

# GROUP H

## BRAKES

### ANTI-LOCK BRAKING SYSTEM (ABS)

#### TABLE OF CONTENTS

	PAGE
Driving With ABS, Maintenance .....	H - 46
General Information Before Repairs on the ABS .....	H - 46
Hydraulic Modulator, Remove and Install (ABS-2E and ABS-2EH).....	H - 47
Electronic Control Unit (ABS-2E) .....	H - 48
Electronic Control Unit (ABS-2EH).....	H - 48
Wheel Speed Sensor, Remove and Install .....	H - 49
Front Wheel Brake .....	H - 49
Rear Wheel Brake .....	H - 50
Relay for Solenoid Valve or Pump Motor, Remove and Install (up to MY93½).....	H - 51
ABS Checking Procedures, Using TECH 1 .....	H - 53

## DRIVING WITH ABS, MAINTENANCE

### Instructions

When the ignition is switched on, the 'ABS' symbol in the instrument panel illuminates and then goes out after approximately 4 seconds.

If the ABS telltale either does not go out or comes on intermittently while driving, then there is a fault in the system.

With both ABS-2E and ABS -2EH, diagnosis can be made either with the diagnostic switch KM-640 in position "K" or with TECH 1 Scan Tool, fitted with the 87-94 ECU Program Module.

After driving off from rest, the ABS carries out a self-test which may be audible as a noise from the return pump.

When braking hard, the vehicle remains free from wheel lock until the vehicle almost stops (approximately 4 km/h), thus guaranteeing vehicle control.

Braking in the control range of the ABS is indicated to the driver by a pulsing of the brake pedal, combined with noises from the return pump, warning him/her to adjust his/her speed in relation to the road surface conditions. If a defect occurs in the ABS, the ABS telltale lights up, indicating that the ABS is inoperative. However the conventional braking system remains fully functional. Should a defect become apparent, the vehicle should be checked and /or repaired as soon as possible by an authorised Holden Dealer.

### Maintenance

The following points must be observed when working on a Calibra vehicle fitted with ABS:

- When carrying out electrical welding operations, the wiring harness plug must be removed from the electronic control unit.
- During painting operations, the electronic control unit may be exposed to a maximum temperature of 95 °C for a short time and for a longer term - approximately 2 hours, to a maximum of 85 °C.
- After working on the braking system, it must be bled and a pressure inspection carried out.
- All connections are to be checked for leaks.
- Ensure that battery cable connections are clean and tight.
- Do not use a 'quick' battery charger to start the engine.
- Ensure all wiring harness connections are sound.
- Never unplug the wiring harness multiplug from the electronic control unit or plug it in, while the ignition is switched on.

### General Information Before Repairs on the ABS

After operations that affect ABS components (e.g. accident repairs), the entire ABS must be checked.

With either ABS-2E or ABS-2EH:

System checking and diagnosis can be made either with the diagnostic switch KM-640 in position "K" or with TECH 1 Scan Tool, fitted with the 87-94 ECU Program Module.

Also refer to the "ABS Checking Procedures" included in this Section.

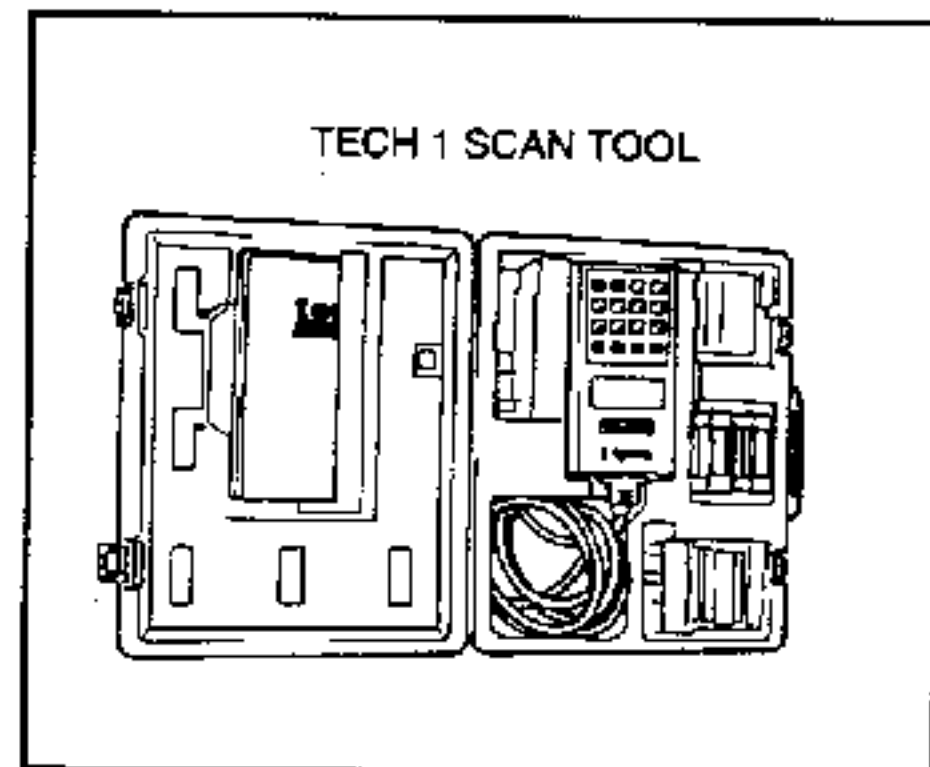
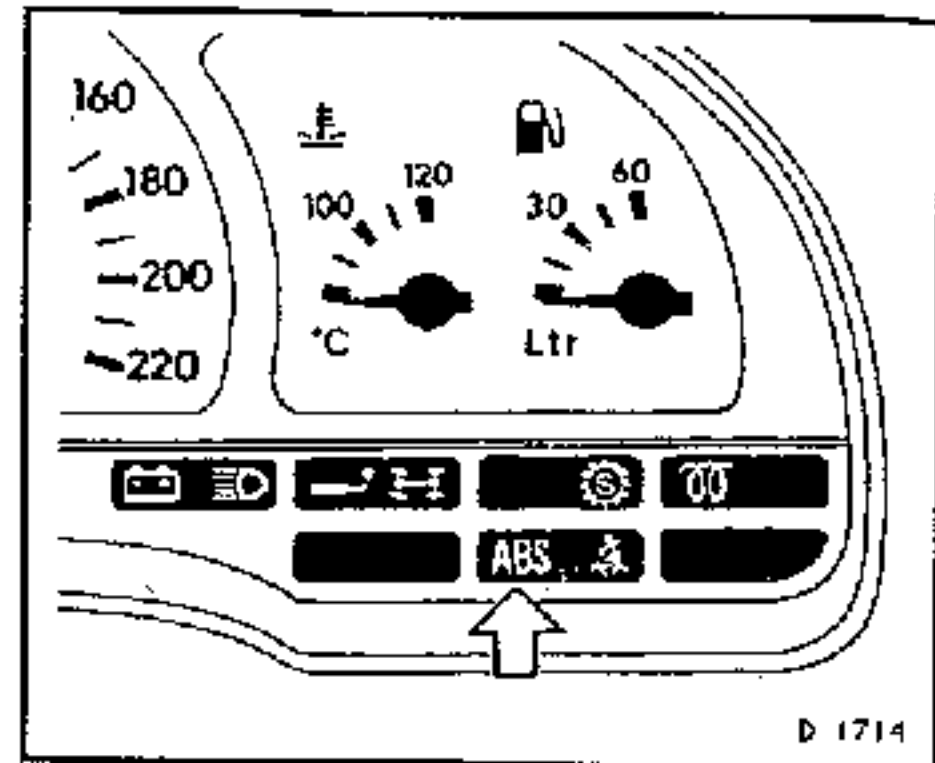
### Function Check

After work on the braking system has been completed, where ABS component have NOT been involved, a simple function check is sufficient.

After starting the engine, the ABS telltale in the instrument panel, must go out.

### Important!

The brake master cylinder on Calibra vehicles fitted with ABS are not serviceable and if found to be faulty, must be replaced as a complete unit.



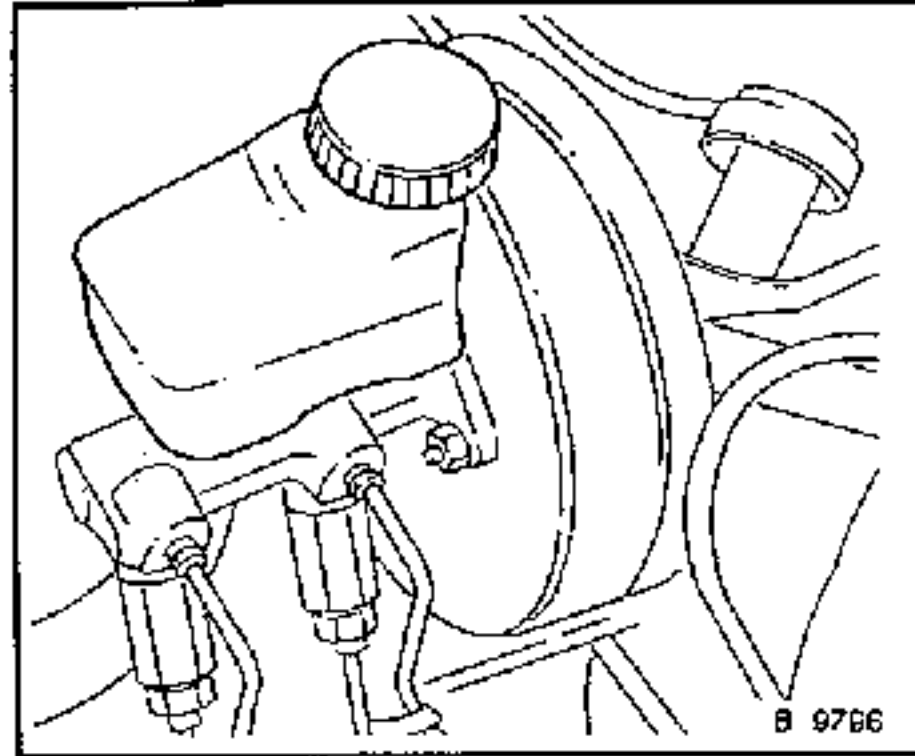
# ABS

## Hydraulic Modulator, Remove and Install (ABS -2E and ABS-2EH)

### Remove, Disconnect

Ground cable from battery.

Top up brake fluid level to the 'MAX' mark in the master cylinder reservoir.



### Remove, Disconnect

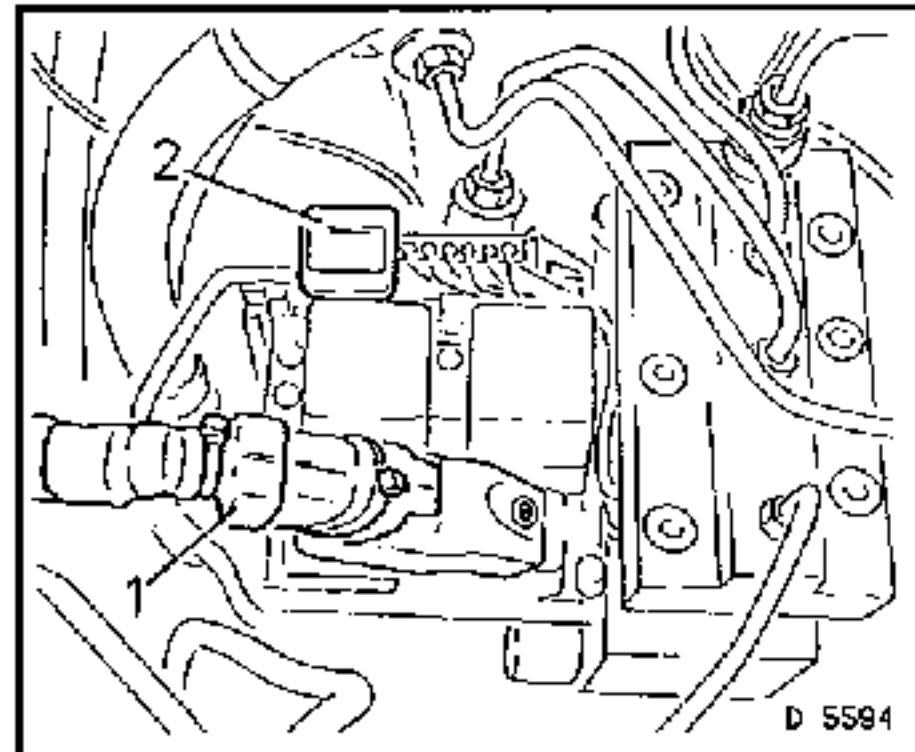
Cover from hydraulic modulator

Wiring harness plug connection (1).

Solenoid valves plug connection (2).

Brake lines from the hydraulic modulator.

If necessary lines may be carefully pushed aside but all openings must be plugged.

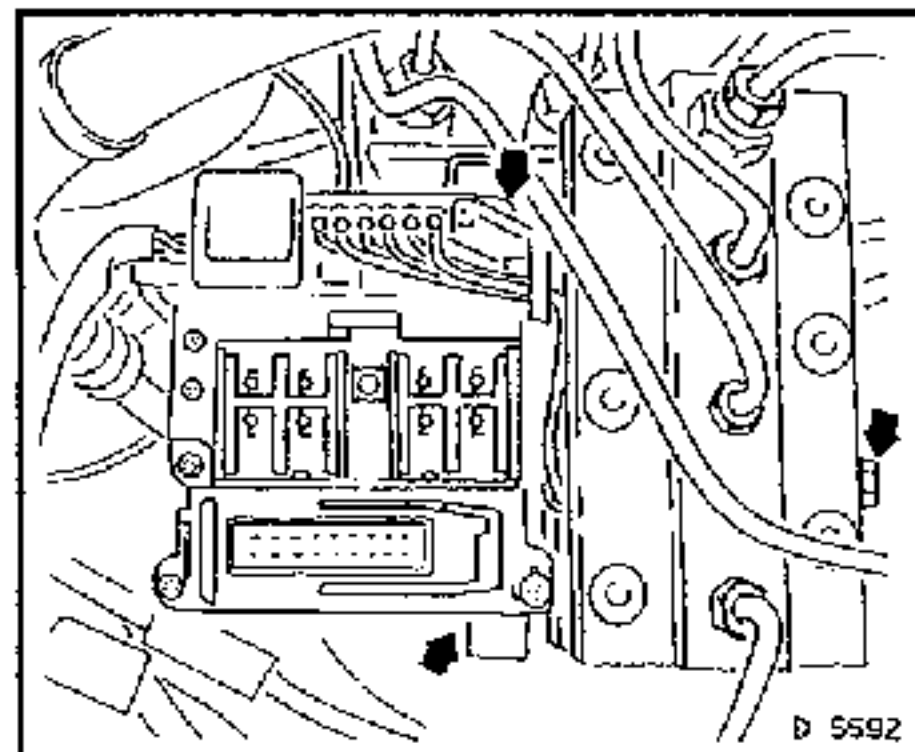


### Remove, Disconnect

Ground cable from hydraulic modulator.

Hydraulic modulator from bracket - tilt slightly and remove upwards.

When the hydraulic modulator is to be replaced, plug all fluid openings and remove both relays, if possible.



### Inspect

Hydraulic modulator bracket for a sound seating - clean.

Damping bearing for good condition and correct seating.

### Install, Connect

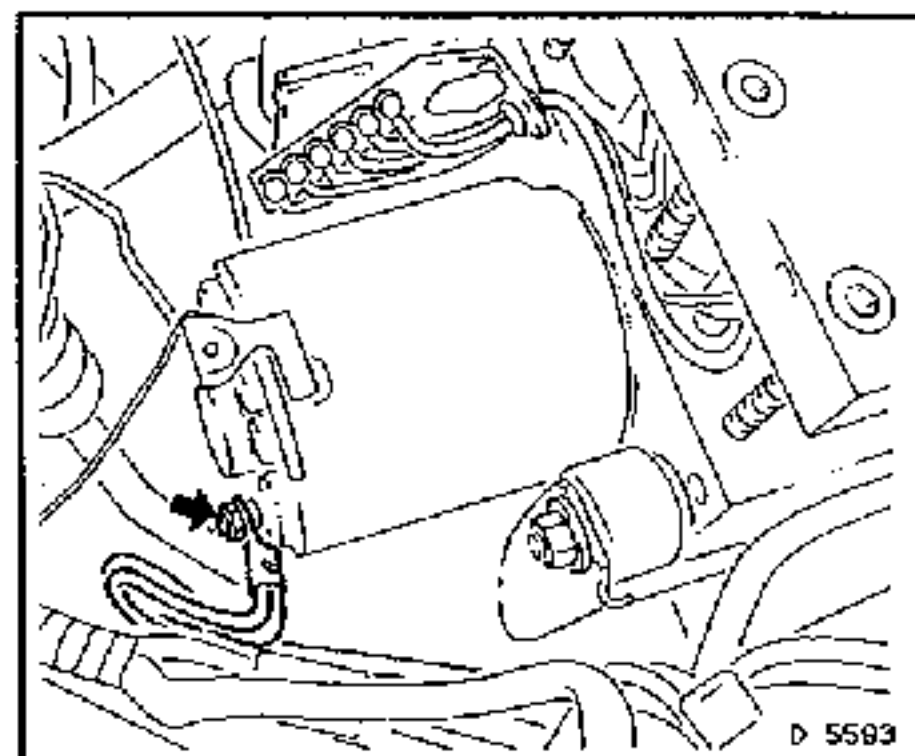
Ground cable to hydraulic modulator.

Hydraulic modulator to bracket.

Brake line union nuts to modulator.

### Tighten (Torque)

Hydraulic modulator to bracket..... 8 Nm  
Brake line union nuts..... 16 Nm



# ABS

## Install, Connect

Wiring harness plug connection (1)

Solenoid valves plug connection (2)

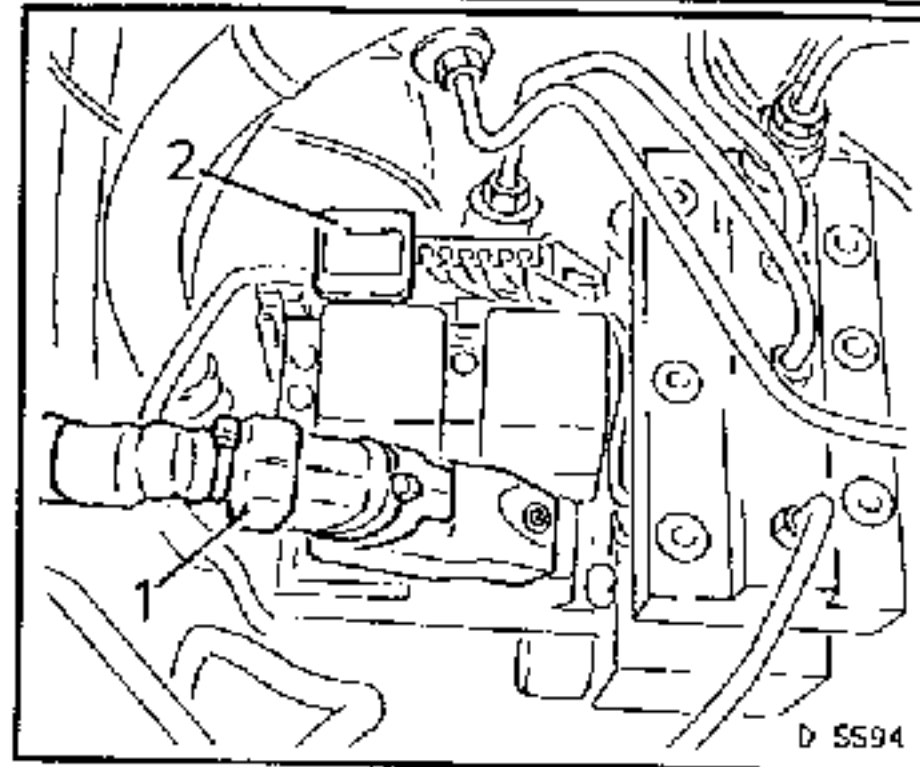
Both relays (if possible), cover to hydraulic modulator.

Remove cap from bleed screw and bleed brake system and check for leaks.

### Important!

Always bleed the front brake circuits first, on Calibra vehicles fitted with ABS.

Carry out a function check.



## Electronic Control Unit (ABS-2E)

### Important!

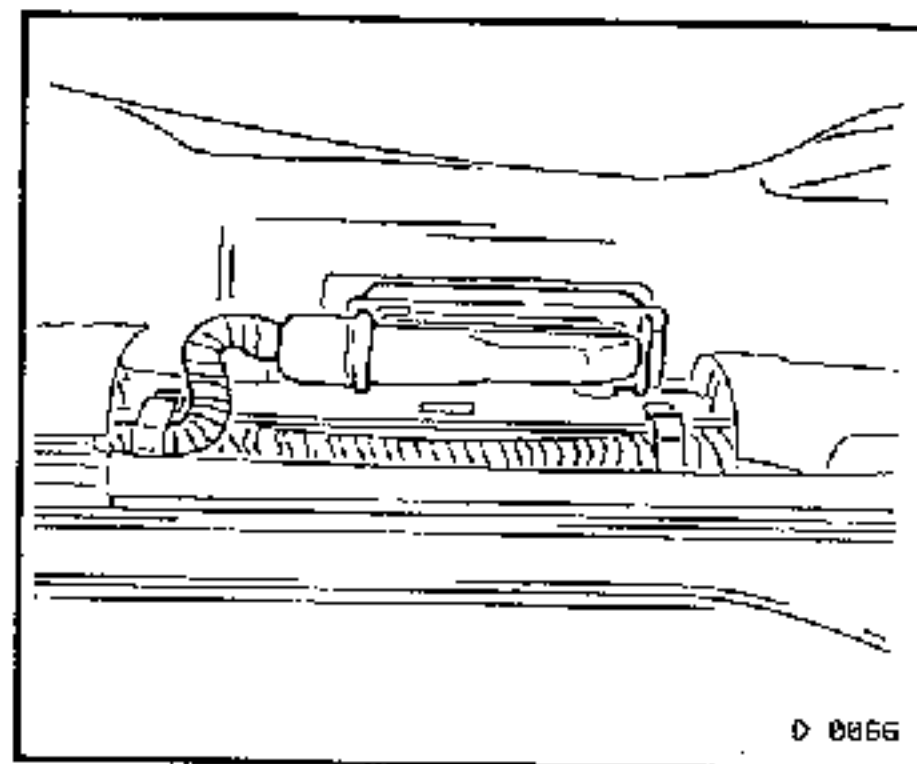
Only remove electronic control unit when the ignition is switched off and the battery ground, disconnected.

### Remove, Disconnect

Cover of control unit from left reinforcement.

Control unit from bracket.

Wiring harness plug from control unit.



## Install, Connect

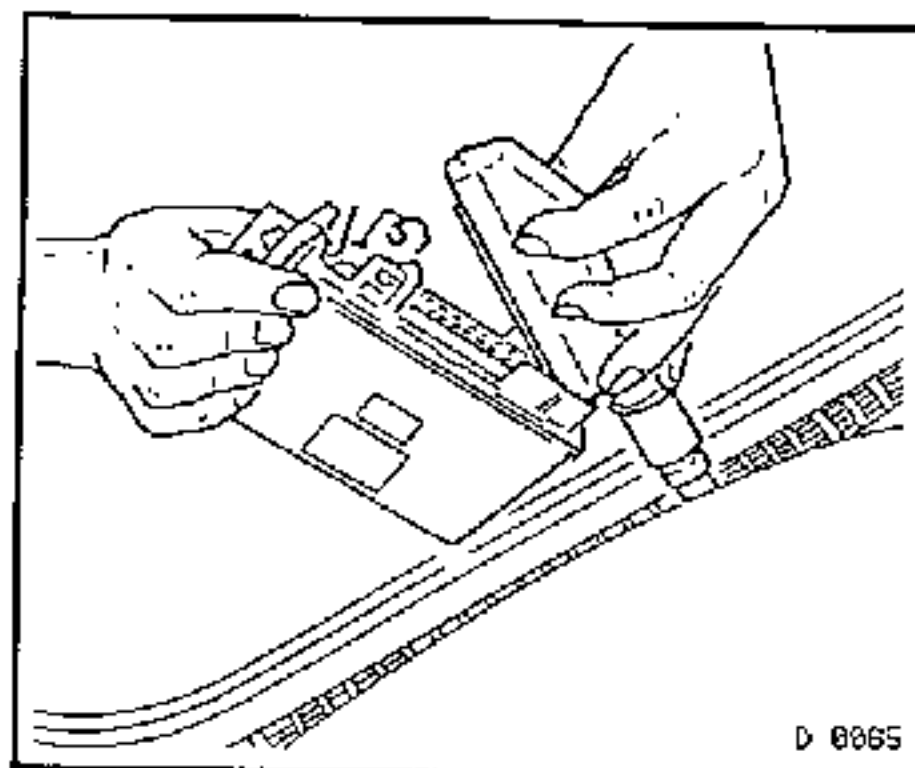
Wiring harness plug in the bracket on the control unit. Push until the catch clicks in with an audible sound.

Control unit in bracket.

Ground cable to battery.

Carry out a function check.

Install cover over control unit.



## Electronic Control Unit, Remove and Install (ABS-2EH)

### Important!

Only remove electronic control unit when the ignition is switched off and the battery ground, disconnected.

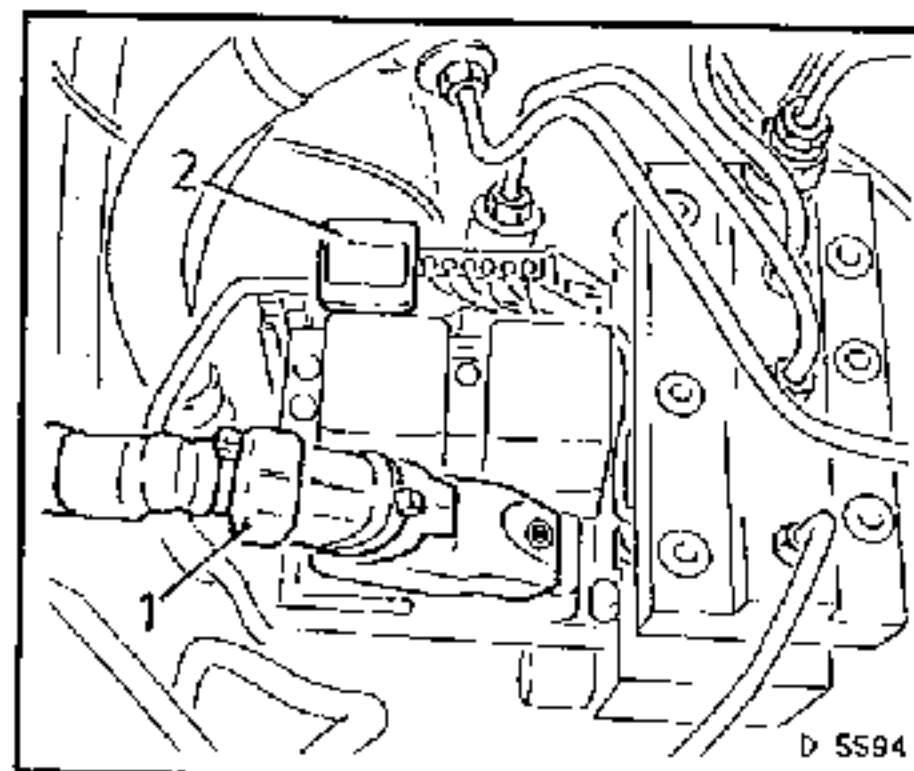
### Remove, Disconnect

Ground cable from battery.

Cover from hydraulic modulator.

Wiring harness plug connection (1).

Solenoid valves plug connection (2).





# ABS

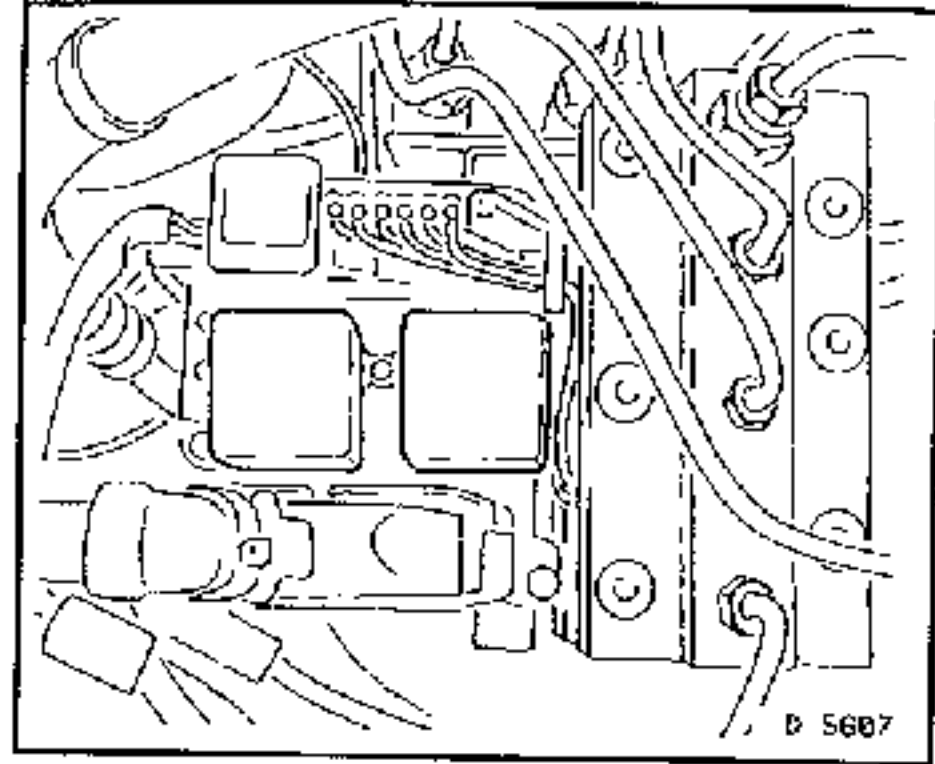
## Remove, Disconnect

Relay for solenoid valve, relay for pump motor, if possible.

Wiring harness plug (1).

Fastening bolts (2).

Remove control unit.



## Install, Connect

In reverse order.

## Tighten (Torque)

Control unit fastening bolts..... 1.5 Nm

## Wheel Speed Sensor, Remove and Install

### FRONT WHEEL BRAKE

#### Remove, Disconnect

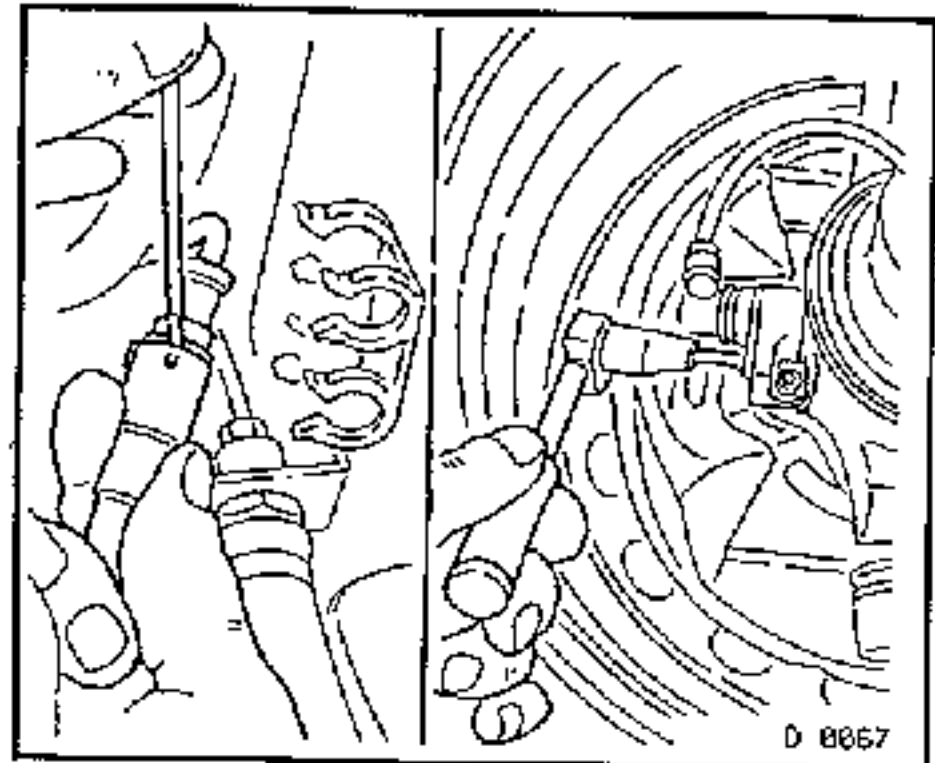
Ground cable from battery.

Wiring harness plug from bracket on wheel well.

Wiring harness plug from wheel speed sensor plug.

Wheel speed sensor cable from retaining clips.

Wheel speed sensor from bracket - lever out with a screwdriver.



#### Install, Connect

Wheel speed sensor to bracket. Coat metal housing of wheel speed sensor with lithium bearing grease, NLGI No. 4 EP.

#### Tighten (Torque)

Wheel speed sensor to bracket..... 8 Nm

#### Install, Connect

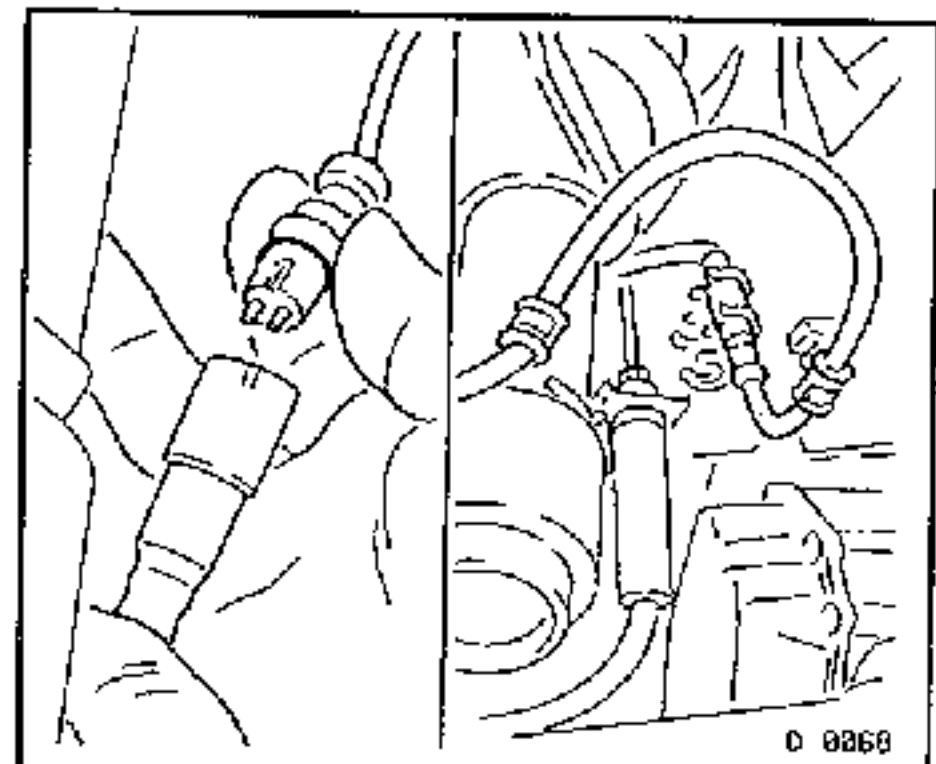
Wheel speed sensor cable in retaining clips.

Wheel speed sensor plug to wiring harness plug.

Wiring plug in bracket on wheel well.

Ground cable to battery.

Carry out a function check.



## Wheel Speed Sensor, Remove and Install

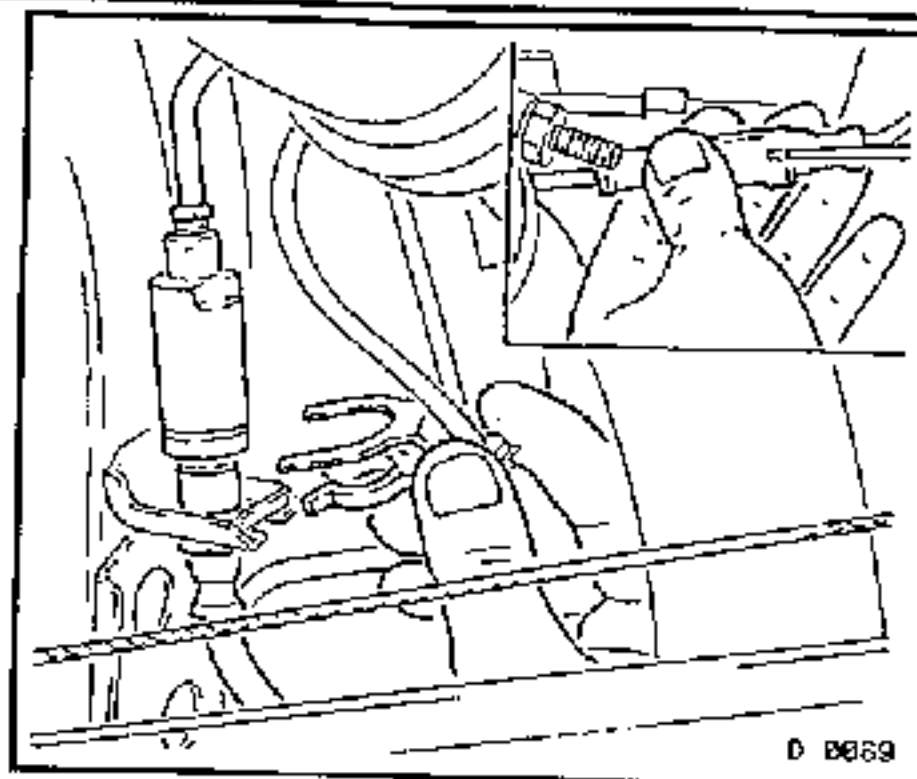
### REAR WHEEL BRAKE

Ground cable from battery.

Wiring harness plug from bracket on vehicle underbody.

Wiring harness plug from wheel speed sensor plug.

Wheel speed sensor cable from retaining clips.

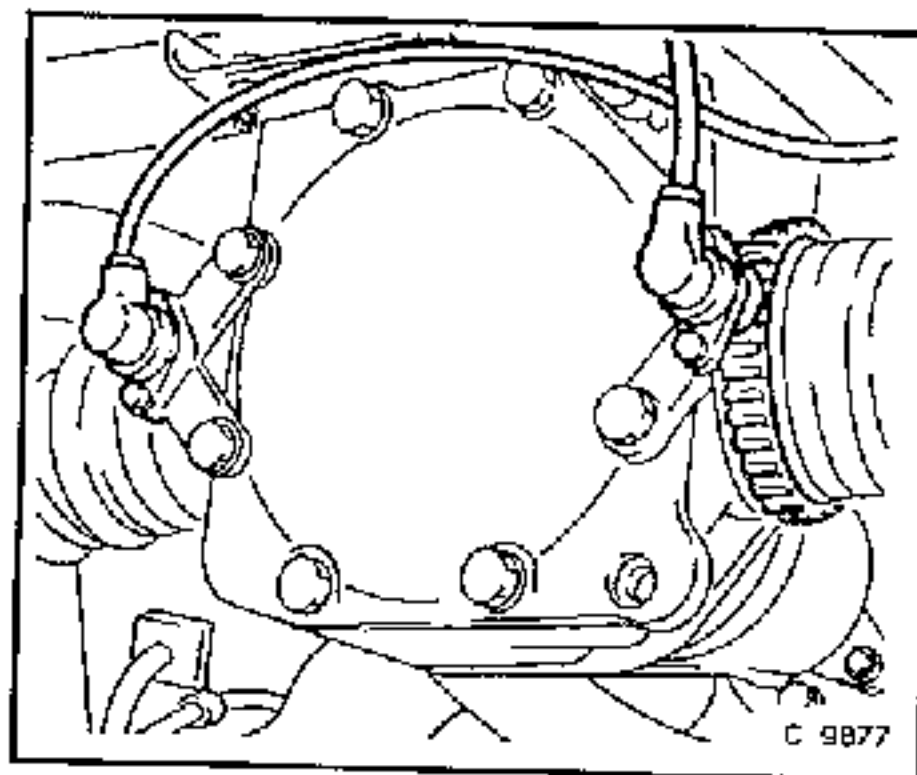


### Note:

Illustration C 9077 shows the rear wheel speed sensor for the 4WD Calibra, while illustration D 2248 shows the FWD version.

### Remove, Disconnect

Wheel speed sensor with spacer ring.



### Install, Connect

Wheel speed sensor with spacer ring.

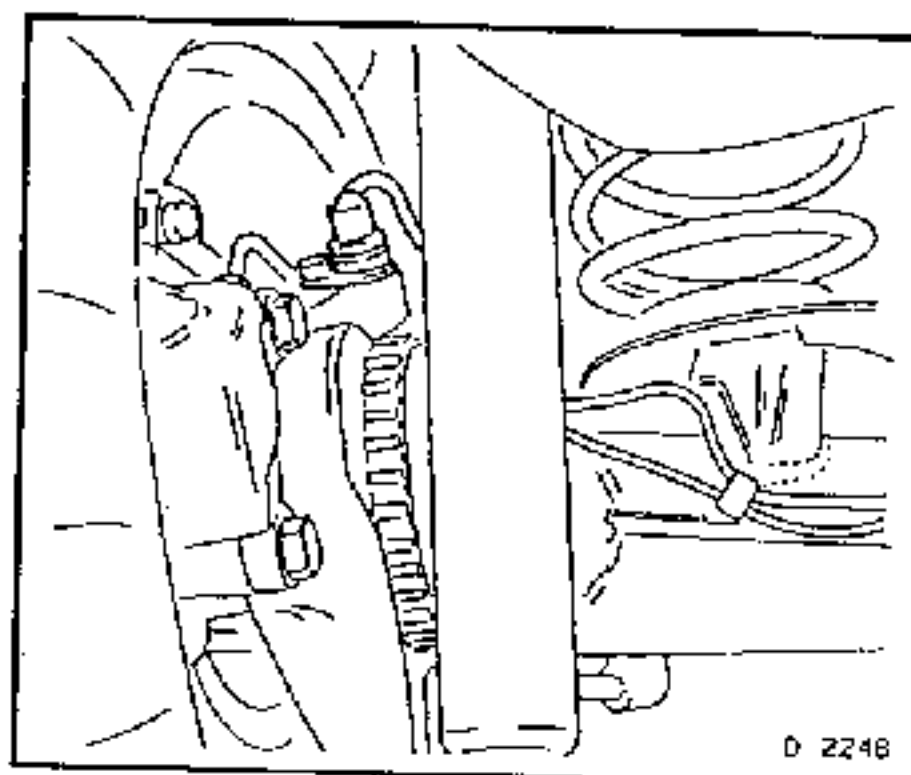
Before installation, coat metal housing of wheel speed sensor with lithium bearing grease, NLGI No. 4 EP.

Wheel speed sensor in clips.

Wheel speed sensor plug to wiring harness plug.

Plug connector to bracket.

Ground cable to battery.



### Inspect

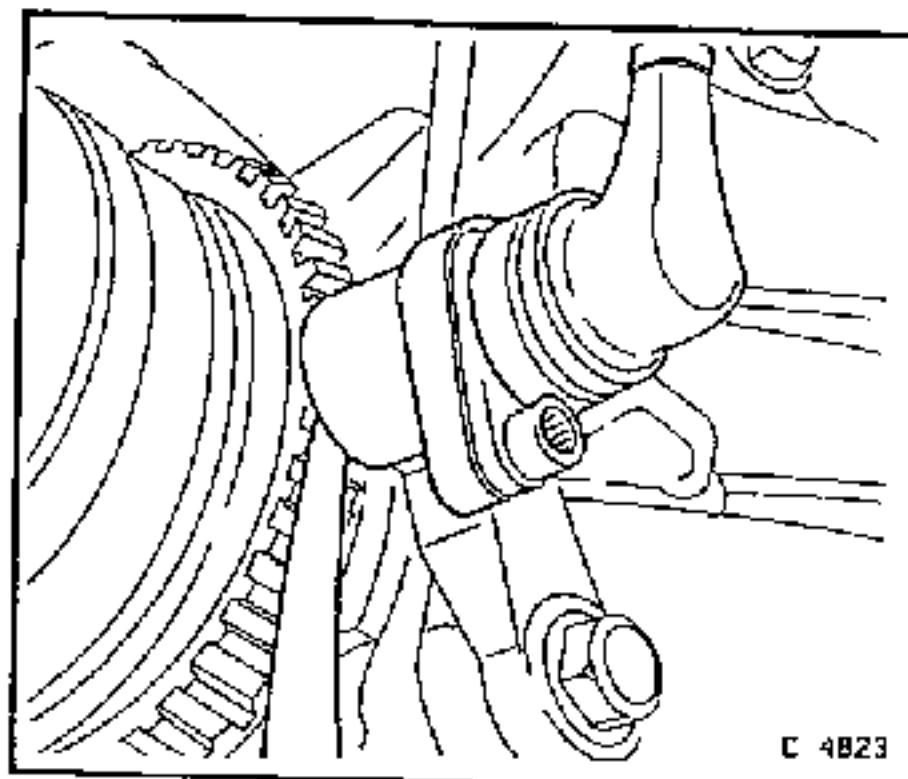
Wheel speed sensor air gap to pulse ring.

With 4WD only:

Specification = 0.5 - 1.5 mm.

Adjust by placing spacer shims underneath sensor.

Carry out function check.



# ABS

## Relay for Solenoid Valve or Pump Motor, Remove and Install

(ABS-2E/ABS -2EH, up to MY93½)

### Important!

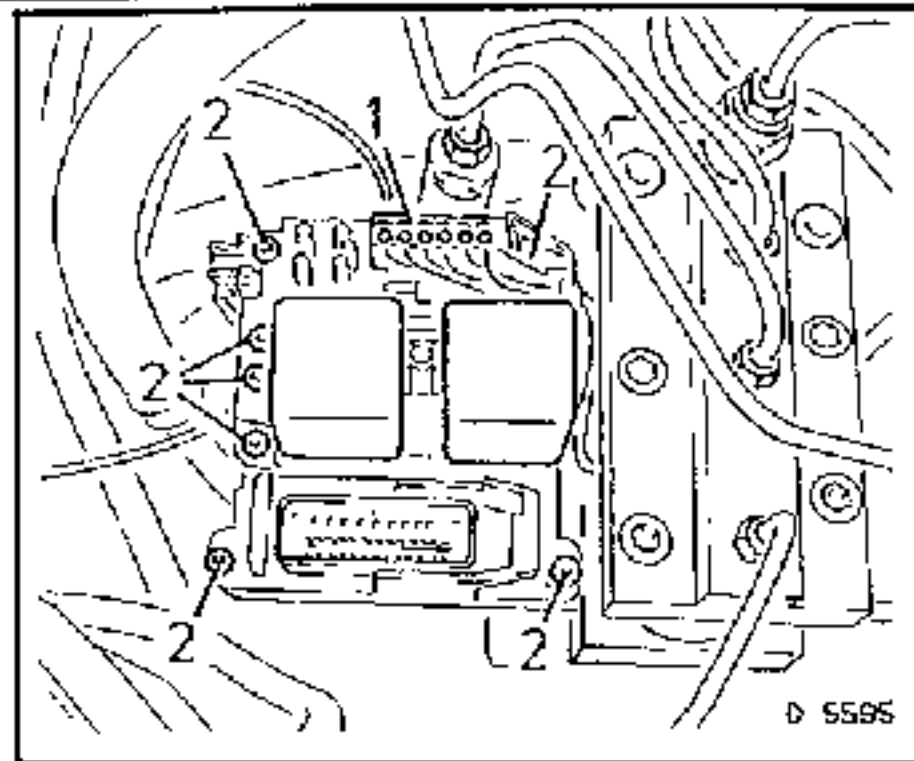
As of My 93½, the relays are an integral part of the control unit and can therefore only be replaced with the control unit.

### Remove, Disconnect

Ground cable from battery.

Cover from hydraulic modulator.

Relay for solenoid valve and relay fro pump motor.



### Install, Connect

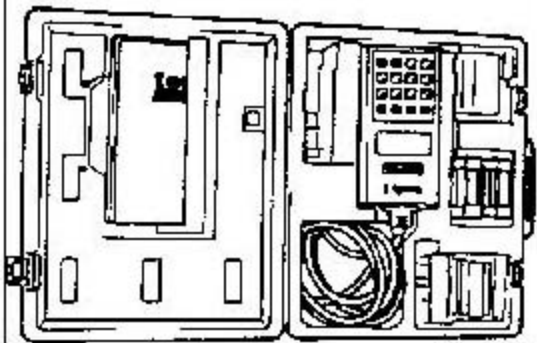
Relays.

Cover of hydraulic modulator.

Ground cable to battery.

Carry out function check.

# TECH 1 SCAN TOOL



# GROUP N

## ELECTRICAL EQUIPMENT AND INSTRUMENTS

### ANTI-THEFT WARNING SYSTEM

#### TABLE OF CONTENTS

	PAGE
General Information.....	N - 36
Survey of Components.....	N - 38
Control Unit for Anti-Theft Warning System, Remove and Install .....	N - 39
Ultrasonic Sensor, Remove and Install .....	N - 39
Bonnet Contact, Remove and Install.....	N - 40
Checking Procedures - Anti-Theft Warning System.....	N - 41

# ANTI-THEFT WARNING SYSTEM

## GENERAL INFORMATION

The electronically controls Anti-theft Warning System (ATWS) ensures a high degree of safety from vehicle break-ins, robbery and vehicle theft. The ATWS is used in conjunction with central door locking.

The ATWS monitors the doors, luggage compartment, passenger compartment, engine compartment, radio, luggage compartment and special circuits in the vehicle. Also as of model year 1993, the rear window is monitored via the rear window demist heated wires.

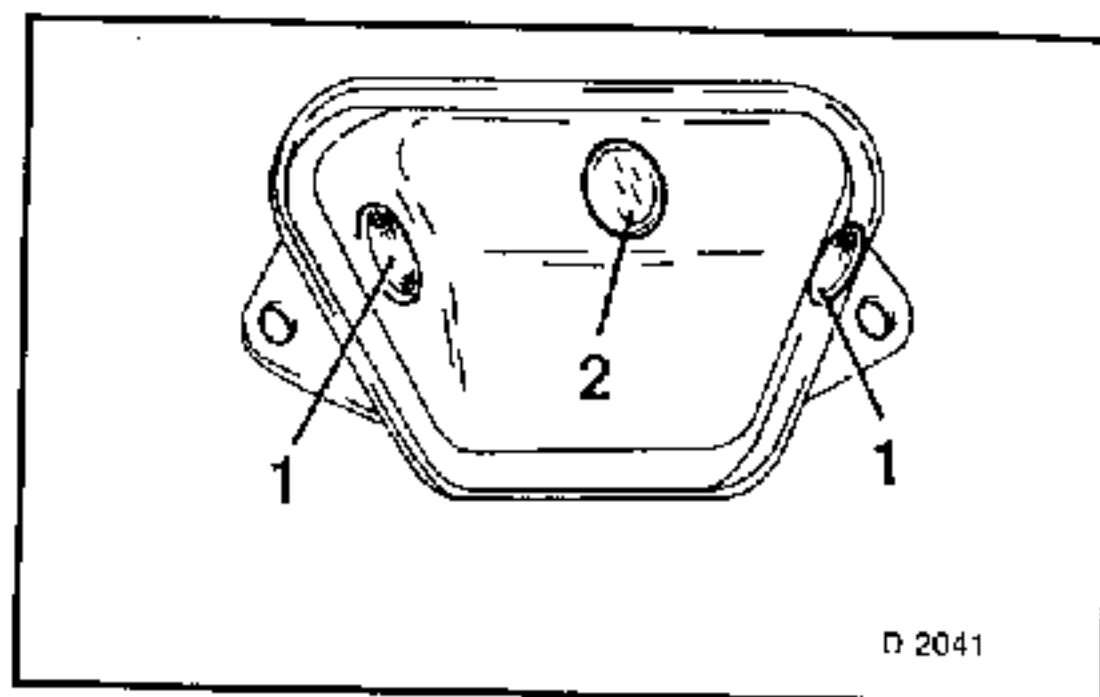
Two ultrasonic modules monitor the vehicle interior. The modules are positioned in the headlining above the B pillars. The housings are coloured to match the headlining.

A signal sent from the ultrasonic sensor is compared hundredths of a second later with the echo registered at the sensor. The sensor is switched over from the sender to the receiver. After every activation process, the control unit learns how the echo looks in a normal state. As soon as the signal deviates from the state, the warning signal is triggered.

### Ultrasonic module, passenger side

This ultrasonic module employs two ultrasonic sensors and a light diode. The light diode serves to indicate the condition of the ATWS and to send out the alarm and trouble blink code.

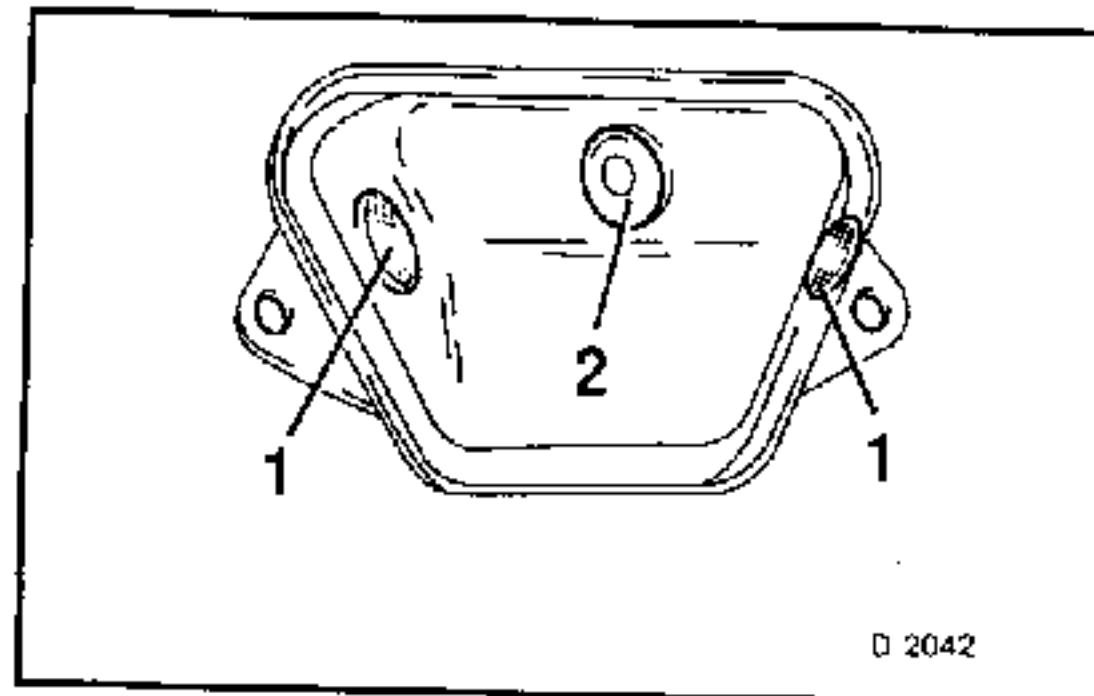
1. Ultrasonic sensor
2. Light diode



### Ultrasonic module, drivers side

When the ATWS is switched on, the interior can be intentionally excepted from monitoring (i.e. when animals are to remain in the vehicle). To do this, actuate the button at ultrasonic sensor on the drivers side before activating the system.

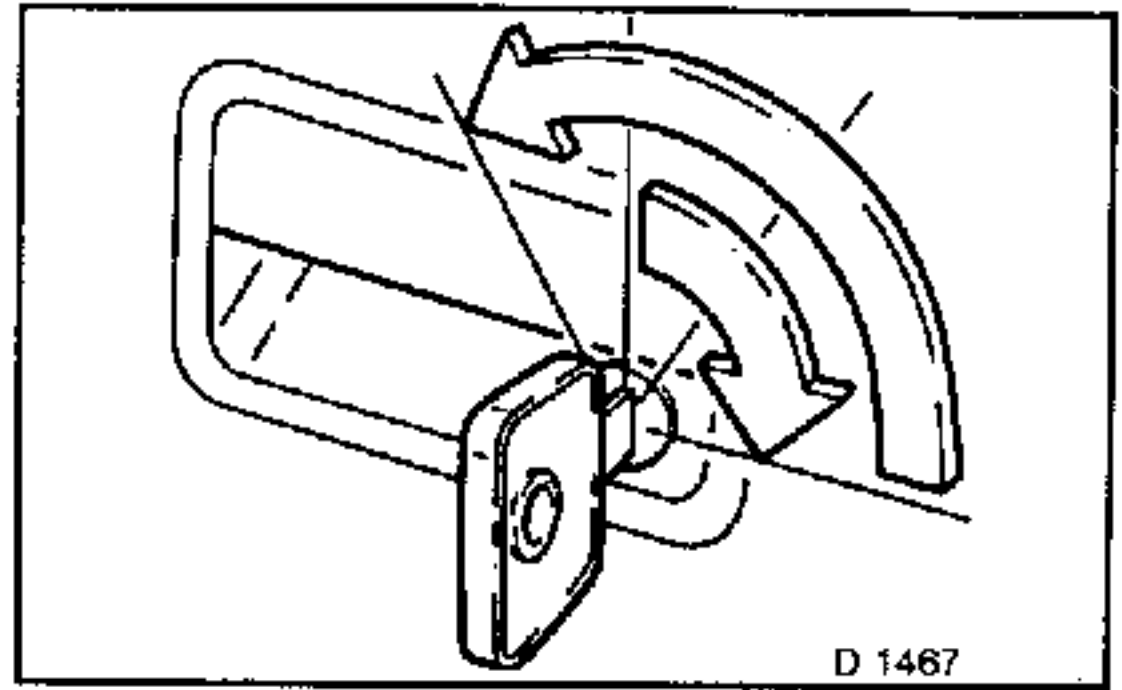
1. Ultrasonic sensor
2. Key button



# ANTI-THEFT WARNING SYSTEM

At the same time the drivers door is closed - in the anti-theft position - the ATWS is switched on by turning the key 90° to the right, and turned off by turning the key approx. 120° to the left.

The luggage compartment lock can be deactivated / activated only if beforehand the ATWS has been activated at the lock on the drivers door.



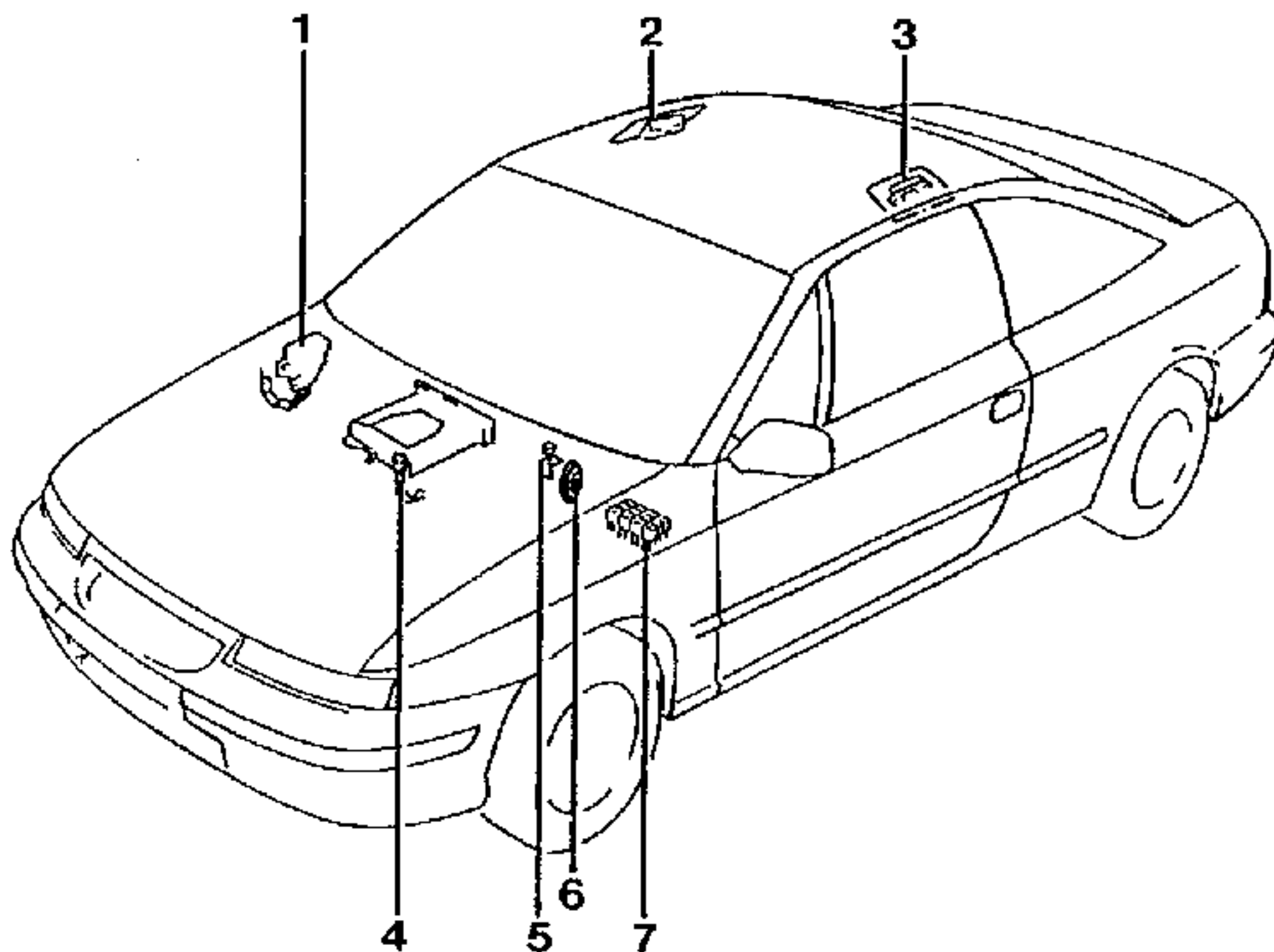
After being switched on, the ATWS indicates alarm readiness by illuminating the light diode in the ultrasonic module on the passenger side for 10 seconds. During this time the control unit carries out a self test. After a period of 10 seconds and an additional 10 seconds after extinction of the LED, the ATWS is activated. The correct functioning of the ultrasonic sensors requires that all windows and the sun roof be closed.



# ANTI-THEFT WARNING SYSTEM

## SURVEY OF COMPONENTS

- 1 – Control unit K94
- 2 – Ultrasonic sensor with LED
- 3 – Ultrasonic sensor with probe
- 4 – Radio contact
- 5 – Bonnet contact
- 6 – Horn, anti-theft warning system
- 7 – Relay, starter circuit interruption K3



D 1992

# ANTI-THEFT WARNING SYSTEM

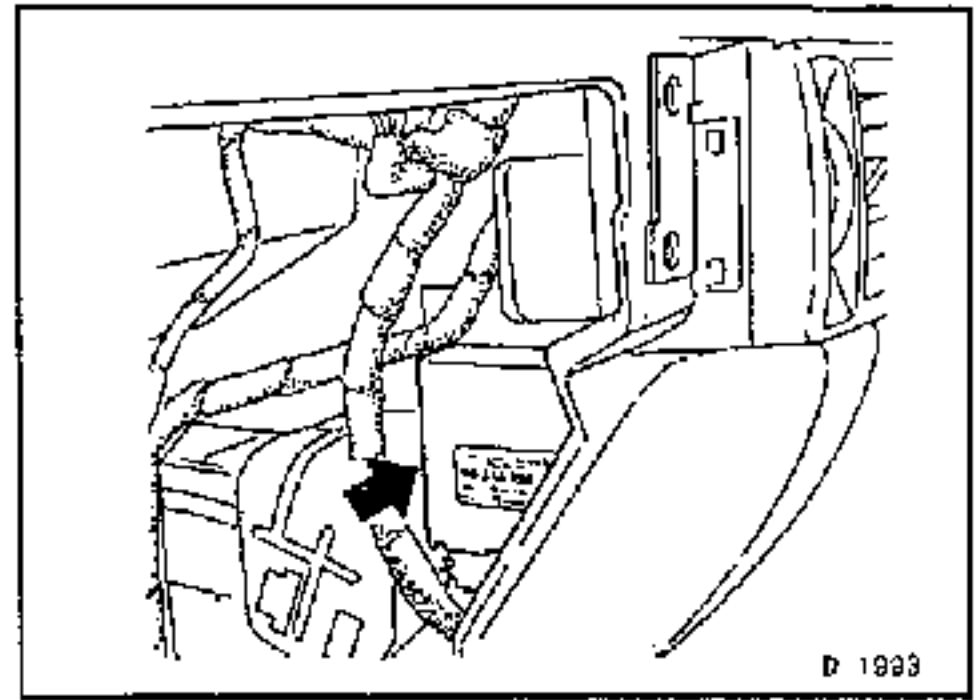
## CONTROL UNIT FOR ANTI-THEFT WARNING SYSTEM, REMOVE AND INSTALL

### Remove, Disconnect

Disconnect battery.

Glove compartment – group D (Mixed-air Heating (Interior) Remove and Install Completely).

Upper air duct, fastening bolt, control unit – towards front, wiring harness plug above.



### Install, Connect

Wiring harness plug, control unit, fastening bolt, air duct, glove compartment.

Reconnect battery.

## ULTRASONIC SENSOR, REMOVE AND INSTALL

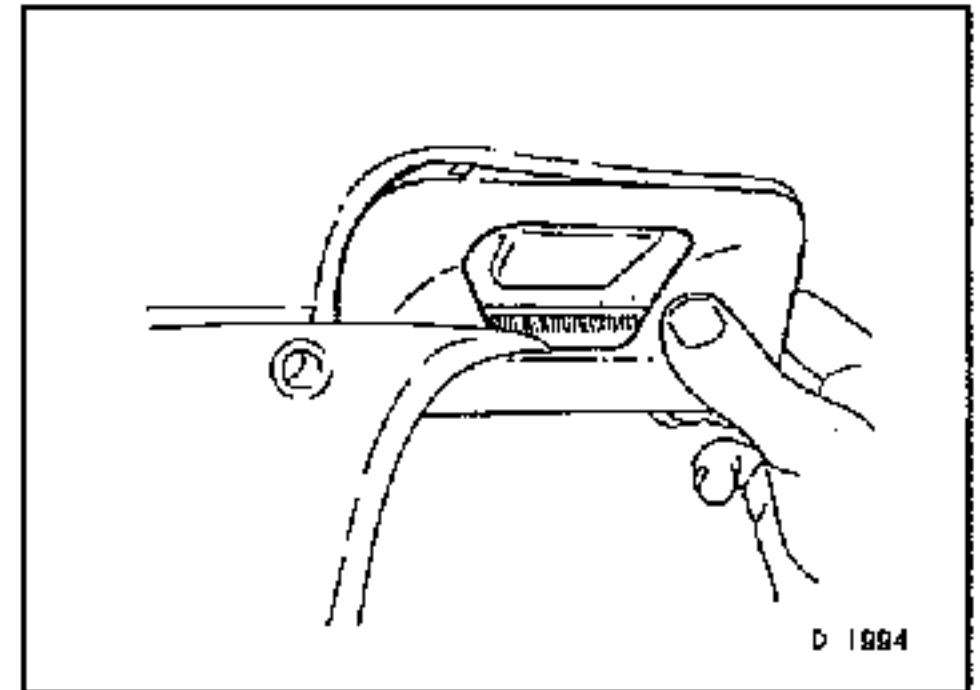
### Remove, Disconnect

Disconnect battery.

B pillar trim – unscrew and pull out above.

Trim for ultra sonic sensor – pull out downwards.

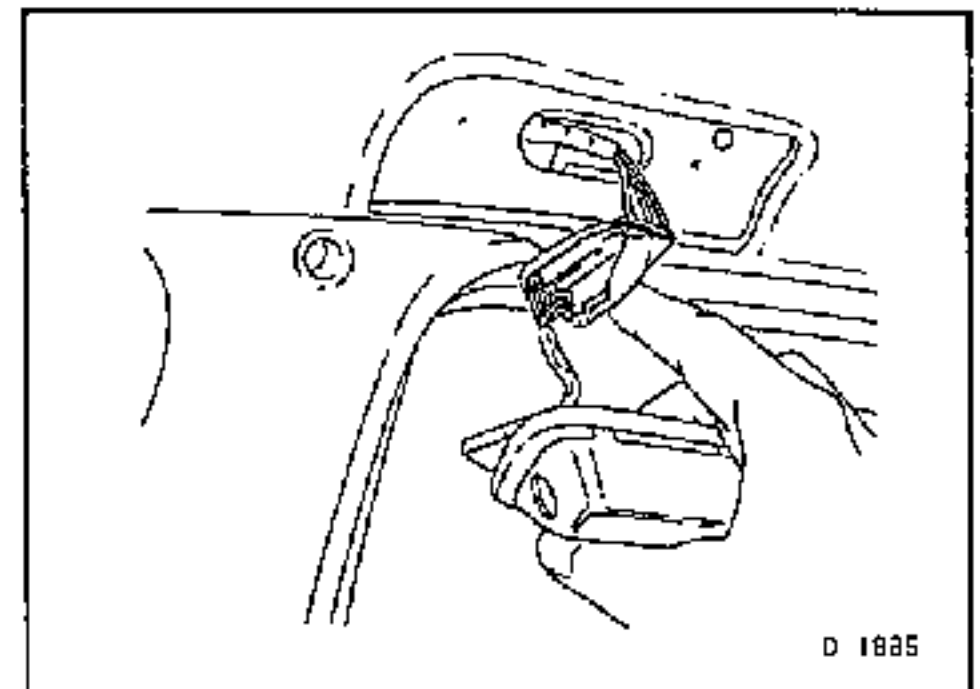
Ultrasonic sensor, wiring harness plug.



### Install, Connect

Wiring harness plug, ultrasonic sensor, trim.

Ultrasonic sensor, B pillar trim, reconnect battery.



# ANTI-THEFT WARNING SYSTEM

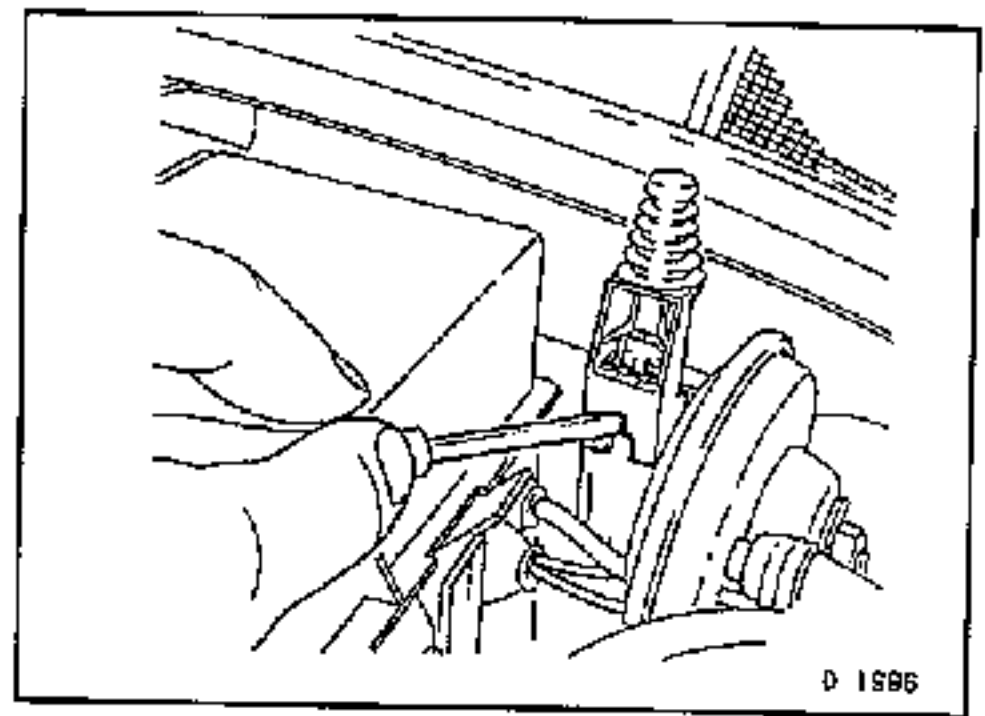
## BONNET CONTACT, REMOVE AND INSTALL

### Remove, Disconnect

Bonnet contact – press in tongue at plug casing using screwdriver, wiring harness plug.

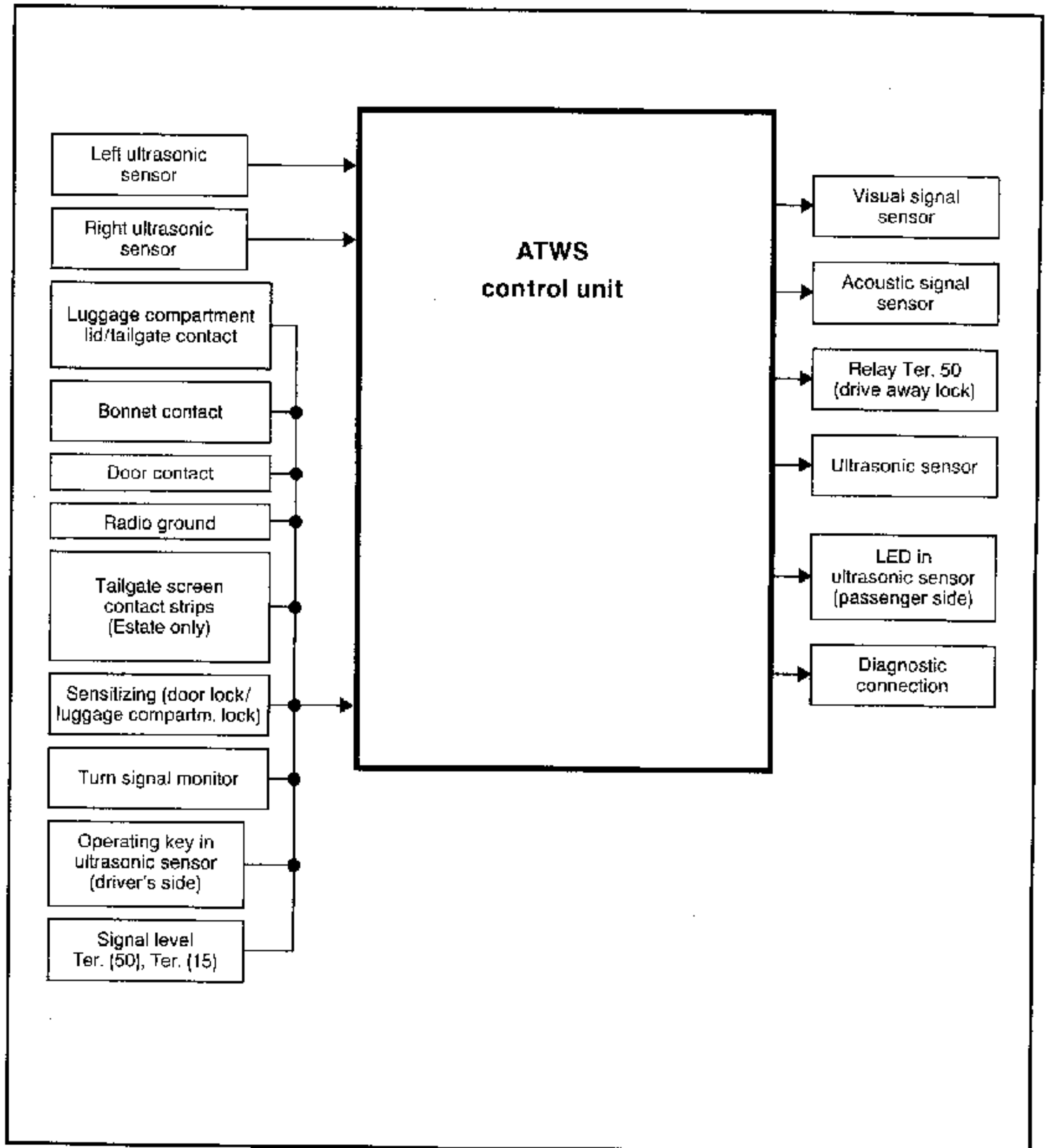
### Install, Connect

Wiring harness plug, snap in bonnet contact.



# ANTI-THEFT WARNING SYSTEM

## 4 Block Diagram, Anti Theft Warning System



# GROUP J

## DOUBLE OVERHEAD CAM ENGINE

### ENGINE DAMPING BLOCKS; ENGINE SHORT BLOCK

#### TABLE OF CONTENTS

	PAGE
Engine Damping Blocks, Replace .....	J - 340
Engine without Transmission, Remove and Install (C 20 XE, without Pot Flywheel) .....	J - 341
Engine with Transmission, Remove and Install (C 20 XE/C 20 LET, with Pot Flywheel) .....	J - 349
Engine Repair, Using Short Block .....	J - 361
Recommended Torque Values .....	J - 368

# DOHC ENGINE - ENGINE SHORT BLOCK

## Engine Damping Blocks, Replace

### Remove, Disconnect

Ground cable from battery.

### Install, Connect

Engine to Engine Holder KM-263-B.

### Remove, Disconnect

If fitted, the lower engine cover.

## Replace Right Hand Damping Block:

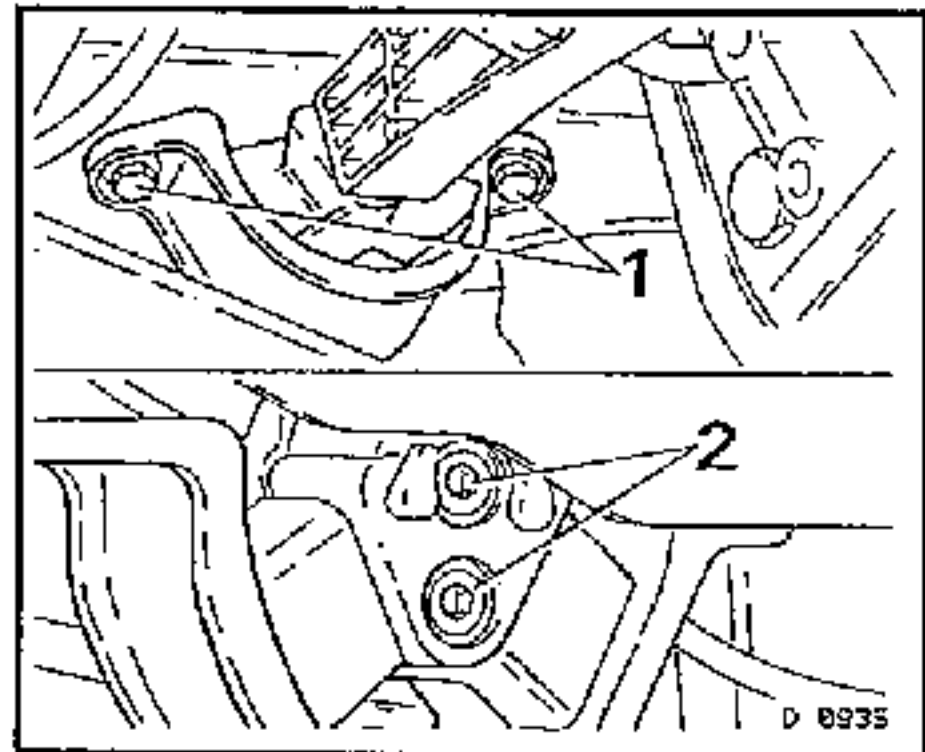
### Remove, Disconnect

Protective cover from wheel well.

Engine damping block from side member (1).

Lower engine slightly.

Bolts (2) from the holder.



### Install, Connect

Engine damping block to bracket.

### Tighten (Torque)

Engine damping block to bracket .....	35 Nm
Bracket to cylinder block .....	60 Nm
Engine damping block to side member .....	65 Nm*

\* Use locking compound to Holden's Specification  
HN1256, Loctite 242 or equivalent.

## Front Left Hand Engine Damping Block, Replace

### Remove, Disconnect

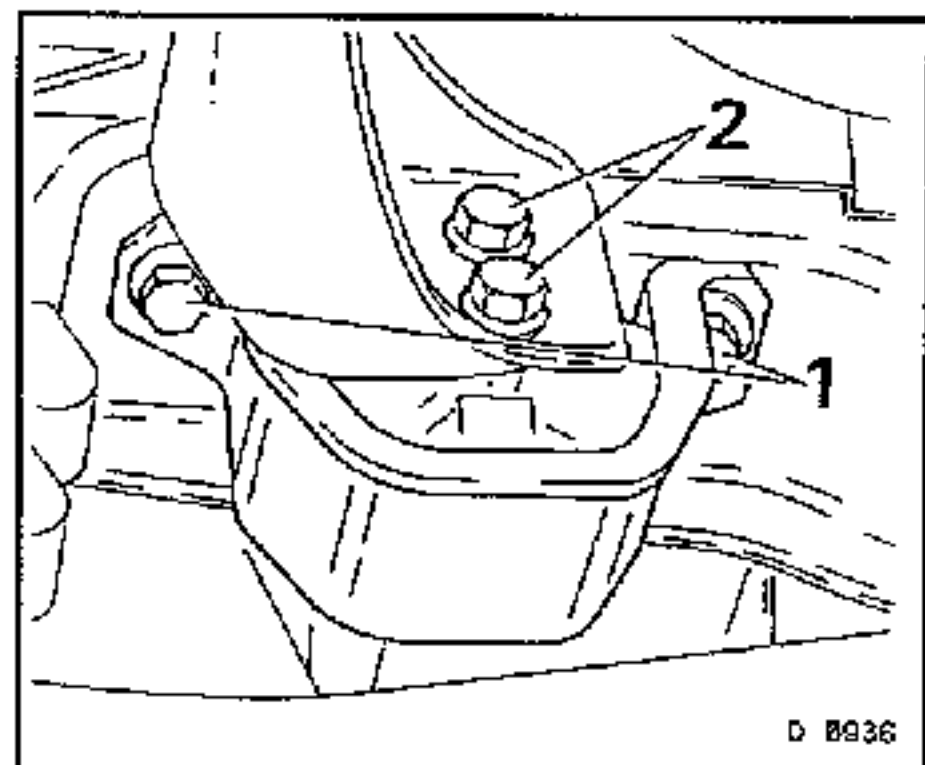
Engine damping block from side member (1).

Engine damping block from bracket (2).

### Tighten (Torque)

Engine damping block to bracket .....	60 Nm
Engine damping block to side member .....	65 Nm*

\* Use locking compound to Holden's Specification  
HN1256, Loctite 242 or equivalent.



# DOHC ENGINE - ENGINE SHORT BLOCK

## Replace Rear Engine Damping Block:

For C 20 XE Engines:

### Remove, Disconnect

Engine damping block from front axle body (1).

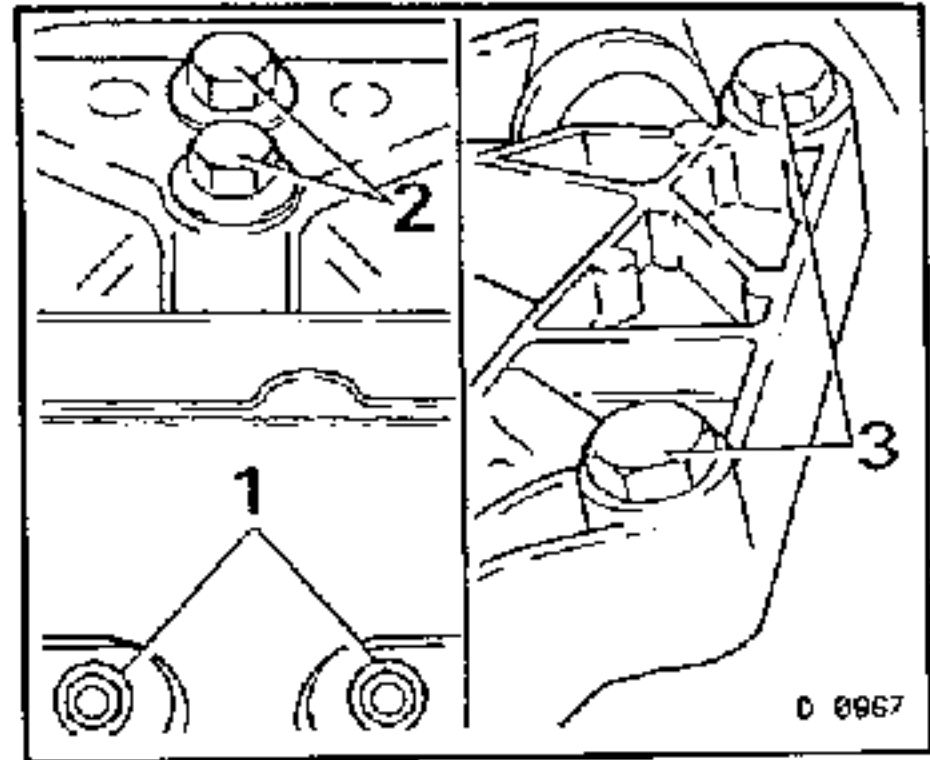
Engine damping block from bracket (2).

Bracket from transmission (3).

### Tighten (Torque)

Bracket to transmission.....	60 Nm*
Engine damping block to bracket .....	45 Nm
Engine damping block to front axle body ..	40 Nm

\* Use new locking plates.



For C 20 LET:

Lower front axle body. Refer to Section E, "Frame, Front Wheel Suspension System, Wheels and Tyres", in Volume 1.

### Remove, Disconnect

Engine damping block from bracket.

### Tighten (Torque)

Engine damping Block to bracket .....	45 m
---------------------------------------	------

### Install, Connect

Front axle body.

With all Engines:

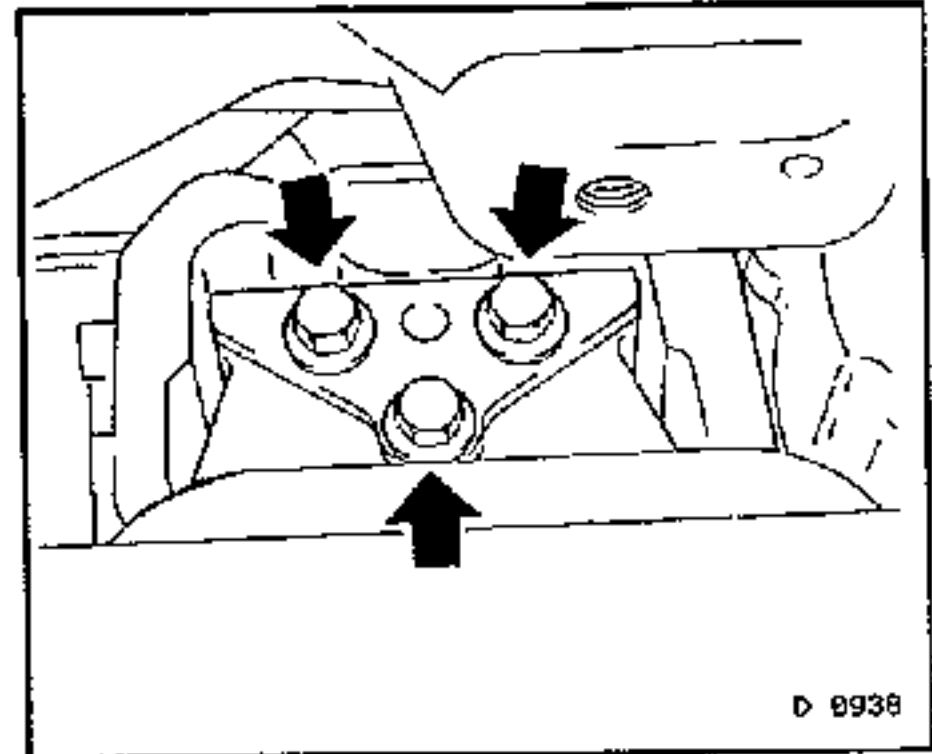
### Remove, Disconnect

Engine Holder KM-263-B.

### Install, Connect

Engine lower cover.

Ground cable to battery.



## Engine without Transmission, Remove and Install (C 20 XE without Pot Flywheel)

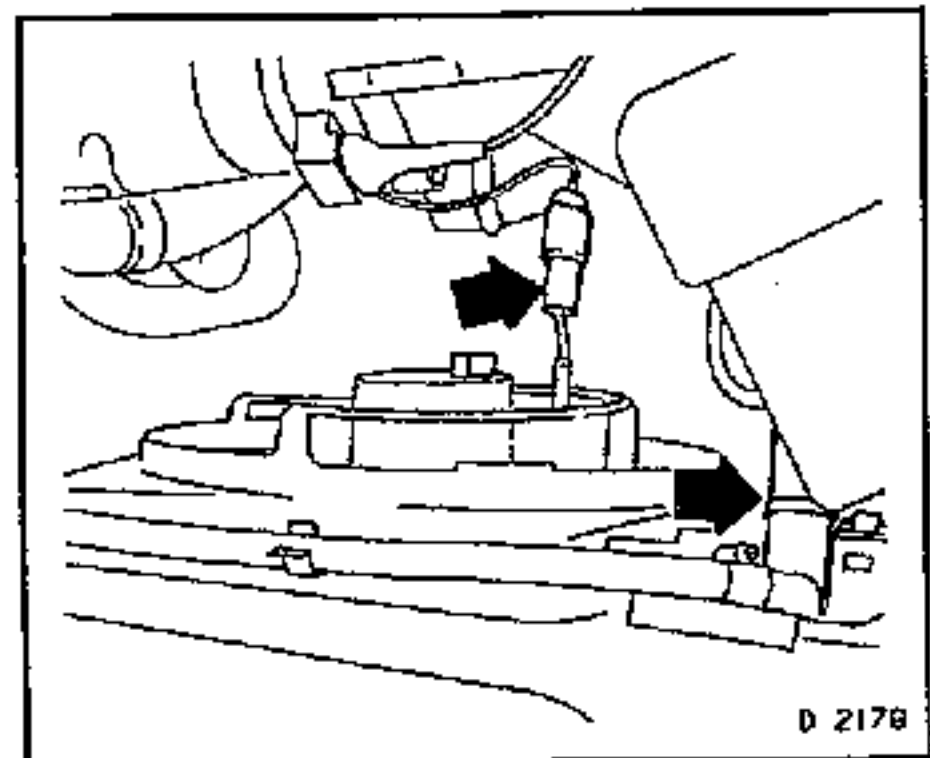
### Remove, Disconnect

Bonnet, engine compartment cover.

Ground cable from battery.

Lower coolant hose from radiator (arrow).

Fan motor wiring harness plug (arrow).



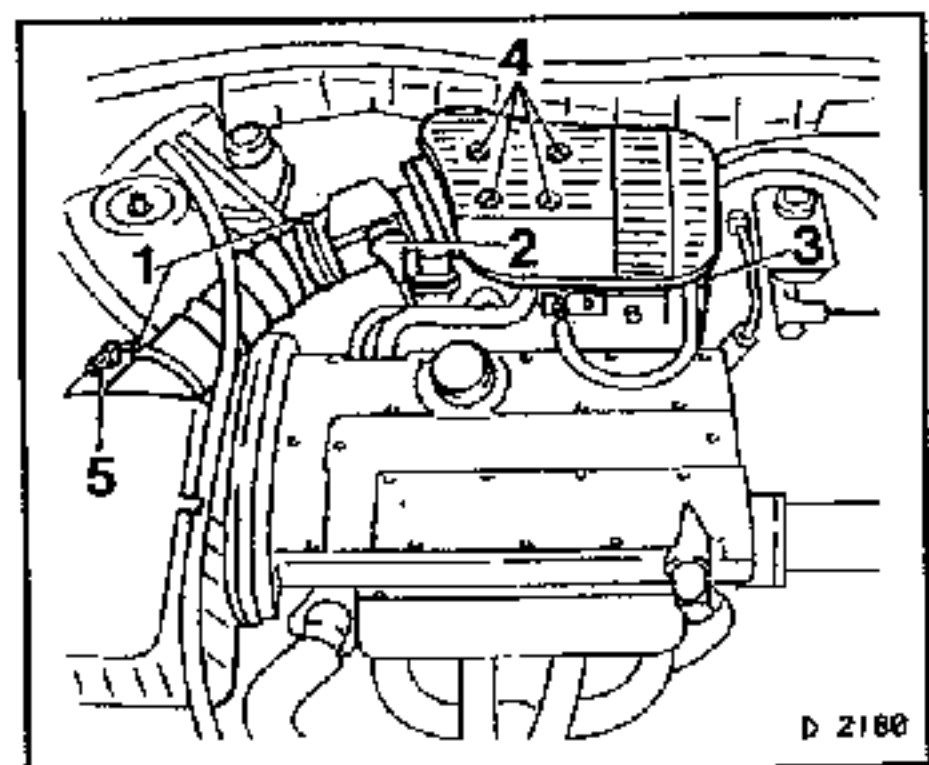
### Remove, Disconnect

Air intake hose (1), wiring harness plug (2) from mass air flow meter, idle speed adjuster hose (3) from pre-volume chamber.

Pre-volume chamber (4) with mass air flow meter.

Wiring harness plug (5) from inductive pulse pick-up.

Air cleaner housing. Refer to 'Air Cleaner Housing, Remove', in the Section "Engine Timing Side, Air Cleaner", in this Volume.





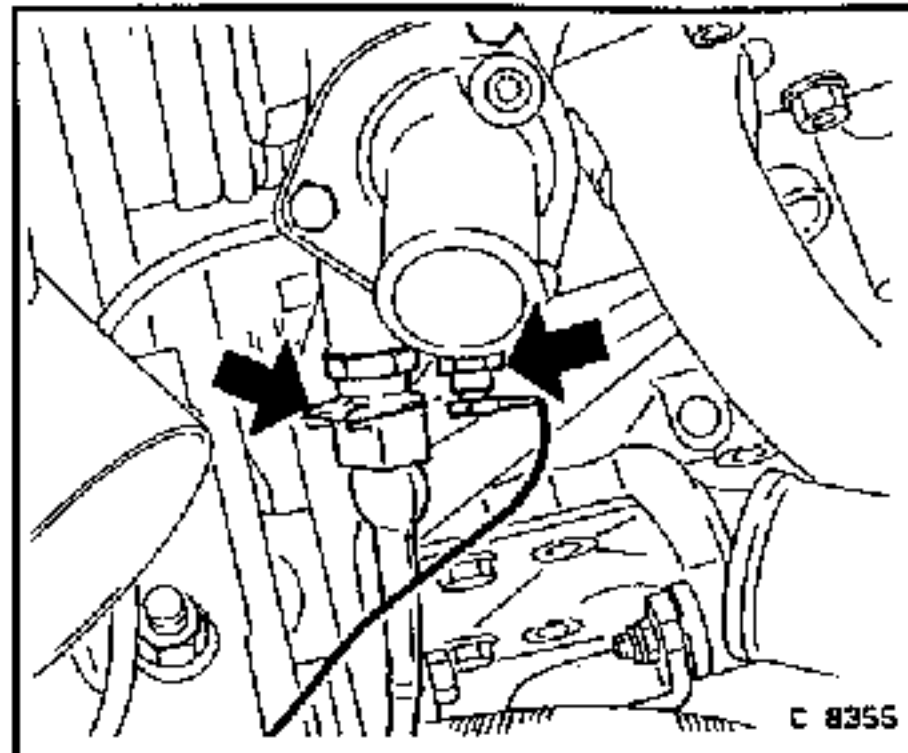
# DOHC ENGINE - ENGINE SHORT BLOCK

## Remove, Disconnect

Coolant hose.

Wiring harness plugs (arrows) from the thermostat housing.

Performance header. Refer to 'Gasket, Performance Header, Replace', in the Section "Cylinder Head", in this Volume.

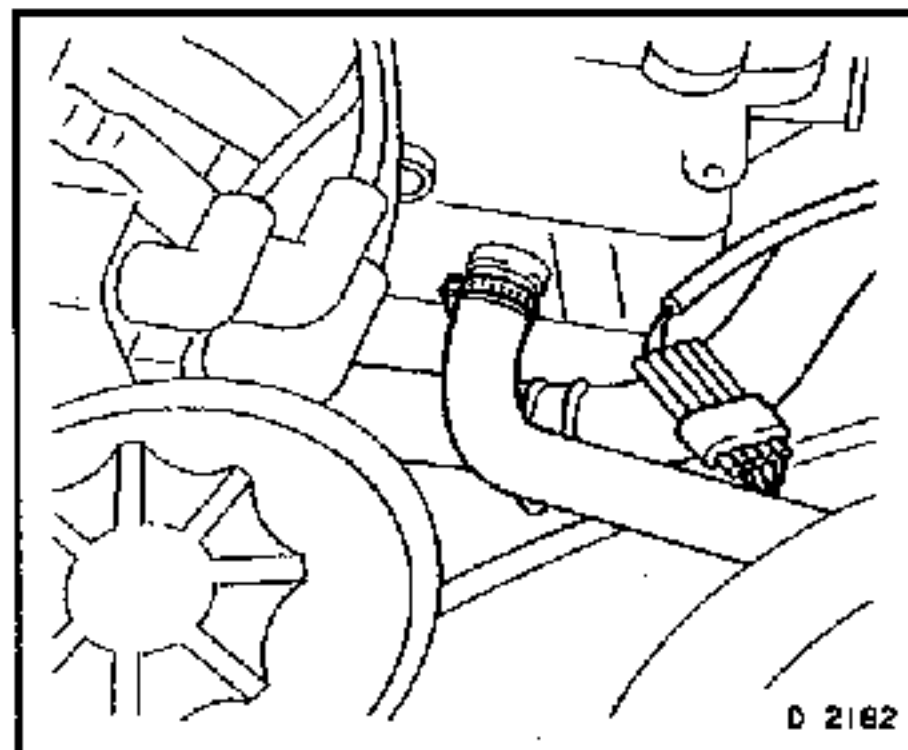


## Remove, Disconnect

Wiring harness plug and high voltage cable from high voltage distributor.

Coolant hose from cylinder head, coolant hoses from coolant pipe. Use a suitable clean container to drain coolant.

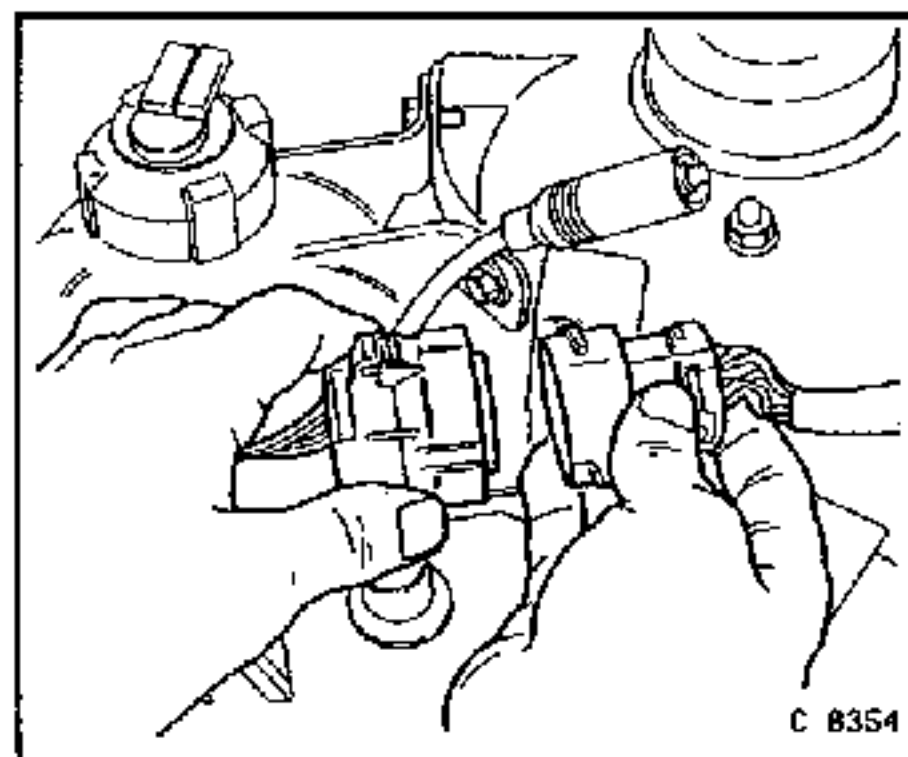
Multi-plug.



## Remove, Disconnect

Wiring harness plug for reversing lamp.

Engine to body wiring harness multi-plug.

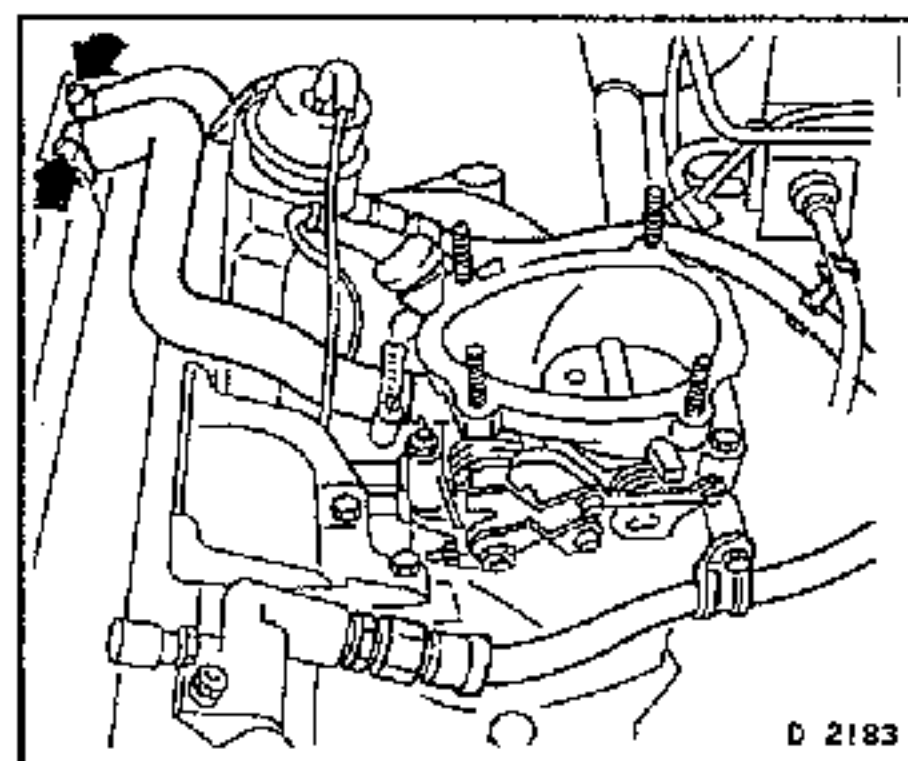


## Remove, Disconnect

Bowden cable.

Fuel lines, sealing first with suitable clamps to prevent fuel spillage.

Hose connections (arrows) from cylinder head cover.



# DOHC ENGINE - ENGINE SHORT BLOCK

## Remove, Disconnect

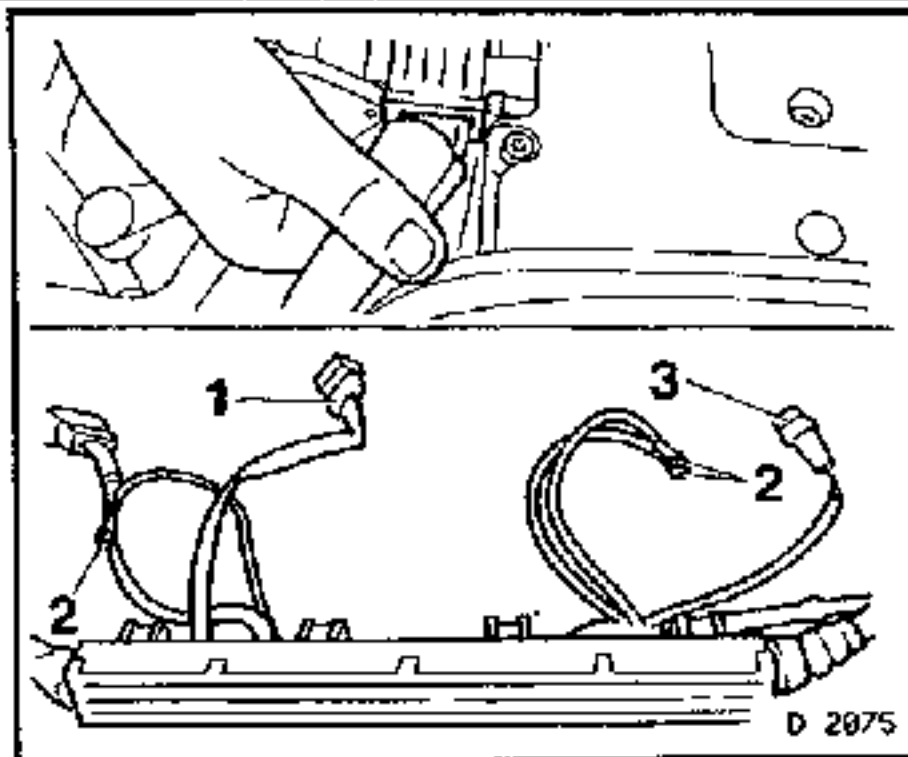
Plug strip from injectors.

Wiring harness plug (1) from throttle valve switch (M 2.5) or potentiometer (M 2.8).

Ground connections (2) from fuel distributor pipe.

Wiring harness plug (3) from controlled canister purge valve.

Lay injector plug strip towards the rear of the engine.

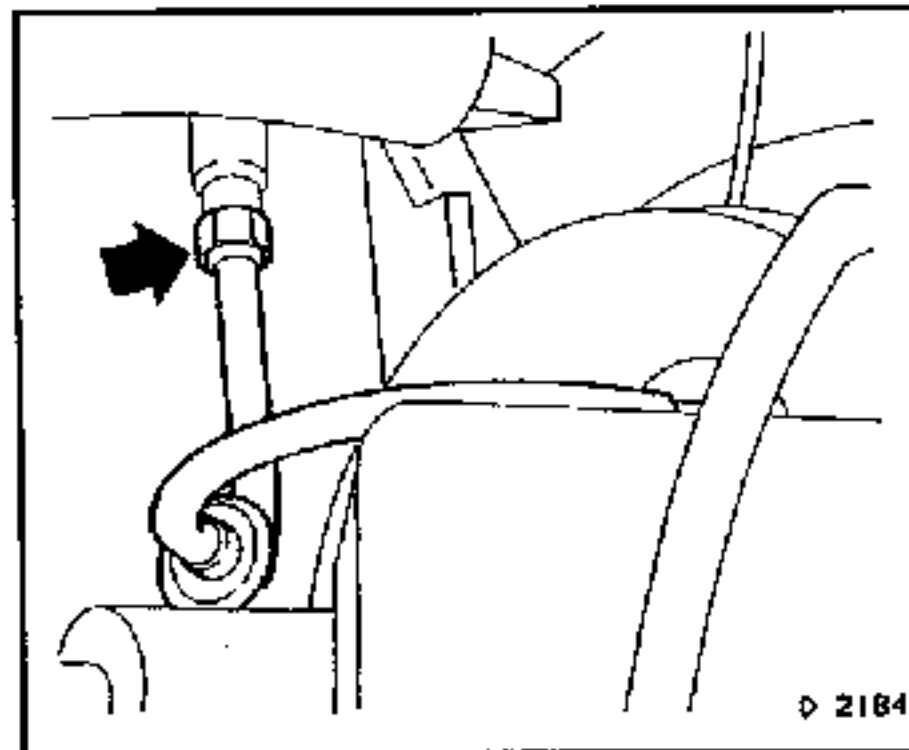


## Remove, Disconnect

Brake servo vacuum line (arrow) from intake manifold.

Alternator. Refer to the Section "Alternator", in this Volume.

Coolant hose from the coolant reservoir tank.

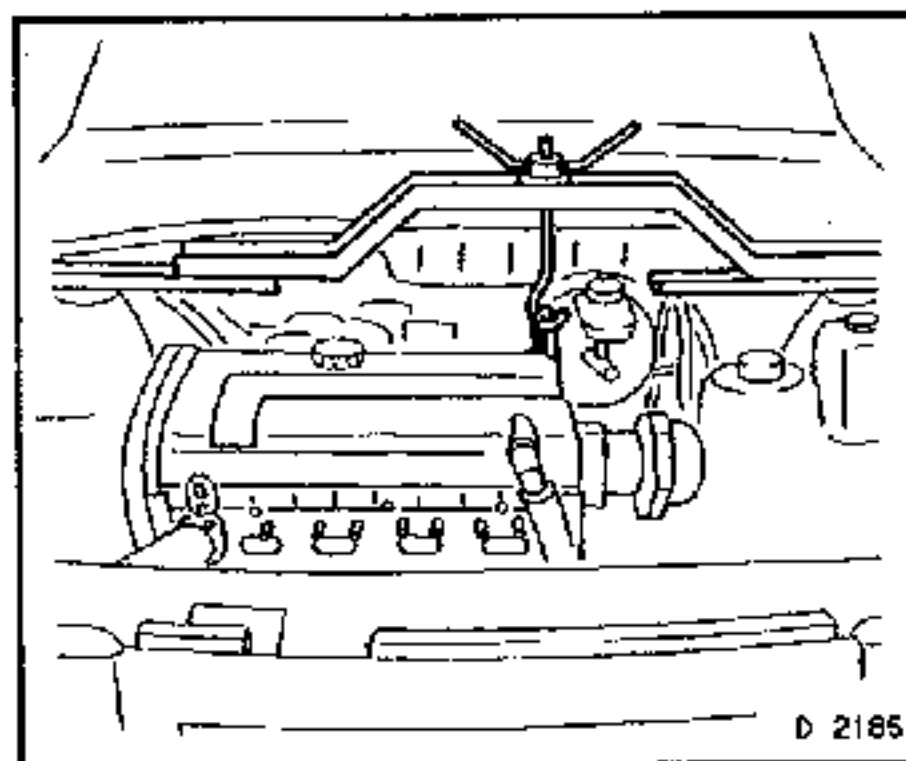


## Remove, Disconnect

Clutch cable from the clutch release lever, the shift rod and shift guide. Refer to Section K "Clutch and Transmission" in Volume 4.

Upper transmission bolts from the cylinder block.

Attach engine holder KM-263-B.



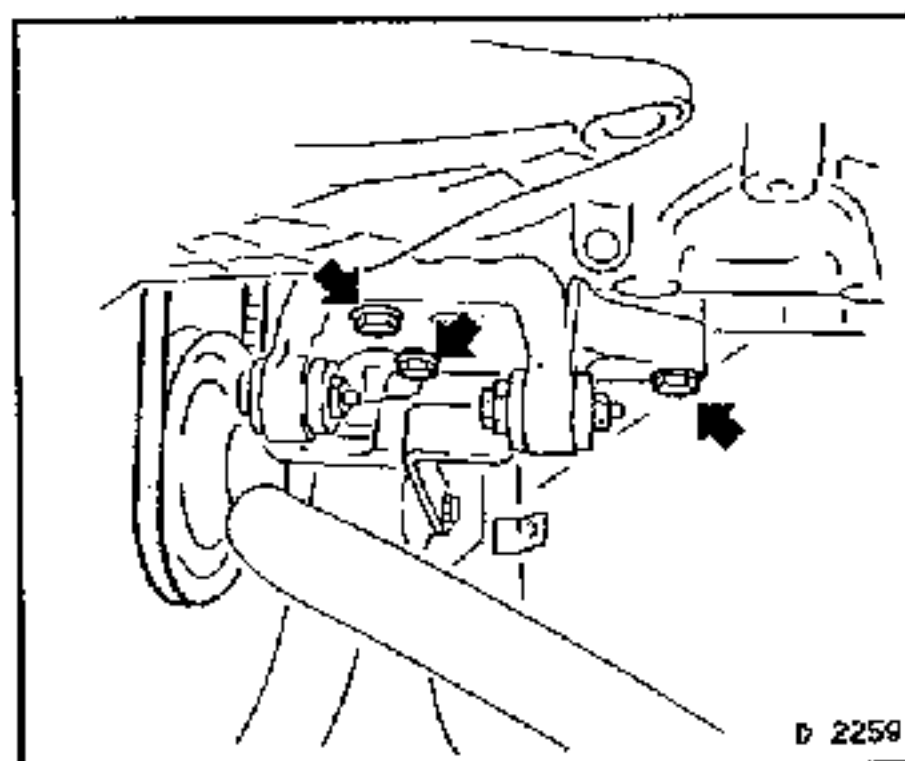
## Remove, Disconnect

V-belts for power steering pump and A/C compressor.

Power steering pump (arrows) from cylinder block. Lay the pump and bracket to one side.

### Important!

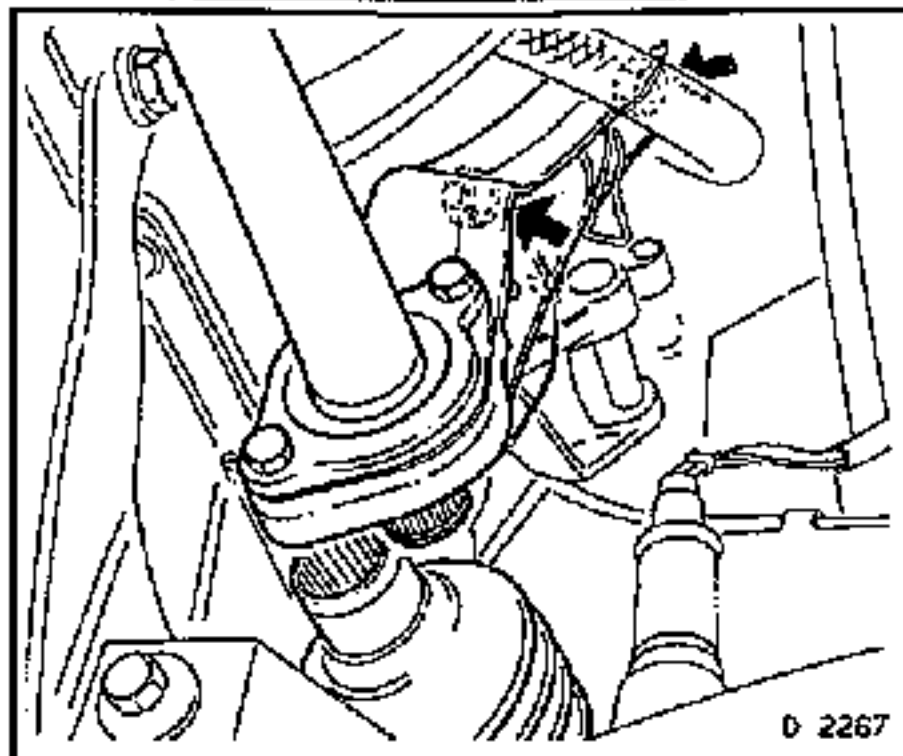
Leave the hydraulic system intact.



# DOHC ENGINE - ENGINE SHORT BLOCK

## Remove, Disconnect

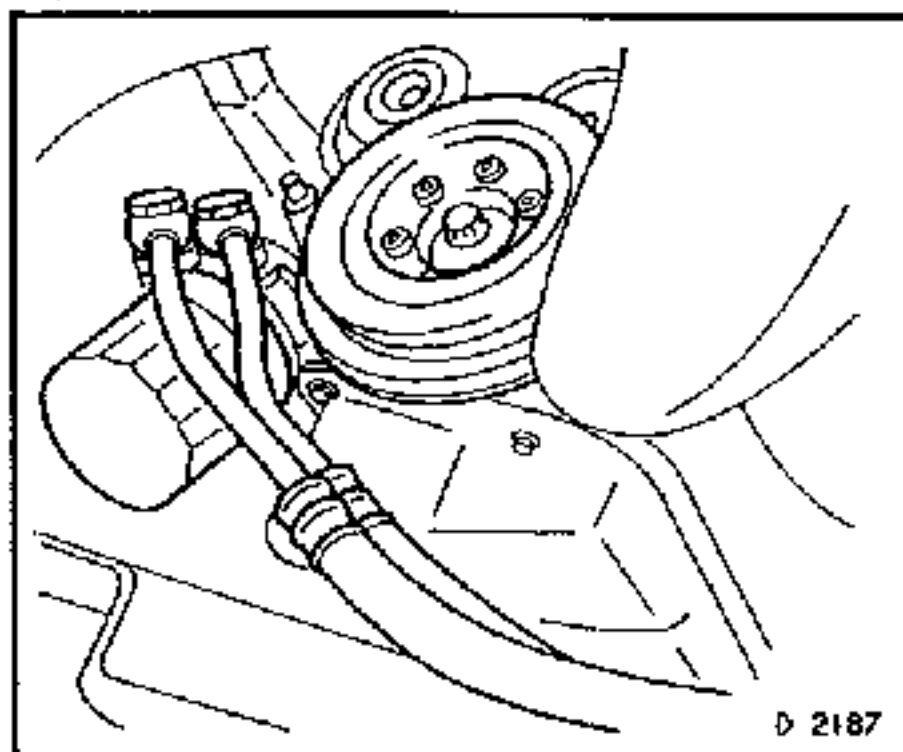
Intermediate shaft bracket (arrows), from cylinder block.



## Remove, Disconnect

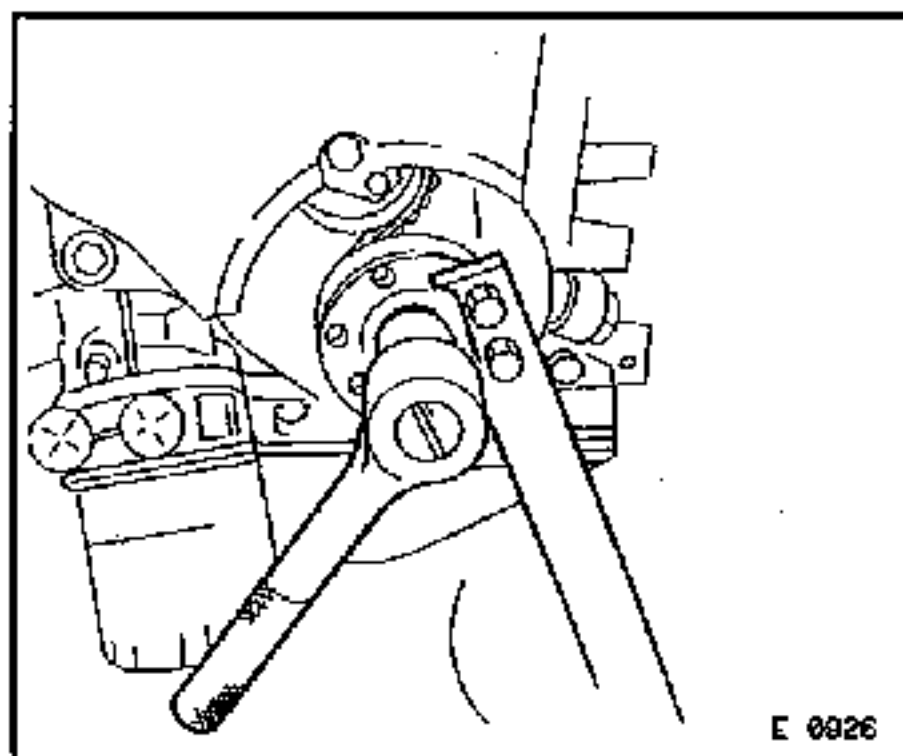
Crankshaft pulley, using KM-321-A. Hold the toothed belt drive gear with MKM-604-21 (Torx E 20) during this process.

Oil cooler lines and oil filter cartridge. Use a commercially available removal tool. Collect oil with a suitable sized clean container.



## Remove, Disconnect

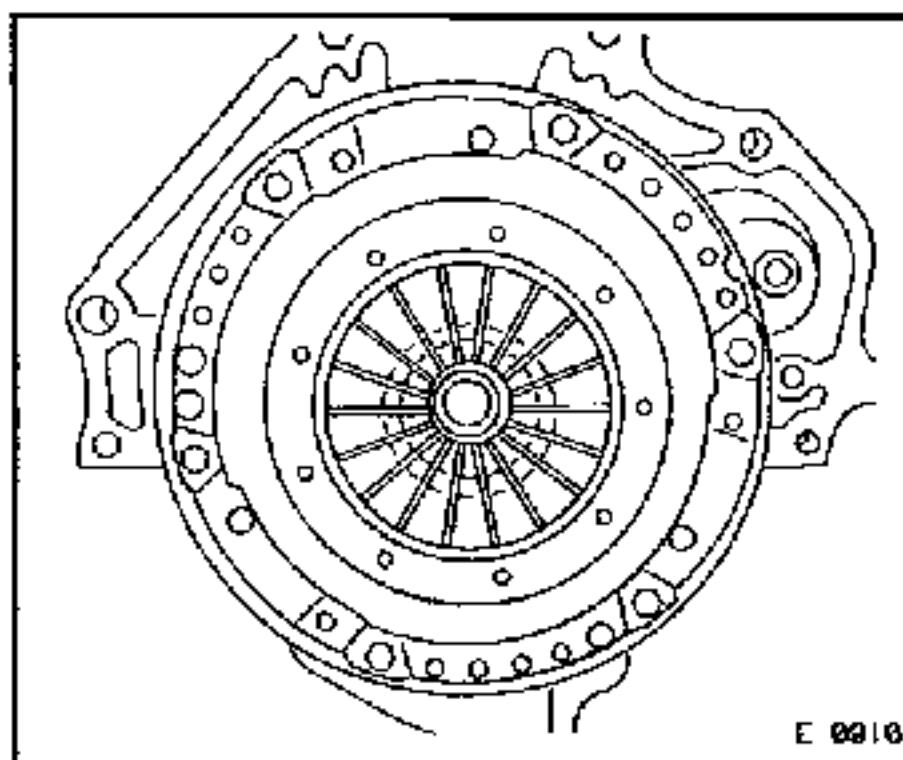
Fastening bolt for the toothed belt drive gear, using MKM-604-21 (Torx E 20). Hold the gear with holding wrench KM-662-A, as shown. Follow manufacturer's instructions.



## Remove, Disconnect

Clutch assembly. Refer to Section K, "Clutch and Transmission", in Volume 4.

Wiring harness plug for dynamic oil level check.

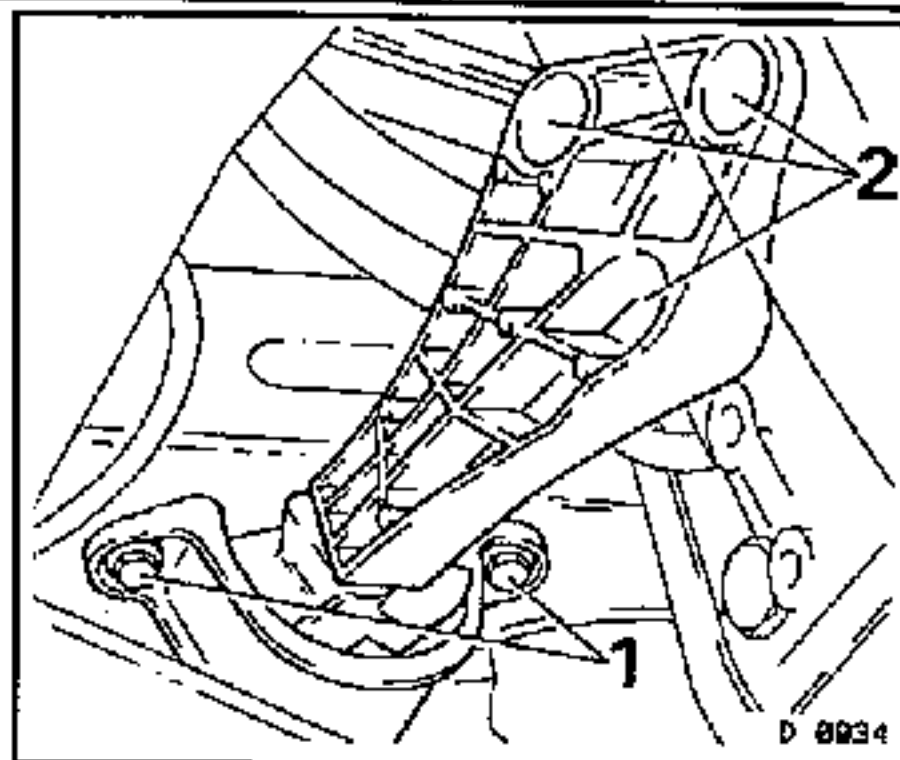


# DOHC ENGINE - ENGINE SHORT BLOCK

## Remove, Disconnect

Engine damping block (1) from the side member.

Bracket (2) from the cylinder block.



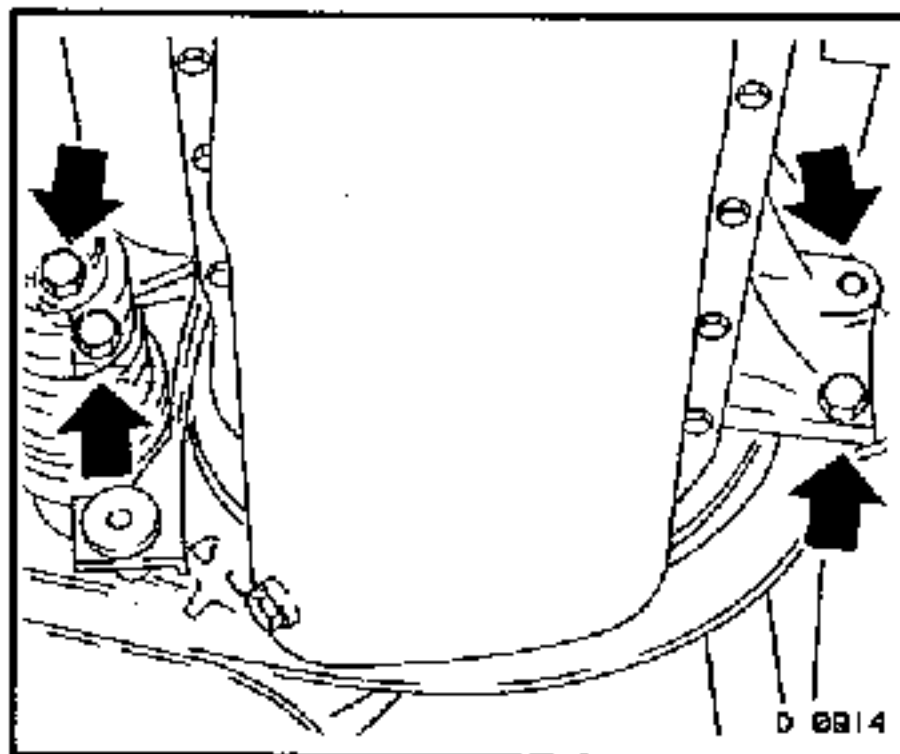
## Remove, Disconnect

The lower transmission bolts (arrows) from the cylinder block.

Support engine with jack.

Remove holder KM-263-B.

Attach lifting cable to engine and support, pull the transmission from the engine and remove engine up and out of the engine compartment.



## Install, Connect

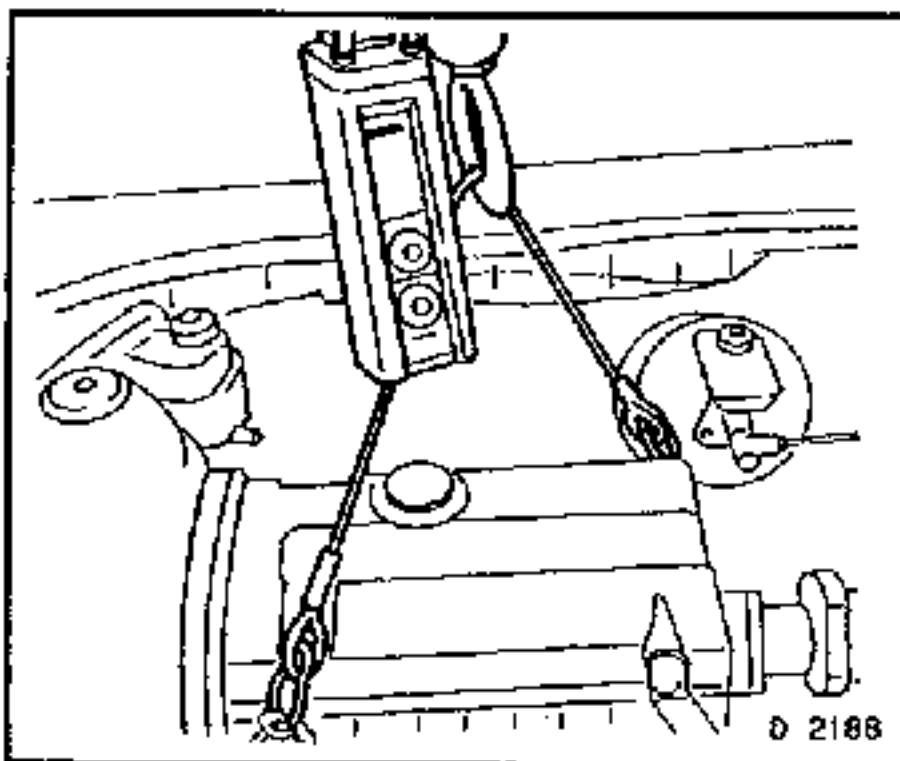
Lower engine, aligning the sleeves in the rear of the cylinder block, with the transmission.

## Tighten (Torque)

Transmission to cylinder block,  
upper bolts..... 75 Nm.

## Install, Connect

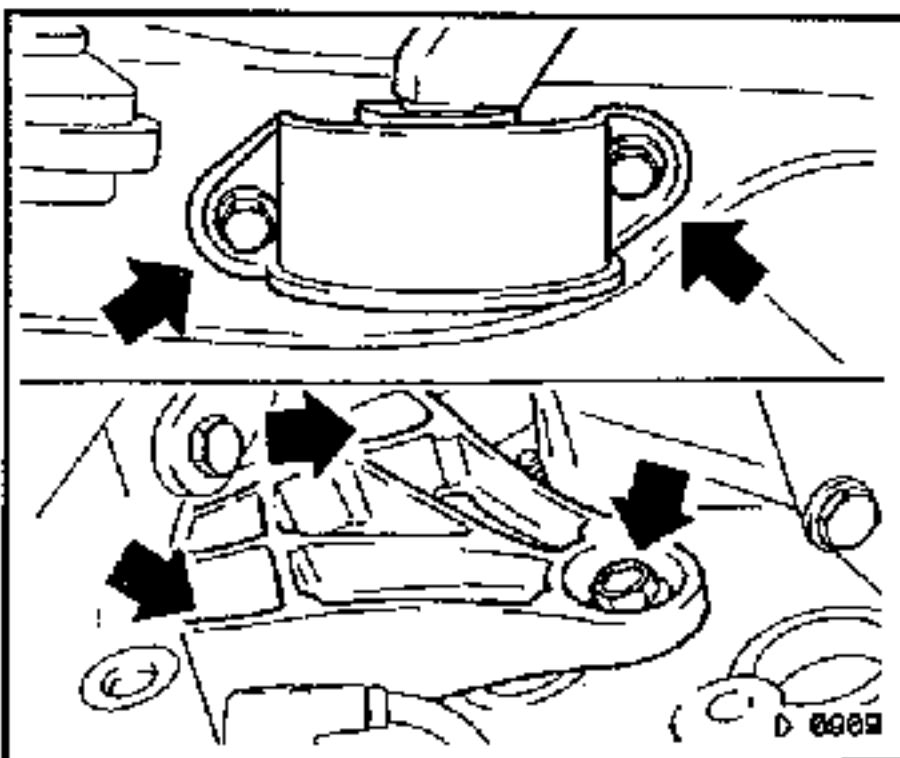
Engine holder KM-263-B, then remove the supporting jack.



## Tighten (Torque)

Transmission to cylinder block,  
lower bolts..... 75 Nm  
Engine suspension bracket to  
cylinder block..... 60 Nm  
Right engine damping block to  
side member..... 65 Nm \*

\* Apply locking compound such as Loctite 242 or equivalent to Holden's Specification HN1256.

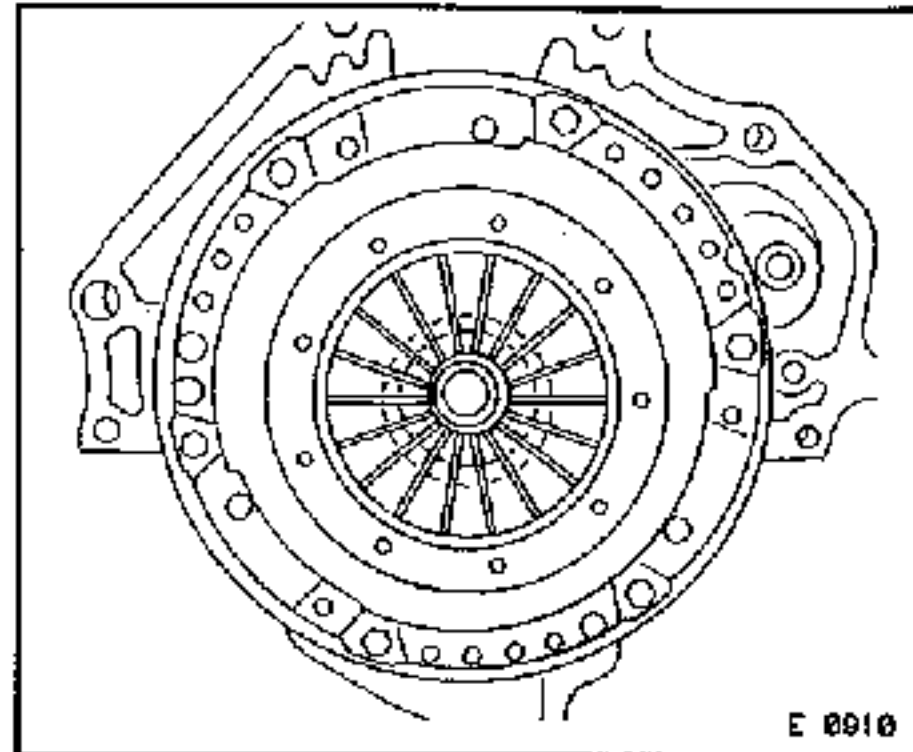


# DOHC ENGINE - ENGINE SHORT BLOCK

## Install, Connect

Wiring harness plug for dynamic oil level check.

Clutch assembly. Refer to Section K, "Clutch and Transmission", in Volume 4.



## Install, Connect

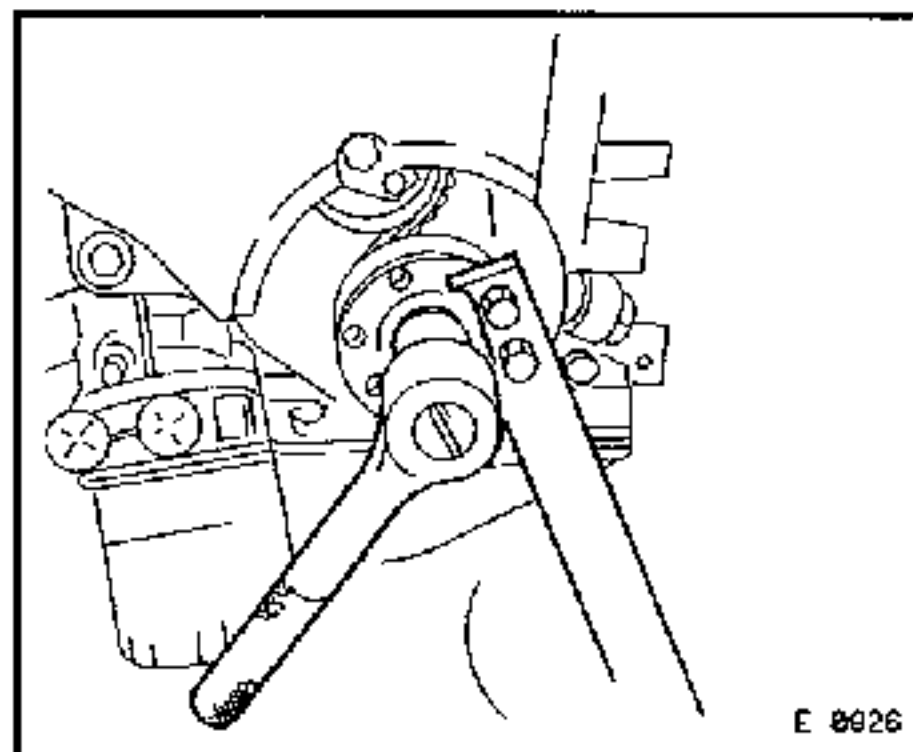
Toothed belt drive gear to crankshaft. Use holding wrench KM-662-A to hold while tightening with MKM-604-21 (Torx E 20).

## Torque - Angle Method

Fastening bolt for toothed belt drive gear to crankshaft..... 250 Nm + 40° + 50°

## Important!

Use a new bolt and apply grease to the threads before installation.

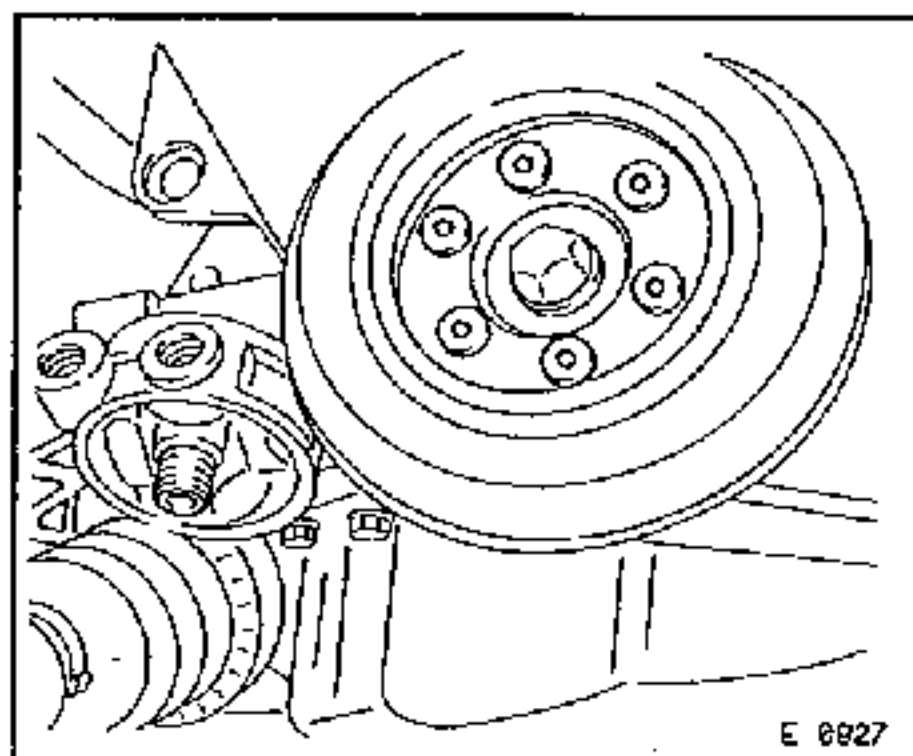


## Install, Connect

Crankshaft pulley, using KM-321-A, while holding the toothed belt drive gear with MKM-604-21 (Torx E 20).

## Tighten (Torque)

Crankshaft pulley to toothed belt drive gear..... 20 Nm



## Install, Connect

Oil filter to oil pump, after filling with clean engine oil.

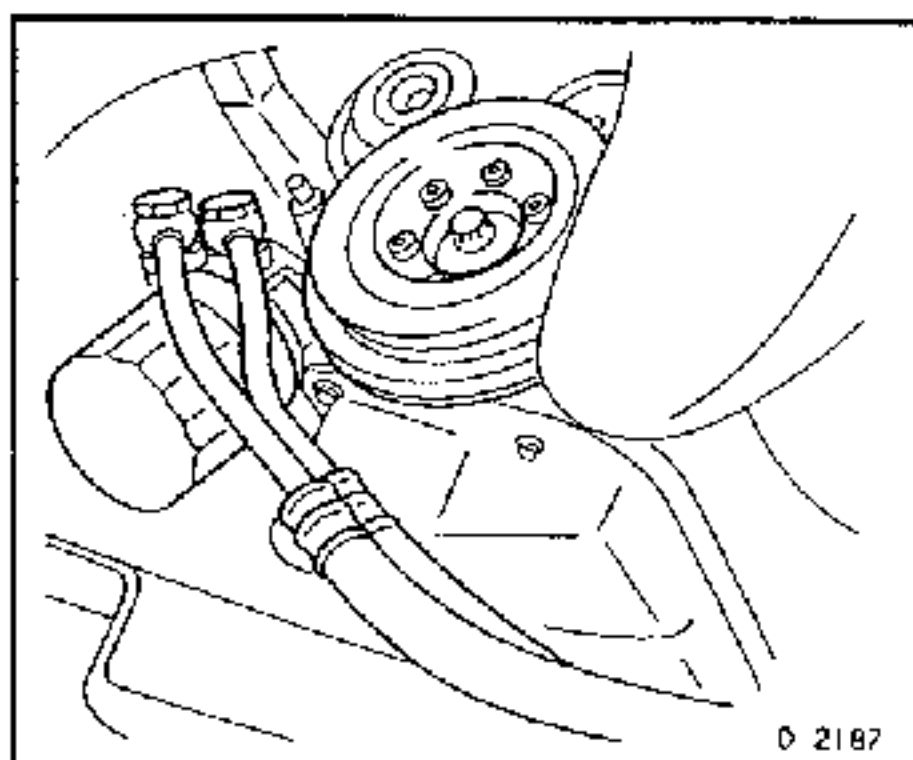
Oil cooler lines to adaptor.

## Tighten (Torque)

Oil filter to oil pump..... 15 Nm  
Oil cooler lines to adaptor..... 38 Nm

## Note:

Use a thin film of clean engine oil on the new filter seal ring, before installation.



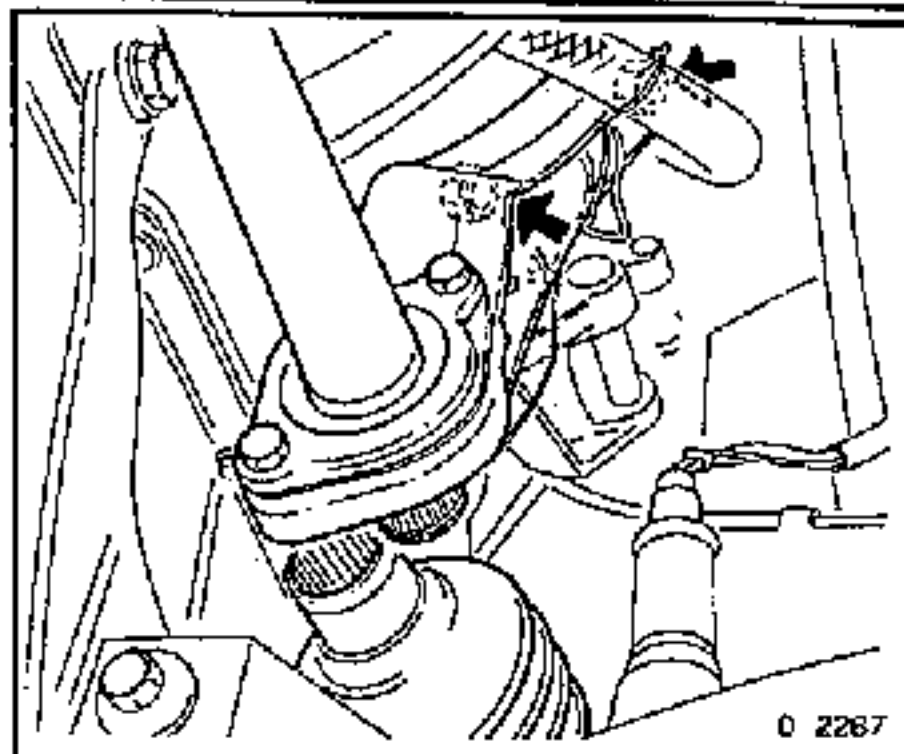
# DOHC ENGINE - ENGINE SHORT BLOCK

## Install, Connect

Intermediate shaft bracket.

## Tighten (Torque)

Intermediate shaft bracket to  
cylinder block..... 55 Nm



## Install, Connect

Power steering pump bracket to cylinder block.

## Tighten (Torque)

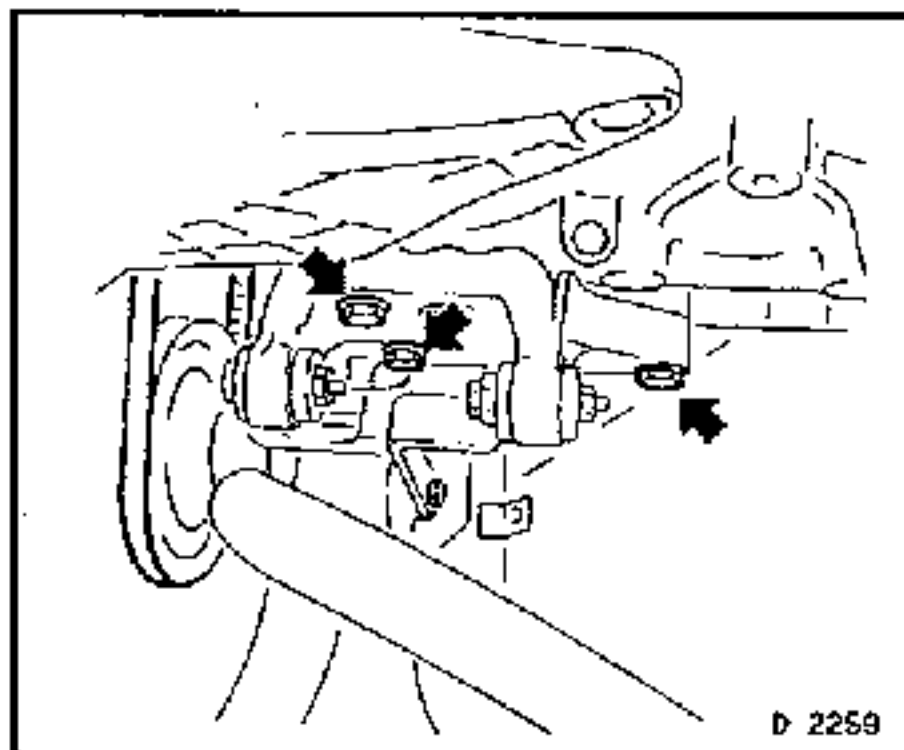
Power steering pump bracket to  
cylinder block..... 40 Nm

## Adjust

V-belt tension. Refer to "Checking and Adjusting Procedures", in this Volume.

### Note:

All V-belts have the same tension specification.



## Install, Connect

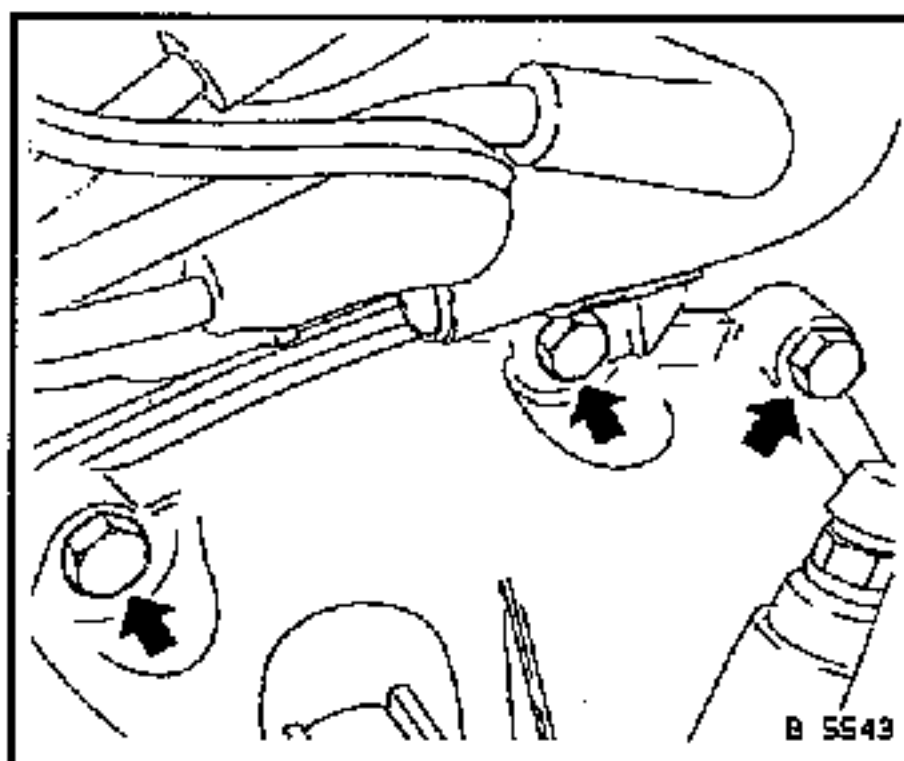
Transmission to cylinder block upper bolts.

## Tighten (Torque)

Transmission to cylinder  
block upper bolts..... 75 Nm

## Install, Connect

Shift guide, shift rod and clutch cable. Refer to Section K "Clutch and Transmission", in Volume 4.



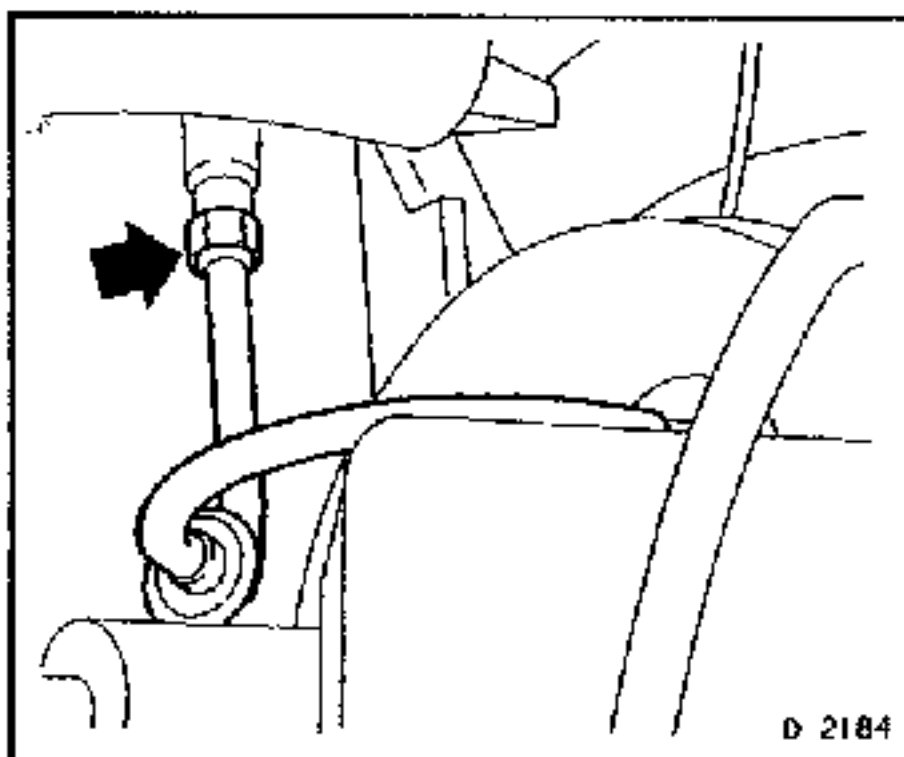
## Install, Connect

Alternator. Refer to the Section "Alternator", in this Volume.

Coolant hoses to coolant reservoir tank.

## Tighten (Torque)

Brake servo vacuum line to  
intake manifold ..... 20 Nm



# DOHC ENGINE - ENGINE SHORT BLOCK

## Install, Connect

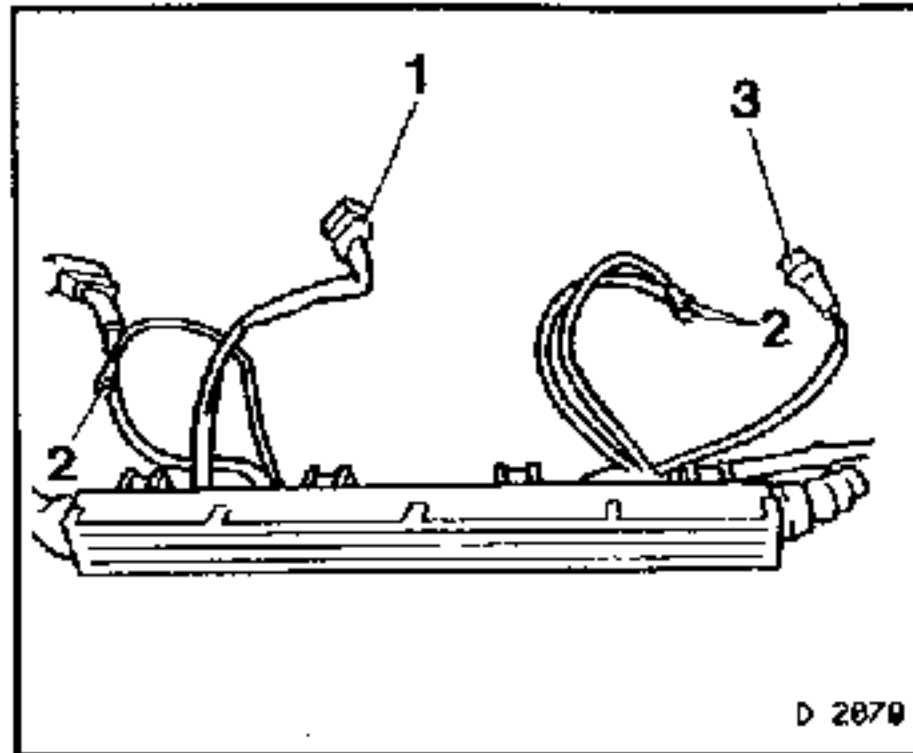
Wiring harness plug (3) and vacuum hose to controlled canister purge valve.

Ground connections (2) to fuel distributor pipe.

Wiring harness plug (1) to throttle valve switch (M 2.5) or potentiometer (M 2.8).

Injector plug strip to injectors.

Check that all ground connections are in good condition and secure.



## Install, Connect

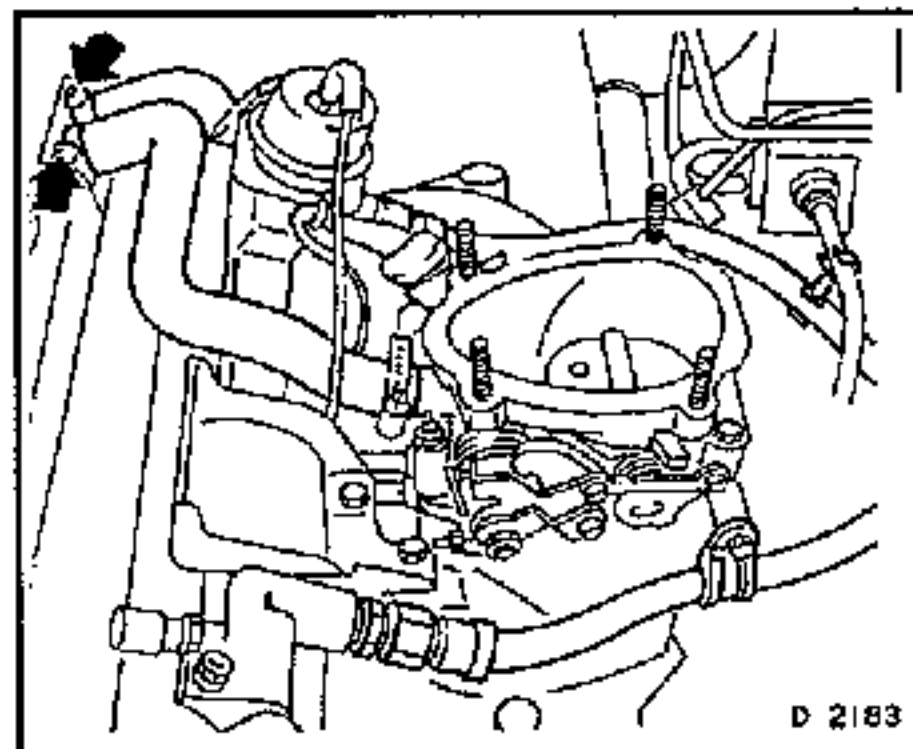
Hose connections (arrows) to cylinder head cover.

Fuel lines. Remove clamps.

Bowden cable. Install with no tension on the cable.

Engine to body harness multi-plug.

Reversing lamp, wiring harness plug.



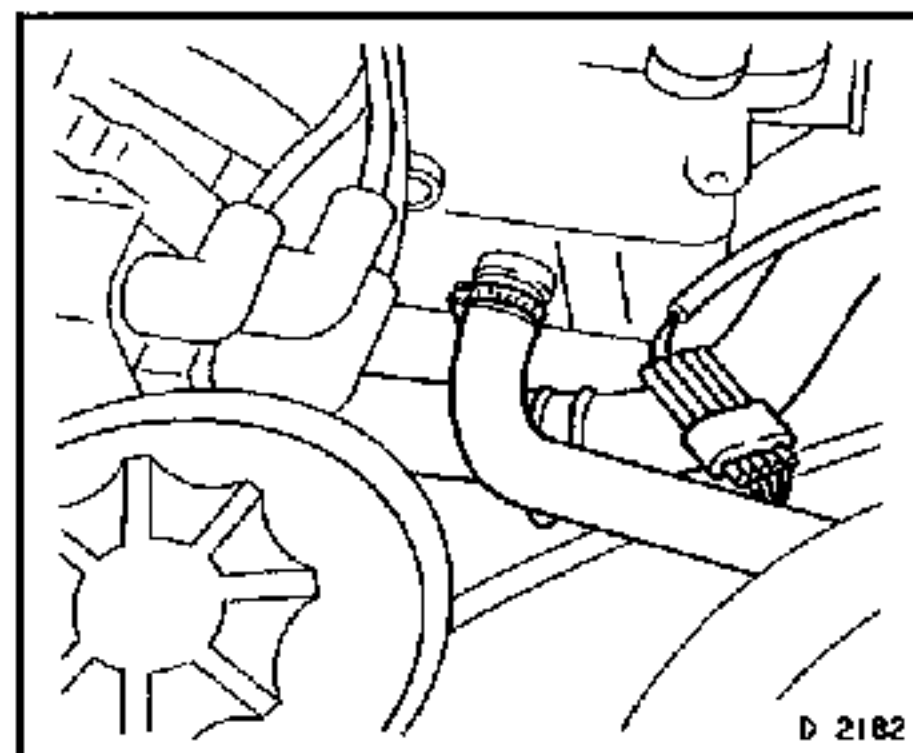
## Install, Connect

Multi-plug.

Coolant hoses to coolant pipe.

Coolant hose to cylinder head.

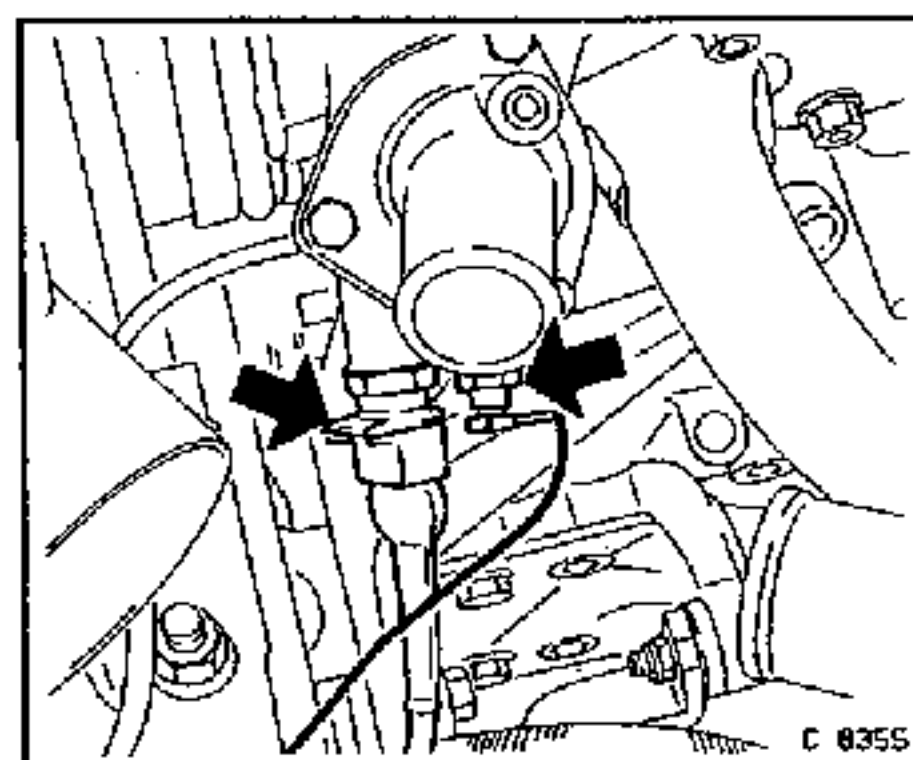
Wiring harness plug a high voltage cable to high voltage distributor.



## Install, Connect

Performance header. Refer 'Gasket, Performance Header to Cylinder Head, Replace', in Section, 'Cylinder Head', in this Volume.

Wiring harness plugs (arrows) and upper coolant hose to thermostat housing.





# DOHC ENGINE - ENGINE SHORT BLOCK

## Install, Connect

Air cleaner housing. Refer to 'Air Cleaner Housing, Remove', in the Section "Engine Timing Side, Air Cleaner", in this Volume.

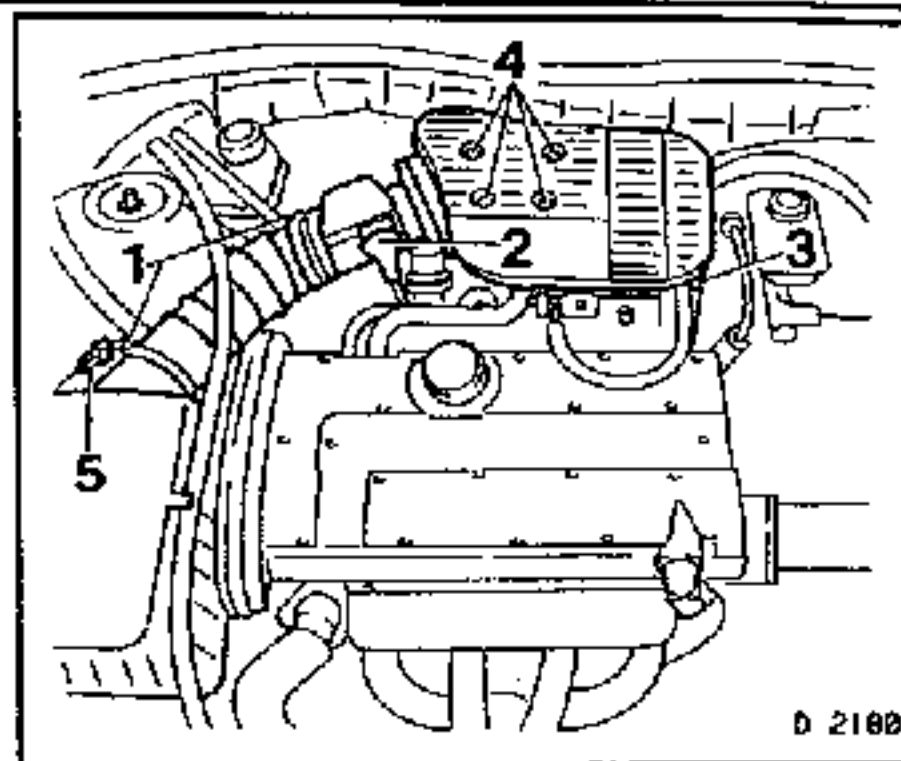
Wiring harness plug (5) to inductive pulse pick-up.

Pre-volume chamber (4) with mass air flow meter.

Idle speed adjuster hose (3) to pre-volume chamber.

Wiring harness plug (2) to mass air flow meter.

Air intake hose (1).



## Install, Connect

Fan motor wiring harness plug (arrow).

The lower coolant hose to the radiator.

Ground cable to battery.

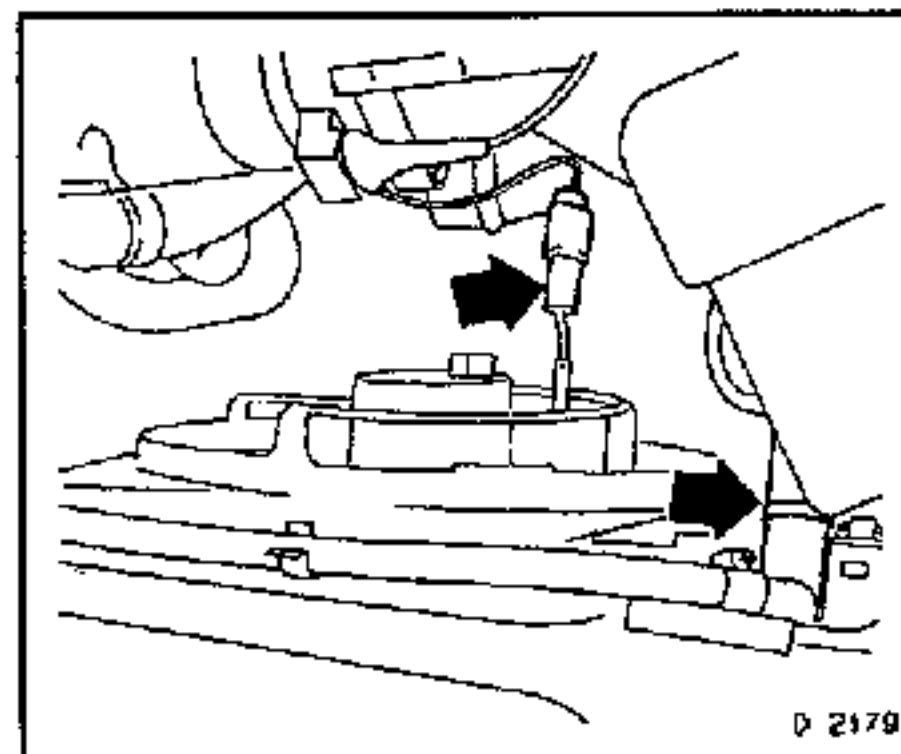
Engine compartment cover.

Bonnet.

## Inspect

Engine oil level, topping up as necessary.

Top up and bleed cooling system. Refer to "Cooling System", in this Volume.



## Engine with Transmission, Remove and Install (C 20 XE or C 20 LET with Pot Flywheel)

### Remove, Disconnect

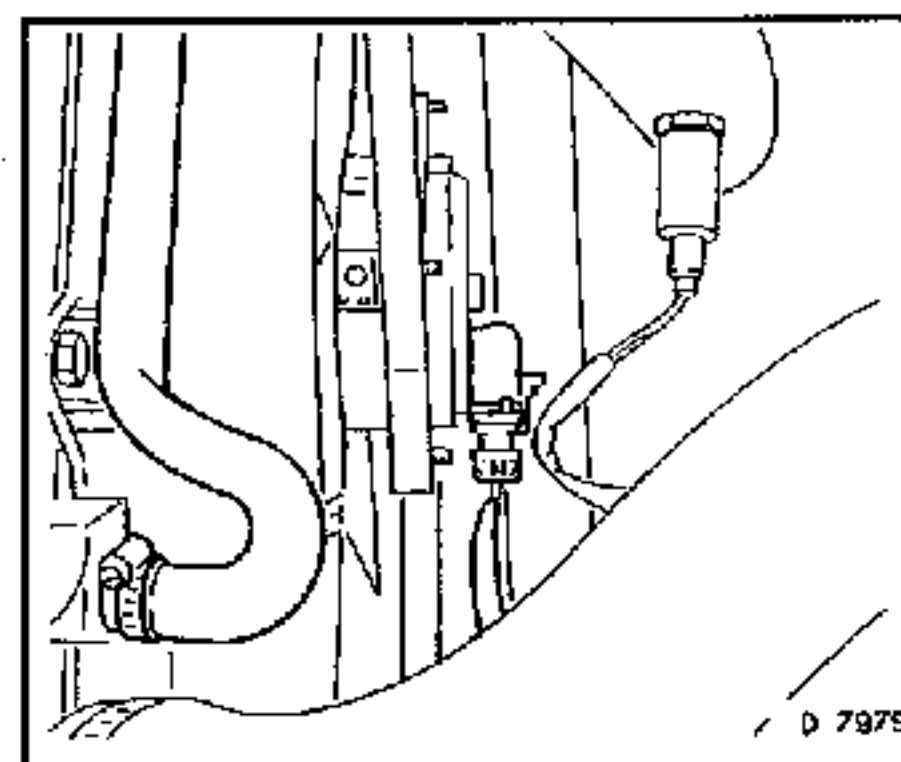
Engine compartment cover.

Battery.

Disconnect fan motor wiring harness plug.

Radiator fan shroud with fan motor, from radiator. Remove upwards.

The lower coolant hose from the radiator. Collect coolant in a suitable sized, clean container.

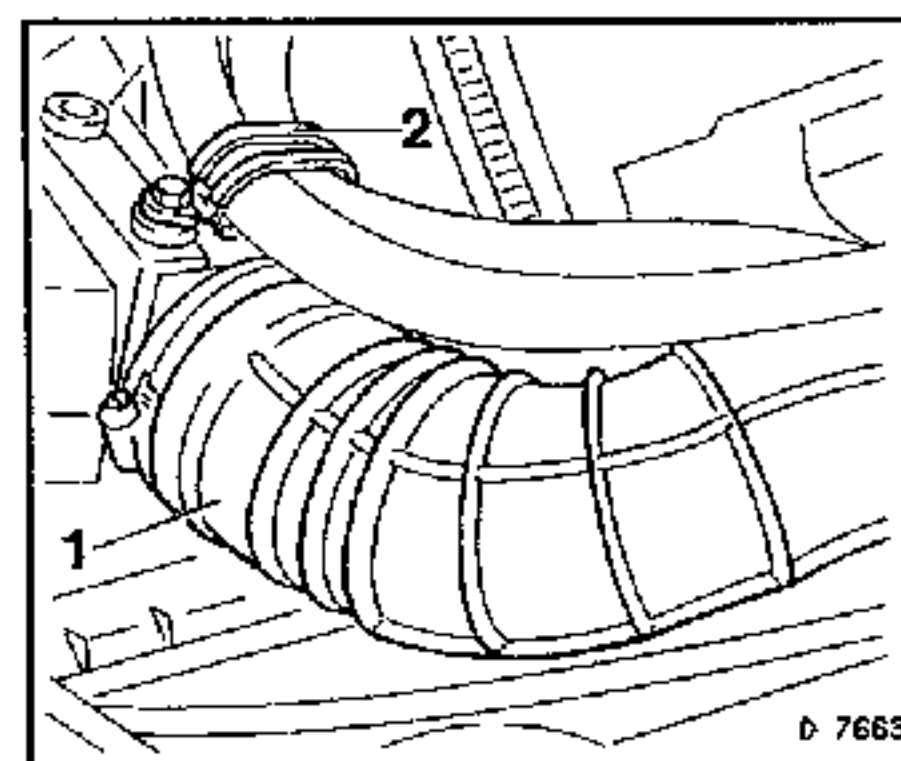


### Remove, Disconnect

For C 20 LET:

Air hose (1) and retainer (2). Plug turbocharger openings to prevent dirt entry.

Cover from throttle valve manifold.



# DOHC ENGINE - ENGINE SHORT BLOCK

## Remove, Disconnect

For C 20 XE:

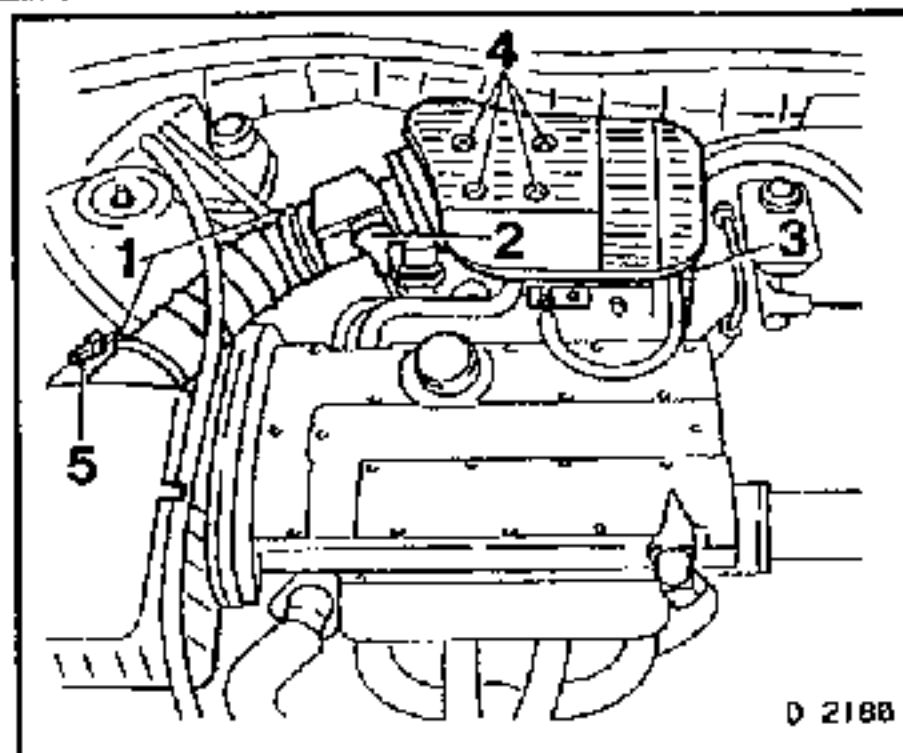
Air intake hose (1).

Wiring harness plug (2) from mass air flow meter.

Idle speed adjuster hose (3) from the pre-volume chamber.

Pre-volume chamber with mass air flow meter (4).

Wiring harness plug (5) from inductive pulse pick-up.

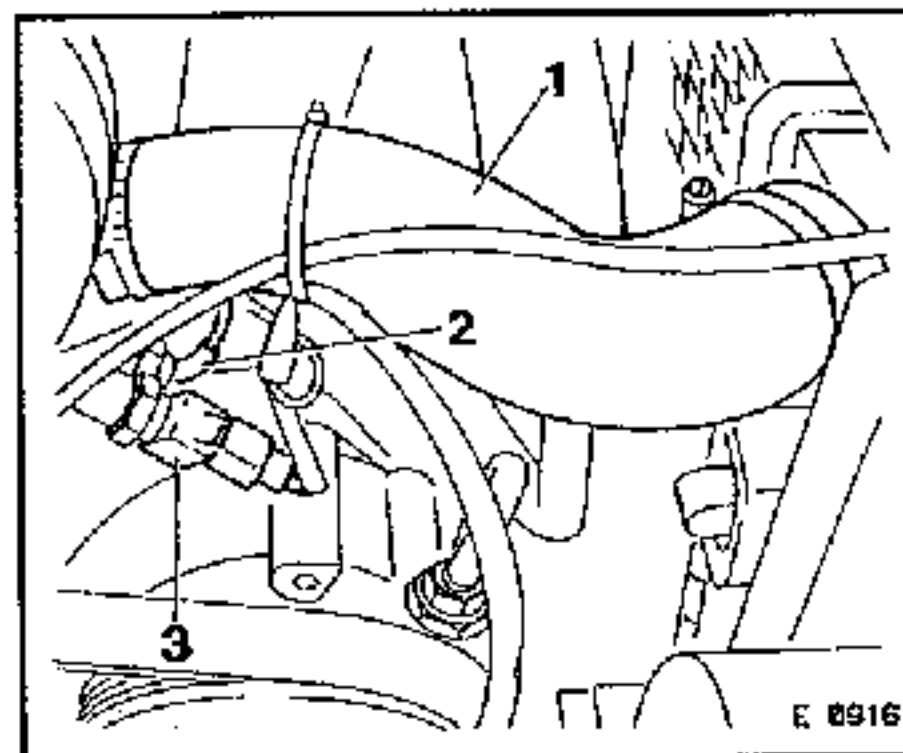


## Remove, Disconnect

Coolant hose (1).

Wiring harness plugs (2 and 3) from the thermostat housing.

Coolant hoses from the coolant reservoir tank.

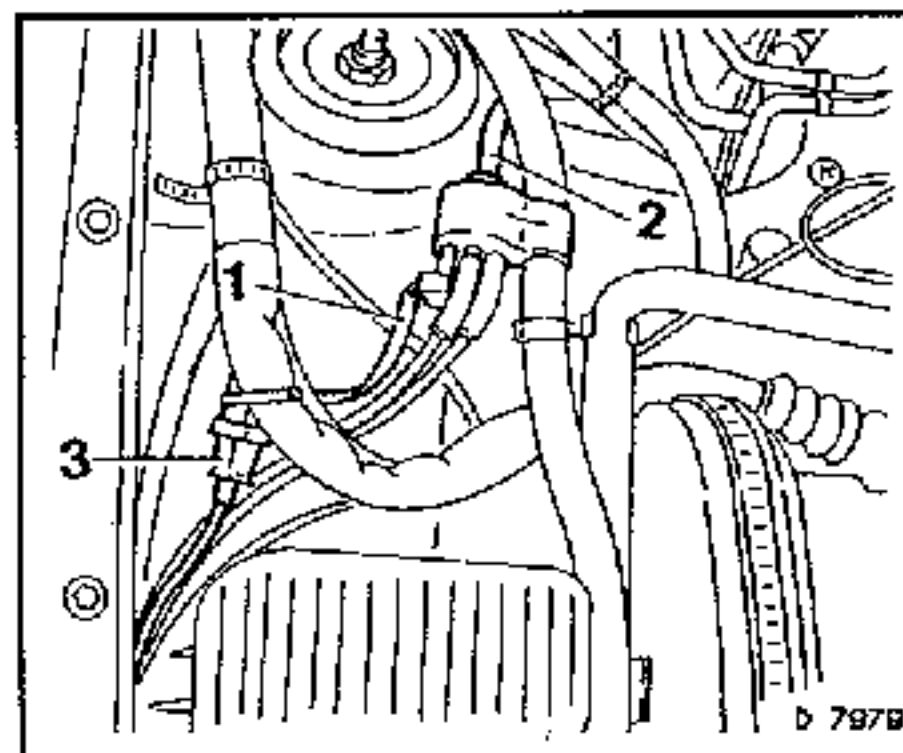


## Remove, Disconnect

For C 20 LET:

Wiring harness plug (1) and hose (2) from the charge pressure switch-over valve.

Wiring harness plug (3).

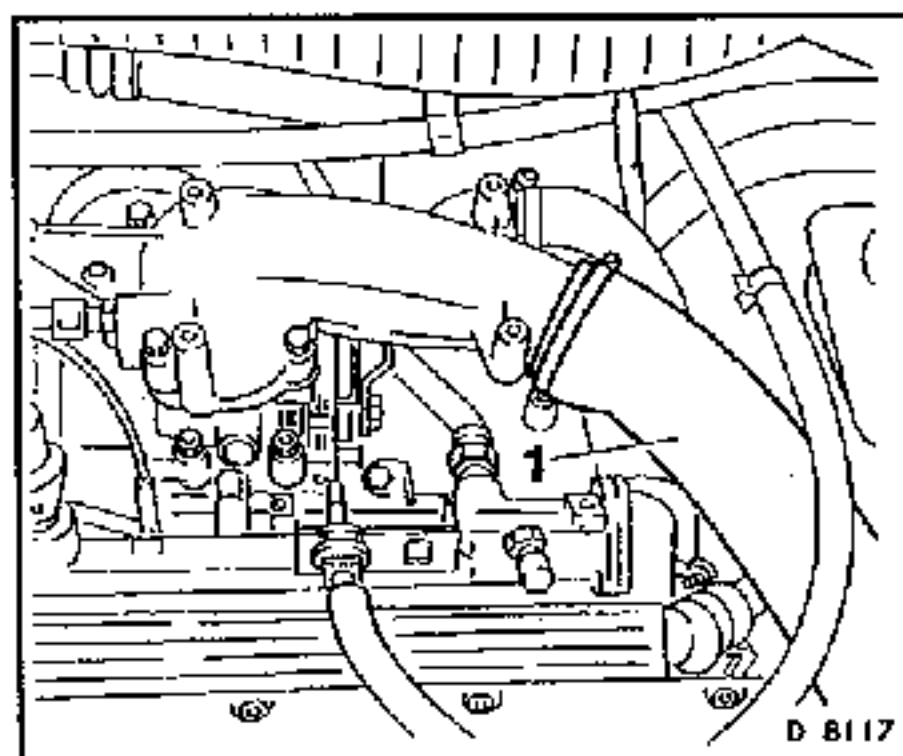


## Remove, Disconnect

For C 20 LET:

Air hose (1) from charge air cooler and throttle valve manifold.

Throttle housing to control unit vacuum hose.

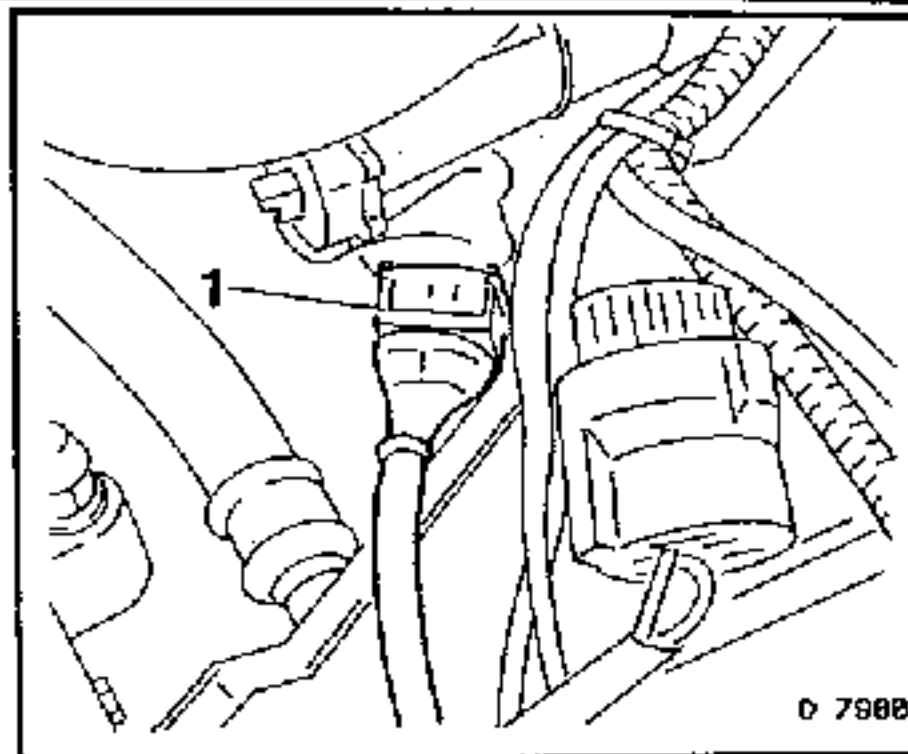


# DOHC ENGINE - ENGINE SHORT BLOCK

## Remove, Disconnect

Wiring harness plug (1) from ignition coil control unit.

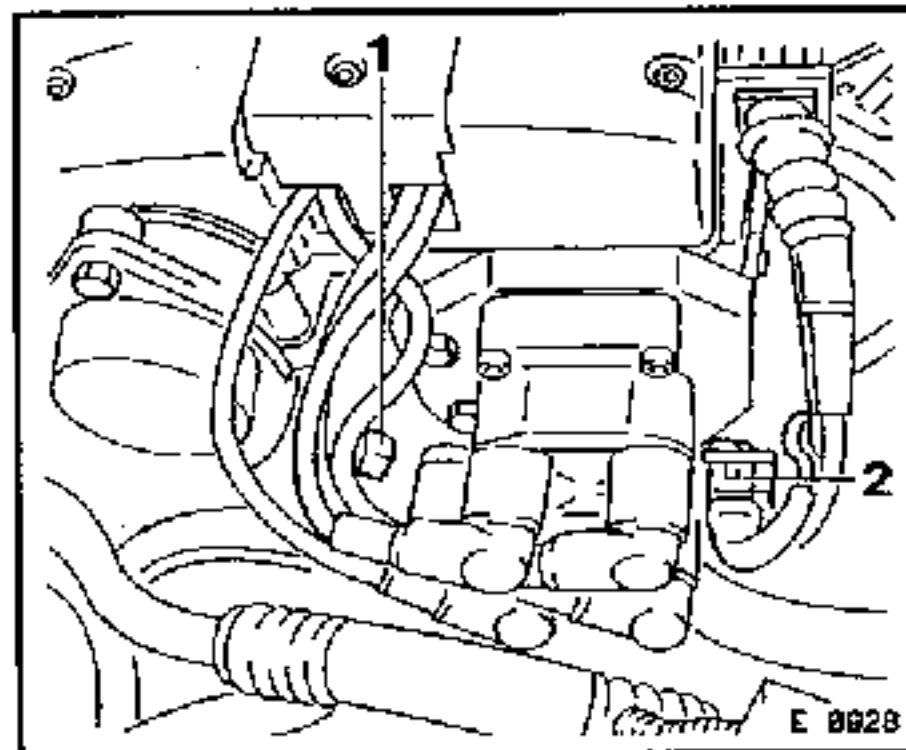
Wiring harness plug and high voltage cable from high voltage distributor.



## Remove, Disconnect

For C 20 XE: Engine as of MY'93:

Wiring harness plug from camshaft sensor (1) and dual spark ignition coil (2).



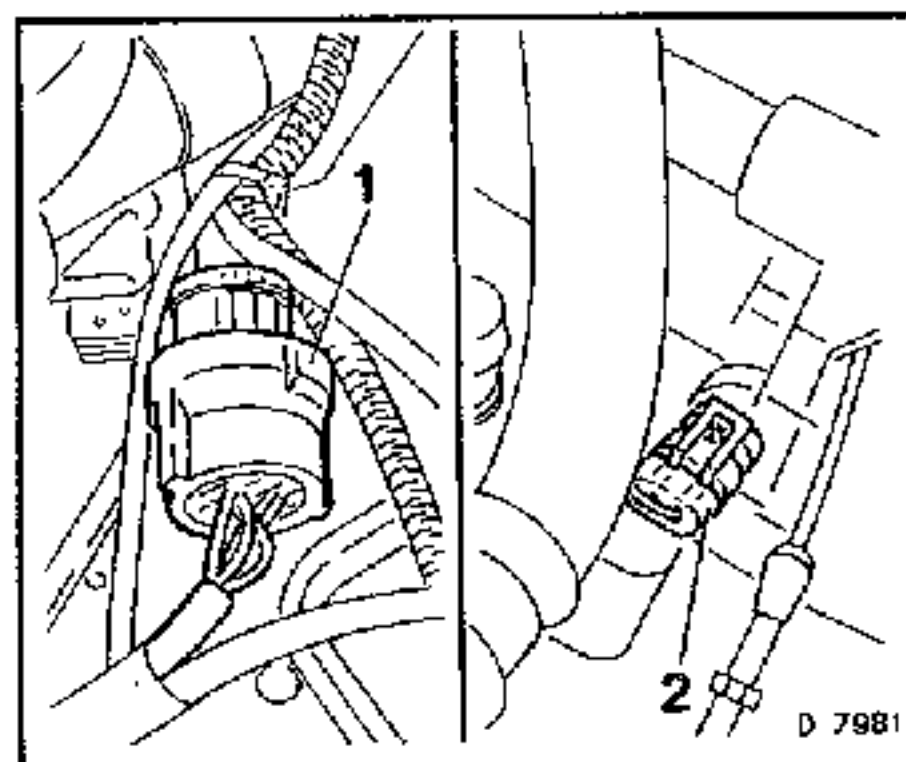
## Remove, Disconnect

Engine to body harness multi-plug.

Wiring harness plug (2) for reversing lamp.

For C 20 LET only:

Wiring harness plug from 1st gear recognition switch.



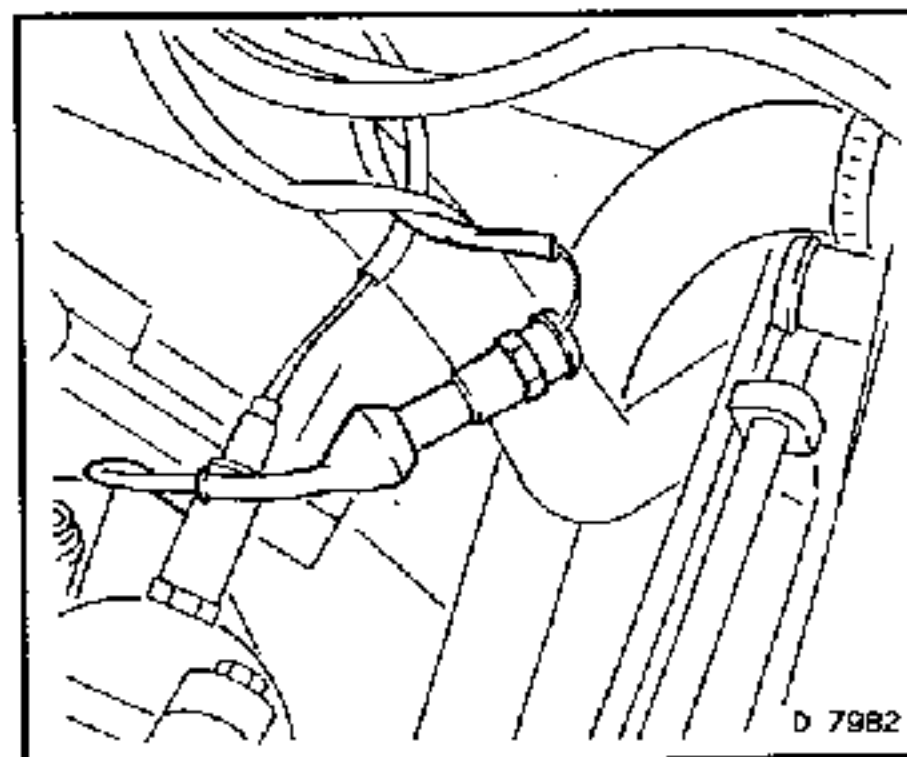
## Remove, Disconnect

Wiring harness plug from dynamic oil level check.

Wiring harness plug from oxygen sensor, at bulkhead.

For C 20 LET only:

Transfer box temperature sensor wiring harness plug.



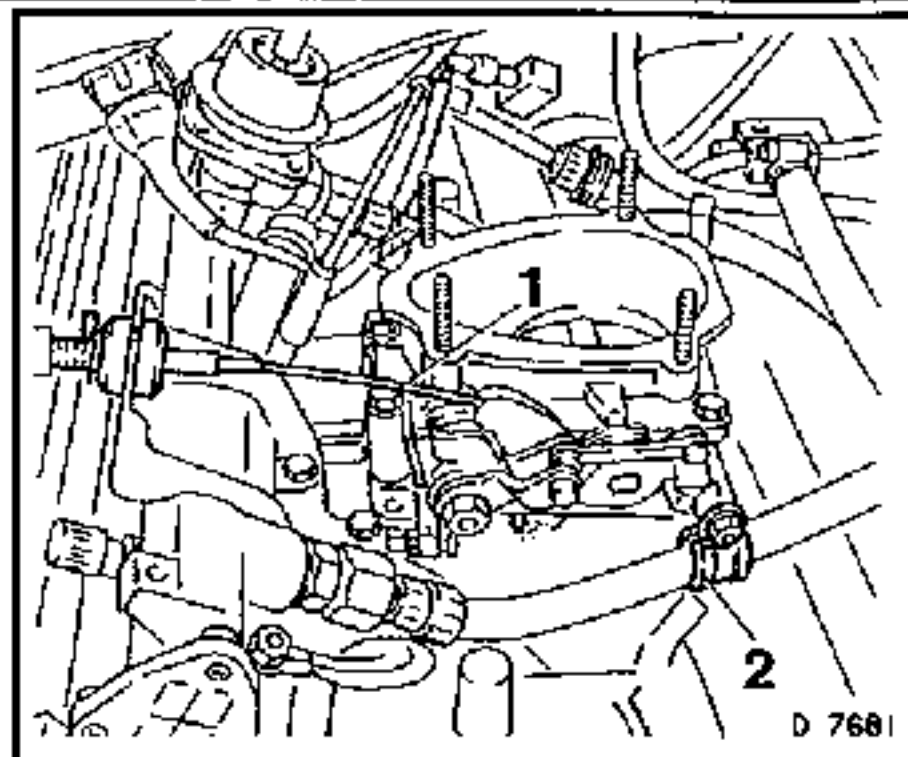
# DOHC ENGINE - ENGINE SHORT BLOCK

## Remove, Disconnect

Bowden cable (1).

Fuel lines, sealing first with suitable clamps to prevent fuel spillage.

Fuel line bracket (2) from throttle body.



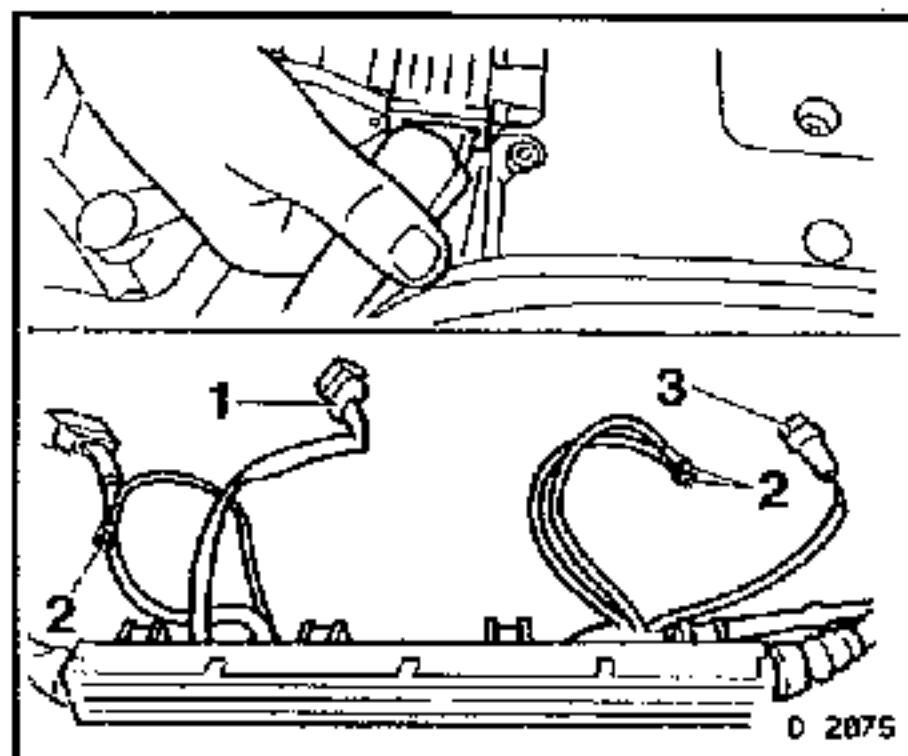
## Remove, Disconnect

For C 20 XE:

Wiring harness plug from throttle valve switch (M 2.5) or potentiometer (M 2.8).

Ground connections (2) from fuel distributor pipe.

Wiring harness plug (3) from controlled canister purge valve.



## Remove, Disconnect

For C 20 LET:

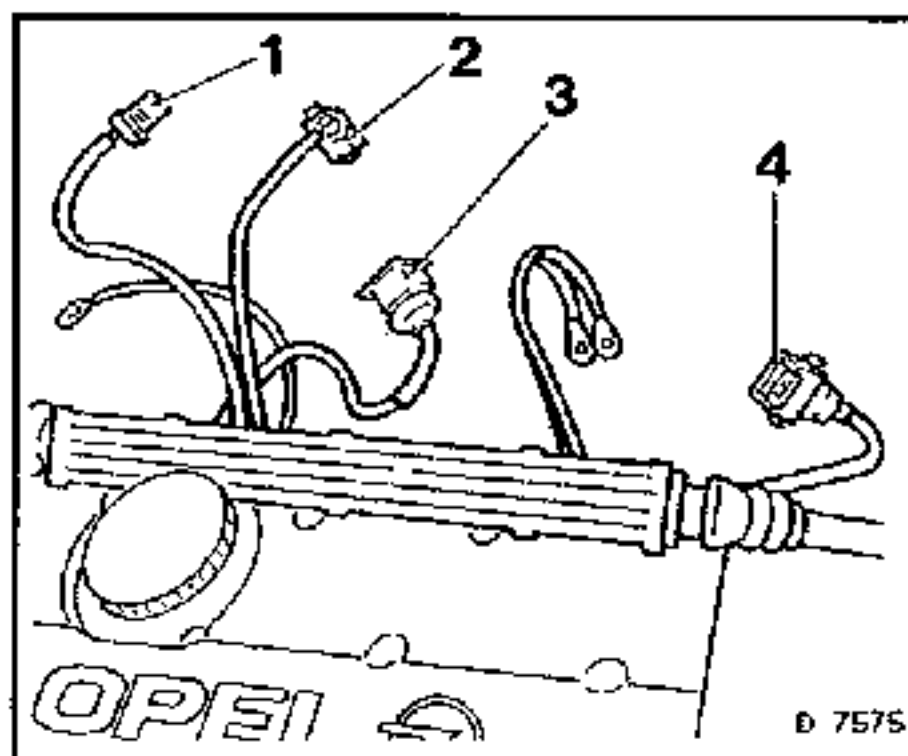
Wiring harness plug (1) from hot start valve.

Wiring harness plug (2) from intake air temperature sensor.

Wiring harness plug (3) from throttle valve potentiometer.

Wiring harness plug (4) from controlled canister purge valve.

After pulling back the retaining clamp at the No. 1 fuel injector, remove the injector plug strip and lay the wiring harness to one side.

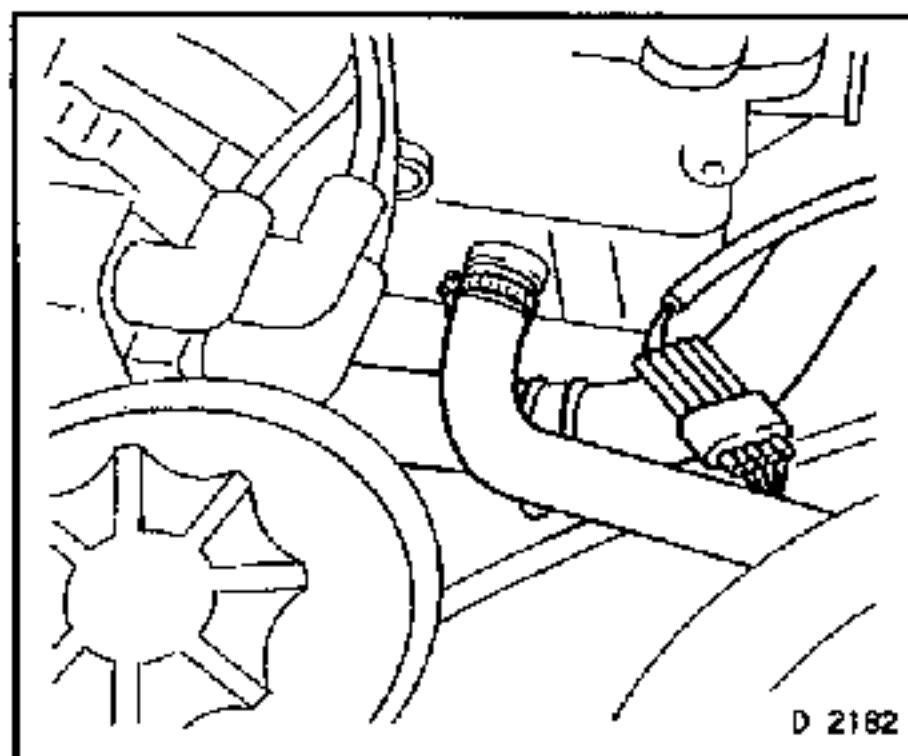


## Remove, Disconnect

Coolant hose from cylinder head.

Coolant hoses from the coolant pipes.

Multi-plug.



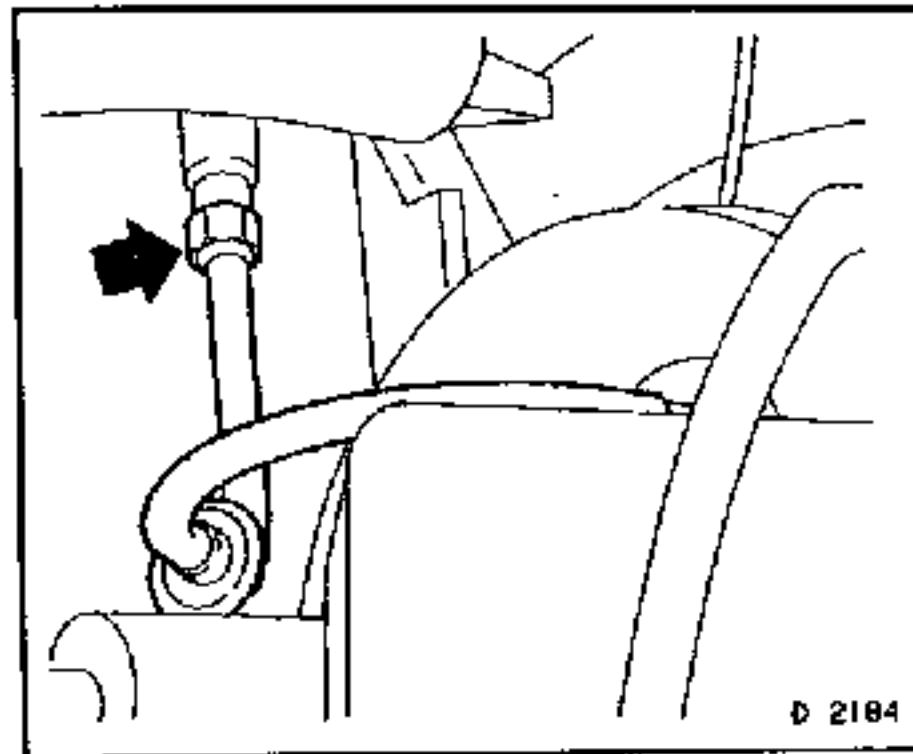
# DOHC ENGINE - ENGINE SHORT BLOCK

## Remove, Disconnect

Brake servo vacuum line (arrow) from intake manifold.

Vacuum hose from the controlled canister purge valve.

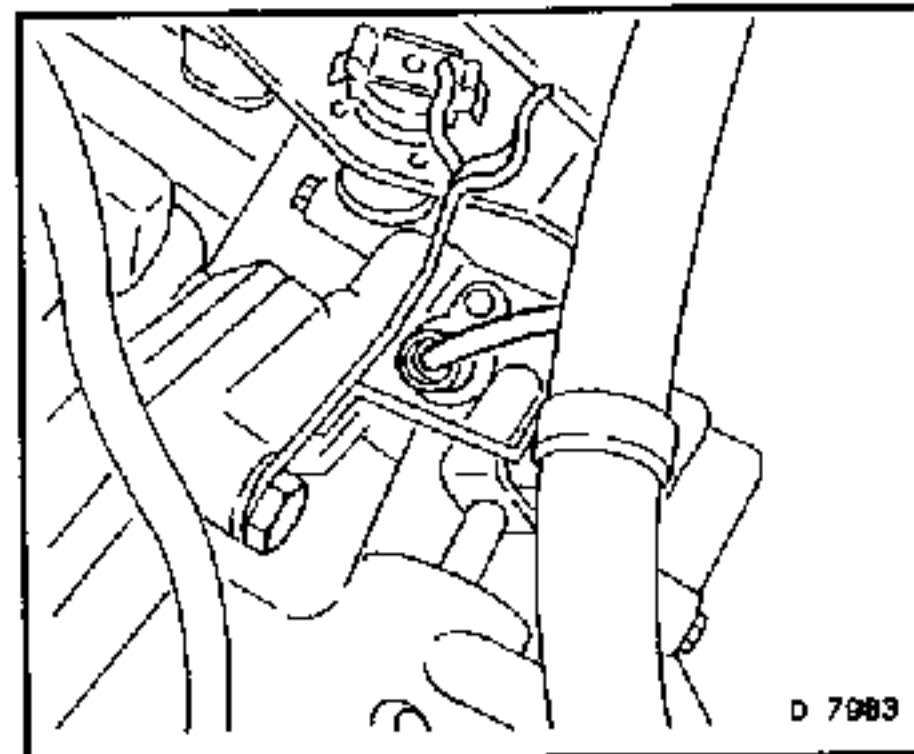
Clutch cable from the clutch release lever. Refer to Section K, "Clutch and Transmission," in Volume 4.



## Remove, Disconnect

Speedometer cable or wiring harness plug for odometer frequency sensor.

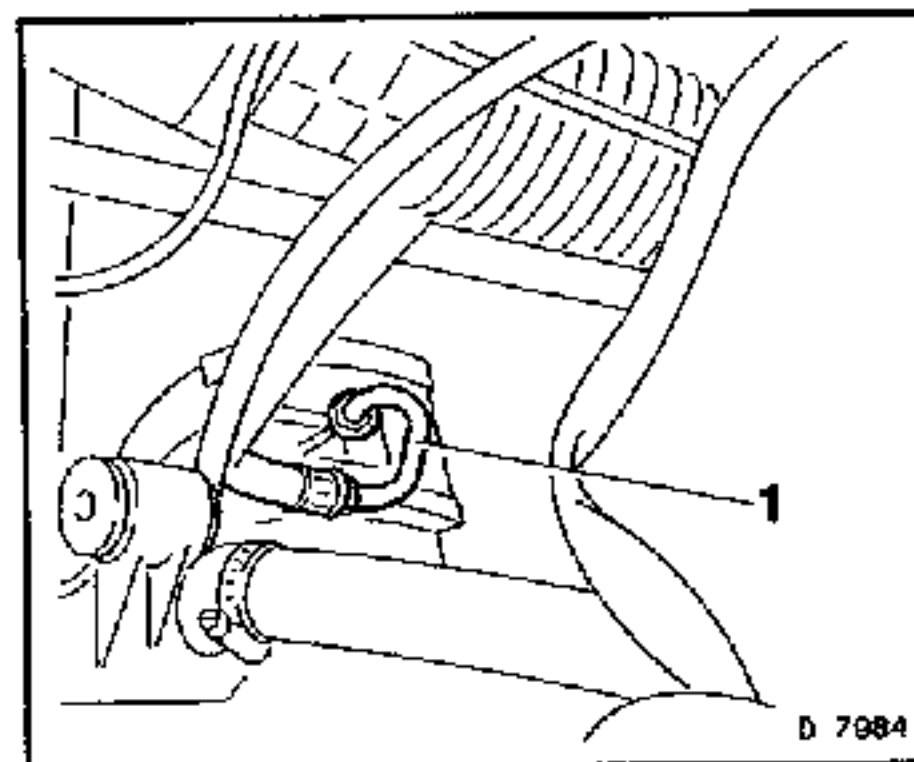
Shift rod and shift guide. Refer to Section K, "Clutch and Transmission," in Volume 4.



## Remove, Disconnect

For C 20 LET:

Hydraulic line (1) from the transfer box. Place a clean container beneath.



## Remove, Disconnect

Engines up to MY'93:

V- belts from alternator, power steering pump and A/C compressor.

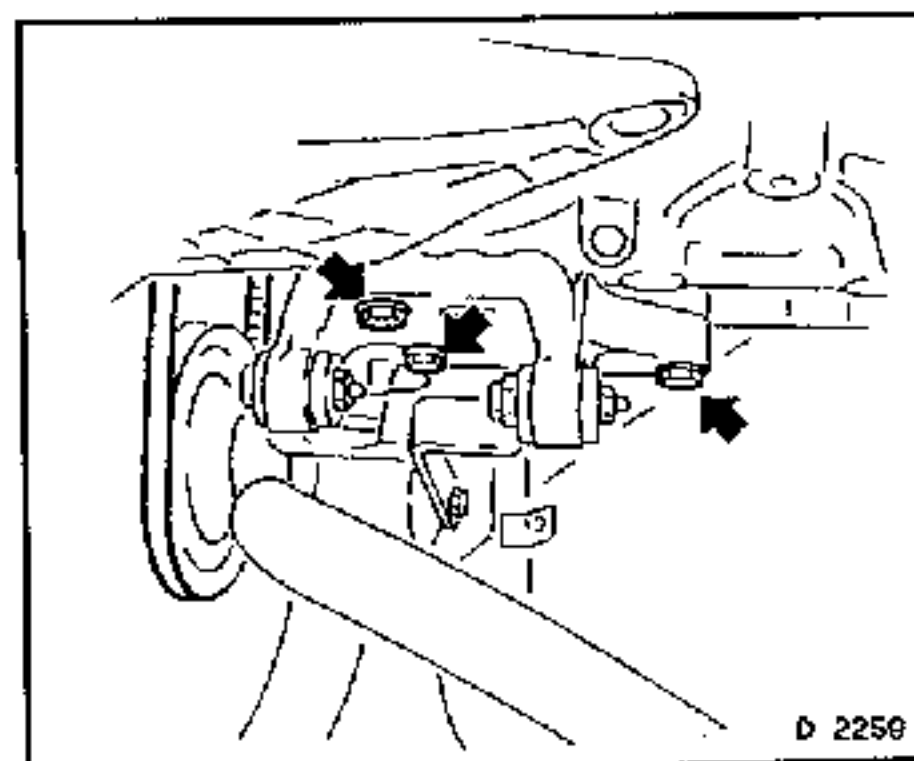
Power steering pump bracket from the cylinder block.

Swing to one side and secure.

### Important!

Do not disconnect any hydraulic or A/C lines.

Attach engine holder KM-263-B.

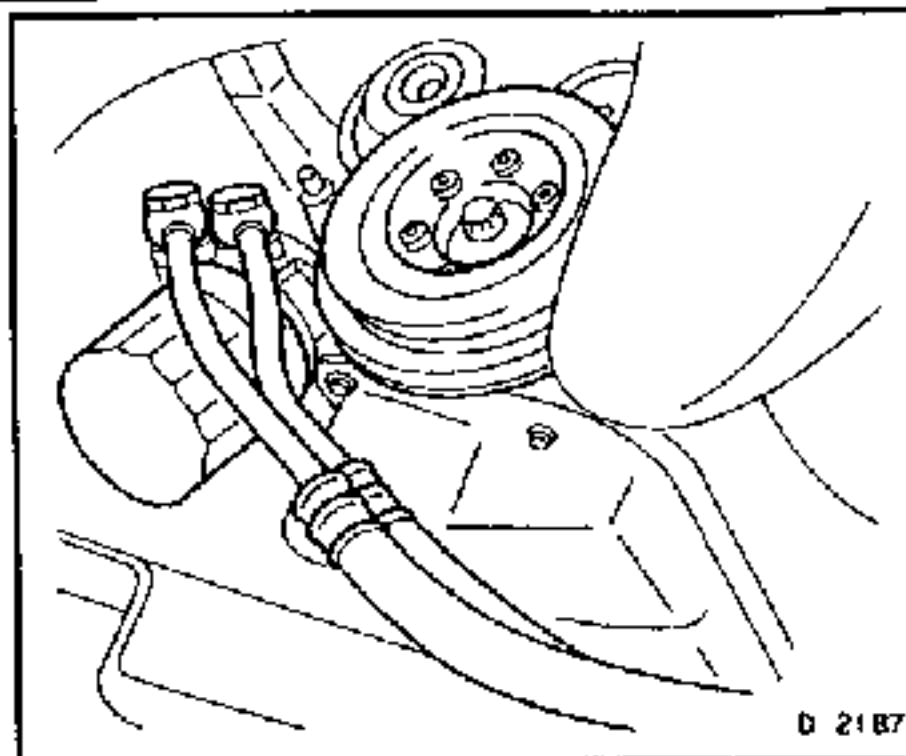


# DOHC ENGINE - ENGINE SHORT BLOCK

## Remove, Disconnect

Oil cooler lines.

Oil filter cartridge, using a commercially available tool. Place a suitable sized, clean container underneath the engine.

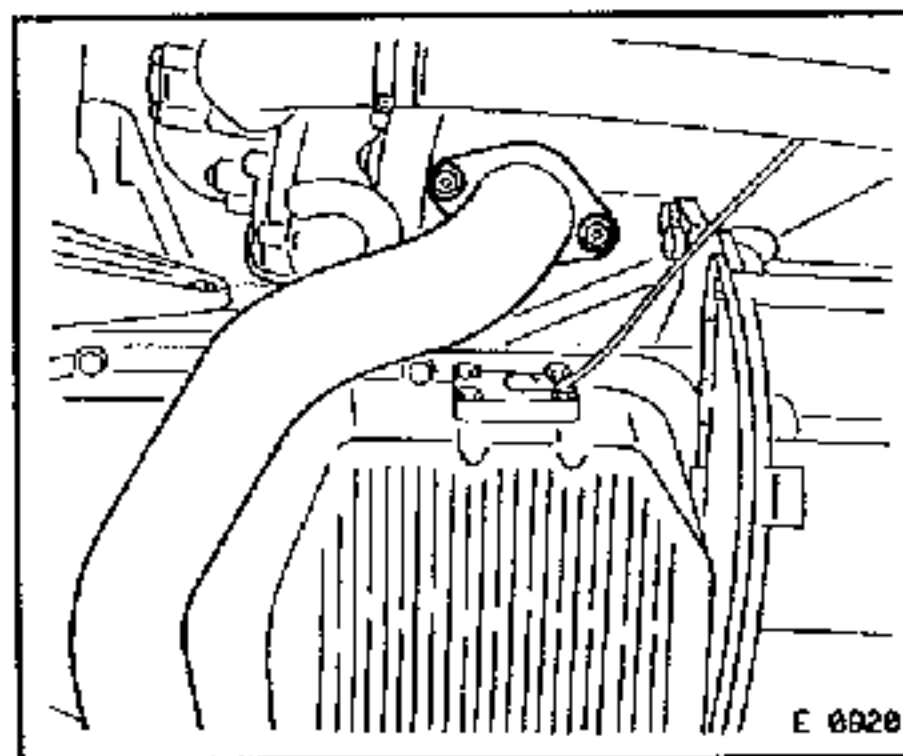


## Remove, Disconnect

Exhaust pipe or performance header. Refer to 'Gasket, Performance Header, Replace', in the Section 'Cylinder Head', in this Volume.

For C 20 LET:

The lower charge air line.



## Remove, Disconnect

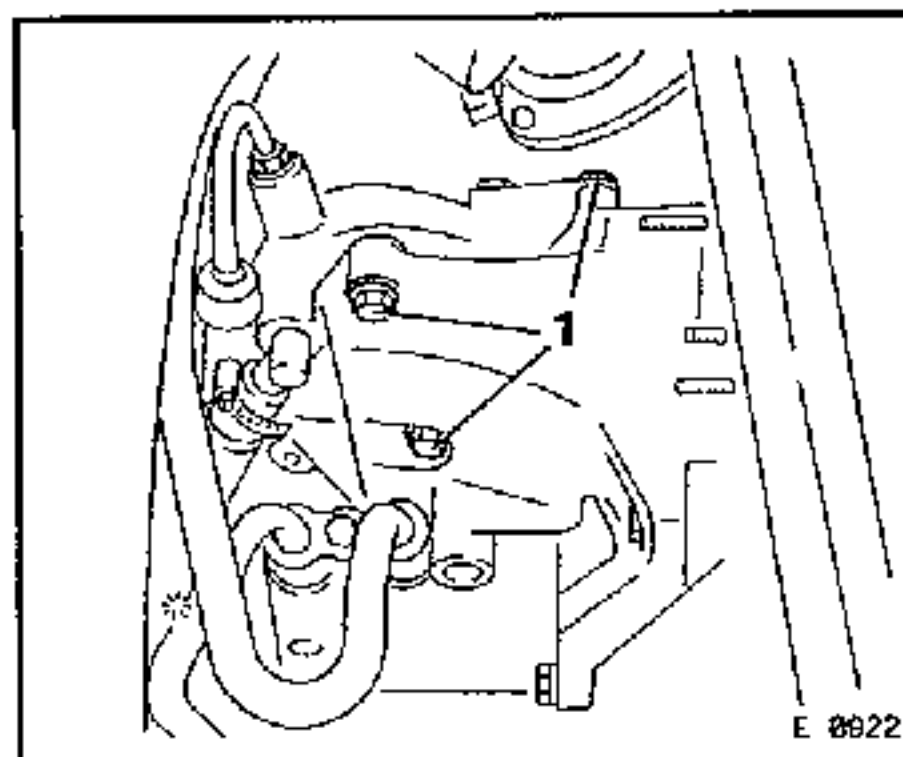
Mark the direction of rotation of the ribbed V- belt.

Engines as of MY'93:

Release ribbed V-belt, by rotating the tension roller clockwise, then remove the ribbed V-belt.

Fastening bolts (1) from the power steering hydraulic pump.

Swing pump to one side and secure. Do not disconnect hydraulic lines.

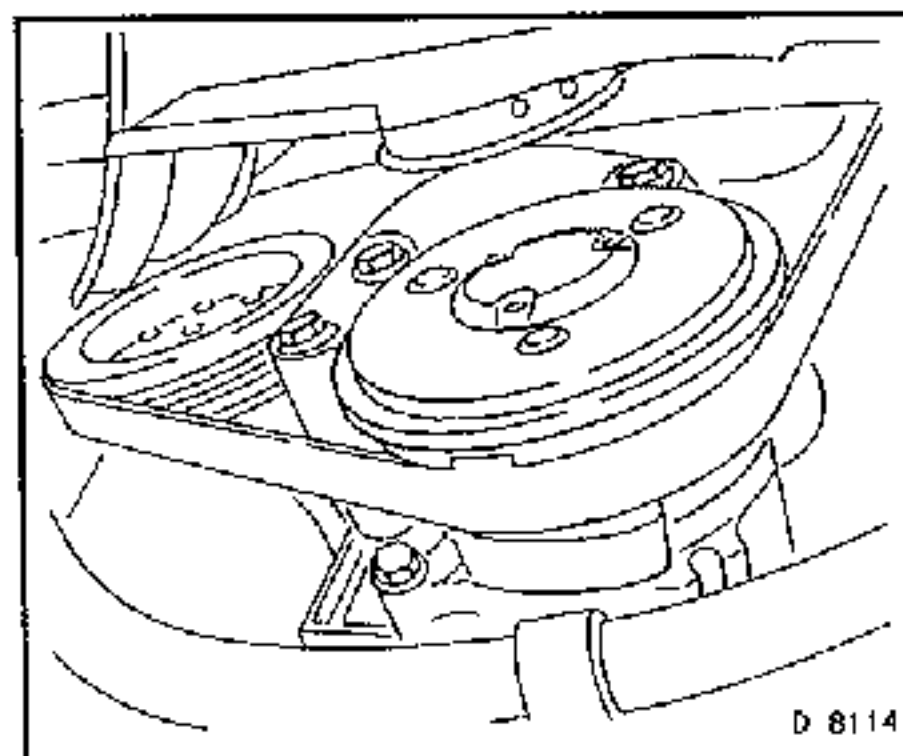


## Remove, Disconnect

Engines as of MY'93:

Power steering pump and compressor from the bracket.

Refer to 'Engine Accessories Bracket, Replace', in the Section 'Engine Timing Side, Air Cleaner Housing', in this Volume.

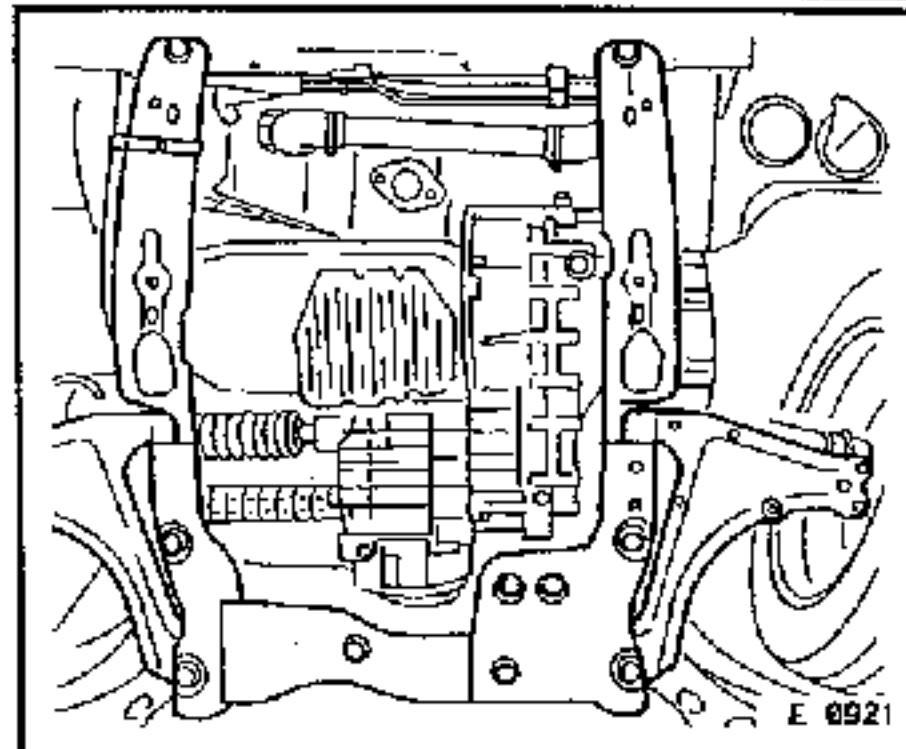


# DOHC ENGINE - ENGINE SHORT BLOCK

## Remove, Disconnect

Front wheels, ball joints from steering knuckles and axle driving shafts from the front axle body.

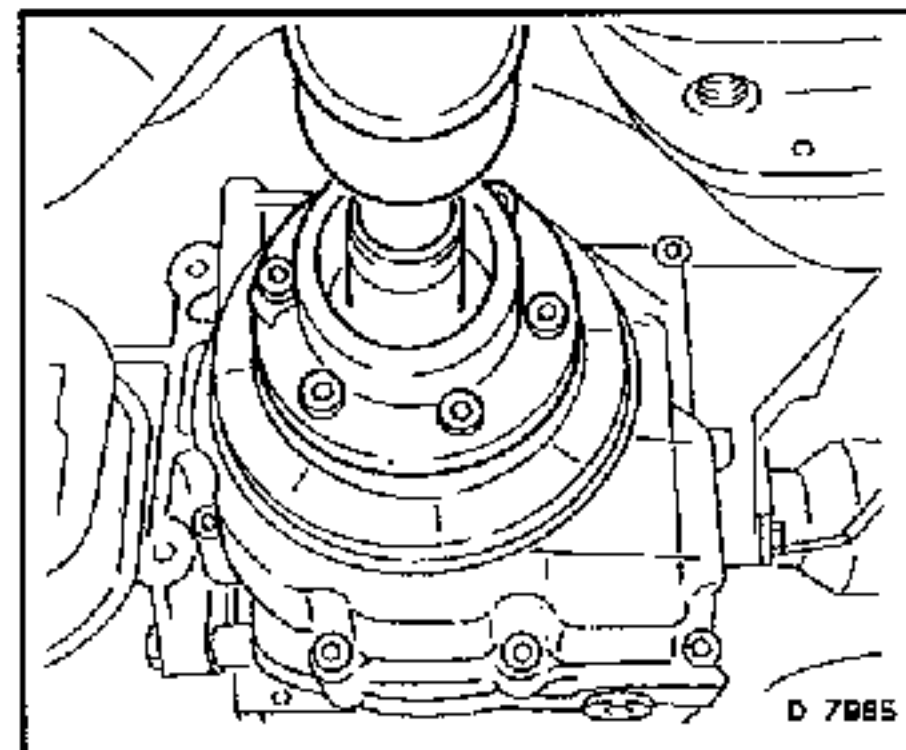
Refer to Groups E, "Frame, Front Suspension et al" in Volume 1 and K, "Clutch and Transmission" in Volume 4.



## Remove, Disconnect

For C 20 LET:

Cardan shaft from transfer box. Refer to Section K, "Clutch and Transmission" in Volume 4.



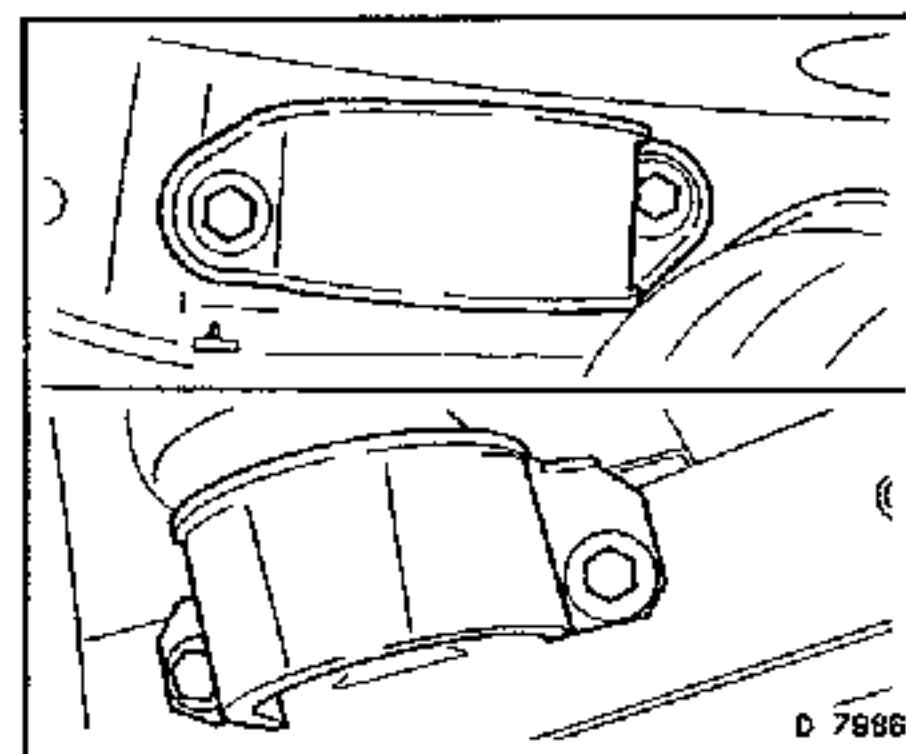
## Remove, Disconnect

Ground cable from transmission.

Support engine with jack, then remove engine damping blocks from side members.

Remove holder KM-263-B.

Lower engine with transmission downwards.



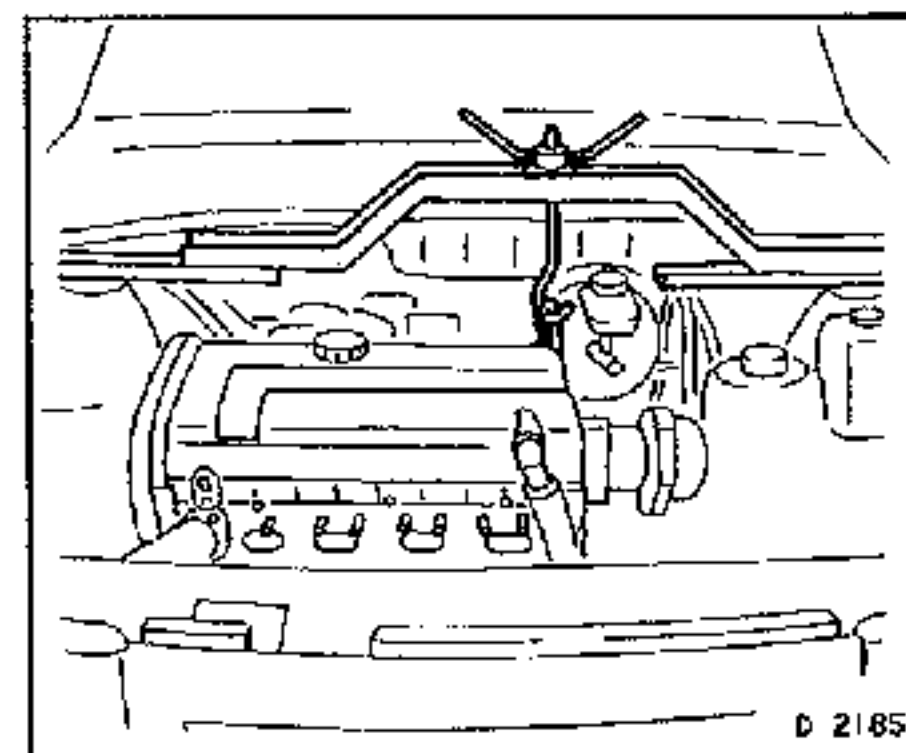
## Install, Connect

Engine with transmission into engine compartment.

## Tighten (Torque)

Engine damping blocks to side members..... 65 Nm \*

\* Clean threads and apply locking compound such as Loctite 242 or equivalent, to Holden's Specification HN1256.





# DOHC ENGINE - ENGINE SHORT BLOCK

## Install, Connect

Ground cable to transmission.

Oil filter to oil pump, after filling with clean engine oil.

### Note:

Use a thin film of clean engine oil on the new filter seal ring, before installation.

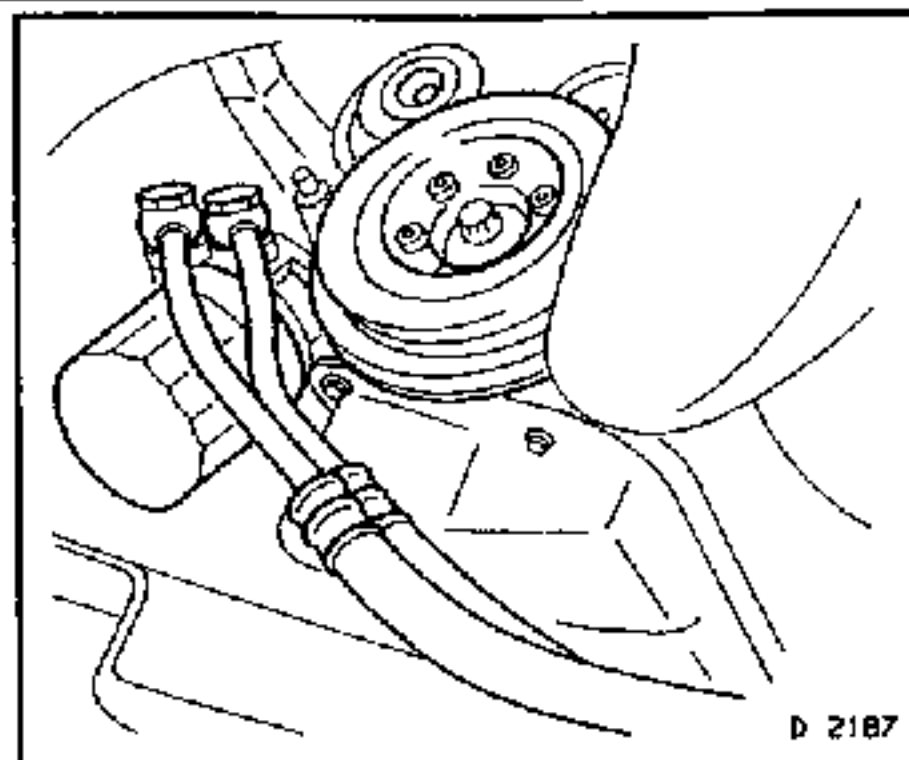
Oil cooler lines to adaptor.

## Tighten (Torque)

Oil filter cartridge to oil pump .....	15 Nm
Oil cooler lines to adaptor .....	30 Nm

For C 20 LET:

Cardan shaft to transfer box .....	30 Nm
------------------------------------	-------



## Install, Connect

Engines as of MY'93:

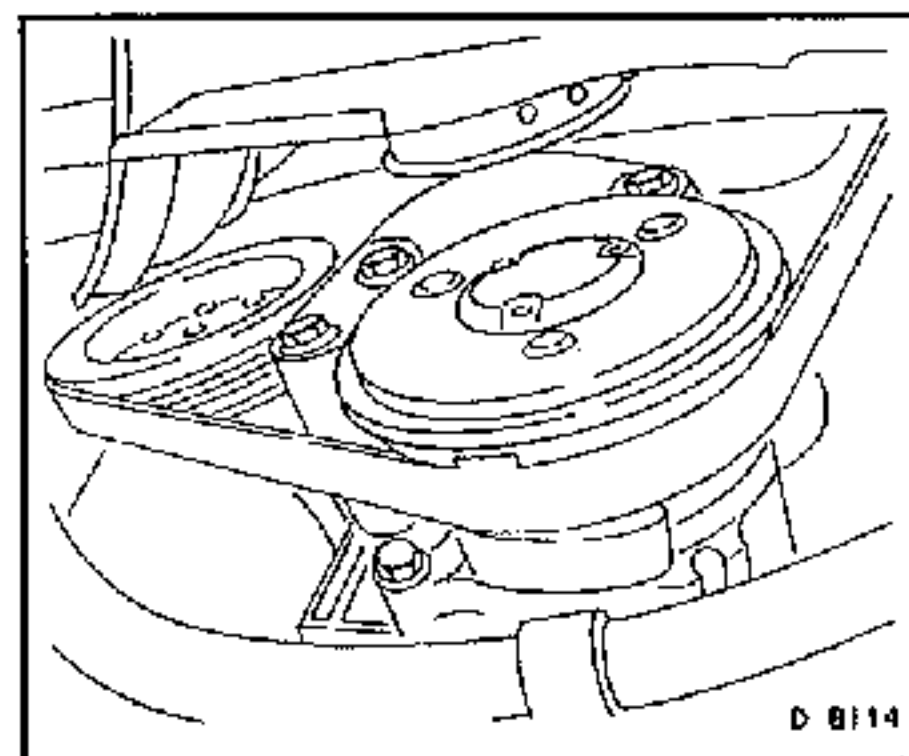
Power steering pump and A/C compressor to accessories bracket.

Refer to 'Engine Accessories Bracket, Replace', in the Section 'Engine Timing Side, Air Cleaner Housing', in this Volume.

Ribbed V-belt. Rotate the ribbed V-belt tension roller in an anti-clockwise direction to allow belt installation.

### Note:

Direction of ribbed V-belt rotation before installation.



## Install, Connect

Front axle body, axle driving shafts, ball joints in steering knuckles, front wheels.

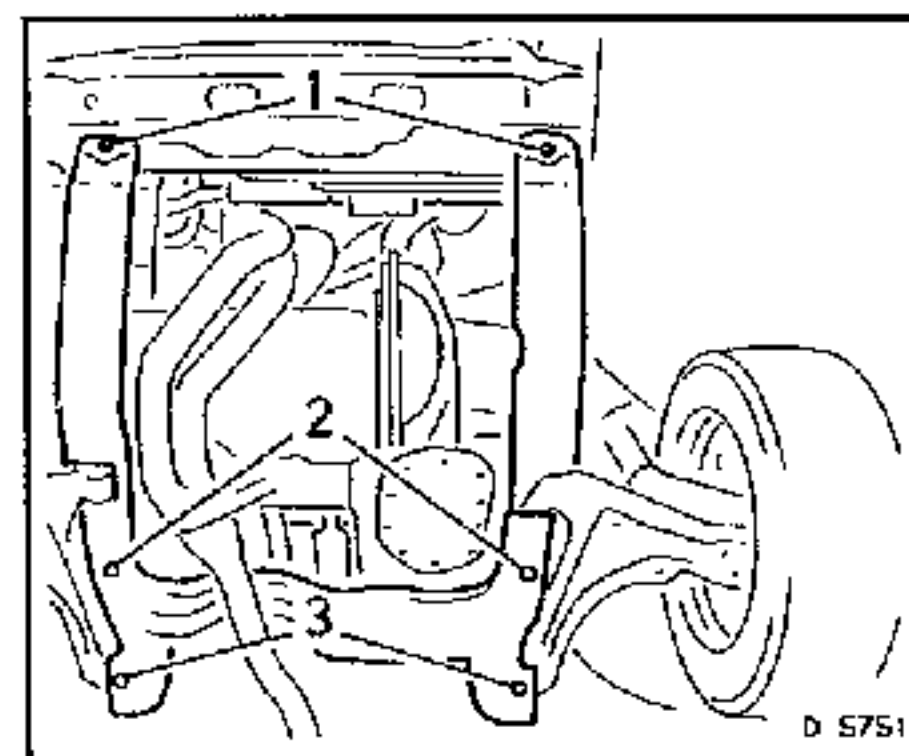
Refer to Groups E, 'Frame, Front Suspension et al' in Volume 1 and K, 'Clutch and Transmission' in Volume 4.

## Tighten (Torque)

Front axle body to underbody	
Bolts (1) .....	115 Nm
Bolts (2) .....	170 Nm

## Torque - Angle Method

Bolts (3) .....	100Nm + 75° - 90°
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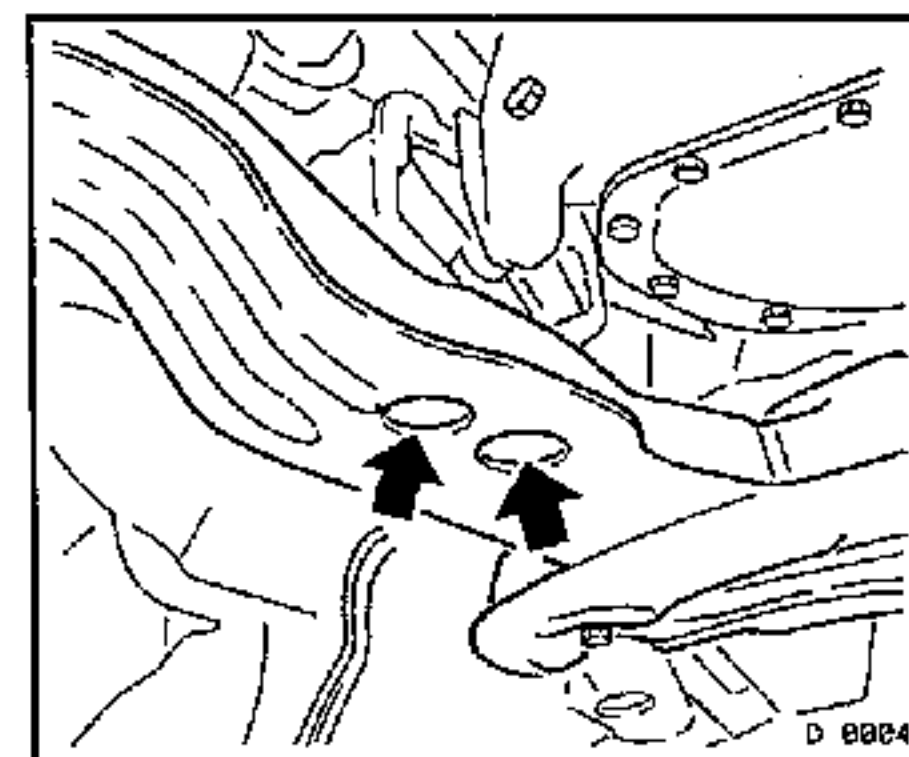
## Tighten (Torque)

Transmission bracket to front axle (arrows) .....	40 Nm
Ball joints to steering knuckle .....	70 Nm *
Front wheels to front hub .....	110 Nm

\* Use new retaining clamps and nuts.

## Remove, Disconnect

Engine holder KM-263-B



# DOHC ENGINE - ENGINE SHORT BLOCK

## Install, Connect

Engine pipe or performance header.

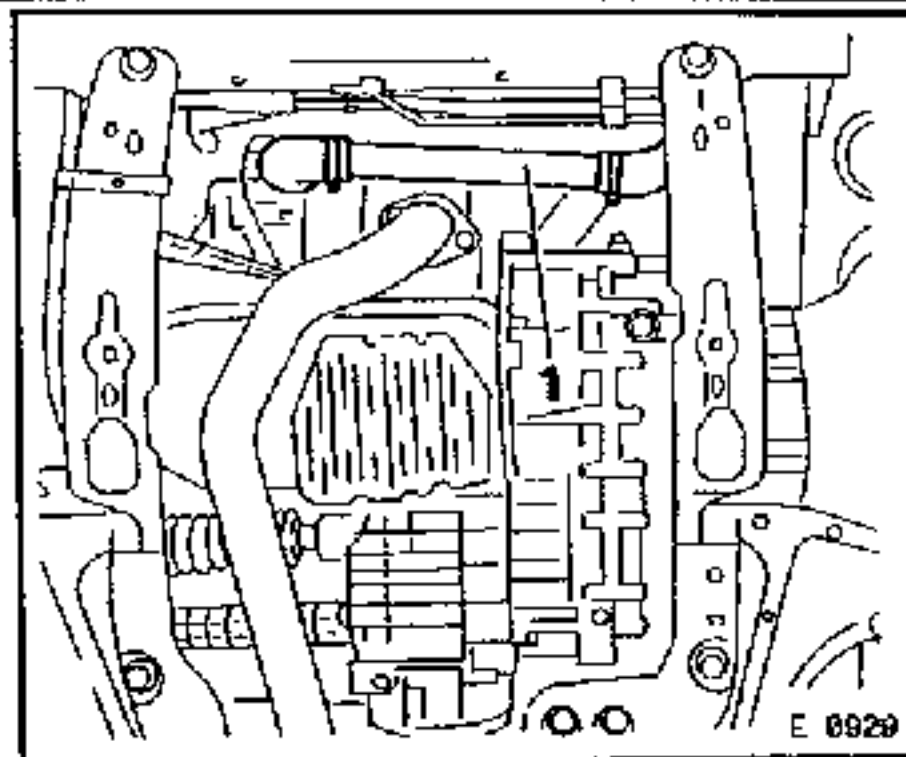
Refer to 'Gasket, Performance Header, Replace', in the Section "Cylinder Head", in this Volume.

For C 20 LET:

The lower air charge line (1).

## Tighten (Torque)

Exhaust pipe to exhaust adaptor (C 20 LET) .....	12 Nm
Performance header with cover plate to cylinder head .....	22 Nm
Exhaust pipe to catalytic converter .....	25 Nm



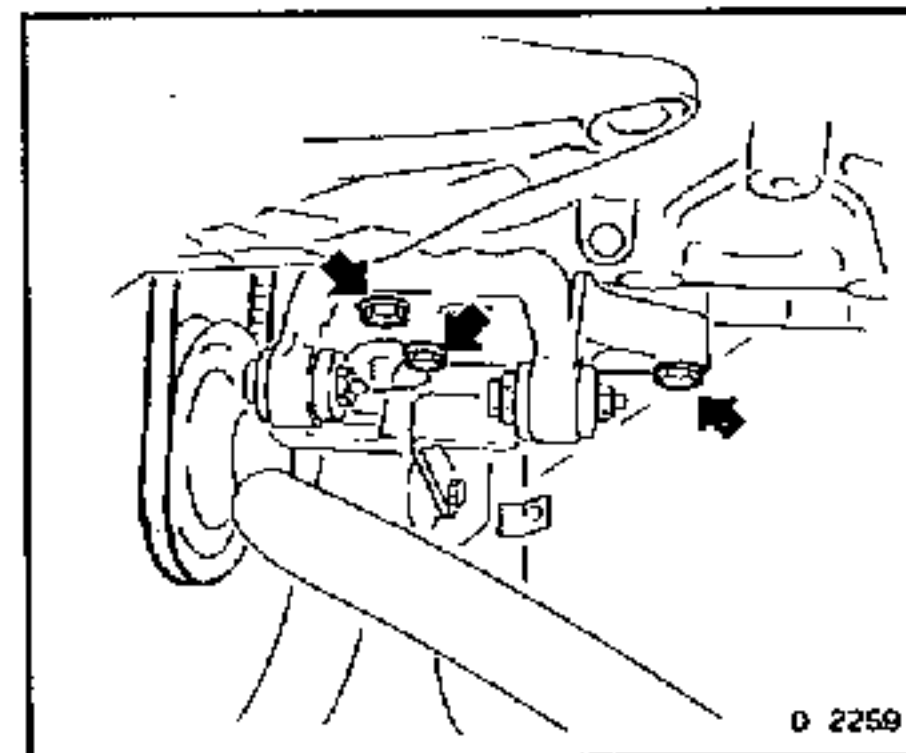
Engines up to MY'93:

## Tighten (Torque)

Power steering pump bracket to cylinder block .....	40 Nm
---	-------

## Adjust

V-belt tension. Refer to "Checking and Adjusting Procedures", in this Volume.



## Install, Connect

For C 20 LET:

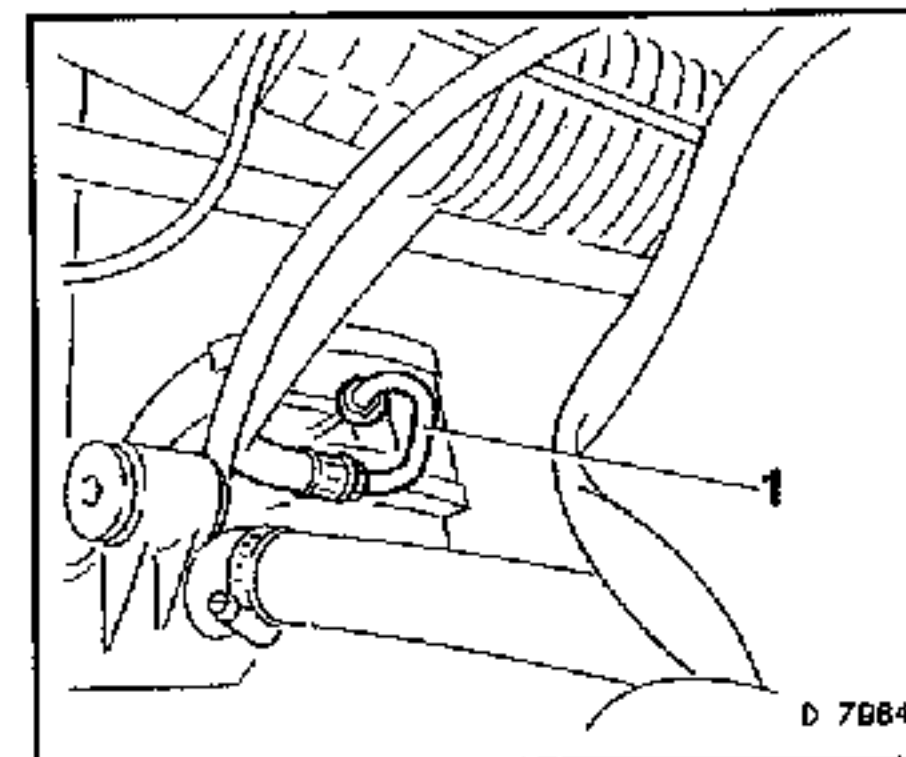
## Tighten (Torque)

Hydraulic line to transfer box .....	30 Nm
--------------------------------------	-------

## Install, Connect

Shift guide, shift rod and clutch cable. Refer to Section K "Clutch and Transmission", in Volume 4.

Speedometer cable or wiring harness plug to the odometer frequency sensor.



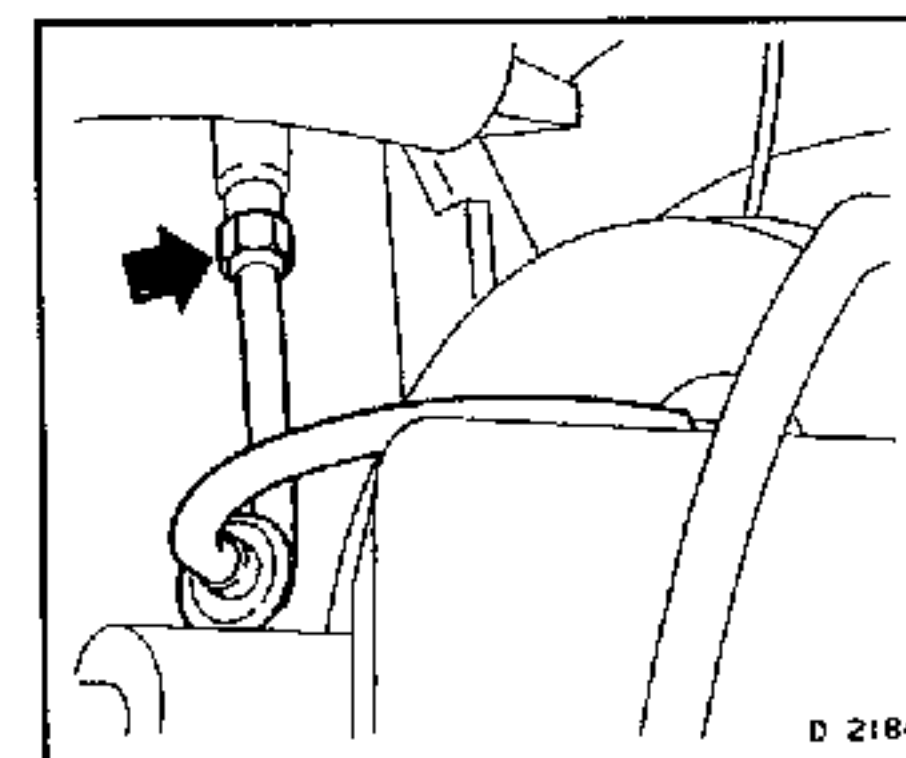
## Install, Connect

Vacuum hose to controlled canister purge valve.

Brake servo vacuum line to intake manifold.

## Tighten (Torque)

Brake servo vacuum line to intake manifold .....	20 Nm
--	-------



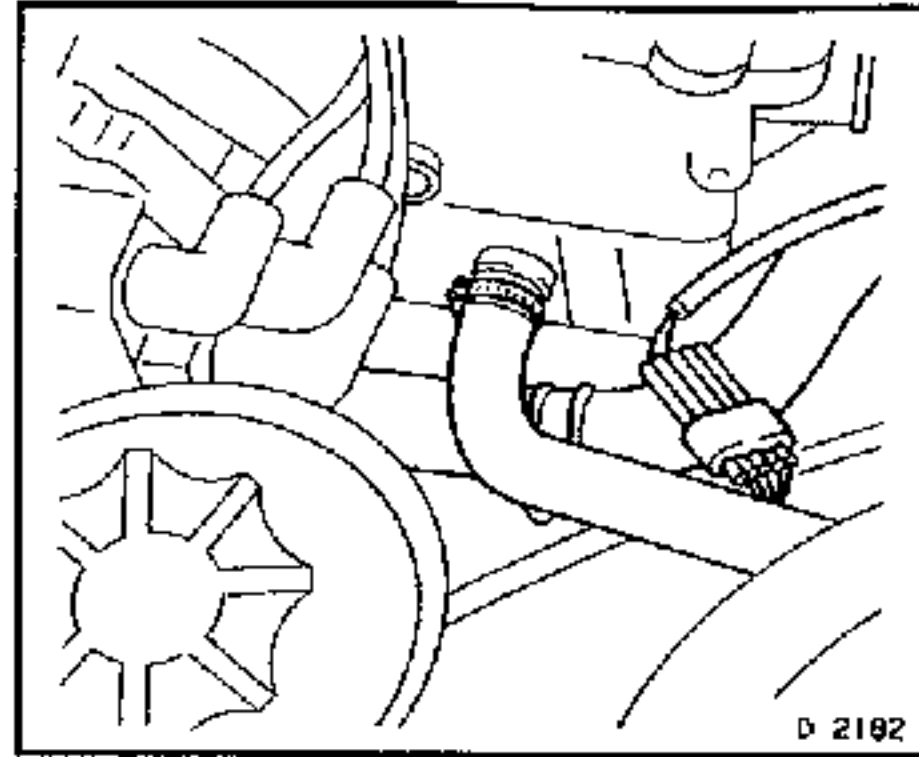
# DOHC ENGINE - ENGINE SHORT BLOCK

## Install, Connect

Multi-plug.

Coolant hoses to coolant pipe.

Coolant hose to cylinder head.



## Install, Connect

For C 20 LET:

Plug strip to injectors.  
Ground connections.

Wiring harness plug (4) to controlled canister purge valve.

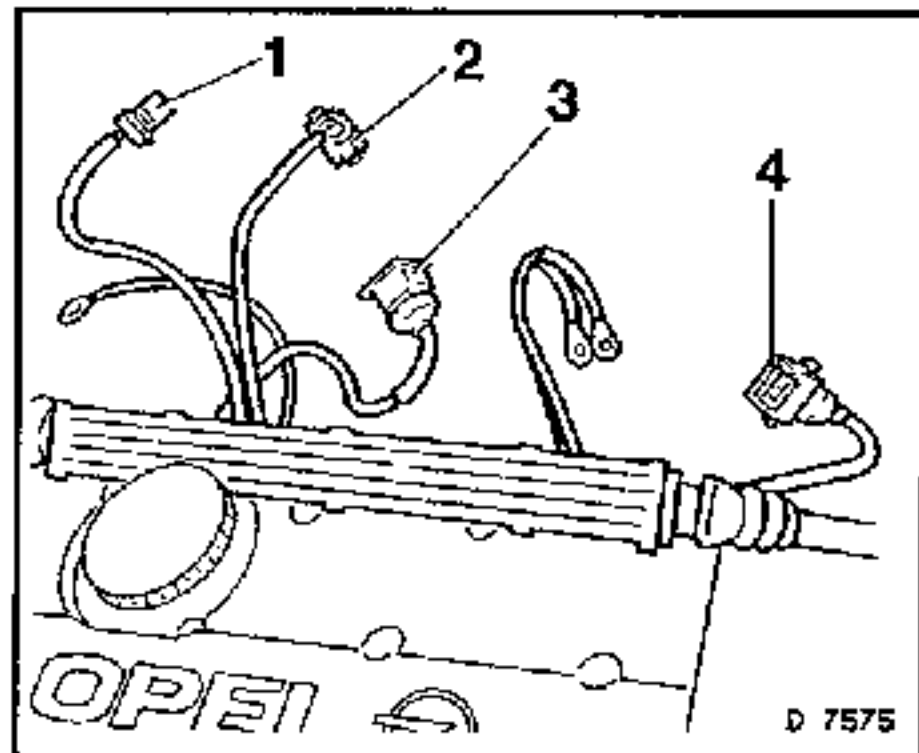
Wiring harness plug (3) to throttle valve potentiometer.

Wiring harness plug (2) to Intake air temperature sensor.

Wiring harness plug (1) to hot start valve.

### Note:

The routing of all wiring and connectors.



## Install, Connect

For C 20 XE:

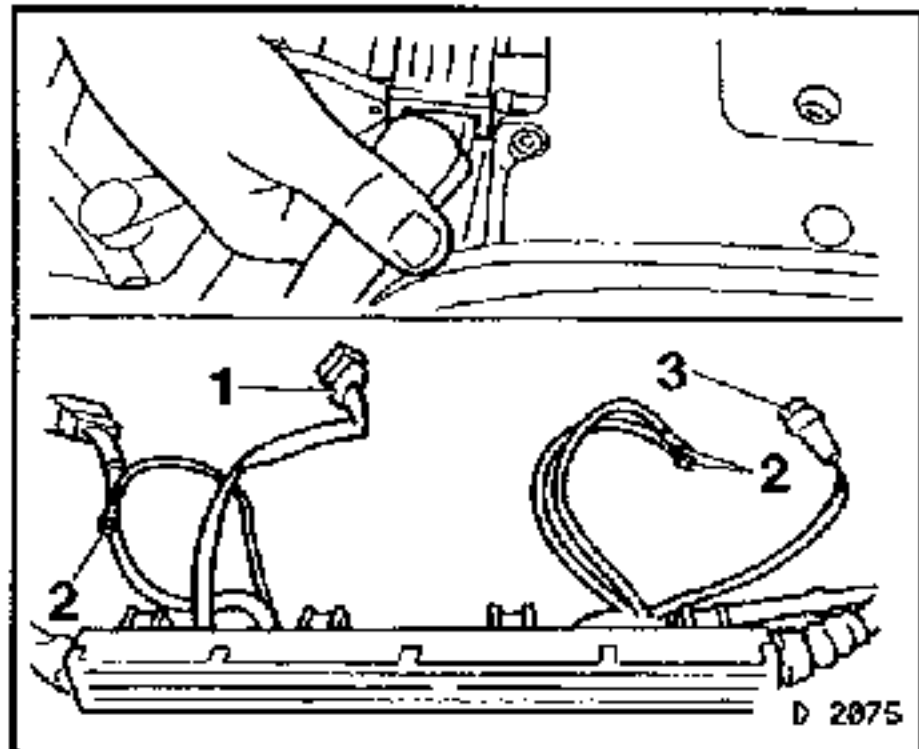
Wiring harness plug (1) to controlled canister purge valve.

Ground connections (2) to fuel distributor pipe.

Wiring harness plug (1) to throttle valve switch (M 2.5) or potentiometer (M 2.8).

### Note:

The routing of all wiring and connectors.



## Install, Connect

Bowden cable. Install without cable tension.

Fuel lines, then remove clamps.

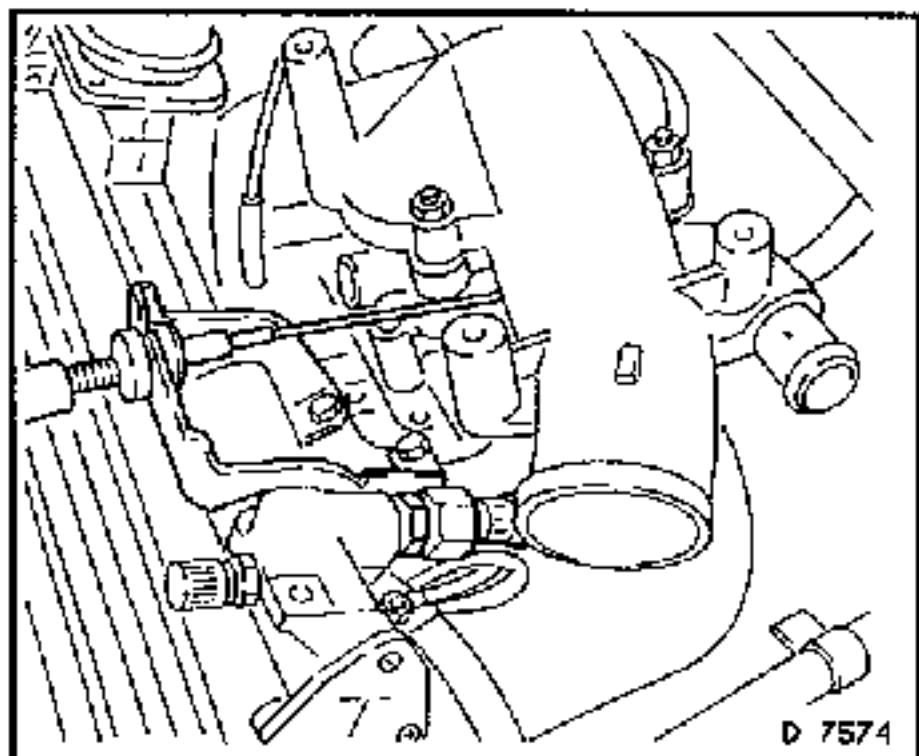
Fuel line bracket to throttle body.

Oxygen sensor wiring harness plug.

Wiring harness plug for dynamic oil level check.

For C 20 LET:

Transfer box temperature sensor wiring harness plug.



# DOHC ENGINE - ENGINE SHORT BLOCK

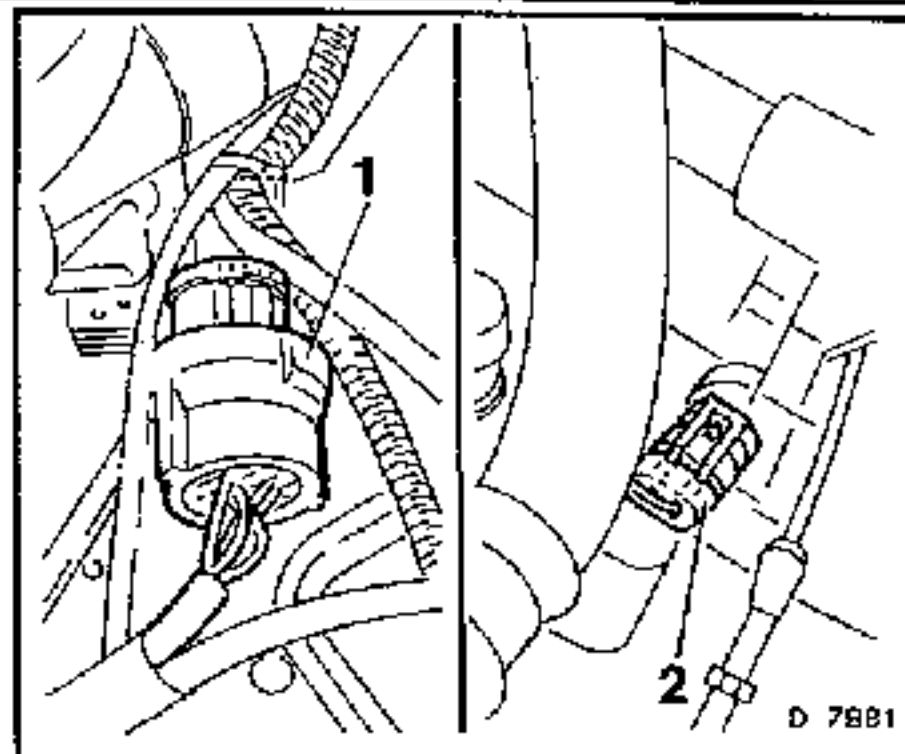
## Install, Connect

Engine harness to body wiring harness multi-plug (1).

Wiring harness plug (2) for reverse lamp.

For C 20 LET:

Wiring harness plug for first gear recognition switch.

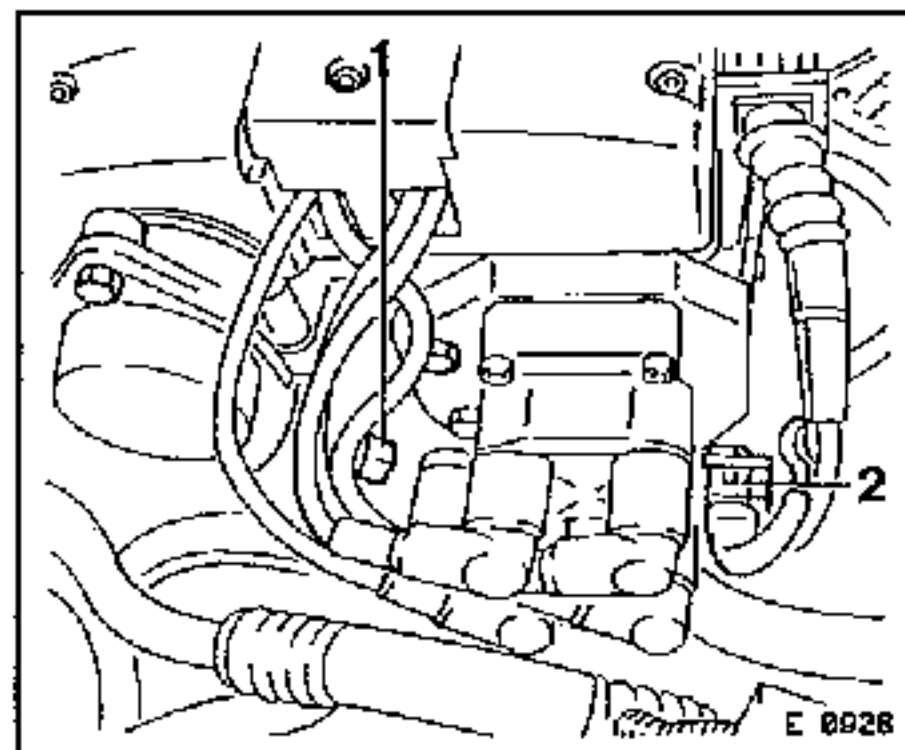


## Install, Connect

C 20 XE Engines as of MY'93:

Wiring harness plug to camshaft sensor (1).

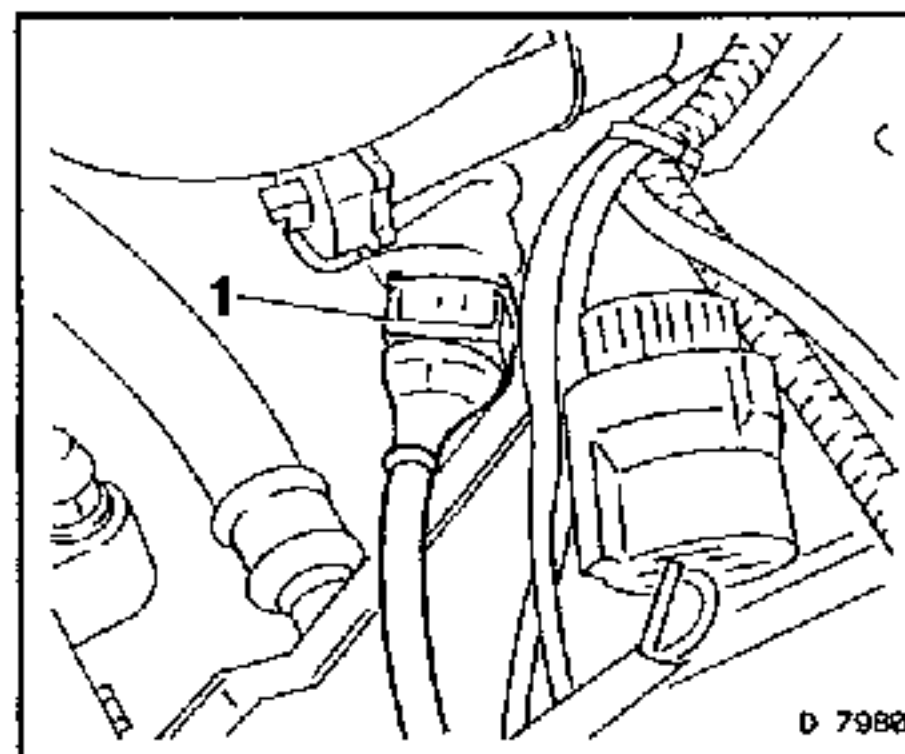
Wiring harness plug to ignition coil (2).



## Install, Connect

Wiring harness plug and high voltage cables to high voltage distributor.

Wiring harness plug (1) to ignition coil/control unit.

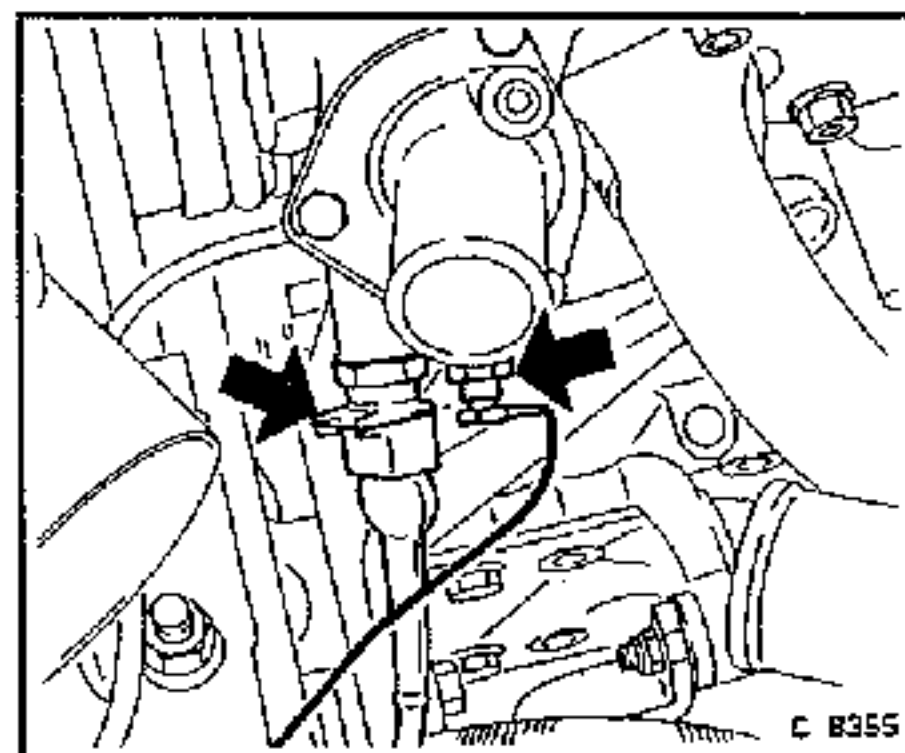


## Install, Connect

Wiring harness plugs (arrows) to thermostat housing.

Upper coolant hose to thermostat housing.

Coolant hoses to coolant reservoir tank.



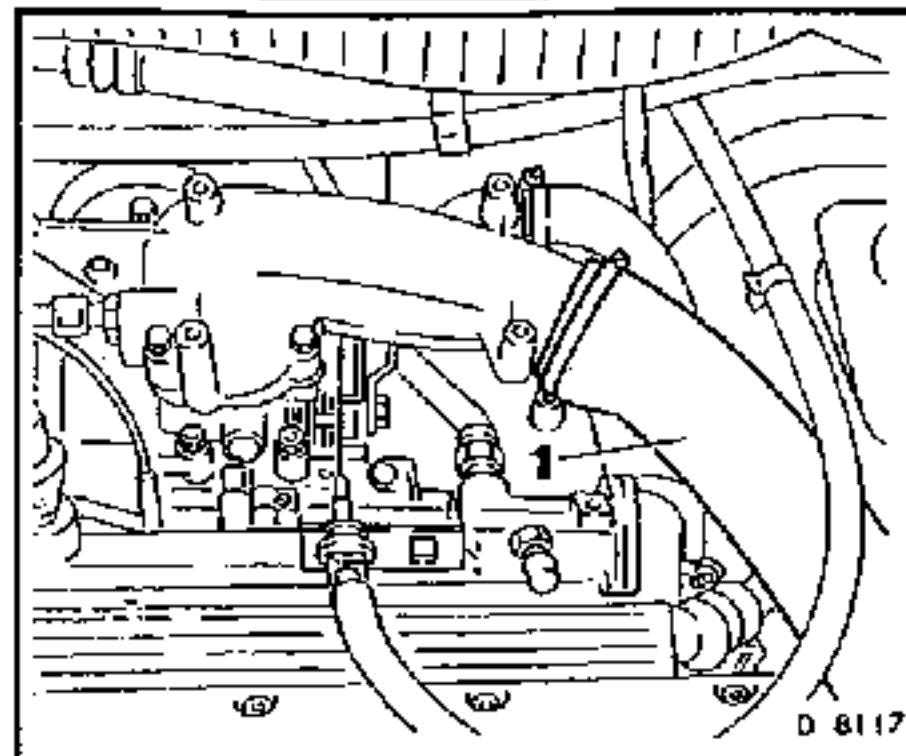
# DOHC ENGINE - ENGINE SHORT BLOCK

## Install, Connect

For C 20 LET:

Air hose (1) to charge air cooler and throttle valve manifold.

Vacuum hose from throttle body to control unit.

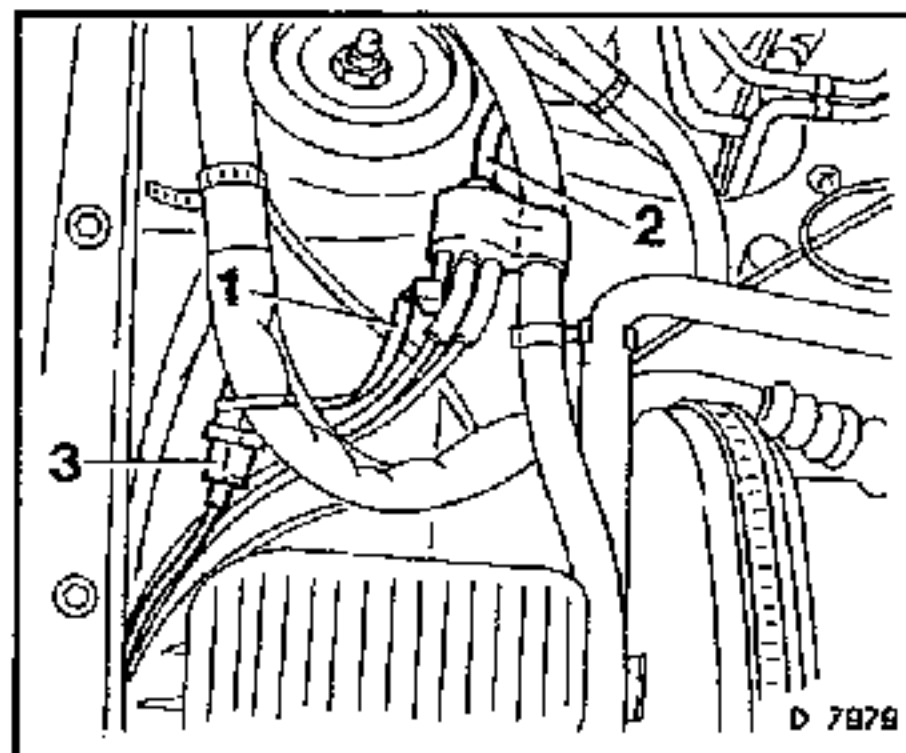


## Install, Connect

For C 20 LET:

Wiring harness plug (3) and wiring harness plug (1).

Hose (2) to charge pressure control switch-over valve.



## Install, Connect

For C 20 XE:

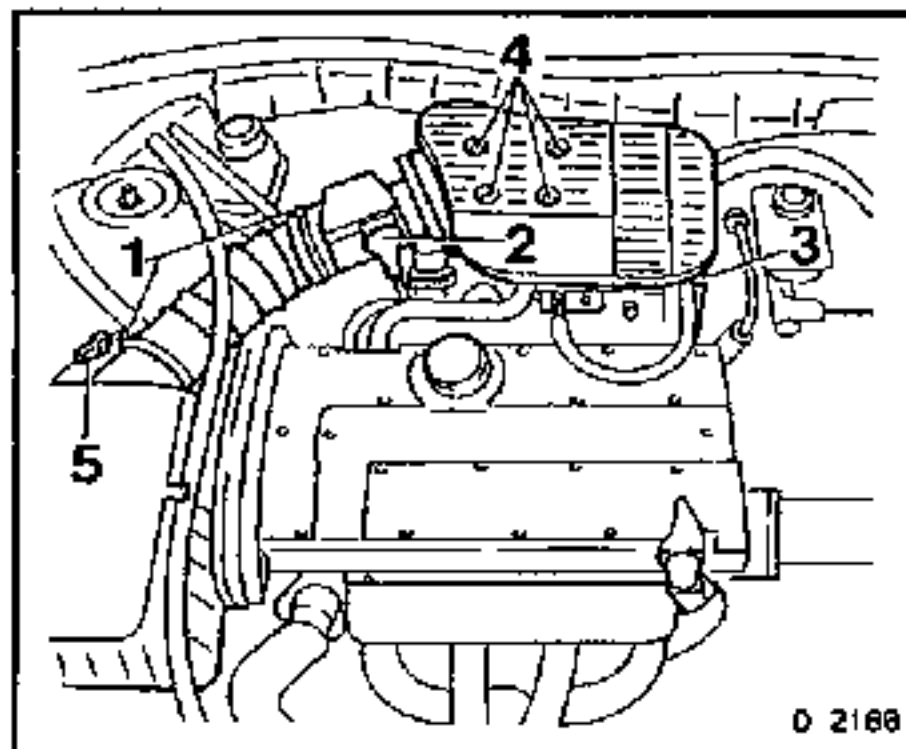
Wiring harness plug (5) to inductive pulse pick-up.

Pre-volume chamber with mass air flow meter (4).

Idle speed adjuster hose (3) to pre-volume chamber.

Wiring harness plug (2) to mass air flow meter.

Air intake hose (1).



## Install, Connect

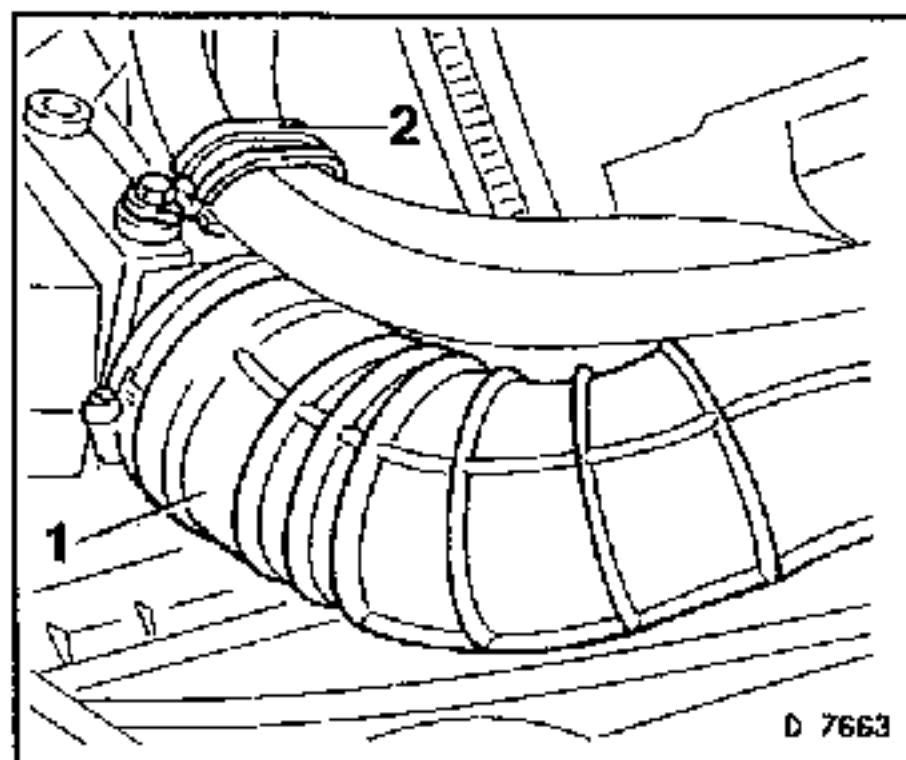
For C 20 LET:

Air hose (1) and bracket (2)

Cover to throttle valve manifold.

## Tighten (Torque)

Cover to throttle valve manifold ..... 5 Nm



# DOHC ENGINE - ENGINE SHORT BLOCK

## Install, Connect

The lower coolant hose to the radiator.

Fan motor and fan shroud, to the radiator.

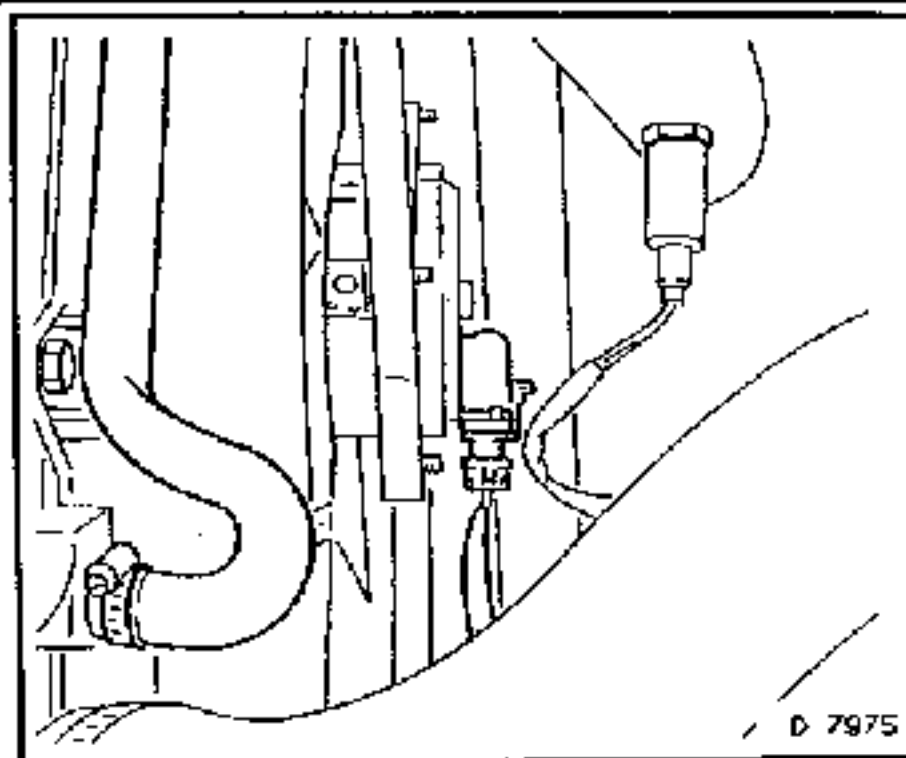
Ground cable to battery.

## Inspect

Check engine oil level and top up as necessary.

Top up and bleed cooling system. Refer to "Cooling System" Section in this Volume.

Top up and bleed the hydraulic braking system. Refer to Section H, "Brakes", in Volume 1.



## Engine Repair, Using Short Block

### Disconnect

All engine attaching parts and mount on engine overhaul stand KM-412.

For C 20 XE:

Use adaptor KM-412-8-A.

For C 20 LET:

Use adaptor KM-412-8-2

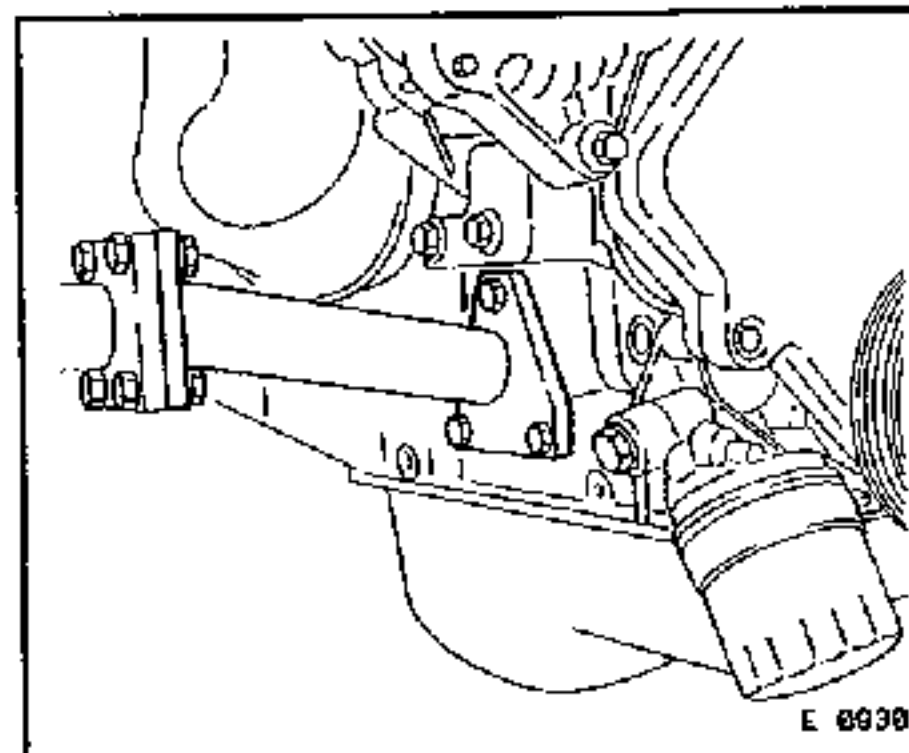
Drain engine oil into a suitable clean container.

### Install, Connect

Oil pan drain plug.

### Tighten (Torque)

Oil pan drain plug to oil pan..... 45 Nm

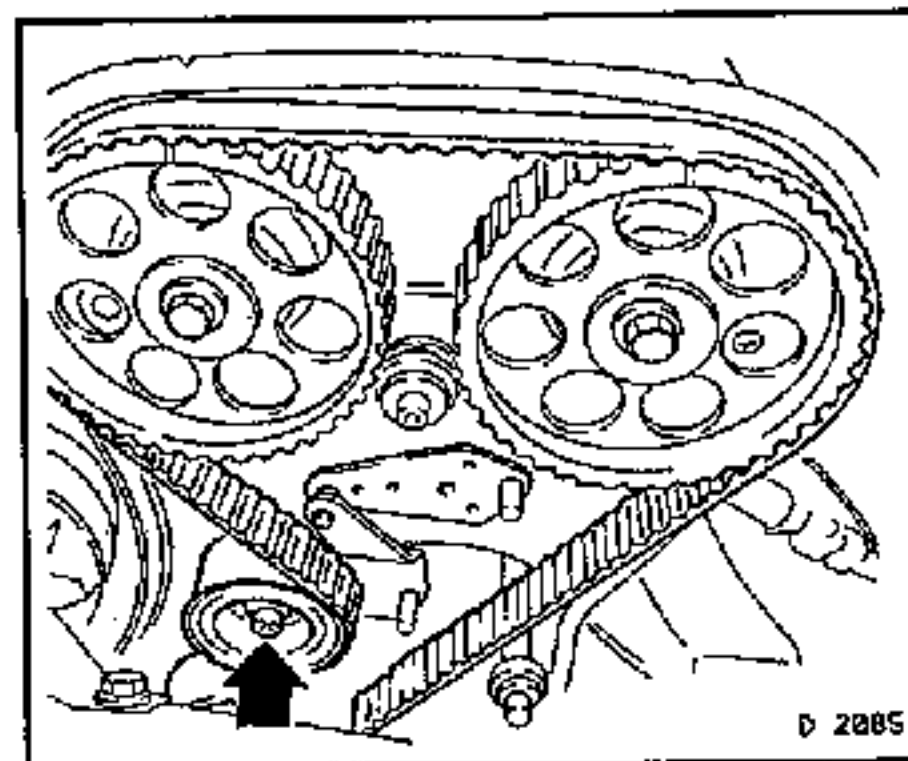


### Remove, Disconnect

Front toothed belt cover.

Toothed belt tension roller (arrow), toothed belt guide pulley, toothed belt.

Toothed Belt. Refer "Toothed Belt, Replace", in this Volume.



### Remove, Disconnect

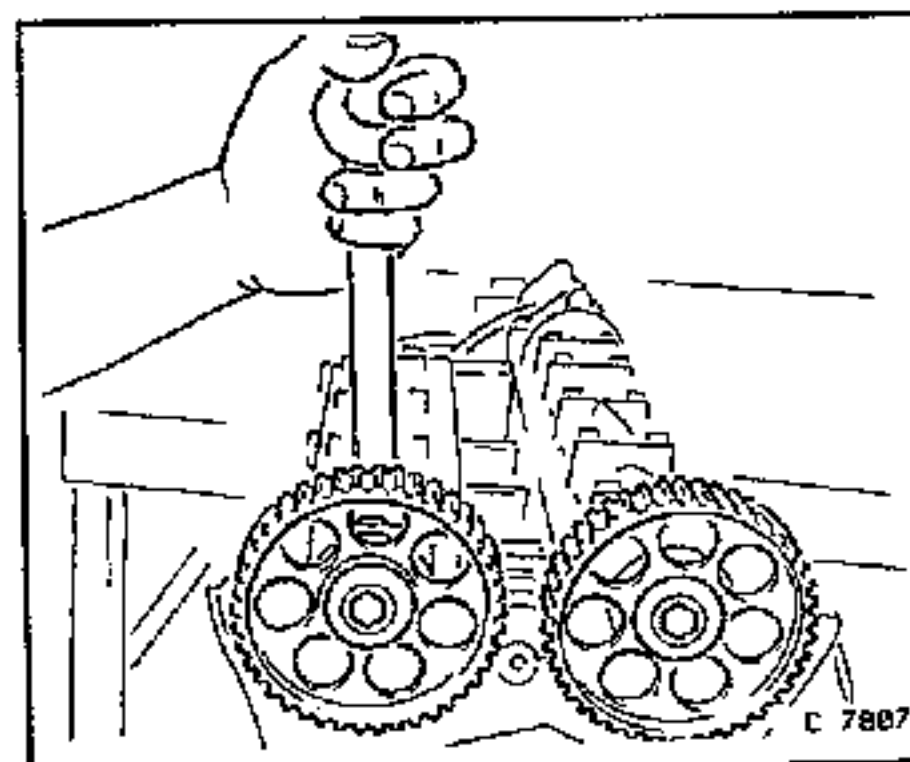
Ignition cable cover.

Spark plug connectors, using KM-717.

Crankcase ventilation hose connections from cylinder head cover.

Cylinder head cover.

Camshaft gears. Refer "Camshaft Gears, Remove and Install", in this Section.



# DOHC ENGINE - ENGINE SHORT BLOCK

## Remove, Disconnect

Rear toothed belt cover. Refer "Toothed Belt Rear Cover, Replace", in this Volume.

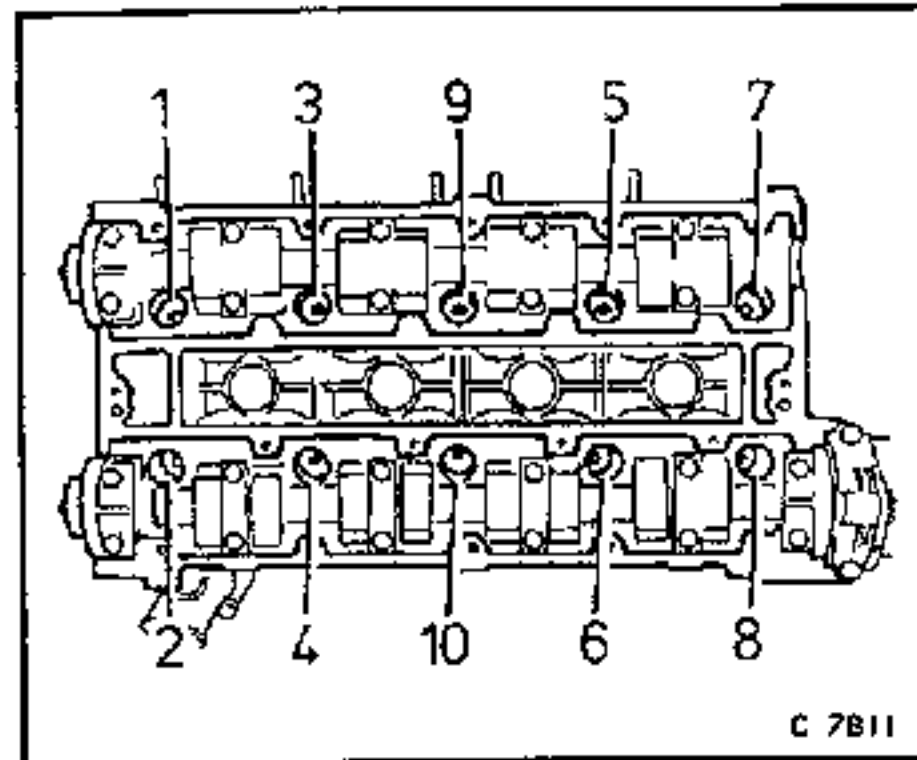
Intake manifold to cylinder block support.

Cylinder head bolts. Progressively loosen cylinder head bolts in the sequence shown, using MKM-604-19-A (Torx E 14).

## Important!

First loosen all bolts  $\frac{1}{4}$  turn, then  $\frac{1}{2}$  turn.

When removing the bolts, take note of the washers under each of the bolts.

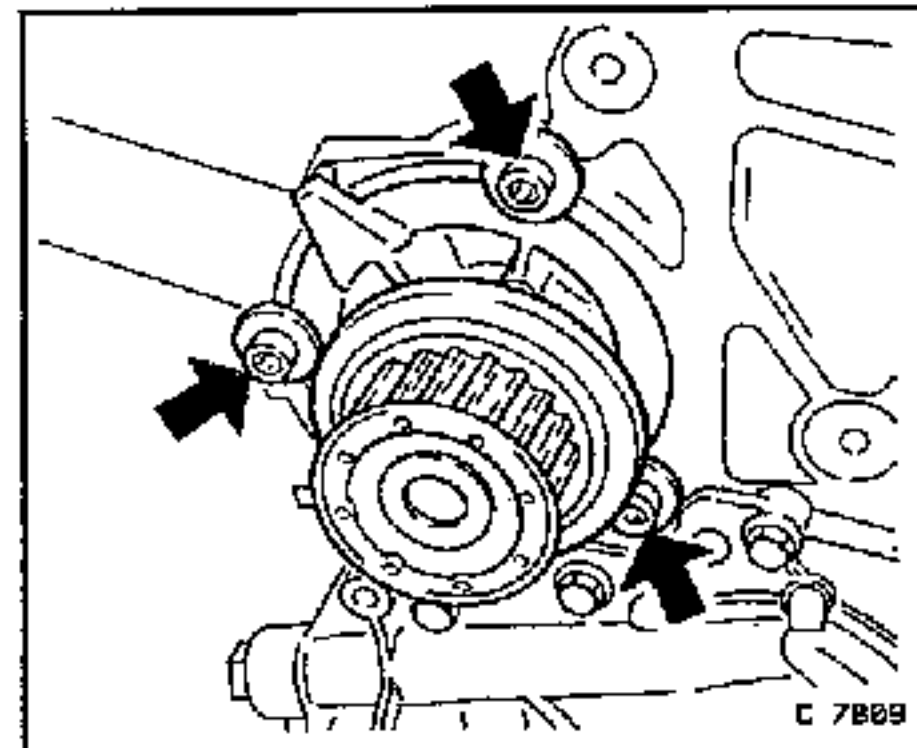


## Remove, Disconnect

Water pump (arrows) from the cylinder block.

Toothed belt drive gear, after first removing the fastening bolt for the toothed belt drive gear, using MKM-604-21 (Torx E 20). Hold the gear with wrench KM-662-A.

Then, install puller KM-210-A, with KM-516 and KM647, as required.

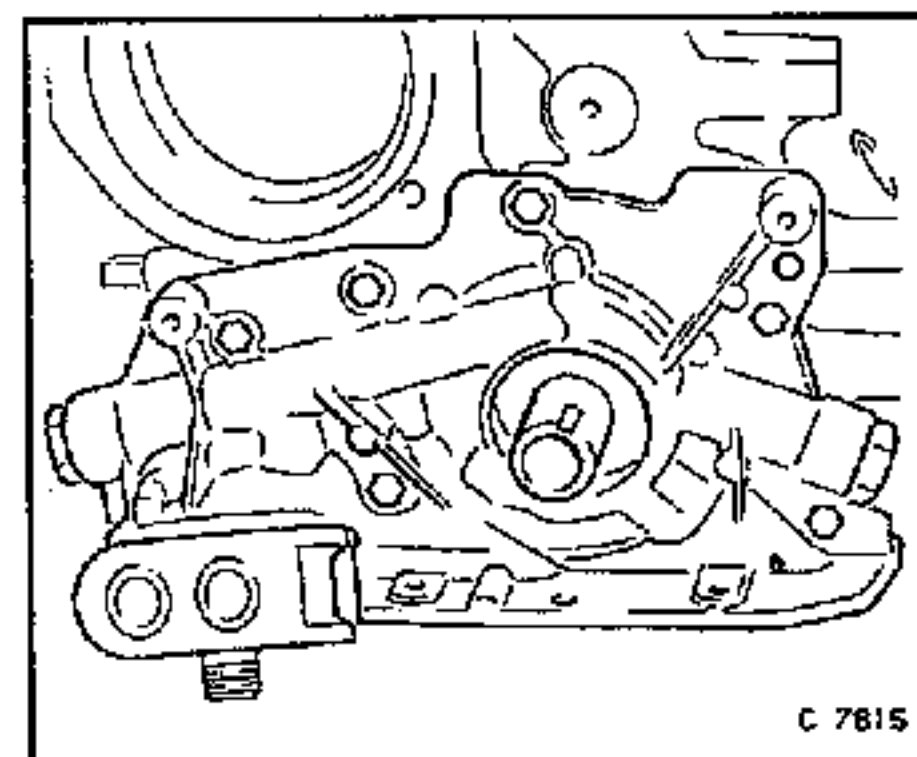


## Remove, Disconnect

Oil pan, oil intake pipe and baffle plate.

Spacing ring from crankshaft journal.

Oil pump.



## Remove, Disconnect

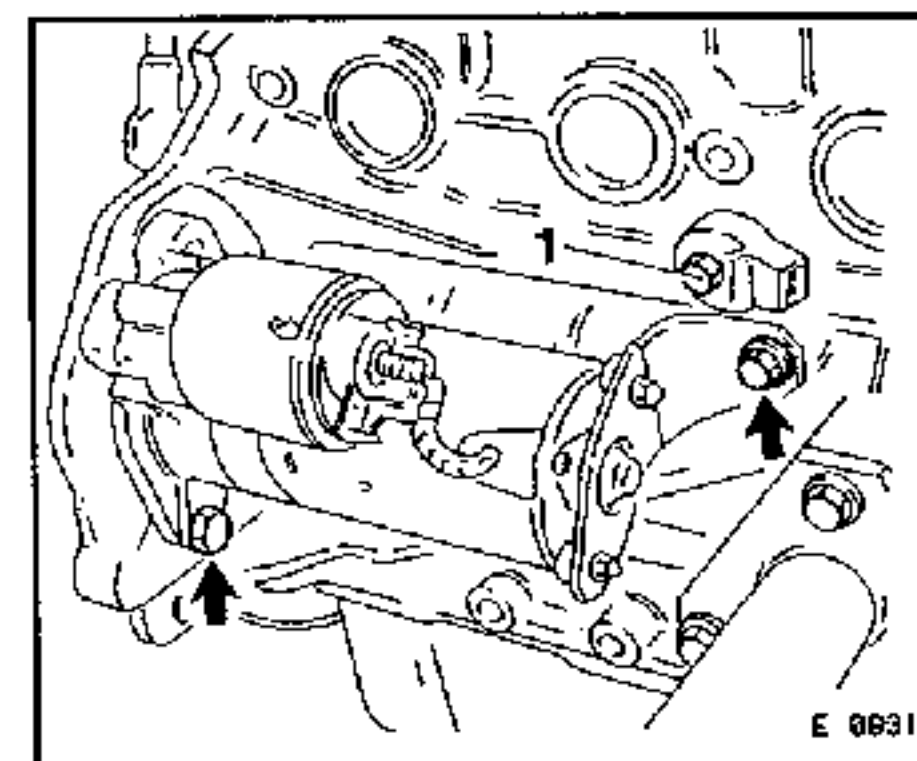
Coolant hose from coolant inlet fittings.

Coolant pipe.

Oil temperature switch.

Starter motor with support (arrows).

Knock sensor (1).





# DOHC ENGINE - ENGINE SHORT BLOCK

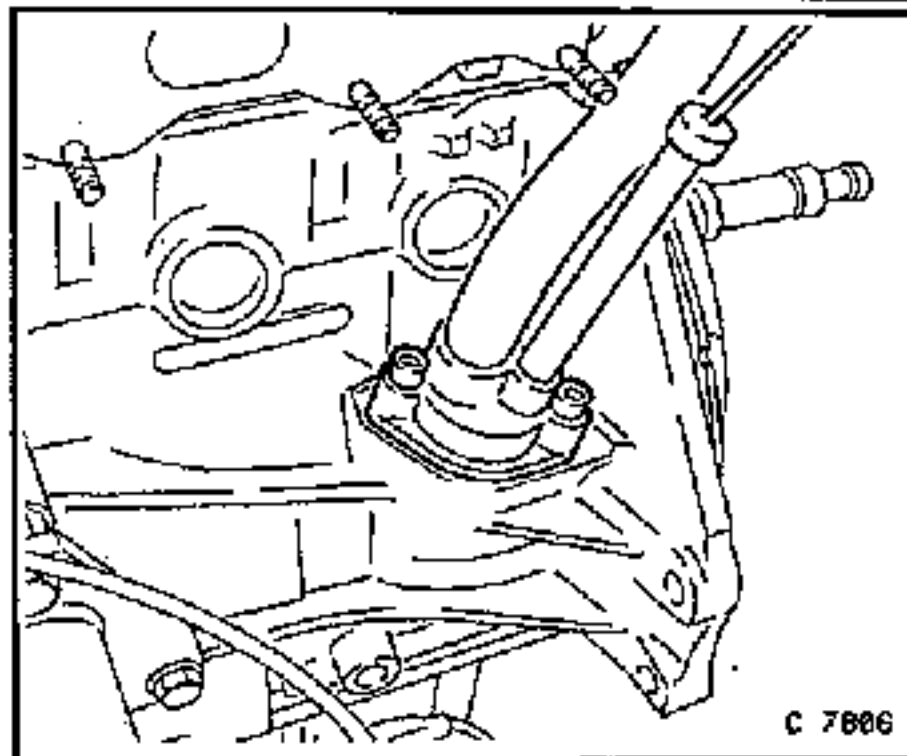
## Remove, Disconnect

Inductive pulse pick-up.

Engine ventilation flange.

## Clean, Inspect

All parts, replacing as required.



## Assemble New Short Block

## Install, Connect

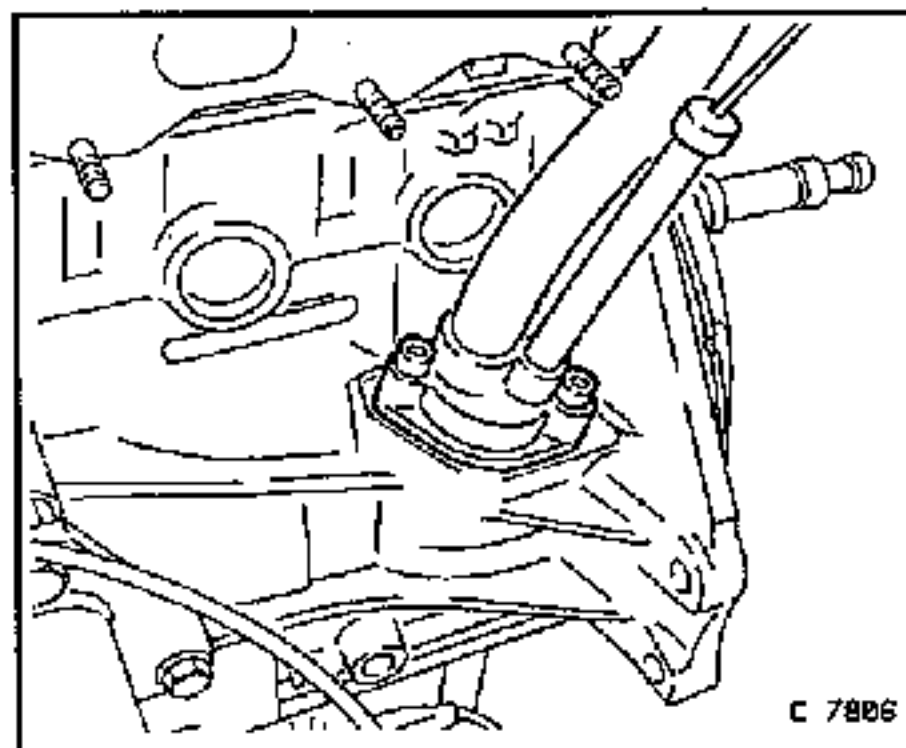
Locating sleeves in the cylinder block top surface, using KM-427.

## Tighten (Torque)

Engine ventilation flange to cylinder block.....	25 Nm *
Inductive pulse pick-up to cylinder block.....	6 Nm **
Starter motor to cylinder block.....	45 Nm
Starter support to cylinder block.....	25 Nm
Knock sensor to cylinder block.....	20 Nm
Oil temperature switch cylinder block.....	30 Nm
Coolant pipe to cylinder block.....	20 Nm

\* Use a new gasket

\*\* Use a new seal ring



## Install, Connect

Coolant hose to water inlet fitting.

Oil pump with a new gasket.

## Tighten (Torque)

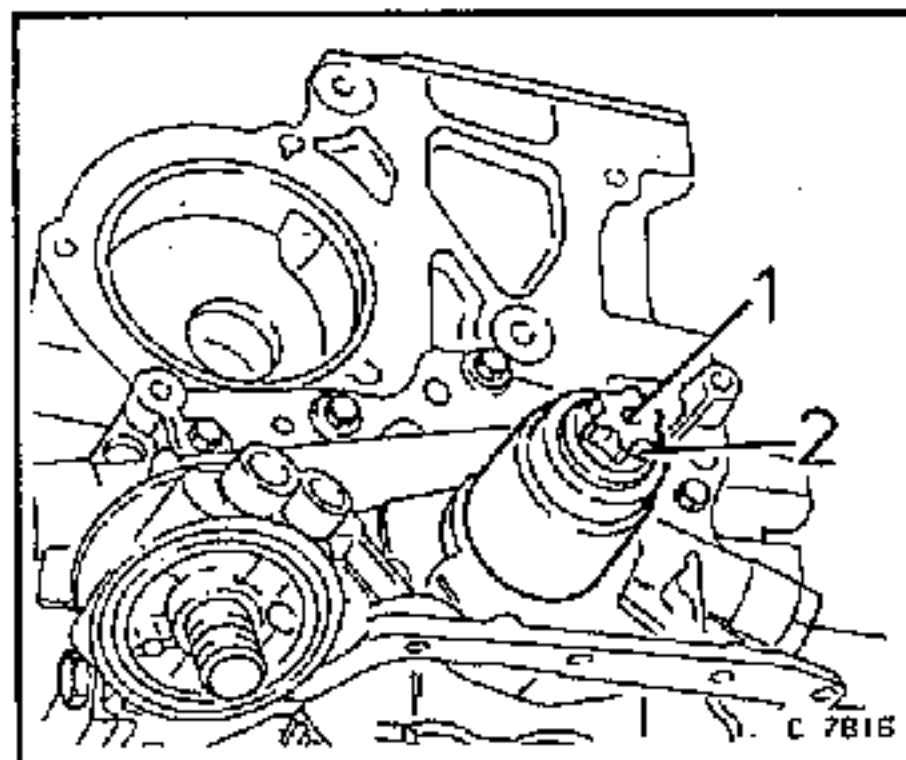
Oil pump to cylinder block .....	6 Nm
----------------------------------	------

## Install, Connect

Seal ring, using KM-693 and the Torx bolt (1) and washer (2) from the toothed belt drive gear.

## Note:

Apply protective grease to the seal lip before installation.



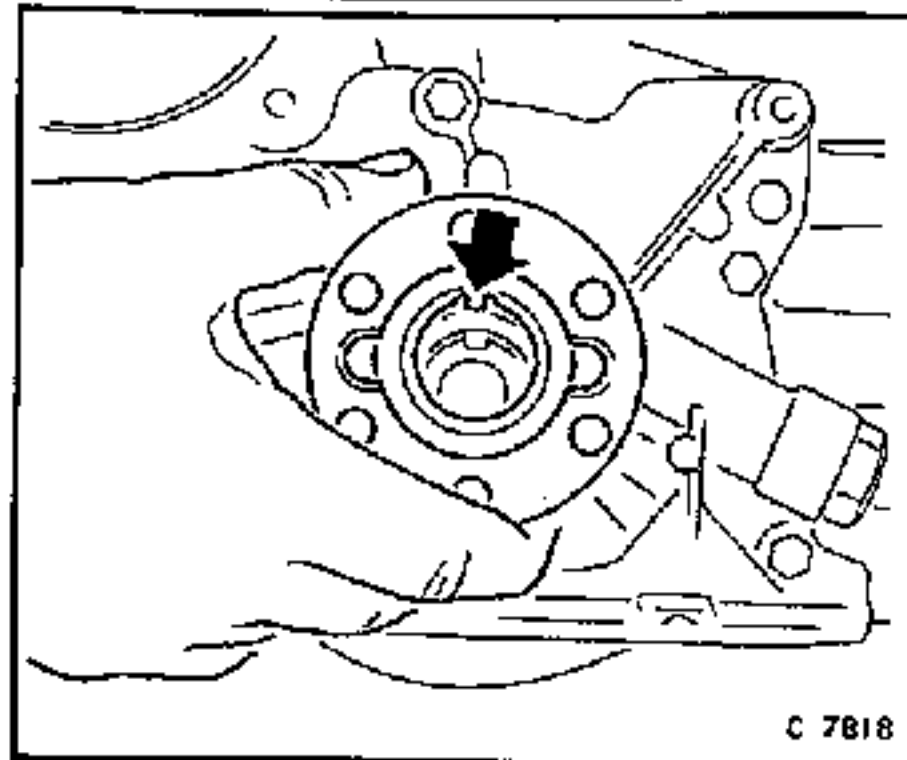


# DOHC ENGINE - ENGINE SHORT BLOCK

## Install, Connect

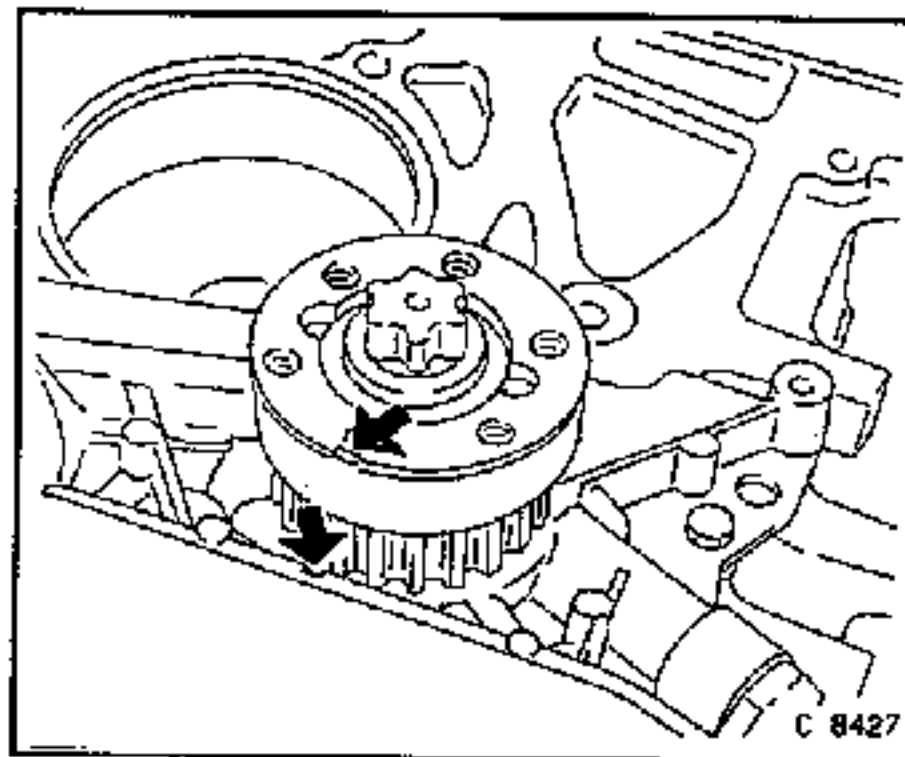
The timing ring, coating first with sealant such as Dow Corning Silicone 732 or equivalent, to Holden's Specification HN1373.

Toothed belt drive gear, noting the installation position.



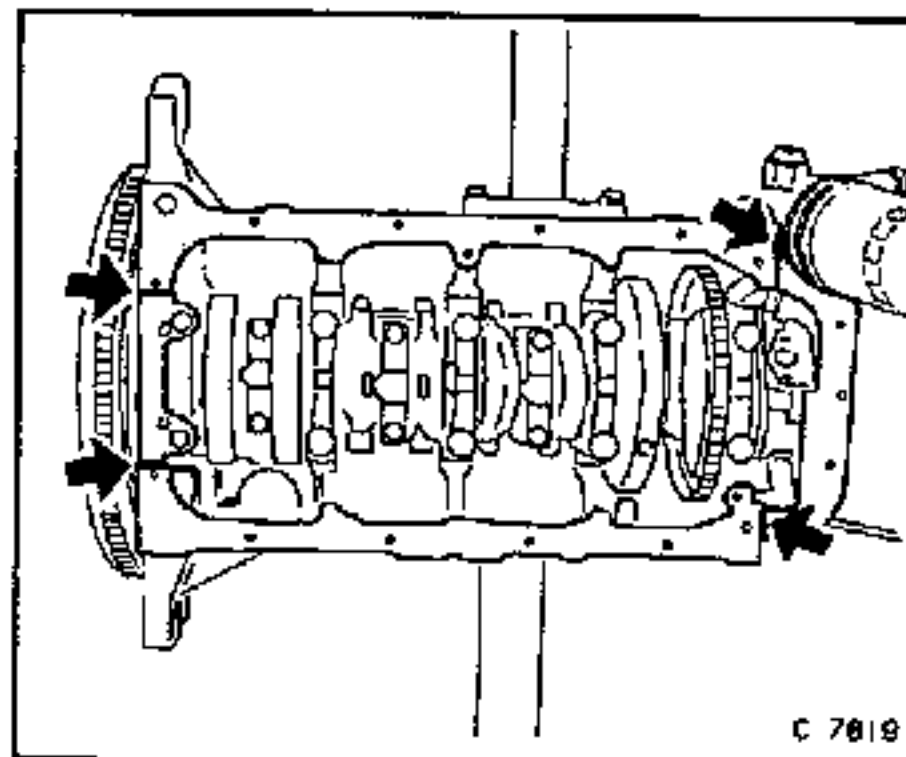
## Adjust

Using MKM-604-21 (Torx E20), turn the crankshaft in the direction of rotation until No.1 piston is at TDC, as indicated in illustration C 8427.



## Apply

Adhesive sealing compound such as General Electric RTV159 or equivalent, to the places indicated (arrows).



## Install, Connect

Cork gasket and baffle plate.

Oil intake bracket and pipe.

Second cork gasket.

Oil pan to cylinder block.

## Tighten (Torque)

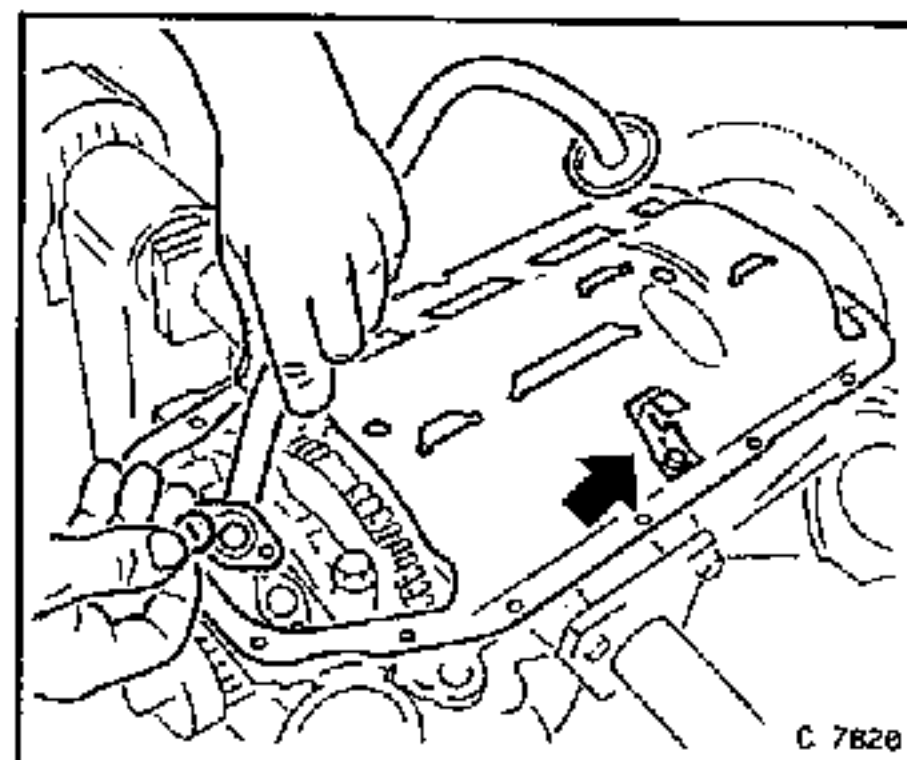
Oil intake pipe bracket to cylinder block	6 Nm
Oil intake pipe to oil pump	8 Nm
Oil pan to cylinder block	15 Nm *

\* Insert oil pan bolts using locking compound such as Loctite 242 or equivalent to Holden's Specification HN1256

## Important!

Maximum installation time is 10 minutes.

When installing the cork gaskets, check for the correct number of spacing rings.



# DOHC ENGINE - ENGINE SHORT BLOCK

## Install, Connect

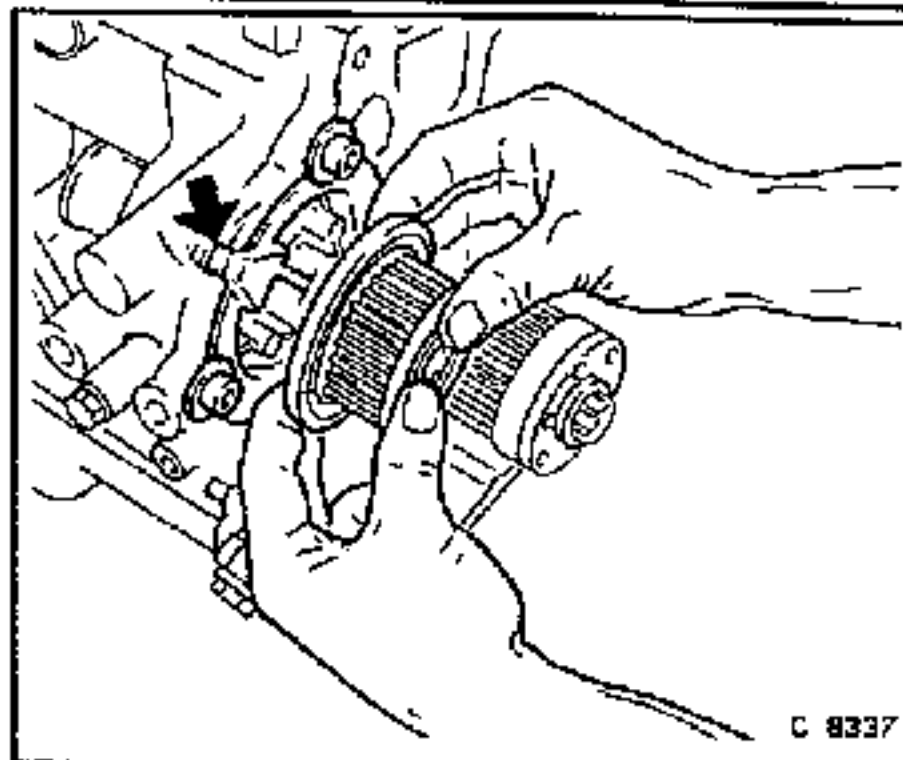
Water pump to cylinder block, after applying a thin bead of silicone grease such as Dow Corning No. 44 or equivalent to Holden's Specification HN1014:

## Tighten (Torque)

Water pump to cylinder block ..... 25 Nm

## Important!

The two lugs on the cylinder block and water pump must be aligned (arrow).



C 8337

## Install, Connect

New cylinder head gasket. Align the mark "OBEN/TOP" upwards and to the timing side of the engine.

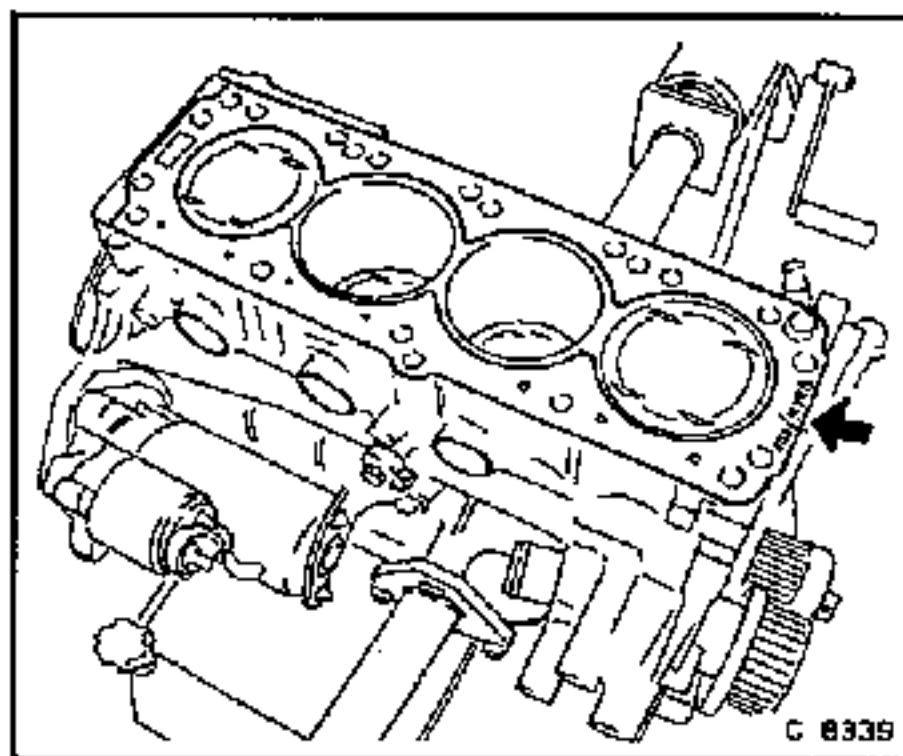
Install the cylinder head, indexing with the locating sleeves in the cylinder block.

Install new cylinder head bolts, each with a washer.

Using MKM-604-19-A (Torx E 14), install bolts until they are all just seated.

## Important!

Use NEW bolts.



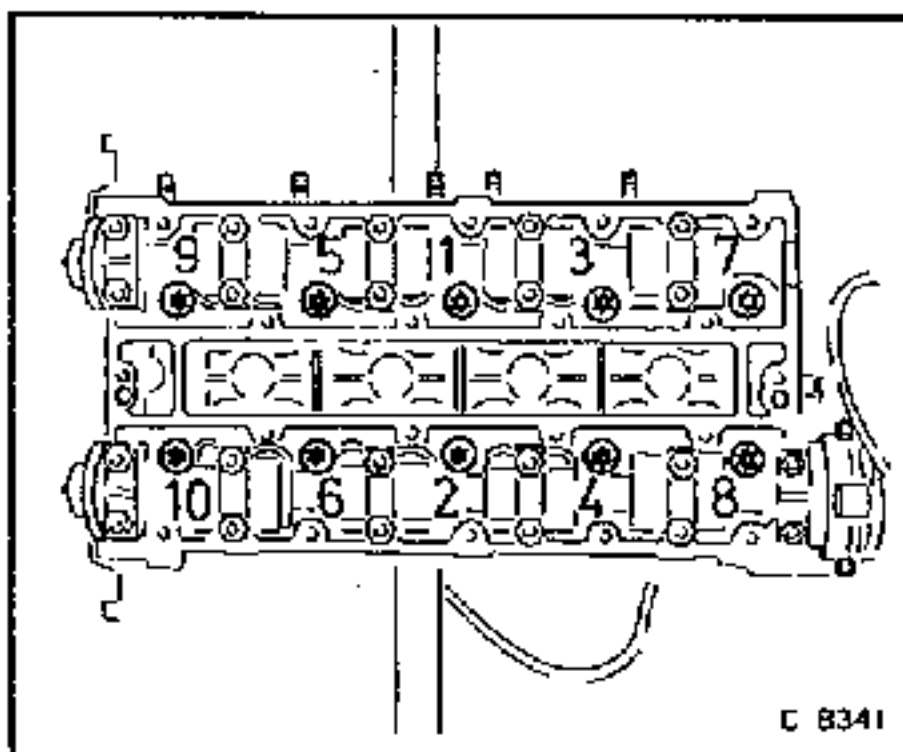
C 8339

## Tighten (Torque)

Cylinder head to cylinder block.  
Tighten in the sequence shown, in four stages, using angular wrench KM-470-B.

## Torque - Angle Method

Tightening procedure ..... 25 Nm + 90° + 90° + 90°



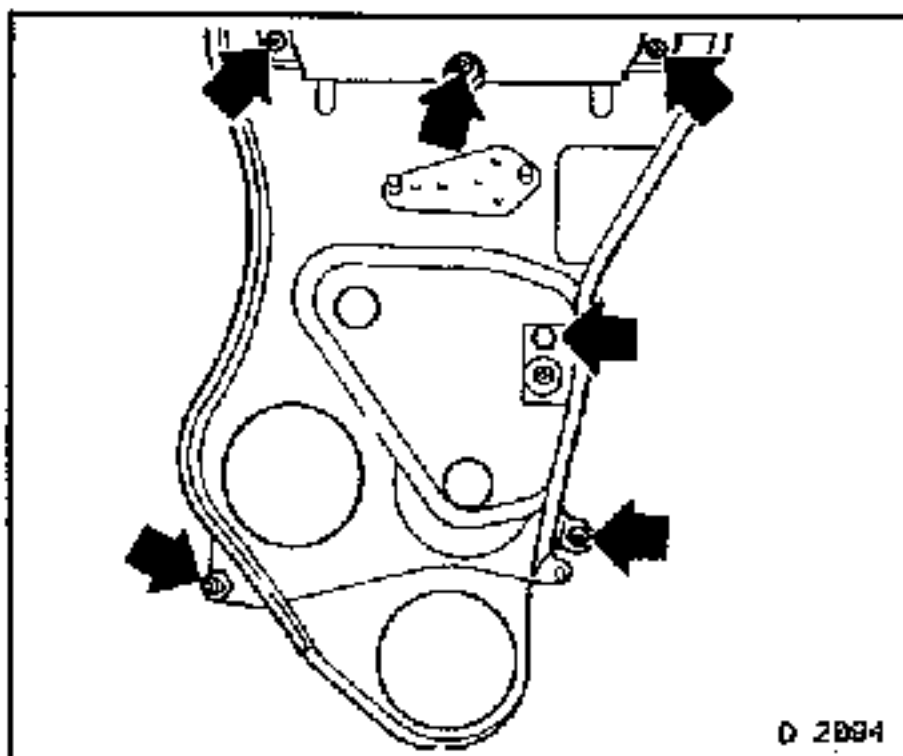
C 8341

## Tighten (Torque)

Rear toothed belt cover to  
cylinder block ..... 6 Nm  
Intake manifold to cylinder  
head support ..... 25 Nm \*

\* For C 20 LET Engines:

Install after the engine has been installed in the vehicle.



D 2894

# DOHC ENGINE - ENGINE SHORT BLOCK

Engines up to MY'93:

## Install, Connect

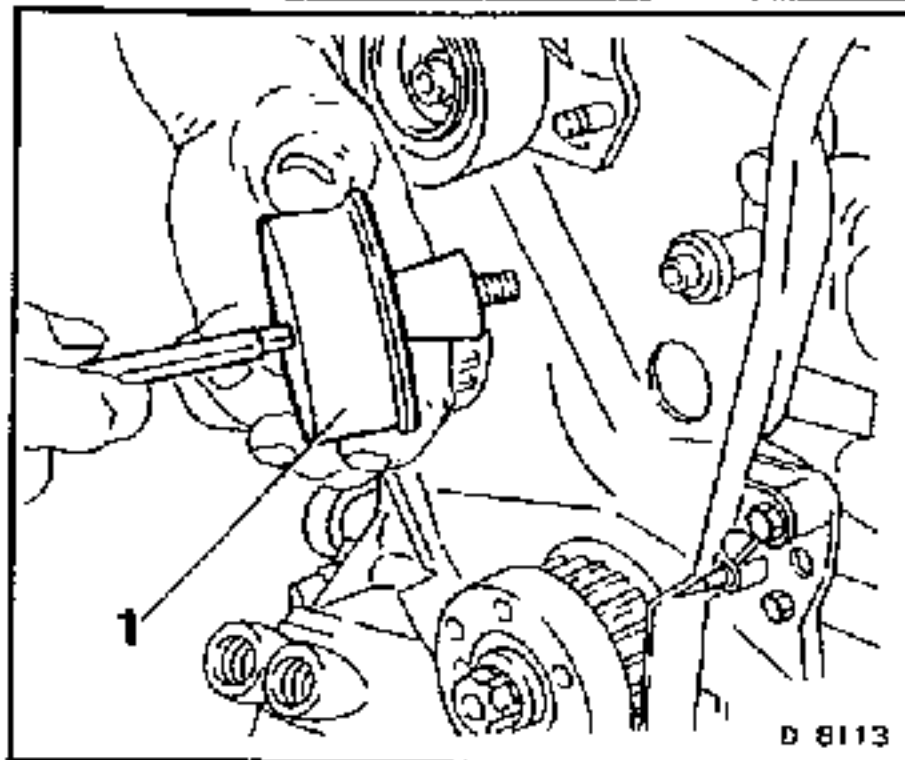
Toothed belt guide pulley (1) to cylinder block, installing the spacing sleeve with the small diameter to the toothed belt guide pulley or to the tension roller carrier plate.

Toothed belt tension roller to cylinder block.

## Torque - Angle Method

Toothed belt guide pulley to cylinder block ..... 25 Nm + 45° + 15° \*

\* Use new bolts.



Engines as of MY'93:

## Install, Connect

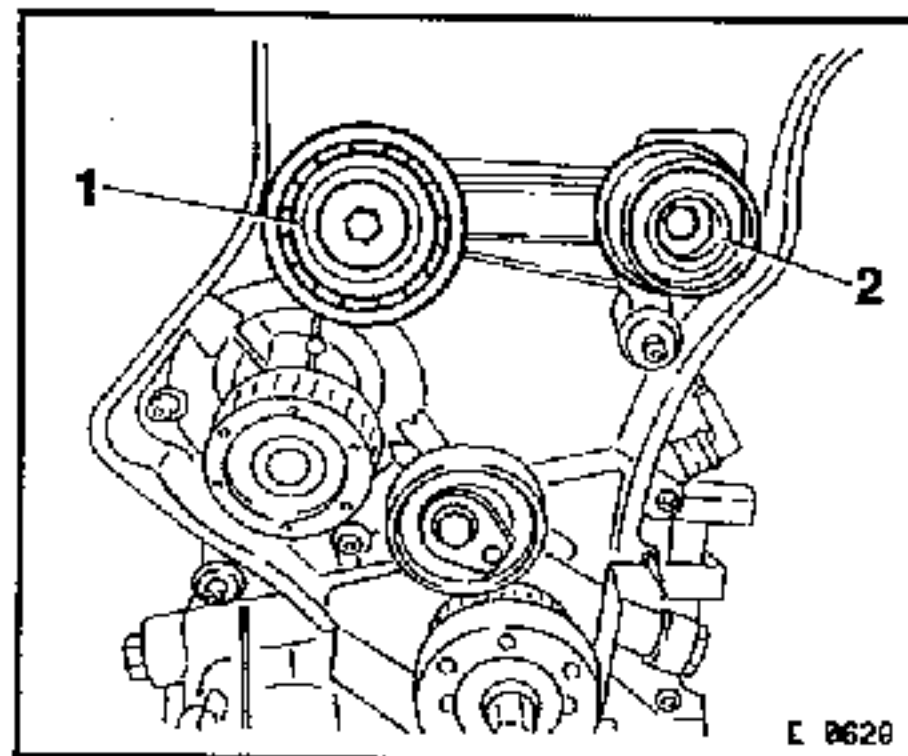
Toothed belt guide pulley (1) to cylinder block.

Toothed belt guide pulley (2) to guide pulley bracket.

Toothed belt tension roller to oil pump housing.

## Tighten (Torque)

Toothed belt guide pulley (1) to cylinder block .....	25 Nm
Toothed belt guide pulley (2) to guide pulley bracket .....	25 Nm
Toothed belt tension roller to oil pump housing .....	20 Nm



## Install, Connect

Camshaft gears with the timing marks to the front.

Before installing, turn each camshaft until the locating pin faces upwards, by using an open ended spanner on the camshaft hex provided.

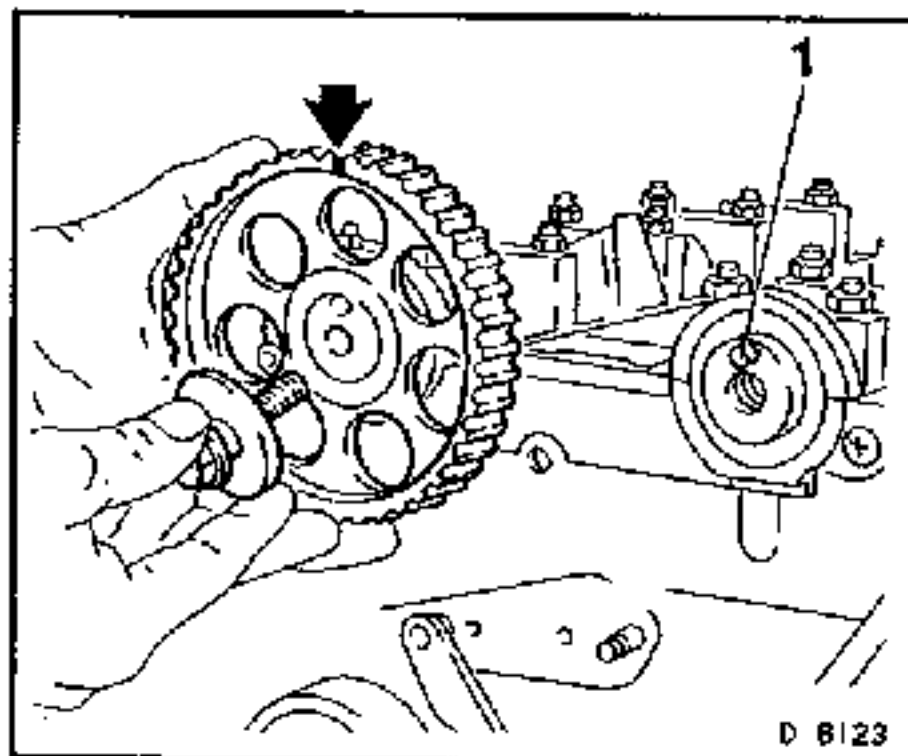
Each camshaft gear must index with this pin before tightening a new fastening bolt.

## Torque - Angle Method

Camshaft gear to camshaft ..... 50 Nm + 60° + 15°

### Note:

Hold each camshaft at the hex during the tightening process.



## Install, Connect

Cylinder head cover with a new gasket.

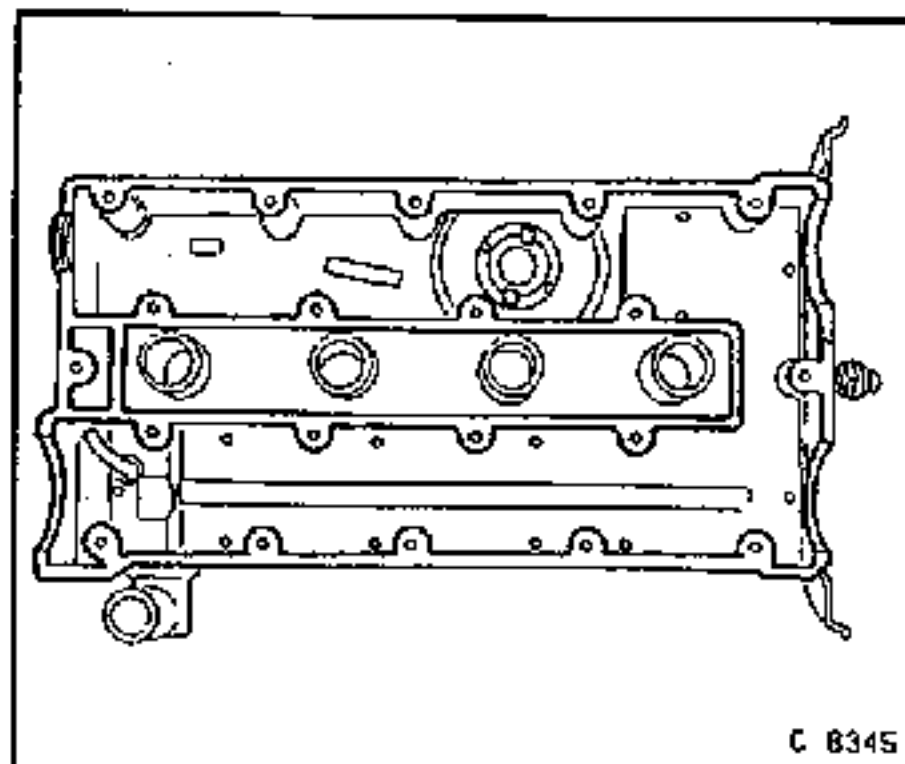
Crankcase ventilation hoses to the cylinder head cover.

Spark plug connectors.

Ignition cable cover.

## Tighten (Torque)

Cylinder head cover to cylinder head .....	8 Nm
Ignition cable cover to cylinder head cover .....	8 Nm



# DOHC ENGINE - ENGINE SHORT BLOCK

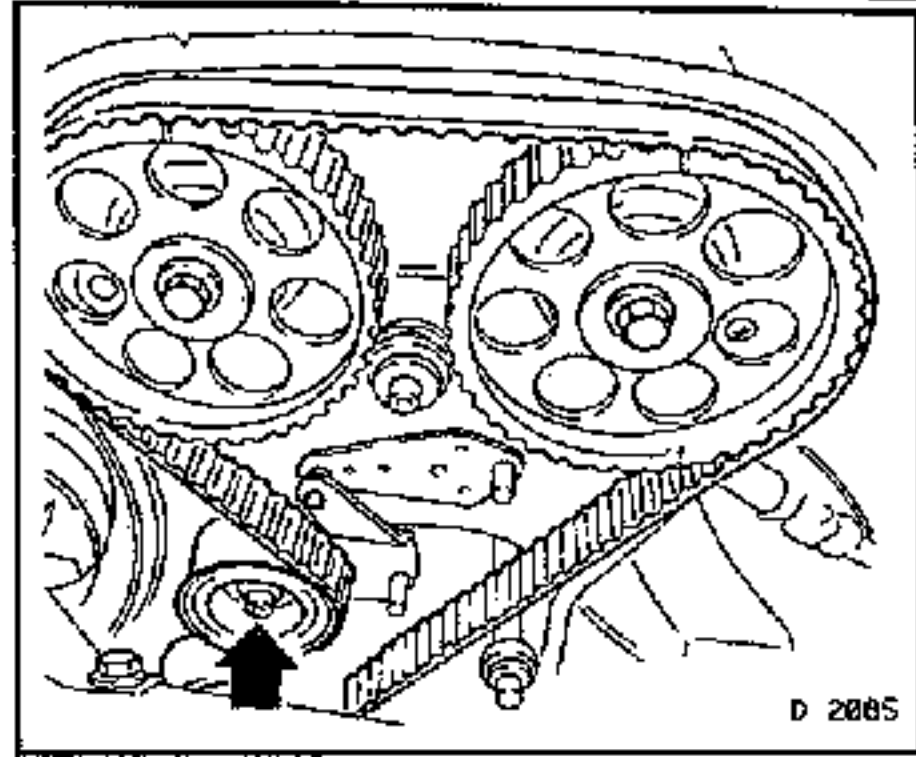
## Install New Toothed Belt

### Important!

The tooth profile for the toothed belt differs from engines up to MY'93 and for those from MY'93 onwards.

### Adjust

Refer "Toothed Belt, Replace", in this Volume.



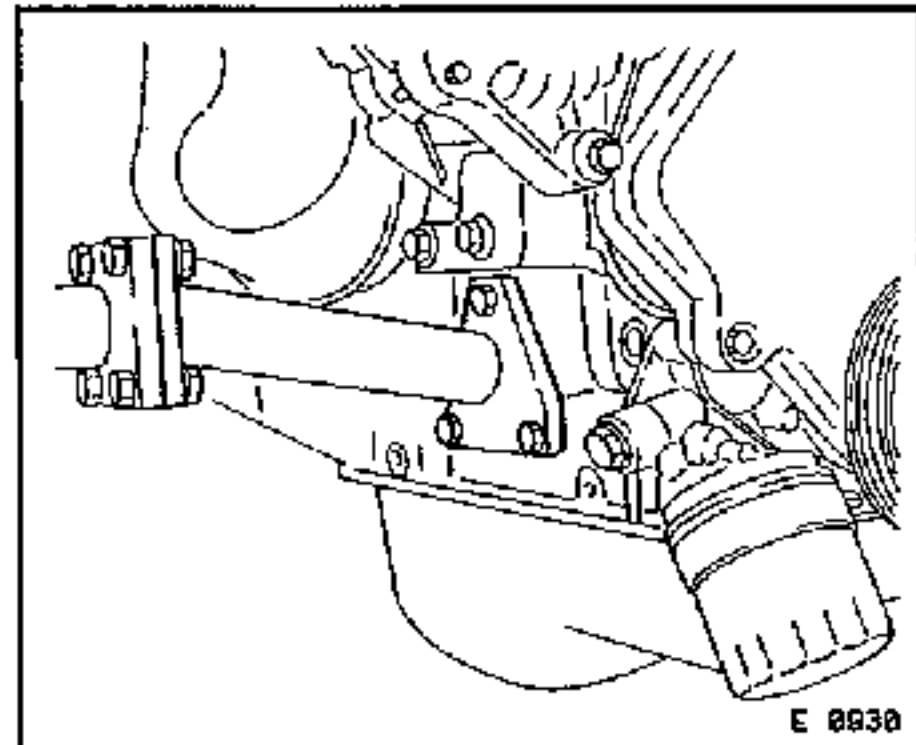
### Inspect

Top up engine oil to the "MAX" mark on the dipstick.

### Remove, Disconnect

Engine from engine overhaul stand KM-412.

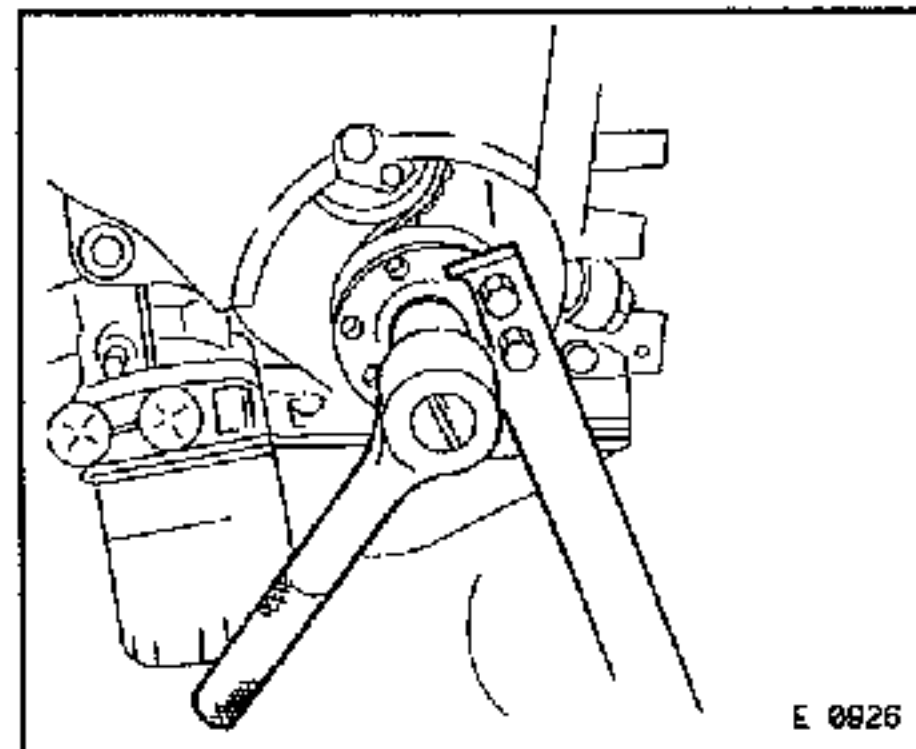
Adaptors from the engine.



### Important!

Remove the fastening bolt temporarily fitted to the toothed belt drive gear.

After the engine has been installed in the vehicle, replace with a new bolt. Refer to "Engine without Transmission, Remove and Install", in this Section.



# DOHC ENGINE - ENGINE SHORT BLOCK

## RECOMMENDED TORQUE VALUES

### (Engine Damping Blocks; Engine Short Block)

	Nm
Alternator clamping bracket to intake manifold.....	25
Bracket for P/S pump and A/C compressor to cylinder block.....	40
Bracket, intermediate shaft to cylinder block.....	55 (2)
Bracket, oil intake pipe to cylinder block.....	6
Bracket, transfer box to cylinder block.....	60
Brake servo vacuum line to intake manifold.....	20
Camshaft gear to camshaft.....	50 + 60° + 15° (4)
Cardan shaft to transfer box.....	30 (3)
Coolant pipe to cylinder block.....	20
Crankshaft pulley to toothed belt drive gear.....	20
Cylinder head cover to cylinder head.....	8
Cylinder head to cylinder block.....	25 + 90° + 90° + 90° (4)(9)
Engine bracket left, to transmission.....	60
Engine bracket rear, to transmission.....	60 (10)
Engine damping block left, to engine bracket.....	60
Engine damping block left, to side member.....	65 (5)
Engine damping block rear, to crossmember.....	40
Engine damping block rear, to engine bracket.....	45
Engine damping block right, to engine bracket.....	35
Engine damping block right, to side member.....	65 (5)
Exhaust pipe to exhaust adaptor.....	12 (1)
Hydraulic line to transfer box.....	30 (3)
Ignition cable cover to cylinder head cover.....	8
Inductive pulse pick-up to cylinder block.....	6
Knock sensor to cylinder block.....	20
Oil cooler lines to adaptor.....	30
Oil drain plug to oil pan.....	45
Oil filter cartridge to oil pump.....	15
Oil intake pipe to oil pump.....	8 (5)
Oil pan to cylinder block.....	15 (5)(6)
Oil temperature switch to cylinder block.....	30
Performance header with cover plate to cylinder head.....	22
Rear toothed belt cover to cylinder block.....	6
Right engine damping block to side member.....	65 (5)
Shift rod to knurled bolt.....	15
Spark plug to cylinder head.....	25
Starter to cylinder block - engine side (M 10).....	45
Starter to cylinder block - transmission side (M 12).....	60
Support for starter to cylinder block.....	25
Support to intake manifold and cylinder block.....	25
Thermostat housing to cylinder head.....	15
Toothed belt drive gear to crankshaft.....	250 + 40° - 50° (4)(7)
Toothed belt guide roller to cylinder block.....	25 + 45° + 15° (4)
Toothed belt guide roller to cylinder block.....	25 (7)
Toothed belt tension roller to cylinder block.....	25 + 45° + 15° (4)
Toothed belt tension roller to cylinder block.....	20 (7)
Transmission to cylinder block (M 10).....	45
Transmission to cylinder block (M 12).....	60
Water pump to cylinder block.....	25
Wheel bolts to front wheel hub.....	110

- (1) C 20 LET only.
- (2) Vehicles with front wheel drive.
- (3) Vehicles with four wheel drive.
- (4) Use new bolt/s.
- (5) Threads must be cleaned before reuse and coated with Locking Compound to Holden's Specification HN1256, Loctite 242 or equivalent.
- (6) Maximum assembly time 10 minutes.
- (7) Engines as of MY'93.
- (8) Install bolt with grease.
- (9) No re-tightening required.
- (10) Use new locking plates.

# GROUP J

## DOUBLE OVERHEAD CAM ENGINE

### CHECKING AND ADJUSTING PROCEDURES

#### TABLE OF CONTENTS

	PAGE
V-belt Tension, Check and Adjust.....	J - 272
Compression, Check.....	J - 273
Engine Oil Temperature, Measure .....	J - 274
Engine Oil Pressure, Check.....	J - 274
Engine Pressure Loss, Check.....	J - 274
Engine Oil Consumption, Measure.....	J - 278
Valve Timing, Check and Adjust (Engines up to MY'93).....	J - 279
Valve Timing, Check and Adjust (Engines as of MY'93).....	J - 280
Toothed Belt Tension, Adjust (Engines up to MY'93).....	J - 281
Toothed Belt, Install and Tension (Engines as of MY'93) .....	J - 281
Recommended Torque Values .....	J - 282

# DOHC ENGINE-CHECKING & ADJUSTING PROCEDURES

## V-belt Tension, Check and Adjust

### Note:

For engines as of MY'93, this operation is not required, as these engines are fitted with an automatic, ribbed V-belt tension roller.

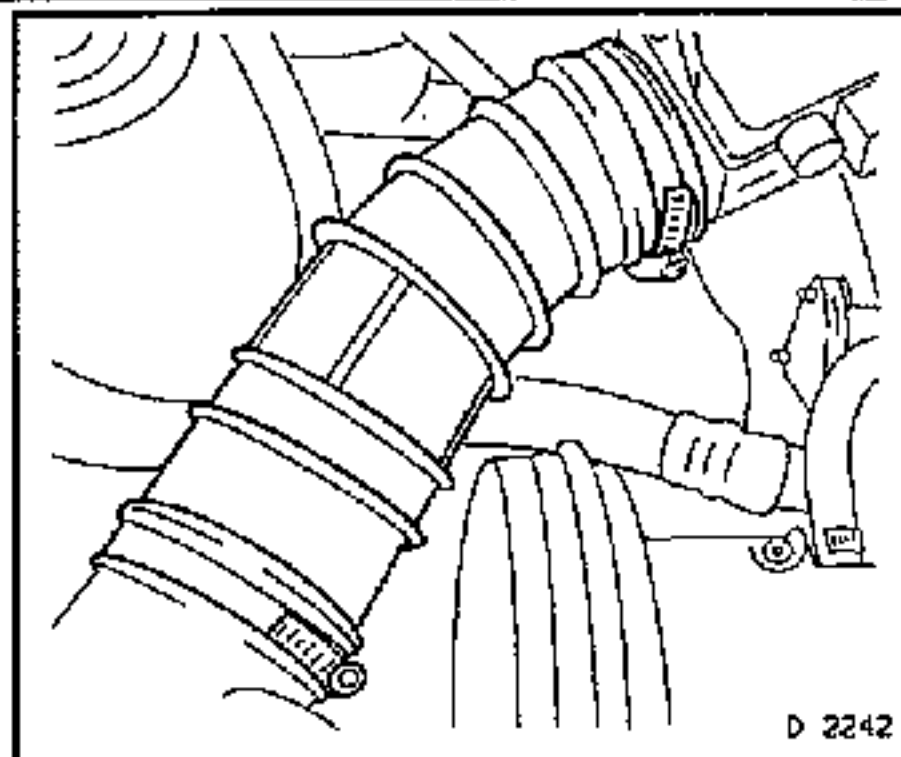
### Remove, Disconnect

For C 20 XE;

Air intake hose.

For C 20 LET;

Cover from throttle valve manifold.



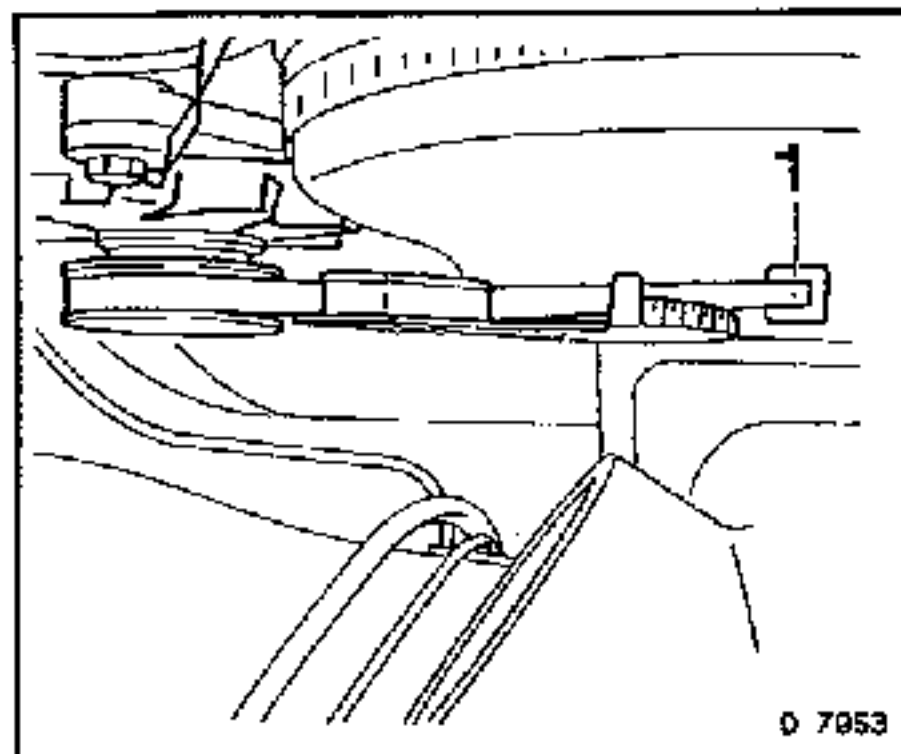
### Measure

V-belt tension, using KM-128-A. Push lever (1) until pin touches V-belt and a buzzing sound is heard.

Read off measurement and multiply by 100 to calculate the V-belt tension in N.

### Specification:

Used V-belt .....	250 - 300 N
New V-belt .....	450 N.



### Adjust

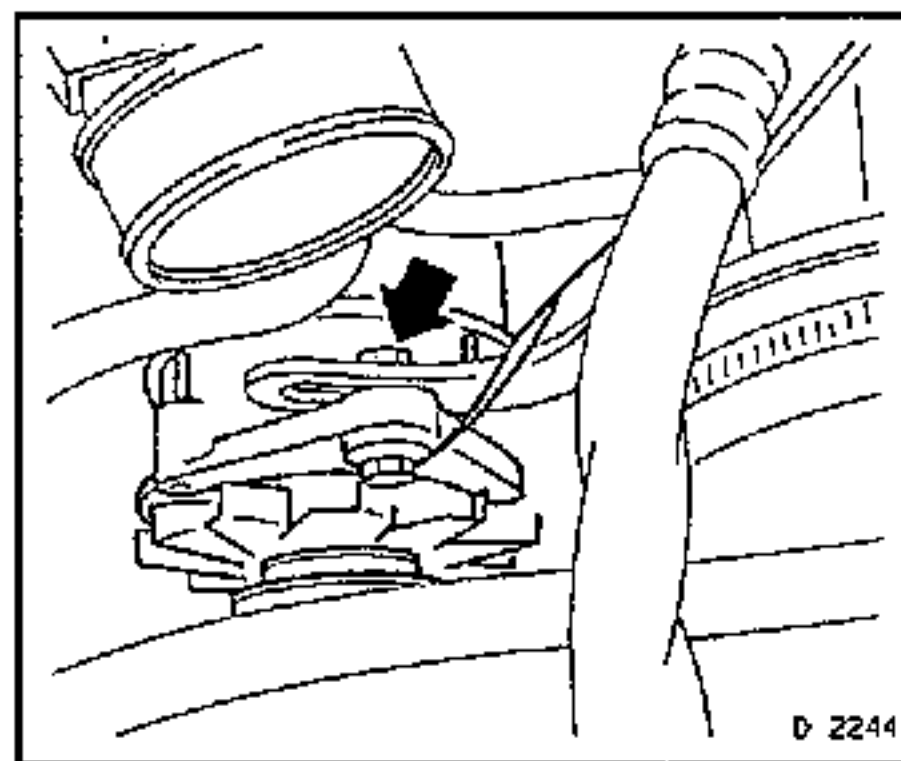
Loosen clamping bracket and lever alternator bracket, to move alternator.

### Inspect

Check that the ground cable is in perfect condition.

### Install, Connect

Air intake hose or throttle manifold cover.



### Tighten (Torque)

Clamping bracket to alternator.....	25 Nm.
Lower alternator bracket (M 10).....	40 Nm.
Cover to throttle valve manifold .....	5 Nm.



# DOHC ENGINE-CHECKING & ADJUSTING PROCEDURES

## Compression, Check

Engine is to be at normal operating temperature (oil temperature to be at least 80 °C).

### Remove, Disconnect

Ignition cable cover from cylinder head cover

Spark plug connectors, using KM-717, then spark plugs, using KM0194-B.

Terminal "15" from ignition coil or wiring harness plug from ignition control unit.

Fuel pump relay (arrow).

### Note:

For the C 20 XE (as of MY'93) and the C 20 LET engines, the fuel pump relay is located in the front right footwell.

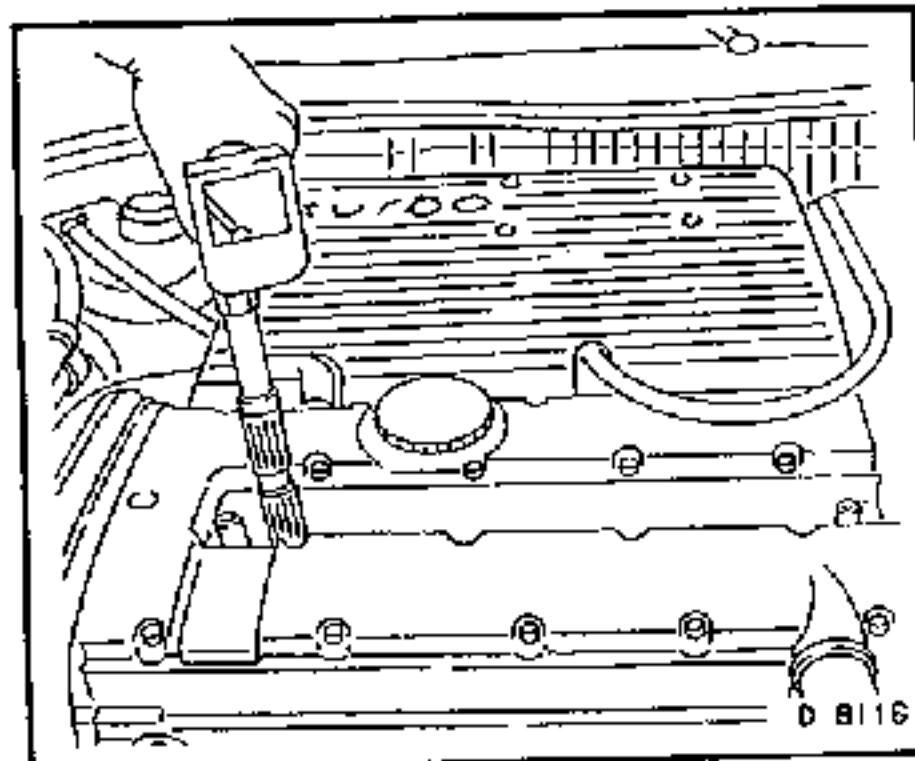
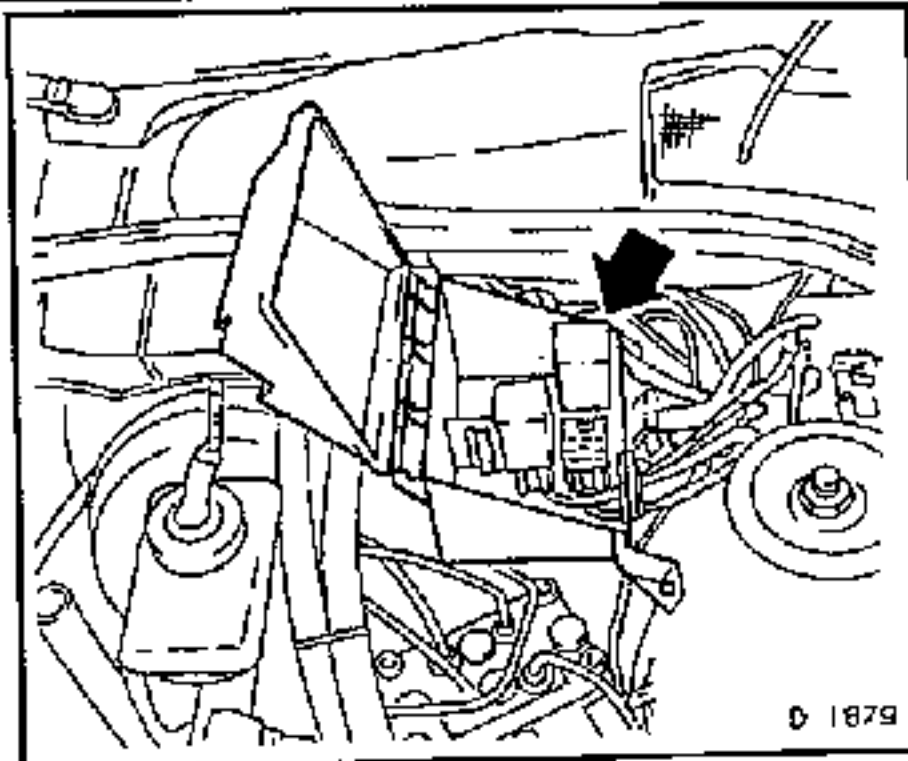
### Inspect

#### Note:

Use compression gauge with a rubber cone and a measuring range of 1,750 kPa.

Operate starter for approximately 4 seconds with a fully opened throttle valve. The engine speed is to at least 300 rpm.

Allowed deviation of individual cylinders must not exceed 100 kPa.



### Install, Connect

Spark plugs.

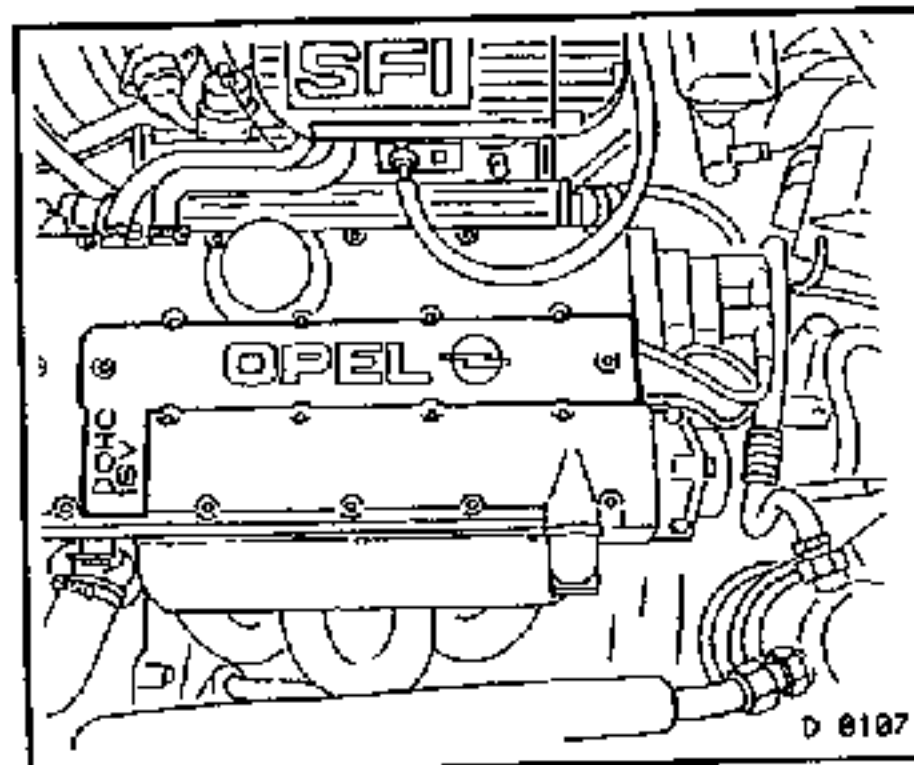
Spark plug connectors.

Ignition cable cover to cylinder head.

### Tighten (Torque)

Spark plug to cylinder head ..... 25 Nm

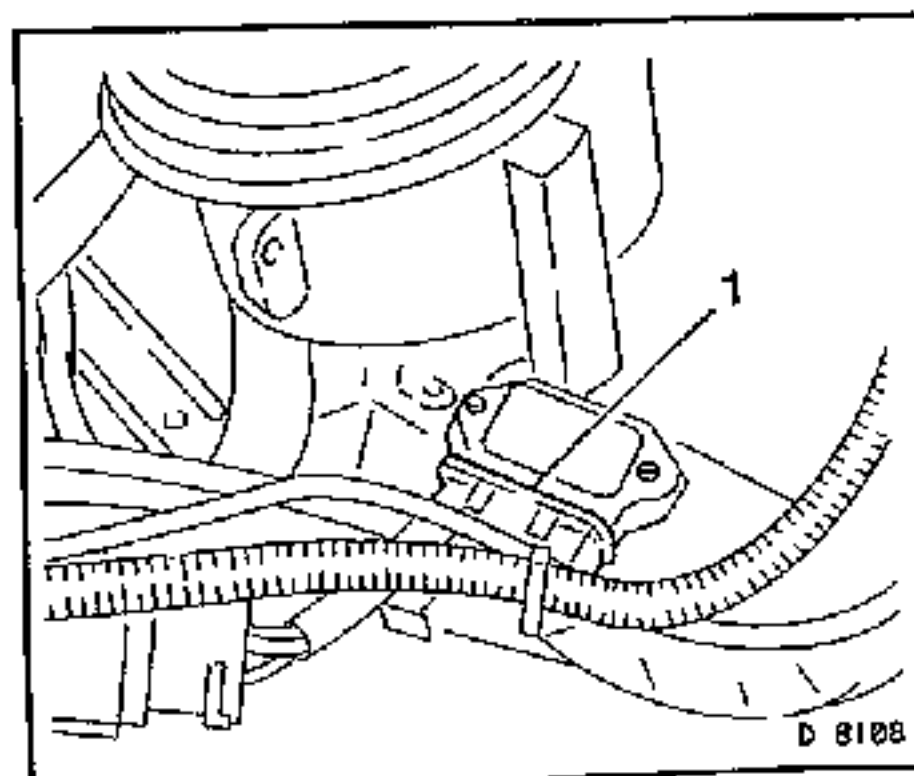
Ignition cable cover to  
cylinder head cover ..... 8 Nm



### Install, Connect

Terminal "15" to ignition coil or wiring harness plug (1) to ignition coil control unit.

Fuel pump relay.





# DOHC ENGINE-CHECKING & ADJUSTING PROCEDURES

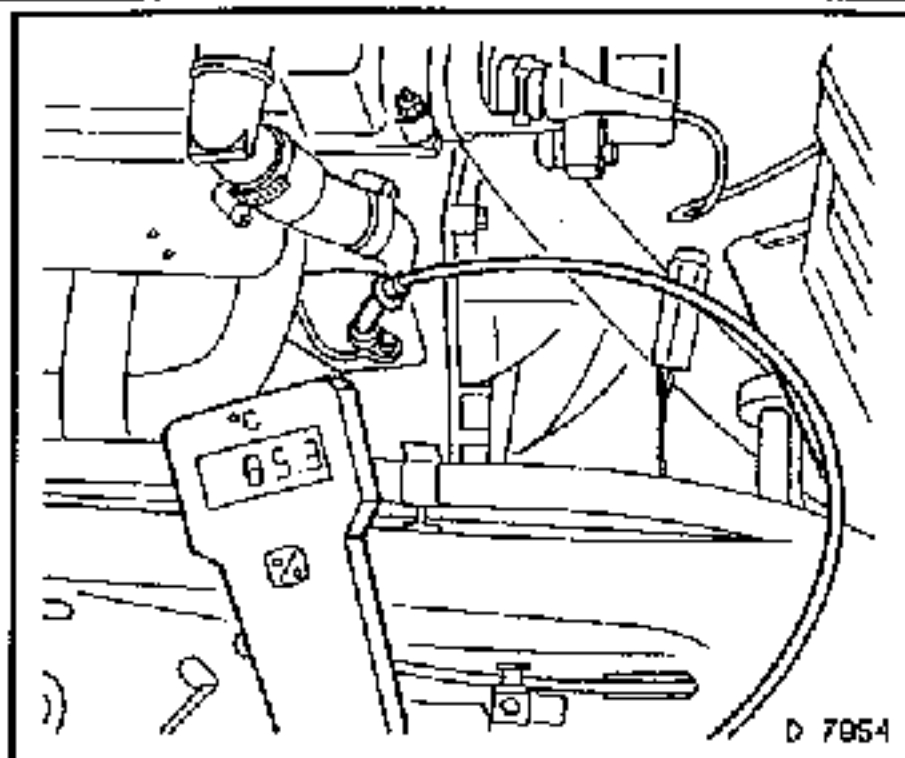
## Engine Oil Temperature, Measure

### Measure

Engine oil temperature, using MKM-596.

Insert measuring probe in dipstick tube to approximately 1 cm above the bottom of the oil pan.

Seal dipstick tube with rubber plug supplied. Observe manufacturer's instructions.



## Engine Oil Pressure, Check

### Remove, Disconnect

If fitted, engine compartment cover.

Oil pressure switch.

### Install, Connect

Oil pressure gauge KM-498-B and KM-135 to oil pressure switch opening.

### Check

That engine oil pressure is at least 30 kPa at idle speed with an oil temperature of at least 80 °

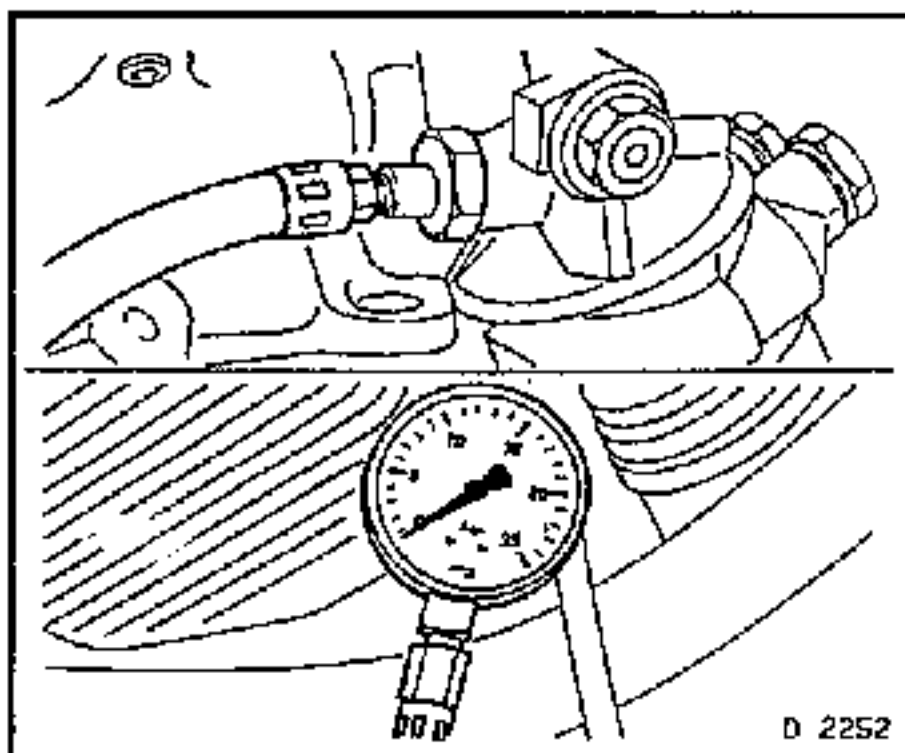
### Install, Connect

Oil pressure switch to oil pump.

Engine compartment cover, if removed.

### Tighten (Torque)

Oil pressure switch to oil pump..... 40 Nm



## Engine Pressure Loss, Check

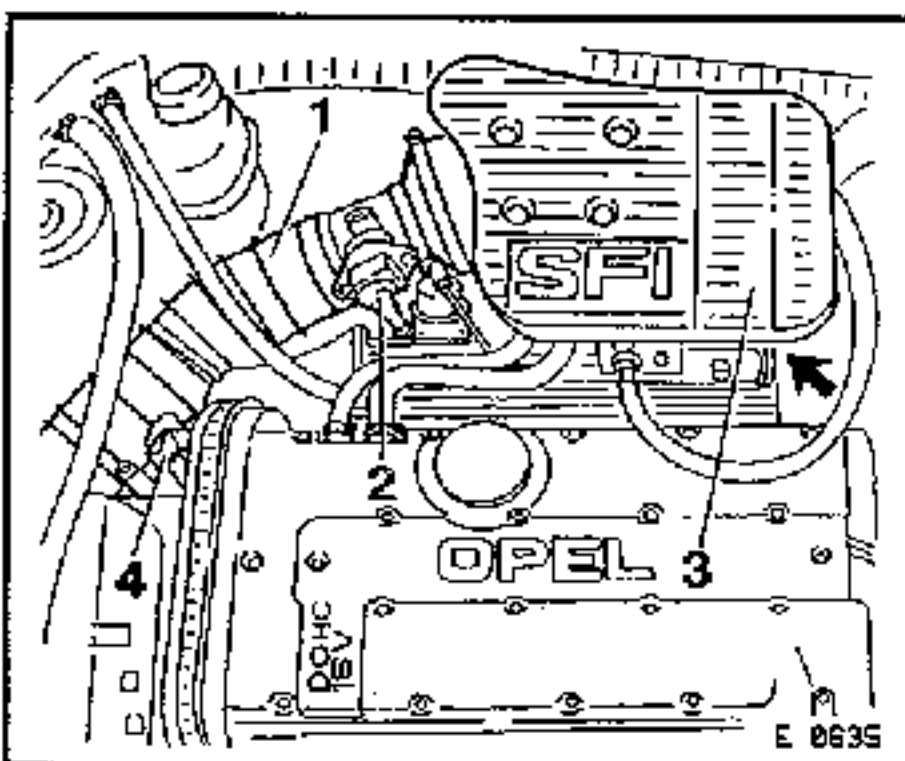
### Remove, Disconnect

If fitted, engine compartment cover.

Air intake hose (1) from air cleaner, wiring harness plug (2) from mass air flow meter, Hose (arrow) from pre-volume chamber, pre-volume chamber (3) with the air intake hose.

For C 20 XE as of MY'93:

Wiring harness plug (4) from the intake air temperature sensor.



### Remove, Disconnect

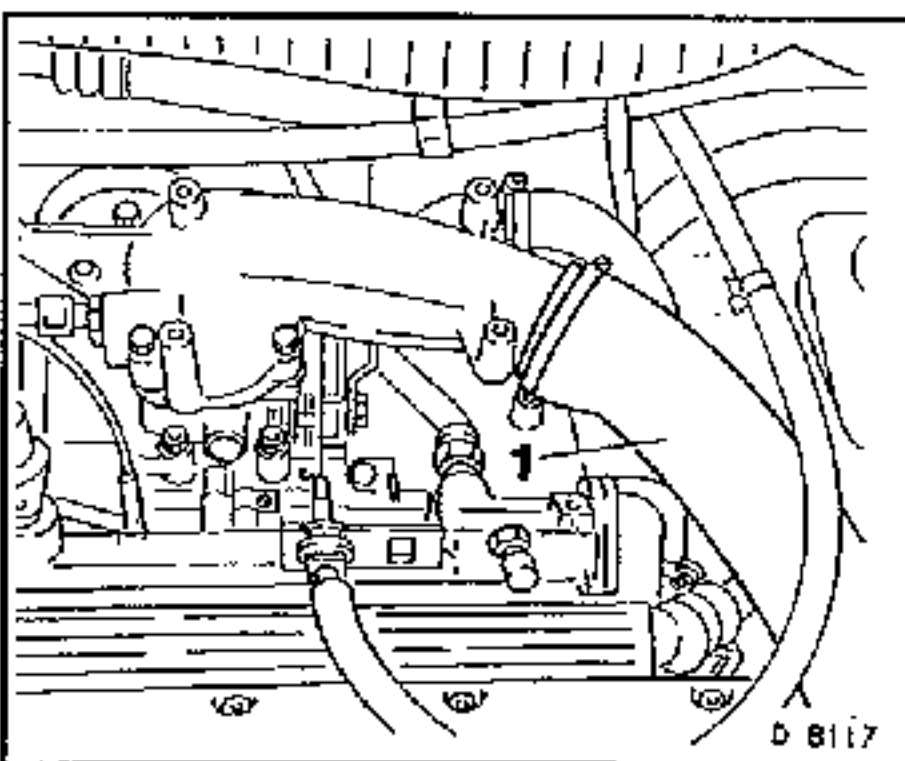
For C 20 LET:

Cover from throttle valve manifold.

Air intake hose (1) from throttle valve manifold.

Ignition cable cover from cylinder head cover

Spark plug connectors, using KM-717, then spark plugs, using KM0194-B.



# DOHC ENGINE-CHECKING & ADJUSTING PROCEDURES

## Remove, Disconnect

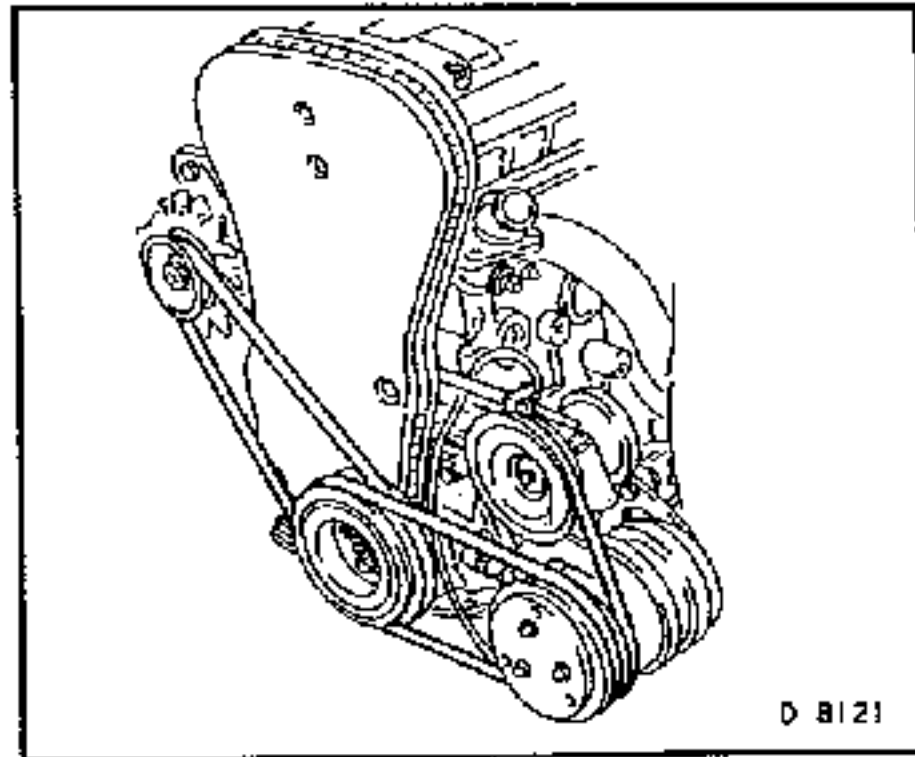
If fitted, engine compartment cover.

### Engines up to MY'93:

V-belt from alternator, power steering pump and A/C compressor

### With all DOHC Engines:

Front toothed belt cover.

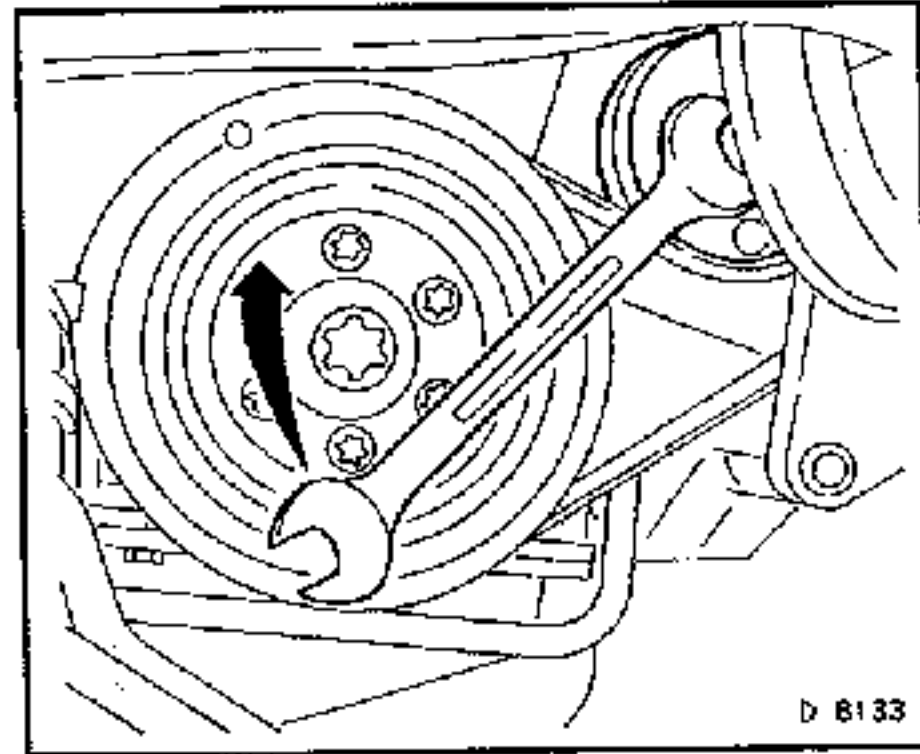


## Remove, Disconnect

### Engines as of MY'93:

Mark direction of rotation of ribbed V-belt, with felt tipped pen or similar.

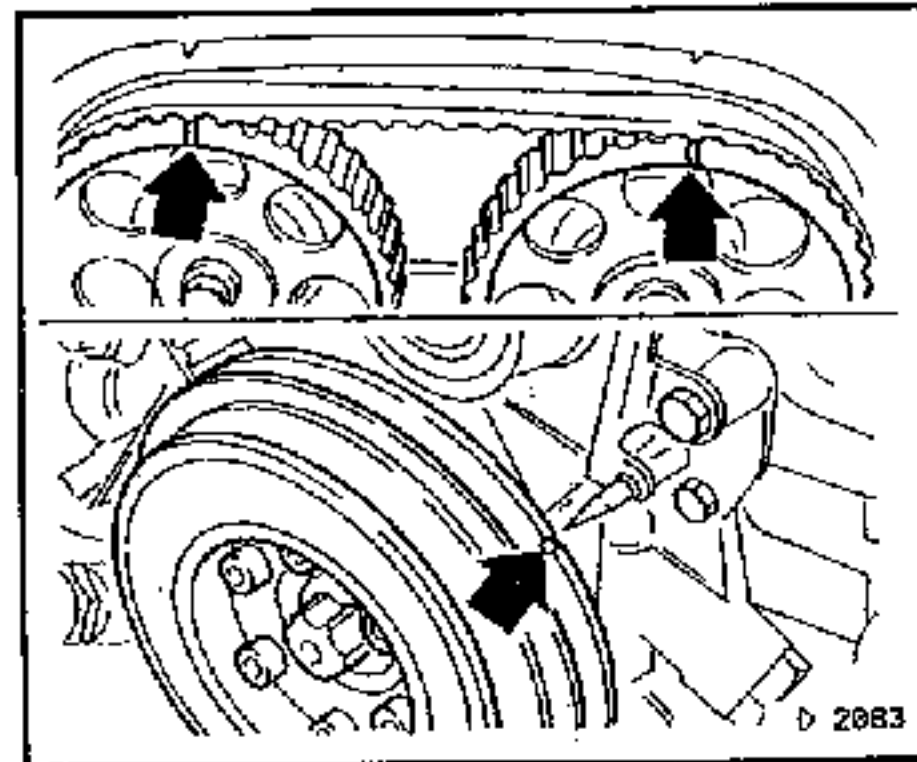
Ribbed V-belt by turning the ribbed V-belt tension roller in the direction of the arrow.



## Inspect

Using MKM-604-21 (Torx E 20) at the fastening bolt for the crankshaft pulley, turn the crankshaft slowly and evenly until No. 1 piston is at the "TDC" position, as indicated by the pulley notch and pointer being aligned.

The camshaft gears must then be aligned with the notches on the cylinder head cover.



## Install, Connect

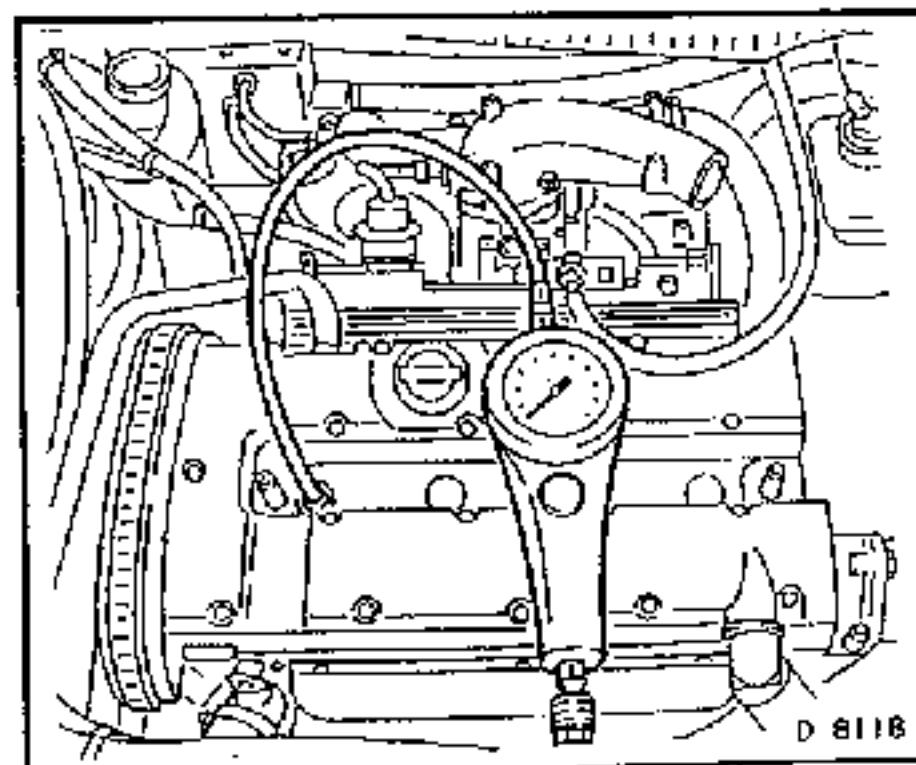
Adaptor in spark plug hole for the 1st cylinder to be checked.

The compression loss tester to a compressed air supply, then calibrate the tester.

The compression loss tester to the adapter. Observe manufacturer's instructions.

### Important!

The crankshaft must not turn during this test operation. To stop this, engage 1st gear and the park brake.



# DOHC ENGINE-CHECKING & ADJUSTING PROCEDURES

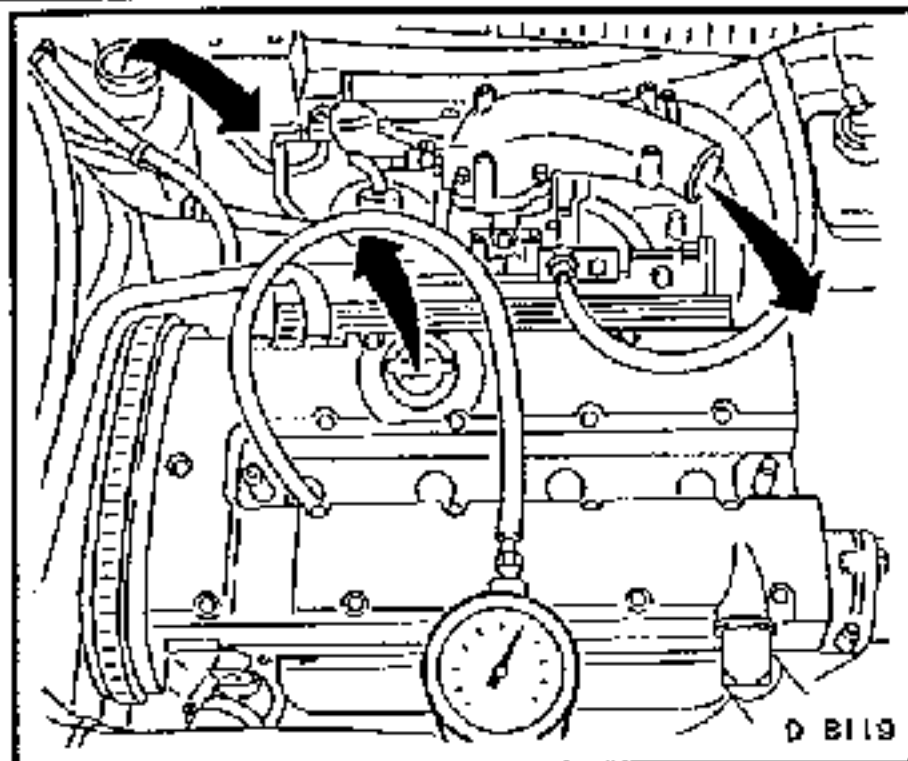
## Inspect

Air flow from:

Intake and exhaust, coolant reservoir tank and crankcase.

Allowable compression variation between individual cylinders is approximately 10%.

Allowable total compression loss on one cylinder is 25%.

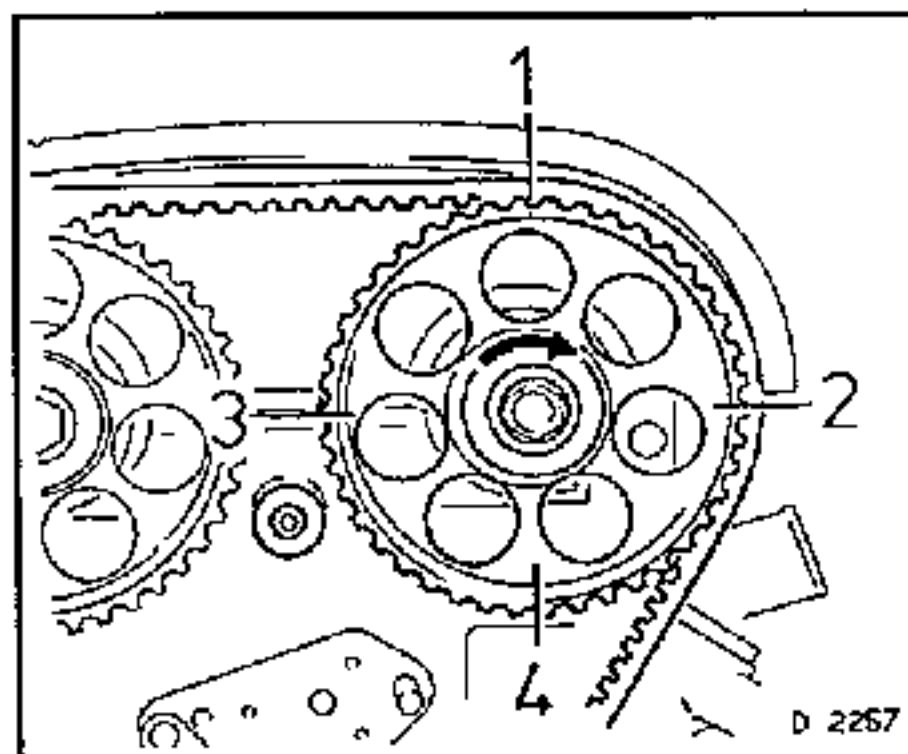


## Inspect

Compression loss for the remaining cylinders.

Cylinders are to be checked in the firing order sequence of 1, 3, 4, 2, with each piston at "TDC".

An indication of these positions can be gained by marking one camshaft pulley.



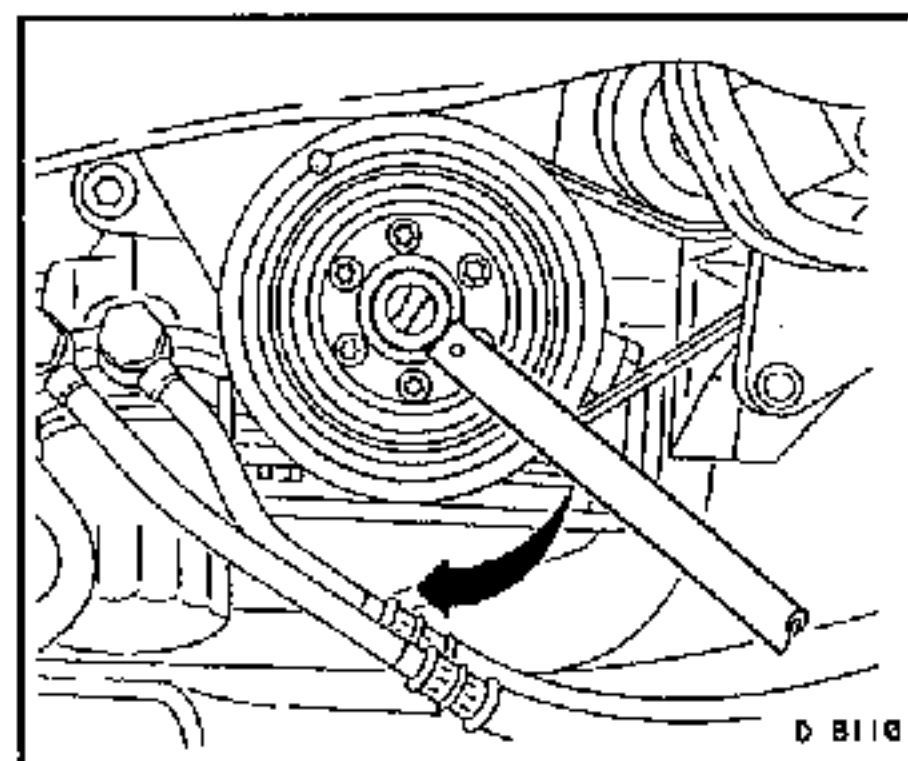
## Inspect

Turn the crankshaft with MKM-604-21 (Torx E 20), a further 180° in the direction of engine rotation (this corresponds to 90° at the camshaft), until the mark on the camshaft pulley aligns with the notch on the cylinder head cover.

Determining the remaining piston positions is a similar process.

## Important!

Turn the crankshaft smoothly and slowly.



## Install, Connect

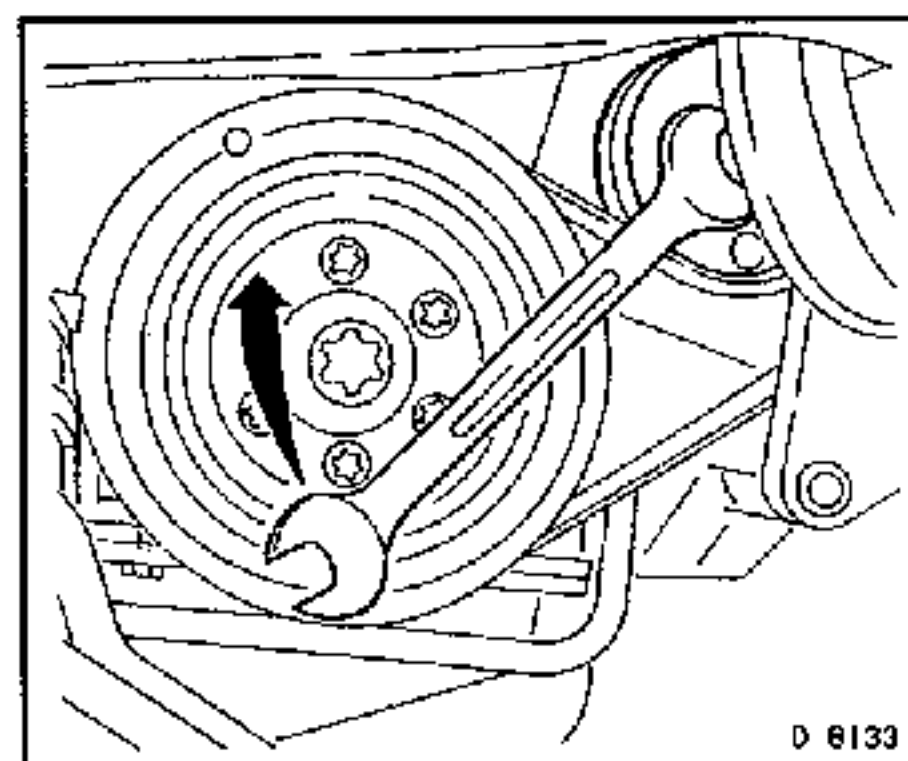
### Engines as of MY'93:

Ribbed V-belt by turning the ribbed V-belt tension roller in the direction of the arrow.

### Note:

Pay attention to the direction of rotation mark on the ribbed V-belt when installing.

If removed, the engine compartment cover.



# DOHC ENGINE-CHECKING & ADJUSTING PROCEDURES

## Install, Connect

Front toothed belt cover.

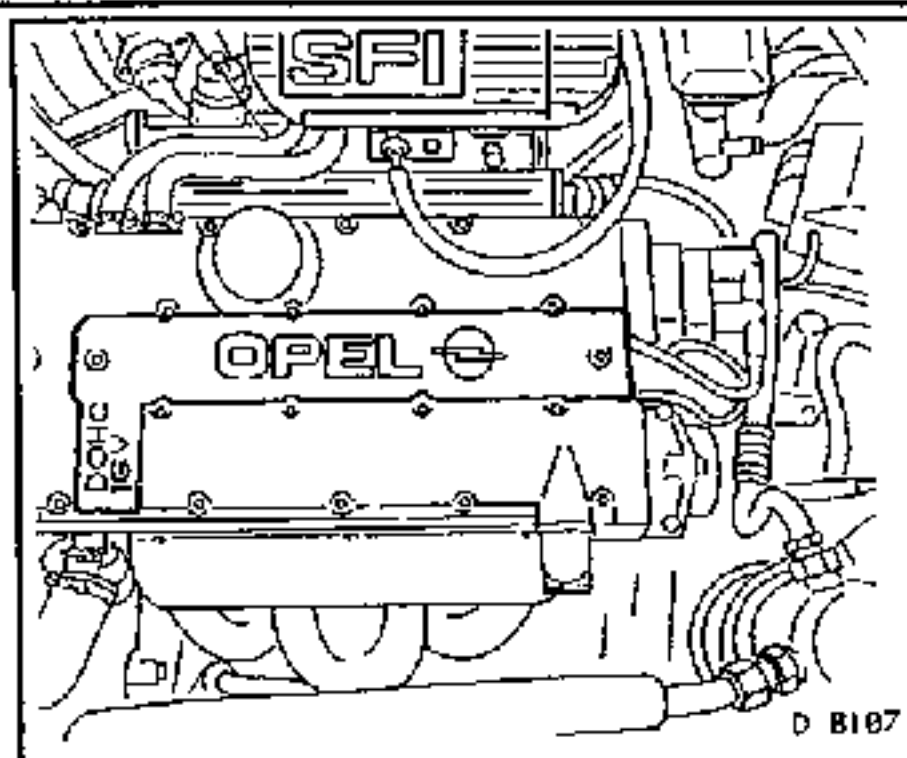
### Engines up to MY'93:

Install and tension the V-belt. Refer to: "V-belt Tension, Check and Adjust", earlier in this Section.

Spark plugs, using KM-194-B, then install the spark plug connectors.

Ignition cable cover to cylinder head cover.

Oil filler cap, engine dipstick, coolant reservoir cap.



## Install, Connect

Pre-volume chamber (3) with air intake hose, hose (arrow) to pre-volume chamber, wiring harness plug (2) to mass air flow meter, air intake hose (1) to air cleaner.

For C 20 XE, as of MY'93:

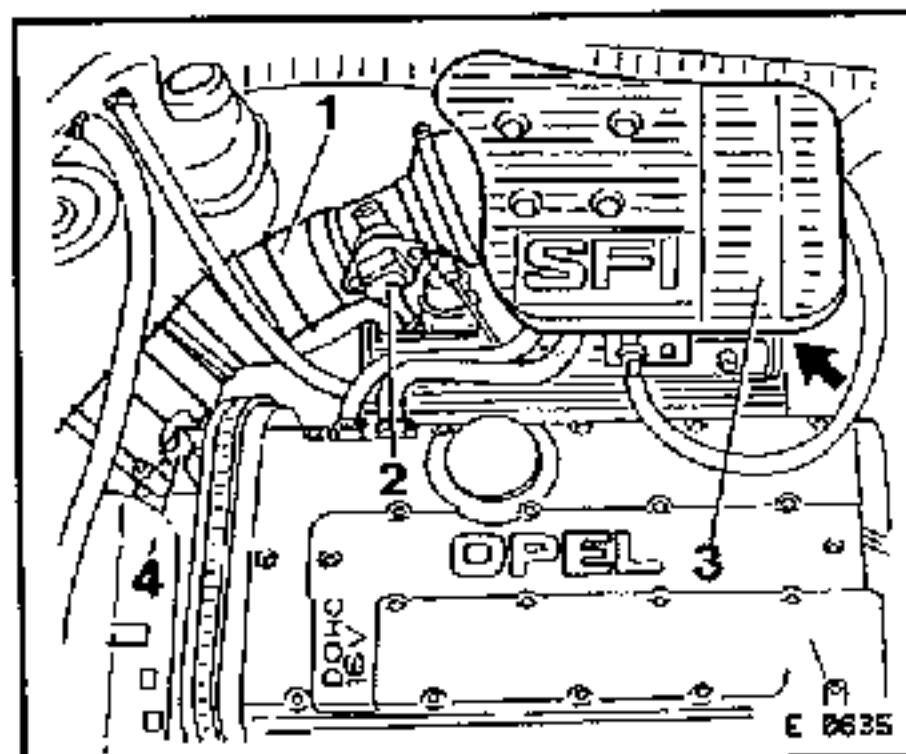
Wiring harness plug (4) to intake air temperature sensor.

For C 20 LET:

Air intake hose and throttle valve manifold cover.

## Tighten (Torque)

Cover to throttle manifold .....	5 Nm
Spark plugs to cylinder head .....	25 Nm
Ignition cable cover to cylinder head cover .....	8 Nm



# DOHC ENGINE-CHECKING & ADJUSTING PROCEDURES

## Engine Oil Consumption, Measure

### General

The term "oil consumption" of an internal combustion engine refers to the amount of oil that is used because of combustion. Oil consumption should under no circumstances be confused with oil loss caused by leaks from the oil pan, cylinder head cover, etc.

The task of the engine oil is to:

1. Separate surfaces that slide on one another with an oil film, i.e. prevent dry friction.
2. Conduct the heat away, that is produced by friction.
3. Conduct combustion residue away.

These tasks require that the engine will consume a certain amount of oil; i.e. the expectation of many who claim that further development of the internal combustion engine will lead to an engine that does not require oil, are totally without foundation.

The oil consumption is however, influenced by external operating factors, driving style and manufacturing tolerances. Under normal circumstances, the consumption is so minimal that only a small amount needs to be topped up between the prescribed oil change intervals, or even no topping up at all.

Topping up is necessary however, if the oil level falls below the "MIN" mark on the dipstick.

Similarly, the oil level should not exceed the upper "MAX" mark on the dipstick, as this leads to an increased consumption of oil.

As oil consumption is a technical necessity, indications that an engine is not consuming oil means that it can be concluded that the oil is being diluted because of the particular operating conditions under which the vehicle is being subjected.

Frequent cold starts, driving when over-cold, etc., result in the oil flowing back to the oil pan containing fuel particles and condensation, and thereby becoming "diluted". This situation can lead to the incorrect supposition that the engine is not consuming any oil at all.

Oil diluted in this way, lacks lubricating quality and may lead to engine damage if the prescribed oil change intervals are not observed. The main causes for oil dilution are frequent driving in urban traffic and frequent driving at low engine speeds, particularly when the engine is cold.

With a new vehicle, the rate of oil consumption starts to stabilise after the vehicle has travelled a few thousand kilometres; therefore, measurements of oil consumption only become realistic after about 7,500 km. Before measuring the oil consumption, check that the engine is not losing oil through a leak.

### Notes:

- The oil dipstick can only be used for checking and not for measurement.
- The engine must always be switched off for at least 2 minutes before the oil level can be accurately checked.
- If, after an oil change, the recommended quantity of engine oil level does not match the maximum level on the dipstick, this can be attributed to manufacturing tolerances.

All information regarding permissible oil consumption and filling quantities is included in the Owner's Handbook.

### Measuring Method

1. The check is carried out with the vehicle on a horizontal surface with the engine at operating temperature (engine oil temperature at least 80 °C).
2. Allow the engine to run at idle speed immediately before draining the oil.
3. Drain engine oil immediately after switching the engine off and record the time with a stop watch - draining time 3 minutes. (Experiments have shown that effective engine draining should be complete in 3 minutes.) Always allow the engine oil to drain until the stream of oil reduces to drops.
4. Allow the drained engine oil to cool down to approximately 20 °C (1 to 2 hours).
5. Measure the amount of cooled oil in a commercially available, transparent measuring cylinder (with a capacity of 1 to 2 litres), then add sufficient fresh oil to bring the total quantity to the recommended maximum, less 0.25 litres for the unchanged oil filter.
6. Using this amount of oil, the customer should drive the vehicle for at least 500 km without changing the engine oil. (The customer's normal driving style and routes should be maintained during this period.)
7. The procedure described above (points 1 to 4) is then repeated with exactly the same amount of time for draining.
8. The amount of engine oil "missing" from the second measurement is the engine oil consumed for that particular distance travelled.



# DOHC ENGINE-CHECKING & ADJUSTING PROCEDURES

## Valve Timing, Check and Adjust (Engines up to MY'93)

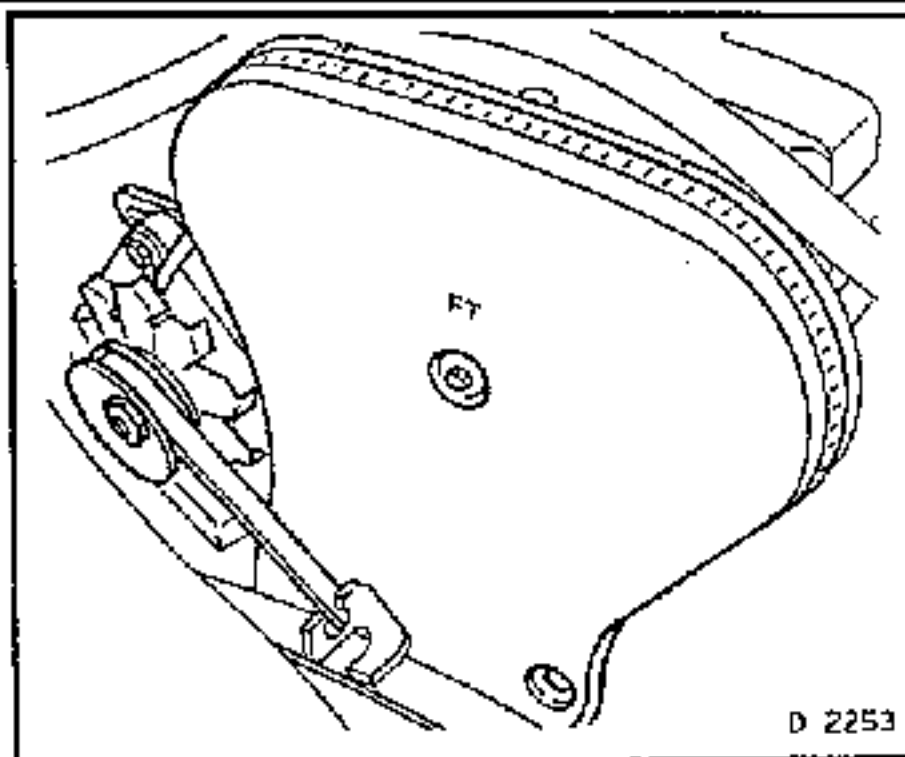
### Remove, Disconnect

Air cleaner housing. Refer to; "Air Cleaner Housing, Remove and Install", in the next Section, in this Volume.

V-belt from alternator.

Front toothed belt cover.

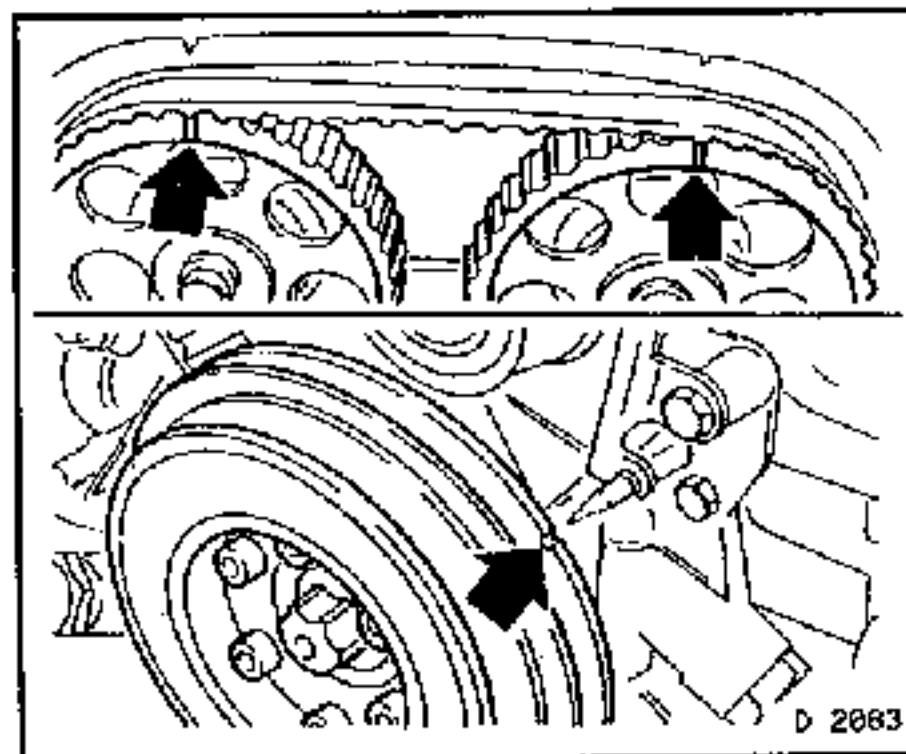
If fitted, the engine compartment cover



### Inspect

Using MKM-604-21 (Torx E 20) at the fastening bolt for the crankshaft pulley, turn the crankshaft slowly and evenly until No. 1 piston is at the "TDC" position, as indicated by the pulley notch and pointer being aligned.

The camshaft gears must then be aligned with the notches on the cylinder head cover.



### Remove, Disconnect

The toothed belt tension roller (arrow) and, remove toothed belt.

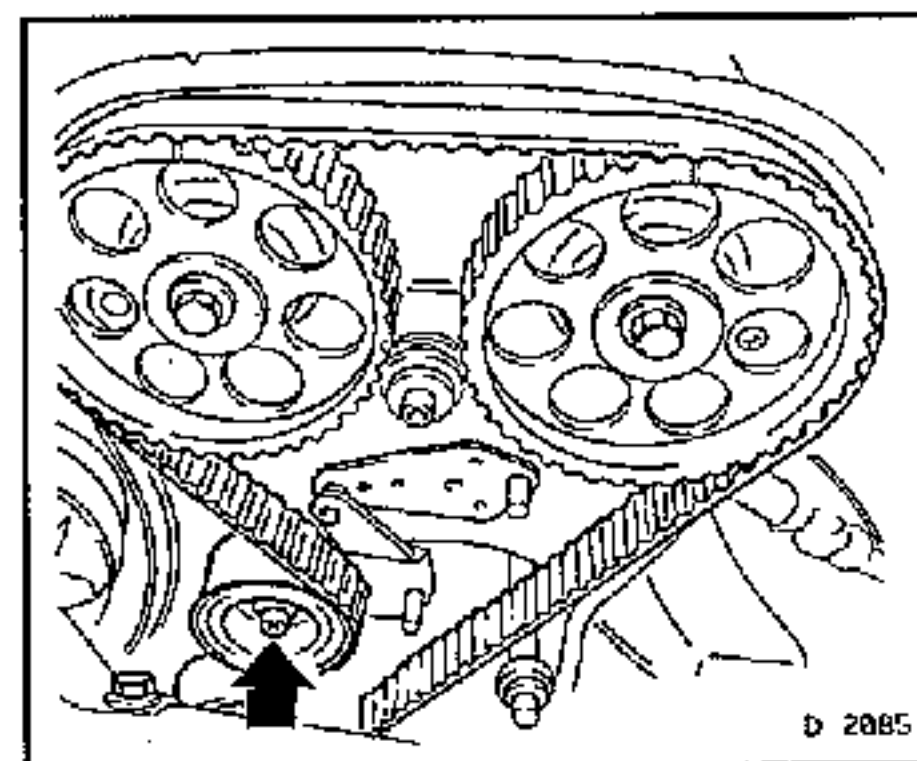
Place camshaft pulleys on the marks.

### Important!

Adjustment of the tension on a used toothed belt is NOT permitted. After any operation that involves the removal of the toothed belt, ALWAYS install a new toothed belt to the engine. Refer to; "Toothed Belt, Replace", in the next Section, in this Volume.

### Note:

Replacement of the toothed belt is a service requirement every 4 year period or 60,000 km whichever occurs first.



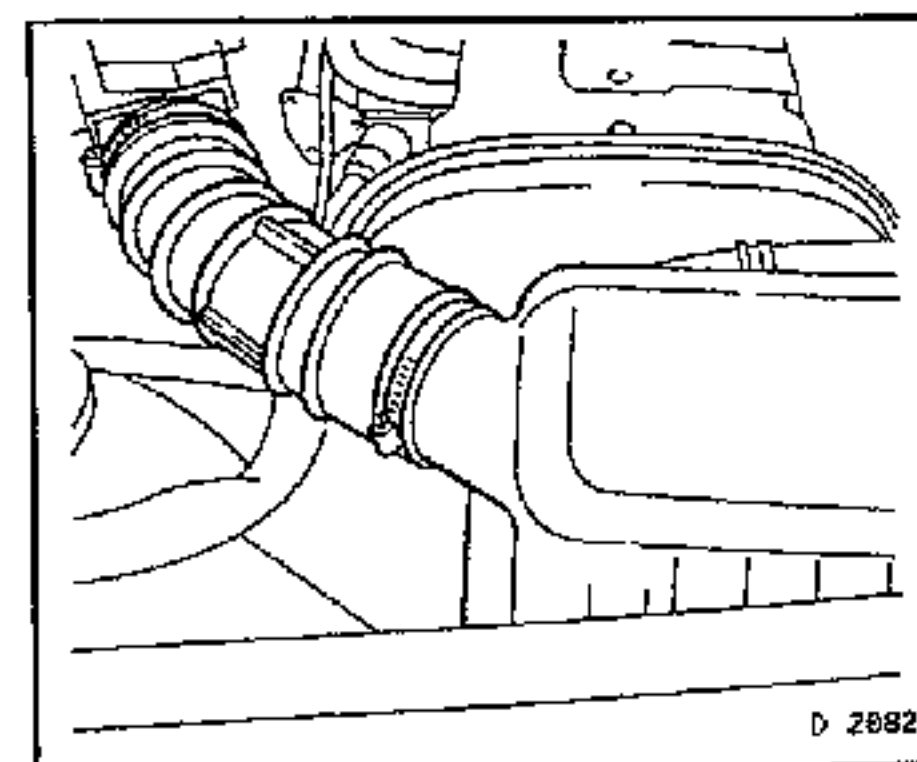
### Install, Connect

Front toothed belt cover.

V-belts to alternator, power steering pump and A/C compressor and tension. Refer to; "V-belt Tension, Check and Adjust", earlier in this Section.

Air cleaner housing. Refer to; "Air Cleaner Housing, Remove and Install", in the next Section in this Volume.

Engine compartment cover, if removed.



# DOHC ENGINE-CHECKING & ADJUSTING PROCEDURES

## Valve Timing, Check and Adjust (Engines as of MY'93)

### Remove, Disconnect

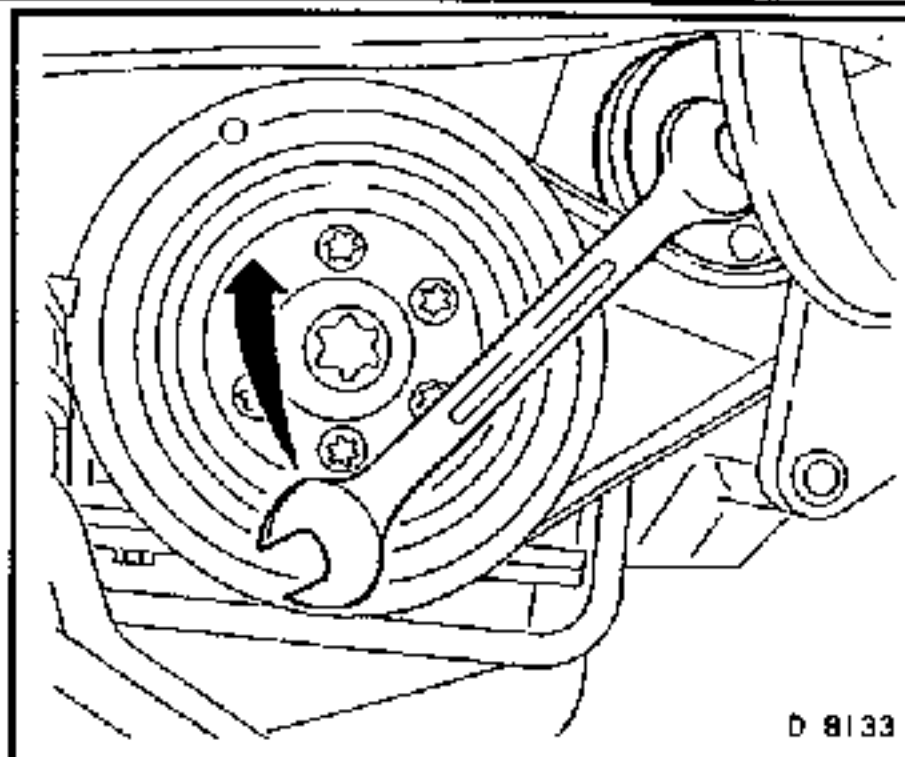
Air cleaner housing. Refer to; "Air Cleaner Housing, Remove and Install", in the next Section in this Volume.

Mark the direction of rotation on the ribbed V-belt with a felt tipped pen or similar.

Release tension of ribbed V-belt, via ribbed V-belt tension roller in the direction of arrow and remove ribbed V-belt.

Front toothed belt cover.

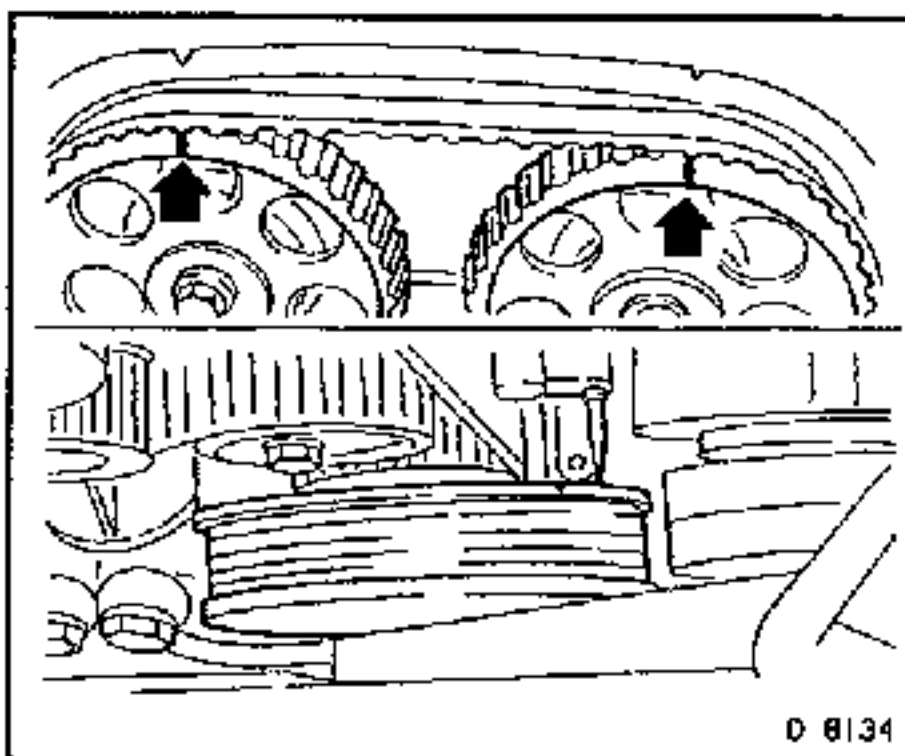
Engine compartment cover, if fitted.



### Inspect

Using MKM-604-21 (Torx E 20) at the fastening bolt for the crankshaft pulley, turn the crankshaft slowly and evenly until No. 1 piston is at the "TDC" position, as indicated by the pulley notch and pointer being aligned.

The camshaft gears must then be aligned with the notches on the cylinder head cover.



### Remove, Disconnect

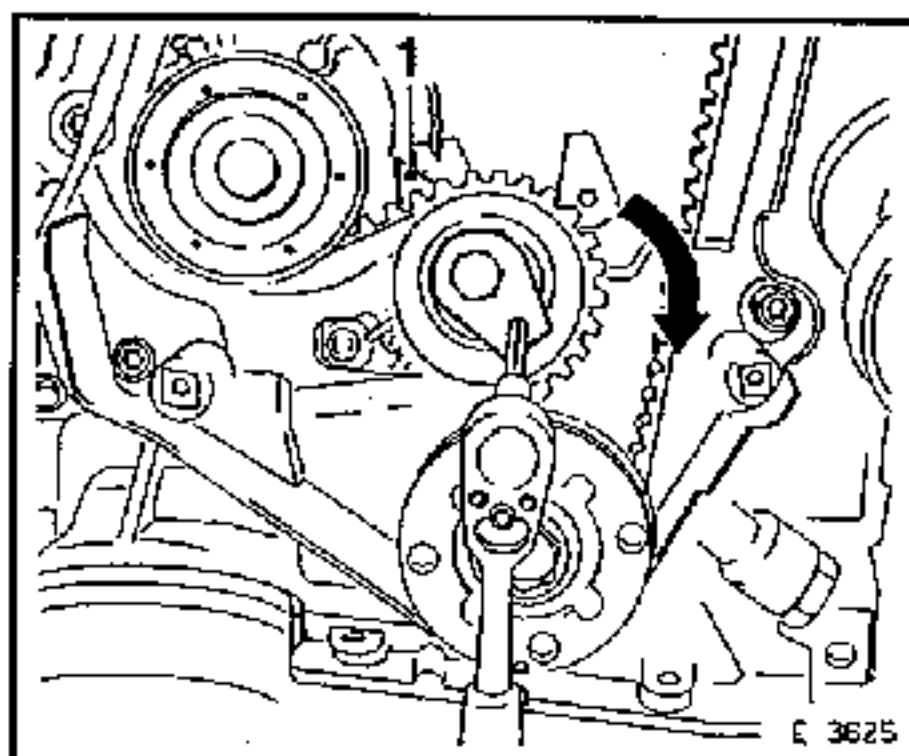
Loosen toothed belt tension roller, then turn cam in direction of arrow (clockwise) until pointer (1) lies at the left stop.

Remove toothed belt.

### Adjust

Place camshaft pulleys on their respective marks.

Adjust toothed belt tension. Refer to; "Toothed Belt, Replace", in the next Section in this Volume.



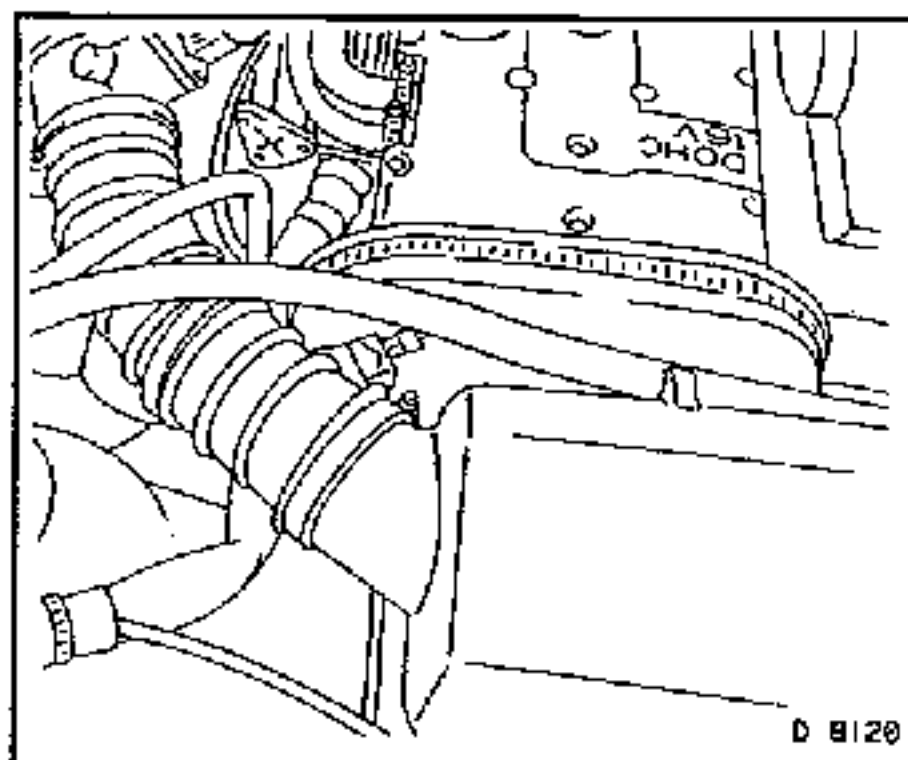
### Install, Connect

Front toothed belt cover.

Install ribbed V-belt. Refer to; "Ribbed V-belt Tension, Check and Adjust", earlier in this Section.

Air cleaner housing. Refer to; "Air Cleaner Housing, Remove and Install", in the next Section in this Volume.

Engine compartment cover, if removed.



# DOHC ENGINE-CHECKING & ADJUSTING PROCEDURES

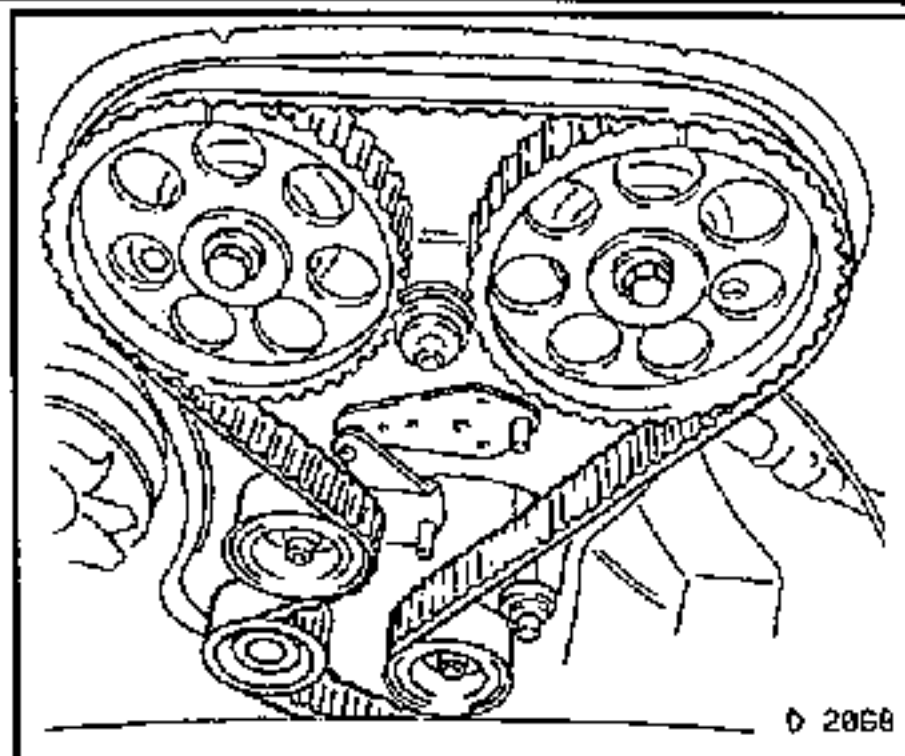
## Toothed Belt Tension, Adjust (Engines up to MY'93)

### Important!

Adjustment of the tension on a used toothed belt is NOT permitted. After any operation that involves the removal of the toothed belt, ALWAYS install a new toothed belt to the engine. Refer to; "Toothed Belt, Replace", in the next Section, in this Volume.

### Note:

Replacement of the toothed belt is a service requirement every 4 year period or 60,000 km whichever occurs first.



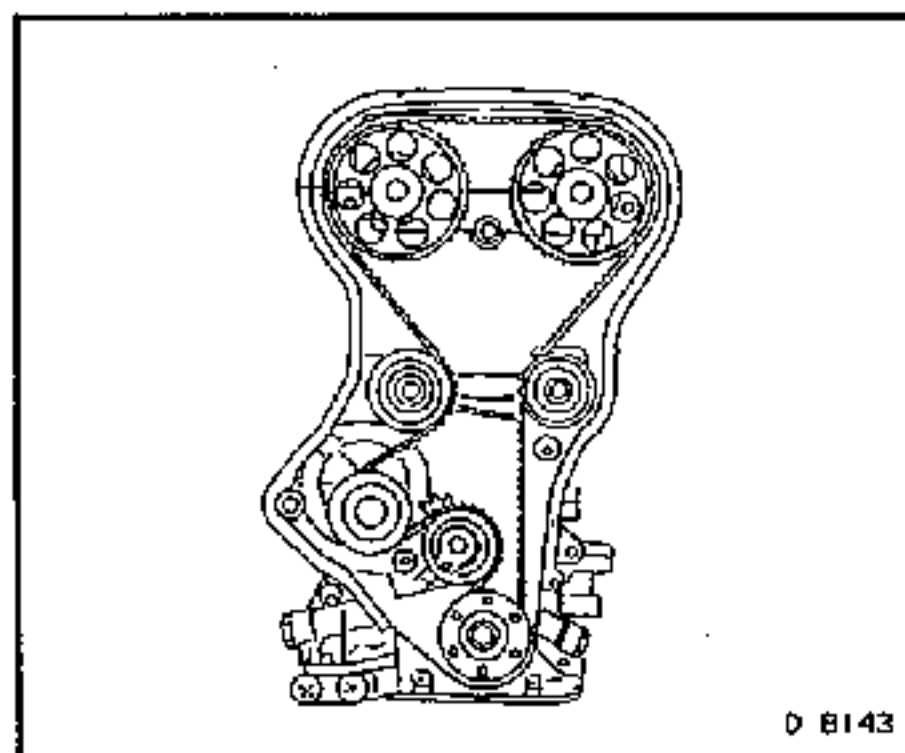
## Toothed Belt Tension, Adjust (Engines as of MY'93)

### Adjust

The toothed belt is automatically tensioned by the toothed belt tension roller. The adjustment procedure is detailed in; "Toothed Belt, Replace", in the next Section in this Volume.

### Note:

Replacement of the toothed belt is a service requirement every 4 year period or 60,000 km whichever occurs first.





# DOHC ENGINE-CHECKING & ADJUSTING PROCEDURES

## RECOMMENDED TORQUE VALUES

### (Engine Checking and Adjusting Procedures)

	Nm
Alternator clamping bracket to intake manifold .....	25
Clamping bracket to alternator .....	25
Cover to throttle valve manifold .....	5 (1)
Front toothed belt cover to cylinder head, intermediate piece and oil pump ....	8
Ignition cable cover to cylinder head cover .....	8
Lower alternator bracket fastening (M 10) .....	40
Oil pressure switch to oil pump .....	40
Spark plug to cylinder head .....	25

(1) C 20 LET only

# GROUP N

## ELECTRICAL EQUIPMENT AND INSTRUMENTS

### CHECK CONTROL

#### TABLE OF CONTENTS

	PAGE
Control Unit for Check Control, Replace .....	N - 16
Check Control Bulbs, Replace (Analog Instruments) .....	N - 16
Sensor for Remaining Coolant Quantity, Replace .....	N - 16
Sensor for Remaining Cleaning Fluid Quantity, Replace .....	N - 17
Sensor for Remaining Engine Oil Quantity, Replace .....	N - 17

# CHECK CONTROL

## CONTROL UNIT FOR CHECK CONTROL, REPLACE

### Remove, Disconnect

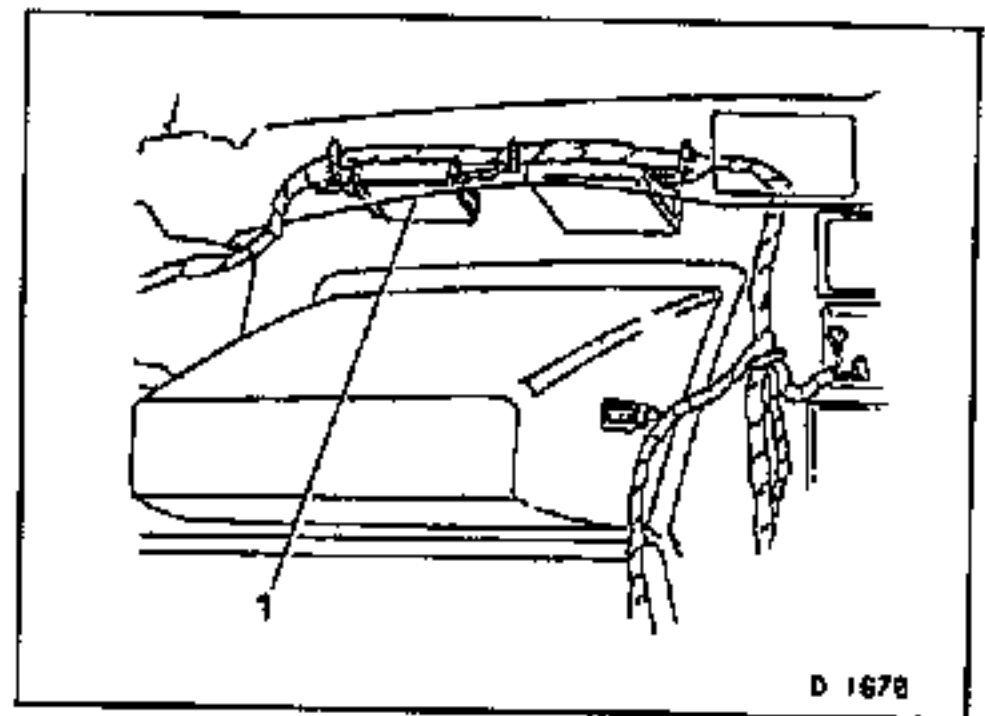
Glove compartment – group D (Mixed Air Heating (Interior),  
Remove and Install Completely)

Wiring harness plug from control unit (1), control unit.

Illus. shows control unit as seen from engine compartment.

### Install, Connect

Control unit, wiring harness plug, glove compartment.



## CHECK CONTROL BULBS, REPLACE (ANALOG INSTRUMENTS)

### Remove, Disconnect

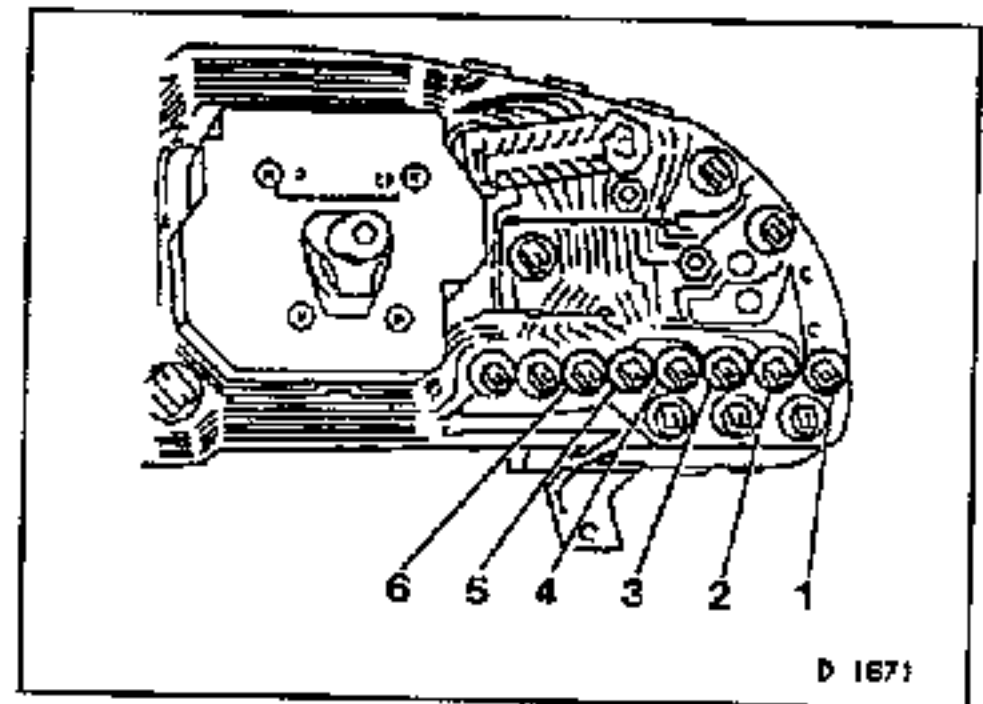
Instrument assembly – group N.

Relevant bulb from instrument assembly (turn to the left).

- 1 – Cleaning fluid level
- 2 – Oil level
- 3 – Coolant level
- 4 – Low beam/rear lamp
- 5 – Brake lamp/trailer brake lamp
- 6 – Brake lining thickness front

### Install, Connect

Bulb, instrument assembly.



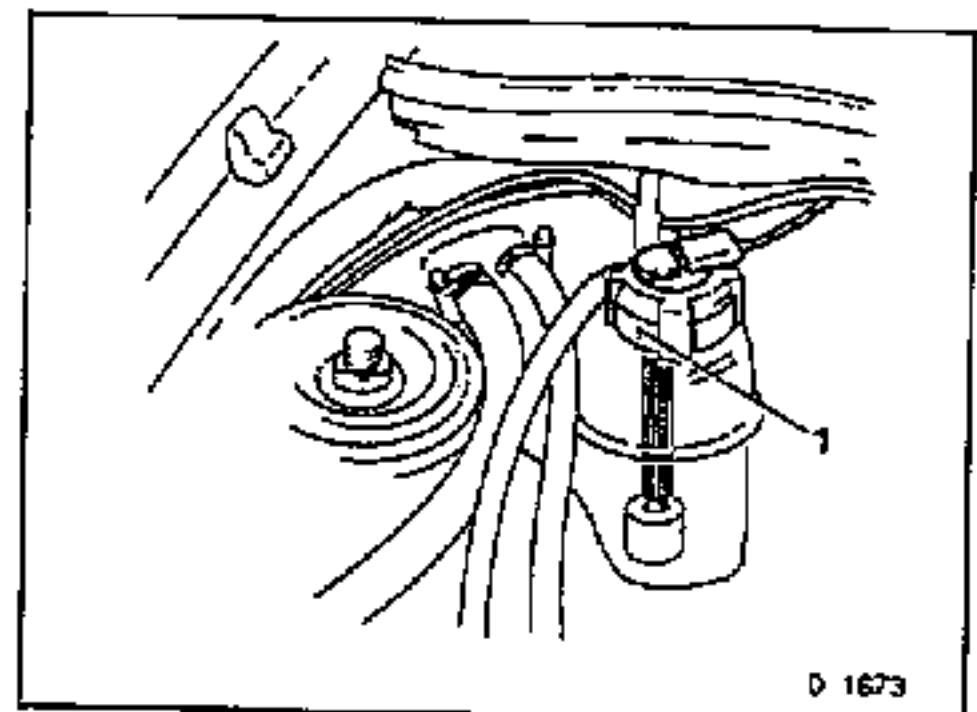
## SENSOR FOR REMAINING COOLANT QUANTITY, REPLACE

### Remove, Disconnect

Wiring harness plug, sensor for coolant compensating tank.

### Install, Connect

Sensor, wiring harness plug.



# CHECK CONTROL

## SENSOR FOR REMAINING CLEANING FLUID QUANTITY, REPLACE

### Remove, Disconnect

Wiring harness plug, reservoir sensor.

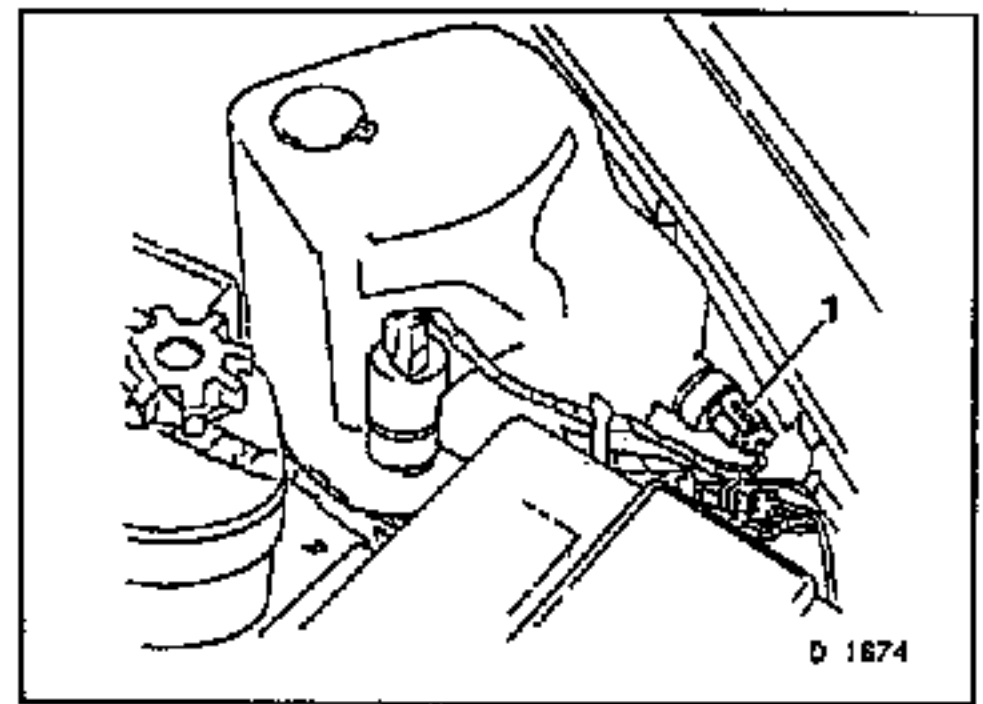
### Important!

Collect any cleaning fluid which may run out.

### Install, Connect

Sensor, wiring harness plug.

Top up cleaning fluid.



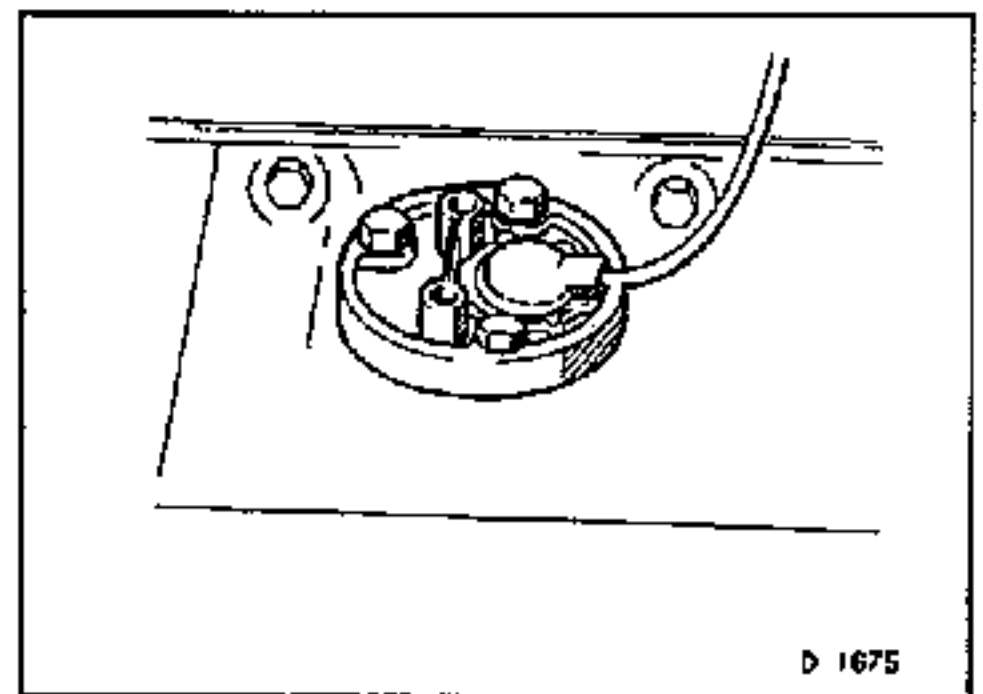
## SENSOR FOR REMAINING ENGINE OIL QUANTITY, REPLACE

### Remove, Disconnect

Wiring harness plug from sensor, sensor from oil pan.

### Install, Connect

Sensor, wiring harness plug.



# GROUP J

## DOUBLE OVERHEAD CAM ENGINE

### COOLING SYSTEM

#### TABLE OF CONTENTS

	PAGE
Seal Ring - Thermostat Housing to Cylinder Head, Replace .....	J - 392
Radiator, Remove and Install (C 20 XE Engine) * .....	J - 393
Cooling System, Check for Leaks .....	J - 393
Cooling System, Top Up and Bleed .....	J - 393
Fan Motor, Replace .....	J - 394
Thermostat, Replace .....	J - 394
Water Pump, Replace .....	J - 395
Recommended Torque Values .....	J - 396

\*For C 20 LET Engine, see Section, "TURBOCHARGING SYSTEM", in this Volume.

# DOHC ENGINE - COOLING SYSTEM

## Seal Ring - Thermostat Housing to Cylinder Head, Replace

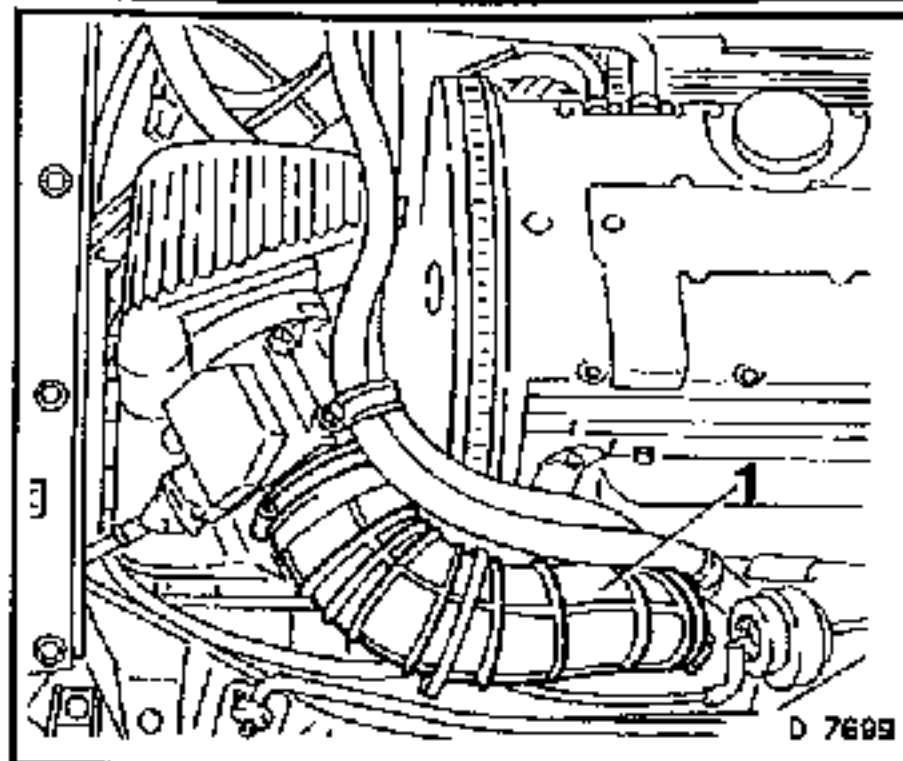
### Remove, Disconnect

For C 20 LET:

Air intake hose (1) from hot wire mass air flow meter and turbocharger.

Engine compartment cover.

The lower coolant hose from radiator. Collect coolant in a suitable, clean container.



### Remove, Disconnect

Coolant hose (1).

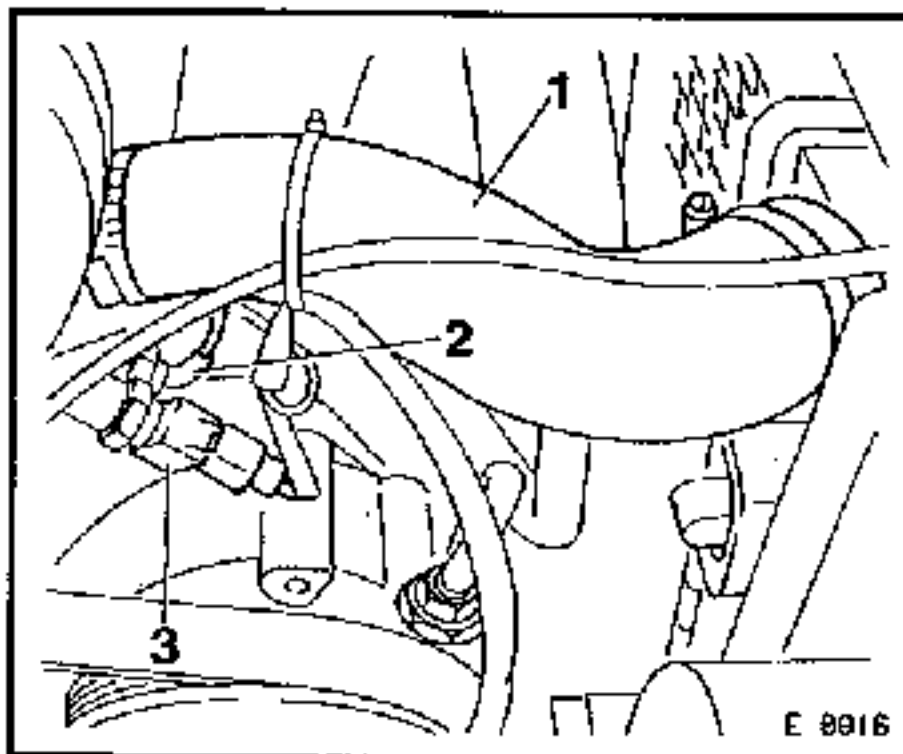
Wiring harness plugs (2 and 3) from the thermostat housing.

For C 20 XE:

Performance header. Refer to 'Gasket, Performance Header, Replace', in the Section "Cylinder Head", in this Volume.

Thermostat housing from cylinder head.

Remove seal ring.



### Clean

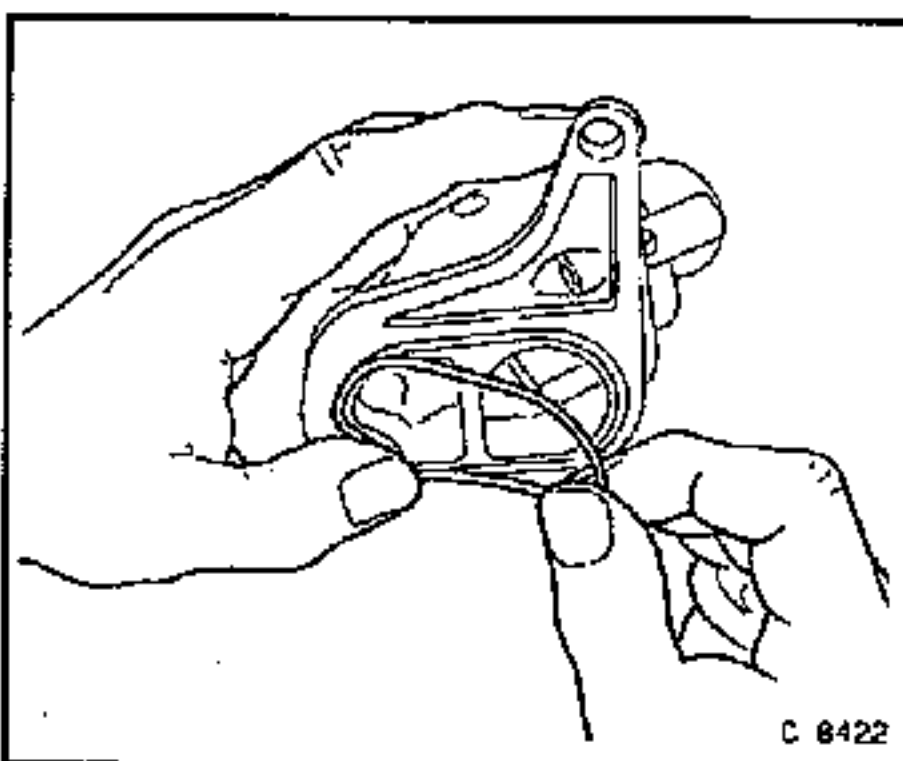
Sealing surfaces.

### Install, Connect

New seal ring to thermostat housing.

### Tighten (Torque)

Thermostat housing to cylinder head .....	15 Nm
Cover plate to cylinder head (bolts M 6) .	9 Nm
Cover plate to cylinder head (nuts M 8) .	22 Nm



### Install, Connect

Wiring harness plugs to thermostat housing.

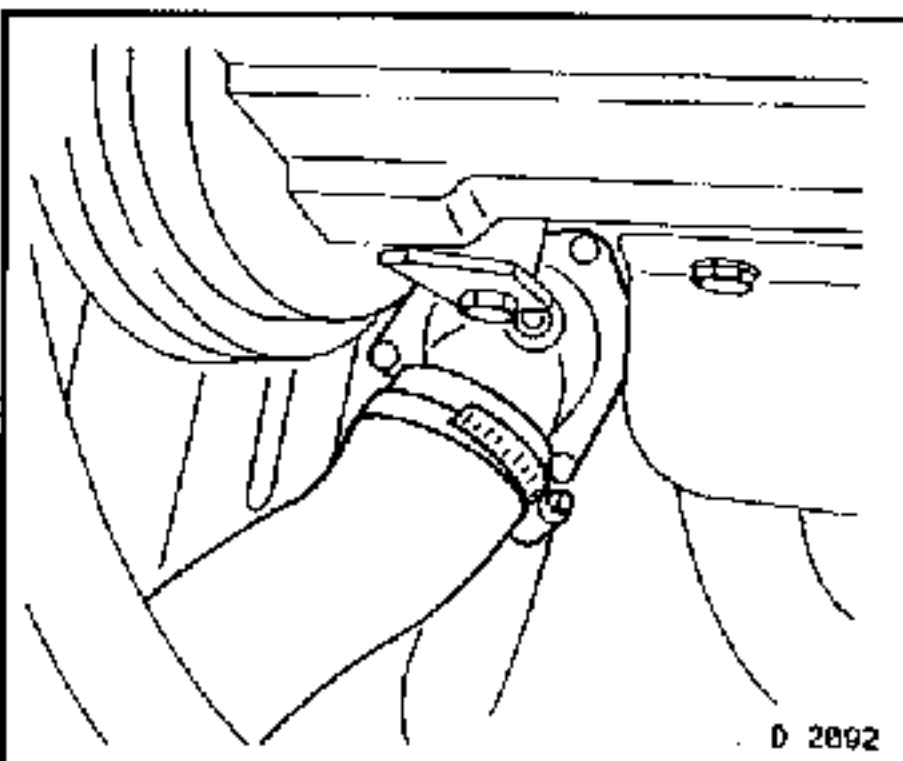
Upper and lower coolant hoses.

For C 20 LET:

Air intake hose.

Engine compartment cover.

Top up and bleed cooling system, as detailed in this Section.



# DOHC ENGINE - COOLING SYSTEM

## Radiator, Remove and Install (C 20 XE)

### Remove, Disconnect

Ground cable from battery.

Engine compartment cover.

The lower coolant hose (1) from radiator. Collect coolant in a suitable, clean container.

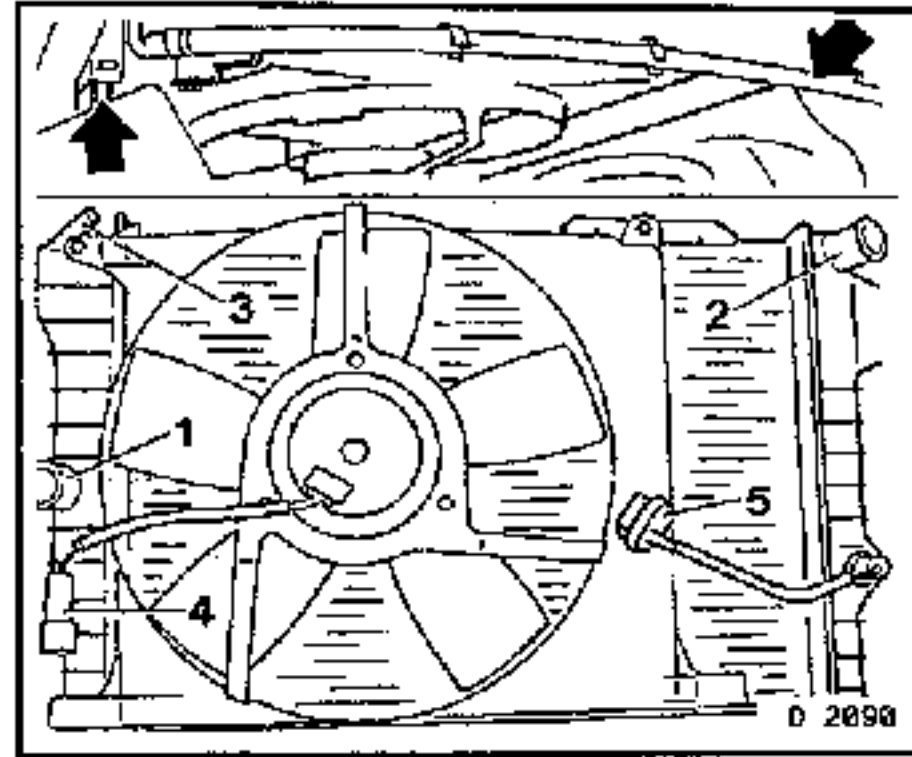
Upper coolant hose (2) from radiator.

Coolant reservoir hose from radiator (3).

Multi-plug from fan motor.

Multi-plug from temperature sensor.

Retainer (arrows) from air deflector.



Remove radiator with fan motor and radiator fan shroud, in an upwards direction.

Transfer attaching parts when replacing

### Install, Connect

Radiator in lower retainer.

Retainer on air deflector.

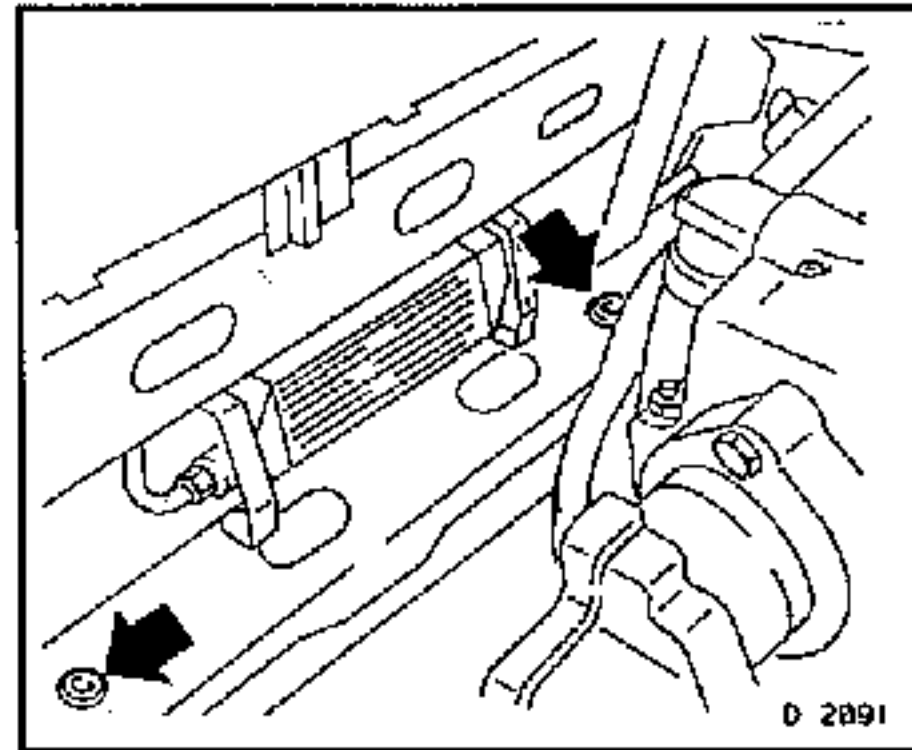
Coolant hoses.

Multi-plugs.

Engine compartment cover.

Ground cable to battery.

Top up and bleed cooling system as detailed in this Section.



## Cooling System, Check for Leaks

Engine must be at operating temperature (oil temperature to be at least 80 °C).

Check coolant level.

### Install, Connect

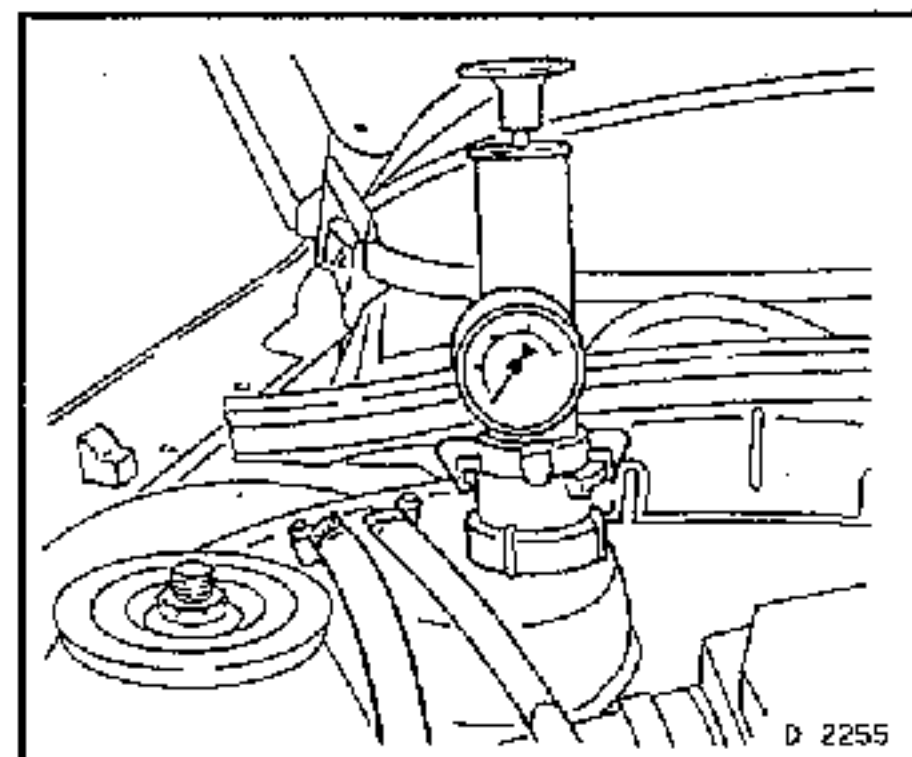
Use KM 471 with a commercially available pressure tester to the coolant reservoir tank, observing manufacturer's instructions.

Pressurise cooling system to 100 kPa (1 bar).

### Inspect

Cooling system for leaks.

Remove tester and close coolant reservoir tank.



## Cooling System, Top Up and Bleed

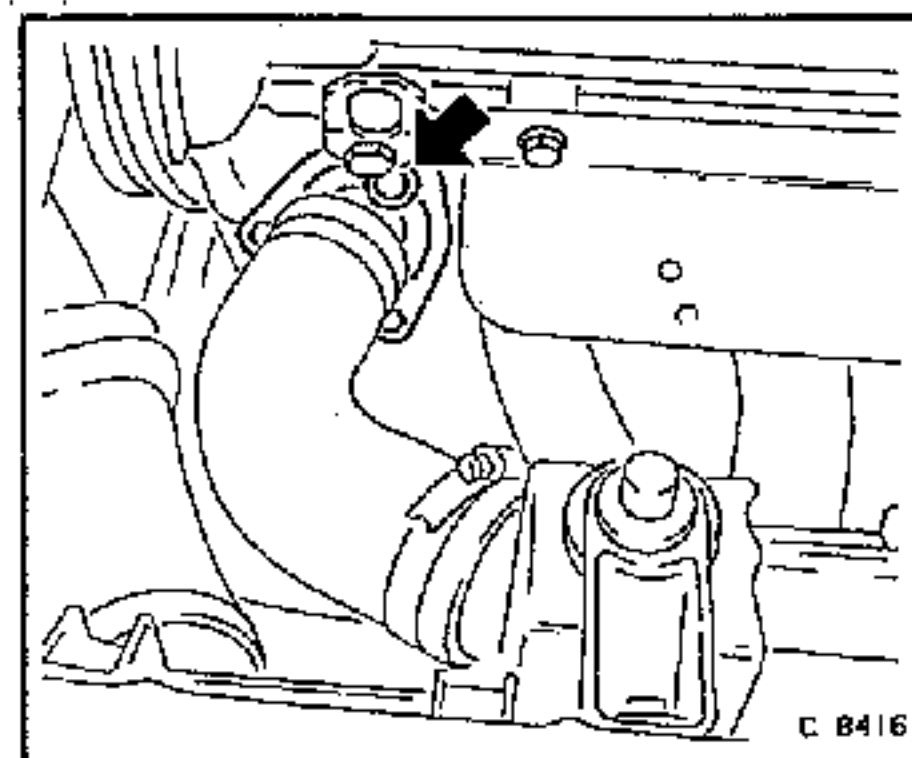
### Important!

Only use an ethylene glycol based coolant inhibitor/anti-freeze, that complies with Holden's Specification HN2043.

Ratio of coolant additive must be maintained at 50% additive to 50% clean water

### Remove, Disconnect

Allen key headed bolt (arrow)



# DOHC ENGINE - COOLING SYSTEM

Fill coolant reservoir tank with coolant until it flows from the Allen key headed bolt hole, free of bubbles.

## Install, Connect

Allen key headed bolt, after applying sealing compound to the threads, such as Loctite 515 or equivalent, to Holden's Specification HN1581.

Fill coolant to "KALT" (cold) mark on the reservoir tank.

Seal the cooling system and run the engine until operating temperature is reached and the thermostat opens (coolant temperature approximately 92 °C).

## Inspect

Coolant level. Allow the engine to cool down. Then, if necessary, top up coolant to "KALT" (cold) mark on the coolant reservoir tank, using 50% coolant to 50% clean water.

## Fan Motor, Replace

### Remove, Disconnect

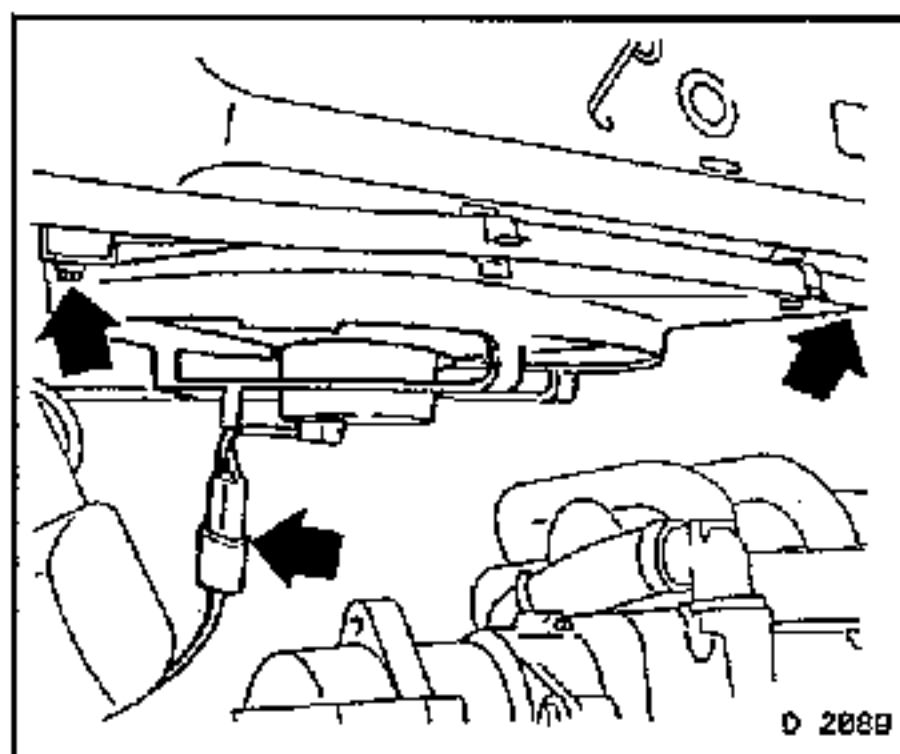
Ground cable from battery.

Multi-plug (arrow).

Radiator fan shroud with the fan motor attached. Remove upwards.

For C 20 LET:

Coolant hose from radiator fan shroud bracket.



### Remove, Disconnect

Fan motor from radiator fan shroud and fan.

### Install, Connect

Fan to fan motor and radiator fan shroud.

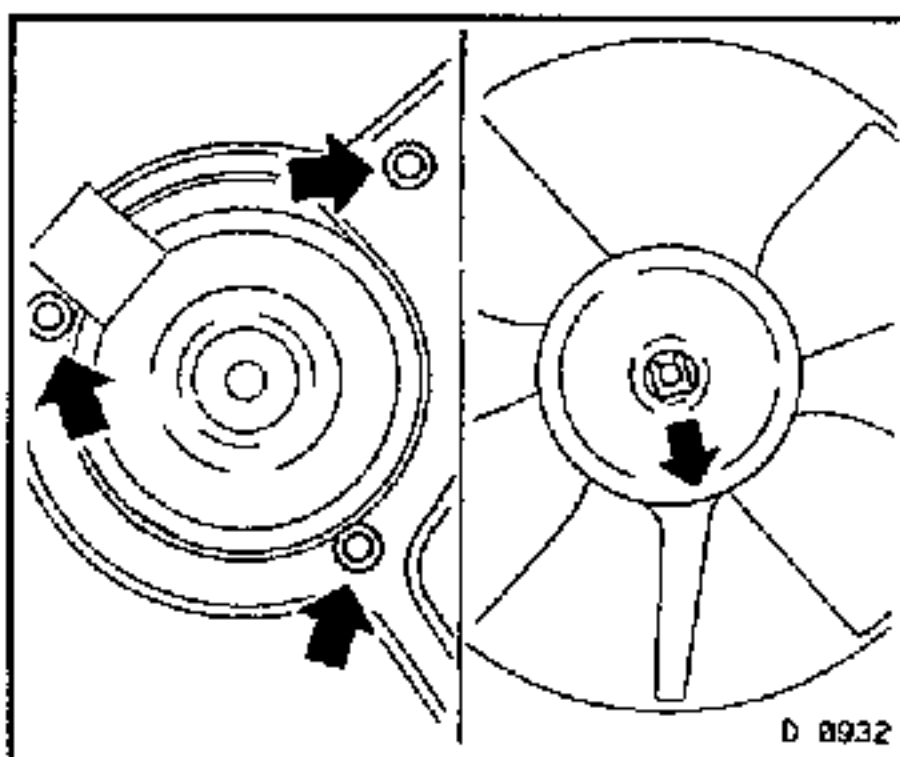
Radiator fan shroud with fan motor to radiator.

Multi-plug.

Ground cable to battery.

For C 20 LET:

Coolant hose to radiator fan shroud bracket.



## Thermostat, Replace

### Remove, Disconnect

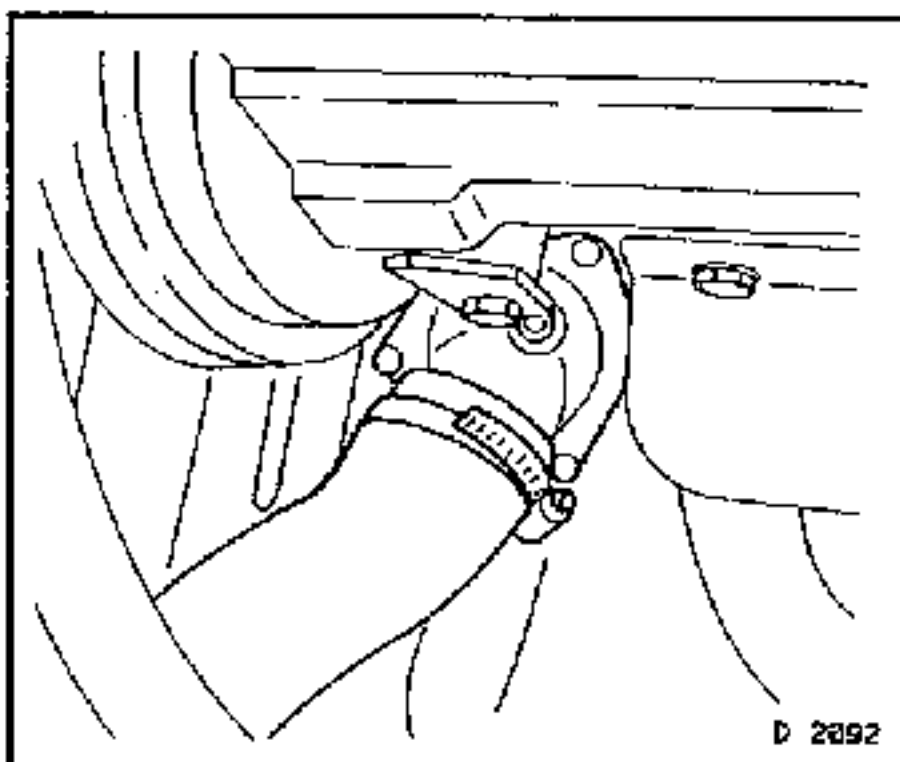
Engine compartment cover.

The lower coolant hose from the radiator. Collect the coolant in a suitable clean container.

Upper coolant hose from the water outlet fitting.

Water outlet fitting with thermostat from the thermostat housing.

Sealing ring.





# DOHC ENGINE - COOLING SYSTEM

## Clean

Sealing surfaces.

## Install, Connect

New seal ring.

Water outlet fitting with the thermostat, to the thermostat housing.

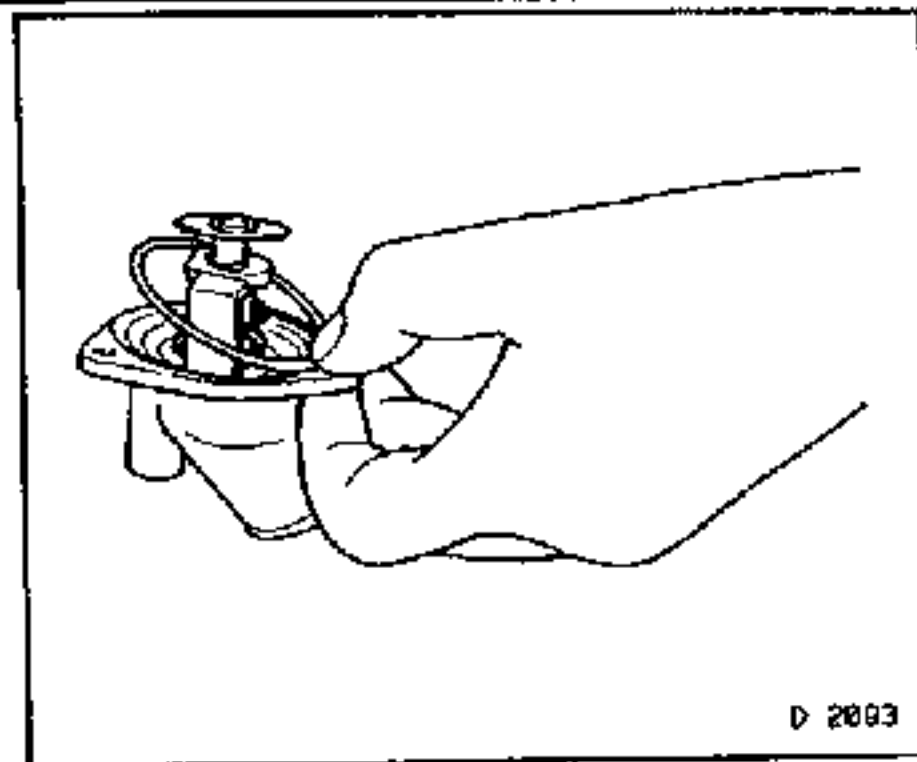
## Tighten (Torque)

Water outlet fitting to thermostat housing .... 8 Nm

Upper and lower coolant hoses.

Engine compartment cover.

Top up and bleed cooling system as detailed in this Section.



## Water Pump, Replace

### Remove, Disconnect

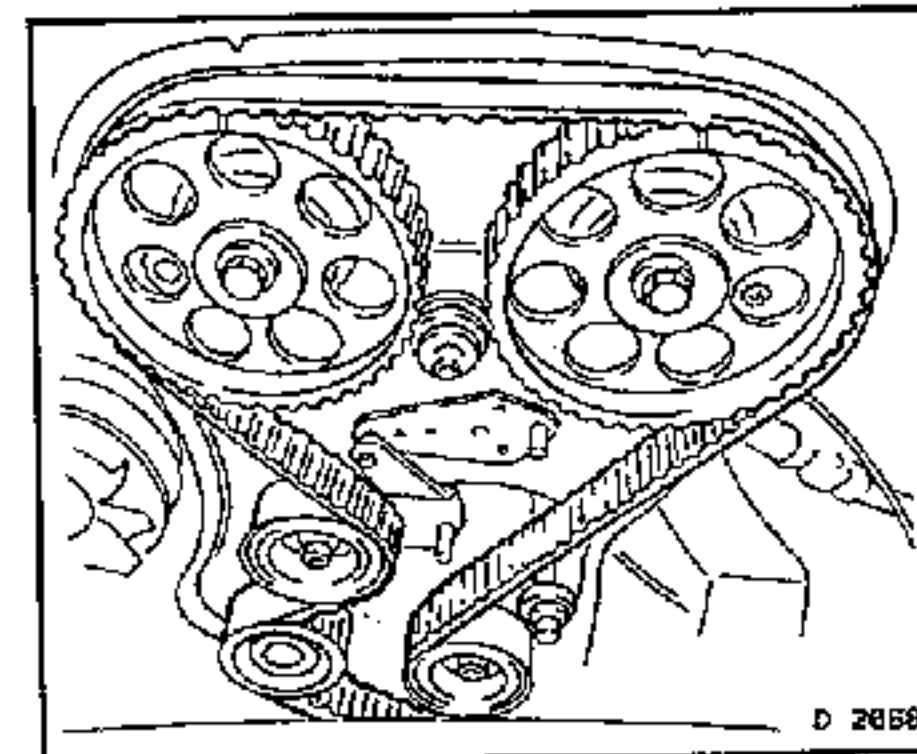
Engine compartment cover.

The lower coolant hose from the radiator. Collect the coolant in a suitable clean container.

Engines as of MY'93:

Mark the direction of rotation of the toothed belt.

Toothed Belt. Refer to this operation in the Section, "Engine Timing Side, Air Cleaner Housing", in this Volume.



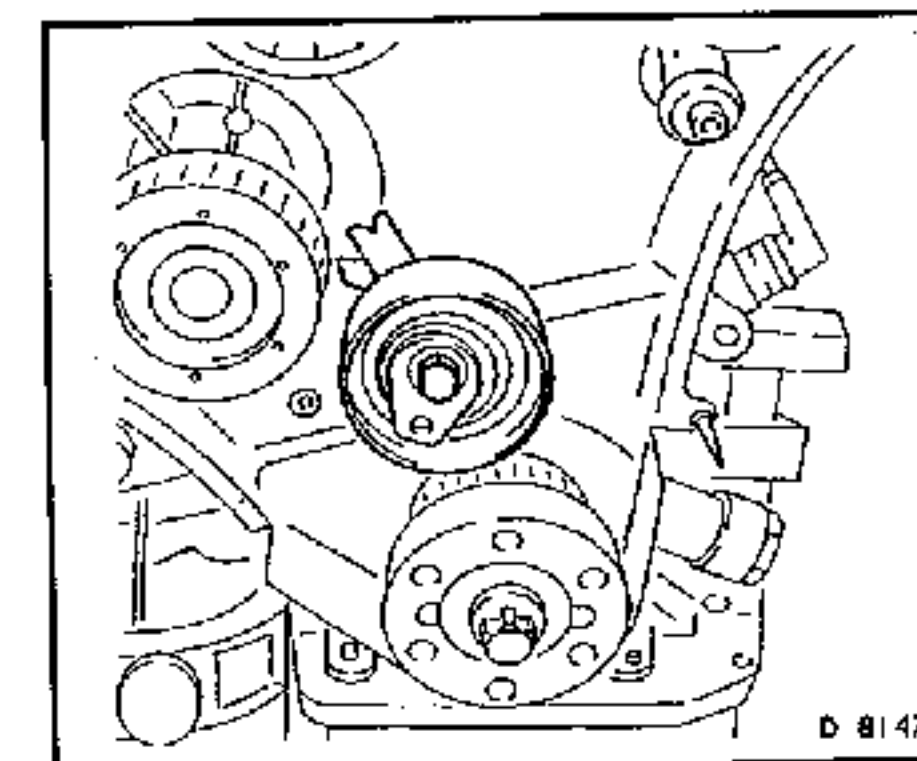
### Remove, Disconnect

Engines up to MY'93:

Rear toothed belt cover. Refer to this operation in the Section, "Engine Timing Side, Air Cleaner Housing", in this Volume.

Engines as of MY'93:

Toothed belt tension roller from the oil pump housing

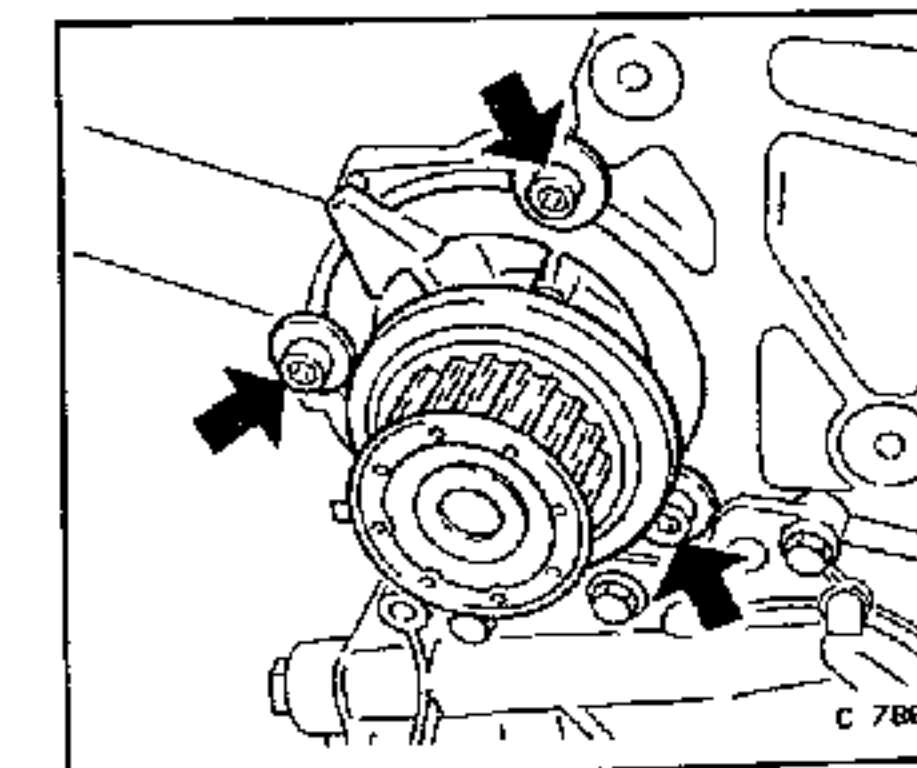


### Remove, Disconnect

Water pump from cylinder block.

## Clean

Sealing surfaces.



# DOHC ENGINE - COOLING SYSTEM

## Install, Connect

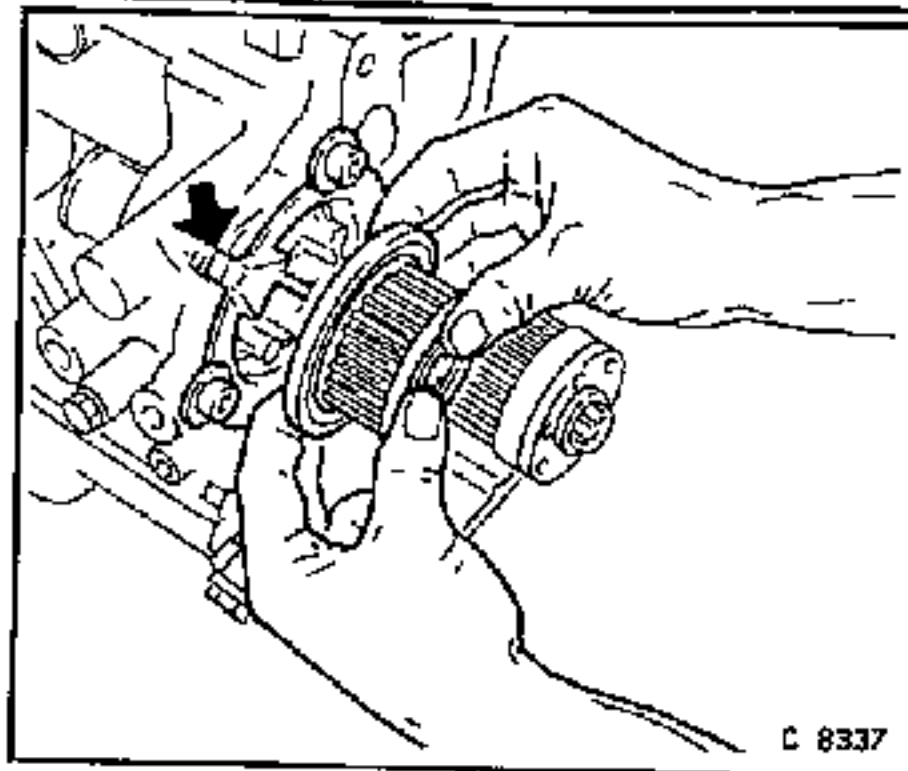
Before installing the water pump lightly coat the sealing surface in the cylinder block and a new sealing ring with silicone sealant such as Dow Corning or equivalent to Holden's Specification HN1014.

## Tighten (Torque)

Water pump to cylinder block..... 25 Nm

## Important!

The spur on the cylinder block must align with that on the water pump (arrow).



## Install, Connect

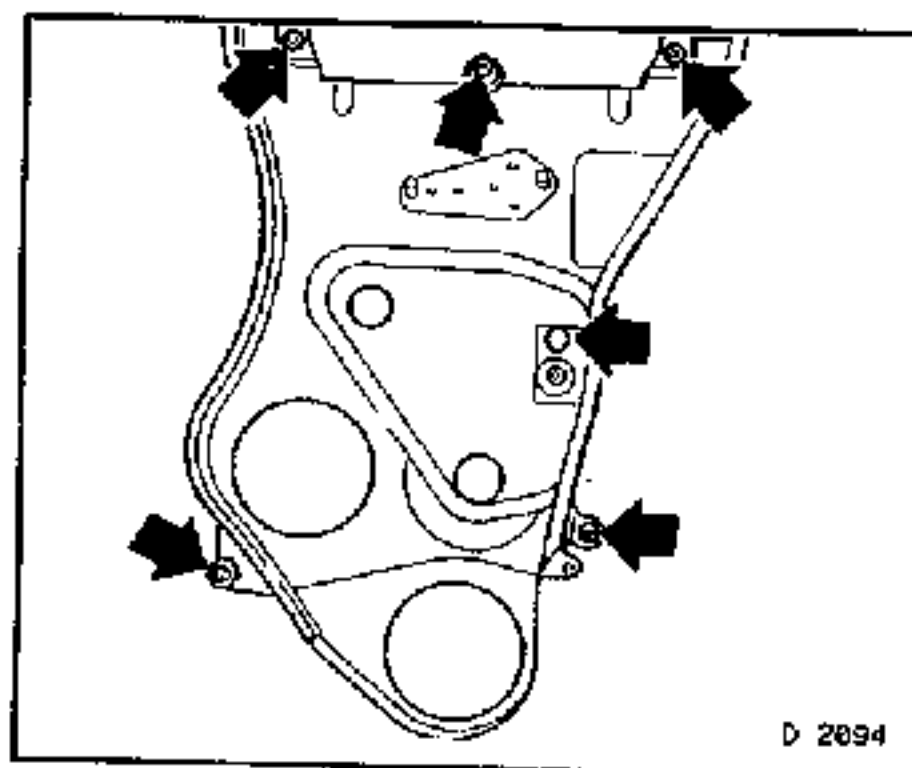
Engines up to MY'93:

Rear toothed belt cover. Refer to this operation in the Section, "Engine Timing Side, Air Cleaner Housing", in this Volume.

Engines as of MY'93:

Toothed belt tension roller. Refer to this operation in the Section, "Engine Timing Side, Air Cleaner Housing", in this Volume.

Toothed belt. Refer to this operation in the Section, "Engine Timing Side, Air Cleaner Housing", in this Volume.

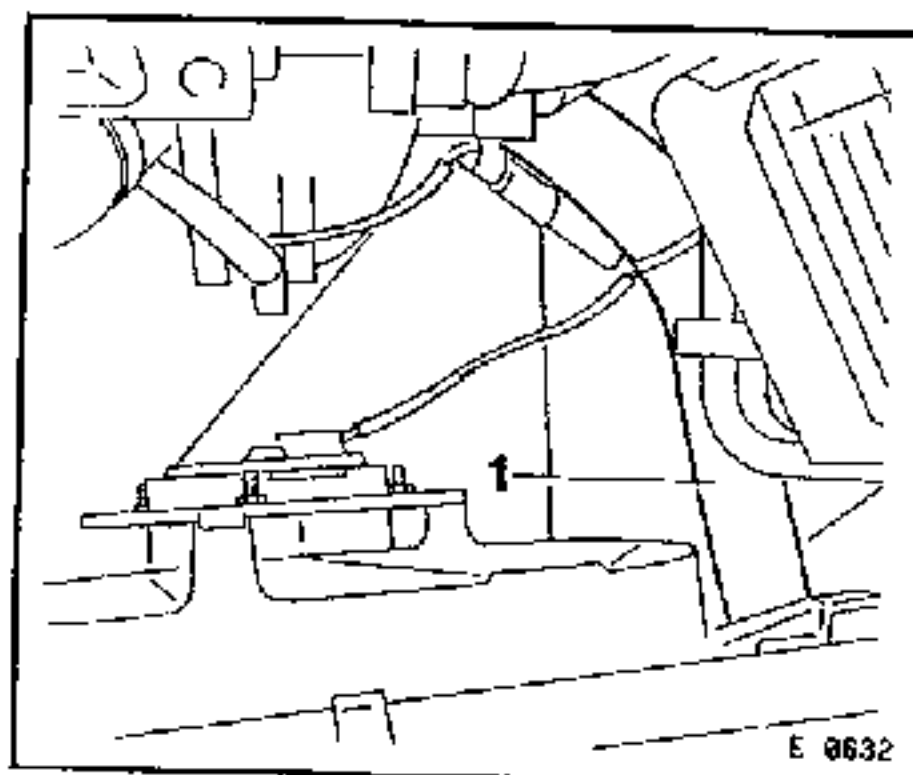


## Install, Connect

The lower coolant hose (1) to the radiator.

Engine compartment cover.

Top up and bleed cooling system as detailed in this Section.



## RECOMMENDED TORQUE VALUES

### (Cooling System)

Camshaft housing cover to housing .....	Nm
Camshaft pulley to camshaft .....	8
Rear toothed belt cover to oil pump housing and camshaft housing .....	45
Temperature sensor to intake manifold .....	8
Thermostat housing to cylinder head .....	10
Water outlet connection to thermostat housing .....	15
	8

# DOHC ENGINE - CRANK DRIVE

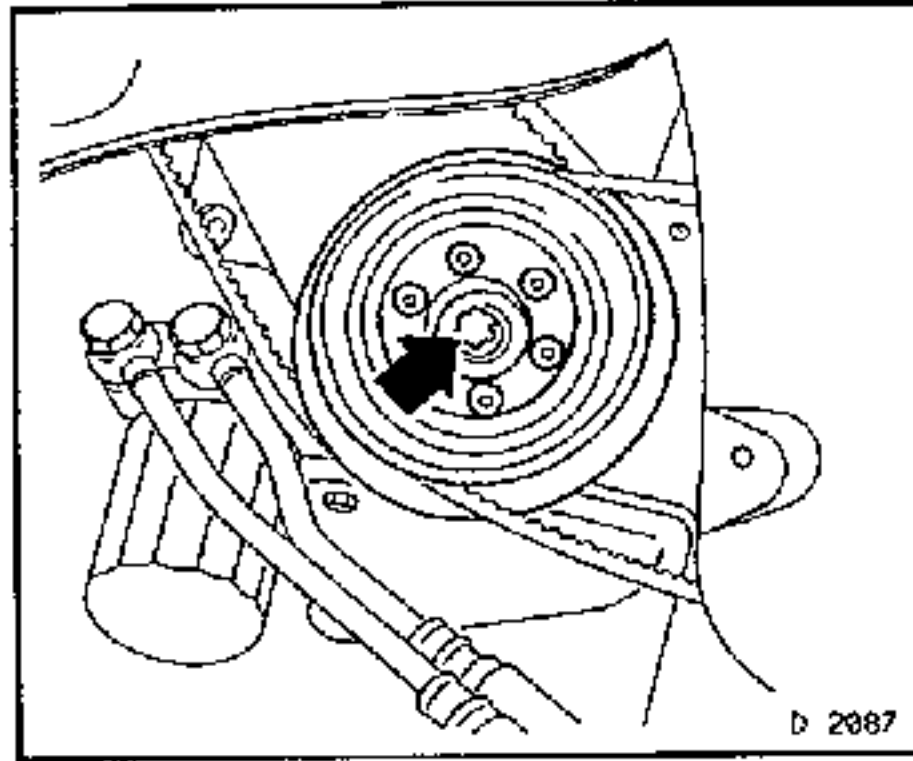
## Flywheel, Remove and Install

### Remove, Disconnect

Transmission and clutch. Refer to Section K, "Clutch and Transmission", in Volume 4.

Flywheel after marking the relative position to the crankshaft.

Use MKM-604-21 (Torx E 20) on the toothed belt drive gear (arrow) to hold the crankshaft when loosening the flywheel fastening bolts.



### Torque - Angle Method

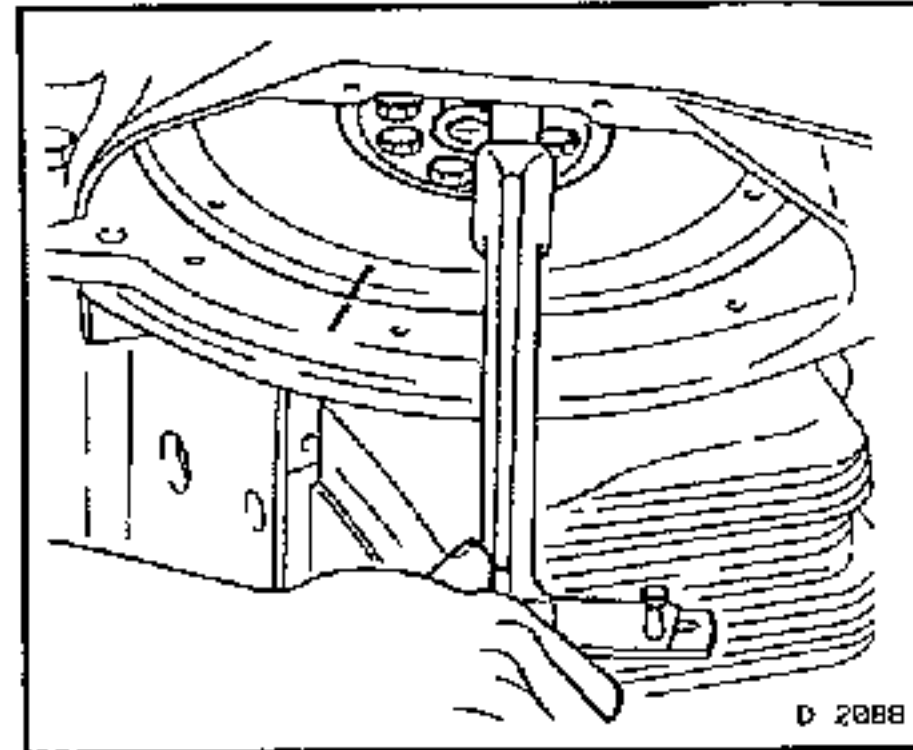
Flywheel to crankshaft..... 65 Nm + 30° + 15° \*

\* Use new bolts.

Use MKM-604-21 (Torx E 20) on the toothed belt drive gear to hold the crankshaft while tightening the flywheel fastening bolts.

### Install, Connect

Clutch, thrust bearing guide sleeve, thrust bearing, and transmission. Refer to Section K, "Clutch and Transmission", in Volume 4.



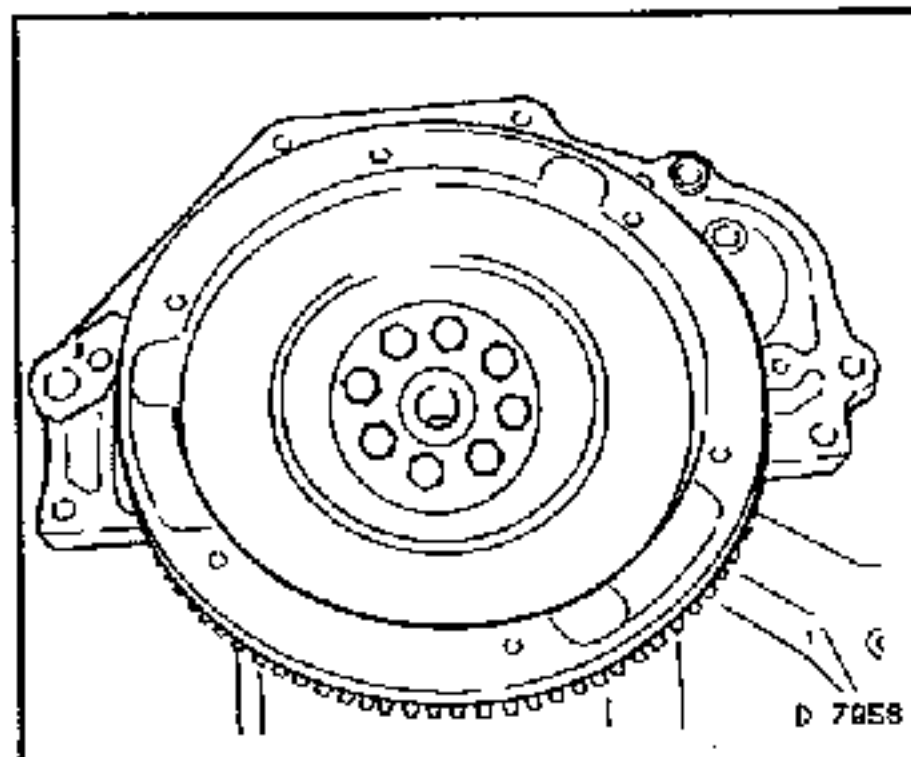
## Pot Flywheel, Remove and Install

### Remove, Disconnect

Transmission and clutch. Refer to Section K, "Clutch and Transmission", in Volume 4.

Pot flywheel after marking the relative position to the crankshaft.

Hold the pot flywheel by using KM-652.



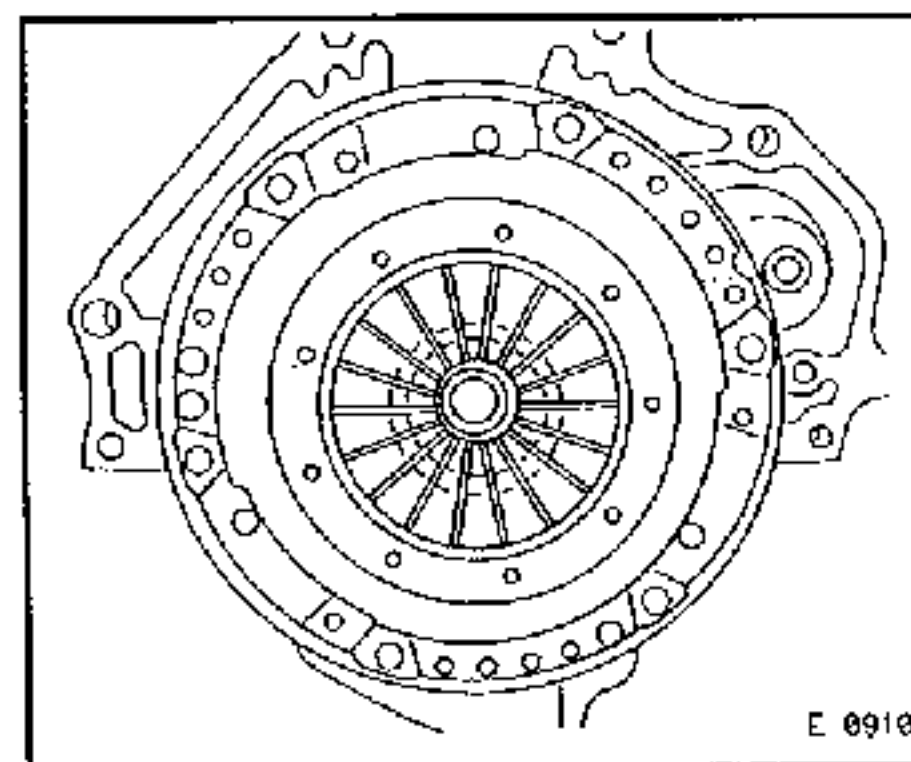
### Torque - Angle Method

Flywheel to crankshaft..... 65 Nm + 30° + 15° \*

\* Use new bolts.

### Install, Connect

Clutch, thrust bearing guide sleeve, thrust bearing, and transmission. Refer to Section K, "Clutch and Transmission", in Volume 4.



# DOHC ENGINE - CRANK DRIVE

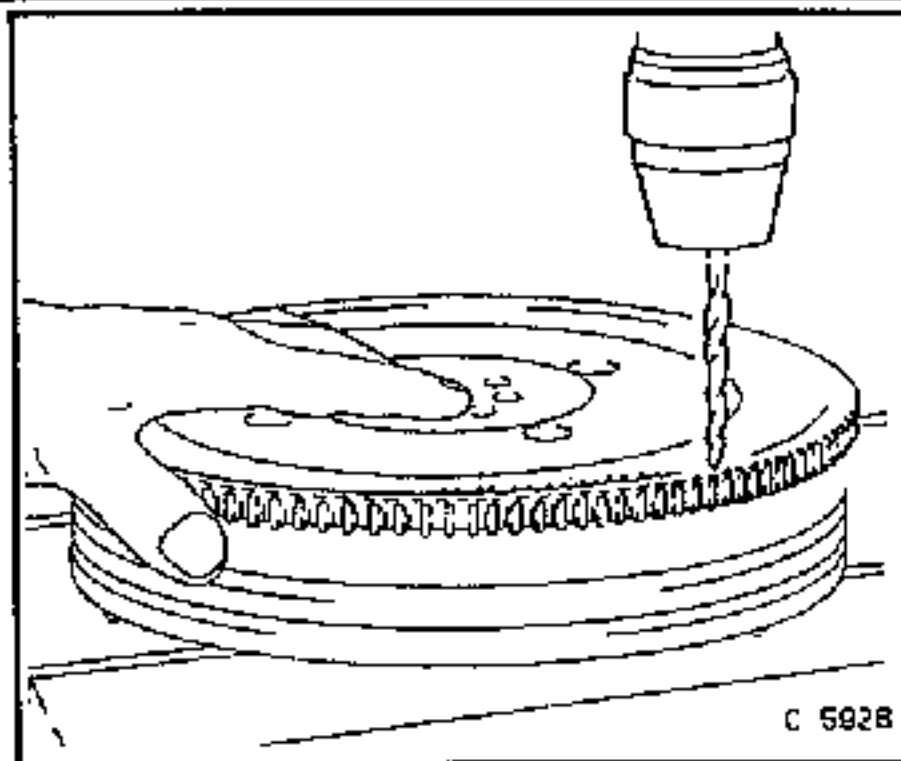
## Starter Ring Gear, Replace

### Remove, Disconnect

Flywheel. Refer to previous operation, in this Section.

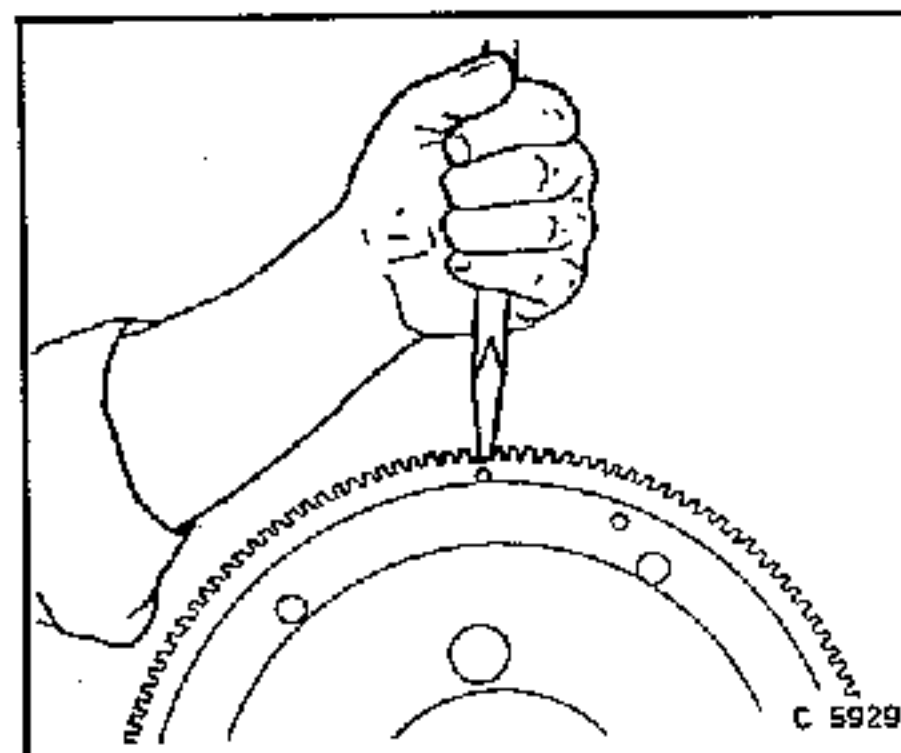
### Disassemble

Drill starter ring gear at a tooth gap, using a 6 mm drill bit to a depth of approximately 8 mm.



### Disassemble

Separate starter ring gear using a cold chisel at the drilled hole.

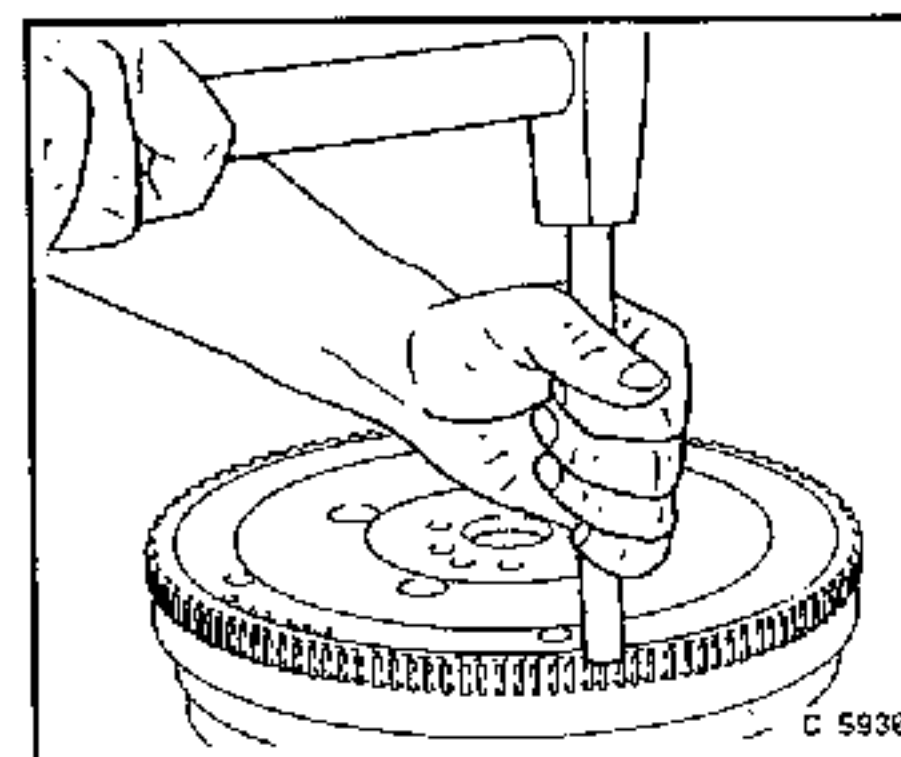


### Assemble

Starter ring with the chamfered edge to the flywheel, after heating the ring gear to a temperature between 180 - 230 °C (yellow burnished colour).

### Install, Connect

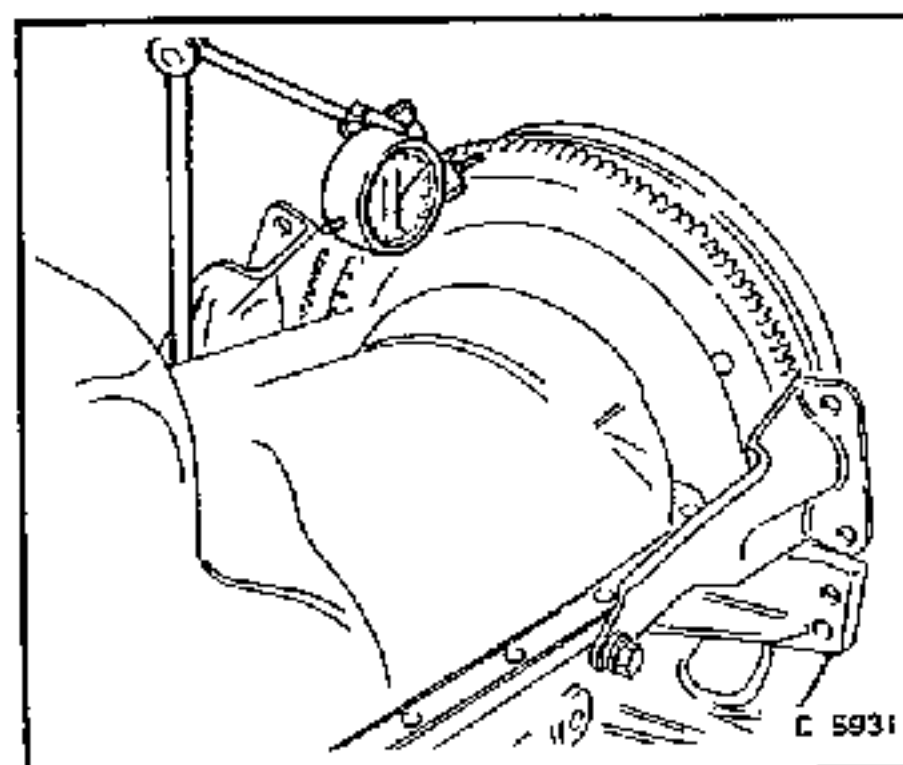
Flywheel. Refer to the previous operation in this Section.



### Check

Using a dial indicator and magnetic stand and check the lateral run-out of the starter ring gear.

Specification ..... 0.5 mm max.



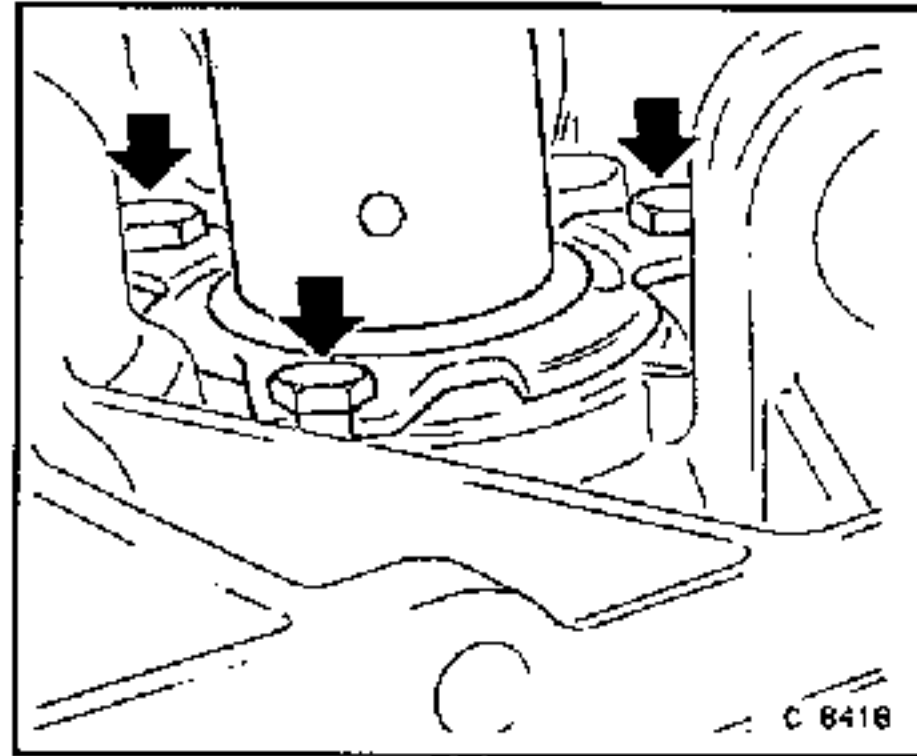
# DOHC ENGINE - CRANK DRIVE

## Rear Crankshaft Seal Ring, Replace (Engines without Pot Flywheel)

### Remove, Disconnect

Transmission, clutch, thrust bearing and thrust bearing guide sleeve. Refer to Section K, "Clutch and Transmission", in Volume 4.

Flywheel. Refer to operation in this Section.



### Install, Connect

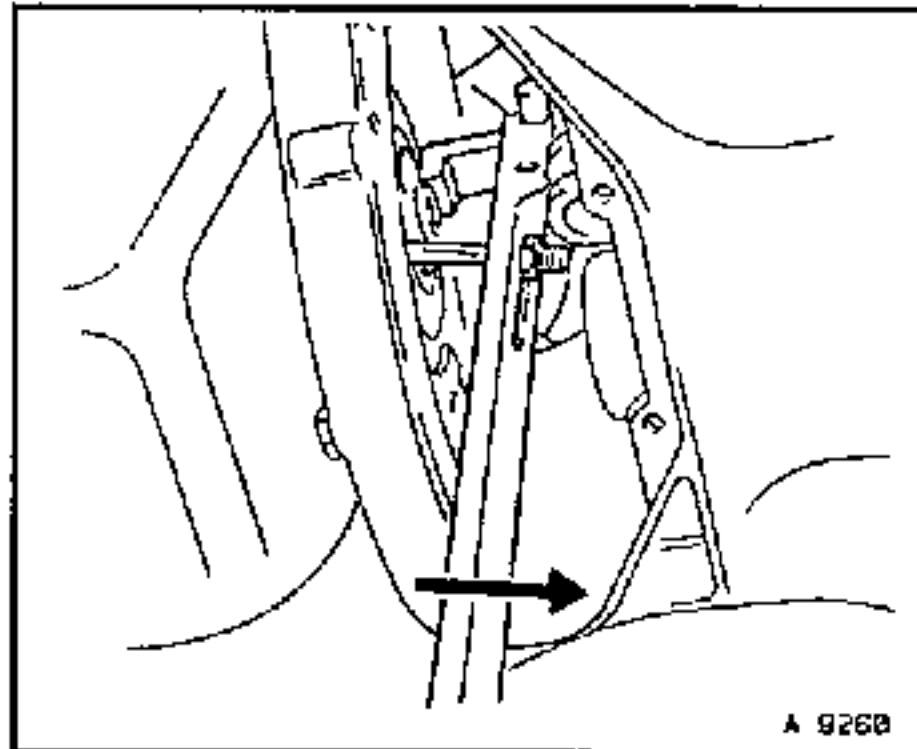
Remover hook KM-665 between seal lip and the crankshaft journal.

### Assemble

Support KM-469-4, lever KM-469-13-A and pin KM-328-8.

### Remove, Disconnect

Shaft seal ring using this combination of special service tools.

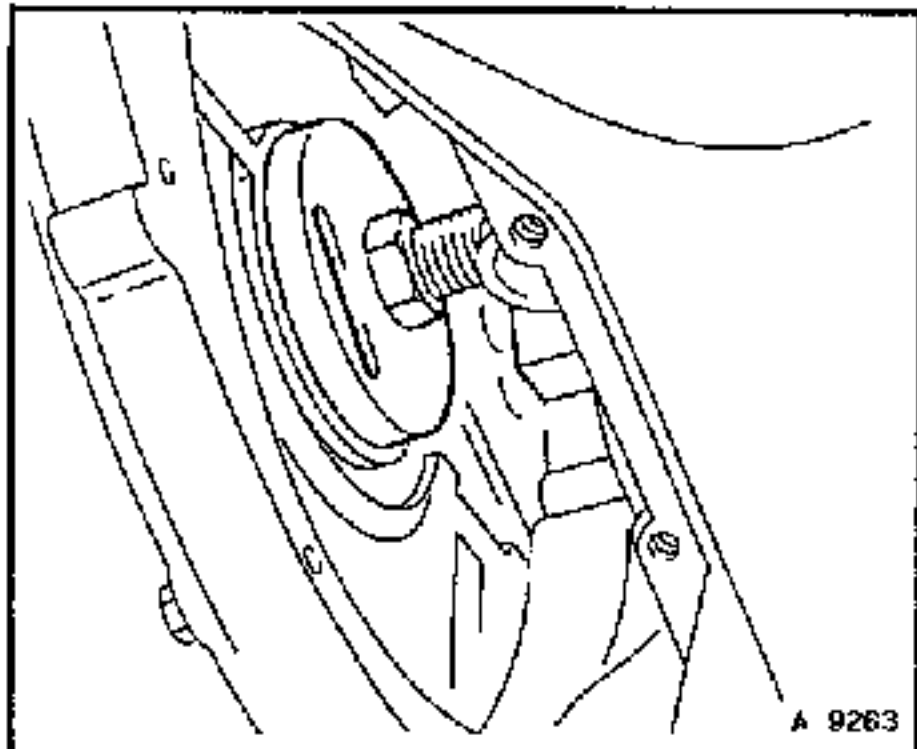


Apply protective grease to the seal lip before installing.

### Install, Connect

Using protective sleeve KM-635-1, install seal onto crankshaft journal.

Mount compress ring KM-635-2 on seal ring.



### Install, Connect

Seal ring to stop on cylinder block. Use holding plate KM-511-11 and Torx bolt KM-469-12-B.

### Important!

Insert the locating pins (arrows) into the bores of the transmission.

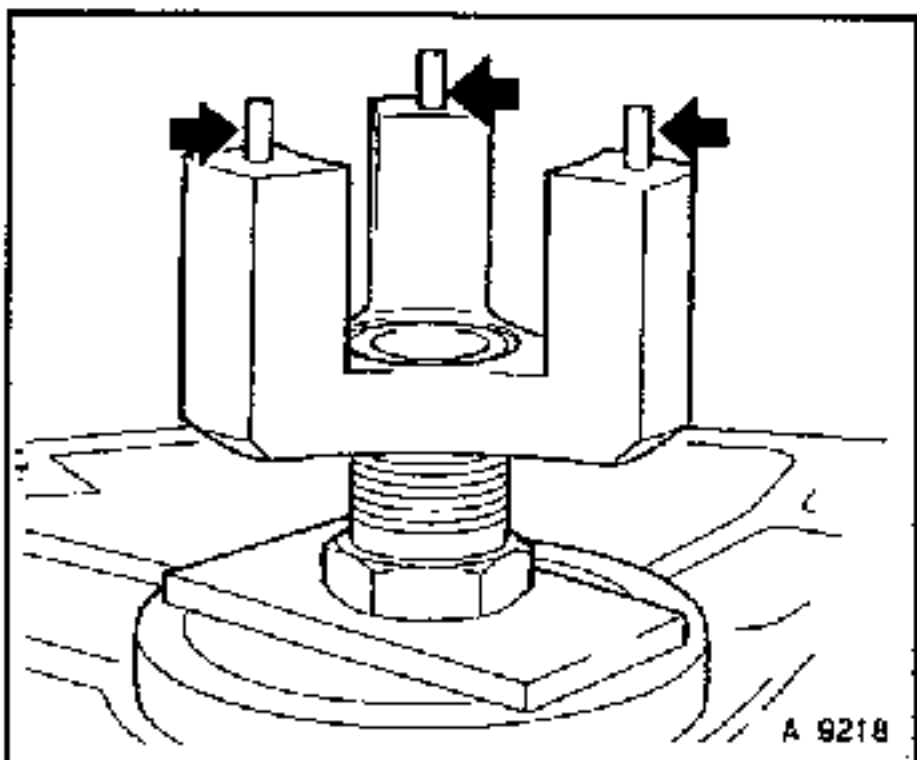
### Remove, Disconnect

Special service tools.

### Install, Connect

Flywheel. Refer to the previous operation in this Section.

Clutch, thrust bearing guide sleeve, thrust bearing, and transmission. Refer to Section K, "Clutch and Transmission", in Volume 4.



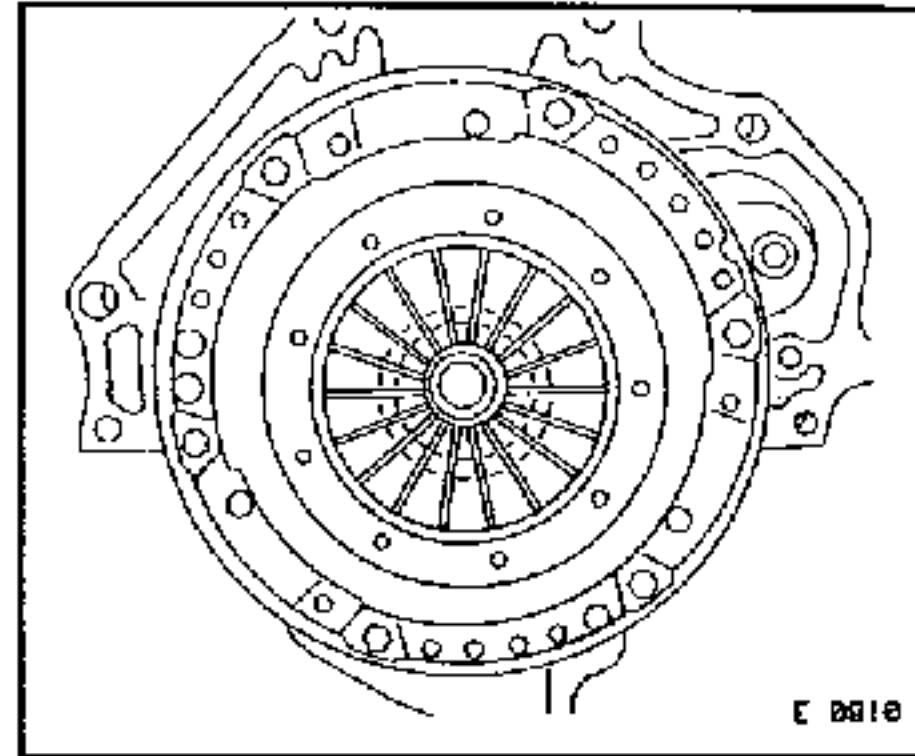
# DOHC ENGINE - CRANK DRIVE

## Rear Crankshaft Seal Ring, Replace (Engines with Pot Flywheel)

### Remove, Disconnect

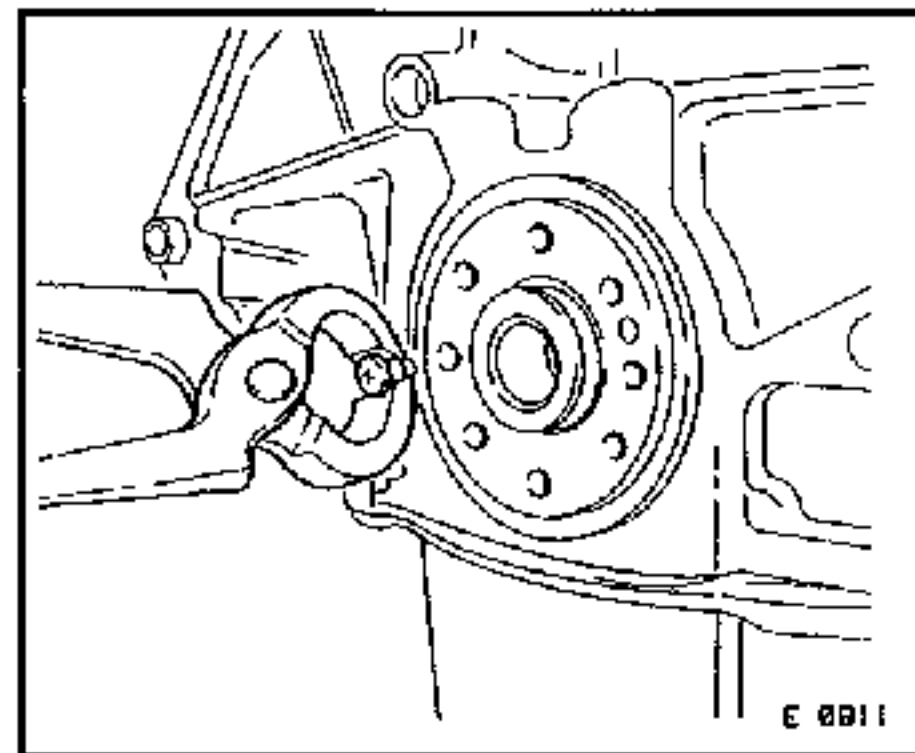
Transmission and clutch. Refer to Section K, "Clutch and Transmission", in Volume 4.

Pot flywheel. Refer to the operation described in this Section.



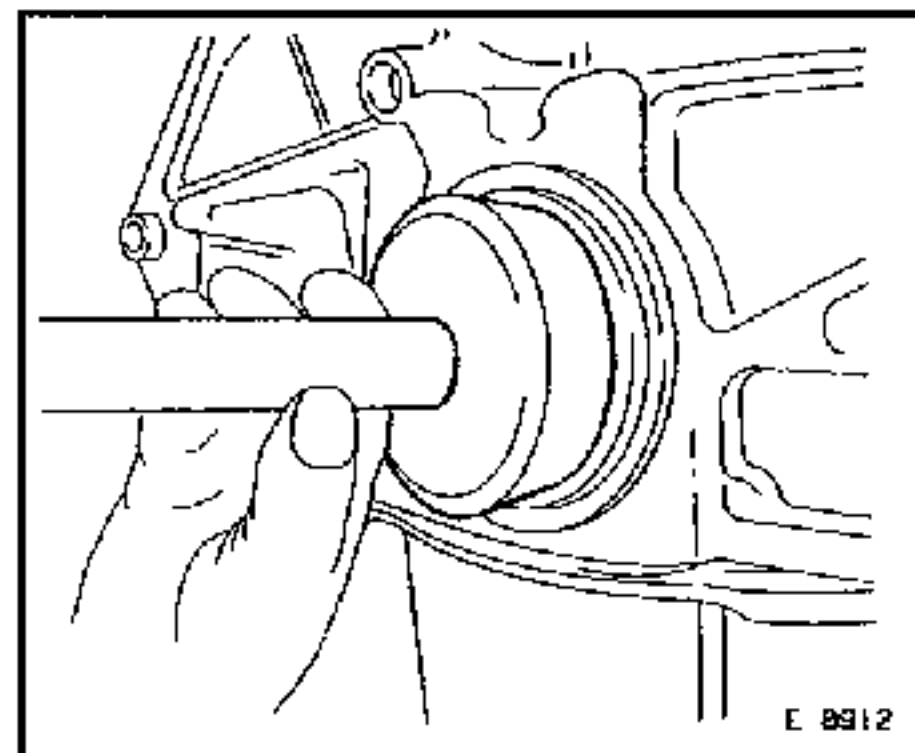
### Remove, Disconnect

Drill a hole in the centre of one side of the seal ring, insert a self tapping screw and lever the seal out, with a suitable tool.



### Install, Connect

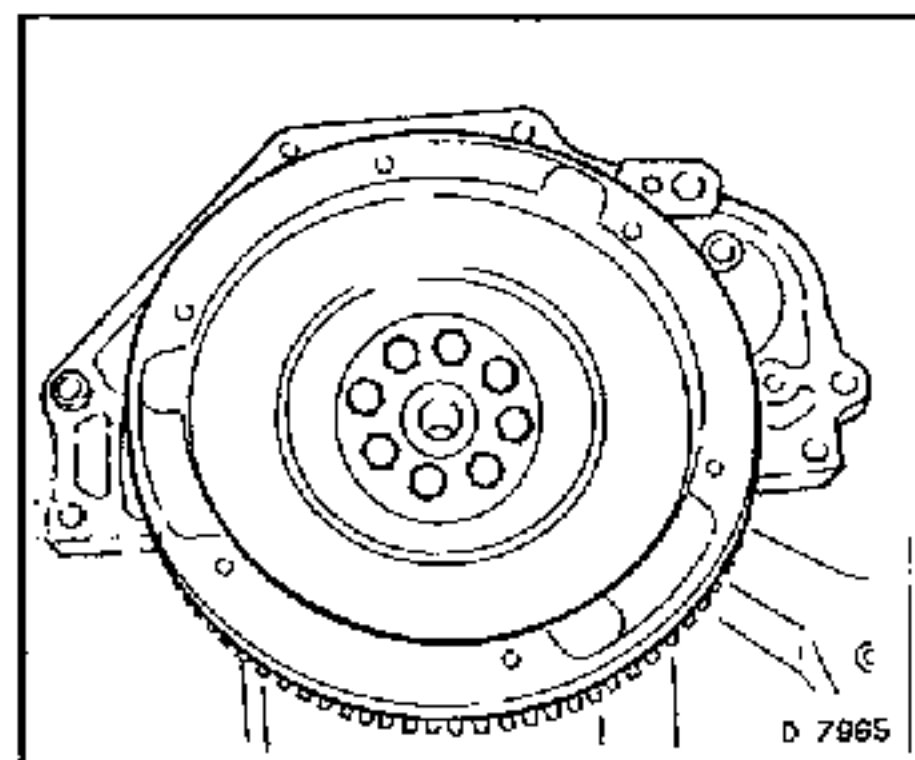
Seal ring using protective sleeve KM-635-1. Coat seal lip with protective grease before installing. Compress ring KM-635-2 and KM-535.



### Install, Connect

Pot flywheel. Refer to the previous operation in this Section.

Clutch, thrust bearing guide sleeve, thrust bearing, and transmission. Refer to Section K, "Clutch and Transmission", in Volume 4.



# DOHC ENGINE - CRANK DRIVE

## Front Crankshaft Seal Ring (in Oil Pump Housing), Replace

### Note:

While the operation is described here is for engines up to MY'93, the procedure is similar for all engines.

### Remove, Disconnect

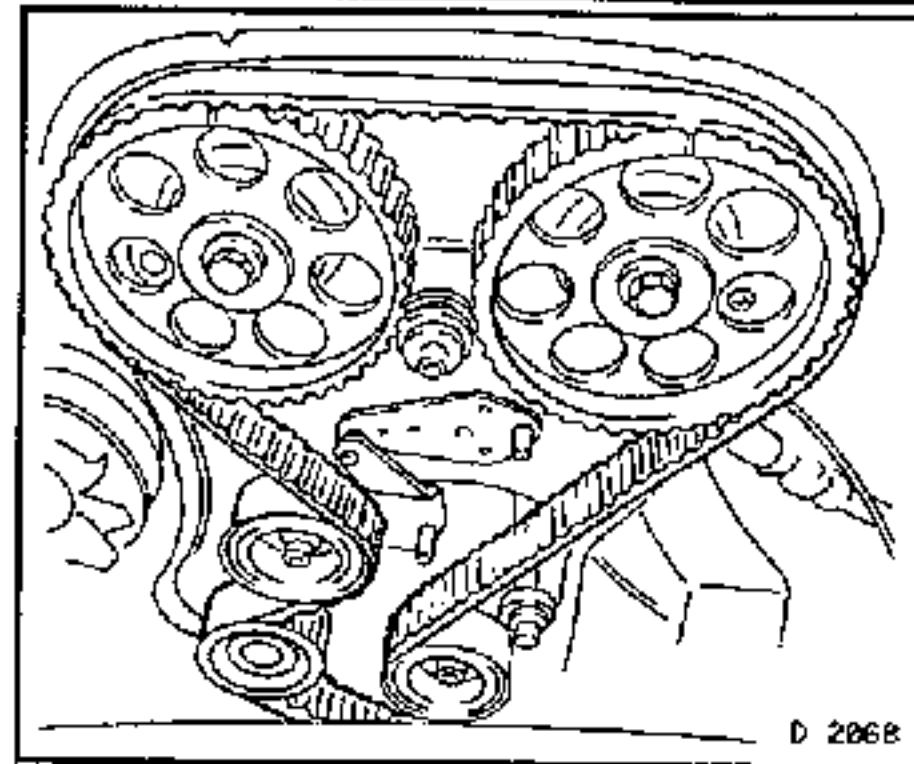
Right front wheel.

Engine compartment cover.

Engines as of MY'93:

Mark the direction of rotation of the toothed belt.

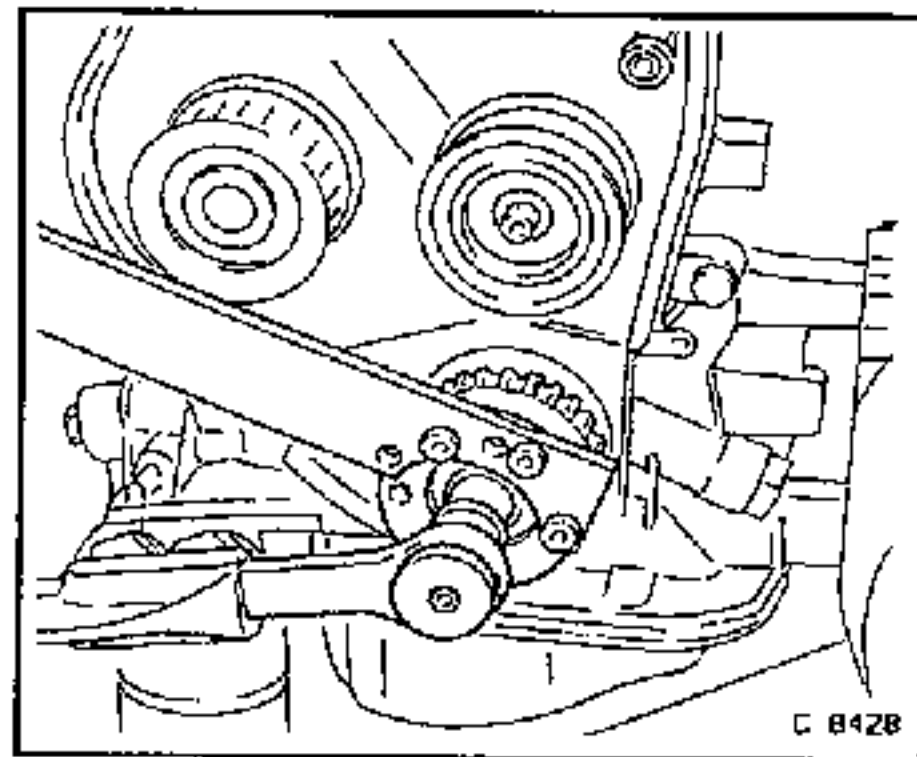
Toothed Belt. Refer "Toothed Belt, Replace", in this Volume.



### Remove, Disconnect

Toothed belt drive gear. Use holding wrench KM-662-A and MKM-604-21 (Torx E 20), to remove the fastening bolt.

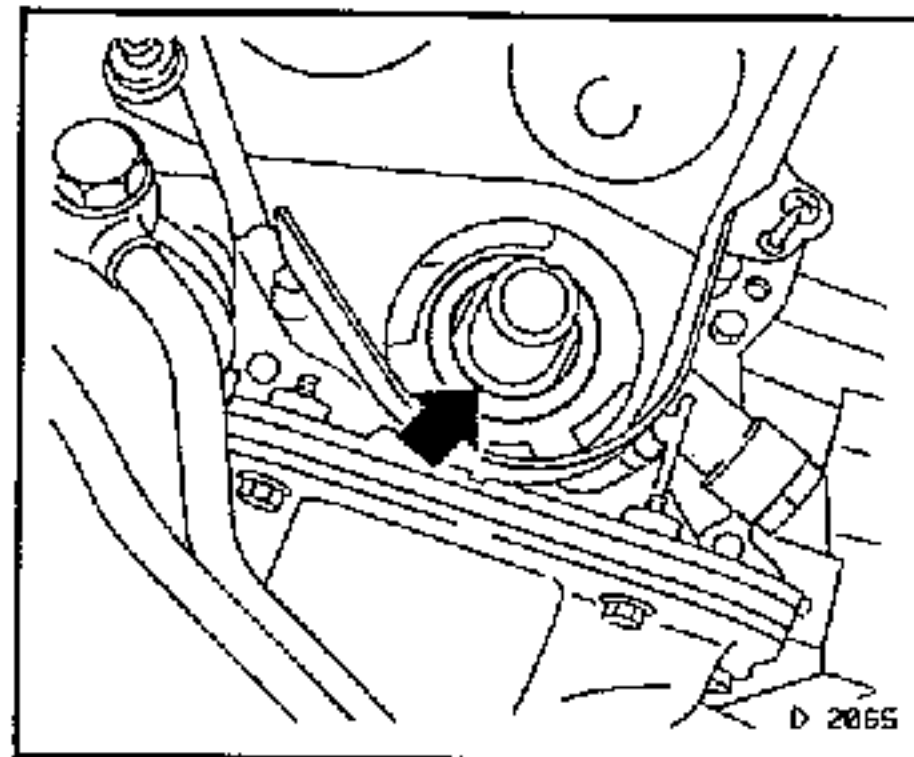
Install wheel puller KM-210-A, with KM-516 and KM-647 if necessary, to remove the toothed belt drive gear.



### Remove, Disconnect

Spacing ring.

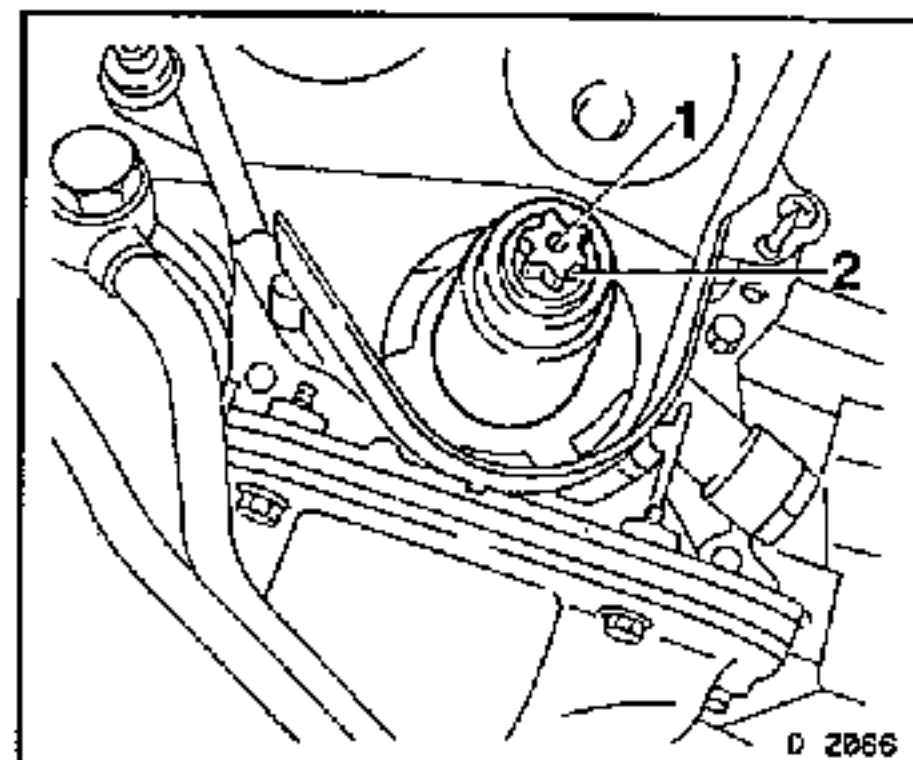
Drill a hole in one side of the sealing ring. Insert a self tapping screw and remove the seal using a suitable tool.



### Install, Connect

Seal ring with KM-693 and the toothed belt drive gear torx bolt (1) and washer.

Coat the seal lip with protective grease before installing.



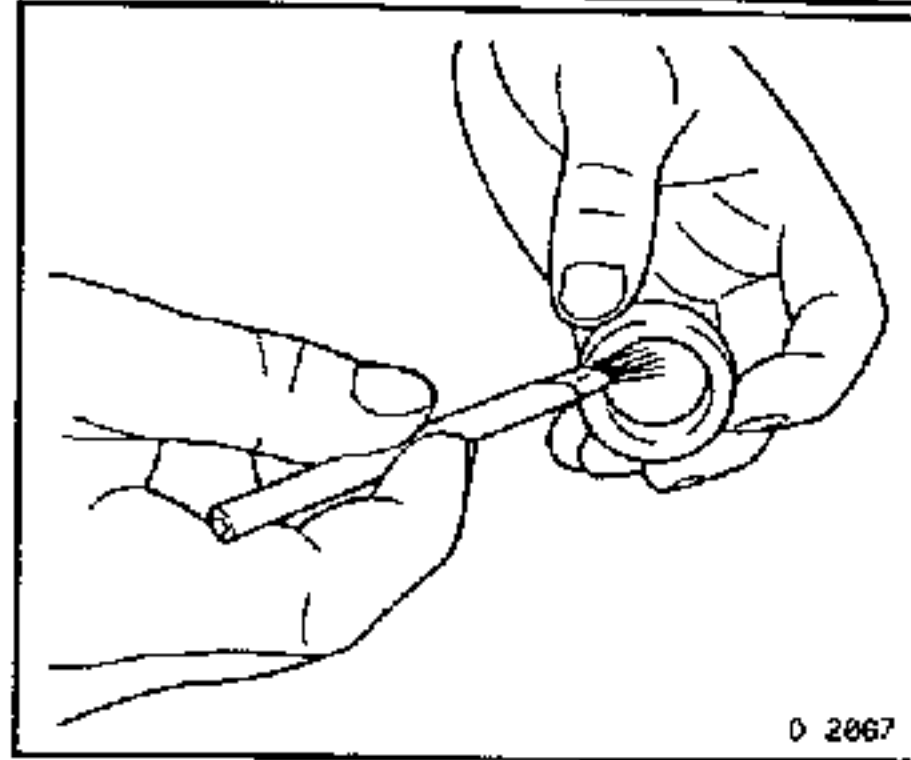


# DOHC ENGINE - CRANK DRIVE

## Install, Connect

Spacing ring on crankshaft journal. Apply a thin layer of silicone sealant such as Dow Corning 732 or equivalent to Holden's Specification HN1373, to the spacing ring before installation.

Toothed belt drive gear to the crankshaft journal noting the alignment position.



## Torque - Angle Method

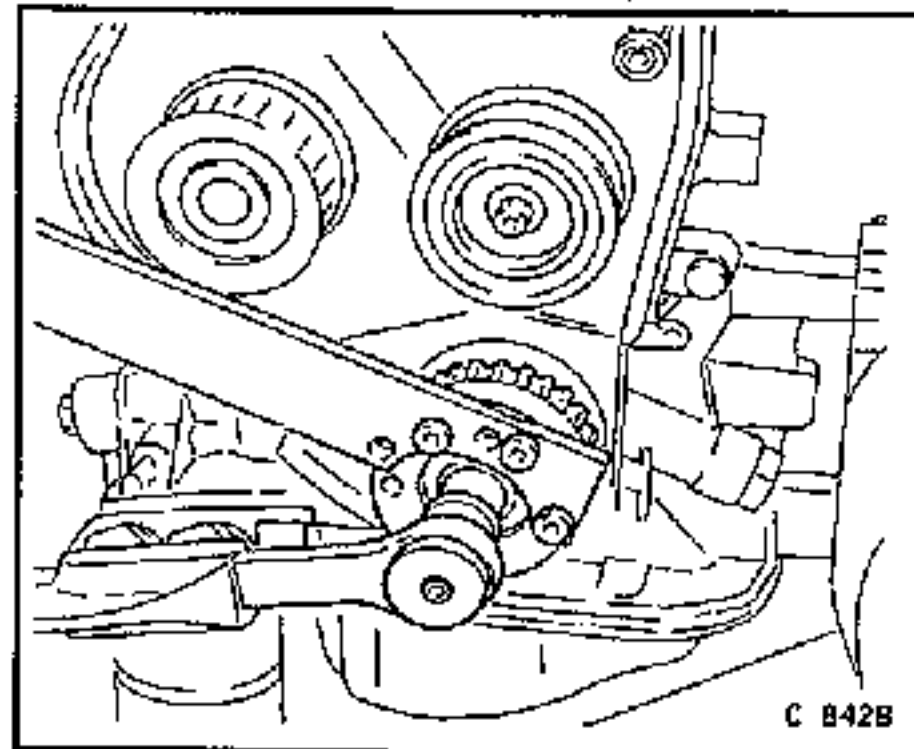
Toothed belt drive gear to crankshaft..... 250 Nm + 40° + 50° \*

\* Use new bolt.

### Important!

Apply grease to the toothed belt drive gear bolt threads before installing.

To tighten the bolt, use holding wrench KM-862-A and MKM-604-21 (Torx E 20). Observe manufacturer's instructions.



## Install, Connect

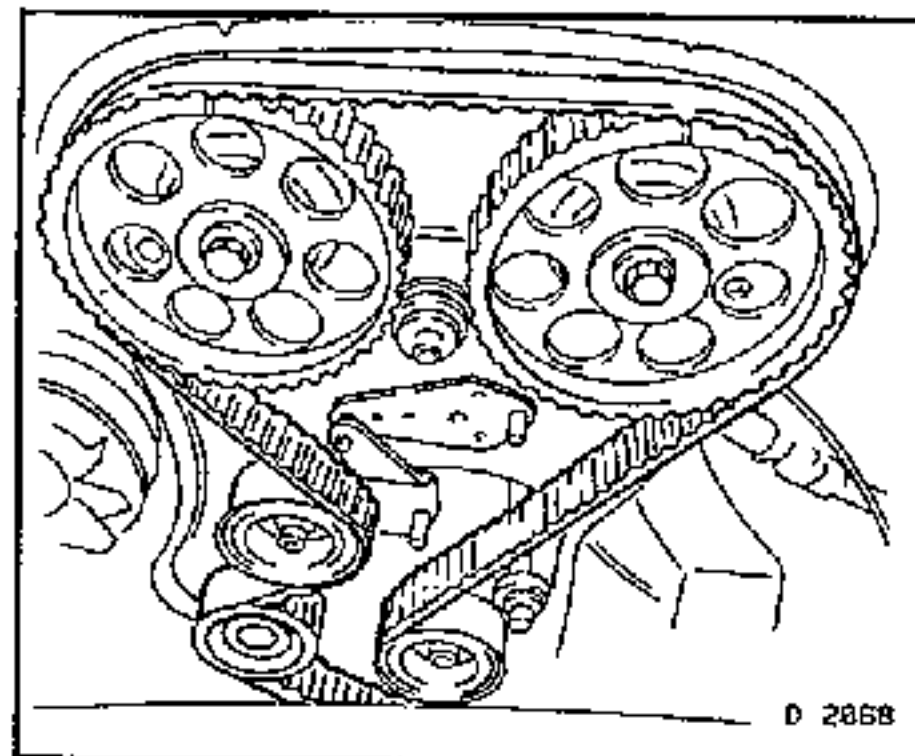
Toothed Belt. Refer "Toothed Belt, Replace", in this Volume.

Engine compartment cover.

Right front wheel.

## Tighten (Torque)

Wheel bolts to front wheel hub ..... 110 Nm



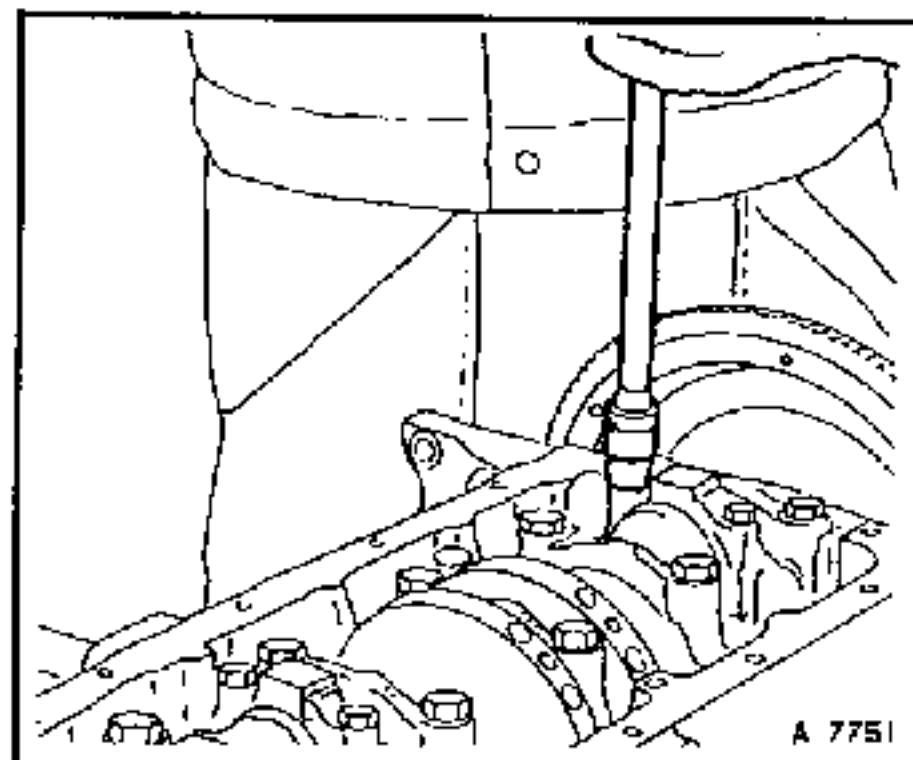
## Piston with Con-rod, Remove and Install

### Remove, Disconnect

Cylinder head. Refer to the Section "Cylinder Head", in this Volume.

Oil pan. Refer "Oil Pan Gasket, Replace", in the Section "Oil Circuit", in this Volume.

Piston with con-rod. Mark the con-rod cover before removal.





# DOHC ENGINE - CRANK DRIVE

## Inspect

All parts, replacing as necessary.

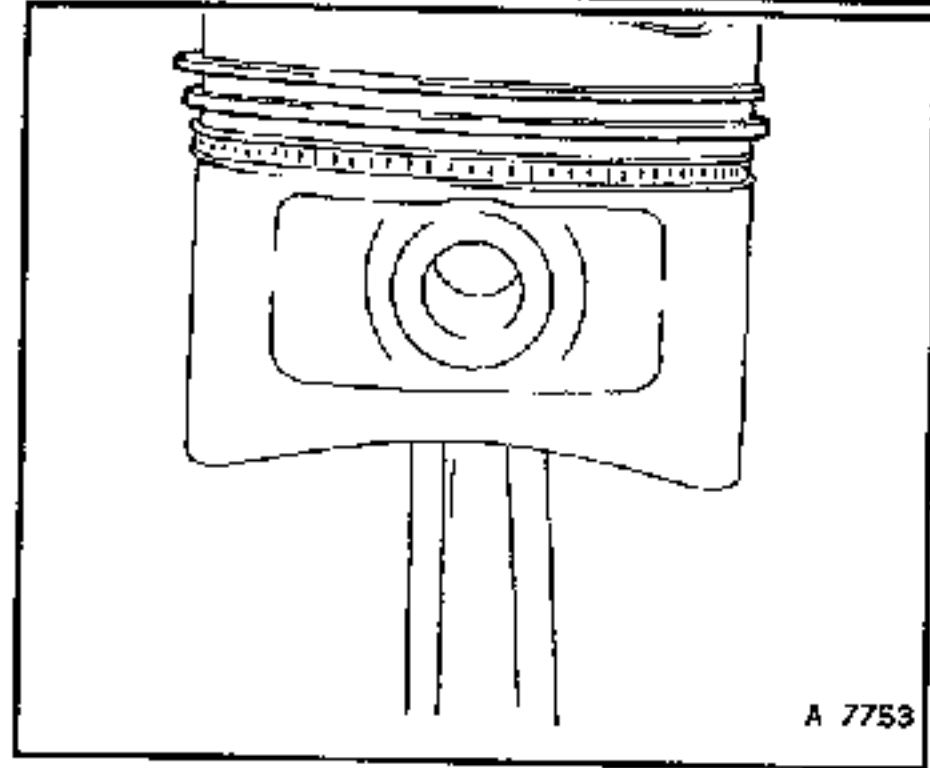
## Install, Connect

Install piston rings, using a commercially available tool.

### Important!

For the two compression rings, align the ring gaps 180° apart.

When installing the segmented oil control ring, arrange the upper steel ring from 25 - 50 mm to the left of the gap of the intermediate ring and the lower steel ring, 25 - 50 mm to the right.

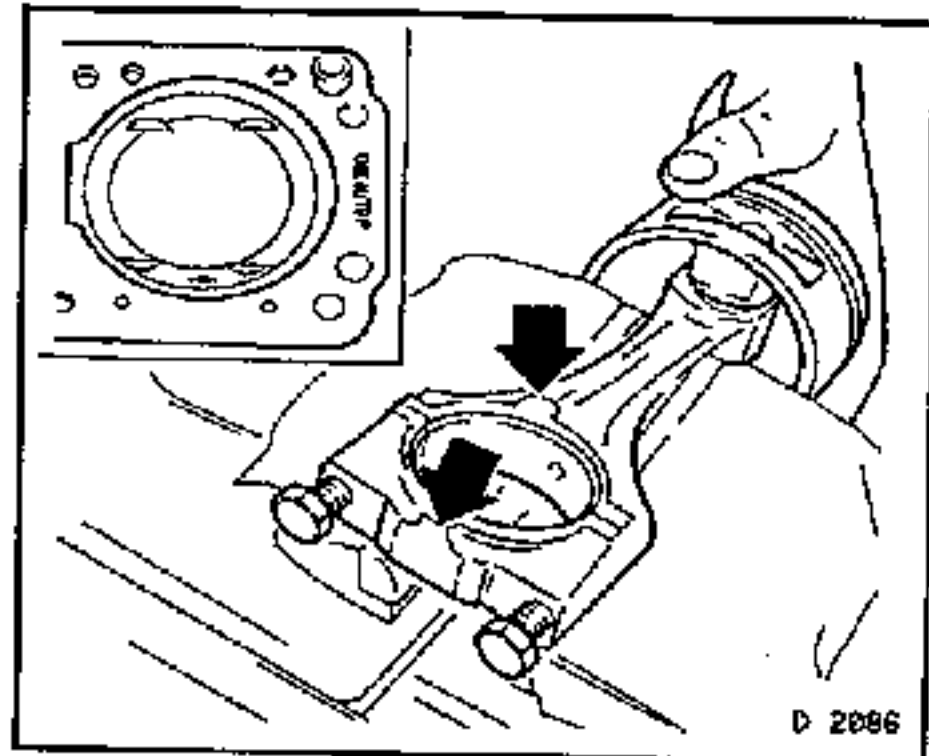


## Install, Connect

Piston with con-rod. Insert with parts coated with clean engine oil.

### Important!

Note the installation position. The arrow on the piston crown points to the engine timing side and the bead on the con-rod (arrows) to the clutch side.



## Torque - Angle Method

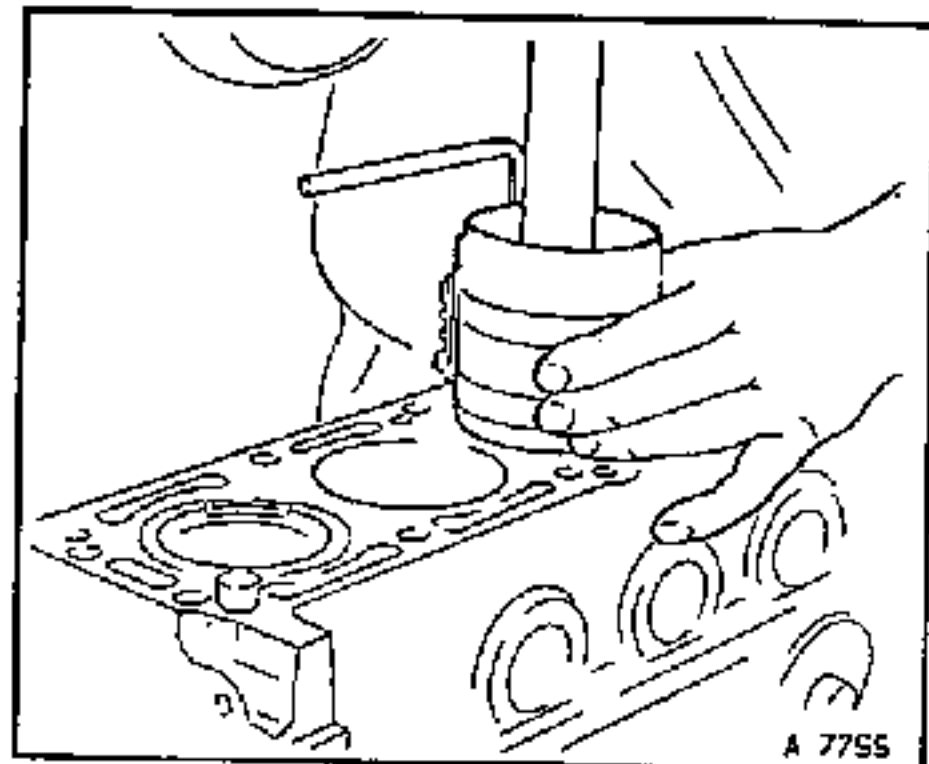
Con-rod bearing cover to con-rod 35 Nm + 45° + 45° \*

\* Use new bolts.

## Install, Connect

Oil pan. Refer 'Oil Pan Gasket, Replace', in the Section "Oil Circuit", in this Volume.

Cylinder head. Refer to the Section "Cylinder Head", in this Volume.



## Piston Rings, Replace

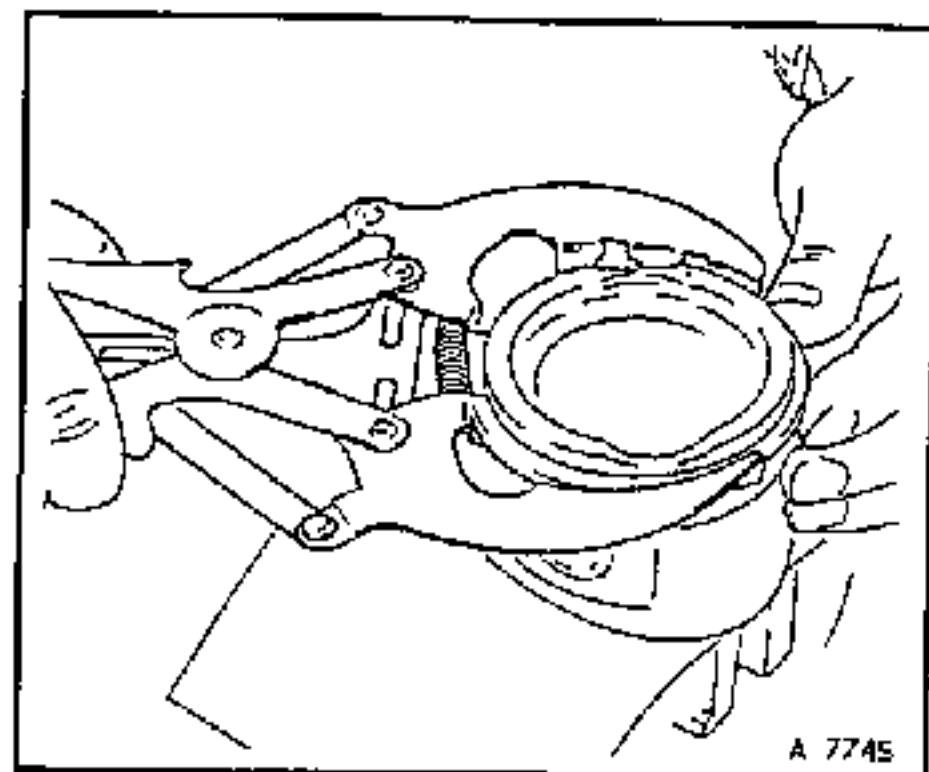
### Remove, Disconnect

Piston with con-rod. Refer to previous Operation in this Section.

Piston rings, using commercially available, piston ring clamp pliers.

### Clean

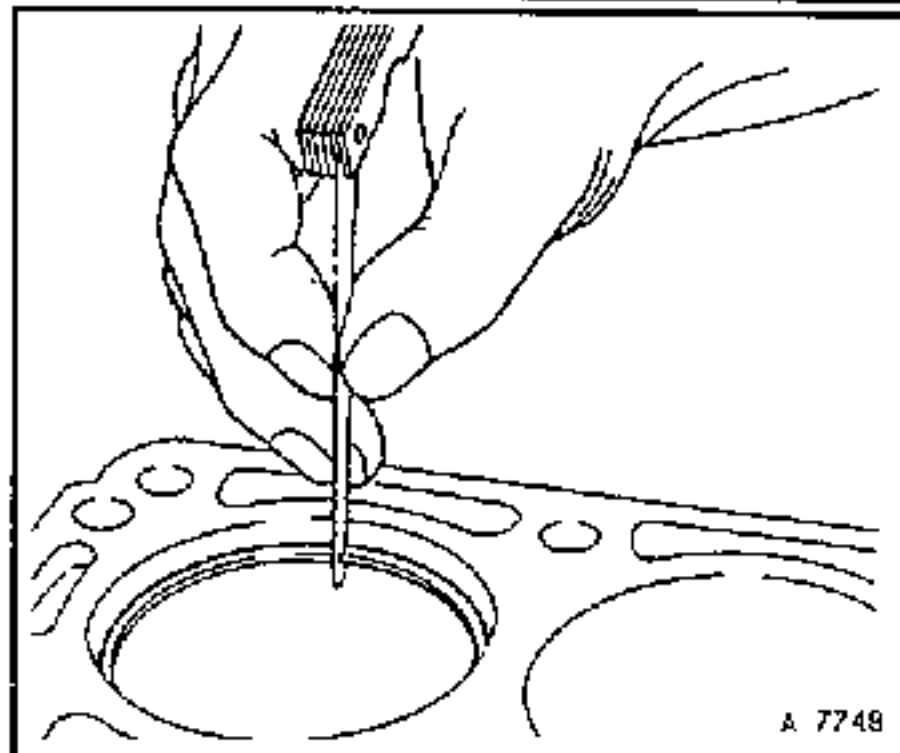
Piston ring grooves, using a ground section of an old piston ring.



# DOHC ENGINE - CRANK DRIVE

## Check

Piston ring gap. For these and piston sizes, refer to "Technical Data" at the end of this Volume.



## Install, Connect

Oil scraper ring;

Arrange offset of steel band rings, each 25 - 50 mm to the left and right of the intermediate ring gap.

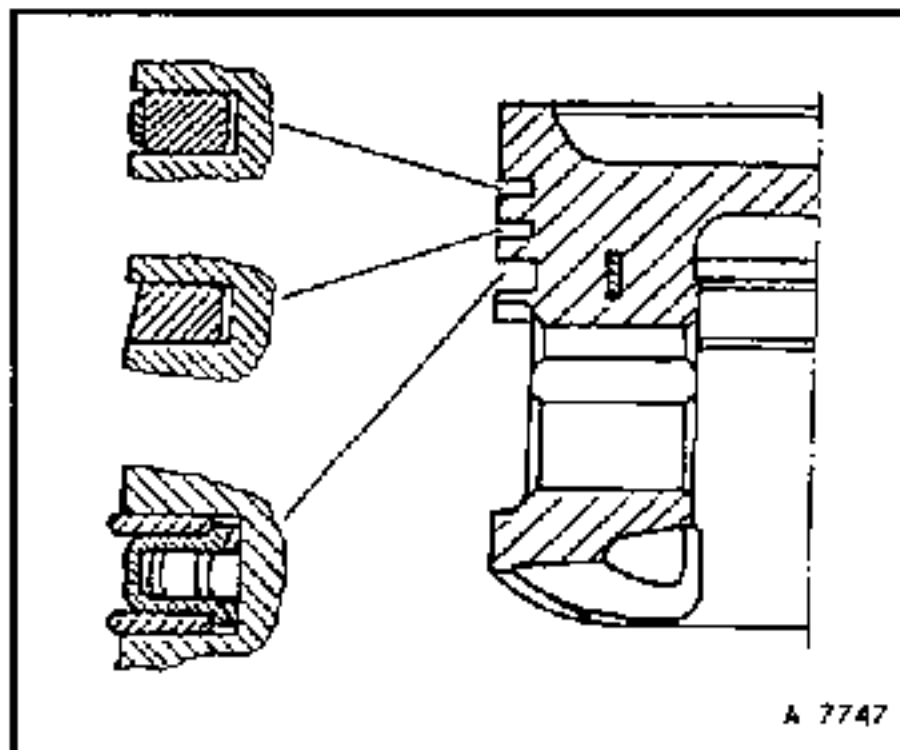
Piston rings;

Arrange offset of ring gaps by approximately 180.

### Important!

Install the second piston ring with the "TOP" identification mark facing upwards.

Piston with con-rod. Refer to previous Operation in this Section.



## Crankshaft, Remove and Install

Mount engine on Engine Overhaul Stand KM-412, with appropriate adaptors.

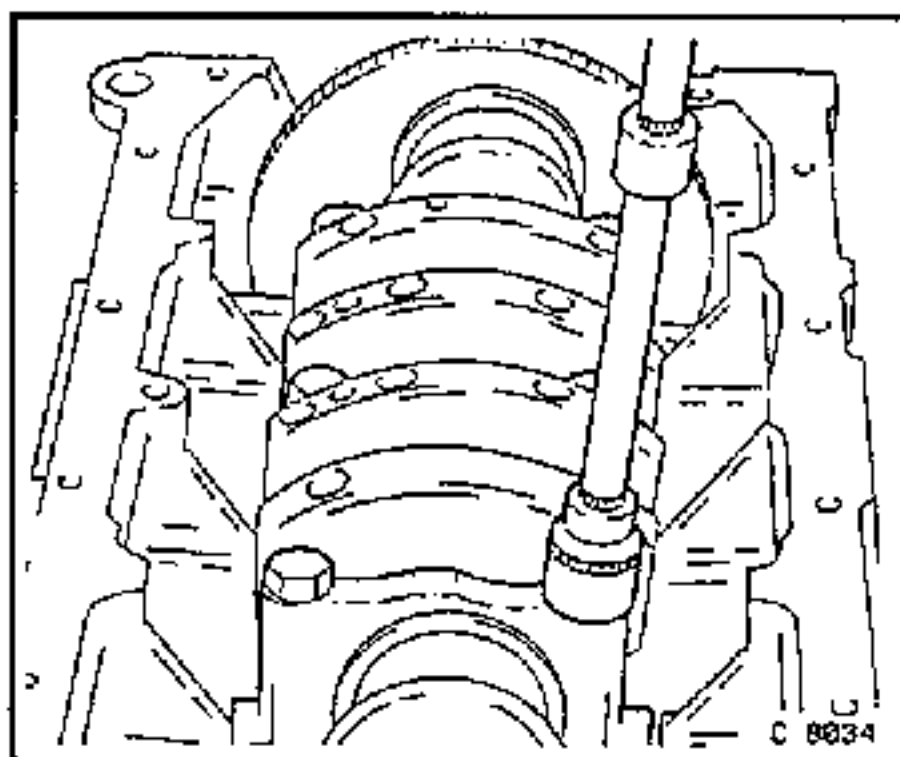
Drain engine oil into a suitable container.

### Remove, Disconnect

The following items;

Drive disc, oil pan and oil pump. Refer to various Operations in this Volume.

Con-rod and crankshaft main bearing covers after marking each for correct reassembly.



### Remove, Disconnect

Crankshaft from the engine block.

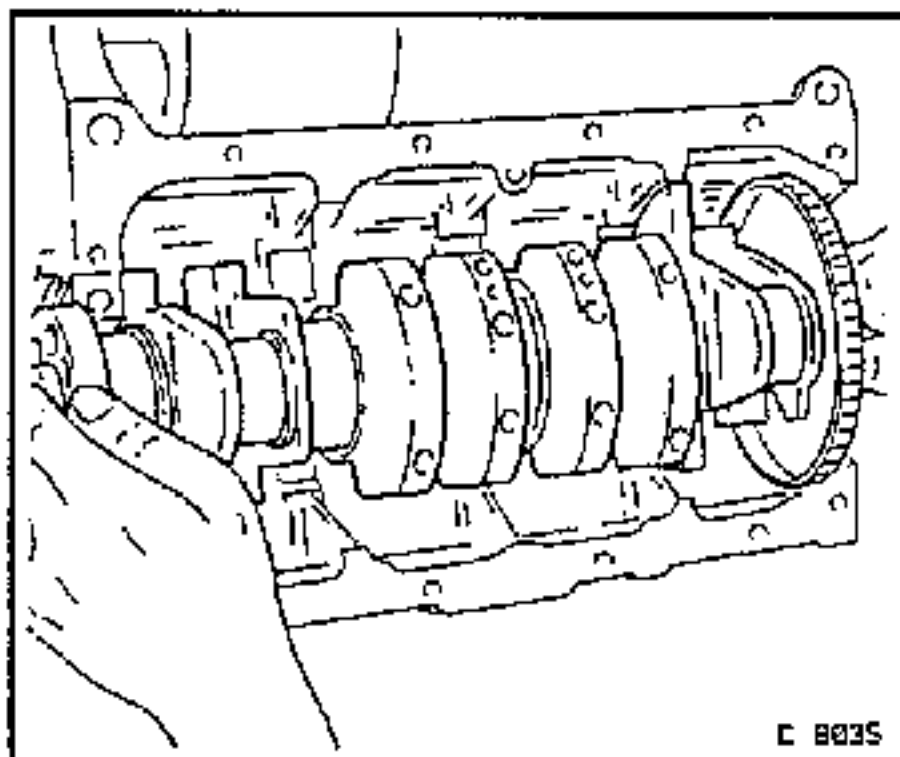
### Clean

### Inspect

Crankshaft. Refer to this Operation, later in this Section.

Replace all parts as required.

If replacing the crankshaft, the pulse sensor disc may need to be modified.



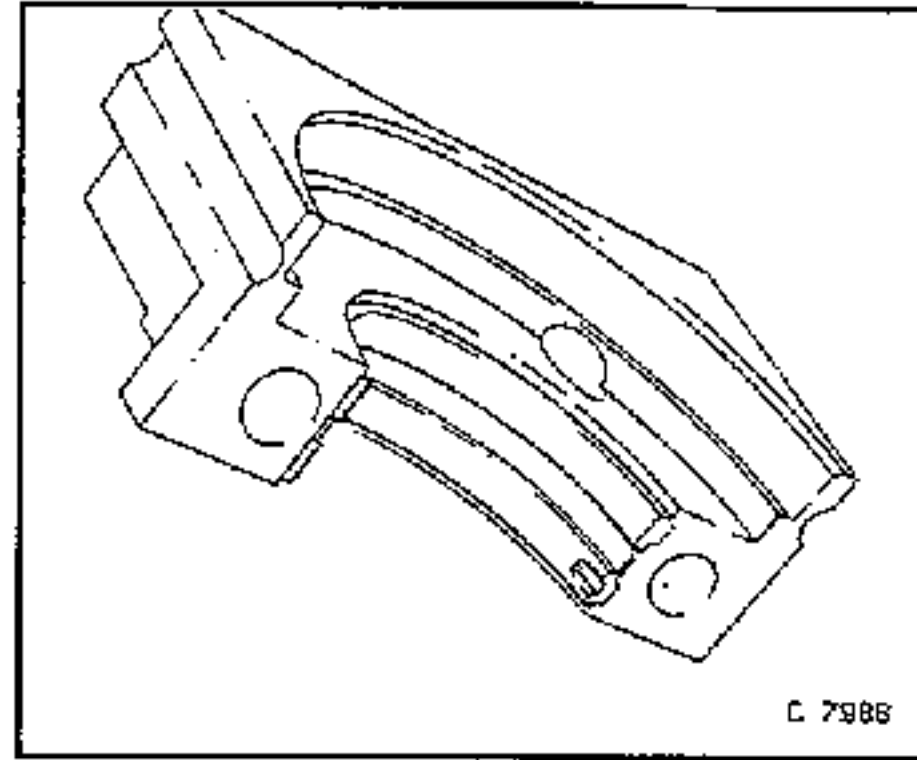
# DOHC ENGINE - CRANK DRIVE

## Install, Connect

New bearing shells into the cylinder block and bearing covers.

Coat bearings with clean engine oil.

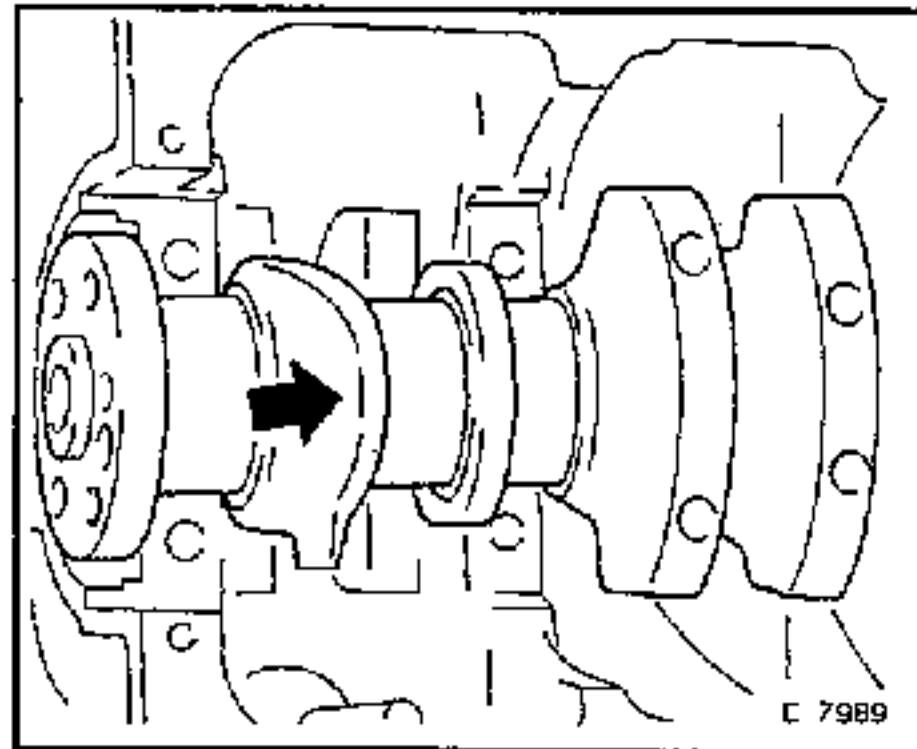
Refer to "Technical Data" at the end of this Volume for oversize bearing shell specifications.



## Install, Connect

New crankshaft into the cylinder block.

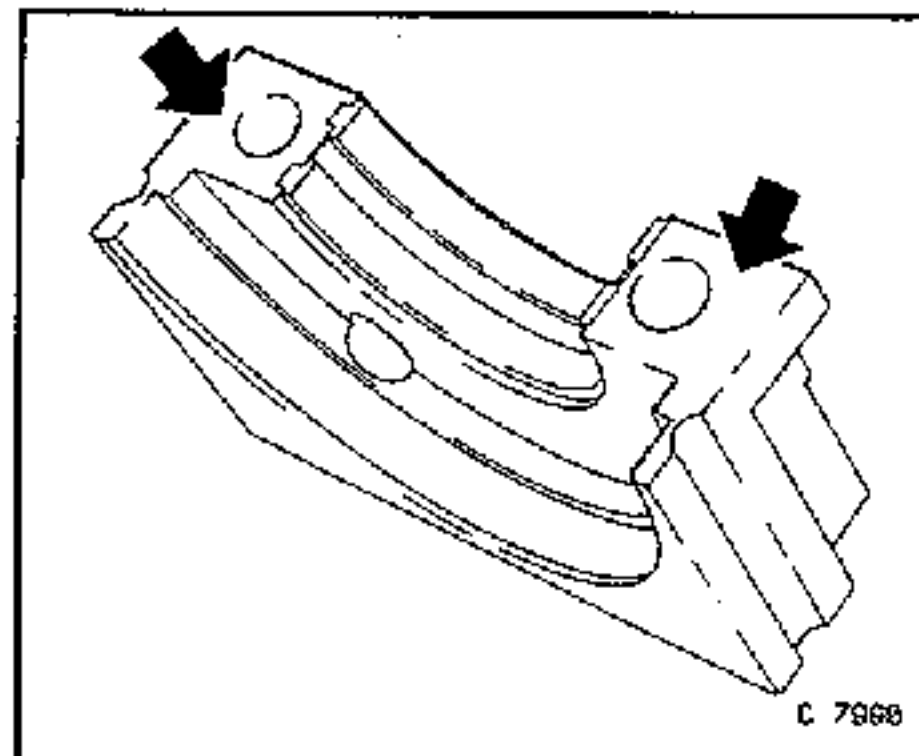
The seating of the crankshaft can be corrected by light blows with a rubber hammer on the crank throw land (arrow).



## Install, Connect

Front and rear main bearing covers.

Coat mating surfaces (arrows) with sealing compound, to Holden's Specification HN1373, such as Dow Corning Silicone 732, or equivalent.

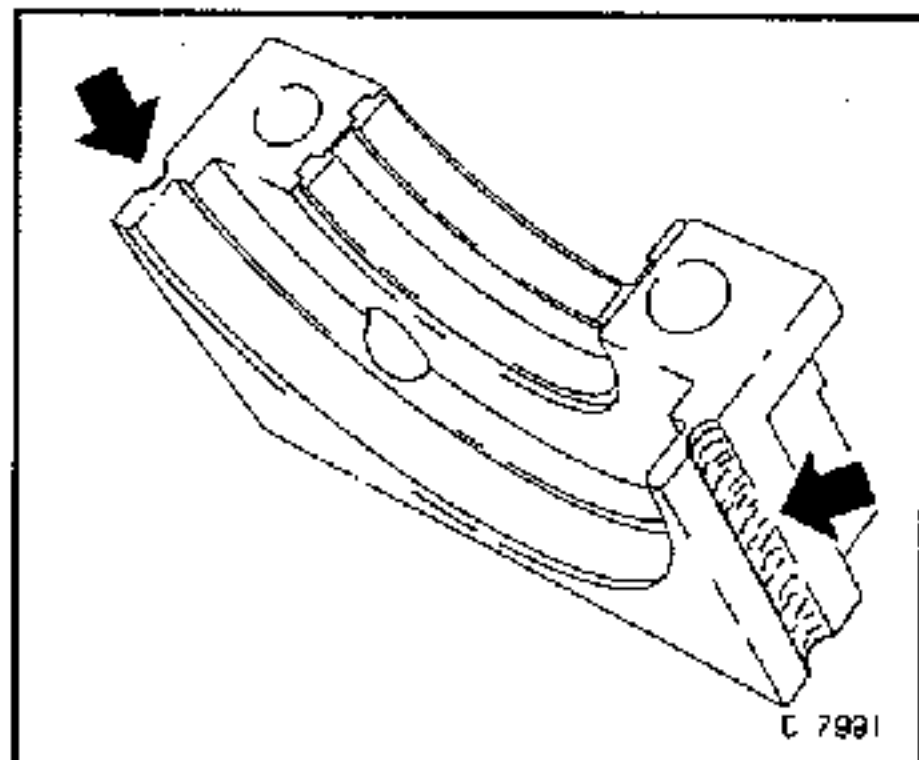


## Install, Connect

Apply a bead of sealing compound such as General Electric RTV 159 or equivalent, to the side grooves of both bearing cover halves (arrows).

### Important!

After installation of bearing cover, press in the sealing compound from above, until it emerges from the joints.



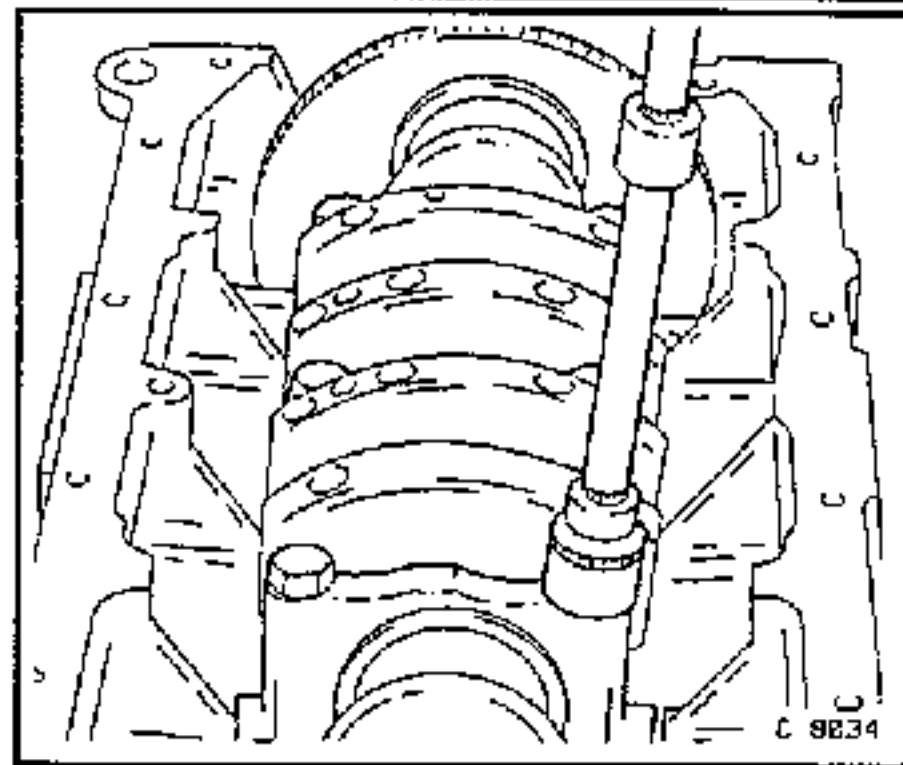
# DOHC ENGINE - CRANK DRIVE

## Torque - Angle Method

Crankshaft bearing cover to cylinder block.....	50 Nm + 45° + 15°
Con-rod bearing cover to con-rod.....	35 Nm + 45° + 15°

Use new bolts.

Align the front bearing cover to the engine on the timing side.



## Install, Connect

Oil pump, oil pan, rear crankshaft seal, drive plate and engine accessories, as detailed in various sections in this Volume.

## Important!

Check valve timing before installing toothed belt.

## Remove, Disconnect

Engine from Engine Stand KM-412 and adaptors from the engine.

Install engine.

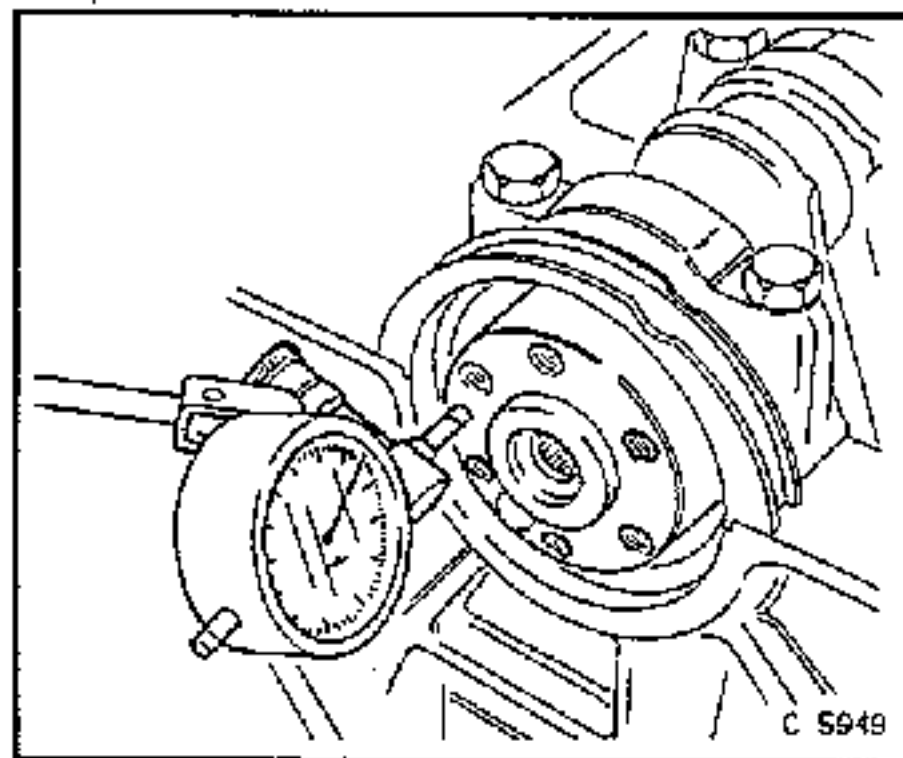
## Crankshaft, Check

### Inspect

Crankshaft end play with bearing shells installed.

Crankshaft mounting surfaces for the drive plate.

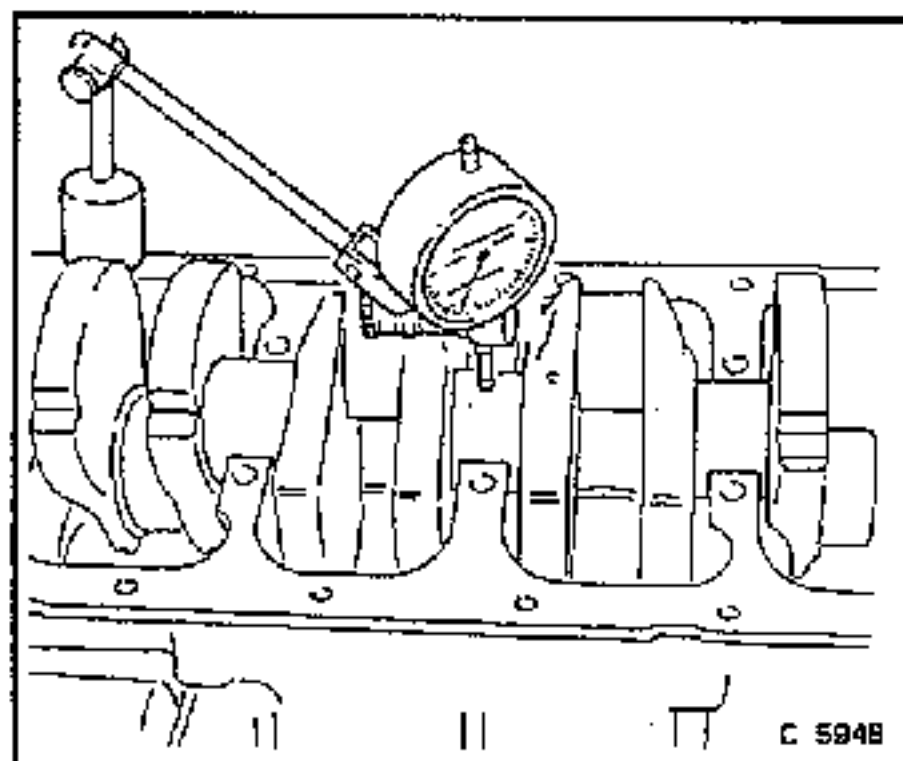
For tolerance specifications, refer to; "Technical Data"; at the end of this Volume.



### Inspect

With the main bearing covers and shells removed, check for out-of-round on crankshaft main journals with a dial indicator.

For tolerance specifications, refer to; "Technical Data"; at the end of this Volume.



# DOHC ENGINE - CRANK DRIVE

## Bearing Clearance with Covers Removed.

### Inspect

#### Important!

Lightly grease the crankshaft journal and lightly oil the bearing shells to avoid the gauging strip tearing when the bearing cover is removed.

### Measure

With commercially available "Plastigage" material.

Cut threads to length of bearing width and lie along crankshaft journal (arrow). Install bearing cover and torque bolts.

### Torque - Angle Method

Crankshaft bearing cover to cylinder block .....	50 Nm + 45° + 15°
Con-rod bearing cover to con-rod ..	35 Nm + 45° + 15°

### Measure

Width of each compressed strip (arrow), using the measuring scale.

#### Note:

"Plastigage" is available in a number of varying tolerance ranges.

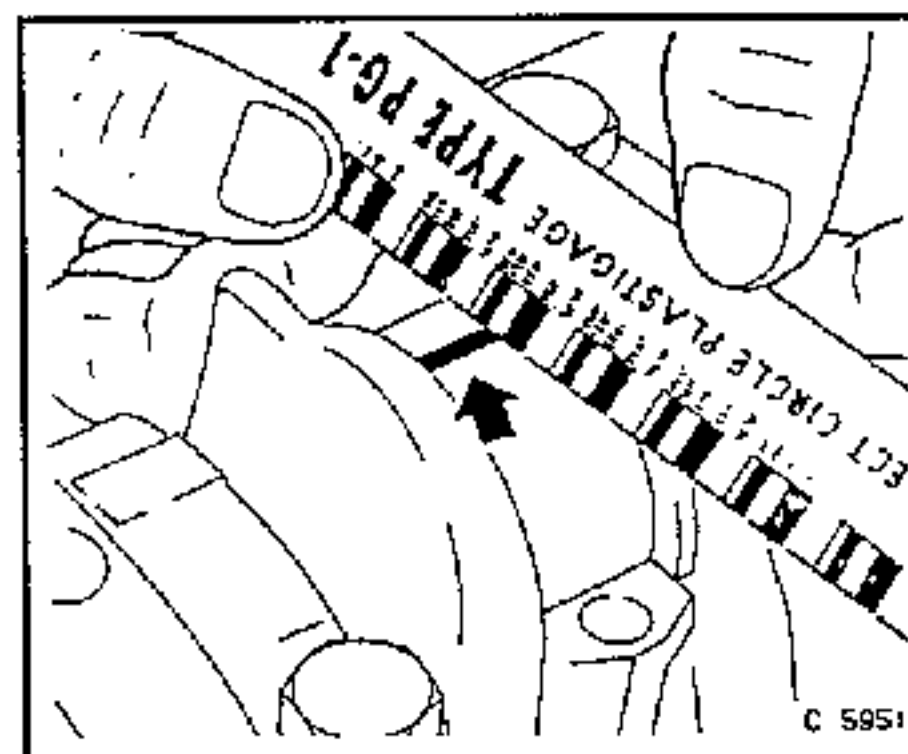
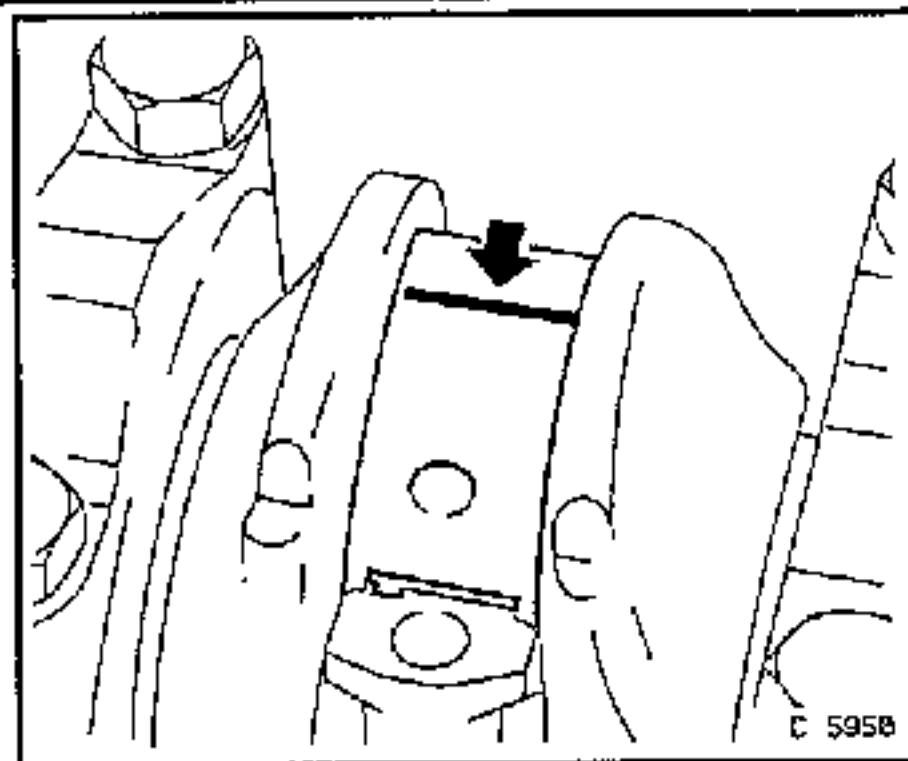
For bearing clearance tolerances, refer to; "Technical Data" at the end of this Volume.

### Torque - Angle Method

All bearing covers to the cylinder block and con-rods.

Crankshaft bearing cover to cylinder block .....	50 Nm + 45° + 15°
Con-rod bearing cover to con-rod ..	35 Nm + 45° + 15°

Use new bolts.



## Con-rod Bearing, Replace

### Remove, Disconnect

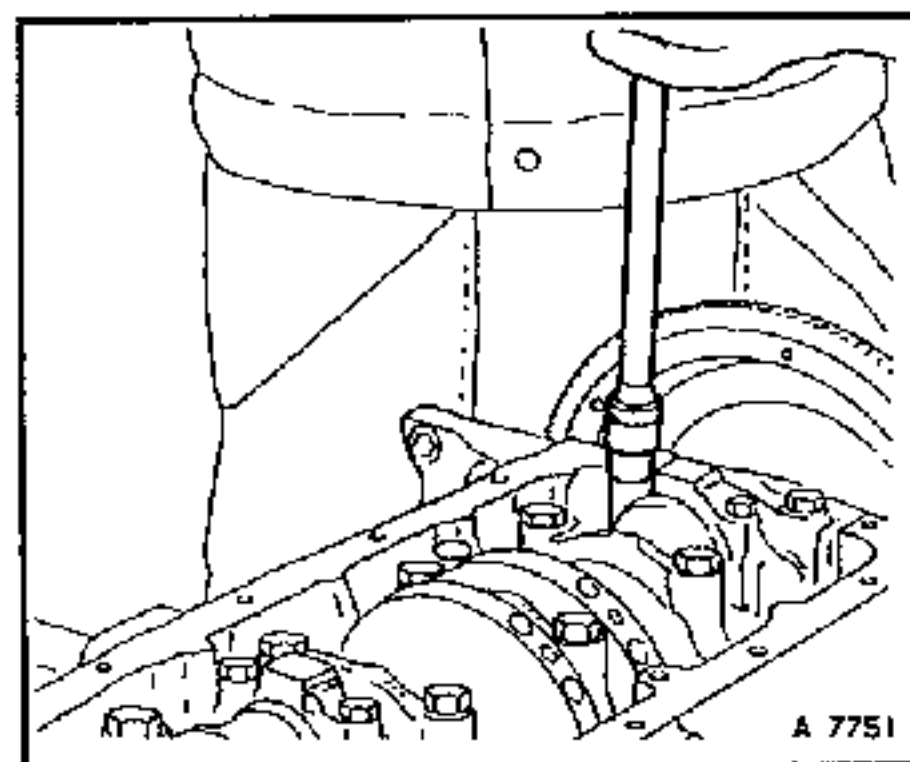
Oil pan. Refer 'Oil Pan Gasket, Replace', in the Section "Oil Circuit", in this Volume.

Mark con-rod cover to con-rod.

Con-rod bearing.

### Clean

Con-rod bearing journal, con-rod bearing cover.



### Install, Connect

New bearing shells, applying clean engine oil.

Con-rod bearing cover.

### Torque - Angle Method

Con-rod bearing cover to con-rod ..	35 Nm + 45° + 15°
-------------------------------------	-------------------

Use new bolts.

### Install, Connect

Oil pan. Refer 'Oil Pan Gasket, Replace', in the Section "Oil Circuit", in this Volume.

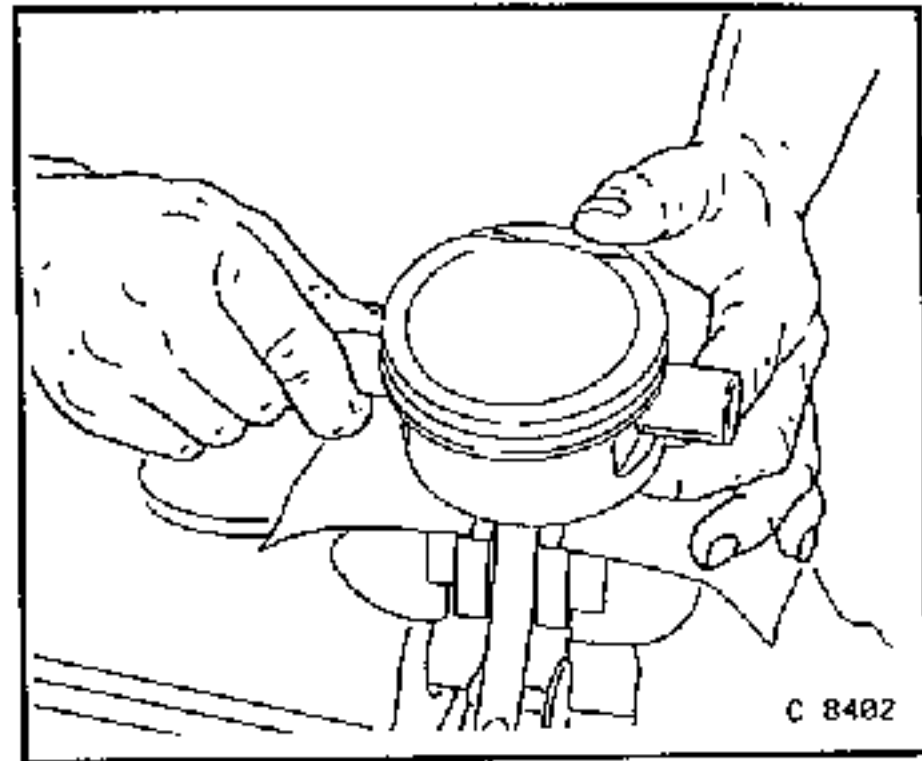
# DOHC ENGINE - CRANK DRIVE

## Con-rod, Replace

### Remove, Disconnect

Piston. Refer 'Piston with Con-Rod, Remove and Install', in this Section.

Press out piston pin retainer from the piston pin.



C 8482

### Assemble

Con-rod, piston, piston pin. Coat all parts lightly with clean engine oil.

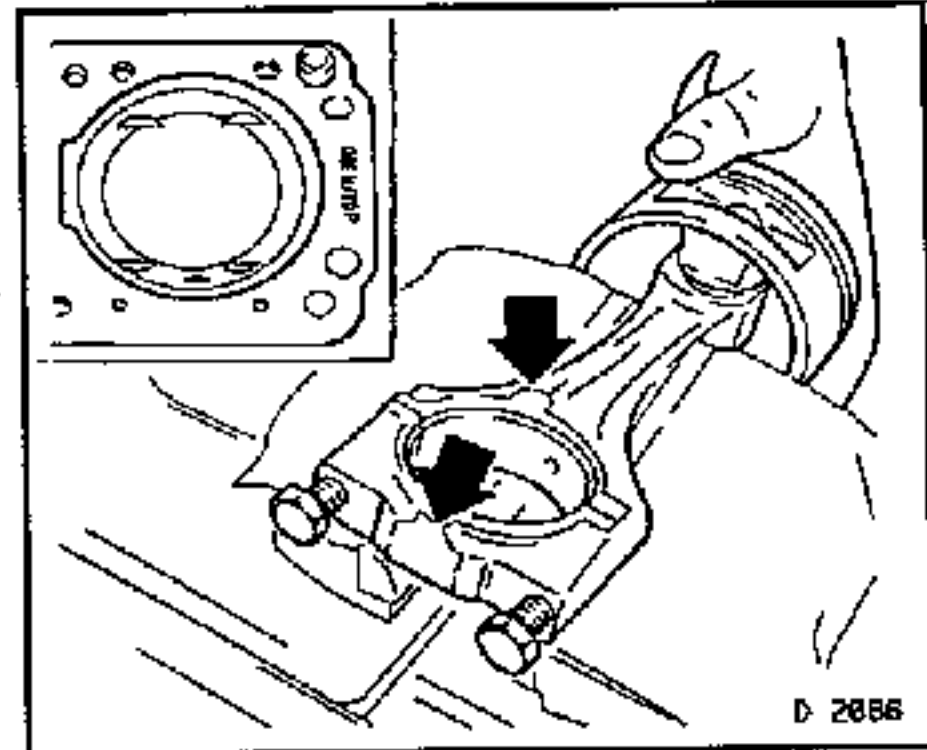
Use a new piston pin retainer.

### Important!

Note the installation position. The arrow on the piston crown points to the engine timing side and the bead on the con-rod (arrows) to the clutch side.

### Install, Connect

Piston. Refer 'Piston with Con-Rod, Remove and Install', in this Section.



D 2856

## Cylinder Block, Check for Plane Surface (Cylinder Head Removed)

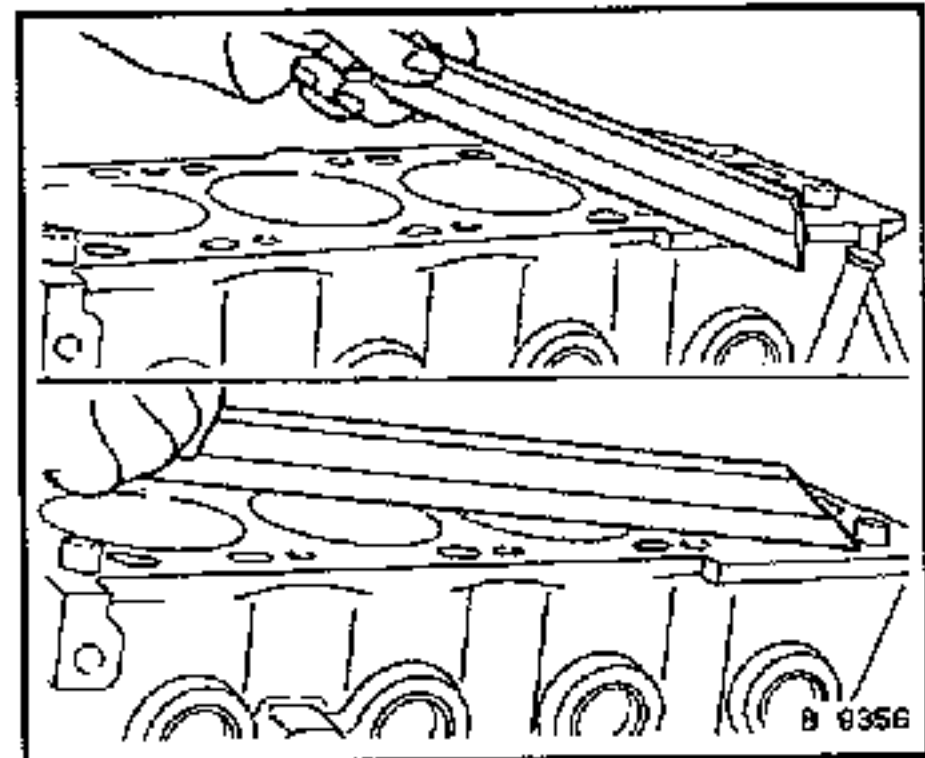
### Clean

Cylinder block sealing surface.

### Inspect

Cylinder block sealing surface, lengthwise, sideways and diagonally for warpage. Use a straight edge and feeler gauge.

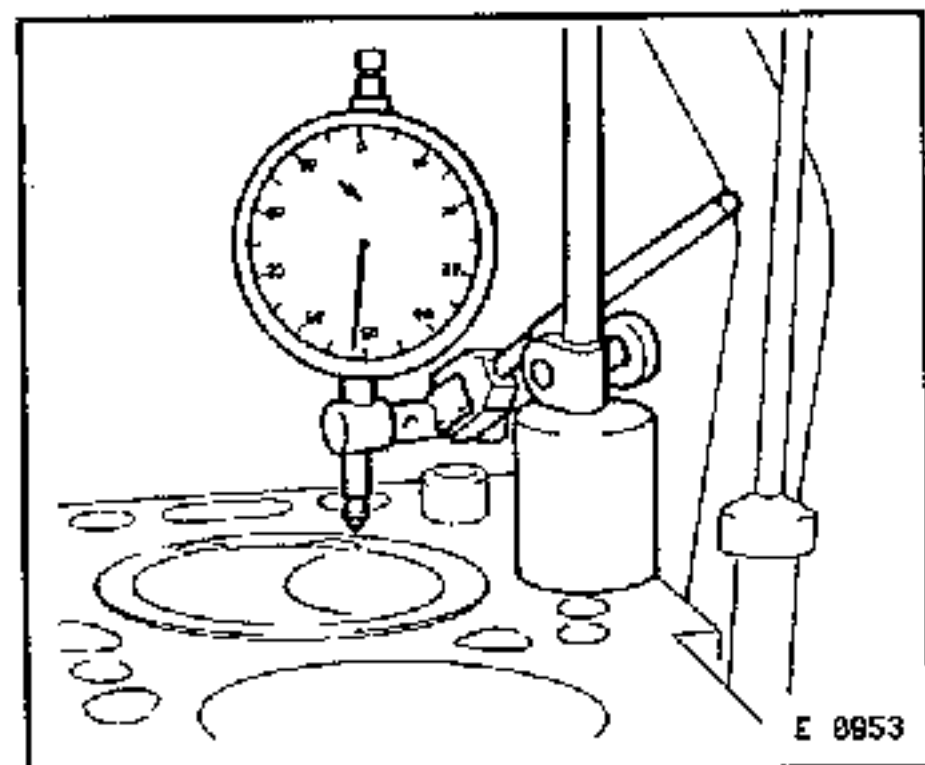
Specification..... 0.025 mm max.



B 8356

### Important!

After surface grinding, check that piston projection does not exceed 0.4 mm



E 0953

# DOHC ENGINE - CRANK DRIVE

## RECOMMENDED TORQUE VALUES

(Crank Drive)

	Nm
Con-rod bearing cover to con-rod .....	35 + 45° + 15° (3)
Cylinder head to cylinder block .....	25 + 90° + 90° + 90° (3)(5)
Flywheel to crankshaft.....	65 + 30° + 15° (3)
Front toothed belt cover to cylinder head, intermediate piece and oil pump....	8
Oil pan to cylinder block .....	15 (1)(2)
Pot flywheel to crankshaft.....	65 + 30° + 15° (3)
Rear toothed belt cover to cylinder block .....	6
Toothed belt drive gear to crankshaft.....	250 + 40° - 50° (3)(4)
Wheel bolts to front wheel hub.....	110

- (1) Apply Locking Compound to bolt threads, such as Loctite 242 or equivalent to GMH Spec. HN1256.
- (2) Maximum assembly time 10 minutes.
- (3) Use new bolt/s.
- (4) Insert bolt with greased thread.
- (5) No re-tightening required.

# DOHC ENGINE - CYLINDER HEAD

## Front Seal Ring - Camshaft Housing, Replace

### Remove, Disconnect

Engines up to MY'93:

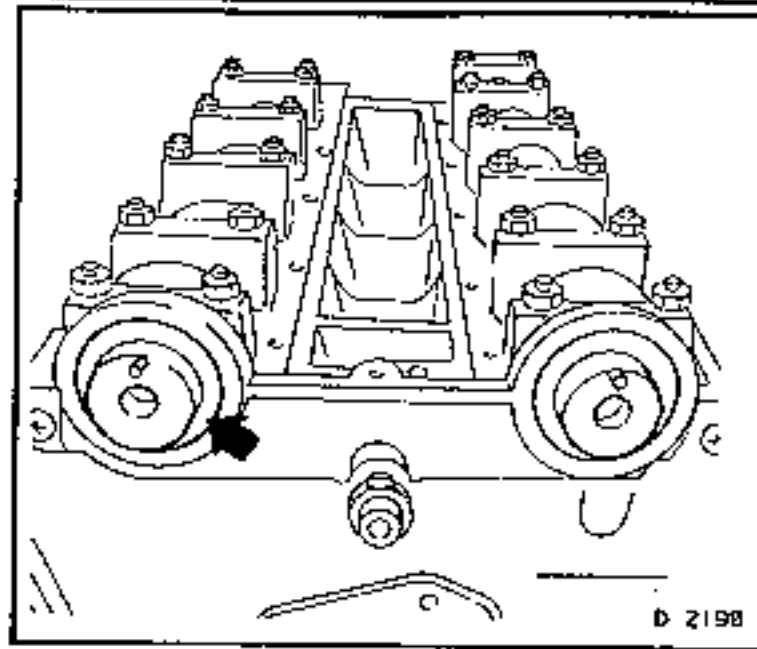
Mark the direction of rotation of the toothed belt.

All Engines:

Toothed Belt. Refer "Toothed Belt, Replace", in this Volume.

Camshaft gear/s. Refer "Camshaft Gears, Remove and Install", in this Section.

Drill a small hole in the centre of the seal (arrow). Insert self tapping screw and remove seal by carefully levering against the screw.



### Clean

All sealing surfaces.

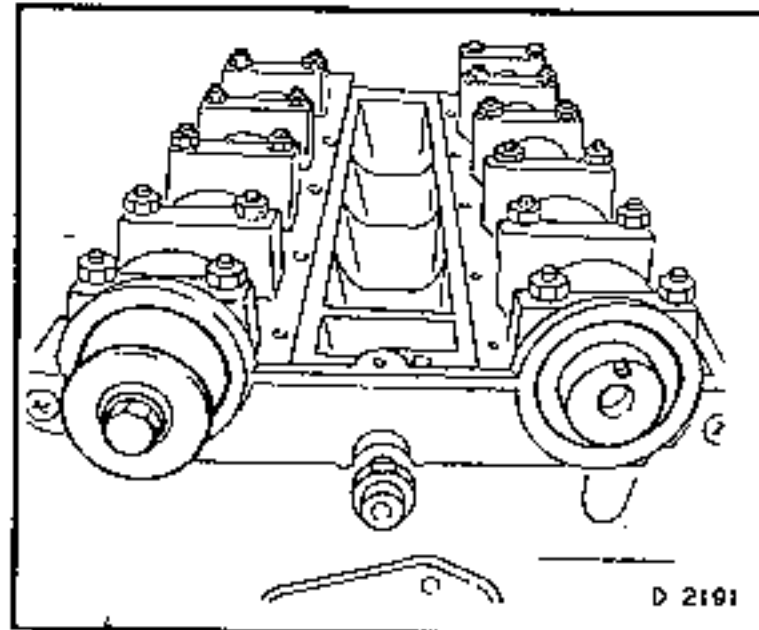
### Install, Connect

New seal ring, using KM-422 and the camshaft gear retaining bolt.

Coat the seal lip with grease, before installation.

Toothed Belt. Refer "Toothed Belt, Replace", in this Volume.

Camshaft gear/s. Refer "Camshaft Gears, Remove and Install", in this Section.



## Gasket - Performance Header to Cylinder Head, Replace (C 20 XE)

### Remove, Disconnect

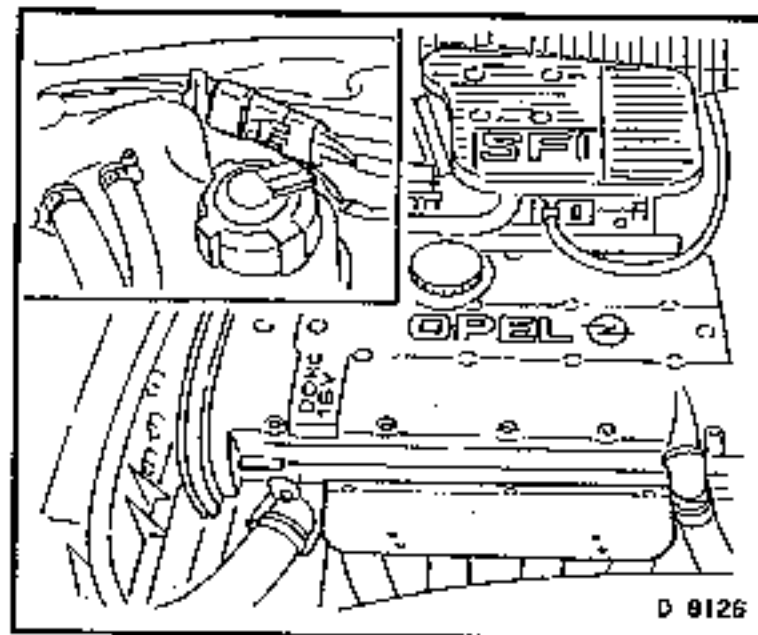
Ground cable from battery.

Cover plate from performance header.

Bolts from performance header.

For C 20 XE:

Disconnect wiring harness plug from oxygen sensor.



### Remove, Disconnect

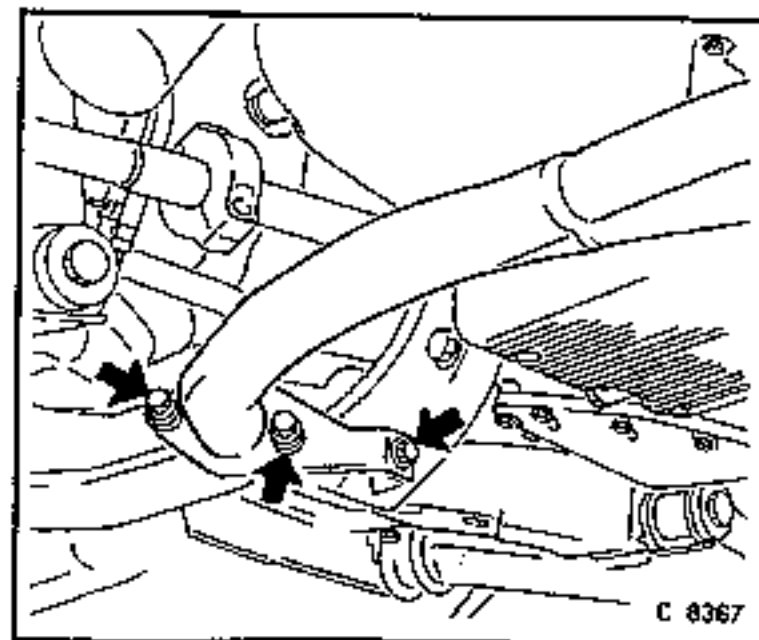
Engine compartment cover.

Fastening bolts from exhaust joint and bracket.

Engines as of MY'93 (with A/C):

Flange, oil dipstick tube/engine vent from cylinder block.

Remove performance header, downwards.





# DOHC ENGINE - CYLINDER HEAD

## Clean

All sealing surfaces.

## Install, Connect

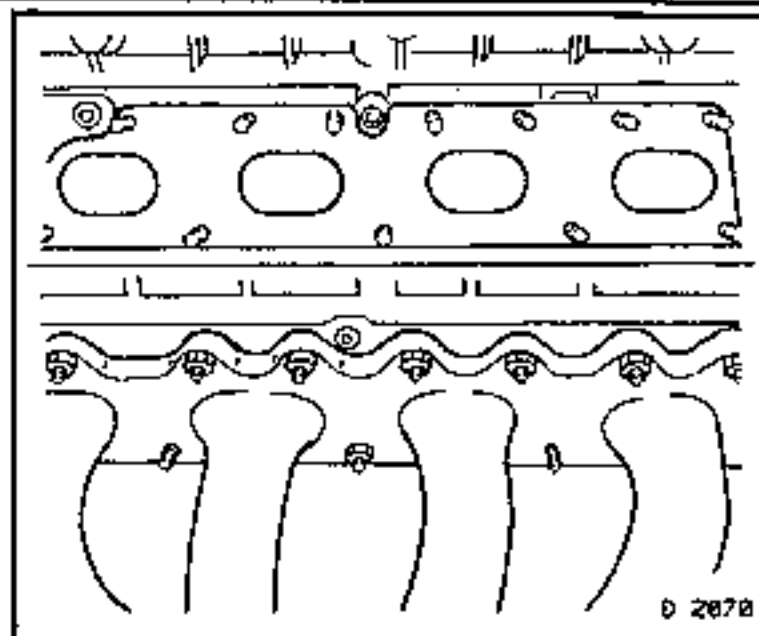
Performance header, using new gasket.

Exhaust joint and bracket.

## Tighten (Torque)

Performance header to cylinder head.....	22 Nm *
Cover plate to cylinder head bolts (M 6) .	9 Nm
Fastening bolts to exhaust joint.....	12 Nm
Fastening bolts to bracket .....	20 Nm

\* Use new gasket.



## Install, Connect

For C 20 XE:

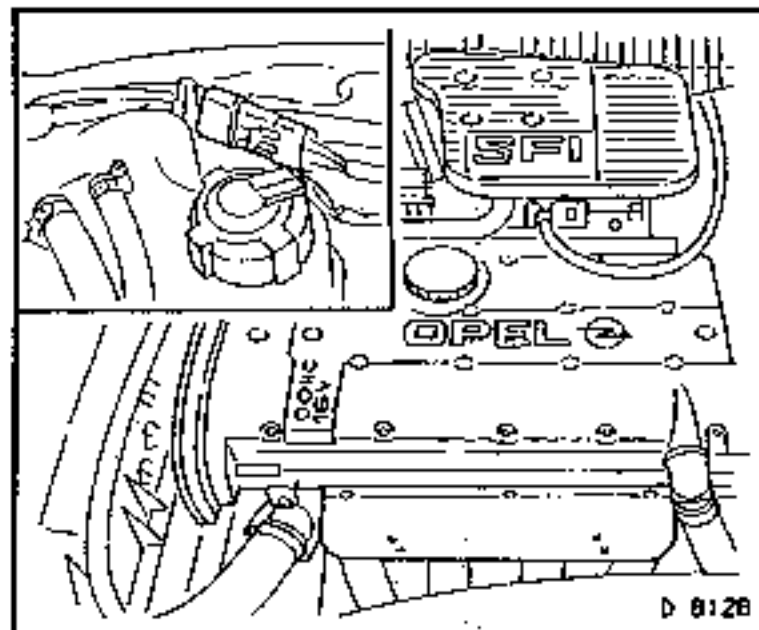
Connect oxygen sensor wiring harness plug.

If removed:

Flange, oil dipstick guide tube/engine vent to cylinder block.

Engine compartment cover.

Ground cable to battery.



## Gasket - Intake Manifold to Cylinder Head, Replace (C 20 XE)

### Remove, Disconnect

Ground cable from battery.

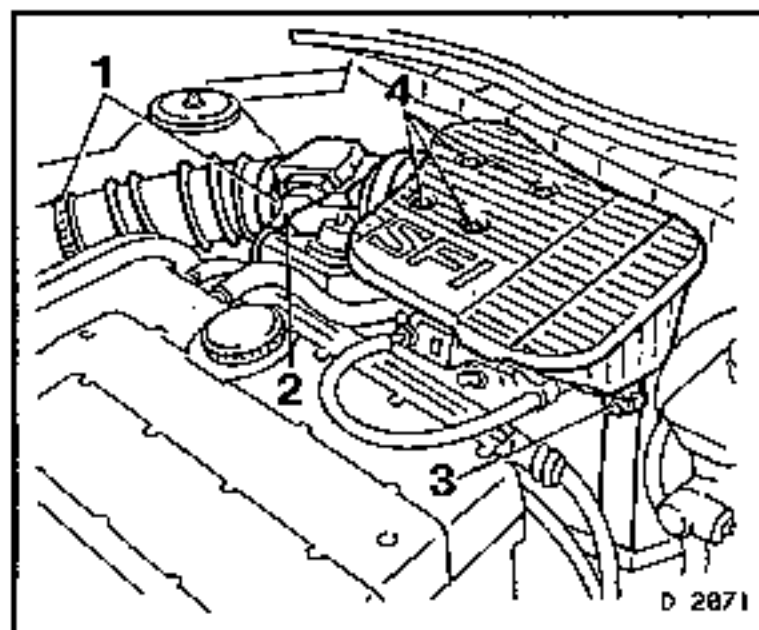
Engine compartment cover.

Lower coolant hose from radiator. Collect coolant in a suitable, clean container.

C 20 XE Engine as of MY'93:

Wiring harness plug from intake air temperature sensor.

Air intake hose (1), wiring harness plug (2) from mass air flow meter, hose connection (3) from pre-volume chamber, pre-volume chamber (4), with mass air flow meter.



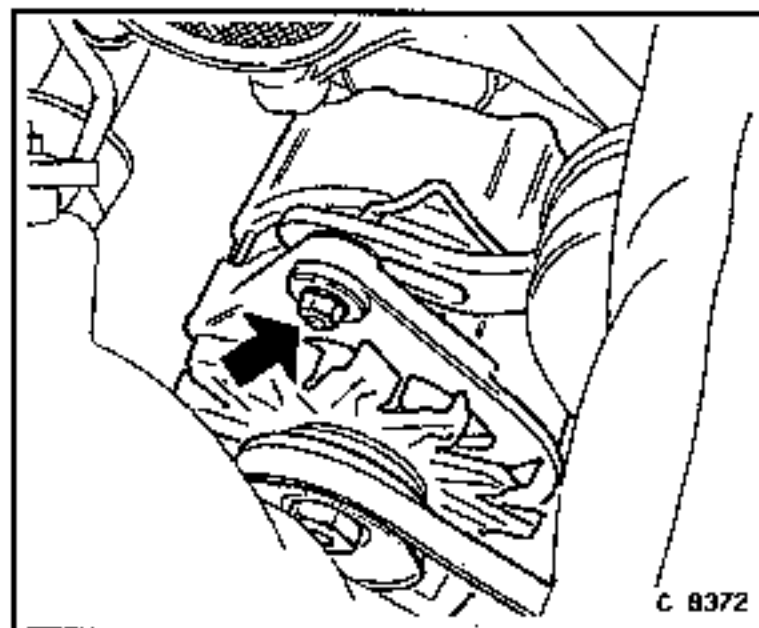
### Remove, Disconnect

Engines up to MY'93:

V-belt from alternator.

Alternator clamping bracket from intake manifold.

Loosen lower alternator bracket, then swing the alternator outwards.



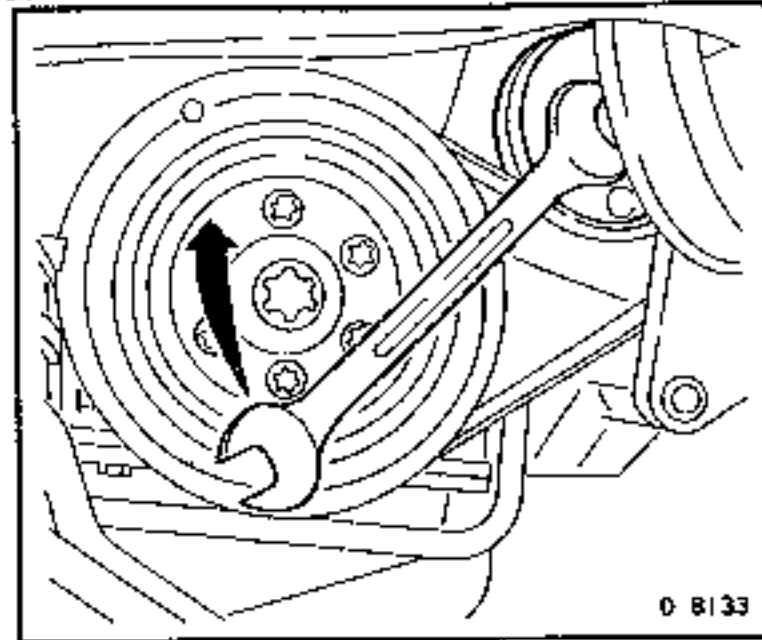
# DOHC ENGINE - CYLINDER HEAD

## Remove, Disconnect

Engines as of MY'93:

Mark the direction of rotation of ribbed V-belt.

Release ribbed V-belt, using the ribbed V-belt tension roller, by rotating the tension roller (arrow), then remove the ribbed V-belt.

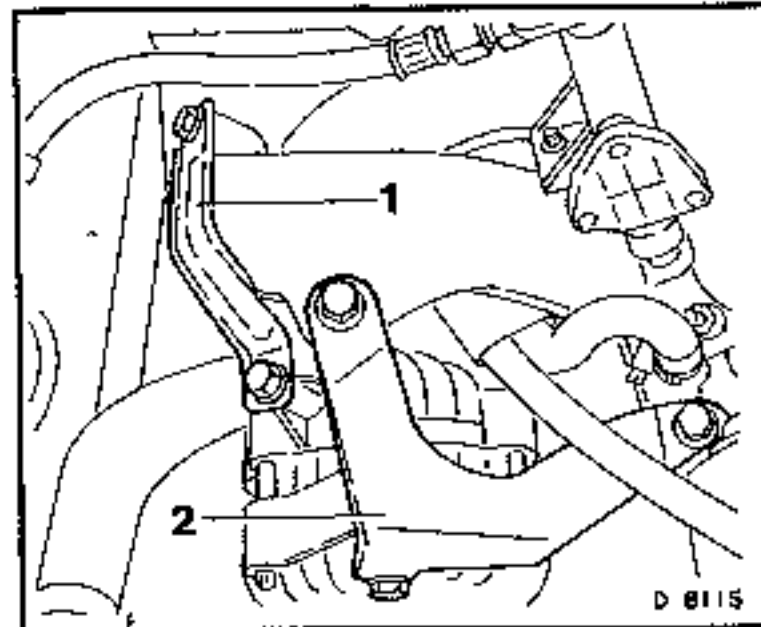


## Remove, Disconnect

Engines as of MY'93:

Support (1) and brace (2) from the alternator or from intake manifold.

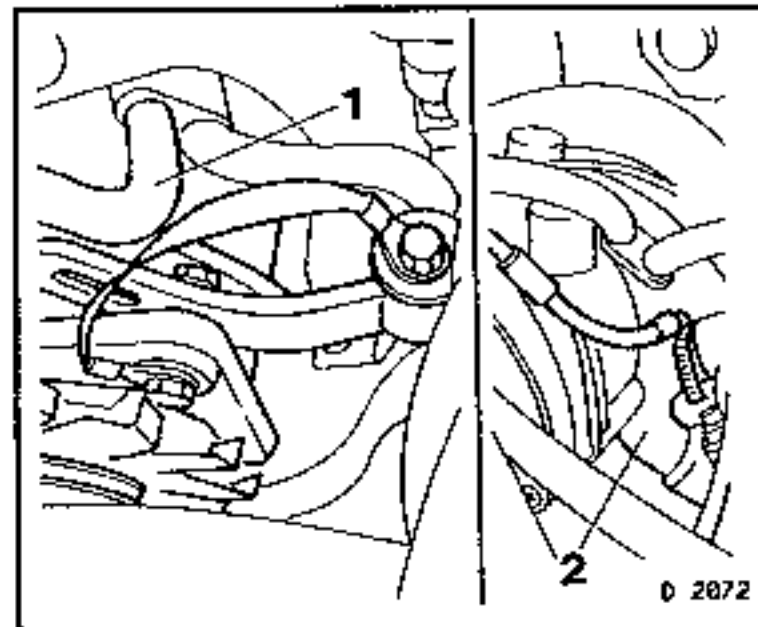
Loosen the lower alternator fastening bolt then swing alternator outwards.



## Remove, Disconnect

Coolant hose (1) from the coolant reservoir.

Coolant hose (2) from the intake manifold.



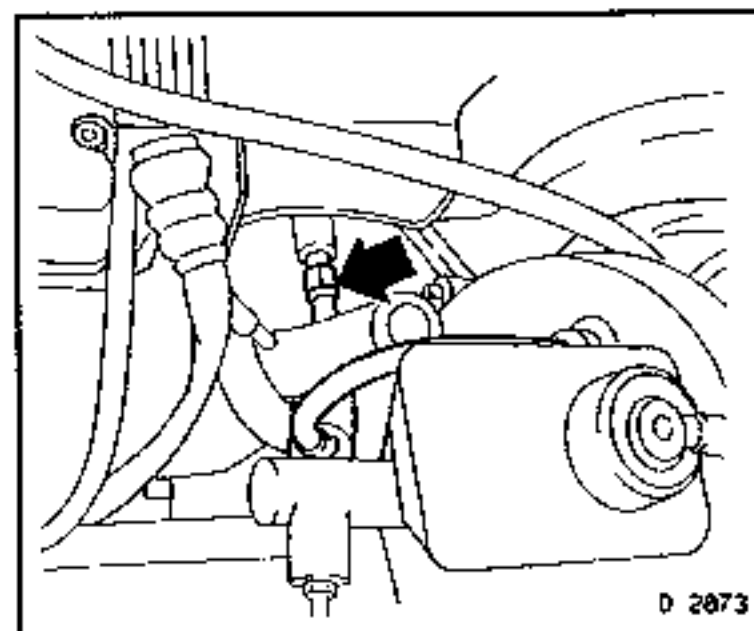
## Remove, Disconnect

Brake servo vacuum line (arrow) from intake manifold.

If fitted;

Vacuum line from the intermediate piece from the brake servo connection.

Intake manifold to cylinder head support. Loosen the lower fastening bolt, then swing the support to one side.

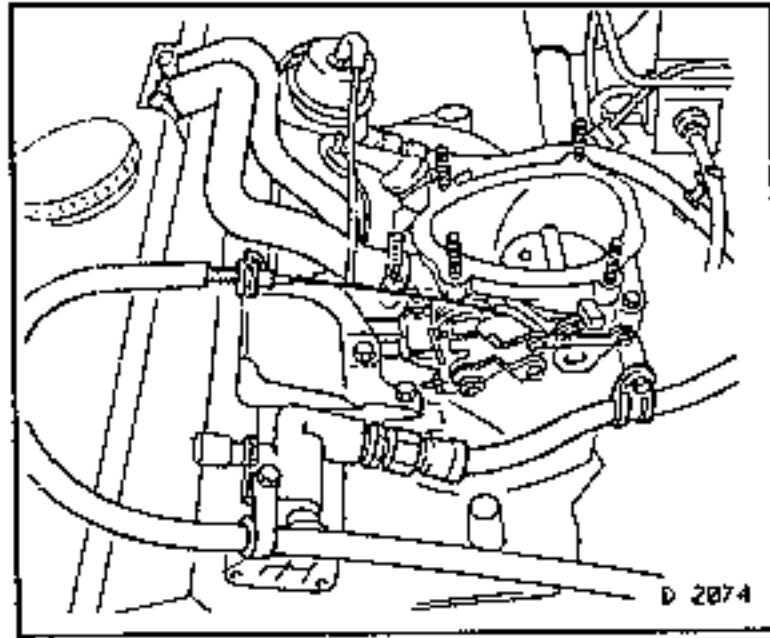


# DOHC ENGINE - CYLINDER HEAD

## Remove, Disconnect

Bowden cable, fuel lines, sealing first with suitable clamps to prevent fuel spillage.

Engine vent hose connections from cylinder head cover.



## Remove, Disconnect

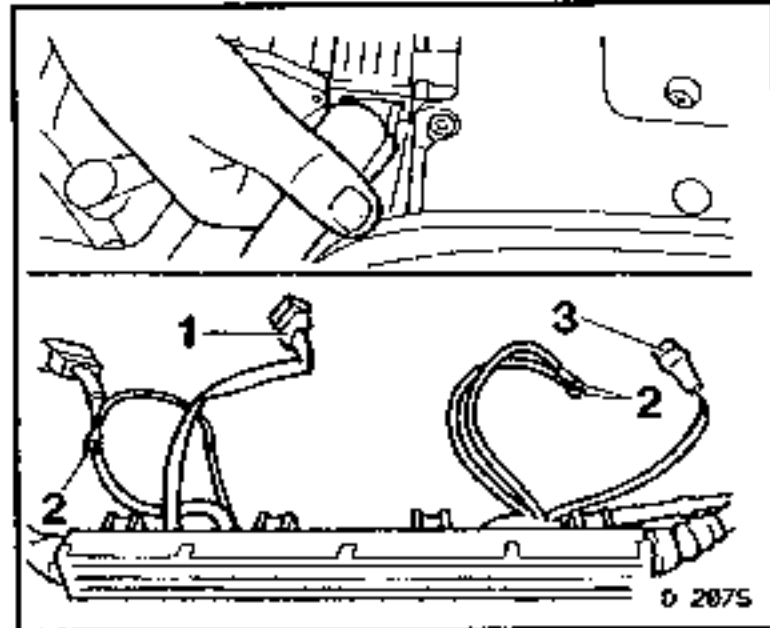
Injector plug strip as follows;

Fuel injector wiring harness plug (1) from throttle valve switch or potentiometer.

Ground connections (2) from fuel distributor pipe.

Wiring harness plug (3) from controlled canister purge valve.

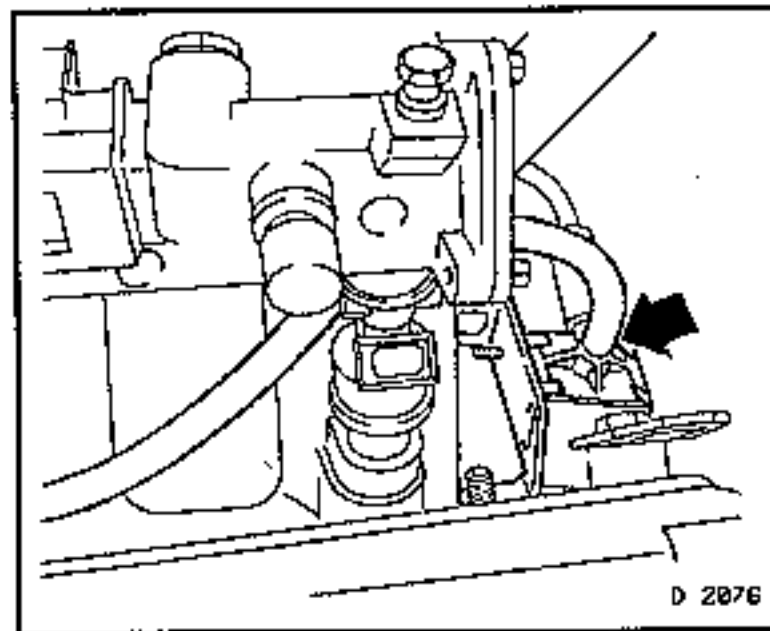
Lay the fuel injector plug strip over to the rear.



## Remove, Disconnect

Fastening nuts from intake manifold.

Vacuum line (arrow) from controlled canister purge valve, then remove the controlled canister purge valve.



Support the intake manifold, then;

## Remove, Disconnect

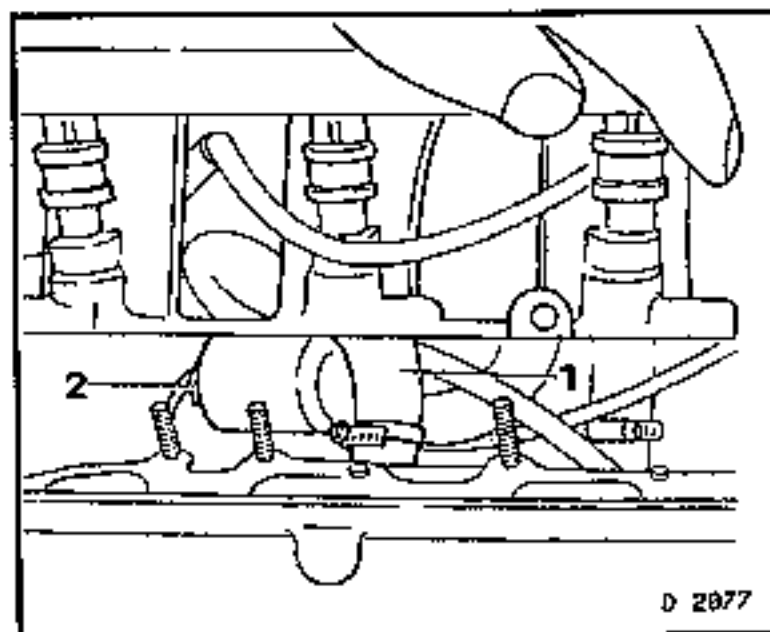
Coolant hose (1) from coolant pipe.

Wiring harness plug (2) from idle speed adjuster.

Intake manifold from the engine.

## Clean

All sealing surfaces, taking care not to damage machined alloy surfaces.



# DOHC ENGINE - CYLINDER HEAD

## Install, Connect

Intake manifold, using new gasket.

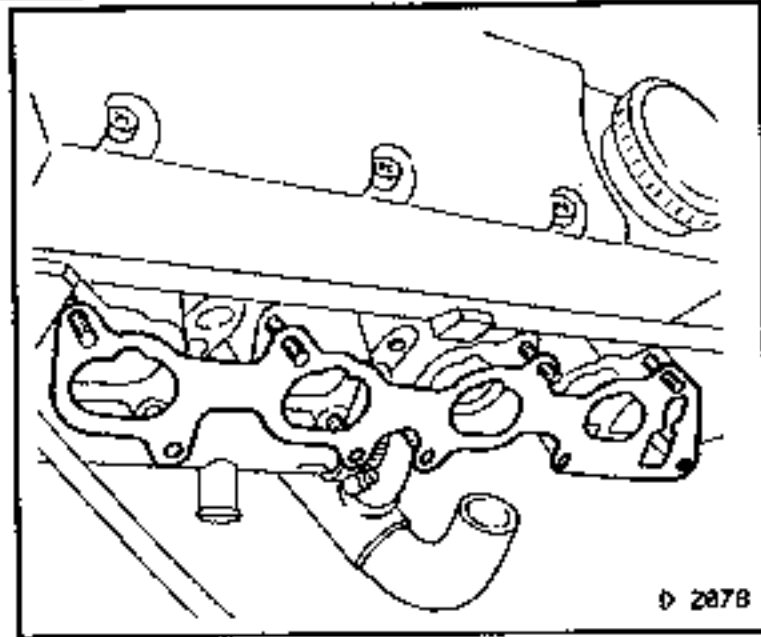
Wiring harness plug to idle speed adjuster.

Coolant hose to coolant pipe.

Controlled canister purge valve and vacuum line.

## Tighten (Torque)

Intake manifold to cylinder head ..... 22 Nm



## Install, Connect

Wiring harness plug (3) to controlled canister purge valve.

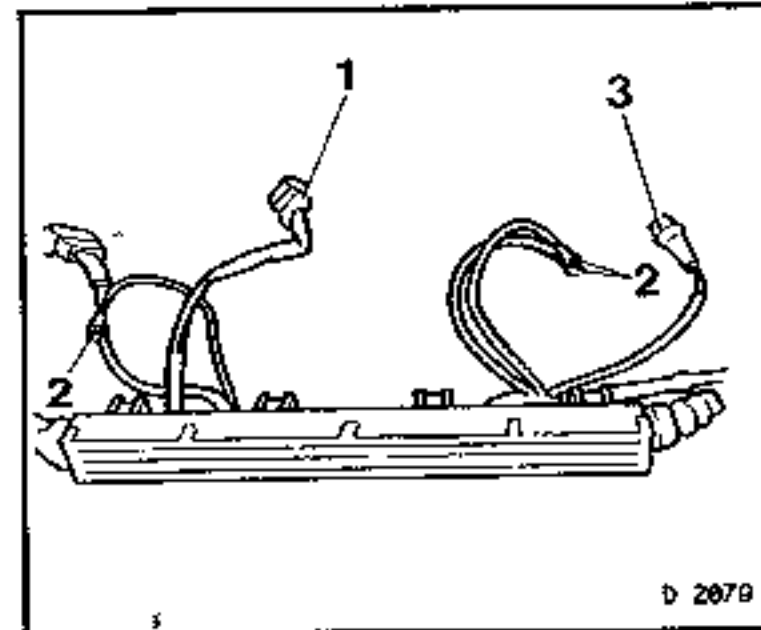
Ground connections (2) to fuel distributor pipe.

Wiring harness plug (1) to throttle valve switch or potentiometer.

Injector plug strip.

## Important!

Check that all ground connections are in good condition and secure.



## Install, Connect

Hose connections to cylinder head cover.

Fuel lines, then remove clamps.

Bowden cable.

Brake servo vacuum line to intake manifold.

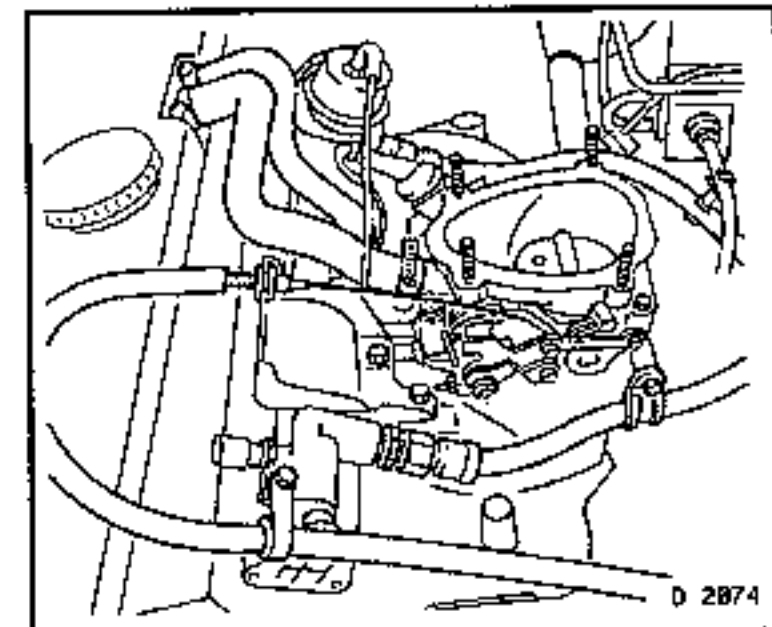
If removed;

Vacuum line to intermediate piece for brake servo connection.

## Tighten (Torque)

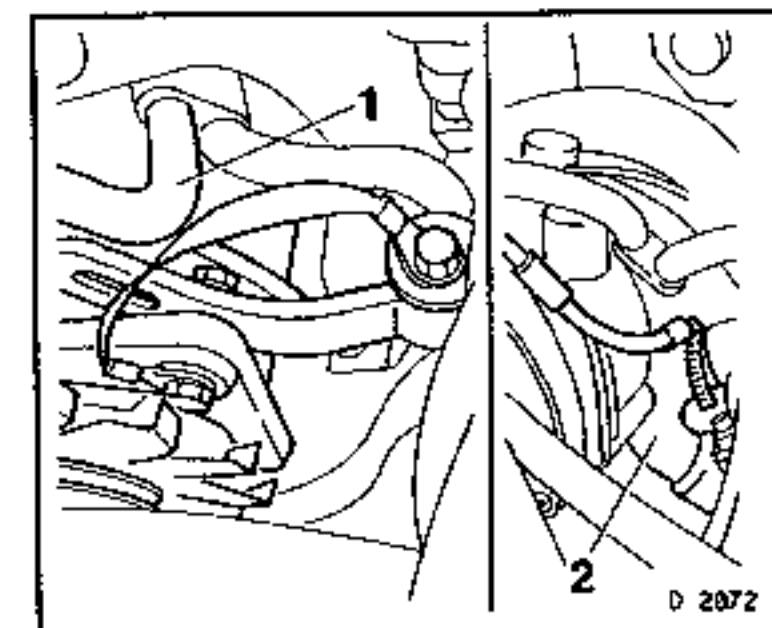
Intake manifold to cylinder block support ..... 25 Nm

Brake servo vacuum line to intake manifold . 20 Nm



## Install, Connect

Coolant hoses (1 and 2) to coolant reservoir tank or to intake manifold.



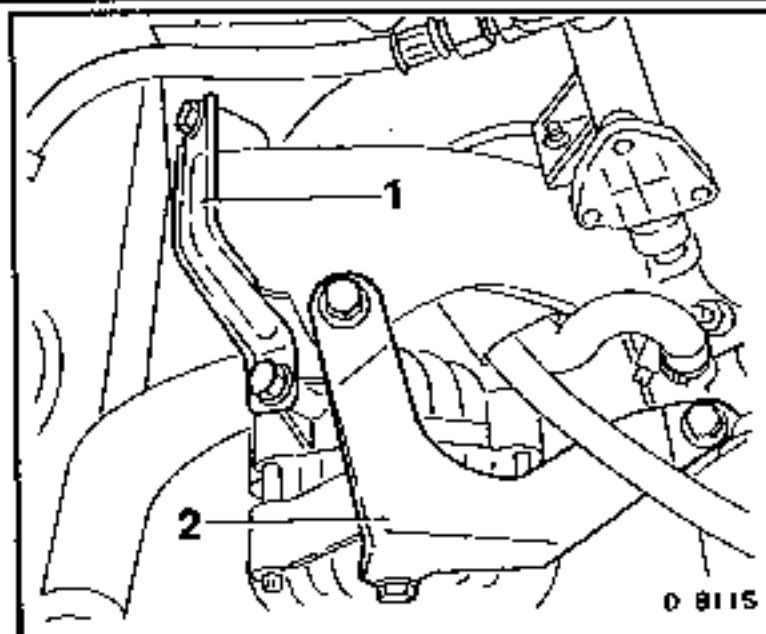
# DOHC ENGINE - CYLINDER HEAD

## Install, Connect

Engines up to MY'93:

Alternator clamping bracket to intake manifold.

Install V-belt to alternator and tension. Refer 'V-belt, Tension, Check and Adjust', in the Section, 'Checking and Adjusting Procedures', in this Volume.



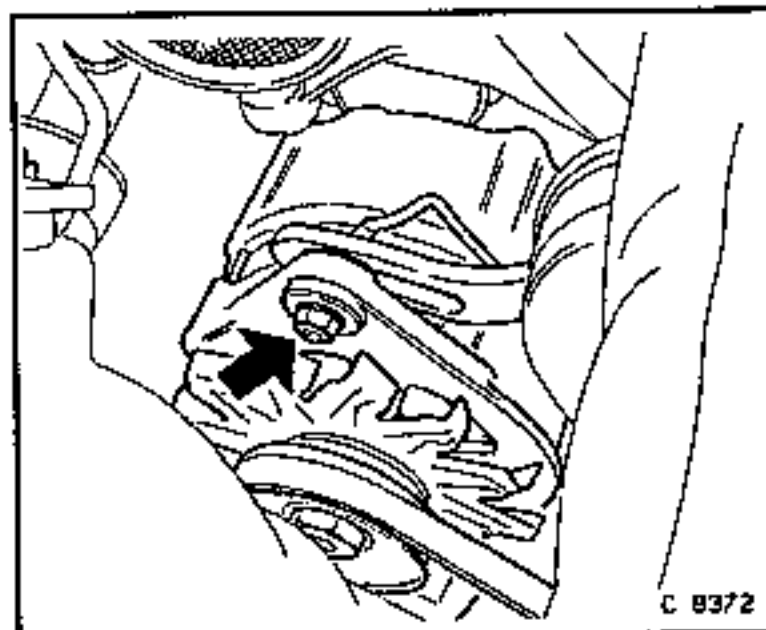
## Install, Connect

Engines as of MY'93:

Support (1) and brace (2) to alternator or to intake manifold.

## Tighten (Torque)

Alternator support and brace .....	18 Nm
Lower alternator fastening bolt .....	35 Nm

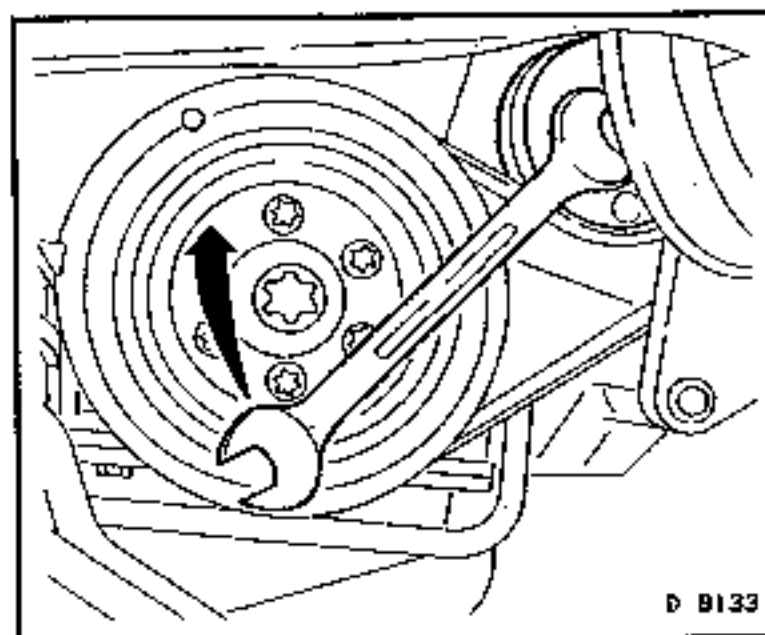


## Install, Connect

Engines as of MY'93:

Ribbed V-belt, after releasing the ribbed V-belt tension roller (arrow).

Note the direction of rotation of the ribbed V-belt, when installing.



## Install, Connect

Pre-volume chamber (4) with mass air flow meter, hose connection (3), to pre-volume chamber, wiring harness plug (2) to mass air flow meter, air intake hose (1).

C 20 XE Engine as of MY'93:

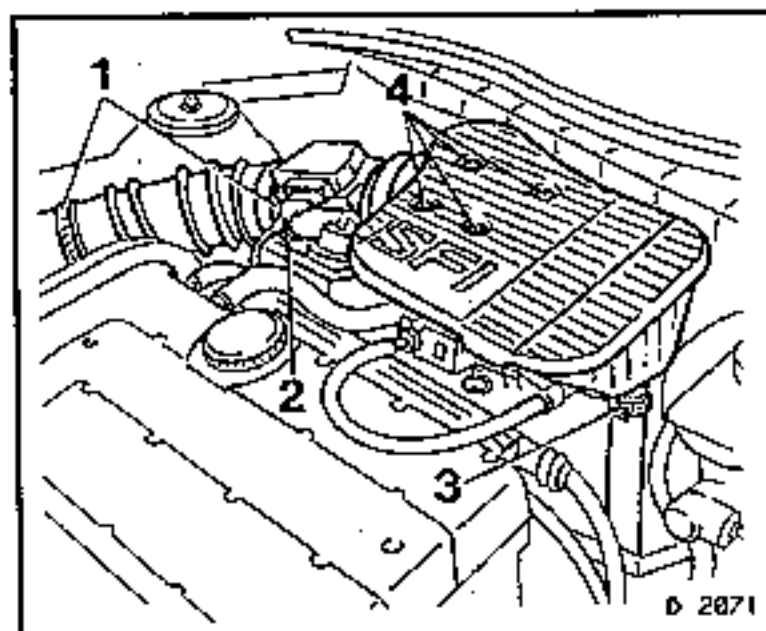
Wiring harness plug to intake air temperature sensor.

The lower coolant hose to the radiator.

Engine compartment cover.

Ground cable to battery.

Top up and bleed cooling system. Refer to the Section, 'Cooling System', in this Volume for details.



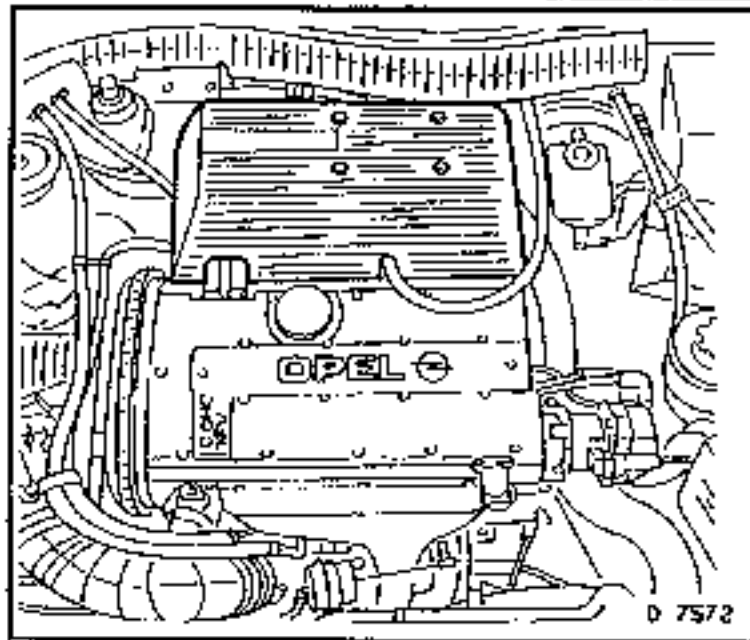
# DOHC ENGINE - CYLINDER HEAD

## Gasket - Intake Manifold to Cylinder Head, Replace (C 20 LET)

### Remove, Disconnect

Ground cable from battery.

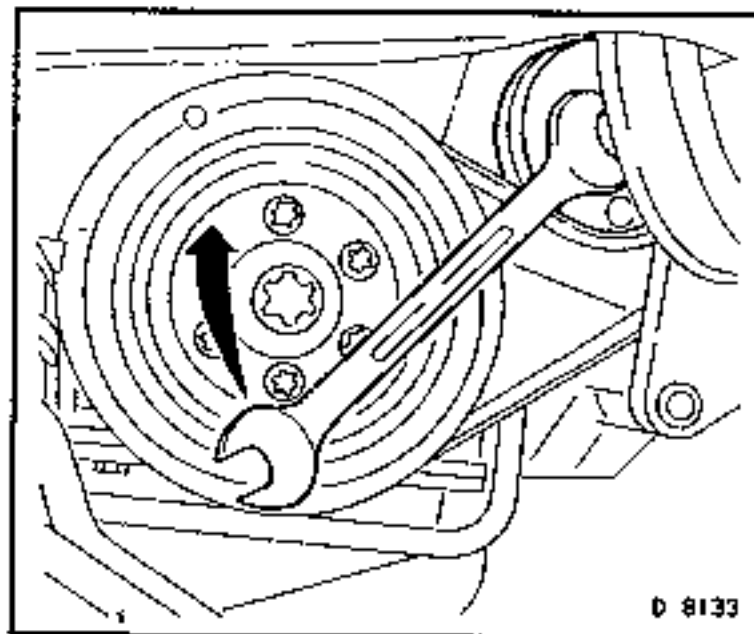
Cover from throttle valve manifold.



### Remove, Disconnect

Mark the direction of rotation of the ribbed V-belt.

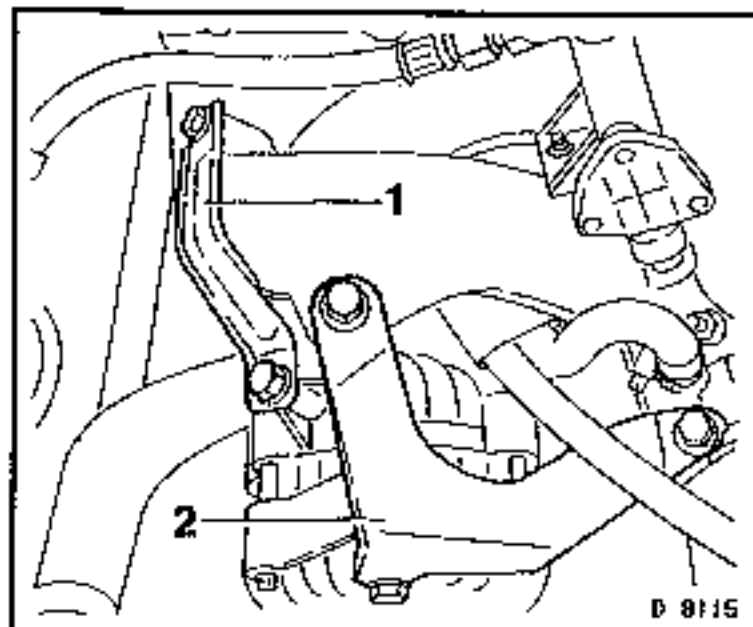
Release ribbed V-belt, using the ribbed V-belt tension roller, by rotating the tension roller (arrow), then remove the ribbed V-belt.



### Remove, Disconnect

Support (1) and brace (2) from alternator or from intake manifold.

Loosen the lower alternator fastening bolt, then swing the alternator to the rear.

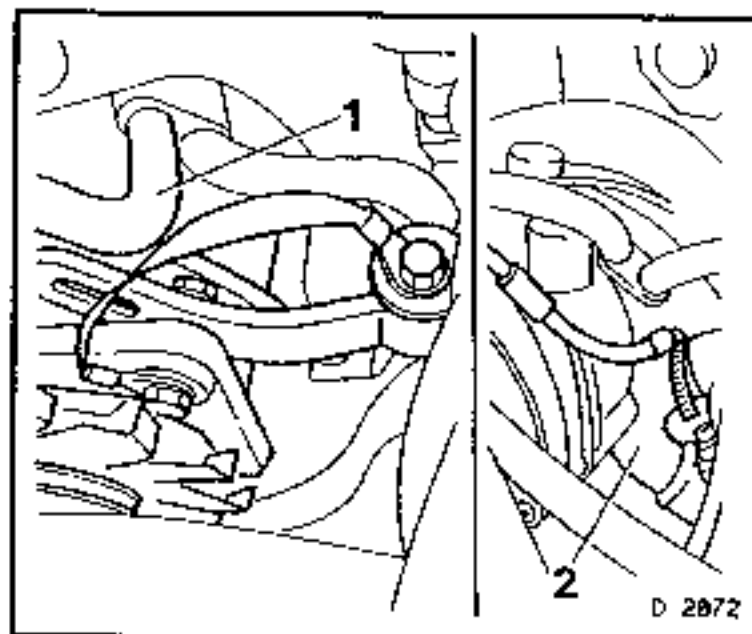


### Remove, Disconnect

Coolant hose (1) from the coolant reservoir tank.

Coolant hose (2) from intake manifold.

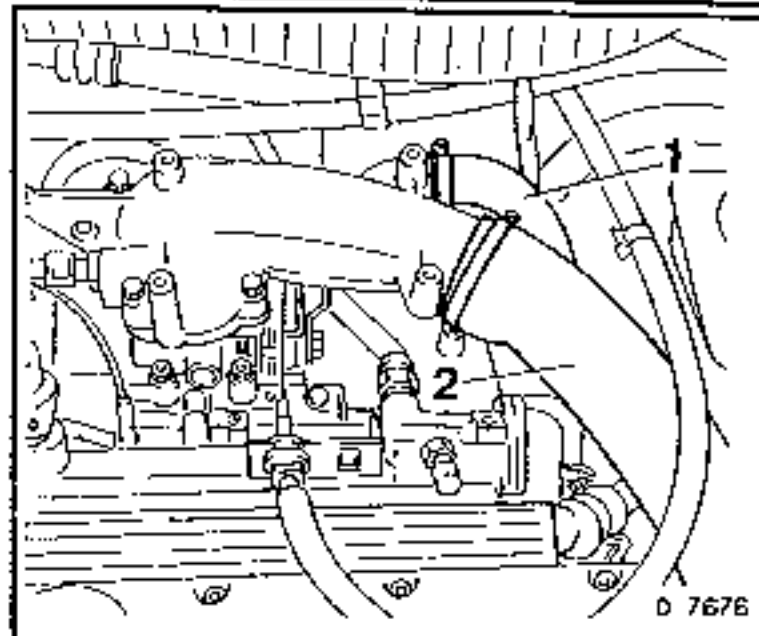
Collect coolant in a suitable, clean container.



# DOHC ENGINE - CYLINDER HEAD

## Remove, Disconnect

Air hoses (1 and 2) from throttle valve manifold.



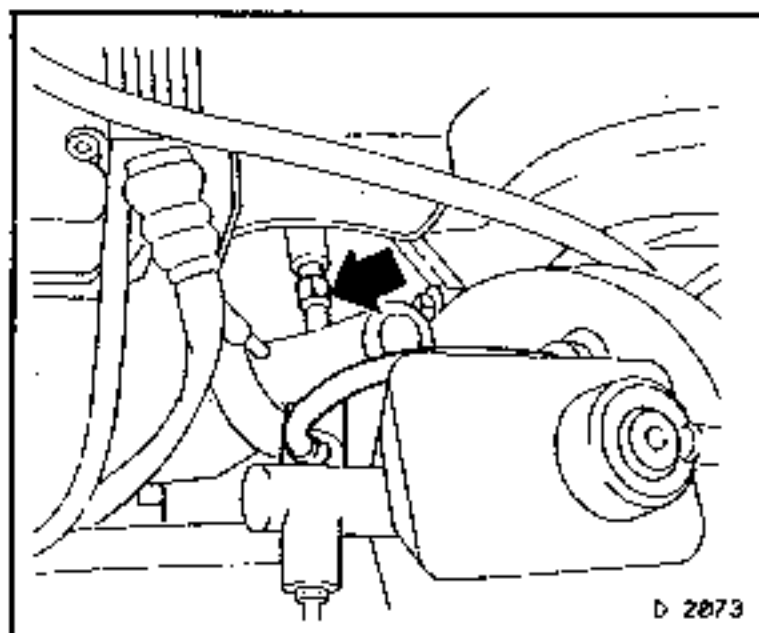
## Remove, Disconnect

Brake servo vacuum line (arrow) from intake manifold.

If fitted;

Vacuum line from Intermediate piece for brake servo connection.

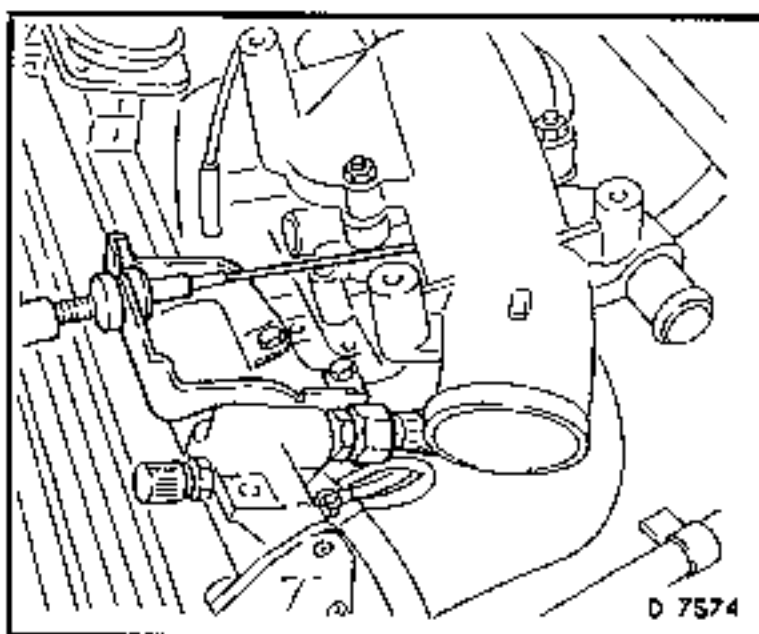
Intake manifold to cylinder block support. Loosen the lower fastening bolt, then swing support to one side.



## Remove, Disconnect

Bowden cable, fuel lines, sealing first with suitable clamps to prevent fuel spillage.

Engine vent hose connections from cylinder head cover.



## Remove, Disconnect

Injector plug strip as follows;

Pull back the retaining clip from No. 1 cylinder injector.

Wiring harness plug (1) from hot start valve.

Wiring harness plug (2) from intake air temperature sensor.

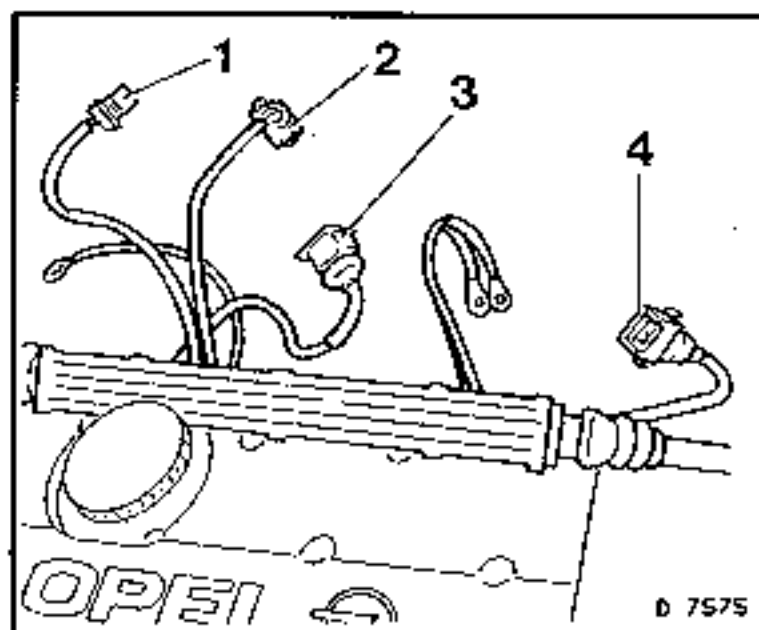
Wiring harness plug (3) from throttle valve potentiometer.

Wiring harness plug (4) from controlled canister purge valve.

Ground connections from fuel distributor pipe.

**Note:**

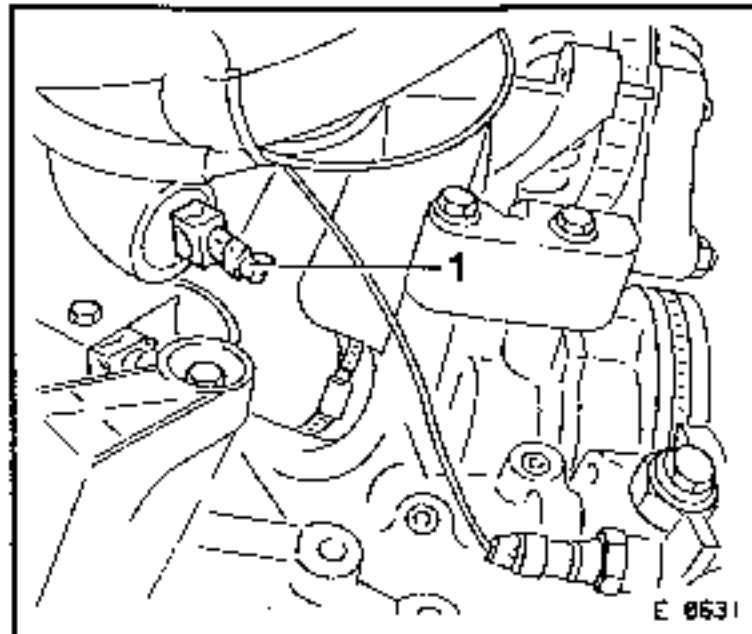
Routing of all wiring and connections.



# DOHC ENGINE - CYLINDER HEAD

## Remove, Disconnect

Wiring harness plug (1) from idle speed adjuster.  
Lay the fuel injector plug strip over to the front.

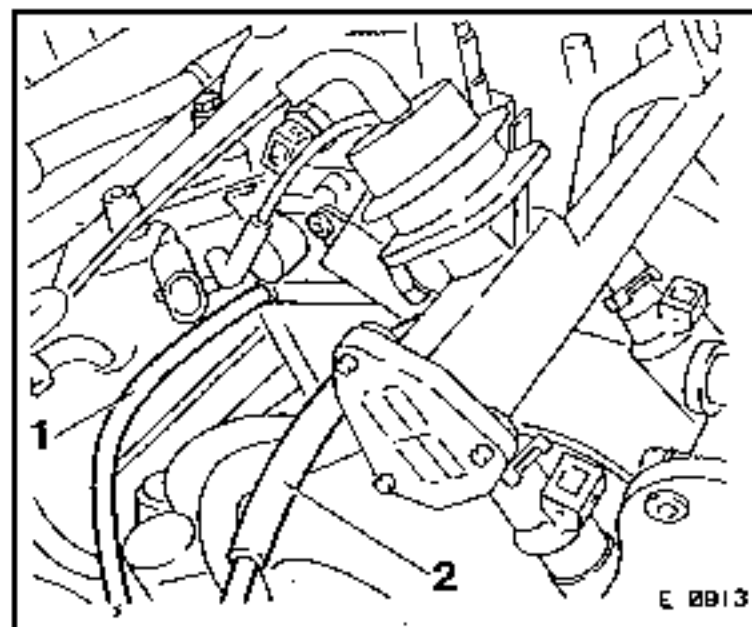


## Remove, Disconnect

Vacuum hose (1) from the throttle body.  
Vacuum hose (2) from the 'T' piece.  
Intake manifold from the engine.

## Clean

All sealing surfaces, taking care not to damage machined alloy surfaces.

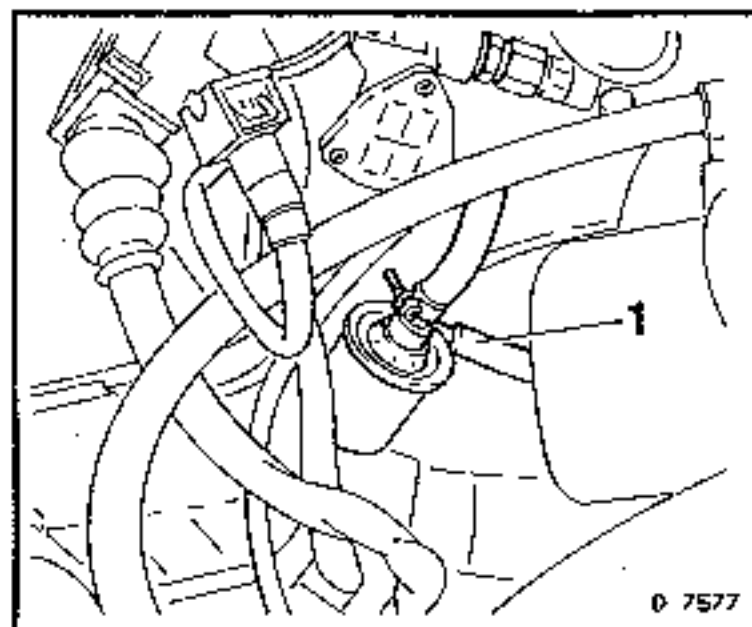


## Remove, Disconnect

Fastening nuts from the intake manifold.  
Vacuum line (1) from the controlled canister purge valve, then the controlled canister purge valve.  
Intake manifold from the cylinder head.

## Clean

All sealing surfaces, taking care not to damage machined alloy surfaces in the process.

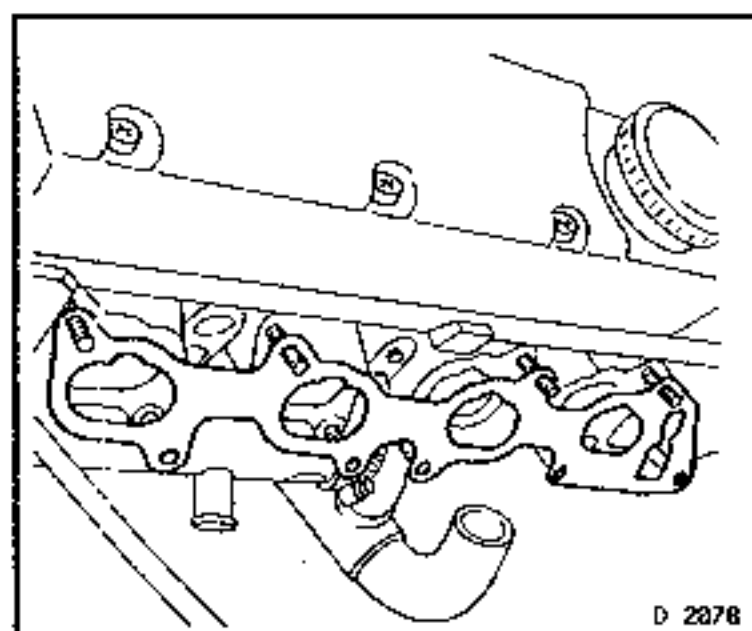


## Install, Connect

Intake manifold, using new gasket.  
Controlled canister purge valve and vacuum line.

## Tighten (Torque)

Intake manifold to cylinder head ..... 22 Nm





# DOHC ENGINE - CYLINDER HEAD

## Install, Connect

Injector plug strip to injectors.

All vacuum hoses.

Wiring harness plug (1) to hot start valve.

Wiring harness plug (2) to intake air temperature sensor.

Wiring harness plug (3) to throttle valve potentiometer.

Wiring harness plug (4) to controlled canister purge valve.

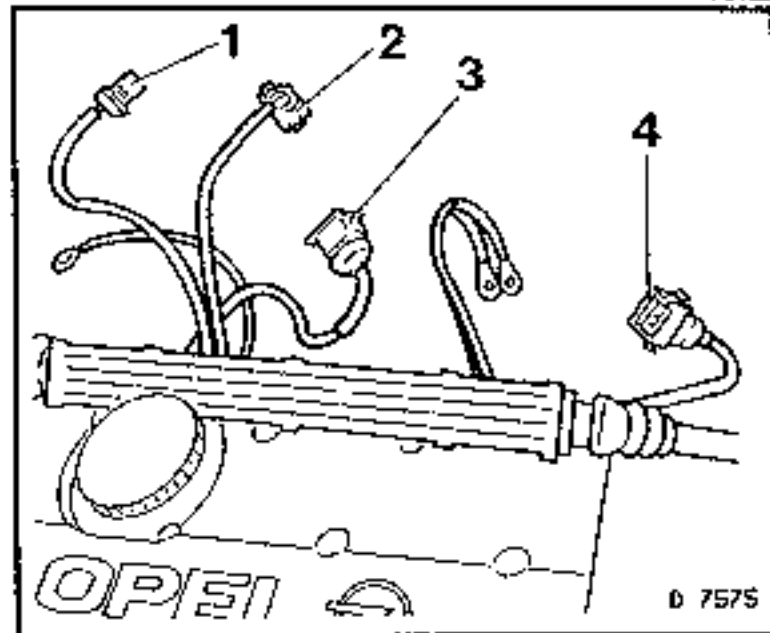
Wiring harness plug to idle speed adjuster.

Ground connections (2) to fuel distributor pipe.

### Note:

Wiring harness routing.

Check that all ground connections are in good condition and secure.

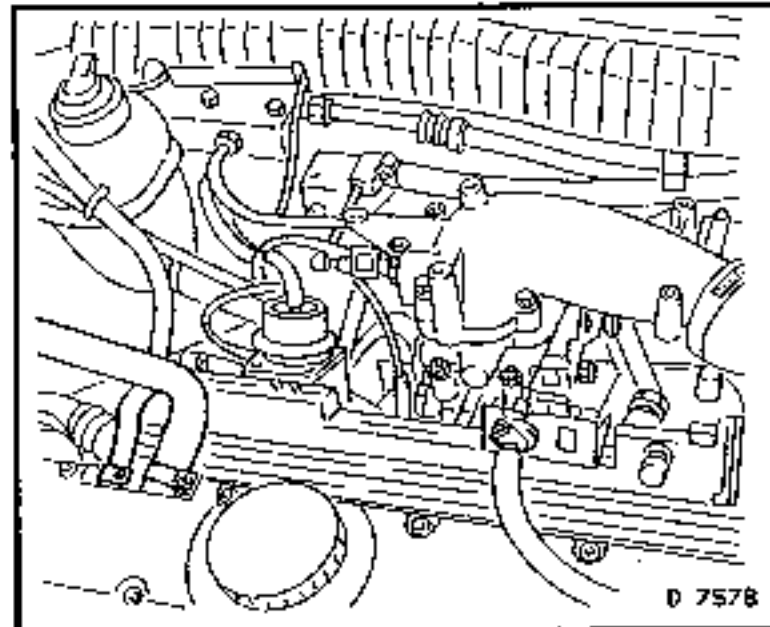


## Install, Connect

Engine vent hoses to cylinder head cover.

Fuel lines. Disconnect clamps.

Bowden cable. Install with no tension on the cable.



## Install, Connect

Air hose to throttle valve manifold.

Coolant hoses to coolant reservoir tank or intake manifold.

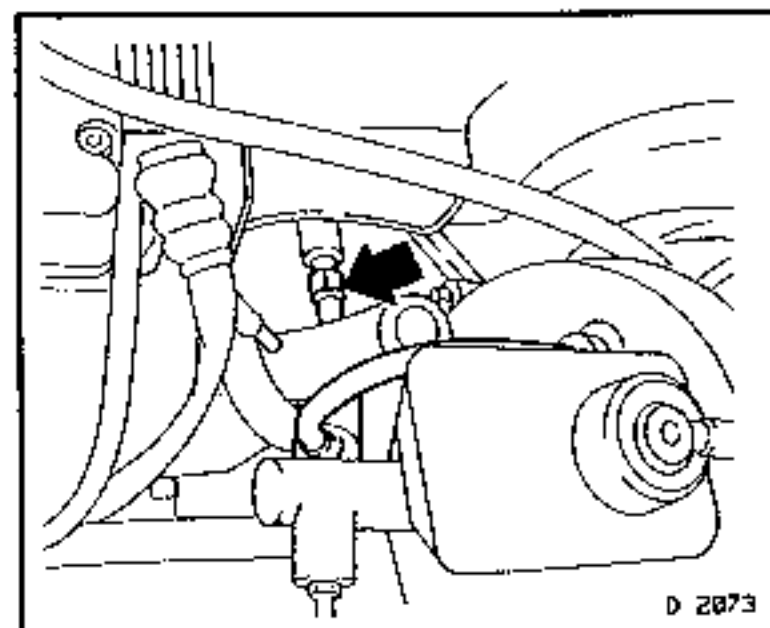
Brake servo line to intake manifold (arrow).

### Tighten (Torque)

Intake manifold to cylinder block support .....	25 Nm
Brake servo line to intake manifold .....	20 Nm

If removed;

Vacuum line to intermediate piece from brake servo connection.



## Install, Connect

Alternator support (1) and brace (2) to alternator or intake manifold.

### Tighten (Torque)

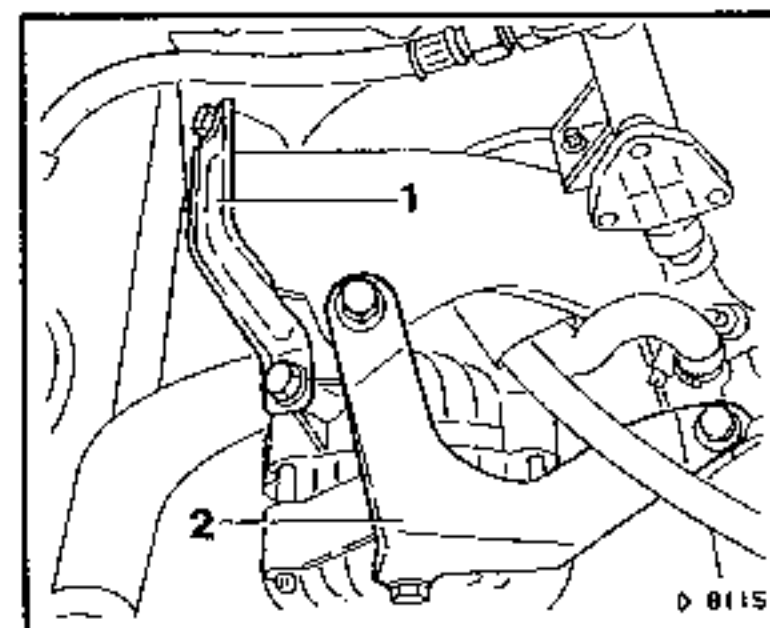
Alternator support and brace .....	18 Nm
Lower alternator fastening bolt .....	35 Nm

## Install, Connect

Install ribbed V-belt, using the ribbed V-belt tension roller.

### Note:

The direction of rotation of the ribbed V-belt.



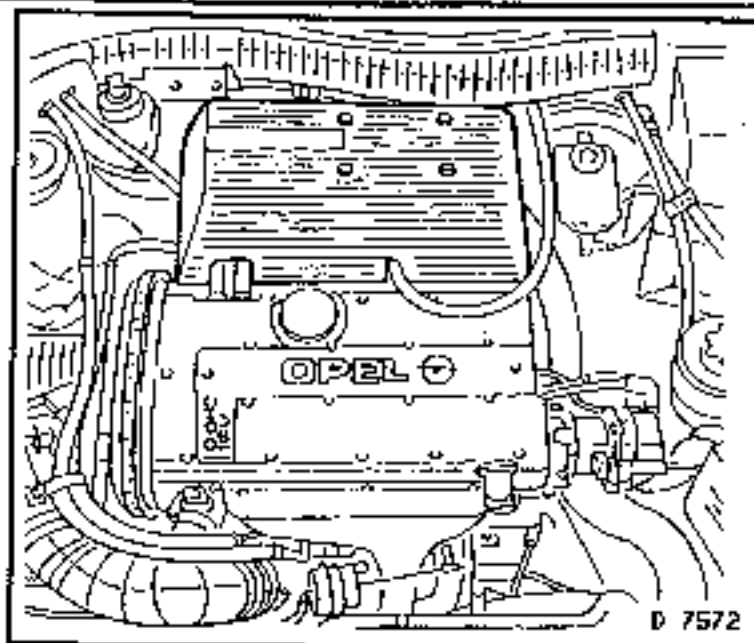
# DOHC ENGINE - CYLINDER HEAD

## Install, Connect and Tighten (Torque)

Cover to throttle valve manifold, ..... 5 Nm

Ground cable to battery.

Top up and bleed cooling system. Refer to the Section, "Cooling System", in this Volume for details.



## Camshaft (Intake and/or Exhaust), Replace

### Remove, Disconnect

#### Note:

Before removing the toothed belt, rotate the crankshaft in the direction of engine rotation until the TDC mark is 60° BTDC (dimension I).

Engines as of MY'93:

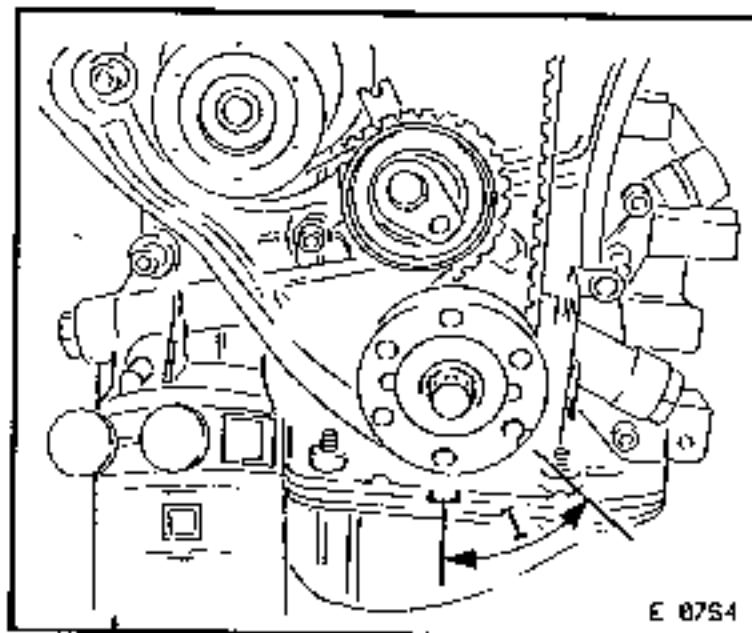
Mark the direction of rotation of the toothed belt.

All Engines:

Toothed Belt. Refer "Toothed Belt, Replace", in this Volume.

Camshaft gear/s. Refer "Camshaft Gears, Remove and Install", in this Section.

High voltage distributor. Refer to the appropriate Motronic Section in this Volume.



### Remove, Disconnect

C 20 XE Engines as of MY'93:

Camshaft sensor disc. Refer to the Motronic M 2.8 Section in this Volume.

All Engines:

Camshaft bearing cover.

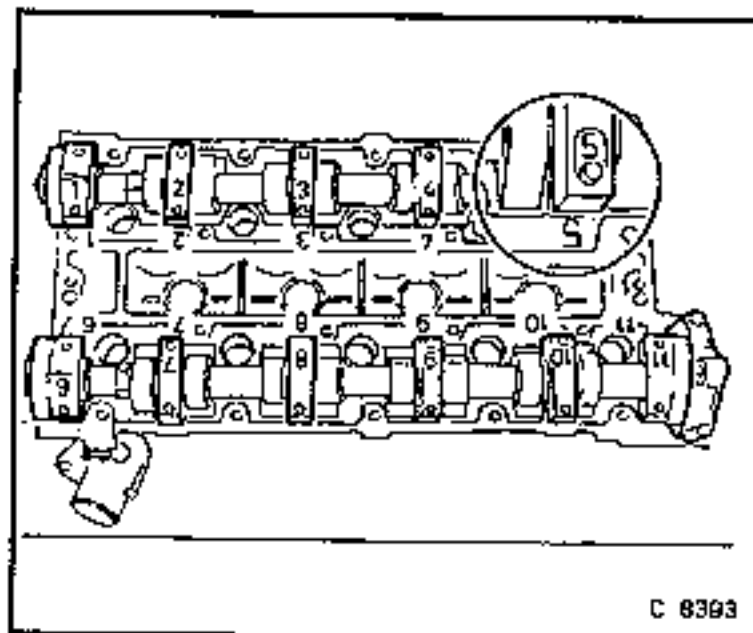
Progressively loosen nuts in stages of 1/8 to 1 turn, working from the outside, inwards.

#### Note:

The numbered identification markings on each camshaft bearing cap.

### Important!

Camshaft must come away evenly from the bearing seats and from the front guide bearing.

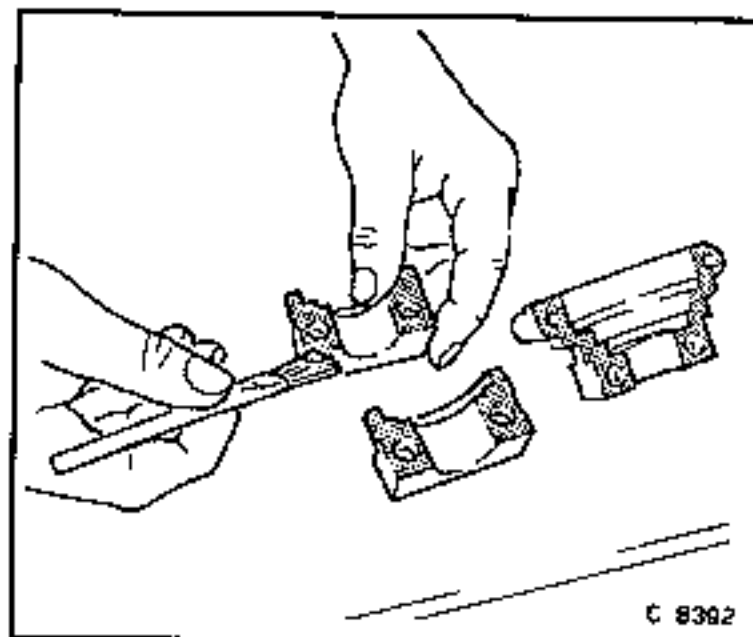


## Clean, Inspect

All parts, replacing as necessary.

Coat all sliding surfaces with molybdenum disulphide (MoS<sub>2</sub>) grease or spray.

Apply silicone sealing compound such as Dow Corning 732 or equivalent, to Holden's Specification HN1373, to the sealing surfaces of the outer camshaft bearing covers.



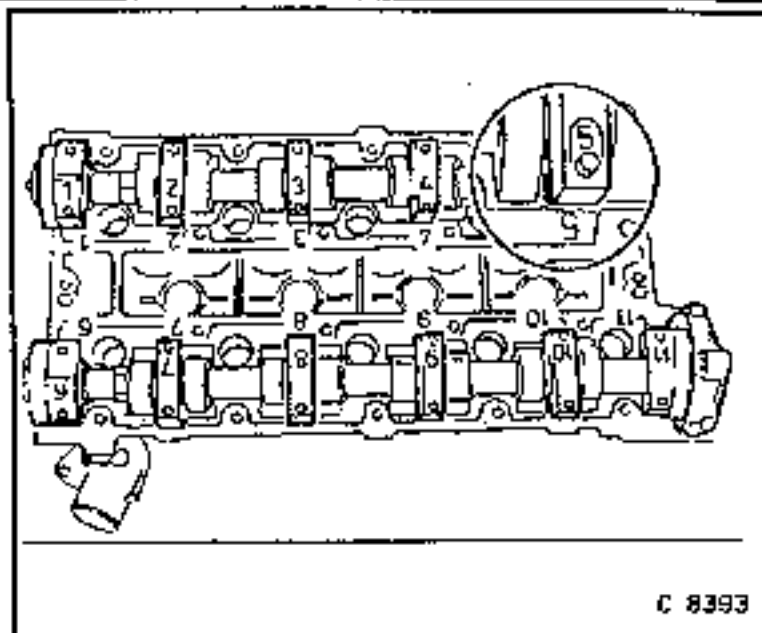
# DOHC ENGINE - CYLINDER HEAD

## Install, Connect

Camshaft bearing covers.

### Important!

Take care that the identification number on each cover, matches with the number on the cylinder head.

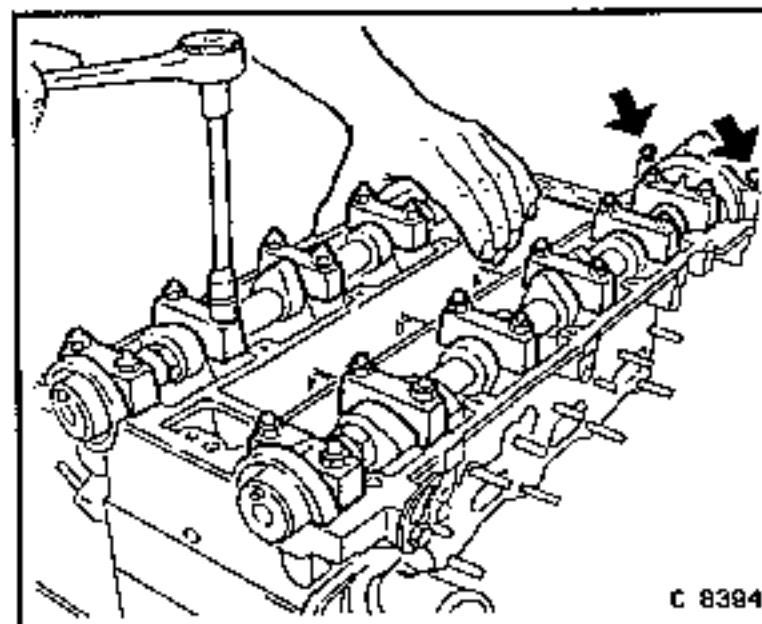


## Tighten (Torque)

Camshaft bearing cover to cylinder head .....	20 Nm
Rear camshaft bearing cover (arrows) to cylinder head (M 6) .....	10 Nm

### Important!

Progressively tighten the camshaft covers 1/2 to 1 turn at a time, working from the centre, outwards.



Turn camshaft with open ended spanner, until the guide studs (1), point upwards.

## Install, Connect

New camshaft sealing rings, using KM-422 and the camshaft gear retaining washer.

Apply grease to the seal lips before installation.

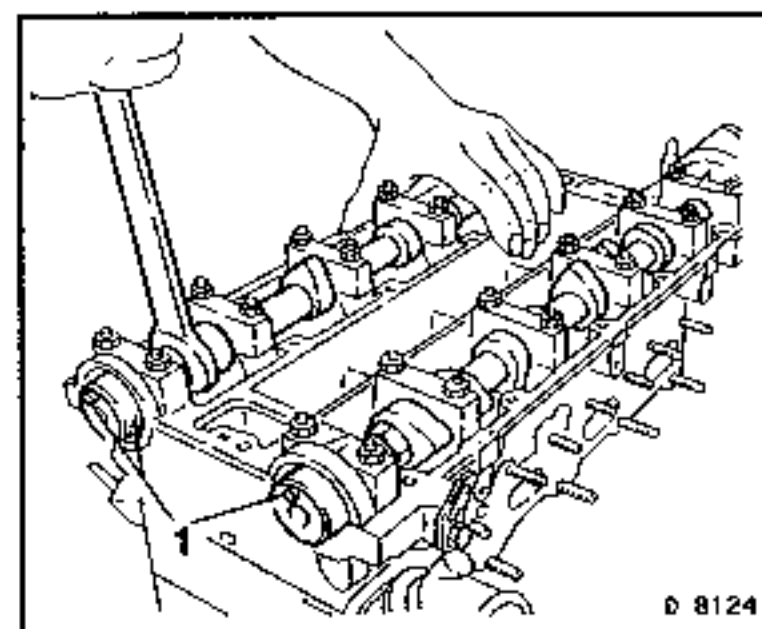
High voltage distributor.

Camshaft gear/s. Refer "Camshaft Gears, Remove and Install", in this Section.

Toothed Belt. Refer "Toothed Belt, Replace", in this Volume.

C 20 XE Engine as of MY'93:

Camshaft sensor disc. Refer to Motronic M 2.B Section in this Volume, for details.



## Camshaft Gears, Remove and Install

### Remove, Disconnect

Engines as of MY'93:

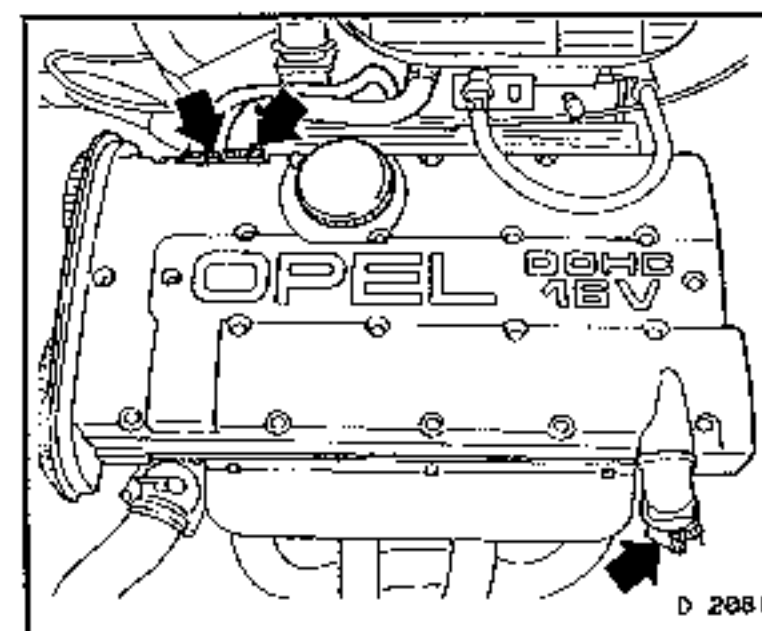
Mark the direction of rotation of the toothed belt.

Toothed Belt. Refer "Toothed Belt, Replace", in this Volume.

Ignition cable cover, spark plug connections, using KM-717.

Hose connections (arrows) from cylinder head cover.

Cylinder head cover.

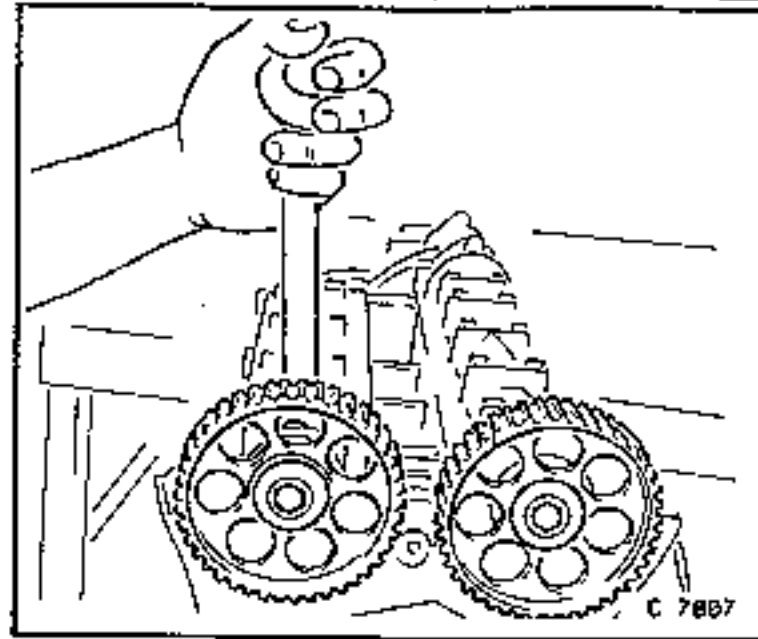


# DOHC ENGINE - CYLINDER HEAD

## Remove, Disconnect

Camshaft gear/s.

Hold each camshaft with an open ended spanner on the hex provided, while loosening the retaining bolt.



## Install, Connect

Camshaft gear/s, with the timing mark to the front (arrow). The guide pin on the camshaft engages with the corresponding hole in the camshaft gear.

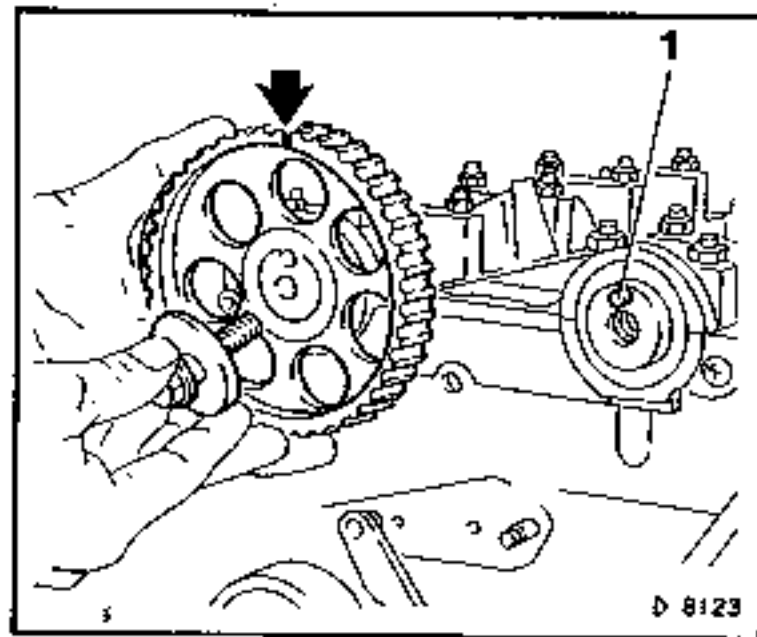
## Torque - Angle Method

Camshaft gear to camshaft ..... 50 Nm + 60° + 15° \*

\* Use new bolt/s.

### Note:

While tightening, hold the camshaft with an open ended spanner on the hex provided.



## Install, Connect

Cylinder head cover with a new gasket.

Hose connections (arrows) to cylinder head cover.

Spark plug connectors.

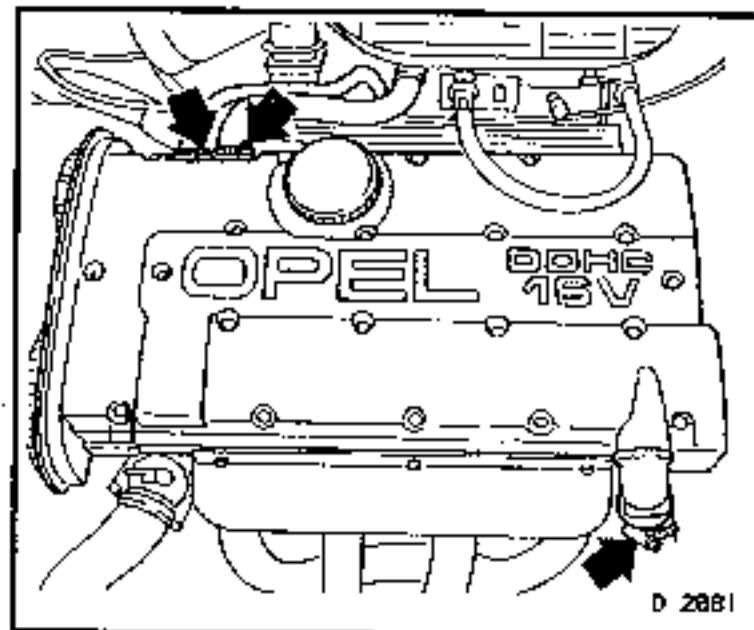
Ignition cable cover.

Toothed Belt. Refer "Toothed Belt, Replace", in this Volume.

## Tighten (Torque)

Cylinder head cover to cylinder head ..... 8 Nm

Ignition cable cover to  
cylinder head cover ..... 8 Nm



## Cylinder Head, Remove and Install (C 20 XE)

### Important!

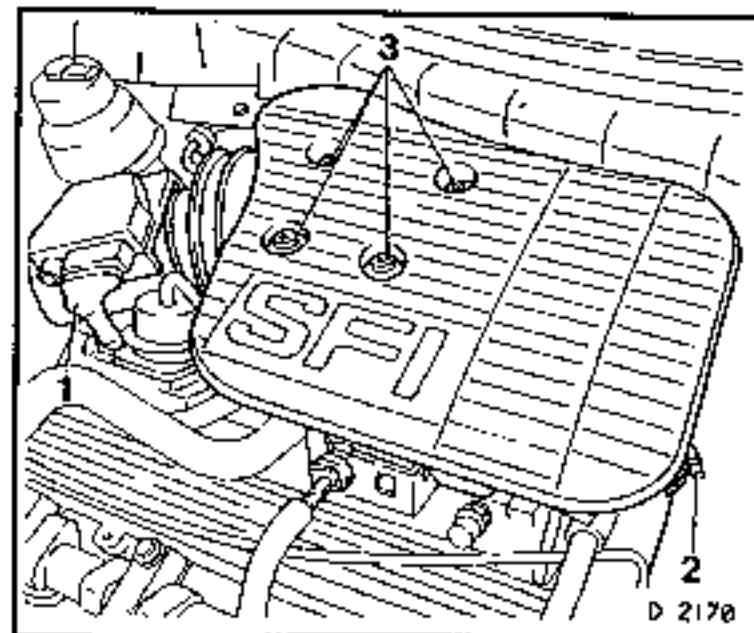
Only remove the cylinder head when the engine is cold, (i.e. at room temperature).

## Remove, Disconnect

Ground cable from battery.

Wiring harness plug (1) from mass air flow meter, Idle speed adjuster hose (2) from pre-volume chamber.

Pre-volume chamber (3) with mass air flow meter.



# DOHC ENGINE - CYLINDER HEAD

## Remove, Disconnect

The lower coolant hose from the radiator. Collect the coolant in a suitable, clean container.

### Note:

Before removing the toothed belt, rotate the crankshaft in the direction of engine rotation until the TDC mark is 60° BTDC (dimension I).

Engines as of MY'93:

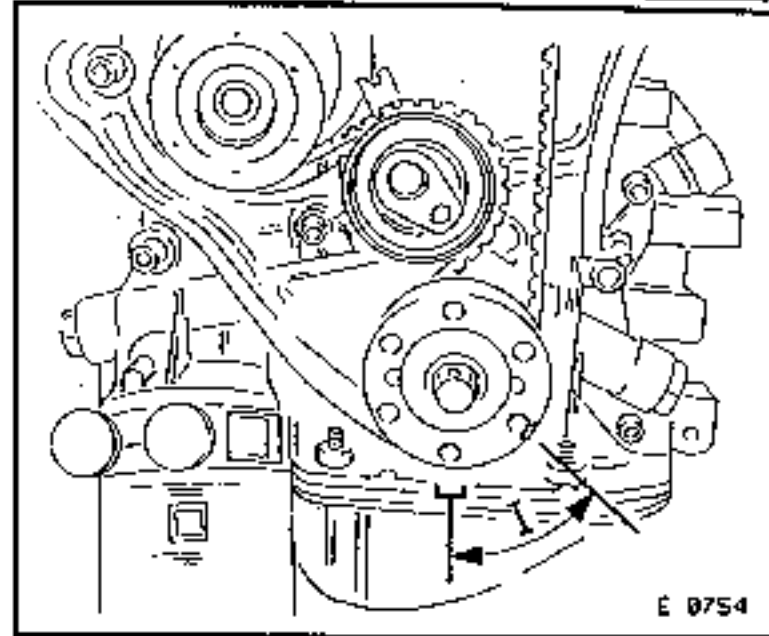
Mark the direction of rotation of the toothed belt.

All Engines:

Toothed Belt. Refer 'Toothed Belt, Replace', in this Volume.

Camshaft gear/s. Refer 'Camshaft Gears, Remove and Install', in this Section.

Performance header. Refer 'Gasket, Performance Header to Cylinder Head, Replace', in this Section.

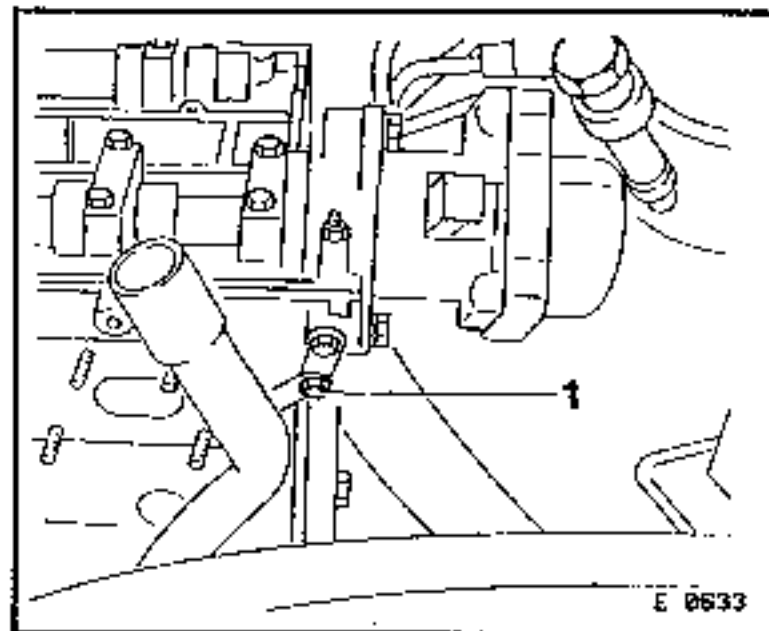


## Remove, Disconnect

Wiring harness plug and upper coolant hose from the thermostat housing.

Wiring harness plug and high voltage cables from the high voltage distributor.

Fastening bolt (1).

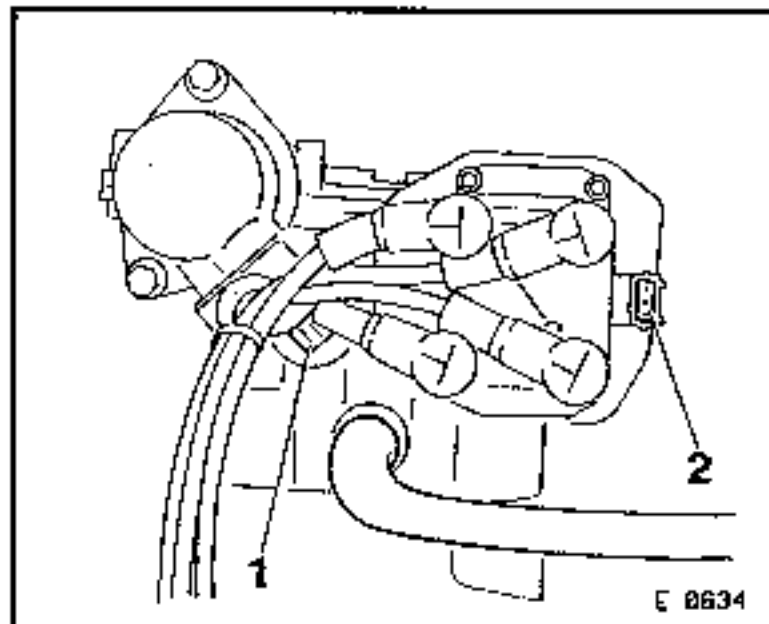


## Remove, Disconnect

C 20 XE Engines as of MY'93:

Wiring harness plug (1) from camshaft sensor.

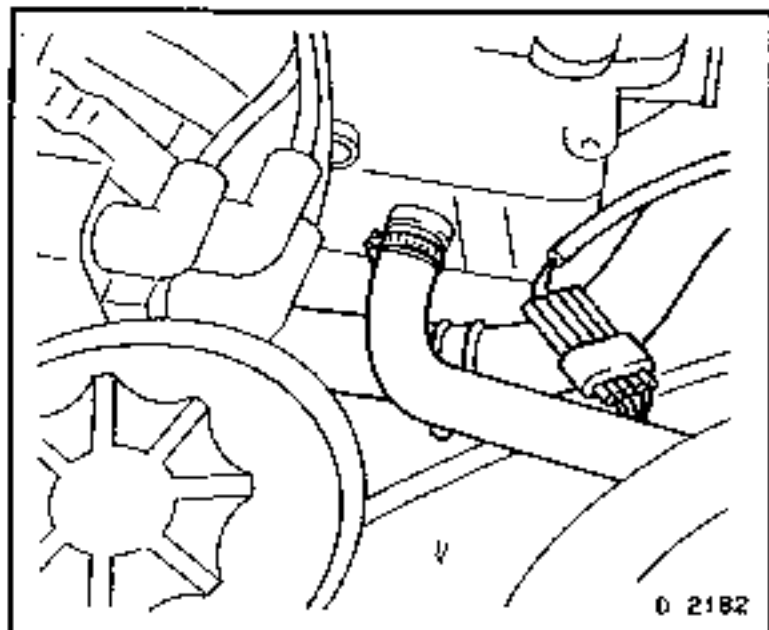
Wiring harness plug (2) from dual spark ignition coil.



## Remove, Disconnect

Coolant hose.

Multi-plug.

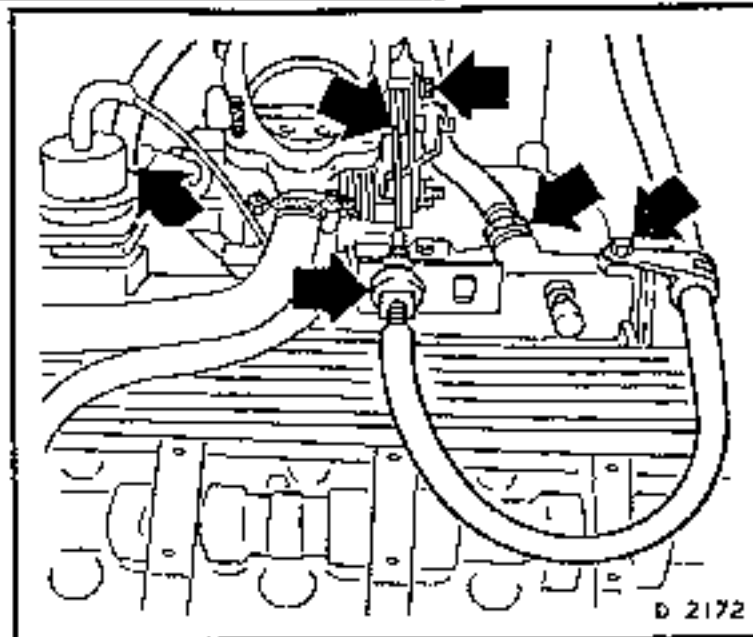


# DOHC ENGINE - CYLINDER HEAD

## Remove, Disconnect

Bowden cable.

Fuel lines, sealing first with suitable clamps to prevent fuel spillage.



## Remove, Disconnect

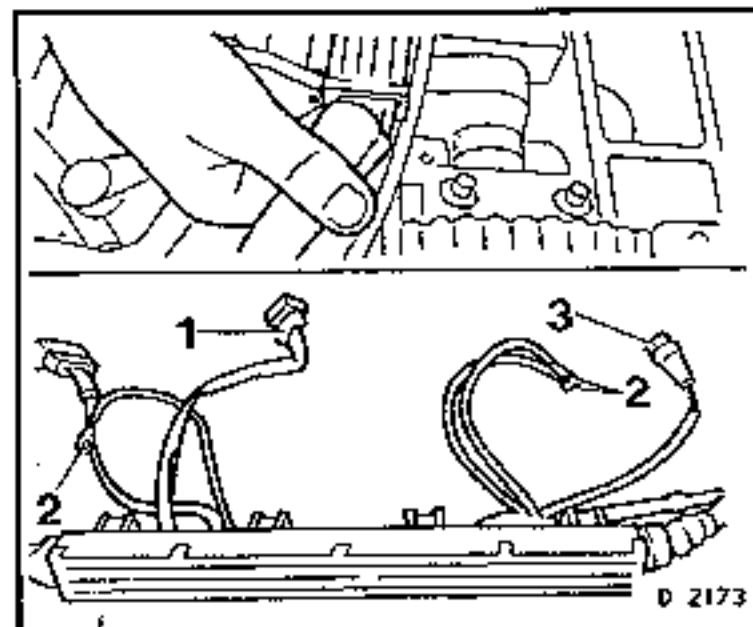
Plug strip from injectors.

Wiring harness plug (1) from throttle valve switch (M 2.5) or potentiometer (M 2.8).

Ground connections (2) from fuel distributor pipe.

Wiring harness plug (3) from controlled canister purge valve.

Lay injector plug strip towards the rear of the engine.



## Remove, Disconnect

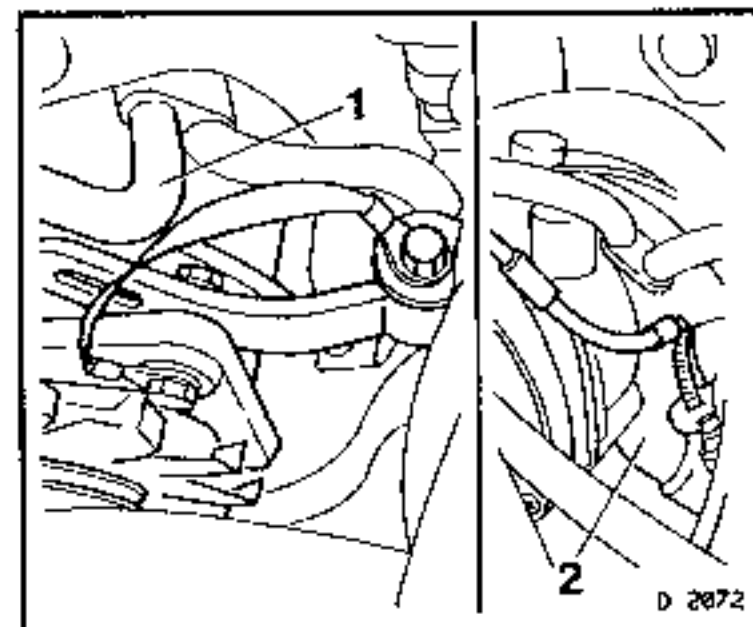
Engines up to MY'93:

Alternator clamping bracket from intake manifold.

Loosen lower alternator fastening bolt. Swing alternator to the rear.

Coolant hose (1) from coolant reservoir tank.

Coolant hose (2) from intake manifold.

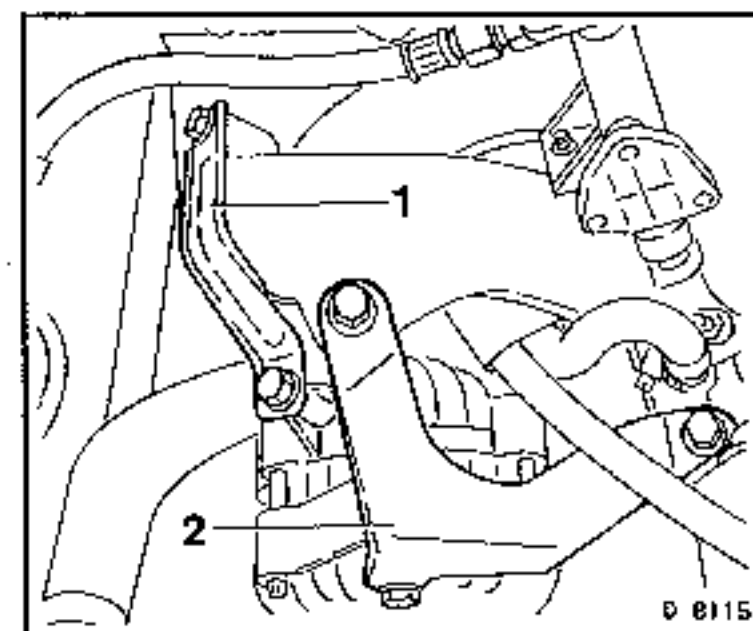


## Remove, Disconnect

Engines as of MY'93:

Clamping bracket and brace from alternator or from intake manifold.

Loosen lower alternator bolt and swing alternator to the rear.



# DOHC ENGINE - CYLINDER HEAD

## Remove, Disconnect

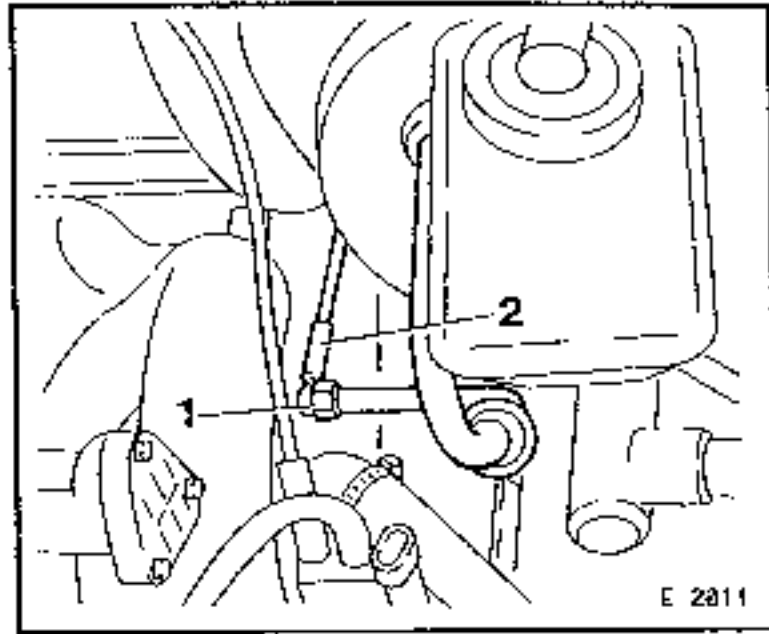
Brake servo vacuum line (1) from intake manifold.

If fitted;

Vacuum line (2) from intermediate piece for brake servo connection.

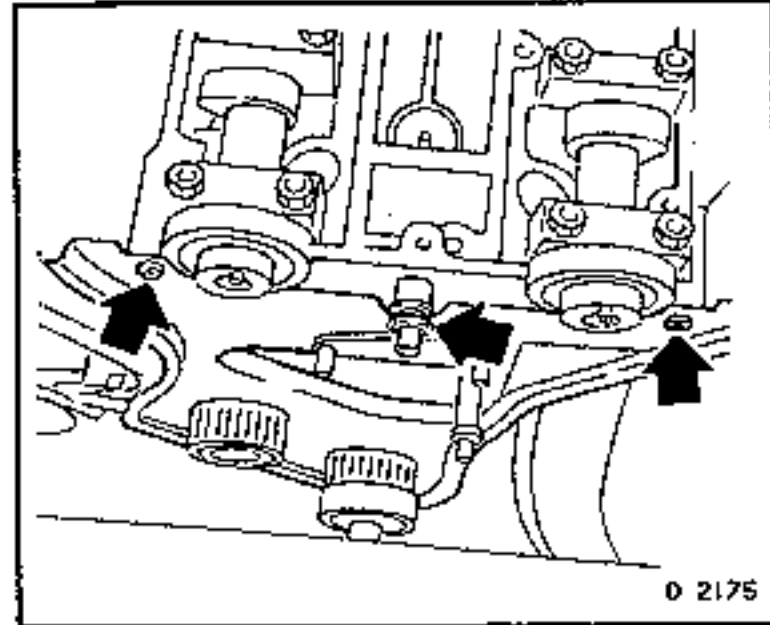
Intake manifold to cylinder block support, from the intake manifold.

Coolant hose from the coolant reservoir.



## Remove, Disconnect

Fastening bolts (arrows) of the rear toothed belt cover from the cylinder head. Refer to this operation in "Engine, Timing Side, Air Cleaner", in this Volume.



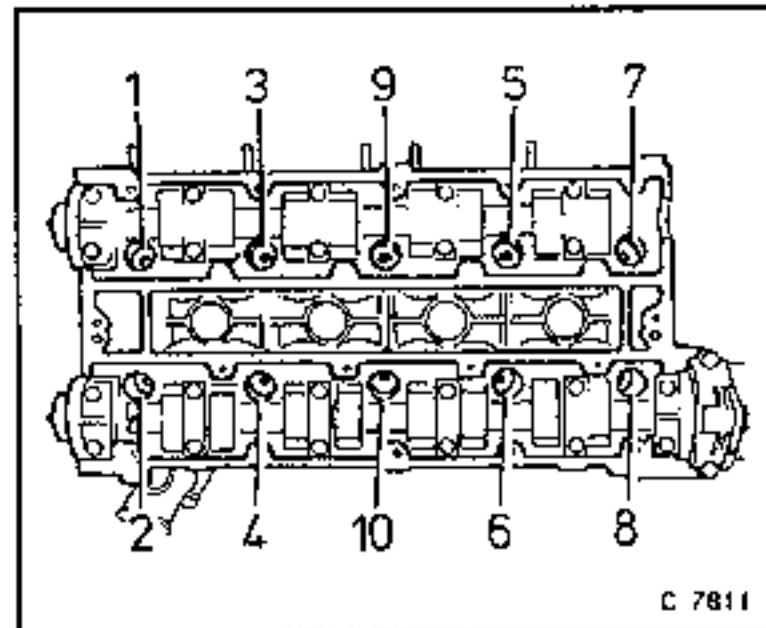
## Remove, Disconnect

Progressively loosen the cylinder head bolts in the sequence shown, using MKM-604-19-A (Torx E 14).

### Important!

First loosen all bolts  $\frac{1}{4}$  turn, then  $\frac{1}{2}$  turn.

When removing the bolts, take note of the washers.



## Clean

All sealing surfaces, counter bores for the cylinder head bolts and the threads in the cylinder block.

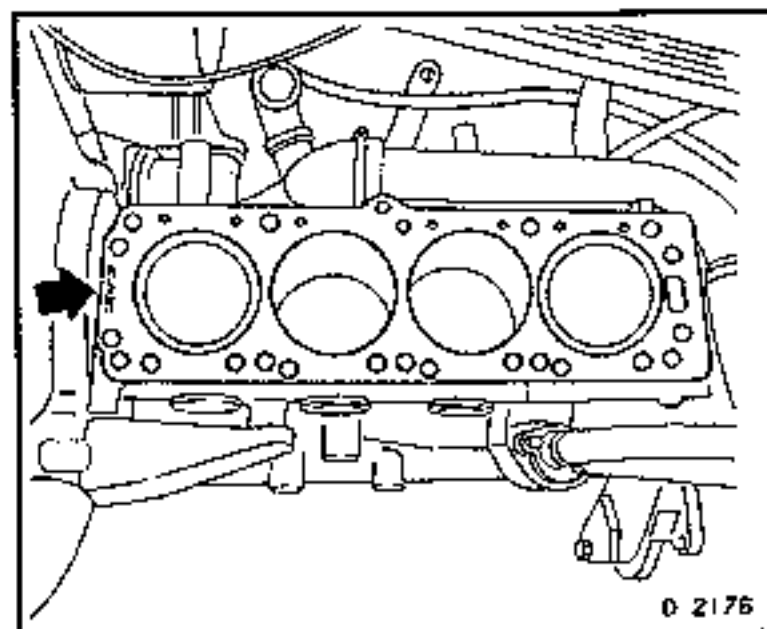
Take care not to damage finely machined surfaces.

## Check

Cylinder block and head for plane surface. Refer to this operation at the end of this Section.

## Install, Connect

New cylinder head gasket onto the guide bushes in the cylinder block. Align the mark "OBEN/TOP" (arrow), upwards and towards the timing side of the engine.



# DOHC ENGINE - CYLINDER HEAD

## Install, Connect

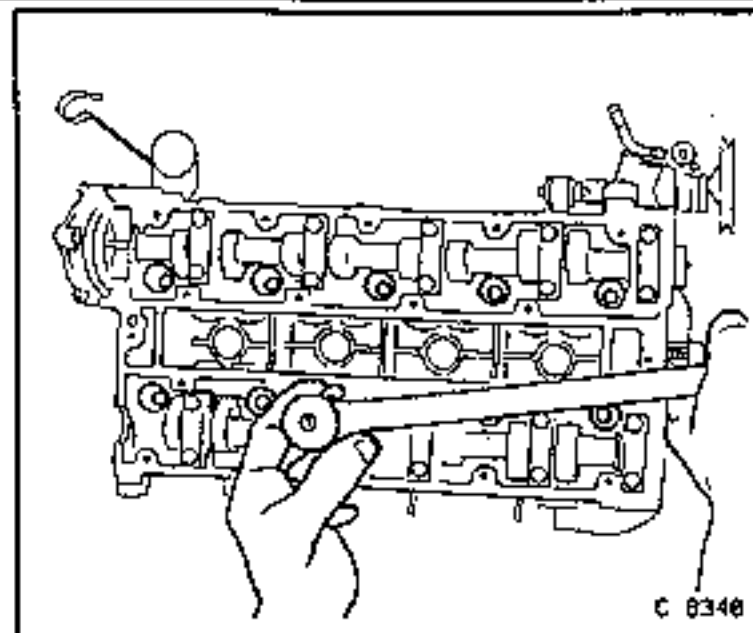
Mount cylinder head on the cylinder block, indexing with the location tubes in the cylinder block.

Insert new cylinder head bolts with their washers.

### Important!

New bolts MUST be used.

Insert bolts until they are all seated, using MKM-604-19-A (Torx E 14).



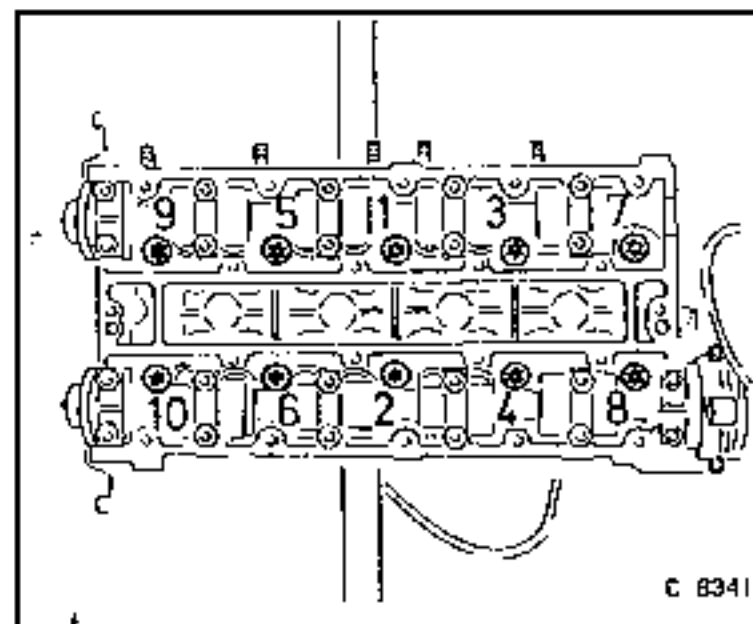
## Tighten (Torque)

Cylinder head to cylinder block.  
Tighten cylinder head bolts in the sequence shown, in four stages, using angular torque wrench KM-470-B.

### Torque - Angle Method

Tightening procedure..... 25 Nm + 90° + 90° + 90° \*

\* No re-tightening is required



## Tighten (Torque)

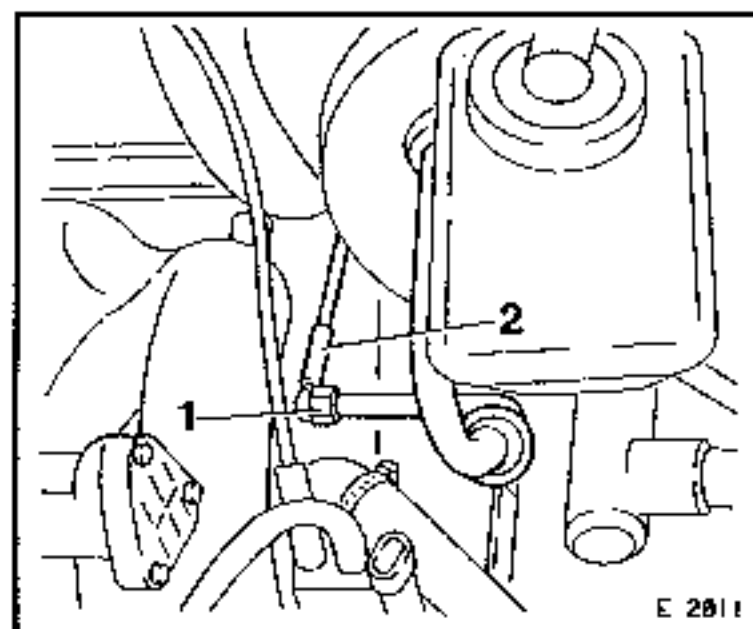
Rear toothed belt cover to cylinder head.....	6 Nm
Intake manifold to cylinder block support .....	25 Nm
Brake servo vacuum line to intake manifold.....	20 Nm

### Install, Connect

Coolant pipe to coolant reservoir

If removed;

Vacuum Line (2) to intermediate piece for brake servo connection.

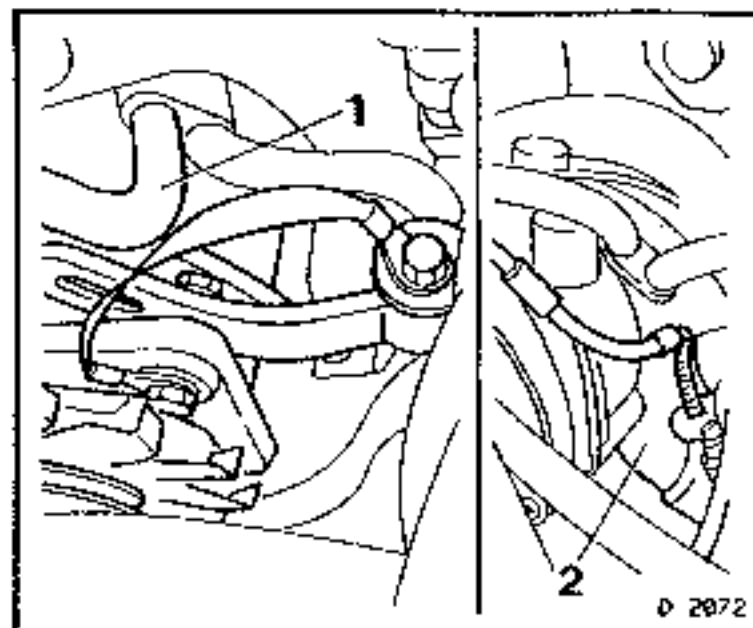


## Tighten (Torque)

Clamping bracket to alternator and intake manifold .....	18 Nm
Support to alternator and intake manifold.....	18 Nm
Alternator clamping bracket to intake manifold.....	25 Nm

### Install, Connect

Coolant hose (1 and 2).





# DOHC ENGINE - CYLINDER HEAD

## Install, Connect

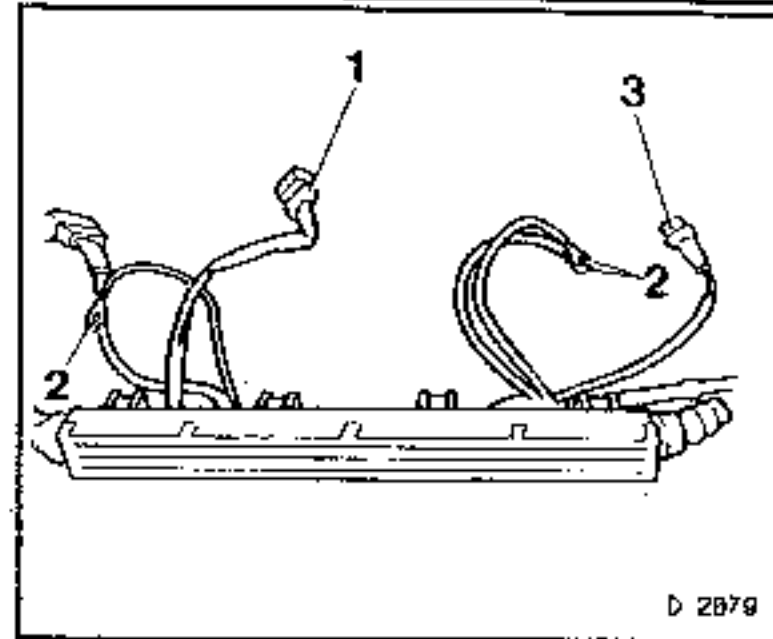
Wiring harness plug (3) to controlled canister purge valve.

Ground connections (2) to fuel distributor pipe.

Wiring harness plug (1) to throttle valve switch (M 2.5) or potentiometer (M 2.8).

Plug strip to injectors.

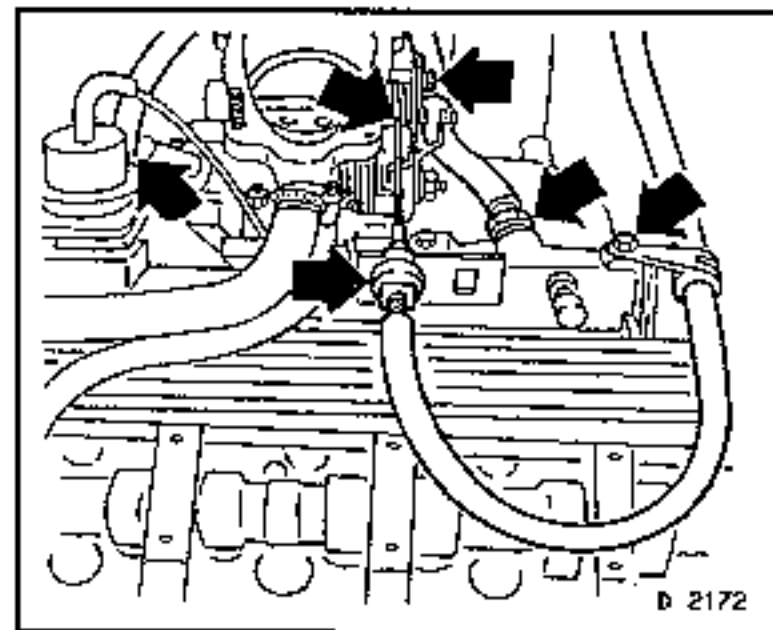
Check that all ground connectors are in good condition and secure.



## Install, Connect

Fuel lines. Disconnect clamps.

Bowden cable. Install with no tension on the cable.



## Install, Connect

C 20 XE Engines as of MY'93:

Wiring harness plug to camshaft sensor and dual spark ignition coil.

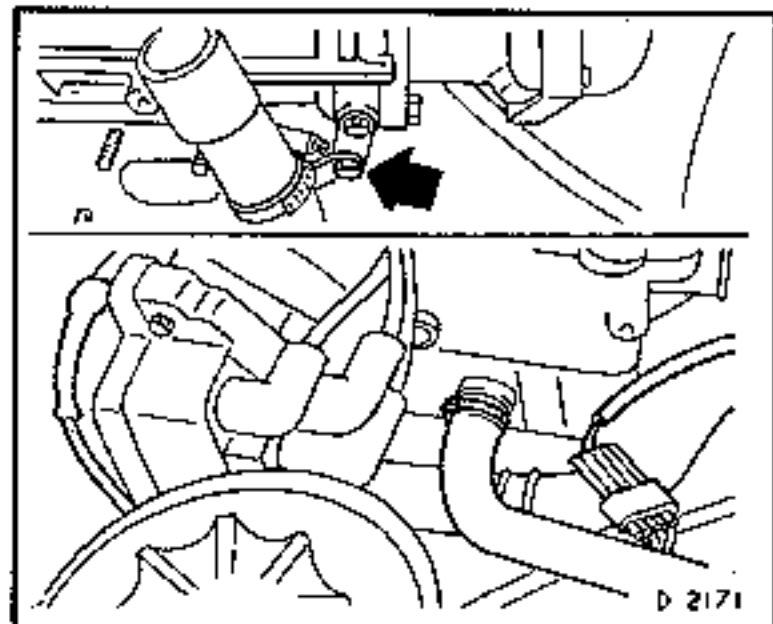
Coolant hose to cylinder head.

Multi-plug.

Wiring harness plug and high voltage cable to high voltage distributor.

Fastening bolt (arrow) to cylinder head.

Wiring harness plug and upper coolant hose to thermostat housing.



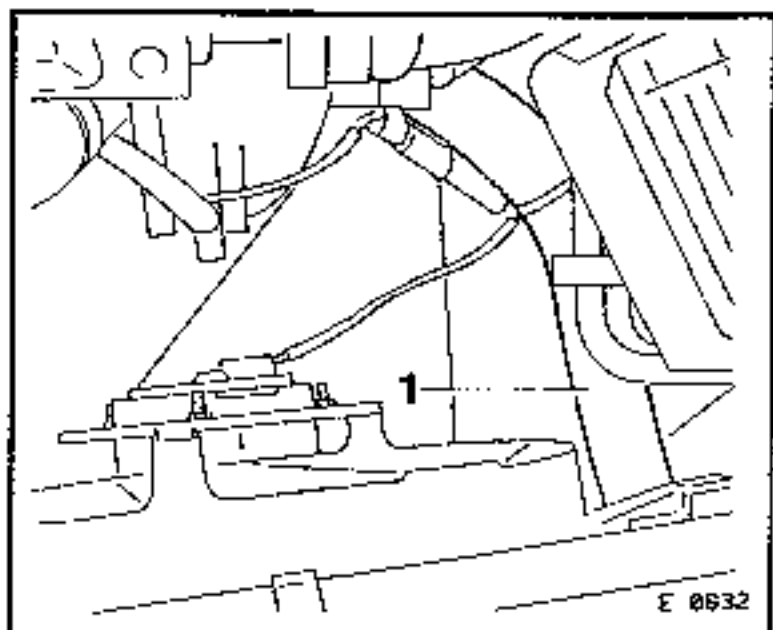
## Install, Connect

Performance header. Refer "Gasket, Performance Header to Cylinder Head, Replace". In this Section.

Camshaft gear/s. Refer "Camshaft Gears, Remove and Install", In this Section.

Toothed Belt. Refer "Toothed Belt, Replace", in this Volume.

Lower coolant hose (1) to the radiator.



# DOHC ENGINE - CYLINDER HEAD

## Install, Connect

Pre-volume chamber (3) with mass air flow meter.

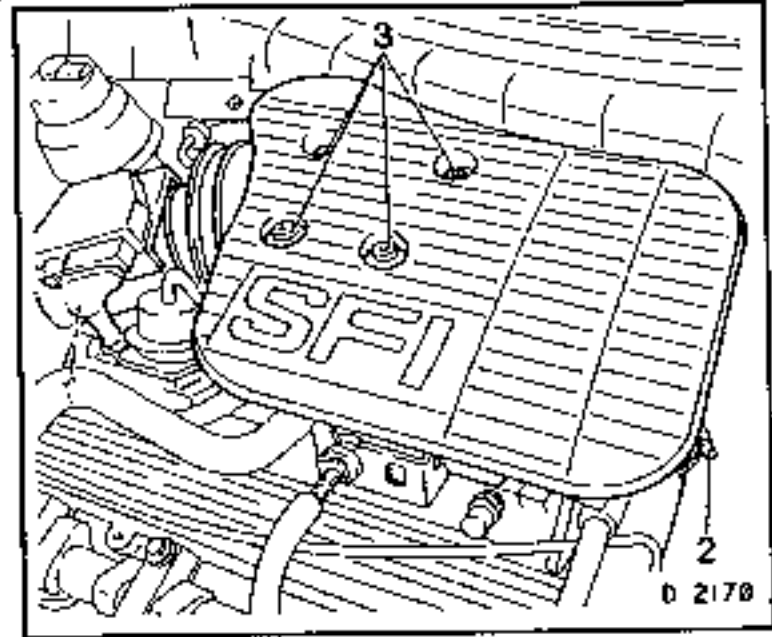
Hose (2) to pre-volume chamber.

Wiring harness plug (1) to air flow meter.

Engine compartment cover.

Ground cable to battery.

Top up and bleed cooling system. Refer "Cooling System", in this Volume.



## Cylinder Head, Remove and Install (C 20 LET)

### Important!

Only remove the cylinder head when the engine is cold, (i.e. at room temperature).

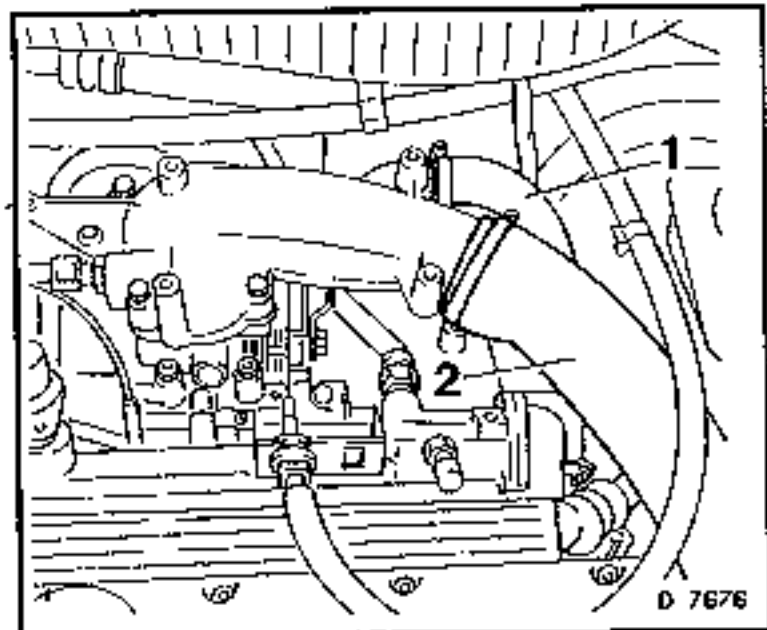
### Remove, Disconnect

Ground cable from battery.

Cover from throttle valve manifold.

Air hose (1) from throttle valve manifold.

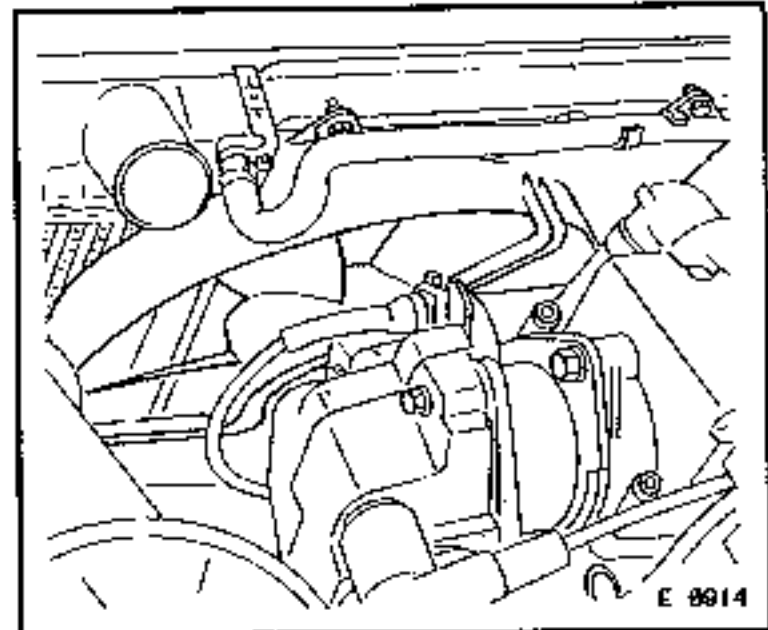
Air hose (2) from charge air cooler or from throttle valve manifold.



### Remove, Disconnect

Wiring harness plug from fan motor.

Fan motor with fan shroud.



### Remove, Disconnect

The lower coolant hose from the radiator. Collect coolant in a suitable, clean container.

#### Note:

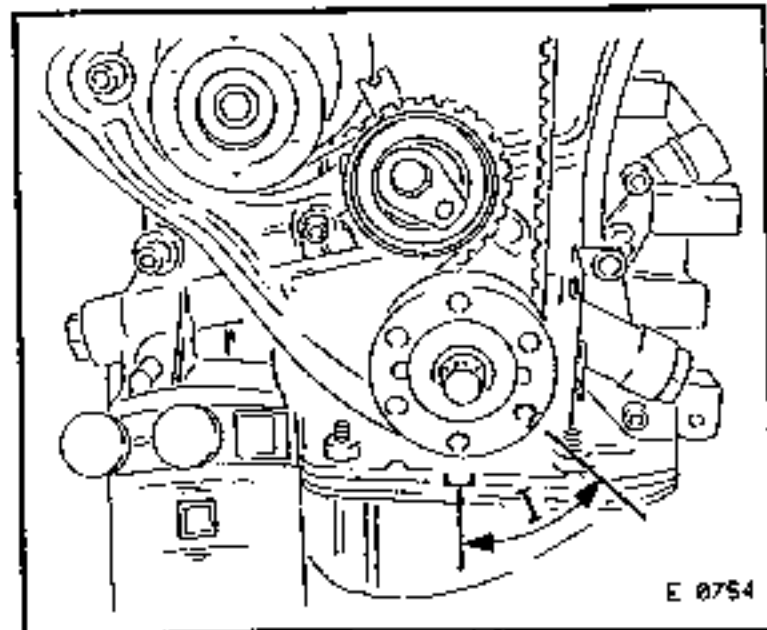
Before removing the toothed belt, rotate the crankshaft in the direction of engine rotation until the TDC mark is 60° BTDC (dimension I).

Mark the direction of rotation of the toothed belt.

Toothed Belt. Refer "Toothed Belt, Replace", in this Volume.

Camshaft gear/s. Refer "Camshaft Gears, Remove and Install", in this Section.

Exhaust manifold with turbocharger. Refer to the Section, "Turbocharging System - C 20 LET" in this Volume.

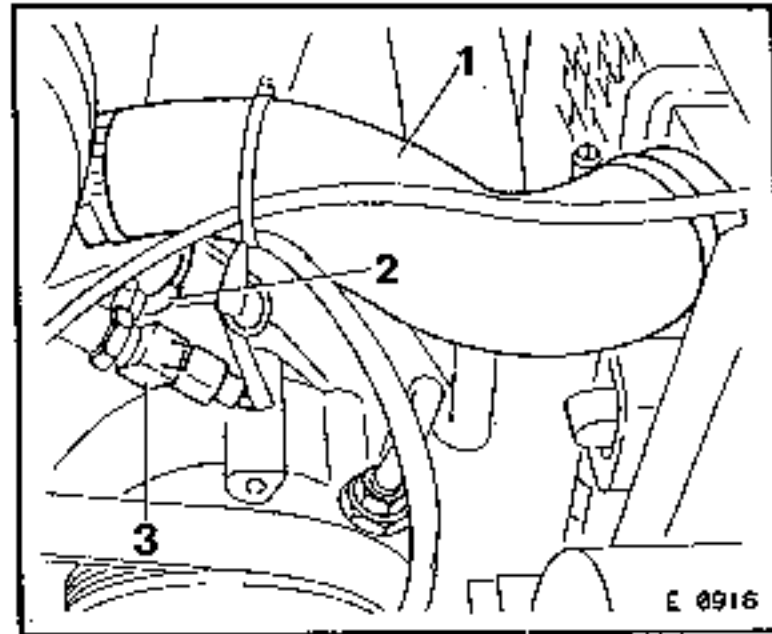


# DOHC ENGINE - CYLINDER HEAD

## Remove, Disconnect

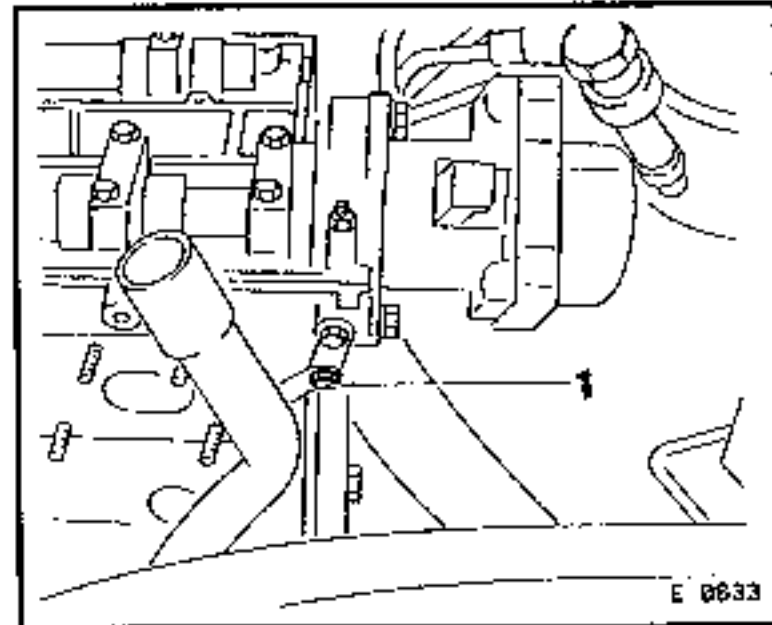
Coolant hose (1).

Wiring harness plugs (2 and 3) from the thermostat housing.



## Remove, Disconnect

Fastening bolt (1) from the cylinder head.

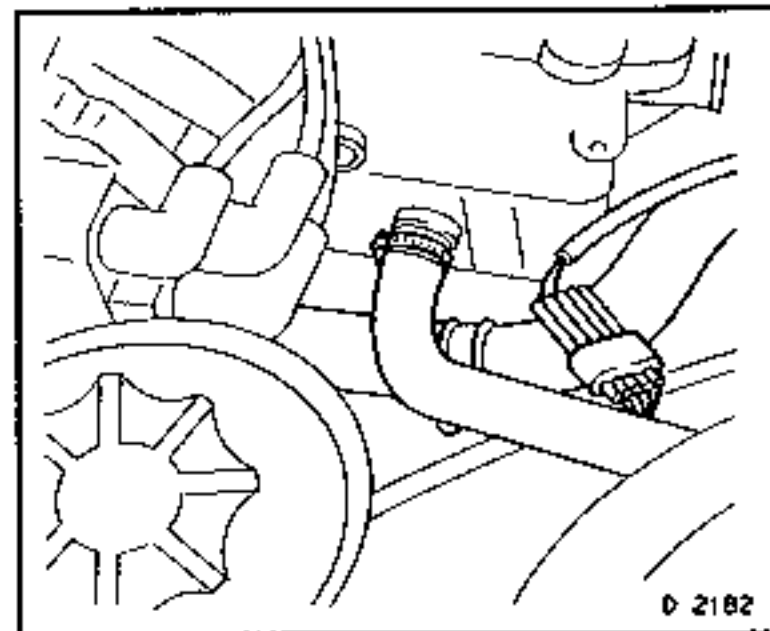


## Remove, Disconnect

Coolant hose.

Multi-plug.

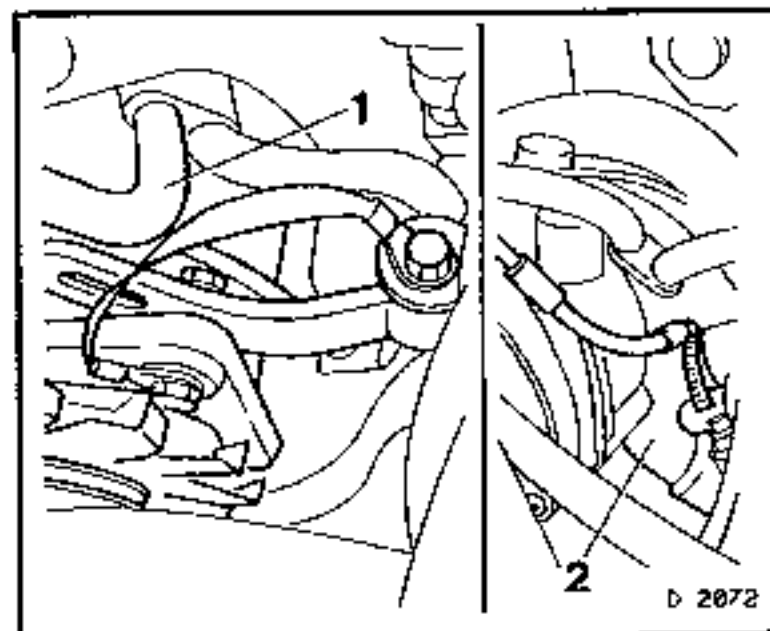
Wiring harness plug and high voltage cable from the high voltage distributor.



## Remove, Disconnect

Coolant hose (1) from the coolant reservoir tank.

Coolant hose (2) from the intake manifold.

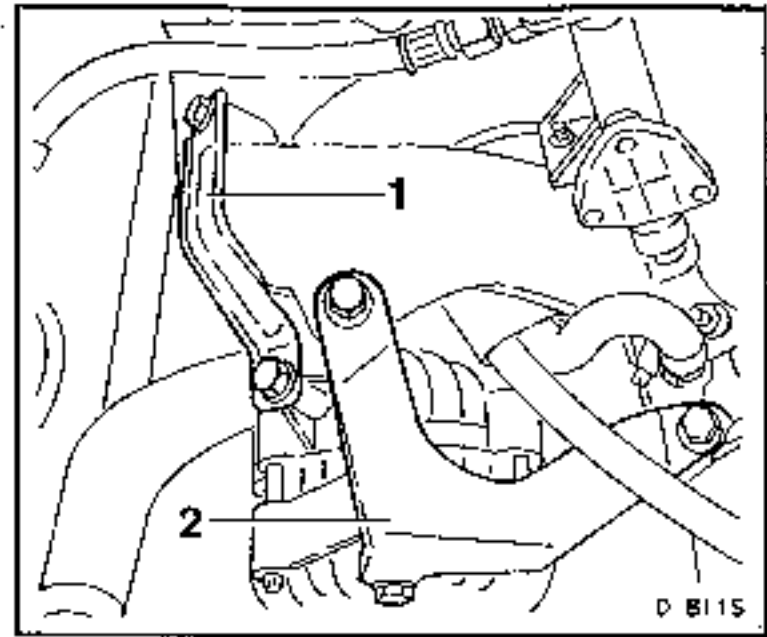


# DOHC ENGINE - CYLINDER HEAD

## Remove, Disconnect

Clamping bracket and brace from alternator or from intake manifold.

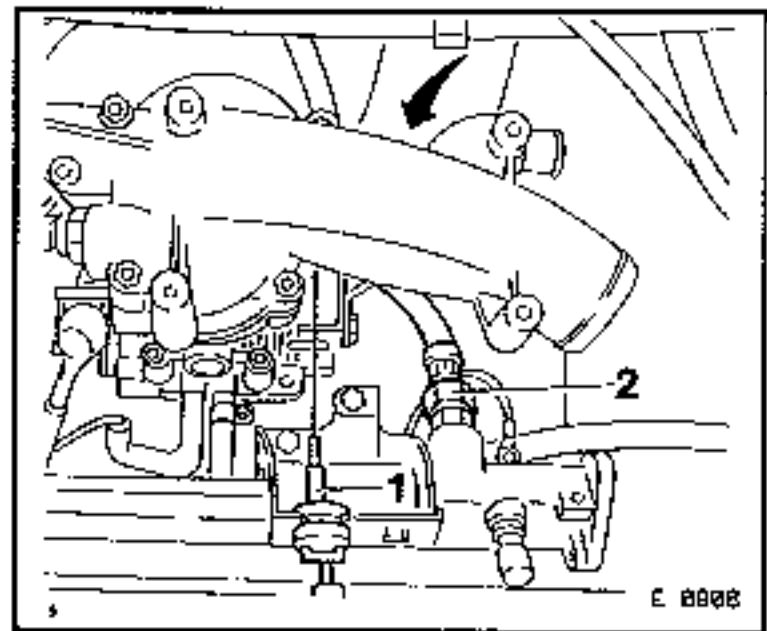
Loosen lower alternator bolt and swing alternator to the rear.



## Remove, Disconnect

Bowden cable (1), fuel line bracket (arrow).

Close off fuel lines using a suitable clamp.



## Remove, Disconnect

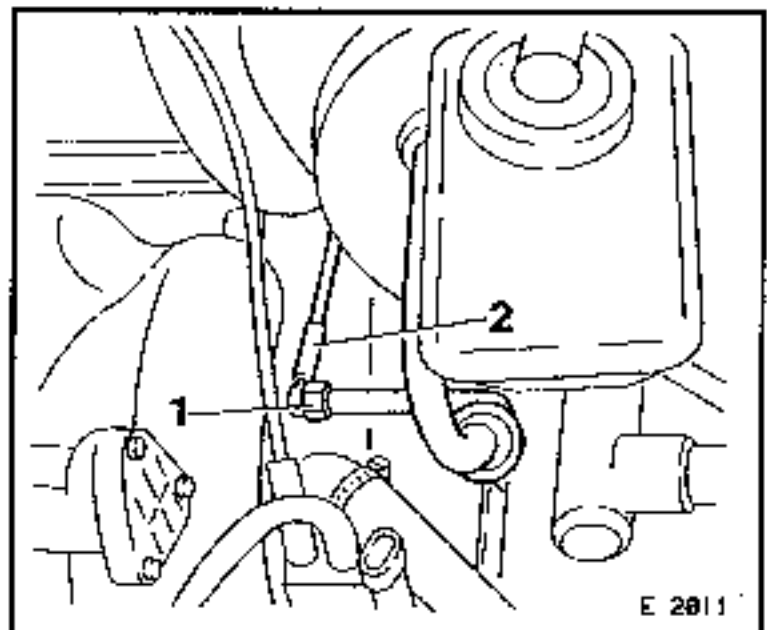
Brake servo line (1) from the intake manifold.

If fitted;

Vacuum line (2) from intermediate piece for brake servo connection.

Intake manifold to cylinder block support from Intake manifold.

Coolant pipe from the coolant reservoir tank.



## Remove, Disconnect

Injector plug strip from connectors. To do this, first pull back retaining clamp for the No. 1 injector.

Wiring harness plug (1) from hot start valve.

Wiring harness plug (2) from intake air temperature sensor.

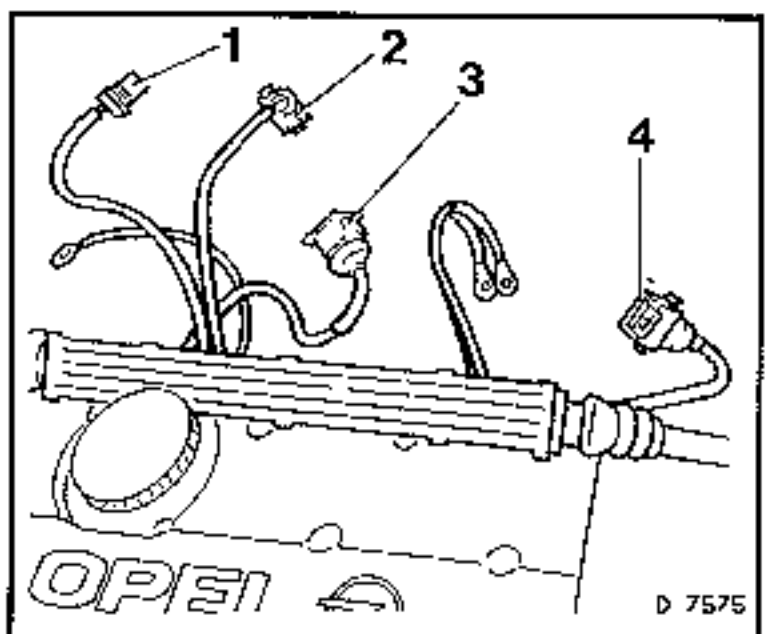
Wiring harness plug (3) from throttle valve potentiometer.

Wiring harness plug (4) from controlled canister purge valve.

Ground connections from fuel distributor pipe.

### Note:

Routing of all wiring and connections.

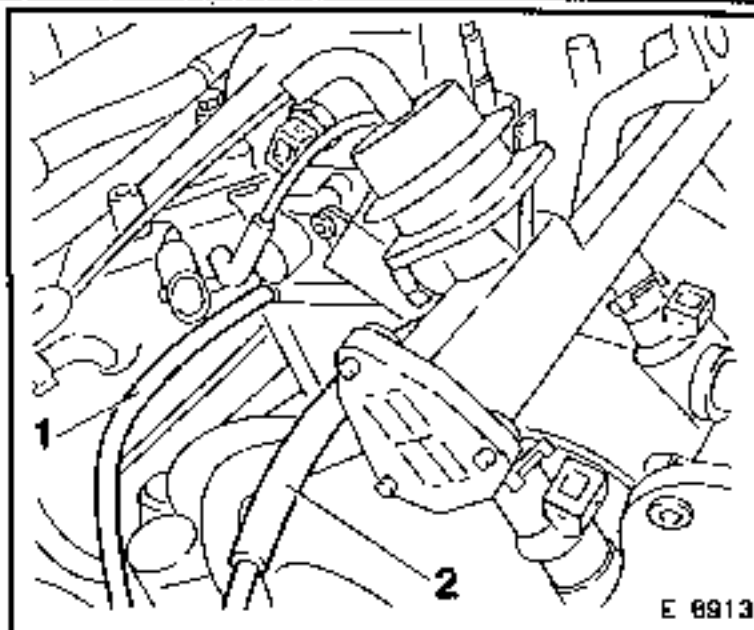


# DOHC ENGINE - CYLINDER HEAD

## Remove, Disconnect

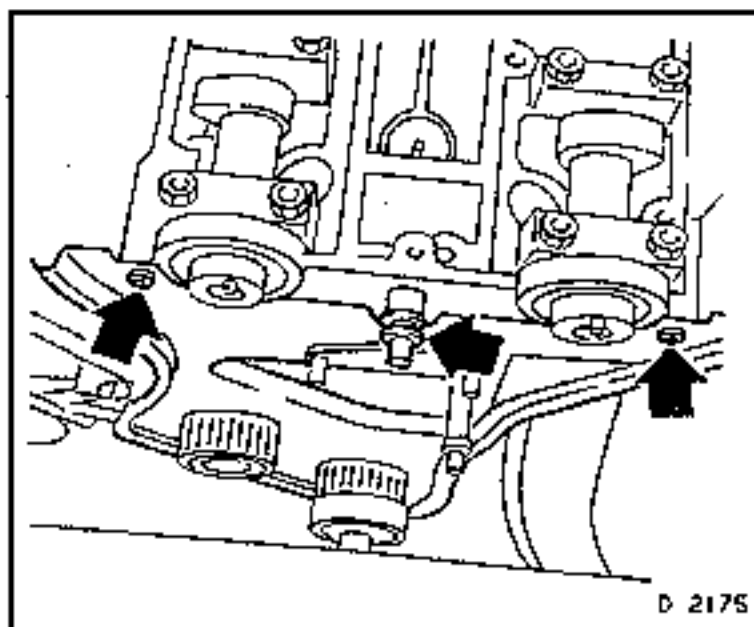
Vacuum hose (1) from the throttle body.

Vacuum hose (2) from the 'T' piece.



## Remove, Disconnect

Fastening bolts (arrows) of the rear toothed belt cover from the cylinder head. Refer to this operation in "Engine, Timing Side, Air Cleaner", in this Volume.



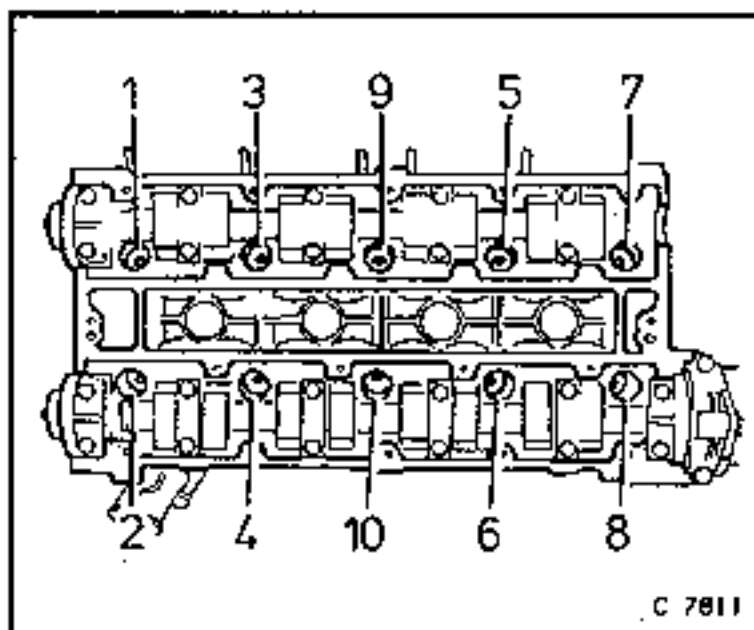
## Remove, Disconnect

Progressively loosen the cylinder head bolts in the sequence shown, using MKM-604-19-A (Torx E 14).

### Important!

First loosen all bolts  $\frac{1}{4}$  turn, then  $\frac{1}{2}$  turn.

When removing the bolts, take note of the washers.



## Clean

All sealing surfaces, counter bores for the cylinder head bolts and the threads in the cylinder block.

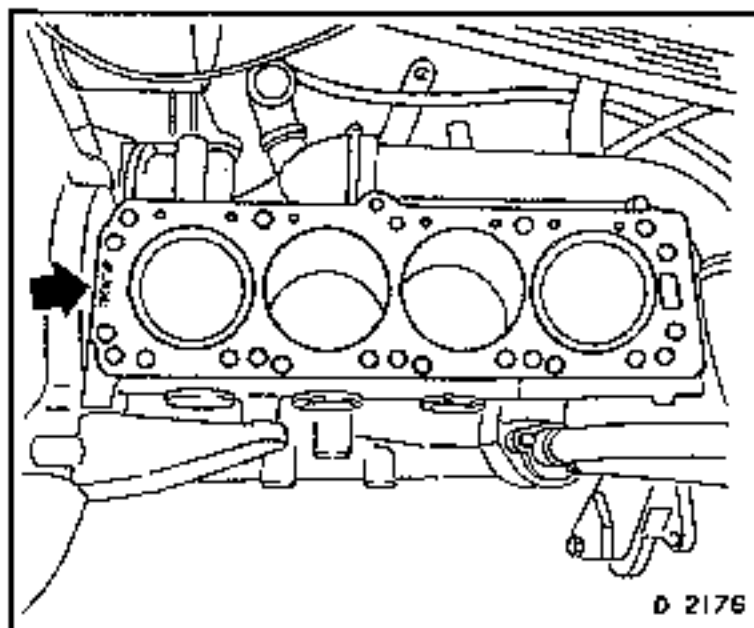
Take care not to damage finely machined surfaces.

## Check

Cylinder block and head for plane surface. Refer to this operation at the end of this Section.

## Install, Connect

New cylinder head gasket onto the guide bushes in the cylinder block. Align the mark "OBEN/TOP" (arrow), upwards and towards the timing side of the engine.



# DOHC ENGINE - CYLINDER HEAD

## Install, Connect

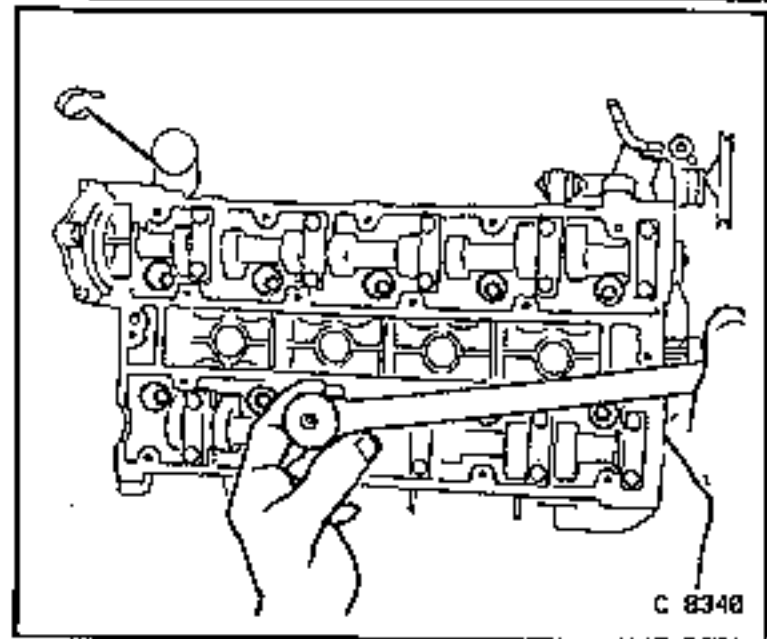
Mount cylinder head on the cylinder block, indexing with the location tubes in the cylinder block.

Insert new cylinder head bolts with their washers.

### Important!

New bolts MUST be used.

Insert bolts until they are all seated, using MKM-604-19-A (Torx E 14).



## Tighten (Torque)

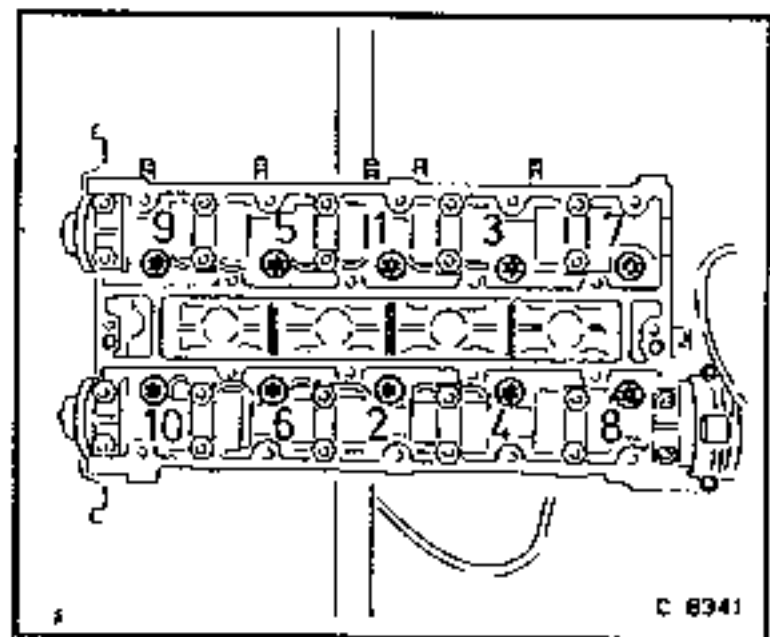
Cylinder head to cylinder block.

Tighten cylinder head bolts in the sequence shown, in four stages, using angular torque wrench KM-470-B.

### Torque - Angle Method

Tightening procedure..... 25 Nm + 90° + 90° + 90° \*

\* No re-tightening is required



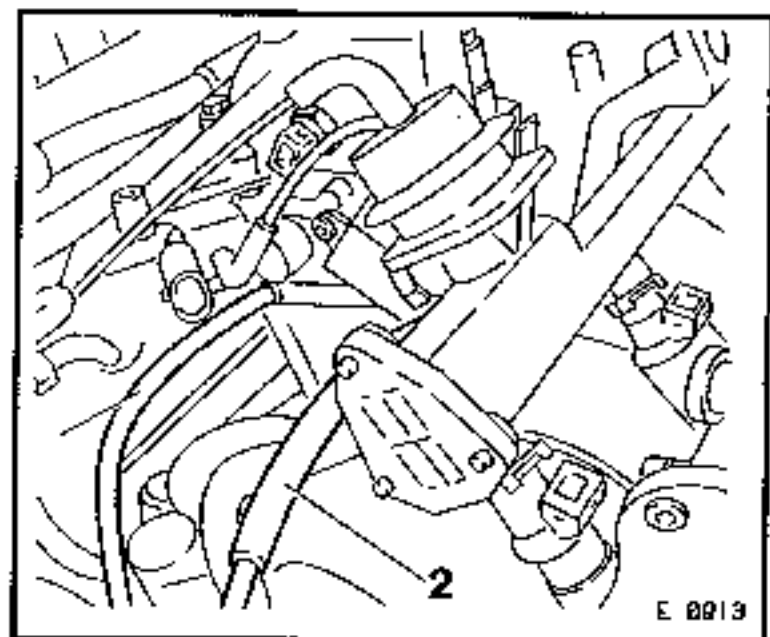
## Tighten (Torque)

Rear toothed belt cover to cylinder head..... 6 Nm

## Install, Connect

Vacuum hose (1) to throttle body.

Vacuum hose (2) to the 'T' piece.



## Install, Connect

Ground connections to the fuel distributor pipe.

Wiring harness plug (4) and vacuum hose from carbon canister to controlled canister purge valve.

Wiring harness plug (3) to throttle valve potentiometer.

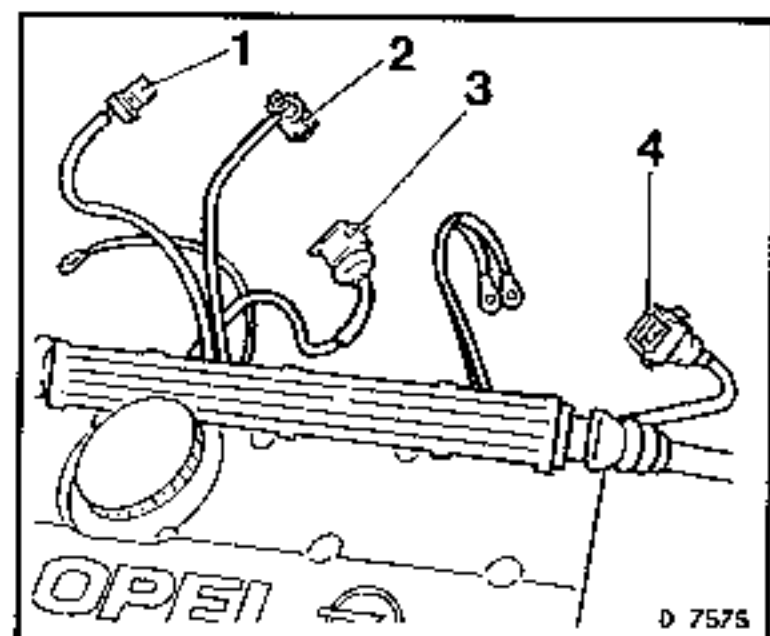
Wiring harness plug (2) to intake air temperature sensor.

Wiring harness plug (1) to hot start valve.

### Note:

Routing of all wiring and connections.

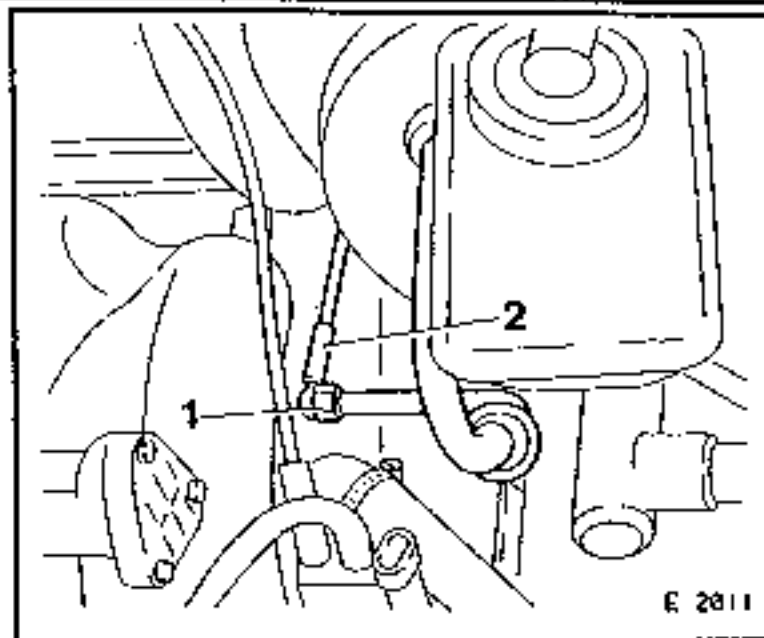
The injector plug strip to the injectors.



# DOHC ENGINE - CYLINDER HEAD

## Tighten (Torque)

Intake manifold to cylinder block support ..... 25 Nm  
 Brake servo line (1) to intake manifold ..... 20 Nm  
 If removed;  
 Vacuum line to intermediate piece for brake servo  
 connection.



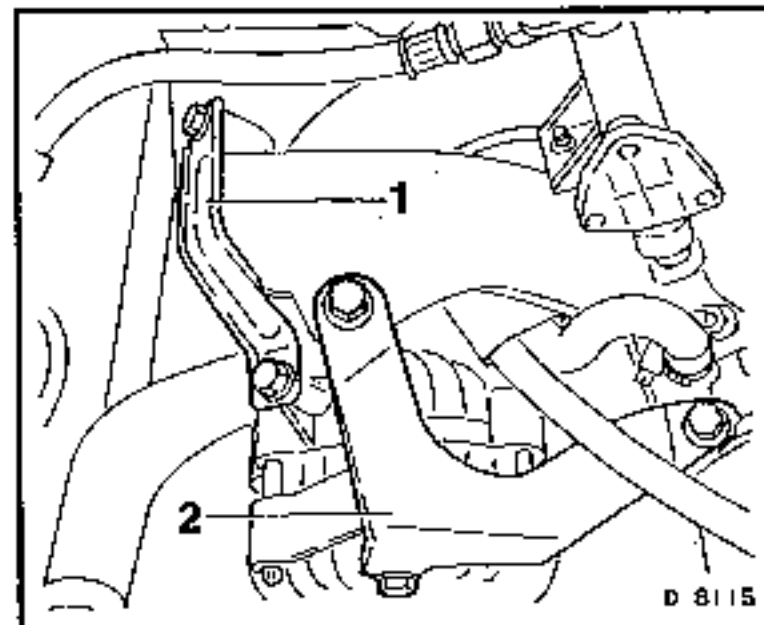
## Install, Connect

Fuel lines. Disconnect clamps.

Bowden cable. Install with no tension on the cable.

## Tighten (Torque)

Clamping bracket (1) to alternator  
 and intake manifold ..... 18 Nm  
 Support (2) to alternator and  
 intake manifold ..... 18 Nm  
 Alternator clamping bracket to  
 intake manifold ..... 25 Nm



Coolant pipe to coolant reservoir tank or to intake  
 manifold

## Install, Connect

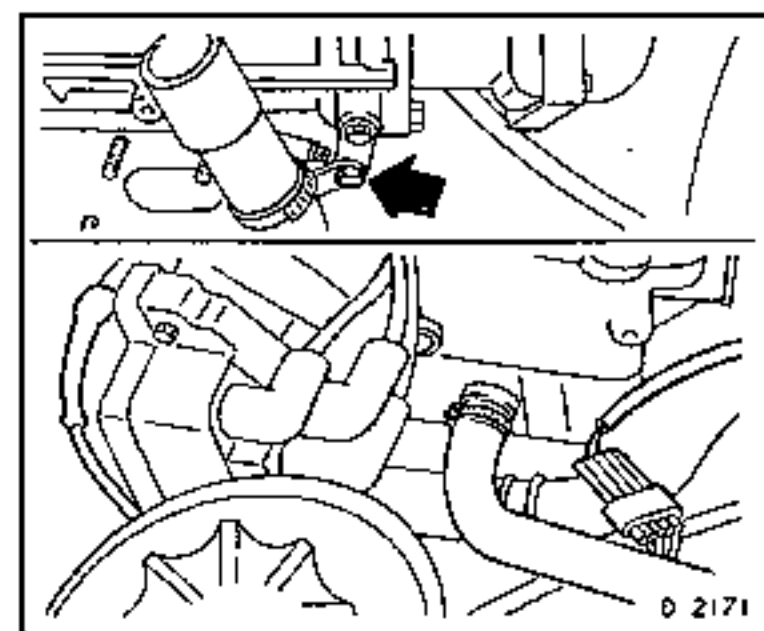
Coolant hose to cylinder head.

Multi-plug.

Wiring harness plug and high voltage cable to high  
 voltage distributor.

Fastening bolt (arrow) to cylinder head.

Wiring harness plug and upper coolant hose to  
 thermostat housing.

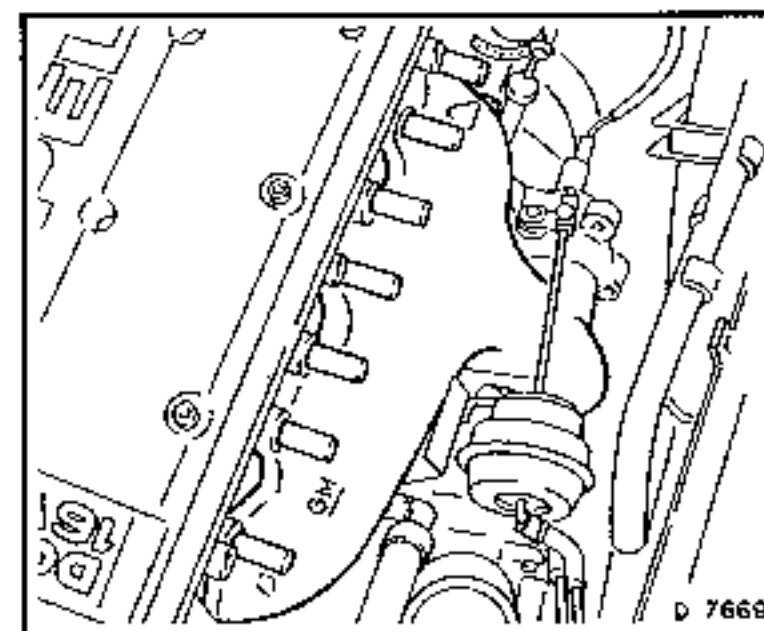


## Install, Connect

Exhaust manifold with turbocharger. Refer to the  
 Section, "Turbocharging System - C 20 LET" in this  
 Volume.

Camshaft gear/s. Refer "Camshaft Gears, Remove and  
 Install", in this Section.

Toothed Belt. Refer "Toothed Belt, Replace", in this  
 Volume.



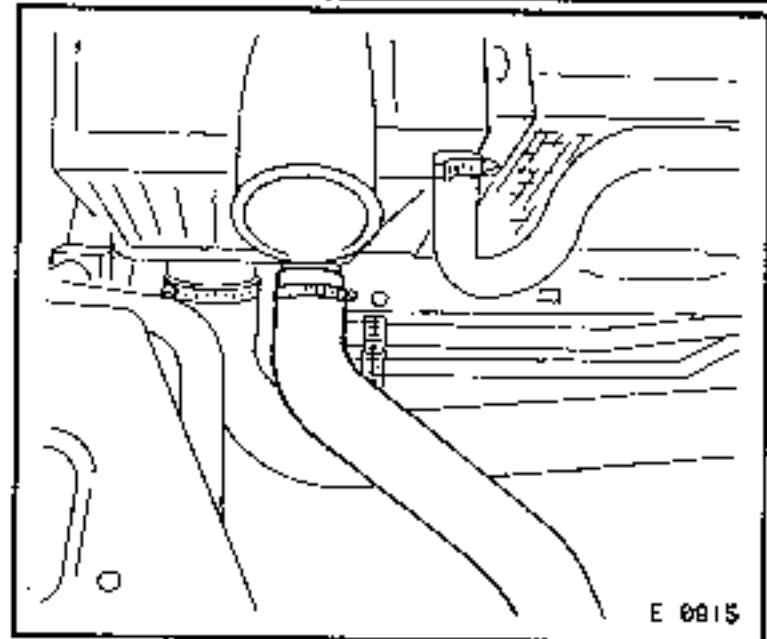
# DOHC ENGINE - CYLINDER HEAD

## Install, Connect

Lower coolant hose to radiator.

Fan motor with radiator fan shroud, to radiator.

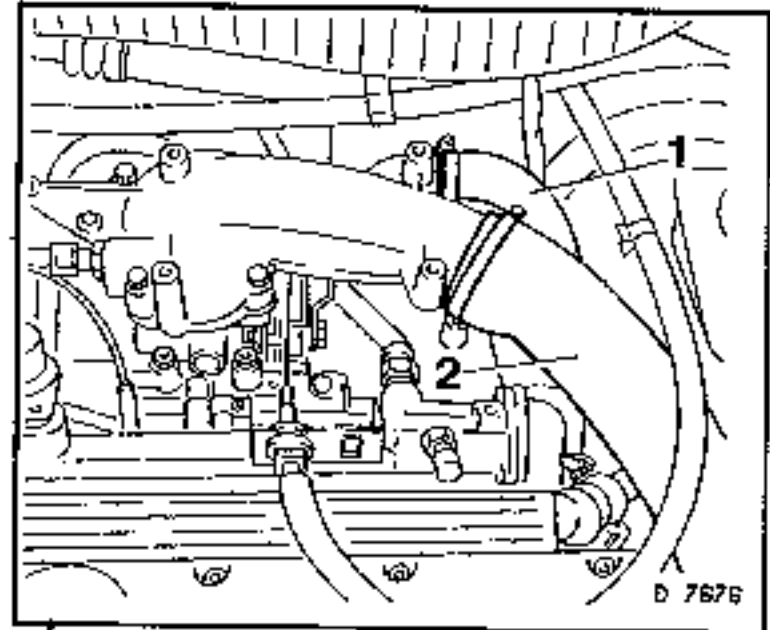
Wiring harness plug to fan motor.



## Install, Connect

Air hose (1) to throttle valve manifold/

Air hose (2) to charge air cooler or to throttle valve manifold.



## Install, Connect

Cover to throttle valve manifold

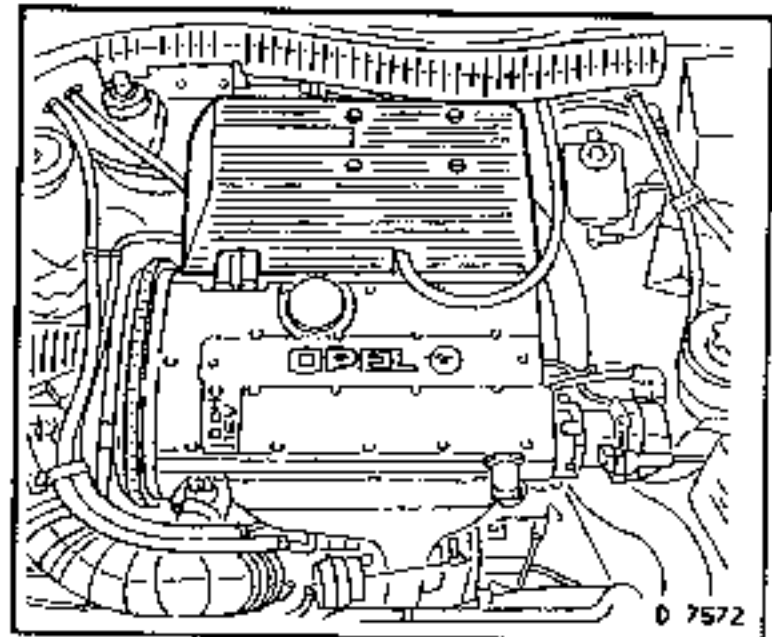
## Tighten (Torque)

Cover to throttle valve manifold ..... 5 Nm

Ground cable to battery.

Check engine oil level and adjust as necessary.

Top up and bleed cooling system. Refer to the Section, "Cooling System" in this Volume.



## Cylinder Head, Disassemble & Assemble

### Remove, Disconnect

Cylinder head. Refer to the previous operations in this Section.

High voltage distributor.

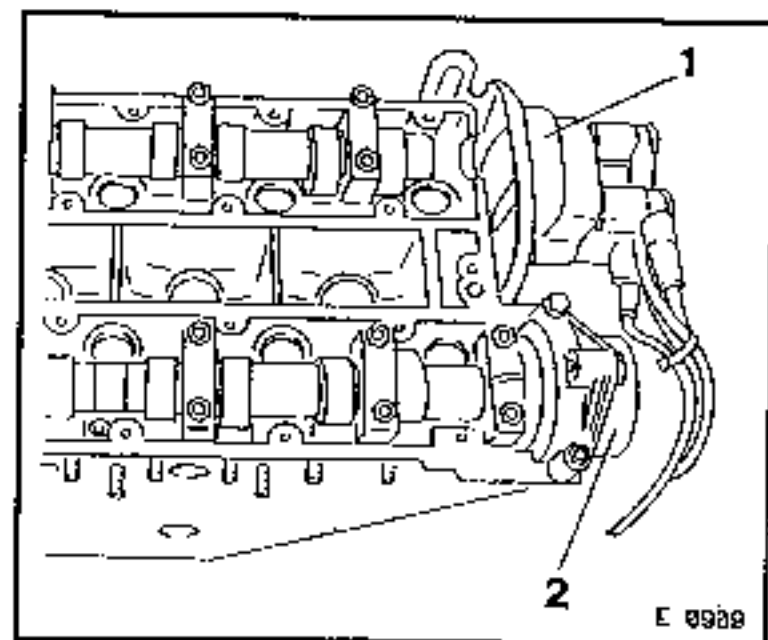
Intake manifold.

Thermostat housing.

Spark plugs, using KM-194-B.

C 20 XE Engine as of MY93:

Dual spark ignition coil (1) and camshaft sensor (2).





# DOHC ENGINE - CYLINDER HEAD

## Remove, Disconnect

Camshaft bearing covers.

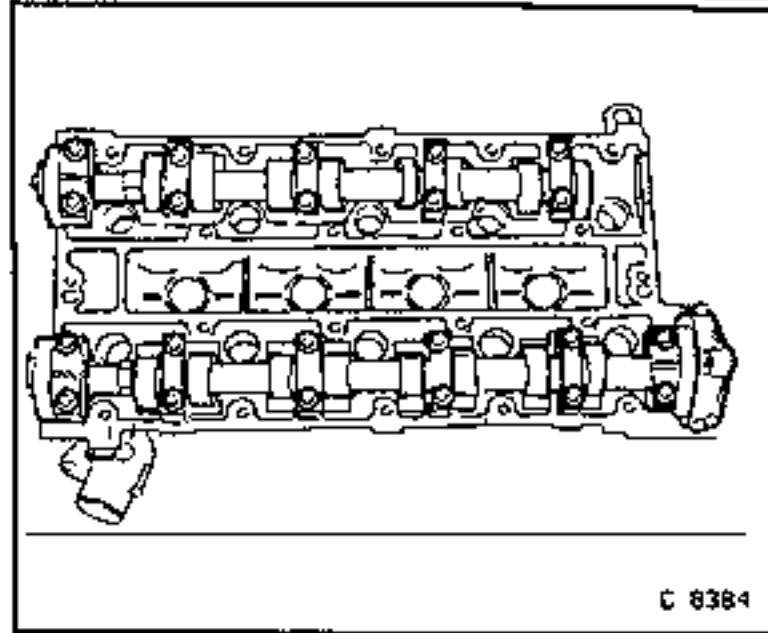
Progressively loosen nuts in stages of  $\frac{1}{2}$  to 1 turn, working from the outside, inwards.

### Note:

The numbered identification markings on each camshaft bearing cap.

### Important!

Camshaft must come away evenly from the bearing seats and from the front guide bearing.



## Remove, Disconnect

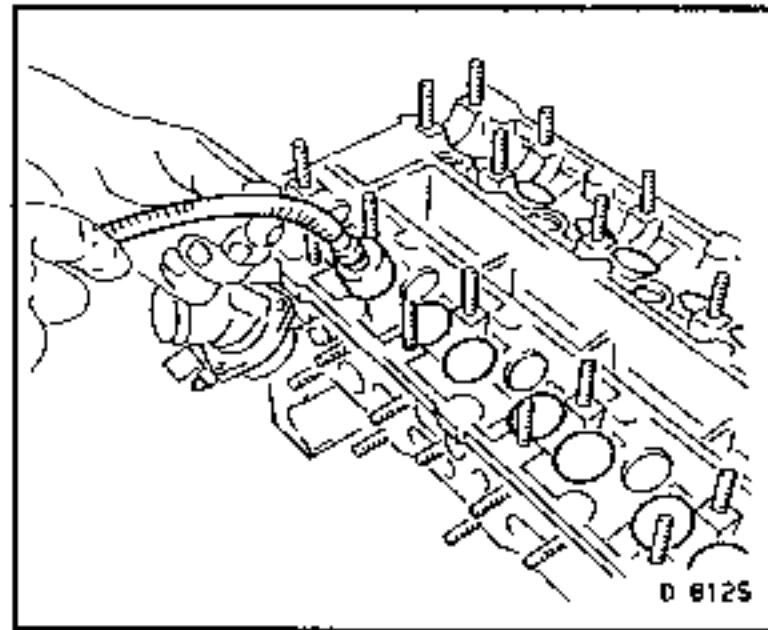
Hydraulic valve lifters using a suitable sized suction cup.

### Important!

Store all lifters in the order of removal and in the same attitude (groove in the lower area).

### Disassemble

There are no serviceable parts in the hydraulic valve lifters.



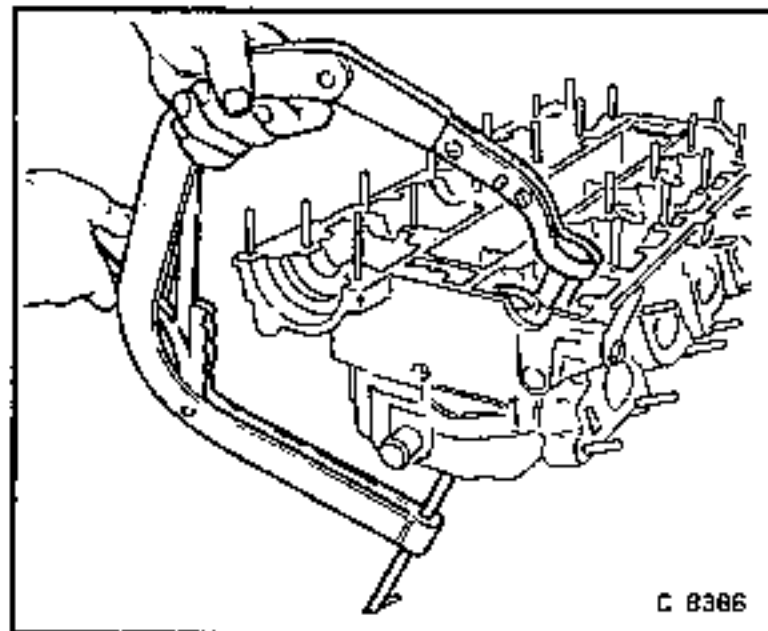
## Remove, Disconnect

Valves;  
Tension valve springs using KM-348 with adaptor KM-653.

Valve collets, valve spring plates and valve springs.

### Important!

All valve train components should be kept in their order of removal.



## Remove, Disconnect

Valve stem seals, as shown in illustration C 8387.

Valve spring washers.

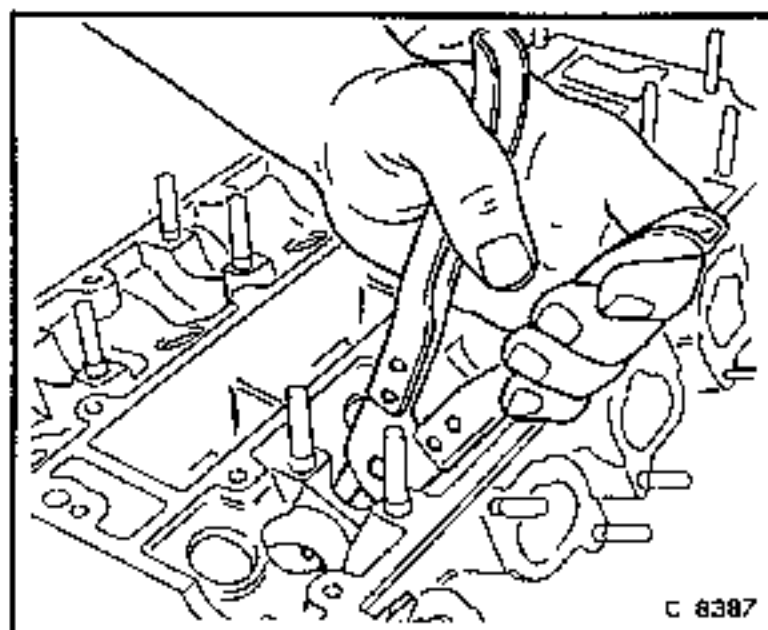
Valves.

### Important!

All valve train components should be kept in their order of removal.

### Important!

Sodium filled valves are not to be disposed of with 'normal scrap'. Local authority regulations and legal requirements must be observed when disposal is required.



# DOHC ENGINE - CYLINDER HEAD

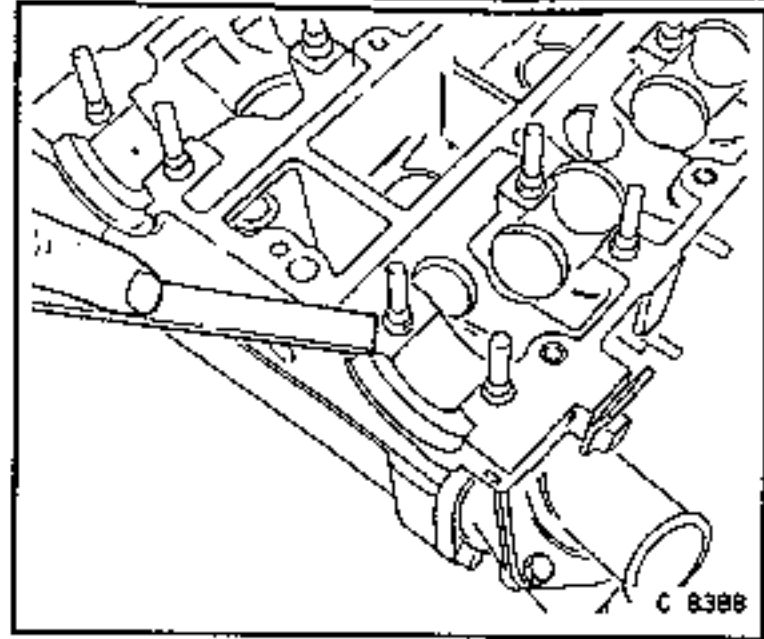
## Clean, Inspect

All component sealing surfaces, guides, sliding and bearing surfaces.

## Important!

Do not damage valve seats during the cleaning process.

Overhaul cylinder head. Refer to this operation later in this Section.



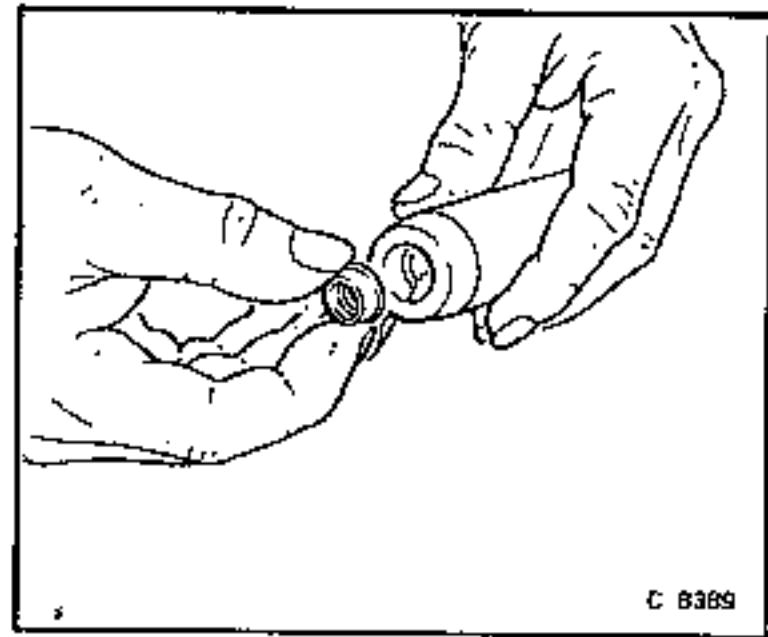
## Important!

Insert valves using clean engine oil.

Insert valve spring washers.

## Install, Connect

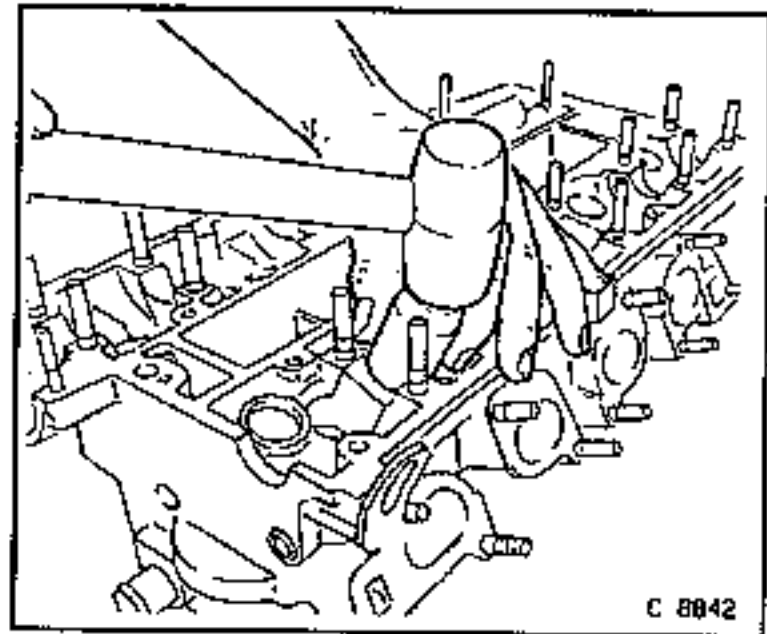
Lubricate installer KM-663 lightly with clean grease and install new valve stems.



## Install, Connect

Cut mounting sleeve (contained in the packaging) to the required length and place on the valve stem.

Use installer KM-663 with the valve stem seal mounted on the guide and install by lightly tapping with a hammer, until the installer bottoms out.



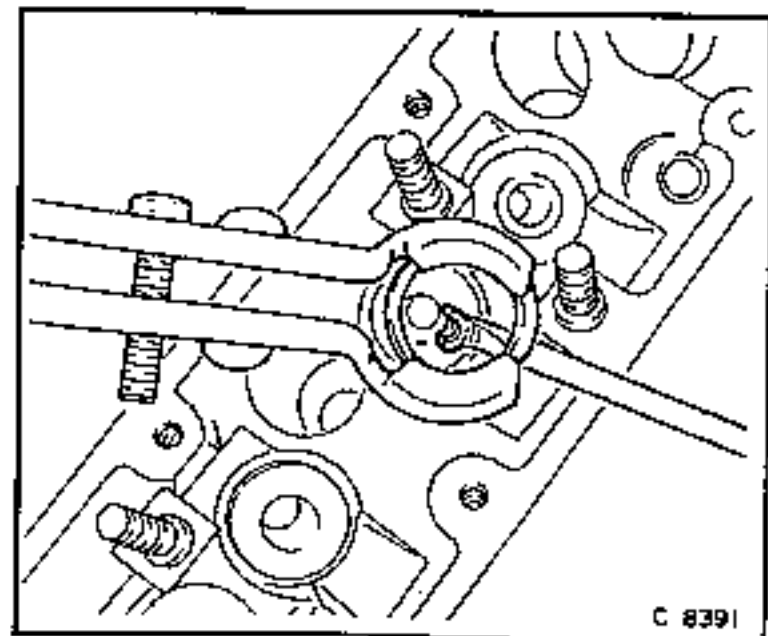
## Install, Connect

Valve springs, valve spring plates and valve collets, using KM-348 and adaptor KM-653.

Hydraulic valve lifters.

Lubricate all sliding and rotating components with molybdenum disulphide ( $\text{MoS}_2$ ) grease or spray.

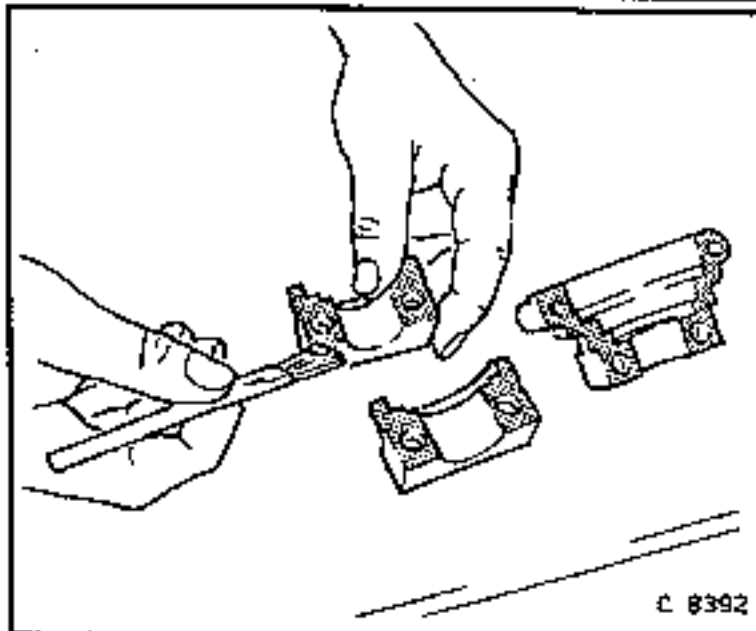
Insert both camshafts.



# DOHC ENGINE - CYLINDER HEAD

## Apply

Silicone sealing compound such as Dow Corning 732 or equivalent, to Holden's Specification HN1373, to the sealing surfaces of the outer camshaft bearing covers.

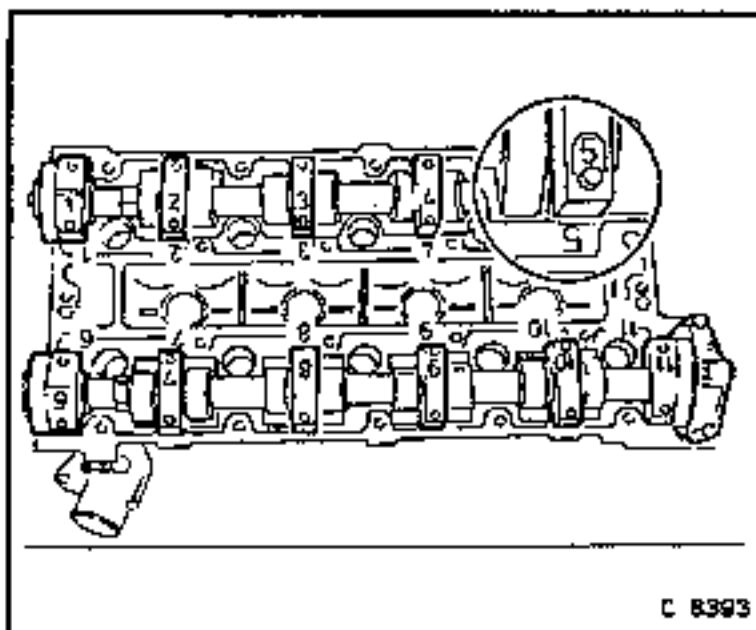


## Install, Connect

Camshaft bearing covers.

### Important!

Take care that the identification number on each cover, matches with the number on the cylinder head.

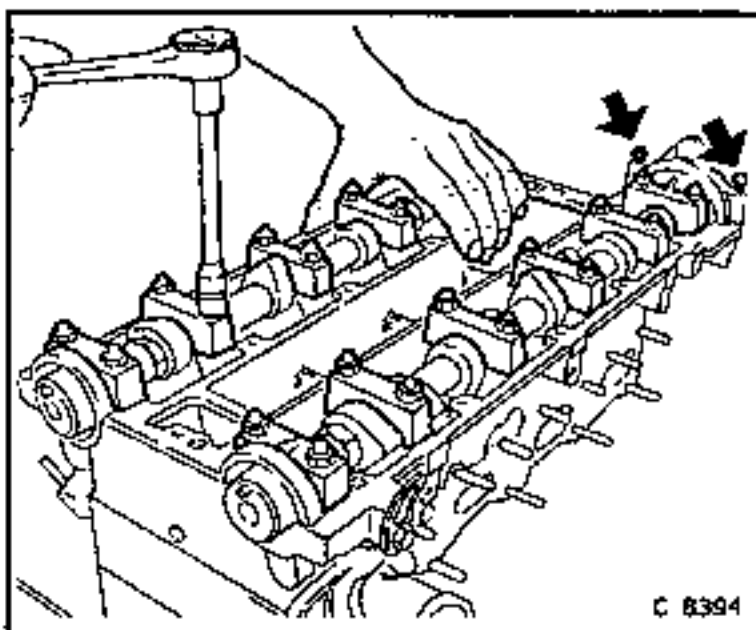


## Tighten (Torque)

Camshaft bearing cover to cylinder head (M 8) .....	20 Nm
Rear camshaft bearing cover (arrows) to cylinder head (M 6) .....	10 Nm

### Important!

Progressively tighten the camshaft covers  $\frac{1}{2}$  to 1 turn at a time, working from the centre, outwards.

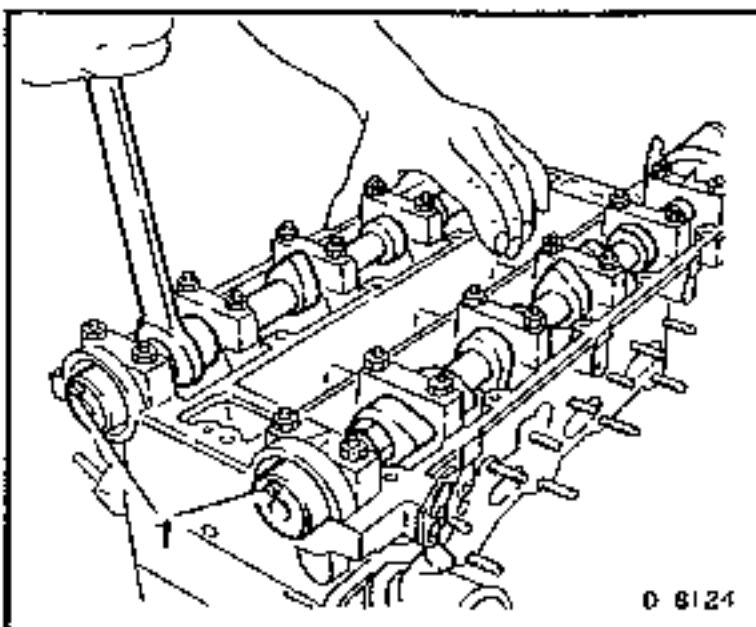


## Install, Connect

New seal rings, using KM-422 and the washer and bolt from one of the camshaft gears.

Lubricate each seal lip with grease before installing.

Rotate each camshaft using an open ended spanner on the camshaft hex provided, until each guide pin (1), points upwards.



# DOHC ENGINE - CYLINDER HEAD

## Install, Connect

Using KM-194-B, install spark plugs.

Thermostat housing to cylinder head using a new 'O' ring.

Intake manifold to cylinder head, using a new gasket.

## Tighten (Torque)

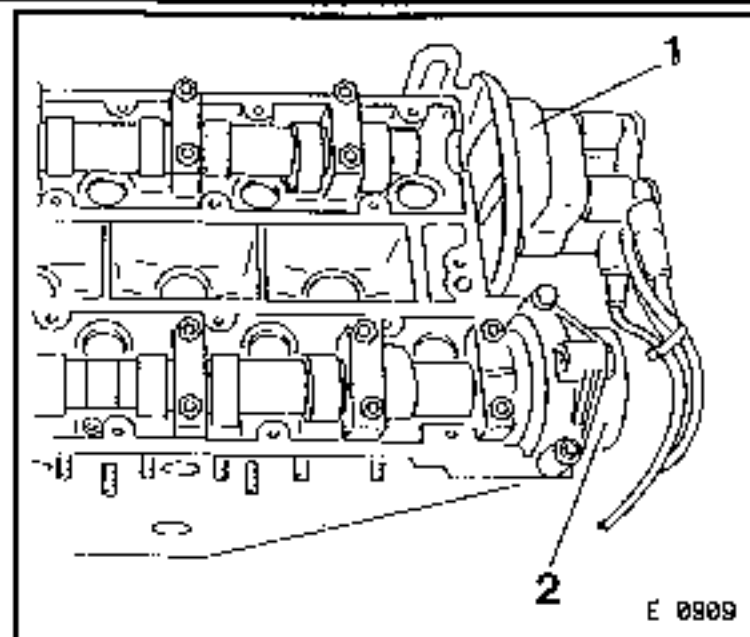
Spark plugs in cylinder head .....	25 Nm
Thermostat housing to cylinder head .....	15 Nm
Intake manifold to cylinder head .....	22 Nm

Cylinder head. Refer operation in this Section.

High voltage distributor. Refer to the appropriate Motronic Section in this Volume.

C 20 XE Engine as of MY'93:

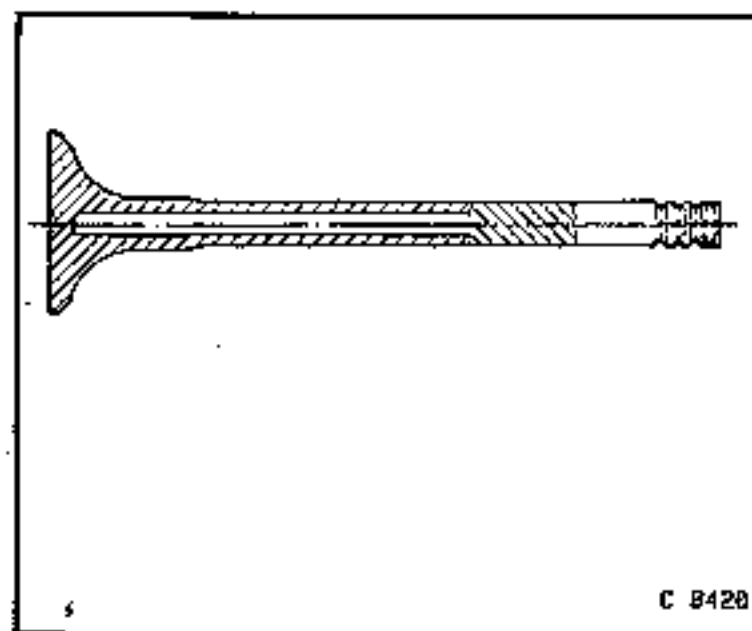
Dual spark ignition coil (1) and camshaft sensor (2). Refer to the appropriate Motronic Section in this Volume.



## Exhaust Valve (Sodium filled), Disposal

### Important!

Sodium filled valves are not be disposed of with 'normal scrap'. Local authority regulations and legal requirements must be observed when disposal is required.



## Cylinder Head, Overhaul

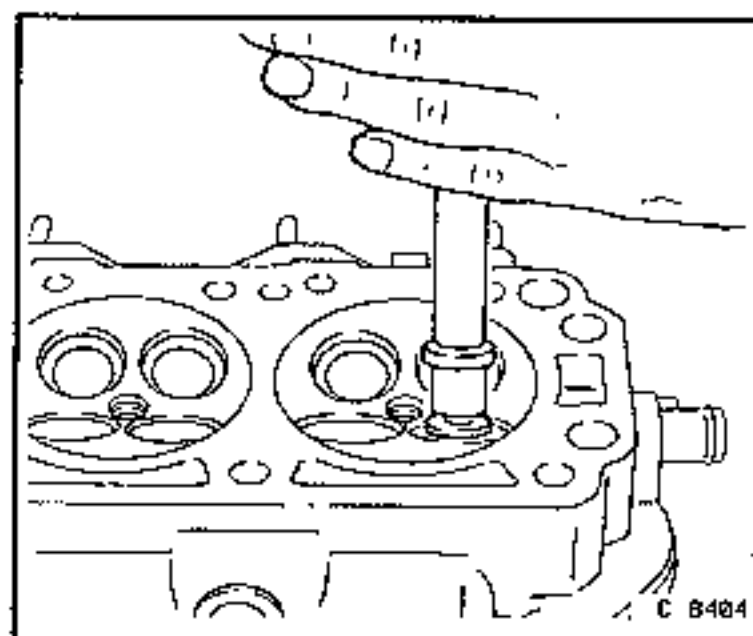
With cylinder head disassembled, as detailed in this Section.

### Valve, Lap In

Lightly oil the valve stem, then use fine grade lapping paste applied to the valve seat area. Using a lifting/rotating action in a rhythmical manner, distribute the valve lapping paste.

### Clean

Valves and cylinder head from all traces of valve lapping paste.



### Valve, Regrind

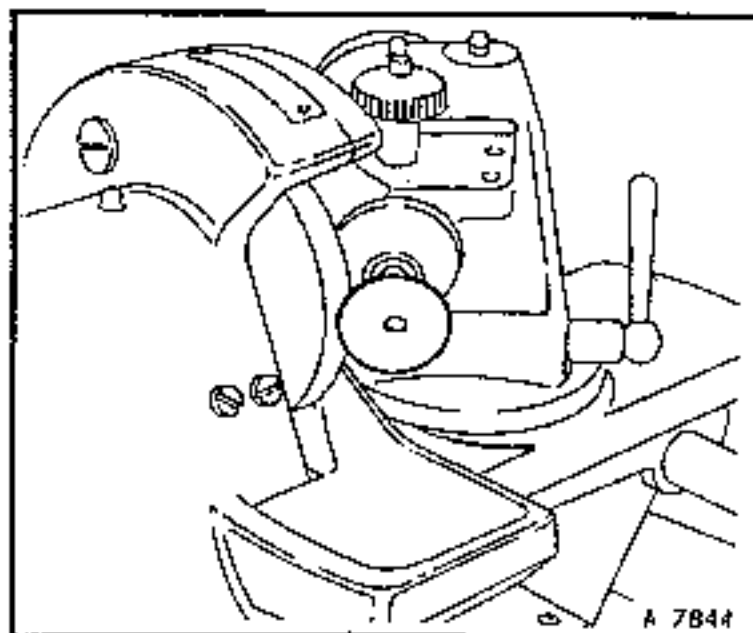
#### Important!

Should inspection show that either burning or pitting has occurred on the valve seat area, then the valve may be reground no more than twice.

The angle for valve grinding is 45° 20'.

### Inspect

Temporarily install valves and measure the stem height above the valve guide. Refer to 'Technical Data' at the end of this Volume for specifications.



# DOHC ENGINE - CYLINDER HEAD

## Valve, Guide, Measure

### Measure

Diameter of each valve guide, using a dial indicator and an internal measuring instrument.

### Important!

Oversize valve stems may have been fitted in production.

### Inspect

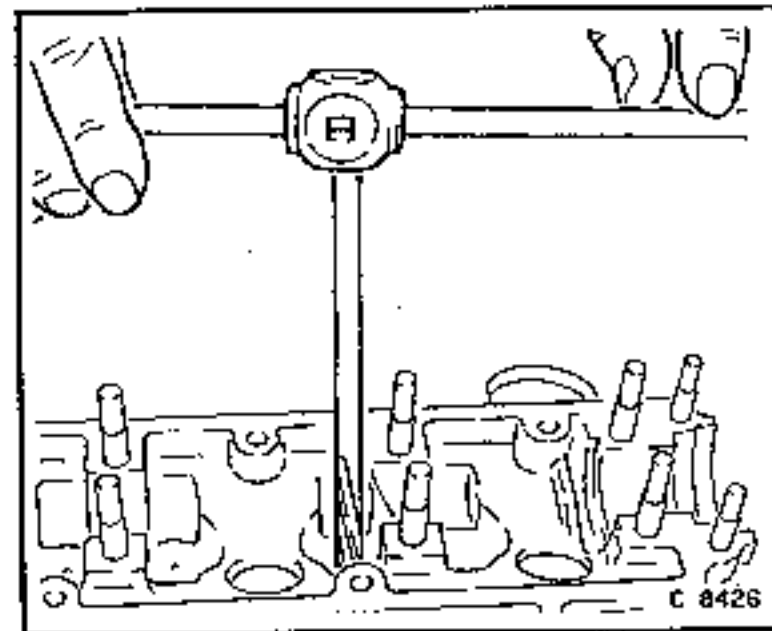
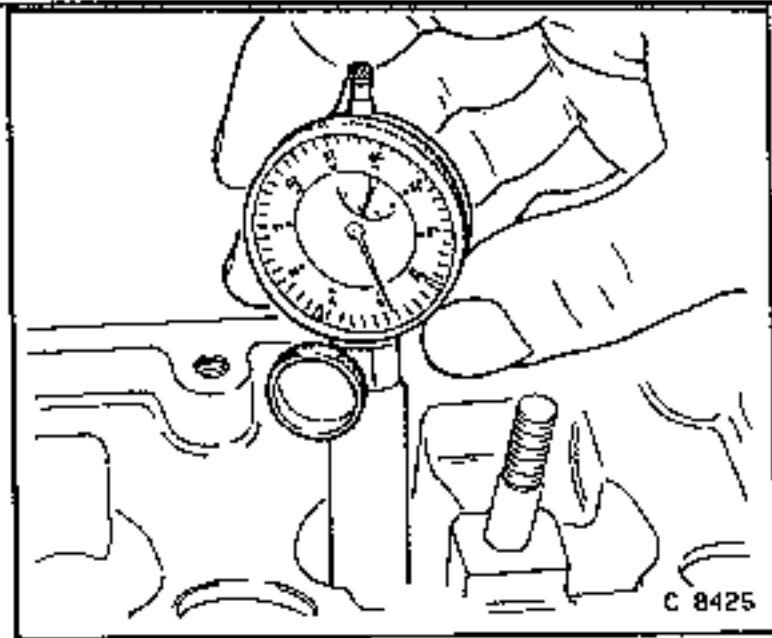
Valves with oversize stems can be identified by markings on the valve guide and the stem end, with the following markings:

Oversize (mm)	Reamer Number	Identification Mark	
		Production	Service
Standard	—	None	K
0.075	KM-664-1	1	K 1
0.150	KM-664-2	2	K 2

### Ream

The valve guide, using the next oversize reamer, working from the upper surface of the cylinder head, as shown.

When valve guides have been reamed oversize, remove the original markings and stamp in a new, identification.



## Valve Seat, Recondition

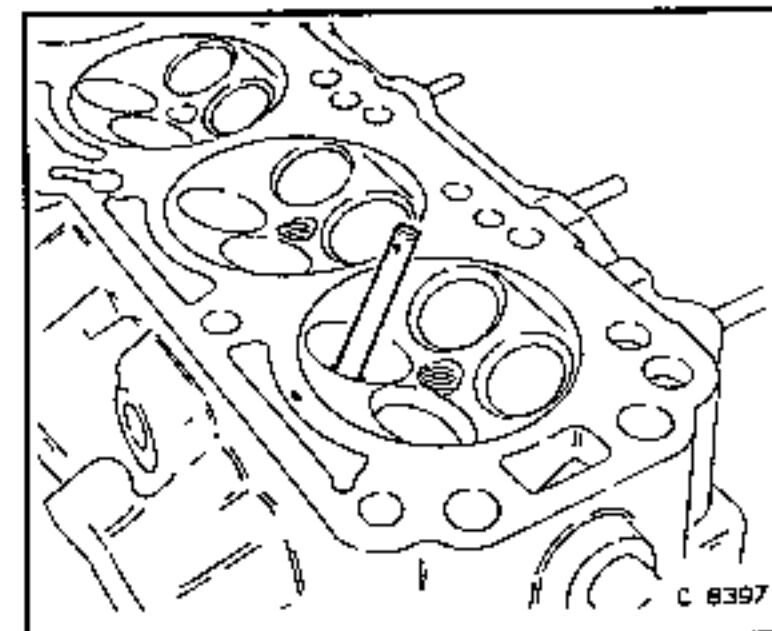
Support cylinder head on a suitable block of wood.

### Important!

Valve seat cutting depth is limited to 0.4 mm.

### Install, Connect

Guide drift KM-340-7.



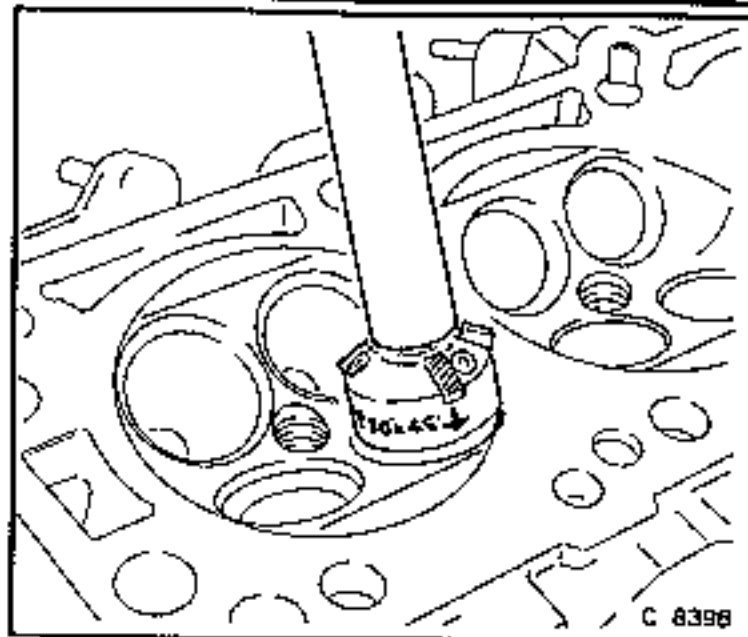
# DOHC ENGINE - CYLINDER HEAD

## Install, Connect

Valve seat cutter KM-340-12, then recondition valve seat, using the 45° side. Note that the upper side is the corrective 30° cutter.

### Important!

Take particular note of the directional arrows on the cutter.



## Install, Connect

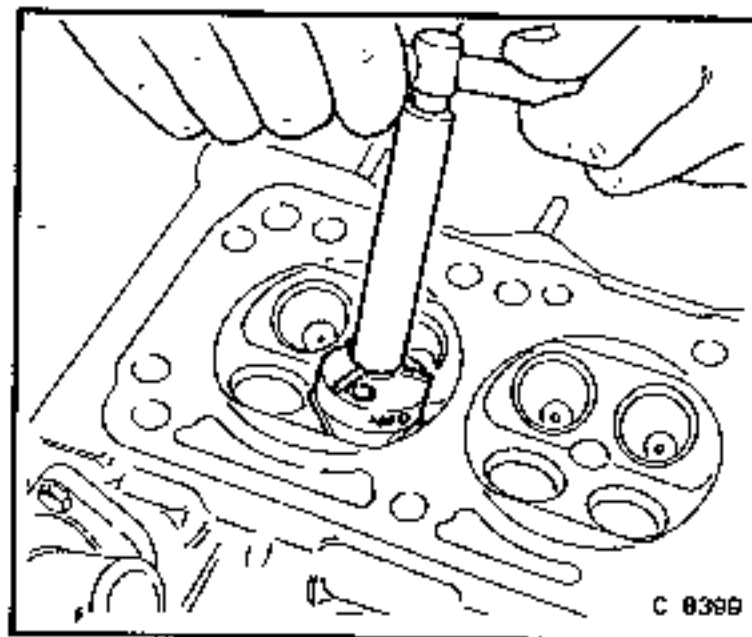
Valve seat cutter KM-340-26, then recondition valve seat. Note that the upper side is the corrective 60° cutter.

### Clean

All shavings from the cylinder head and valve ports.

### Important!

Once assembled, the valve stem heights must not exceed those stated in "Technical Data" at the end of this Volume.



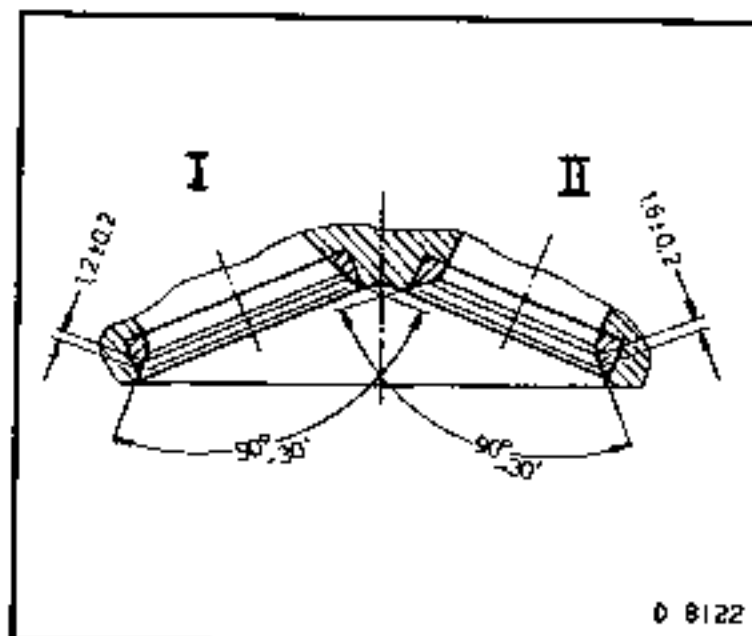
## Inspect

Valve seat widths;

Intake (I) .....	$1.2 \pm 0.2$ mm
Exhaust (II) .....	$1.6 \pm 0.2$ mm

If required, the seats and valves may need further reconditioning.

With the valves installed, check for leakage by pouring petrol in the combustion chambers.



## Cylinder Head Sealing Surface, Check for Plane Surface

### Clean

All cylinder head machined surfaces.

### Inspect

Cylinder head both in the length and width for distortion and warpage, using a straight edge and a feeler gauge.

Maximum specification variation ..... 0.05 mm

### Important!

If grinding is required, it is only possible within the given tolerance of;

Total height of cylinder head..... 135.58 - 135.68 mm

(Sealing surface to sealing surface).

# DOHC ENGINE - CYLINDER HEAD

## RECOMMENDED TORQUE VALUES

### (Cylinder Head)

	Nm
Alternator clamping bracket to intake manifold .....	25
Brake servo vacuum line to intake manifold .....	20
Camshaft bearing cover (rear) to cylinder head (M 6) .....	10
Camshaft bearing cover to cylinder head (M 8) .....	20
Camshaft pulley to camshaft .....	50 + 60°, then 15° (3)
Cover plate to cylinder head (bolts M 6) .....	9
Cover to throttle valve manifold .....	5 (1)
Cylinder head cover to cylinder head .....	8
Cylinder head to cylinder block .....	25 + 90° + 90° + 90° (3)(4)
Fastening bolt to bracket .....	20
Fastening bolts to exhaust joint .....	12 (2)
Front toothed belt cover to cylinder head, intermediate piece and oil pump ....	8
Ignition cable cover to cylinder head cover .....	8
Intake manifold to cylinder head .....	22
Intake manifold to cylinder block support .....	25
Lower alternator fastening .....	35 (5)
Performance header with cover plate to cylinder head .....	22 (2)
Rear toothed belt cover to cylinder head .....	6
Shackle to intake manifold and alternator .....	18
Spark plug with threaded bushing to cylinder head .....	25
Support to intake manifold and alternator .....	18
Support to intake manifold and cylinder block .....	25
Thermostat housing to cylinder head .....	15

(1) C 20 LET only.

(2) Use new nuts.

(3) Use new bolt/s.

(4) No re-tightening required.

(5) Engines as of MY '93.

# **GROUPS K, L, M, N, R, S**

**CLUTCH AND TRANSMISSION,  
FUEL AND EXHAUST SYSTEMS  
STEERING**

**ELECTRICAL EQUIPMENT & INSTRUMENTS,  
OPTIONAL EQUIPMENT & ACCESSORIES  
CIRCUIT DIAGRAMS**

## **GENERAL INFORMATION**

### **TABLE OF CONTENTS**

	<b>PAGE</b>
Vehicle Identification.....	GI - 2
Lubricants, Sealants and Locking Compounds.....	GI - 4
Safety Measures .....	GI - 4



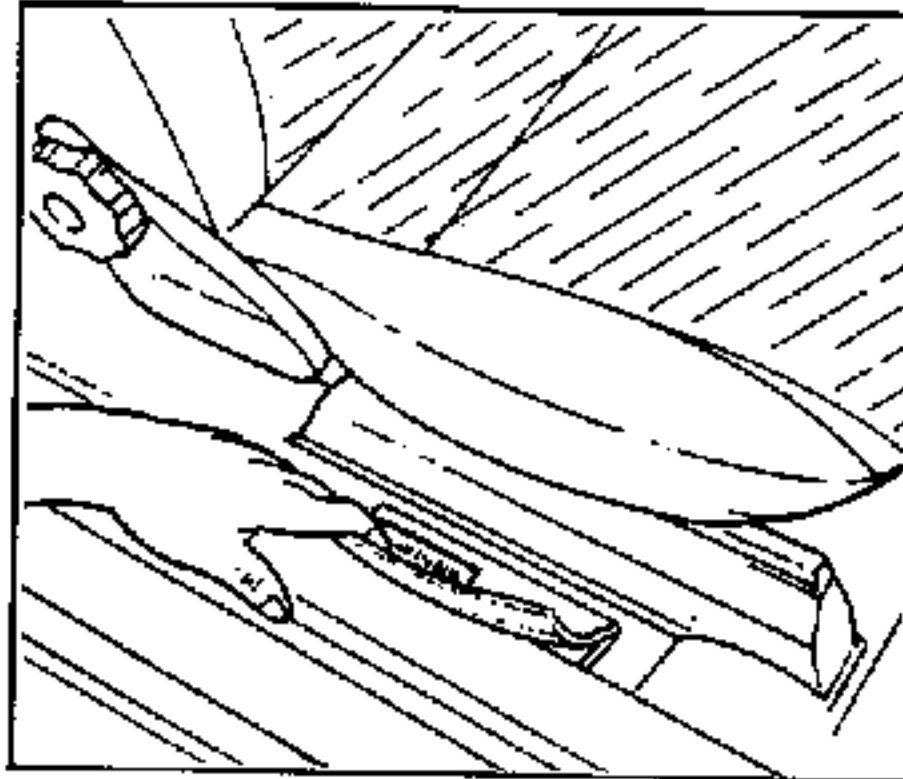
# GENERAL INFORMATION

## VEHICLE IDENTIFICATION

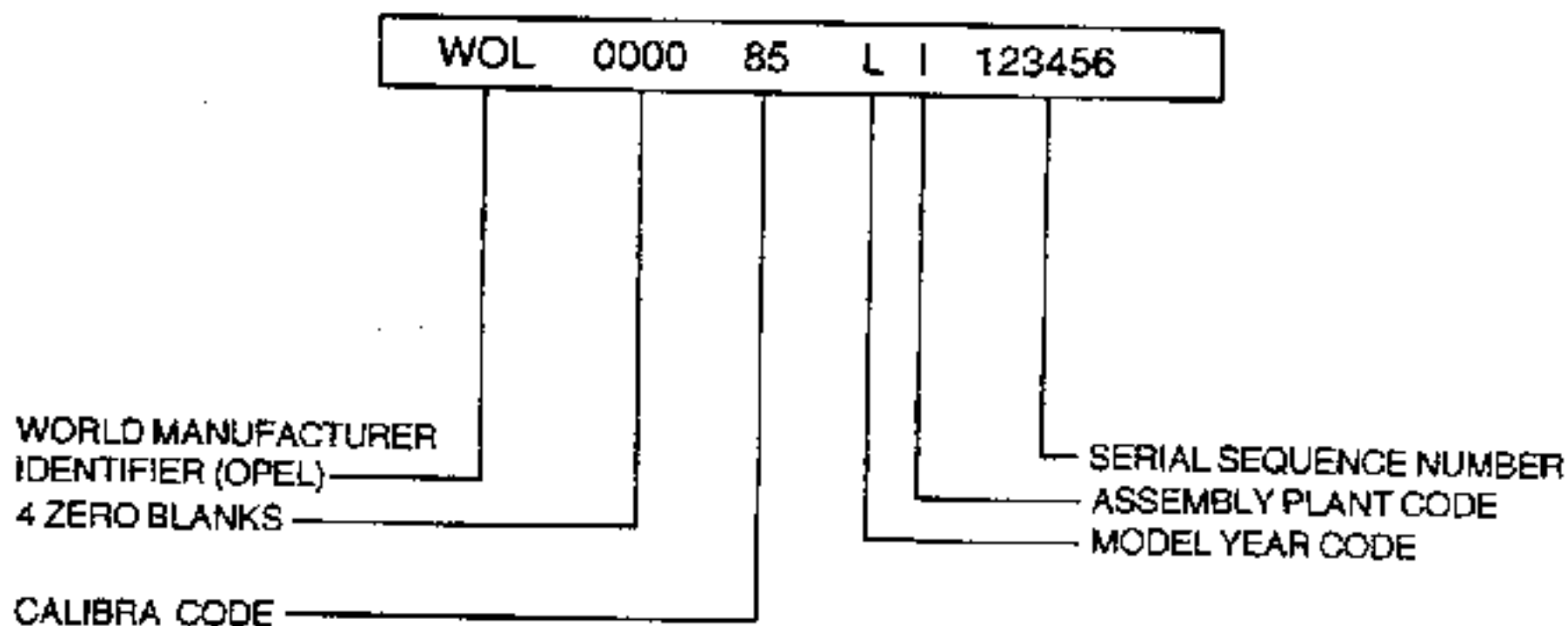
From time to time in this Volume, reference will be made to a particular 'Model Year' (MY), when discussing various changes that have taken place since the introduction of the Calibra vehicle into the Australian market. As the 'Model Year' refers to the time that the vehicle was produced, this may not necessarily be the year in which the vehicle was first registered. The most accurate means of determining the Model Year of a particular vehicle, is to study the Vehicle Identification Number (V.I.N.).

### VEHICLE IDENTIFICATION NUMBER

The vehicle identification number is stamped into the body, next to the right hand front seat. To access this number, the carpet has been cut to form a flap.



A breakdown of the Calibra V.I.N. numbering system follows;



As shown, the Model Year of any particular Calibra vehicle can be positively identified from the letter following the model '85' identification. For example, a Model Code of 'M' would indicate that the vehicle was a MY'91 vehicle, whereas a code letter of 'O' would indicate a MY'93, and so on. The Model Year, changes on September 1 each year. Sometimes reference will also be made to 'half year' models (e.g. MY 92½), in this Volume. If so, this would mean that a vehicle was produced after March 1 of that particular year. Therefore a MY'92½ would be a vehicle produced between March 1 and September 1 of 1992.

## POWER TRAIN COMBINATIONS

Model Availability		Engine		Transmission		Axle Ratio	
Code	Description	Description		Type	Description	Front	Rear
8YE77 Model '85'	Calibra Hatchback Coupe	C 20 NE	2.0 litre, L4, PFI SOHC	AF 20	4 Speed Automatic	2.40:1	NA
		C 20 XE	2.0 litre, L4, PFI DOHC	F 20	5 speed Manual	3.55:1	NA
		C 20 LET	2.0 litre, L4, PFI DOHC - Turbocharged	F 28/6	6 speed Manual	3.72:1	3.70:1

# GENERAL INFORMATION

## TRANSMISSION RATIOS

Gear Ratio Selection	Transmission		
	AF 20 - 4 speed Automatic - Electronic Control	F 20 - 5 speed Manual Transaxle	F 28/6 - 6 Speed Manual Transaxle with Fixed 4WD
1st Gear	3.672	3.55	3.57
2nd	2.098	2.16	2.13
3rd	1.391	1.48	1.46
4th	1.000	1.13	1.10
5th	—	0.89	0.89
6th	—	—	0.74
Reverse	4.022	3.33	3.32

## TRANSMISSION IDENTIFICATION NUMBERS

### Manual Transmission - DOHC Engines

#### F 20 FIVE SPEED TRANSMISSION

The transmission designation of **F 20** (for C 20 XE engined vehicles), is an embossed "F 20" on the upper face of the transmission housing, adjacent to the shift housing.

The serial number is stamped on the transmission end shield cover.

In the example; "A 126 1 2 C 372 xxxx";

- A (1) = Manufacturing plant
- 126 (2) = Day of the year
- 1 (3) = Last digit of the year
- 2 (4) = Work shift (1 is early, 2 is late shift)
- C (6) = Transmission code for short ratio
- 373 (7) = Axle ratio
- xx (5) = Space for numbers or letters for special purposes.

The identification can also consist of two lines.

#### F 28/6 SIX SPEED TRANSMISSION

For the **F 28/6** transmission fitted to C 20 LET engined vehicles, the transmission identification plate is attached to the horizontal surface, below the clutch release lever.

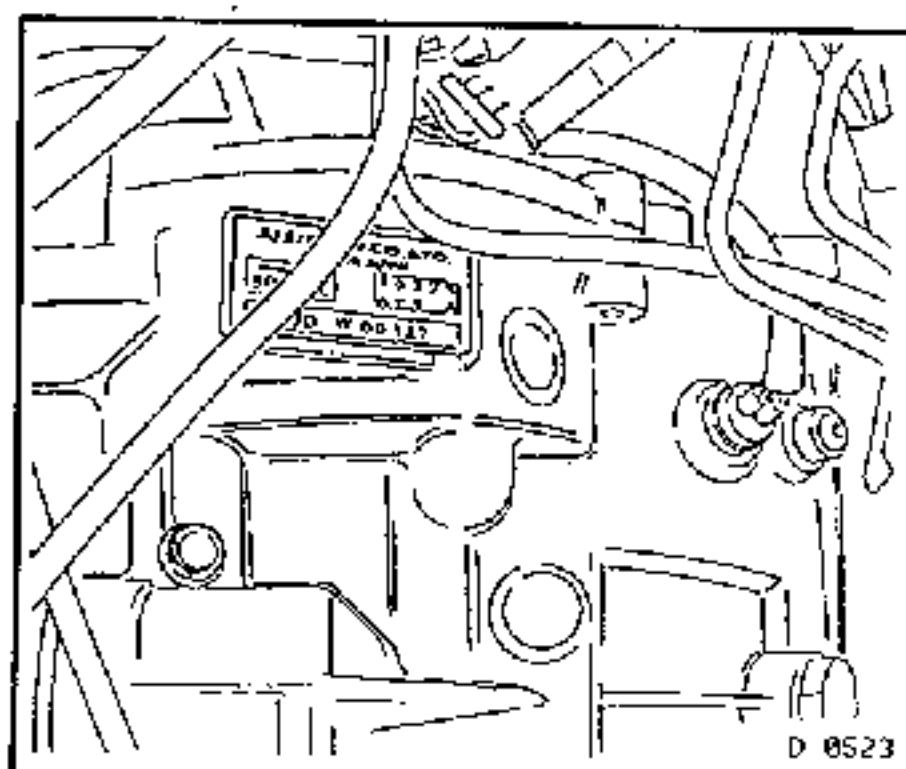
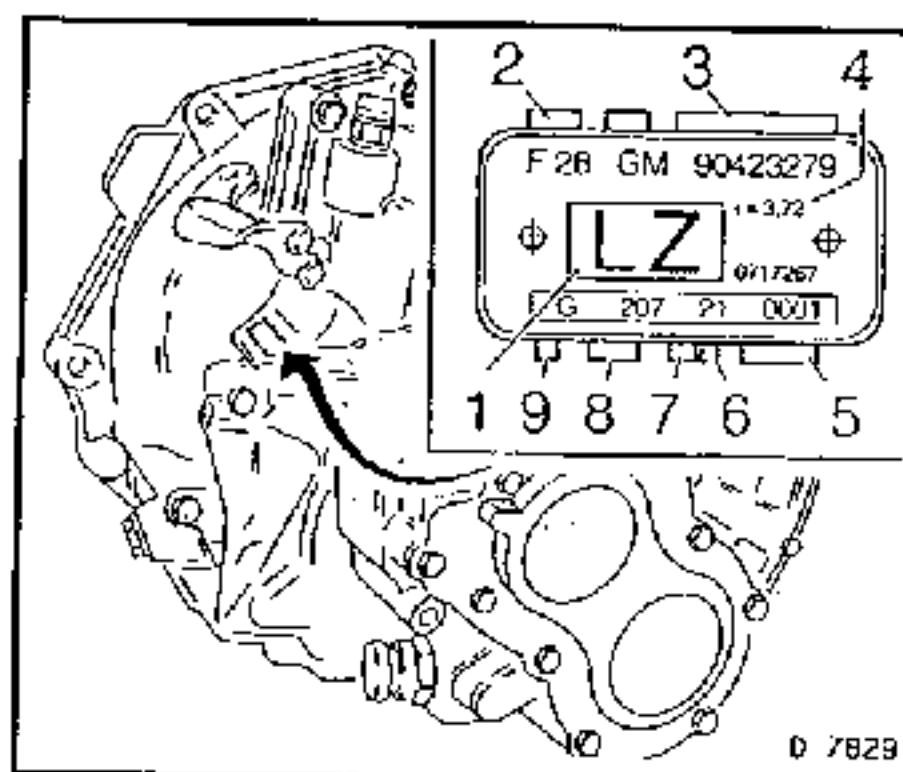
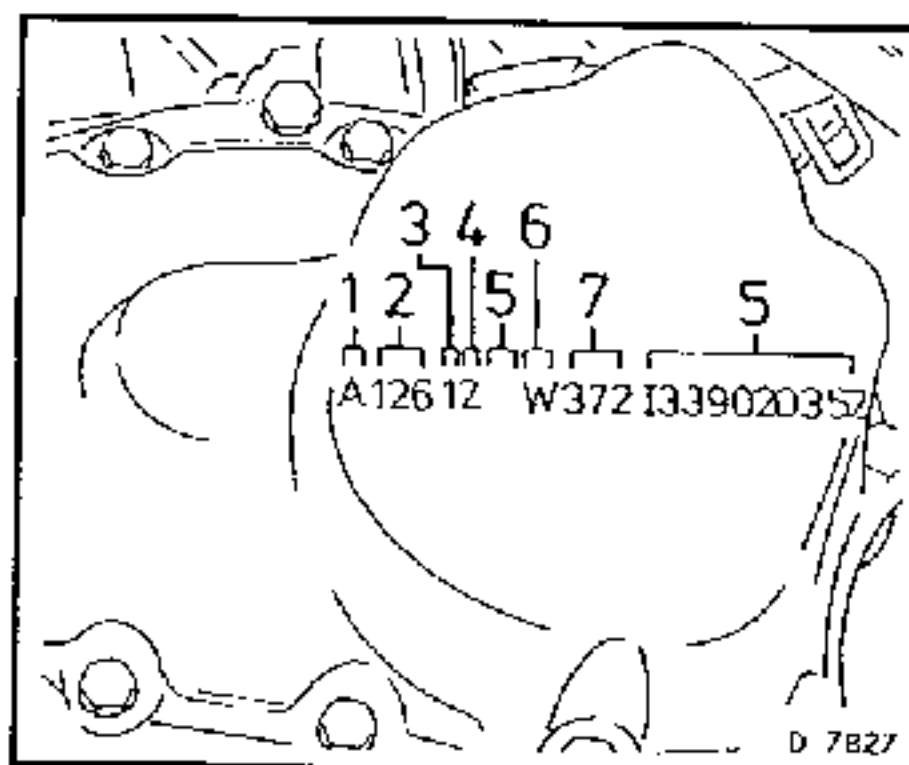
Information on this identification plate, is as shown.

- 1 = Identification code
- 2 = Transmission type
- 3 = Part number
- 4 = Axle ratio
- 5 = Serial number
- 6 = Work shift (1 is early, 2 is late shift)
- 7 = Last digit of the year
- 8 = Day in the year
- 9 = Manufacturing works; e.g. G = Getrag

#### AF 20 AUTOMATIC TRANSMISSION

The four speed version of this transmission is fitted to the C 20 NE SOHC engine.

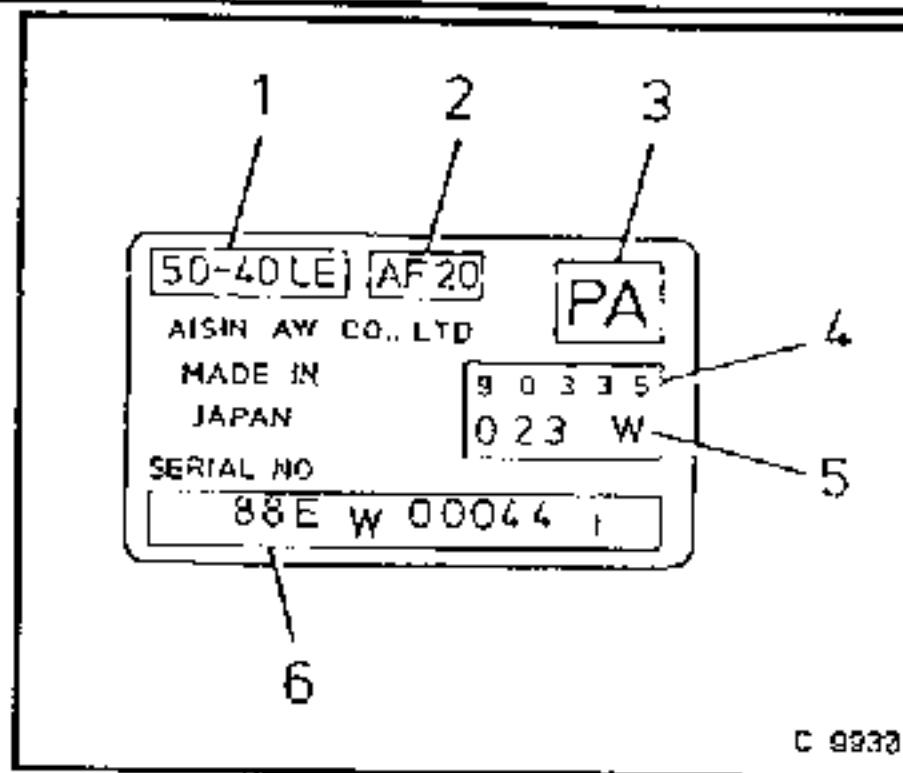
The identification plate is located on the top of the transmission, visible when the engine bonnet is opened.



# GENERAL INFORMATION

Explanation of the identification marks are;

- 1 = AW transmission type
- 2 = Opel transmission type
- 3 = Model code
- 4 = Opel parts number
- 5 = Calibration code
- 6 = Series number



## LUBRICANTS, SEALANTS AND LOCKING COMPOUNDS

Various lubricants, sealants and locking compounds are called up in the service operations described in this publication. Wherever possible, a local source has been nominated and where applicable, Holden's Specification numbers have also been quoted, to assist Technicians' in locating and using the recommended product in a particular operation.

## SAFETY MEASURES

It is expressly recommended that the warnings and cautionary measures outlined in this Publication be carefully read and observed, to limit the possibility of injury to workshop personnel - because of unprofessional conduct - or damage to the vehicle and the possibility of jeopardising safety.

- ★ This vehicle may be equipped with an Air Bag (or SRS - Supplemental Restraint System). Refer to AIR BAG SAFETY REGULATIONS in Volume 1, Section G of the YE Calibra Service Instructions before performing any service operations on or around Air Bag components, the steering mechanism or wiring.

Failure to follow the Safety Regulations could result in Air Bag deployment, resulting in possible injury or unnecessary Air Bag system repairs.

- ★ During operations where there is a risk of an electrical short circuit, disconnect the ground cable from the battery. This also applies when the vehicle is being electrically welded. Disconnecting the ground automatically deletes the memory contents of electronic systems. When the battery is reconnected, the Board Computer must be reprogrammed as necessary. Since the radio is coded and radio stations programmed, the customer must be informed about decoding and the deleted station memory.
- ★ At temperatures above 80° C (e.g. drying oven), remove all electronic control units closest to the heat source.
- ★ Never disconnect or reconnect wiring harness plugs from/to electronic control units or trigger boxes with the ignition switched on.
- ★ Disconnect battery from vehicle electrical system before charging or quick charging.
- ★ Never use a quick charger for starting.
- ★ Use extreme caution when touching high voltage-parts of the ignition system.
- ★ During operations on the fuel system, thoroughly clean the connection points and the immediate vicinity.
- ★ If repairs cannot be carried out immediately, plug opened components or mask them off carefully.
- ★ During operations in the engine compartment, note that the engine cooling fan can switch on automatically with the attendant risks of injury.

# GROUP K

## CLUTCH & TRANSMISSION

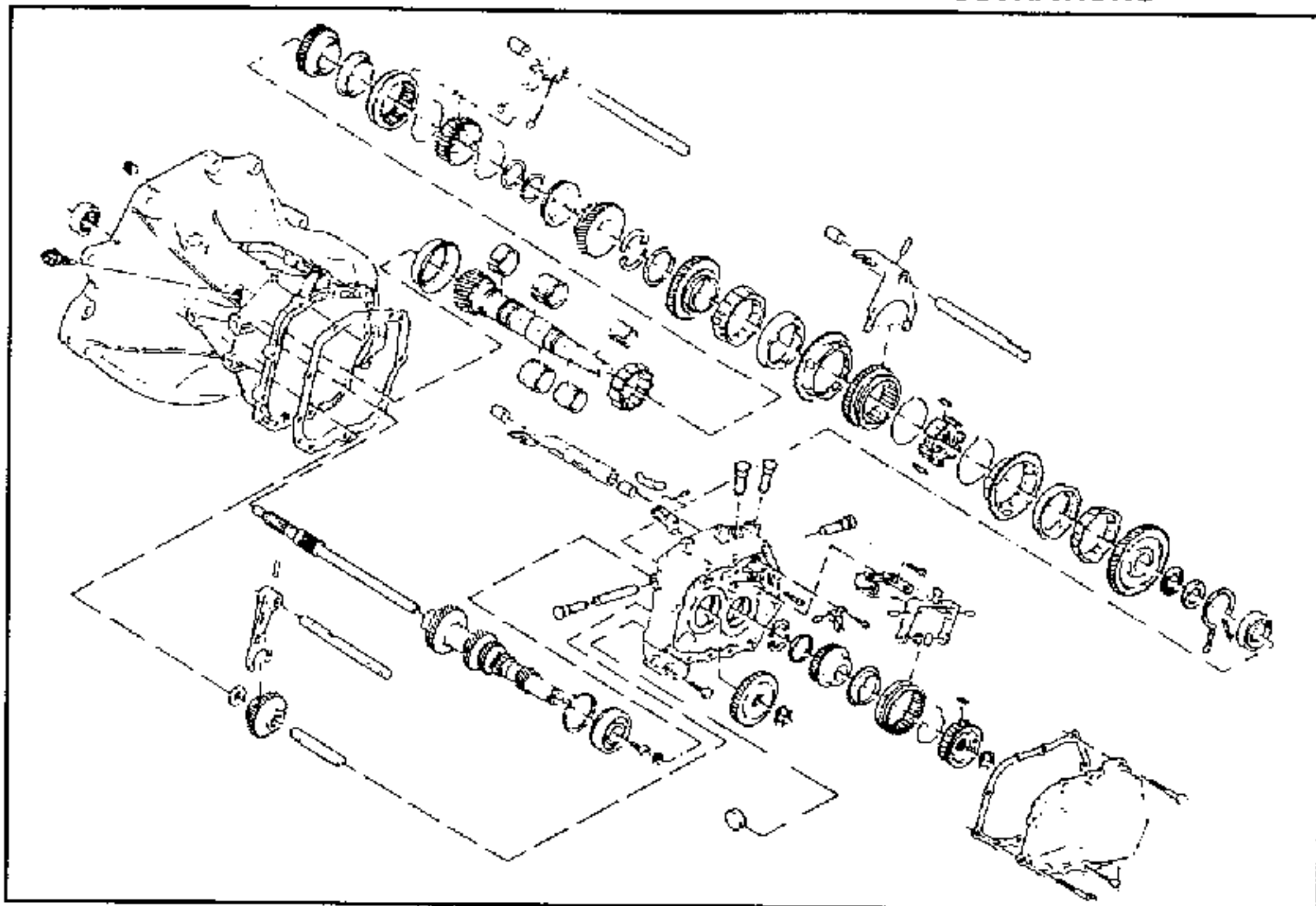
### MANUAL TRANSMISSION AND CLUTCH

#### TABLE OF CONTENTS

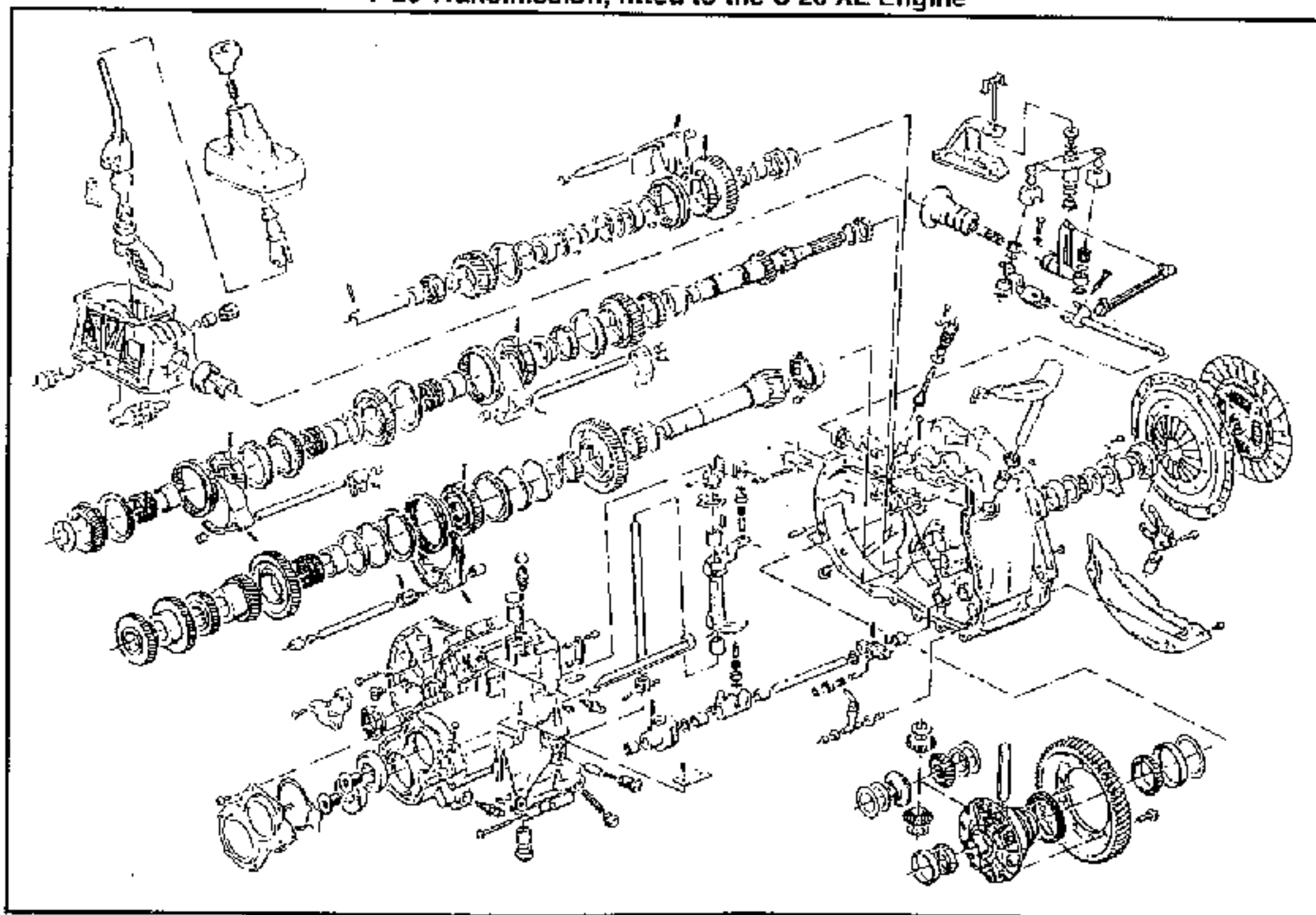
	PAGE
General Arrangement Illustrations.....	K - 4
Minor Servicing Operations.....	K - 9
Manual Transmission and Differential, Remove and Install.....	K - 29
Differential and Manual Transmission, Overhaul .....	K - 43
Clutch.....	K - 69
Special Service Tools .....	K - 79
Technical Data .....	K - 91

# MANUAL TRANSMISSION & CLUTCH

## TRANSMISSION AND CLUTCH ARRANGEMENT ILLUSTRATIONS

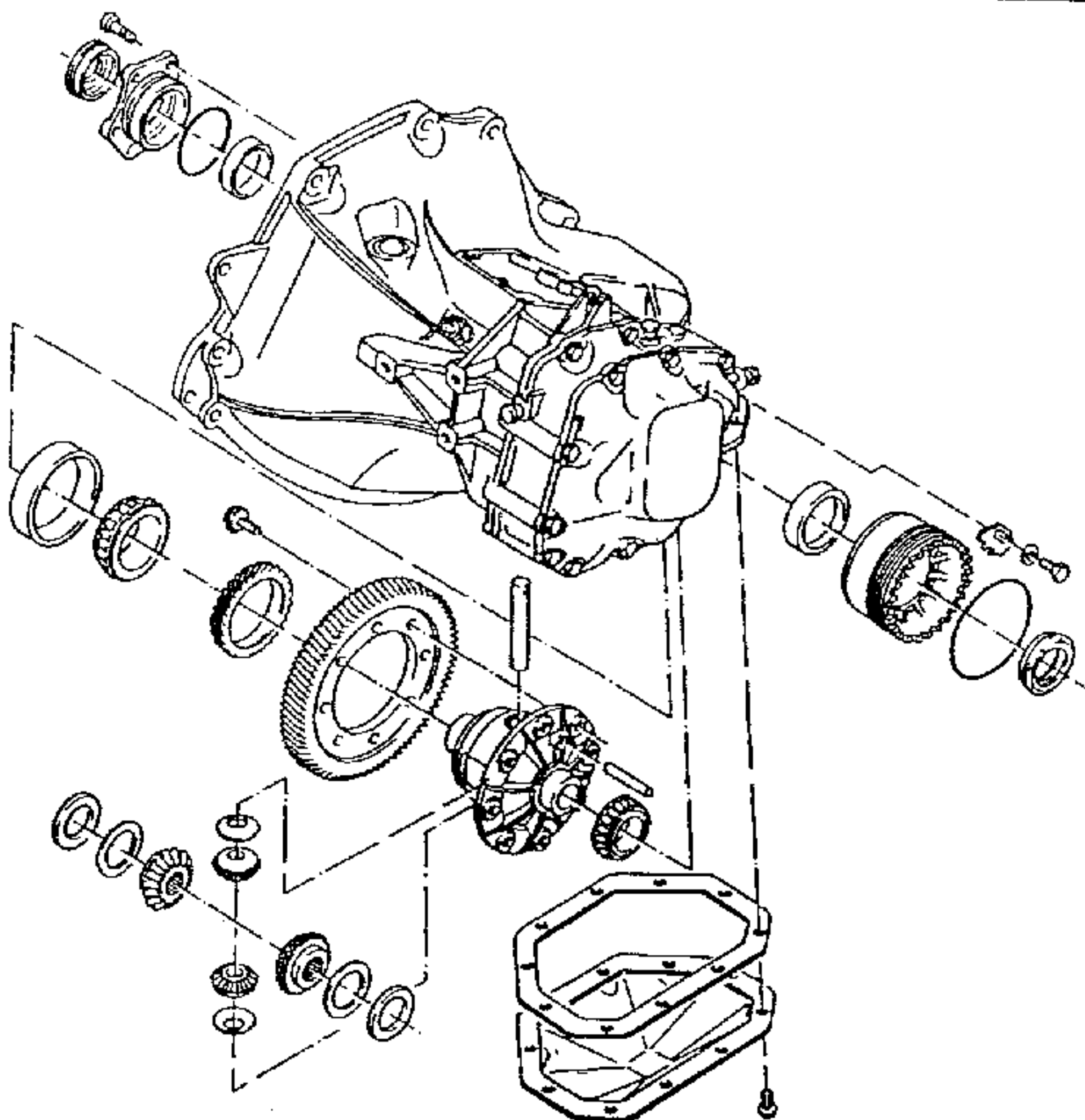


F 20 Transmission, fitted to the C 20 XE Engine



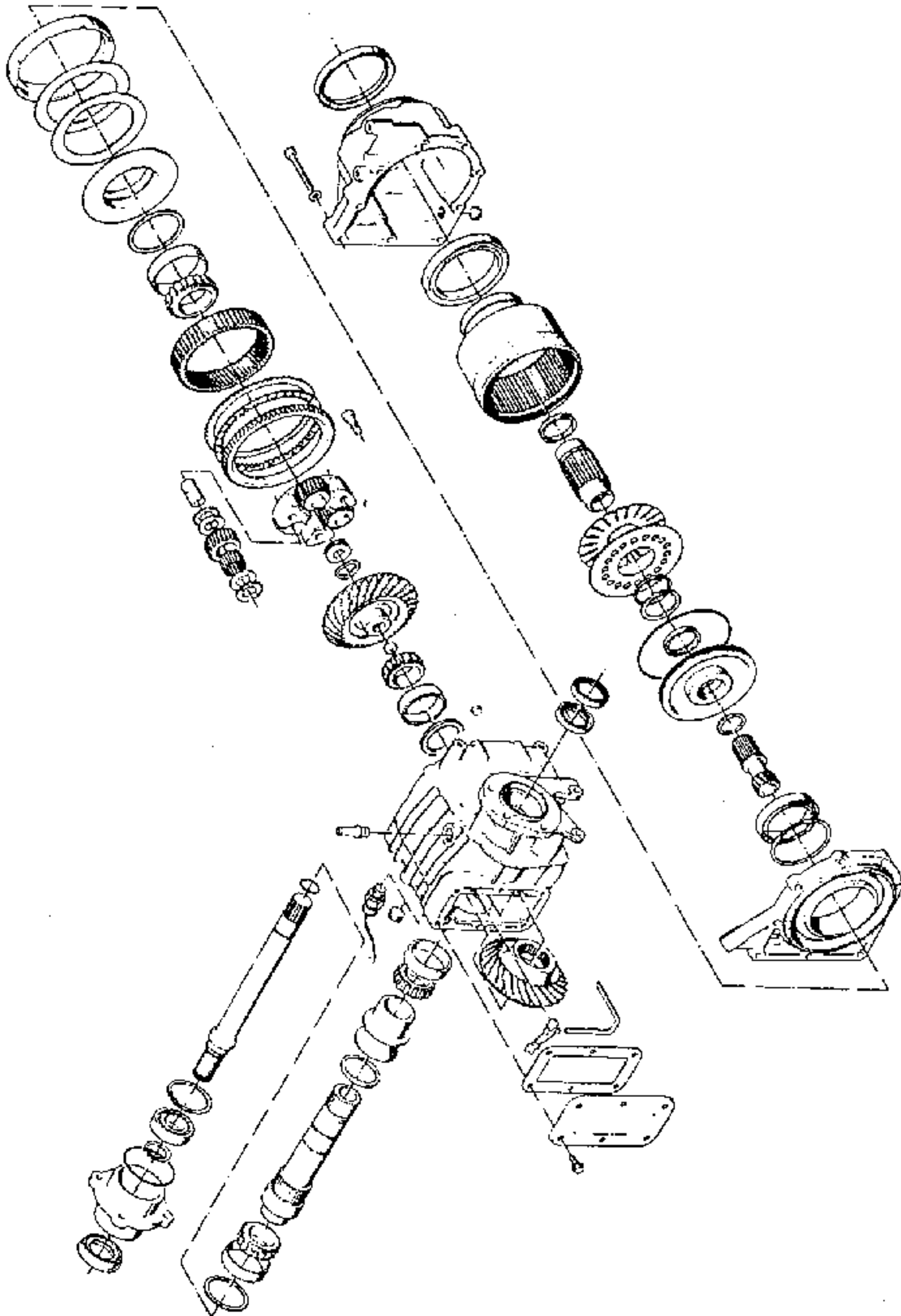
F 28/6 Transmission fitted to the C 20 LET Engine

# MANUAL TRANSMISSION & CLUTCH



D 2240

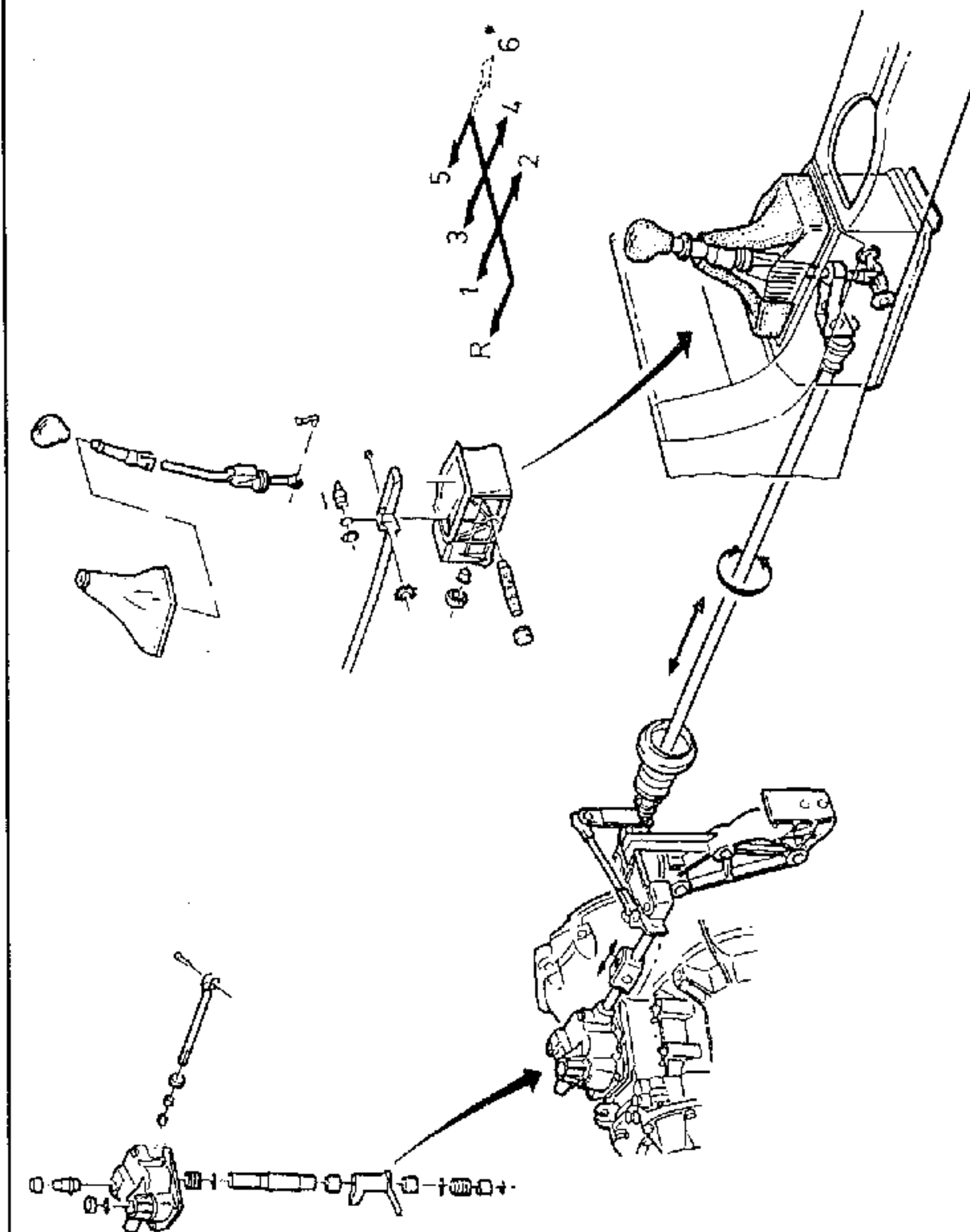
F 20 Differential, Front Wheel Drive



Transfer Box (Four Wheel Drive)

# MANUAL TRANSMISSION & CLUTCH

D 7846



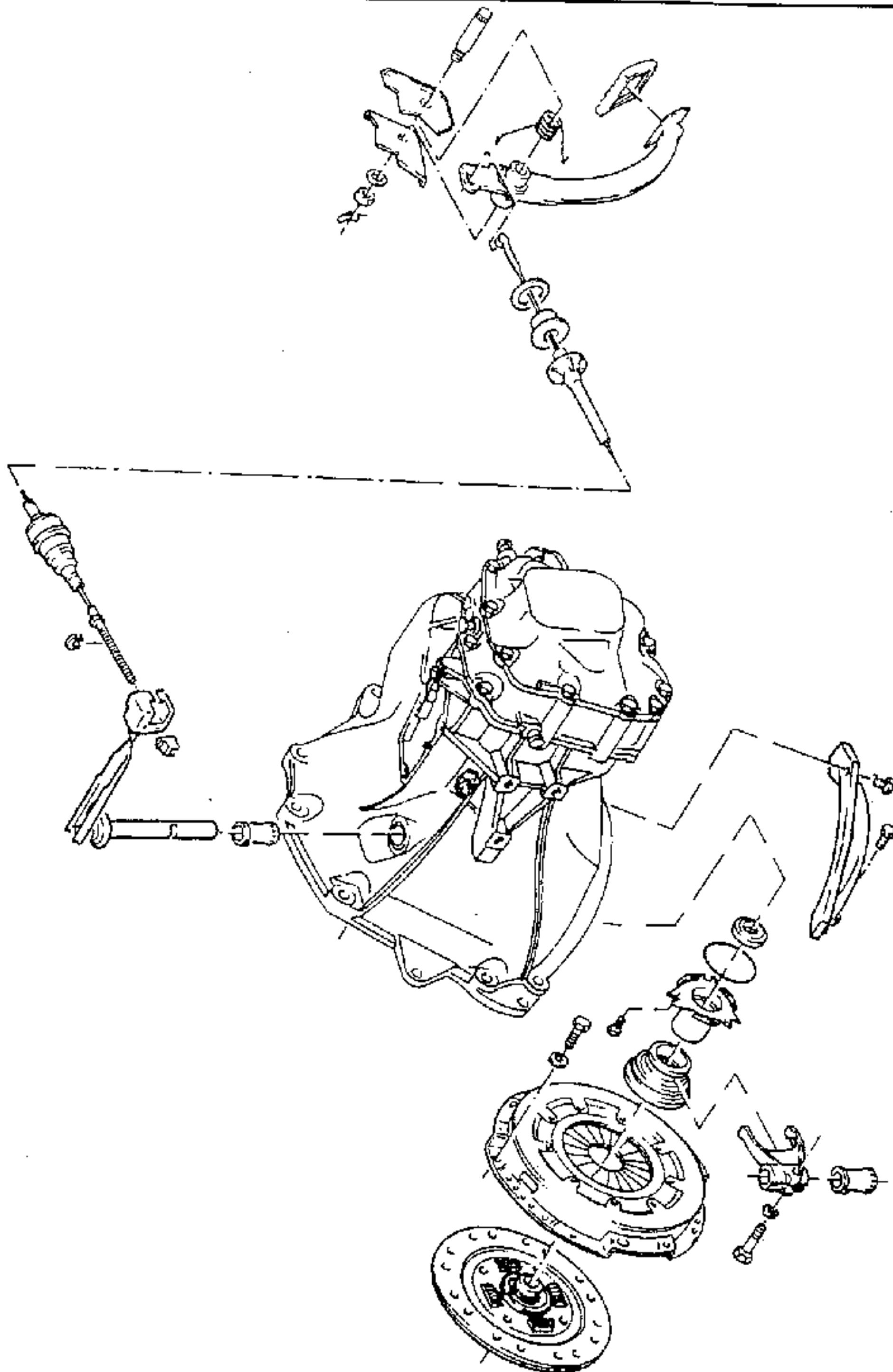
Transmission Shift Linkage

\* 6th gear for the F 28/6 Transmission



# MANUAL TRANSMISSION & CLUTCH

D 7848



Clutch Assembly - F 20 Transmission

# GROUP K

## MANUAL TRANSMISSION & CLUTCH

### MINOR SERVICING OPERATIONS

#### TABLE OF CONTENTS

	PAGE
CHECKING AND ADJUSTING OPERATIONS .....	K - 10
Transmission Fluid Level, Check.....	K - 10
Transmission Shift Linkage, Adjust (F 20 up to MY'92½).....	K - 10
Transmission Shift Linkage, Adjust (F 20, F 28/6 as of MY'93).....	K - 12
TRANSMISSION SHIFT LINKAGE SERVICE OPERATIONS .....	K - 13
Gearshift Lever, Remove and Install .....	K - 13
Gearshift Lever Cover, Remove and Install.....	K - 13
Shift Linkage, Remove and Install .....	K - 13
Dust Boot on Shift Linkage, Replace.....	K - 15
Shift Guide, Remove and Install and/or Selector Rod, Replace .....	K - 15
Shift Linkage Lever, Remove and Install .....	K - 16
Shift Cover, Remove and Disassemble.....	K - 17
Shift Cover, Assemble and Install.....	K - 19
TRANSMISSION SEALING OPERATIONS - TRANSMISSION INSTALLED .....	K - 20
Axle Shaft Seal Rings, Replace.....	K - 21
Speedometer Driven Gear and/or O-ring, Replace .....	K - 23
Gasket for Shift Cover, Replace .....	K - 24
Gasket for End Shield, Replace .....	K - 24
Gasket for Differential Cover, Replace .....	K - 26
1st Gear Recognition Switch and/or Seal, Replace - F 28/6 Transmission.....	K - 26
Reversing Lamp Switch and/or Seal, Replace .....	K - 27

# MINOR SERVICING OPERATIONS

## CHECKING & ADJUSTING OPERATIONS

### Transmission Fluid Level, Check

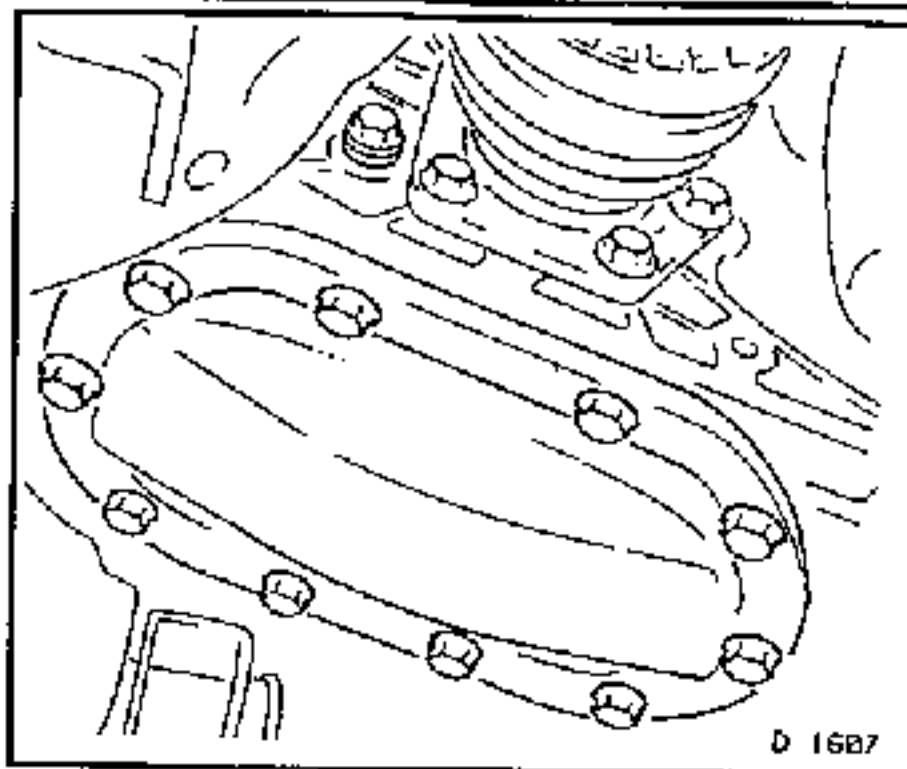
#### Remove, Disconnect

Lower engine compartment cover.

Fluid check bolt.

F 20: Checking aperture, rear right.

F 28/6 Checking aperture, rear left.

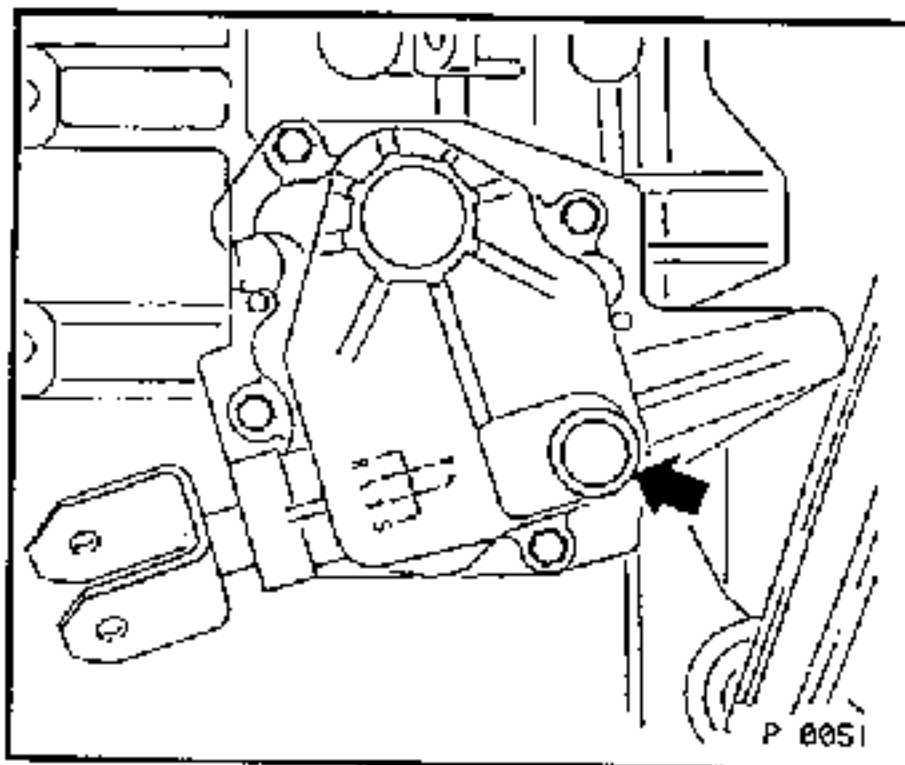


#### Adjust

Top up fluid as necessary:

F 20: Fill through the aperture for bleeder screw in shift cover (arrow).

F 28/6 Fill through the aperture for bleeder screw.



#### Inspect

To check the fluid level, fill to the lower edge of the aperture.

Quantity after repairs:

F 20: 1.9 litres

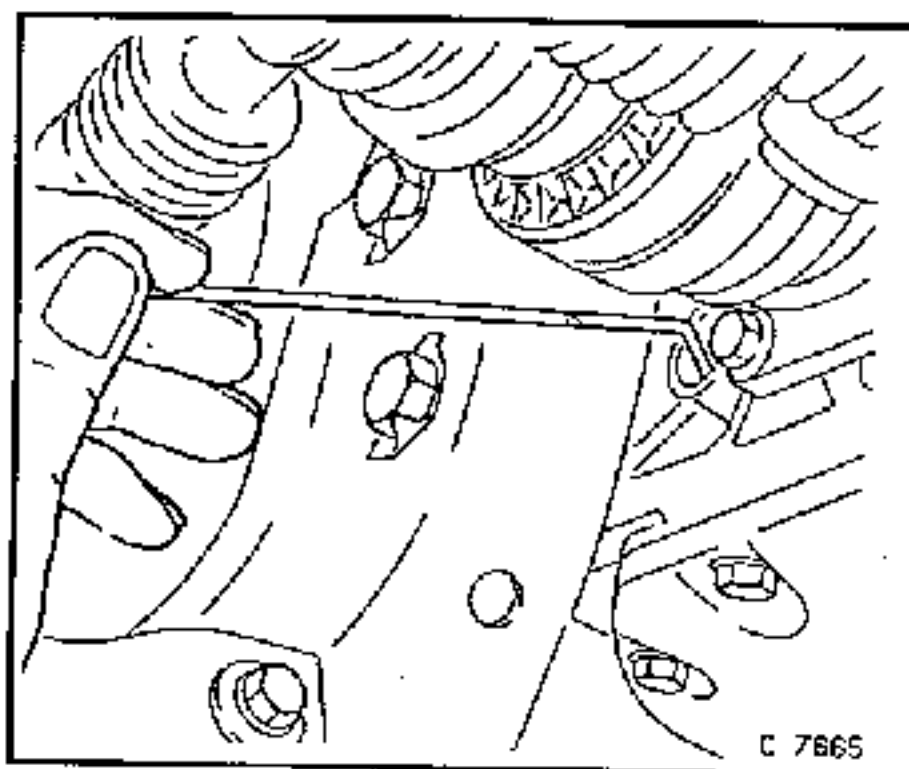
F 28/6 1.8 litres

If fluid needs topping up, simply fill with gear oil 80W GL4 to Holden's Specification HN1855 or equivalent.

#### Tighten (Torque)

Fluid check bolt F 20 ..... 4 Nm

Fluid check bolt F 28/6 ..... 30 Nm



#### Install, Connect

Lower engine compartment cover.

### Transmission Shift Linkage - F 20, Adjust

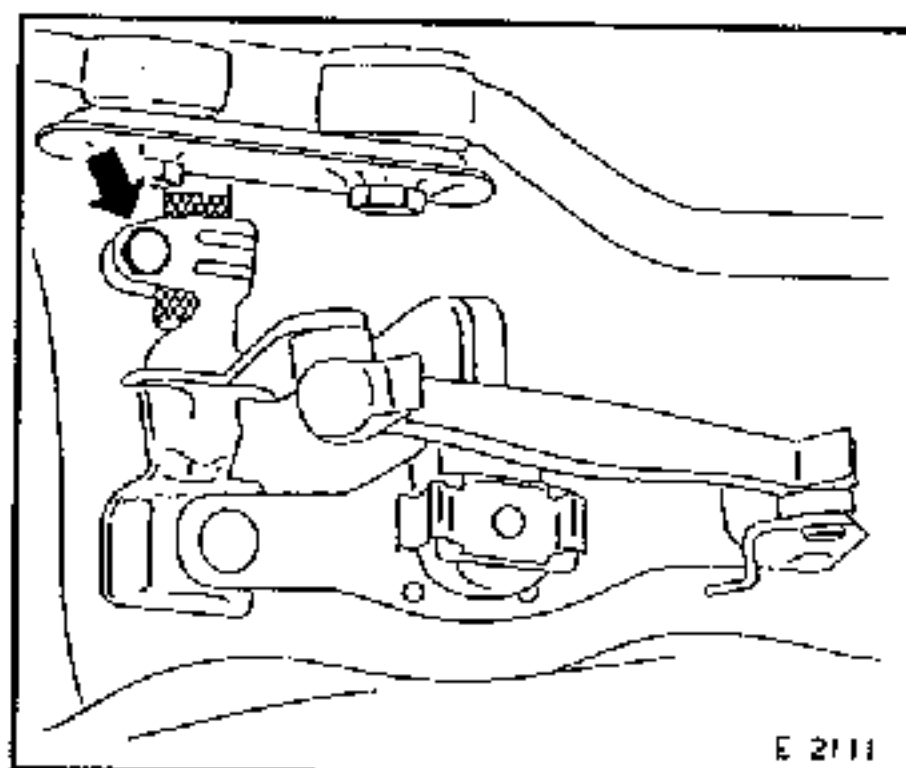
(Up to MY'92½)

With the gearshift in neutral;

#### Remove, Disconnect

Gearshift lever cover from shift tunnel and fold back.

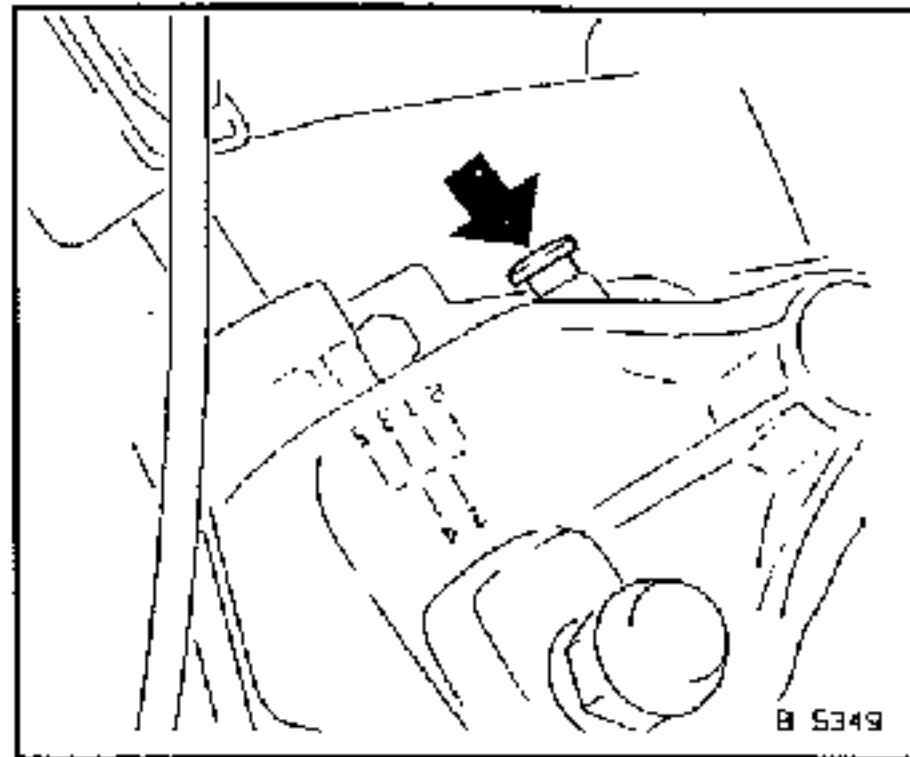
Loosen bolt for shift rod clamp (arrow).



# MINOR SERVICING OPERATIONS

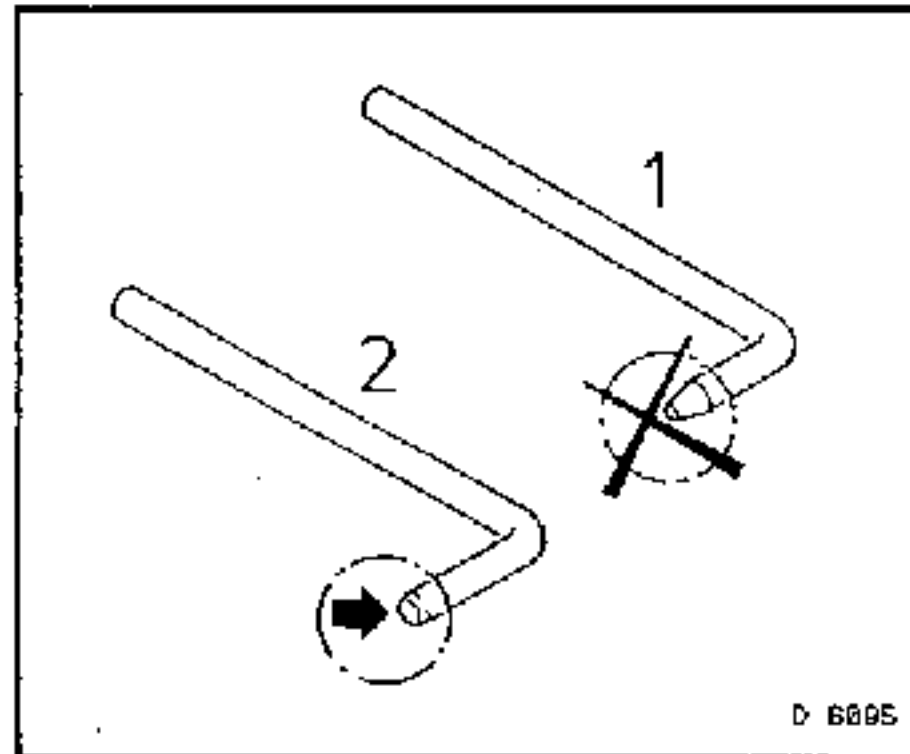
## Remove, Disconnect

Plugs for adjustment bore hole from shift cover (arrow).



## Adjust

Turn shift rod to the left and insert guide KM-527 or KM-527-A up to the stop in the adjustment bore hole.



## Adjust

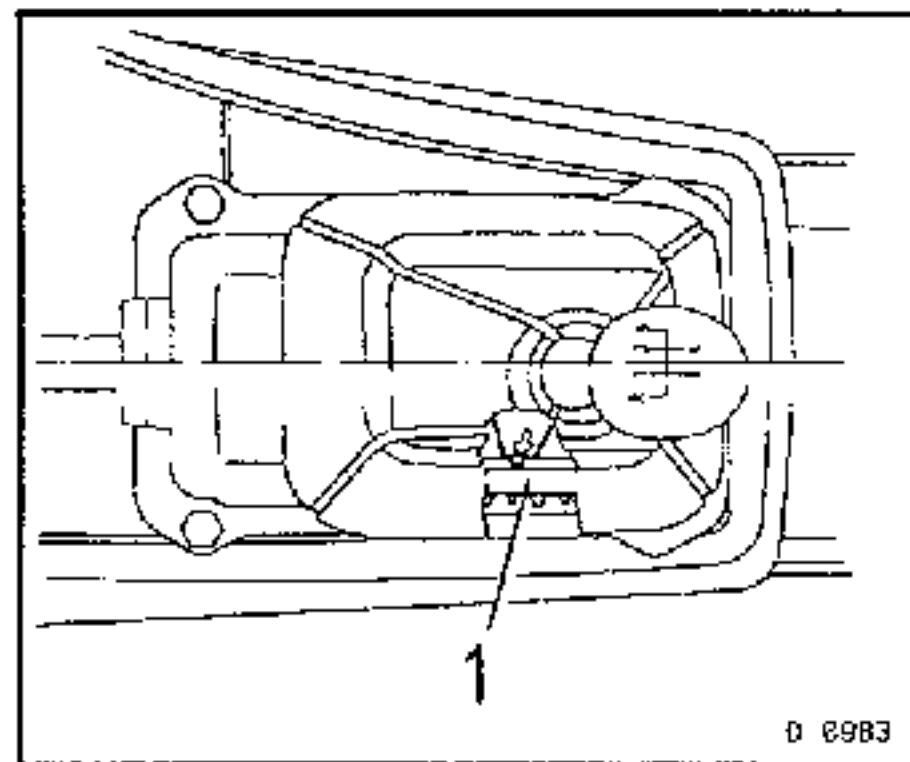
Transmission shift linkage as follows;

Press gearshift lever to the stop so that the tip of the arrow points to the notch (1).

Fasten shift rod in that position.

## Tighten (Torque)

Shift rod clamp bolt ..... 15 Nm



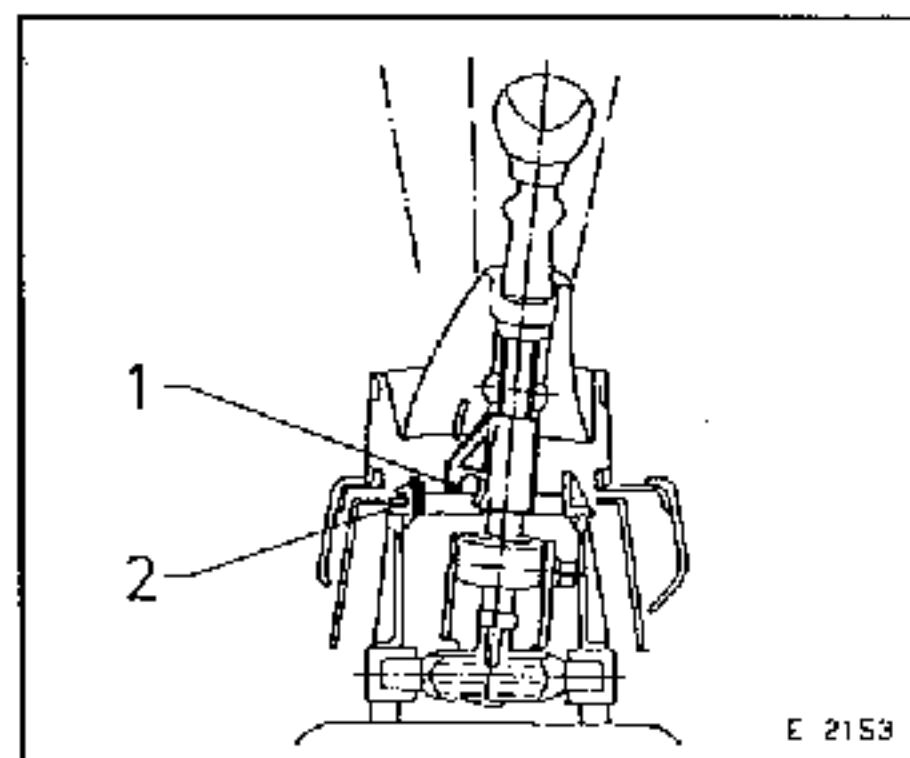
## Inspect

Play between the hook (1) and stop (2) with tool KM-527 or KM-527-A inserted, must be a maximum of 3 mm.

Remove KM-527 or KM-527-A from shift cover.

Press new plug to the stop, into the adjustment bore hole.

Fit gearshift lever cover in shift tunnel.



# MINOR SERVICING OPERATIONS

## Transmission Shift Linkage - F 20, F 28/6, Adjust

(As of MY'93)

### Remove, Disconnect

Plug (1) from bore hole;

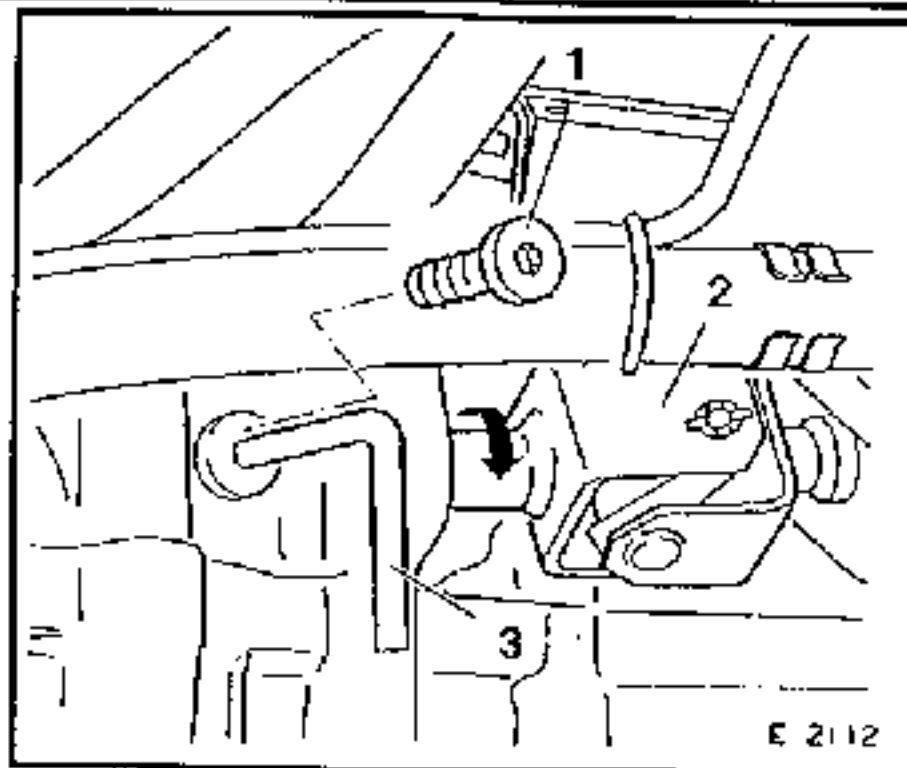
Remove top of transmission for F 28/6.

Remove from shift cover for F 20.

Turn shift rod to the left.

### Insert

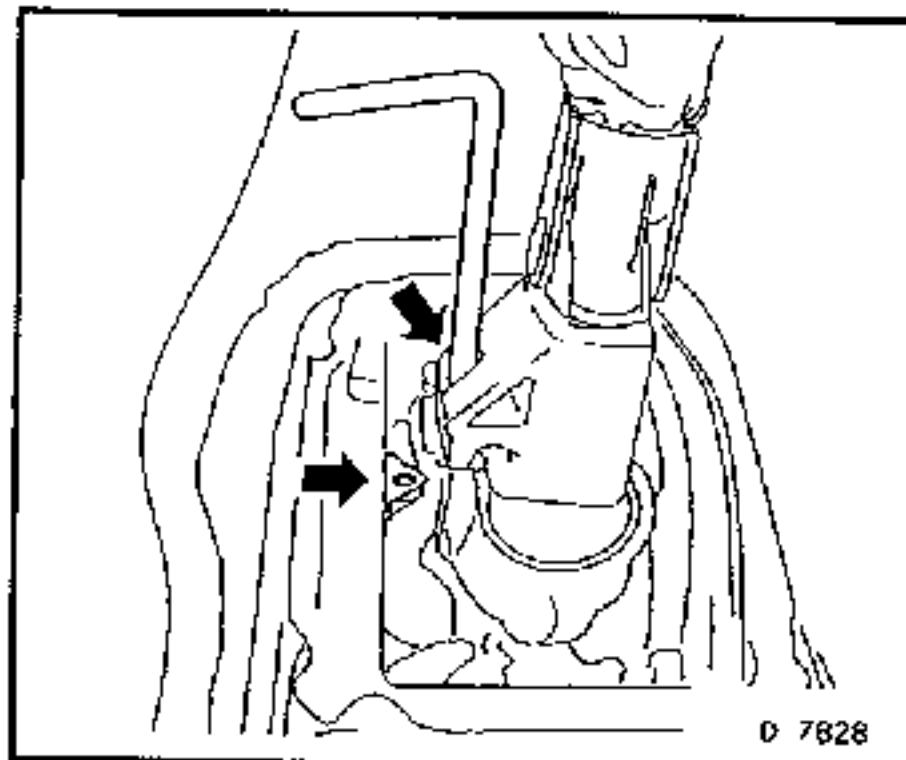
Guide pin KM-527 or KM-527-A (3) up to the stop in the adjustment bore hole



If KM-527 is used, grind a chamfer of 3 mm on the shift leg of the tool.

### Install, Connect

Tilt gearshift lever so that a second KM-527 or KM-5267-A can be inserted into the bore holes in the gearshift lever and gearshift lever housing. This locks the gearshift lever in place.



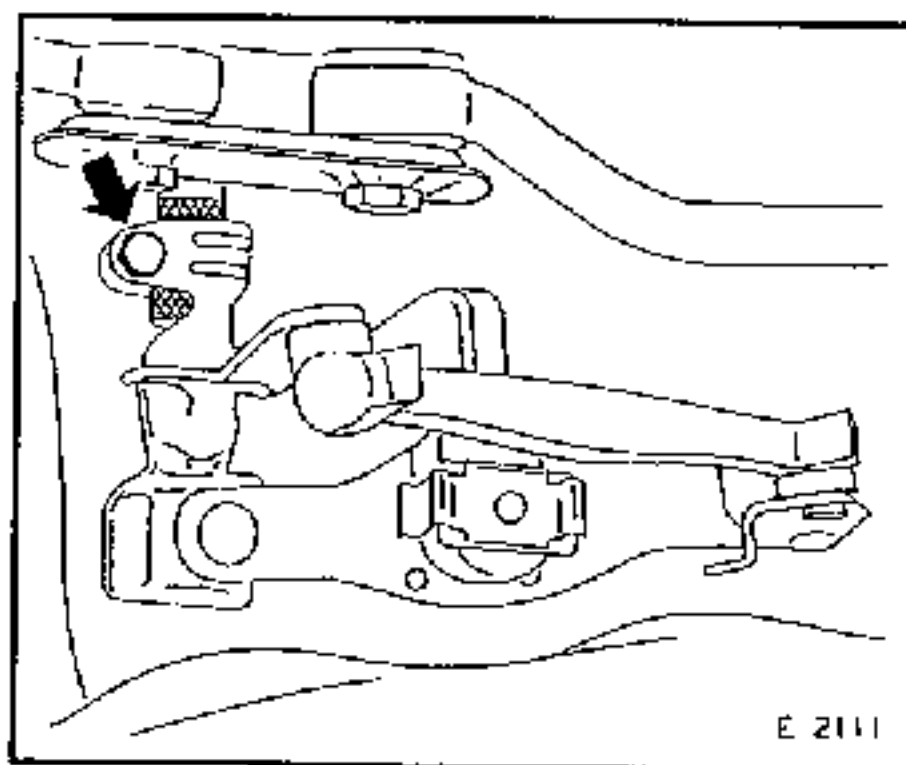
### Tighten (Torque)

Shift rod clamp bolt (arrow)..... 15 Nm

### Remove, Disconnect

KM-527 or KM-527-A from transmission and press in a new plug to the adjustment bore hole

KM-527 or KM-27-A from gearshift lever housing.

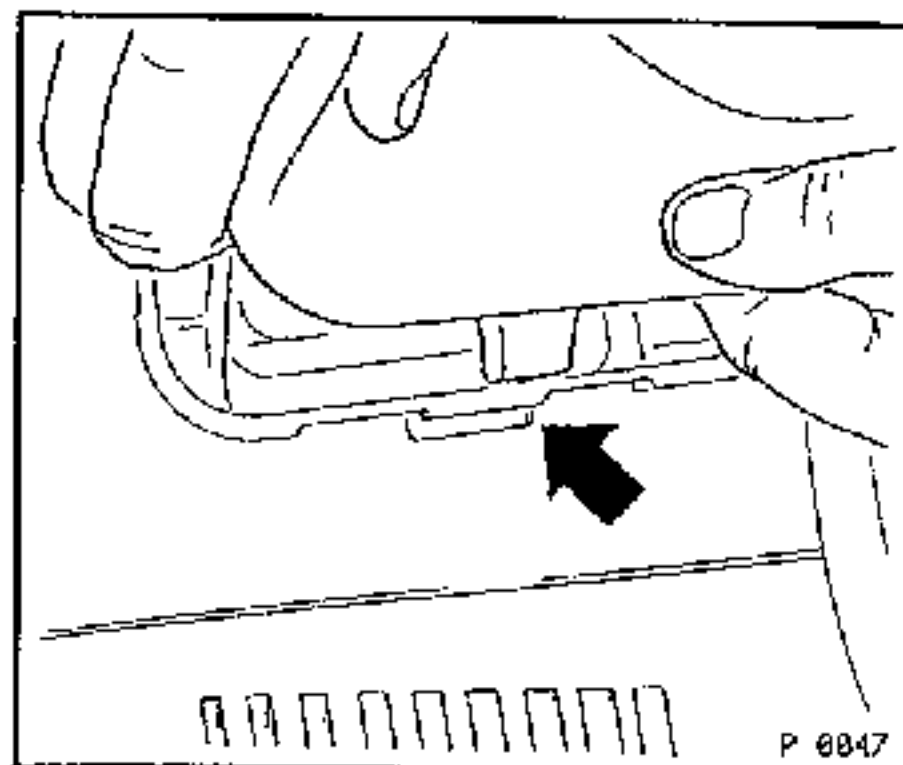


### Install, Connect

Fit gearshift lever cover to shift tunnel (arrow).

### Inspect

The shift pattern to ensure that all gears can be selected easily and smoothly, with the vehicle stationary, engine running and the clutch pedal depressed.



# MINOR SERVICING OPERATIONS

## TRANSMISSION SHIFT LINKAGE, SERVICE OPERATIONS

### Gearshift Lever, Remove and Install

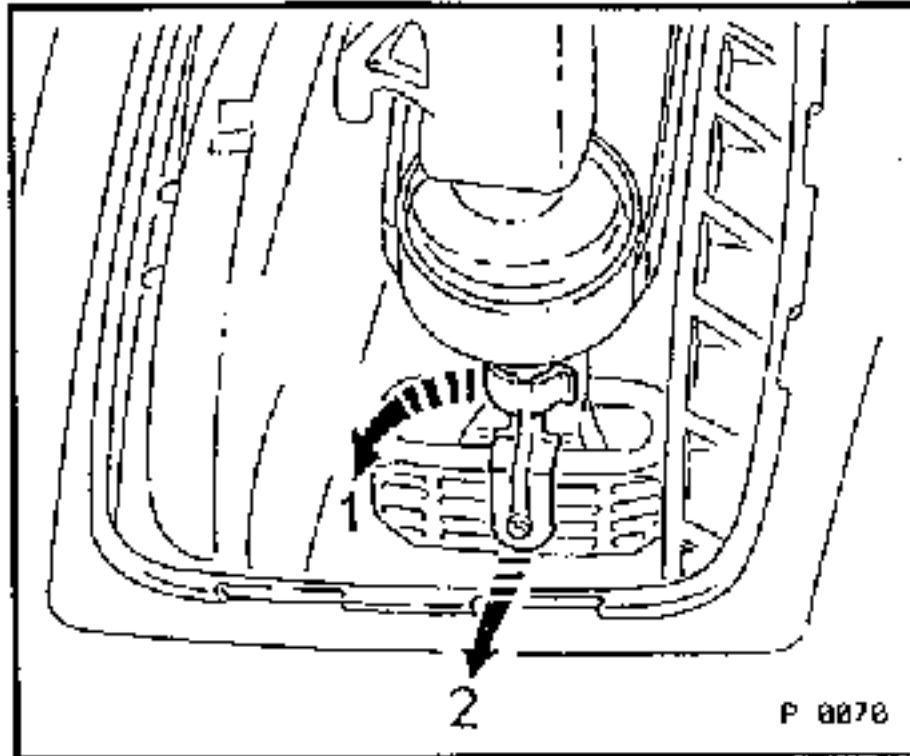
With the gearshift lever in neutral;

#### Remove, Disconnect

Gearshift lever cover from shift tunnel and fold back.

Press the clip from the gearshift lever (1) and remove the pin (2).

Lever the damping ring from the groove in the gearshift lever.



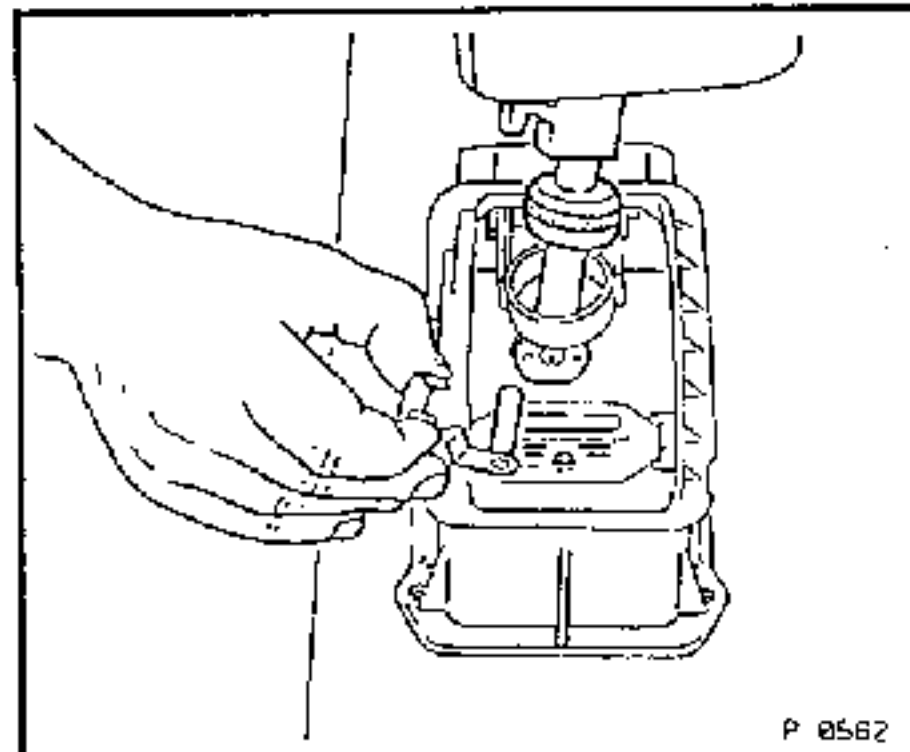
#### Install, Connect

Fit new damping ring into the gearshift lever groove.

Lubricate gearshift lever bearing with NLGI No. 0, lithium based grease to Holden's Specification HN1923.

Gearshift lever, insert pin and press clip onto gearshift lever.

Fit gearshift lever cover to shift tunnel.



### Gearshift Lever Cover, Remove and Install

#### Remove, Disconnect

Gearshift lever. Refer to previous operation.

Tension gearshift lever in a vice. Place an open-ended spanner under the metal insert and drive off the gearshift lever knob.

Cable tie, then gearshift lever cover.

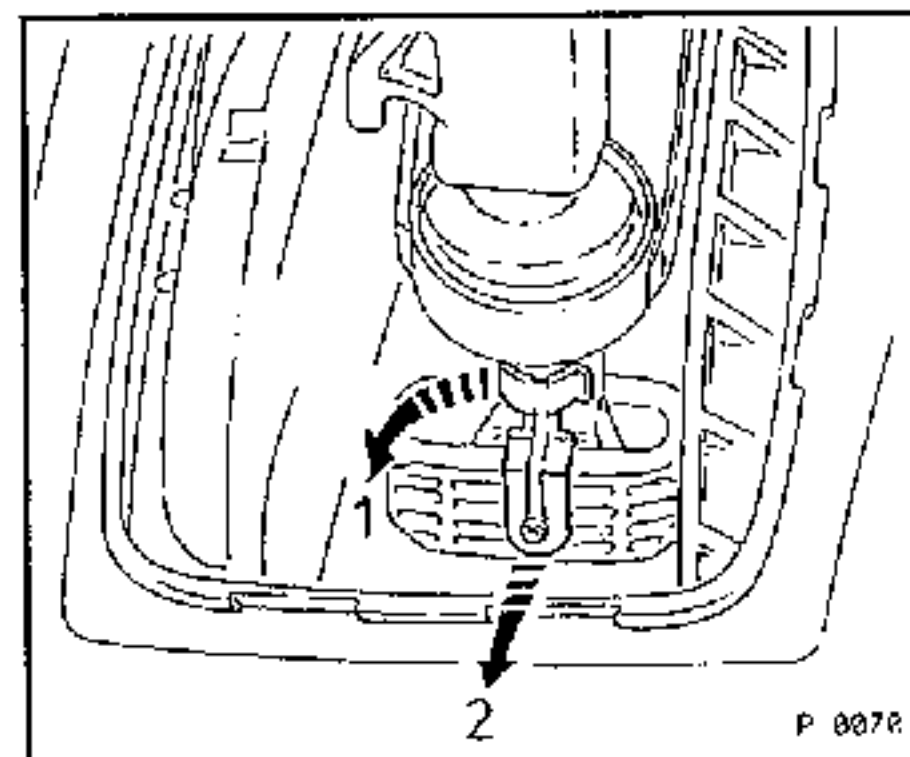
#### Install, Connect

A new gearshift lever cover - pull up on collar and secure with cable tie.

Lubricate reverse gear pawl knob with soap solution.

Heat the insert of the leather gearshift knob with an industrial hot air gun and press on gearshift lever as far as it will go.

Gearshift lever. Refer to previous operation.

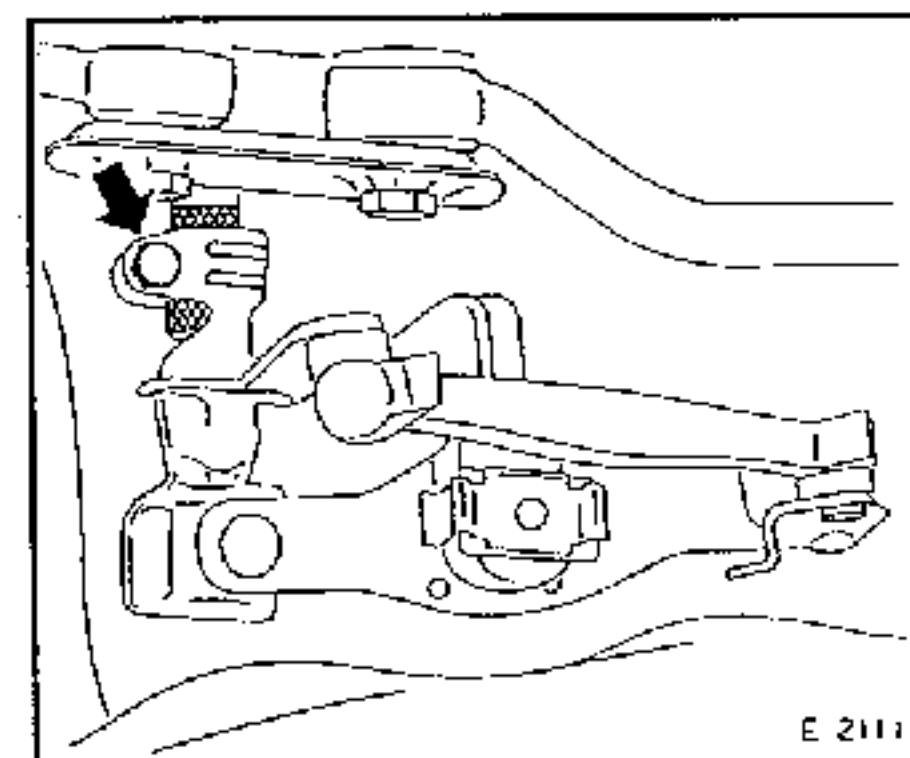


### Shift Linkage, Remove and Install

#### Remove, Disconnect

Loosen bolt for shift rod clamp (arrow).

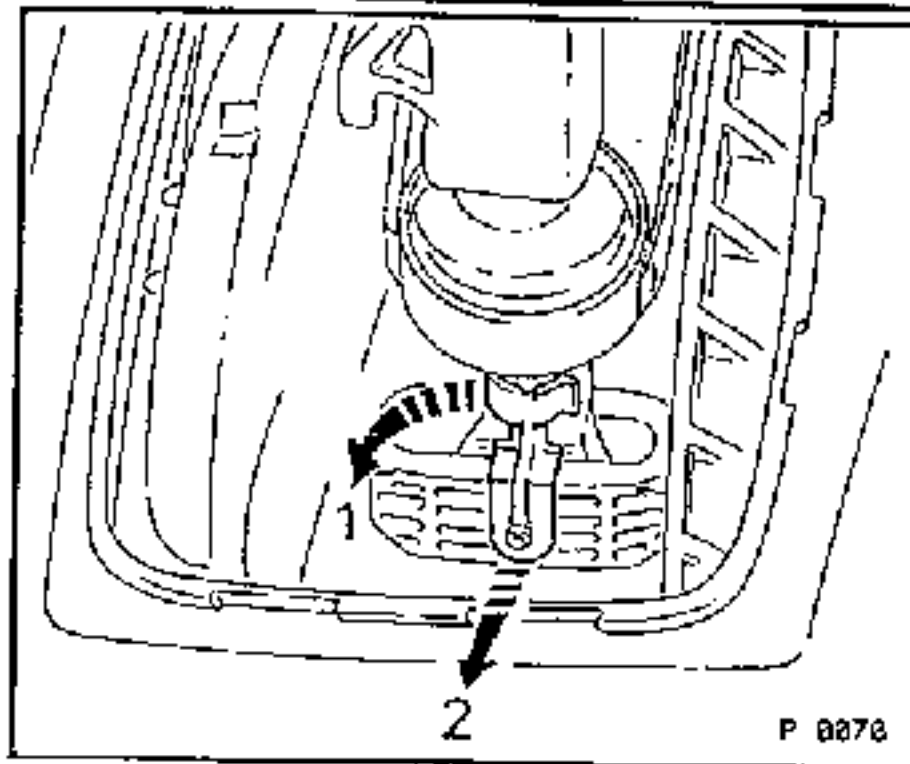
Put manual shift lever in 4th gear position, then separate the plug connection.



# MINOR SERVICING OPERATIONS

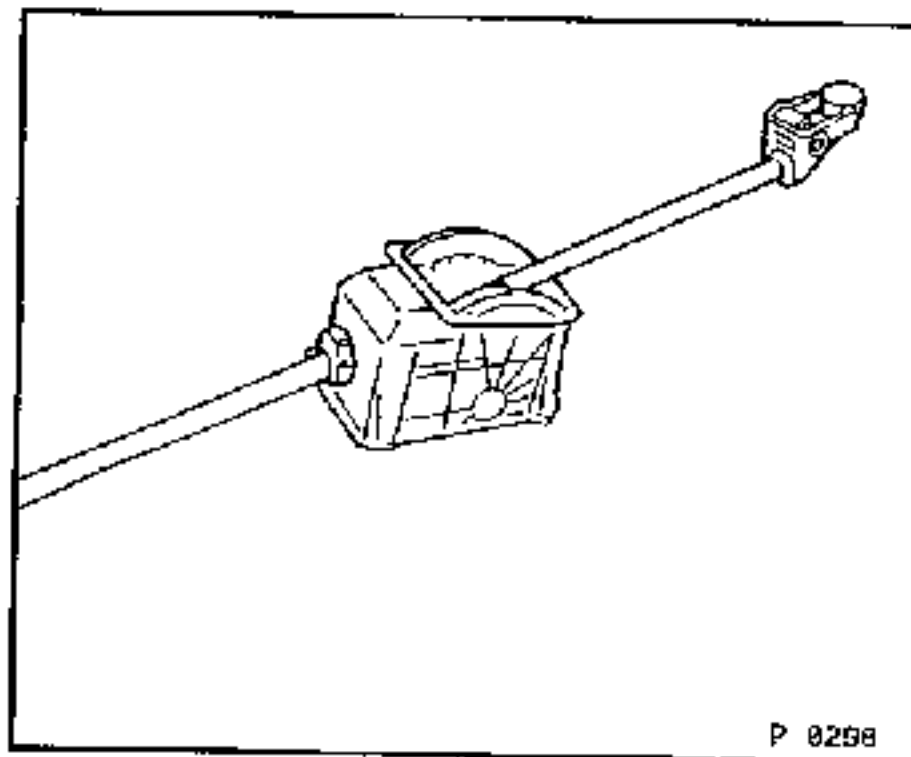
## Remove, Disconnect

Gearshift lever. Refer the operation in this Section.



## Remove, Disconnect

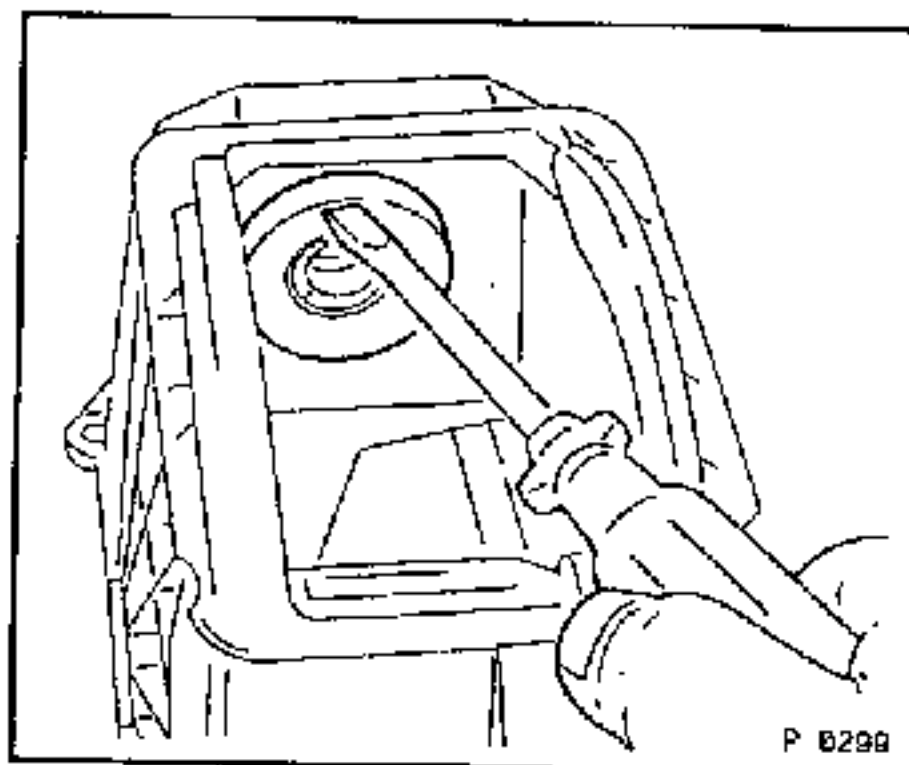
Shift housing with shift rod from underbody.



## Remove, Disconnect

Shift rod from bearing bushing.

Bushing with bearing bushing from shift housing.



## Remove, Disconnect

Press bearing bushing (1) from bushing (2).

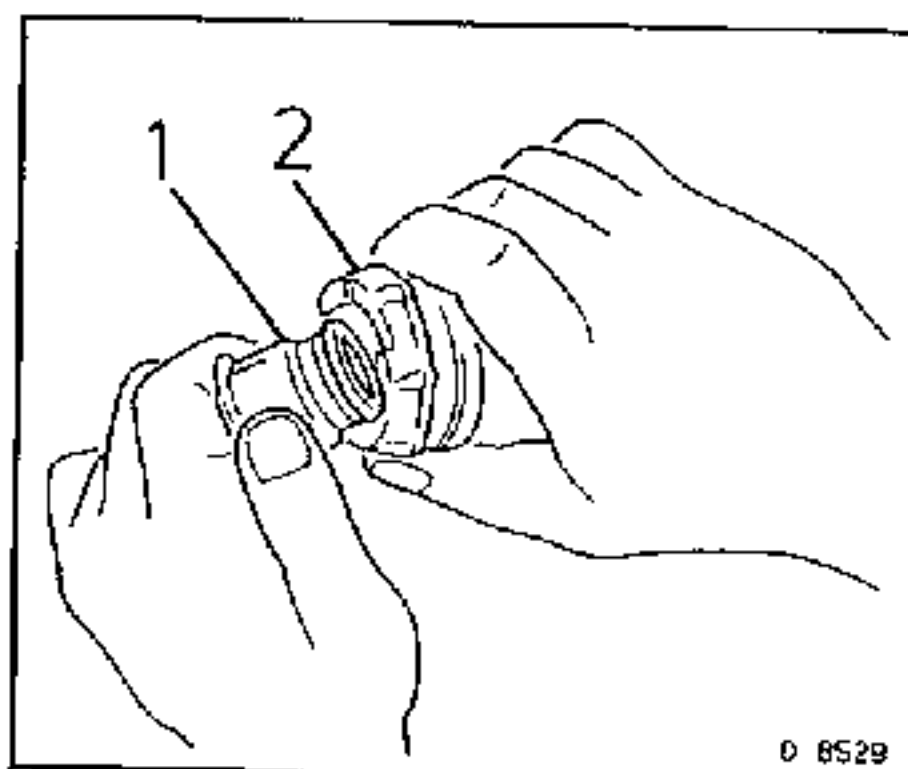
## Install, Connect

Press new bearing bushing (1) in bushing (2).

Press bearing ring from the inside, into the shift housing.

Fill the inner grooves of bushing with Silicon Grease, to Holden's Specification HN2056.

Shift rod into bearing bushing.



# MINOR SERVICING OPERATIONS

## Tighten (Torque)

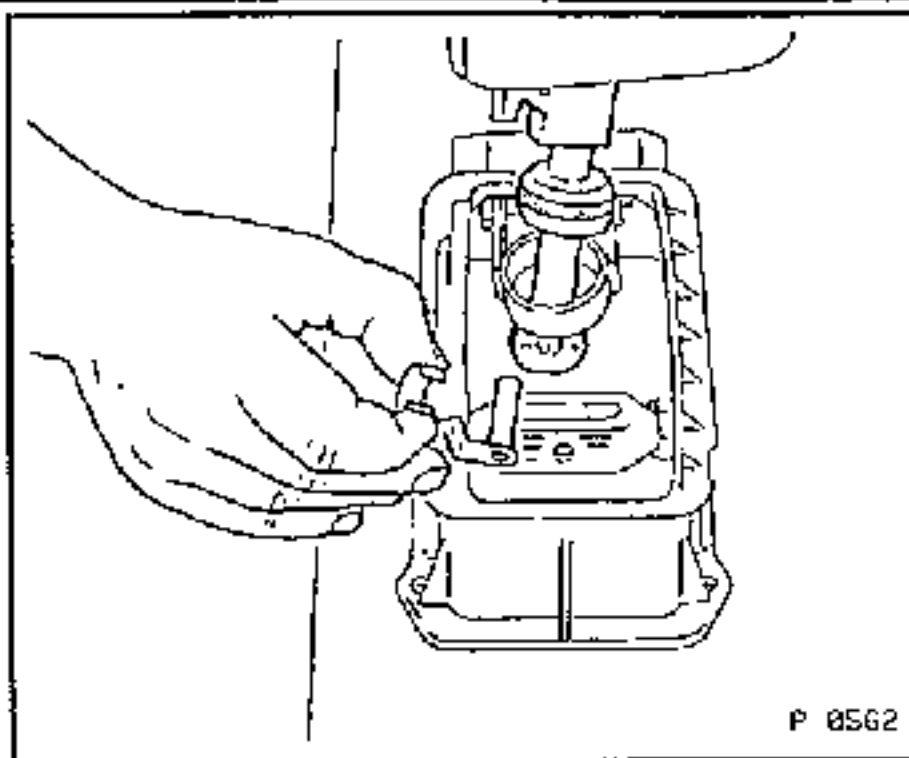
Shift housing to underbody..... 6 Nm

## Install, Connect

Gearshift lever.

## Adjust

Transmission shift linkage. Refer the operation in this Section.



## Dust Boot on Shift Linkage, Replace

Loosen shift rod clamp bolt (arrow).

Select 4th gear - separate the plug connection.

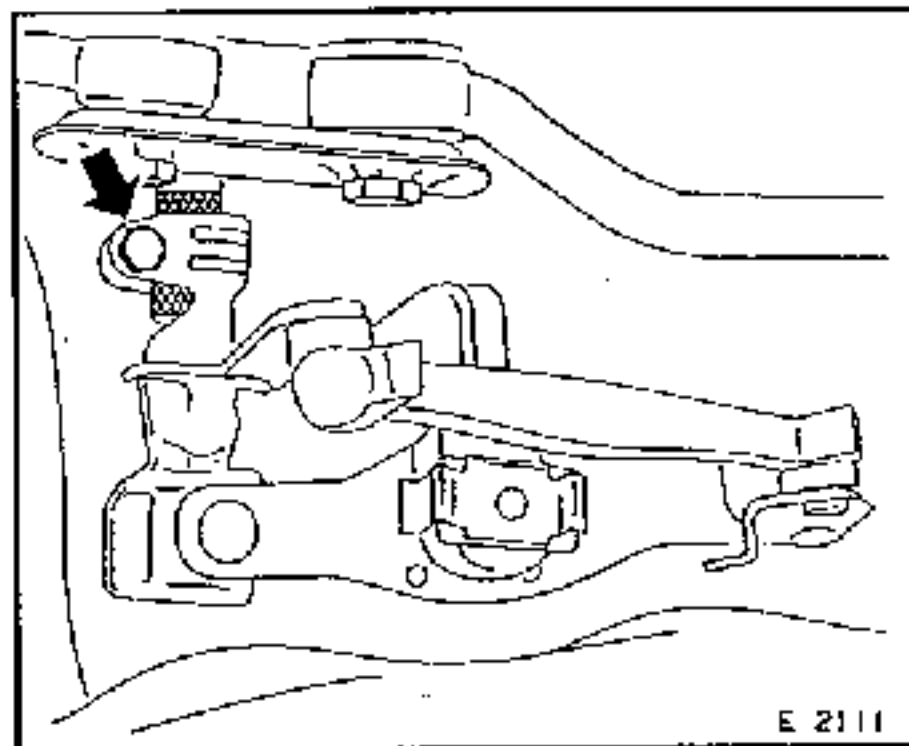
## Remove, Disconnect

(Up to MY'92½)

Clamp from shift rod, then dust boot from shift rod and bulkhead.

(As of MY'93)

Dust boot from shift rod and bulkhead.



## Install, Connect

Push new dust boot onto shift rod without twisting and insert in bulkhead.

(Up to MY'92½)

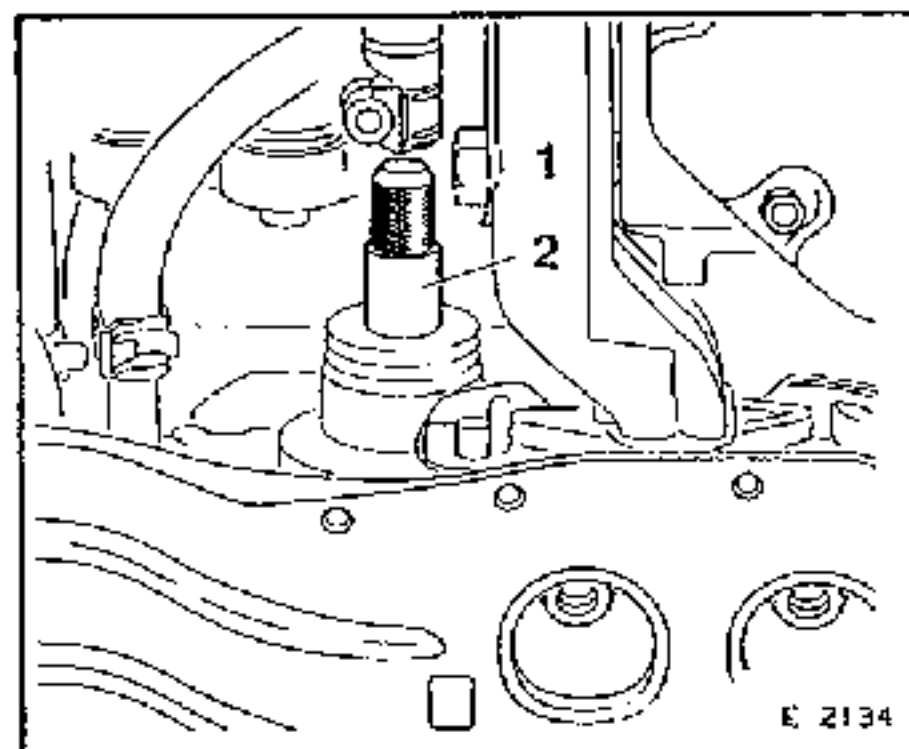
Clamp on shift rod and push knurled stem of the shift rod into the shift guide.

(As of MY'93)

Knurled stem of shift rod into the shift guide.

## Adjust

Transmission shift linkage. Refer the operation in this Section.



## Shift Guide, Remove and Install Selector Rod, Replace

## Remove, Disconnect

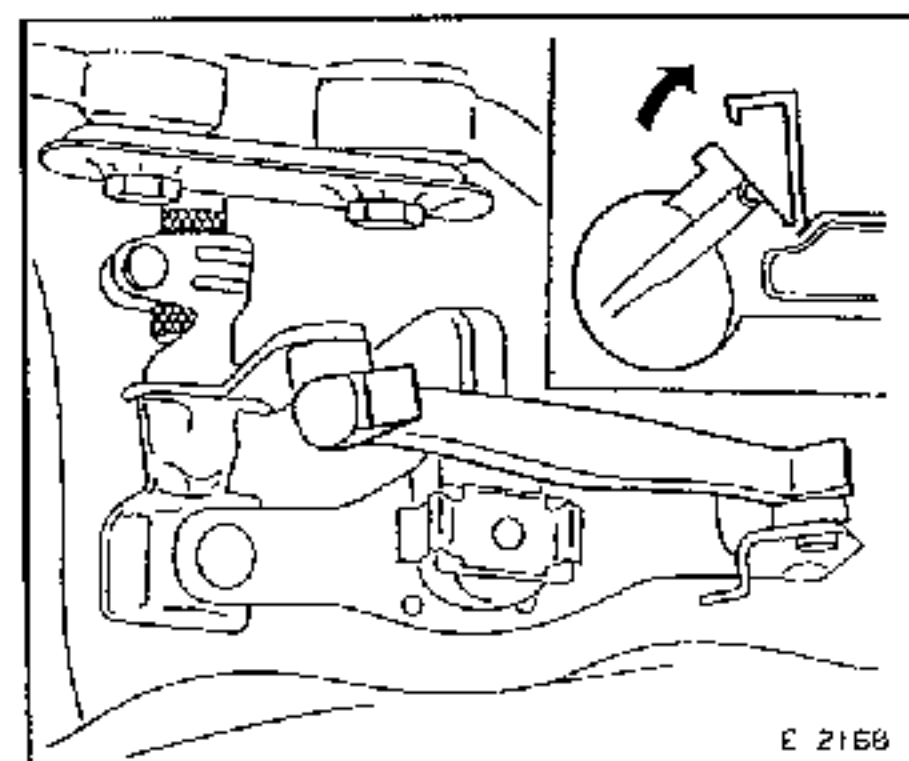
Press plastic clips of selector rod outwards, with a screwdriver (arrow).

Press both ball sockets of selector rod from ball pivot.

## Install, Connect

Lubricate ball sockets with Silicone Grease, to Holden's Specification HN2056.

Press ball sockets onto pivot and engage plastic clips.





# MINOR SERVICING OPERATIONS

## Shift Linkage Lever, Remove and Install

### Remove, Disconnect

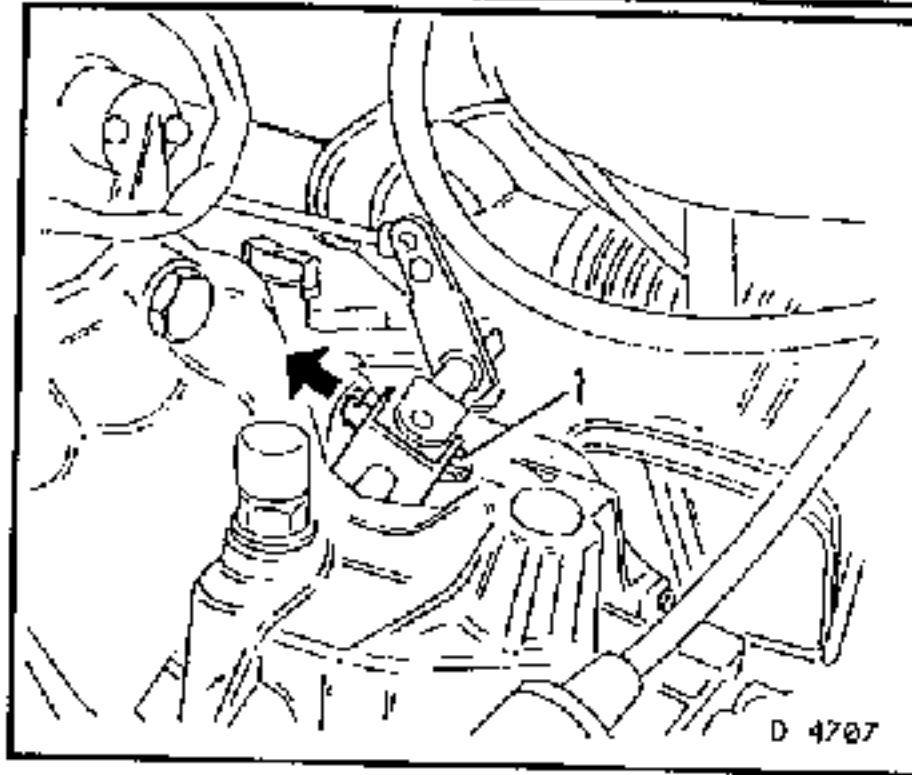
Selector rod.

Separate Cardan joint from shift linkage;

Press the retaining springs (1) of the hollow pin (arrow) together, then press out hollow pin.

#### Note:

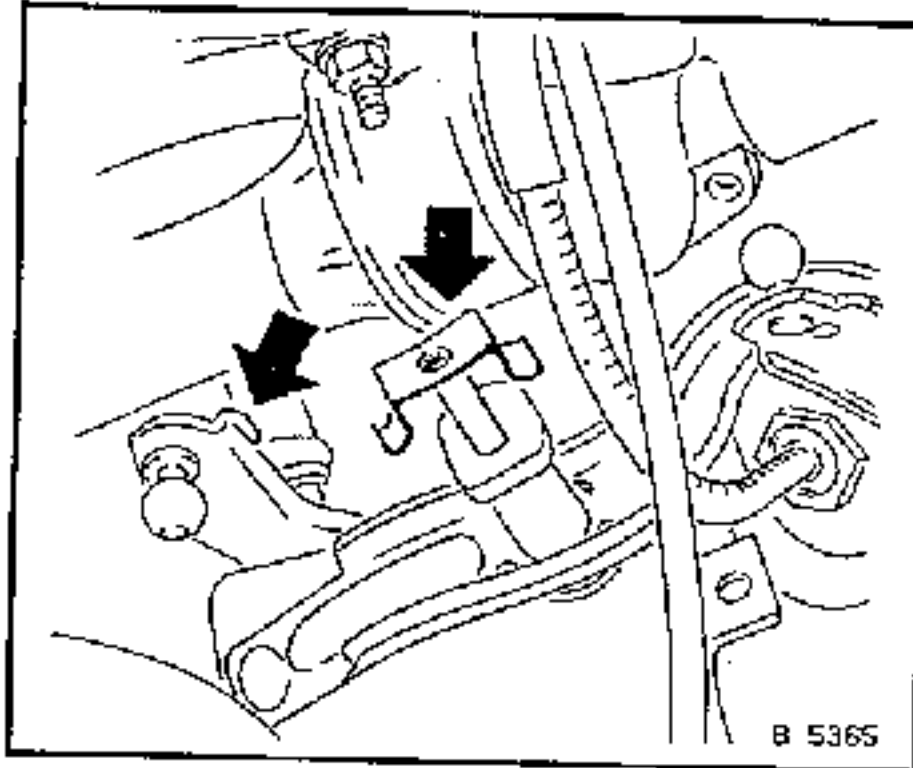
Hollow pin must be replaced once removed.



### Remove, Disconnect

Loosen bolt for shift rod clamp (left arrow) and disconnect plug.

Remove pin with spring clip (right arrow) from guide bearing. Remove guide lever assembly from transmission.

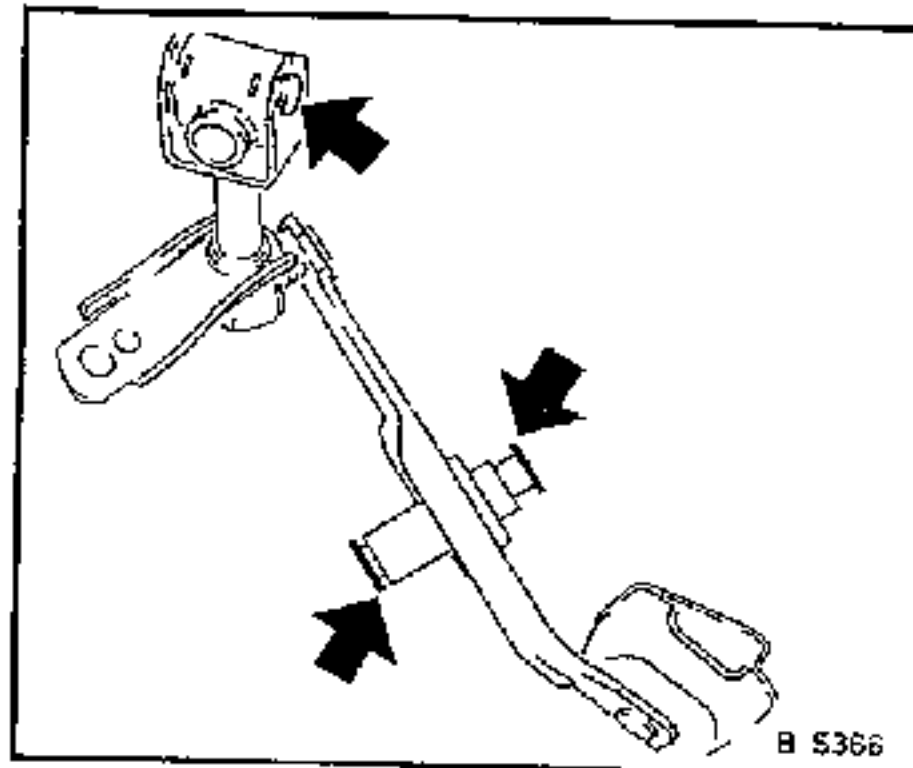


### Remove, Disconnect

Both bushings of shift linkage lever bearing may be replaced. If necessary, replace Cardan joints.

#### Important!

Do not disassemble the shift linkage lever any further.



### Install, Connect

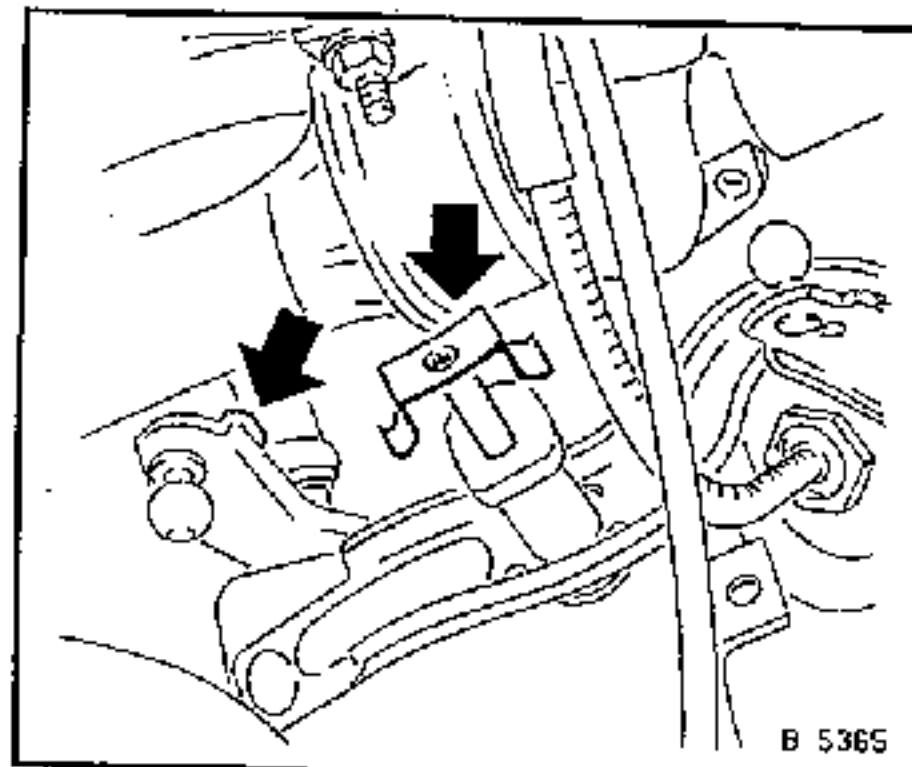
Shift linkage lever assembly to transmission with pin.

Spring clamps until they catch.

Lubricate bearing bushings with Dow Corning No 44, silicone grease or equivalent, to Holden's Specification HN1014.

Shift rod plug connection - connect shift guide.

Shift rods - tighten clamp bolt after adjustment.



# MINOR SERVICING OPERATIONS

## Install, Connect

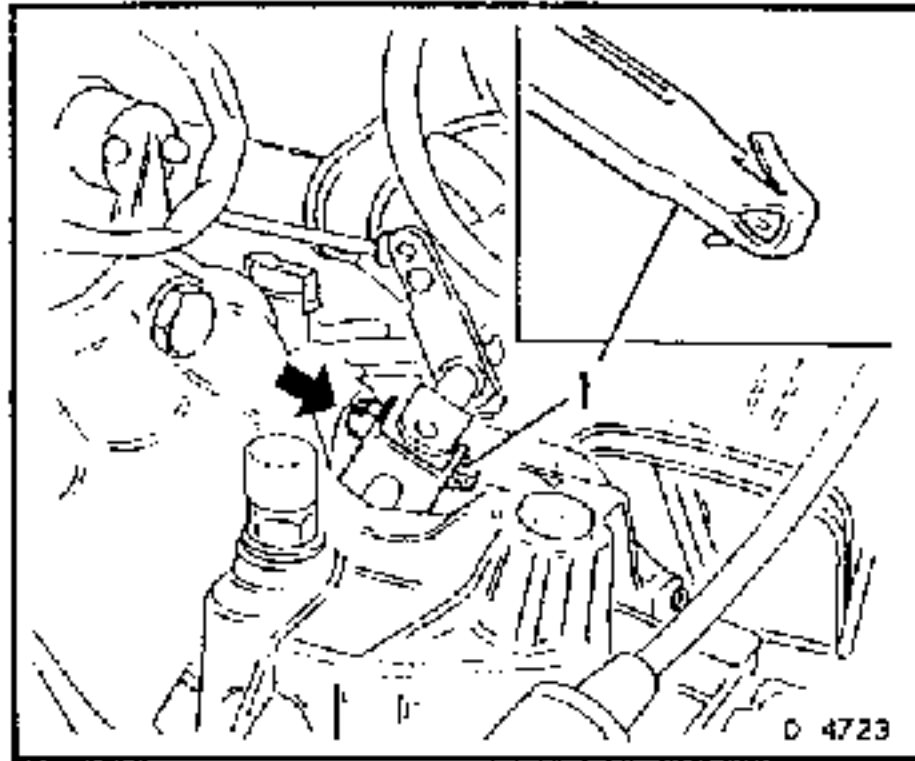
New hollow pin to Cardan joint, secure with expanding springs (1).

Lubricate the pin with Dow Corning No 44, silicone grease or equivalent, to Holden's Specification HN1014.

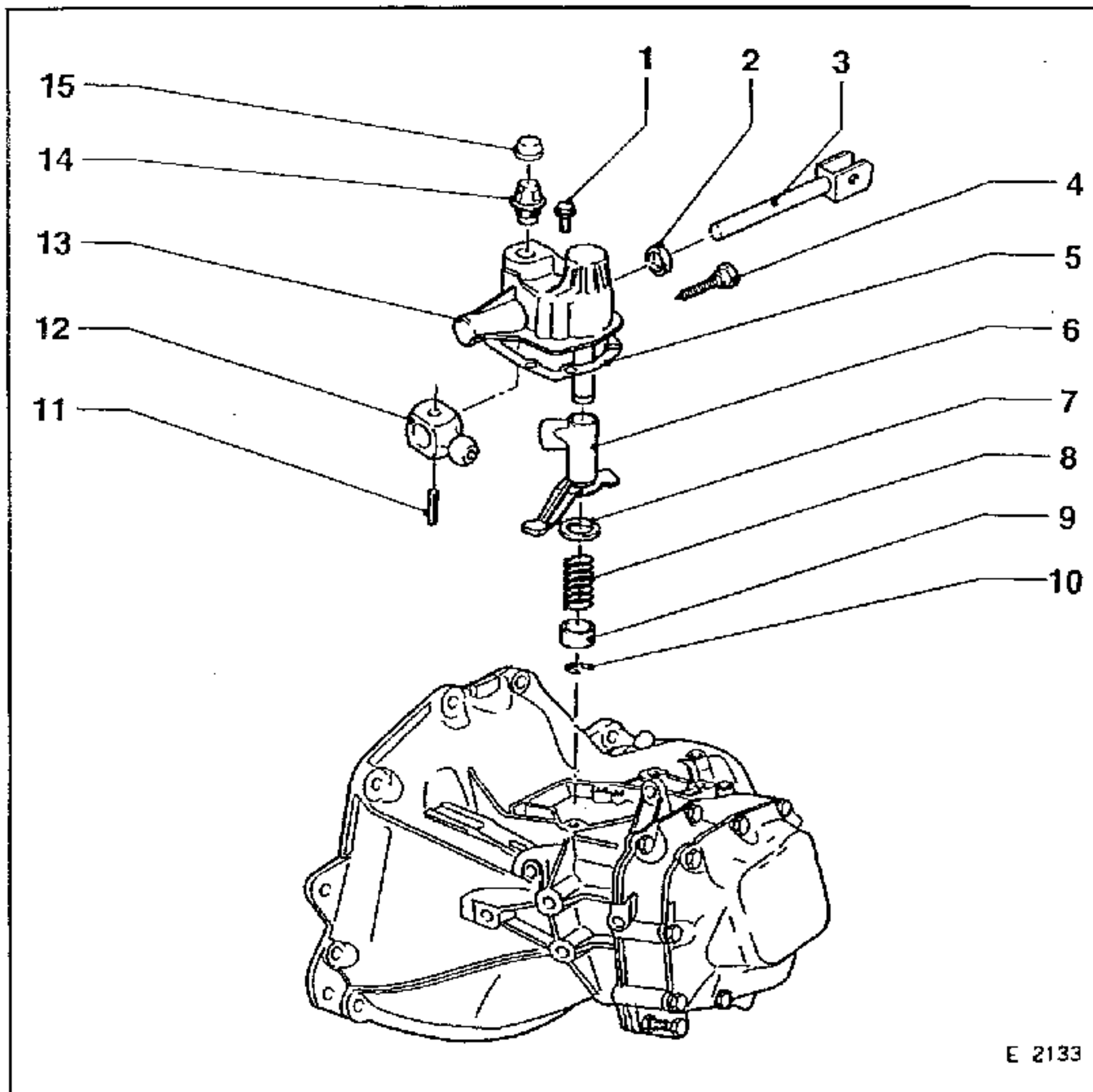
Press ball sockets of selector rod onto ball pivot of guide lever and engage plastic clips.

## Adjust

Transmission shift linkage. Refer the operation in this Section.



## Shift Cover, Remove and Disassemble



### Illustration Key:

1 Hex bolt (M 7 x 20)	4 Adjustment hole plug	7 Washer	10 Snap ring	13 Shift cover
2 Shaft seal ring	5 Gasket	8 Thrust spring	11 Roll pin	14 Vent bolt
3 Shift rod	6 Shift Intermediate lever	9 Bushing	12 Selector finger	15 Vent bolt cap

# MINOR SERVICING OPERATIONS

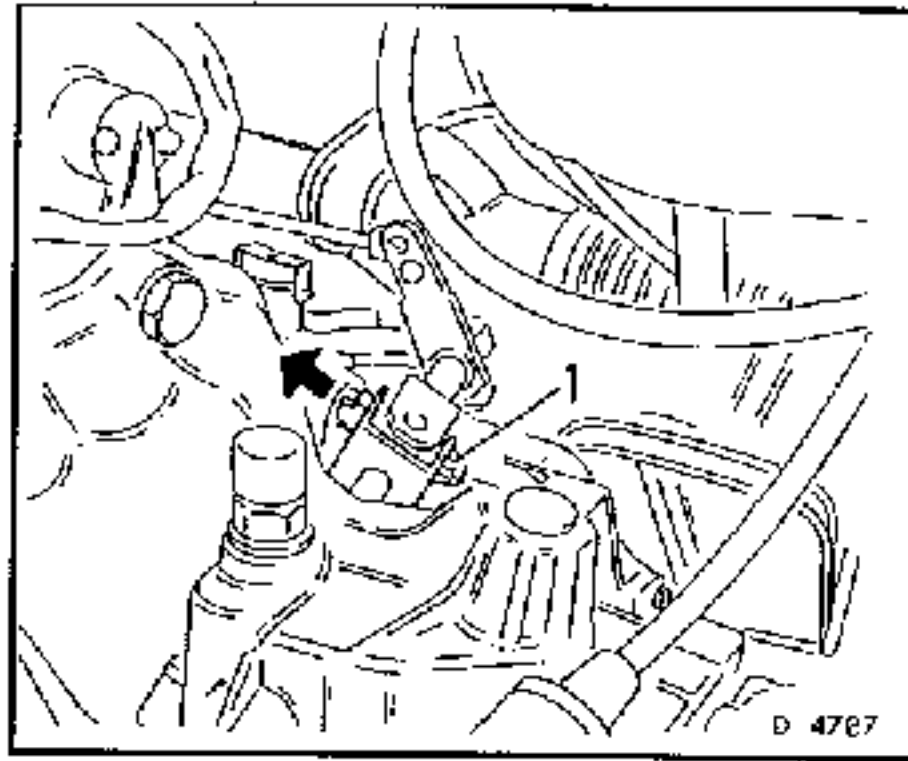
## Remove, Disconnect

Separate Cardan joint from shift linkage.

Press hollow pin retaining spring (1) together, then press out pin.

### Note:

Hollow pin is to be replaced, once removed.



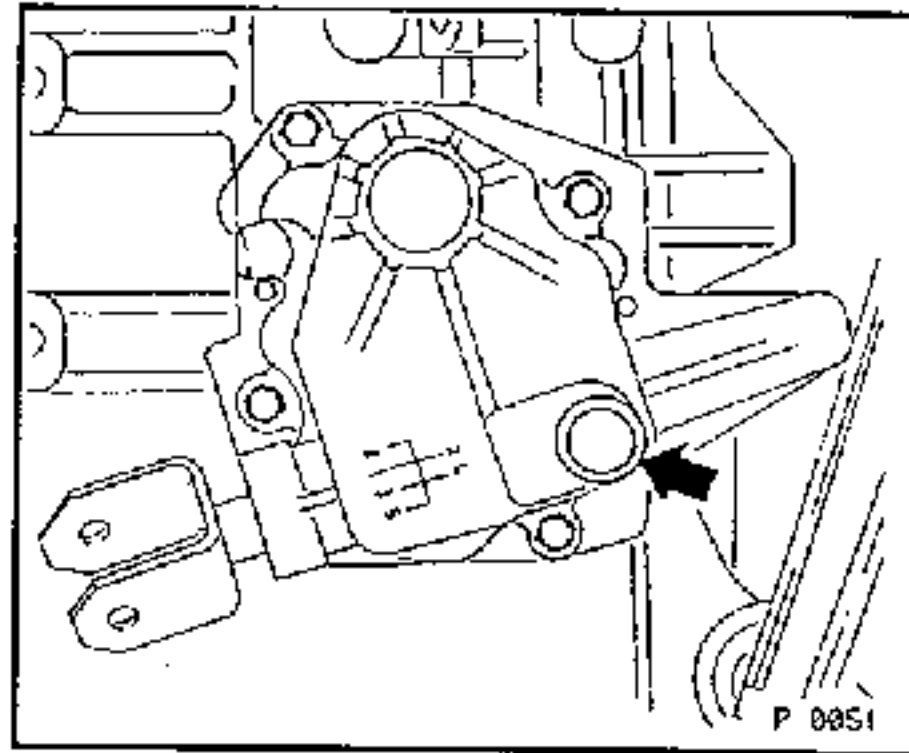
## Remove, Disconnect

Closure bolt for transmission ventilation from shift cover (arrow).

Remove plug from adjustment hole and insert KM-527 or KM-527-A.

If KM-527 is used, grind a 3 mm chamfer on the short leg. Re-stamp the tool with the suffix "A".

Shift cover from transmission.

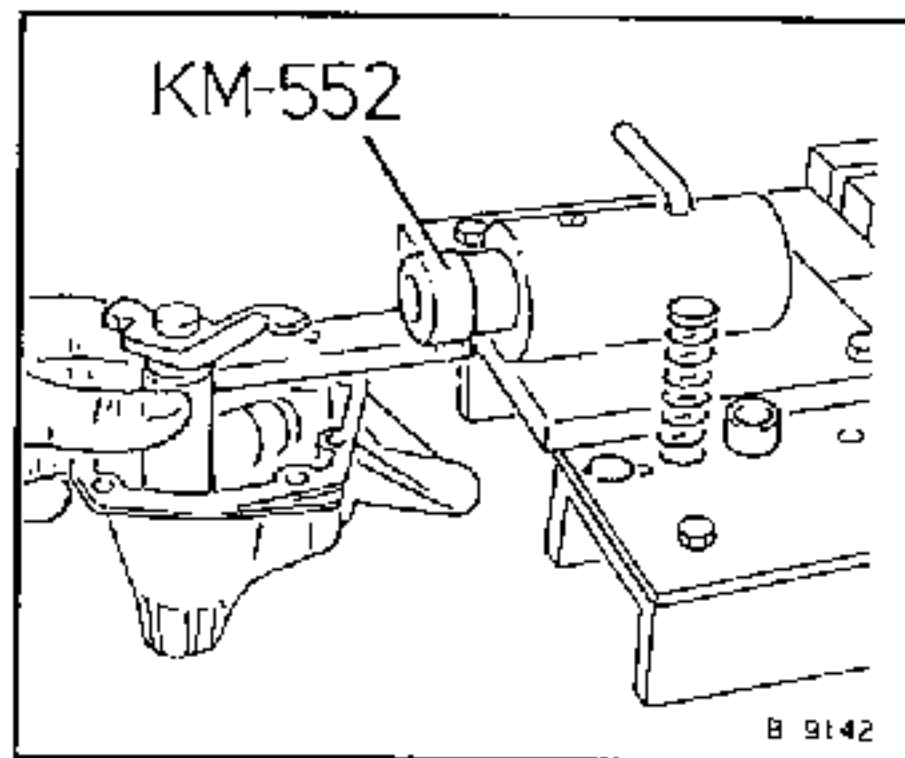


## Install, Connect

Shift cover on KM-552 or KM-448 and remove KM-527 or KM-527-A.

## Disassemble

Retaining ring, bushing, thrust spring, washer and intermediate shift lever from the guide pin.



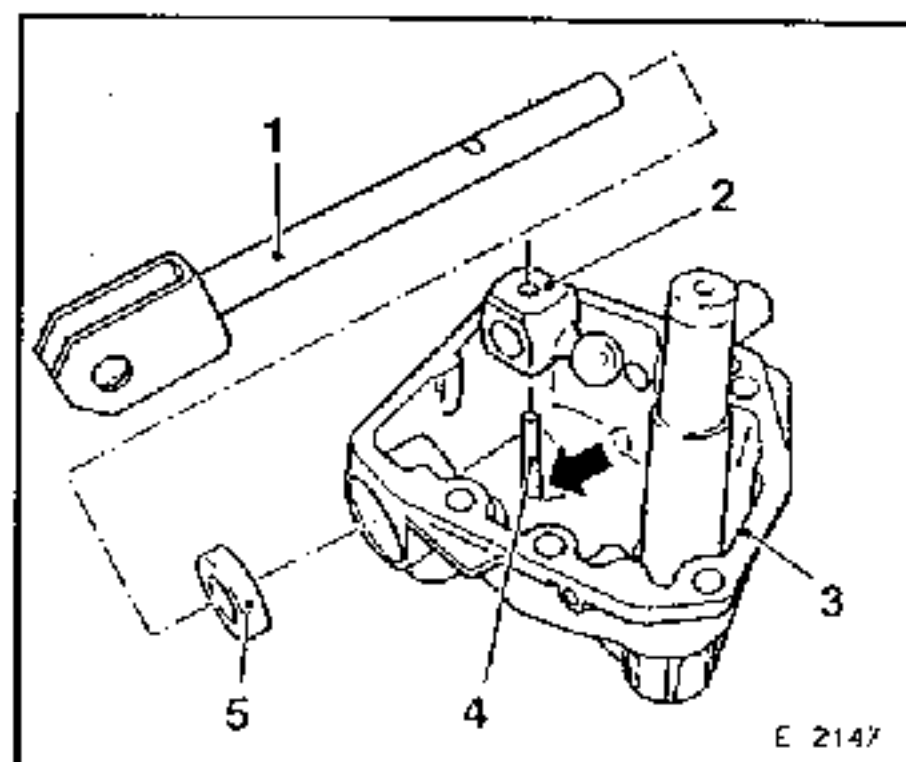
## Remove, Disconnect

Turn rod (1) and selector finger (2) so that roll pin (4) in recess (arrow), can be driven out.

Shift rod (1) from selector finger (2) and cover (3). Lever seal (5) from cover (3).

Do not disassemble the cover any further.

The cover is serviced as an assembly with the guide pin.



# MINOR SERVICING OPERATIONS

## Shift Cover, Assemble and Install

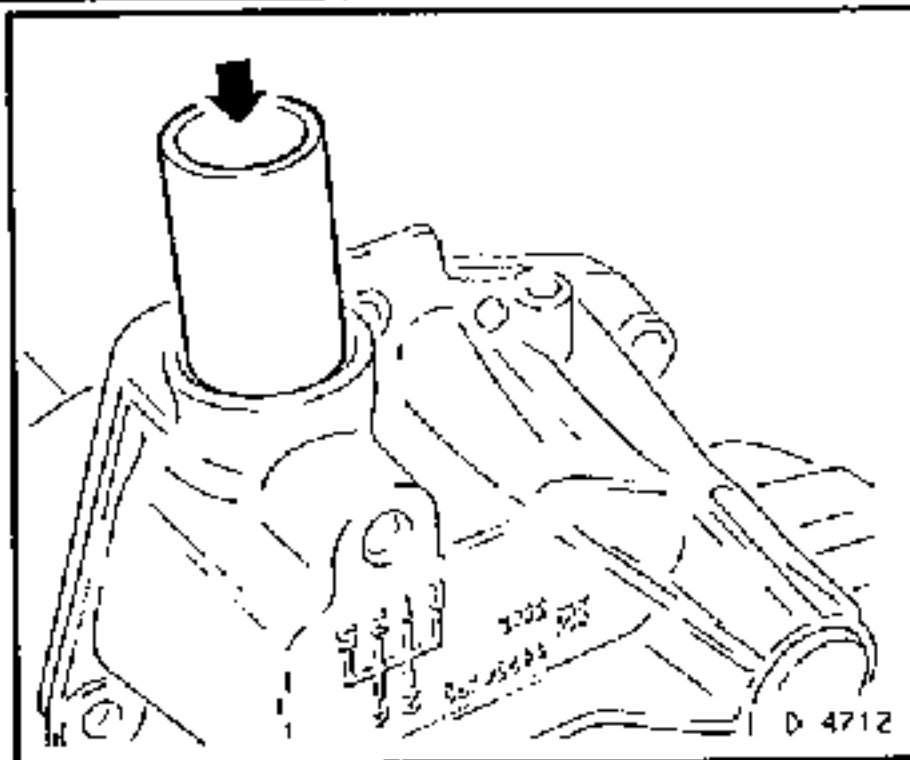
### Install, Connect

Drive in new seal ring with suitable sleeve (arrow). Coat seal lips with Molybdenum Disulphide grease to Holden's Specification HN1461.

Lubricate all bearing bushings with GL4, 80W gear oil, to Holden's Specification HN1855.

Guide shift rod into selector finger and cover.

Drive in new roll pin and centre in the selector finger.

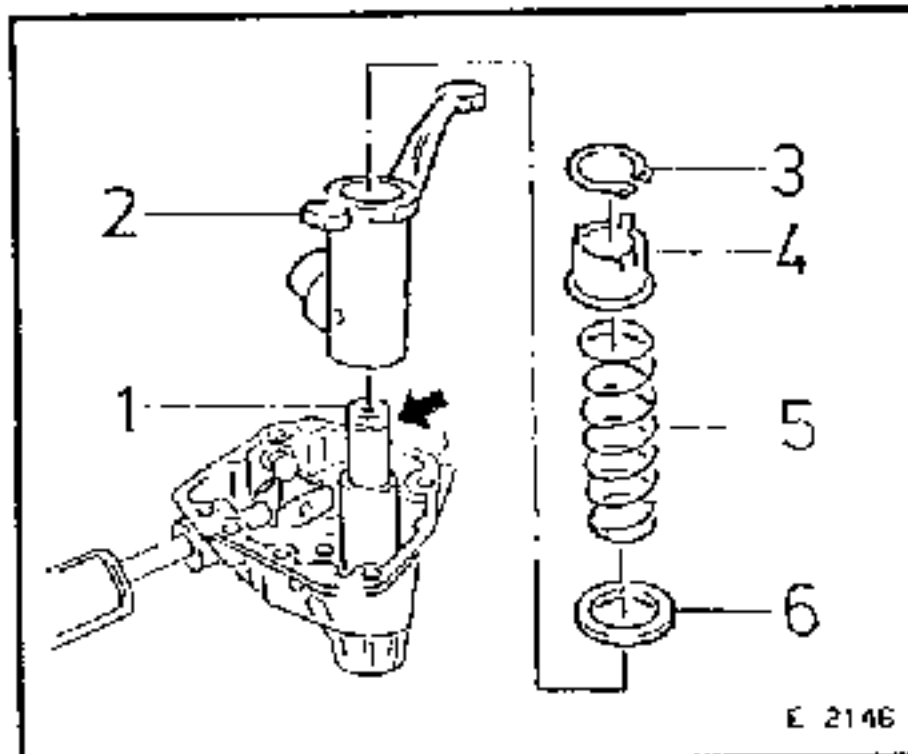


### Assemble

Shift cover.

Place intermediate lever (2), washer (6), thrust spring (5) and bushing (4) onto guide pin (1).

Insert new snap ring (3) in groove (arrow).



Before installing cover,

### Measure

Play (1) between dowel pin (3) and actuation of shift rod, 3rd/4th gear (2), using a feeler gauge.

Specification (1) = 0.5 mm.

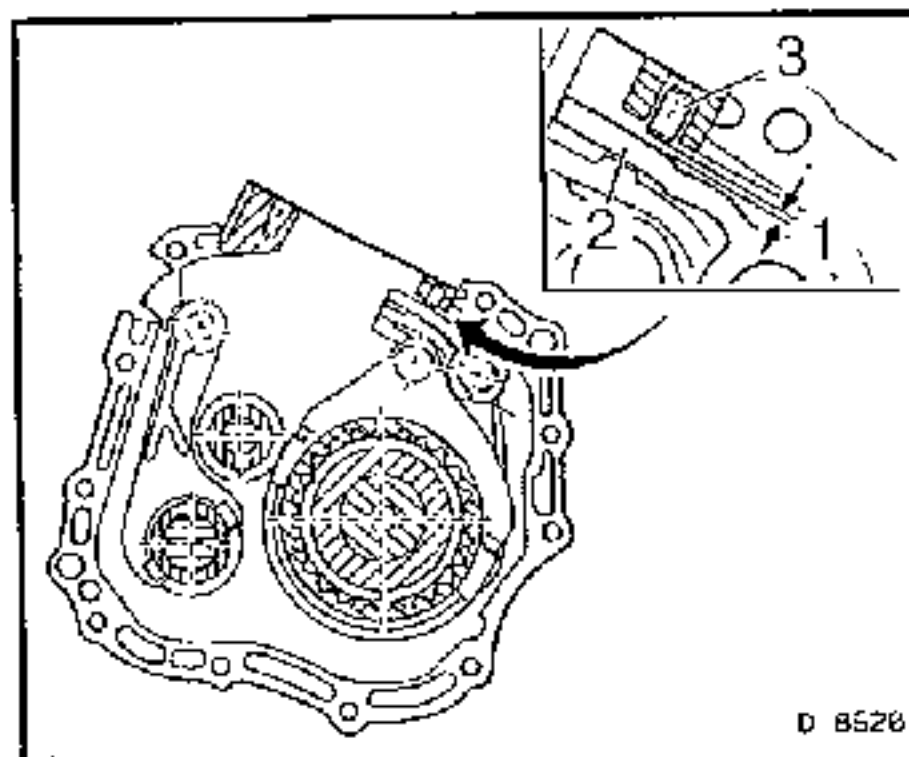
### Adjust

If play is too large;

Using drift punch, drive dowel pin (3) slightly into transmission housing and check play again.

If play is too small;

No play correction is necessary, as the shift rod presses the dowel pin into the correct position.



### Install, Connect

Place KM-527-A into adjustment bore hole.

Apply lithium bearing grease NLGI No. 4, to a new gasket.

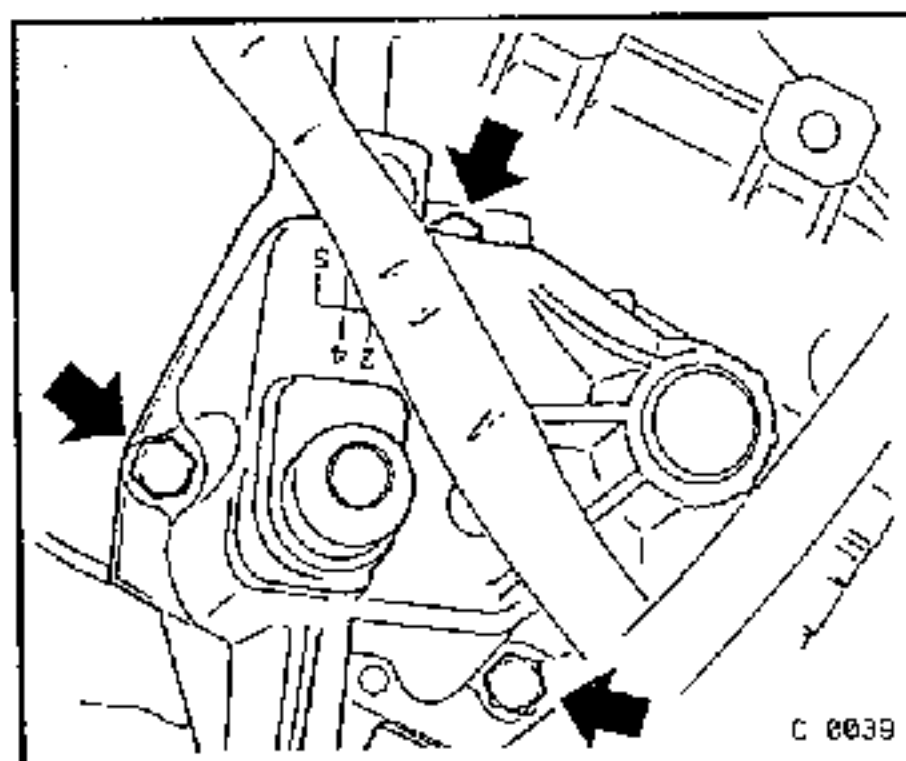
With the transmission in neutral, install the cover.

### Tighten (Torque)

Selector cover to transmission ..... 15 Nm

Remove KM-527-A.

Insert new plug to the adjustment bore hole.



# MINOR SERVICING OPERATIONS

## Install, Connect

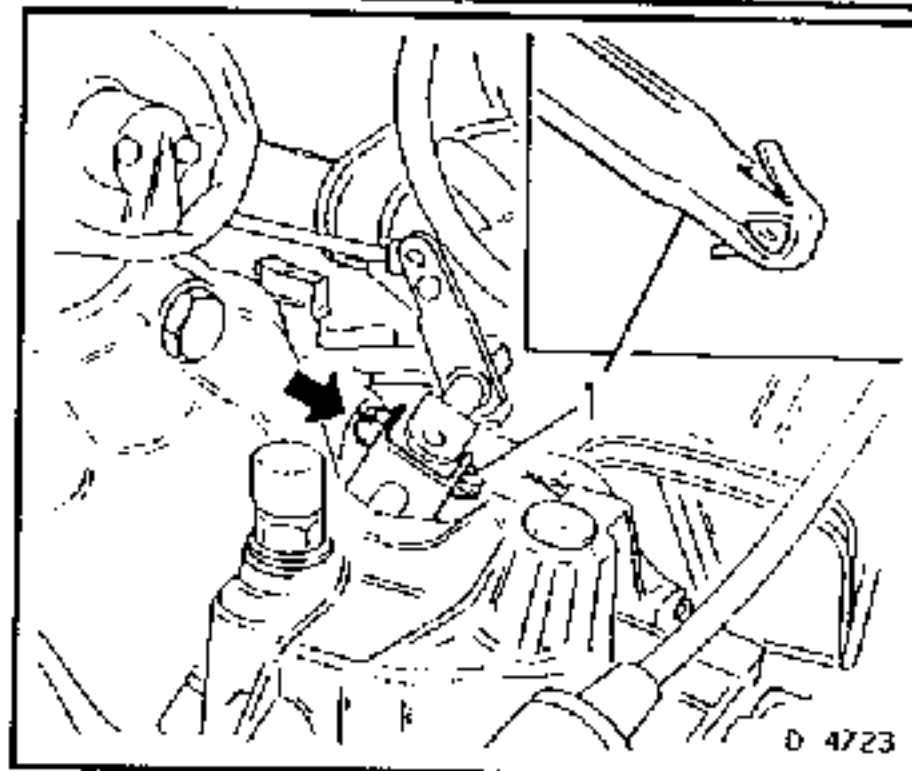
Closure bolt for transmission ventilation.

New hollow pin (1) to Cardan joint - the expanding springs will self-engage.

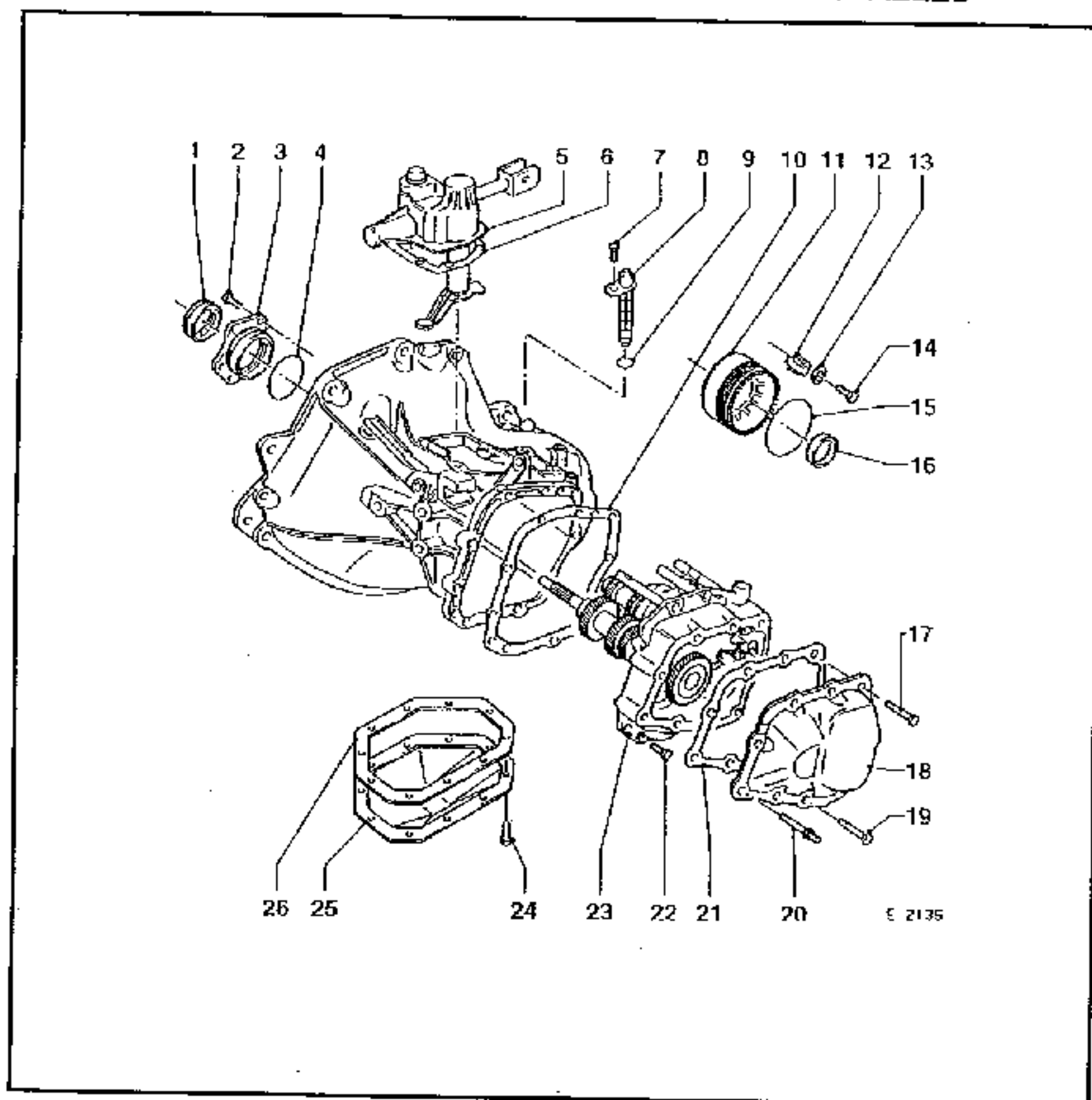
Lubricate pin with Dow Corning No. 44 silicone grease, to Holden's Specification HN1014, or equivalent.

## Inspect

Transmission gear oil level. Refer 'Transmission Shift Linkage, Adjust' in this Section.



## TRANSMISSION SEALING OPERATIONS - TRANSMISSION INSTALLED



### Illustration Key:

1 Axle shaft seal ring	10 End cover gasket	19 Hex bolt M 7 x 15
2* Hex bolt	11 Bearing ring	20 Hex bolt
3* Bearing flange	12 Tab washer	21 End shield cover gasket
4* Rubber O-ring	13 Split washer	22 Hex bolt
5 Shift cover	14 Hex bolt	23 End shield
6 Gasket	15 Rubber O-ring	24 Hex bolt
7 Hex bolt	16 Axle shaft seal ring	25 Differential cover
8 Speedometer driven gear	17 Hex bolt M 8 x 58	26 Gasket
9 Rubber O-ring	18 End shield cover	* F 20 FWD only

# MINOR SERVICING OPERATIONS

## Axle Shaft Seal Rings, Replace

### Note:

For vehicles with 4WD, the operation for the right side (transfer box side), is described in the Section "Sealing Operations on Installed Transfer Box", in this Group.

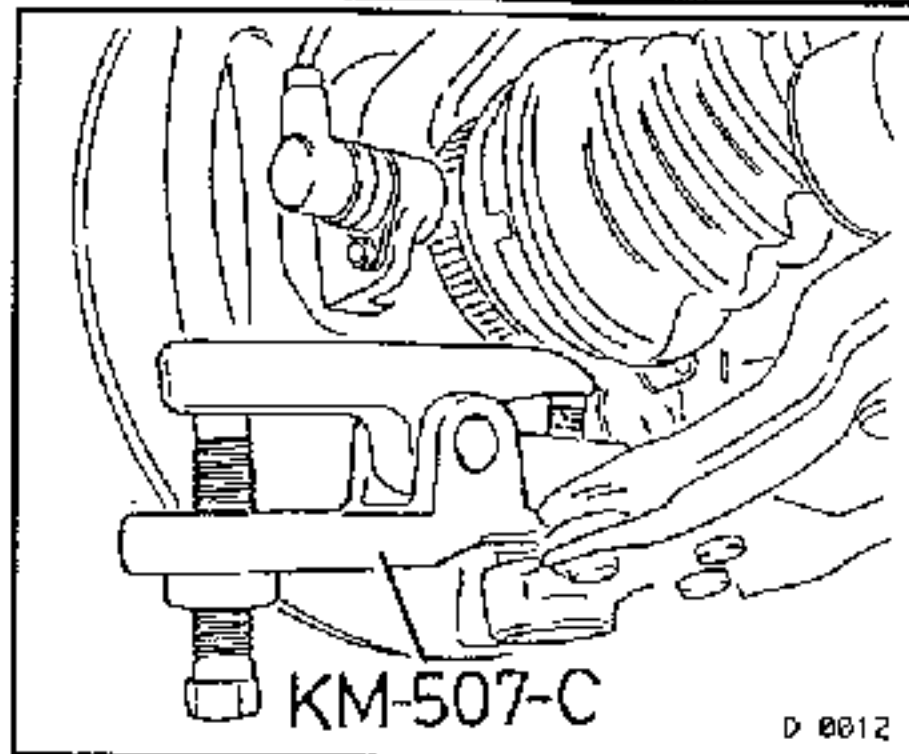
### Remove, Disconnect

Both front wheels.

Lower control arm ball joints from steering knuckles, using KM-507-C.

Lower engine compartment cover.

If necessary; the stabiliser mounting from the control arms. Refer to Group E, in Volume 1 for this operation.



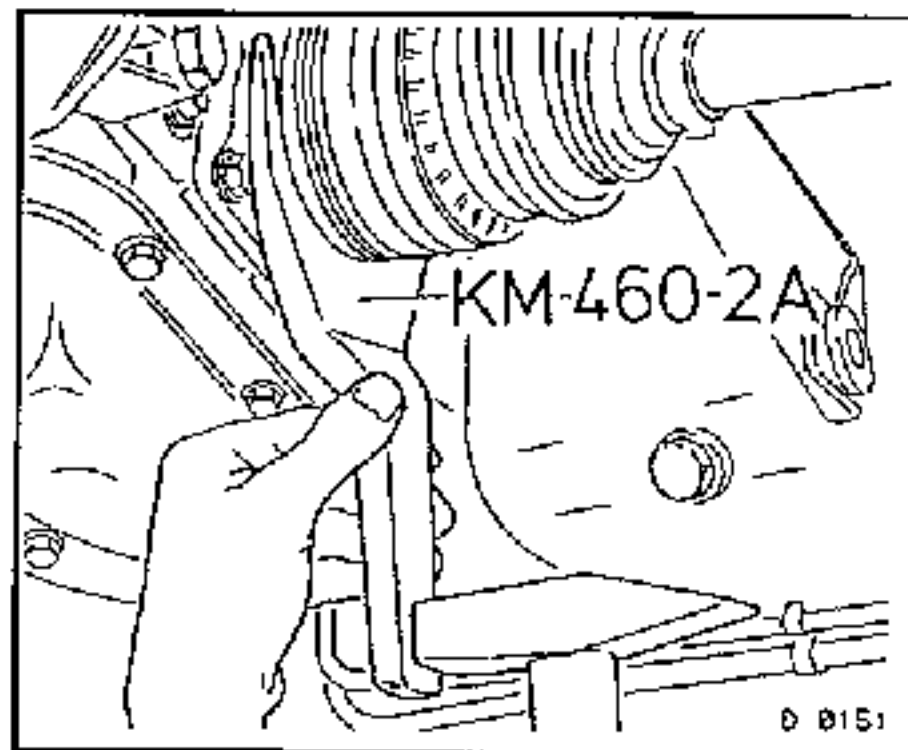
### Remove, Disconnect

Axle shafts from the transmission or from the intermediate shaft. Use;

	Left	Right
F 20:	KM-503-A	Soft metal drift
F 28/6	KM-503-A	Soft metal drift

### Note:

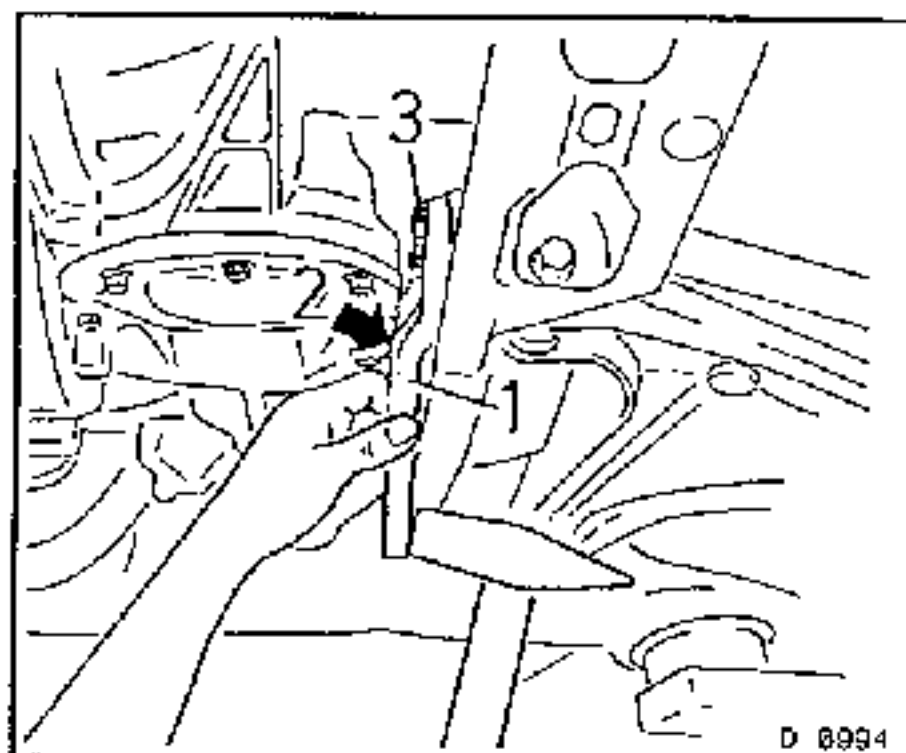
The chamfered edge of the tool faces the transmission.



### Important!

For F 20 on the left side;

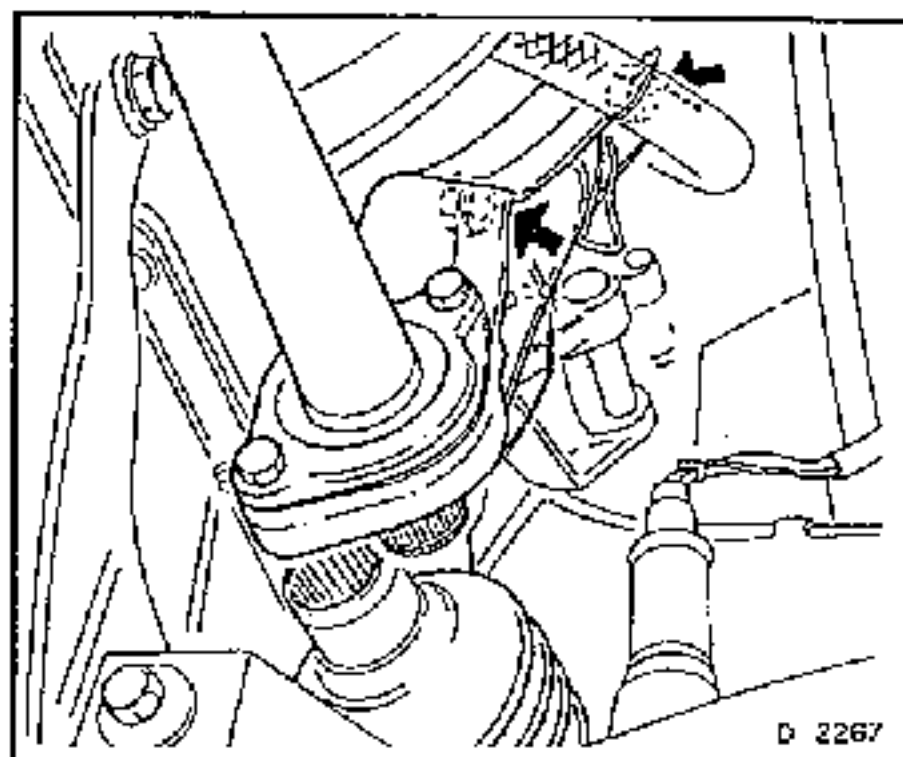
Support KM-503-A (1) on the differential cover (2), NOT on the bearing ring (3).



### Remove, Disconnect

For F 20 on the right side;

Unbolt the intermediate shaft bracket from the engine block (2 bolts, arrows) and remove the intermediate shaft from the transmission.



# MINOR SERVICING OPERATIONS

## Important!

Have a suitable clean container on hand to catch oil spillage

Plugs gaps.

Use tie wire to support the axle shafts. Do not let them hang on their own weight!

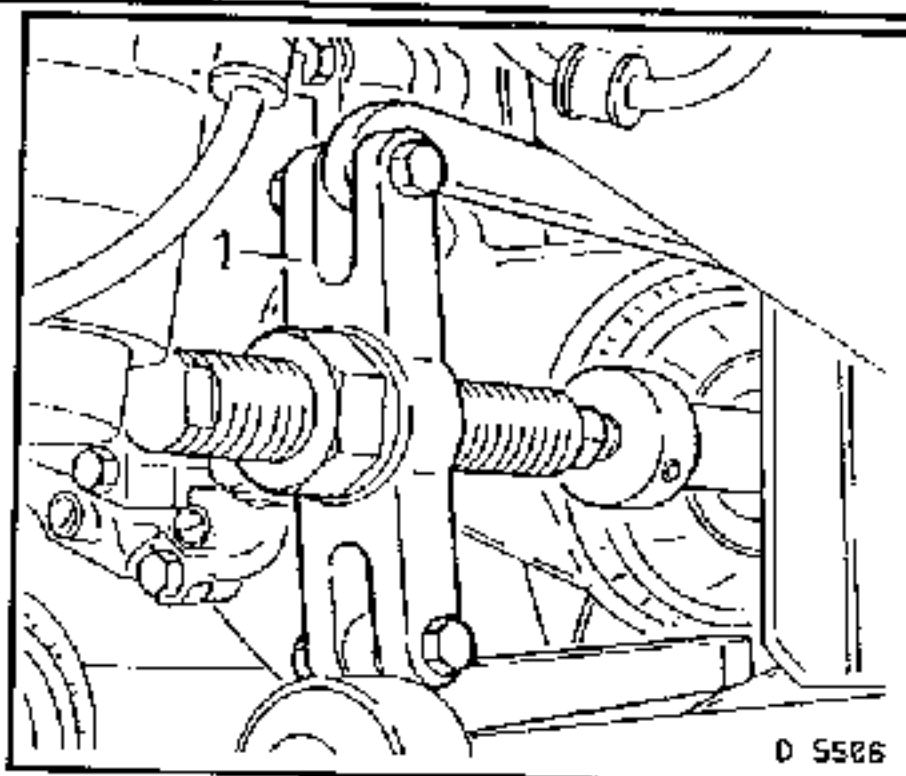
## Remove, Disconnect

Seal ring;

F 20: From bearing ring or bearing flange.

F 28/6 From transmission casing.

Use MKM-557 (1) to remove seal rings.



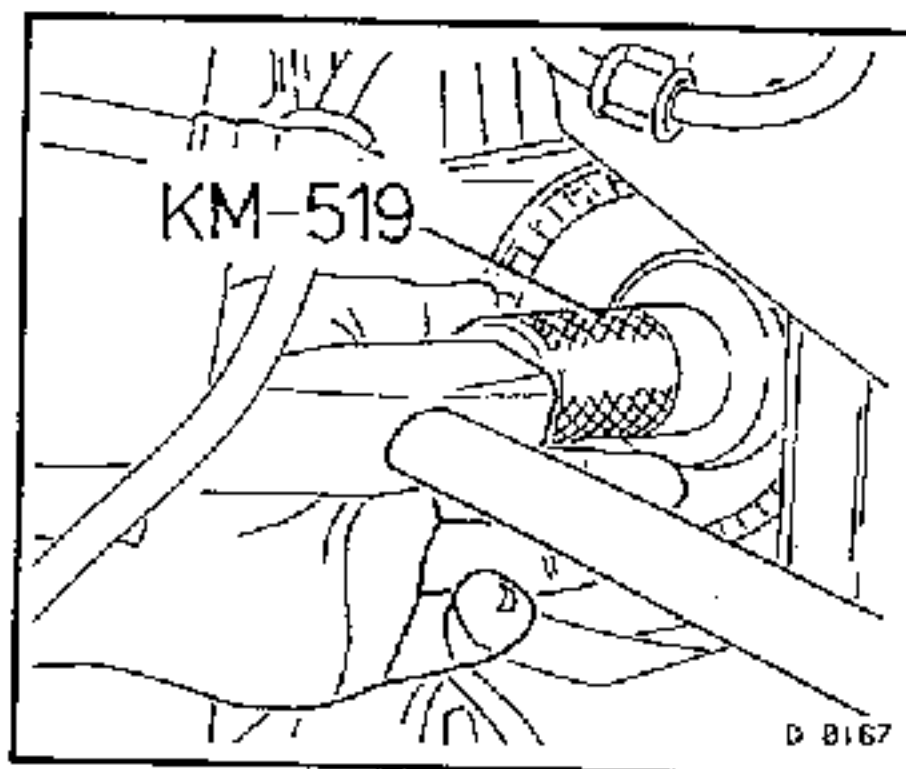
## Install, Connect

Seal ring;

F 20: Use KM-519 to install seal in bearing flange or bearing ring.

F 28/6 Use KM-519 to install seal in transmission casing.

Drive seal rings in until they are flush.

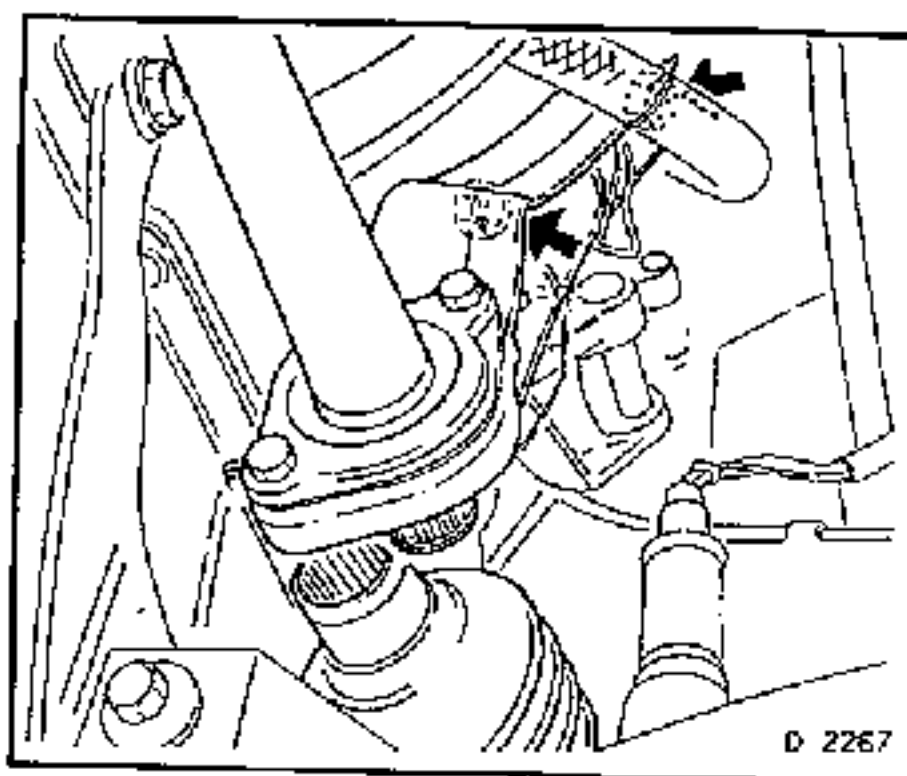


## Install, Connect

F 20: Intermediate shaft and bracket.

## Tighten (Torque)

Intermediate shaft bracket to engine block..... 55 Nm



## Install, Connect

New retaining ring (1) on axle shaft.

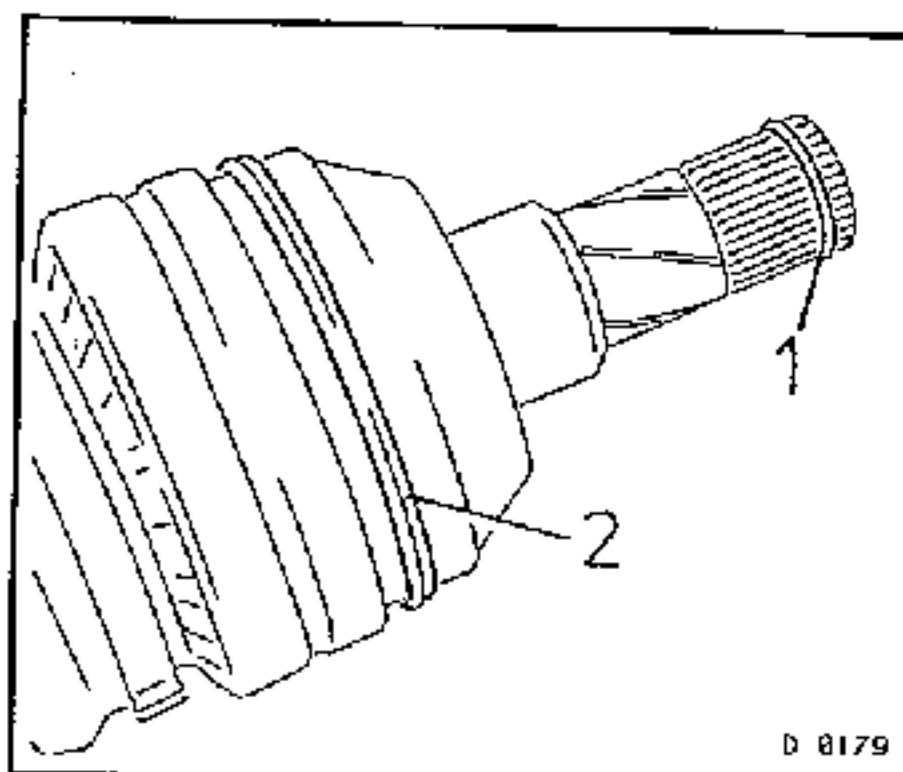
Apply transmission gear oil to the axle splines.

Insert axle into transmission;

Use a square drift and drive on the friction bed weld (2) until the axle engages fully.

## Inspect

To check for full installation, try to pull the axle out by grasping on the outer joint diameter (NOT on the axle shaft itself).





# MINOR SERVICING OPERATIONS

## Install, Connect

New self-locking nut to stabiliser fastening.

Maintain a pre-tension dimension 't' = 38 - 39 mm.

Front wheel.

## Tighten (Torque)

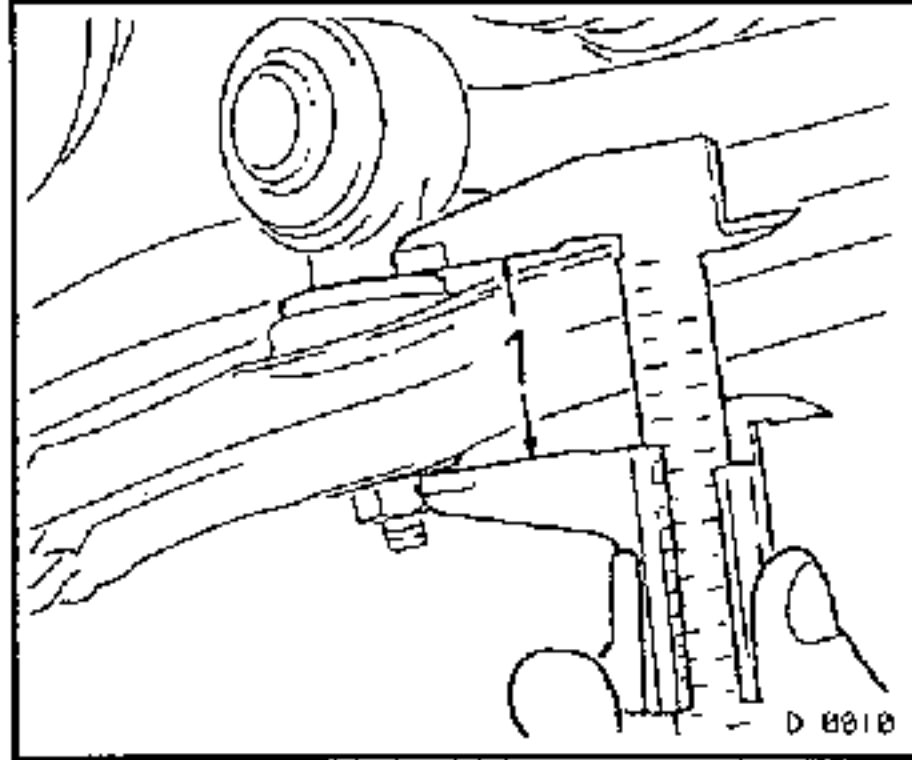
Stabiliser to control arm .....	20 Nm
Front wheel.....	110 Nm

## Inspect

Transmission oil level. Refer to the operation, in this Section.

## Install, Connect

Lower engine compartment cover.



## Speedometer Driven Gear and/or O-ring, Replace

For F 20 transmission;

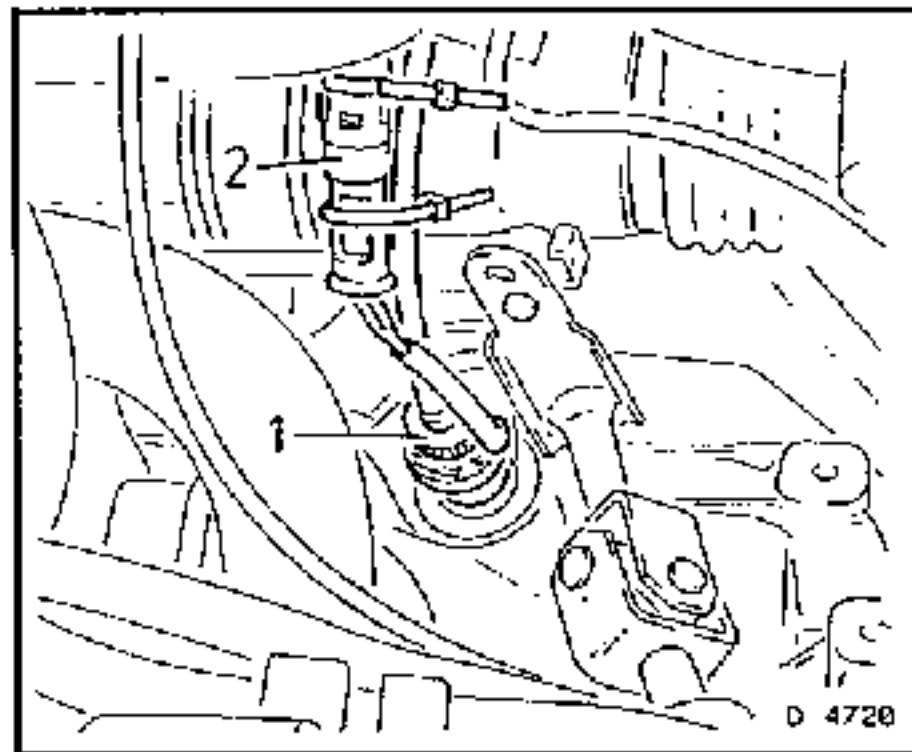
### Remove, Disconnect

Speedometer cable (1), and/or wiring harness plug for odometer frequency sensor (2).

Bolt for retainer.

Lever driven gear assembly from transmission.

Rubber O-ring from groove.



## Install, Connect

New rubber O-ring (2) in groove (arrow).

Lubricate gear teeth with lithium base grease NLGI No. 4 EP.

Gear and guide (1) into transmission.

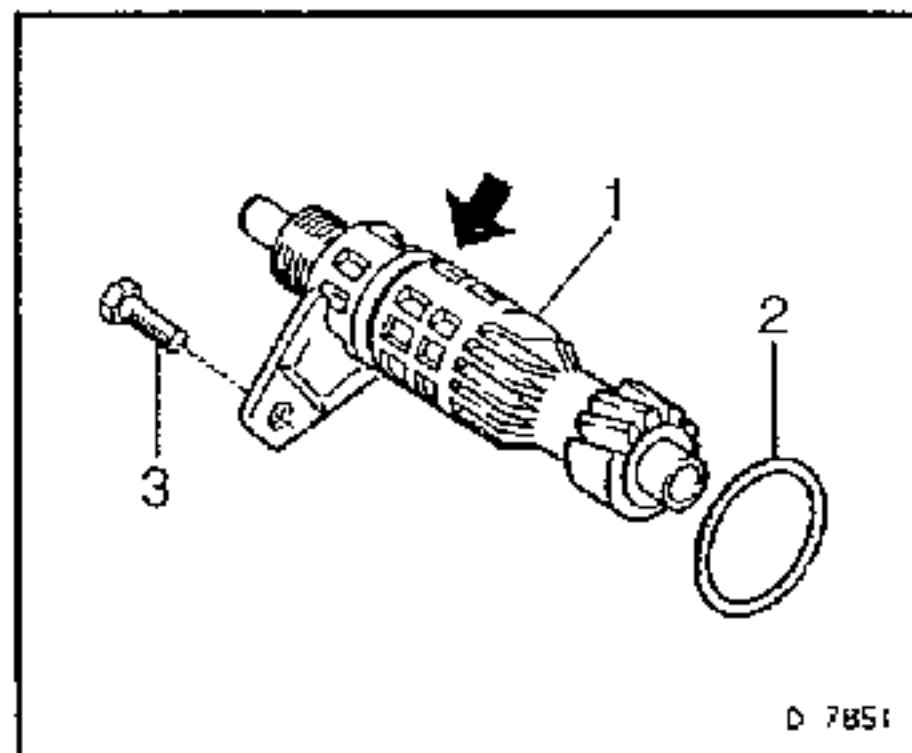
Retaining bolt.

## Tighten (Torque)

Speedometer driven gear to transmission.... 4 Nm

## Install, Connect

Speedometer cable to guide and/or wiring harness plug to odometer frequency sensor.



For F 28/6 transmission;

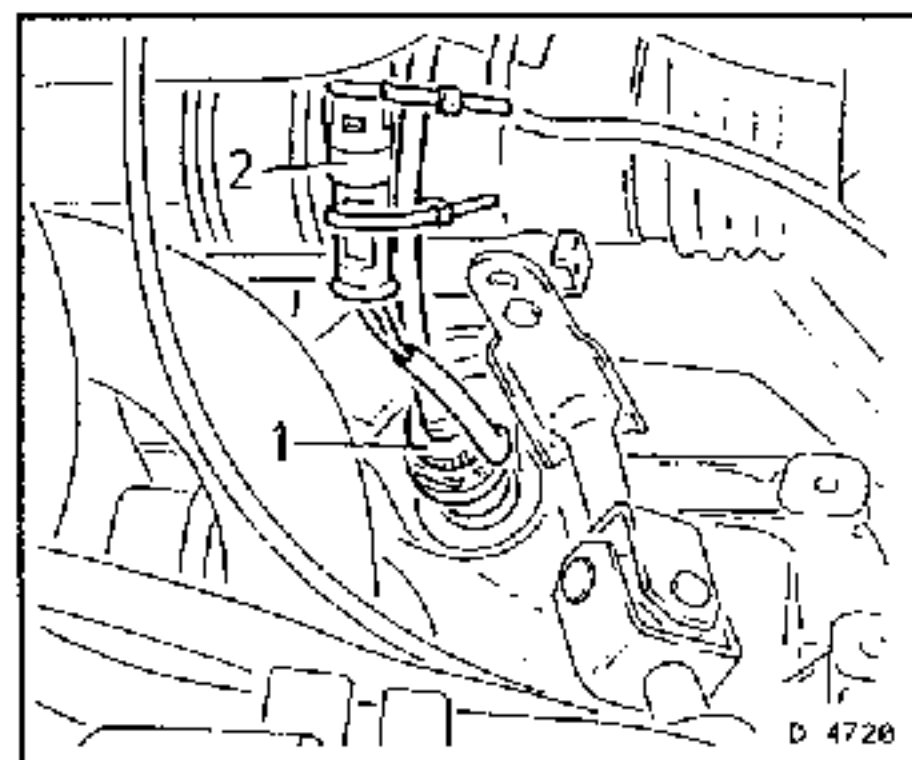
Remove coolant hoses from bracket.

Speedometer cable (1) and/or wiring harness plug from odometer frequency sensor (2).

Retainer plate from guide.

Lever guide from housing.

Rubber O-ring from groove.





# MINOR SERVICING OPERATIONS

## Install, Connect

New rubber O-ring (2) in groove (arrow).

Lubricate gear teeth with lithium base grease NLGI No. 4 EP.

Insert guide (3) so that groove for retainer faces the retainer bolt hole.

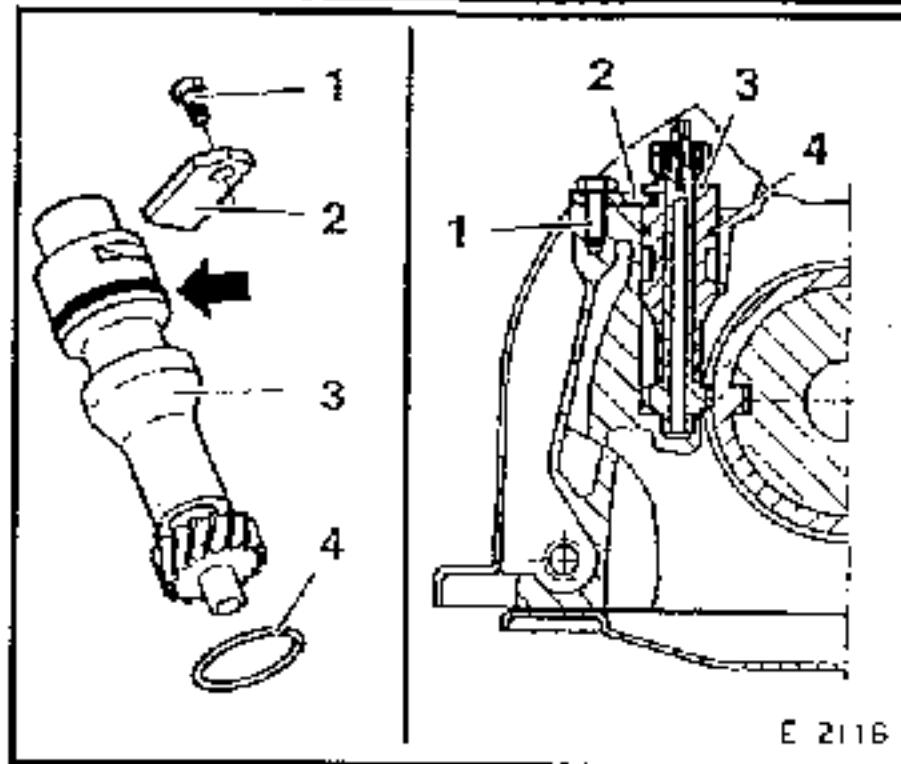
Retaining bolt (1).

## Tighten (Torque)

Speedometer driven gear to transmission.... 4 Nm

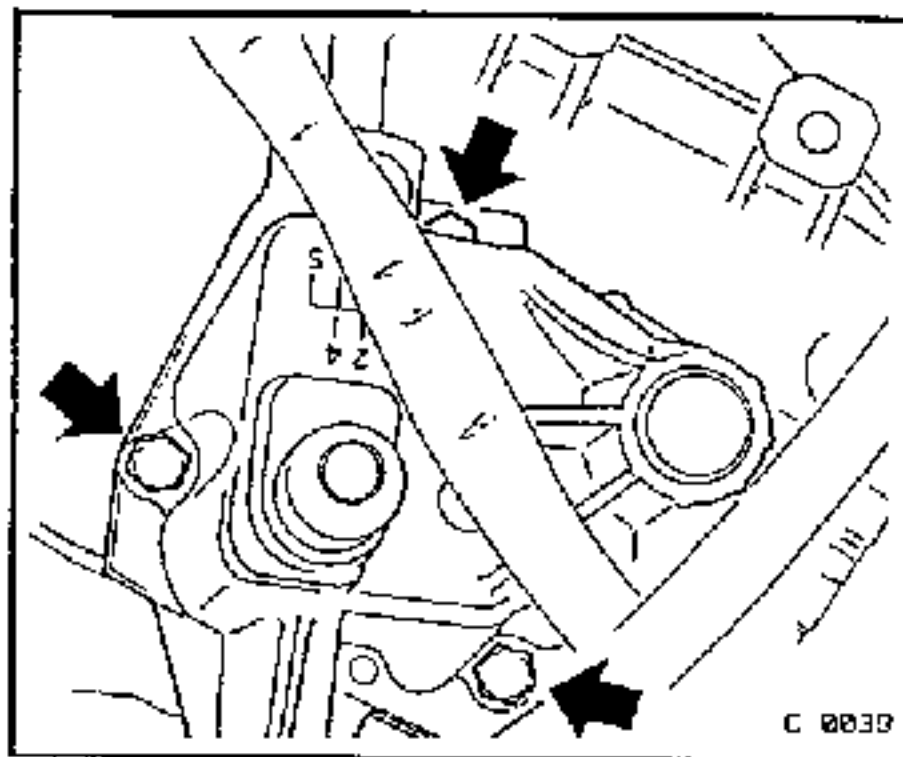
## Install, Connect

Speedometer cable to guide and/or wiring harness plug to odometer frequency sensor.



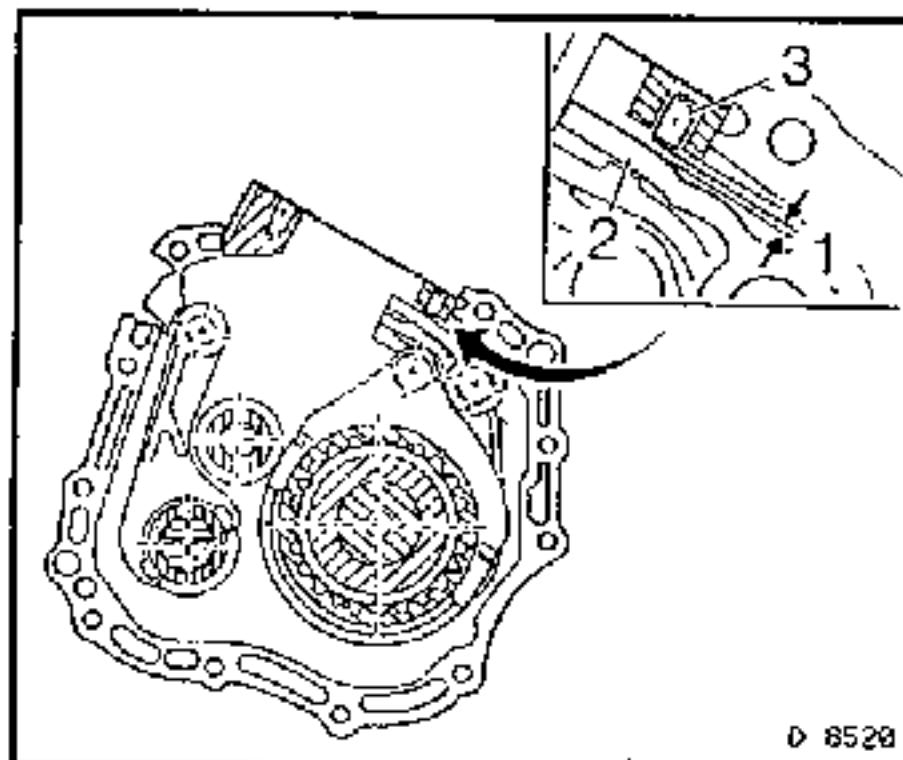
## Gasket for Shift Cover, Replace

See "Shift Cover, Remove and Disassemble", in this Section. Disassembly and assembly are not required.



## Important!

When installing cover, check the play (1) between the dowel pin and the shift rod actuation. See "Shift Cover, Assemble and Install", in this Section.



## Gasket for End Shield, Replace

### Remove, Disconnect

Ground cable from battery.

Shift cover. See "Shift Cover, Remove and Disassemble", in this Section.

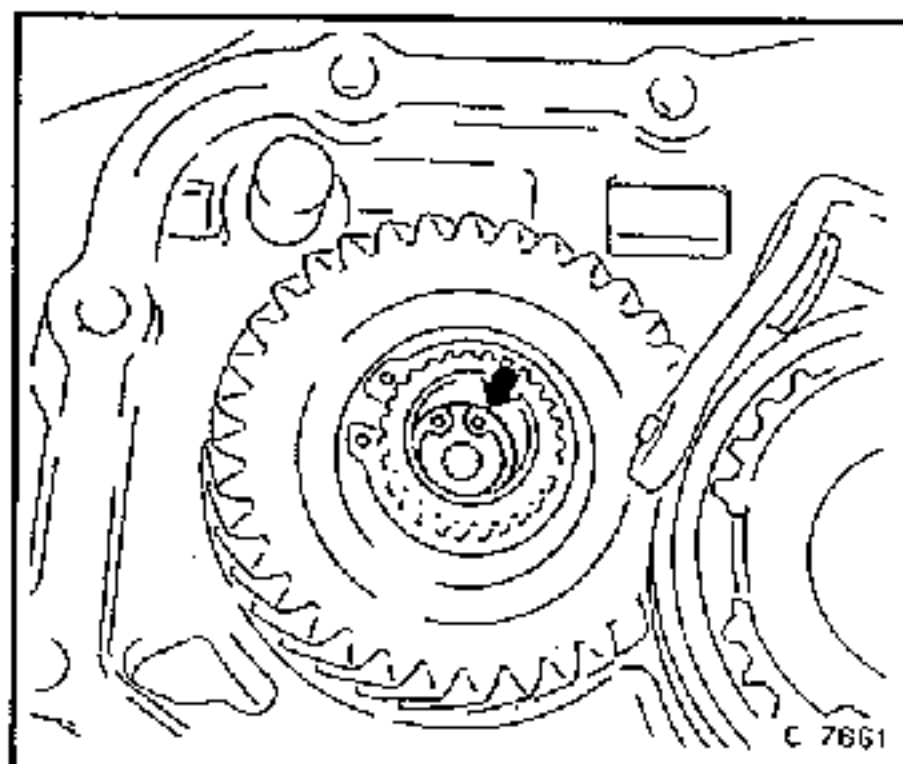
Front left wheel.

Protective panelling from left front wheel housing. See "Wing Remove and Install" in Group A, in Volume 1.

Reversing lamp switch.

Support engine with KM-263-B and spring hooks.

End shield cover from transmission.



# MINOR SERVICING OPERATIONS

## Remove, Disconnect

Damping block from left front frame side member.

Lower engine with KM-263-B until end shield can be guided out past the front frame side member.

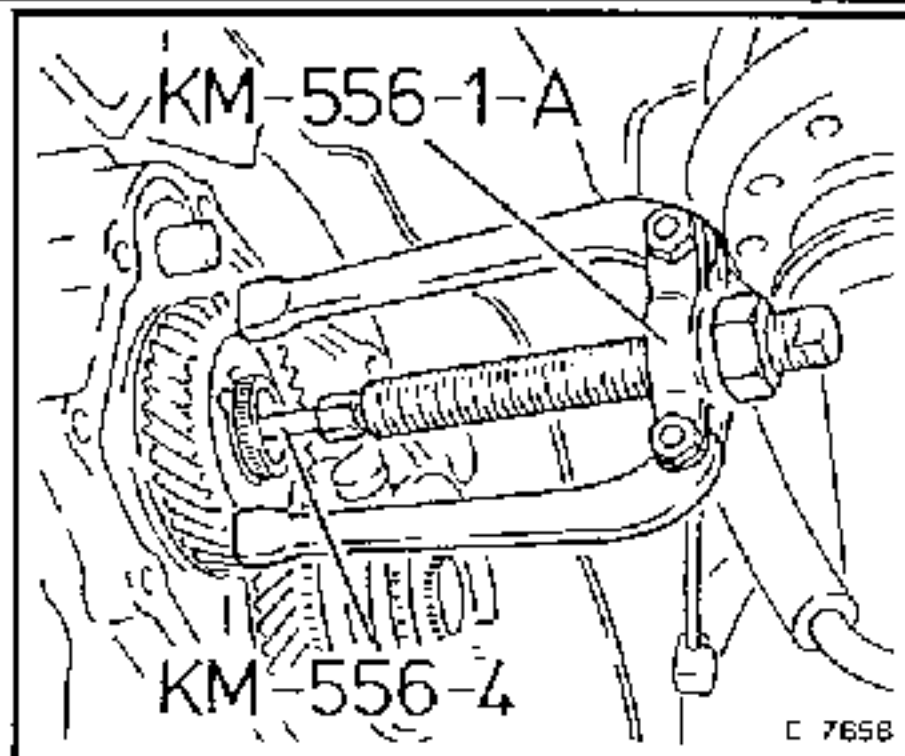
Axle shaft must not be allowed to contact the front axle body.

Remove transmission drive shaft from clutch splines and gear cluster with KM-556-1 and KM-556-4. See "Clutch Disc, Remove and Install", in this Group.

End shield from transmission.

## Important!

Have a suitable clean container on hand to catch the spilled gear oil.



## Install, Connect

A new gasket to the transmission with lithium bearing grease NLGI No. 4, applied to a new gasket and install end shield cover to transmission. Note the spacing washer (axle reverse idler gear) and magnet.

## Tighten (Torque)

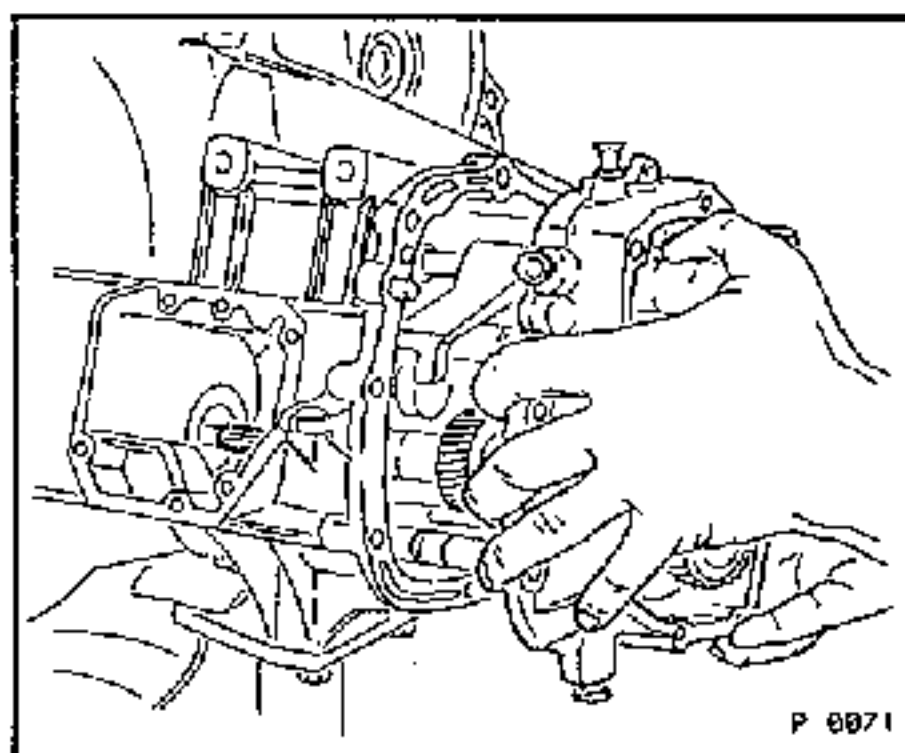
End shield cover to transmission

M 7 .....	15 Nm
M 8 .....	20 Nm

Reversing lamp switch ..... 20 Nm

Wiring harness plug.

Press in transmission drive shaft to gear cluster and clutch splines (See "Clutch Plate, Remove and Install", in this Group).



## Install, Connect

End shield cover to transmission.

After raising engine with hydraulic jack, damping block with new bolts to front side frame members.

Front side panelling.

Front wheel.

## Tighten (Torque)

End shield cover to transmission

M 7 x 1.0 .....	15 Nm
M 8 x 1.25 .....	20 Nm

Damping block to front side frame ..... 65 Nm

Wheel studs ..... 110 Nm

## Install, Connect

Shift cover to transmission. See the operation in this Section.

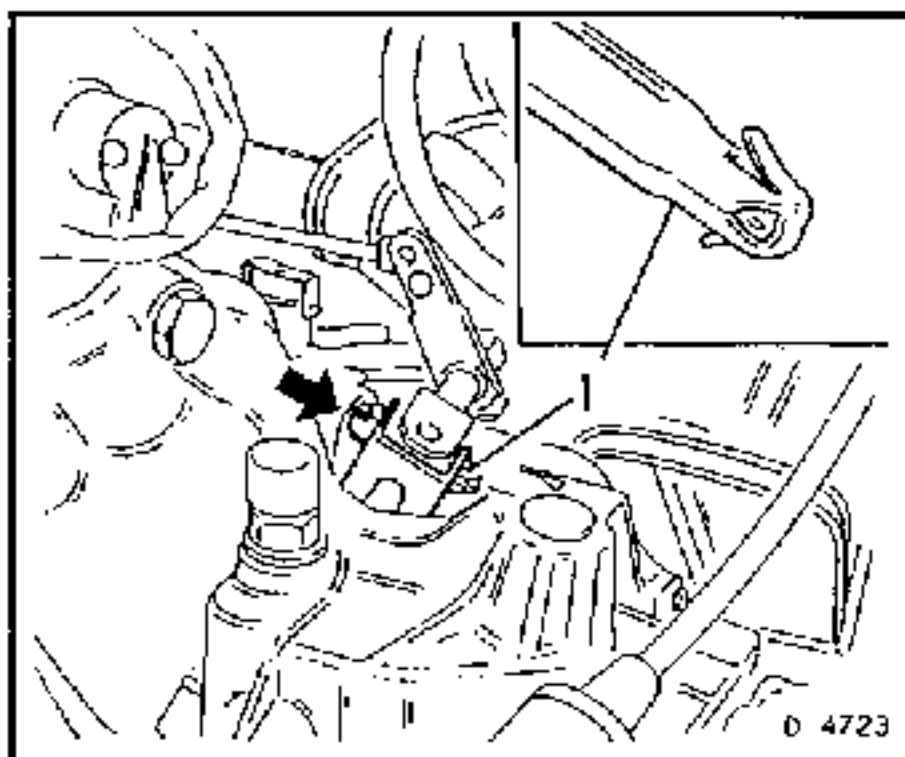
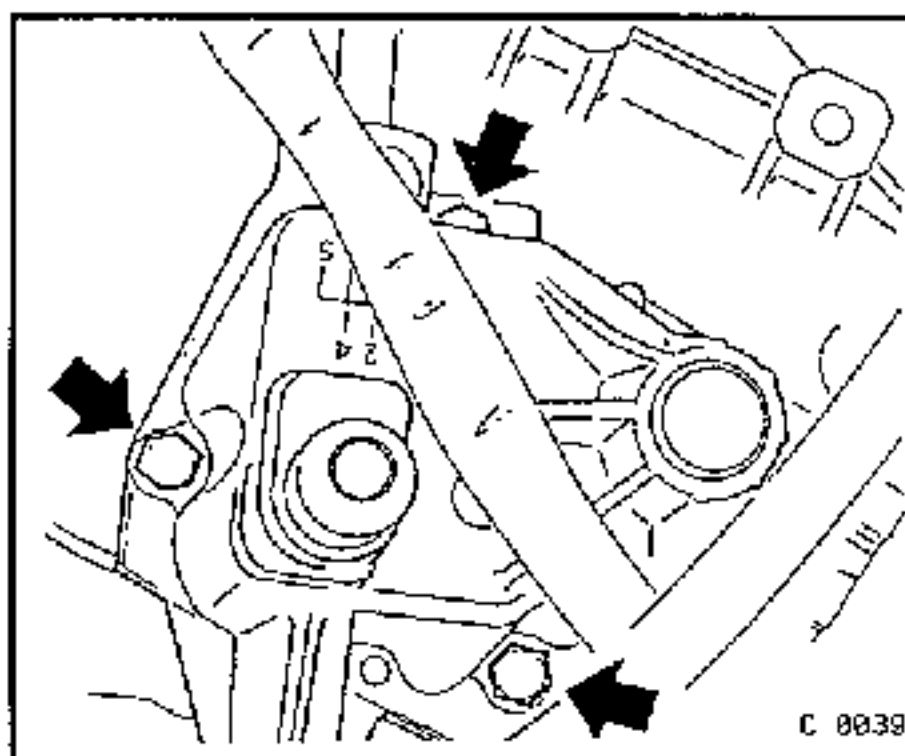
## Install, Connect

New hollow pin after lubricating with Dow Corning No 44 silicone grease, to Holden's Specification HN1014, or equivalent. The spring clips are self-engaging.

Remove KM-263-B engine support.

Ground cable to battery.

Top up transmission gear oil. See "Transmission Fluid Level, Check", in this Section.



# MINOR SERVICING OPERATIONS

## Gasket for Differential Cover, Replace

When cover is removed, oil spillage will occur, so have a suitable, clean container on hand.

### Remove, Disconnect

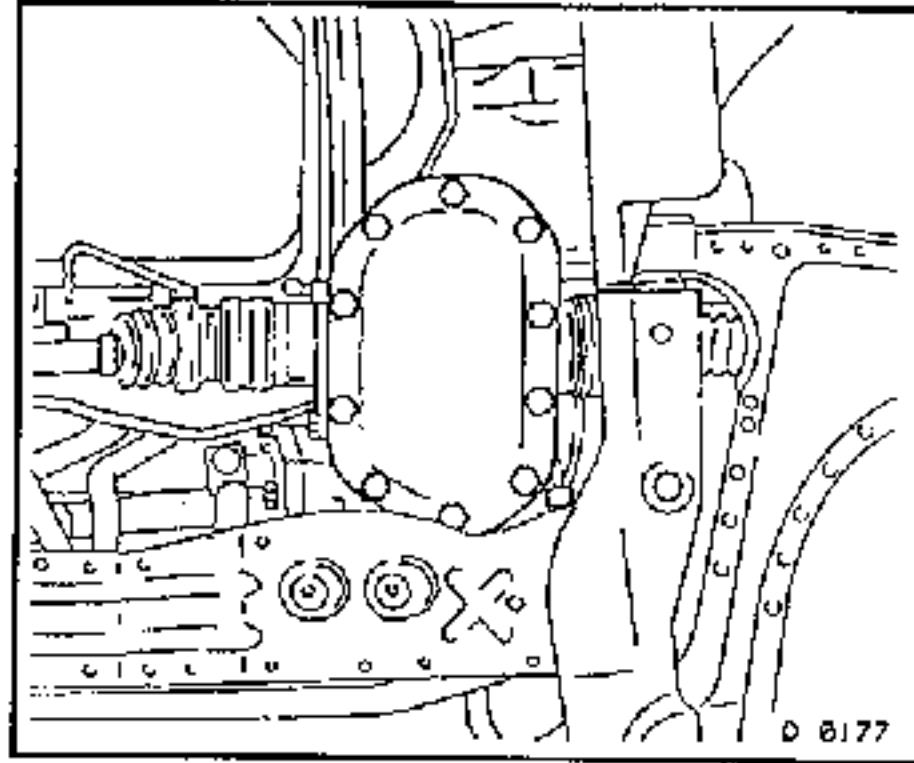
Differential cover.

For 4WD;  
Lower front axle body. See operation "Stabiliser, Remove and Install", in Group E, Volume 1.

### Important!

Front exhaust pipe, front right wheel and guide joints all remain installed.

Support front axle body when lowered.

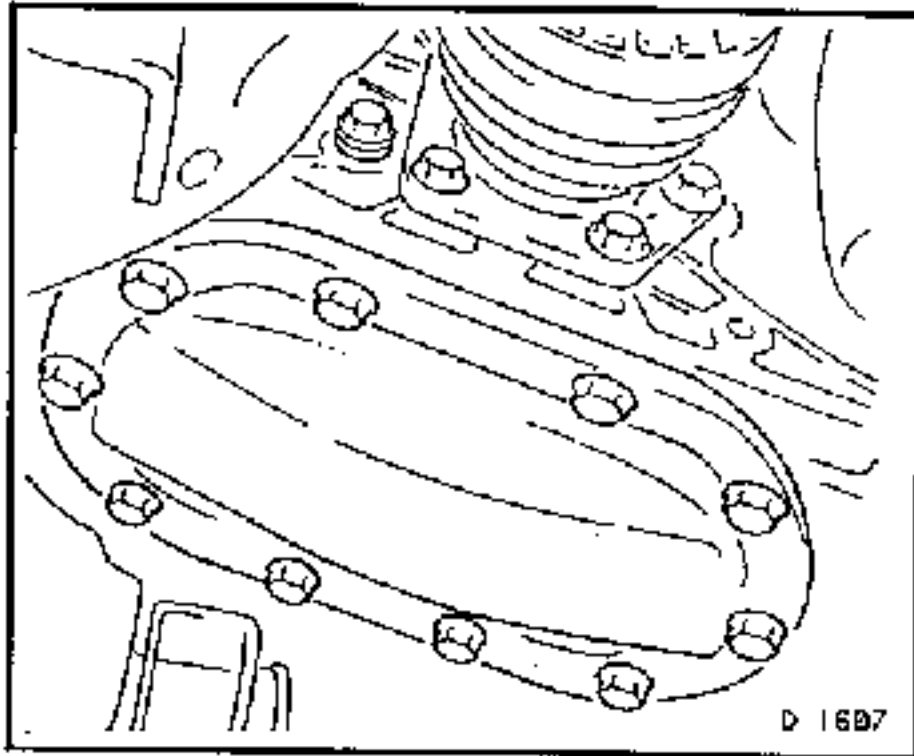


### Install, Connect

Apply NLGI No. 4 EP lithium bearing grease, to a new gasket and install cover.

### Tighten (Torque)

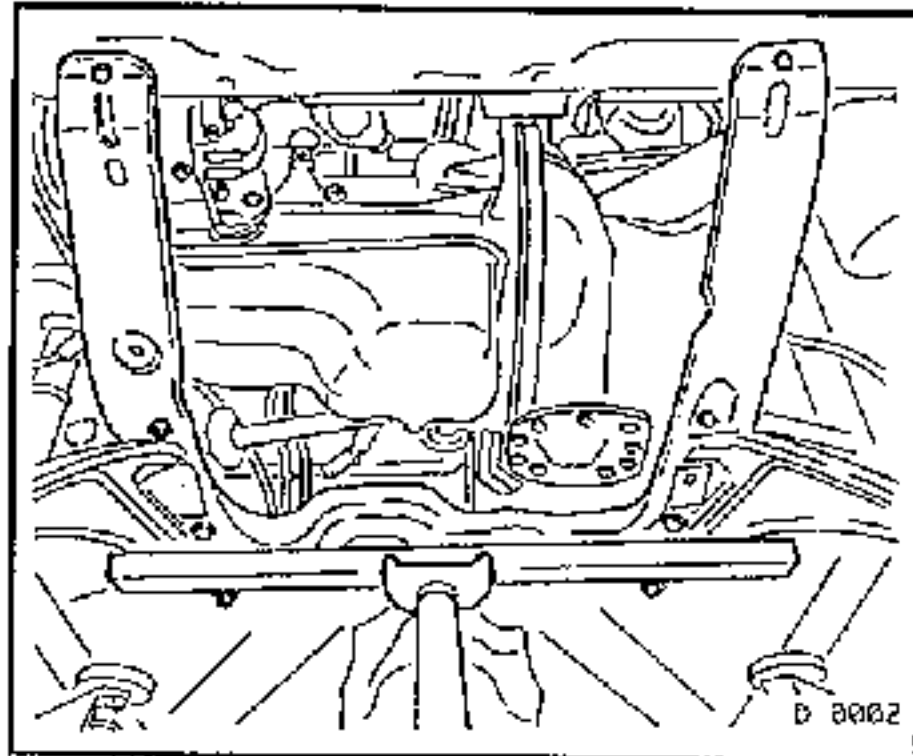
Cover to transmission	
Sheet metal version .....	30 Nm
Light alloy version .....	18 Nm



### Install, Connect

For 4WD;  
Raise front axle body. See operation "Stabiliser, Remove and Install", in Group E, Volume 1.

Top up transmission gear oil. See "transmission Fluid Level, Check", in this Section.



## 1st Gear Recognition Switch and/or Seal, Replace - F 28/6 Transmission

### Remove, Disconnect

Lift circlip and remove wiring harness plug (1).

1st gear recognition switch (2) from the transmission.

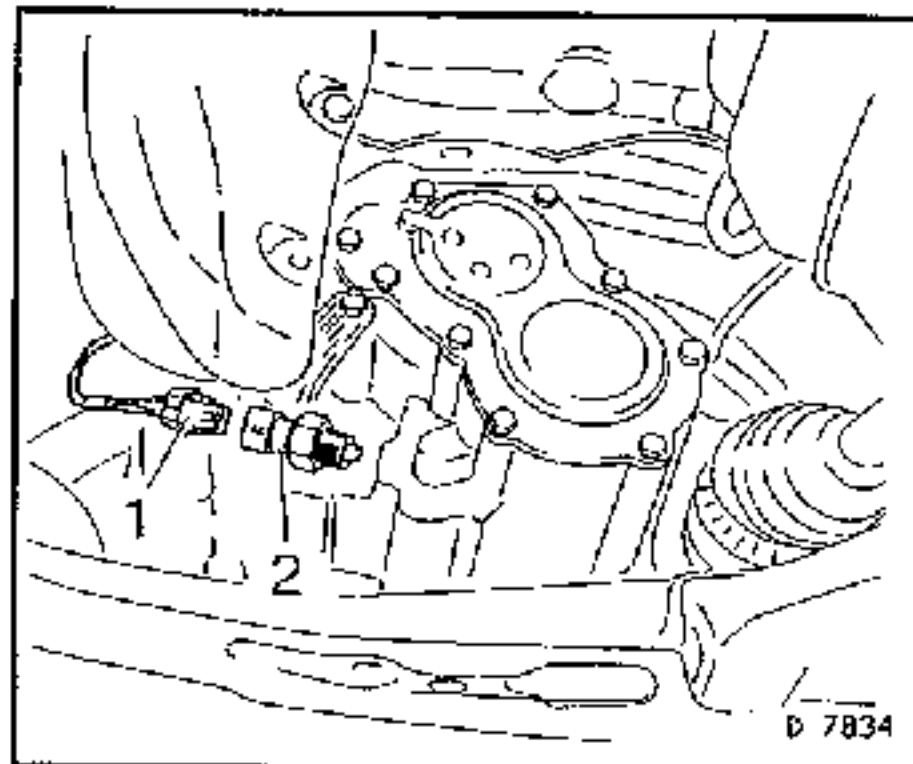
### Install, Connect

Apply Loctite 515 or equivalent, to Holden's Specification HN1581 to the switch threads and install.

### Tighten (Torque)

1st gear recognition switch .....	20 Nm
-----------------------------------	-------

Wiring harness plug to switch. Ensure that the circlip engages fully.



# MINOR SERVICING OPERATIONS

## Reversing Lamp Switch and/or Seal, Replace

### Remove, Disconnect

Lift circlip, remove wiring harness plug (1).

Reversing lamp switch from transmission.

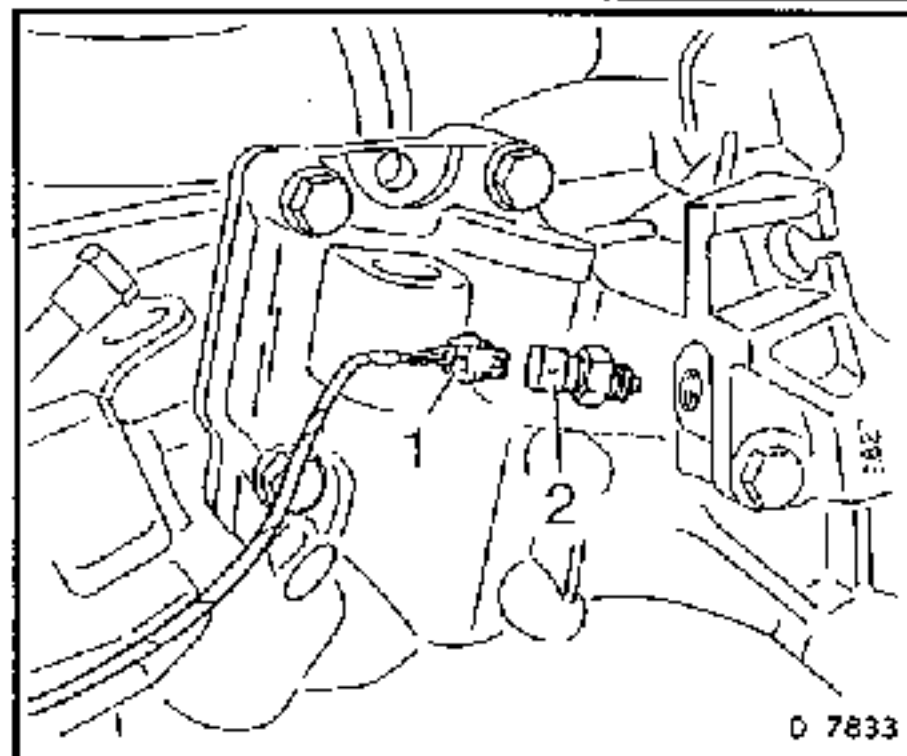
### Install, Connect

Apply Loctite 515 or equivalent, to Holden's Specification HN1581 to the switch threads and install.

### Tighten (Torque)

1st gear recognition switch..... 20 Nm

Wiring harness plug to switch. Ensure that the circlip engages fully.



# GROUP N

## ELECTRICAL EQUIPMENT AND INSTRUMENTS

### WIRING HARNESS, FUSE BOX

#### TABLE OF CONTENTS

	PAGE
Survey of Relays and Control Units .....	N - 4
Survey of Relay Carrier in Engine Compartment MY '91 .....	N - 7
Survey of Relay Carrier in Engine Compartment MY '92 .....	N - 7
Survey of Relay Carrier in Engine Compartment MY '93 .....	N - 7
Wiring Harness, Front Door.....	N - 8
Wiring Harness, Body, Front .....	N - 9
Wiring Harness, Engine.....	N - 10
Wiring Harness, Instrument Panel.....	N - 11
Wiring Harness, Body, Rear .....	N - 12
Fuse Box, Remove and Install .....	N - 13

# WIRING HARNESS, FUSE BOX

## SURVEY OF RELAYS AND CONTROL UNITS

### A Beside driver's seat

- 1 ABS control unit K50 (up to MY '92)

### B Front quarter panel, lower left

- 1 Time relay – outside mirror, heated K35  
(up to MY '90, as of MY '91 Pos. 2 behind fuse box)

### C Relay carrier in engine compartment, left up to MY '89

- 1 Relay – cooling fan, K51
- 2 Relay – cooling fan 1st speed K67
- 3 Relay – engine speed K82
- 4 Relay – auxiliary fan K87
- 5 Relay – mixture preheating K45 or  
relay – filter heating K80
- 6 Relay – wash/wipe system, headlamp K9
- 7 Time relay – wash/wipe pump, headlamp K97 or  
relay – surge arrestor K47

### 8 Relay – preheating time K25 or

- relay – fuel pump K58 or
- relay – injection system K68 or
- relay – electronic carburettor K55

### D Front quarter panel, lower right

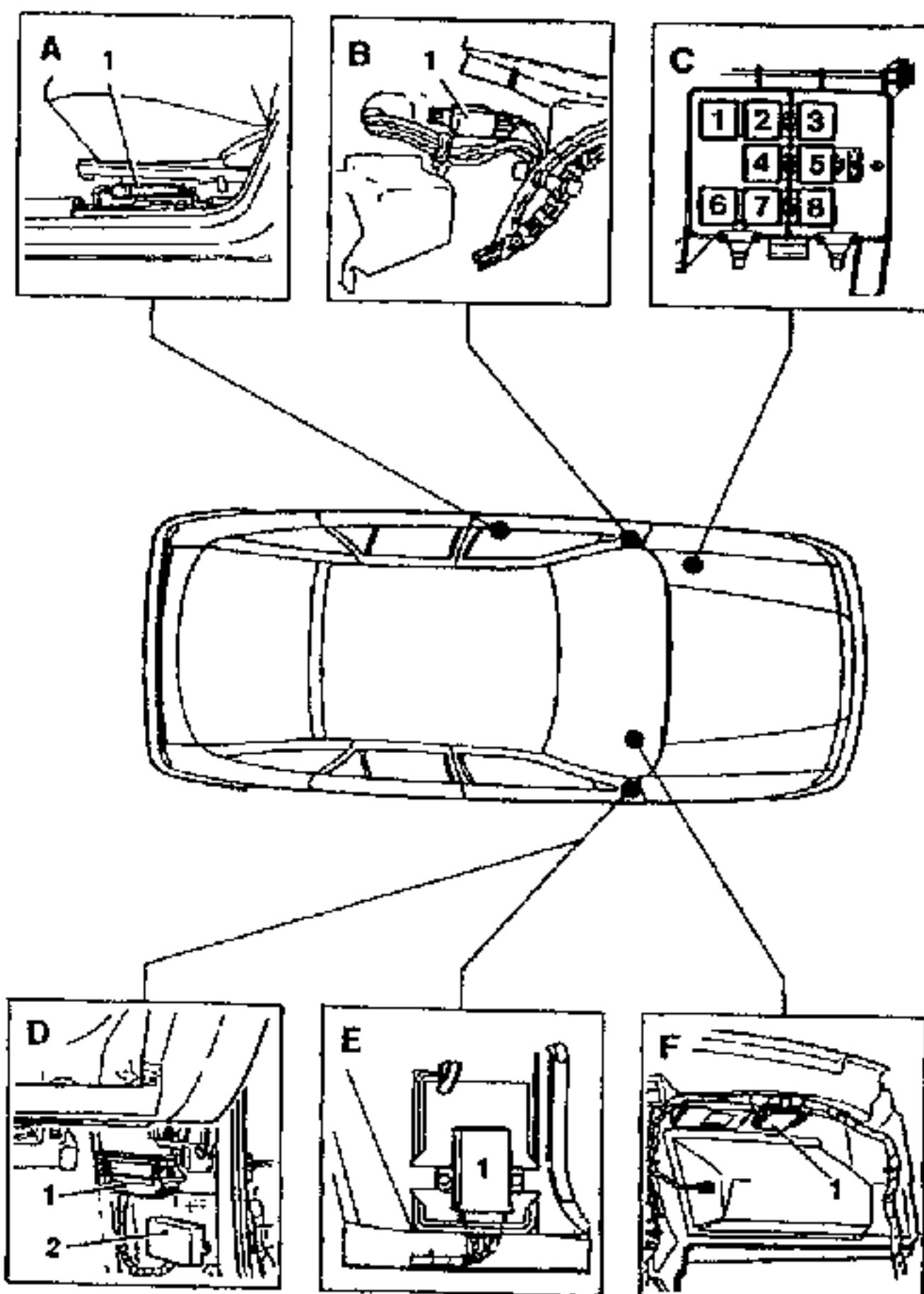
- 1 Motronic K91 or K69 or  
TBI control unit K57
- 2 Carburettor, electronic control unit EID K54

### E Quarter panel front, lower right

- 1 Control unit for central locking K37

### F Above glove compartment

- 1 Control unit for check control K86



D 7901

# WIRING HARNESS, FUSE BOX

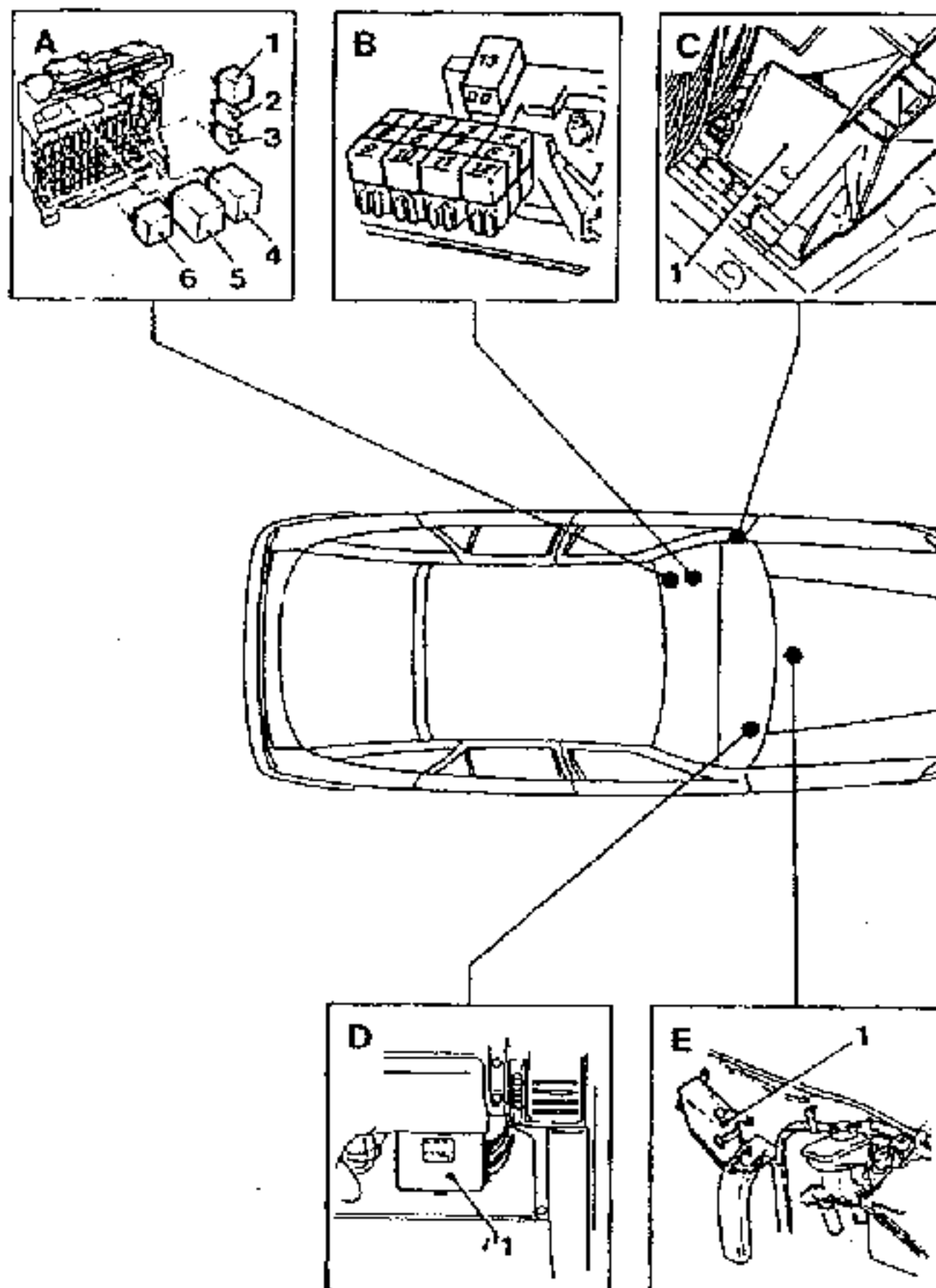
## A Fuse box, view from passenger compartment

- 1 Relay – fog lamp K5 or  
relay – rear fog lamp K89
- 2 Relay – heated rear screen K1 or  
relay – fog lamp K5
- 3 Relay – heated rear screen K1 (up to MY '90, except Model  
85)  
Relay – fanfare K63 (Model 85)  
Relay – fanfare K63 (all Models as of MY '91)
- 4 Relay – windscreen wipers, interval K8
- 5 Turn signal unit K10
- 6 Warning buzzer H19 (see B8)

- 3 Sensor – bulb control trailer hitch P39 up to  
MY '90 or  
relay – wash/wipe system, headlamp K9 except  
Model 85 or relay – compressor K90 except  
Model 85 or relay – fan, air conditioning K64  
(see B7, B11)  
Relay – headlamp wiper K97 (as of MY '91)
- 4 Fuse F38 – anti-theft warning system, except  
Model 85
- 5 Relay – trailer hitch P39 as of MY '91
- 6 Relay – air conditioning K3 except Model 85
- 7 Relay – air conditioning and AT K90 or  
relay – air conditioning K64 except Model 85

## B Relay carrier – behind fuse box, view from engine compartment

- 1 Relay – rear screen wiper, interval K30 or  
relay – air conditioning K6 (see B9)  
Time relay – outside mirror, heated K35 as of MY '91
- 2 relay – fanfare K63 or  
relay – fan, air conditioning K7 (see B10)



E 2354

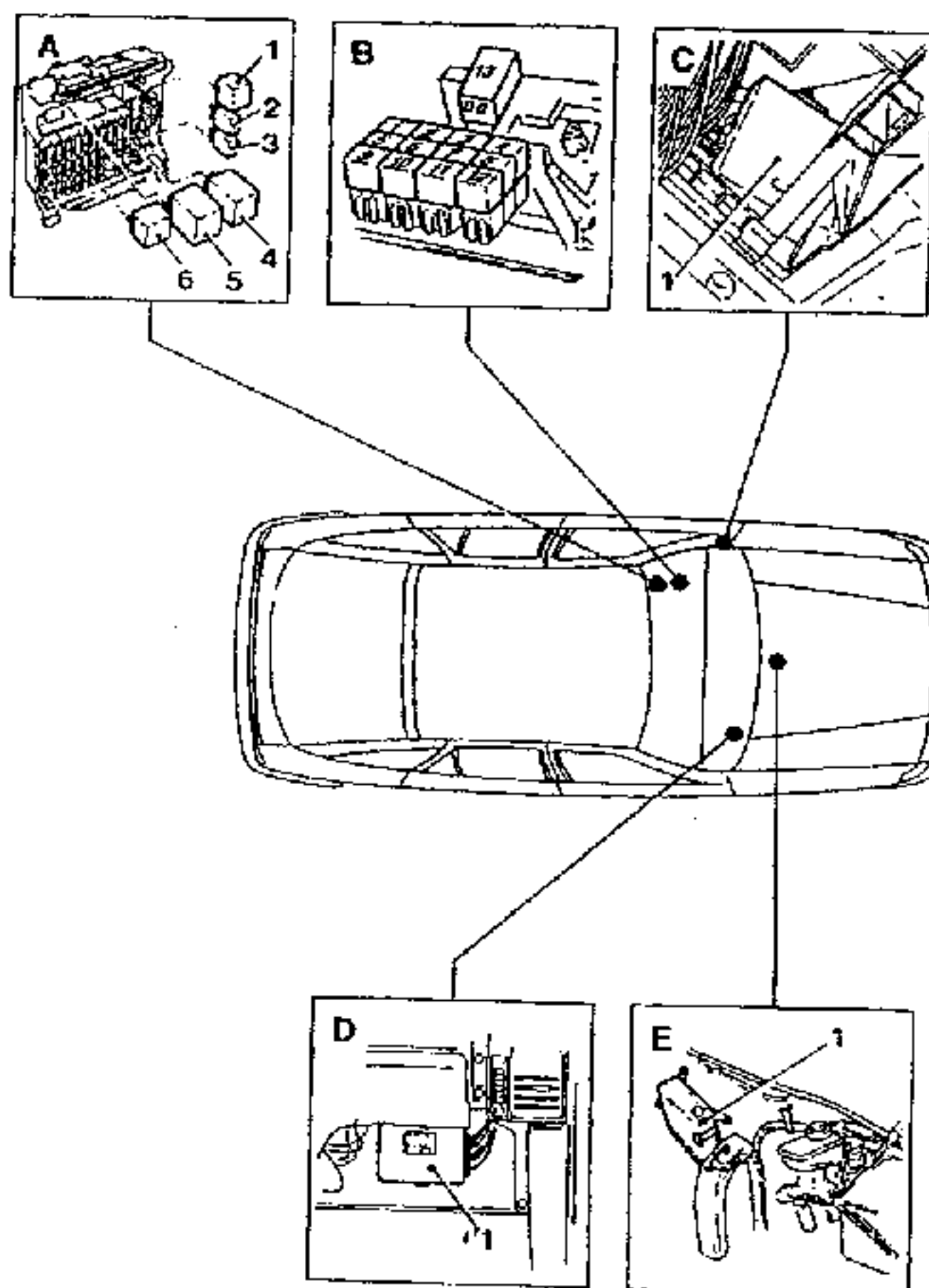
# WIRING HARNESS, FUSE BOX

- B Relay carrier behind fuse box, view from engine compartment
- 8 Fuse – F38 anti-theft warning system Model 85 only
- 9 Relay – air conditioning K6 (see B1)
- 10 Relay – fan, air conditioning K7 (see B2)
- 11 Relay – fan, air conditioning K64 (see B3, B7)
- 12 Relay – anti-theft warning system K3 Model 85 only
- 13 Relay – low beam K59 or control unit – low beam reduced K62 (Great Britain only) or control unit - temperature, catalytic converter K88

- C Under instrument panel, left
- 1 Control unit – 4 wheel drive K83

- D Behind glove compartment
- 1 Control unit – automatic transmission K85

- E Engine compartment, centre splash wall
- 1 Control unit EI Plus K84



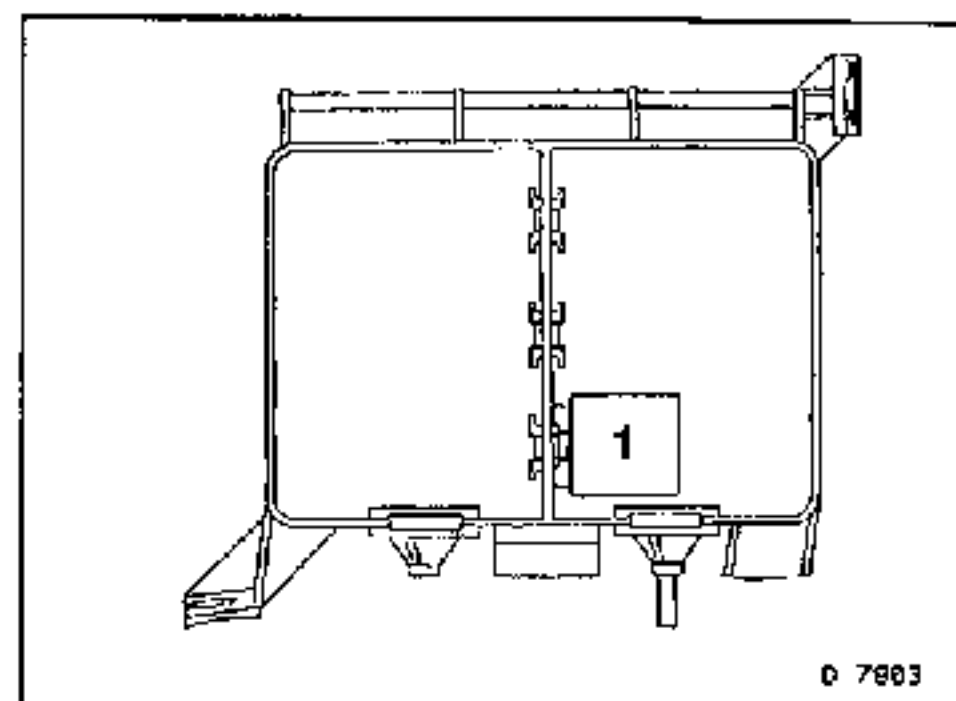
E 2354



# WIRING HARNESS, FUSE BOX

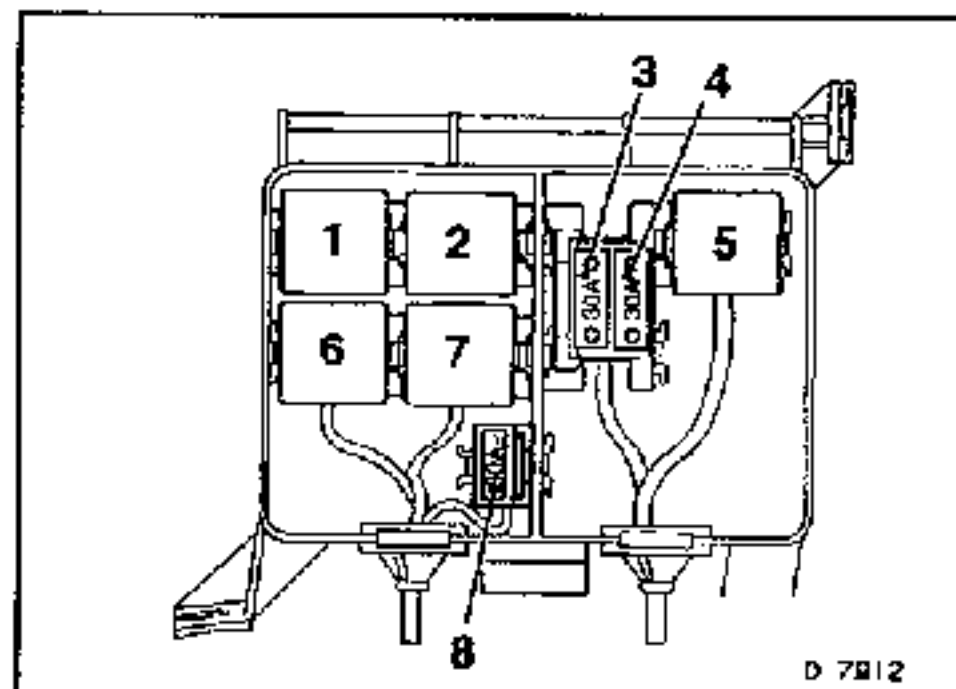
## SURVEY OF RELAY CARRIER IN ENGINE COMPARTMENT MY '91

- 1 = Relay – injection system – fuel K68 (20 E)  
black wiring harness plug



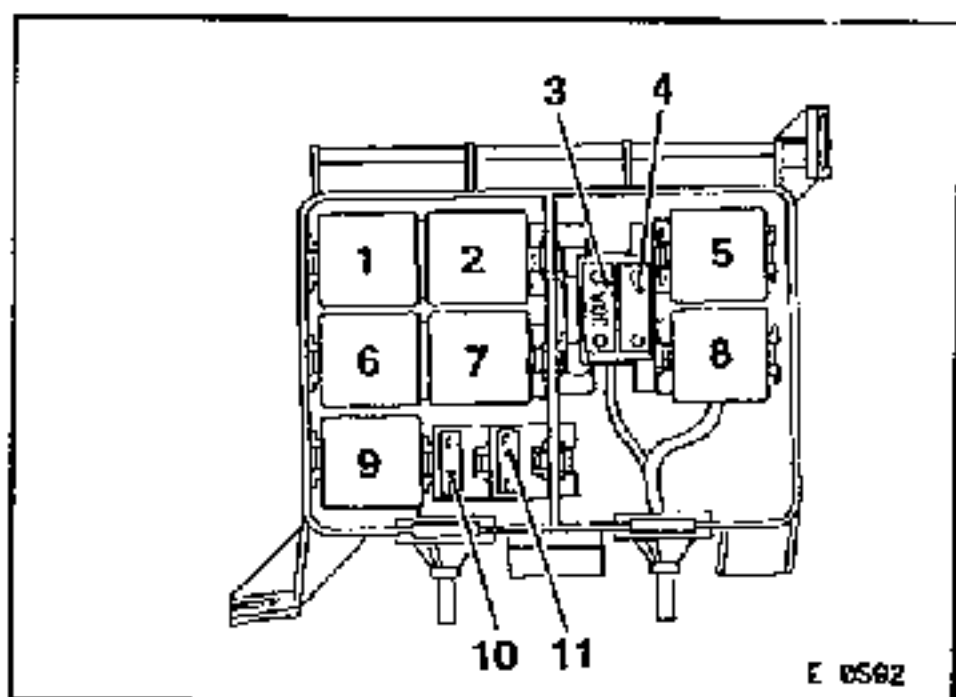
## SURVEY OF RELAY CARRIER IN ENGINE COMPARTMENT MY '92

- 1 = Relay – cooling fan K52 green wiring harness plug  
2 = Relay – cooling fan K87 blue wiring harness plug  
3 = Fuse 30A AC F47 black wiring harness plug  
4 = Fuse 30A cooling fan F42 black wiring harness plug  
5 = Relay – parking lock K102 (AT) white wiring harness plug  
6 = Relay – cooling fan, after-running, K34 (C 20 LET) blue wiring harness plug or  
Relay – cooling fan K51 (except C 20 LET) blue wiring harness plug  
7 = Relay – cooling fan K67 blue wiring harness plug  
8 = Fuse 30A cooling fan F34 green wiring harness plug



## SURVEY OF RELAY CARRIER IN ENGINE COMPARTMENT MY '93

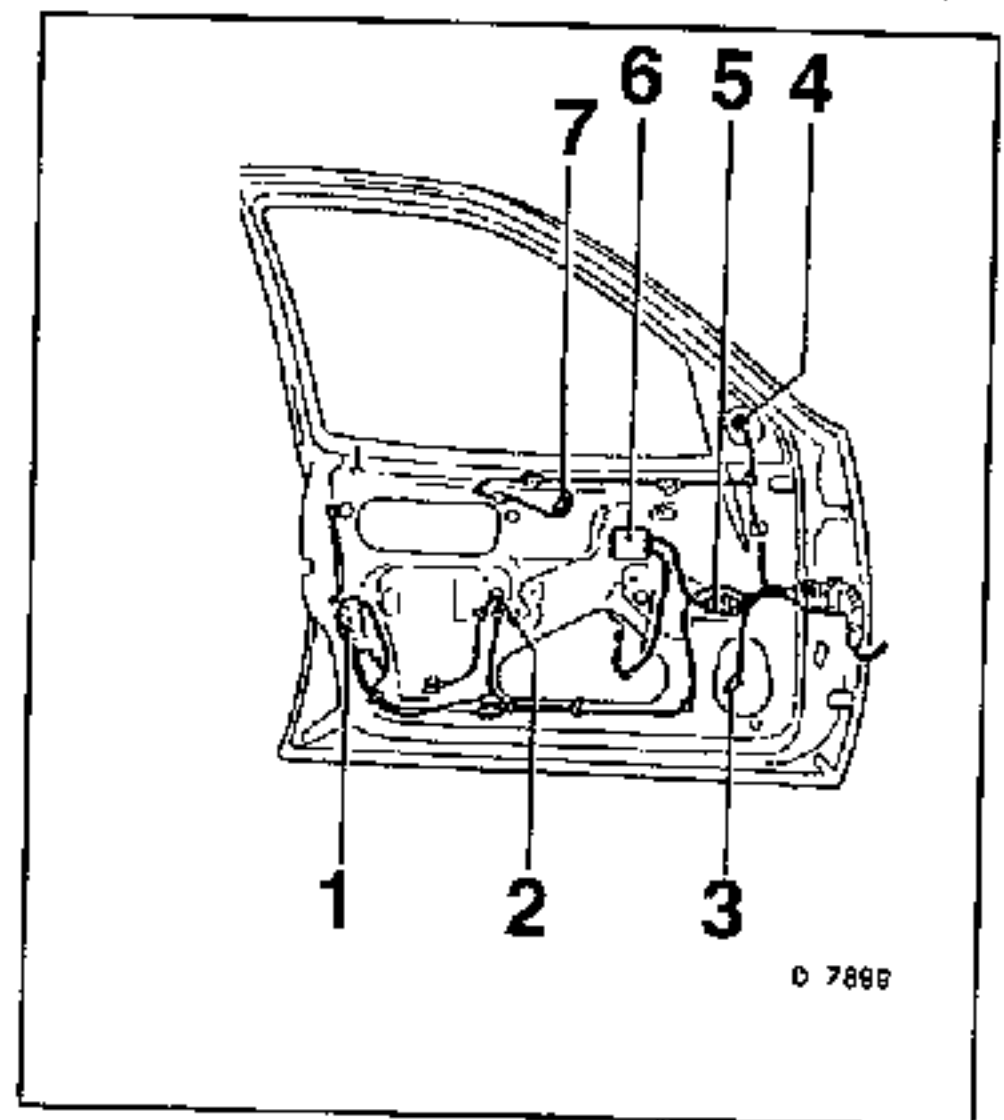
- 1 = Relay – cooling fan K52 green wiring harness plug  
2 = Relay – cooling fan K87 blue wiring harness plug  
3 = Fuse 30A air conditioning F47 green wiring harness plug  
4 = Fuse 40A cooling fan F42 black wiring harness plug (C 20 LET)  
4 = Fuse 30A cooling fan F42 black wiring harness plug  
5 = Not applicable  
6 = Relay – cooling fan, after - running, K34 green wiring harness plug (C 20 LET)  
6 = Not applicable  
6 = Relay – cooling fan K51 blue wiring harness plug  
7 = Relay – cooling fan K67 blue wiring harness plug  
7 = Relay – cooling fan K67 blue wiring harness plug (C 20 LET)  
8 = Relay – parking lock K102 white wiring harness plug (AT / Japan, obligatory)  
9 = Not applicable  
10 = Not applicable  
11 = Fuse 30A cooling fan F34 green wiring harness plug



# WIRING HARNESS, FUSE BOX

## WIRING HARNESS, FRONT DOOR

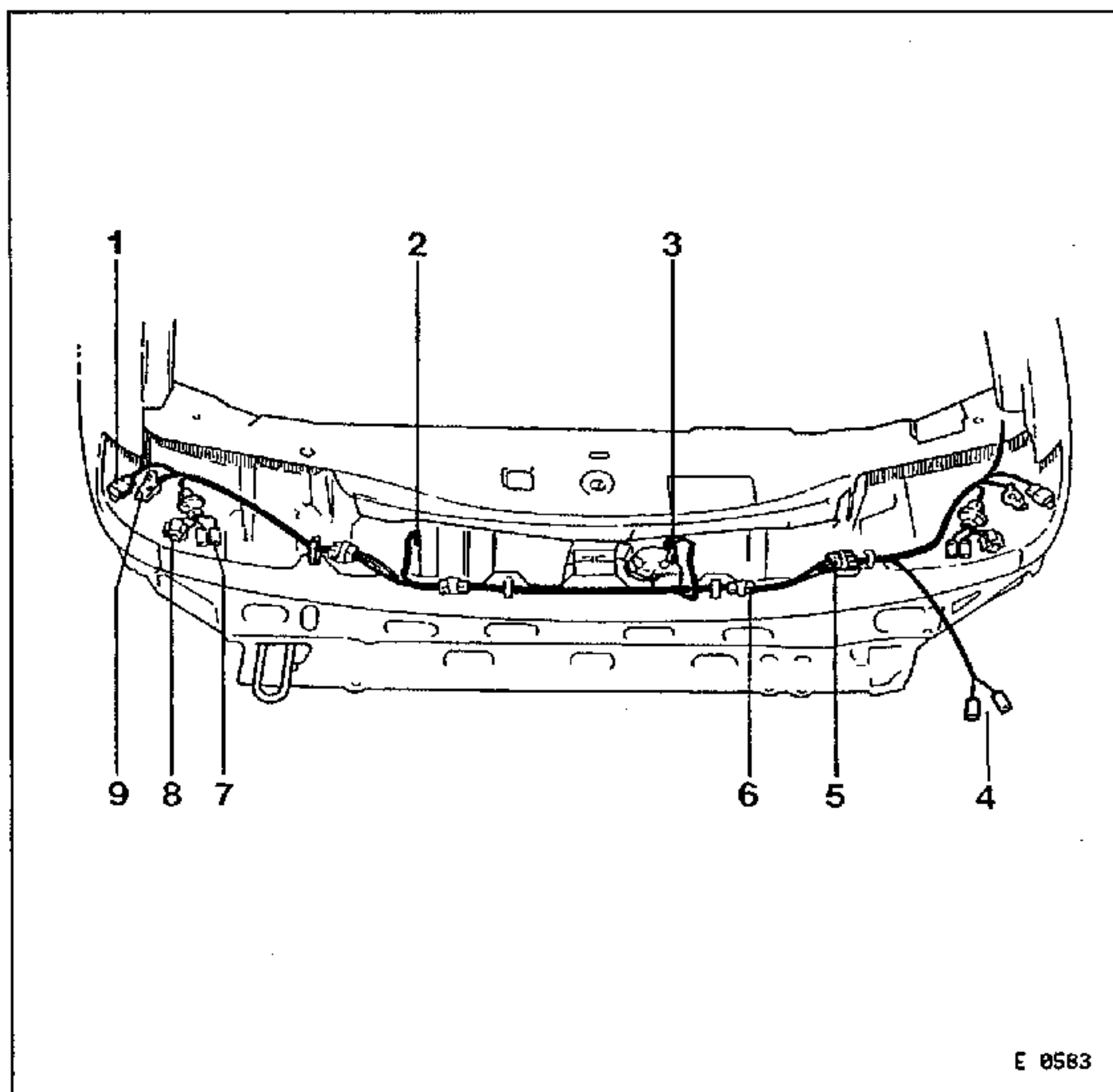
- 1 - Servo motor, door lock
- 2 - Wiring harness plug, lamp
- 3 - Wiring harness plug, door speaker
- 4 - Wiring harness plug, outside mirror
- 5 - Wiring harness plug, window winder
- 6 - Window winder motor with window winder control unit
- 7 - Operating switch, outside mirror left and right



# WIRING HARNESS, FUSE BOX

## WIRING HARNESS, BODY, FRONT

- 1 – Drive for headlamp range control
- 2 – Cooling fan switch
- 3 – Horn
- 4 – Fanfare
- 5 – Headlamp wiper motor
- 6 – Foglamp
- 7 – Parking lamp
- 8 – Headlamp
- 9 – Signal lamp



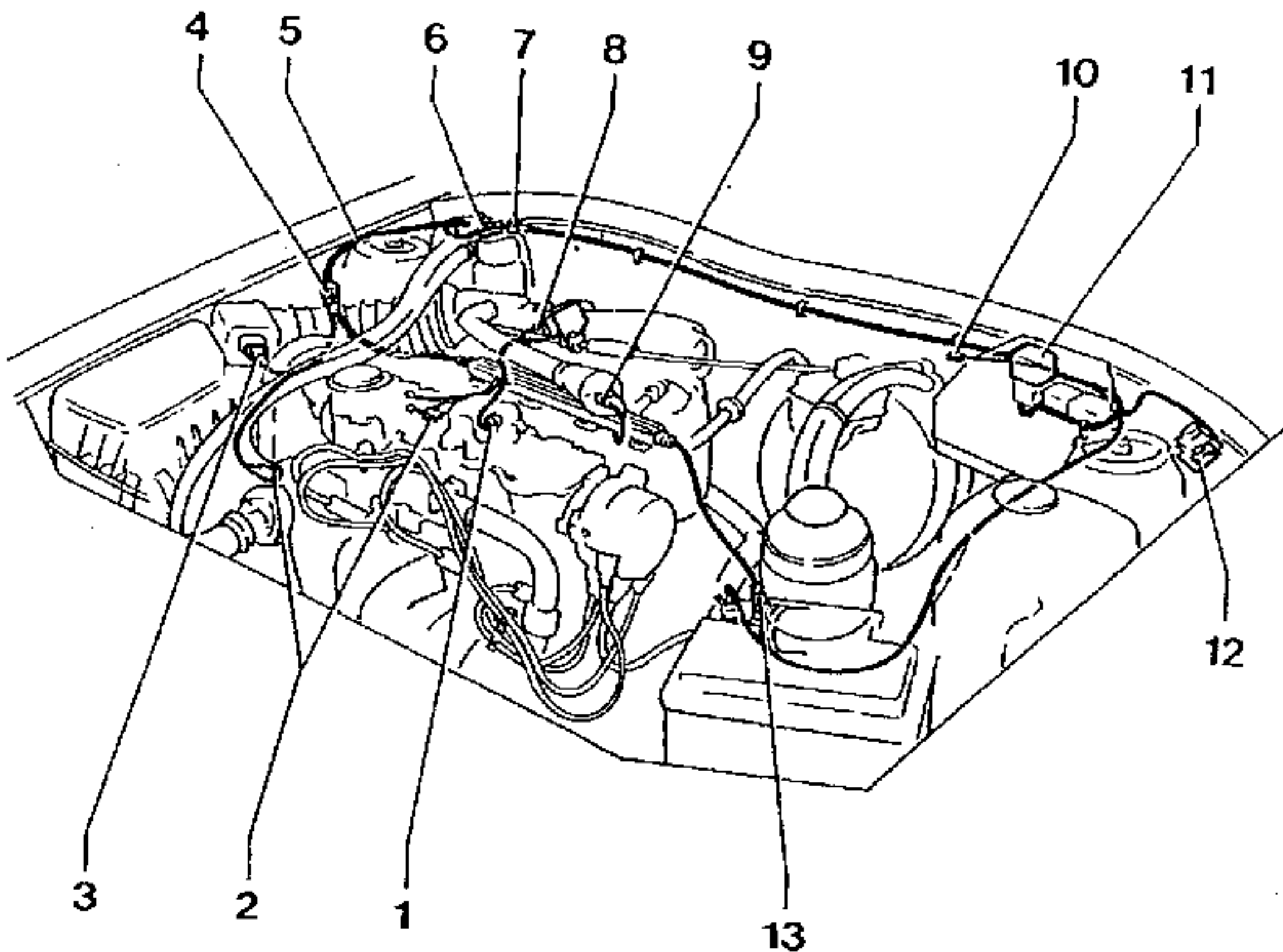
# WIRING HARNESS, FUSE BOX

## WIRING HARNESS, ENGINE

Illus. D 0840 gives example of wiring harness on C 20 NE engines.

- 1 - Fuel tank vent valve
- 2 - Temperature sensor, water
- 3 - Air flow meter
- 4 - Crankshaft pulse pick-up
- 5 - Motronic wiring harness
- 6 - For interference suppressor filter
- 7 - Oxygen sensor

- 8 - Throttle valve switch
- 9 - Idle speed actuator
- 10 - To transmission wiring harness
- 11 - Relay
- 12 - Octane number adjustment
- 13 - Ignition coil



D 0840

# WIRING HARNESS, FUSE BOX

## WIRING HARNESS, INSTRUMENT PANEL

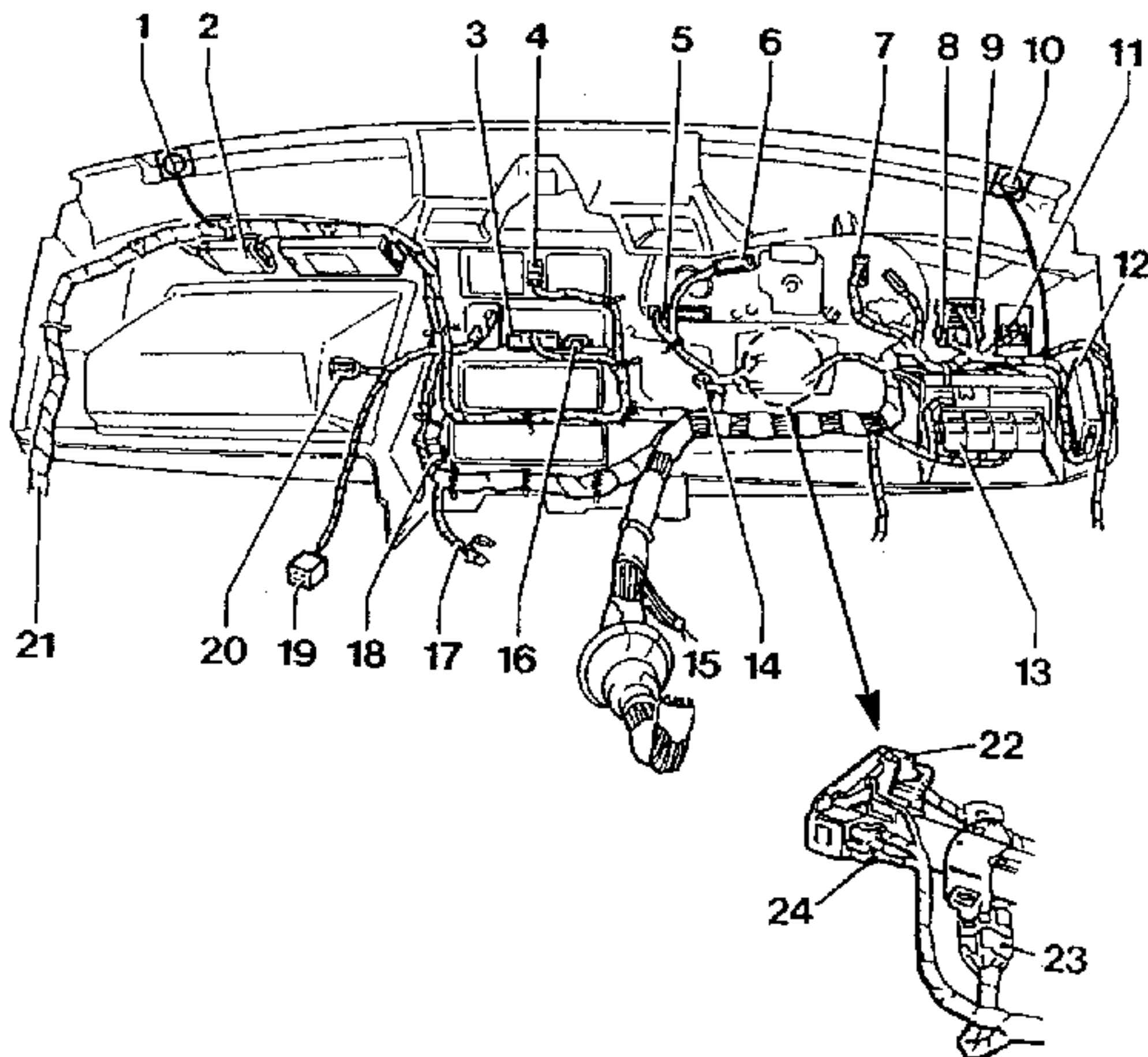
Illus. shows reverse side of instrument panel

- 1 - Loudspeaker, right
- 2 - Check Control control unit
- 3 - Switch
- 4 - Hazard warning light switch
- 5 - System monitoring display
- 6/7 - Instrument
- 8 - Headlamp range control
- 9 - Rear lamp switch
- 10 - Loudspeaker, left
- 11 - Light switch
- 12 - Four wheel drive control unit
- 13 - Relay

- 14 - To radio receiver wiring harness
- 15 - To left A pillar
- 16 - Fan switch
- 17 - Cigarette lighter
- 18 - Board computer
- 19 - Solenoid valve
- 20 - Glove compartment lamp
- 21 - ATWS control unit
- 22 - Turn signal lamp switch
- 23 - Ignition switch (contact piece)
- 24 - Wiper switch

### Important

For vehicles with airbags observe safety regulations in group C.



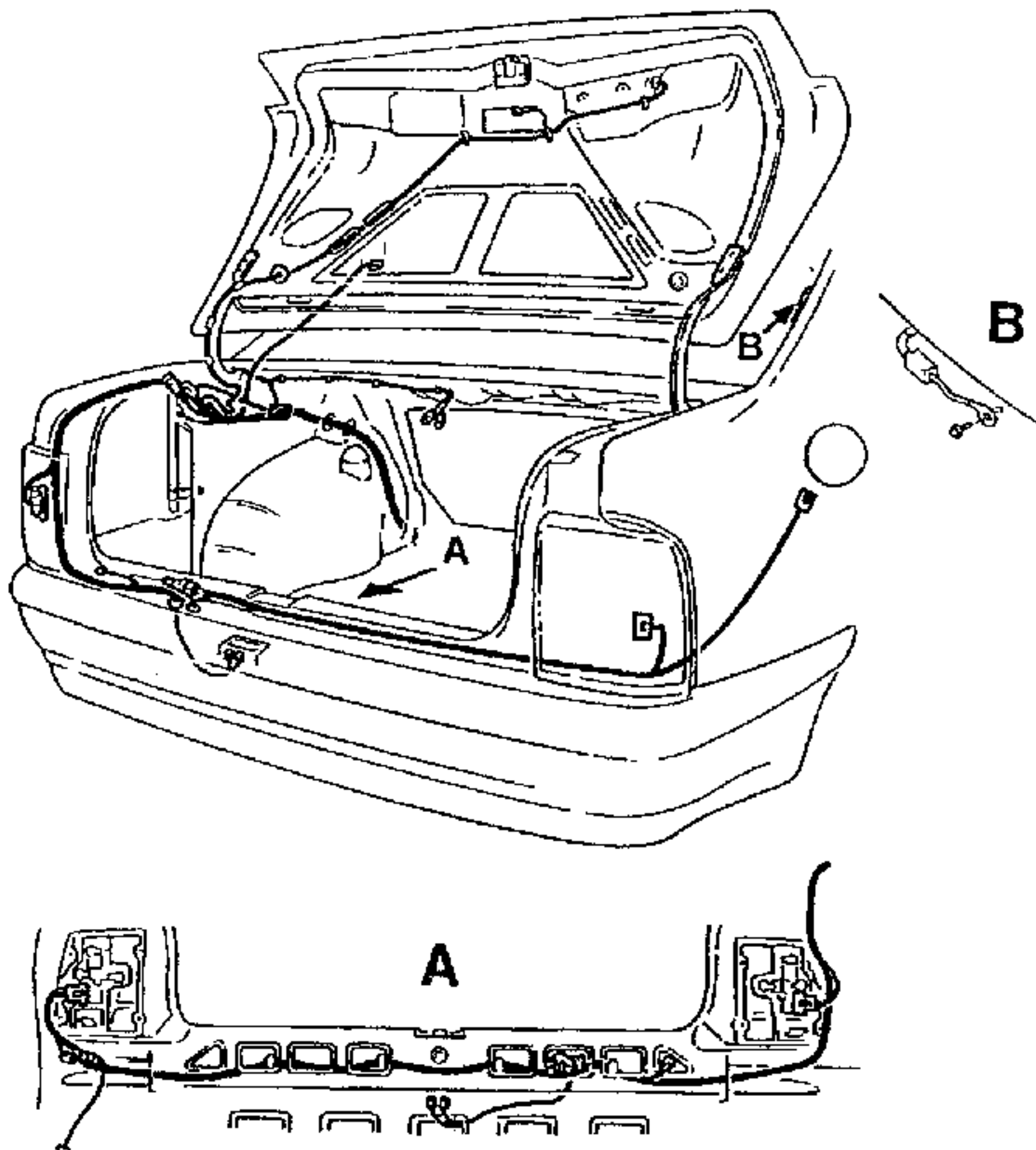
E 0589

# WIRING HARNESS, FUSE BOX

## WIRING HARNESS, BODY, REAR

A = Rear panel wiring harness

B = Heated rear screen ground connection



E 0584

# WIRING HARNESS, FUSE BOX

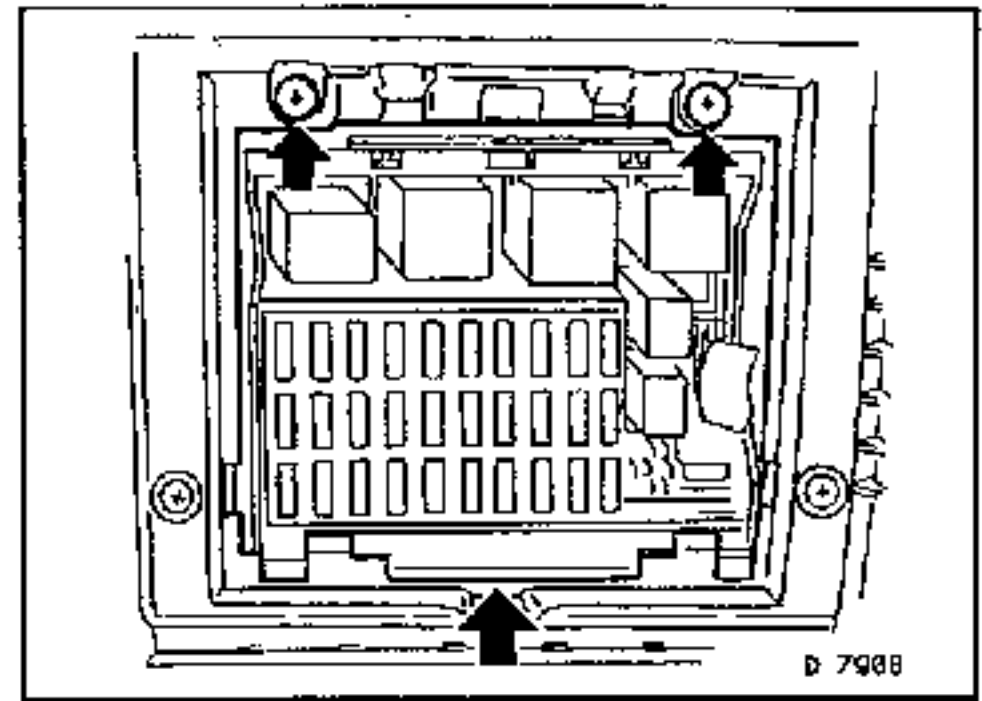
## FUSE BOX, REMOVE AND INSTALL

### Remove, Disconnect

Cover, unclip lower part of fuse box, 2 upper screws

### Install, Connect

Fuse box, cover



# GROUP N

## ELECTRICAL EQUIPMENT AND INSTRUMENTS

### CENTRAL DOOR LOCKING

#### TABLE OF CONTENTS

	PAGE
Control Unit, Remove and Install.....	N - 102
Servo Motor (Door), Remove and Install.....	N - 102
Servo Motor (Luggage Compartment Lid), Remove and Install.....	N - 102
Servo Motor (Fuel Filler Flap), Remove and Install.....	N - 102
Switch (Drivers Door), Remove and Install.....	N - 103
Servo Motor (Drivers Door), Adjust.....	N - 103
Servo Motor (Passenger Door), Adjust .....	N - 104



# CENTRAL DOOR LOCKING

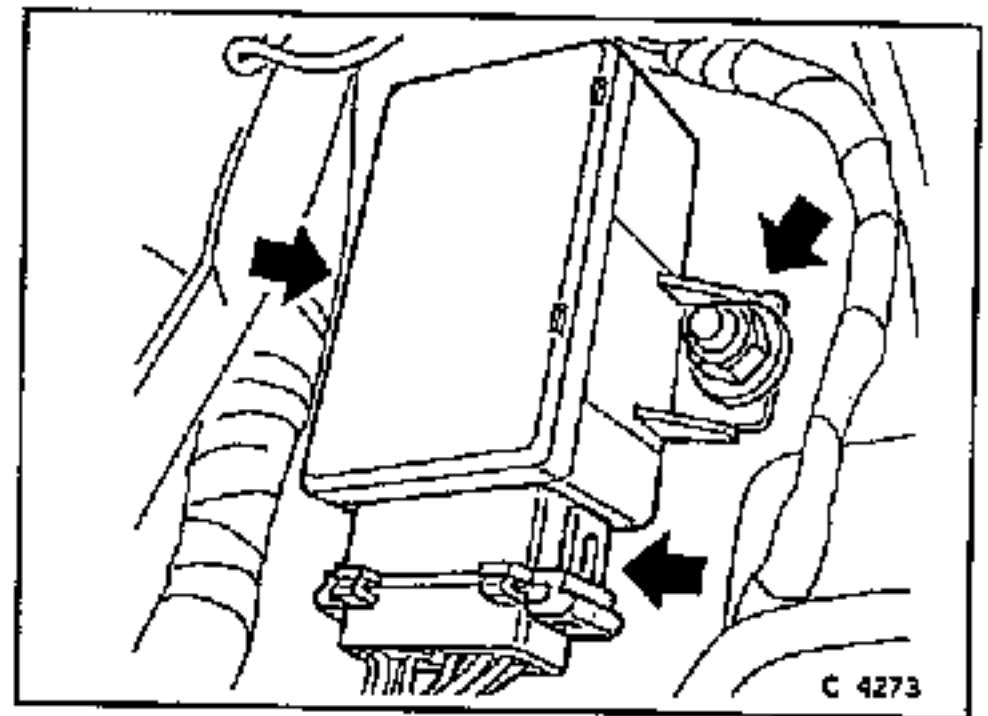
## CONTROL UNIT, REMOVE AND INSTALL

### Remove, Disconnect

A pillar trim – right footwell.  
Control unit, wiring harness plug.

### Install, Connect

Wiring harness plug, control unit, a pillar trim.



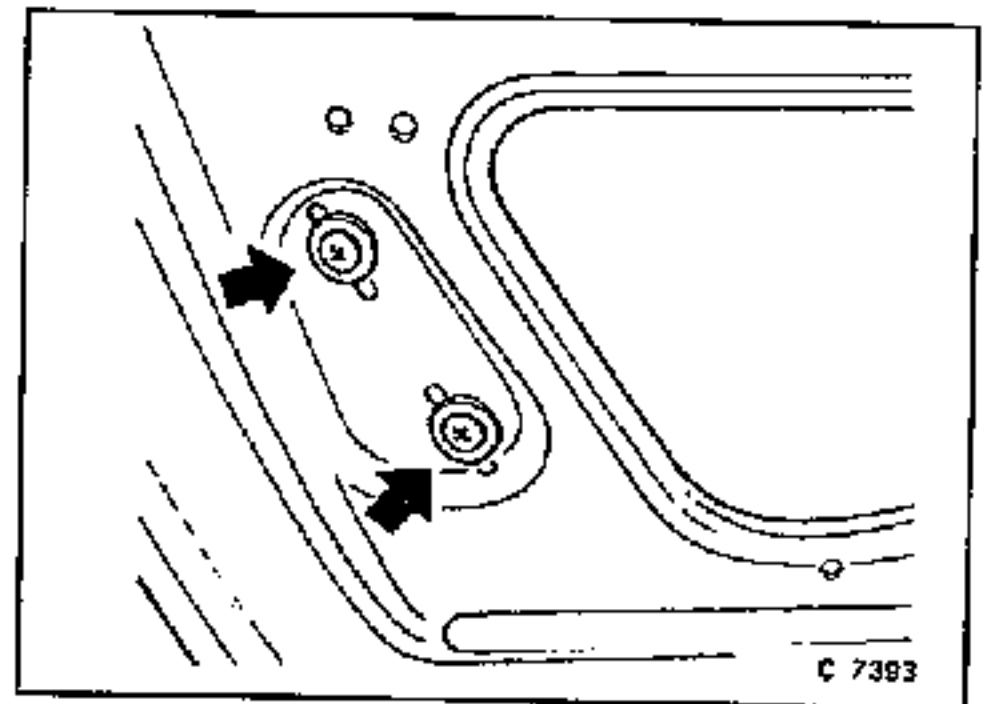
## SERVO MOTOR (DOOR), REMOVE AND INSTALL

### Remove, Disconnect

Door inner trim:  
See corresponding operation in group C.  
Servo motor from door, wiring harness plug from servo motor.

### Install, Connect

Wiring harness plug, servo motor, door inner trim.



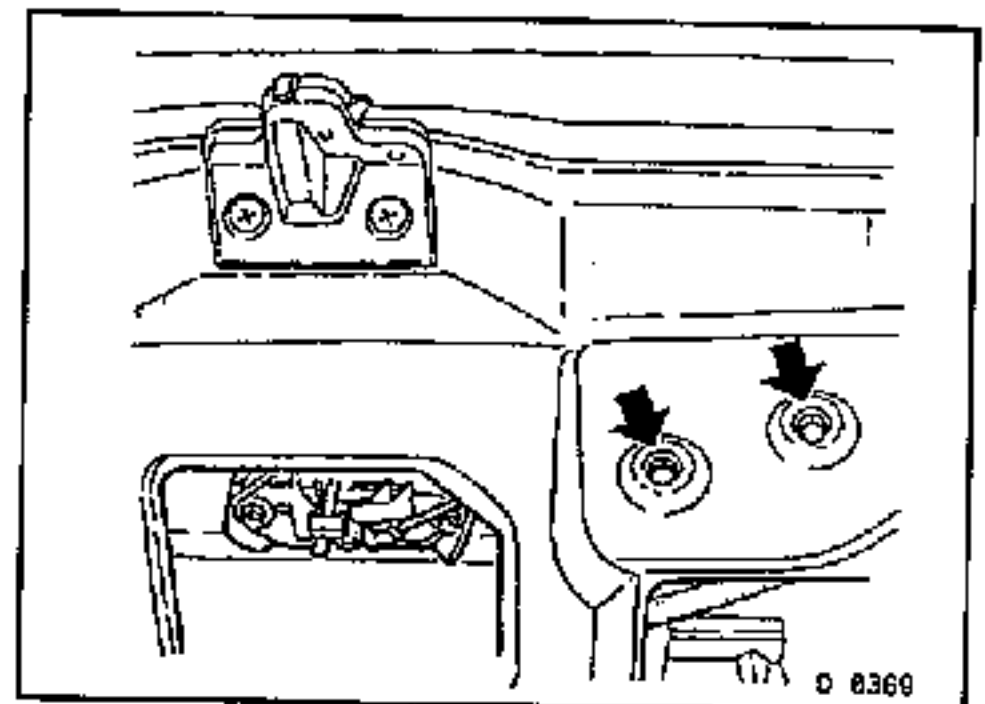
## SERVO MOTOR (LUGGAGE COMPARTMENT LID), REMOVE AND INSTALL

### Remove, Disconnect

Servo motor from luggage compartment lid, wiring harness plug.

### Install, Connect

Wiring harness plug, servo motor.



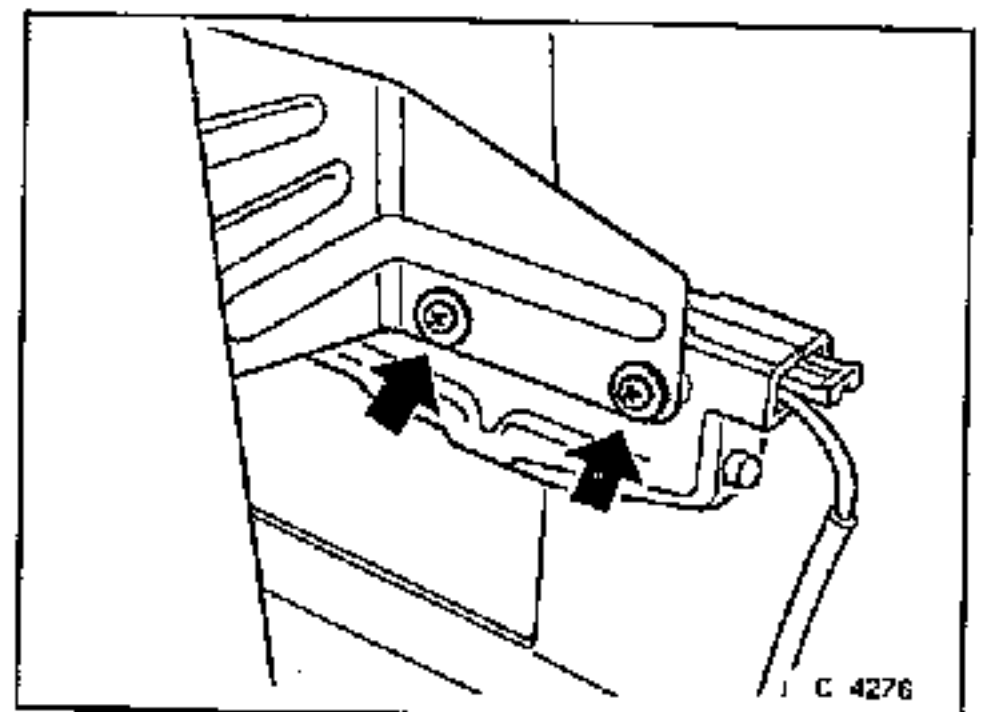
## SERVO MOTOR (FUEL FILLER FLAP), REMOVE AND INSTALL

### Remove, Disconnect

Luggage compartment side cover, servo motor from bracket, wiring harness plug from servo motor, linkage.

### Install, Connect

Linkage, wiring harness plug, servo motor, luggage compartment side cover.



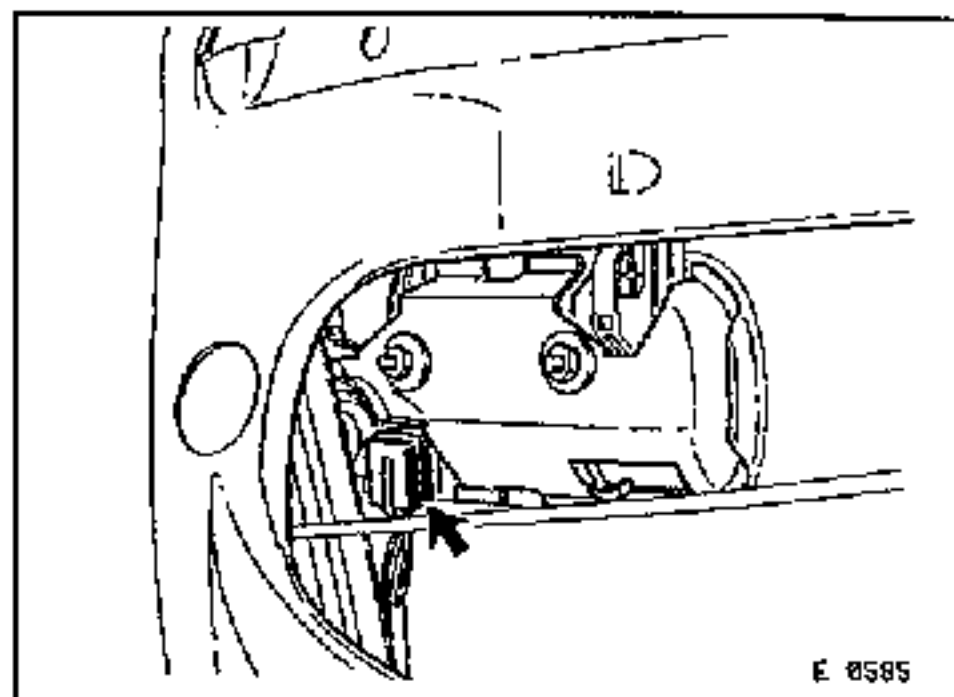
# CENTRAL DOOR LOCKING

## SWITCH (DRIVER'S DOOR), REMOVE AND INSTALL

### Remove, Disconnect

Door inner trim – group C.

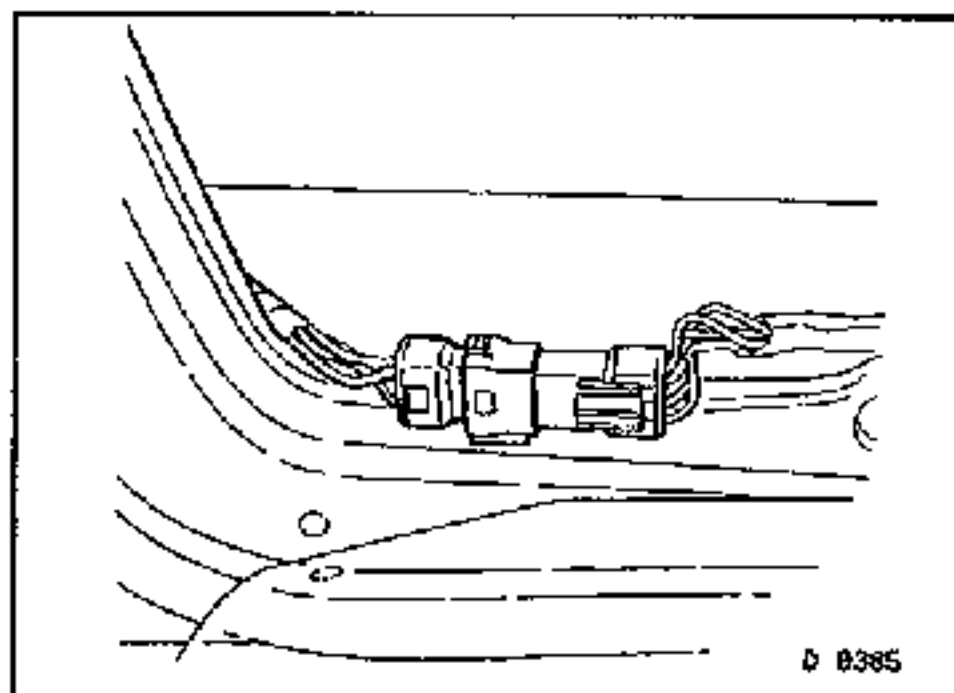
Clip, switch and electrical connections.



Disconnect wiring harness plug at door wiring harness.

### Install, Connect

Wiring harness plug, switch, door inner trim.



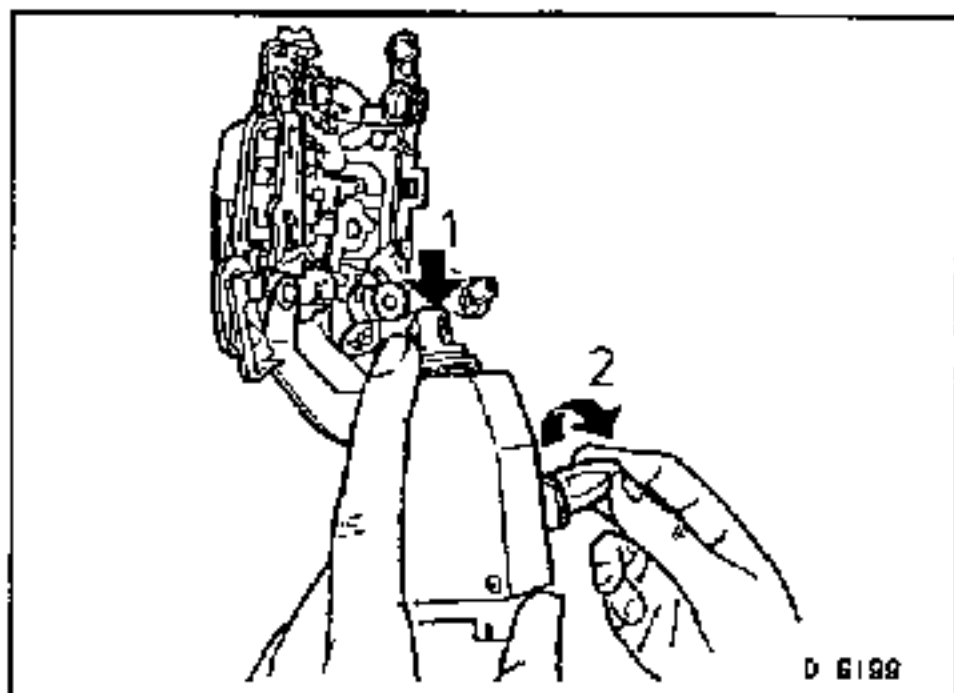
## SERVO MOTOR (DRIVER'S DOOR), ADJUST

### Remove, Disconnect

Disconnect battery, door inner trim panelling – group C,  
Servo motor door lock assembly – group C.

### Adjust

Press slider (1) of servo motor in lock position and hold, loosen  
servo motor screws (2).



Bring lock lever to stop by sliding servo motor with rubber  
damper, tighten screw.

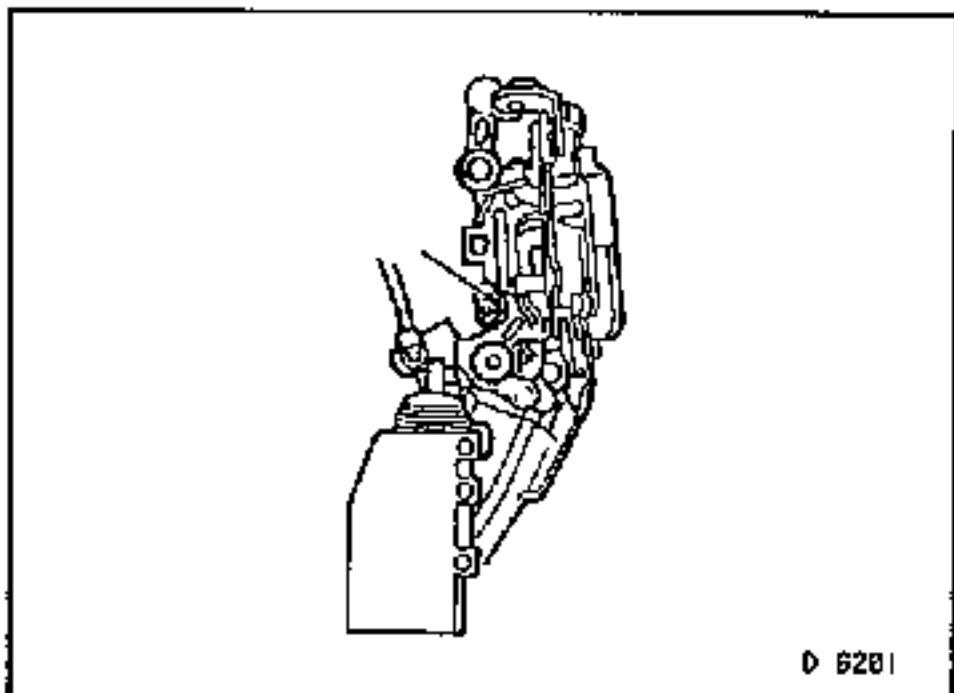
### Install, Connect

Door lock servo motor assembly, connect battery.

Check for proper function.

Install door inner trim panelling.

If necessary, program electronic components  
(i.e. board computer, electrical window winder).



# CENTRAL DOOR LOCKING

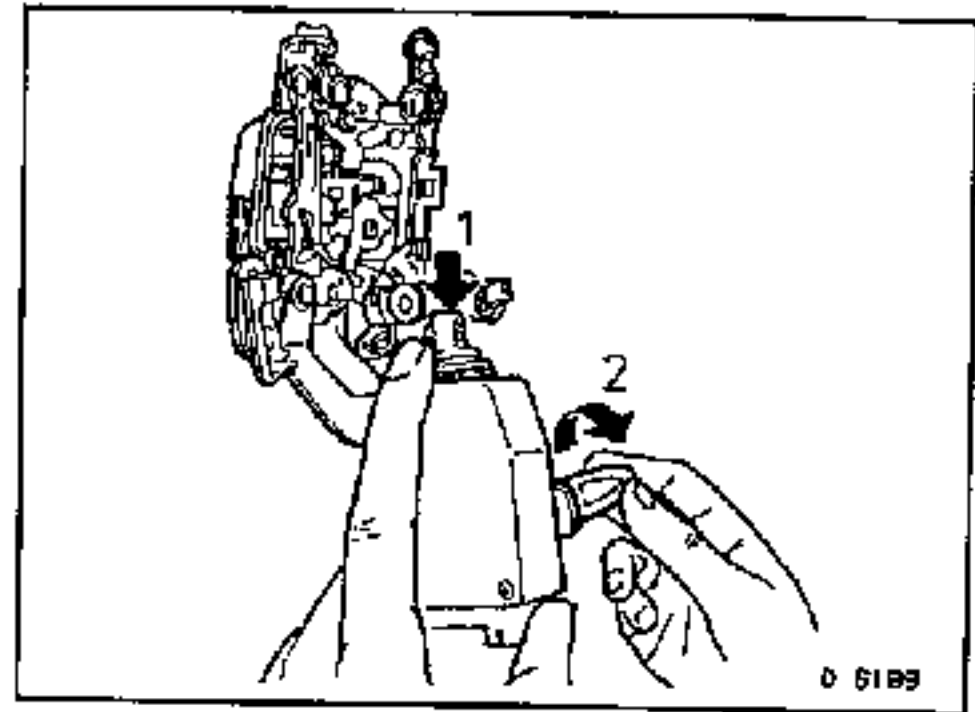
## SERVO MOTOR (PASSENGER DOOR), ADJUST

### Remove, Disconnect

Disconnect battery, door inner trim panelling – group C,  
Door lock servo motor assembly – group C.

### Adjust

Press servo motor slider (1) in lock position and hold, loosen  
servo motor screws (2).



Adjust lock lever to a clearance of 2 mm/0.08 in. by moving the  
servo motor, tighten screws.

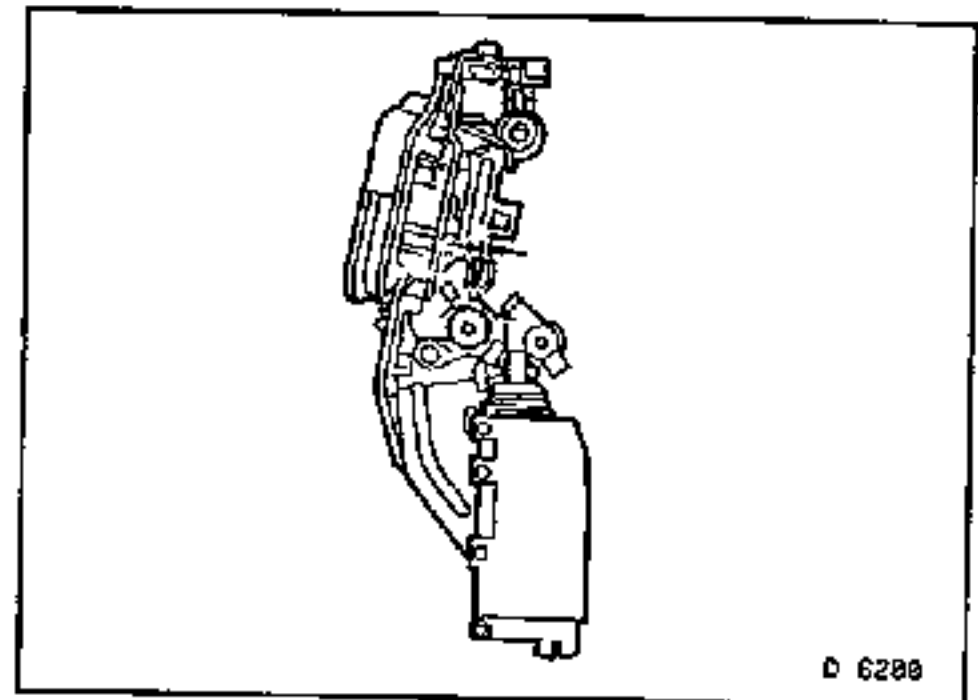
### Install, Connect

Install door lock servo motor assembly, connect battery.

Check for proper function.

Install door inner trim panelling.

If necessary, program electronic components  
(i.e. board computer, electrical window winder).



# GROUP J

## DOUBLE OVERHEAD CAM ENGINE

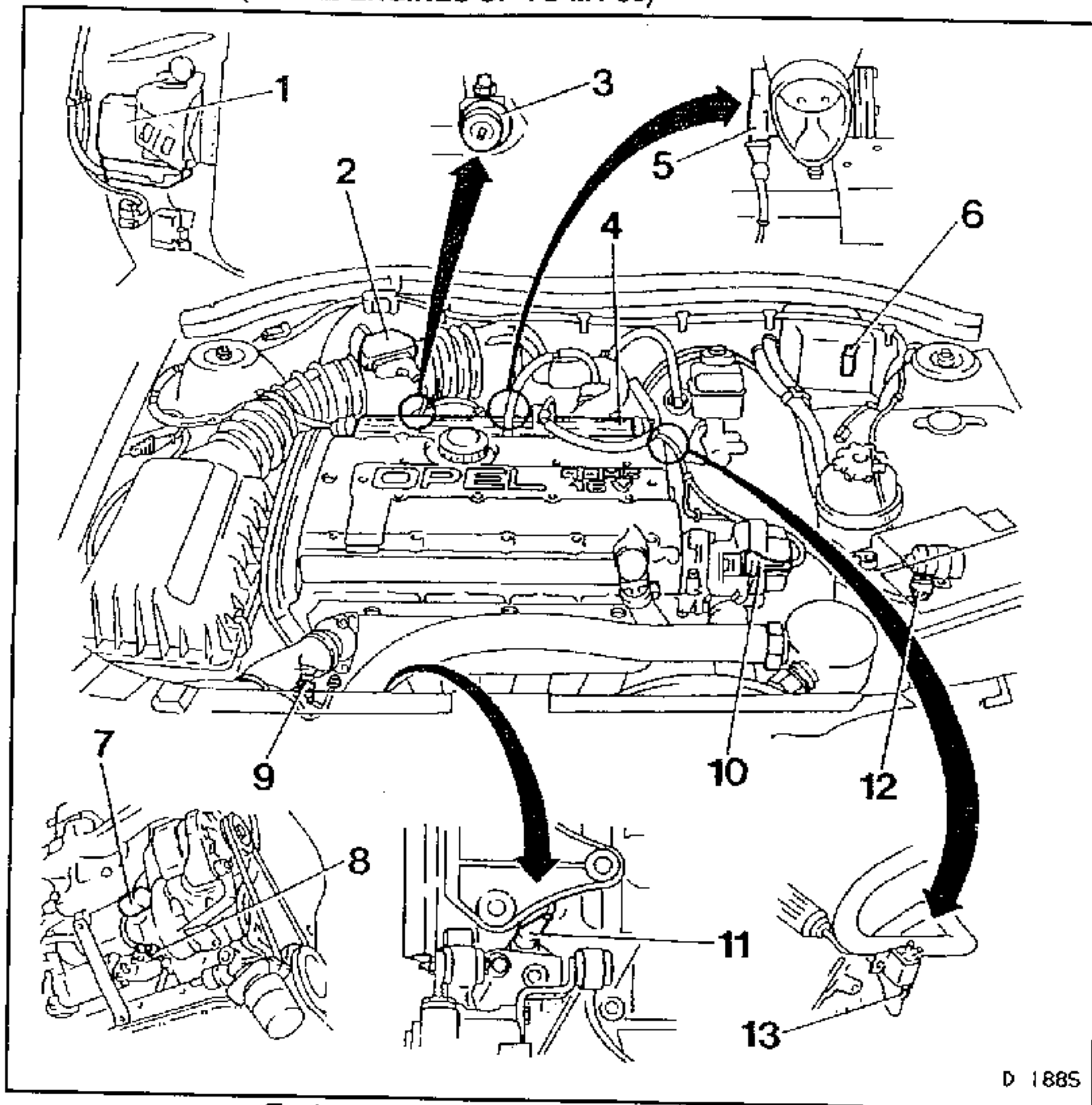
### MOTRONIC M 2.5 (C 20 XE Engines Up To MY'93)

#### TABLE OF CONTENTS

	PAGE
General Arrangement Illustration (M 2.5) .....	J - 416
General Instructions .....	J - 416
Throttle Body, Remove and Install (M 2.5, M2.8) .....	J - 417
Throttle Valve Switch, Remove and Install (M 2.5) .....	J - 418
Throttle Valve Switch, Adjust (M 2.5) .....	J - 418
Injectors, Remove and Install (M 2.5, M 2.8) .....	J - 418
Hot Wire Mass Air Flow Meter, Remove and Install (M 2.5) .....	J - 420
High Voltage Distributor, Remove and Install (M 2.5) .....	J - 420
Inductive Pulse Pick-up, Remove and Install (M 2.5) .....	J - 421
Knock Sensor, Remove and Install (M 2.5, M 2.8) .....	J - 422
Ignition Coding Plug (M 2.5) .....	J - 422
Fuel Pressure Regulator, Remove and Install (M 2.5, M 2.8) .....	J - 422
Fuel Pressure, Check (M 2.5, M 2.8) .....	J - 422
Fuel Pump Relay, Remove and Install (M 2.5) .....	J - 423
Oxygen Sensor, Remove and Install (M 2.5, M 2.8) .....	J - 423
Idle Speed Adjuster, Remove and Install (M 2.5, M 2.8) .....	J - 424
Control Unit, Remove and Install (M 2.5) .....	J - 424
Controlled Canister Purge Valve, Remove and Install (M 2.5) .....	J - 424
Coolant Temperature Sensor, Remove and Install (M 2.5, M 2.8) .....	J - 425
Pre-volume Chamber, Remove and Install (M 2.5, M 2.8) .....	J - 425
Ignition Coil, Remove and Install (M 2.5) .....	J - 426
Recommended Torque Values .....	J - 426
Checking Procedures, Using TECH 1 .....	J - 427

# DOHC ENGINE - MOTRONIC M 2.5

MOTRONIC M 2.5 (C 20XE ENGINES UP TO MY'93)



Typical Component Locations (LHD Shown)

## Illustration Key:

- |  |   |
|--|---|
| 1. Control Unit (Location; Right Footwell) | 8. Knock Sensor                               |
| 2. Hot Wire Mass Air Flow Meter            | 9. Coolant Temperature Sensor                 |
| 3. Fuel Pressure Regulator                 | 10. High Voltage Distributor with Hall Sensor |
| 4. Injector Plug Strip                     | 11. Inductive Pulse Pick-up                   |
| 5. Throttle Valve Switch                   | 12. Ignition Coil                             |
| 6. Fuel Pump Relay                         | 13. Controlled canister Purge Valve           |
| 7. Idle Speed Adjuster                     |   |

## General Instructions

This Section describes the service operations for the Motronic M 2.5 engine management system, which are generally, the same as those for Motronic M 2.8. In view of this, the illustrations used, show the Motronic M 2.5 system and, unless specified, relate to both the Motronic M 2.5 and Motronic M 2.8.

Alternatively, those operations that differ from Motronic M 2.5, are described in the Section "Motronic M 2.8 (C 20 XE Engines as of MY'93)".

# DOHC ENGINE - MOTRONIC M 2.5

## Throttle Body, Remove and Install (M 2.5, M 2.8)

### Remove, Disconnect

Pre-volume chamber. Refer to this operation later in this Section.

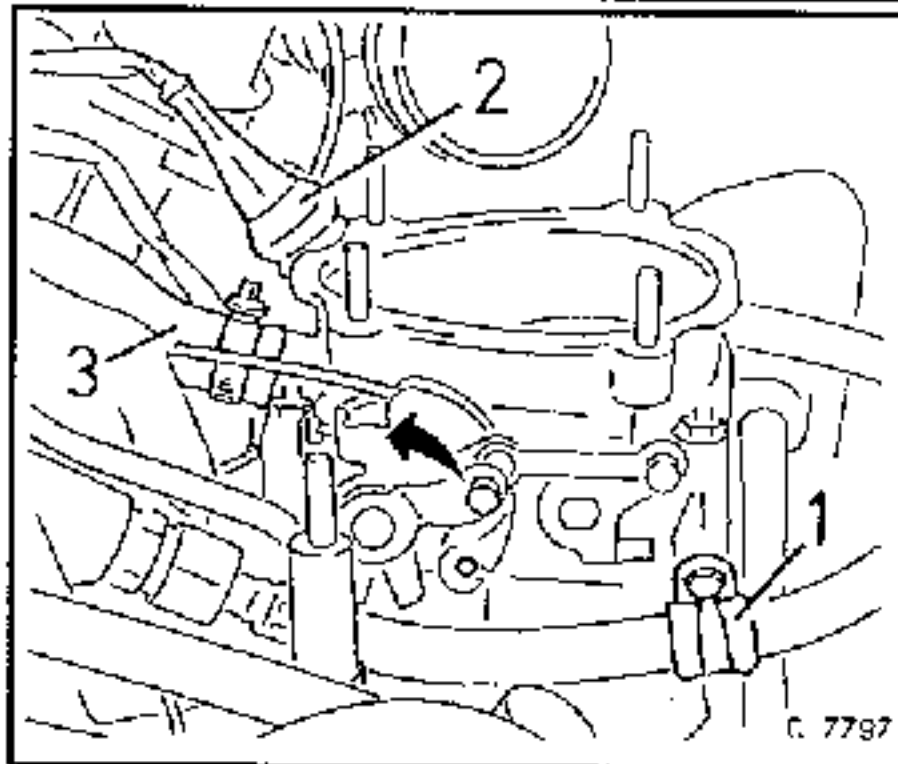
Fuel line bracket (1).

Wiring harness plug (2).

Bowden cable.

Hose (3).

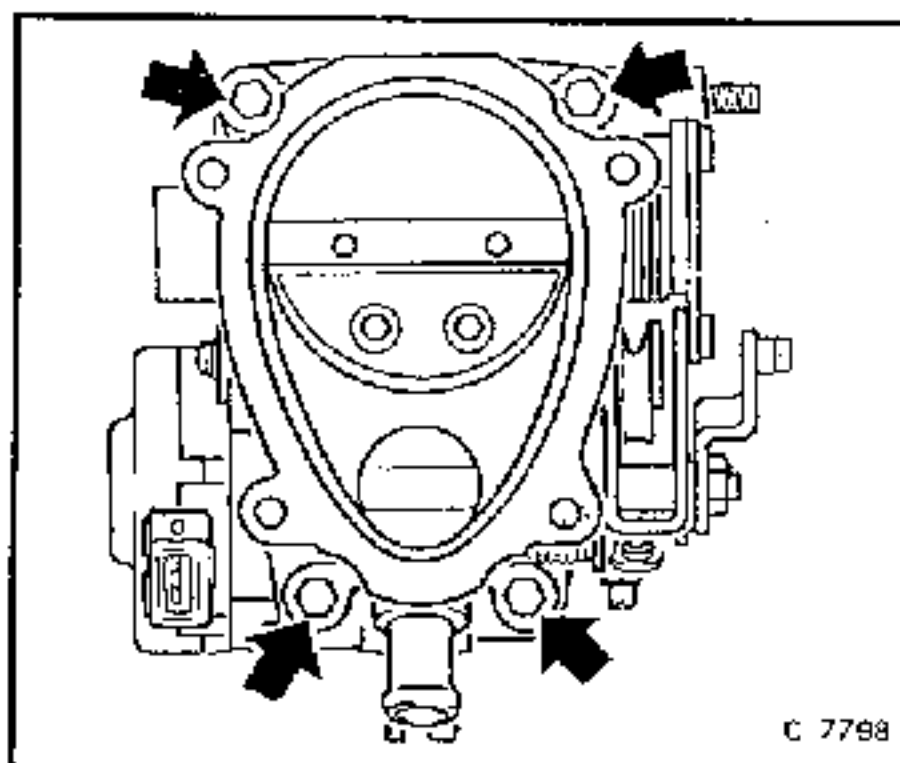
Vacuum hose from fuel pressure regulator.



### Remove, Disconnect

Throttle body.

Throttle valve switch (M2.5) or throttle valve potentiometer (M 2.8).



### Install, Connect

Throttle valve switch (M2.5) or throttle valve potentiometer (M 2.8).

### Tighten (Torque)

Throttle body fasteners ..... 9 Nm

### Install, Connect

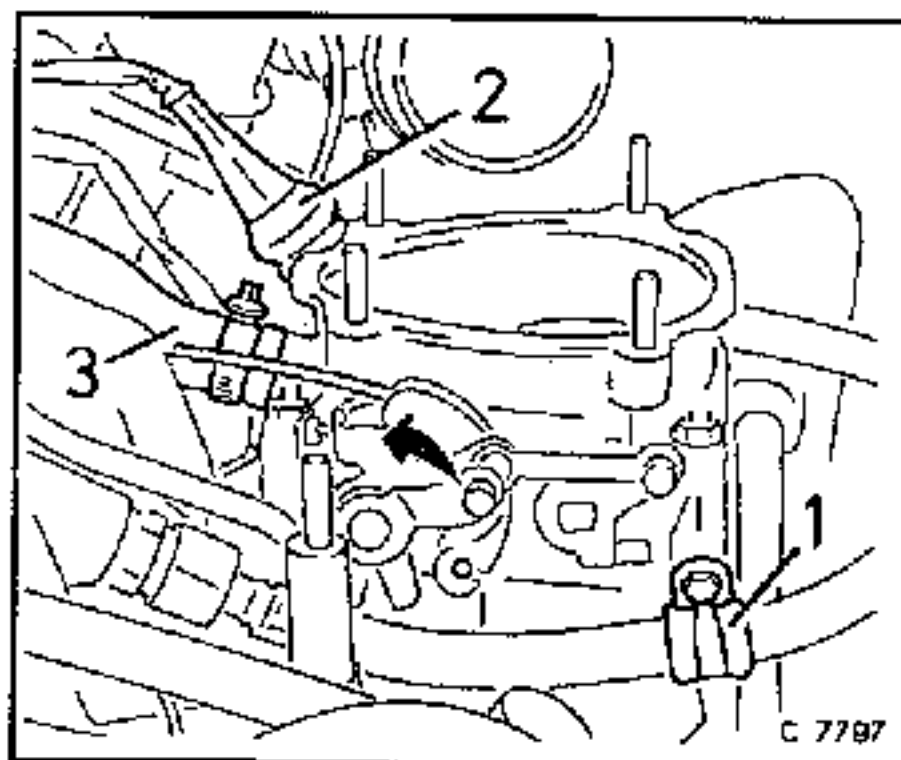
Fuel pressure regulator hose.

Bowden cable.

Wiring harness plug (2).

Fuel line bracket (1).

Pre-volume chamber. Refer to this operation later in this Section.



### Important!

If any part of the throttle valve linkage is damaged or worn, replace the complete throttle body. No service adjustments are possible.

### Adjust

Throttle valve switch (M2.5 only). Refer next operation.

# DOHC ENGINE - MOTRONIC M 2.5

## Throttle Valve Switch, Remove and Install (M 2.5)

### Remove, Disconnect

Pre-volume chamber. Refer to this operation later in this Section.

Hot wire mass air flow meter. Refer to this operation later in this Section.

Throttle valve switch wiring harness plug.

Throttle valve switch.

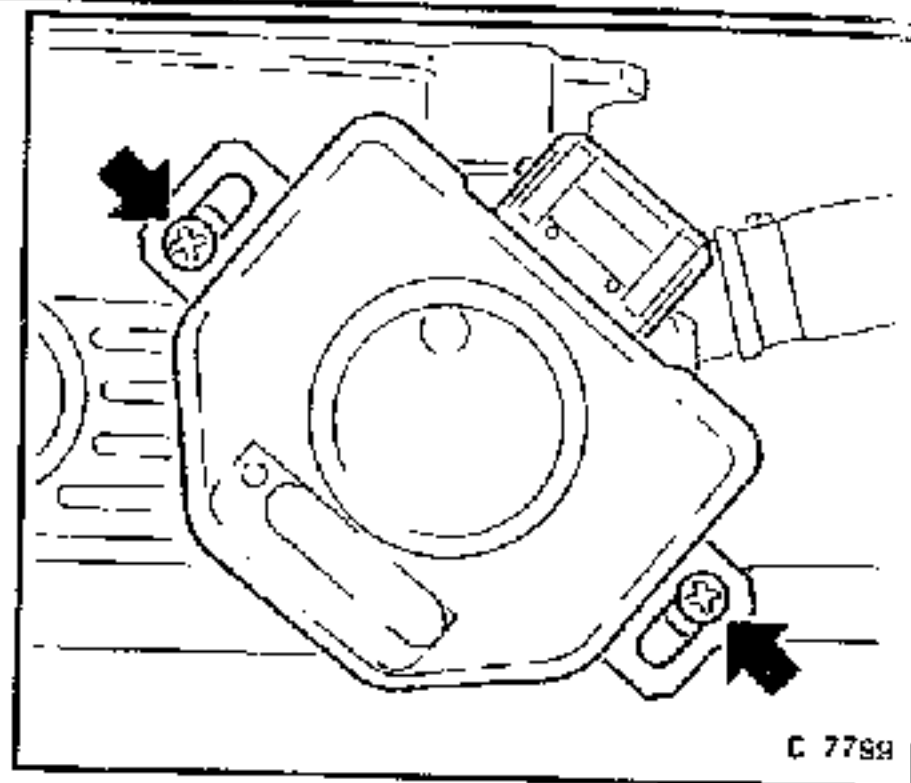
### Install, Connect

Throttle valve switch. Adjust as detailed in this section.

Throttle valve switch wiring harness plug.

Hot wire mass air flow meter.

Pre-volume chamber.



## Throttle Valve Switch, Adjust (M 2.5)

### Remove, Disconnect

Pre-volume chamber. Refer to this operation later in this Section.

Hot wire mass air flow meter. Refer to this operation later in this Section.

### Adjust

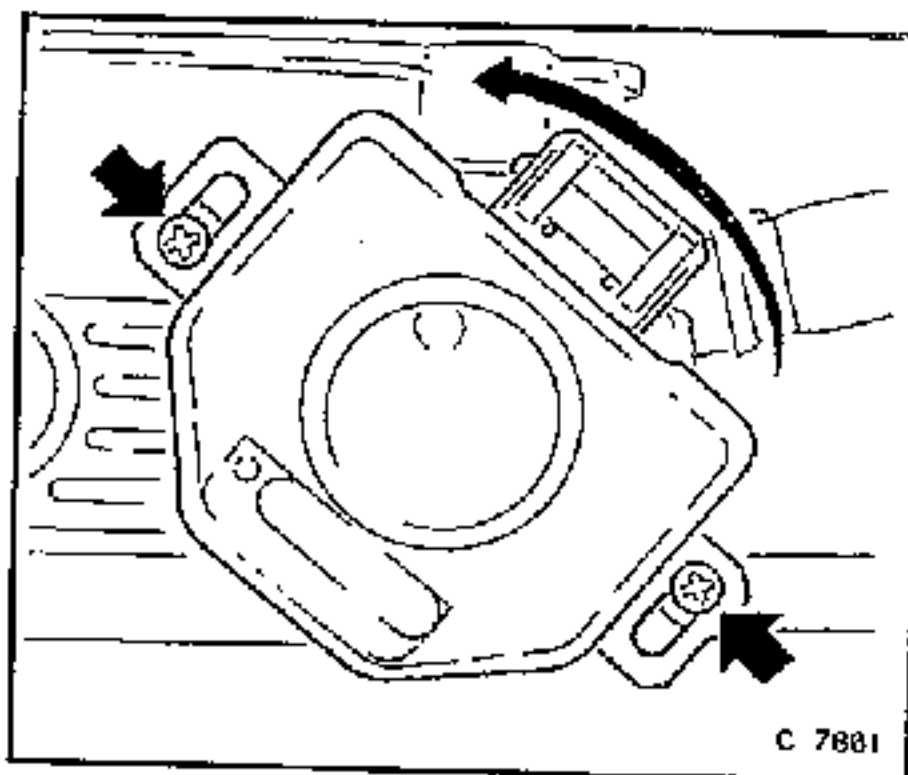
Loosen bolts, then turn throttle valve switch anti-clockwise until resistance is felt. Tighten the throttle valve switch in this position.

Check that an audible click is heard, both when the throttle is held wide open and when the throttle is closed.

### Install, Connect

Pre-volume chamber.

Hot wire mass air flow meter.



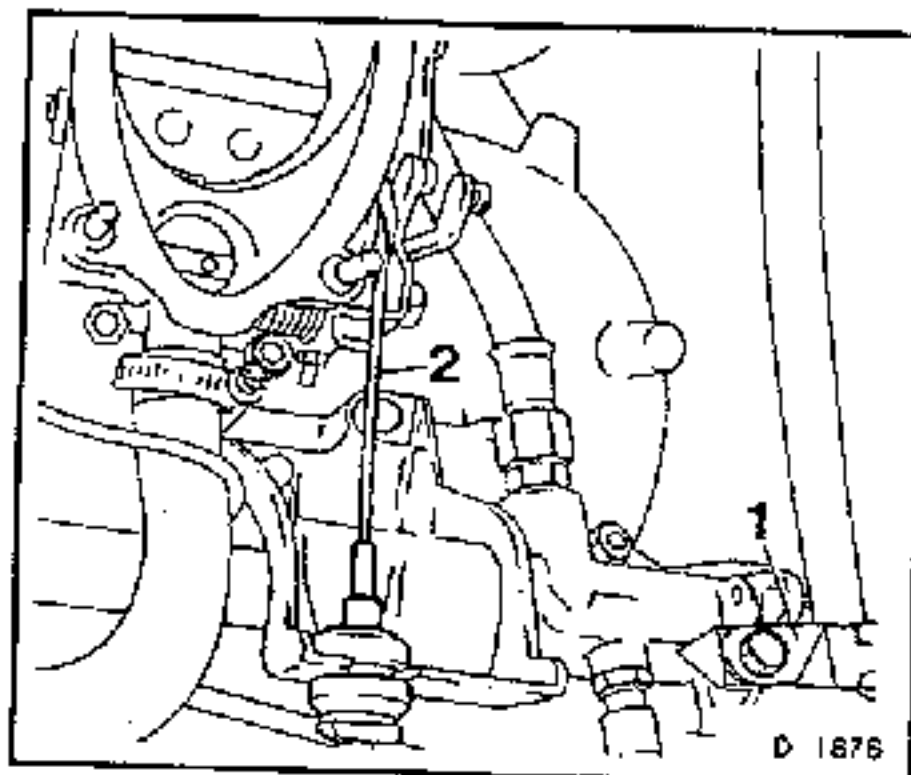
## Injectors, Remove and Install (M2.5, M2.8)

### Remove, Disconnect

Pre-volume chamber. Refer to this operation later in this Section.

Clamp (1).

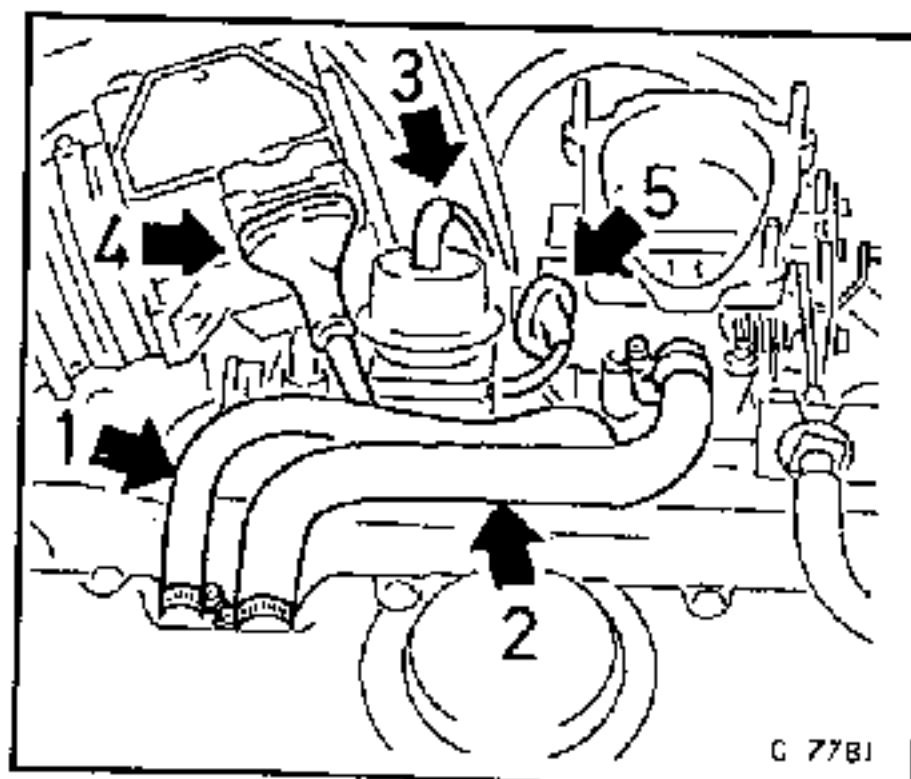
Bowden cable (2).



### Remove, Disconnect

Hoses (1, 2 and 3).

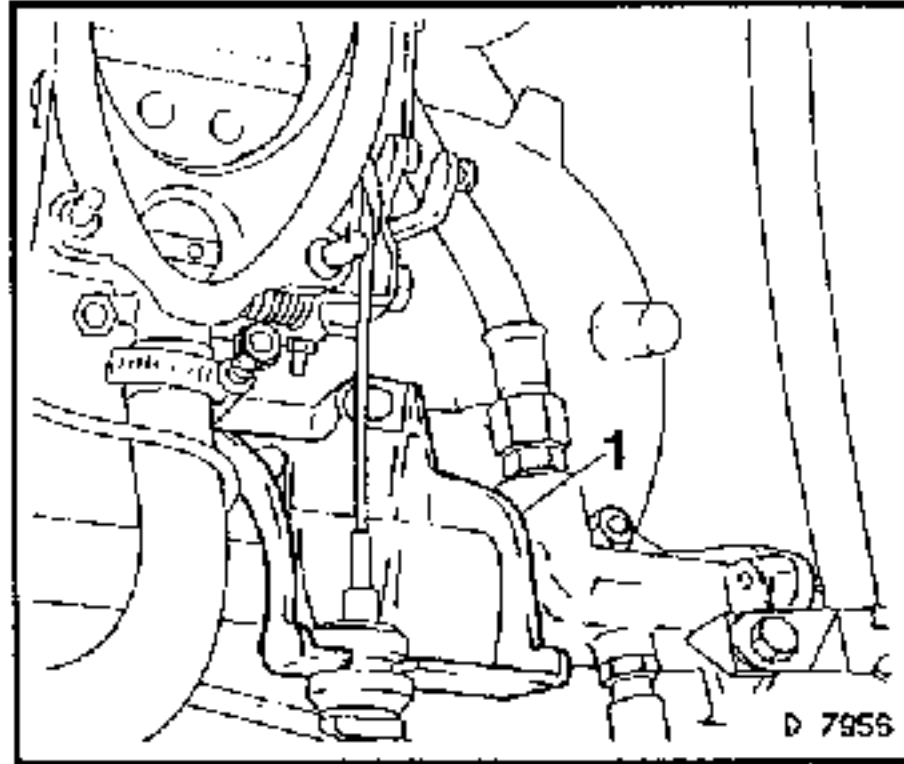
Wiring harness plugs (4 and 5).



# DOHC ENGINE - MOTRONIC M 2.5

## Remove, Disconnect

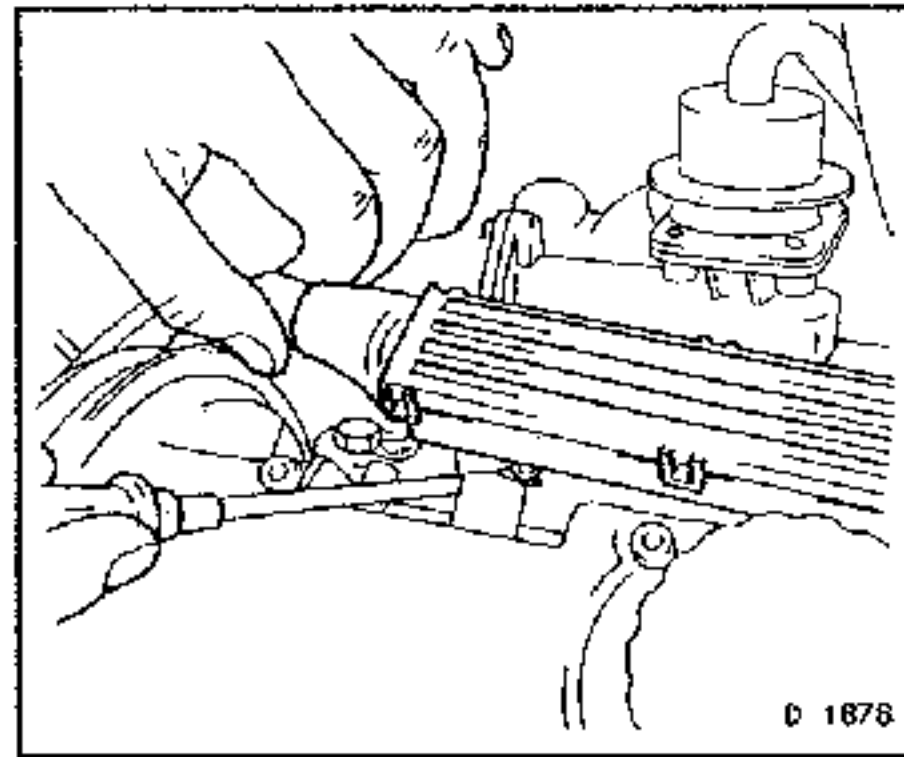
Bowden cable bracket (1).



## Remove, Disconnect

No. 1 cylinder injector retaining clamp from the plug strip, then remove the plug strip.

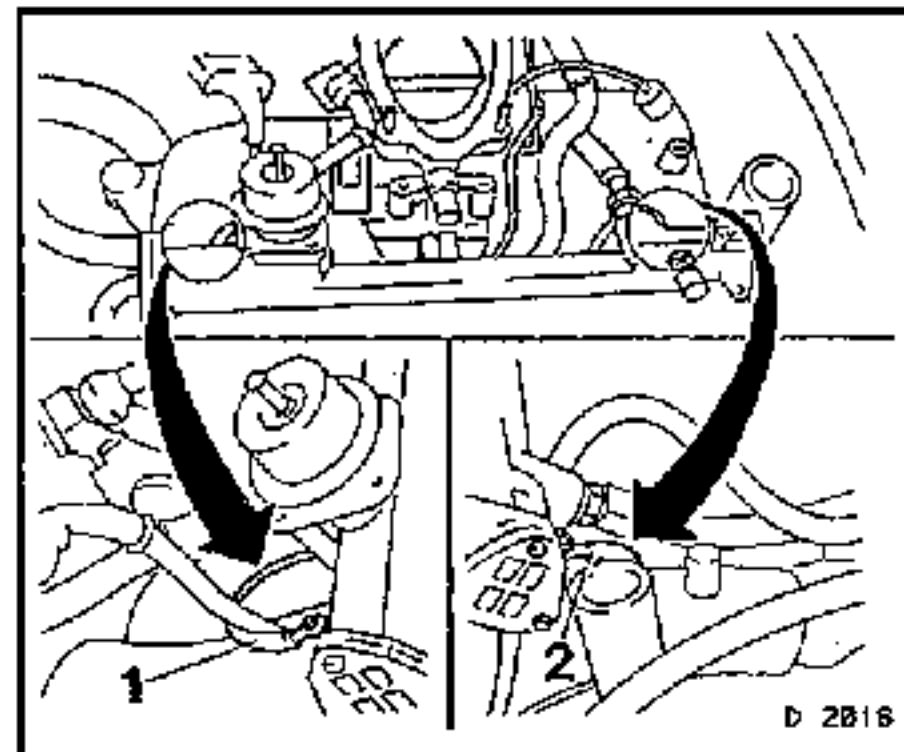
Insert retaining clamp in the plug strip.



## Remove, Disconnect

Ground cables (1 and 2).

Fuel distributor pipe with the injectors still attached.



## Remove, Disconnect

Retaining clip, then injector from fuel distribution pipe.

### Important!

When installing use new sealing rings.

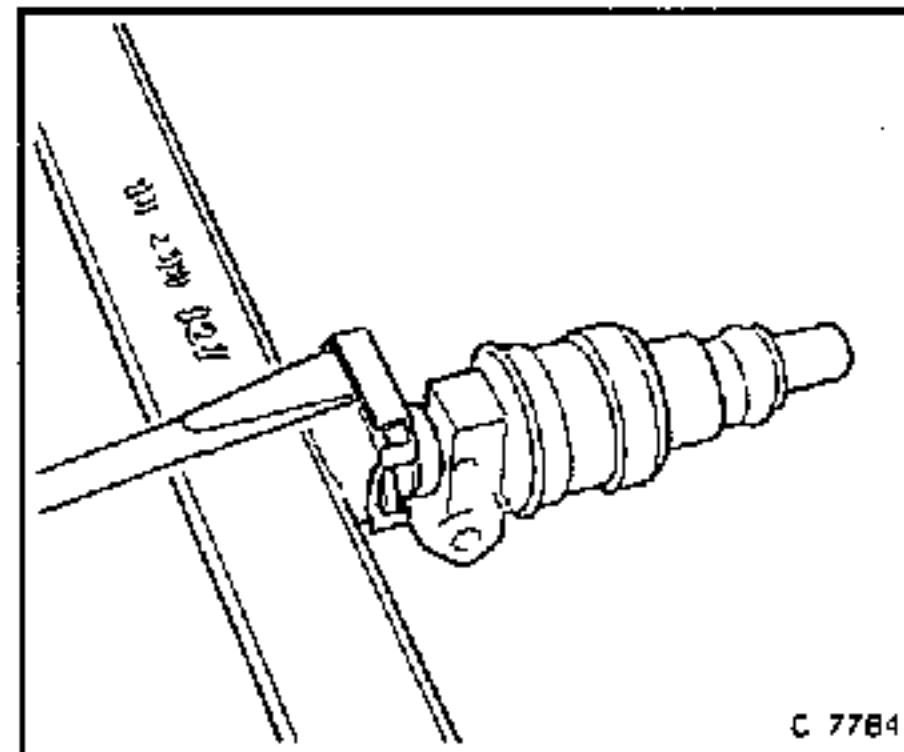
Also, ensure that all hoses and cables are routed and installed correctly.

## Install, Connect

Injector, retaining clip.

Fuel distributor pipe with injector.

Nuts, ground cables.





# DOHC ENGINE - MOTRONIC M 2.5

## Install, Connect

Injector plug strip.

Bowden cable bracket.

## Tighten (Torque)

Bowden cable bracket ..... 8 Nm

## Install, Connect

Wiring harness plugs to the throttle valve switch and hot wire mass air flow meter (M 2.5).

Wiring harness plugs to the throttle valve potentiometer and hot film mass air flow meter (M 2.8).

## Adjust

Bowden cable.

## Hot Wire Mass Air Flow Meter, Remove and Install (M 2.5)

### Remove, Disconnect

Wiring harness plug from the hot wire mass air flow meter.

### Install, Connect

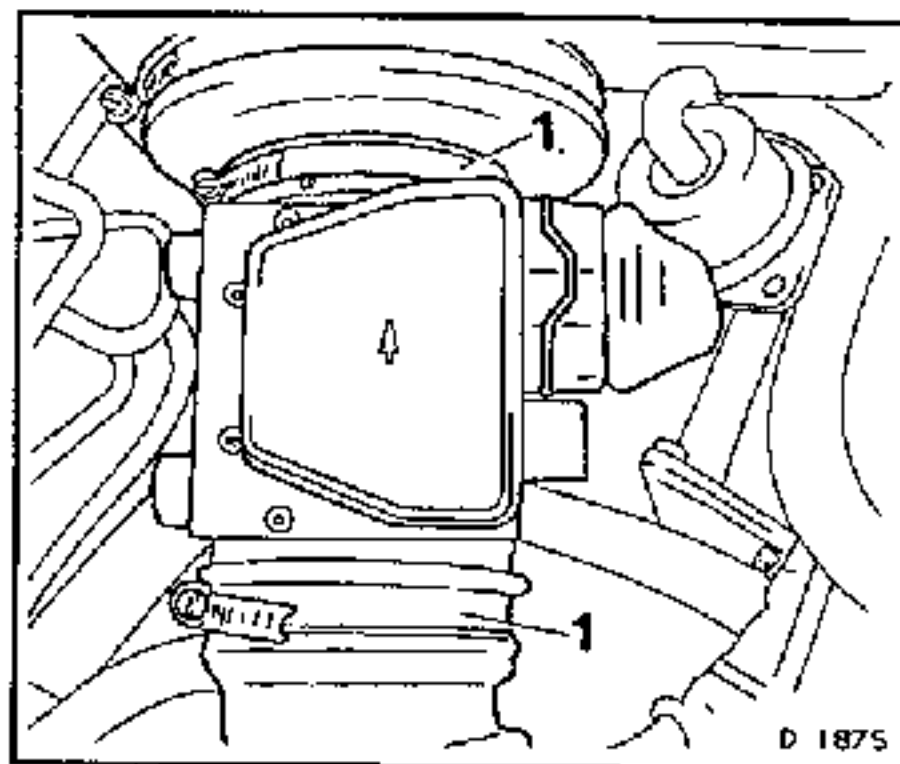
Hot wire mass air flow meter.

Hose clamps.

Wiring harness plug to the hot wire mass air flow meter.

### Important!

Ensure that all hoses and clamps are correctly installed and air tight.

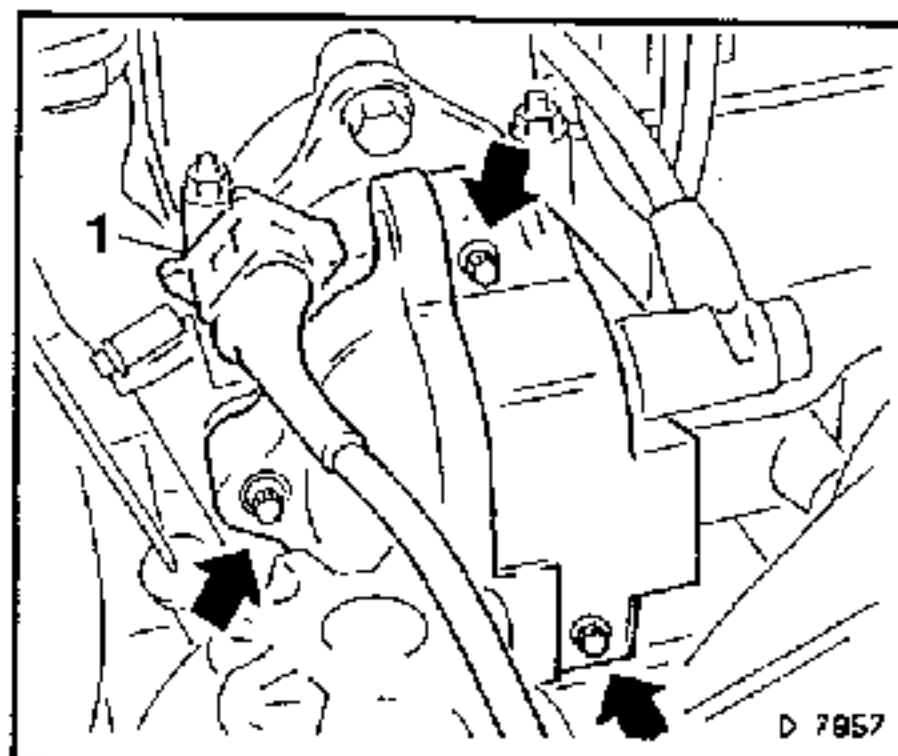


D 1875

## High Voltage Distributor, Remove and Install (M 2.5)

### Remove, Disconnect

Wiring harness plug (1), distributor cap.



D 7857

### Remove, Disconnect

High voltage distributor, seal ring.

### Install, Connect

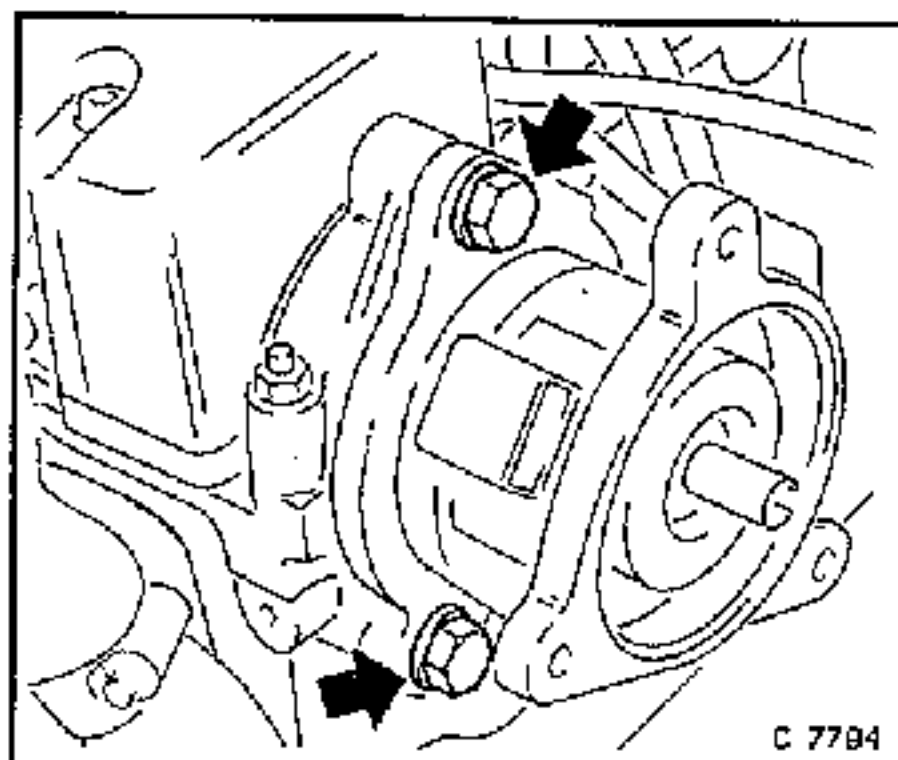
Seal ring, high voltage distributor,

### Tighten (Torque)

Distributor bolts ..... 15 Nm

### Install, Connect

Distributor cap, wiring harness plug.



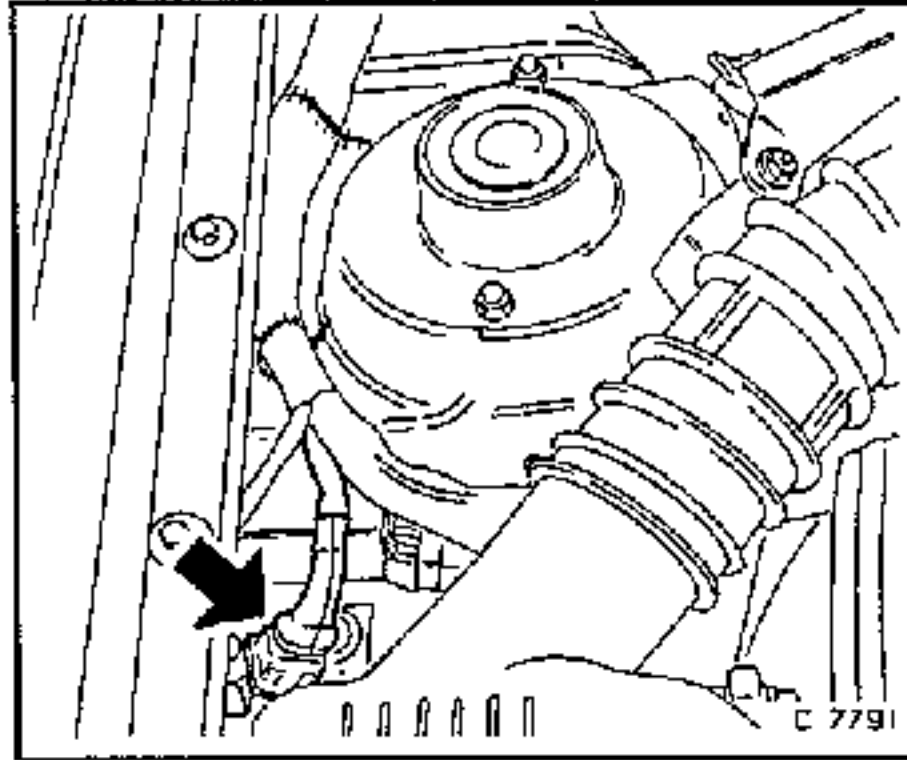
C 7784

## DOHC ENGINE - MOTRONIC M 2.5

### Inductive Pulse Pick-Up, Remove and Install (M 2.5)

#### Remove, Disconnect

Wiring harness plug (arrow), noting wiring harness routing.



#### Remove, Disconnect

Pulse pick-up with seal ring.

#### Install, Connect

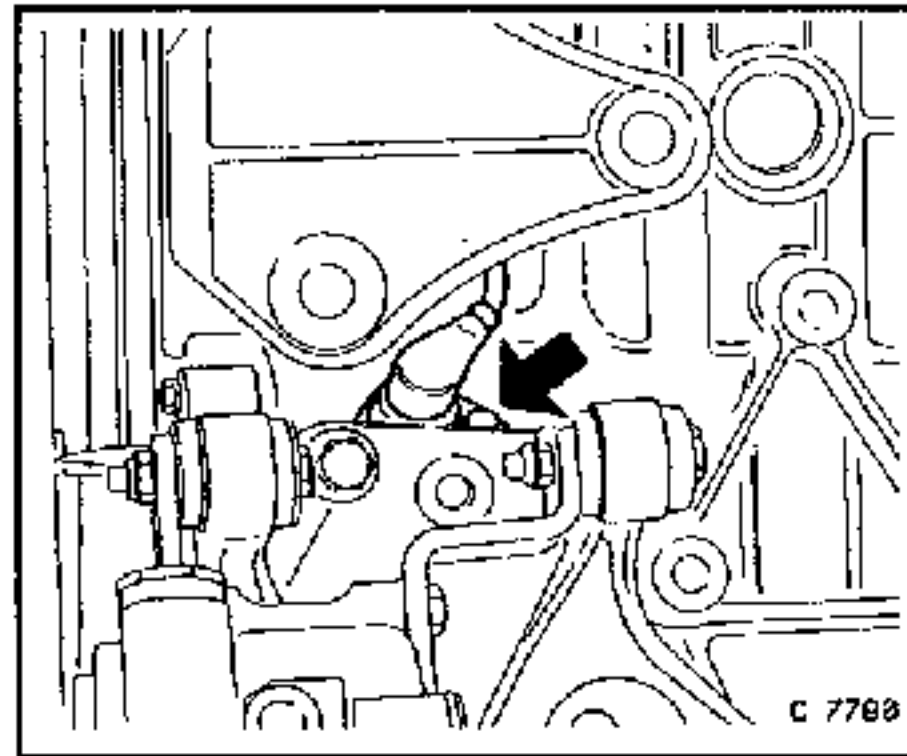
Pulse pick-up with new seal ring.

#### Tighten (Torque)

Pulse pick-up fastening bolt..... 6 Nm

#### Install, Connect

Wiring harness plug, Ensure correct wiring harness routing.



### Knock Sensor, Remove and Install (M 2.5, M 2.8)

#### Remove, Disconnect

Ground cable from battery.

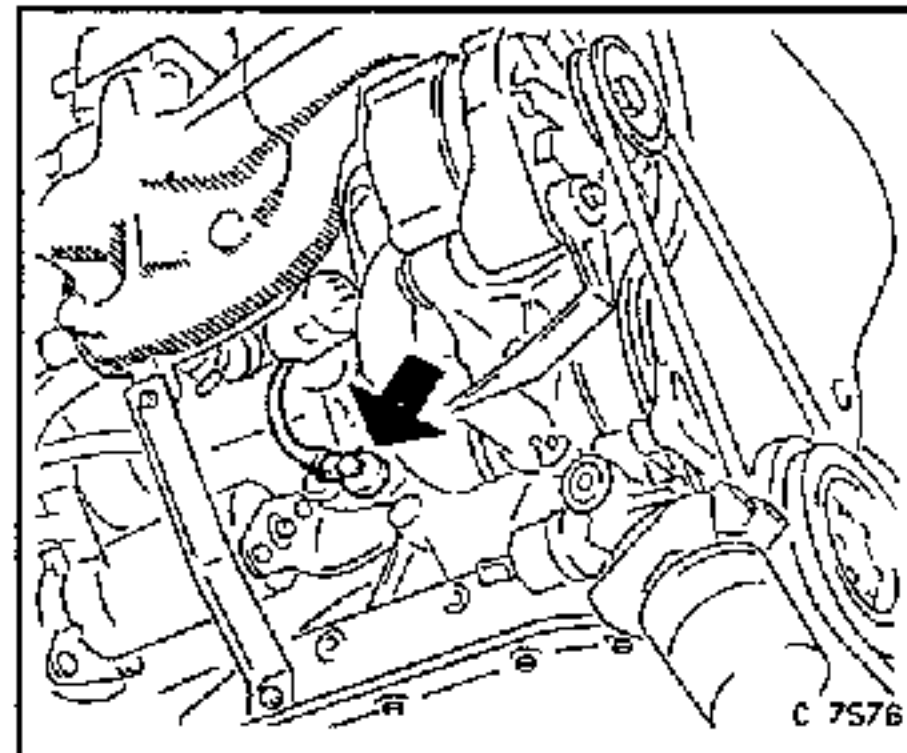
For C 20 LET:

Alternator. Refer to "Alternator" Section in this Volume.

Knock sensor wiring harness plug.

#### Important!

Carefully clean the knock sensor to cylinder block contact surfaces.



#### Install, Connect

Knock sensor.

#### Tighten (Torque)

Knock sensor bolt ..... 20 Nm

#### Install, Connect

Knock sensor wiring harness plug.

For C 20 LET:

Alternator. Refer to "Alternator" Section in this Volume.

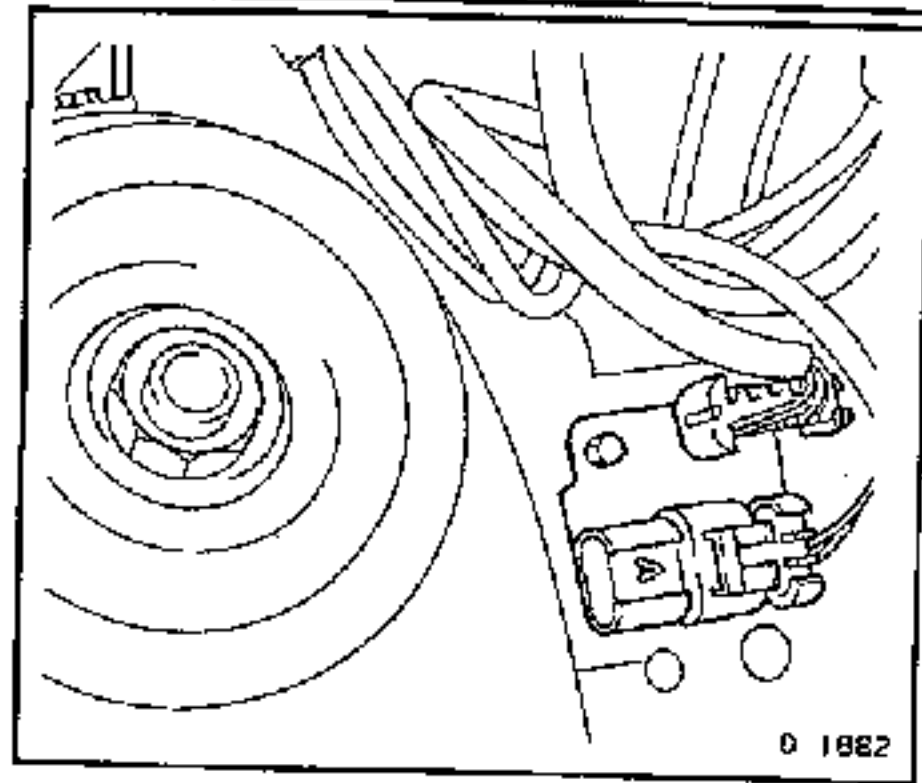
Ground cable to battery.

# DOHC ENGINE - MOTRONIC M 2.5

## Ignition Coding Plug (M 2.5)

### Important!

The coding plug must not be changed. The coding plug fitted, matches the ignition map in the control unit, to enable the vehicle to comply with various regulations such as noise and exhaust emissions.



## Fuel Pressure Regulator, Remove and Install (M 2.5, M 2.8)

### Important!

Be careful of fuel spillage, when fuel pressure is released. Refer (1) in illustration D 7636.

### Remove, Disconnect

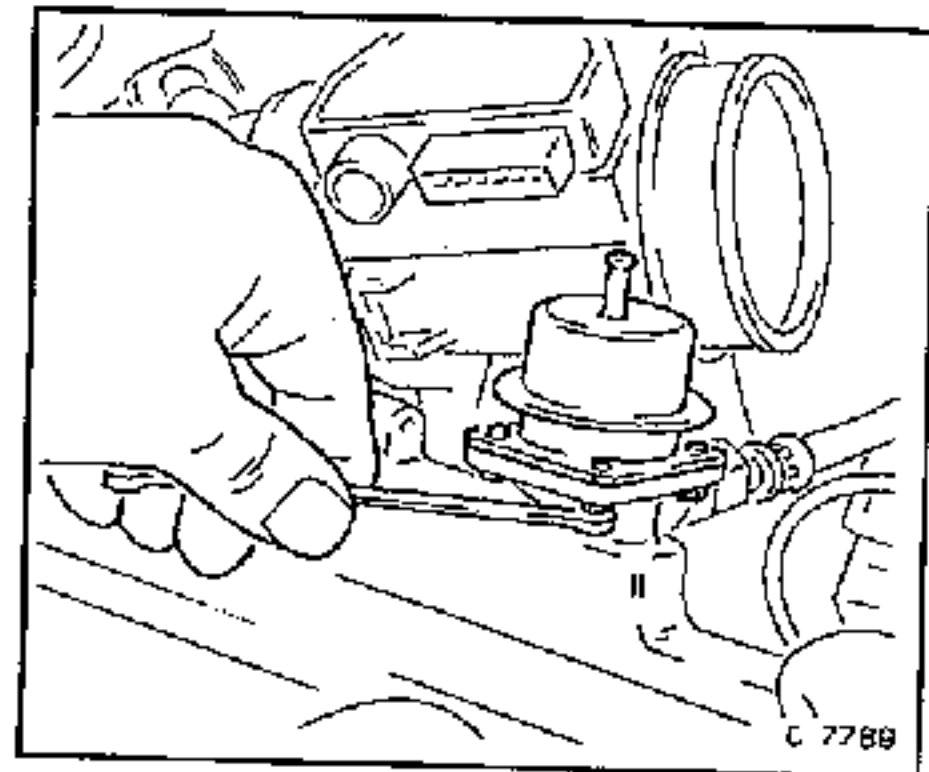
Pre-volume chamber. Refer to this operation later in this Section.

Wiring harness plugs from the throttle valve switch and hot wire mass air flow meter (M 2.5).

Wiring harness plugs from the throttle valve potentiometer and hot film mass air flow meter (M 2.8).

Vacuum hose from the fuel pressure regulator.

Fuel pressure regulator from the fuel distribution pipe.



### Install, Connect

Fuel pressure regulator.

### Tighten (Torque)

Fuel pressure regulator ..... 4 Nm

Fuel pressure regulator vacuum hose.

Wiring harness plugs to the throttle valve switch and hot wire mass air flow meter (M 2.5).

Wiring harness plugs to the throttle valve potentiometer and hot film mass air flow meter (M 2.8).

Pre-volume chamber. Refer to this operation later in this Section.

## Fuel Pressure, Check (M 2.5, M 2.8)

### Remove, Disconnect

Slowly open screw cap (1) to decrease the fuel pressure.

Fuel pressure regulator vacuum hose.

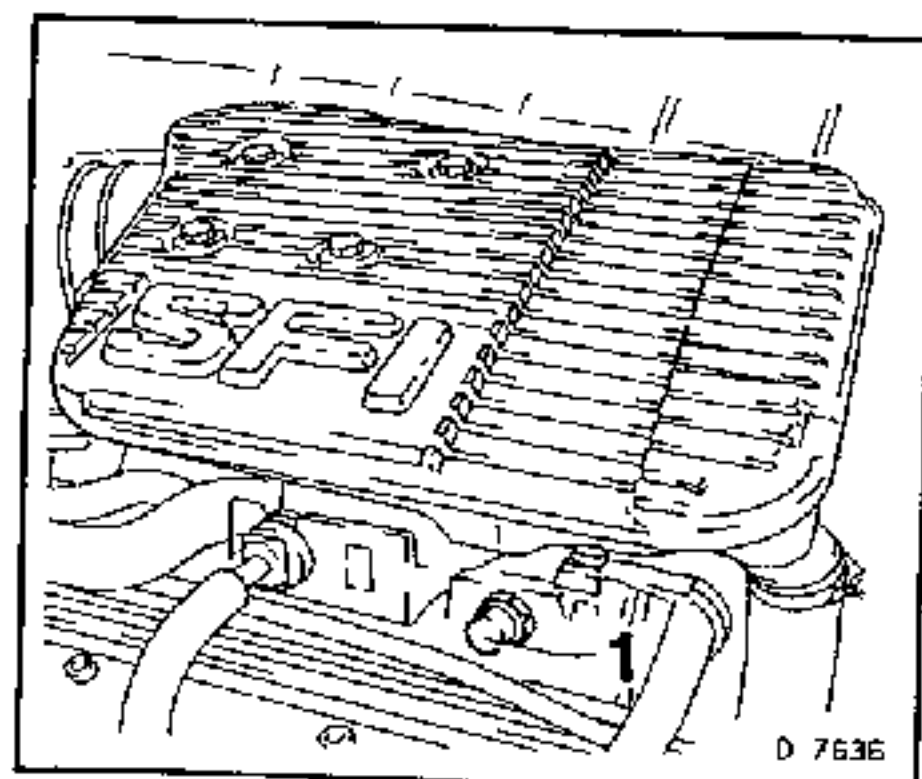
### Measure

Fuel pressure.

### Install, Connect

Fuel pressure gauge KM-J-34730-1 to the checking connection.

Bleed air from the fuel pressure gauge. Start the engine and run at idle speed.



# DOHC ENGINE - MOTRONIC M 2.5

## Specification:

### M 2.5:

With vacuum hose connected .....	200 - 220 kPa
With vacuum hose disconnected .....	230 - 270 kPa

### M 2.8:

With vacuum hose connected .....	220 - 270 kPa
With vacuum hose disconnected .....	300 - 350 kPa

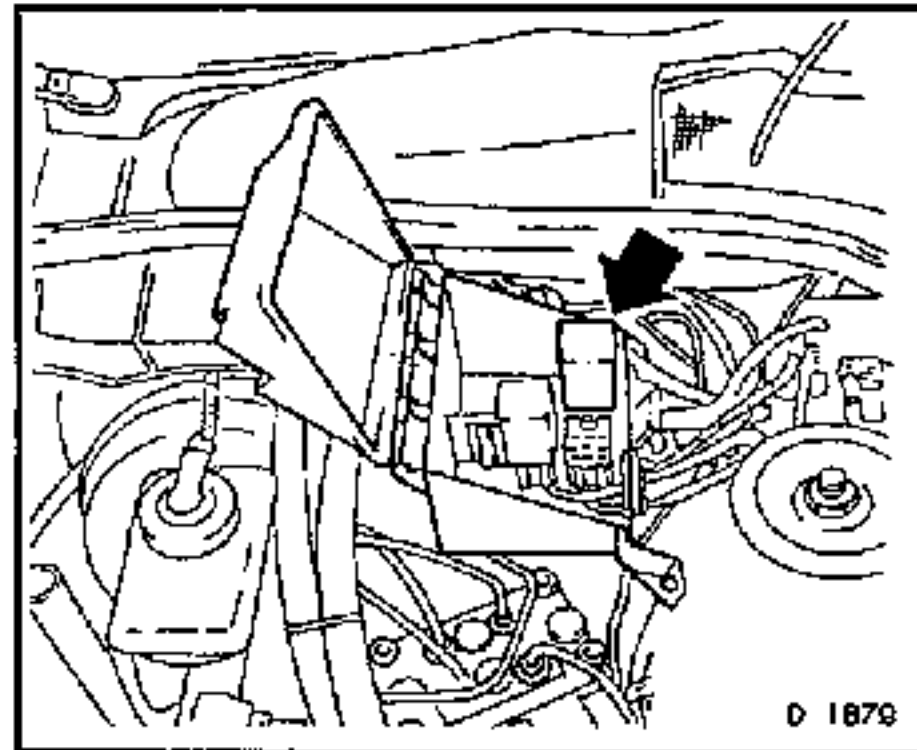
## Fuel Pump Relay, Remove and Install (M 2.5)

### Remove, Disconnect

Fuel pump relay from the relay socket (arrow).

### Install, Connect

Fuel pump relay to the relay socket (arrow).

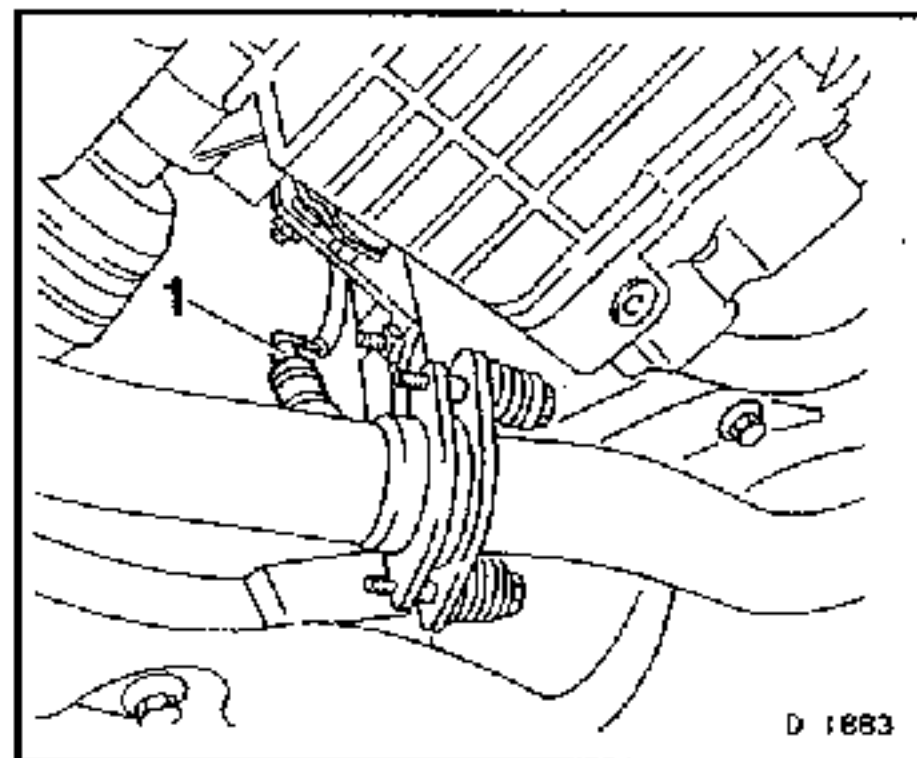


## Oxygen Sensor, Remove and Install (M 2.5, M 2.8)

### Remove, Disconnect

Oxygen sensor wiring harness plug.

Oxygen sensor (1) from the front exhaust pipe.



### Tighten (Torque)

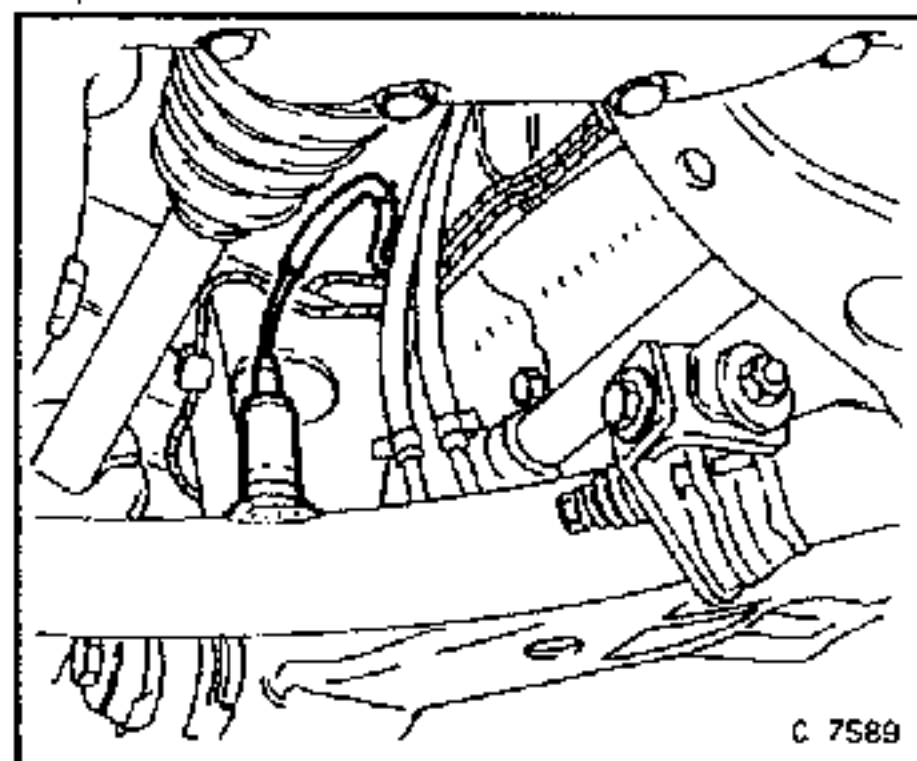
Oxygen sensor to exhaust pipe ..... 30 Nm

### Important!

If oxygen sensor is being re-used, apply special grease to the cleaned oxygen sensor threads. This grease, part number 5613695, is available from authorised Holden parts outlets.

### Install, Connect

Oxygen sensor wiring harness plug, checking that the routing of the wiring harness is correct.



# DOHC ENGINE - MOTRONIC M 2.5

## Idle Speed Adjuster, Remove and Install (M 2.5, M 2.8)

### Important!

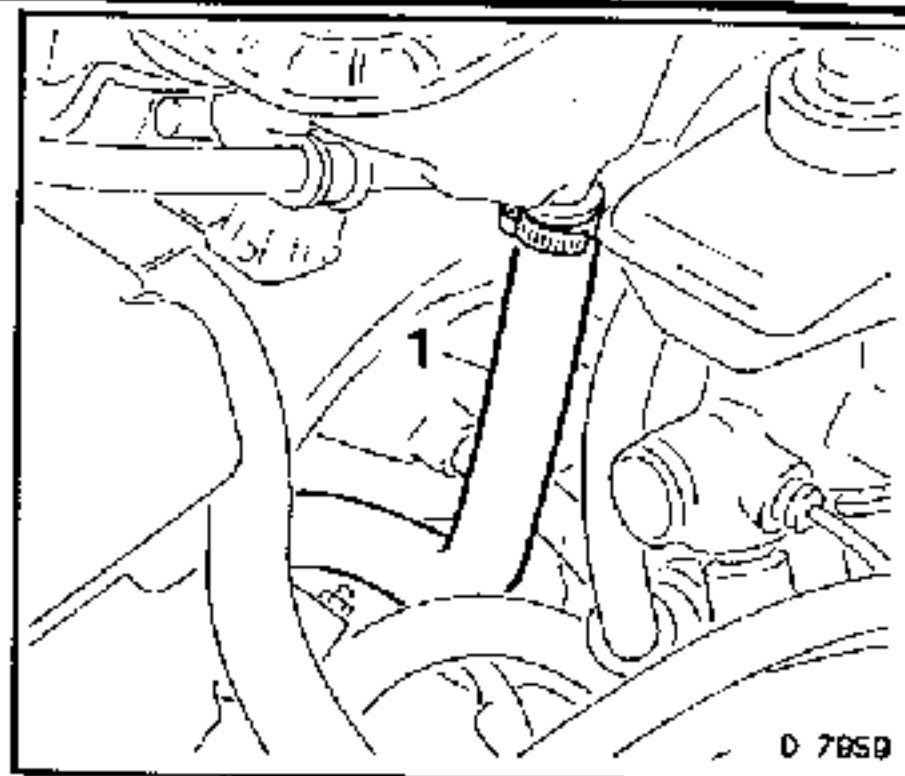
Mark hoses for correct installation.

### Remove, Disconnect

Ground cable from battery.

Hose (1) from pre-volume chamber.

The intake manifold to idle speed adjuster hose from the intake manifold.



### Remove, Disconnect

Wiring harness plug from the idle speed adjuster.

Idle speed adjuster with hoses still attached.

Hoses from the idle speed adjuster.

### Install, Connect

Hoses to the idle speed adjuster.

Idle speed adjuster with hoses attached.

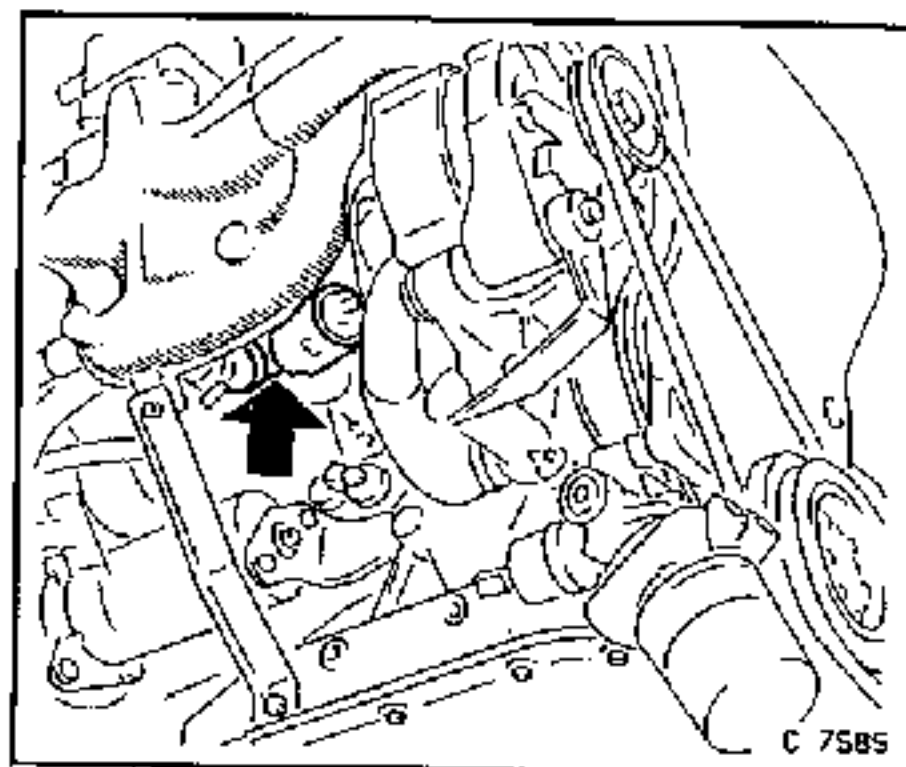
Hoses to pre-volume chamber and to intake manifold.

Wiring harness plug to idle speed adjuster.

Ground cable to battery.

### Important!

Ensure that all hoses are air tight and correctly routed.



## Control Unit, Remove and Install (M 2.5)

### Remove, Disconnect

Switch off ignition.

Unclip right footwell cover, after removing the right hand door sill panel.

Control unit.

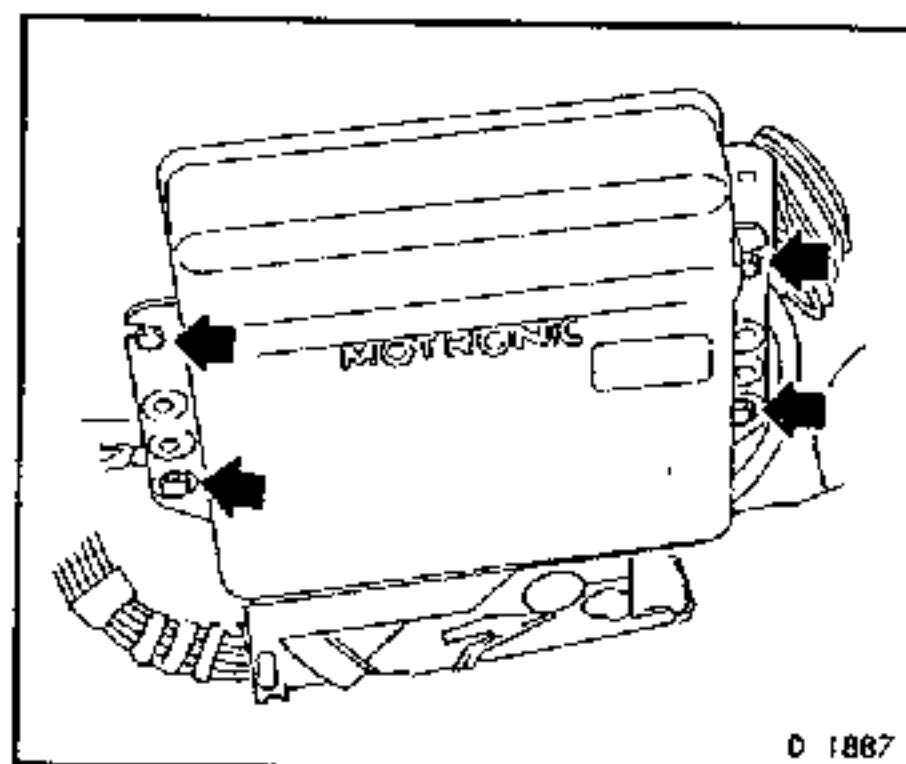
Control unit wiring harness plug.

### Install, Connect

Control unit wiring harness plug.

Control unit.

Footwell cover, and right hand door sill panel.



## Controlled Canister Purge Valve, Remove and Install (M 2.5)

### Remove, Disconnect

Wiring harness plug (1) from controlled canister purge valve.

Hoses (2) from controlled canister purge valve. Close off hose to carbon canister with a suitable clamp.

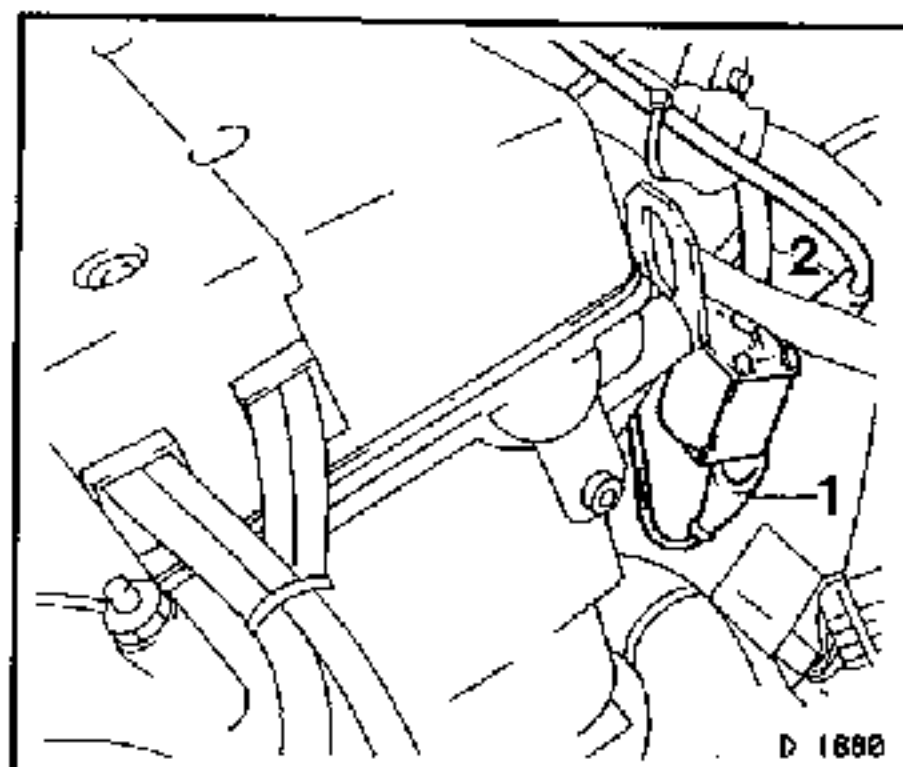
Controlled canister purge valve.

### Install, Connect

Controlled canister purge valve.

Hoses (2). Remove clamp.

Wiring harness plug (1) to controlled canister purge valve.



# DOHC ENGINE - MOTRONIC M 2.5

## Coolant Temperature Sensor, Remove and Install (M 2.5, M 2.8)

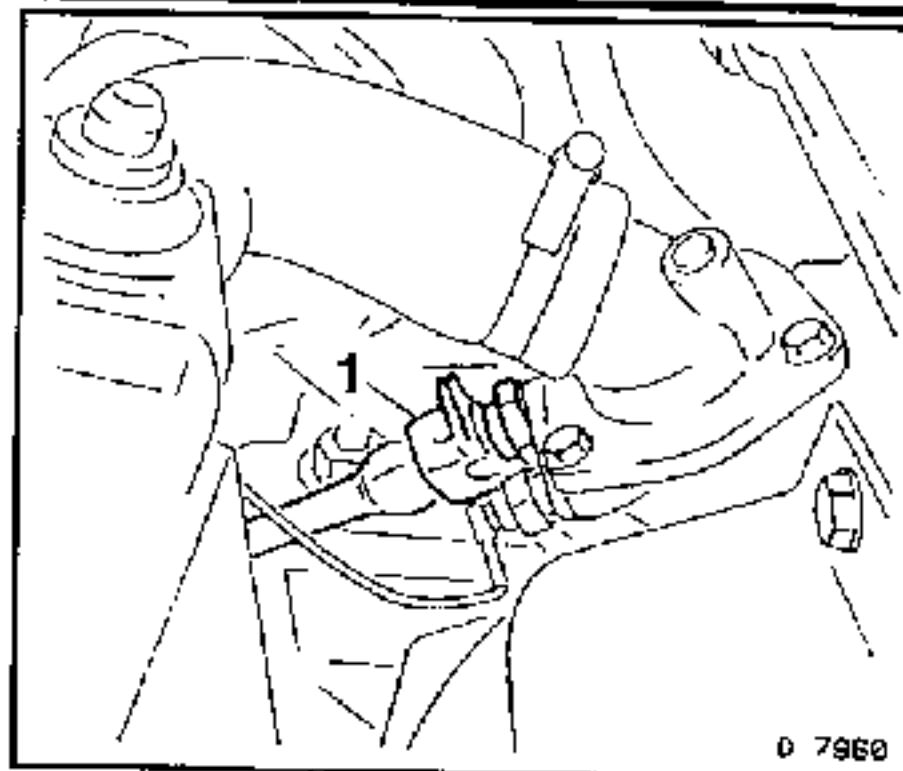
### Important!

Use a suitable clean container to catch spilled coolant.

### Remove, Disconnect

Wiring harness plug (1) from the coolant temperature sensor,

Coolant temperature sensor from the thermostat housing.



### Install, Connect

Coolant temperature sensor to the thermostat housing, using a new seal.

### Tighten (Torque)

Coolant temperature sensor..... 11Nm

### Important!

Top up and bleed cooling system. Refer to "Cooling System", in this Volume.

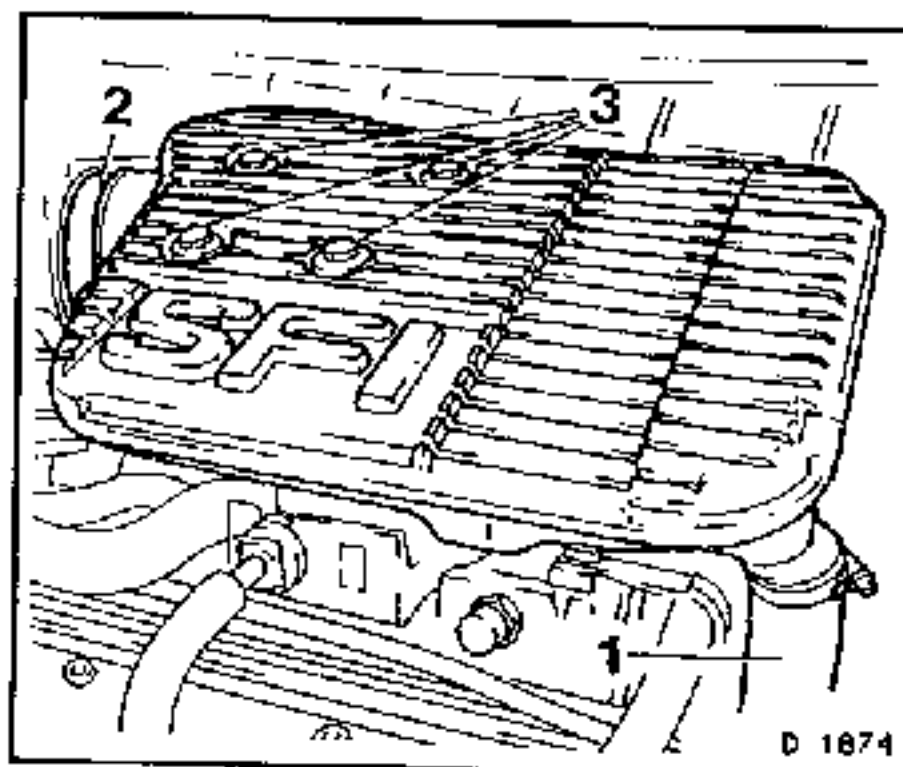
## Pre-Volume Chamber, Remove and Install (M 2.5, M 2.8)

### Remove, Disconnect

Hose (1), hose clamp (2).

Bolts (3).

Pre-volume chamber. Note seal ring.



### Important!

Apply a contact cement such as Permatex MA1 or equivalent to 4 - 6 points in the seal seat, before installation.

### Install, Connect

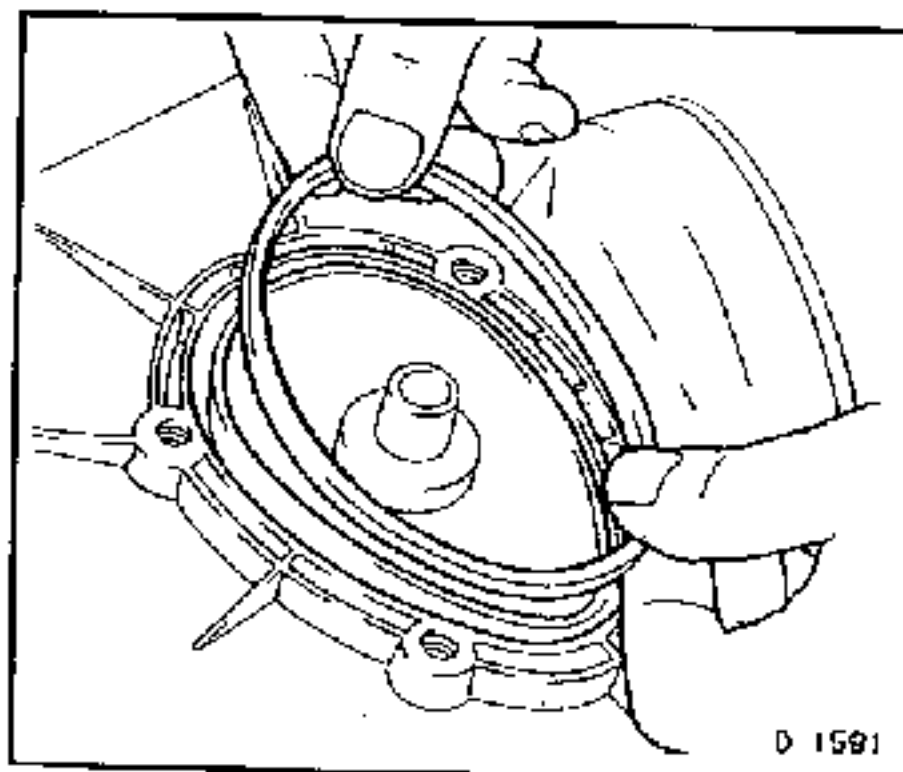
A new seal ring, ensuring that it seats correctly.

Pre-volume chamber.

Hose clamp (2, in D 1874).

Bolts (3, in D 1874).

Hose (1, in D 1874).



# DOHC ENGINE - MOTRONIC M 2.5

## Ignition Coil, Remove and Install (M 2.5)

### Remove, Disconnect

Ignition switched off.

Cable connections from ignition coil.

Wiring harness plug from the ignition control unit.

Bolts (1).

Ignition coil with ignition control unit.

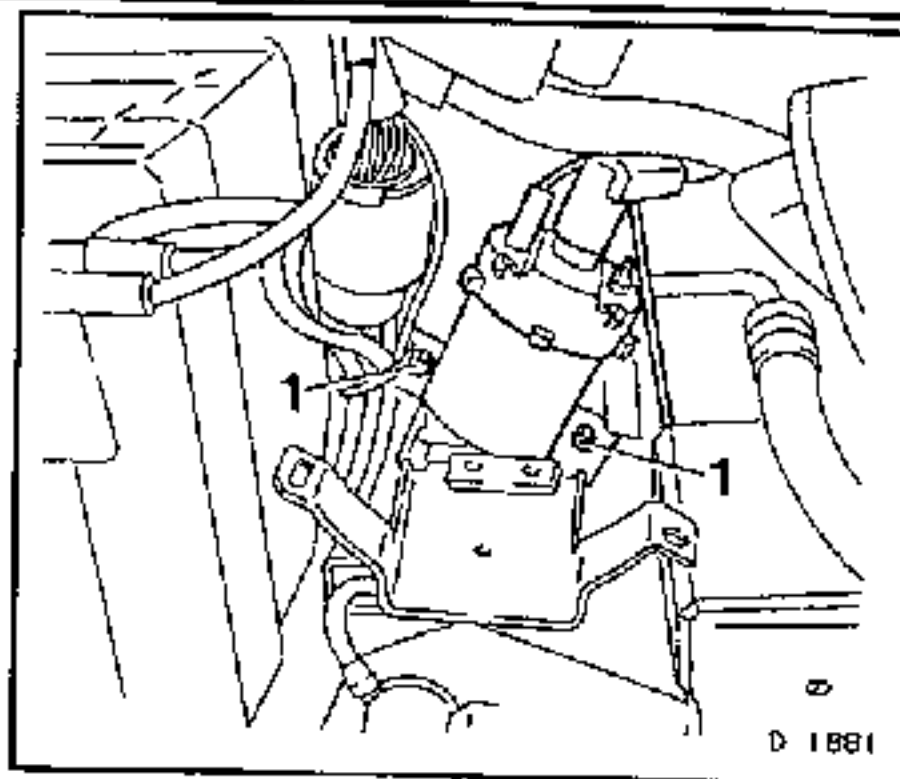
### Install, Connect

Ignition coil with ignition control unit.

Bolts (1).

Cable connections to ignition coil.

Wiring harness plug to the ignition control unit.



## RECOMMENDED TORQUE VALUES

(Motronic M 2.5)

	Nm
Bowden cable bracket .....	8
Coolant temperature sensor .....	11
Fuel pressure regulator.....	4
Injector plug strip .....	8
Knock sensor .....	20
Oxygen sensor to exhaust pipe .....	30 (1)
Pulse pick-up retaining bolt.....	6
High voltage distributor clamp bolt .....	15

(1) If re-using, apply Special Grease, Part Number 5613695 to the cleaned oxygen sensor threads.



# GROUP J

## DOUBLE OVERHEAD CAM ENGINE

### MOTRONIC M 2.7 (C 20 LET)

#### TABLE OF CONTENTS

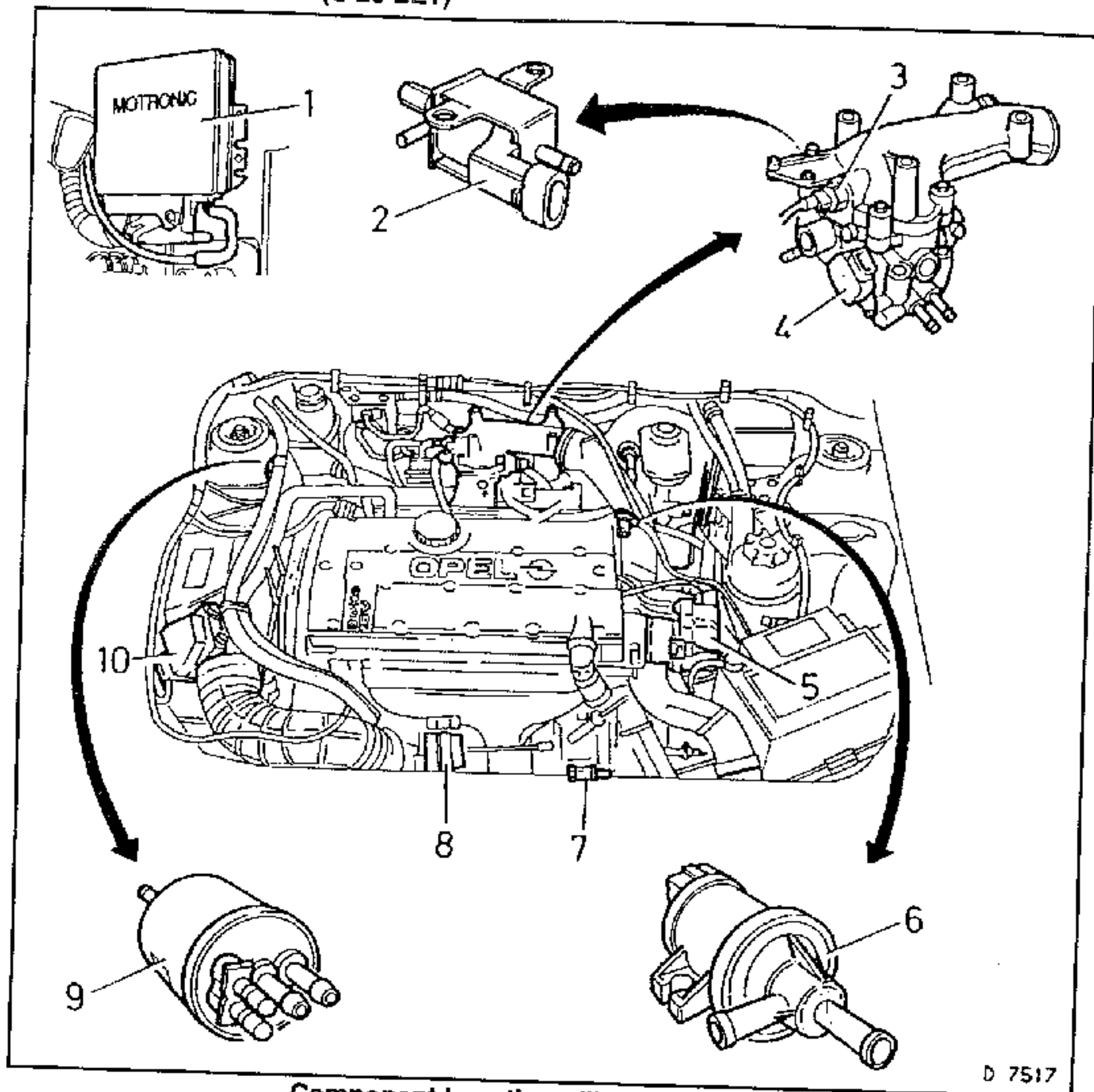
	PAGE
General Arrangement Illustrations .....	J - 666
Throttle Body, Remove and Install .....	J - 669
Throttle Valve Potentiometer, Remove and Install .....	J - 672
Injectors, Remove and Install .....	J - 673
Hot Start Valve, Remove and Install .....	J - 675
Hot Wire Mass Air Flow Meter, Remove and Install .....	J - 675
Inductive Pulse Pick-up, Remove and Install .....	J - 676
Fuel Pressure Regulator, Remove and Install .....	J - 677
Fuel Pressure, Check .....	J - 678
Fuel Pump Relay, Remove and Install .....	J - 678
Oxygen Sensor, Remove and Install .....	J - 679
Switch for 1st Gear Recognition, Replace *	
Idle Speed Adjuster, Remove and Install .....	J - 679
Control Unit, Remove and Install .....	J - 680
Controlled Canister Purge Valve, Remove and Install .....	J - 680
Intake Air Temperature Sensor, Remove and Install .....	J - 680
Coolant Temperature Sensor, Remove and Install .....	J - 681
Charge Control Switchover Valve, Remove and Install .....	J - 681
Ignition Coil, Remove and Install .....	J - 682
Recommended Torque Values .....	J - 682
Checking Procedures, Using TECH 1 .....	J - 683

- \* For service procedures on this item, refer to Section K - "OPERATIONS ON MANUAL TRANSMISSION AND DIFFERENTIAL" in "CLUTCH AND TRANSMISSION", Volume 4 of these Service Instructions



# DOHC ENGINE - MOTRONIC M 2.7

## MOTRONIC M 2.7 (C 20 LET)



D 7517

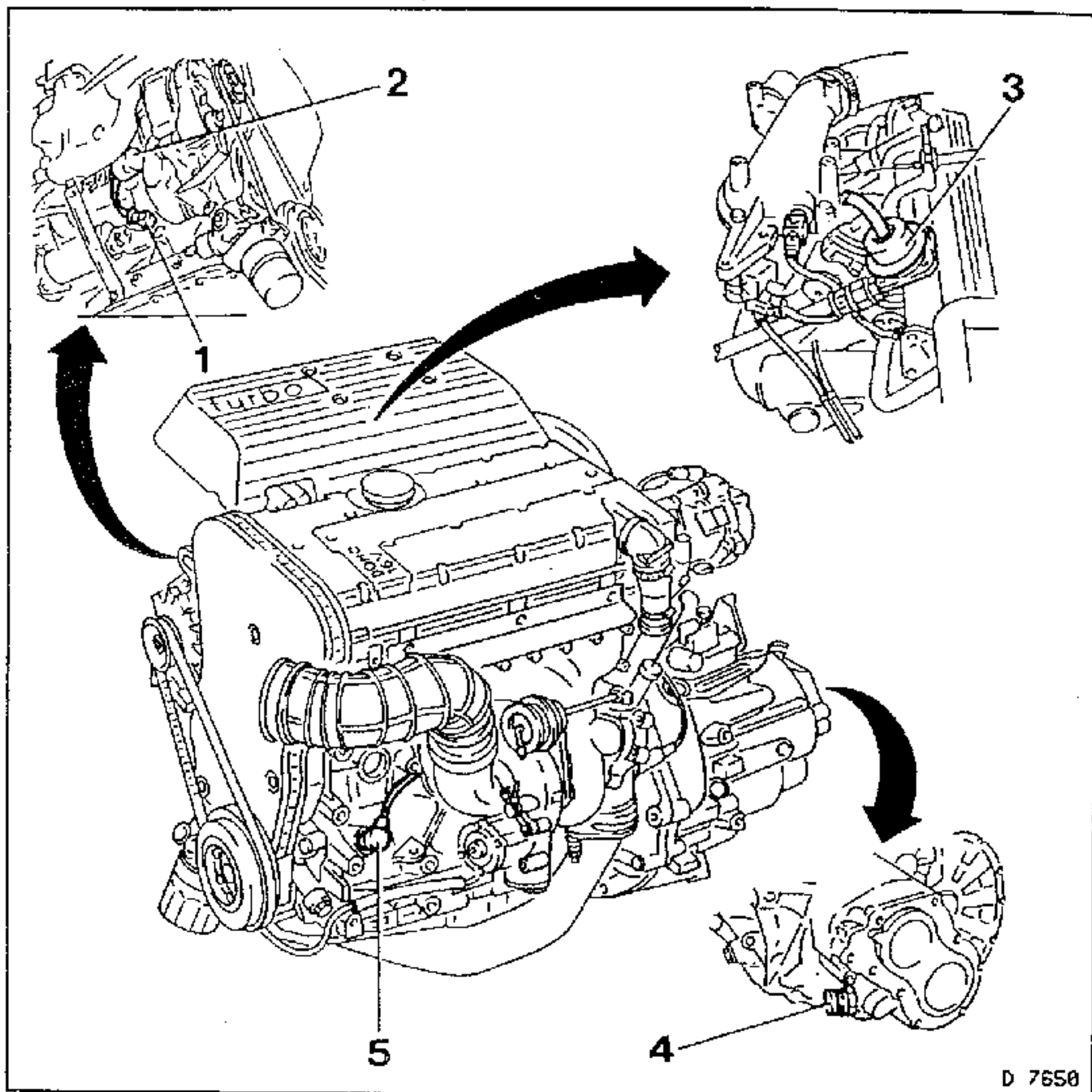
Component Location - Illustration No. 1

### Illustration Key:

1. Control Unit (Location; Right Footwell)
2. Hot Start Valve
3. Intake Air Temperature Sensor
4. Throttle Valve Potentiometer
5. High Voltage Distributor with Hall Sensor
6. Controlled Canister Purge Valve
7. Oxygen Sensor
8. Charge Pressure Regulating Valve Control Unit
9. Charge Pressure Control Switchover Valve
10. Hot Wire Mass Air Flow Sensor

# DOHC ENGINE - MOTRONIC M 2.7

MOTRONIC M 2.7 (C 20 LET)



D 7650

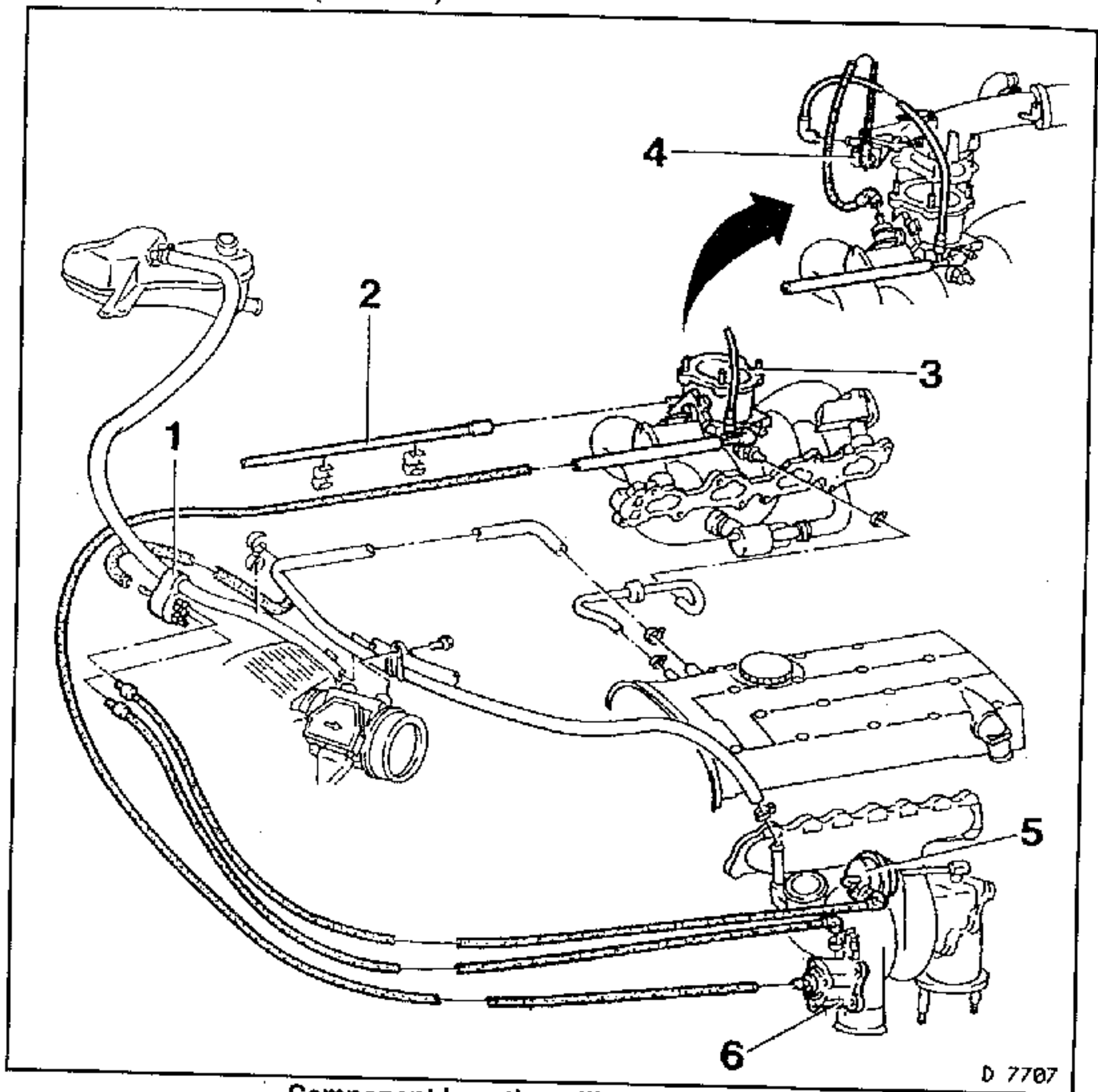
Component Location - Illustration No. 2

**Illustration Key:**

1. Knock Sensor
2. Idle Speed Adjuster
3. Fuel Pressure Regulator
4. Switch - 1st Gear Recognition
5. Inductive Pulse Pick-Up

# DOHC ENGINE - MOTRONIC M 2.7

MOTRONIC M 2.7 (C 20 LET)



Component Location - Illustration No. 3

**Illustration Key:**

1. Charge Pressure Control Switchover Valve
2. Connection to Motronic Control Unit M 2.7
3. Throttle Body
4. Hot Start Valve
5. Charge Pressure Regulating Valve Control Unit
6. Air Bypass Valve

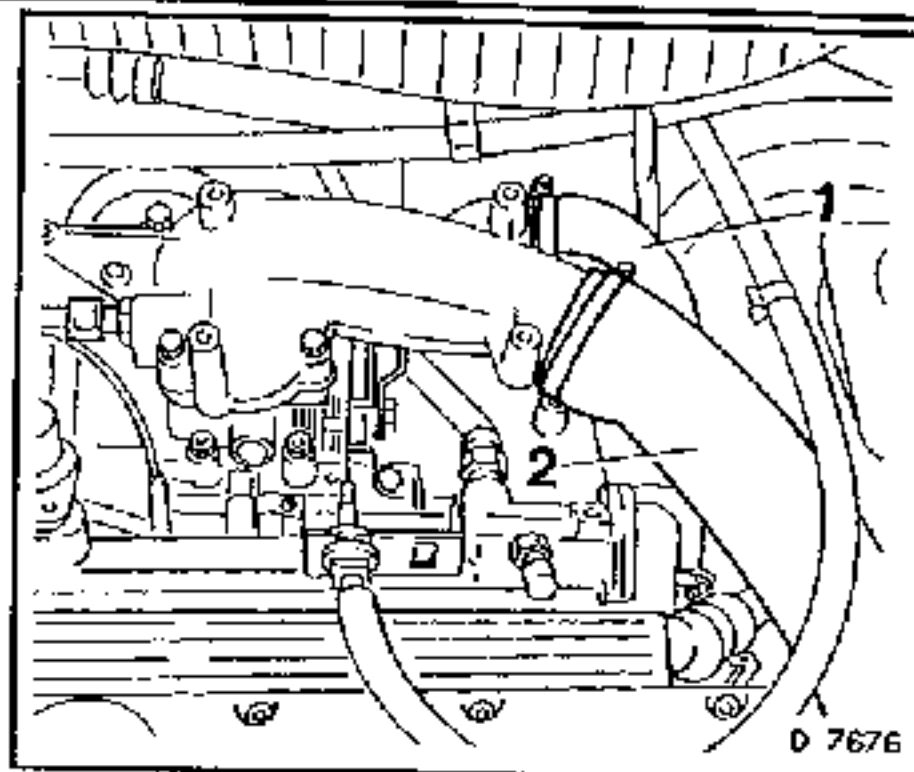
# DOHC ENGINE - MOTRONIC M 2.7

## Throttle Body, Remove and Install

### Remove, Disconnect

Throttle body manifold cover.

Hose (1 and 2) from the throttle valve manifold.

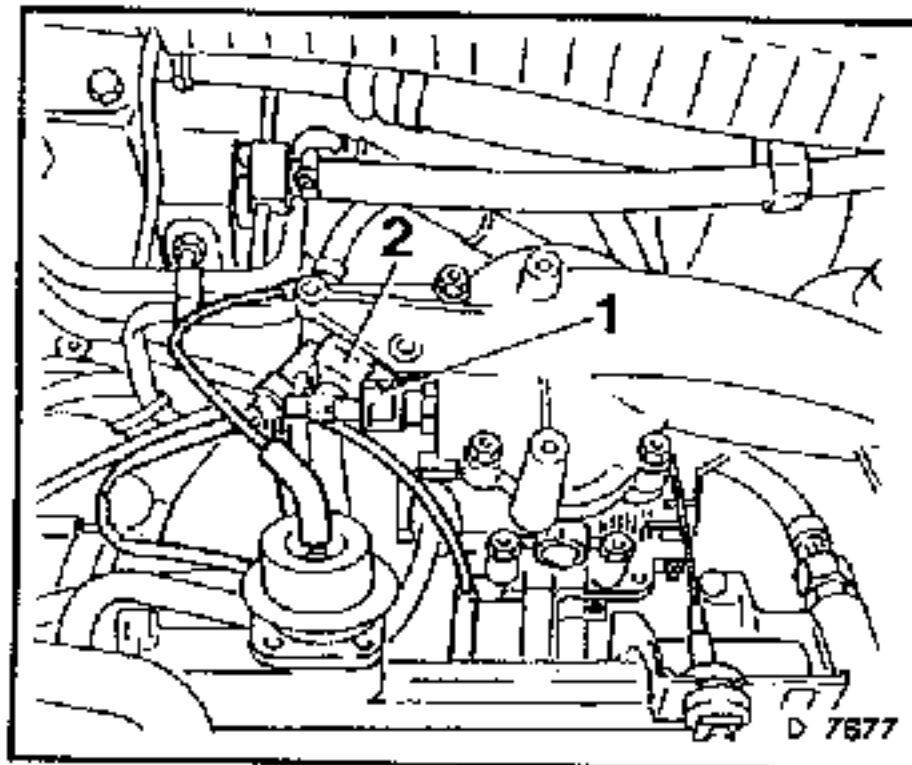


### Remove, Disconnect

Label vacuum hoses.

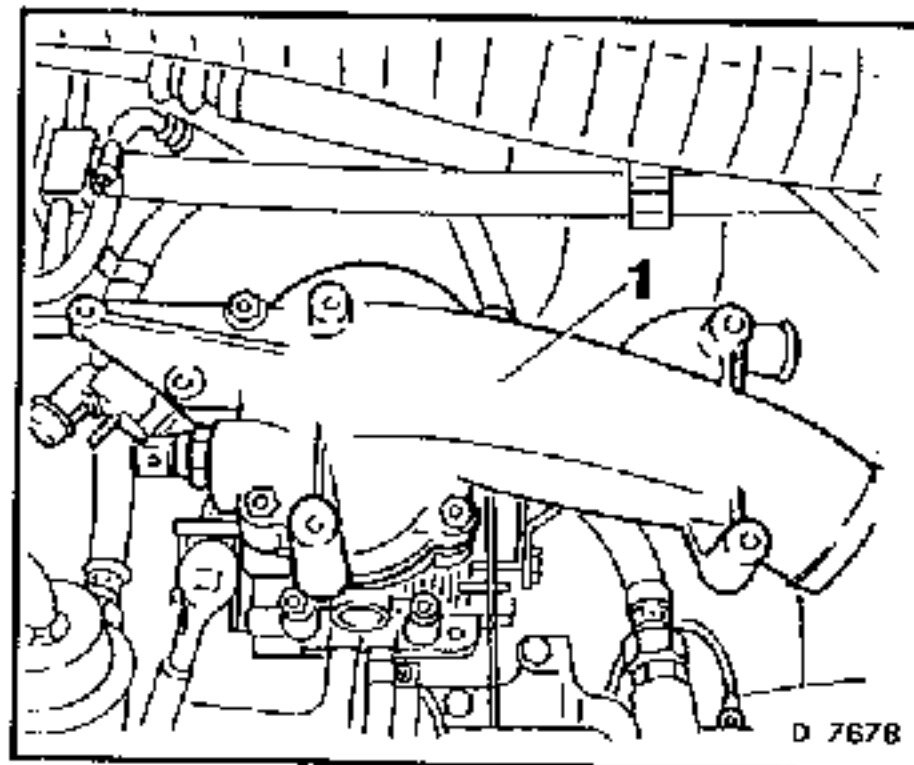
Wiring harness plug (1) from intake air temperature sensor.

Wiring harness plug and vacuum hoses from the hot start valve (2).



### Remove, Disconnect

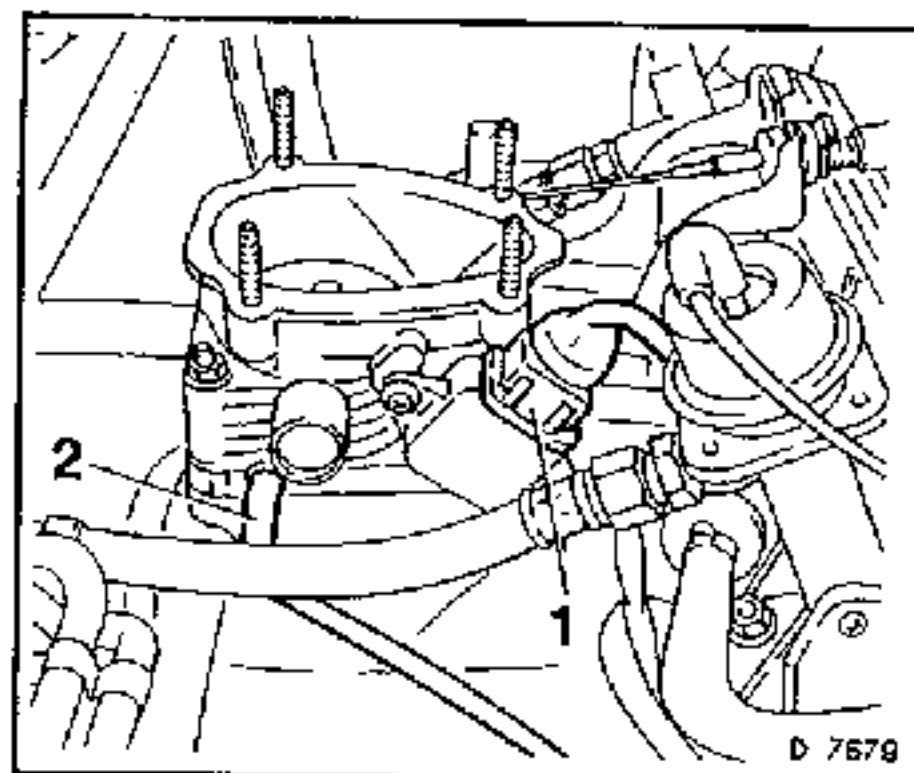
Throttle valve manifold (1) with gasket.



### Remove, Disconnect

Wiring harness plug (1) from throttle valve potentiometer.

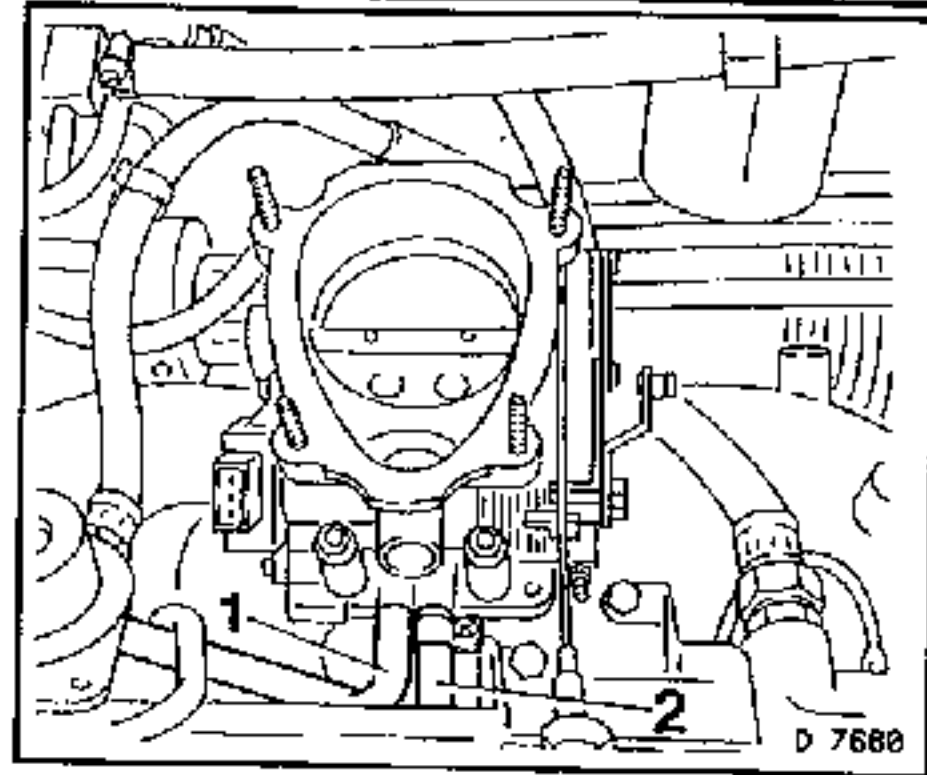
Pressure/vacuum hose (2) from throttle body.



# DOHC ENGINE - MOTRONIC M 2.7

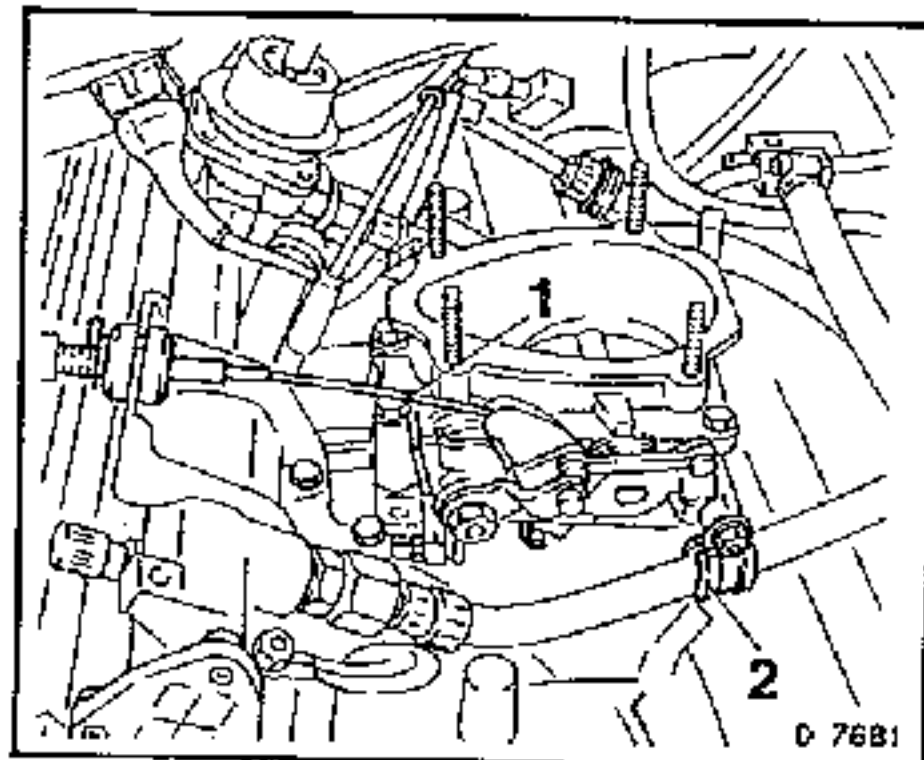
## Remove, Disconnect

Pressure/vacuum hoses (1 and 2) from throttle body.  
Throttle body.



## Remove, Disconnect

Bowden cable (1).  
Fuel line bracket (2).

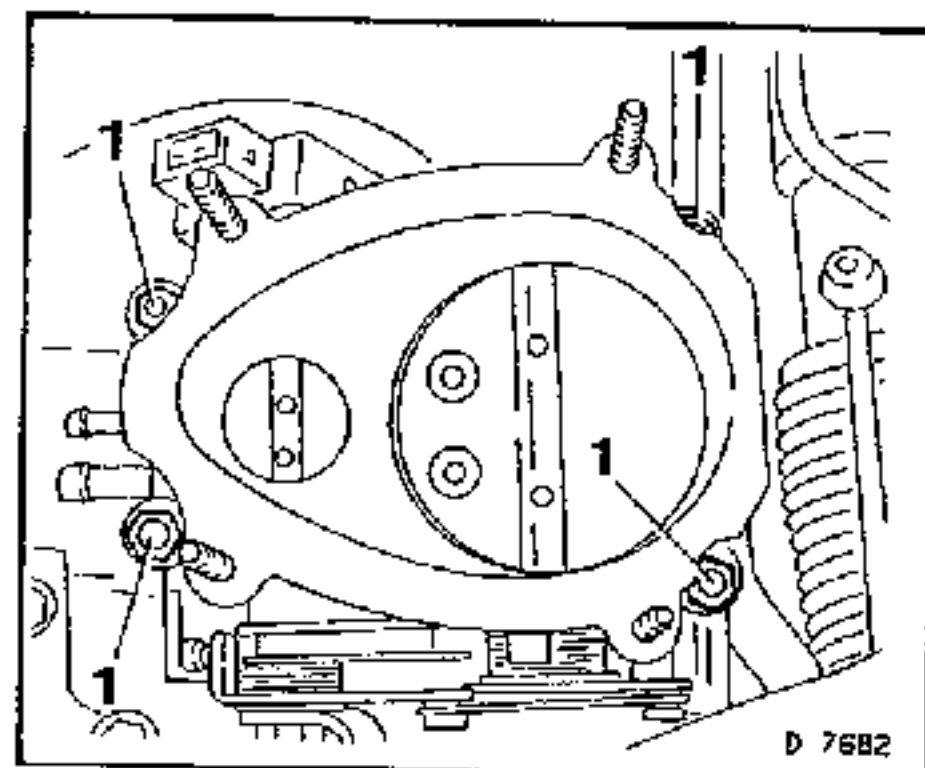


## Remove, Disconnect

Nuts (1) from throttle body.  
Throttle body with gasket.

## Clean

Sealing surfaces of throttle body and intake manifold.  
Ensure the utmost cleanliness.

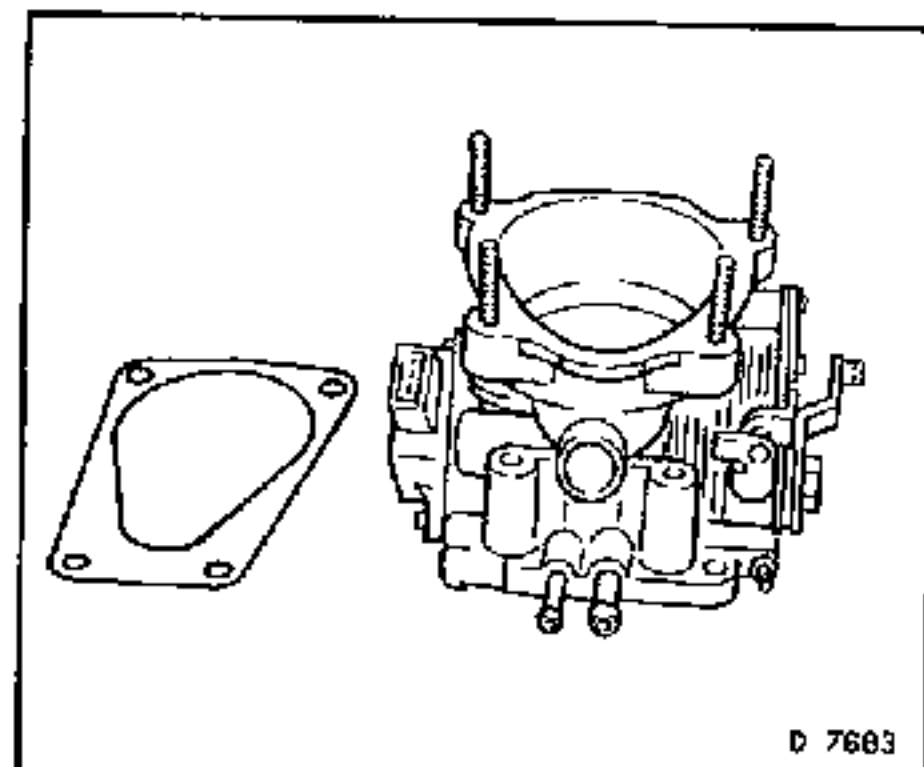


## Install, Connect

Throttle body with new gasket.

## Tighten (Torque)

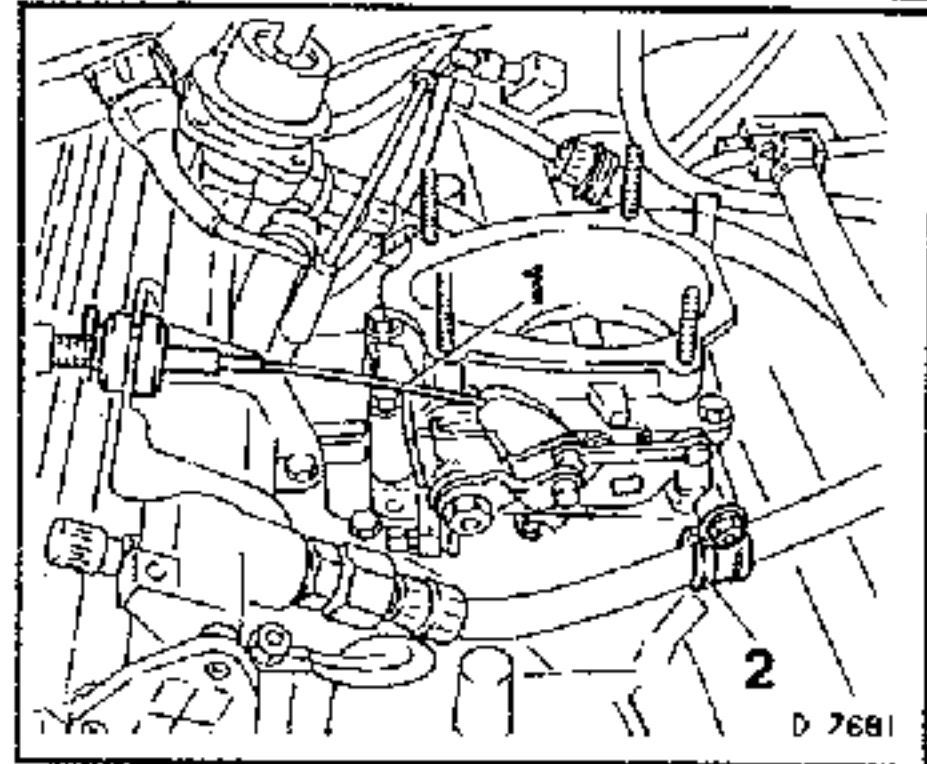
Throttle body to intake manifold..... 9 Nm



# DOHC ENGINE - MOTRONIC M 2.7

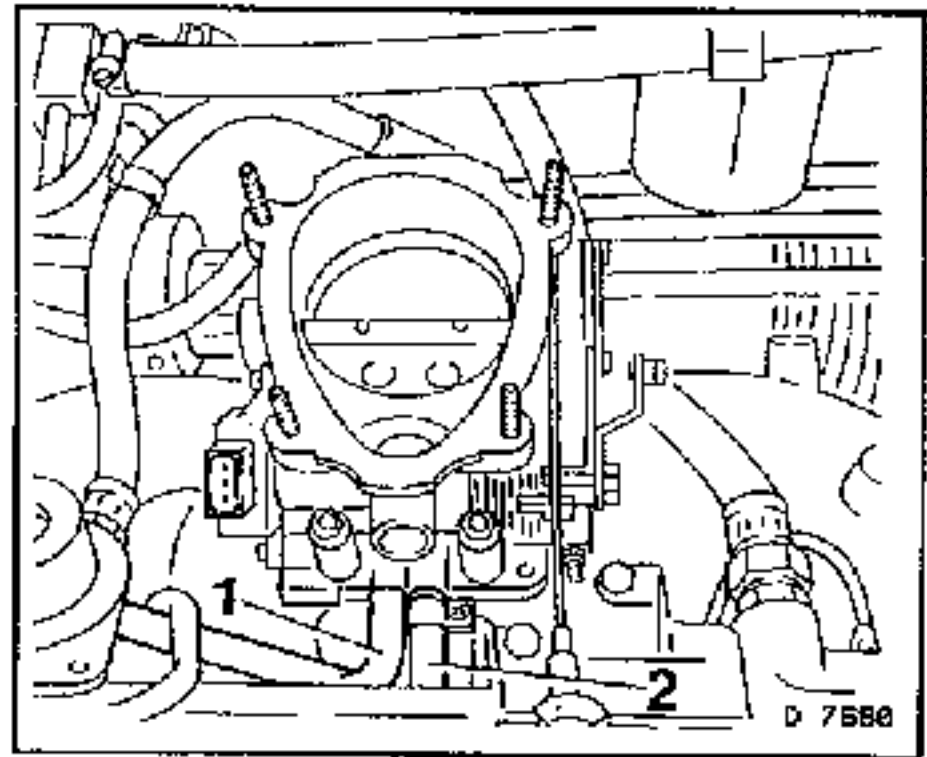
## Install, Connect

Bowden cable (1).  
Fuel line bracket (2).



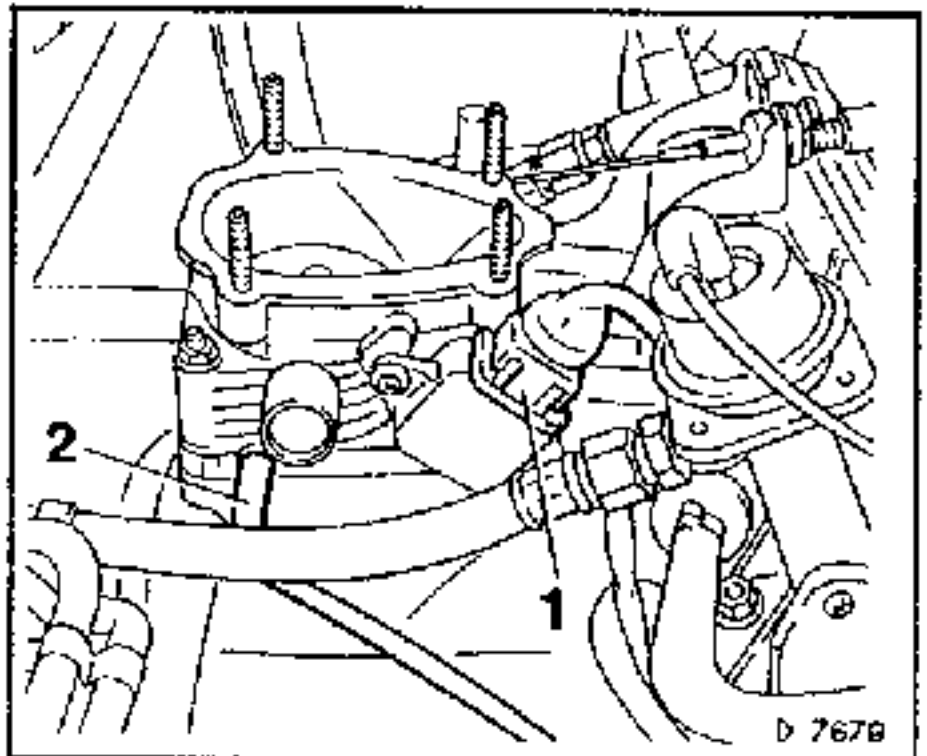
## Install, Connect

Pressure/vacuum hoses (1 and 2) to throttle body.



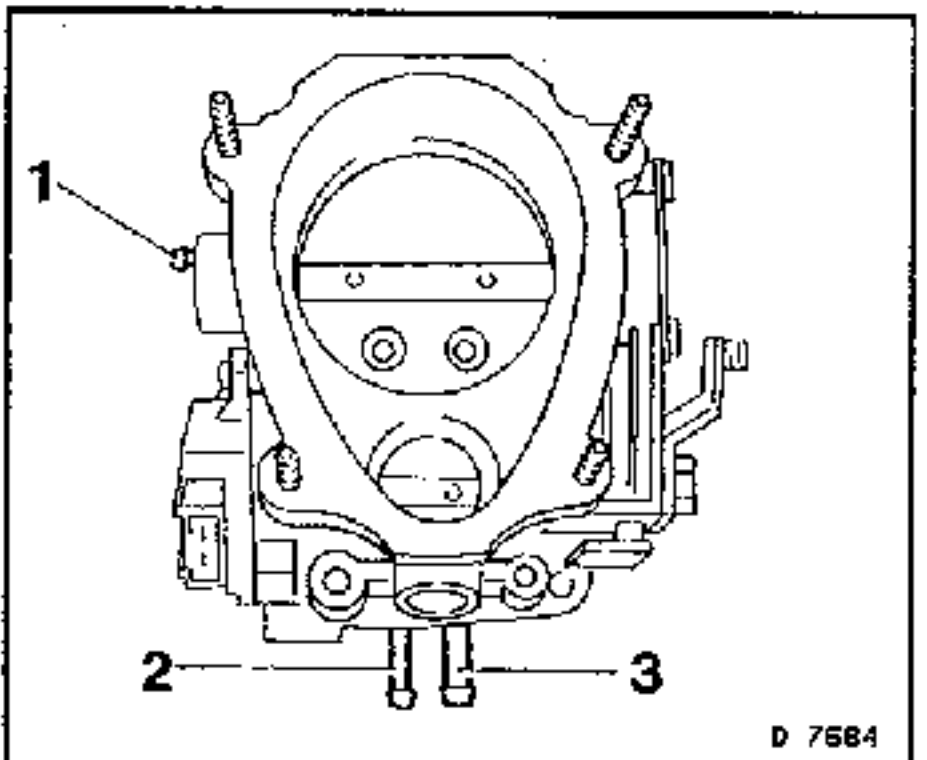
## Install, Connect

Wiring harness plug (1) to throttle valve potentiometer.  
Pressure/vacuum hose (2) to throttle body.



## Install, Connect

Throttle body connections;  
1 = Connection to Motronic control unit M 2.7.  
2 = Connection to branch piece.  
3 = Connection to controlled canister purge valve.



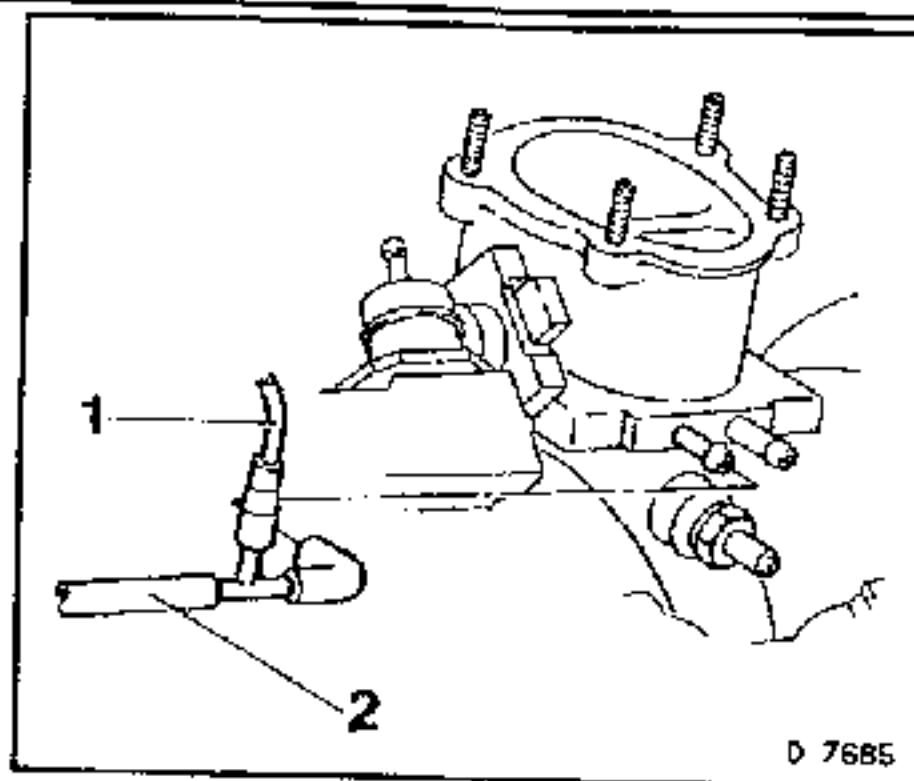
# DOHC ENGINE - MOTRONIC M 2.7

## Install, Connect

Branch piece connections;

1 = Connection to hot start valve.

2 = Connection to air bypass valve and turbocharger.

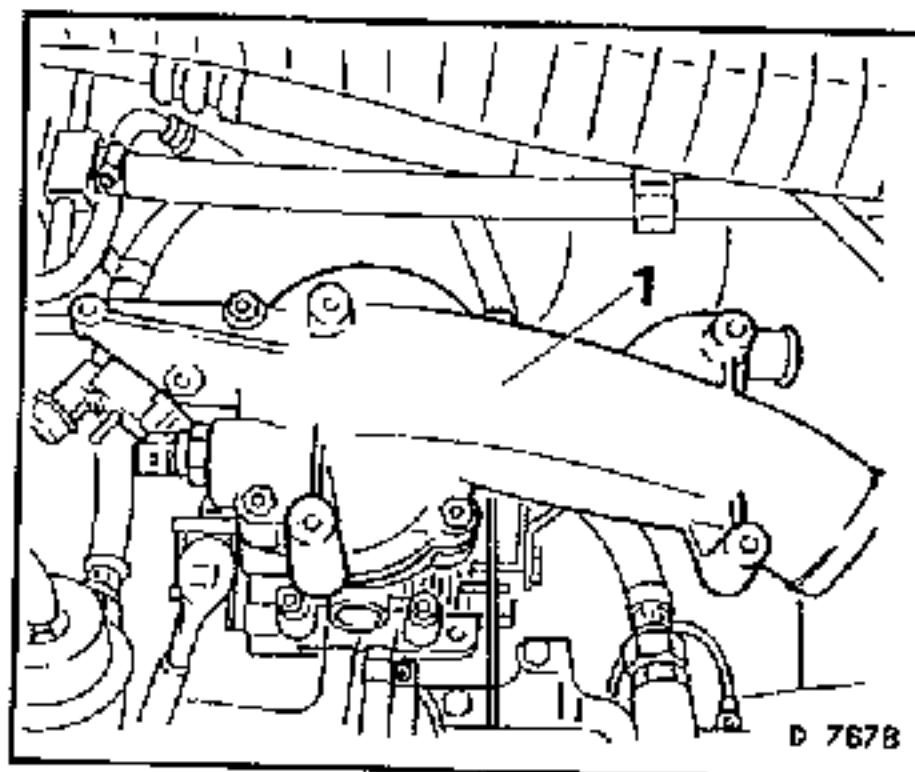


## Install, Connect

Throttle valve manifold, using a new gasket.

## Tighten (Torque)

Throttle valve manifold to throttle body .. 8 Nm



## Install, Connect

Pressure/vacuum hose to branch piece.

Vacuum hose and wiring harness plug to hot start valve (2).

Wiring harness plug (1) to intake air temperature sensor.

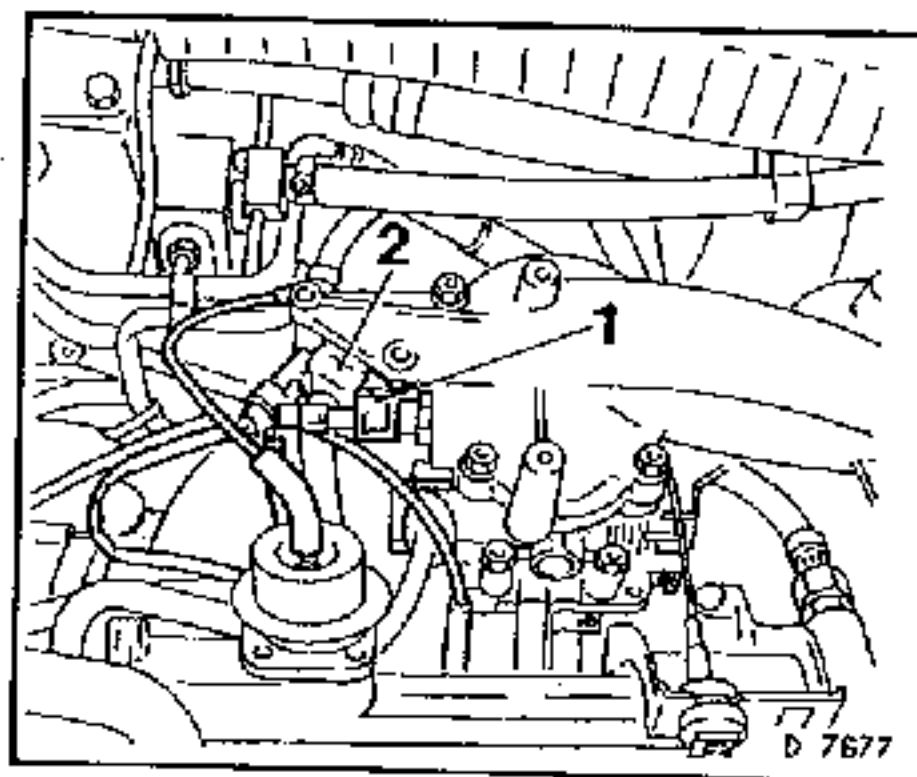
Hose for idle speed adjuster.

Hose for charge air cooler to throttle valve manifold.

Throttle valve manifold cover.

## Tighten (Torque)

Throttle valve manifold cover..... 5 Nm.



## Throttle Valve Potentiometer, Remove and Install

### Note:

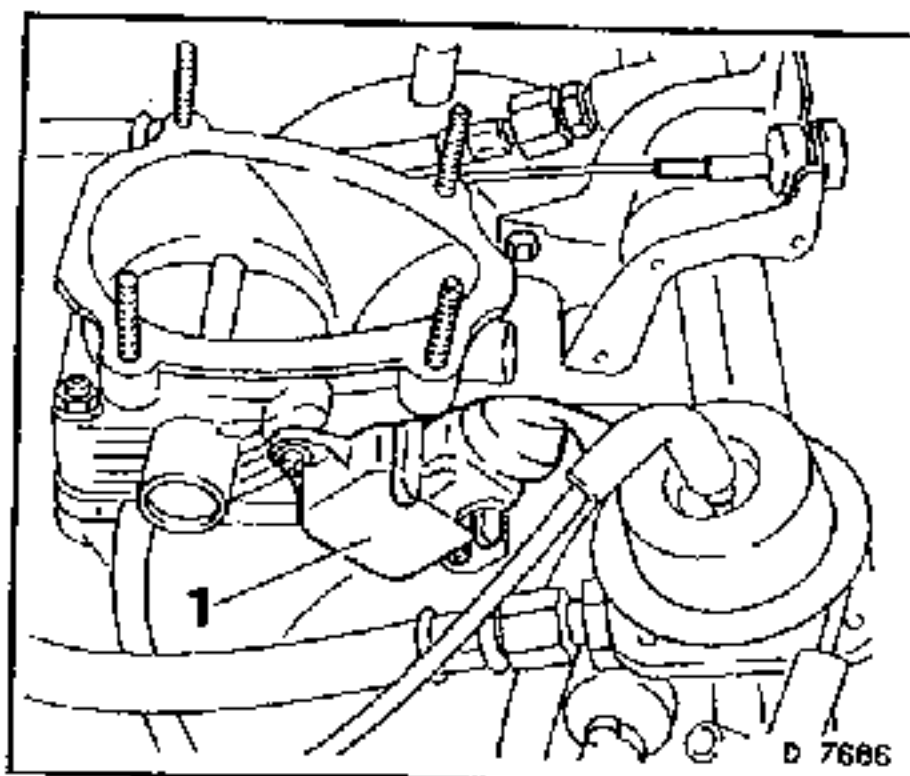
For a more clear view, illustration D 7686 shows the throttle valve potentiometer with the throttle valve manifold removed.

### Remove, Disconnect

Throttle valve manifold cover.

Wiring harness plug to throttle valve potentiometer.

Throttle valve potentiometer (1).





# DOHC ENGINE - MOTRONIC M 2.7

## Install, Connect

Throttle valve potentiometer (1).

Wiring harness plug to throttle valve potentiometer.

Throttle valve manifold cover.

## Tighten (Torque)

Throttle valve manifold to throttle body ... 5 Nm

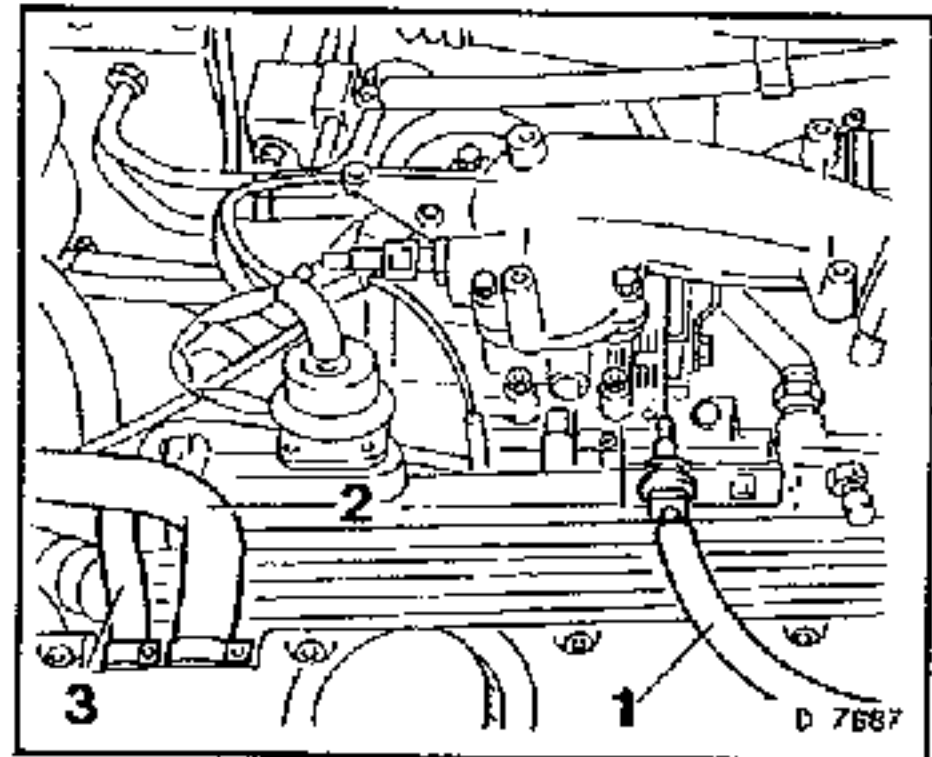
## Injectors, Remove and Install

### Remove, Disconnect

Throttle valve manifold cover.

Bowden cable (1).

Crankcase ventilation hoses (2 and 3).

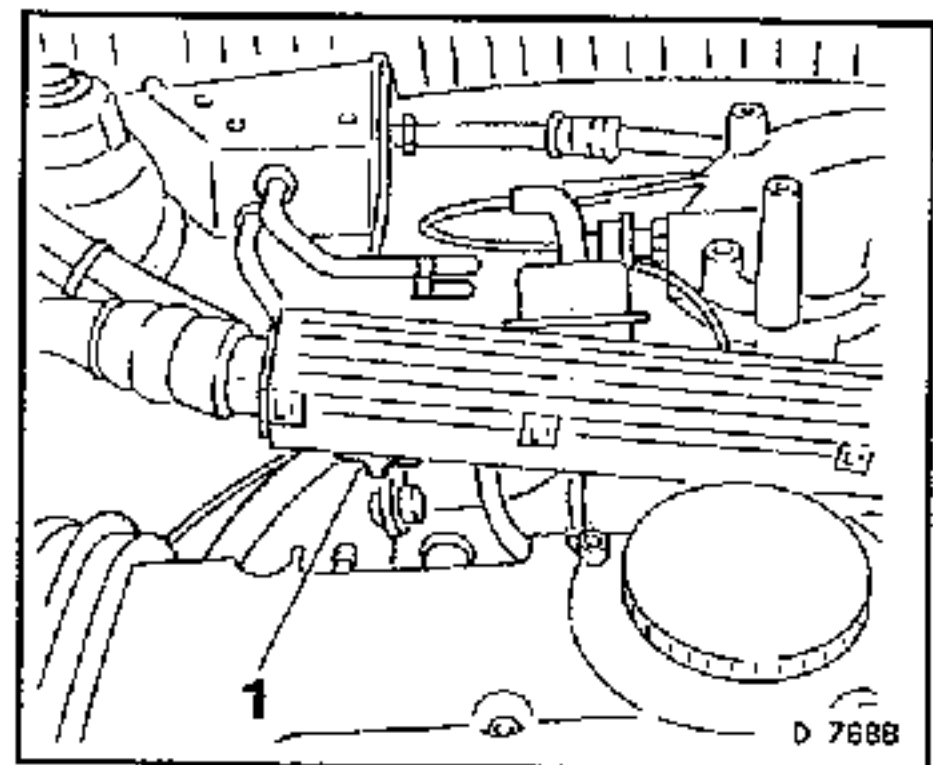


### Remove, Disconnect

No. 1 cylinder injector retaining clip (1) from the plug strip.

Remove plug strip.

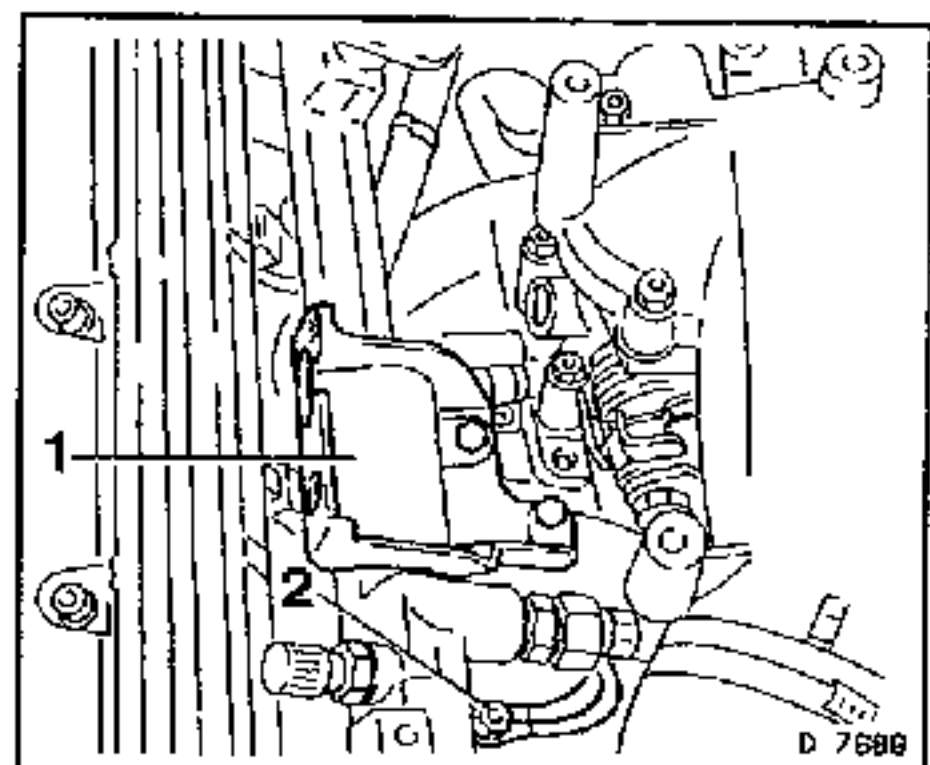
Insert retaining clamp (1) in plug strip.



### Remove, Disconnect

Bowden cable bracket (1).

Ground cable (2).

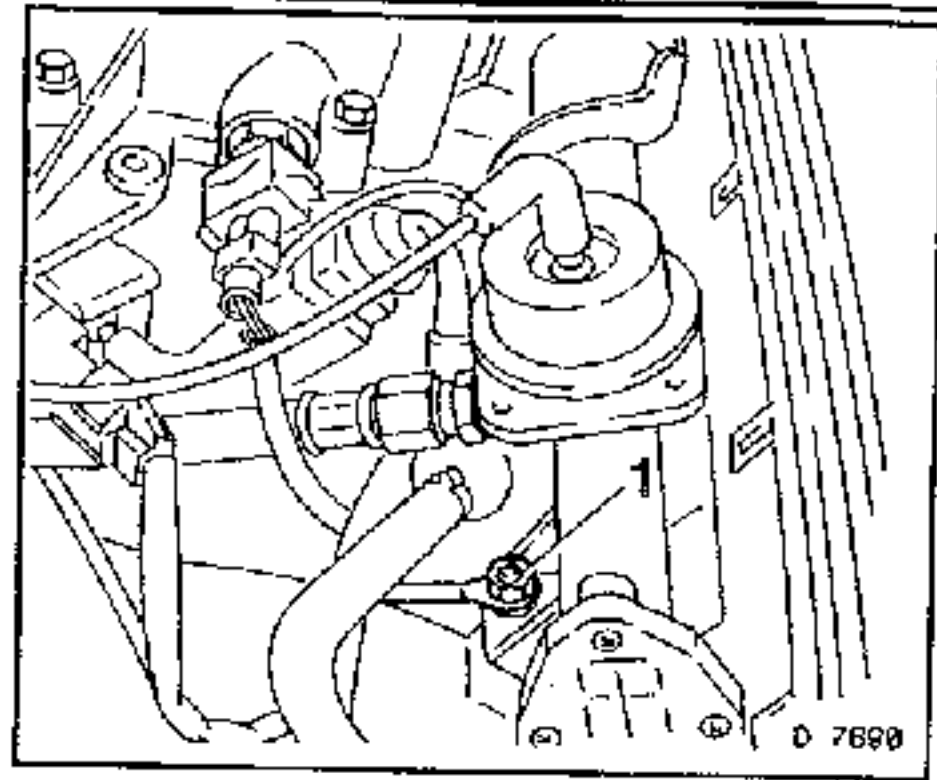




# DOHC ENGINE - MOTRONIC M 2.7

## Remove, Disconnect

Ground cable (1).



## Remove, Disconnect

Fuel distributor pipe.

Fuel distributor pipe, with injectors, from the intake manifold.

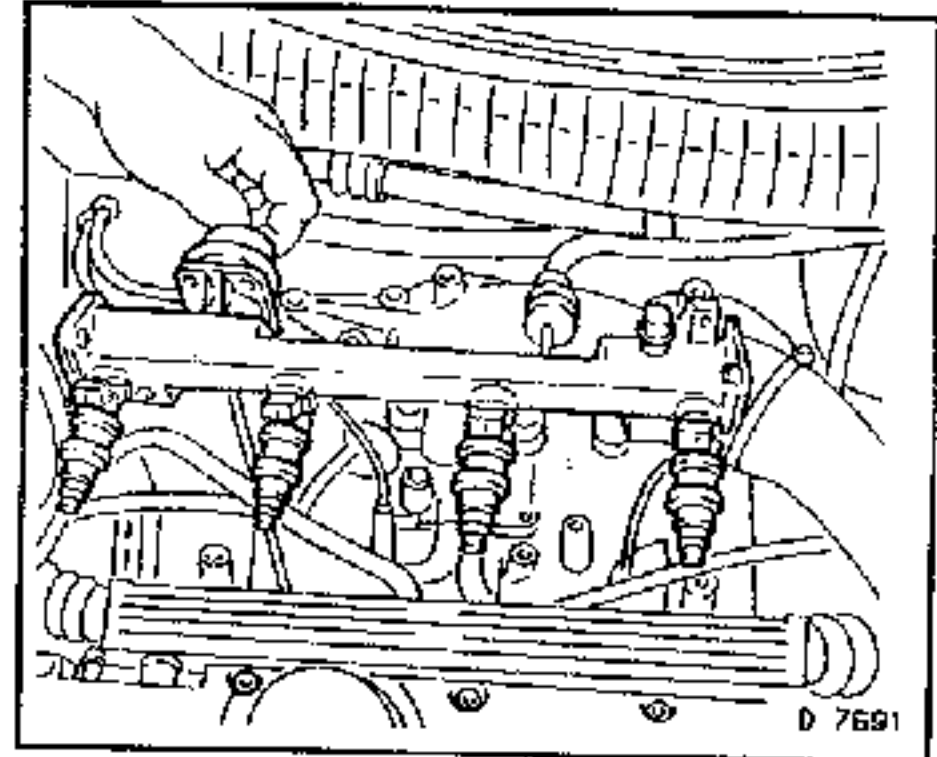
Injector clips and injectors from fuel distributor pipe.

### Important!

Release fuel pressure first and be prepared for escaping fuel.

## Install, Connect

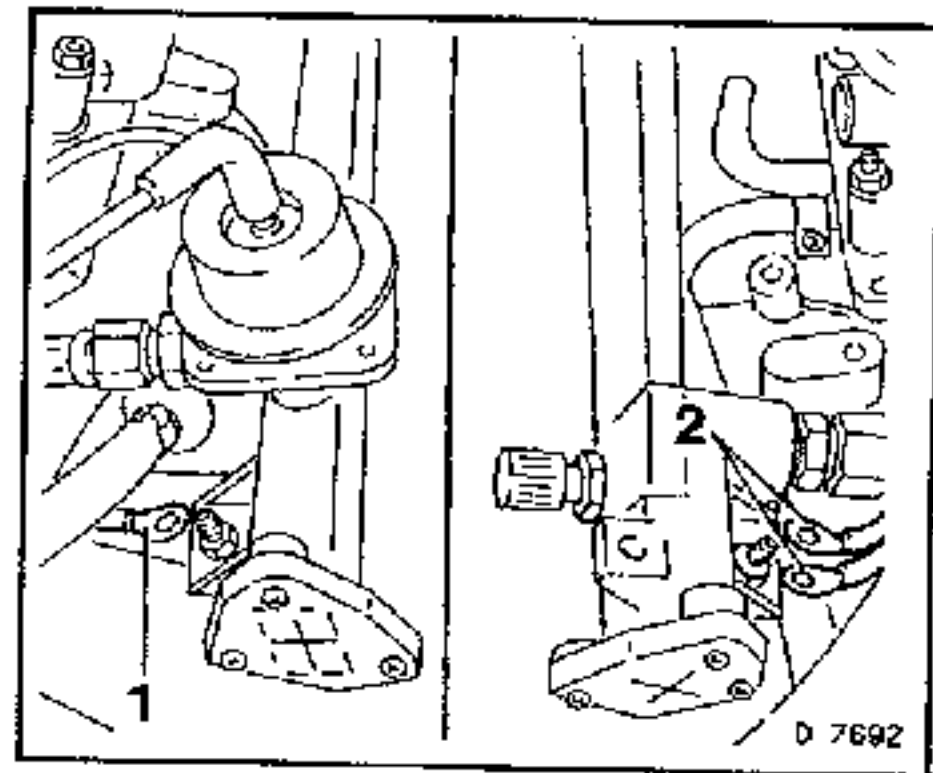
Injector/s with new seal rings to the fuel distributor pipe and secure with retaining clips.



## Install, Connect

Fuel distributor pipe with injectors to the intake manifold, ensuring that all seat correctly.

Ground cable (1 and 2) to fuel distributor pipe.

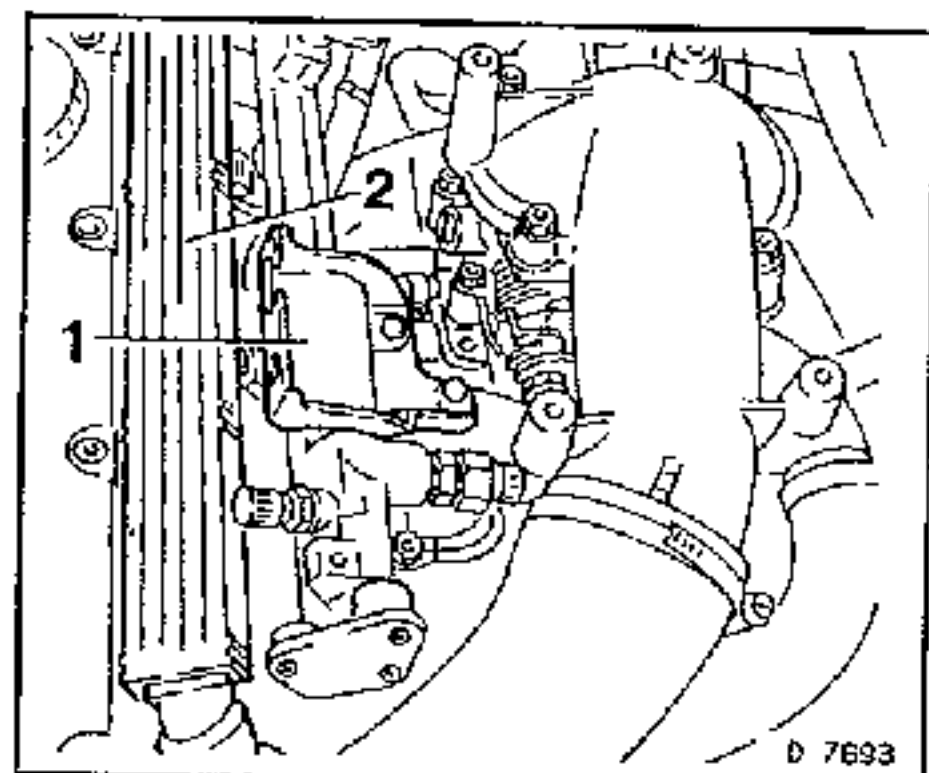


## Install, Connect

Bowden cable bracket (1).

Plug strip (2) to injectors.

Plug strip must click with an audible sound when installed correctly.



# DOHC ENGINE - MOTRONIC M 2.7

## Install, Connect

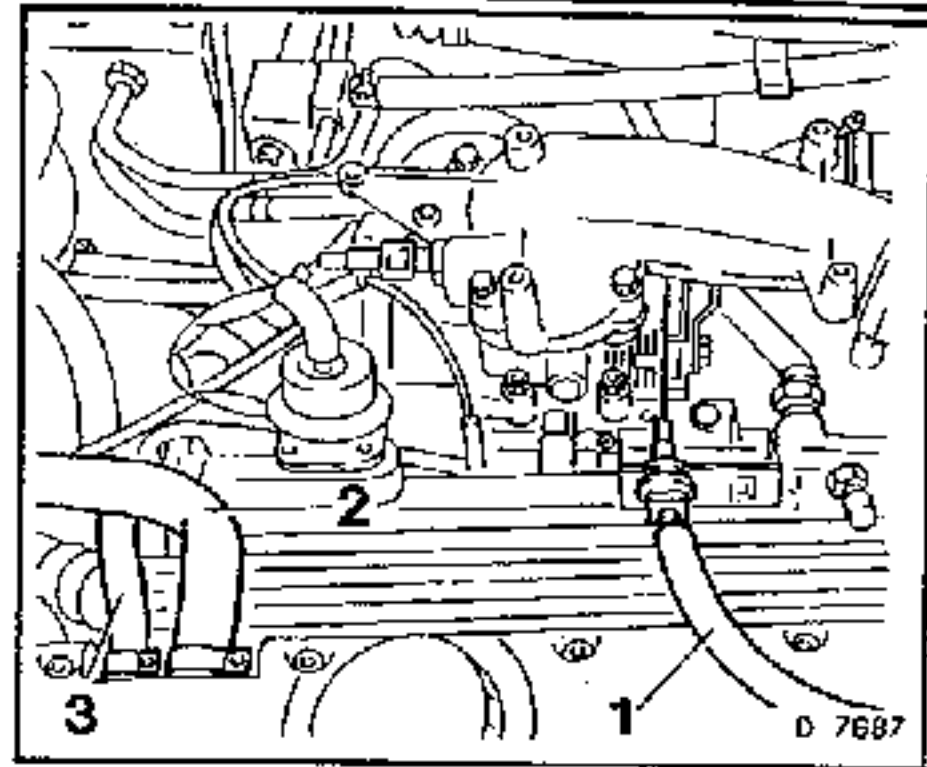
Attach Bowden cable (1), free of tension.

Crankcase ventilation hoses (1 and 2).

Throttle valve manifold cover.

## Tighten (Torque)

Throttle valve manifold cover..... 5 Nm



## Hot Start Valve, Remove and Install

### Note:

For a more clear view, Illustration D 7950 shows the hot start valve with the throttle valve manifold removed.

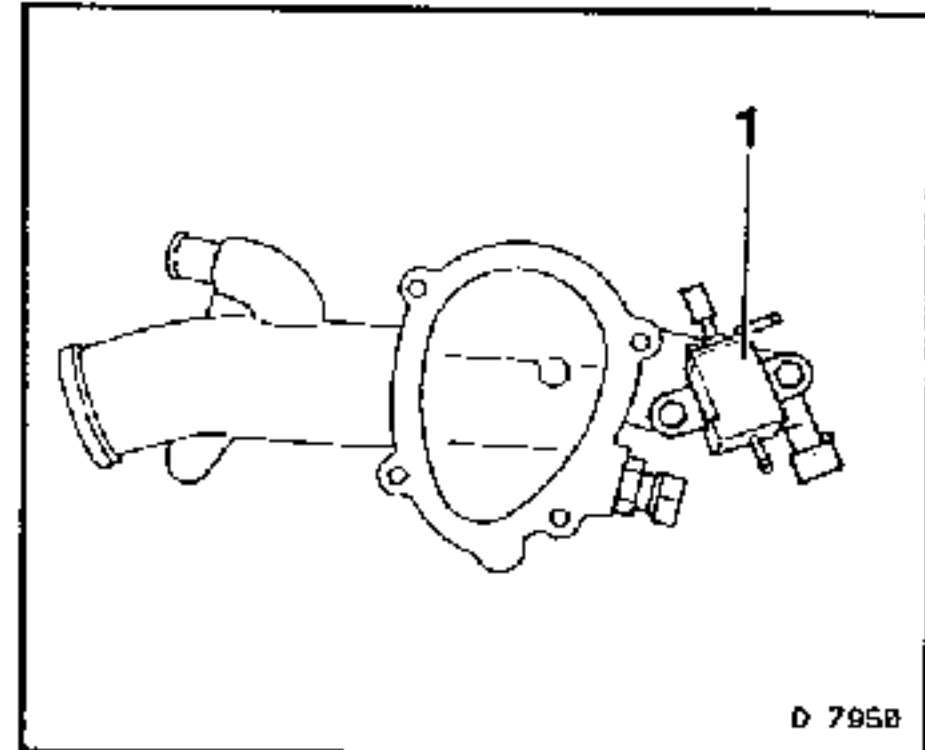
### Remove, Disconnect

Throttle valve manifold cover.

Wiring harness plug from hot start valve.

Vacuum hoses.

Hot start valve (1) from the throttle valve manifold, removing the throttle valve manifold if necessary.



Hose layout diagram for the hot start valve.

### Install, Connect

Hot start valve (1) to throttle valve manifold.

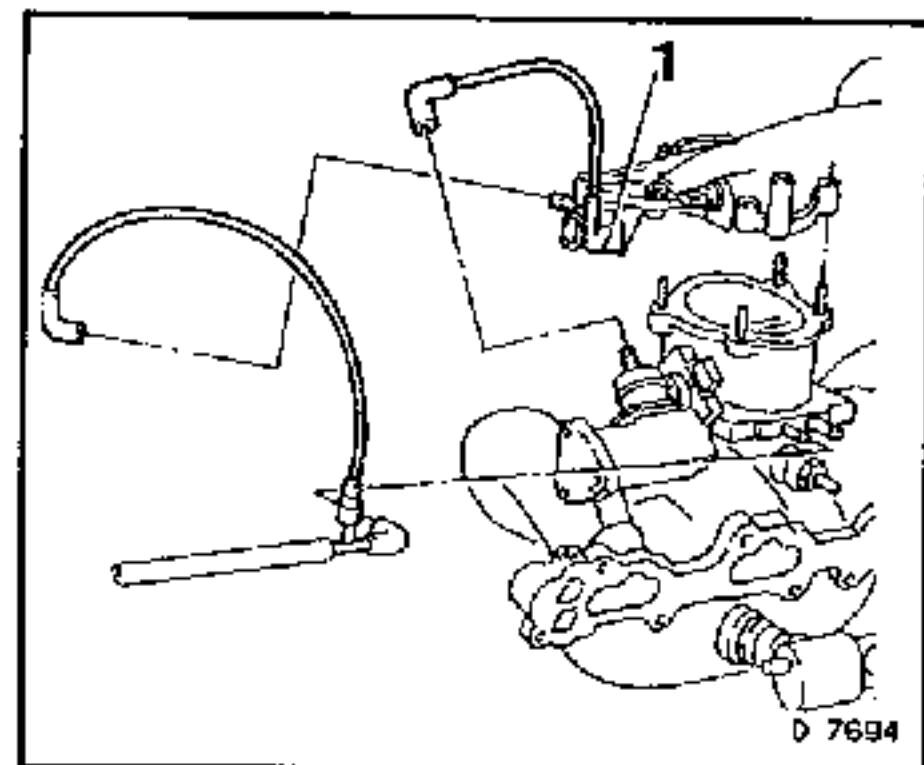
Vacuum hoses

Wiring harness plug to hot start valve.

Throttle valve manifold cover.

### Tighten (Torque)

Throttle valve manifold cover..... 5 Nm

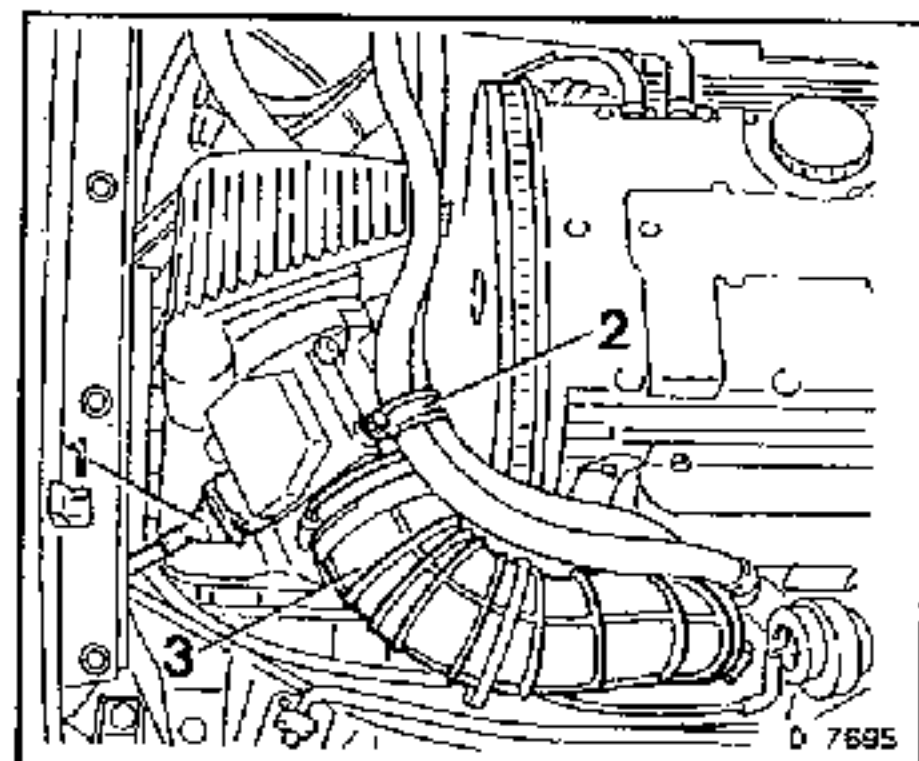


## Hot Wire Mass Air Flow Meter, Remove and Install

### Remove, Disconnect

Wiring harness plug (1).

Bracket (2) and intake hose (3) from the hot wire mass air flow sensor.

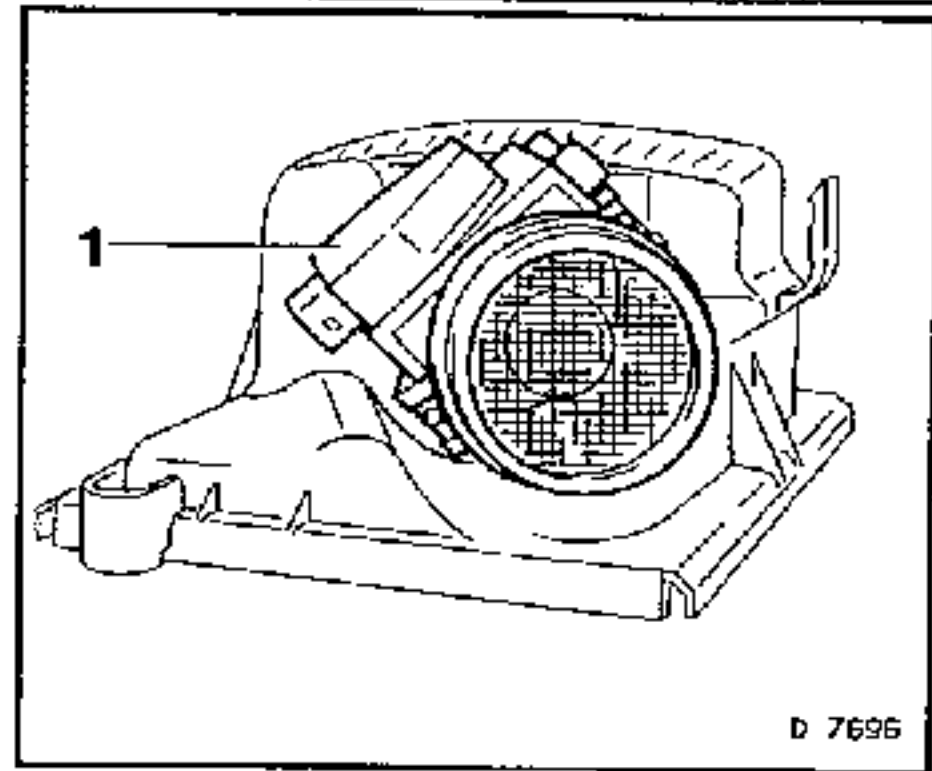


# DOHC ENGINE - MOTRONIC M 2.7

## Remove, Disconnect

Upper part of air cleaner with hot wire mass air flow sensor.

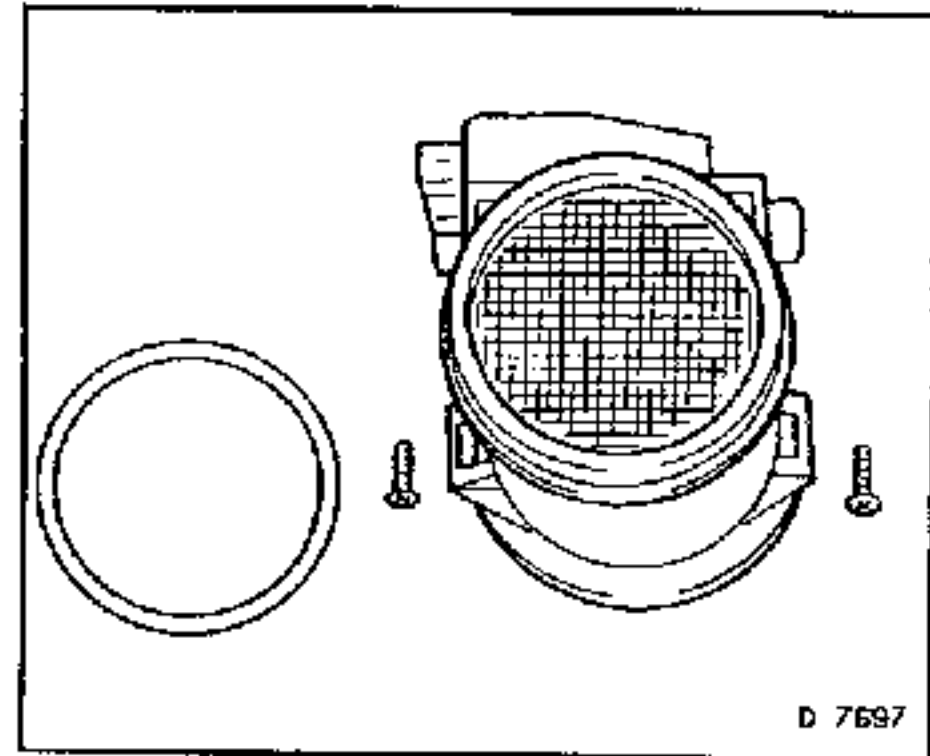
Hot wire mass air flow sensor (1) from the upper part of the air cleaner. Note the seal ring in the upper part of the air cleaner.



## Install, Connect

Hot wire mass air flow sensor with new seal ring to the upper part of the air cleaner.

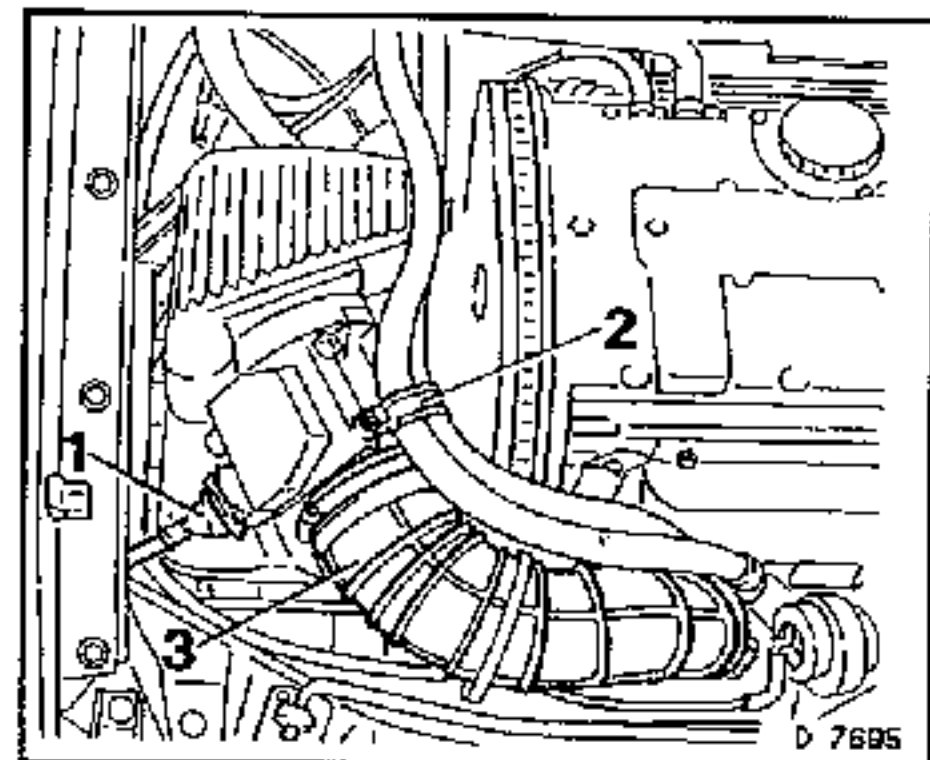
Upper part of the air cleaner and hot wire mass air flow sensor.



Wiring harness plug (1).

Bracket (2) and intake hose (3) to hot wire mass air flow sensor.

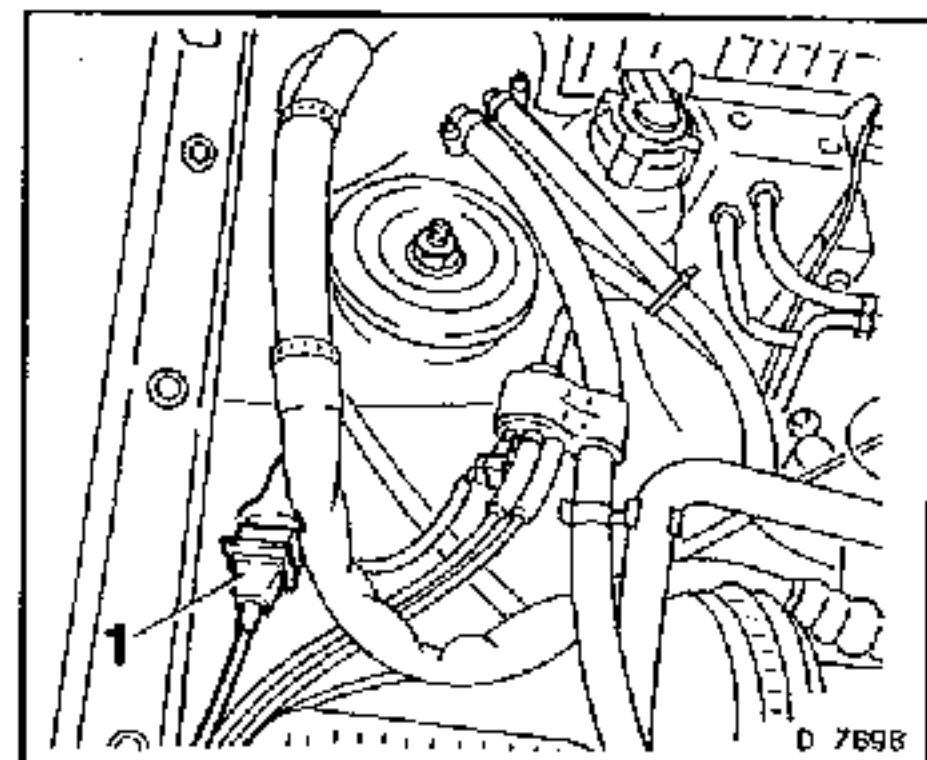
Ensure correct seal of the intake hose.



## Inductive Pulse Pick-up, Remove and Install

### Remove, Disconnect

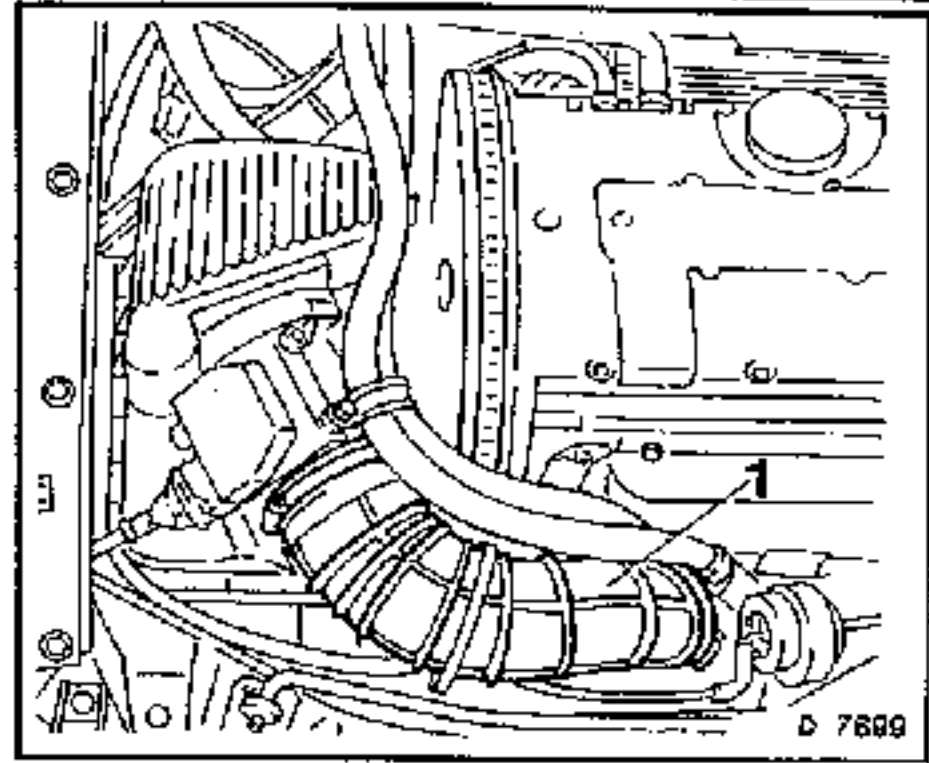
Wiring harness plug (1), noting the wiring harness routing.



# DOHC ENGINE - MOTRONIC M 2.7

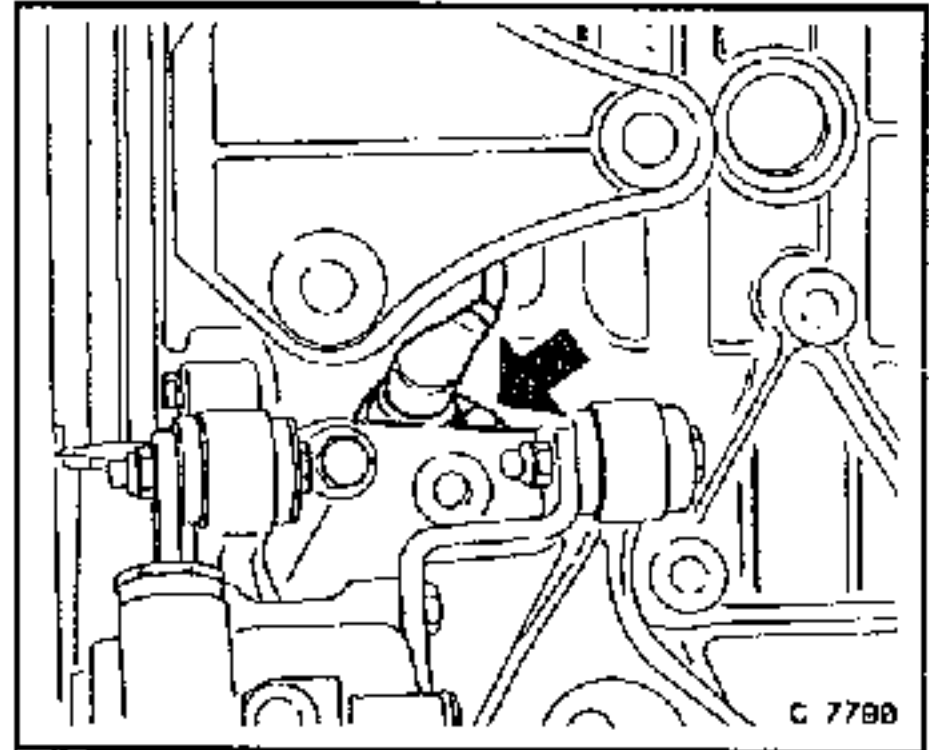
## Remove, Disconnect

Intake hose (1) between the hot wire mass air flow sensor and turbocharger.



## Remove, Disconnect

Inductive pulse pick-up with seal ring.



## Install, Connect

Inductive pulse pick-up with new seal ring.

## Tighten (Torque)

Inductive pulse pick-up ..... 6 Nm

## Install, Connect

Intake hose between hot wire mass air flow sensor and turbocharger.

Wiring harness plug to inductive pulse pick-up.

Ensure that all hoses are correctly fitted and air tight.

## Fuel Pressure Regulator, Remove and Install

### Remove, Disconnect

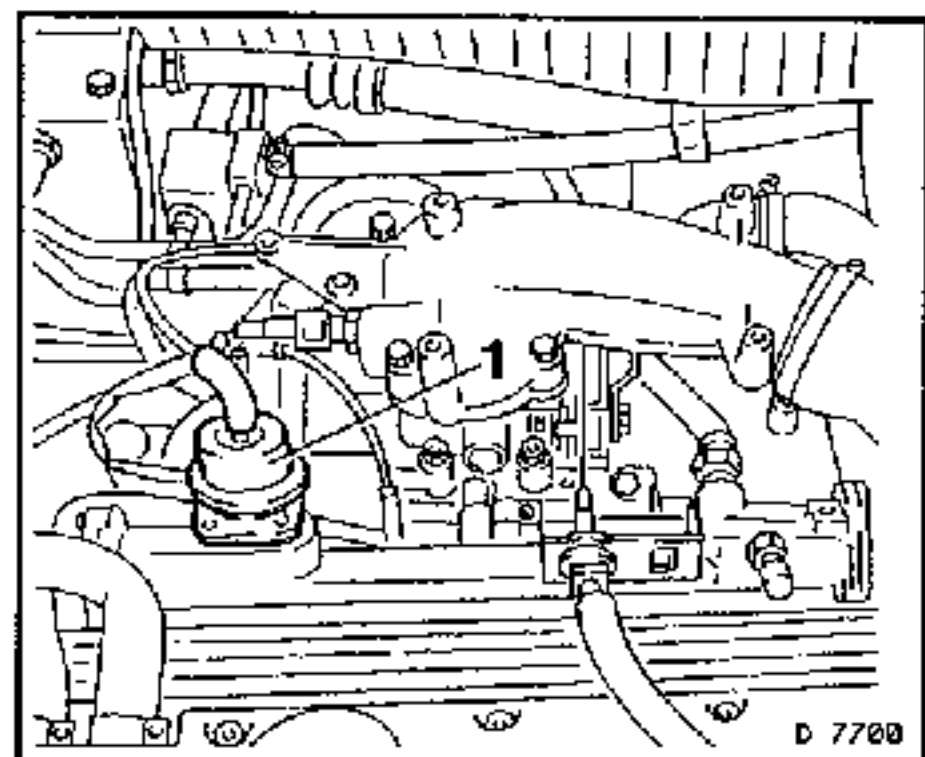
Throttle valve manifold cover.

Vacuum hose from fuel pressure regulator (1).

Fuel pressure regulator (1) from fuel distributor pipe.

### Important!

Release fuel pressure first and be prepared for escaping fuel.



# DOHC ENGINE - MOTRONIC M 2.7

## Install, Connect

Fuel pressure regulator to fuel distributor pipe.

Vacuum hose to fuel pressure regulator.

Throttle valve manifold cover.

## Tighten (Torque)

Fuel pressure regulator to fuel distributor pipe.....	4 Nm
Throttle valve manifold cover.....	5 Nm

## Fuel Pressure, Check

### Remove, Disconnect

Throttle valve manifold cover.

Slowly open cap (1) to release fuel pressure. Be prepared for fuel spillage.

### Install, Connect

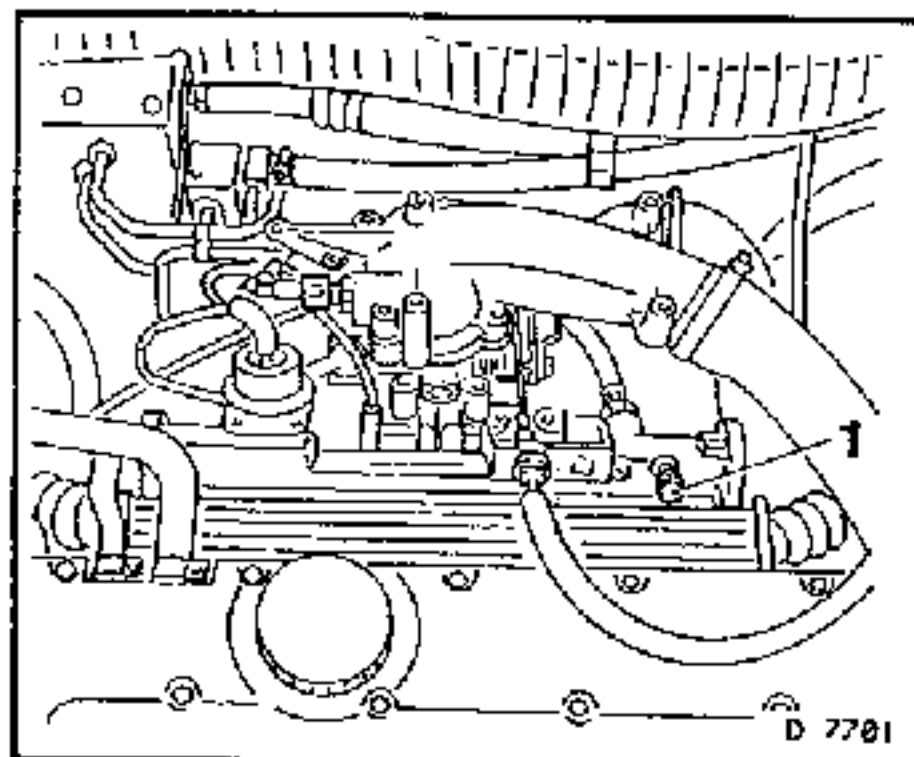
Fuel pressure gauge KM-J-34730-1 or KM-J-34730-91 to the pressure check point.

Bleed the fuel pressure gauge of air.

Start the engine and run at idle speed.

### Measure

Fuel pressure.



## Specification:

### M 2.7:

With vacuum hose connected.....	220 - 270 kPa
With vacuum hose disconnected .....	300 - 350 kPa

## Install, Connect

Throttle valve manifold cover.

## Tighten (Torque)

Throttle valve manifold cover.....	5 Nm
------------------------------------	------

## Fuel Pump Relay, Remove and Install

### Remove, Disconnect

Ground cable from battery.

Unclip right footwell cover, after removing the right hand door sill panel.

Relay bracket.

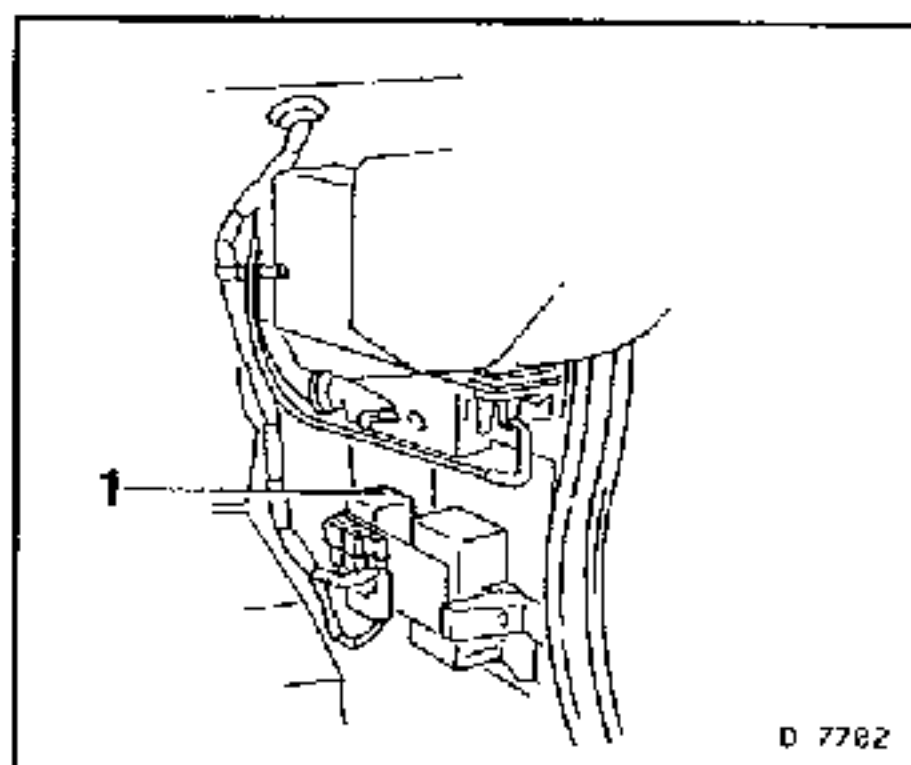
Fuel pump relay (1) from socket.

### Install, Connect

Fuel pump relay (1) in socket.

Relay bracket.

Footwell cover, and right hand door sill panel.



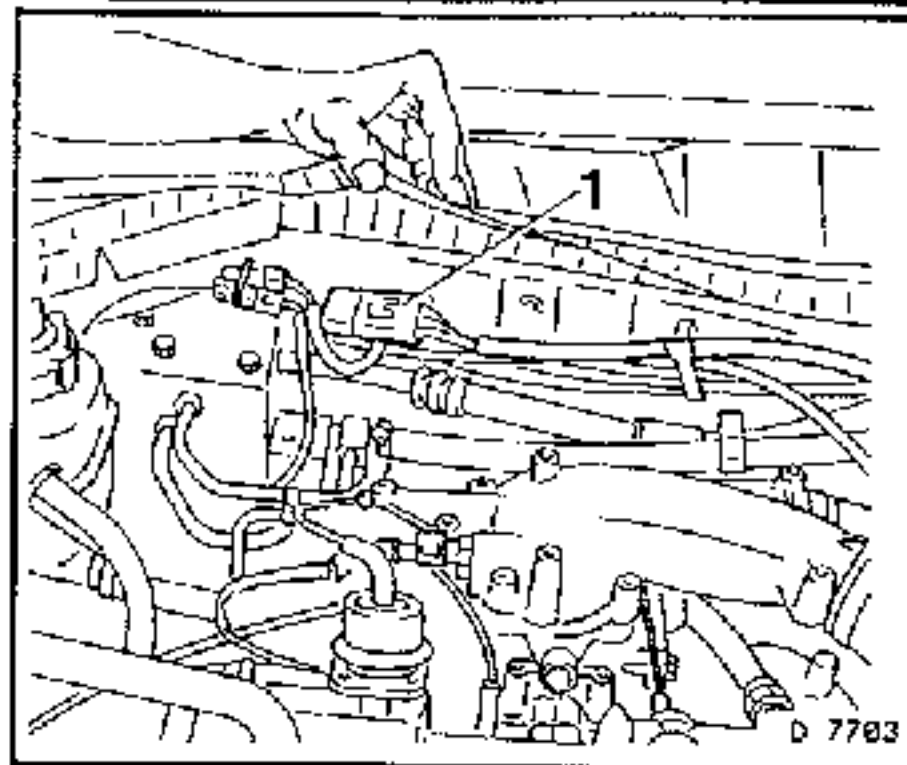
# DOHC ENGINE - MOTRONIC M 2.7

## Oxygen Sensor, Remove and Install

### Remove, Disconnect

Oxygen sensor wiring harness plug.

Oxygen sensor (1) from the front exhaust pipe.



### Install, Connect

Oxygen sensor.

### Tighten (Torque)

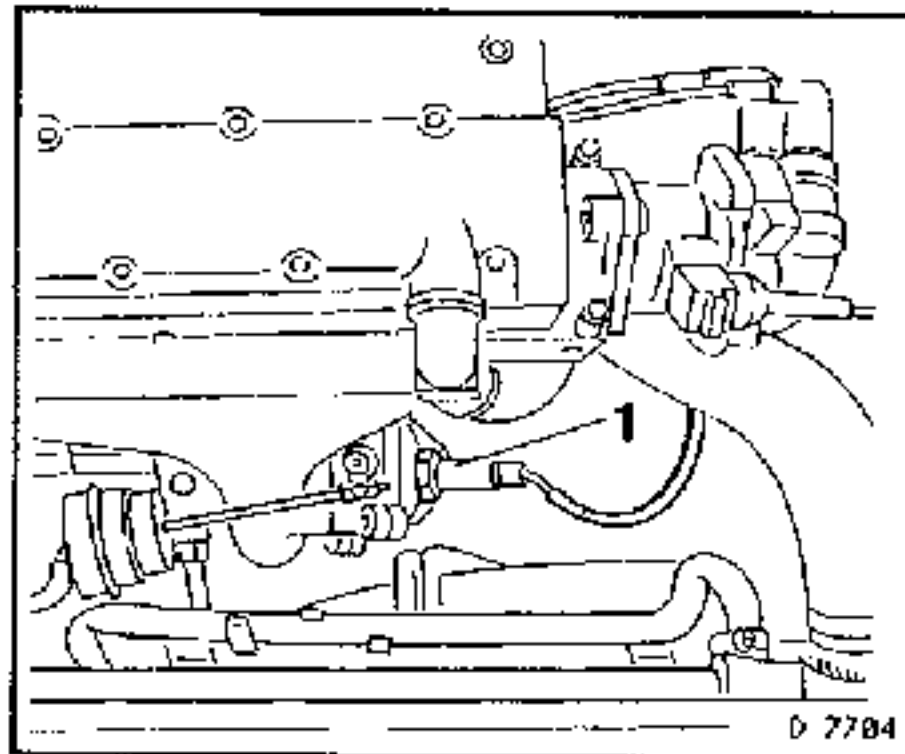
Oxygen sensor to exhaust pipe ..... 30 Nm

### Important!

If oxygen sensor is being re-used, apply special grease to the cleaned oxygen sensor threads. This grease, part number 5613695, is available from authorised Holden parts outlets.

### Install, Connect

Oxygen sensor wiring harness plug, checking that the routing of the wiring harness is correct.



## Idle Speed Adjuster, Remove and Install

### Note:

For a more clear view, illustration D 7705 shows the idle speed adjuster with the engine removed.

### Remove, Disconnect

Ground cable from battery.

Alternator. Refer to "Alternator" Section in this Volume.

Hose (1) from throttle valve manifold.

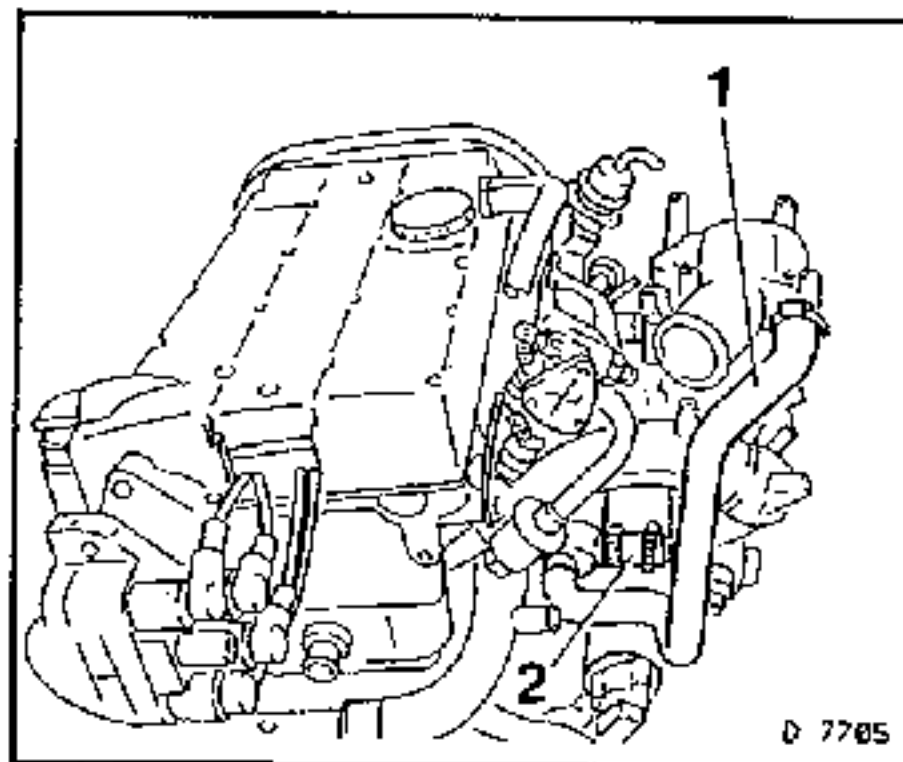
Hose (2) from the intake manifold.

Wiring harness plug from the idle speed adjuster.

Idle speed adjuster hose.

### Note:

The hose routing.



### Install, Connect

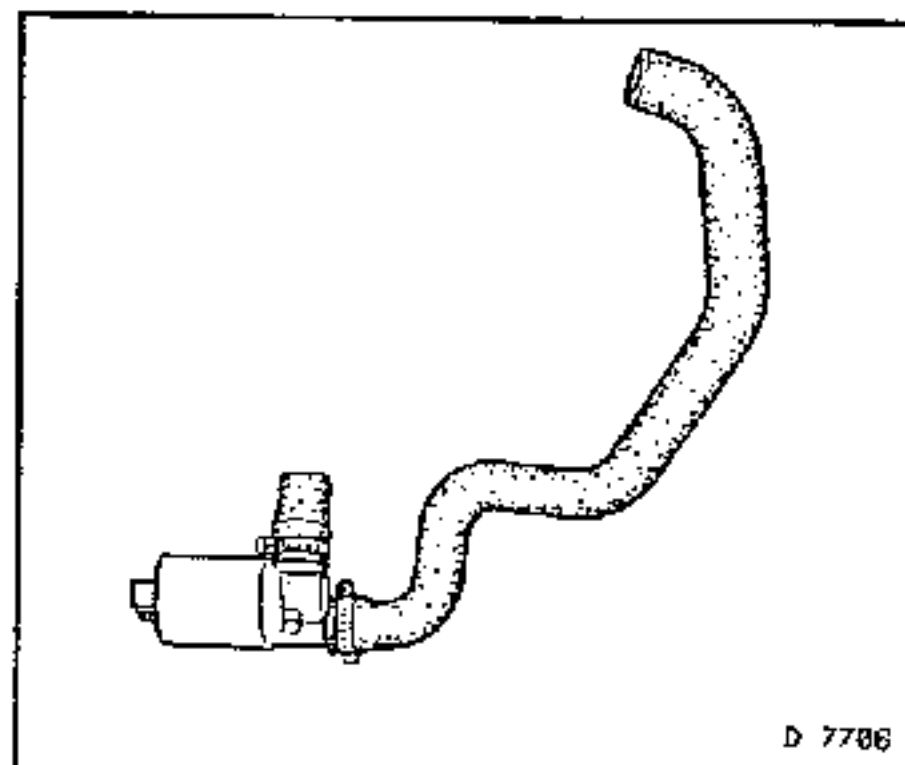
Idle speed adjuster.

Hoses to Throttle valve manifold and Intake manifold.

Wiring harness plug to idle speed adjuster.

Alternator. Refer to "Alternator" Section in this Volume.

Ground cable to battery.



# DOHC ENGINE - MOTRONIC M 2.7

## Motronic Control Unit, Remove and Install

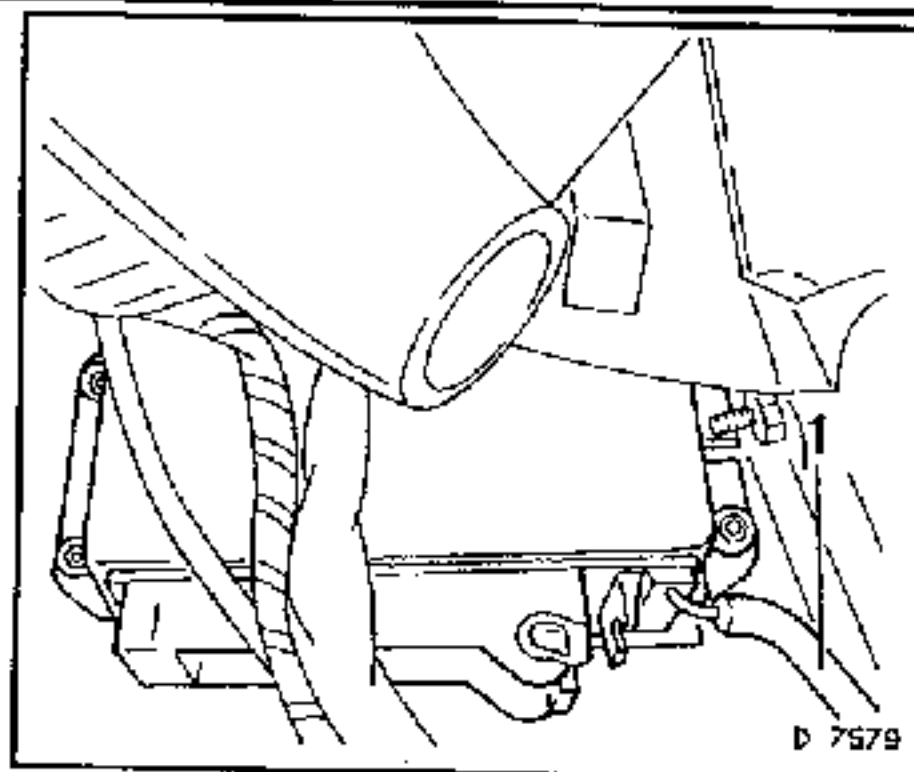
### Remove, Disconnect

Ground cable from battery.

Unclip right footwell cover, after removing the right hand door sill panel.

Relay bracket, then control unit.

Wiring harness plug and pressure/vacuum hose from the control unit.



### Install, Connect

Wiring harness plug and pressure/vacuum hose to the control unit.

Control unit, then relay bracket.

Footwell cover, and right hand door sill panel.

Ground cable to battery.

## Controlled Canister Purge Valve, Remove and Install

### Remove, Disconnect

Wiring harness plug from controlled canister purge valve.

Hoses (1 and 2) from controlled canister purge valve. Close off hose (2) (carbon canister) with a clamp.

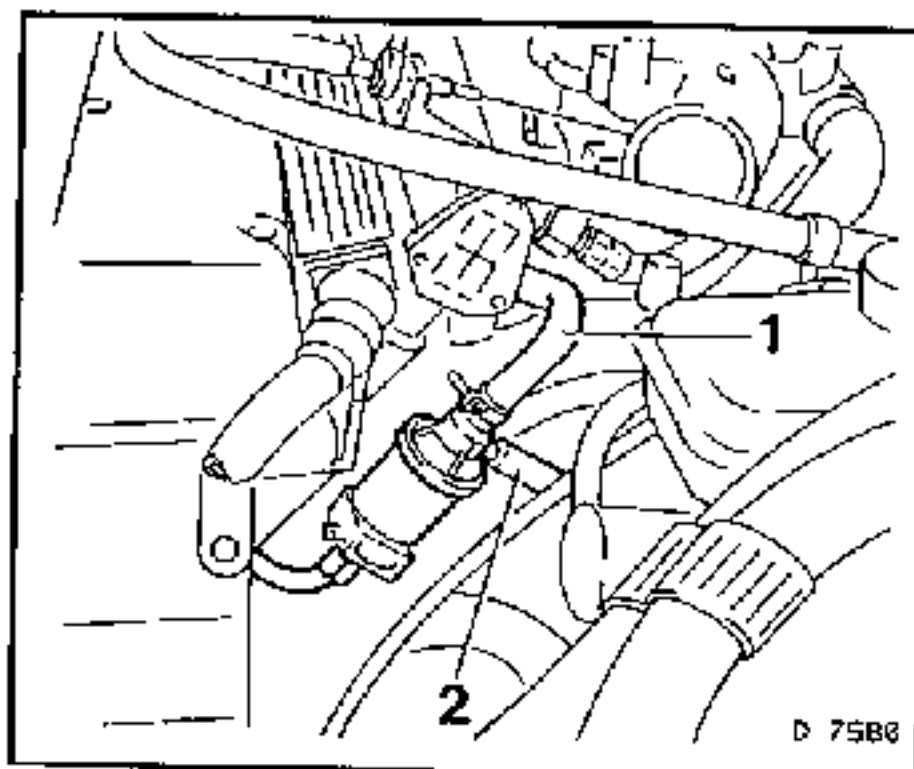
Controlled canister purge valve.

### Install, Connect

Controlled canister purge valve.

Hose (1) from throttle body and hose (2) from carbon canister. Remove clamp from hose (2).

Wiring harness plug (1) to controlled canister purge valve.



## Intake Air Temperature Sensor, Remove and Install

### Remove, Disconnect

Throttle valve manifold cover.

Wiring harness plug from intake air temperature sensor.

Intake air temperature sensor (1) with seal ring.

### Install, Connect

Intake air temperature sensor with a new seal ring.

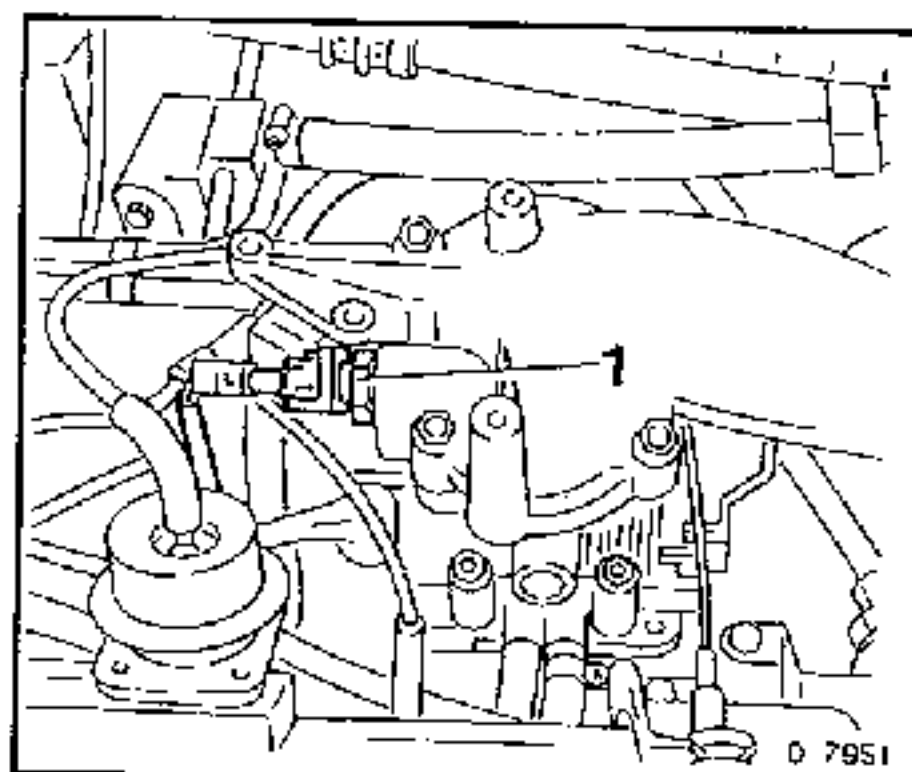
Throttle valve manifold cover.

### Tighten (Torque)

Intake air temperature sensor.....	10 Nm
Throttle valve manifold cover.....	5 Nm

### Install, Connect

Wiring harness plug to Intake air temperature sensor.



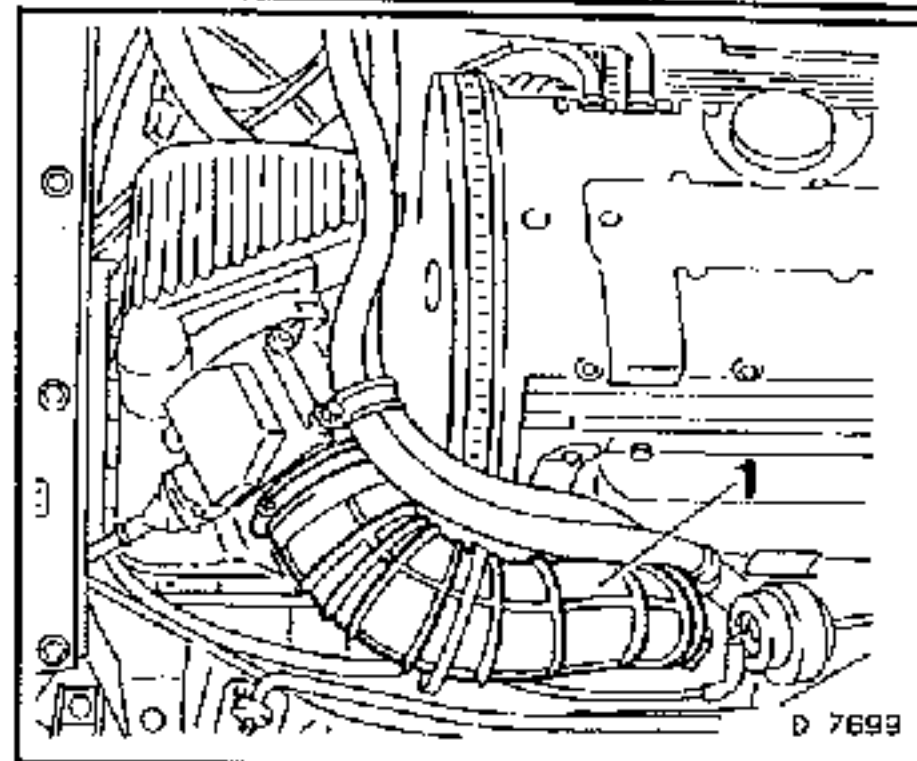


# DOHC ENGINE - MOTRONIC M 2.7

## Coolant Temperature Sensor, Remove and Install

### Remove, Disconnect

Intake hose (1) between hot wire mass air flow sensor and turbocharger.



### Remove, Disconnect

Wiring harness plug from coolant temperature sensor.

Coolant temperature sensor (1).

### Note:

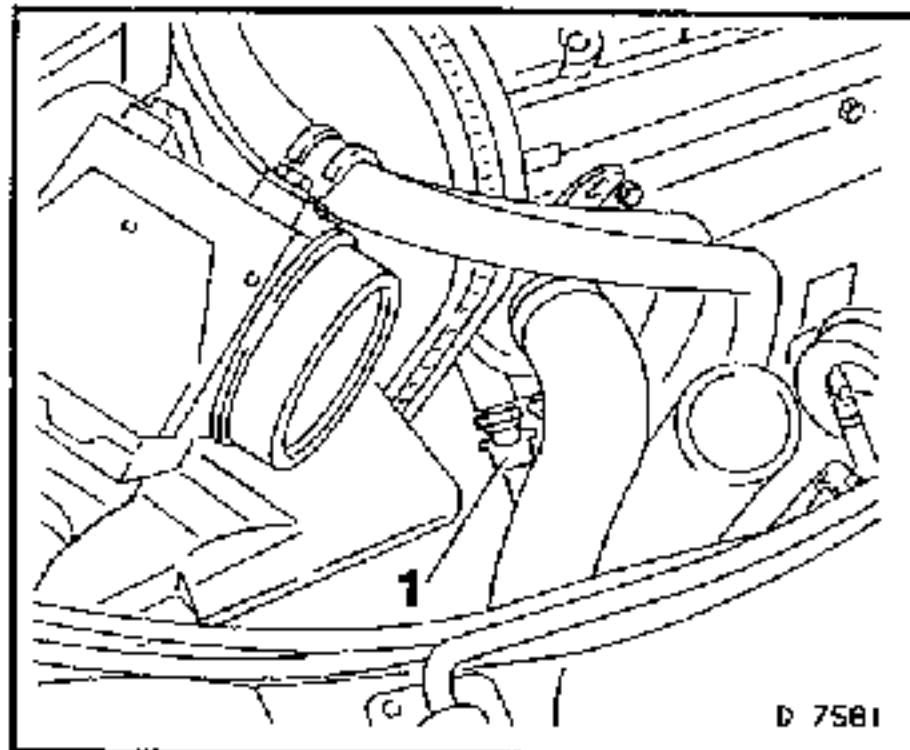
Have a suitable clean container available for coolant draining.

### Install, Connect

Coolant temperature sensor with new seal ring.

### Tighten (Torque)

Coolant temperature sensor ..... 11 Nm



### Install, Connect

Wiring harness plug to coolant temperature sensor.

Intake hose between hot wire mass air flow sensor and turbocharger. Ensure that the hose is air tight.

Top up and bleed cooling system. Refer to "Cooling System", in this Volume.

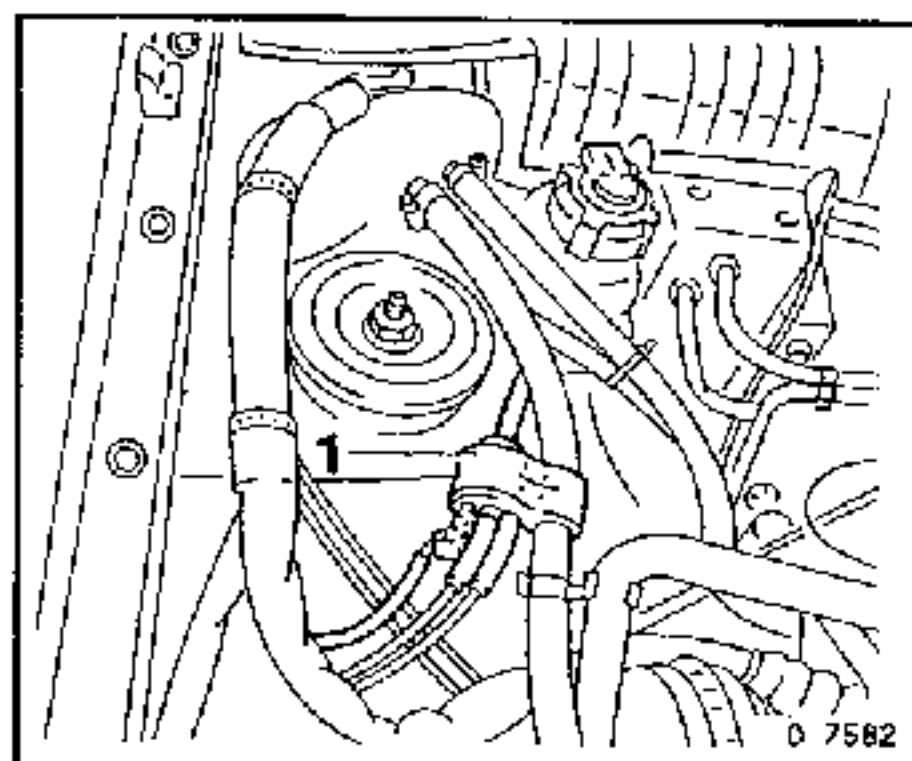
## Charge Control Switchover Valve, Remove and Install

### Remove, Disconnect

Wiring harness plug for charge pressure control switchover valve.

Pressure vacuum hoses. Identify each before removing.

Charge pressure control switchover valve from the rubber mounting.





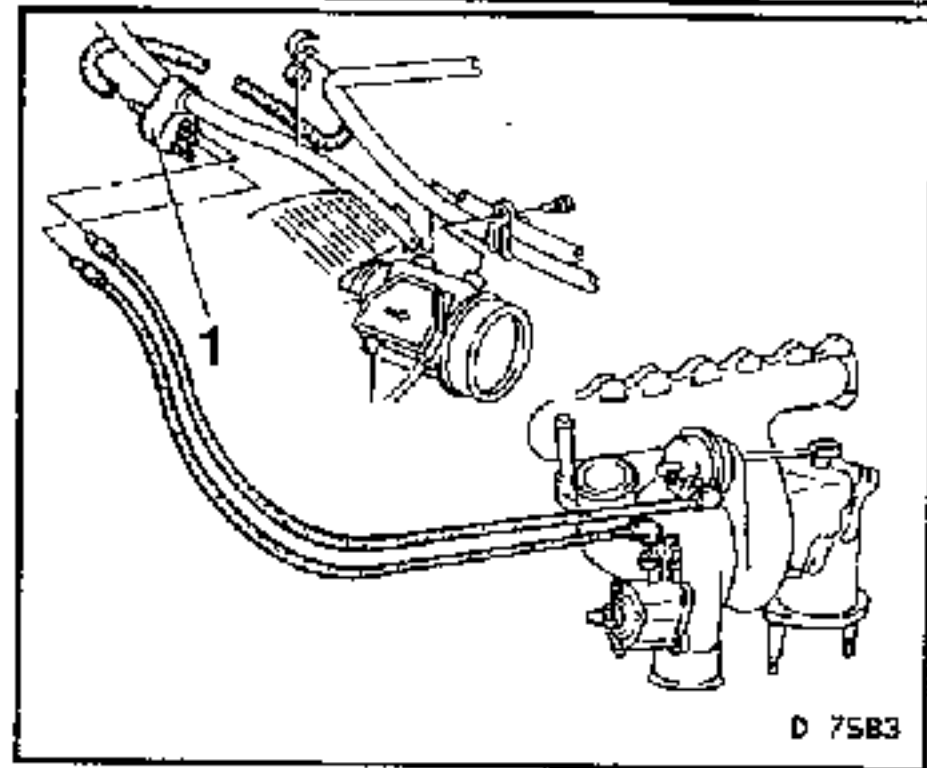
# DOHC ENGINE - MOTRONIC M 2.7

## Install, Connect

Charge pressure control switchover valve from the rubber mounting (1).

Pressure vacuum hoses, noting identification made before removal.

Wiring harness plug to charge pressure control switchover valve.



## Ignition Coil, Remove and Install

Switch ignition off.

### Remove, Disconnect

Cable connectors from ignition coil (1).

Wiring harness plug (2) from ignition module (trigger box).

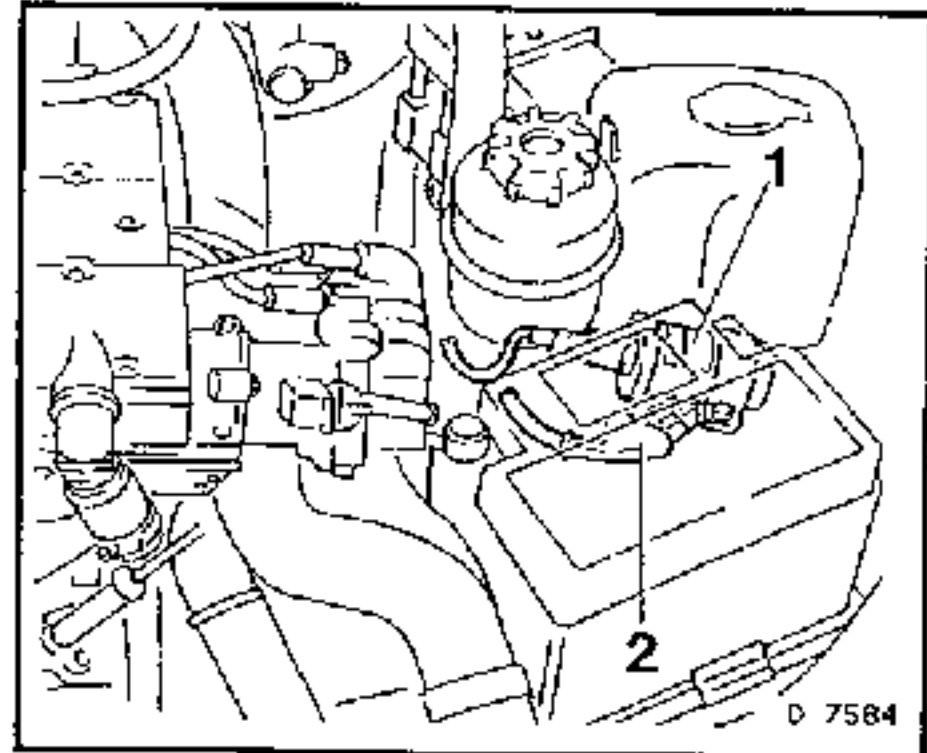
Ignition coil (1).

### Install, Connect

Ignition coil (1).

Wiring harness plug (2) to ignition module (trigger box).

Cable connectors to ignition coil (1).



## RECOMMENDED TORQUE VALUES

(Motronic M 2.7)

	Nm
Coolant temperature sensor with new seal ring.....	11
Fuel pressure regulator to fuel distributor pipe .....	4
Inductive pulse pick-up with new seal ring.....	6
Intake temperature sensor with new seal ring .....	10
Oxygen sensor to exhaust pipe .....	30 (1)
Throttle body to intake manifold.....	9
Throttle valve manifold to throttle body .....	8
Throttle valve manifold cover to throttle valve manifold. ....	5

(1) If re-using, apply Special Grease, Part Number 5613695 to the cleaned oxygen sensor threads.

# GROUP J

## DOUBLE OVERHEAD CAM ENGINE

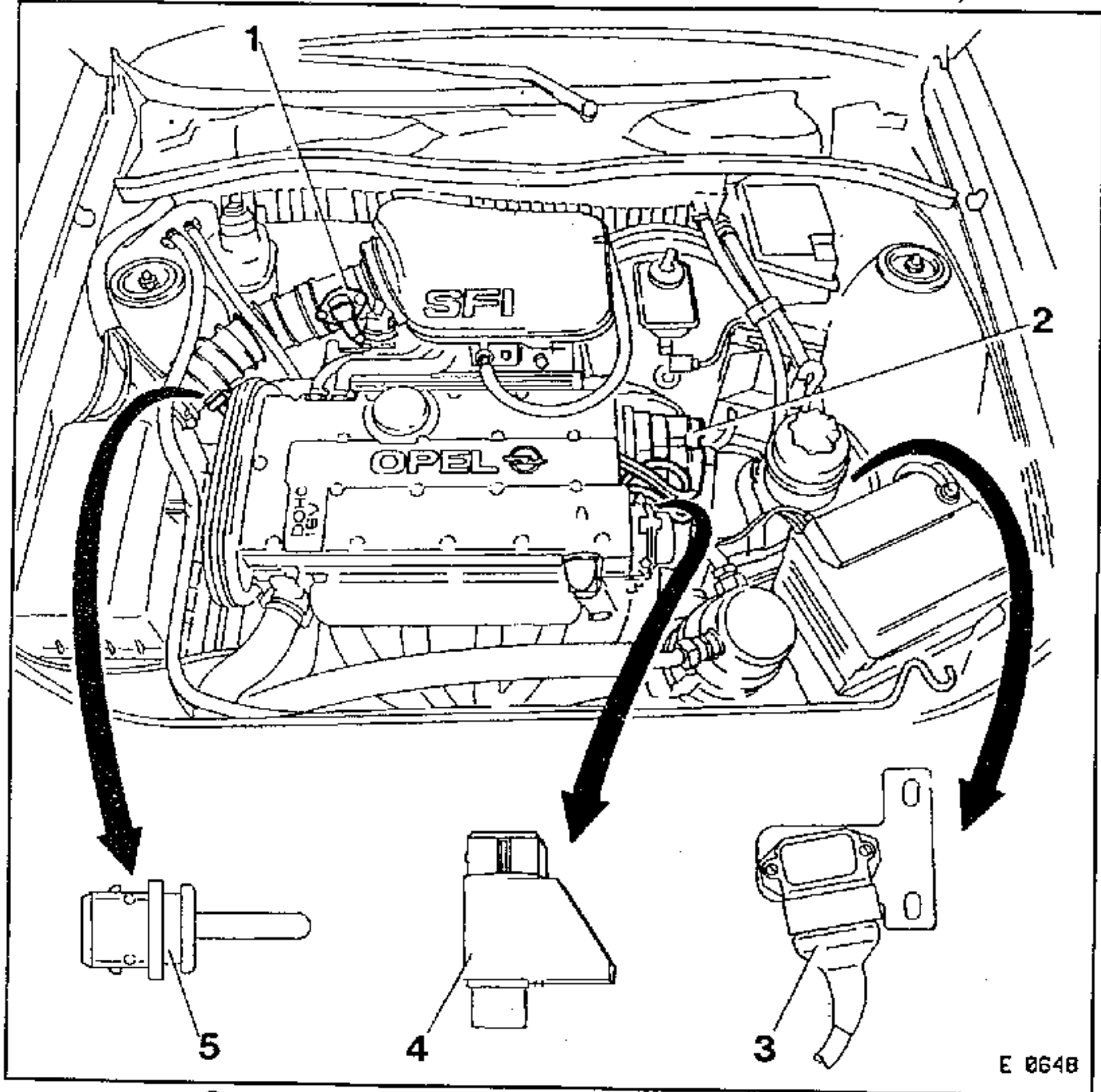
### MOTRONIC M 2.8 (C 20 XE as of MY '93)

#### TABLE OF CONTENTS

	PAGE
General Arrangement Illustration .....	J - 526
Dual Spark Ignition Coil, Remove and Install .....	J - 527
Ignition Module (Trigger Box), Remove and Install .....	J - 528
Throttle Valve Potentiometer, Remove and Install .....	J - 528
Hot Film Mass Air Flow Meter, Remove and Install .....	J - 529
Intake Air Temperature Sensor, Remove and Install .....	J - 530
Camshaft Sensor Disc, Remove and Install .....	J - 530
Camshaft Sensor, Remove and Install .....	J - 531
Inductive Pulse Pick-up, Remove and Install .....	J - 531
Fuel Pump Relay, Remove and Install .....	J - 532
Motronic Control Unit, Remove and Install .....	J - 532
Controlled Canister Purge Valve, Remove and Install .....	J - 532
Recommended Torque Values .....	J - 533
Checking Procedures, Using TECH 1 .....	J - 535

# DOHC ENGINE - MOTRONIC M 2.8

SURVEY OF ENGINE COMPARTMENT M 2.8 (C 20XE ENGINES as of MY'93)



Component Locations Different to M 2.5 (LHD Shown)

**Illustration Key:**

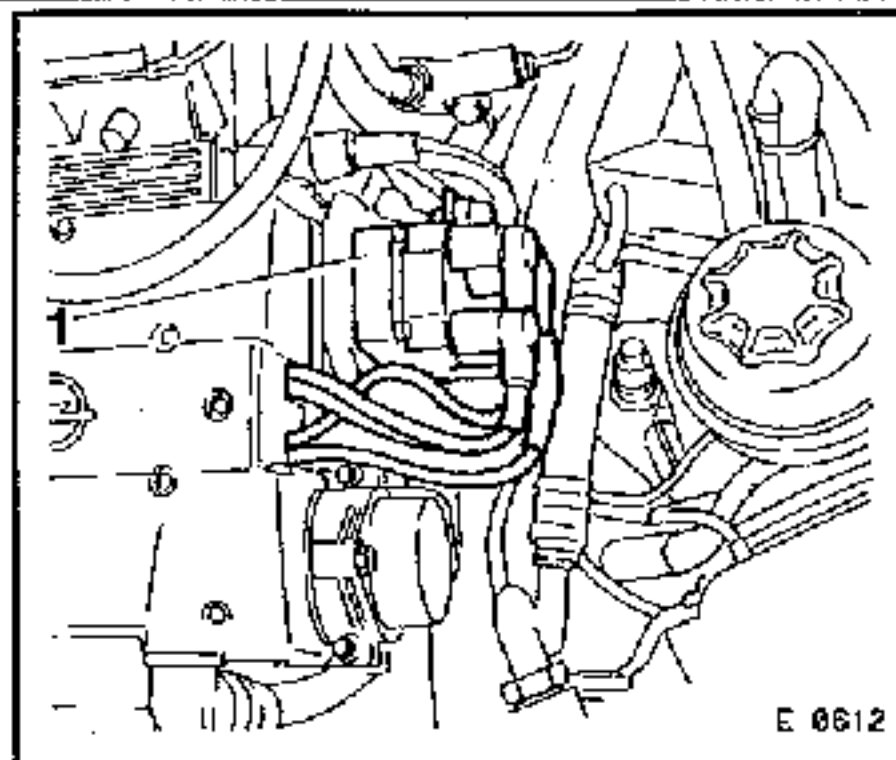
1. Hot Film Mass air Flow Sensor
2. Dual Spark Ignition Coil
3. Ignition Module (Trigger Box)
4. Camshaft Sensor
5. Intake Air Temperature Sensor

# DOHC ENGINE - MOTRONIC M 2.8

## Dual Spark Ignition Coil, Remove and Install

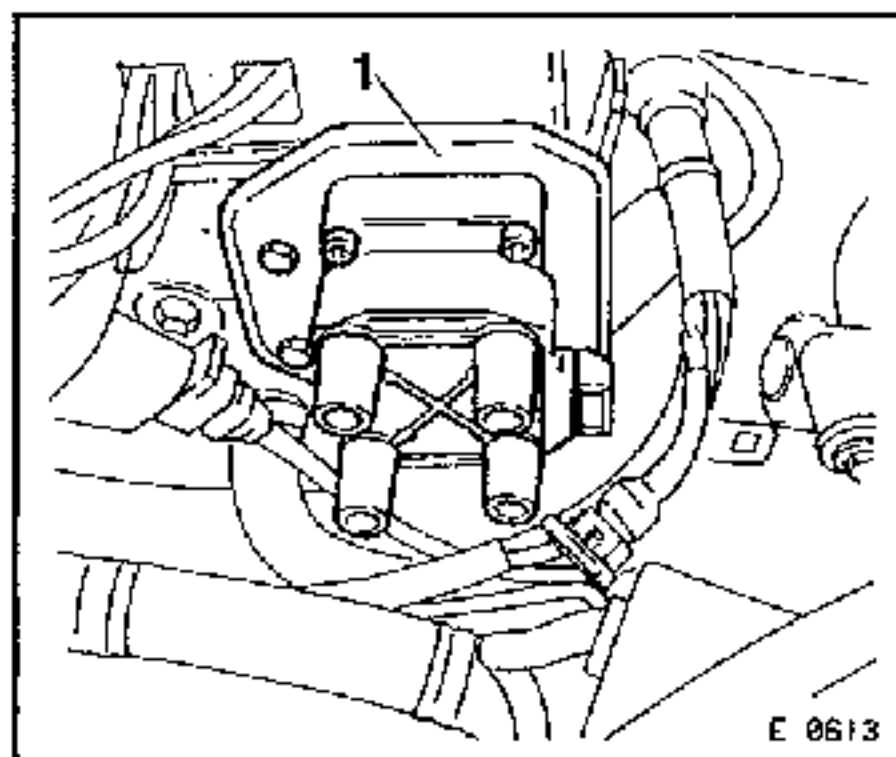
### Remove, Disconnect

Ignition cable plug and wiring harness plug from the dual spark ignition coil (1).



### Remove, Disconnect

Bracket (1) with the dual spark ignition coil.

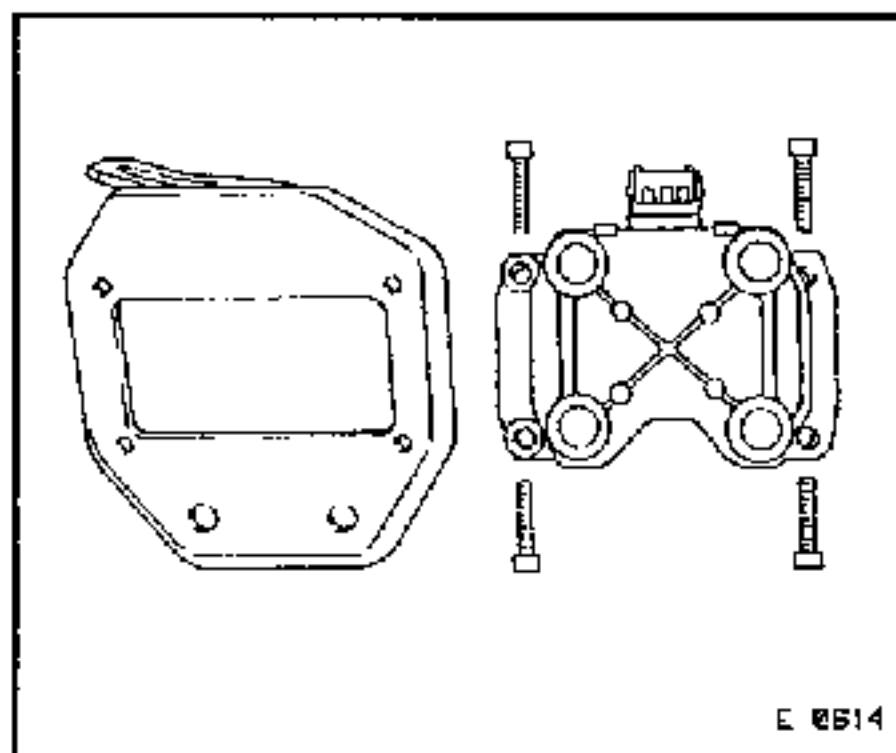


### Remove, Disconnect

Dual ignition coil from the bracket, noting the position of the dual spark ignition coil for reassembly.

### Install, Connect

Dual ignition coil to the bracket, noting the position of the dual spark ignition coil.



### Install, Connect

Dual spark ignition coil and bracket assembly

### Tighten (Torque)

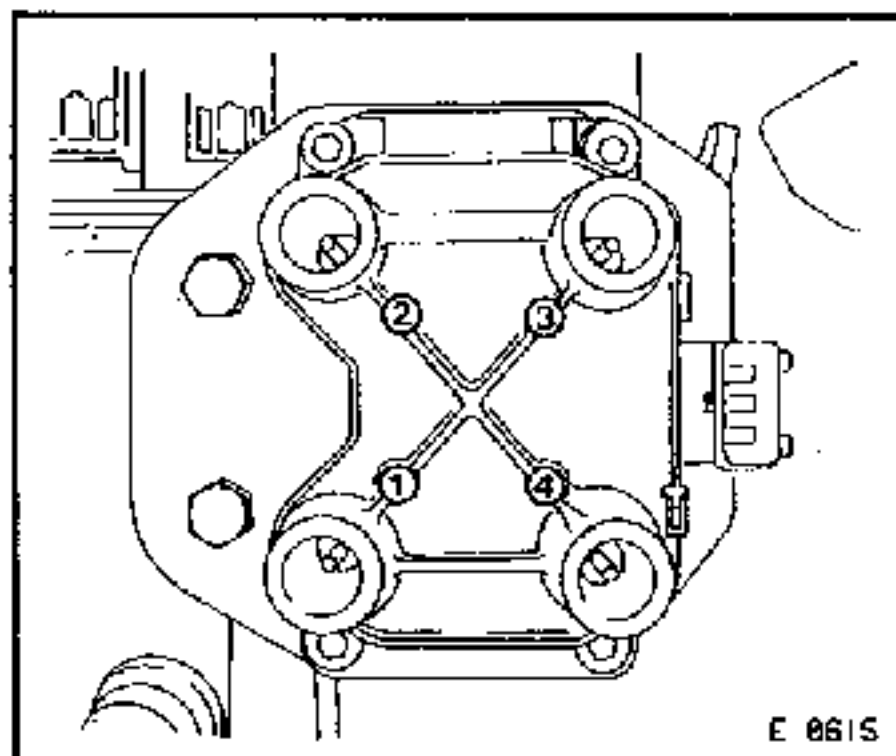
Dual spark ignition coil bracket ..... 25 Nm

Wiring harness plug to dual spark ignition coil.

Ignition cables to the dual spark ignition coil, noting the correct sequence.

### Note:

For convenience, cylinder numbers are on both the cables and the dual spark ignition coil.



# DOHC ENGINE - MOTRONIC M 2.8

## Ignition Module (Trigger Box), Remove and Install

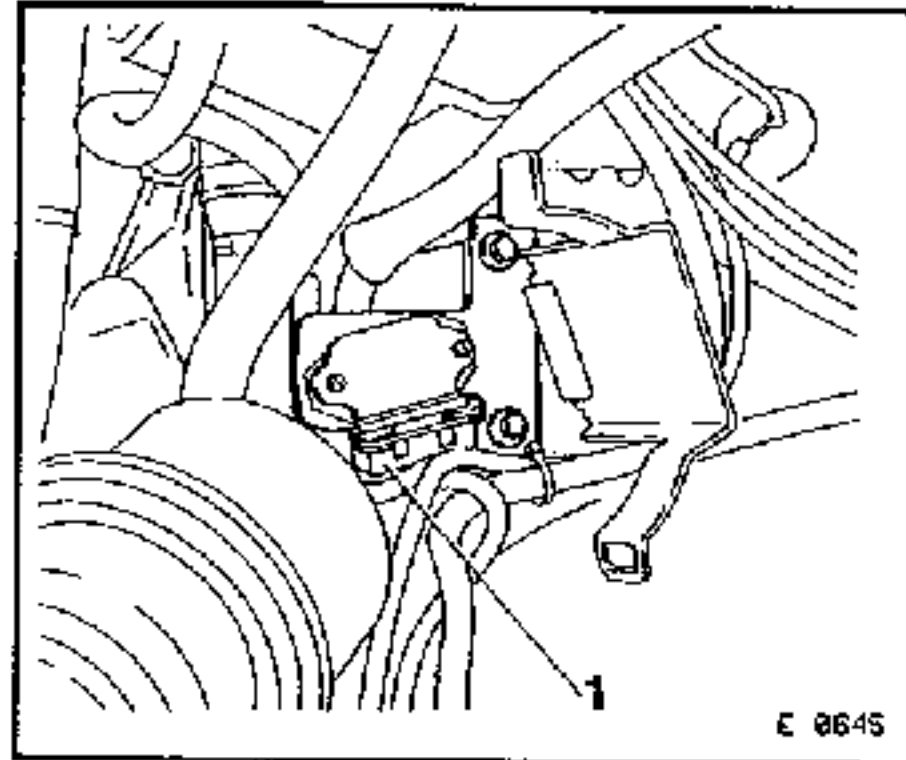
### Note:

Illustration E 0645 shows the ignition module with the power steering fluid reservoir removed, for clarity.

### Remove, Disconnect

Wiring harness plug (1) from ignition module.

Ignition module with heat sink plate.



### Remove, Disconnect

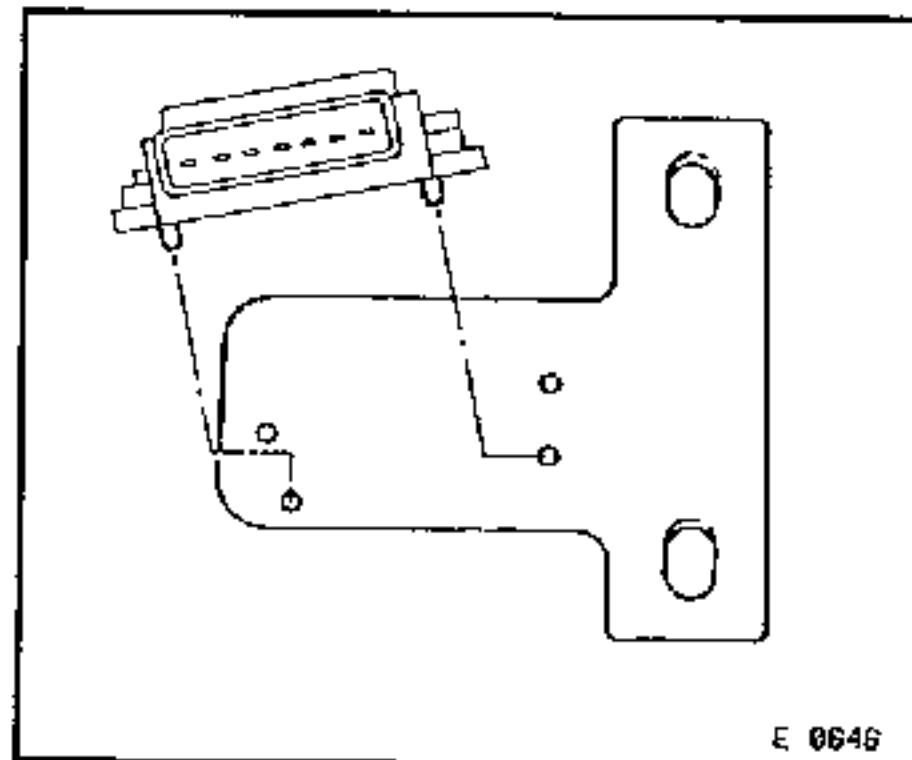
Ignition module from heat sink plate.

### Install, Connect

Ignition module to heat sink plate, ensuring that a sound contact is made.

Ignition module and heat sink plate assembly.

Wiring harness plug to ignition module.



## Throttle Valve Potentiometer, Remove and Install

### Remove, Disconnect

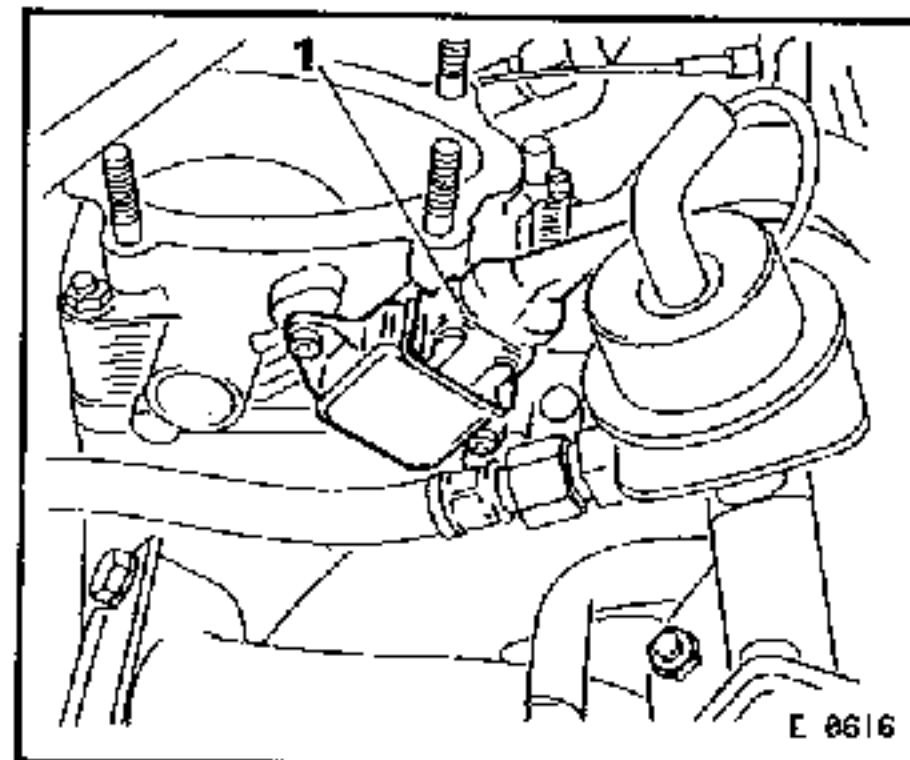
Wiring harness plug from the intake air temperature sensor.

Wiring harness plug from the hot film mass air flow sensor.

Pre-volume chamber, complete with air intake hose.

Wiring harness plug from the throttle valve potentiometer.

Throttle valve potentiometer from the throttle valve shaft.



### Install, Connect

Throttle valve potentiometer from the throttle valve shaft.

Wiring harness plug (1) to the throttle valve potentiometer.

Pre-volume chamber, complete with air intake hose.

Wiring harness plug to the intake air temperature sensor.

Wiring harness plug to the hot film mass air flow sensor.

# DOHC ENGINE - MOTRONIC M 2.8

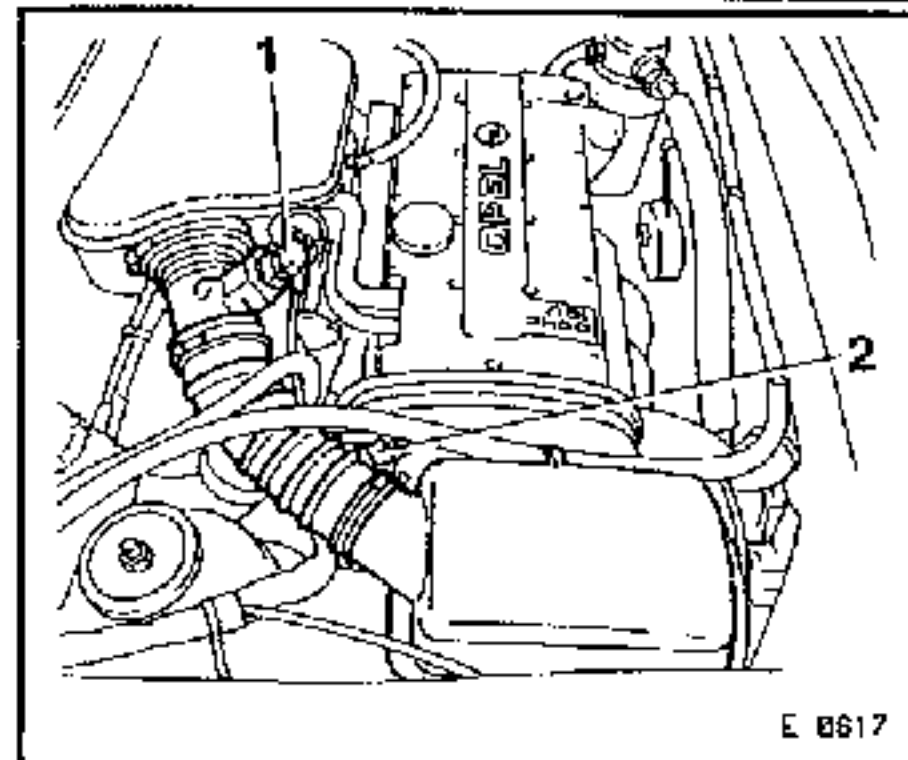
## Hot Film Mass Air Flow Sensor, Remove and Install

### Remove, Disconnect

Wiring harness plug (1) from the hot film mass air flow sensor.

Wiring harness plug (2) from the intake air temperature sensor.

Upper portion of the air cleaner, together with the air intake hose and hot film mass air flow sensor.

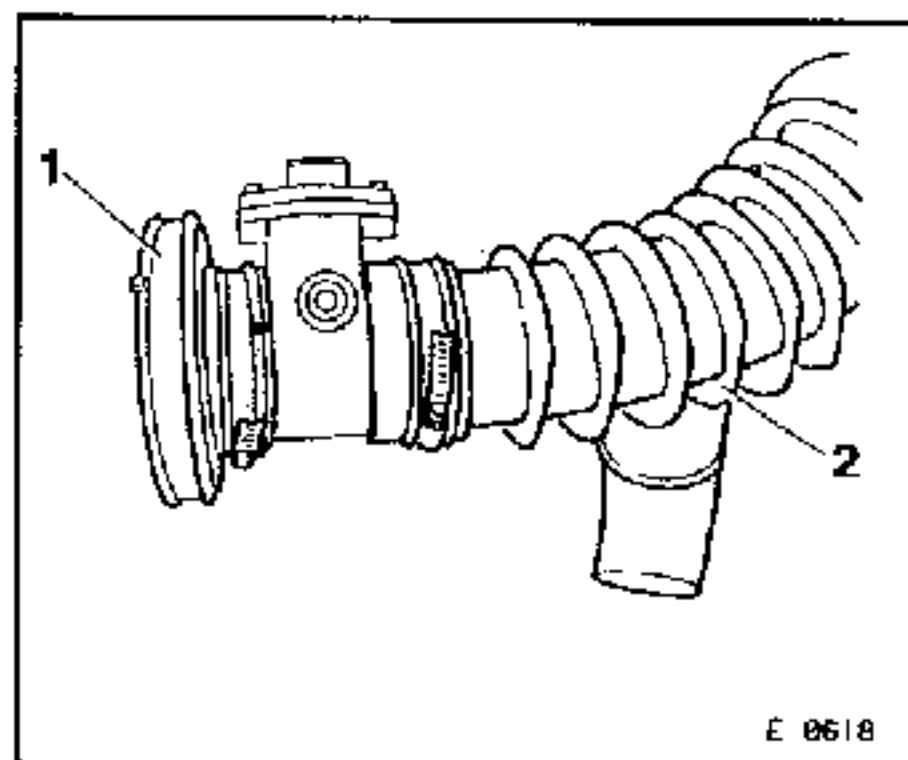


### Remove, Disconnect

Intake hoses (1 and 2) from the hot film mass air flow sensor.

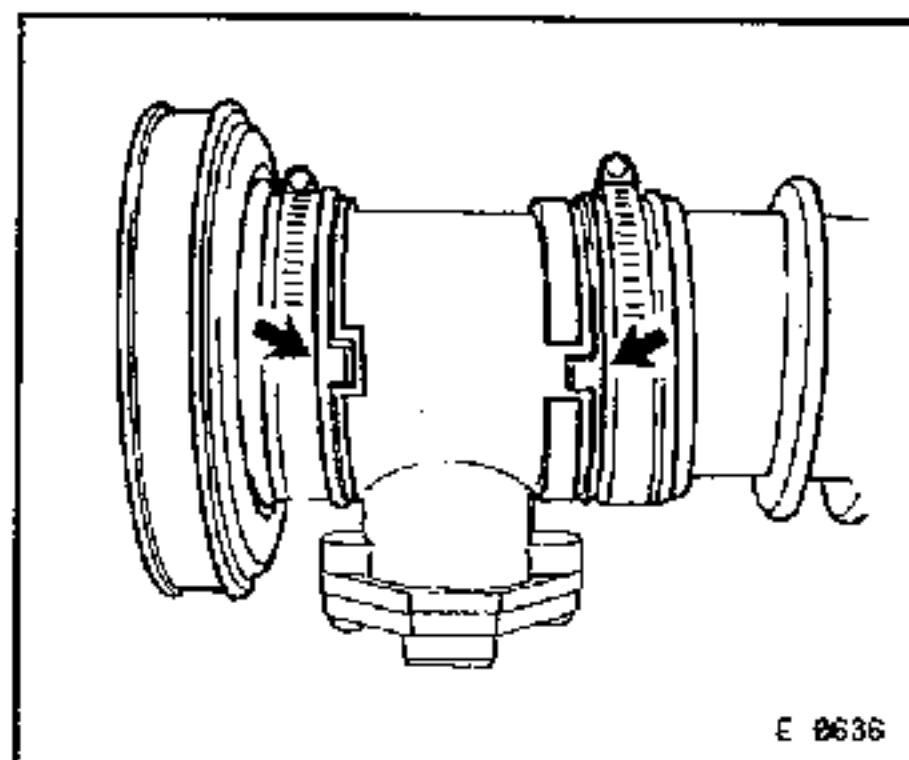
#### Note:

The position of the intake hoses for correct assembly.



### Install, Connect

Both intake hoses to the hot film mass air flow sensor, ensuring correct positioning as indicated (arrows).



### Install, Connect

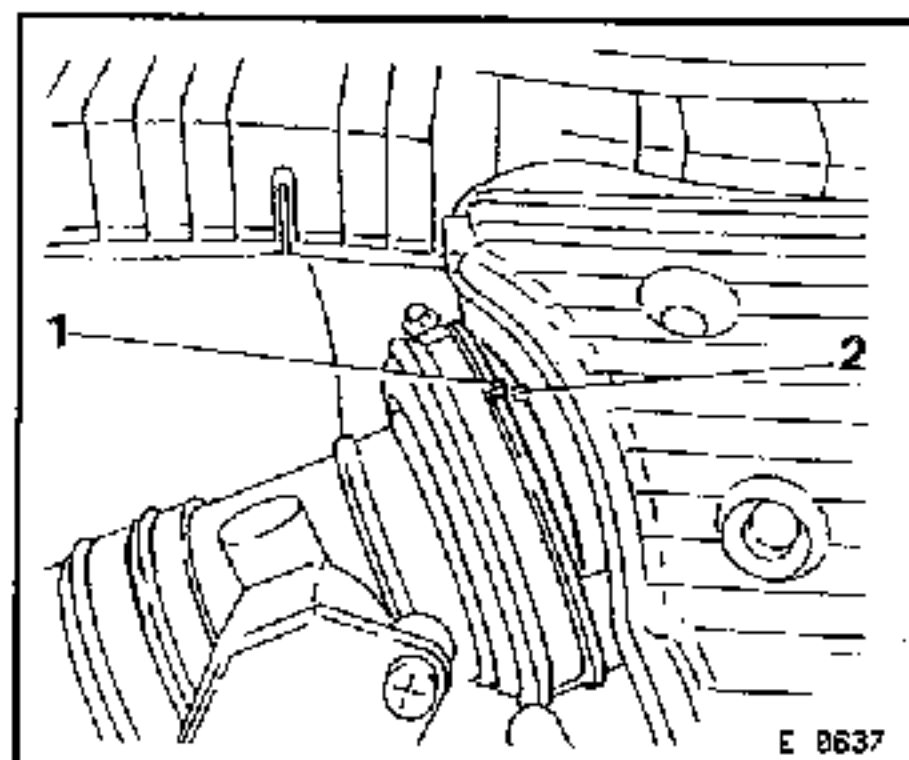
Upper portion of the air cleaner, together with the air intake hose and hot film mass air flow sensor.

#### Note:

Ensure that the seating at the pre-volume chamber is secure and that the marks (1 and 2) are aligned.

Wiring harness plug (1) to the hot film mass air flow sensor.

Wiring harness plug (2) to the intake air temperature sensor.



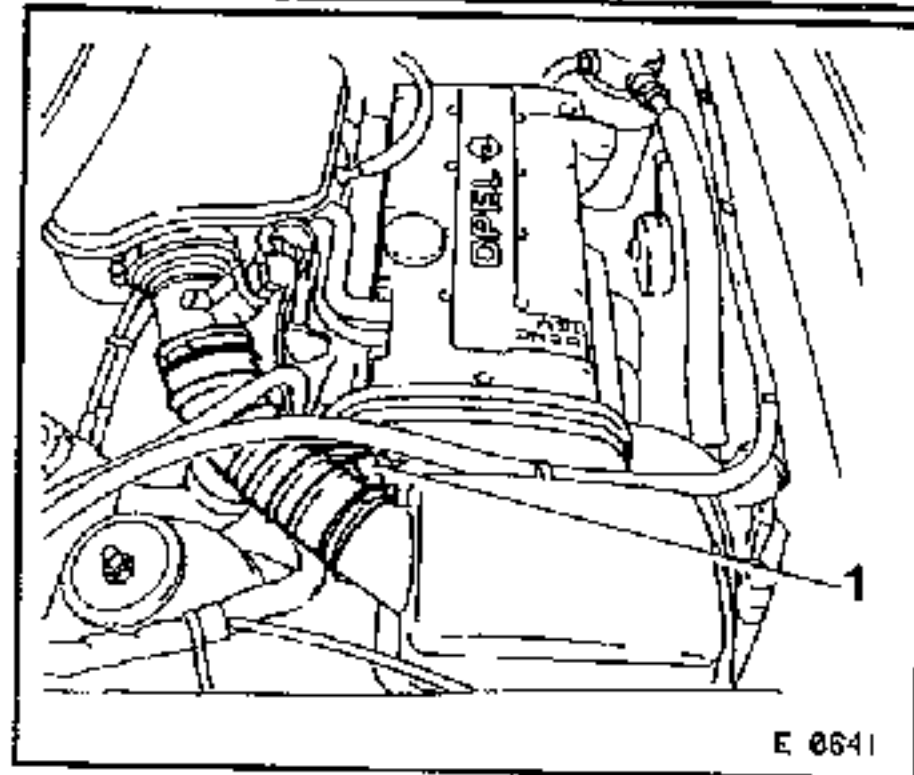
# DOHC ENGINE - MOTRONIC M 2.8

## Intake Air Temperature Sensor, Remove and Install

### Remove, Disconnect

Wiring harness plug (1) from intake air temperature sensor.

Air intake hose.



### Remove, Disconnect

Intake air temperature sensor from hose.

### Important!

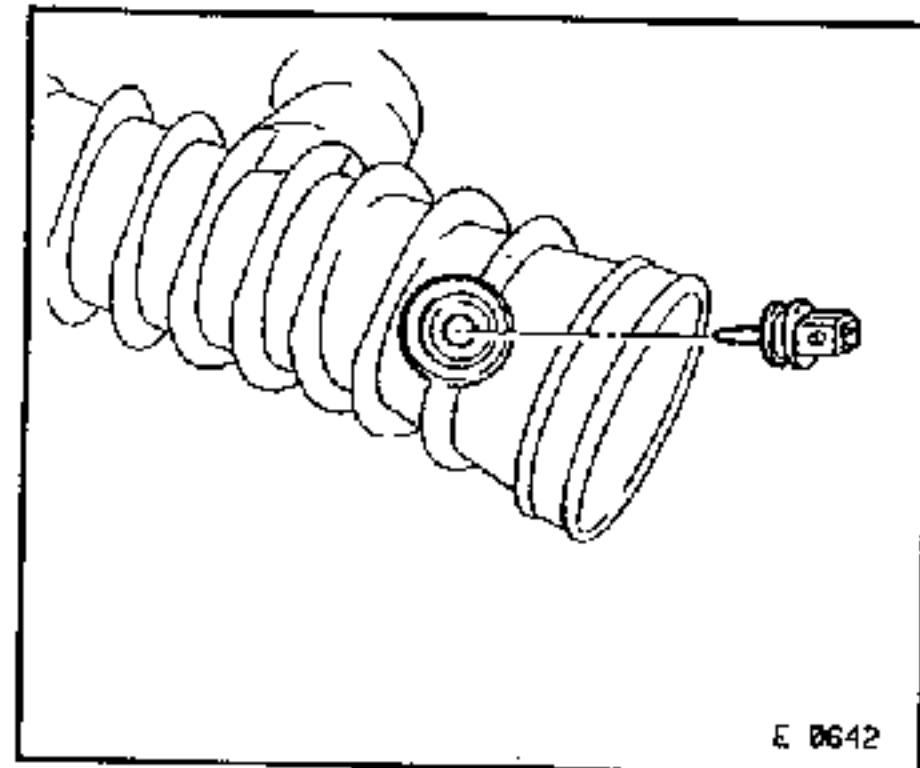
Do not damage the air intake hose during this process.

### Install, Connect

Intake air temperature sensor to hose.

Air intake hose.

Wiring harness plug (1) to intake air temperature sensor.

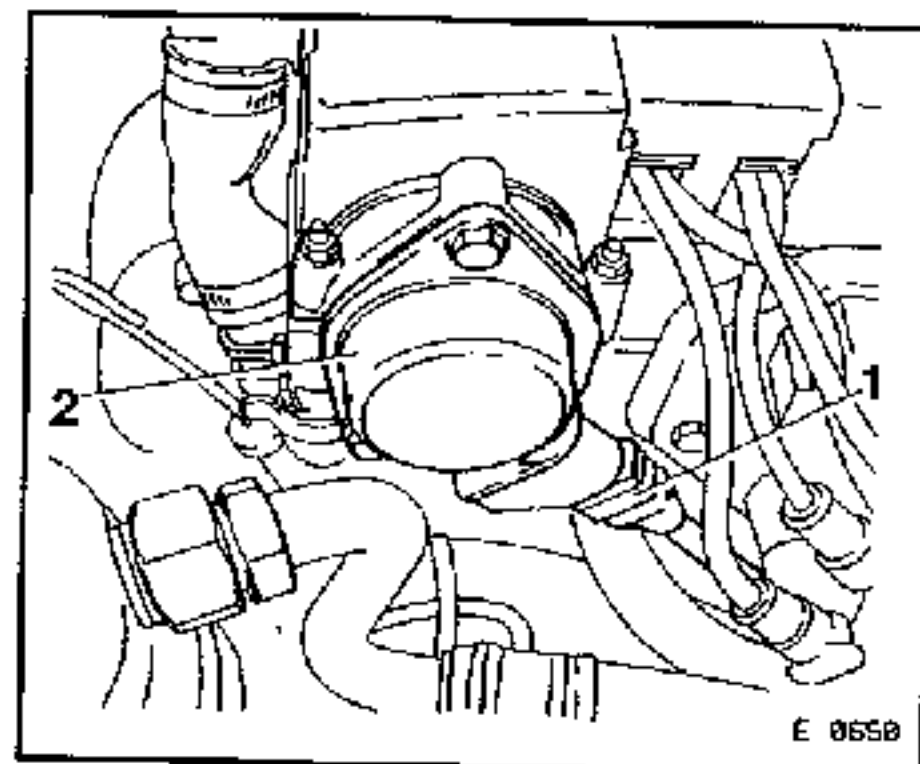


## Camshaft Sensor Disc, Remove and Install

### Remove, Disconnect

Wiring harness plug (1).

Camshaft sensor housing (2).



### Remove, Disconnect

Disc (1).

### Install, Connect

Disc (1).

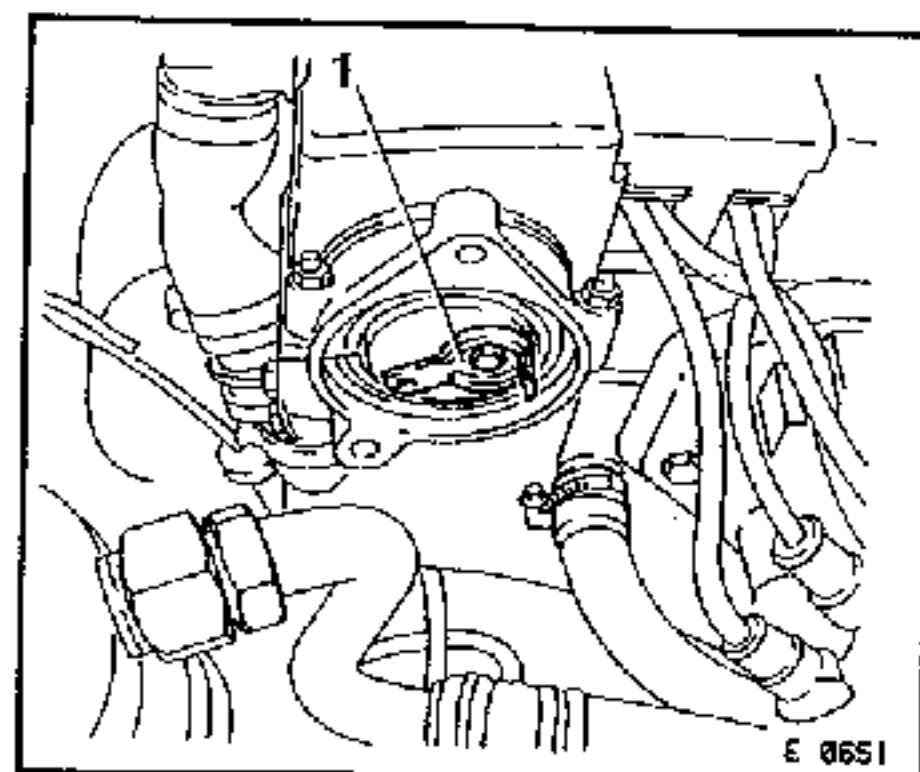
Camshaft sensor housing.

### Tighten (Torque)

Camshaft sensor disc.....	8 Nm
Camshaft sensor housing.....	15 Nm

### Install, Connect

Wiring harness plug to the camshaft sensor.



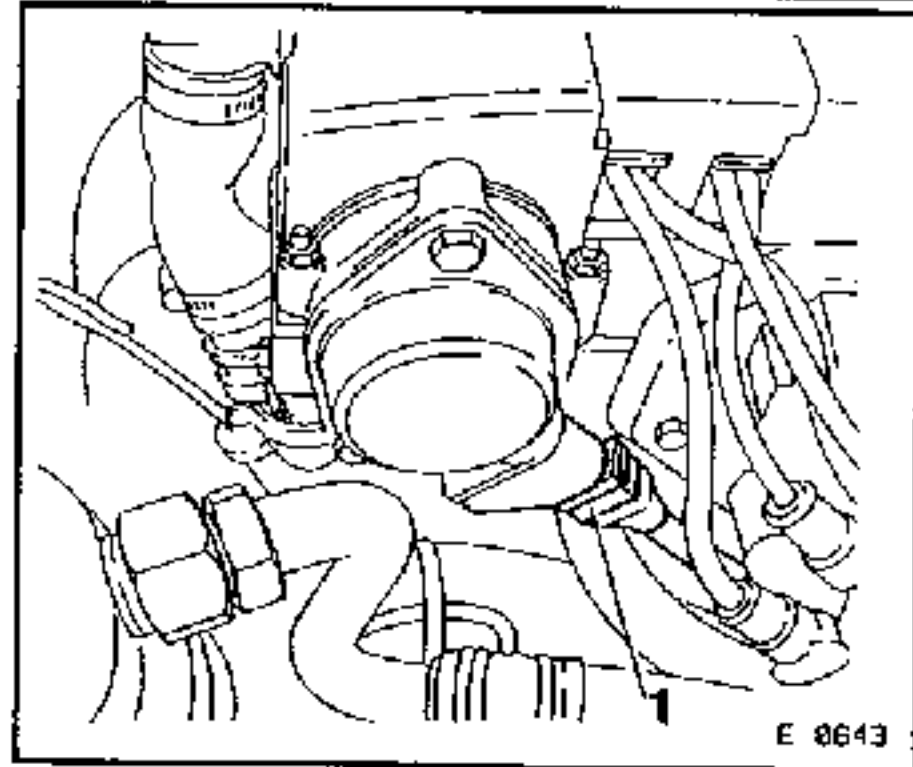
# DOHC ENGINE - MOTRONIC M 2.8

## Camshaft Sensor, Remove and Install

### Remove, Disconnect

Wiring harness plug from camshaft sensor.

Camshaft sensor (1) with sealing ring, from housing.



### Install, Connect

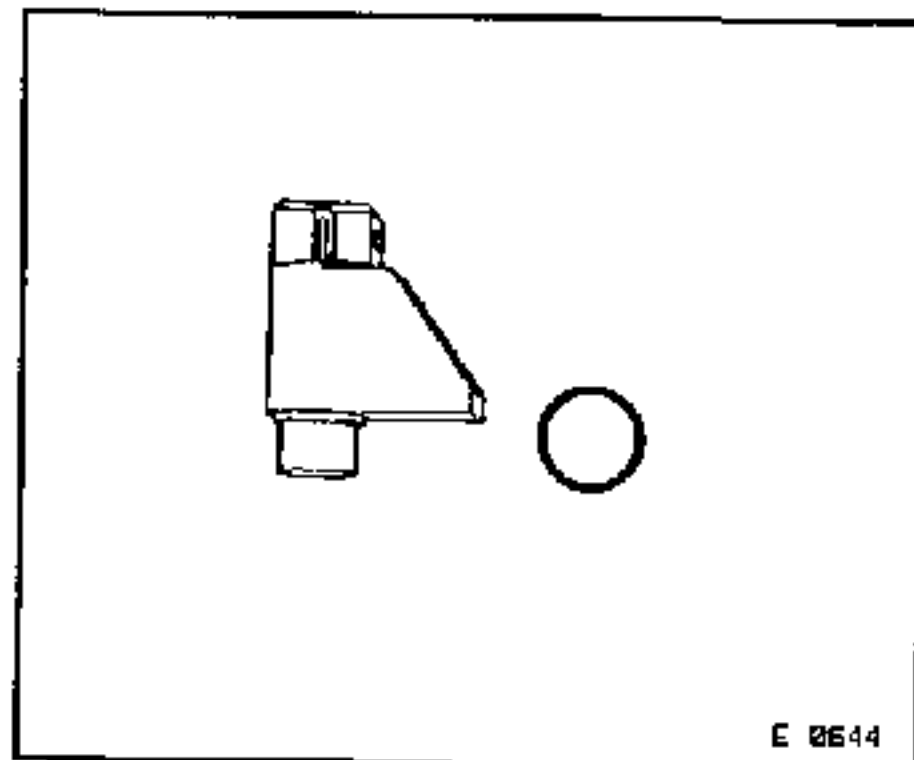
Camshaft sensor with seal ring.

### Tighten (Torque)

Camshaft sensor..... 6 Nm

### Install, Connect

Wiring harness plug to camshaft sensor.



## Inductive Pulse Pick-up, Remove and Install

### Note:

Inspect the engine accessories bracket to see if the hole (1) has a small opening. If so, remove the bracket. Refer to the Section, "Engine Timing Side, Air Cleaner Housing", in this Volume for the necessary procedure.

### Remove, Disconnect

Wiring harness plug from the inductive pulse pick-up.

Required straps securing the inductive pulse pick-up lead. Note lead routing for reassembly.

Inductive pulse pick-up.

### Note:

Should the engine accessories bracket have a large opening (1), level with the inductive pulse pick-up, separate the cable from the inductive pulse pick-up, then remove the inductive pulse pick-up.

### Install, Connect

Inductive pulse pick-up with new seal ring.

### Tighten (Torque)

Inductive pulse pick-up ..... 6 Nm4

### Install, Connect

Wiring harness plug to inductive pulse pick-up.

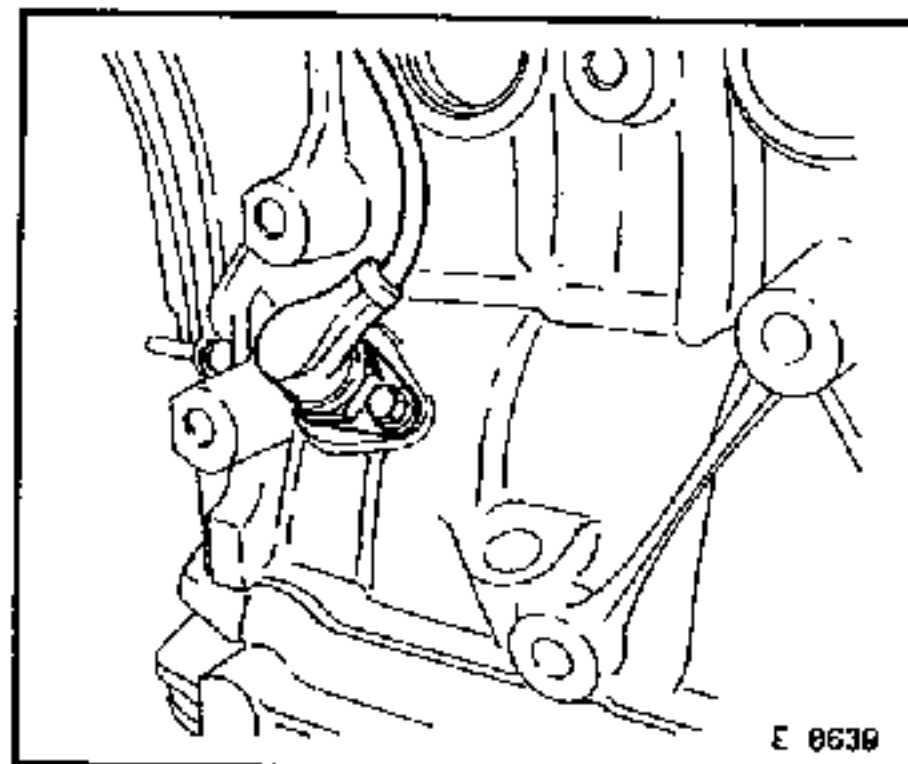
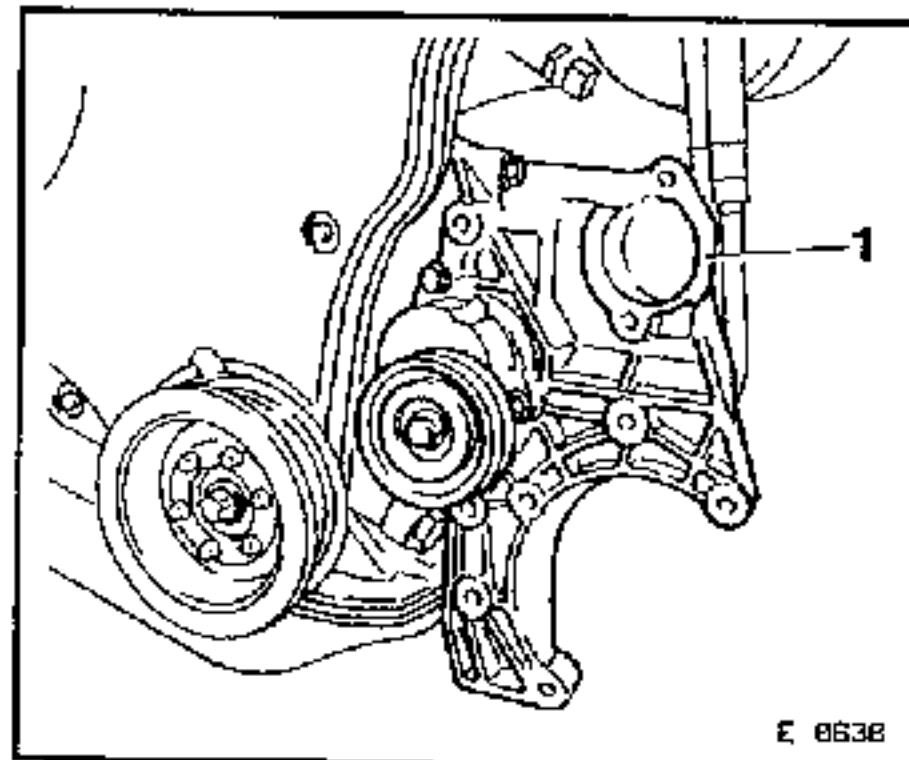
### Note:

Version with larger opening; ensure that cable routing does not touch the exhaust manifold or rotating parts such as the ribbed V-belt.

### Install, Connect

Cable retaining straps as noted on removal.

If removed, the engine accessories bracket. Refer to the Section, "Engine Timing Side, Air Cleaner Housing", in this Volume for the necessary procedure.





# DOHC ENGINE - MOTRONIC M 2.8

## Fuel Pump Relay, Remove and Install

### Remove, Disconnect

Unclip right footwell cover, after removing the right hand door sill panel.

Relay bracket.

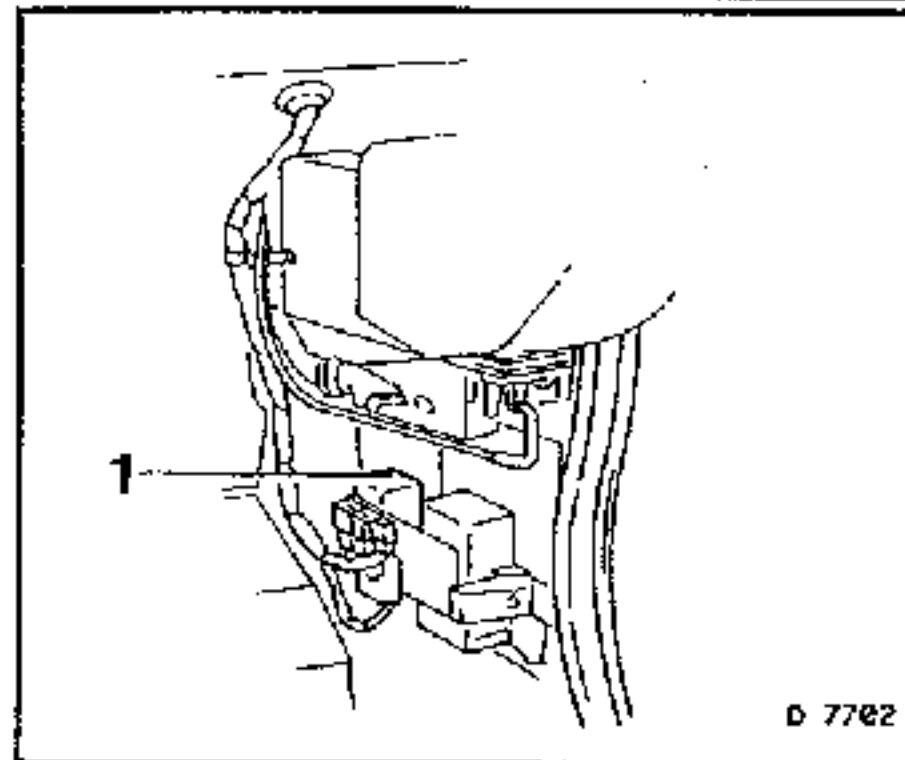
Fuel pump relay (1) from socket.

### Install, Connect

Fuel pump relay (1) in socket.

Relay bracket.

Footwell cover, and right hand door sill panel.



## Motronic Control Unit, Remove and Install

### Remove, Disconnect

Switch off ignition.

Unclip right footwell cover, after removing the right hand door sill panel.

Control unit.

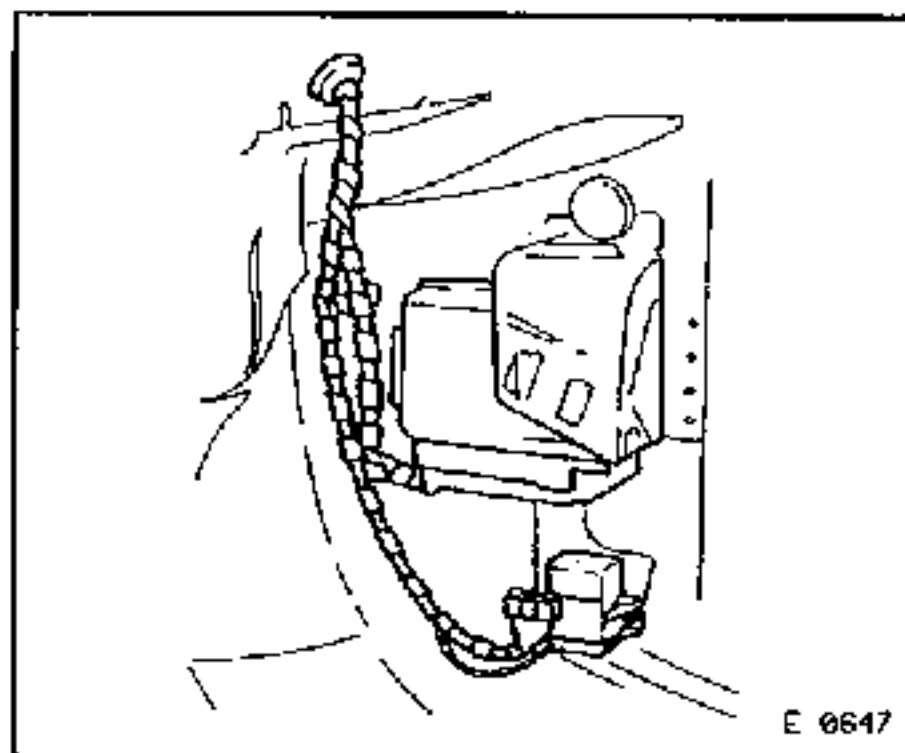
Control unit wiring harness plug.

### Install, Connect

Control unit wiring harness plug.

Control unit.

Footwell cover, and right hand door sill panel.



## Controlled Canister Purge Valve, Remove and Install

### Note:

For a more clear presentation, illustration E 0640, shows the controlled canister purge valve with the engine removed.

### Remove, Disconnect

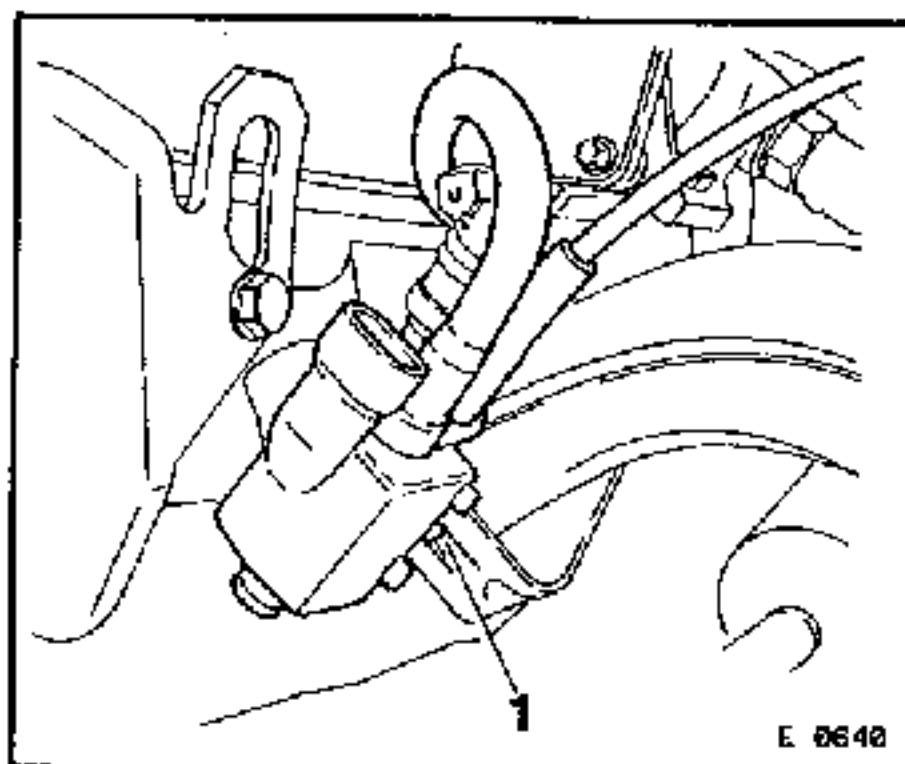
Wiring harness plug from controlled canister purge valve.

Hoses from the controlled canister purge valve.

Clamp the hose leading to the carbon canister.

Using a screwdriver, press in the lug (1) to release the controlled canister purge valve.

Controlled canister purge valve.



### Install, Connect

Controlled canister purge valve to the bracket. Press the retaining lug back towards the transmission side.

Hoses to the controlled canister purge valve.

Unclamp the carbon canister hose.

Wiring harness plug to the controlled canister purge valve.

# DOHC ENGINE - MOTRONIC M 2.8

## RECOMMENDED TORQUE VALUES

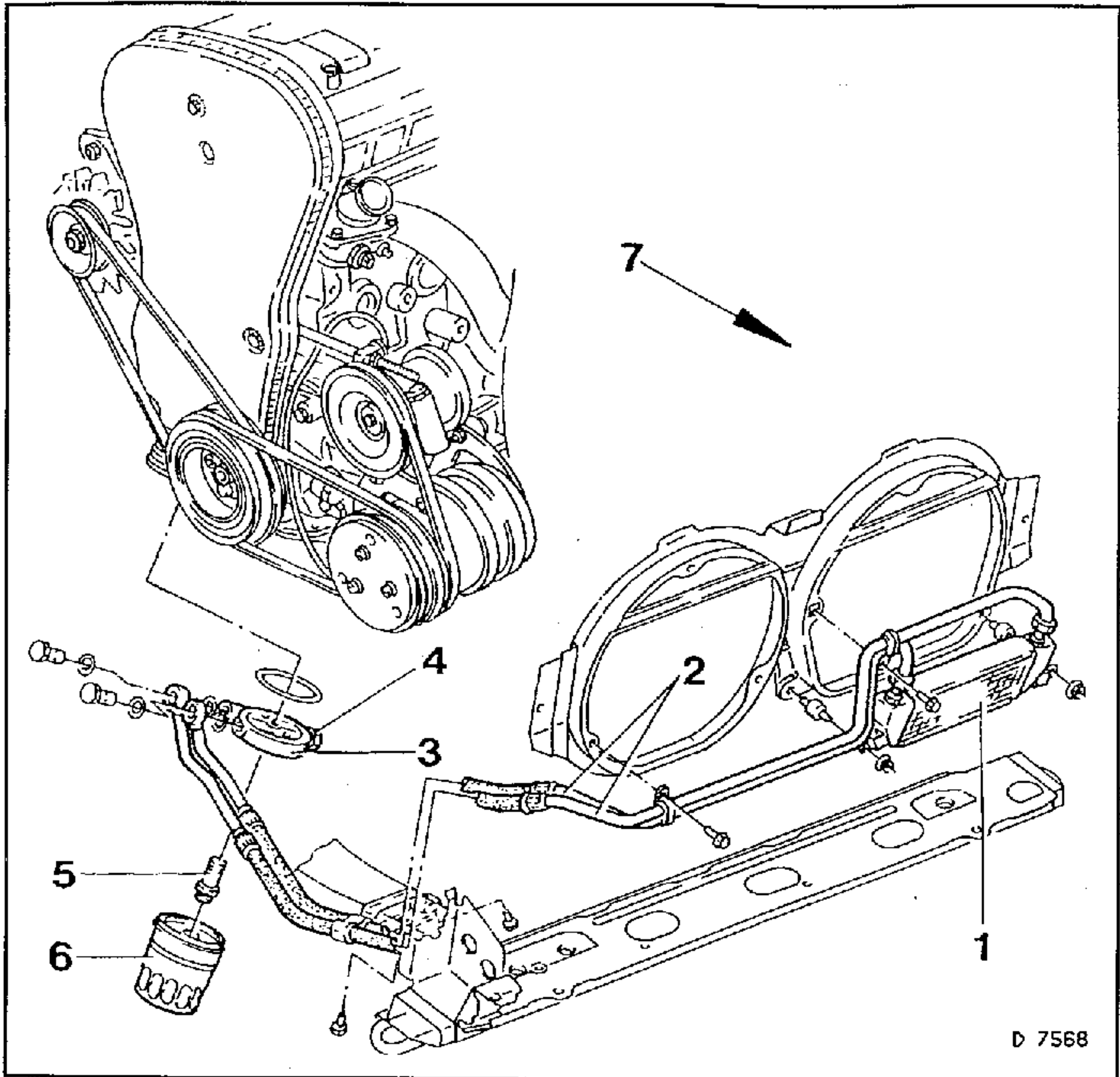
(Motronic M 2.8)

	Nm
Camshaft sensor disc retaining bolt .....	8
Camshaft sensor housing bolts .....	15
Camshaft sensor with sealing ring .....	6
Dual spark ignition coil with bracket .....	25
Inductive pulse pick-up with new seal ring .....	6
Oxygen sensor to exhaust pipe .....	30 (1)

(1) If re-using, apply Special Grease, Part Number 5613695 to the cleaned oxygen sensor threads.

# DOHC ENGINE - OIL CIRCUIT

## OIL CIRCUIT



Layout of Oil Cooler (C 20 XE)

### Illustration Key;

1. Oil Cooler
2. Oil Cooler Line
3. Adaptor, Oil Cooler
4. Blanking Plug for Thermostat
5. Hollow Threaded Adaptor
6. Oil Filter Cartridge
7. Front of Vehicle

### Note:

While the above illustration shows a C 20 XE engine up to MY'93 (V-belt drive), the general arrangement of the oil cooler circuit and components remains the same for all C 20 XE models.

# DOHC ENGINE - OIL CIRCUIT

## Oil Filter Cartridge, Replace

### Remove, Disconnect

Flap on engine compartment cover (Under the right hand wheel arch) for the oil filter cartridge.

Oil filter cartridge using a commercially available tool.

### Install, Connect

New oil filter cartridge, after filling with clean engine oil and lightly applying a smear of oil to the oil filter cartridge seal ring.

Flap on the engine compartment cover for the oil filter cartridge.

### Tighten (Torque)

Oil filter cartridge to oil pump..... 15 Nm

### Inspect

Engine oil level, topping up as required.

## Bypass Valve, Replace

### Remove, Disconnect

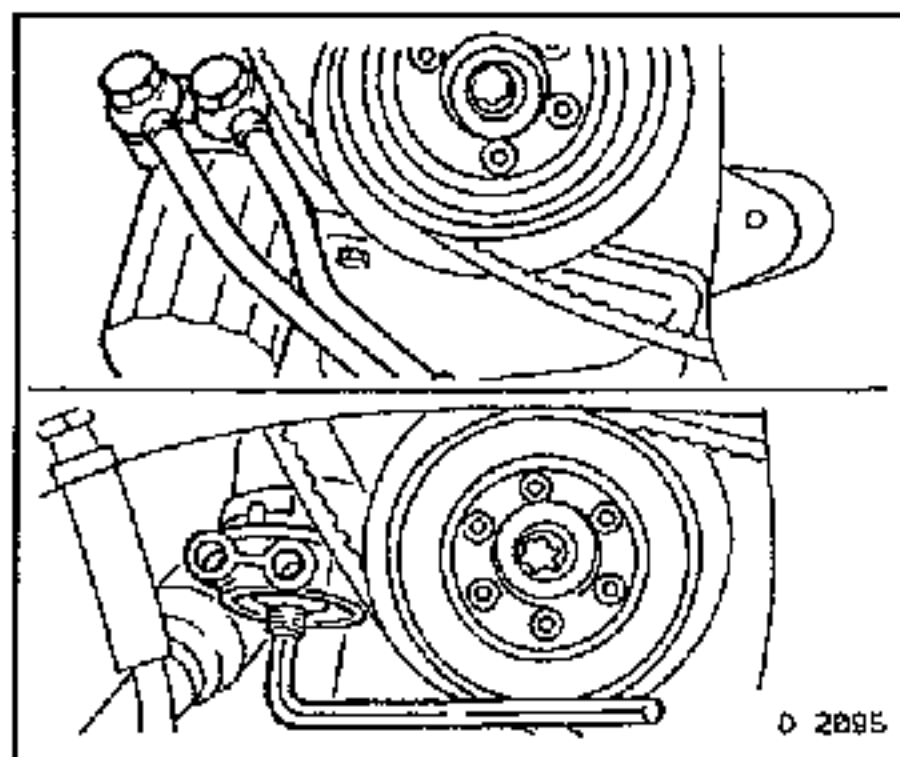
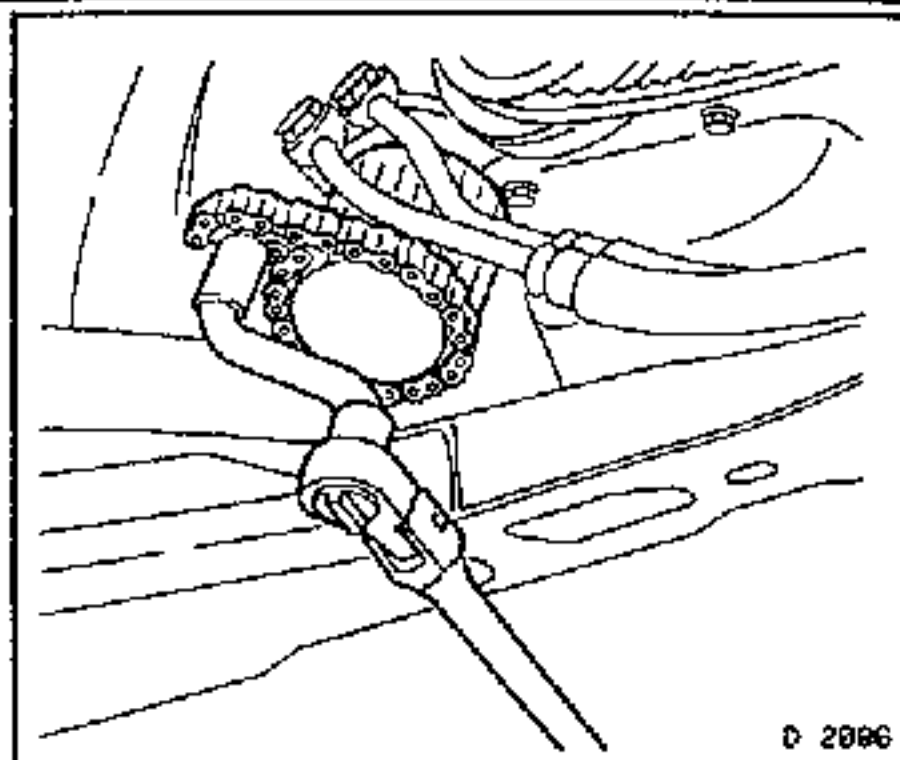
Engine compartment cover.

Oil cooler lines from oil cooler adaptor.

Oil filter cartridge using a commercially available tool.

Hollow threaded adaptor, using a commercially available Allen key.

Oil cooler adaptor.



### Remove, Disconnect

Using an M 10, taper tap, cut a thread into the bypass valve disc, then prise the bypass valve from its seat.

### Install, Connect

Bypass valve, using a 15 mm drift, until the valve is seated.

Oil cooler adaptor with a new seal ring.

Hollow threaded adaptor.

New oil filter cartridge. Refer to previous operation in this Section.

Fill engine with new engine oil as required.

Oil cooler lines to the oil cooler adaptor.

Engine compartment cover.

### Tighten (Torque)

Hollow threaded adaptor to oil pump ..... 23 Nm \*

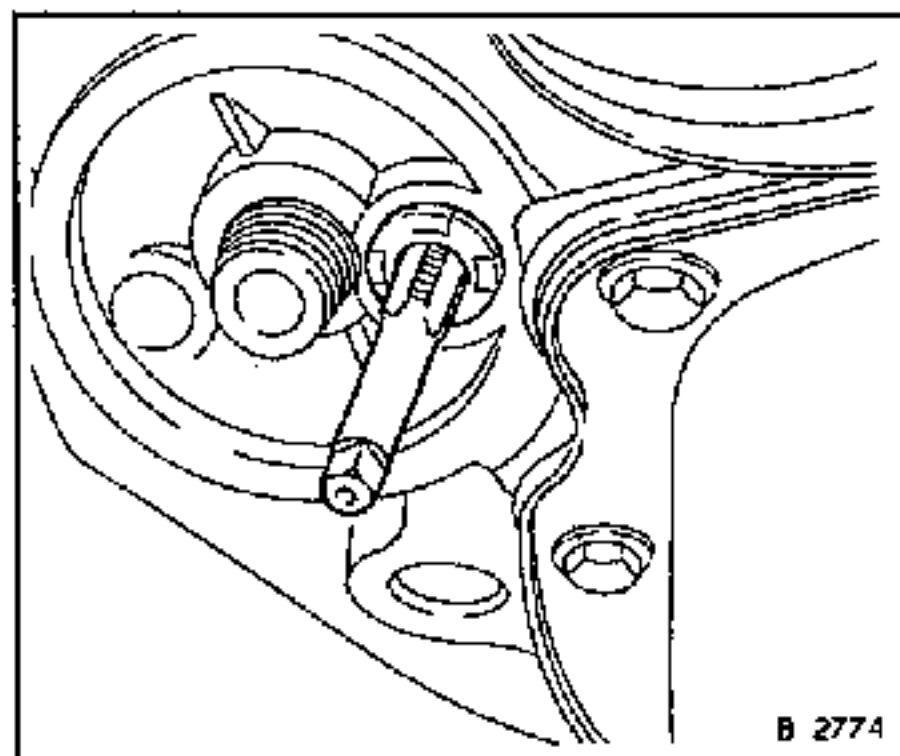
Oil filter cartridge to oil pump..... 15 Nm

Oil cooler lines to oil cooler adaptor..... 30 Nm

\* Apply thread locking compound to the threads, such as Loctite 242 or equivalent to Holden's Specification HN1256.

### Inspect

Check and adjust engine oil level.



# DOHC ENGINE - OIL CIRCUIT

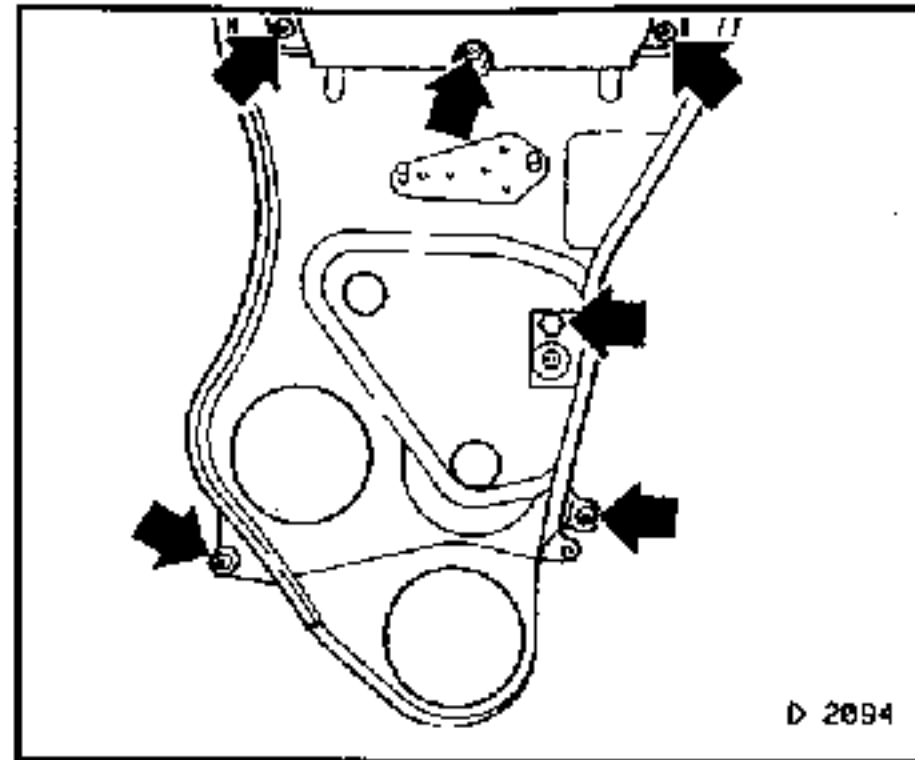
## Oil Pump, Remove and Install

### Remove, Disconnect

Right hand front wheel.

Engine compartment cover.

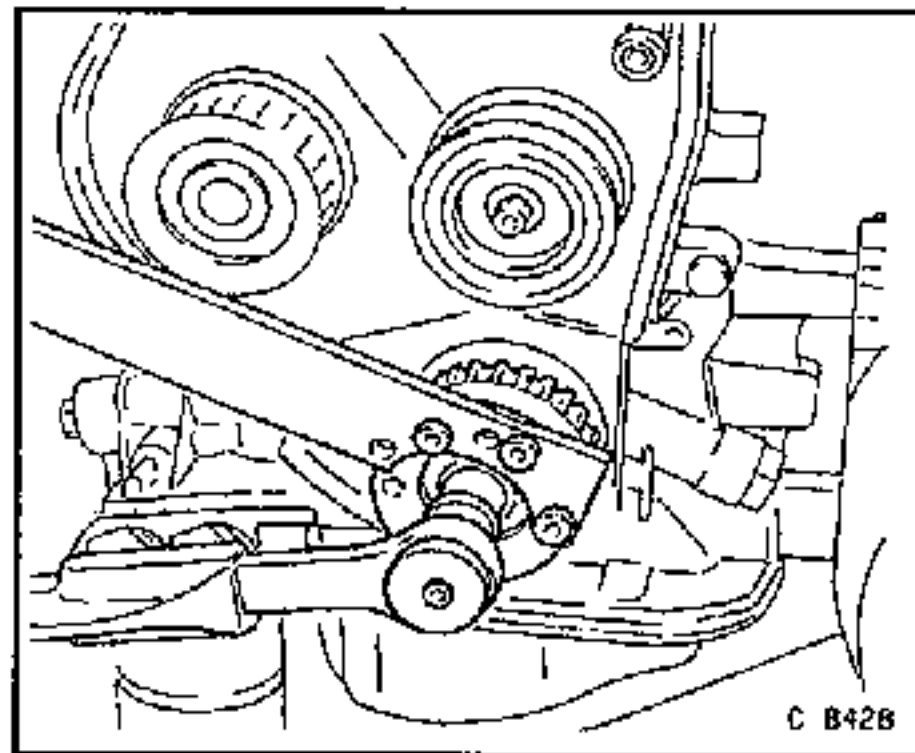
Toothed belt and rear toothed belt cover. Refer to respective operations in the Section, "Engine Timing Side", in this Volume.



### Remove, Disconnect

Use holding wrench KM-662-A to hold the toothed belt drive gear, while removing the fastening bolt with MKM-604-21 (Torx E 20).

Install wheel puller KM-210-A with KM-516 and KM-647, as necessary and remove the toothed belt drive gear.



### Remove, Disconnect

Spacing ring (1) from the crankshaft journal.

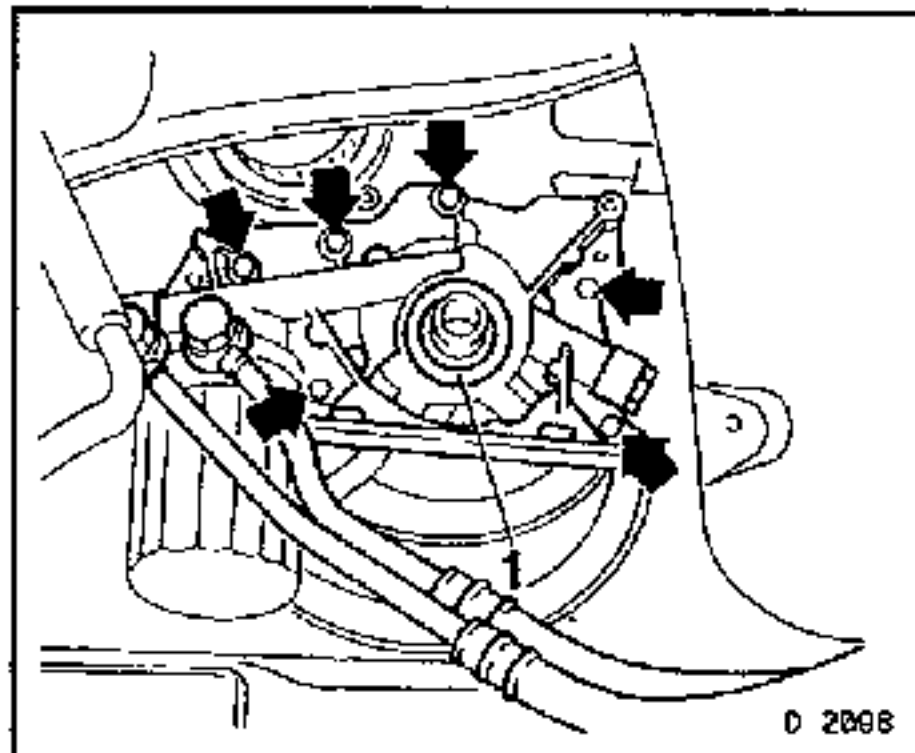
Oil pan. Refer 'Oil Pan Gasket, Replace', in this Section.

Oil pressure switch wiring harness plug.

Oil cooler lines from the oil cooler adaptor.

Oil filter cartridge using a commercially available tool.

Oil pump (arrows) from the cylinder block.



## Oil Pump, Check

### Remove, Disconnect

Oil pump. Refer to the previous operation.

Oil pump cover and pressure relief valve.

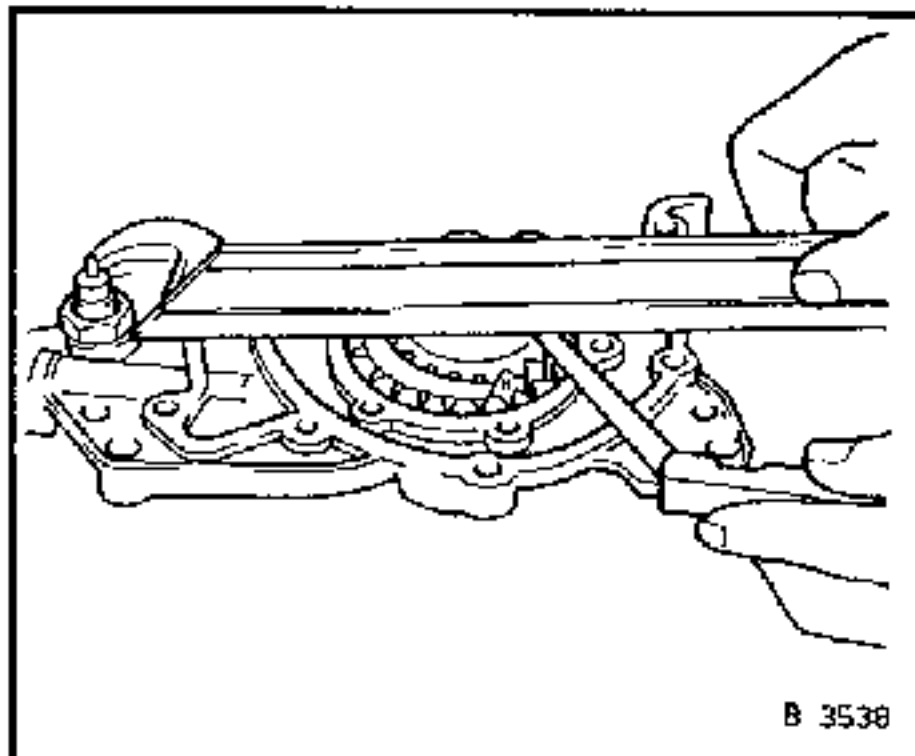
### Inspect

End clearance of toothed gears..... 0.03 - 0.1 mm

Check housing, oil pump cover and pressure relief valve for signs of wear.

### Clean

All sealing surfaces.



# DOHC ENGINE - OIL CIRCUIT

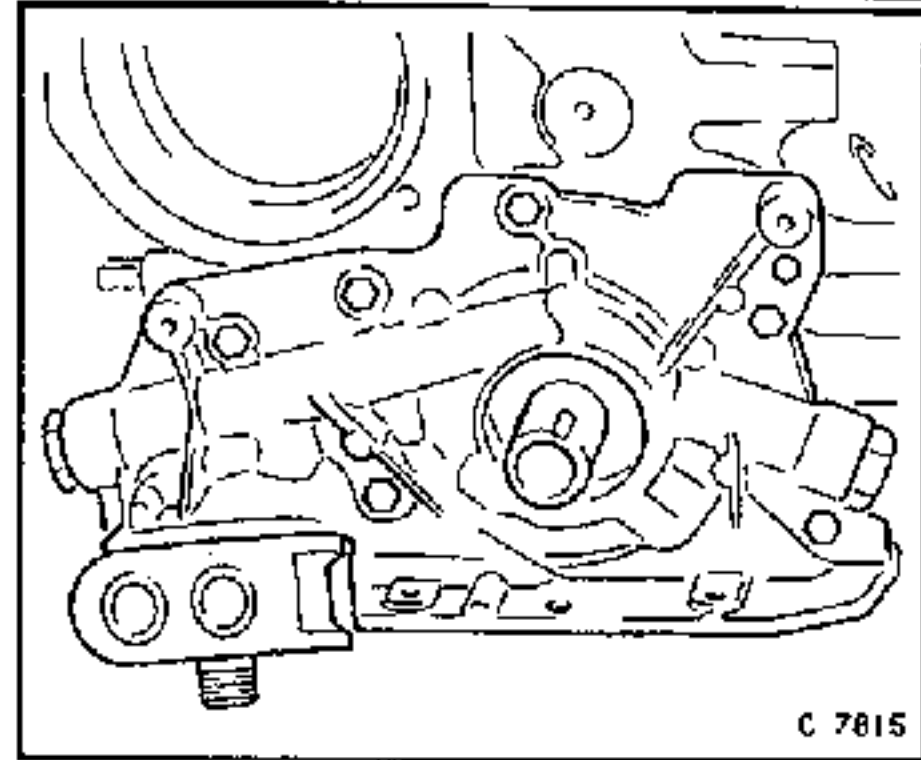
## Install, Connect

Oil pump with new gasket and sealing ring (use protecting sleeve KM-693 after coating the seal lips with protective grease).

New oil filter cartridge, after filling with clean engine oil and applying a smear of oil to the sealing ring.

Oil cooler lines.

Wiring harness plug to the oil pressure switch.



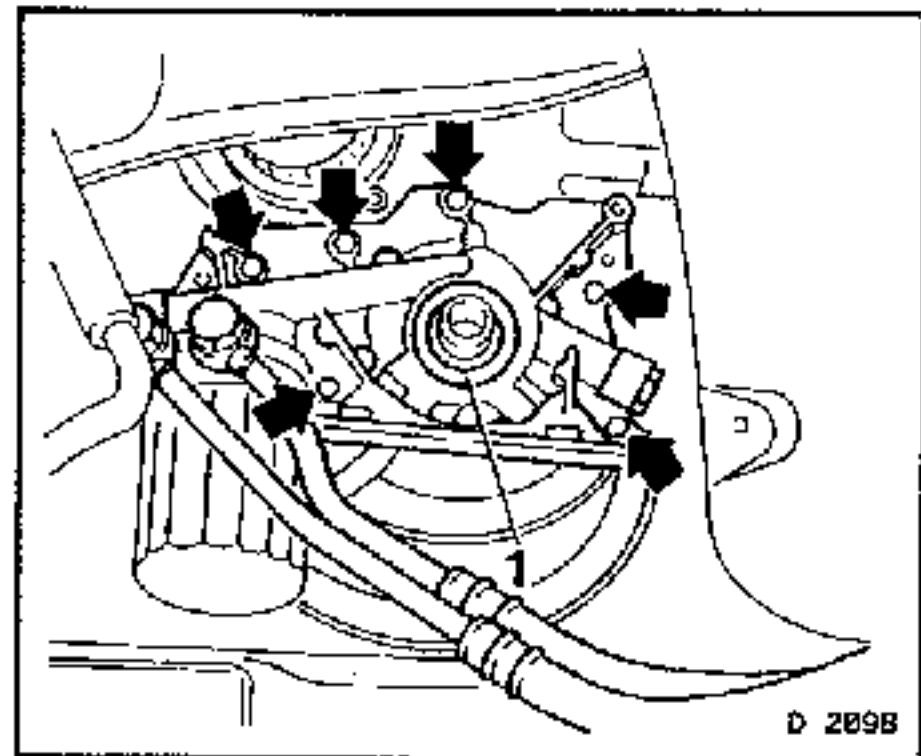
## Install, Connect

Oil pan. Refer 'Oil Pan Gasket, Replace', in this Section.

Spacing ring on crankshaft after applying a thin layer of silicone sealant such as Dow Corning 732 or equivalent to Holden's Specification HN1373.

## Tighten (Torque)

Oil pump to cylinder block.....	6 Nm
Oil filter cartridge to oil pump.....	15 Nm
Oil cooler lines to oil cooler adaptor .	30Nm



## Install, Connect

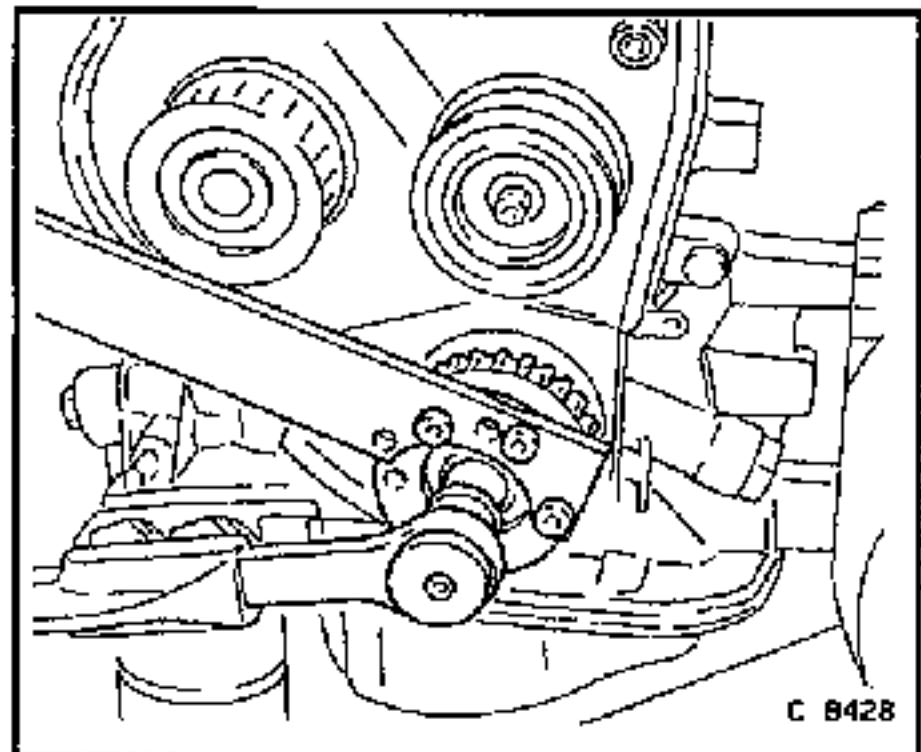
Toothed belt drive gear.

Use holding wrench KM-662-A, while tightening the fastening bolt with MKM-604-21 (Torx E 20). Apply grease to the Torx bolt threads.

## Torque - Angle Method

Toothed belt drive gear to crankshaft.....	250 Nm + 40-50°
--	-----------------

Use new bolts.



## Install, Connect

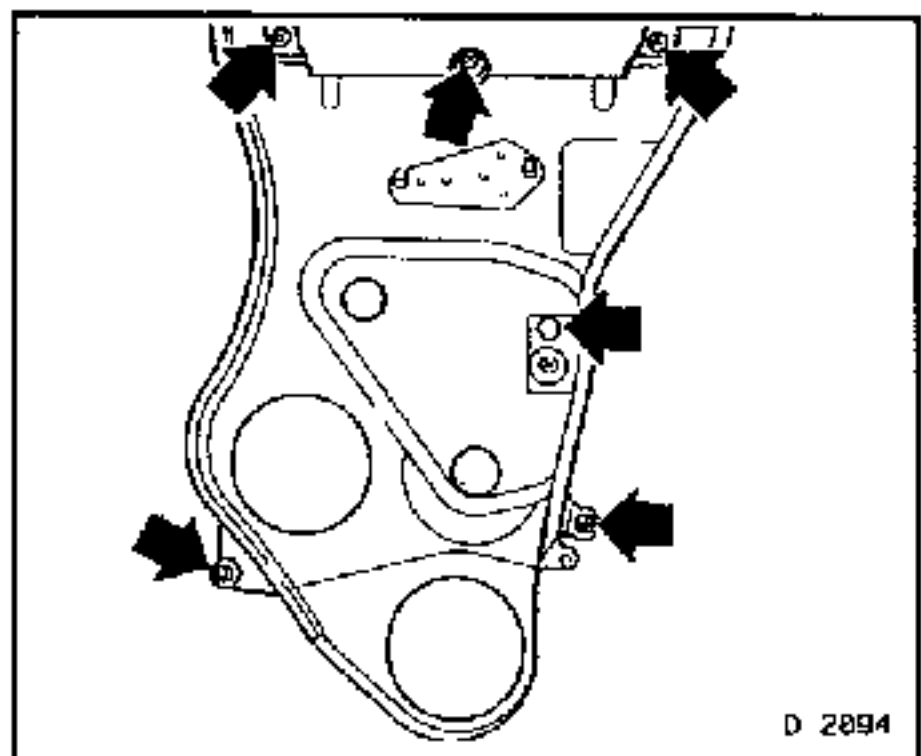
Rear toothed belt cover and toothed belt. Refer to respective operations in the Section, "Engine Timing Side", in this Volume.

Engine compartment cover.

Right hand front wheel.

## Tighten (Torque)

Wheel bolts to front wheel hub .....	110 Nm
--------------------------------------	--------



# DOHC ENGINE - OIL CIRCUIT

## Oil Pan Gasket, Replace

### Remove, Disconnect

For C 20 XE:

Performance header. Refer to 'Gasket, Performance Header, Replace', in the Section 'Cylinder Head', in this Volume.

For C 20 LET:

Front exhaust pipe.

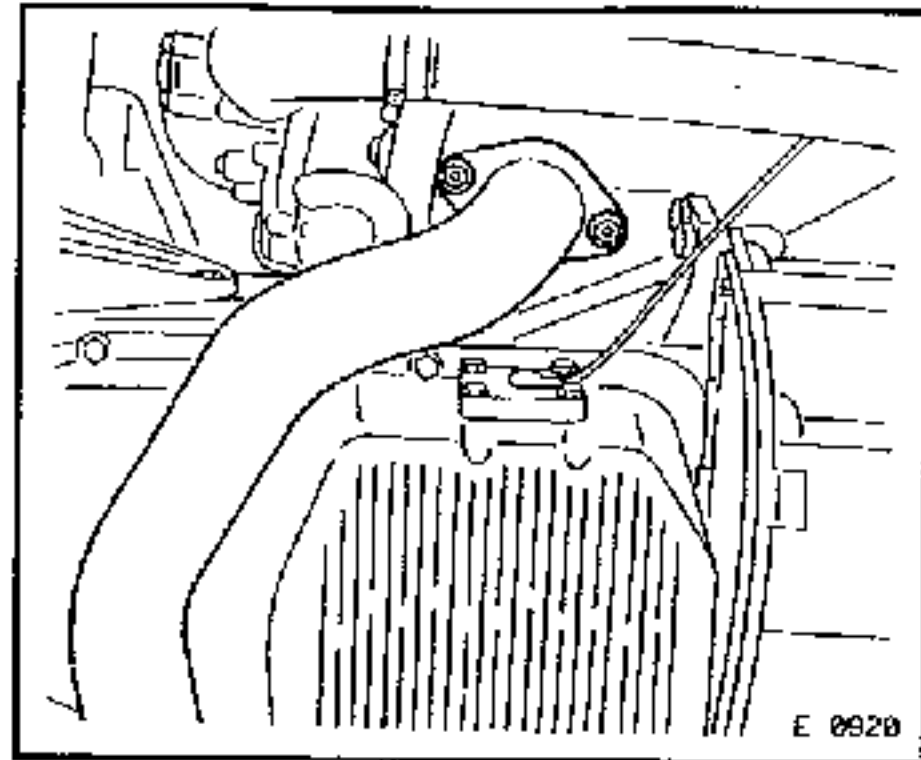
For all Engines:

Wiring harness plug for dynamic oil level check.

Oil drain plug. Collect engine oil in a suitable container.

### Tighten (Torque)

Oil pan plug to oil pan..... 45 Nm

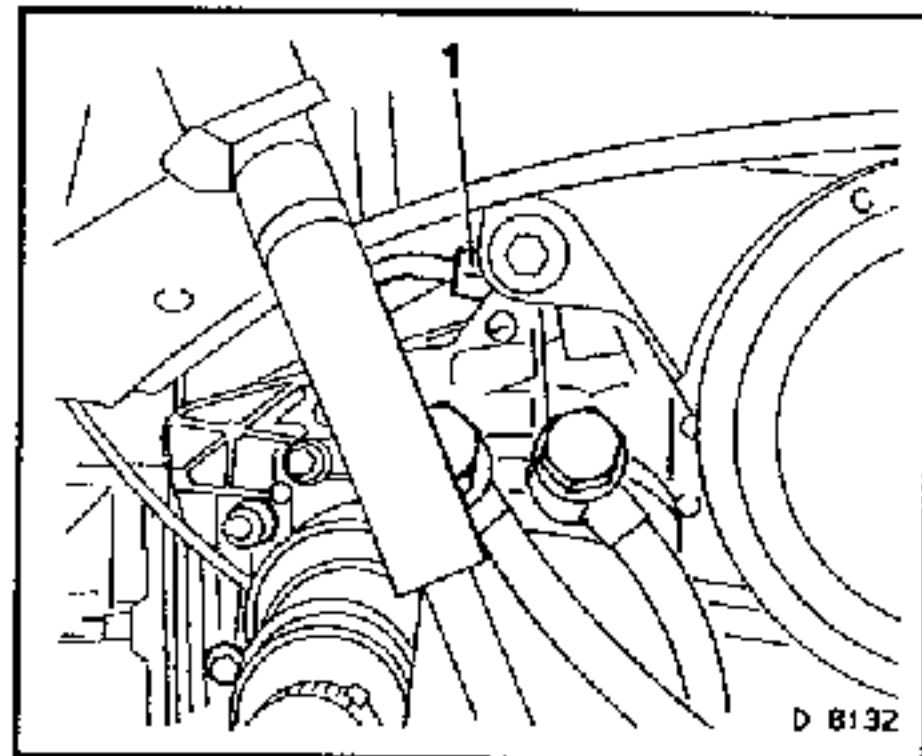


### Remove, Disconnect

For C 20 LET:

Oil feed line (1) from cylinder block connection piece and from turbocharger.

Cover from the transmission.

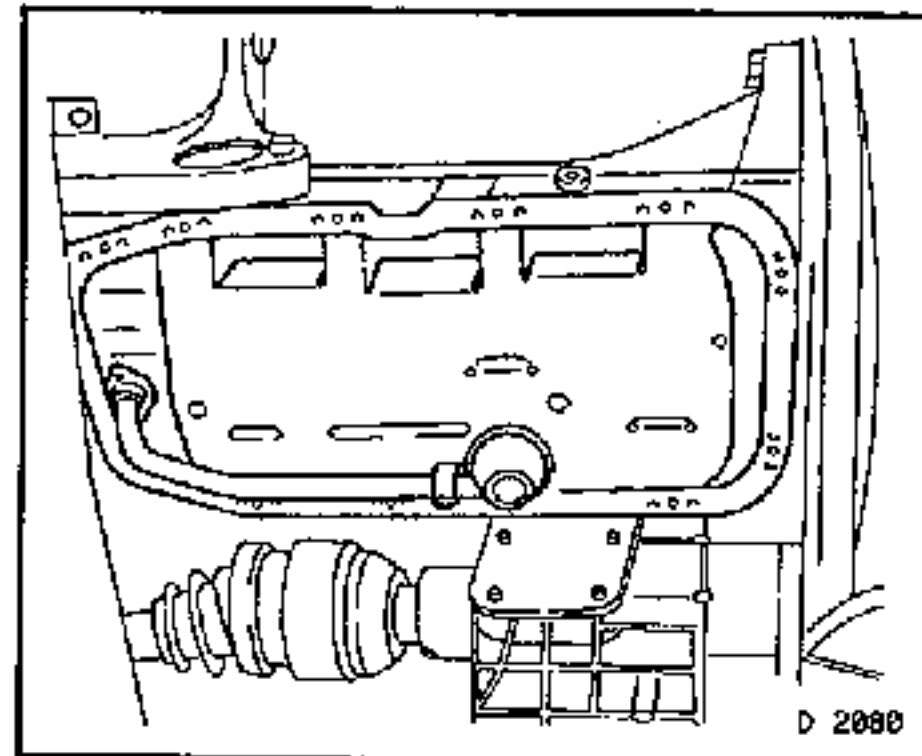


### Remove, Disconnect

Oil pan, oil intake pipe, oil intake pipe bracket, baffle plate.

### Clean

All sealing surfaces.



### Apply

Sealing compound such as General Electric RTV 159 or equivalent to each of the joints (arrows).

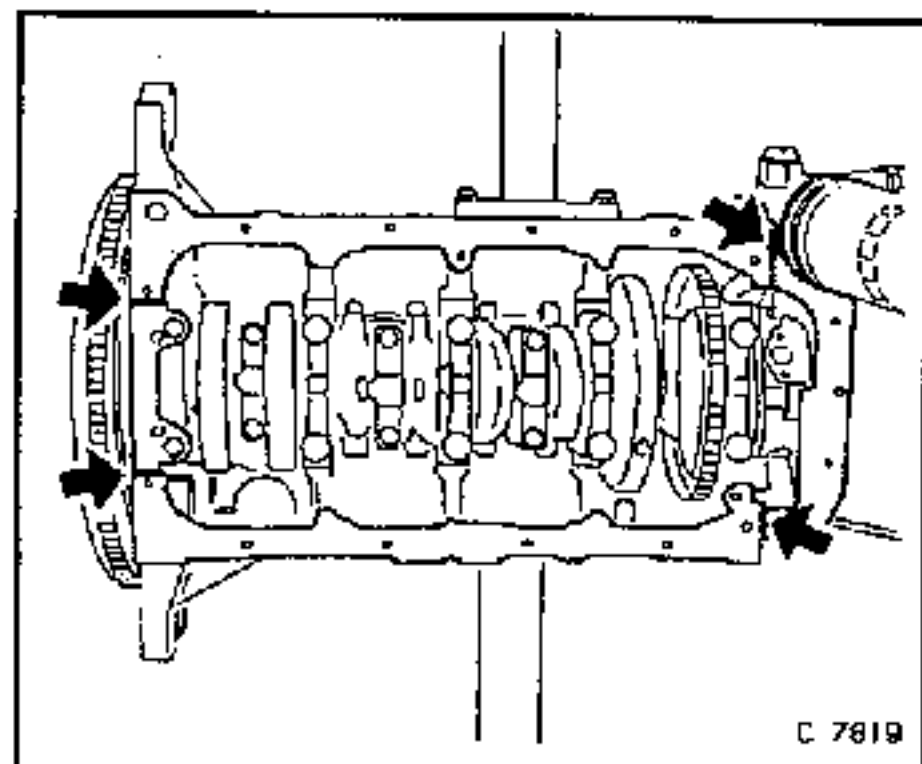
### Install, Connect

New gasket.

### Important!

Check that the correct number of spacing rings are available.

Baffle plate.





# DOHC ENGINE - OIL CIRCUIT

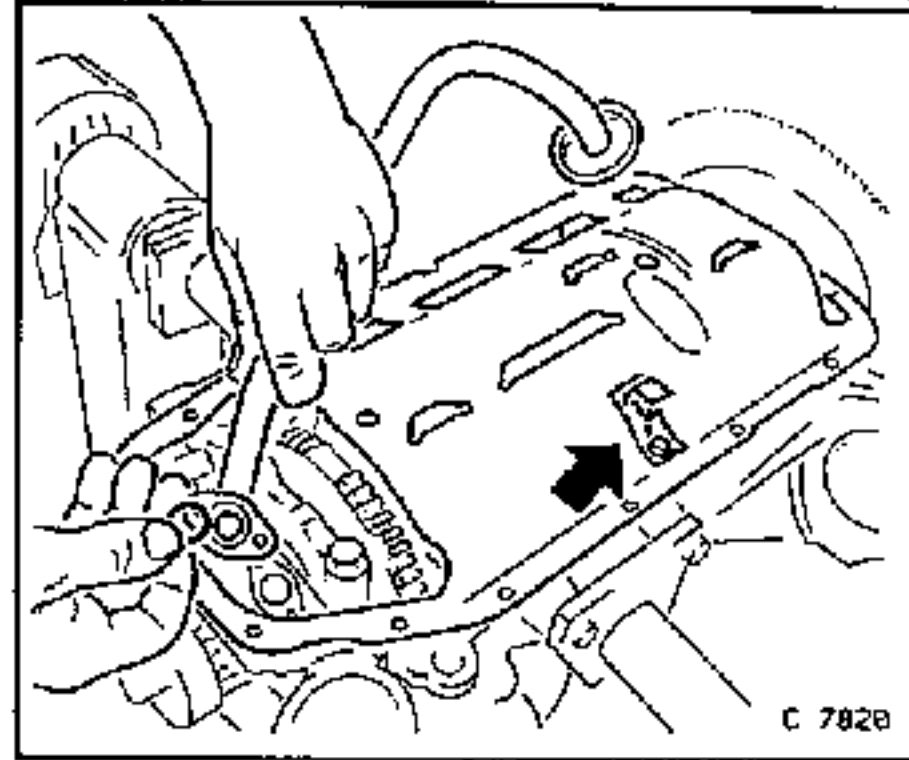
## Install, Connect

Oil intake pipe (with a new seal ring) and bracket.

## Tighten (Torque)

Oil intake pipe bracket to cylinder block.... 6 Nm  
Oil intake pipe to the oil pump ..... 8 Nm \*

- \* Apply thread locking compound to the threads, such as Loctite 242 or equivalent to Holden's Specification HN1256.

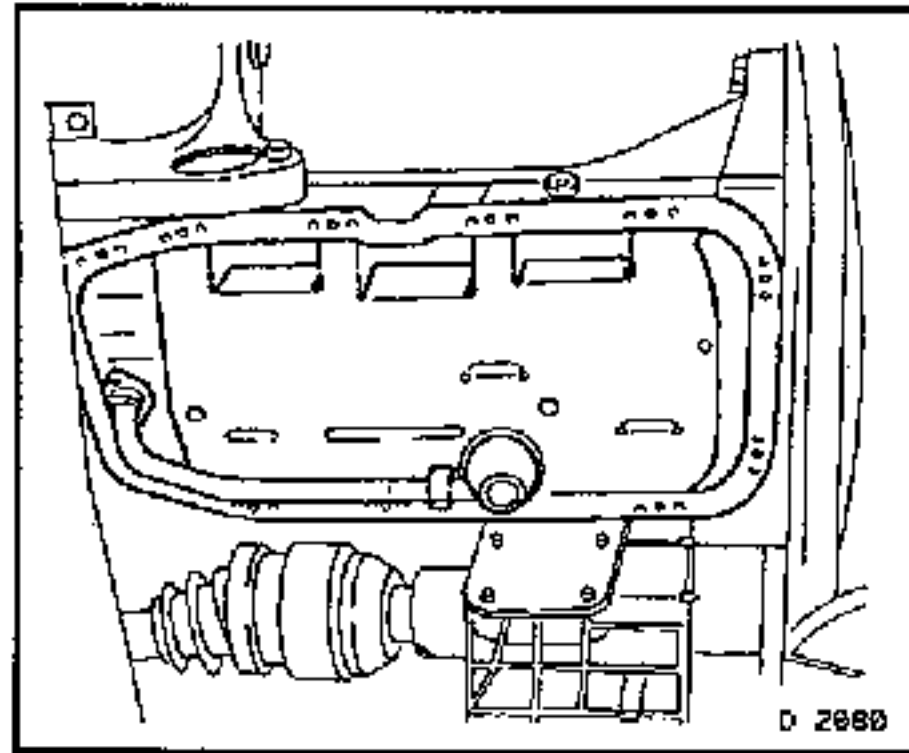


## Install, Connect

Second cork gasket.

## Important!

Check that the correct number of spacing rings are available.



## Install, Connect

Oil pan to cylinder block.

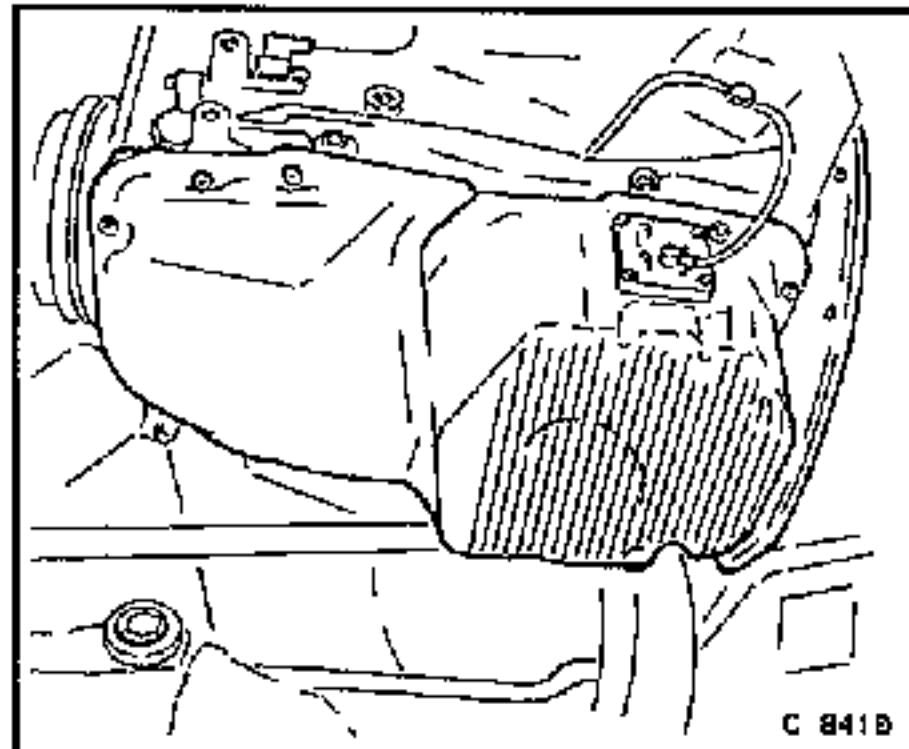
## Tighten (Torque)

Oil pan to cylinder block ..... 15 Nm \*

- \* Apply thread locking compound to the threads, such as Loctite 242 or equivalent to Holden's Specification HN1256.

## Note:

Maximum installation time for this operation is 10 minutes.



## Install, Connect

Cover on transmission.

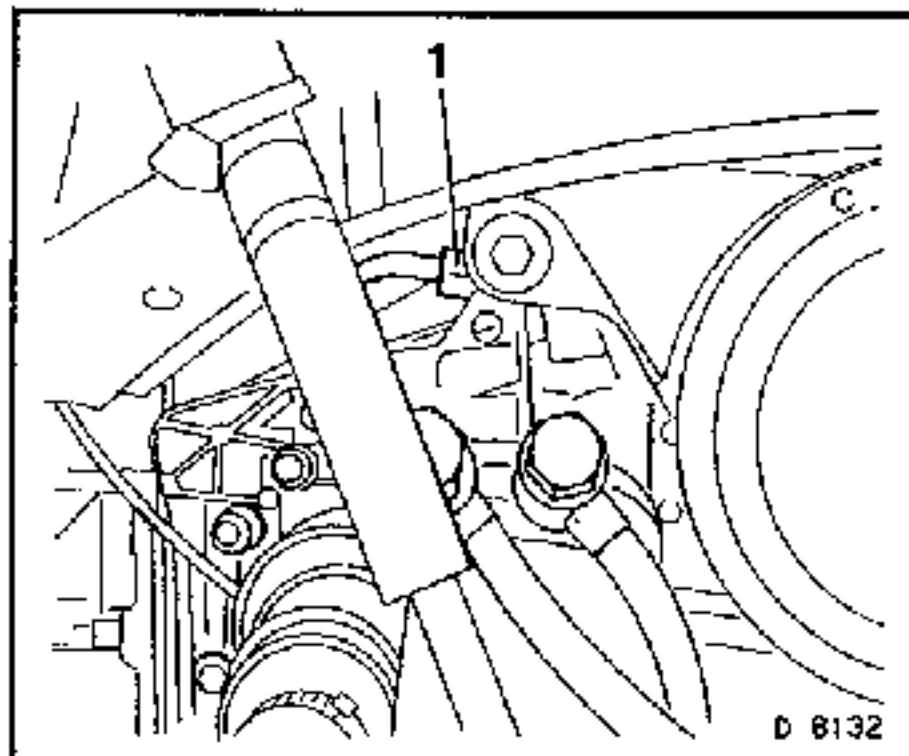
For C 20 LET:

Oil feed line (1) to cylinder block connection piece or to turbocharger.

Front exhaust pipe.

For C 20 XE:

Performance header. Refer to 'Gasket, Performance Header, Replace', in the Section "Cylinder Head", in this Volume.





# DOHC ENGINE - OIL CIRCUIT

## Oil Cooler Thermostat, Replace

### Remove, Disconnect

Engine compartment cover.

Blanking plug (arrow), seal ring, spring and piston.

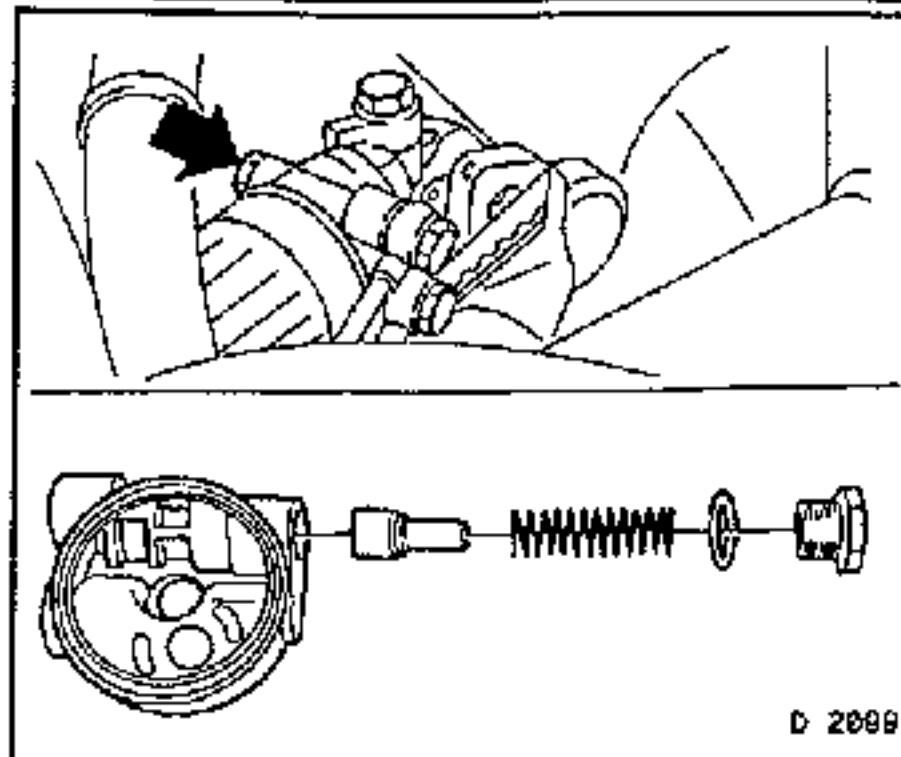
### Install, Connect

Piston, spring, new seal ring and blanking plug.

Engine compartment cover.

### Tighten (Torque)

Blanking plug (M 20) to housing..... 30 Nm



## Oil Pump Safety Valve, Replace

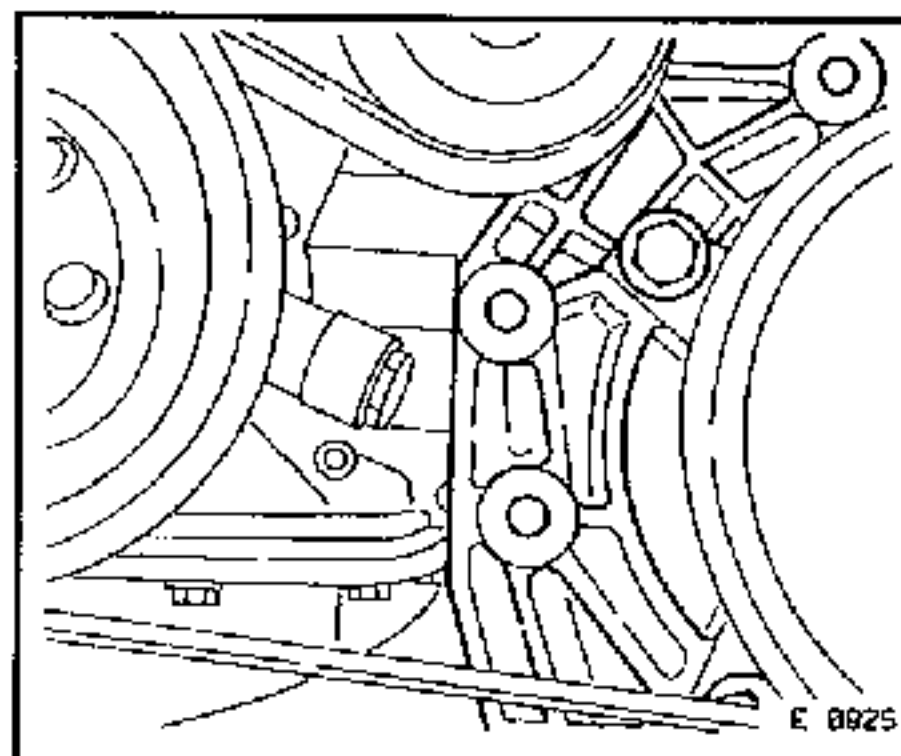
### Remove, Disconnect

Engine compartment cover.

Engine accessories bracket.

For engines as of MY'93 with the ribbed V-belt, refer to 'Engine Accessories Bracket, Remove and Install', in the Section 'Engine Timing Side, Air Cleaner Housing', in this Volume.

Blanking plug, seal ring, spring and piston.



### Install, Connect

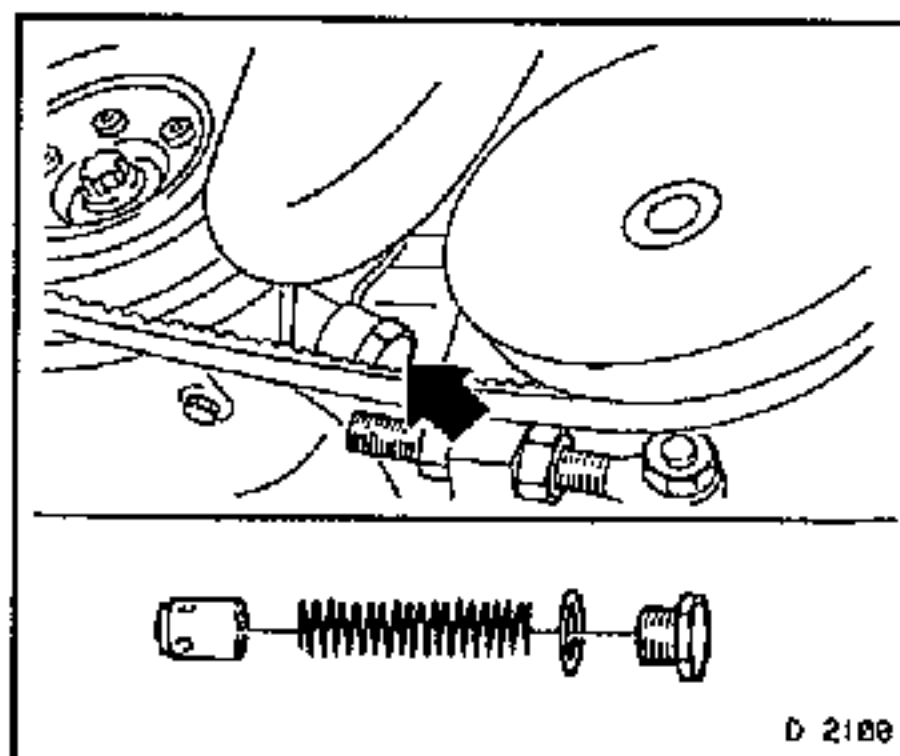
Piston, spring, new seal ring, blanking plug.

Engine accessories bracket.

Engine compartment cover.

### Tighten (Torque)

Blanking plug to oil pump..... 30 Nm



## RECOMMENDED TORQUE VALUES

### (Oil Circuit)

	Nm
Bracket for oil intake pipe to cylinder block .....	6
Closure bolt for safety valve to oil pump .....	30
Oil drain plug to oil pan .....	45
Oil intake pipe to oil pump .....	8 (1)
Oil pan to cylinder block (version: baffle plate with attached gasket) ....	5 (2)
Oil pan to cylinder block (version: baffle plate with vulcanised gasket) .	10 (2)
Oil pressure switch/sensor to oil pump.....	40
Oil pump to cylinder block.....	6

(1) Threads must be cleaned before reuse and coated with Locking Compound to Holden's Specification HN1256, Loctite 242 or equivalent.

(2) Maximum installation time 10 minutes.

# GROUP C

## BODY EQUIPMENT

### SEATS, UPHOLSTERY, INNER TRIM PANELS

#### TABLE OF CONTENTS

	PAGE
Door Inner Trim Panel, Replace.....	C - 22
Door Pocket - Front Door, Replace.....	C - 22
Handle - Front Door Replace.....	C - 22
Rear Seat Cushion, Replace.....	C - 22
Rear Seat Backrest, Remove and Install.....	C - 23
Panelling - ABS Control Unit and/or Door Sill, Replace.....	C - 23
Panelling - Lower 'A' Pillar, Replace.....	C - 23
Panelling - Rear Quarter Panel, Replace.....	C - 23
Panelling - 'B' Pillar, Replace.....	C - 24
Panelling - Upper 'A' Pillar, Replace.....	C - 24
Panelling - 'C' Pillar, Replace.....	C - 24
Headlining, Replace.....	C - 25
Panelling - Lower Rear Panel, Replace.....	C - 25
Panelling - Tailgate, Replace.....	C - 25
Glove Compartment, Remove and Install.....	C - 26
Centre Console, Remove and Install.....	C - 27
Instrument Panel Padding, Remove and Install.....	C - 28
Air Duct Cover, Replace.....	C - 31
Front Seats, Remove and Install.....	C - 33
Vehicles Without Seat Belt Tensioner.....	C - 33
Vehicles With Seat Belt Tensioner.....	C - 34
Seat Belt Tensioner, Remove and Install or Replace.....	C - 35
Seat Belt Tensioner - Triggering Procedure.....	C - 37
Upholstery - Front Seat, Replace.....	C - 37
Front seat Backrest, Remove and Install.....	C - 38
Upholstery - Front Seat Backrest, Replace.....	C - 39
Headrest Sleeve, Remove and Install.....	C - 39
Lumbar Support - Overview.....	C - 40
Lumbar Support - Replace Completely/Front Seat Backrest Frame, Replace.....	C - 41
Upholstery - Rear Seat Cushion, Replace.....	C - 42
Upholstery - Rear Seat Backrest, Replace.....	C - 42
Wooden Strip - Door Inner Trim Panel, Replace.....	C - 43
Front Seat Belt, Replace.....	C - 44
Rear Seat Belt, Replace.....	C - 45
Recommended Torque Values.....	C - 46

# SEATS, UPHOLSTERY, INNER TRIM PANELS

## Door Inner Trim Panel - Front Door, Replace

### Remove, Disconnect

Door handle cover. Lever out from below with a screwdriver.

Door inner trim panel 6 bolts (arrows), 12 clips.

Wiring harness plug from the speaker from behind the panel.

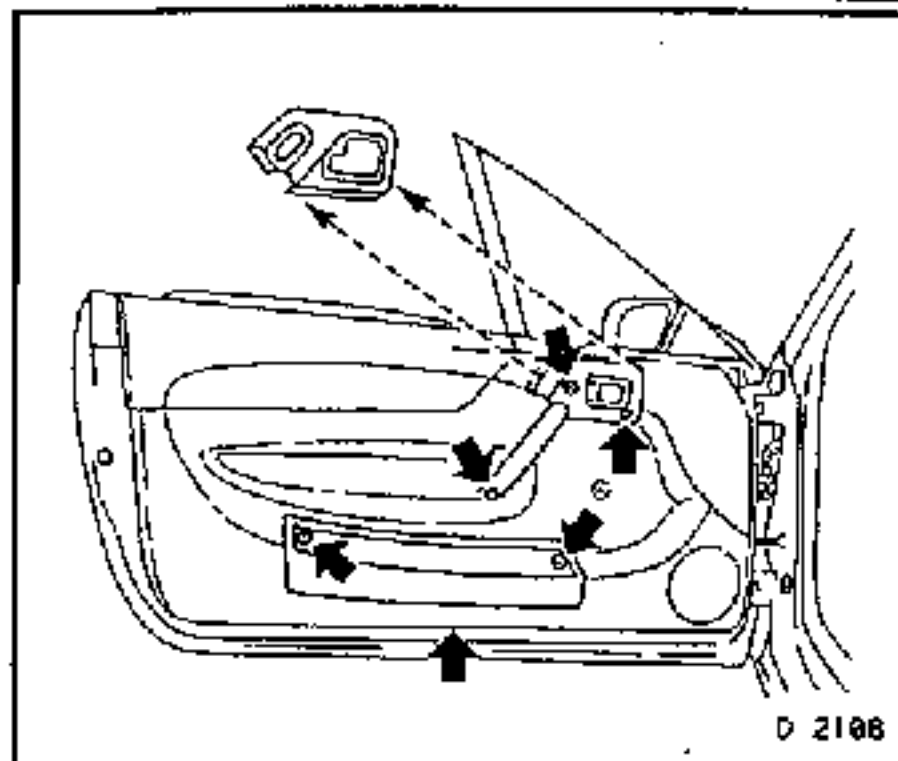
Door inner trim panel.

**Note:** For the RH door, disconnect the wiring harness plug from the external electric mirror switch.

### Install, Connect

Wiring harness plug to the speaker and electric external mirror (RH door).

Door inner trim panel, door handle cover.



## Door Pocket - Front Door, Replace

### Remove, Disconnect

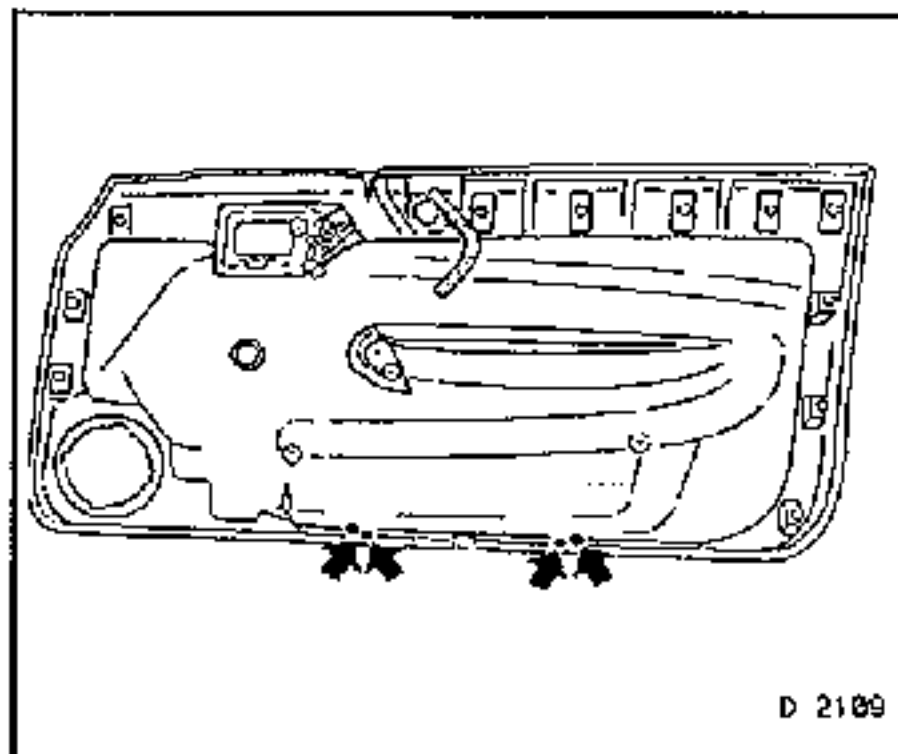
Inner front door trim panel. Refer to previous operation.

Door pocket - 2 bolts, 2 clips from inside.

### Install, Connect

Door pocket.

Inner front door trim panel.



## Handle - Front Door, Replace

### Remove, Disconnect

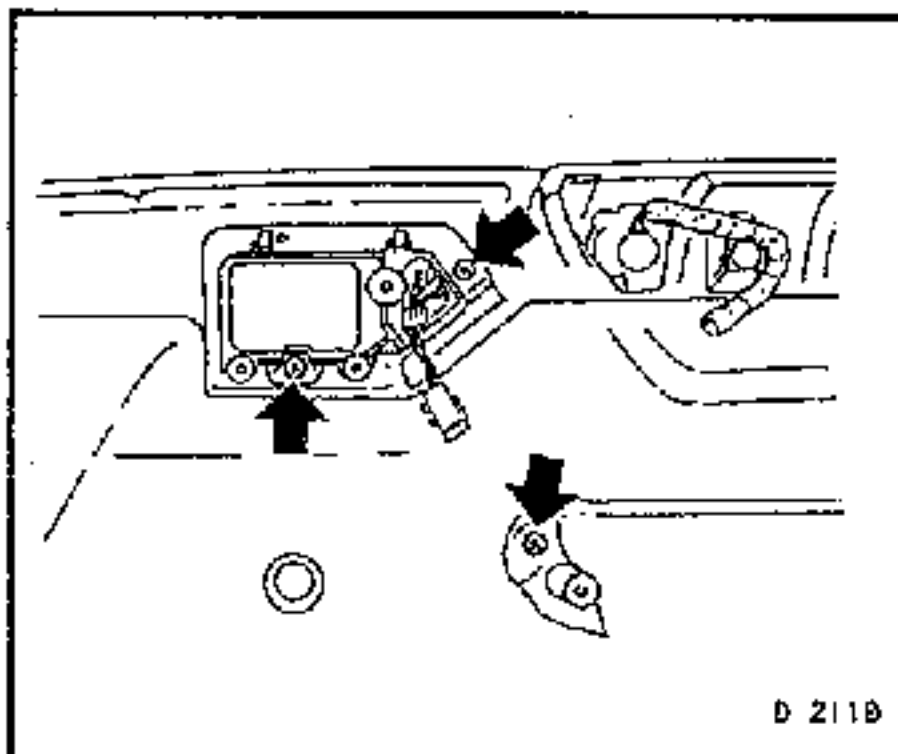
Inner front door trim panel. Refer to operation in this Section.

Handle - 3 bolts (arrows) from inside.

### Install, Connect

Handle.

Inner front door trim panel. Refer to operation in this Section.



## Rear Seat Cushion, Replace

### Remove, Disconnect

Pull on each of the two straps provided, to release the two rear seat cushion catches.

Pull rear seat cushion forward and up.

### Install, Connect

Rear seat belt buckles through holes in rear seat cushion.

Push seat cushion down and to the rear.

Push down at the front of the rear seat cushion at each side, until an audible click is heard indicating the catches have secured the rear seat cushion.

# SEATS, UPHOLSTERY, INNER TRIM PANELS

## Rear Seat Backrest, Remove and Install

### Remove, Disconnect

Rear seat cushion. Refer to previous operation.

Release the seat back catch and pull the seat back forward.

Use trim remover KM-475-A to partially remove the rear seat back trim plugs from each lower corner of the rear seat back to be removed.

Two bolts from each side hinge, using MKM-604-A, Torx bit and socket set.

Rear seat back.

### Install, Connect

Hinge bolts.

Rear seat back trim.

Rear seat back cushion.

## Panelling - ABS Control Unit and/or Door Sill, Replace

### Remove, Disconnect

ABS control unit panelling;

A - 2 bolts.

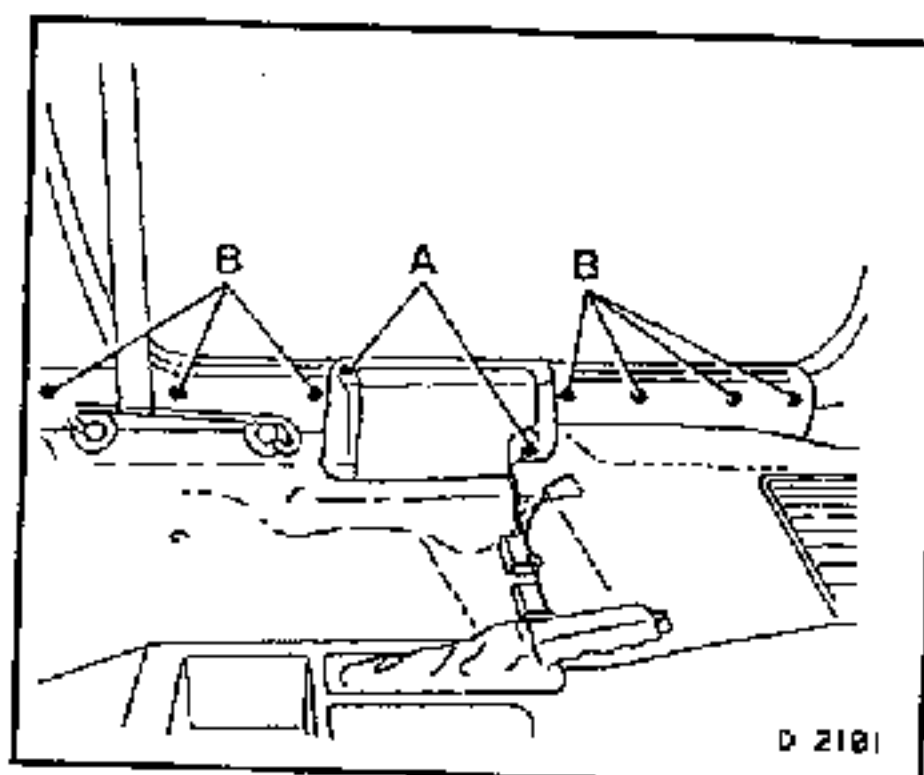
Door sill panelling;

B - 7 bolts.

### Install, Connect

Door sill panelling.

ABS control unit panelling.



## Panelling - Lower 'A' Pillar, Replace

### Remove, Disconnect

ABS control unit panelling and/or door sill panelling.

Remove weatherstrip of front doors in area of lower 'A' pillar.

Panelling - 2 body bound bolts.

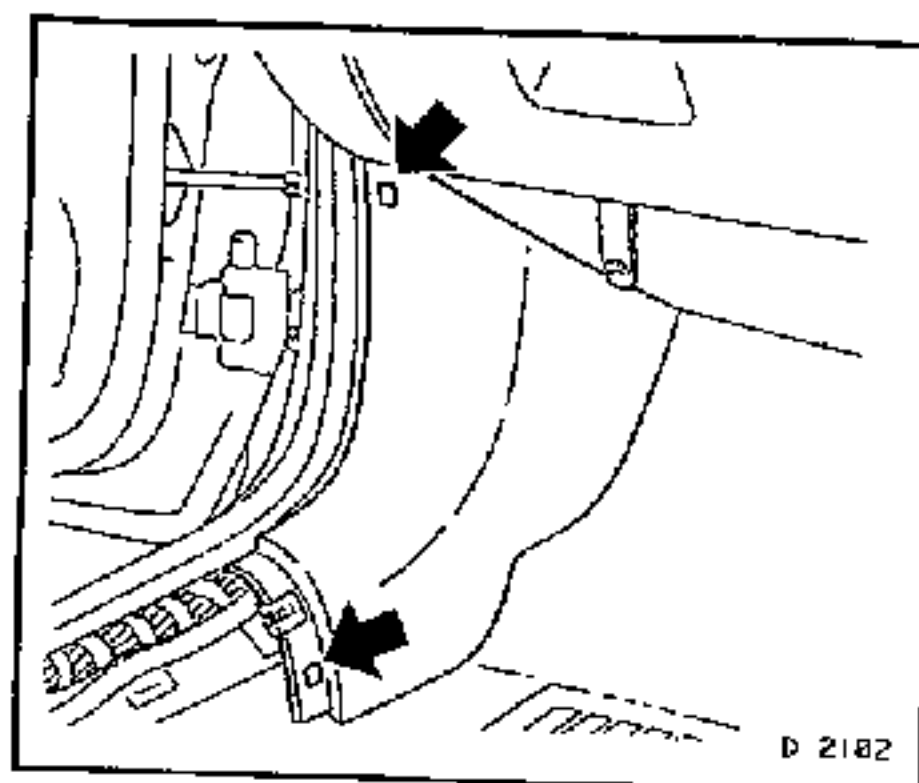
### Install, Connect

Lower 'A' pillar panelling - 2 body bound bolts.

Weatherstrip.

Door sill panelling.

ABS control unit panelling.



## Panelling - Rear Quarter Panel, Replace

### Remove, Disconnect

Rear seat cushion. Refer to previous operation.

Partially loosen door sill panelling in area of 'B' pillar.

Partially remove weatherstrip of door in area of lower 'B' pillar.

Panelling of rear quarter panel;

A - 1 bolt.

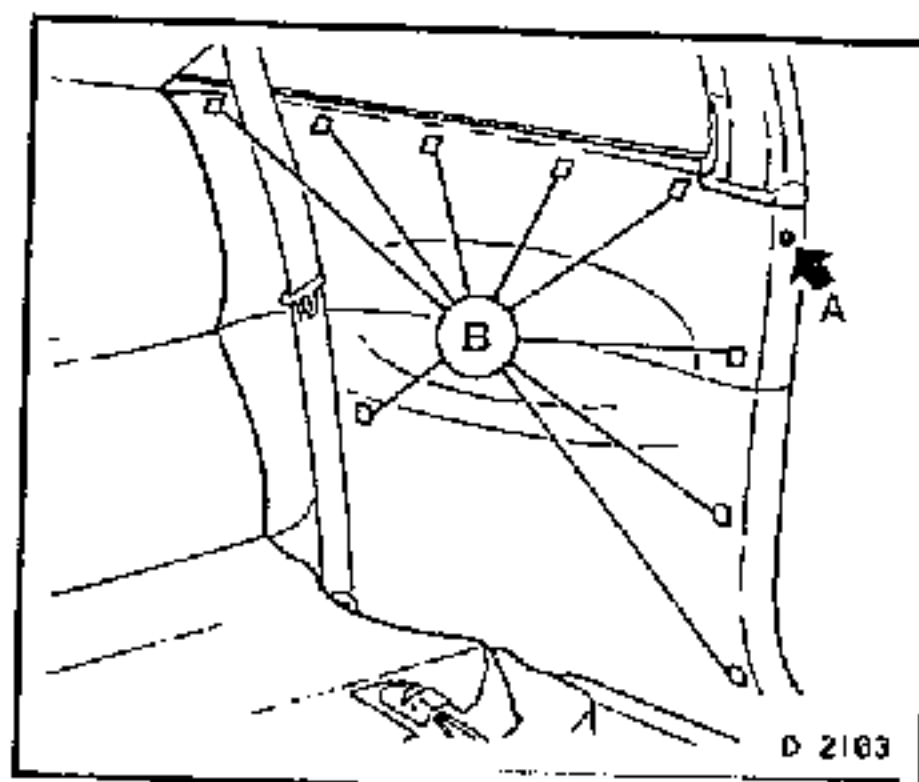
B - 9 clips (reverse of panelling).

### Install, Connect

Panelling to rear quarter panel, weatherstrip.

Panelling on door sill.

Rear seat cushion.



# SEATS, UPHOLSTERY, INNER TRIM PANELS

## Panelling - 'B' Pillar, Replace

### Remove, Disconnect

Panelling from rear quarter panel. Refer to previous operation.

Seat belt anchor.

Pull out coat hooks upwards.

Panelling on 'B' pillar, coat hooks.

### Install, Connect

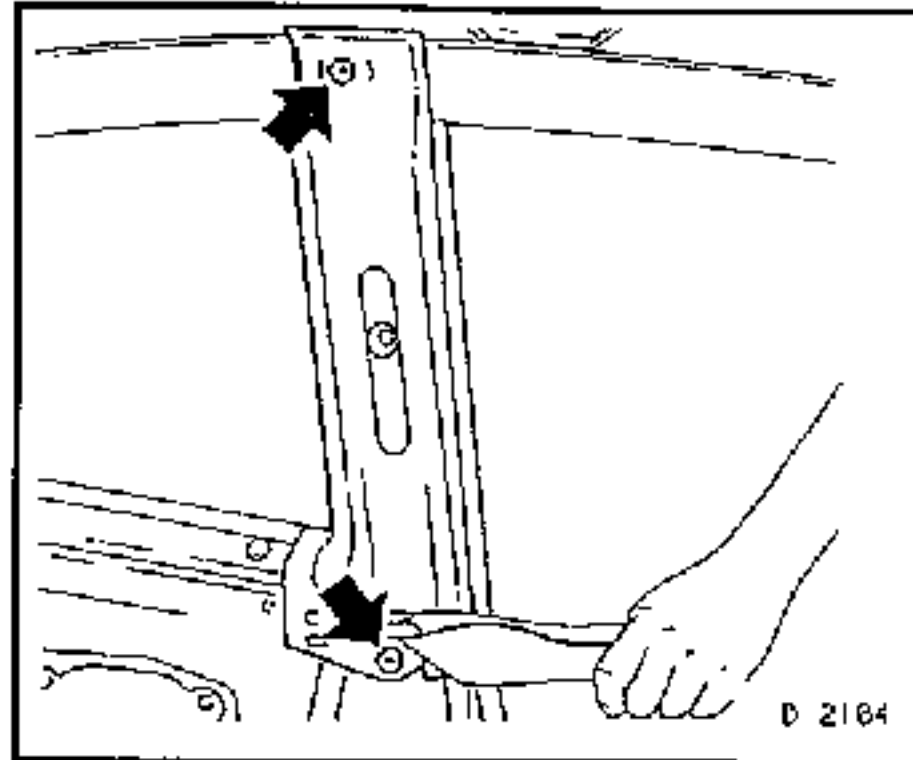
Belt anchor.

### Tighten (Torque)

Belt anchor to 'B' pillar ..... 35 Nm

### Install, Connect

Rear quarter panelling. Refer to previous operation.



## Panelling - Upper 'A' Pillar, Replace

### Remove, Disconnect

Coat hooks. Partially loosen panelling from 'B' pillar.

Belt anchor.

Panelling from 'A' pillar.

A - 1 bolt

B - 5 clips

Panel from anti-theft warning system.

### Install, Connect

Panelling on 'A' pillar.

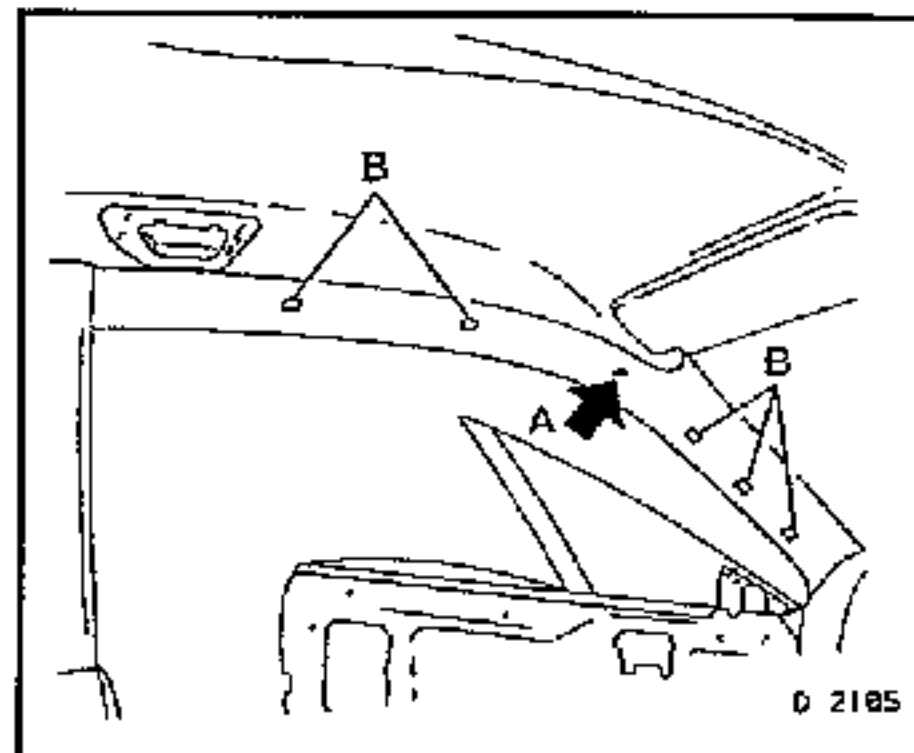
Panelling on 'B' pillar, coat hooks.

Belt anchor.

### Tighten (Torque)

Belt anchor to 'B' pillar ..... 35 Nm

Panel to anti-theft sensor.



## Panelling 'C' Pillar, Replace

### Remove, Disconnect

Rear seat cushion, loading compartment cover.

Panelling from rear quarter. Refer to previous operation.

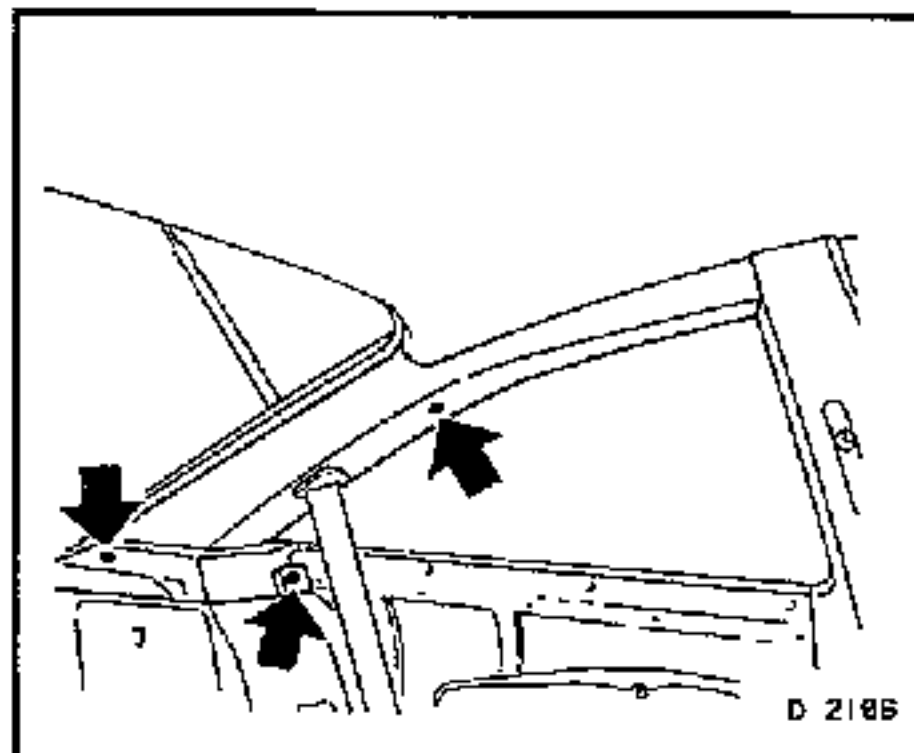
Seat belt anchors on 'B' and 'C' pillars.

Panelling from 'B' pillar. Refer to previous operation.

Panelling from 'C' pillar;

2 Torx bolts with MKM-604-A.

1 bolt.



### Install, Connect

Panelling on 'C' pillar.

Panelling on 'B' pillar.

Belt anchors on 'B' and 'C' pillars.

### Tighten (Torque)

Belt anchor to 'B' and 'C' pillars ..... 35 Nm

### Install, Connect

Panelling on rear quarter panel.

Rear seat cushion, rear seat back.

# SEATS, UPHOLSTERY, INNER TRIM PANELS

## Headlining, Replace

### Remove, Disconnect

'A', 'B' and 'C' Inner panelling. See previous operations in this Section.

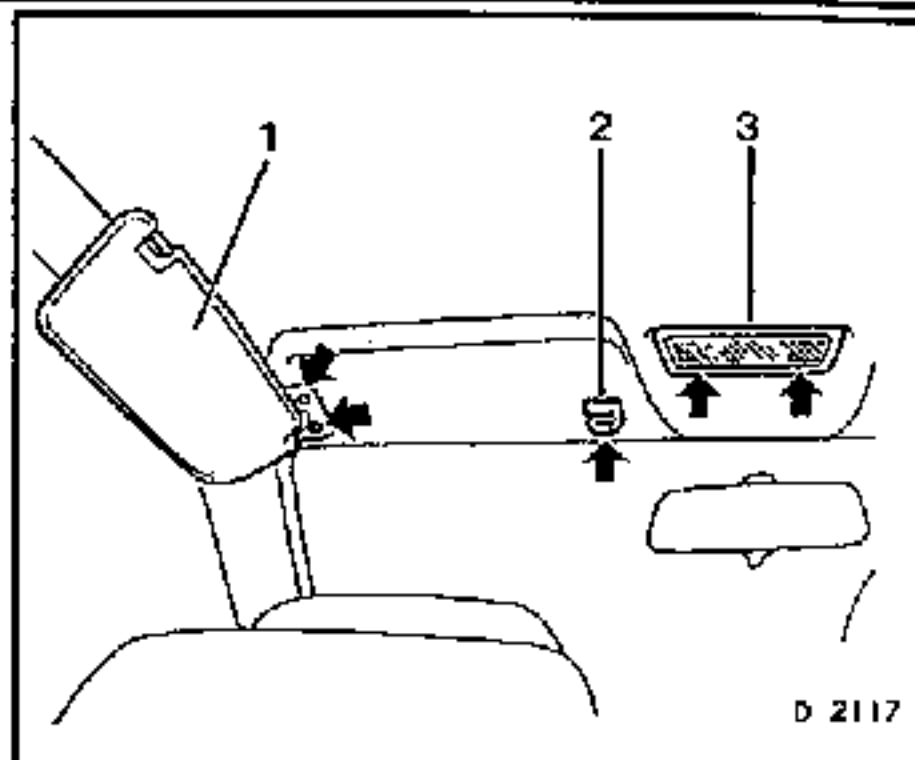
Sun visors (1) - 2 bolts each, retainer (2) - 1 bolt.

Unclip interior lamp (3).

Headlining - 3 clips at rear.

Sliding roof;  
Electric winder unit  
Edge strip.

Anti-theft warning system panel.



### Install, Connect

Headlining.

Interior lamp.

Sun visors and retainers.

Inner panelling.

Sliding roof;  
Electric winder unit  
Edge strip.

Anti-theft warning system panel.

## Panelling - Lower Rear Panel, Replace

### Remove, Disconnect

Rear panel inner trim panelling;

A - 5 clips using KM-475-A.

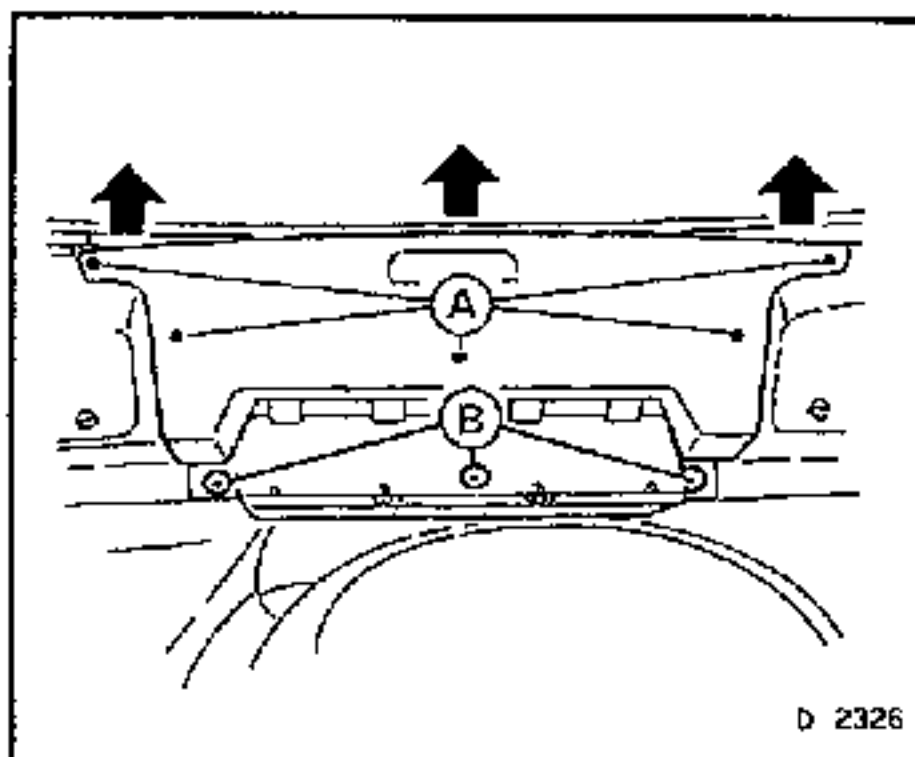
B - 3 plastic nuts.

### Important!

Pull out inner trim panelling upwards.

### Install, Connect

Inner trim panelling.



## Panelling - Tailgate, Replace

### Remove, Disconnect

Tailgate inner trim panelling;

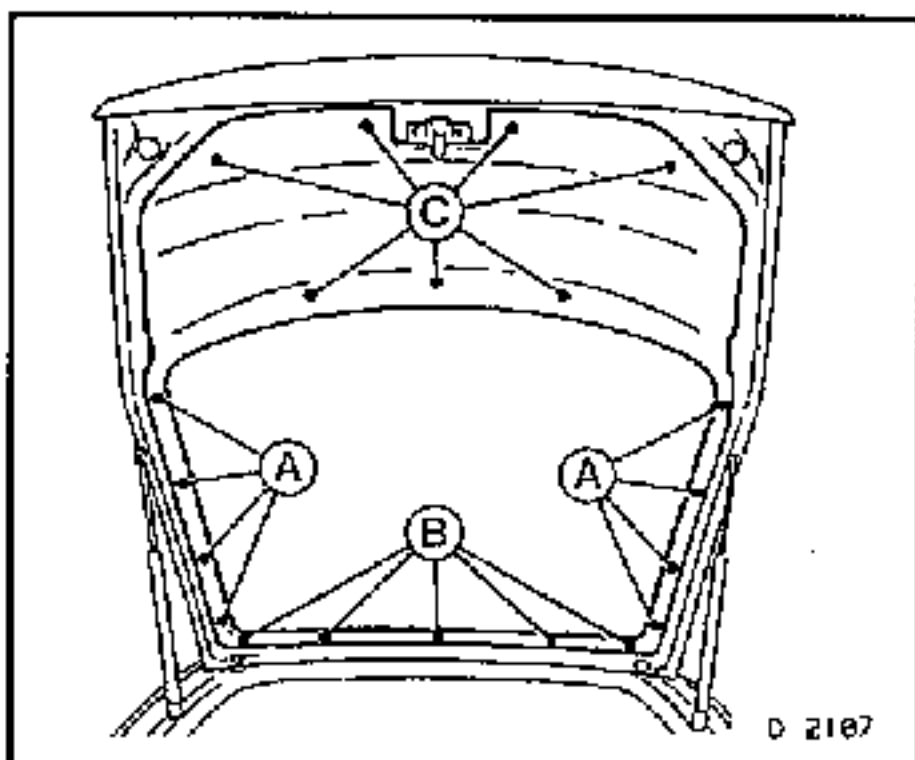
A - 4 clips each side, using KM-469-A.

B - 5 clips, using KM-469-A.

C - 7 torx bolts, using MKM-604-A.

### Install, Connect

Tailgate inner panelling.



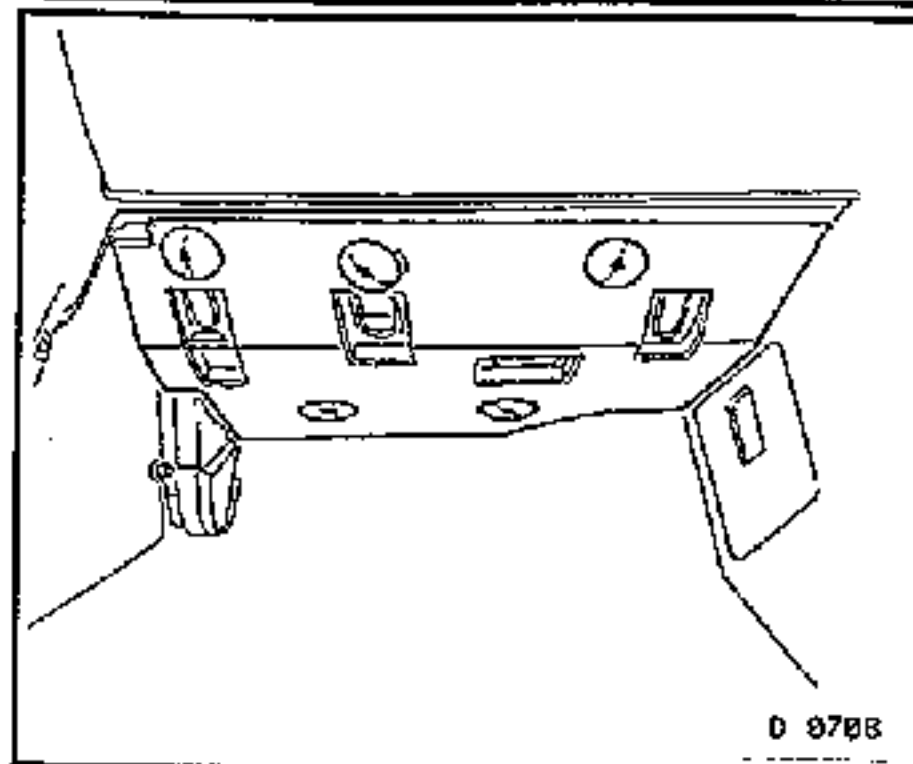
# SEATS, UPHOLSTERY, INNER TRIM PANELS

## Glove Compartment, Remove and Install

### Remove, Disconnect

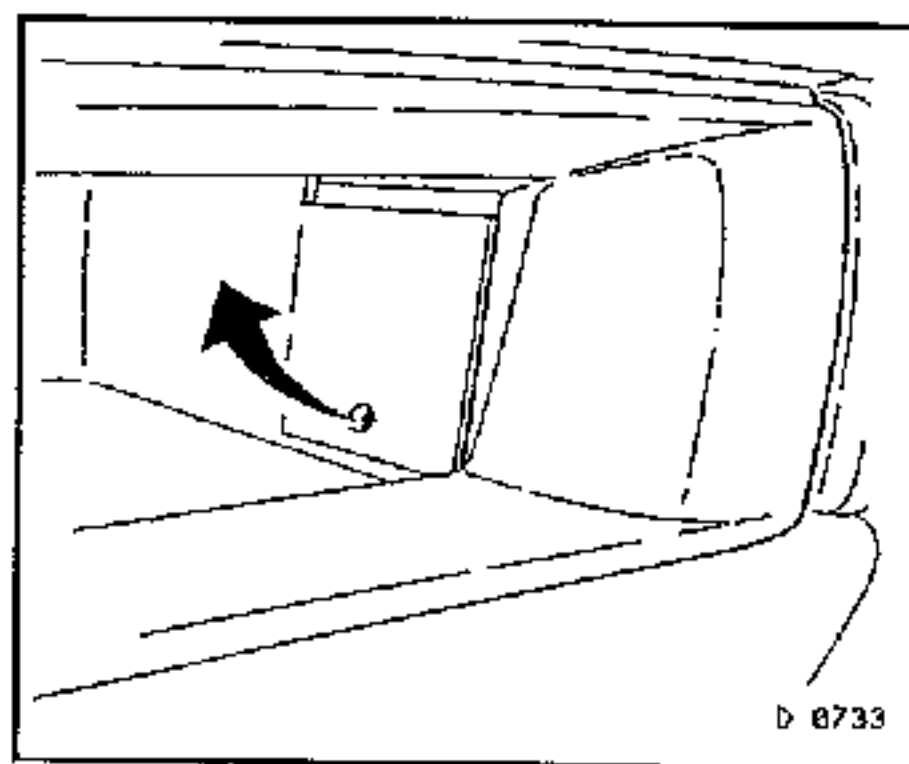
Footwell cover;

5 twist retainers.



### Remove, Disconnect

Upper part of glove compartment catches (arrow).

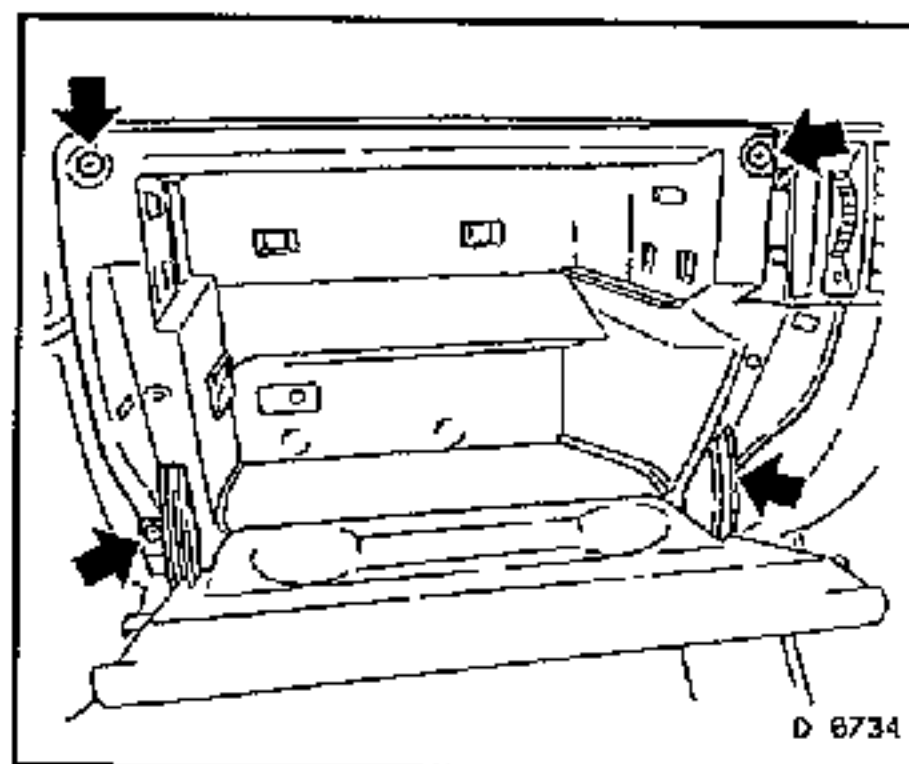


### Remove, Disconnect

Glove compartment screws (arrows).

Glove compartment illumination lamp wiring harness plug.

Cooling duct connection from rear.



### Install, Connect

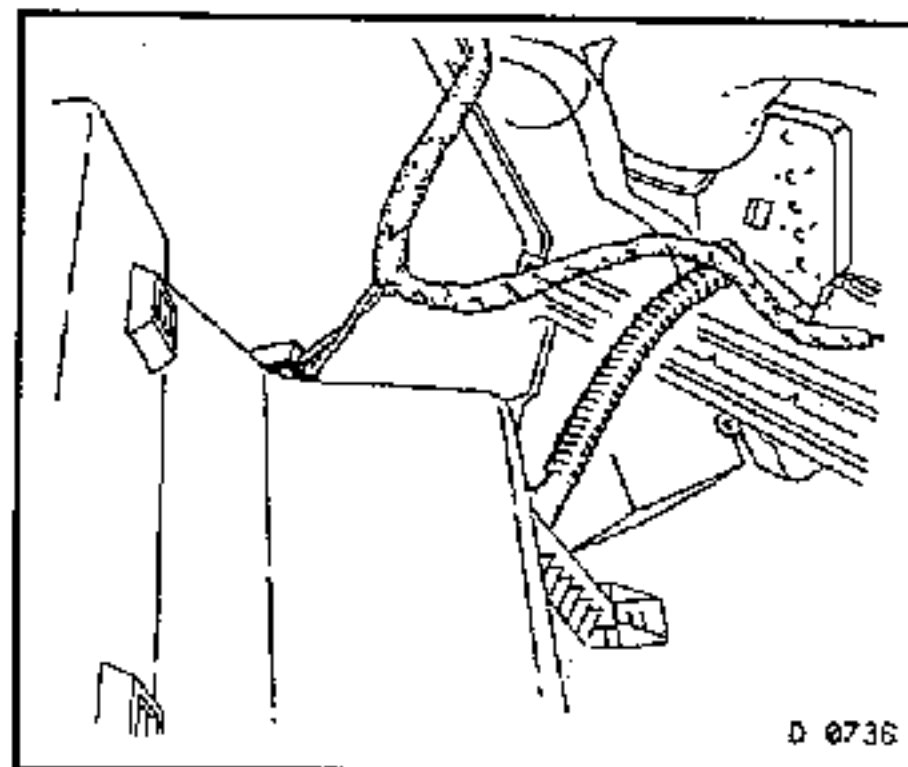
Wiring harness plug to glove compartment illumination lamp.

Cooling duct.

Glove compartment.

Upper panel.

Footwell cover.

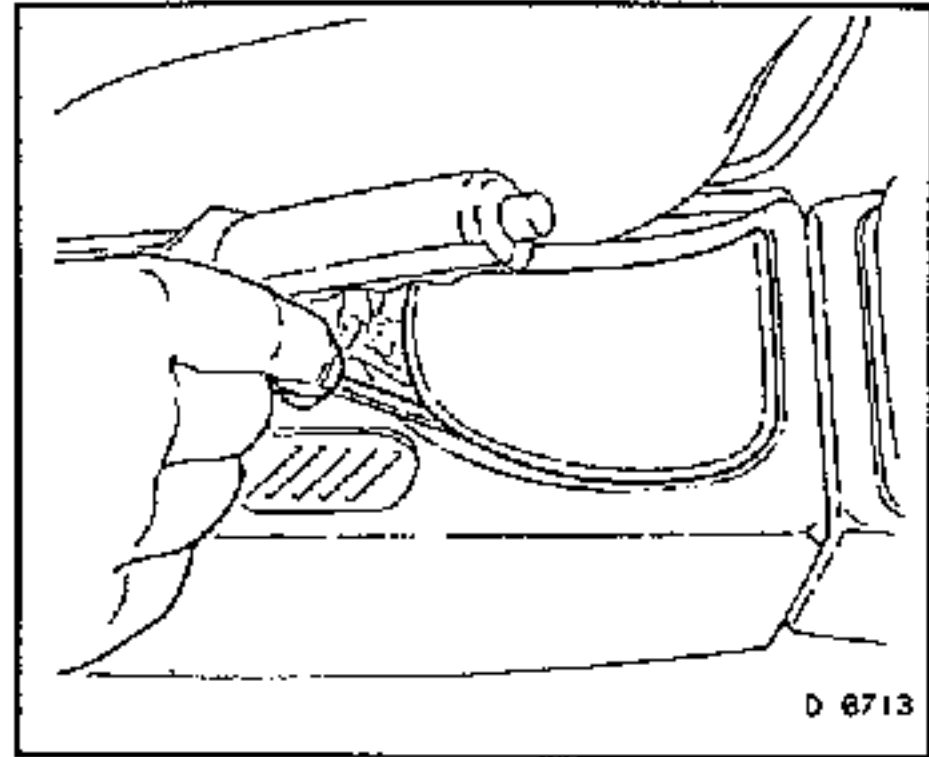


# SEATS, UPHOLSTERY, INNER TRIM PANELS

## Centre Console, Remove and Install

### Remove, Disconnect

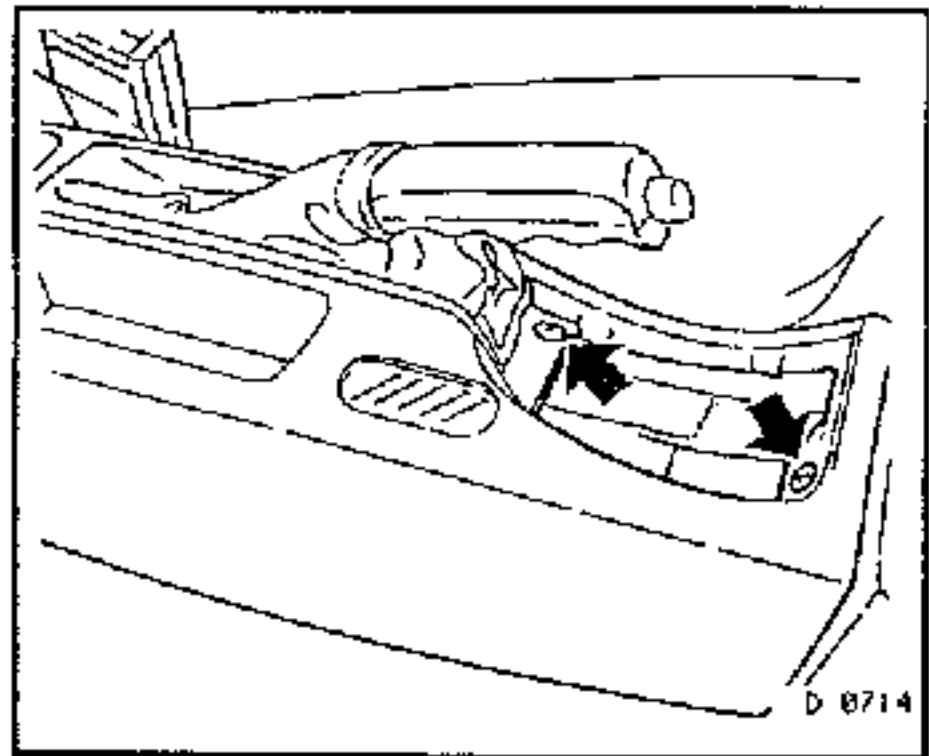
Unclip parking brake handle recess.



### Remove, Disconnect

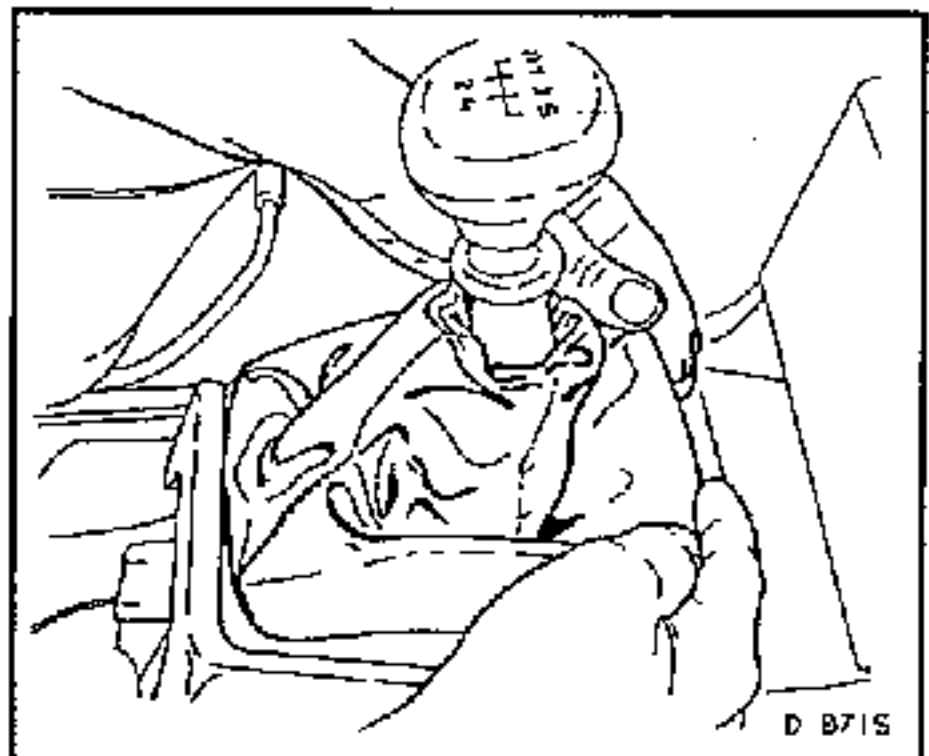
Cover of parking brake lever imitation leather cover.

Rear centre console.



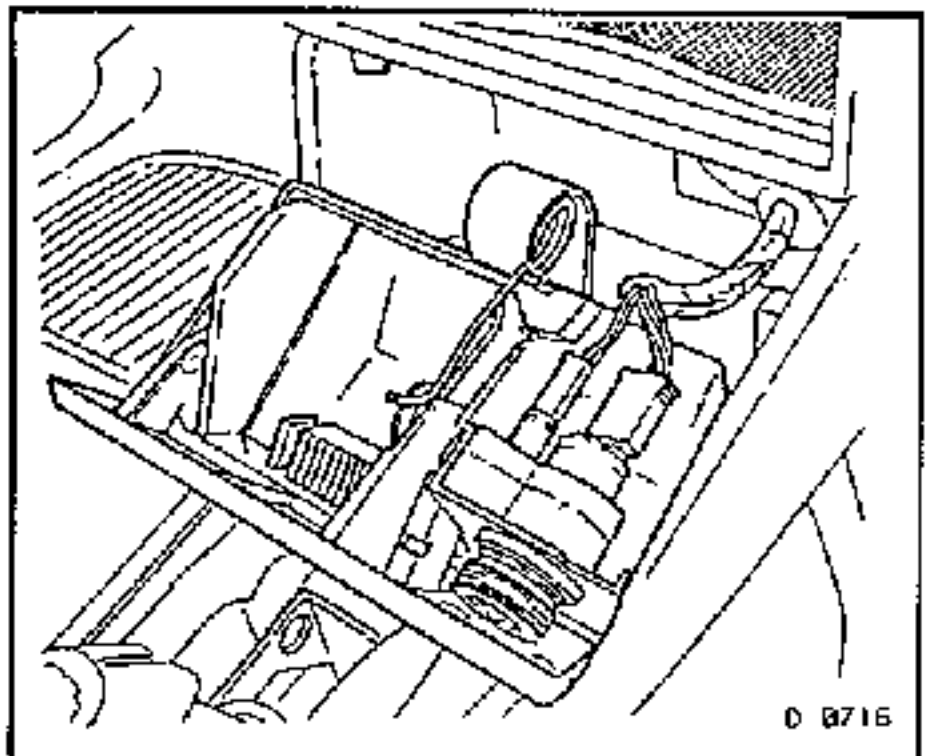
### Remove, Disconnect

Gear shift lever imitation leather cover from front of centre console.



### Remove, Disconnect

Ashtray, wiring harness plug from cigarette lighter and illumination - 2 bolts.





# SEATS, UPHOLSTERY, INNER TRIM PANELS

## Remove, Disconnect

Front centre console - 4 bolts.

Engage parking brake. Select 2nd gear.

## Install, Connect

Front centre console.

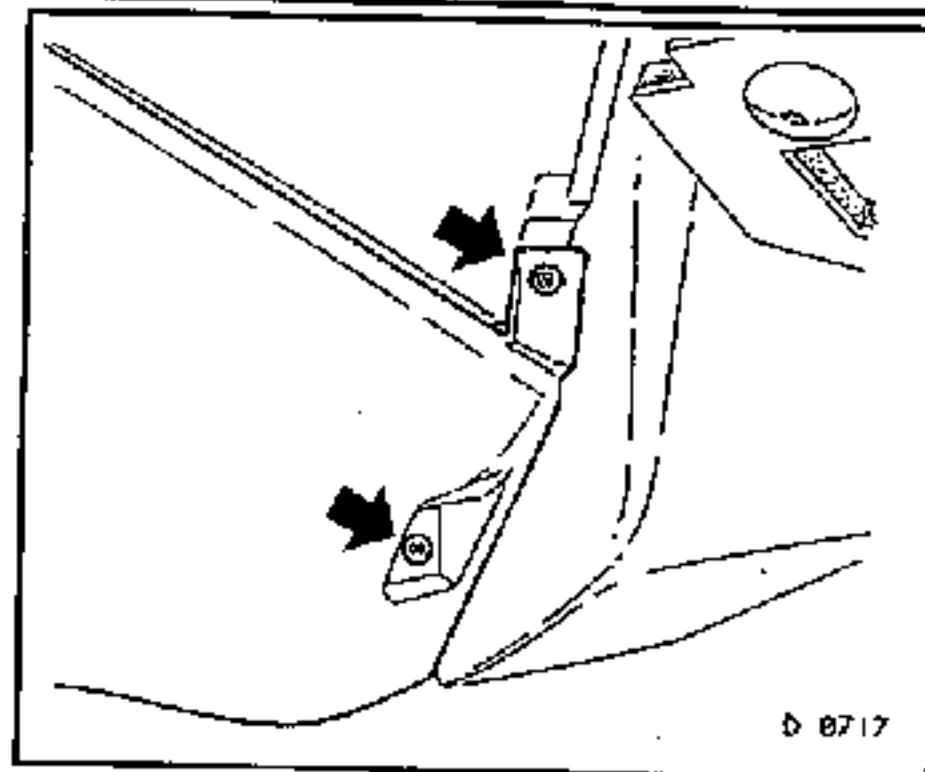
Wiring harness plug to cigarette lighter, ashtray.

Gear shift lever imitation leather cover.

Centre console.

Parking brake imitation leather cover.

Parking brake handle recess.



## Instrument Panel Padding, Remove and Install

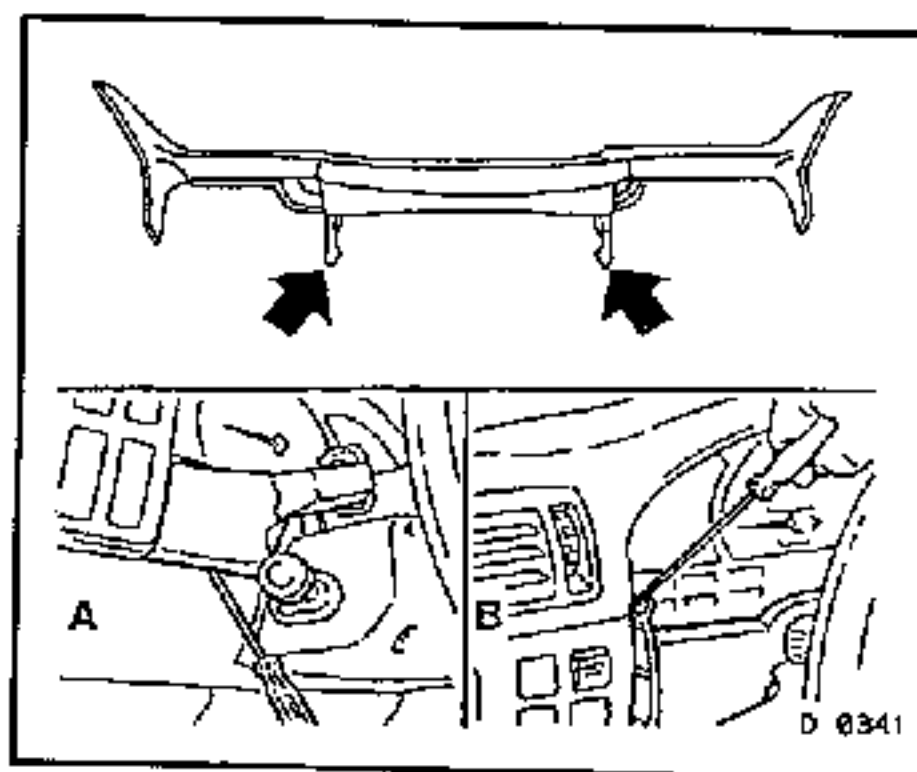
### Remove, Disconnect

Glove compartment. Refer previous operation in this Section.

Steering wheel. Refer 'Air Bag', in this Section (if fitted) and/or Group M, 'Steering' in Volume 4.

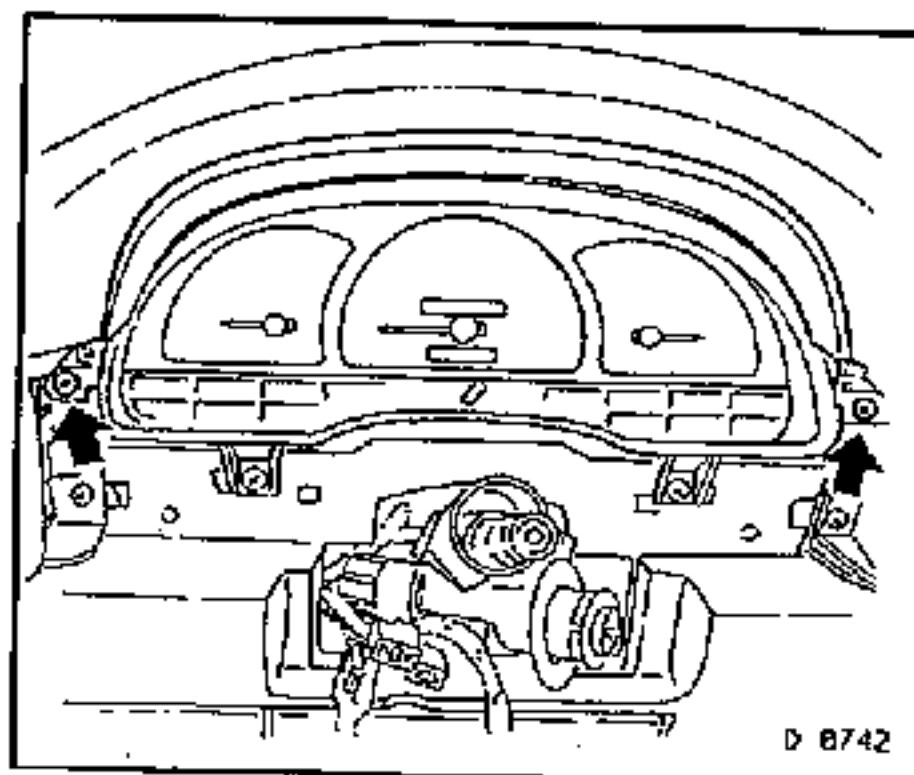
Signal switch panelling. Refer Group N, 'Headlamps, Exterior Lamps, Interior Lamps, Switches, in Volume 4.

Turn signal switch, wiper switch. Refer Group M, 'Steering Column Assembly, Remove and Install', in Volume 4.



### Remove, Disconnect

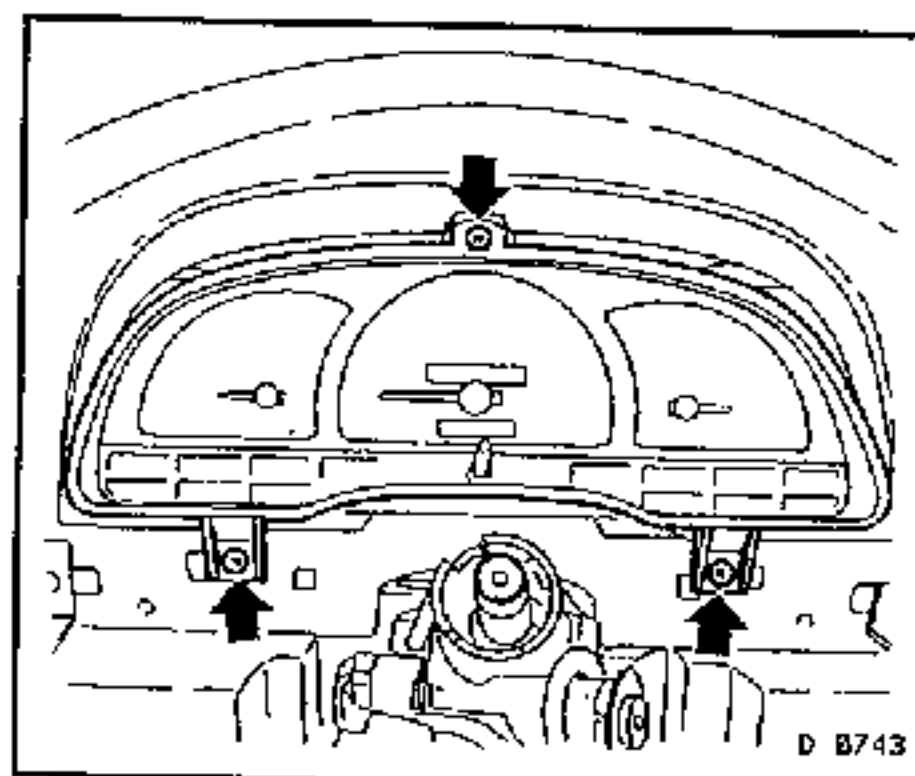
Lower and upper instrument panel covers.



### Remove, Disconnect

Instrument cluster.

Wiring harness plugs from the rear of the cluster.

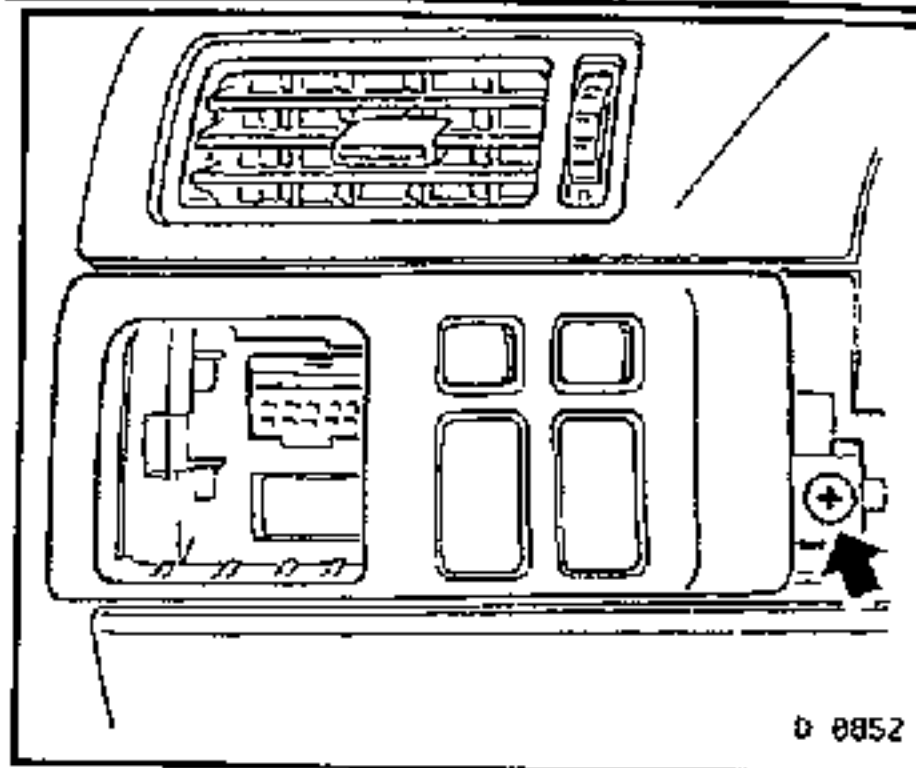


# SEATS, UPHOLSTERY, INNER TRIM PANELS

## Remove, Disconnect

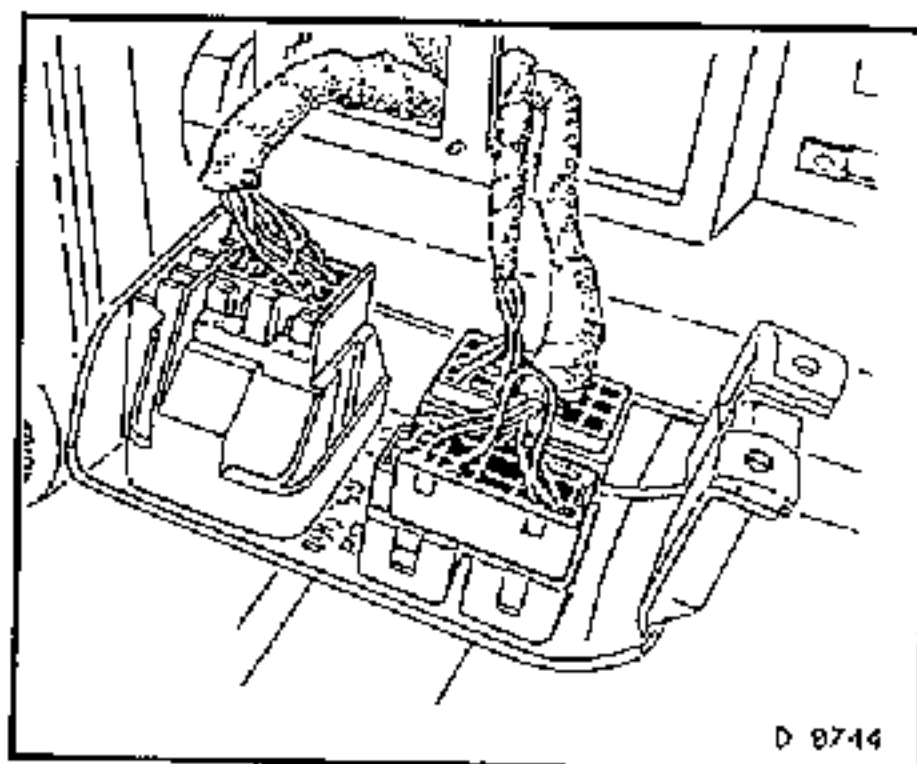
Lamp and interior switches. Refer N, 'Headlamps, Exterior Lamps, Interior Lamps, Switches, In Volume 4.

Pull insert sideways from instrument panel padding.



## Remove, Disconnect

Wiring harness plugs, by depressing retainers.



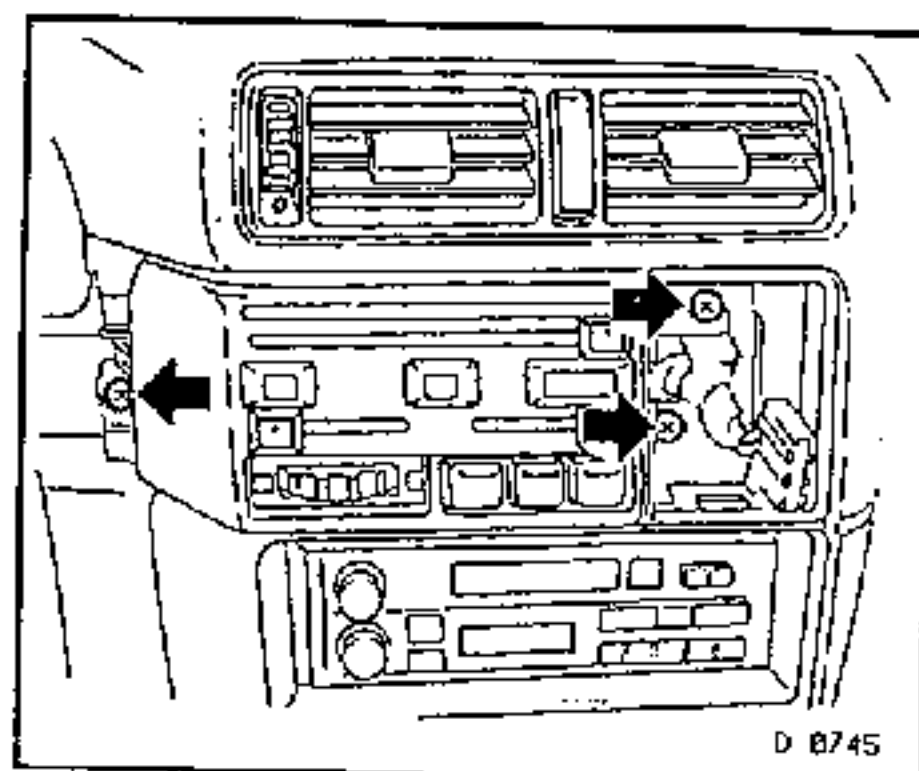
## Remove, Disconnect

Radio. Refer Group R, 'Accessories' in Volume 4.

Clock or board computer.

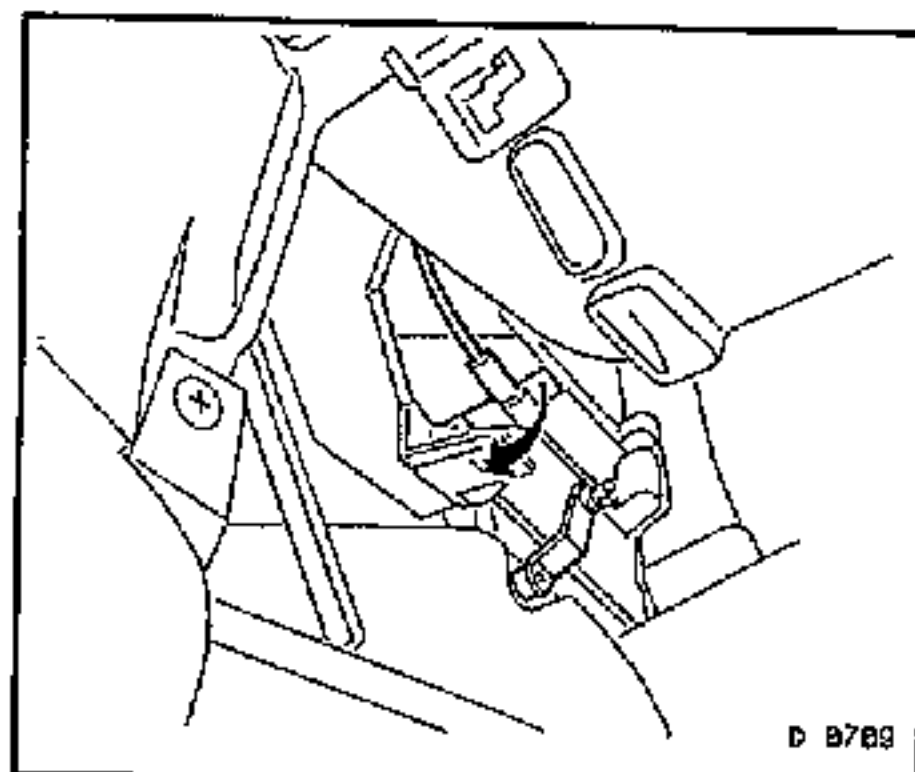
Wiring harness plug.

3 bolts (arrows).



## Remove, Disconnect

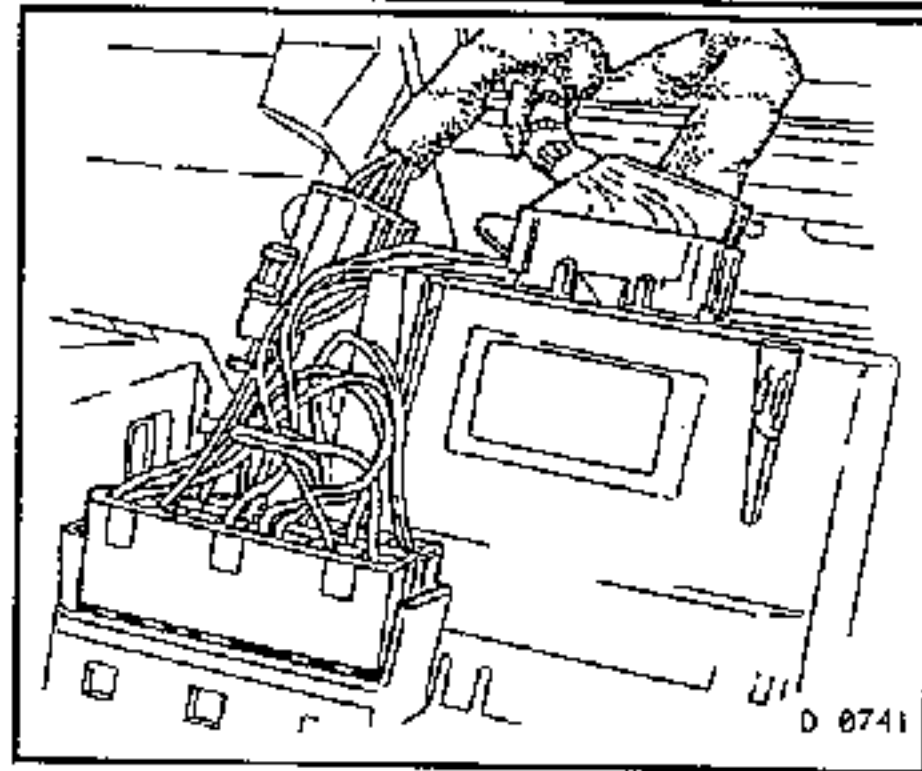
Bowden cable (arrow), counter hold for mixed air flap.



# SEATS, UPHOLSTERY, INNER TRIM PANELS

## Remove, Disconnect

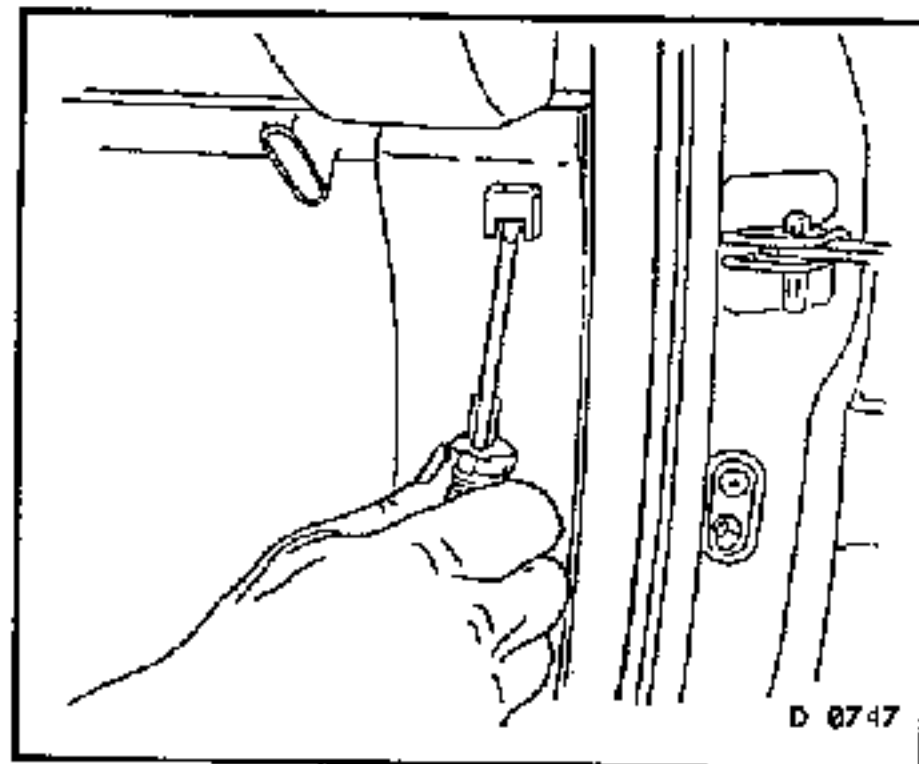
Wiring harness plug from controls, fan switch, illumination and switches for heated rear screen and front seat heating (if fitted).



## Remove, Disconnect

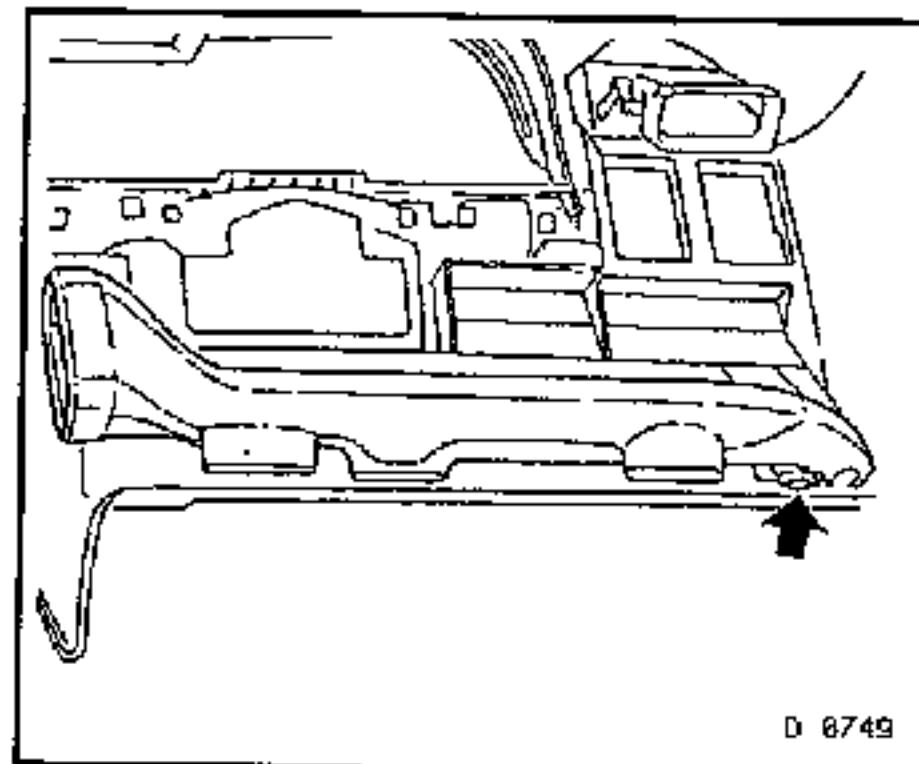
Housing for centre mixed air duct. Refer to operation in this Section.

Footwell side panelling from both sides. Prise the retaining plug out, using a screwdriver.



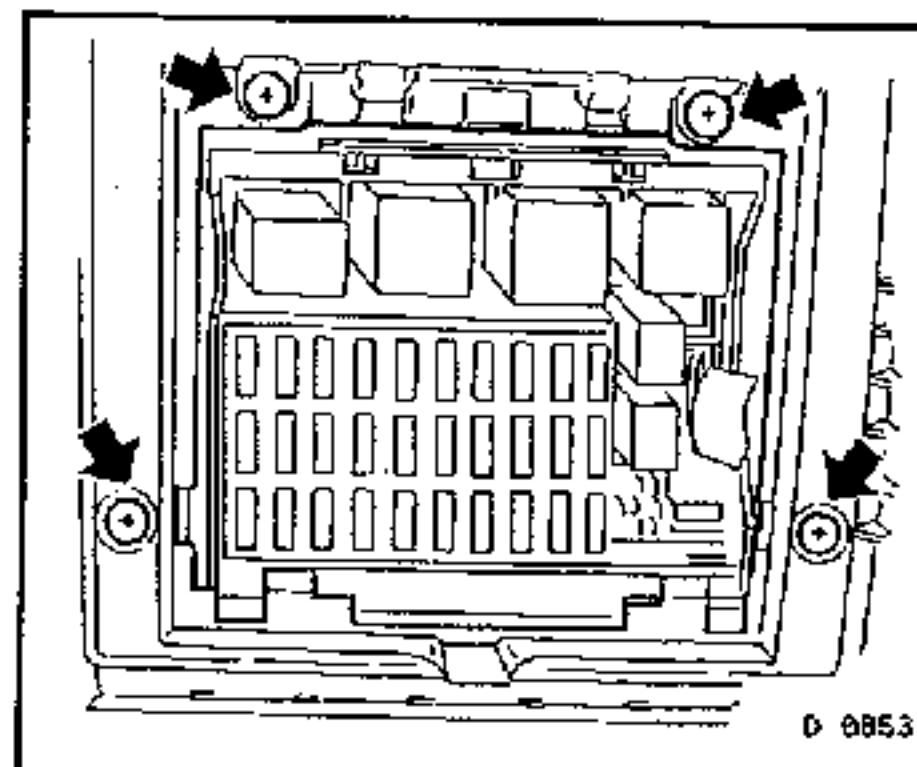
## Remove, Disconnect

Air distribution channel for footwell. Illustration shows the RH channel.



## Remove, Disconnect

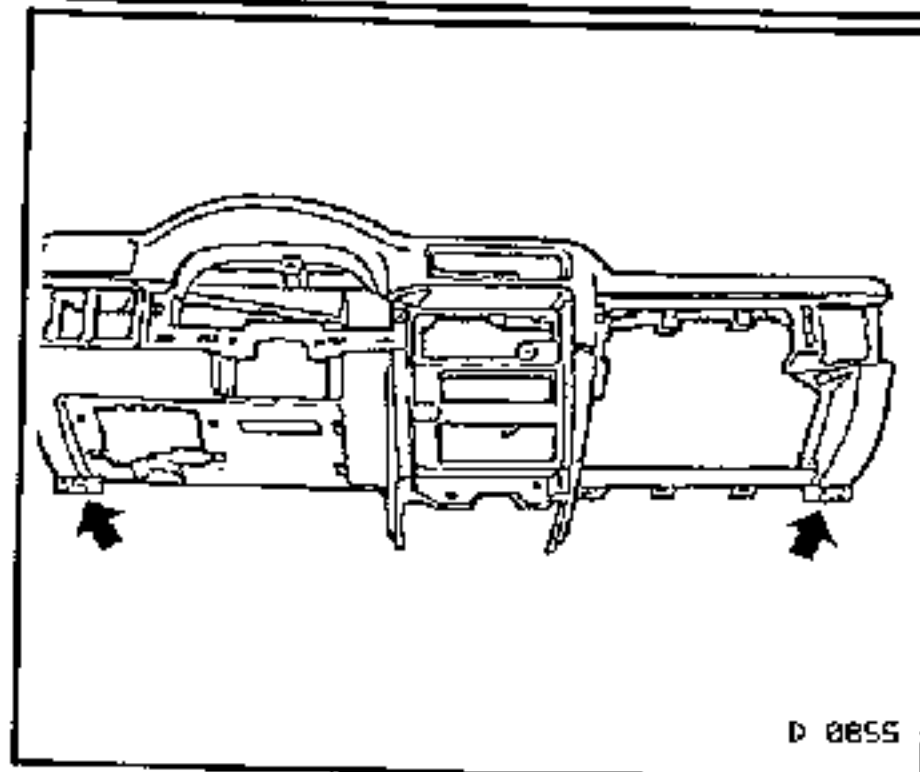
Fuse box cover. Press behind instrument panel padding.



# SEATS, UPHOLSTERY, INNER TRIM PANELS

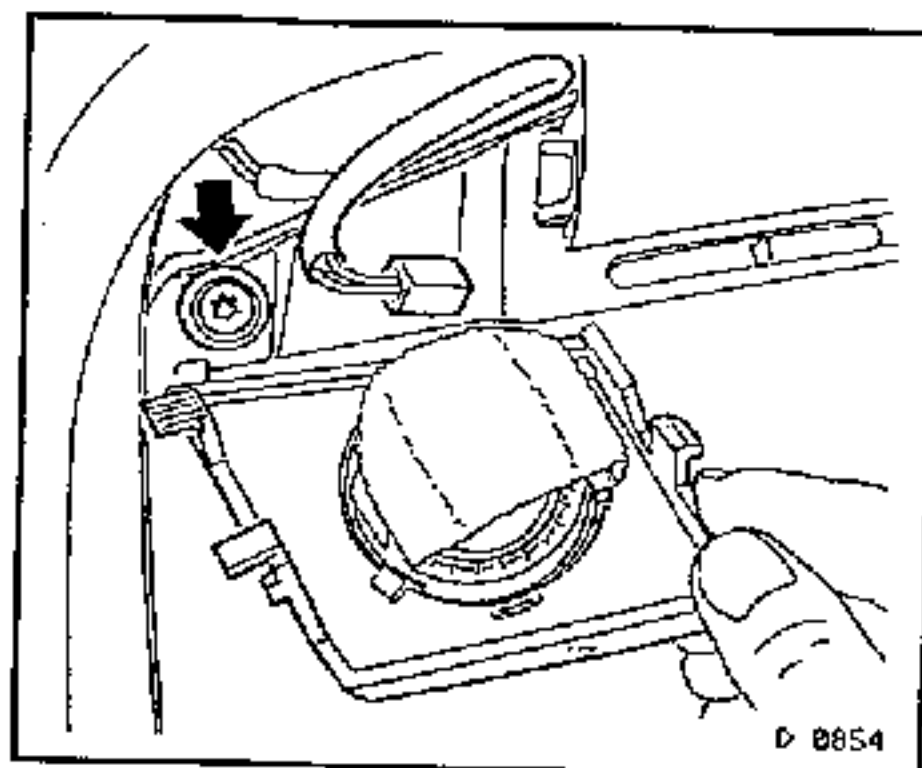
## Remove, Disconnect

Wiring harness from instrument panel padding;  
2 bolts - use MKM-604-9.



## Remove, Disconnect

Cover with speaker from instrument panel padding;  
2 bolts - use MKM-604-9.

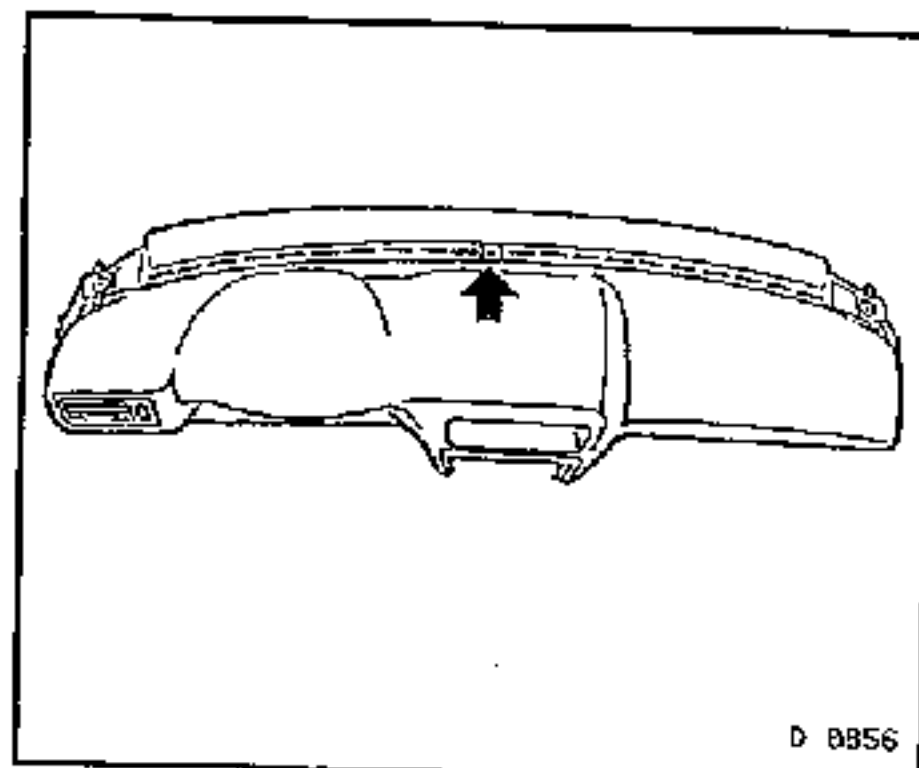


## Remove, Disconnect

Unclip cover for centre bolt;  
1 bolt - use MKM-604-9.  
Instrument panel padding from vehicle.

## Install, Connect

Instrument panel padding following the removal stages  
in reverse.



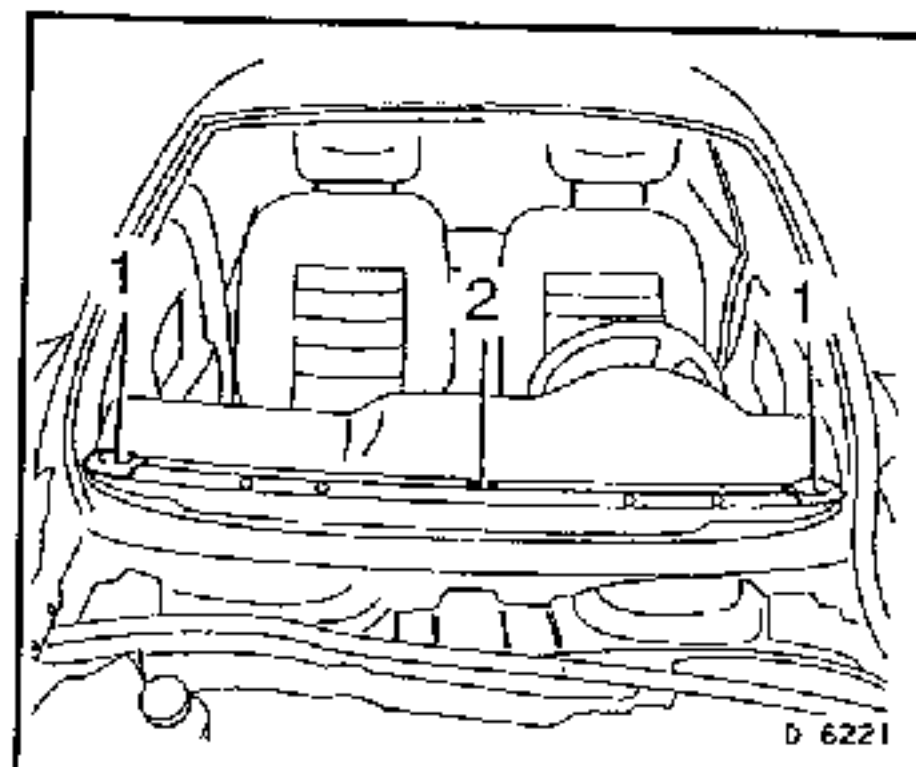
## Air Duct Cover, Replace

### Remove, Disconnect

Windscreen. Refer Group "Glass, Window Guides,  
Window Winders", in this Section.

Speaker (1), cover (2).

Unbolt air duct cover.



# SEATS, UPHOLSTERY, INNER TRIM PANELS

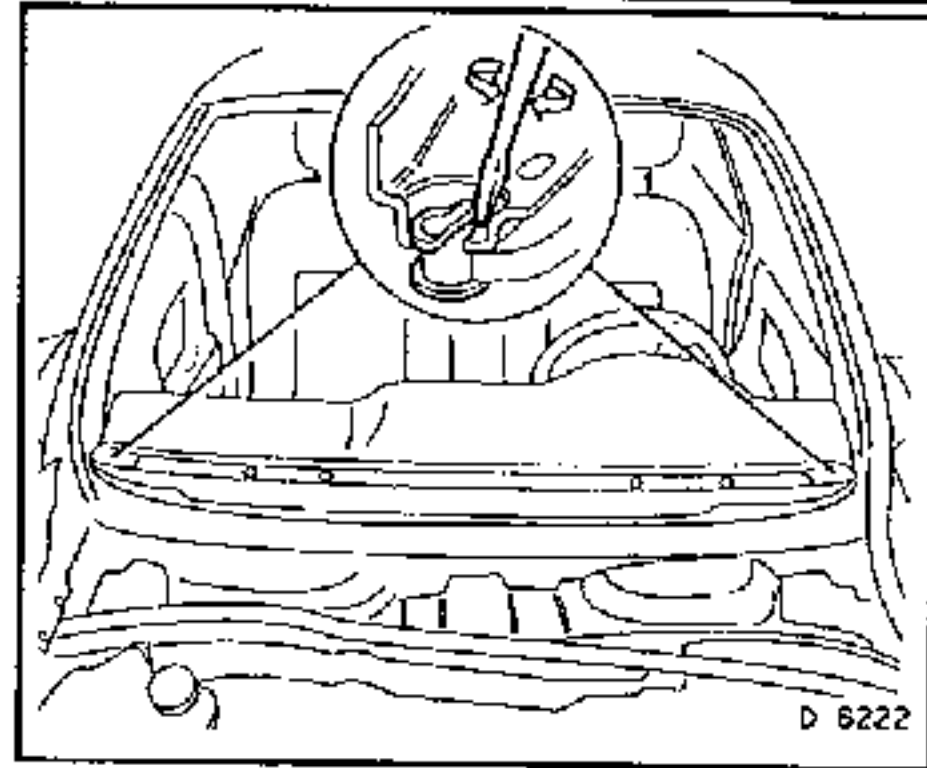
## Remove, Disconnect

Bend up knurled edge of the two rivet sleeves with a screwdriver.

Rivet sleeves.

### Note:

These sleeves are re-used for installation.



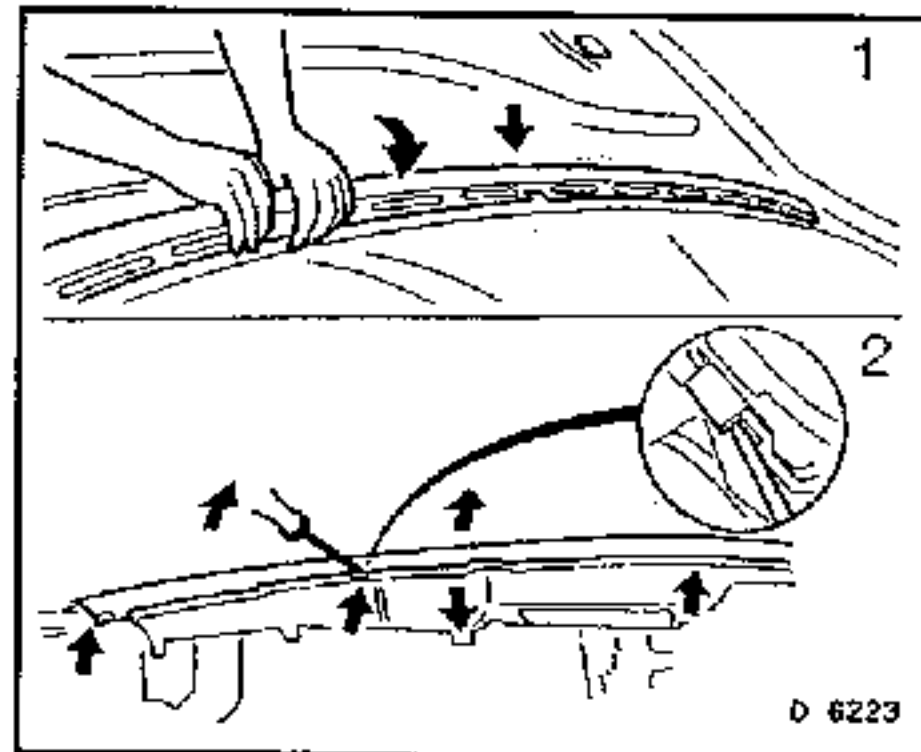
## Remove, Disconnect

Loosen cover;

Pull up cover from connection seam, beginning at the sides (1).

Break off weld points at catches with a screwdriver (2).

Air duct cover.

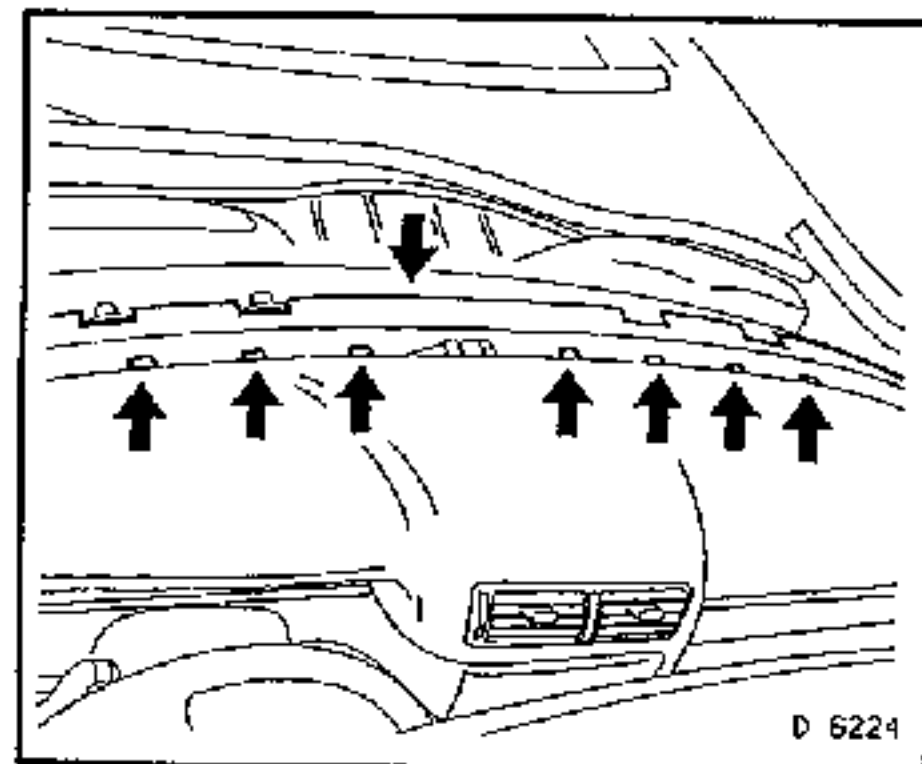


## Install, Connect

Sand cement areas of new air duct cover, air duct and instrument panel padding, using paper with P180 - P240 grit.

Clean cementing surfaces.

Do not apply any primer to the cement surfaces.



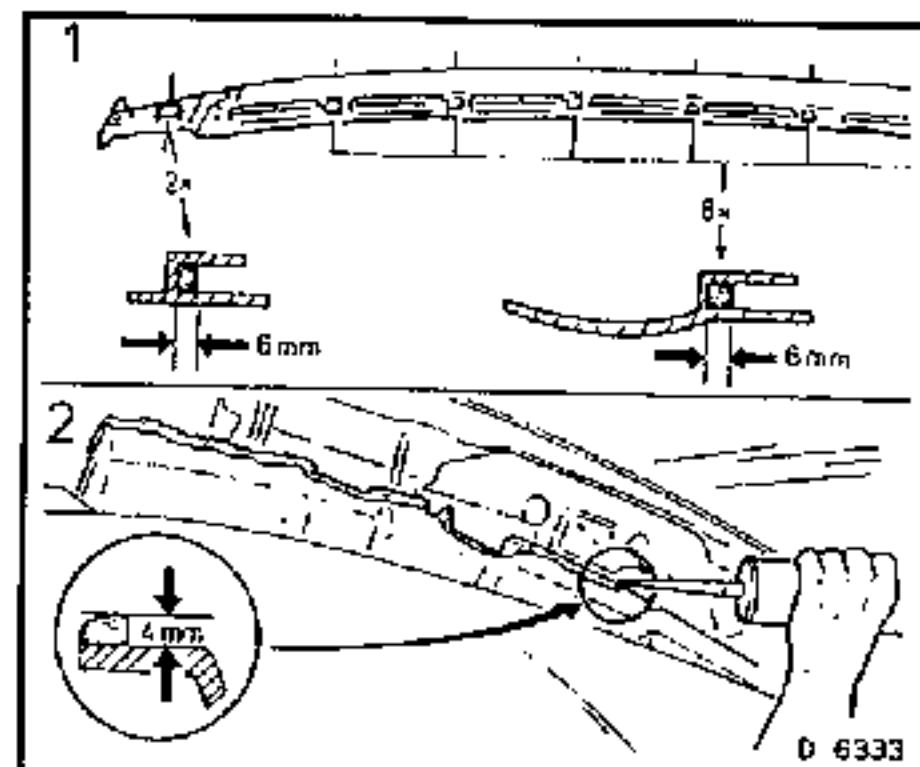
## Install, Connect

Cement in cover, using 2 component glass cement;

Apply bead of cement to catches (1) and to air duct (2).

### Important!

Work quickly to install both the air duct cover and the windscreen, as there is sufficient cement for both operations.



# SEATS, UPHOLSTERY, INNER TRIM PANELS

## Install, Connect

Hold cover at an angle and insert into the 10 catches, using an assistant.

Place cover lightly on the cement bead.

Insert rivet sleeves, bending back the sleeve edges.

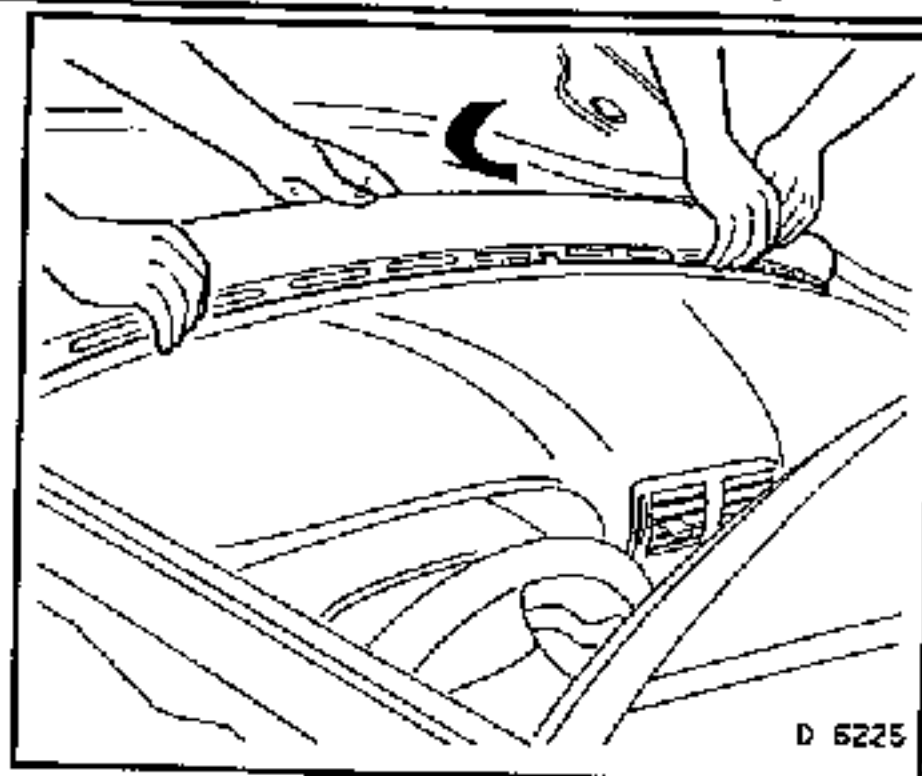
Cement in windscreen. Refer Group "Glass, Window Guides, Window Winders", in this Section.

Fasten cover.

Speaker.

Centre cover.

Bonnet.

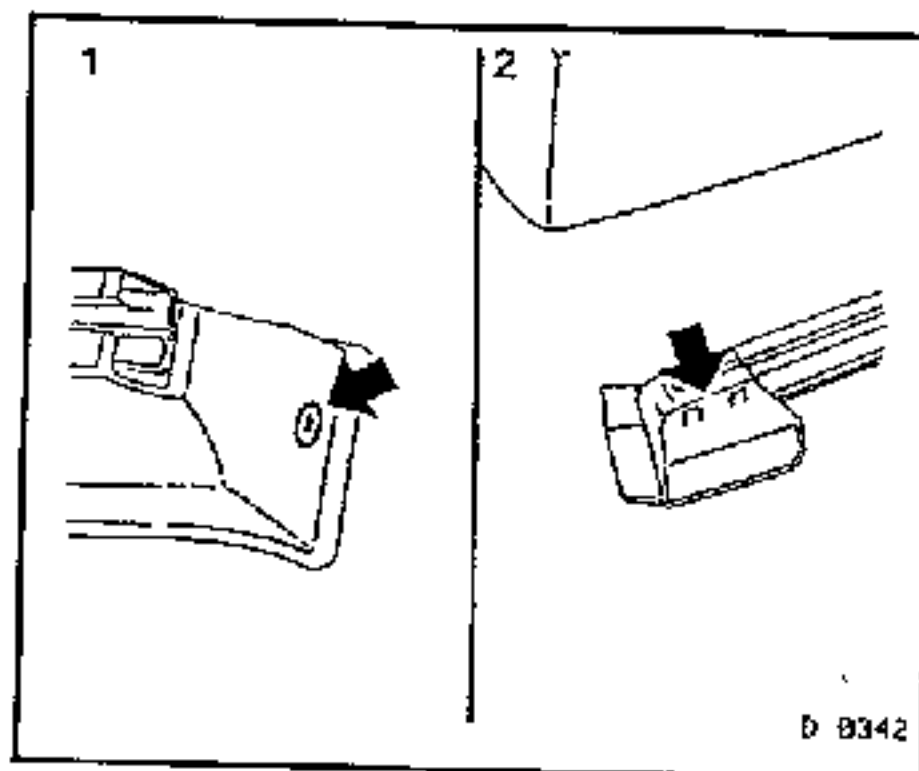


## Front Seats, Remove and Install Vehicles Without Seat Belt Tensioner

### Remove, Disconnect

Front outer panel - bolted (view 1).

Rear inner panel - clipped (view 2).

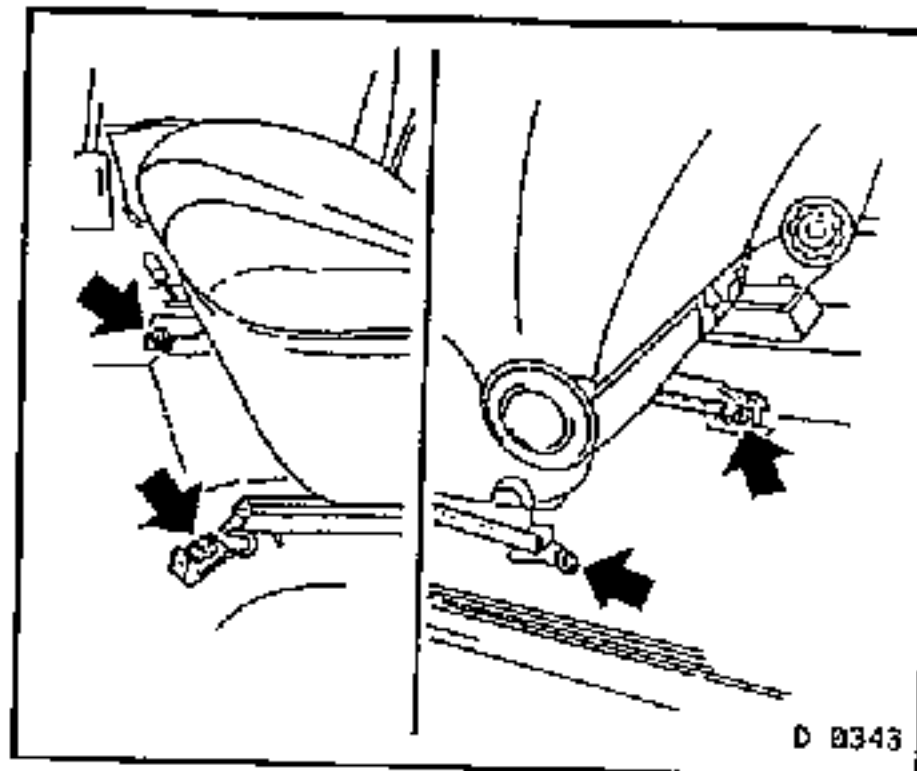


### Remove, Disconnect

Bolts (2 off) from front seat rails.

Bolts (2 off) from rear seat rails.

Seat/s from vehicle.



## Install, Connect

Seat/s to vehicle.

### Tighten (Torque)

Bolts to underbody ..... 20 Nm \*

\* Use new bolts.

**Note:** The sequence from 1 to 4.

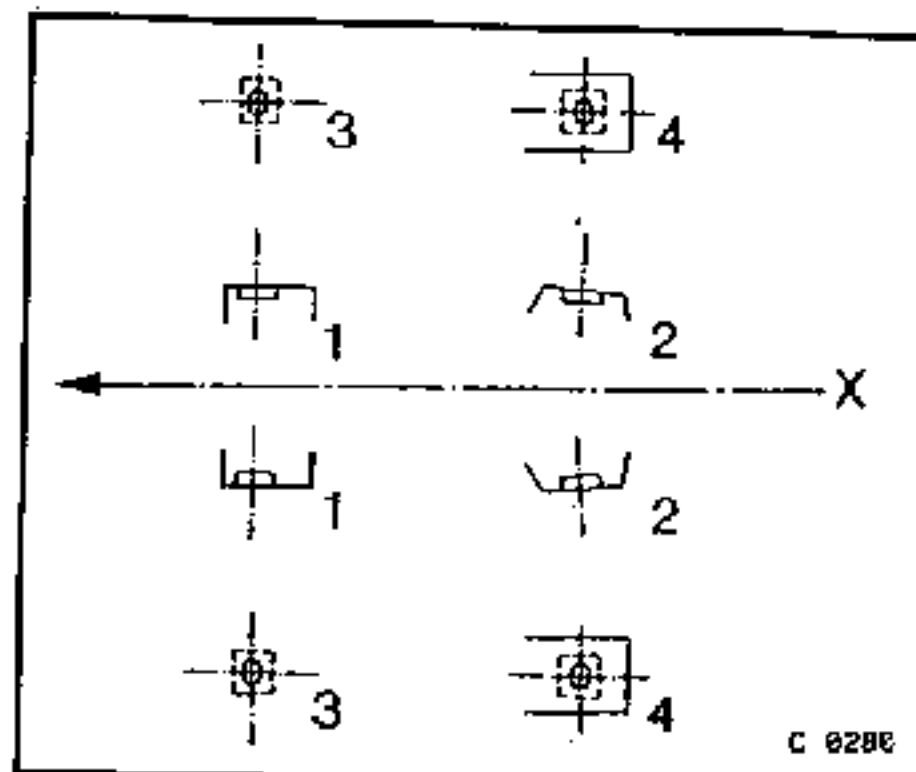
'X' is the centreline of the vehicle pointing to the front.

### Install, Connect

Retaining plate for front outside panel.

Front panel.

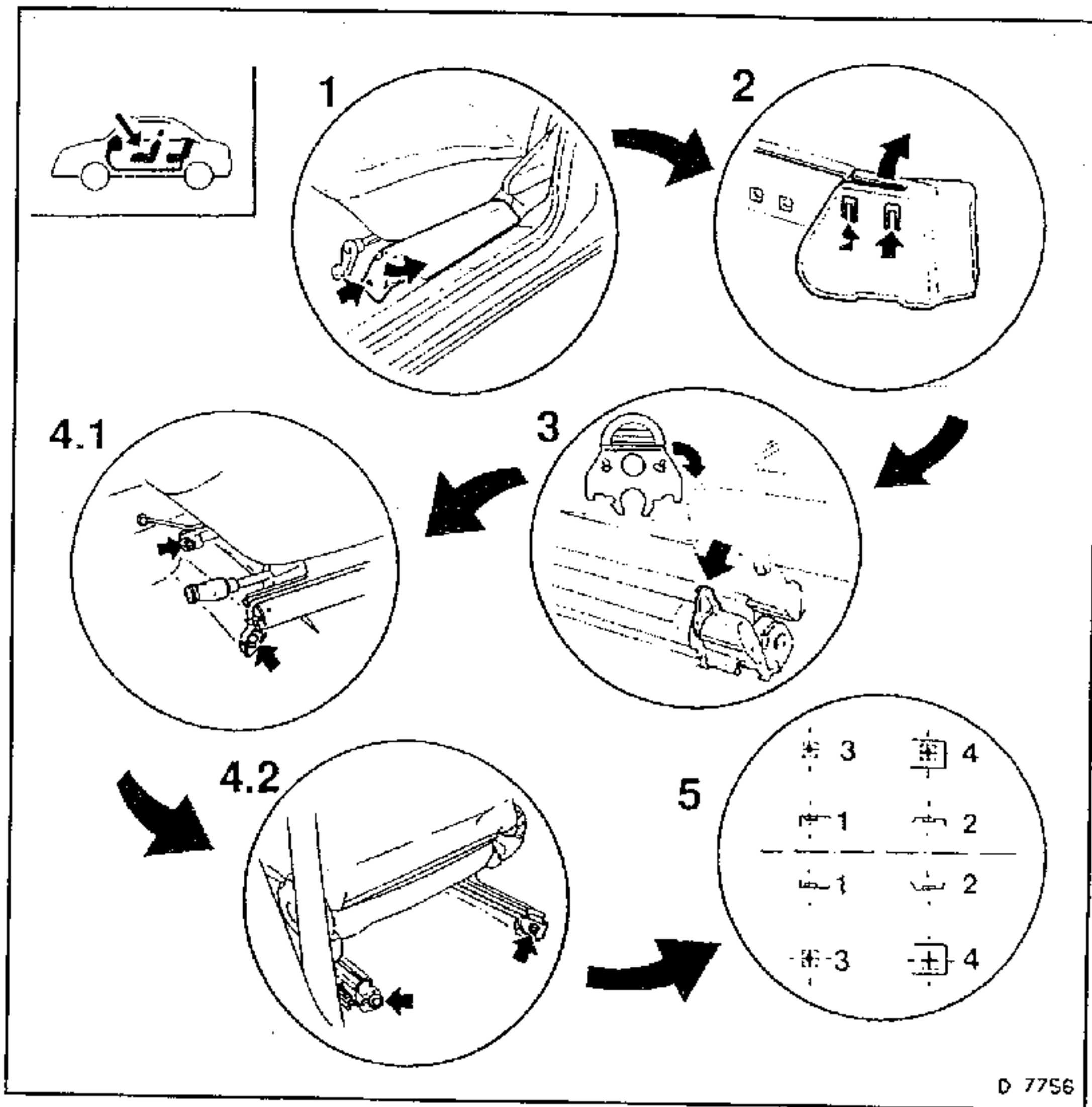
Rear panel.



# SEATS, UPHOLSTERY, INNER TRIM PANELS

## Front Seats, Remove and Install

Vehicles With Seat Belt Tensioner



D 7756

### Remove, Disconnect

View 1: Cover, front outer;

1 bolt at front, 1 retaining lug at rear, then remove backwards.

View 2: Cover, rear inner - 2 retaining lugs.

### Important!

View 3: Before removing seat, always insert securing fork, attached to the energy store, into the special aperture on seat belt tensioner.

View 4: Remove front seat.

View 4.1: 2 bolts at the front.

View 4.2: 2 bolts at the rear.

### Install, Connect

Front seat.

### Tighten (Torque)

Bolts to underbody ..... 20 Nm \*

\* Use new bolts.

View 5: Note the sequence from 1 to 4. For a more clear view, see illustration C 0280 on the previous page.

'X' is the centreline of the vehicle pointing to the front.

### Remove, Disconnect

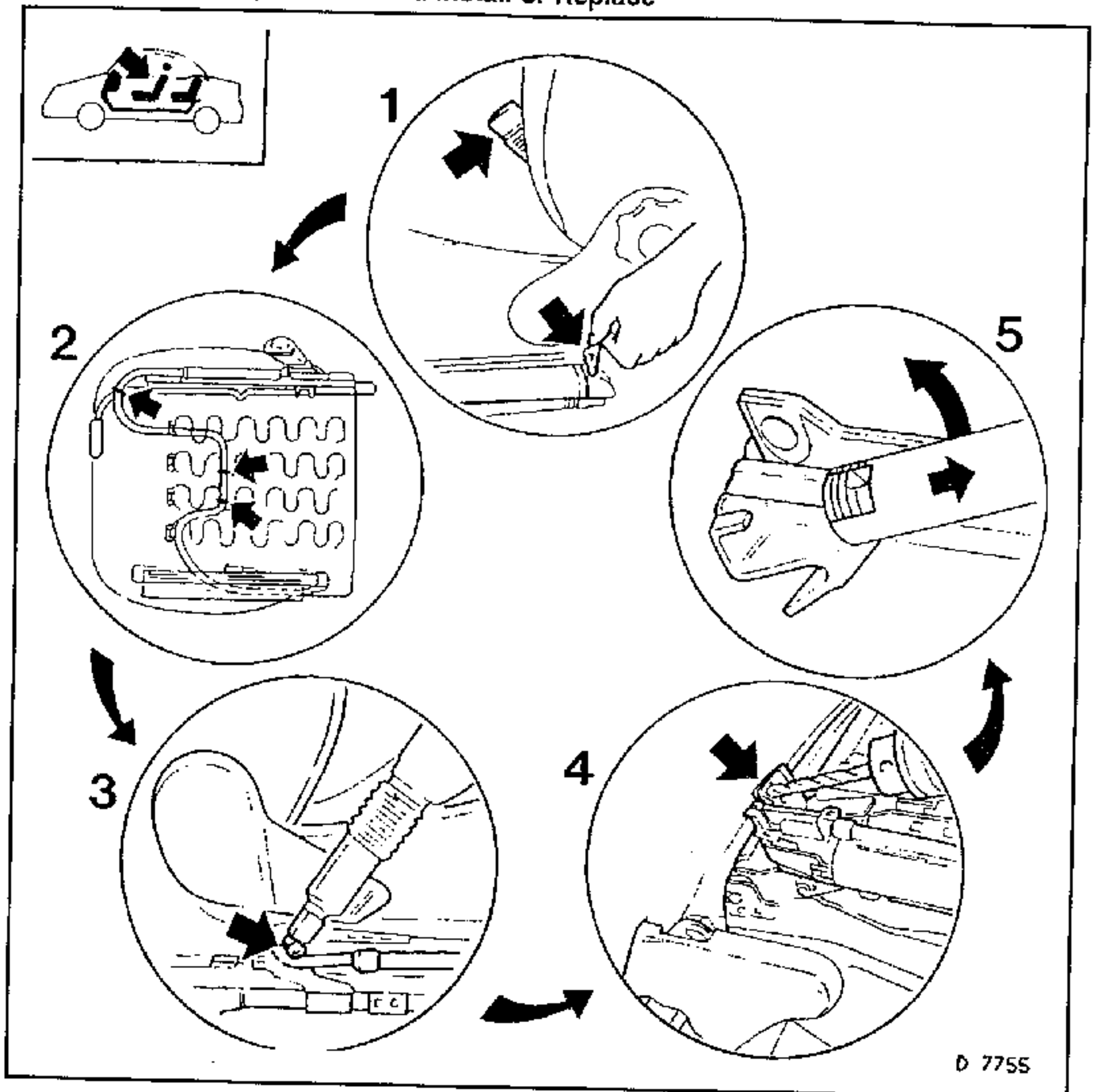
Securing fork.

### Install, Connect

Front and rear covers.

# SEATS, UPHOLSTERY, INNER TRIM PANELS

## Seat Belt Tensioner, Remove and Install or Replace



### Remove, Disconnect

View 1: If seat belt tensioner has not been triggered (no yellow trigger display visible at the lock), firmly insert the securing fork attached to the energy store, at right angles onto the guide tube of the Bowden cable with the covering cap removed (also see illustration D 9984).

### Important!

The securing fork must be fully installed onto the tube. Otherwise the energy store device can easily be activated.

### Remove, Disconnect

Front seat. Refer previous operation in this Section.

View 2: Unclip Bowden cable.

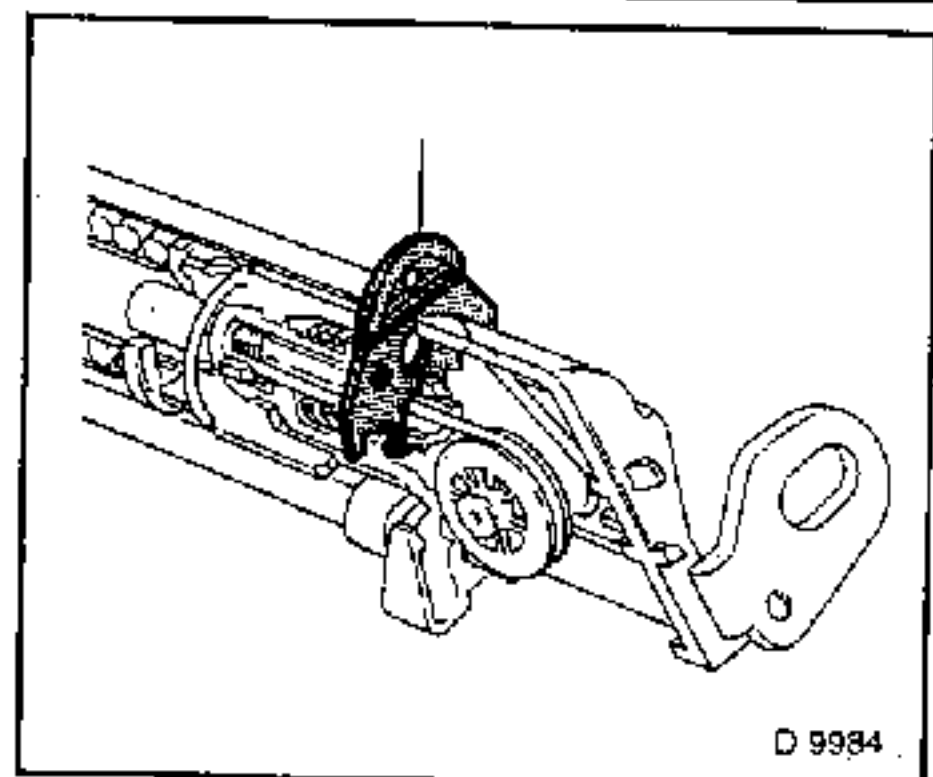
View 3: Unbolt energy lock.

View 4: Drill off energy store fastening rivet.

View 5: Remove energy store from the retainer.

### Important!

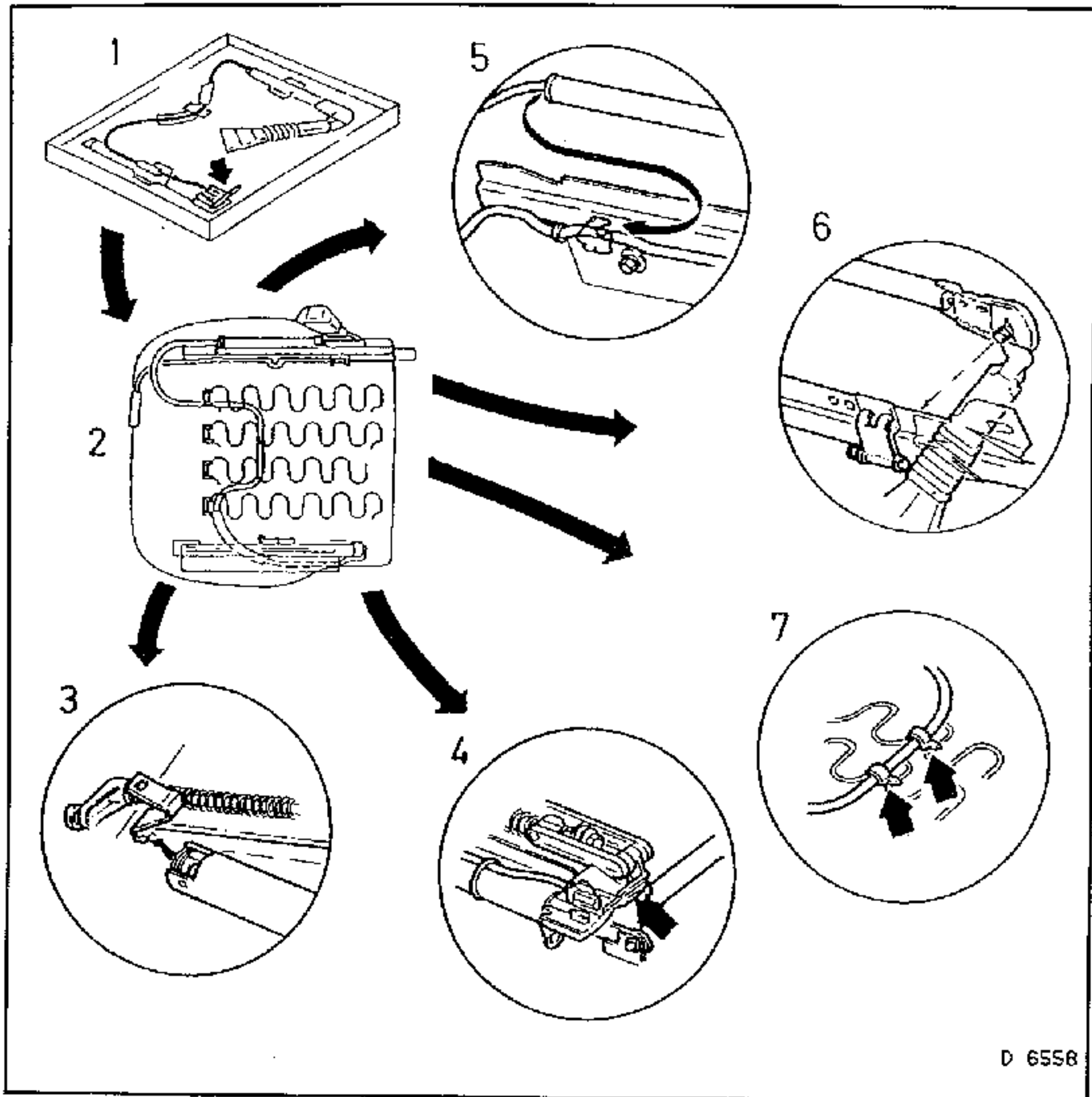
Protect the seat belt tensioner from vibration and do not attempt to dismantle the unit any further.





# SEATS, UPHOLSTERY, INNER TRIM PANELS

## Seat Belt Tensioner, Remove and Install or Replace (Continued)



D 6558

### Install, Connect

View 1: Check that securing fork is correctly installed (arrow). Remove seat belt tensioner from packaging.

View 2: Shows the installation position on the seat.

View 3: Attach the energy store in retainer.

View 4: Bolt the energy store fastening shackle.

View 5: Slide the sleeve into the retaining shackle.

View 6: Bolt the lock to the seat.

### Tighten (Torque)

Seat belt tensioner to front seat..... 35 Nm

View 7: Fasten Bowden cable to seat springs and seat adjuster lever at the points indicated, using cable fasteners.

### Install, Connect

Front seat.

Remove securing fork and store on the end of the energy store.

# SEATS, UPHOLSTERY, INNER TRIM PANELS

## Seat Belt Tensioner - Triggering Procedure

### Remove, Disconnect

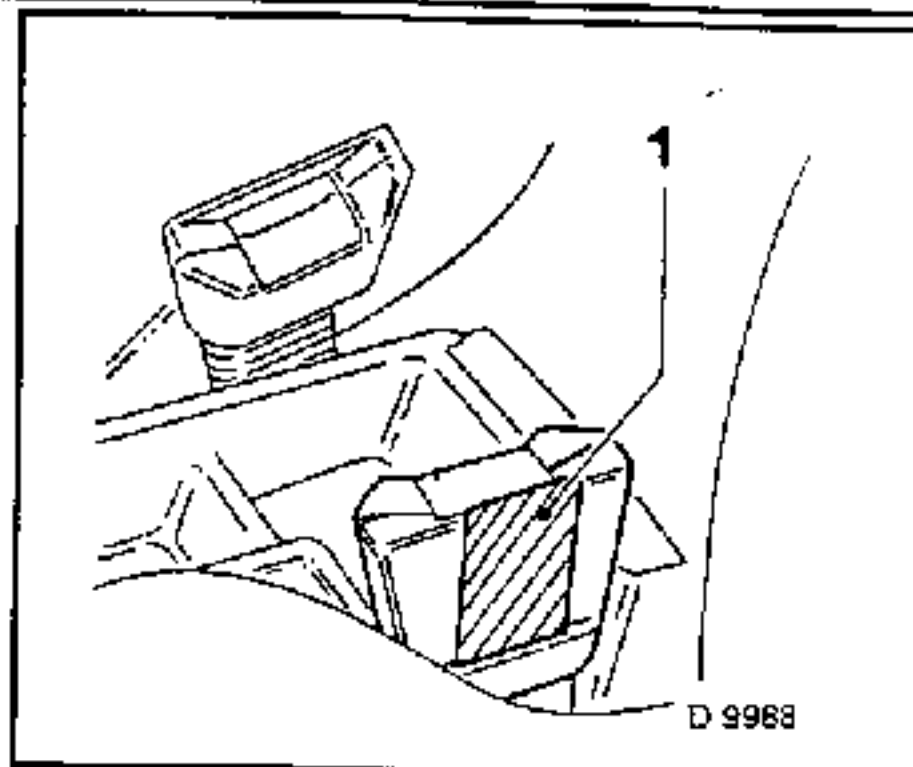
The securing fork from the energy store.

Covering cap.

### Trigger

Strike the end of the Bowden cable guide tube with a sharp hammer blow.

Successful triggering is indicated by the appearance of a yellow tab (1) on the seat belt catch.



## Upholstery - Front Seat, Replace

### Remove, Disconnect

Front seat. Refer operation in this Section.

If fitted, secure seat belt tensioner with securing fork.

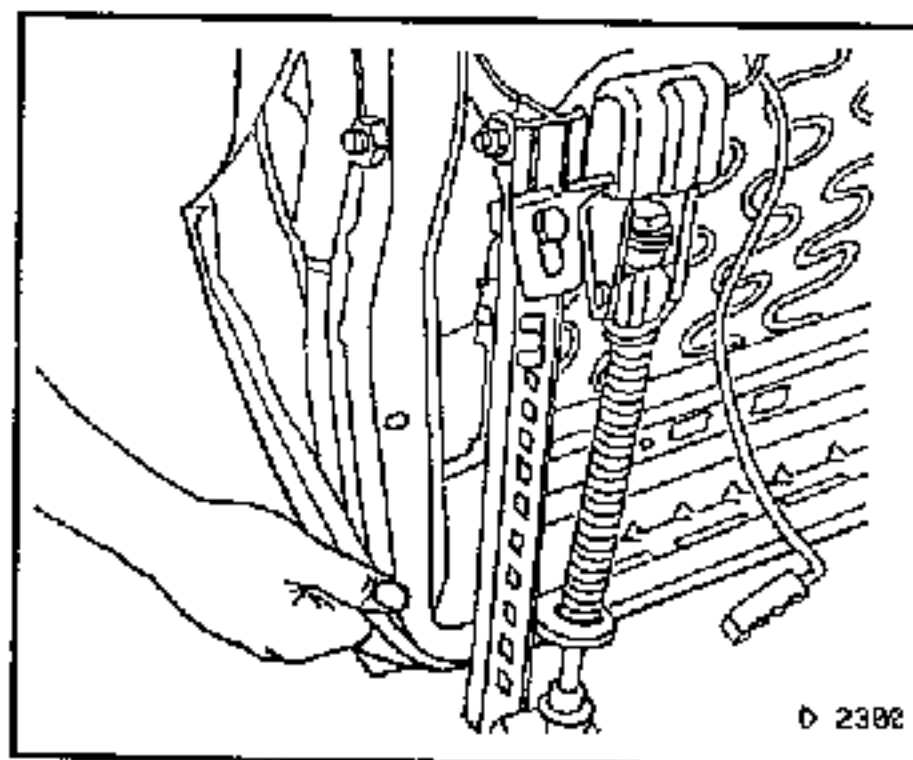
Front seat backrest.

Wiring harness plug for seat heating, if fitted.

Undo upholstery from below the seat.

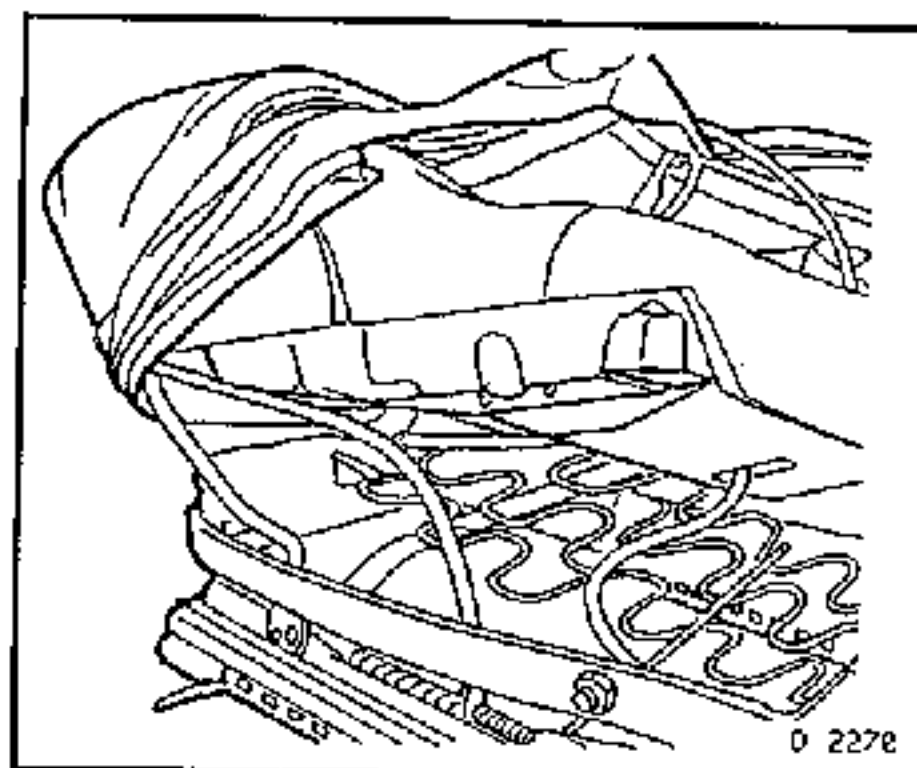
### Important!

For vehicles with seat belt tensioners, protect the removed seat from vibration.



### Remove, Disconnect

Upholstery with cushion from seat frame.



### Remove, Disconnect

Seat surface ring clips.

Upholstery from the cushion.

### Install, Connect

Upholstery on cushion. Secure cushion with ring clips underneath.

Front seat back rest to front seat.

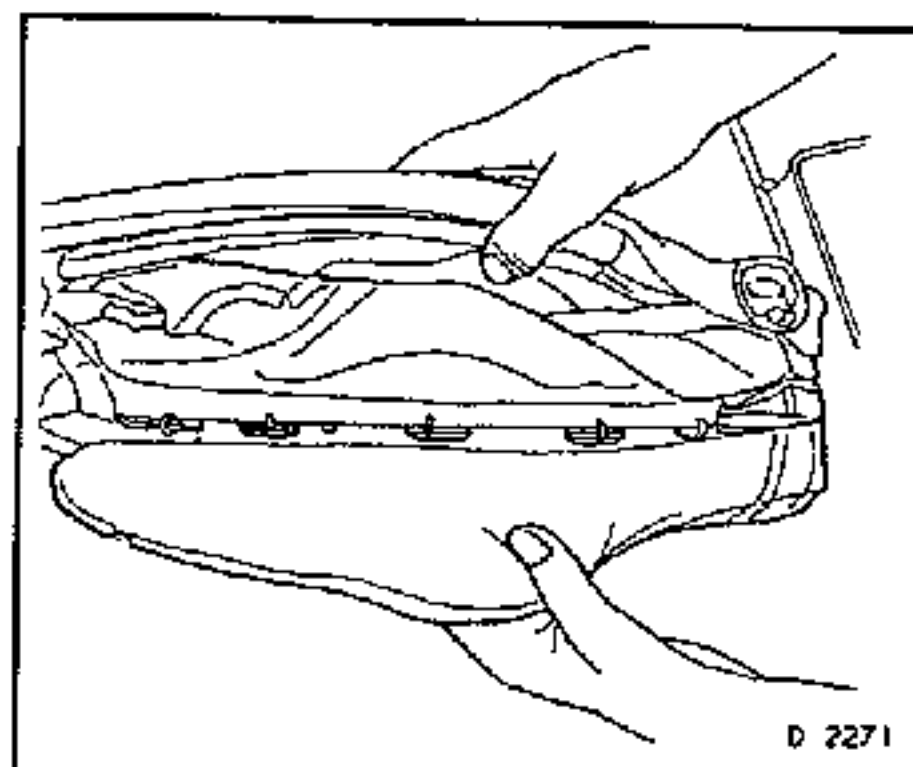
Connect wiring harness plug to seat heating (if fitted).

Front seat.

Remove seat belt tensioner securing fork if fitted.

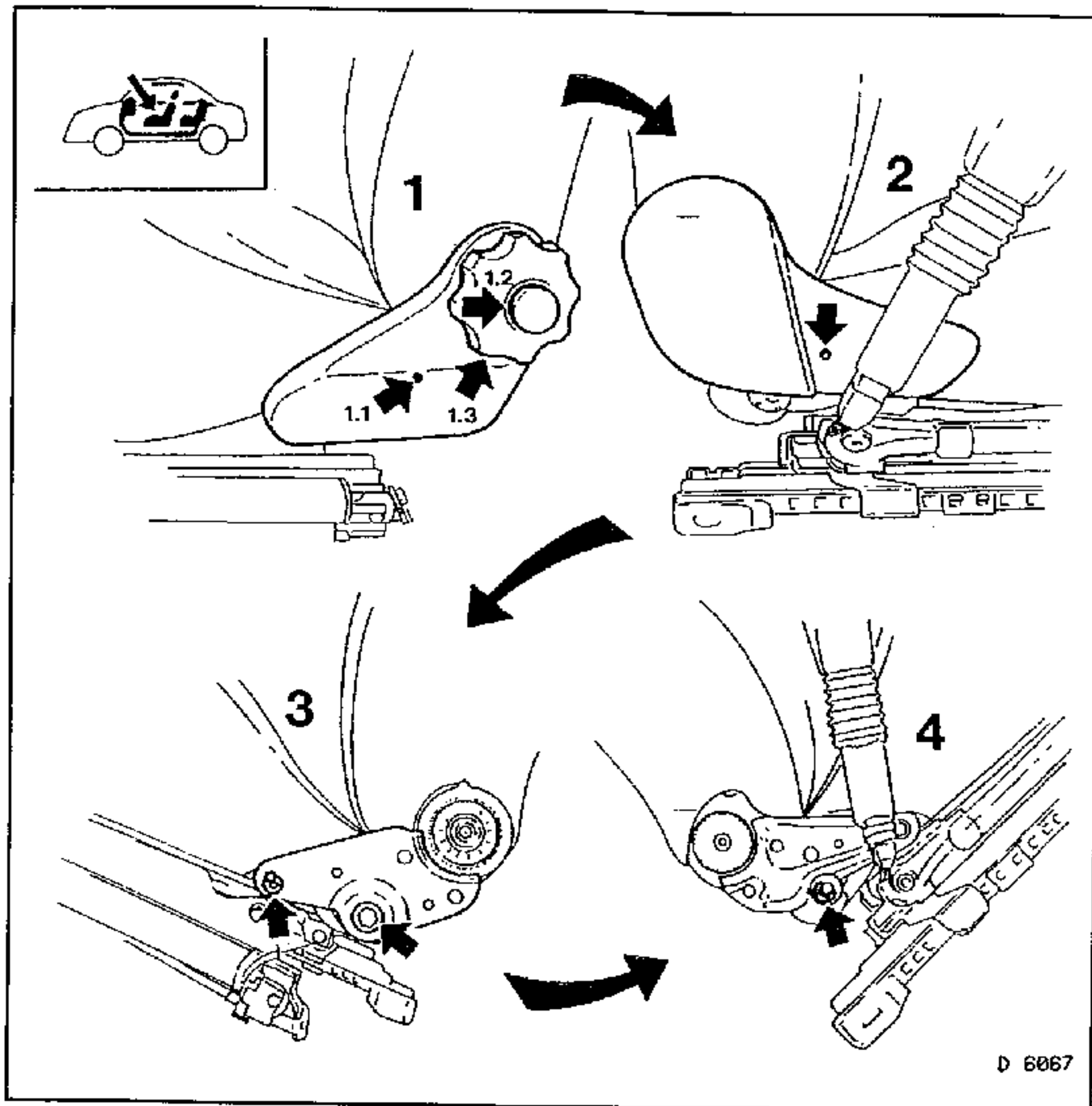
### Important!

Ensure all cables are routed correctly.



# SEATS, UPHOLSTERY, INNER TRIM PANELS

## Front Seat Backrest, Remove and Install



**Note:** Illustration D 6067 shows a seat fitted with a seat belt tensioner but the procedure is the same for all seats.

### Remove, Disconnect

Front seat. Refer to operation in this Section. If fitted with seat belt tensioners install securing fork.

View 1: Outer cover;  
View 1.1 Pin, body bound rivet.  
View 1.2: Lever off plug.  
View 1.3: Remove hand wheel.

View 2: Inner cover;  
Pin, body bound rivet.

View 3: Outside;  
Bolt, retainer.

View 4: Inside;  
Retainer

Front seat backrest.

### Install, Connect

Front seat backrest.

Inner and outer covers

Front seat. If fitted, remove securing fork and clip onto the end of the energy store.

### Important!

For vehicle fitted with seat belt tensioners, protect the seat from vibration at all times.

# SEATS, UPHOLSTERY, INNER TRIM PANELS

## Upholstery - Front Seat Backrest, Replace

### Remove, Disconnect

Front seat. Refer operation in this Section. If fitted with seat belt tensioners insert securing fork.

Front set backrest, disconnecting wiring harness plug to seat heating if fitted.

Headrests.

Detach upholstery from underneath;

Ring clips, sleeves for headrests, upholstery.

### Important!

If fitted with seat belt tensioners, protect seat from vibration.

### Install, Connect

Upholstery;

Ring clips, hook into upholstery from underneath.

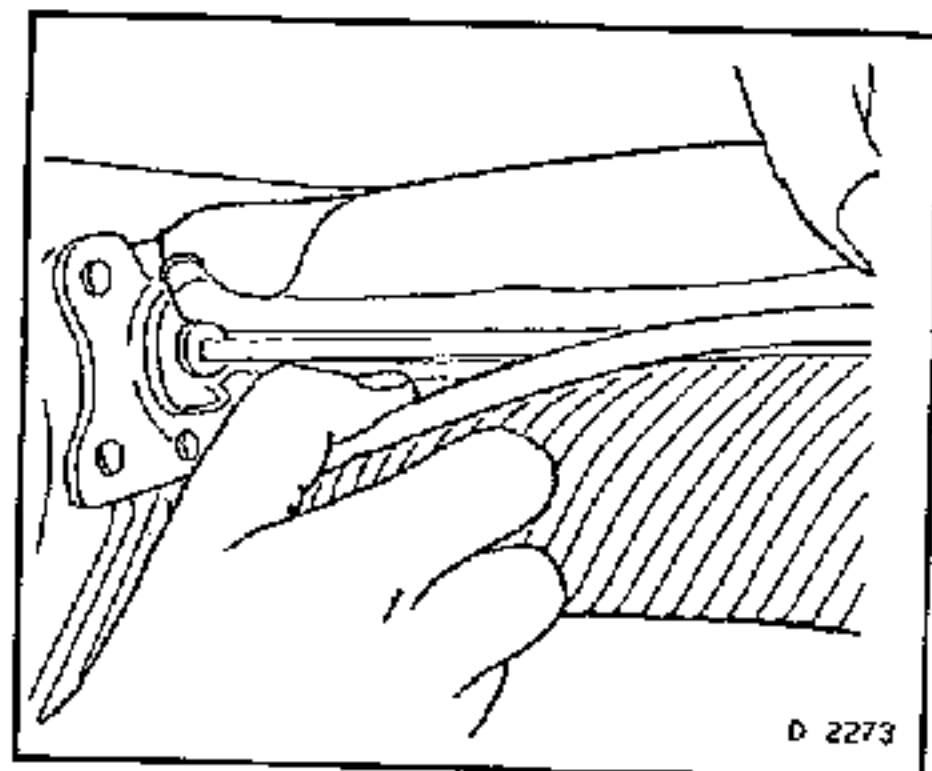
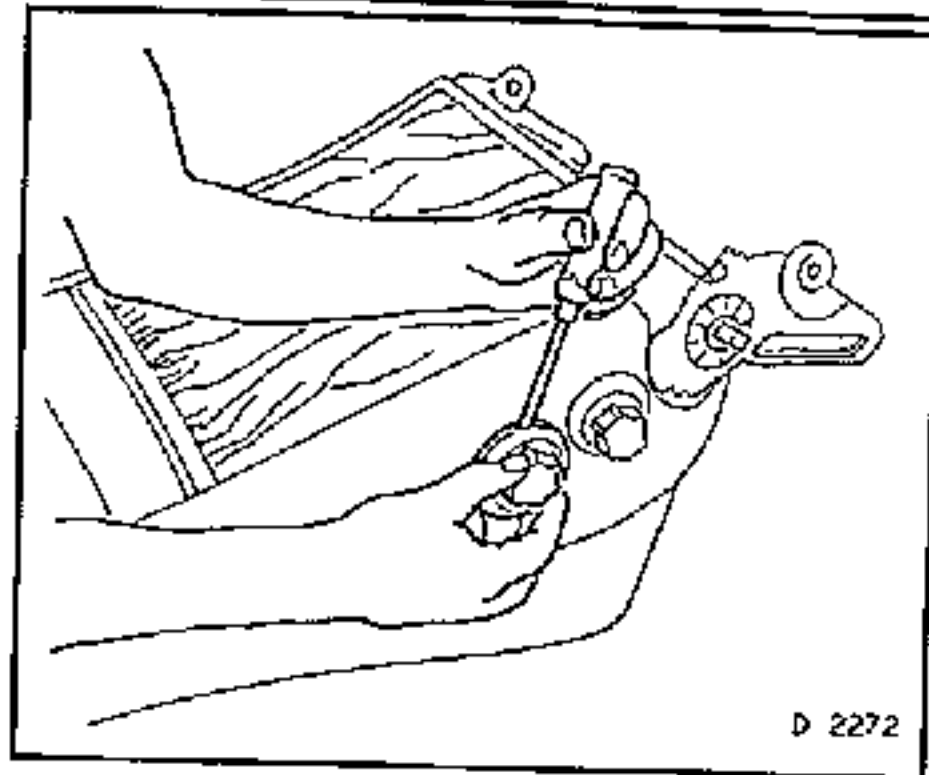
Sleeves for headrests.

Front seat backrest to front seat.

Wiring harness plug to seat heating if fitted.

Front seat. If fitted, remove securing fork and clip onto the end of the energy store.

Headrests.



## Headrest Sleeve, Remove and Install

### Remove, Disconnect

Headrest.

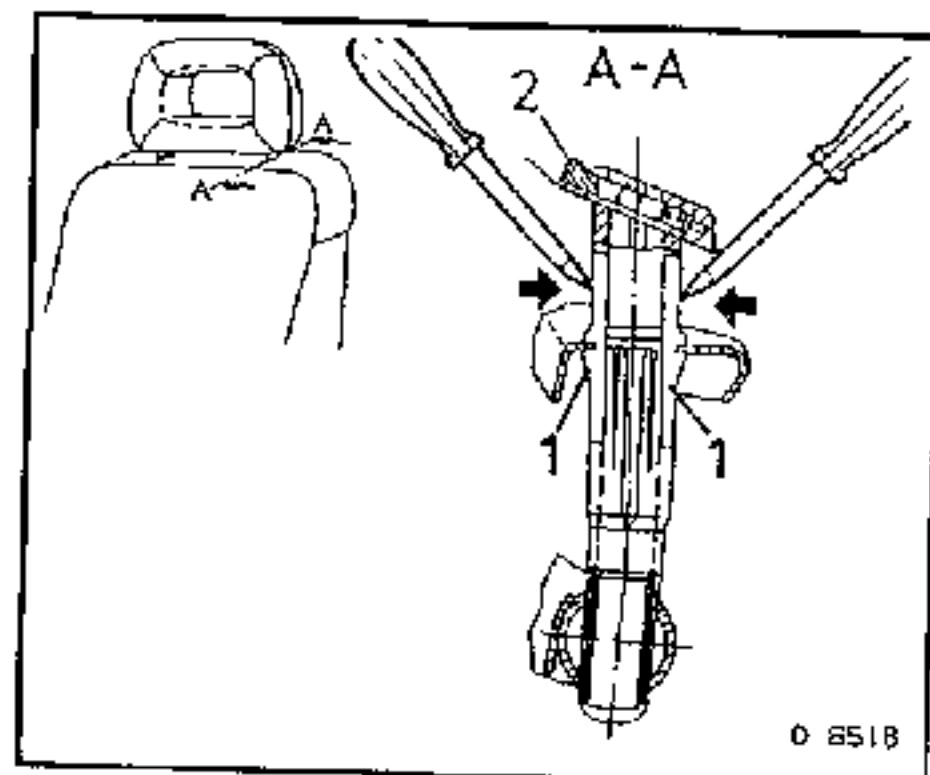
Sleeve from front headrest;

Release locking nubs (1), using two thin screwdrivers.

Lever out the sleeve, taking care not to damage the upholstery.

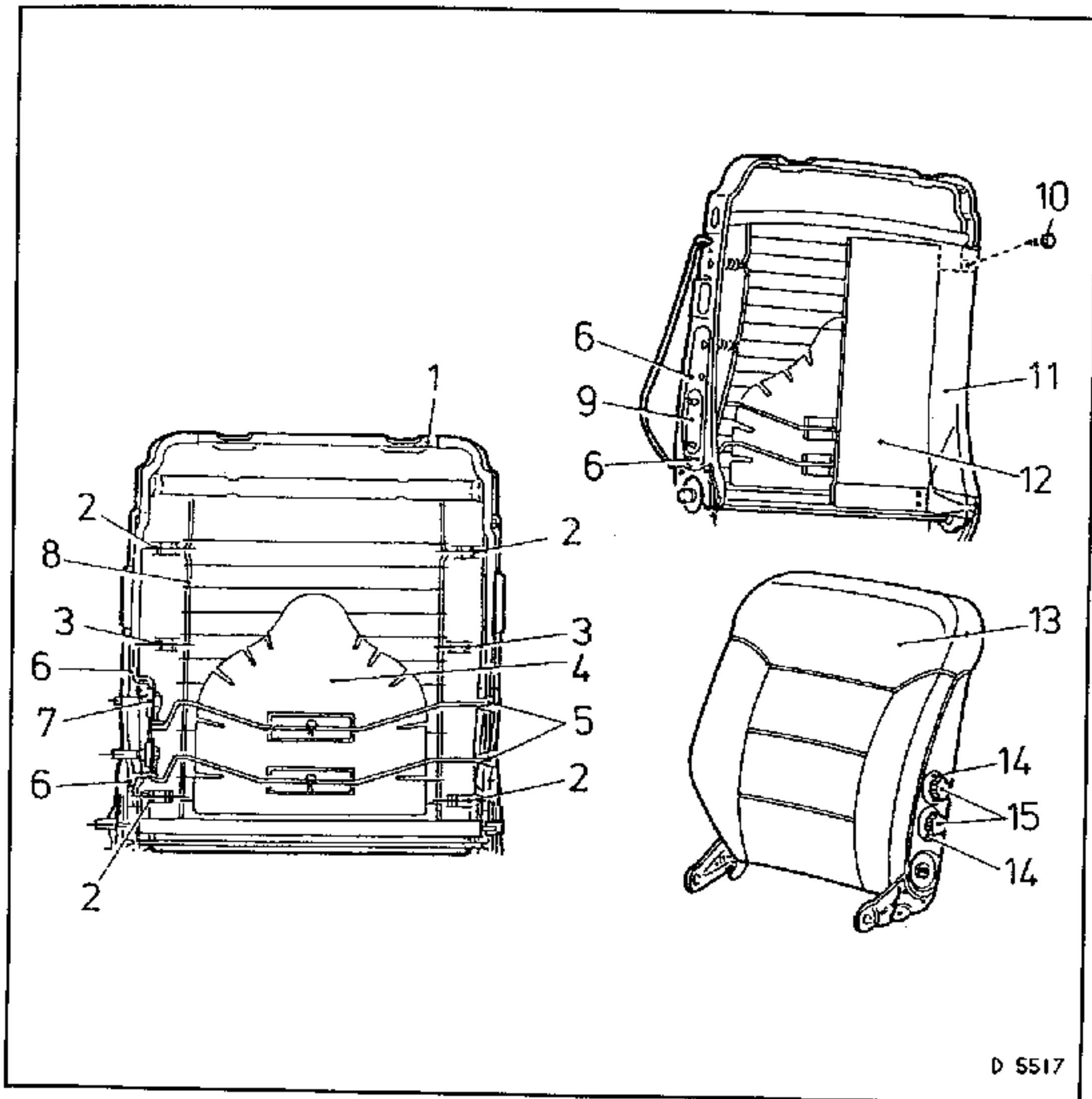
### Install, Connect

Reverse to removal, except that the press button (2), faces forward.



# SEATS, UPHOLSTERY, INNER TRIM PANELS

## Lumber Support - Overview



### Illustration Key:

- |   |                                    |     |                                 |
|---|------------------------------------|-----|---------------------------------|
| 1 | Frame                              | 9.  | Damping                         |
| 2 | Tension Spring (71 mm)             | 10. | Bolt                            |
| 3 | Tension Spring (69 mm)             | 11. | Wadding Liner (120 mm x 420 mm) |
| 4 | Pressure Plate                     | 12. | Cover                           |
| 5 | Bushing                            | 13. | Upholstery                      |
| 6 | Steel blind rivet (4.8 mm x 10 mm) | 14. | Cover Panel                     |
| 7 | Adjuster                           | 15. | Rotary Knob                     |
| 8 | Wire Mat                           |     |                                 |

# SEATS, UPHOLSTERY, INNER TRIM PANELS

## Lumbar Support, Replace Completely

## Front Seat Backrest Frame, Replace

### Remove, Disconnect

Front seat. Refer operation in this Section. If fitted with seat belt tensioners insert securing fork.

Front sea backrest, disconnecting wiring harness plug to seat heating if fitted.

Headrests, headrest sleeves.

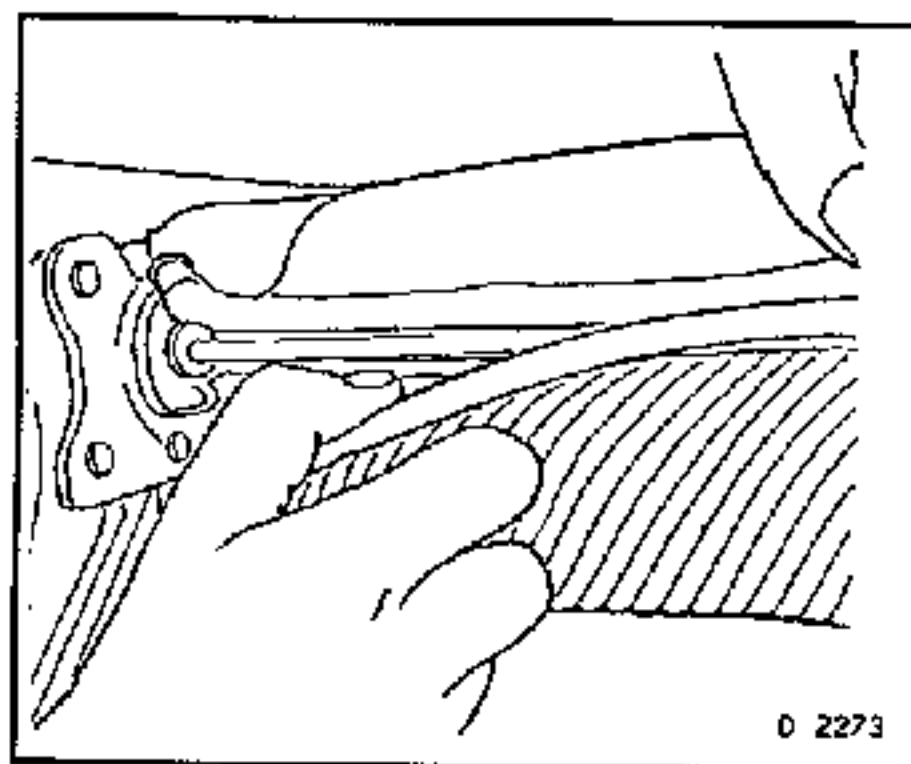
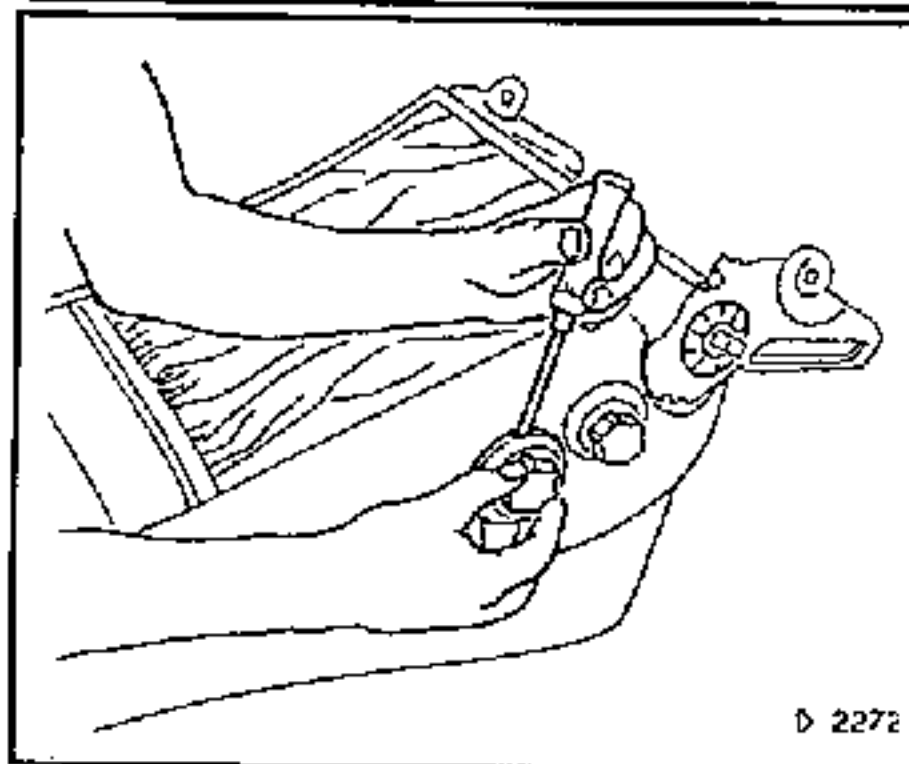
Rotary knob.

### Important!

If fitted with seat belt tensioners, protect seat from vibration.

### Remove, Disconnect

Front seat upholstery. Refer to the operation in this Section.



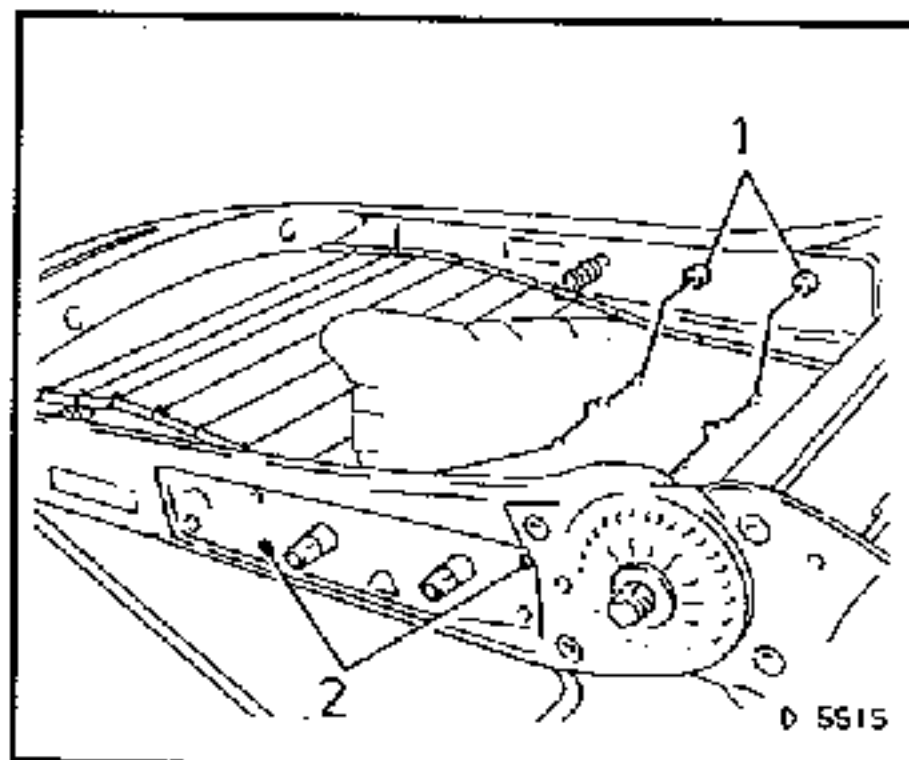
### Remove, Disconnect

Cover from frame, damping.

Release bushings (1).

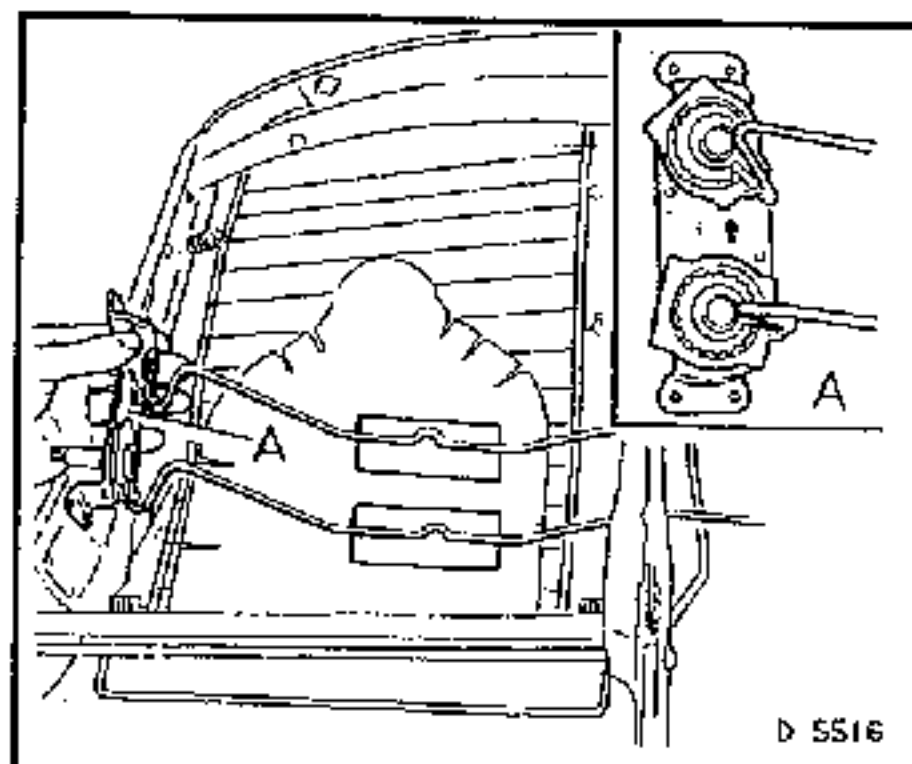
Drill off adjuster from frame (2). Do not damage frame during this process.

Pressure plate.



### Install, Connect

Pressure plate adjuster, observing the mark shown in inset (A).



# SEATS, UPHOLSTERY, INNER TRIM PANELS

## Install, Connect

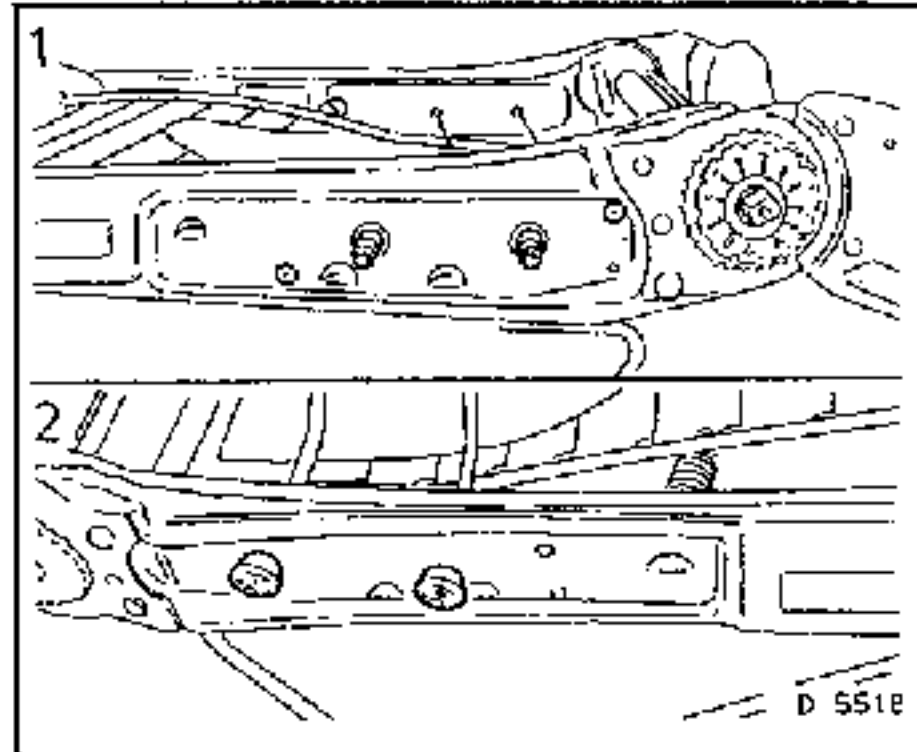
Rivet adjuster diagonally (1), using blind steel rivets, 4.8 mm x 10 mm.

Bushing (2).

Cement on damping cover.

## Inspect

Lumbar support function.



## Install, Connect

Front seat backrest upholstery.

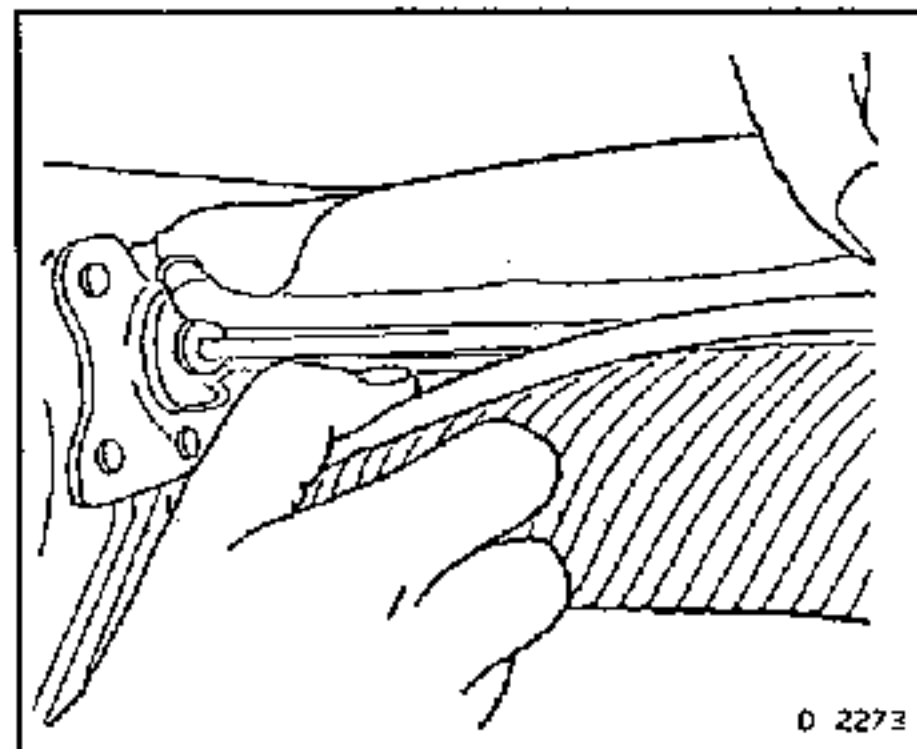
Rotary knob.

Headrest sleeves.

Front seat backrest.

Front seat. If fitted with seat belt tensioners, remove securing fork and clip onto the end of the energy store.

Headrest.



## Upholstery - Rear Seat Cushion, Replace

### Remove, Disconnect

Rear seat cushion. Refer to operation in this Section.

Ring clips around edges.

Ring clips for seat surface.

Upholstery.

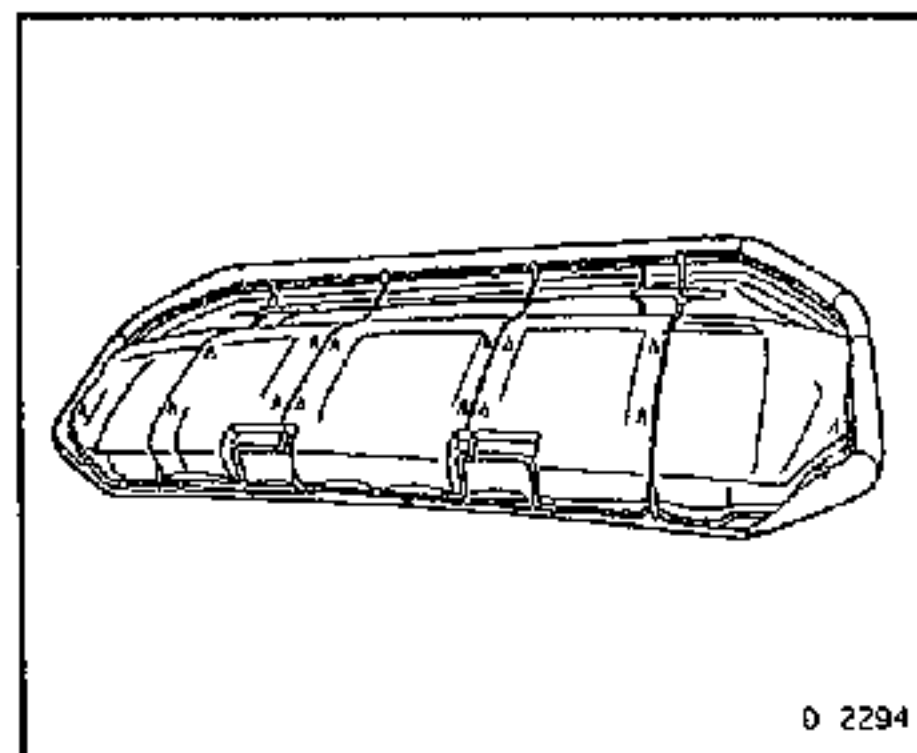
### Install, Connect

Upholstery.

Ring clips for seat surface.

Ring clips around edges.

Rear seat cushion.

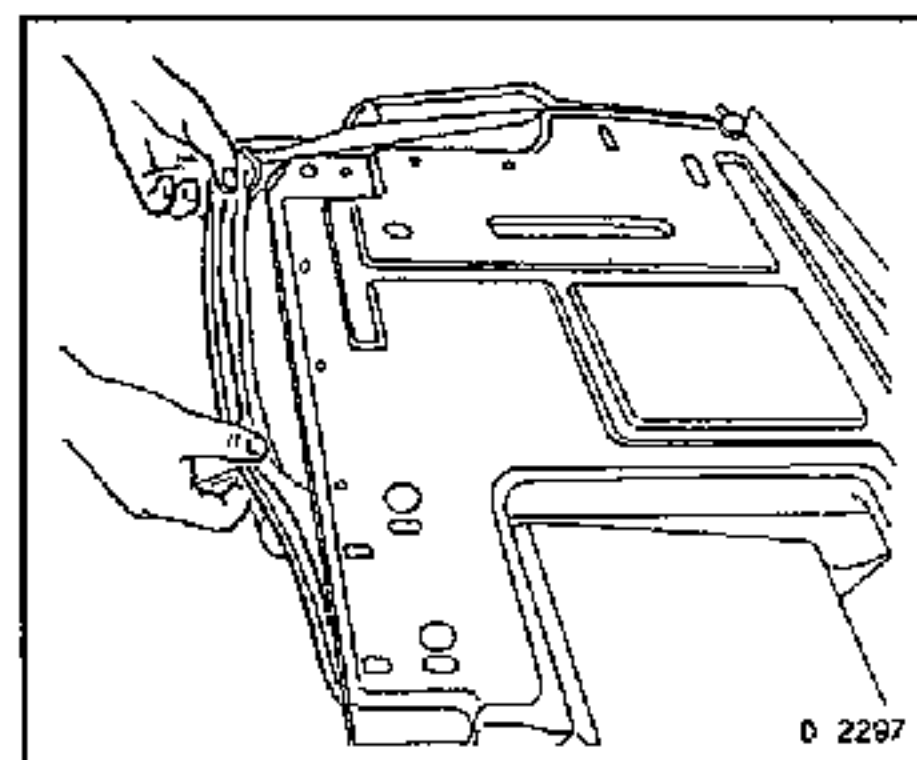


## Upholstery - Rear Seat Backrest, Replace

### Remove, Disconnect

Rear seat backrests. Refer operation in this Section.

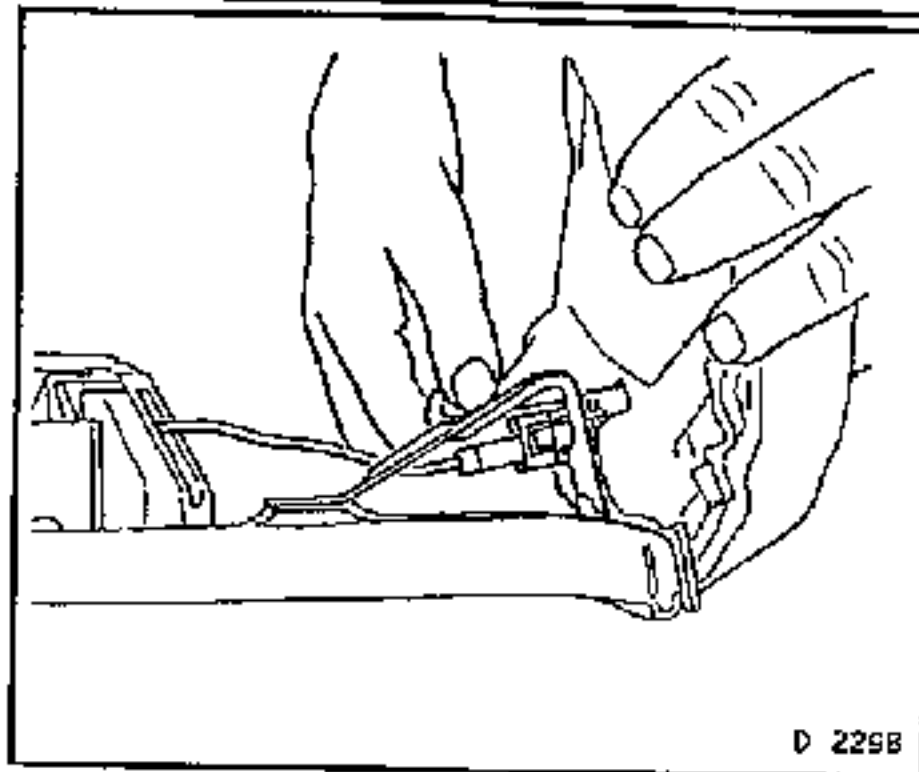
Upholstery from below the seat backrest.



# SEATS, UPHOLSTERY, INNER TRIM PANELS

## Remove, Disconnect

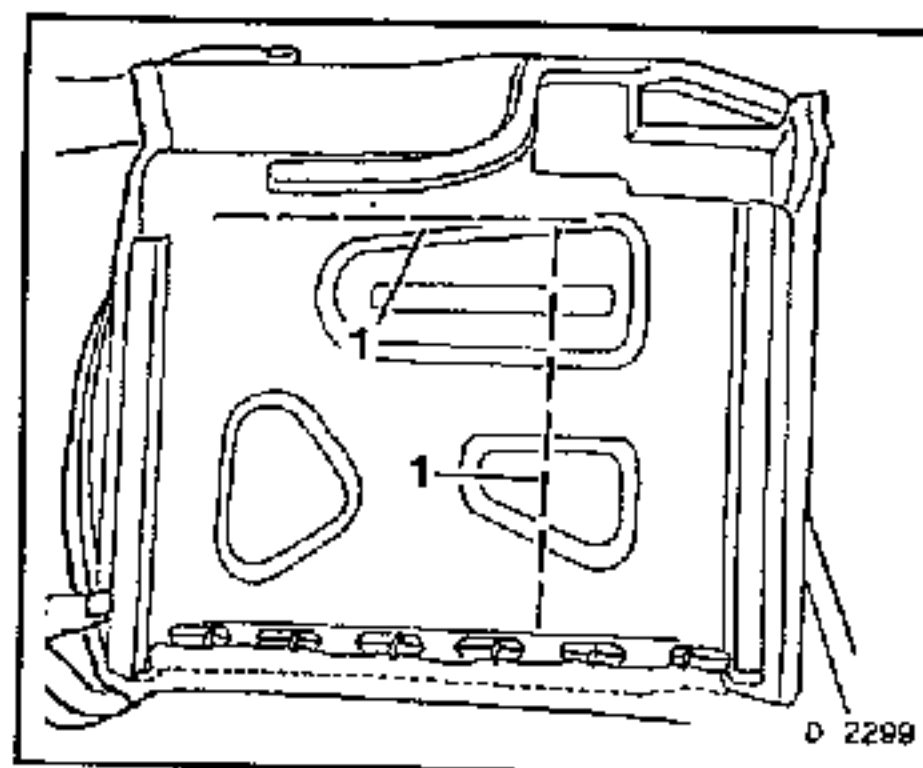
Fold up upholstery with the cushion and unclip the release button.



## Remove, Disconnect

Ring clips (1).

Upholstery from cushion.



## Install, Connect

Upholstery on cushion.

Upholstery and cushion on the frame.

Clip in release button.

Fasten upholstery, using ring clips to secure.

Rear seat backrests.

## Wooden Strip - Door Inner Trim Panel, Replace

### Remove, Disconnect

Door trim inner panelling. Refer to the operation in this Section.

4 spring clamps (arrows) from the rear of the door trim inner panel, securing the wooden strip.

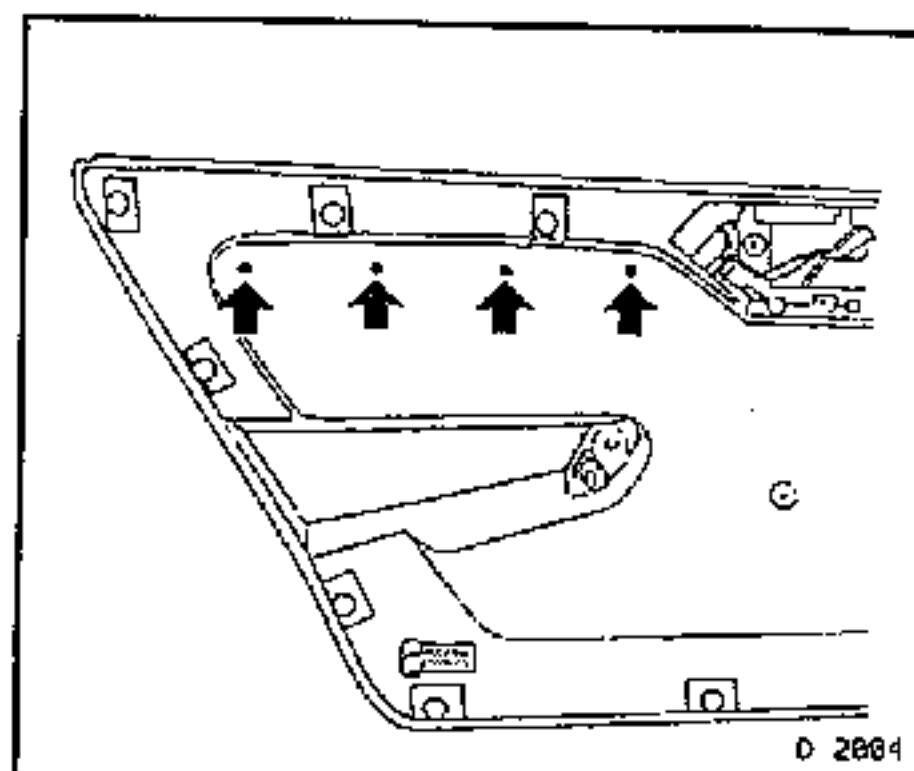
Wooden strip.

### Install, Connect

Wooden strip.

Spring clamps.

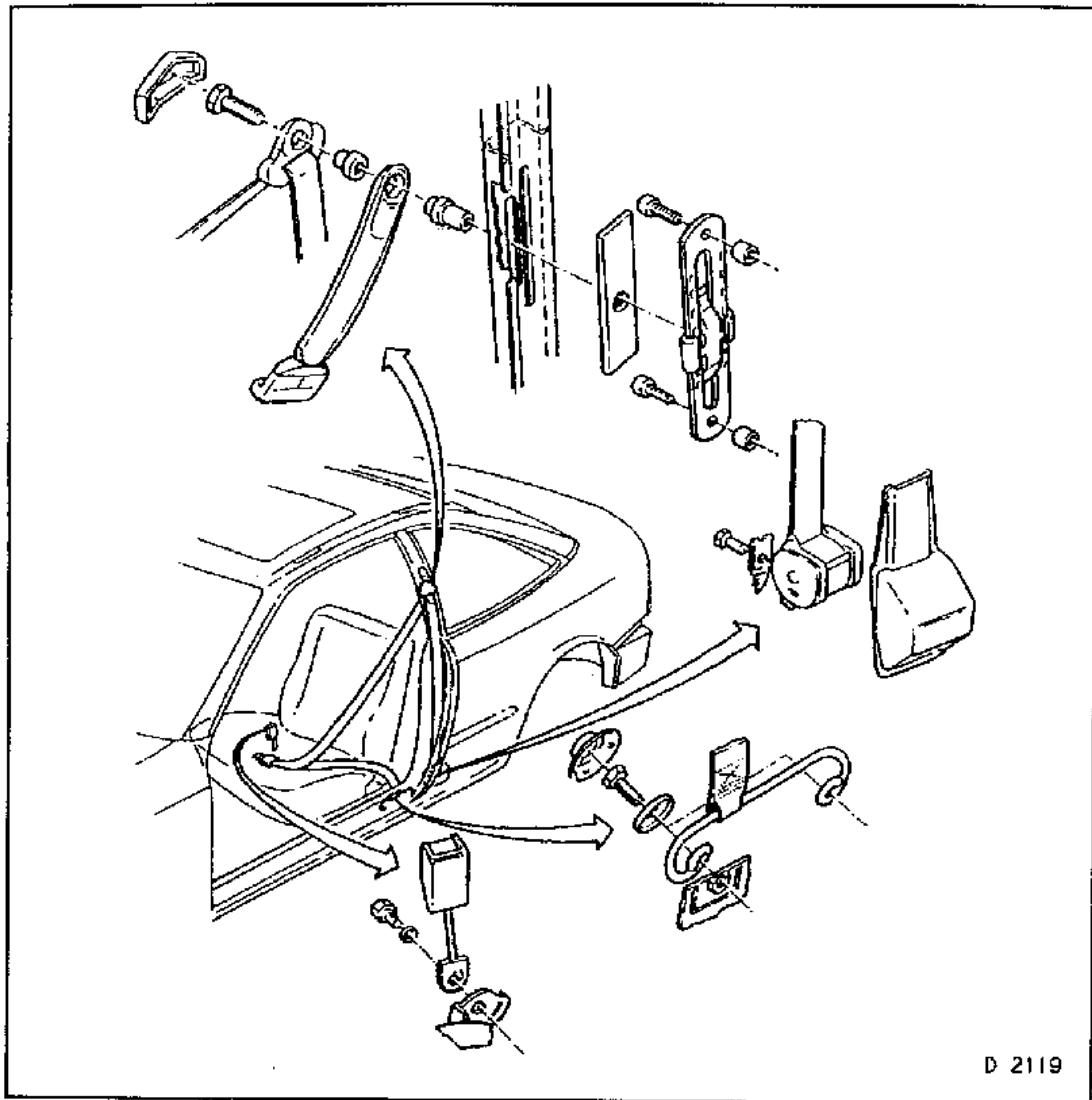
Door trim inner panelling.





# SEATS, UPHOLSTERY, INNER TRIM PANELS

## Front Seat Belt, Replace



D 2119

### Remove, Disconnect

Rear seat cushion, inner trim panelling on side quarter panel.

Belt anchor on 'B' pillar.

Inner trim panelling on 'B' pillar.

Vehicles without seat belt tensioner;

Seat, belt catch.

Vehicles with seat belt tensioners;

Front seat. Refer operation in this Section.

Seat belt tensioner. Refer operation in this Section.

Height adjuster.

Reel retractor.

Sliding bar.

### Install, Connect

Sliding bar.

Reel retractor.

Height adjuster.

Belt lock/seat belt adjuster.

Seat.

Inner trim panelling on 'B' pillar.

Inner trim panelling on side quarter panel.

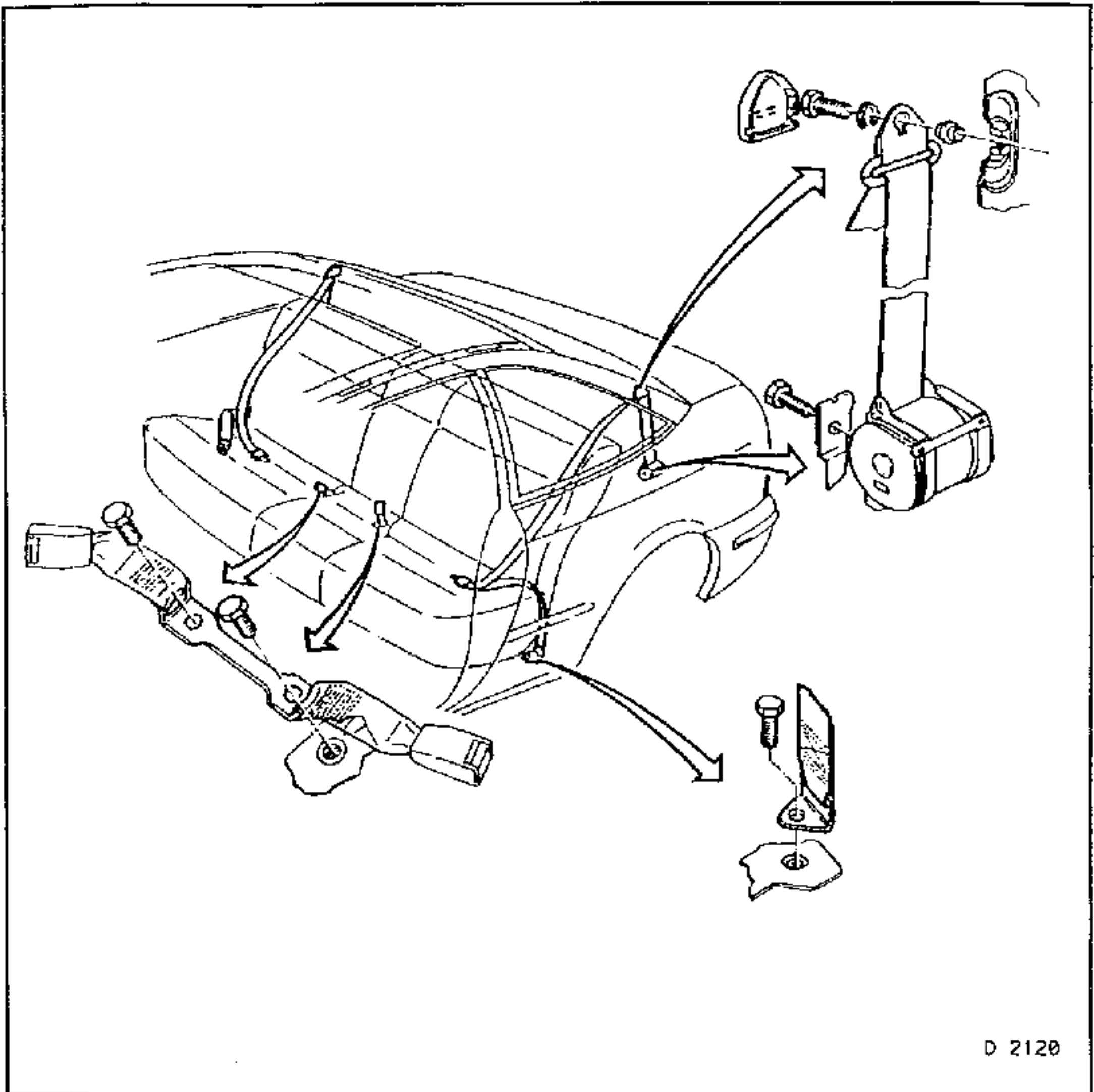
Rear seat cushion.

### Tighten (Torque)

Height adjuster to 'B' pillar .....	20 Nm
Reel retractor to 'B' pillar frame .....	35 Nm
Sliding bar to sill .....	35 Nm
Belt lock/seat belt tensioner to seat ..	35 Nm
Belt anchor to 'B' pillar .....	35 Nm
Seat to underbody .....	20 Nm

# SEATS, UPHOLSTERY, INNER TRIM PANELS

## Rear Seat Belt, Replace



### Remove, Disconnect

Rear seat cushion.

Belt lock.

Belt anchor from floor and 'C' pillar.

Reel retractor.

#### Note:

The reel retractor is accessible from the storage box in the luggage compartment.

### Install, Connect

Reel retractor.

Guide belt and guide through aperture of 'C' pillar inner panelling.

Belt anchor to floor assembly and 'C' pillar.

Belt lock.

Rear seat cushion.

### Tighten (Torque)

Belt anchor to floor assembly and 'C' pillar .....	35 Nm
Reel retractor to 'C' pillar frame .....	35 Nm

# SEATS, UPHOLSTERY, INNER TRIM PANELS

## RECOMMENDED TORQUE VALUES

	Nm
Seat frame bolts to underbody.....	20
Seat belt tensioner to front seat.....	35
Front seat belt height adjuster to 'B' pillar .....	20
Front seat belt reel retractor to 'B' pillar frame .....	35
Front seat belt sliding bar to sill .....	35
Front seat belt lock/seat belt tensioner to seat.....	35
Front seat belt anchor to 'B' pillar.....	35
Rear seat belt anchor to floor assembly and/or 'C' pillar.....	35
Rear seat belt reel retractor to 'C' pillar frame .....	35

## NOTES

# GROUP K

## CLUTCH AND TRANSMISSION

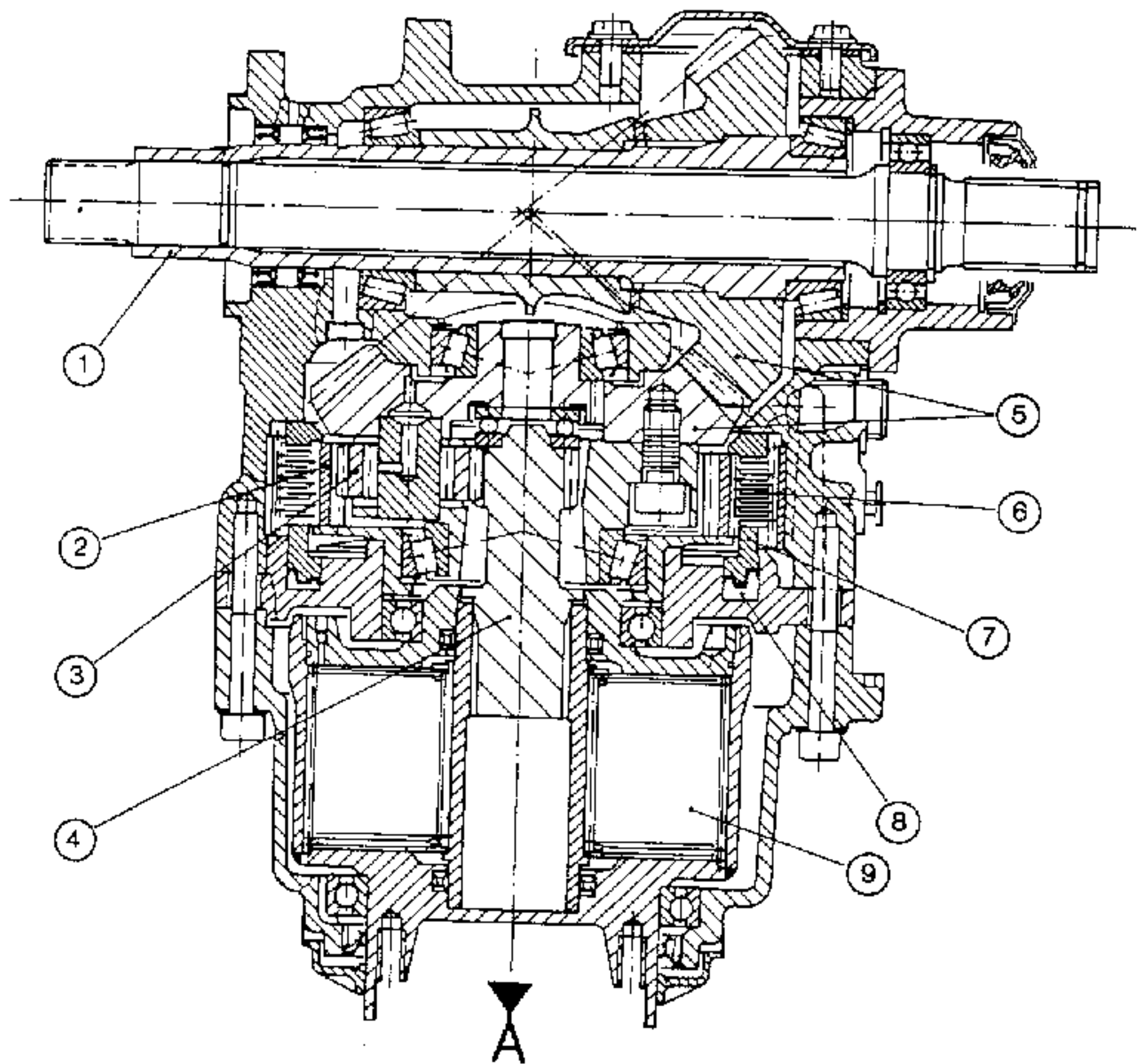
### TRANSFER BOX

#### TABLE OF CONTENTS

	PAGE
Transfer Box, General Arrangement Illustrations .....	K - 96
General Information on Four Wheel Drive .....	K - 99
CHECKING AND ADJUSTING OPERATIONS	
Transfer Box Fluid Level, Check .....	K - 100
Hydraulic System, Top Up and Bleed .....	K - 100
FOUR WHEEL DRIVE CONTROL	
Pressure Switch, Replace .....	K - 101
Electronic Control Unit, Replace .....	K - 101
Fluid Pressure Regulator, Replace .....	K - 101
Control Valve, Replace .....	K - 102
Fluid Pressure Accumulator, Replace .....	K - 102
SEALING OPERATIONS ON INSTALLED TRANSFER BOX	
Axle Shaft Seal Ring, Right and/or Rubber O-ring of Drive-through Shaft, Replace ..	K - 104
SEALING OPERATIONS ON REMOVED TRANSFER BOX	
Seal Ring to VC Clutch (Propshaft), Replace .....	K - 106
Seal Rings of Hollow Shaft, Replace .....	K - 108
OPERATIONS ON TRANSFER BOX	
Temperature Switch, Replace .....	K - 111
Transfer Box, Remove and Install .....	K - 112
Checking Procedures, Four Wheel Drive .....	K - 117
Special Service Tools .....	K - 173
Technical Data .....	K - 175
Recommended Torque Values .....	K - 175

# TRANSFER BOX

## TRANSFER BOX



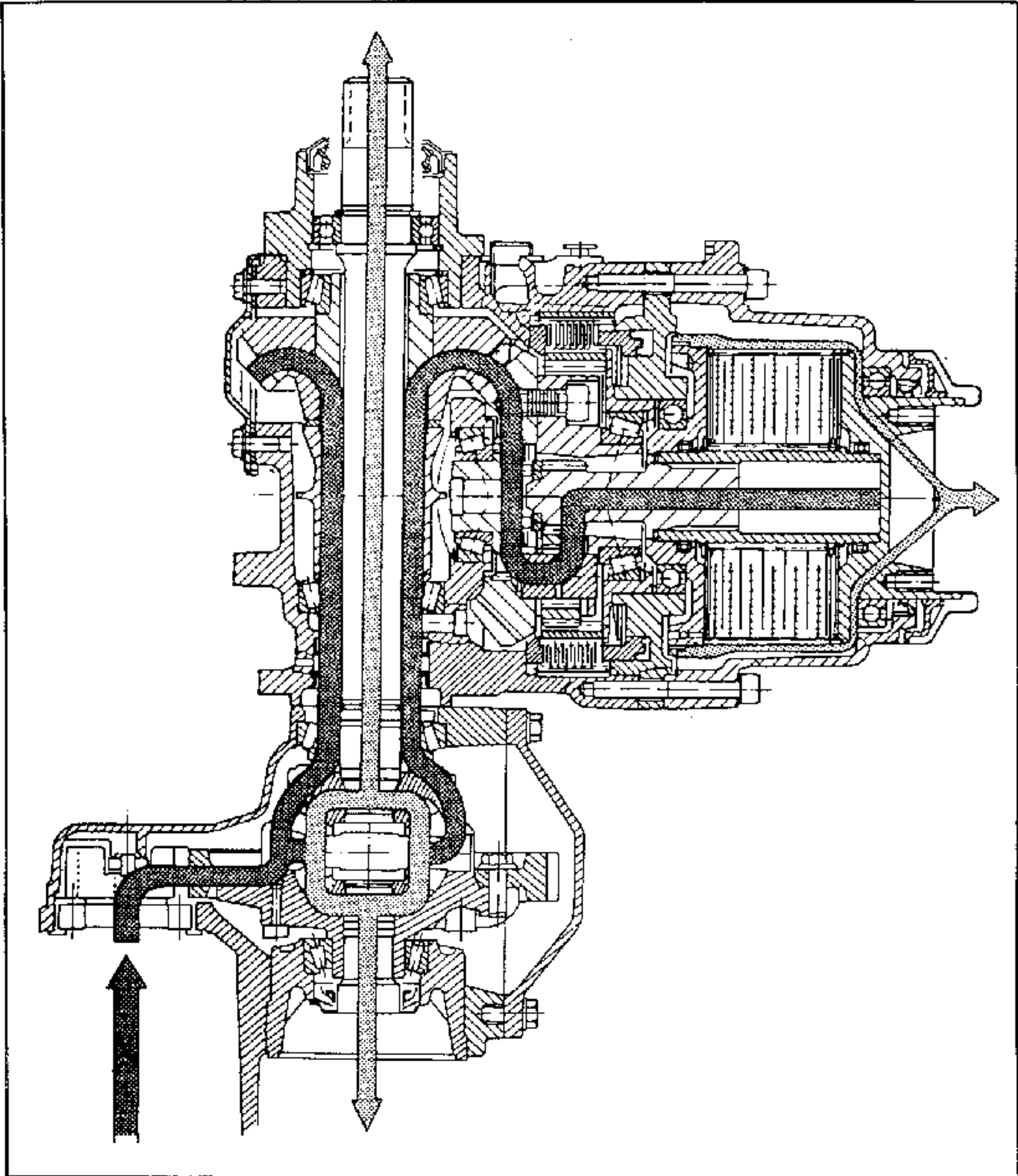
Sectioned View

### Illustration Key:

- |                          |                     |
|--------------------------|---------------------|
| 1 Drive via Hollow Shaft | 6 Multi-Disc Clutch |
| 2 Ring Gear              | 7 Hydraulic Piston  |
| 3 Planetary Gear         | 8 Cylinder Chamber  |
| 4 Sun Gear               | 9 Viscous Coupling  |
| 5 Hypoid Gear            | A To Rear Axle      |

# TRANSFER BOX

## TRANSFER BOX

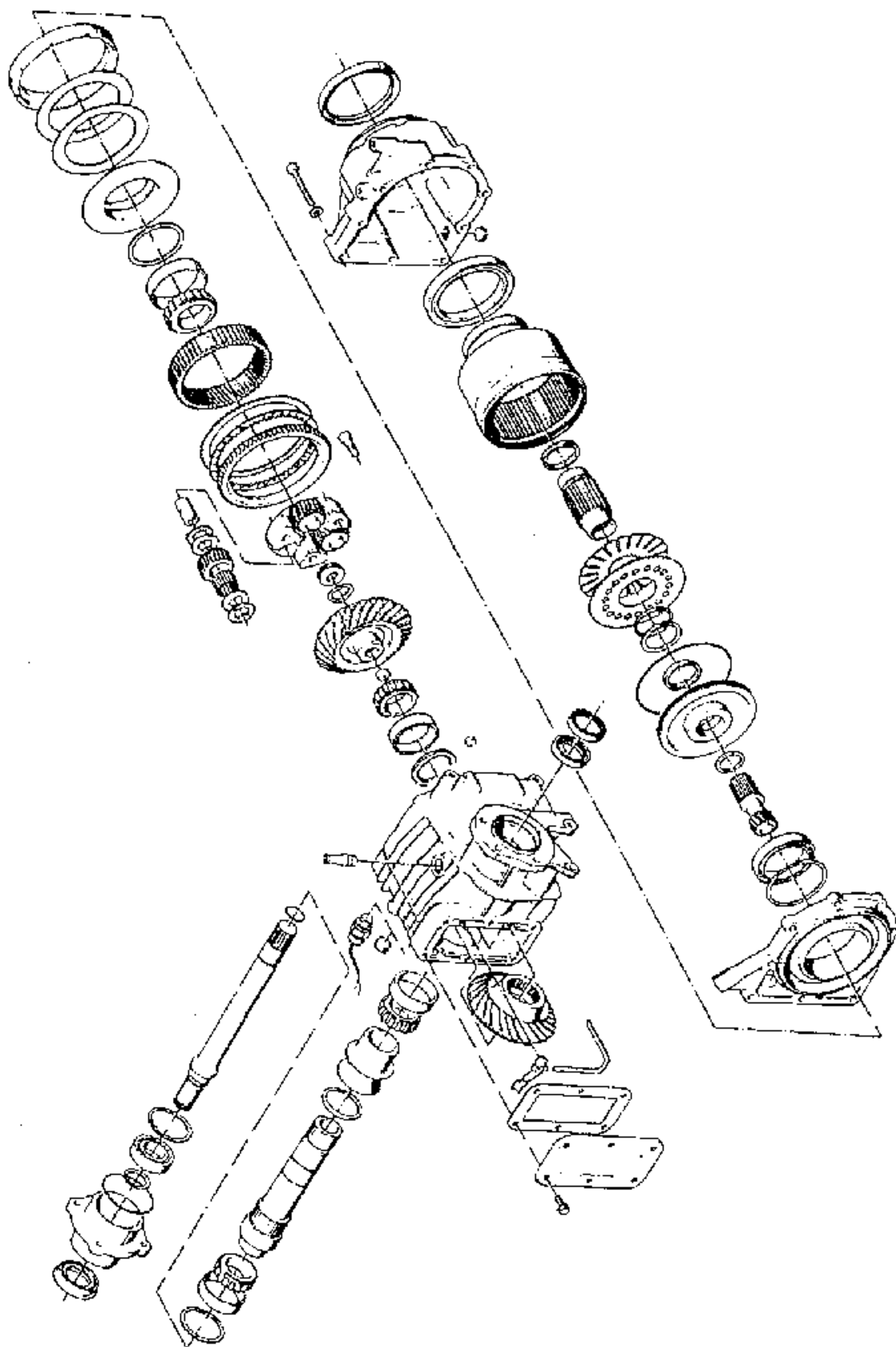


Power Flow

# TRANSFER BOX

## TRANSFER BOX

D 7268



Exploded View

- **General Info on 4WD:**

1. The 4WD is permanently engaged without any intervention on the part of the driver and is only switched off and on again when the brake pedal is actuated during braking operations of speeds over 25/km/h
2. If a fault develops in the 4WD system, a trouble code is registered in the control unit and the fault is indicated by the 4WD dash light, the system is immediately switched to FWD only
3. Differences in tire profile greater than 2 mm or differences in rolling circumference greater than 15 mm between the wheels of the front and rear axles, will lead to excessively high fluid temperatures. Always keep the tyres identical
4. The supply electrical voltage to 4WD control unit is interrupted if the fluid temperature exceeds 160C. should this occur, the vehicle will operate on FWD only, this operation will continue until the fluid temperature switch is replaced, the stored trouble code 33 can then be read with the use of Tech 1 or as a blink code

- **Maintenance:**

Observe the following when working on vehicle with 4WD system:

1. When electric welding remove the wiring harness plug to the ECU
2. during painting, the ECU can be exposed to temperatures in the order of 95C for very short periods or to a max of 2 hours if the temperature is 5C max
3. after working on the 4WD system, the hydraulic system must be bled
4. all connections must be checked for leaks
5. ensure the battery terminals are clean and tight
6. do not use quick charger for starting the engine
7. ensure that all wiring harness plugs are connected correctly
8. never connect or disconnect a wiring harness plug while the ignition is switched on

- **Important Service Note:**

With all 4WD Calibra vehicles, up to an ISOVIN of WOL00005R1102550, must have the pressure accumulator replaced every 6 years or 90,000 km which ever occurs first  
From this ISOVIN, a revised design accumulator was introduced



# TRANSFER BOX

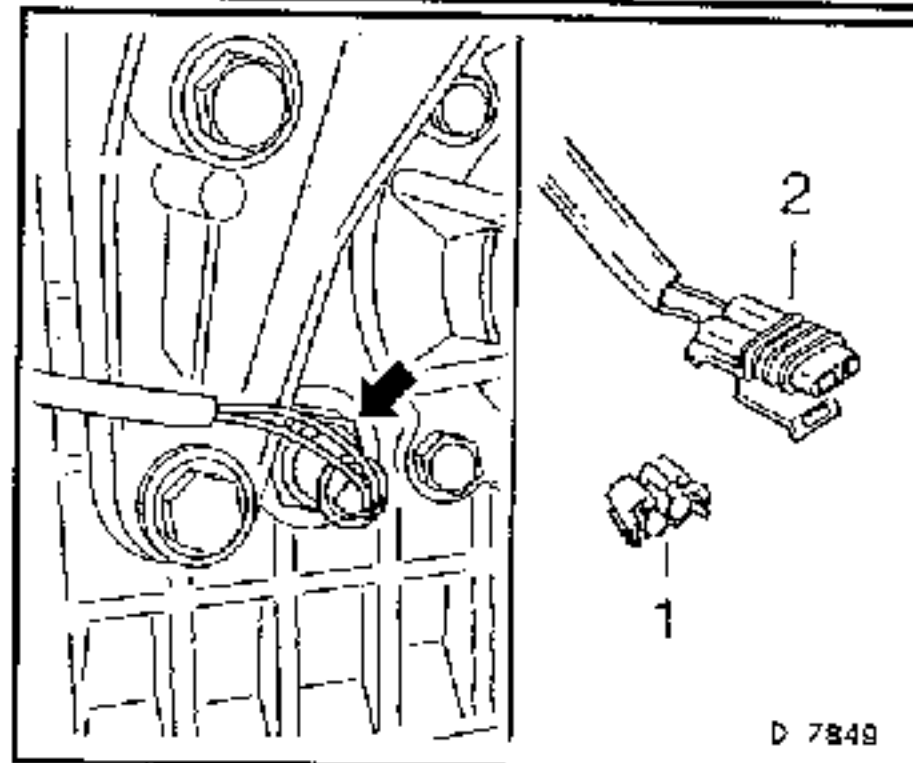
## Transfer Box Fluid Level, Check

### Remove, Disconnect

The wiring harness plug for the temperature switch, is located under the cowl cover. Separate the cable cover, exposing the wiring harness plug.

Wiring harness plug cover (1) from the wiring harness plug (2).

Unscrew the temperature switch, using a thin walled ring spanner.



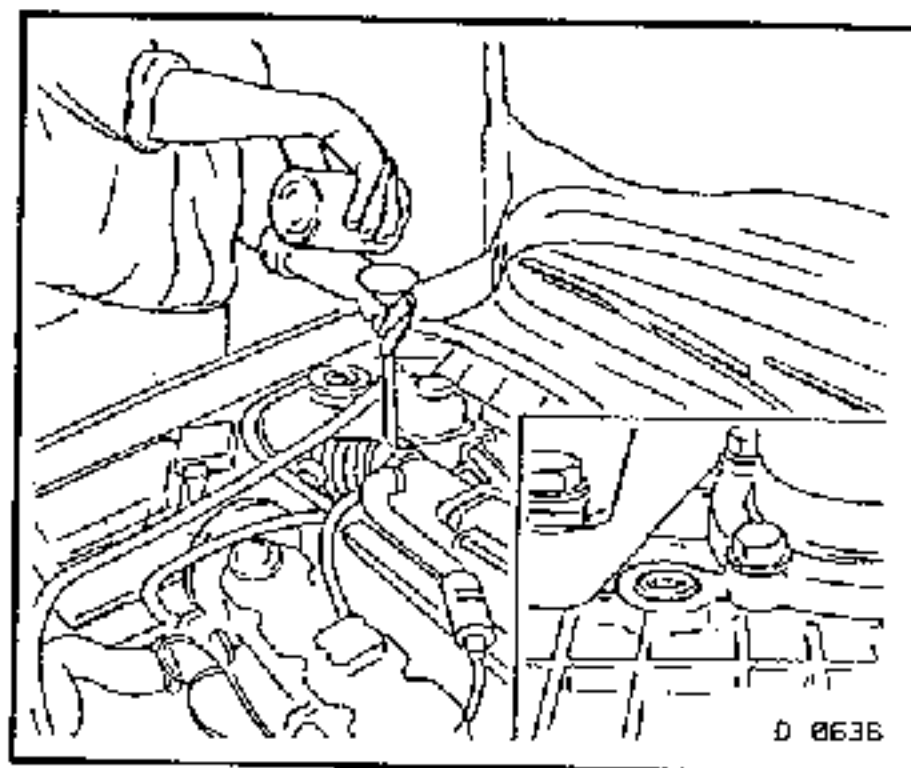
### Inspect

Correct fluid level, to the lower edge of the threaded hole.

As required, top up with synthetic fluid, such as Castrol SYNTHANS 75W/80 or equivalent, to Holden's Specification HN2157.

Access is made through the bleeder hose.

Check the fluid level again after approximately 3 minutes.



### Tighten (Torque)

Temperature switch..... 25 Nm \*

\* Use a new O-ring.

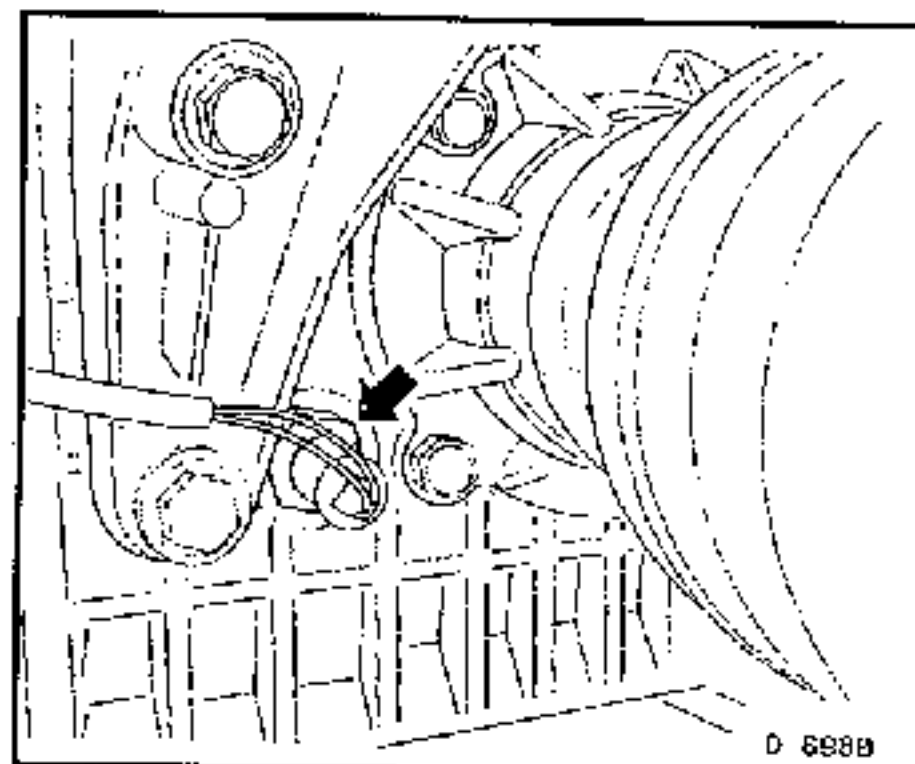
### Install, Connect

The wiring harness plug for the temperature switch, under the cowl panel.

Fasten both the wiring harness and the bleeder hose to the wiring harness with cable straps.

### Important!

Ensure that the bleeder hose is not flattened or kinked by the retaining straps. If this occurs, system bleeding operations will be hampered.



## Hydraulic System, Top Up and Bleed

### Remove, Disconnect

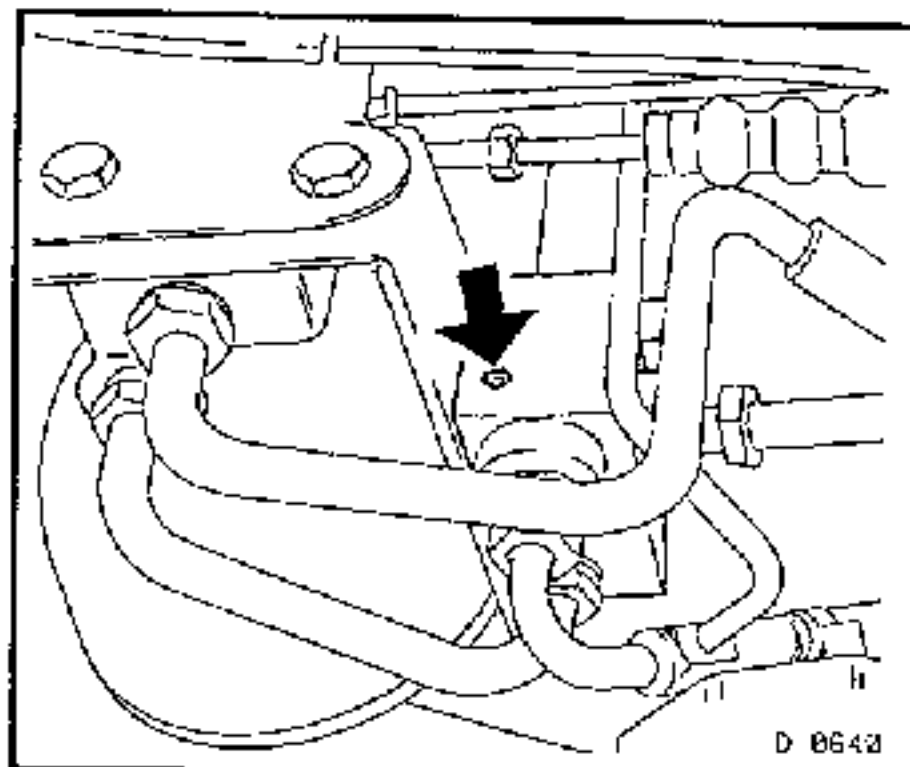
Fuse F 19 for the shift valve, from the fuse box.

Open the bypass screw on the shift valve (arrow), approximately 3 turns.

Fill the fluid reservoir to the 'MAX' mark and start the engine.

Top up the fluid as soon as the 'MIN' mark is reached. Allow the engine to run for approximately 5 minutes for the system to stabilise.

Turn the steering wheel to full lock and hold against the stop for approximately 5 seconds only. Turn the steering wheel to the opposite lock and repeat the process.



# TRANSFER BOX

Close the bypass screw for 20 seconds and then re-open. After a further 20 seconds close the bleeder valve again.

## Tighten (Torque)

Bleeder valve screw to modulator ..... 1.5 Nm

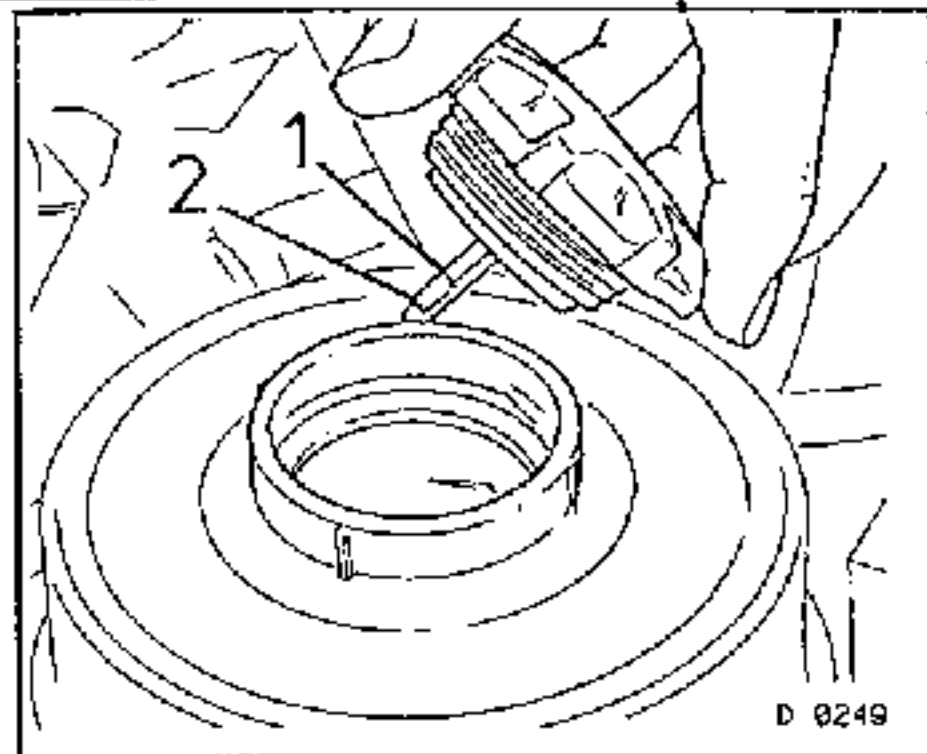
Reinstall the fuse (F 19) and switch the ignition ON.

Actuate the brake pedal approximately 25 times.

Fluid level;

Fluid at operating temperature  
(approximately 80 °C) to the 'MAX' mark.

Fluid cold (approximately 20 °C) to the 'MIN' mark.



## FOUR WHEEL DRIVE CONTROL

### Pressure Switch, Replace

#### Remove, Disconnect

Wiring harness plug from pressure switch.

Pressure switch from control valve.

As fluid will leak, block aperture with a suitable plug.

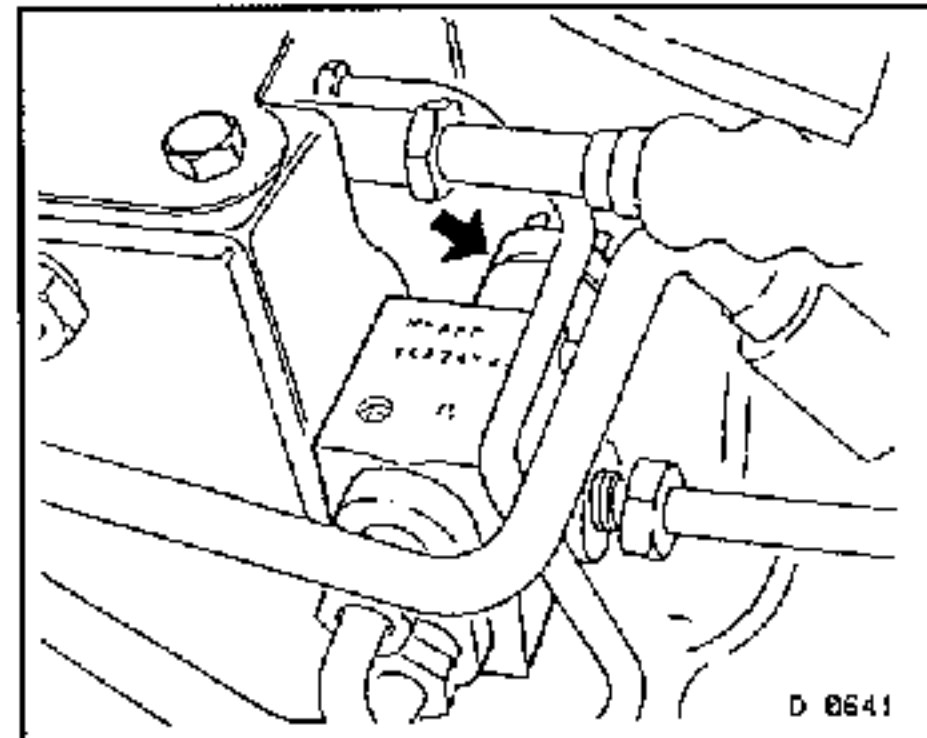
#### Tighten (Torque)

Pressure switch to control valve ..... 17 Nm

#### Install, Connect

Wiring harness plug.

Bleed hydraulic system. Refer this operation in this Section.



### Electronic Control Unit, Replace

#### Remove, Disconnect

Fuse box. Refer to Group N for this operation.

Control unit from bracket.

Wiring harness plug from control unit.

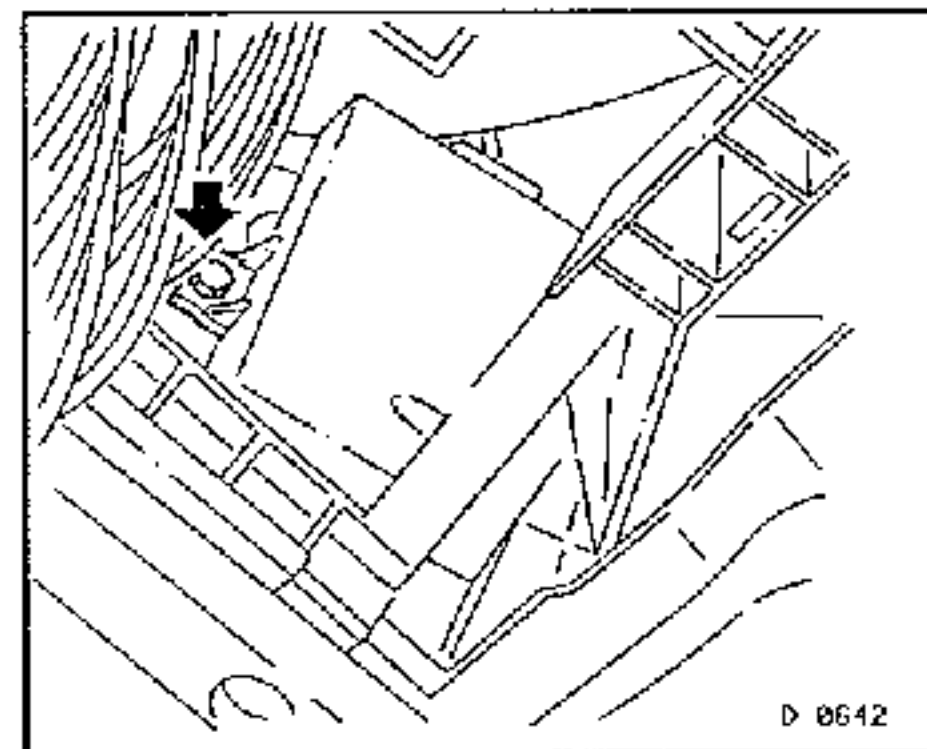
#### Install, Connect

Wiring harness plug to control unit.

Control unit to bracket.

Fuse box.

Carry out a system function check.



### Fluid Pressure Regulator, Replace

#### Remove, Disconnect

Fluid lines from fluid pressure regulator. Leave in their respective installation positions or tag lines.

Also loosen lower line (2) at the control valve.

As fluid will escape, plug all openings.

Fluid pressure regulator from bracket (4 bolts).

# TRANSFER BOX

## Install, Connect

Fluid pressure regulator to bracket.

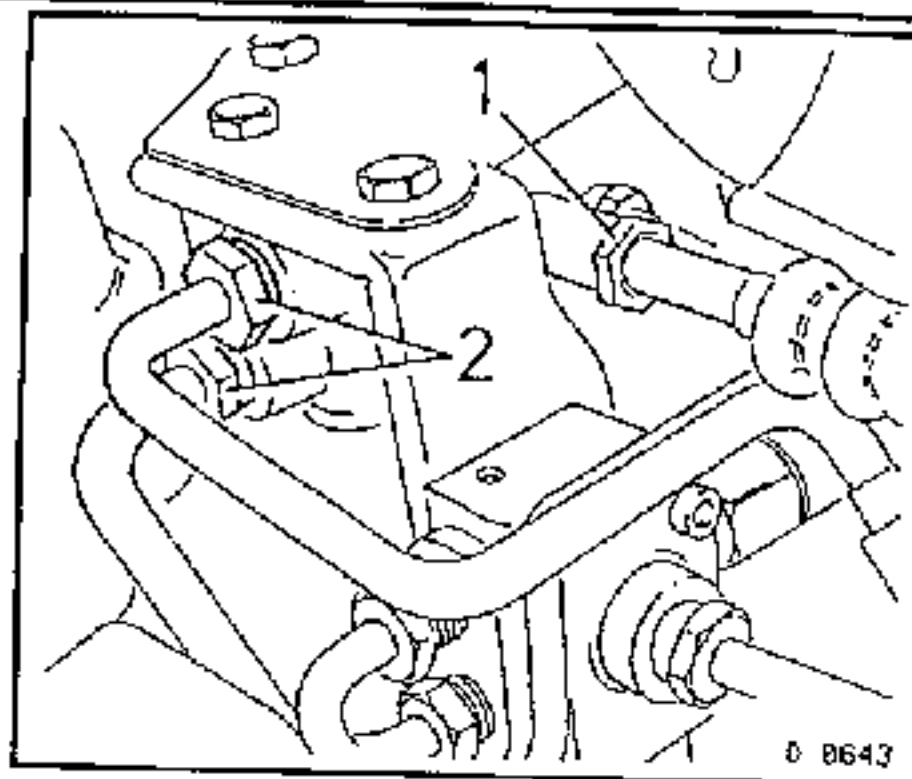
All fluid lines to the fluid pressure regulator.

## Tighten (Torque)

Fluid pressure regulator to bracket .....	23 Nm
Fluid pressure lines (2) to fluid pressure regulator and control valve.....	30 Nm
Fluid return line (1) .....	17 Nm

Bleed the hydraulic system as detailed earlier in this Section.

Carry out a system function check.



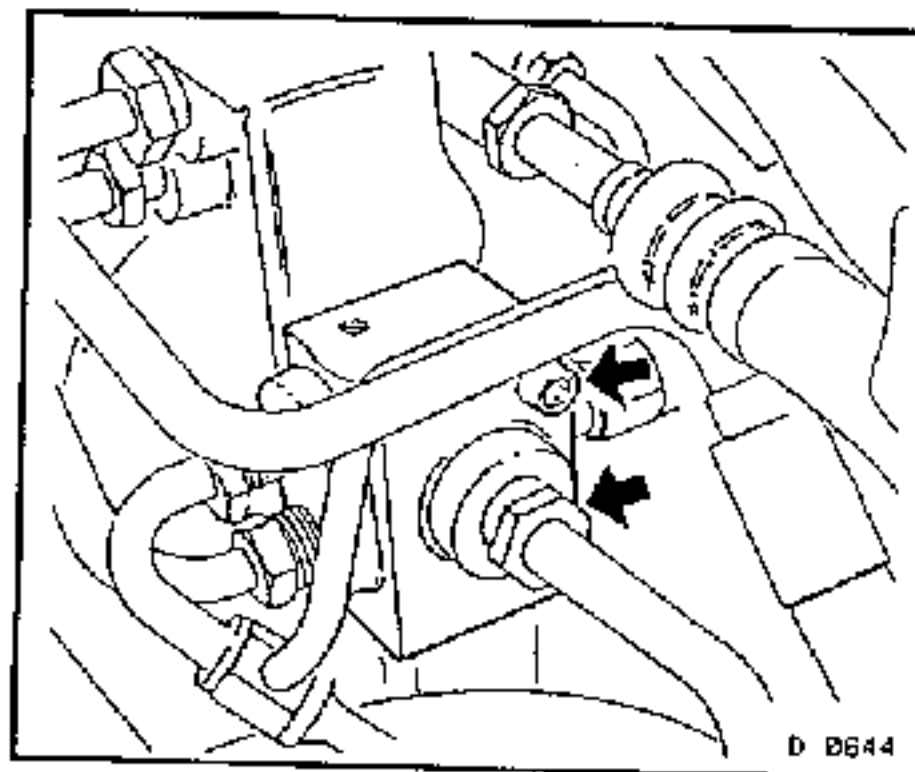
## Control Valve, Replace

### Remove, Disconnect

Fluid lines from control valve.

Wiring harness plug from pressure switch and control valve.

Control valve from bracket (2 bolts).



### Tighten (Torque)

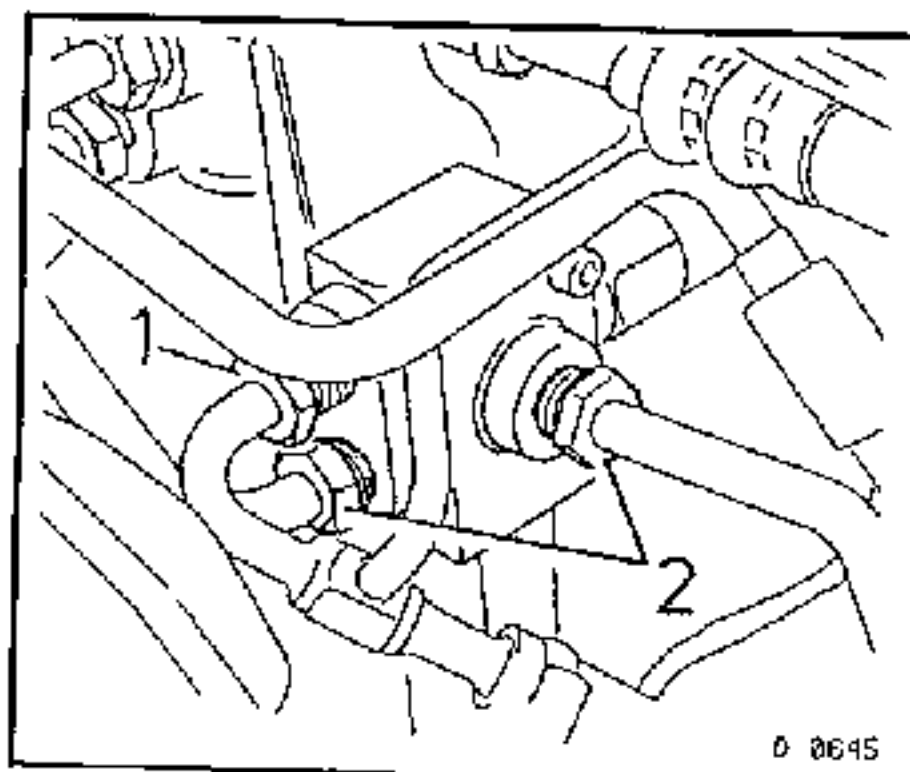
Control valve to bracket.....	7 Nm
Fluid pressure lines (2) .....	30 Nm
Fluid return line (1) .....	17 Nm

### Install, Connect

Wiring harness plug.

Bleed the hydraulic system as detailed earlier in this Section.

Carry out a system function check.

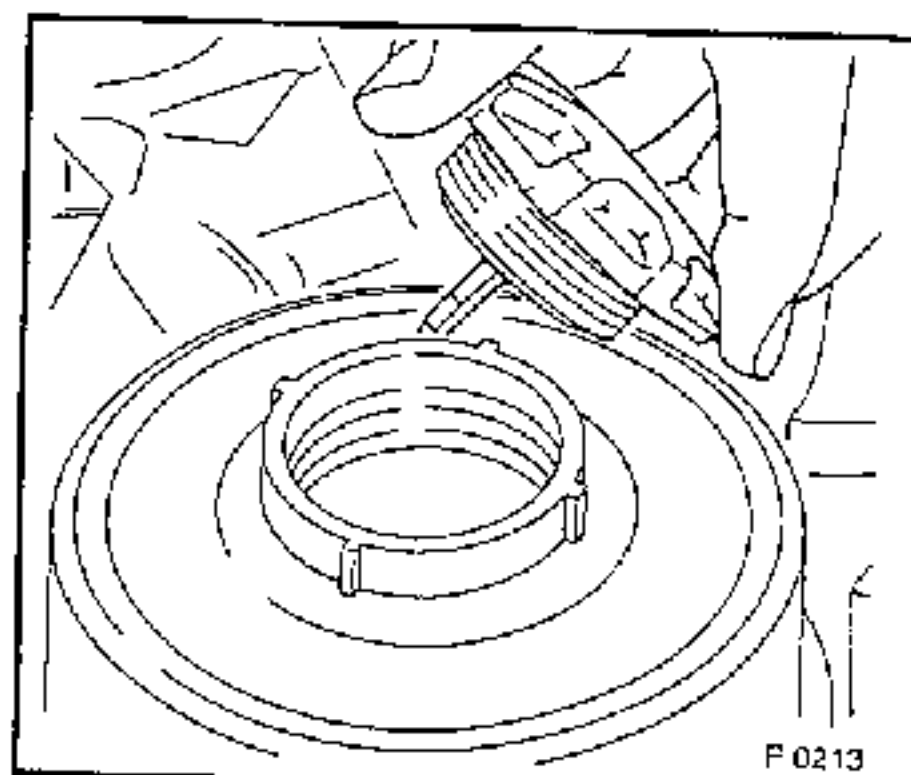


## Fluid Pressure Accumulator, Replace

De-pressurise system, as follows:

Remove the cover on the fluid reservoir.

Switch on ignition and actuate the brake pedal approximately 25 times.



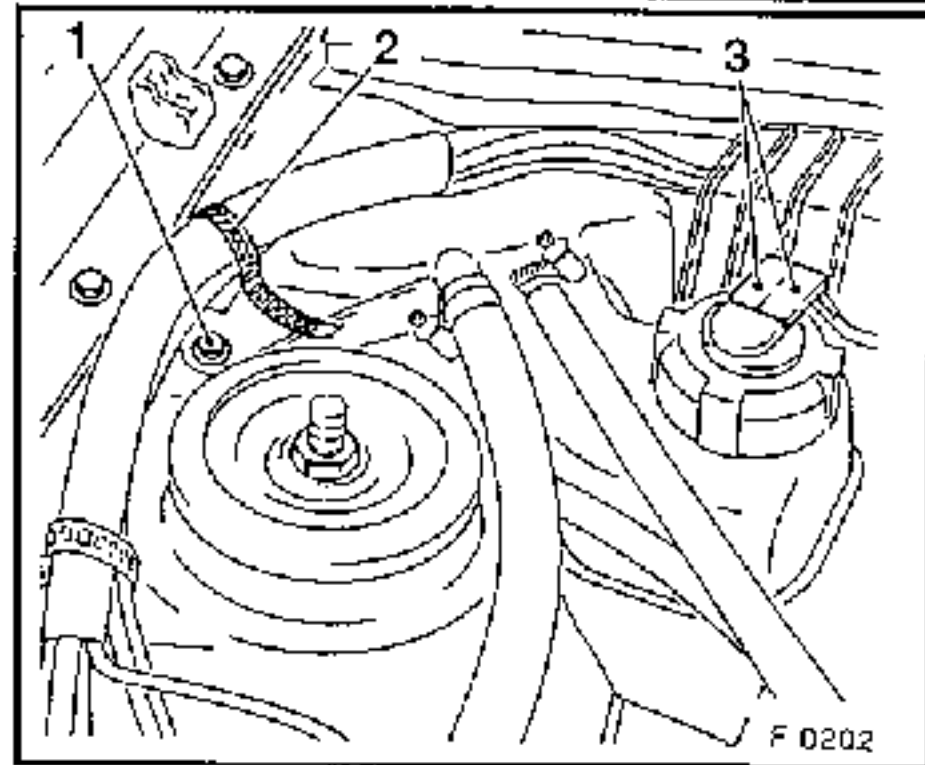
# TRANSFER BOX

## Remove, Disconnect

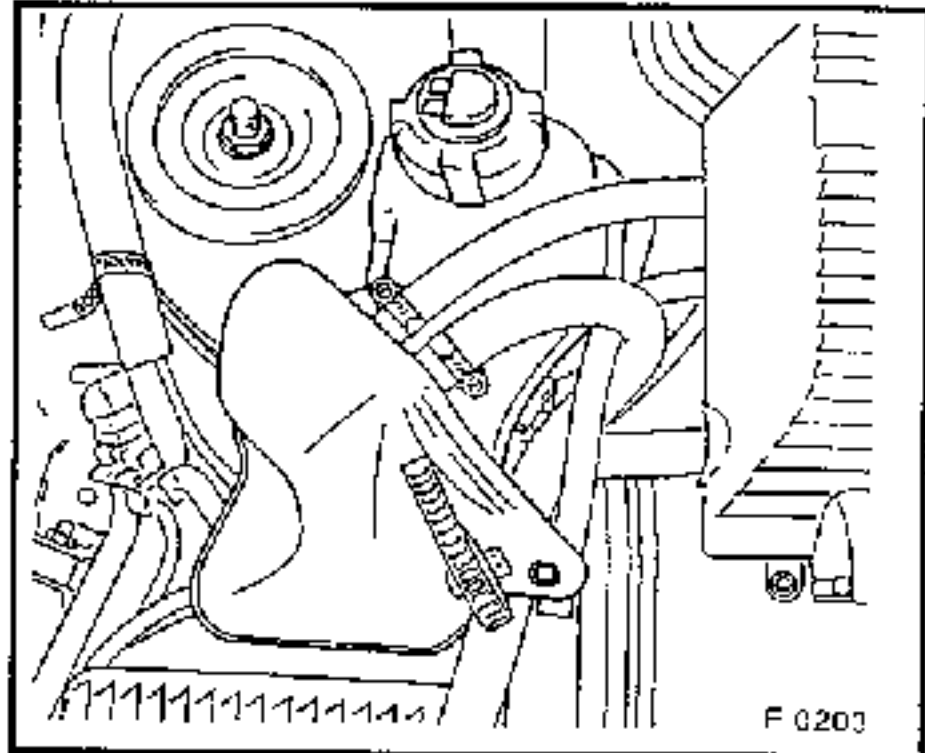
Bolt (1) from coolant reservoir tank.

Detach wiring harness from strap (2).

Both wiring harness plug connectors to the coolant reservoir cap (3).

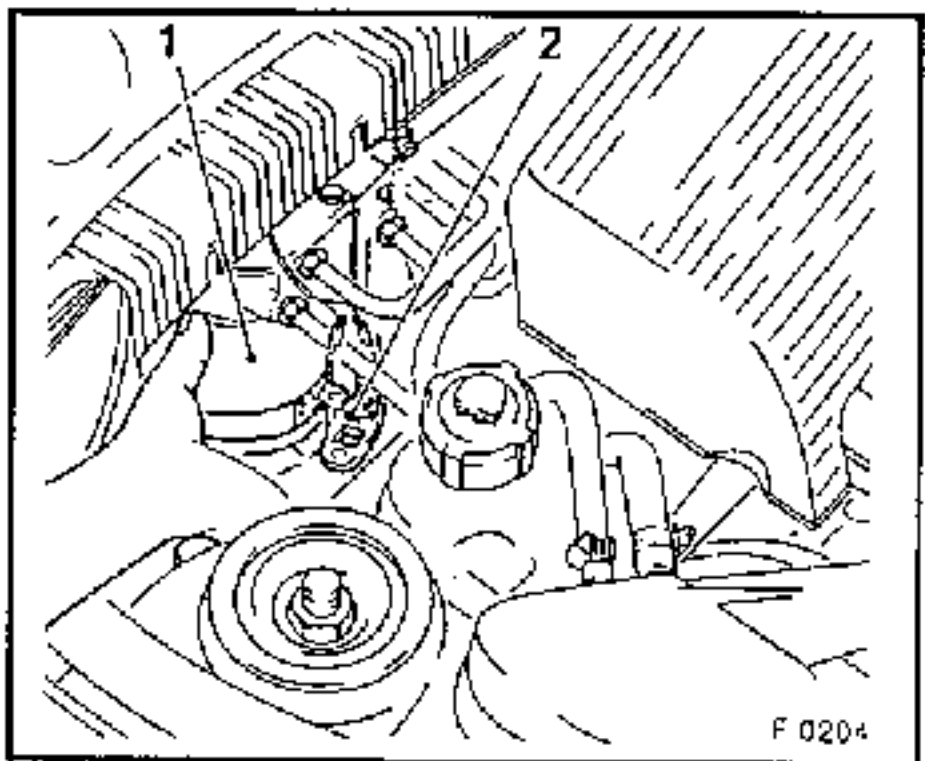


Lay the coolant reservoir tank to one side as shown.



## Remove, Disconnect

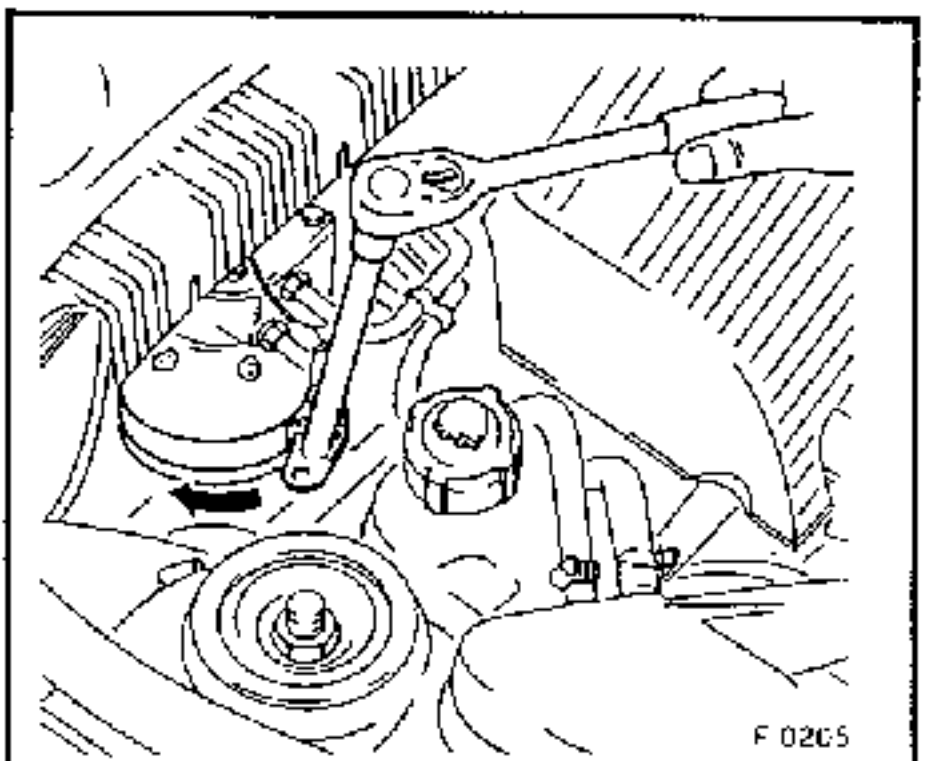
Apply a commercially available tool such as an oil filter wrench (2) to the accumulator (1).



## Remove, Disconnect

Use a socket extension and ratchet to loosen the accumulator (arrow) from the fluid pressure regulator.

Unscrew accumulator and remove from above.



# TRANSFER BOX

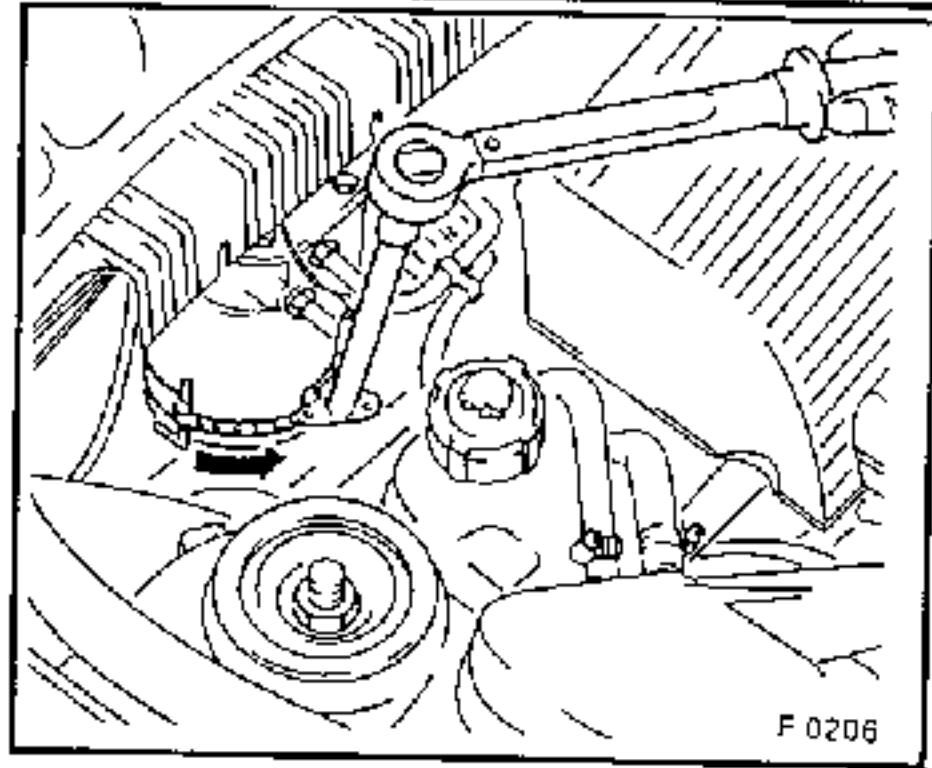
## Install, Connect

New accumulator to the pressure regulator, and tighten by hand (arrow).

Then tighten with a torque wrench

## Tighten (Torque)

Accumulator to pressure regulator..... 45 Nm



## Install, Connect

Coolant reservoir tank.

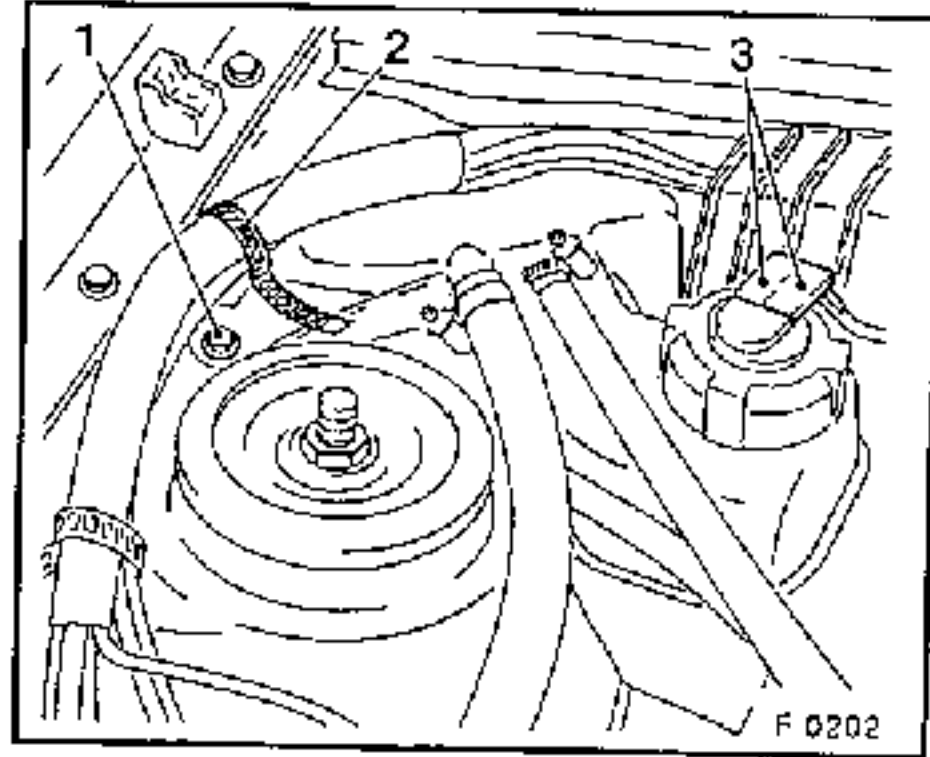
Fasten wiring harness with a cable strap.

Both wiring harness plugs to the coolant reservoir cap.

## Inspect

Bleed the hydraulic system as detailed earlier in this Section.

Carry out a system function check.



## SEALING OPERATIONS ON INSTALLED TRANSFER BOX

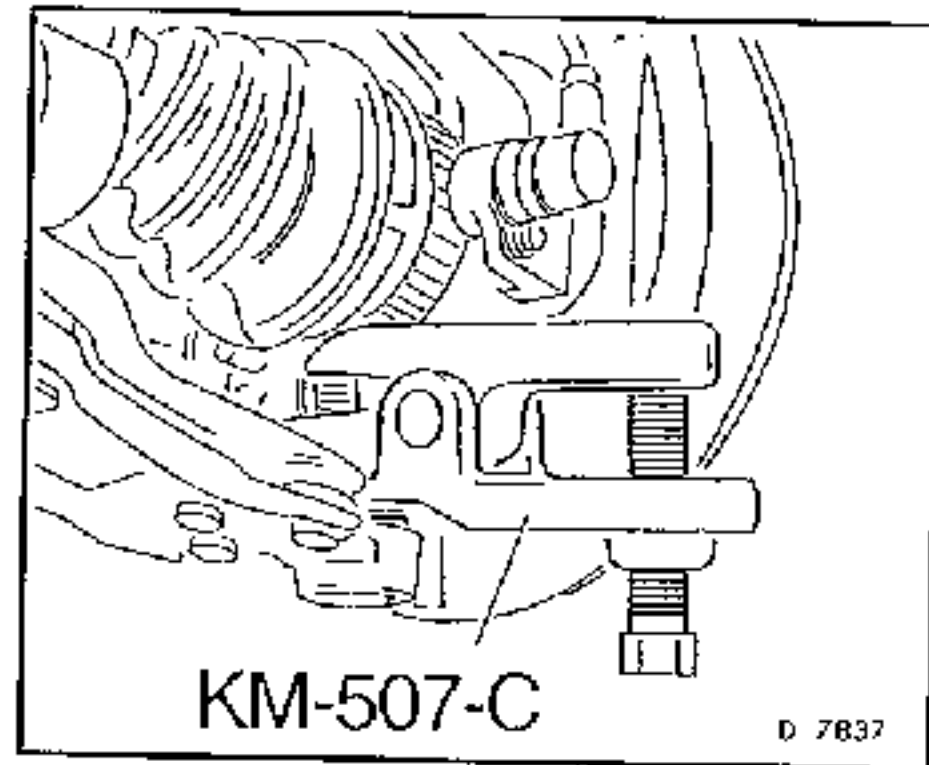
### Axle Shaft Seal Ring, Right and/or Rubber O-ring of Drive-through Shaft, Replace

#### Remove, Disconnect

Right front wheel.

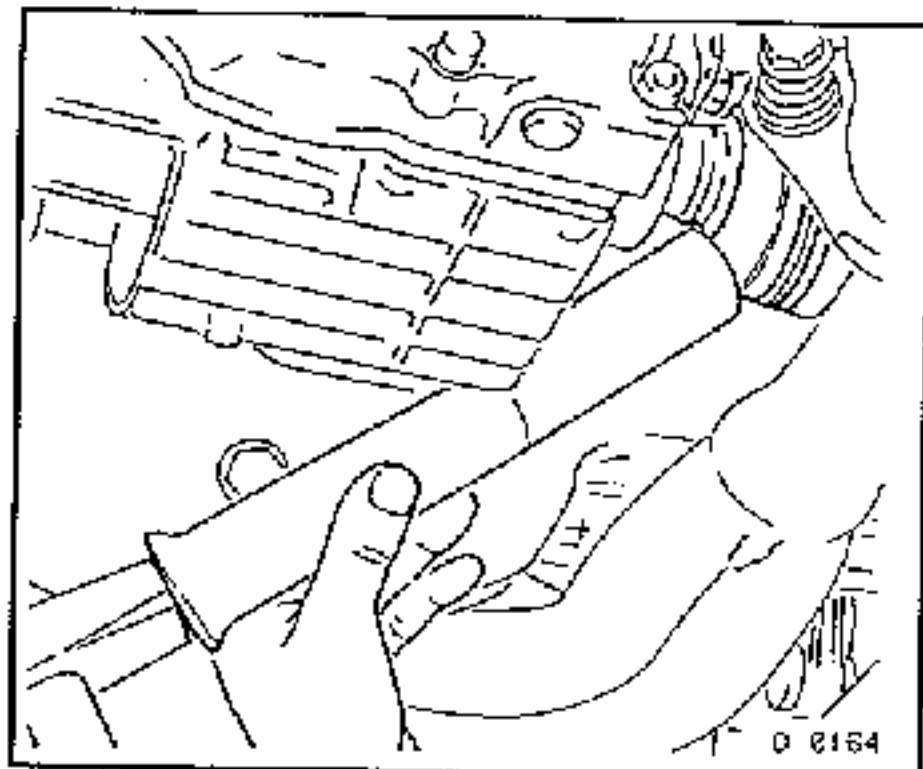
Right ball joint, using KM-507-C.

Lower engine compartment cover.



#### Remove, Disconnect

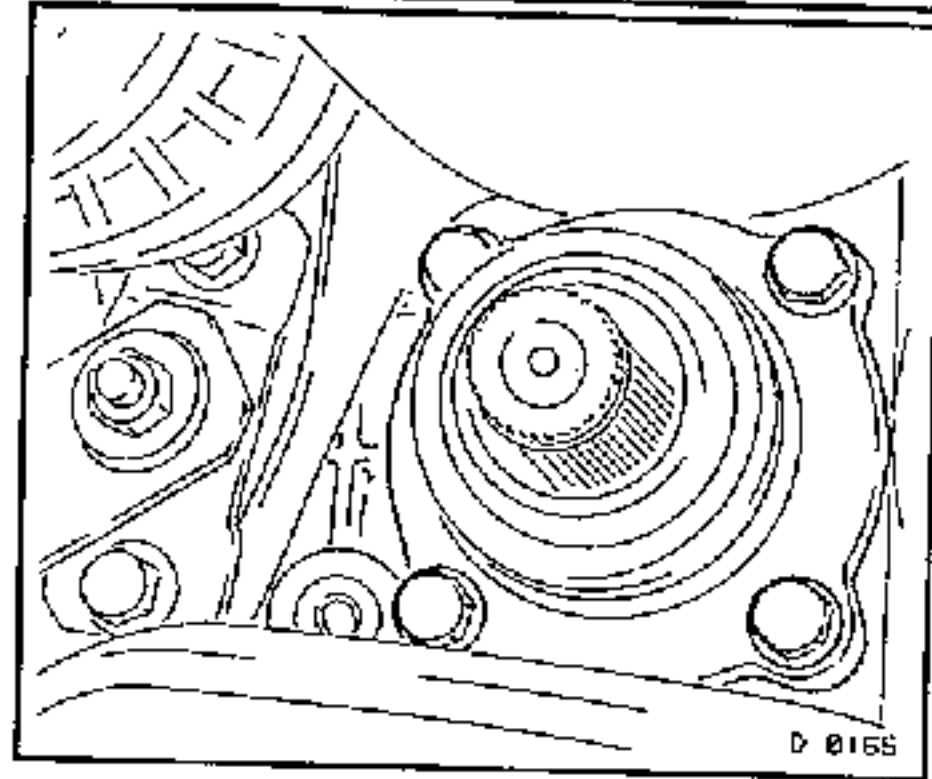
Right axle shaft from transfer box, using a soft metal drift.



# TRANSFER BOX

## Remove, Disconnect

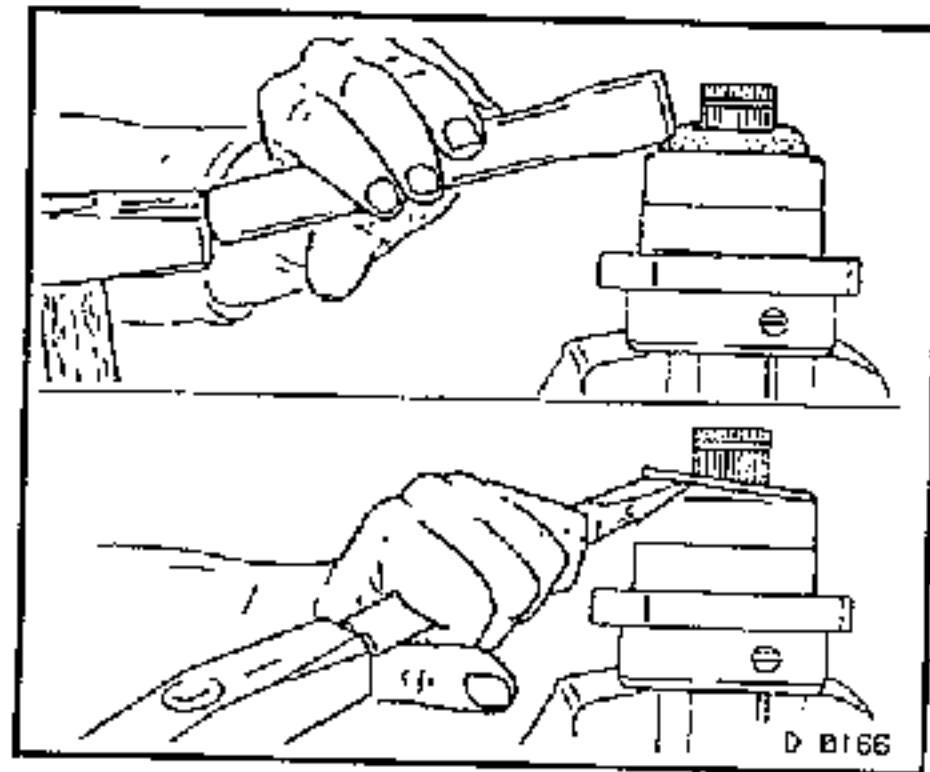
Bearing flange with drive-through shaft from transfer box.



## Remove, Disconnect

Cover of seal ring, with a flat chisel.

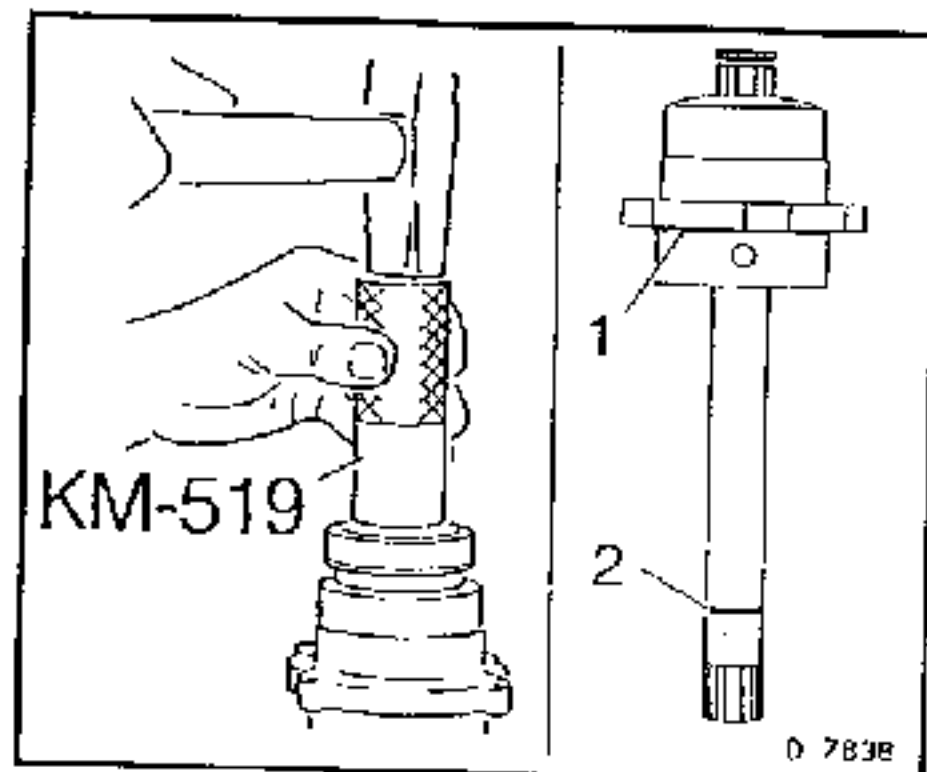
Seal ring by flanging the edge of the seat, using a flat chisel.



## Install, Connect

New seal ring in end shield, using KM-519.

New rubber O-rings at end shield (1) and drive-through shaft (2).



## Install, Connect

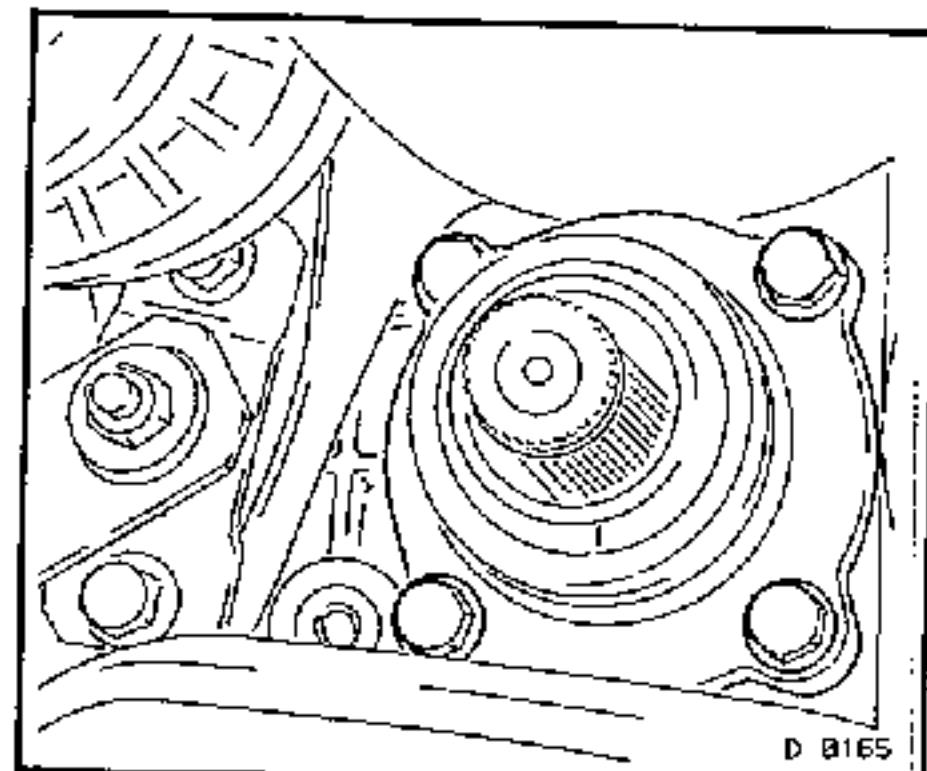
Bearing flange with drive-through shaft to transfer box.

## Tighten (Torque)

Bearing flange to transfer box ..... 25 Nm

## Important!

Fluid bores at bearing flange and housing must be in alignment.



# TRANSFER BOX

## Install, Connect

New retaining ring on drive-through shaft.

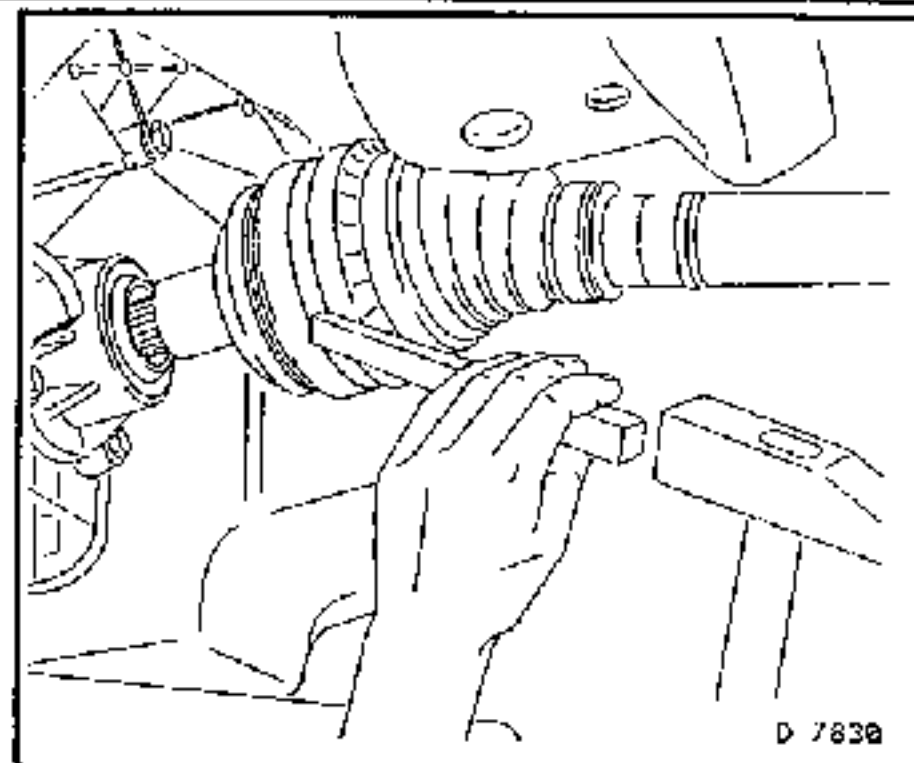
Lubricate splines with 80W transmission gear oil.

Insert axle shaft into transfer box.

Use a square drift at the friction welding seam and drive axle shaft in until it catches in the snap ring.

## Inspect

Check for a firm seating by trying to pull the axle shaft out by grasping on the outer circumference of the joint itself. Do not pull on the shaft!



## Install, Connect

Ball joint. Secure with cotter pin.

Front wheels.

## Tighten (Torque)

Castellated nut to ball joint.....	70 Nm
Front wheel bolts.....	110 Nm

## Inspect

Fluid levels of both the manual transmission and transfer box. Refer to these operations in the Section "Manual Transmission and Clutch" and in this Section, respectively.

## Install, Connect

Lower engine compartment cover.

## SEALING OPERATIONS ON REMOVED TRANSFER BOX

### Seal Ring to VC \* Clutch (Propshaft), Replace

\* Reference to the Viscous Clutch is commonly by the expression "VC Clutch" throughout this Section.

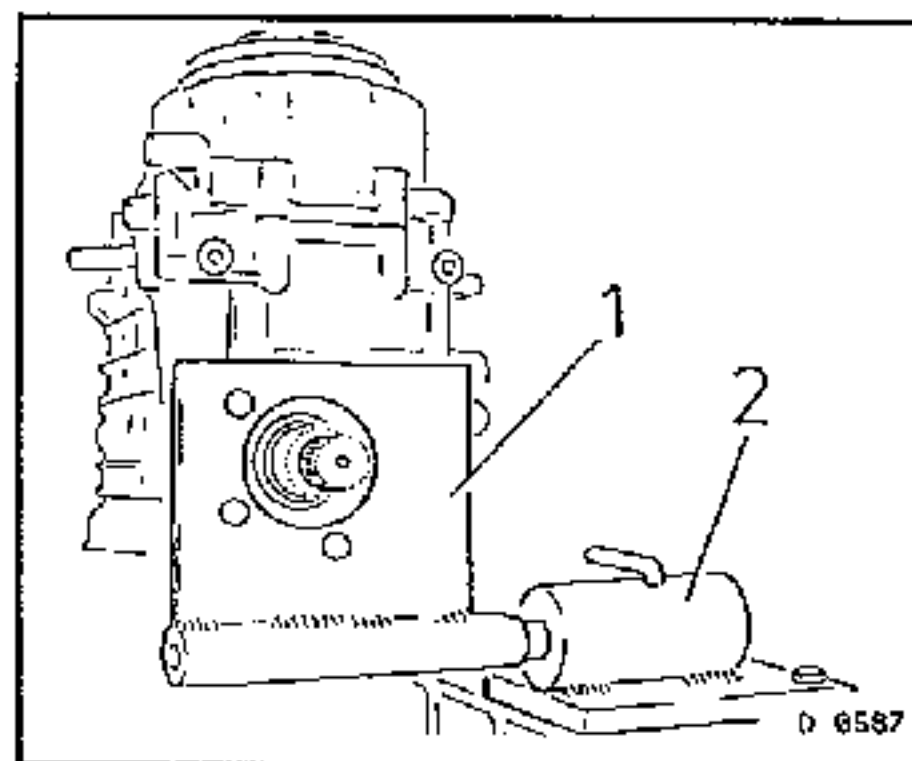
## Install, Connect

Transfer box with KM-707 (1) to KM-113-2 (2).

## Remove, Disconnect

Temperature switch and drain plug.

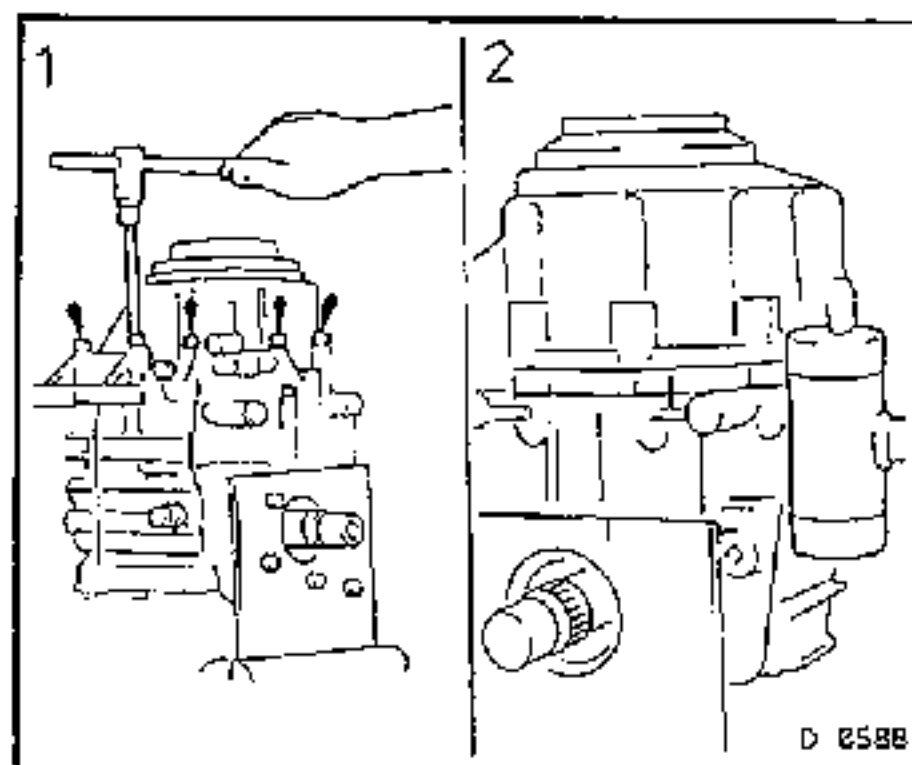
Drain transfer box fluid in to a suitable container.



## Remove, Disconnect

Upper part of VC clutch housing.

Unscrew 9 hex bolts (view 1) and separate the housing by lightly tapping with a plastic hammer (view 2).





# TRANSFER BOX

## Remove, Disconnect

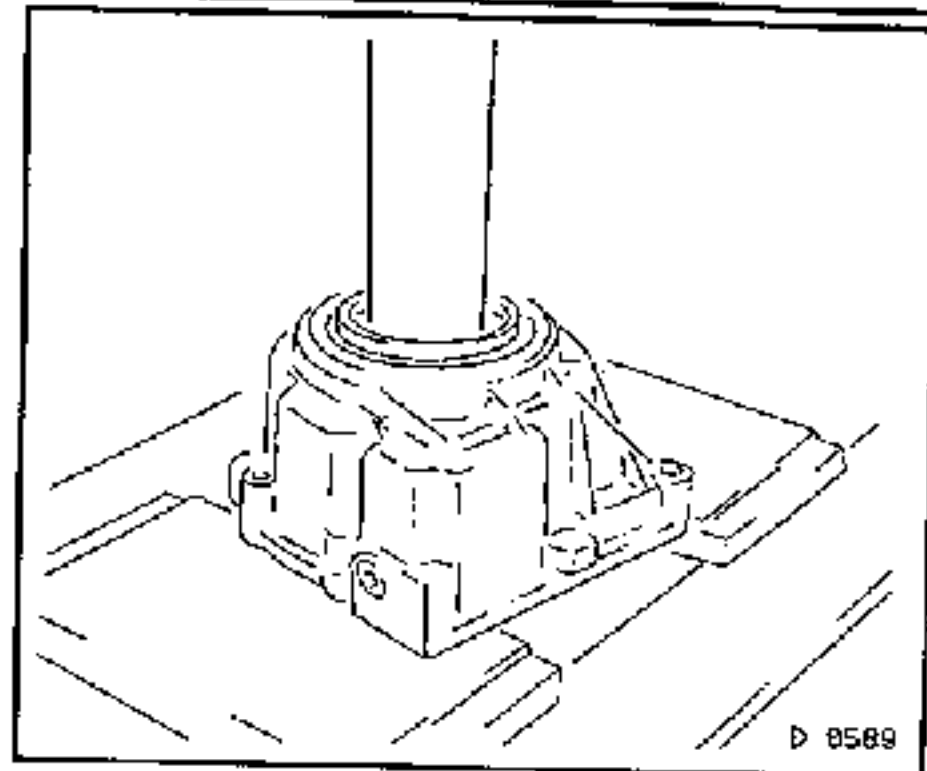
VC clutch.

Lay two flat or square bars underneath and press VC clutch from housing.

Press seal ring from housing.

## Clean

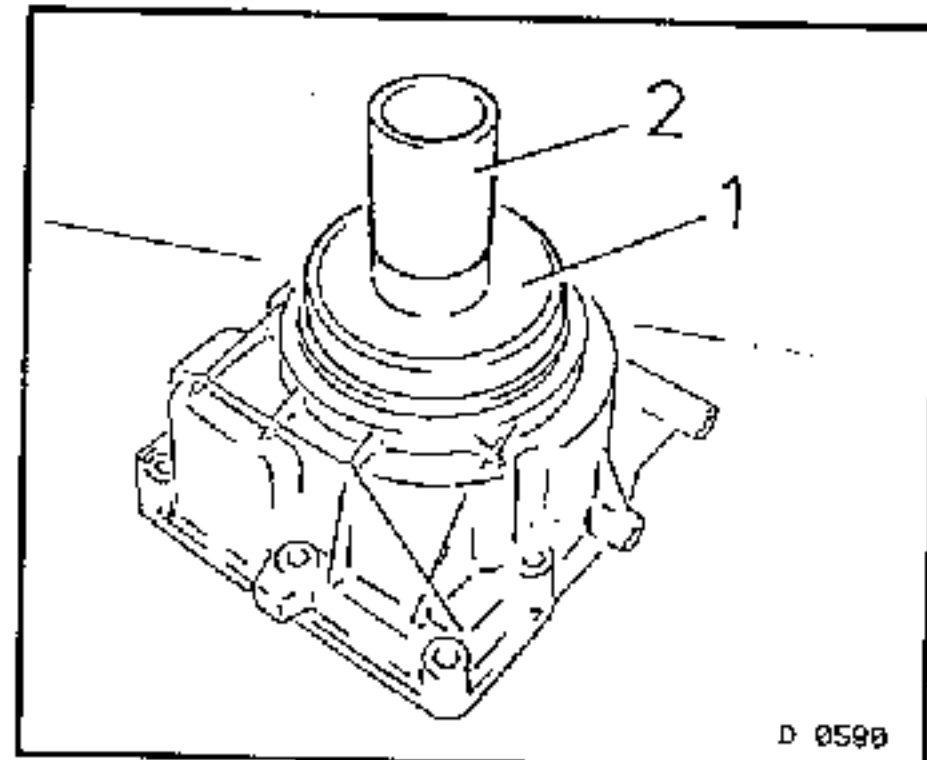
All sealing surfaces on the transfer box and housing.



## Install, Connect

Seal ring.

Press flush into housing, using KM-635-2 (1) and sleeve (2).

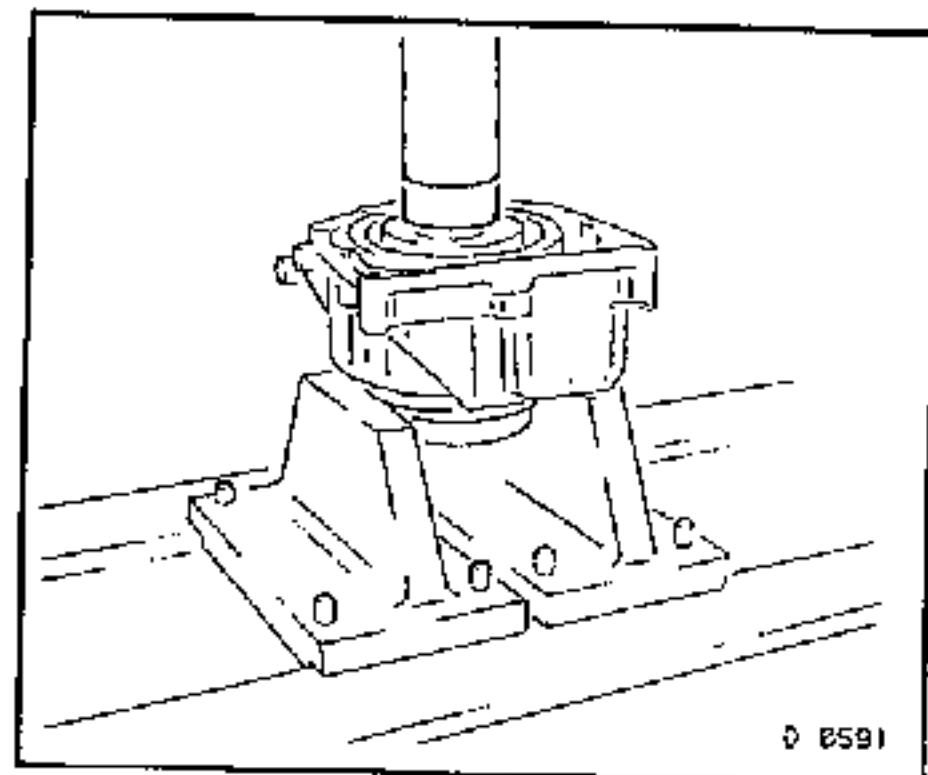


## Install, Connect

VC clutch;

Lay two flat or square bars underneath and press VC clutch into housing up to stop.

Apply sealant such as Loctite 515, or equivalent, to Holden's Specification HN1581, to the sealing surfaces.



## Install, Connect

Upper part of housing with VC clutch to the transfer box.

## Tighten (Torque)

Upper housing bolts to transfer box... 22 Nm

## Adjust

Transmission and transfer box oil levels as required.

## Install, Connect

Temperature switch, using a new seal ring.

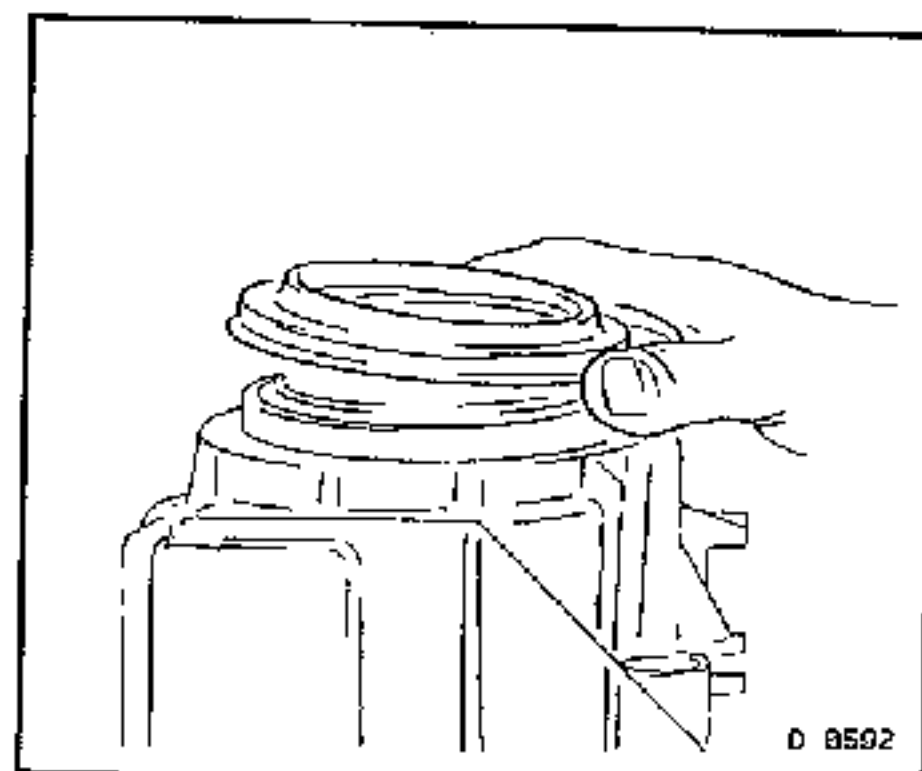
## Tighten (Torque)

Temperature switch to transfer box... 25 Nm

## Install, Connect

Cover on wiring harness plug to temperature switch.

Disconnect KM-707 from transfer box.





# TRANSFER BOX

## Seal Rings of Hollow Shaft, Replace

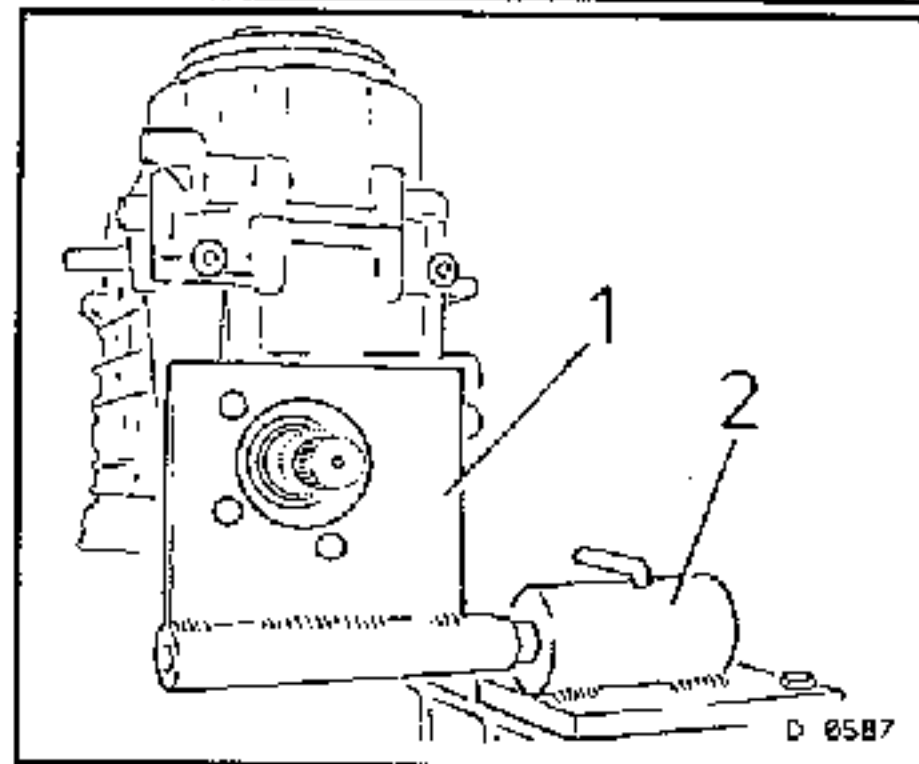
### Install, Connect

Transfer box with KM-707 (1) on KM-113-2 (2).

### Remove, Disconnect

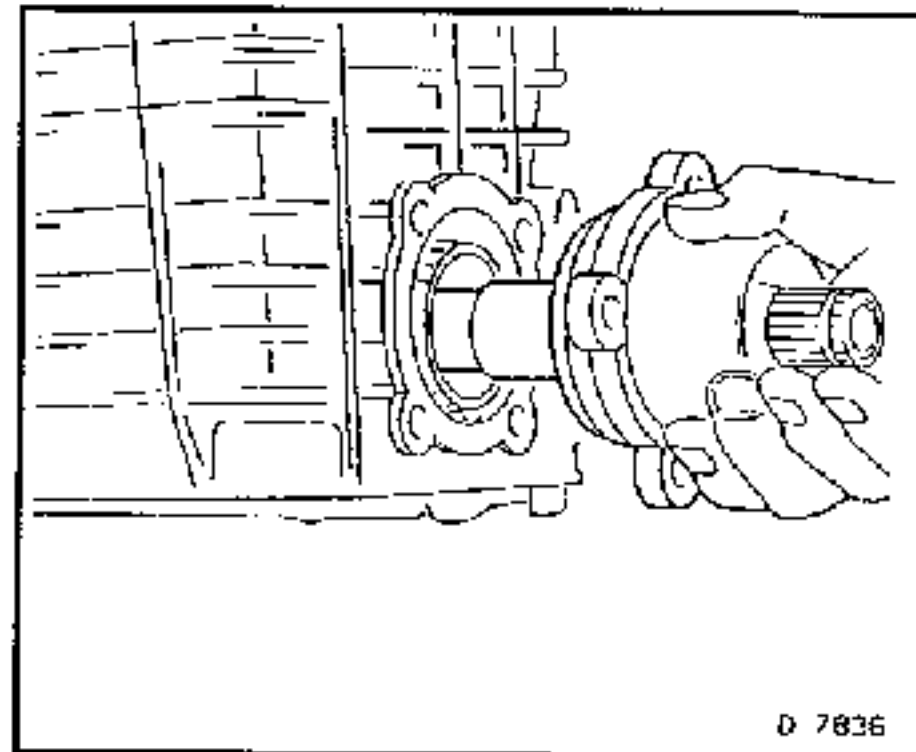
Temperature switch and drain plug.

Drain transfer box fluid in to a suitable container.



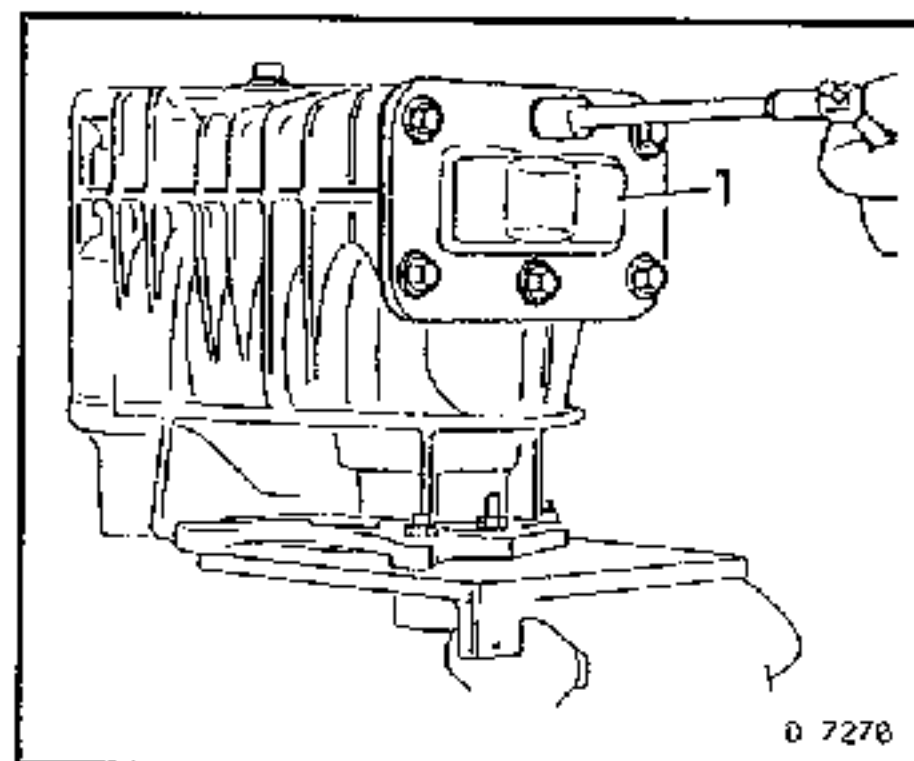
### Remove, Disconnect

End shield with drive shaft from hollow shaft.



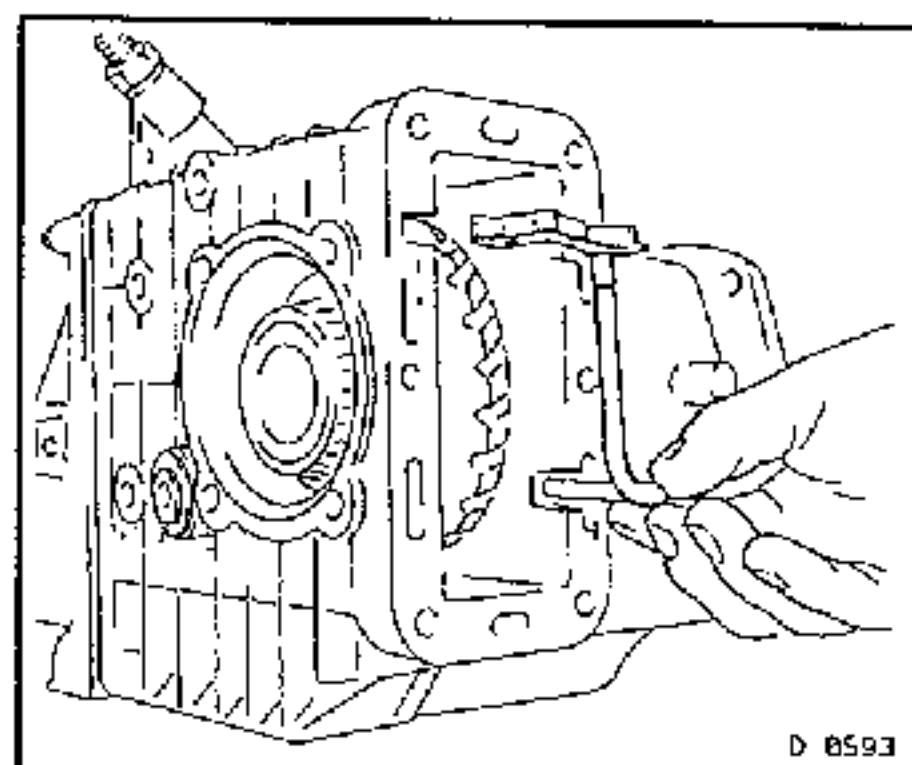
### Remove, Disconnect

Housing cover from transfer box (6 bolts).



### Remove, Disconnect

Fluid line from transfer box.

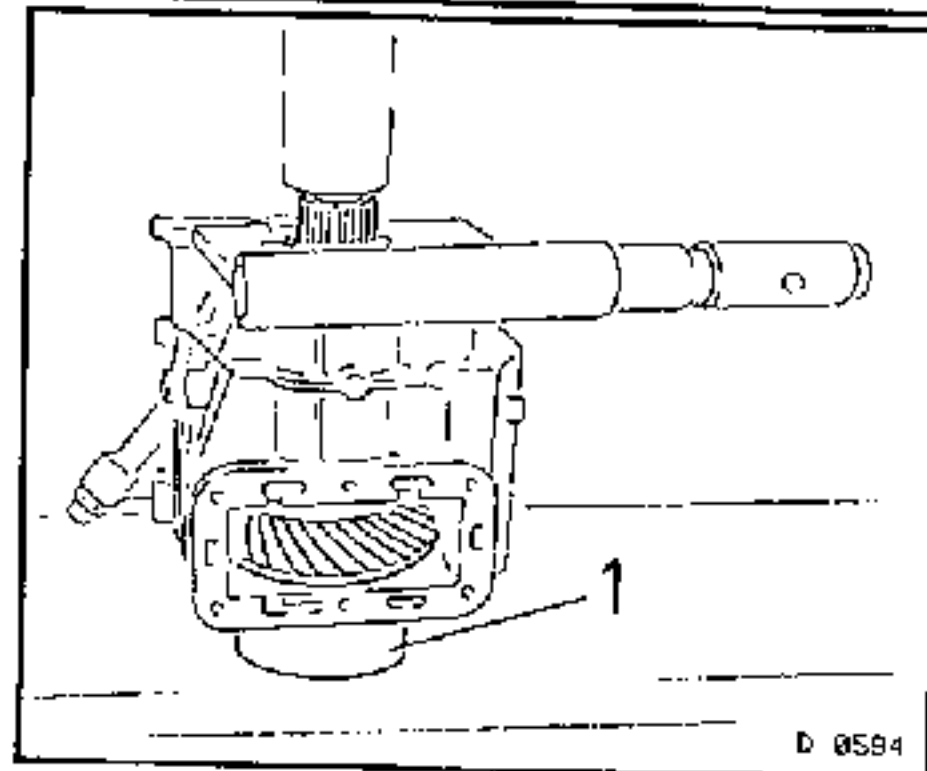


# TRANSFER BOX

## Remove, Disconnect

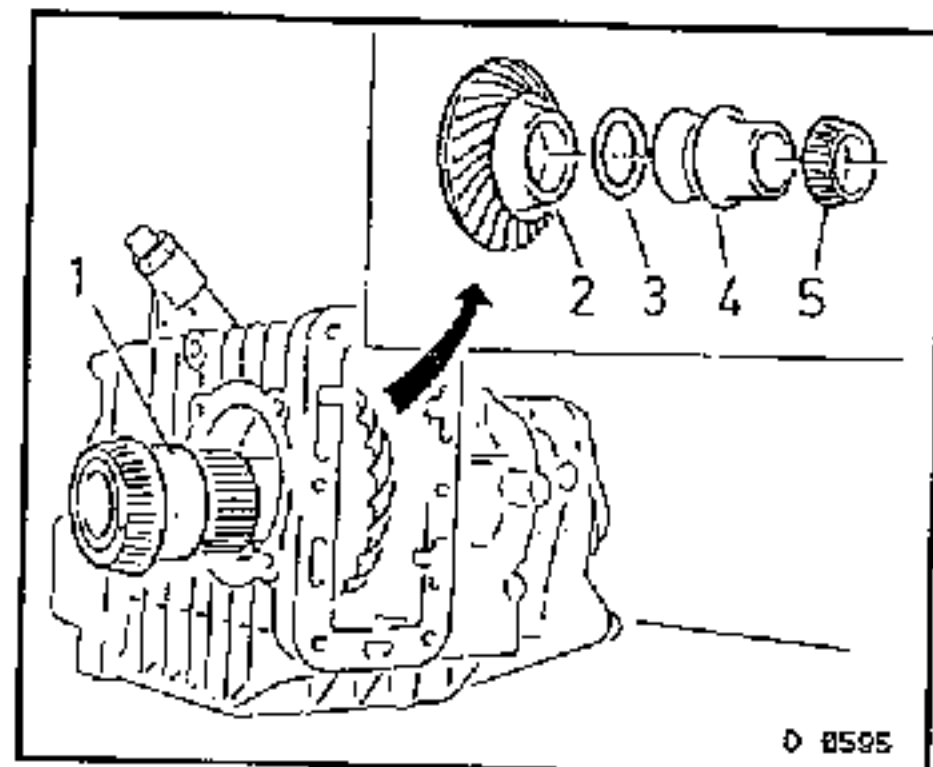
Hollow shaft.

Support bevel gear with sleeve (1) and press out hollow shaft.



## Remove, Disconnect

Hollow shaft (1), bevel gear (2), adjustment disc (3), spacer block (4) and tapered roller bearing (5) from the transfer box.



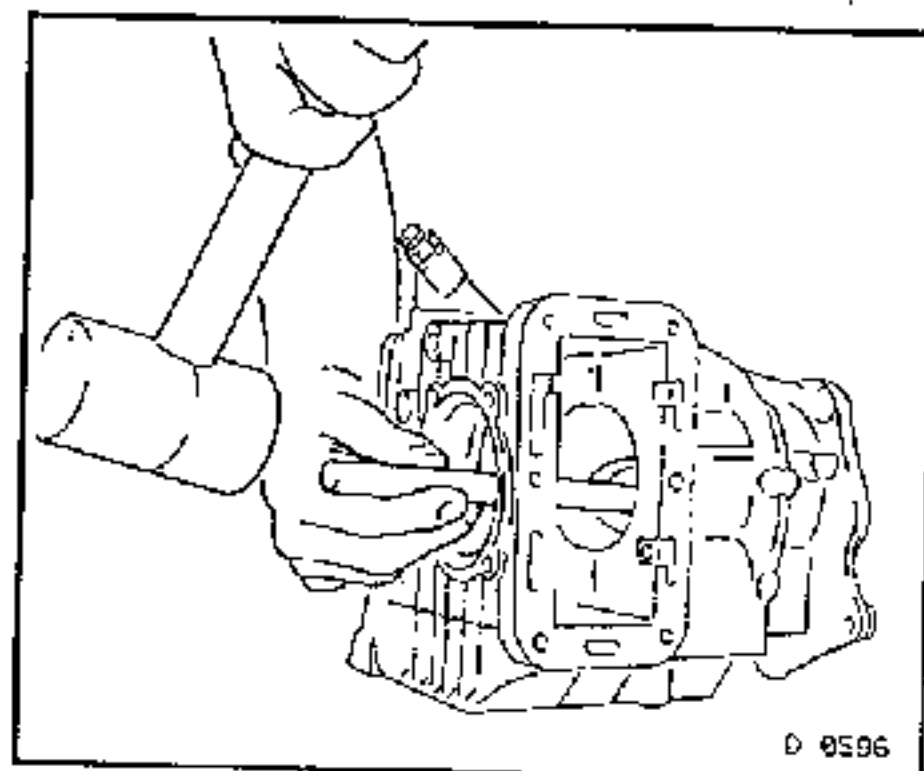
## Remove, Disconnect

Seal rings.

Knock both seal rings from the housing using a suitable drift.

## Clean

Sealing ring bores, sealing surfaces on housing cover and transfer box.



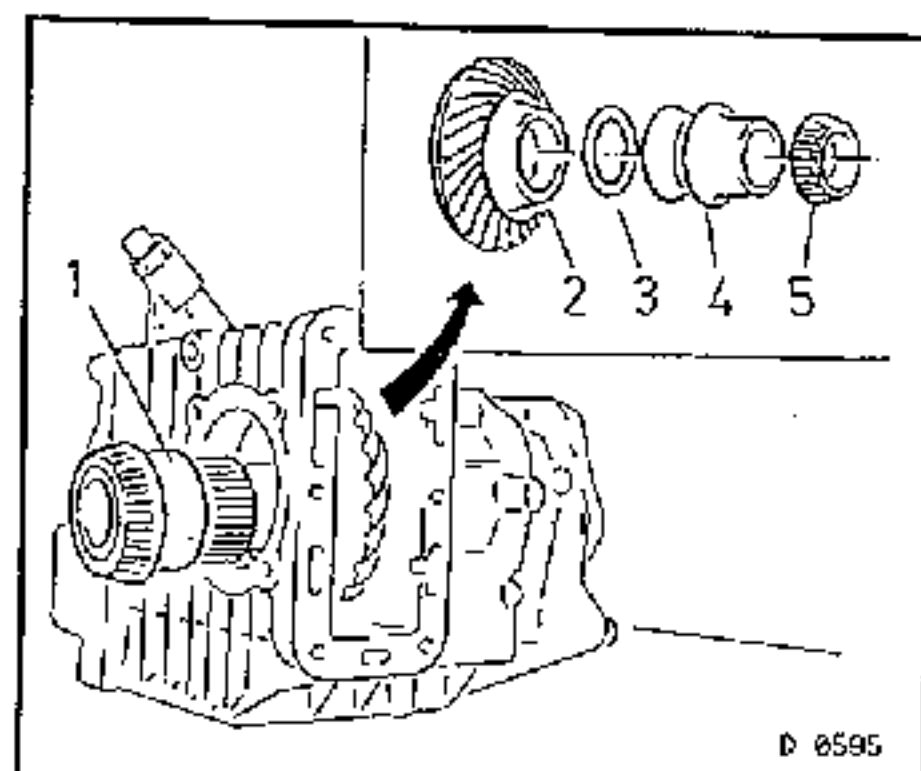
## Install, Connect

Tapered roller bearing (5), spacer block (4), adjustment disc (3), bevel gear (2) and hollow shaft (1) into the transfer box.

## Important!

The adjustment disc (3) must be inserted in spacer block (4).

Observe seating of the adjustment disc as well, when pressing in hollow shaft.



# TRANSFER BOX

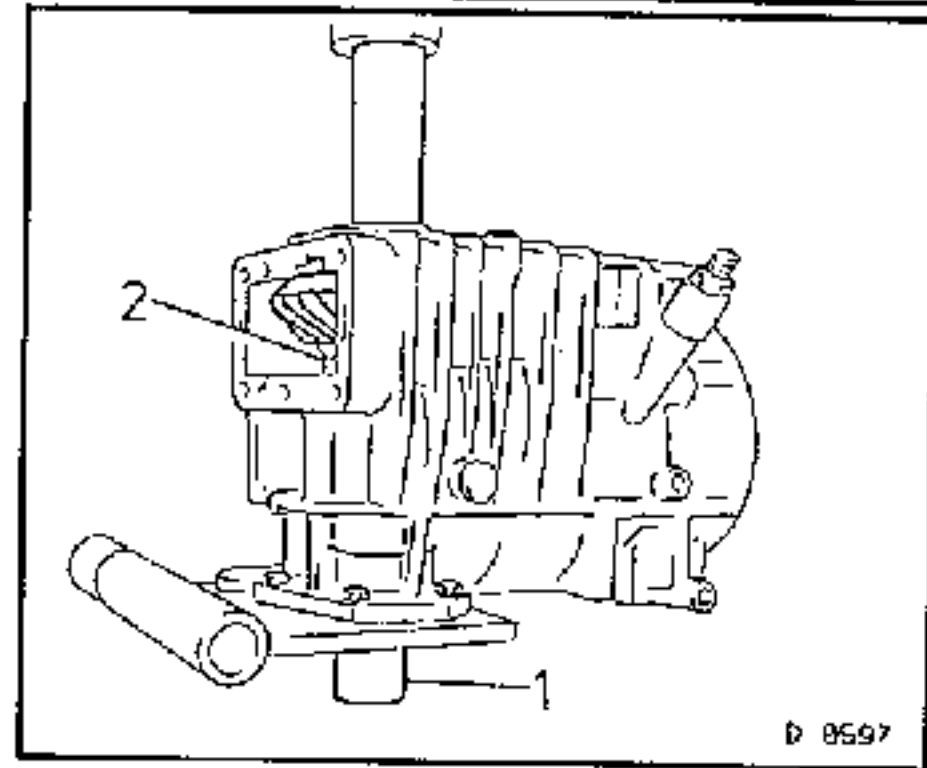
## Install, Connect

Press in hollow shaft;

Place installing sleeve KM-706 (1) to support tapered roller bearing underneath and press hollow shaft in until it stops.

### Important!

Observe the seating of adjustment disc (2).



## Install, Connect

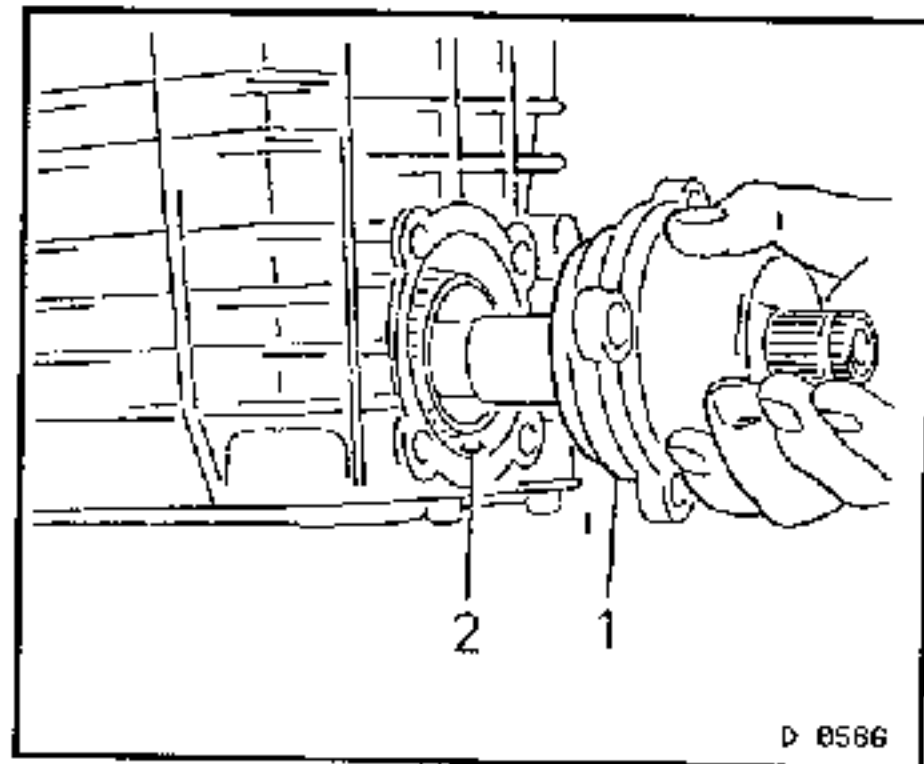
Fluid line to transfer box.

### Tighten (Torque)

Housing cover to transfer box..... 30 Nm  
End cover with drive shaft to  
transfer box..... 25 Nm

Note that the bore (1) in the end cover must match with the bore (2) in transfer box.

Use new rubber O-rings.



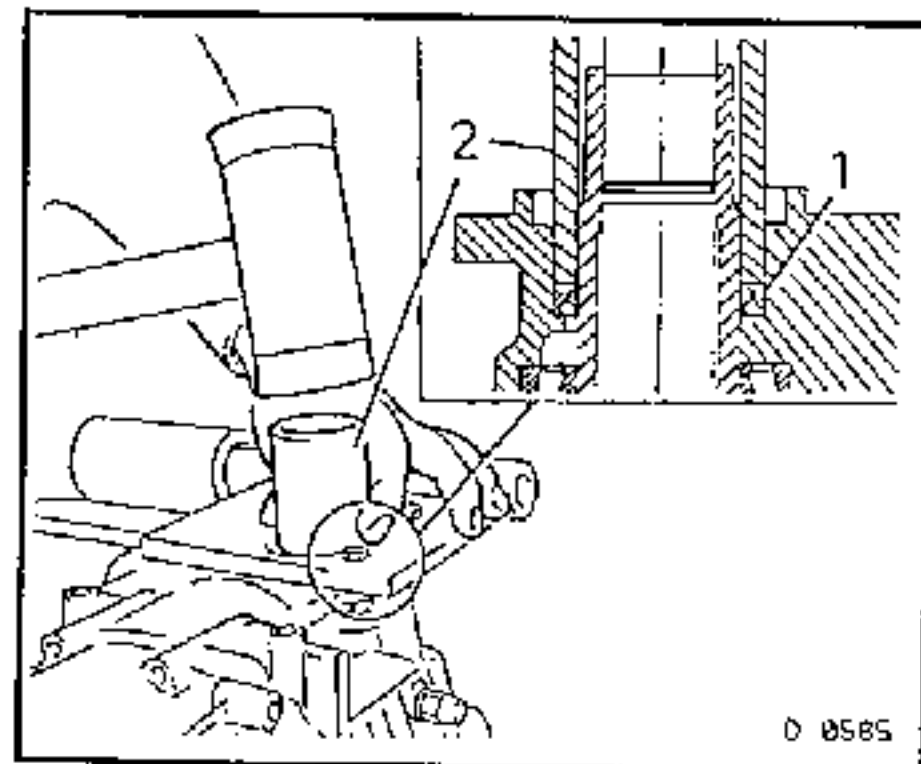
## Install, Connect

Inner seal ring;

Coat seal ring (1) with multi-purpose grease and drive in up to the stop, using KM-705 (2).

### Important!

The seal lip faces inwards.



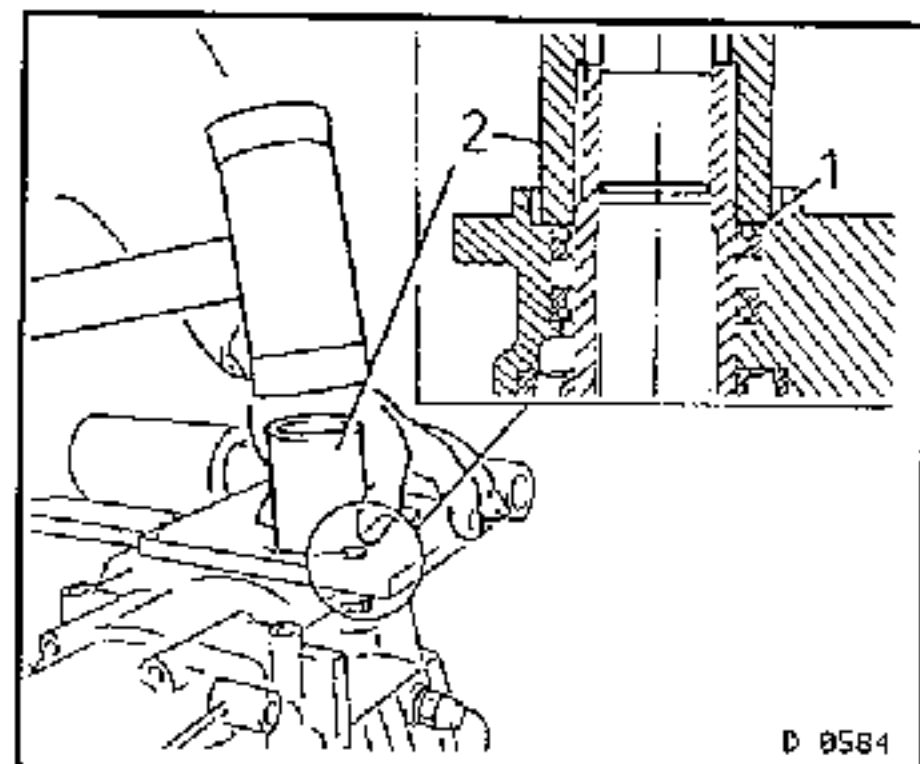
## Install, Connect

Outer seal ring;

Coat seal ring with multi-purpose grease and drive in up to the stop, using KM-706 (2).

### Important!

The seal lip of shaft seal ring must face outwards.



# TRANSFER BOX

## Tighten (Torque)

Fluid drain bolt to transfer box..... 4 Nm + 40° - 180°

## Check

Fluid level in the transmission and transfer box. Adjust as required.

## Tighten (Torque)

Temperature switch to transfer box..... 25 Nm

Use new seal ring.

## Remove, Disconnect

KM-707 from transfer box.

## OPERATIONS ON TRANSFER BOX

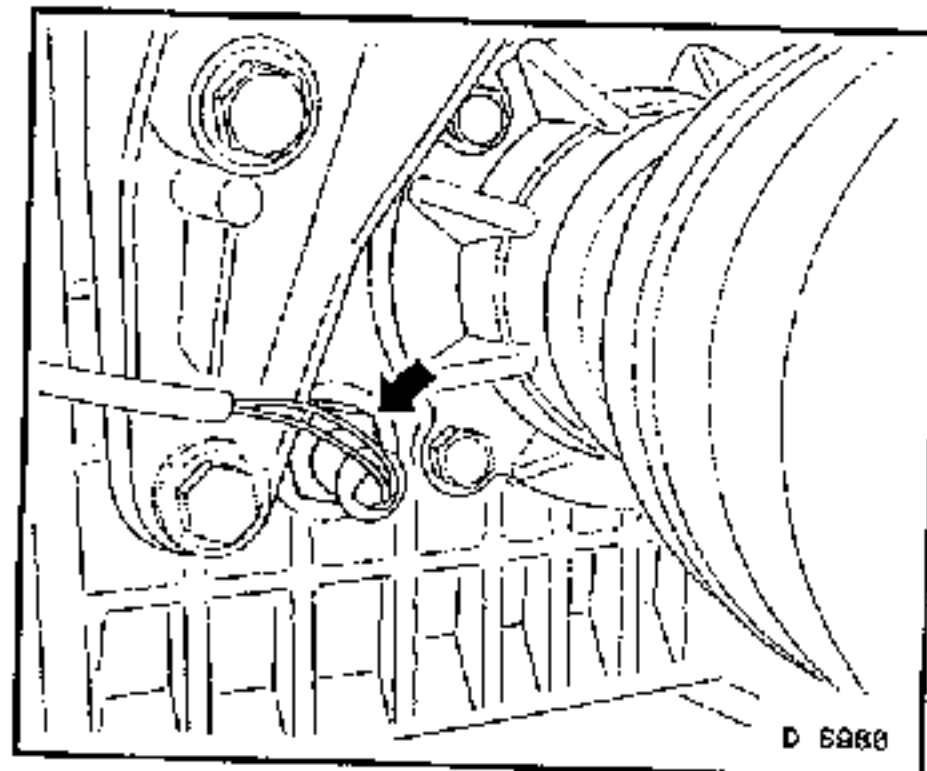
### Temperature Switch, Replace

#### Remove, Disconnect

Wiring harness plug for transfer box temperature switch under the cowl cover.

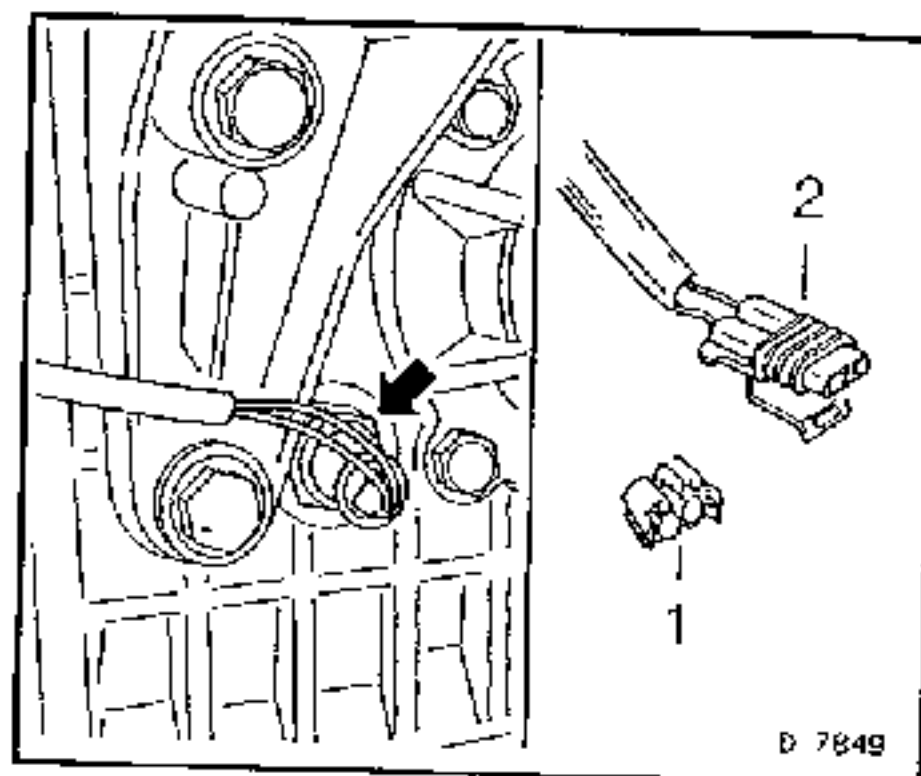
Separate the cable strap, bleeder hose and expose wiring harness for transfer box temperature switch downwards.

Separate wiring harness and unscrew temperature switch, using a thin walled ring spanner.



#### Remove, Disconnect

The wiring harness plug cover (1) from the wiring harness plug (2) of a new temperature switch.



#### Install, Connect

New temperature switch to the transfer box, using a new seal ring.

#### Tighten (Torque)

Transfer box temperature switch..... 25 Nm

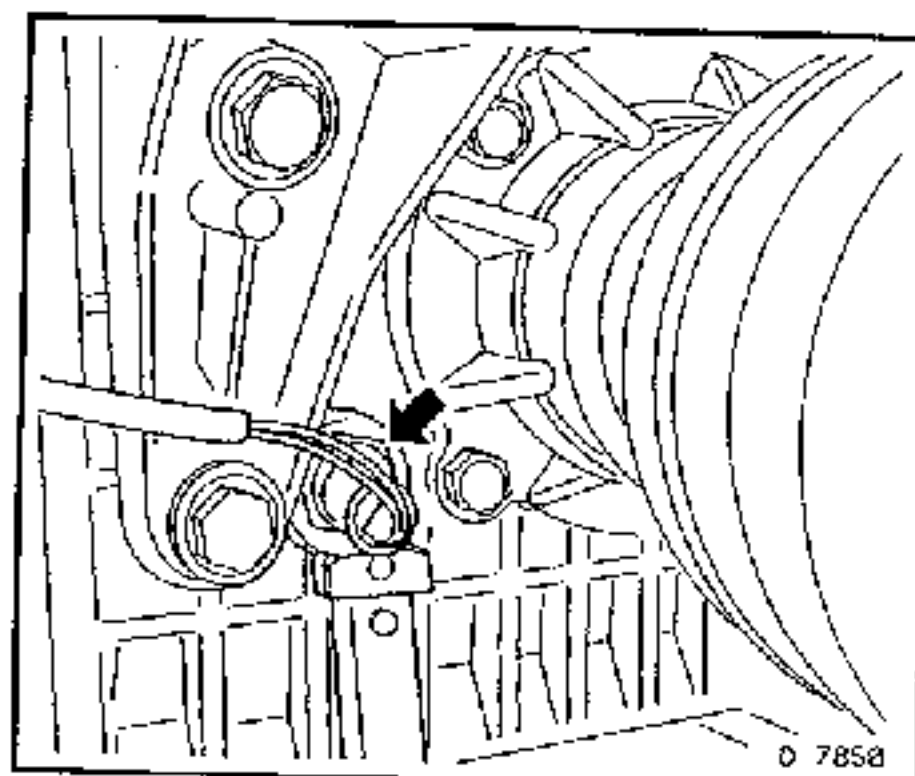
Wiring harness plug cover.

Wiring harness plug under cowl cover.

Fasten wiring harness and bleeder hose with a cable strap.

#### Important!

During this process, do not kink or twist the bleeder hose. If this occurs, bleeding the hydraulic system will be difficult.



# TRANSFER BOX

## Transfer Box, Remove and Install

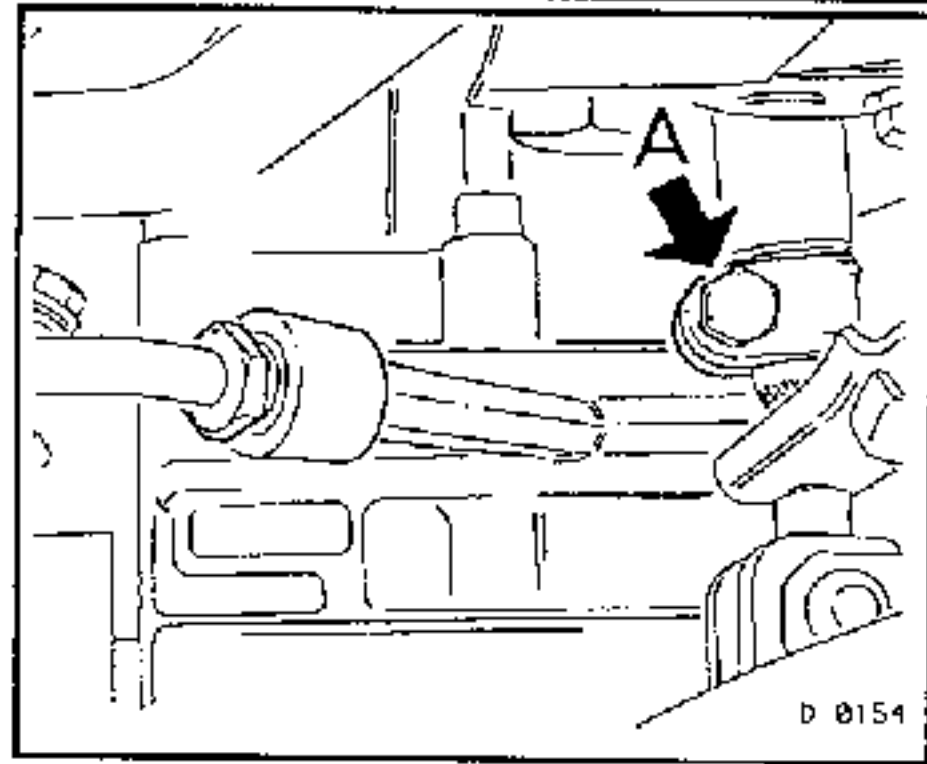
### Remove, Disconnect

Intake manifold cover.

Ground cable from battery.

Loosen bolt (A) for shift rod clamp.

Select 4th gear position, then loosen the shift rod connection.

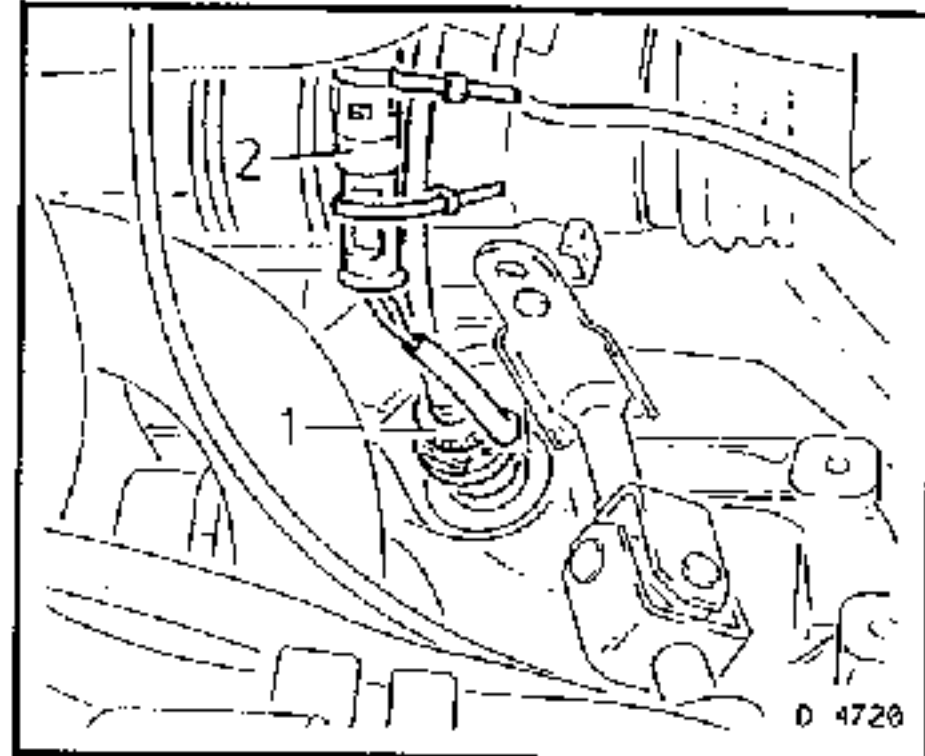


### Remove, Disconnect

Wiring harness plug for transfer box temperature switch under the cowl cover.

Separate the cable strap, bleeder hose and expose wiring harness for transfer box temperature switch downwards.

Speedometer cable (1) and/or wiring harness plug (2) from odometer frequency sensor.



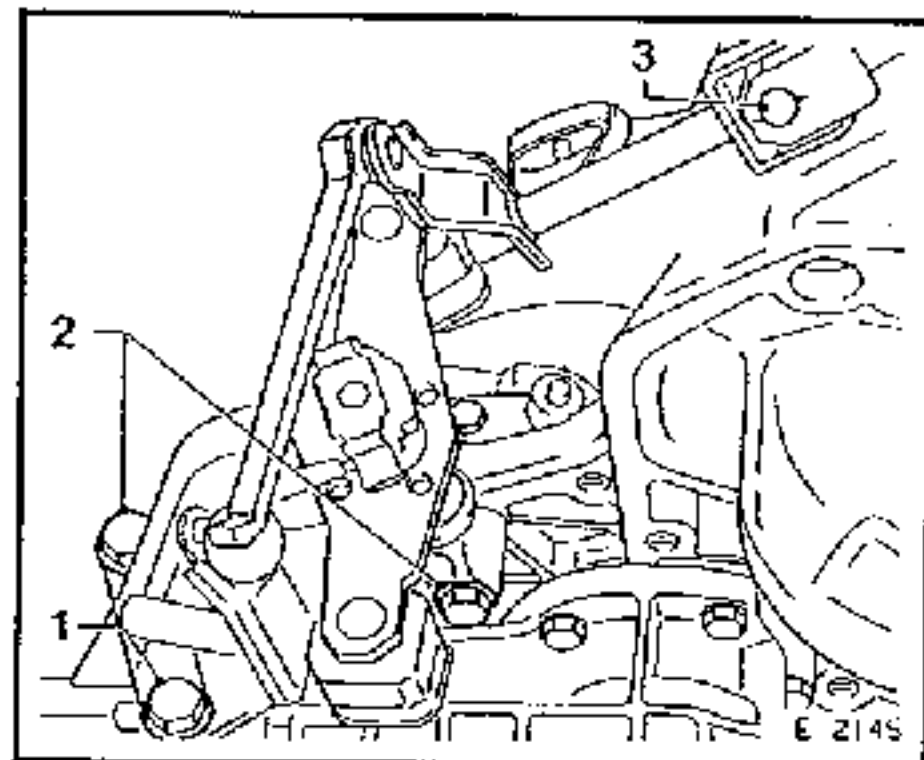
### Remove, Disconnect

Bracket for coolant hoses (rear bolt for manual transmission to engine block).

Shift guide from transmission (2) and transfer box (1).

Compress detent clips from hollow universal joint pin (3).

Upper three fastening bolts from transfer box to manual transmission.



### Remove, Disconnect

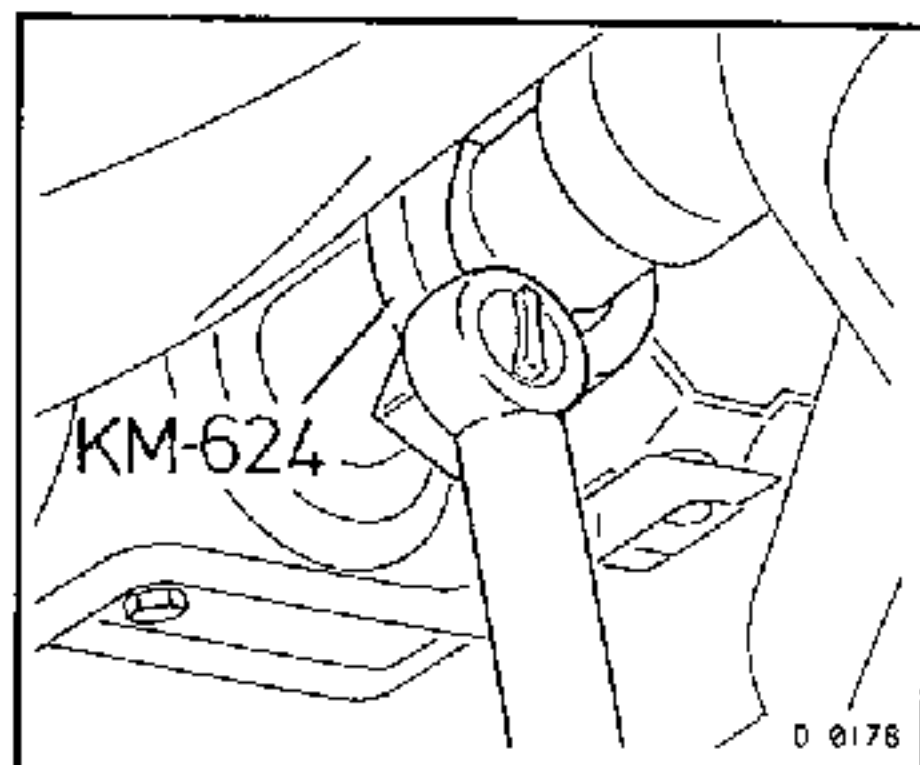
Lower engine compartment cover.

Drain fluid from transfer box.

Loosen lock nut for slider on propshaft, using KM-624.

Propshaft from transfer box, separating at the join with a suitable soft metal drift.

Front exhaust pipe.



# TRANSFER BOX

## Remove, Disconnect

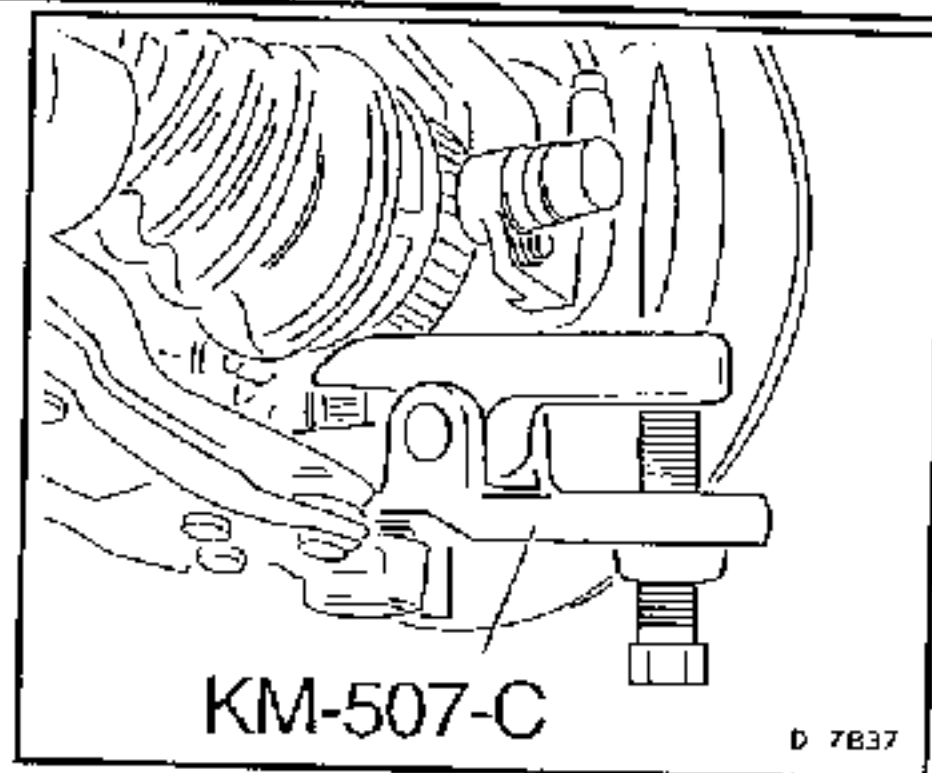
Right front wheel.

Retaining clamp and castellated nut from right hand ball joint.

Right ball joint from spring strut, using KM-507-C.

Front axle body. Refer the operation in Group E, Volume 1.

Hydraulic line from transfer box.

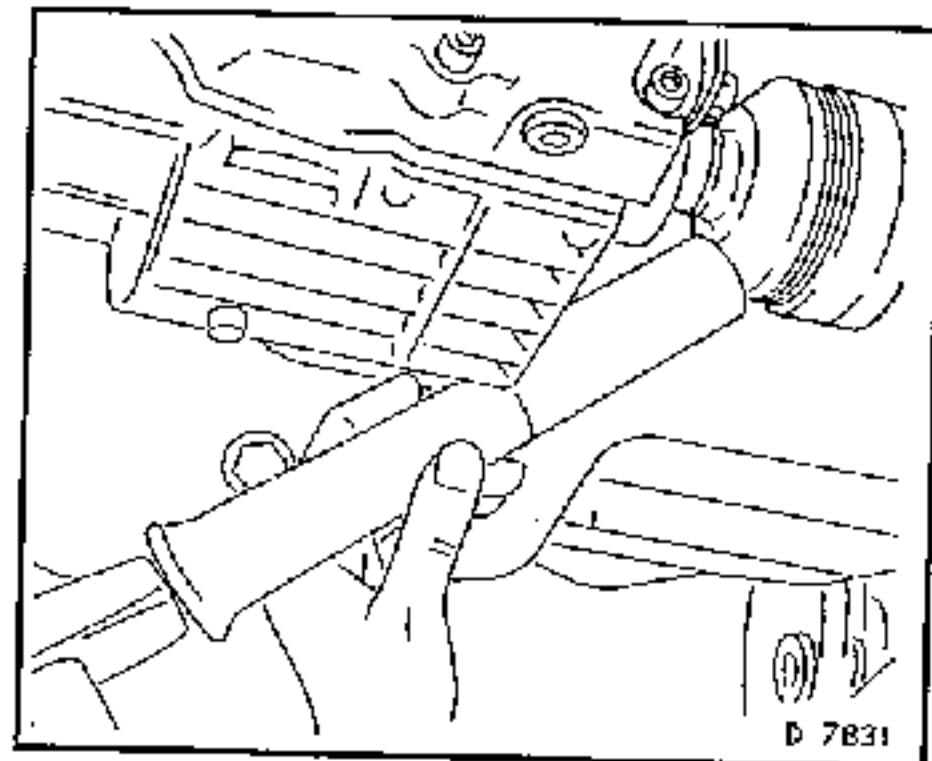


## Remove, Disconnect

Right axle shaft from transfer box.

Separate axle shaft from seat at the transfer box end, using a soft metal drift.

Support drive axle with tie wire.



## Remove, Disconnect

Lower fastening bolts (1) from transfer box.

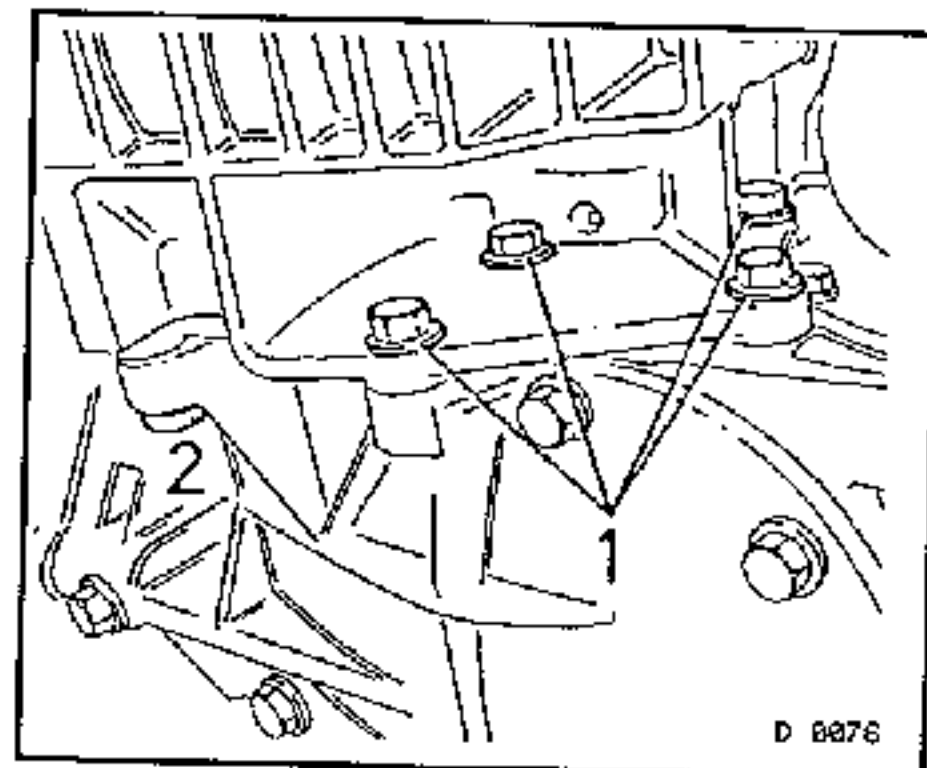
One bolt remains as a retainer (2).

Place hydraulic jack under transfer box.

Unscrew bolt (2).

Bracket for transfer box from engine and transfer box.

Separate transfer box from transmission sideways, then lower and remove from the vehicle.



## Install, Connect

New O-ring seal at the flange of the transfer box.

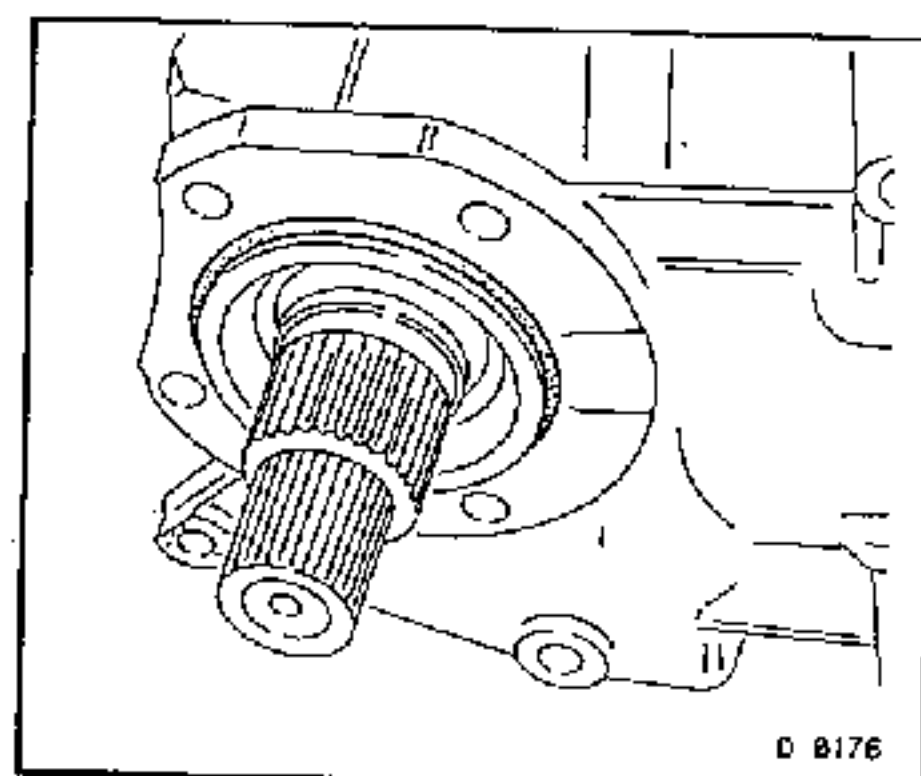
## Inspect

Threads of;

8 bolt holes for transfer box at transmission.

3 bolt holes for bracket at transfer box.

If necessary, clean with an M 8 x 1.25 mm tap.



# TRANSFER BOX

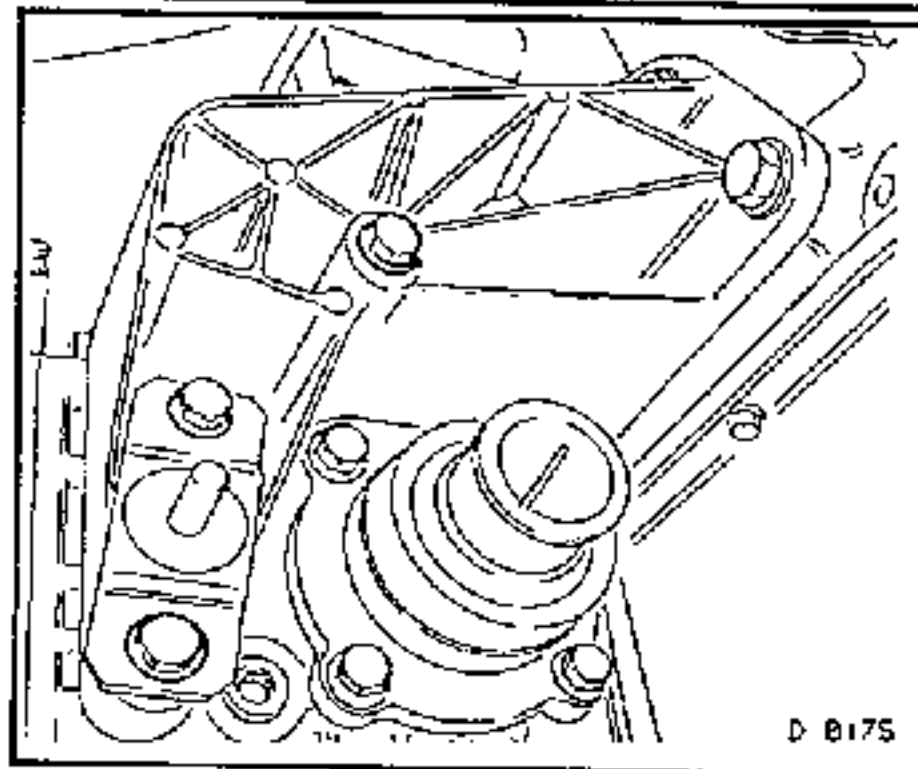
## Install, Connect

Transfer box to transmission, using thread locking compound to the threads, such as Loctite 242 or equivalent to Holden's Specification HN1256.

Bracket for transfer box to engine.

## Tighten (Torque)

Transfer box to transmission .....	20 Nm
Bracket to engine block .....	60 Nm



## Install, Connect

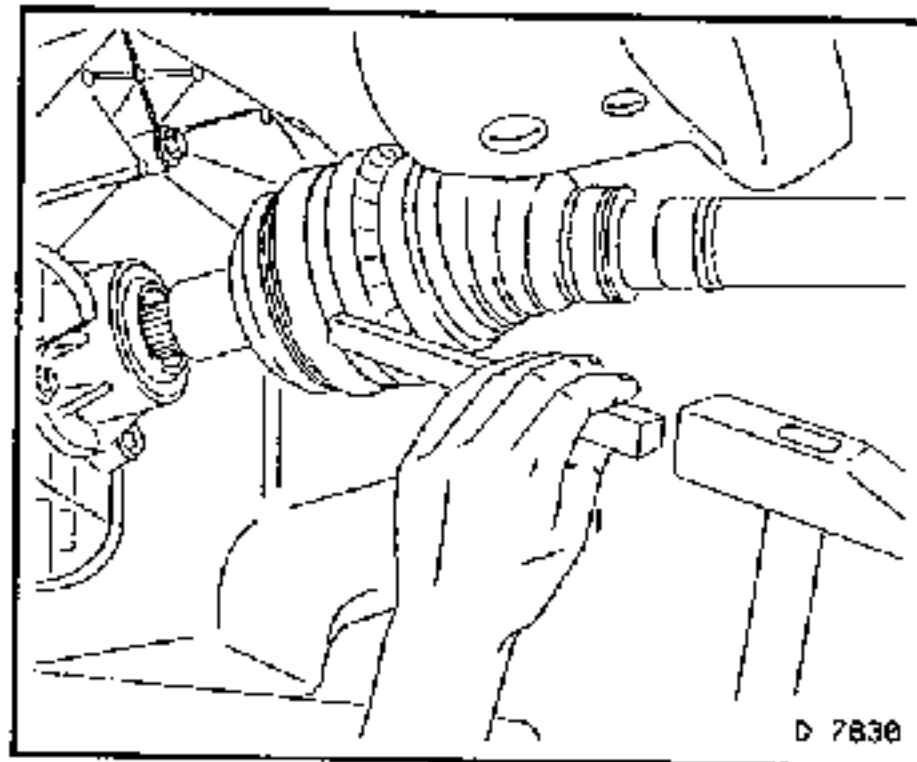
Right axle shaft with new retaining ring, until it catches. Use a square drift as shown.

Check that it is secure by trying to pull the joint from the transfer box. Do not pull on the axle shaft itself.

## Tighten (Torque)

Hydraulic line to transfer box .....	30 Nm
Ball joint to steering knuckle .....	70 Nm *
Wheel bolts .....	110 Nm

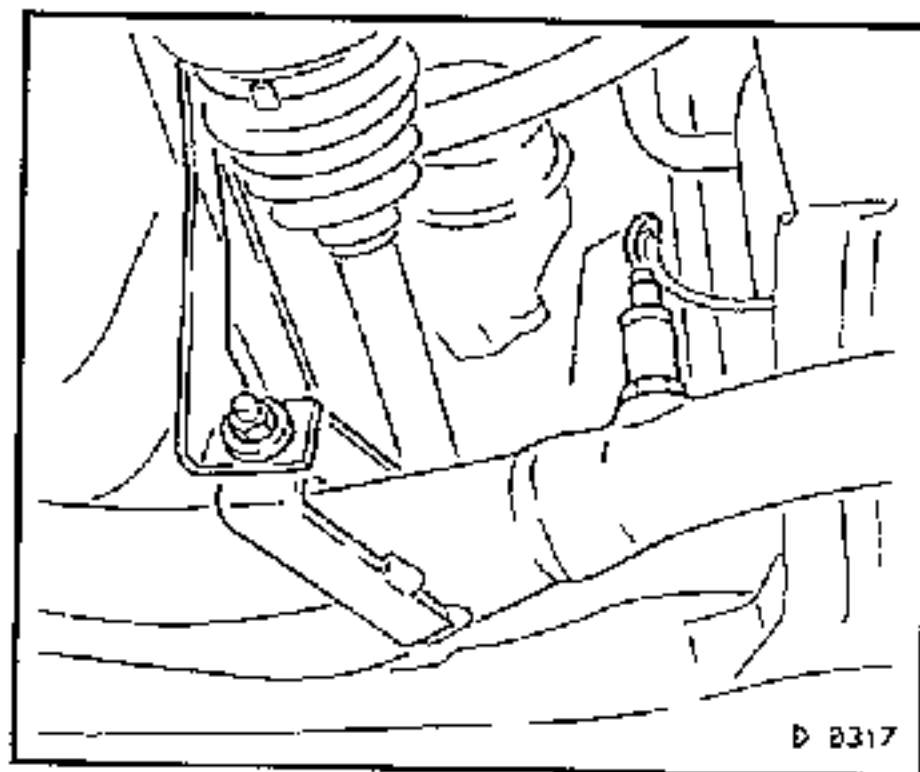
\* Fit new retaining springs.



## Install, Connect

Front axle body. Refer to operation in Group E, in Volume 1.

Front exhaust pipe.



## Install, Connect

Propshaft to transfer box.

Lock nut to slider, using KM-524.

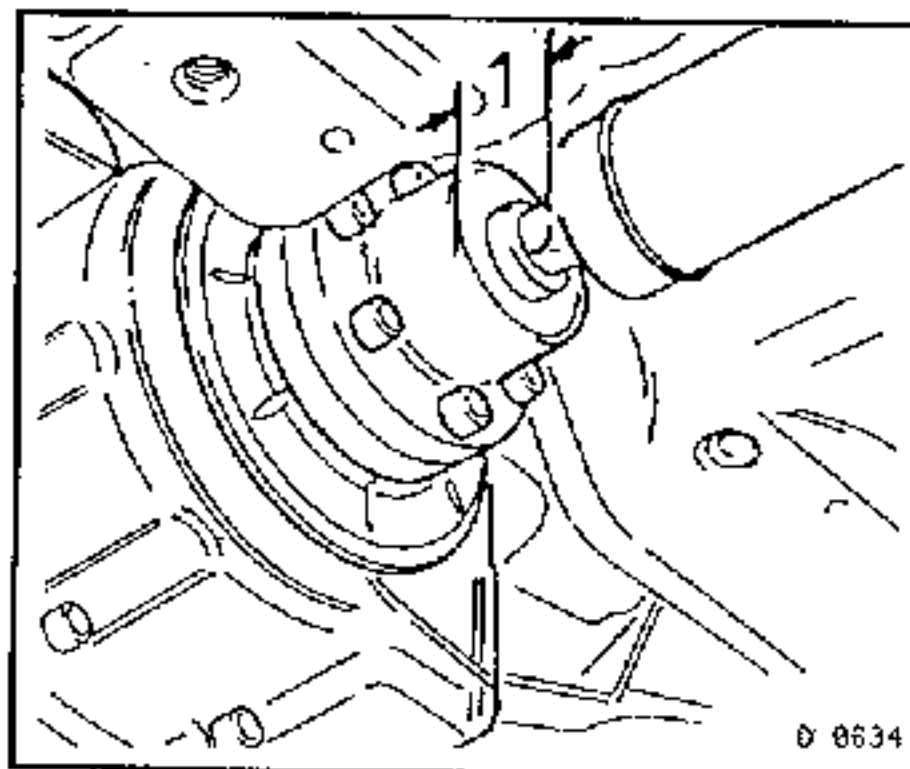
Note the distance "1" =  $30 \pm 2$  mm

## Tighten (Torque)

Propshaft to transfer box .....	30 Nm
Lock nut to slider .....	40 Nm

### Note:

Illustration D 0634 Shows the propshaft at the transfer box end, with the front axle body removed, for clarity.





# TRANSFER BOX

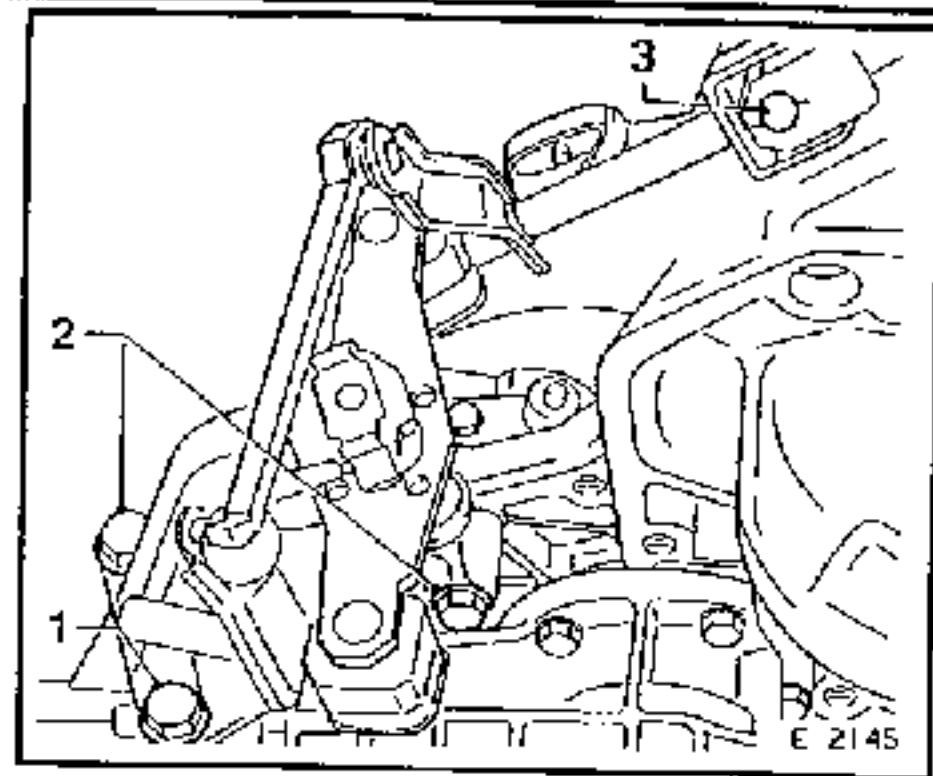
## Install, Connect

Upper three bolts for transfer box to manual transmission.

Shift guide to manual transmission (2) and transfer box (1).

## Tighten (Torque)

Transfer box to manual transmission.....	20 Nm
Shift guide to manual transmission and transfer box.....	22 Nm



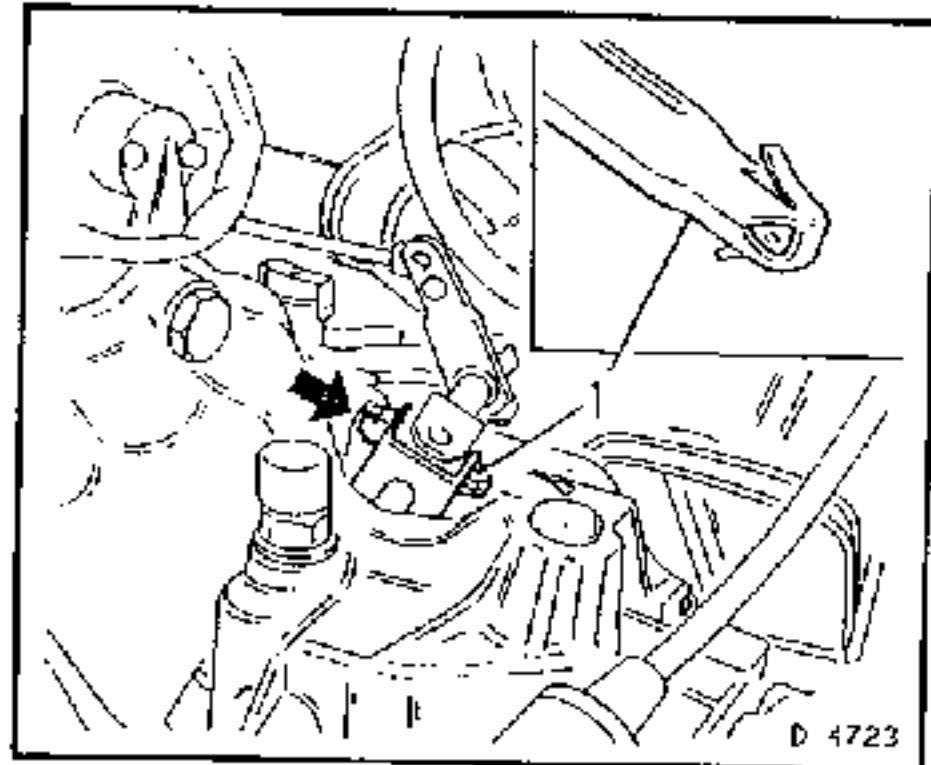
## Install, Connect

New hollow pin (1) to universal joint, after applying silicone grease to the pin, such as Dow Corning No. 44, or equivalent, to Holden's Specification HN1014. The expanding clips snap into place.

## Tighten (Torque)

Hydraulic line to transfer box..... 30 Nm

Position knurled stem to shift rod clamp but do not tighten clamp bolt before adjusting.



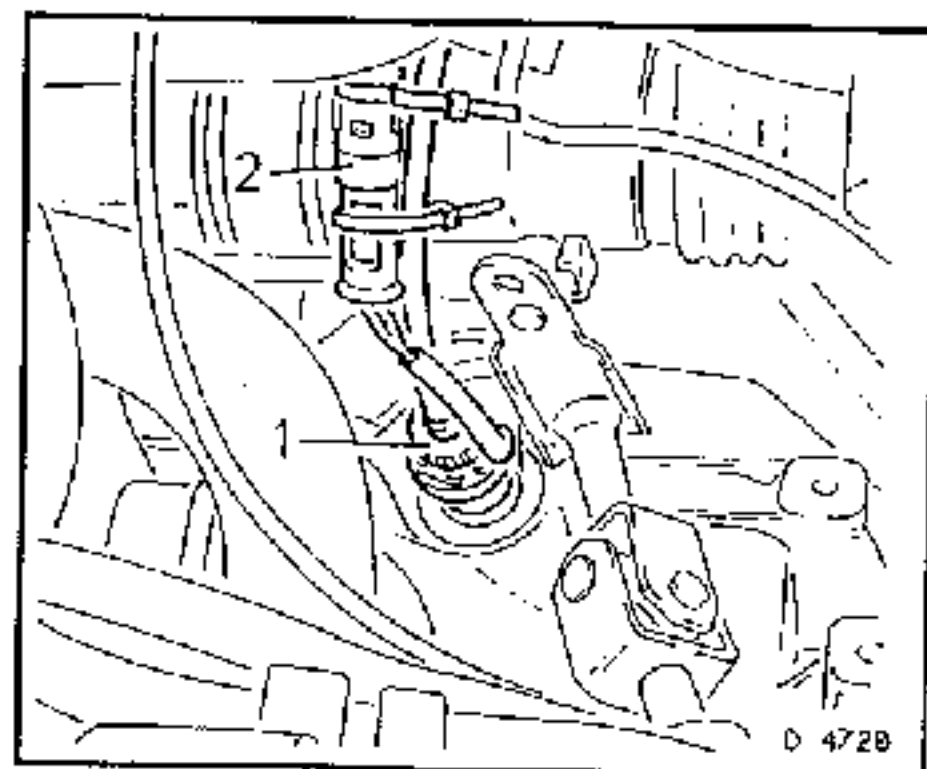
## Install, Connect

Speedometer cable (1) and/or wiring harness plug (2) for odometer frequency sensor.

Wiring harness plug for transfer box temperature switch, to wiring harness with cable straps.

## Important!

During this process do not kink or twist the bleeder hose. If this occurs, bleeding the hydraulic system will be difficult.



## Install, Connect

Ground cable to battery.

## Adjust

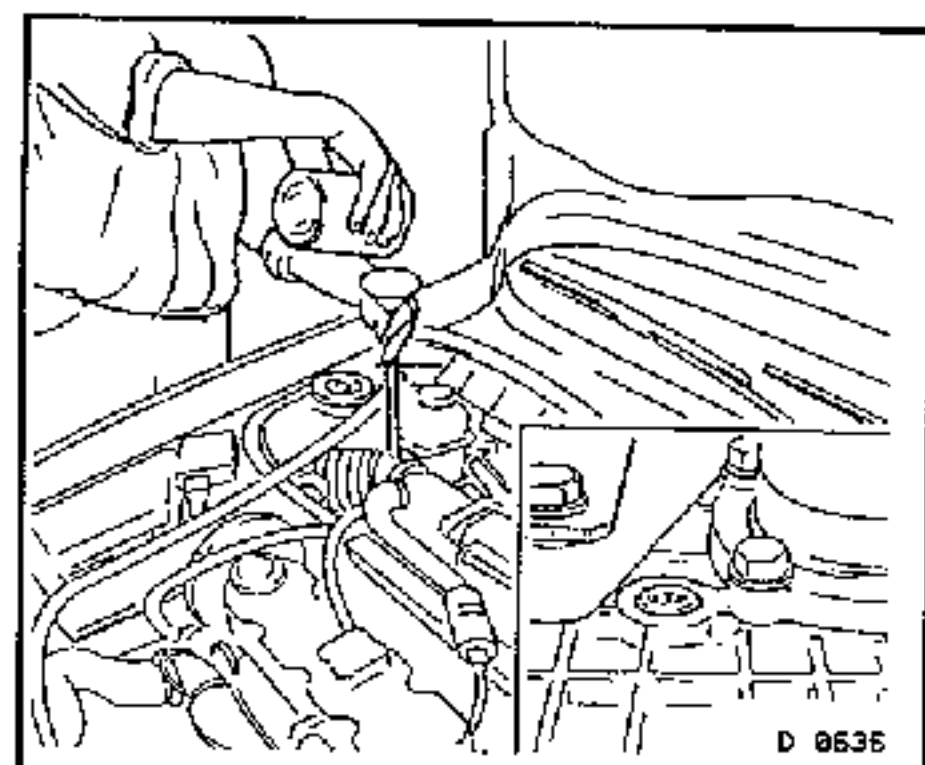
Transmission shift linkage. Refer to 'Checking and Adjusting Operations', in the Section, Manual Transmission, in this Group.

## Inspect

Fluid levels of both the manual transmission and transfer box. Refer to these operations in the Section "Manual Transmission and Clutch" and in this Section, respectively.

Lower engine compartment cover.

Intake manifold cover.

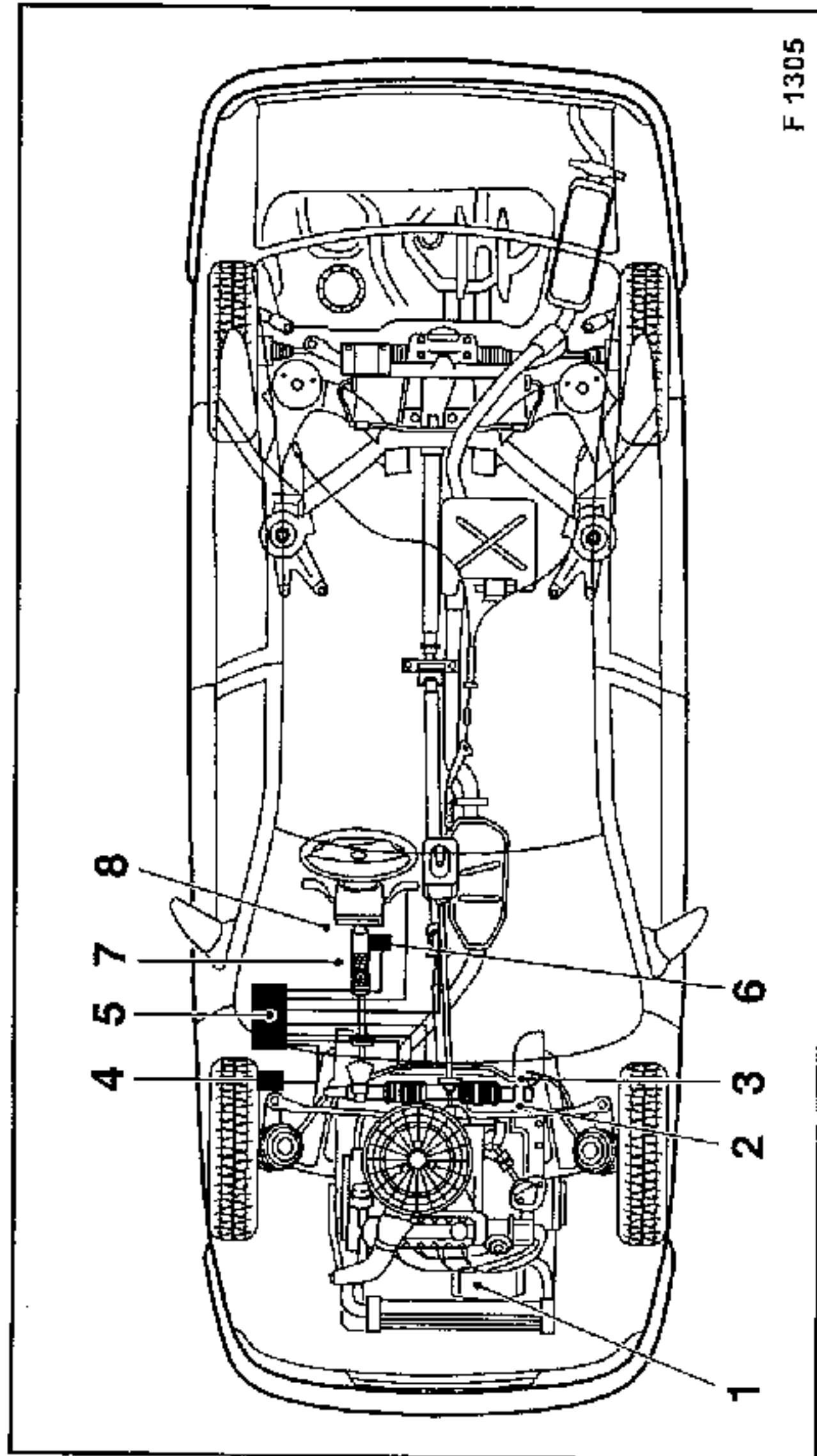




# TRANSFER BOX

## 3. Survey of System

### 3.1 Four Wheel Drive 4x4 Components in RHD Calibra

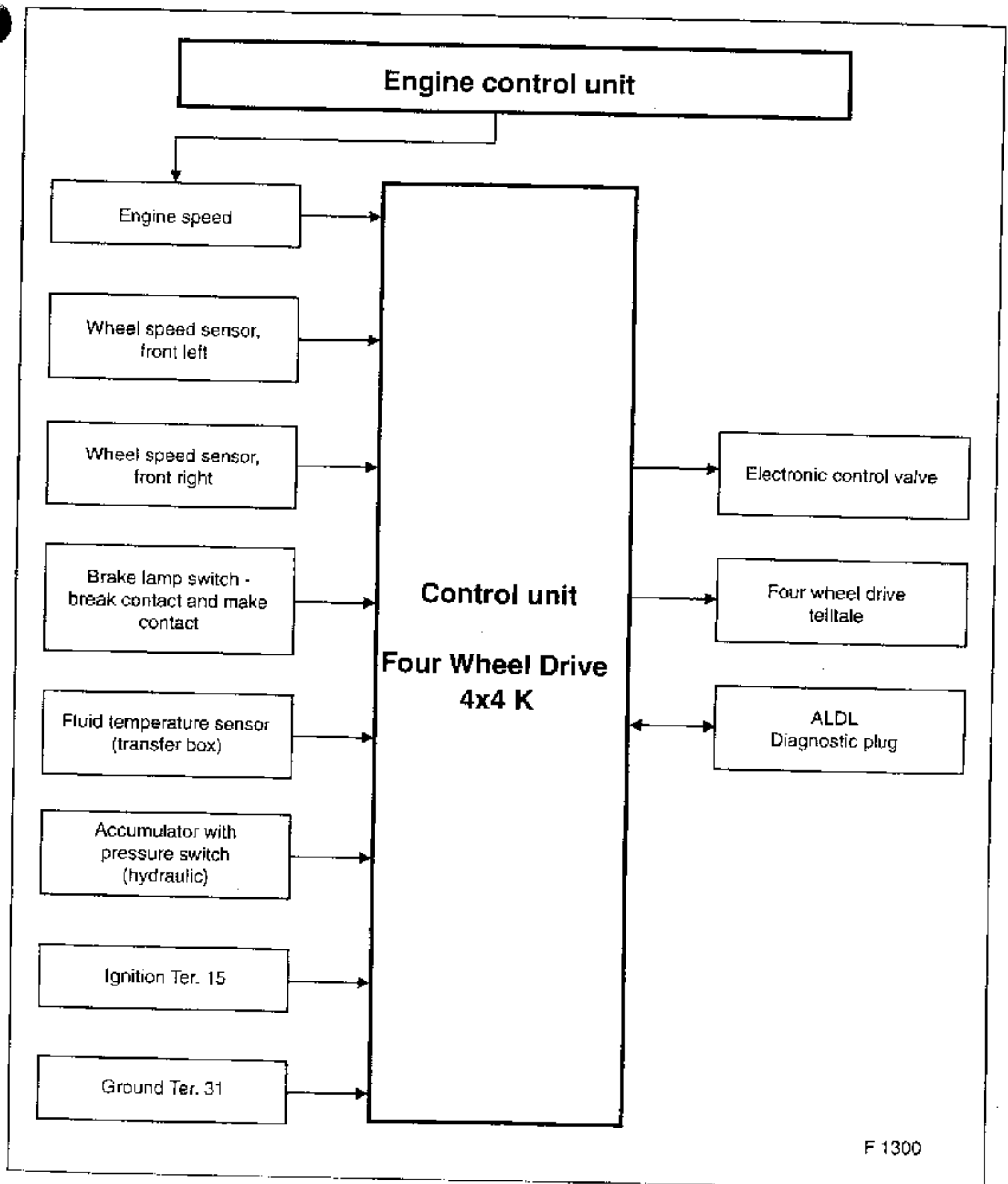


#### Illustration Key:

- |   |                             |
|---|-----------------------------|
| 1 Pulse Pick-up for engine speed                        | 5 Electronic control unit   |
| 2 Accumulator   | 6 Plug connection X21/X22   |
| 3 Control valve with solenoid valve and pressure switch | 7 Brake lamp switch         |
| 4 Diagnostic plug                                       | 8 Four wheel drive telltale |

# TRANSFER BOX

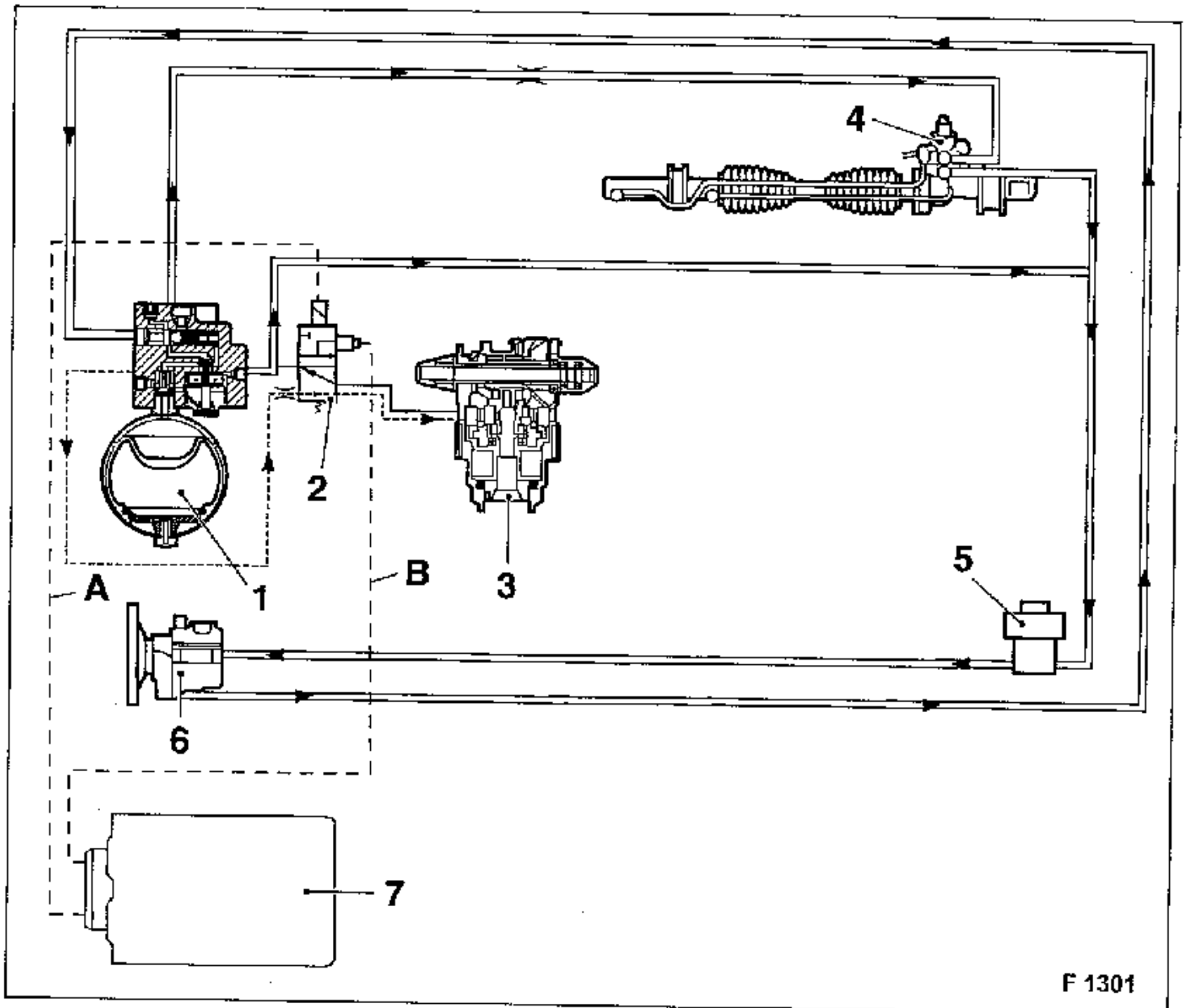
## 3.2 Block Diagram, Four Wheel Drive (4x4 K)



# TRANSFER BOX

## 3.3 Hydraulic Regulation

### 3.3.1 Survey of Hydraulic System



- |   |   |   |   |
|---|---|---|---|
| 1 | Accumulator   | 5 | Fluid reservoir - power steering and four wheel drive |
| 2 | Control valve with solenoid valve and pressure switch | 6 | Fluid pump  |
| 3 | Transfer box  | 7 | Control unit, 4x4 K                                   |
| 4 | Power steering  | A | Electr. connection, control unit to solenoid valve    |
|   |   | B | Electr. connection, control unit to pressure switch   |

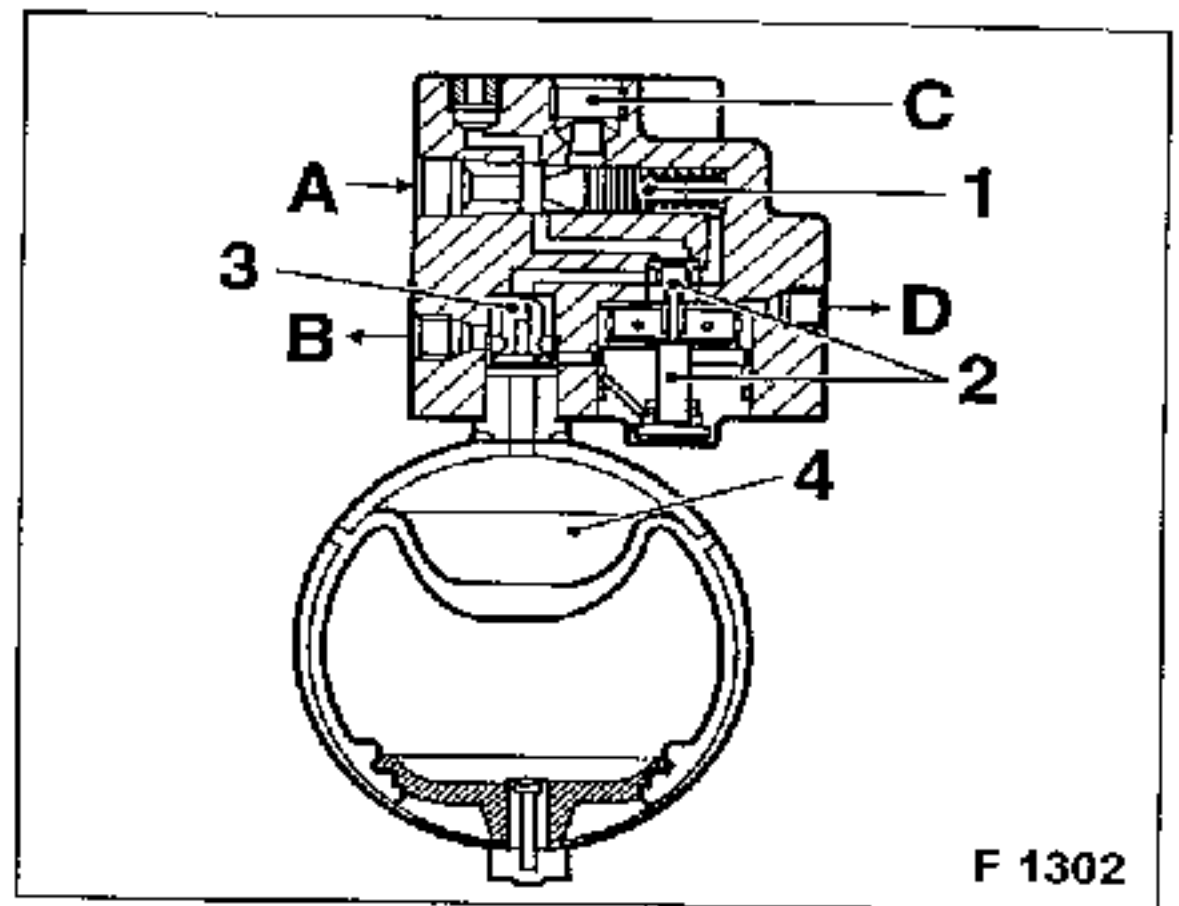
# TRANSFER BOX

## Survey of Hydraulic System (Continued)

### Accumulator

- 1 Throttle valve
- 2 Shift valve
- 3 Non-return valve
- 4 Accumulator

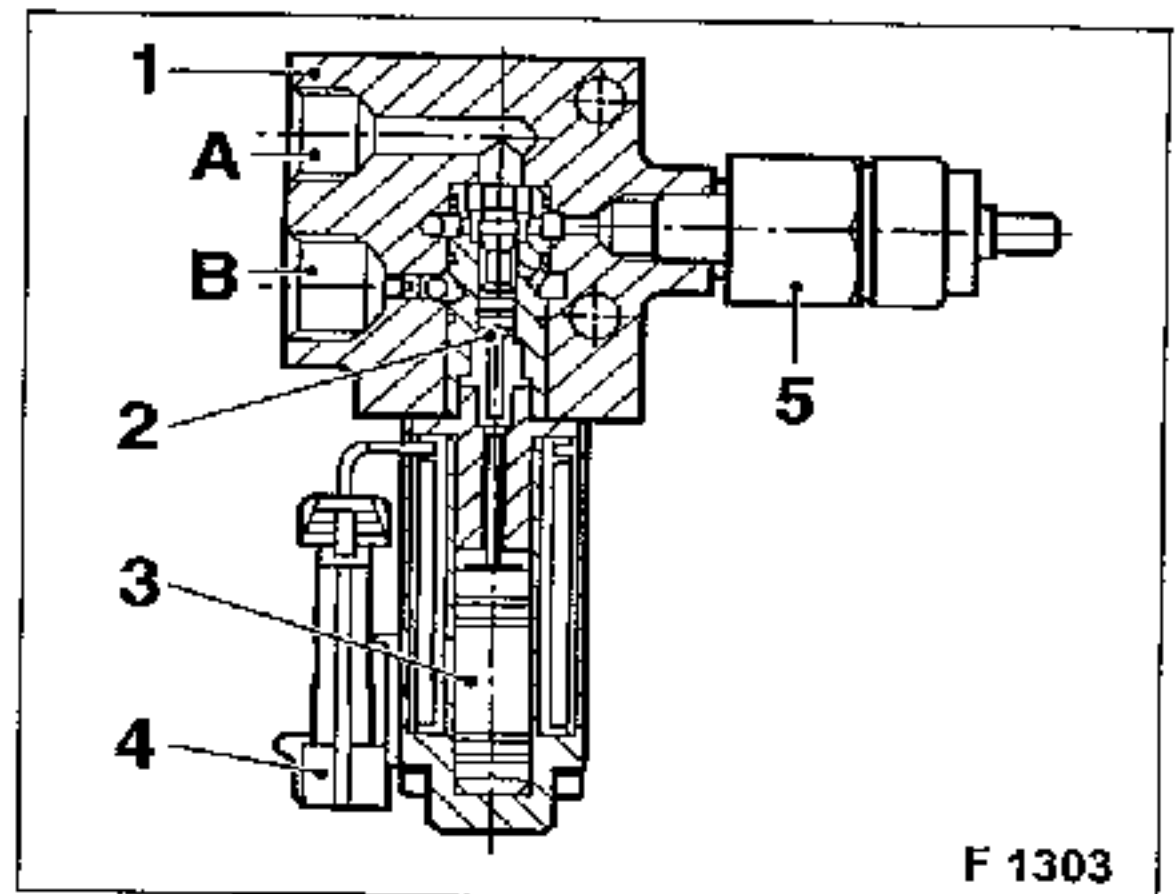
- A = from power steering fluid pump to fluid pressure regulator
- B = from accumulator to control valve
- C = from fluid pressure regulator to power steering
- D = from fluid pressure regulator to fluid reservoir



### Control Valve

- 1 Valve body
- 2 Valve plunger
- 3 Solenoid
- 4 Electric plug connection
- 5 Pressure switch
- A Connection for return line
- B Connection from accumulator

The sectional view does not show the connection to the transfer box.



## 4 Abbreviations, Definitions

BATTERY VOLTAGE	=	Battery voltage
ENGINE SPEED	=	Actual engine speed
FL WHEEL SPEED	=	Wheel speed, front left wheel
FR WHEEL SPEED	=	Wheel speed, front right wheel
BRAKE SWITCH 1	=	Signal from brake lamp switch 1
BRAKE SWITCH 2	=	Signal from brake lamp switch 2
PRESSURE SWITCH	=	Hydraulic pressure switch, transfer box
SOLENOID VALVE	=	Solenoid valve, transfer box
OIL TEMPERATURE	=	Fluid temperature sensor in transfer box
CHECK LIGHT	=	Four wheel drive telltale

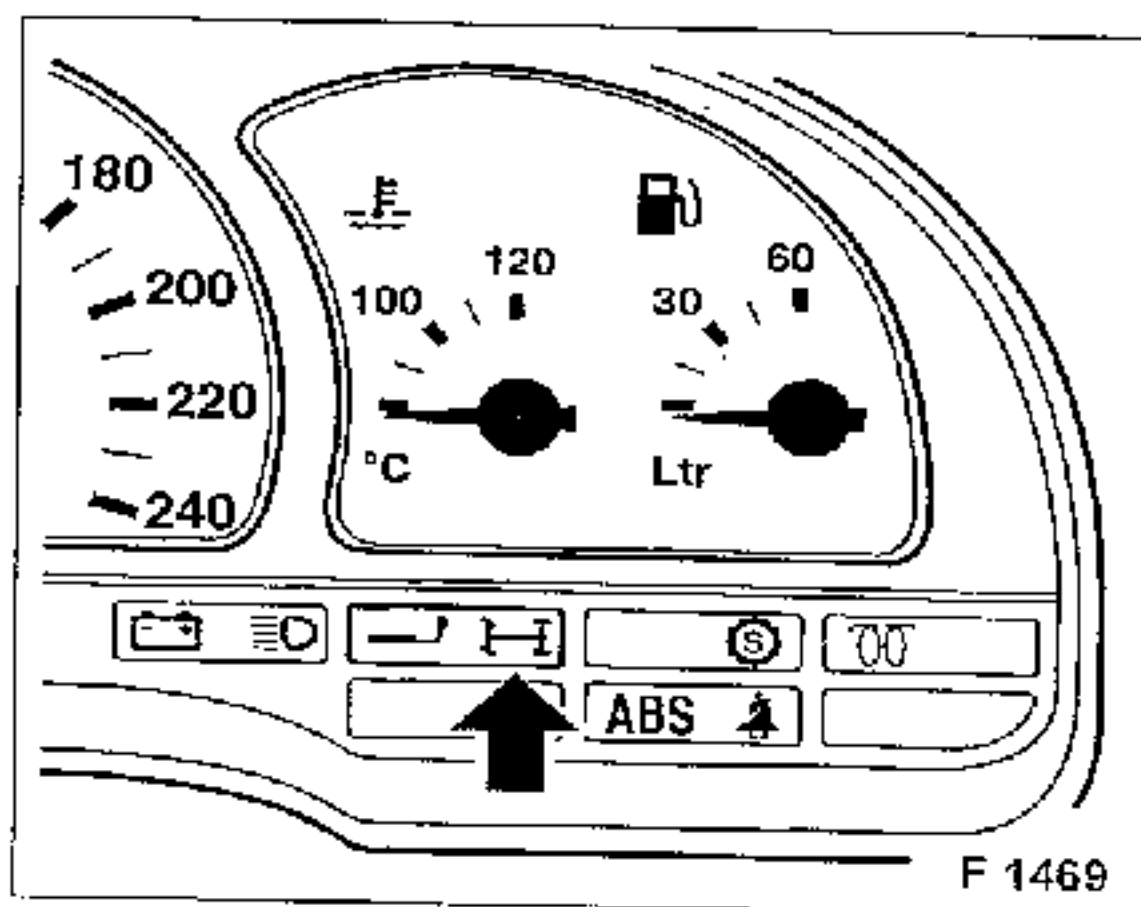
## 5 Checking

### 5.1 General Information

The four wheel drive is equipped with self-diagnosis.

If a fault is recognised, the control unit stores a two-digit trouble code. Note the following:

- **If the four wheel drive telltale illuminates constantly** and only extinguishes when the ignition is switched off, a fault has occurred, and has been recognised and stored by the control unit.  
**The four wheel drive is switched off.** Braking stability is nonetheless guaranteed.



- **If the four wheel drive telltale flashes**, it must be assumed that the four wheel drive will not switch off during braking. This means that the vehicle does not brake with its usual stability, especially in low friction road conditions (ice, snow, rain).

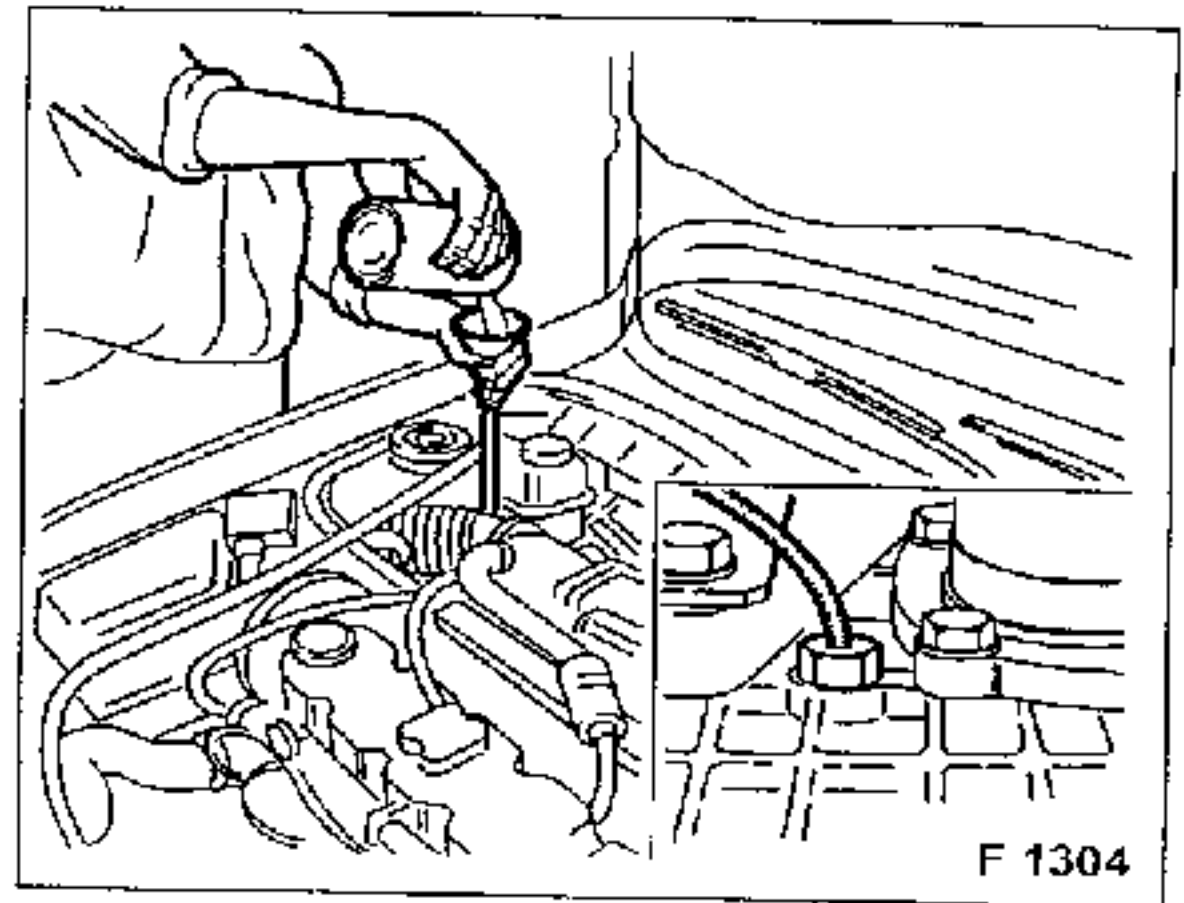
# TRANSFER BOX

## 5.2 Fluid Level Check and Bleeding

### Filling the Transfer Box

The transfer box is filled via its vent hose. Fluid also penetrates to the visco-clutch bearings through a bore in the interior of the transfer box. Therefore, note the following:

When filling or draining fluid, proceed with utmost care. Before filling the transfer box, unscrew the fluid temperature sensor. Use a funnel for filling.



The fluid flows very slowly. If poured in too quickly (capacity approx. 0.6 ltr.), the fluid will spill back out of the check bore. Note the filling capacity. The same applies for draining fluid. Fluid should be drained in a controlled manner to allow the amount of fluid which has already been lost to be determined. The amount of fluid which is drained can be used as a guide for the amount of fluid to be topped up.

### Fluid Level Check in Transfer Box

The fluid in the transfer box must be changed as specified by the maintenance intervals in the Opel/Vauxhall Inspection System.

Top up the fluid to the lower edge of the checking bore.

For further details on the fluid change, consult the Service Instructions and the "Opel/Vauxhall Inspection System" brochure.

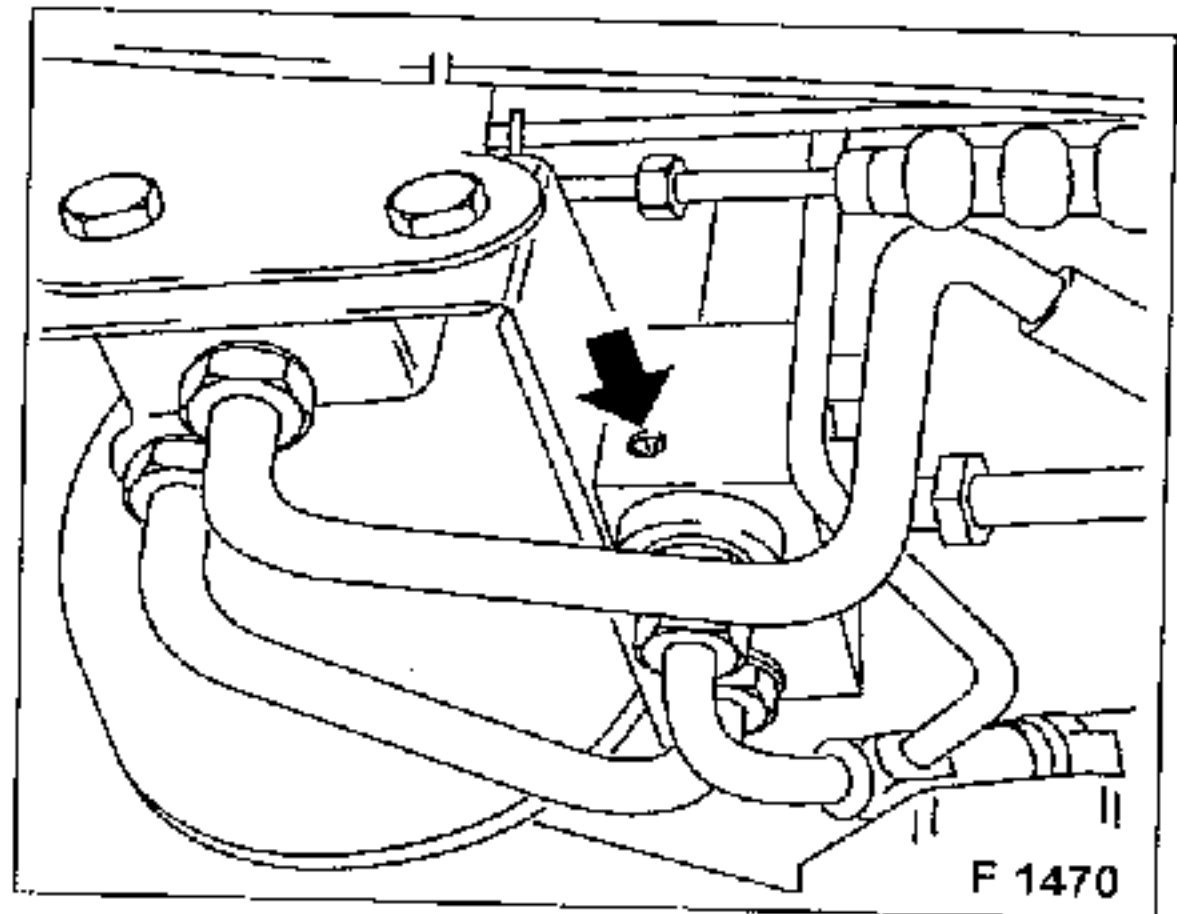
# TRANSFER BOX

## Hydraulic System, Bleed

Remove fuse F19 from the fuse box.  
Open bypass bolt (see arrow in illus. F 1470) on control valve (approx. 3 turns).

Fill compensation tank (see illus. F 1471) to mark "MAX" (1) and start engine.  
Immediately top up sinking fluid level to mark "MIN" (2) and allow engine to run for approx. 5 minutes.

Turn steering to right full lock and hold in this position for approx. 5 seconds; repeat procedure with steering at left full lock.

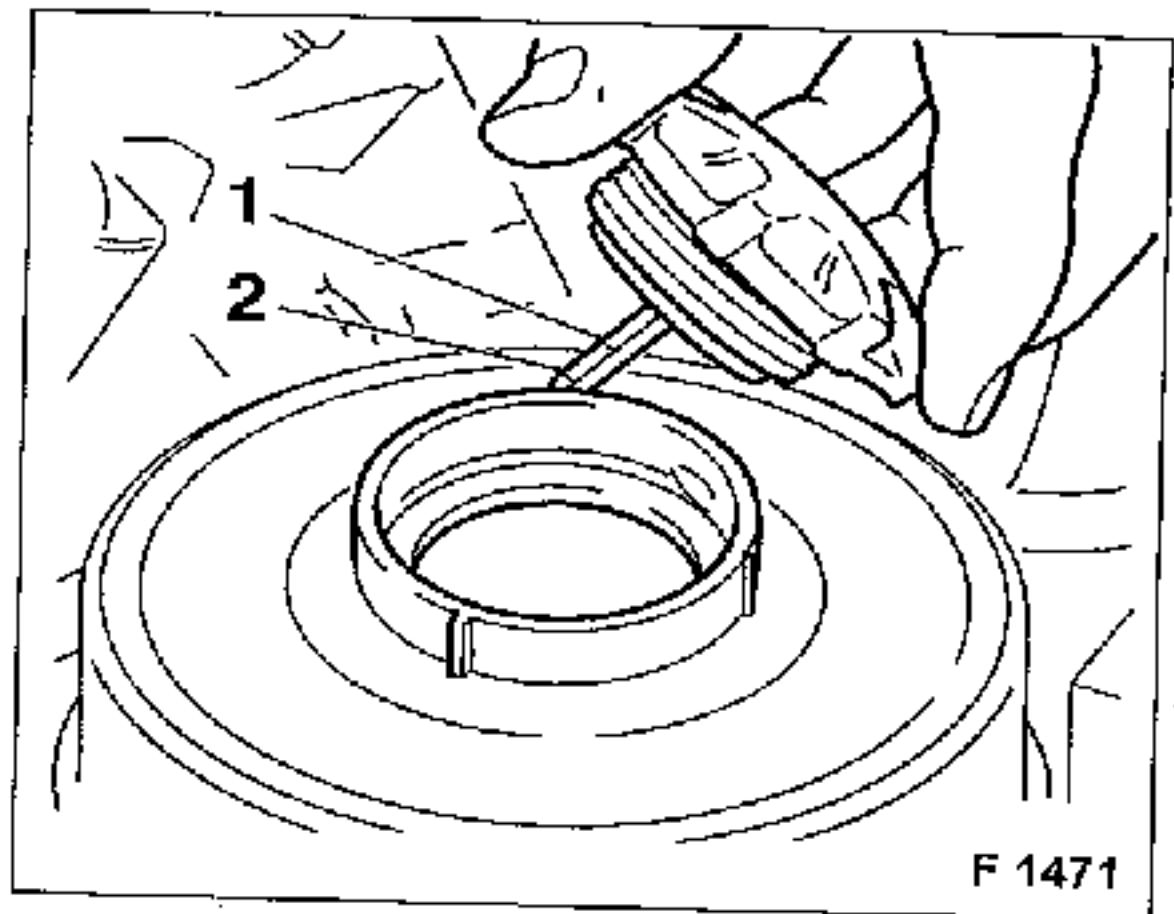


Close bypass bolt for 20 seconds and open again.  
After a further 20 seconds, close bypass bolt (with 1.4 Nm/1 lbf. ft.).  
Switch off engine.  
Insert fuse F19 and switch on ignition.  
Actuate brakes approx. 25 times.

## Fluid level check:

Fluid at operating temperature  
(approx. 80 °C/176 °F)  
to mark "MAX" (1)

Fluid cold (approx. 20 °C/68 °F)  
to mark "MIN" (2)



# GROUP J

## DOUBLE OVERHEAD CAM ENGINE

### ENGINE TIMING SIDE, AIR CLEANER HOUSING

#### TABLE OF CONTENTS

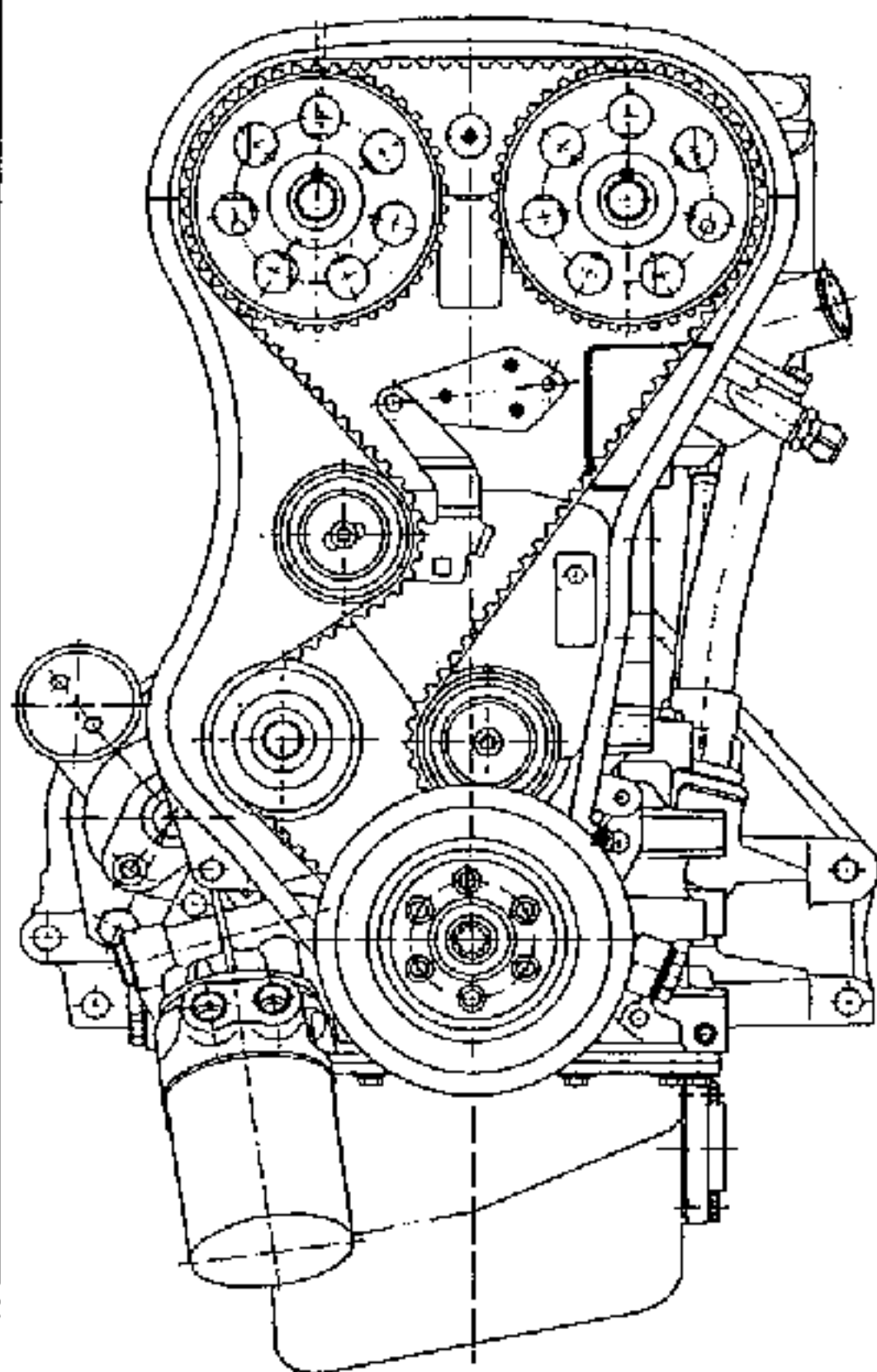
	PAGE
General Arrangement Illustrations <sup>1</sup> .....	J - 284
Ribbed V-belt, Replace (Engines as of MY '93, with Power Steering and A/C).....	J - 286
Ribbed V-belt Tension Roller, Replace (with Power Steering and A/C).....	J - 287
Engine Accessories Bracket, Replace (with Power Steering and A/C).....	J - 288
Toothed Belt, Replace (Engines up to MY '93).....	J - 291
Toothed Belt, Replace (Engines as of MY '93).....	J - 295
Toothed Belt Tension Roller, Replace (Engines up to MY '93).....	J - 298
Toothed Belt Tension Roller, Replace (Engines as of MY '93).....	J - 298
Toothed Belt Guide Roller, Replace (Engines up to MY '93).....	J - 299
Toothed Belt Guide Roller, Replace (Engines as of MY '93).....	J - 299
Rear Toothed Belt Cover, Remove & Install.....	J - 300
Air Cleaner Housing, Remove and Install (C 20 XE Engine).....	J - 303
Air Cleaner Housing, Remove and Install (C 20 LET Engine).....	J - 303
Recommended Torque Values.....	J - 304



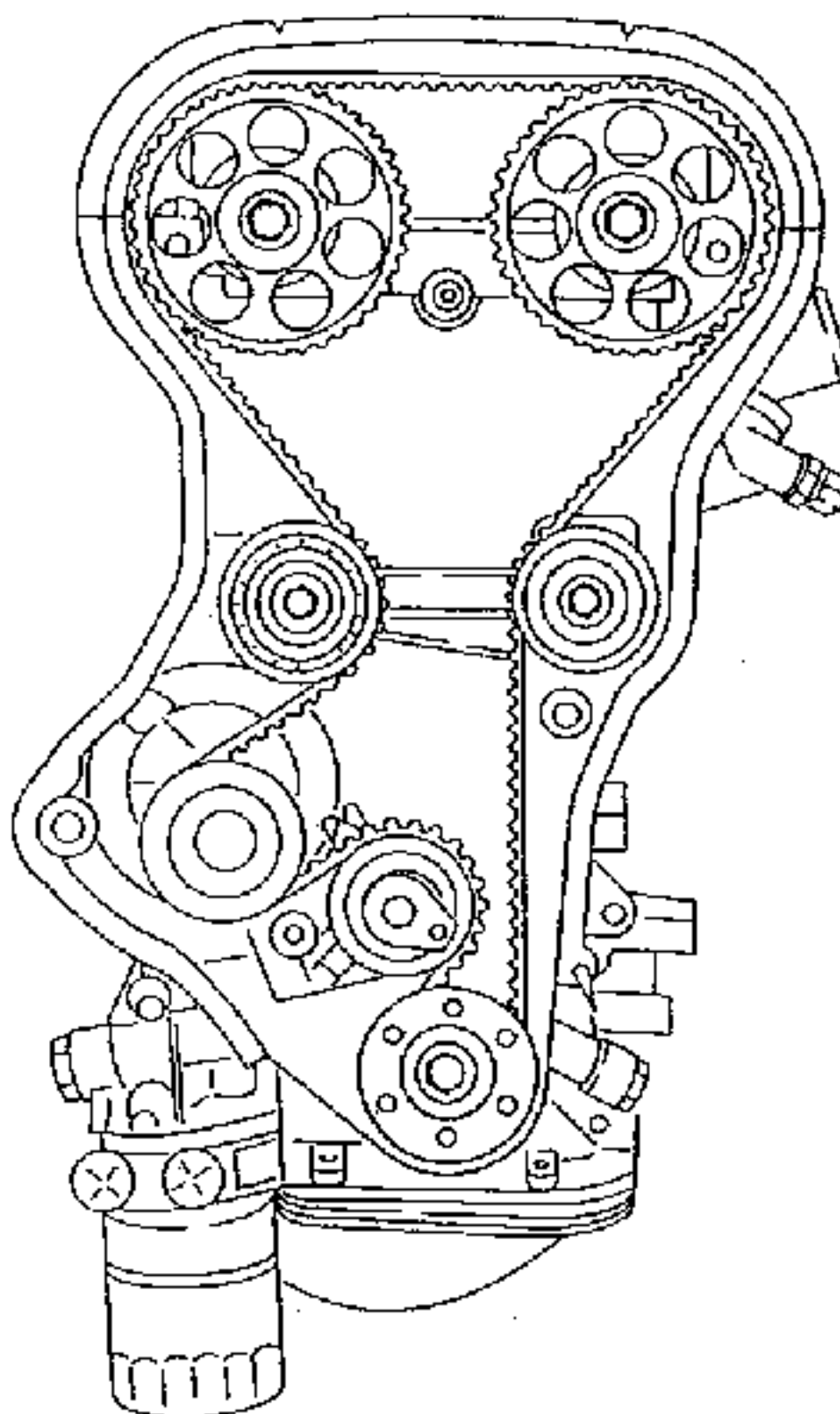
# DOHC ENGINE - ENGINE TIMING SIDE/AIR CLEANER

## ENGINE TIMING SIDE

Engine Timing -  
C 20 XE (Up to MY'93)



Engine Timing -  
C 20 XE and C 20 LET (As of MY'93)

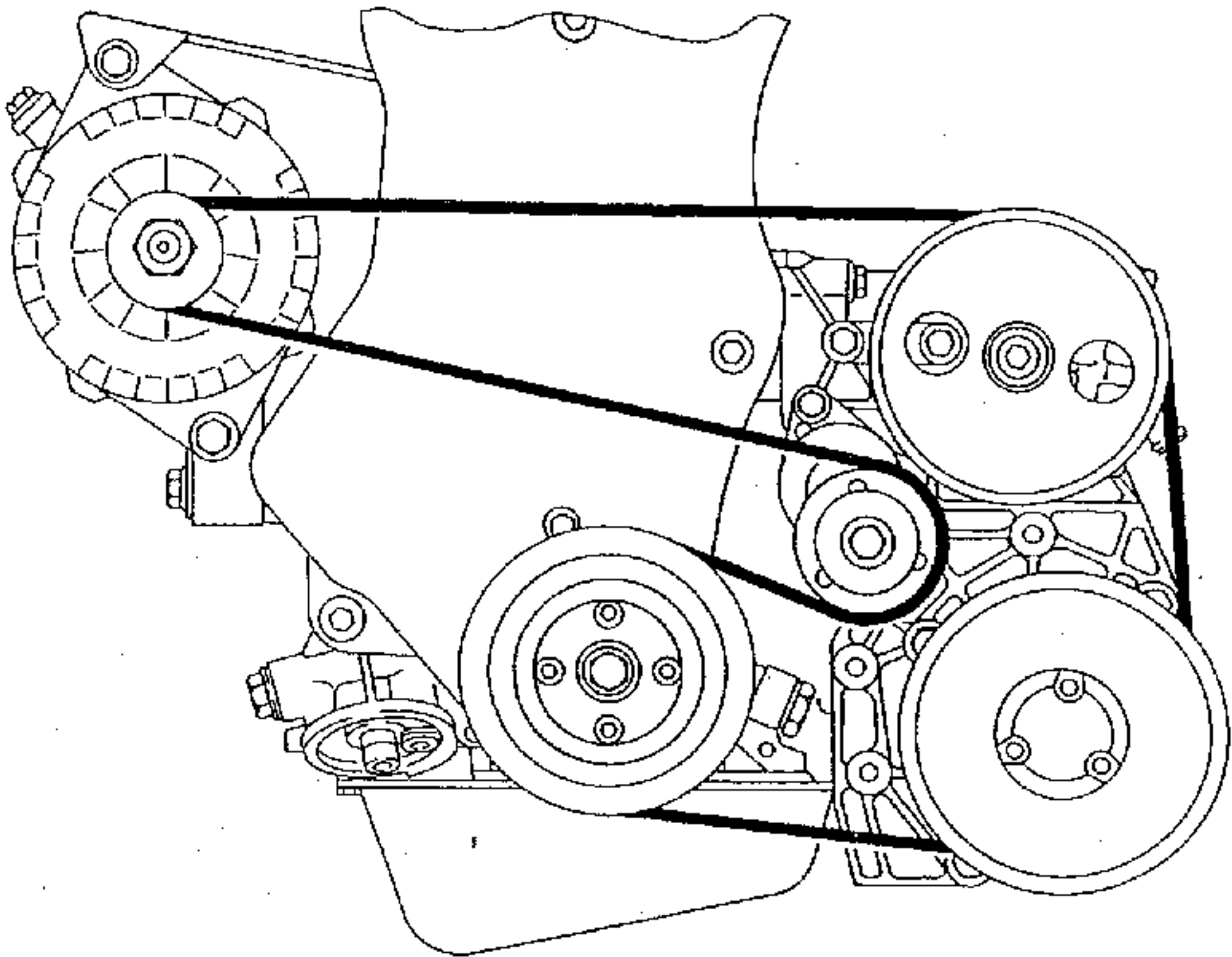


## 2 litre DOHC Engines

### Important!

As the toothed belt, tooth profile also changed with the introduction of the automatic toothed belt tension roller from MY'93, the new belt will not service back to earlier engines unless all toothed belt gears are also changed. The tooth profile changed from a 'curvilinear' to a 'modified curvilinear' design.

# DOHC ENGINE - ENGINE TIMING SIDE/AIR CLEANER



D 8128

C 20 XE and C 20 LET - Ribbed V-belt Routing with Power Steering and Air Conditioning

# DOHC ENGINE - ENGINE TIMING SIDE/AIR CLEANER

**Ribbed V-belt, Replace (Engines as of MY '93, with Power Steering and A/C)**

## **Remove, Disconnect**

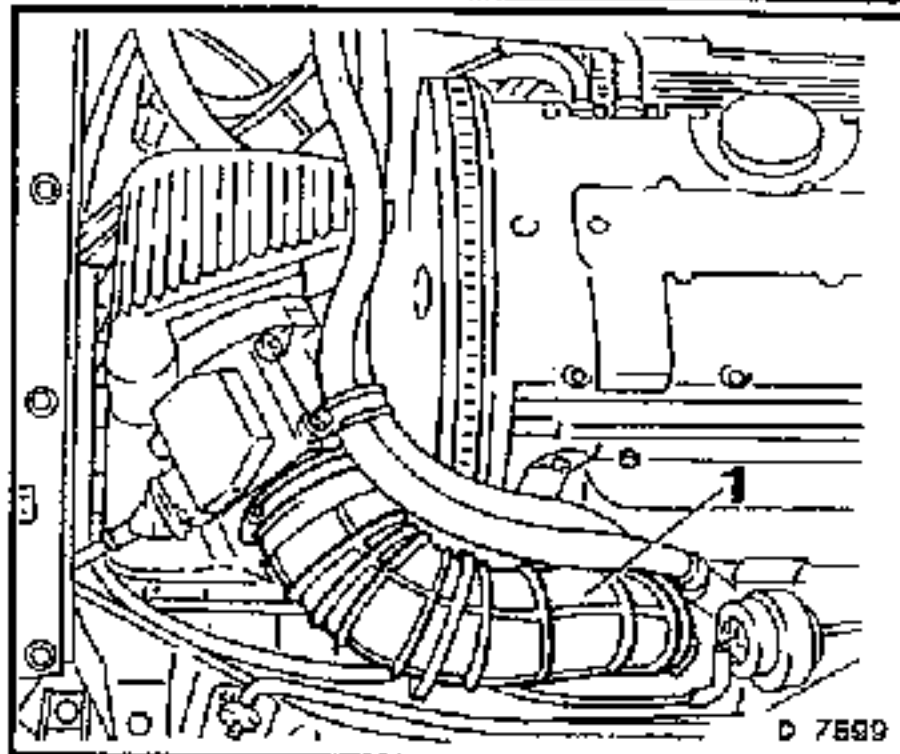
C 20 XE:

Air intake hose from air cleaner, engine compartment cover.

C 20 LET:

Air intake hose (1) between hot wire mass air flow meter and turbocharger.

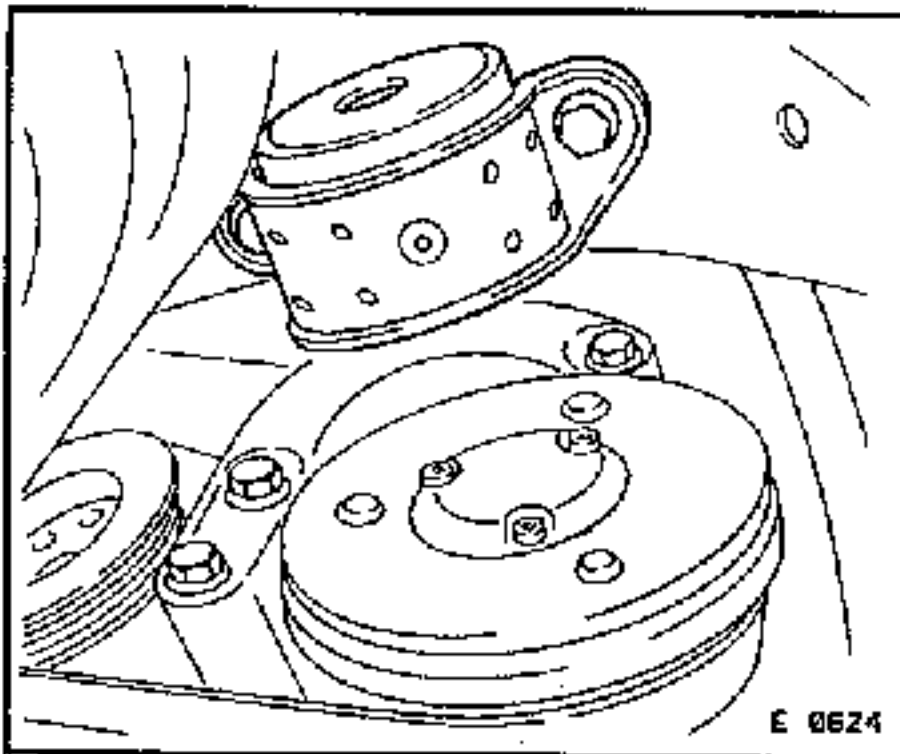
Attach engine to Engine Holder KM-263-B.



## **Remove, Disconnect**

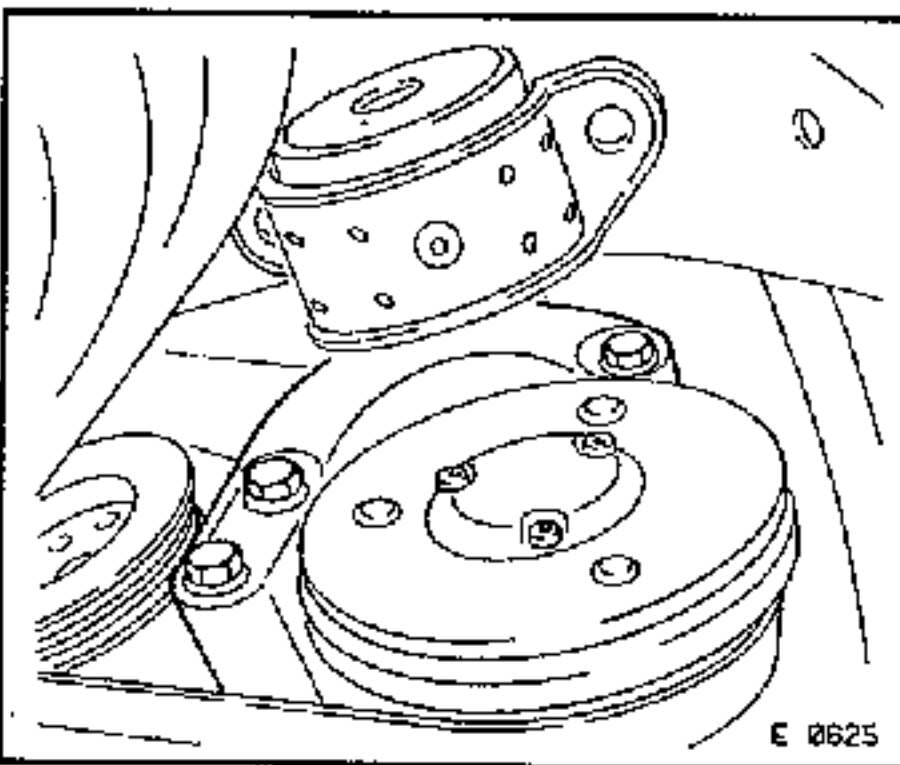
Right engine damping block from side member. Slowly lower engine.

Detach panelling from wheel housing.



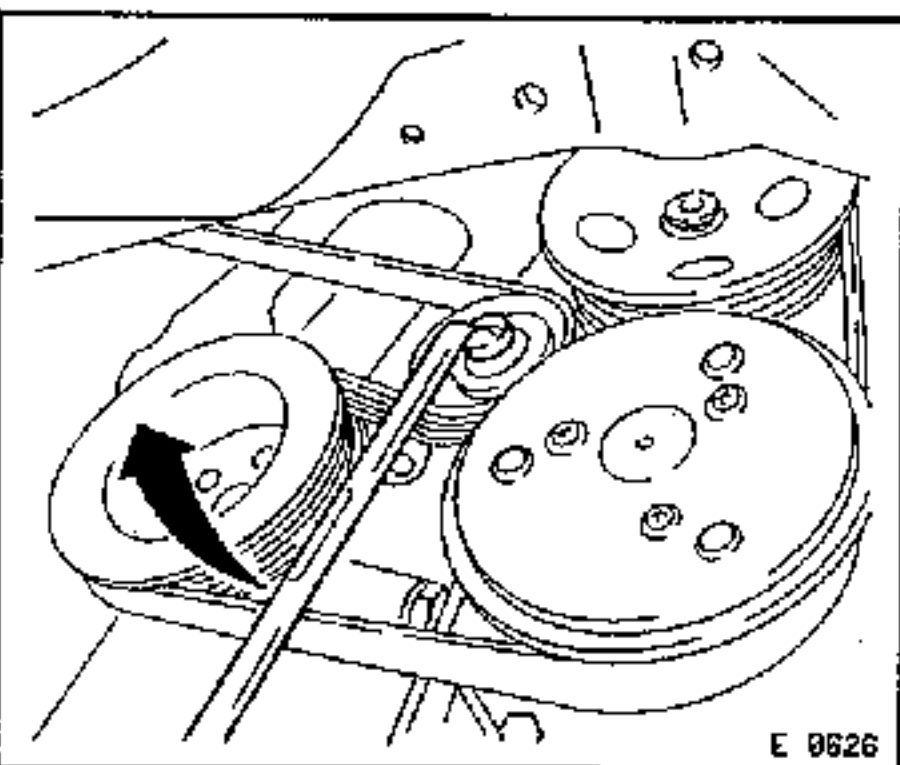
## **Remove, Disconnect**

Engine damping block bracket from power steering pump/compressor support.



## **Remove, Disconnect**

Release V-belt via ribbed V-belt- tension roller in direction of arrow and remove ribbed V-belt.



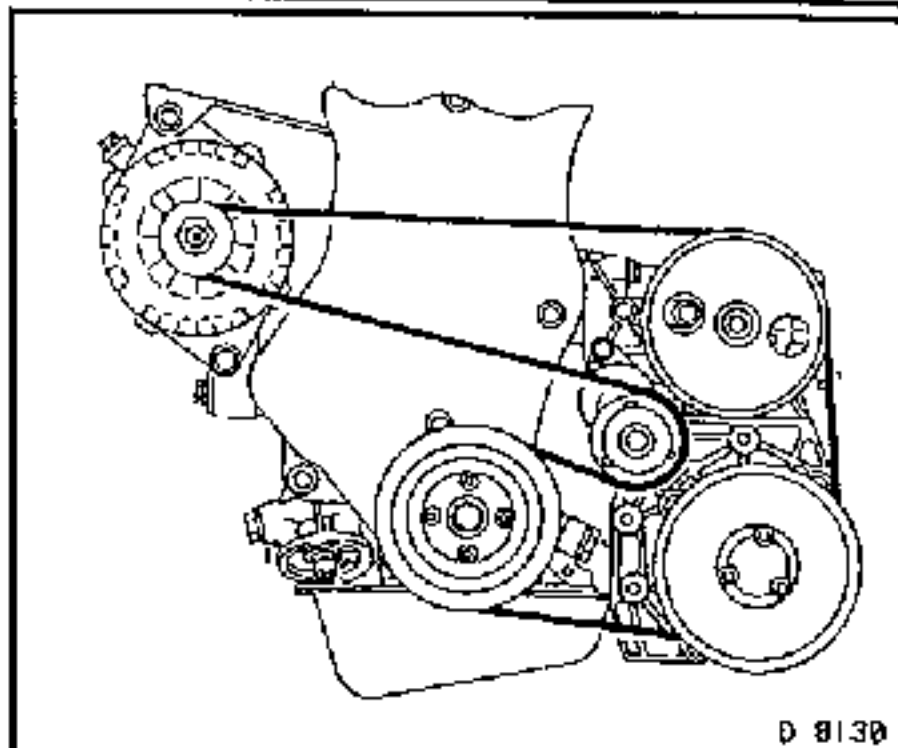
# DOHC ENGINE - ENGINE TIMING SIDE/AIR CLEANER

## Install, Connect

Install ribbed V-belt. Tension ribbed V-belt via ribbed V-belt tension roller.

Note ribbed V-belt routing.

The ribbed V-belt is automatically tensioned by the ribbed V-belt tension roller.



## Install, Connect

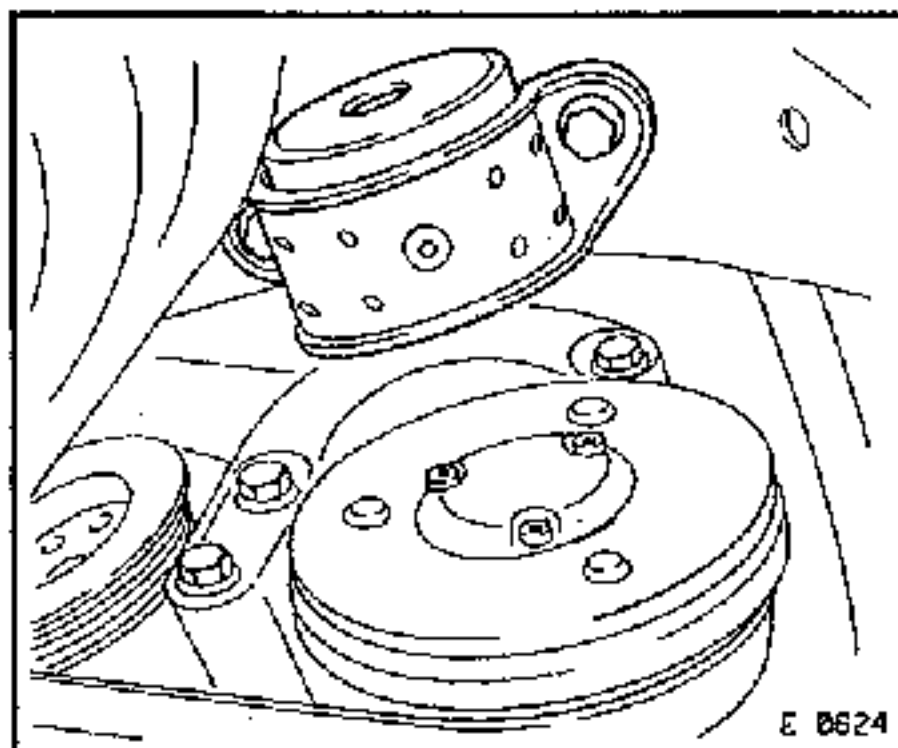
Engine damping block bracket, engine damping block to side member.

Paneling to wheel housing.

## Tighten (Torque)

Engine damping block bracket to  
P/S pump / A/C compressor support..... 60 Nm  
Engine damping block to side member..... 65 Nm \*

\* Clean threads and install with sealing compound to Holden's Specification HN1256 - Loctite 242 or equivalent.



## Install, Connect

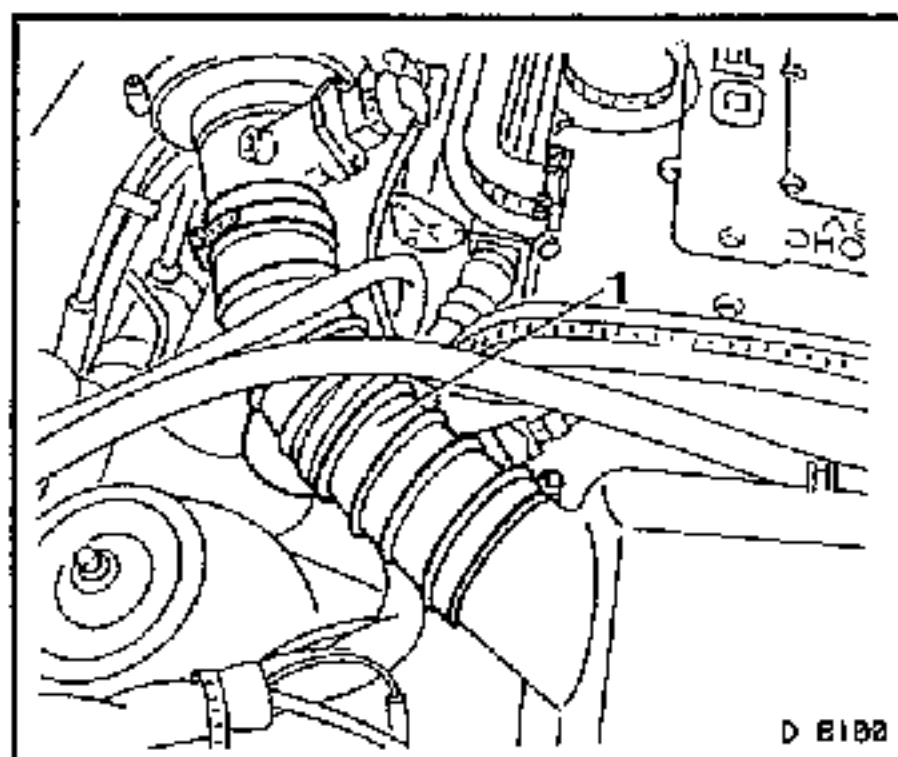
Remove Engine Holder KM-263-B.

C 20 XE:

Engine compartment cover, air intake hose (1) to air cleaner.

C 20 LET:

Air intake hose to hot wire mass air flow meter or to turbocharger.



## Ribbed V-belt Tension Roller, Replace (with Power Steering and A/C)

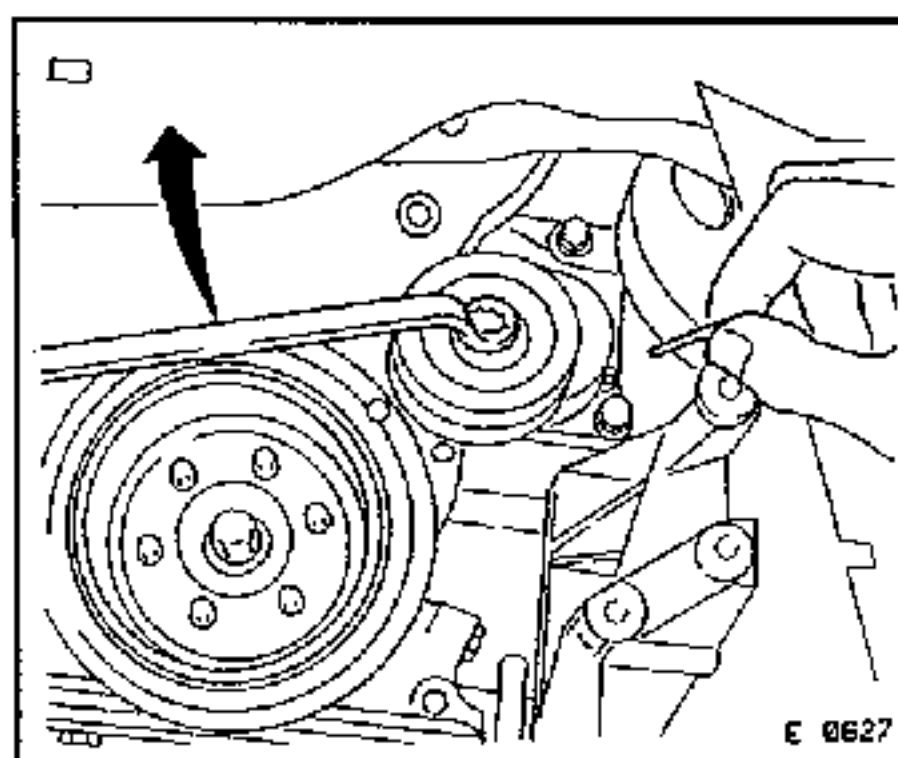
### Note:

This operation is described for an engine with power steering but the procedure is similar for engines fitted with power steering and air conditioning.

## Remove, Disconnect

Ribbed V-belt - see previous operation in this Section.

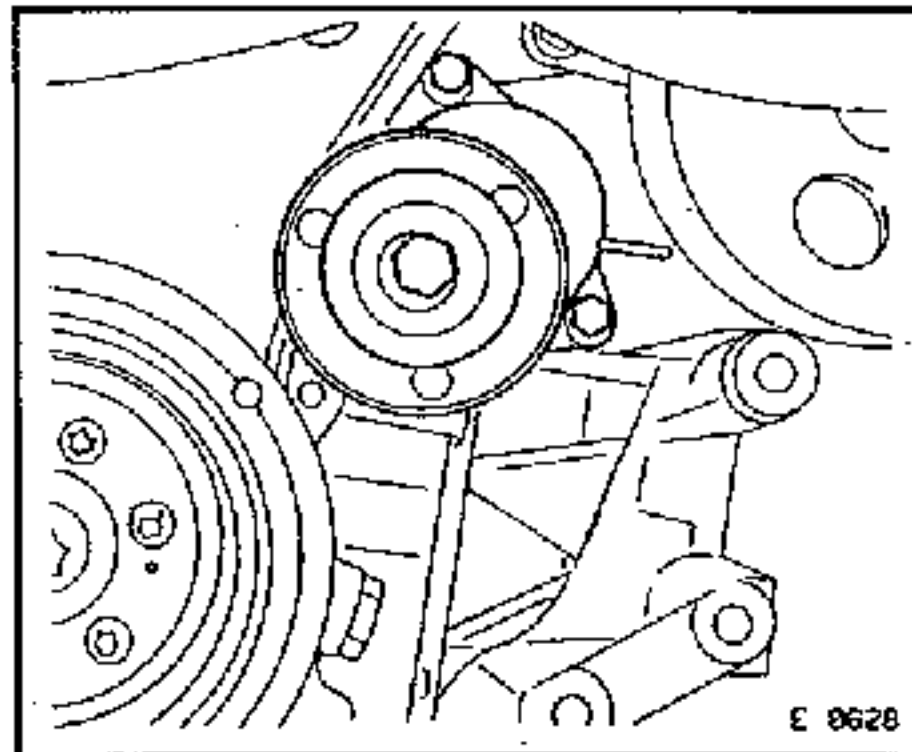
Tension ribbed V-belt-tension roller in direction of arrow using ring spanner and insert retaining pin in special opening.



# DOHC ENGINE - ENGINE TIMING SIDE/AIR CLEANER

## Remove, Disconnect

Ribbed V-belt- tension roller from support.



## Install, Connect

New ribbed V-belt tension roller with retaining pin to support.

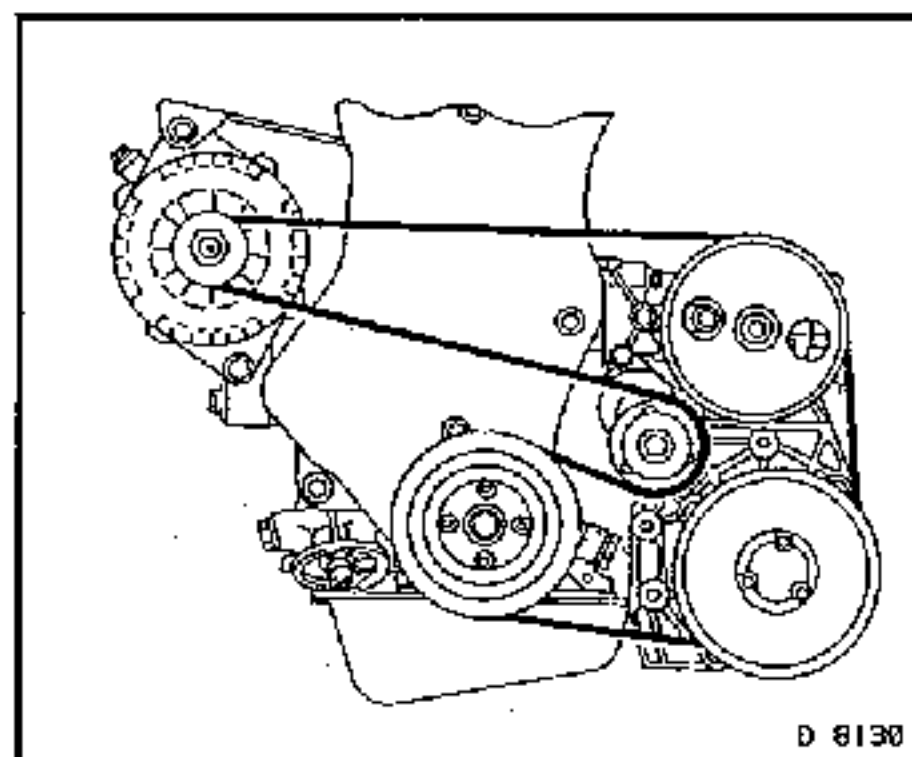
## Tighten (Torque)

Ribbed V-belt tension roller to support... 18 Nm

## Install, Connect

Install ribbed V- belt. Tension ribbed V-belt tension roller and remove retaining pin.

Ribbed V-belt - see previous operation in this Section.



## Engine Accessories Bracket, Replace (With Power Steering & A/C)

### Note:

The following describes the bracket removal procedure without disconnecting either the hydraulic or the air conditioning systems.

## Remove, Disconnect

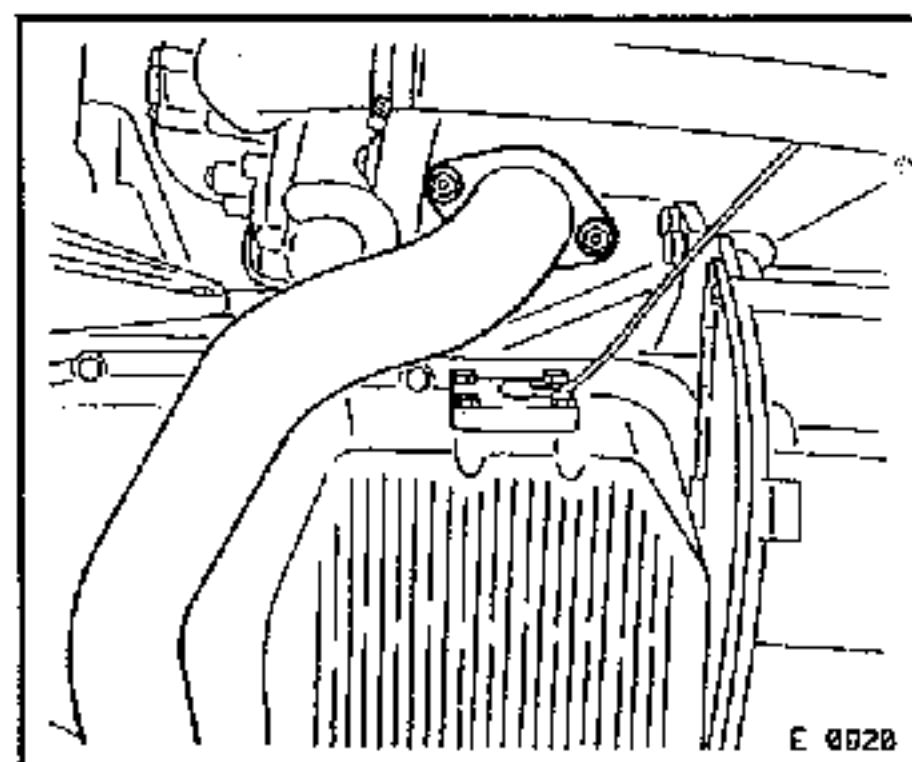
Ground cable from battery.

C 20 XE:

Performance header - refer to operation in the Section "Cylinder Head" in this Volume.

C 20 LET:

Front exhaust pipe.

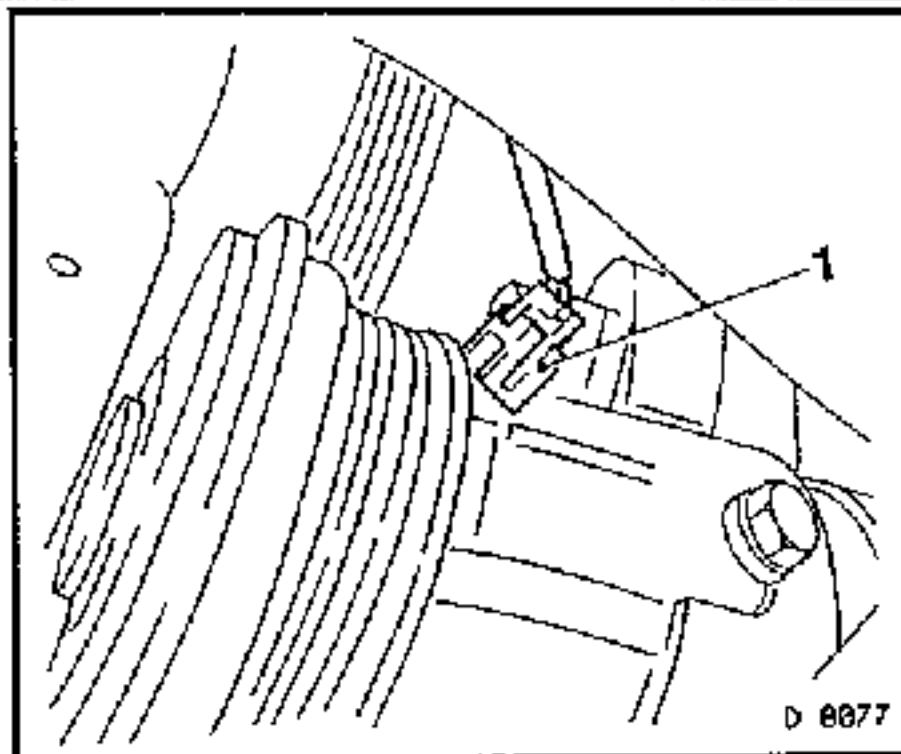


# DOHC ENGINE - ENGINE TIMING SIDE/AIR CLEANER

## Remove, Disconnect

Ribbed V-belt in conjunction with power steering and A/C. Refer "Ribbed V-belt Replace", in this Section.

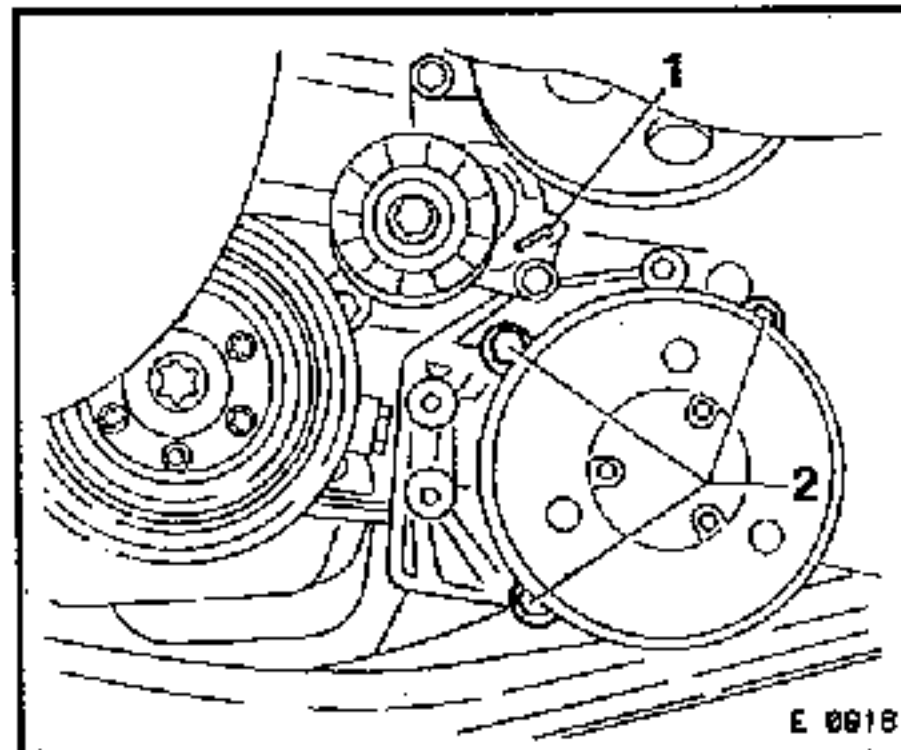
Wiring harness plug (1) from A/C compressor.



## Remove, Disconnect

Insert retaining pin (1) in ribbed V-belt tension roller.

Front fastening bolts (2) from A/C compressor.



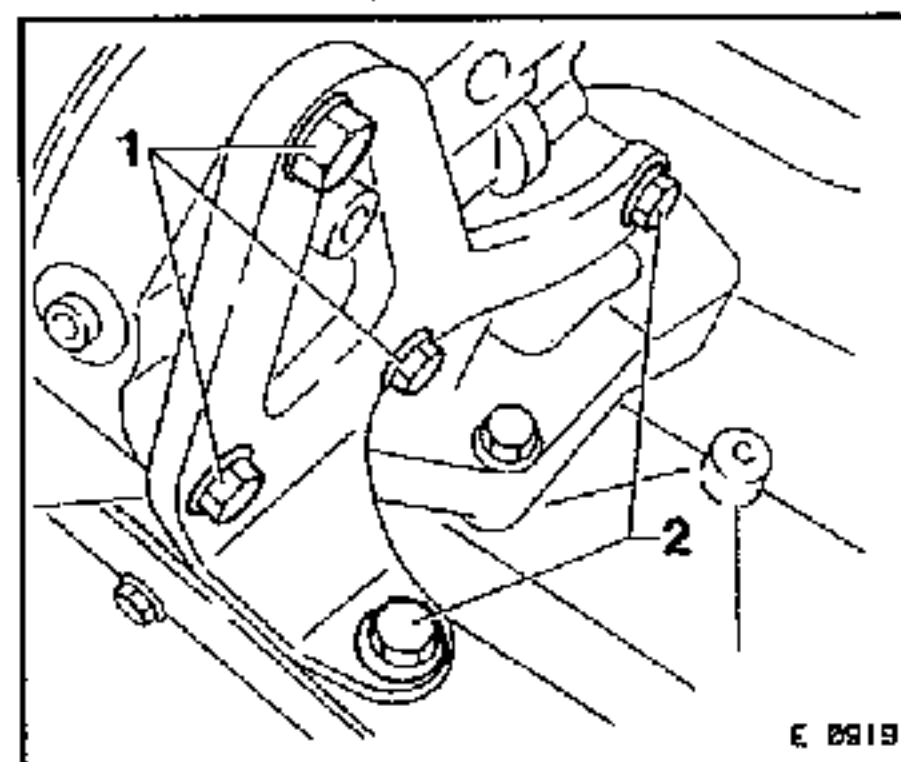
## Remove, Disconnect

Rear fastening bolts (1) from A/C compressor.

Bracket fastening bolts (2) from support or from cylinder block.

**Note:**  
The different bolt lengths.

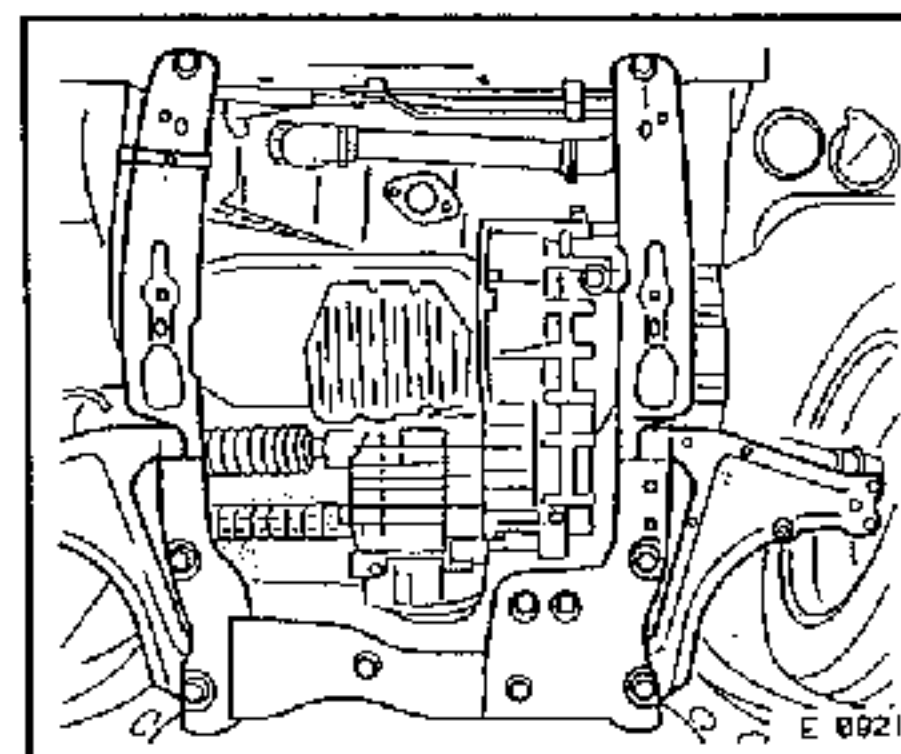
Place A/C compressor on front axle body.



## Remove, Disconnect

Front axle body - see group E, in Volume 1 of these Service Instructions for details.

**Note:**  
When the front axle body is lowered, check that the refrigerant lines are not under tension - support A/C compressor or detach.

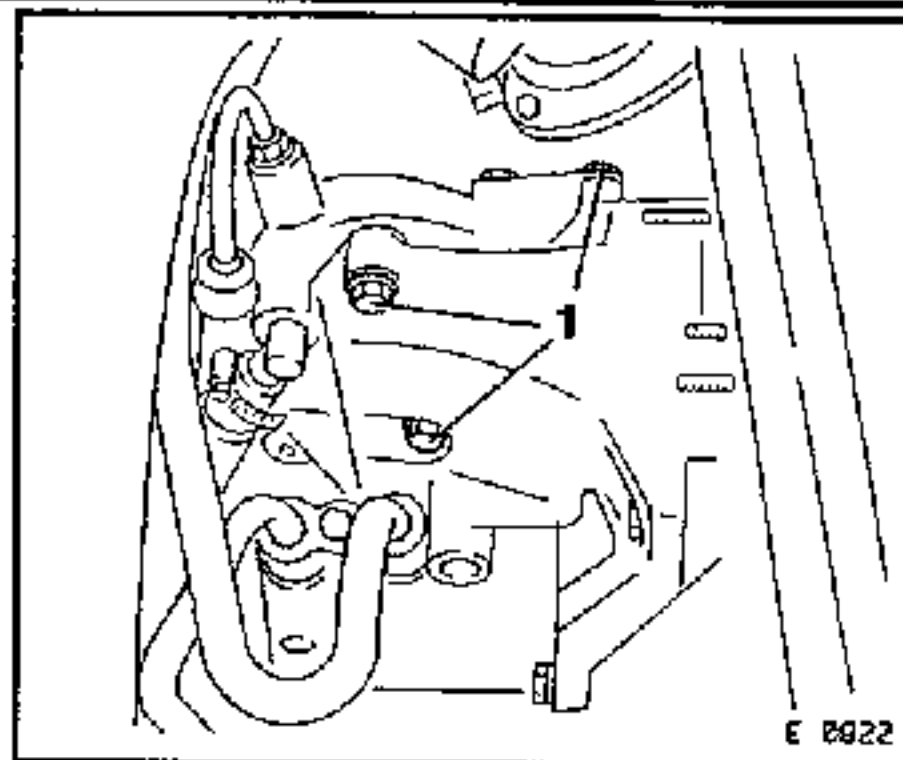


# DOHC ENGINE - ENGINE TIMING SIDE/AIR CLEANER

## Remove, Disconnect

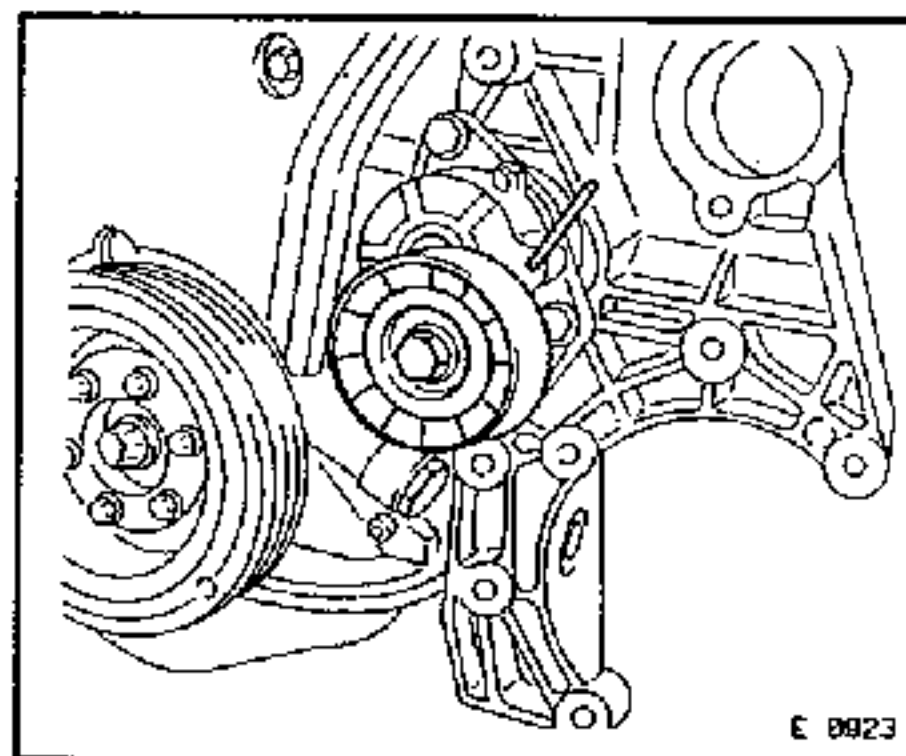
Fastening bolts (1) from the power steering pump.

Support power steering pump by tying to a suitable point, avoiding tension on the hydraulic hoses.



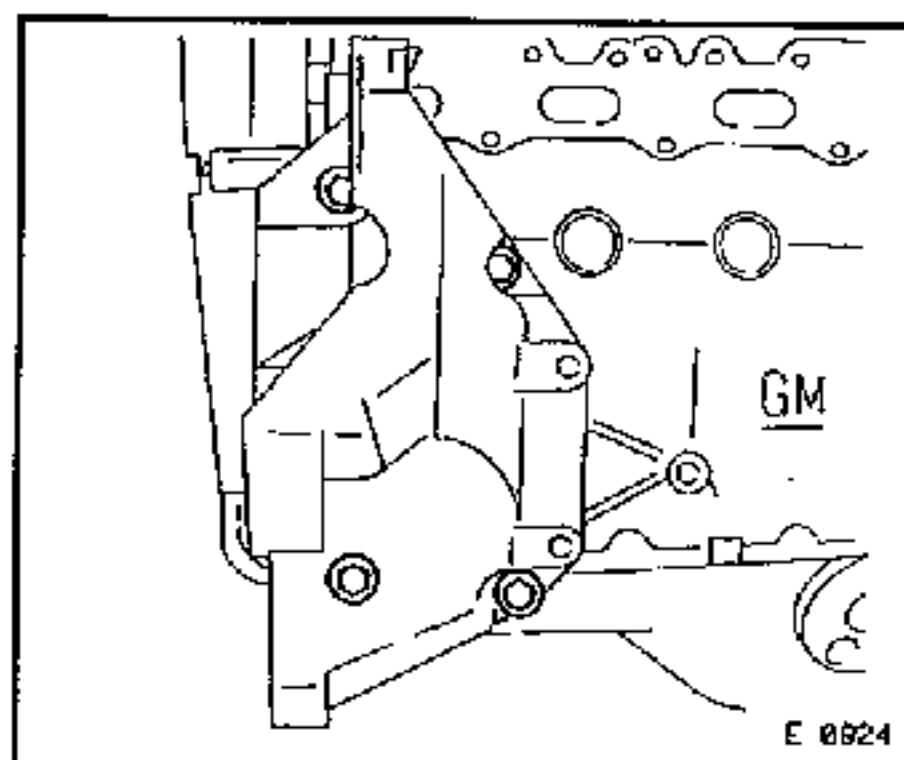
## Remove, Disconnect

Ribbed V-belt tension roller from the support.



## Remove, Disconnect

Support from cylinder block. Remove from below the vehicle.



## Install, Connect

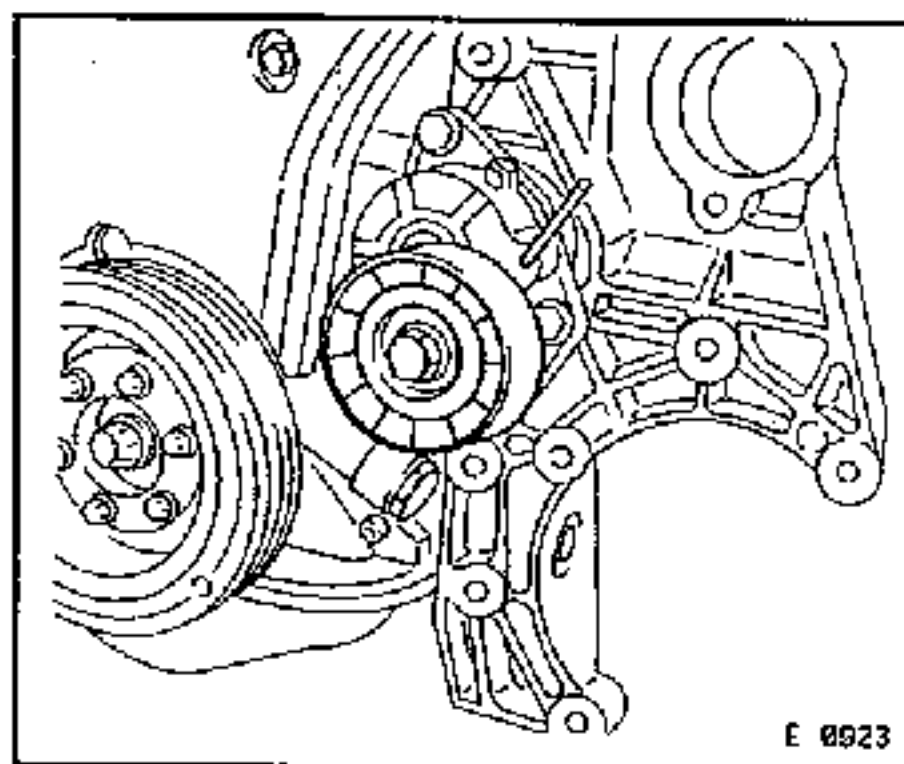
The support and the V-belt tension roller.

C 20 LET:

Before installing support - insert upper fastening bolt for the power steering hydraulic pump.

## Tighten (Torque)

Support to cylinder block .....	35 Nm
Ribbed V-belt tension roller to support ...	18 Nm





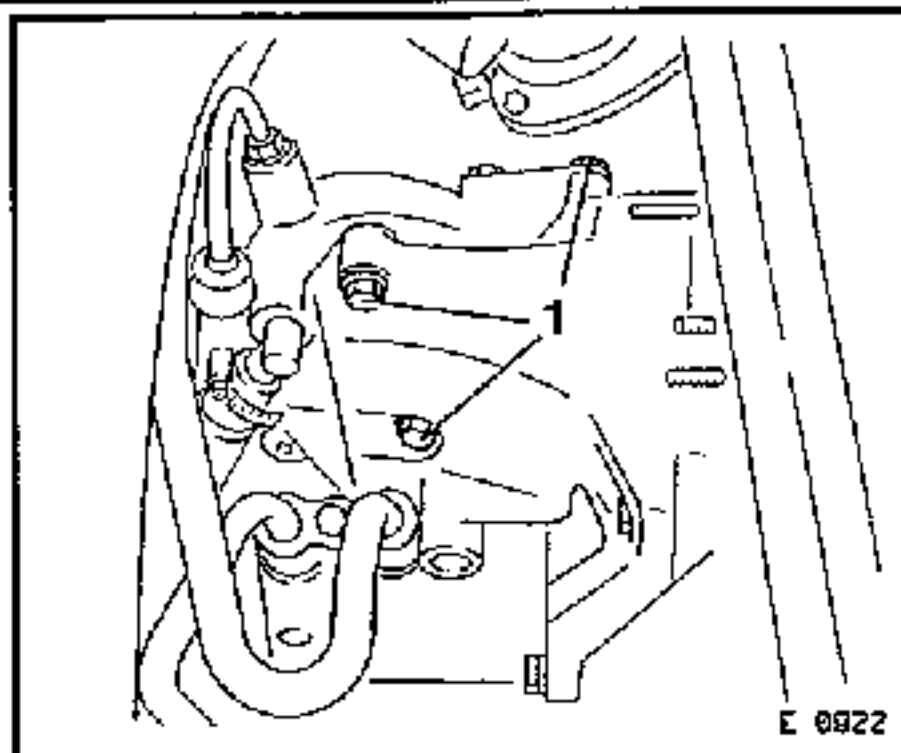
# DOHC ENGINE - ENGINE TIMING SIDE/AIR CLEANER

## Tighten (Torque)

Power steering pump to support ..... 25 Nm  
Shackle, power steering pump  
to support ..... 18 Nm

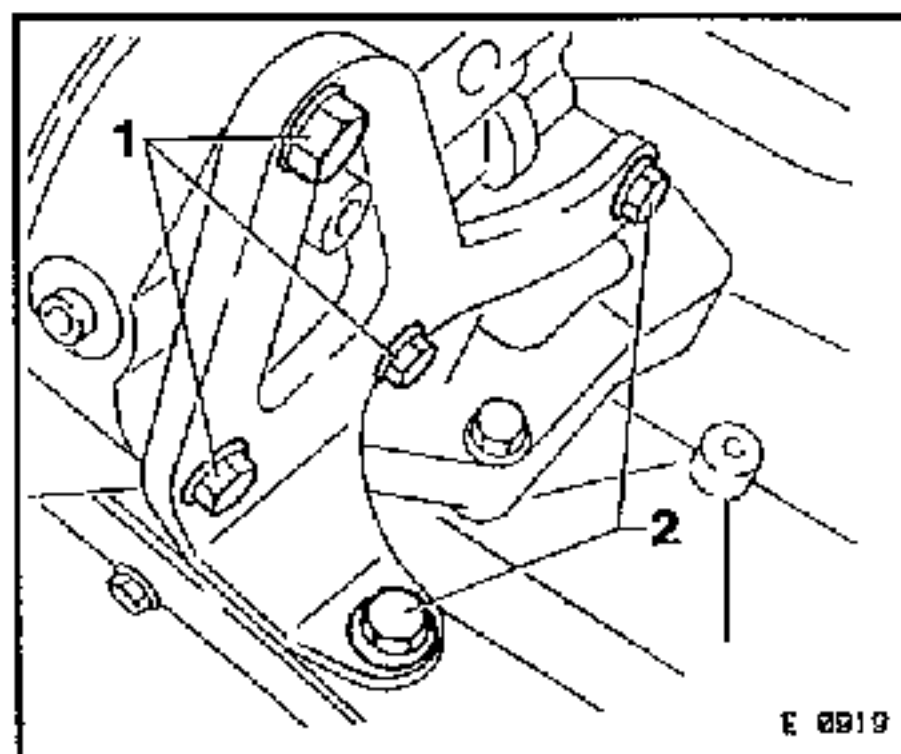
## Install, Connect

Front axle body - see group E, in Volume 1 of these  
Service Instructions for details.



## Tighten (Torque)

Bolts (1) to A/C compressor ..... 20 Nm  
Bolts (2) to support or to  
cylinder block ..... 35 Nm  
A/C compressor to support ..... 35 Nm



## Install, Connect

Wiring harness plug to A/C compressor

Ribbed V-belt in conjunction with power steering and  
A/C. Refer "Ribbed V-belt Replace", in this Section.

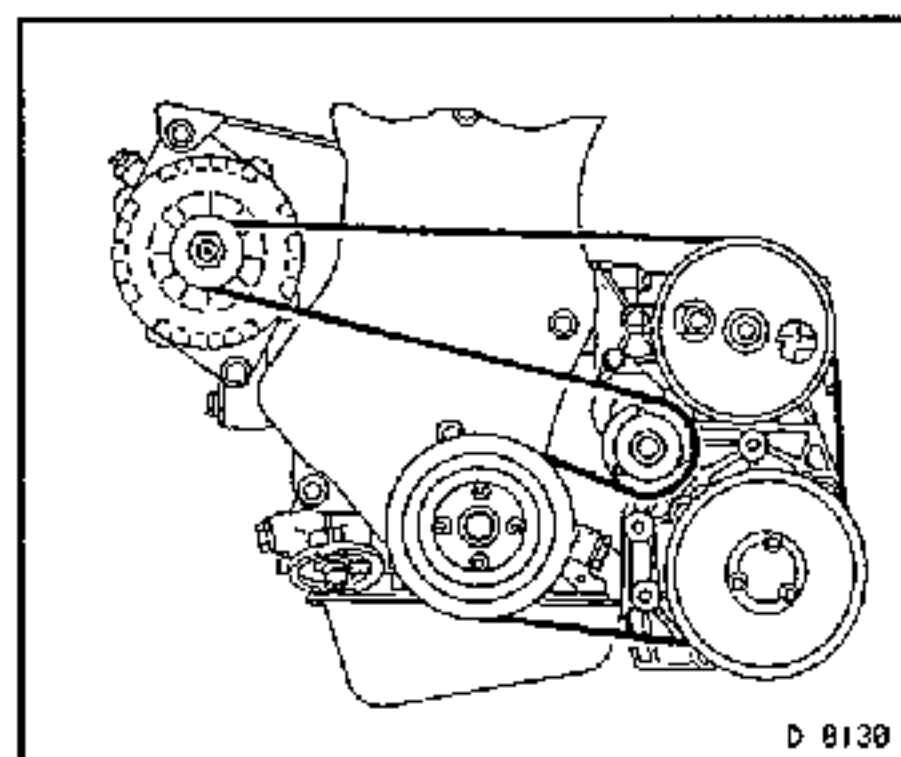
C 20 XE:

Performance header - refer to operation in the Section  
"Cylinder Head" in this Volume.

C 20 LET:

Front exhaust pipe.

Ground cable to battery.



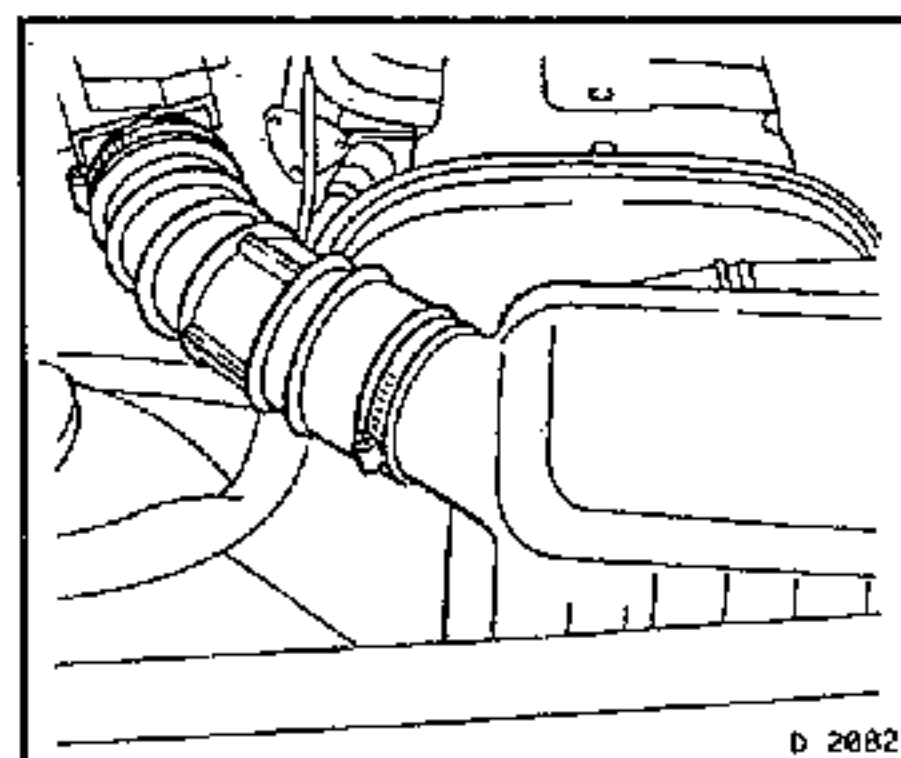
## Toothed Belt, Replace (Engines up to MY'93)

### Remove, Disconnect

Ground cable from battery.

Air intake hose.

Air cleaner housing. Refer to "Air Cleaner Housing,  
Remove and Install", at the end of this Section.



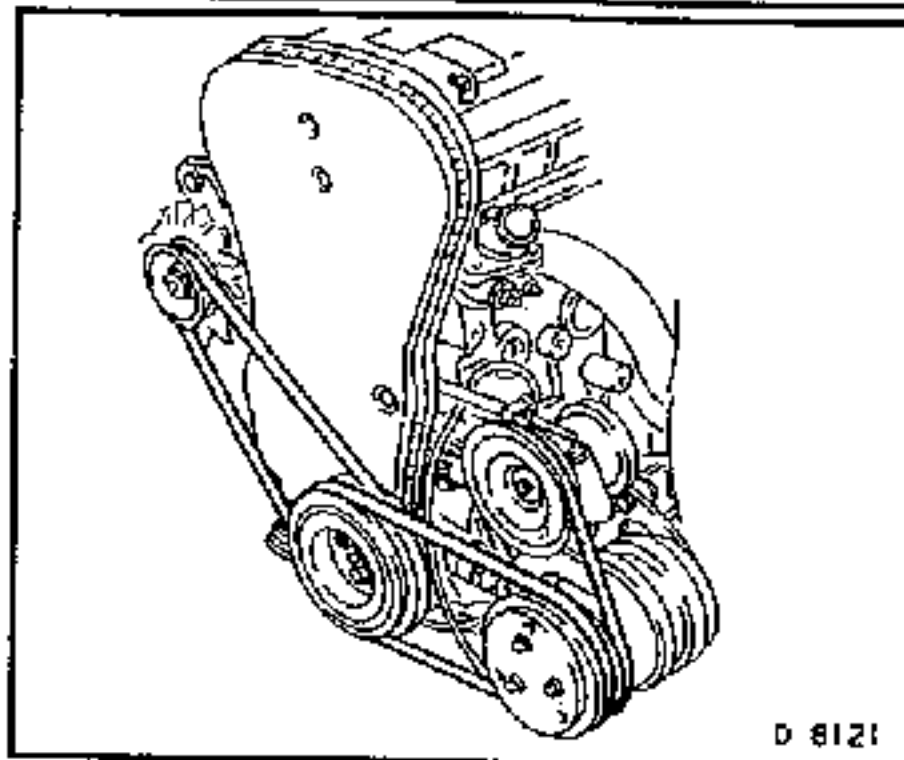


# DOHC ENGINE - ENGINE TIMING SIDE/AIR CLEANER

## Remove, Disconnect

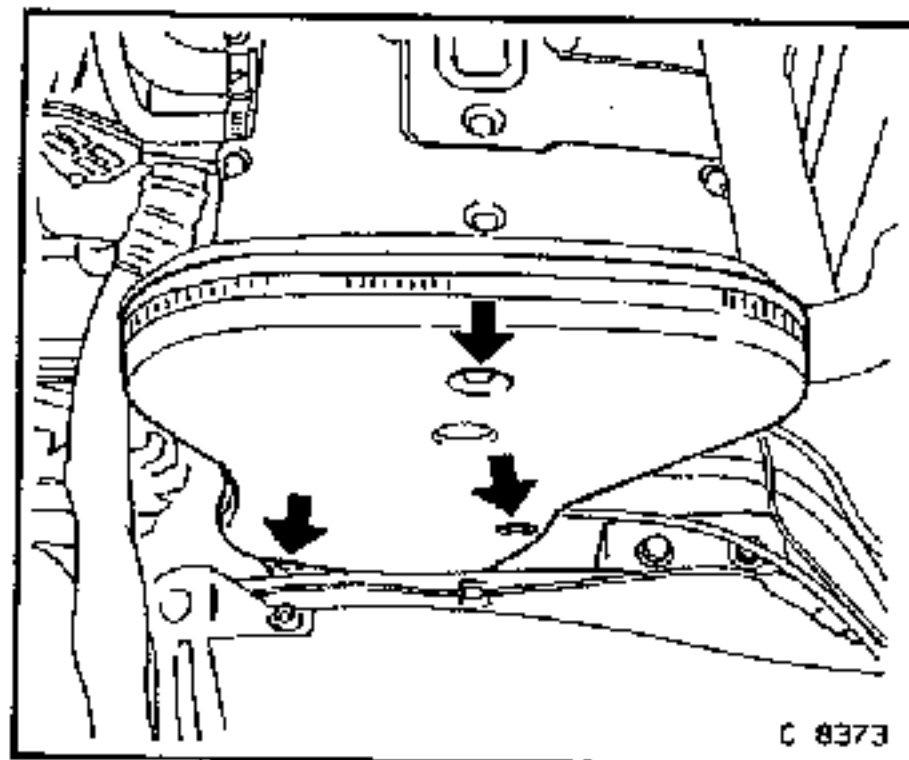
V-belts from alternator, A/C compressor and power steering pump.

Engine compartment cover.



## Remove, Disconnect

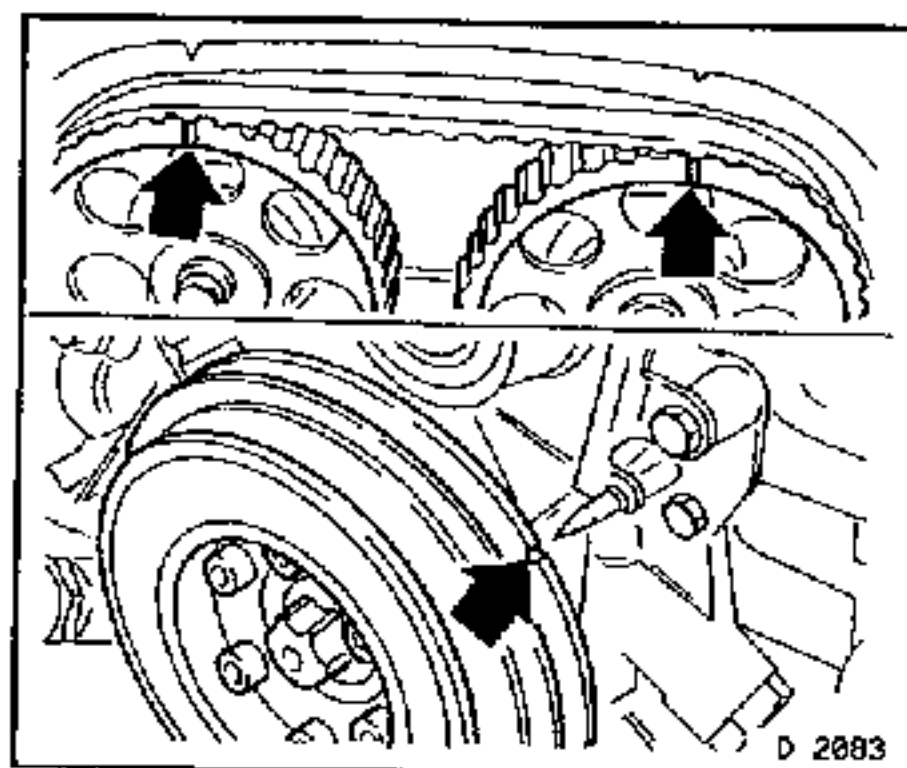
Front toothed belt cover (arrows).



## Inspect

Using MKM-604-21 (Torx E 20) at the fastening bolt for the crankshaft pulley, turn the crankshaft slowly and evenly until No. 1 piston is at the "TDC" position, as indicated by the pulley notch and pointer being aligned. The camshaft gears should then be aligned as shown.

See "Valve Timing, Check and Adjust", on page J-279 in this Volume for more detail.

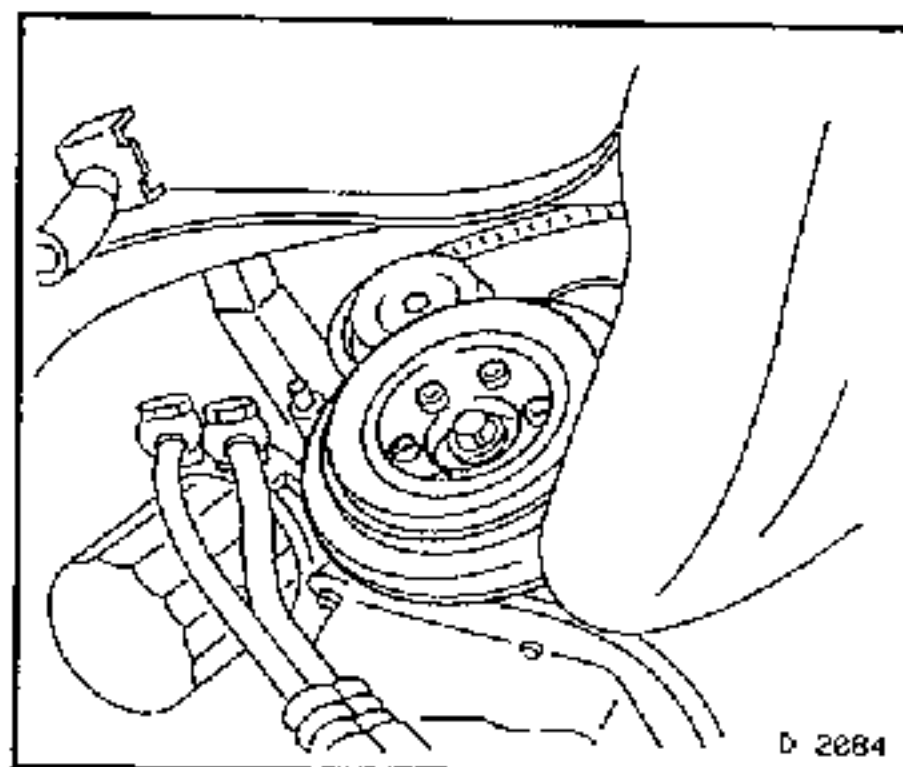


## Remove, Disconnect

Crankshaft pulley using KM-321-1. Use MKM-604-21 (Torx E 20) to hold the pulley.

## Important!

Before removing the crankshaft pulley, check that the crankshaft pulley and camshaft gear marks are all aligned.



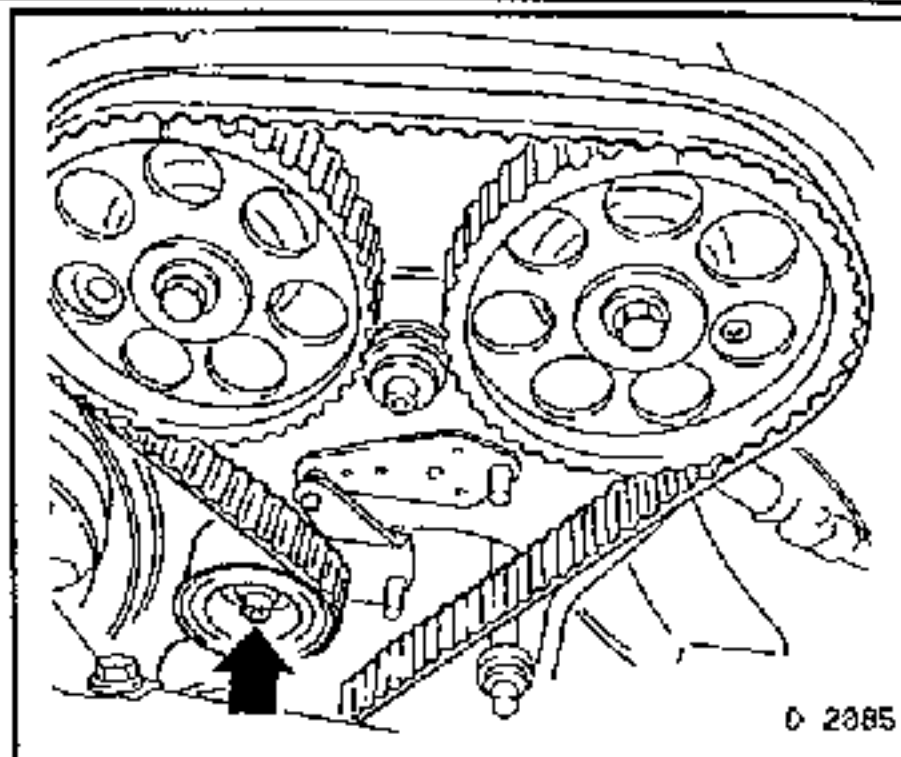
# DOHC ENGINE - ENGINE TIMING SIDE/AIR CLEANER

## Remove, Disconnect

Toothed belt tension roller (arrow) and remove toothed drive belt.

### Important!

Do not turn the crankshaft or camshaft/s when the toothed belt tension roller is released.



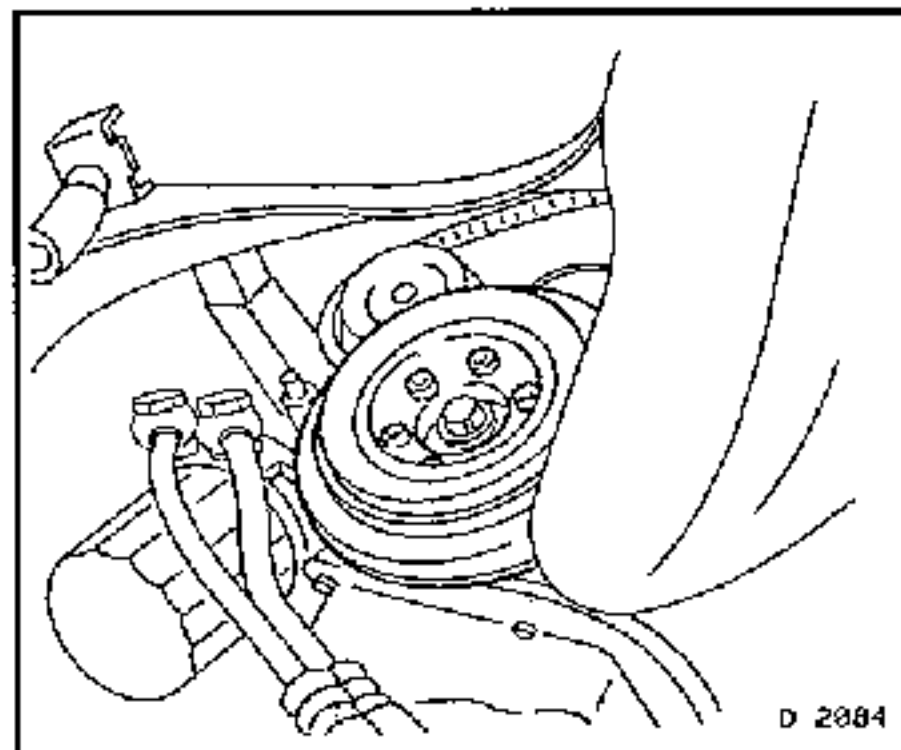
## Install, Connect

New toothed belt, with the tension side, tightened.

Crankshaft pulley using KM-321-A. Use MKM-604-21 (Torx E 20) on a fastening bolt of the toothed belt drive gear to hold while tightening.

### Tighten (Torque)

Crankshaft pulley to toothed belt drive gear..... 20 Nm



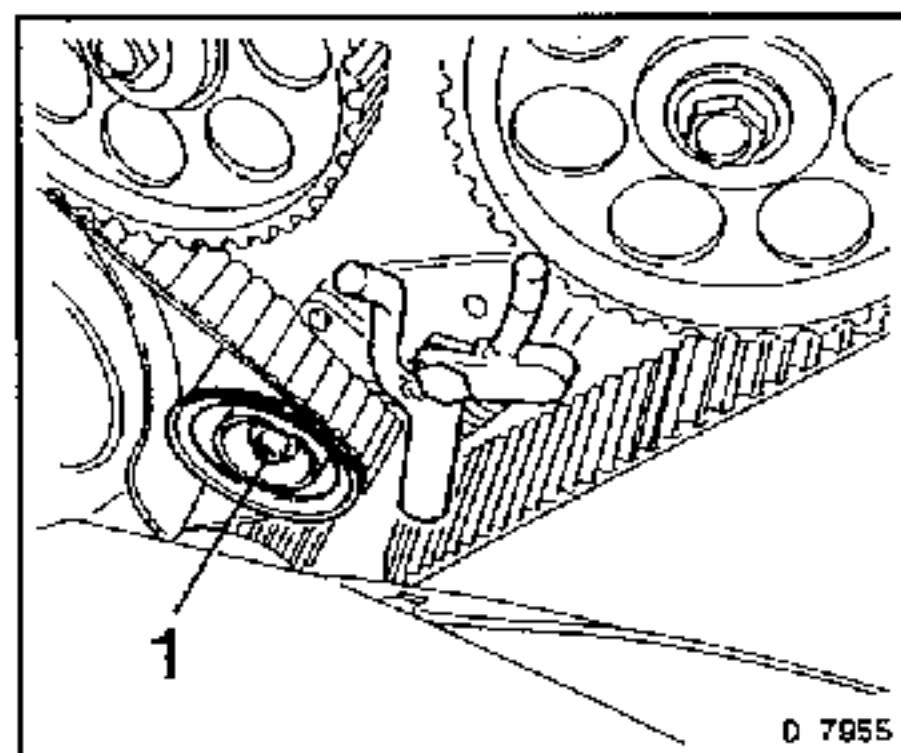
## Adjust

Toothed belt tension.

### Important!

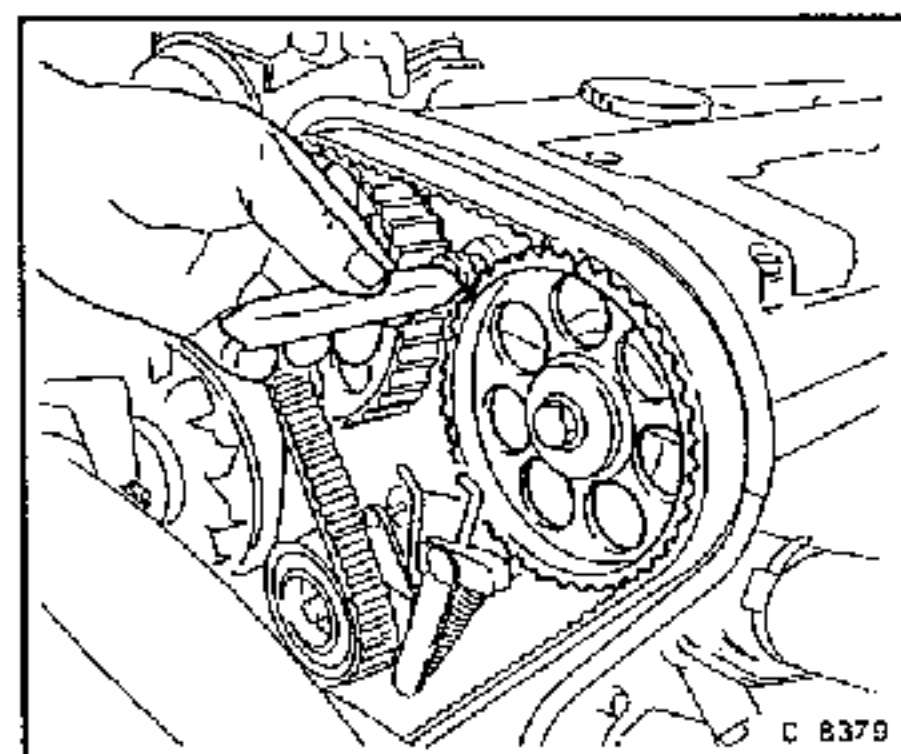
Adjust with then engine cold (ambient temperature).

Apply adjuster KM-666, with the fastening bolt (1) loosened.



## Adjust

Mark the 8th tooth on the camshaft pulley, anti-clockwise from the TDC mark.



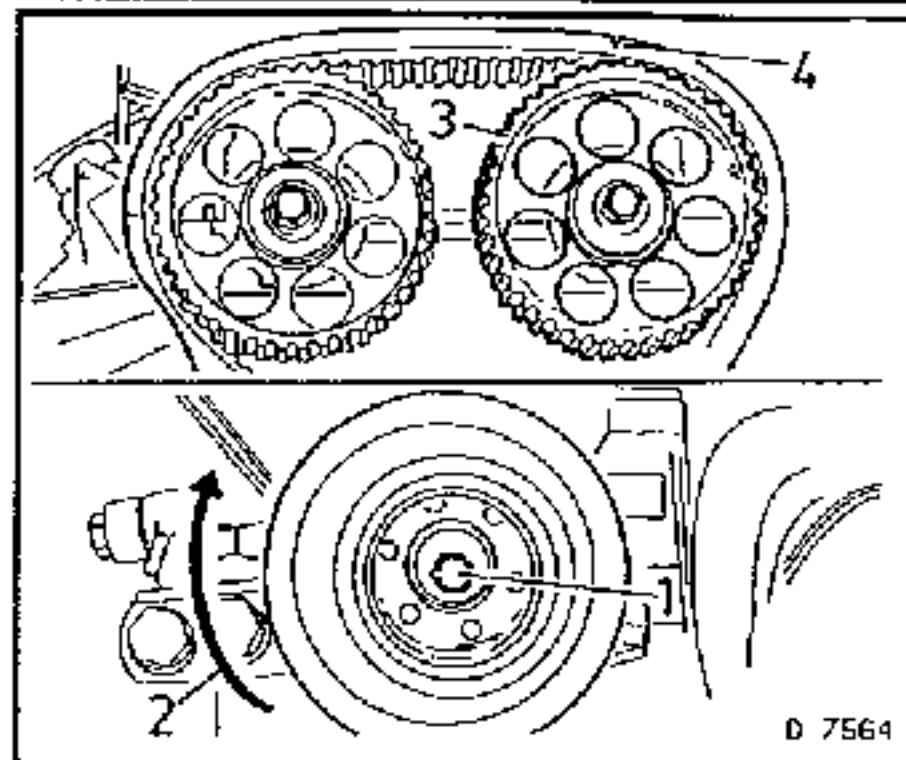
# DOHC ENGINE - ENGINE TIMING SIDE/AIR CLEANER

## Adjust

Using MKM-604-21 (Torx E 20) on the toothed belt drive gear (1), turn the crankshaft two turns in the direction of engine rotation (2), until the mark on the 8th tooth of the camshaft pulley (3) is aligned with the notch in the cylinder head cover (4).

## Important!

Turn the crankshaft slowly and smoothly. Otherwise the toothed belt may jump a tooth.



## Torque - Angle Method

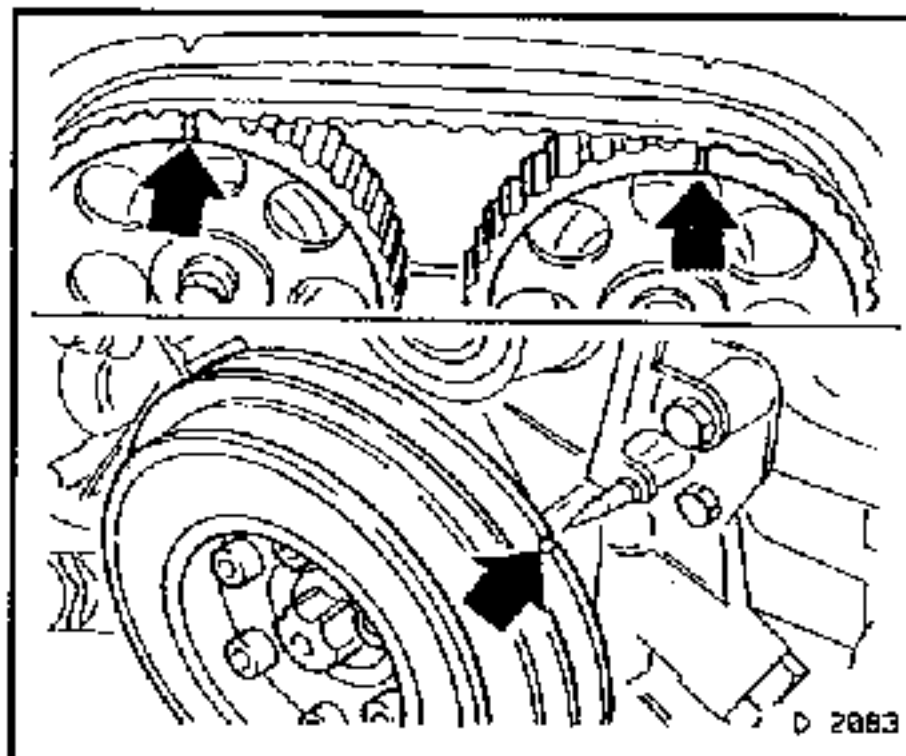
Toothed belt tension roller to cylinder block ..... 25 Nm + 45° +15°

## Important!

Use a new bolt.

Remove adjuster KM-666.

Turn camshaft pulleys in the direction of engine rotation until the TDC marks are lined up with the engine cover marks. The crankshaft pointer must then be aligned with the pointer (arrows).



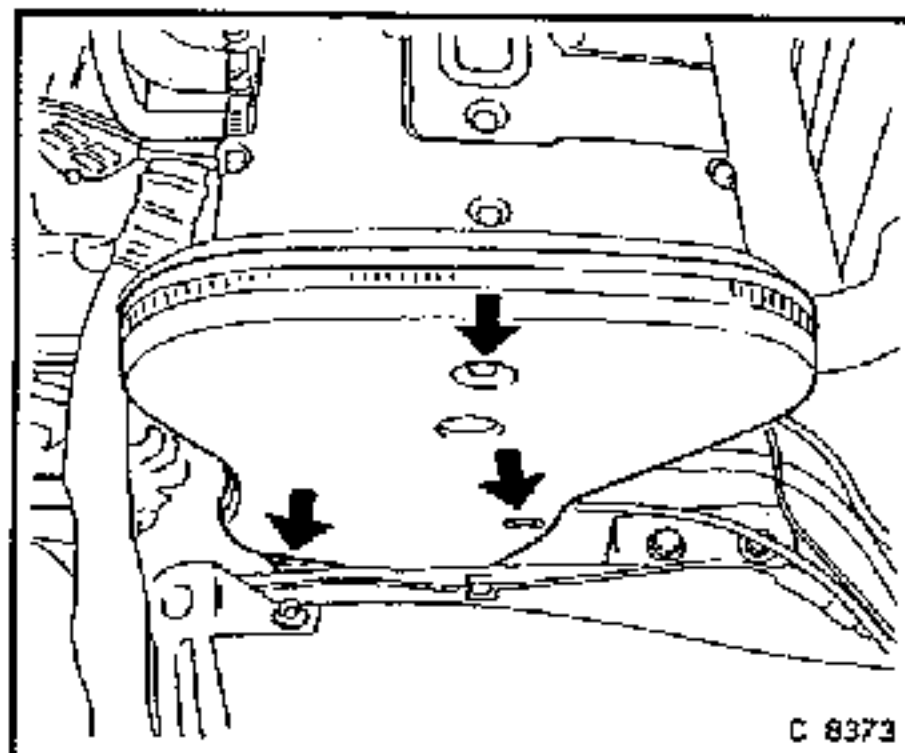
## Install, Connect

Front toothed belt cover.

## Tighten (Torque)

Front toothed belt cover bolts ..... 8 Nm

Make sure that the rubber grommets on the fastening studs are firmly seated in position.

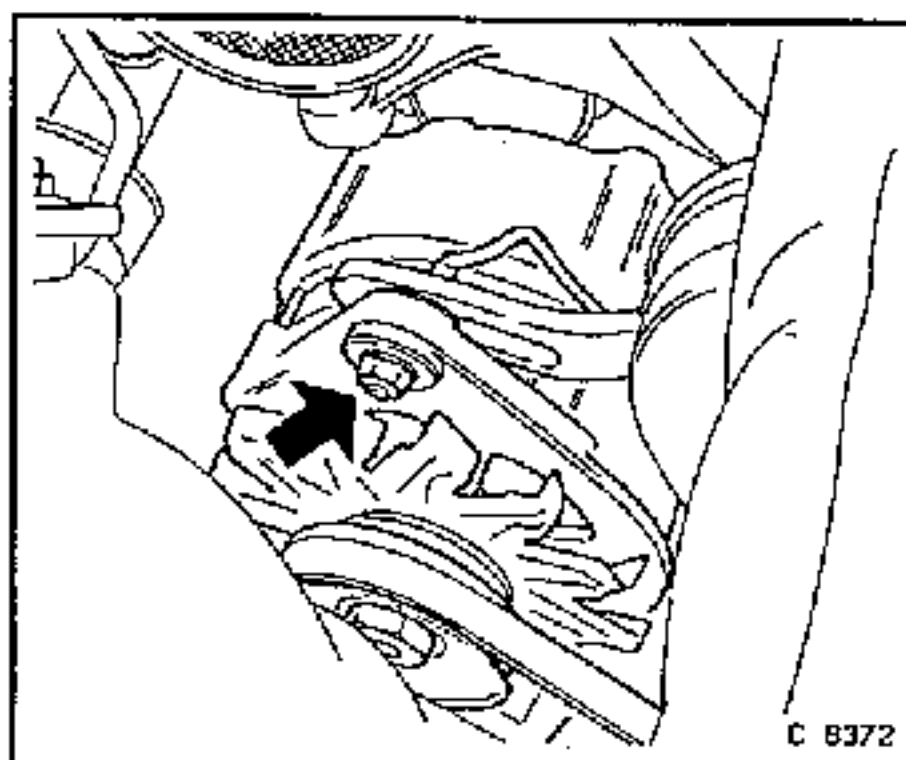


## Install, Connect

V-belt to power steering pump, A/C compressor and alternator.

## Adjust

V-belt tension. See operation in "Checking and Adjusting Procedures" on page J-272, in this Volume.



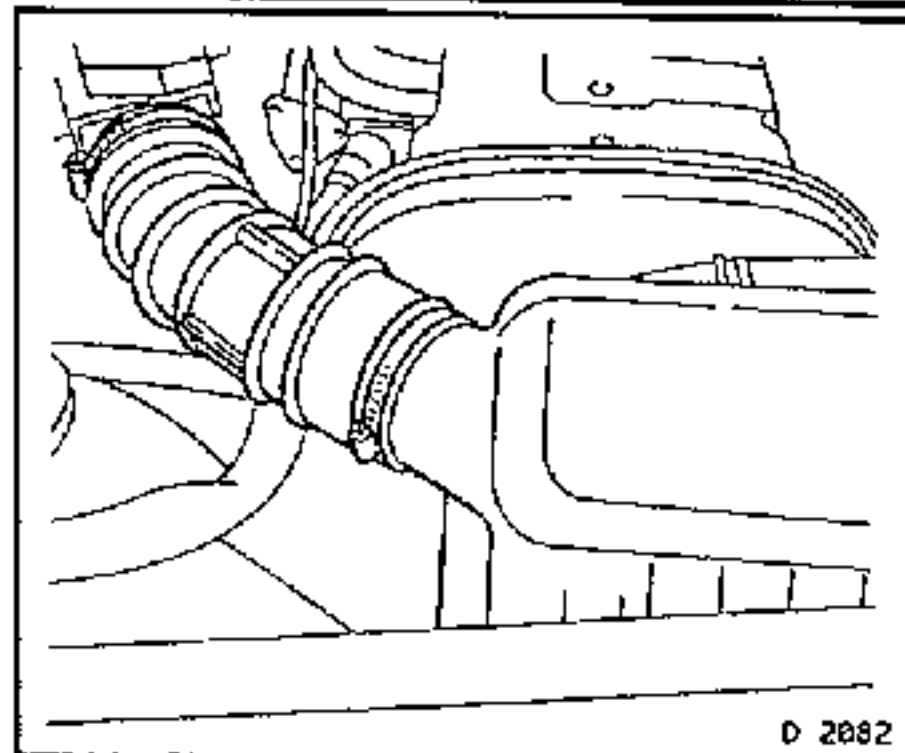
# DOHC ENGINE - ENGINE TIMING SIDE/AIR CLEANER

## Install, Connect

Air cleaner housing. Refer to "Air Cleaner Housing, Remove and Install", at the end of this Section.

Air intake hose.

Ground cable to battery.



## Toothed Belt, Replace (Engines as of MY'93).

### Remove, Disconnect

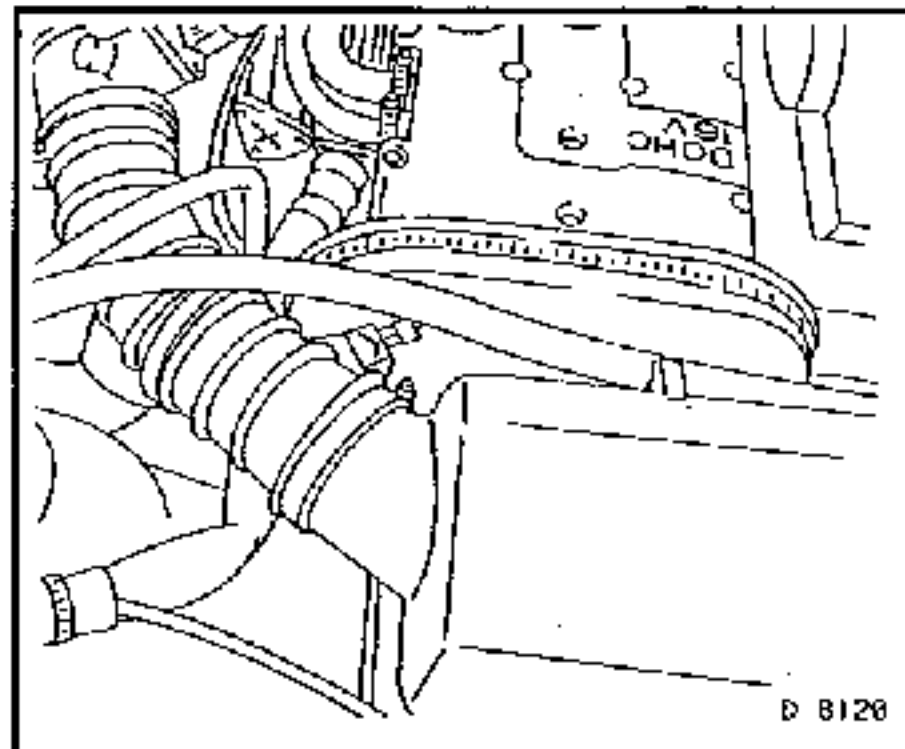
Ground cable from battery.

C 20 XE:

Wiring harness plug from intake air temperature sensor.

Air cleaner housing. Refer to "Air Cleaner Housing, Remove and Install", at the end of this Section.

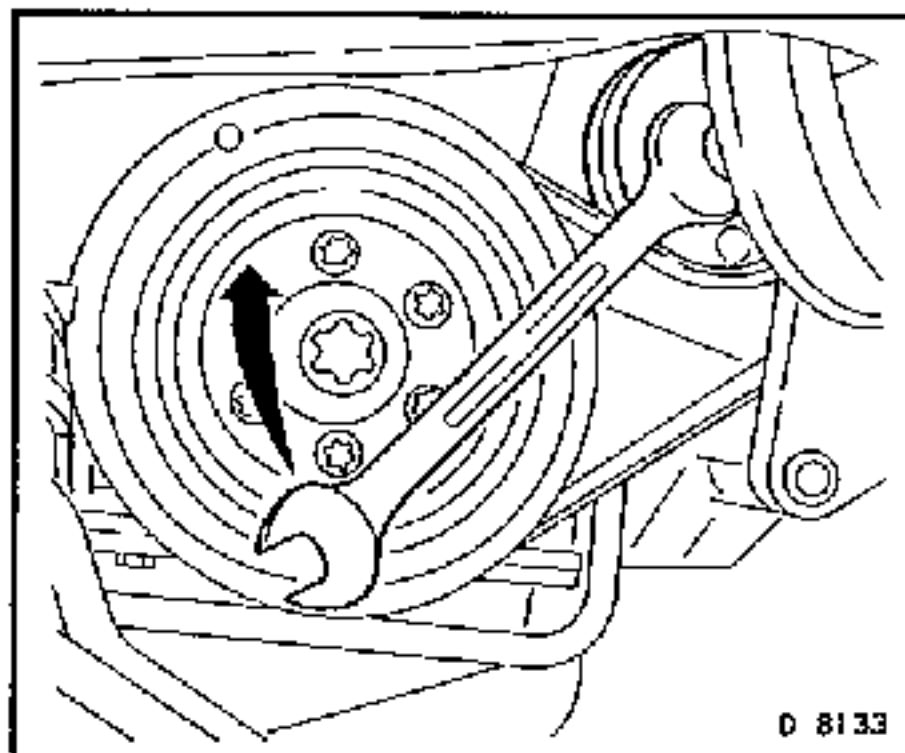
Engine compartment cover.



### Remove, Disconnect

Mark rotational direction of ribbed V-belt.

Release V-belt by turning the V-belt tension roller in the direction shown, then remove V-belt.



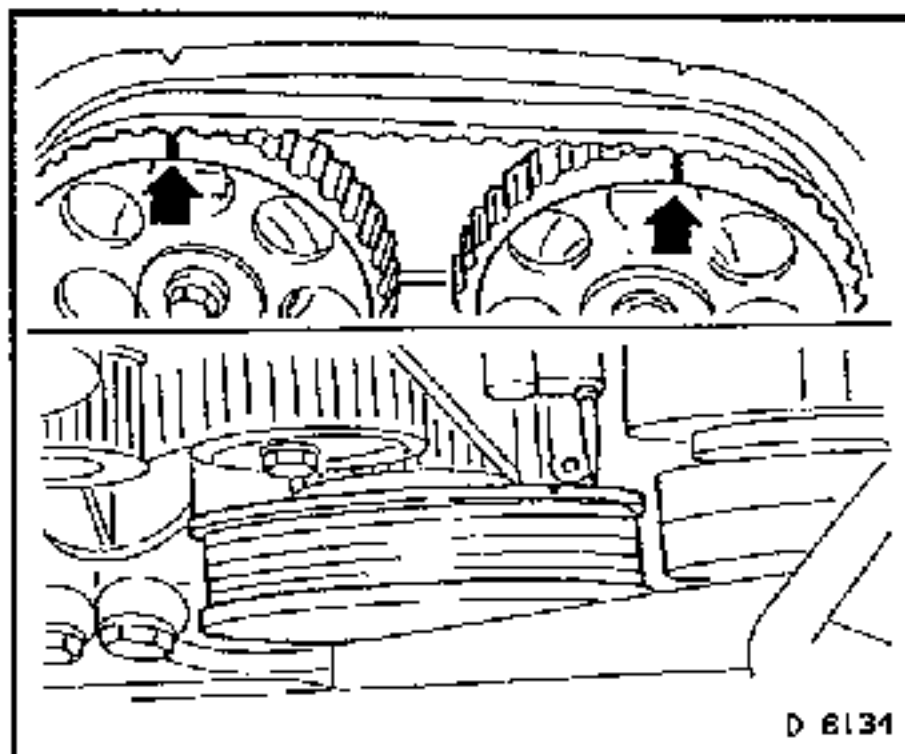
### Remove, Disconnect

Front toothed belt cover.

### Inspect

No.1 piston at TDC on the compression stroke.

If required, use MKM-604-21 (Torx E 20) and turn the toothed belt drive gear in the direction of engine rotation until the marks line up as shown.



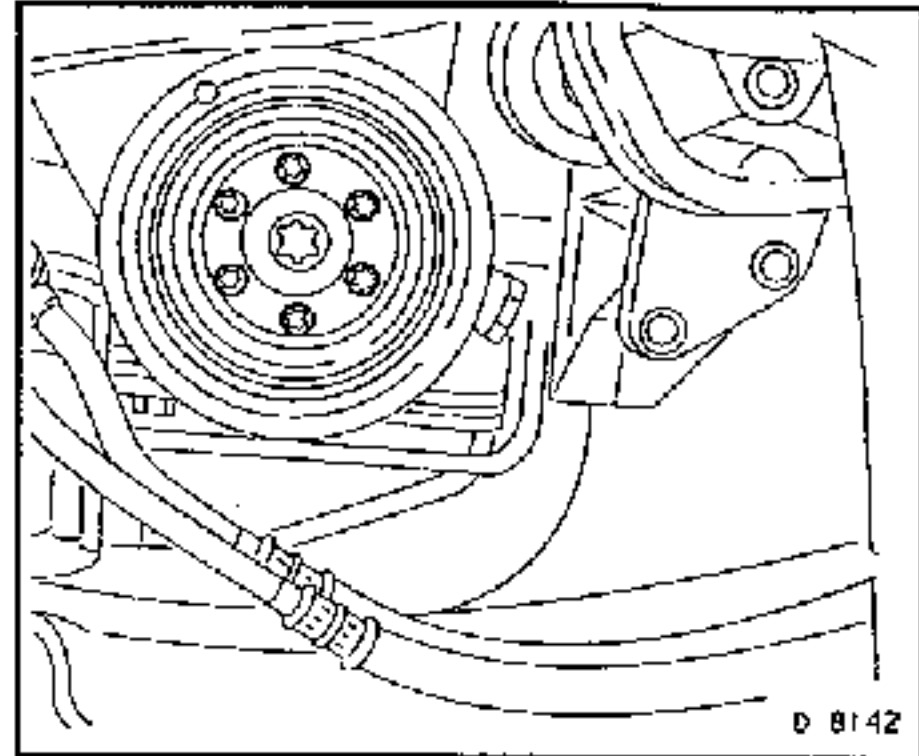
# DOHC ENGINE - ENGINE TIMING SIDE/AIR CLEANER

## Remove, Disconnect

Crankshaft pulley. Use MKM-604-21 (Torx E 20) to hold the toothed belt drive gear, then remove the pulley fastening bolts.

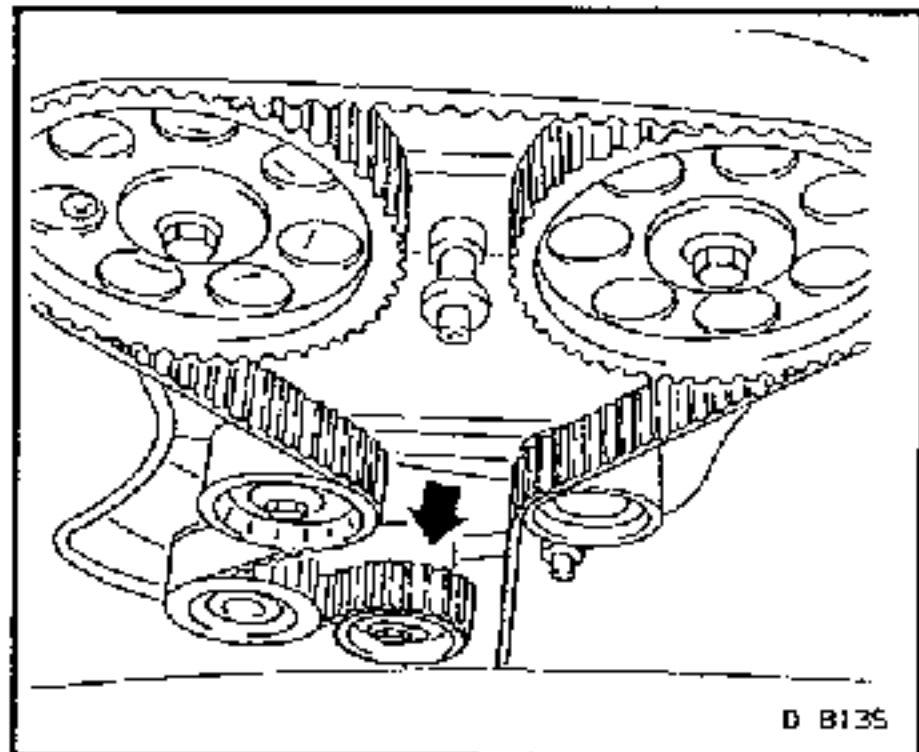
## Important!

Make sure that the timing marks at the crankshaft and the camshafts are all lined up.



## Remove, Disconnect

Loosen the toothed belt tension roller, then remove the toothed belt.

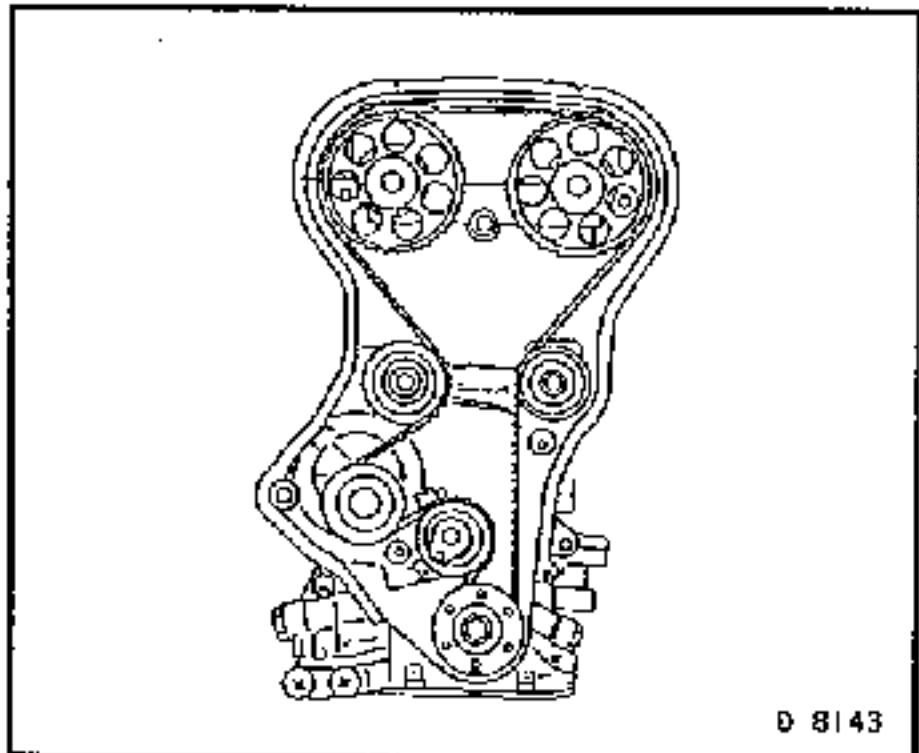


## Install, Connect

Install new toothed belt, with the tension side, tight.

## Check

That the timing marks at the crankshaft and the camshafts are all lined up.

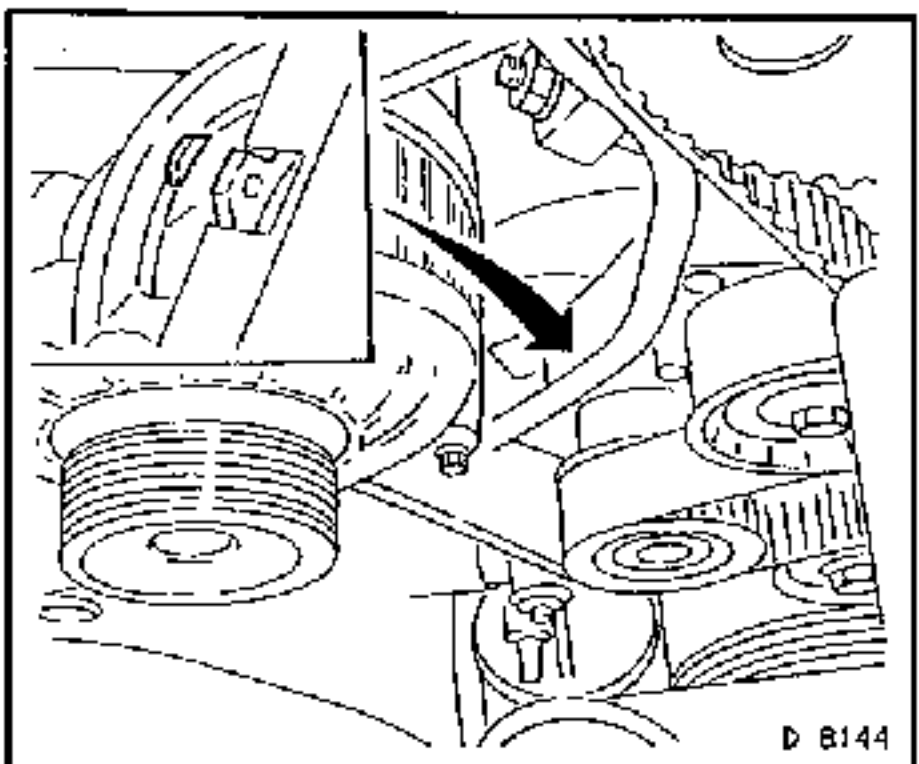


## Adjust

Only adjust the toothed belt tension on a cold (ambient temperature) engine.

## Check

That the lug on the water pump must align with the lug on the cylinder block.

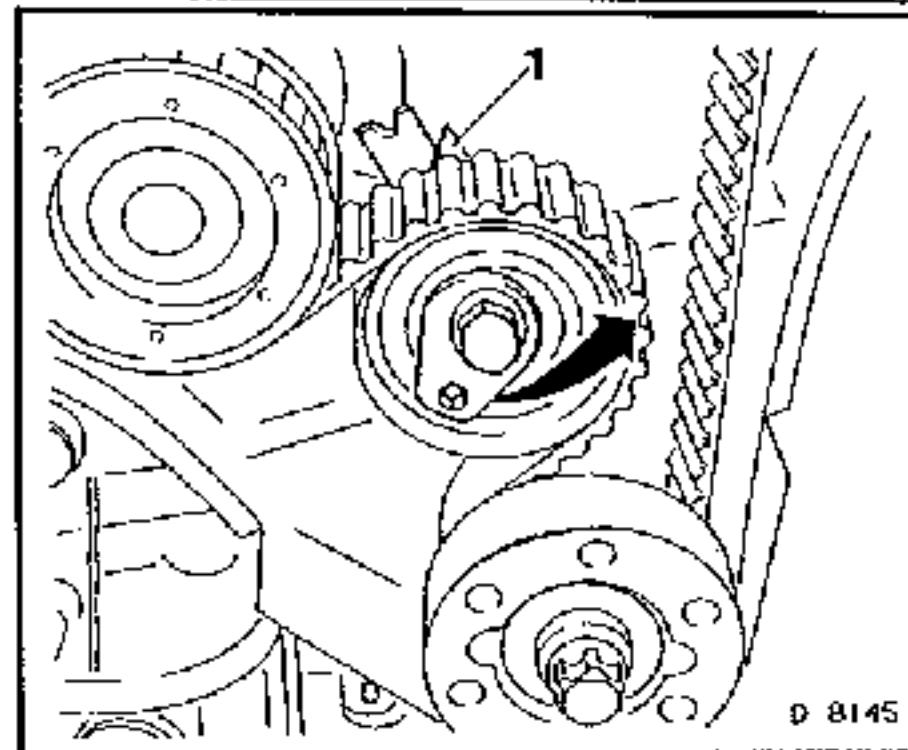


# DOHC ENGINE - ENGINE TIMING SIDE/AIR CLEANER

## Adjust

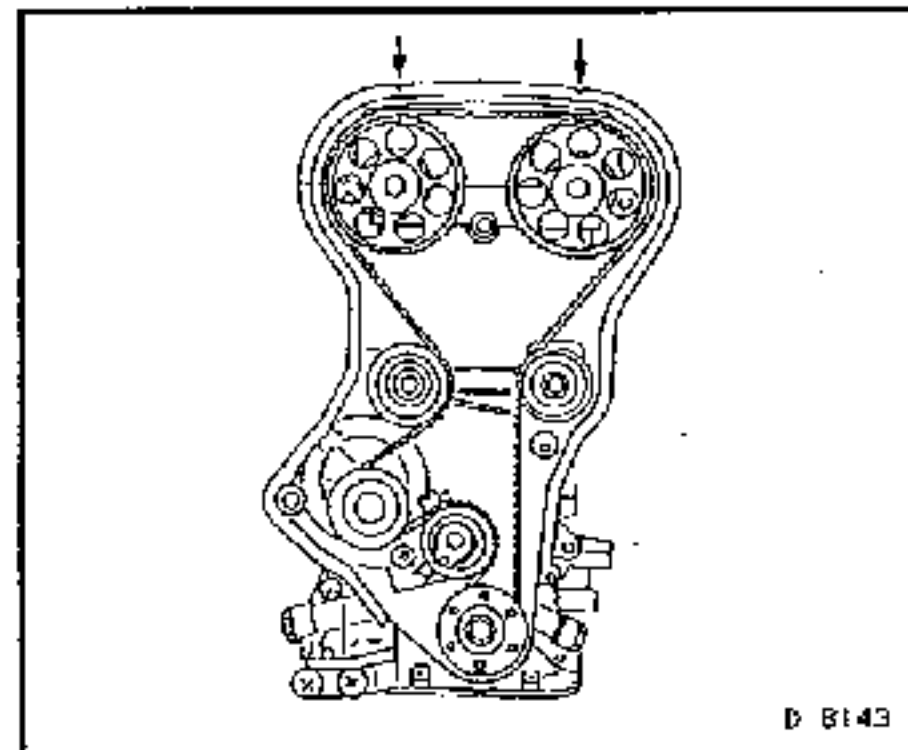
Tension toothed belt on the adjustment eccentric in the direction of the arrow until the pointer (1) is at the top.

Lightly tighten the toothed belt tension roller fastening bolt.



## Adjust

Use MKM-604-212 (Torx E 20) on the toothed belt drive gear and turn the engine through two turns (720°), in the direction of engine rotation until II of the timing marks are aligned.



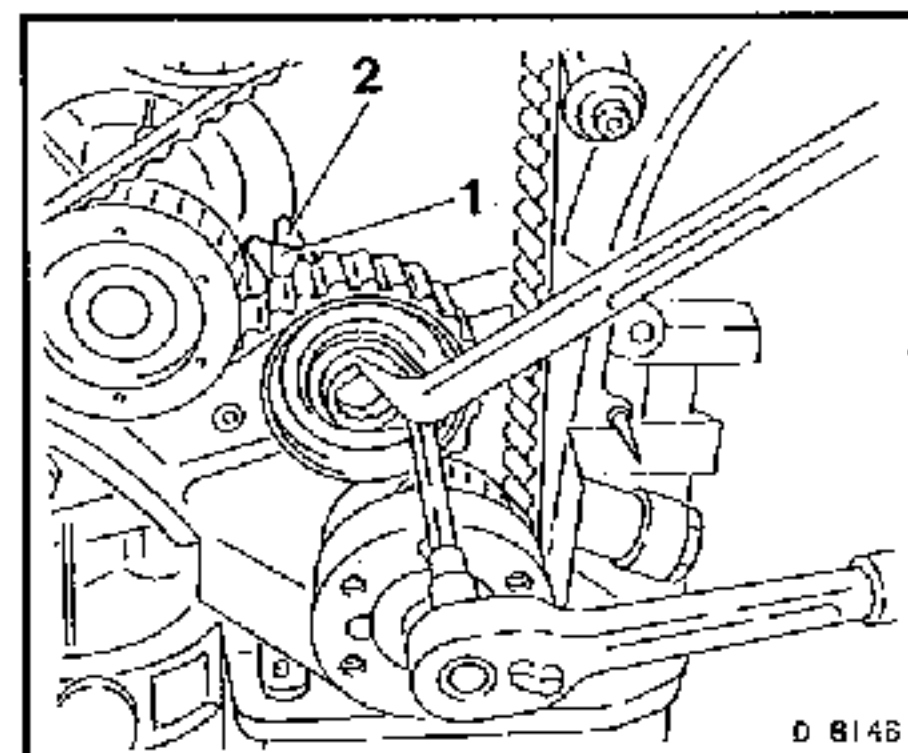
## Adjust

Loosen the toothed belt tension roller, then turn the adjustment eccentric clockwise until pointer (1) lines up with the notch (2).

Turn engine through a full turn and check the alignment of the timing marks again.

## Tighten (Torque)

Toothed belt tension roller to  
oil pump housing..... 20 Nm



## Tighten (Torque)

Crankshaft pulley to toothed  
belt drive gear..... 20 Nm  
Front toothed belt cover bolts..... 8 Nm

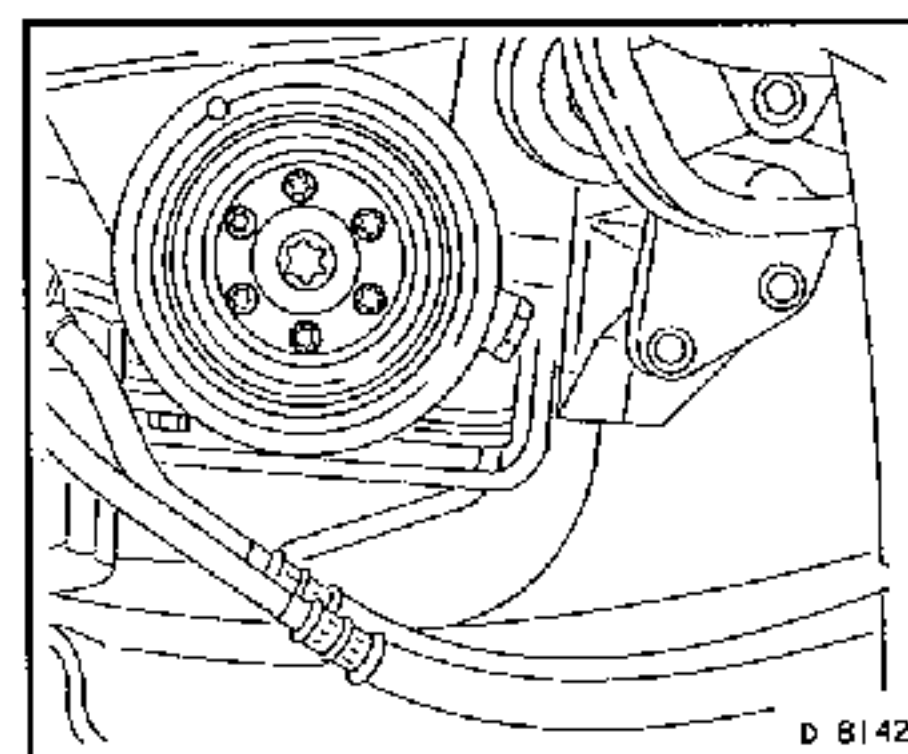
Make sure that the rubber grommets on the fastening studs are firmly seated in position.

## Install, Connect

Ribbed V-belt. Tension ribbed V-belt via ribbed V-belt tension roller.

## Note:

The direction of the ribbed V-belt.





# DOHC ENGINE - ENGINE TIMING SIDE/AIR CLEANER

## Install, Connect

If removed, the engine compartment cover.

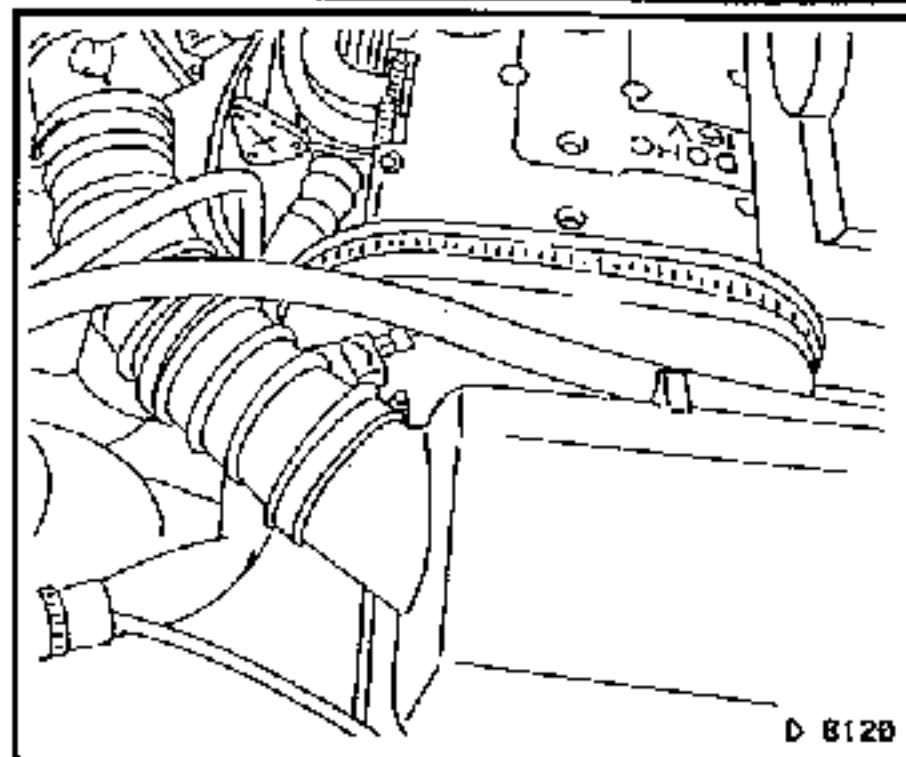
Air cleaner housing. Refer to "Air Cleaner Housing, Remove and Install", at the end of this Section.

C 20 XE:

Air intake hose to hot film mass air flow meter.

The wiring harness plug to the intake air temperature sensor.

Ground cable to battery.

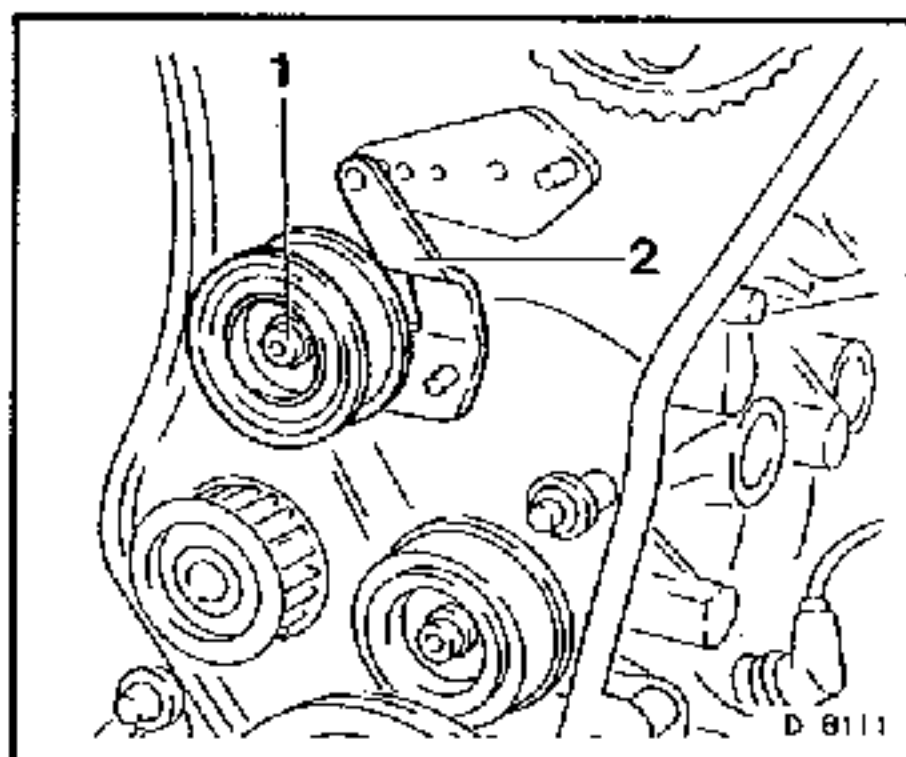


## Toothed Belt Tension Roller, Replace (Engines up to MY'93)

### Remove, Disconnect

Toothed belt. Refer to "Toothed Belt, Replace", in this Section.

Toothed belt tension roller (1), toothed belt tension roller support plate (2) with the spacer sleeve.



### Install, Connect

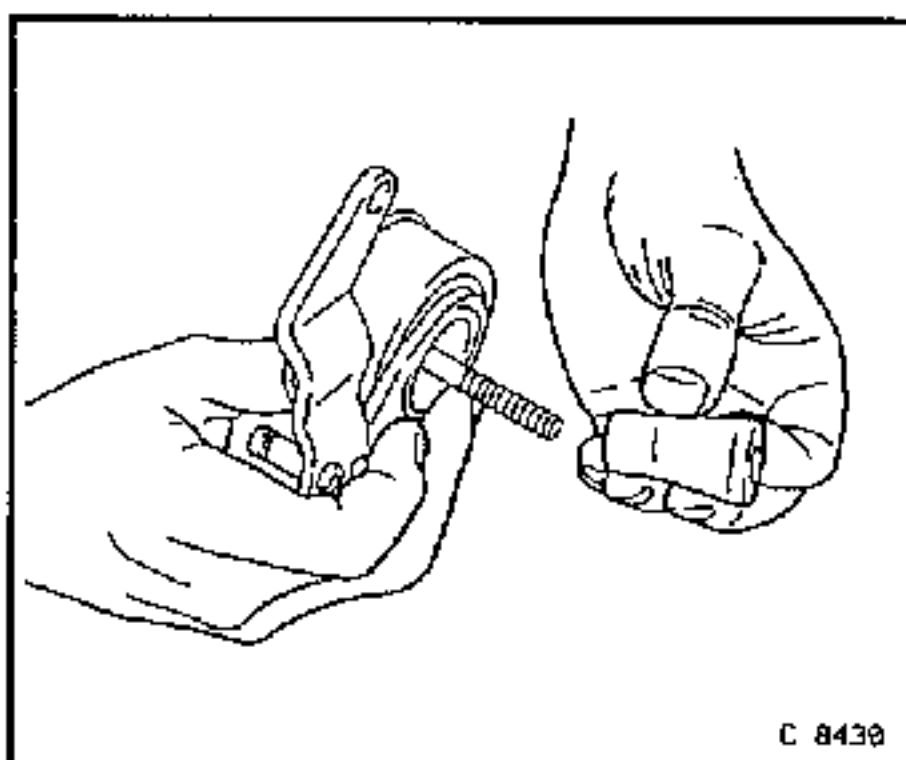
Spacer sleeve, toothed belt tension roller support plate, toothed belt tension roller.

Install new toothed belt and tension. Refer "Toothed Belt, Replace" in this Section.

When installing the spacer sleeve, note that the smaller diameter points to the toothed belt tension roller support plate.

### Torque - Angle Method

Toothed belt tension roller  
to cylinder block ..... 25 Nm + 45° + 15°



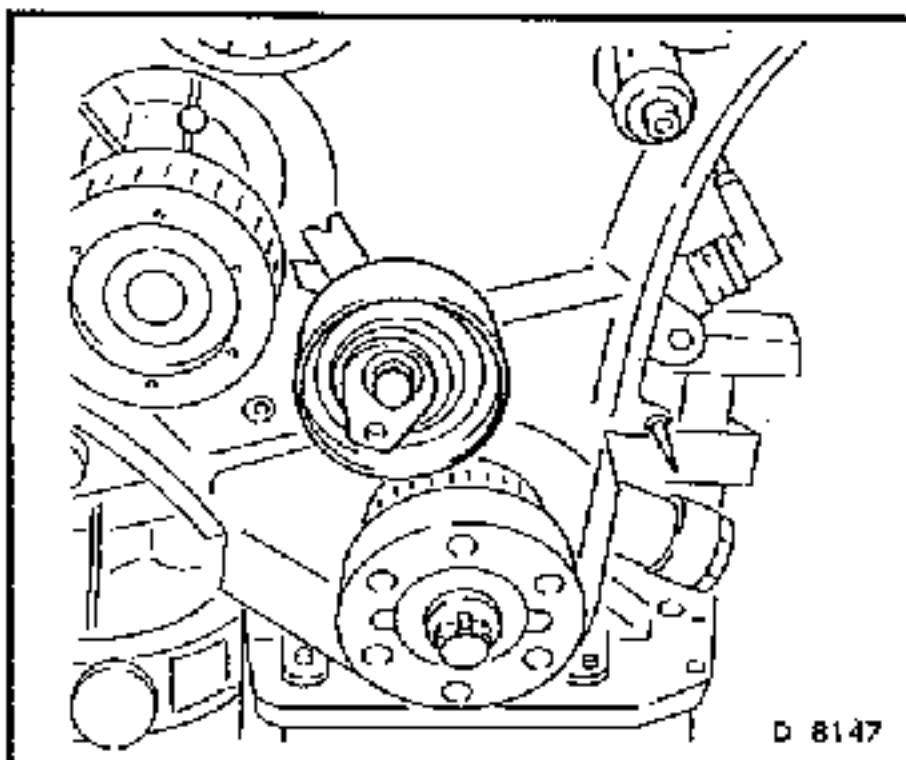
## Toothed Belt Tension Roller, Replace (Engines as of MY'93)

### Remove, Disconnect

Mark direction of rotation of toothed belt.

Toothed belt. Refer "Toothed Belt, Replace", in this Section.

Toothed belt tension roller from the oil pump housing.



# DOHC ENGINE - ENGINE TIMING SIDE/AIR CLEANER

## Install, Connect

Toothed belt tension roller. Ensure that stop lever (1) engages with the pilot holes (2) on oil pump housing.

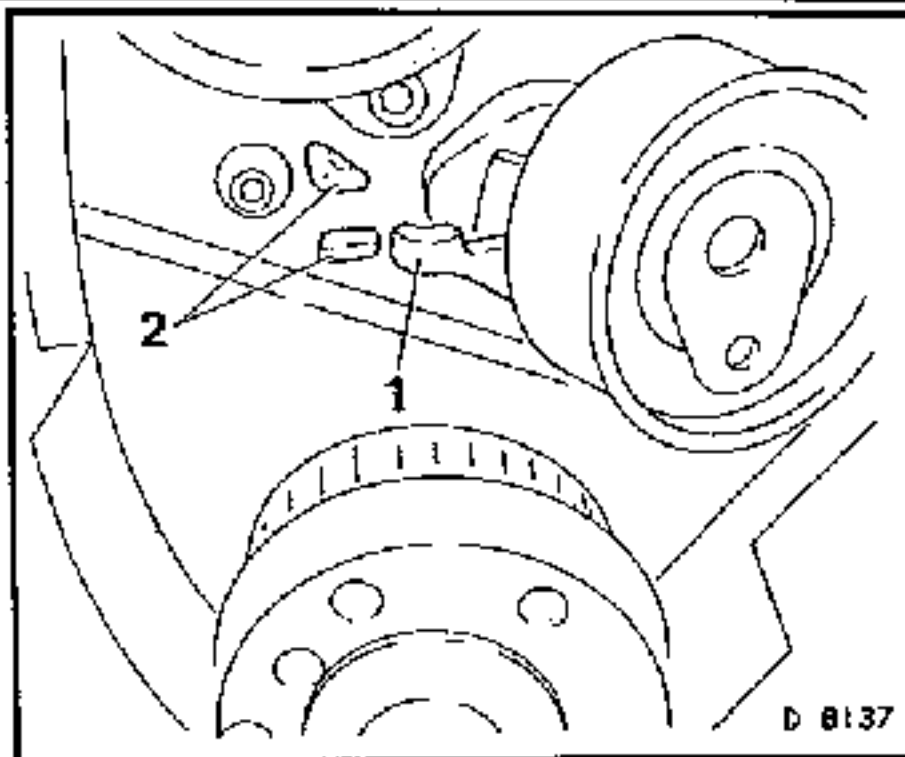
The toothed belt and tension. Refer "Toothed Belt, Replace", in this Section.

### Note:

Direction of rotation of toothed belt.

## Tighten (Torque)

Toothed belt tension roller to  
oil pump housing..... 20 Nm

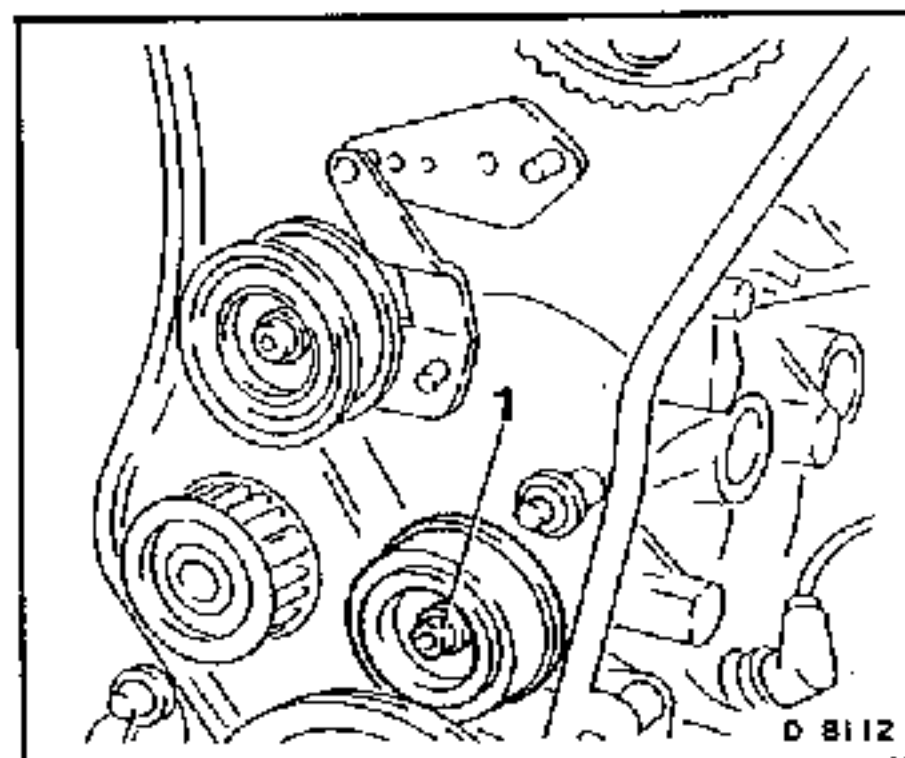


## Toothed Belt Guide Roller, Replace (Engine up to MY'93)

### Remove, Disconnect

Toothed belt. Refer "Toothed Belt, Replace", in this Section.

Toothed belt guide roller (1) with spacer sleeve.



### Install, Connect

Spacer sleeve, toothed belt guide roller (1).

Install new toothed belt and tension. Refer "Toothed Belt, Replace", in this Section.

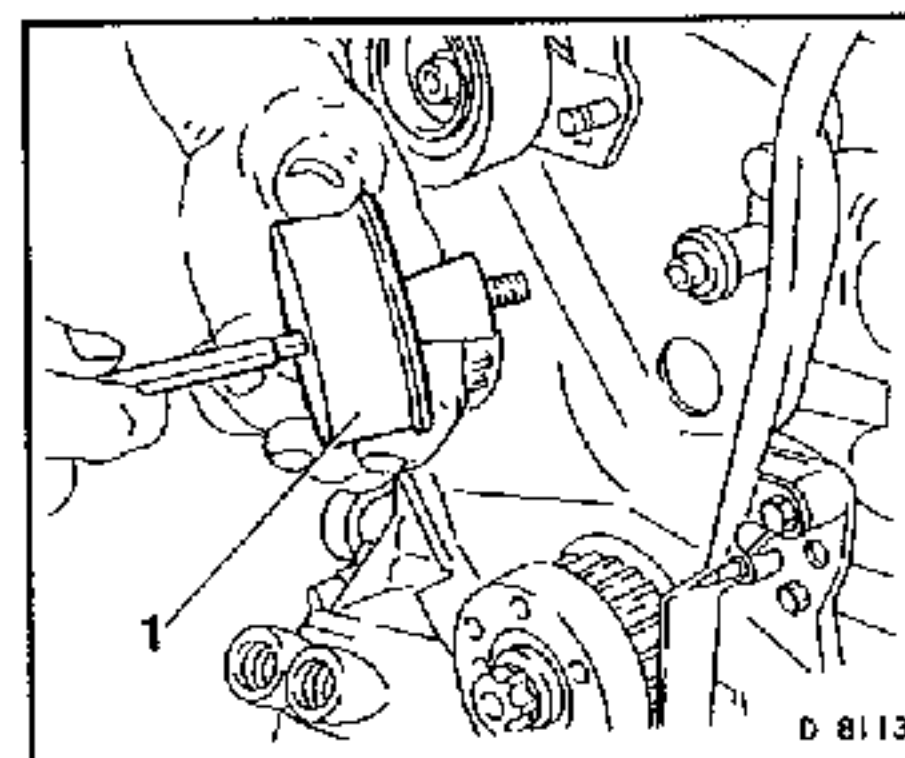
When installing the spacer sleeve, note that the smaller diameter points to the toothed belt guide roller support plate.

### Torque - Angle Method

Toothed belt guide roller to  
cylinder block..... 25 Nm + 45° + 15°

### Important!

Use a new bolt.



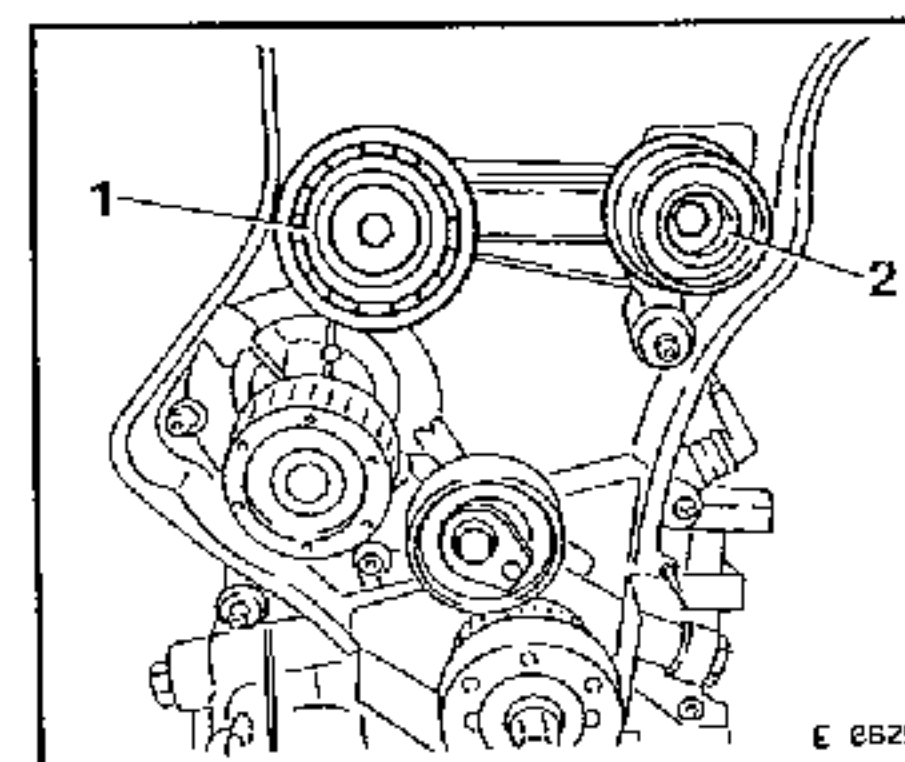
## Toothed Belt Guide Roller, Replace (Engine as of MY'93)

### Remove, Disconnect

Mark direction of rotation of toothed belt.

Toothed belt. Refer "Toothed Belt, Replace", in this Section.

Toothed belt guide roller (1 and 2), from bracket and from the cylinder block.





# DOHC ENGINE - ENGINE TIMING SIDE/AIR CLEANER

## Install, Connect

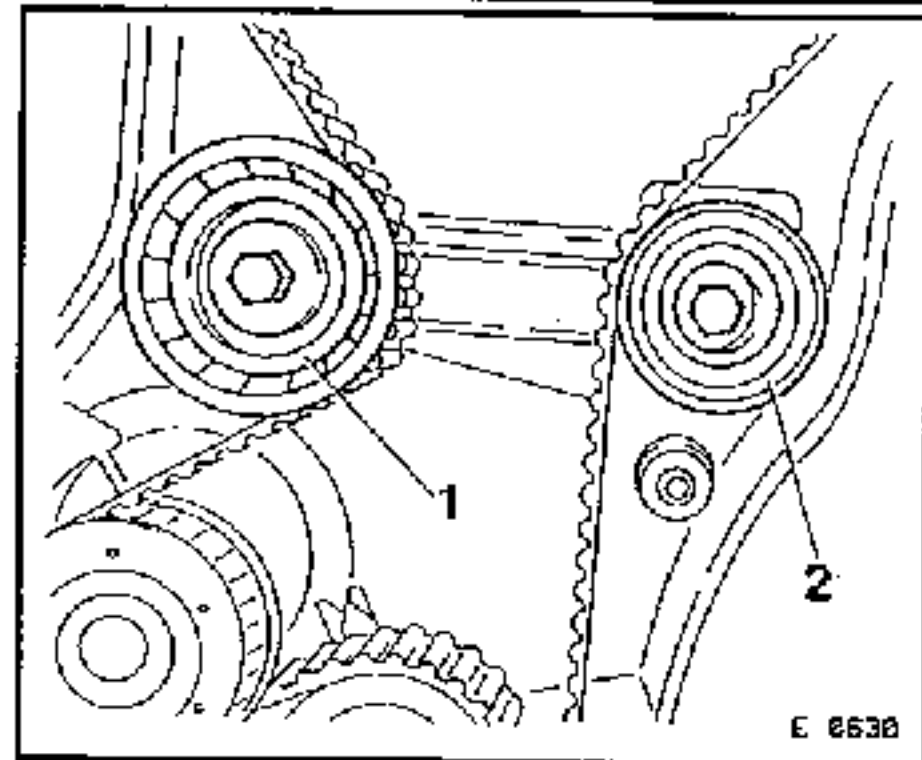
Toothed belt and tension. Refer "Toothed Belt, Replace", in this Section.

### Note:

Direction of toothed belt rotation.

## Tighten (Torque)

Toothed belt guide roller (1) to cylinder block .....	25 Nm
Toothed belt guide roller (2) to guide roller bracket.....	25 Nm



## Rear Toothed Belt Cover, Remove and Install

### Engines as of MY'93

#### Remove, Disconnect

Mark direction of rotation of toothed belt.

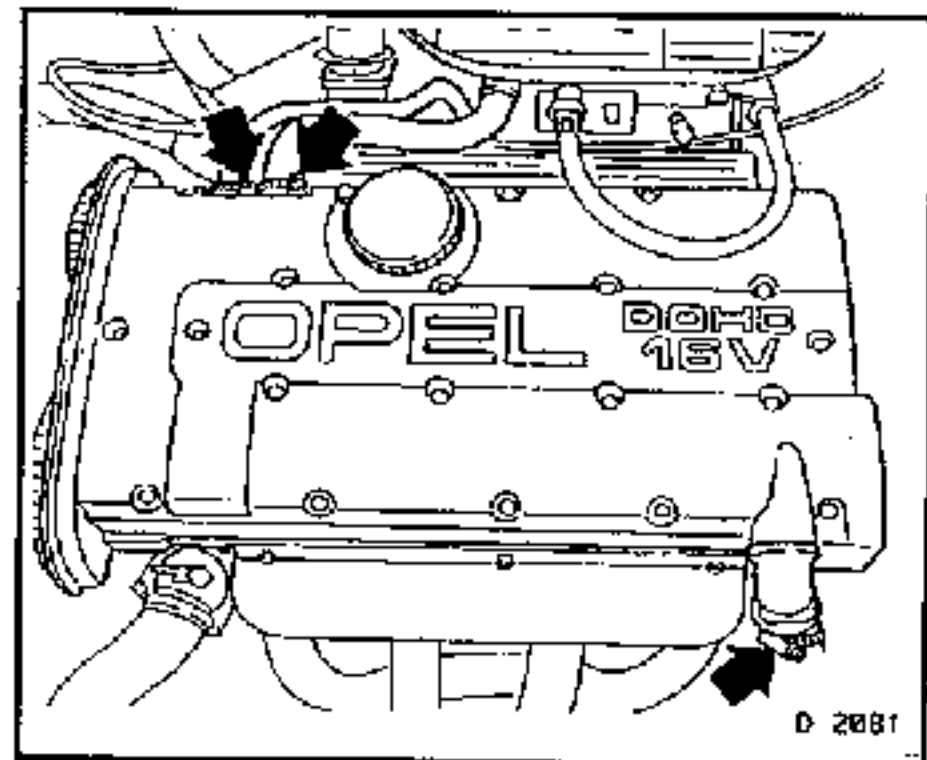
Toothed belt. Refer "Toothed Belt, Replace", in this Section.

C 20 LET:

Cover from throttle valve manifold.

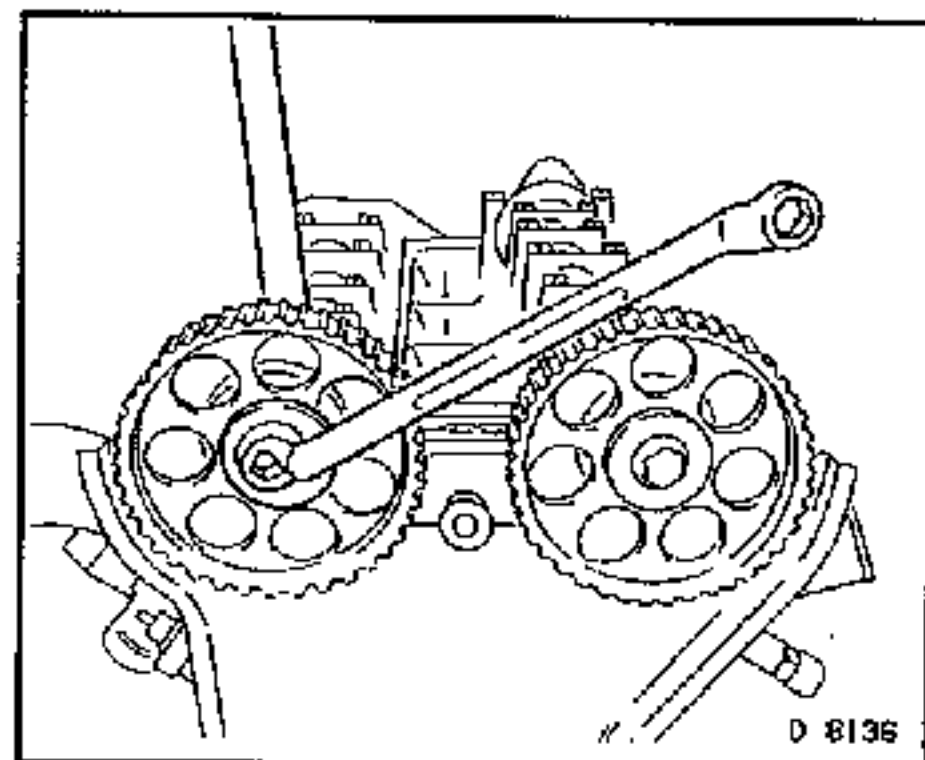
Both Engines:

Ignition cable cover, spark plug connectors using KM-717, hose connections (arrows) from cylinder head cover, cylinder head cover.



#### Remove, Disconnect

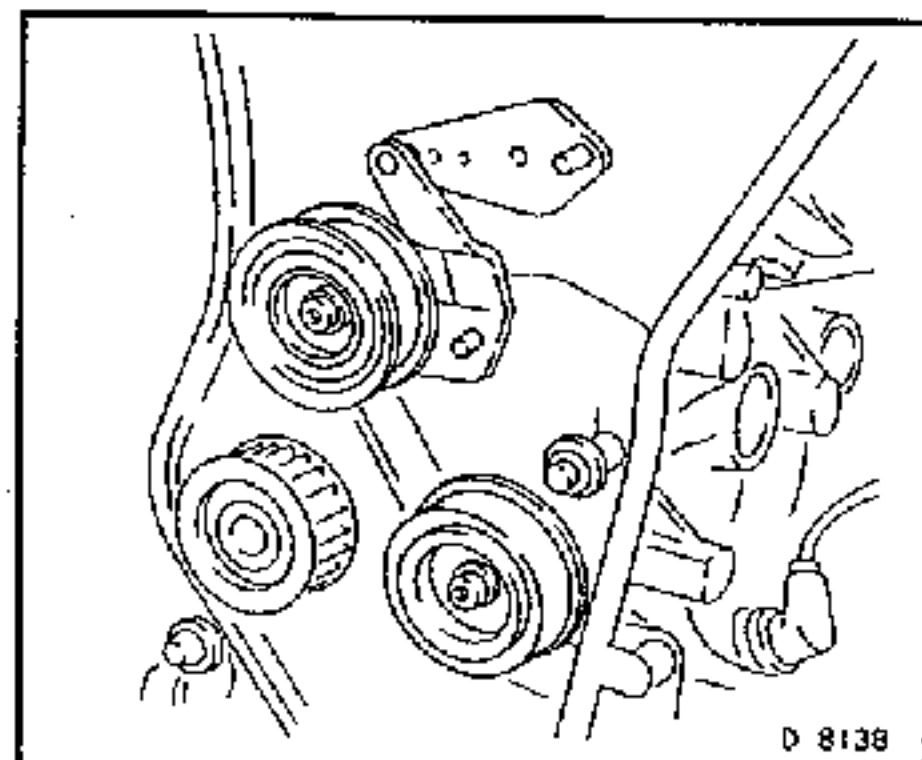
Camshaft pulleys. Hold each camshaft with an open ended spanner on the hex provided.



#### Remove, Disconnect

### Engines up to MY'93

Toothed belt tension roller and toothed belt guide roller.

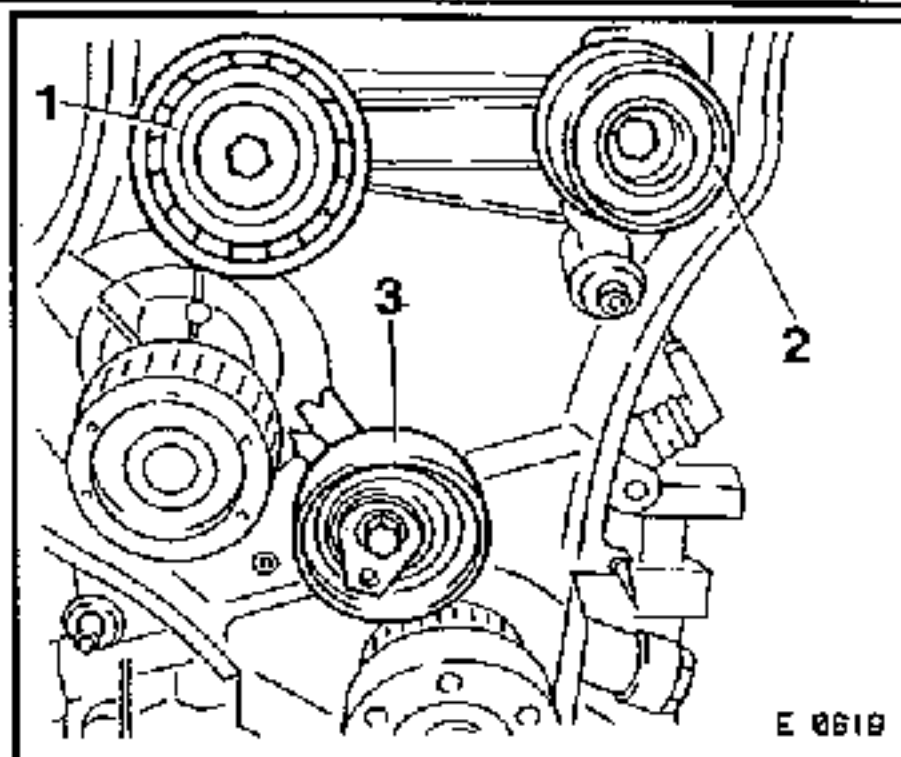


# DOHC ENGINE - ENGINE TIMING SIDE/AIR CLEANER

## Remove, Disconnect

### Engines as of MY'93

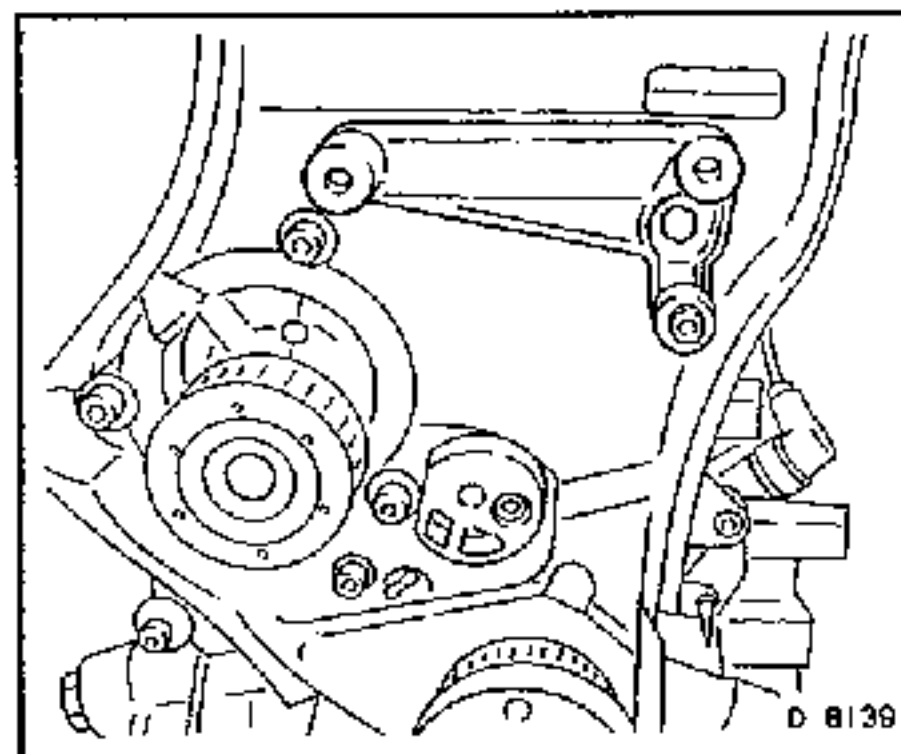
Toothed belt guide rollers (1 and 2), toothed belt tension roller (3).



## Remove, Disconnect

### Engines as of MY'93

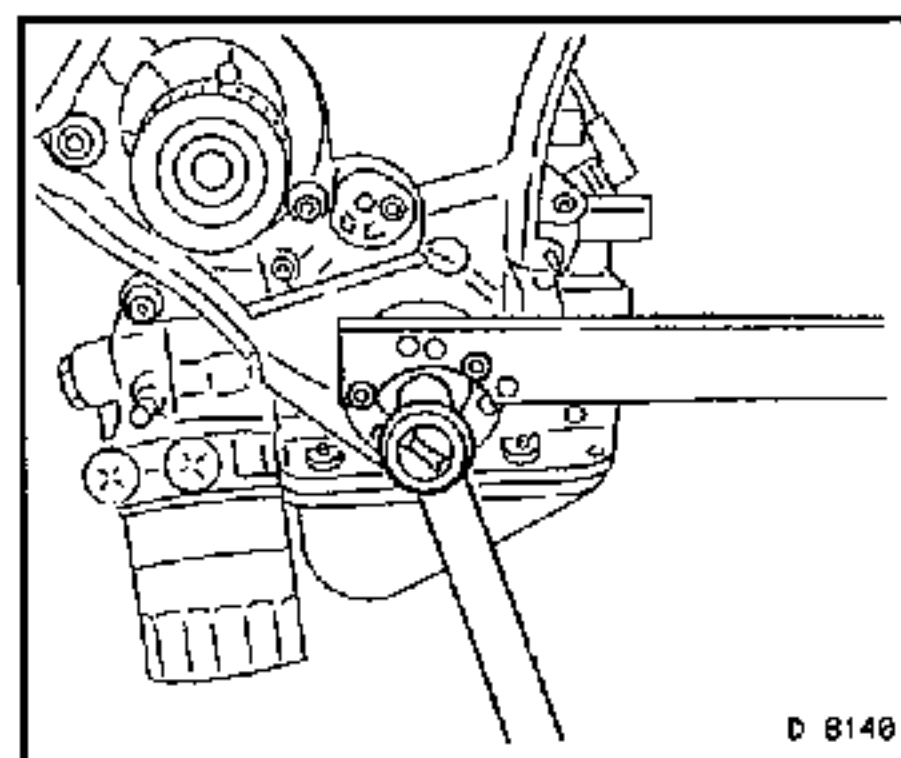
Toothed belt guide roller bracket.



## Remove, Disconnect

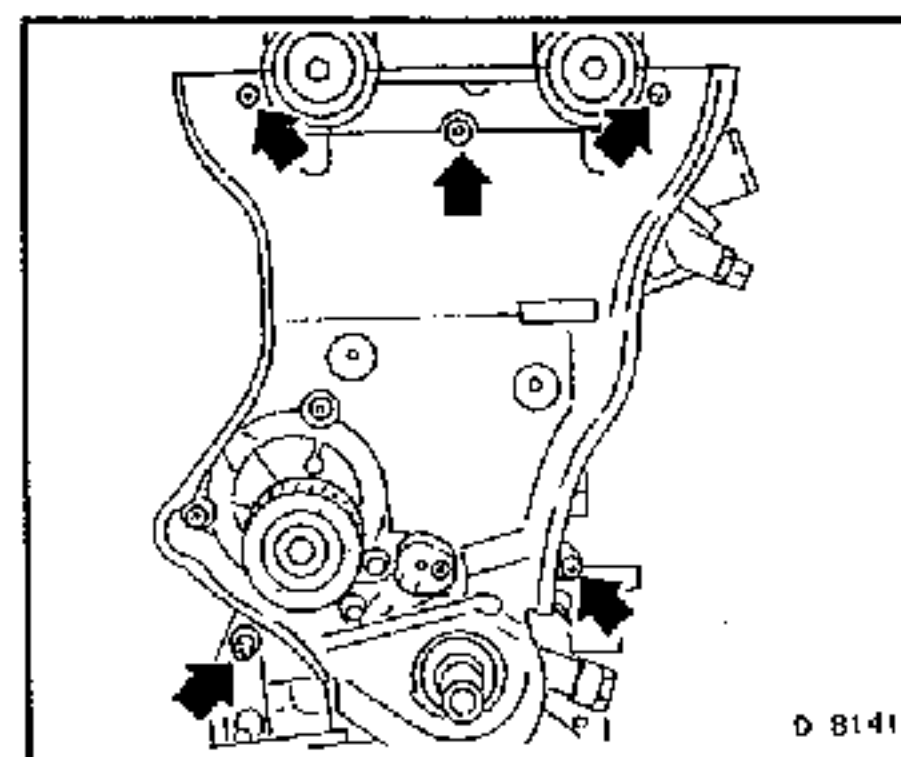
Toothed belt drive gear.

Hold with wrench KM-662-A, while removing drive gear bolt with MKM-604-21 (Torx E 20).



## Remove, Disconnect

Rear toothed belt cover from cylinder head and oil pump housing (arrows).



# DOHC ENGINE - ENGINE TIMING SIDE/AIR CLEANER

## Install, Connect

Rear toothed belt cover.

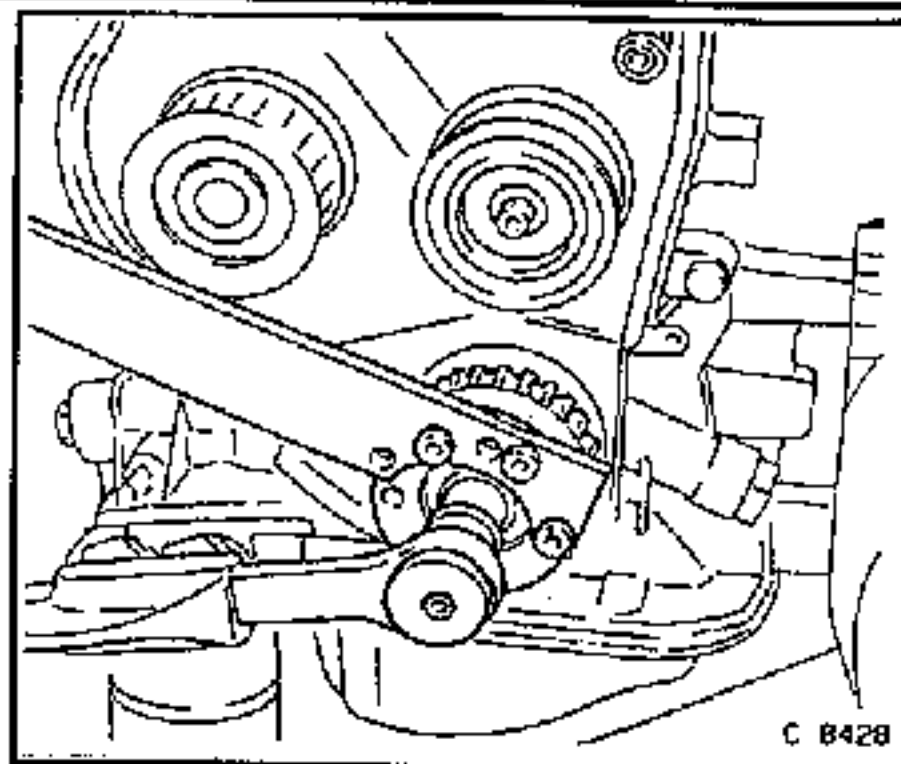
Push toothed belt drive gear on to crankshaft nose, noting the installation position.

Toothed belt guide roller bracket.

## Tighten (Torque)

Toothed belt guide roller bracket to cylinder block .....	25 Nm
Rear toothed belt cover to cylinder head and oil pump housing .....	6 Nm
Toothed belt drive gear to crankshaft .....	250 Nm+40°+50°*

\* Use new bolt.

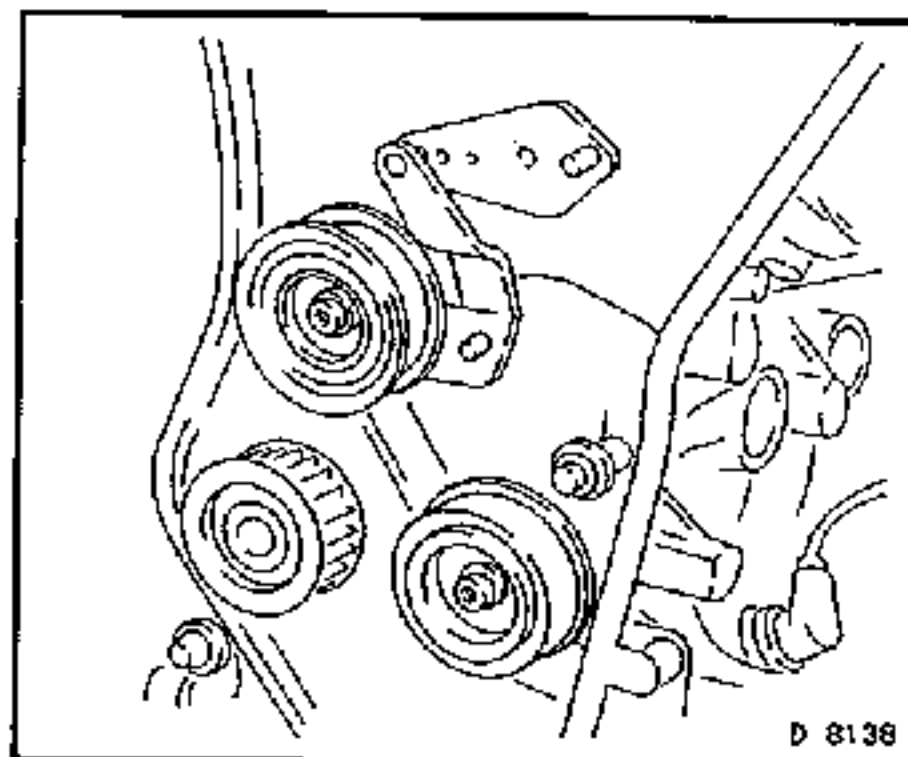


## Engines up to MY'93

## Tighten (Torque)

Toothed belt tension roller to cylinder block .....	25 Nm + 45° + 15° *
Toothed belt guide roller to cylinder block .....	25 Nm + 45° + 15° *

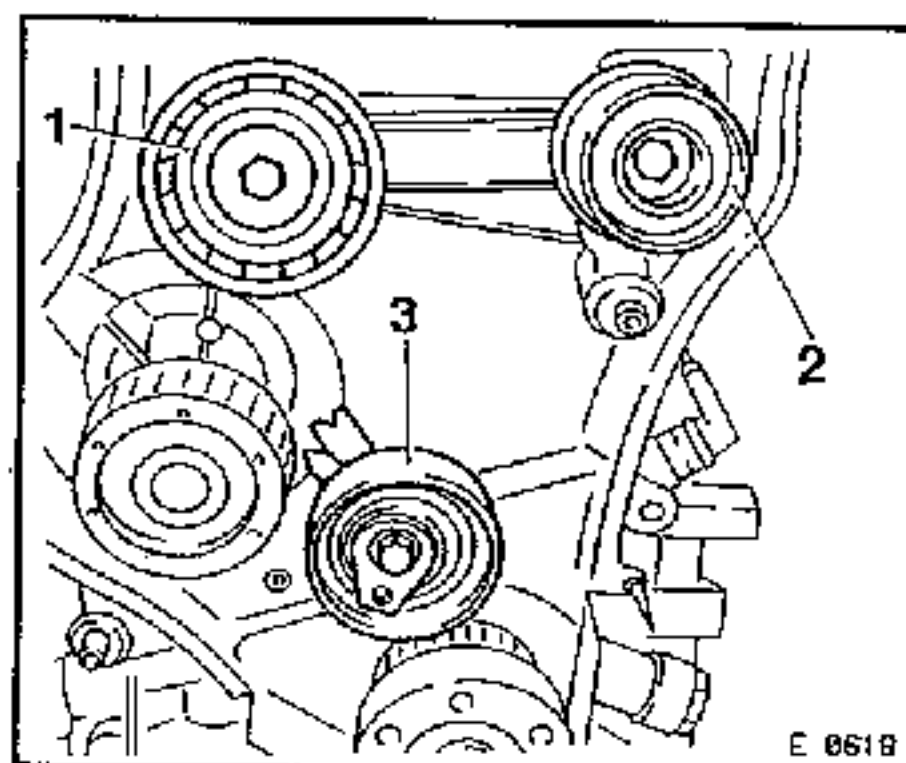
\* Use new bolts.



## Engines as of MY'93

## Tighten (Torque)

Toothed belt guide roller (1) to cylinder block .....	25 Nm
Toothed belt guide roller (2) to guide roller bracket .....	25 Nm
Toothed belt tension roller (3) to oil pump housing .....	25 Nm



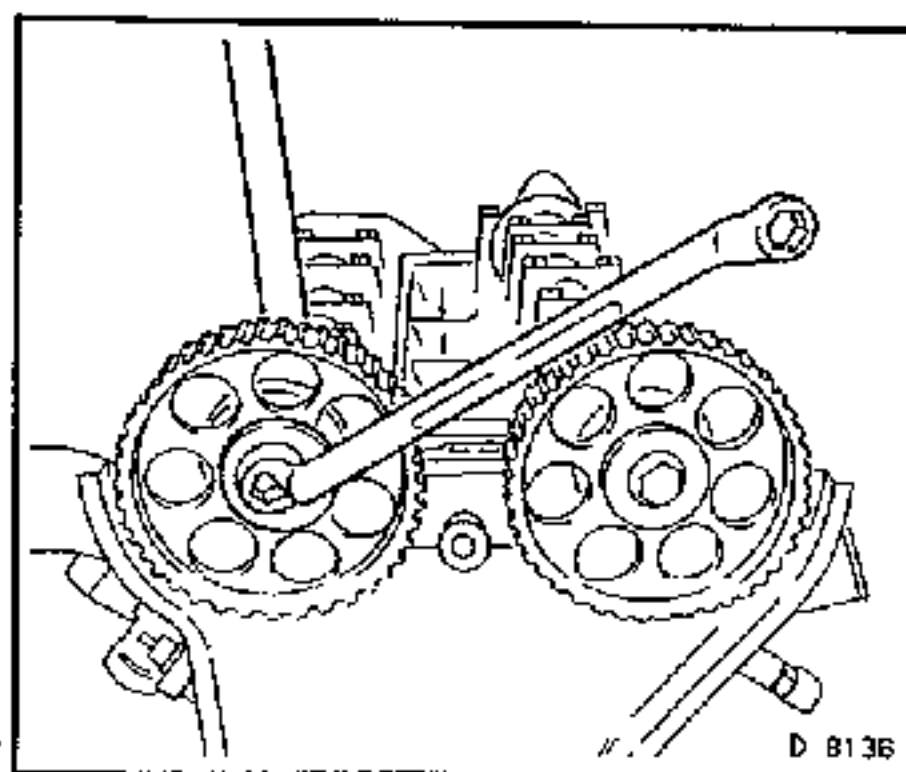
## Install, Connect

Camshaft pulleys, cylinder head cover, hose connections to cylinder head cover, spark plug connectors, ignition cable cover.

## Tighten (Torque)

Camshaft pulley to camshaft .....	50 Nm + 60° + 15° *
Cylinder head cover to cylinder head .....	8 Nm

\* Use new bolts.



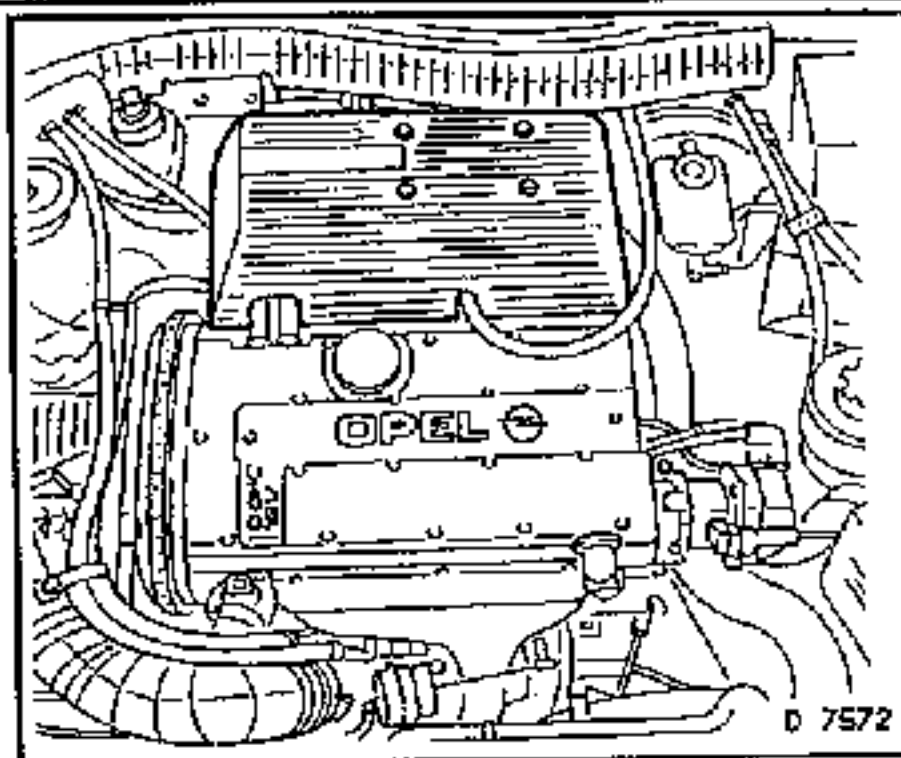
# DOHC ENGINE - ENGINE TIMING SIDE/AIR CLEANER

## C 20 LET only: Tighten (Torque)

Cover to throttle valve manifold ..... 5 Nm

## Install, Connect

Toothed belt. Refer "Toothed Belt, Replace", in this Section.



## Air Cleaner Housing, Remove and Install (C 20 XE)

### Note:

For engines as of MY'93, only loosen the bolts shown in Illustration D 2178.

### Remove, Disconnect

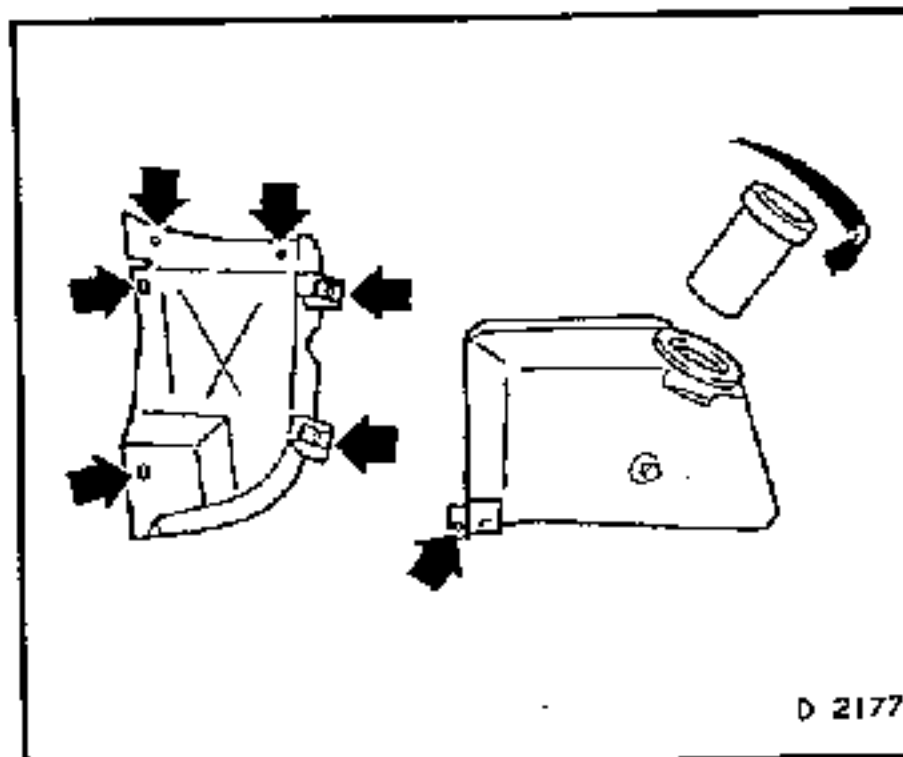
Engine compartment cover.

Lower right water deflector (6 places).

Resonator (1 bolt). Remove downwards, twist connection (bayonet catch).

Air intake hose, upper part of housing (2 clips, bolts)

Filter element, lower part of housing (3 bolts) remove upwards.



### Install, Connect

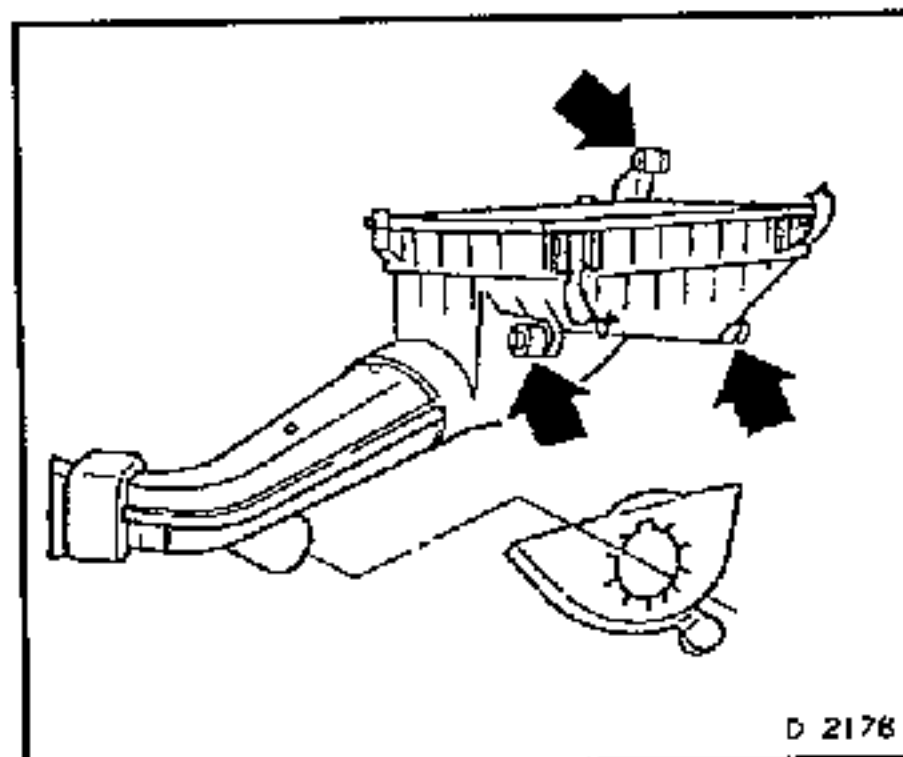
Lower part of housing (ensure that sleeve is correctly seated).

Filter element, upper part of housing and air intake hose.

Twist connection to connect resonator.

Lower right water deflector.

Engine compartment cover.



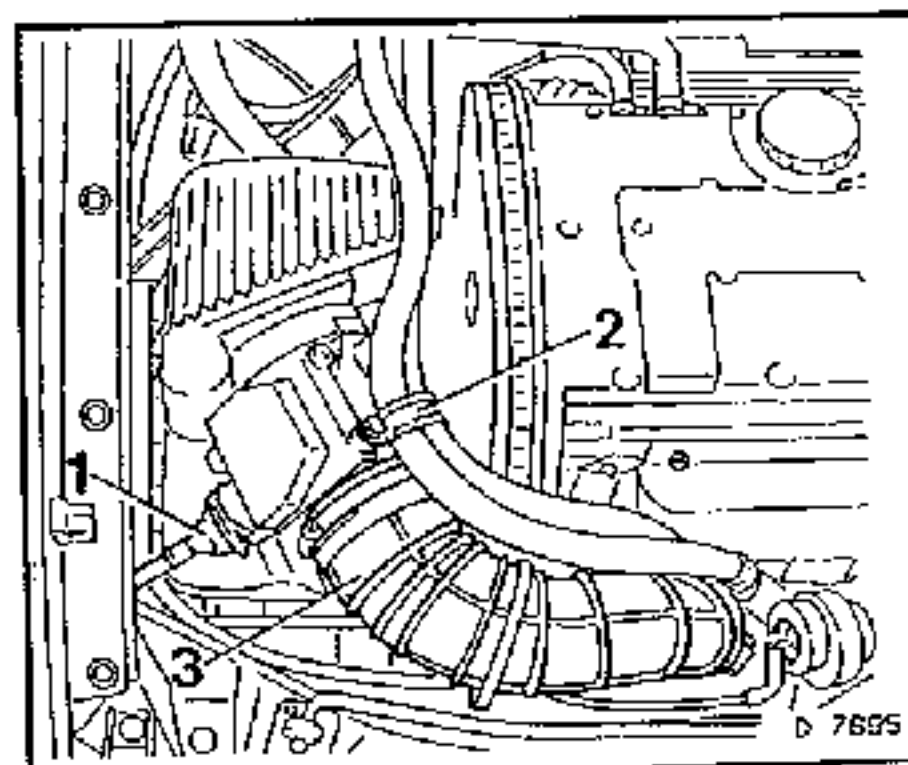
## Air Cleaner Housing, Remove and Install (C 20 LET)

### Remove, Disconnect

Wiring harness plug (1), bracket (2), air intake hose (3).

Upper part of housing (2 clips, 2 bolts).

Filter element, lower part of housing (3 bolts). Remove upwards.



# DOHC ENGINE - ENGINE TIMING SIDE/AIR CLEANER

## Install, Connect

Lower part of housing (ensure that sleeve is correctly seated).

Filter element, upper part of housing and air intake hose.

Bracket, wiring harness plug.

## RECOMMENDED TORQUE VALUES

### (Engine, Timing Side, Air Cleaner Housing)

	Nm
A/C compressor to auxiliary aggregates bracket .....	35 (2)
Auxiliary aggregates bracket to cylinder block .....	35 (2)
Bracket to A/C compressor .....	20 (2)
Bracket, engine damping block bracket to engine accessories bracket .....	60 (2)
Bracket, engine damping block to engine bracket .....	60 (2)
Bracket, toothed belt guide roller to cylinder block .....	25 (2)
Camshaft pulley to camshaft .....	50 + 60°, then 15° (4)
Cover to throttle valve manifold .....	5 (1)
Crankshaft pulley to toothed belt drive gear .....	20
Cylinder head cover to cylinder head .....	8
Engine damping block to bracket .....	65 (2)
Front toothed belt cover to cylinder head, intermediate piece and oil pump ....	8
Power steering hydraulic pump shackle to engine accessories bracket .....	18 (2)
Power steering hydraulic pump to engine accessories bracket .....	25 (2)
Rear toothed belt cover to cylinder head and oil pump housing .....	6
Ribbed V-belt tension roller to engine accessories bracket .....	18 (2)
Right engine damping block to side member .....	65 (3)
Toothed belt drive gear to crankshaft .....	250 + 40° - 50° (4)
Toothed belt guide roller to cylinder block .....	25 + 45°, then 15° (4)
Toothed belt tension roller to cylinder block .....	25 + 45°, then 15° (4)
Toothed belt guide roller to cylinder block .....	25 (2)
Toothed belt guide roller to guide roller bracket .....	25 (2)
Toothed belt tension roller to oil pump housing .....	20 (2)

(1) C 20 LET only

(2) Engines as of MY'93.

(3) Clean thread and insert bolt with Locking Compound to GMH Spec. HN1256, Loctite 242 or equivalent

(4) Use new bolt/s.