VM MOTORI S.p.A.

Workshop Manual
Engine Family R750

Edition 13 - 04/2017

SUMMARY

INTRODUCTION

MODELS COVERED

R 750 EU4/EU5/EU6 common rail industrial engines are applied to vehicles of the road, such as road sweepers and trucks. R 750 TE3, IE3, TE4, IE4, ISE4 are applied to vehicles not of the road, agricultural and lifting application.

NOTICE TO USERS OF THIS MANUAL

Throughout this publication, Dangers, Warnings and Cautions (accompanied by the International HAZARD Symbol ⚠) are used to alert the mechanic to special instructions concerning a particular service or operation that may be hazardous if performed incorrectly or carelessly. OBSERVE THEM CAREFULLY!
These safety alerts alone cannot eliminate the hazards that they signal. Strict compliance to these special instructions when performing the service, plus common sense operation, are major accident prevention measures.

⚠ DANGER

DANGER—indicates an imminently hazardous situation that, if not avoided, will result in death or serious injury.

⚠ WARNING

WARNING—indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury.

⚠ CAUTION

CAUTION—indicates a potentially hazardous situation that, if not avoided, may result in minor or moderate injury or property damage. It may also be used to alert against unsafe practices.

This manual has been written and published by the Service Department of VM Motori to aid our dealers' mechanics and company service personnel when servicing the products described herein. **We reserve the right to make changes to this manual at any time and without prior notice in accordance with the Company's policy of constant product improvement.**

Published by VM Motori, from whom further copies may be obtained through your normal literature ordering procedure (refer to front page to identify the order number).
A copy of this manual is available from VM Motori web site Customer Reserved Area "Extranet"

VM Motori S.p.A. - Service Department, Via Ferrarese 29 - 44042 Cento (FE) ITALY

Every reasonable effort is made to ensure that the VM Motori's publications are accurate, but nothing shown, described or referred to herein should be regarded as an infallible guide to the procedures, materials, specifications, dimensions, design or availability of any particular engine, nor does this publication constitute an offer for the sale of any particular engine. No liability can be accepted by the VM Motori or any Distributor or Dealer for any malfunction, damage, loss, injury or death caused by the use of incorrect or misinterpreted information, omissions or errors that may have arisen during the preparation of this workbook.

It is assumed that these personnel are familiar with industrial product servicing procedures.
Furthermore, it is assumed that they have been trained in the recommended service procedures of VM Motori Products, including the use of mechanics' common hand tools and the special VM Motori or recommended tools from other suppliers.
We could not possibly know of and advise the industrial trade of all conceivable procedures and of the possible hazards and/or results of each method. Therefore, anyone who uses a service procedure and/or tool, which is not recommended by the manufacturer, first must completely satisfy himself that neither his nor the products safety will be endangered.
All information, illustrations and specifications contained in this manual are based on the latest product information available at the time of publication. As required, revisions to this manual will be sent to all dealers contracted by us to service these products.
Refer to dealer service bulletins, warranty, owner manuals and installation manuals for other pertinent information concerning the products described in this manual.
Extranet area contained in VM Motori web site is another source of information.

REPLACEMENT PARTS

Use of parts other than the recommended service replacement parts, will avoid the warranty on those parts that are damaged as a result.

WARNING

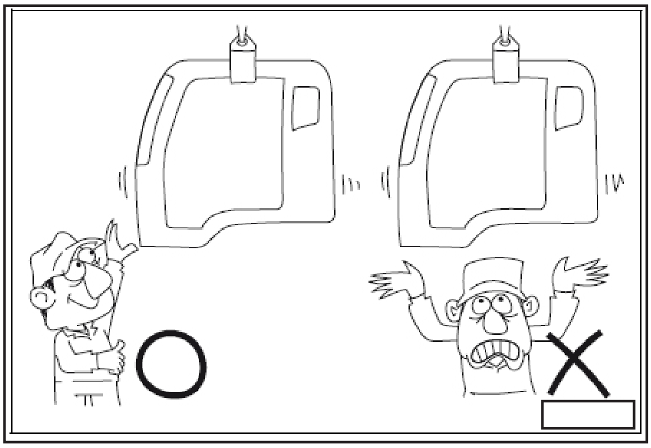
When servicing the electrical, ignition and fuel systems, it is extremely important that all
components are properly installed and tightened. If not, any electrical or ignition
component opening would permit sparks to ignite fuel vapors from fuel system leaks, if
they existed.

CLEANLINESS AND CARE OF PRODUCT

A VM Motori Product is a combination of many machined, honed, polished and lapped surfaces with tolerances that are measured in the thousands of a mm. When any product component is serviced, care and cleanliness are important.
Throughout this manual, it should be understood that proper cleaning and protection of
machined surfaces and friction areas is a part of the repair procedure. This is considered standard shop practice even if not specifically stated.
Whenever components are removed for service, they should be retained in order. At the
time of installation, they should be installed in the same locations and with the same mating surfaces as when removed.

Any time the intake or exhaust openings are exposed during service they should be covered to protect against accidental entrance of foreign material which could enter the cylinders and cause extensive internal damage when the engine is started.
It is important to note, during any maintenance procedure replacement fasteners must have the same measurements and strength as those removed. Numbers on the heads of the metric bolts and on the surfaces of metric nuts indicate their strength. American bolts use radial lines for this purpose, while most American nuts do not have strength markings. Mismatched or incorrect fasteners can result in damage or malfunction, or possibly personal injury. Therefore, fasteners removed should be saved for reuse in the same locations whenever possible. Where the fasteners are not satisfactory for reuse, care should be taken to select a replacement that matches the original.

Personnel should not work on or under an engine that is suspended. Engines should be attached to work stands, or lowered to ground as soon as possible.



HANDLING PRECAUTIONS FOR ELECTRIC CIRCUITS

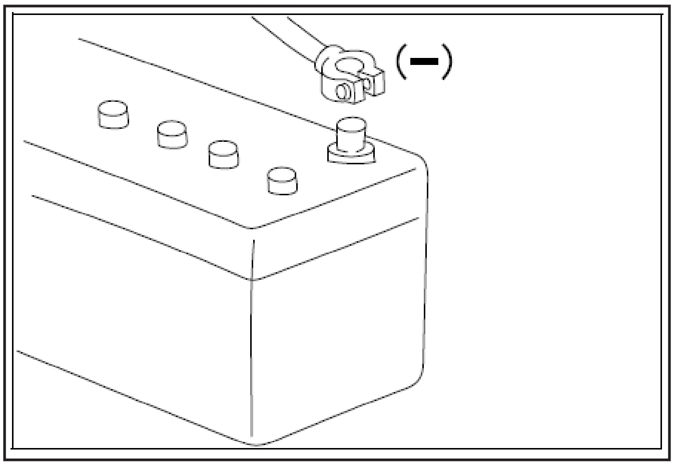
ENGINE ELECTRONIC CONTROL UNIT

⚠ WARNING

IN ORDER TO AVOID ECU DAMAGE PAY ATTENTION TO THE FOLLOWING INSTRUCTIONS:

- **DO NOT CUT ENGINE VOLTAGE OFF DURING ENGINE OPERATION**
- **BEFORE CUT ENGINE VOLTAGE OFF THROUGH ELETTRICAL DEVICES (BREAKERS, SWITCH, ETC.) WAIT FOR 30 SEC. AT LEAST SO THAT THE ECU CAN BE CARRIED OUT THE "AFTER-RUN" PROCEDURE**
- **DO NOT USE START BOOSTER TO LET START THE ENGINE**

It should be kept in mind, while working on the product, that the electrical systems are capable of violent and damaging short circuits or severe electrical shocks. When performing any work where electrical terminals could possibly be grounded or touched by the mechanic, the battery cables should be disconnected at the battery.

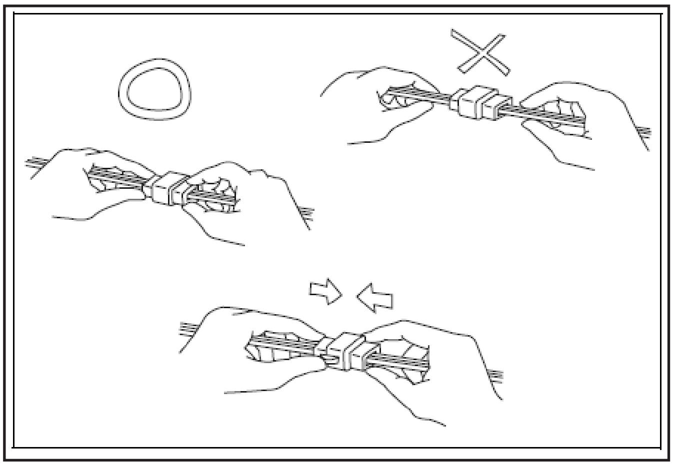


Before working on the electrical system, disconnect the (–) battery cable to prevent short circuits.

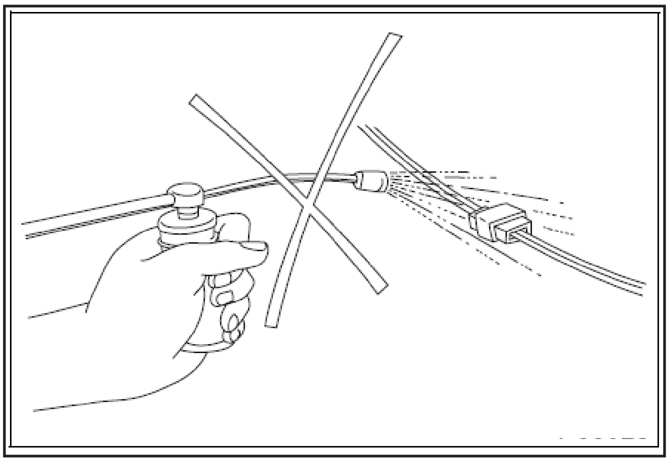
CAUTION

Make sure the starter switch and lighting switches are OFF before disconnecting or connecting battery cable. Semiconductor components may otherwise be damaged.

When separating connectors, grasp the connectors themselves rather than the harnesses.To separate locking connectors, first push them in the direction of the arrows. To reconnect locking connectors, push them together until they click.

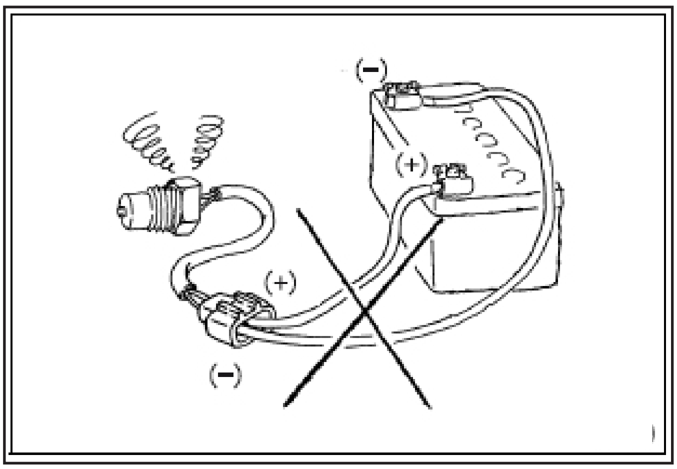


Before washing the engine, cover electrical parts to keep them dry. (Use plastic sheets or the like.) Keep water away from harness connectors and sensors and immediately wipe off any water that gets on them.

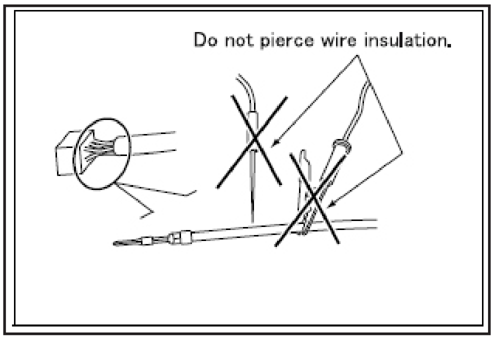


When applying a voltage to a part for inspection purposes, check that the (+) and (–) cables are connected properly then gradually increase the voltage from zero. Do not exceed the specified voltage.
Remember that control units and sensors do not necessarily operate on the battery voltage.

CAUTION



• Do not pierce wire insulation with test probes or alligator clips when performing electrical inspections. Doing so can, particularly with the chassis harness, hasten corrosion.

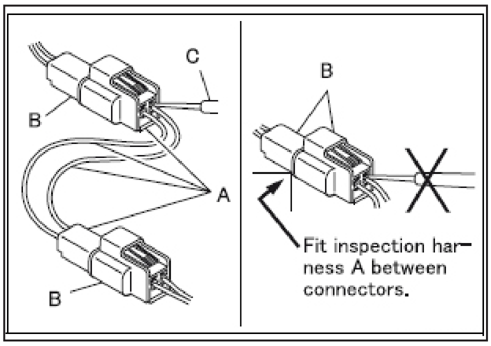


INSPECTION OF HARNESSES

INSPECTIONS WITH CONNECTORS FITTED TOGETHER

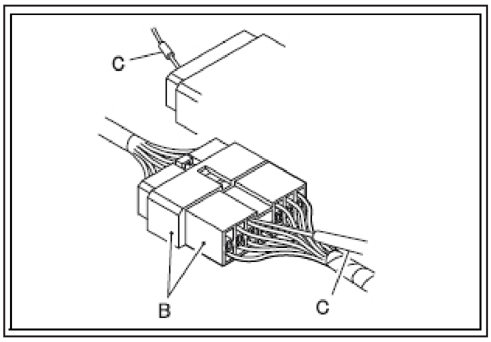
Waterproof connectors

• Connect an inspection harness and connector A between the connectors B of the circuit to be inspected. Perform the inspection by applying a test probe C to the connectors of the inspection harness. Do not insert the test probe C into the wire-entry sides of the waterproof connectors since this would damage their waterproof seals and lead to rust.



Non-waterproof connectors

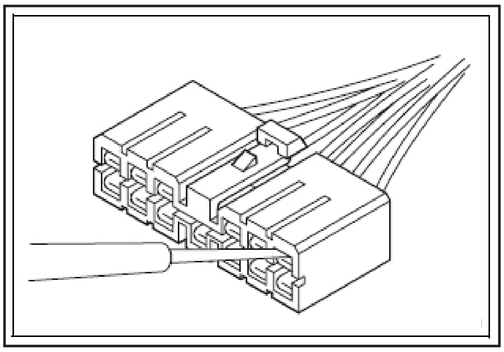
Perform the inspection by inserting a test probe C into the wireentry sides of the connectors. An extra-narrow probe is required for control unit connectors, which are smaller than other types of connector. Do not force a regular-size probe into control unit connectors since this would cause damage.



INSPECTIONS WITH CONNECTORS SEPARATED

Inspections on female terminals

Perform the inspection by carefully inserting a test probe into the terminals. Do not force the test probe into the terminals since this could deform them and cause poor connections.

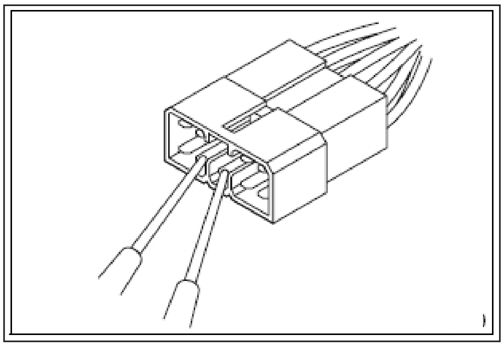


Inspections on male terminals

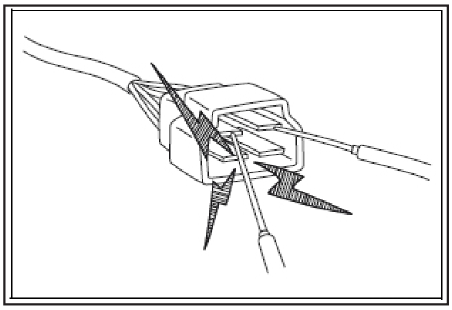
Perform the inspection by applying test probes directly to the pins.

CAUTION .

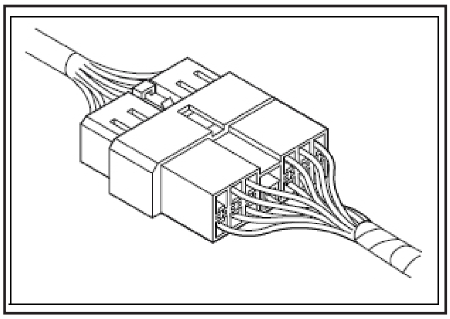
• Be careful not to short-circuit pins together with the test probes. With control unit connectors, short-circuiting of pins can cause damage to the control unit's internal circuitry.



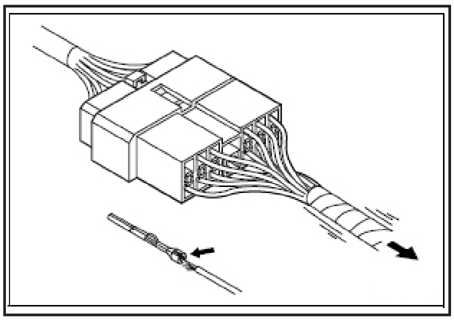
When using a multimeter to check continuity, do not allow the test probes to touch the wrong terminals



INSPECTION OF CONNECTORS
Visual inspection
Check that the connectors are fitted together securely

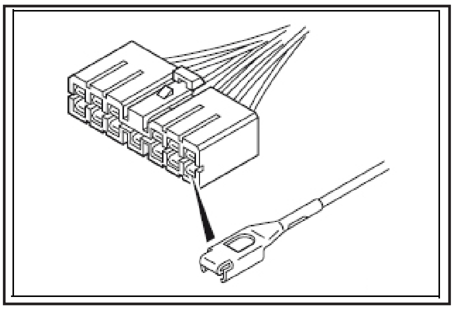


Check whether wires have been separated from their terminals due to pulling of the harness

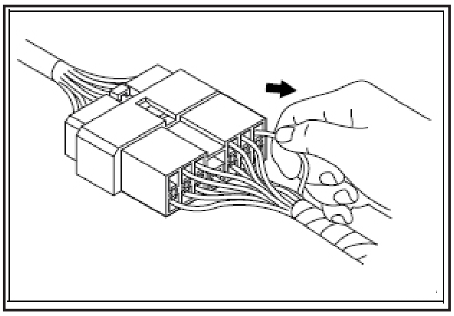


Check that male and female terminals fit together tightly

Check for defective connections caused by loose terminals, by rust on terminals, or by contamination of terminals by foreign substances.

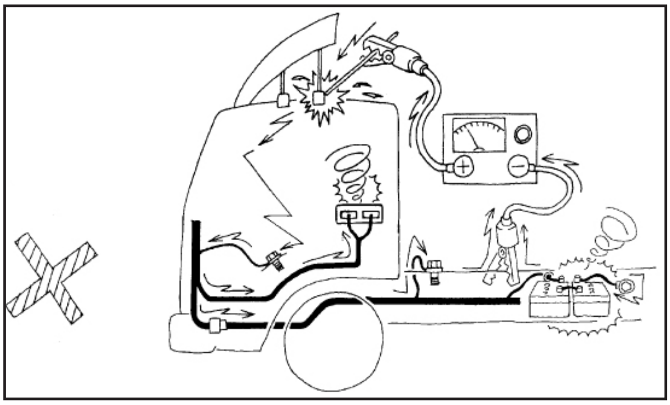


Checking for loose terminals
• If connector terminal retainers become damaged, male and female terminals may not mate with each other when the connector bodies are fitted together. To check for such terminals, gently pull each wire and see whether any terminals slip out of their connector housings.



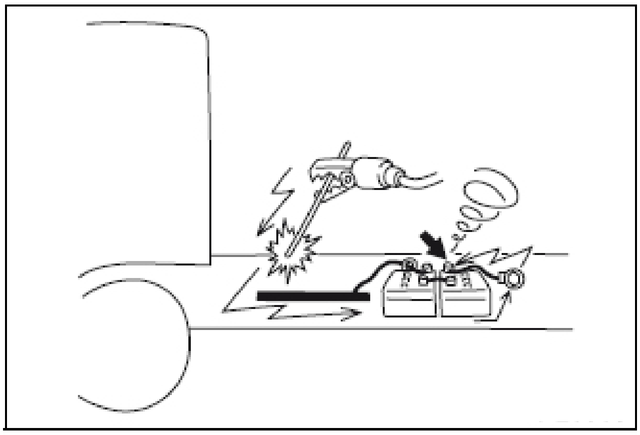
PRECAUTIONS FOR ARC WELDING

When arc welding is performed, current from the welder flows to ground via the vehicle's metal parts. Unless appropriate steps are taken, **this current can damage engine control units**, other electrical devices and wiring harnesses.
And any electrical device near the point on the vehicle to which the (–) cable of the welder is connected, might be largely damaged.



REMOVE THE ELCTRONIC ENGINE CONTROL UNIT FROM THE VEHICLE

Current flows backward as shown nearby



From battery (–) cable
To prevent damage to the battery and to electrical devices that are connected directly to the battery, it is essential to disconnect the battery's (–) cable.
Procedure
Turn the starter switch to the LOCK position.
Disconnect the battery's (–) cable.
Cover all parts of the vehicle that may be damaged by welding sparks.
Connect the welder's (–) cable to the vehicle as close as possible to the area being welded. Do not connect the welder's (–) cable to the cab if the frame is being welded, and vice versa.
Set the welding current in accordance with the part being welded.

SERVICE MANUAL - UPDATING

Edition 0 _ 07 - 2007			
DATE dd/mm/yyyy		**CHAPTER / PARAGRAPH**	**ACTION DESCRIPTION**
04/07/2007			First Issue

Edition 1 _ 11 - 2007			
DATE gg/mm/aaaa		**CHAPTER / PARAGRAPH**	**ACTION DESCRIPTION**
28/11/2007		Maintenance / Engine Specifications	updating: API and ACEA engine oil specifications regarding all engine models of R750 family
			modification: engine oil change quantity (oil filter cartridge included), concerning all engine versions, with counter balancer shaft and oil pan with major capacity
			Insertion: new DPF particulate filter cleaning procedure using an electrical oven
		Engine Block / Crankshaft	Insertion: crankshaft tech drawing about R756

Edition 2 _ 03 - 2008			
DATE gg/mm/aaaa		**CHAPTER / PARAGRAPH**	**ACTION DESCRIPTION**
14/03/2008		Maintenance / Engine Oil	Added important note about 2 different oil pan capacities on R750 engines. Take care during engine oil change and filling.
		Basic Engine / Fractured connecting Rod	New paragraph “Fractured Connecting Rod”
		Specia Tools	Added spare parts code about socket for removal alternator pulley
		Labour Time Guide	Added labour time for cleaning DPF filter with compressed air
		Exhaust Side / Turbocharger	Added note about failure of turcharger: with an important oil leakage into exhaust side evaluate a cleaning of DPF Filter

Edition 3 _ 04 - 2008			
DATE dd/mm/yyyy		**CHAPTER / PARAGRAPH**	**ACTION DESCRIPTION**
23/04/2008		Special Tools	Inserted: Electrical Owen for DPF Filter cleaning, Engine test harness. Updated the Diagnostic Tool P/N
		Introduction	Inserted: Handling Precautions for Electric Circuits, Precautions for Arc Welding

Edition 4 _ 07- 2008			
DATE dd/mm/yyyy		**CHAPTER / PARAGRAPH**	**ACTION DESCRIPTION**
23/07/2008		Special Tools	Inserted: Compression Tester Adapter Tool.
			Inserted: Break out Box Tool.
		Timing Side / Crankshaft gear	Heating of crankshaft gear before installing it on crankshaft
		Introduction	Warning about ECU safeguard

Edition 5_ 09 - 2008			
DATE dd/mm/yyyy		**CHAPTER / PARAGRAPH**	**ACTION DESCRIPTION**
08/09/2008		Engine Block	Inserted: new chapter “Crankcase”, inspection procedure of balance shaft assembly plugs and their caulking.

Edition 6 _ 12- 2008			
DATE dd/mm/yyyy		**CHAPTER / PARAGRAPH**	**ACTION DESCRIPTION**
17/12/2008		Introduction	Inserted: indication DO NOT use START-BOOSTERS to let start the engine
		Maintenance	Inserted: required conditions about: • DPF filter cleaning with electrical oven • service regeneration through diagnostic tool

Edition 7 _ 03- 2010

DATE dd/mm/yyyy		CHAPTER / PARAGRAPH	ACTION DESCRIPTION
22/01/2010		General Information	Updating of engine codes about R750 EURO5 engines family
		Maintenance	ENGINE SPECIFICATIONS: updating of R754EU5 R756EU5 engine models MAINTENANCE SCHEDULE: updating of maintenance chart about engi-nes model EURO5 ENGINE OIL: • updating of ACEA oil specifications about engines EURO 5 • added delete procedure about ENGINE OIL DILUTION function AIR FILTER: maintenance procedure about engines EURO5 DPF DIESEL PARTICULATE FILTER : description of DPF filter about engines EURO 5.
		Timing Side	“PTO” IDLER GEAR: updating of Loctite 572 on PTO cover gears bolt threads OIL PUMP: updating of dimensions about R750 EURO 5 engine models
		Basic Engine	CYLINDER HEAD VALVE SEAT: updating of dimensions about R750 EURO 5 engine models
		Injection Side	LOW PRESSURE SYSTEM REQUIREMENTS: updating of specifications as from installation manual
		Electrical System	ELECTRICAL SCHEMATIC DIAGRAMS , ENGINE WIRING HARNESS, INSTALLATION ELECTRIC DIAGRAM: updating in relation to EURO 5 engine models
		Special Tools	updating of injector extractor fork for R750 EURO 5 engine models, VM code 68400045G
		Engine Block	CRANKCASE: updating installation plugs for closing counter balance shaft oil lubrication passages
		Basic Engine	HYDRAULIC TAPPET: insert new tappet 40432003F
		Timing Side	IDLER GEAR (between crankshaft and camshaft gear): insert new idler gear

Edition 8 _ 04- 2010

DATE dd/mm/yyyy		CHAPTER / PARAGRAPH	ACTION DESCRIPTION
07/04/2010		Maintenance	**OIL CHANGE/OIL DILUTION CALULATION**: updating of reset pro-cedure
		Maintenance	**DPF FILTER EURO 5**: updating of cleaning procudure through com-pressed dry air
		Electrical System	**INSTALLATION ELECTRICAL DIAGRAM “K SIDE”**: updating electrical diagram R750EU5 engines **INSTALLATION ELECTRICAL DIAGRAM “K SIDE”**: new electrical diagram R750IE3 engines
		Labout Time Guide	Insert ECU diagnosis time

Edition 9 _ 10 - 2010			
DATE dd/mm/yyyy		**CHAPTER / PARAGRAPH**	**ACTION DESCRIPTION**
08/10/2010		Maintenance	**ENGINE SPECIFICATIONS**: updating of exhaust back pressure about R750IE3 - EU4 - EU5 engine models
			DPF FILTER EURO 4: cleaning procedure of pressure lines (from pressure sensor and DPF filter) every time the DPF filter comes cleaned
			ENGINE SPECIFICATIONS, ENGINE OIL: updating of engine oil specifications and oil pan capacities

Edition 10 _ 03- 2011			
DATE dd/mm/yyyy		**CHAPTER / PARAGRAPH**	**ACTION DESCRIPTION**
07/03/2011		Maintenance	**ENGINE OIL/OIL CHANGE**: engine oil change in case of Pcode 252F “engine oil critical mass”
		Maintenance	**DPF Filter:** updating of cleaning and regeneration DPF filters for engine models Euro 4 e 5 in case of : • service repair and • in presence of Pcode 242F (euro 5) and 2463 (euro4) concernig to “SOOT MAX”.
		Special Tools	Oscilloscope use Recommendation
		Exhaust Side	**EGR & TVA VALVES:** cleaning indication of vacuum modulators internal filter
		Basic Engine	**ROCKER ARMS:** delete rocker arms pins wear limit

Edition 11 / 11- 2012		
DATE dd/mm/yyyy	**CHAPTER / PARAGRAPH**	**ACTION DESCRIPTION**
31/08/2012	Maintenance	**ENGINE SPECIFICATIONS**: add Tech Data about new engine models R754ISE4-IE4 - About engine type R756EU5.01A OEM SCHMIDT installed oil pan high capacity (16,5 Kg) with increase oil change interval up to “EVERY 500 HRS” instead of 300 hrs.
	Maintenance	**MAINTENANCE INTERVALS:** Oil change interval. Engine type R756EU5.01A OEM SCHIMDT, oil change “EVERY 500 HRS” instead of 300 hrs due to oil pan high capacity.
	Maintenance	**ENGINE EXTERNAL VIEW:** add pictures new engine models R750IE4-ISE4-TE4
	Maintenance	**ENGINE COOLANT:** add new engine coolant PETRONAS PARAFLU UP
	Maintenance	**DPF FILTER**: add new cleaning/regeneration procedure for R754IE4
	Maintenance	**STORAGE:** updating of storage procedure using new protective PETRONAS fluids
	Maintenance	**MAINTENANCE INTERVALS:** updating of maintenance intervals for engine models R750IE4. About engine type R756EU5.01A OEM SCHMIDT with oil pan high capacity (16,5 Kg) the oil change interval goes to “EVERY 500 hrs” instead of 300 hrs.
	Maintenance	**ALTERNATOR BELT:** add belt for engine model R750IE4 with Hutchinson linear tensioner
	General Information	**ENGINE SERIAL NO.:** add new engine codes for R754TE4-IE4-ISE4
	Exhaust side	**INTAKE TVA VALVE / EGR VALVE:** add new components for engine models R750IE4
	Engine Control	**DTC’s:** add new diagnostic trouble codes for model R750IE4
	Elettrical system	Add electrical diagrams, wiring harness for model R750IE4
	Special Tools	**NEW SPECIAL TOOL:** belt fitting tool for Huchtinson linear tensioner for engine models R750TE4-IE4-ISE4

Edition 12 - 06 / 2014			
DATE dd/mm/yyyy		**CHAPTER / PARAGRAPH**	**ACTION DESCRIPTION**
18/06/2014		General information	**ENGINE SERIAL NUMBER:** new engine codes for engine models R754EU6 - R756EU6
		Maintenance/Engine specifi-cations	**ENGINE SPECIFICATIONS**: new technical data for engine model R754EU6. For engine model **R754EU6.05A "BUCHER / JOHNSTON cu-stomers",** installed **oil sump with major capacity (11,5 Kg)** with increasing of oil change interval up to "EVERY 500 hours" instead of 300 hours. Updating of **BIODIESEL percentage: from 5% to 7%** **DPF Filter on R754EU6 engine**: DPF regeneration soot threshold **SCR system**: schematic layout, general description, DEF fluid, inducement system DWS light. Dosing control unit DCU box for R754EU6
		Maintenance/Intervals	**INTERVALS**: add for R754EU6 engine maintenance interval for replacement of DCU control unit filter, EVERY 1000 hrs.
		Harness connector kit	New chapter
		Basic Engine/Cylinder Head	**Cylinder Head Bolts:** indication about use of new bolts whenever the cylinder head are removed.
		Timing side/Coolant pump	Updating of coolant pump torque procedure
		Exhaust Side/Intake and Exhaust manifolds	Updating of torque bolt procedure for intake and exhaust manifolds, EGR cooler for engine models R754TE4/IE4/EU6
		Special Tools	Add new diagnostic tool VM pn 68500019F. The diagnostic tool VM pn L'attrezzo 68500010F is not anymore supplied
		Engine Control/Diagnostic trouble codes	Add new trouble codes for R754EU6
		Electrical System	add electrical diagram about R754EU6 engine model

Edition 13 - 04 / 2017			
DATE **dd/mm/yyyy**		**CHAPTER / PARAGRAPH**	**ACTION DESCRIPTION**
4/4/2017		Exhaust Side/Intake and Exhaust manifolds	**EXHAUST & INTAKE MANIFOLDS:** torque procedure has been updated **EXH GAS TEMPERATURE and PRESSURE SENSORS:** torque procedure has been updated: involved engines R754EU6 - R756EU6
		Basic Engine/Cylinder Head	**Cylinder Head Bolts: VM discourage the reuse of the bolts**. Use of new bolt is recommended
		Maintenance/Engine Tecg data	updated oil capacity for engine with majored oil pan R750EU6
		Maintenance	add MIL actvation for engine EU6
		Maintenance/Schedule	for engine EU5/IE4/EU6 increased the scheduled coolant change from 1200 hrs /2 yeas to 4000 hrs / 4 years. Add coolant chemical verification every 600 hrs
		Special Tools	add tool for Hutchinson Belt Tensioner (Linear Tensioner) add engine starting tool R750EU6 add tool for timing counter balance shaft unit
		Engine Block	add paragraph **COUNTER BALANCE SHAFT UNIT / CRANKSHAFT COUNTER WEGHITS**

Edition xx _ xx-			
DATE dd/mm/yyyy		CHAPTER / PARAGRAPH	ACTION DESCRIPTION

GENERAL INFORMATION

INTRODUCTION

This comprehensive overhaul and repair manual is designed as a service guide for the VM common rail diesel engines belonging to R750 family models. It provides specific information, including procedures for disassembly, inspection, assembly and adjustment, to enable dealers and service mechanics to repair these products. Before attempting repairs, read through the procedures to understand the methods and tools used and the cautions and warnings required for safety.

HOW TO ORDER THIS MANUAL

This manual can be order through your normal literature ordering procedure (refer to front page to identify the order number).

A copy of this manual is available from VM Motori web site Customer Reserved Area "Extranet"

ENGINE SERIAL NUMBER AND ENGINE PLATE IDENTIFICATION

ENGINE SERIAL NUMBER

1 - VM serial number stamped in the crankcase

2 - VM serial number and specification plate

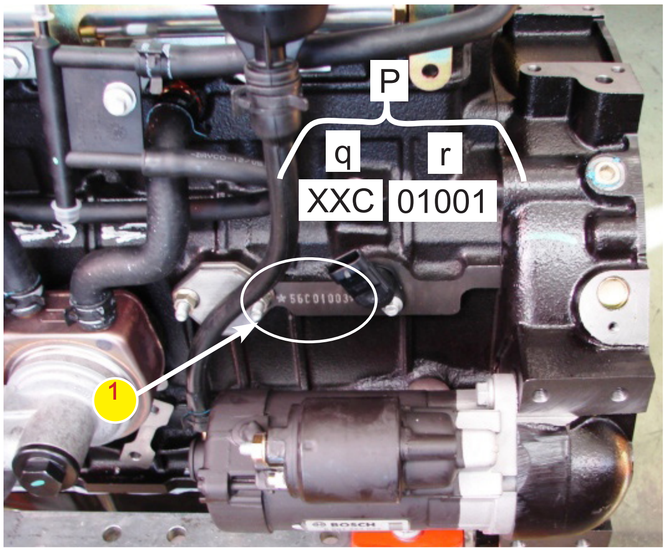
P) Engine serial number (punched on the crankcase)

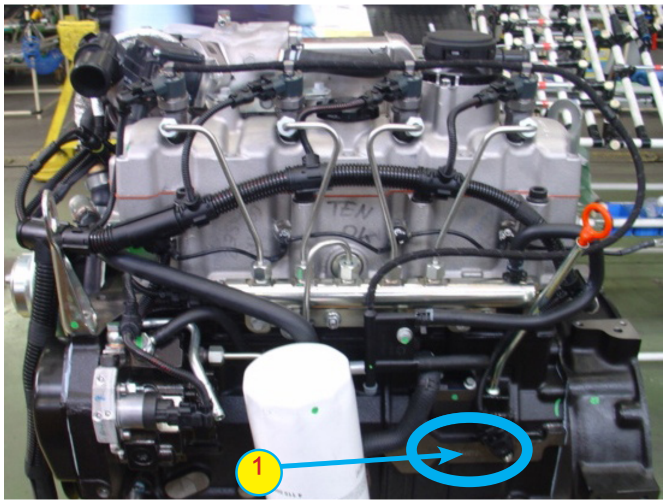
q) Engine code

r) Consecutive number

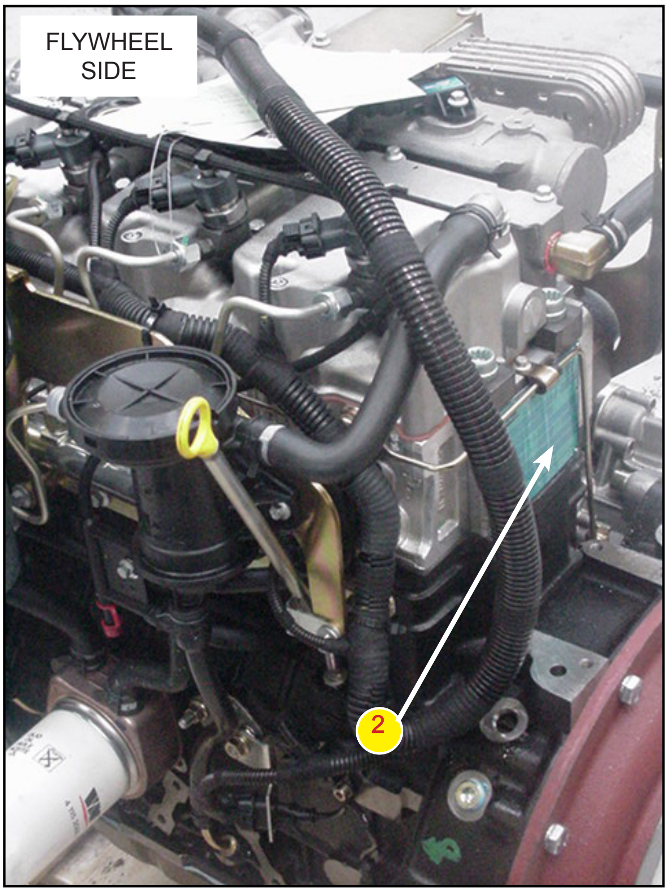
The table helps you to identify the model through the engine code.

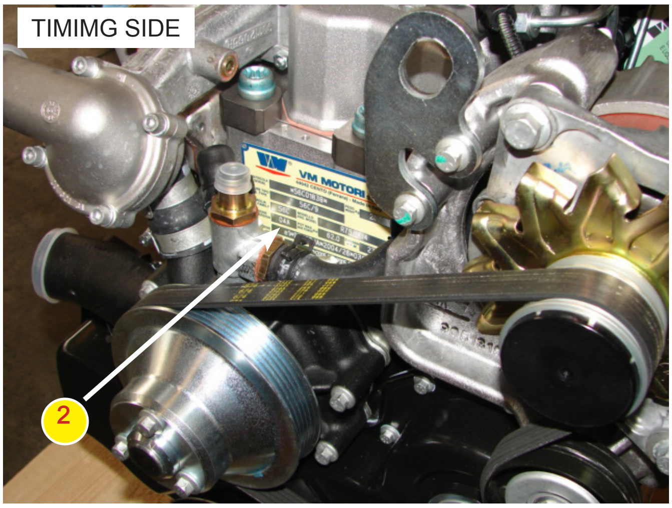
Engine code	Engine model
56C	R754EU4
79C	R756EU4
80C	R756IE3
05D	R754EU5
06D	R756EU5
20D	R754IE3
34D	R754IE4
39D	R754ISE4
45D	R754TE4
50D	R753IE4
60D	R754EU6
61D	R756EU6

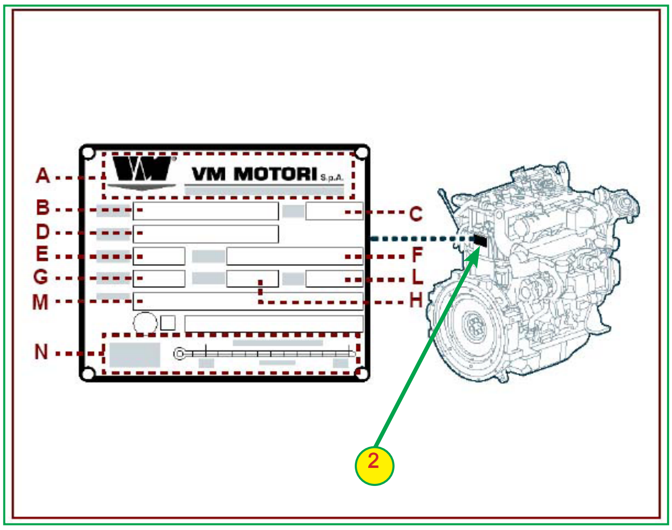




ENGINE PLATE IDENTIFICATION







A) Manufacturer identification
B) Serial number
C) Weight
D) Type
E) Family
F) Model
G) Version
H) Maximum power (kW)
L) Maximum number of revolutions
M) Homologation number
N) Lubricating oil features

MAINTENANCE

ENGINE SPECIFICATIONS

R 754 EU4, R 756 EU4, R 756 IE3

GENERAL SPECIFICATIONS				
	Engine Model		**R754 IE3/EU4**	**R756 IE3/EU4**
Engine	Engine Type		In–line 4 cylinder	In–line 6 cylinder
	Cylinder	Bore	94 mm	
		Stroke	107 mm	
	Firing order		1 - 3 - 4 - 2	1-5-3-6-2-4
	Displacement		2.970 liters	4.455 liters
	Compression Ratio		17,5 ± 0.5 : 1	17,5 ± 0.5 : 1
	Injection System Type		Direct - Common Rail	
	Cooling System Type		Forced Water Cooling	
	Intake System Type		Turbocharger/Intercooler	
	Maximum Power (Ratings are based upon ECE Directive R120) KW (CV)		74 (100) @ 3000 rpm	121 (165) @ 3000 rpm
	Maximum Torque		340 Nm @ 1350 rpm	535 Nm @ 1350rpm
	Engine Rotation (Looking at flywheel)		counterclockwise	
	Idle Speed		800 ± 50 rpm	750 ± 50 rpm
	Weight (Dry)		269 kg	335 kg
	Maximum permanent lengthwise inclination (with flywheel up)		35°	30°
	Maximum permanent lengthwise inclination (with flywheel down)		35°	
	Maximum permanent crosswise inclination		30°	
	Valve clearance - intake and exhaust		Hydraulic	
	Maximum pressure difference between cylinders		500 kPa (72 PSI)	

	Engine Model		R754 IE3/EU4	R756 IE3/EU4
Engine Systems	Fuel	Specifications	The engine has been designed to be powered by standard fuels (conforms to specifications DIN EN 590) available on the European market. If it is to be powered by BIODIESEL fuels (conforms to specifications UNI EN 14214), it can be mixed, **up to 7%**, with fuel (conforms to specifications DIN EN 590) available on the European market. About R750 engine models use only fuel with low sulphur content (not above 10-50 ppm)	
	Fuel System Low Fuel Pressure Line	Fuel Pump Type	Gerotor Type	
		Fuel Flow Rate		
		Fuel Flow Pressure		
		Fuel Filter Type	filtering area filtrante 6300 ± 200 cm2 / filtration efficiency 5 micron @ 95%	
	Fuel System High Fuel Pressure Line	Fuel Pump Type	3 – cylinder radial plunger	
		Delivery/Pump Rotation		
		Common Rail Pressure	max 1400 bar	
		Injection Pressure	max 1350 bar	
		Injector Type	solenoid type	
	Engine Oil	Standard	SAE 10W 40 API CI-4	
		Oil Change (Including Filter) **STANDARD OIL PAN**	10L - 8.7 Kg	13.8L - 12 kg
		Oil Change (Including Filter) **MORE OIL PAN CAPACITY**	/	/
		Oil Change (Including Filter) **COUNTER BALANCER SHAFT IN OIL PAN**	MAX 7.9 Kg	/
		Oil Pump Type	Internal Rotor	
		Thermostat		
		Consumption	0.5 - 1 (gr/CVh)	
		Oil temperature (alarm)	128°C	
		Oil pressure (with hot engine)	1.2 bar (idle 800±50 rpm) / 3.2 bar (rating 3000 rpm)	1.2 bar (idle 750±50 rpm) / 3.2 bar (rating 3000 rpm)
	Coolant System	Normal operating temperature	80-85° C	
		Thermostat	start opening 80 ± 2 °C / 90°C fully open	start opening 80 ± 2 °C / 90°C fully open
		Capacity	5 liters (without radia-tor and pipes)	7.5 liters (without radiator and pipes)
		Water Circuit Pressure	0.9 - 1.1 bar	
		Standard	ASTM D 3306	

Engine Systems	Engine Model		R754 IE3/EU4	R756 IE3/EU4
	Electric System	Battery	12 V	12 V
		Alternator	2.3 Kw - 105 A	2.3 Kw - 110 A
		Starter	12V, 2.4 kW	

Engine Systems	Intake System	Admittable depressure	MAX 70 mbar - with new air filter <35mbar	
		Air Cosumption m3/h	365 @ 3000 rpm	673 @ 3000 rpm
	Exhaust System	Max. Exhaust backpressure	(R750EU4) 350 mbar with DPF (Diesel Particulate Filter) new, clean or regenerated (R750IE3) 250 mbar	
		Exhaust Gas Temperature (in accordance with ECE Regulation R120)	625°C @ 3000 rpm	637°C @ 3000 rpm

R 754 EU5, R 756 EU5

GENERAL SPECIFICATIONS				
	Engine Model		R754 EU5	R756 EU5
Engine	Engine Type		In–line 4 cylinder	In–line 6 cylinder
	Cylinder	Bore	94 mm	
		Stroke	107 mm	
	Firing order		1 - 3 - 4 - 2	1-5-3-6-2-4
	Displacement		2.970 liters	4.455 liters
	Compression Ratio		17,8 ± 0.5 : 1	17,8 ± 0.5 : 1
	Injection System Type		Direct - Common Rail	
	Cooling System Type		Forced Water Cooling	
	Intake System Type		Turbocharger/Intercooler	
	Maximum Power - KW (CV)		74 (100) @ 3000 rpm	121 (165) @ 3000 rpm
	Maximum Torque		340 Nm @ 1400 rpm	500 Nm @ 1400 rpm
	Engine Rotation (Looking at flywheel)		counterclockwise	
	Idle Speed		800 ± 50 rpm	750 ± 50 rpm
	Weight (Dry)		260 kg	335 kg
	Maximum permanent lengthwise inclination (with flywheel up)		30°/57%	30°
	Maximum permanent lengthwise inclination (with flywheel down)		35°/70%	
	Maximum permanent crosswise inclination		30°/57%	
	Valve clearance - intake and exhaust		Hydraulic	
	Maximum pressure difference between cylinders		500 kPa (72 PSI)	

	Engine Model		R754 EU5	R756 EU5
Engine Systems	Fuel	Specifications	The engine has been designed to be powered by standard fuels (conforms to specifications DIN EN 590/2004) available on the European market. If it is to be powered by BIODIESEL fuels (conforms to specifications UNI EN 14214), it can be mixed, **up to 7%**, with fuel (conforms to specifications DIN EN 590) available on the European market. About R750E engine models use only fuel with low sulphur content (not above 10-50 ppm)	
	Fuel System Low Fuel Pressure Line	Fuel Pump Type	Gerotor Type	
		Fuel Flow Rate		
		Fuel Flow Pressure		
		Fuel Filter Type	Filter efficiency in according Bosch std KM 45 110 004_ en / Water separation in according ISO 16332	
	Fuel System High Fuel Pressure Line	Fuel Pump Type	3 – cylinder radial plunger	
		Delivery/Pump Rotation		
		Common Rail Pressure	max 1600 bar	
		Injection Pressure		
		Injector Type	solenoid type	
	Engine Oil	Standard	SAE 10W 40 ACEA E6 - API CJ4	
		Oil Pan Capacity **STANDARD OIL PAN**	10L -8,7 Kg	13.8L - 12 kg
		Oil Change (Including Filter) **MORE OIL PAN CAPACITY**	/	(modello R756EU5.01A - 16,5 KG - 18.9 L)
		Oil Pan Capacity **COUNTER BALANCER SHAFT IN OIL PAN**	7.9 kg	/
		Oil Pump Type	Internal Rotor	
		Thermostat		
		Consumption	0.2 (gr/KWh)	
		Oil temperature (alarm)	135°C	
		Oil pressure (with hot engine)	> 1.5 bar / 120°C (rpm engine idle) 4 - 4.5 bar / 80°C (max 3000 rpm)	
	Coolant System	Normal operating temperature	80-85° C	
		Thermostat	start opening 80 ± 2 °C / 90°C fully open	start opening 80 ± 2 °C / 90°C fully open
		Capacity	5 liters (without radiator and pipes)	7.5 liters (without radiator and pipes)
		Water Circuit Pressure	0.9 - 1.1 bar	
		Standard	ASTM D 3306	

			R754 EU5	R756 EU5
Engine Systems	Engine Model		R754 EU5	R756 EU5
Engine Systems	Electric System	Battery	12 V Cold Cranking Amps (CCA) 950 A EN Capacity 140 Ah	
		Alternator	14V - 2.3 Kw - 105 A	
		Starter	12V, 2.5kW	

Engine Systems	Intake System	Admittable depressure	max 40 mbar - with new air filter	
		Air Cosumption m3/h		
	Exhaust System	Max. Exhaust backpressure	(R754EU5 350 mbar) - (R756EU5 - 450 mbar) with DPF (Diesel Particulate Filter) new, clean or regenerated	
		Exhaust Gas Temperature after turbocharger	569 °C	

R 754 TE4, IE4, ISE4

GENERAL SPECIFICATIONS					
	Engine Model		**R754TE4**	**R754IE4**	**R754ISE4**
Engine	Engine Type		In–line 4 cylinder		
	Cylinder	Bore	94 mm		
		Stroke	107 mm		
	Firing order		1 - 3 - 4 - 2		
	Displacement		2.970 liters		
	Compression Ratio		17,5 ± 0.5 : 1		
	Injection System Type		Direct - Common Rail		
	Cooling System Type		Forced Water Cooling		
	Intake System Type		Turbocharger	Turbocharger/Intercooler	
	Maximum Power - KW (CV)			(108.8) @ 2600 rpm	(75.3) @ 2600 rpm
	Maximum Torque			420 Nm @ 1100 rpm	310 Nm @ 1100 rpm
	Engine Rotation (Looking at flywheel)		counterclockwise		
	Idle Speed		800 ± 50 rpm		
	Weight (Dry)		260 kg		
	Maximum permanent lengthwise inclination (with flywheel up)		30°/57%		
	Maximum permanent lengthwise inclination (with flywheel down)		35°/70%		
	Maximum permanent crosswise inclination		30°/57%		
	Valve clearance - intake and exhaust		Hydraulic		
	Maximum pressure difference between cylinders		500 kPa (72 PSI)		

	Engine Model		R754TE4	R754IE4	R754ISE4
Engine Systems	Fuel	Specifications	The engine has been designed to be powered by standard fuels (conforms to specifications DIN EN 590/2004) available on the European market. If it is to be powered by BIODIESEL fuels (conforms to specifications UNI EN 14214), it can be mixed, **up to 7%**, with fuel (conforms to specifications DIN EN 590) available on the European market. About R750E engine models use only fuel with low sulphur content (not above 10-50 ppm)		
	Fuel System Low Fuel Pressure Line	Fuel Pump Type	Gerotor Type		
		Fuel Flow Rate			
		Fuel Flow Pressure			
		Fuel Filter Type	Filter efficiency in according Bosch std KM 45 110 004_en / Water separation in according ISO 16332		
	Fuel System High Fuel Pressure Line	Fuel Pump Type	3 – cylinder radial plunger		
		Delivery/Pump Rotation			
		Common Rail Pressure			
		Injection Pressure	max 1800 bar		
		Injector Type	solenoid type		
	Engine Oil	Standard	SAE 10W 40 ACEA E6 - API CJ4		
		Oil Pan Capacity **STANDARD OIL PAN**	9.8 L (8.7 Kg)	9.8 L (8.7 Kg)	9.8 L (8.7 Kg)
		Oil Change (Including Filter) **MORE OIL PAN CAPACITY**		model R754IE4.05A - 13L (11.5Kg)	
		Oil Pan Capacity **COUNTER BALANCER SHAFT IN OIL PAN**		/	/
		Oil Pump Type	Internal Rotor		
		Thermostat			
		Consumption	0.2 (gr/KWh)		
		Oil temperature (alarm)	135°C		
		Oil pressure (with hot engine 80°C)	2 bar (rpm engine idle) 4 bar (max 2600 rpm)		
	Coolant System	Normal operating temperature	80-85° C		
		Thermostat	start opening 80 ± 2 °C / 90°C fully open		
		Capacity	5 liters (without radiator and pipes)		
		Water Circuit Pressure	1.0 - 1.2 bar		
		Standard	ASTM D 3306 type 1		

	Engine Model		R754TE4	R754IE4	R754ISE4
Engine Systems	Electric System	Battery	12 V Cold Cranking Amps (CCA) 950 A EN Capacity 140 Ah		
		Alternator	14V - 2.3 Kw - 110 A		
		Starter	12V, 2.5kW		

Engine Systems	Intake System	Admittable depressure	max 30 mbar - with new air filter		
		Air Cosumption m3/h			
	Exhaust System	Max. Exhaust backpressure	250 mbar with DPF (Diesel Particulate Filter) new, clean or regenerated		
		Exhaust Gas Temperature after turbocharger		616°C @ 2600 rpm	522.3°C @ 2600 rpm

R 754 EU6, R 756 EU6

GENERAL SPECIFICATIONS				
	Engine Model		**R754 EU6**	**R756 EU6**
Engine	Engine Type		In–line 4 cylinder	In–line 6 cylinder
	Cylinder	Bore	94 mm	
		Stroke	107 mm	
	Firing order		1 - 3 - 4 - 2	1-5-3-6-2-4
	Displacement		2.970 liters	4.455 liters
	Compression Ratio		17,5 ± 0.5 : 1	17,5 ± 0.5 : 1
	Injection System Type		Direct - Common Rail	
	Cooling System Type		Forced Water Cooling	
	Intake System Type		Turbocharger/Intercooler	
	Maximum Power - KW (CV)		84 (112) @ 3000 rpm	120 (163.2) @ 3000 rpm
	Maximum Torque		420 Nm @ 1100 rpm	500 Nm @ 1400
	Engine Rotation (Looking at flywheel)		counterclockwise	
	Idle Speed		800 ± 150 rpm	800 ± 150 rpm
	Weight (Dry)		260 ± 20 kg	335 kg
	Maximum permanent lengthwise inclination (with flywheel up)		30°/57%	
	Maximum permanent lengthwise inclination (with flywheel down)		35°/70%	
	Maximum permanent crosswise inclination		30°/57%	
	Valve clearance - intake and exhaust		Hydraulic	
	Maximum pressure difference between cylinders		500 kPa (72 PSI)	

			R754 EU6	R756 EU6
	Engine Model		**R754 EU6**	**R756 EU6**
Engine Systems	Fuel	Specifications	The engine has been designed to be powered by standard fuels (conforms to specifications DIN EN 590/2004) available on the European market. If it is to be powered by BIODIESEL fuels (conforms to specifications UNI EN 14214), it can be mixed, **up to 7%**, with fuel (conforms to specifications DIN EN 590) available on the European market. About R750E engine models use only fuel with low sulphur content (not above 10-50 ppm)	
	Fuel System Low Fuel Pressure Line	Fuel Pump Type	Gerotor Type	
		Fuel Flow Rate		
		Fuel Flow Pressure		
		Fuel Filter Type	Filter efficiency in according Bosch std KM 45 110 004_ en / Water separation in according ISO 16332	
	Fuel System High Fuel Pressure Line	Fuel Pump Type	3 – cylinder radial plunger	
		Delivery/Pump Rotation		
		Common Rail Pressure	max 1800 bar	
		Injection Pressure		
		Injector Type	solenoid type	
	Engine Oil	Standard	SAE 10W 40 ACEA E6, E9 - API CJ4	
		Oil Pan Capacity **STANDARD OIL PAN**	9.8 L (8.7 Kg)	13.8L - 12 kg
		Oil Change (Including Filter) **MORE OIL PAN CAPACITY**	model R754EU6.05A 13L (11.5Kg)	model R756EU6.01A model R756EU6.05A - 18.9 L - (16,5 KG)
		Oil Pan Capacity **COUNTER BALANCER SHAFT IN OIL PAN**	/	/
		Oil Pump Type	Internal Rotor	
		Thermostat		
		Consumption	0.2 (gr/KWh)	
		Oil temperature (alarm)	135°C	
		Oil pressure (with hot engine)	2 bar / 80°C (rpm engine idle) 4 - 4.5 bar / 80°C (max 3000 rpm)	
	Coolant System	Normal operating temperature	80-85° C	
		Thermostat	start opening 80 ± 2 °C / 90°C fully open	start opening 80 ± 2 °C / 90°C fully open
		Capacity	5 liters (without radiator and pipes)	7.5 liters (without radiator and pipes)
		Water Circuit Pressure	1 - 1.2 bar	
		Standard	ASTM D 3306 type1	
	DIesel Exhaust Fluid "DEF"	Standard	Aqueous Urea Solution (AUS32) conform to ISO 22241 specifications	

	Engine Model		R754 EU6	R756 EU6
Engine Systems	Electric System	Battery	12 V Cold Cranking Amps (CCA) 950 A EN Capacity 140 Ah	
		Alternator	14V - 2.3 Kw - 105 A	
		Starter	12V, 2.5kW	

Engine Systems	Intake System	Admittable depressure	max 40 mbar - with new air filter	
		Air Cosumption m3/h		
	Exhaust System	Max. Exhaust backpressure	(R754EU6 350 mbar) - (R756EU5 - mbar) with Aftertreatment system devices DPF + DOC + SCR, new, clean	
		Exhaust Gas Temperature after turbocharger	562.8° C @ 2600 RPM	616,6° C @ 3000 giri/min

MAINTENANCE INTERVALS

⚠ **WARNING**

Avoid injury or death, product damage, fire or explosion. The electrical system is capable of violent and damaging short circuits or severe electrical shocks. When performing any activity where any electrical terminals could possibly be grounded or touched, the battery cables should be disconnected at the battery.
Always disconnect battery cables from the battery before working around electrical system components to prevent injury to yourself and damage to the electrical system should a wire be accidentally shorted.

MAINTENANCE SCHEDULE - R750 EURO 4 - IE3

AFTER FIRST 50 HOURS

• **REPLACE THE ENGINE OIL FILTER** (If the engine has not been in operation, the filter must be replaced once every 12 months)

EVERY 10 HOURS OR EVERY DAY

• **CHECK THE ENGINE OIL LEVEL**. (This task interval can be extended based on operator experience with the product.)
• **CHECK THE COOLANT LEVEL**
• **CHECK THE AIR FILTER ELEMENT CLEANING AND POSSIBLE REPLACEMENT IF DIRTY**
• **CHECK THE RADIATOR CLEANING**

EVERY 300 HOURS

• **CHANGE THE ENGINE OIL.** (Or every year, whichever occurs first.)

⚠ In particulary severe operating conditions, in dusty environments and when operating under extreme loads, the engine oil must be replaced every 150 working hours.

• **REPLACE THE ENGINE OIL FILTER** (Or every year, whichever occurs first.)
• **REPLACE THE FUEL FILTER** (every 300 hours or 30.000 km.) (Or every year, whichever occurs first.)

EVERY 900 HOURS

• **REPLACE THE POLY-V ALTERNATOR BELT** (Or every 2 years, whichever occurs first.)

EVERY 1200 HOURS

• **REPLACE ENGINE COOLANT** (Or every 2 years, whichever occurs first.)

EVERY 1500 HOURS or 50.000 km

• **DIESEL PARTICULATE FILTER CLEANING**

EVERY 4000 HOURS

• **PARTIAL ENGINE OVERHAUL**

EVERY 8000 HOURS

• **TOTAL ENGINE OVERHAUL**

MAINTENANCE SCHEDULE - R750EU5 - R750EU6 - R750TE4-IE4-ISE4

AFTER FIRST 50 HOURS

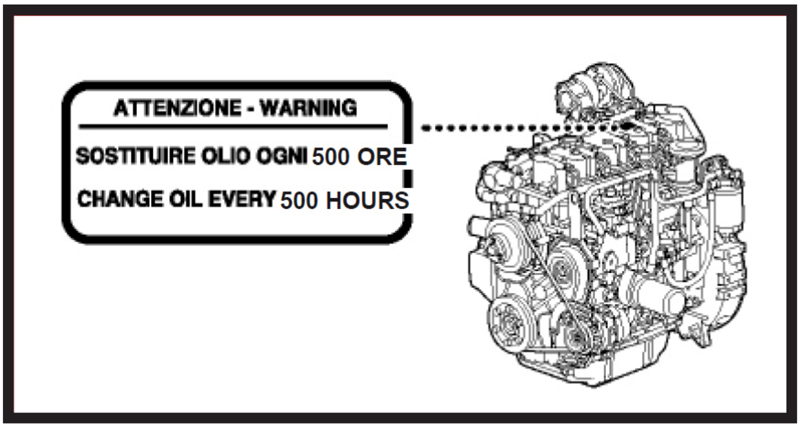
• **REPLACE THE ENGINE OIL FILTER** (If the engine has not been in operation, the filter must be replaced once every 12 months)

EVERY 10 HOURS OR EVERY DAY

• **CHECK THE ENGINE OIL LEVEL**. (This task interval can be extended based on operator experience with the product.)
• **CHECK THE COOLANT LEVEL**
• **CHECK THE AIR FILTER ELEMENT CLEANING AND POSSIBLE REPLACEMENT IF DIRTY**
• **CHECK THE RADIATOR CLEANING**

EVERY 300 HOURS

IMPORTANT: Engine models R754IE4.05A, R756EU5.01A, R754EU6.05A, R756EU6.01A-R756EU6.01A, the oil change can be carried out EVERY 500 hours (engine equipped with oil pan, major oil capacity). On rocker arm cover is applied a yellow label in order to remind the oil change interval at EVERY 500 HOURS of engine operation. (see photo).



• **CHANGE THE ENGINE OIL.** (Or every year, whichever occurs first.)

IMPORTANT: Whenever the engine oil is changed it is necessary to reset the OIL DILUTION CALCULATION function (refer to paragraph OIL DILUTION CALCULATION).

⚠ In particular severe operating conditions, in dusty environments and when operating under extreme loads, the engine oil must be replaced every 150 working hours.

• **REPLACE THE ENGINE OIL FILTER** (Or every year, whichever occurs first.)
• **REPLACE THE FUEL FILTER** (every 300 hours or 30.000 km.) (Or every year, whichever occurs first.)
• **REPLACE AIR FILTER CARTRIDGE**
• **CHECK THE CLEANING OF AIR INTAKE CIRCUIT**
• **CHECK THE CLEANING AND TIGHTNESS OF INTERCOOLER PIPES**
• **CHECK THE TIGHTNESS OF OIL SEPARATOR PIPES AND RELATED SYSTEM**
• **CHECK THE TIGHTNESS OF VACUUM PUMP PIPES AND RELATED SYSTEM**
• **CHECK THE CLEANING OF EXHAUST CIRCUIT FROM DUST**

EVERY 600 HOURS

- **CHECK CHEMICAL FEATURES OF ENGINE COOLANT**

EVERY 900 HOURS

- **REPLACE THE POLY-V ALTERNATOR BELT** (Or every 2 years, whichever occurs first.)
- **CHECK THE CLEANING OF FUEL TANK AND RELATED FILLING PLUG**
- **REPLACE THE SERVICE INDICATOR ON AIR FILTER**

EVERY 1000 HOURS

- **REPLACE DCU BOX FILTER**

EVERY 4000 HOURS

- **REPLACE ENGINE COOLANT** (Or every 4 years, whichever occurs first.)

EVERY 4000 HOURS

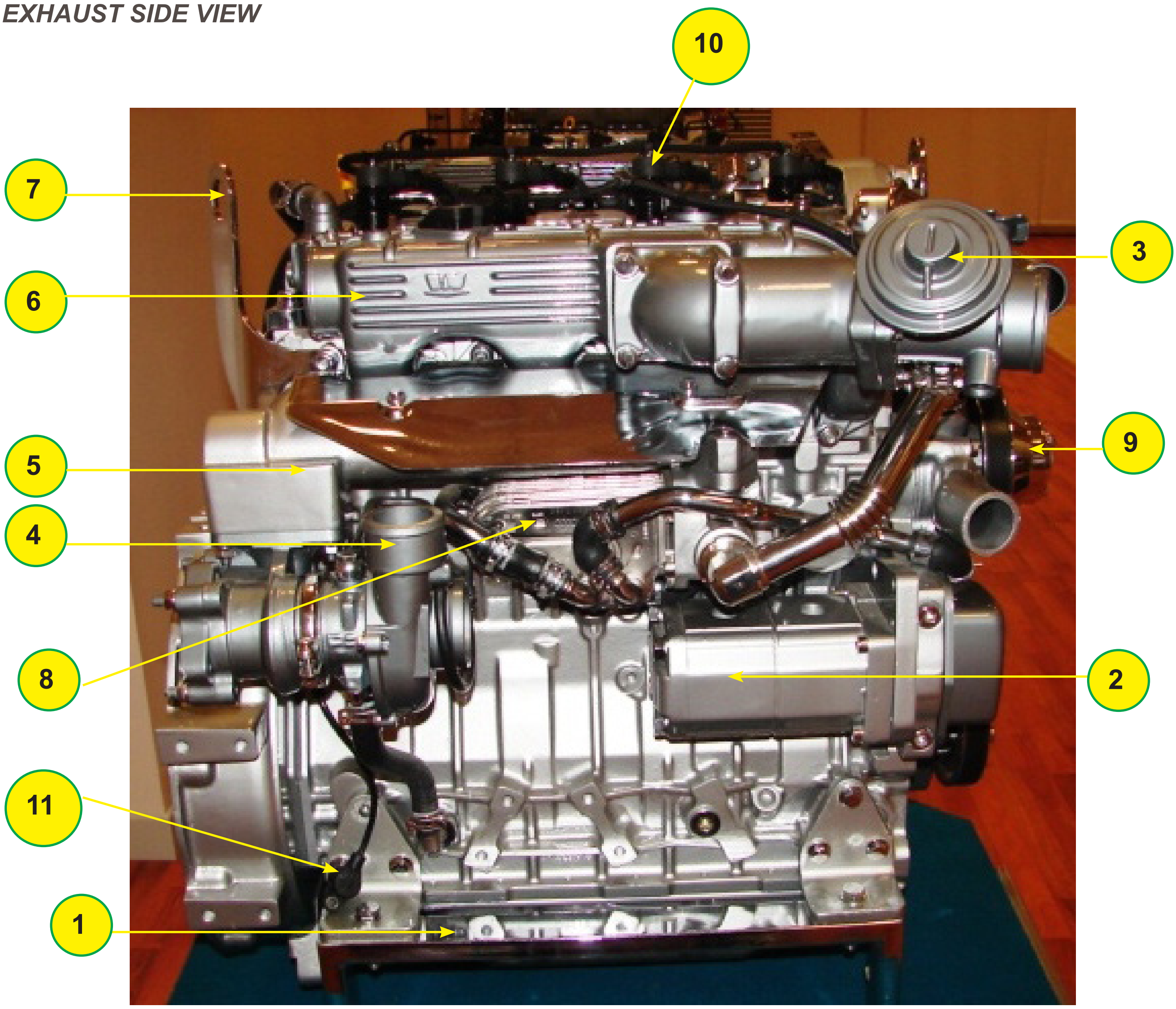
- **PARTIAL ENGINE OVERHAUL**
- **DIESEL PARTICULATE FILTER REGENERATION**

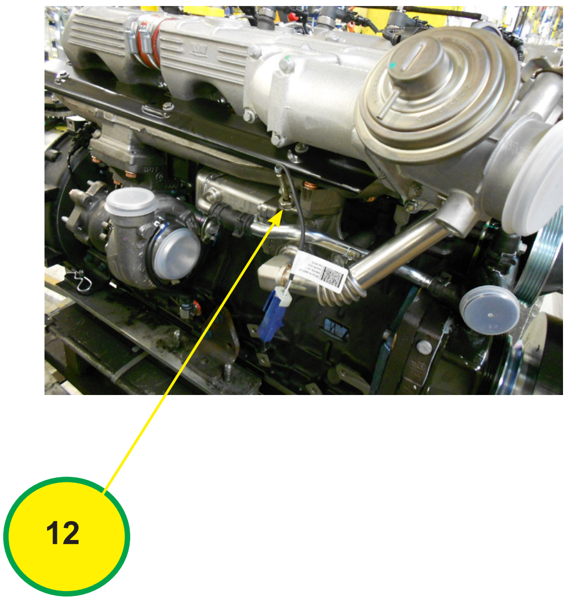
EVERY 8000 HOURS

- **TOTAL ENGINE OVERHAUL**

ENGINE EXTERNAL VIEWS - R750EU4, EU5, IE3

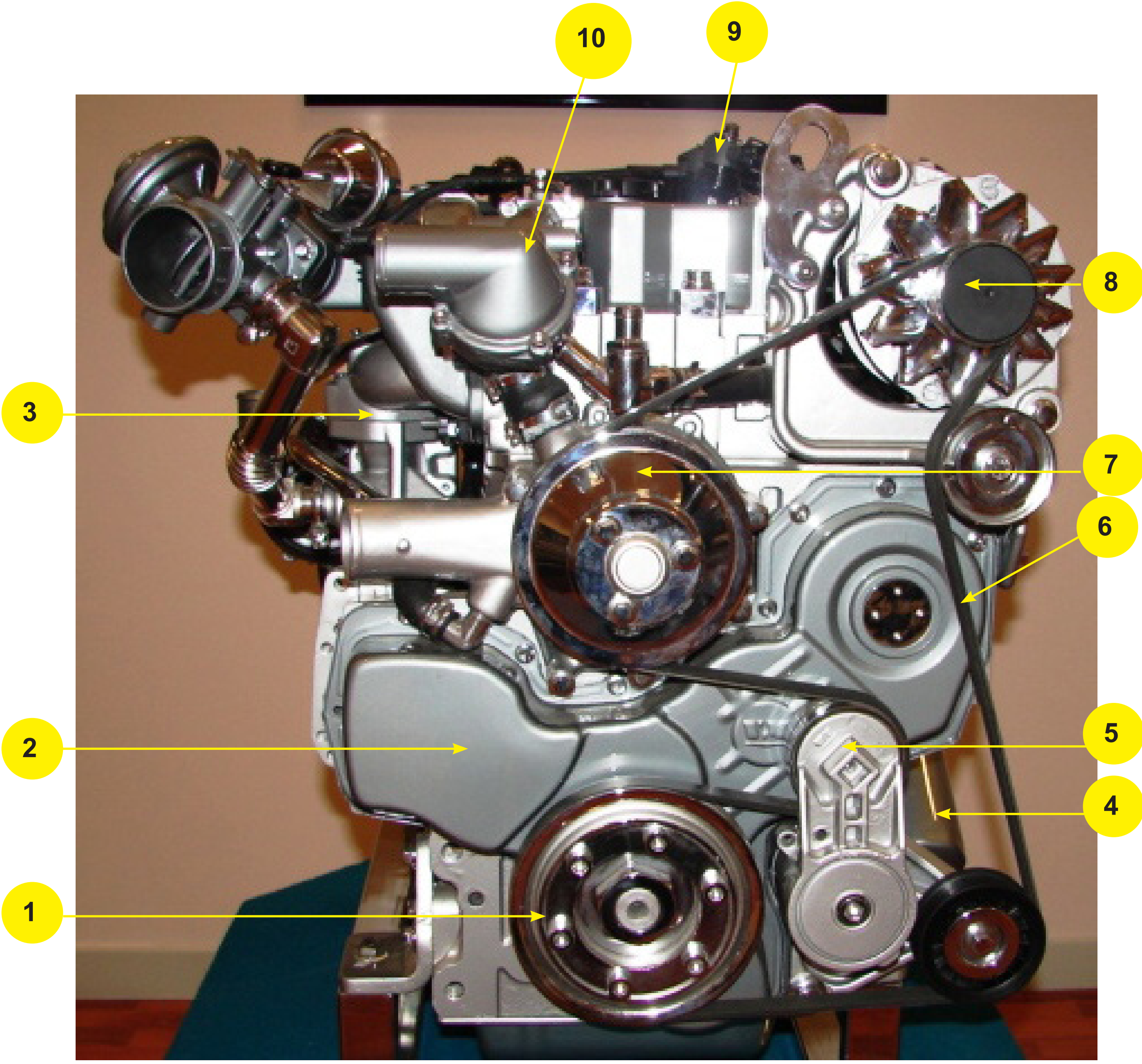
EXHAUST SIDE VIEW





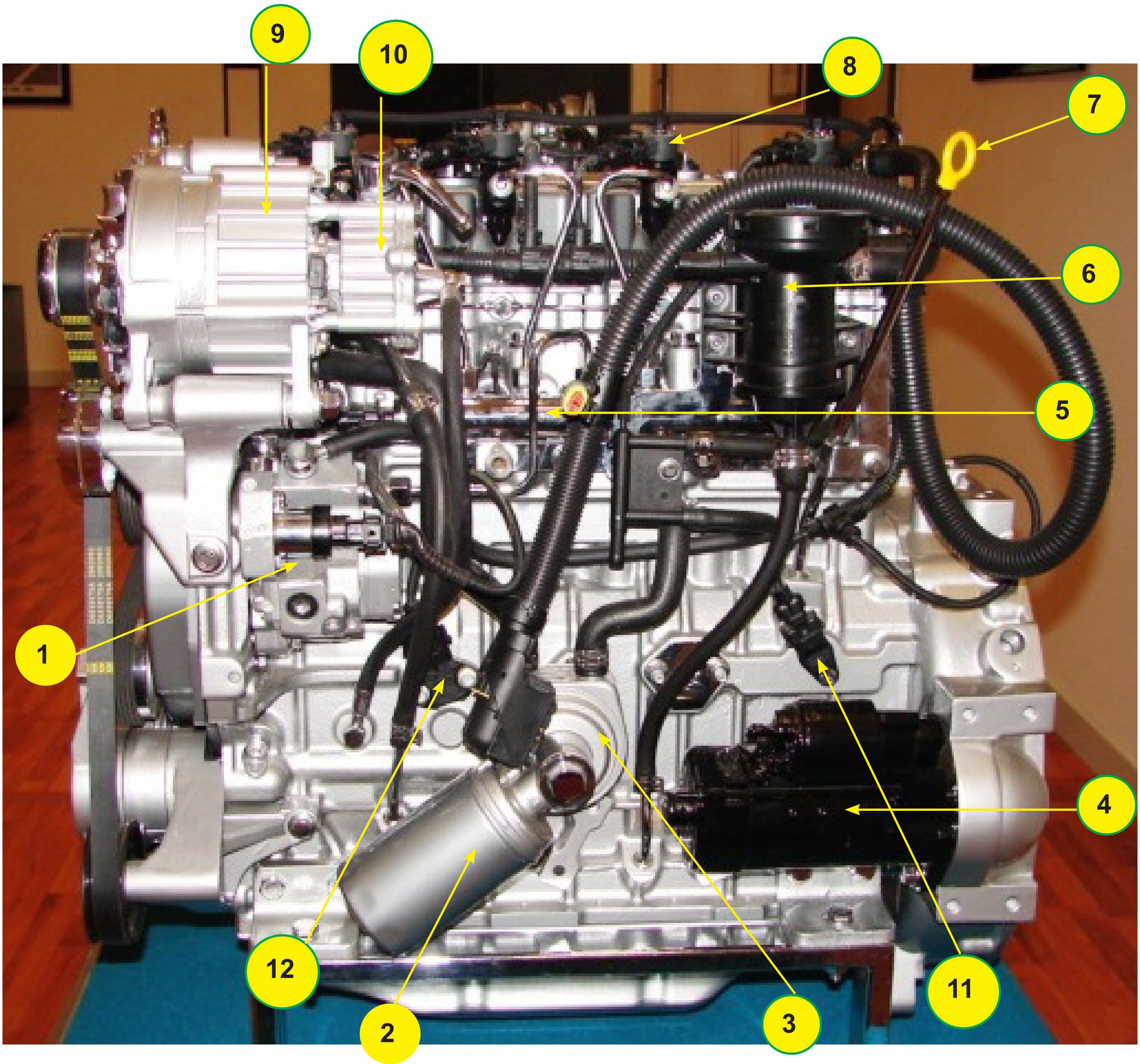
1. Oil pan
2. Hydraulic pump
3. EGR valve and Intake Throttle
4. Turbocharger
5. Exhaust manifold
6. Intake manifold
7. Rear Engine lifting eye
8. EGR cooler
9. Water pump pulley
10. Injector
11. Crankshaft speed sensor / crankshaft position sensor
12. Exhaust temperature Sensor on EGR cooler assy (installed on engine models R756EU6)

TIMING SIDE VIEW



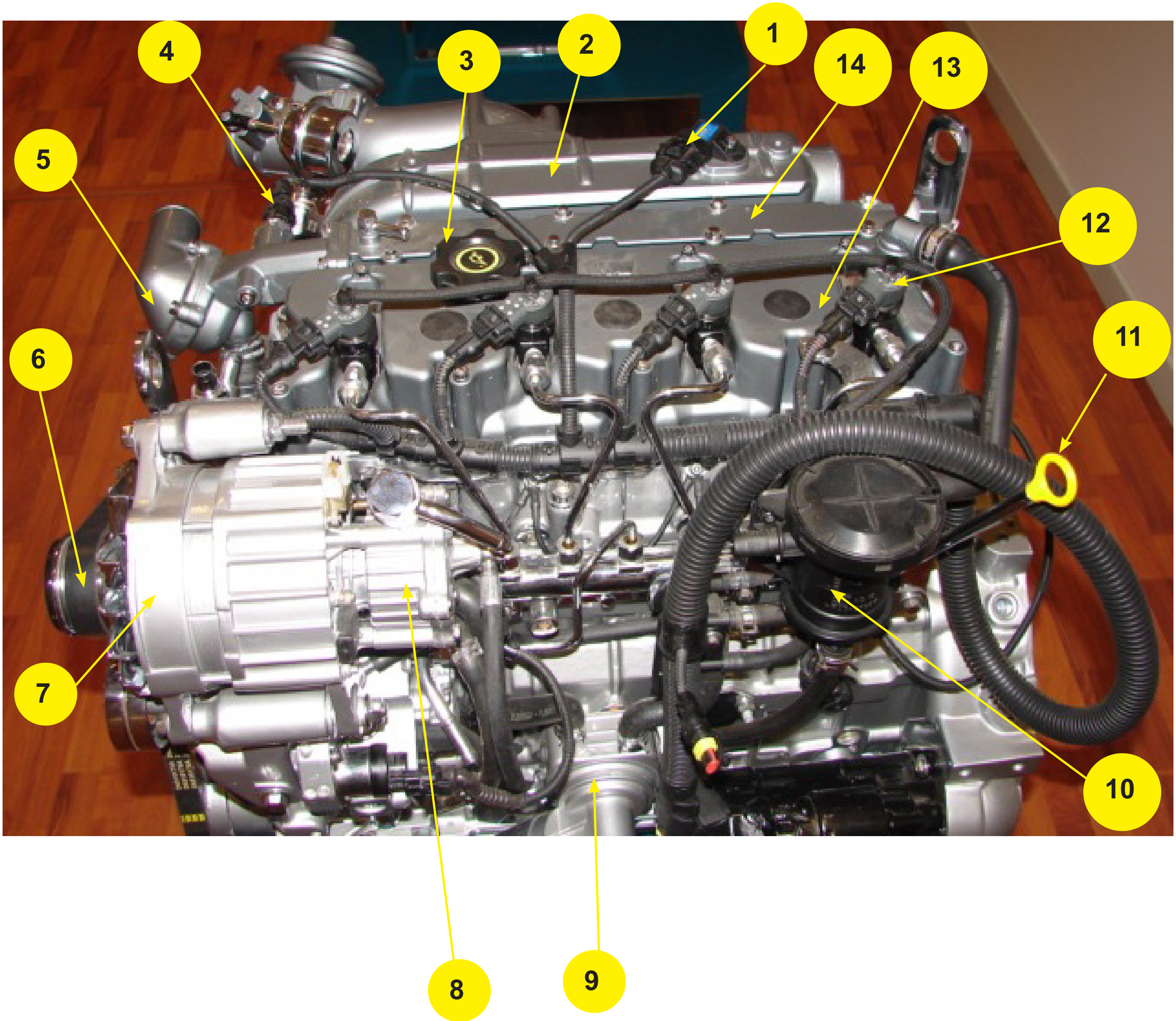
1. Crankshaft pulley
2. Timing cover
3. Turbocharger
4. Oil filter
5. Automatic belt tensioner
6. Alternator Poly V Belt
7. Water pump pulley
8. Alternator
9. Injector
10. Coolant manifold (thermostatic valve housing)

INJECTION SIDE VIEW



1. High pressure pump
2. Oil filter
3. Oil heat exchanger
4. Starter
5. Rail
6. Oil separator
7. Oil dipstick tube
8. Injector
9. Alternator
10. Vacuum pump
11. Camshaft sensor
12. Oil pressure & temperature sensor

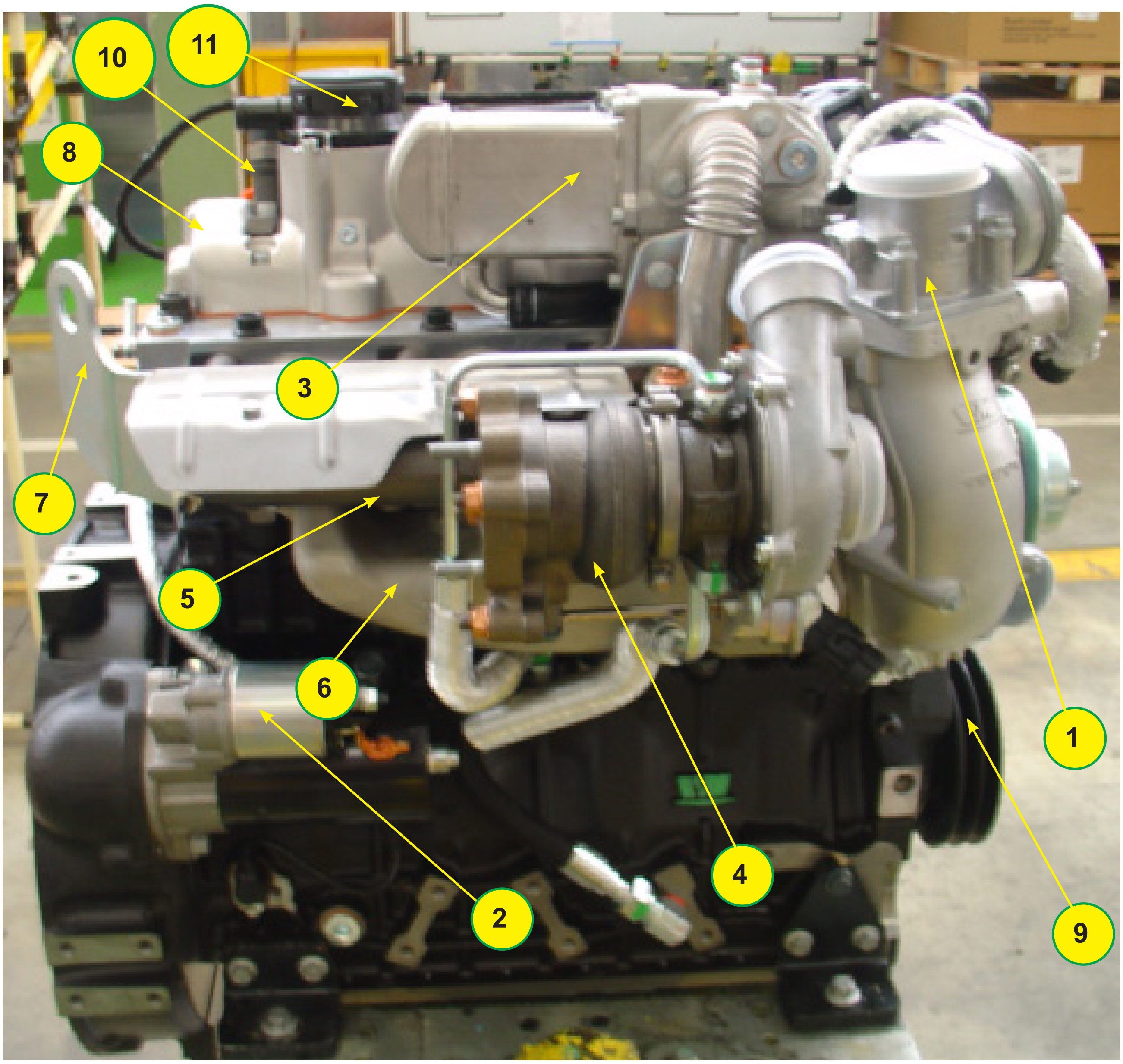
TOP SIDE VIEW



1. Intake temperature & pressure sensor
2. Intake manifold
3. Oil filler cap
4. Coolant temperature sensor
5. Thermostatic valve housing
6. Poly V belt alternator
7. Alternator
8. Vacuumm pump
9. Oil filter housing
10. Oil separator
11. Oil dipstick tube
12. Injector
13. Rocker arm valve cover
14. Coolant manifold

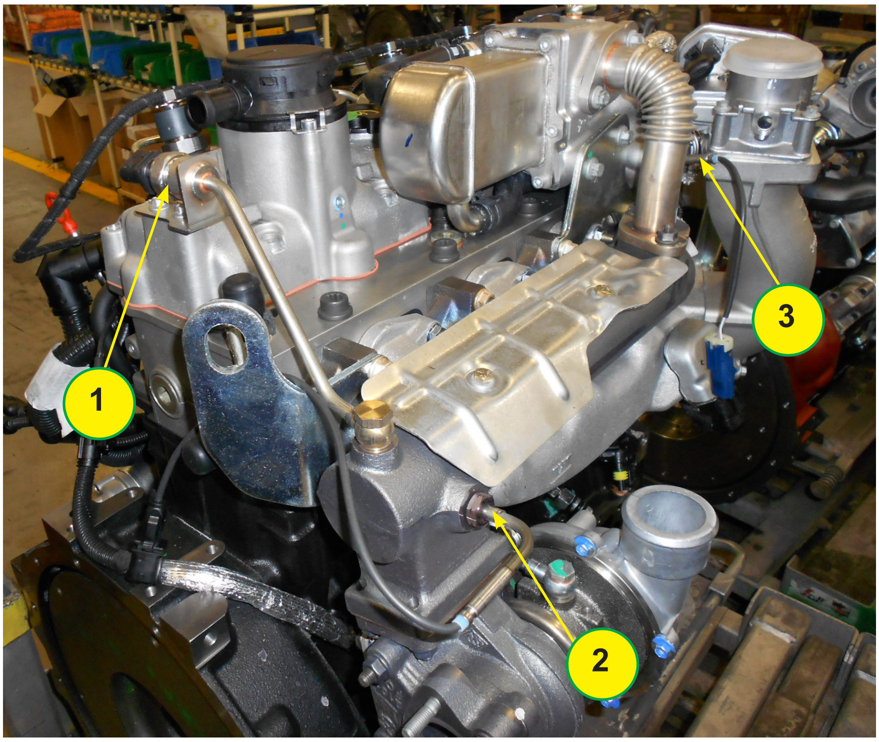
ENGINE EXTERNAL VIEWS - R750TE4, IE4, ISE4, R754EU6

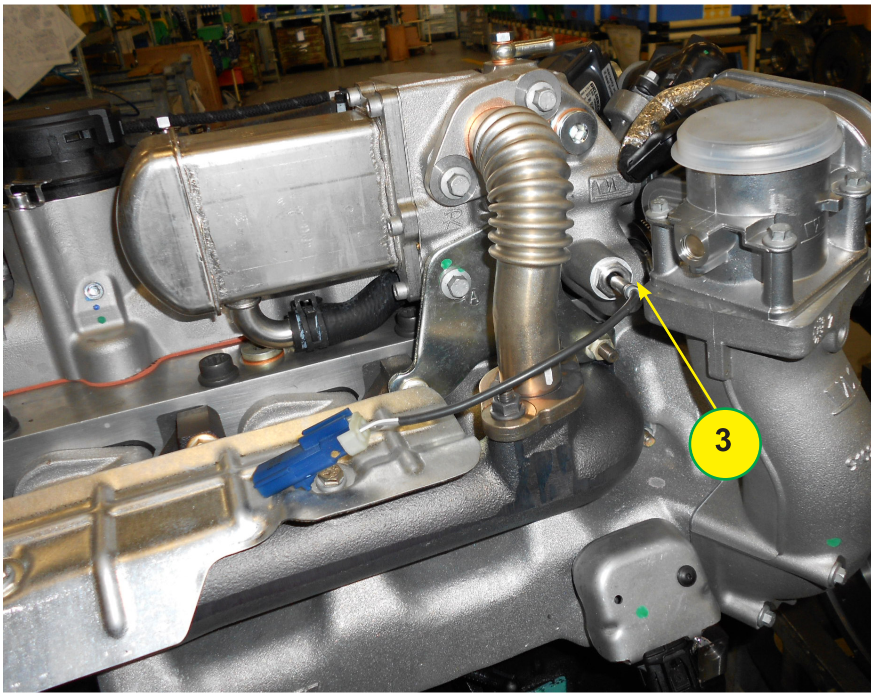
EXHAUST SIDE VIEW



1. Electrical Intake Throttle Valve TVA
2. Starter Motor
3. EGR cooler
4. Turbocharger
5. Exhaust Manifold
6. Intake Manifold
7. Engine Rear Eye Lift bracket
8. Rocker Arms Cover
9. Crankshaft Pulley
10. Injector
11. Oil separator

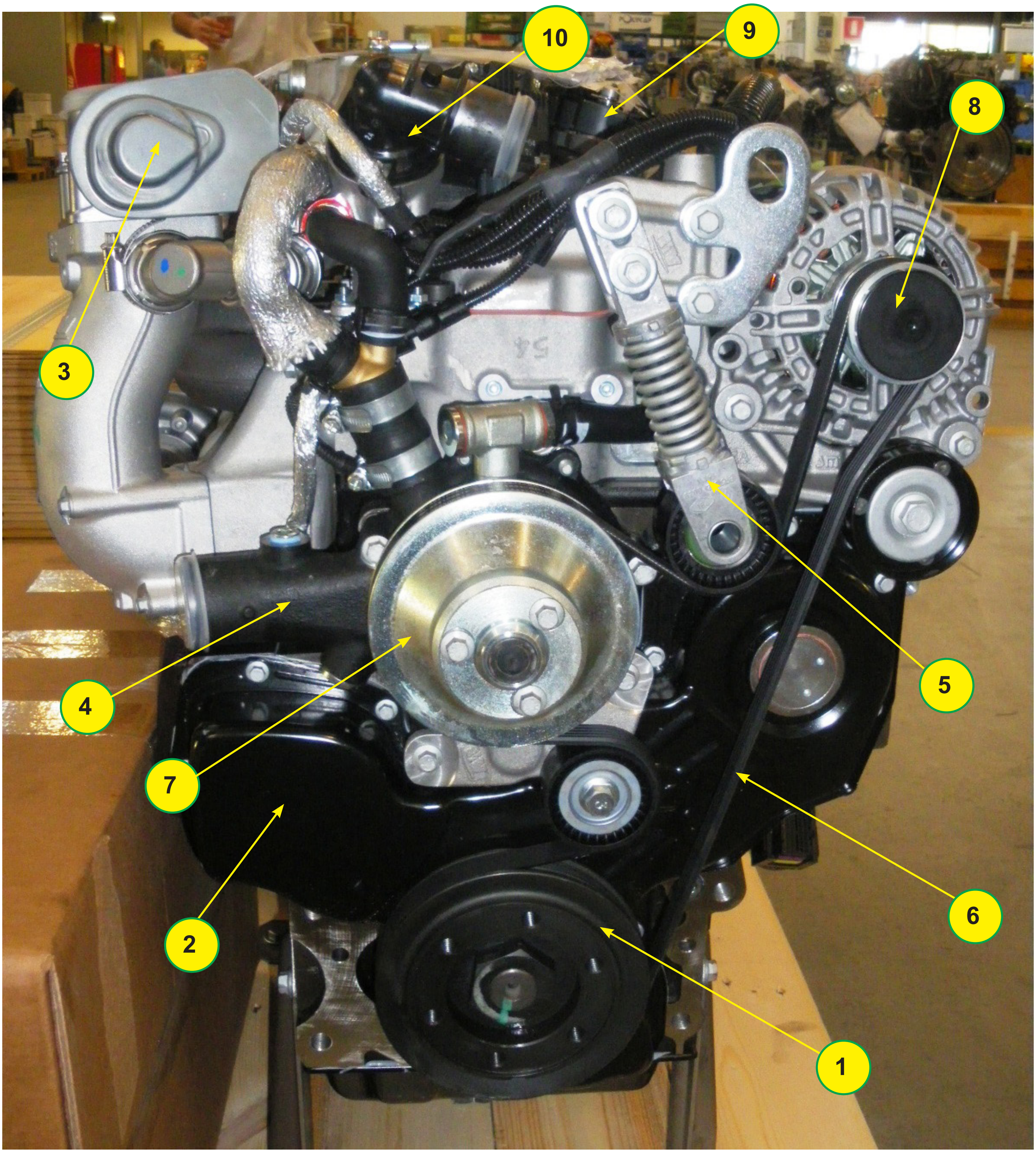
R754EU6





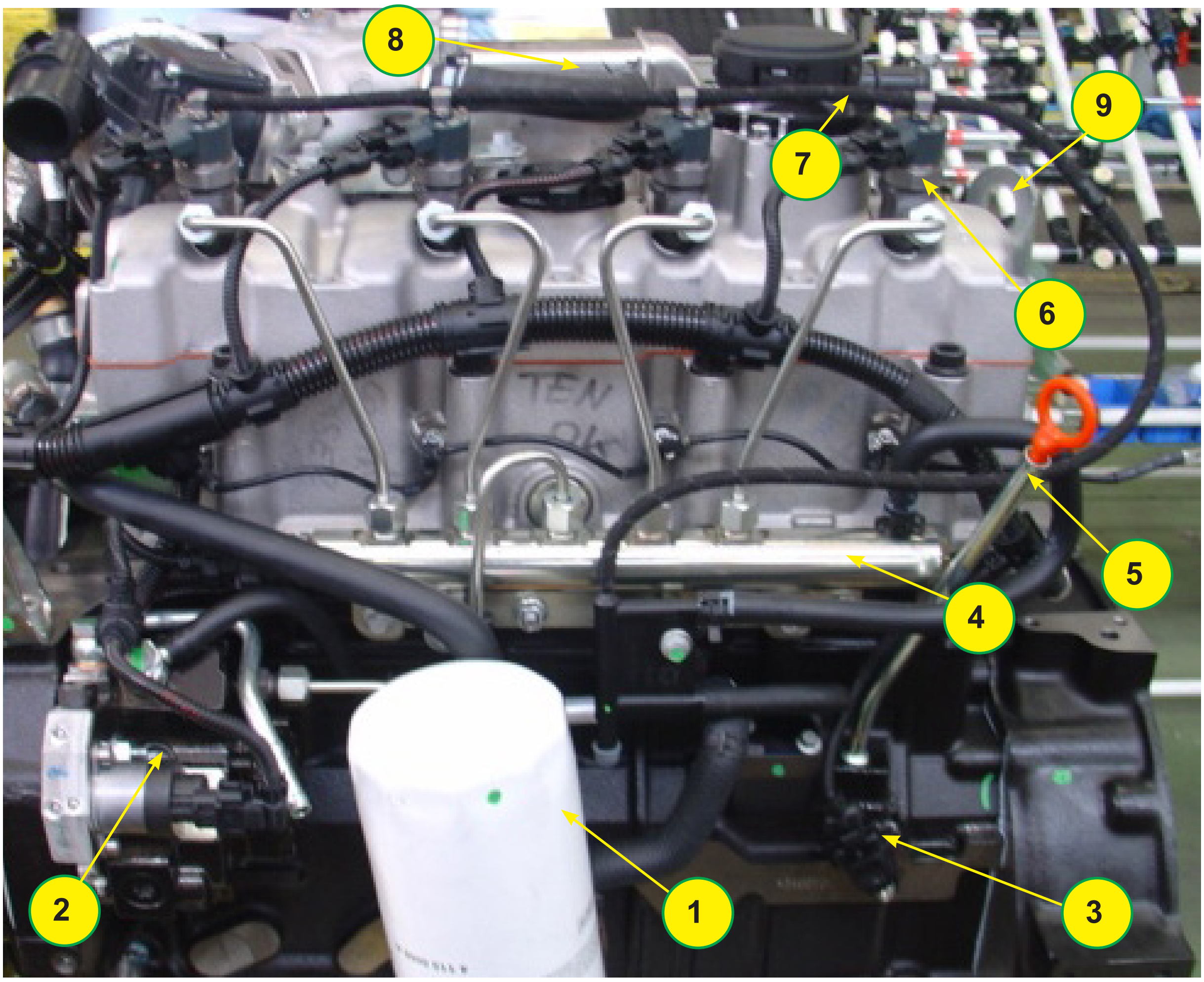
1. Exhaust gas pressure sensor
2. Exhaust gas temperature sensor
3. Exhaust gas temperature sensor

TIMING SIDE VIEW



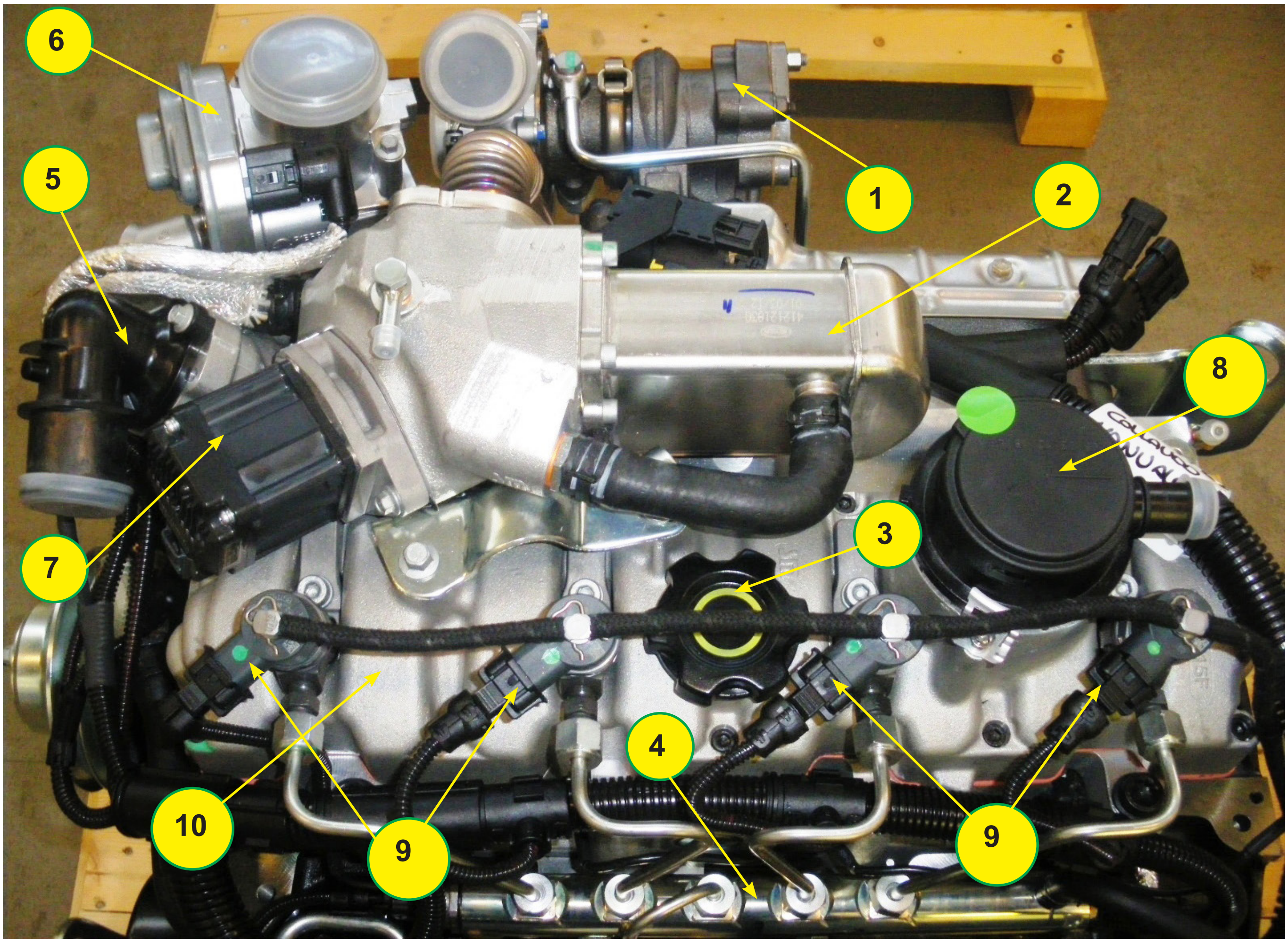
1. Crankshaft pulley
2. Timing Cover
3. Intake Throttle Valve TVA (electrical valve)
4. Coolant pump
5. Poly-v belt tensioner
6. Poly V belt
7. Coolant Pump Pulley
8. Alternator
9. Injector
10. Coolant Thermostatic valve - Cover

INJECTION SIDE VIEW



1. Oil Filter
2. High Pressure Injection Pump
3. Camshaft Sensor
4. Common Rail
5. Oil dipstick (pipe)
6. Injector
7. Oil Separator
8. Exhaust Gas Heat Exchanger (EGR cooler)
9. Engine eye rear lifting

TOP SIDE VIEW



1. Turbocharger
2. Exhaust Gas Heat Exchanger (EGR cooler)
3. Engine Lube Oil - Filler Cap
4. Rail
5. Coolant Thermostatic Valve - Cover
6. Intake Throttle Valve TVA (electrical)
7. (Electrical EGR Valve)
8. Oil separator
9. Injector
10. Rocker Arms Cover

ENGINE OIL

SPECIFICATIONS

To help obtain optimum engine performance and to provide maximum protection, the engine requires engine oil with a rating of ACEA-SAE-API.
We strongly recommend the use of the following engine oil specifications:

SAE	10W - 40 (Synthetic Based Engine Oil)

R750 EURO 4	
ACEA	
API	CI-4

R750 EU5 / EU6 - R750TE4, IE4, ISE4	
ACEA	E6, E9
API	CJ-4

IMPORTANT:

the engine oil used on R750 EU5 / EU6 engine models is valid on engines R750EU4 too.

OIL LEVEL

IMPORTANT

Two (2) different oil pans, with different oil capacity, are installed on R750 engines.(Refert to Section “Engine Specifications” to determine oil pans capacities”).
During oil change use the lowest oil quantity for filling the engine until the MIN level is reached, indicated by oil dipstick MIN mark. If the MIN oil level is not reached, add oil, 100 - 200 ml at a time for reaching the MIN oil level. Add further oil quantity (100 - 200 ml at a time) for reaching the MAX oil level.

CAUTION

ENVIRONMENTAL HAZARD! Discharge of oil or oil waste into the environment is restricted by law. Do not spill oil or oil waste into the environment when using or servicing your engine. Contain and dispose of oil or oil waste as directed by local authorities.
An overfilled engine crankcase or block can cause a fluctuation or drop in oil pressure. The over-full condition results in the engine crankshaft splashing and agitating the oil, causing it to become aerated. The aerated oil causes a loss of engine performance and an increase in crankcase back pressure. An extreme overfill condition could result in large amounts of oil being drawn into the intake.
Checking engine oil level must be done carefully. The oil level must be maintained between the minimum and the maximum oil level mark on the dipstick. To ensure that you are not getting a false reading, observe the following before checking the oil level.
• Ensure that the vehicle or the engine at rest in a flat surface.
• Allow five minutes for the oil to drain into the oil pan if the engine has just been operated or oil has just been added.

CHECKING

IMPORTANT: Engine crankcase oil must be checked at intervals specified in Maintenance Schedules.

1. Check the engine oil daily before the first start-up.

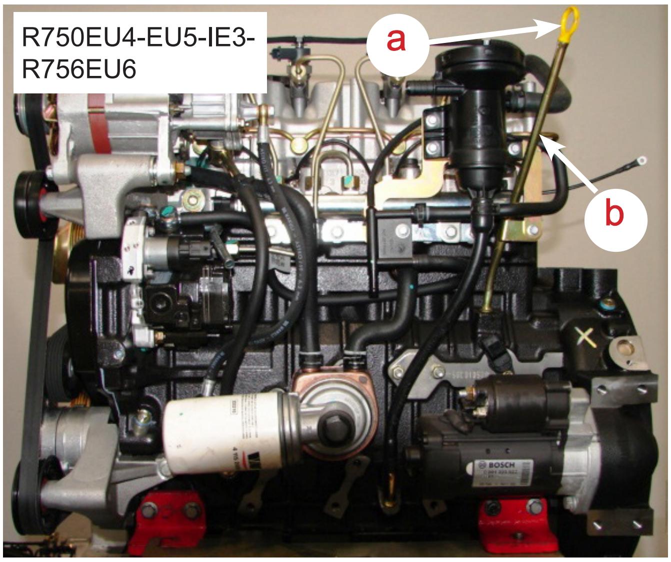
CAUTION

Avoid possible injury or damage to the crankcase oil dipstick and internal engine components. Do not remove the oil dipstick when the engine is running. Stop the engine completely before removing or inserting the dipstick.

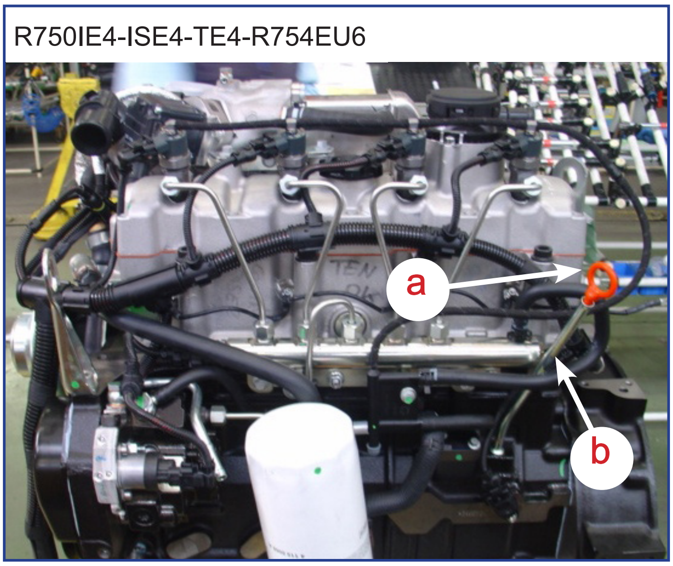
2. If the engine is operating, stop the engine. Allow approximately 5 minutes for the oil to drain into the oil pan.

3. Remove the dipstick. Wipe the dipstick clean and reinstall it fully into the dipstick tube.

a - Dipstick
b - dipstick tube



4. Remove the dipstick and observe the oil level. Oil level must be between the marks on the dipstick.
5. Add specified oil to bring the level up to, but not over, the maximum mark on the dipstick.
Refer to "Engine Specifications - Engine oil Capacities" for the oil quantity and oil specifications for quality.



IMPORTANT

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FILLING

IMPORTANT: Do not overfill. Refer to “Engine Specifications - Engine oil Capacities” for the oil quantity and oil specifications for quality.

Two (2) different oil pans, with different oil capacity, are installed on R750 engines.(Refert to Section “Engine Specifications” to determine oil pans capacities”).
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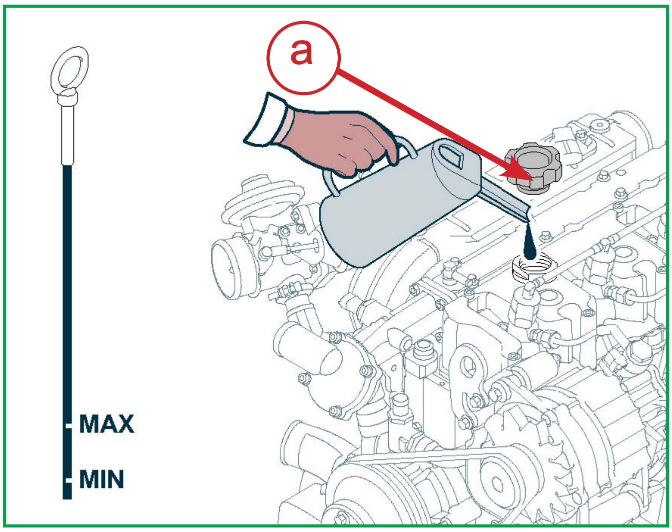
1. Remove the oil filler cap.

a - Oil filler cap



NOTE: Always use the dipstick to determine the exact quantity of oil or fluid required.

2. Add the specified oil to bring the level up to, but not over, the maximum mark on the dipstick.

3. Install the oil filler cap.

CHANGING—OIL AND FILTER

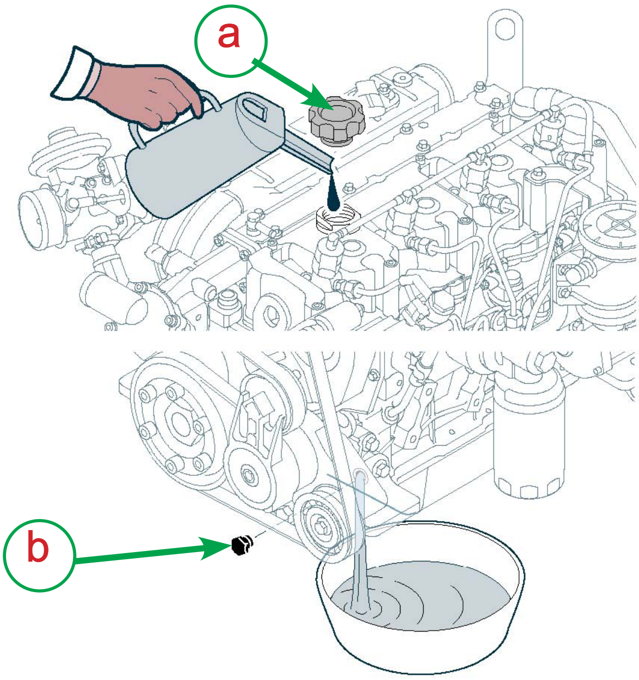
Refer to the Maintenance schedule for the change interval.

IMPORTANT: On R750EU5/EU6 - R750 IE4 engine models, whenever the engine oil is changed it is necessary to reset the OIL DILUTION function (refer to following paragraph OIL DILUTION).

IMPORTANT: in presence of error code 252F "engine oil critical mass" carry out the engine oil change even if earlier than scheduled maintenance interval.

IMPORTANT: Change engine oil when the engine is warm from operation. Warm oil flows more freely, carrying away more impurities. Use only specified engine oil (refer to Engine Specifications - Engine Oil Specifications).

1. Start the engine and allow it to reach normal operating temperature.
2. Stop the engine and allow approximately 10 minutes for the oil to drain into the oil pan.
3. remove the oil dipstick and remove oil filler cap
4. Remove the threaded plug from the oil pan.



a - Oil filler cap
b - Threaded plug

5 Install the plug with the washer in the oil pan.

Oil sump threaded plug	**78.5 Nm**

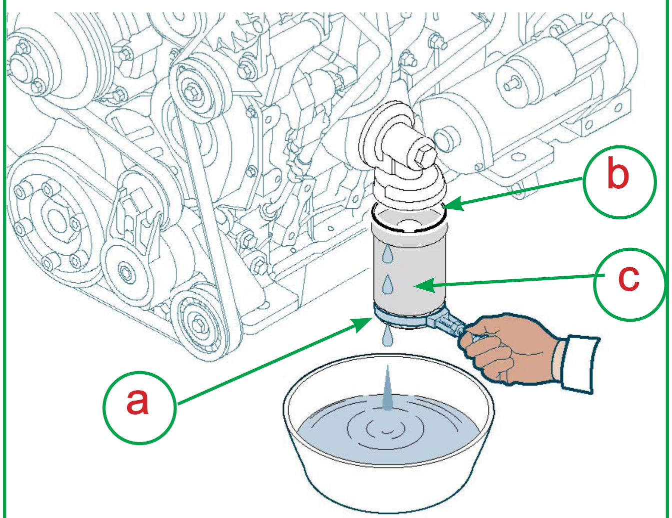
6 Use an appropriate device to loosen the oil filter cartridge.
7 Remove the oil filter cartridge.
8 Disconnect and properly dispose of the old oil filter element. Discard the old O-ring from the oil filter.
9. Install the new O-ring. Apply lubricant engine oil to the O-ring.
10. Thread the new filter element into the oil filter housing.

IMPORTANT: Over tightening the oil filter will cause deformation resulting in oil leakage.

Oil filter cartridge	**12.7 Nm**

11. Turn the oil filter until the sealing surface contacts the housing.
12. Torque the oil filter using an appropriate socket.
13. Refill the engine with new engine oil.
Refer to Filling.
14. Start the engine and check for leaks

a - Device
b - O-ring
c - Filter element



CAUTION

ENVIRONMENTAL HAZARD! Discharge of oil or oil waste into the environment is restricted by law. Do not spill or discharge oil or oil waste into the environment when using or servicing your boat. Contain and dispose of oil or oil waste as defined by local authorities.

ENGINE OIL DILUTION - R750EU5/EU6 - R750IE4 ENGINE MODELS

During DPF regeneration, additional fuel is injected via multiple post injections in order to increase the exhaust gas temperature.
The additional fuel drops in the oil sump so the oil viscosity will be reduced and oil change may be necessary after running the DPF service regeneration.
• As a rule of thumb, it is recommended to change the engine oil after service regeneration if the engine is over 80% of the oil change interval.
• Remind to reset engine oil dilution algorithm at every oil change via scan tool or accelerator procedure because the oil contamination is calculated by engine ECU.

Whenever you change the engine oil, you must reset the **"Oil dilution calculation"** function.

IMPORTANT: The Oil Dilution Calculation function can be reset with the Diagnostic Tool

To reset of Oil dilution calculation function restored is necessary to use the diagnostic tool.
In the absence of diagnostic tool it is possible to reset the function through the following procedure:

1. With engine turned off bring the engine start key to ON position
2. Fully press the accelerator pedal (from 0% to 100%)
3. Wait for 3 secs before leaving it
4. Leave the accelerator pedal up to original position (0 %) and wait for 3 secs before pressing it again.

The above procedure to points 2, 3, 4 must be carried out 5 times. On some vehicles the accelerator pedal procedure is not feasible: in place of pedal accelerator use the potentiometer accelerator.

VERIFICATION: if the procedure has been correctly carried out the engine oil low pressure pilotlight blinks 3 times by 1 second spaced by 0.5 seconds. On some vehicles the verification is not feasible.

COOLANT

SPECIFICATIONS

CAUTION

Propylene glycol, alcohol or methanol based antifreeze is not recommended for use in the closed cooling system.
Use only de-ionized or distilled water to dilute the antifreeze if it is not pre-diluted.

Diesel engines are high compression engines and create higher engine operating temperatures. The closed cooling system and engine must remain as clean as possible to provide adequate engine cooling. Adequate engine cooling can only be assured by using the proper antifreeze and water. VM Motori recommends that the closed cooled section of the closed cooling system must be filled with a low-silicate formula of ethylene glycol antifreeze in solution with deionized or distilled water. A low-silicate formula prevents antifreeze separation, which causes a silicate gelatin to form.
This gelatin will block engine and heat exchanger passages causing the engine to overheat.
The coolant, if not premixed, should be mixed, using antifreeze and deionized water, before being added to the closed cooling system. Common tap water or softened water contains unwanted minerals, which can leave deposits in the system that reduce the efficiency of the cooling system. The closed cooled section of the closed cooling system should be kept filled year-round with an approved antifreeze-coolant solution. Do not drain the closed cooled section for storage because draining will promote rusting of internal surfaces. If the engine will be exposed to freezing temperatures, ensure that the closed cooled section is filled with a properly mixed antifreeze-coolant solution to protect the engine and the closed cooling system to the lowest temperature to which they will be exposed.

IMPORTANT: The antifreeze-coolant used in these engines must be a low-silicate ethylene glycol, containing deionized, purified water. Using other types of engine coolant may cause fouling of the heat exchangers and overheating of the engine. Do not combine different types of coolants without knowing that they are compatible. Refer also to the coolant manufacturer's instructions.

VM Motori approves this type of antifreeze-coolant solution:

Solution	**50% Antifreeze + 50% de-ionized or distilled water**	**Antifreeze meets the following industry specifications: ASTM D 3306 type 1.**

Refer to Maintenance Schedules for change intervals.
Refer to Engine Specifications - Coolant System/Capacities for capacity

IMPORTANT: Since Settember 2011 a new antifreeze "Petronas Paraflu Up" has been introduced.
Paraflu Up (red colour) has a Monoethylene glycol base, formulated with organic inhibitors based on O.A.T. (Organic Acid Technologic).
The specifications are the same.

CHECKING THE LEVEL

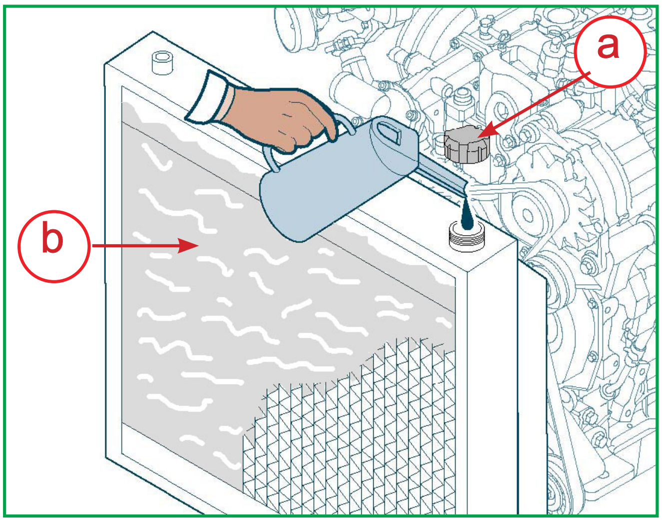
⚠ CAUTION

Avoid serious injury from burns. Do not remove the coolant cap when the engine is hot. Coolant may discharge violently.

IMPORTANT: Check engine coolant before starting the engine, when the engine is cold.

1. Allow the engine to cool.
2. Remove the pressure cap from the coolant expansion tank or radiator and observe the coolant level.
3. The coolant level in the radiator should be kept at the bottom side of the pressure cap neck. If the vehicle is equipped with an expansion tank the coolant level should be kept between the upper (MAX) and lower (MIN) marks.Please refer to the user manual of the vehicle.
4. If the coolant level is correct, install the pressure cap.
5. If the coolant level is low, add the specified coolant. Refer to Filling or Capacities for coolant quantity.
6. Install the pressure cap.

a - Pressure cap
d - Radiator



FILLING THE CLOSED COOLING SYSTEM

1. Remove the pressure cap with the engine is cold.

IMPORTANT: Use only the specified coolant. (Refer to Coolant specifications)

2. If the coolant is being replaced or the level is low, slowly add the specified coolant to the level indicated in section “Checking Level”.

⚠ CAUTION

Overheating from insufficient cooling water will cause engine and drive system damage. Ensure that there is sufficient coolant always available before operating the engine every day.

3. Do not install the pressure cap. Start and operate the engine at fast idle (1500-1800 RPM). Add coolant if necessary to maintain the coolant at the level specified previously.

IMPORTANT: When installing the pressure cap, be sure to tighten it securely to avoid coolant loss.

4. Install the pressure cap after the engine has reached normal operating temperature (thermostat fully open), and the coolant level remains constant, as specified previously (Refer to Engine Specifications).

5. Test the engine operation. Observe the temperature gauge and check the engine for coolant leaks. If the temperature gauge indicates excessive temperature or coolant leaks exist, stop the engine immediately and inspect for the cause.

6. After the first operation, allow the engine to cool.
7. Remove the pressure cap and add the specified coolant to the level indicated in section “Checking Level” .
8. Install and securely tighten the pressure cap.

DRAINING THE CLOSED COOLING SYSTEM

CAUTION

ENVIRONMENTAL HAZARD! Discharge or oil, coolant, and other engine and drive fluids into the environment is restricted by law. Do not spill or discharge oil, coolant, and other engine and drive fluids into the environment when using or servicing your vehicle. Contain and dispose of oil, coolant, and other engine and drive fluids as defined by local authorities.

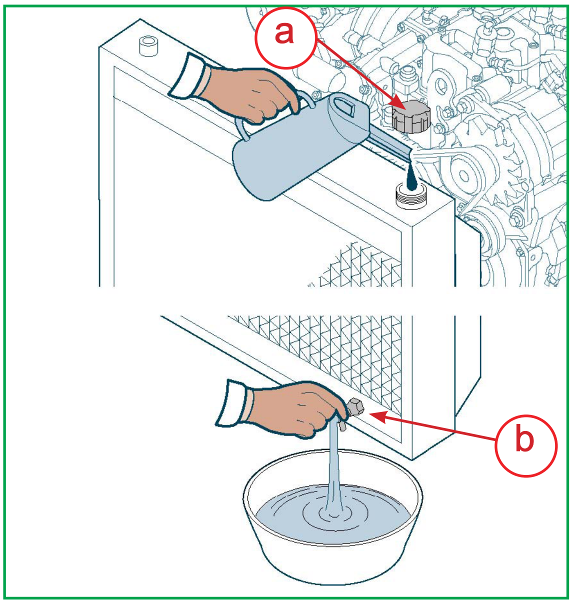
WARNING

Avoid personal injury and burns from hot engine coolant. Allow the engine to cool down before removing the coolant pressure cap. A sudden loss of pressure could cause hot coolant to boil and discharge violently.

1. Allow the engine to cool.
2. Remove the pressure cap from the coolant expansion tank or radiator.

NOTE: Drain coolant into a suitable container. Dispose of old coolant properly.

3. Loosen the radiator drain plug or tap. If the plug/tap is not present, remove lower rubber pipe from radiator.



a - Coolant pressure cap
b - Drain plug/tap

4 After the coolant has drained completely, close the radiator drain valve or install the rubber pipe in the radiator. Tighten all drain plugs and drain valves securely.
5. If required, clean the closed cooling system. Refer to Cleaning the Closed Cooling System.
6. Fill the system with the specified coolant. Refer to Filling.

CLEANING THE CLOSED COOLING SYSTEM

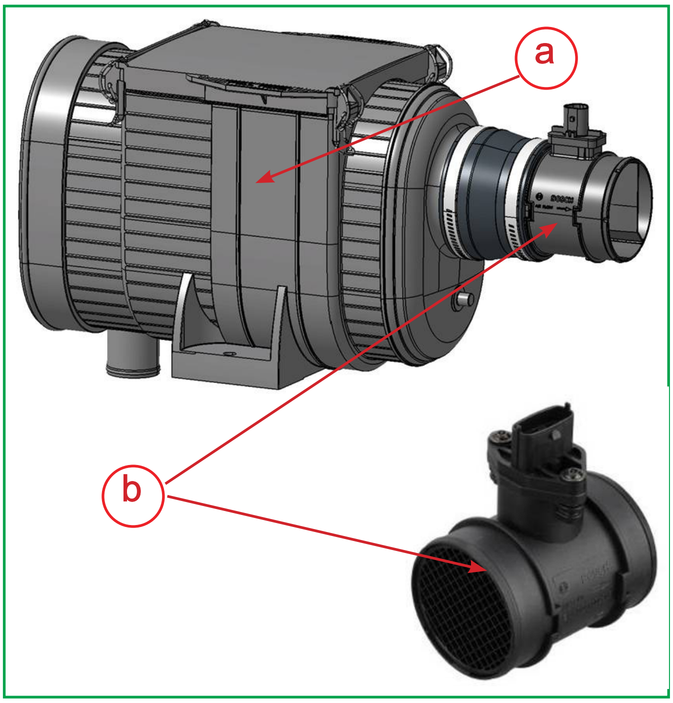
Closed cooling section of closed cooling system must be cleaned in accordance with the maintenance scheduled intervals or whenever decreased cooling efficiency is experienced.

AIR FILTER ELEMENT

R 750 EU4

NOTE: To remove the air filter element, refer to the vehicle manufacturer's instructions.

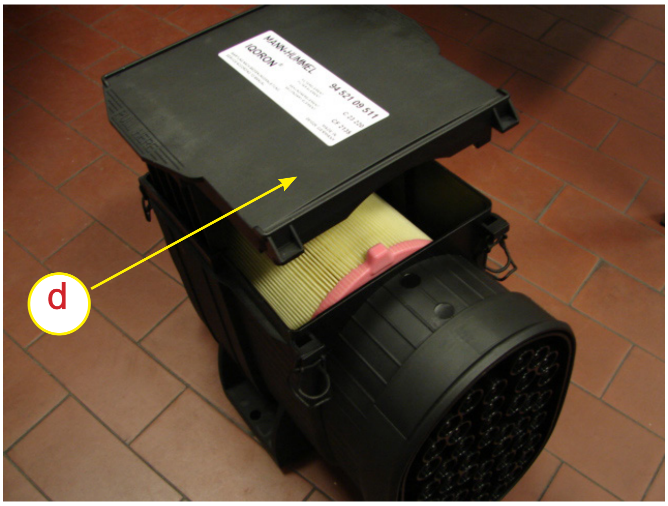
R 750 EU5/EU6 - R750IE4-ISE4-TE4



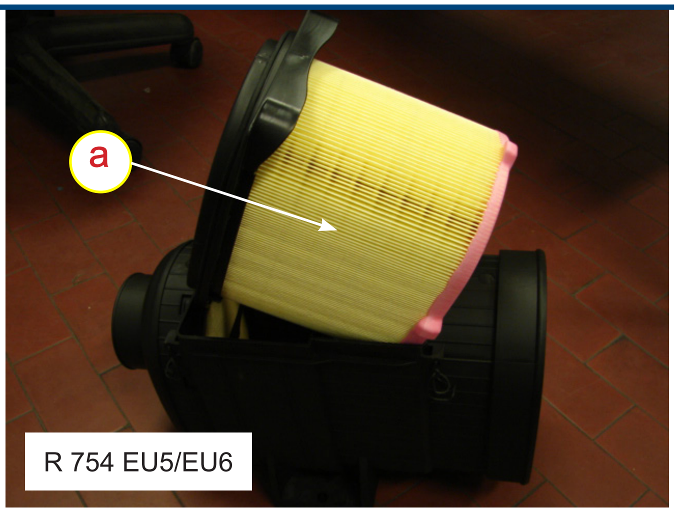
A air filter box
B air mass flow meter

Slacken the clamps C.

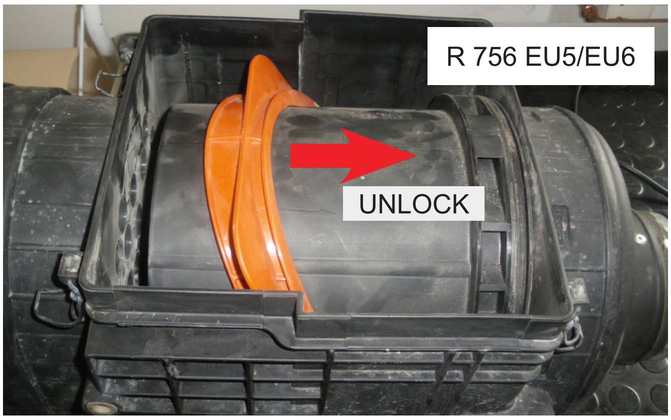
Remove the cover D.



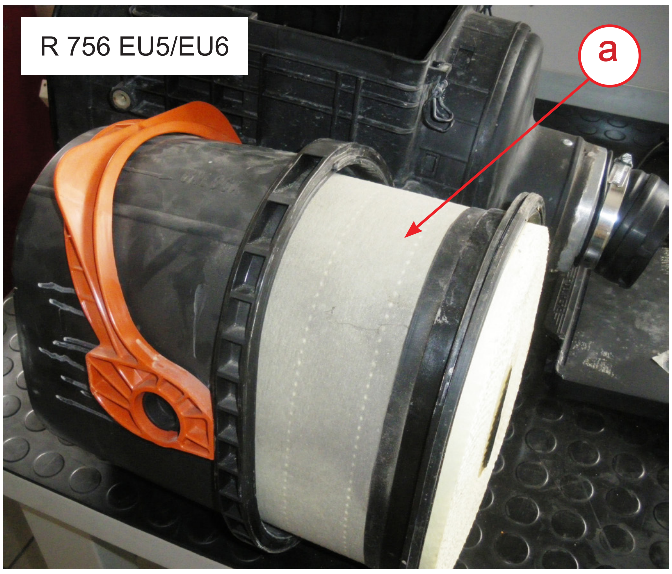
Replace the main air filter cartridge A.



On R 756 EU5 engine model it is needed to pull the orange handle as shown in the picture. Remove the air filter cartdridge from the box.

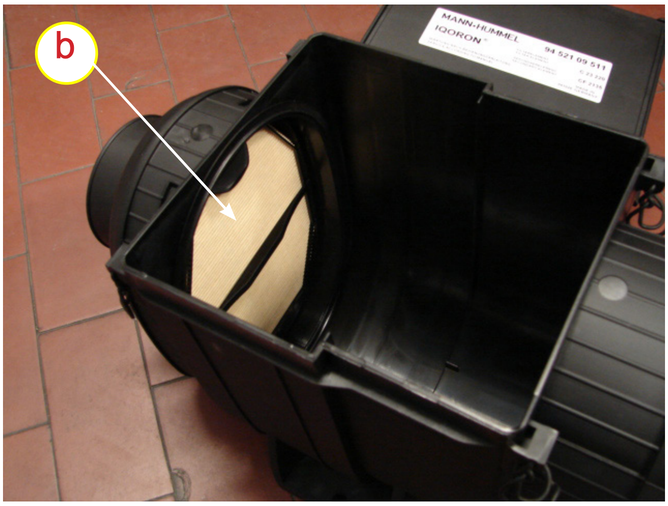


Replace the main air filter cartdridge A.

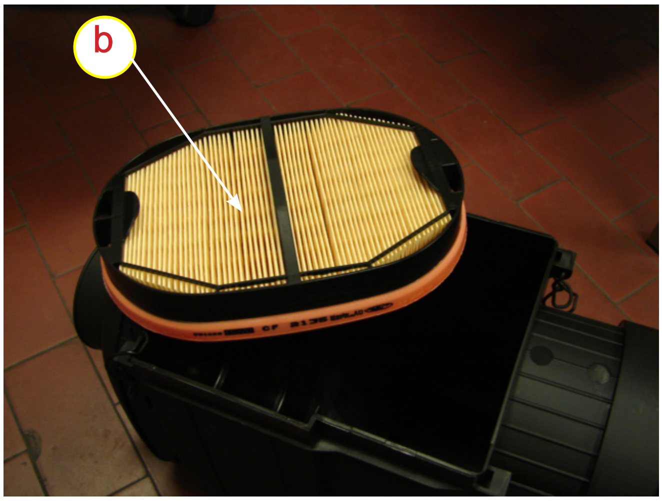


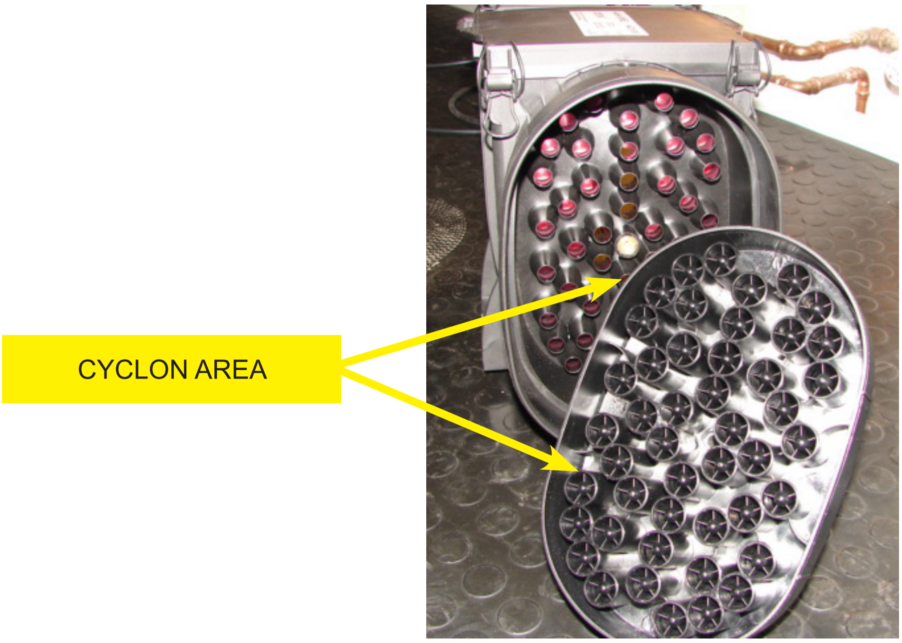
Replace the secondary (pre-filter) air filter cartridge B.

NOTE: After having replaced the main cartridge (A) two or three times, it is important to replace the cartridge (B), as well.



Clean the CYCLON area.





FUEL SYSTEM

GENERAL INFORMATION

⚠ WARNING

Always disconnect battery cables from battery before working on fuel system to prevent fire or explosion.

⚠ WARNING

FIRE AND EXPLOSION HAZARD: Fuel leakage from any part of the fuel system can be a fire and explosion hazard which can cause serious bodily injury or death. Careful periodic inspection of entire fuel system is mandatory, particularly after storage. All fuel components should be inspected for leakage, softening, hardening, swelling or corrosion.
Any sign of leakage or deterioration requires replacement before further engine operation.

⚠ WARNING

IMPORTANT: Use of improper or water-contaminated diesel fuel can cause serious engine damage. Use of improper fuel is considered misuse of the engine, and the resulting damage will not be covered by warranty.

SPECIFICATIONS

The engine has been designed to be powered by standard fuel (conforms to specifications DIN EN 590) available on the European market. If it is to be powered by BIODIESEL fuels (conforms to specifications UNI EN 14214), it can be mixed, **up to 7%**, with fuel (conforms to specifications DIN EN 590) available on the European market. About R750 engine models use only fuel with low content of sulphur (not above 10-50ppm)

DIESEL FUEL IN COLD WEATHER

Unaltered diesel fuels thicken and gel in cold temperatures unless they are treated. Virtually all diesel fuels are climatized to allow their use in a particular region for that time of the year. If it becomes necessary to treat the diesel fuel further, it is the owner's and operator's responsibility to add a commercial standard brand anti-gel diesel fuel additive according to product directions.
No liability can be accepted by the VM Motori for any malfunction or engine damage, caused by the use of diesel fuel additive and the resulting damage will not be covered by warranty.

FUEL FILTER

DRAINING

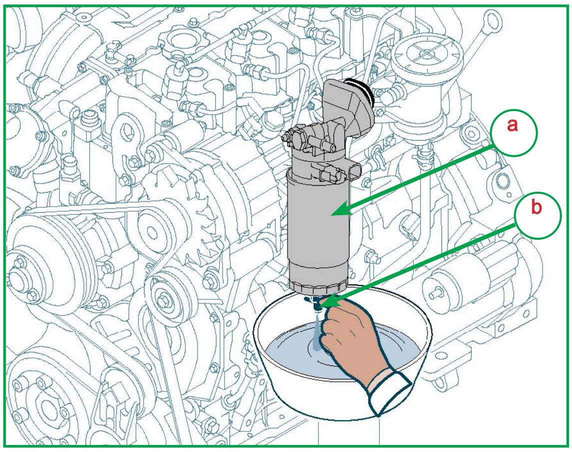
The water-separating fuel filter can be drained of water and small dirt particles by opening the water drain cap (bleed valve).

IMPORTANT: **To ensure complete draining in warm weather, open the water drain cap before starting daily operations. In cold weather, when there is a possibility that the condensed water will freeze, drain the filter shortly after the end of daily operations.**

NOTE: Place a suitable container under the fuel filter to catch contaminated fuel or water.

1. Using a suitable container to catch contaminated fuel or water, open the drain cap at bottom of the filter.
2. Drain the fuel filter until the fuel is clear in appearance.
3. Close the drain cap
4. Fill the water-separating fuel filter if the fuel has heen completely drained from the filter. Refer to Filling.

a - Fuel filter
b - Drain cap



FILLING & AIR BLEEDING

Follow this procedure after installing a new filter or after the fuel has been completely drained from the filter when checking for water.

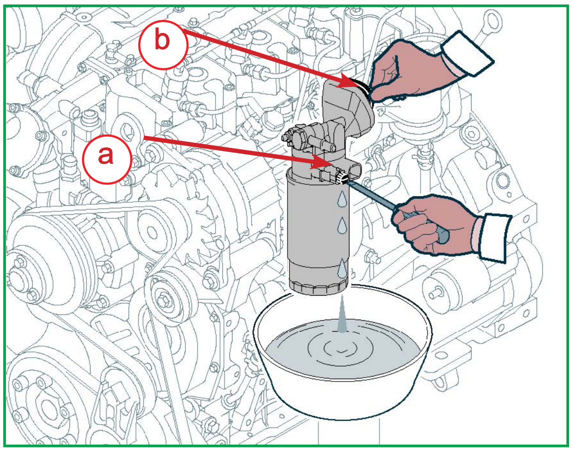
1. Loosen the air vent (bleed) screw on fuel filter header assembly.

NOTE: The fuel filter is equipped with a primer plunger on the fuel filter header to assist in filling the fuel filter.

2. Move the primer plunger up and down repeatedly. The filter is full when an air-free stream of fuel flows from the air vent screw.
3. Securely tighten the air vent screw.
4. Start the engine and check for fuel leaks. Stop the engine immediately if a fuel leaks exist. Recheck the installation of the fuel filter.

⚠ WARNING

Ensure that no fuel leaks exist before closing the engine hatch.



a - Air vent (bleed) screw
b - Primer Plunger

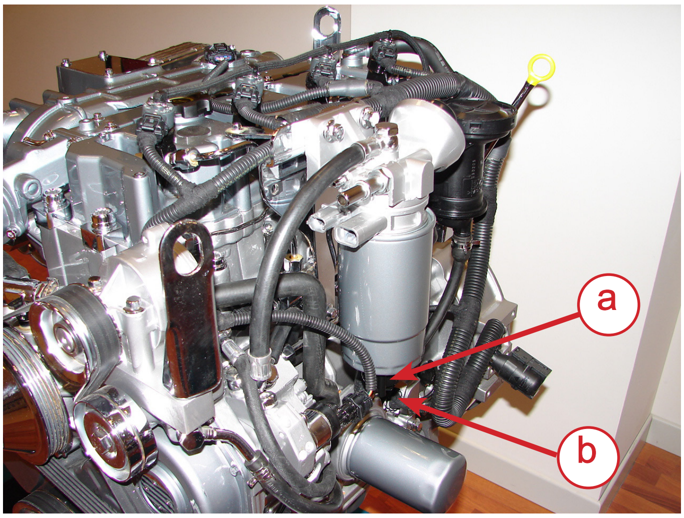
REMOVAL

⚠ CAUTION

Absolute cleanliness is required for work on the fuel system, since the injection pump and fuel injectors have very close tolerances. Even minute particles of dirt or small amounts of water can impair the function of the fuel injection system.

1. Disconnect both battery cables from the battery.
2. Unplug the Water In Fuel (WIF) sensor wire from the drain cap.

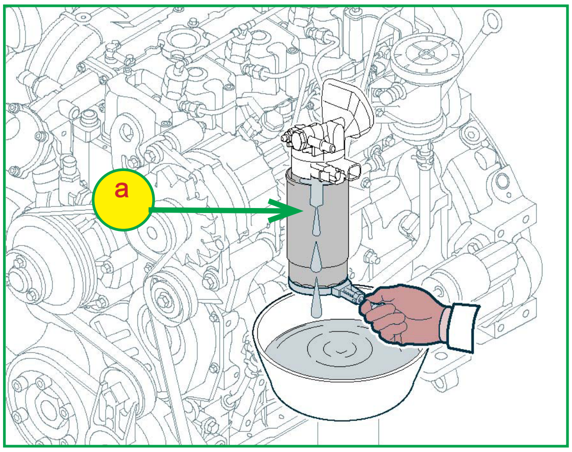
a - Drain cap
b - WIF sensor wire



IMPORTANT: The water-separating fuel filter must be replaced; it cannot be cleaned and reused.

3. If the locking ring is present, loosen it and remove the filter. If is not present, remove by hand or using a commercial device the water-separating fuel filter.

a - Water separating fuel filter
b - Locking ring



INSTALLATION

1. Lubricate the fuel filter seal with engine oil.
2. Fill the new water-separating fuel filter pouring new fuel.

3. Align the fuel filter to the fuel filter header assembly.
Hand tighten the filter to secure the filter to the header assembly.
Do not use a filter wrench. Continue with Filling and Air Bleeding of fuel Filter.

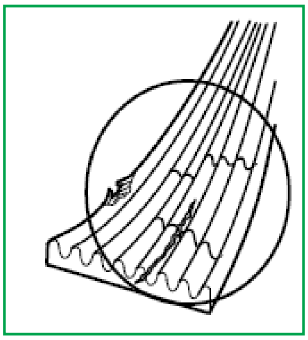
4. Connect the water in the fuel sensor connector and the battery cables.
5. Start the engine and check for fuel leaks.

Stop the engine immediately if fuel leaks exist .
Recheck the fuel filter installation.

ALTERNATOR BELT / POLY - V (SERPENTINE)

INSPECTION

Inspect the belt for proper tension and for the following:
- Excessive wear
- Cracks
- Fraying
- Glazed surfaces



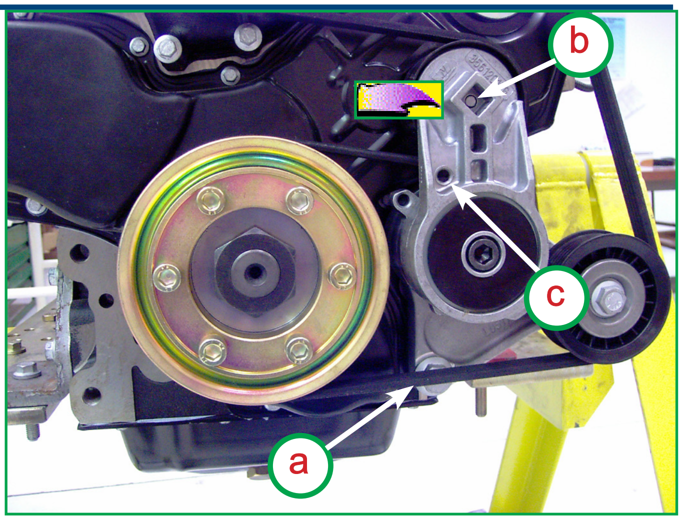
NOTE: Minor, transverse cracks (across the belt width) may be acceptable. Longitudinal cracks (in the direction of belt length) that join transverse cracks are NOT acceptable.

REPLACEMENT - INSTALLATION

WITH AUTOMATIC TENSIONER

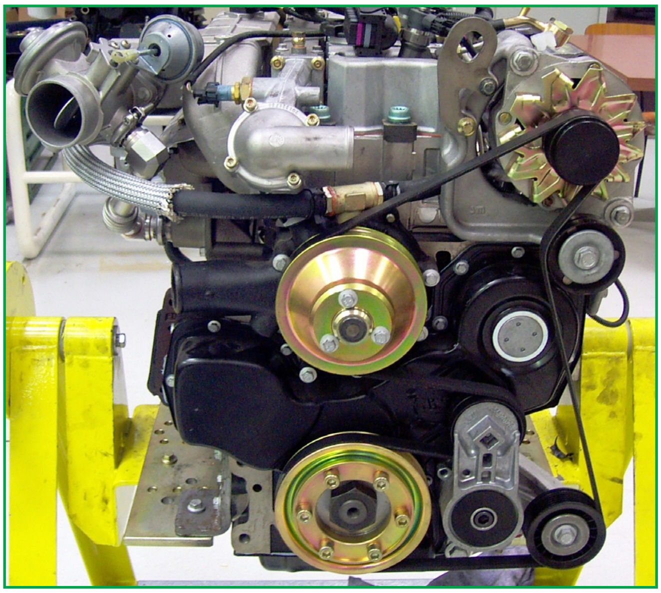
IMPORTANT: **If a belt is to be reused, it should be installed in the same direction of rotation as when first used.**

1. Position a suitable tool in the automatic tensioner release slot.
2. Rotate the automatic tensioner, in the direction of the arrow, to remove the tension on the serpentine belt.



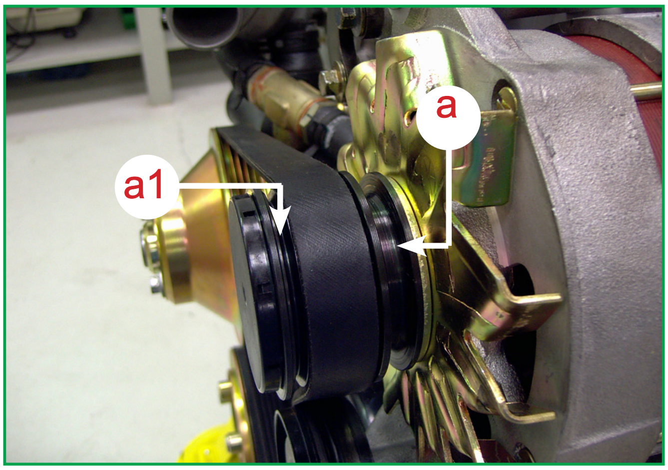
a - Serpentine belt
b - Tensioner release slot
c - Hole
d - pin

3. Install a pin into the tensioner hole to block the tensioner rotation.
4. Before removing the serpentine belt note its position on the alternator, and idler pulleys.
5. Replace the serpentine belt.
6. Install a new belt if required.

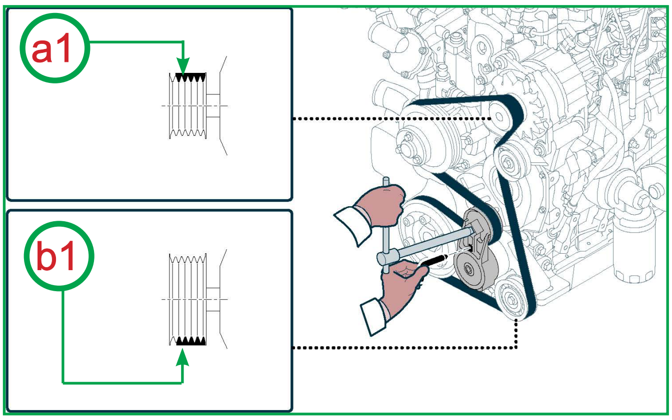


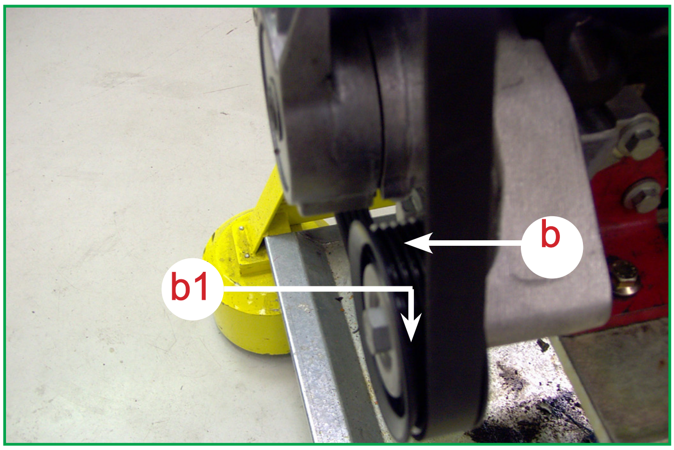
IMPORTANT:**Carefully remove the pin and release the automatic tensioner with the breaker bar, ensuring that the belt stays positioned properly on the alternator and idler pulleys races.**

IMPORTANT: For a correct alignment of the serpentine belt it must be stay positioned on the inner races of the alternator and idler pulleys



a - alternator pulley
b - idler pulley
a1 - alternator pulley outer races remaining
b1 - idler pulley outer race remaining





REPLACEMENT - INSTALLATION

WITH LINEAR TENSIONER TS 21 HUTCHINSON

PROCEDURE CARRIED OUT AT ASSEMBLY LINE

Install the tensioner and mantain loosen the bolt X.
Install the belt.

IMPORTANT: For a correct alignment of the serpentine belt it must be stay positioned on the inner races of the alternator pulley.

a - alternator pulley
a1 - alternator pulley outer races remaining

The tensioner idler pulley must be in contact with the belt.

Torque the bolts X of the tensioner.

Bolt X	**32.4 Nm**

Use a screwdrive to extract the block Y from the tensioner.

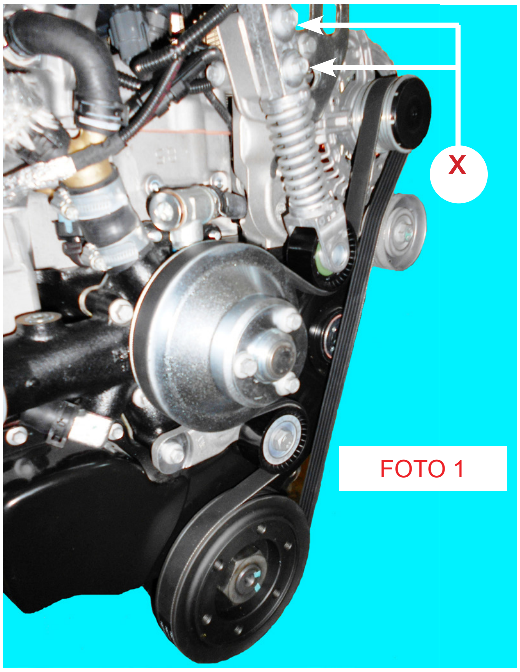
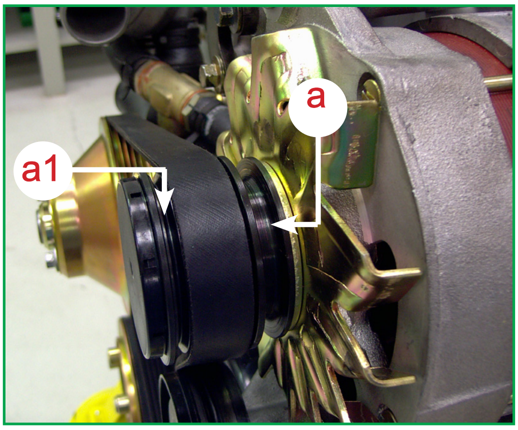


FOTO 1



PROCEDURE TO REPLACE THE BELT IN SERIVCE

Rotate the special tool (1) counterclockwise so that the tensioner belt (2) compresses (Foto 2).

Install the locking bracket (3) as shown in foto 3.

Remove the belt.

Install a new belt and position it as shown in foto 1.

Rotate the special tool (1) counterclockwise so that the tensioner (2) compresses and remove the locking bracket (3).

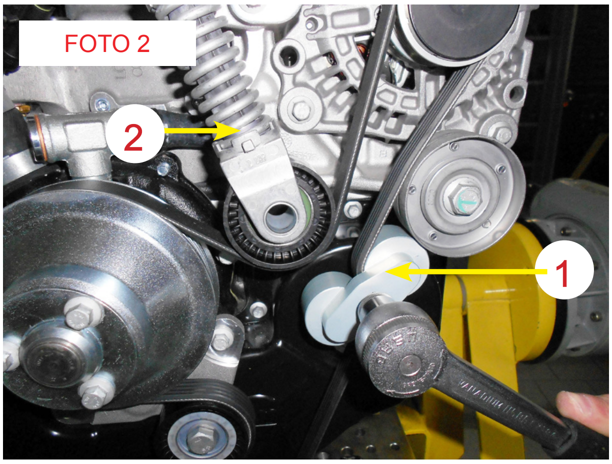


FOTO 2

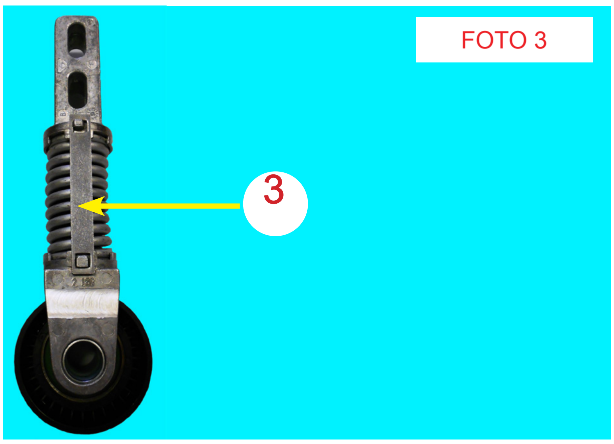
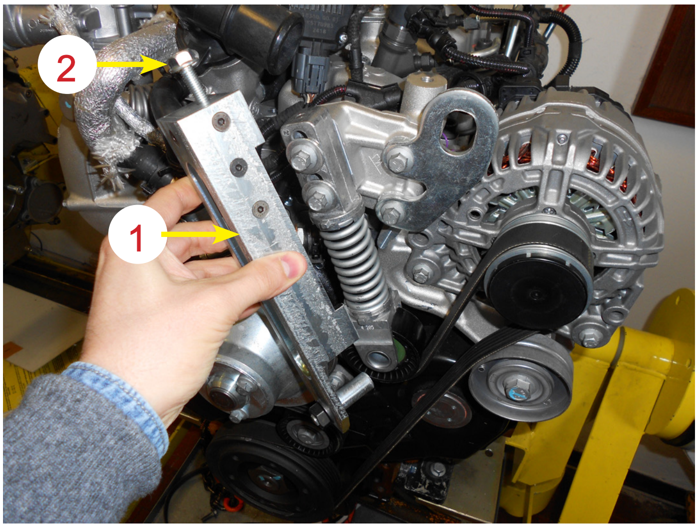


FOTO 3

Sometimes the belt removal tool applied directly to the belt results not so handy in its installation due to poor machine compartment vane space.

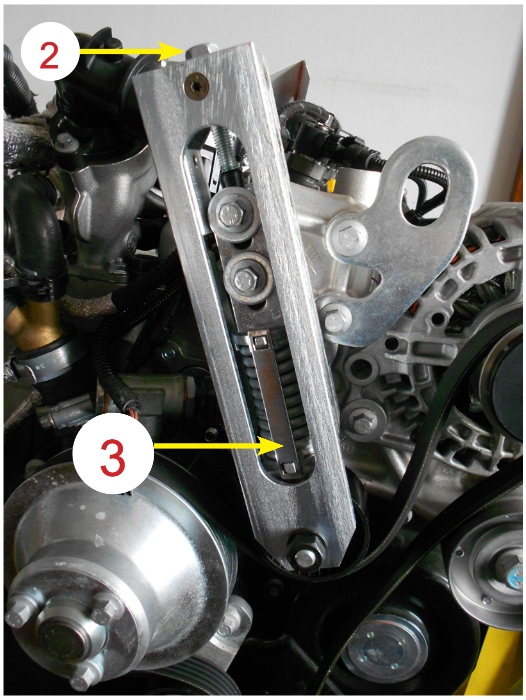
So a new special tool has been created: it can be installed directly to the tensioner.



Apply the special tool (1) to the tensioner

Tighten the bolt (2) until the blockage support (3) fits

Remove the belt.



DIESEL PARTICULATE FILTER (DPF) - EURO 4 ENGINE MODELS

INTRODUCTION

Diesel particular filters remove particulate matter and inorganic ash from diesel exhaust. Under normal operating conditions the filters collect and burn particulate matter through DPF regeneration process. However, inorganic ash, from the oil does not burn, so it slowly accumulates in the filter. This necessitates periodic ash removal from the filter through a cleaning process

MAINTENANCE INTERVAL

Refer to Maintenance scheduled intervals. Some applications, including older higher emission engines, may require more frequent maintenance.
When the DPF filter is clogged and its cleaning is required the operator of the vehicle will be warmed by the alarm system or MIL CHECK light present on the instruments panel control.

SERVICE DPF MAINTENANCE AND CLEANING PROCEDURE

IMPORTANT: before regenerating the DPF filter it is necessary to clean the pressure sensor lines (lines between pressure sensor and DPF filter).

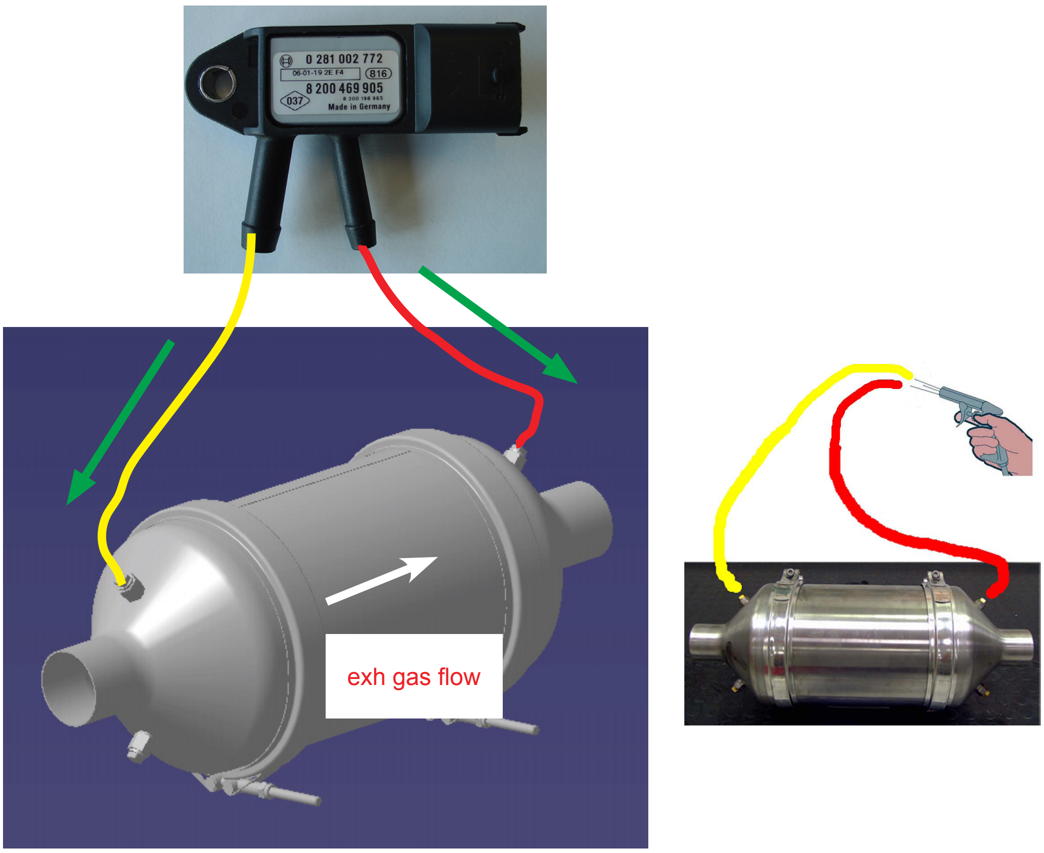
Clean the lines as follows:
1. **mark each line (the pressure lines have different diameter)**
2. **disconnect the lines**
3. **blow with compressed aria in the lines (blow towards DPF filter, see arrows for orientation)**

The DPF must be regenerated from the stored soot and cleaned from stored ash:

1. every 1500 hours or 50.000 km during the scheduled engine maintenance using compressed air or electrical oven (refer to related procedures)

2. On Pcode 2463 (soot max) using compressed air and service regeneration by scan tool refer to related procedures).

Disposal of ash should be in accordance with all local laws and regulations.



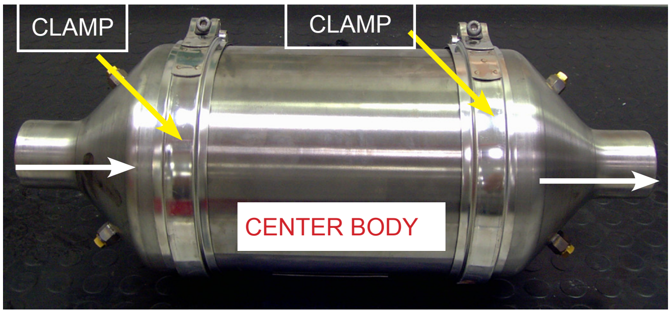
DPF FILTER - ASH CLEANING PROCESS THROUGH "DRY COMPRESSED AIR"

SAFETY EQUIPMENT REQUIRED

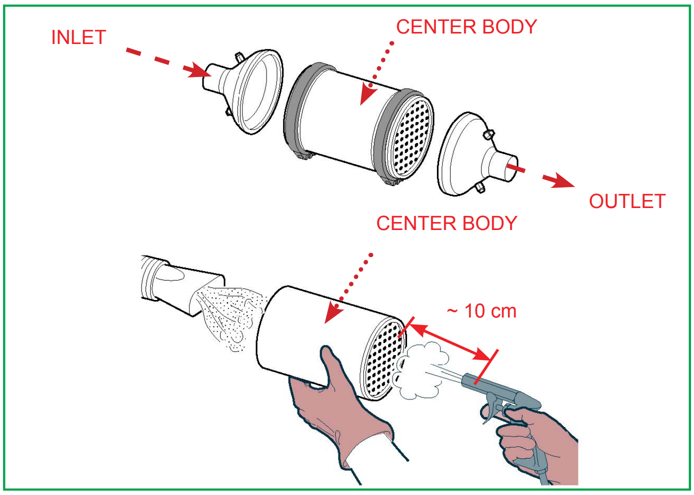
- A source of compressed dry air (80-100 psi / 5.5-7 bar) with a standard shop air-gun
- Dust mask, gloves, safety glasses should be worn during the cleaning.
- An industrial vacuum cleaner or a dust/ash collecting device.

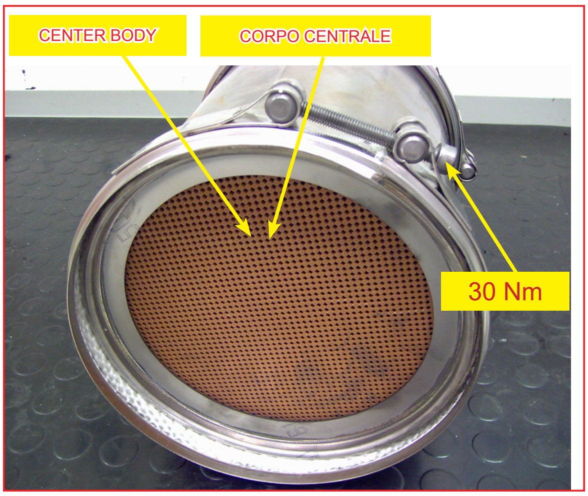
Before removing the DPF filter centerbody for cleaning, mark the exhaust side (exhaust gas outlet side) of the filter. Remove the centerbody.
Using compressed dry air on the outlet side and a vacuum on the inlet side, from a distance approximately of 10 cm blow air (5.5-7 bar) through the filter allowing the vacuum cleaner to collect the ash. Alternatively, connect the inlet side of the filter to a dust/ashcollecting device. Make sure to move the gun slowly, directing air into each individual cell for better results.
Continue this process for approximately 30-40 min. Avoid direct contact of the air nozzle with the filter surface. Larger filters generally require longer cleaning time.
Install the DPF filter centerbody on the vehicle in the reversed flow direction from which it was removed.
The side with the mark should become the inlet side.
It is not recommended cleaning of DPF filters with steam and / or other detergents. Use of these products may damage and / or deactivate the filters.

EXHAUST GAS INLET SIDE



EXHAUST GAS OUTLET SIDE





DPF FILTER REGENERATION USING AN "ELECTRICAL OVEN"

Clean the DPF filter using compressed air (Refer to section "Cleaning process through dry compressed air").
Before removing the DPF filter centerbody for cleaning, mark the exhaust side (exhaust gas outlet) of the filter.
Put the DPF center body into the electrical oven.
Follow the heating steps, shown in this chart:

STEP	TEMPERATURE °C	DURATION (min)	RAMP SHAPE	
start	**ambient into oven**	**/**	**/**	**increasing**
1	0 - 200	60 min	linear	10°C / min
2	200 - 500	120 min	linear	5°C / min
3	500 - 600	30 min	linear	2°C / min
4	600	360 min	constant	
5	600 - 500	30 min	linear	
6	500 - 200	120 min	linear	
7	200 - 120	60 min	linear	
8	120	60 min	constant	
9	switch off	/	/	

Remove the DPF center body from the oven.
Install the DPF filter centerbody on the vehicle in the reversed flow direction from which it was removed.
The side with the mark should become the inlet side.
It is not recommended cleaning of DPF filters with steam and / or other detergents. Use of these products may damage and / or deactivate the filters.

IMPORTANT
DPF Diesel Particulate Filter does not require any additional maintenance other than routine cleaning and regeneration. If the unit does become plugged, the centerbody can be removed, cleaned, regenerated or eventually replaced.
Engine maintenance procedures must be followed to ensure proper DPF filter operation.
Oil consumption that exceeds engine specification will increase the required cleaning frequency.
Whenever the DPF is disassembled replace the clamps and ring spacers.

DPF Filter Clamp torque screws	**30 Nm**

WARNING
In certain conditions it could be necessary to carry out the filter maintenance before scheduled maintenance interval, as in event of faster soot accumulation with consequent clogging of the filter. This higher soot accumulation can happen in case of failure of some engine component (i.e. EGR locked open) or in case of engine particular use: always very low load duty cycle, low idle for very long time, etc. In this case the MIL lamp CHECK will switch on.

The DPF diesel particulate filter may result in a faster clogging and higher soot accumulation if the outlet pneumatic connections or actuators electrical connections of the intake throttle valve and EGR valve are exchanged (see "Intake Throttle Valve Section"). Before removing any connections from above mentioned components, it is recommended to apply a label on them.

ASH REMOVAL

Disposal of ash should be in accordance with all local laws and regulations.

CLEANING AND REGENERATION PROCESS USING SCAN TOOL - ERROR CODE 2463 "SOOT MAX)

Important:
NEVER START THE SERVICE REGENERATION BEFORE CLEANING THE DPF FILTER (refer to air compressed procedure).

IMPORTANT: before regeneration of the DPF filter it is necessary to clean the pressure sensor lines (lines between pressure sensor and DPF filter).

Clean the lines as follows:
1. **mark each line (the pressure lines have different diameter)**
2. **disconnect the lines**
3. **blow with compressed aria in the lines (blow towards DPF filter, see arrows for orientation)**

Using VM scan tool select the regeneraton procedure.
Select the DPF service regeneration under ECU DIAGNOSIS / DIAGNOSTIC TEST /PARTICLE FILTER TEST / PARTICLE FILTER REGENERATION

Follow the corresponding instructions displayed on the screen of the scan tool. The service regeneration phase will increase the engine speed at 1700 rpm to perform a controlled regeneration phase. After about 60 minutes the service regeneration will stop decreasing the engine speed to low idle.

Erase errors in Ecu in DIAGNOSTIC CODE area.

IMPORTANT:
A. The procedure can be interrupted at any time by automatic safety system
B. In case of emergency the procedure can be interrupted by operator by switching off the ignition.

DIESEL PARTICULATE FILTER (DPF) - R750 EU5 ENGINE MODELS

IMPORTANT: the DPF filter is not serviceable.

The diesel after–treatment system consists of a catalytic converter (Main Diesel Oxidation Catalyst + Coated Diesel Particulate Filter).

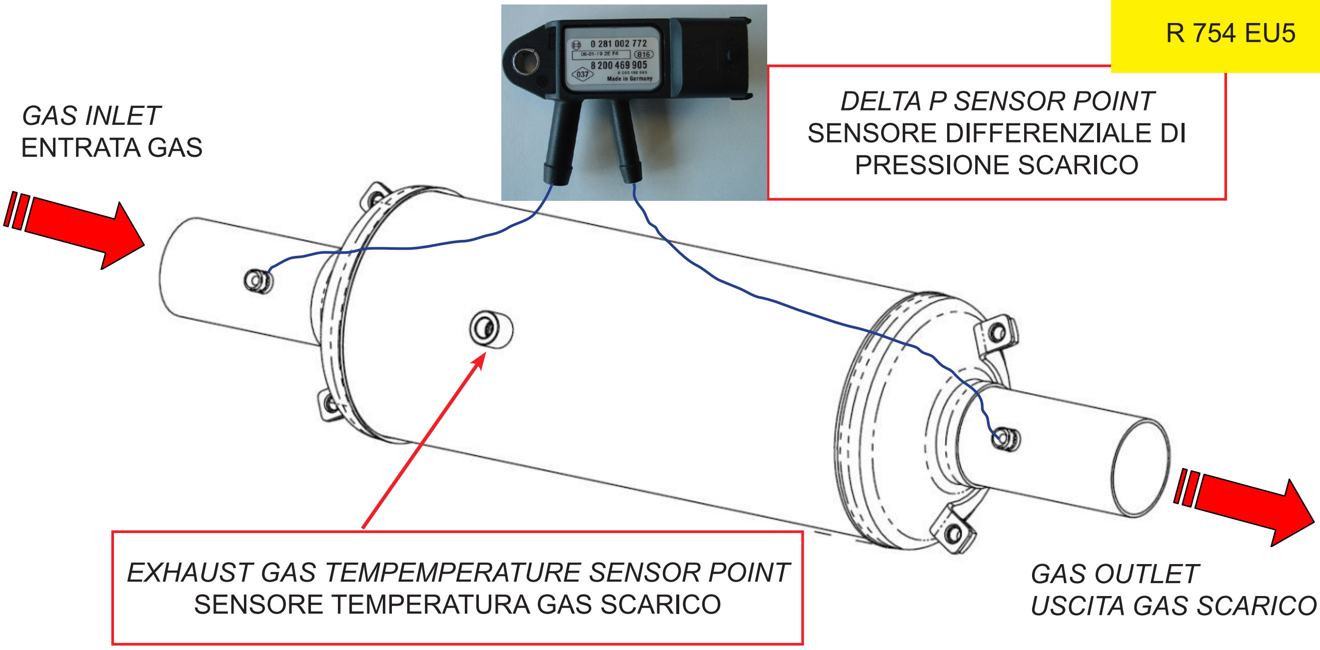
Engine control technology and diesel after–treatment system are designed to reduce exhaust emissions such as hydrocarbons (HC), carbon monoxide (CO) and particulates to meet the todays enhanced emission regulations.

The diesel particulate filter is made from Cordierite and is coated with noble metal. It is designed to reduce hydrocarbons (HC) and carbon monoxide (CO) emissions and to filter particulates from the engine exhaust to minimize discharge of soot to the atmosphere. The particulate matter accumulates in the channels of the coated diesel filter and are burned off at regular interval (through a process called "regeneration") to prevent filter from clogging. Excess soot in filter can cause drop in engine performance and crack the filter during regeneration. During regeneration, additional fuel is injected via multiple post injections to increase the exhaust gas temperature. During this period, the DPF temperature is raised to approximately 600C and the deposited soot is oxidized or burned off to carbon– dioxide (CO_2).

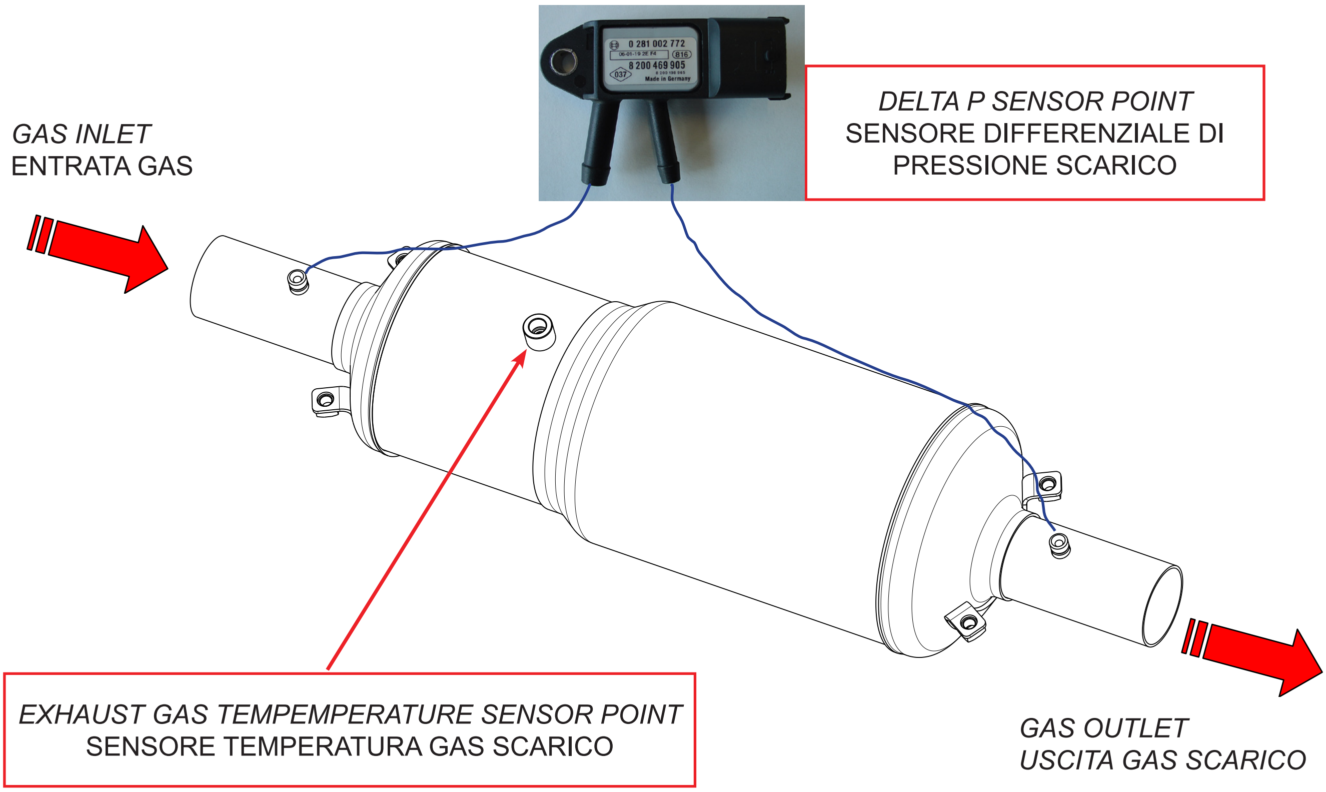
The pressure pipes, which are connected to the differential pressure sensor, measure the level of soot deposit in the coated diesel particulate filter and protect the engine by triggering regeneration when critical soot level is detected in the filter.

Main diesel oxidation catalyst (DOC) is coated with noble metal and has the function of reducing hydrocarbons (HC) and carbon monoxide (CO) emissions. Also, during regeneration, these components help to increase the exhaust gas temperature by burning the post injected fuel. The in–cylinder post injection allows filter regeneration to occur over the entire engine operating range as well as under all ambient temperature and pressure conditions. The regeneration process is smooth and essentially transparent to the driver of the vehicle.

R 754 EU5



R 756 EU5



EURO 5 SERVICE DPF REGENERATION (BY VM SERVICE TOOL)

The DPF must be regenerated from the stored soot:

1. every 4.000 hours during the scheduled engine overhaul.

2. On Pcode 242F (soot max), usually called service regeneration

A) PROCEDURE for 4000h
1. Connect scan tool to ECU and check for error codes using “DIAGNOSTIC CODE” button.
• Do not initiate the service regeneration if error codes are present on the ECU. Engine or exhaust system damage could occur if the service regeneration is initiated with malfunctioning engine components.
Delete present error codes.

2. Make sure the soot does not leak from the end of the DPF before performing the service regeneration.
• Check for sign of soot at the tail pipe first. If soot is present, inspect the DPF outlet pipe. A presence of soot in the rear–end cross–section of the DPF means that the DPF filtering performance has severely decreased.
• If the soot leaks from the end of the DPF, replace the DPF and reset the DPF soot value in ECU using scan tool “DIAGNOSTIC TESTS / REPLACEMENT / PARTICULATE FILTER REPLACEMENT” and do not start the service regeneration procedure.

3. Using an air compressed tool, clean the pressure pipes which are connected to the DPF pressure difference sensor

IMPORTANT: before cleaning the DPF filter it is necessary to clean the pressure sensor lines (lines between pressure sensor and DPF filter).

Clean the lines as follows:
1. **mark each line (the pressure lines have different diameter)**
2. **disconnect the lines**
3. **blow with compressed aria in the lines (blow towards DPF filter, see arrows for orientation)**

4. Warm up the engine until water temperature is higher than 70°C
CAUTION :
• During service regeneration, tailpipe outlet temperature will be over 550°C (1022°F). Make sure any person to be away from the tail pipe.
• Ensure that the vehicle is positioned in an open space and over a heat–resistant surface.
5. Select the DPF service regeneration under DIAGNOSTIC TEST session
6. Follow the corresponding instructions displayed on the screen of the scan tool. The service regeneration phase will increase the engine speed at 1700 rpm to perform a controlled regeneration phase. After about 15 minutes the service regeneration will stop decreasing the engine speed to low idle.
IMPORTANT:
A. The procedure can be interrupted at any time by automatic safety system
B. In case of emergency the procedure can be interrupted by operator by switching off the ignition.
7. Repeat the tag 5 and 6
Note: consider the procedure completed after 2 successful regeneration cycles.
8. Remove the filter from vehicle.
9. Clean the DPF filter with compresser air procedure. Refer to section “Cleaning Process through “dry compressed air”

B) PROCEDURE service regeneration on Pcode 242F "soot max"

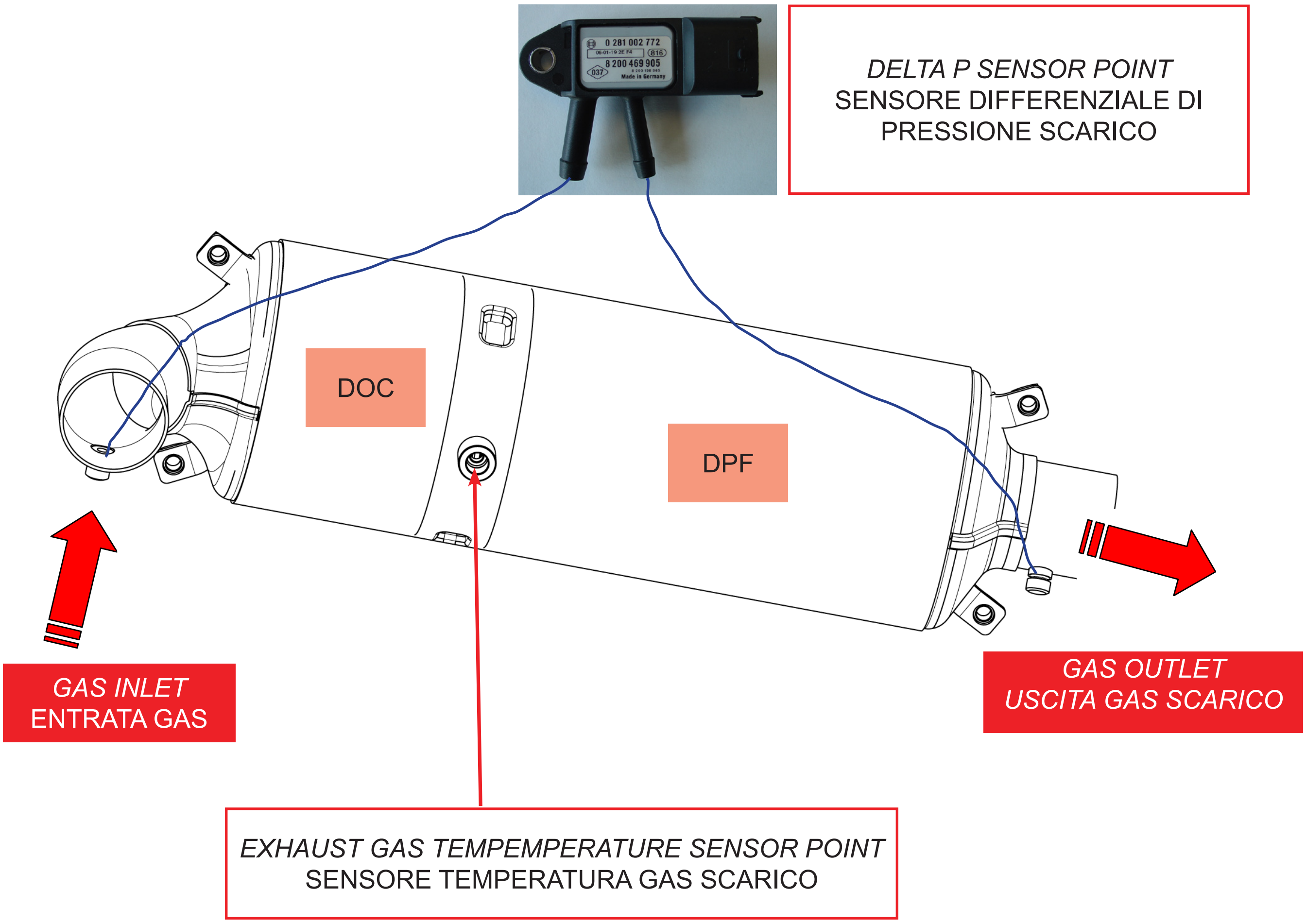
1. Connect scan tool to ECU and check for error codes using "DIAGNOSTIC CODE" button.
• Reset soot value by scan tool: DIAGNOSTIC TESTS / REPLACEMENT/ PARTICULATE FILTER REPLACE-MENT"
• Remove all present error codes: "DIAGNOSTIC CODES"
2. Make sure the soot does not leak from the end of the DPF before performing the service regeneration.
• Check for sign of soot at the tail pipe first. If soot is present, inspect the DPF outlet pipe. A presence of soot in the rear–end cross–section of the DPF means that the DPF filtering performance has severely decreased. (see following picture).
• If the soot leaks from the end of the DPF, replace the DPF and reset the DPF soot value in ECU using scan tool "DIAGNOSTIC TESTS / REPLACEMENT / PARTICULATE FILTER REPLACEMENT" and stop the procedure service regeneration.
3. Using an air compressed tool, clean the pressure pipes which are connected to the DPF pressure difference sensor

IMPORTANT: before cleaning the DPF filter it is necessary to clean the pressure sensor lines (lines between pressure sensor and DPF filter).

Clean the lines as follows:
1. **mark each line (the pressure lines have different diameter)**
2. **disconnect the lines**
3. **blow with compressed aria in the lines (blow towards DPF filter, see arrows for orientation)**

4. Warm up the engine until water temperature is higher than 70°C
CAUTION :
• During service regeneration, tailpipe outlet temperature will be over 550°C (1022°F). Make sure any person to be away from the tail pipe.
• Ensure that the vehicle is positioned in an open space and over a heat–resistant surface.
5. Select the DPF service regeneration under DIAGNOSTIC TEST session
6. Follow the corresponding instructions displayed on the screen of the scan tool. The service regeneration phase will increase the engine speed at 1700 rpm to perform a controlled regeneration phase. After about 15 minutes the service regeneration will stop decreasing the engine speed to low idle.
7. Check oil dilution condition, see Dilution engine lube oil in the section "OIL CHANGE".
IMPORTANT:
A. The procedure can be interrupted at any time by automatic safety system
B. In case of emergency the procedure can be interrupted by operator by switching off the ignition.

DIESEL PARTICULATE FILTER (DPF) - R 754 IE4 / R 754 EU6, R756EU6



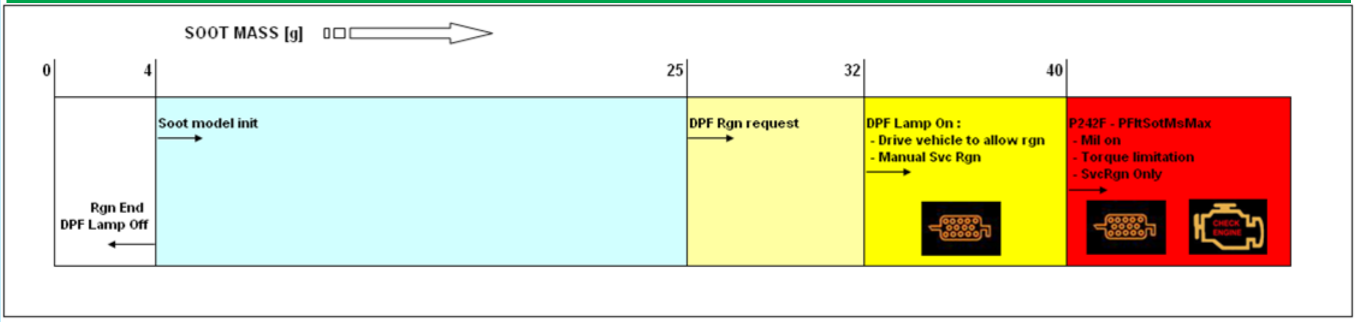
IMPORTANT: the DPF filter is not serviceable.

DPF Regeneration Triggers:
- Soot Mass Physical model (DeltaP sensor)
- Fixed engine operating time → 75h
-

Regeneration Target:
- DOC Inlet Temp > 300°C
- DPF Inlet Temp = 630°C

Regeneration Duration:
- 10-25 minutes in case of physical model trigger
- 15 minutes in case of fixed time trigger

R754IE4



DPF regeneration soot threshold → 25g

DPF Lamp threshold → 32g

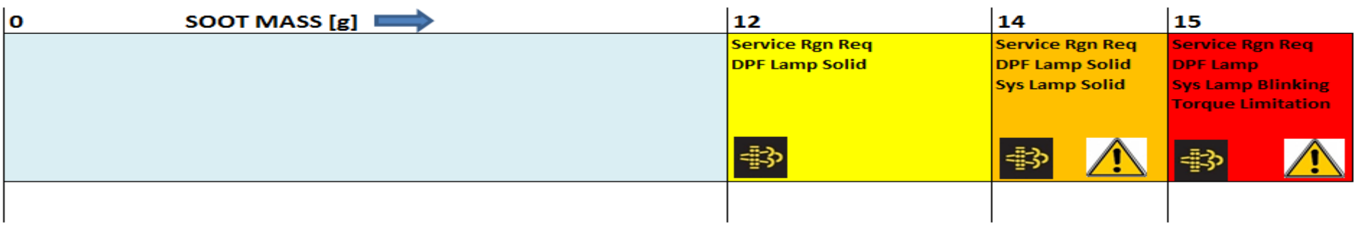
- Extended low idle operating time → the DPF regeneration can't be completed.
- The DPF lamp is suggesting the customer to drive the vehicle at medium/high loads to allow the regeneration process until the DPF lamp shut-off.

Another opportunity is to perform a manual service regeneration → **Manual Svc Rgn switch**.

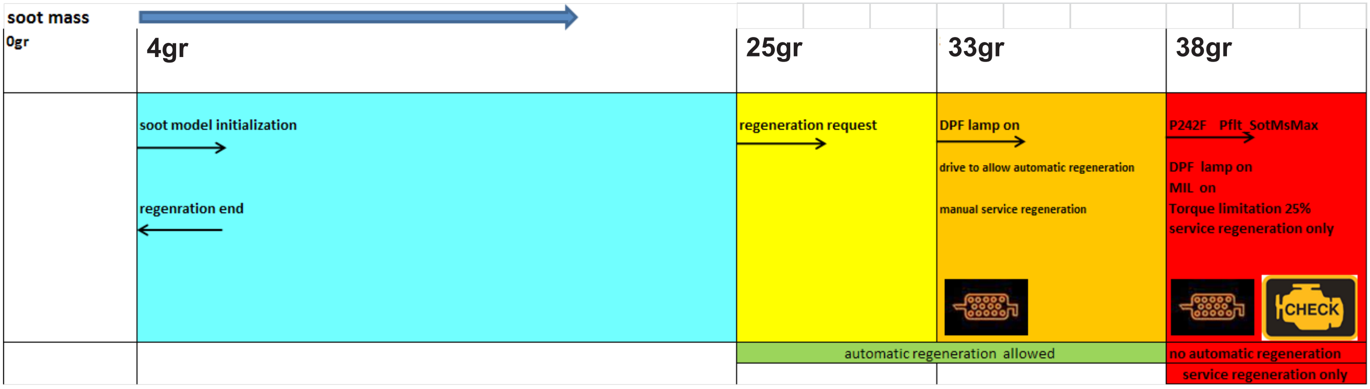
DPF Overload threshold → 40g

- In this case the DPF is overloaded and only service regeneration is allowed → **Svc Rgn by VM Diagnostic Tool**

R754TE4 / ISE4



R754EU6 - R756EU6



DPF regeneration soot threshold → 25g

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- The DPF lamp is suggesting the customer to drive the vehicle at medium/high loads to allow the regeneration process until the DPF lamp shut-off.

Another opportunity is to perform a manual service regeneration → **Manual Svc Rgn switch**.

DPF Overload threshold → 40g

- In this case the DPF is overloaded and only service regeneration is allowed → **Svc Rgn by VM Diagnostic Tool**

MANUAL SERVICE REGENERATION (SWITCH) - R750EU5/EU6/IE4/TE4/ISE4

Aim

when the DPF lamp turns on then it is necessary to drive the vehicle at medium/high loads to allow the DPF regeneration. A second option is to perform a manual service regeneration by using a dedicated switch installed by vehicle manufacturer

Manual Service Regeneration Procedure:

- coolant temp > 65°C
- stop the vehicle at low idle in a safe area: no dry debris underneath the vehicle and no flammable materials near the vehicle
- engage the hand brake
- press the manual service regeneration switch for 3 seconds. The engine speed will rise up to 2000rpm. The service regeneration will take 20-30 minutes. When the regeneration is completed the engine speed will decrease down to low idle.
- The procedure MUST be carry out under continuous control of the end user
- Once the rigeneration will be completed the vehicle can return to normal use
- If the service regeneration switch is pressed for more then 2 minutes or short circuit occures the switch monitor will activate a dedicated fault to interrupt the service rgn process and the switch functionality itself.

SELECTIVE CATALYTIC REDUCTION (SCR) - R 750 EU6

The best way to accomplish the reduction of diesel emissions is to employ a Selective Catalytic Reduction (SCR) system that uses Diesel Exhaust Fluid (DEF).
The SCR system is an after-treatment system, since it treats the vehicle's exhaust after combustion.
Here's how it works:

- A fine mist of DEF is injected into the exhaust while the engine is running.
- The heat from the exhaust converts the DEF into ammonia.
- When the ammonia, mixed with exhaust gases, reaches the SCR catalyst, the NOx emissions are broken down.
- The Diesel Particulate Filter (DPF) then captures soot to incinerate it during regeneration cycles.
- Water vapor, nitrogen and reduced emissions exit the exhaust system.

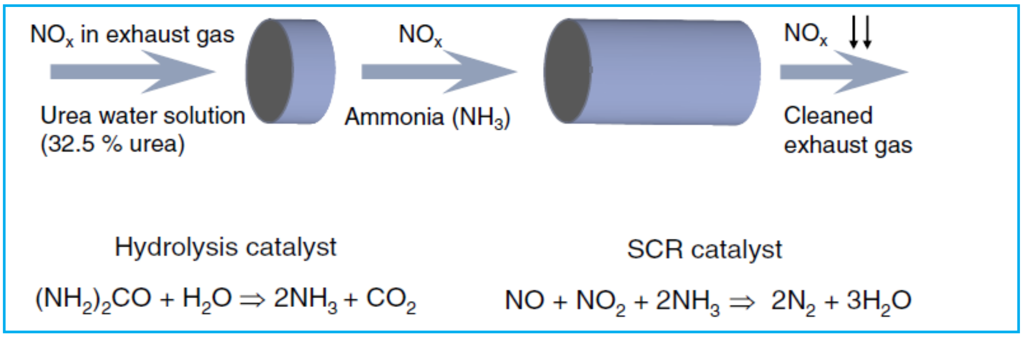
SCR system is based on the principle that selected reducing agents selectively reduce nitrogen oxides in the presence of oxygen.
Here, **"selective"** means that the oxidation of the reducing agent occurs preferentially with the oxygen of the nitrogen oxides and not with the molecular oxygen found in abundance in the exhaust gas.
Ammonia (NH3) has been shown to be the most selective reducing agent here.

REDUCING AGENTS - DIESEL EXHAUST FLUID "DEF"

For operation in the vehicle, NH3 quantities must be stored in the vehicle which are questionable for safety reasons due to their toxicity.
However, Ammonia can be generated from non-toxic carrier substances **such as urea.**
Urea has proven to be a good carrier substance. Urea, < chemical composition (NH2)2CO >, is produced industrially as a fertiliser and animal feed. Urea has a very good solubility in water, and can thus be added to the exhaust gas as a urea-water solution which can be dosed easily. **The urea-water solution is marketed and commonly known as per the brand name "AdBlue".**
At a mass concentration of 32.5 % urea in the water, the freezing point has a local minimum at -11°C.

CHEMICAL REACTIONS

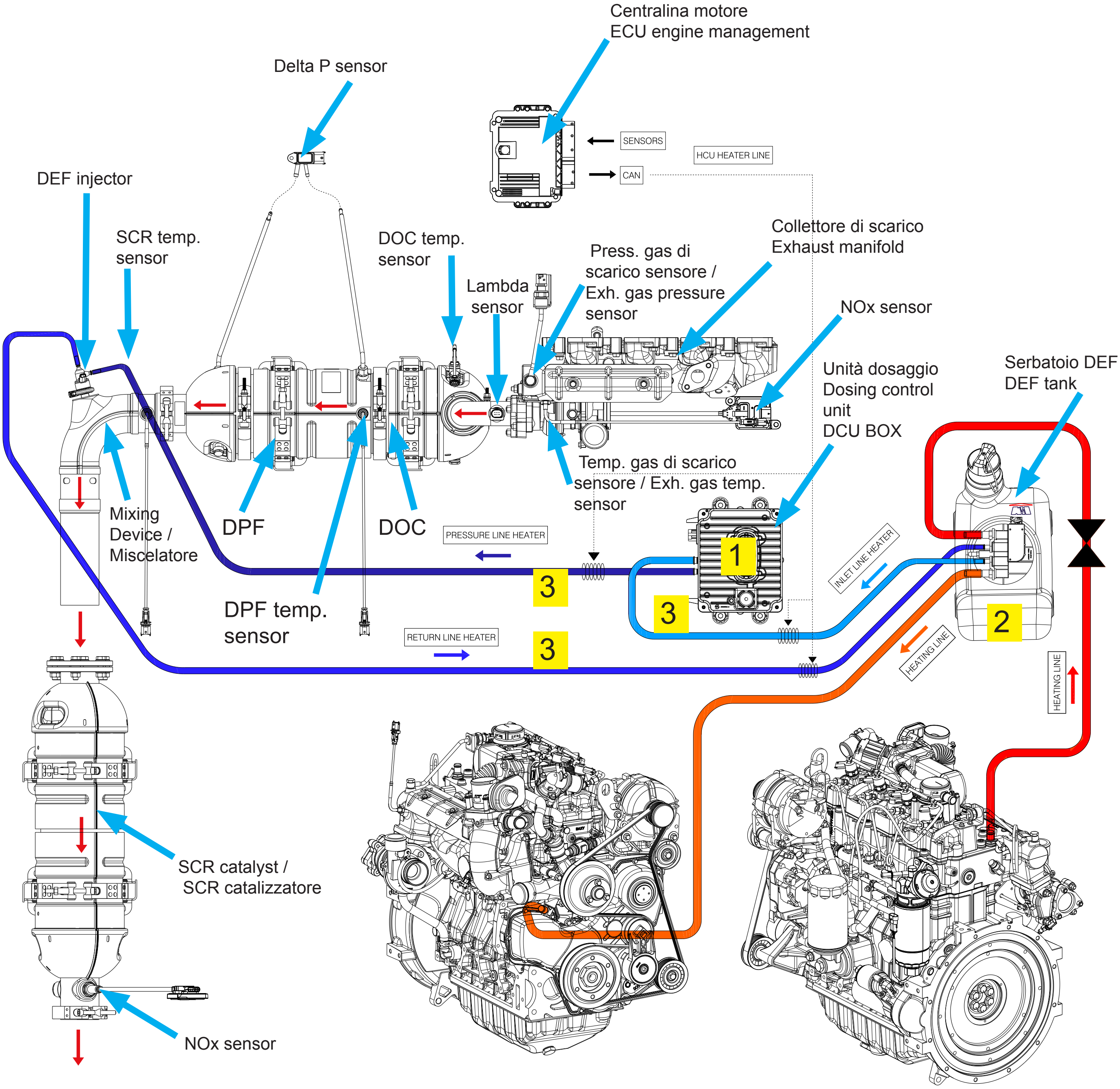
Ammonia must first be produced from urea before the actual SCR reaction. This occurs in two reaction steps, which together are referred to as a hydrolysis reaction and are explained in more detail in figure



IMPORTANT: Diesel Exhaust Fluid (DEF) is a simple, non-toxic and pre-mixed fluid composed of an Aqueous Urea Solution. Diesel Exhaust Fluid (DEF) is manufactured to strict quality standards to ensure proper emissions control. Only DEF that meets ISO 22241 specifications can be used.

IMPORTANT: It is forbidden the use of solutions with different specifications.

SCR SYSTEM - SCHEMATIC VIEW

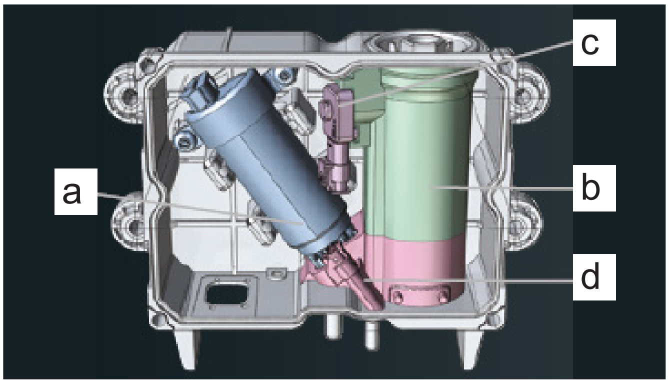


engine coolant inlet
engine coolant outlet
DEF from tank to Dosing Control Unit
DEF from Dosing Control Unit to Injector
DEF return line to the tank

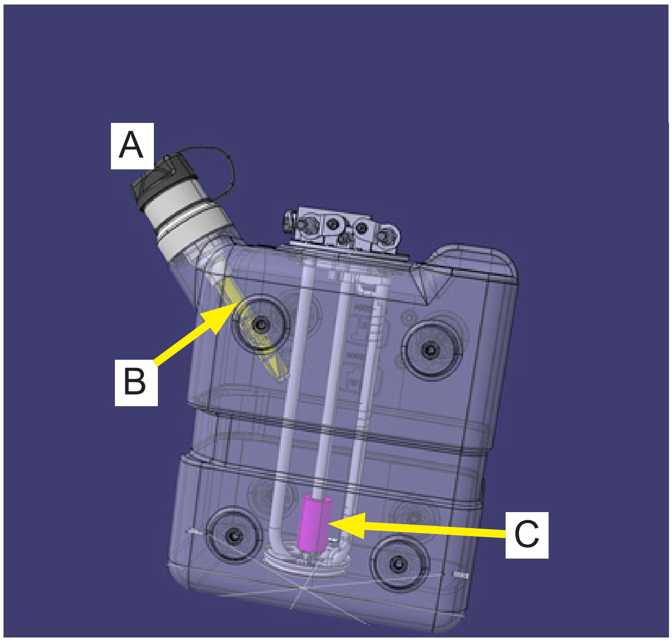
SCR SYSTEM - MAIN COMPONENTS

The SCR system consists of a Dosing Control Unit (DCU box), a tank for Diesel Exhaust Fluid (DEF), a DEF injector, and an SCR catalyst.

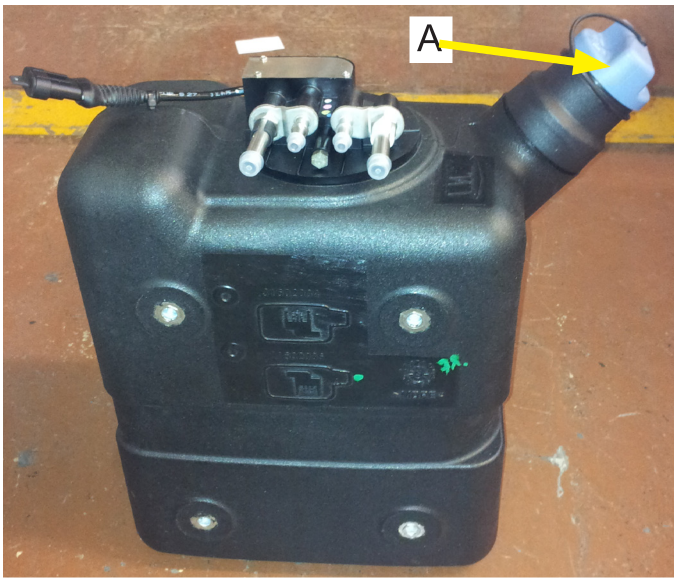
1 - **Dosing Control Unit (DCU box):** this device supplies the fluid DEF to the injector (3). The fluid amount is regulated by the electronic engine system management. The Unit could be installed on the tank containing the DEF fluid. It is composed of:
- pump (a)
- filter (b)
- pressure transducer (c)
- pump/filter heater (d)
- control unit



2 - **DEF tank:** it contains the DEF fluid. It is composed of:
- filling cap (blue colour usually) (A)
- internal filter (B)
- DEF level sensor (C)
- DEF temperature sensor

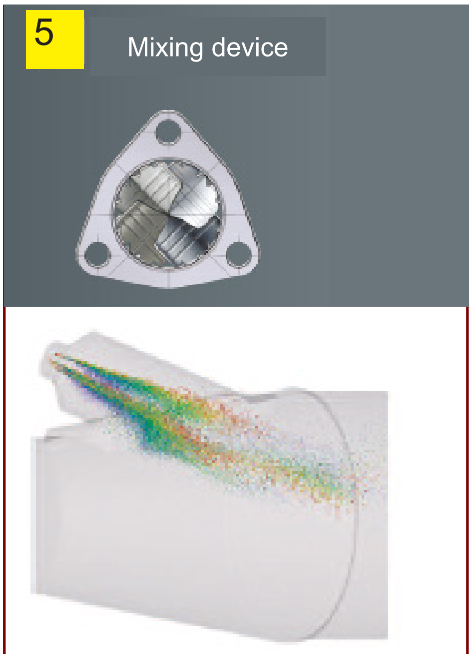


3 - **DEF fluid supply lines:**
the lines are composed of three tubes electrically heated.
The heating pipes is managed by DCU box.
The fluid supply lines are approved by VM Motori S.p.A..



4 - Injector: it sprays the DEF fluid to the SCR catalytic converter through the use of mixing device.

5 - Mixing device: it enables optimal flow distribution of the gaseous ammonia across the SCR catalyst, minimizing urea deposits.



Representation:
DEF injection / UREA distribution

REQUIREMENTS TO ENSURE THE CORRECT OPERATION OF NOx CONTROL SYSTEM (R750EU6 ENGINE MODELS)

In the engines equipped with SCR system a driver warning and a two stage driver inducement system have to be implemented, so that the users will not continue to operate the vehicle without correcting the concern.
The inducement system comprises a driver warning inducement lamp (DWS) and a two stage of torque reduction:

- first level: torque reduction of 25% and a disablement of the vehicle,
- second level: limitation of the vehicle speed to MAX 20 km/h ("creep mode"), if a defect is not repaired in a timely manner (*).

The malfunctions may be:
1. DEF fluid low level
2. Identification of incorrect DEF fluid
3. Monitoring system tampering
4. DEF fluid dosing interruption
5. EGR valve blocked
6. Incorrect AdBlue consumption
7. DEF fluid freeze

(*) for those vehicles not equipped with speed sensor the limitation will be 60% of rated engine RPMs and 50% of torque reduction.

DRIVER WARNING SYSTEM ACTIVATION (DWS LAMP)

- Inform the operator that a condition has occurred which compromises the vehicle emission control system.
- Visual (DWS Lamp) and possibly audible alarms on the dashboard
- Designed such that it cannot be defeated, ignored, or disabled without correcting the concern.
- Activation of the warning system is linked to the status of the corresponding Diagnostic Trouble Code (DTC). If one of the malfunctions listed in table 1 is detected and the corresponding DTC has got the status active the inducement warning lamp is turned ON.

Table 1: NOx control driver warning and inducement system activation

Malfunctions	**Warning 1st step (warning lamp)**	**Inducement Counter for activation of level 1 (derating)**	**Inducement Counter for activation of level 2 (creep mode)**
Low reagent level	Fault active (DEF level < 17%)	none	AdBlue level < 9%
Reagent quality	Fault active	10 h (starting from fault active)	20 h (starting from fault active)
Reagent dosing interruption	Fault active	10 h (starting from fault active)	20 h (starting from fault active)
Reagent consumption	Fault active	10 h (starting from fault active)	20 h (starting from fault active)
Impeded EGR valve	Fault active	36h (starting from fault active)	100 h (starting from fault active)
Tampering of monitoring system	Fault active	36h (starting from fault active)	100 h (starting from fault active)

Table 2: inducement system activation levels

Level		lamp DWS status	Engine torque derate	Engine RPMs derate	Vehicle speed limitation (max. 20km/h)
1	Warning Mode	continuous	no	no	no
2	Derate Mode	continuous	yes (-25%)	no	no
3	Creep Mode	blink	yes (-50%)	**(***)**	**(*)**

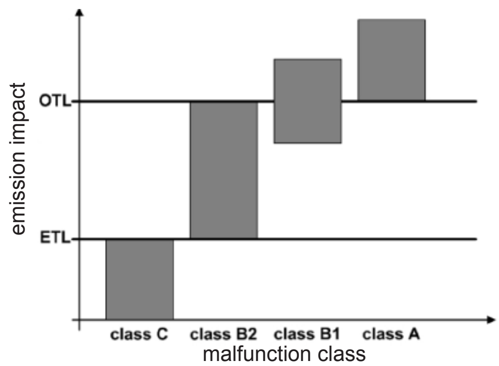
(*) : only if the vehicle is equipped with the vehicle speed sensor

(***) : reduction by 60% of rated engine RPMs for vehicle equipped without vehicle speed sensor.

MIL ACTIVATION ON EURO VI ENGINES

EURO VI Emission Regulation clearly formulates the requirement of classifying each malfunction of an emission-related component or system of an engine system according to its real emission impact. Thus four different malfunction classes have been introduced.

FAILURE CLASSIFICATION BY SEVERITY CLASS



OTL = On Board diagnosis (OBD) Threshold limits
ETL = Emission threshold limits

A new concept has classified the malfunctions by considering both the level of the magnitude of the failures and the reliability of the diagnosis:

- ☐ Failure that need immediate repair due to their high emission impact (CLASS A failures)
- ☐ Failure that only have the potential to lead to non acceptable emissions and need to be investigated (CLASS B1 failures)
- ☐ Failure having an emission impact below the regulated OBD threshold limit value (CLASS B2 failures)
- ☐ Failure with a low emission impact that when tested the affected engine would remain conform to the emission legislation (CLASS C failures)

MIL INFORMATION OF A FAILURE OCCURRENCE

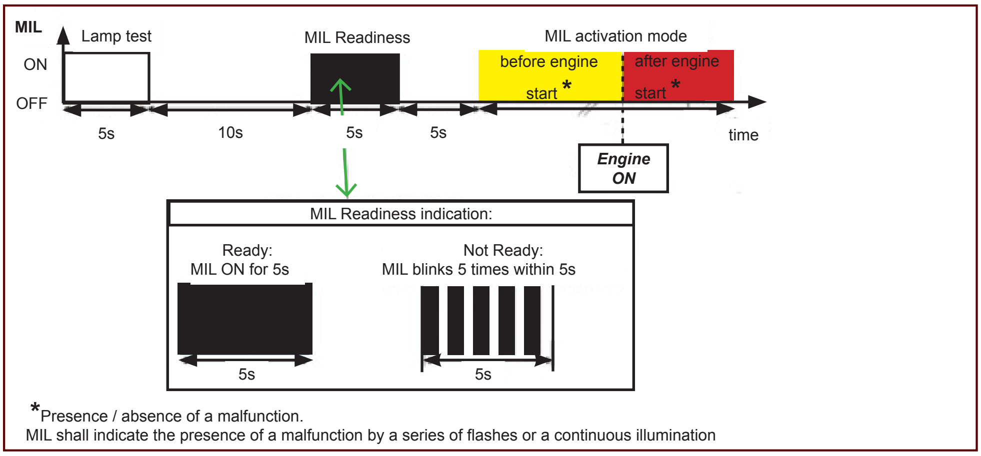
In the event of an emission-related component or engine system failure detected by the On Board Diagnosis (OBD) system, the MIL lamp shall be continuosly or shortly illuminated in according to one of the activation modes as follows decribed and shown in the table:

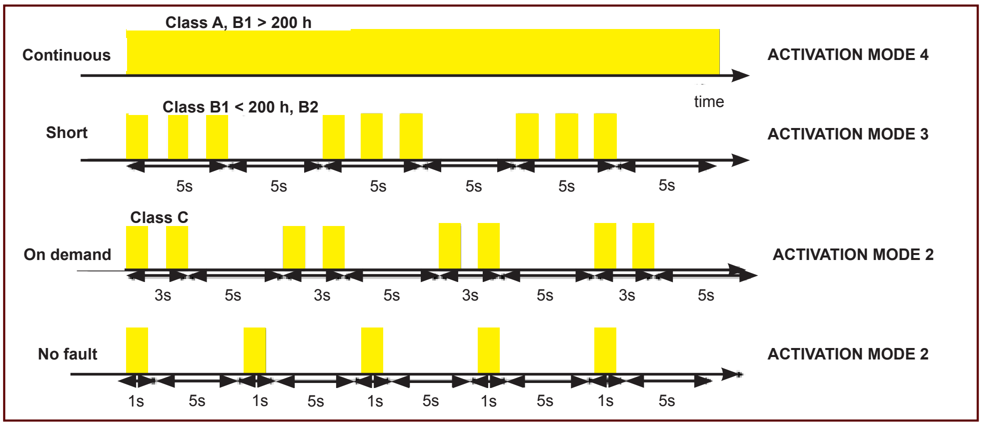
- ☐ **Continuos MIL**
  - The MIL is continuosly ON
  - ☐ Class A failures
  - ☐ Class B1 failures not repaired > 200 engine operating hours
- ☐ **Short MIL**
  - The MIL is ON at every cycles for 15 seconds
  - ☐ Class B1 failures not repaired < 200 engine operating hours
  - ☐ Class B2 failures
- ☐ **On demand MIL**
  - ☐ Class C failures
  - ☐ Engine start Key ON mode (engine not operating)

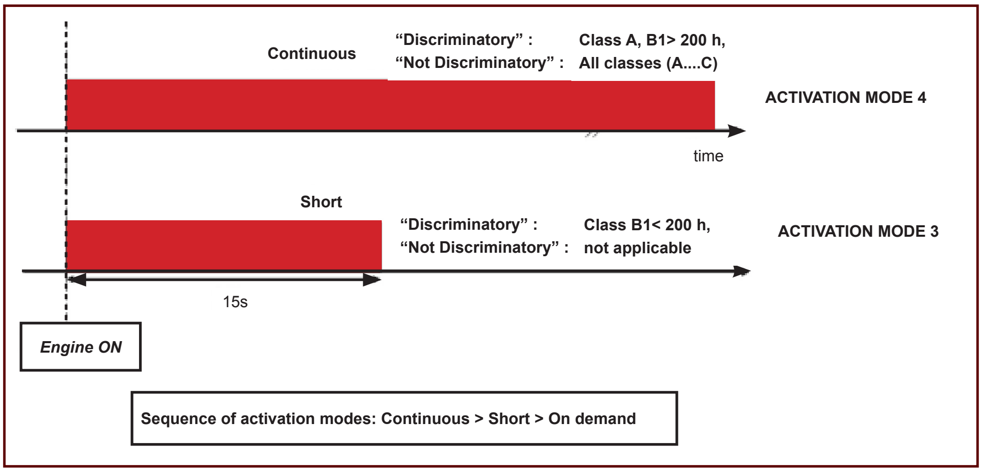
MALFUNCTION CLASSES / MIL ACTIVATION MODES			
Malfunction class	**Condition**	**MIL activation, engine OFF**	**MIL activation at engine ON**
A	-	**Continuous** (activation mode 4 *)	**Continuous**
B1	failure not repaired > 200 hrs	**Continuous** (activation mode 4 *)	**Continuous**
B1	failure not repaired < 200 hrs	**Short** (activation mode 3 *)	**Short**
B2	-	**Short** (activation mode 3 *)	**Short**
C	-	**On demand** (activation mode 2 *)	-

*** Reference in legislation**

MIL ACTIVATION MODES BEFORE AND AFTER ENGINE START







INFORMATION OF A FAILURE OCCURENCE

☐ **Continuous MIL**

Means that maintenance is immediately necessary

☐ **Short MIL**

Means that the failure is not so severe and the driver/engine safety is not compromised. A sufficient time is left to the driver to check the failure

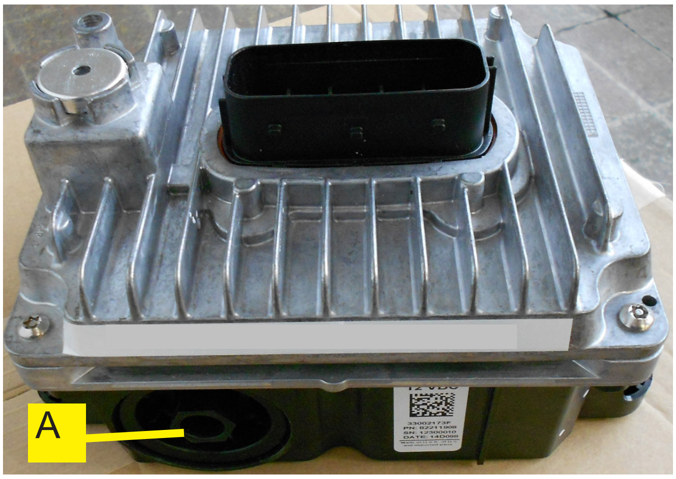
☐ **On demand MIL**

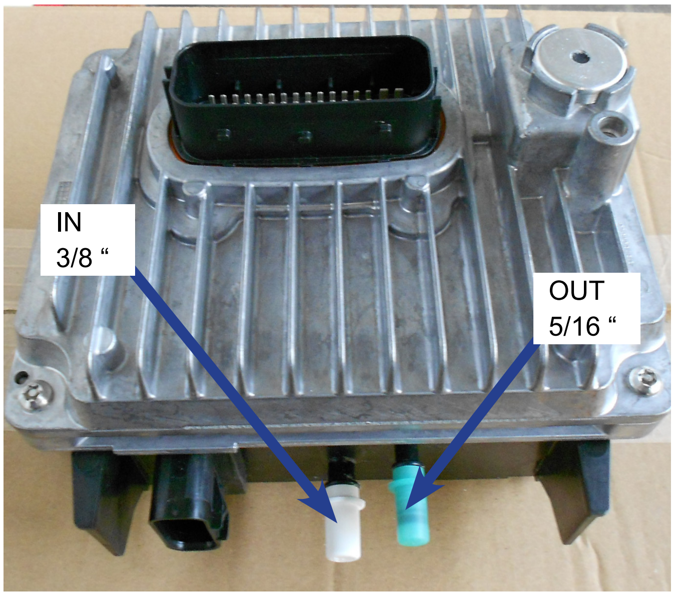
Means that the failure is acceptable but needs to checked. The on demand MIL is desplayed during key ON.

DOSING CONTROL UNIT (DCU BOX)

FILTER REPLACEMENT

Remove the cap A by using a 22mm HEX wrench.
Remove the filter





EXTENDED STORAGE

STORAGE INFORMATION

VM Motori engines are shipped from the factory with a sufficient preservation for a 6 (six) months shelf life.

Each time the storage procedure is performed the “shelf life” will be extended for six months. The procedure should be performed 30 days of the expiration of VM Motori’s preservation or the current protection.

When the engine is being not operated for short periods of time, less than one month, it is advisable to start the engine and operate until it reaches normal operating temperature at least once per month.
The engine must always be started and operated until it reaches normal operating temperature once per month if it is installed for emergency purposes.

When the engine is being not operated for long periods of time, such as one month or more, up to six months, it is needed to carry out a specific treatment to protect it for 6 months.
If the engine remains not operating for a further period of time, check the need to repeat the protective treatment to extend the protection for other 6 months. (Refer to Preparing the Engine for Extended Storage - Engine Protective Treatment)

PREPARING ENGINE FOR EXTENDED STORAGE

The protection procedure is only considered complete when all the following tasks have been performed:
1) protection against external corrosion
2) protection against internal corrosion
3) packaging and storage

This procedure is valid for the following engine situations:
- on a vehicle
- on a pallet

For engines on pallets, it is necessary to install the following accessories for engine start-up:
- battery
- fuel tank
- cooling radiator (for liquid-cooled engines only)
- command belt for the alternating current generator
- command belt for the water pump (for liquid-cooled engines only)

1) EXTERNAL PROTECTION

UNPAINTED SURFACES: the unpainted metal components and surfaces (for instance the engine handwheel) must be protected with “FL MECA FLUID / P118V” anticorrosion oil.
RUBBER COMPONENTS: unpainted manifolds and pipes must be protected with talcum powder. Check the tightening of the relative fixing clips.
DRIVE BELTS: after applying the internal protection, remove the belts and put them into storage. Protect the surfaces of the metal pulleys with “FL MECA FLUID / P118V” spray.
ENGINE OPENINGS: Seal all the engine openings, including the exhaust. Use cardboard, plywood or metal covers, making sure they do not leave behind any fragments of material. All the engine openings (e.g. air suction ducts or turbocharger air inlet) must be protected with covers or guards to prevent the entry of solids, liquids or dusts that delay the evaporation of the anticorrosion agents. Apply plugs to the fuel inlet and outlet pipes of the injection system.
BATTERY: Disconnect the battery. When it is fully charged, store it in a safe place. Before doing this, protect the terminals against corrosion by applying an anti-rust spray.

2) INTERNAL PROTECTION

COMBUSTION CHAMBER: Remove the heating glowplugs from the head, check the piston is in its lowest stroke position (lower standstill point), then spray with Petronas PROT 30 M protective oil. Repeat the operation for the other cylinders, then reinstall the glowplugs.
TURBOCHARGER: Remove the inlet plug from the pipe that delivers oil to the turbocharger, and fill with Petronas PROT 30 M protective oil. Replace the inlet plug, applying the correct tightening torque.
ELECTRIC COMPONENTS: Apply anticorrosion spray to the electric contacts and connectors.
AIR SUCTION SYSTEM: check the air filter is in good condition, and no foreign bodies/liquids are present:

- If the air filter is damaged, replace it
- If there are any foreign bodies, remove them

LUBRICATION SYSTEM: this procedure must be carried out together with the injection system protection procedure.

- Using the oil dipstick and check whether there is engine oil in the sump.
- Drain the oil from the sump.
- Fill the engine with Petronas PROT 30 M protective oil.
- Check the coolant level (for water-cooled engines only). The coolant mixture must be 50% demineralised or distilled water and 50% Petronas Paraflu Up (protective radiator fluid with monoethylene glycol and organic inhibitor formulation complying with ASTM D 3306 type 1 Standards).
- Start up the engine and run it until it reaches the right temperature for water-cooled engines (about 70°- 80°C); for air-cooled engines, run the engine for about 20 (twenty) minutes.
- With the engine up to temperature, carry on for about 5 minutes so that the system components are lubricated.
- Switch off the engine and wait for it to cool down.
- Drain the oil from the sump.
- Drain off the coolant.
- Check for any fluid leakage (and make any necessary repairs).
- Disconnect the engine from all the components used for the test.

INJECTION SYSTEM: this procedure must be carried out together with the lubrication system protection procedure.

- Make sure there are no deposits or sediments in the fuel tank.
- Prepare a mixture of diesel fuel complying with the DIN EN 590 specifications, and Petronas DIESEL TMF PLUS additive. The ratio must be at least 1:400 (1 litre of additive to 400 litres of fuel). If you use Biodiesel (complying with the UNI EN 14214 specifications), it must be mixed with diesel fuel up to 7%;

Important

VM Motori, however, recommends the use of diesel without Biodiesel.

Important

The use of any other fuel is forbidden.

- Fill the tank with this fuel mixture.
- Where relevant, check there is no interference between the radiator fan blades and the relative air duct.

Start up the engine and run it until it reaches the right temperature for water-cooled engines (about 70°- 80°C); for air-cooled engines, run the engine for about 20 (twenty) minutes.

- Drain the fuel tank.
- Check for any fluid leakage (and make any necessary repairs).
- Switch off the engine and wait for it to cool down.

SEAWATER SYSTEM (for marine engines and on-board auxiliary units only): this procedure must be carried out together with the injection system protection procedure.

- Connect the seawater intake of the seawater pump to an auxiliary tank containing a mixture of 40% freshwater and 60% Petronas Paraflu Up (protective radiator fluid with monoethylene glycol and organic inhibitor formulation complying with ASTM D 3306 type 1 Standards), making sure it seeps out from the drainage point.
- Check for any fluid leakage (and make any necessary repairs).
- Switch off the engine and wait for it to cool down.
- Disconnect the engine from all the components used for the test

3) STORAGE CONDITIONS

- Engines on pallets

After applying the anticorrosion protection, the engine must be placed in a dry, well-ventilated environment and adequately covered. The covering must be applied in such a way that air can circulate around the engine, preventing the formation of condensation.

- Engines on vehicles

The vehicle must be stored so as to minimise exposure to atmospheric agents

START-UP

- Engines on pallets

Remove the covers and protective elements applied to the engine openings (for instance, air suction ducts or turbocharger air inlet, exhaust gas ducts or turbocharger guard).
Check there is no damage to the external engine components; make any necessary repairs.
Clean the throats of the metal belt pulleys, using a suitable solvent. Install the service belts
Check the rubber tubes and manifolds are in good condition, and check the tightening of the relative fixing clips; if they are damaged, replace them.
All surfaces and components protected with “FL MECAFLUID / P118 V” protective oil can be cleaned with a suitable solvent.
Check the level of the fluids: engine oil and coolant. Top up if necessary.

- Engines on vehicles

Check there is no damage to the external engine components; make any necessary repairs.
Clean the throats of the metal belt pulleys, using a suitable solvent. Install the service belts.
Check the rubber tubes and manifolds are in good condition, and check the tightening of the relative fixing clips; if they are damaged, replace them.
All surfaces and components protected with “FL MECAFLUID / P118 V” protective oil can be cleaned with a suitable solvent.
Check the level of the fluids: engine oil and coolant. Top up if necessary.

Important

Nothing needs to be done to remove the internal protection (either for engines on pallets or on vehicles).

REMOVAL AND INSTALLATION

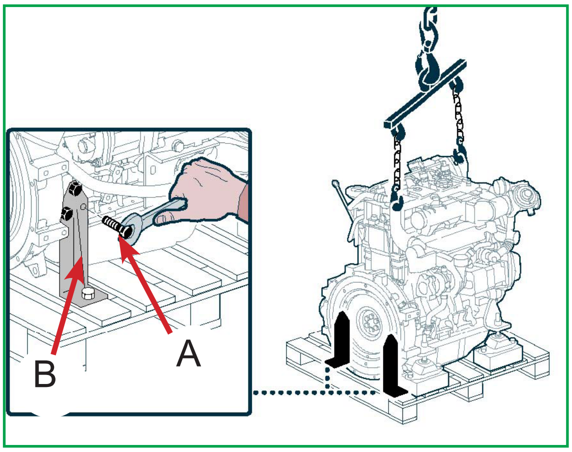
ENGINE LIFTING EYE BRACKET

Place the lifting device as shown in the figure.

Loosen the screws (A) and disassemble the side supports (B).

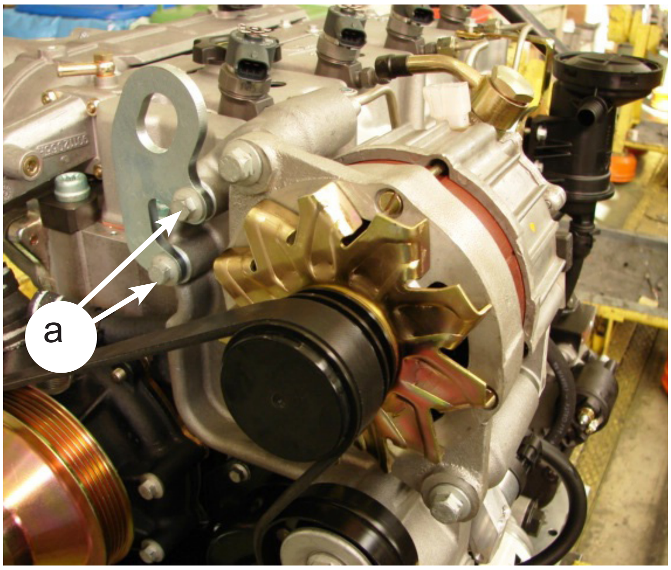
Move the engine to the installation area.

Further information are available inside the owner manual or installation manual.



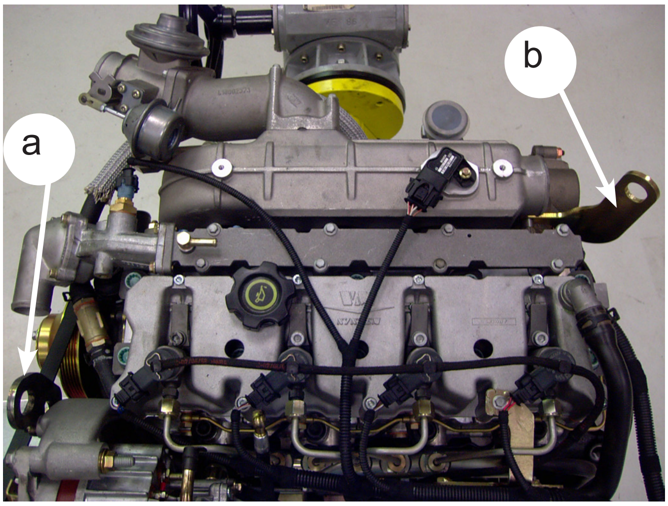
a - lifting eye bracket screw (front side)

lifting eye bracket (front side)	**27.5 Nm**



b - lifting eye bracket nut (rear side)

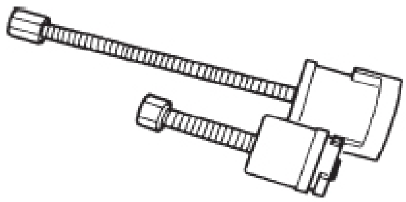
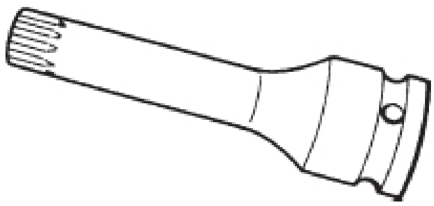
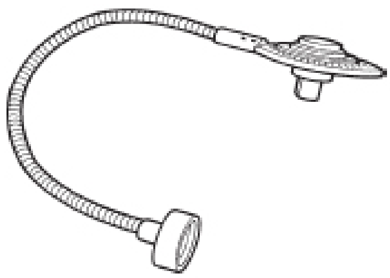
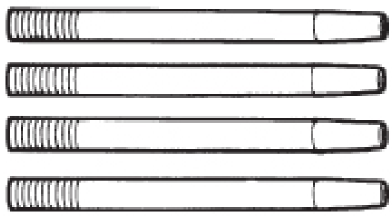
Refer to exhaust manifold torque procedure	**Nm**

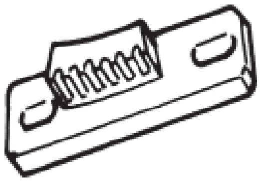
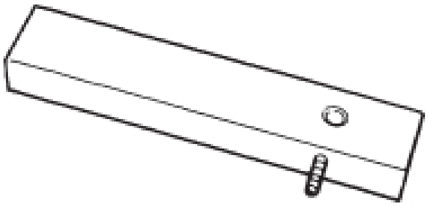
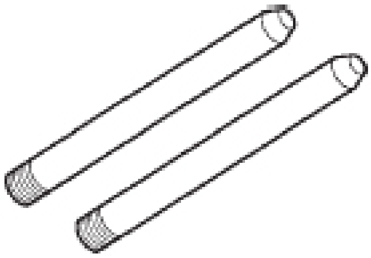


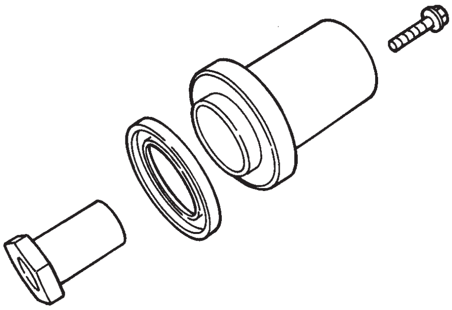
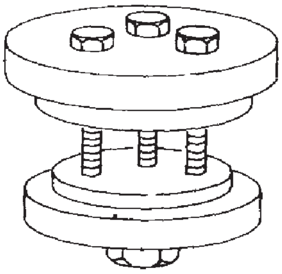
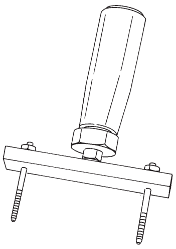
FASTENER TIGHTENING SPECIFICATIONS

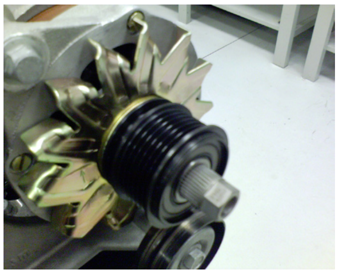
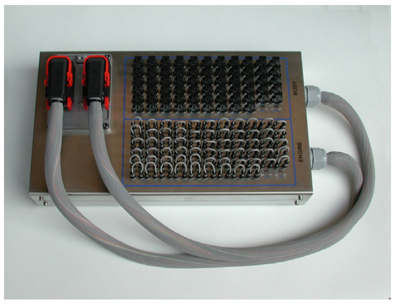
COMPONENT	Nm	SYSTEM
CENTER MAIN BEARING CARRIERS - BOLTS	44,1	ENGINE BLOCK
OIL DELIVERY TO MAIN BEARING CARRIERS - SPECIAL SCREW ON BLOCK	53,9	ENGINE BLOCK
CAMSHAFT FLANGE - SCREW	27,5	ENGINE BLOCK
OIL PISTON COOLING JET - SCREW	12,7	ENGINE BLOCK
IDLER GEAR (BEETWEN CAMSHAFT AND CRANKSHAFT GEARS) - BOLT	32,4	TIMING SIDE
IDLER GEAR (BEETWEN CAMSHAFT AND INJECTION PUMP GEARS) - SCREW	SEE PROCEDURE	TIMING SIDE
OIL PUMP - SCREW	27,5	TIMING SIDE
COOLANT PUMP - SCREW	32,4	TIMING SIDE
CRANKSHAFT FRONT HUB - NUT	SEE PROCEDURE	TIMING SIDE
CRANKSHAFT FRONT PULLEY - SCREW	45,1	TIMING SIDE
RAIL - SCREW	SEE PROCEDURE	INJECTION SIDE
RAIL BRACKET - SCREW	SEE PROCEDURE	INJECTION SIDE
INJECTOR - CLAMP SCREW	SEE PROCEDURE	INJECTION SIDE
HIGH PRESSURE INJECTION PUMP - FLANGE NUT	27,5	INJECTION SIDE
HIGH PRESSURE INJECTION PUMP GEAR - NUT	86,3	INJECTION SIDE
ENGINE OIL HEAT EXCHANGER (MODINE) - BOLT	60.1	INJECTION SIDE
OIL FILTER HOUSING - BOLT	39,2	INJECTION SIDE
COOLANT MANIFOLD - SCREW	11,8	INJECTION SIDE
OIL DELIVERY PIPE TO ROCKER ARM - HOLLOW BOLT ON CYL. HEAD	14	INJECTION SIDE
OIL DELIVERY PIPE TO ROCKER ARM - HOLLOW BOLT ON CRANCASE	23,5	INJECTION SIDE
EXHAUST MANIFOLD - NUT	SEE PROCEDURE	EXHAUST SIDE
INTAKE MANIFOLD - NUT	SEE PROCEDURE	EXHAUST SIDE
TURBOCHARGER - NUT	32,4	EXHAUST SIDE
OIL DELIVERY PIPE TO TURBOCHARGER- HOLLOW BOLT ON TURBO FLANGE	24,5	EXHAUST SIDE
OIL DELIVERY PIPE TO TURBOCHARGER - NUT ON BLOCK	32,4	EXHAUST SIDE
EGR HEAT EXCHANGER (INSTALLED ON HOUSING) - SCREW	1478	EXHAUST SIDE
EGR HEAT EXCHANGER (INSTALLED ON BLOCK) - SCREW	32,4	EXHAUST SIDE
EGR HOUSING HEAT EXCHANGER (INSTALLED ON EXHAUST MANIFOLD) - NUT	32,4	EXHAUST SIDE
ASSEMBLY EGR & INTAKE THROTTLE VALVE - SCREW	10,8	EXHAUST SIDE
EGR VALVE (R754IE4-TE4-ISE4)	13.7	EXHAUST SIDE
ELBOW ASSEMBLY EGR & INTAKE THROTTLE VALVE - SCREW	10,8	EXHAUST SIDE
VACUUM PUMP OIL DELIVERY PIPE - HOLLOW BOLT (ON BLOCK)	27,5	ENGINE ELECTRICAL
ALTERNATOR - NUT	45,1	ENGINE ELECTRICAL
ALTERNATOR IDLE PULLEY	80 ± 5	ENGINE ELECTRICAL
STARTER MOTOR - BOLT	83,4	ENGINE ELECTRICAL
VACUUM PUMP OIL DELIVERY PIPE - HOLLOW BOLT (ON VACCUM PUMP)	27,5	ENGINE ELECTRICAL
REAR MAIN BEARING CARRIER - NUT	24,5	FLYWHEEL SIDE
FLYWHEEL HOUSING - SCREW	68,6	FLYWHEEL SIDE
FLYWHEEL	SEE PROCEDURE	FLYWHEEL SIDE
OIL FILTER	12,7	MAINTENANCE
CONNECTING ROD - SCREW	SEE PROCEDURE	BASIC ENGINE
CYLINDER HEAD	SEE PROCEDURE	BASIC ENGINE
ROCKER ARM - NUT	29	BASIC ENGINE
GLOW PLUG OR PLUG	14,2	BASIC ENGINE
ALTERNATOR BRACKET - SCREW	68,6	REMOVAL & INSTALLATION
FRONT ENGINE LIFTING BRACKET (INSTALLED ON ALTERNATOR BRACKET)	27,5	REMOVAL & INSTALLATION
REAR ENGINE LIFTING BRACKET (INSTALLED ON EXHAUST MANIFOLD)	SEE PROCEDURE	EXHAUST SIDE

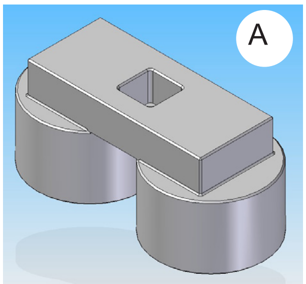
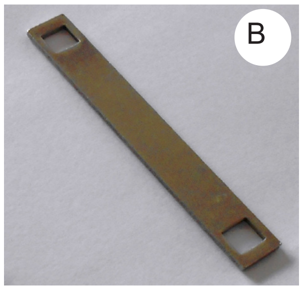
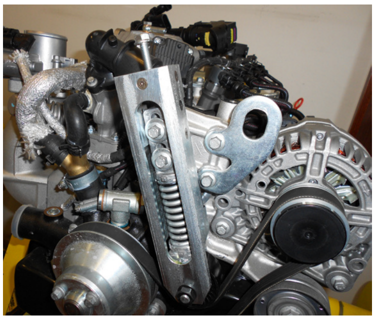
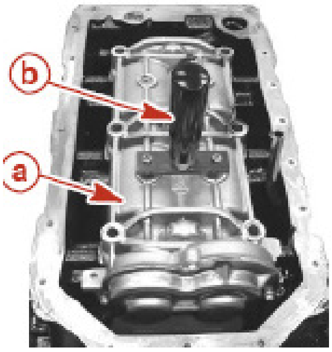
SPECIAL TOOLS

VM code	Description	Picture
68400012A	Cylinder liner extractor	
68400015A	Crankshaft and camshaft bearing remover/installer	
68410006A	Crankshaft assembly tool	
68410012F	Assembly/disassembly Hydraulic tappets tool	
68420016F	XZN wrench for cylinder head bolt (12 mm)	
68420015F	XZN wrench for cylinder head bolt (14 mm)	
68420019F	Angular torque wrench	
68460003A	Cylinder head assembly dowels	

68480003A	Flywheel ring gear clamp (to be installed in place of starter motor)	
68490007A	Cylinder liner protusion gauge	
68460005F	Pins for flywheel assembly	
68400038F	Crankshaft gear extractor for engines with cylindrical crankshaft end	
68500010F	**R750 EURO 4 / 5** **R750 IE3, TE3** **R750 IE4, TE4, ISE4** Diagnostic tool -- ***The software updating is available on VM Motori web site, Customer Reser-ved Area "EXTRANET"***	

68410013G	Front Oil Seal Installer	
68400040F 68400046F 68400044F 68400045F 68400045G	Injector Remover (Complete) Body Stud Fork R750 EURO 4 / IE3 Fork R750 EURO 5	
68410010F	Rear Oil Seal Installer	
68480013F	Counter balancing crankshaft pins (only for engines where the counter weight balance is installed)	
6844009F 68440010F	Cylinder head seal hydraulic test Cylinder head seal test with hydraulic O-rings	

68420022F	Alternator idle pulley remover	
68490038F	**ONLY FOR R750 EURO 4** Owen for DPF Filter cleaning 3kW - 220V	
68490035F 68490036F 68490037F	Test Engine harness **R750EU4-EU5 / TE3 / IE3 / TE4/ISE4/IE4** (without potentiometer accelerator and ECU) (with potentiometer accelerator and without ECU) (with potentiometer accelerator and with ECU)	
68490040F	Test Engine harness **R750EU6**	
68490034F	engine compression adapter tester tool	
68500017F 68500016F	**Break out box** (without jumpers) (complete of jumpers)	

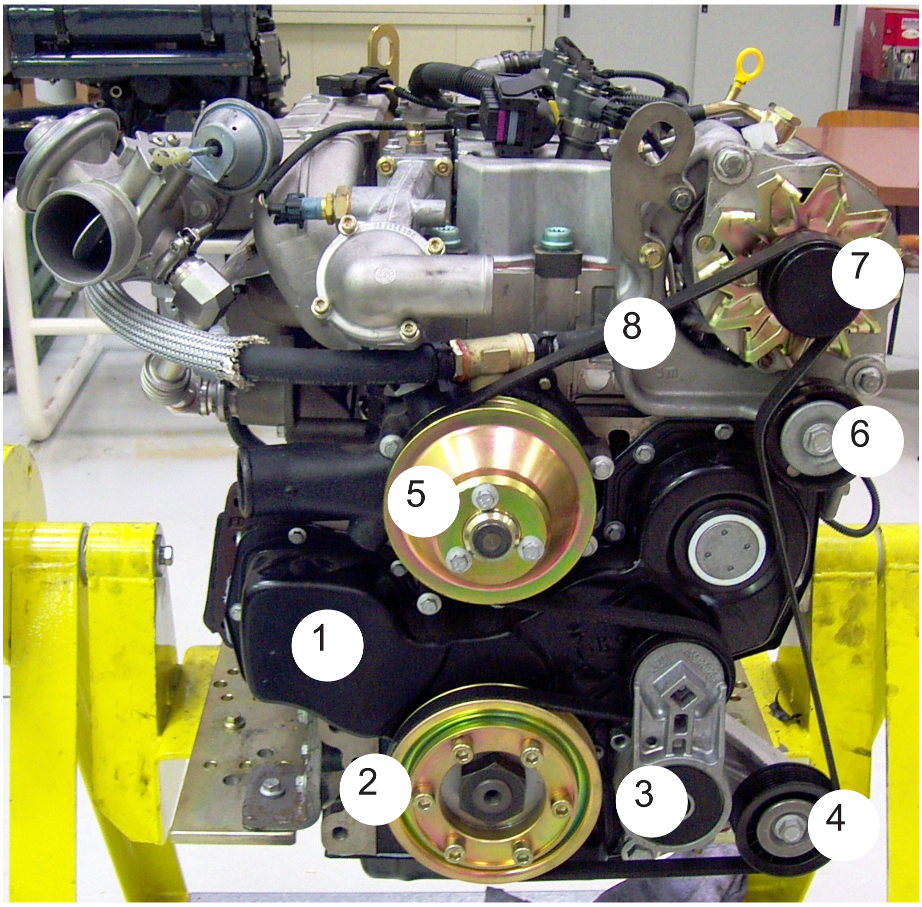
	Oscilloscope (recommended type “PicoScope”) Tool useful to visualize crankshaft and camshaft waveform	
68490007F	Belt fitting tool (R750IE4-TE4-ISE4-R754EU6) (to be installed on the belt) A: belt fitting B: tensioner locking spring	 + 
68490039F	Belt fitting tool (R750IE4-TE4-ISE4-R754EU6) (to be installed on the tensioner)	
68500019F	R750 engine family - Diagnostic tool **(this supersedes the VM diagnostic tool 68500010F not anylonger supplied)**	
68480013F	**Counter-balance shaft timing tool**	 

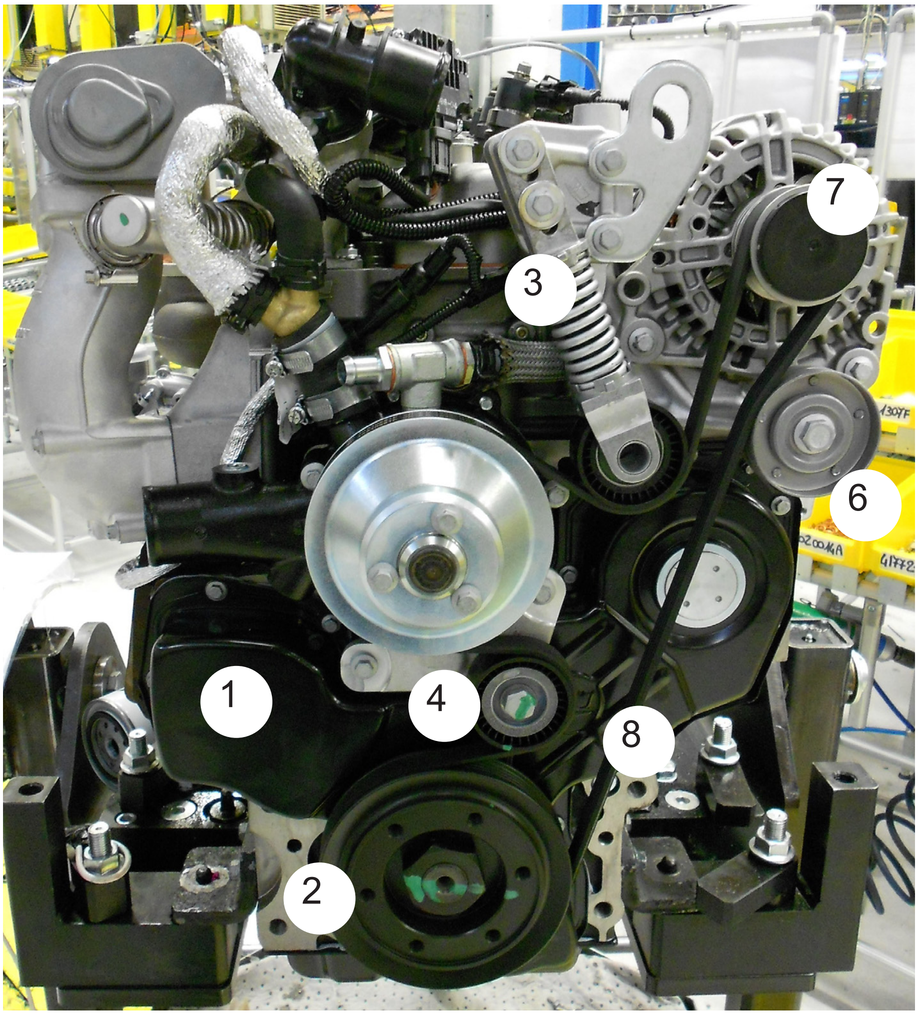
HARNESS CONNECTOR KIT

O = PRESENT / = NOT PRESENT	R750 TE3/ IE3/EU4	R750EU5	R750EU5 air mass connector	R754IE4	R754EU6 vehicle side	R754EU6 SCR system	R756EU6 vehicle side
	33002154	33002162	33002163	33002164	33002169	33002176	33002172
Engine ECU	O	O	/	O	O	/	O
differential pressure sensor	O	O	/	O	O	/	O
EGR/TVA valve vacuum modulator	O	O	/	/	/	/	O
electrical TVA valve	/	/	/	O	O	/	/
electrical EGR valve	/	/	/	O	O	/	/
fuel temperature	O	O	/	O	O	/	O
fuel heater	O	O	/	O	O	/	O
alternator	O	O	/	/	O	/	O
water in the fuel sensor	O	O	/	O	O	/	O
EGR/TVA signal out	O	O	/	/	/	/	O
EOBD diagnosis	O	O	/	O	O	/	O
accelerator pedal	O	O	/	O	O	/	O
exh. gas temp. (DPF - IN)	/	/	/	/	O	/	O
exh. gas temp. (DOC - IN)	/	/	/	/	O	/	O
exh. temp. DPF	/	O	/	O	/	/	/
exh. temp. T3 (exh. mani-fold)	/	/	/	/	O	/	/
exh. pressure sensor	/	/	/	/	O	/	/
exh. gas temp. EGR cooler OUT	/	/	/	/	O	/	O
LAMBDA sensor	/	/	/	/	O	/	O
ambient temp. sensor	/	/	/	/	O	/	/
air mass sensor	/	O	O	/	/	/	O
CAN-BUS SCR system	/	/	/	/	O	O	O
DCU box TENNECO (14 way)	/	/	/	/	/	O	/
UREA level and temperature	/	/	/	/	/	O	/
temperature SCR - IN	/	/	/	/	/	O	/
NOx DOC IN	/	/	/	/	/	O	/
NOx DOC OUT	/	/	/	/	/	O	/
UREA injector	/	/	/	/	/	O	/
heating lines	/	/	/	/	/	O	/
UREA tank heater	/	/	/	/	/	O	/
ACU Tenneco (62 way)	/	/	/	/	/	O	/

TIMING SIDE

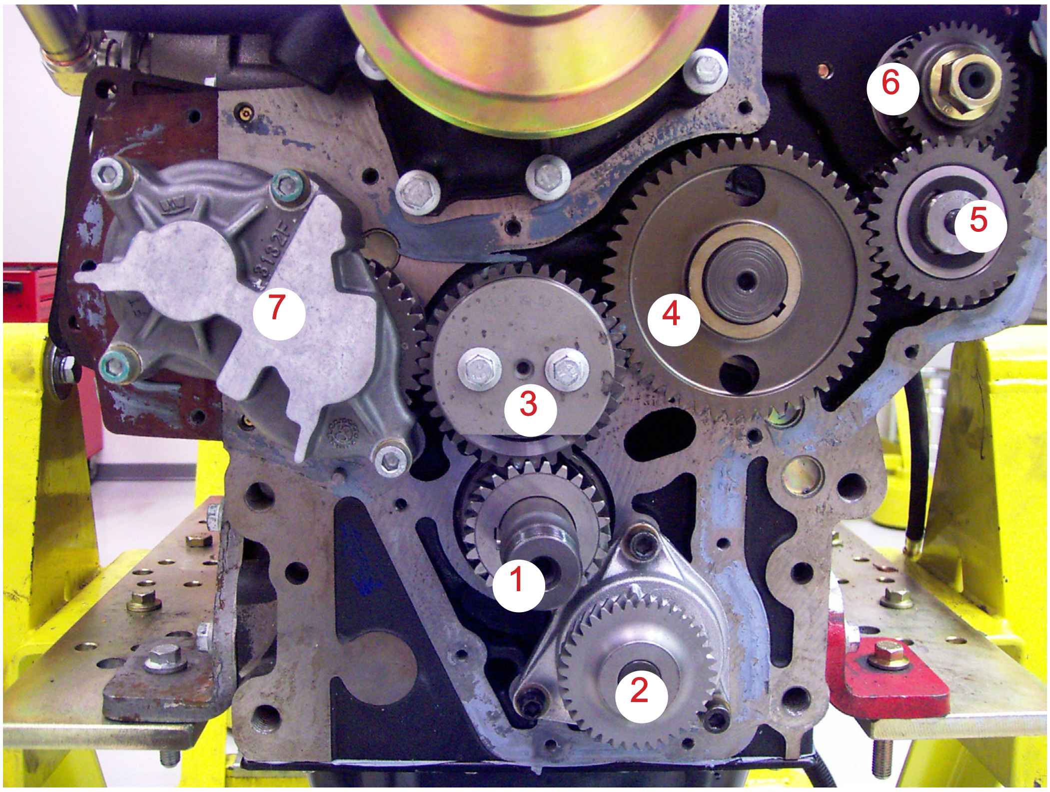
1. Timing cover (metal sheet)
2. Crankshaft pulley
3. Belt Tensioner
4. Plastic Idler pulley
5. Coolant pump pulley
6. Metal idler pulley
7. Alternator
8. Poly - V alternator belt



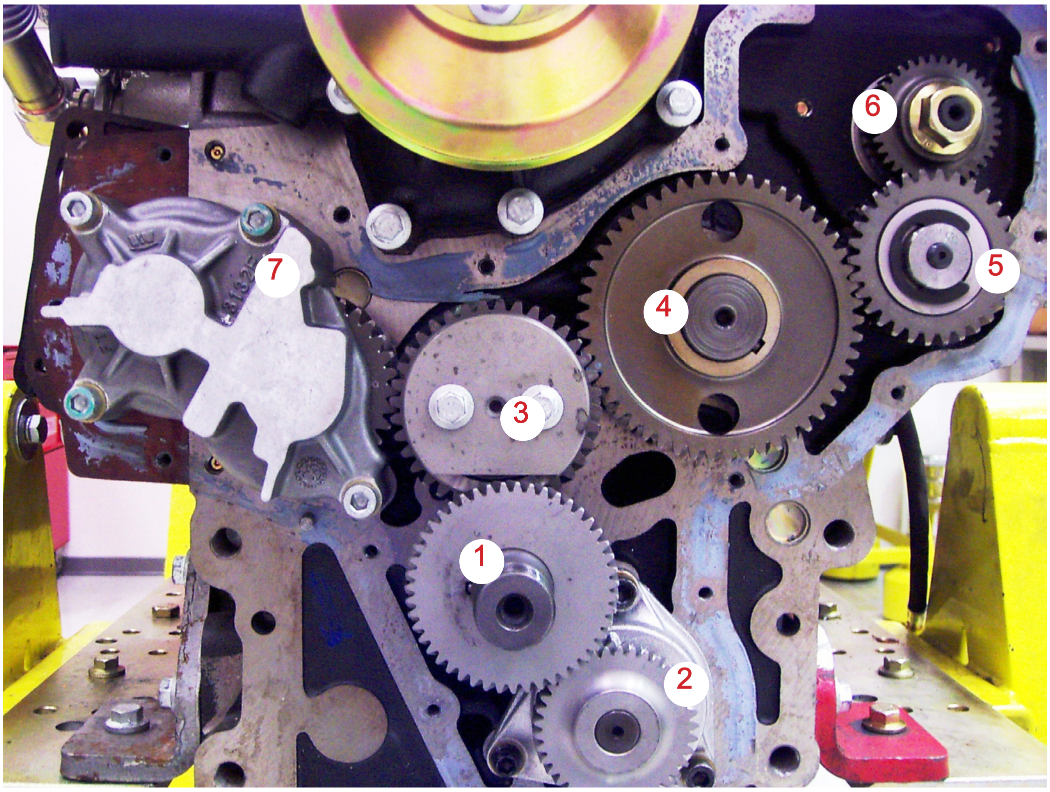


TIMING GEARS

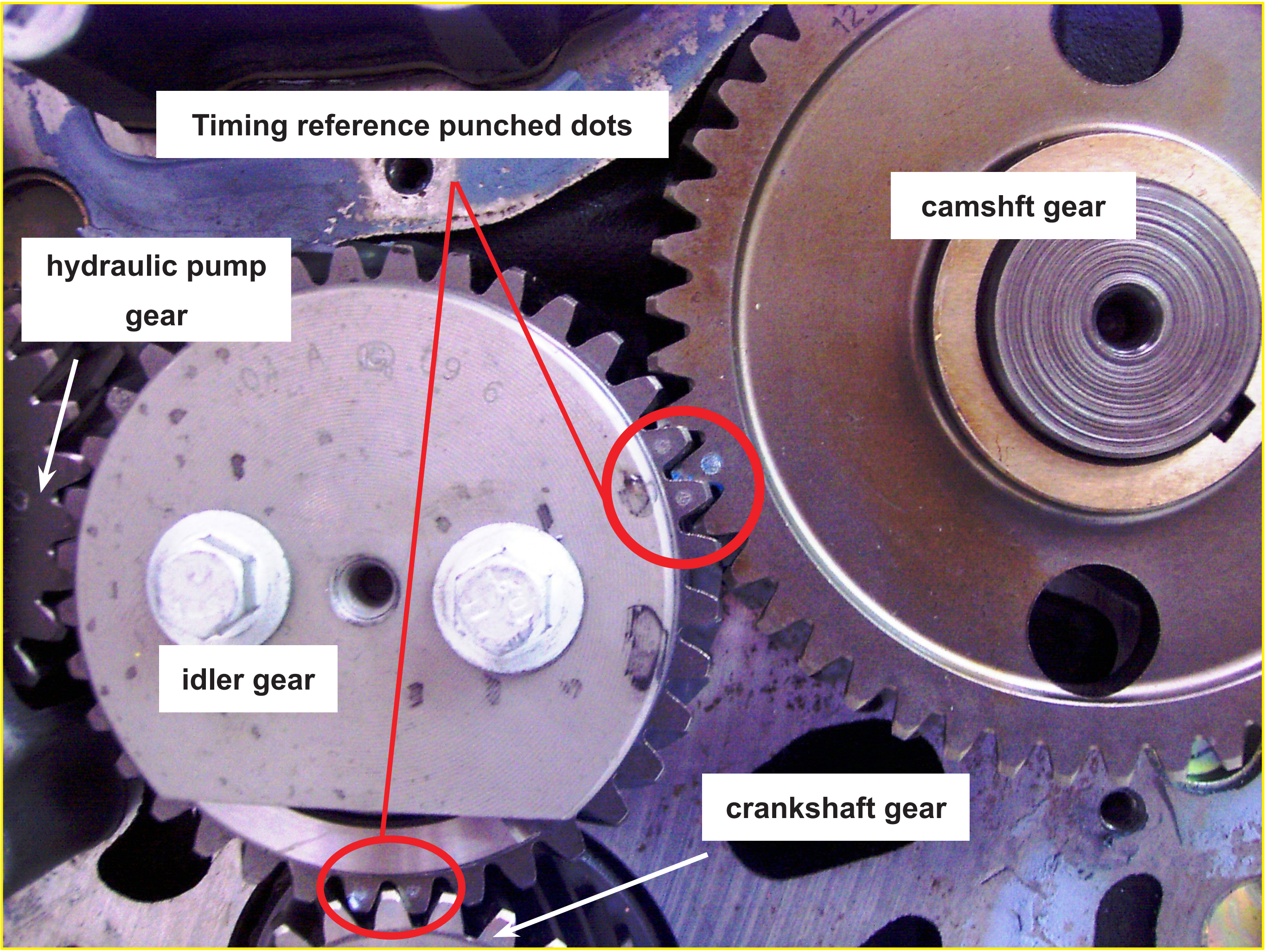
1. Crankshaft gear
2. Oil pump gear
3. Idler gear
4. Camshaft gear
5. Idler gear
6. Injection pump gear
7. Hydraulic pump gear

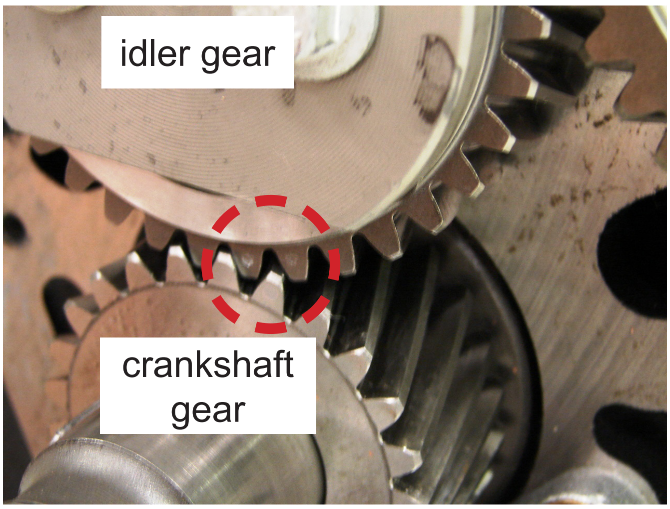


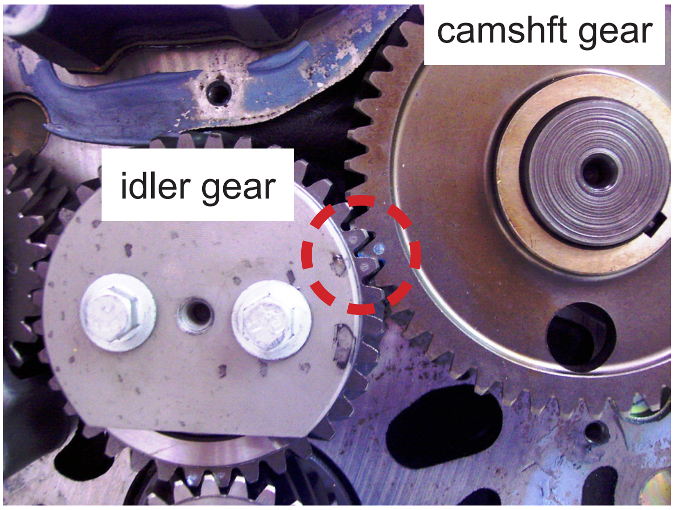
1. Gear driving oil pump gear (crankshaft gear not visible)
2. Oil pump gear
3. Idler gear
4. Camshaft gear
5. Idler gear
6. Injection pump gear
7. Hydraulic pump gear



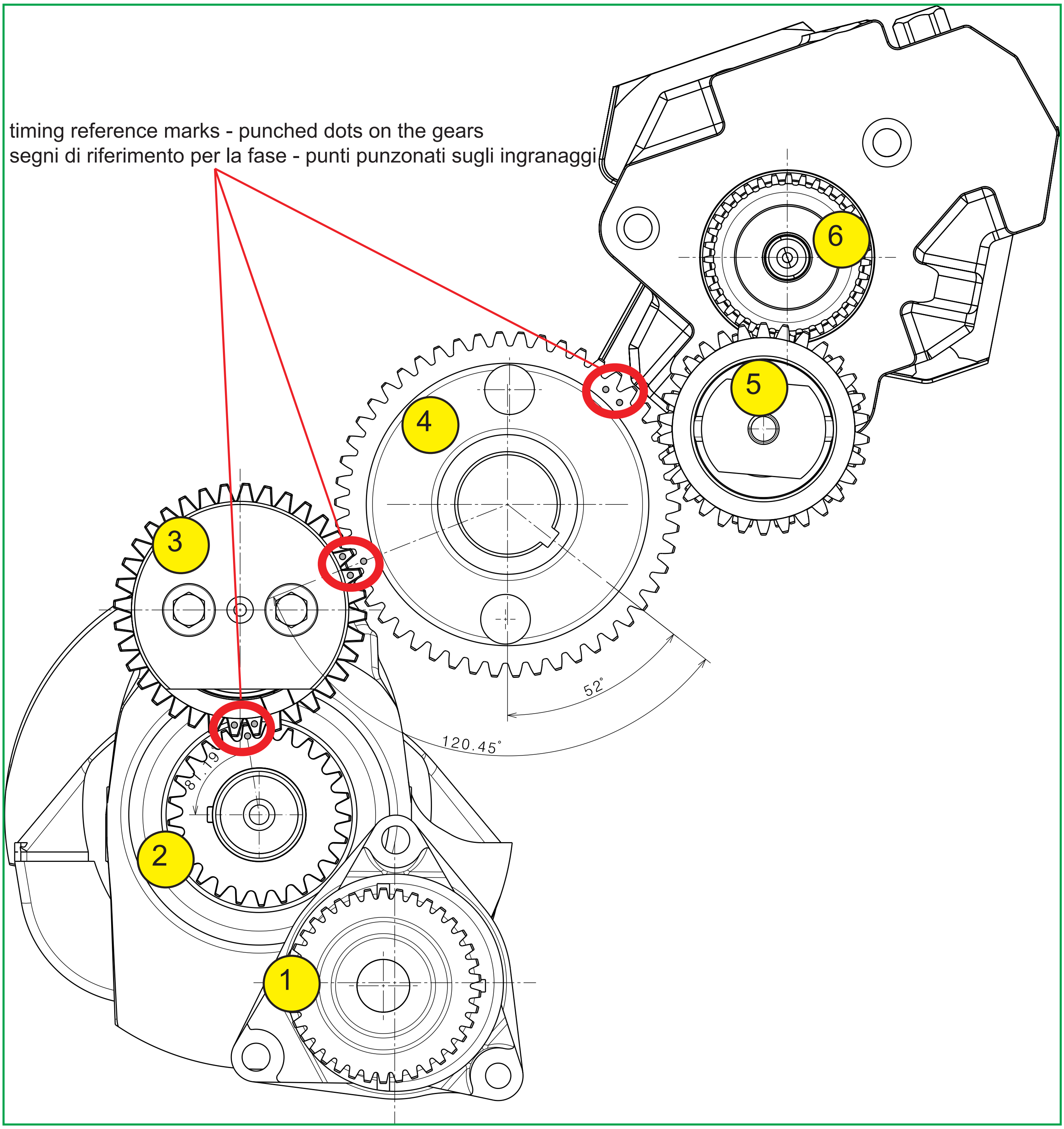
TIMING GEARS WITH CYLINDER NUMBER 1 PISTON IS AT COMPRESSION STROKE TDC.







1 - Oil pump gear
2 - Crankshaft gear
3 - Idler gear
4 - Camshaft gear
5 - Idler gear
6 - High pressure injection pump gear

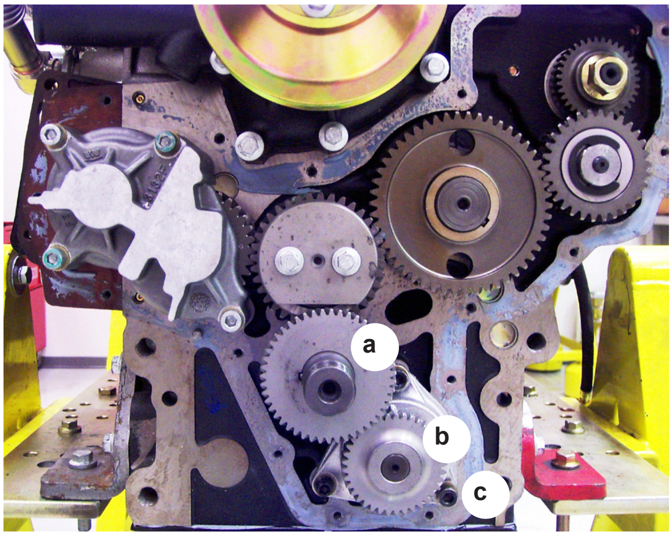


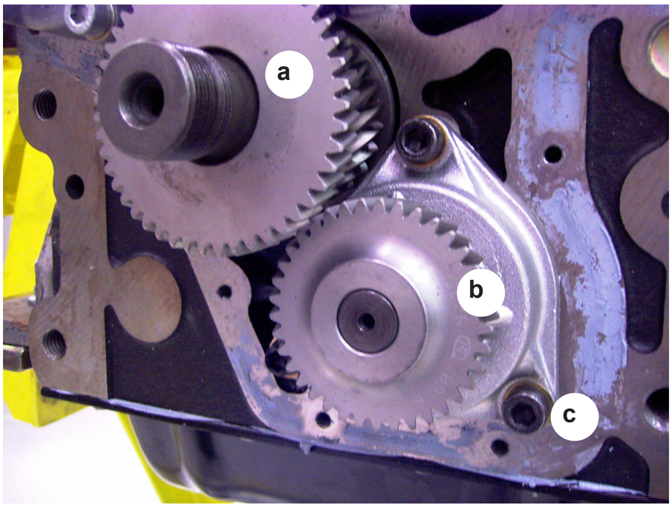
OIL PUMP

REMOVAL

- Remove the gear driving the oil pump gear.
- Remove the 3 screws with washers (Note bolts position).

- a - gear driving the oil pump gear
- b - oil pump and its gear
- c - screws with washers





CLEANING

1. Disassemble and wash all parts in cleaning solvent.
2. Put on safety glasses and dry parts with compressed air.

INSPECTION

1. Inspect the oil pump shaft, rotors, and housing for excessive wear or damage. Replace the oil pump assembly if excessive wear or damage is found.
2. Check clearance between the inner and outer oil pump rotors.
3. Check clearance between the outer rotor and housing.
4. Check the outer and inner rotor end float (reentering of outer rotor from oil pump body).
5. If the measured values are greater than specified, the pump is faulty and must be replaced as a complete unit.
6. Check the rotor and gear coupling rolling torque.

SPECIFICATIONS

a - Shaft

b - Inner rotor

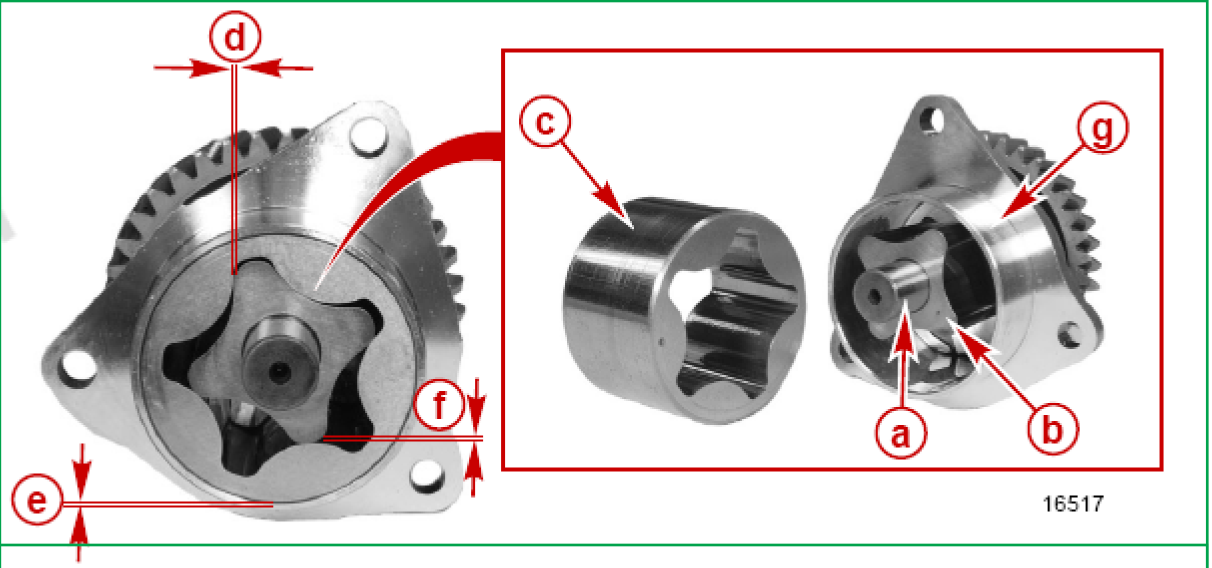
c - Outer rotor

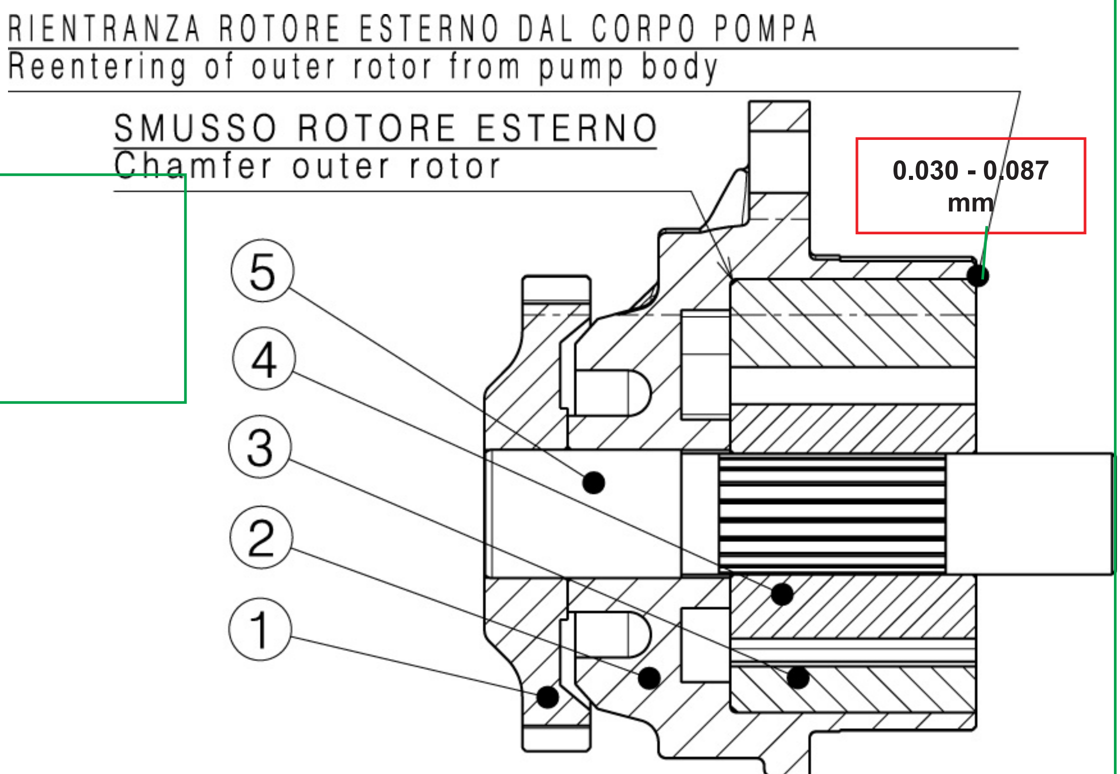
d - Clearance between rotors (see outer rotor)

e - Clearance between housing and outer rotor (see pump housing)

f - Difference between height of inner rotor and outer rotor seat (Reentering of outer rotor from pump body - see picture below)

g - Rotor housing





1 - Oil pump gear

2 - Rotor housing

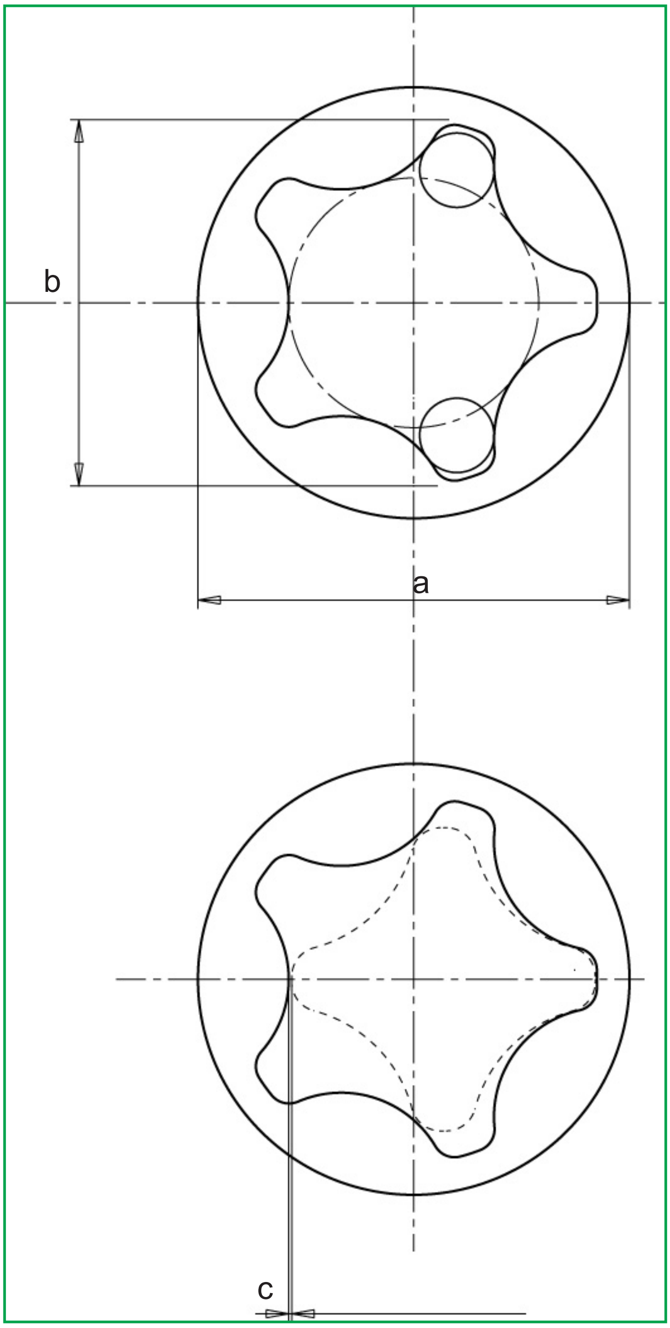
3 - Outer rotor

4 - Inner rotor

5 - Shaft

Axial clearance between gear and pump body	**0.150 - 0.250 mm**
Rotor and gear coupling rolling torque resistance	**9 kgm**
Difference between height of inner rotor and outer rotor seat	**0.030 - 0.087 mm**

OUTER ROTOR



R754 EU4, EU5, EU6 - R754IE4

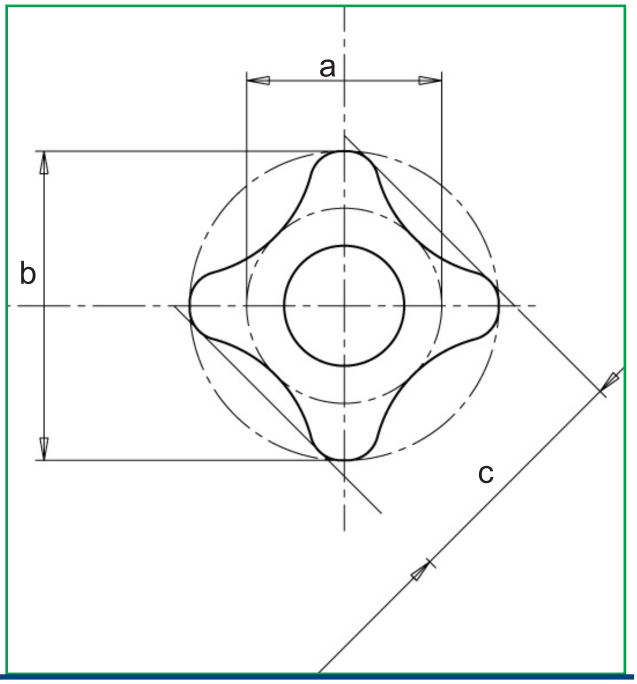
a -	**57.95 - 58 mm**
b -	**49.3 - 49.4 mm**
Heigh of outer rotor:	**32.483 - 32.5 mm**

R756 EU4, EU5, EU6

a -	**57.95 - 58 mm**
b -	**49.3 - 49.4 mm**
Heigh of outer rotor:	**37.983 - 38 mm**

c - Clearance between rotors	**0.07 - 0.20 mm**

INNER ROTOR



a	**25.92 - 25.97 mm**
b	**41.12 - 41.15 mm**
c	**32.045 - 32.075 mm**
Heigh of inner rotor: **R754** **R756**	 **32.483 - 32.5 mm** **37.983 - 38 mm**

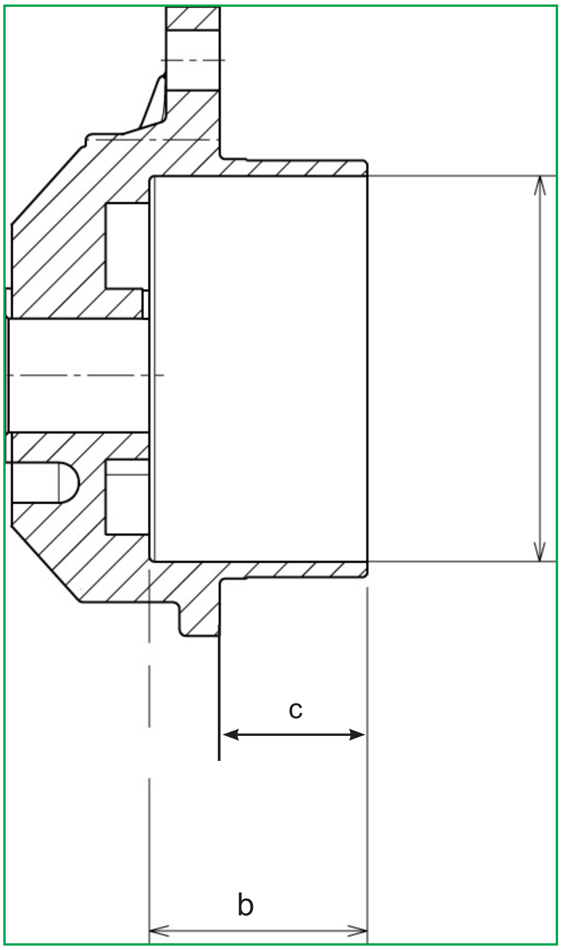
OIL PUMP BODY

R754 EU4, EU5, EU6 - R754IE4

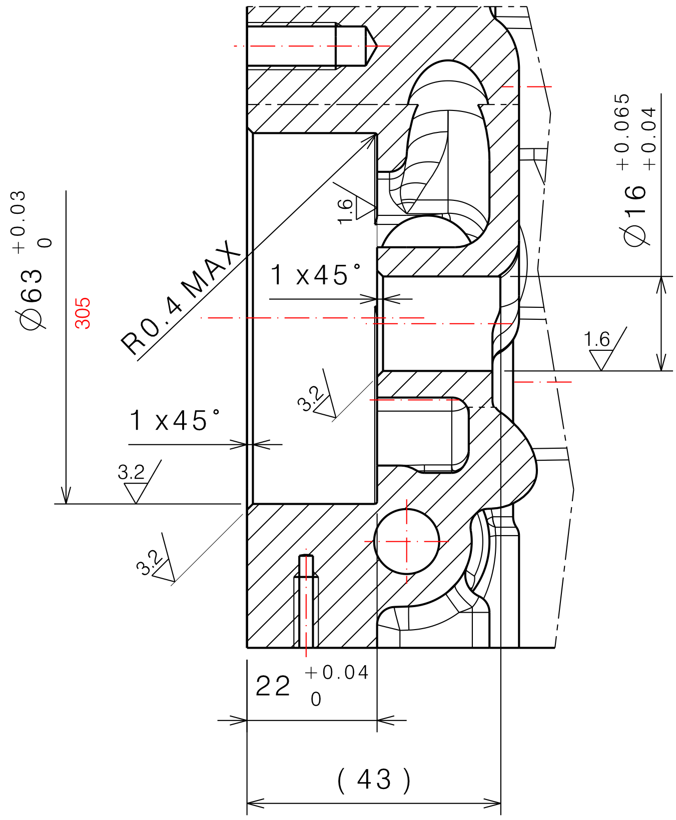
a - Inside diameter of rotor housing	58.13 - 58.18 mm
Clearance between housing and outer rotor	0.13 - 0.23 mm
b - Rotor seat depth in housing	32.53 - 32.57 mm
c - depth	22.06 - 22.10 mm 15.56 - 15.60 mm

R756 EU4, EU5, EU6

a - Inside diameter of rotor housing	58.13 - 58.18 mm
Clearance between housing and outer rotor	0.13 - 0.23 mm
b - Rotor seat depth in housing	38.03 - 38.07 mm
c - depth	22.06 - 22.10 mm



OIL PUMP HOUSING INTO CRANKCASE

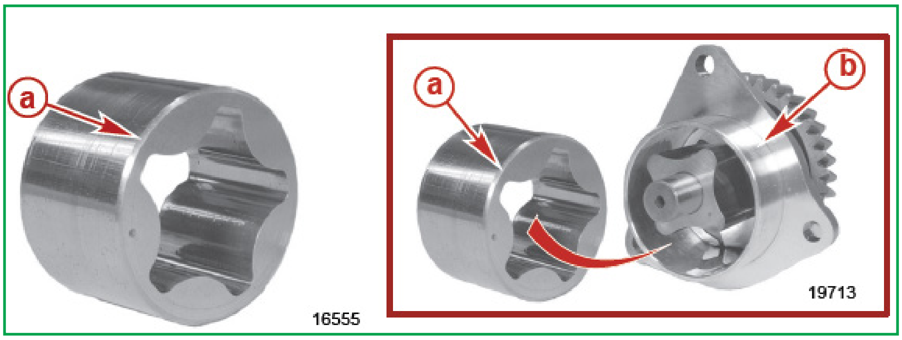


INSTALLATION

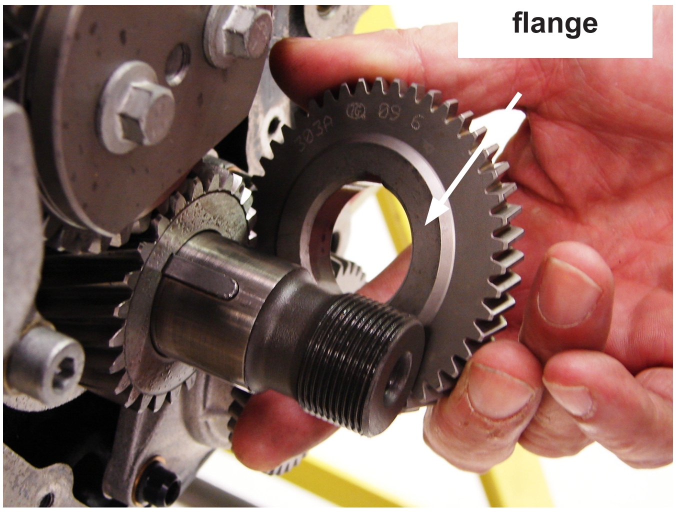
- Lubricate the oil pump rotor housing and the inner and outer rotor surfaces with engine oil.
- Install the bevelled (chamfered) end of the outer rotor towards the seat (the inside) of the rotor housing.
- Install the 3 screws and spring washers into the mounting holes in the oil pump. Install the oil pump in the cylinder block.
- Torque the 3 oil pump screws evenly in a diagonal pattern.

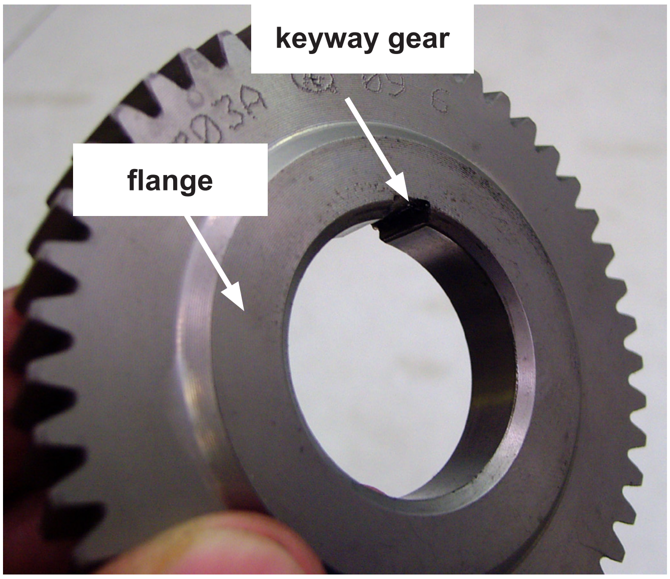
Oil pump screws	**27.5 Nm**

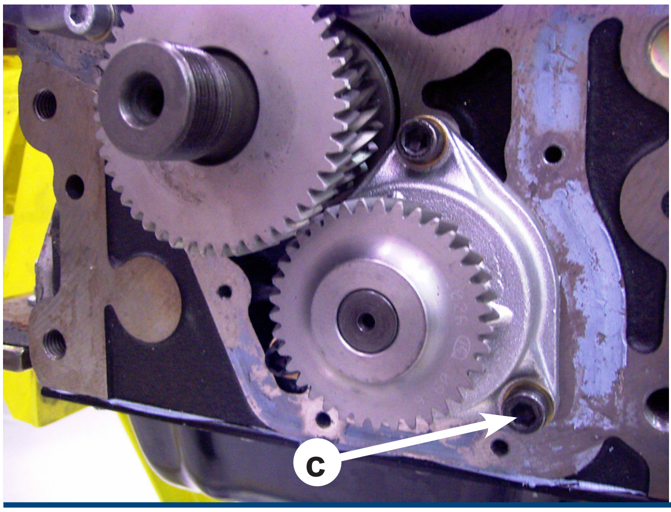
- Install the gear driving the oil pump gear by aligning the keyway gear with the crankshaft key and the side with flange must be pointed toward the crankshaft gear. The flat surface of the gear must be pointed towards outside.
- Check that the oil pump gear is not in a bind by ensuring that there is some clearance (backlash) between the crankshaft sprocket and oil pump gear. Verify the installation if no backlash exists between the gears.
- Install the timing gear cover.
- Complete the engine assembly.
- Verify oil pressure and check for leaks when you start the engine.



a - Bevelled (chamfered) end
b - Rotor housing
c - Oil pump screws

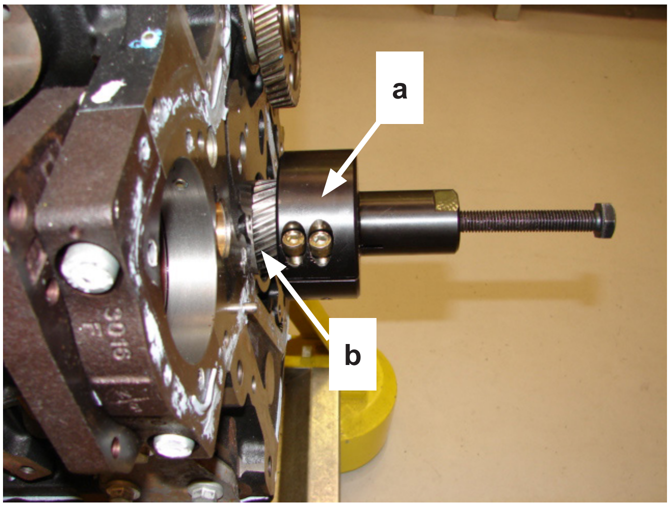






CRANKSHAFT GEAR

REMOVAL



NOTE: Replace the timing gear only if worn or damaged.
Before removing the gear make the reference marks on it and idler gear, so that its installation results easier in order to mantain the gears timing.
Take the oil pump driving gear off.
Remove the oil pump and the idler gear if nedeed.
Install the Crankshaft Gear Puller onto the gear.
Tighten the four clamping screws securely.
Turn the Crankshaft Gear Puller screw and remove the timing gear.

a - Crankshaft gear puller with clamping screws
b - crankshaft gear

INSTALLATION

Install the gear by aligning the keyway sprocket with the crankshaft spline.
Remark new gear making the same reference previously made on replaced gear and align the reference marks on the gear with idler gear reference marks, or if necessary, time the crankshaft gear with the idler gear and camshaft gear (Refer to Timing gears with cylinder number 1 piston is at compression stroke TDC.).

NOTE: Before **installing the crankshaft gear on the crankshaft, heat the gear at 70°C and istall it against crankshaft shoulder keeping it in position for 10 seconds.**

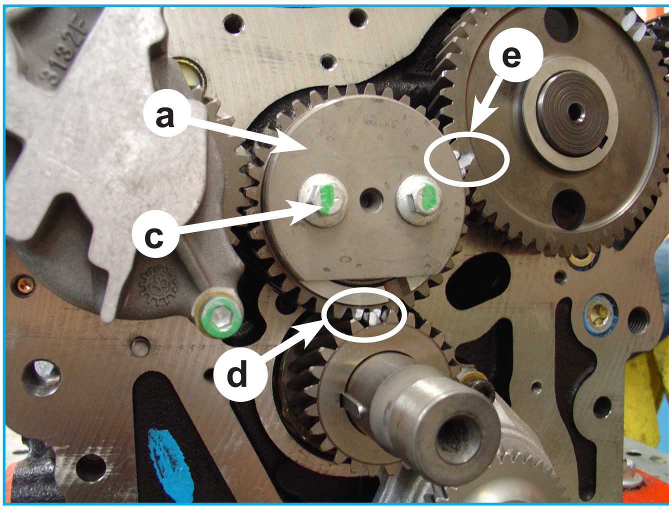
HYDRAULIC PUMP IDLER GEAR (BETWEEN THE CRANKSHAFT AND CAMSHAFT GEARS)

REMOVAL

Remove the 2 idler gear bushing screws..
Before removing the gear make a reference mark on all 3 gears, crankshaft, idler and camshaft gear or align the 3 gears as shown in the picture so that the timing dots (punched on each gear) are properly aligned, timed.
Remove the idler gear bushing and idler gear assembly.

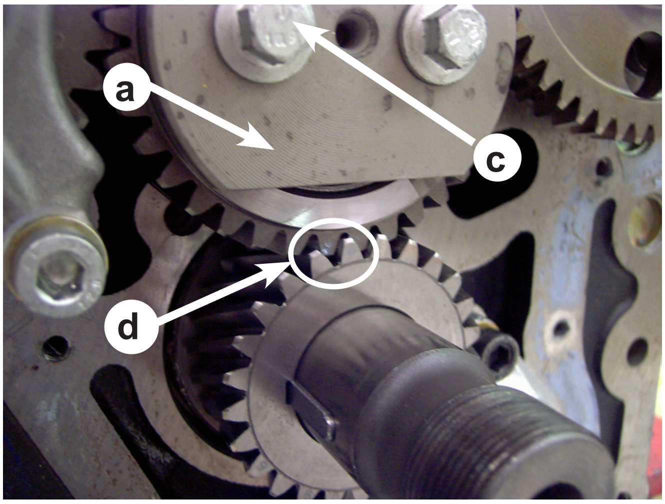
a - Idler gear bushing
b - Idler gear assembly
c - Idler gear bushing screw
d - crankshaft gear and idler gear assembly timing dots aligned (dots punched on the gear)
e - Idler gear assembly and camshaft gear timing dots aligned (dots punched on the gears)
f - timing reference dots punched on the gears (facing outside)

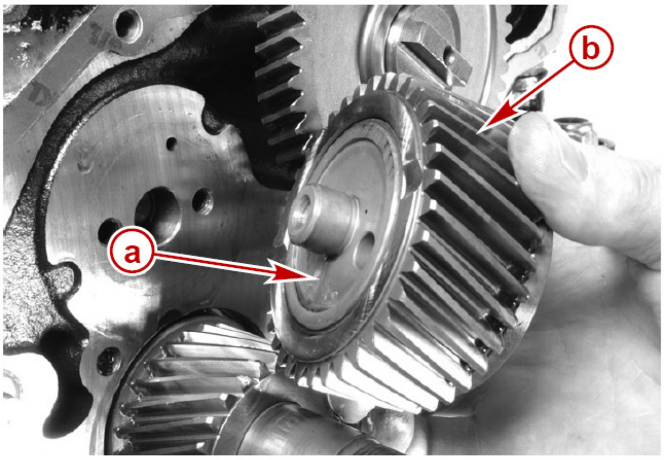
Separate the idler gear bushing from the idler gear assembly.

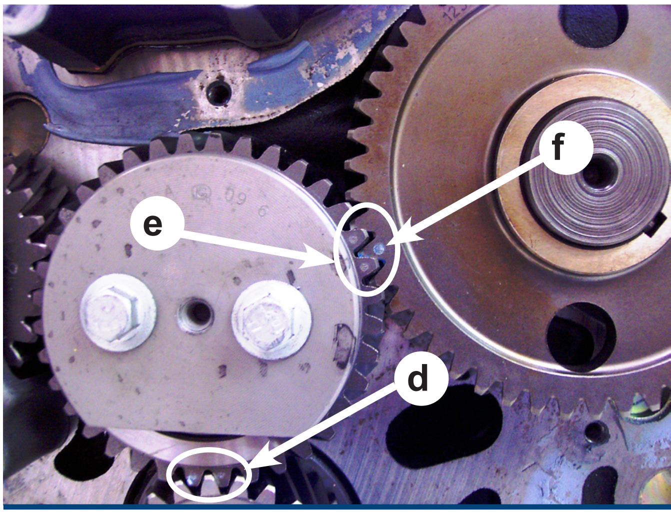


TIMING GEARS WITH CYLINDER NUMBER 1 PISTON IS AT COMPRESSION STROKE TDC.

TIMING REFERENCE PUNCHED DOTS ON THE GEARS COATED BY A DOT OF FELT-TIP PEN, CARRIED OUT DURING ASSEMBLING PROCESS.

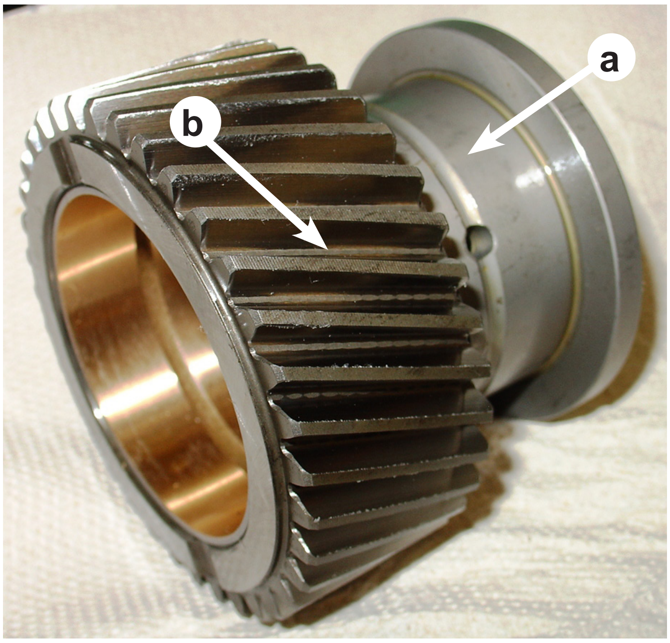


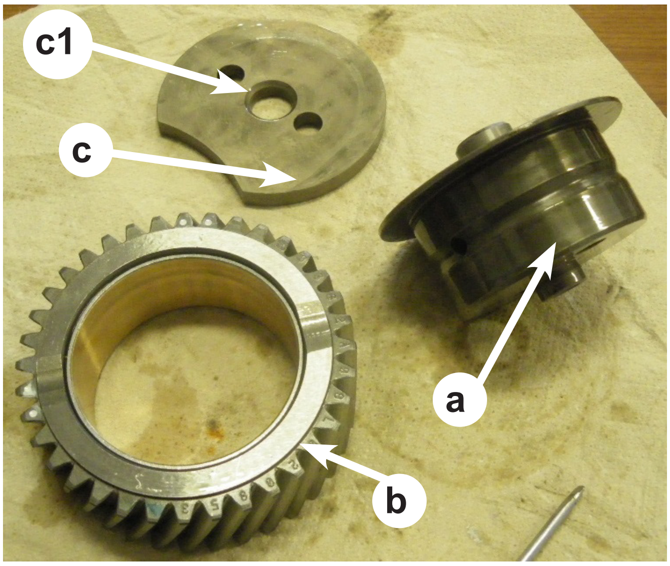




INSTALLATION

Lubricate the idler gear assembly (bearing and idler gear bushing and pin shim **C**).
Install the idler gear bushing into the idler gear assembly. Verify that the bushing rotates freely.
Ensure that the timing reference dots on the gear are facing outside, not towards the block.
Install the idler gear assembly. Ensure the timing dots on the adjacent gears (crankshaft and camshaft gear) are properly aligned or that the reference marks carried out previously are properly aligned.
Verify that the cut area of the bushing is towards the crankshaft sprocket so that the oil pump driving gear fits properly.
Ensure that **the tapered side C1 of pin shim ring C faces the gear**, inside engine **(only on EU5, EU6 engine model).**





Torque the 2 idler gear bushing screws

X = Idler gear bushing screws	**32.4 Nm**

x - idler gear bushing screws
a - Idler gear bushing
b - Idler gear
c - pin shim ring for idle gear (on EU5, EU6)
c1 - tapered side of pin shim ring (on EU5, EU6)

f - timing reference dots punched on the gear (facing outside)
g - cut area of the bushing is towards the crankshaft sprocket.

h - oil pump driving gear

SPECIFICATIONS - OLD TYPE

Inner diameter - Idler gear bushing	**53.465 - 53.480 mm**
Inner diameter - Idler gear	**53.500 - 53.519 mm**
Clerance - Installation	**0.02 - 0.054 mm**
Wear Limit	**0.2 mm**

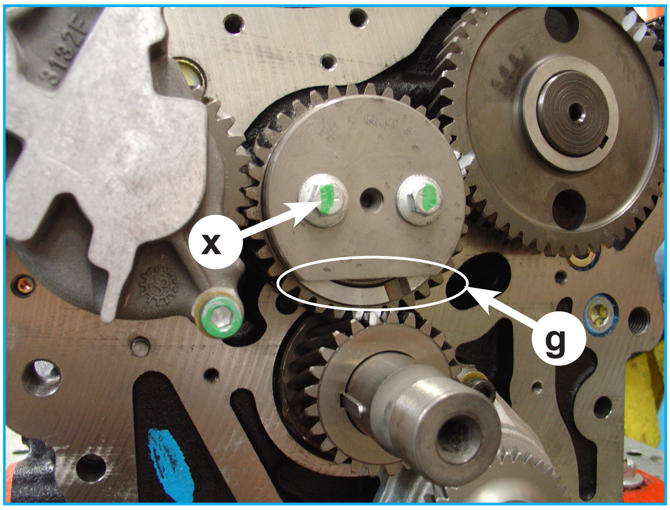
SPECIFICATIONS - NEW TYPE

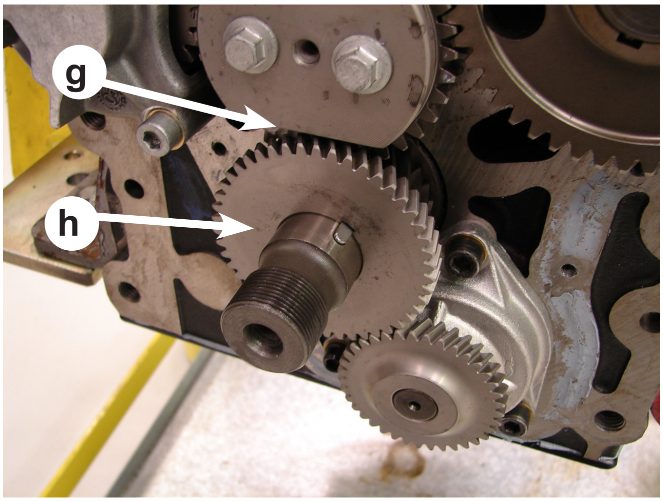
Inner diameter - Idler gear bushing	**53.445 - 53.475 mm**
Inner diameter - Idler gear	**53.500 - 53.519 mm**
Clerance - Installation	**0.025 - 0.074 mm**
Wear Limit	**0.2 mm**

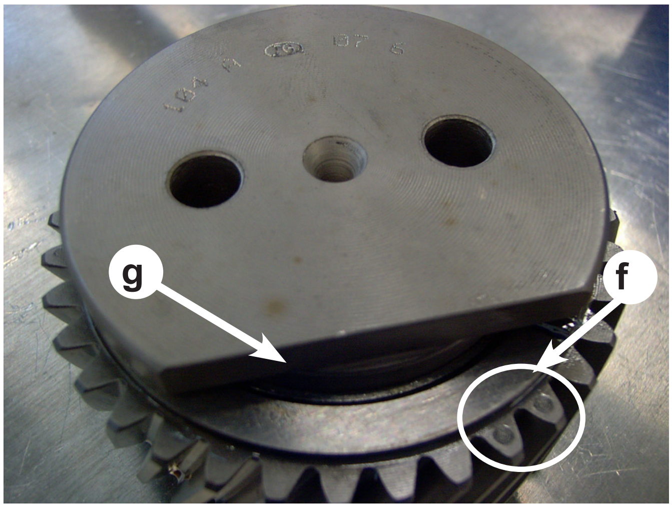
x - idler gear bushing screws
a - Idler gear bushing
b - Idler gear
c - pin shim ring for idle gear (on EURO 5)
c1 - tapered side of pin shim ring

f - timing reference dots punched on the gear (facing outside)
g - cut area of the bushing is towards the crankshaft sprocket.

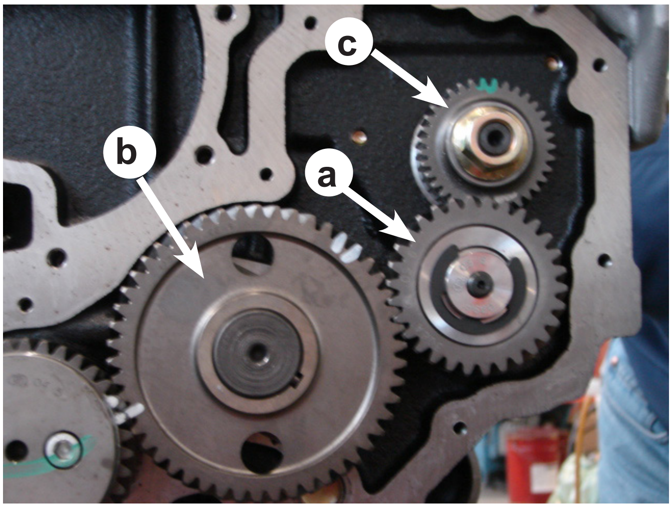
h - oil pump driving gear







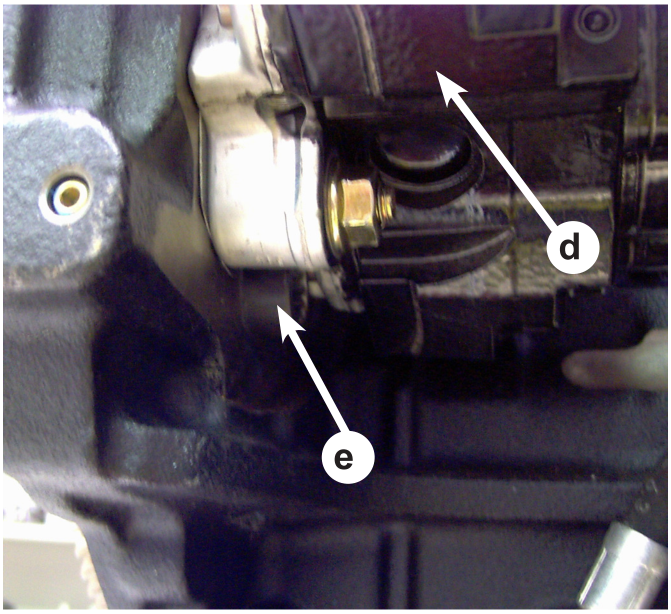
INJECTION PUMP IDLER GEAR (BETWEEN THE CAMSHAFT AND INJECTION PUMP GEARS)



REMOVAL

Remove the idler gear fixing screw, at the bottom of the injection pump.

a - Idler gear (between the camshaft and injection pump gears)
b - camshaft gear
c - injection pump gear
d - injection pump
e - idler gear fixing screw



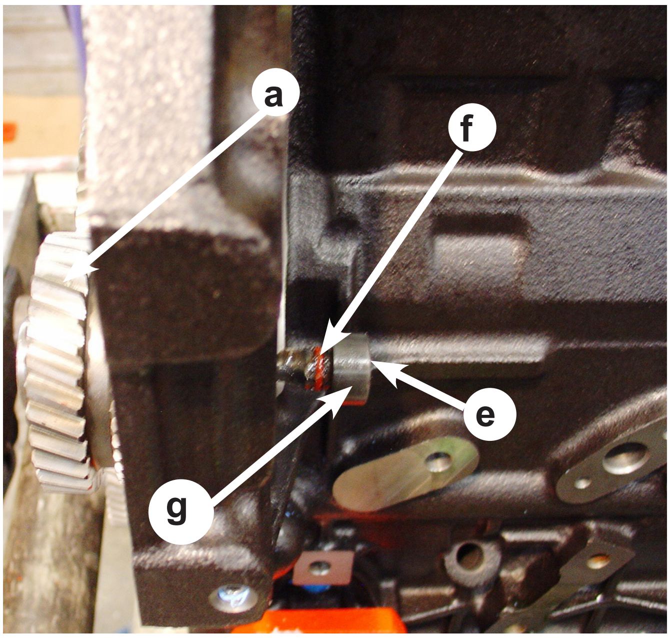
INSTALLATION

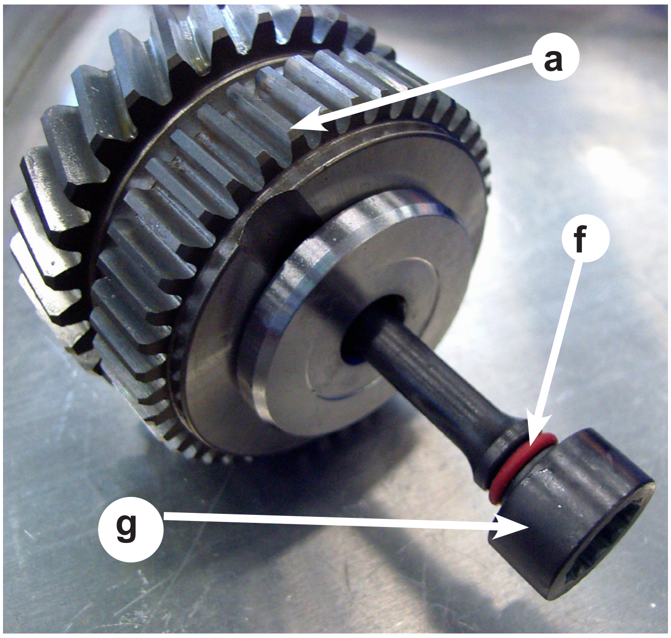
Install the gear between the camshaft gear and injection pump gear.

This gear must not to be timed.
Thread the bolt with a new O-ring, grease it with Moliykote 111 grease, and torque the bolt as follows:

1st Step - tightening	**35 Nm**
Loosen the bolt by an angle between	**30° ÷ 90°**
2nd Step - re-tightening	**35 Nm**

f - O-ring
g - screw

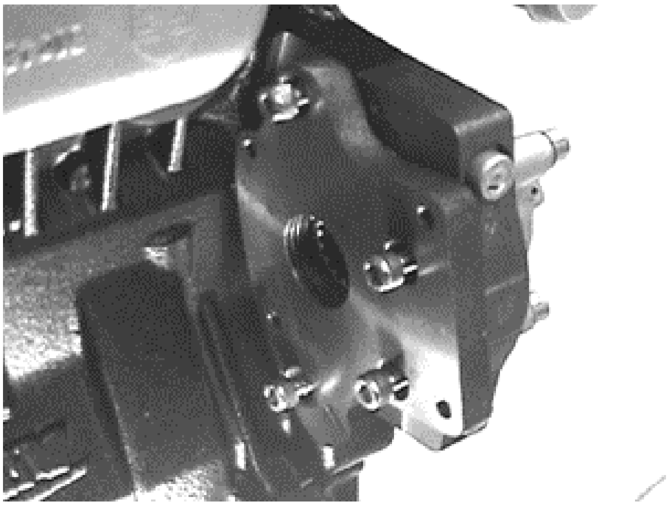


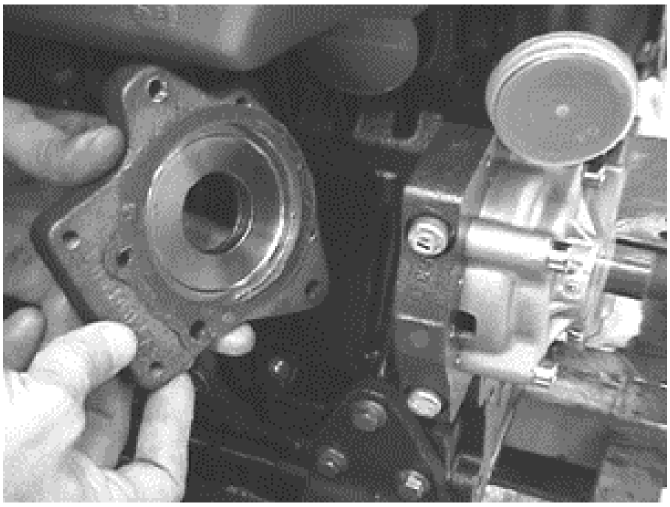


HYDRAULIC PUMP GEAR ASSEMBLY

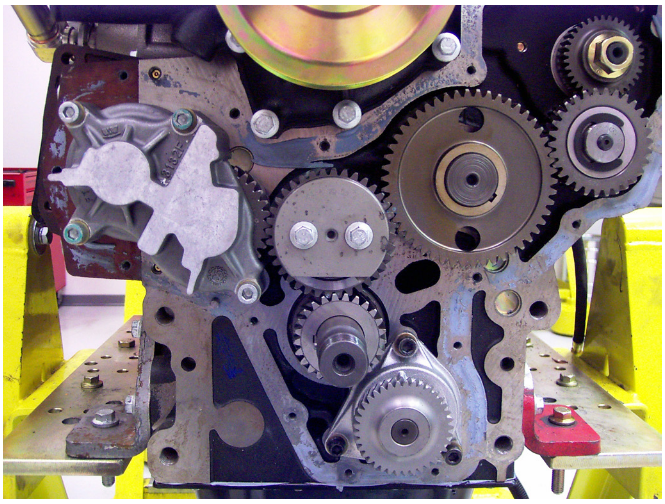
REMOVAL

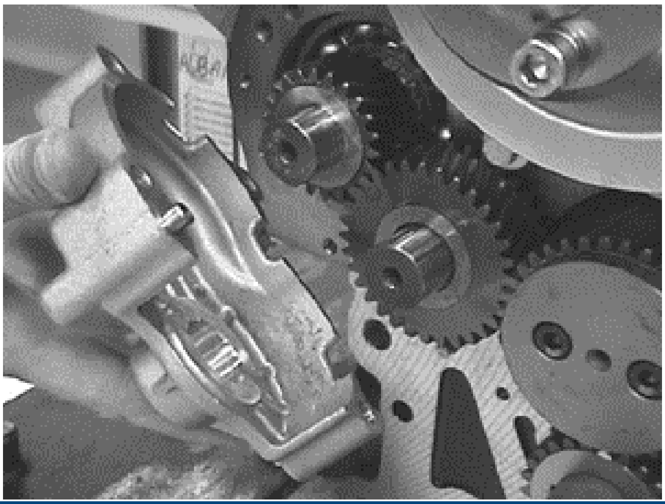
Loosen the rear allen screws and remove the rear flange.



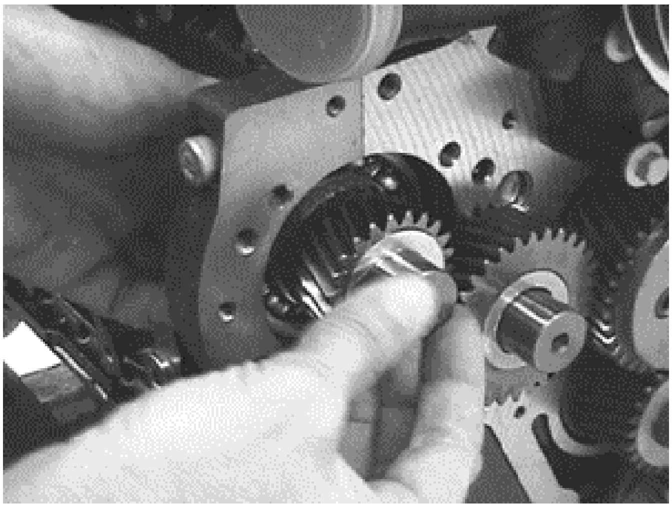


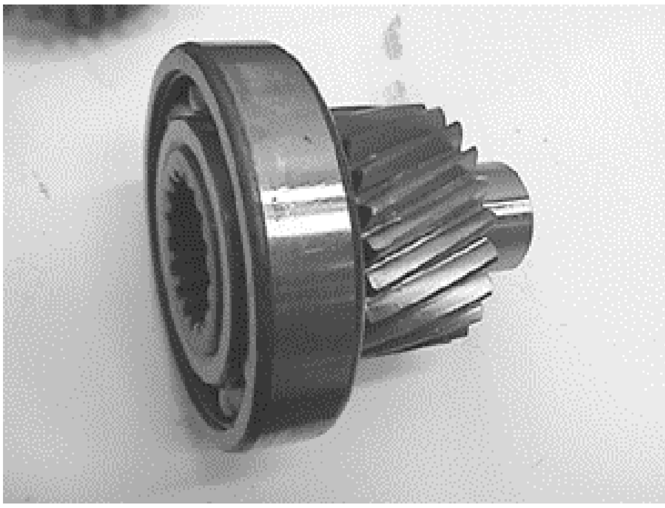
Loosen the front allen screws and remove the cover.



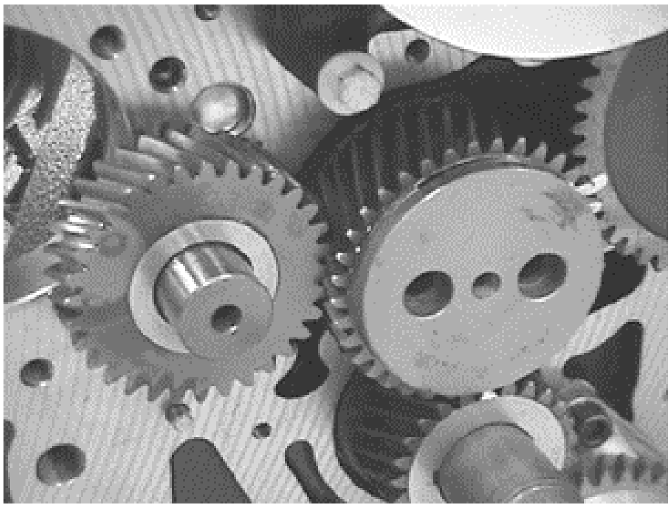


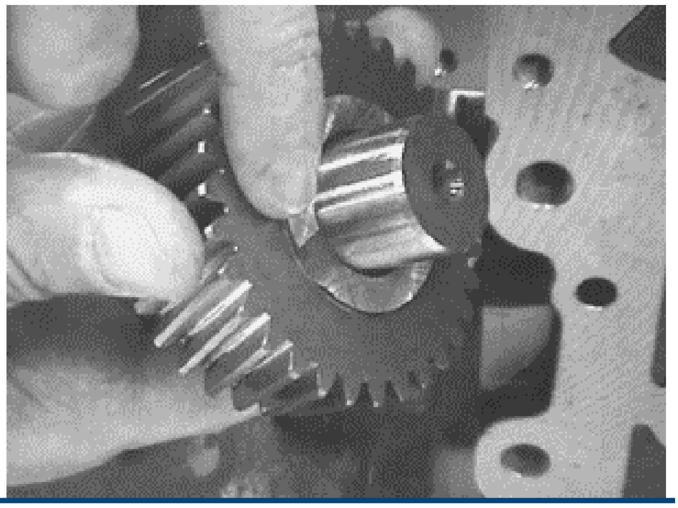
Remove the hydraulic pump sprocket assembly (driving gear + ball bearing)





Remove the hydraulic pump idler gear

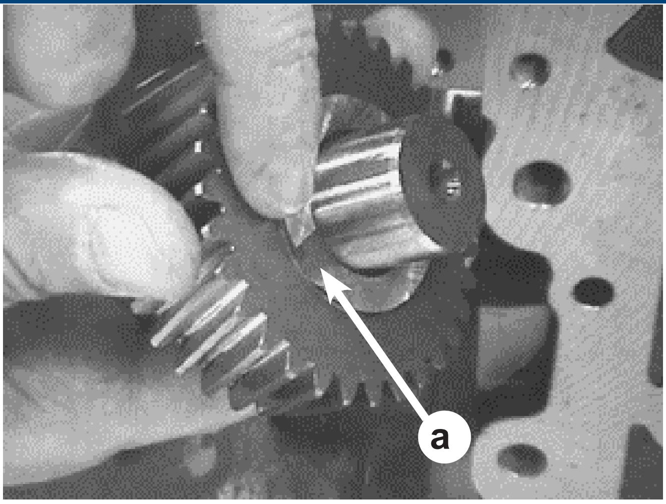




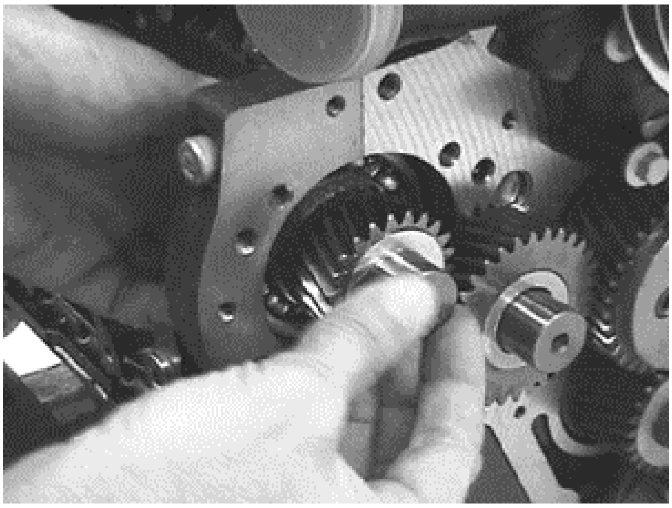
INSTALLATION

Install the idler gear into the block.
Oil the idle gear shaft
Ensure that the grooves are towards the block

a - groove



Install the hydraulic pump sprocket assembly (gear + ball bearing) into the block bore.
Oil the outer surface of ball bearing.

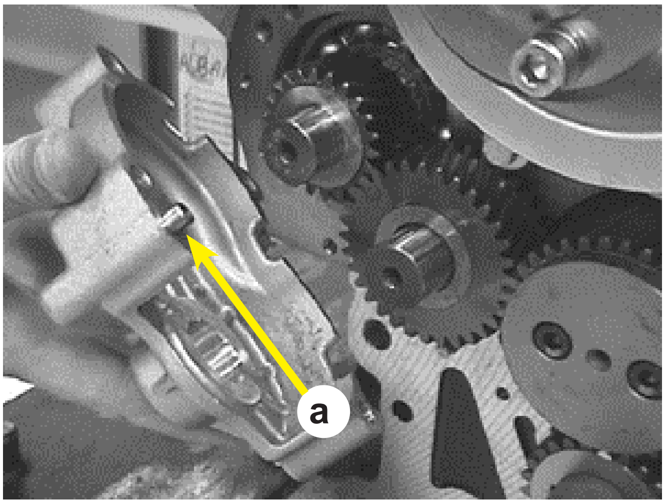


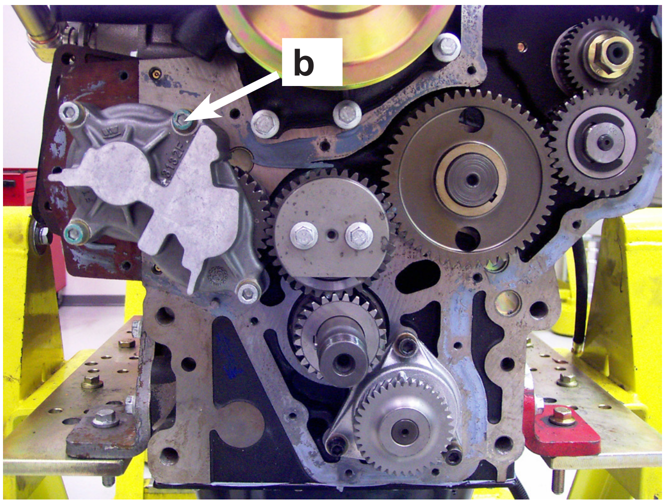
Install the front cover by aligning the pins with block holes.

a - pin
b - Hydraulic pump cover fixing screws

Apply Loctite 572 on the allen screws thread and torque them.

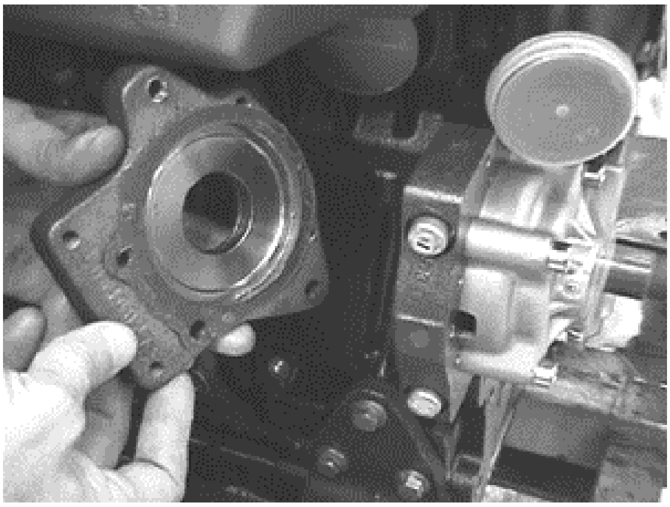
Hydraulic pump cover fixing screws	**24.5 Nm**

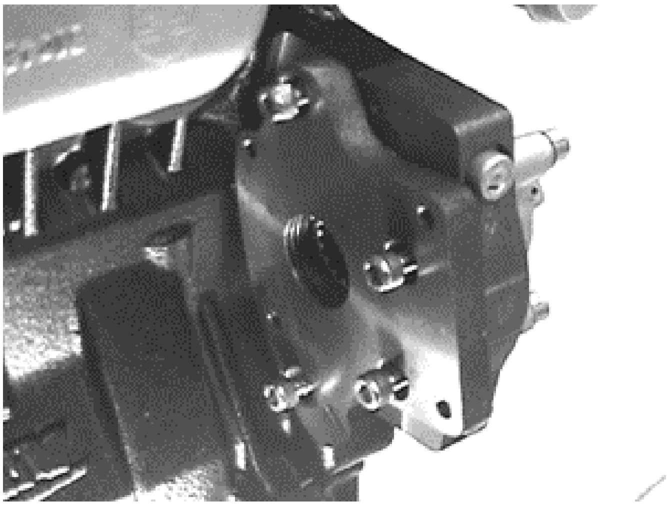




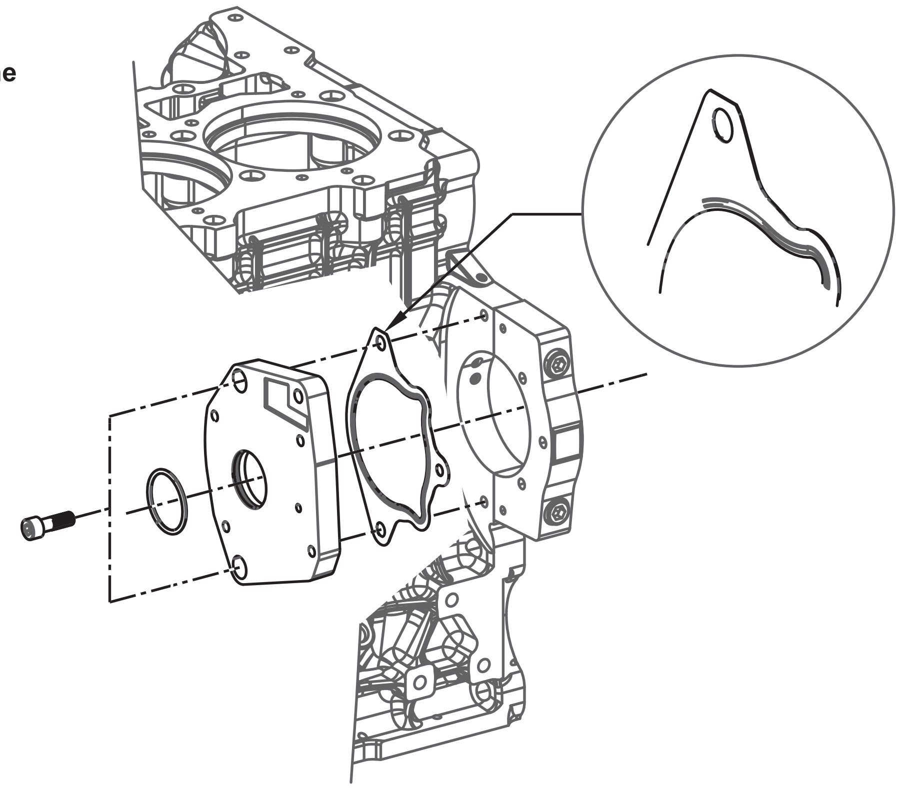
Install rear flange.
Apply Loctite 572 on threads bolts and torque them.

Rear flange Fixing Screws	**19.6 Nm**





Note: install the gasket with the cut side as showed in the picture

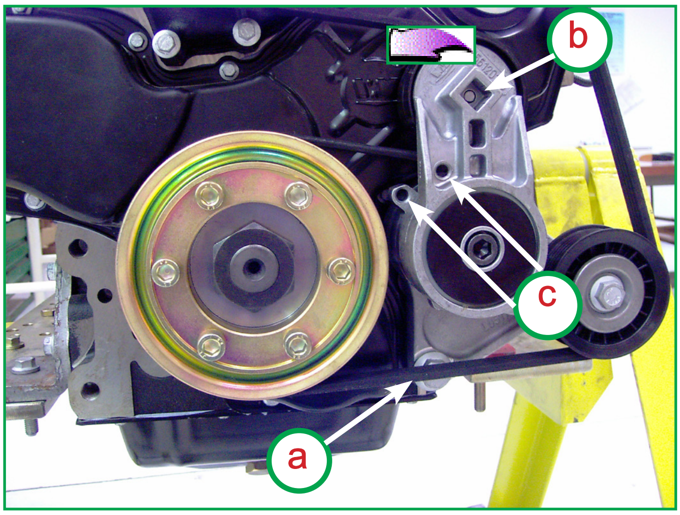


BELT TENSIONER - (AUTOMATIC TYPE)

REMOVAL

Remove the alternator belt (Refer to Altenator Belt)
Position a suitable tool in the automatic tensioner release slot. Move (rotate) in direction of the arrow the tensioner and align 2 holes.
Insert a pin into to 2 holes to block the tensioner.
Remove the tensioner bolt.

a - Serpentine belt
b - Tensioner release slot
c - Hole
d - pin

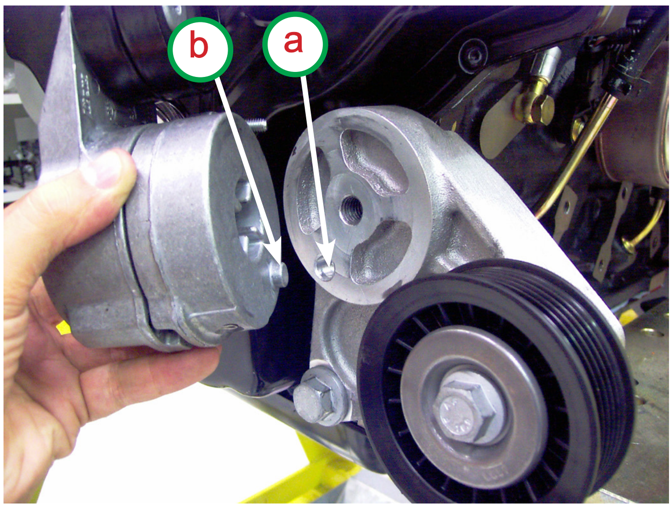


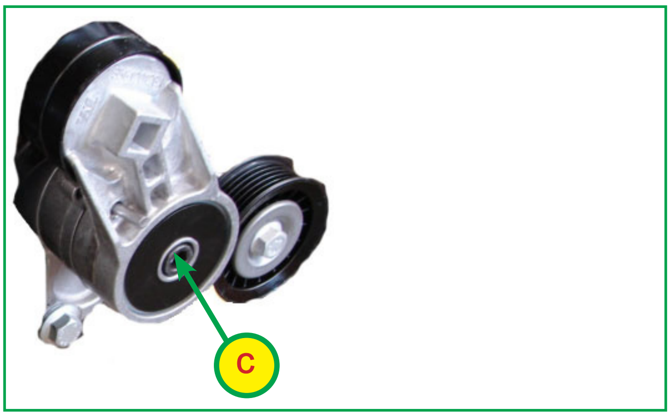
INSTALLATION

Align the pin with the drilling in the bracket and install the automatic tensioner assembly. Torque the automatic tensioner mounting screw.

Tensioner bolt	**78.5 Nm**

a - drilling
b - pin
c - screw





BELT TENSIONER BRACKET

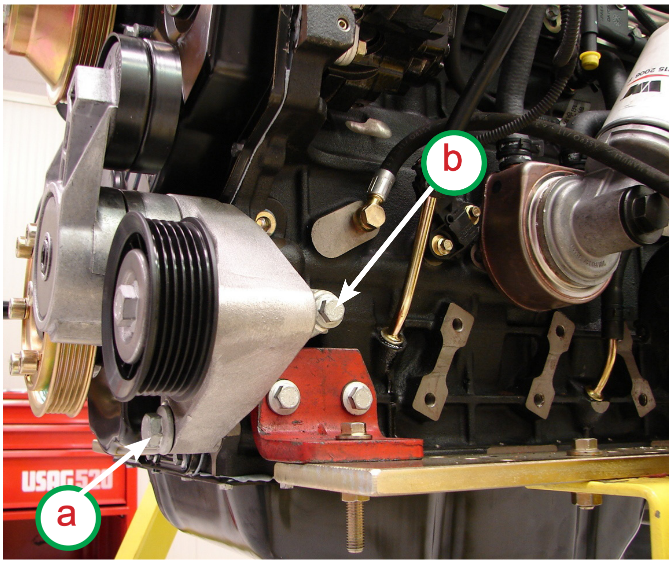
REMOVAL

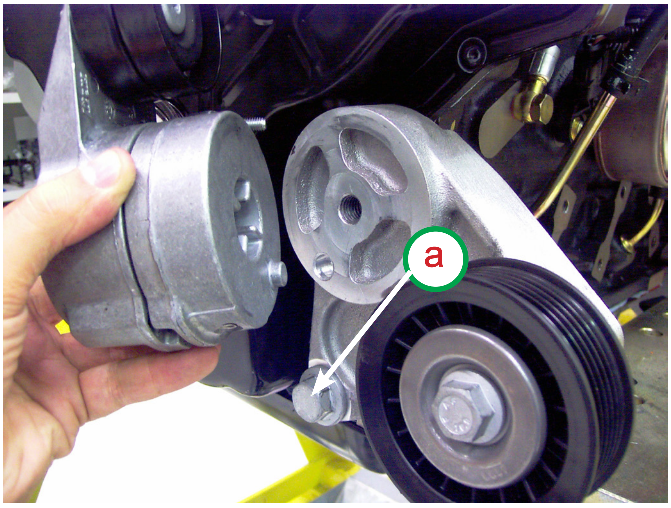
Remove the alternator belt and belt tensioner (Refer to proper section).
Remove the bolts from the bracket.

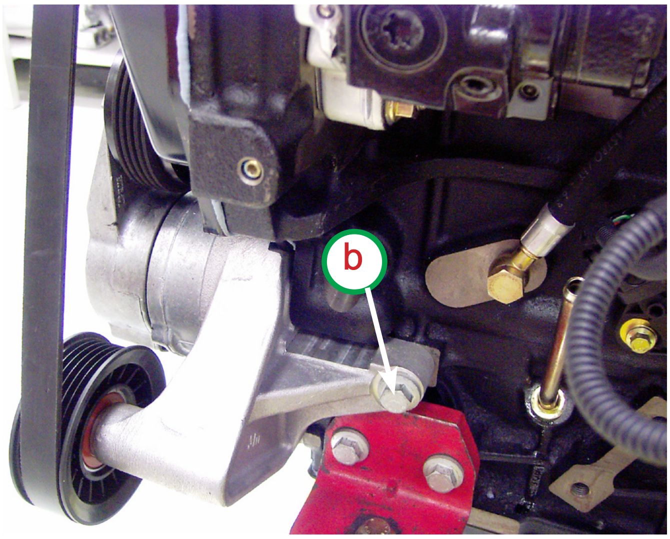
INSTALLATION

Install and torque the bolt at:

a	**78.5 Nm**
b	**44.1 Nm**







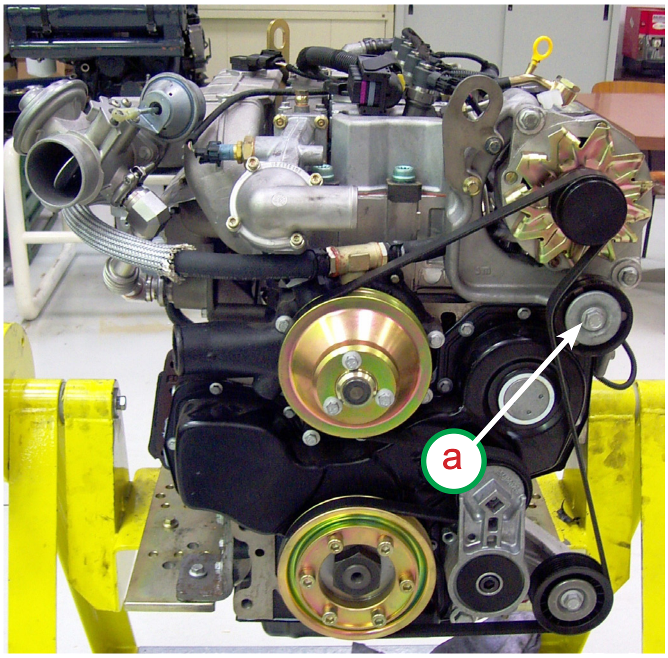
IDLER PULLEYS

REMOVAL

Remove the alternator belt. (Refer to alternator belt section)

Remove the left-hand therad bolt.

a - metal pulley



INSTALLATION

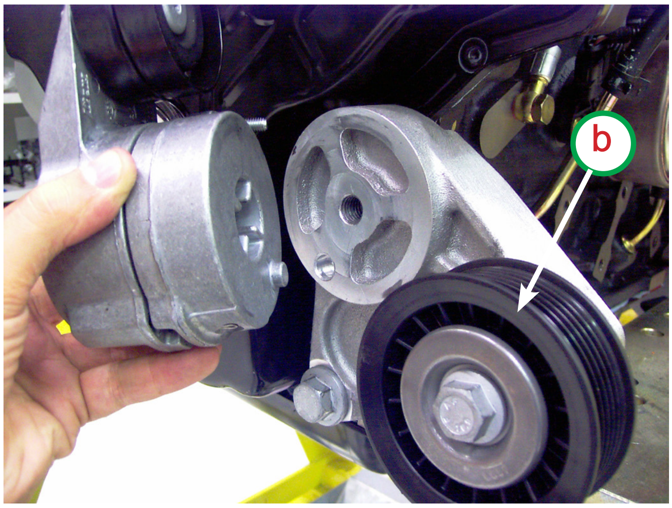
Install the bolt (left-hand therad) and torque it

Idler pulley screw	**53 Nm**

Remove the right-hand therad bolt.

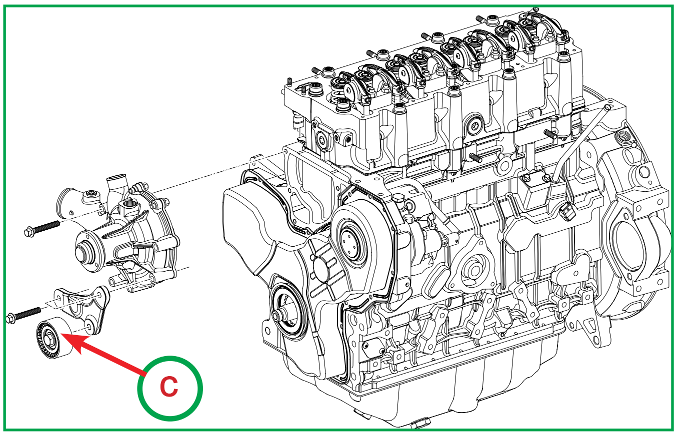
Install the bolt and torque it.

b - Plastic Pulley



Idler pulley screw	**53 Nm**

c - Idler pulley -plastic



Install the bolt (left-hand therad) and torque it

Idler pulley screw	**53 Nm**

CRANKSHAFT HUB AND PULLEY

REMOVAL

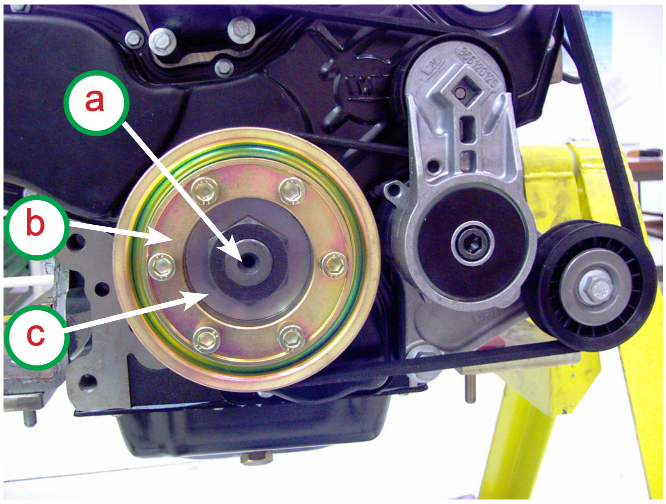
Remove the alternator belt (Refer to Alternator Belt section).
Install the Flywheel ring gear clamp tool in place of starter to block the crankshft rotation.

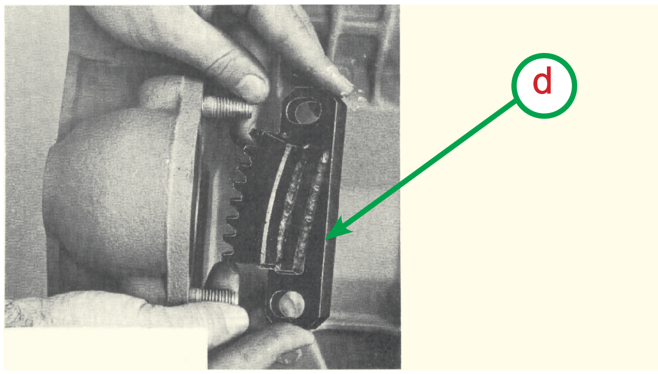
Remove the 6 crankshaft pulley bolts and take the pulley off.

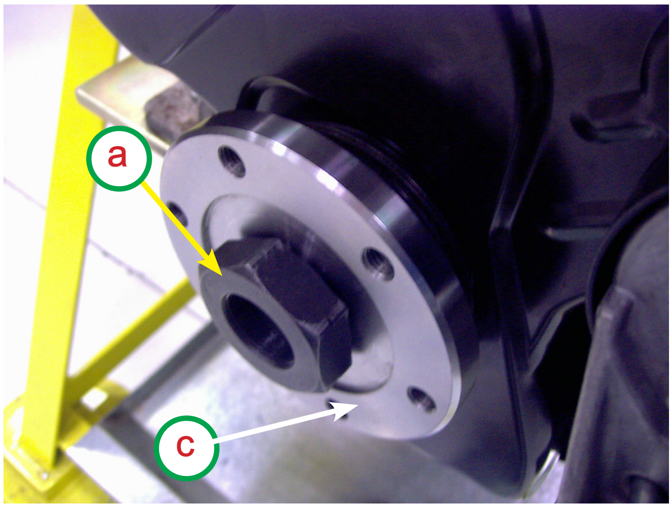
Using a suitable **46 mm** socket, remove the left-hand thread crankshaft hub nut.

IMPORTANT: **It is also possible take the crankshaft pulley and hub off as assembly without removing crankshaft pulley from the hub.**

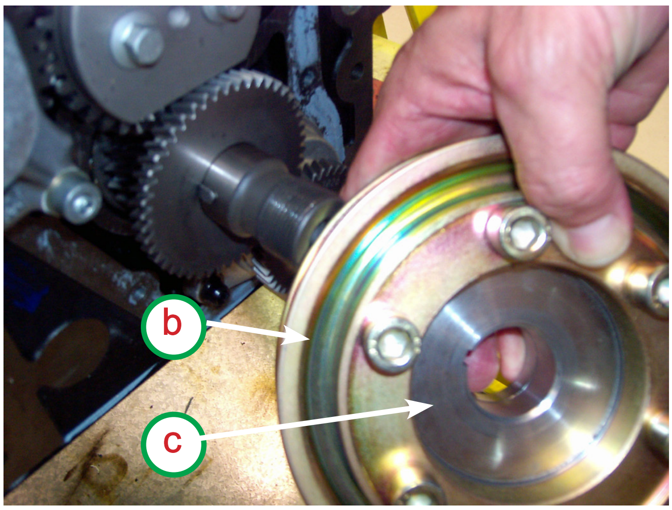
a - crankshaft hub nut
b - crankshaft pulley
c - crankshaft hub
d - Flywheel ring gear clamp tool





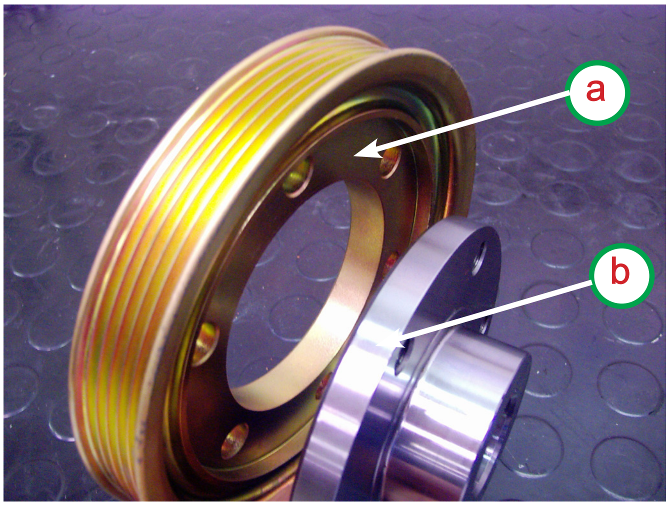


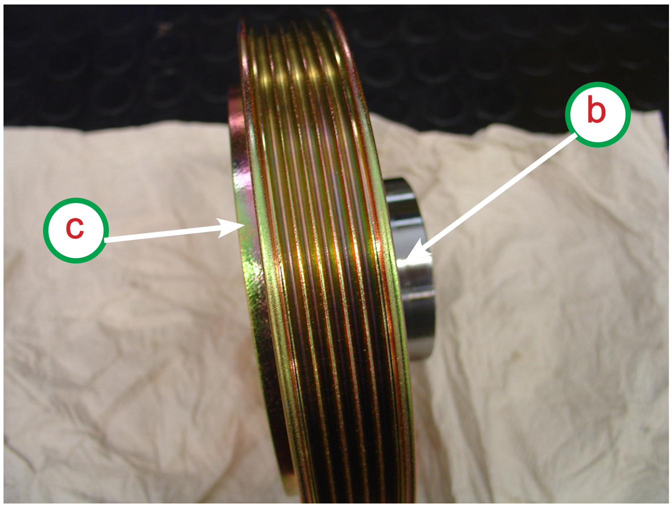
CRANKSHAFT HUB AND PULLEY AS ASSEMBLY

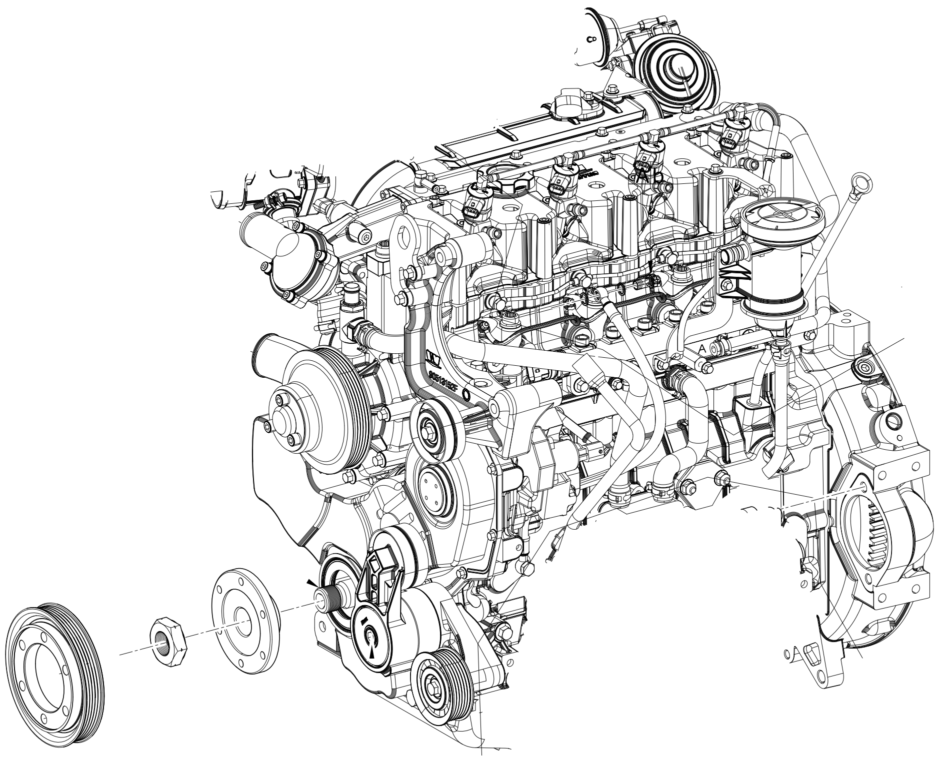


If the pulley has been removed from the hub, install the hub on the pulley as shown in the picture.
Make sure that the pulley rim is towards outside.

a - crankshaft pulley
b - crankshaft hub
c - pulley rim

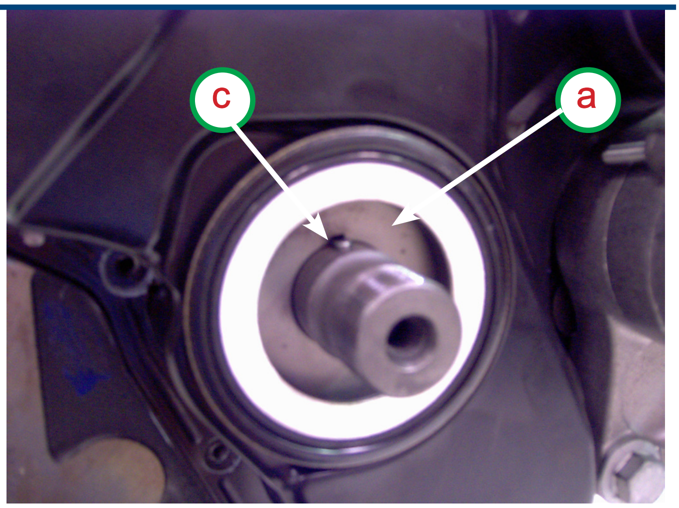






Clean contact surfaces between the crankshaft hub and crankshaft nut with cleaning solvent and dry with compressed air.
Clean the crankshaft threads.
Clean the crankshaft hub surface in contact with the oil pump gear driving.
If the timing gear cover oil seal has been removed for replacement, clean the seating surface in the cover.

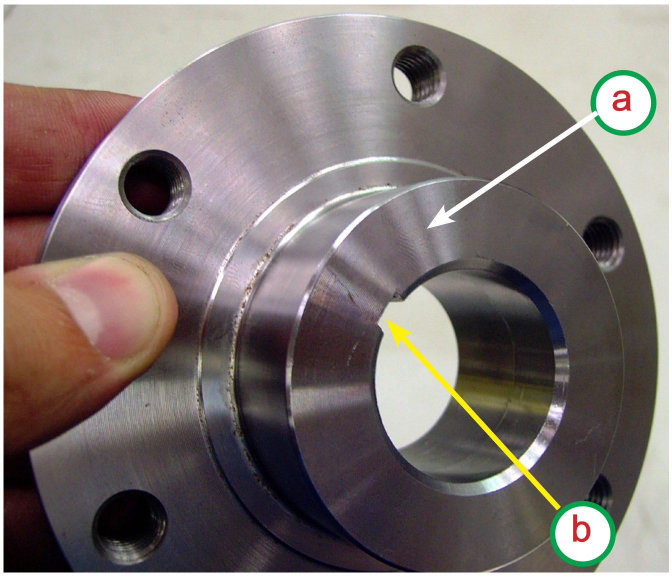
Front Oil seal and the sealing lip of an oil seal can be damaged by grease on your hands or the dirt from gloves. A damaged oil seal or oil seal lip could result in an oil leak. When fitting or replacing crankshaft hub, do not touch inside the oil seal or touch the oil seal lip with your bare hands or with dirty gloves.



Install the Flywheel Holder Tool in place of the starter motor to block the crankshaft rotation.

Apply lubricant **"Molykote G Rapid Plus Paste"** to the left-hand thread crankshaft hub nut threads and on the crankshaft hub contact side.

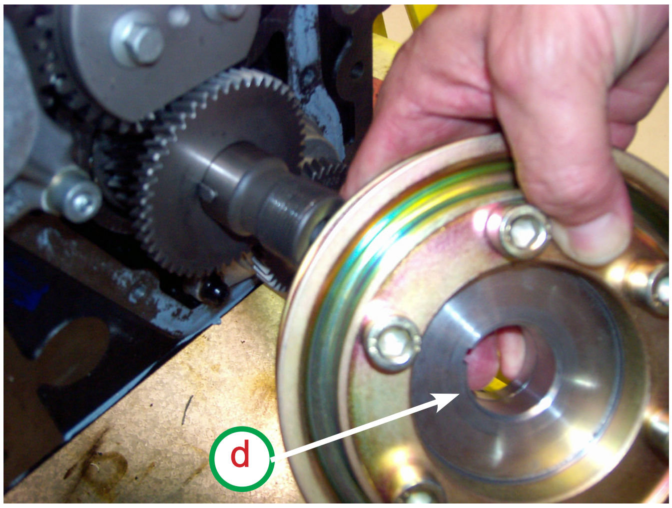
Align the keyway of crankshaft hub with crankshaft spline and finger tighten the left-hand thread crankshaft hub nut.



⚠ **WARNING: the left-hand thread crankshaft hub nut must be installed with flange-side towards crankshaft gear (the inside of engine).**

TIGHTENING PROCEDURE
Torque the nut at 400 Nm.
Loosen and retorque it at 600 Nm

a - crankshaft hub contact surface (oil pump gear driving)
b - crankshaft hub keyway
c - crankshaft spline
d - crankshaft hub contact surface (crankshaft nut)
e - left-hand thread crankshaft hub - flange-side

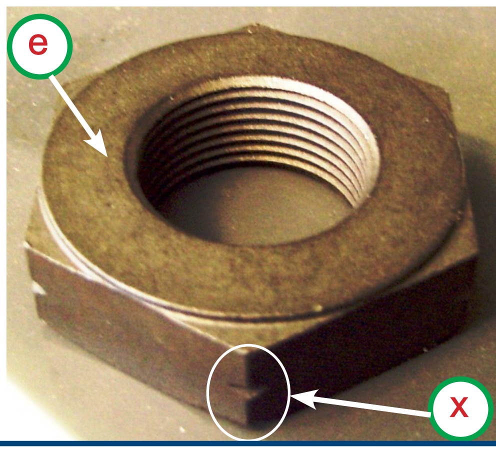


Install fixing pulley bolts with proper washers and torque them.

Crankshaft pulley bolt	**45.1 Nm**

Remove the Flywheel Holder Tool.

x - identification mark for left-hand thread nut



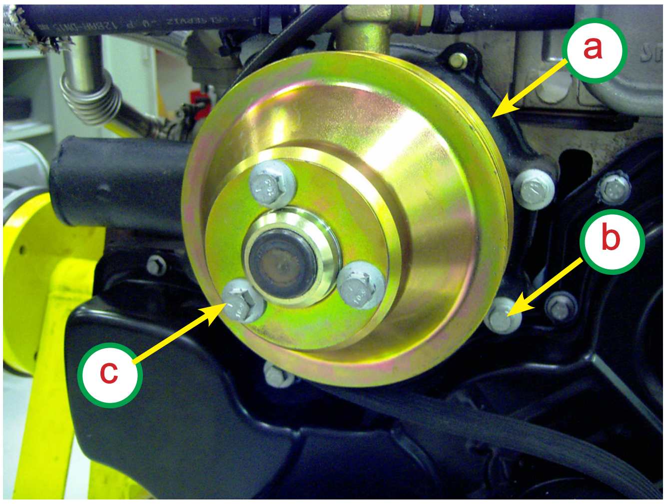
WATER PUMP AND PULLEY

REMOVAL

Remove any pipes or rubber hoses from the pump.
Remove the alternator belt (Refer to Alternator Belt Section).
Remove the water pump pulley screws or water pump housing screws to take the water pump assembly off.

a - water pump housing
b - water pump housing screws
c - water pump pulley screws

Remove the old gasket from the pump housing and block. Be careful not to gouge or nick the sealing surfaces.

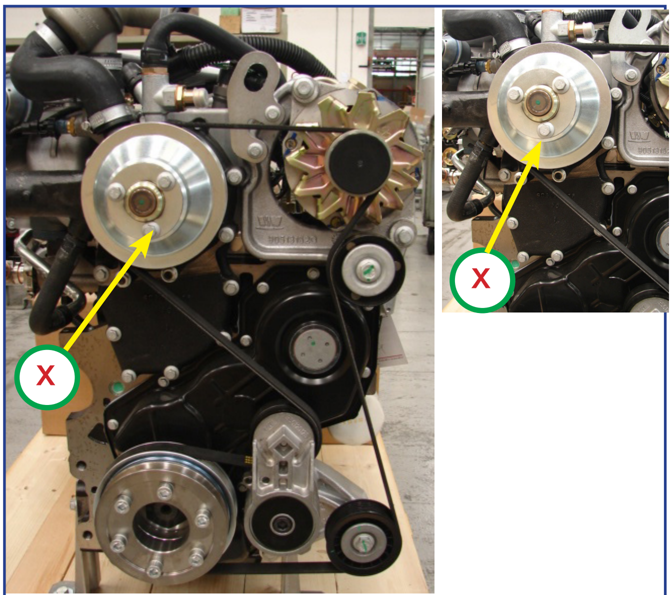


INSTALLATION

Inspect the water circulating pump body for blockage, cracks, sand holes, corrosion or other damage.
Inspect the impeller for cracks, corrosion, or damage.
Inspect the impeller shaft and bearings for excessive side play, abnormal noise when turning, or wear.
Inspect the pulley for bends, cracks, corrosion, improper runout, or other damage.

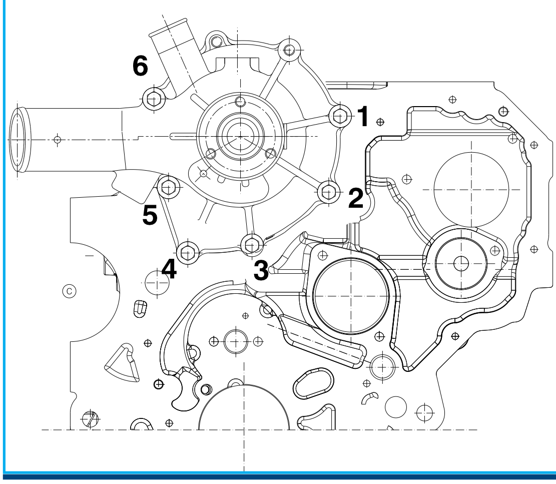
Apply sealant Loctite to both sides of the new water circulating pump gasket.
Install the new water circulating pump gasket on the engine block.
Torque the water circulating pump flange screws as per procedure.
Torque water pump pulley screws.

pre-tightening screw 1-3-6-4-2-5 (1-3-6-4-2-5-14-13 for water pump upper position)	**6 Nm**
final tightening screw 1-3-6-4-2-5 (1-3-6-4-2-5-14-13 for water pump upper position)	**32.4 Nm**
pre-tightening screw 7-9-12-10-8-11	**6 Nm**
final tightening screw 7-9-12-10-8-11	**32.4 Nm**
water pump pulley screws	**27.5 Nm**

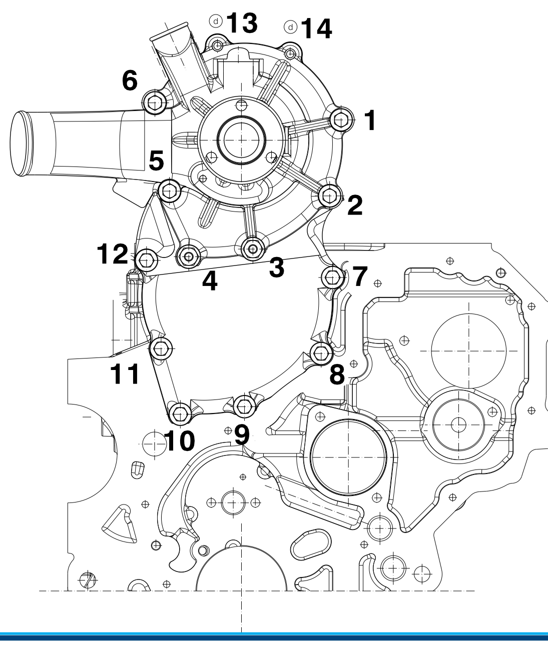


x - water pump - upper position

water pump - standard position



water pump - upper position



TIMING GEAR COVER

METAL SHEET COVER

REMOVAL

Remove any component that hinder the cover removal.
Remove the fixing bolts around the cover perimeter.
Use a knife to cut the sealant silicon. Detach the cover from crankcase by ensuring do not bend it.

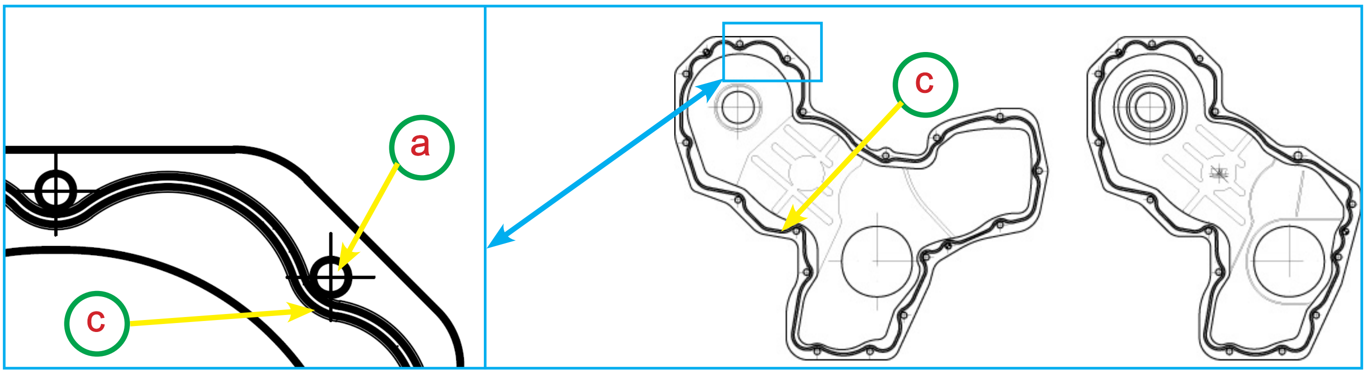
INSTALLATION

Check the front oil seal for wear or damage. Replace the oil seal if needed. (Refer to Front Oil Seal section).
Remove the old silicon material from the cylinder block and timing gear cover. Be careful not to gouge or nick the sealing surfaces.
Apply a continuous bead of sealant **(silicon type Dow Corning 7091)** (as shown in the pictures) along the cover perimeter, following the races and on the inside of hole bolts as shown.
Align the cover with the pins installed in the block.
Torque the timing gear cover flange screws evenly, in a cross pattern to:

timing gear cover flange screws	**12.7 Nm**

a - holes
b - races
c - bead of sealant

IMPORTANT: wait for 20 minutes or more before starting the engine so that the silicon can get dry.

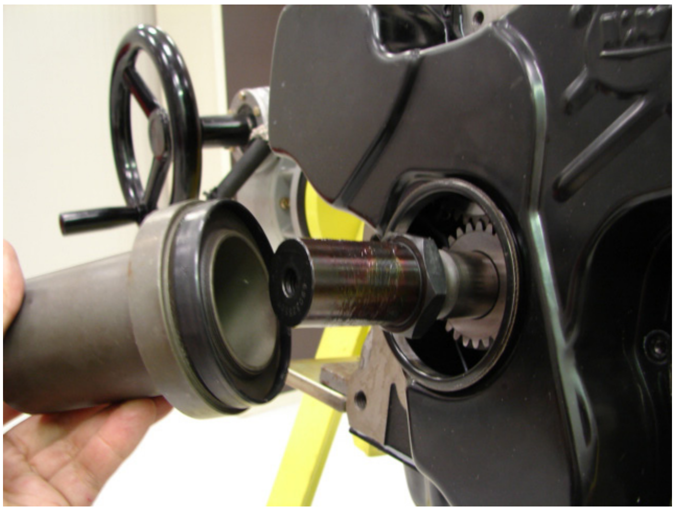


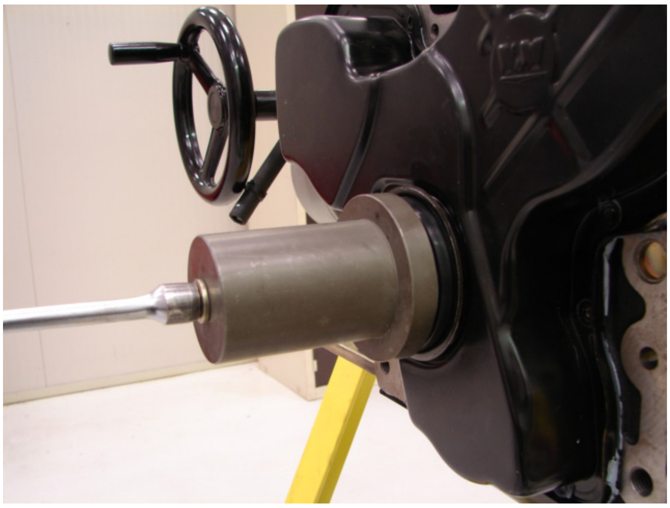
FRONT OIL SEAL

REMOVAL

IMPORTANT: Oil seals and the sealing lip of an oil seal can be damaged by grease on your hands or the dirt from gloves. A damaged oil seal or oil seal lip could result in an oil leak. When fitting or replacing an oil seal, do not touch inside the oil seal or touch the oil seal lip with your bare hands or with dirty gloves.
The seal is made of special compounds; do not touch or handle the lips of the seal. Do not attempt to install front main seal using a hammer or mallet. Damage to the seal or timing cover could result.

Lubricate the oil seal outer surfaces. Do not touch or handle the lips of the seal.
Install the new front oil seal in the Front Oil Seal Installer.
Torque the screw and the seal will stop when seated.



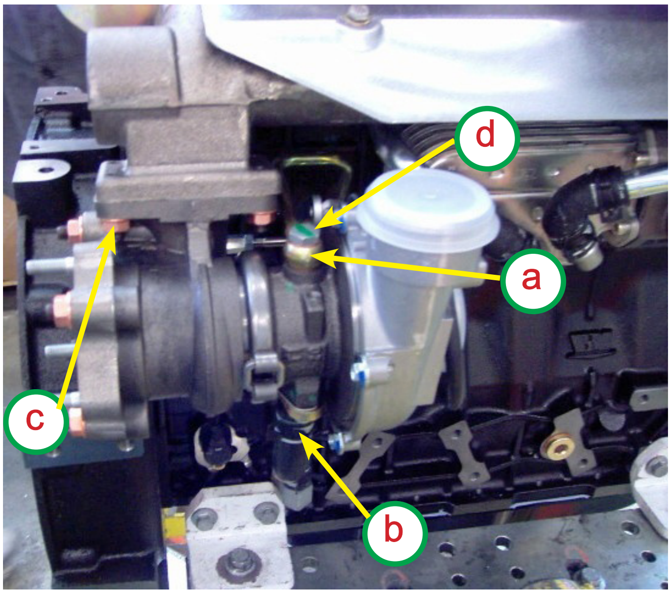


EXHAUST SIDE

TURBOCHARGER

REMOVAL

IMPORTANT: In case of failure of turbocharger (seized bearings, broken shaft, etc.) with consequent oil leakage from turbocharger exhaust side, evaluate the DPF filter cleaning (Refer to Section “Maintenance - DPF Filter”)..



Loosen the hollow bolt and hex nut of the oil delivery pipe and remove oil delivery pipe.

Loosen the clamp of the oil drain pipe and take it off.

Remove mounting nuts.

Remove the old gasket.

a - oil delivery pipe

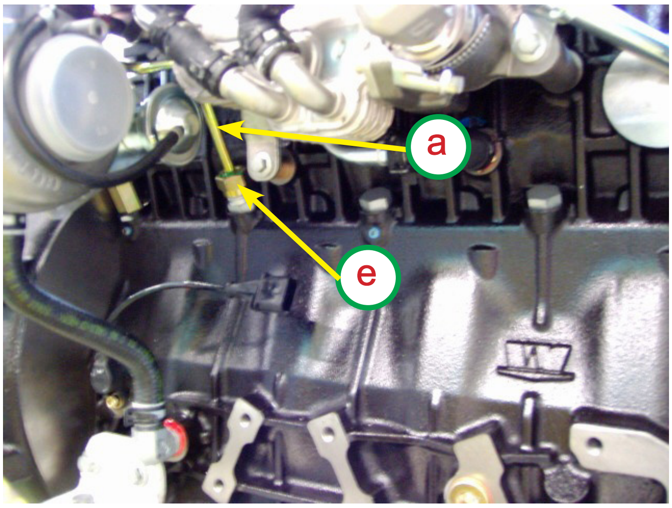
b - oil drain pipe (clamp)

c - mounting nuts

d - hollow bolt

e - hex nut (oil feed pipe)

f - hex nut (oil drain pipe)



INSTALLATION

Install a new gasket on the exhaust manifold.

Install the turbo and torque the nuts evenly, in a diagonal pattern.

Turbocharger flange nuts (c)	**32.4 Nm**

Install the oil drain pipe.

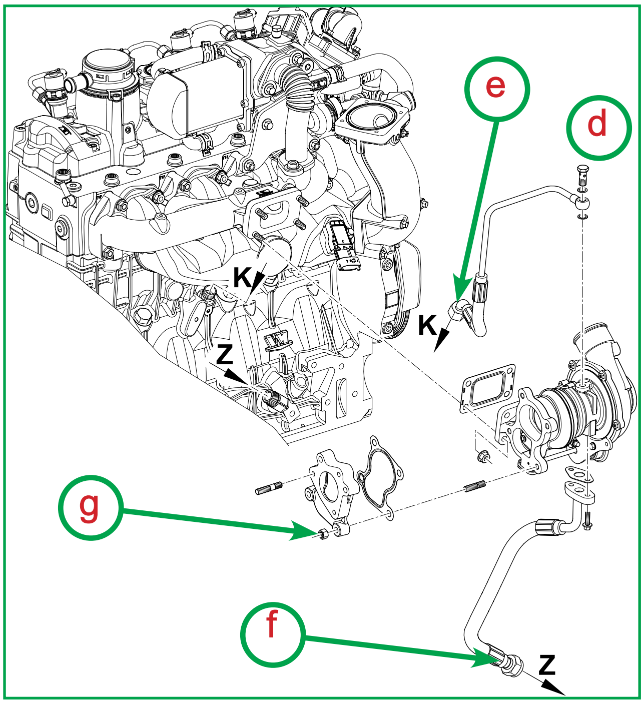
Finger tighten the hollow bolt with new washers on the turbo and hex nut on the block.

Torque the hollow bolt and the hex nut.

Oil delivery pipe hollow bolt (d)	**24.5 Nm**
Oil delivery pipe hex nut (e)	**32.4 Nm**

Oil delivery pipe hex nut (f)	**49 Nm**

Turbocharger flange (g)	**32.4 Nm**



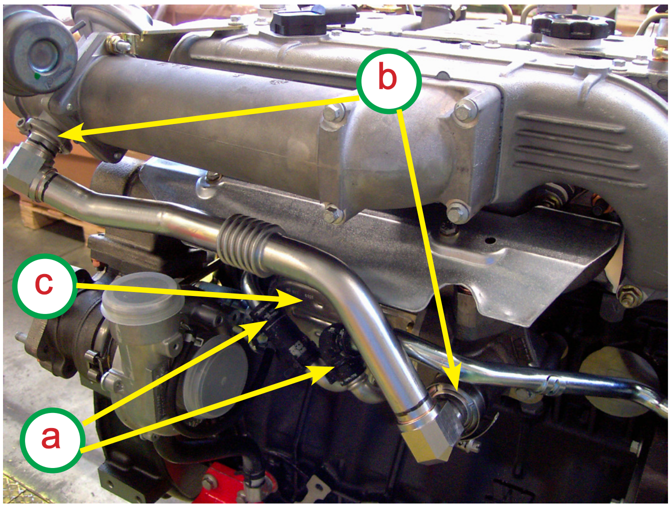
EGR COOLER - R750TE3-IE3-EU4-EU5-R756EU6

REMOVAL

Loosen the clamps of the rubber hoses and remove them from EGR cooler.

Loosen the clamps of the pipe connected to EGR cooler housing and throttle valve.

Remove the pipe.



a - rubber hose (clamp)

b - pipe (clamp)

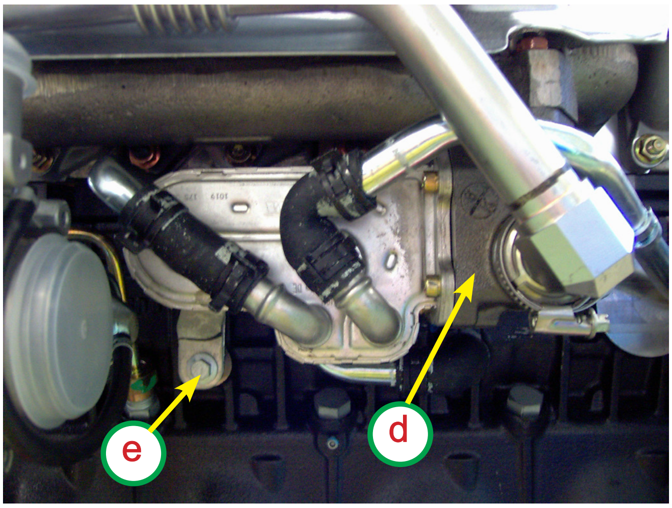
c - EGR cooler

d - EGR cooler housing

e - bolts fixing the EGR cooler assembly to cranckcase

f - nuts fixing EGR housing to exhaust manifold and the old gasket.

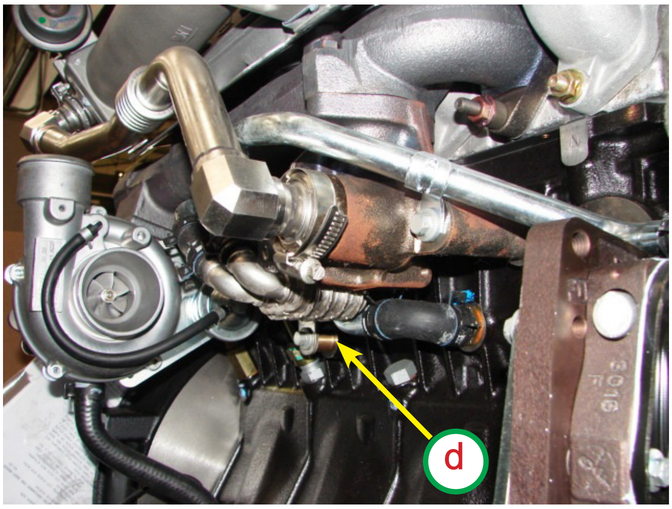
g - spacer between EGR cooler and crankcase

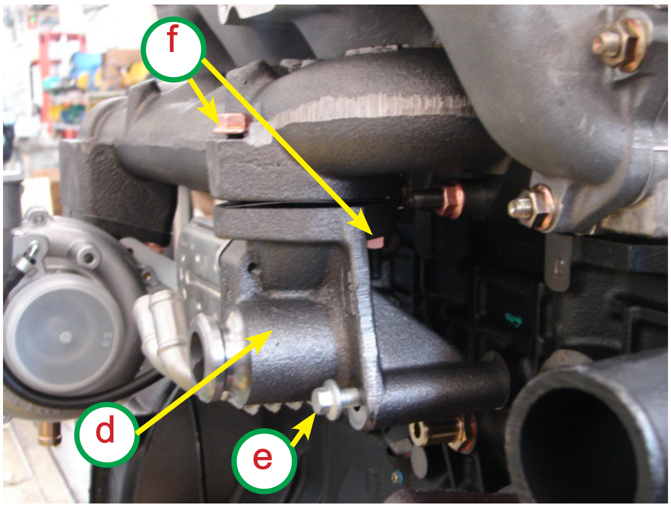


Loosen and remove the bolts fixing the EGR cooler assembly to cranckcase.

IMPORTANT: Between the EGR cooler and crankcase a spacer is inserted. Do not forget it during assembling.

Remove nuts fixing EGR housing to exhaust manifold and old gasket.



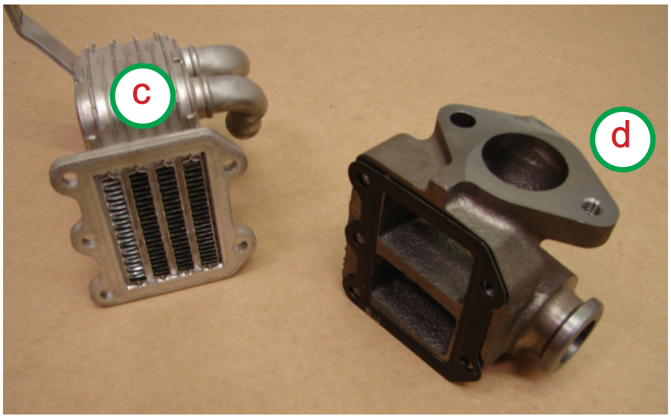


Loosen the 5 fixing screws and remove the housing from EGR cooler.

IMPORTANT: Never use a caustic cleaning solution, as it may attack aluminum. Also, never use a wire brush which could damage blade or mating surfaces.

c - EGR cooler

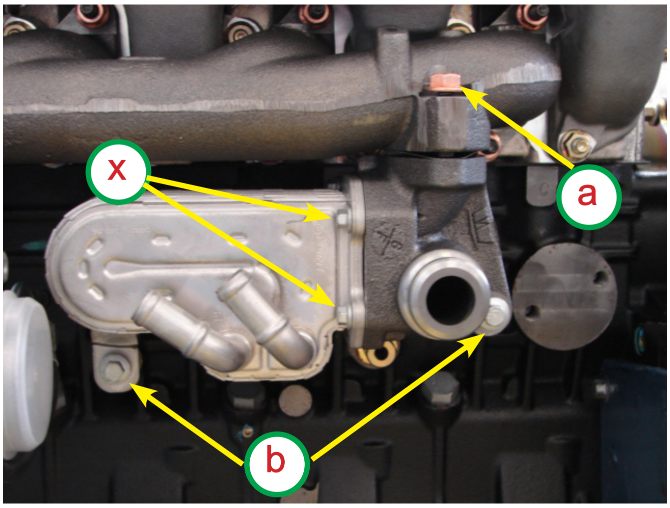
d - EGR cooler housing with gasket.



INSTALLATION

Assemble the EGR cooler assembly by using a new gasket.

X = EGR cooler fixing bolt	
pre-tightening (sequence 1,2,3,4,5,6)	**5 Nm**
final tightening (sequence 1,2,3,4,5,6)	**14.7 Nm**



Install a new gasket on mating surface of EGR housing cooler and install it in the exhaust manifold studs.

Finger tighten 2 nuts fixing the EGR cooler assembly to exhaust manifold and bolt fixing EGR cooler assembly to crankcase.

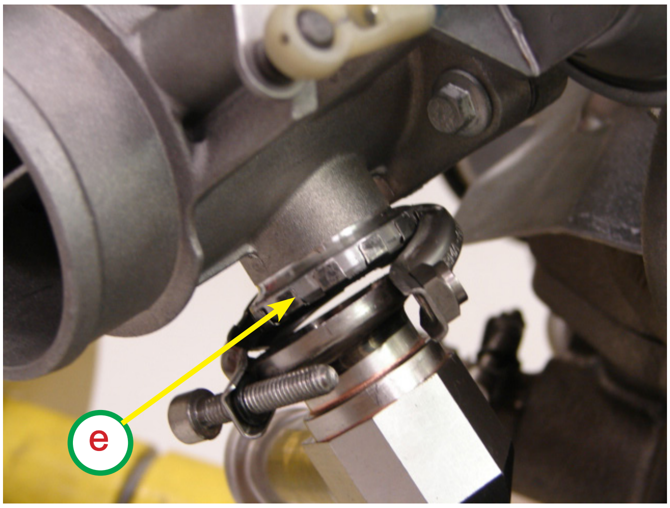
IMPORTANT: Mind to install the spacer between the EGR cooler and crankcase.

a - nuts fixing EGR cooler assembly to exhaust manifold with new gasket.

b - bolts fixing the EGR cooler assembly to cranckcase

Torque nuts and bolts as indicate in the table.

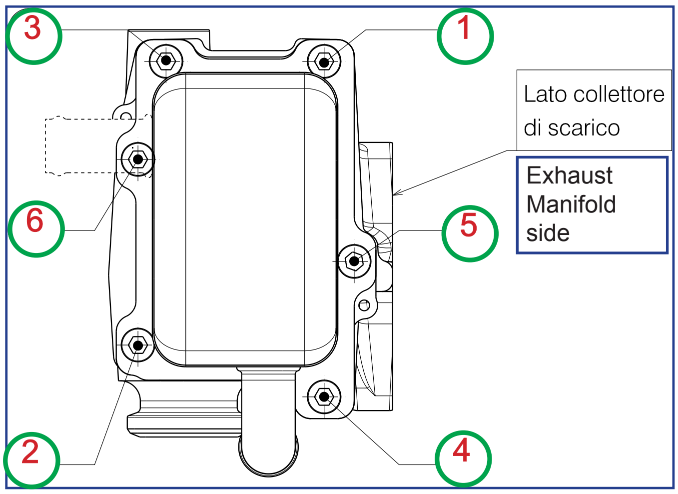
a = nuts fixing EGR cooler assembly to exhaust manifold	**32.4 Nm**
b = bolts fixing the EGR cooler assembly to crankcase	**32.4 Nm**



Install a new washers in the collars of the metal pipe clamps.

Install the pipe and torque the screw of the clamps.

e - washer



Install the rubber hoses and proper clamps.

EGR COOLER - R754 TE4-IE4-ISE4-EU6

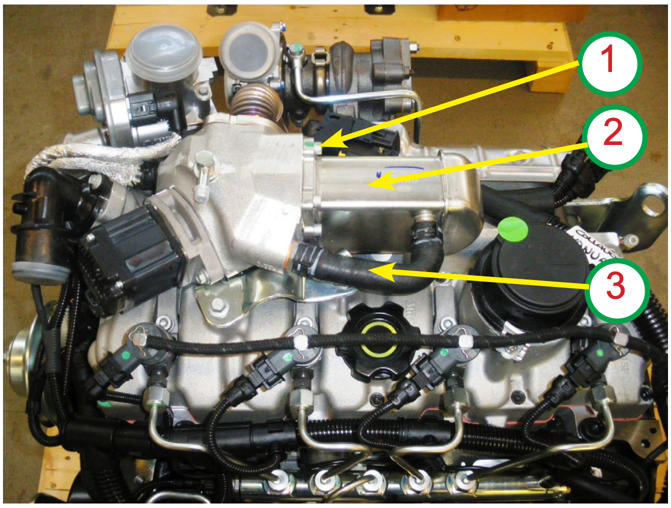
REMOVAL

Loosen the clamps and remove the EGR cooler rubber pipes.

3 - 6 - EGR cooler pipes

2 - EGR cooler

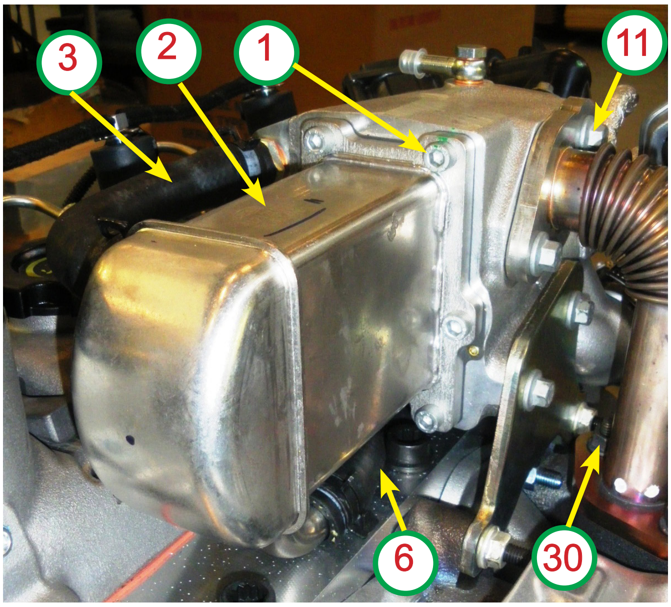
1 - EGR cooler fixing bolt



Remove the fixing bolt EGR cooler and remove it and proper gasket.

IMPORTANT: Never use a caustic cleaning solution, as it may attack aluminum. Also, never use a wire brush which could damage blade or mating surfaces.

2 - EGR cooler



INSTALLATION

Assemble the EGR cooler using a new gasket.

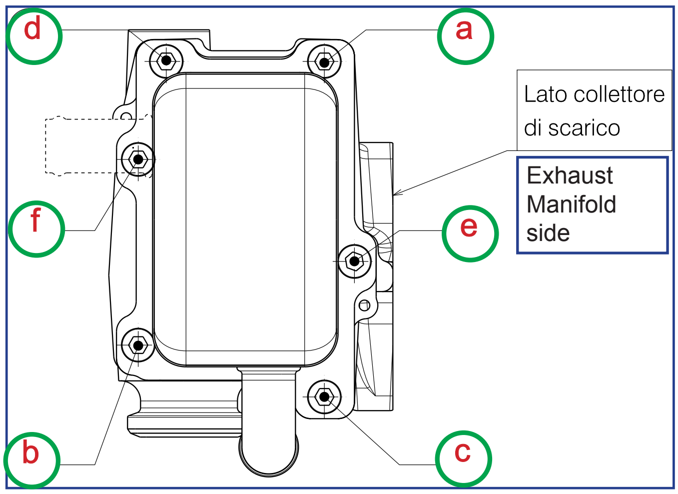
1 - EGR cooler fixing bolt

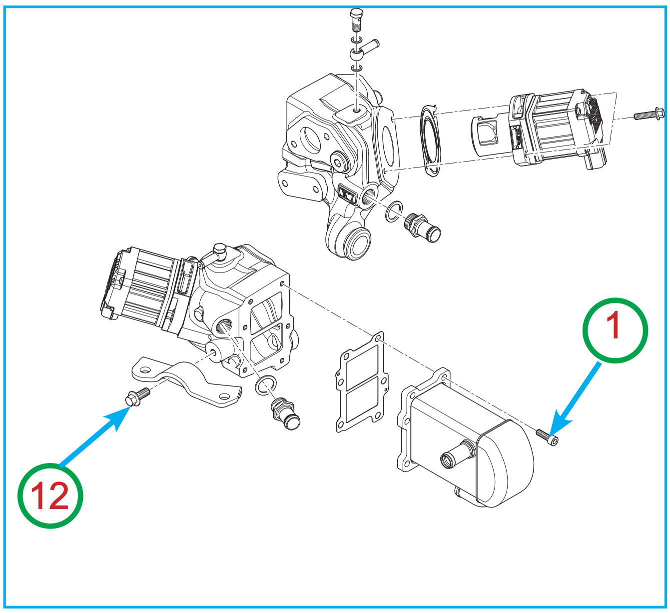
1 = EGR cooler fixing bolt	
pre-tightening (sequence a,b,c,d,e,f)	**5 Nm**
final tightening (sequence a,b,c,d,e,f)	**14.7 Nm**

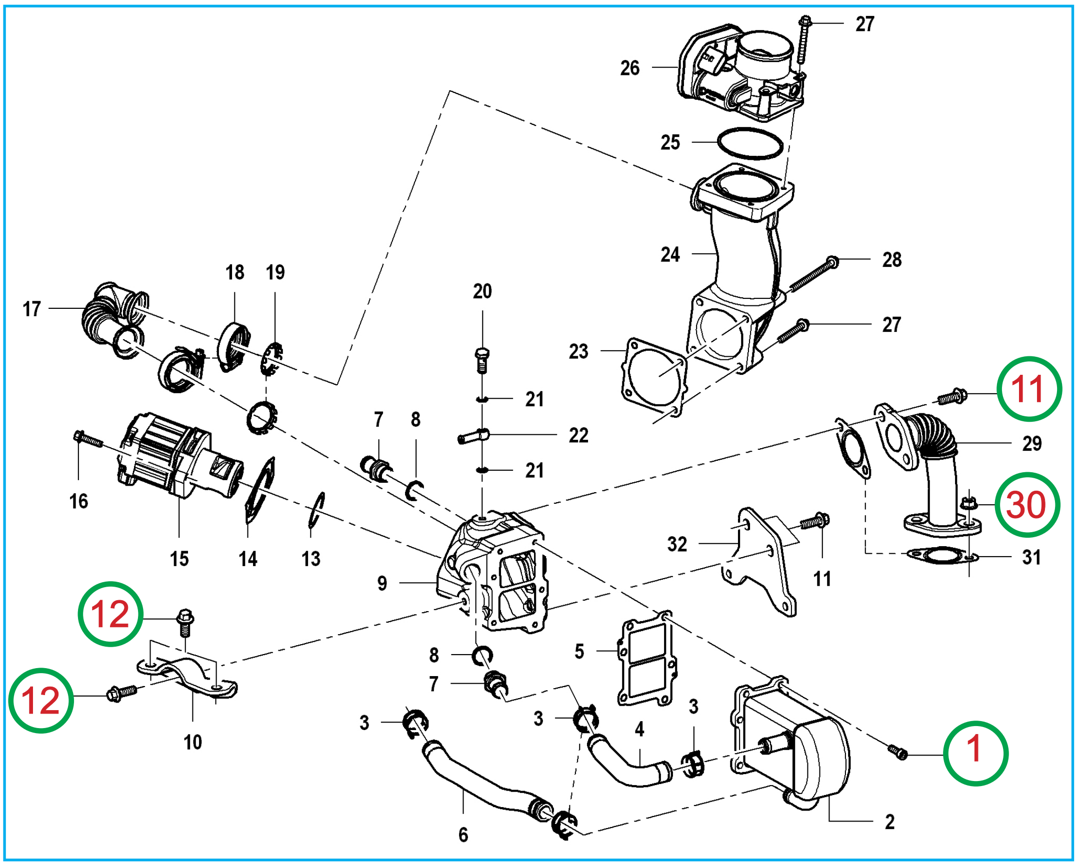
Installa rubber pipes and related clamps.

11, 30 = EGR pipe (bolt and nut)	**32.4 Nm**

12 = EGR cooler body	**32.4 Nm**



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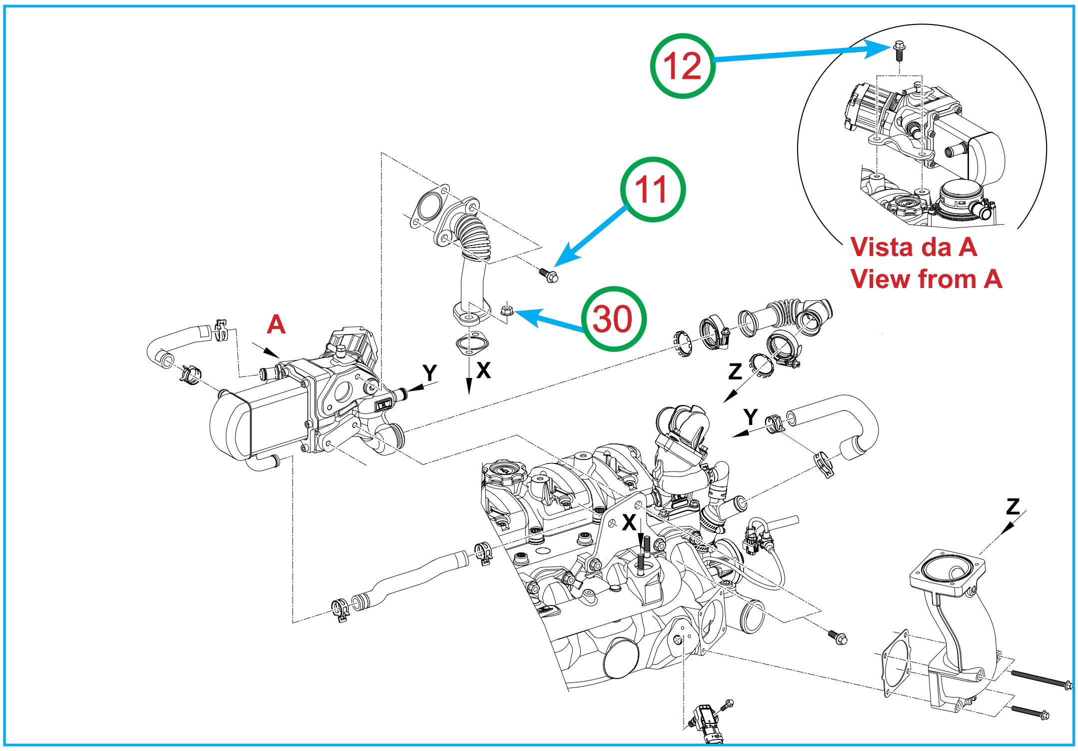
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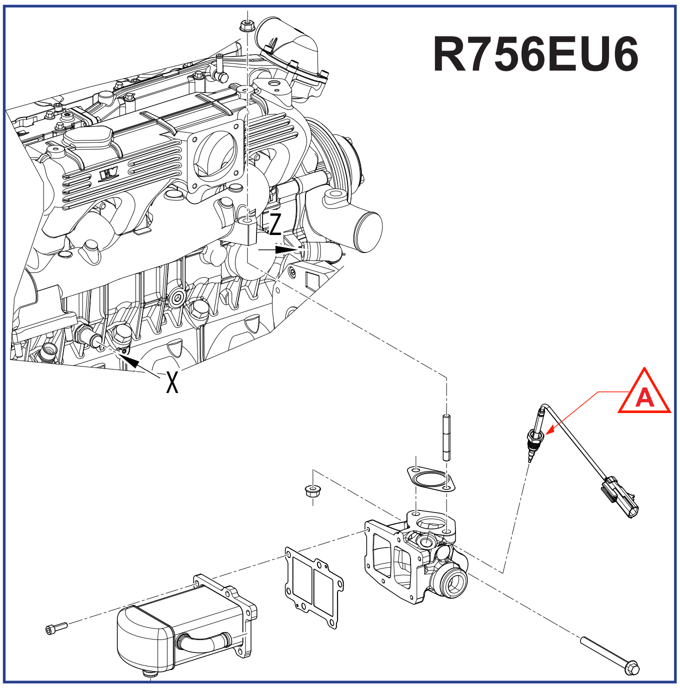
EXHAUST GAS TEMPERATURE/PRESSURE SENSORS

IMPORTANT: **handle with care. The sensor tip "A" is in ceramic. Fragile part.**

Install the sensor A on EGR cooler assy **(R756EU6)**

A - exhaust temperature sensor R756EU6	**24.5 Nm**



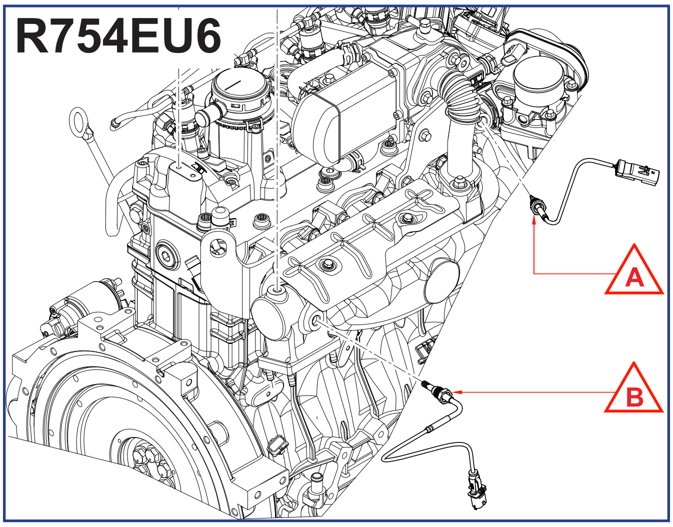
IMPORTANT: **handle with care. The sensor tip "A" and "B" is in ceramic. Fragile part.**

Install the sensor A on EGR cooler assy **(R754EU6)**

A - exhaust temperature sensor R754EU6	**24.5 Nm**

Install the sensor B on exhaust manifold **(R754EU6)**

B - exhaust temperature sensor R754EU6	**45.1 Nm**



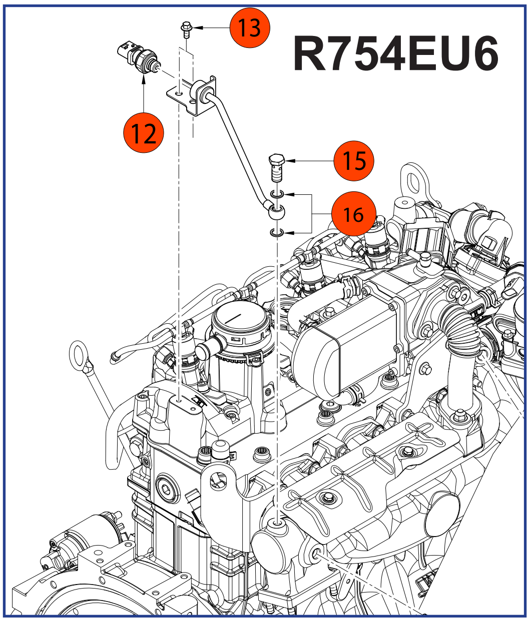
IMPORTANT: **respect the torque sequence of the exhaust pressure sensor (12).**

For the correct assembling, pre-install the hollow bolt 15 and related copper washers on the hollow pipe: apply ORAPI HT 900 antifriction paste on the hollow bolt thread and position the pipe.

Hand-tight the hollow bolt 15 and the screw 13.

Torque the parts as per following sequence:

1) Screws (13)	**10.8 Nm**
2) Hollow bolt (15)	**27.5 Nm**
3) Sensor (12)	**14 Nm**



INTAKE THROTTLE / EGR VALVE & PROPER ACTUATORS - R750TE3-IE3-EU4-EU5 - R756EU6

REMOVAL

WARNING

The DPF diesel antiparticulate filter may result in a FIRE HAZARD if the inlet/outlet pneumatic connections or actuators electrical connections of the intake throttle valve and EGR valve are exchanged. Before removing any connections from above mentioned components, it is recommended to apply a label on them.

Label the pneumatic rubber pipes connected to outlet of throttle valve and EGR valve.

a - Throttle valve (pneumatic oulet)

b - EGR valve (pneumatic oulet)

These 2 outles are connected to 2 identical modulator vacuum sensors and it results very simple to exchange them.

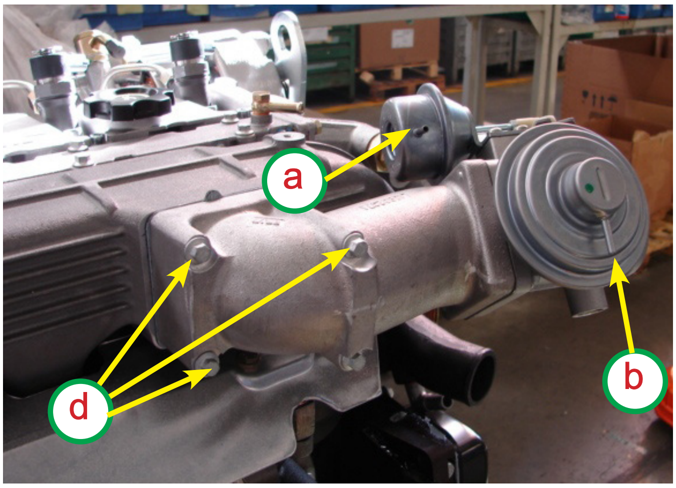
Loosen the bolts fixing throttle valve to intake manifold.

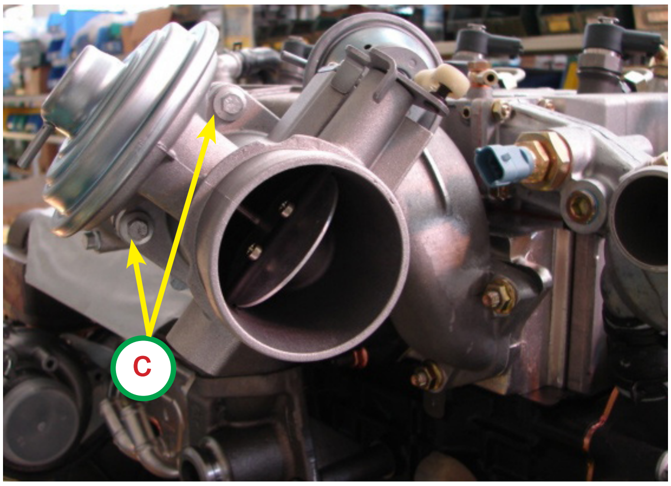
Remove the intake throttle valve and old gasket.

Loosen bolts fixing the throttle valve to elbow and separate the valve from elbow.

c - bolts fixing the throttle valve to elbow

d - bolts fixing throttle valve to intake manifold





INSTALLATION

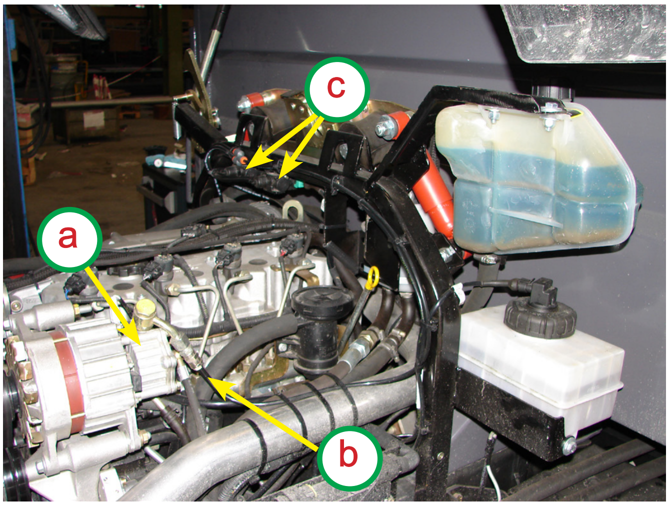
Take a new gasket and install the throttle valve on the elbow.

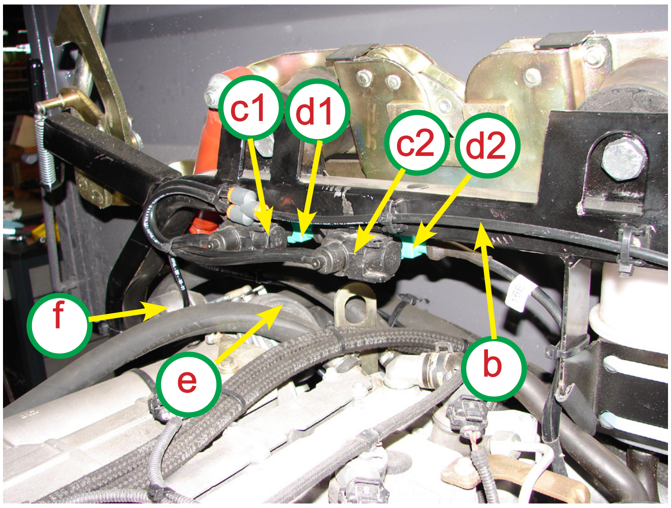
Torque the bolts at:

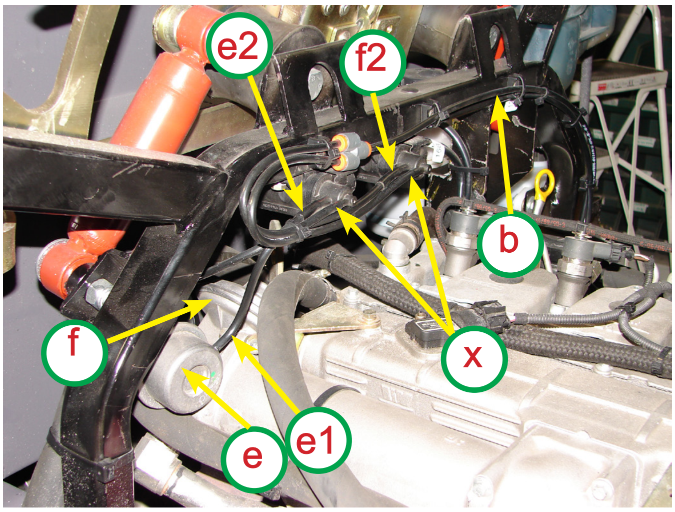
c = bolts fixing the throttle valve to elbow	**10.8 Nm**

Install a new gasket on elbow mating surface and torque the bolts at:

d = bolts fixing the elbow to intake manifold	**10.8 Nm**







a - Vacuum pump

b - Pnuematic outlet from vacuum pump

c - Actuators (c1: EGR valve / c2: Intake throttle valve)

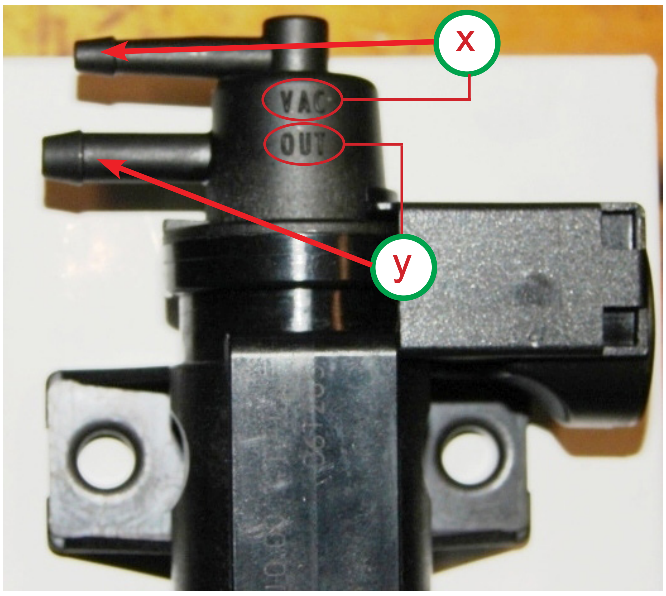
d - Actuators electrical connection (d1: EGR valve / d2: Intake throttle valve

e - Intake Throttle valve
e1 - Intake Throttle valve - Pneumatic Inlet (in the valve)
e2 - Intake Throttle valve Pneumatic Outlet from proper Actuator

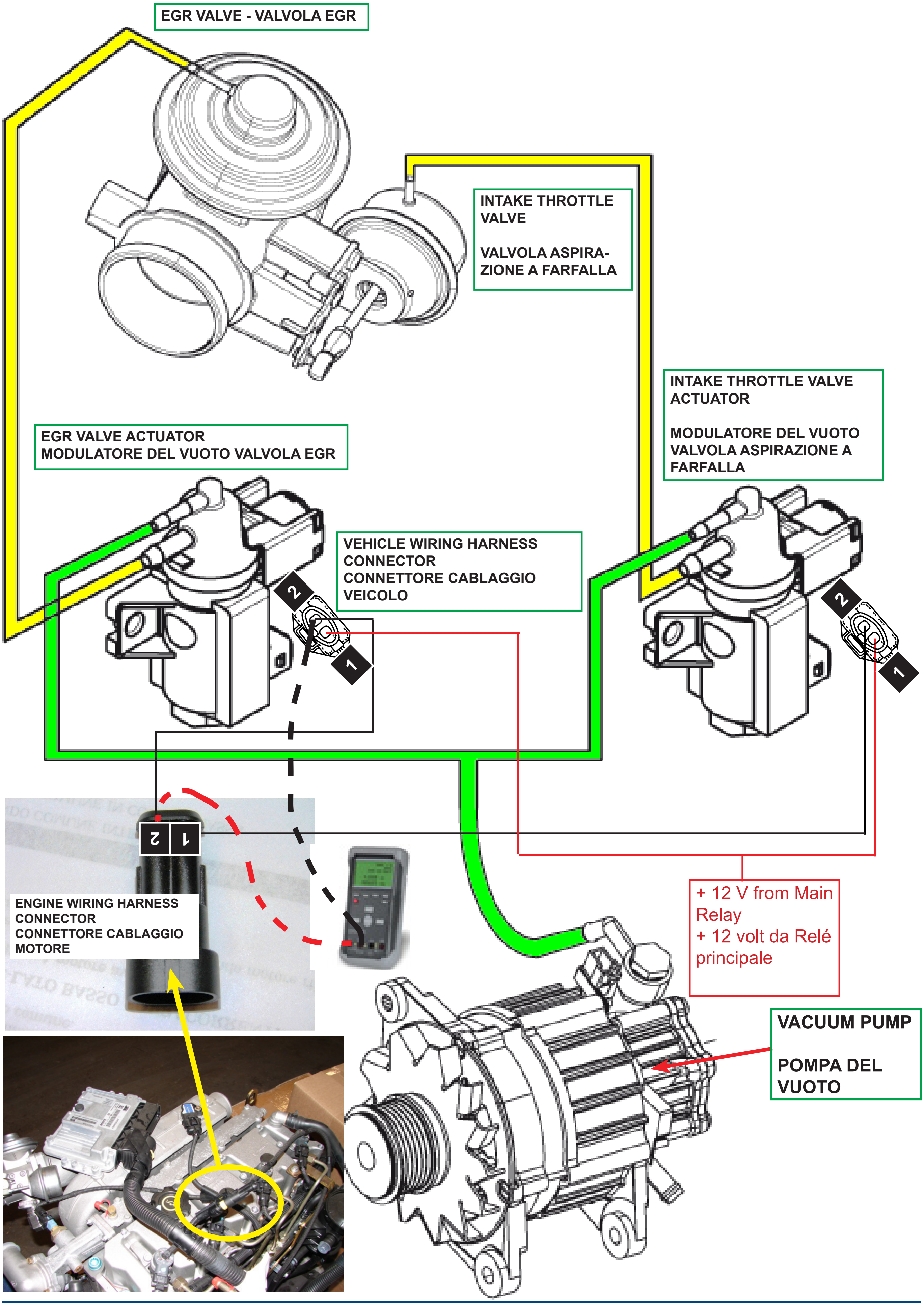
f - EGR valve
f1 - EGR valve - Pneumatic Inlet (NOT VISIBLE)
f2 - EGR valve Pneumatic Outlet from proper Actuator

x - Actuators Pnuematic Inlet from vacuum pump (VAC=vacuump)

y - OUT=pnuematic outlet from actuator to Intake Throttle valve or EGR valve



EGR & INTAKE THROTTLE VALVE CONNECTIONS TEST



INSTRUCTIONS

Measure with a tester the continuity between pin 2 of one of two the vehicle wiring harness connectors (connectors that will be connected to proper modulators) and pin 1 of engine wiring harness connector. Once verified the continuity, the electrical connection is related to Intake Throttle valve.
Measure with a tester the continuity between pin 2 of remaining engine wiring harness connector and pin 2 of the vehicle wiring harness connector, to establish the electrical connection related to EGR valve.
Once verified the electrical connections, carry on with pneumatic hoses connection to proper component.

FINAL ENGINE TEST
Operate the engine
Run the engine at idle RPM for several minutes to allow the vacuum system charges.
Stop the engine
Verify Intake Throttle Valve drive rod moves, so that it closes intake inlet.

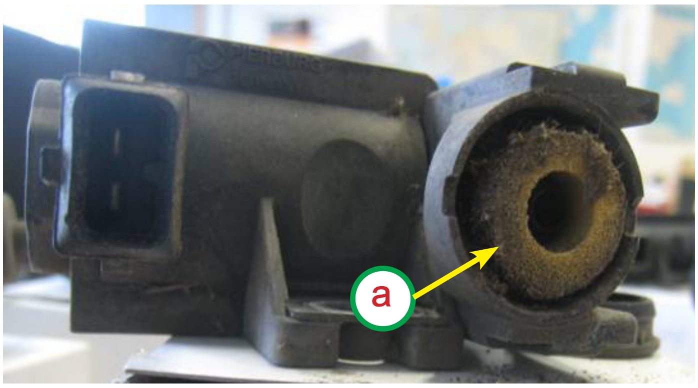
EGR & INTAKE THROTTLE VALVE VACUUM MODULATORS - MAINTENANCE

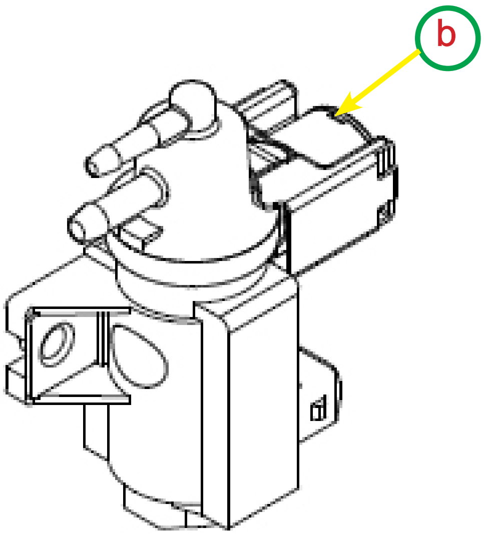
If the TVA and/or EGR valves error codes are stored into ECU check the vacuum modulator internal filter cleaning..

If the filter is clogged or dirty an EGR and/or TVA valves malfunction could occur.

a - vacuum modulator internal filter
b - cover "slot"

To inspect the internal filter remove the cover through the slot "b"





INTAKE THROTTLE VALVE / EGR VALVE - R750 TE4 - IE4 - ISE4 - R754EU6

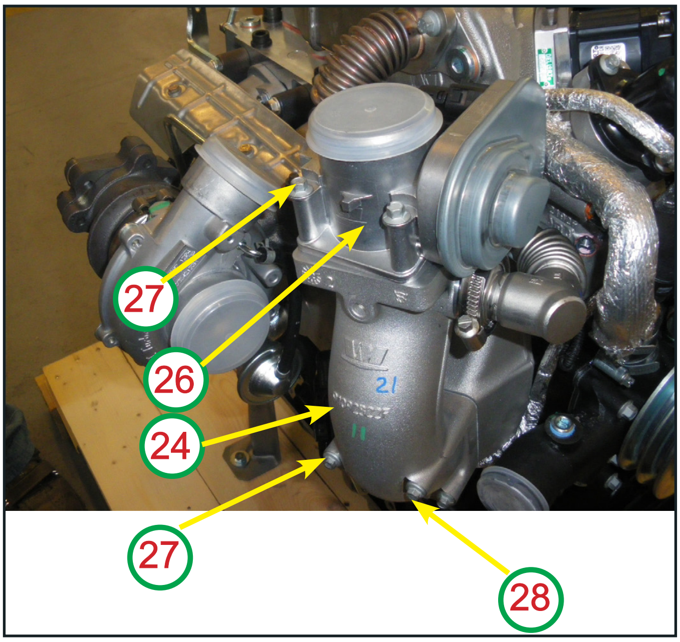
INTAKE THROTTLE VALVE

The intake throttle valve installed on R750TE4-IE4-ISE4 engine models is electrical type and triggered by engine ECU.

REMOVAL

Remove the fixing bolt that fix the valve to intake elbow. Repalce the OR.

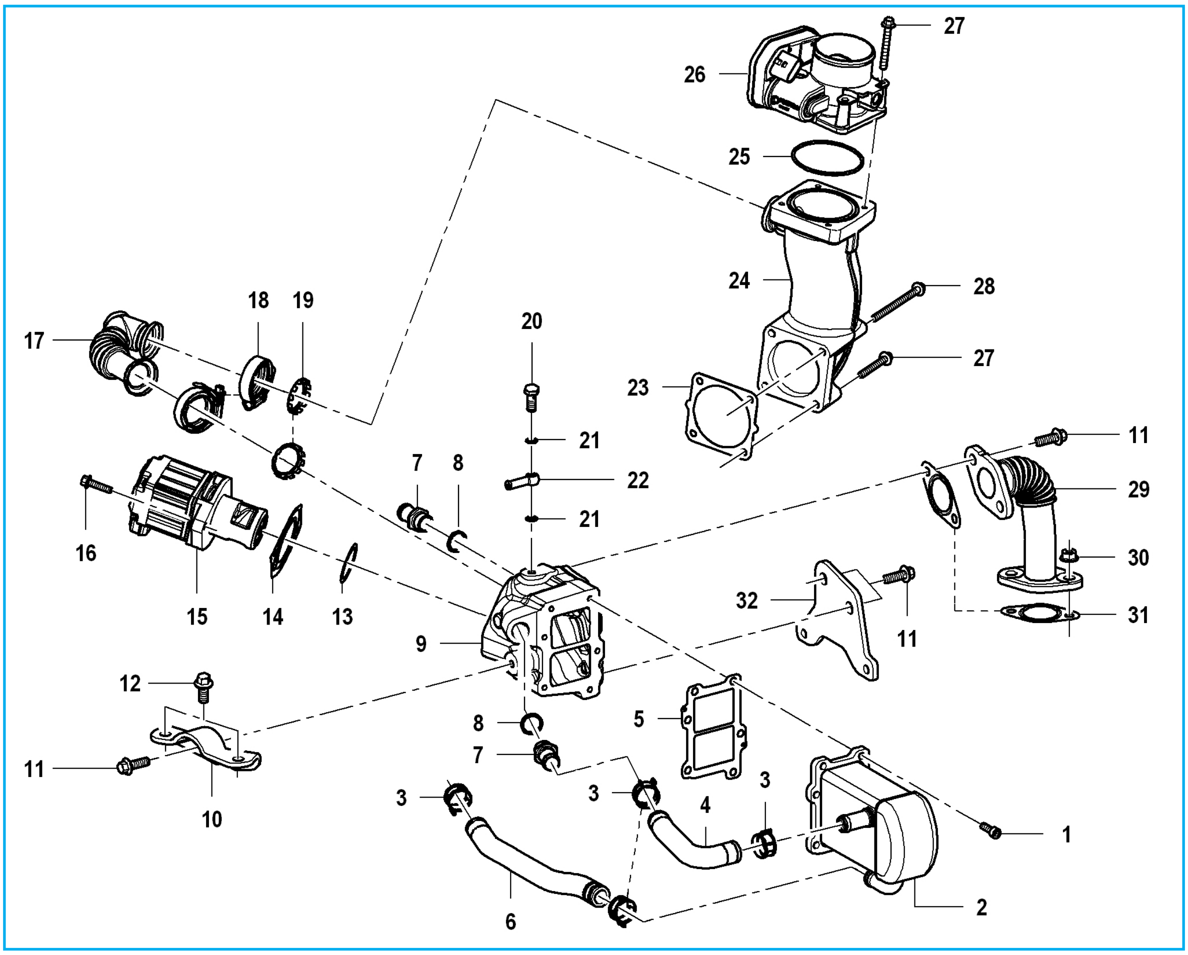
27 - fixing bolt
26 - valve
25 - OR
24 - intake elbow



INSTALLATION

Install a new OR on intake elbow.
Install the valve on the elbow and tighten the bolts.

27, 28 = fixing bolt	**10.8 Nm**



EGR VALVE

On the engine models R750TE4-IE4-ISE4 the EGR valve is electrical type and triggered by engine ECU.

REMOVAL

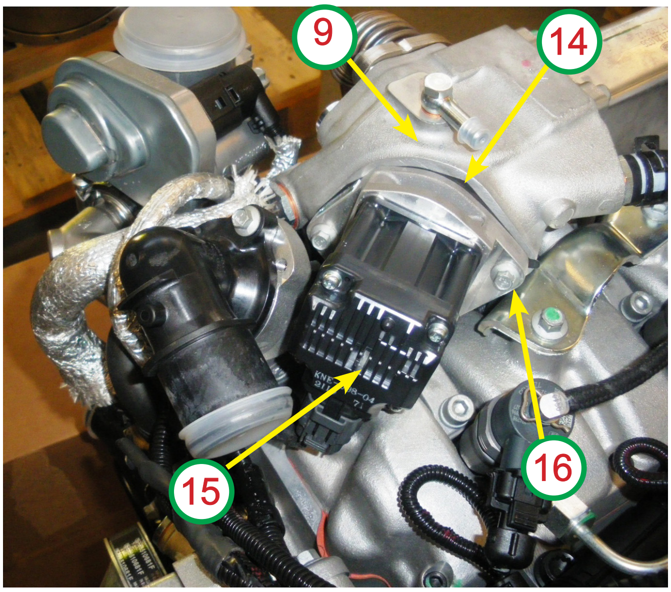
Remove the fixing bolts that fix the valve to EGR cooler body. Replace the gaskets.

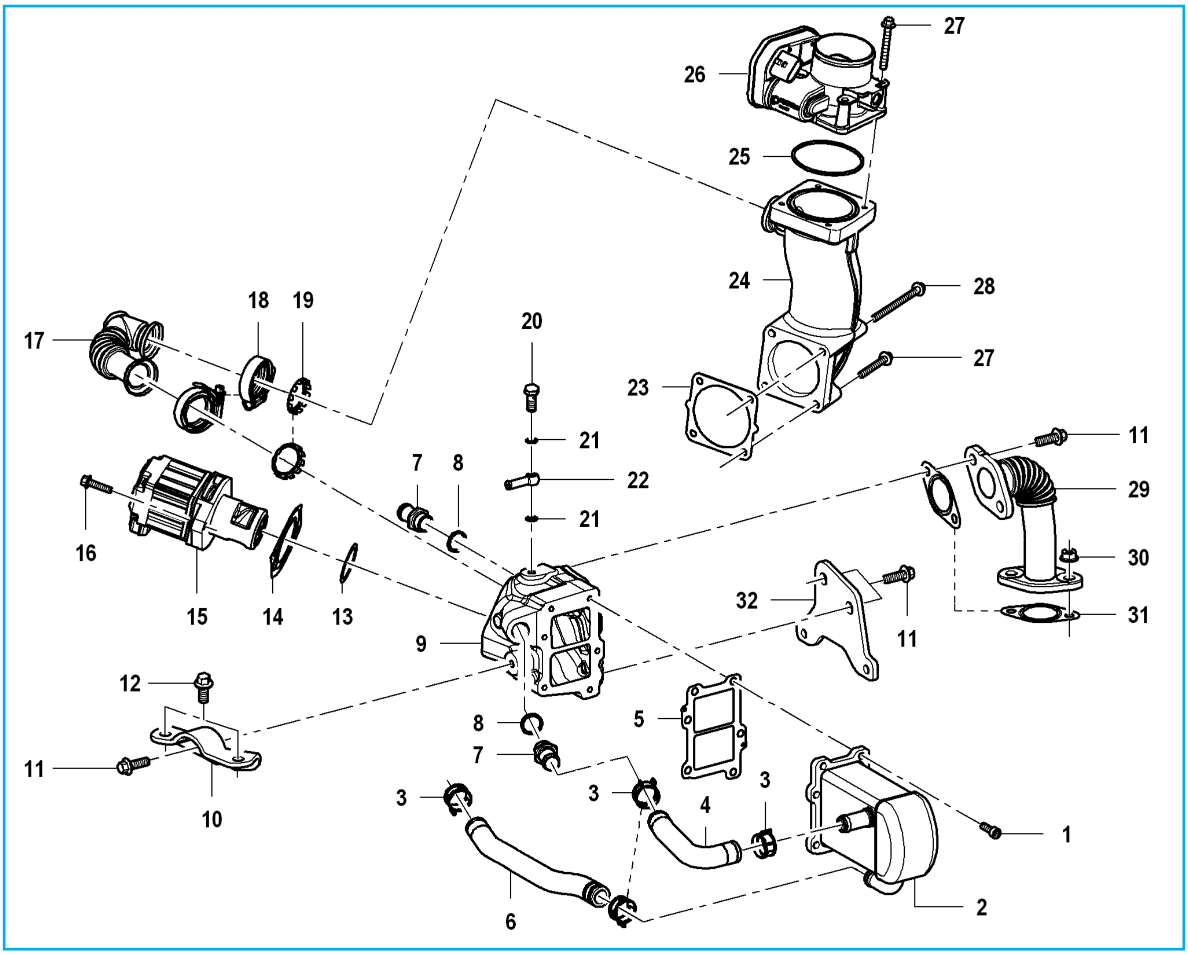
16 - EGR valve fixing bolt
15 - EGR valve
13-14 - gasket
9 - EGR cooler body

INSTALLATION

Install new gaskets and position the EGR valve on EGR cooler body. Install the fixing bolts and torque them.

16 = EGR valve fixing bolts	**13.7 Nm**





EXHAUST MANIFOLD

REMOVAL

Loosen the 2 bolts fixing the heat shield and remove it.

a - heat shield

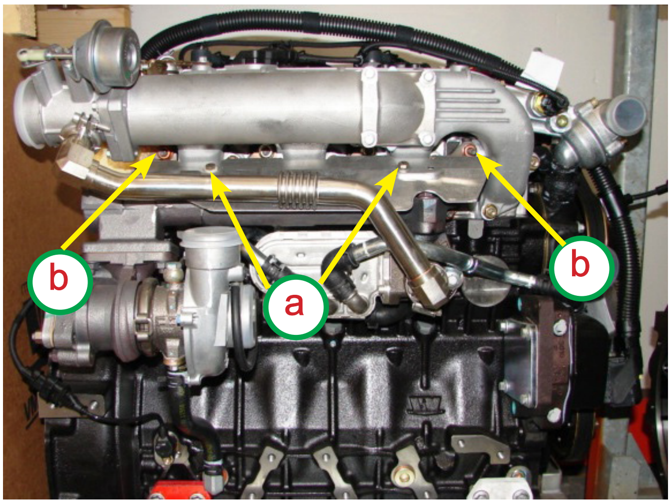
Remove any component wich hinders the turbocharger removal.

Loosen and remove fixing flange nuts.

b - flange nuts fixing exhaust manifold

Remove all spacers if present from the studs and remove the exhaust manifold and old single gaskets.

c - spacer

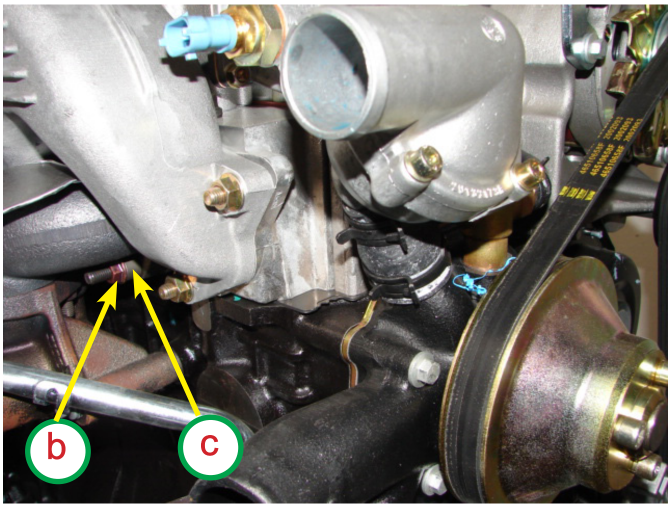


INSTALLATION

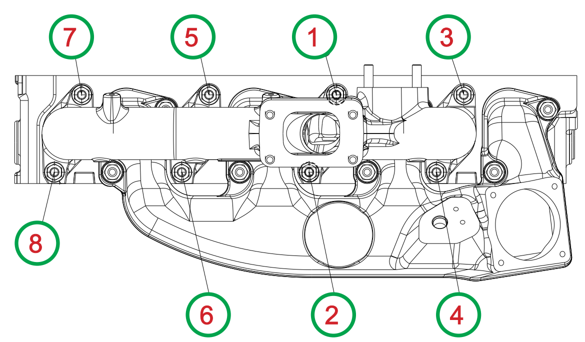
Install new single gaskets on the studs if necessary.

Install the exhaust manifold and proper spacers.

Install flange nuts and torque them following the sequence here described.



Exhaust flange nut	R754IE4/ TE4/ISE4	R750EU4/ IE3/TE3/ EU5/EU6
sequence 1,2,3,4,5,6,7,8 - pretithtening	36 Nm	32.4 Nm
sequence 1,2,3,4,5,6,7,8 final tightening	36 Nm	32.4 Nm



INTAKE MANIFOLD

REMOVAL

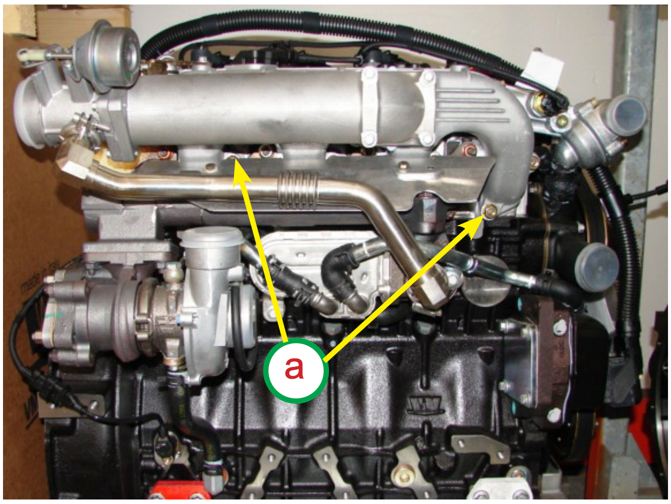
Remove the exhaust manifold and any component wich hinders the intake manifold removal.

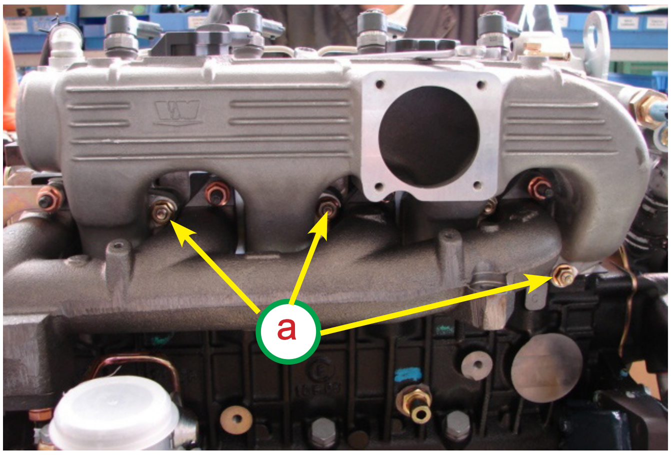
If nedeed remove the Intake Throttle Valve and proper elbow fixed to intake manifold.

Remove fixing flange nuts and take the intake manifold off.

a - flange nut

If necessary replace the gaskets.



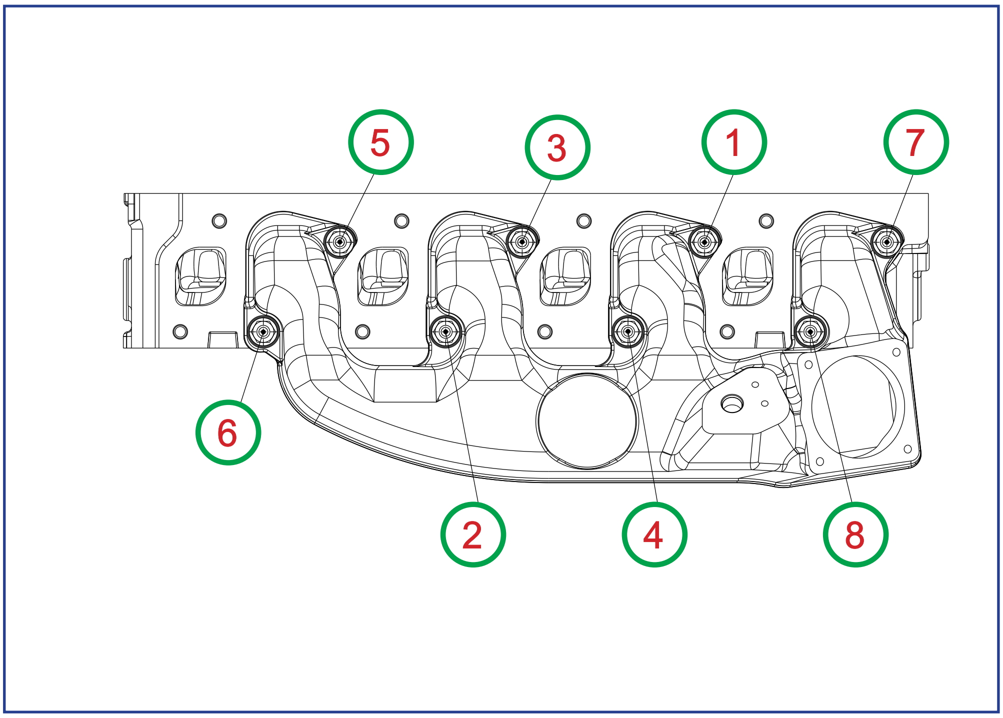


INSTALLATION

Install new gaskets on studs if nedeed.

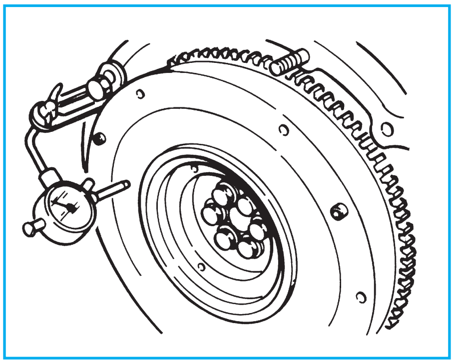
Install the flange nuts and torque them evenly in a cross pattern, as indicated.

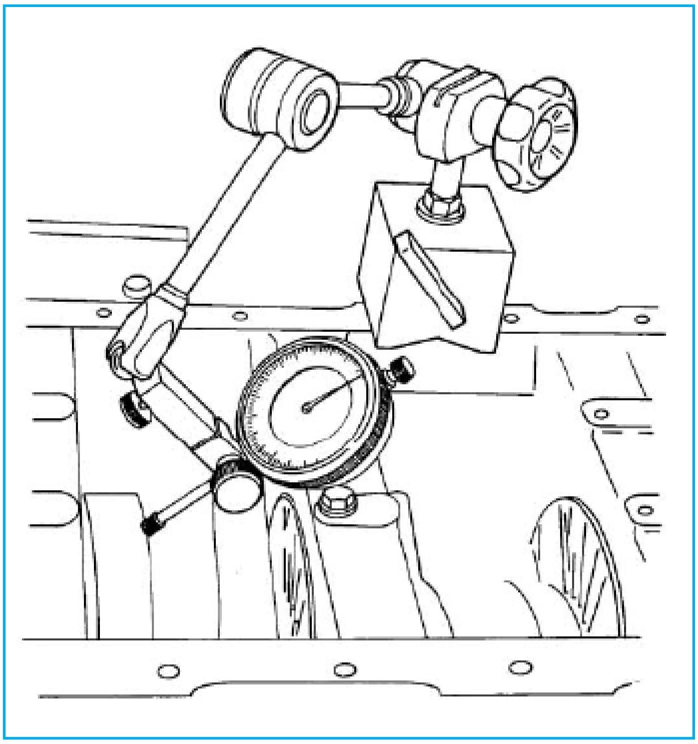
Intake flange nut	**R754IE4/TE4/ ISE4**	**R750EU4/ IE3/TE3/ EU5/EU6**
sequence 1,2,3,4,5,6,7,8 - pretithtening	**27.5 Nm**	**27.5 Nm**
sequence 1,2,3,4,5,6,7,8 - final tithtening	**27.5 Nm**	**27.5 Nm**



CRANKSHAFT END PLAY (AXIAL CLEARANCE)

Install the Flywheel. Refer to Flywheel.
Attach the Dial Indicator to the cylinder block to check the installed crankshaft end play (axial clearance).
Measurement can be made from the crankshaft counter weight or flywheel outer surface..
Firmly force the crankshaft rearward. Record the measurement.
Firmly force the crankshaft forward. Record the measurement.
Subtract the measurements to determine the crankshaft end play (axial clearance).





crankshaft end play	**0.080 - 0.230 mm**

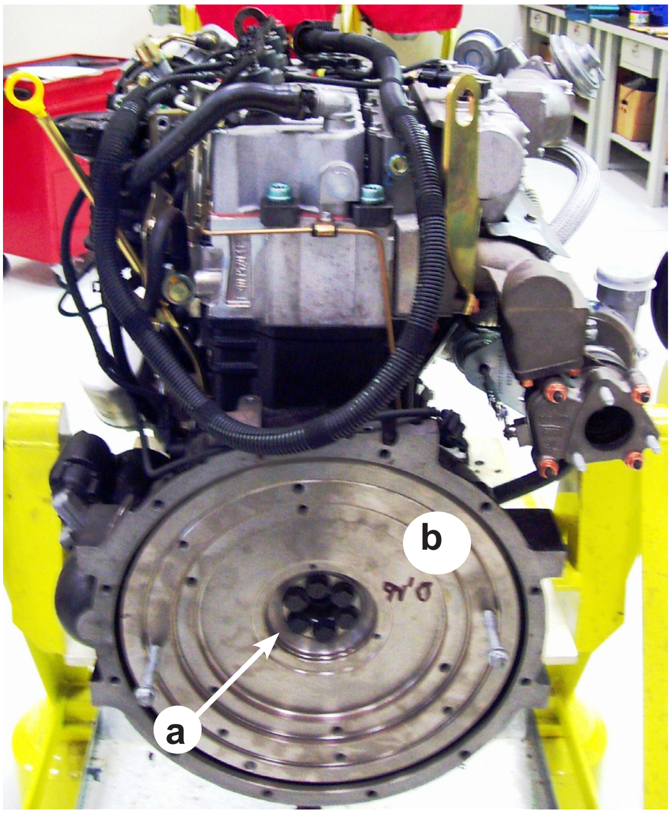
If the end play (axial clearance) is incorrect, calculate the necessary thickness of the thrust washers needed.
Install different thickness thrust washers in rear main carrier and recheck the end play (axial clearance).
Refer to Rear Main Bearing Carrier to determine thickness thrust washers.

Repeat the steps until the proper end play (axial clearance) is obtained.

FLYWHEEL

REMOVAL

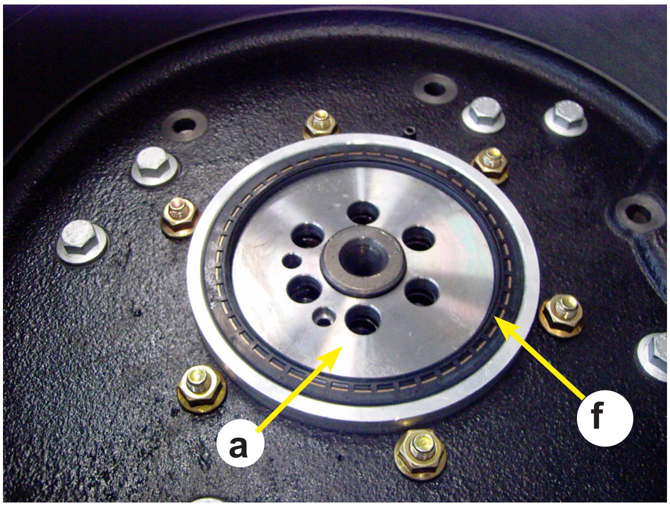
- Measure and record the crankshaft End Play (Axial Clearance) before removing the flywheel. (Refer Crankshaft End Play - Axial Clearance).
- Remove the starter and install the special tool, flywheel holder tool, to block the crankshaft rotation.
- Remove 2 of the flywheel bolts and install the Flywheel Assembly Guide Pins (Refer to special tools).
- Remove the remaining flywheel bolts and remove the flywheel.

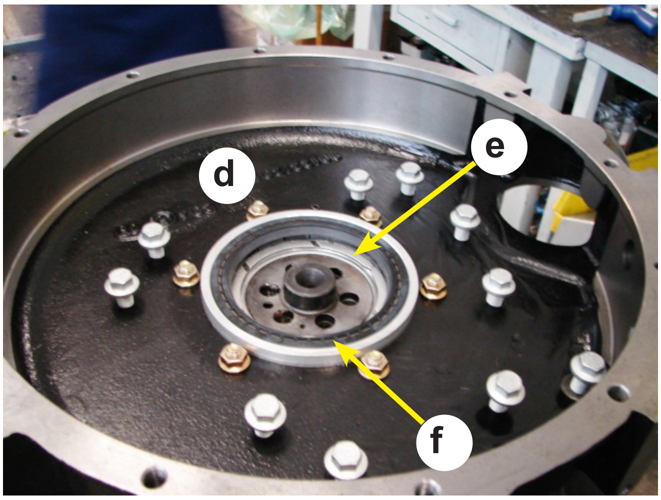


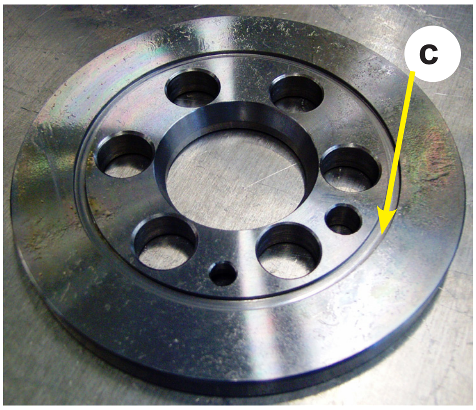
- a - Flywheel bolts
- b - Flywheel
-
- Take the flywheel off and remove the special tool, flywheel holder tool, blocking the crankshaft rotation

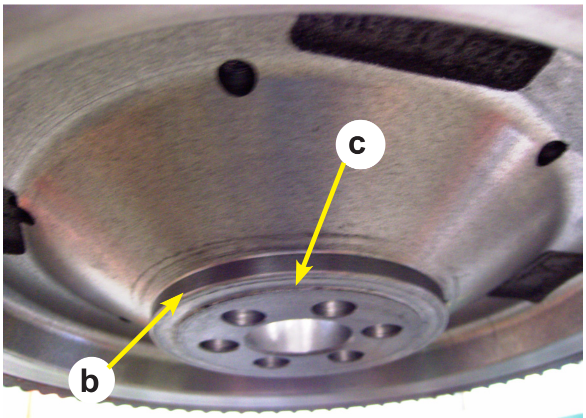
When taking the flywheel off a crankshaft thrust plate could be installed.
If not present, it is melted with the flywheel. In this case verify the O-ring presence.

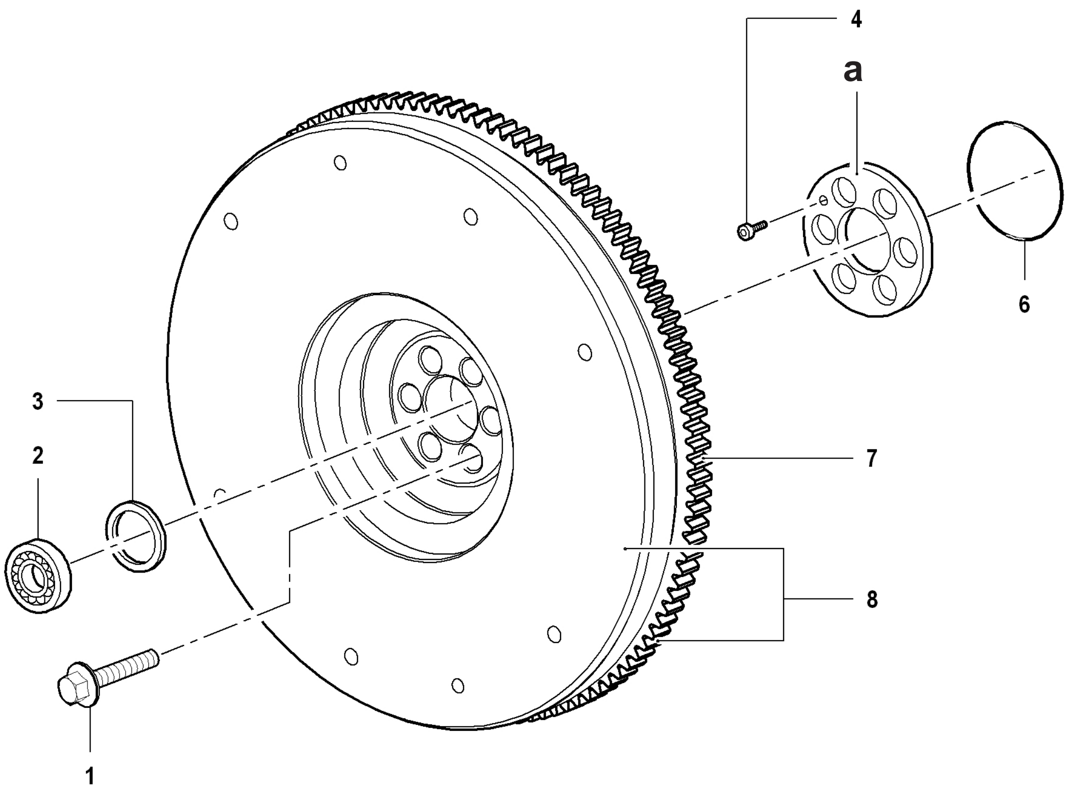
- a - cranckshaft thrust plate (NOT melted with flywheel)
- b - cranckshaft thrust plate (melted with flywheel)
- c - thrust plate o-ring groove
- d - engine without crankshaft thrust plate
- e - thrust washers
- f - rear oil seal











INSTALLATION

Install a new O-ring in thrust plate groove. A small amount of grease, such as Molykote, may be used to hold the O--ring in position during installation. Whenever the flywheel is removed, replace the O-ring.
Install the thrust plate with O-ring towards the crankshaft.

Ensure that there are no scratches, nicks, cracks, or seizure marks on the flywheel mating surface. Only minor scratches, nicks, or seizure marks can be removed. Replace the flywheel if damaged.

When installing the flywheel, do not touch or handle the lips of the rear oil seal. Ensure that the rear oil seal is in good conditions. Replace it if any doubt exists. (Refer to Rear Main Bearing Carrier).

Ensure that thrust washers are not damaged or worn and are properly seated into the rear main bearing carrier. Replace them if any doubt exists (Refer to Rear Main Bearing Carrier).

Install the 2 Flywheel Assembly Guide Pins in the crankshaft..

Install the flywheel with O-ring (if the cranckshaft thrust plate is melted with flywheel) onto the crankshaft using the Flywheel Assembly Guide Pins.

NOTE: VM suggest to replace the bolts whenever they have been removed. Replace the bolts if any doubt exists about reuse. In case of reuse lubricate the threads and underside of the head of the flywheel bolts with engine oil. New bolts must NOT be lubricated.

Install and hand tighten four of the flywheel bolts.

Remove the Flywheel Assembly Guide Pins and install the remaining flywheel bolts.

Remove the starter and install the special tool, flywheel holder tool, to block the crankshaft rotation.

Torque the flywheel bolts evenly in a clockwise direction, cross pattern at **50 Nm**..

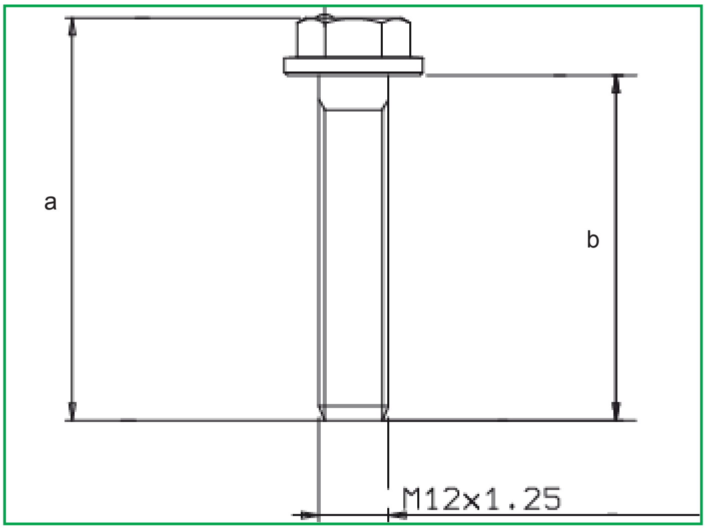
Loosen completely one flywheel bolt at a time, and tighten the bolts evenly in a clockwise direction, cross pattern at **20 Nm + 75° .**

NOTE: Verify the Crankshaft End Play (Axial Clearance).
Refer to Crankshaft End Play (Axial Clearance) to set the crankshaft end play.

Remove the special tool, flywheel holder tool, to block the crankshaft rotation and install the starter.

BOLT SPECIFICATIONS

a	**70 mm**
b	**58.75 - 60.25 mm**



FLYWHEEL RING GEAR

1. Heat the ring gear with a torch on the engine side of the ring gear.

2. Once heated, knock the ring gear off the flywheel. Do not strike the flywheel when removing the ring gear.

CAUTION

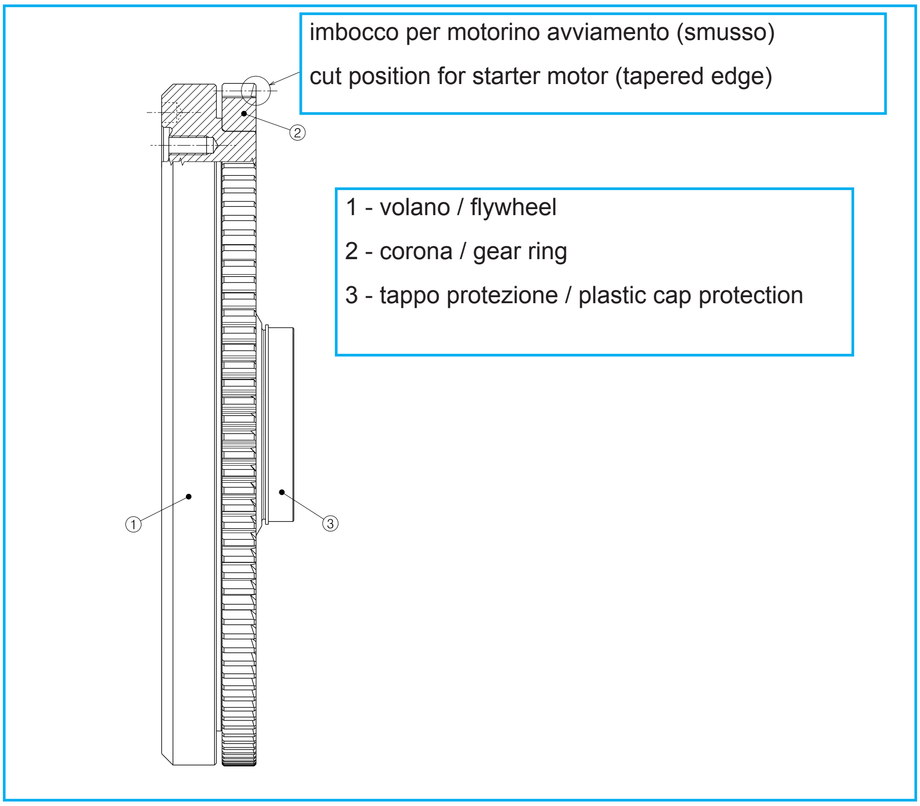
Some components are made of steel that has been heat treated to increase hardness.

Applying excessive heat to the hardened steel will alter the hardness and make the steel weaker. Do not heat any portion of these hardened steel components, such as a flywheel ring gear, to a temperature higher than 210 °C.

3. Heat the new ring gear for 20 minutes in an oven preheated to 190 - 210° C , or heat evenly until the gear expands enough to slip onto the flywheel. Do not overheat the ring gear.

IMPORTANT: The ring gear must be installed so the bevel on the teeth is toward the crankshaft side of the flywheel.

4. Install the ring gear. Ensure that the ring gear is seated properly against the flywheel shoulder. The ring gear can move away from the flywheel shoulder no more than 0.50 mm.



FLYWHELL HOUSING

REMOVAL

Remove the flywheel (refer to Flywheel).

Remove the crankshaft thrust plate if fitted.

Remove the flywheel housing bolts.

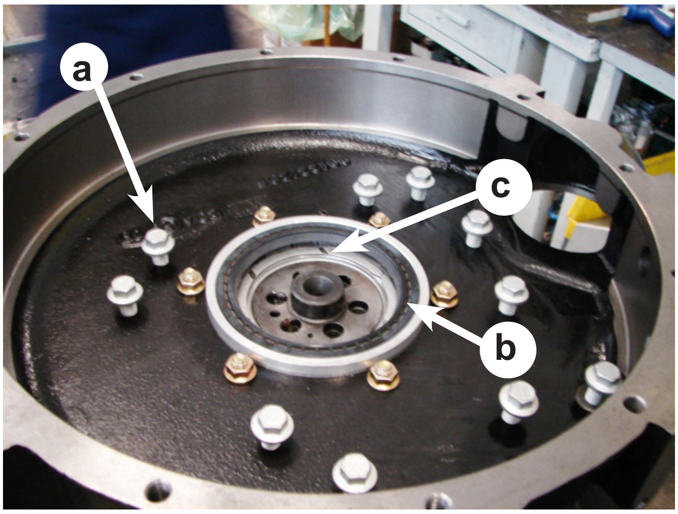
Using a rubber mallet, tap evenly around the housing. The flywheel housing with rear main bearing carrier, will be pulled from the cylinder block.

When removing the flywheel housing, do not touch or handle the lips of the rear oil seal and do not damage the rear main bearing carrier O-ring.

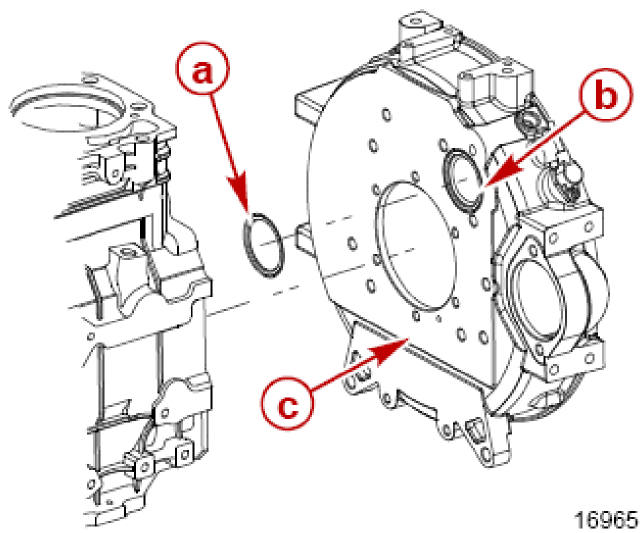
a - flywheel housing bolts

b - rear oil seal

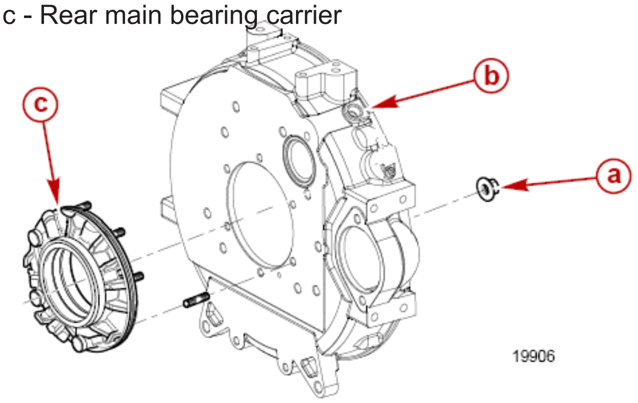
c - thrust washers



a - O-ring into the groove of the flywheel housing
b - Groove
c - Flywheel housing



a - Rear main bearing carrier flange nuts
b - Flywheel housing with detached rear main bearing carrier
c - Rear main bearing carrier



INSTALLATION

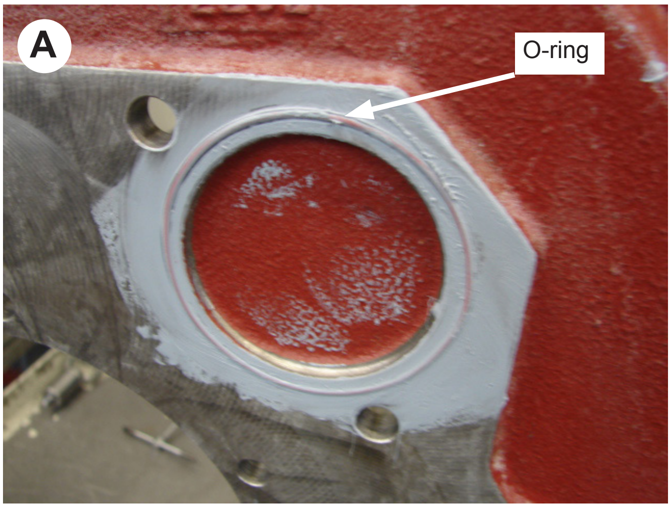
IMPORTANT: Whenever the flywheel and flywheel housing are removed, replace all installed O--rings.

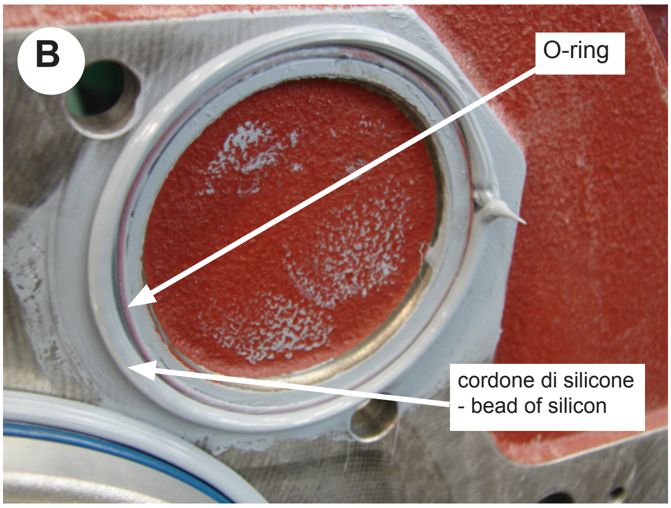
Ensure that thrust washers are not damaged or worn and are properly seated into the rear main bearing carrier. Replace them if any doubt exists **(Refer to Rear Main Bearing Carrier).**
Apply silicon **Dow Corning 7091** on flywheel housing groove where the O-ring seats. **PHOTO A.**
Install a new O--ring into the groove of the flywheel housing.
Apply a bead of sealant (thickness 2 mm) around the O-ring as shown in the **PHOTO B.**

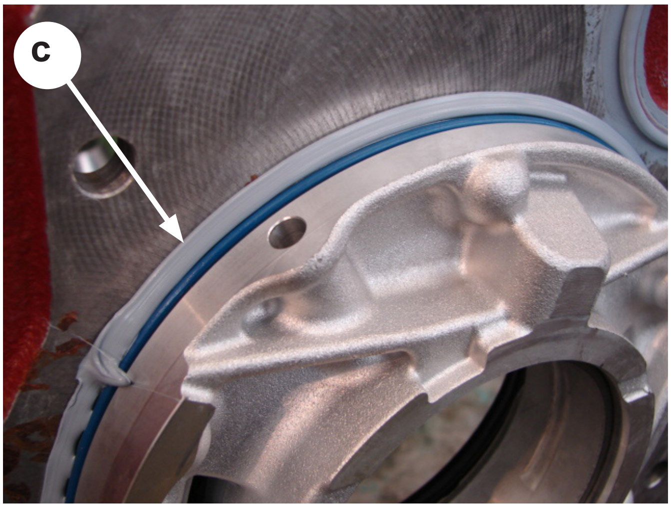
Install a new O-ring into the groove around the rear main bearing carrier.
Apply a bead of sealant (thickness 2 mm) around the O-ring as shown in the **PHOTO C.**

Lubricate the rear crankshaft journal and rear main bearing.
Install the flywheel housing.
Install and torque the flywheel housing bolts evenly in a diagonal pattern.

flywheel housing bolts	**68.6 Nm**







REAR MAIN BEARING CARRIER

REMOVAL

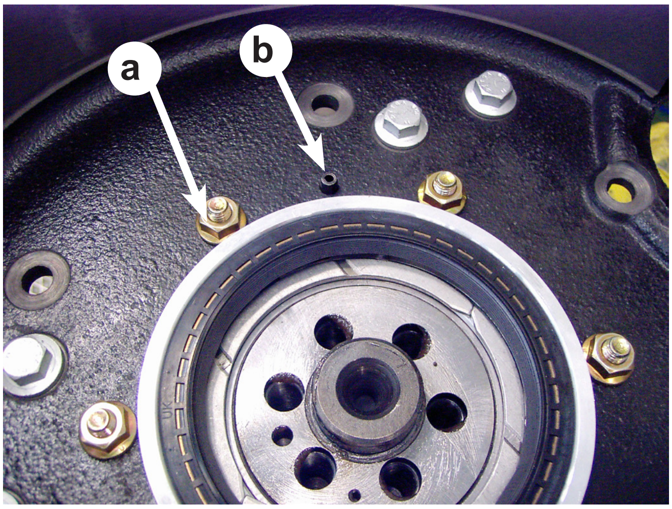
Remove the flywheel and flywheel housing. (Refer to proper section).
Disassemble the rear main bearing carrier from the flywheel housing by removing the flange nuts

INSTALLATION

Check the thrust washers condition and that they are properly seated into the rear main bearing carrier.
Replace them if any doubt exists.
Install a new O-ring around the groove of the carrier. and apply silicon (Refer to Flywheel Housing).
Align the flywheel housing with the rolled pin installed in the rear carrier.
Install the flange nut and torque them.

Rear Main Bearing Carrier fixing flange nut	**24.5 Nm**

a - Rear main bearing carrier flange nuts
b- Rolled pin install in the rear carrier



THRUST WASHERS

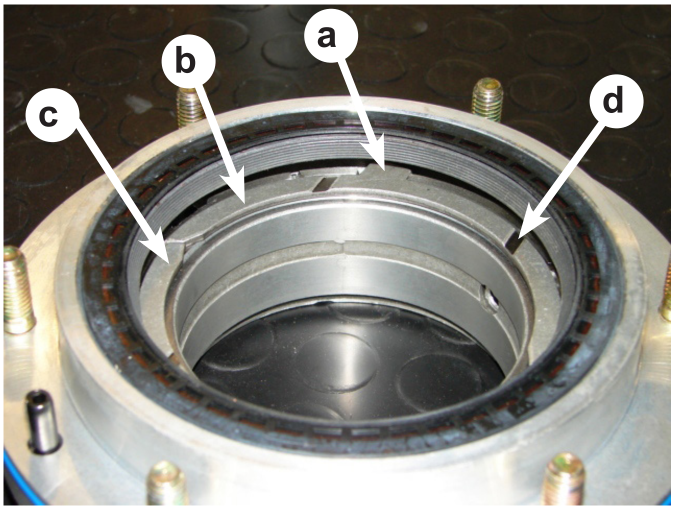
REMOVAL

Using a suitable device, carefully pry out the washer halves. Do not damage the rear main bearing carrier or rear oil seal.

INSTALLATION

Ensure that the washer halves are properly seated in the rear main carrier and that the oil passages are towards outside as shown in the picture.
Align the tab of a washer half with the notch in the rear main bearing carrier
Press the washer halves simultaneously into the carrier.

a - tab
b / c - washer halves
d - oil passages (grooves)



SPECIFICATIONS

Thrust Washer	
Standard	**2.310 - 2.360 mm**
First oversized (+0.10)	**2.410 - 2.460 mm**
Second oversized (+0.20)	**2.510 - 2.560 mm**

REAR MAIN BEARING

REMOVAL

Using a suitable mandrel, press the rear main bearing out of the carrier.

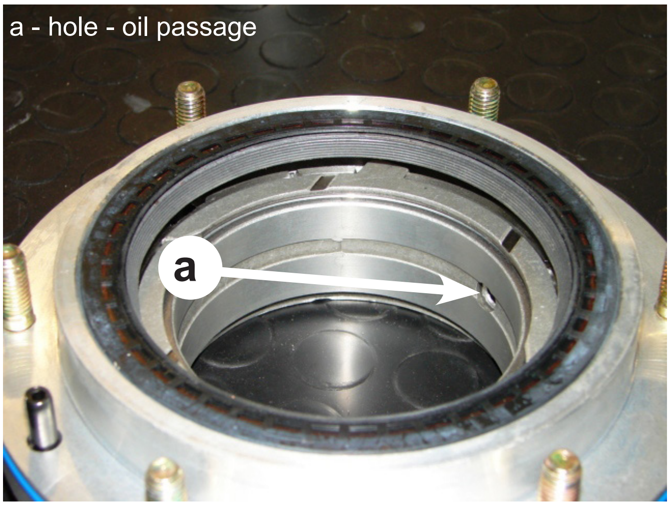
INSTALLATION

Align the hole of a new rear main bearing with the oil passage in the rear main bearing carrier and press the new bearing into the carrier.

SPECIFICATIONS

Rear main bearing inner diameter (installed into the carrier)	**80.045 - 80.07 mm**
First oversized bearing	**0.25 mm**

IMPORTANT: Refer to Crankshaft Section to determine the Rear Main Bearing Crankshaft Journal Outside Diameter and Rear Main Bearing Clearance.



REAR OIL SEAL

REMOVAL

Using a suitable device, carefully pry out the old seal. Do not damage the rear main bearing carrier or thrust washers.

INSTALLATION

IMPORTANT: The seal is made of special compounds; do not touch or handle the lips of the seal. Do not attempt to install rear main seal using a hammer or mallet. Damage to the seal or rear main bearing carrier could result.
Lubricate the rear oil seal outer surfaces. Do not touch or handle the lips of the seal.
Install the new rear oil seal in the bearing carrier using the Flywheel Seal Installer. The seal will stop when seated.

CPS TARGET WHEEL BOLT

REMOVAL

Remove the flywheel, flywheel housing with rear main bearing carrier.

Slacken and remove no. 3 bolts retaining the CPS (Crankshaft Position Sensor) target wheel.

a - CPS (Crankshaft Position Sensor) target wheel bolts

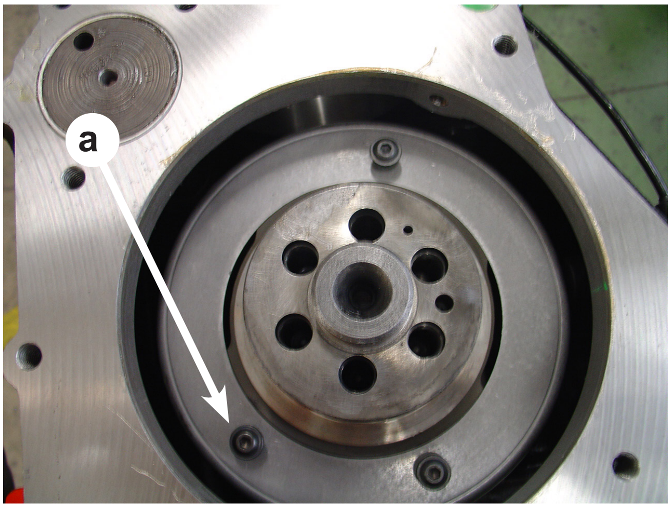
INSTALLATION

Usually replace the old bolts.

Replace the old bolts and apply loctite 510 on the bolt thread.

Install the bolts and torque them.

CPS (Crankshaft Position Sensor) target wheel bolts	**14.7 Nm**



CYLINDER HEAD GASKET

IMPORTANT: When cylinder heads are removed for service but pistons and cylinder liners are not disturbed,use the same thickness gaskets that were removed. Refer to Head Gasket Identification.

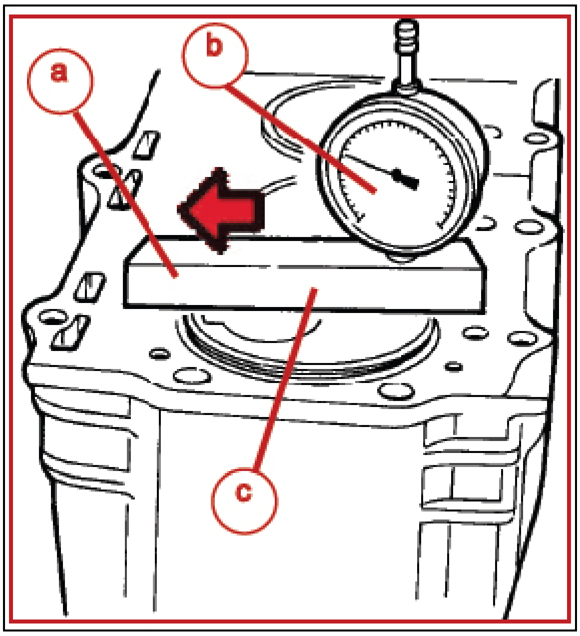
Refer to the following procedures during a complete engine rebuild or when pistons and liners are being replaced.

1. Use the dial indicator and Support Block tool (liner gauge bar) (refer to Special Tools) to measure piston height above the cylinder block with the piston at Top Dead Center (TDC).

2. Place Support Block on cylinder block surface and set the dial indicator to zero 0.

3. Move the Support Block tool to the piston surface with the piston at TDC point as shown.Record the measurement.

4. Measure the piston protrusion (height) of all pistons. Use the average measurement to determine the gasket thickness required for all cylinders.



a - Support Block tool

b - Dial indicator

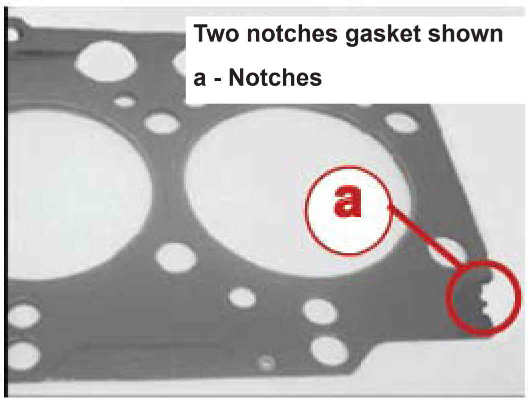
c - piston

Piston protrusion (height) above cylinder block - AVERAGE	Gasket thickness required
0.60 - 0.72 mm	**1.42 mm**
0.73 - 0.82 mm	**1.52 mm**
0.83 - 0.95 mm	**1.62 mm**

5. After determining the head gasket thickness required, identify and select the proper the cylinder head gasket.

Note the identification marks (holes or notches) in the lower right hand corner.

No mark indicates a thickness of	**1.42 mm**
Two marks indicate a thickness of	**1.52 mm**
One mark indicates a thickness of	**1.62 mm**



Two notches gasket shown

a - Notches

CYLINDER HEAD - ENTIRE FOR ALL CYLINDERS (R750IE4-TE4-ISE4-R754EU6)

INSTALLATION

1. Clean out bolt holes in cylinder block. Be certain no contaminants (dirt, old oil or coolant) remain in the holes.
2. Clean the gasket surfaces on block and heads.
3. **IMPORTANT: Cylinder head bolts must be always replaced whenever the bolts are removed or loosened**
4. **NOTE: New cylinder head bolts must not be lubricated. They are already lubricated with an anti-seizing lubricant from the manufacturer, and do not require additional lubrication.**
5. **NOTE:** VM Motori discourage the reuse of the bolts: in case of reuse, lubricate with Molykote G Rapid Plus Paste the bolt threads and underside of bolt heads of all 12M (12 mm) cylinder head bolts (side bolts) and 14M (14 mm) cylinder head bolts (center bolts)
6. **IMPORTANT: Cylinder head gasket must be installed dry. Do not use any sealant or adhesive on the gasket.**
7. Position the cylinder head gasket on the cylinder block.
8. Install the Cylinder Head Guide Pins (refer to Special Tools) into the 12 mm bolt holes in the gasket and cylinder block at each cylinder location. These pins will align the gasket and cylinder heads.

- Install the 12M cylinder head side bolts and 14M cylinder head center bolts and finger tighten all bolts
- **a = entire cylinder head**
- **b = side bolts**
- **c = central bolts**

BOLTS TORQUE SPECIFICATIONS

CENTER BOLTS

a. First pass torque and sequence:

Torque Value - 30 Nm

Sequence

3-2-1-4-5-8-9-10-7-6

b. Second pass torque and sequence:

Torque Angle + 65°

Sequence

1-2-3-4-5-6-7-8-9-10

c. Final pass and sequence:

Torque Angle + 65°

Sequence

1-2-3-4-5-6-7-8-9-10

- Now, torque the side bolt numbered sets as specified and in the sequence shown, following steps a, b, c and d.

SIDE BOLTS

a. First pass and sequence:

Torque value - 30 Nm

Sequence

11, 12, 13, and 14

b. Second pass and sequence:

Torque angle + 85°

Sequence

11, 12, 13, and 14

c. Third pass and sequence:

Torque value 30 Nm

Sequence

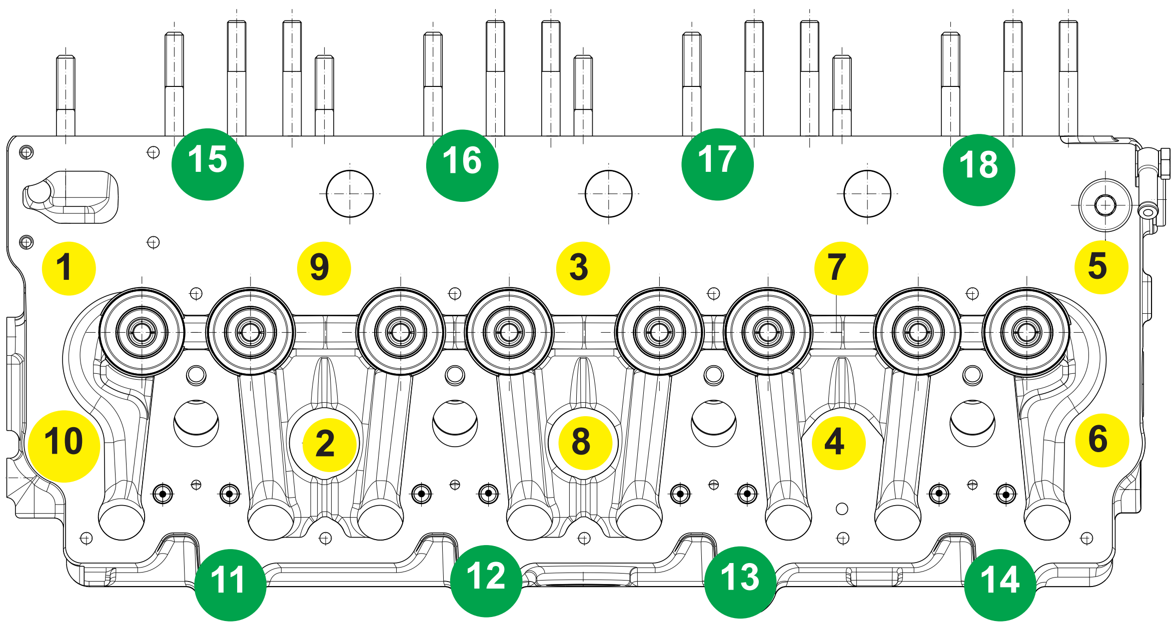
15, 16, 17, and 18

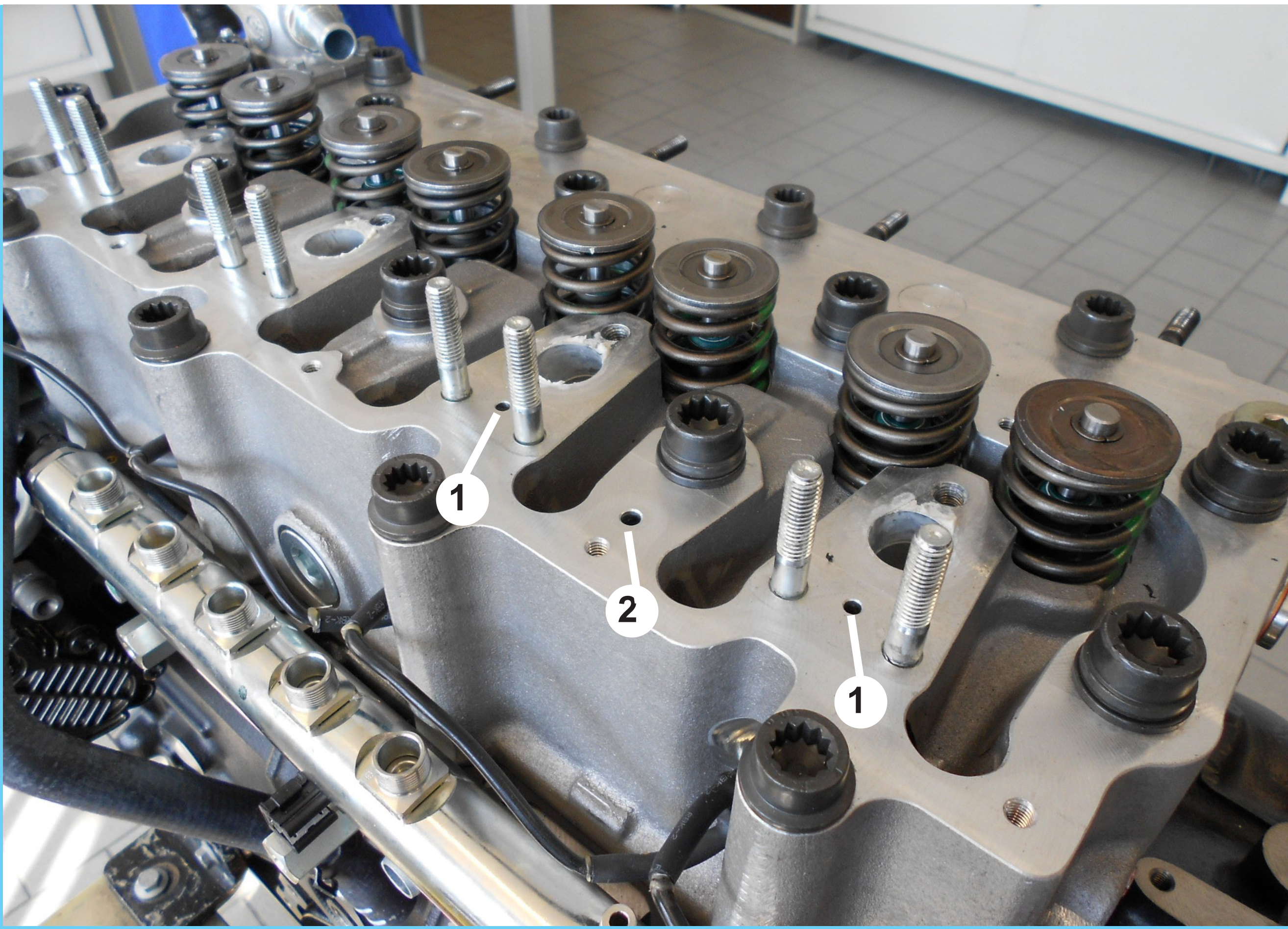
d. Final pass and sequence:

Torque angle + 85°

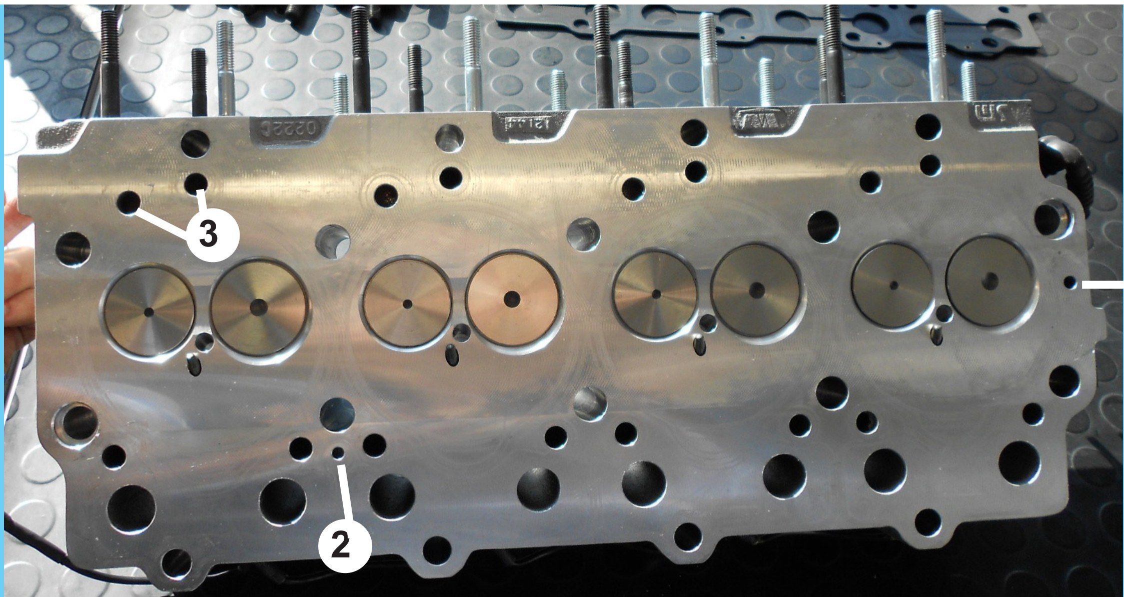
Sequence

15, 16, 17, and 18





1. Rocker Arm lubrication oil passages
2. Rocker Arm oil return passage



1. Rocker arms oil feed passage
2. Rocker arm oil return passage
3. Coolant passages

CYLINDER HEAD - SINGLE FOR EACH CYLINDER

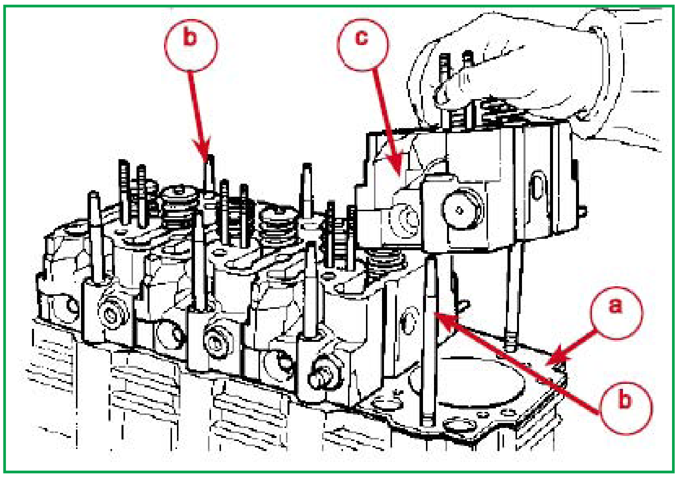
INSTALLATION

- Clean out bolt holes in cylinder block. Be certain no contaminants (dirt, old oil or coolant) remain in the holes.
- Clean the gasket surfaces on block and heads.
- **IMPORTANT: Cylinder head bolts must be always replaced whenever the bolts are removed or loosened.**
- **NOTE: New cylinder head bolts must not be lubricated. They are already lubricated with an anti-seizing lubricant from the manufacturer, and do not require additional lubrication.**
- **NOTE:** VM Motori discourage the reuse of the bolts: in case of reuse, lubricate with Molykote G Rapid Plus Paste the bolt threads and underside of bolt heads of all 12M (12 mm) cylinder head bolts (side bolts) and 14M (14 mm) cylinder head bolts (center bolts)
- **IMPORTANT: Cylinder head gasket must be installed dry. Do not use any sealant or adhesive on the gasket.**
- Position the cylinder head gasket on the cylinder block.
- Install the Cylinder Head Guide Pins (refer to Special Tools) into the 12 mm bolt holes in the gasket and cylinder block at each cylinder location. These pins will align the gasket and cylinder heads.
- Beginning with cylinder number 1, install the cylinder heads over the guide pins.

a - Cylinder head gasket

b - Guide pin locations (two at each cylinder)

c - Cylinder head

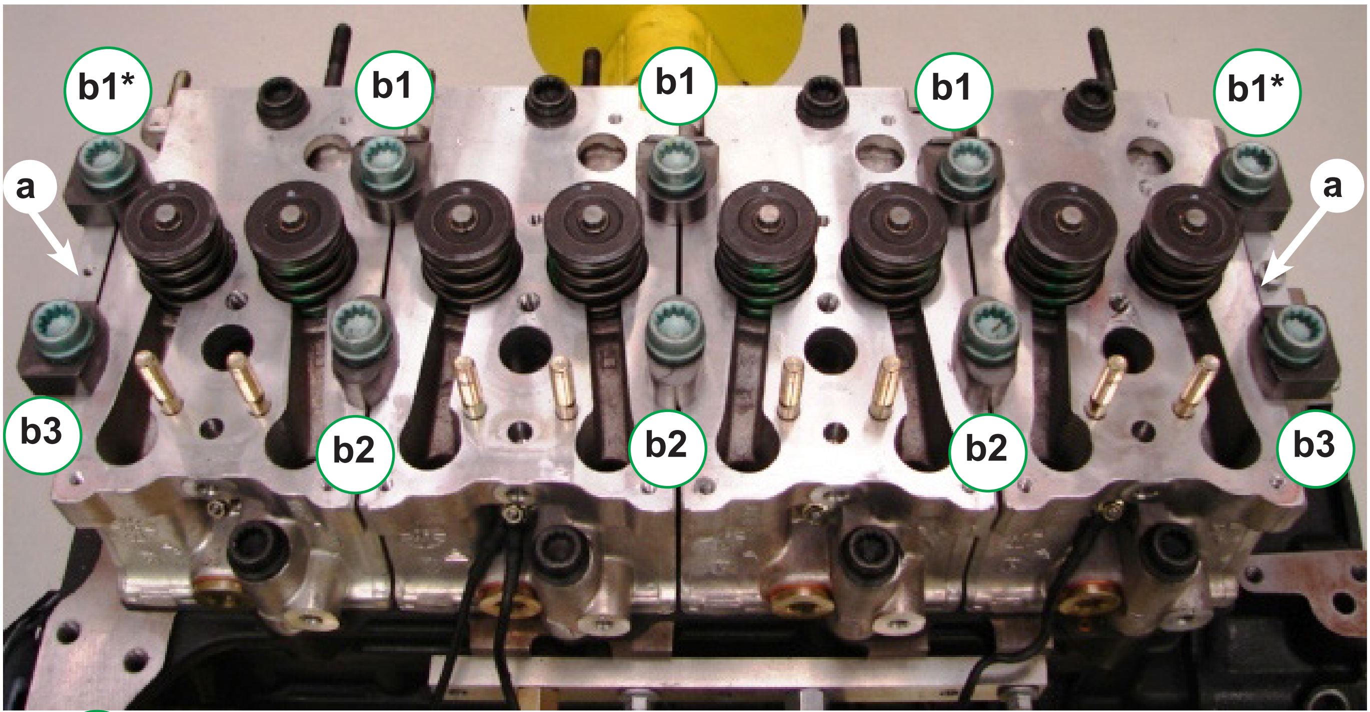


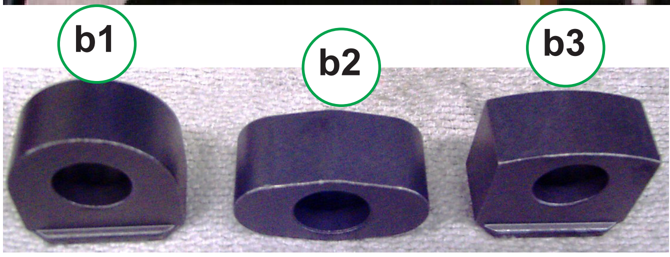
- One at a time, remove the Cylinder Head Guide Pins and install the 12M cylinder head side bolts previously lubricated is reused, finger tight. Do not disturb the cylinder head placement.
- Install and finger tighten all lubricated 14M cylinder head center bolts, including the proper formed spacer washers (terminal bridges, three types) and cylinder head spacers, for the ends of the first and last cylinder heads, as shown in the following.

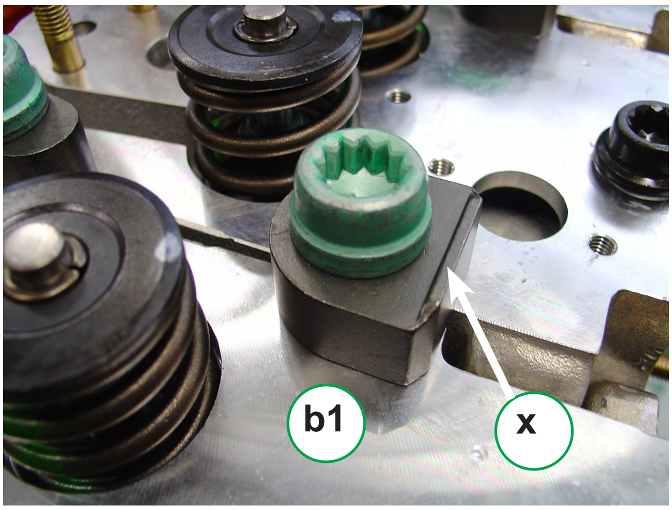
a - Spacer, first and last cylinder head ends

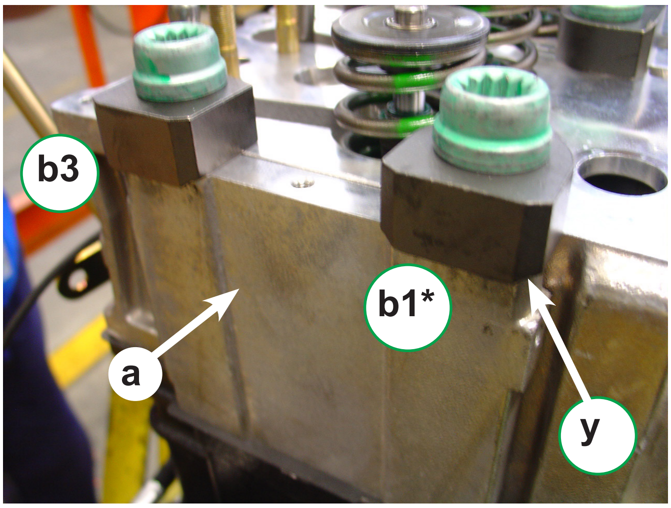
b - (b1,b2,b3) - Formed spacer washers (terminal bridges, three types)

b1 and b1* have the same shape but b1 is overturned than b1*, the edge is upwards.







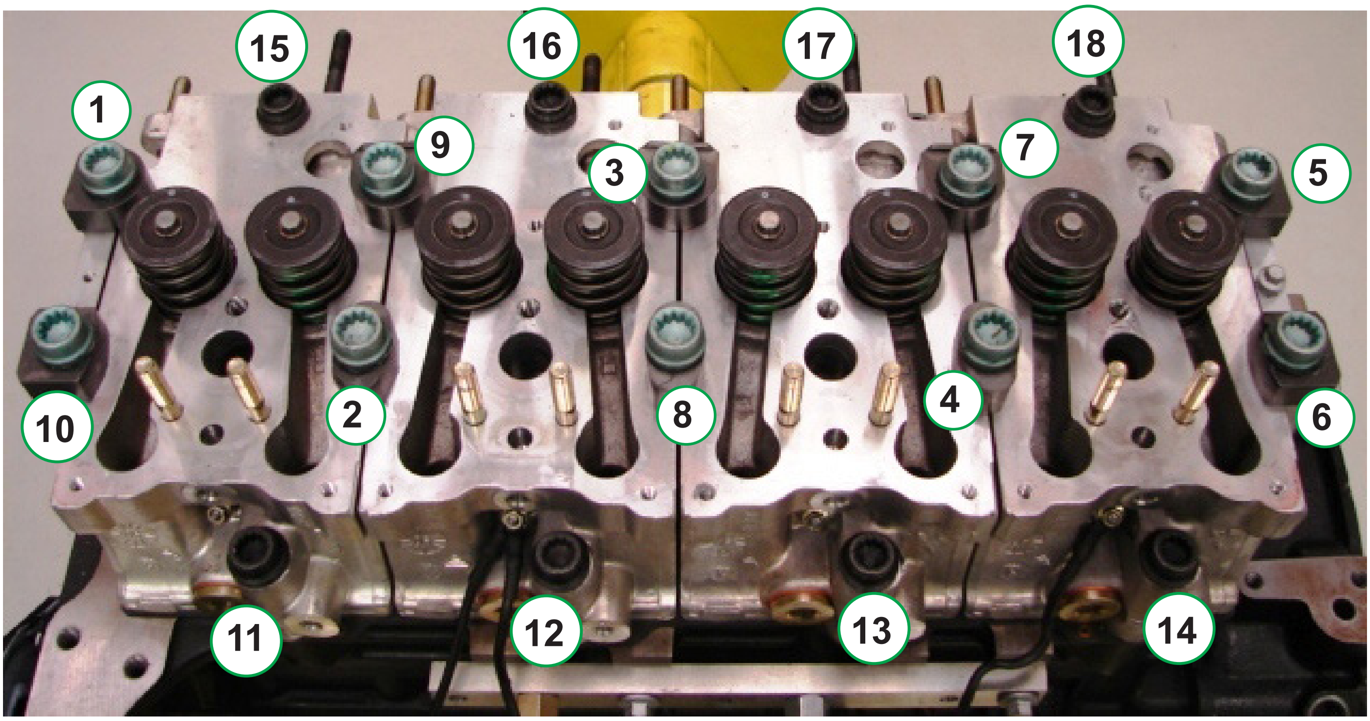


b1 and b1* have the same shape but b1 is overturned than b1*, the edge is upwards.

x - edge upwards

y - edge downwards

- Using the appropriate tools (refer to Special Tools), lightly hand tighten all bolts.



- Correctly align the cylinder heads by temporarily installing the exhaust or intake (or both) manifold with gaskets and finger tighten each flange nuts.
- Slightly loosen the 12M and 14M bolts as needed, to allow the cylinder heads to align.

Max disalignement 0.2 mm (measured on intake/exhaust flanges manifold)

- Hand tighten the exhaust manifold nuts sufficiently to align the cylinder heads to the exhaust manifold.
- Using the appropriate tools (refer to Special Tools), hand tighten all 14M and 12M cylinder head bolts.
- Torque the center bolt 14M set as specified and in the sequence shown, following steps a, b, and c. Do not torque the side bolt set at this time.

CENTER BOLTS

a. First pass torque and sequence:

Torque Value - 30 Nm

Sequence

3-2-1-4-5-8-9-10-7-6 (4 cylinder heads engine)

11, 12, 13, 14, 10, 9, 8, 4, 3, 2, 1, 5, 6, 7 (6 cylinder heads engine)

b. Second pass torque and sequence:

Torque Angle + 65°

Sequence

1-2-3-4-5-6-7-8-9-10 (4 cylinder heads engine)

1-2-3-4-5-6-7-8-9-10-11-12-13-14 (6 cylinder heads engine)

c. Final pass and sequence:

Torque Angle + 65°

Sequence

1-2-3-4-5-6-7-8-9-10 (4 cylinder heads engine)

1-2-3-4-5-6-7-8-9-10-11-12-13-14 (6 cylinder heads engine)

- Now, torque the side bolt numbered sets as specified and in the sequence shown, following steps a, b, c and d.

SIDE BOLTS

a. First pass and sequence:

Torque value - 30 Nm

Sequence

11, 12, 13, and 14 (4 cylinder heads engine)

15, 16, 17, 18, 19 and 20 (6 cylinder heads engine)

b. Second pass and sequence:

Torque angle + 85°

Sequence

11, 12, 13, and 14 (4 cylinder heads engine)

15, 16, 17, 18, 19 and 20 (6 cylinder heads engine)

c. Third pass and sequence:

Torque value 30 Nm

Sequence

15, 16, 17, and 18 (4 cylinder heads engine)

21, 22, 23, 24, 25 and 26 (6 cylinder heads engine)

d. Final pass and sequence:

Torque angle + 85°

Sequence

15, 16, 17, and 18 (4 cylinder heads engine)

21, 22, 23, 24, 25 and 26 (6 cylinder heads engine)

TORQUE PROCEDURE AFTER THE FIRST 20-30 MINUTES OF OPERATION

IMPORTANT: the tightening procedure of the cylinder head here below described must be carried out whenever the cylinder head (or heads) is removed. This procedure is valid for ALL types of cylinder head: single and entire.

IMPORTANT

When the cylinder heads are replaced or disassembled an additional angular torque and conventional torque must be applied. Torque the cylinder head mounting bolts as specified after the first 20-30 minutes of operation and with engine cold..

1. Operate the engine at a fast idle for few minutes. Then operate the engine at 1/3 RPM of the rated RPM for approximately 20-30 minutes until water temperature reaches 70-80 degrees °C, normal operating temperature.

2. Let the engine cool down completely, at least less than 40° C, temperature measured on 1st cylinder head..

3. Follow the sequence one at a time, completely loosen each M14 center bolt and torque as indicated in steps here indicated:

CENTER BOLTS - M14

Slacken completely one bolt at a time and retorque it at 30 Nm + 120° (or 60°+60°) by following the sequence indicated here below.

Slackening Sequence

1-2-3-4-5-6-7-8-9-10 (4 cylinder heads engine) / 1-2-3-4-5-6-7-8-9-10-11-12-13-14 (6 cylinder heads engine)

Torque Value 30 Nm + Torque Angle 120° (or 60°+60°)

Torque Sequence

1-2-3-4-5-6-7-8-9-10 (4 cylinder heads engine)

1-2-3-4-5-6-7-8-9-10-11-12-13-14 (6 cylinder heads engine)

SIDE BOLTS - M12

NOTE: The 12M side bolts numbered 11 ÷ 18 (4 cylinder heads engine) or 15 ÷ 26 (6 cylinder heads engine) do not require tightening again.

If necessary, check the 12M side bolts with a conventional torque wrench, checking the torque on each side bolt as indicated.

Torque Value 90 Nm

Torque Sequence

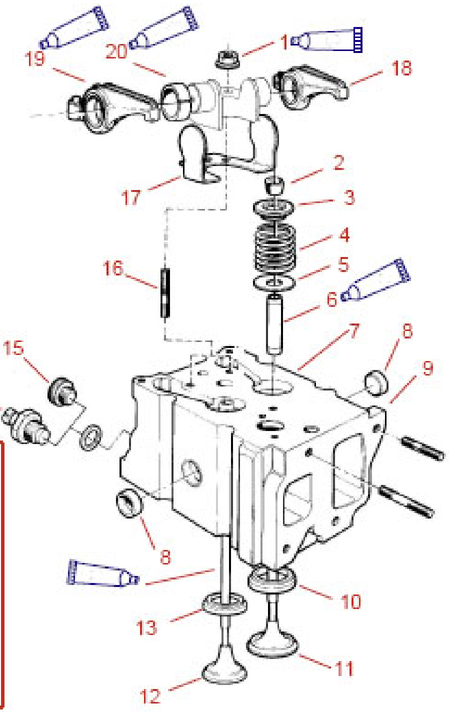
11-12-13-14-15-16-17-18 (4 cylinder heads engine)

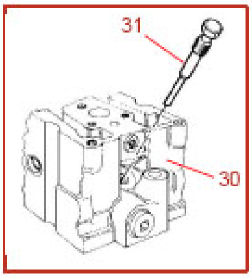
15-16-17-18-19-20-21-22-23-24-25-26 (6 cylinder heads engine)

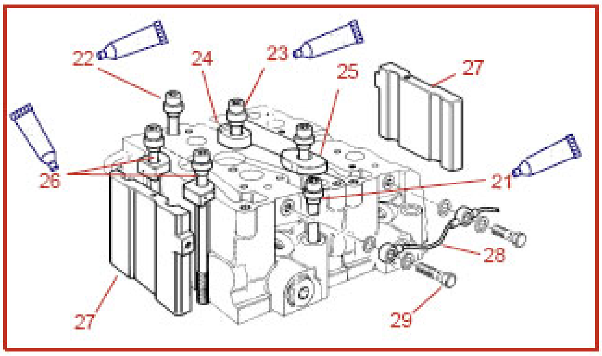
DISASSEMBLY

Using a valve spring compressor, remove the valve locks, the retainers, the springs, and the spring plates.

Remove the valves from the cylinder head and place in a rack or label the parts in order for reassembly in their original locations.







1 Rocker pedestal nut
2 Valve cone (valve keeper)
3 Valve spring retainer
4 Valve spring
5 Plate washer
6 Valve Guide
7 Cylinder head
8 Expansion plugs

10 Intake valve seat
11 Intake valve
12 Exhaust valve
13 Exhaust valve seat
16 Rocker arm support stud
17 Strap
18 Rocker arm
19 Rocker arm
20 Rocker arm bushing
21 12M cylinder head bolt, injector side
22 12M cylinder head bolt, manifold side
23 14M cylinder head center bolt
24 Formed spacer washer (manifold side clamp)
25 Formed spacer washer (intermediate clamp)
26 Formed spacer washer (front and rear, end spacer)
27 End spacer
28 Oil pipe
29 Hollow bolt and sealing washers
30 Injector side of cylinder head
31 Plug, glow plug hole (or glow plug if equipped)

EXPANSION PLUGS

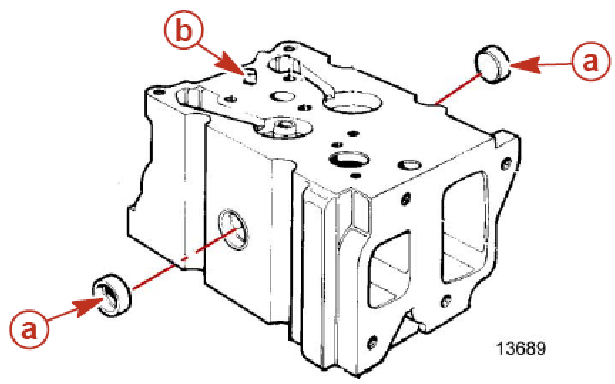
REMOVAL

1. Remove expansion plugs if leaking or damaged.

NOTE: These plugs may be removed with a sharp punch or they may be drilled and pried out.

REPAIR

1. Apply sealant (Loctite 290) to the outer diameter of the expansion plugs.



a - Expansion plugs

a - tappi a scodellino

CYLINDER HEAD END SPACER

REPAIR

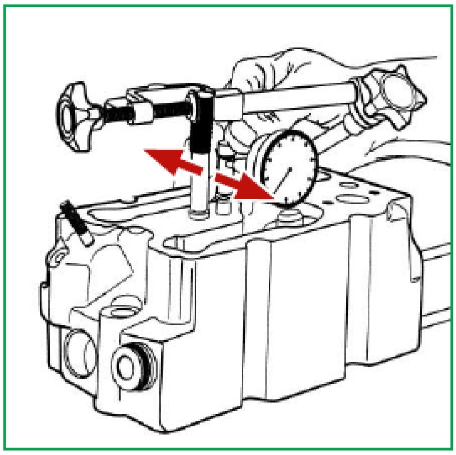
End spacer	**89.92 - 90 mm**

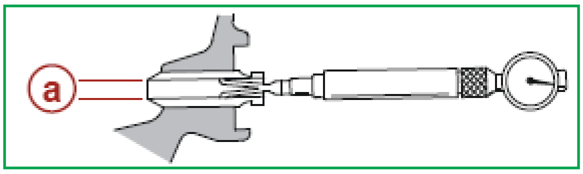
VALVE GUIDES

1. Inspect the valve guides for cracks or chips.
2. Inspect the valve guide bores for seizure marks, carbon deposits or scoring.
3. Inspect the valve guide height.
4. Remove the valve stem seals.
5. Insert a new valve into guide.
6. Measure the valve stem clearance as follows:

a. Attach a dial indicator to cylinder head. Position it against the valve stem and close to the valve guide.

b. While holding the valve head off of the seat by about 2 mm move valve stem back and forth in directions shown. Compare stem clearance with specifications.





SPECIFICATIONS FOR R750EU4-EU5-IE3-TE3-R756EU6 ENGINE MODELS

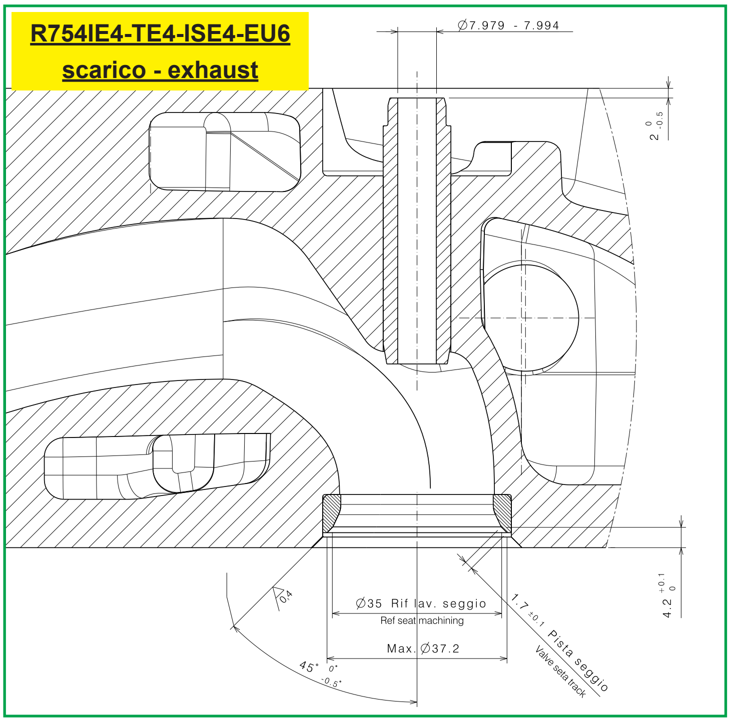
Valve guidestem diameter - See chapter "Valves"	
Exhaust	7.921 - 7.939 mm
Intake	7.94 - 7.96 mm

Valve guide clearance - production	
Exhaust	(0.061 - 0.094) mm
Intake	(0.04 - 0.075) mm

c. Measure the valve guide inner diameter with a valve guide bore gauge. If measured value of stem clearance is not within specifications, replace the valve guide.

Valve guide inner diameter (as per spare part)	
Exhaust	8 - 8.015 mm
Intake	

Valve guide height	
Exhaust	54.75 - 55.25 mm
Intake	



SPECIFICATIONS FOR R754IE4-TE4-ISE4-EU6 ENGINE MODELS

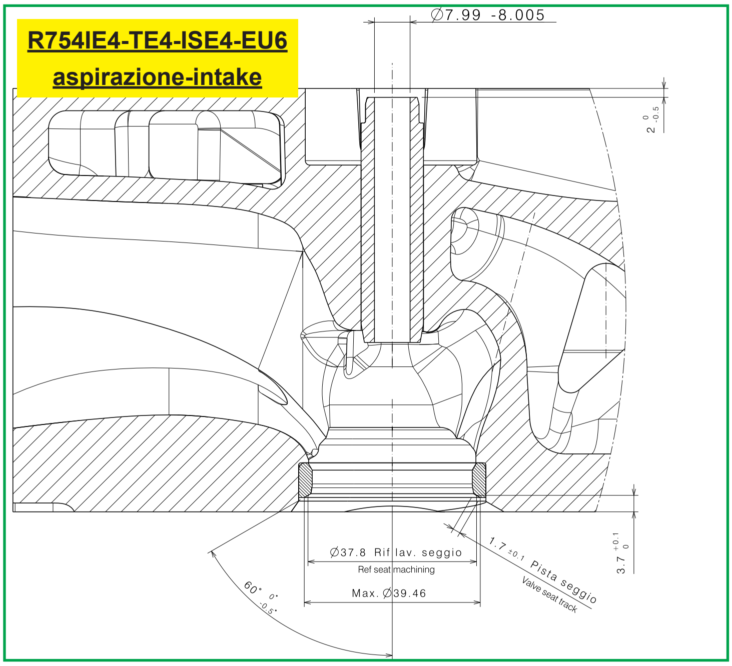
Valve guidestem diameter - See chapter "Valves"	
Exhaust	7.921 - 7.939 mm
Intake	7.94 - 7.96 mm

Valve guide clearance - production	
Exhaust	(0.04 - 0.073) mm
Intake	(0.03 - 0.065) mm

c. Measure the valve guide inner diameter with a valve guide bore gauge. If measured value of stem clearance is not within specifications, replace the valve guide.

Valve guide inner diameter - production	
Exhaust	7.979 - 7.994 mm
Intake	7.99 - 8.005 mm

Valve guide height	
Exhaust	54.75 - 55.25 mm
Intake	

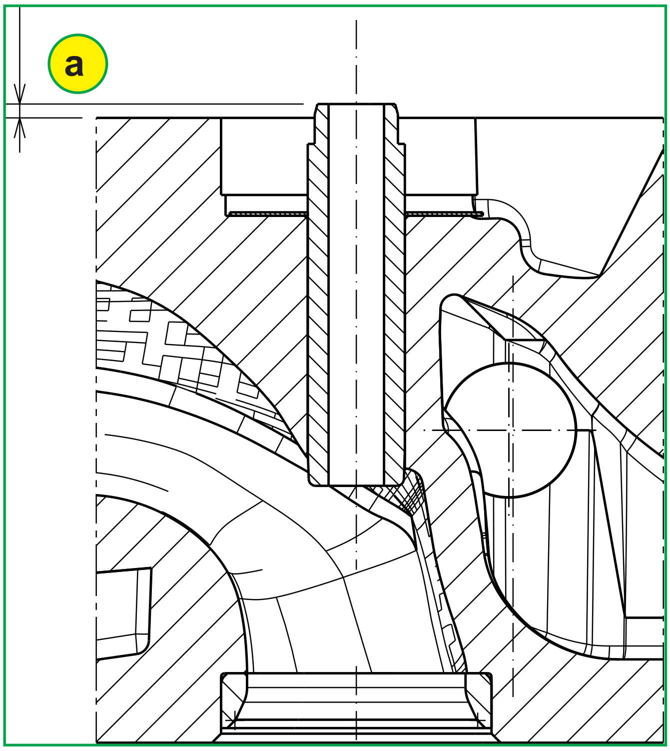


REPLACEMENT

CAUTION: Aluminum cylinder heads can be distorted or melted when heated improperly or unevenly.

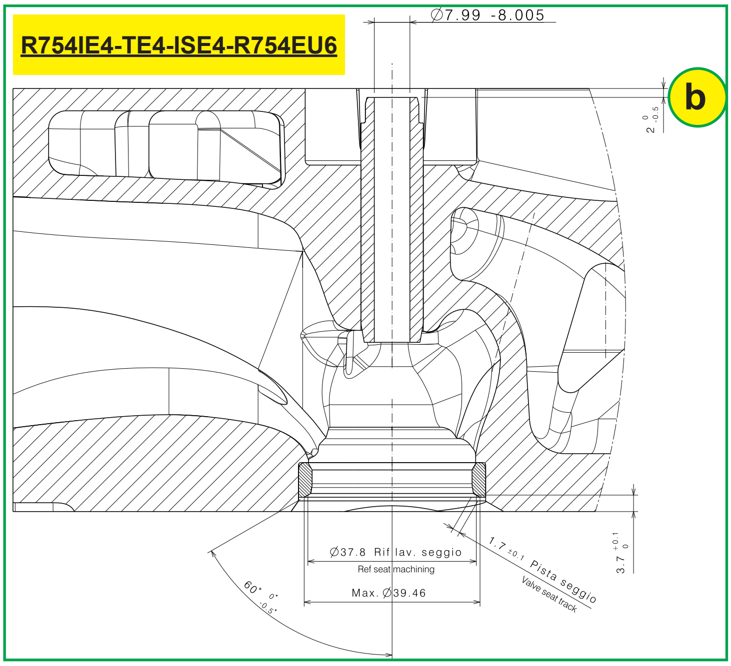
A torch will improperly and unevenly heat an aluminum cylinder head. Do not use a torch to heat an aluminum cylinder head. To heat an aluminum cylinder head during valve seat or valve guide replacement, use an oven appropriately designed and constructed for the purpose.

1. Remove the valve stem seals.
2. Heat the cylinder head in an oven to 85 degrees C (185 degrees F).
3. Using a suitable drift, drive out the old guide from the underside of the cylinder head.
4. With the cylinder head temperature at 85 degrees C (185 degrees F), press the new guide in to obtain measurement as shown.



a - Guide height measurement (above cylinder head upper surface) (EXHAUST/INTAKE)

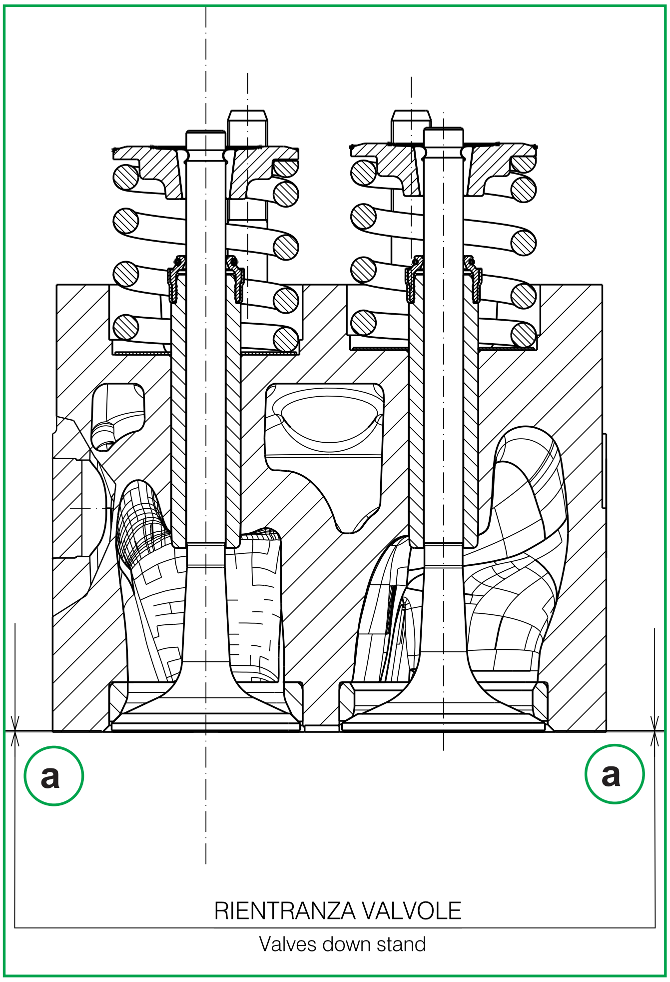
a	**1.5 - 2 mm**
b (engines R754IE4-I-SE4-TE4-R754EU6 with entire cylinder head)	**1.5 - 2 mm**



IMPORTANT: If the valve guide has been removed, both the valve and the valve guide must be replaced as a set.

VALVE SEATS

1. Inspect the valve seats for cracks, excessive wear, and looseness in counterbore.
2. Measure exhaust and intake valve seats. Refer to valve seat specifications.
3. If measured values are not as specified, recondition the valve seat. If the valve seats cannot be repaired, it will be necessary to replace the cylinder head. **Refer to Repair - Valve Seat Reconditioning.**

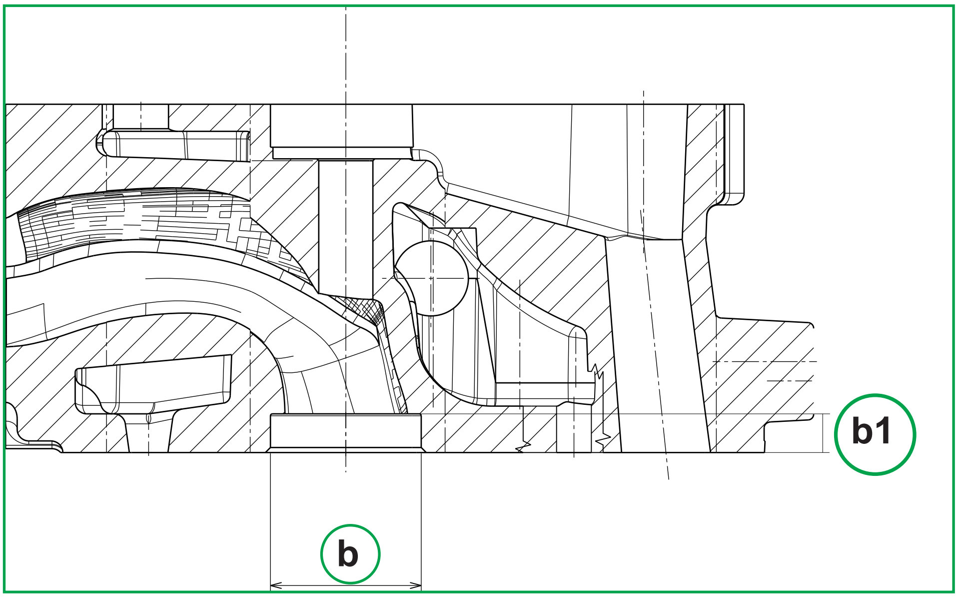


Measurements

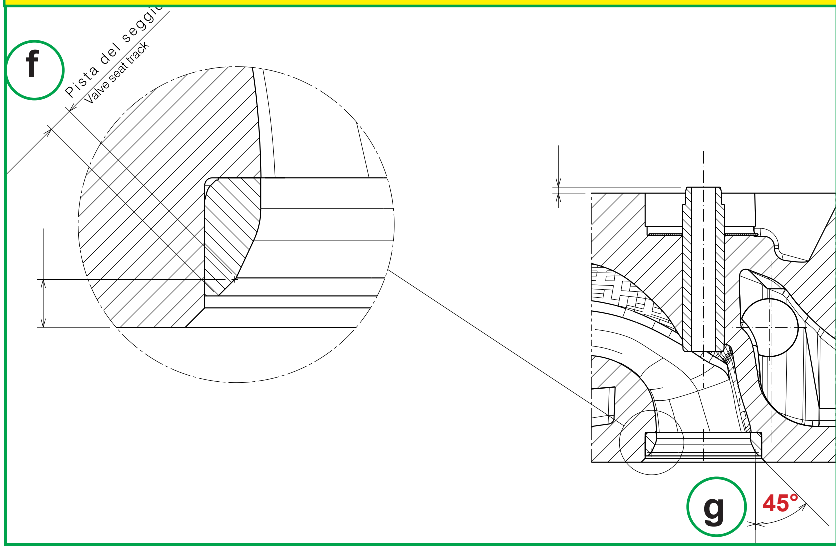
a - Valve recession

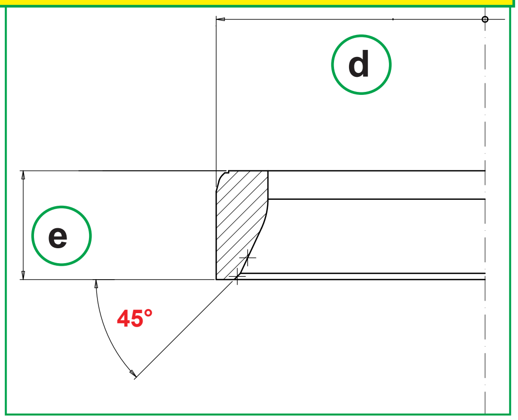
b - Counterbore inner diameter

Valve recession (service limit) (a)	
Exhaust Intake	0 - 0.3 mm
Counterbore inner diameter (b)	
Exhaust	38.964 - 38.988 mm
Intake	41.962 - 41.985 mm
Counterbore inner height (b1)	
Exhaust Intake	10 - 10.01 mm
Exhaust and Intake **(engines R754IE4-I-SE4-TE4-R754EU6 with entire cylinder head)**	11 - 11.1 mm

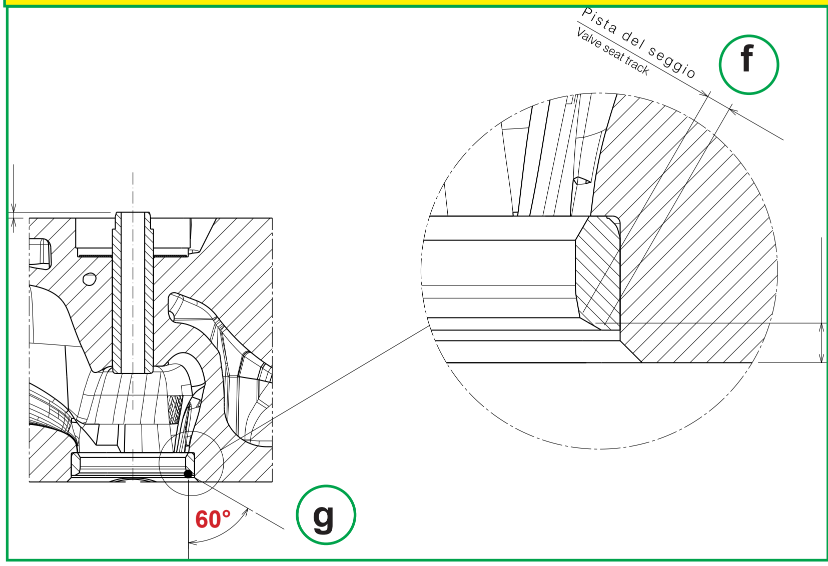


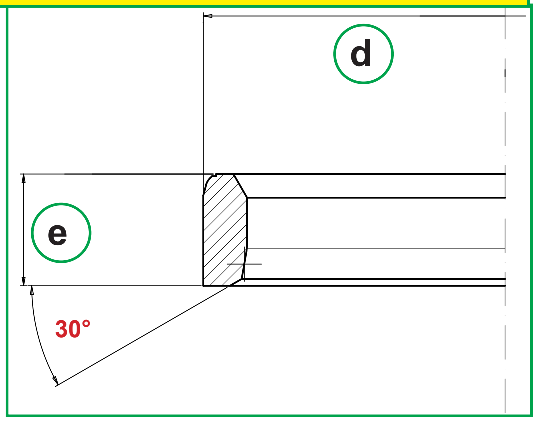
EXHAUST





INTAKE





Measurements

d - Seat outer diameter

e - Seat height

f - Seat width

g - Seat angle

Seat outer diameter (d)	
Exhaust	39.050 - 39.066 mm
Intake	42.070 - 42.086 mm
Seat height (e)	
Exhaust /	7.85 - 7.95 mm
Intake	7.73 - 7.83 mm

Seat width (f)	
R750 EU4-IE4-ISE4-TE4, R754EU6 Exhaust Intake	1.6 - 1.8 mm
R750 EU5 - R756EU6 Exhaust Intake	1.6 - 1.8 mm 2 - 2.2 mm

VALVE SEAT RECONDITIONING

NOTE: Several different types of equipment are available for reconditioning valve seats.
Equipment manufacturer’s recommendations should be followed carefully to attain proper results.
IMPORTANT: Regardless of type of equipment, it is essential that valve guide bores be free of carbon or dirt to achieve proper centering of pilot in valve guide, ensuring concentricity when reconditioning valve seats.
Recondition pitted or worn valve seats to the specified angles.

If during seats valve reconditioning excessively lowers valve recess or if the seat widht is wider than above specified measures, replace valve seat insert. During replacement operation, special care should be taken not to damage seat insert counterbore.

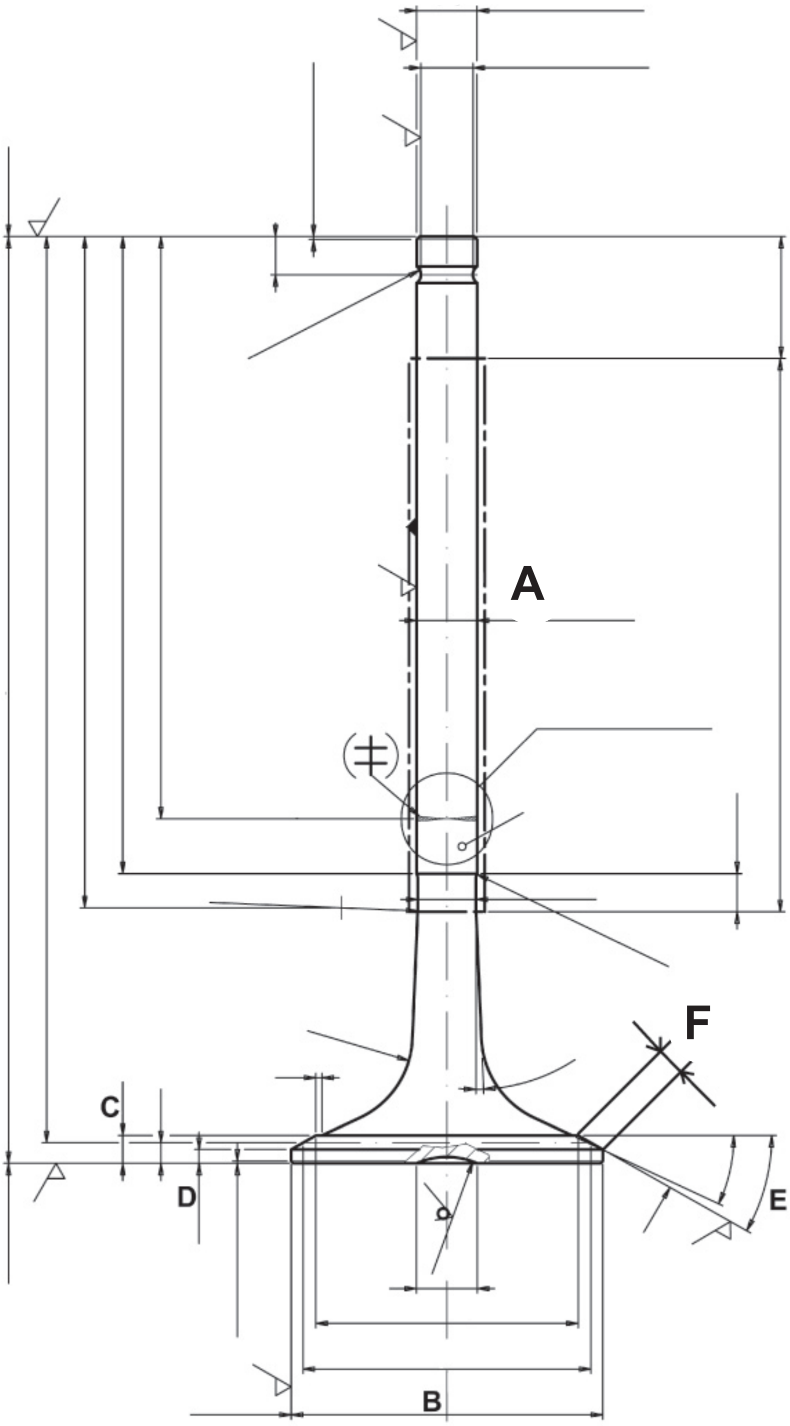
Install seat valve inserts after heating cylinder head in an oven at 150°C or cooling them down at -170°C in liquid nytrogen athmosphere.
Seat installation into head bore must be free, no requiring pressure for installation if above conditions are maintained.

VALVES

1. I nspect valves for damage, warpage, or both. Replace if necessary.

2. Measure the valve. If measured values are not as specified, repair the valve. **Refer to Valve Refacing. Replace the valve if it cannot be repaired.**

	INTAKE (mm)	EXHAUST (mm)
A - Stem diameter (production, new)	**7.94 - 7.96**	**7.921 - 7.939**
F - Face width (production, new)	**3.57 - 3.85**	**2.640 - 2.992**
D - Margin thickness (Production, new)	**1.82**	**1.73**
Service limit	**1.30**	
E - Face angle (production, new)	**29 degrees 30 minutes**	**44 degrees 30 minutes**
B - Head diameter (production, new)	**40.8 - 41**	**37.9 - 38.1**



VALVE REFACING

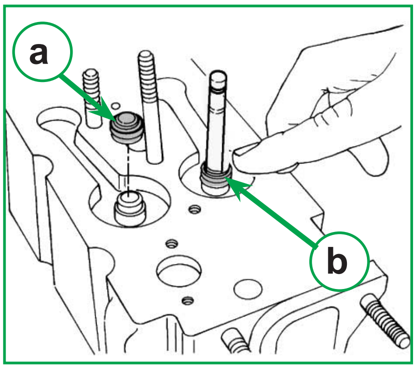
Pitted valves can be refaced to proper angle on a valve grinder, that ensuring the correct relation between the cylinder head seat and the valve mating surface.
Replace valves with excessive wear on stems or valves that are warped excessively. When an excessively--warped valve head is refaced, a knife edge will be ground on part or all of the valve head due to the amount of metal that must be removed to completely reface. Knife edges lead to breakage or burning.
NOTE: Various equipment is available for refacing valves. Manufacturer's recommendations should be carefully followed to attain proper results.
After refacing, measure the valves and replace if out of specifications.
1. Recondition the valve face to the proper angle if the valve face is pitted or worn.

NOTE: When refacing do not thin the valve margin thickness **less than 1.30 mm**.

After reconditioning, measure the valve margin. If the valve margin is less than the specified amount, replace the valve.

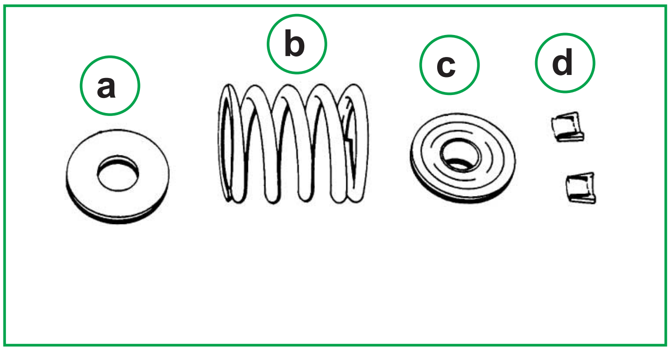
ASSEMBLY

NOTE: Valve stem seals are used on intake and exhaust valves.
1. Lubricate valve guides and valve stems with engine oil.
2. Install each valve in the port from which it was removed or for which it has been fitted.
3. I nstall the valve guide seal onto the valve stem and push down until seated against the guide.



a - Valve stem seal
b - Seal installed on guide

4. Install the plate washer, the valve spring, and the retainer on valve stem.
5. Compress the valve spring using valve spring compressor.
NOTE: Lubricant may be used to hold valve locks in place while releasing compressor tool
6. Coat the valve stem locks with lubricant to hold in place.
7. Install the valve stem locks.



a - Plate washer
b - Valve spring
c - Retainer
d - Valve locks

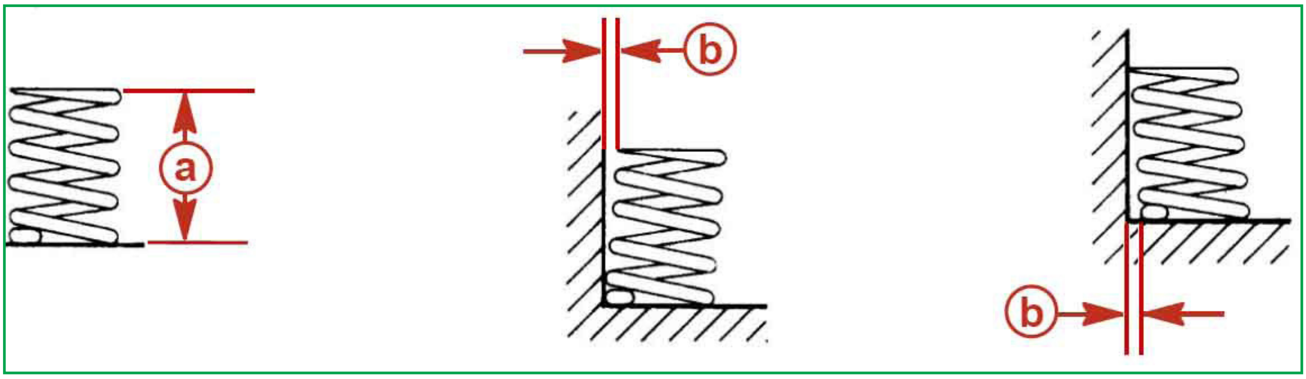
8. Slowly release the valve spring compressor, ensuring that the valve locks seat properly
in the valve stem groove.

VALVE SPRINGS

1. Inspect the valve springs for discoloration due to excessive heat.
2. Inspect the valve spring valve locks, the retainers, and the washer for wear, distortion, or cracks.
3. Measure the free standing height of each spring. Replace the spring if measured value is other than specified.
4. Measure the spring inclination (distortion). If the measured value exceeds the specified limit, the valve spring must be replaced.

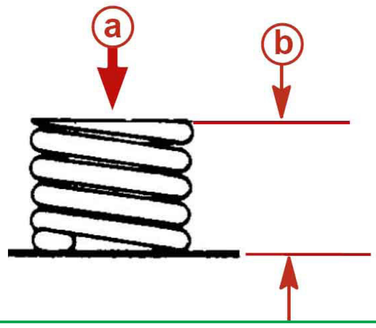
a - Free standing height
b - Spring inclination

Free standing height	**Exhaust - Intake**	**48 mm**
Spring inclination	**Exhaust - Intake**	**Service limit 2 mm**



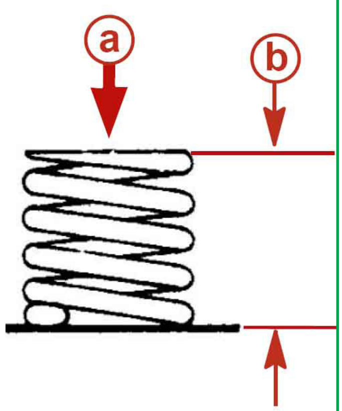
Valve open
a - Applied pressure
b - Height

Applied pressure 294 N ± 6%
Height 38.5 mm



Valve closed
a - Applied pressure
b - Height

Applied pressure 635 N ± 4%
Height 28.2 mm



ROCKER ARM

REMOVAL

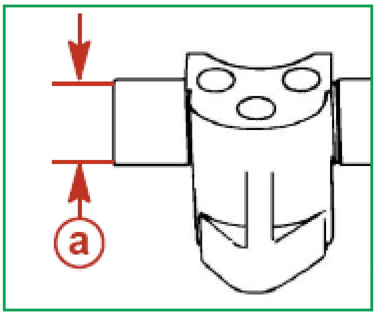
1. Remove the rocker arm covers.
IMPORTANT: Mark or store the components during removal for reassembly in their original location.
2. Remove the rocker arm assemblies and valve push rods. Place the components in a numbered rack according to their position in the engine or mark the parts in order for reassembly to the original location.

CLEANING

1. Wash the components in cleaning solvent.
2. Put on safety glasses and dry the components with compressed air.

INSPECTION

1. Inspect components for excessive wear, cracks or damage.
NOTE: The push rods are hollow and serve as oil galleries to lubricate each individual rocker arm assembly.
2. Visually inspect each pushrod for wear and deposits. Ensure the valve pushrod oil passage is not restricted.
3. Roll each valve pushrod on a flat surface and inspect the shaft for bends.
4. Replace all damaged parts.
5. Using a micrometer, measure the outside diameter of rocker arm support journals.
Replace the rocker arm support if the journal outside diameter is less than specified.

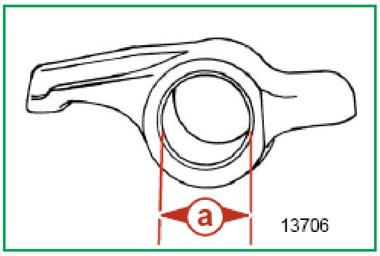


a - Rocker arm support journal outside diameter

R750TE3-IE3-EU4-EU5-R756EU6

Outside diameter	**24.97-25.00 mm**

6. Using an inside micrometer, measure inside diameter of the rocker arm bushing.



a - Rocker arm bushing inside diameter

Inside diameter (Production)	**25.020 - 25.041 mm**
Assembly clearance	**0.020 - 0.071 mm**
Wear limit	

R750TE4-IE4-ISE4, R754EU6

Outside diameter	**21.979 - 22 mm**

6. Using an inside micrometer, measure inside diameter of the rocker arm bushing.

Inside diameter (Production)	**22.03 - 22.05 mm**
Assembly clearance	**0.030 - 0.071 mm**
Wear limit	

ASSEMBLY - R750TE3-IE3-EU4-EU5

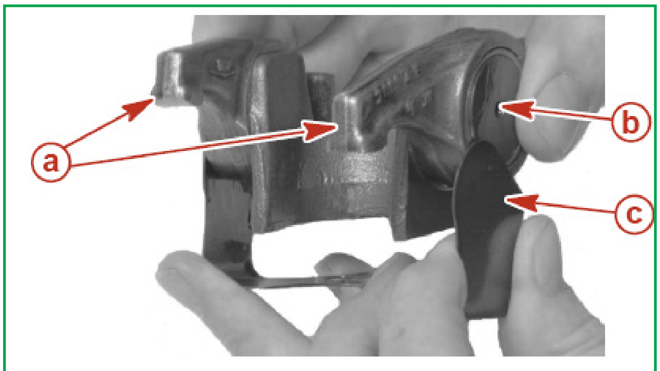
IMPORTANT: Before assembling the rocker arms assembly drain all of the residual oil in the valve lifter out of the drain hole in the valve lifter, by compressing the valve lifter, using the Valve Lifter Tool (Refer to Valve lifter section).
Lubricate with engine oil the rocker arm bushings and rocker arm support journals.
Install the rocker arms on the rocker arm support journals.
Position as shown.
Install the strap around the rocker arm assembly. Ensure that the strap is not spread open or the valve cover will not fit.
Lubricate the outer surfaces and ends of the valve pushrods.
Lubricate the valve lifter contact surfaces.
Install the valve pushrods in their original locations. Ensure that the valve pushrods seat in the lifter sockets.
Lubricate the rocker arm and rocker arm contact surfaces.
Lubricate the threads of the rocker arm support studs.
Install the rocker arm assembly onto the rocker arm support studs. Simultaneously align the valve pushrods with the rocker arm sockets.
Install both rocker arm support nuts on the rocker arm support. Torque the rocker arm support nuts evenly.

Rocker arm support nut	**29 Nm**

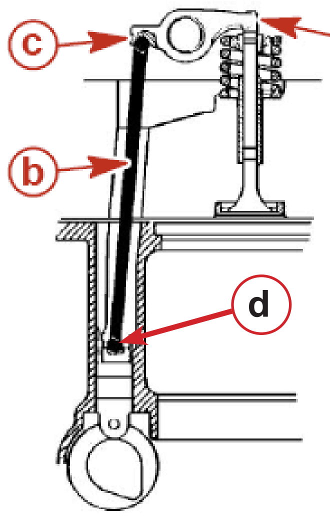
x - rocker arm support nut
y - Rocker arm support

IMPORTANT: Valve lash adjustment, or valve clearance, is hydraulically controlled and automatically set when the rocker arm support flanged nuts are properly torqued.

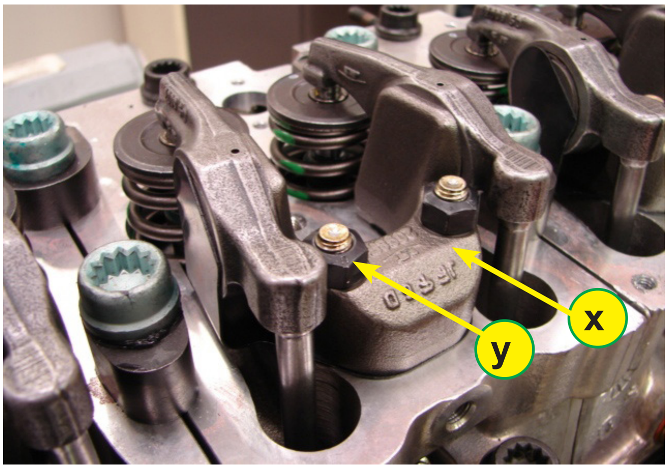
Repeat the steps for the rocker arm assembly on each cylinder.
No valve lash adjustment is required.

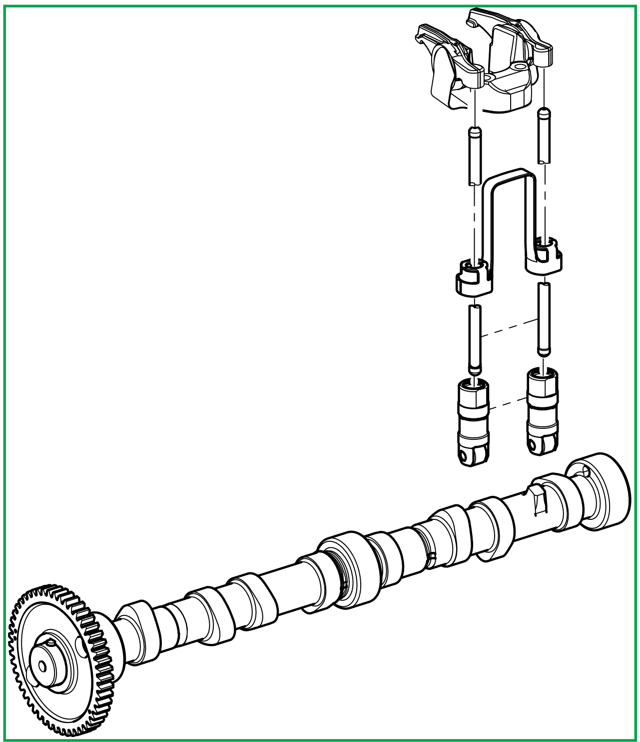


a - Rocker arm
b - Rocker arm support
c - Strap



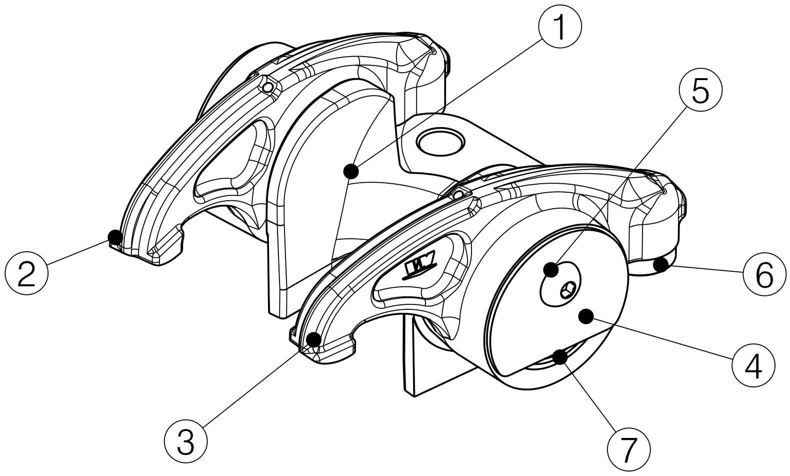
a - Rocker arm assembly
b - Pushrod
c - Rocker arm socket
d -Valve pushrod seat in the lifter socket



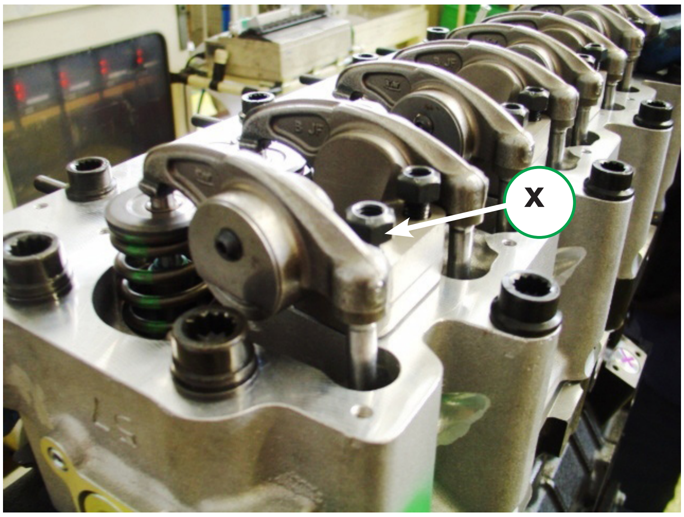


ASSEMBLY - R750TE4-IE4-ISE4, R754EU6

1. Rocker Arm Support
2. Exhaust rocker arm
3. Intake rocket arm
4. Washer block
5. Bolt
6. Anti-wear insert
7. Bushing



IMPORTANT: Before assembling the rocker arms assembly drain all of the residual oil in the valve lifter out of the drain hole in the valve lifter, by compressing the valve lifter, using the Valve Lifter Tool (Refer to Valve lifter section).



Lubricate with engine oil the rocker arm bushings and rocker arm support journals.

Install the rocker arms on the rocker arm support journals. Position as shown.

Install the washer block as shown in the picure and torque the bolt.

Lubricate the outer surfaces and ends of the valve pushrods. Lubricate the valve lifter contact surfaces.

Install the valve pushrods in their original locations. Ensure that the valve pushrods seat in the lifter sockets.

Lubricate the rocker arm and rocker arm contact surfaces.

Lubricate the threads of the rocker arm support studs.

Install the rocker arm assembly onto the rocker arm support studs. Simultaneously align the valve pushrods with the rocker arm sockets.

Install both rocker arm support nuts on the rocker arm support. Torque the rocker arm support nuts evenly.

Rocker arm support nut	**29 Nm**

x - rocker arm support nut
y - Rocker arm support

IMPORTANT: Valve lash adjustment, or valve clearance, is hydraulically controlled and automatically set when the rocker arm support flanged nuts are properly torqued.

Repeat the steps for the rocker arm assembly on each cylinder.
No valve lash adjustment is required.

VALVE LIFTERS

CAUTION: Camshafts and valve lifters develop matched wear patterns during engine operation. Mismatching worn camshafts and valve lifters or using worn components with new components can cause rapid and excessive wear resulting in engine component failure. Always use new camshafts and valve lifters whenever any of the components are replaced.

The hydraulic roller valve lifters are held in position and prevented from rotation by special retainers. There is one retainer for each cylinder head. Care should be exercised when installing the retainers to ensure that the flat portions of the lifters are properly positioned in the retainers.

REMOVAL

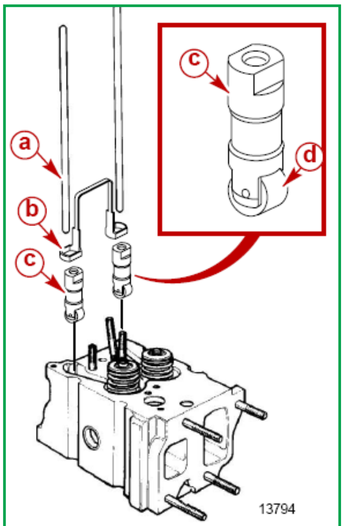
1. Remove the valve covers.

IMPORTANT: Place rocker arm assemblies, pushrods and valve lifters in a rack for reassembly in their original locations.

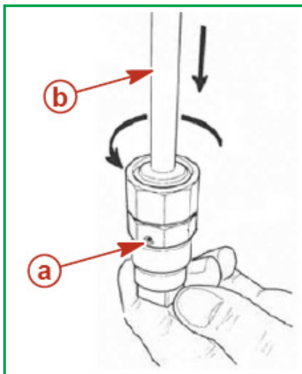
2. Remove the rocker arm assemblies and the valve pushrods. Keep parts in matched sets.

IMPORTANT: Lifters must be reassembled in the exact same position on the camshaft lobes so that the roller will operate in the same direction on the same lobe, if reused.

3. Make matching marks on all retainers and valve lifters showing the location and orientation in the bores.
4. Lift the retainer piece away from around the top of the valve lifters. Do not disturb the valve lifters at this time.
5. Insert the Valve Lifter Tool firmly into the valve lifter. Press downward on the internal spring until the top of the tool is lower than the stop. Turn the tool 90° and remove the valve lifter.
6. Remove the remaining valve lifters while keeping them in order for reassembly.



a - Push rod
b - Retainer
c - Valve lifter
d - Roller



a - Drain hole
b - Valve Lifter Tool

CLEANING

1. Except for the valve lifters, clean the parts with cleaning solvent.
2. Put on safety glasses and dry parts with compressed air.
3. While holding upright wipe the valve lifters with a clean, oil saturated, lint free cloth.

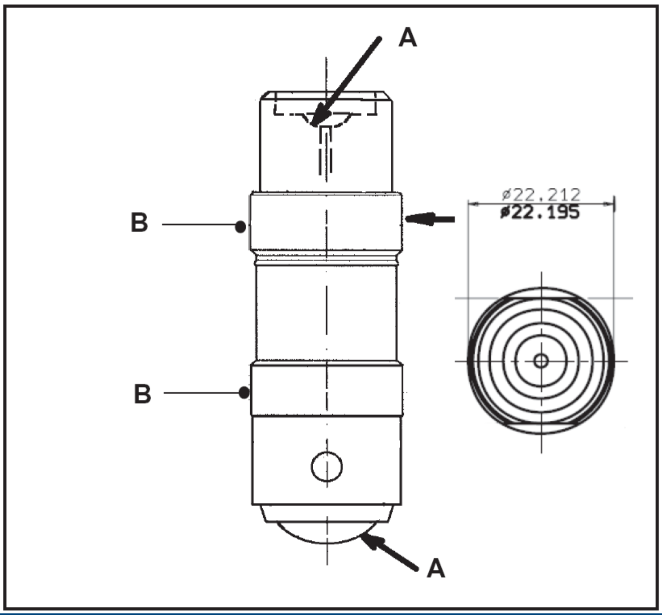
Store lifters in the upright position.

INSPECTION

1. Inspect the valve push rod seat **A**. If the valve push rod seat is scuffed or worn, inspect the valve push rod. Check that valve push rod seat surfaces show no signs of dents, scoring and/or damage.
2. Inspect the outer valve lifter body wall. If wall is scuffed or worn, inspect engine block valve lifter bore.
3. Inspect the roller of the valve lifter. If the roller is scuffed or worn, inspect camshaft lobe.
4. Measure the outer diameter **B** of the valve lifter. If the measured value is less than specified, replace the valve lifter.

Outer diameter	**22.195 - 22.212 mm**

5. Inspect all parts carefully. If any parts are damaged or worn, the entire valve lifter assembly must be replaced.



INSTALLATION

CAUTION: Camshafts and valve lifters develop matched wear patterns during engine operation.

Mismatching worn camshafts and valve lifters or using worn components with new components can cause rapid and excessive wear resulting in engine component failure.

Always use new camshafts and valve lifters whenever any of the components are replaced.

IMPORTANT: Before installation, coat the entire valve lifter with engine oil. If installing a new camshaft and valve lifters, engine oil has to be poured over valve lifters and camshaft lobes.

IMPORTANT: Before assembling the valve lifters drain all of the residual oil in the valve lifter out of the drain hole in the valve lifter, by compressing the valve lifter, using the Valve Lifter Tool (Refer to Valve lifter section).

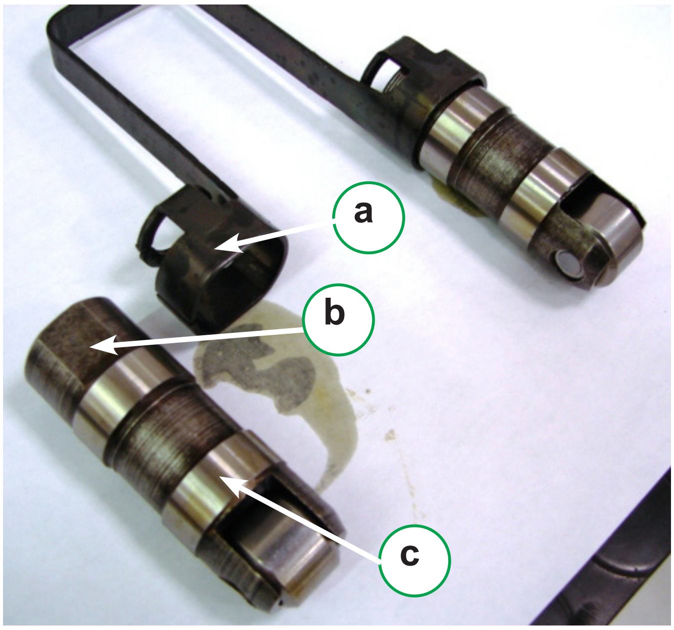
Drain all of the residual oil in the valve lifter out of the drain hole in the valve lifter, by compressing the valve lifter, using the Valve Lifter Tool.

Before installing the valve lifters, coat the entire valve lifter with engine oil.

Install the valve lifters in the bores in order of removal, using the Valve Lifter Tool. Align the matching marks made prior to disassembly. Ensure the valve lifter drain hole is pointing towards the crankshaft.

Install the retainers around the square top of the lifters to prevent them from rotating.

Lubricate and install the valve push rods. Ensure the valve push rods seat in the valve lifter sockets.



a - retainer

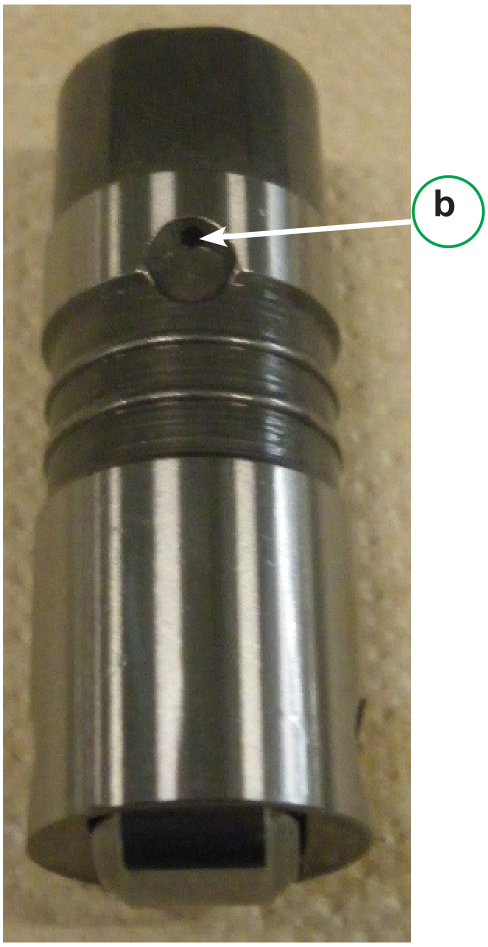
b - square top or flat portion

c - lifter

NEW HYDRAULIC TAPPET VM PN 40432003F INSTALLED SINCE NOVEMBER 2009 IN PLACE OF VM CODE 40432001F.

THE LASTEST TAPPET VM PN 40432003F SUPERSEDES THE PREVIOUS ONE.

BOTH TAPPEST ARE INTERCHANGEABLES



VALVE PUSH RODS

REMOVAL

1. Remove the valve covers.
IMPORTANT: Organize rocker arm assemblies and valve push rods in a rack for reassembly in their original locations.
2. Remove the rocker arm assemblies.
3. Lift the valve push rods from their seat in the valve lifter.
a - VALVE PUSH ROD
b -- VALVE LIFTER SEAT (NOT VISIBLE HERE)

CLEANING

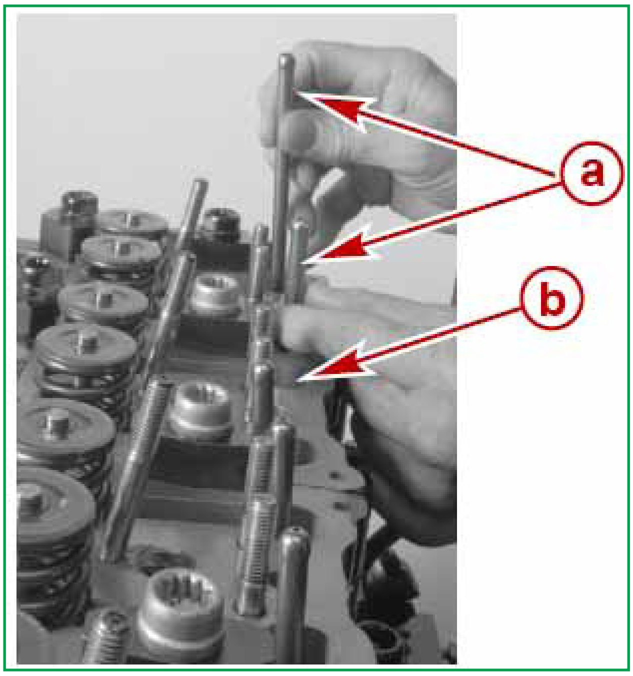
1. Clean the rocker arm assemblies and push rods.
2. Clean the valve push rod oil passages.
3. Put on safety glasses and dry the components with compressed air.

INSPECTION

1. Inspect all contact surfaces for excessive wear or scoring.
2. Ensure that the valve push rod oil passage is not restricted.
3. Roll the valve push rods on a flat surface and inspect them for bends.
4. Replace all damaged parts.

INSTALLATION

IMPORTANT: Before assembling the valve push rods drain all of the residual oil in the valve lifter out of the drain hole in the valve lifter, by compressing the valve lifter, using the Valve Lifter Tool (Refer to Valve lifter section).
1. Lubricate the outer surfaces and ends of valve push rods.
2. Install the valve push rods in their original locations. Ensure that the push rods seat in the valve lifter seat.
3. Install the rocker arms.



FRACTURED CONNECTING ROD

REMOVAL

IMPORTANT: Each connecting rod assembly must be reassembled in the same original location. Mark or identify each connecting rod assembly to ensure placement in the original cylinder number location during reassembly. Retain the rod cap and bearings with the connecting rod and piston assembly. Do not mix the components.
Remove the connecting rod bearings. Keep the bearings, with the original connecting rod and connecting rod cap, together as a matched set.

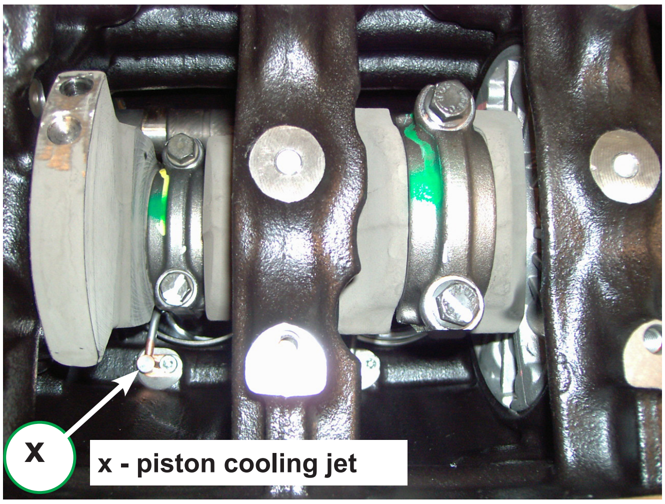
IMPORTANT: The connecting rod can damage the crankshaft journal, the cylinder bore, and piston cooling jet. Ensure no components are damaged during connecting rod removal.

While protecting the crankshaft journal, cylinder bore, and piston cooling jets from damage, push the piston and connecting rod out of the cylinder.

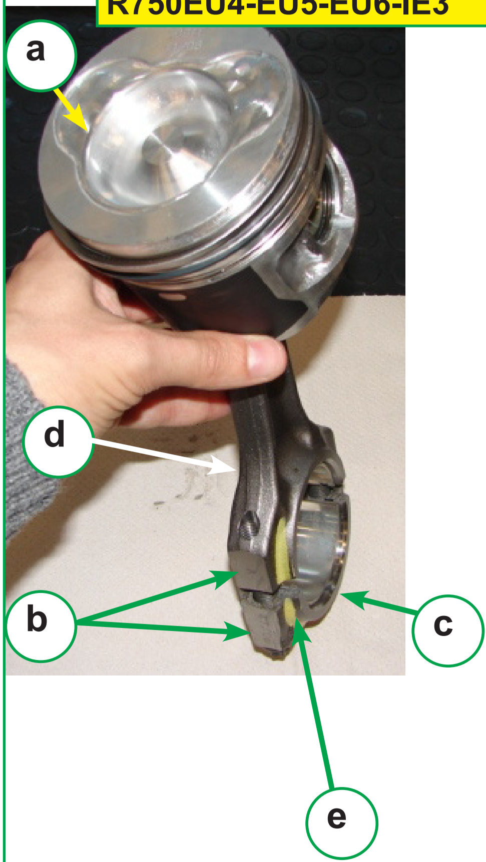
IMPORTANT: The mating surfaces of the connecting rods and the connecting rod bearing caps form an individual fit and as a result must not be interchanged or damaged under any circumstances. To avoid damage, do not lay connecting rods or connecting rod bearing caps on their mating surfaces.

DISASSEMBLY

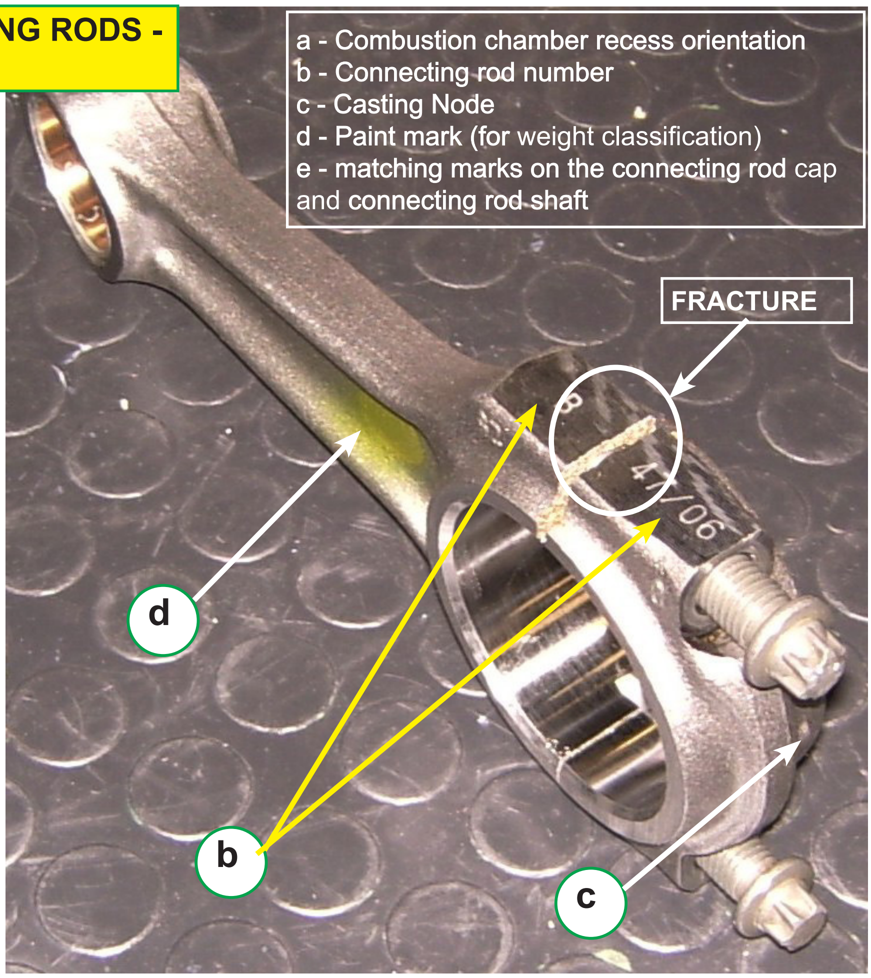
1. Clamp the connecting rod in a soft--jawed vise.
2. Use the Piston Ring Expander Tool to remove the first and second compression rings and the oil control ring with spring.
3. Remove the snap rings retaining the piston pin. Push the piston pin out of the connecting rod and piston.
4. Note the orientation of the piston combustion chamber recess in relation to the casting node, paint mark on con rod shaft, and the connecting rod number.



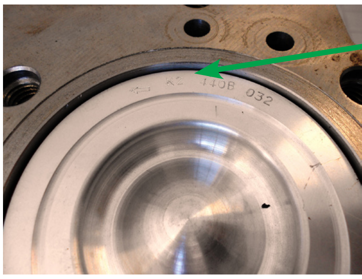
FRACTURED CONNECTING RODS - R750EU4-EU5-EU6-IE3

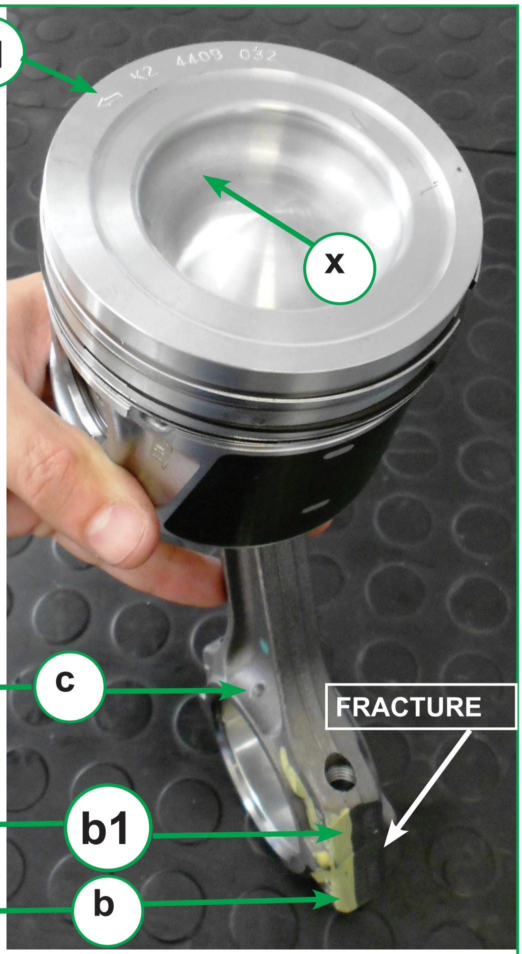


a - Combustion chamber recess orientation
b - Connecting rod number
c - Casting Node
d - Paint mark (for weight classification)
e - matching marks on the connecting rod cap and connecting rod shaft



x - Combustion chamber recess orientation
x1 - piston identification
b - Connecting rod identification
b1 - Connecting rod identication
c - Casting Node

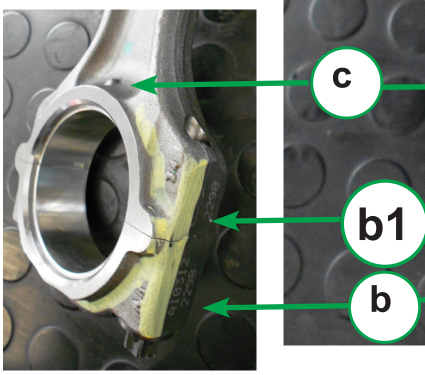




b - Connecting rod identification
example:
1st line AI0712
AI=supplier
07=week of production
12=year of production
2nd line 1996
1996= serial no.

FRACTURED CONNECTING RODS - R750IE4 - TE4 - ISE4 - R754EU6

b1 - Connecting rod identication
example:
1st line: C3
C3: C=seat diameter / 3= weight class
2nd line 2057F
2057F= VM p/n



INSPECTION (FRACTURED CONNECTING ROD)

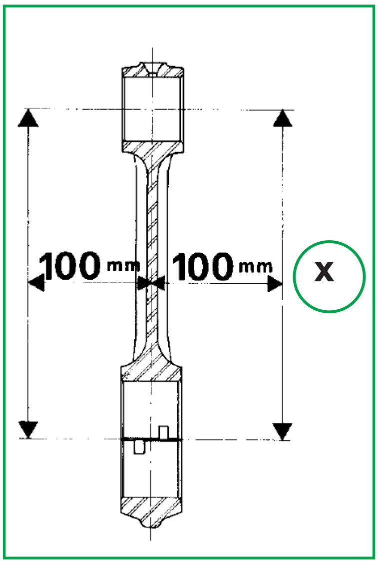
IMPORTANT: Measurements should be taken when components are at room temperature.
Coloured paint marks on the connecting rods shaft identify the weight classification. Ensure all connecting rods have the same color paint mark. Replace connecting rods that are not the same weight classification and do not have the same color paint mark. If only one connecting is replaced, replace however all connecting rods.

IDENTIFICAZIONE BIELLE IN FUNZIONE DELLA SELEZIONE PESI Connecting rods identification in function of masses selection			
≥gr.990 ≤gr.1004.9	>gr.1004.9 ≤gr.1019.9	>gr.1019.9 ≤gr.1034.9	>gr.1034.9 ≤gr.1050
VERDE Green	BLU Blue	BIANCO White	GIALLO Yellow

Check for twisted or bent connecting rods.
Peform Magnaflux inspection of all rods and caps if any doubts exixst.

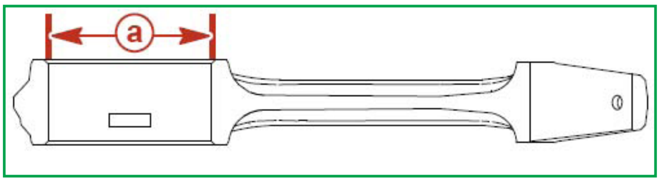
Torque temporarirly the bolts at 88 Nm (Refer to Connecting Rod Assembly for the correct tightening procedure and torque value)

Parallelism deviation between piston pin end and bearing end	0.15 mm
x - Lenght	162.975 - 163.025 mm



Use an inside dial indicator to measure the connecting rod crankshaft journal bore inside diameter, out of round and taper.

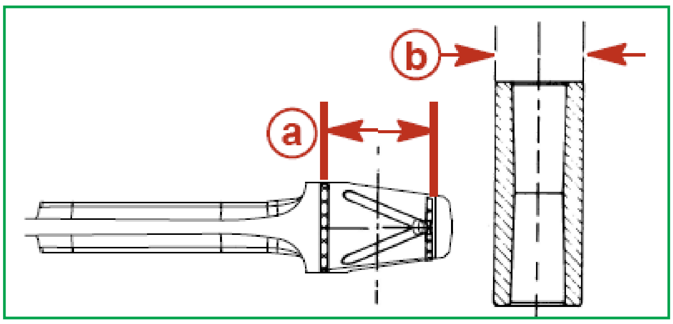
a - Connecting rod crankshaft journal bore



Inner diameter (without bearings)	57.563 - 57.582 mm
Maximum allowable wear or taper	0.02 mm

IMPORTANT: Refer to Crankshaft Section to determine the Connecting Rod Crankshaft Journal Outer Diameter and Connecting Rod Bearing Clearance.

Inspect for damage to the bearing cap and bolt threads.
Measure connecting rod bushing inner diameter and piston pin outer diameter.
Replace the connecting rod bushing if clearance exceeds specification.
a - Rod bushing inner diameter
b - Piston pin outer diameter

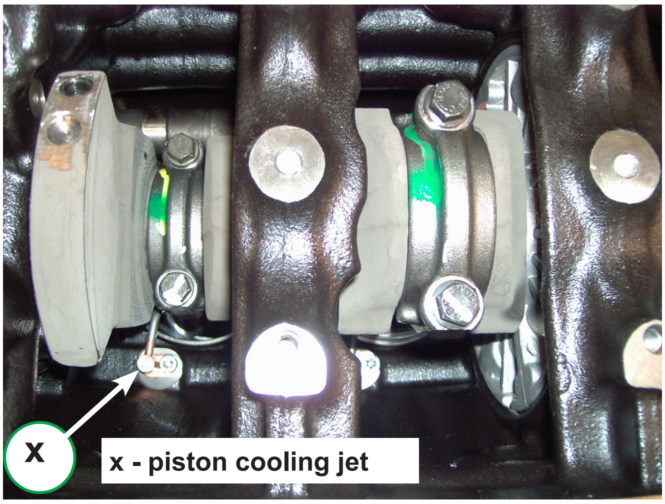


IMPORTANT: In service when replacing the rod bushing it must be bored once that is installed into its rod. Install the bushing by aligning the lubrication oil hole with the rod hole.

Bushing inner diameter	30.035 - 30.050 mm
Piston pin outer diameter	29.992 - 29.996 mm
Piston pin bore	34 - 34.025 mm
Maximum allowable wear or taper	0.01 mm
Mounting Clearance	0.039 - 0.058 mm

ASSEMBLY (FRACTURED CONNECTING ROD)

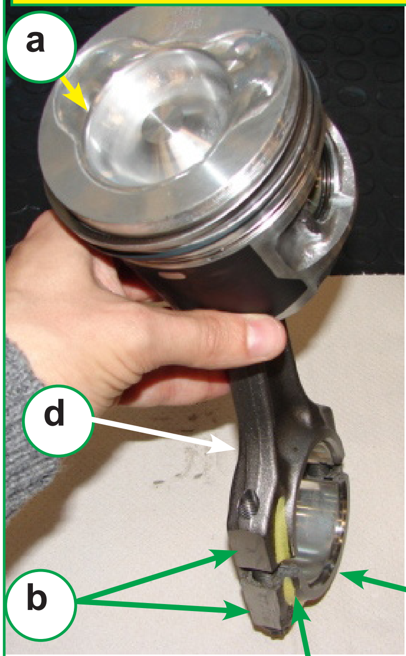
Lubricate with engine oil the inside of the connecting rod bushing, piston pin bore, and piston pin.
Assemble the piston to the connecting rod with the combustion chamber recess, paint mark on con ros shaft, and the connecting rod number all oriented as noted during disassembly, or refer to the picture.
Assemble the piston to the connecting rod with the combustion chamber recess orientated towards intake & exhaust side and the connecting rod number positioned as shown in the picture.
Insert the piston pin and install the snap ring.
Install the piston-connecting rod assembly into the cylinder block bore by taking care do not damage the liner surface and crankshaft journal.

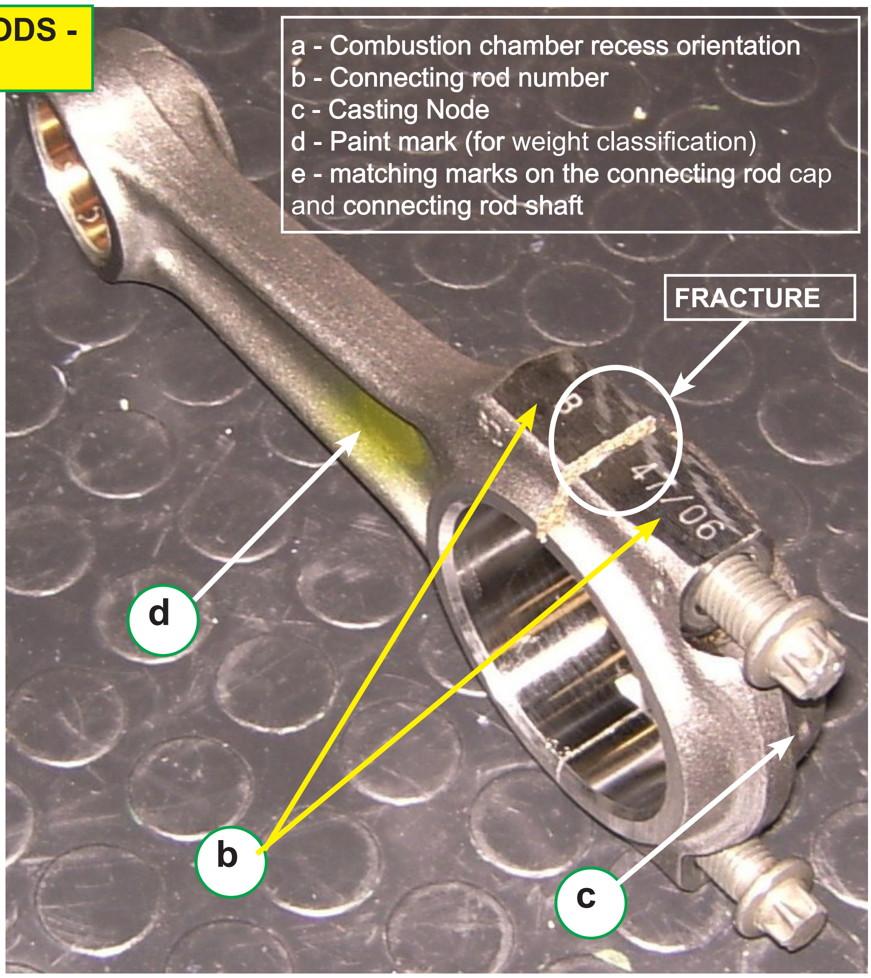


IMPORTANT: The connecting rod can damage the crankshaft journal, the cylinder bore, and the piston cooling jet. Ensure no components are damaged during connecting rod installation.

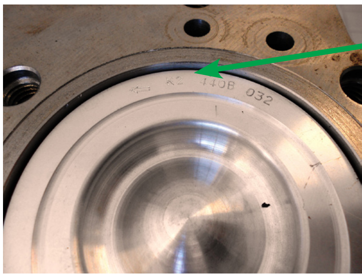
Align the connecting rod with the crankshaft journal and tap on the piston top until the connecting rod bearing contacts the journal. Do not scratch or nick the crankshaft journal.
Ensure that the matching marks on the connecting rod cap and the connecting rod shaft are the same and that the rod cap numbers point toward the camshaft/ injection side. .

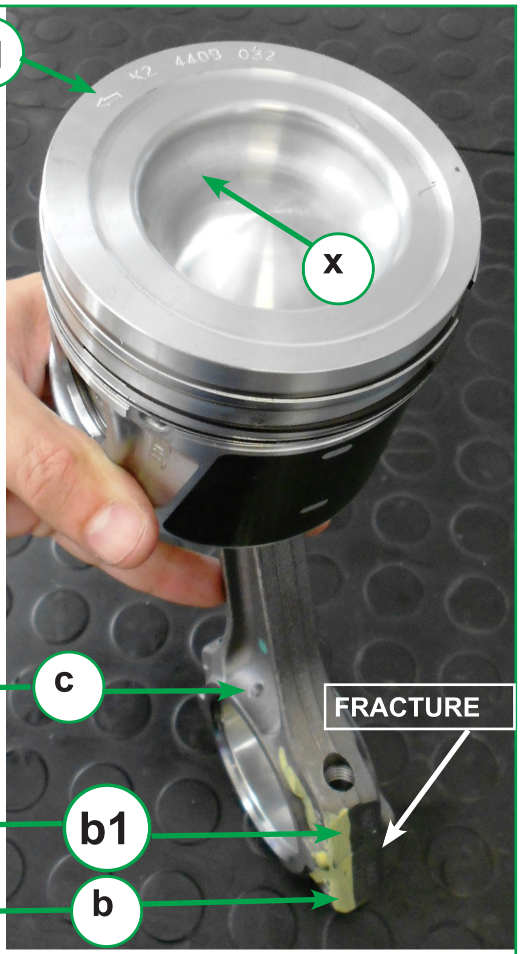
FRACTURED CONNECTING RODS - R750EU4-EU5-EU6-IE3





x - Combustion chamber recess orientation
x1 - piston identification
b - Connecting rod identification
b1 - Connecting rod identication
c - Casting Node

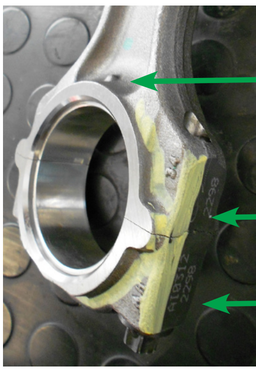




b - Connecting rod identification
example:
1st line AI0712
AI=supplier
07=week of production
12=year of production
2nd line 1996
1996= serial no.

FRACTURED CONNECTING RODS - R750IE4 - TE4 - ISE4 - R754EU6

b1 - Connecting rod identication
example:
1st line: C3
C3: C=seat diameter / 3= weight class
2nd line 2057F
2057F= VM p/n



IMPORTANT: New connecting rod screw threads and the screw head do not generally require lubrication. An anti-friction product has been applied by the factory.
Usually the bolts are replaced: if the screw threads are not stretched, and the top or bottom of the bolt head does not show damage, the connecting rod screws may be reused. When reusing a connecting rod screw, lubricate the threads and bottom of the screw head with engine oil.

Lubricate the connecting rod screw threads and the underside of the screw head, unless the screws are being replaced with new screws that are pre-lubricated.
Apply engine oil to the crankshaft journal and connecting rod bearing surfaces.
Install the connecting rod cap.
Install and finger tighten the connecting rod screws and torque them as specified :

Connecting rod screw - Fractured Connecting Rod	
First pass	10 Nm

Connecting rod screw - Fractured Connecting Rod	
Second pass	30 Nm
Final pass (Angle Torque)	+ 40

Verify that proper torque was achieved by testing the torque setting of each connecting rod screw to be at least as specified in the following table. Do not apply more than this specified amount during the validation test.

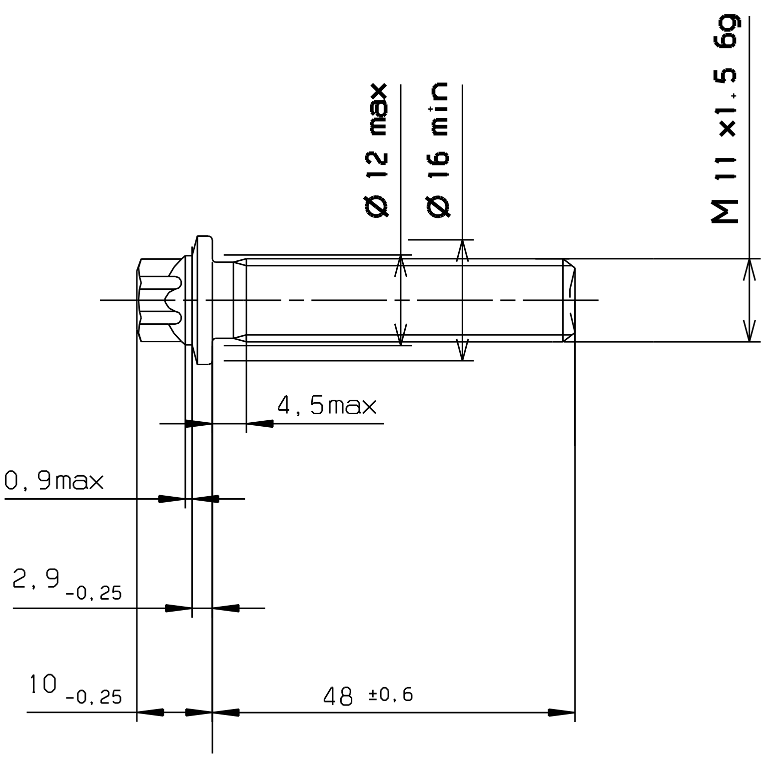
Connecting rod screw validation test torque	88 Nm

Ensure that the connecting rod assembly and the crankshaft journal are not binding and that there is proper side--to--side movement.

IMPORTANT: Refer to Crankshaft Section to determine Connecting Rod Bearing Clearance between the bearings and crankshaft journal when the connecting rod is installed on crankshaft..

Install the remaining piston and connecting rod assemblies.

CONNECTING ROD BOLT SPECIFICATION - CONNECTING ROD BROACHED



BROACHED CONNECTING ROD

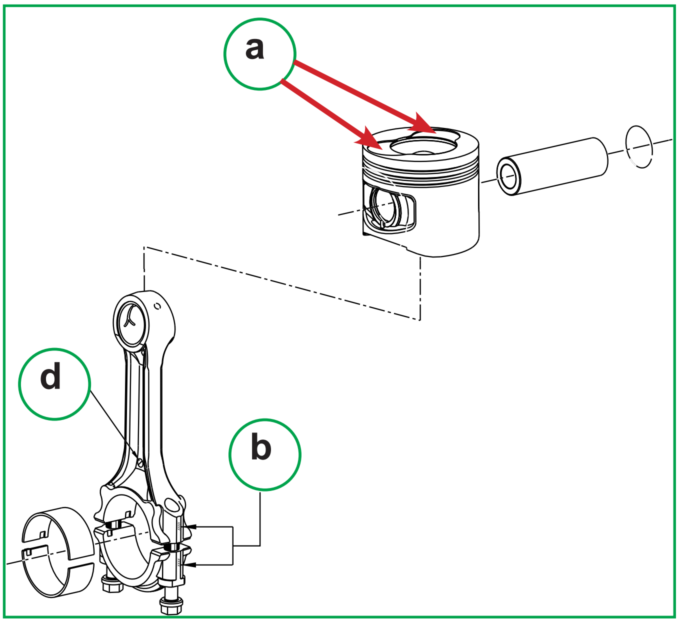
REMOVAL

IMPORTANT: Each connecting rod assembly must be reassembled in the same original location. Mark or identify each connecting rod assembly to ensure placement in the original cylinder number location during reassembly. Retain the rod cap and bearings with the connecting rod and piston assembly. Do not mix the components. Remove the connecting rod bearings. Keep the bearings, with the original connecting rod and connecting rod cap, together as a matched set.

IMPORTANT: The connecting rod can damage the crankshaft journal, the cylinder bore, and piston cooling jet. Ensure no components are damaged during connecting rod removal.

While protecting the crankshaft journal, cylinder bore, and piston cooling jets from damage, push the piston and connecting rod out of the cylinder.

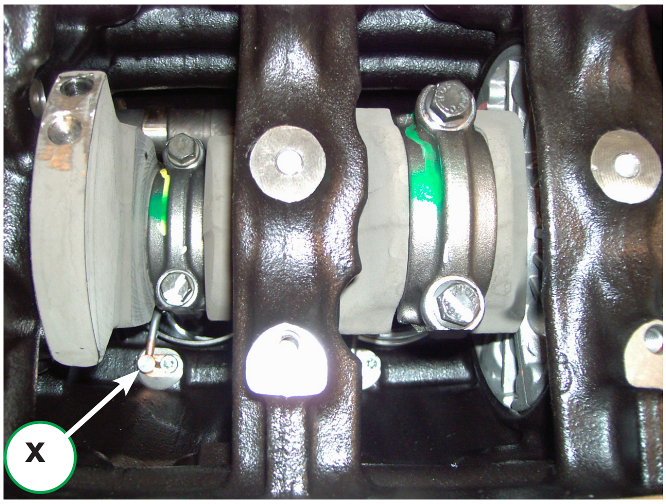
IMPORTANT: The mating surfaces of the connecting rods and the connecting rod bearing caps form an individual fit and as a result must not be interchanged or damaged under any circumstances. To avoid damage, do not lay connecting rods or connecting rod bearing caps on their mating surfaces.

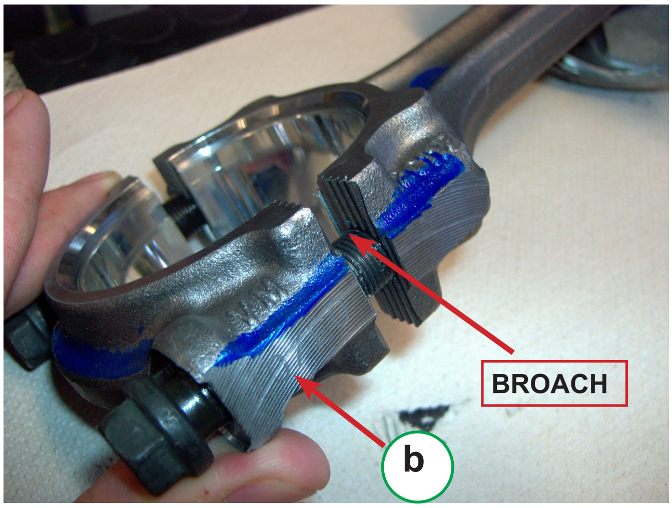


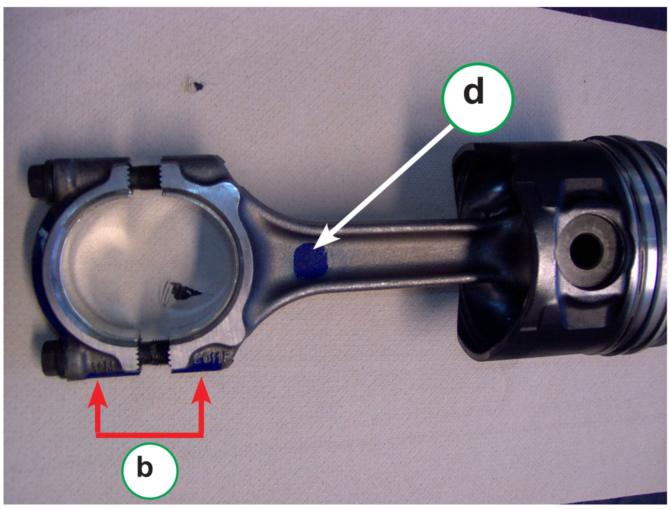
a - Combustion chamber recess orientation
b - Connecting rod number
c -
d - Paint mark (for weight classification)
e - matching marks on the connecting rod cap and connecting rod shaft

DISASSEMBLY

1. Clamp the connecting rod in a soft--jawed vise.
2. Use the Piston Ring Expander Tool to remove the first and second compression rings and the oil control ring with spring.
3. Remove the snap rings retaining the piston pin. Push the piston pin out of the connecting rod and piston.
4. Note the orientation of the piston combustion chamber recess in relation to paint mark on con rod shaft, and the connecting rod number.







INSPECTION (CONNECTING ROD - BROACHED)

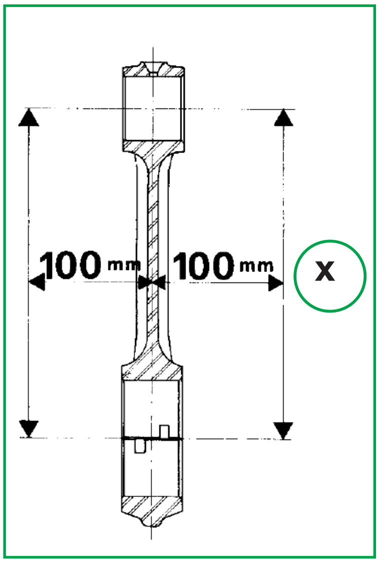
IMPORTANT: Measurements should be taken when components are at room temperature.
Coloured paint marks on the connecting rods shaft identify the weight classification. Ensure all connecting rods have the same color paint mark. Replace connecting rods that are not the same weight classification and do not have the same color paint mark. If only one connecting is replaced, replace however all connecting rods.

IDENTIFICAZIONE BIELLE IN FUNZIONE DELLA SELEZIONE PESI Connecting rods identification in function of masses selection.			
≥940gr. ⇩ ≤954.9gr.	>954.9gr. ⇩ ≤969.9gr.	>969.9gr. ⇩ ≤984.9gr.	>984.9gr. ⇩ ≤1000gr.
VERDE Green	BLU Blue	BIANCO White	GIALLO Yellow

Check for twisted or bent connecting rods.
Peform Magnaflux inspection of all rods and caps if any doubts exixst.

Torque temporarirly the bolts at 88 Nm (Refer to Connecting Rod Assembly for the correct tightening procedure and torque value)

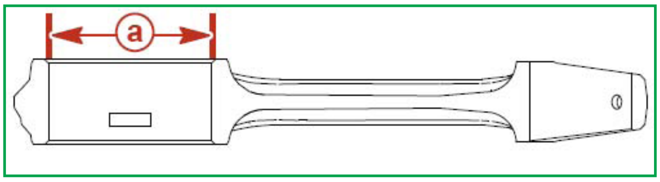
Parallelism deviation between piston pin end and bearing end	0.15 mm
x - Lenght	162.975 - 163.025 mm



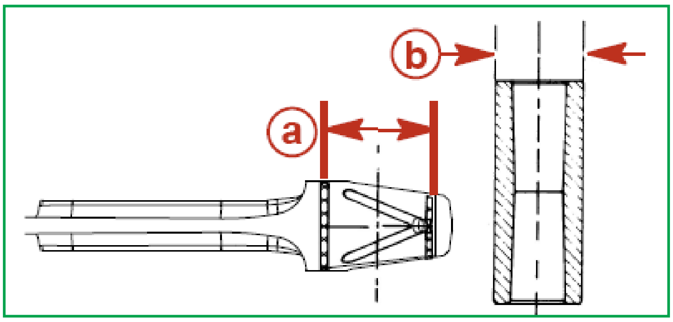
Use an inside dial indicator to measure the connecting rod crankshaft journal bore inside diameter, out of round and taper.

a - Connecting rod crankshaft journal bore

Inner diameter (without bearings)	57.563 - 57.582 mm
Maximum allowable wear or taper	0.02 mm



IMPORTANT: Refer to Crankshaft Section to determine the Connecting Rod Crankshaft Journal Outer Diameter and Connecting Rod Bearing Clearance.
Inspect for damage to the bearing cap and bolt threads.
Measure connecting rod bushing inner diameter and piston pin outer diameter.
Replace the connecting rod bushing if clearance exceeds specification.



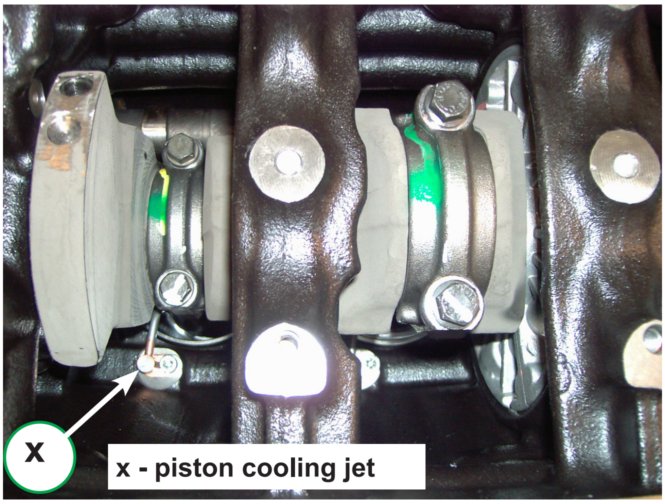
a - Rod bushing inner diameter
b - Piston pin outer diameter

IMPORTANT: In service when replacing the rod bushing it must be bored once that is installed into its rod. Install the bushing by aligning the lubrication oil hole with the rod hole.

Bushing inner diameter	30.035 - 30.050 mm
Piston pin outer diameter	29.992 - 29.996 mm
Piston pin bore	34 - 34.025 mm
Maximum allowable wear or taper	0.01 mm
Mounting Clearance	0.039 - 0.058 mm

ASSEMBLY (CONNECTING ROD - BROACHED)

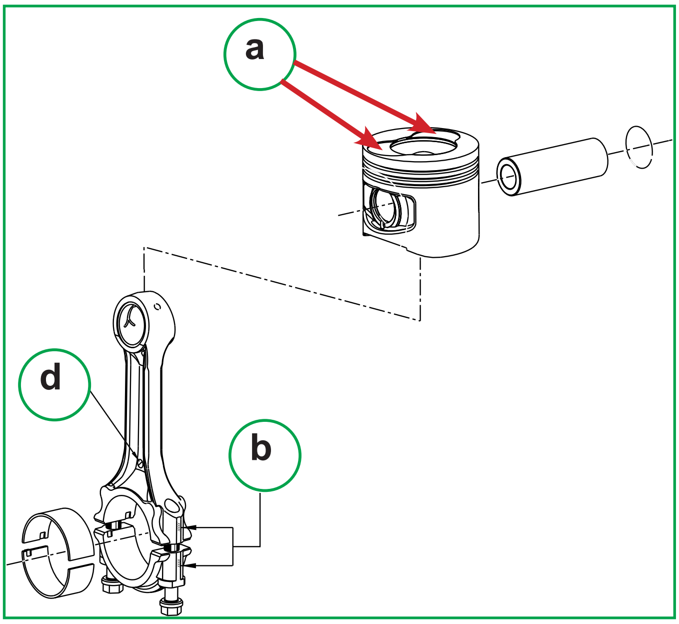
Lubricate with engine oil the inside of the connecting rod bushing, piston pin bore, and piston pin.
Assemble the piston to the connecting rod with the combustion chamber recess, paint mark on con ros shaft, and the connecting rod number all oriented as noted during disassembly, or refer to the picture.
Assemble the piston to the connecting rod with the combustion chamber recess orientated towards intake & exhaust side and the connecting rod number positioned as shown in the picture.
Insert the piston pin and install the snap ring.
Install the piston-connecting rod assembly into the cylinder block bore by taking care do not damage the liner surface and crankshaft journal.

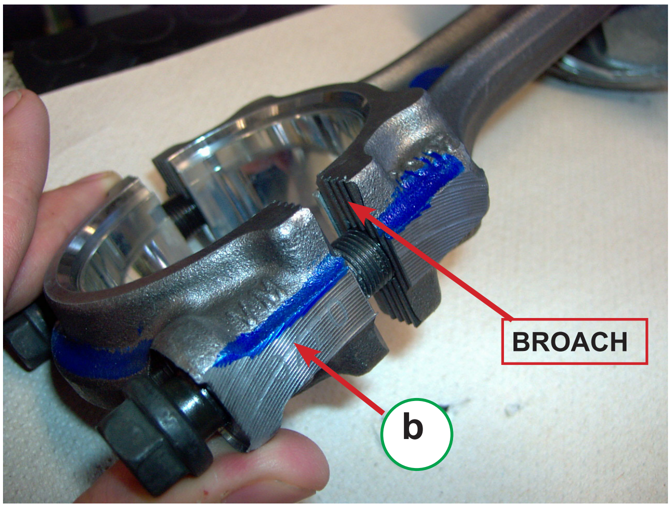


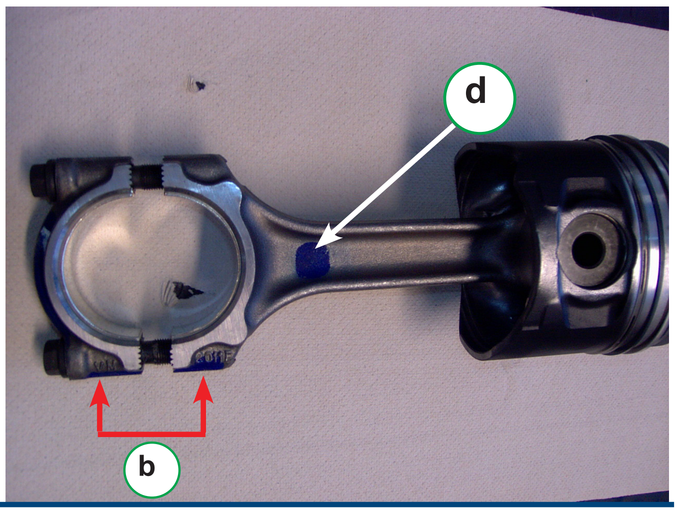
IMPORTANT: The connecting rod can damage the crankshaft journal, the cylinder bore, and the piston cooling jet. Ensure no components are damaged during connecting rod installation.

Align the connecting rod with the crankshaft journal and tap on the piston top until the connecting rod bearing contacts the journal. Do not scratch or nick the crankshaft journal.
Ensure that the matching marks on the connecting rod cap and the connecting rod shaft are the same and that the rod cap numbers point toward the camshaft/ injection side. .

BROACHED CONNECTING RODS







a - Combustion chamber recess orientation
b - Connecting rod number
c -
d - Paint mark (for weight classification)
e - matching marks on the connecting rod cap and connecting rod shaft

IMPORTANT: New connecting rod screw threads and the screw head do not generally require lubrication. An anti-friction product has been applied by the factory.
Usually the bolts are replaced: if the screw threads are not stretched, and the top or bottom of the bolt head does not show damage, the connecting rod screws may be reused. When reusing a connecting rod screw, lubricate the threads and bottom of the screw head with engine oil.

Lubricate the connecting rod screw threads and the underside of the screw head, unless the screws are being replaced with new screws that are pre-lubricated.
Apply engine oil to the crankshaft journal and connecting rod bearing surfaces.
Install the connecting rod cap.
Install and finger tighten the connecting rod screws and torque them as specified :

Connecting rod screw - Broached Connecting Rod	
First pass	30 Nm
Final pass (Angle Torque)	+ 60°

Verify that proper torque was achieved by testing the torque setting of each connecting rod screw to be at least as specified in the following table. Do not apply more than this specified amount during the validation test.

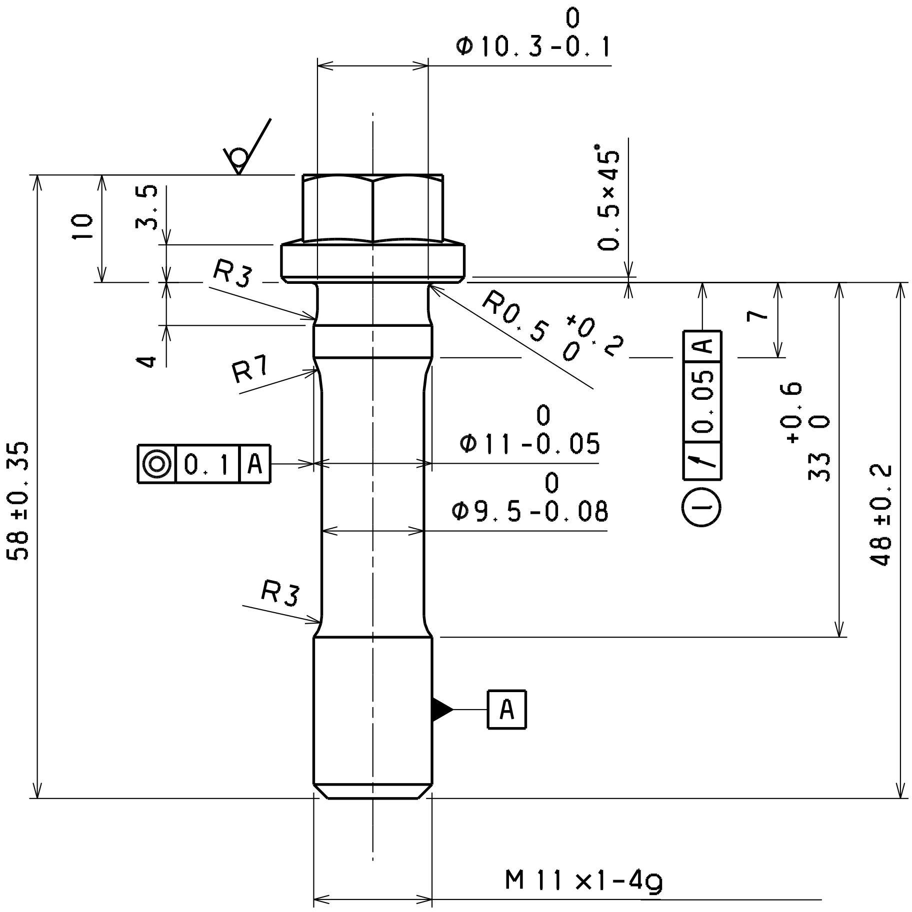
Connecting rod screw validation test torque	88 Nm

Ensure that the connecting rod assembly and the crankshaft journal are not binding and that there is proper side--to--side movement.

IMPORTANT: Refer to Crankshaft Section to determine Connecting Rod Bearing Clearance between the bearings and crankshaft journal when the connecting rod is installed on crankshaft..

Install the remaining piston and connecting rod assemblies.

CONNECTING ROD BOLT SPECIFICATION - CONNECTING ROD BROACHED



PISTON

DISASSEMBLY

1. Clamp the connecting rod in a soft-jawed vise.
2. Use the Piston Ring Expander Tool to remove the first and second compression rings and the oil control ring with spring.
3. Remove the snap rings retaining the piston pin. Push the piston pin out of the connecting rod and piston.
4. Note the orientation of the piston combustion chamber recess in relation to the paint mark, the casting node (only for fractured connnecting rods), and the connecting rod number. (Refer to Connecting Rods Section)

CLEANING

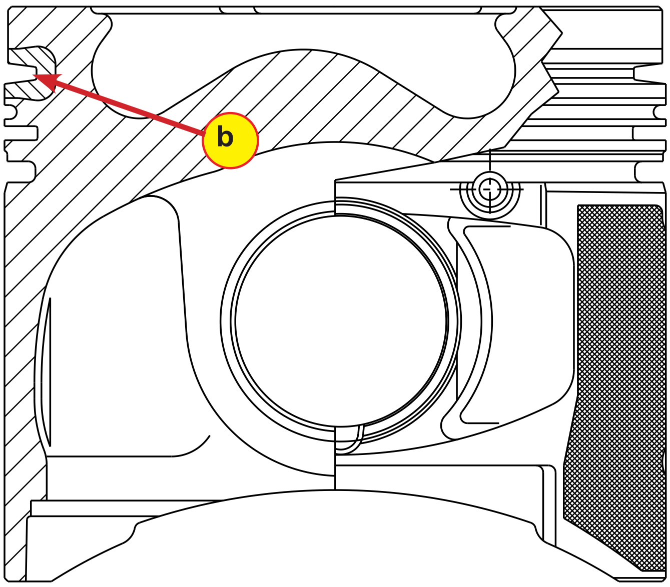
IMPORTANT: Do not wire brush on any part of a piston.
1. Wash the components in cleaning solvent.
2. Clean varnish from piston skirts and pins with a suitable cleaning solvent.
3. Clean the ring grooves.
4. Clean the piston oil lubrication holes and slots.
5. Put on safety glasses and dry the components with compressed air.

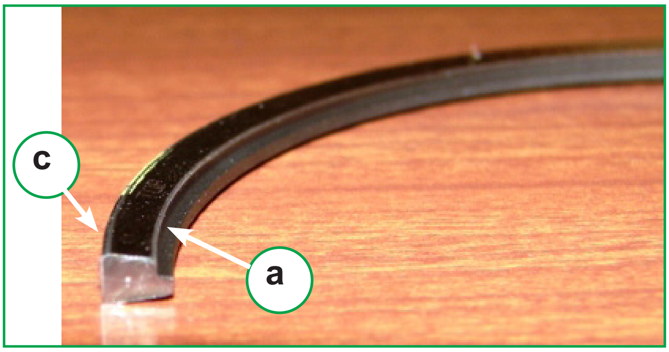
INSPECTION

Inspect the piston for cracked ring lands, skirts or pin bosses, wavy worn ring lands, scuffed or damaged skirts or eroded areas at top of piston. Replace pistons that are damaged or show signs of excessive wear.

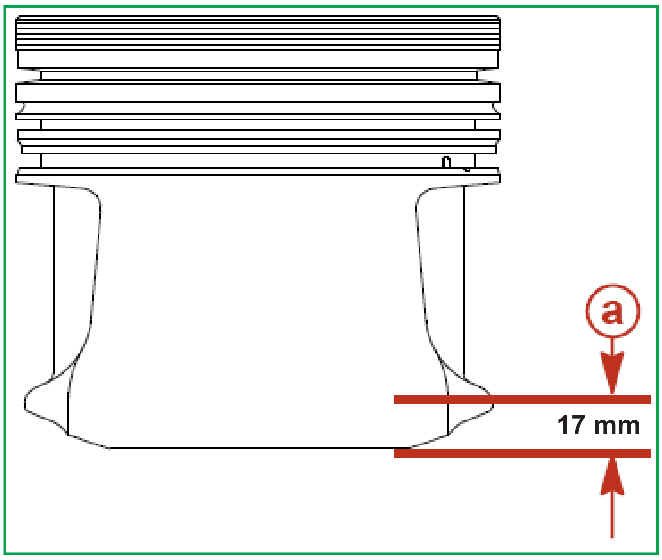
NOTE: Do not mistake tapered or different ring design characteristics for unusual wear patterns. The first (upper) compression ring is trapezoidal (tapered) in design. That is, it has a taper on both upper and lower surfaces. Correspondingly, the first compression ring groove is tapered on top and bottom. The second (scraper) compression ring and the oil control ring are more typical in design.

a - First compression ring - trapezoidal (tapered)
b - First compression ring groove - (tapered)
c - Outer edge of first compression ring





Measure the piston outer diameter **17 mm** from the bottom and 90 degrees to the piston pin . Replace the piston if measurement is less than specified.



a - Outer diameter measurement point

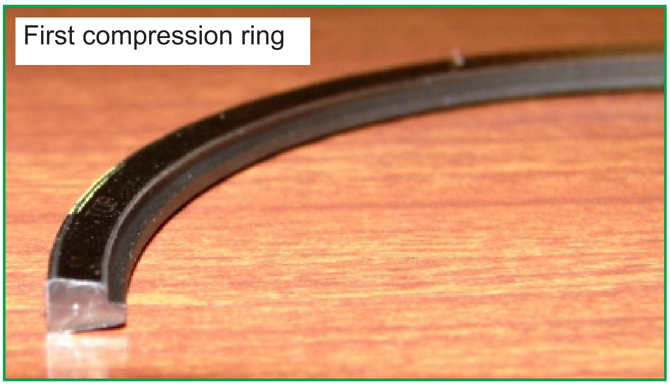
Outer diameter	
R750IE3/TE3/EU4/ EU5-R756EU6	93.930 - 93.950 mm
R754EU6/IE4/ISE4	93.897 - 93,913 mm
Wear limit	0.10 mm

Inspect the piston ring grooves for nicks or burrs that might cause the rings to bind.
Except on the upper piston ring groove, insert the edge of the rings into respective piston ring groove and roll the ring entirely around the groove to make sure that ring does not bind. If resistance or binding occurs at any point, determine the cause.
a. If binding is caused by a distorted ring, recheck with another ring.
IMPORTANT: When using a fine cut file, do not remove excess material. Verify with a feeler gauge and compare to specifications.
b. If binding is caused by ring groove, remove the material causing the binding by dressing the ring groove with a fine cut file.

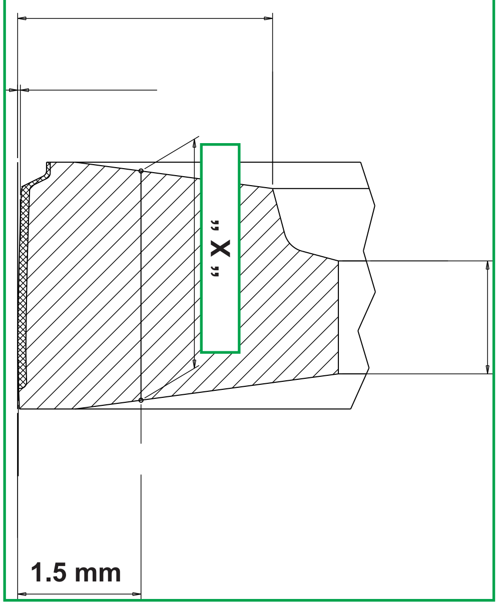
Measure the thickness of the rings. Replace piston rings as a set if out of specification.

Piston Ring Thickness (Production)	
First compression “ X “ (tapered - outer edge)	2.568 -2.597 mm R754IE4, TE4, ISE4, R754EU6 = 2.575 - 2.595 mm
Second compression	1.970 - 1.995 mm R754IE4, TE4, ISE4, R754EU6 = 1.97 - 1.99 mm
Oil control	2.97 - 2.99 mm

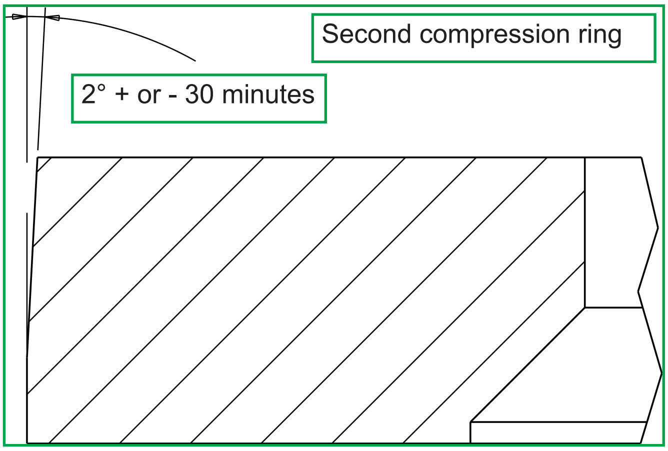
First compression ring

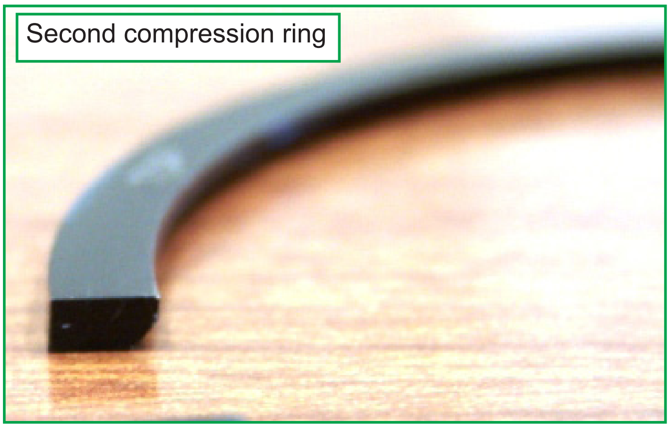


First compression ring

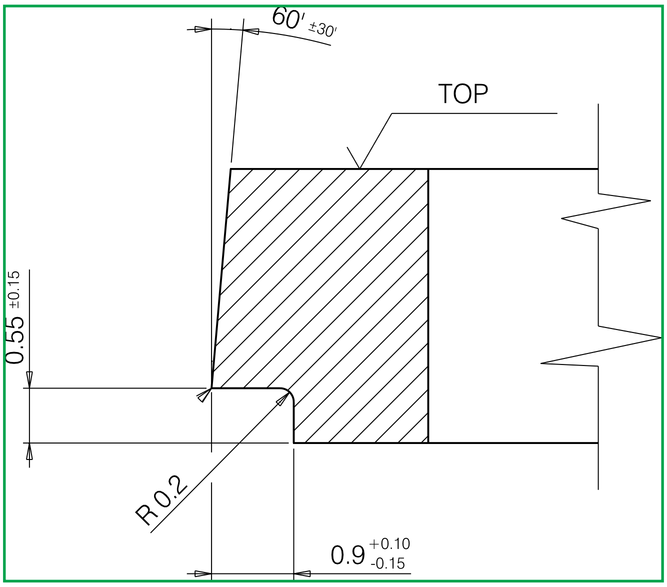


R750 EU4-EU5-IE3-TE3-R756EU6





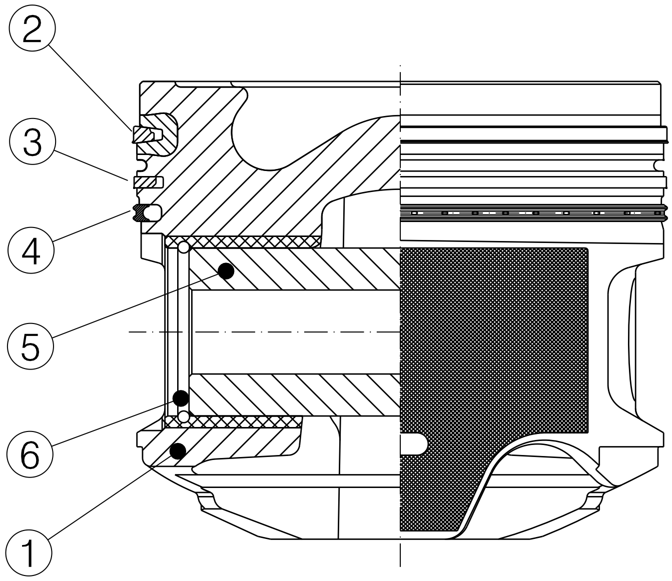
R750 IE4-TE4-ISE4 / R754EU6



Second compression ring

Measure the piston ring groove width.

Piston Ring Groove Width (Production)	
First compression (tapered - outer edge)	3 mm (nominal)
Second compression	2.06 - 2.08 mm
Oil control	3.03 - 3.05 mm



2 - Not applicable - first compression ring and groove tapered
3 - Second compression ring and groove
4 - Oil control ring and groove

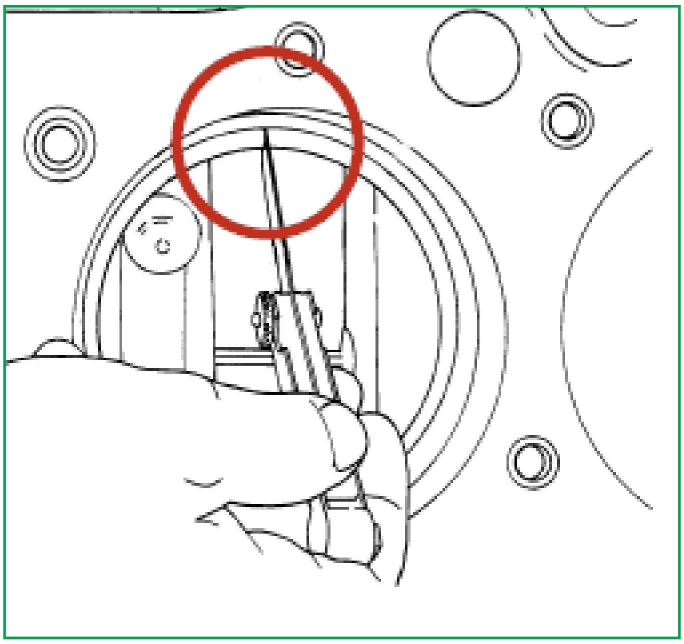
Using a feeler gauge, measure the clearance between the serviceable, or new, second compression and oil control piston rings and ring groove at several points around the piston. Replace the piston if the measured values exceed the specification.

Piston Ring Groove	
Clearance	
First compression	Not applicable (tapered)
Second compression	0.065 - 0.11 mm R754IE4, TE4, ISE4, R754EU6 = 0.07 - 0.11 mm
Oil control	0.04 - 0.08 mm

Check the piston ring end gap:
a. Position the selected ring in the cylinder bore.

NOTE: The ring must be level (at right angles to the bore surface) for measurement. Push the ring 6 mm into the bore with the crown of the piston.

b. Measure the gap between the ends of the ring with a feeler gauge as shown.



Piston Ring End Gap (Production)	
First compression	0.30 - 0.42 mm
Second compression	0.65 - 0.85 mm
Oil control	0.30 - 0.60 mm

Piston Ring End Gap	
First compression	0.5 mm maximum
Second compression	0.9 mm maximum
Oil control	0.7 mm maximum

c. If the gap between the ends of the piston ring is less than specified, remove the
ring and try to fit another. Check the cylinder bore if the specification cannot be met with new rings. Refer to Cylinder Liners.
d. Fit each ring to the cylinder in which it is going to be installed.

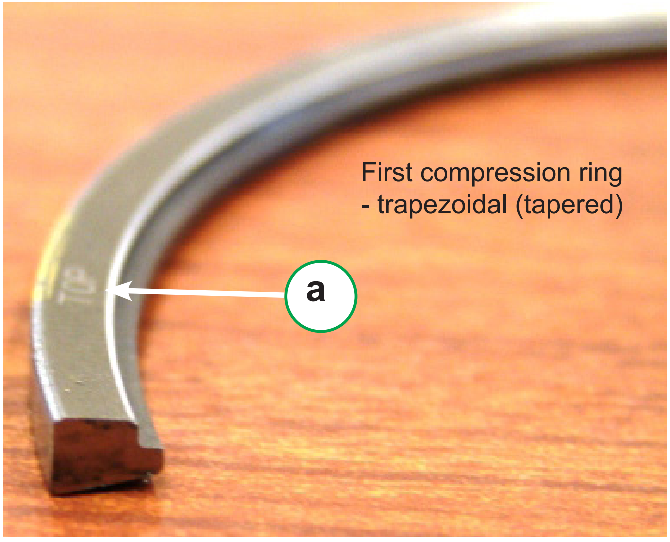
ASSEMBLY

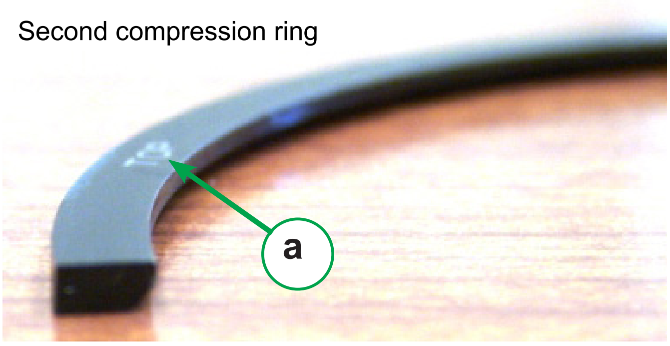
1. Lubricate the inside of the connecting rod bushing, piston pin bore, and piston pin.
2. Assemble the piston to the connecting rod (Refer to connecting Rod Section).
3. Insert the piston pin and install the snap ring.
4. Clamp the connecting rod in a soft-jawed vise

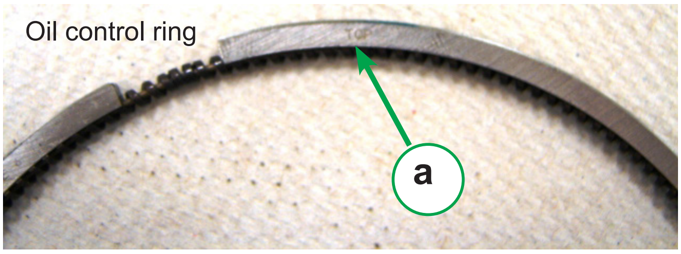
IMPORTANT: Always install rings with ring markings ("CTOP", "PIP" or a dot) facing the top of piston.

a - ring markings

5. Install the oil control ring spring in lower piston groove.
6. Using the Piston Ring Expander Tool, install the oil control ring.
7. By hand, squeeze the ring into the groove to seat the spring and check for binding.
8.Using the tool, install the second compression ring in the center piston groove. The inner taper is toward the bottom of the piston.
9. By hand, squeeze the ring into the groove and check for binding.
10. Using the tool, install the first compression ring in upper piston groove.
11. By hand, squeeze the ring into the groove and check for binding.



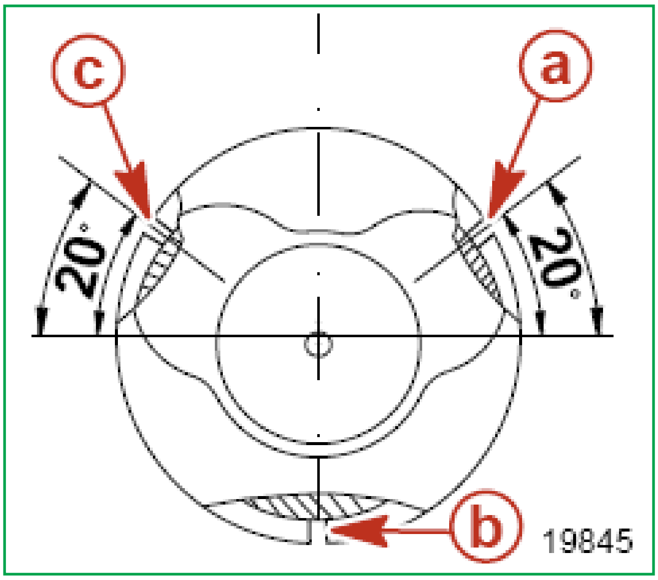




INSTALLATION

1. Before installing pistons into cylinders, ring gaps must be positioned as show in the picture:
a. First compression ring (trapezoidal) gap, 20° to the right of combustion chamber recess.
b. Second compression ring gap, centered on the combustion chamber recess.
c. Oil control ring gap, 20° to the left of combustion chamber recess.

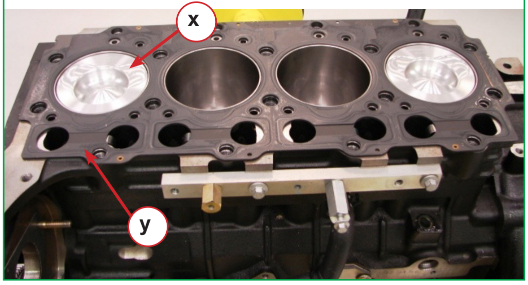
a - First compression ring (trapezoidal) gap
b - Second compression ring gap
c - Oil control ring gap

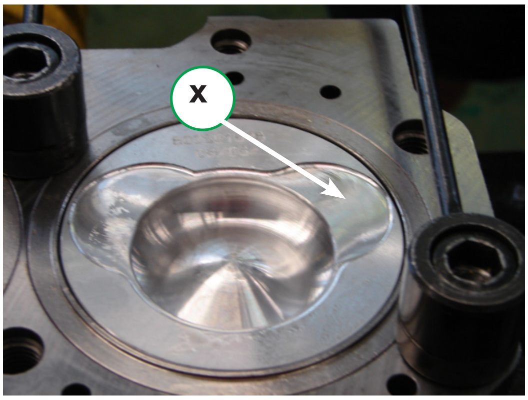


2. Lubricate the cylinder bores and piston rings.
3. Each piston and connecting rod assembly must be installed in the cylinder from which it was removed.

4. Turn the crankshaft to position the crank pin away from the cylinder so the connecting rod will not damage it during installation.
5. Using a ring compressor, install the piston by tapping on the piston-top with a suitable device.
6. Insert the connecting rod bearings into the connecting rod and matching connecting rod cap. Lubricate the bearings and crankshaft journal with engine oil.
IMPORTANT: The connecting rod can damage the crankshaft journal, the cylinder bore, and the piston cooling jet. Ensure no components are damaged during connecting rod installation.
7. Align the connecting rod with the crankshaft journal and tap on the piston top until the connecting rod bearing contacts the journal. Do not scratch or nick the crankshaft journal.
8.Install the connecting rod cap.
9. Install and torque the connecting rod screws. (Refer to Connecting Rod Section)

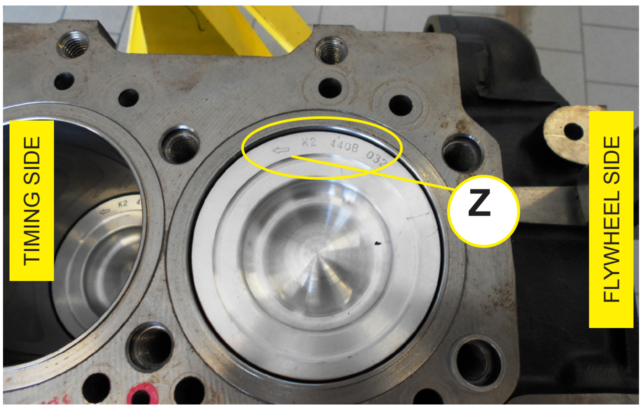
x - Combustion chamber recess
y - Camshaft/Injection side

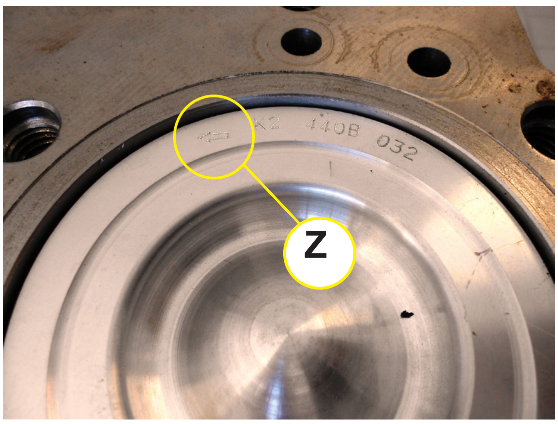




R750EU4-EU5-IE3-R756EU6

Z - The arrow on the piston top indicates the installation direction: TOWARDS TIMING SIDE **R754TE4-IE4-ISE4 / R754EU6**



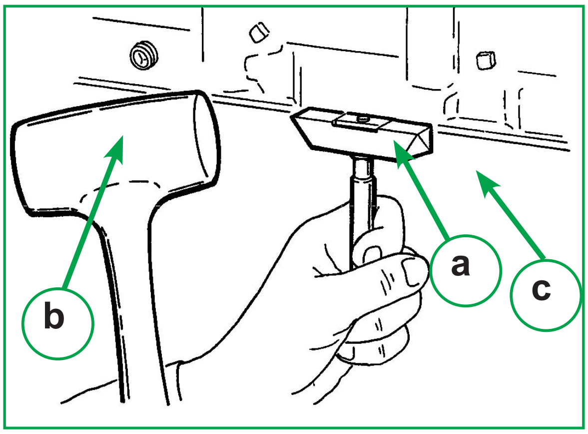


OIL PAN & OIL PICKUP

REMOVAL

Drain the oil out of the engine. Refer to the Maintenance section.
Remove the oil pan screws.
Cut through oil pan sealant on pan rails using a suitable tool. Ensure do not bend the pan rails.
Remove the oil pan.

a - Sealant cutting tool
b - Hammer
c - Oil pan



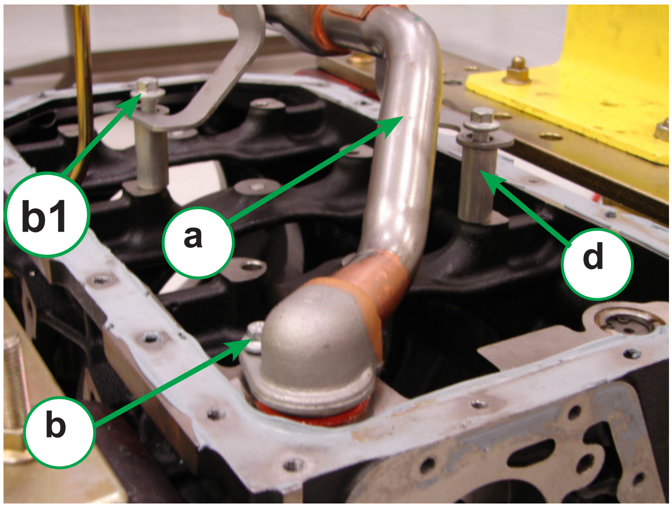
OIL PICKUP

REMOVAL

1. Remove the oil pick-up tube and strainer mounting screws.
2. Remove the oil pickup tube and strainer and spacers.

a - Oil pickup tube
b - Oil pickup tube screw
c - Oil strainer
d - Spacers

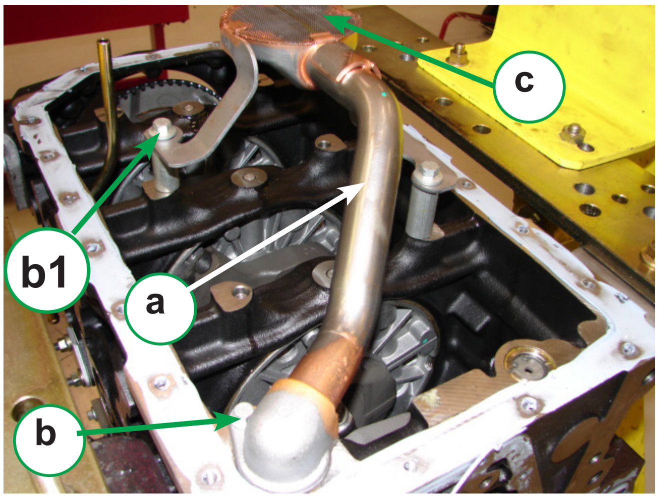
3. Remove the old oil pickup tube O-ring.



INSTALLATION

1. Replace the oil pickup tube O-ring.
2. Lubricate the oil pickup tube O-ring.
3. Install the oil pick-up tube and strainer on the engine block.
4. Install the oil pick-up tube and strainer screws. Torque the screws.

oil pick-up tube and strainer screws	(b) 12.7 Nm
	(b1) 32.4 Nm



1. Wipe off all excess oil and foreign matter from sealing surface on crankcase and oil pan. Thoroughly de-grease all sealing surfaces prior to application of sealant.

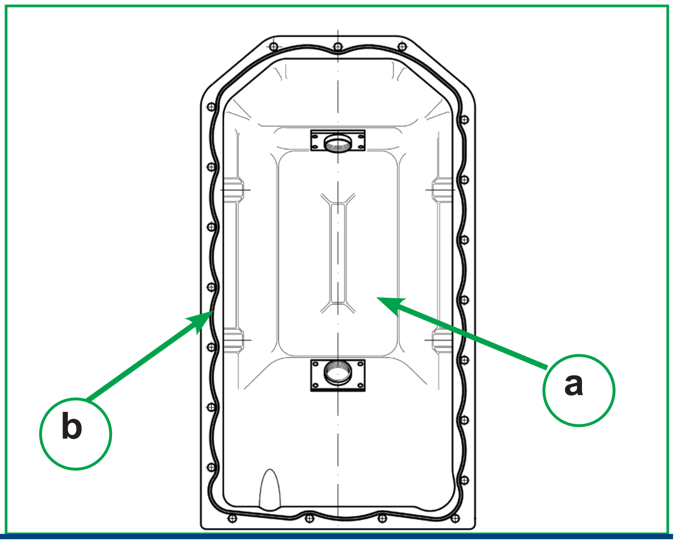
CAUTION

Excessive amounts of sealant could loosen and become lodged on the oil pickup strainer resulting in a restricted oil flow. Do not apply excessive amounts of sealant.

2. Apply a continuous bead of sealant (silicon type Dow Corning 7091) around the oil pan flange on the inside of the bolt holes as shown.
3. Install the oil pan.
4. Install oil pan screws finger tight. Torque the oil pan screws evenly, in a diagonal pattern.

Oil pan screw	12.7 Nm

a - Oil pan flange
b - Continuous bead of sealant



OIL PRESSURE RELIEF VALVE

The oil pressure relief valve (oil pressure regulator valve) is installed vertically in the underside of the crankcase.

REMOVAL

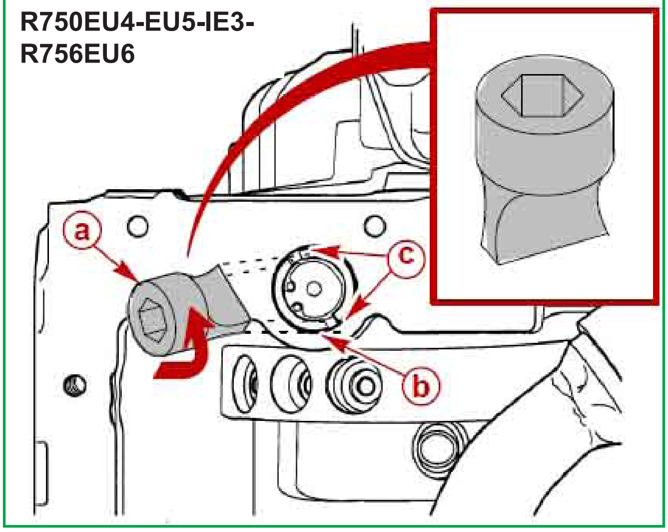
1. Remove the oil pan.
2. Clean old gasket material from the area around the relief valve.
3. If removing only the relief valve and spring, or springs: proceed to Disassembly.
Observe all precautions and perform all steps except step 1.
4. If removing the complete pressure relief valve assembly:

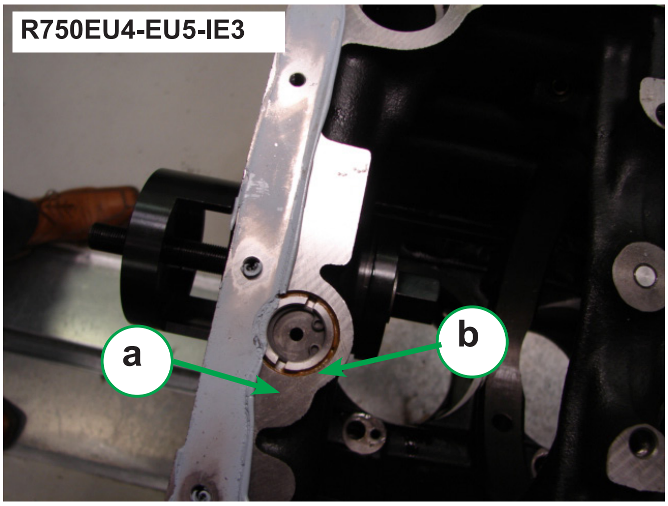
a. Unscrew the oil pressure relief valve assembly from the crankcase using a suitable tool. The tool should engage the 2 slots opposite each other on the edge of the valve assembly.

NOTE: Locking compound is used during installation of the oil pressure relief valve assembly. Area around the assembly may need to be heated to aid in removal.

b. Remove the pressure relief valve assembly from the crankcase.
c. Proceed to Disassembly.

a - Example of suitable tool
b - Valve assembly
c - Slots





DISASSEMBLY

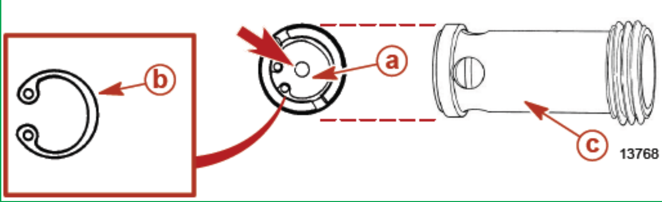
1. Lock the pressure relief valve assembly in a soft-jawed vise, if the complete assembly was removed.

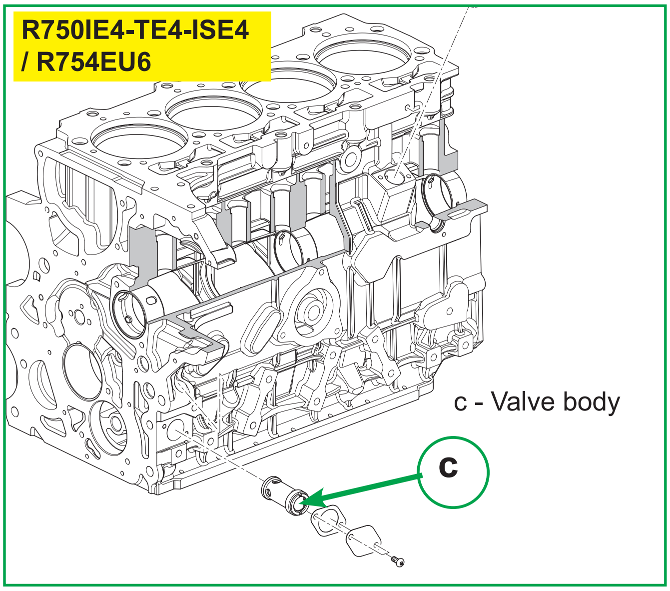
CAUTION

The oil pressure relief valve cap and high pressure spring are retained by a snap-ring. If released suddenly the spring could propel the valve cap with enough force to cause injury.
Use caution when removing or installing the snap-ring. Wear safety glasses.

2. Push the cap in against the high pressure spring and hold. Remove snap-ring.
3. Release spring pressure slowly.

a - Cap
b - Snap-ring
c - Valve body





4. Remove cap, springs and relief valve from bore of the valve body.
NOTE: Some oil pressure relief valves have only one spring.

CLEANING

1. Clean gasket sealing material from cylinder block and pan flanges.
2. Wash all parts in cleaning solvent.
3. Put on safety glasses and dry parts with compressed air.

INSPECTION

1. Replace the complete oil pressure valve assembly if the spring is broken.
2. Replace the complete valve assembly if the valve is badly worn or sticking in the bore.
3. The valve can be lapped into it the seat using a grinding paste, if necessary to restore pressure.
4. Ensure that the valve slides freely in the valve seat and valve body when coated with oil.

ASSEMBLY

1. Coat the inside of the oil pressure relief valve seat and body bore with engine oil.
Liberally coat the remaining components.
2. Assemble the valve, springs, and cap. Install parts into valve seat and body.
3. Push the cap in against the high pressure spring and hold.
4. Install the snap-ring.

INSTALLATION

1. If installing only the oil pressure relief valve and spring, or springs: refer to Assembly.
Observe all precautions and perform all steps with the valve body still in the crankcase.
2. If installing the complete oil pressure relief valve assembly:

a. Apply sealant Loctite 510 to the threads when replacing the complete oil pressure relief valve assembly.
Screw the complete assembly into the crankcase.
b. Using a suitable tool, torque the oil pressure relief valve assembly into the crankcase.

Oil pressure relief valve assembly	**53.9 Nm**

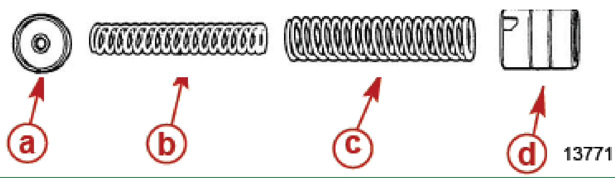
a - Oil pressure relief valve assembly
b - Threads

Oil pressure relief valve assembly - cover fixing screw “C”	**5.9 Nm**

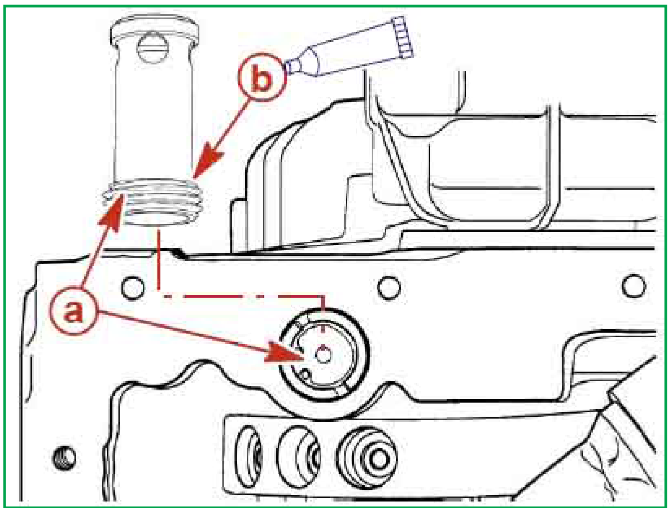
IMPORTANT: apply Loctite 510 on both gasket surfaces.

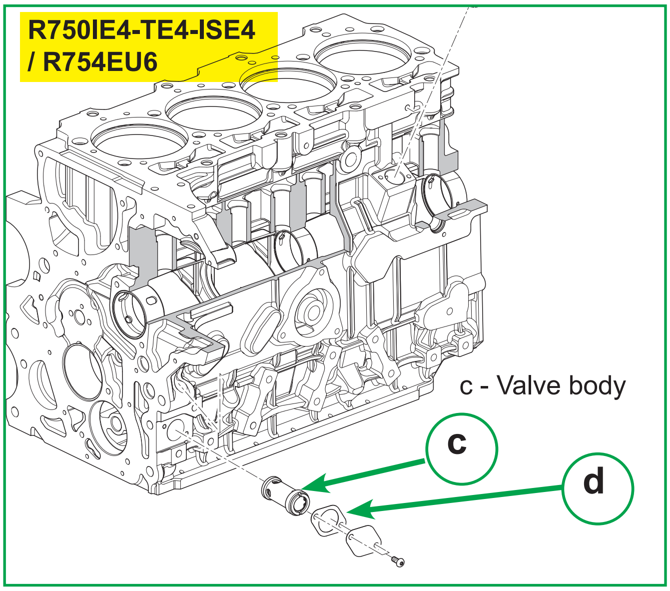
d - gasket

a - Cap
b - Spring (inner - if dual spring equipped)
c - Spring (outer - if dual spring equipped)
d - Relief valve



a - Relief valve
b - Spring (inner - if dual spring equipped)
c - Spring (outer - if dual spring equipped)
d - Cap
e - Snap-ring
f - Valve seat and body





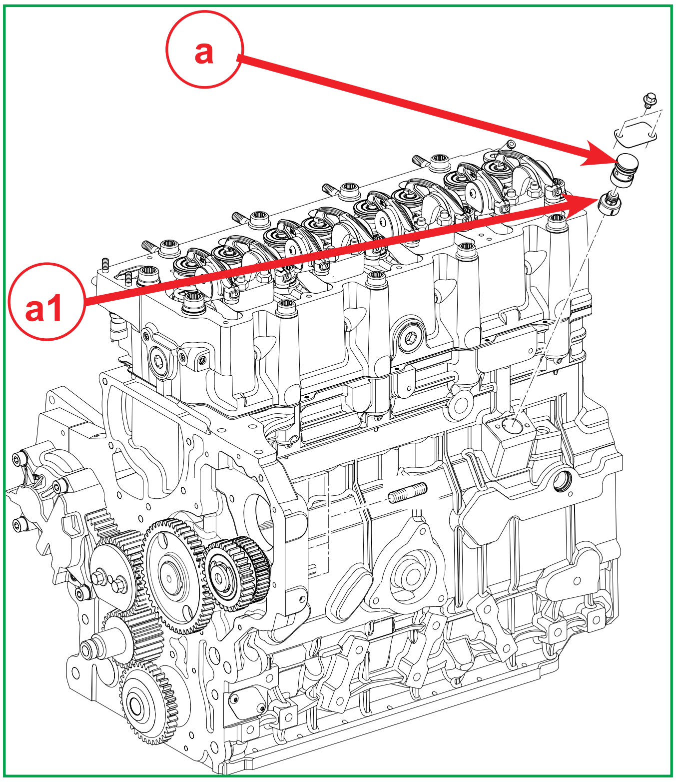
OIL DRAIN FROM SEPARATOR VALVE (R750IE4-TE4-R754EU6)

These engine models have on the block installed the oil drain valve from separator valve.

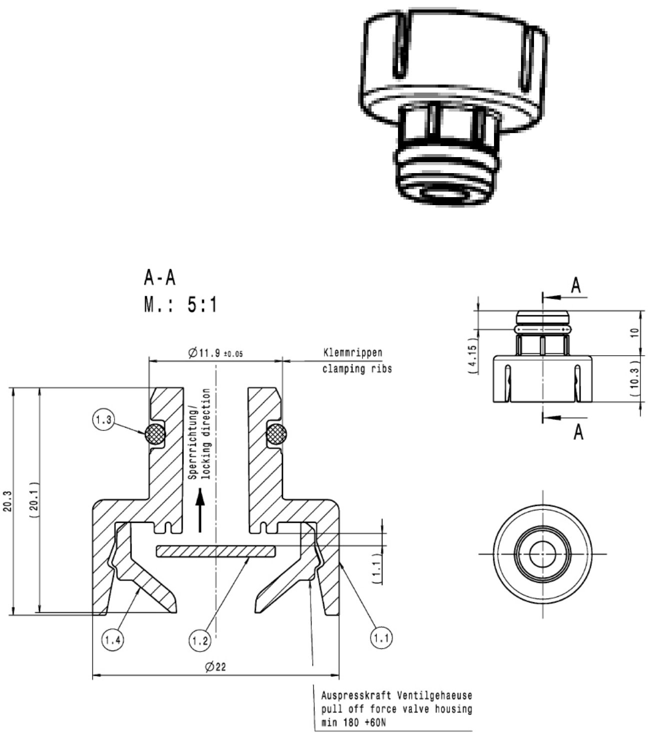
The valve assembly is composed of body and valve.

Valve cover bolt	14 Nm

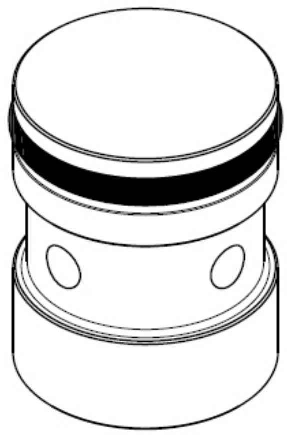
a - valve body
a1 -- valve

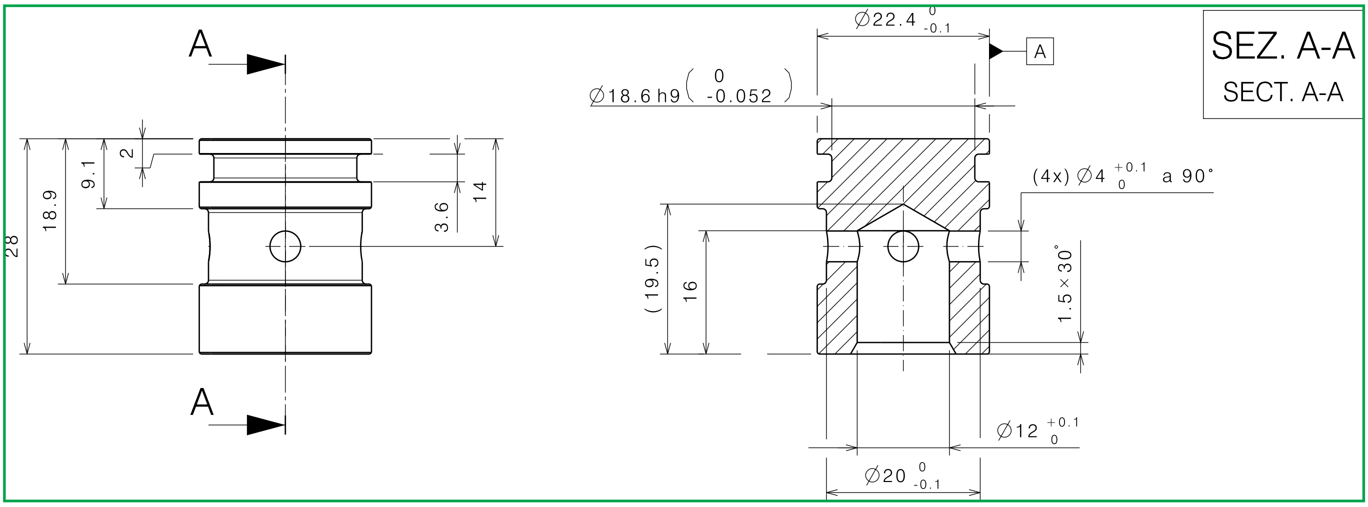


a1 -- valve



a -- valve body

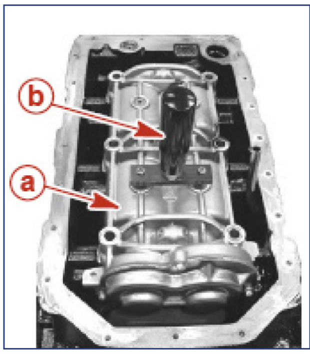


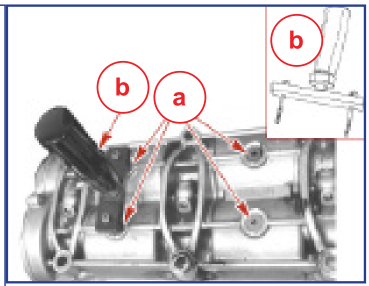


COUNTER-BALANCE SHAFT UNIT

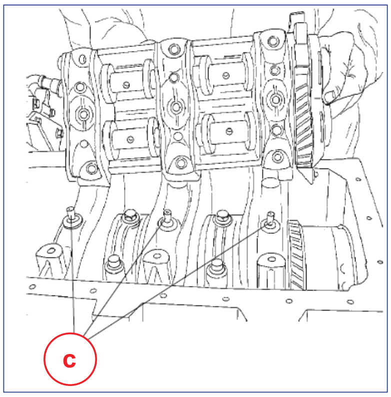
REMOVAL

IMPORTANT: before removing and installing the counterbalance shaft unit it is needed to engine piston 1st at its TCD.
In this position it is possible to use the tool 68480013F (b) to block the counterbalance (a): the pins of the tool have to be installed into holes (a) of the counterbalance so that its rotation is locked.





Remove the counter-balance unit fixing bolts. Remove the unit and pay attention do not damage the Orings on the guides (c): these guides take engine oil for lubrification to the counter balance shaft unit



INSTALLATION

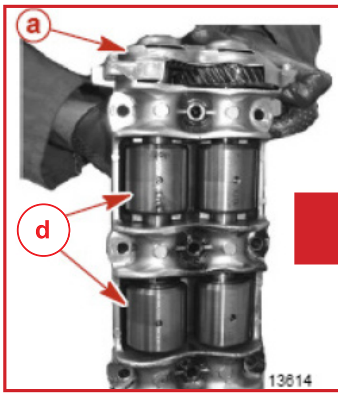
Bring the piston 1st at its TDC.
Align the weights (d) as indicated on the pictures: install the pins of the tool speciale 68480013F inside the holes of the counter shaft unit (a): **the weights don't have to be visible.**

With the weights in this position it is possible to use the tool 68480013F (b) to lock the unit (a): the pins of the tool have to be installed into holes (a) of the counterbalance so that its rotation is locked.

Manteining the tool in this position, install the unit on the engine block: pay attention do not damage the Orings on the guides (c): these guides take engine oil for lubrification to the counter balance shaft unit.

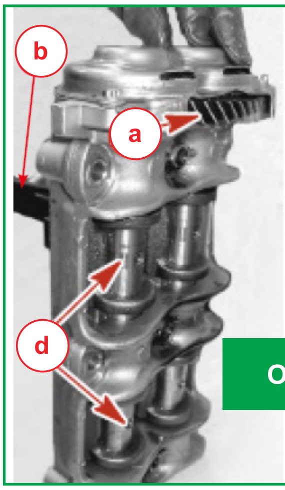
Remove the special tool and tighten the counterbalance shaft fixing bolts.

Fixing bolts / counter balance shaft	**32.4 Nm**



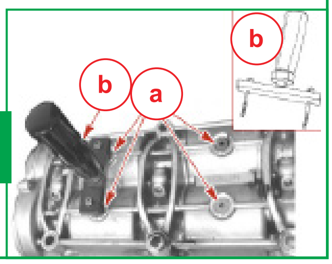
WRONG ALIGNMENT OF THE WEIGHTS
(weights are visible)
a - unit
d - weights

NOT OK



RIGHT ALIGNMENT OF THE WEIGHTS
(weights NOT visible)
a - unit
d - weight
b - special tool

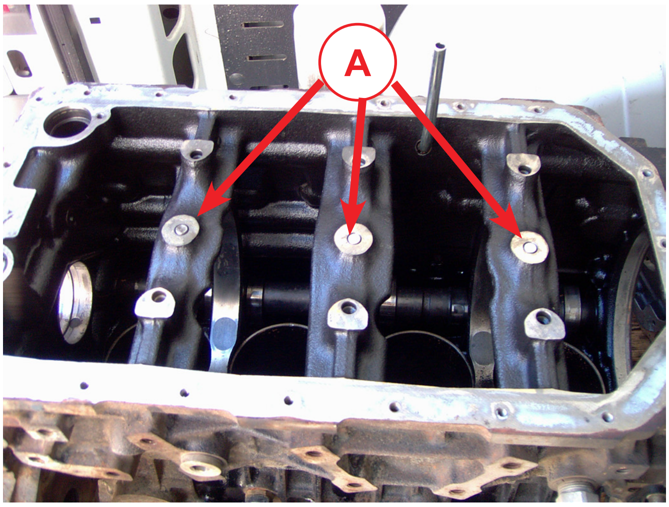
OK



CRANKCASE

In case of engine overhaul or oil pan removal verify the installation and related caulking of plugs that close the balance shaft assembly lubricating oil gallery, on engine whit balance shaft assembly installed.

A - plugs



INSPECTION

On some engine versions is possible the balance shaft assembly is not installed. The balance shaft assembly lube oil gallery on the block are close by plugs.

A - Plugs

In case of engine overhaul verify if the plugs **(A)** are caulked **(see photo 2-3)**

In case of **photo 1** the plug "**B**" comes out of block or is not correctly installed. The plug is **NOT** properly seated. The plug must be correctly installed and caulked. **(see photo 2-3)**

B - plug comes out of crankcase

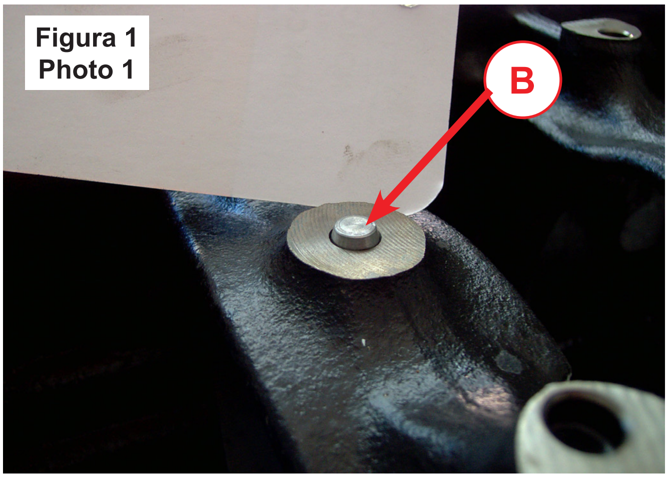


Figura 1
Photo 1

IMPORTANT: carry out always the caulking on all plugs: install the plug at the same level of the block surface as shown in the **photo 2-3** and carry out the caulking by 180°.

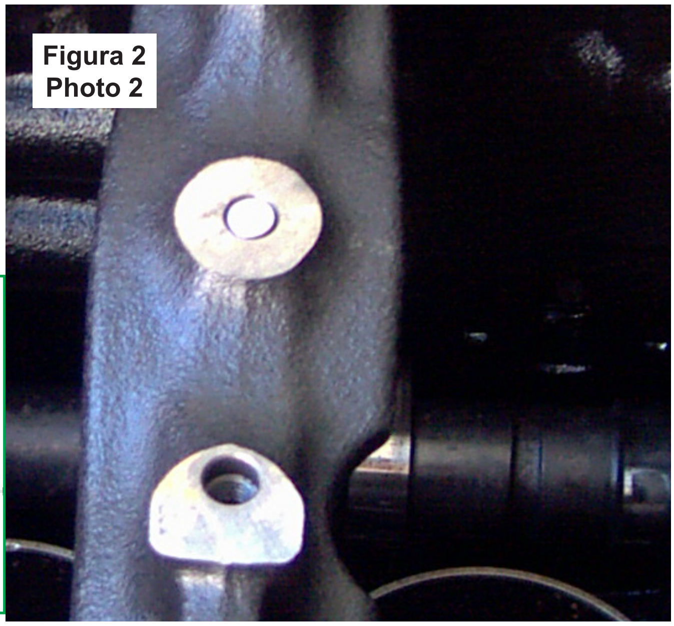
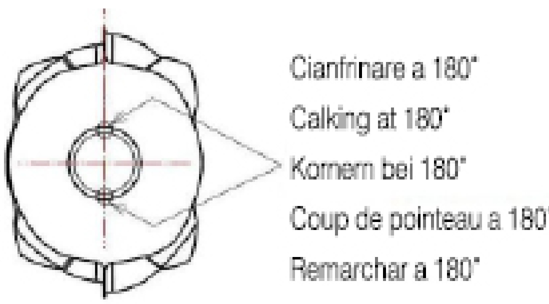


Figura 2
Photo 2

Figura 3
Photo 3

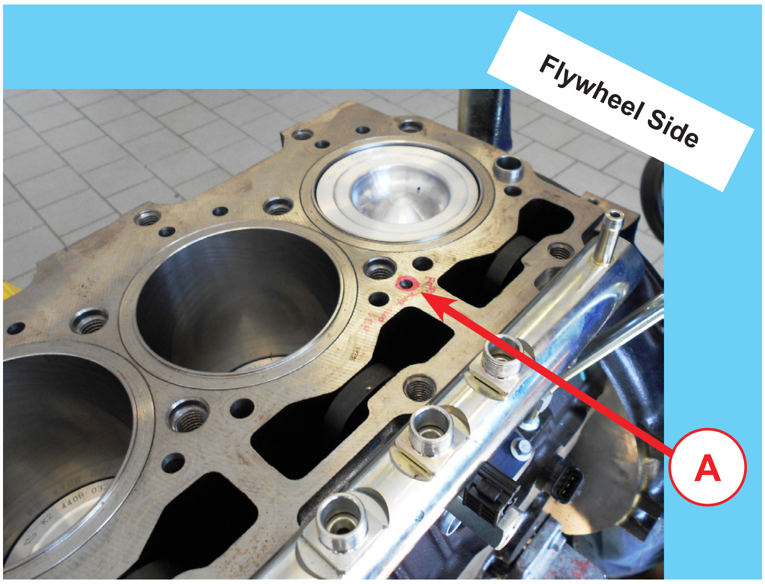


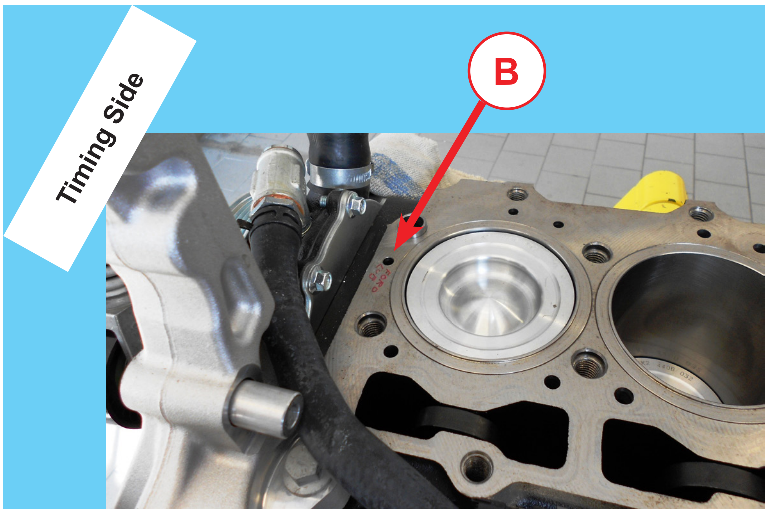
ROCKER ARMS - ENGINE TYPE R750 IE4 - TE4 - ISE4 - R754EU6

In the engine block are present no.2 passages, one for oil lubrification and another for oil return.

A: oil return from rocker arms
B: oil supply to rocker arms

Refer also to section BASIC ENGINE - CYLINDER HEAR ENGINE TYPE R750IE4-TE4-ISE4 - R754EU6





LINER

REMOVAL

Remove the liners by using the special tool

Remove engine components as needed, including pistons.

Remove the piston cooling jets (oil spray nozzles).

Remove the plate from Cylinder Liner Puller Tool.

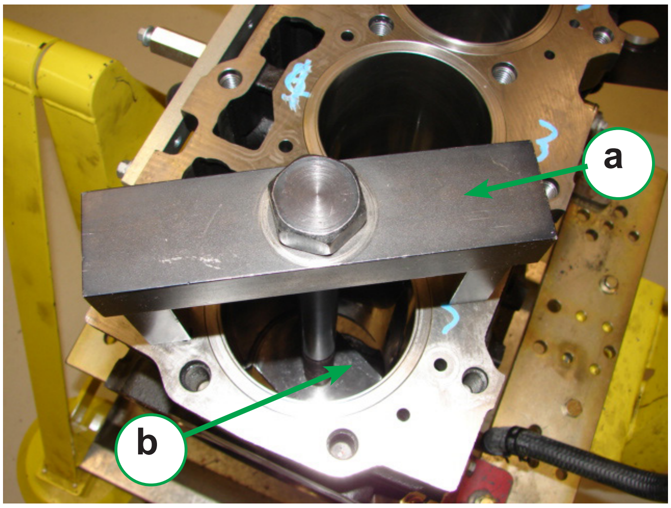
a - Cylinder Liner Puller Tool

b - Plate

IMPORTANT: To avoid mismatching cylinder liners and pistons upon reassembly, mark the liners in a suitable fashion as to the cylinder number and orientation in the cylinder block.

Install the Cylinder Liner Puller Tool into the cylinder liner and attach the plate to the tool at bottom of the cylinder liner.

Screw the nut of the tool and remove the cylinder liners. Note the O-rings on the cylinder liner lower part.



SPECIFICATIONS

Remove old sealant from the cylinder liners.

Clean the cylinder liners, especially at areas where shown, and in the areas where the O-rings fit.

c - Areas for special cleanliness

Wash the liners in cleaning solvent.

Put on safety glasses and dry the components with compressed air.

Inspect the cylinder liners for abnormal wear or cracks.

Inspect the cylinder liners for a ridge at the top of the ring travel. Remove the ridge if the cylinder liners are within specification.

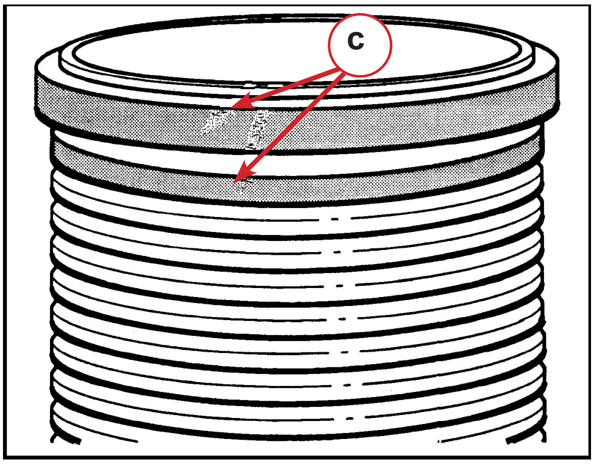
Measure the cylinder liners for taper and out of round using a dial indicator or inside micrometer. If wear exceeds specification replace the cylinder liners.

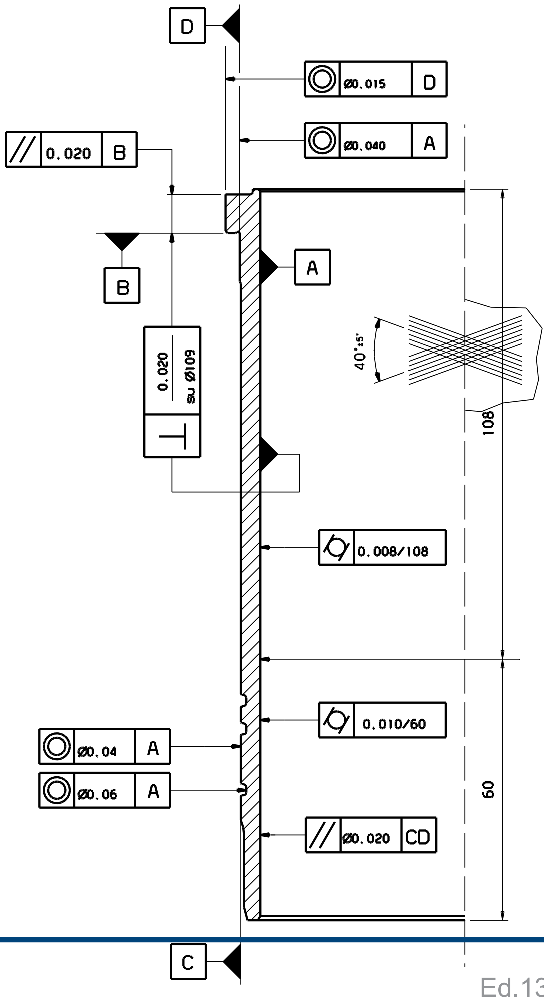
NOTE: Carefully move the gauge up and down in the cylinder liner bore to determine taper.

Measure the taper at three different vertical positions and at opposite sides of the cylinder liner bore. Turn the gauge to different points around the cylinder liner wall to determine the out of round condition.

Maximum measurement depth is 108 mm down from the top edge of the cylinder liner.

Cylinder Liner	
Production diameter - inner	93.995 - 94.015 mm
Wear limit	0.10 mm
Production out of round or taper	0.008 mm
Maximum out of round or taper	0.10 mm





INSTALLATION

Cylinder liners on all engines are required to protrude, or rise above, the surface of the cylinder block.

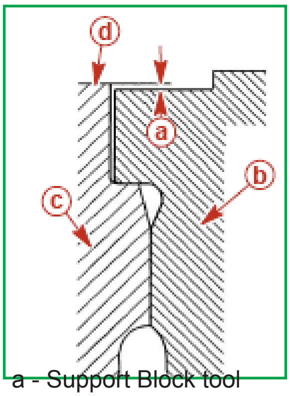
⚠ **CAUTION** :Cylinder liner protrusion can only be correctly measured with the cylinder liners fully seated in the cylinder block.
Incorrect measurements will result in engine performance problems or severe engine damage. Ensure the cylinder liners are fully seated in the cylinder block before measuring cylinder liner protrusion.
NOTE: The cylinder liners will rotate freely in the bore when the cylinder block and cylinder liner are completely clean and ready for measuring cylinder liner protrusion.
a. Unless being replaced, install the cylinder liners in the same cylinder block bore **without O-rings** as marked or noted upon disassembly.
b. Using a precision depth gauge measure and record the amount of cylinder liner recess (the depth below the cylinder head mounting surface of the cylinder block) of each liner.

1. Use the dial indicator and Support Block tool (liner gauge bar) (Refer to Special Tools Section) to measure the liner protrusion above the cylinder block.
2. Place Support Block with the dial indicator feeler gauge on the cylinder block.
3. Set the dial indicator to zero (0).
4. Move the dial indicator to the liner on the liner neck. Record the measurement.
5. Measure the liner protrusion of all liners.
6. Verify the amount of liner protrusion for each liner as specified:

Cylinder liner protrusion	- 0.01 ÷ + 0.07 mm

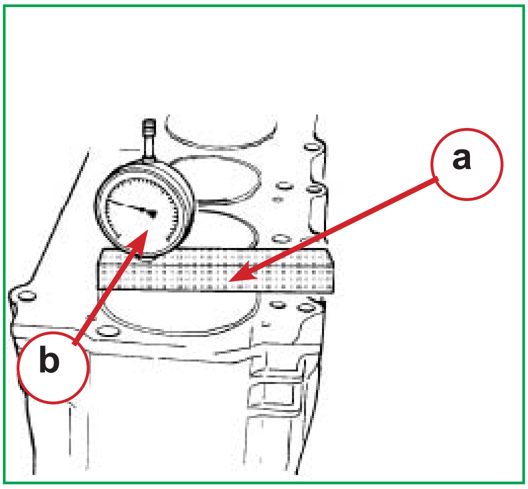
If the amount is incorrect, replace the liner and install another one.
If the amount is correct to procede with the installation of all liners as follows:
7. Install two coloured O- rings (same colour) in the liner grooves lower part and another O- ring (different colour than previous 2 O-rings) in liner groove lower part. (see picture).
IMPORTANT: The first two O-rings have a different thickness and colour than the second one. Do not mix O-rings one another.

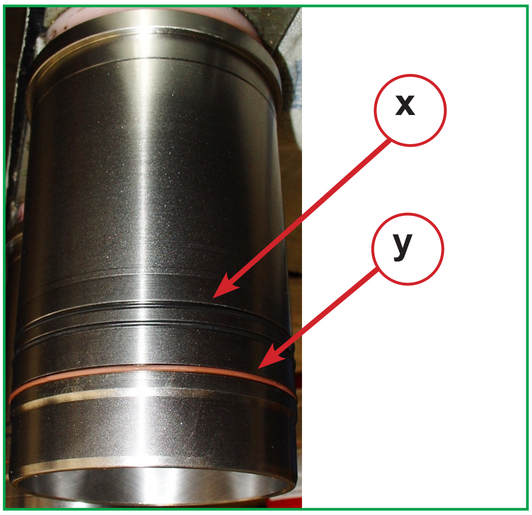
8. Lubricate with lubricant lower centering collars in cylinder block (those areas where lower liner O- rings seal against the bore).
IMPORTANT: Do not lubricate upper bore area where sealant (LOCTITE 986) will be applied later.(see next step 9).
9. Select and apply the specified sealant (LOCTITE 986) to the liner surfaces, as shown in the picture.



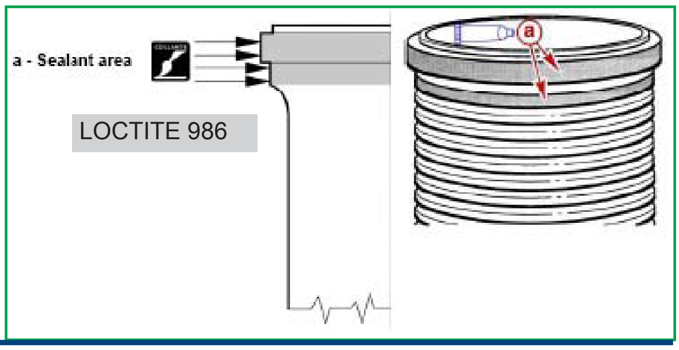
a - Cylinder liner recess
b - Cylinder liner
c - Cylinder block
d - Cylinder head mounting surface

a - Support Block tool
b - dial indicator





x - two coloured O- rings in the liner grooves lower part (same colour)
y - O- ring in liner groove lower part. (different colour than other 2 o-rings with same colour)



10. Install the cylinder liners in the cylinder block, being careful not to damage the O- rings.

11. Once the liners are installed, hold the liners securely in position with the bolts and formed spacer-washers.

Temporarily torque the bolts and allow the sealant to get dry.

a - Cylinder liner

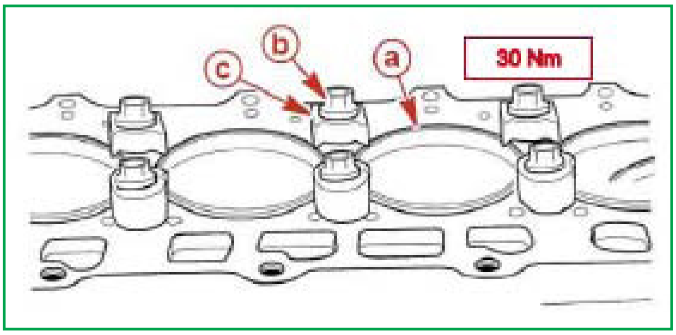
b - Suitable bolt

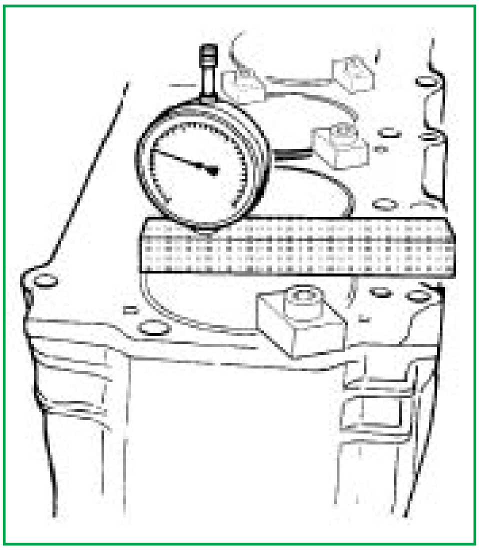
c - Formed spacer washer

IMPORTANT: If the cylinder heads are not installed within 1 hour, the cylinder liners must remain clamped by the spacer washers and bolts for roughly 8 hours, so that the sealant can properly cure. After 8 hours the spacer washers and bolts can be removed and the cylinder heads can be installed.

12. After the sealant is dry, verify the cylinder liner protrusion as stated before.

13. If the cylinder liner protrusion is correct, continue the engine assembling.





CAMSHAFT

TESTING - MEASURING LOBE LIFT

1. Remove the rocker arm assemblies.
2. Secure the dial indicator to the cylinder head so the dial indicator plunger rests inside the push rod cup.
3. Turn the crankshaft so that the camshaft lobe is at the bottom of its travel.
4. Set the dial indicator to “0” (zero).
5. Turn the crankshaft 2 (two) complete revolutions while reading the dial indicator.
6. Measure all lobes of camshaft in the same manner.

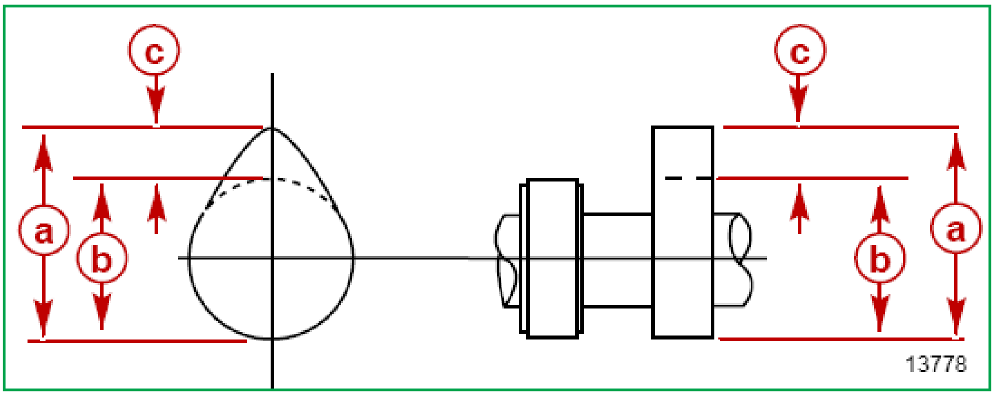
IMPORTANT: Camshaft replacement will be necessary if lobe dimensions are less than 0.05 mm of the values specified.

Camshaft - Lobe lift	
Exhaust	7.303 mm
Intake	6.850 mm
Wear Limit	0.05 mm

CAMSHAFT LOBE DIAMETER

1. Measure the total camshaft height with a micrometer. Subtract the lobe diameter. The difference is lobe lift. If the lobe lift is less than specified, the camshaft must be replaced.

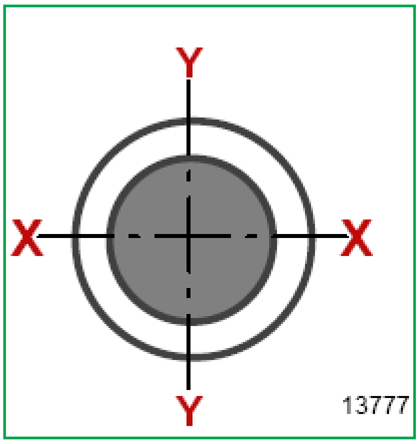
Camshaft - Lobe diameter	
Exhaust	38.550 - 38.650 mm
Intake	39.450 - 39.550 mm
Wear Limit	0.05 mm



a - Total camshaft height
b - Lobe diameter
c - Lobe lift

CAMSHAFT JOURNAL DIAMETER

1. Use a micrometer to measure each camshaft journal diameter in two directions (“X-X”)
and (“Y-Y”). If the measured value is less than specified, the camshaft must be replaced.



NOTE: Camshaft bearings are available in 0.250 mm undersized. Clerance between camshaft journal and camshaft bearings, refert to “Camshaft Bearings” section.

Camshaft	**Journal diameter**
Front	**53.495 - 53.510 mm**
Center	**53.450 - 53.470 mm**
Rear	**53.480 - 53.500 mm**
Wear limit	**0.200 mm**

CLEARANCE BETWEEN THRUST PLATE AND CAMSHAFT

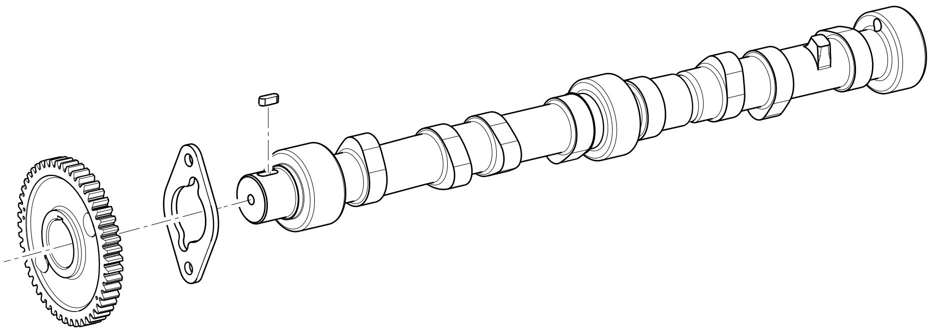
1. Measure clearance between thrust plate and camshaft.

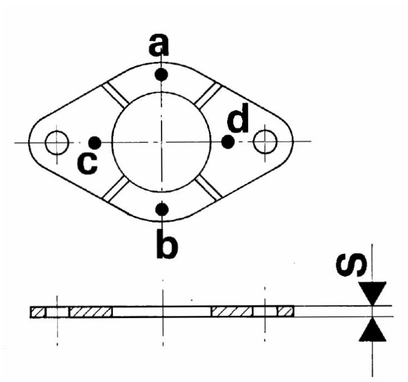
Camshaft	
Thrust plate and camshaft clearance	0.030-0.095 mm

IMPORTANT: Camshaft gear is a press fit on shaft. If removal is needed, upon reassembly gear must be heated in an oven to **180-200 degrees °C (360-390 degrees °F) for 10 minutes** and pressed on the shaft. After installing the proper thrust plate and positioning the key, press the gear until it is tight against the shoulder.

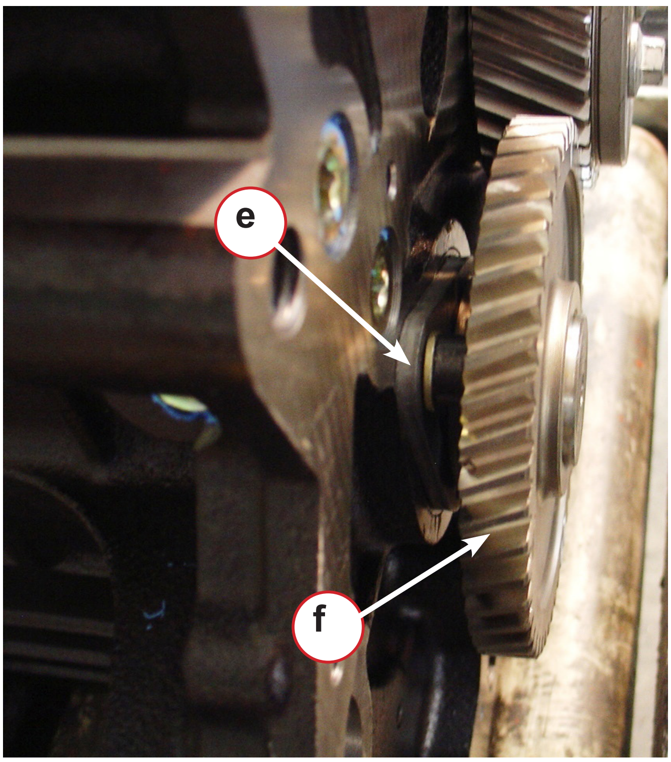
2. If the measured value exceeds specification, remove and inspect the thrust plate thickness at four opposite points. Replace the plate if assembly clearance is less than specified at any point.

Camshaft thrust plate thickness (S)	3.95 - 4.05 mm





s - Camshaft thrust plate thickness
a,b,c,d - Thickness dimension at four opposite points
e - Camshaft thrust plate
f - camshaft gear

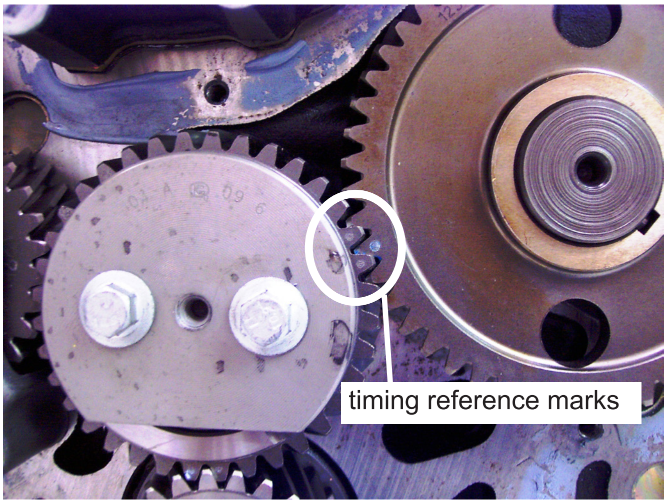


REMOVAL

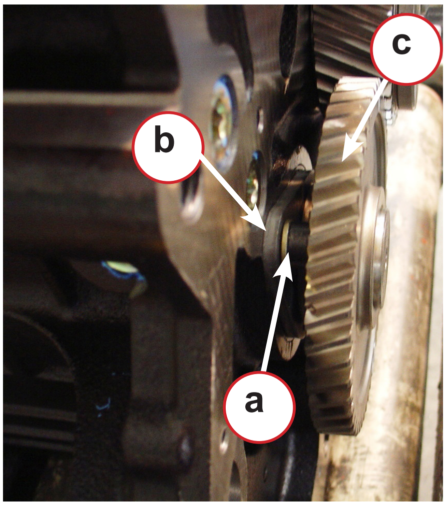
Turn crankshaft to cylinder number 1 TDC of its compression stroke so that the timing marks on camshaft gear and idler gear are aligned as shown.

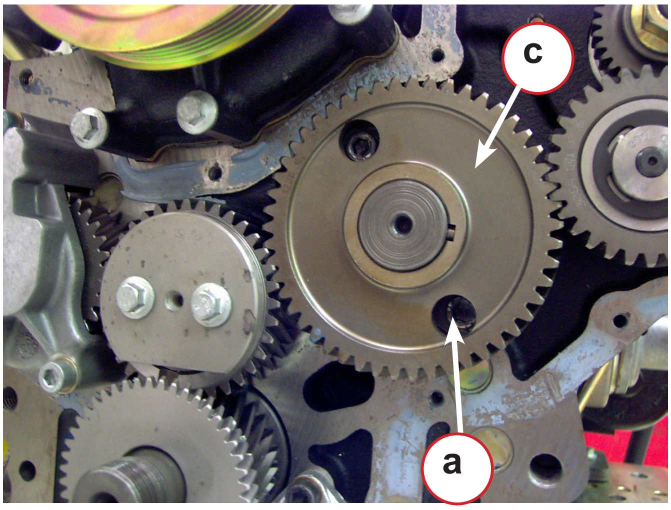
IMPORTANT: Place rocker arm assemblies, valve push rods and lifters in a rack for reassembly in their original locations.

Remove the rocker arm assemblies and valve push rods. Remove the valve roller lifters.
Remove the cylinder heads.
Remove the oil level dipstick.
Remove camshaft thrust plate mounting screws and lock washers.
Carefully withdraw the camshaft. Take care not to damage the camshaft bearings.



a - Camshaft thrust plate mounting screw
b - Camshaft thrust plate
c - camshaft gear





INSTALLATION

Lubricate the camshaft lobes with engine oil
Lubricate the camshaft bearings.
Install the camshaft. Be careful not to damage the bearings.
Align the timing marks on camshaft gear and idler gear as shown previously.
Install the thrust plate mounting screws using the lockwashers. Torque the screws.

Camshaft thrust plate mounting screw	**27.5 Nm**

CAMSHAFT BEARINGS

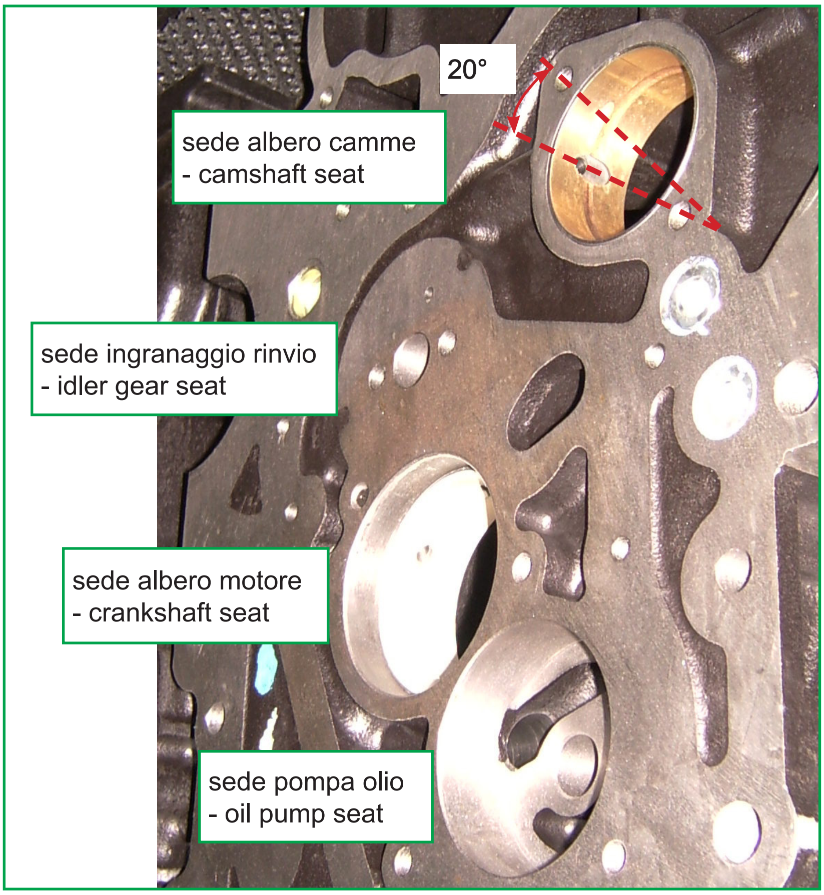
INSPECTION

1. Remove the camshaft.
2. Inspect the camshaft bearings. Replace the bearings if they are worn or damaged.
3. Measure the inner diameter of the camshaft bearings and compare to the camshaft journal dimensions. Calculate the bearing clearance.

⚠ **IMPORTANT: In service when replacing the front camshaft bushing it must be bored once that is installed into its cranckcase seat. Install the front bushing by aligning the lubrication oil hole in the block with the bushing hole. Refer to the picture to identify the inclination angle.**

SPECIFICATIONS

Camshaft Front Bushing	
Bushing inner diameter (Bushing **bored** into the block)	53.59 - 53.62 mm
Clearance (bushing - journal)	0.08 - 0.125
Camshaft Rear and Center Bearing	
Bearing inner diameter (bearings installed in the block)	53.550 - 53.600 mm
Clearance (Center Bearing)	0.08 - 0.15
Clearance (Rear Bearing)	0.05 - 0.12
First oversized Bushing	0.25 mm



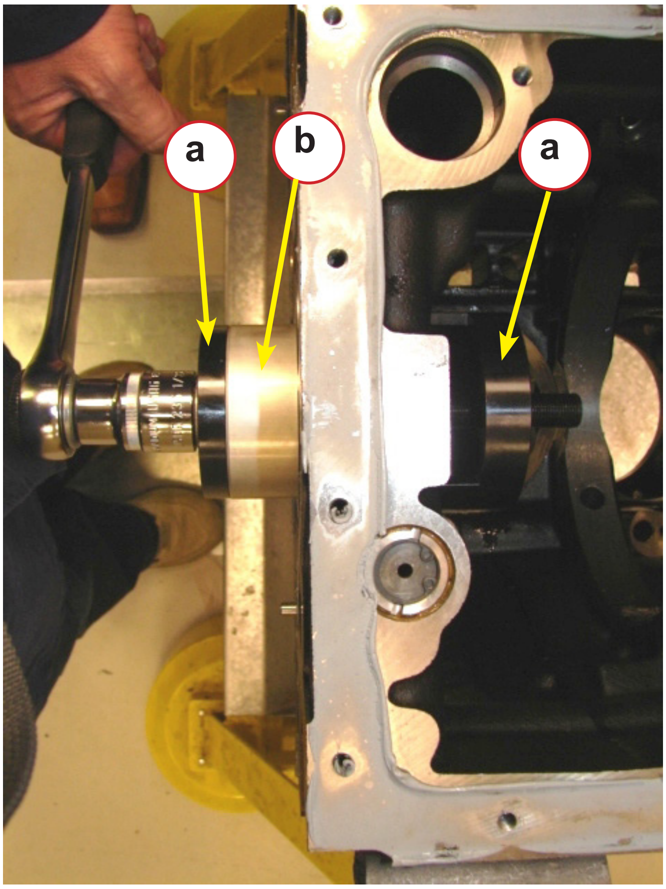
FRONT JOURNAL CAMSHAFT BUSHING

Install a new bearing on bearing puller tool.
Align the oil passage in the engine block with the hole of the new bearing.
NOTE: To aid installation retain bearing halves on tool with a rubber band or similar.

Assemble the Front Main Bearing and Camshaft Bearing Puller into front main bearing.

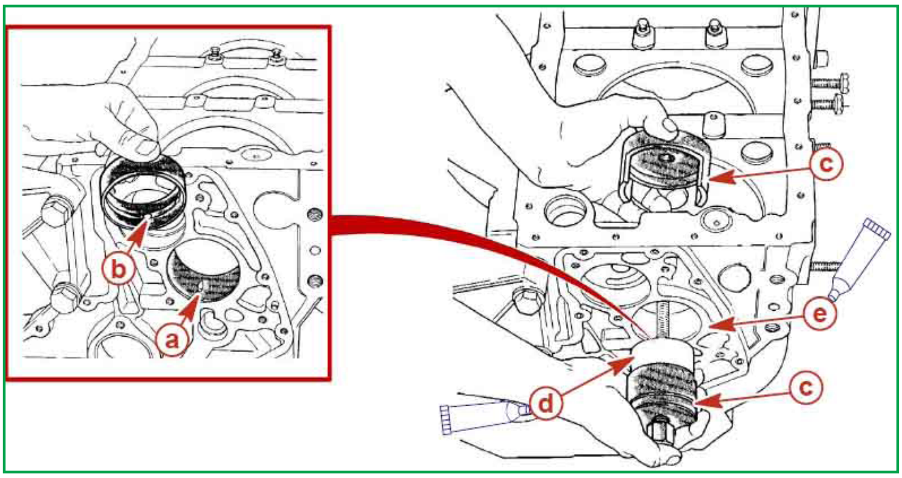
a - Bearing puller tool
b - Front main bearing (new bushing)

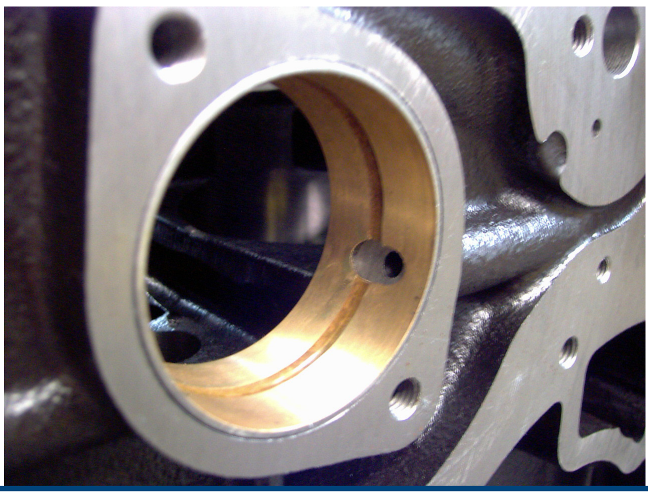
Apply Loctite 601 on the bearing outer surface.
Using two wrenches, hold the puller screw and then, turn the nut until the old bearing has been pulled out from proper seat.
The Front Main Bearing and Camshaft Bearing Tool will install the bearing to the correct depth.

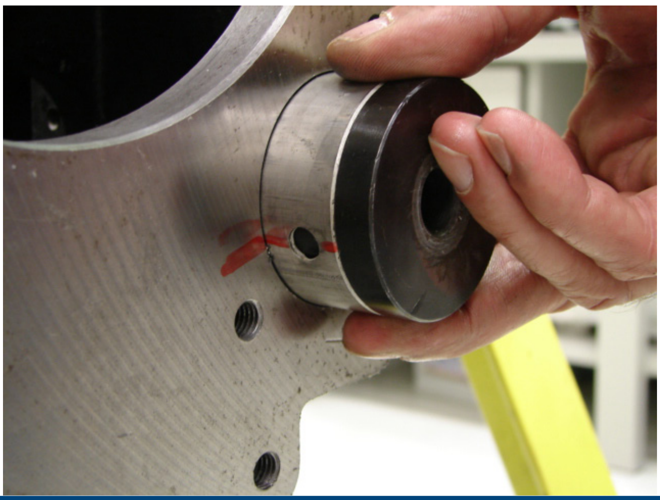


IMPORTANT: While removing/install a new bearing (Crankshaft Front Main Bearing or Camshaft Bearing) ensure that the oil hole in the bearing is positioned correctly. The oil hole in the bearing must be aligned with the oil passage in the engine block for proper lubrication.

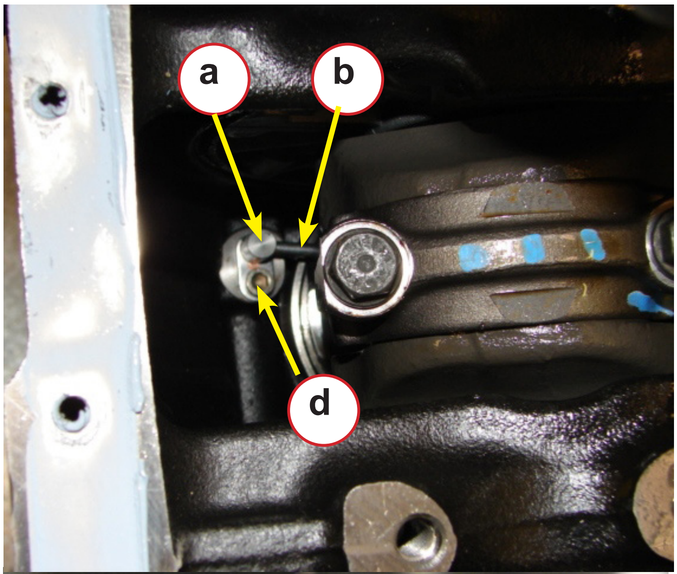
a - Oil passage (in crankcase)
b - Bearing hole
c - Front Main Bearing and Camshaft Bearing Puller Tool
d - Bearing halves (on tool)
e - Bearing bore







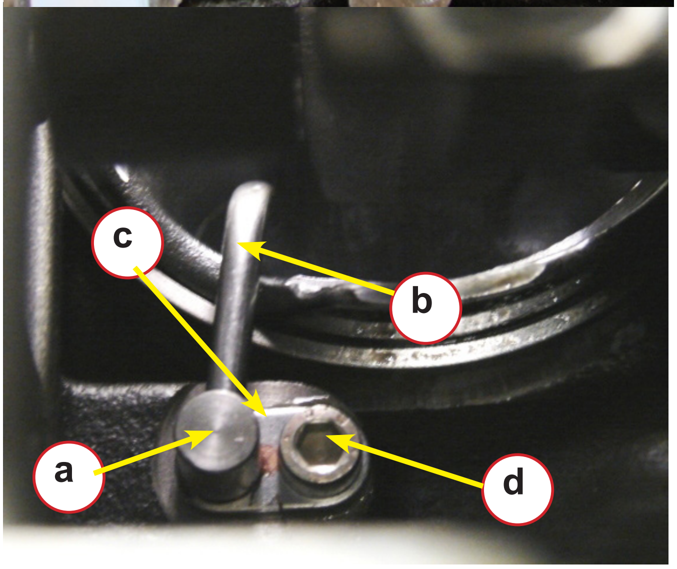
PISTON COOLING JETS (OIL SPRAY NOZZLES)



Oil spray from the piston cooling jet nozzles cools and lubricates the piston and other engine components. Inadequate or improper oil spray could result in engine damage.
Ensure the oil spray nozzles are clean and the piston cooling jet assemblies are correctly installed to allow proper oil spray distribution.

Remove the piston cooling jet assembly from near the cylinder bore.
Remove and discard the O-ring seal on the piston cooling jet.

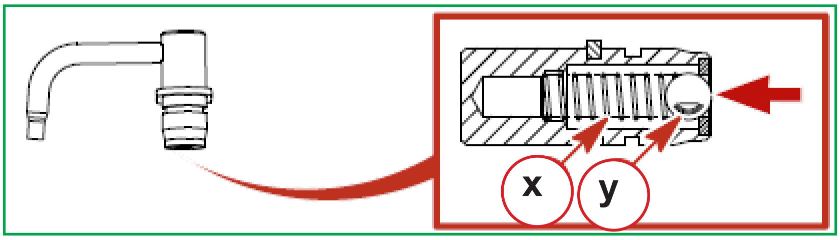
a - Cooling jet assembly
b - Nozzle
c - Plate
d - Bolt



Clean the passages of the piston cooling jet and cylinder block.
Put on safety glasses.
Blow out any debris from cleaning, using compressed air.
Ensure the check valve ball moves freely against the spring in the bore.

x - Spring
y - Check valve ball

2. Check for a cracked, bent or damaged tube or nozzle.



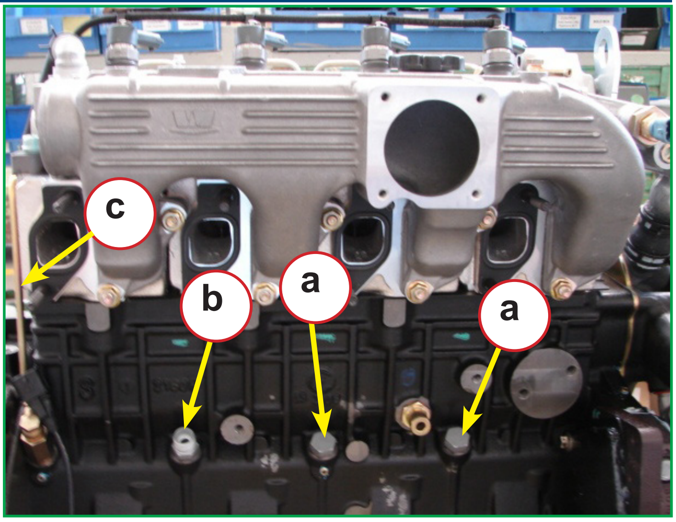
Install a new O-ring in the piston cooling jet groove.
Lubricate the piston cooling jet O-ring.
Insert the piston cooling jet assembly into the cylinder block.
Ensure that the piston cooling jet assembly is correctly seated.
Position the tube and nozzle as shown.
Apply sealant to the piston cooling jet assembly screw threads.
Install and torque the piston cooling jet assembly screw.

Piston cooling jet assembly screw	**12.7 Nm**

CRANKSHAFT

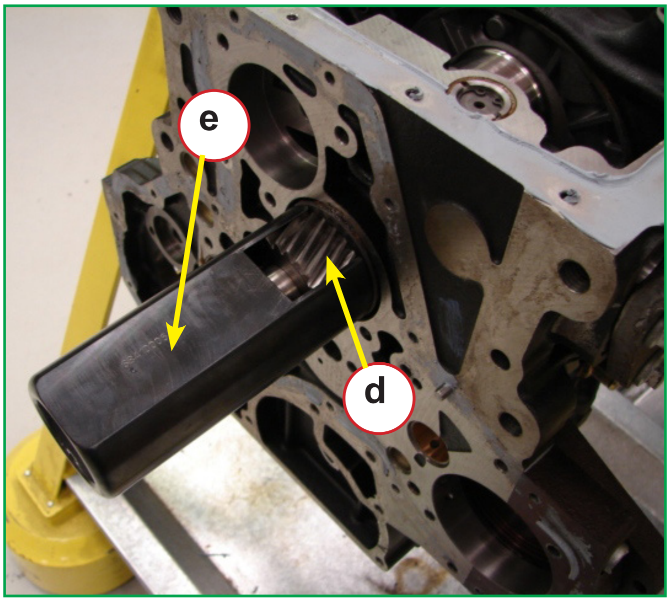
REMOVAL

1. Remove the main bearing locating screws and special locating screws that hold the main bearing carriers in cylinder block and supply lubricating engine oil to main bearings carriers and front / rear main bearings.



a - Locating screw - standard
b - Special locating screw (for oil supply hose to turbocharger)
c - Oil supply pipe - rocker arms

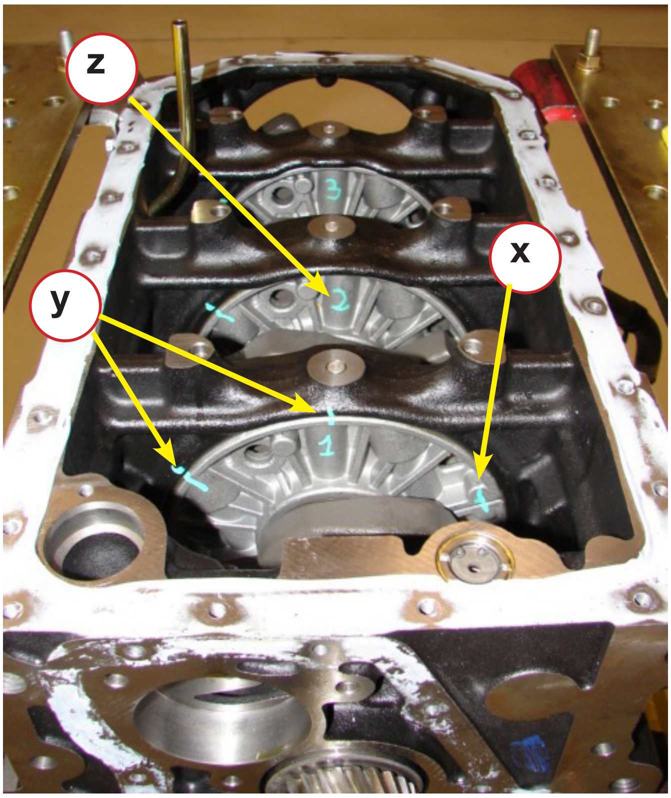
2. Install the Crankshaft Installer Tool over the timing gear to protect front main bearing.



d - Crankshaft Installer Tool
e - Crankshaft gear

IMPORTANT: Before removing the crankshaft from the block, number or mark the bearing carriers according to the journal upon which they are fitted. Also make matching marks on both bearing carrier halves for correct reassembly.

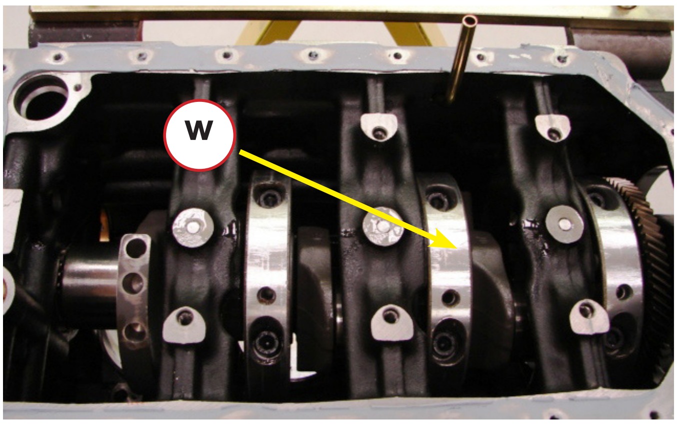
IMPORTANT: When removing the crankshaft do not damage the piston cooling jet. Ensure to remove the oil piston cooling jet. (Refer to Oil Piston cooling Jets Section)



x - matching marks on both bearing carrier halves
y - matching marks on all main bearing carriers (between carrier and block)
z - number all main center bearing carrier according to the journal upon which they are fitted

3. Withdraw the crankshaft so that the main bearing carries can be disassembled.
Disassemble all main bearing carriers.
Take crankshaft off from the cylinder block.

w - main bearing carriers removed proper block bore



INSPECTION

1. Inspect crankshaft for deep grooves, scratches, pitted surfaces or uneven wear.
2. Inspect crankshaft rear oil seal surface for scoring or damage.
3. Inspect crankshaft oil passages for restrictions.
4. Inspect the crankshaft threaded bolt holes for damage.
5. Inspect the crankshaft balancer keyway for damage.

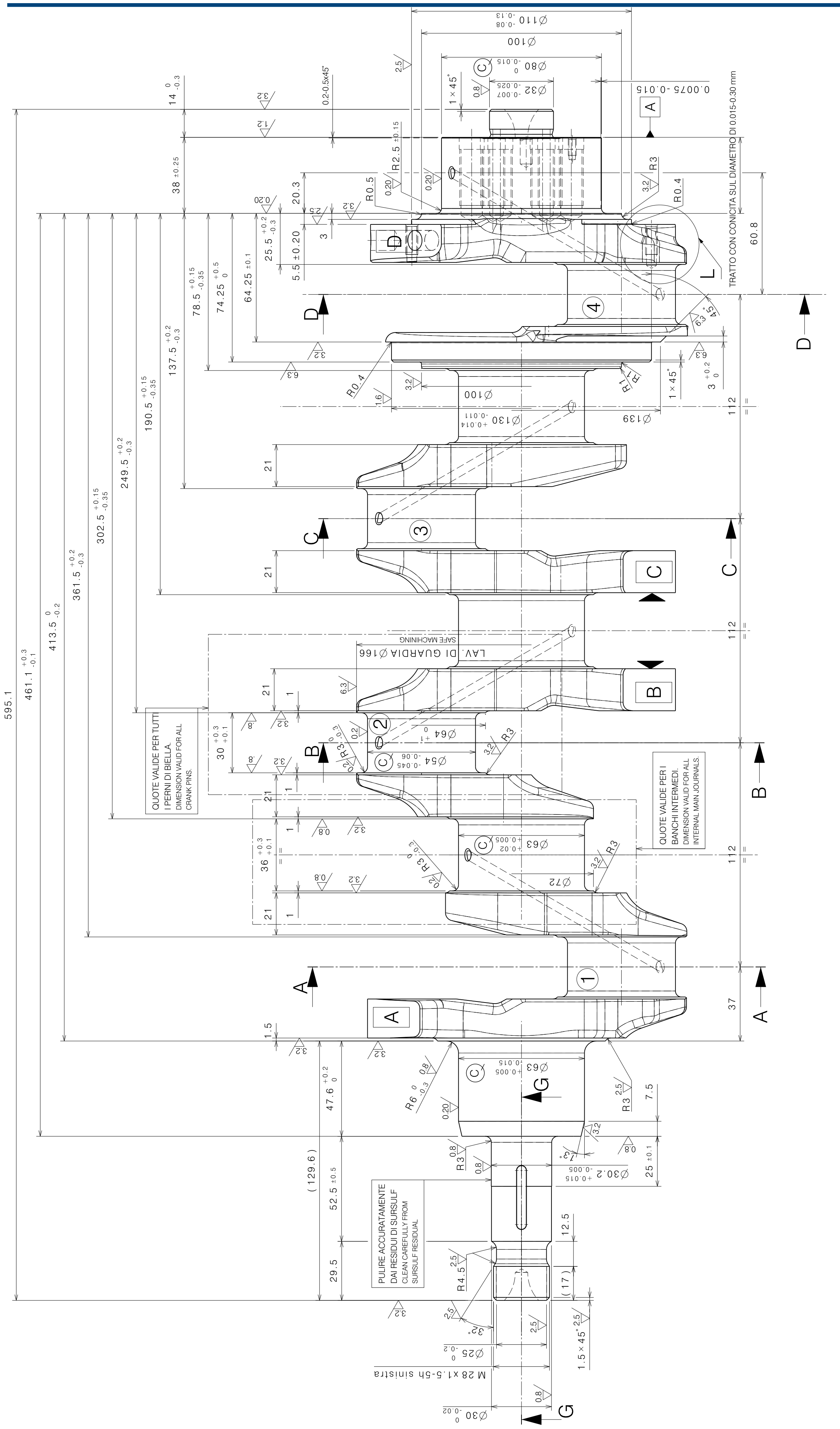
6. After a seizure, overheating or grinding, crankshaft must be Magnafluxed to verify no surface cracks are present.
After grinding perform “SURSULF” treatment (hardness HV 587 with load of 500 gr. corresponding to HRc 53).
After treatment “SURSULF” perform lapping o n all surfaces with roughness Ra 0.18 / 0.22.

IMPORTANT: It is forbidden the crankshaft straightening after SURSULF treatment. No material may be removed, either by hand or machine grinding, from thrust faces of crankshaft. Replace crankshaft if machined surfaces on front and rear ends or threaded areas of crankshaft ends are out-of-round, worn or damaged.

7. Measure the journals of the crankshaft to determine if replacement or grinding is necessary.

SPECIFICATIONS

Lenght (4 cylinders)	595.1 mm
Lenght (6 cylinders)	819.1 mm
Crankshaft Front Main Bearing Journal Outer diameter	62.985 - 63.005 mm
First Oversized Bearing	0.25 mm
Center Main Bearing Crankshaft Journal Outer diameter	63.005 - 63.02 mm
First Oversized Bearing	0.25 mm
Rear Main Bearing Crankshaft Journal Outer diameter	79.985 - 80 mm
First Oversized Bearing	0.25 mm
Crankshaft Connecting Rod Journal Outer diameter	53.940 - 53.955 mm
First Oversized Bearing	0.25 mm
Wear limit	0.10 mm
Front Main Bearing Clearance (between crankshaft Front Main Bearing Journal Outer diameter and crankshaft Front Main Bearing inner diameter)	0.023 - 0.083 mm
Center Main Bearing Clearance (between Center Main Bearing Crankshaft Journal Outer diameter and main bearings carrier inner diameter)	0.008 - 0.051 mm
Rear Main Bearing Clearance (between Rear Main Bearing Crankshaft Journal Outer diameter and Rear Main Bearing carrier inner diameter)	0.045 - 0.085 mm
Connecting Rod Bearing Clerance (between Crankshaft Connecting Rod Journal Outer diameter and connecting ros bearings inner diameter)	0.012 - 0.066 mm


QUOTE VALIDE PER TUTTI I PERNI DI BIELLA.
DIMENSION VALID FOR ALL CRANK PINS.
QUOTE VALIDE PER I BANCHI INTERMEDI.
DIMENSION VALID FOR ALL INTERNAL MAIN JOURNALS.
PULIRE ACCURATAMENTE DAI RESIDUI DI SURSULF
CLEAN CAREFULLY FROM SURSULF RESIDUAL
TRATTO CON CONICITA SUL DIAMETRO DI 0.015-0.30 mm
LAV. DI GUARDIA Ø166
SAFE MACHINING
M 28 x1.5-5h sinistra

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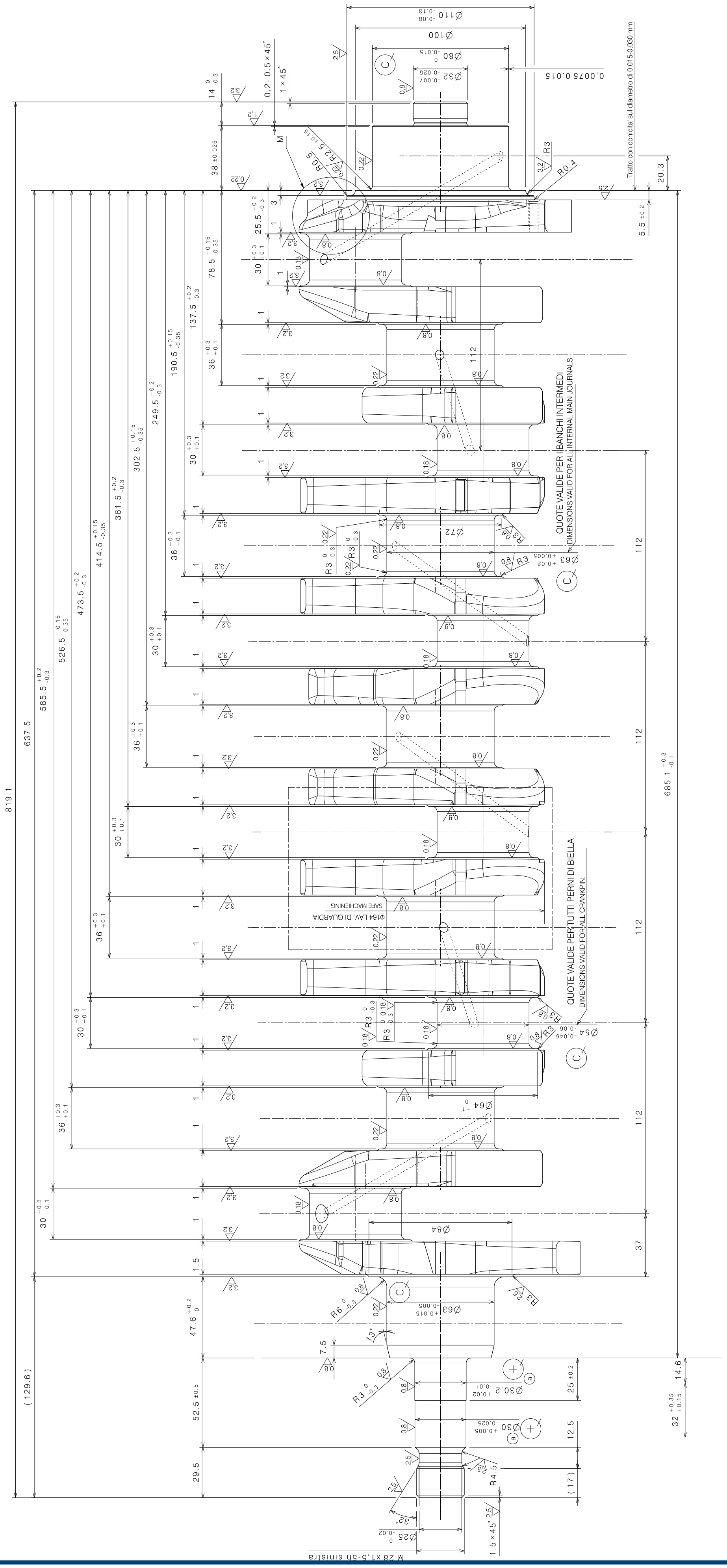
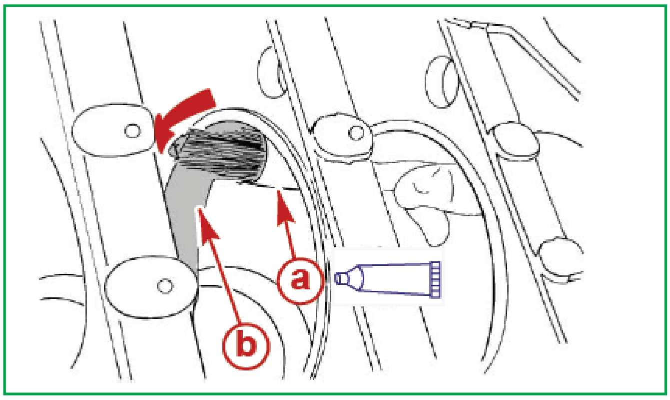

QUOTE VALIDE PER I BANCHI INTERMEDI
DIMENSIONS VALID FOR ALL INTERNAL MAIN JOURNALS
QUOTE VALIDE PER TUTTI PERNI DI BIELLA
DIMENSIONS VALID FOR ALL CRANKPIN.
Tratto con conicita' sul diametro di 0.015-0.030 mm
Ø164 LAV. DI GUARDIA
SAFE MACHIENING
M 28 x1,5-5h sinistra

INSTALLATION

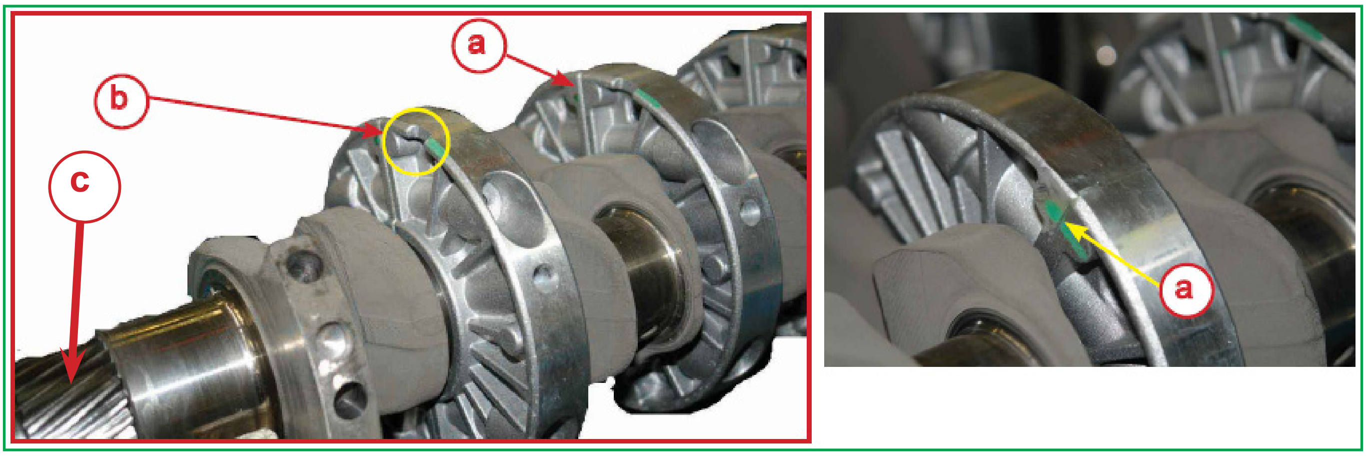
Lubricate with grease the main bearing bores in the cylinder block.
Install the matching main bearing carrier halves on crankshaft journals in their original locations (marked during disassembly) or by referencing the factory paint marks on the side.
Ensure that all carriers were positioned so that the front of the carrier halve is toward the crankshaft gear after installing them on the journal.
Lubricate with MOLYguard LMP 180 grease the bearing carrier underside bolts and thread and torque them.

Bearing carrier bolt	44.1 Nm

a - Brush dipped in lubricant
b - Main bearing bore

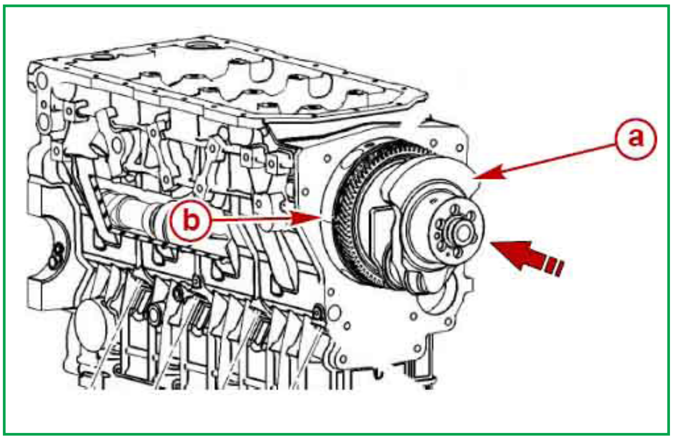


a- Reference paint marks made by factory or operator during disassembly
b-- Reference that identifies the front of the carrier, it must be pointed toward the crankshaft gear.
c- crankshaft gear

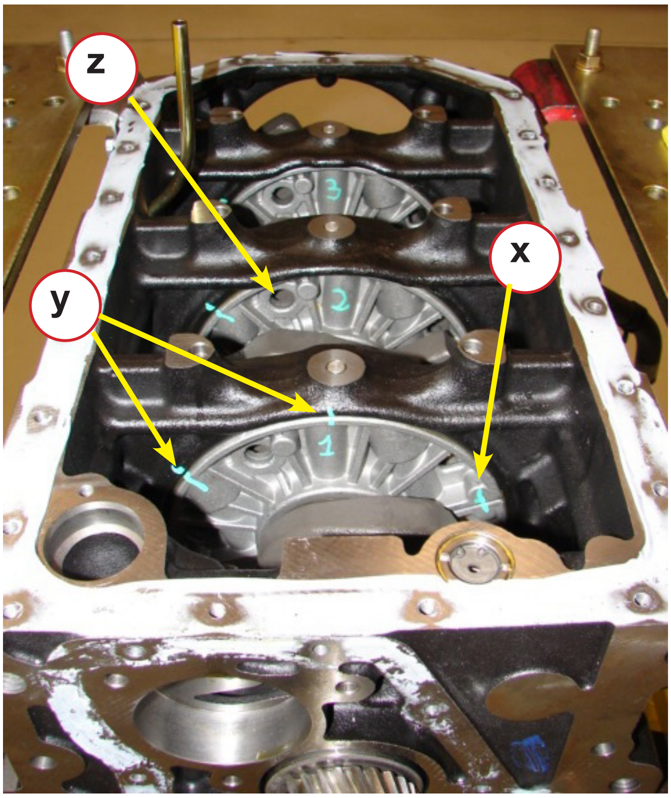


Install the Crankshaft Installer Tool over the timing gear to protect the front main bearing.
Position the engine cylinder block horizontal with the oil pan flange facing up.
Carefully insert the crankshaft with the main bearing carriers attached into the cylinder block.

a - Crankshaft assembly
b - Main bearing carrier entering cylinder block

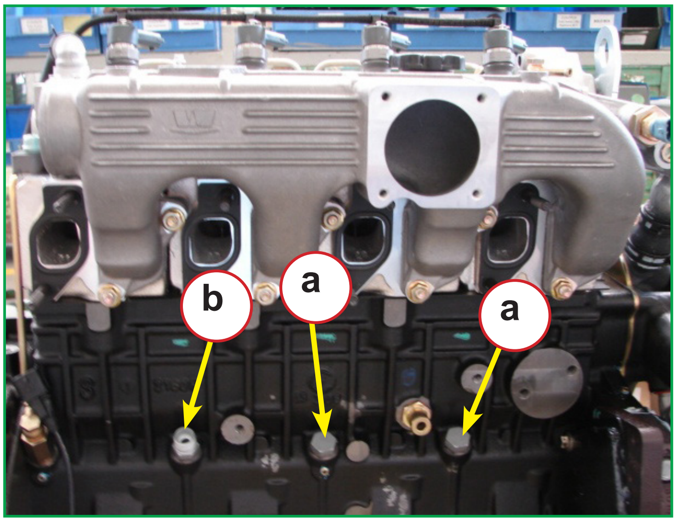


Rotate the bearing carriers to align with marks made during disassembly. If no marks are present, position the bearing carriers with the round hole through the casting pointing toward the oil pan flange.



x - matching marks on both bearing carrier halves
y - matching marks on all main bearing carriers (between carrier and block)
z - Round holes through the castings

Install new sealing washers on all main bearing locating screws and special locating screws.
To avoid damaging the threads,hand thread the main bearing locating screws and special locating screws into the bearing carriers.
Torque all main bearing locating screws and special locating screws.



a - Locating screw - standard
b - Special locating screw (for oil supply hose to turbo-charger)

Locating screw	53.9 Nm

CRANKSHAFT FRONT MAIN BEARING

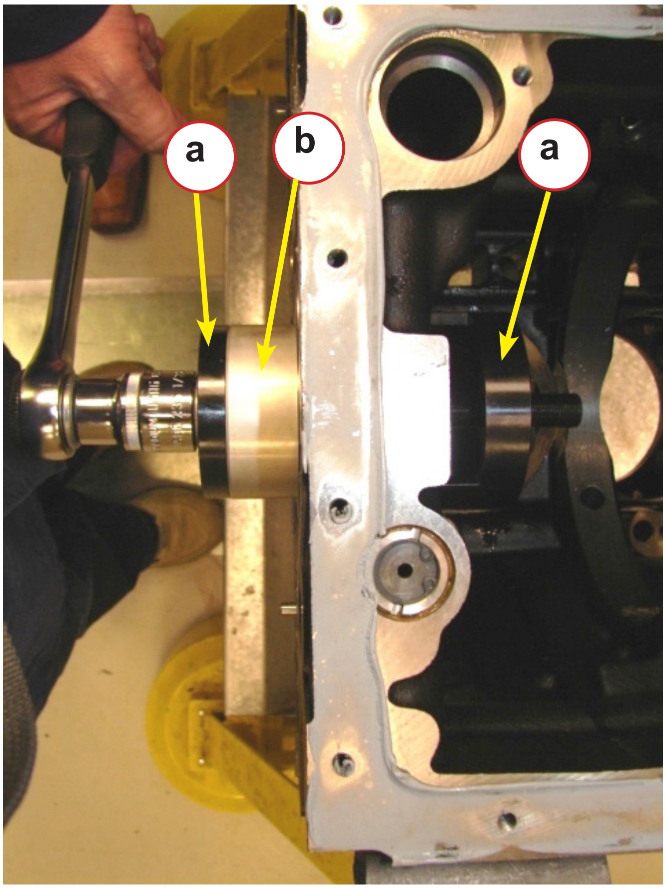
Install a new bearing on bearing puller tool.
Align the oil passage in the engine block with the hole of the new bearing.
NOTE: To aid installation retain bearing halves on tool with a rubber band or similar.

Assemble the Front Main Bearing and Camshaft Bearing Puller into front main bearing.

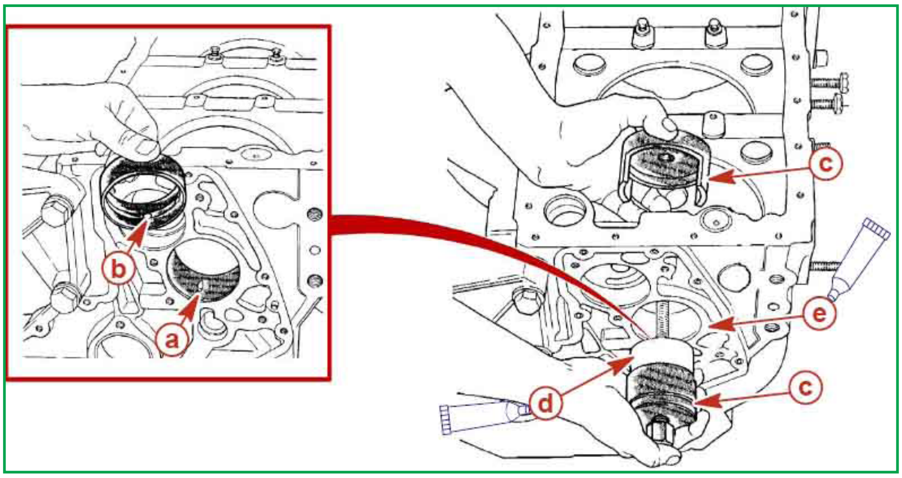
a - Bearing puller tool
b - Front main bearing

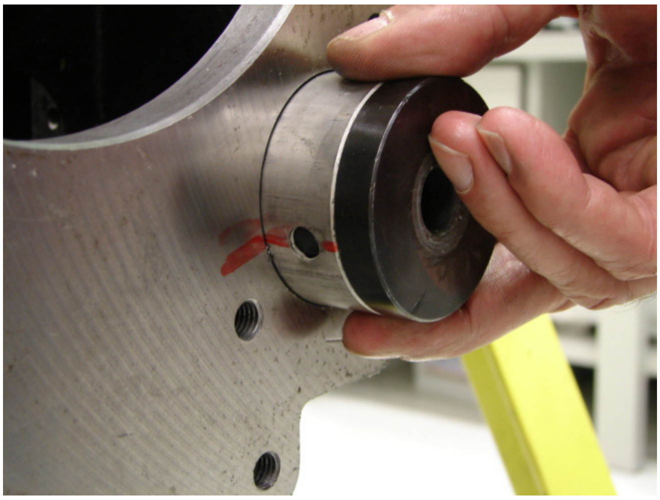
Apply Loctite 601 on the bearing outer surface.
Using two wrenches, hold the puller screw and then, turn the nut until the old bearing has been pulled out from proper seat.
The Front Main Bearing and Camshaft Bearing Tool will install the bearing to the correct depth.

IMPORTANT: While removing/install a new bearing (Crankshaft Front Main Bearing or Camshaft Bearing) ensure that the oil hole in the bearing is positioned correctly. The oil hole in the bearing must be aligned with the oil passage in the engine block for proper lubrication.



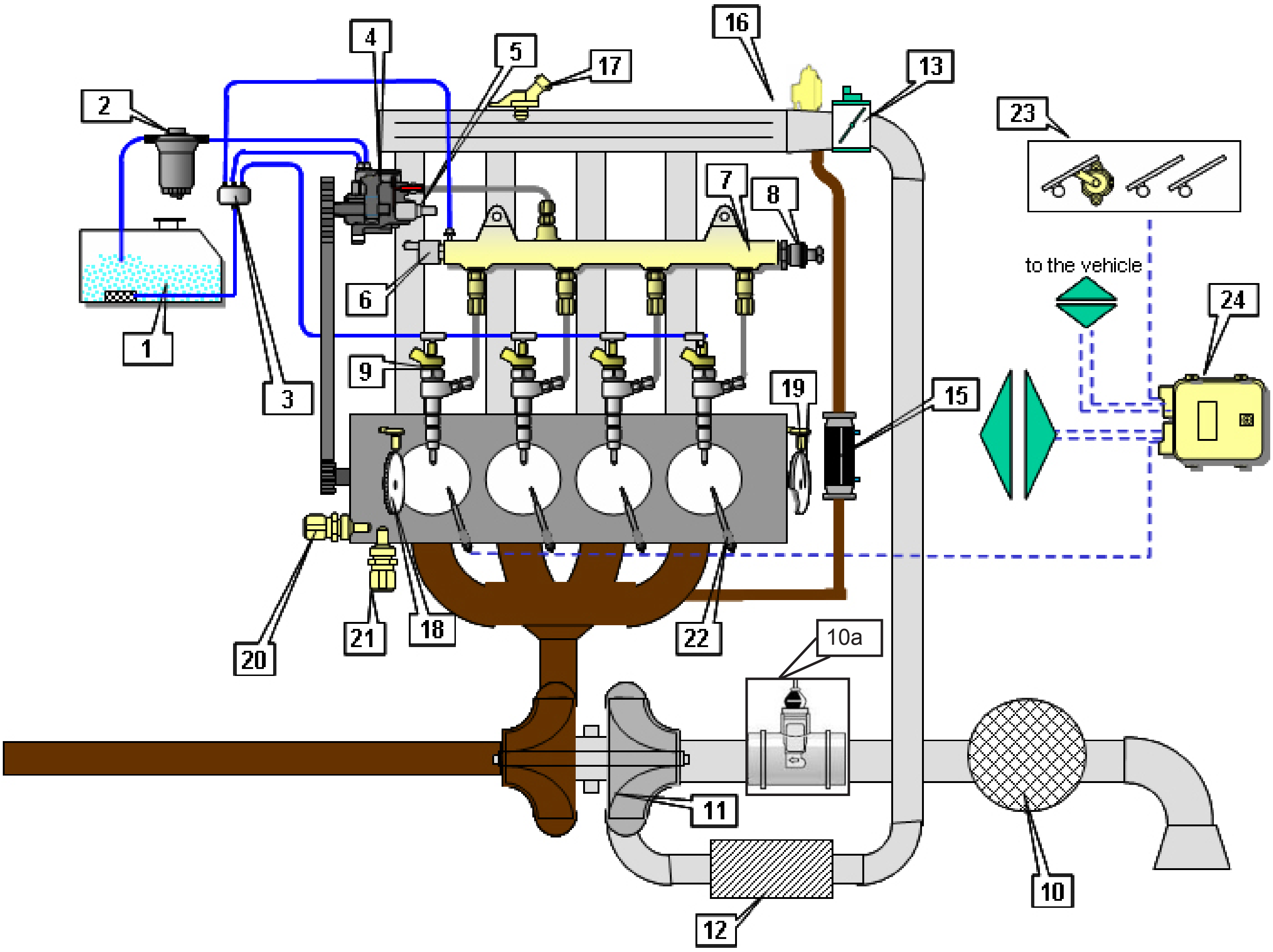
a - Oil passage
b - Bearing hole
c - Front Main Bearing and Camshaft Bearing Puller Tool
d - Bearing halves (on tool)
e - Bearing bore





INJECTION FUEL SYSTEM

DIAGRAM



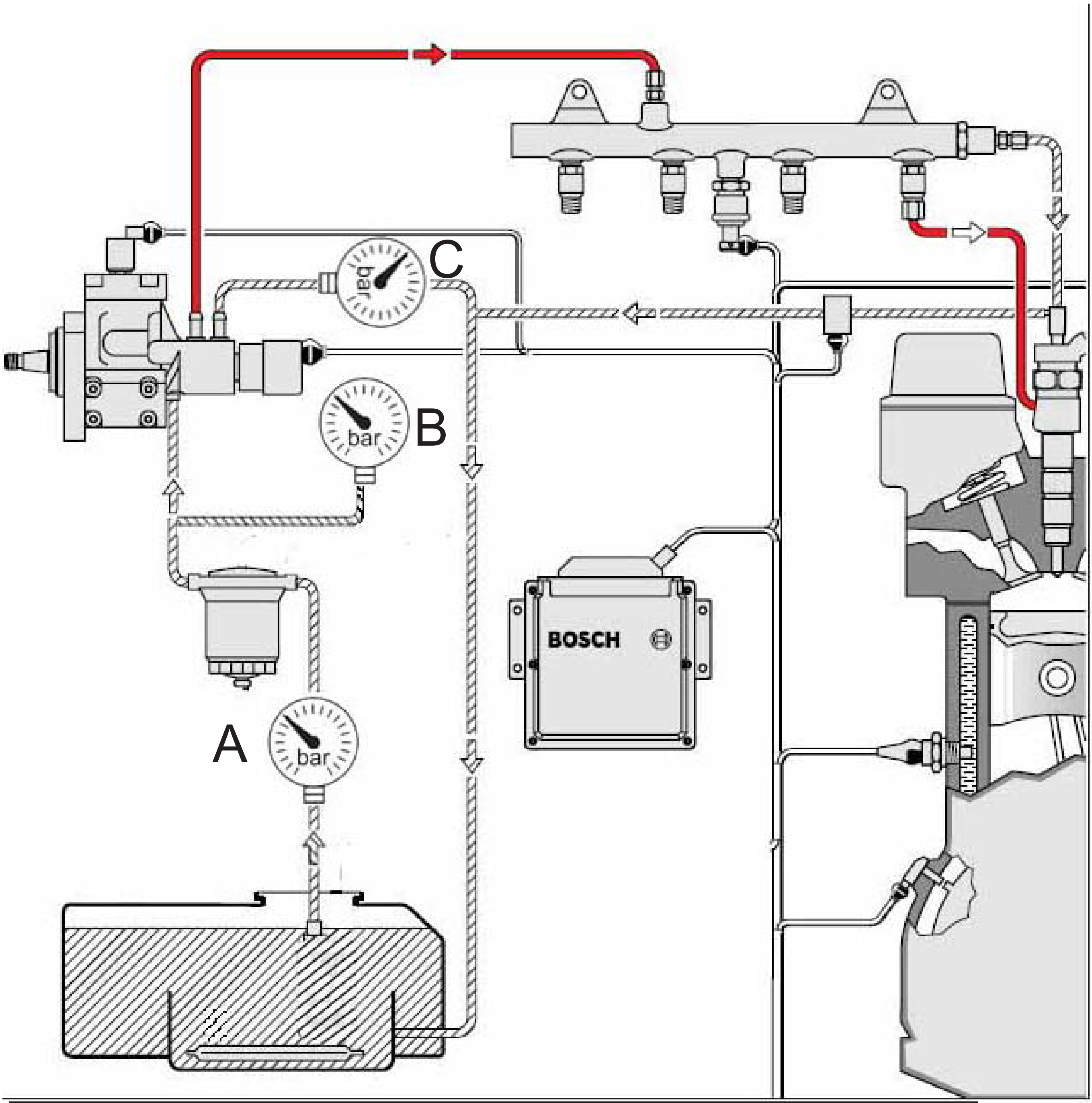
1. Serbatoio combustibile
2. Filtro combustibile
3. Blocchetto di rifiuto nafta
4. Pompe iniezione alta pressione
5. Valvola di regolazione pressione combustibile
6. Valvola regolazione pressione nel rail
7. Accumulatore di pressione (Rail)
8. Sensore pressione rail
9. Iniettori
10. Filtro Aria - **10a. Debimetro (solo per motori EURO 5)**
11. Turbocompressore
12. Intercooler
13. Valvola aspirazione a farfalla
14. Valvola EGR
15. Scambiatore di calore EGR
16. Collettore EGR
17. Collettore aspirazione/ sensore pressione aria comburente
18. Sensore di posizione albero motore/sensore giri
19. Sensore da fase albero camme
20. Sensore temperatura liquido di raffreddamento
21. Sensore pressione e temperatura olio motore
22. Candelette
23. Pedale acceleratore
24. Centralina motore

1. Tank
2. Fuel Filter Assembly
3. Fuel refuses collecting block
4. High Pressure Pump
5. Fuel metering Valve
6. Rail Pressure Regulator Valve
7. Rail
8. Rail Pressure Sensor
9. Injectors
10. Air Filter

10a. Air Mass Flow meter - only for EURO 5 engine models

11. Compressor
12. Intercooler
13. Electronic Throttle Body
14. EGR Pneumatic Valve
15. EGR Cooler
16. EGR Distributor
17. Intake Manifold Pressure + Temperature Sensor
18. Crankshaft Position / Engine Speed Sensor
19. Camshaft Position Sensor
20. Coolant Temperature Sensor
21. Oil temp & Pressure sensor
22. Glow Plugs
23. Pedal Assembly
24. Engine Control Unit

LOW PRESSURE SYSTEM REQUIREMENTS



A	Inlet fuel filter - 0.4 bar
B	Outlet fuel filter/Inlet low pressure pump
B	max vacuum pressure
Difference between A - B	(max. bar)
C	fuel pump return
C	≤ 0.6 bar

HIGH PRESSURE PUMP

REMOVAL

Release the clamp and disconnect the fuel delivery rubber hose from the pump.

Loosen and remove the fuel return hose hollow bolt and proper washers from the pump.

Loosen and remove the fuel delivery pipe nut from high pressure pump to rail.

Loosen and remove the 3 fixing flange screws.

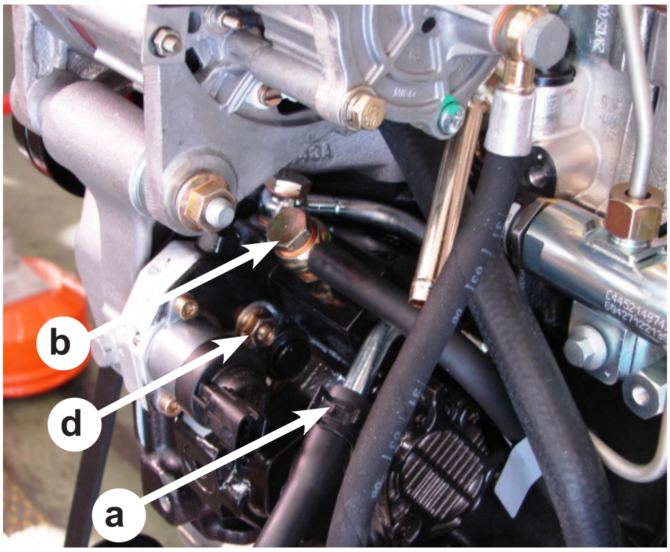
Take the pump off. Replace the gasket install on the studs.

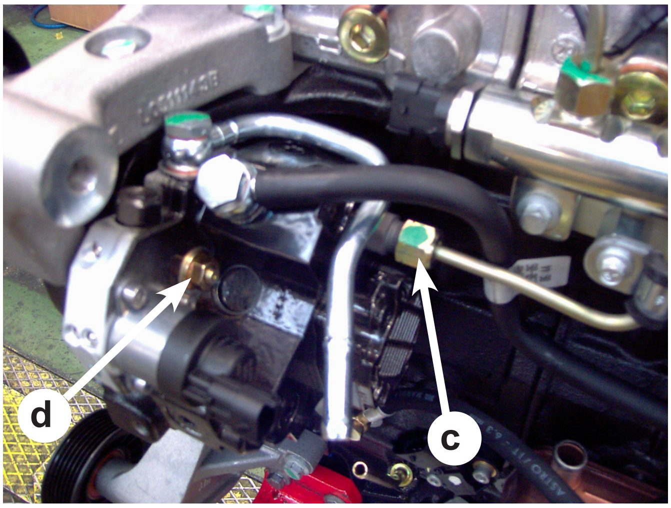
a - fuel delivery rubber hose clamp

b - fuel return rubber hose hollow bolt and proper washers

c - fuel delivery pipe from high pressure pump to rail.

d - fixing flange nut

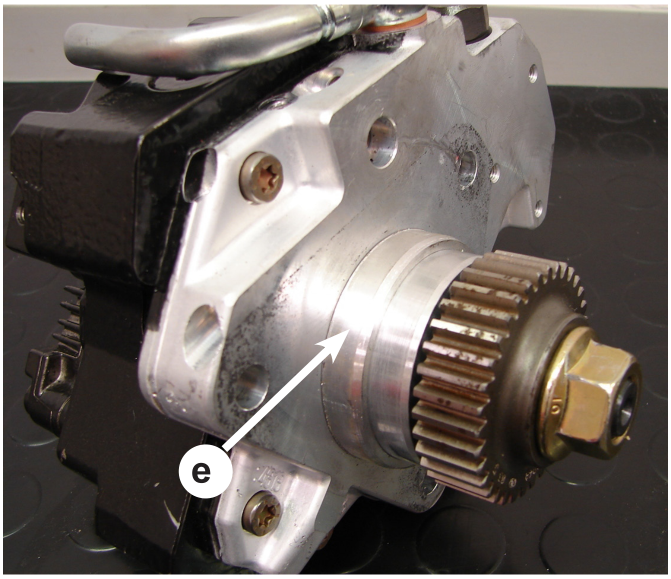




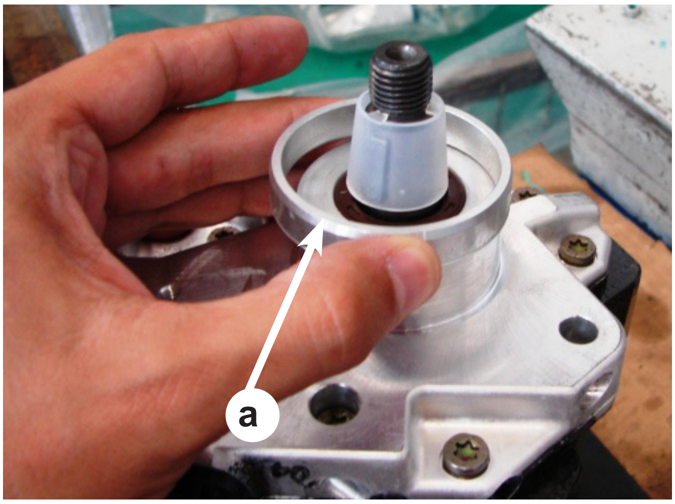
Loosen the flange nut and use a normal gear extractor to remove the injection pump gear.

Remove the collar out without damaging the body flange of the pump. At the spare parts the pump will supply as assembly: pump and collar.

e - collar



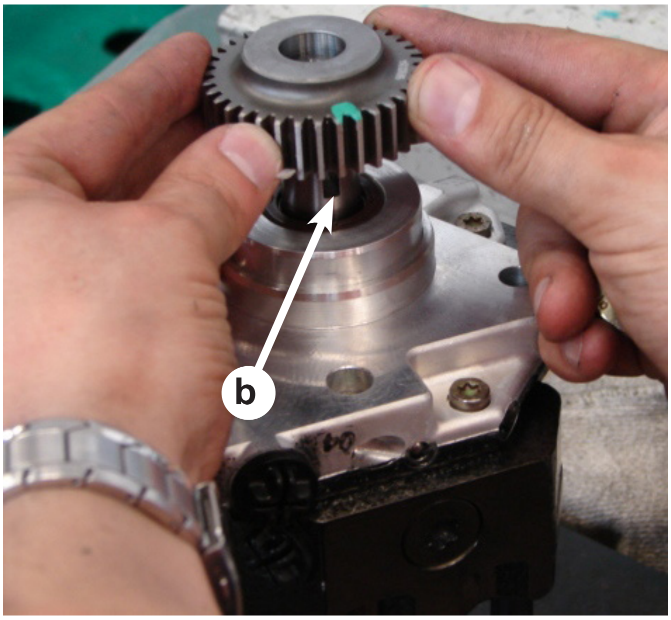
INSTALLATION



Install the collar with bevelled side towards outside.

Press the collar till it goes in contact with body flange pump.

a - bevel



Install the gear on the pump shaft.

IMPORTANT: The spline is not installed on the pump shaft keyway.

b - keyway

Install the nut and torque it.

High pressure pump gear nut	86.4 Nm

Install a new gasket on the studs.

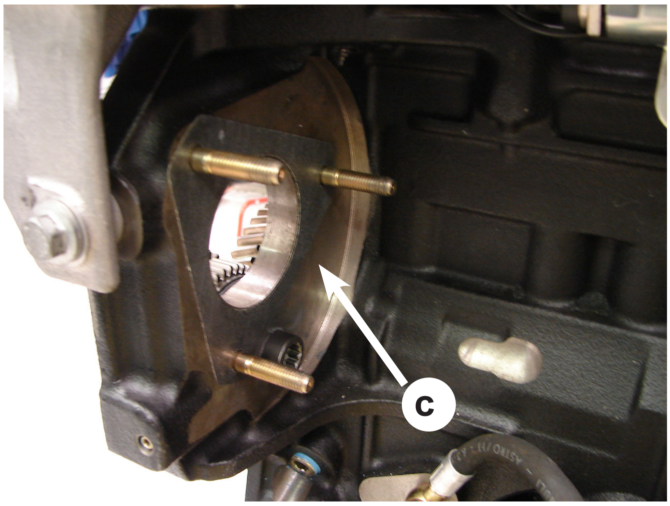
c - gasket

Install the high pressure pump on studs, thread the flange nuts and torque them.

d - flange nut

High pressure pump flange nut	27.5 Nm

NOTE: THE PUMP MUST NOT BE TIMED.



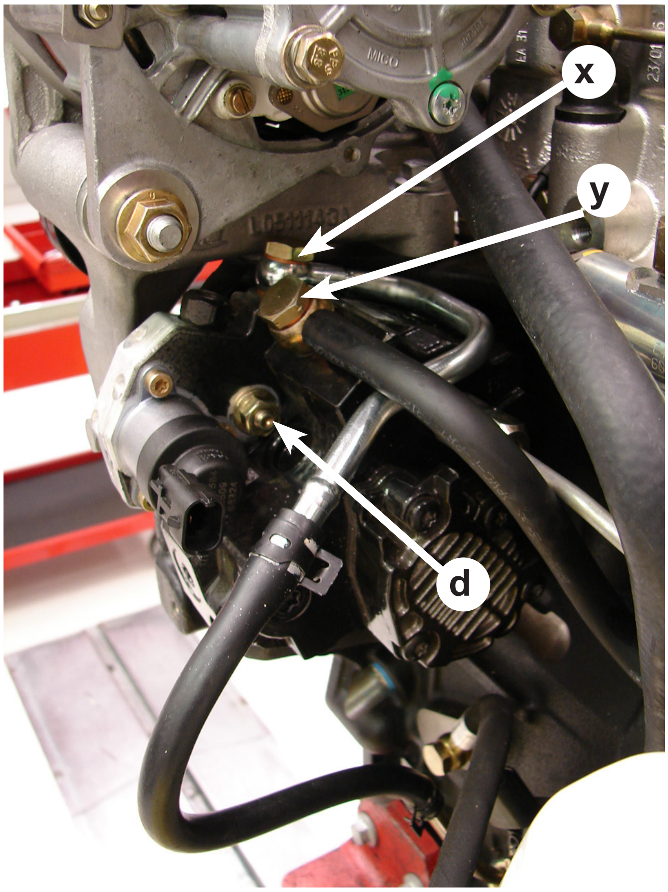
Install with proper clamp the fuel return rubber hose to the pump.

Install the fuel delivery hose hollow bolt with proper washers to the body pump and torque it.

x - fuel delivery hose hollow bolt

y - fuel return hose hollow bolt

fuel delivery hose hollow bolt	27.5 Nm
fuel return hose hollow bolt	



WARNING: When the pump is removed a specific procedure must be performed to install correctly high pressure fuel delivery pipes.

Before installing the high pressure pipe from pump to rail and high pressure pipes from rail to injectors a specific procedure must be observed. (Refer to High Pressure fuel components Tightening Procedure)

NOTE: Whenever each of these components such as the high pressure pump, injectors, rail and any high pressure fuel pipe (pipe from pump to rail and pipes from rail to injectors) are loose and/or removed, a specific procedure must be performed in order to avoid fuel leakage in the high pressure fuel system, high pressure fuel delivery pipes.

(REFER TO HIGH PRESSURE FUEL COMPONENTS TIGHTENING PROCEDURE)

INJECTOR

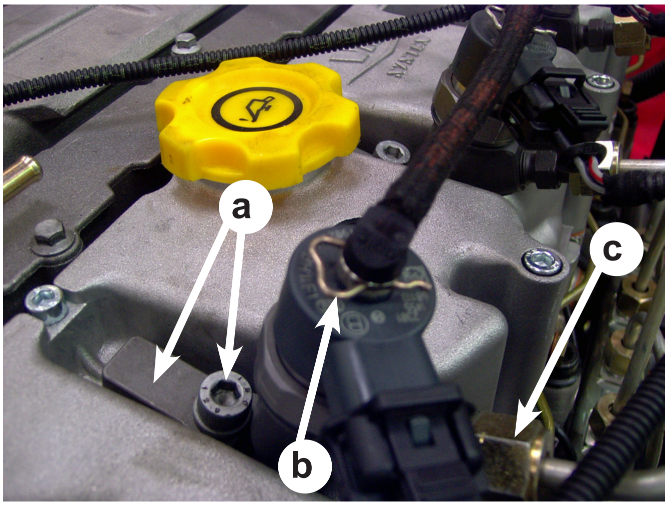
Removal

IMPORTANT: Whenever injectors are removed for service, they must be retained in order. At the time of installation, they must be installed in the same locations as when removed, because each injector has a proper IMA code.

Loosen the injector fixing screw and remove the clamp.

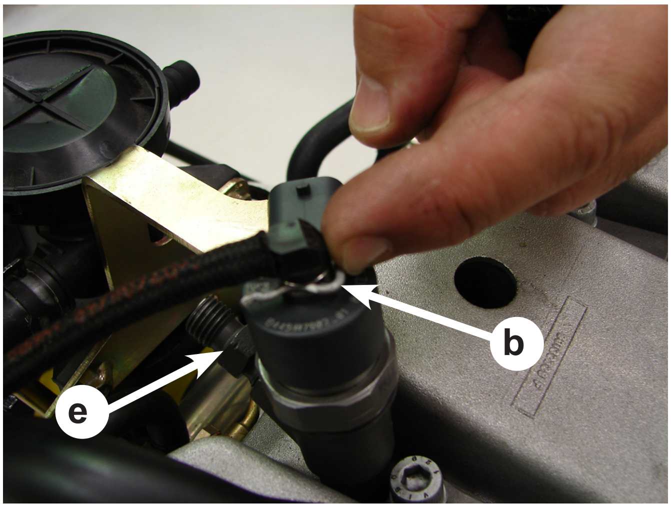
Loosen the high pressure fuel pipe nut.

IMPORTANT: When loosing high pressure pipe nut on injector retain injector feed connector with a wrench 13 mm.



Push the fuel return hose clamp to remove it.

Take the injector off by hand.



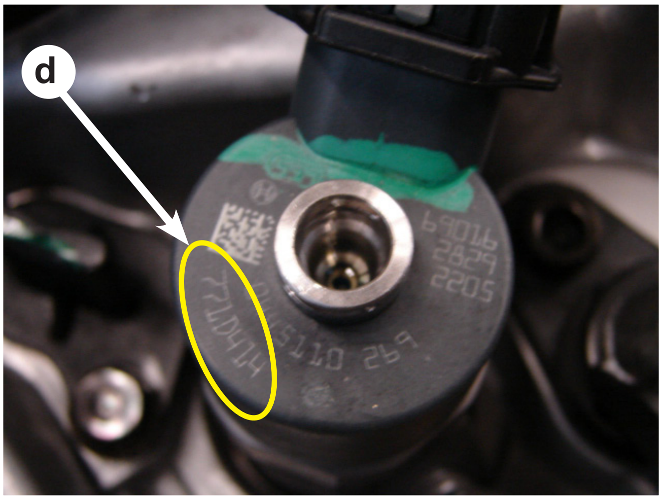
a - injector fixing screw and the clamp

b - fuel return hose clamp

c - high pressure fuel pipe nut

d - IMA code

e - injector feed connector



IMPORTANT:

R750EURO 4 IMA code is composed by number 6 digit

R750EURO 5/6 IMA code is composed by number 7 digit

INSTALLATION

Verify the cleaning into cylinder head bore where the injector is located.

Install a new O-ring in proper groove in the injector and apply Molykote P 1500 paste as shown in the photo.

Verify that the washer is installed at the end of the injector.

Install the injector into the cylinder head.

Verify the presence of the plaque on rocker arm cover.

Install the injector clamp and fixing screw with spherical washer, to be installed as shown in the photos.

a - injector clamp

b - injector washer

c - injector fixing screw and proper spherical washer

d - plaque on rocker arm cover

e - injector O-ring with Molikote P 1500 paste

f - cylinder head bore where the injector is located.

g - IMA code

Finger tighten completely the injector fixing screws and torque them.

injector fixing screw	21 - 25 Nm

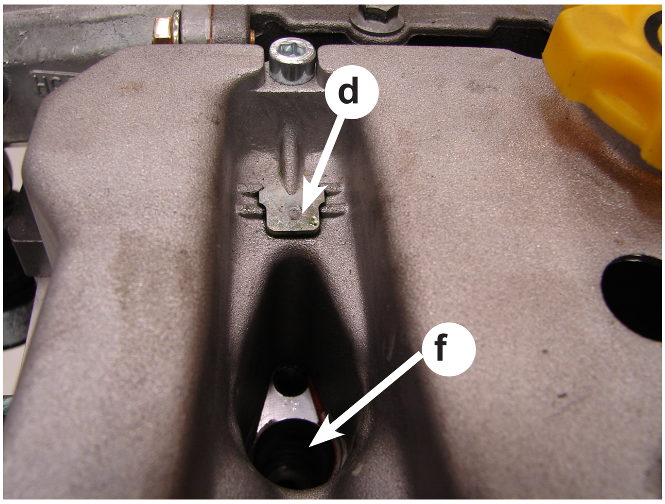
⚠ **WARNING: When the injector is removed a specific procedure must be performed to install correctly high pressure fuel delivery pipes.**

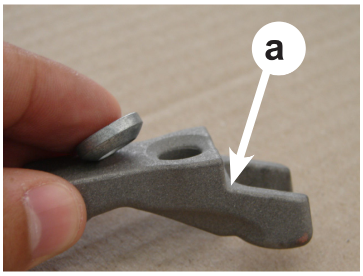
Before installing the injector high pressure fuel pipes from rail to injectors a specific procedure must be observed. (Refer to High Pressure fuel components Tightening Procedure)

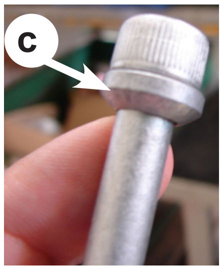
NOTE: Whenever each of these components such as the high pressure pump, injectors, rail and any high pressure fuel pipe (pipe from pump to rail and pipes from rail to injectors) are loose and/or removed, a specific procedure must be performed in order to avoid fuel leakage in the high pressure fuel system, high pressure fuel delivery pipes.

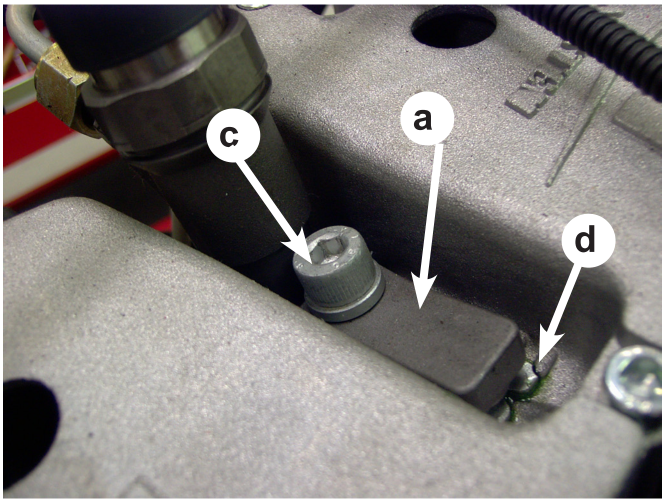
(REFER TO HIGH PRESSURE FUEL COMPONENTS TIGHTENING PROCEDURE)

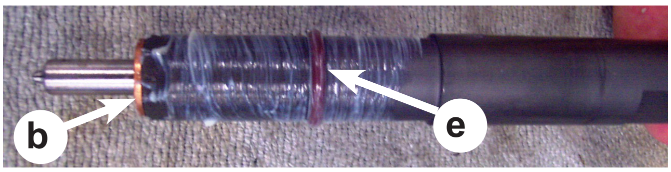
⚠ **IMPORTANT: Whenever one or all injectors are replaced, new IMA code must be re-written inside ECU by diagnostic tool.**

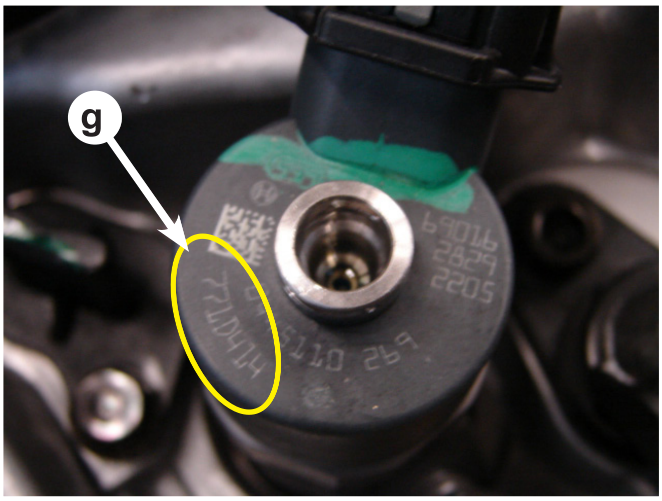












RAIL

REMOVAL

Remove any component wich hinders the rail removal.

Remove high pressure pipes from the rail: from rail to injector and from high pressure pump to rail.

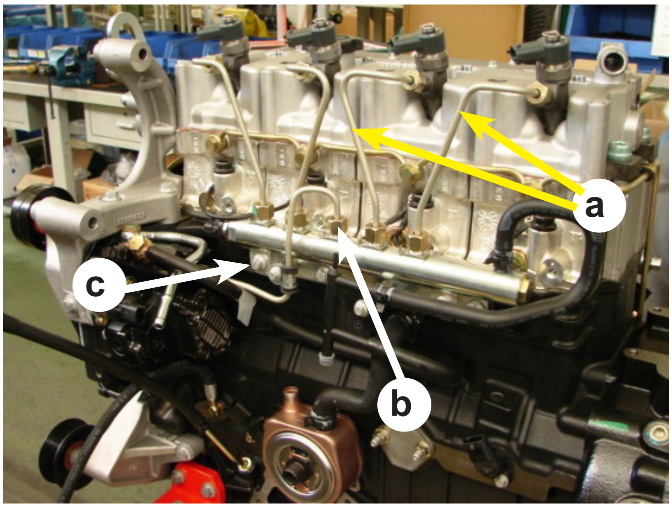
Remove the bolts fixing to rail bracket.

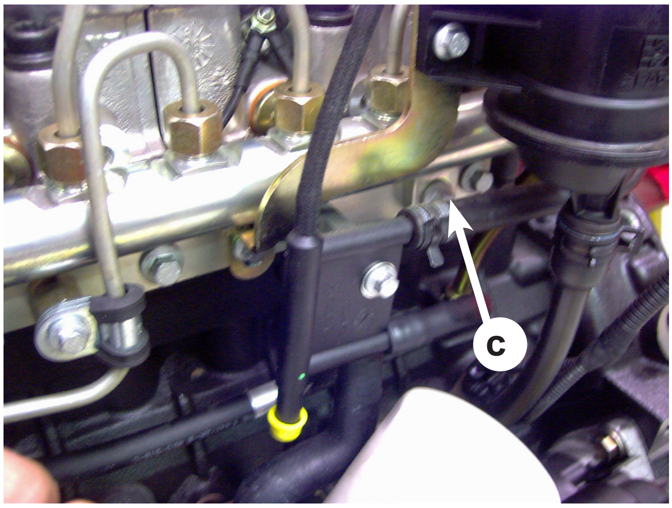
Remove the rail.

a - high pressure pipes (from rail to injectors)

b - high pressure pipes (from rail to high pressure pump)

c - rail fixing bolt to rail bracket





INSTALLATION

WARNING: When the rail is removed a specific procedure must be performed to install correctly high pressure fuel delivery pipes.

Before installing the high pressure pipe from pump to rail and high pressure pipes from rail to injectors a specific procedure must be observed. (Refer to High Pressure fuel components Tightening Procedure)

NOTE: Whenever each of these components such as the high pressure pump, injectors, rail and any high pressure fuel pipe (pipe from pump to rail and pipes from rail to injectors) are loose and/or removed, a specific procedure must be performed in order to avoid fuel leakage in the high pressure fuel system, high pressure fuel delivery pipes.

(REFER TO HIGH PRESSURE FUEL COMPONENTS TIGHTENING PROCEDURE)

HIGH PRESSURE FUEL COMPONENTS TIGHTENING PROCEDURE

NOTE: Whenever each of these components such as the high pressure pump, injectors, rail and any high pressure fuel pipe (pipe from pump to rail and pipes from rail to injectors) are loose and/or removed, a specific procedure must be performed in order to avoid fuel leakage in the high pressure fuel system, high pressure fuel delivery pipes. If this procedure is observed, a correct alignment of high fuel pressure pipes is carried out so that the fuel leakage in high pressure fuel system is avoided.

IMPORTANT: Whenever any high pressure fuel delivery pipe (pipe from pump to rail and pipes from rail to injectors) is loose and/or removed, it must be replaced in order to avoid fuel leakage in the high pressure fuel system.

1 - Verify that the injectors are properly tight. (Refer to Injector Section).

2 - Verify that the high pressure pump is properly tight. (Refer to High pressure Pump Section).

3 - Even if the following screws are tight, therefore loosen them:

- the screws fixing the rail to the bracket
- the screws fixing the rail bracket to crankcase.

4 - Finger tighten completely and simultaneously every high pressure pipes nuts.

5 - Install the clamp on the high pressure pipe from pump to rail and finger tighten proper screw.

6 - Torque the high pressure pipe nut no. 3 (for engine with 4 cylinders) no. 4 (for engine with 6 cylinders) at **RAIL SIDE 19 ± 2 Nm**

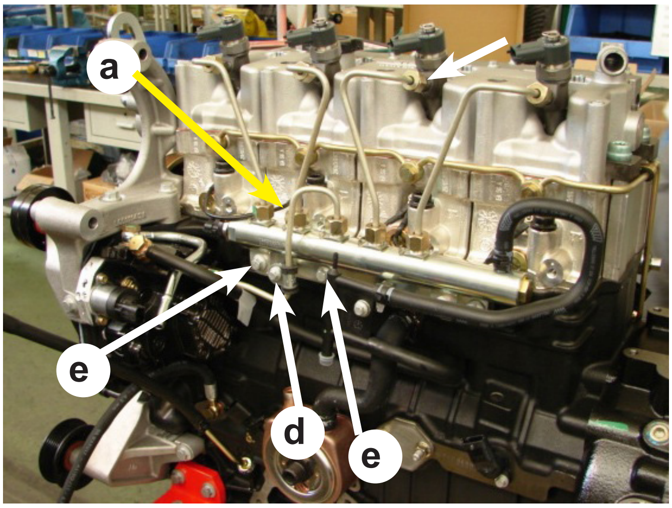
7 - Torque the high pressure pipe remaining nuts at **RAIL SIDE** (no. 1,2,4,5 for engine with 4 cylinders and 1,2,3,5,6,7 for engine with 6 cylinder.) **19 ± 2 Nm**

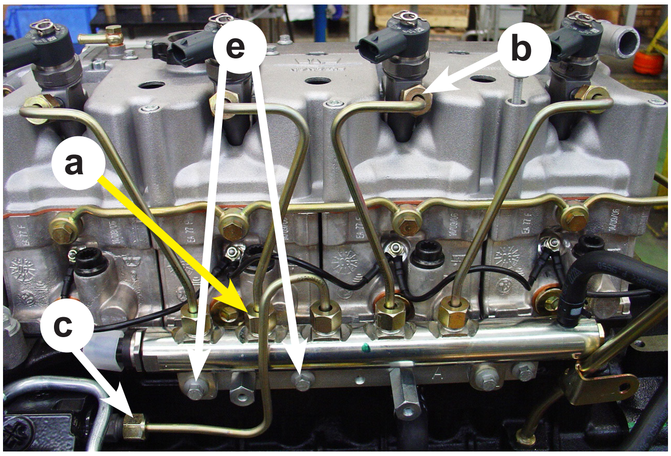
8 - Torque the high pressure pipe nuts at **INJECTOR SIDE** (no.1,2,3,4 for engine with 4 cylinders and 1,2,3,4,5,6 for engine with 6 cylinder.) **27 ± 2 Nm**

9 - Torque the high pressure pipe nut at **HIGH PRESSURE PUMP 20.5 ± 2 .5 Nm**

10 - Torque the screw of the clamp fixing the high pressure pipe from pump to rail to rail bracket **14.7 ± 2 Nm**

11 - Torque the screws fixing the rail to the bracket and the screws fixing the rail bracket to crankcase **33 ± 2 Nm**





a - high pressure pipe nuts at RAIL SIDE (no. 3 for engine with 4 cylinders) (no.4 for engine with 6 cylinder)

b - high pressure pipe nuts at INJECTION SIDE

c - high pressure pipe nut at HIGH PRESSURE PUMP

d - screw of the clamp fixing the high pressure pipe from pump to rail to rail bracket

e - screws fixing the rail to the bracket and the screws fixing the rail bracket to crankcase

OIL FILTER HOUSING

REMOVAL

To remove the oil filter cartridge, refer to Maintenance Section.

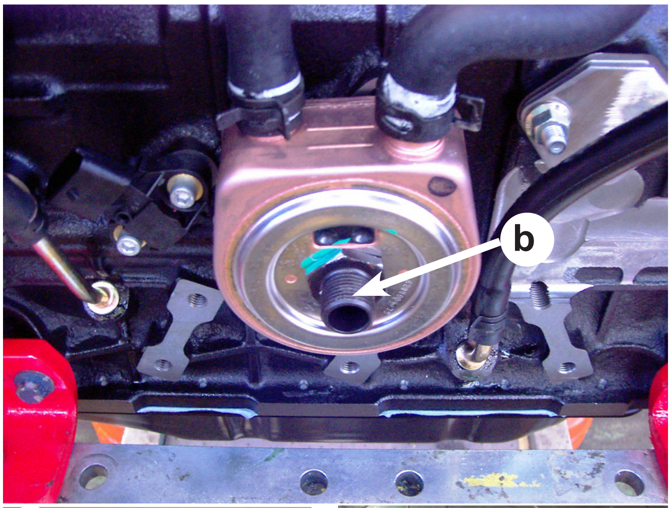
Loosen the bolt fixing the oil filter assembly (oil filter cartridge and oil filter housing) to oil heat exchanger.

Remove the oil filter assembly.

Loosen the special bolt fixing the oil heat exchanger to crankcase. Loosen the clamp fixing the rubber hoses to oil heat exchanger and remove it.

a - bolt fixing the oil filter assembly (oil filter cartridge and oil filter housing) to oil heat exchanger.

b - special bolt fixing the oil heat exchanger to crankcase.



INSTALLATION

Replace the old O-ring into the groove of oil heat exchanger and install a new one. Grease the O-ring with Molykote 111.

Install the oil heat exchanger and torque the special bolt fixing the oil heat exchanger to crankcase.

"b" special bolt fixing the oil heat exchanger to crankcase.	**60 Nm**

Replace the old O-ring into the groove of oil filter assembly and install a new one. Grease the O-ring with Molykote 111.

Replace the O-ring into the groove bolt fixing the oil filter assembly and grease it with Molykote 111.

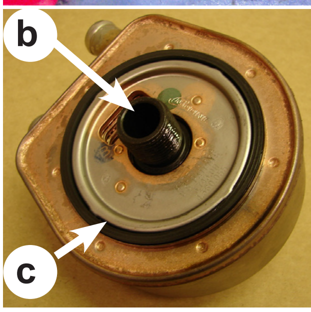
Finger tighten and torque it.

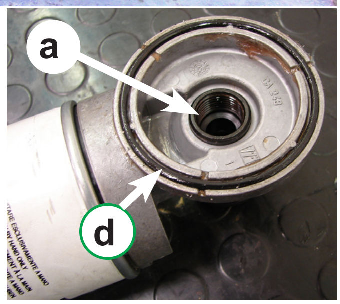
"a" bolt fixing the oil filter assembly	**39.2 Nm**

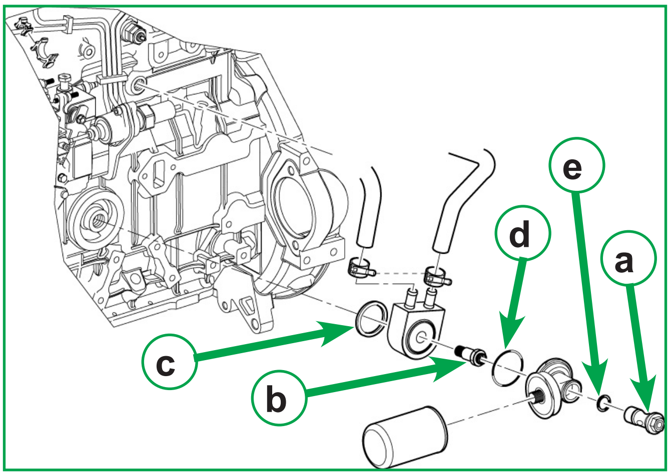
c - O-ring into the groove of oil heat exchanger

d - O-ring into the groove of oil filter assembly

e - O-ring into the groove bolt fixing the oil filter assembly to oil heat exchanger.







OIL DELIVERY PIPE TO ROCKER ARM

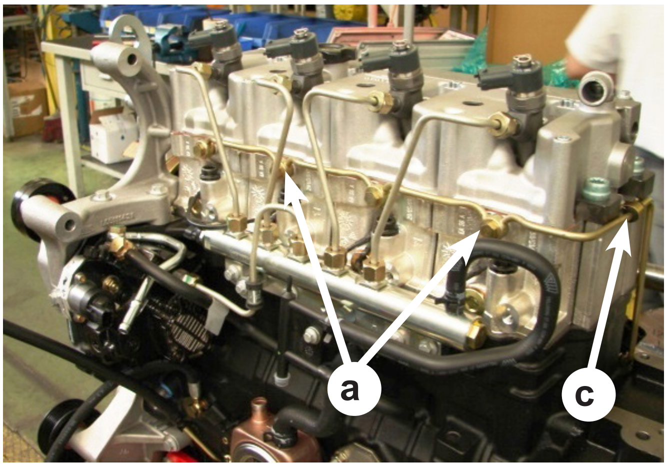
REMOVAL

Loosen and remove the hollow bolts (injection and exhaust side) and proper washers. Loosen also the clamp fixing the pipe to cylinder head end spacer).

a - hollow bolts (injection side)

b - hollow bolt (exhaust side)

c - clamp fixing pipe to cylinder head spacer

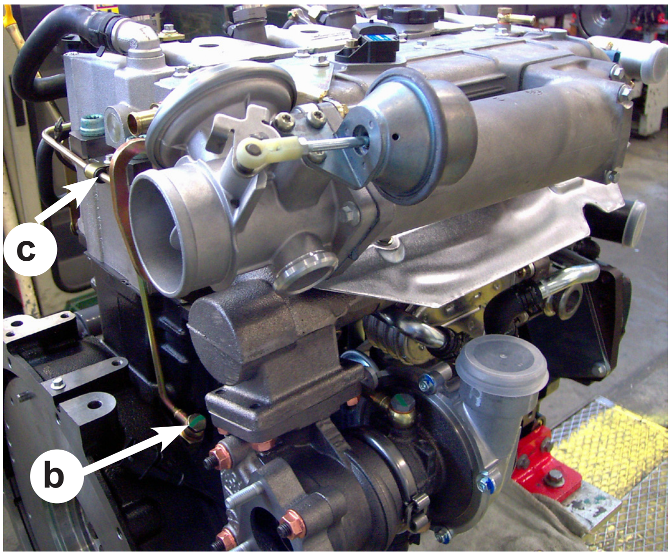


INSTALLATION

Install the hollow bolts with new washers. Lubricate with engine oil the hollow bolts thread.

Install the clamp and tighten securely it.

hollow fixing bolt (cylinder head side)	14 Nm
hollow fixing bolt (exhaust side)	23.5 Nm



ROCKER ARM COVER

REMOVAL

Remove any component that hinders the rocker arm cover removal.

Loosen and remove the fixing screws.

Remove the gasket.

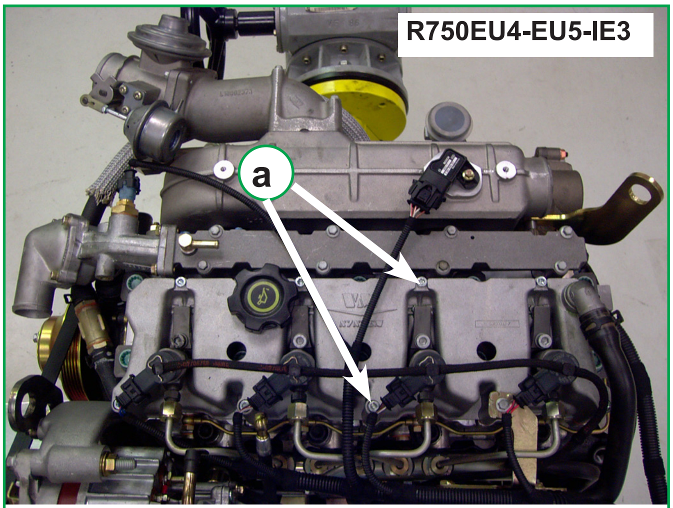
a - rocker arm fixing screw

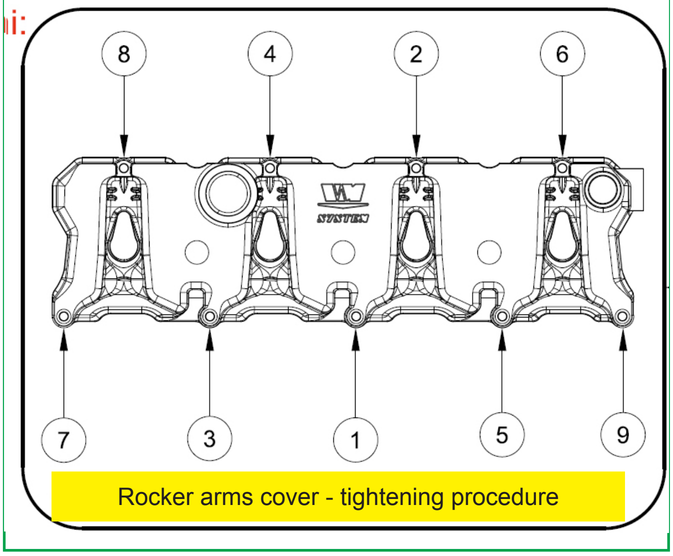
INSTALLATION

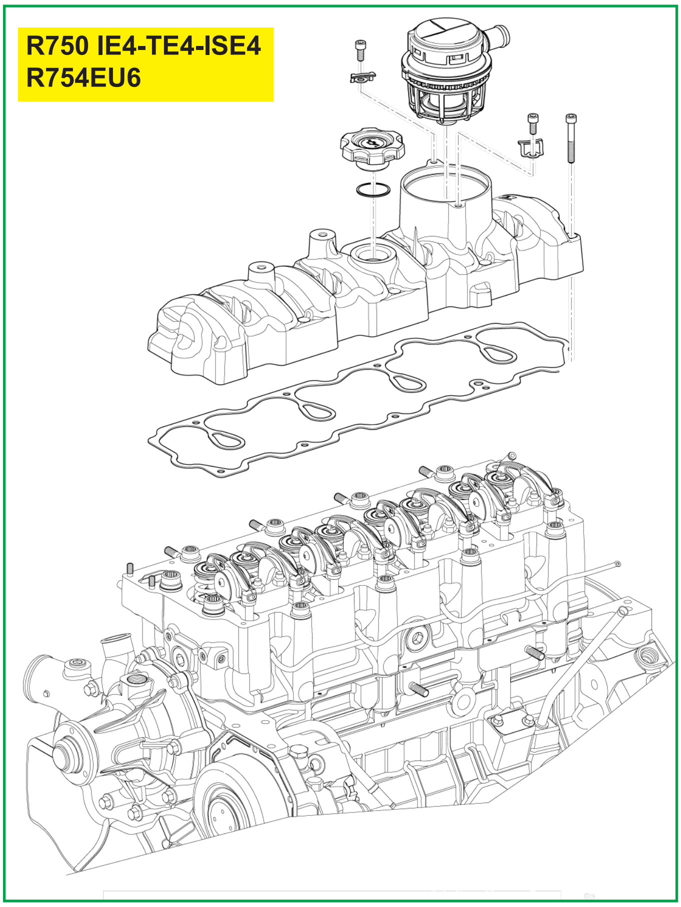
Install a new gasket if necessary.

Install the cover and torque the fixing screws in a cross pattern (see picture)

rocker arm fixing screws	11.8 Nm







COOLANT MANIFOLD

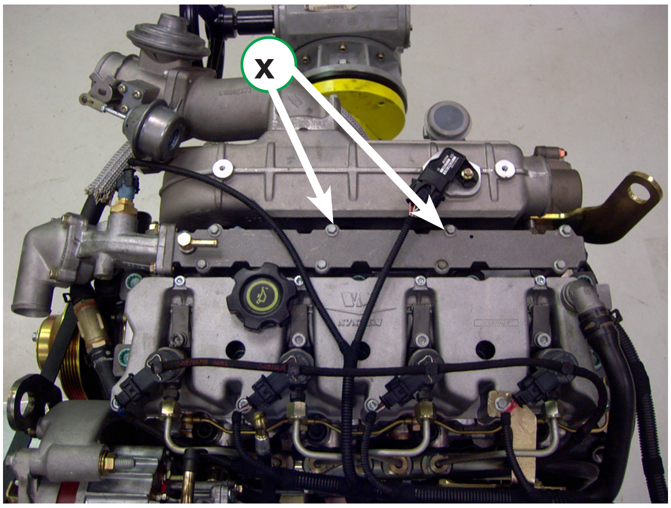
REMOVAL

Remove any component that hinder the coolant manifold removal.

Remove the fixing screws and take the manifold off.

Replace the old gasket.

x - coolant manifold fixing screw



INSTALLATION

Inspect the sealing surfaces for deep nicks and scratches.

Inspect the castings for cracks or corrosion that might prevent a proper seal.

Replace or repair components as needed.

IMPORTANT: The end cover and the coolant manifold gasket flanges must align for proper sealing on the cylinder heads. Align the flanges using a straight edge as shown.

Align the coolant manifold end cover and the coolant manifold using a straight edge device and then, torque the coolant manifold end cover screws evenly in a diagonal pattern.

Insert a new gasket between Coolant manifold and Coolant manifold end cover, by applying Loctite 510 on both surfaces.

coolant manifold screws	11.8 Nm
coolant manifold end cover screws	10.8 Nm

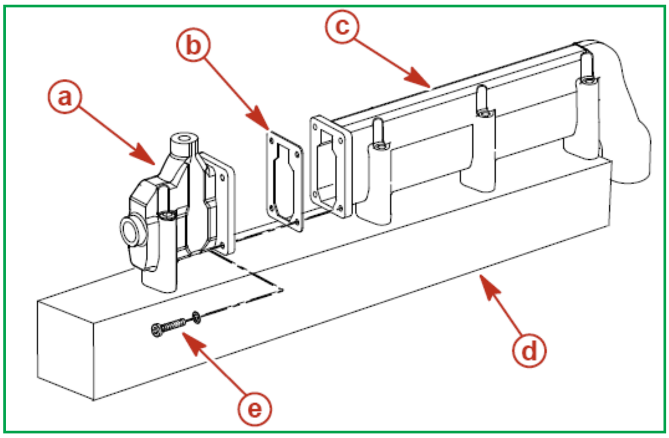
a - Coolant manifold end cover

b - Gasket

c - Coolant manifold

d - Typical straight edge device

e - Coolant manifold end cover screw and washer



THERMOSTATIC VALVE

REMOVAL

Remove the thermostat cover screws.

Remove the cover and take the thermostat off.

x - thermostat cover screws

y - thermostat

INSTALLATION

Install the cover and torque the fixing screws.

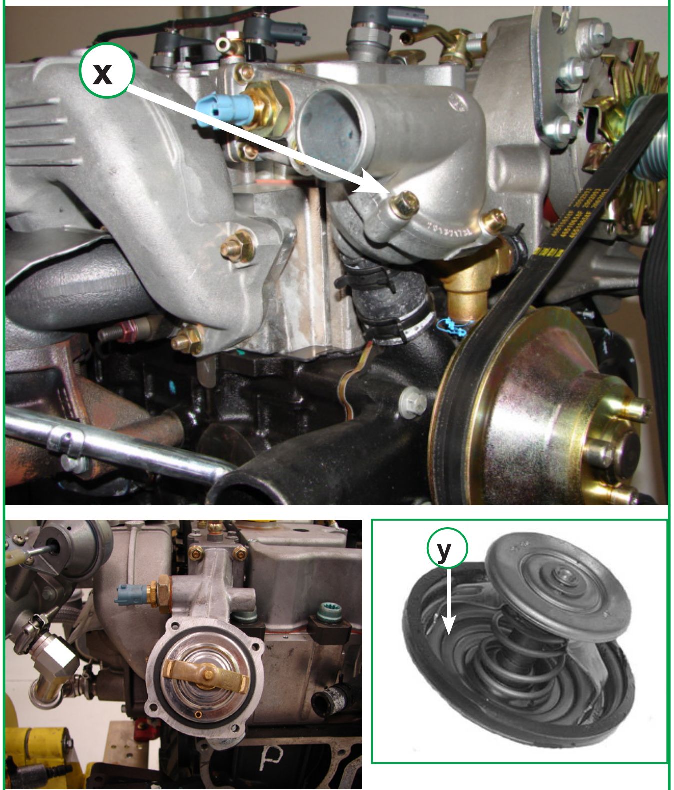
thermostat cover screws (x)	10.8 Nm

IMPORTANT

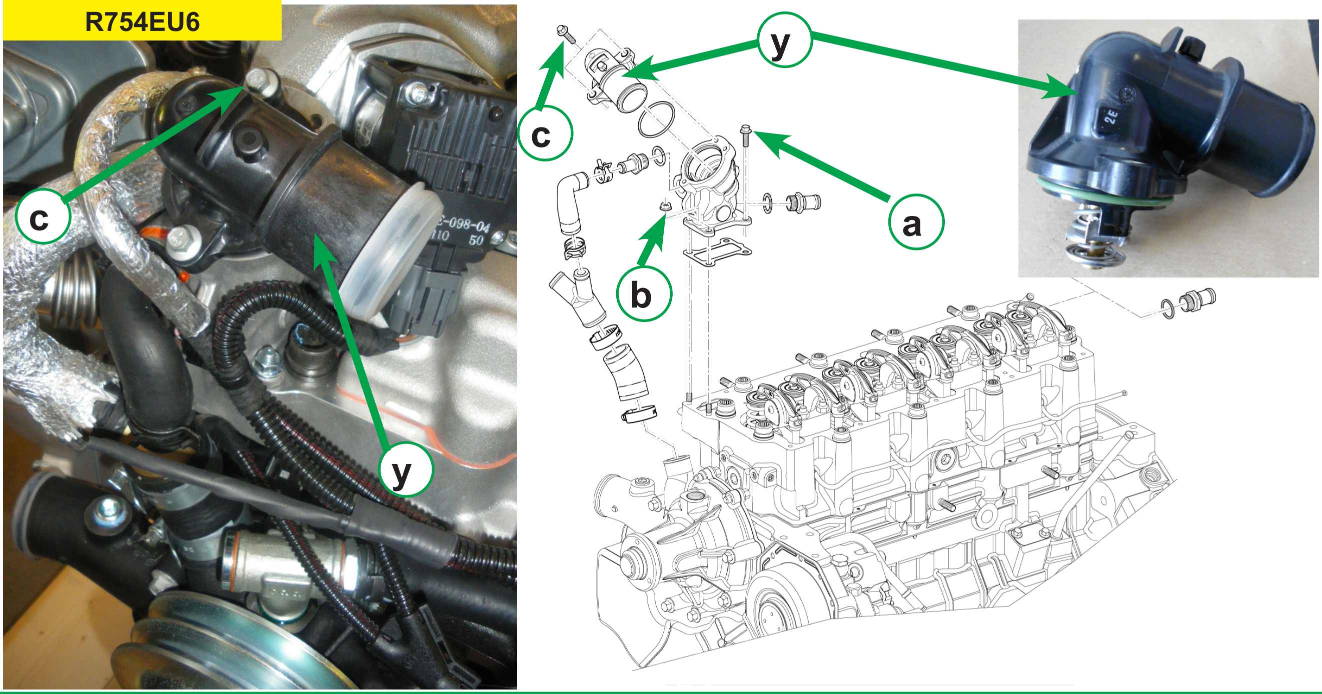
On R750IE4-TE4-ISE4- R754EU6 engine models the thermostat is supplied as assembly

R750IE4-TE4-ISE4-R754EU6	
Bolt (a)- nut (b)	**11.8 Nm**
Bolt (c)	**13.7 Nm**

R750EU4-EU5-IE3



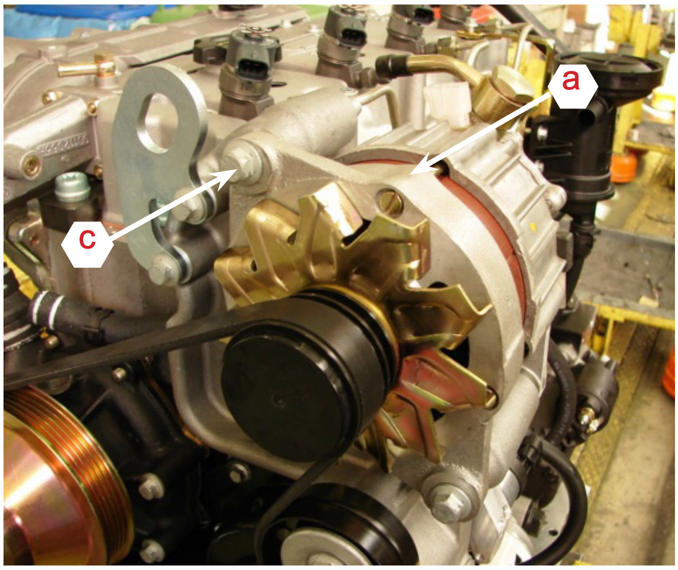
R750IE4-TE4-ISE4
R754EU6



ALTERNATOR

REMOVAL

- Remove Poly-V belt.
- Disconnect wiring electrical connections from the alternator.
- Detach from the vacuum pump any oil feeding and draining hose
- Loosen and remove the alternator fixing bolt.
- a - Alternator
- b - Vacuum pump
- c - alternator fixing bolt
- d1 - Vacuum pump oil feeding
- d2 - Vacuum pump oil draining hose



INSTALLATION

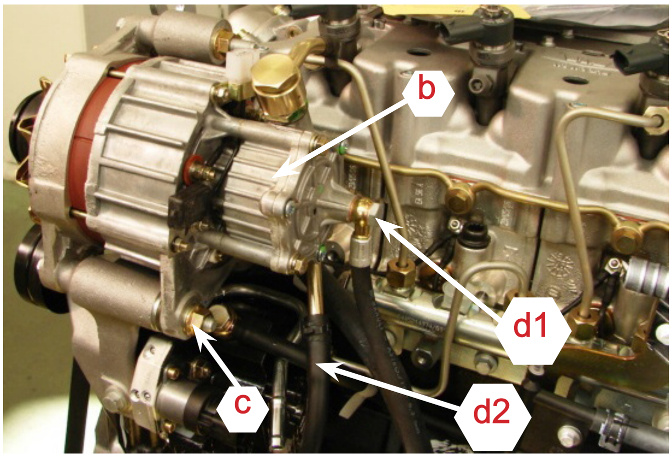
Position the alternator on the bracket.

Thread the bolts in the alternator and torque the nuts.

Alternator fixing bolt	45.1 Nm

Install vacuum pump oil feeding hollow bolt with proper washers and draining hoses .

vacuum pump oil feeding hollow bolt (on vacuum pump)	27.5 Nm
vacuum pump oil feeding hollow bolt (on crankcase)	27.5 Nm



ALTERNATOR PULLEY

REMOVAL

The alternator pulley could be idle type: it can be identified if the front cover is present or the special tool 68420022F installs on the pulley.

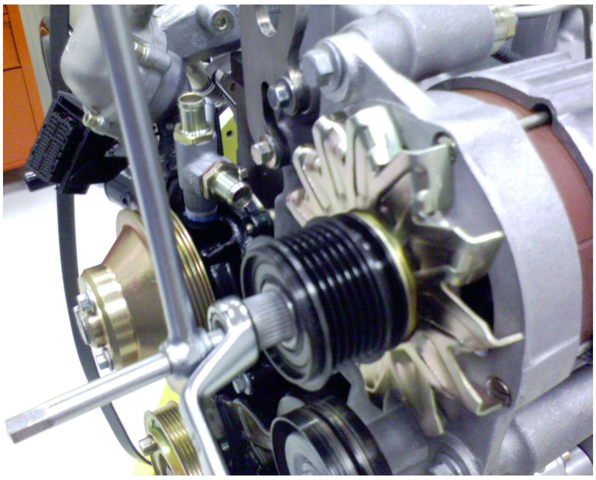
Remove the cover and install the special tool 68420022F and dissamble the pulley.

INSTALLATION

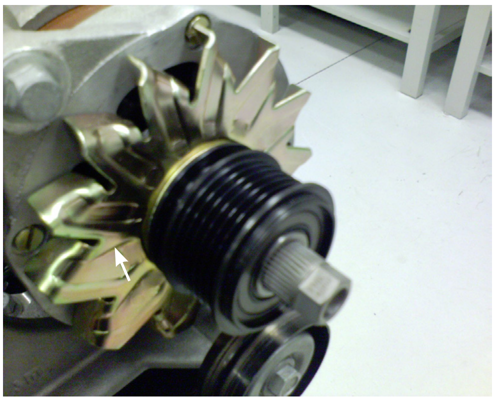
Thread the pulley on the alternator shaft.

Tighten the pulley.

Alternator idle pulley	80 ± 5 Nm

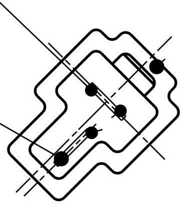


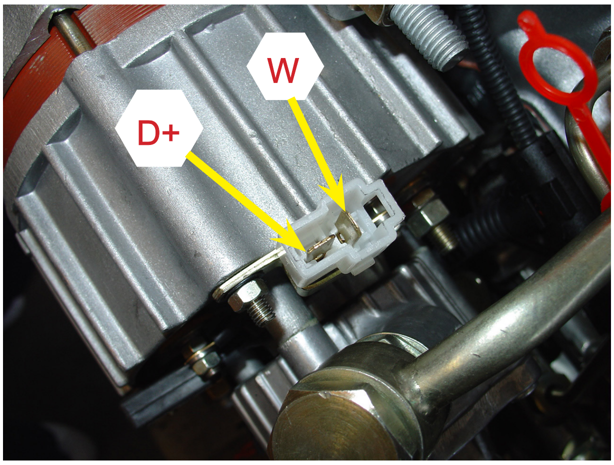
⚠ **IMPORTANT: Install alternator fan with the arrow rinted on it as shown in the photo.**



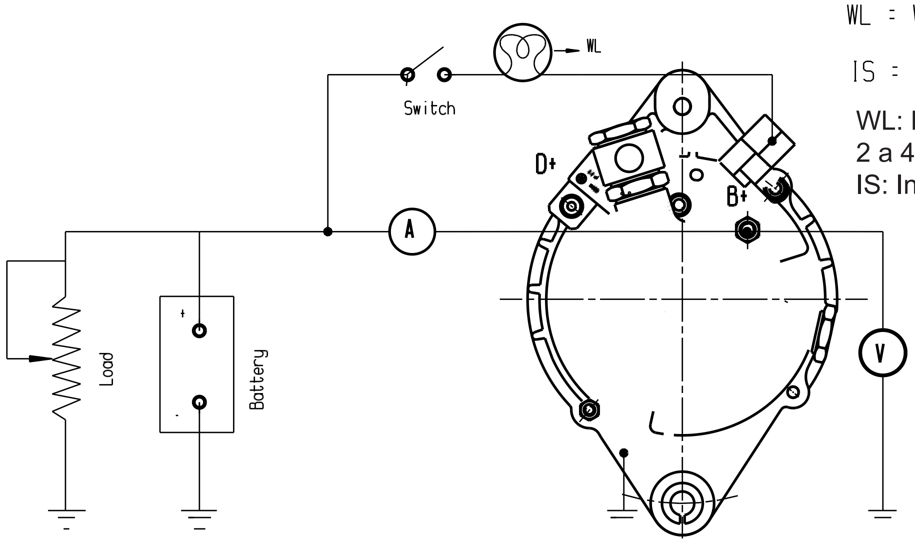
W TERMINAL, AC OUT PUT
6 PULSES PER REVELUTION
TERMINALE W - corrente in uscita

D+ TERMINAL, FOR CHARGE
IDICATOR LAMP (12V, 2W)
TERMINALE D+ - per carica / lampada carica batteria





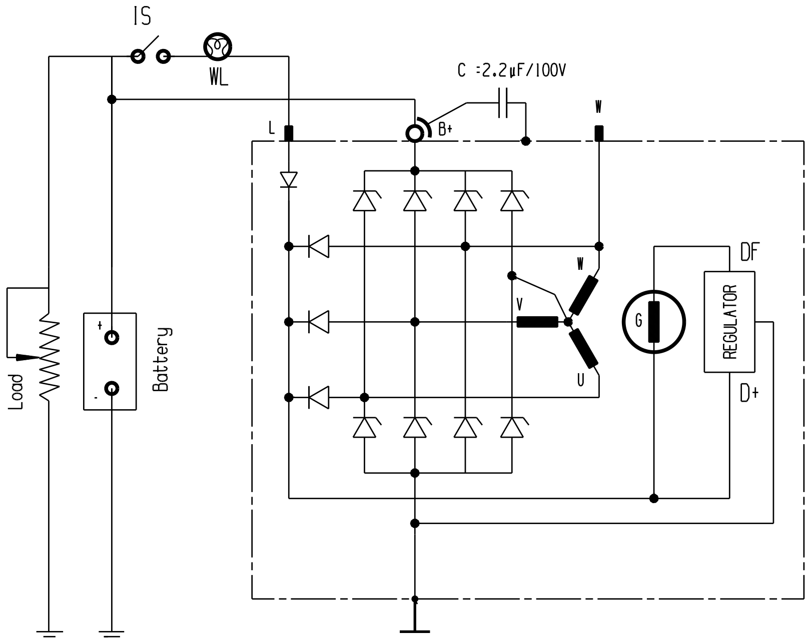
WIRING DIAGRAM FOR TESTING ALTERNATOR

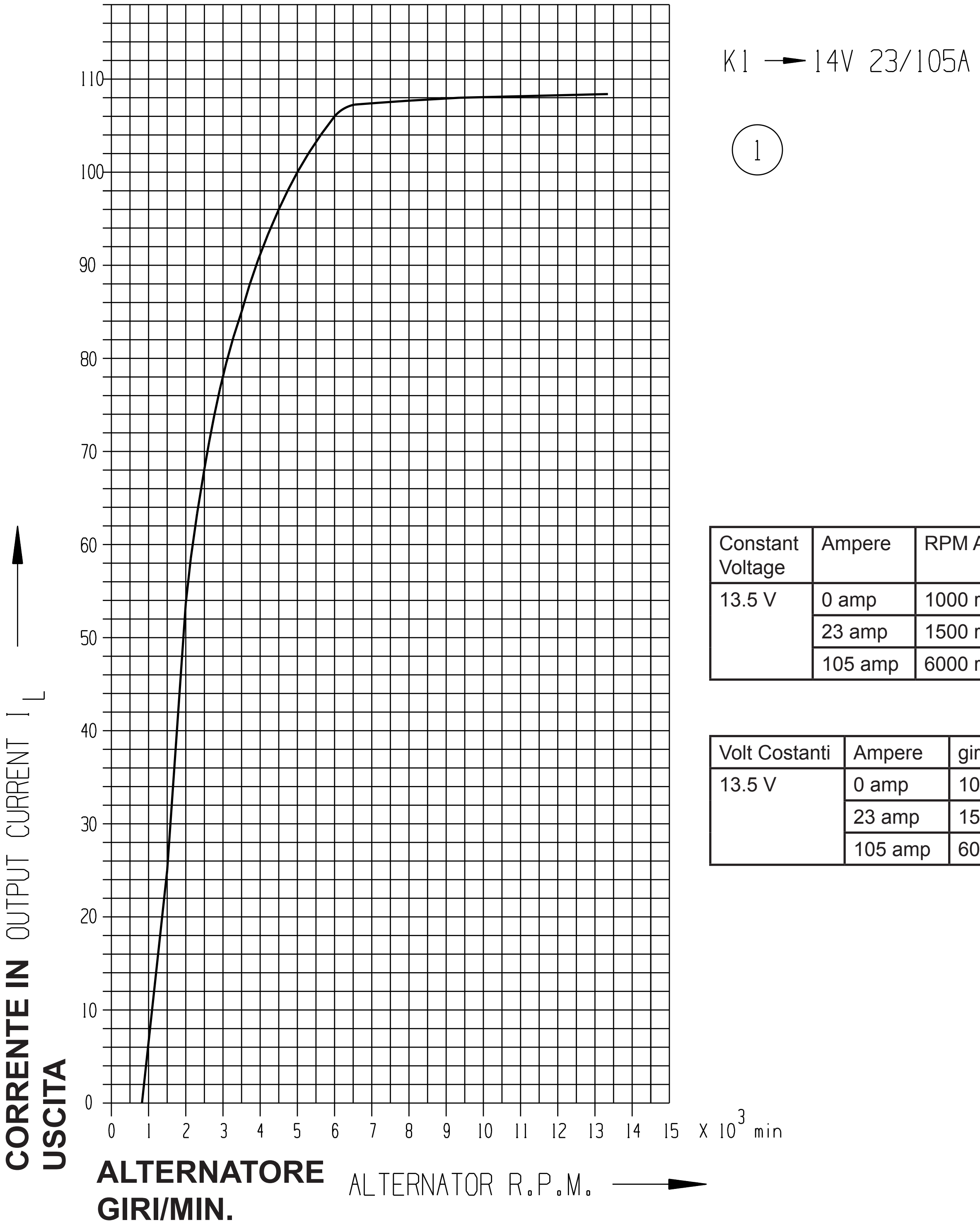


WL : Warning Lamp
2 to 4 Watts, 12V
IS : Ignition Switch

WL: Lampada carica alternatore da 2 a 4 watts, 12 V
IS: Interuttore accensione

CIRCUIT DIAGRAM





Constant Voltage	Ampere	RPM Alternator
13.5 V	0 amp	1000 rpm
	23 amp	1500 rpm
	105 amp	6000 rpm

Volt Costanti	Ampere	giri/min Alternatore
13.5 V	0 amp	1000 giri/min
	23 amp	1500 giri/min
	105 amp	6000 giri/min

STABILISED TEMPERATURE CURVE T_U=25°C ; T_L=25°C

T =AMBIENT TEMPERATURE, T_L = AIR INTAKE TEMPERATURE

OUTPUT OF 5% OF ALL ALTERNATORS CAN BE 3% BELOW

THE VALUES OF THE RATED CURRENT CURVE.

$$I_L = f(n)$$

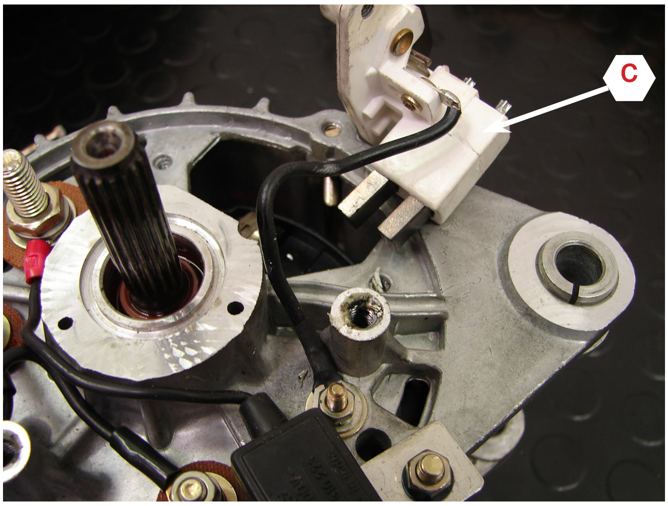
AT U_{ALT} = 13.5V CONSTANT

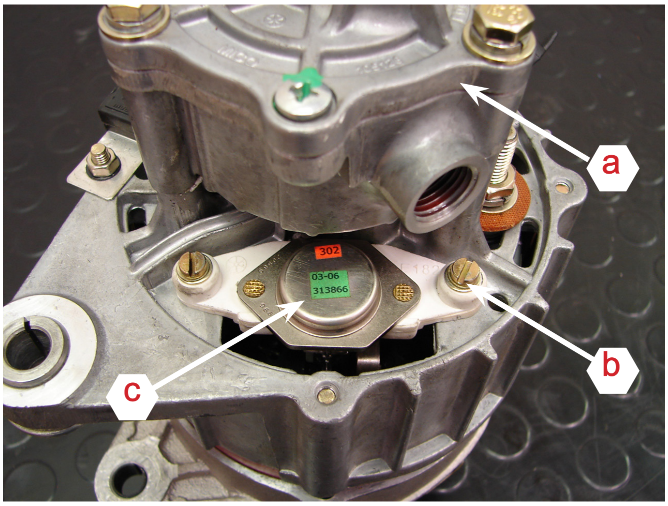
RAPPORTO PULEGGIA ALBERO MOTORE / PULEGGIA ALTERNATORE 2.63
CRANKSHAFT PULLEY / ALTERNATOR PULLEY RATIO 2.63

VOLTAGE REGULATOR

REMOVAL

- Remove the alternator from the engine.
- Remove the vacuum pump if needed and loosen the voltage regulator fixing screws.
- a - vacuum pump
- b - voltage regulator fixing screws
- c - voltage regulator



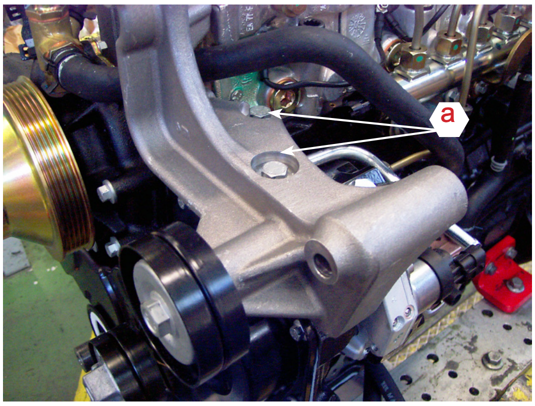


ALTERNATOR BRACKET

REMOVAL

- Unscrew the alternator bracket bolts.
- Remove the bracket

a - alternator fixing bracket bolts



ASSEMBLING

- Position the bracket on the cranckcase
- Thread the bolts and torque them.

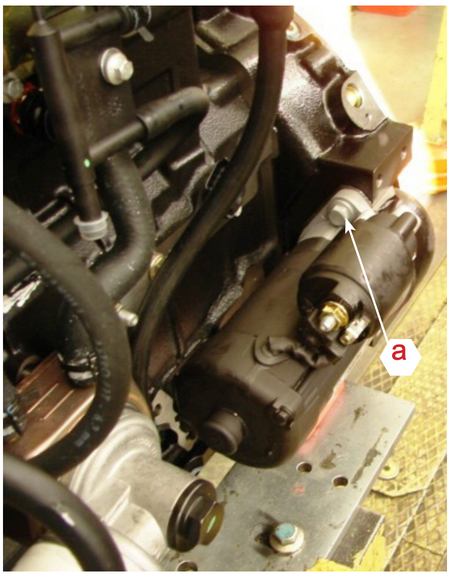
Alternator bracket bolt	68.6 Nm

STARTER

REMOVAL

- Unscrew the starter fixing bolts.
- Remove the starter

a - starter fixing bolts



ASSEMBLING

- Position the starter on the flywheel housing
- Thread the bolts and torque them.

Starter fixing bolt	83.4 Nm

VACUUM PUMP

REMOVAL

If needed remove the alternator from the engine.

Disconnect oil feed pipe and oil return pipe from vacuum pump.

Loosen the vacuum pump fixing screws.

INSTALLATION

Ensure that the O-ring is properly seated.

Replace it if needed.

Install the vacuum pump on the alternator.

Torque the vacuum pump fixing screws to alternator.

x - oil feed pipe to vacuum pump

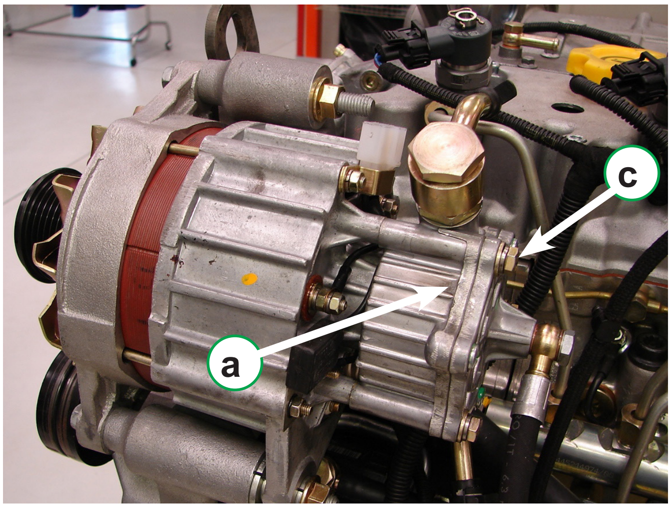
y - oil return pipe from vacuum pump

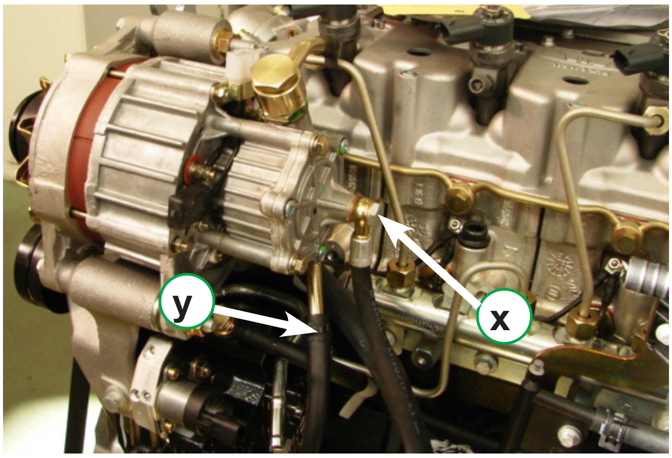
a - vacuum pump

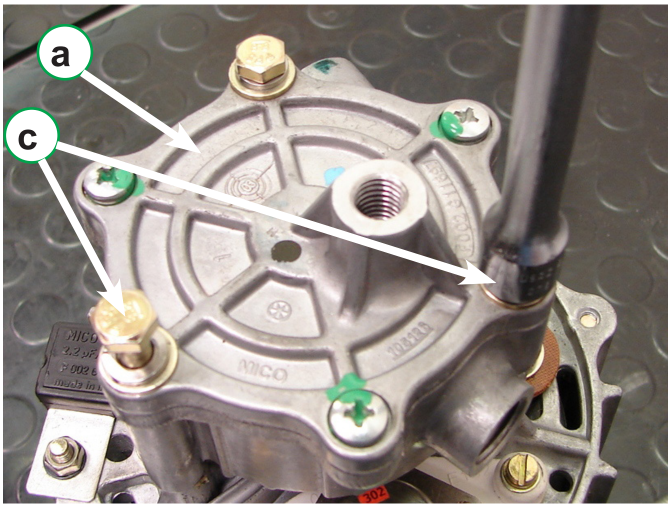
b - O-ring

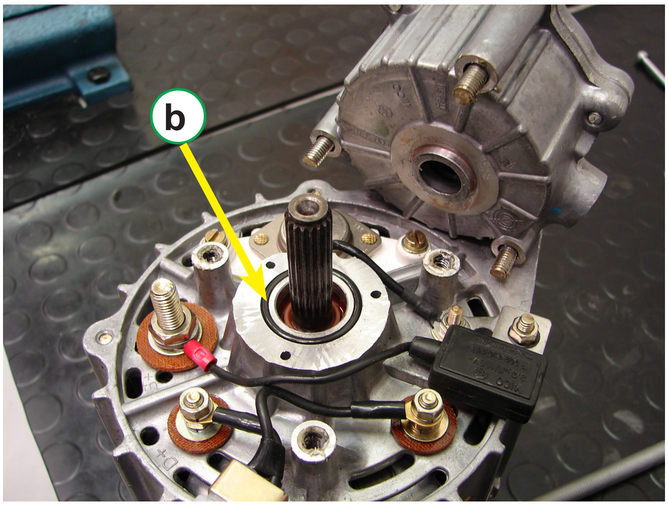
c - vacuum pump fixing screw

Refer to section "Alternator" to identify the torque value of vacuum pump oil supply hollow bolt





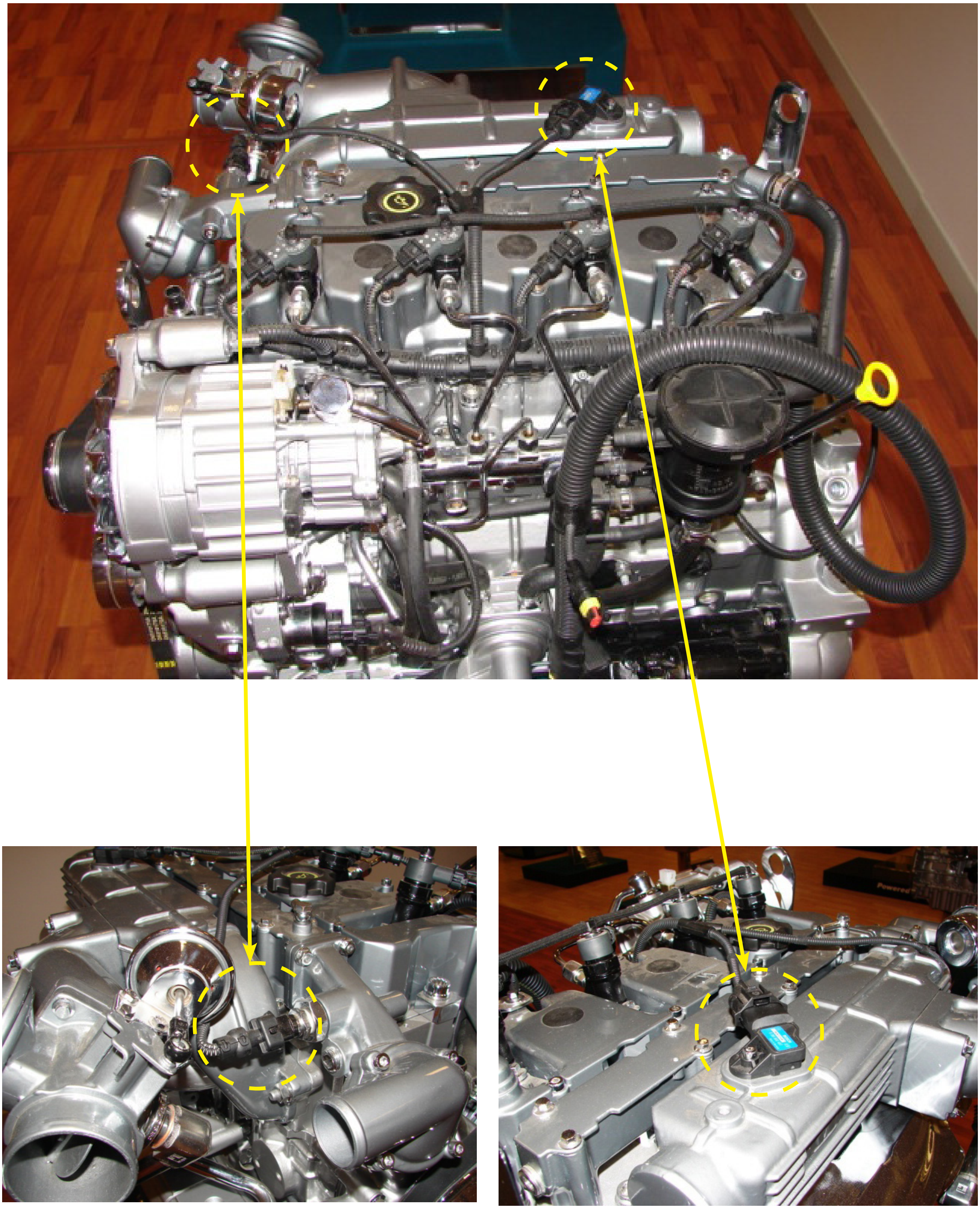




ENGINE CONTROL

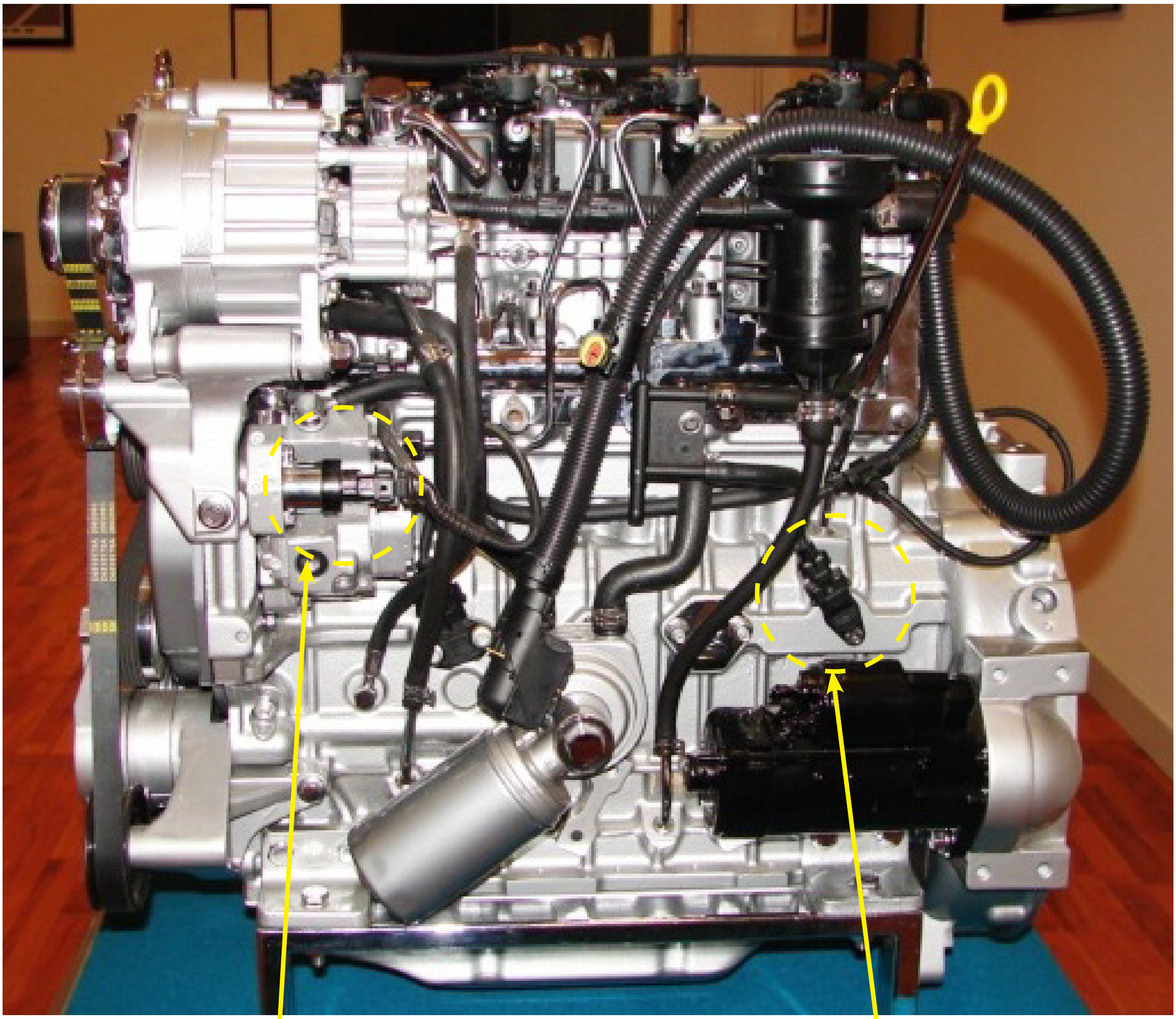
ELECTRICAL SENSORS (R750EU4, EU5, IE3, TE3)

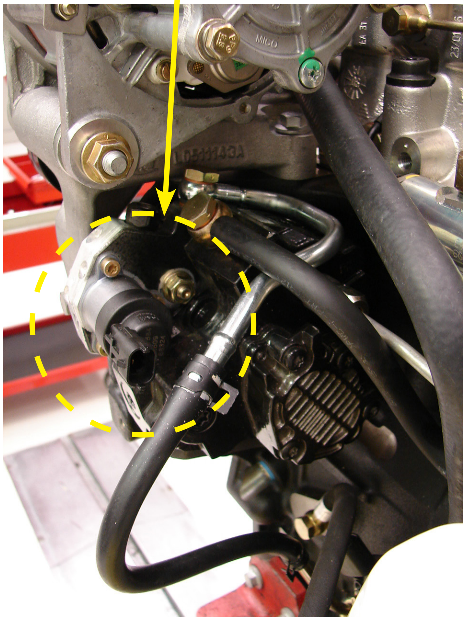
LOCATION

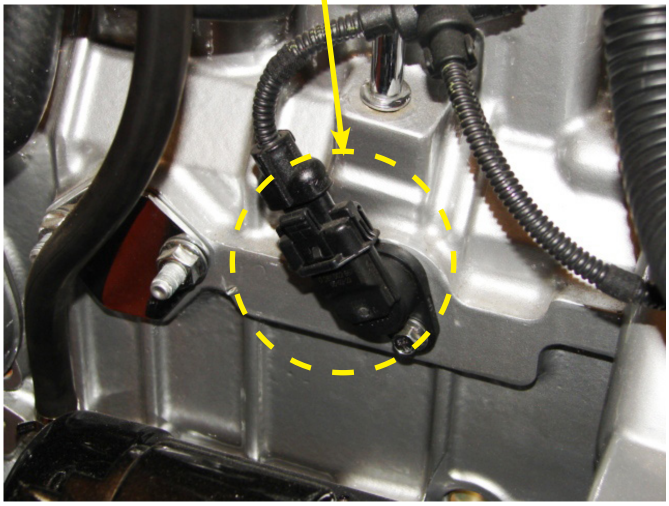


Engine Coolant temperature

Intake - air temperature and pressure sensor

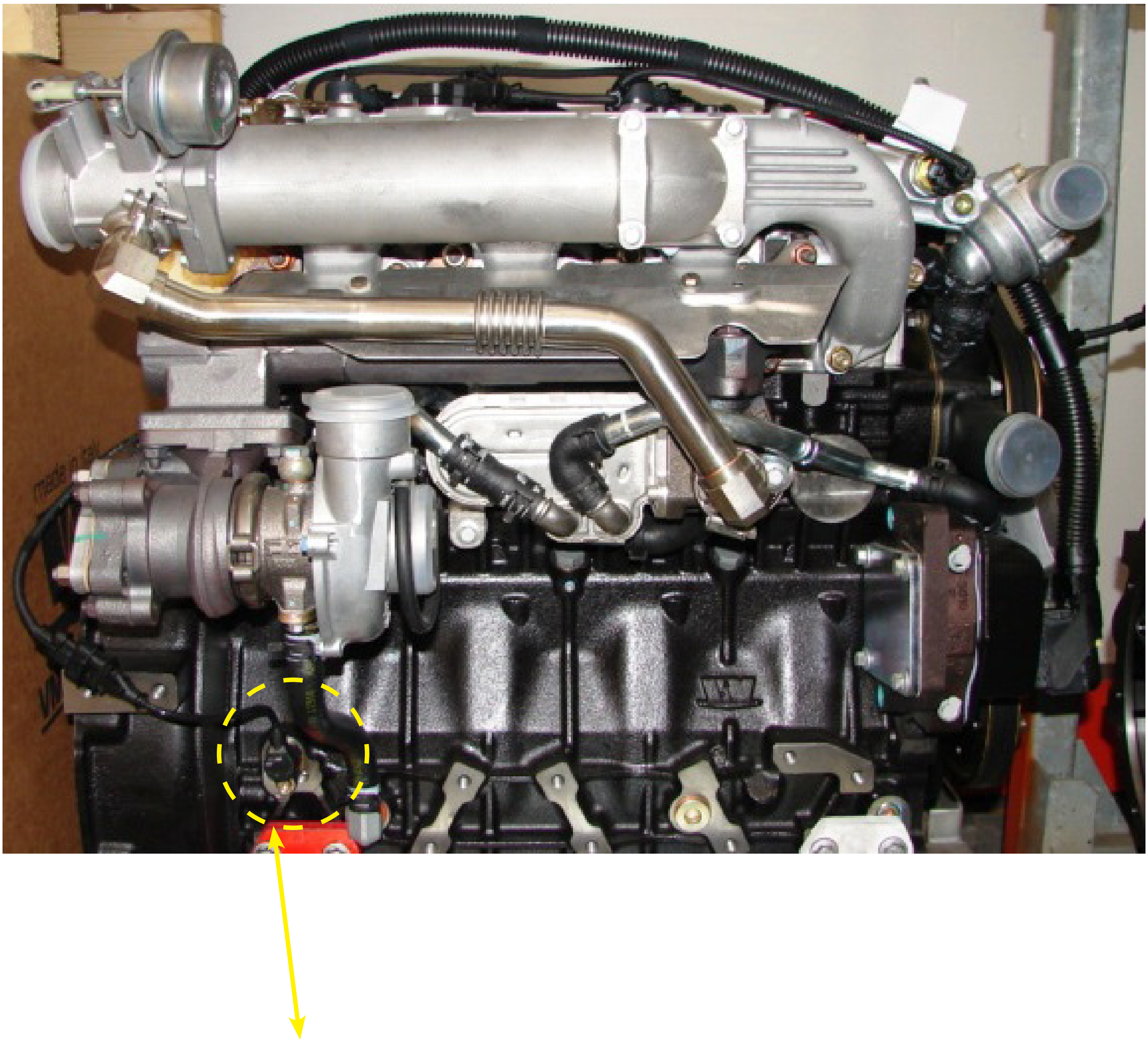




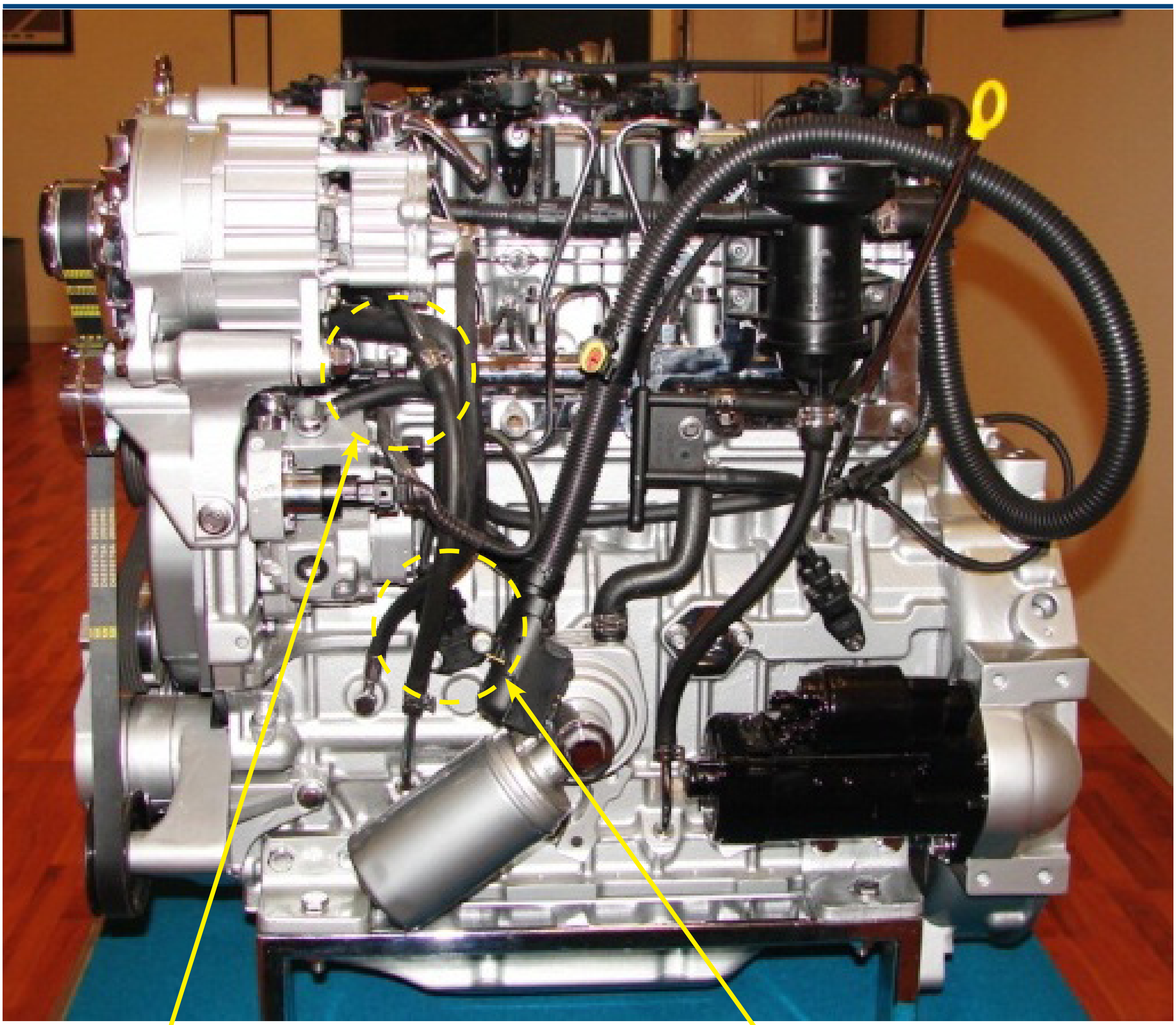


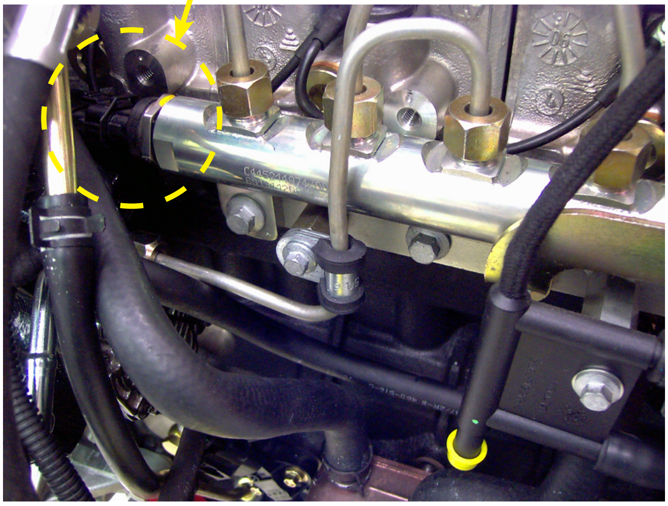
Camshaft / Phase sensor

Fuel pressure regulator valve

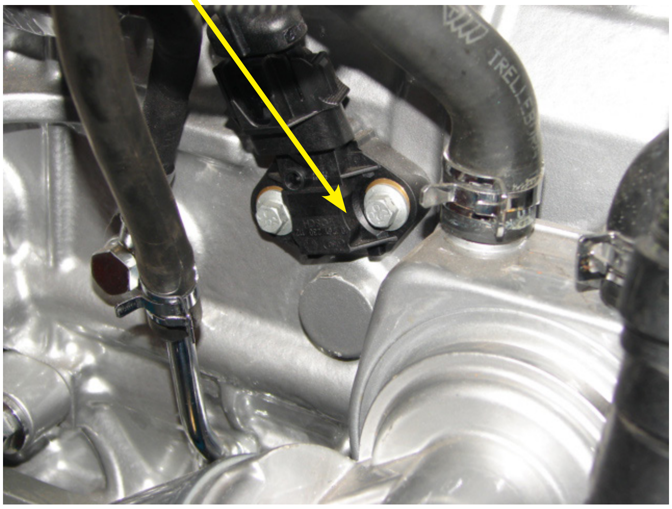


Crankshaft position sensor / engine RPM sensor





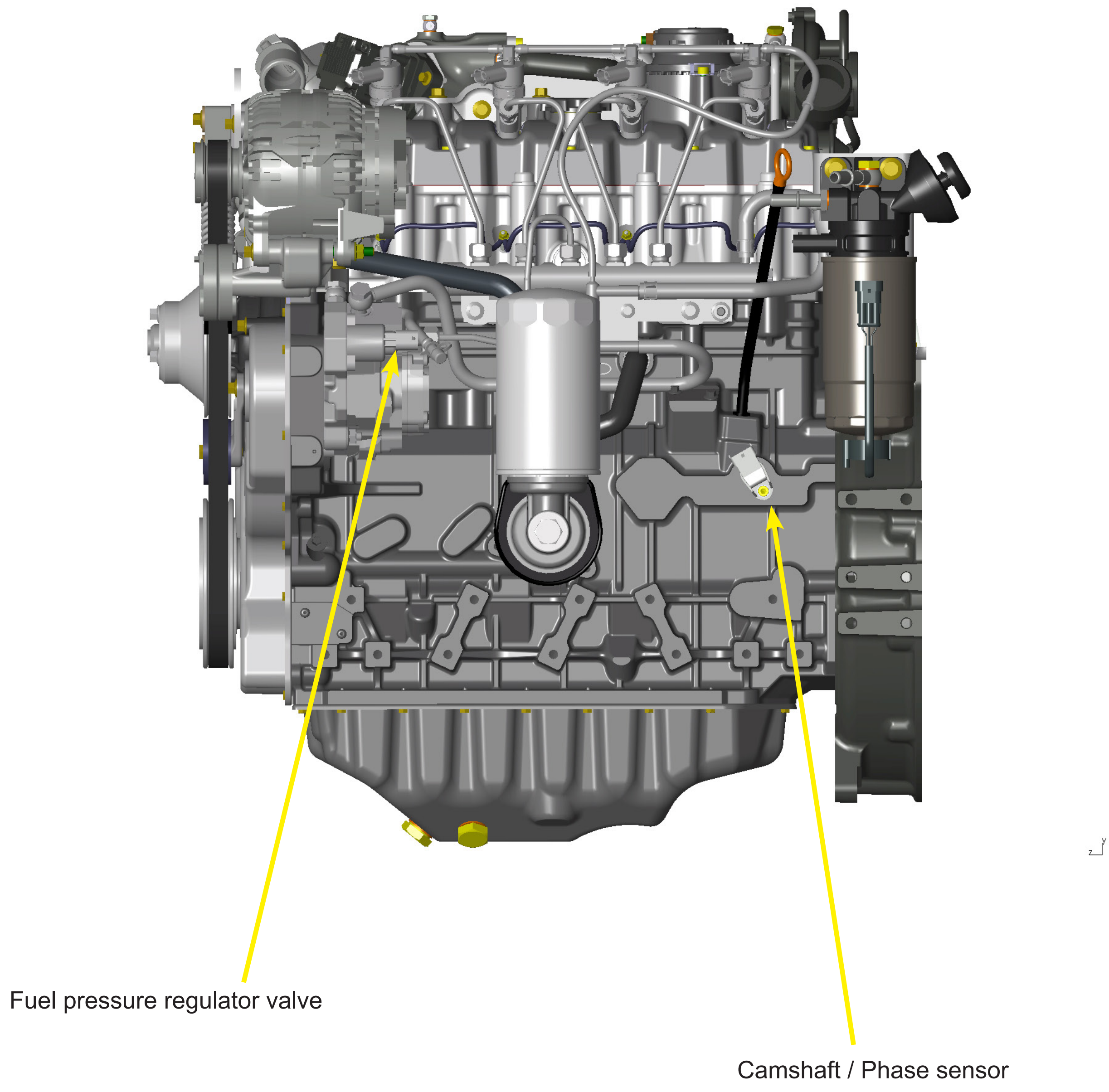
Pressure sensor - Rail

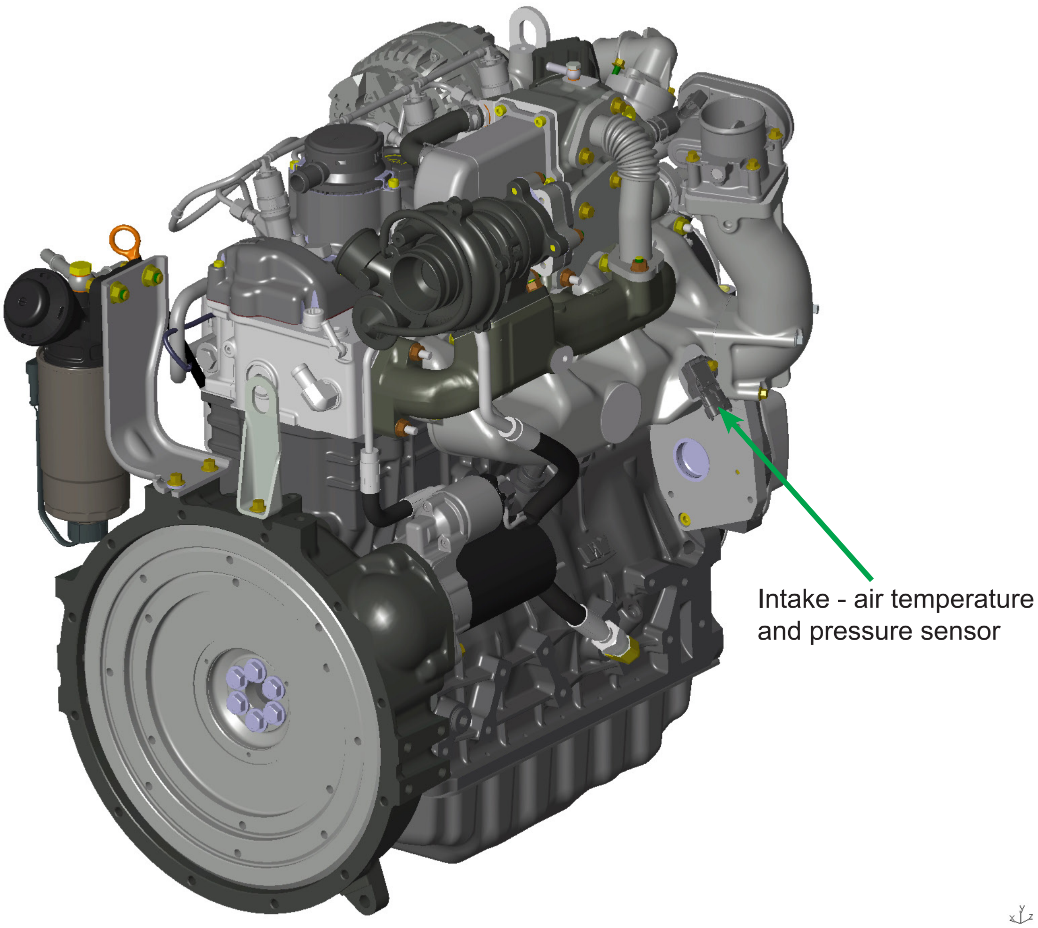


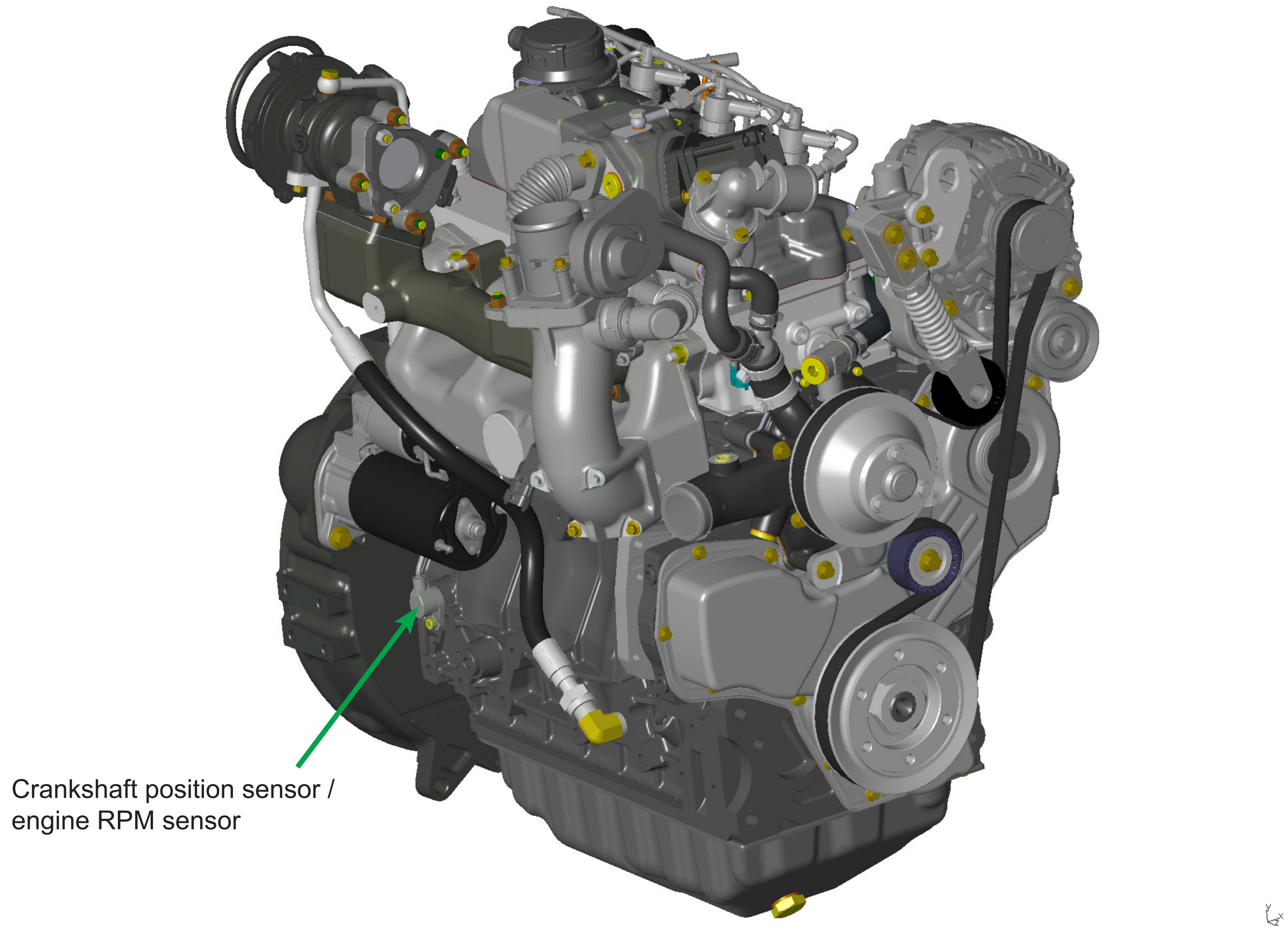
Lube Engine oil Temperature and Pressure sensor

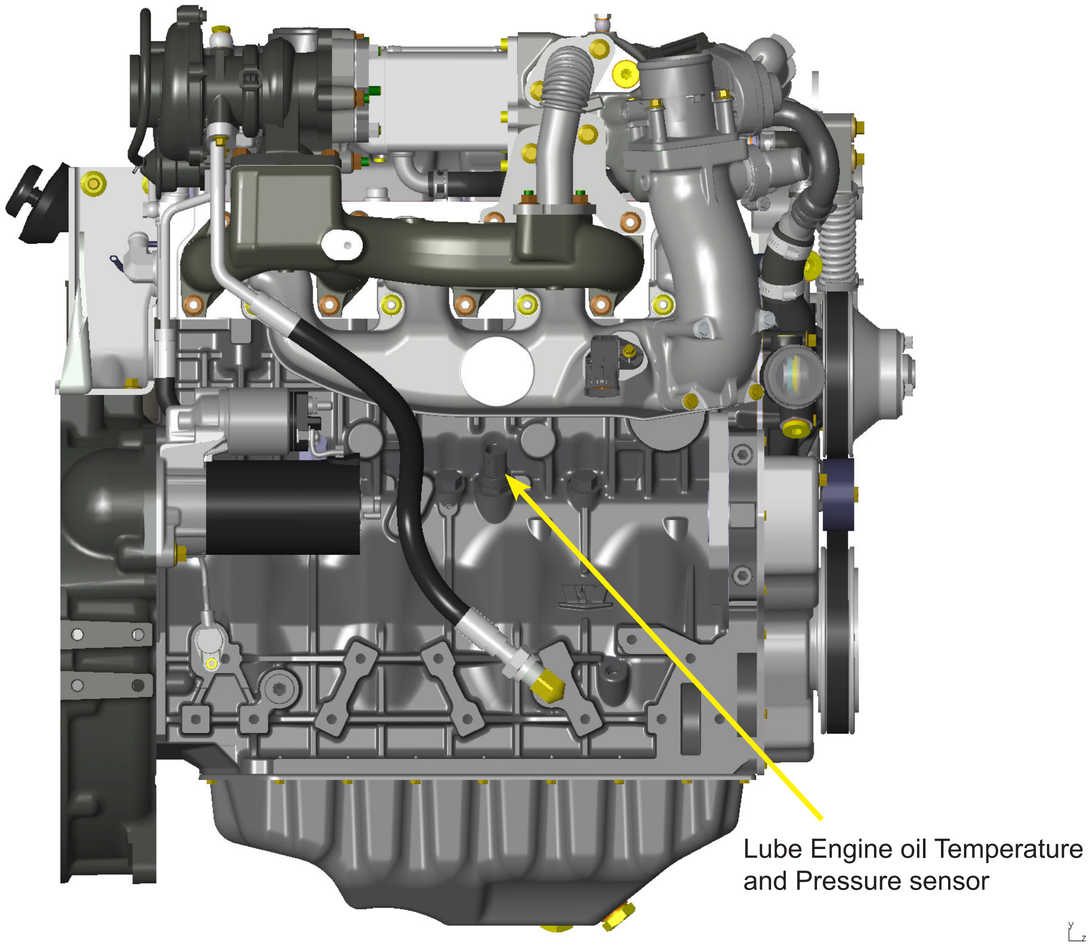
ELECTRICAL SENSORS (R750IE4, TE4, ISE4, R754EU6)

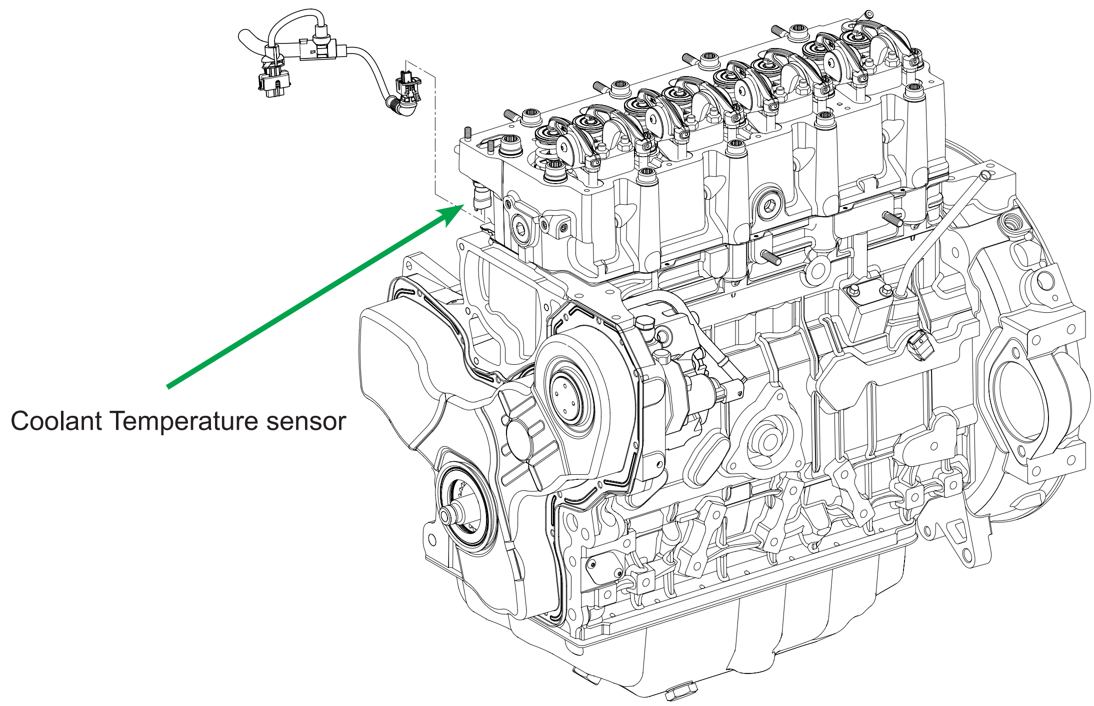
LOCATION




Intake - air temperature
and pressure sensor


Crankshaft position sensor /
engine RPM sensor

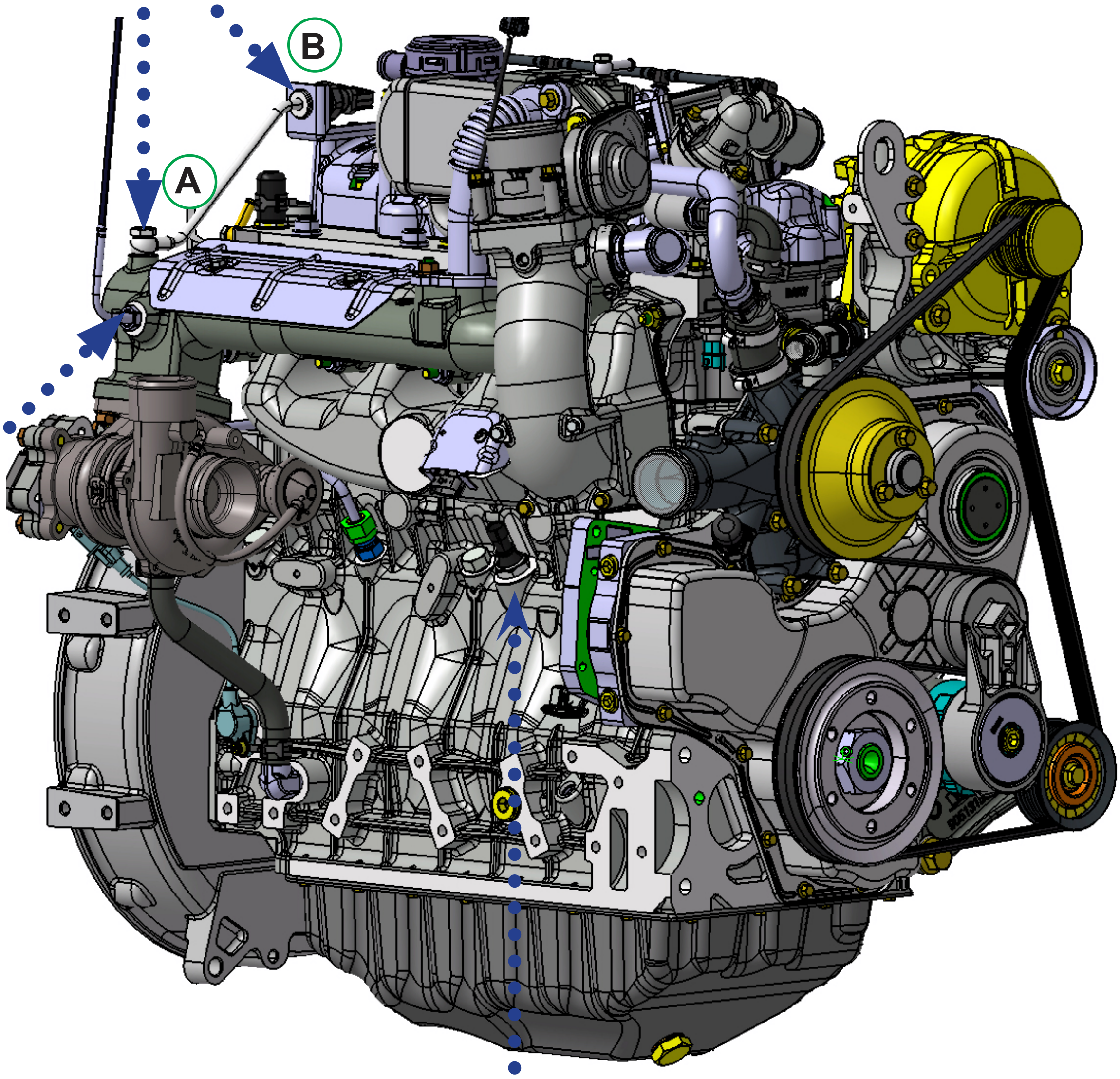

Lube Engine oil Temperature
and Pressure sensor


Coolant Temperature sensor

R754EU6

Exh gas pressure P3 - Exhaust manifold

A - Nm	27.5
B - Nm	14

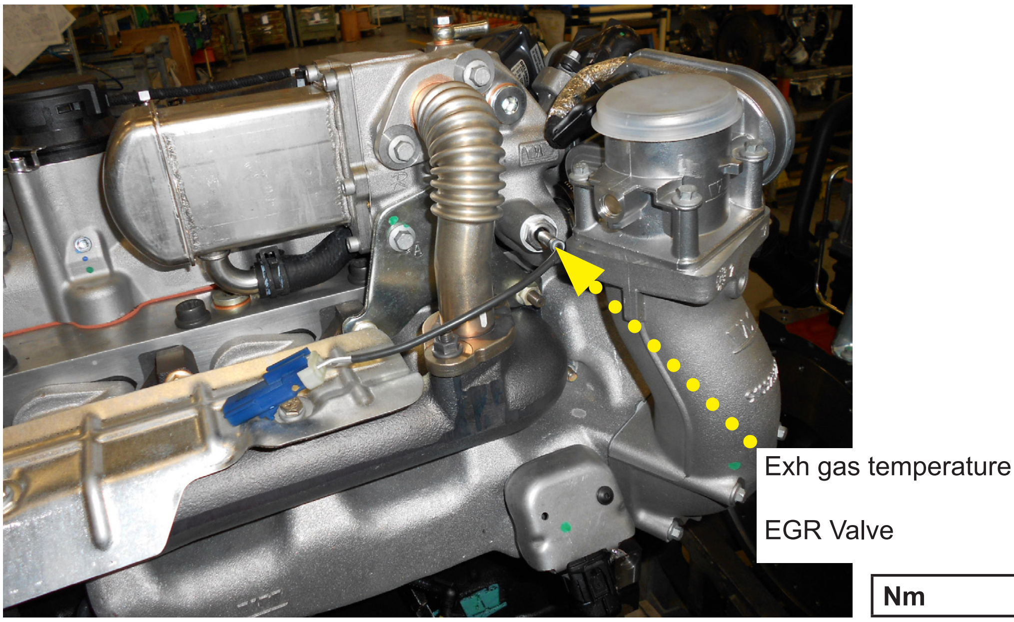


Exh gas temperature T3 - Exhaust manifold

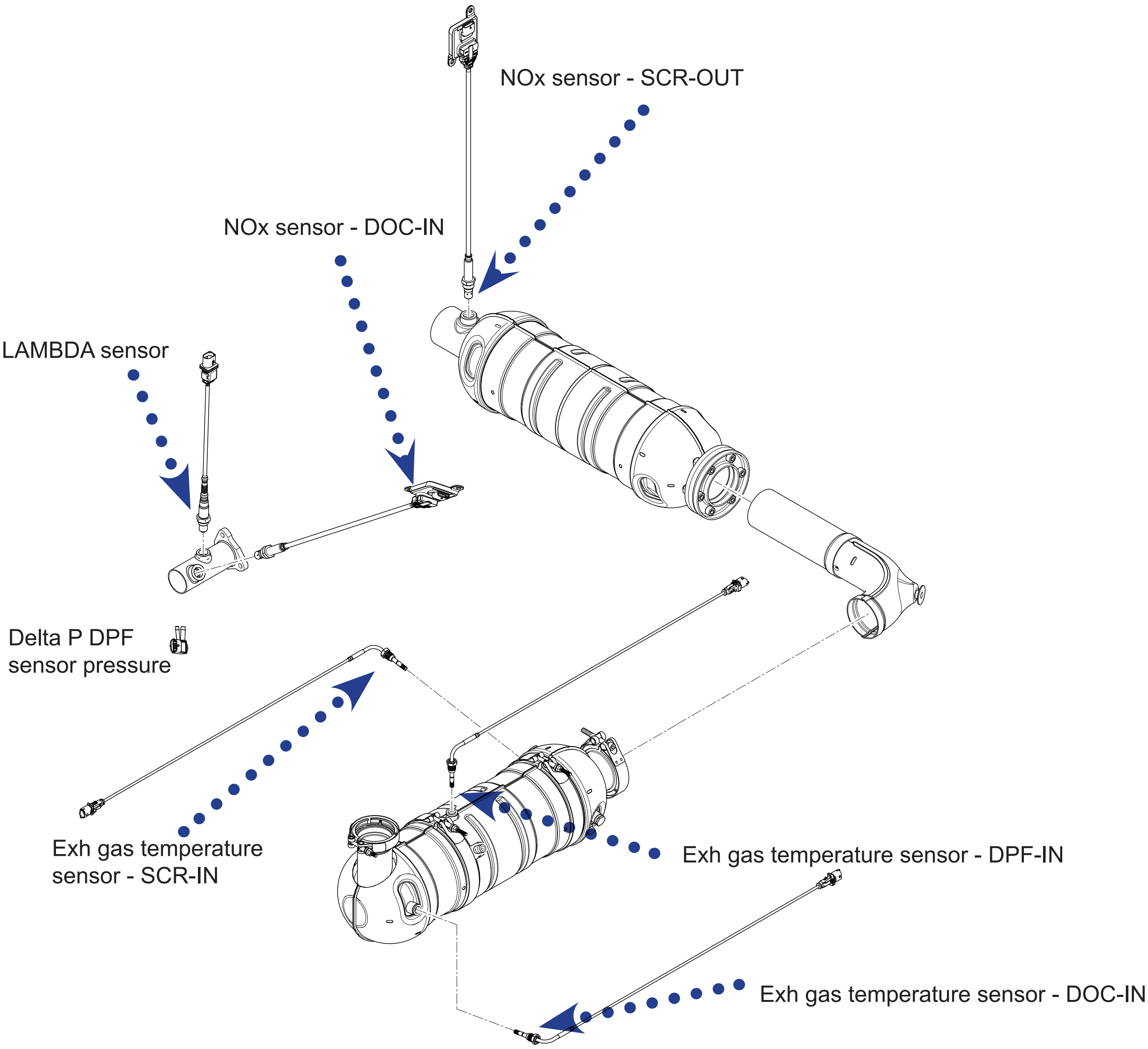
Nm	45.1

Oil pressur switch

Nm	34.3


Exh gas temperature
EGR Valve

Nm	**24.5**


NOx sensor - SCR-OUT
NOx sensor - DOC-IN
LAMBDA sensor
Delta P DPF
sensor pressure
Exh gas temperature
sensor - SCR-IN
Exh gas temperature sensor - DPF-IN
Exh gas temperature sensor - DOC-IN

ENGINE SPEED & CRANKSHAFT POSITION SENSOR

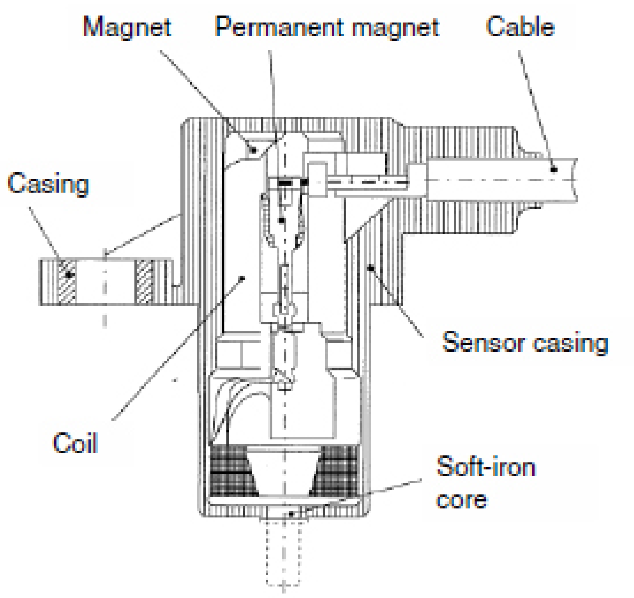
Engine-speed sensors are used to measure the engine speed and to determine the crankshaft position or the position of the pistons, see figure “Cross-section of engine speed sensor”.

The engine speed sensor (separated from the toothed wheel by an air gap) is mounted directly across from the ferro-magnetic pulse wheel, see figure “Inductive engine-speed sensor, magnetic flux”.
It contains a soft iron core (pole pin) which is enclosed by a winding. The pole pin is connected with a permanent magnet. A magnetic field stretches over the pole pin all the way into the pulse wheel. The magnetic flux through the coil depends on whether a gap or a tooth on the pulse wheel is opposite the sensor. A tooth combines the stray flux of the magnet. The used flux through the coil is increased. On the other hand, a gap weakens the magnetic flux.

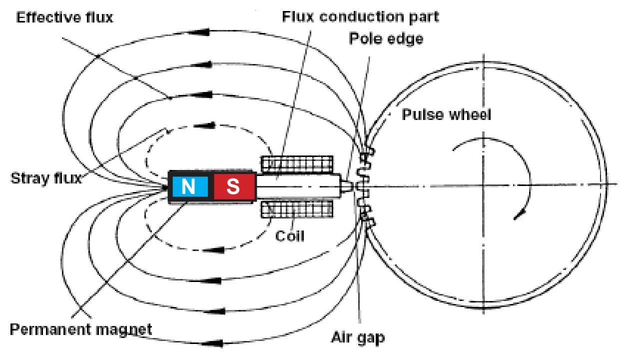
This change in magnetic flux induces a sinusoidal voltage in the coil which is proportional to the rate of change and thus to the engine speed, see figure “Signal acquisition engine speed sensor”.
The amplitude of the alternating voltage strongly increases with an increasing engine speed (few mV ... > 100 V). A sufficient amplitude is attained as of a minimum engine speed of 30 rpm.

The number of teeth in the pulse wheel depends on the usage. For solenoid-valve-controlled engine management systems, pulse wheels with 60 mn division are used, where two teeth have been removed. Thus, the pulse wheel has 60 - 2 = 58 teeth. The particularly large tooth gap represents a reference mark and is assigned to a defined crankshaft position. It is used to synchronise the control unit.

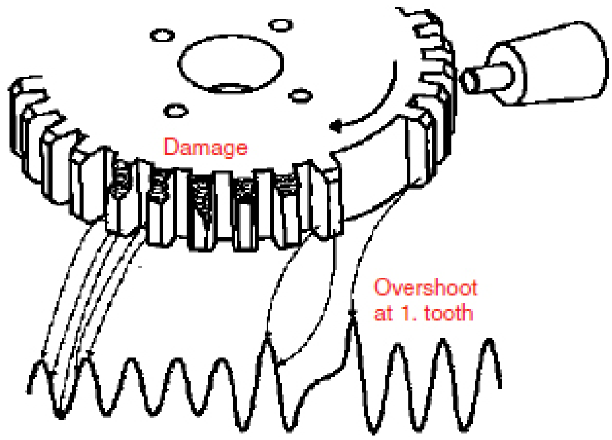
Cross-section of engine speed sensor



Inductive engine-speed sensor, magnetic flux



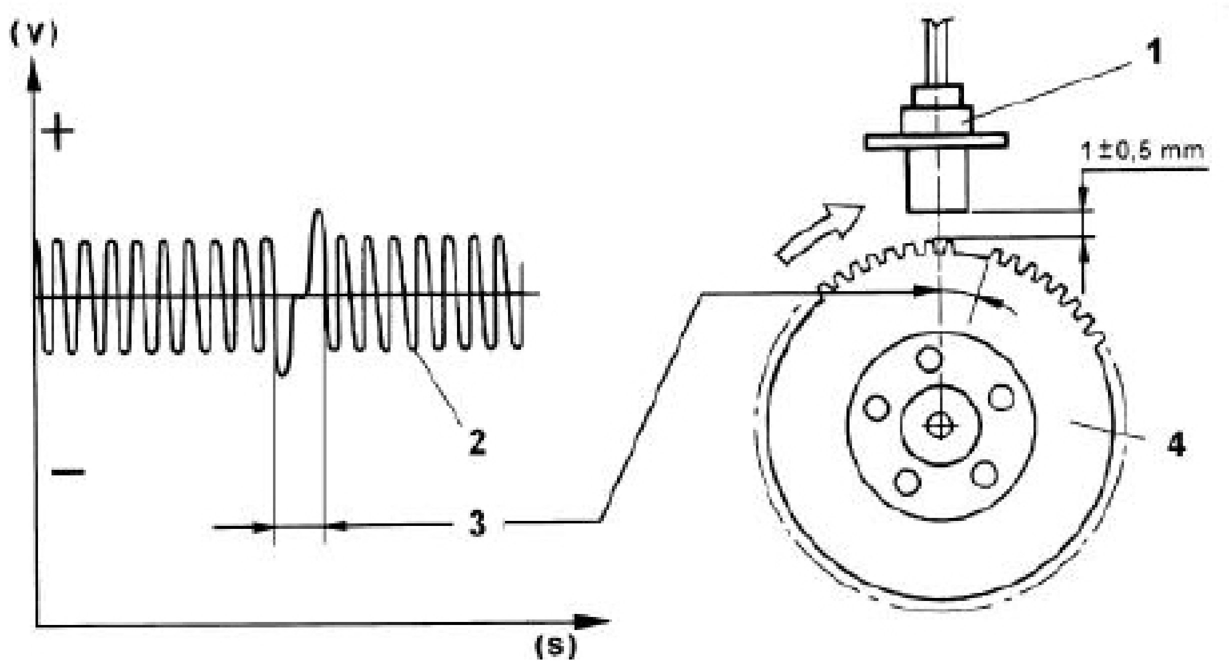
Signal acquisition engine speed sensor



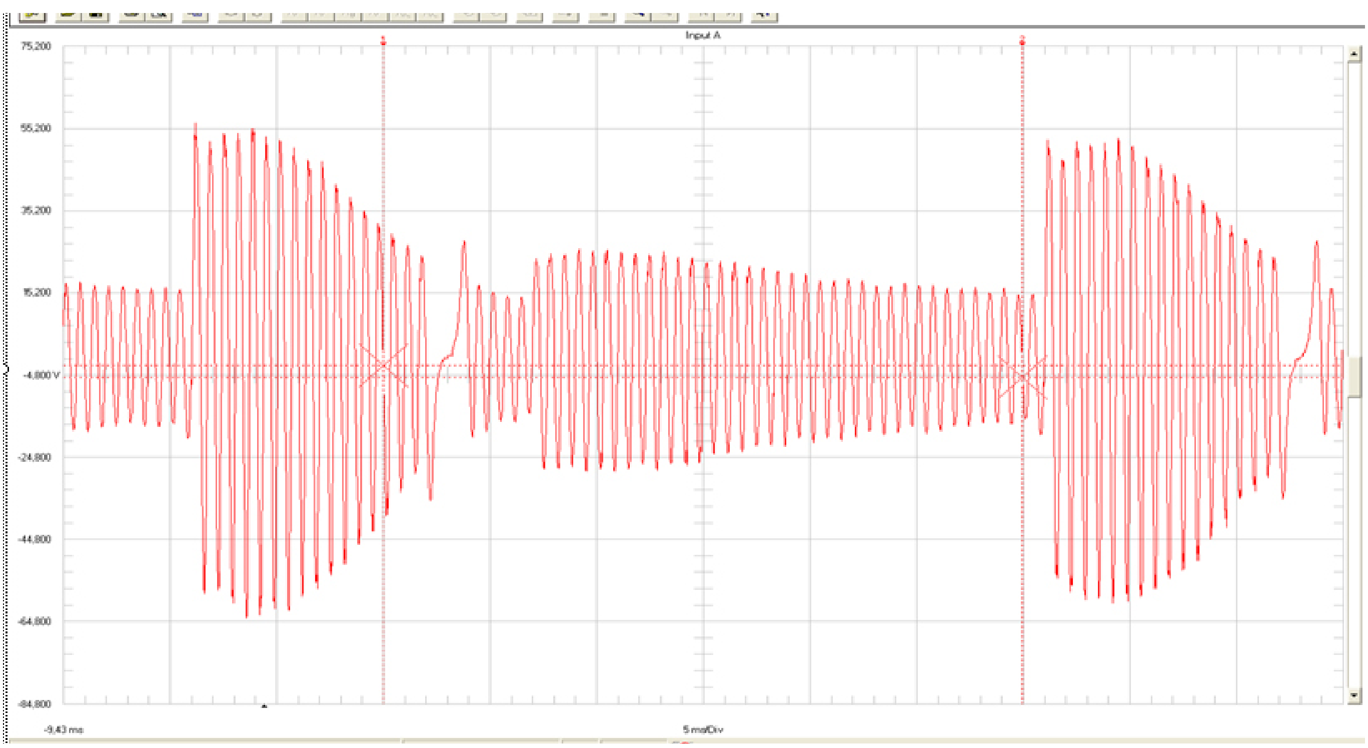
- Trigger wheel with 60 – 2 teeth
- Amplitude error by damaged teeth
- Distance information by Damage missing teeth

ENGINE SPEED SENSOR - TIPICAL WAVE FORM

1. engine speed sensor
2. wave form
3. signal from missed no.2 teeth
4. toothed wheel

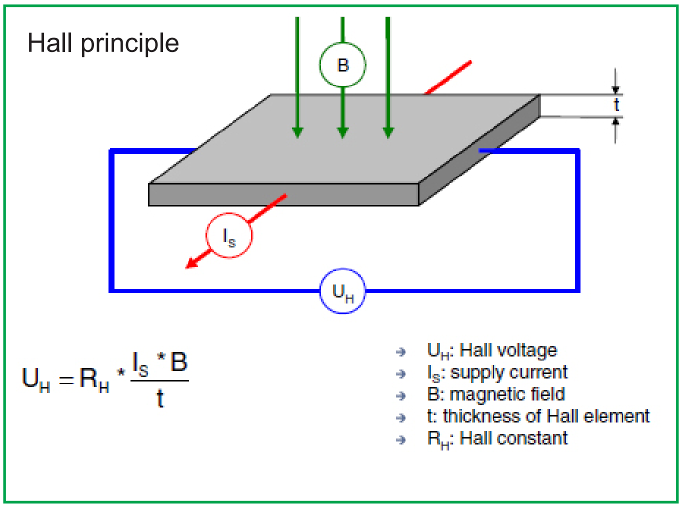


UNCORRECT SPEED SENSOR WAVE FORM



PHASE SENSOR

Unlike the crankshaft, the camshaft is geared down 1:2.
Its position indicates whether a piston moving towards top dead center (TDC) is currently in a compression stroke or exhaust cycle. The phase sensor at the camshaft provides this information to the control unit ECU.
Phase sensors, which are implemented as Hall rod sensors, use the Hall effect, see figure Hall principle.

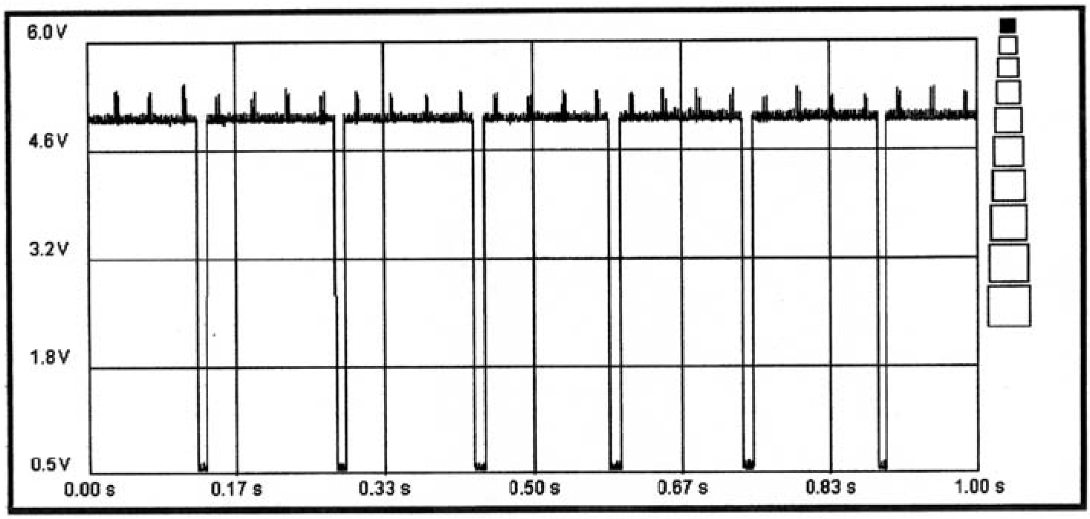


A current-carrying semiconductor layer immersed in a normal magnetic field (force lines at right angles to current direction) generates a potential difference known as a Hall voltage the T terminals.
If current intensity remains constant, the generated voltage depends on magnetic field intensity alone. Periodic changes in magnetic field intensity are sufficient to generate a modulated electrical signal with frequency proportional to the speed of magnetic field change.
The distance between the sensor and the camshaft tooth axis is altered to produce this change.
The rotation of the tooth alters the distance and produces a high voltage signal corresponding to the reference mark.

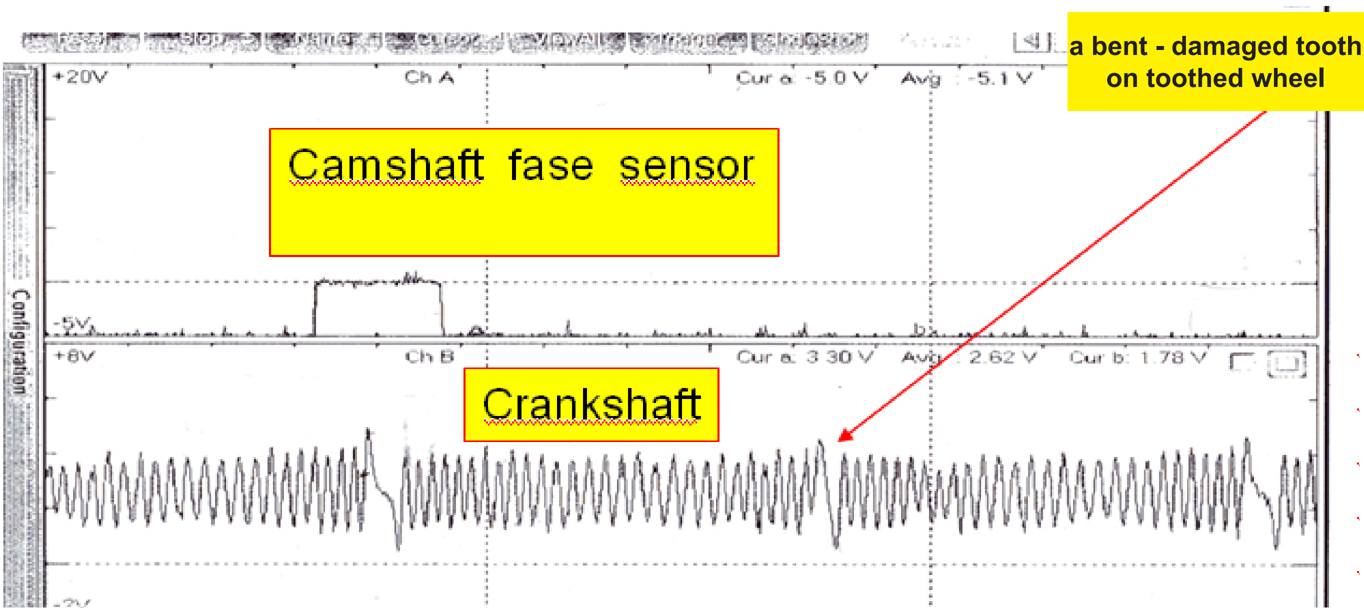
A machined tooth is present on the camshaft and it rotates with the camshaft itself.

The Hall-IC is placed between the rotor-tooth and a permanent magnet. The permanent magnet provides a magnetic field perpendicular to the Hall element. If a tooth now passes the current-carrying sensor element (semi-conductor plate) of the rod sensor, it changes the strength of the magnetic field perpendicular to the Hall element. In this way, there is a greater diversion, perpendicular to the direction of the current, of electrons which are driven by longitudinal stress applied to the element. This creates a voltage signal (Hall voltage) which lies in the millivolt range and, independent of the relative speed, between the sensor and the pulse rotor tooth. The integrated evaluation electronics in the Hall-IC of the sensor processes the signal and provides it as a square-wave signal.

PHASE SENSOR - TIPICAL WAVE FORM



FAILURE CODE P0335 - CRANKSHAFT POSITION SENSOR ERROR, ENGINE DOES NOT START



A tooth of pulse wheel installed on crankshaft was bent - damaged: in this condition the did not start.

DIAGNOSTIC TROUBLE CODES "EURO 4"

NOTE: In VM Motori internet web site Customer Reserved Area "EXTRANET", section "Diagnostic Tool & Trouble-shooting Common Rail Engines R750 MR700-500" are available:

- **the lastest Diagnostic Tool Software Release for Common Rail Engine Models**
- **Industrial and Marine Common Rail engine troubleshooting symptoms charts**

ENGLISH	ITALIANO	DTC
Crankshaft/Camshaft Position Sensor Offset Error	Errore di Posizione Sensore Albero a Camme/Albero Motore	P0016
BPA Boost Pressure Actuator Solenoid Circuit Malfunction	Malfunzionamento Circuito Solenoide Attuatore di Controllo Pressione di Sovralimentazione BPA	P0046
BPA Boost Pressure Actuator Solenoid Circuit Malfunction	Malfunzionamento Circuito Solenoide Attuatore di Controllo Pressione di Sovralimentazione BPA	P0047
BPA Boost Pressure Actuator Solenoid Circuit Malfunction	Malfunzionamento Circuito Solenoide Attuatore di Controllo Pressione di Sovralimentazione BPA	P0048
Air Temperature Signal Duty Cycle Error	Errore Duty Cycle Segnale Temperatura Aria	P0070
Fuel Rail Pressure Monitoring Error for Active Pressure Control by Metering Unit Governor	Errore Pressione Rail durante Controllo Pressione Rail da Regolatore di Pressione	P0087
Fuel Rail Pressure Monitoring Error for Active Pressure Control by Metering Unit Governor	Errore Pressione Rail durante Controllo Pressione Rail da Regolatore di Pressione	P0088
Fuel Rail Pressure Monitoring Error for Active Pressure Control by Metering Unit Governor	Errore Pressione Rail durante Controllo Pressione Rail da Regolatore di Pressione	P0089
Fuel Rail Pressure Monitoring Error for Active Pressure Control by Metering Unit Governor	Errore Pressione Rail durante Controllo Pressione Rail da Regolatore di Pressione	P0090
Fuel Rail Pressure Monitoring Error for Active Pressure Control by Metering Unit Governor	Errore Pressione Rail durante Controllo Pressione Rail da Regolatore di Pressione	P0091
Fuel Rail Pressure Monitoring Error for Active Pressure Control by Metering Unit Governor	Errore Pressione Rail durante Controllo Pressione Rail da Regolatore di Pressione	P0092
Raw Air Mass Signal Plausability Error	Errore di Plausibilità Segnale Portata Aria	P0100
Raw Air Mass Signal Plausability Error	Errore di Plausibilità Segnale Portata Aria	P0101
Battery Voltage Signal Range Check Error	Errore Intervallo di Controllo Segnale Tensione Batteria	P0103
Air Mass Signal Range Check Error of Reference Signal	Errore Segnale Portata Aria di Riferimento	P0104
Intake Air Temperature Sensor Error	Errore Sensore Temperatura Aria in Aspirazione	P0110
Intake Air Temperature Sensor Warning	Allarme Sensore Temperatura Aria in Aspirazione	P0113
Engine Coolant Sensor Error	Errore Sensore Acqua Motore	P0115
Engine Coolant Temperature Warning	Allarme Temperatura acqua Motore	P0118
Accelerator Pedal Position Sensor 1 Error	Errore Posizione Pedale Acceleratore - Sensore 1	P0120
Fuel Temperature Sensor Error	Errore Sensore Temperatura Gasolio	P0180
Fuel Rail Pressure Signal Error	Errore Segnale Pressione Rail	P0190
Fuel Rail Pressure Sensor Offset Monitoring Error	Errore Controllo Scostamento Segnale Pressione Rail	P0191
Oil Temperature Sensor Signal Error	Errore Segnale da Sensore Temperatura Olio Motore	P0195
Engine Oil Temperature Warning	Allarme Temperatura Olio Motore	P0198

Cylinder 1 - Injector Circuit Malfunction Warning	Cilindro 1 - Allarme di Malfunzionamento Circuito Iniettore	P0201
Cylinder 2 - Injector Circuit Malfunction Warning	Cilindro 2 - Allarme di Malfunzionamento Circuito Iniettore	P0202
Cylinder 3 - Injector Circuit Malfunction Warning	Cilindro 3 - Allarme di Malfunzionamento Circuito Iniettore	P0203
Cylinder 4 - Injector Circuit Malfunction Warning	Cilindro 4 - Allarme di Malfunzionamento Circuito Iniettore	P0204
Cylinder 5 - Injector Circuit Malfunction Warning	Cilindro 5 - Allarme di Malfunzionamento Circuito Iniettore	P0205
Cylinder 6 - Injector Circuit Malfunction Warning	Cilindro 6 - Allarme di Malfunzionamento Circuito Iniettore	P0206
Accelerator Pedal Position Sensor 2 Error	Errore Posizione Pedale Acceleratore - Sensore 2	P0220
Accelerator Pedal Position Sensors Synchronization Error	Errore di Sincronizzazione Sensori di Posizione Pedale Acceleratore	P0221
Turbo/Super Charger Overboost Condition	Condizioni di Alta Pressione di Sovralimentazione	P0234
Boost Pressure Sensor Error	Errore Sensore Pressione di Sovralimentazione	P0235
Boost Pressure Warning	Allarme Pressione di Sovralimentazione	P0238
Metering Unit Solenoid PWM Control Circuit Malfunction	Malfunzionamento Circuito di Controllo PWM Solenoide Regolatore di Pressione	P0252
Metering Unit Solenoid PWM Control Circuit Malfunction	Malfunzionamento Circuito di Controllo PWM Solenoide Regolatore di Pressione	P0253
Metering Unit Solenoid PWM Control Circuit Malfunction	Malfunzionamento Circuito di Controllo PWM Solenoide Regolatore di Pressione	P0254
PCV Pressure Control Valve Analogic/Digital Channel Error	Errore Canale Analogico/Digitale di Controllo Valvola Regolazione Portata Combustibile PCV	P0256
PCV Pressure Control Valve PWM Circuit Malfunction	Malfunzionamento Circuito PWM di Controllo Valvola Regolazione Portata Combustibile PCV	P0257
PCV Pressure Control Valve PWM Circuit Malfunction	Malfunzionamento Circuito PWM di Controllo Valvola Regolazione Portata Combustibile PCV	P0258
PCV Pressure Control Valve PWM Circuit Malfunction	Malfunzionamento Circuito PWM di Controllo Valvola Regolazione Portata Combustibile PCV	P0259
Cylinder 1 - Injector Circuit Malfunction Specific Error	Cilindro 1 - Errore Specifico di Malfunzionamento Circuito Iniettore	P0262
Cylinder 2 - Injector Circuit Malfunction Specific Error	Cilindro 2 - Errore Specifico di Malfunzionamento Circuito Iniettore	P0265
Cylinder 3 - Injector Circuit Malfunction Specific Error	Cilindro 3 - Errore Specifico di Malfunzionamento Circuito Iniettore	P0268
Cylinder 4 - Injector Circuit Malfunction Specific Error	Cilindro 4 - Errore Specifico di Malfunzionamento Circuito Iniettore	P0271
Cylinder 5 - Injector Circuit Malfunction Specific Error	Cilindro 5 - Errore Specifico di Malfunzionamento Circuito Iniettore	P0274
Cylinder 6 - Injector Circuit Malfunction Specific Error	Cilindro 6 - Errore Specifico di Malfunzionamento Circuito Iniettore	P0277
Turbo/Super Charger Underboost Condition	Condizioni di Bassa Pressione di Sovralimentazione	P0299
Crankshaft Position Sensor Error	Errore Sensore di Giri Albero Motore	P0335
Engine Overspeed Warning	Allarme Fuorigiri Motore	P0338
Camshaft Position Sensor Error	Errore Sensore di Fase Albero a Camme	P0340
GCU-R Glow Control Unit - Standard Voltage System Relay Circuit Malfunction	GCU Unità di Controllo Candelette Malfunzionamento Relè	P0380
Glow Lamp Indicator Malfunction	Malfunzionamento Spia Candelette	P0381

EGR Exhaust Gas Recirculation Flow Insufficient Detected	Portata Insufficiente del Ricircolo dei Gas di Scarico EGR	P0401
EGR Exhaust Gas Recirculation Flow Excessive or Inlet Air Circuit Malfunction Detected	Portata Eccessiva del Ricircolo dei Gas di Scarico EGR o Malfunzionamento Impianto di Ingresso Aria	P0402
EGR Exhaust Gas Recirculation Actuator Malfunction	Malfunzionamento Attuatore Ricircolo Gas di Scarico EGR	P0404
Fan 1 Control Relay Malfunction	Malfunzionamento Circuito Relè Ventola 1	P0480
Fan 2 Control Relay Malfunction	Malfunzionamento Circuito Relè Ventola 2	P0481
Fan 3 Control Relay Malfunction	Malfunzionamento Circuito Relè Ventola 3	P0482
TVA Throttle Valve Actuator Monitoring Error Indicated by Digital Status Signal	Errore Attuatore Valvola Parzializzatrice Aspirazione TVA Indicato da Segnale Digitale di Stato	P0487
TVA Throttle Valve Actuator Circuit Malfunction	Malfunzionamento Circuito Attuatore Valvola Parzializzatrice Aspirazione TVA	P0488
EGR Exhaust Gas Recirculation Actuator Malfunction	Malfunzionamento Attuatore Ricircolo Gas di Scarico EGR	P0489
EGR Exhaust Gas Recirculation Actuator Malfunction	Malfunzionamento Attuatore Ricircolo Gas di Scarico EGR	P0490
Vehicle Speed Sensor Malfunction	Malfunzionamento Sensore di Velocità Veicolo	P0500
Brake Signal Error	Errore Segnale Freno	P0504
Incorrect Immobilizer Key	Chiave Immobilizer non Corretta	P0513
Engine Oil Pressure Sensor/Switch Signal Error	Errore Segnale da Sensore Pressione Olio Motore	P0520
Engine Oil Pressure Lamp Malfunction	Malfunzionamento Spia Pressione Olio Motore	P0521
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TVA Throttle Valve Actuator Circuit Malfunction	Malfunzionamento Circuito Attuatore Valvola Parzializzatrice Aspirazione TVA	P2142
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DPF Particulate Filter - Differential Pressure Sensor Defective	DPF Filtro Particolato - Sensore Pressione Diffe-renziale Difettoso	P2452

DPF Particulate Filter - Differential Pressure not Plausible	DPF Filtro Particolato - Pressione Differenziale non Plausibile	P2453
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CAN A Controller Error	Errore Controllo Linea CAN A	U0028
CAN B Controller Error	Errore Controllo Linea CAN B	U0037
CAN C Controller Error	Errore Controllo Linea CAN C	U0046
CAN Message Timeout Error from Transmission Controller Unit TCU	Errore Messaggio CAN da Centralina Cambio TCU	U0101
CCVS CAN Error on Cruise Control	CCVS Errore Messaggio CAN da Cruise Control	U0104
RXEEC2 CAN Message Timeout Error	RXEEC2 Errore Messaggio CAN	U0107
PTO CAN Message Timeout Error	PTO Errore Messaggio CAN	U0117
TSC1-VE Speed Override Vehicle Dynamic Control Module VC Error Message	TSC1-VE Errore Messaggio da Controllo Veicolo VC	U0122
EBC1 CAN Message Timeout Error	EBC1 Errore Messaggio CAN	U0129
TSC1-PE Torque/Speed Override Control Module PTO Error Message	TSC1-PE Errore Messaggio da Controllo Esterno di Coppia/Velocità PTO	U0140
Lost Communication with Vehicle Immobilizer Control Module	Comunicazione con Centralina Immobilizer Interrotta	U0167
Invalid Data Received from Transmission Controller Unit TCU	Dati Ricevuti da Centralina Cambio TCU non Coerenti	U0402
RXEEC2 CAN Message Out of Range	RXEEC2 Messaggio CAN oltre i limiti	U0408
Invalid Data Received from Vehicle Immobilizer Control Module (EEPROM Error)	Dati Ricevuti da Centralina Immobilizer non Coerenti (Errore EEPROM)	U0426
EEC2 Message or Accelerator Pedal not Present	EEC2 Errore Messaggio CAN o Pedale Acceleratore non presente	U1001
Accelerator Pedal Signal Above Threshold Value	Segnale Pedale Acceleratore Eccede Limite Superiore	U1002

DIAGNOSTIC TROUBLE CODES "EURO 5"

NOTE: In VM Motori internet web site Customer Reserved Area "EXTRANET", section "Diagnostic Tool & Trouble-shooting Common Rail Engines R750 MR700-500" are available:

- **the lastest Diagnostic Tool Software Release for Common Rail Engine Models**
- **Industrial and Marine Common Rail engine troubleshooting symptoms charts**

DTC	SPN	Description	FMI Max	FMI Min	FMI Sig	FMI Npl	FMI Max	FMI Min	FMI Sig	FMI Npl
16	228	Crankshaft/ Camshaft Position Sensor Offset Error	1	FF	FF	FF	offset between camshaft and crankshaft			
87	157	Error Fuel Low Rail Pressure	1	FF	FF	FF	maximum positive deviation of rail pressure exceeded			
87	157	Error Fuel Low Rail Pressure	5	FF	FF	FF	maximum positive deviation of rail pressure exceeded concerning set flow of fuel			
87	157	Error Fuel Low Rail Pressure	9	FF	FF	FF	minimum rail pressure exceeded			
88	157	Error Fuel High Rail Pressure	1	FF	FF	FF	maximum negative rail pressure de-viation with metering unit on lower limit is exceeded			
88	157	Error Fuel High Rail Pressure	5	FF	FF	FF	maximum rail pressure exceeded			
89	157	Fuel Rail Pressure Monitoring Error for Active Pressure Control by Metering Unit Governor	5	FF	FF	FF	setpoint of metering unit in overrun mode not plausible			
96	172	Air mass temperatu-re signal error	1	2	FF	FF	Voltage abo-ve upper limit	Voltage below lower limit		
100	132	Raw Air Mass Si-gnal Error	9	A	B	FF	Signal range check high error	Signal ran-ge check low error	signal cutoff or short circuit to either battery or ground	
101	132	Raw Air Mass Signal Plausability Error	1	2	FF	FF	airmass ratio is higher than threshold high	airmass ratio is lower than threshold low		

102	132	Error path exceeding the maximum drift limit in low-idle mode	5	6	FF	FF	If the upper limit is exceeded when the correction value calculation is released	If values fall below the lower when the correction value calculation is released		
102	132	Error path exceeding the maximum drift limit in the load range	9	A	FF	FF	If the upper limit is exceeded when the correction value calculation is released	If values fall below the lower when the correction value calculation is released		
103	132	Battery Voltage Signal Range Check Error	1	2	FF	FF	Voltage above upper Limit	Voltage below lower Limit		
110	105	Intake Air Temperature Sensor Error	1	2	FF	FF	Voltage above upper limit	Voltage below lower limit		
113	105	Intake Air Temperature Sensor Warning	1	FF	FF	FF	air temperature above upper Limit			
115	110	Engine Coolant Sensor Error	1	2	3	4	Voltage above upper limit	Voltage below lower limit	Can Msg. value defect	plausibility defect between OTS and CTS
118	110	Engine Coolant Temperature Warning	1	FF	FF	FF	Coolant temperature above upper limit			
120	91	Accelerator Pedal Position Sensor 1 Error	1	2	FF	4	Voltage above upper limit	Voltage above upper limit		Unplausible voltage
168	174	Fuel over temp	1	FF	FF	FF	Over temp			
180	174	Fuel Temperature Sensor Error	1	2	FF	FF	Voltage above upper limit	Voltage below lower limit		
190	164	Fuel Rail Pressure Signal Error	1	2	FF	FF	Voltage above upper limit	Voltage below lower limit		
195	175	Oil Temperature Sensor Signal Error	1	2	3	4	Voltage above upper limit	Voltage below lower limit	signal error for CAN	Plausibility error between OTS and CTS
198	175	Engine Oil Temperature Warning	1	FF	FF	FF	Oil Temperature above upper limit			
201	651	Cylinder 1 - Injector Circuit Malfunction Warning	FF	FF	3	FF			Open load	
202	652	Cylinder 2 - Injector Circuit Malfunction Warning	FF	FF	3	FF			Open load	

203	653	Cylinder 3 - Injector Circuit Malfunction Warning	FF	FF	3	FF			Open load	
204	654	Cylinder 4 - Injector Circuit Malfunction Warning	FF	FF	3	FF			Open load	
216	629	ECU Overrun Monitoring Error	1	FF	FF	FF	Energising time exceeds limit of overrun monitoring (ECU Overrun monitoring error)			
216	629	ECU Redundant Engine Speed Monitoring Error	5	FF	FF	FF	Plausibility error in engine speed check (ECU Redundant engine speed monitoring error)			
220	91	Accelerator Pedal Position Sensor 2 Error	1	2	FF	FF	Voltage above upper limit	Voltage above upper limit		
221	91	Accelerator Pedal Position Sensors Synchronization Error	FF	FF	FF	4				deviation between APP1 and APP2 voltage too high
234	641	Turbo/Super Charger Overboost Condition	FF	2	FF	FF		negative governor deviation below limit		
235	102	Boost Pressure Sensor Error	1	2	3	4	Voltage above upper limit	Voltage below lower limit	CAN signal defect	Not plausible with atmospheric pressure sensor
238	102	Boost Pressure Warning	1	FF	FF	FF	Boost pressure above upper limit			
252	1347	Metering Unit Solenoid PWM Control Circuit Malfunction	FF	FF	3	4			open load of metering unit output	excess temperature of metering unit powerstage
253	1347	Metering Unit Solenoid PWM Control Circuit Malfunction	FF	2	FF	FF		short circuit to ground of metering unit output		
254	1347	Metering Unit Solenoid PWM Control Circuit Malfunction	1	FF	FF	FF	short circuit to battery of metering unit output			

262	651	Cylinder 1 - Injector Circuit Malfunction Specific Error	1	2	3	4	short circuit on Low Side to battery	general short circuit	short circuit Low Side to High Side	not-classif-yable error
263	651	Energizing Time Calibration Error	1	2	FF	FF	above upper limit of ener-gizing time	below lower limit of energi-zing time		
265	652	Cylinder 2 - Injector Circuit Malfunction Specific Error	1	2	3	4	short circuit on Low Side to battery	general short circuit	short circuit Low Side to High Side	not-classif-yable error
266	652	Energizing Time Calibration Error	1	2	FF	FF	above upper limit of ener-gizing time	below lower limit of energi-zing time		
268	653	Cylinder 3 - Injector Circuit Malfunction Specific Error	1	2	3	4	short circuit on Low Side to battery	general short circuit	short circuit Low Side to High Side	not-classif-yable error
269	653	Energizing Time Calibration Error	1	2	FF	FF	above upper limit of ener-gizing time	below lower limit of energi-zing time		
271	654	Cylinder 4 - Injector Circuit Malfunction Specific Error	1	2	3	4	short circuit on Low Side to battery	general short circuit	short circuit Low Side to High Side	not-classif-yable error
272	654	Energizing Time Calibration Error	1	2	FF	FF	above upper limit of ener-gizing time	below lower limit of energi-zing time		
299	641	Turbo/Super Char-ger Underboost Condition	1	FF	FF	FF	positive governor de-viation above limit			
335	190	Crankshaft Position Sensor Error	1	2	FF	FF	no crankshaft signal	wrong crankshaft signal		
338	190	Engine Overspeed Warning	1	FF	FF	FF	engine speed above upper limit			
340	723	Camshaft Position Sensor Error	1	2	FF	FF	no camshaft signal	wrong camshaft signal		
380	676	GCU-R Glow Con-trol Unit - Standard Voltage System Relay Circuit Mal-function	1	2	3	4	Short Circuit to Battery	Short Circuit to Ground	No Load	Excess Tempera-ture
381	675	Glow Lamp Indica-tor Malfunction	1	2	3	4	Short Circuit to Battery	Short Circuit to Ground	No Load	Excess Tempera-ture
401	27	EGR Exhaust Gas Recirculation Flow Insufficient Detected	FF	2	FF	FF		negative governor deviation below limit		

402	27	EGR Exhaust Gas Recirculation Flow Excessive or Inlet Air Circuit Malfunction Detected	1	FF	FF	FF	Positive governor deviation above limit			
403	27	EGR Exhaust Gas Recirculation Actuator Malfunction	FF	FF	3	4			No Load	Excess Temperature
405	27	EGR Exhaust Gas Recirculation Flow Insufficient Detected During DPF Regeneration	FF	2	FF	FF		negative governor deviation below limit		
489	27	EGR Exhaust Gas Recirculation Actuator Malfunction	FF	2	FF	FF		Short Circuit to Ground		
490	27	EGR Exhaust Gas Recirculation Actuator Malfunction	1	FF	FF	FF	Short Circuit to Battery			
500	84	Vehicle Speed Sensor Malfunction	1	FF	3	4	exceeding of the maximum vehicle speed		HW signal for vehicle speed not valid	vehicle speed not plausible with injection mass and engine speed
520	100	Engine Oil Pressure Sensor/Switch Signal Error	1	2	3	FF	Voltage above upper limit	Voltage below lower limit	Voltage signal absent	
521	835	Engine Oil Pressure Lamp Malfunction	1	2	3	4	short circuit to battery	short circuit to ground	No Load	excess temperature
522	100	Critical Engine Oil Pressure Warning	1	FF	FF	FF	Oil Pressure below lower limit			
524	100	Low Engine Oil Pressure Warning	1	FF	FF	FF	Oil Pressure below lower limit			
544	173	DPF Particulate Filter - Exhaust Gas Temperature Sensor Error	5	6	FF	FF	Voltage above upper limit	Voltage below lower limit		
560	168	Battery Voltage Error	1	2	FF	FF	Voltage above upper limit	Voltage above upper limit		
571	597	Brake Signal Error	FF	FF	3	4			brake signal is defective	brake signal not plausible
585	527	Cruise Control Multi-Function Input “A”/”B” Correlation Error (Invalid Switch Combination Detected)	FF	FF	FF	4				Eeprom error

600	629	ECU Internal Communication Error - SPI	1	FF	FF	FF	communication error of CJ940 (ECU Internal Communication Malfunction)			
600	627	ECU Internal Communication Error Between Function Computer and Monitoring Module	FF	FF	FF	4				Set, if SPI-communication failed
601	629	ECU Processor Recovery Locked	FF	FF	FF	4				A recovery has occurred
602	629	ECU Processor Recovery Suppressed	FF	FF	FF	4				a recovery has occurred
606	625	Plausibility Error on Base Map for Torque to Quantity Conversion	FF	FF	FF	4				Not plausible fault
606	629	TPU Time Processing Unit Monitoring Error	FF	FF	FF	8				Deviation between TPU and system time
607	629	ECU Internal Watchdog/Controller Error	FF	FF	FF	8				Set, if error-counter of Watchdog or controller are not plausible or the system must shut down (ECU Internal Watchdog error)
615	677	T50 Terminal Signal Plausibility Error	1	FF	FF	FF	Terminal 50 always Pressed			
616	677	Starter Relay Circuit Malfunction (Low Side Power Stage)	1	2	3	4	Short Circuit to Battery	Short Circuit to Ground	No load	Overheated
617	677	Starter Relay Circuit Malfunction (high Side Power Stage)	FF	2	FF	FF		Short Circuit to Ground		
641	1079	Sensor Supply Voltage 1 Check Error	1	2	FF	FF	Voltage above upper limit	Voltage below lower limit		
645	1351	Air Conditioning Relay Circuit Malfunction	1	2	3	4	Short Circuit to Battery	Short Circuit to Ground	No load	Excess Temperature
650	1213	MIL Lamp Circuit Malfunction	1	2	3	4	Short Circuit to Battery	Short Circuit to Ground	No load	Unplausible

651	1079	Sensor Supply Voltage 2 Check Error	1	2	FF	FF	Voltage above upper limit	Voltage below lower limit		
685	1485	Main Relay Control Error	1	2	FF	FF	main relay does not open in time	main relay opens too early		
697	1079	Sensor Supply Voltage 3 Check Error	1	2	FF	FF	Voltage above upper limit	Voltage below lower limit		
1620	629	ECU Redundant Shut Off Test Error during Initialization	FF	2	3	4		Watch dog switch off path defect ECU Internal Shut-off Path Watchdog	Voltage monitoring upper limit shut off path defect ECU Internal Shut-off Path High Voltage	Voltage monitoring lower limit shut off path defect ECU Internal Shut-off Path Low Voltage
1628	628	Dataset Variant Coding Plausibility Error	FF	FF	3	4			Signal fault	Not plausible fault
2002	131	DPF Particulate Filter - Filter Dismounted or Defective	FF	A	FF	FF		Corrected maximum differential pressure is lower than the threshold		
2102	634	TVA Throttle Valve Actuator Circuit Malfunction	FF	2	FF	FF		Short Circuit to Ground		
2103	634	TVA Throttle Valve Actuator Circuit Malfunction	1	FF	FF	FF	Short Circuit to Battery			
2146	657	Injector Bank 1 Circuit Malfunction Specific Error	1	2	FF	4	general short circuit	short circuit on Low Side to ground		not-classifyable error
2149	658	Injector Bank 2 Circuit Malfunction Specific Error	1	2	FF	4	general short circuit	short circuit on Low Side to ground		not-classifyable error
2226	108	Barometric Pressure Sensor Error	1	2	FF	4	Voltage above upper limit	Voltage above upper limit		Not plausible with boost pressure sensor
2264	97	Water Level in Fuel Actuator Malfunction	1	2	3	4	Short Circuit to Battery	Short Circuit to Ground	No Load	Excess Temperature
2269	97	Water in Fuel Detection	1	FF	FF	FF	Water in fuel detected			
2293	157	PRV Rail Pressure Relief Valve Error	1	2	3	FF	PRV was recognised as OPEN	pressure shock requested	PRV did not open after pressure shock	

2452	131	DPF Particulate Filter - Differential Pressure Sensor Defective	1	2	FF	FF	Voltage above upper limit	Voltage below lower limit		
2453	81	DPF Particulate Filter - Differential Pressure not Plausible	FF	FF	FF	1C				hose line defective or signal not plausible
2454	81	Soot mass over limit	1	FF	FF	FF	Over limit			
2533	677	T15 Terminal Signal Plausibility Error	FF	FF	3	FF			No Terminal 15 signals detected	
2687	859	Fuel Filter Heating Relay Circuit Malfunction	1	2	3	4	Short Circuit to Battery	Short Circuit to Ground	No Load	Excess Temperature
242F	131	DPF Particulate Filter - Engine Protection Active	1	FF	FF	FF	Differential pressure above limit			
242F	81	DPF Particulate Filter - Engine Protection Active	5	FF	FF	FF	Soot mass greater than the threshold			
251C	979	PTO Enable Switch Circuit Malfunction	1	2	FF	4	short circuit to battery	short circuit to ground		Multiple State Switch not Plausible
252F	98	Critical Oil Mass Check Error	1	2	FF	FF	Max Error path for critical engine oil mass	Min Error path for critical engine oil mass		
60B	629	Analog digital converter error	1	2	3	4	Voltage above upper limit	Voltage below lower limit	Check signal error	Time out conversion
60C	627	ECU Internal Supply Voltage Error	1	FF	FF	FF	ECU internal supply voltage above upper limit			
60C	627	ECU Internal Supply Voltage Error	FF	6	FF	FF		ECU internal supply voltage below lower limit		
61F	634	TVA Throttle Valve Actuator Circuit Malfunction	FF	FF	7	8			No Load	Excess Temperature
62B	629	ECU - Fuel Injector Control Module A Performance Error	1	2	3	4	CY33X internal reset / clockloss / undervoltage	CY33X is unlocked / CY33X init error	CY33X is in Testmode	CY33X SPI communication error /checksum/ readback
62B	629	ECU - Fuel Injector Control Module B Performance Error	5	6	7	8	CY33X internal parity error	CY33X internal program flow error	CY33X check of inv. YSEL during ON failed	CY33X ON timeout for at least 1 cylinder

62F	628	ECU Internal EEPROM Memory Error	FF	2	3	4		error during last read operation	error during last write operation	default value used
C001	639	CAN Messages Error from Communication Manager	FF	FF	3	FF			Timeout in CAN send messages	
C028	639	CAN A Controller Error	1	FF	FF	FF	Bus off in CAN A			
C037	639	CAN B Controller Error	1	FF	FF	FF	Bus off in CAN B			
C046	639	CAN C Controller Error	1	FF	FF	FF	Bus off in CAN C			
C101	898	TSC1-TE CAN Message Timeout Error from Transmission Controller Unit TCU	15	FF	17	FF	timeout for TSC1-TE, when active		timeout for TSC1-TE, when inactive	
C107	91	RXEEC2 CAN Message Timeout Error	FF	FF	3	FF			Timeout of CAN message EEC2	
C122	898	TSC1-VE Speed Override Vehicle Dynamic Control Module VC Error Message	1	FF	3	FF	timeout for TSC1-VE, when active		timeout for TSC1-VE, when inactive	
C140	898	TSC1-PE Torque/ Speed Override Control Module PTO Error Message	1	2	FF	FF	timeout for TSC1-PE, when active	timeout for TSC1-PE, when inactive		
C408	91	RXEEC2 CAN Message Out of Range	1	FF	FF	FF	Out of range data in CAN message RxEEC2			

DIAGNOSTIC TROUBLE CODES "IE4, TE4, IE4"

NOTE: In VM Motori internet web site Customer Reserved Area "EXTRANET", section "Diagnostic Tool & Trouble-shooting Common Rail Engines R750 MR700-500" are available:

- the lastest Diagnostic Tool Software Release for Common Rail Engine Models
- Industrial and Marine Common Rail engine troubleshooting symptoms charts

DTC	SPN	FMI				SYS LAMP	TRIP MIL	MAIN RECOVERY ACTIONS	English description
max		max	min	sig	pls				
0	0	1	2	4	8	SysLamp OFF	0		Manual rigeneration switch malfunction.
16	228	1	FF	FF	FF	SysLamp ON	3		Crankshaft/ Camshaft Position Sensor Offset Error
87	157	1	FF	FF	FF	SysLamp ON	0	- Quantity cut - Regen off	Fuel Rail Pressure Monitoring Error for Active Pressure Control by Metering Unit Governor
87	157	5	FF	FF	FF	SysLamp BLINK	0	- Engine shutoff - Regen off	Fuel Rail Pressure Monitoring Error for Active Pressure Control by Metering Unit Governor
87	157	9	FF	FF	FF	SysLamp BLINK	0	- Engine shutoff	Fuel Rail Pressure Monitoring Error for Active Pressure Control by Metering Unit Governor
88	157	1	FF	FF	FF	SysLamp ON	0	- Quantity cut - Regen off	Fuel Rail Pressure Monitoring Error for Active Pressure Control by Metering Unit Governor
88	157	5	FF	FF	FF	SysLamp BLINK	0	- Engine shutoff	Fuel Rail Pressure Monitoring Error for Active Pressure Control by Metering Unit Governor
89	157	5	FF	FF	FF	SysLamp ON	0		Fuel Rail Pressure Monitoring Error for Active Pressure Control by Metering Unit Governor
110	105	1	2	FF	FF	SysLamp ON	3	- EGR off - Regen off	Intake Air Temperature Sensor Error
113	105	1	FF	FF	FF	SysLamp OFF	0	- EGR off - Regen off	Intake Air Temperature Sensor Warning
115	110	1	2	3	4	SysLamp ON	3		Engine Coolant Sensor Error
118	110	1	FF	FF	FF	SysLamp OFF	0		Engine Coolant Temperature Warning

DTC max	SPN	FMI max	min	sig	pls	SYS LAMP	TRIP MIL	MAIN RECOVERY ACTIONS	English description
168	174	1	FF	FF	FF	SysLamp OFF	0		Fuel over temp
180	174	1	2	FF	FF	SysLamp OFF	0		Fuel Temperature Sensor Error
190	164	1	2	FF	FF	SysLamp ON	0	- Quantity cut - Regen off - Torque cut	Fuel Rail Pressure Signal Error
195	175	1	2	3	4	SysLamp OFF	0	- Regen off	Oil Temperature Sensor Signal Error
198	175	1	FF	FF	FF	SysLamp ON	0		Engine Oil Temperature Warning
201	651	FF	FF	3	FF	SysLamp ON	0	- Quantity cut - Regen off - Torque cut	Cylinder 1 - Injector Circuit Malfunction Warning
202	652	FF	FF	3	FF	SysLamp ON	0	- Quantity cut - Regen off - Torque cut	Cylinder 2 - Injector Circuit Malfunction Warning
203	653	FF	FF	3	FF	SysLamp ON	0	- Quantity cut - Regen off - Torque cut	Cylinder 3 - Injector Circuit Malfunction Warning
204	654	FF	FF	3	FF	SysLamp ON	0	- Quantity cut - Regen off - Torque cut	Cylinder 4 - Injector Circuit Malfunction Warning
216	629	1	FF	FF	FF	SysLamp ON	0		ECU Overrun Monitoring Error
216	629	5	FF	FF	FF	SysLamp ON	0		ECU Redundant Engine Speed Monitoring Error
234	641	FF	2	FF	FF	SysLamp ON	0	- EGR off - Regen off - Torque cut	Turbo/Super Charger Overboost Condition
235	102	1	2	3	4	SysLamp ON	0	- EGR off - PCR off - Regen off - Torque cut	Boost Pressure Sensor Error
238	102	1	FF	FF	FF	SysLamp OFF	0		Boost Pressure Warning
252	1347	FF	FF	3	4	SysLamp ON	0	- Quantity cut - Regen off - Torque cut	Metering Unit Solenoid PWM Control Circuit Malfunction
253	1347	FF	2	FF	FF	SysLamp BLINK	0	- Engine shutoff - Quantity cut - Regen off	Metering Unit Solenoid PWM Control Circuit Malfunction

DTC max	SPN	FMI max	min	sig	pls	SYS LAMP	TRIP MIL	MAIN RECOVERY ACTIONS	English description
254	1347	1	FF	FF	FF	SysLamp ON	0	- Quantity cut - Regen off - Torque cut	Metering Unit Solenoid PWM Control Circuit Malfunction
262	651	1	2	3	4	SysLamp BLINK	0	- Engine shutoff - Regen off	Cylinder 1 - Injector Circuit Malfunction Specific Error
263	651	1	2	FF	FF	SysLamp OFF	0		Energizing Time Calibration Error
265	652	1	2	3	4	SysLamp BLINK	0	- Engine shutoff - Regen off	Cylinder 2 - Injector Circuit Malfunction Specific Error
266	652	1	2	FF	FF	SysLamp OFF	0		Energizing Time Calibration Error
268	653	1	2	3	4	SysLamp BLINK	0	- Engine shutoff - Regen off	Cylinder 3 - Injector Circuit Malfunction Specific Error
269	653	1	2	FF	FF	SysLamp OFF	0		Energizing Time Calibration Error
271	654	1	2	3	4	SysLamp BLINK	0	- Engine shutoff - Regen off	Cylinder 4 - Injector Circuit Malfunction Specific Error
272	654	1	2	FF	FF	SysLamp OFF	0		Energizing Time Calibration Error
299	641	1	FF	FF	FF	SysLamp ON	0	- EGR off - Regen off - Torque cut	Turbo/Super Charger Underboost Condition
335	190	1	2	FF	FF	SysLamp BLINK	0	- Engine shutoff	Crankshaft Position Sensor Error
338	190	1	FF	FF	FF	SysLamp OFF	0		Engine Overspeed Warning
340	723	1	2	FF	FF	SysLamp OFF	0		Camshaft Position Sensor Error
380	676	1	2	3	4	SysLamp OFF	0		GCU-R Glow Control Unit - Standard Voltage System Relay Circuit Malfunction
381	675	1	2	3	4	SysLamp OFF	0		Glow Lamp Indicator Malfunction
403	27	FF	FF	1	FF	SysLamp ON	3	- EGR off - Regen off	EDM trasmission error
404	27	16	17	FF	FF	SysLamp ON	3	- EGR off - Regen off	Power supply high/low error - the supply voltage is more than 18 v or less than 8 v

DTC	SPN	FMI				SYS LAMP	TRIP MIL	MAIN RECOVERY ACTIONS	English description
max		max	min	sig	pls				
405	27	FF	FF	4	FF	SysLamp ON	3	- EGR off - Regen off	Position sensor failure - position sensor open circuit short to ground
407	27	1	2	4	8	SysLamp ON	0	- EGR off - Regen off	desidered position exceeds 16-76 steps specified in CAN communication
407	27	FF	FF	4	FF	SysLamp ON	3	- EGR off - Regen off	High/low temperature thermistore failure - temperature > 135°C or < 0°C
487	634	FF	FF	13	19	SysLamp ON	3	- EGR off - Regen off	TVA Throttle Valve Actuator Circuit Malfunction
489	27	FF	FF	4	FF	SysLamp ON	3	- EGR off - Regen off	Motor terminal/coil open load
490	27	4	FF	FF	FF	SysLamp ON	3	- EGR off - Regen off	Motor coil short to batt
500	84	1	FF	3	4	SysLamp ON	0	- EGR off - Regen off	Vehicle Speed Sensor Malfunction
520	100	1	2	3	FF	SysLamp OFF	0	- Regen off	Engine Oil Pressure Sensor/Switch Signal Error
521	835	1	2	3	4	SysLamp OFF	0		Engine Oil Pressure Lamp Malfunction
522	100	1	FF	FF	FF	SysLamp ON	0	- Torque cut	Critical Engine Oil Pressure Warning
524	100	1	FF	FF	FF	SysLamp ON	0		Low Engine Oil Pressure Warning
544	173	5	6	FF	FF	SysLamp OFF	0		DPF Particulate Filter - Exhaust Gas Temperature Sensor Error
560	168	1	2	FF	FF	SysLamp ON	0		Battery Voltage Error
571	597	FF	FF	3	4	SysLamp OFF	0		Brake Signal Error
585	527	FF	FF	FF	4	SysLamp OFF	0		Cruise Control Multi-Function Input “A”/”B” Correlation Error (Invalid Switch Combination Detected)
600	629	1	FF	FF	FF	SysLamp ON	0		ECU Internal Communication Error - SPI

DTC max	SPN	FMI max	min	sig	pls	SYS LAMP	TRIP MIL	MAIN RECOVERY ACTIONS	English description
600	627	FF	FF	FF	4	SysLamp OFF	0		ECU Internal Communication Error Between Function Computer and Monitoring Module
601	629	FF	FF	FF	4	SysLamp ON	0		ECU Processor Recovery Locked
602	629	FF	FF	FF	4	SysLamp ON	0		ECU Processor Recovery Suppressed
606	625	FF	FF	FF	4	SysLamp OFF	0		Plausibility Error on Base Map for Torque to Quantity Conversion
606	629	FF	FF	FF	8	SysLamp ON	0		TPU Time Processing Unit Monitoring Error
607	629	FF	FF	FF	8	SysLamp BLINK	0	- Engine shutoff	ECU Internal Watchdog/Controller Error
615	677	1	FF	FF	FF	SysLamp ON	0		T50 Terminal Signal Plausibility Error
616	677	1	2	3	4	SysLamp ON	0		Starter Relay Circuit Malfunction (Low Side Power Stage)
617	677	FF	2	FF	FF	SysLamp ON	0		Starter Relay Circuit Malfunction (high Side Power Stage)
641	1079	1	2	FF	FF	SysLamp ON	0	- Regen off - Torque cut	Sensor Supply Voltage 1 Check Error
645	1351	1	2	3	4	SysLamp OFF	0		Air Conditioning Relay Circuit Malfunction
651	1079	1	2	FF	FF	SysLamp ON	0	- EGR off - PCR off - Quantity cut - Regen off - Torque cut	Sensor Supply Voltage 2 Check Error
685	1485	1	2	FF	FF	SysLamp ON	0		Main Relay Control Error
697	1079	1	2	FF	FF	SysLamp ON	0	- Regen off - Torque cut	Sensor Supply Voltage 3 Check Error
1620	629	FF	2	3	4	SysLamp BLINK	0	- Engine shutoff - Torque cut	ECU Redundant Shut Off Test Error during Initialization

DTC max	SPN	FMI max	FMI min	FMI sig	FMI pls	SYS LAMP	TRIP MIL	MAIN RECOVERY ACTIONS	English description
1628	628	FF	FF	3	4	SysLamp OFF	0		Dataset Variant Coding Plausibility Error
2002	131	FF	A	FF	FF	SysLamp ON	3	- Regen off	DPF Particulate Filter - Filter Dismounted or Defective
2102	634	FF	11	FF	FF	SysLamp ON	3	- EGR off - Regen off	TVA Throttle Valve Actuator Circuit Malfunction
2103	634	12	FF	FF	FF	SysLamp ON	3	- EGR off - Regen off	TVA Throttle Valve Actuator Circuit Malfunction
2146	657	1	2	FF	4	SysLamp BLINK	0	- Engine shutoff	Injector Bank 1 Circuit Malfunction Specific Error
2149	658	1	2	FF	4	SysLamp BLINK	0	- Engine shutoff	Injector Bank 2 Circuit Malfunction Specific Error
2226	108	1	2	FF	4	SysLamp ON	3	- EGR off - PCR off	Barometric Pressure Sensor Error
2264	97	1	2	3	4	SysLamp OFF	0		Water Level in Fuel Actuator Malfunction
2269	97	1	FF	FF	FF	SysLamp OFF	0		Water in Fuel Detection
2293	157	1	2	3	FF	SysLamp BLINK	0	- Engine shutoff - Regen off	PRV Rail Pressure Relief Valve Error
2413	27	FF	FF	73	FF	SysLamp ON	3	- EGR off - Regen off	EGR valve stuck close
2413	27	FF	FF	71	FF	SysLamp ON	3	- EGR off - Regen off	EGR initialization error - the sensor output does not change during initialization
2413	27	FF	FF	72	FF	SysLamp ON	0	- EGR off - Regen off - Torque cut	Valve stick error - open
2413	27	77	77	FF	FF	SysLamp ON	3	- EGR off - Regen off	ECD/EDM duty deviation
2452	131	1	2	FF	FF	SysLamp ON	3		DPF Particulate Filter - Differential Pressure Sensor Defective
2453	81	FF	FF	FF	1C	SysLamp OFF	0		DPF Particulate Filter - Differential Pressure not Plausible

DTC max	SPN	FMI max	min	sig	pls	SYS LAMP	TRIP MIL	MAIN RECOVERY ACTIONS	English description
2454	81	1	FF	FF	FF	SysLamp ON	0	- EGR off - Quantity cut - Regen off	Soot mass over limit
2533	677	FF	FF	3	FF	SysLamp ON	0		T15 Terminal Signal Plausibility Error
2687	859	1	2	3	4	SysLamp OFF	0		Fuel Filter Heating Relay Circuit Malfunction
242F	131	1	FF	FF	FF	SysLamp ON	0	- EGR off - Regen off - Torque cut	DPF Particulate Filter - Engine Protection Active
242F	81	5	FF	FF	FF	SysLamp ON	0	- EGR off - Regen off	DPF Particulate Filter - Engine Protection Active
251C	979	1	2	FF	4	SysLamp OFF	0		PTO Enable Switch Circuit Malfunction
252F	98	1	2	FF	FF	SysLamp ON	0	- EGR off - Regen off	Critical Oil Mass Check Error
40A	27	98	FF	FF	FF	SysLamp ON	3	- EGR off - Regen off	EGR internal overtemperature
60B	629	1	2	3	4	SysLamp ON	3		E.C.U. Analogic/ Digital Converter Error
60C	627	1	FF	FF	FF	SysLamp ON	0		ECU Internal Supply Voltage Error
60C	627	FF	6	FF	FF	SysLamp ON	0		ECU Internal Supply Voltage Error
61F	634	71	77	FF	FF	SysLamp OFF	0	- Regen off	TVA jammed or desidered position error
61F	634	1	2	FF	8	SysLamp OFF	0		monitor line error or ground open load
62B	629	1	2	3	4	SysLamp BLINK	0	- Engine shutoff	ECU - Fuel Injector Control Module A Performance Error
62B	629	5	6	7	8	SysLamp BLINK	0	- Engine shutoff - Regen off	ECU - Fuel Injector Control Module B Performance Error
62F	628	FF	2	3	4	SysLamp ON	3		ECU Internal EEPROM Memory Error
C001	639	FF	FF	8	FF	SysLamp ON	3	- EGR off - Regen off	EGR valve transmission error - the message from ECM desappears for 1 sec.

DTC	SPN	FMI				SYS LAMP	TRIP MIL	MAIN RECOVERY ACTIONS	English description
max		max	min	sig	pls				
C001	639	FF	FF	3	FF	SysLamp ON	3	- EGR off	CAN Messages Error from Communication Manager
C028	639	1	FF	FF	FF	SysLamp ON	3		CAN A Controller Error
C037	639	1	FF	FF	FF	SysLamp ON	3		CAN B Controller Error
C046	639	1	FF	FF	FF	SysLamp ON	3		CAN C Controller Error
C107	91	FF	FF	3	FF	SysLamp ON	3		RXEEC2 CAN Message Timeout Error
C122	898	1	FF	3	FF	SysLamp ON	3		TSC1-VE Speed Override Vehicle Dynamic Control Module VC Error Message
C408	91	1	FF	FF	FF	SysLamp ON	3		RXEEC2 CAN Message Out of Range

DIAGNOSTIC TROUBLE CODES “R745EU6”

EDC17		SCR	
Nome Italiano	data	Nome Italiano	data
Lambda sensor : LSU sensor temperature Ri exceeds the maximum limit	0053-03	Coolant Valve Stuck Open	3363-7
Lambda sensor : LSU sensor temperature Ri is below the minimum limit	0053-04	CAN 1 Bus Performance	639-3
Diagnostic fault check for SRC high in air pressure upstream of intake valve sensor	0069-00	CAN 1 Message Missing	639-19
Plausibility Check for air pres-sure at the upstream of intake valve sensor	0069-01	CAN 2 Bus Performance	1231-3
barometric pressure, Environ-mental temperature, time out error	0070-02	CAN 2 Message Missing	1231-19
Physical range check for Am-bient temperature	0071-00	DEF Consumption High	4331-16
Ambient temp: SRC Min	0072-16	DEF Consumption Low	4331-18
Ambient temp, SRC Max	0073-17	DEF Level Empt	4096-31
Fuel Metering Unit : maximum positive deviation of rail pressu-re exceeded	0087-00	DEF Level Low	1761-18
Fuel Metering Unit : leakage is detected based on fuel quantity balance	0087-02	DEF Level Sensor SRC High	1761-3
Fuel Metering Unit : minimum rail pressure exceeded	0087-0C	DEF Level Sensor SRC Low	1761-4
Fuel Metering Unit : set point of metering unit in overrun mode not plausible	0087-06	DEF Pressure Monitor High	4334-16
Fuel Metering Unit : set point of metering unit in idle mode not plausible	0087-04	DEF Pressure Monitor Low	4334-18
Fuel Metering Unit : maximum negative rail pressure deviation with metering unit on lower limit is exceeded	0088-01	DEF Pressure Rationality High	4334-20
Fuel Metering Unit : maximum negative rail pressure deviation with metering unit on lower limit is exceeded	0088-02	DEF Pressure Rationality Low	4334-21
Fuel Metering Unit : maximum rail pressure exceeded	0088-03	DEF Pressure Sensor SRC High	4334-3

Fault detection by monitoring for maximum rail pressure	0088-04	DEF Pressure Sensor SRC Low	4334-4
Rail pressure sensor : maximum rail pressure exceeded	0088-00	DEF Quality	4094-31
Monitoring for Injection quantity during Limp home mode with PRV	0088-06	DEF Temp Sensor SRC High	3031-3
Monitoring for Fuel temperature during Limp home mode with PRV	0088-0C	DEF Temp Sensor SRC Low	3031-4
Charge air cooler downstream Over Temperature	0096-00	Enclosure Heater Short to Battery	4357-3
SRC low for Charge air cooler downstream Temperature	0097-16	Enclosure Heater Short to Ground	4357-4
SRC High for Charge air cooler downstream Temperature	0098-17	Exhaust Temp Monitor	4360-20
Engine Coolant over temperature	0116-00	Excessive Nox	4792-0
Coolant temperature : SRC low for Engine coolant temperatur	0117-16	Delivery System Failure to Prime	5435-7
Coolant temperature : SRC High for Engine coolant temperature	0118-17	High Side Output Short to Ground	3596-4
Coolant Thermostat valve: stuck open valve	0128-03	Injector Open Load	4331-2
Lambda sensor : Fault code to indicate SRC High error for O2 calibration	0130-03	Injector Short to Battery	4331-3
Lambda sensor : Fault code to indicate SRC Low error for O2 calibration	0130-04	Injector Short to Ground	4331-4
Lambda sensor : Fault check to indicate SPI chip error of lambda sensor	0130-02	Injector Stuck	4331-7
Lambda sensor : low battery voltage at the SPI chip	0131-04	1m Line Heater Short to Battery	4354-3
Lambda sensor : O2 value above the max threshold	0132-03	1m Line Heater Short to Ground	4354-4
Lambda sensor : short to battery at IA,IP, UN, VG	0134-12	3m Line Heater Short to Battery	4355-3
Lambda sensor : short to ground at IA,IP, UN, VG	0134-11	3m Line Heater Short to Ground	4355-4
Lambda sensor : SCB error of the LSU Heater Power stage	0135-03	4m Line Heater Short to Battery	4356-3
O2 Sensor Heater Circuit short to ground	0135-04	4m Line Heater Short to Ground	4356-4
O2 Sensor Heater Circuit over temperature	0135-0C	Inlet NOx Sensor Error	3226-12

O2 Sensor Heater Circuit open load	0135-02	Inlet NOx Sensor Rationality	3255-12
Fuel Temperature Too High	0168-00	Inlet NOx Sensor Tampering	3255-10
Fuel temperature Sensor : Signal Range check low for fuel temperature sensor	0182-04	NOx Sensor Error	3226-10
Fuel temperature Sensor : Signal Range check high for fuel temperature sensor	0183-03	Outlet NOx Sensor Rationality	3226-31
Rail pressure: raw value is above maximum offset	0191-03	NOx Sensor Tampering	3255-31
Rail pressure: raw value is below minimum offset	0191-04	DOC Inlet Temp Sensor SRC High	4765-3
Fuel pressure Sensor : Sensor voltage below lower limit	0192-03	DOC Inlet Temp Sensor SRC Low	4765-4
Fuel pressure Sensor : Sensor voltage above upper limit	0193-17	DPF Inlet Temp Sensor SRC High	3242-3
Fuel pressure Sensor : Rail pressure raw value is intermittent	0194-0C	DPF Inlet Temp Sensor SRC Low	3242-4
Injector, solenoid : Open load error of an injector 1	0201-13	Pump Open Load	5435-2
Injector, solenoid : Open load error of an injector 2	0202-13	Pump Short to Battery	5435-3
Injector, solenoid : Open load error of an injector 3	0203-13	Pump Short to Ground	5435-4
Injector, solenoid : Open load error of an injector 4	0204-13	SCR Inlet Temp Sensor SRC High	4360-3
Level 2 Monitoring : Diagnostic fault check to report the error due to Over Run	0216-03	SCR Inlet Temp Sensor SRC Low	4360-4
Diagnostic fault check to report the error due to cooling injection in Over Run	0216-0C	SCR Inlet Temp Sensor Rationality	4360-21
Overspeed detection in component engine protection	0219-03	SCR Control At Limit	3360-11
Turbocharger/Supercharger Overboost Condition - deviation beetwen Boost pressure and Setpoint	0234-02	SCR Efficiency Monitor	4792-31
Intake air pressure sensor : Diagnostic fault check for SRC low in air pressure upstream of intake valve sensor	0237-16	Sensor Supply Voltage Monitor High	3509-3
Intake air pressure sensor : Diagnostic fault check for SRC high in air pressure upstream of intake valve sensor	0238-17	Sensor Supply Voltage Monitor Low	3509-4

Turbocharger Boost over pressure warning	0243-00	Tank Heater Short to Battery	3363-3
Fuel Metering Unit : Intermittent contact between ECU and MeUn	0251-03	Tank Heater Short to Ground	3363-4
Fuel Metering Unit : open load of metering unit output	0251-13	Unheated Freeze	3363-2
Fuel Metering Unit : over temperature of device driver of metering unit	0252-0C	Battery Voltage High	168-3
Fuel Metering Unit : short circuit to ground of metering unit output	0253-04	Battery Voltage Low	168-4
Fuel Metering Unit : short circuit to battery of metering unit output	0254-03		
Injector, solenoid Power stage : Short circuit high side to low side in the injector 1	0261-03		
Injector, solenoid Power stage : Short circuit in the injector 1	0262-02		
DFC reporting error state on comparing energizing time to Max value injector 1	0263-03		
DFC reporting error state on comparing energizing time to Min value injector 1	0263-04		
Injector, solenoid Power stage : Short circuit high side to low side in the inje	0264-03		
Injector, solenoid Power stage : Short circuit in the injector 4	0265-02		
DFC reporting error state on comparing energizing time to Max value injector 2	0266-03		
DFC reporting error state on comparing energizing time to Min value injector 2	0266-04		
Injector, solenoid Power stage : Short circuit high side to low side in the injector 3	0267-03		
Injector, solenoid Power stage : Short circuit in the injector 3	0268-02		
DFC reporting error state on comparing energizing time to Max value injector 3	0269-03		

DFC reporting error state on comparing energizing time to Min value injector 3	0269-04		
Injector, solenoid Power stage : Short circuit high side to low side in the injector 4	0270-03		
Injector, solenoid Power stage : Short circuit in the injector 4	0271-02		
DFC reporting error state on comparing energizing time to Max value injector 4	0272-03		
DFC reporting error state on comparing energizing time to Min value injector 4	0272-04		
Turbocharger/Supercharger Underboost Condition	0299-01		
Crankshaft signal diagnose - no signal	0335-00		
Crankshaft signal diagnose - disturbed signal	0336-00		
Camshaft signal diagnose - disturbed signal	0340-00		
Camshaft signal diagnose - no signal	0341-00		
Glow Plug/Heater Indicator Circuit over temperature	0381-19		
Glow Plug/Heater Indicator Circuit shot to battery	0381-12		
Glow Plug/Heater Indicator Circuit short to ground	0381-11		
Glow plug control module short to ground	0383-00		
Glow plug control module short circuit to battery	0384-00		
EGR low flow	0401-00		
EGR open terminal error	0403-04		
EGR supply voltage High	0404-00		
EGR supply voltage low error	0404-02		
Exhaust Gas Recirculation “A” Control Circuit Range/Performance	0404-92		
Diagnostic fault check for EGR low internal temperature thermistor failure	0404-04		
EGR Drive Motor Position Sensor Circuit High	0404-96		

Diagnostic fault check for EGR high internal temperature ther-mistor failure	0407-04		
Passive oxidation catalyst mo-nitoring: The calculated con-version rate is lower than the limiting value	0420-04		
Over temperature for oxidation Catalyst upstream temperature sensor	0426-00		
Diagnostic fault check for SRC low in Oxidation Catalyst upstream temperature	0427-16		
Diagnostic fault check for SRC high in Oxidation Catalyst upstream temperature	0428-17		
Exhaust Pressure Sensor “A” Circuit over pressure	0471-00		
Exhaust Pressure Sensor “A” Circuit Low	0472-04		
Exhaust Pressure Sensor “A” Circuit High	0473-17		
Diagnostic fault check for EGR Over current	0490-04		
Vehicle speed sensor plausibi-lity	0500-0C		
Oil pressure sensor : Defect fault check for plausibility from digital sensor	0520-01		
Engine Oil Pressure lamp over temperature	0521-19		
Engine Oil Pressure lamp shot circuit to battery	0521-12		
Engine Oil Pressure lamp short circuit to ground	0521-11		
Defect fault check for minimum oil pressure from digital sensor	0524-00		
Temperature sensor upstream turbine: SRC min	0545-04		
Temperature sensor upstream turbine: SRC max	0546-17		
Battery voltage : SRC low for battery voltage sensor	0562-16		
Battery voltage : SRC high for battery voltage sensor	0563-17		
Analog Digital Converter: Dia-gnostic fault check to report errors in SPI-communication	0600-0C		

Analog Digital Converter: Diagnostic fault check to report multiple error while checking the complete ROM-memory	0605-04		
Visibility of Software Resets in DSM	0607-0B		
Visibility of Software Resets in DSM	0607-0D		
Visibility of Software Resets in DSM	0607-0C		
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Starter relay HS power stage output short circuit to ground	0616-11		
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Open circuit at the lambda sensor pump current pin	2237-02		
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Open circuit at the lambda sensor Nernst cell pin	2244-02		
Water in fuel level sensor defect detection or circuit open load	2269-03		
pressure relief valve reached maximum allowed opening count	2293-00		
pressure relief valve is forced to open, perform pressure increase	2293-01		
pressure relief valve is forced to open, perform pressure shock	2293-02		
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Averaged rail pressure is outside the expected tolerance range	2293-04		
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Diagnostic fault check for maximum deviation of EGR valve duty cycle	2413-74		
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Diagnostic fault check for EGR Dynamic range fault	2413-71		
Temperature sensor upstream turbine: over temperature	2428-00		
Differential pressure sensor: Fault check for pressure sensor plausibility in afterrun	2453-0B		
DPF differential pressure lines freeze	2453-0C		
DPF Differential pressure sensor: SRC min	2454-16		
DPF Differential pressure senso: SRC max	2455-17		
EGR cooler low efficiency	2457-00		
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DPF lamp over temperature	2499-02		
DPF lamp short to battery	2499-03		
DPF lamp short to ground	2499-0C		
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Fuel Supply Heater Control Circuit Low	2688-11		
Fuel Supply Heater Control Circuit High	2689-12		
Inducement low level activated by tampering of monitoring system	015D-03		
Inducement low level activated by EGR valve blocked	1,50E-2		
Fuel balancing control correction exeeded injector 1	01DC-03		

DPF inhibit switch fault	202F-00		
Warning level from DCU	204F-00		
Inducement low level from DCU	204F-03		
Inducement severe level from DCU	204F-04		
Water in fuel lamp over current	226A-19		
Water in fuel lamp short to battery	226A-12		
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Particulate filter monitoring: Maximum soot mass	242F-04		
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Inducement severe level activated by tampering of monitoring system	025D-03		
Inducement severe level activated by EGR valve blocked	2,50E-2		
check of missing injector adjustment value programming: injector 1	268C-0C		
check of missing injector adjustment value programming: injector 2	268D-0C		
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Fuel balancing control correction exeeded injector 2	02DC-03		
Inducement warning level activated by tampering of monitoring system	035D-03		
Inducement warning level activated by EGR valve blocked	3,50E-2		
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Error for ambient temperature range reported by EGR	040B-00		
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Diesel Particulate filter upstream temperature sensor : Diagnostic fault check for SRC low	042C-16		
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Creep mode active	4,50E+0		
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Creep mode active after engine restart	4,50E-3		
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Fuel balancing control correction exeeded injector 4	04DC-03		
Diagnostic fault check to report the NTP error in ADC monitoring	060B-00		
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Diagnostic fault check to report errors in query-/response-communication	060B-03		
Power stages, Injector : Loss of synchronization sending bytes to the MM from CPU	060B-04		
Power stages, Injector : DFC to set a torque limitation once an error is detected before MoCSOP’s error reaction is set	060B-05		

Power stages, Injector : Wrong set response time	060B-06		
Power stages, Injector : Too many SPI errors during MoC-SOP execution	060B-07		
Power stages, Injector : Diagnostic fault check to report the error in under voltage monitoring	060B-08		
Power stages, Injector : Diagnostic fault check to report that WDA is not working correct	060B-09		
Power stages, Injector : OS timeout in the shut off path test, Failure setting the alarm task period	060B-0A		
Power stages, Injector : Diagnostic fault check to report that the positive test failed	060B-0B		
Power stages, Injector : Diagnostic fault check to report the timeout in the shut off path test	060B-0C		
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Diagnostic fault check to report ‘WDA active’ due to errors in query-/response communication	060C-02		
Diagnostic fault check to report ‘ABE active’ due to under voltage detection	060C-04		
Diagnostic fault check to report ‘ABE active’ due to overvoltage detection	060C-03		
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APP value is above the threshold calibration	060D-00		
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Diagnostic fault check to report the plausibility error in rail pressure monitoring level 2	061B-04		
Diagnostic fault check to report the error due to torque comparison monitoring level 2	061B-0C		
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Throttle valve stick	061F-00		
Throttle valve diagnostic feedback not plausible	061F-02		
Throttle valve diagnostic feedback open load	061F-01		
Injection cut off demand for shut off coordinator	062B-00		
Internal Control Module Fuel Injector Control Performance	062B-01		
Error in the plausibility of the injection energizing time	062B-02		
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Diagnosis fault check to report the demand for normal mode due to an error in the PoI2 quantity	062B-06		
Diagnosis fault check to report the error to demand for an ICO due to an error in the PoI2 shut-off	062B-08		
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Early opening defect of main relay	068A-23		
Air temprature monitoring plau-sibility check	009A-07		
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Bus off of CAN node A, passive error	C028-04		
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Communication Bus B passive error	C037-04		
Vehicle Communication Bus B, Bus off error	C037-03		
CAN-Transmit-Frame EEC1, Electronic Engine Control #1 message	C107-01		
Accelerator pedal position 1, Engine percent load at current speed, Accelerator pedal 1 low idle switch status, Accelerator pedal 2 low idle switch status	C107-02		
Accelerator Pedal Position 1, time out message error	C107-00		
TimeOut from EGR message	C10A-08		
Lost Communication With Re-ductant Control Module	C10E-08		
Aftertreatment SCR Operator Inducement Severity, time out error	C10E-0C		
PTO message time out error	C117-00		
CAN-Receive-Frame Torque / Speed control from VE to EDC through TSC1_VE Message active	C122-03		

CAN-Receive-Frame Torque / Speed control from VE to EDC passive error	C122-02		
Transmission Control Unit message to EDC Data length Check	C122-0C		
Transmission Control Unit message to EDC time out error	C122-00		
Accelerator Pedal Position 1, Data lenght message error	C408-00		
Invalid Data Received From Exhaust Gas Recirculation Control Module „B“	C40C-00		
Aftertreatment SCR Operator Inducement Severity, Data lenght error	C40F-04		
Cruise control not plausible	0564-00		
Maximum threshold error for vehicle speed	0503-03		
Plausibility check for Brake	0571-0C		

LABOUR TIME GUIDE

KEY TO DEFINITIONS

R/R = removal and re-installation

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 quantity of components involved in the operation, this number can be omitted if there are no other similar components on the engine.

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

3Z - EAA

3Z = Replacement
EAA= Camshaft

This type of code is used when there are other similar components or multiple components on the engine.

10Z - OAA / 6

10Z = Test
OAA = Injector
/6 = no.6 injectors

OPERATION TIME

0.125 = 7.30 minutes
0.25 = 15 minutes
0.50 = 30 minutes
0.75 = 45 minutes
1 = 1 hour

COMPONENTS GROUPS

A - SYSTEM (ENGINE - CRANKCASE - LINER)
B - SYSTEM (CRANKSHAFT - MAIN REAR CARRIER)
C - SYSTEM (PISTON - CONNECTING RODS)
D - SYSTEM (CYLINDER HEAD - ROCKER ARM)
E - SYSTEM (CAMSHAFT - HYDRAULIC TAPPET - PUSH RODS)
G - SYSTEM (LUBRICATION)
H - SYSTEM (COOLING)
J - SYSTEM (BELT - PULLEY - TENSIONER)
K - SYSTEM (INTAKE AND EXHAUST, DPF FILTER)
M - SYSTEM (FLYWHEEL HOUSING - OIL PAN - TIMING COVER)
O - SYSTEM (FUEL)
P - SYSTEM (INJECTION PUMP)
Q - SYSTEM (CRANKSHAFT MAIN BEARINGS)
S - SYSTEM (ELECTRICAL)

ECU DIAGNOSIS

Operation	Hrs
ECU diagnosis + download engine collect data (log file)	1
ECU calibration - updating	0.50
Engine idle RPM - RPM modification	0.50
IMA injector code writing	0.50
EGR-TVA Test	0.50
DPF filter Regeneration	1
Compression cylinder Test	0.50
Dash Board light/lamps Test	0.50
Injector test	0.50
Engine serial number writing	0.50
Electrical measurement through break out box	1

Operation	SYSTEM	No. Cyl.	Hours
14Z - AAA	**ENGINE REMOVAL AND REINSTALLATION** (ENGINE INSTALLED ON THE VEHICLE)		4
3Z - AAA	**SHORT BLOCK REPLACEMENT**	4 6	11 11.50
7Z - AAA	**MAJOR ENGINE OVERHAUL** Steam clean and completely dismantle; clean all parts; flush all oil and water passages and replace plugs; check crankshaft for size and wear and inspect all parts. Check the liner wear and if necessary replace them. Replace, or renew where necessary, camshaft and auxiliary drive bushes, main and big end bearings and thrust washers. Inspect and replace timing gears, as necessary. Replace water pump, oil pump. Overhaul turbochargeR Clean head and disassemble completely; inspect all parts and magnaflux head (Magnaflux crack detector); and Hydraulic test with special tool (pressure the cylinder head at ~ 2 bar (29 psi) dip it in a hot water +50-60°C (+122-140°F) for two minutes and check for air bubble.) Check longitudinal and horizontal warpage on head surface; replace valve guides or ream as needed. Grind valves and seats; replace valves and/or seats, as required. Check springs, keepers and retainers and replace as required. Lap valves and reassemble. Final test bench.	4 6	25 32.50
8Z - AAA	**PARTIAL ENGINE OVERHAUL** Steam clean parts and partial dismantle (cylinder heads and pistons). Clean the disassembled parts, replace plug (only if worn), check liners dimension and wear. Hone cylinder liners and replace the compression rings. Check or replace, valves, guide valves and seats grind. Inspect and replace timing gears, as necessary. Inspect and renew, as required water pump, oil pump and turbocharger. Engine reassembly and test bech.	4 6	10 12
2I - AAA	**OIL CONSUMPTION RECTIFICATION** Remove cylinder head, lube oil pan and oil pump. Remove all pistons and connecting rods. Deglaze all cylinder bores. Clean and check pistons for wear, renewing as necessary and replace all piston rings. Check condition of oil pump and renew if necessary. Reassemble all parts using new gaskets.	4 6	10.25 15.50
1N - AAA	**ENGINE FLYWHEEL SIDE - OIL LEAKAGE** R&R flywheel and flywheel housing Rear crankshaft seal - replacement Rear main carrier o-ring - replacement Camshaft o-ring Flywheel o-ring		1.50

Operation	SYSTEM	No. Cyl.	Hours
3Z - ABA	**CYLINDER BLOCK - REPLACEMENT** Steam clean complete engine, dismantle, clean and inspect all component parts. Reassemble engine complete into new bare block with same or new pistons, using new rings main and big end bearings and thrust washers, gaskets and seals, and torque to specifications. Run engine and check for leaks.	4 6	11 16.50
3Z - AIA/1	**LINER - REPLACEMENT (ONE)**	4	6.75
3Z - AIA/1	**LINER - REPLACEMENT (ONE)**	6	9.25
3Z - AIA/4	**LINER - REPLACEMENT (ALL)**	4	7.75
3Z - AIA/6	**LINER - REPLACEMENT (ALL)**	6	10.25

B - SYSTEM (CRANKSHAFT - MAIN REAR & CENTER CARRIER - FLYWHEEL - TIMING GEARS)

Operation	SYSTEM	No. Cyl.	Hours
3Z - BAA	**CRANKSHAFT - REPLACEMENT** – rear crankshaft seal & o-ring, camshaft o-ring, flywheel o-ring replacement. – R&R flywheel housing. – R&R oil pan and strainer. – R&R oil pump. – R&R vibration damper. – R&R thrust washers, replace if necessary. – R&R timing gear cover. – R&R head. – R&R main center bearing carriers. – R&R pistons and connecting rods.	4 6	13 15
3Z - BIA	**REPLACE MAIN REAR BEARING CARRIER** R&R Flywheel and flywheel housing		1.25
3Z - BHA	**CENTER MAIN BEARING CARRIERS** R&R oil pan and strainer	4 6	12.50 14.50
3Z - BLA	**CRANKSHAFT FRONT HUB**		0.75
3Z - BFA	**FLYWHEEL (WITH FLYWHEEL GEAR)**		0.50
3Z - BFE	**FLYWHEEL GEAR**		0.75
3Z - BAF	**CRANKSHAFT FRONT GEAR**		1.75
3Z - EAC 3Z - BAF 3Z - LCA 3Z - PAC	**TIMING GEARS** EAC (CAMSHAFT GEAR) BAF (CRANKSHAFT FRONT GEAR) LCA (IDLER GEAR) PAC (INJECTION DRIVE GEAR)		2.50

C - SYSTEM (PISTON - CONNECTING RODS)

Operation	SYSTEM	No. Cyl.	Hours
3Z - CAA/1	PISTON AND CONNECTING ROD (ONE)	4	6.50
3Z - CAA/1	PISTON AND CONNECTING ROD (ONE)	6	9
3Z - CAA/4	PISTON AND CONNECTING ROD (ALL)	4	7.50
3Z - CAA/6	PISTON AND CONNECTING ROD (ALL)	6	10
3Z - CAD	PISTON RINGS (ALL PISTONS)	4	7.75
		6	10.25

D - SYSTEM (CYLINDER HEAD - ROCKER ARMS)

Operation	SYSTEM	No. Cyl.	Hours
8Z - DAA	**TOP OVERHAUL (CYLINDER HEADS AND/OR GASKETS)** Remove cylinder head(s) and gasket(s). Remove all traces of jointing compound and old gasket. Check cylinder head(s) and reseat valves. Fit new gasket and replace head(s) if necessary, Check injector atomisers and service as necessary. Torque head. Engine bench test	4 6	8.50 10.50
3Z - DAA	**CYLINDER HEAD AND GASKET REPLACEMENT (ALL CYL.HEADS)** R&R and renew rocker arm assembly R&R intake manifold R&R exhaust manifold R&R water manifold from heads R&R rocker arm lubricating pipe Installation new gaskets	4 6	4.50 6
10Z - DFA	**ROCKER ARM ASSEMBLY - CHECK (ALL)** Clean and disassemble rocker arm assembly. Inspect all parts and renew or replace as necessary. Reassemble head assembly.	4 6	1.25 1.50
3Z - DGG 3Z - DGF	**INTAKE & EXHAUST VALVE GUIDES - REPLACEMENT (ALL)** Includes: R&R cylinder head	4 6	7.50 9
3Z - DGH/1 3Z - DGI/1	**VALVE SPRING - REPLACEMENT (ONE)**		1
3Z - DGH/4/6 3Z - DGI/4/6	**VALVE SPRING - REPLACEMENT (ALL)**		2

E - SYSTEM (CAMSHAFT - HYDRAULIC TAPPET - PUSH RODS)

Operation	SYSTEM	No. Cyl.	Hours
3Z - EAA	CAMSHAFT - REPLACEMENT	4 6	6.50 8.50
3Z - ECA	PUSH RODS		1.75
3Z - EBB	HYDRAULIC TAPPET	4 6	5 6.50
3Z - EFA	VALVE COVER		1.50

G - SYSTEM (LUBRICATION)

Operation	SYSTEM	No. Cyl.	Hours
3Z - GEA	OIL HEAT EXCHANGER (MODINE)		0.50
3Z - GAA	OIL PUMP		1.25
3Z - GGA	OIL PRESSURE RELIEF VALVE		1
3Z - GAQ	ROCKER ARM OIL FEED PIPE		0.50
3Z - GBA	OIL FILTER		0.25

H - SYSTEM (COOLING)

Operation	SYSTEM	No. Cyl.	Hours
3Z - HAA	COOLANT PUMP		0.50
3Z - HAL	COOLANT PUMP PULLEY		0.25
3Z - HDA	THERMOSTATIC VALVE		0.25
3Z - HHA	RADIATOR		1

J - SYSTEM (BELT - PULLEY - TENSIONER)

Operation	SYSTEM	No. Cyl.	Hours
3Z - JBA	COOLANT PUMP BELT - AUTOMATIC BELT TENSIONER		0.25

K - SYSTEM (INTAKE AND EXHAUST, DPF FILTER)

Operation	SYSTEM	No. Cyl.	Hours
3Z - KAA	INTAKE MANIFOLD		0.75
3Z - KDA	TURBOCHARGER		0.50
3Z - KBA	EXHAUST MANIFOLD		0.75
3Z - KCH	EGR COOLER		0.75
3Z - KCA	EGR VALVE & INTAKE THROTTLE VALVE ASS.BY		0.25
5E - KGB	DPF FILTER (cleaning by compressed air and replacement DPF filter clamps		0.90

M - SYSTEM (FLYWHEEL HOUSING - OIL PAN - TIMING COVER)

Operation	SYSTEM	No. Cyl.	Hours
3Z - MAA	**FLYWHEEL HOUSING** Rear crankshaft seal - replacement Ream main carrier o-ring - replacement Camshaft o-ring Flywheel o-ring		1.50
3Z - MCA	**TIMING COVER** R&R alternator belt R&R crankshaft front hub cleaning of silicon from timing cover		1
3Z - MCE	TIMING COVER - FRONT OIL SEAL		0.75
3Z - MBA	OIL PAN		0.75

O - SYSTEM (FUEL)			
Operation	SYSTEM	No. Cyl.	Hours
3Z - OAA/1	INJECTOR (ONE)		0.50
3Z - OAA	INJECTOR (ALL)	4 6	1 1.25
10Z - OAA	FUEL RETURN QUANTITY FROM INJECTOR - TEST		0.25
12Z - OEL	AIR BLEEDING FROM INJECTION SYSTEM		0.25
3Z - OEC	FUEL FILTER		0.25
3Z - OHB	FUEL PRESSURE ACCUMULATOR (RAIL)		0.50

P - SYSTEM (INJECTION PUMP)			
Operation	SYSTEM	No. Cyl.	Hours
3Z - PAC	FUEL PUMP DRIVE GEAR		0.75
3Z - PAA	INJECTION PUMP - REPLACEMENT		0.75
3Z - PCA	FUEL PRESSURE CONTROL VALVE (MPROP)		0.25

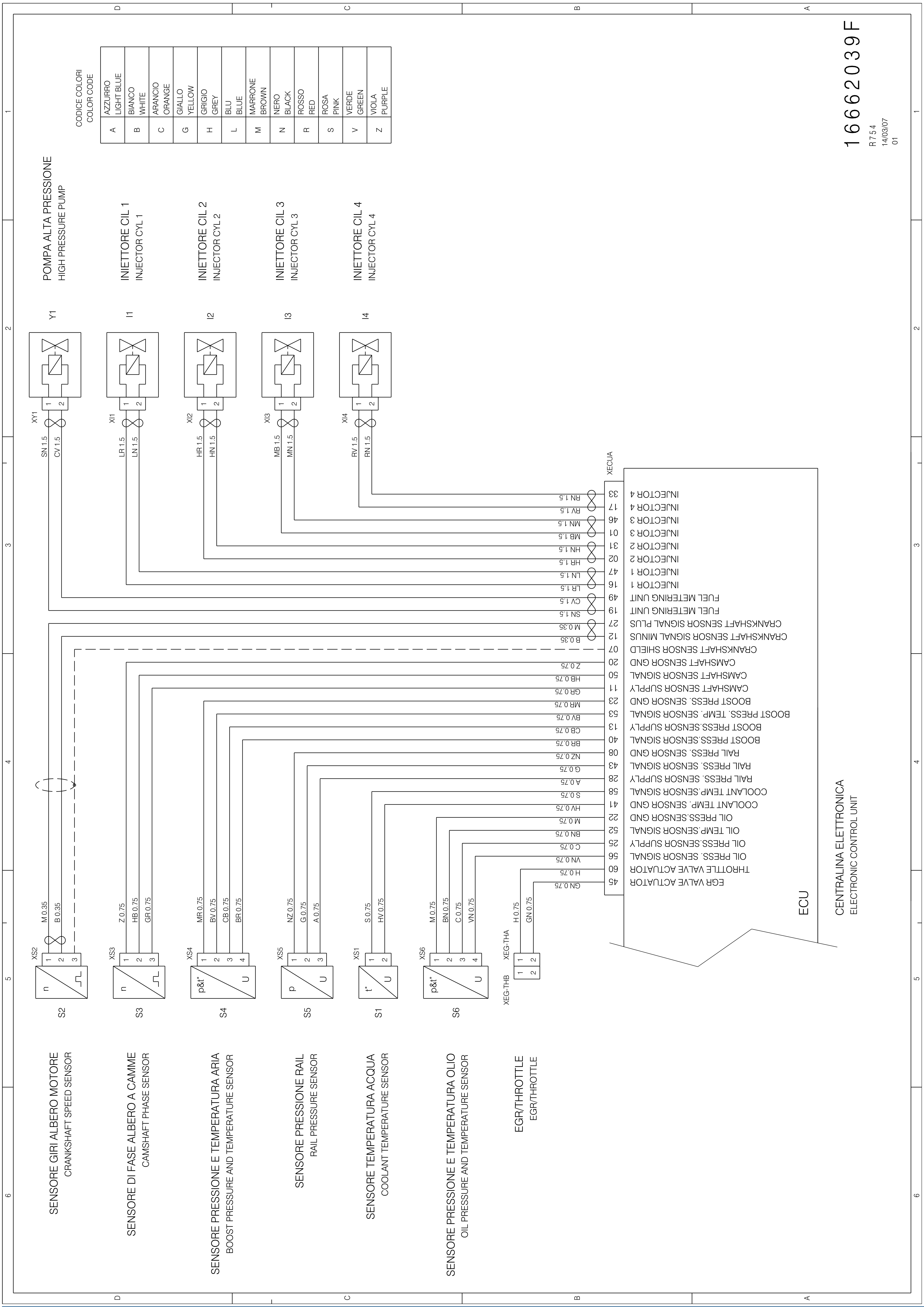
Q - SYSTEM (CRANKSHAFT MAIN BEARINGS AND CONNNECTING ROD BEARINGS)			
Operation	SYSTEM	No. Cyl.	Hours
3Z - QAA	CRANKSHAFT FRONT MAIN BEARING	4 6	13.50 15.50
3Z - QBB	CONNECTING ROD BEARINGS (ALL CON-RODS) R&R oil pan and strainer Cleaning of silicon from oil pan Engine test for oil leakage	4 6	2 3
3Z - QAD	CRANKSHAFT REAR MAIN BEARING (REAR MAIN BEARING CARRIER) **Replace also:** • Rear crankshaft seal - replacement • Rear main carrier o-ring - replacement • Camshaft o-ring • Flywheel o-ring		1.75

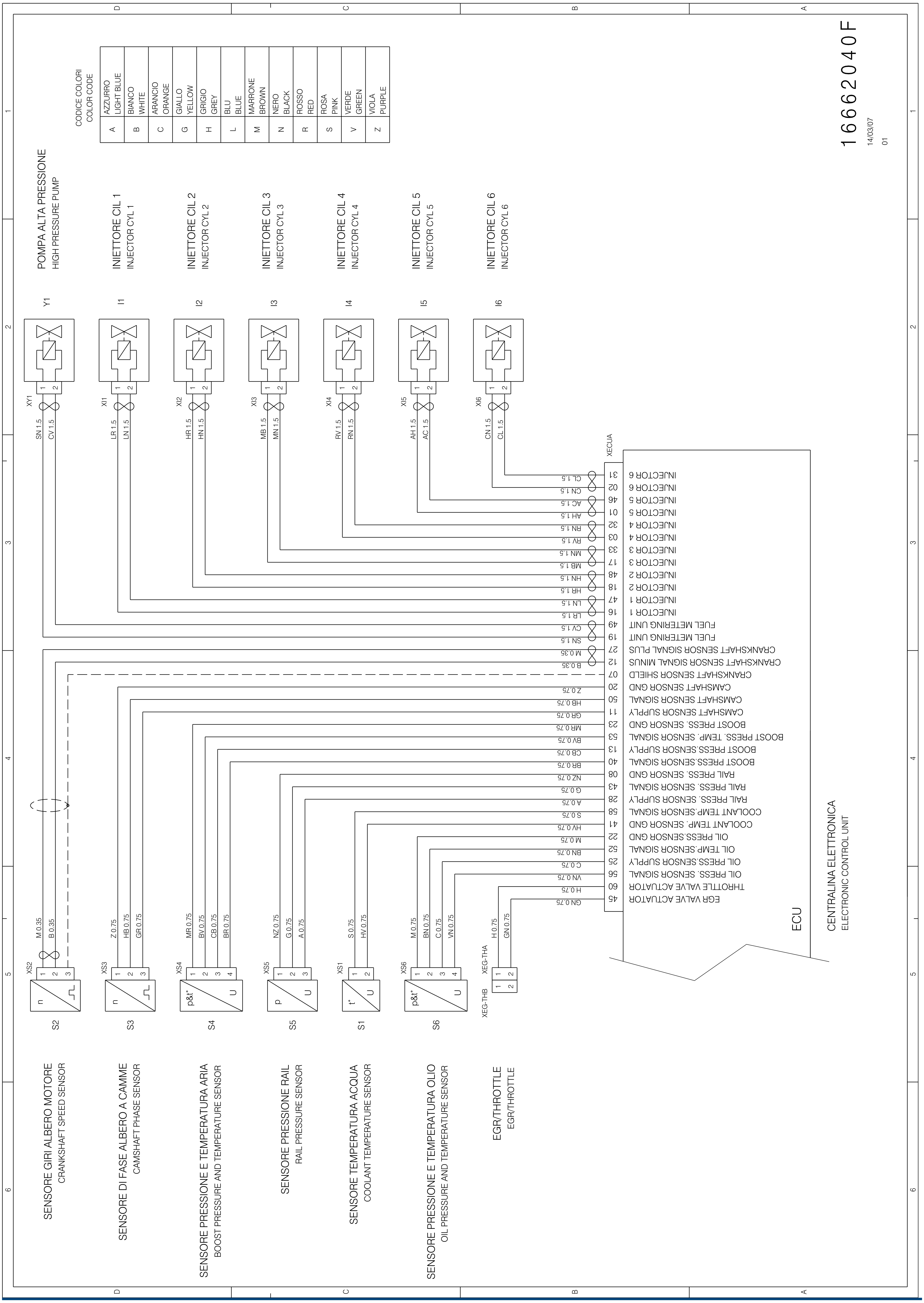
S - SYSTEM (ELECTRICAL)

Operation	SYSTEM	No. Cyl.	Hours
3Z - SEA	ALTERNATOR		0.50
3Z - SEF	ALTERNATOR VOLTAGE REGULATOR		0.50
3Z - SGA	STARTER MOTOR		0.25
3Z - SGD	STARTER MOTOR - SOLENOID		0.50
3Z - SAA	ENGINE WIRING HARNESS		1

ELECTRICAL SCHEMATIC DIAGRAMS - “A” SIDE - ENGINE

R754 EURO4 - EURO 5

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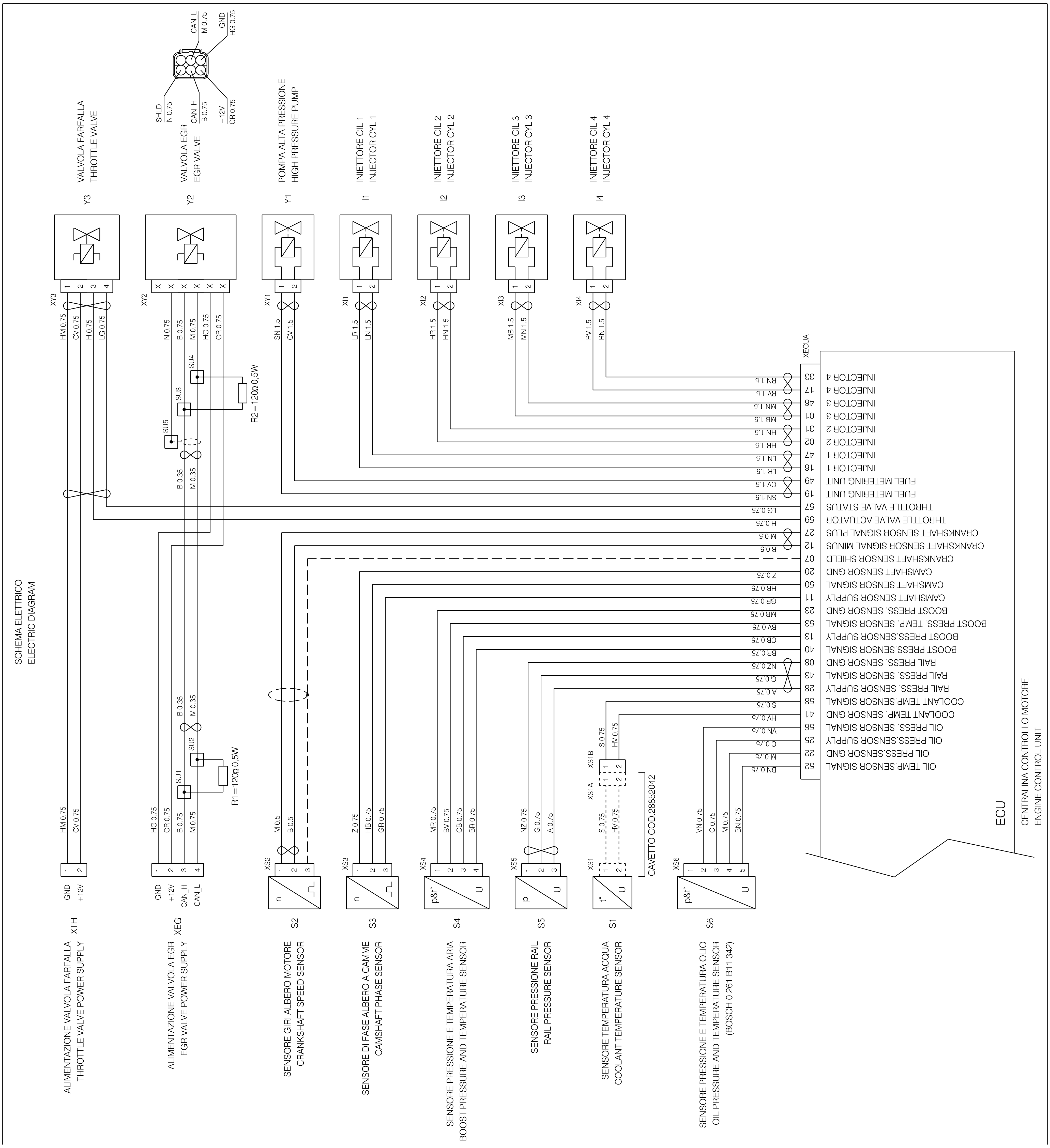
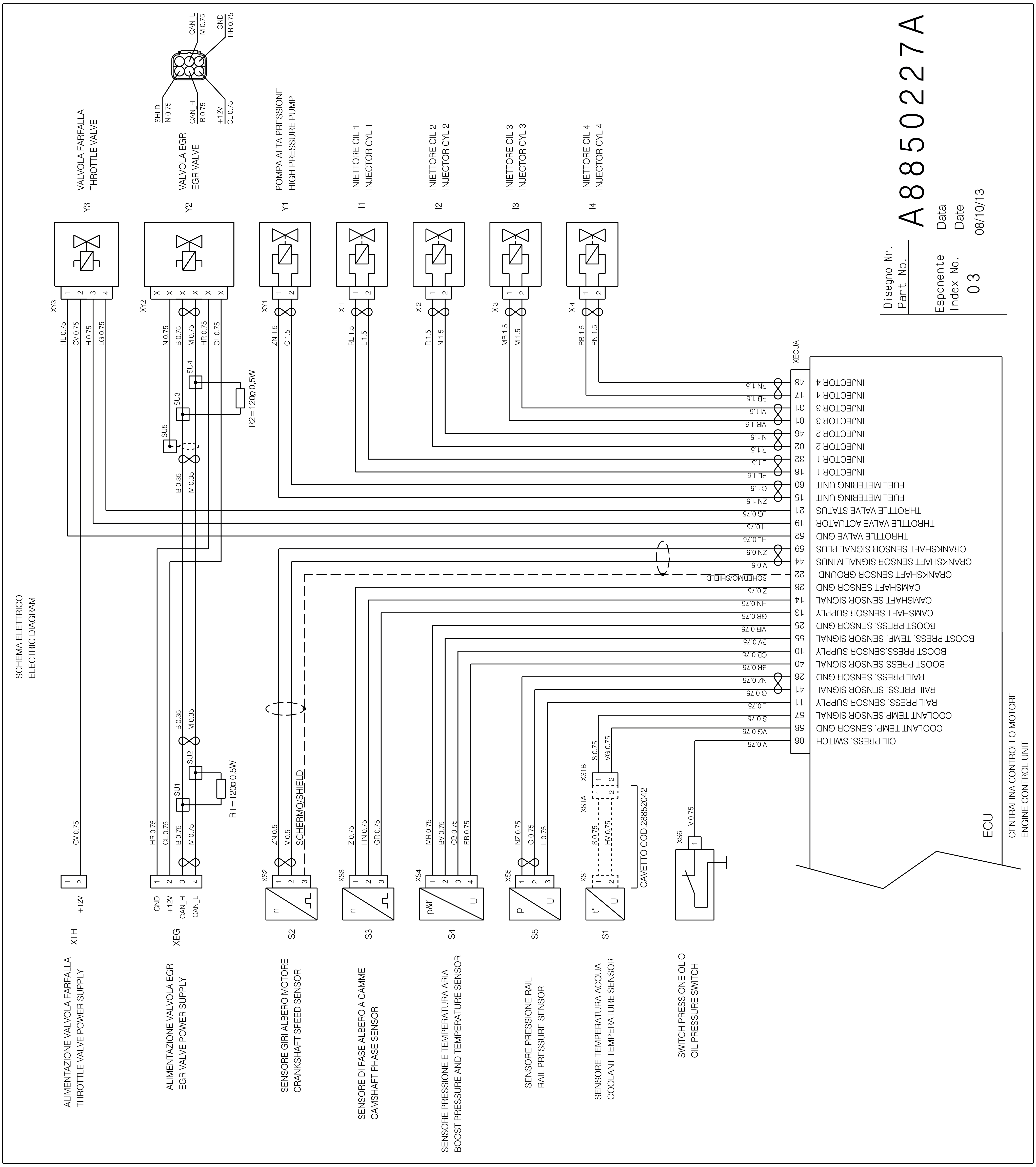
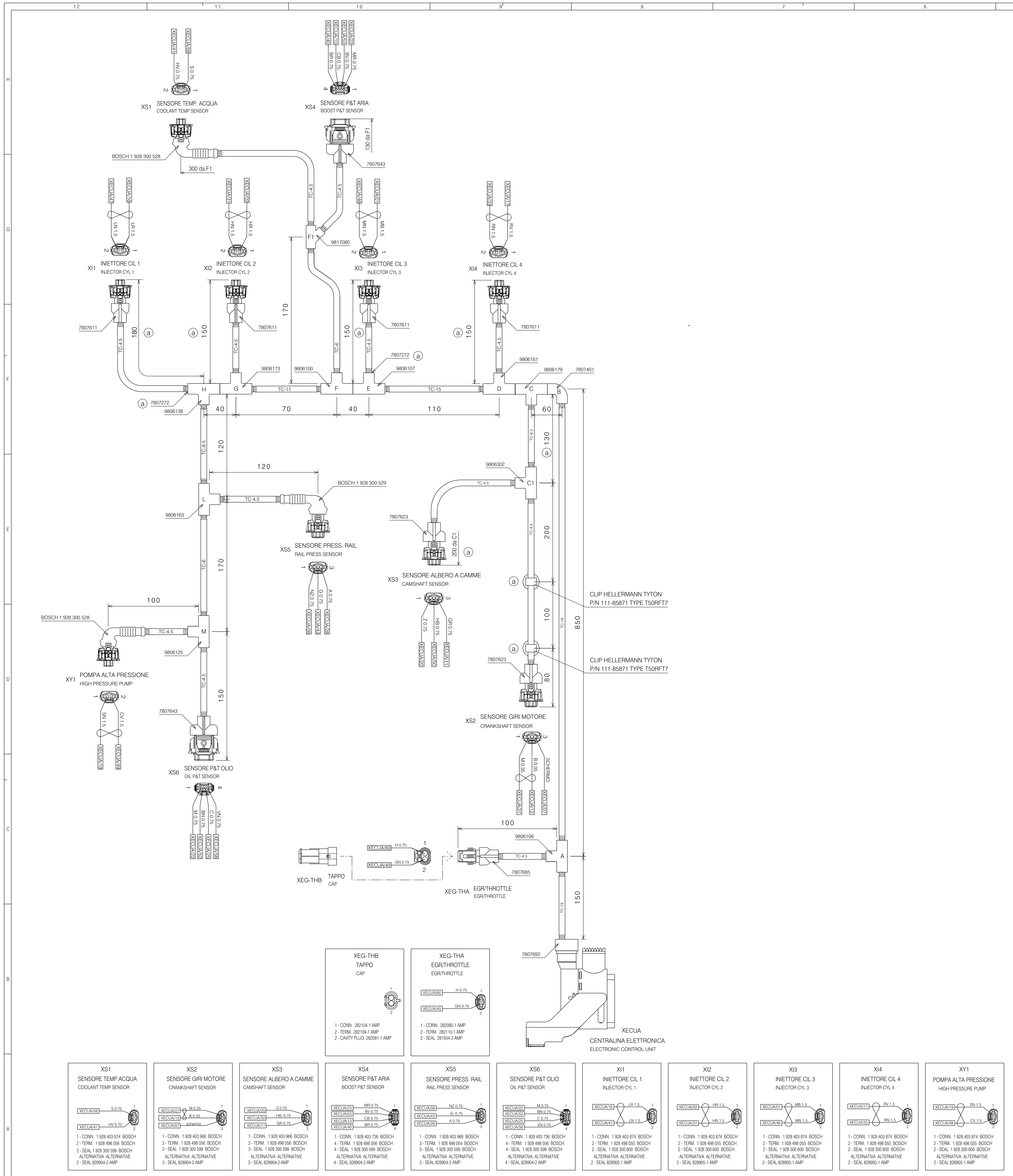
14/03/07
01
CODICE COLORI
COLOR CODE
A AZZURRO LIGHT BLUE
B BIANCO WHITE
C ARANCIO ORANGE
G GIALLO YELLOW
H GRIGIO GREY
L BLU BLUE
M MARRONE BROWN
N NERO BLACK
R ROSSO RED
S ROSA PINK
V VERDE GREEN
Z VIOLA PURPLE
POMPA ALTA PRESSIONE
HIGH PRESSURE PUMP
INIETTORE CIL 1
INJECTOR CYL 1
INIETTORE CIL 2
INJECTOR CYL 2
INIETTORE CIL 3
INJECTOR CYL 3
INIETTORE CIL 4
INJECTOR CYL 4
INIETTORE CIL 5
INJECTOR CYL 5
INIETTORE CIL 6
INJECTOR CYL 6
SENSORE GIRI ALBERO MOTORE
CRANKSHAFT SPEED SENSOR
SENSORE DI FASE ALBERO A CAMME
CAMSHAFT PHASE SENSOR
SENSORE PRESSIONE E TEMPERATURA ARIA
BOOST PRESSURE AND TEMPERATURE SENSOR
SENSORE PRESSIONE RAIL
RAIL PRESSURE SENSOR
SENSORE TEMPERATURA ACQUA
COOLANT TEMPERATURE SENSOR
SENSORE PRESSIONE E TEMPERATURA OLIO
OIL PRESSURE AND TEMPERATURE SENSOR
EGR/THROTTLE
EGR/THROTTLE
CENTRALINA ELETTRONICA
ELECTRONIC CONTROL UNIT
ECU
XECUA
31 INJECTOR 6
02 INJECTOR 6
46 INJECTOR 5
01 INJECTOR 5
32 INJECTOR 4
03 INJECTOR 4
33 INJECTOR 3
17 INJECTOR 3
48 INJECTOR 2
18 INJECTOR 2
47 INJECTOR 1
16 INJECTOR 1
49 FUEL METERING UNIT
19 FUEL METERING UNIT
27 CRANKSHAFT SENSOR SIGNAL PLUS
12 CRANKSHAFT SENSOR SIGNAL MINUS
07 CRANKSHAFT SENSOR SHIELD
20 CAMSHAFT SENSOR GND
50 CAMSHAFT SENSOR SIGNAL
11 CAMSHAFT SENSOR SUPPLY
23 BOOST PRESS. SENSOR GND
53 BOOST PRESS. TEMP. SENSOR SIGNAL
13 BOOST PRESS.SENSOR SUPPLY
40 BOOST PRESS.SENSOR SIGNAL
08 RAIL PRESS. SENSOR GND
43 RAIL PRESS. SENSOR SIGNAL
28 RAIL PRESS. SENSOR SUPPLY
58 COOLANT TEMP.SENSOR SIGNAL
41 COOLANT TEMP. SENSOR GND
22 OIL PRESS.SENSOR GND
52 OIL TEMP.SENSOR SIGNAL
25 OIL PRESS.SENSOR SUPPLY
56 OIL PRESS. SENSOR SIGNAL
09 THROTTLE VALVE ACTUATOR
45 EGR VALVE ACTUATOR

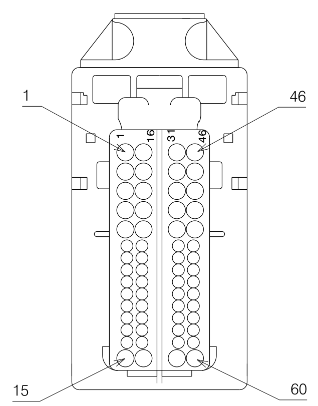

SCHEMA ELETTRICO
ELECTRIC DIAGRAM
Y3 VALVOLA FARFALLA
THROTTLE VALVE
Y2 VALVOLA EGR
EGR VALVE
Y1 POMPA ALTA PRESSIONE
HIGH PRESSURE PUMP
I1 INIETTORE CIL 1
INJECTOR CYL 1
I2 INIETTORE CIL 2
INJECTOR CYL 2
I3 INIETTORE CIL 3
INJECTOR CYL 3
I4 INIETTORE CIL 4
INJECTOR CYL 4
R2=120Ω 0.5W
R1=120Ω 0.5W
XTH ALIMENTAZIONE VALVOLA FARFALLA
THROTTLE VALVE POWER SUPPLY
XEG ALIMENTAZIONE VALVOLA EGR
EGR VALVE POWER SUPPLY
S2 SENSORE GIRI ALBERO MOTORE
CRANKSHAFT SPEED SENSOR
S3 SENSORE DI FASE ALBERO A CAMME
CAMSHAFT PHASE SENSOR
S4 SENSORE PRESSIONE E TEMPERATURA ARIA
BOOST PRESSURE AND TEMPERATURE SENSOR
S5 SENSORE PRESSIONE RAIL
RAIL PRESSURE SENSOR
S1 SENSORE TEMPERATURA ACQUA
COOLANT TEMPERATURE SENSOR
S6 SENSORE PRESSIONE E TEMPERATURA OLIO
OIL PRESSURE AND TEMPERATURE SENSOR
(BOSCH 0 261 B11 342)
CAVETTO COD.28852042
XECUA
33 INJECTOR 4
17 INJECTOR 4
46 INJECTOR 3
10 INJECTOR 3
31 INJECTOR 2
02 INJECTOR 2
47 INJECTOR 1
16 INJECTOR 1
49 FUEL METERING UNIT
19 FUEL METERING UNIT
57 THROTTLE VALVE STATUS
59 THROTTLE VALVE ACTUATOR
27 CRANKSHAFT SENSOR SIGNAL PLUS
12 CRANKSHAFT SENSOR SIGNAL MINUS
07 CRANKSHAFT SENSOR SHIELD
20 CAMSHAFT SENSOR GND
50 CAMSHAFT SENSOR SIGNAL
11 CAMSHAFT SENSOR SUPPLY
23 BOOST PRESS. SENSOR GND
53 BOOST PRESS. TEMP. SENSOR SIGNAL
13 BOOST PRESS.SENSOR SUPPLY
40 BOOST PRESS.SENSOR SIGNAL
08 RAIL PRESS. SENSOR GND
43 RAIL PRESS. SENSOR SIGNAL
28 RAIL PRESS. SENSOR SUPPLY
58 COOLANT TEMP.SENSOR SIGNAL
41 COOLANT TEMP. SENSOR GND
56 OIL PRESS. SENSOR SIGNAL
25 OIL PRESS.SENSOR SUPPLY
22 OIL PRESS.SENSOR GND
52 OIL TEMP.SENSOR SIGNAL
ECU
CENTRALINA CONTROLLO MOTORE
ENGINE CONTROL UNIT


SCHEMA ELETTRICO
ELECTRIC DIAGRAM
VALVOLA FARFALLA THROTTLE VALVE Y3
VALVOLA EGR EGR VALVE Y2
POMPA ALTA PRESSIONE HIGH PRESSURE PUMP Y1
INIETTORE CIL 1 INJECTOR CYL 1 I1
INIETTORE CIL 2 INJECTOR CYL 2 I2
INIETTORE CIL 3 INJECTOR CYL 3 I3
INIETTORE CIL 4 INJECTOR CYL 4 I4
R2=120Ω 0,5W
R1=120Ω 0,5W
XECUA
48 INJECTOR 4
17 INJECTOR 4
31 INJECTOR 3
01 INJECTOR 3
46 INJECTOR 2
02 INJECTOR 2
32 INJECTOR 1
16 INJECTOR 1
60 FUEL METERING UNIT
15 FUEL METERING UNIT
21 THROTTLE VALVE STATUS
19 THROTTLE VALVE ACTUATOR
52 THROTTLE VALVE GND
59 CRANKSHAFT SENSOR SIGNAL PLUS
44 CRANKSHAFT SENSOR SIGNAL MINUS
22 CRANKSHAFT SENSOR GROUND
28 CAMSHAFT SENSOR GND
14 CAMSHAFT SENSOR SIGNAL
13 CAMSHAFT SENSOR SUPPLY
25 BOOST PRESS. SENSOR GND
55 BOOST PRESS. TEMP. SENSOR SIGNAL
10 BOOST PRESS.SENSOR SUPPLY
40 BOOST PRESS.SENSOR SIGNAL
26 RAIL PRESS. SENSOR GND
41 RAIL PRESS. SENSOR SIGNAL
11 RAIL PRESS. SENSOR SUPPLY
57 COOLANT TEMP.SENSOR SIGNAL
58 COOLANT TEMP. SENSOR GND
06 OIL PRESS. SWITCH
ECU
CENTRALINA CONTROLLO MOTORE
ENGINE CONTROL UNIT
CAVETTO COD.28852042
SCHERMO/SHIELD
ALIMENTAZIONE VALVOLA FARFALLA THROTTLE VALVE POWER SUPPLY XTH
ALIMENTAZIONE VALVOLA EGR EGR VALVE POWER SUPPLY XEG
SENSORE GIRI ALBERO MOTORE CRANKSHAFT SPEED SENSOR S2
SENSORE DI FASE ALBERO A CAMME CAMSHAFT PHASE SENSOR S3
SENSORE PRESSIONE E TEMPERATURA ARIA BOOST PRESSURE AND TEMPERATURE SENSOR S4
SENSORE PRESSIONE RAIL RAIL PRESSURE SENSOR S5
SENSORE TEMPERATURA ACQUA COOLANT TEMPERATURE SENSOR S1
SWITCH PRESSIONE OLIO OIL PRESSURE SWITCH XS6
Disegno Nr. Part No.
A8850227A
Esponente Index No.
03
Data Date
08/10/13



XECUA
CENTRALINA ELETTRONICA
ELECTRONIC CONTROL UNIT

XECUA				
PIN	COLOR	SEZ.	DEST. CONN./PIN	CONTACT/SEALING
01	MB	1.50	XI3/1	1241608-1 TYCO
02	HR	1.50	XI2/1	1241608-1 TYCO
03	---	---	---	1394872-1 TYCO
04	---	---	---	1394872-1 TYCO
05	---	---	---	1394872-1 TYCO
06	---	---	---	1394871-1 TYCO
07	SCH.	---	XS2/3	968220-1 TYCO
08	NZ	0.75	XS5/1	968221-1 TYCO
09	---	---	---	1394871-1 TYCO
10	---	---	---	1394871-1 TYCO
11	GR	0.75	XS3/3	968221-1 TYCO
12	B	0.35	XS2/2	968220-1 TYCO
13	CB	0.75	XS4/3	968221-1 TYCO
14	---	---	---	1394871-1 TYCO
15	---	---	---	1394872-1 TYCO
16	LR	1.50	XI1/1	1241608-1 TYCO
17	RV	1.50	XI4/1	1241608-1 TYCO
18	---	---	---	1394872-1 TYCO
19	SN	1.50	XY1/1	1241608-1 TYCO
20	Z	0.75	XS3/1	1241608-1 TYCO
21	---	---	---	1394871-1 TYCO
22	M	0.75	XS6/1	968221-1 TYCO
23	MR	0.75	XS4/1	968221-1 TYCO
24	---	---	---	1394871-1 TYCO
25	C	0.75	XS6/3	968221-1 TYCO
26	---	---	---	1394871-1 TYCO
27	M	0.35	XS2/1	968220-1 TYCO
28	A	0.75	XS5/3	968221-1 TYCO
29	---	---	---	1394871-1 TYCO
30	---	---	---	1394872-1 TYCO
31	HN	1.50	XI2/2	1241608-1 TYCO
32	---	---	---	1394872-1 TYCO
33	RN	1.50	XI4/2	1241608-1 TYCO
34	---	---	---	1394872-1 TYCO
35	---	---	---	1394872-1 TYCO
36	---	---	---	1394871-1 TYCO
37	---	---	---	1394871-1 TYCO
38	---	---	---	1394871-1 TYCO
39	---	---	---	1394871-1 TYCO
40	BR	0.75	XS4/4	968221-1 TYCO
41	HV	0.75	XS1/2	968221-1 TYCO
42	---	---	---	1394871-1 TYCO
43	G	0.75	XS5/2	968221-1 TYCO
44	---	---	---	1394871-1 TYCO
45	GN	0.75	XEG-THA/2	1241608-1 TYCO
46	MN	1.50	XI3/2	1241608-1 TYCO
47	LN	1.50	XI1/2	1241608-1 TYCO
48	---	---	---	1394872-1 TYCO
49	CV	1.50	XY1/2	1241608-1 TYCO
50	HB	0.75	XS3/2	1241608-1 TYCO
51	---	---	---	1394871-1 TYCO
52	BN	0.75	XS6/2	968221-1 TYCO
53	BV	0.75	XS4/2	968221-1 TYCO
54	---	---	---	1394871-1 TYCO
55	---	---	---	1394871-1 TYCO
56	VN	0.75	XS6/4	968221-1 TYCO
57	---	---	---	1394871-1 TYCO
58	S	0.75	XS1/1	968221-1 TYCO
59	---	---	---	1394871-1 TYCO
60	H	0.75	XEG-THA/1	1241608-1 TYCO



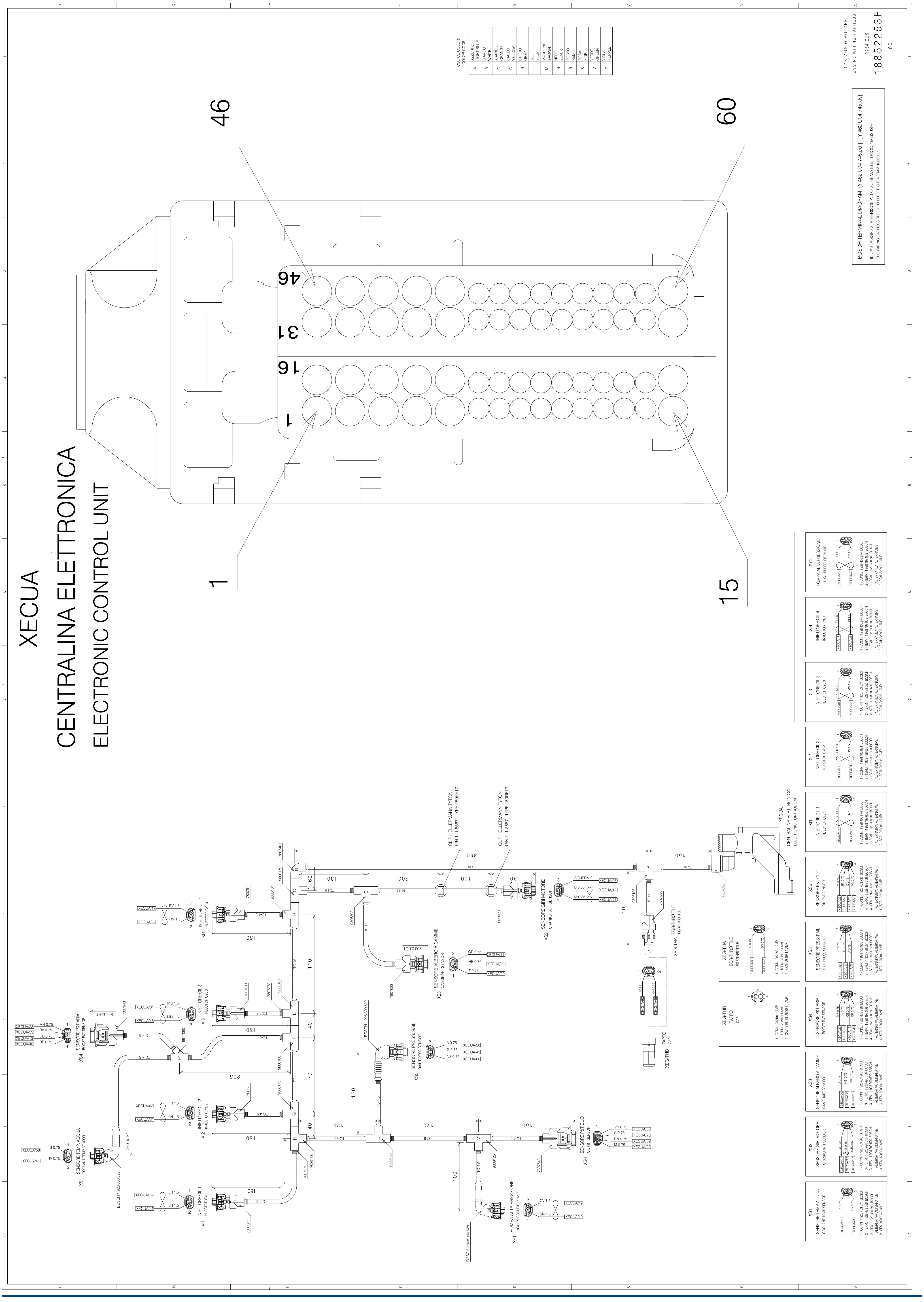
1 - 60 POSITION MQS HOUSING 284742-1 TYCO
19 - MQS 0.63 mm SEALING CAP 1394871-1 TYCO
10 - MQS 1.5 mm SEALING CAP 1394872-1 TYCO
3 - MQS 0.63 mm CONTACT 0.2-0.5 mmq 968220-1 TYCO
14 - MQS 0.63 mm CONTACT 0.75 mmq 968221-1 TYCO
14 - MQS 1.5 mm CONTACT 0.75 - 1.5 mmq 1241608-1 TYCO

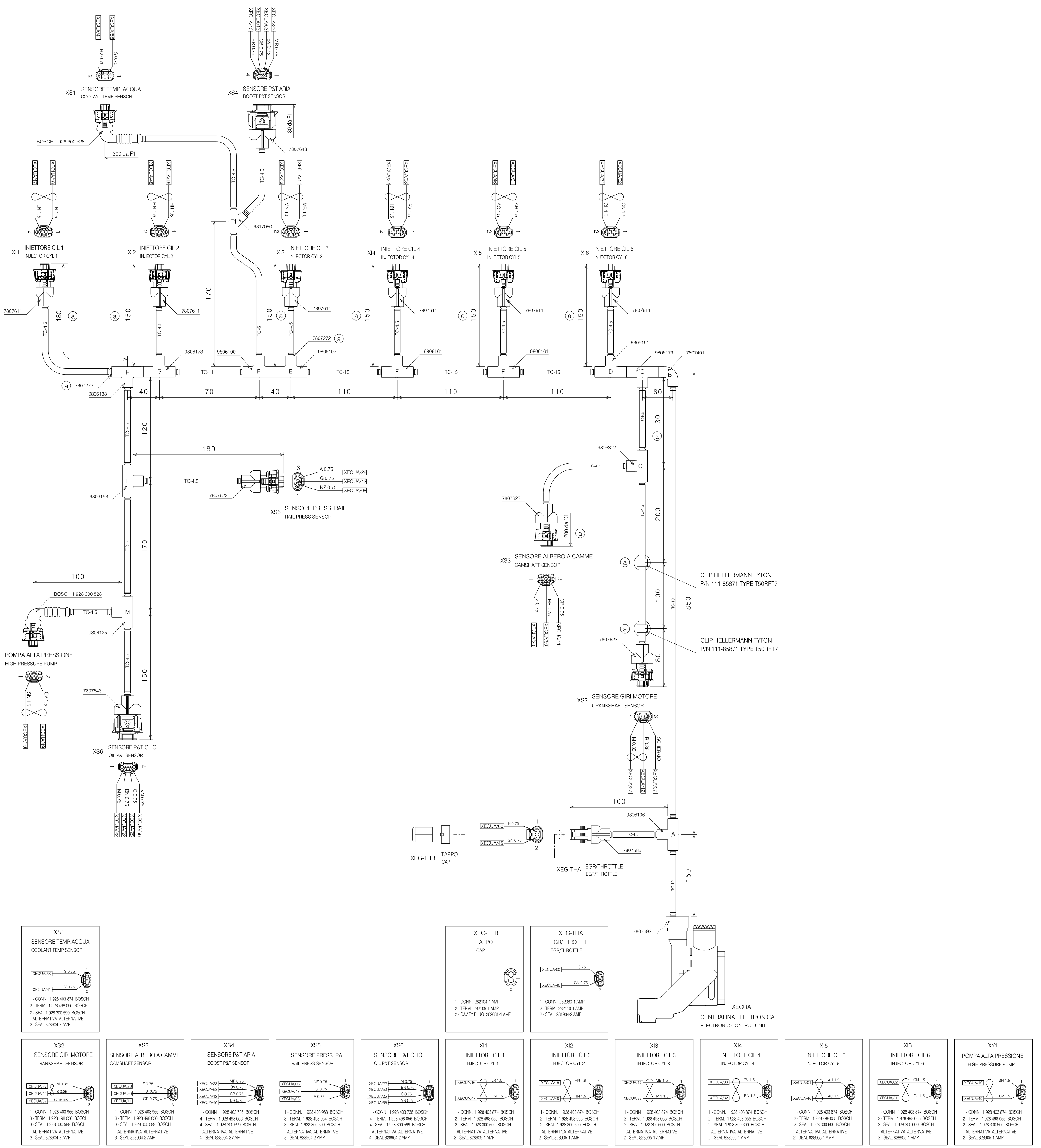
CODICE COLORI
COLOR CODE

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
R	ROSSO RED
S	ROSA PINK
V	VERDE GREEN
Z	VIOLA PURPLE

BOSCH TERMINAL DIAGRAM: [Y 462 U04 745.pdf] [Y 462 U04 745.xls]
IL CABLAGGIO SI RIFERISCE ALLO SCHEMA ELETTRICO 16662039F
THE WIRING HARNESS REFER TO ELECTRIC DIAGRAM 16662039F

18852239F
R754
20/03/07
01


XECUA
CENTRALINA ELETTRONICA
ELECTRONIC CONTROL UNIT
46
60
31
16
1
15
BOSCH TERMINAL DIAGRAM: [Y 462 U04 745.pdf] [Y 462 U04 745.xls]
CABLAGGIO MOTORE
ENGINE WIRING HARNESS
R754 EU5
1885225 3F



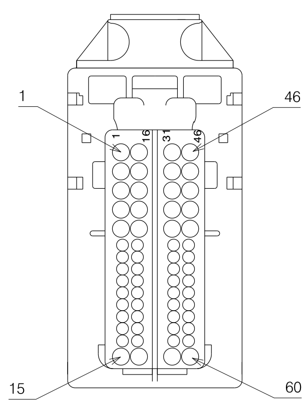
CODICE COLORI
COLOR CODE

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
R	ROSSO	RED
S	ROSA	PINK
V	VERDE	GREEN
Z	VIOLA	PURPLE

XECUA
CENTRALINA ELETTRONICA
ELECTRONIC CONTROL UNIT

XECUA

PIN	COLOR	SEZ.	DEST. CONN./PIN	CONTACT/SEALING
01	AH	1.50	XI5/1	1241608-1 TYCO
02	CN	1.50	XI6/1	1241608-1 TYCO
03	RV	1.50	XI4/1	1241608-1 TYCO
04	---	---	---	1394872-1 TYCO
05	---	---	---	1394872-1 TYCO
06	---	---	---	1394871-1 TYCO
07	SCH.	---	XS2/3	968220-1 TYCO
08	NZ	0.75	XS5/1	968221-1 TYCO
09	---	---	---	1394871-1 TYCO
10	---	---	---	1394871-1 TYCO
11	GR	0.75	XS3/3	968221-1 TYCO
12	B	0.35	XS2/2	968220-1 TYCO
13	CB	0.75	XS4/3	968221-1 TYCO
14	---	---	---	1394871-1 TYCO
15	---	---	---	1394872-1 TYCO
16	LR	1.50	XI1/1	1241608-1 TYCO
17	MB	1.50	XI3/1	1241608-1 TYCO
18	HR	1.50	XI2/1	1241608-1 TYCO
19	SN	1.50	XY1/1	1241608-1 TYCO
20	Z	0.75	XS3/1	1241608-1 TYCO
21	---	---	---	1394871-1 TYCO
22	M	0.75	XS6/1	968221-1 TYCO
23	MR	0.75	XS4/1	968221-1 TYCO
24	---	---	---	1394871-1 TYCO
25	C	0.75	XS6/3	968221-1 TYCO
26	---	---	---	1394871-1 TYCO
27	M	0.35	XS2/1	968220-1 TYCO
28	A	0.75	XS5/3	968221-1 TYCO
29	---	---	---	1394871-1 TYCO
30	---	---	---	1394872-1 TYCO
31	CL	1.50	XI6/2	1241608-1 TYCO
32	RN	1.50	XI4/2	1241608-1 TYCO
33	MN	1.50	XI3/2	1241608-1 TYCO
34	---	---	---	1394872-1 TYCO
35	---	---	---	1394872-1 TYCO
36	---	---	---	1394871-1 TYCO
37	---	---	---	1394871-1 TYCO
38	---	---	---	1394871-1 TYCO
39	---	---	---	1394871-1 TYCO
40	BR	0.75	XS4/4	968221-1 TYCO
41	HV	0.75	XS1/2	968221-1 TYCO
42	---	---	---	1394871-1 TYCO
43	G	0.75	XS5/2	968221-1 TYCO
44	---	---	---	1394871-1 TYCO
45	GN	0.75	XEG-THA/2	1241608-1 TYCO
46	AC	1.50	XI5/2	1241608-1 TYCO
47	LN	1.50	XI1/2	1241608-1 TYCO
48	HN	1.50	XI2/2	1241608-1 TYCO
49	CV	1.50	XY1/2	1241608-1 TYCO
50	HB	0.75	XS3/2	1241608-1 TYCO
51	---	---	---	1394871-1 TYCO
52	BN	0.75	XS6/2	968221-1 TYCO
53	BV	0.75	XS4/2	968221-1 TYCO
54	---	---	---	1394871-1 TYCO
55	---	---	---	1394871-1 TYCO
56	VN	0.75	XS6/4	968221-1 TYCO
57	---	---	---	1394871-1 TYCO
58	S	0.75	XS1/1	968221-1 TYCO
59	---	---	---	1394871-1 TYCO
60	H	0.75	XEG-THA/1	1241608-1 TYCO

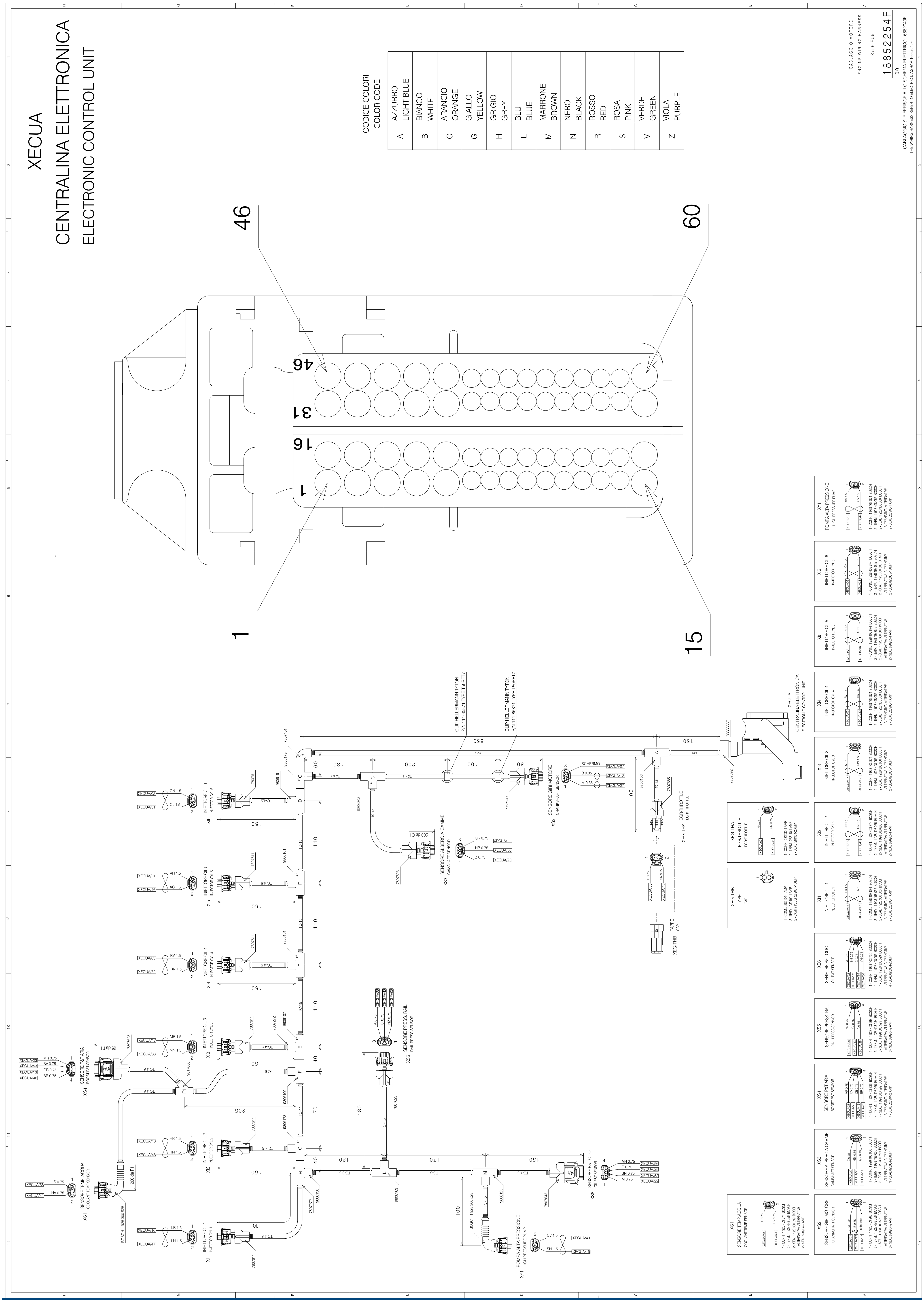


1 - 60 POSITION MQS HOUSING 284742-1 TYCO
19 - MQS 0.63 mm SEALING CAP 1394871-1 TYCO
6 - MQS 1.5 mm SEALING CAP 1394872-1 TYCO
3 - MQS 0.63 mm CONTACT 0.2-0.5 mmq 968220-1 TYCO
14 - MQS 0.63 mm CONTACT 0.75 mmq 968221-1 TYCO
18 - MQS 1.5 mm CONTACT 0.75 - 1.5 mmq 1241608-1 TYCO

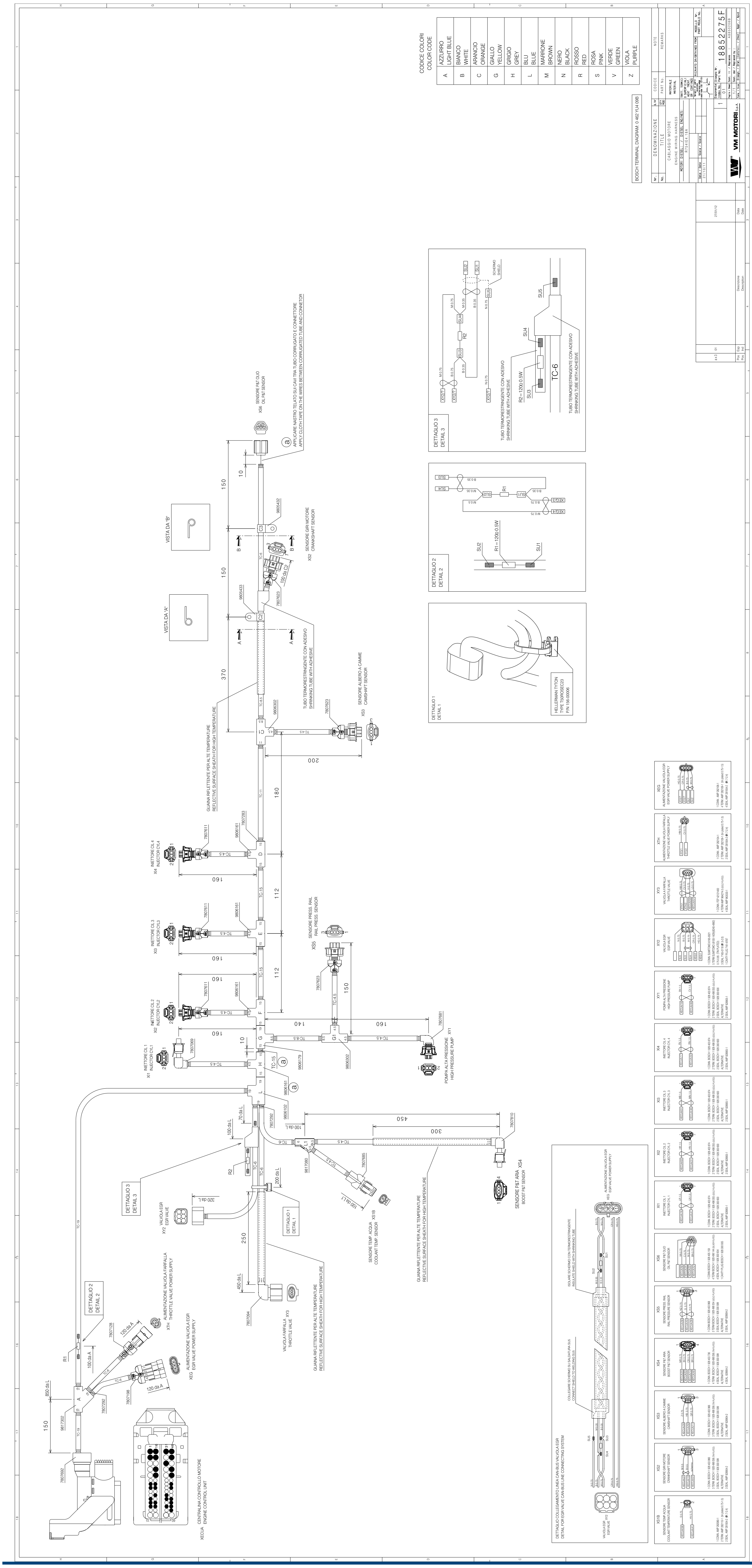
BOSCH TERMINAL DIAGRAM: [Y 462 U04 745.pdf] [Y 462 U04 745.xls]

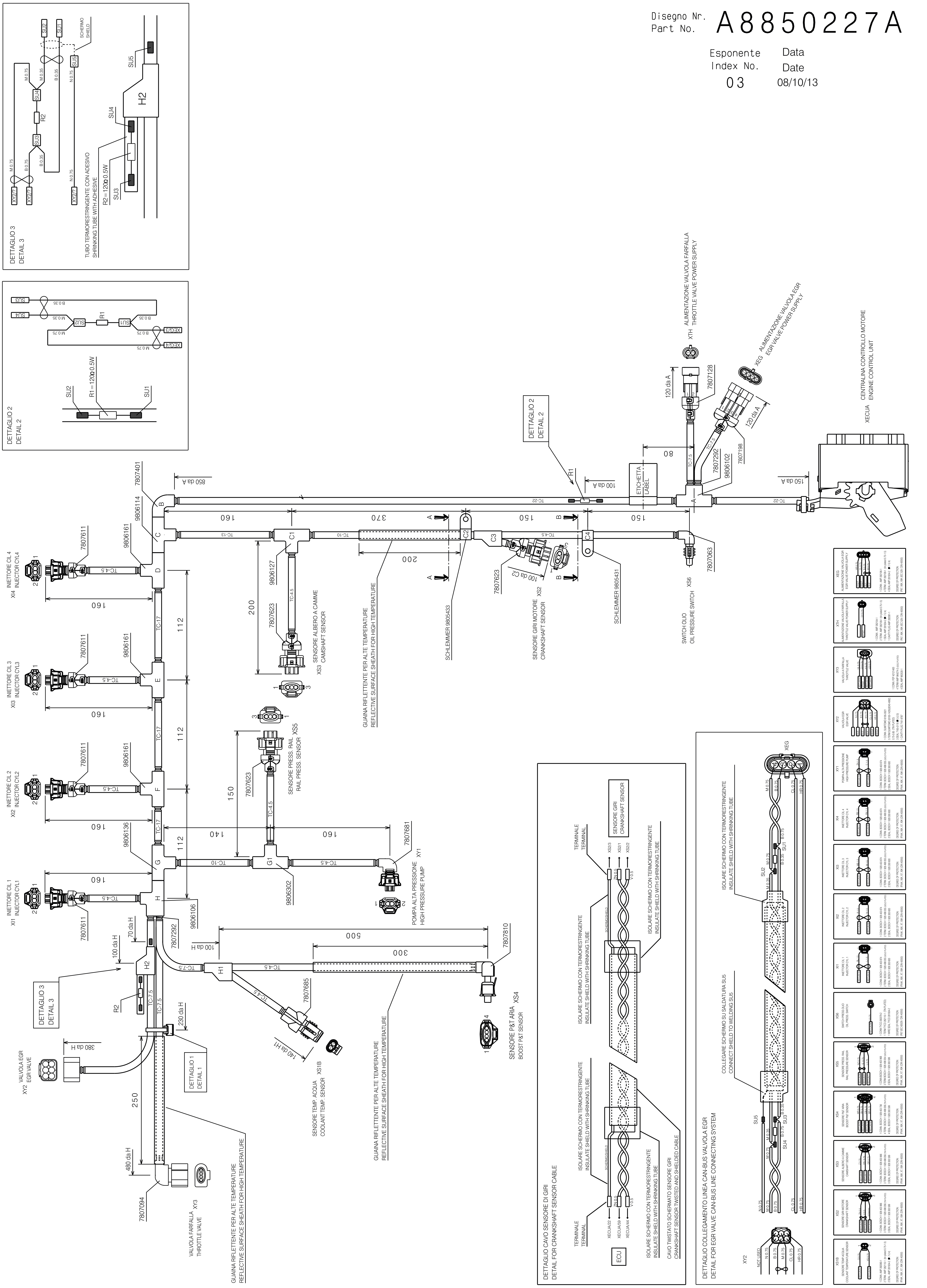
IL CABLAGGIO SI RIFERISCE ALLO SCHEMA ELETTRICO 16662040F
THE WIRING HARNESS REFER TO ELECTRIC DIAGRAM 16662040F

18852240F
R756
14/03/07
01



CODICE COLORI COLOR CODE	
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
R	ROSSO RED
S	ROSA PINK
V	VERDE GREEN
Z	VIOLA PURPLE

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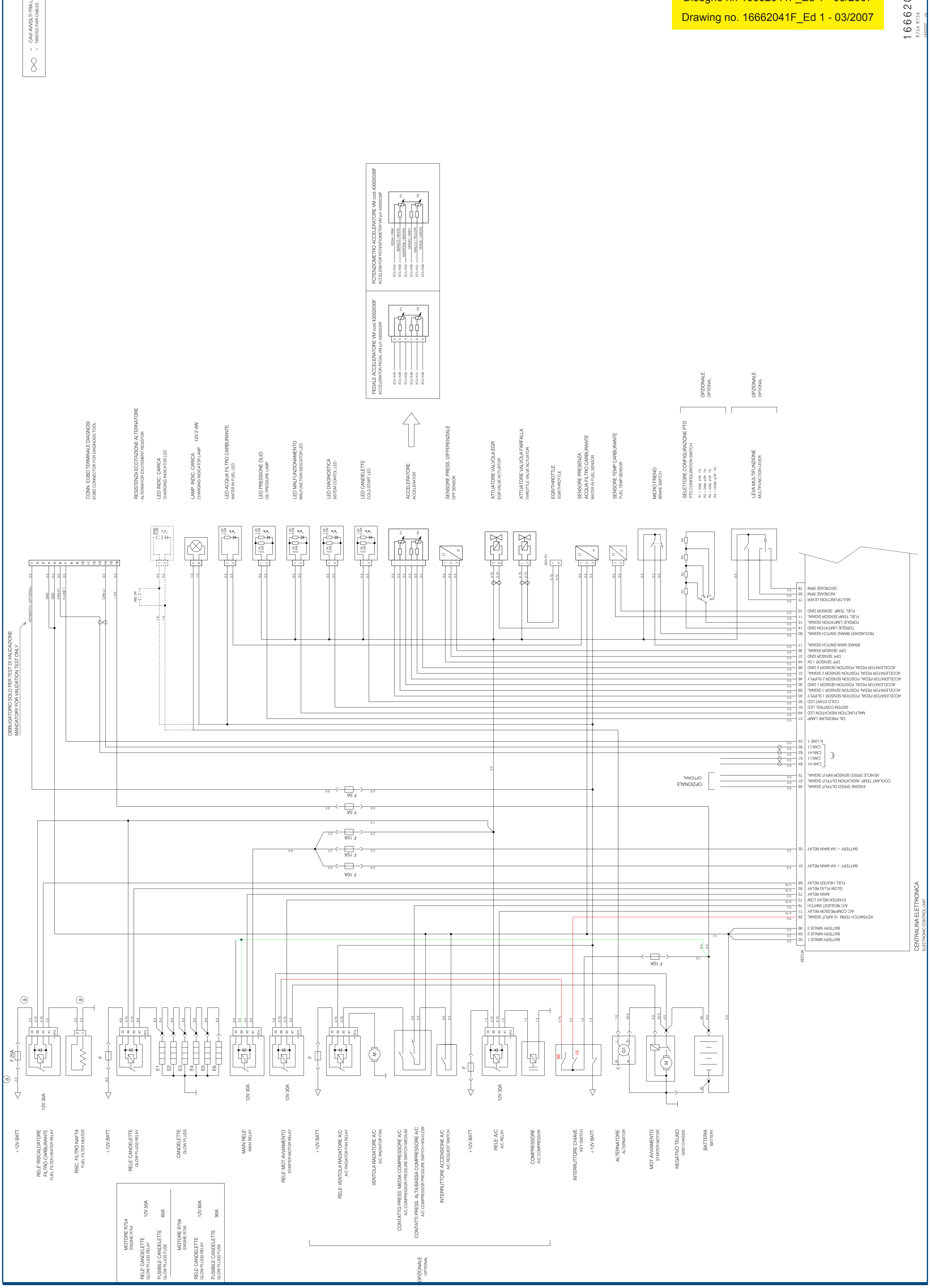
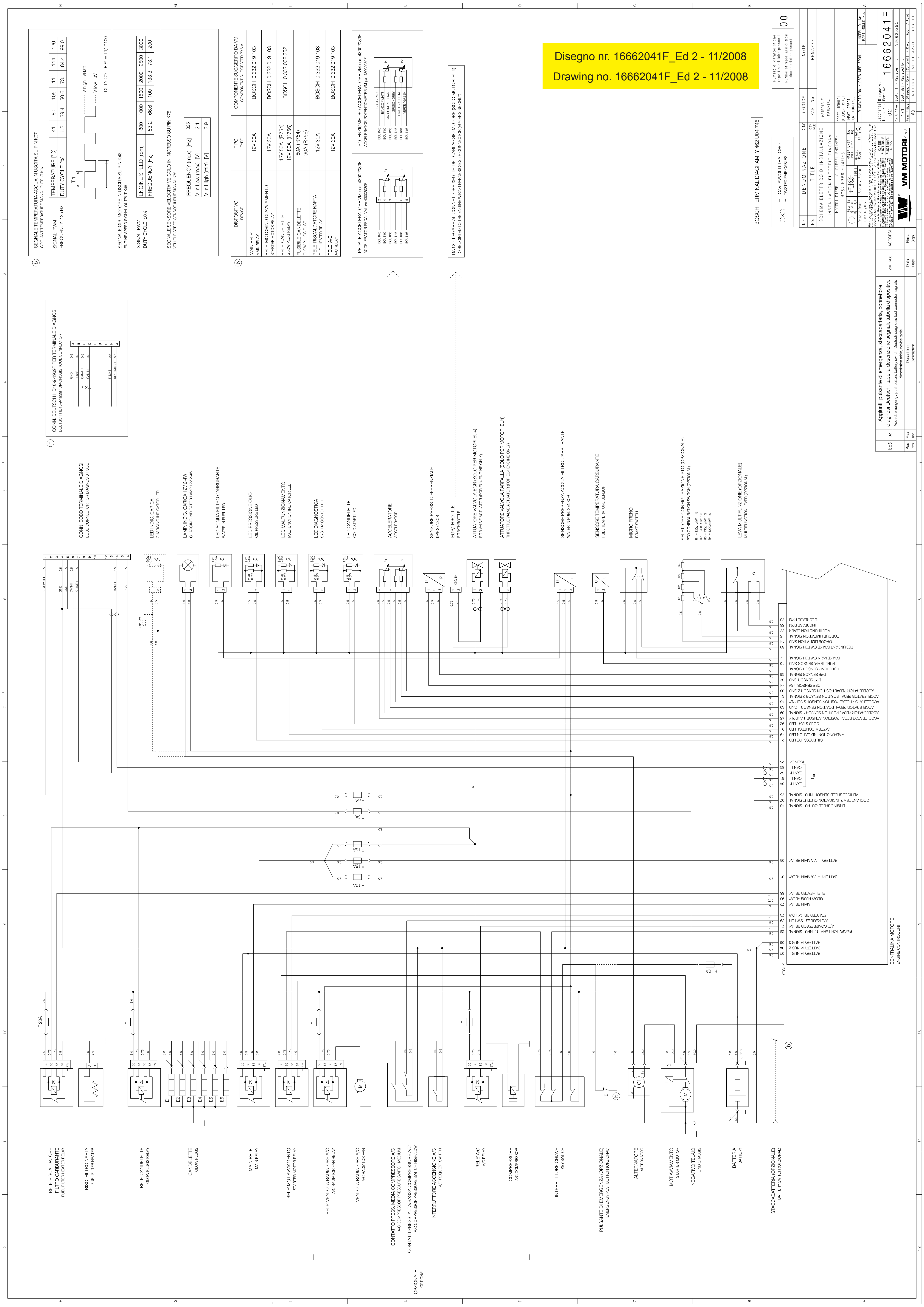
Part No.
A8850227A
Esponente
Index No.
03
Data
Date
08/10/13
DETTAGLIO 3
DETAIL 3
DETTAGLIO 2
DETAIL 2
DETTAGLIO 1
DETAIL 1
CENTRALINA CONTROLLO MOTORE
ENGINE CONTROL UNIT
XECUA
ALIMENTAZIONE VALVOLA FARFALLA
THROTTLE VALVE POWER SUPPLY
XTH
ALIMENTAZIONE VALVOLA EGR
EGR VALVE POWER SUPPLY
XEG
INIETTORE CIL.1
INJECTOR CYL.1
XI1
INIETTORE CIL.2
INJECTOR CYL.2
XI2
INIETTORE CIL.3
INJECTOR CYL.3
XI3
INIETTORE CIL.4
INJECTOR CYL.4
XI4
SENSORE ALBERO A CAMME
CAMSHAFT SENSOR
XS3
SENSORE PRESS. RAIL
RAIL PRESS. SENSOR
XS5
POMPA ALTA PRESSIONE
HIGH PRESSURE PUMP
XY1
SENSORE P&T ARIA
BOOST P&T SENSOR
XS4
SENSORE TEMP. ACQUA
COOLANT TEMP. SENSOR
XS1B
VALVOLA EGR
EGR VALVE
XY2
VALVOLA FARFALLA
THROTTLE VALVE
XY3
SENSORE GIRI MOTORE
CRANKSHAFT SENSOR
XS2
SWITCH OLIO
OIL PRESSURE SWITCH
XS6
GUAINA RIFLETTENTE PER ALTE TEMPERATURE
REFLECTIVE SURFACE SHEATH FOR HIGH TEMPERATURE
TUBO TERMORESTRINGENTE CON ADESIVO
SHRINKING TUBE WITH ADHESIVE
DETTAGLIO CAVO SENSORE DI GIRI
DETAIL FOR CRANKSHAFT SENSOR CABLE
DETTAGLIO COLLEGAMENTO LINEA CAN-BUS VALVOLA EGR
DETAIL FOR EGR VALVE CAN-BUS LINE CONNECTING SYSTEM
ISOLARE SCHERMO CON TERMORESTRINGENTE
INSULATE SHIELD WITH SHRINKING TUBE
COLLEGARE SCHERMO SU SALDATURA SU5
CONNECT SHIELD TO WELDING SU5
CAVO TWISTATO SCHERMATO SENSORE GIRI
CRANKSHAFT SENSOR TWISTED AND SHIELDED CABLE
ETICHETTA
LABEL
SCHLEMMER 9805431
SCHLEMMER 9805433

INSTALLATION ELECTRIC DIAGRAM - “K” SIDE - VEHICLE

R754 - R756 EURO4 - R756IE3

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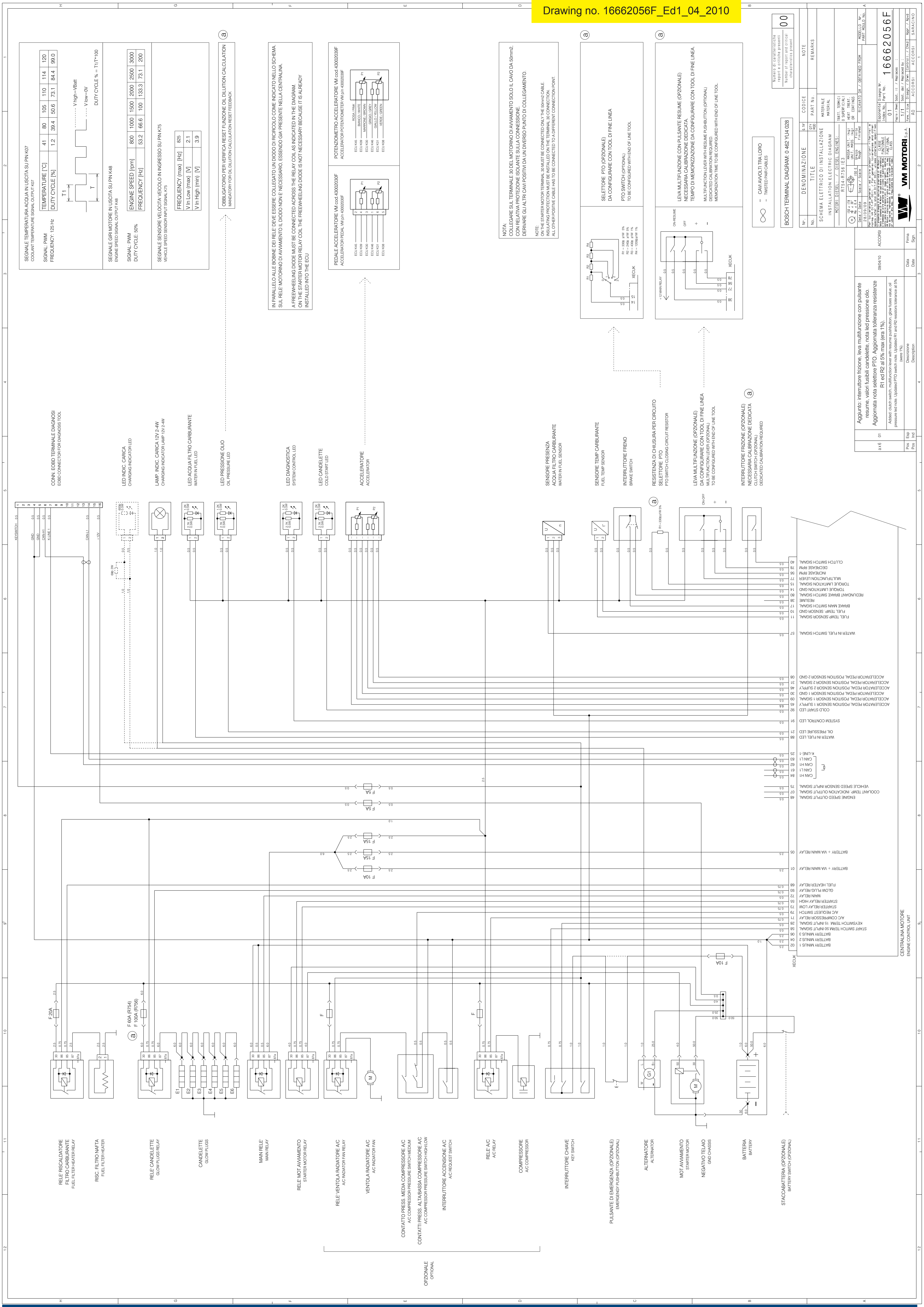

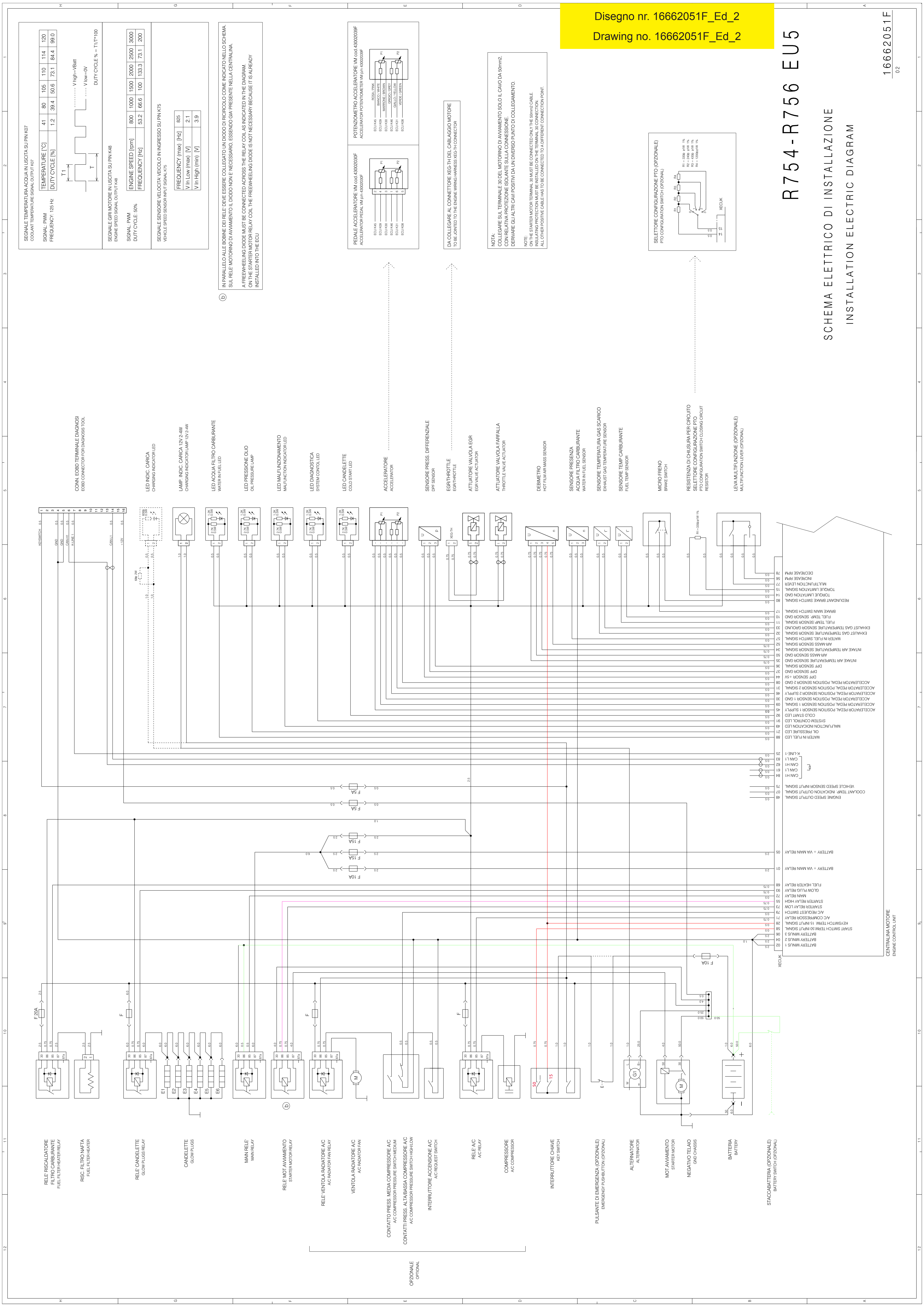
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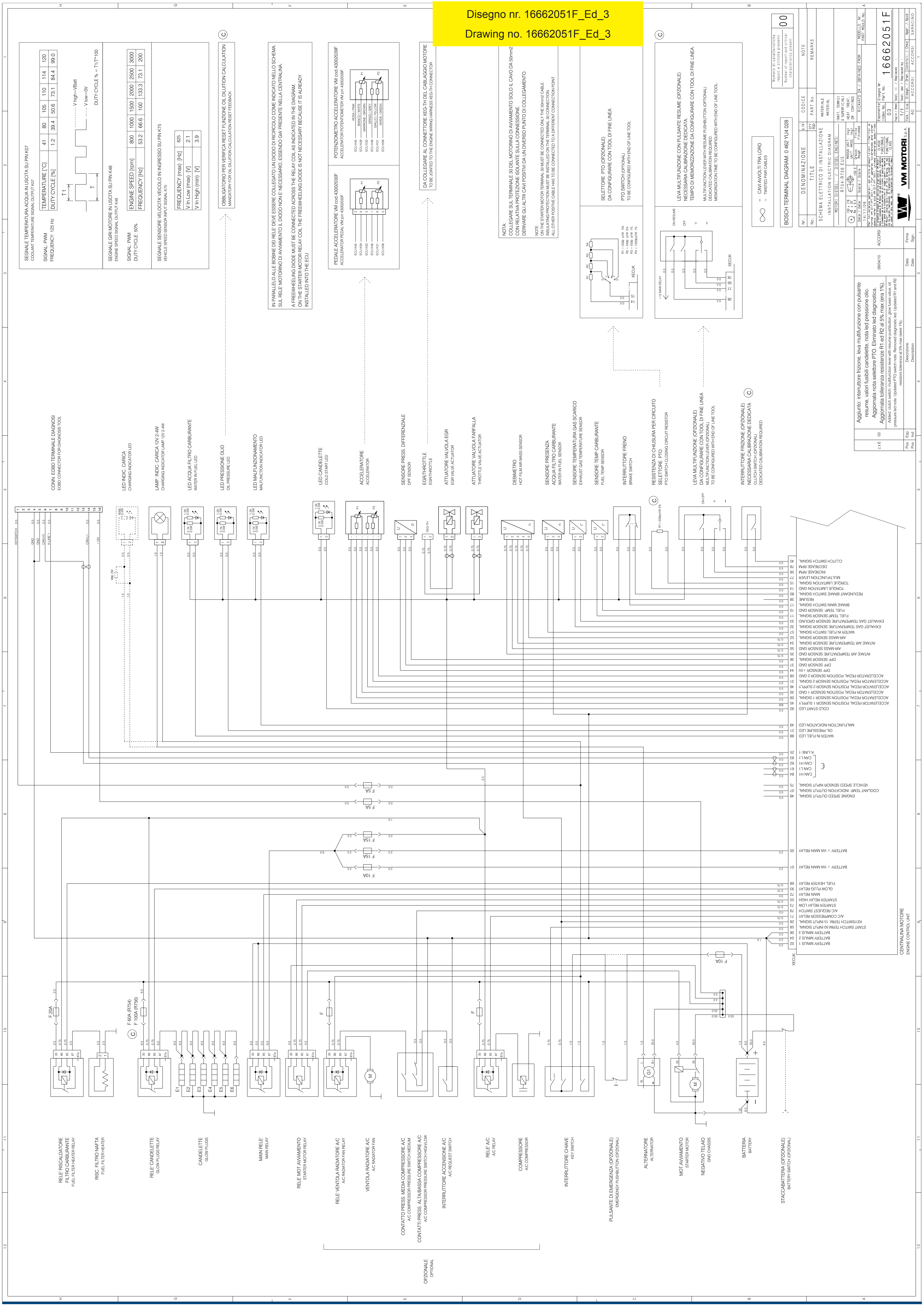
Drawing no. 16662051F_Ed_2
R754-R756 EU5
SCHEMA ELETTRICO DI INSTALLAZIONE
INSTALLATION ELECTRIC DIAGRAM
16662051F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