CASE Engines 668T/M2 and 668T/E2

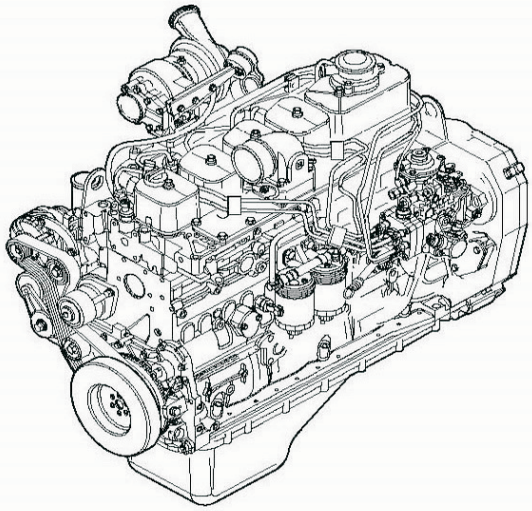
Service Manual

Bur 6-47950NA

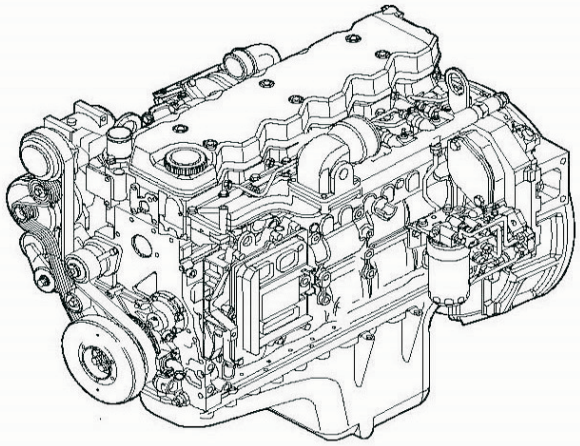
NA North American English

REPAIR MANUAL FOR ENGINES
F4GE0684F - (668T/M2)
F4HE0684J - (668T/E2)

6-47950NA



F4GE0684F



F4HE0684J

Every information, illustration and specification contained in the present manual is based on the most recent information available at the time of printing.

INTRODUCTION

TO THE READER

- ❑ This manual was written for a skilled technician and contains all the technical information needed to repair this vehicle.
- ❑ Read this manual carefully for the information concerning repairing operations.

FURTHER REFERENCES

PAGE NUMBER

- ❑ Every page carries a number on the top right corner. Every page contains the following information:

Example:: **T 1 - 2 - 3**

- **3** → Progressive page number for each group
- **2** → Group number (if any)
- **1** → Section number
- **T** → Technical section
  - **S:** Safety rules
  - **T:** Technical section { Operation principle; Performance tests; Fault diagnosis
  - **EW:** Instruction section for engine repairing

SYMBOLS

This manual contains safety warning symbols and indications referring to possible injuries or vehicle damages.

This symbol regards safety.

Use great care when you see this symbol because possible injuries to the personnel may occur.

Strictly observe the precautions marked with this symbol.

The safety warning symbol is used also to draw attention on the weight of a component or an element.

Make sure you are always using the right equipment and lifting techniques when handling heavy loads, in order to prevent injuries or damages.

ENGINES
F4GE0684F - F4HE0684J OVERHAUL

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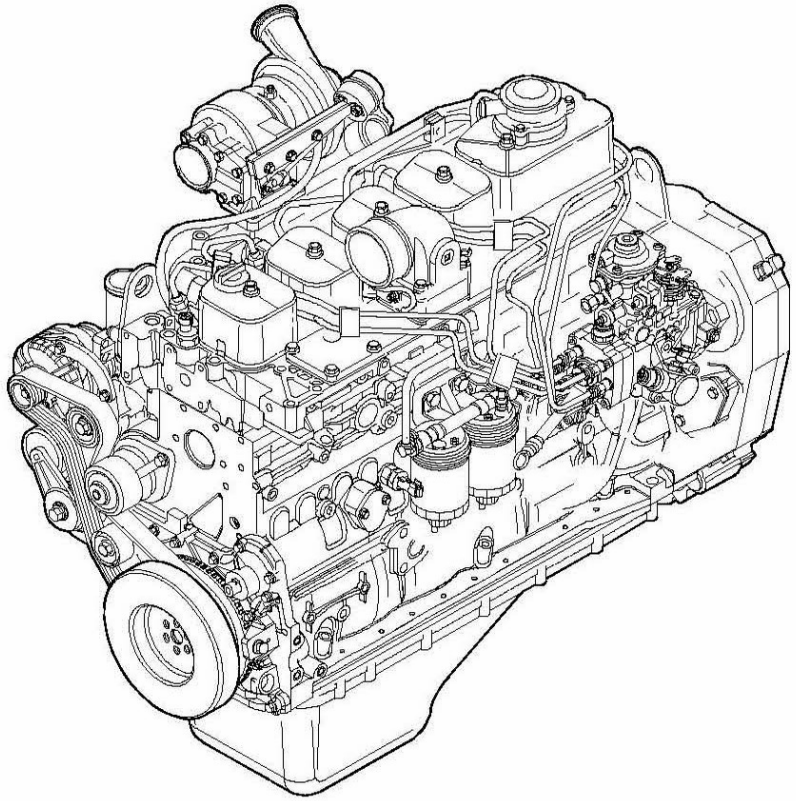
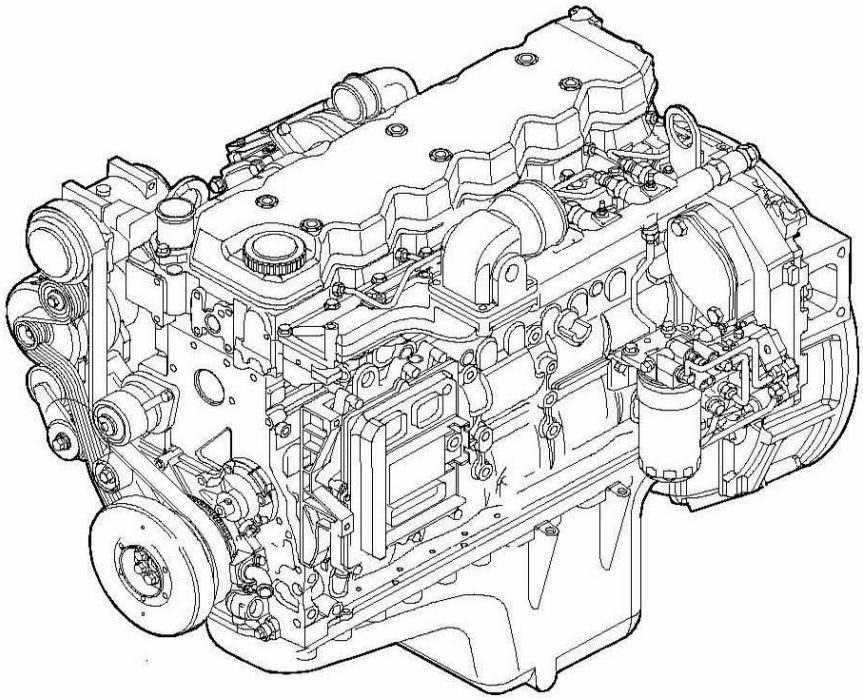
Figure 1



86483

ENGINE F4GE0684F

Figure 2



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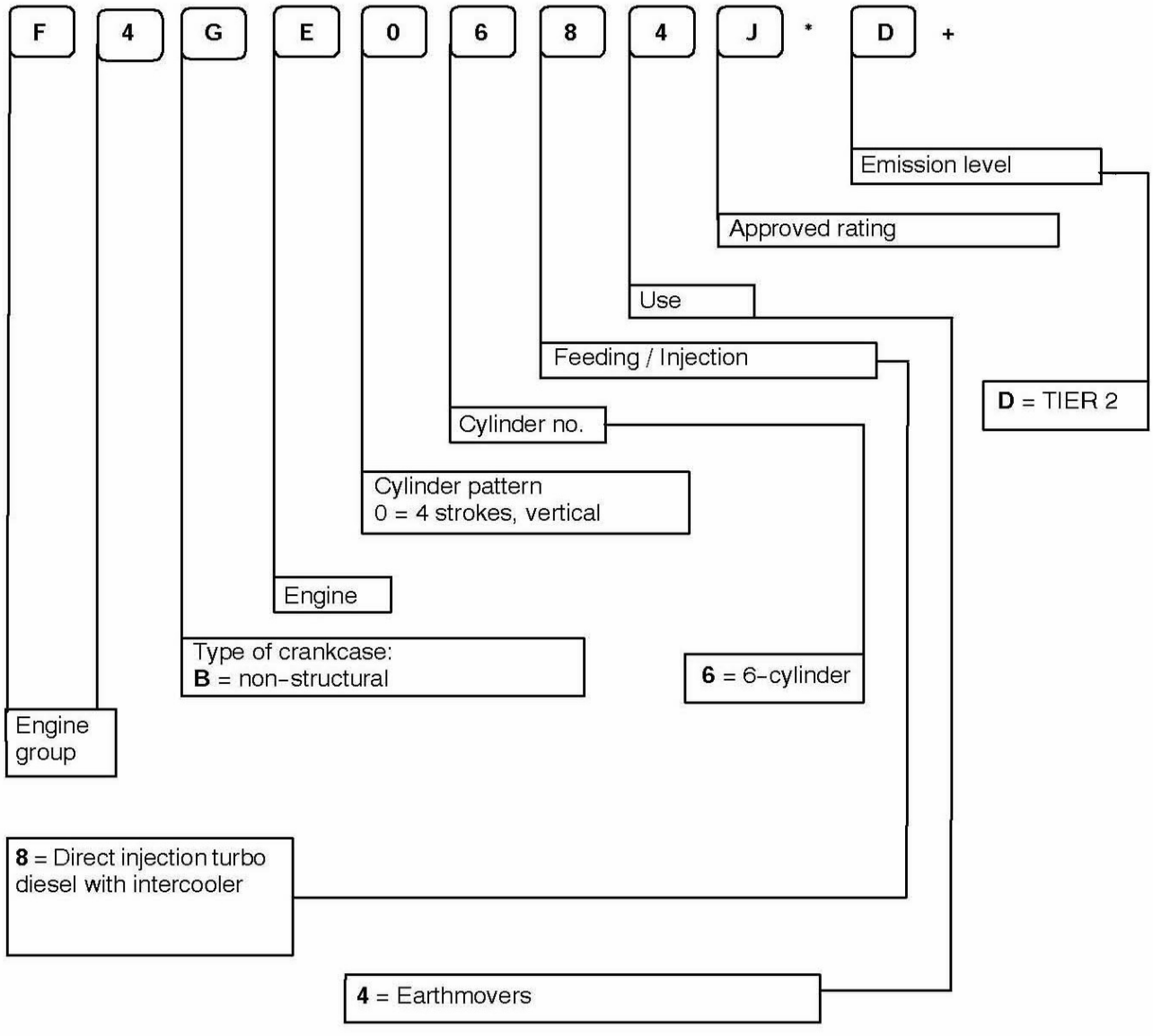
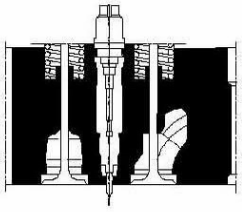
ENGINE F4HE0684J

ENGINE CODING



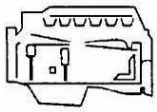
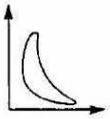
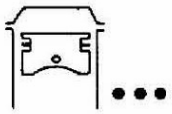
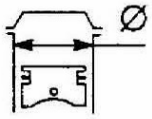
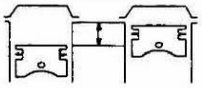
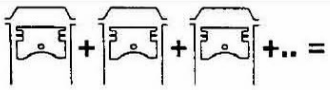
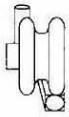
ENGINE F4GE0684F - F4HE0684J OVERHAUL

MAIN ENGINE FEATURES

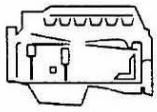
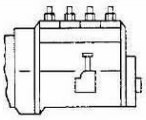
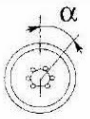
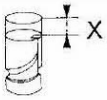
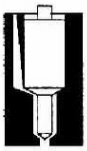
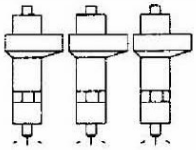
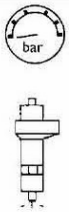
A	LW130.B	LW170.B
B	**F4GE0684F**	**F4HE0684J**
C	***D601**	***D100**
D		
E	6728 cm^3	
F	110 kW 2000 rpm	145 kW 2000 rpm
G	Direct injection	
		
H	In-line injection pump	
I	**T.A.A.** **(Boosted by intercooler)**	

A Wheeled loaders
B Type of engine
C Engine model
D Number of cylinders
E Total displacement
F Max. power currently available
G Type of injection
H Injection system
I Air supply system

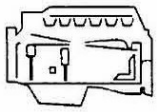
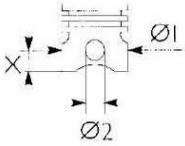
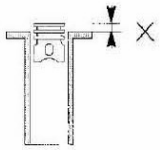
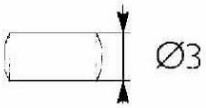
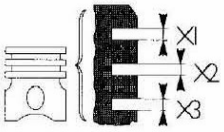
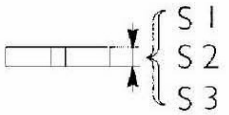
MAIN ENGINE FEATURES

			F4GE6484F	F4HE6484J
	Type		*D601	*D100
	Cycle		4-stroke diesel engine	
	Feeding		Boosted by intercooler	
	Injection		Direct	
	Number of cylinders		In-line, 6-cylinder	
	Bore	mm	11042	
	Stroke	mm	132	
	Total displacement	cm^3	6728 cm^3	
	Compression ratio			
	Max. rating	kW min^{-1}	110 2000	145 2000
	Max. torque	Nm (kgm) min^{-1}	675 1400	850 1400
	No-load idle rpm	min^{-1}	700	
	No-load peak rpm	min^{-1}	-	
	BOOSTING Type of turbocompressor:		With intercooler HOLSET HX35W	
	LUBRICATION		Forced by means of gear pump, pressure relief valve, oil filter	
	Oil pressure with hot engine: at idle rpm at peak rpm	 bar bar	 1.2 3.8	

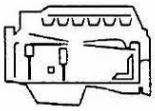
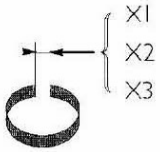
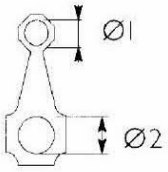
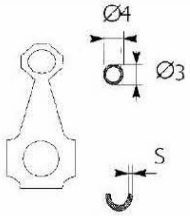
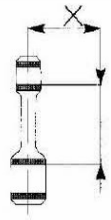
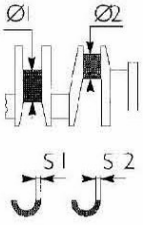
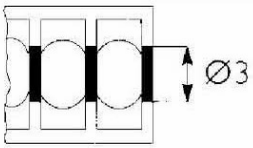
ENGINE F4GE0684F - F4HE0684J OVERHAUL

			F4GE0684F	F4HE0684J
	Type		*D601	*D100
COOLING			By fluid	
	Water pump drive:		By means of belt	
	Thermostat: start of opening:	°C	81 ± 2	
 Ambra Super Gold 15W40 10W30	REFUELLING			
	Full filling capacity 1°	litres	-	
		kg		
	- engine sump	litres	-	
		kg		
	- engine sump + filter	litres		
		kg		
	FEEDING Bosch-type injection		VE6/12F9000 L968	High pressure Common Rail
	Pump setting		0° ± 0°.5	
	Start of delivery	mm	1	
	Type of nozzle		DSLA 145 P1174	Electro-injectors
	Injection sequence		1 - 5 - 3 -6 -2 - 4	
	Injection pressure bar		245 bar	250 - 1450 bar

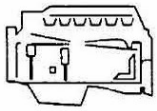
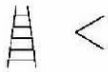
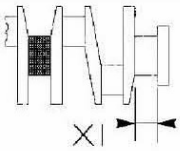
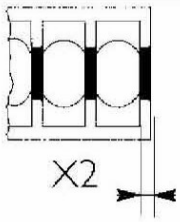
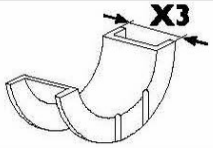
ASSEMBLING PLAY - SPECIFICATIONS

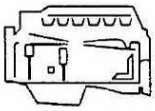
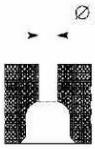
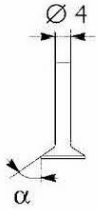
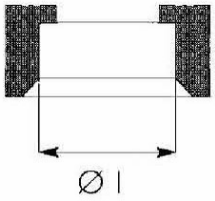
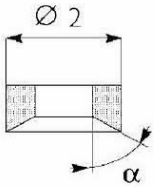
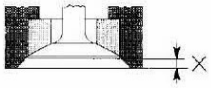
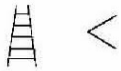
	Type		F4GE0684F	F4HE0684J
			*D601	*D100
CRANK GEAR COMPONENTS AND CYLINDER ASSEMBLY			mm	
	Cylinder liners	∅1	104	
	Pistons: supplied with standard spares			
	Measurement dimension	X	61	
	Outer diameter	∅1	103.730 to 10.748	
	Pin seat	∅2	38.016 to 38.010	
	Piston - cylinder liners		-	
	Piston diameter	∅1	0.5	
	Position of pistons from crankcase	X	-	
	**Piston pin**	∅3	37.994 to 38.000	
	**Piston pin - Pin seat**		0.01 to 0.022	
	Type of piston	X1*	2.705 to 2.735	
	Piston ring slots	X2	2.440 to 2.460	
		X3	4.03 to 4.05	
	Piston rings	S1*	2.560 to 2.605	
		S2	2.350 to 2.380	
		S3	3.977 to 3.990	
	Piston rings– Slots	1	0.100 to 0.175	
		2	0.010 to 0.11	
		3	0.040 to 0.083	
	Piston rings		0.5	

ENGINE F4GE0684F - F4HE0684J OVERHAUL

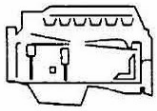
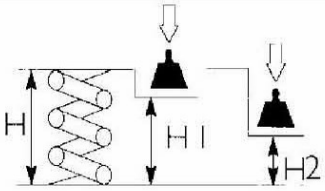
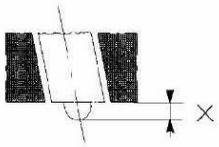
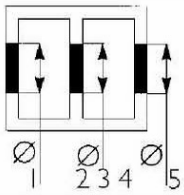
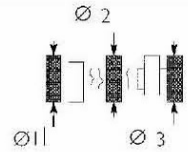
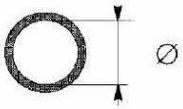
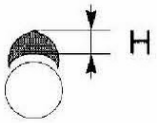
	Type	F4GE0684F	F4HE0684J
		*D601	*D100
CRANK GEAR COMPONENTS AND CYLINDER ASSEMBLY		mm	
	Piston ring end opening in cylinder liner:		
	X1	0.3 to 0.4	
	X2	0.6 to 0.8	
	X3	0.3 to 0.55	
	Connecting rod small-end bushing seat Ø1	41.2797 to 41.553	
	Connecting rod bearing seat Ø2	72.987 to 73.013	
	Connecting rod small-end bushing diameter		
	Outer Ø4	40.987 to 410.13	
	Inner Ø3	38.019 to 38.033	
	Connecting rod small-end bushing – seat	0.266 to 0.566	
	**Piston pin – Bushing**	0.019 to 0.039	
	Measurement dimension X	-	
	Max. error on connecting rod axis parallelism =	-	
	Journals Ø1	82.99 to 83.01	
	Crankpins Ø2	68.987 to 69.013	
	Main half bearings S1*	2.456 to 2.464	
	Connecting rod half bearings S2*	1.955 to 1.968	
	* supplied with spares		
	Bed supports no.:		
	n. 1-5 Ø3	87.982 to 88.008	
	n. 2-3-4	87.977 to 88.013	

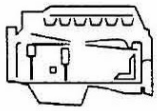
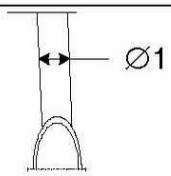
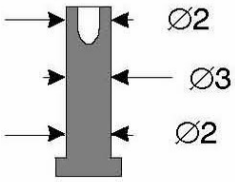
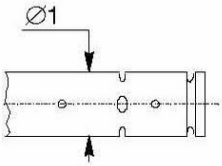
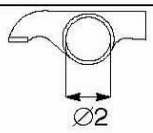
ENGINE F4GE0684F - F4HE0684J OVERHAUL

	Type		F4GE0684F	F4HE0684J
			*D6011	*D100
CRANK GEAR COMPONENTS AND CYLINDER ASSEMBLY			mm	
	Half bearings - journals: n. 1-7 n. 2-3-4-5-6		 0.041 to 0.119 0.041 to 0.103	
	Half bearings - crankpins		0.033 to 0.041	
	Main half bearings Connecting rod half bearings		+ 0.250; + 0.500	
	Shoulder journal	X1	37.475 to 37.545	
	Shoulder bed support	X2	25.98 to 26.48	
	Shoulder half rings	X3	37.28 to 3738	
	Drive shaft shoulder		0.068 to 0.410	

	Type	F4GE0684F	F4HE0684J
		*D601	*D100
VALVE GEAR – CYLINDER ASSEMBLY		mm	
	Valve guide seats on cylinder head ∅1	8.019 to 8.039	70.42 to 7.062
	Valves:		
	∅4	7.96 to 7.98	6.970 to 6.999
	α	60°	60 ÷ 0.25°
	∅4	7.96 to 7.98	6.970 to 6.999
	α	45°	45 ÷ 0.25°
	Valve stem and respective guide	0.052 to 0.092	0.043 to 0.092
	Seat on head for valve seat:		
	∅1	46.987 to 47.013	34.837 to 34.863
	∅1	43.637 to 43.668	34.837 to 34.863
	Valve seat outer diameter; inclination of valve seats on cylinder head:		
	∅2	47.063 to 47.089	34.917 to 34.931
	α	60°	60°
	∅2	43.713 to 43.739	34.917 to 34.931
	α	45°	45°
	Hollow X	0.356 to 1.102	0.59 to 1.11
	X	0.104 to 0.840	0.96 to 1.48
	Between the valve seat and the head	0.050 to 0.102	0.054 to 0.094
		0.050 to 0.102	0.054 to 0.094
	Valve seats	-	

ENGINE F4GE0684F - F4HE0684J OVERHAUL

	Type		F4GE0684F	F4HE0684J
			*D601	*D100
VALVE GEAR – CYLINDER ASSEMBLY			mm	
	Valve spring height:			
	free spring	H	63.5	47.75
	under a load of:			
	329 N (•) - 3398 N (■)	H1	49.02 (•)	35.33 (■)
	641 N (•) - 741 N (■)	H2	38.20 (•)	25.2 (■)
	Injector protrusion	X	not adjustable	
	Seats for distributing shaft bushings no. n. 1-7		-	
	Distributing shaft seats no. 2-3-4-5-6		-	
	Distributing shaft support pins:			
	1 ⇒ 7	∅	53.995 to 54.045	
	Bushing inner diameter	∅	54.083 to 54.147	
	Bushings and seats in crankcase		-	
	Bushings and support pins		0.038 to 0.162	
	Eccentric working lift:			
			6.045	6.45
			7.239	7.582

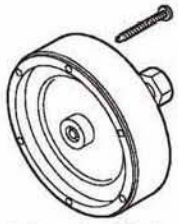
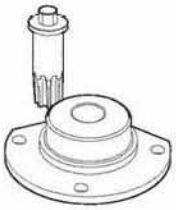
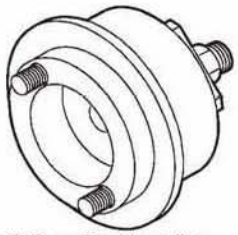
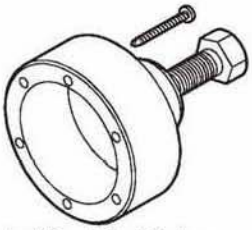
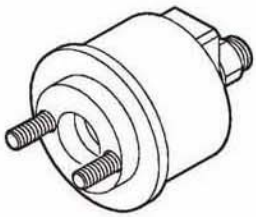
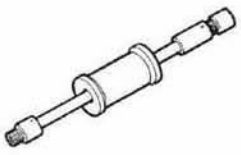
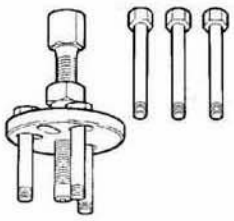
	Type		F4GE0684F	F4HE0684J
			*D601	*D100
VALVE GEAR – CYLINDER ASSEMBLY			mm	
	Seat for tappet collar in the crankcase	∅1	16.000 to 16.030	
	Outer diameter of tappet collar:			
		∅2	15.929 to 15.959	15.924 to 15.954
		∅3	15.965 to 15.980	15.960 to 15.970
	Between the tappets and the seats		0.020 to 0.065	0.025 to 0.070
	Tappets		-	
	Rocker arm shaft	∅1	18.963 to 18.975	21.965 to 21.977
	Rocker arms	∅2	19.000 to 19.026	22.001 to 0027
	Between the rocker arm and the shaft		0.025 to 0.063	0.024 to 0.377

TIGHTENING TORQUE

PART			COPPIA	
			Nm	(kgm)
Cylinder head fastening screw	1st phase: screws M12x1.75x70		50 ± 5	(5 ± 0.5)
	screws M12x1.75x140		40 ± 5	(4 ± 0.5)
	screws M12x1.75x180	▲	70 ± 5	(7 ± 0.5)
	2nd phase:		90°	
	3rd phase: (only for screws 140 and 180 mm long)		90°	
Bed cap fastening screws	1st phase		50 ± 6	(5 ± 0.6)
	2nd phase	▲	80 ± 6	(8 ± 0.6)
	3rd phase		90° ± 5°	
Connecting rod cap fastening	1st phase		30 ± 5	(3 ± 0.5)
	2nd phase	▲	50 ± 5	(5 ± 0.5)
	3rd phase		60° ± 5°	
Engine flywheel fastening screws	pre-tighten	▲	30 ± 5	(3 ± 0.5)
	Angle		60° ± 5°	
Injector fastening			60 ± 5	(6 ± 0.5)
Sump oil drain plug			60 ± 5	(6 ± 0.5)
Fuel filter			contact + 3/4 turn	
Injection pump gear cover fastening screw			25 ± 5	(2.5 ± 0.5)
Valve gear cover and case fastening screw			25 ± 5	(2.5 ± 0.5)
Container fastening screw			25 ± 5	(2.5 ± 0.5)
Intake manifold fastening screw			25 ± 5	(2.5 ± 0.5)
Fuel pump fastening screw			25 ± 5	(2.5 ± 0.5)
Exhaust manifold fastening screw			53 ± 5	(5.3 ± 0.5)
Tappet cover fastening nut			25 ± 5	(2.5 ± 0.5)
Rocker arm support fastening screw			48 ± 8	(4.8 ± 0.8)
Nut for rocker arm adjusting screw			25 ± 5	(2.5 ± 0.5)
Screw fastening the pulley on drive shaft	pre-tighten		50 ± 5	(5 ± 0.5)
	Angle		90° ± 5°	
Distributing shaft shoulder plate fastening screw			25 ± 5	(2.5 ± 0.5)
Fan support fastening screw			25 ± 5	(2.5 ± 0.5)
Injection pump fastening screw			12 ± 5	(1.2 ± 0.5)
Fan pulley fastening screw			45 ± 5	(4.5 ± 0.5)
Turbocompressor fastening screw			25 ± 5	(2.5 ± 0.5)
Heat exchanger fastening screw			25 ± 5	(2.5 ± 0.5)
Oil pump and front cover fastening screw			25 ± 5	(2.5 ± 0.5)
Starter motor fastening screw			55 ± 5	(5.5 ± 0.5)
Alternator fastening screw			45 ± 5	(4.5 ± 0.5)
Water pump fastening screw			25 ± 5	(2.5 ± 0.5)
Oil filter			contact + 3/4 turn	
Belt stretcher fastening screw			45 ± 5	(4.5 ± 0.5)

▲ - Lubrication with oil

TOOLS

TOOL No.	DEFINITION	TOOL No.	DEFINITION
380000663	 Crankshaft Rear Seal Puller	380000988	 Tool for Rotating the Engine Flywheel
380000664	 Crankshaft Rear Seal Installer		
380000665	 Crankshaft Front Seal Puller		
380000666	 Crankshaft Front Seal Installer		
380000671	 Injector Puller		
380000979	 Injector Pump Puller		

GRAPHIC INDICATIONS AND SYMBOLS

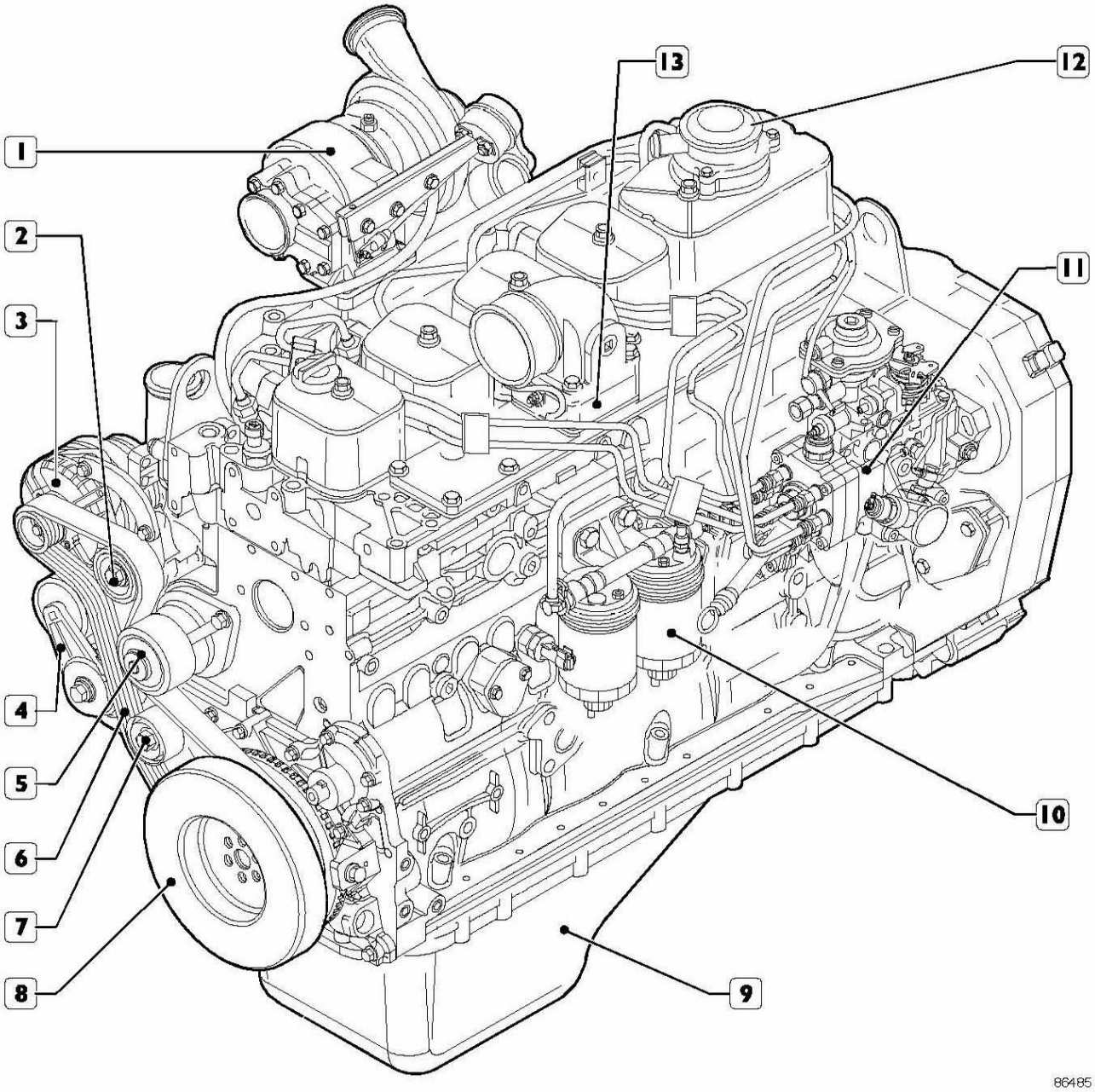
	Detachment Disconnect
	Reattachment Connect
	Removing Disassembling
	Mounting Assembling
	Torque-tighten
	Torque-tighten + angular value
	Countersink
	Adjustment Setting
	Warning Note
	Visual check Mounting position check
	Measurement Dimension to be measured Check
	Equipment
	Surface to be machined Machining finish
	Interference Forced mounting
	Thickness Play
	Lubricate Moisten Grease
	Sealant
	Air bleed

	Intake
	Exhaust
	Operation
ϱ	Compression ratio
	Tolerance Weight difference
	Dragging torque
	Replacement Genuine spares
	Rotation
	Angle Angular value
	Preload
	Revs number
	Temperature
	Pressure
>	Increase Greater than ..... Maximum
<	Decrease Smaller than ..... Minimum
	Selection Classes Increases
	Temperature < 0 °C Cold Winter
	Temperature > 0 °C Hot Summer

GENERAL REMARKS

ENGINE F4GE0684F

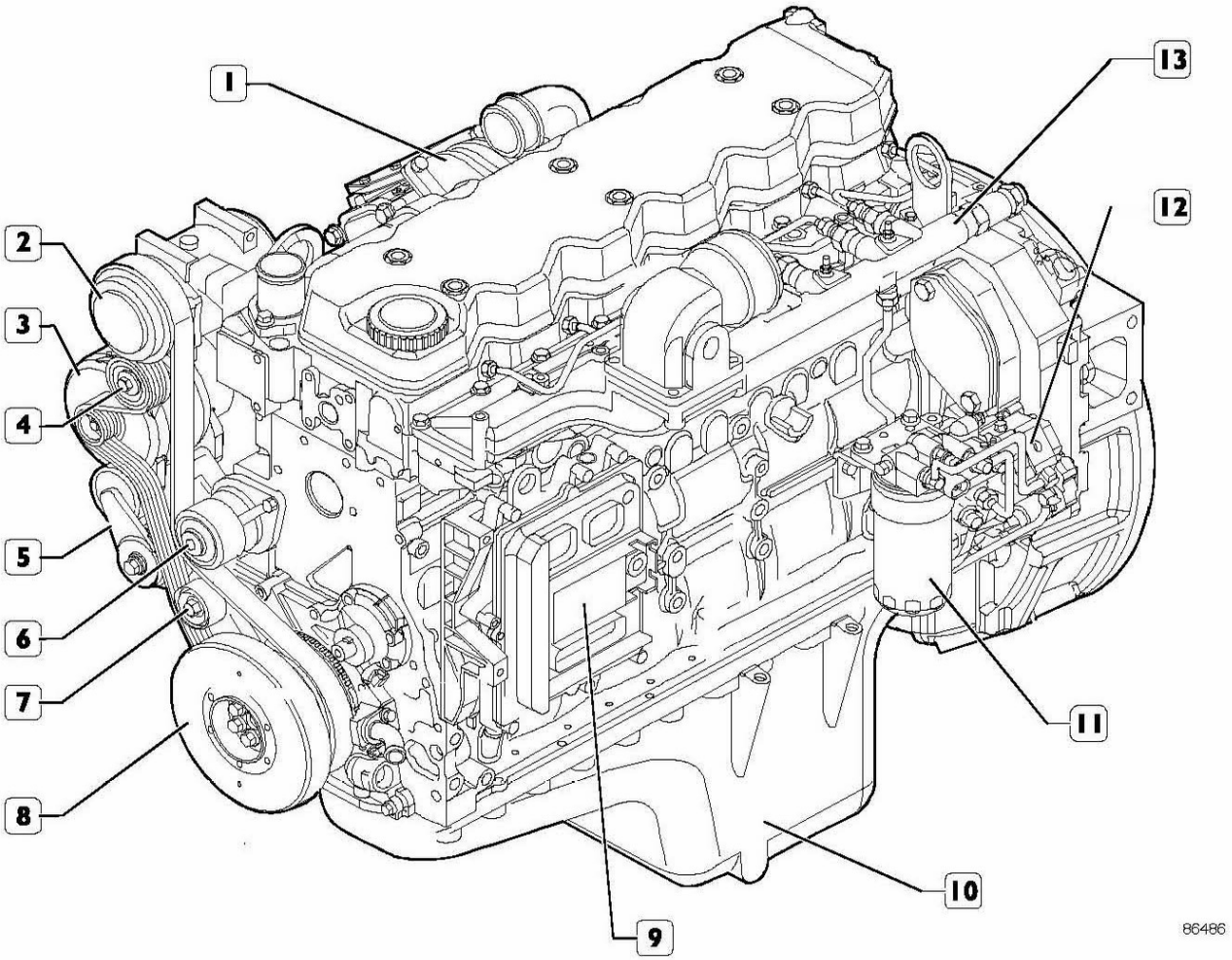
Figure 3



1. Turbocompressor – 2. Fixed guide pulley – 3. Alternator - 4. Automatic belt stretcher – 5. Water pump - 6. Poly-V water pump and alternator drive belt– 7. Fixed guide pulley – 8. Damper flywheel – 9. Sump – 10. Diesel oil filters – 11. Rotary injection pump – 12. Blow-by - 13. Cold start air heater

MOTORE F4HE0684J

Figure 4



1. Turboblower- 2. Conditioner compressor - 3. Alternator - 4. Fixed guide pulley -
5. . Automatic take-up unit - 6. Water pump - 7. Fixed guide pulley
8. Damper flywheel - 9. Electronic control unit - 10. Oil sump - 11. Fuel oil filter - 12. High pressure pump with fuel pump - 13. Common rail

DESCRIPTION OF MAIN MECHANIC ENGINE COMPONENTS

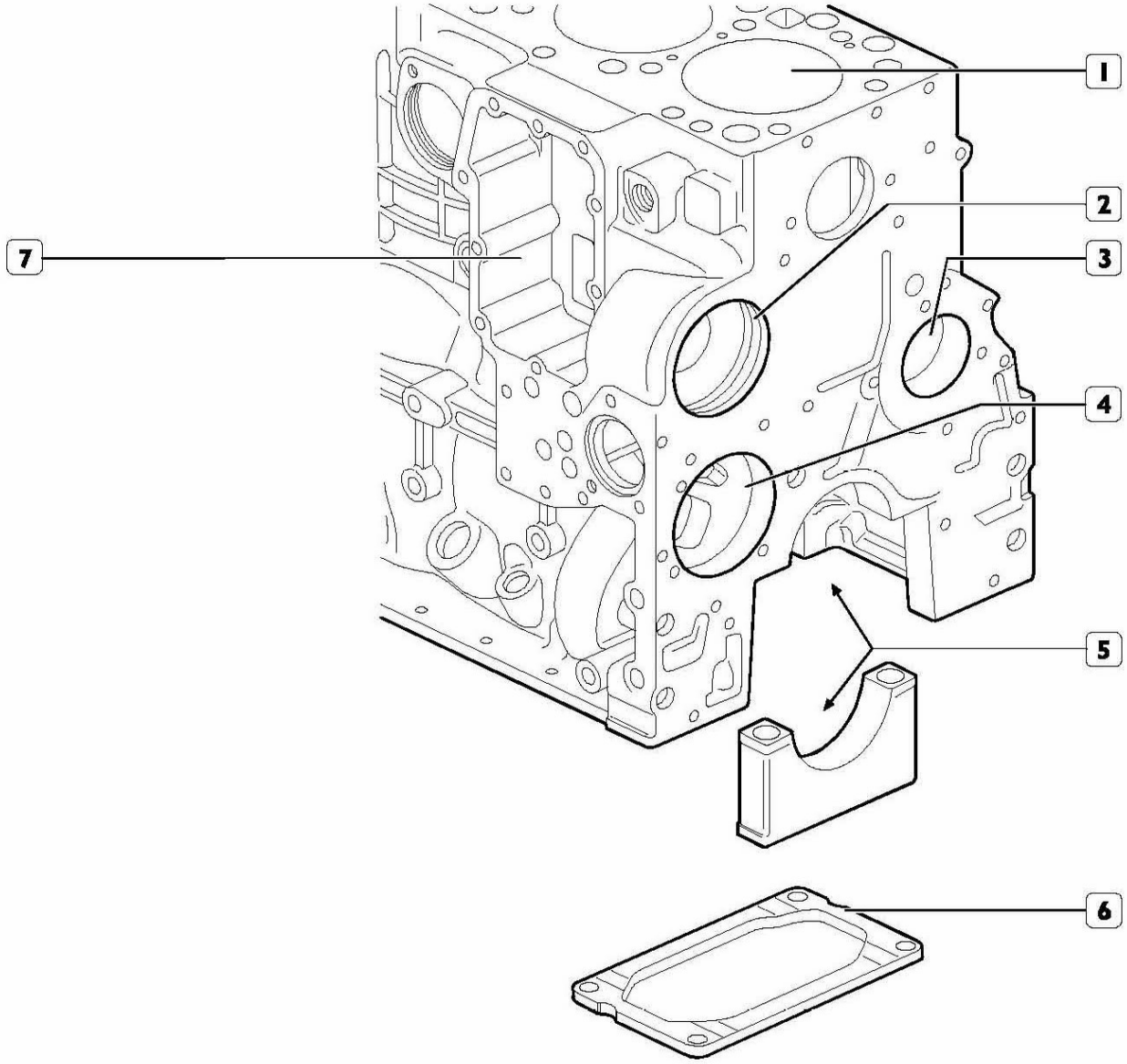
Crankcase

It consists of a cast-iron structure in which the following items are realized: cylinder liners (1); bed supports (5) and seats for: distributing shaft bushings (3), tappets, water/oil heat exchanger (7), water pump (2) and oil pump (4).

It also incorporates the coolant circulation chambers and the engine member lubricating circuit ducts.

Plate (6) is fitted to the lower part of the crankcase and ensures greater resistance to forces and stress.

Figure 5



86605

Drive shaft

It is made of steel and rests on seven induction-hardened supports.

Inside the drive shaft are the lubricating oil ducts.

The following items are force-fitted on the front shank: oil pump drive gear, phonic wheel, damper flywheel and auxiliary component drive pulley.

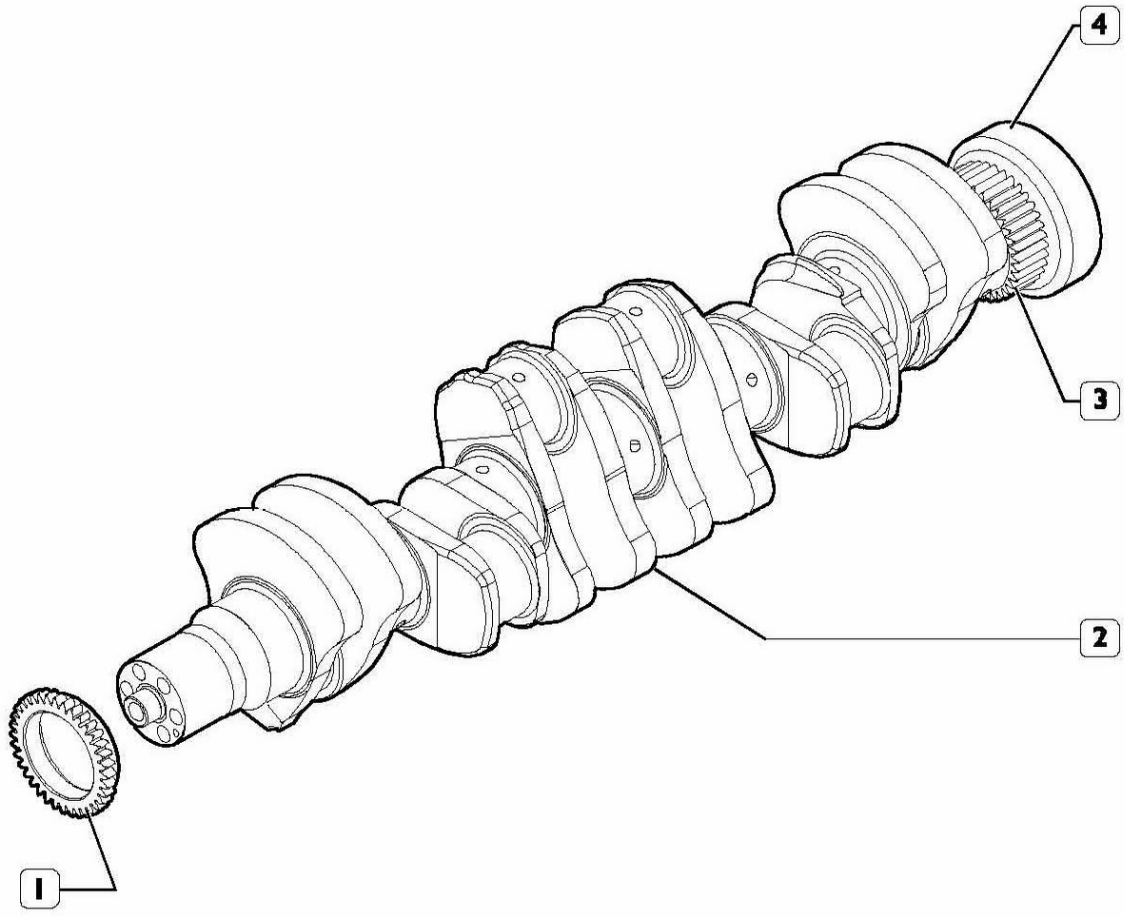
The following items are force-fitted on the rear shank: distributing shaft drive gear and engine flywheel mounting hub.

The main half bearings are made of steel with anti-friction alloy coating.

The penultimate main half bearings are equipped with a shoulder to restrain the drive shaft end play.

Parts (1) and (3) are mounted in an interfering manner on the rear shank and cannot be replaced.

Figure 6



1. Oil pump drive gear - 2. Drive shaft - 3. Valve gear drive gear - 4. Flywheel attachment hub

Drive shaft seal rings

The front and rear seal rings are of the "box" type, with radial seal.

Connecting rods

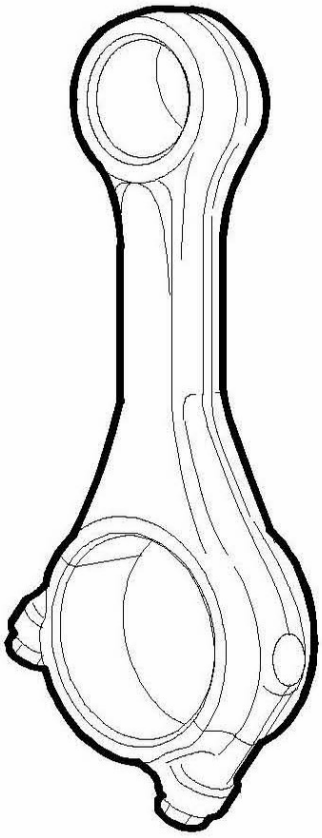
They are steel-stamped, of the oblique cut type, with separation of the cap obtained by an advanced technology (fracture split) instead of mechanic machining.

The connecting rod half bearings are made of steel, with anti-friction alloy coating.

Each connecting rod is marked:

- By a number (on the connecting rod body and cap) indicating its respective match and the cylinder in which it is mounted.
- By a letter (on the connecting rod body) indicating the weight class of the factory-assembled connecting rod.

Figure 7



84038

Pistons

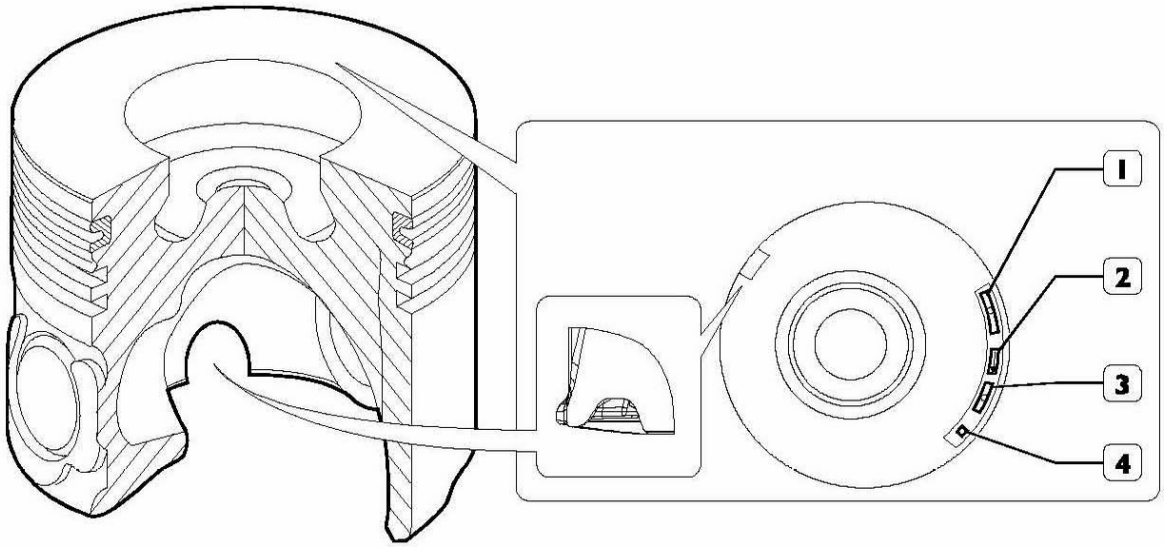
The combustion chamber is machined in the piston crown. The crown of the piston is cooled by the engine oil supplied by the sprayer.

There are three grooves that house the compression rings; the 1st of which is V shaped and is obtained using a cast iron insert.

The following references are engraved on the crown of the piston:

1. Spare part number and design change number.
2. Arrow indicating the assembly sign of the piston in the cylindrical liner; this must be facing towards the front side of the engine block.
3. Date of manufacture.
4. Stamp indicating testing of the 1st groove insert

Figure 8



86549

Distributing shaft

The distributing shaft rests on seven supports in the crankcase.

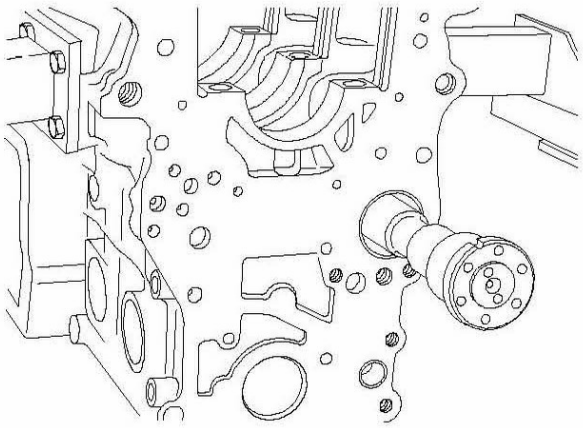
The supports (front and rear) are equipped with steel bushings mounted in an interfering manner and coated with anti-friction material; two control eccentrics are provided for each cylinder.

A. Intake valve control

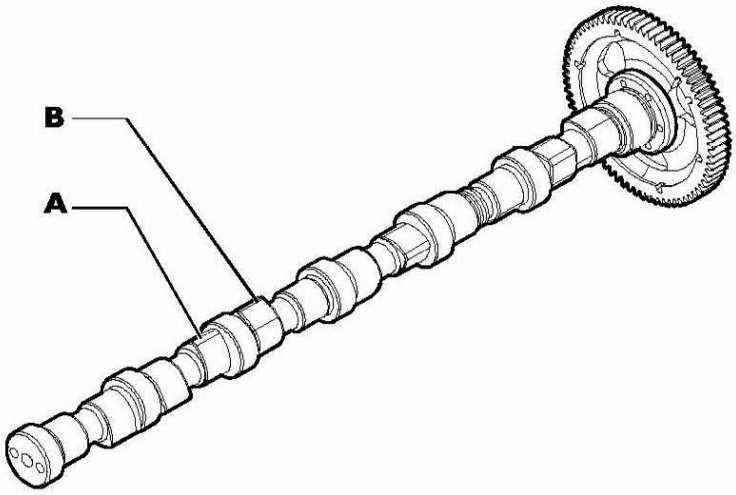
B. Exhaust valve control

The distributing shaft is controlled directly by the drive shaft by means of straight-tooth gears.

Figure 9



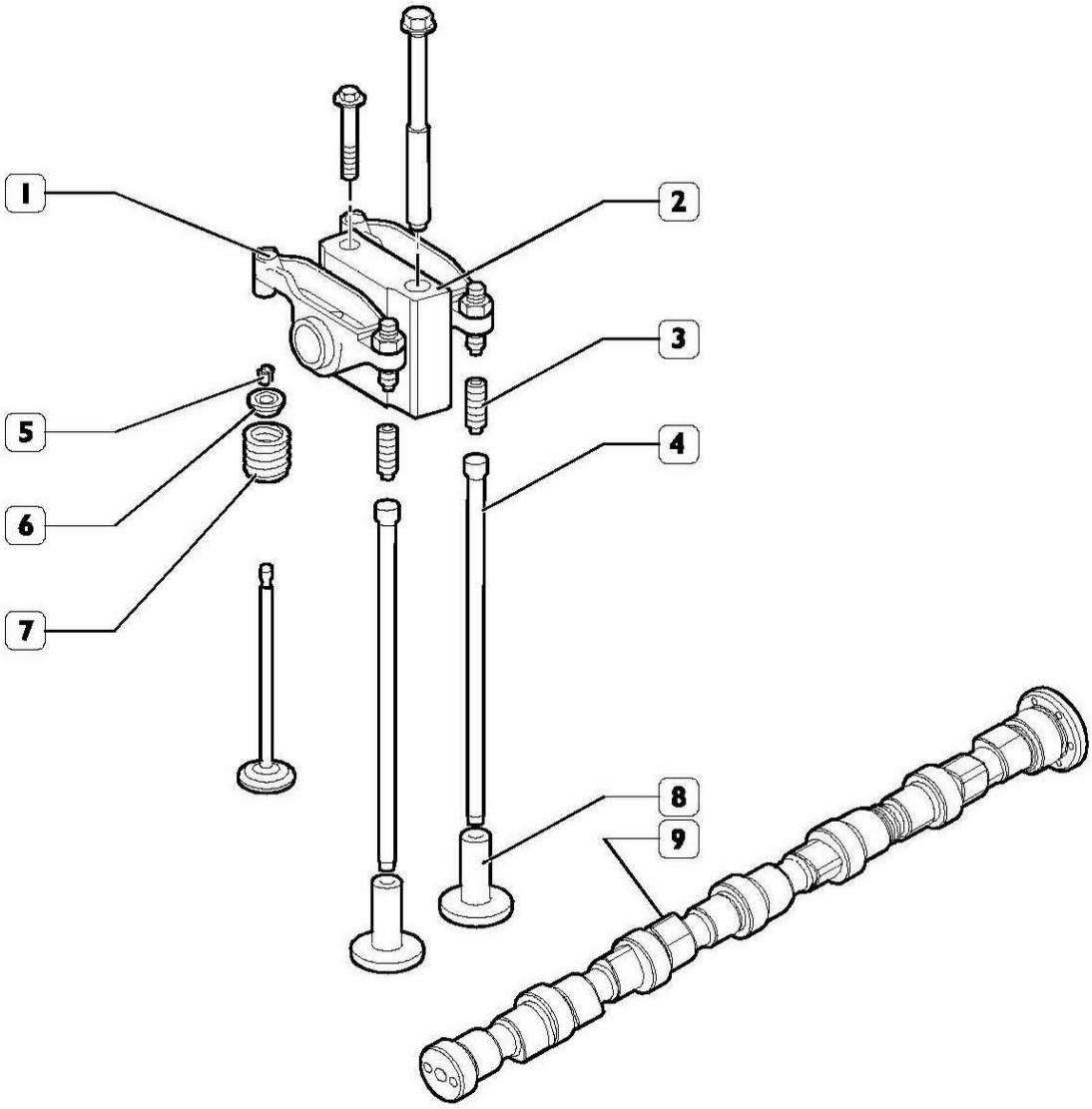
70164



84041

Engine F4GE0684F valve control

Figure 10

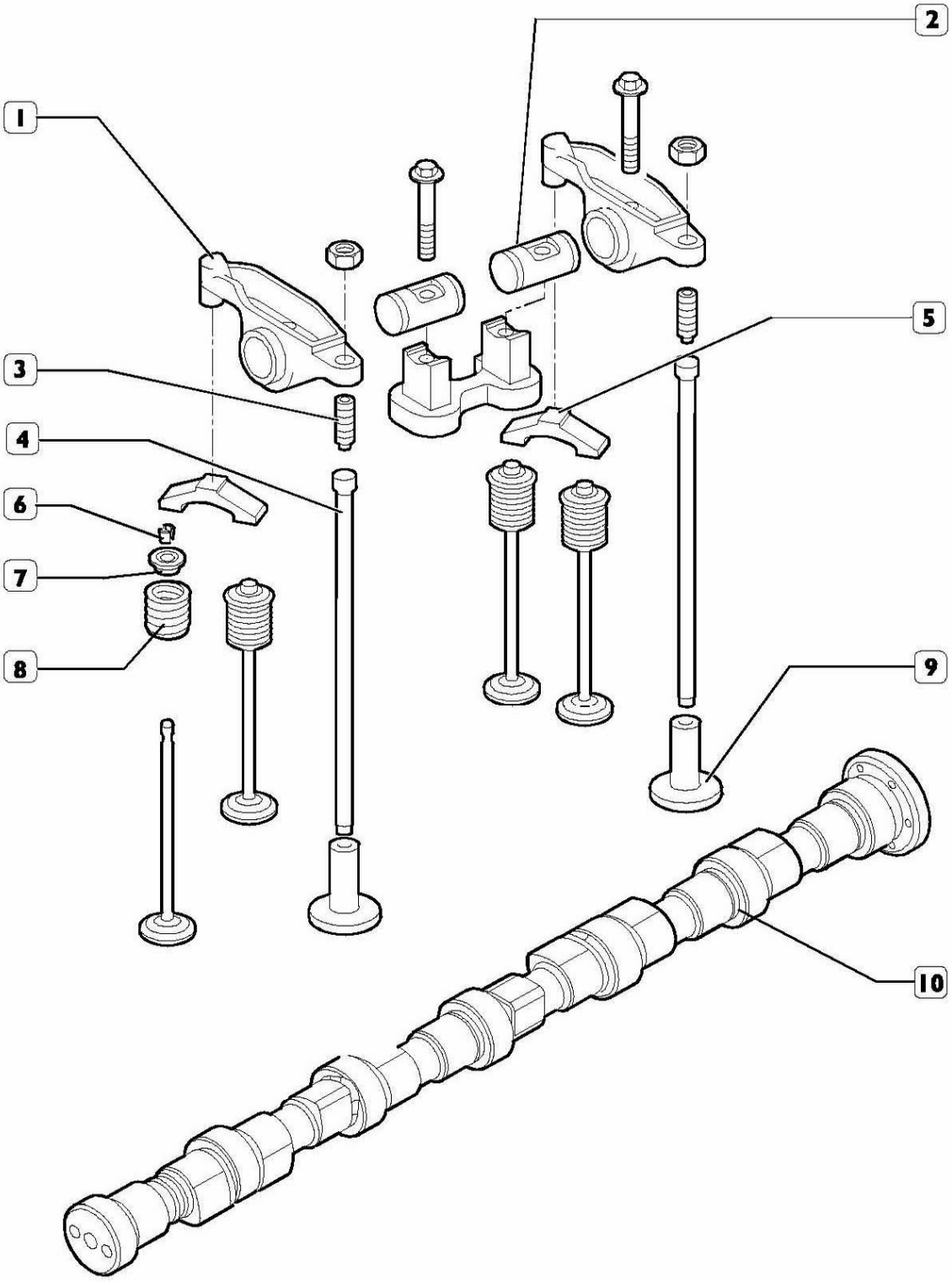


84042

1. Rocker arm – 2. Arbour support – 3. Adjusting screw – 4. Rod – 5. Lock cones – 6. Cup – 7. Spring – 8. Tappet – 9. Distributing shaft

Engine F4HE0684J valve control

Figure 11



1.Rocker arm – 2. Shaft – 3. Adjustment screw – 4. Rod – 5. Bridge – 6. Half-cones – 7. Retainer – 8. Spring – 9. Tappet – 10. Timing shaft

Engine F4GE0684F cylinder head

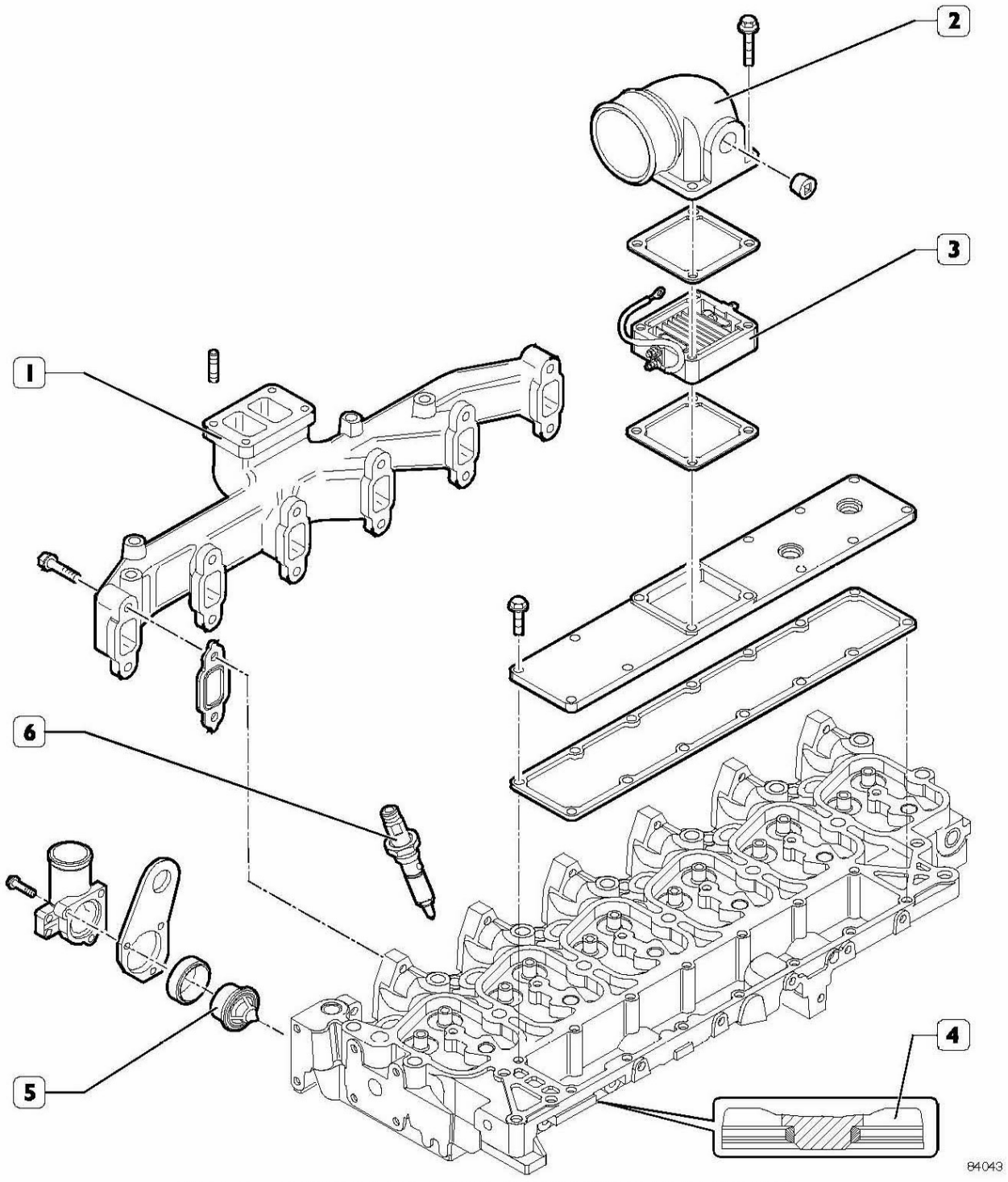
The seats of the following parts are obtained on the cast-iron cylinder head:

- ❑ inserted valve seats (4);
- ❑ injectors (6);
- ❑ thermostat (5);

Moreover, the following components are inserted on the heads:

- ❑ single-block exhaust manifold (1);
- ❑ intake manifold (2) with seat for cold start air heater (3).

Figure 12



DETAIL OF CYLINDER HEAD WITH INSERTED VALVE SEATS

Engine F4GE0684F cylinder head

The seats of the following parts are obtained on the cast-iron cylinder head (8):

- ❑ inserted valve seats (10);
- ❑ injectors (2);
- ❑ thermostat (4);

Moreover, the following components are inserted on the heads:

- ❑ exhaust manifold (1) in two parts;
- ❑ intake manifold (5) with seat for cold start air heater (6);
- ❑ support (7) with injector harness (3).

Figure 13