pause
4 times 0.5-second flashes with 0.5-second pauses between them (4th digit in the code)
2.5 second pause
long 2.5-second flash (end of code)
The code will now be repeated until a new request for diagnosis is made.

ADDITIONAL EXAMPLE:

CODE 1213

will be shown as follows:
2.5 second pause
2.5-second flash (acceptance of diagnosis)
2.5-second pause
A single 2.5-second flash (1st digit in the code)
2.5-second pause
2 times 0.5-second-flashes with 0.5-second pauses between them (2nd digit in the code)
2.5-second pause
A single 2.5-second flash (3rd digit in the code)
2.5-second pause
3 times 0.5-second-flashes with 0.5-second pauses between them (4nd digit in the code)
2.5-second pause
long 2.5-second flash (end of code)
The code will now be repeated until a new request for diagnosis is made.
Continue to interrogate the BLINK CODE device until the code 0000 is displayed.
When all the codes relative to memory faults have been displayed, the code 0000 will appear on the display as follows:
2.5-second pause
2.5-second flash
2.5-second pause
2.5-second flash
2.5-second pause
The sequence will now continue until a new request for diagnosis is made.

DELETING MEMORY ERRORS (requires use of the (RINDA TOOL) device), refer to its operating instructions for details on how to use it, as follows.

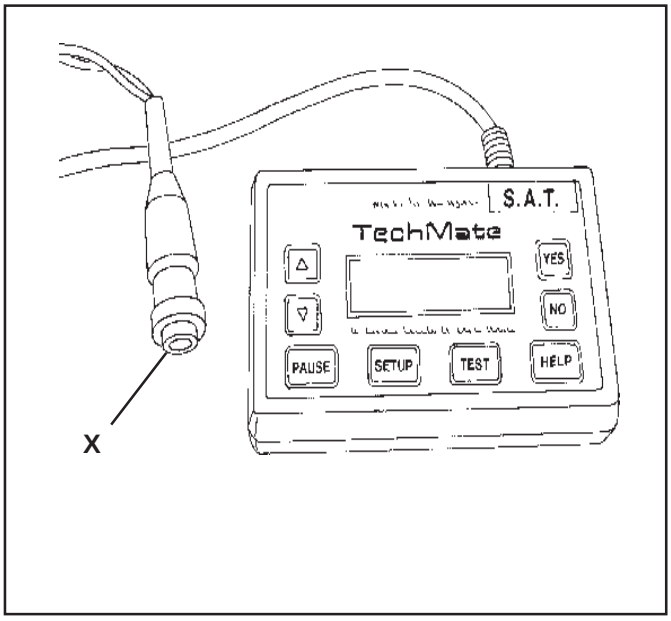
PRACTICAL SUGGESTIONS

We recommend proceeding as follows every time the BLINK CODE device is used:
- interrogate the control unit to check if there are any errors in the memory.
- delete the memory errors
- use the motor for at least 10 minutes to be sure that any errors have been stored in the memory
- repeat the interrogation of the control unit for confirmation of the previously memorised errors.

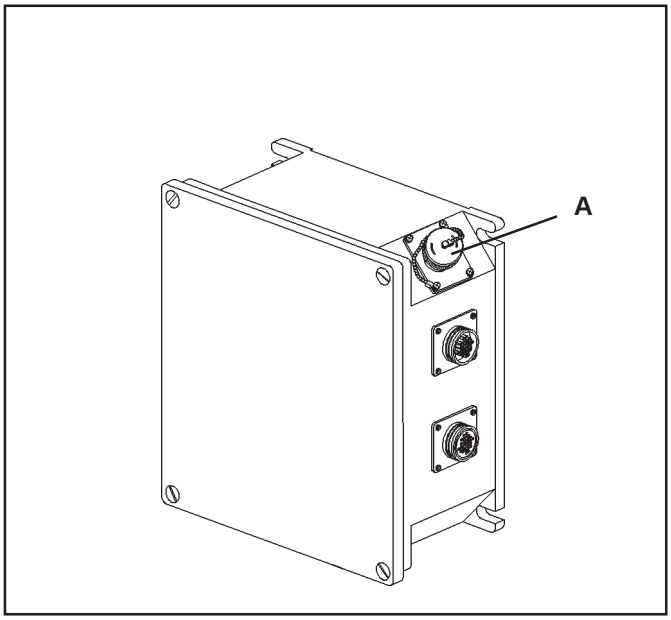
ABBREV.	DESCRIPTION	CODE
DZG	Motor rev's sensor	1131
SEK	Motor rev's read by tooled injector	3332
UBT	Battery voltage too high above 20 V.	1233
NBF	tooled injector	1132
PWG	Accelerator potentiometer	1144
WTF	Water temperature sensor	1113
LTF	Air temperature sensor in the intake manifold	1112
KTF	Diesel temperature sensor	3333
LDF	Booster air sensor	2222
ADF	Atmospheric pressure sensor	1121
URF	Reference voltage	1234
RUC	Micro processor in control unit	1311
MVS	Lead actuator	1214
DIA	Diagnosis light	1242
GAZ	Preheating light / Diagnosis light	1411
EAB	Electrostop / ELAB	1221
EEP	Control unit eprom	1313
HRL	Main cable relay	1231
MES	Diesel flow injection pump actuator	1223
STB	Diesel flow injection pump adjustment	1312
K15	Sub-key control (+ 12 V.)	1232
HDK	Injection pump potentiometer	1222
SBR	Lead adjustment	1321
NO ERR.	No fault found in memory	4444

PROCEDURE FOR FAULT DIAGNOSIS USING THE RINDA TOOL

Put the tool's connection plug **(X)** into the appropriate socket **(A)** on the cable box.
Follow the instructions enclosed with the tool for details on how to use it.
This tool is very convenient to use as it is not necessary to interpret a code composed of illuminated signals, but the type of fault found is indicated directly on the display.
Refer to the relevant operating instructions for information on how to delete the fault found, if any, either with the check light on the control panel (dashboard), or with this tool.



The use of appliances other than those mentioned may cause significant faults and will invalidate your guarantee rights.



RETRIEVAL/REMOVAL OF FAULT CODE

With the Scan Tool connected to the diagnostic connctor (located on the engine electrical box), trouble codes can br retrieved and erased.
The fault identification and defect code number will be displayed on the Scan Tool.
A complete list of fault codes is listed numerically.

SIGNATURE	DESCRIPTION	CODE
MAP	Intake air pressure sensor	0105
ECT	Water temperature sensor	0115
ECM	Reference voltage 2.5 V.	161a
	Fuel temperature sensor	0180
PRM	Engine speed sensor	0725
	Atmosferic pressure sensor	1105
IAT	Air temperature sensor	1110
NBF	Instrumented injector	1201
	Fuel quantity actuator	1220
	Fuel quantity sensor (control sleeve)	1225
SBR	Fault in timing (timing governing)	1230
TPS	Position sensor	1515
	Battery voltage	1600
Key on - pin 15	Battery switched K15	1605
	Processor fault	1615
	Main relay	1625
Solenoid valve	Timing actuator	1630
	Glow plug relay	1635
	Glow plug aux. relay	1640
Glow plug display	Glow plug lamp	1645
	Diagnostic lamp	1650
Electrical shut off	Fuel shut off valve	1660
EEPROM	Fault in EEPROM	1680
Engine speed sen.	RPM signal from injector	1725

ABREVIATIONS:

SRC Sgnal Range Check
LDF/ADF Boost Pressure Sensor/Atmospheric Pressure Sensor
PWG Analog Value From Throttle Position Sensor
LGS Low Idle Switch
BRE Brake (not used)
NBF Needle Movemrnt Sensor (Injector)
EEPROM Electrical Erasable Progammable Read Only Memory
QTY Quantity
GATE AWAY

REMOVAL OF FAULT CODES
After trouble code is display push:
"No" to continue fault identification
"No" to review trouble code
"Yes" to erase trouble code

For further info about the fault identification procedure, please refer to the **INSTRUCTIONS SUPPLIED** with the Scan tool.

TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSES
FAILS TO START	A1 - A2 - A3 - A4 - A5 - A6 - A11- C1 - C2 - C3 - C4 - C5 - C6
STARTS THEN STOPS	A1 - A2 - A3 - A4 - A5
POORACCELERATION	A1 - A2 - A3 - A4 - A5 - D1 - D2
BLACK SMOKE	A6 - A8 - D1 - D2
WHIT SMOKE	B2 - E1 - E2
OVERHEATS	D5 - D6 - D8 - D9 - D10
LOW OIL PRESSURE	B1 - B3 - B4 - B5 - B7 - E6
HI OIL PRESSURE	B3 - B4
EXCESSIVE NOISE	A6 - A8 - D4 - E6
LACK OF POWER	A2 - A3 - A4 - A5 - A6 - A8 - C7 - D1 - E2

	PROBLEM	POSSIBLE CAUSES
FUEL SYSTEM	FUEL PUMP CLOGGED OR FAULTY	A1
	FUEL LINES CLOGGED	A2
	FUEL FILTER CLOGGED	A3
	INJECTION PUMP FAULTY	A4
	AIR IN FUEL SYSTEM	A5
	INJECTORS CLOGGED, DIRTY OR FAULTY	A6
	INJECTION PUMP ADJUSTMENT INCORRECT	A8
LUBRICATION SYSTEM	OIL PUMP	B1
	OIL LEVEL TOO HIGH	B2
	OIL PRESSURE RELIEF VALVE	B3
	OIL VISCOSITY TOO HIGH	B4
	OIL LEVEL TOO LOW	B5
	PRESSURE GAUGE OR PRESSURE SENSOR FAULTY	B7
ELECT. SYST.	BATTERY DISCHARGED	C1
	INCORRECT OR LOOSE ELECTRICAL CONNECTIONS	C2
	STARTING SWITCH FAULTY	C3
	STARTER MOTOR FAULTY	C4
	PICK-UP BADLY FUNCTIONING OR BADLY CONNECTED	C5
	FUSE INTERRUPT	C6
	POTENTIOMETER MOVEMENT NOT COMPLETE	C7
MAINTENANCE	AIR FILTER CLOGGED	D1
	EXCESSIVE LOAD	D2
	TIMING NOT SUFFICIENTLY ADVANCED	D4
	IDLE SPEED TOO LOW	D5
	COOLANT RADIATOR CLOGGED	D6
	SEA-WATER DAFECTIVE	D8
	SEA-WATER FILTER CLOGGED	D9
	LOOSEN BELTS	D10
REPAIRS	PISTON RINGS STICKING	E1
	POOR VALVE SEATING	E2
	MAIN OR BIG-END BEARING SEIZED	E6

INSTALLATION 10

MINIMUM SURFACE AREA AND SUCTION AIRFLOW

ENGINE	VALUES	
MD704	300 cm^2	400/500 m^3/h
MD706	500 cm^2	500/600 m^3/h

CONNECTIONS

GAS/WATER DRAIN

For straight piping, use pipes with an internal diameter of 90 mm, up to 3 mt long, or with a diameter of 100 mm, up to 6 mt long.

For each 90° curve, increase the diameter by 20 mm along the entire length of the piping.

BATTERY

Engine type	Volts	Ah	Ah peak
MD704	12 V	90	400
MD706	12 V	120	500

SECTION OF THE BATTERY-ENGINE CONNECTING CABLE

Engine type	Up to 1.5 mt	Up to 5 mt	Up to 10 mt
MD704	50 mm^2	70 mm^2	95 mm^2
MD706	70 mm^2	95 mm^2	120 mm^2

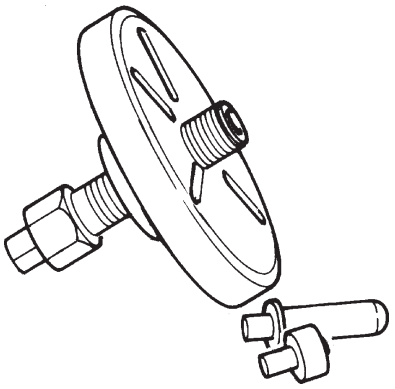
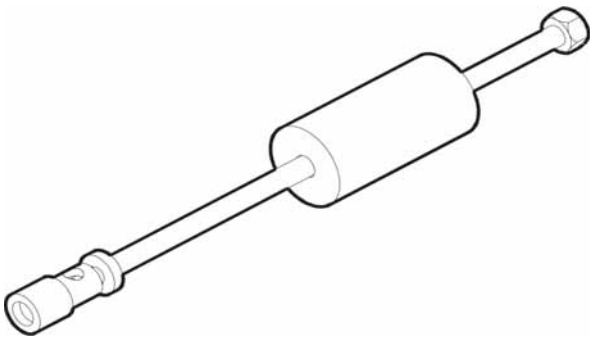
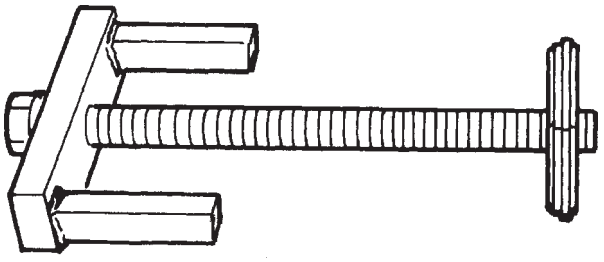
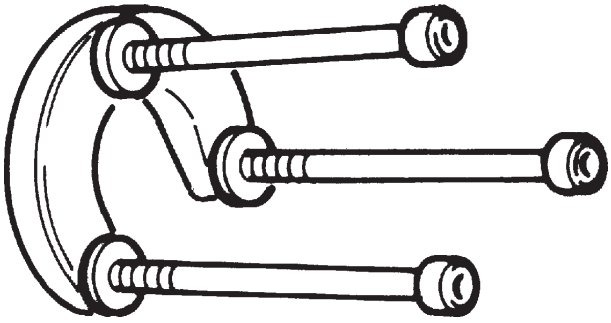
FUEL PIPES

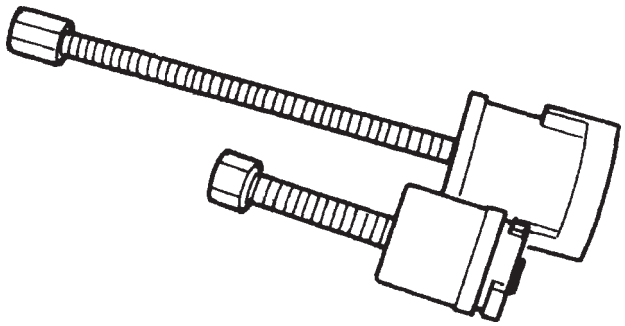
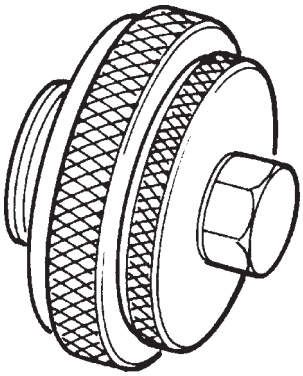
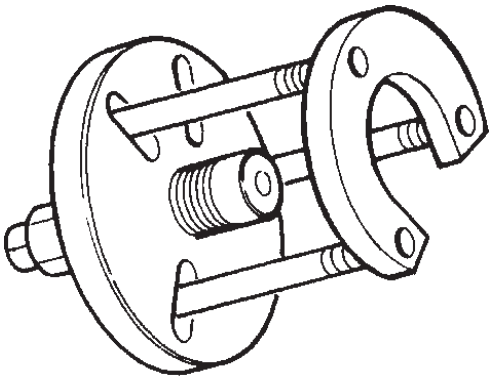
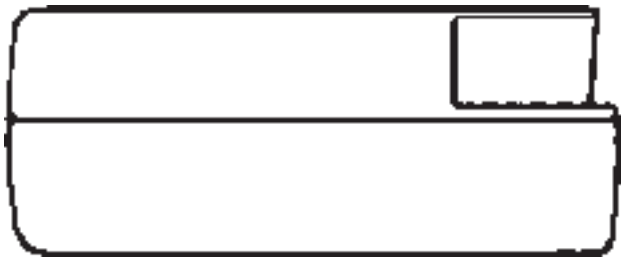
Minimum internal diameter of the pipes: 8 mm

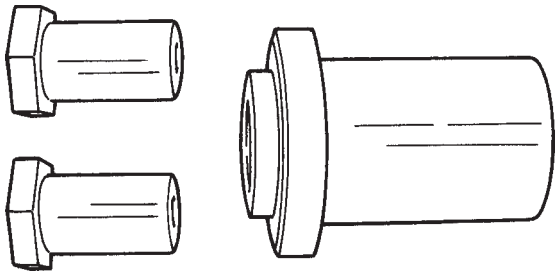
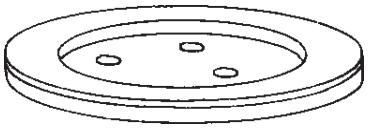
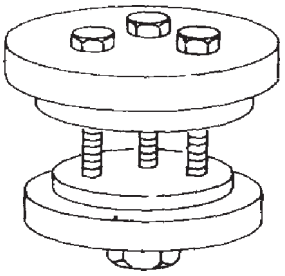
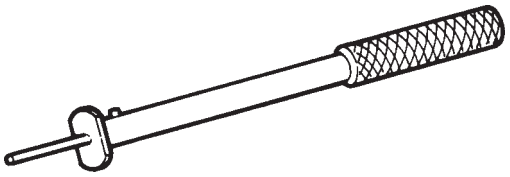
Max suction discharge head 3 mt / H_2O

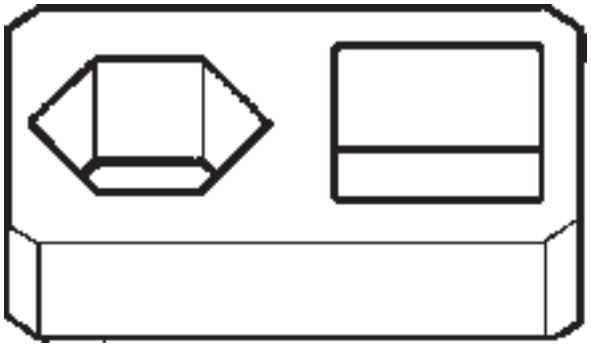
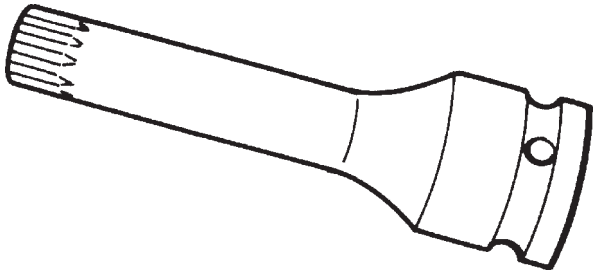
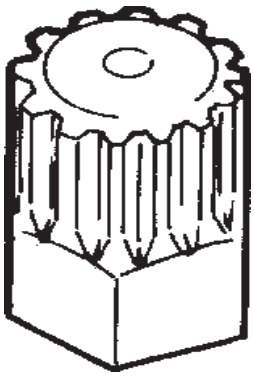
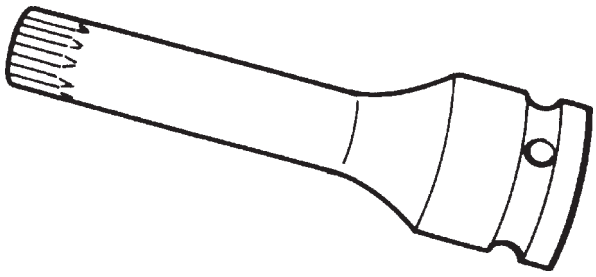
SPECIAL TOOLS 11

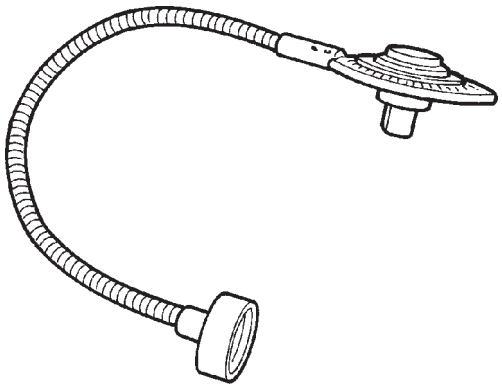
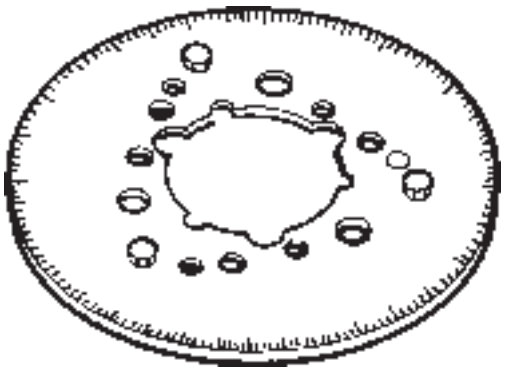
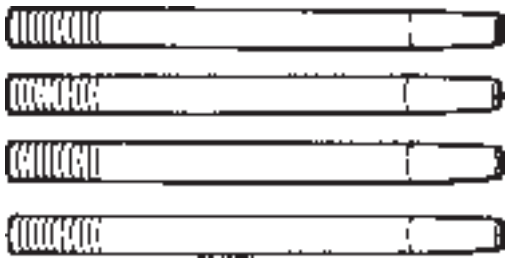
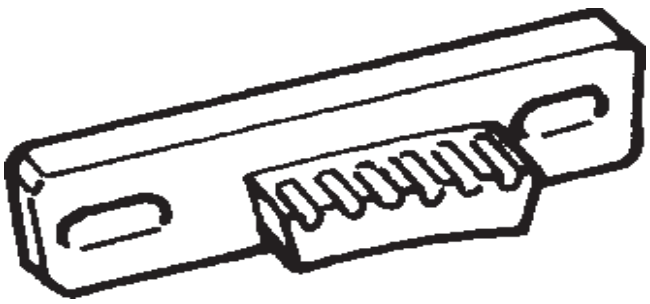
11.1 SPECIAL TOOLS

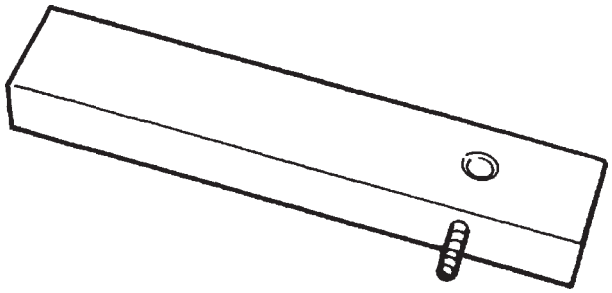
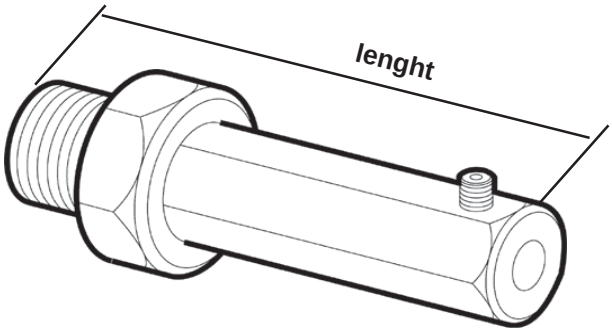
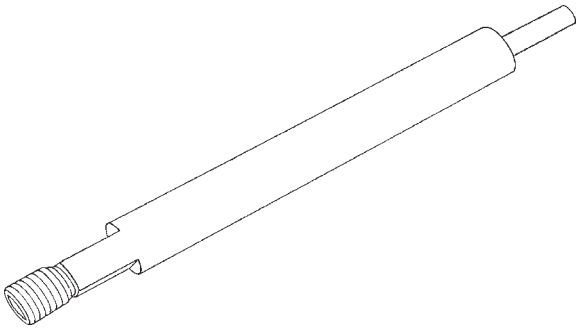
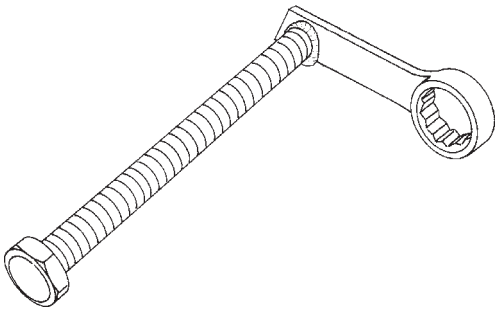
SPARE P.N.		DESIGNATION	TOOL
68400001B A		Front Pulley remover MD700LI MD706LH/LX/LS/ LB MD706MH/MI/MX/MS	
68400004A B		Injector extractor complete with inserts for: SUN/HR-700 MD700	
68400012A C		Cylinder liner extractor	
68400013B D		Crankshaft gear pulley extractor MD700LI MD706LH/LX/LS/ LB MD706MH/MI/MX/MS	

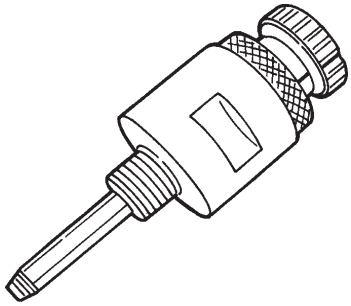
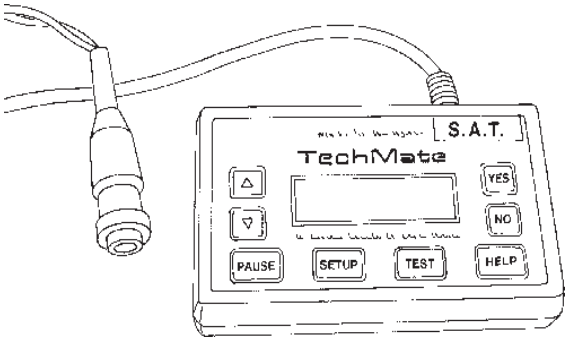
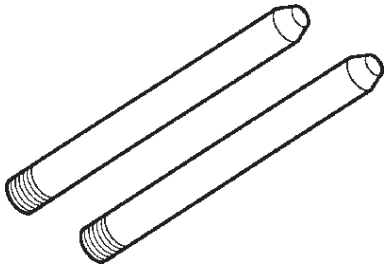
SPARE P.N.		DESIGNATION	TOOL
68400015A E		Crankshaft and camshaft bearing remover/installer	
68400025A F		Injection pump extractor MD700LI MD706LH/LX/LS/ LB MD706MH/MI/MX/MS	
68400028A G		Crankshaft gear puller comple te with front pulley extractor (This tool comprises tools **A+D**) MD700LI MD706LH/LX/LS/ LB MD706MH/MI/MX/MS	
68410006A H		Crankshaft/gear cover assembly tool	

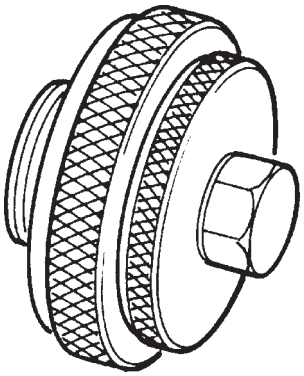
SPARE P.N.		DESIGNATION	TOOL
68410013G I		Tool for mounting from oil seal fusion cover This tool is supplied with an insert with a right thread and a left thread	
68410011F J		Rear seal assembling tool (with rear end bearing assembled on the engine), diameter of rear main bearing journal 70 mm	
68410010F K		Rear seal assembling tool (with rear end bearing removed from the engine), diameter of rear main bearing journal 70 mm	
68410012F L		Assembly/disassembly hydraulic tappets tool	

SPARE P.N.		DESIGNATION	TOOL
68420012A M		Offset tool for cylinder head tightening	
68420016F N		XZN wrench for cylinder head bolt (12 mm.)	
68420017F O		XZN wrench for cylinder head bolt	
68420015F P		XZN wrench for cylinder head bolt (14 mm.)	

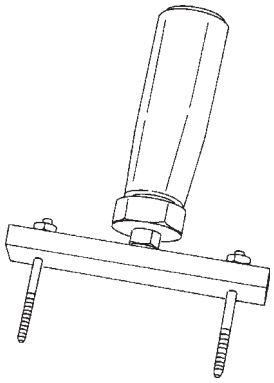
SPARE P.N.		DESIGNATION	TOOL
68420019F Q		Angular torque wrench	
68450003A R		Graduated disc (timing check)	
68460003A S		Cylinder head assembly dowels	
68480003A T		Flywheel ring gear clamp	

SPARE P.N.		DESIGNATION	TOOL
68490007A U		Cylinder liner protusion gauge	
68490014F (KIT 4 pieces) 68490027F 68490026F 68490025F 68490024F V		Dial gauge mounting for Bosch injection pump timing lenght 50mm (M10x1) lenght 50mm (M8x1) lenght 90mm (M8x1) lenght 90mm (M10x1)	
68490015F W		Cylinder pressure check device	
68420020F X		Tool for assembly/ disassembly starter motor	

SPARE P.N.		DESIGNATION	TOOL
68480014F Y		Flyweel TDC alignment pin MD 700 LI MD706LH/ LS/LB/LX	
68490013G Z		Damages check (RINDA TOOL)	
68400036F AA		Adptor for injectors extractor M14 (MD700)	
68460005F AB		Pins for flywheel assembly	

SPARE P.N.	CODE USA *	DESIGNATION	TOOL
68490020F AC		Tool for T.D.C. from injector seat.	
68480016F AD		Flyweel TDC alignment pin MD 704LH/LS	
68400037F AE		Injection pump extractor MD704LH/LS	
68400038F AF		Crankshaft gear extractor MD704LH/LS	

❋ U.S. tools are supplied by Kent Moore and may be slightly different in appearance than tools shown

SPARE P.N.	CODE USA *	DESIGNATION	TOOL
68400039F AG		Crankshaft rotation tool MD704LH/LS 	
68480013F AH		Counter balancing crankshaft pins MD704LH/LS	

LABOR TIME GUIDE 12

KEY TO DEFINITIONS

R/R = removal and re-installation
U.d.P. = unit of power

INTERPRETING THE CODE OF THE OPERATION

Cod. **3Z - EAA / 4**
The first code group identifies the operation performed (ex: **3Z** = replacement)
The second group separated by a dash, identifies the component (ex: **EAA** = camshaft)
The number after the slash, identifies the quality of components involved in the operation, this number can be omitted if there are no other similar components on the engine.

1°) exsample: **3Z - EAA**

replacement — camshaft

This type of code is used when there are no other similar components or multiple components on the engine.

2°) exsample: **10Z - OAA / 1** or **10Z - OAA / 6**

10Z - OAA / 6: test — function — on **6** injectors

10Z - OAA / 1: test — function — on **1** injector

OPER. No.	ENGINE OVERHAUL	CYL. No.	U.d.P.	hours/min.
7Z-AAA	**Total overhaul of the engine:** Including: - Dismantling all the components. - Cleaning all of the components. - Dimension check of the components subject to wear. - Checking the state of the other components. - Replacing the faulty or worn components. - Re-assembly. - Functional test. - Re-tightening the heads.	4 6		26 34
8Z-AAA	**Partial overhaul of the engine:** Including: - Dismantling the piston heads. - Cleaning all of the components dismantled. - Dimensional check of the components subject to wear. - Checking the state of the other components. - Replacing the faulty or worn components. - Re-assembly. - Functional test. - Re-tightening the heads.	4 6		12 14
9Z-AAA	**ENGINE REMOVAL & REINSTALLATION (STANDARD TIME)**	4 6		7 8

OPER. No.	BASIC ENGINE	CYL. No.	U.d.P.	hours/min.
3Z-ABA	**Replacing the monobloc: (crankcase):** - Cleaning the whole engine with steam (high pressure water jet). Dismantling and inspecting the components. - Re-assembling the engine with the new crankcase, using the same pistons or new pistons, new piston ring, a new series of bearings and scrapper rings, gaskets and sealing rings. - Tightening to the specified torque. - Engine test and checking for leaks. - Re-tightening the heads.	4 6		18 20
9Z-DAA	**Re-tightening the heads:**	4 6		0.25 0.30
10Z-DFA	**Checking the roker arms (one):** - Cleaning the dismantling the roker arm group. - Inspecting the parts, overhauling or replacing the same, if necessary. - Re-assembly.	4 6		0.25 0.25
10Z-DFA	**Checking the roker arms (all):** - Cleaning the dismantling the roker arm group. - Inspecting the parts, overhauling or replacing the same, if necessary. - Re-assembly.	4 6		0.50 0.75
3Z-BAA	**Replacing the crankshaft:** - R/R flywheel cover. - R/R oil sump. - R/R heads. - R/R connecting rod-piston group. - R/R bed supports. - R/R front cover.	4 6		18 20
3Z-MCE	**Replacing the front oil seal:**	4 6		0.40 0.40
3Z-BIG	**Replacing the rear oil seal:**	4 6		1 1
3Z-BHA	**Replacing the central bed supports:** - R/R oil sump and sump oil pipe (oil suction pipe). - R/R cover and flywheel. - R/R exchangers. - R/R heads and manifolds. - R/R front cover.	4 6		18 20
11Z-PAA	**Adjusting the engine speed:**	4 6		0.20 0.20

OPER. No.	BASIC ENGINE	CYL. No.	U.d.P.	hours/min.
3Z-BIA	**Replacing main rear bearing:** - R/R flywheel housing and flywheel.	4 6		1 1
3Z-QAA	**Replacing main front bushing:** - R/R front cover and gasket.	4 6		18 20
3Z-QBB	**Replacing busching connecting rod:** - R/R oil sump. - R/R heads and manifolds.	4 6		8 10
3Z-QAD	**Replacing main rear busching:** - R/R flywheel housinf and flywheel.	4 6		1 1
3Z-BLA	**Replacing front pulley:**	4 6		0.20 0.20
3Z-JAA	**Replacing transmission belts:**	4 6		0.10 0.10
3Z-BFA	**Replacing flywheel assembly:**	4 6		0.20 0.20
3Z-BFE	**Replacing starter ring gear:** - R/R flywheel.	4 6		0.40 0.40
3Z-MAA	**Replacing flywheel housing:** - R/R flywheel.	4 6		0.30 0.30
3Z-MCA	**Replacing front cover and gasket:**	4 6		1.30 1.30
3Z-PAC	**Replacing fuel pump drive gear:** - R/R front cover.	4 6		1.40 1.40
3Z-BAF	**Replacing crankshaft gear:** - R/R front cover.	4 6		2 2
3Z-LCB	**Replacing countershaft gear:** - R/R front cover.	4 6		1.20 1.20
3Z-GAA	**Replacing oil pump:** - R/R front cover.	4 6		1.20 1.20

OPER. No.	BASIC ENGINE	CYL. No.	U.d.P.	hours/min.
3Z-BFA **3Z-LCB** **3Z-PAC** **3Z-EAC**	**Replacing timing gear assembly:** - R/R front cover.	4 6		8 8.30
3Z-CAA/1	**Replacing one piston and connecting rod:** - R/R heads and gasket. - R/R oil sump.	4 6		10 12
3Z-CAA/4 **3Z-CAA/6**	**Replacing all pistons and connecting rods:** - R/R heads and gasket. - R/R oil sump.	4 6		12 14
3Z-CAD	**Replacing piston rings on all pistons:** - R/R heads and gasket. - R/R oil sump. - R/R pistons.	4 6		12 14
3Z-EAA	**Replacing camshaft assembly:** - R/R heads. - R/R front cover. - R/R tappets.	4 6		6.30 7
3Z-EAF	**Replacing camshaft oil seal:** - R/R flywheel housing.	4 6		0.40 0.40
3Z-AIA/1	**Replacing one liner:** - R/R heads. - R/R oil sump. - R/R piston.	4 6		10 12
3Z-AIA/4 **3Z-AIA/6**	**Replacing all the liners:** - R/R heads. - R/R oil sump. - R/R pistons.	4 6		12 14
3Z-DFA/1	**Replacing one rocker arm:**	4 6		0.50 0.50
3Z-DFA/4 **3Z-DFA/6**	**Replacing all rocker arms:**	4 6		1.30 1.40
3Z-ECA	**Replacing pushrod:** - R/R rocker arm.	4 6		1 1
3Z-ECA/8 **3Z-ECA/12**	**Replacing all pushrods:** - R/R rocker arms.	4 6		1.40 1.50

OPER. No.	BASIC ENGINE	CYL. No.	U.d.P.	hours/min.
3Z-EBA	**Replacing all tappets:** - R&R heads. - R&R manifolds	4 6		5 6
3Z-MHA	**Replacing valve cover and gasket:**	4 6		0.30 0.30
3Z-KHA	**Replacing intercooler:**	4 6		2 2.10
3Z-KDA	**Replacing turbocharger:**	4 6		0.50 0.50
3Z-KBA	**Replacing exhaust manifold:** - R/R intercooler. - R/R turbocharger.	4 6		1.45 1.30
3Z-HGA	**Replacing water/water exchanger:**	4 6		1 1
3Z-MBA	**Replacing oil sump:**	4 6		0.20 0.30
3Z-HAA	**Replacing fresh water pump:**	4 6		0.30 0.30
3Z-HBA	**Replacing sea water pump:**	4 6		0.15 0.15
3Z-HBC	**Replacing sea water pump impeller:**	4 6		0.10 0.10
3Z-HDA	**Replacing water thermostat valve:**	4 6		0.10 0.10
3Z-HCA	**Replacing head water pipe:**	4 6		0.50 1
1Z-HGA	**Revision and cleaning watwr/water exchanger:**	4 6		1 1
9Z-HGA	**Re-tightening heads:**	4 6		0.25 0.30
1OZ-AAA	**Check running and adjust governor engine:**	4 6		1.20 1.20

OPER. No.	FUEL	CYL. No.	U.d.P.	hours/min.
3Z-PAA	**Replacing mechanical injection pump:** - Check timing pump. - R/R fuel delivery pipes.	4 6		1.30 1.30
3Z-PAA	**Replacing electronic injection pump:** - Check timing pump. - R/R fuel delivery pipes.	4 6		1.30 1.30
3Z-OFA	**Replacing fuel lift pump:**	4 6		0.10 0.10
11Z-PAA	**Calibration mechanical injection pump:**	4 6		0.25 0.25
3Z-OAA	**Replacing injector: (one)**	4 6		0.10 0.10
3Z-OBA	**Replacing instrument injector:**	4 6		0.10 0.10
3Z-OAA/4 3Z-OAA/6	**Replacing all injectors:**	4 6		0.25 0.20
10Z-OAA	**Check functionality injector: (one)** - R&R fuel pipes.	4 6		0.10 0.10
10Z-OAA/4 10Z-OAA/6	**Check functionality all injectors:** - R&R fuel pipes.	4 6		0.20 0.30
12Z-OEL	**Bleed fuel system:**	4 6		0.15 0.15
3Z-HGU	**Replacing water/fuel exchanger:**	6		0.10
3Z-OEC	**Replacing fuel filter:**	4 6		0.05 0.05
3Z-OCA	**Replacing injectors diesel delivery pipe:**	4 6		0.10 0.15
3Z-OEA	**Replacing diesel drain pipe:**	4 6		0.10 0.15

OPER. No.	LUBRIFICATION	CYL. No.	U.d.P.	hours/min.
10Z-GGA	**Check oil pump relief valve:** - R/R oil sump.	4 6		0.50 0.50
3Z-RAA	**Replacing rocker arms lubrication pipe:**	4 6		0.15 0.20
3Z-RCA	**Replacing turbocharger oil delivery pipe:**	4 6		0.10 0.10
3Z-RCD	**Replacing tubocharger oil return pipe:**	4 6		0.10 0.10
3Z-GCA	**Replacing oil filter:**	4 6		0.05 0.05

OPER. No.	ELECTRICAL SYSTEM	CYL. No.	U.d.P.	hours/min.
3Z-SEA	Replacing alternator:	4 6		0.10 0.10
3Z-SGA	Replacing starter motor:	4 6		0.15 0.15
3Z-SGD	Replacing starter solenoid assembly:	4 6		0.30 0.30
3Z-SAA	Replacing wiring harness:	4 6		1 1
3Z-SAB	Replacing electrical plant control unit:	4 6		1 1
3Z-SLA	Replacing control unit:	4 6		0.10 0.10
3Z-SHA	Replacing dash panel:	4 6		0.10 0.10