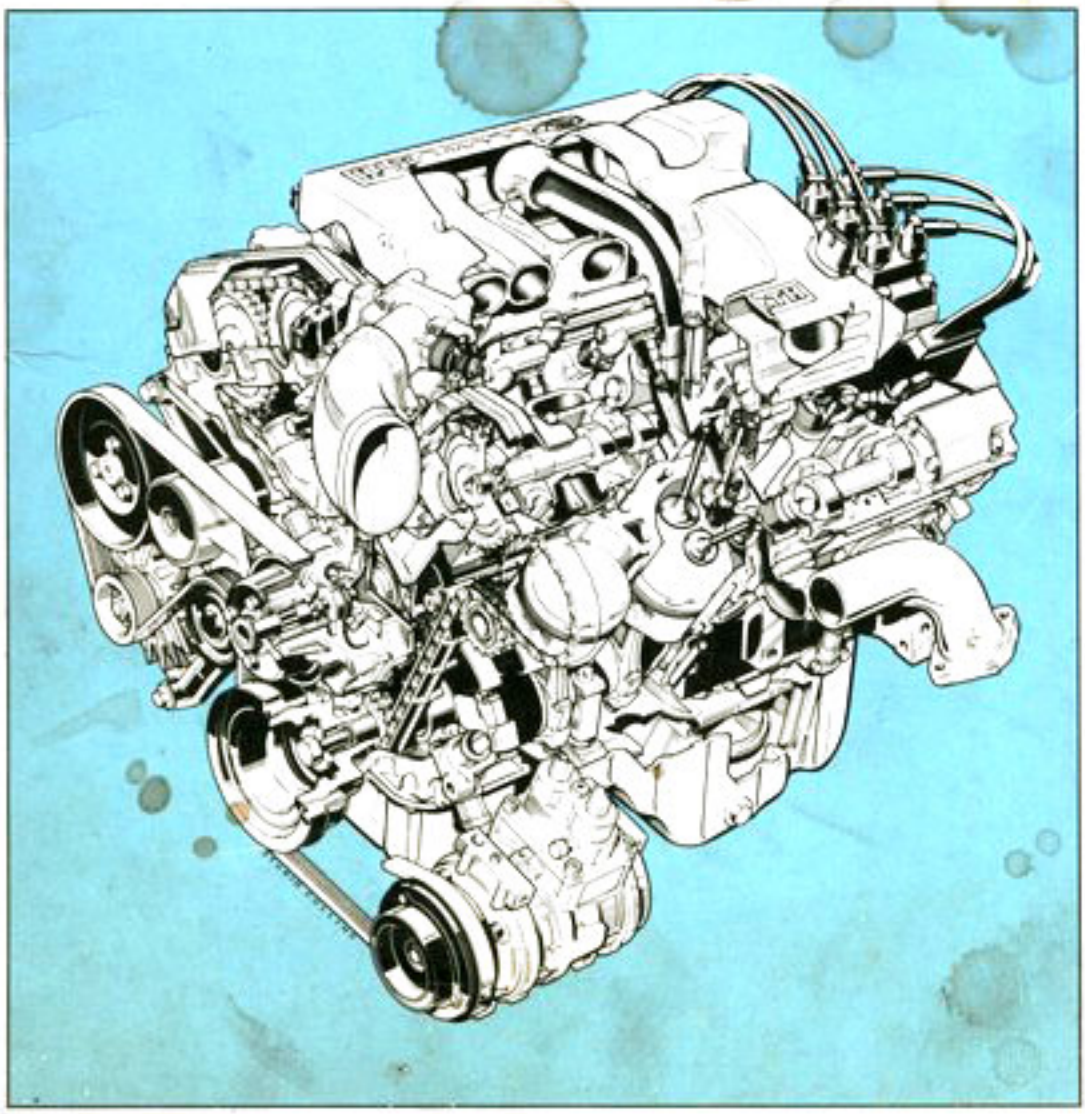
Technical Service Training

Technicians Information

CG 7349 GB 11/90

Scorpio with V6 24V Cosworth Engine



Ford

Service

The new 2.9 l V6 24V Cosworth engine is equipped with EEC IV engine management, E-DIS ignition system, EFI electronic fuel injection system, evaporative emission control (EVAP), exhaust gas recirculation (EGR) and catalytic converters to comply with the 83 US Emission Regulation.

This engine is installed in the Scorpio in conjunction with the partial electronic A4LD automatic transmission, which has also been subject to certain alterations, because of the increased power developed by the Cosworth engine.

This brochure covers in the main all innovations and modifications incorporated into the 2.9 l V6 Cosworth engine, but also summarises improvements made to the A4LD partial electronic automatic transmission and to affected Scorpio vehicles.

The colours featured in the illustrations indicate the scope of modification having been carried out and have the following significance:

- New
- Modified
- Unchanged

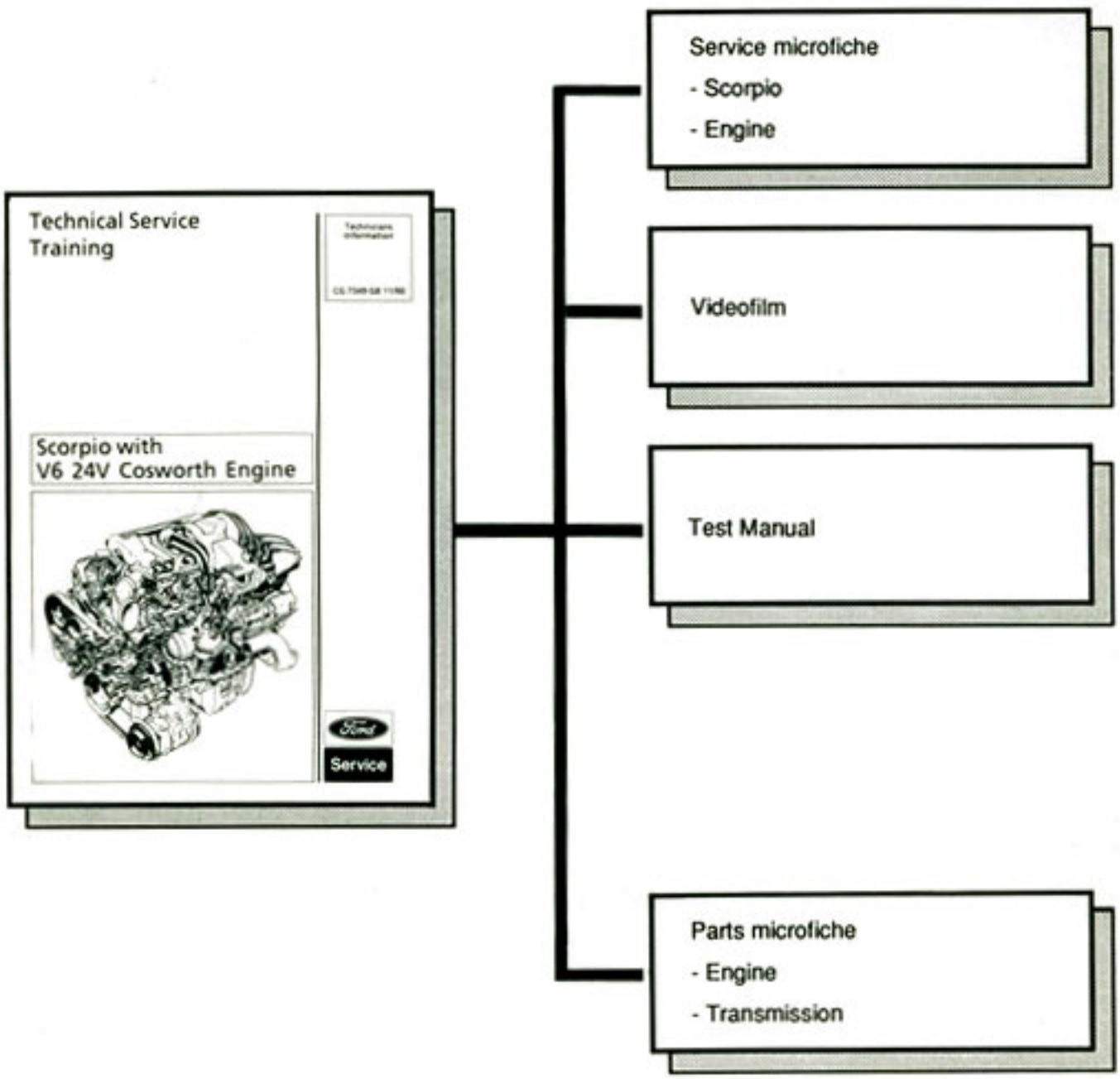
Note: The parts shown in yellow or green on the 2.9 l V6 24V Cosworth engine are modified or adopted parts from the 2.9 l V6 engine.

Please remember that our "Technicians Product Training" brochures are designed for introductory training only.

Repair and adjustment operations should always be carried out according to instructions and specifications in the workshop literature, which is regularly updated.

Contents

Literature Survey



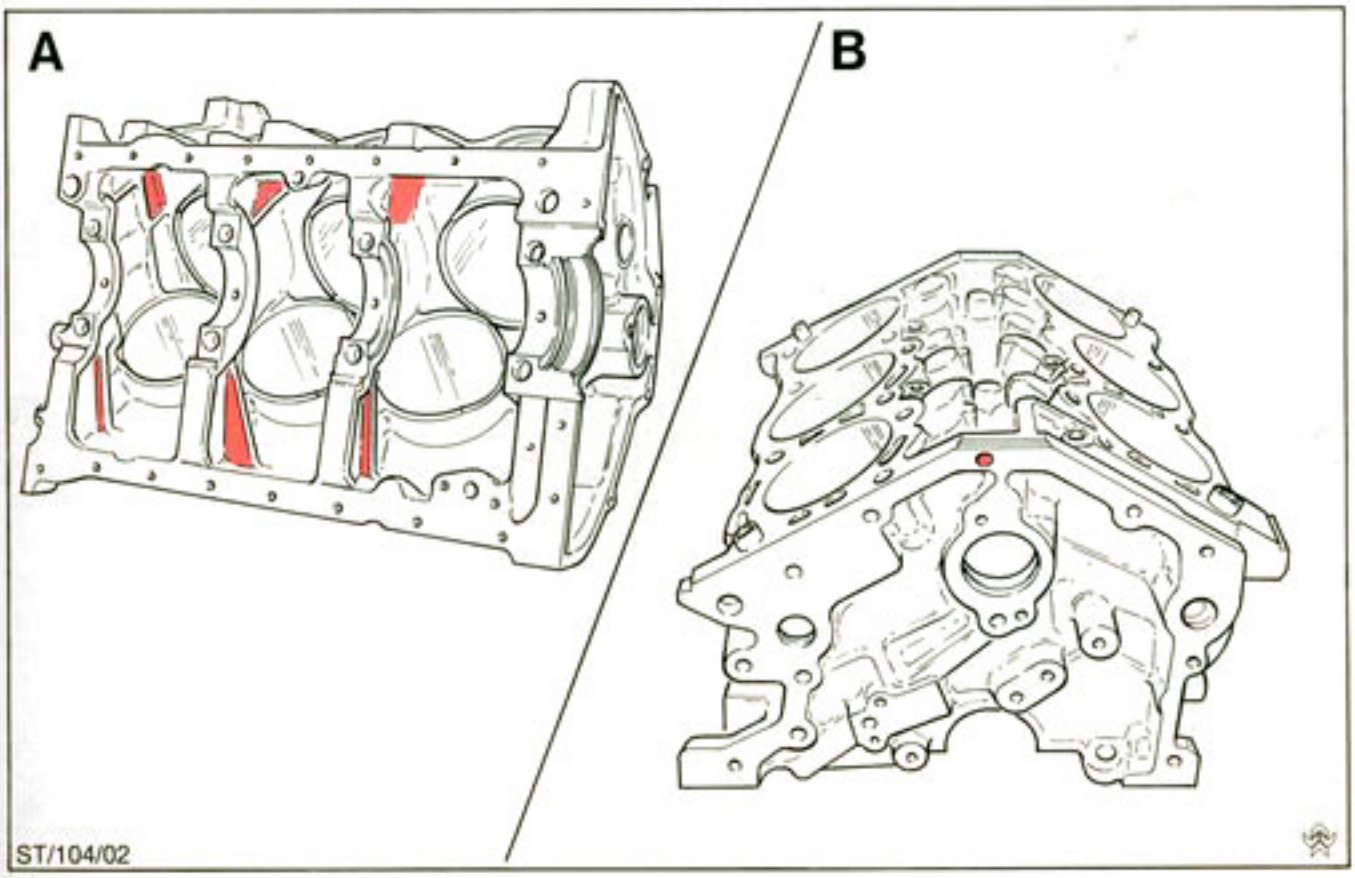
Summary:

- Modified crankcase
- Modified crankshaft
- New pistons and piston pins
- New jackshaft for driving the oil pump
- New oil pump drive and oil circuit
- New front cover
- New crankshaft pulley
- New poly-V-belt for auxiliaries
- New exhaust manifolds and gaskets

Modifications in detail:

Crankcase

- Due to the higher performance developed by the engine, the main bearings in the crankcase housing have been reinforced.
- Additional hole on crankcase flange for mounting the front cover.



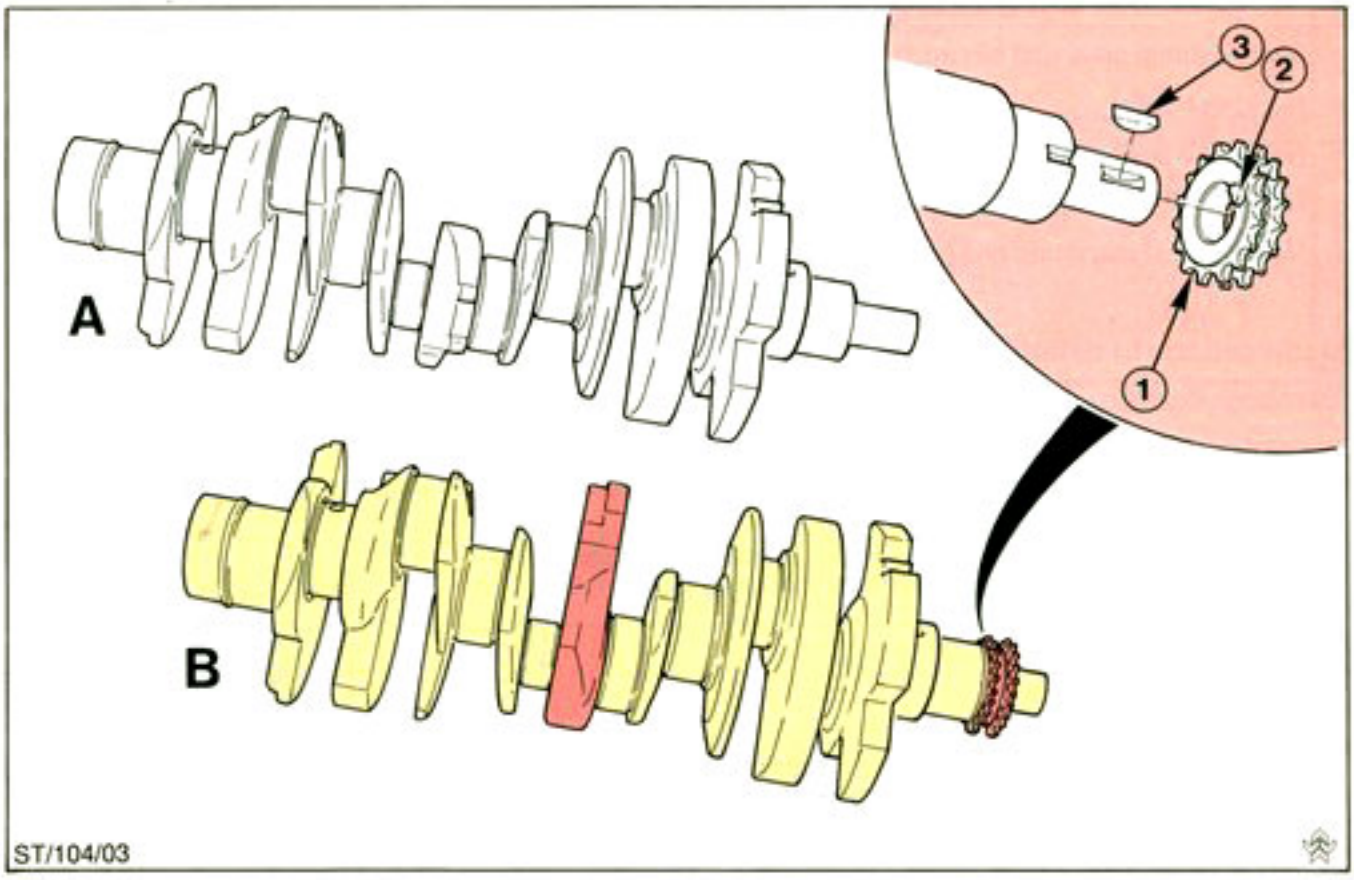
A Reinforcements in crankcase

B Additional hole for new front cover

New

Crankshaft

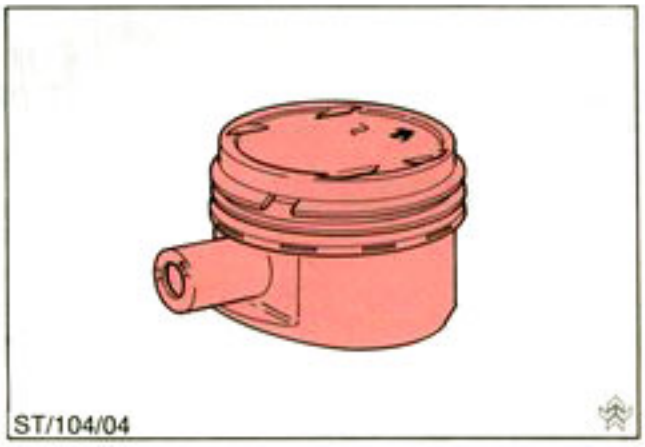
- New crankshaft with modified counterweight (centre) and a double sprocket to drive the duplex (double row) timing chain.
- The double sprocket is located onto the crankshaft by a pin and fixed in position by a woodruff key.



A Crankshaft - 2.9 l V6 engine
1 Double sprocket
2 Sprocket alignment pin
B Crankshaft - 2.9 l V6 24V engine
3 Woodruff key

Pistons

- New graphite-coated pistons with 4 valve pockets, "Front" marking and piston size classifications are exhibited on the piston crowns.
- New shorter piston pins.
- New piston rings.

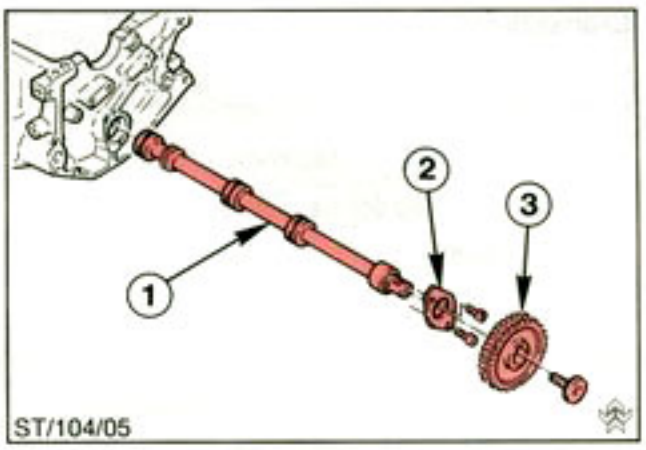


Pistons featured in the 2.9 l V6 24V engine

New Modified

Jackshaft

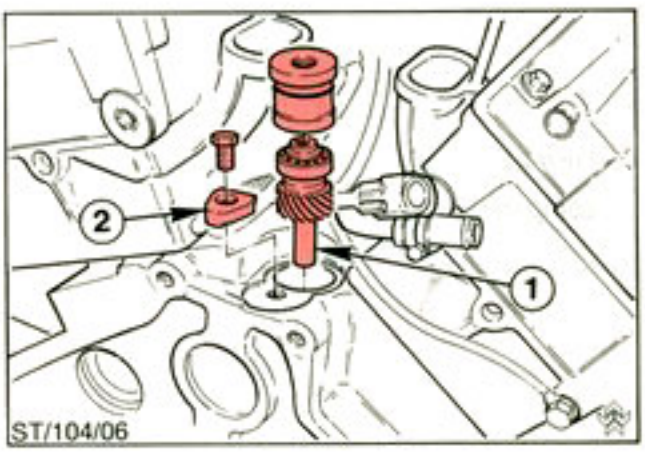
- The jackshaft which drives the oil pump is mounted in the camshaft bore of the engine crankcase.
- A double sprocket is mounted with a torx screw to the front end of the shaft.
- A helical spline is located at the rear end.



1 Jackshaft
2 Retaining plate
3 Double sprocket

Oil Pump Drive

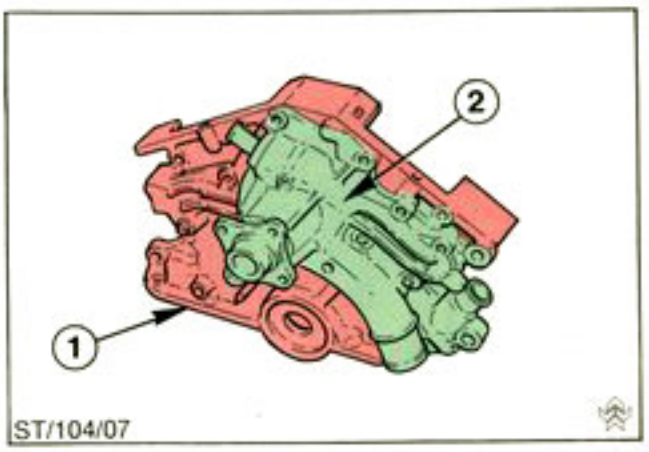
- The new oil pump drive is mounted in the distributor bore of the crankcase.
  This is possible since a distributor is no longer installed, due to the E-DIS system being employed.



1 Oil pump drive
2 Retaining plate

Front Cover

- The front cover is completely new to incorporate the new duplex timing chain.



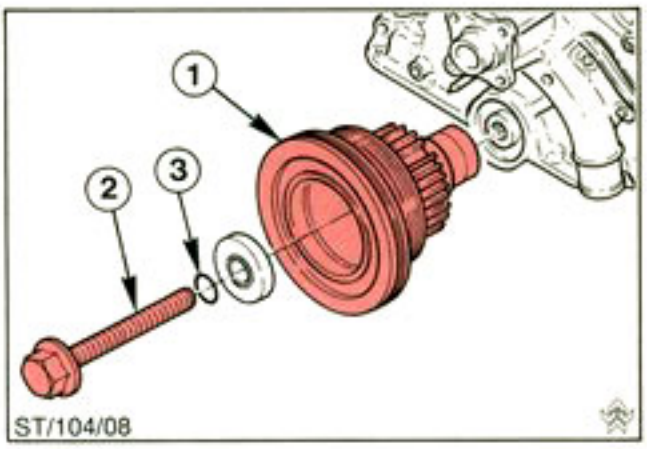
1 Front cover
2 Water pump

New Unchanged

Crankshaft Pulley

- The 36-1 tooth pattern system incorporated for the crankshaft position/speed sensor (CPS) is located on the crankshaft damper/pulley.

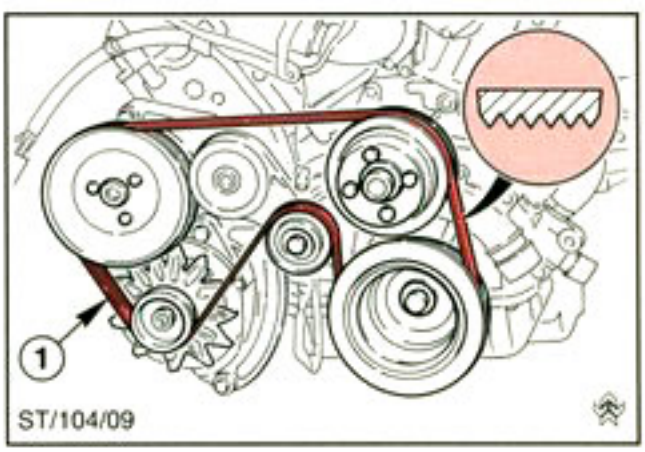
Note: Coat the spacer surface showing to the crankshaft pulley with an sealing compound before fitting.
The damper/pulley bolt may only be used once. Make sure that the new bolt is fitted with an O-ring.



1 Crankshaft pulley 3 O-Ring
2 Pulley bolt

Poly-V-Belt

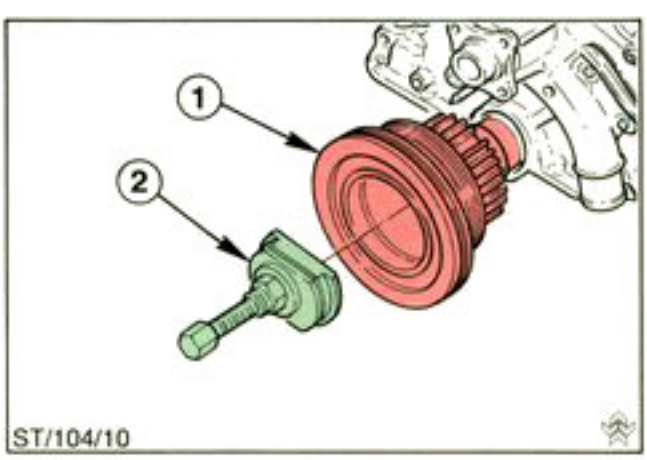
- New poly-V-belt to drive the ancillary components.



1 Poly-V-belt driving ancillary components

Special Notes on Disassembly

- Remove the crankshaft damper/pulley with special tool 21-147.

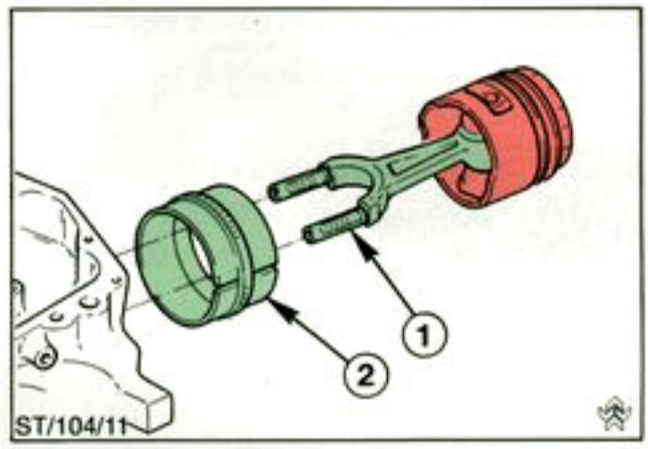


1 Crankshaft damper/pulley
2 Special tool 21-147

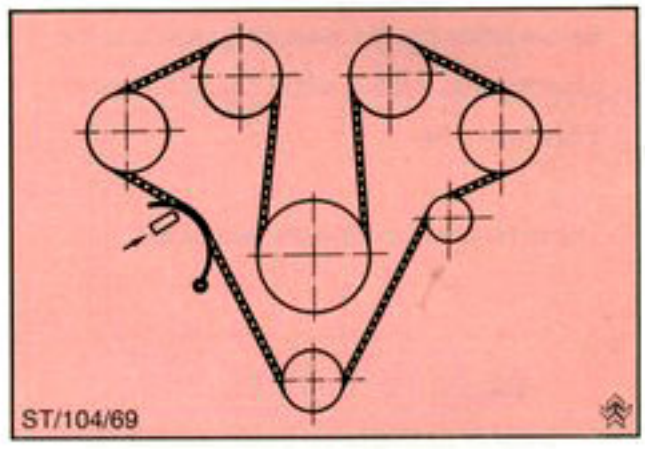
New Unchanged

Special Notes on Assembly:

- When inserting the pistons with connecting rods, fit piston ring clamp, and cover threads of connecting rod stud bolts with suitable plastic tubes in order to avoid damage to the crankshaft.
  The big-end bearing caps are numbered.

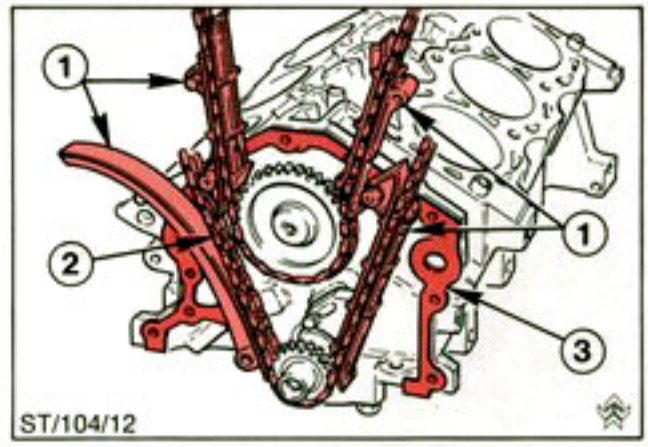


1 Plastic tube
2 Piston ring clamp



Position of the duplex timing chain

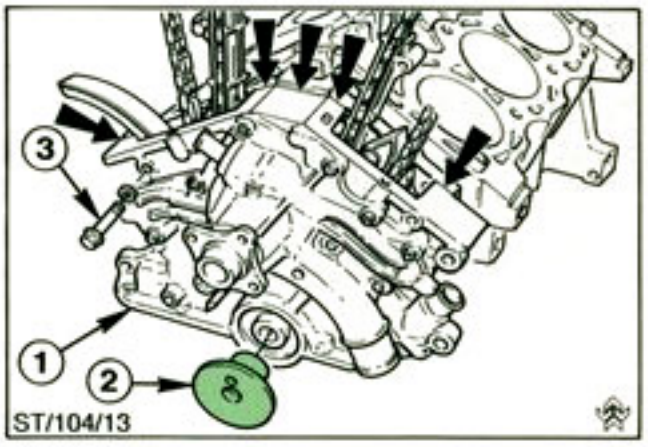
- Before fitting the front cover and gasket, secure the chain guides and fit the duplex timing chain.
- Ensure gasket is not trapped by chain guide bolts.



1 Chain guide
2 Duplex chain
3 Front cover gasket

- Centre the front cover with special tool 21-137 and align on crankcase.

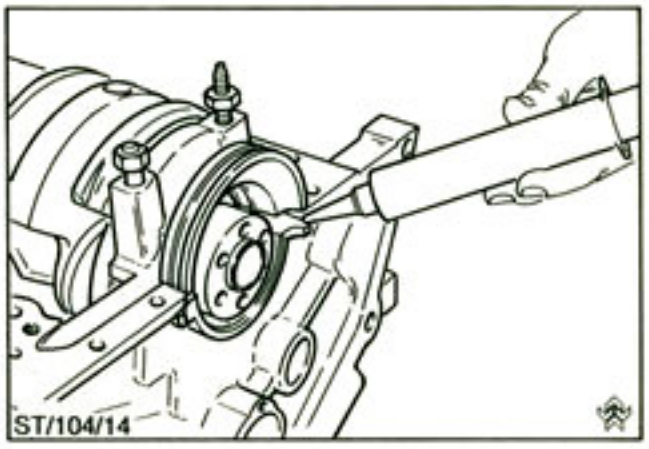
Note: Fit bolt with dowty washer as seen on figure opposite.



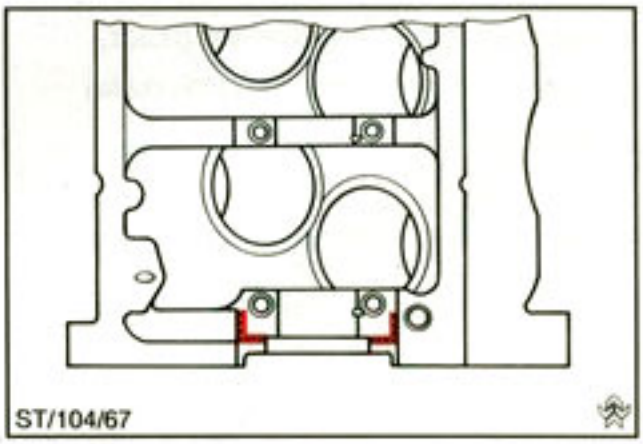
1 Front cover
2 Special tool 21-137
3 Bolt with dowty washer

- Before fitting the No. 4 bearing cap, coat the block sealing surface with *LOCTITE Gasket Eliminator 518*.

- The main bearing caps are numbered.



Coat sealing surfaces with sealing compound



Location of the sealing compound on the cylinder block

Summary:

- New sump
- Additional adapter for oil filter

Modifications in detail:

Oil pump

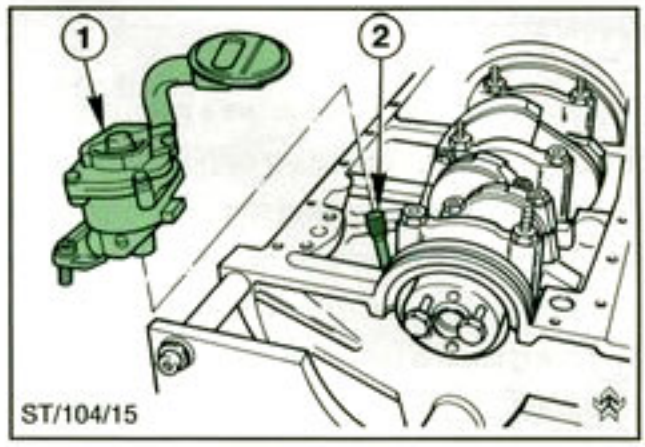
- Carry-over oil pump, runs 9 % faster than on pushrod engine.

- Oil pump drive shaft adopted from 2.9 l V6 engine.

Sump

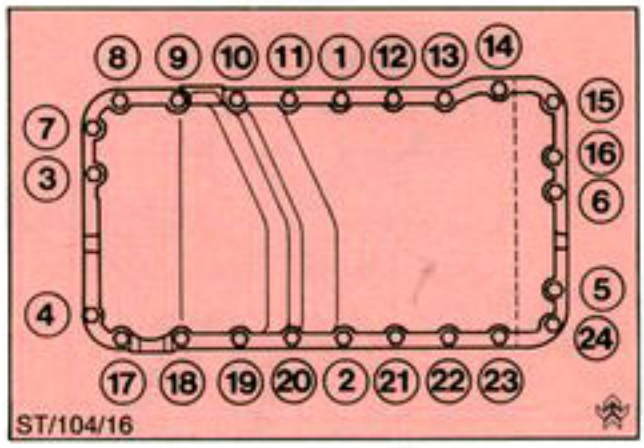
- Cast aluminuim with new gaskets.

Note: New tightening sequence for sump retaining bolts.



1 Oil pump

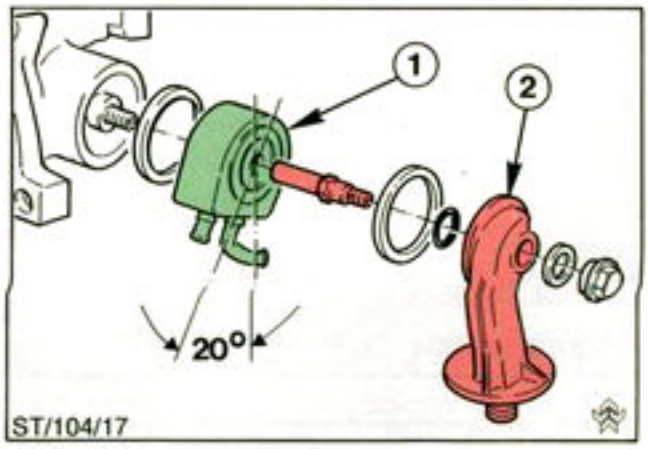
2 Oil pump drive shaft



Tightening sequence of sump retaining bolts

Adapter for Oil Filter

- Due to the restriction of space in the engine compartment the oil filter is secured by means of an adapter to the oil cooler assembly.



1 Oil cooler

2 Adapter

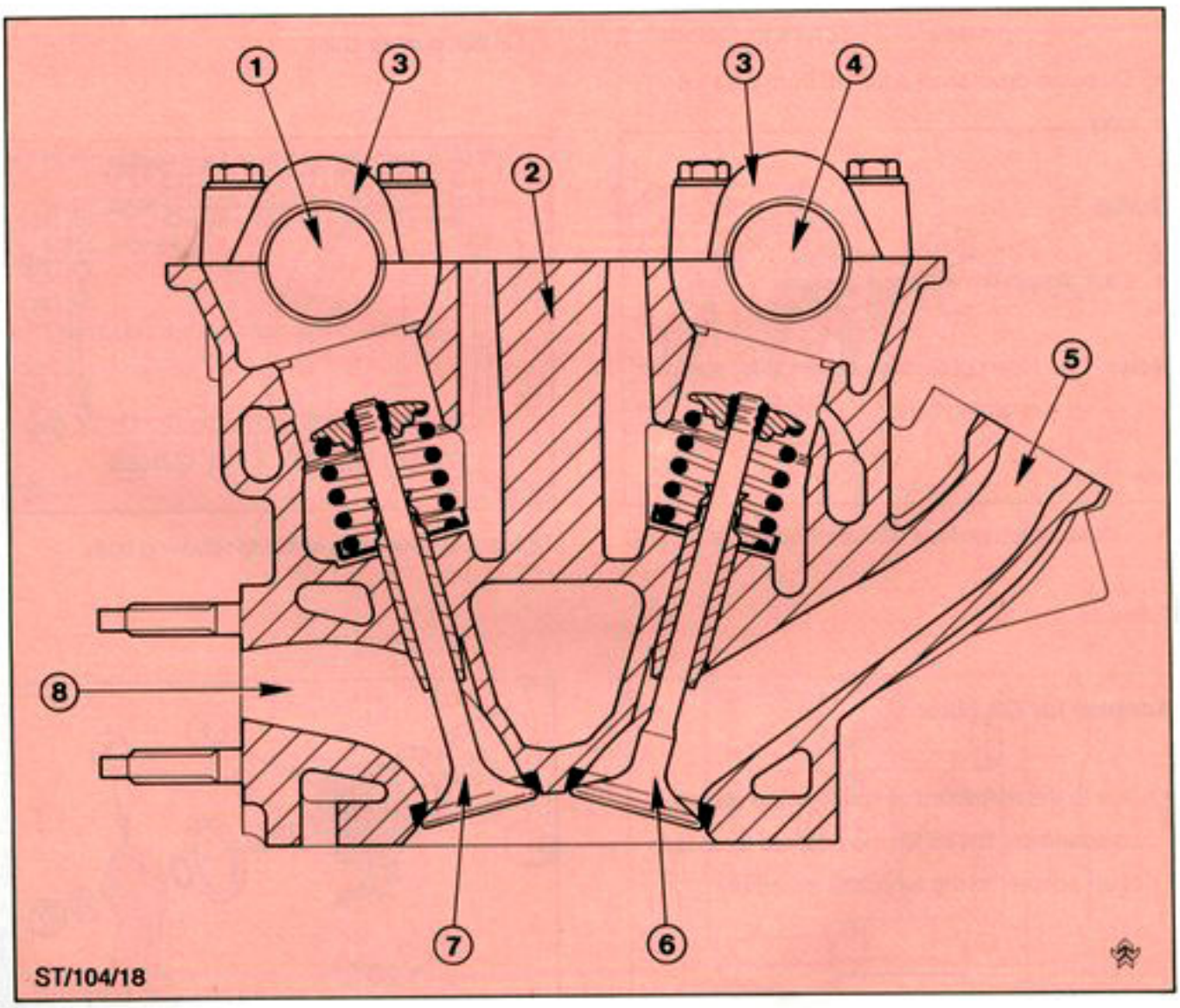
New Unchanged

General

The aluminium cylinder heads are a new concept.

They are based on 4-valve per cylinder technology, each cylinder head accommodates two camshafts and 12 valves with the associated springs and hydraulic tappets. The hydraulic tappets are identical in shape and design and eliminate the need for valve clearance adjustment.

The camshafts are driven by a 2.2 m duplex timing chain. Double sprockets are featured on each camshaft. The timing chain is tensioned in the right-hand cylinder head by means of a hydraulic self-adjusting chain tensioner.

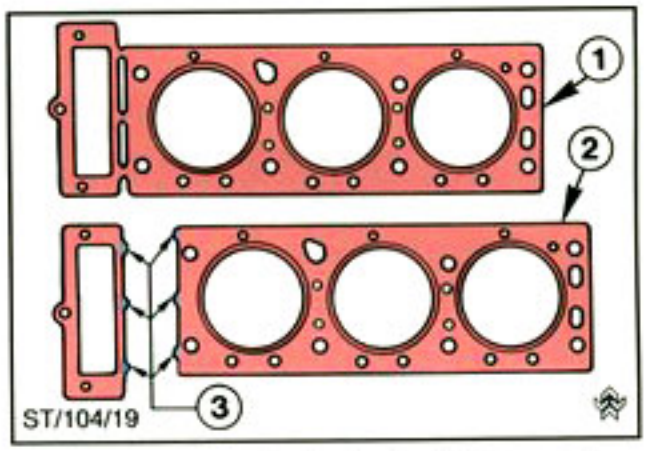


1 Exhaust camshaft
2 Cylinder head
3 Camshaft bearing cap
4 Inlet camshaft
5 Inlet port
6 Inlet valve
7 Exhaust valve
8 Exhaust port

New

Cylinder Head Gaskets

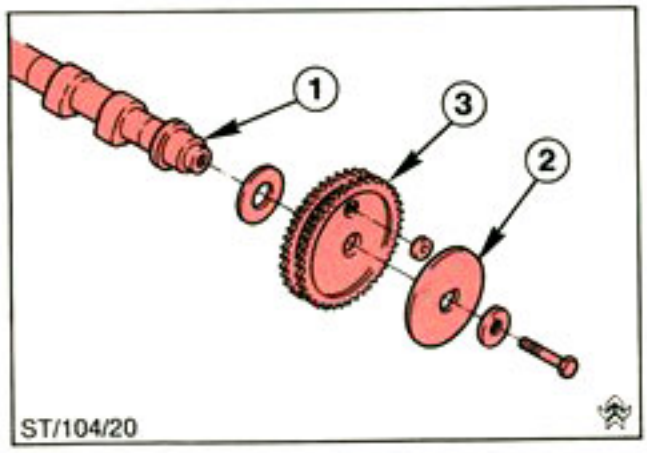
- The cylinder head gaskets are also new.
- The gasket of the left-hand cylinder head is only available as a one piece service part and must be cut through before fitting.
- After cutting trim the edges to eliminate damage to the water hose (see fig.).



1 Gasket of left-hand cylinder head before cutting
2 Gasket of left-hand cylinder head after cutting
3 Edges

Camshafts

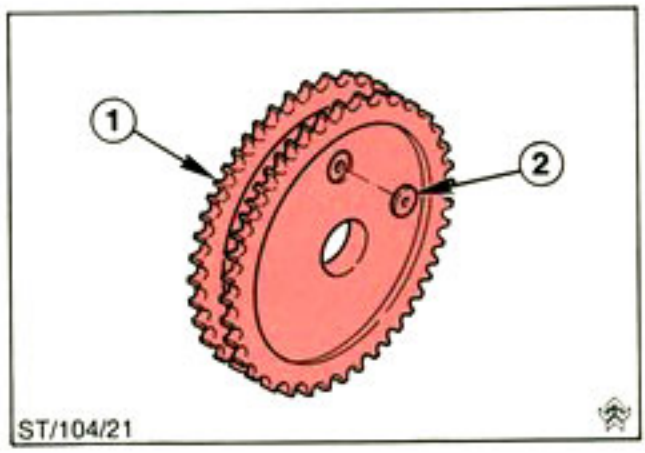
- Camshafts fitted to the left-hand cylinder head are longer than those in the right-hand cylinder head. However, each pair of camshafts is identical.
- Valve timing is set with the aid of marked discs (see Page 16).
- Take care to ensure camshafts, sprockets and marked discs are kept as matched set.



1 Camshaft
2 Marked disc
3 Camshaft sprocket

Camshaft Sprockets

- New camshaft sprockets matching the duplex timing chain with fitted hard plates for locating the marked discs.



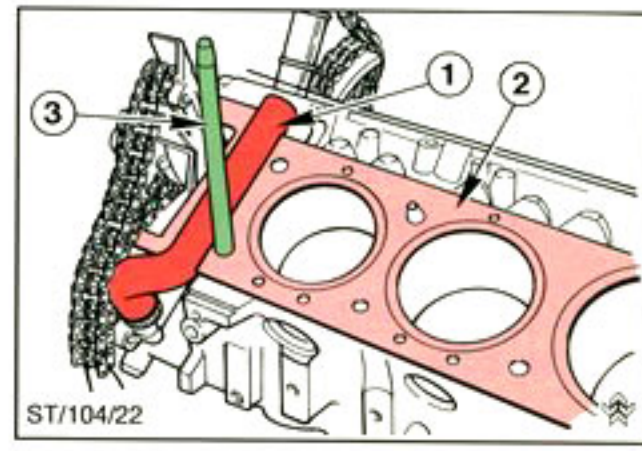
1 Camshaft sprocket
2 Hard plates

New

Fitting the cylinder heads

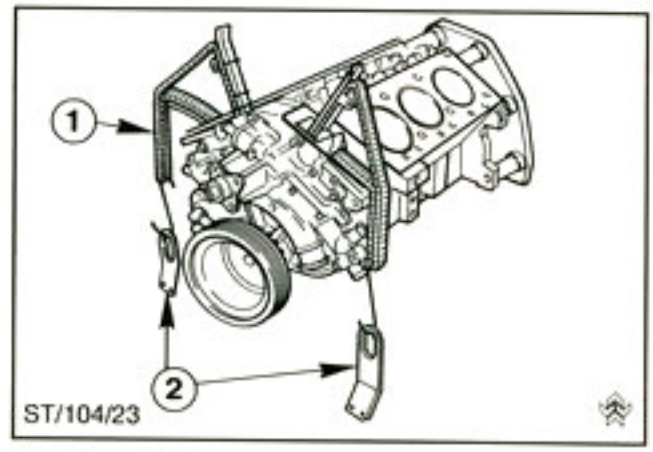
- Before fitting the cylinder heads, attach thermostat housing to cylinder head and secure the cooling hose leading from the water pump to the thermostat housing at the water pump end, with a hose clip. Fit both cylinder head gaskets, the cylinder head guides and screw in special tool 21-128.
- Both gaskets have a "Top" and "Front" indicated on them.

Note: Only use new gaskets.



1 Cooling hose 3 Cylinder head guide
2 Cylinder head gasket

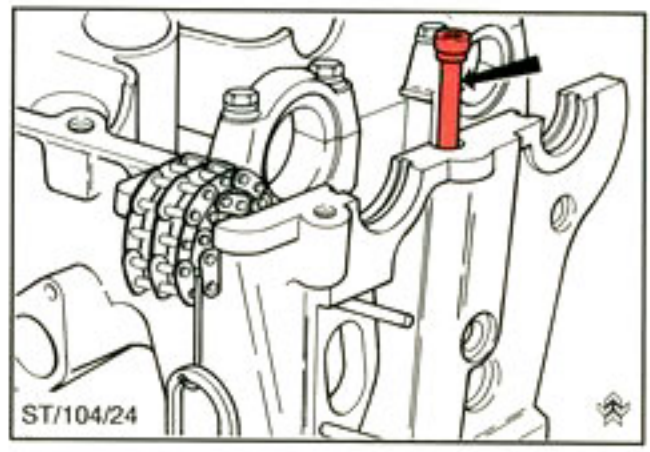
- During all operations keep timing chain under tension to prevent it from disengaging from the crankshaft sprocket. Attaching a weight on both sides ensure this.
- Feed the timing chain through the chain channel before fitting the cylinder head. Fit LH head first.



1 Timing chain
2 Weight

- Fit eight cylinder head bolts per cylinder head and the additional bolt at the front of each cylinder head to provide a secure connection with the front cover.

Note: Only use new cylinder head bolts.

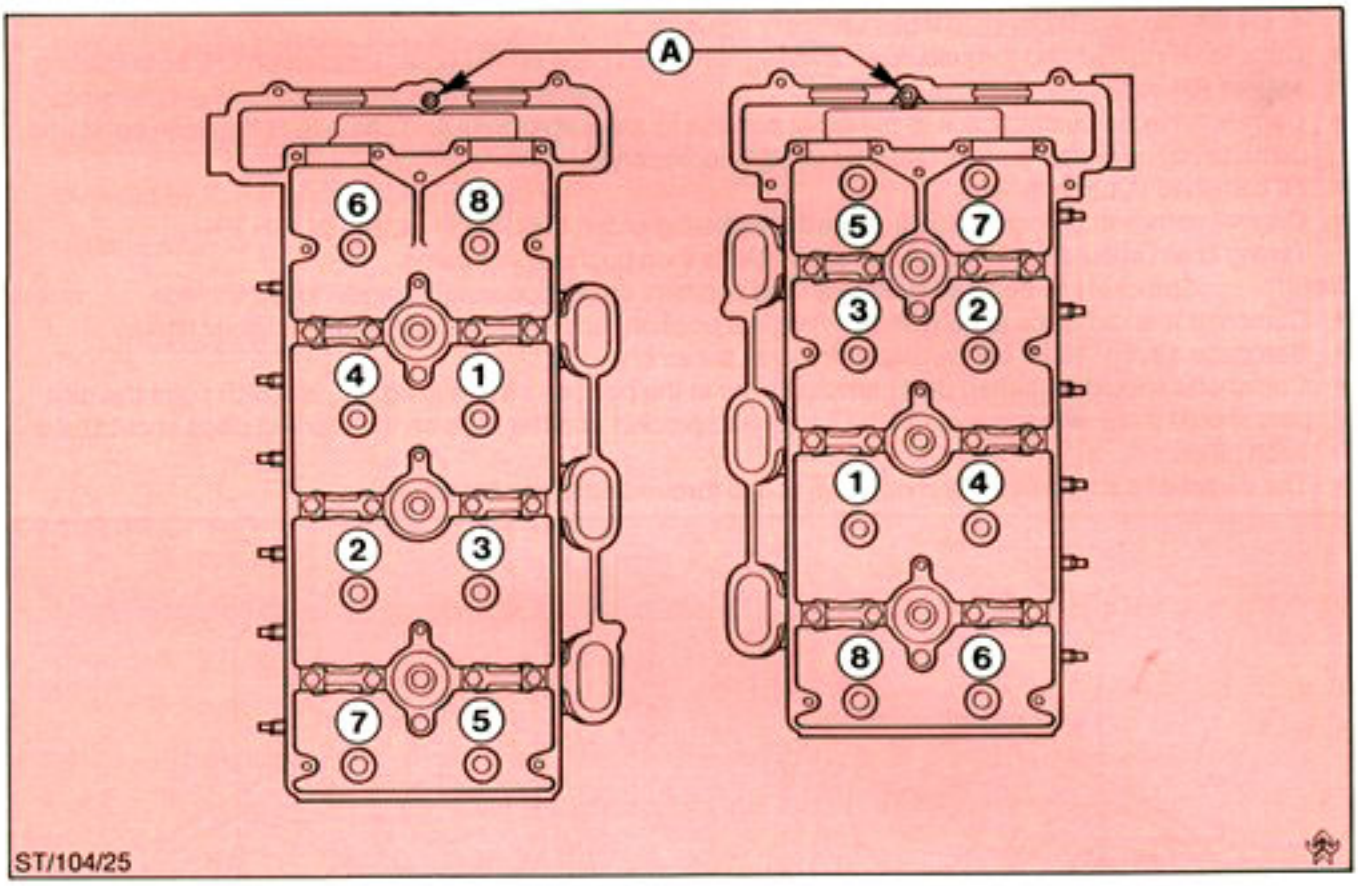


Fitting bolt at front of cylinder head

New Unchanged

- Tighten cylinder head bolts in two stages in the specified sequence.
  First stage torque to 45 - 55 Nm Second stage turn by 180°

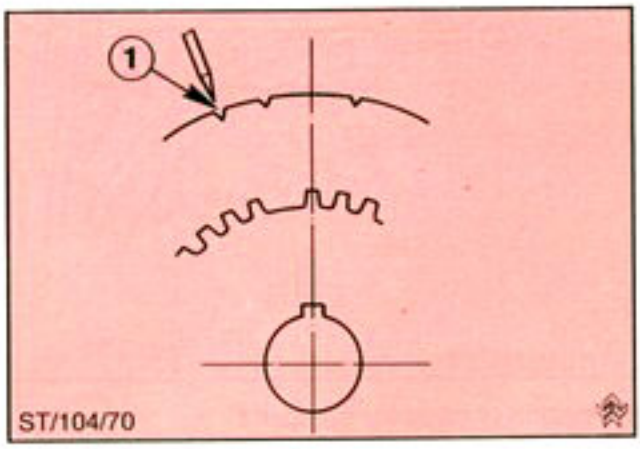
- After tightening the cylinder head bolts to the specification and procedure above, tighten the bolts "A" at the front of the cylinder heads to 17 - 21 Nm.



Tightening sequence - Cylinder head bolts; A Bolts at front of cylinder heads

TDC setting

- TDC of cylinder No. 1 is marked at the crankshaft pulley/damper.



1 TDC of cylinder No. 1

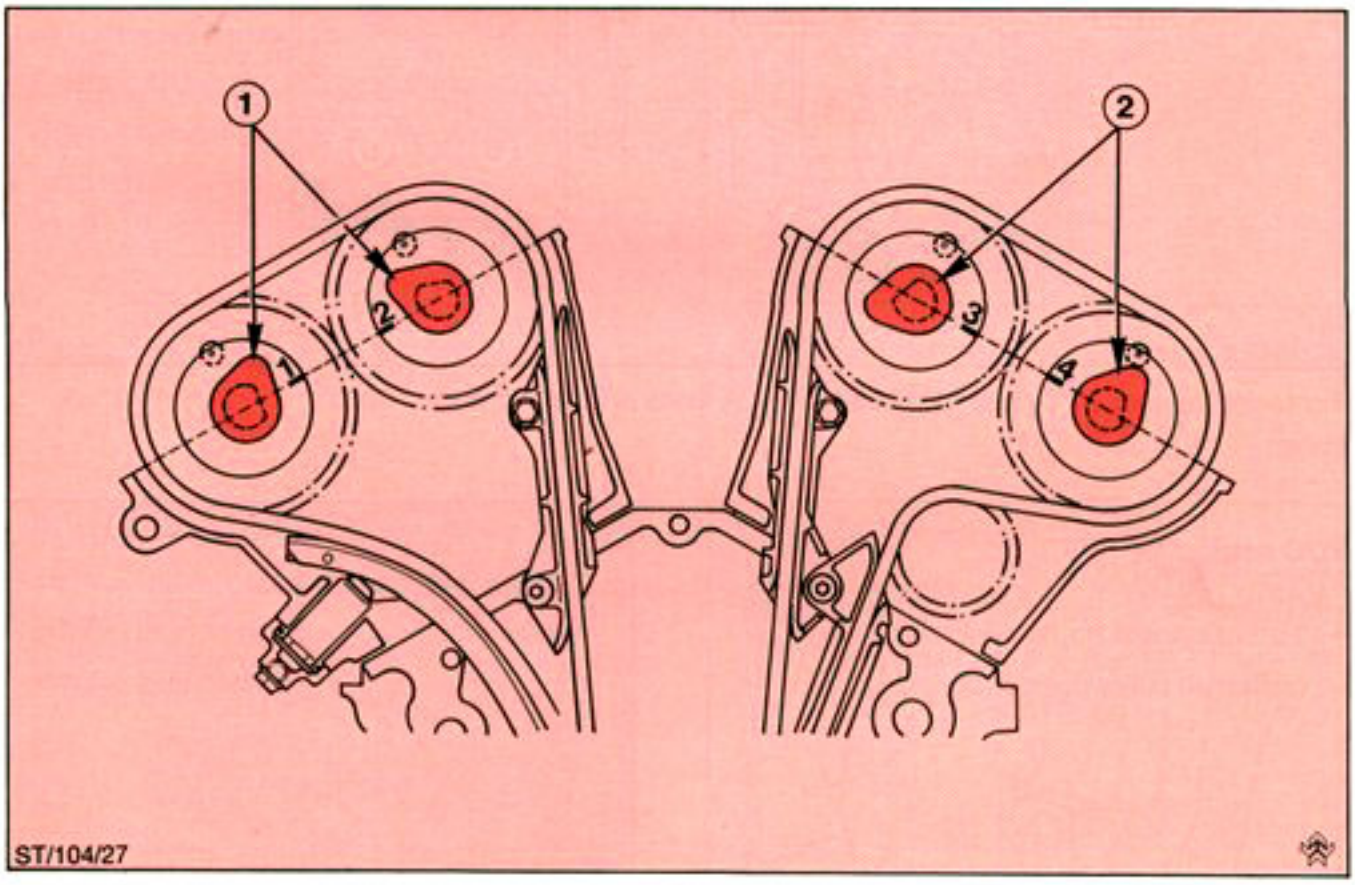
New

Setting the Valve Timing

- Cylinder No. 1 to be at TDC in order to set the timing.
- Camshafts should be refitted inlet to inlet, exhaust to exhaust with lobes positioned as below. This being the relaxed position.
  1 RH EX No. 1 cylinder cam lobes vertically upwards
  2 RH IN No. 3 cylinder cam lobes vertically upwards
  3 LH IN No. 6 cylinder cam lobes vertically upwards
  4 LH EX No. 4 cylinder cam lobes vertically upwards
- Caps to be refitted and torqued down evenly (numbered caps on RH bank, lettered on LH, both starting at front RH cap).
- Camshafts to be pushed back to rearmost position to allow sprockets and chain to fit between head and camshaft nose (a soft hammer may be used if necessary).
- Fit camshaft thrust washers.
- Original camshaft sprockets to be refitted in following order: LH EX, LH IN, RH IN, RH EX.
  Timing chain should be wrapped round sprockets then pushed onto cams.

Note: Sprockets to be fitted such that hard washers are at upper right angles to the fireface.

- Camshaft marked discs to be refitted in original position, and washer and fixing bolt lightly fitted.
- See page 13, fig. 20 for full camshaft/sprocket assembly.
- Camshafts should be turned until camshafts are in the position shown in fig. 27, at which point the disc pins should mate with the holes in the camshaft sprocket and the lines on the marked discs should face each other.
- The camshafts sprocket bolts should then be to torqued up to the correct value.



1 Position of cams for cylinder 1

2 Position of cams for cylinder 4

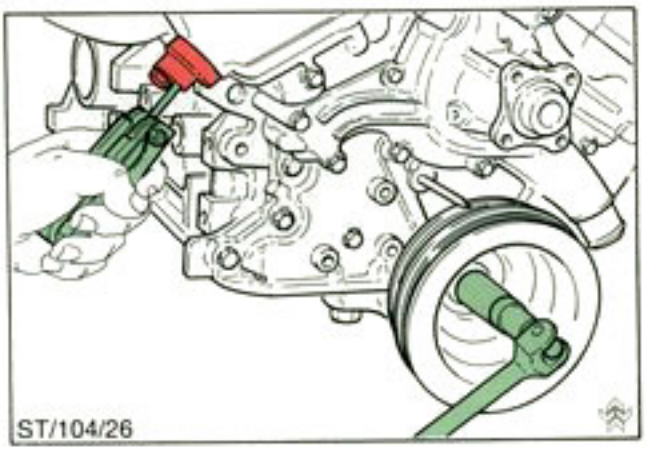
NOTE: Please refer to the service microfiche (Section 21) for further details on adjustment of valve timing.

New

Timing Chain Tensioner

- After fitting the duplex timing chain onto the camshaft sprockets, the new hydraulic self-adjusting timing chain tensioner should be installed.
- It must be locked prior to installation by compressing the component together while screwing clockwise. When installed, it may be released by turning anti-clockwise (use a suitable Allan key).

Note: The timing chain tensioner must be locked before removal.



Releasing the installed timing chain tensioner

Camshaft Covers

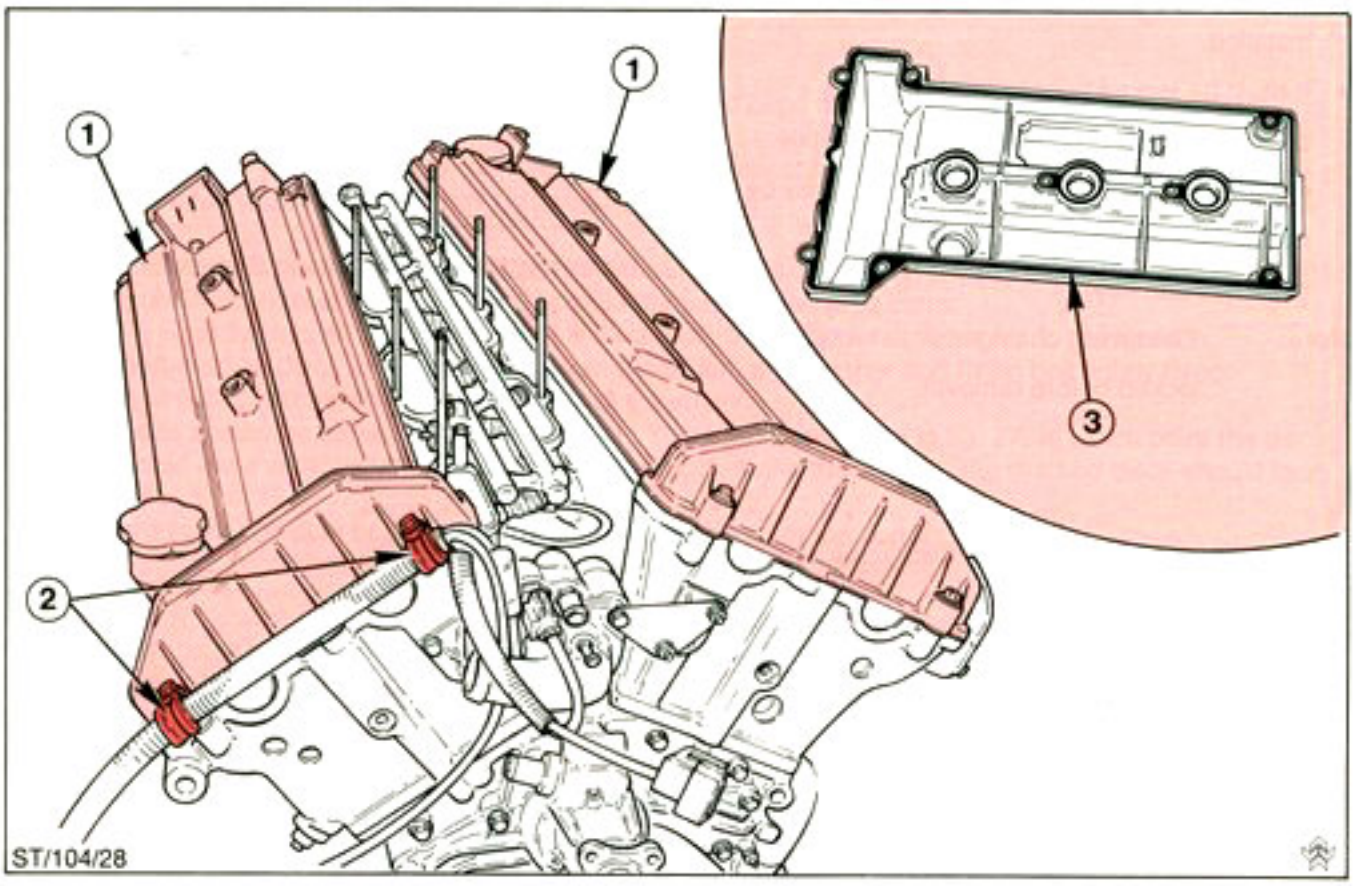
- Never place the camshaft covers with the gaskets facing downwards. This will prevent the gasket being damaged.

Note: The complete camshaft covers must be renewed in the case of a defective gasket. The gasket is vulcanised onto the cover and is therefore, not available as a service part.

- The crankcase emission valve is positioned at the rear of the left-hand camshaft cover.

Special Notes on Assembly:

- Two clips secure a wiring loom to the front flange of the right-hand camshaft cover.



1 Camshaft cover

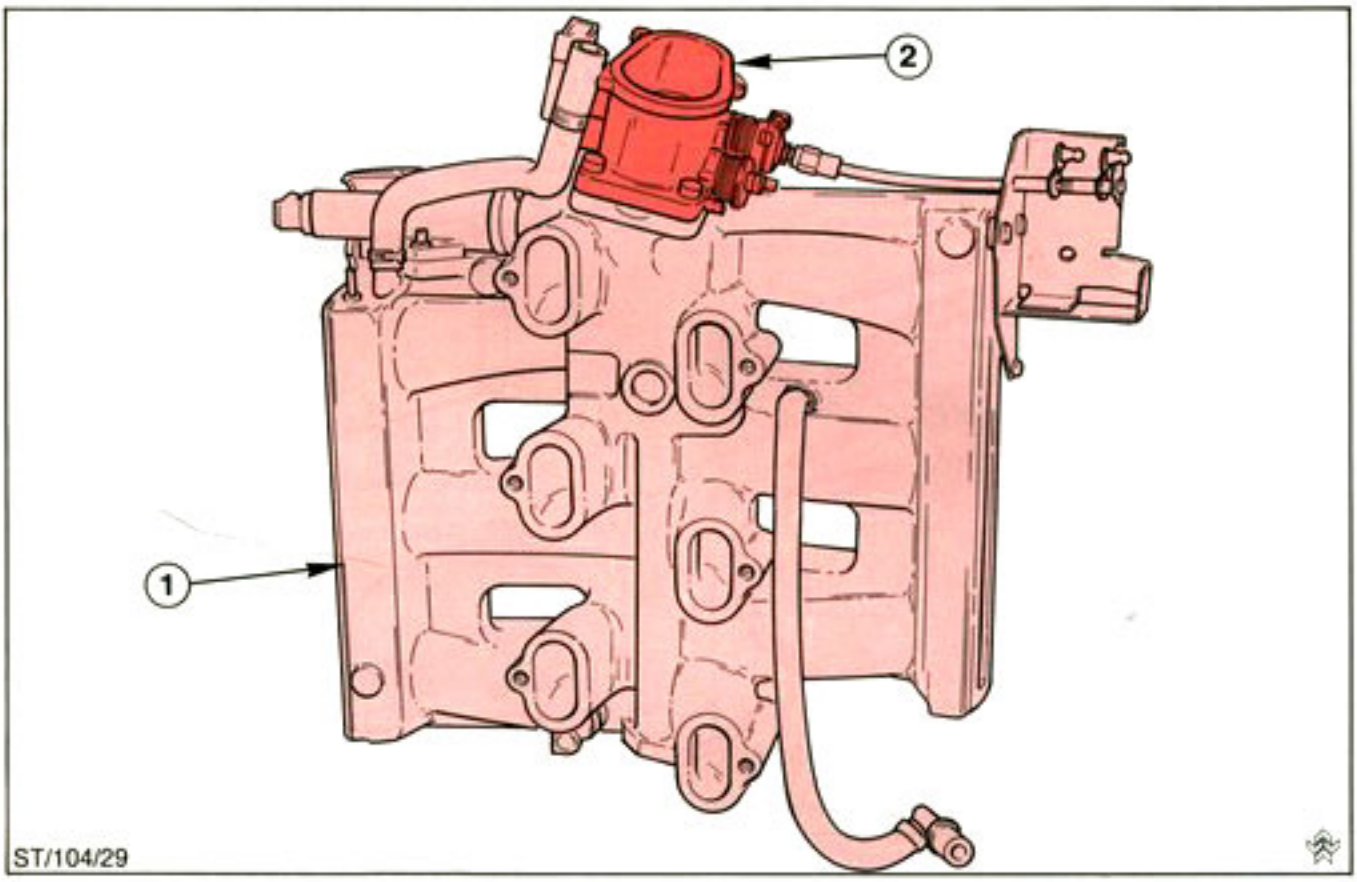
2 Clips securing wiring loom

3 Camshaft cover gasket

New

Plenum Chamber

- The plenum chamber connects the throttle body to the cylinder heads. It is a one piece aluminium casting.
- Vacuum connections necessary for engine management and emission control purposes are connected directly to the plenum chamber.
- The evaporative emission control system (EVAP), exhaust gas recirculation system (EGR) and the crankcase ventilation system are also connected to the plenum chamber.

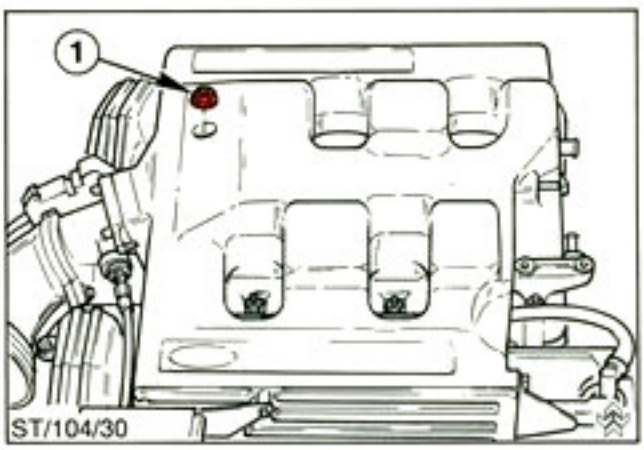


1 Plenum chamber

2 Throttle body

Special Notes for Assembly:

- The right-hand front stud (fig. 1) extends through the plenum chamber. To eliminate any air leaks, the nut for this stud has an integrated seal.



1 Nut with integrated O-ring

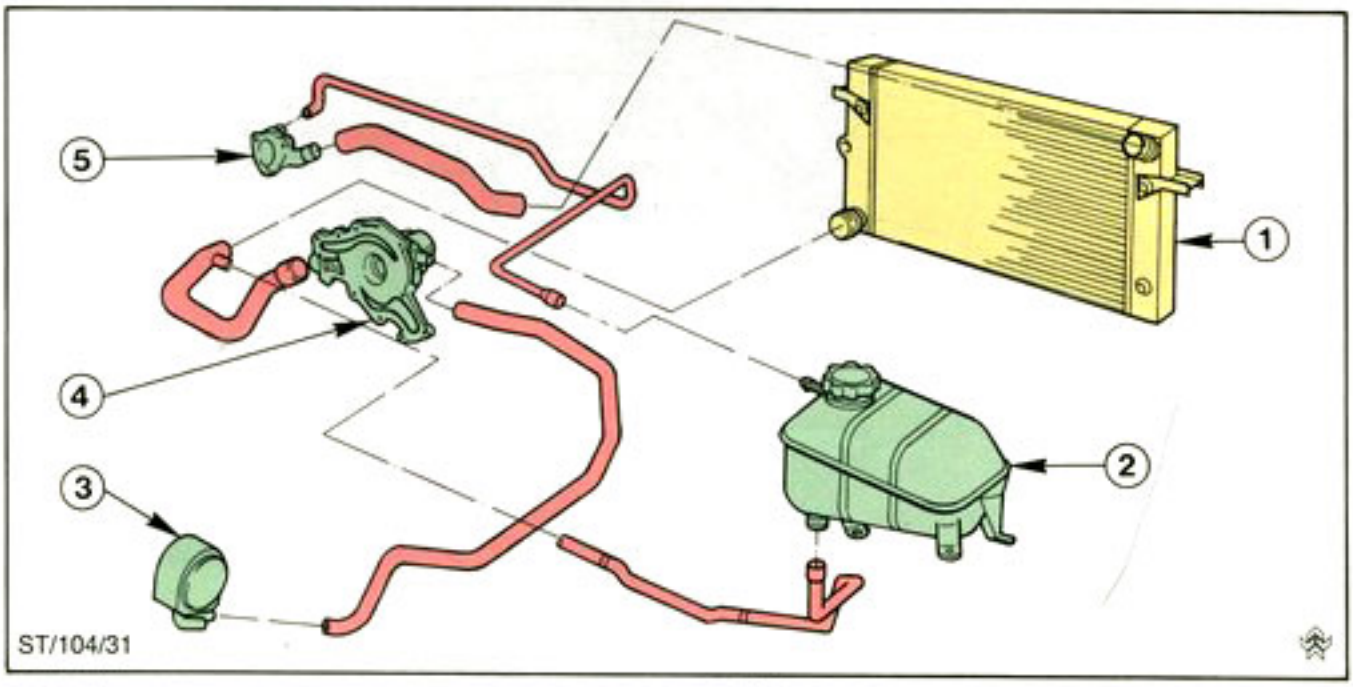
New

General

The cooling system is similar to that of the standard 2.9 l V6 engine. However, some of the coolant hoses have been modified to suit the modified installation positions.

Summary:

- Modified radiator
- Radiator fan
- New radiator hoses



1 Radiator
2 Radiator expansion tank
3 Oil cooler
4 Water pump
5 Thermostat housing

Modifications In Detail:

Radiator

- Because of increased cooling capacity requirements, the 2.5 l turbo diesel radiator is employed and mounted in a new position.

Radiator Fan

- Radiator fan as for standard 2.9 l V6 engine.

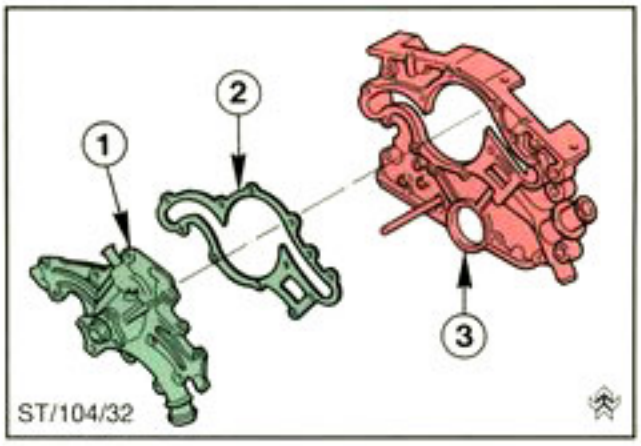
Radiator Hoses

- The radiator hoses have been modified to accomodate the new installation positions of the radiator assembly and expansion tank.

New Modified Unchanged

Water Pump

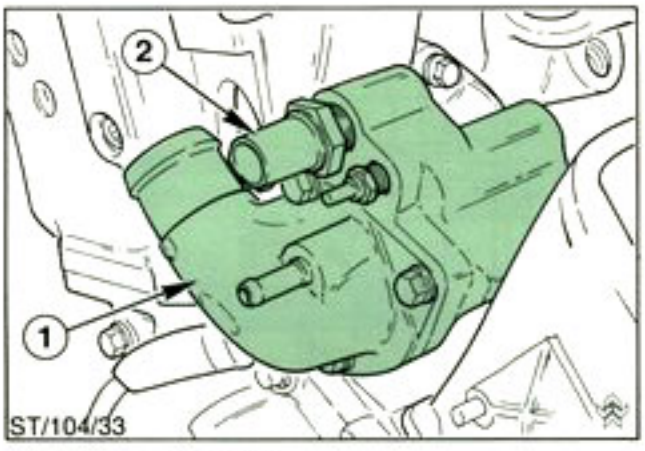
- The water pump is to the same level as the standard 2.9 l V6 engine, and is mounted with a gasket onto the front cover.



1 Water pump 3 Front cover
2 Gasket

Thermostat Housing

- The thermostat housing is located in the V-section and bolted to RH cylinder head.
- The engine coolant temperature (ECT) sensor, which signals coolant temperature to the EEC IV module, and an additional temperature sensor that activates the radiator cooling fan are both installed in the thermostat housing.

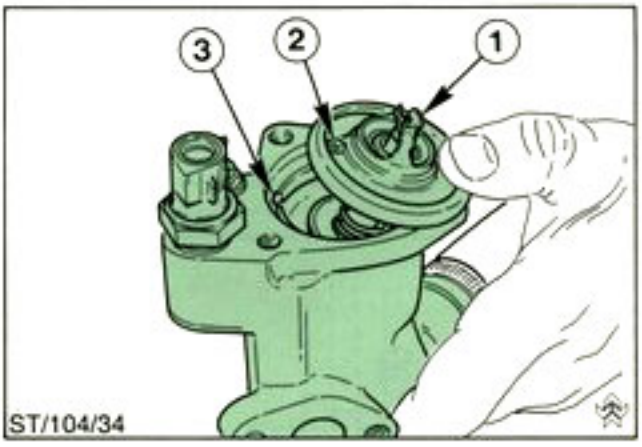


1 Thermostat housing
2 Coolant temperature sensor

Thermostat

- The thermostat has been adapted from the standard 2.9 l V6 engine.

- The thermostat assembly can only be installed one way into its housing.
  The locating pin on the collar of the thermostat assembly must engage in the recess provided in the thermostat housing.

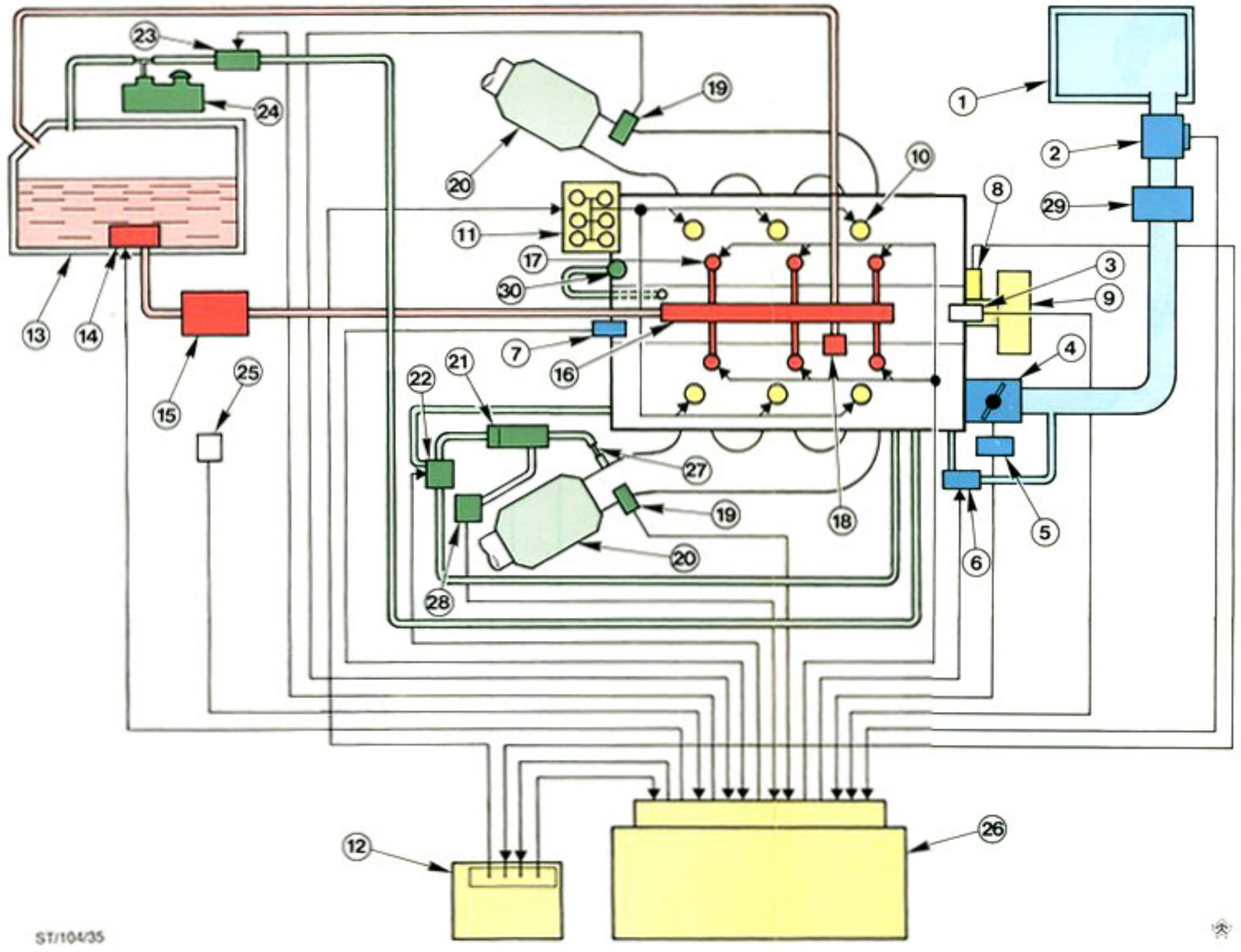


1 Thermostat 3 Recess
2 Locating pin

New Unchanged

General

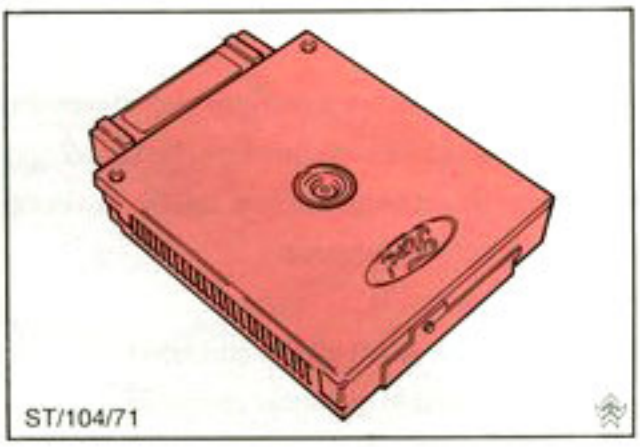
The 2.9 l V6 24V engine is equipped with an EEC IV engine management system, featuring an E-DIS ignition system. In order to comply with the 83 US Emission Regulation, the engine is equipped with evaporative emission control (EVAP), exhaust gas recirculation (EGR) and regulated three-way catalytic converters.



1 Air cleaner assembly
2 Mass air flow sensor (MAF)
3 Engine coolant temperature sensor (ECT)
4 Throttle housing
5 Throttle position sensor (TPS)
6 Idle speed control valve (ISC)
7 Air charge temperature sensor (ACT)
8 Crankshaft position/speed sensor (CPS)
9 Crankshaft pulley with 36-1 pitch for crankshaft position/speed sensor (CPS)
10 Spark plugs
11 Coil
12 E-DIS-6 ignition module
13 Fuel tank
14 Fuel pump
15 Fuel filter
16 Fuel distributor pipe (fuel rail)
17 Injector valves
18 Fuel pressure regulator
19 HEGO sensor
20 Catalytic converter (3-way)
21 Exhaust gas recirculation valve (EGR)
22 Electronic vacuum regulator (EVR)
23 Carbon canister reservoir
24 Canister purge solenoid (EVAP)
25 Vehicle speed sensor (VSS)
26 EEC IV module
27 Control orifice
28 Exhaust pressure transducer (EPT)
29 Resonator
30 PCV valve

EEC IV Module

- The EEC IV module fitted to this level of vehicle is visually identical to modules seen in the past. However, the new module contains a larger capacity and quicker response time to assist with the greater number of features now incorporated within the EEC IV engine management system.



EEC IV module

- The EEC IV module has a Self-test capability and Keep Alive Memory (KAM).

- The KAM stores intermittent fault codes that are detected by the EEC IV module Self-test during a period of 40 drive cycles (engine starts). This greatly assits the detection of possible sensor/actuator circuit failures. The EEC IV module can also emit approximately one hundred failure codes, each code representing a possible faulty circuit/component.

Self-test operation

- Coded information can be extracted from the EEC IV module using three separate methods. Each method checks senors and actuators in varying stages of operation. When performing the Self-test operation each of three methods must be completed in the sequences detailed in the Vehicle System Test Manual.

The three methods are:
- Engine Off Test
- Continuous Code Test
- Engine Running Test

Control Strategy Overview

Engine Cranking (Starting)

Primary control during engine cranking (starting) is for reliable engine start-up.

- Engine RPM at cranking speed
- Engine coolant temperature is low
- Air/fuel ratio is low
- Spark timing is controlled by EEC IV

New

Engine Warm-up

Primary control concern is for rapid and smooth engine warm-up.

- Engine RPM is above cranking speed according to operator's demands
- Engine coolant temperature is still low, but rising
- Spark is set by processor
- Air/fuel ratio is low
- Fuel economy is not closely controlled
- Emission starts to get under controlled

Open Loop Control

Primary control concern is for fuel control and for emissions prior to HEGO sensor signalling the processor.

- Engine RPM depends on demands of the operator
- Engine coolant temperature above warm-up limit
- Air/fuel ratio is controlled by an open loop system to 14.7:1 and is regulated by mass of air entering the system
- HEGO sensor temperature is not high enough to signal the processor
- Spark timing is set by the processor
- EGR is controlled by the processor depending on calibration
- Emissions are controlled by the processor

Closed Loop Control

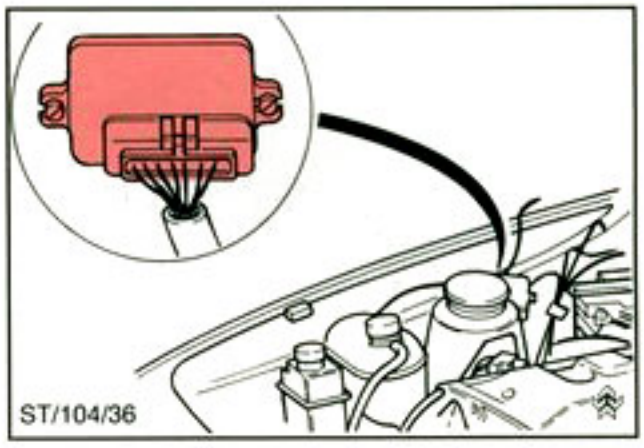
Primary concern is for fuel economy and tightly controlled emissions.

- Engine RPM depends on demands of the operator
- Engine temperature at normal operating range
- Average air/fuel ratio to 14.7:1 ± 0.05
- HEGO sensor is signalling the processor with information on the oxygen content of the exhaust gases
- System will return to open loop if the HEGO sensor should cool down of fails to switch a set number of times
- Secondary air is diverted to the catalytic converter
- Fuel economy is tightly controlled by the processor
- Emissions are tightly controlled by the processor
- Spark timing is controlled by the processor

IGNITION SYSTEM

E-DIS-6 Ignition Module

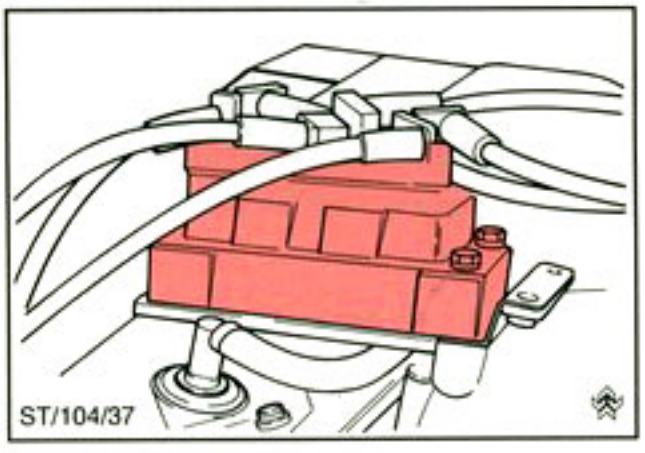
- The E-DIS-6 ignition module incorporated into this level of EEC IV engine management system dispenses with the need for both a distributor assembly and TFI IV module.
- Its function is similar to the E-DIS-4 ignition modules used on 4-cylinder engines.



Position of E-DIS-6 ignition module in vehicle

Ignition Coil

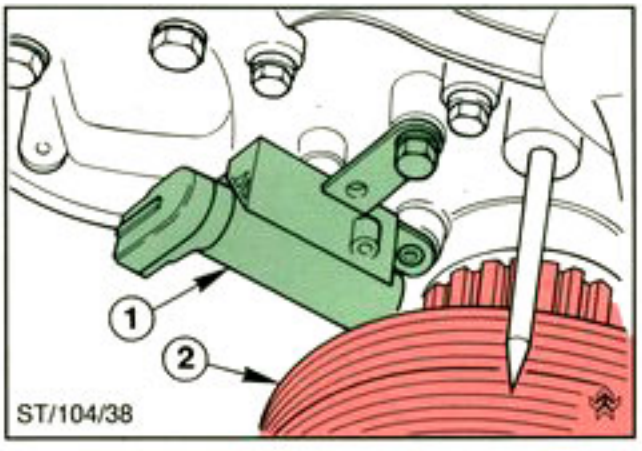
- The ignition coil is of dual spark design and is mounted to the rear of the plenum chamber.
- The function of this component is similar to the ignition coil used on Ford 4-cylinder engines.
- The main difference is that it has been extended to serve 6 cylinders.



Position of ignition coil at rear of engine

Crankshaft Position/Speed Sensor (CPS)

- The crankshaft position/speed sensor works on the same principle as other distributorless ignition system featured on Ford products in the past.
- The CPS sensor is activated by the toothed wheel on the crankshaft. The toothed wheel causes an interruption in the magnetic flux in the sensor, thereby producing alternating electrical pulses.
- The toothed wheel has 35 teeth spaced every 10° with the gap in the 36th position. This missing tooth is used as a reference by the module to define the engine crankshaft position.



1 Crankshaft position/speed sensor (CPS)

2 Crankshaft pulley with 36-1 pitch

New Unchanged

FUEL SYSTEM

Fuel Rail

- The fuel rail is made of aluminium. Don't disconnect the fuel lines if can be avoided to prevent the threads being damaged.

Injector Valves

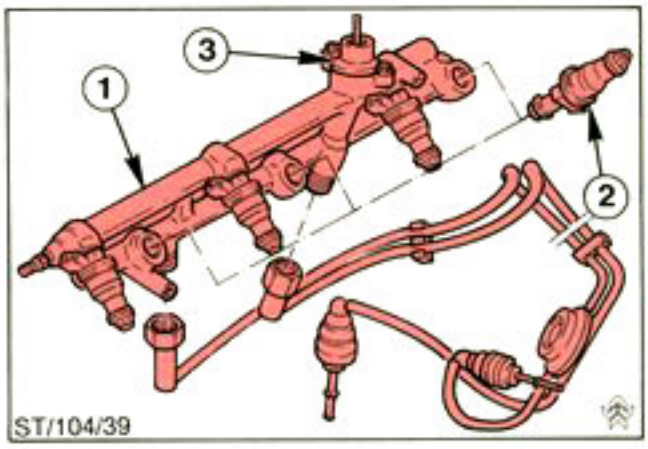
- The injector valves are functionally identical to those of the standard 2.9 l V6 engines.

Fuel Pressure Regulator

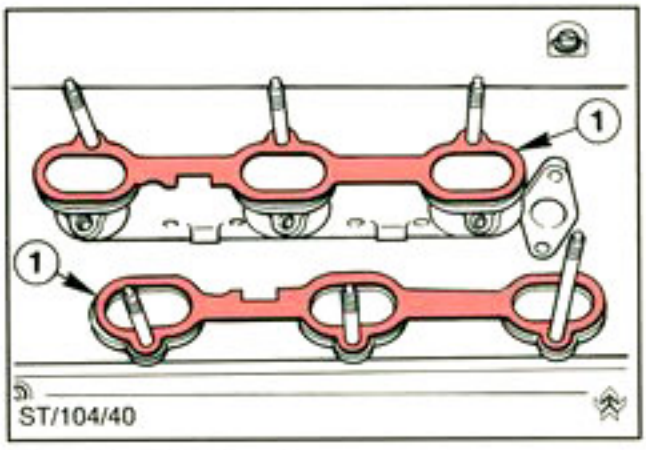
- The fuel pressure regulator is a new and smaller in size. It is fitted directly to the fuel rail assembly.

Special Notes on Assembly:

- First fit the gaskets to the inlet ports and lay in the wiring harness before installing the injector valves and fuel rail assembly.



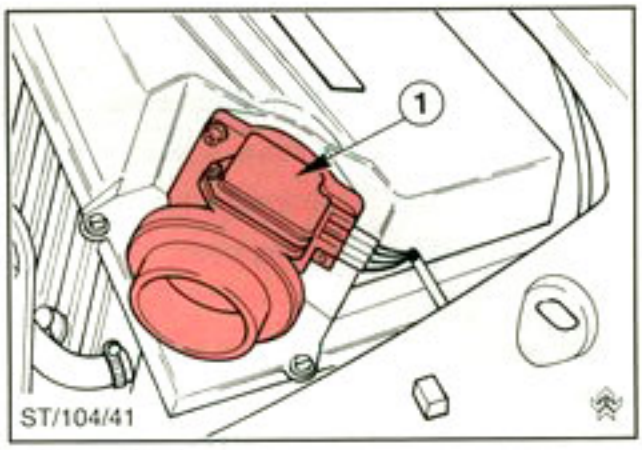
1 Fuel rail assembly
2 Injector valves
3 Pressure regulator



1 Gaskets for inlet ports

INDUCTION SYSTEM

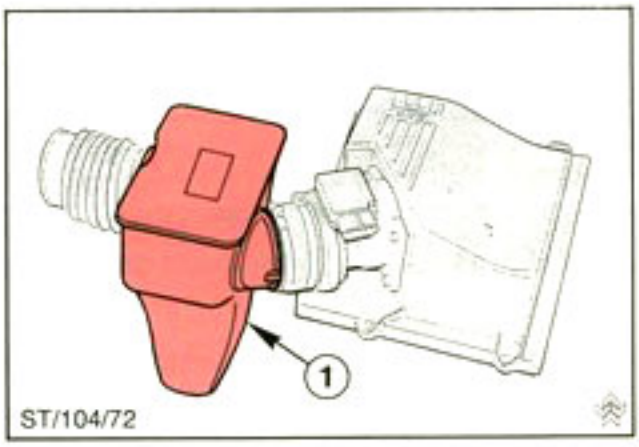
Mass Air Flow Sensor (MAF)



1 Mass air flow sensor

- The mass air flow sensor is a new feature to the EEC IV engine management system. The sensor effectivly consists of a main venturi with a smaller air flow bypass parallel to the main bore which contains the sensing elements. Air enters the main bore where a small percentage goes through the bypass and exits via a labyrinth back into the main bore.
- The advantage of the bypass arrangement is that the sensing elements are protected from contamination and the arrangement needs no periodic burn off.
- The sensing element effectivly consists of a "hot wire" suspended into the bypass to measure mass air flow with an additional sensing element to measure ambient temperature located in front of the hot wire. The mass air flow sensor is a constant temperature hot wire sensing device which measures the rate of a mass air flow into the engine. The sensor consists of two parts: sensing elements and signal conditioning electronics.
- Sensor operation is based upon the electrical balance of a bridge circuit which compensates for the rate of heat loss of the elements when air flow past it a given rate. The output signal is an analog voltage the magnitude of which is a function of the mass air flow rate.
- The air flow rate is determined directly from the sensor unlike in the speed density system of previous years. The sensor does not require compensation for temperature, EGR flow or volumetric efficiency. The sensor measures the air flow change in limiting time lag factors for calculations of fuel delivery. The improved transient air/fuel accuracy will facilitate improved emission control.

Resonator



Resonator

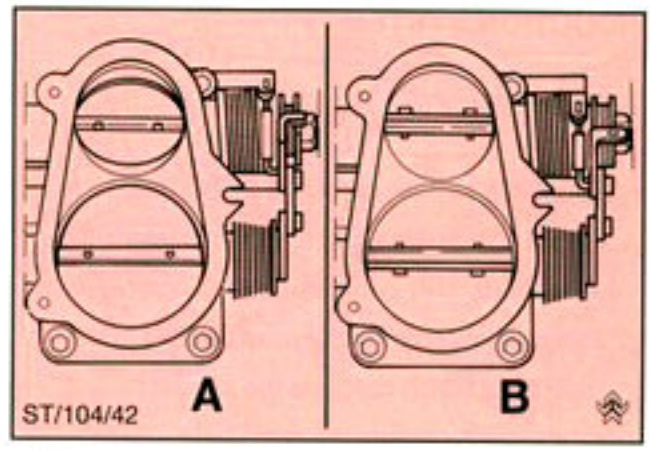
- The resonator prevents pulsation of the intake air.

New

Throttle Housing

- New progressive twin throttle plates with diameters of 38 and 55 mm to achieve improved volumetric efficiency in the lower engine speed range are employed.

- The smaller throttle plate opens first when the throttle pedal is operated. However, with further throttle action the secondary throttle plate will also be activated.

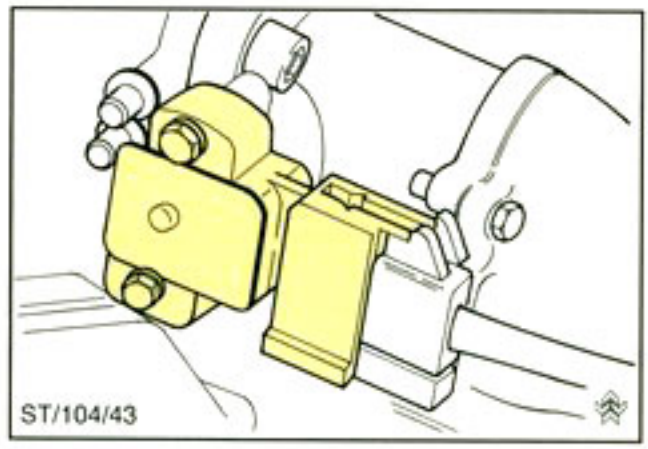


A Small throttle plate open only

B Both throttle plates wide open

Throttle Position Sensor (TPS)

- The throttle position sensor is mounted onto the side of the throttle housing at the same level as the smaller throttle plate. It measures throttle position with an accuracy of ± 1/2°. Its signal is used by the EEC to determine:
  ① closed
  ② partly open
  ③ wide open



Throttle position sensor (TPS)

- Also used for transient fuel enrichment.

- With the throttle plates closed, the EEC IV module controls the idle speed by means of the ignition timing and idle speed control valve in the closed control loop mode (with emission control), but without exhaust gas recirculation in operation.

- With the throttle plate partly open, the EEC IV module controls the amount of fuel and ignition timing in the closed loop mode, with exhaust gas recirculation in operation.

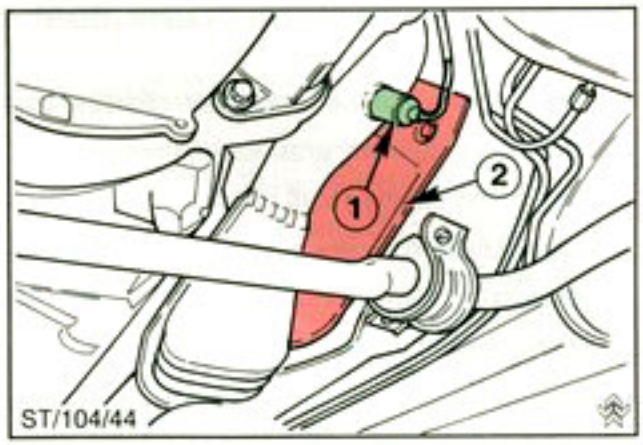
- With the throttle plates wide open (approximately 70% of total throttle pedal movement), the EEC IV module controls the system in the open loop mode (without emission control) but without exhaust gas recirculation. The fuel mixture is enriched and the ignition timing is regulated as required.

New Modified

EMISSION CONTROL SYSTEMS

Heated Gas Oxygen Sensors (HEGO)

- One HEGO sensor is installed in each exhaust system down pipe.
- In the event of failure of one of the HEGO sensors, the amount of fuel for all cylinders is calculated on the basis of the values from the HEGO sensor still functioning.
- In the event of both HEGO sensors failing, the EEC IV module operates in open loop mode.



1 HEGO sensor, left-hand exhaust pipe

2 Heat shield

Three-Way Catalytic Converters

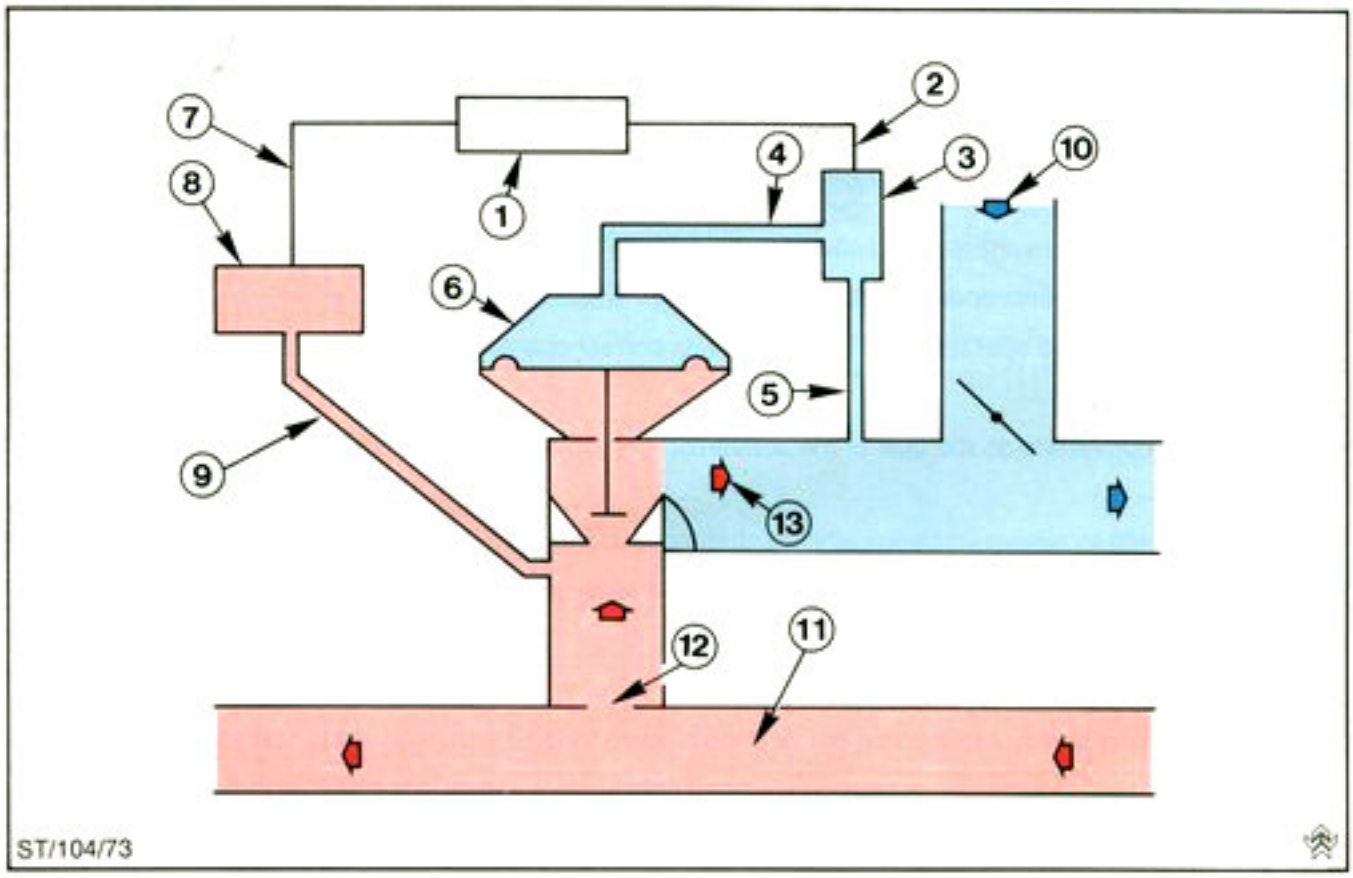
- Each bank has two ceramic catalytic converter assemblies in the exhaust system, which are effective once having reached a temperature of approx. 350 °C.

- The first (smaller) converters are positioned immediately after the exhaust down pipes and warm up quickest to allow earliest operation during the vehicles' warm-up period.
  These will continue to operate when the car is at its correct operating temperature.

- The second converters do the bulk of the convertion of harmful gases during the normal running of the engine.

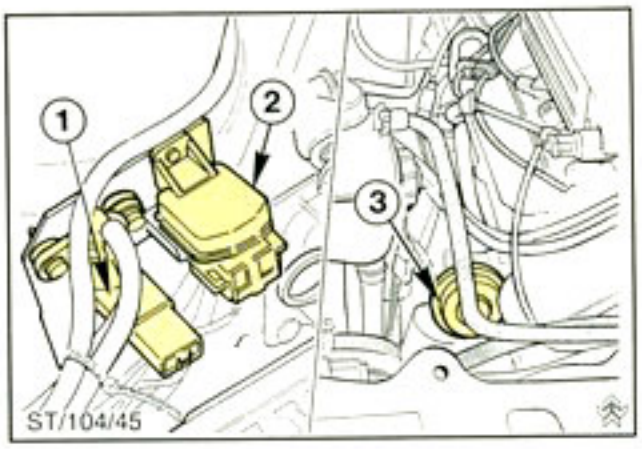
Exhaust Gas Recirculation System (EGR)

- The air intake into the combustion chamber contains oxygen and a high percentage of Nitrogen. Nitrogen at high temperatures and pressures react with oxygen to form oxides of Nitrogen. In the internal combustion engine small amounts of these oxides are formed and emitted to atmosphere through the exhaust system. One way of reducing NO_x is by lowering the peak temperature reached in the combustion chamber and this can be achieved by recirculating up to 12 % of the exhaust gases back into the inlet manifold. Recirculation exhaust gases has a two fold effect on the combustion process.
- It reduces the overall amount of air/fuel mixture, which can enter the combustion chamber for a given engine speed and throttle opening.
- Since the exhaust gases are incombustible, they do not generate additional heat, but instead absorb some of the heat from the combustion process.
- Both of these effects reduce the combustion chamber peak temperature and pressures, hence NO_x emissions, and this assists the vehicle in meeting the emission level.



1 EEC IV module
2 Duty cycle output
3 EVR solenoid valve
4 EVR vacuum output
5 Intake vaccum
6 EGR valve
7 Pressure signal input
8 Exhaust pressure transducer (EPT)
9 Controlled pressure input
10 Air intake
11 Exhaust pressure
12 Orifice
13 EGR flow

- For each engine operating mode, gases flowing through the exhaust system will create a specific and measurable amount of pressure.
- The EGR valve is a vacuum operated pintle type common to most EGR systems.
  The sensor is a ceramic capacitive type pressure sensor that converts exhaust system pressure or vacuum into an analog electrical input signal to the EEC. A signal output indicates minimum or no EGR flow. The electronic regulator is an electrically operated valve used to control the amount of vacuum applied to the EGR valve diaphragm.

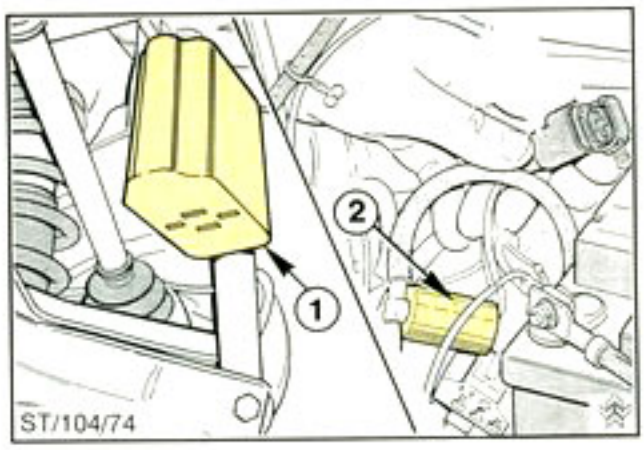


1 EVR solenoid valve
2 Exhaust pressure transducer
3 EGR valve

Evaporative Emission Control System (EVAP)

- The evaporative emission control system consists of a carbon canister reservoir and canister purge solenoid.

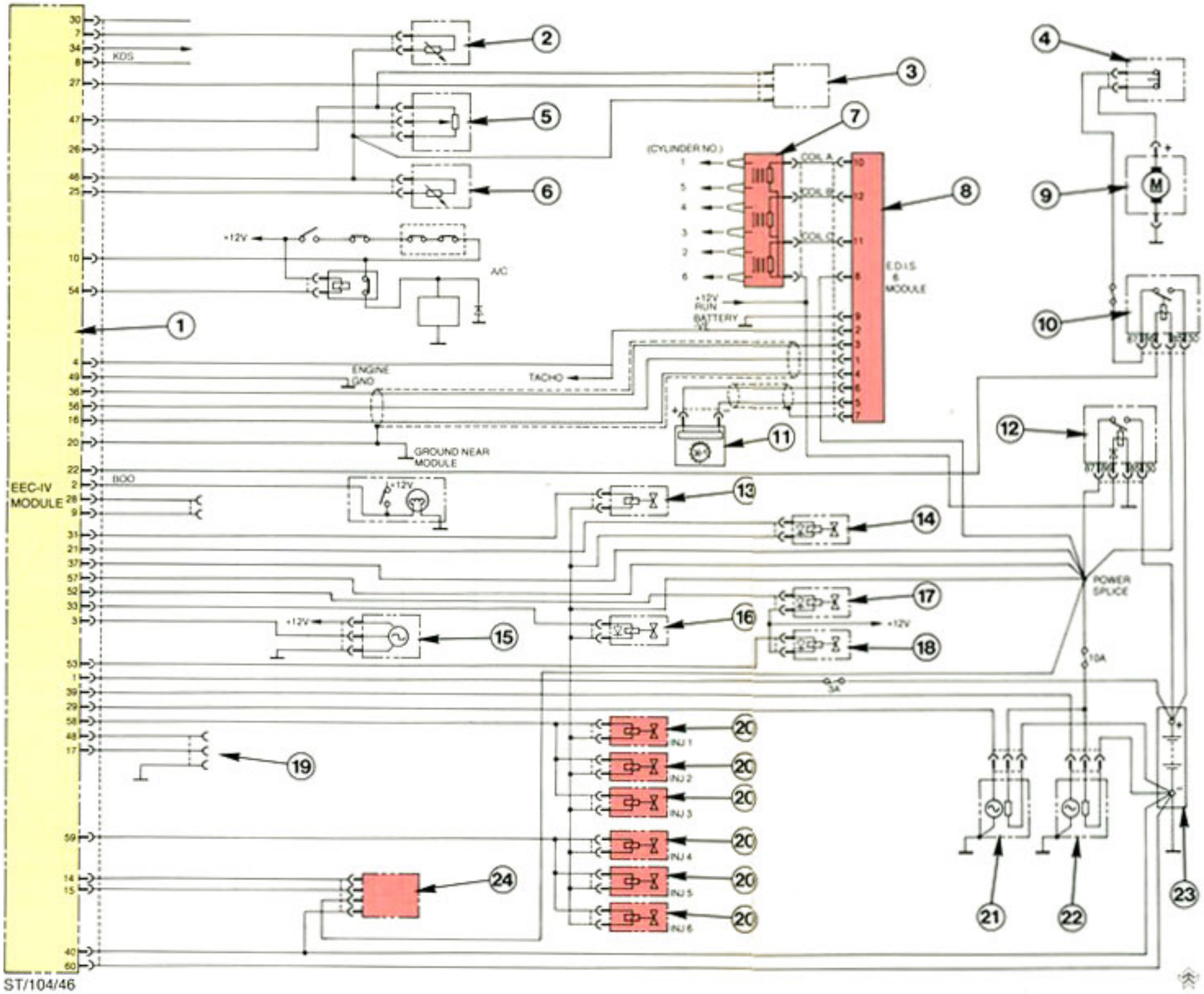
- The function of the EVAP system on the Cosworth is identical to that of the standard 2.9 l V6 engines to the 83 US Emission Regulation specification. It will purge fuel vapour from the fuel tank and store it in the carbon canister reservoir. When the vehicle is next driven the canister purge solenoid will activate and allow the fuel vapour collected and stored in the reservoir to be directed into the engine and burnt during the normal combustion process.



1 Carbon canister reservoir
2 Canister purge solenoid

Modified

Wiring Diagram



ST/104/46

1 EEC IV module
2 Engine coolant temperature sensor (ECT)
3 Exhaust pressure transducer (EPT)
4 Inertia switch (fuel "cut-off" switch)
5 Throttle position sensor (TPS)
6 Air charge temperature sensor (ACT)
7 E-DIS-6 ignition coil
8 E-DIS-6 ignition module
9 Fuel pump
10 Fuel pump relay
11 Crankshaft position/speed sensor (CPS)
12 Power relay (injectors)
13 Canister purge solenoid (EVAP)
14 Idle speed control valve (ISC)
15 Vehicle speed sensor (VSS)
16 Electronic vacuum regulator (EVR)
17 3rd/4th gear shift solenoid
18 Torque converter lockup solenoid
19 Self-test connector
20 Fuel injector valves
21 HEGO sensor (left)
22 HEGO sensor (right)
23 Battery
24 Mass air flow sensor (MAF)

New

Modified

Maintenance

All maintenance operations for the 2.9 l V6 24V Cosworth engines must be performed in compliance with the instructions set out in the FORD Service Manual.

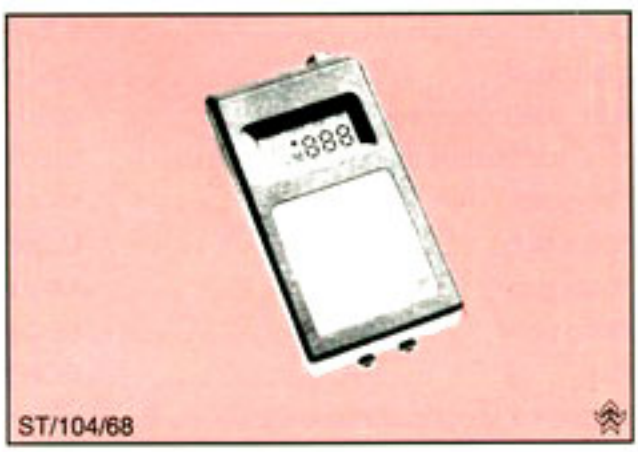
Diagnosis

Diagnosis is divided into check and test procedures.

NOTE: Diagnosis is made considerably easier by the increased self-test capability of the EEC IV module. Nevertheless, it is important that the service technician works systematically through the procedures set out in the vehicle systems test manual and other service literature. Using the recommended check/test equipment is essential.

Self-Test Differences

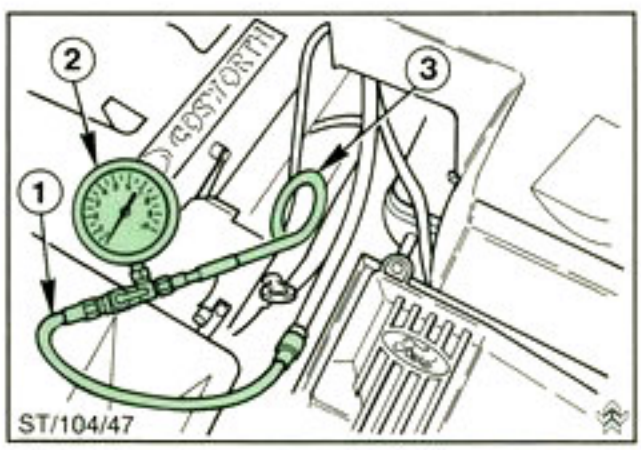
A 3-digit STAR (Self-Test Automatic Readout) tester is required for you to obtain any defect codes that may have been stored in the EEC IV modules Keep Alive Memory (KAM).
The Self-test capability of the EEC IV module enables detailed checks of the engine management system components, generating a more accurate description of possible circuit or component failure. There are approximately one hundred self-test codes available from the EEC IV module and these are presented in more detail in the Vehicle System Test Manual.
In addition, the brake pedal must be depressed once during the engine test procedure, in order to activate the input signal "brake ON/OFF" to the EEC IV module. This is included in the engine run test. Brake pedal should be depressed between code 010 and code 030.



New 3-digit STAR tester

Check Fuel Pressure

For testing fuel pressure and pump pressure use pressure test hoses and special tool 23-024.



1 Pressure test hose 23-024-07
2 Pressure test gauge 23-024
3 Pressure test hose 23-024-06

New Unchanged

Technical Data - Engine

Engine	2,9-l-V6-24V
Engine systems	Electronic engine control (EEC IV) Distributorless ignition system (E-DIS-6) Electronic fuel injection (EFI) Evaporative emission control system (EVAP) Exhaust gas recirculation (EGR) Three-way catalytic converters
Emission regulation	83 US
Bore	93 mm
Stroke	72 mm
Displacement	2936 cm^3
Output	143 kW (195 PS) at 5750/min
Torque	275 Nm at 4500/min
Compression ratio	9.7 : 1
Idle speed	725 rpm
Max. continuous engine speed	6050 rpm
Max. intermittant engine speed	6150 rpm
Firing order	1 - 4 - 2 - 5 - 3 - 6
Spark plugs	Motorcraft AGPR 22P
Spark gap	1.0 mm
Firing point	EEC IV
Fuel	RON 95 unleaded
Engine oil specification	•For normal outside temperatures: "FORD SUPER ENGINE OIL" SEA 15W-40 •For extremly outside temperatures: "FORD SUPER ENGINE OIL" SEA 10W-30 or SEA 20W-50 •For all temperature ranges: "FORD XR+ HIGH PERFORMANCE LOW VISCOUS ENGINE OIL" SAE 10W-40 or "FORD FORMULA S SYNTHETIC ENGINE OIL" SAE 5W-50 •If other oils than FORD engine oils are used, they must comply to the International Specification API SG/CD.
Engine oil filling capacity	Initial fill 5.0 l Service fill with filter replacement 5.0 l without filter replacement 4.5 l

Tightening Torques

	Nm
Main bearing caps	90 - 104
Big end bearing caps	26 - 33
Crankshaft damper/pulley	40 - 50 + 90°
Water drain plug	20 - 25
Jackshaft thrust plate	11 - 13
Jackshaft sprocket	45 - 54
Oil pump to block	17 - 21
Oil pick-up pipe to pump	11 - 13
Oil pump cover	11 - 13
Chain guides M6	8 - 10 + Loctite
Chain guides M8	13 - 17 + Loctite
Front cover to block M8	17 - 21
Front cover to block M6	11 - 13
Water pump	11 - 13
Crankshaft position sensor	8 - 10
Sump baffle	8 - 10
Windage tray	17 - 21
Sump to block	11 - 13
Oil drain plug to sump	21 - 27
Oil drain elbow to sump	8 - 10
Thermostat housing to head	8 - 10
Thermostat housing outlet	8 - 10
Various covers to head	8 - 10
Oil gallery plugs	22 - 28
Oil cross-drill blanking plug 1/16" PTF	5 - 7
Oil cross-drill blanking plug 1/8" PTF	8 - 10
Cam caps	12 - 14
Cam sprocket bolt	68 - 75
Chain guide to head	8 - 10
Chain guide bracket to head	17 - 21
Oil drain elbow to head	8 - 10
Chain tensioner housing	17 - 21
Chain tensioner housing plug	6 - 8
Head to block	45 - 55 + 180°
Head to front cover	17 - 21
Cam cover to head	6 - 8

Fuel Regulator to rail	8 -	10
Fuel rail to head	8 -	10
Throttle body to plenum	14 -	17
Inlet duct to throttle body	4 -	5
Idle speed control valve to plenum	8 -	10
Plenum to head	14 -	17
Oil pump drive housing clamp	17 -	21
Spark plug	28 -	33
Exhaust manifold to head	29 -	34
Oil cooler adapter insert	47 -	50
Filter adapter leg (blind nut)	32 -	35
Lifting eye to head	17 -	21
Coil bracket to plenum	8 -	10
Coil to coil bracket	8 -	10
Throttle bracket to plenum	8 -	10
Fuel pipe bracket	8 -	10
Water pump pulley	17 -	21
P-clip to head	8 -	10
Earth strap to head	17 -	21
ACT sensor	12 -	18
ECT sensor	12 -	18
Oil pressure switch	18 -	22

New Special Tools

Number	Description	Use
21-155	Valve spring compressor	For removing/installing the valves
21-155-01	Adaptor, valve spring compressor	For removing/installing the valves
21-156	Installer, valve stem collets	For removing/installing the valve stem collets
21-157	Adaptor, air supply cylinder	For removing/installing the valves

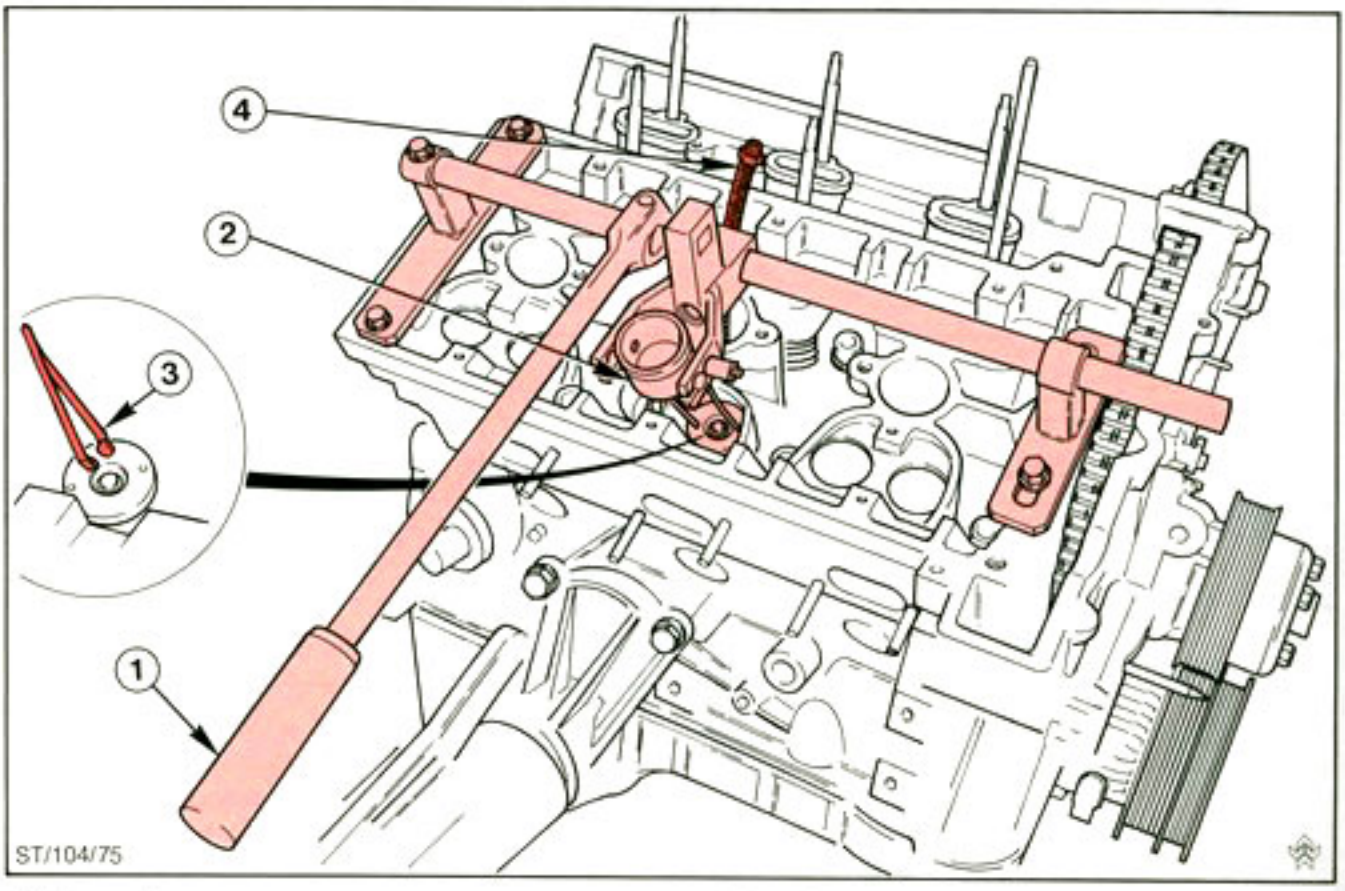
Carryover Special Tools

Number	Description	Use
15 - 053	Slide Hammer	For removing valve stem seals and bearing Oil pump drive (in conjunction with 21 - 142)
21 - 002	Multipoint spanner	For tightening the cylinder head bolts
21 - 023	Universal spindle	For clamping the engine
21 - 051	Remover	For removing the front crankshaft oil seal
21 - 055	Remover	For removing the rear crankshaft oil seal
21 - 059 C	Installer	For installing the rear crankshaft oil seal
21 - 064	Clamping fixture	For clamping the engine on engine assembly stand
21 - 128	Guide bolts	For guiding the cylinder heads onto block
21 - 130 A	Installer	For installing the valve stem seals
21 - 137	Centering and installation tool	For centering the front cover/installing front crankshaft oil seal
21 - 140	Engine retaining fixture	For holding the engine when removing/installing the transmission

New

21 - 140 - 01	Additional pieces for 21 - 140	For holding the engine when removing/installing the transmission
21 - 142	Remover	For removing the valve stem seals
21 - 147	Puller	For removing the crankshaft pulley
21 - 540	Angle gage, bolt tightening	For tightening the main bearing and cylinder head bolts
23 - 024	Pressure test gauge	For testing fuel pressure and pump pressure
23 - 024 - 06	Pressure test hose	For testing fuel pressure and pump pressure
23 - 024 - 07	Pressure test hose	For testing fuel pressure and pump pressure
23 - 027 A	Releasing tool	For releasing the fuel lines

Use of new special tools



1 Valve spring compressor
2 Adaptor, valve spring compressor
3 Installer, valve stem collets
4 Adaptor, air supply cylinder

New

General

The Scorpio with 2.9 l V6 24V engine is available only with the **partial electronic A4LD* automatic transmission**. This transmission is also fitted to other Scorpio and Sierra vehicles, but has been modified to accomodate the higher engine power output.
The main differences are the revised shift times and the higher torque capacity.

***A**utomatic
4-Speed
Lockup (Torque converter bypass)
Over**D**rive (transmission ratio in 4th gear is below 1:1)
Special feature: Engagement of reverse gear blocked hydraulically while the vehicle is moving forward at speeds in excess of 15 km/h. Equally, 1st and 2nd gear are locked out (no automatic downshift) above a certain vehicle speed.

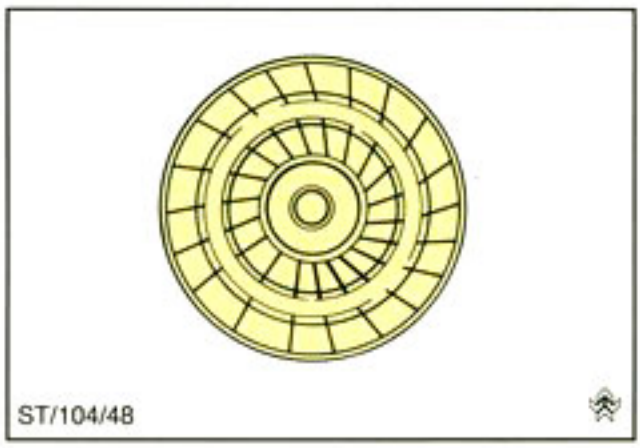
Summary:

- Modified torque converter
- New turbine wheel bearing (axial)
- Modified front planetary gear train
- Modified reverse and direct gear clutch
- Modified overdrive planetary gear train
- Modified pump carrier
- Modified centre shaft
- Special heat shield

Modifications in Detail:

Torque Converter

- The angle of incidence of the converter blades housed within the torque converter have been adapted to the new torque characteristic of the engine; from 235 Nm to 280 Nm.
- The turbine wheel is equipped with an axial needle bearing to handle the higher load.

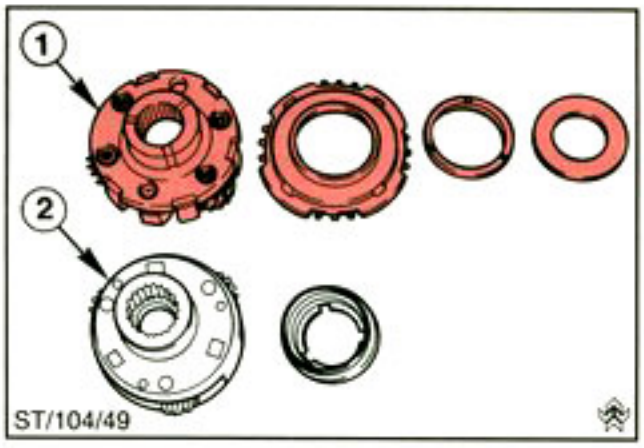


Torque converter

Modified

Front Planetary Gear Train

- The front planetary gear carrier in this transmission is made of steel. The planetary gear train now has four planet gears and is also equipped with a needle bearing (see fig. 50).

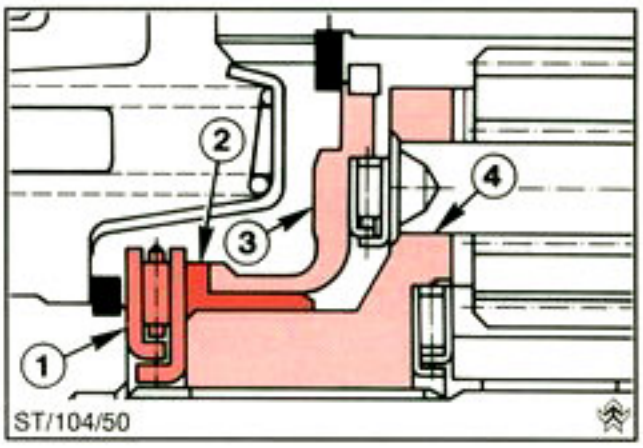


1 New front planetary gear train

2 Previous front planetary gear train

Axial Bearing of Front Planetary Gear Train

- Due to the increased stress occuring, the previous shaped friction ring is replaced by a needle bearing and a bronze bushing.



1 Needle bearing

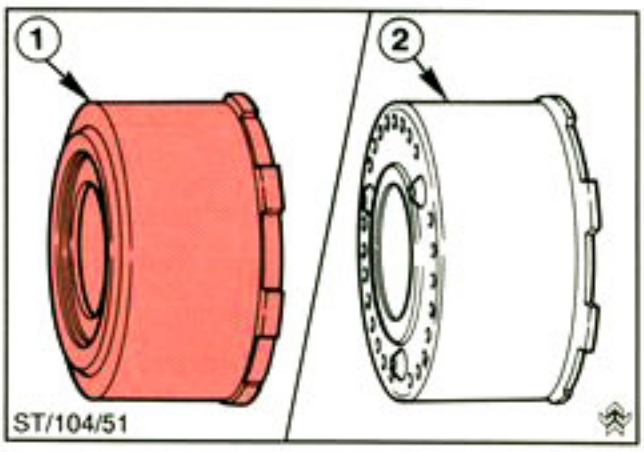
2 Bronze bushing

3 Hub of front planetary gear train

4 Front planetary gear train

Reverse and Direct Gear Clutch

- Due to the higher torque being transmitted, the reverse and direct clutch is manufactured from cast iron instead of pressed steel.



1 New reverse and direct gear clutch

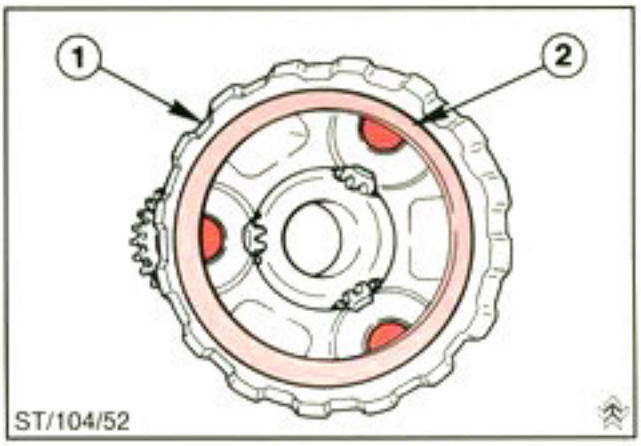
2 Previous reverse and direct gear clutch

New

Overdrive Planetary Gear Train

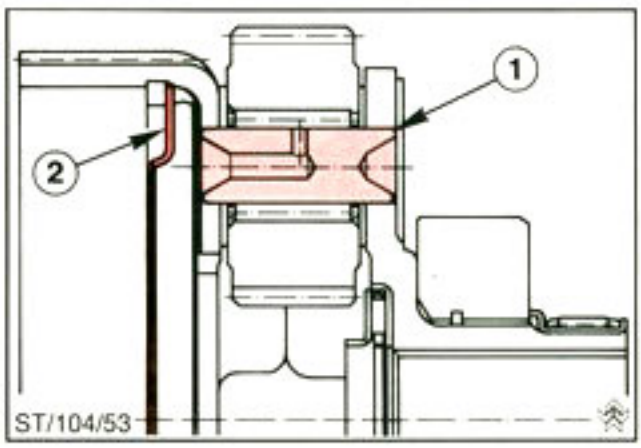
- To increase its strength at high torques and high rotational speeds, the planetary gear spindles have been increased in diameter. At the same time, oil bores have been added to improve lubrication.

- To improve oil feed, an oil distributor plate has been added to the front face of the planetary gear carrier.



1 Overdrive planetary gear carrier

2 Oil distributor plate

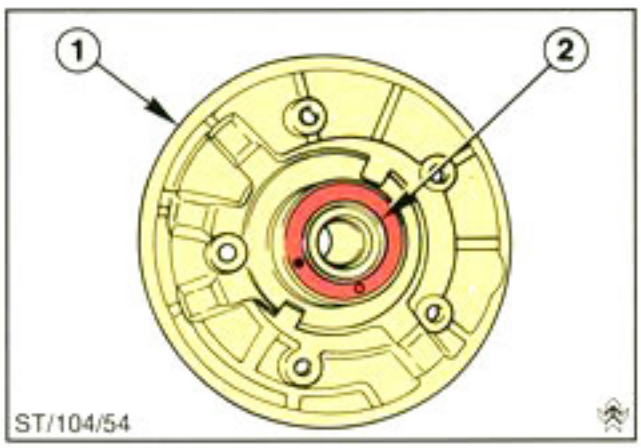


1 Planetary gear axles with lubrication bores

2 Oil guide disc

Pump Carrier

- To improve oil circulation, the oil drain opening in the rear hub of the pump carrier has been increased in size.



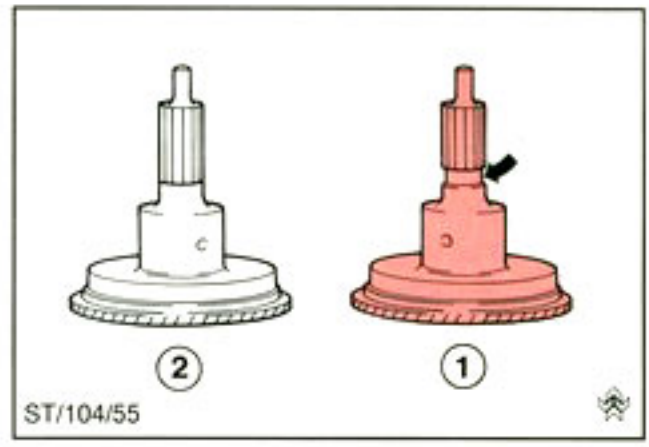
1 Pump carrier

2 Oil drain opening

New Modified

Centre Shaft

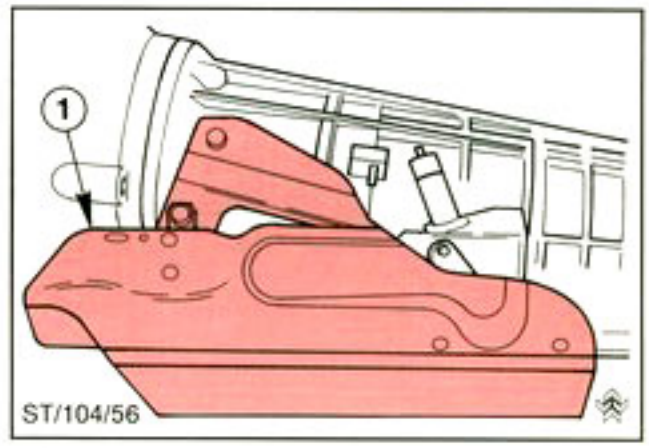
- The new centre shaft is of an improved material.
- To reduce the notch effect, a strain-relief slot has been ground in and shot-hardened (see fig.).



1 New centre shaft
2 Previous centre shaft

Heat Shield

- A special heat shield is fitted on the transmission to protect the kick-down solenoid valve and shift valves from both heat radiation.



1 Heat shield

New

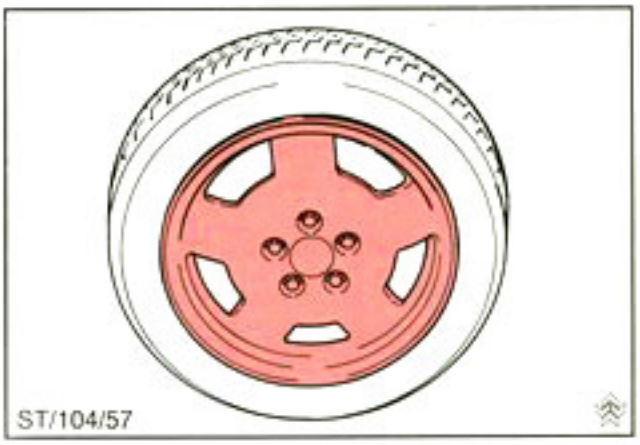
General

In conjunction with the V6 24V Cosworth engine, Scorpio notchback and fastback derivatives have been modified in the following areas:

- Wheels and tyres
- Front/rear axle (shock absorbers, springs, stabiliser bar, track control arm mountings)
- Final drive ratio
- Viscous-coupling limited-slip differential as standard
- More powerful brakes (as Sierra Cosworth)
- Additional heat shields in engine compartment and on floor panel
- Soundproofing between engine and radiator (bottom)
- Engine compartment cover
- Tachometer
- Sports steering wheel
- Lettering on the rear doors

Wheels and Tyres

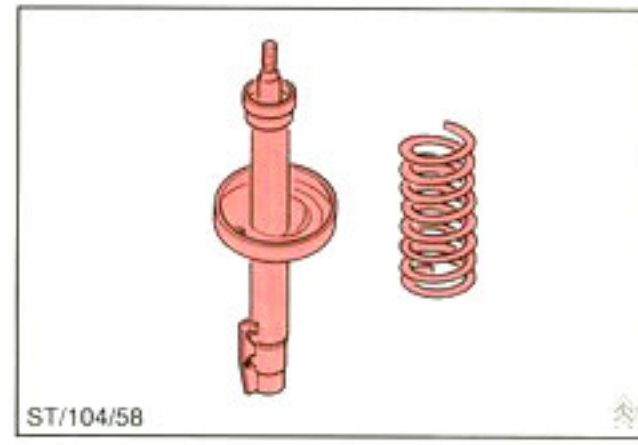
- 16 x 6.5 J aluminium rims with size 205/50 ZR 16 tyres.



New aluminium rims

Front Axle

- Reinforced springs and shock absorbers with higher damping rate.
- Stabiliser bar has been increased in diameter by 1 mm.



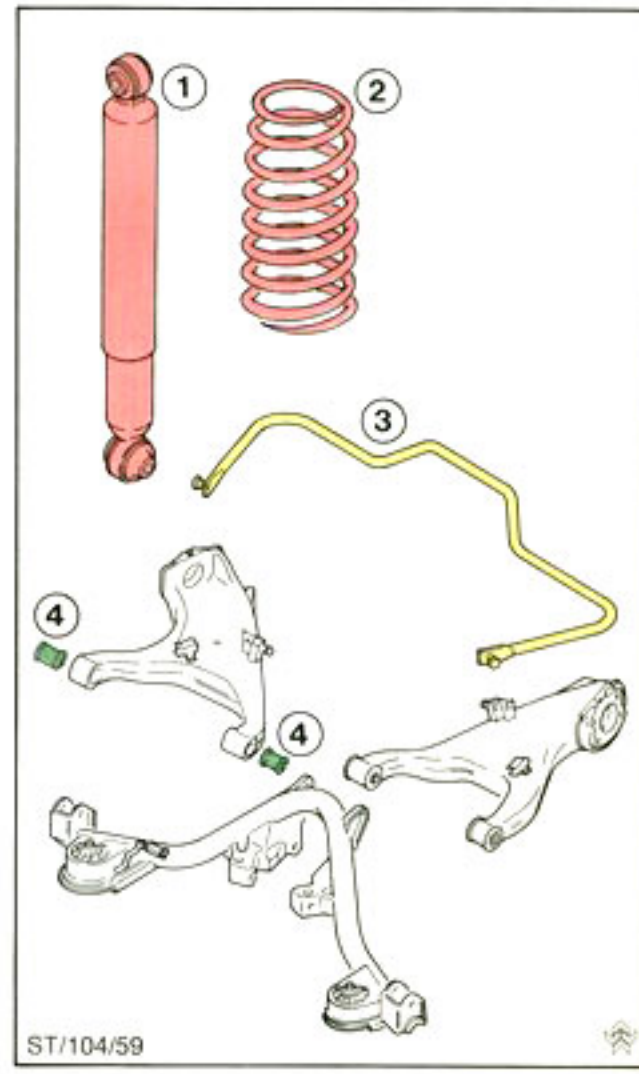
Front shock absorbers and springs

Rear Axle

- Reinforced springs and shock absorbers with higher damping rate.
- Stabiliser bar as Scorpio 4x4 but increased in diameter by 1 mm.
- The final drive ratio is 3.64 : 1.
- The track control arm mountings have been reinforced and now corresponds to that of the Sierra Cosworth.
- Viscous-coupling limited-slip differential as standard. Identified by the adhesive label "(SD)" on the differential housing cover.

Brakes

- Brake system has been improved, to suit the higher performance and now corresponds to the Sierra Cosworth.

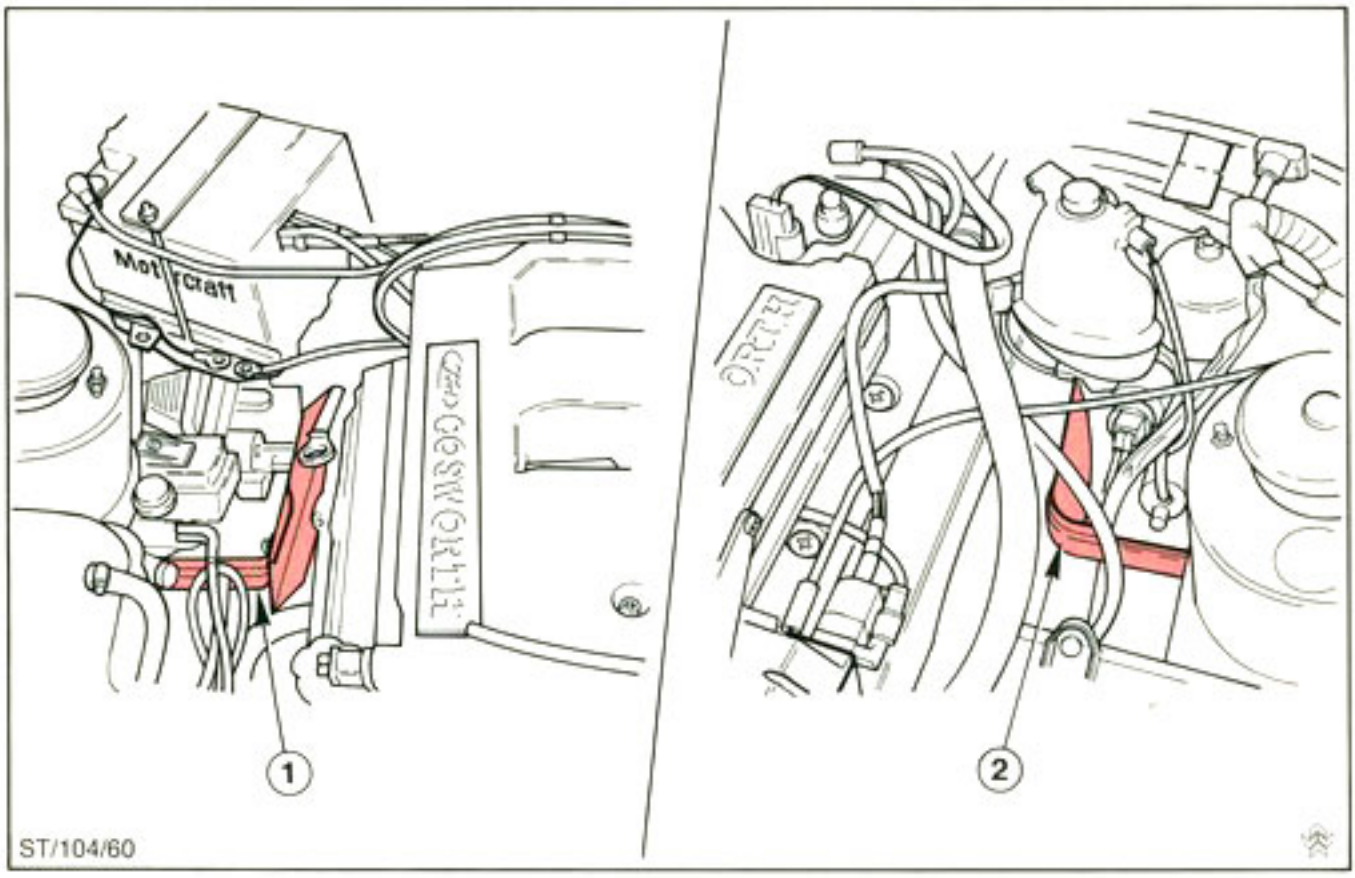


1 Shock absorber 3 Stabiliser bar
2 Spring 4 Track control arm mounting

New Modified Unchanged

Heat Shields

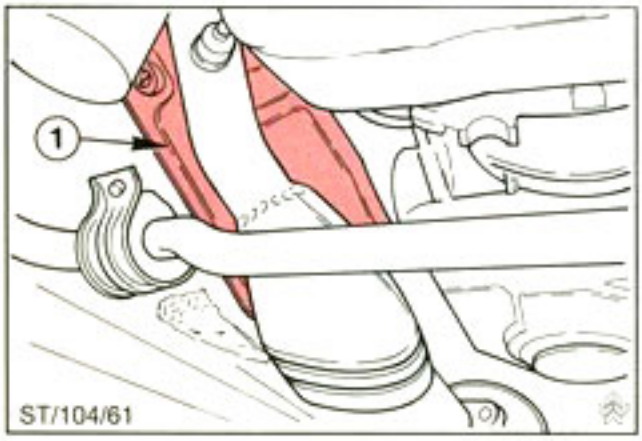
- Additional heat shields on left and right in the engine compartment to protect the master brake cylinder and the ABS valve block from heat radiated by the engine.



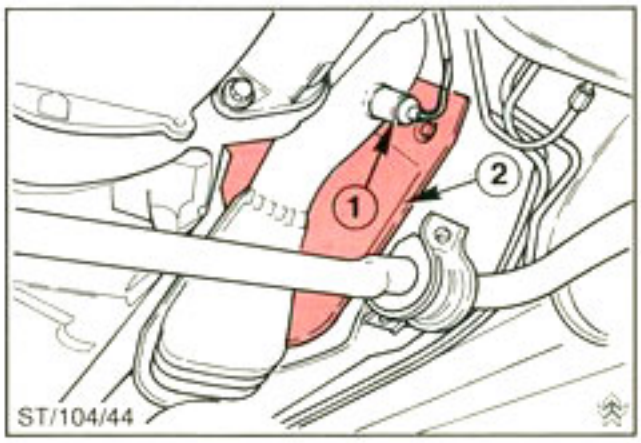
1 Heat shield for ABS valve block

2 Heat shield for master brake cylinder

- Additional heat shields on floor panel to protect against heat radiation from the exhaust system.



1 Heat shield, right-hand exhaust pipe



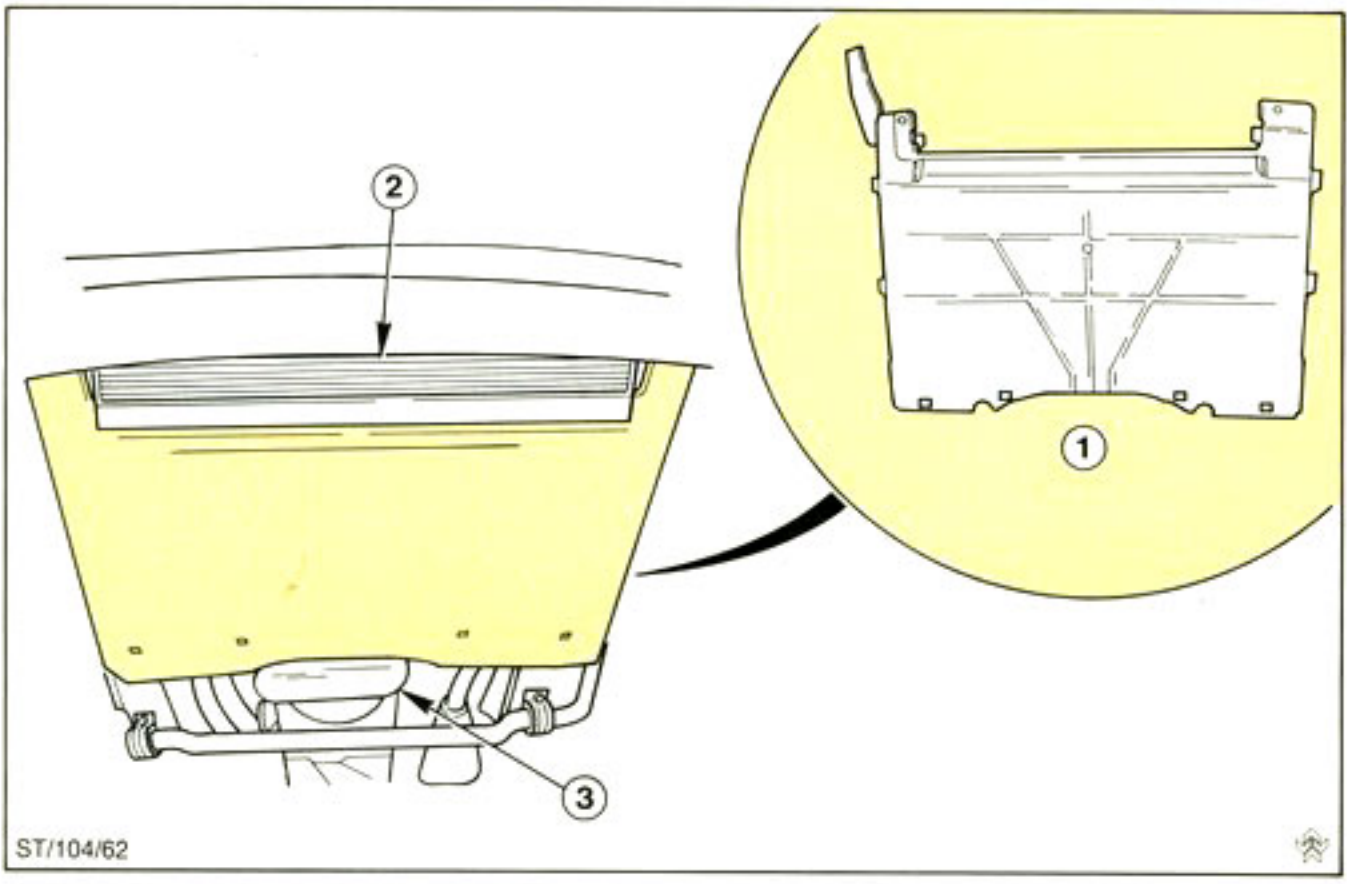
1 HEGO sensor, left-hand exhaust pipe

2 Heat shield

New

Soundproofing

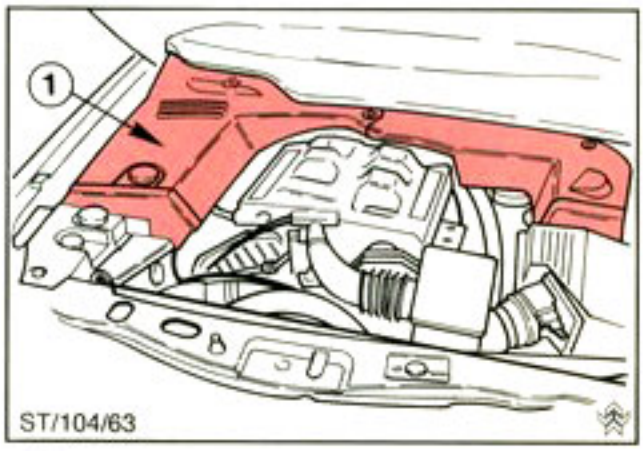
- The soundproofing between the engine and radiator has been adopted from the Scorpio with turbocharged diesel engine and adapted to the new installation.



1 Soundproofing
2 Radiator
3 Sump

Engine Compartment Beautification Covers

- Engine compartment appearance is improved by beautification covers.
- These can be removed easily if this is required for any service work.

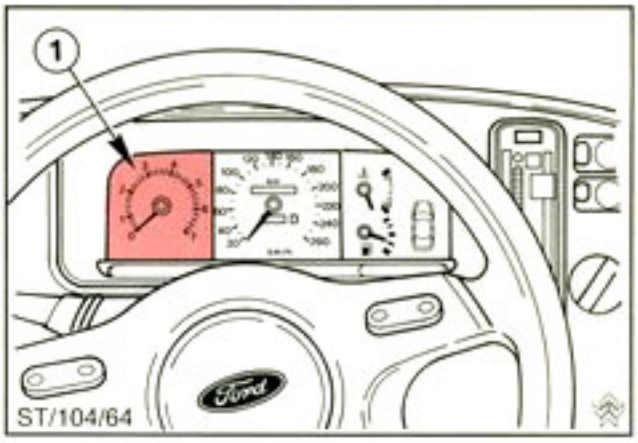


1 Engine compartment beautification cover

New Modified

Tachometer

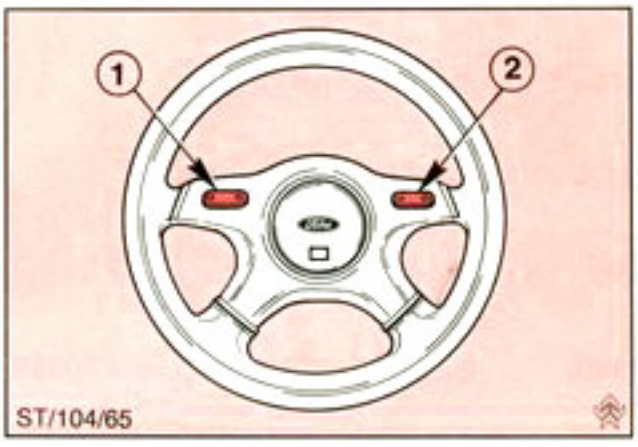
- Circular tachometer with red marking above engine speed 6200 rpm.



1 Tachometer

Steering Wheel

- Four-spoke sports steering wheel with control switches for automatic speed control on the upper steering wheel spokes.



1 Speed control ON/OFF switch

2 Speed control switch

Lettering

- The Scorpio with the V6 24V Cosworth engine is identified on the outside by the lettering "24V" at the rear.

Lettering at the rear

New

Abbreviations used in this brochure:

ACT	**A**ir **C**harge **T**emperature
A4LD	**A**utomatic **4**-speed **L**ockup **O**ver**d**rive
CPS	**C**rankshaft **P**osition **S**ensor
ECT	**E**ngine **C**oolant **T**emperature
E-DIS-6	**E**EC IV with **D**istributorless **I**gnition **S**ystem - **6** cylinder engines
EEC IV	**E**lectronic **E**ngine **C**ontrol system, generation number **IV**
EFI	**E**lectronic **F**uel **I**njection
EGR	**E**xhaust **G**as **R**ecirculation
EPT	**E**xhaust **P**ressure **T**ransducer
EVAP	**Evap**orative **E**mission **C**ontrol **P** System
EVR	**E**lectronic **V**acuum **R**egulator
ISC	**I**dle **S**peed **C**ontrol
PCV	**P**ositive **C**rankcase **V**entilation
TPS	**T**hrottle **P**osition **S**ensor
VSS	**V**ehicle **S**peed **S**ensor
V6	**6** cylinder, **v**-shaped configuration
24V	**24** **V**alves