

# SECTION 6A1-2 - ENGINE MECHANICAL - V6 SUPERCHARGED

## **CAUTION:**

This vehicle will be equipped with a Supplemental Restraint System (SRS). A SRS will consist of either seat belt pre-tensioners and a driver's side air bag, or seat belt pre-tensioners and a driver's and front passenger's side air bags. Refer to CAUTIONS, Section 12M, before performing any service operation on or around SRS components, the steering mechanism or wiring. Failure to follow the CAUTIONS could result in SRS deployment, resulting in possible personal injury or unnecessary SRS system repairs.

## **1. GENERAL INFORMATION**

A supercharged engine is available as an option on VT Series Models. The supercharged engine gives the benefit of much improved power and torque at large throttle openings equivalent to having a larger capacity engine. Fuel economy is better than a larger capacity engine as the supercharger boost is cut at low throttle openings, where the engine performs similarly to its normally aspirated counterpart. The supercharger does not suffer from the lag that a turbocharger exhibits, and because of its more friendly operating environment, it is more reliable than a turbocharger. For supercharger diagnosis, refer to [Section 6C1 POWERTRAIN MANAGEMENT - V6 ENGINE](#).

### **1.1 GENERAL DESCRIPTION**

The supercharger is a positive displacement pump that consists of two counter-rotating rotors in a housing with an inlet port and outlet port. The rotors are designed with three lobes and a helical twist. An air bypass circuit is built into the housing.

Rotors in the supercharger are designed to run at a minimal clearance, not in contact with each other or the housing. The rotors are timed to each other by a pair of precision spur gears which are pressed onto the rotor shafts. The forward end of the rotors are held in position by deep groove ball bearings. The back end of the rotors are supported by sealed roller bearings.

The gears and ball bearings are lubricated by a synthetic oil from the oil reservoir in the supercharger and do not rely on engine oil for lubrication. The cover on the supercharger contains the input shaft which is supported by two deep groove ball bearings and coupled at one end to the rotor drive gears. A pulley is pressed onto the other end of the input shaft. The bearings for the input shaft are also lubricated by the synthetic oil.

Engine mechanical service operations for the V6 Supercharged engine carry over in general from those described for the non-supercharged V6 engine in [Section 6A1-1 ENGINE MECHANICAL - V6 ENGINE](#).

## 1.2 SUPERCHARGER ASSEMBLY

The supercharger is designed to pump more air than the naturally aspirated engine would normally use. This air creates a boost pressure in the intake manifold.

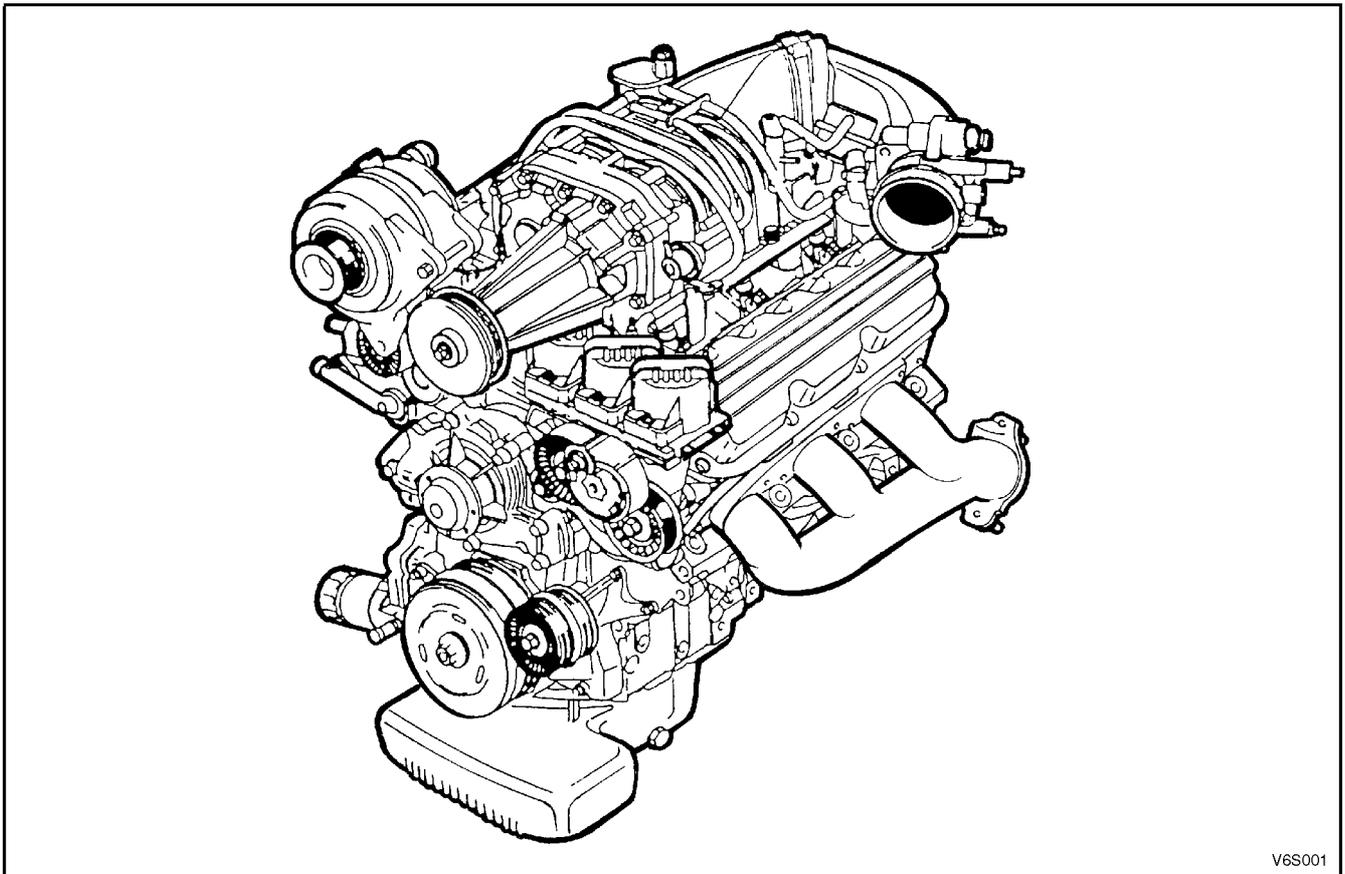
Maximum boost can range from 50 - 75 kPa. Since the supercharger is a positive displacement pump and is directly driven from the engine accessory drive system, boost pressure is available at all driving conditions. When boost is not desired, such as during idle and light throttle cruising, the excess air that the supercharger is producing is recirculated via the bypass passage between the lower intake manifold and the supercharger inlet.

This bypass circuit is regulated by a bypass valve which is similar to a throttle plate. The bypass valve is controlled by a vacuum actuator which is connected to the vacuum source between the throttle and the supercharger inlet. Spring force from the actuator holds the valve closed to create boost and vacuum pulls the valve open when the throttle closes.

The open bypass valve reduces pumping loss thereby increasing fuel efficiency. A PCM controlled solenoid valve is used to reduce boost in the event of engine overheating as signalled by excessive coolant temperature.

For additional information on supercharger and boost control operation, refer to

[Section 6C1 POWERTRAIN MANAGEMENT - V6 ENGINE.](#)



V6S001

Figure 6A1-2-1

### 1.3 SUPERCHARGER DRIVE BELT TENSIONER

The supercharged engine uses two accessory drive belts. The inner belt drives the generator, water pump, air conditioning compressor and power steering pump. The outer belt drives the supercharger. All belt driven accessories are rigidly mounted to the engine. Drive belt tension is maintained by the spring loaded belt tensioners. Each belt has its own tensioner.

A belt squeak when the engine is started or stopped is normal and has no effect on belt durability.

The drive belt tensioner can control belt tension over a broad range of belt lengths due to stretching; however, there are limits to the tensioners ability to compensate. Using the tensioner outside of its operating range can result in poor tension control and/or damage to the tensioner. The belt should be replaced when this condition occurs.

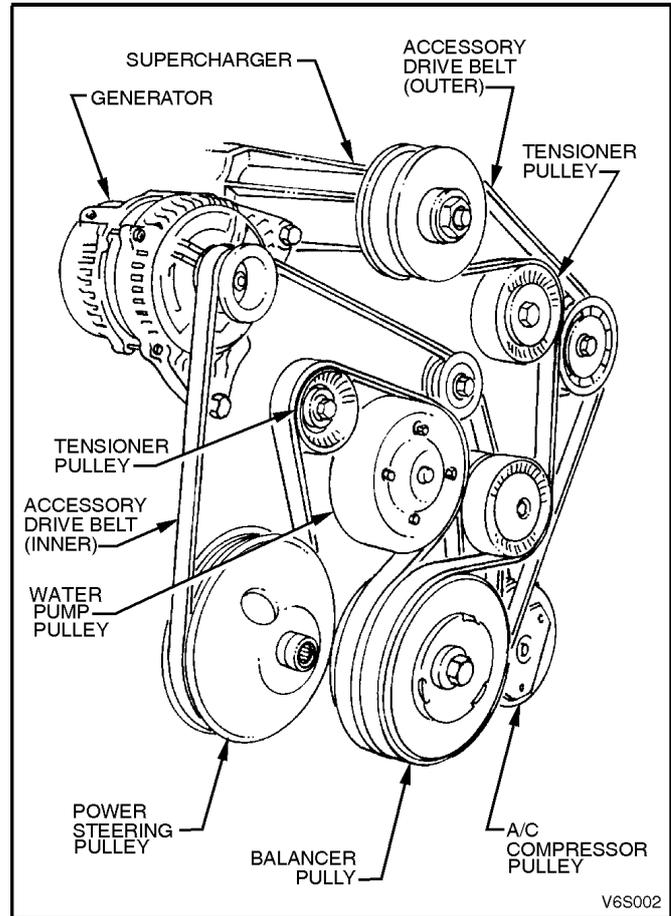


Figure 6A1-2-2

## 1.4 BALANCE SHAFT

The balance shaft has revised balance specifications and can be identified by the four lubrication holes at the rear bushing end of the shaft.

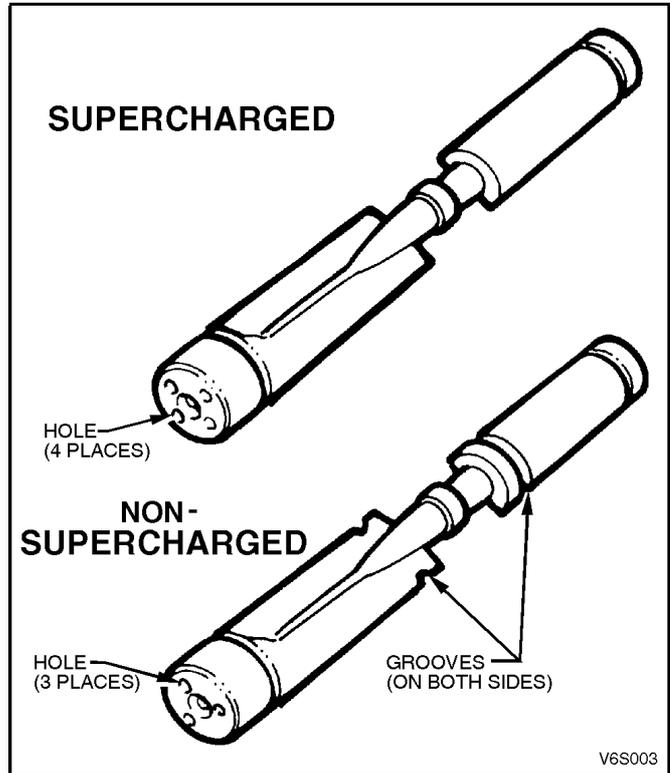


Figure 6A1-2-3

## 1.5 CAMSHAFT SPROCKET

The camshaft sprocket for the supercharged engine can be identified by triangular holes while the standard sprocket retains round holes.

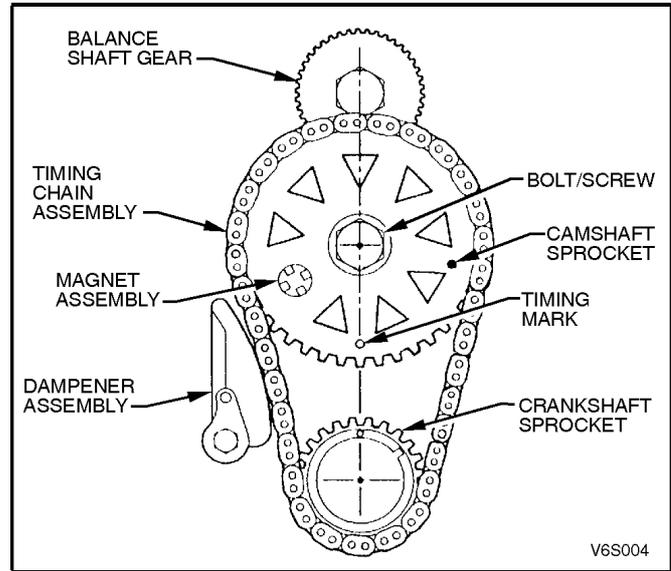


Figure 6A1-2-4

## 1.6 CRANKSHAFT BALANCER

The crankshaft balancer is a twin track type with balance compensation specifically for the supercharged engine.

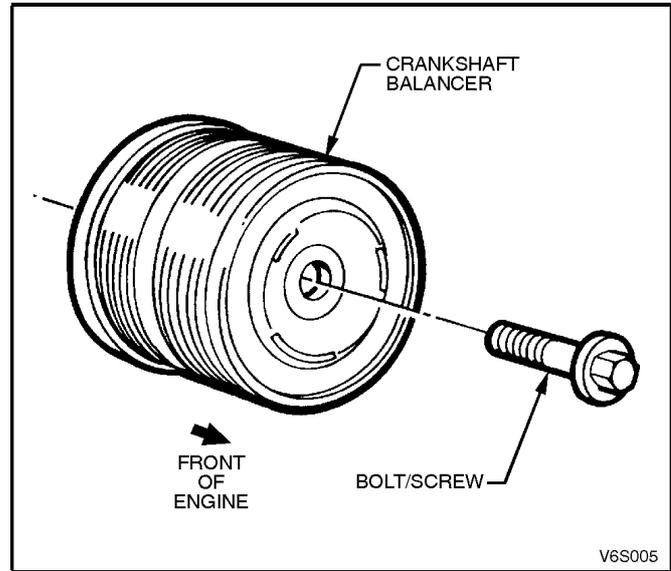


Figure 6A1-2-5

## 1.7 ROCKER COVERS & GASKETS

Rocker covers and gaskets are modified with cut outs to suit relocation of the injectors in the cylinder head inlet ports for the supercharged engine.

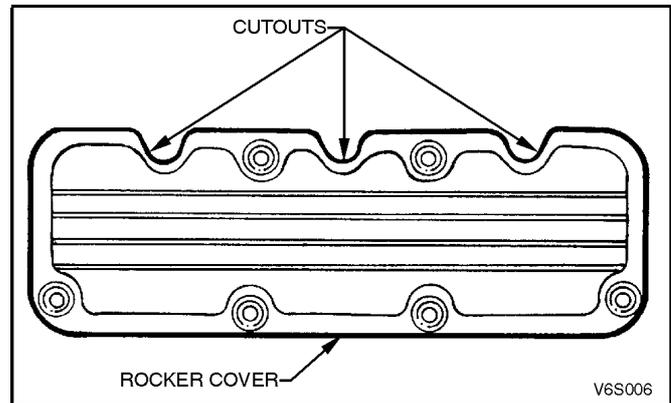


Figure 6A1-2-6

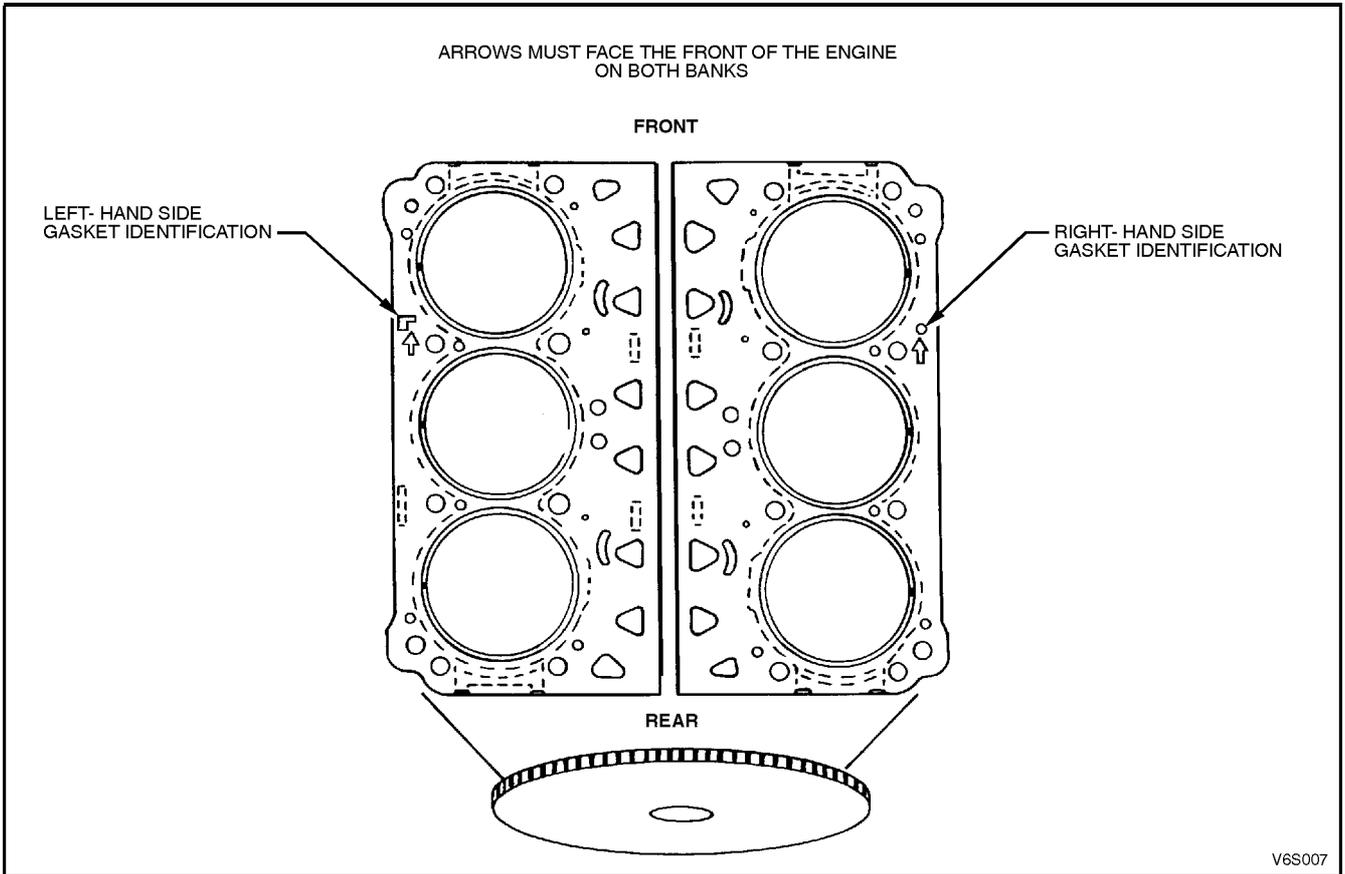
## **1.8 CONNECTING RODS**

The connecting rods have larger pin bush internal diameter and the big end/little end centre distance has been revised.

## **1.9 PISTONS & PINS**

Pistons and pins have been revised with a compression height of 30.6 mm and a larger floating piston pin of 23 mm nominal diameter.

## 1.10 CYLINDER HEADS & GASKETS



V6S007

**Figure 6A1-2-7**

Cylinder heads have been machined for the location of in-head fuel injectors. The cylinder head gaskets feature revised material and construction and are specific to each bank.

## 1.11 FUEL INJECTORS

Fuel injectors for VT supercharged engine are unique to this engine type and are of the high capacity type.

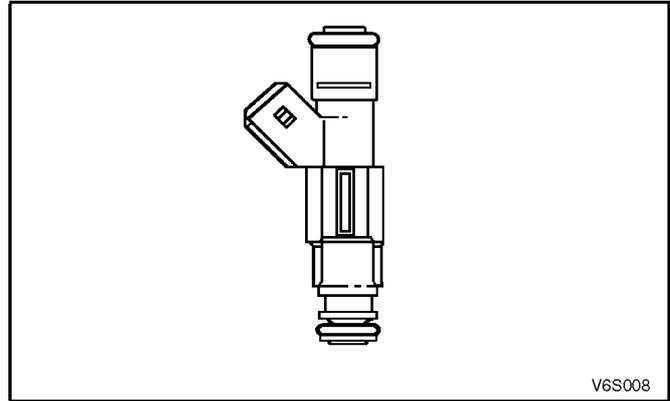


Figure 6A1-2-8

## 1.12 LOWER INLET MANIFOLD AND GASKETS

The lower inlet manifold is a machined aluminium casting incorporating the lower section of the inlet ports, coolant and PCV passages. The top face is machined flat to accommodate the supercharger and with the fuel injectors located in the cylinder heads, cut outs have been incorporated in the manifold gaskets for the injectors

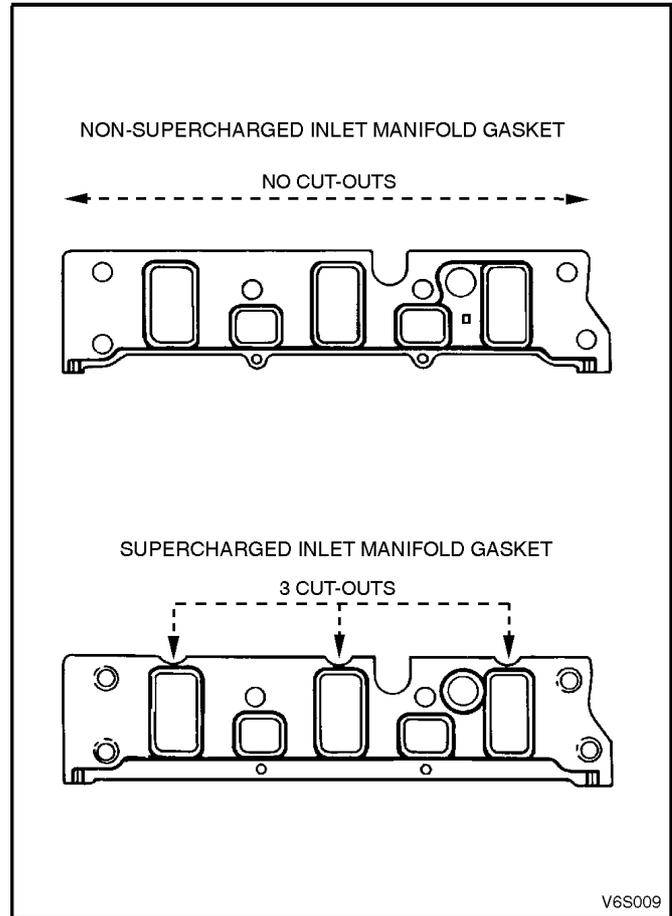


Figure 6A1-2-9

### 1.13 THROTTLE BODY ADAPTOR

The throttle body adaptor is a machined aluminium casting which connects the remote throttle body to the supercharger. The throttle body adaptor includes brake booster and heater vacuum nipples, cable bracket and mounting studs to suit the supercharger inlet.

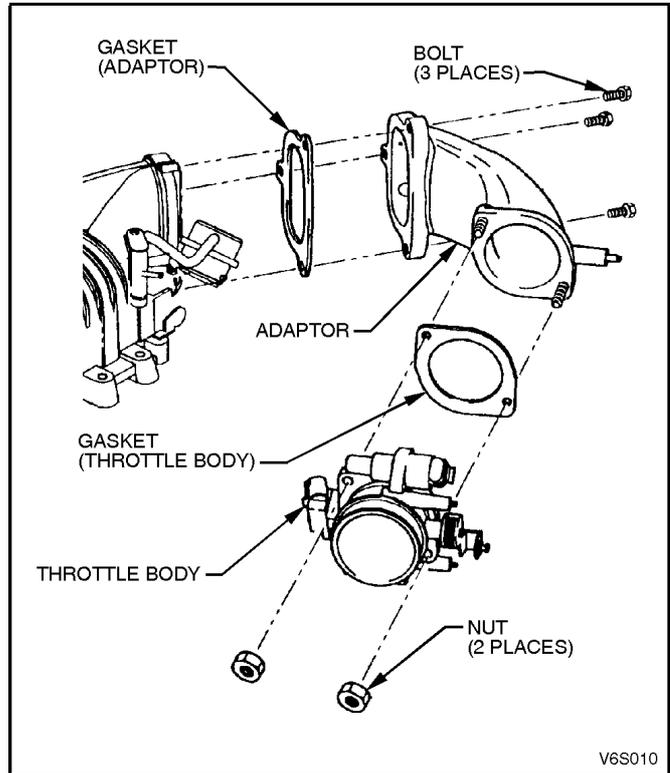


Figure 6A1-2-10

## 1.14 FUEL RAIL

The fuel rail assembly is a steel tube type and specific to the supercharged engine. The fuel rail incorporates the fuel pressure regulator and a Schraeder valve to enable easy connection of a fuel pressure gauge. The fuel pressure regulator is not serviced separately from the fuel rail.

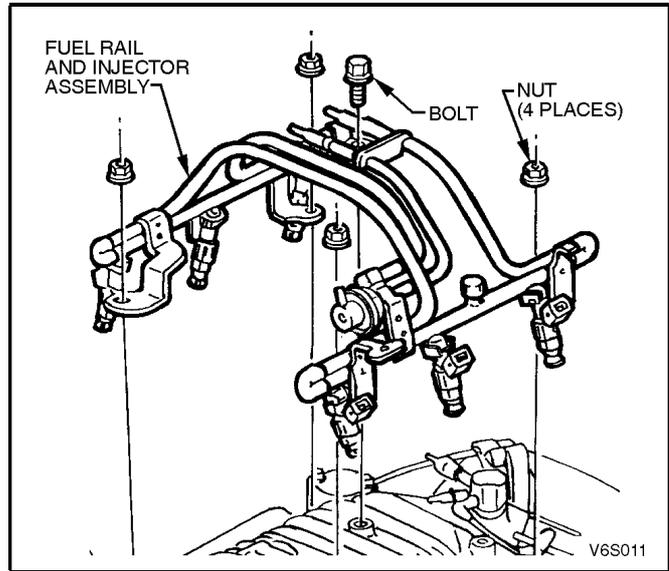


Figure 6A1-2-11

## 1.15 BYPASS VALVE ACTUATOR

The supercharger bypass valve actuator operates a valve which can cut boost at idle or at low throttle openings by diverting inlet air around the supercharger.

For additional information on bypass actuator operation, refer to [Section 6C1 POWERTRAIN MANAGEMENT - V6 ENGINE](#).

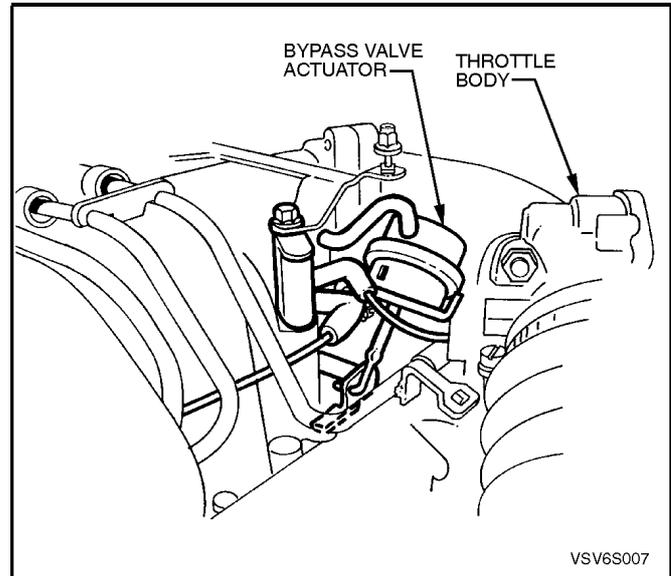


Figure 6A1-2-12

## 1.16 BOOST CONTROL SOLENOID VALVE

A boost control solenoid valve, located at the rear of the left hand cylinder head is a PCM controlled engine protection device which reduces boost in the event of excessive coolant temperature.

Boost pressure is reduced by routing boost air from the supercharger outlet via the solenoid to the lower chamber of the bypass actuator, which then opens the bypass valve.

### NOTE:

Electrical connection must always be maintained to the boost control solenoid valve as no voltage will trigger boost reduction even under normal coolant temperature operation.

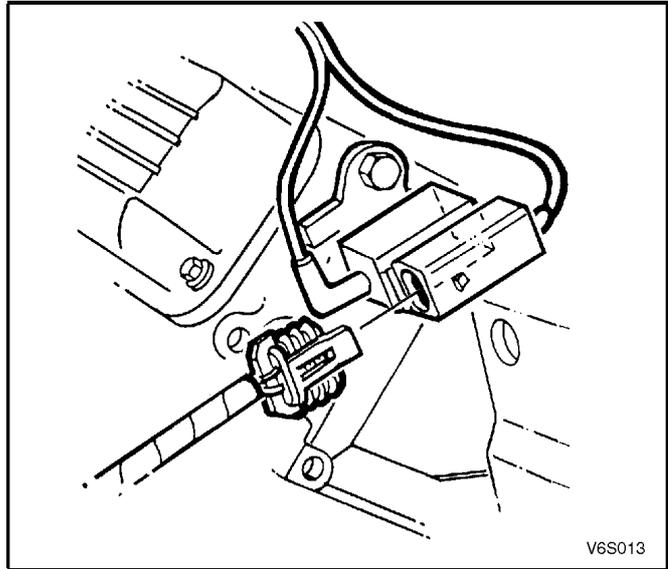


Figure 6A1-2-13

## 1.17 WATER OUTLET HOSE AND RADIATOR INLET PIPE

The water outlet hose connects the thermostat housing outlet port to the radiator inlet pipe to convey the engine coolant from the back of the inlet manifold to the radiator inlet port. The thermostat housing cover is a machined aluminium casting which includes the cooling system bleeder valve. The thermostat housing is located at the rear of the inlet manifold.

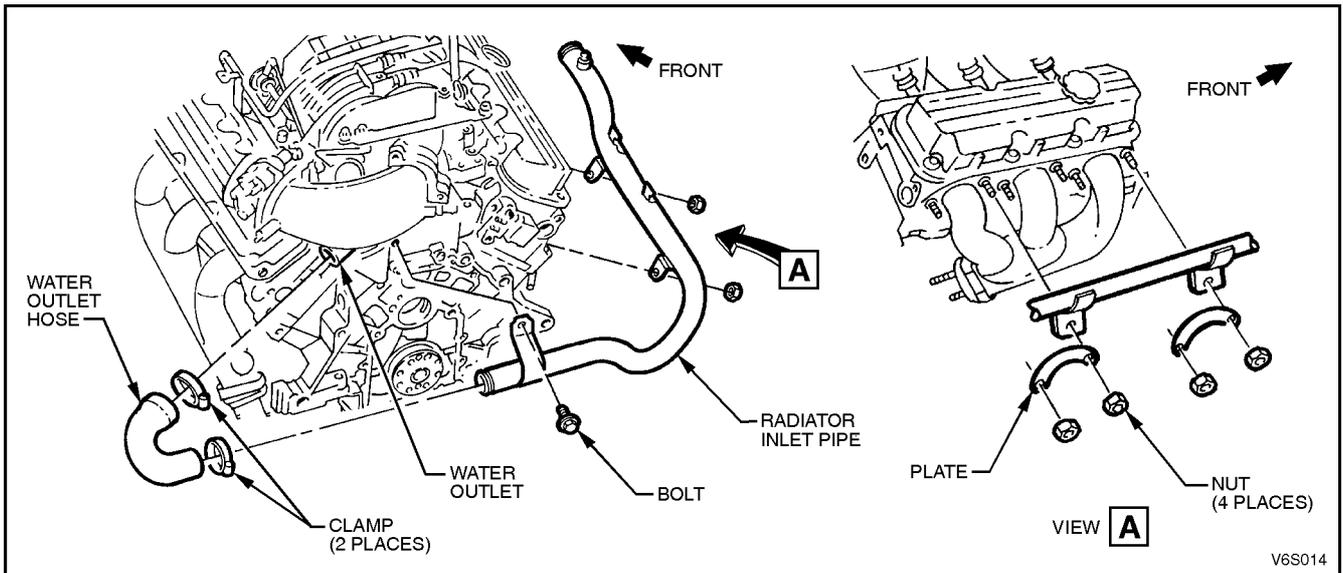


Figure 6A1-2-14

## 1.18 SUPERCHARGER DRIVE BELT IDLER PULLEY & BELT TENSIONER

There are two flat idler pulleys for accessory drive and supercharger drive, mounted on aluminium brackets adjacent to the crankshaft balancer and DIS coil pack.

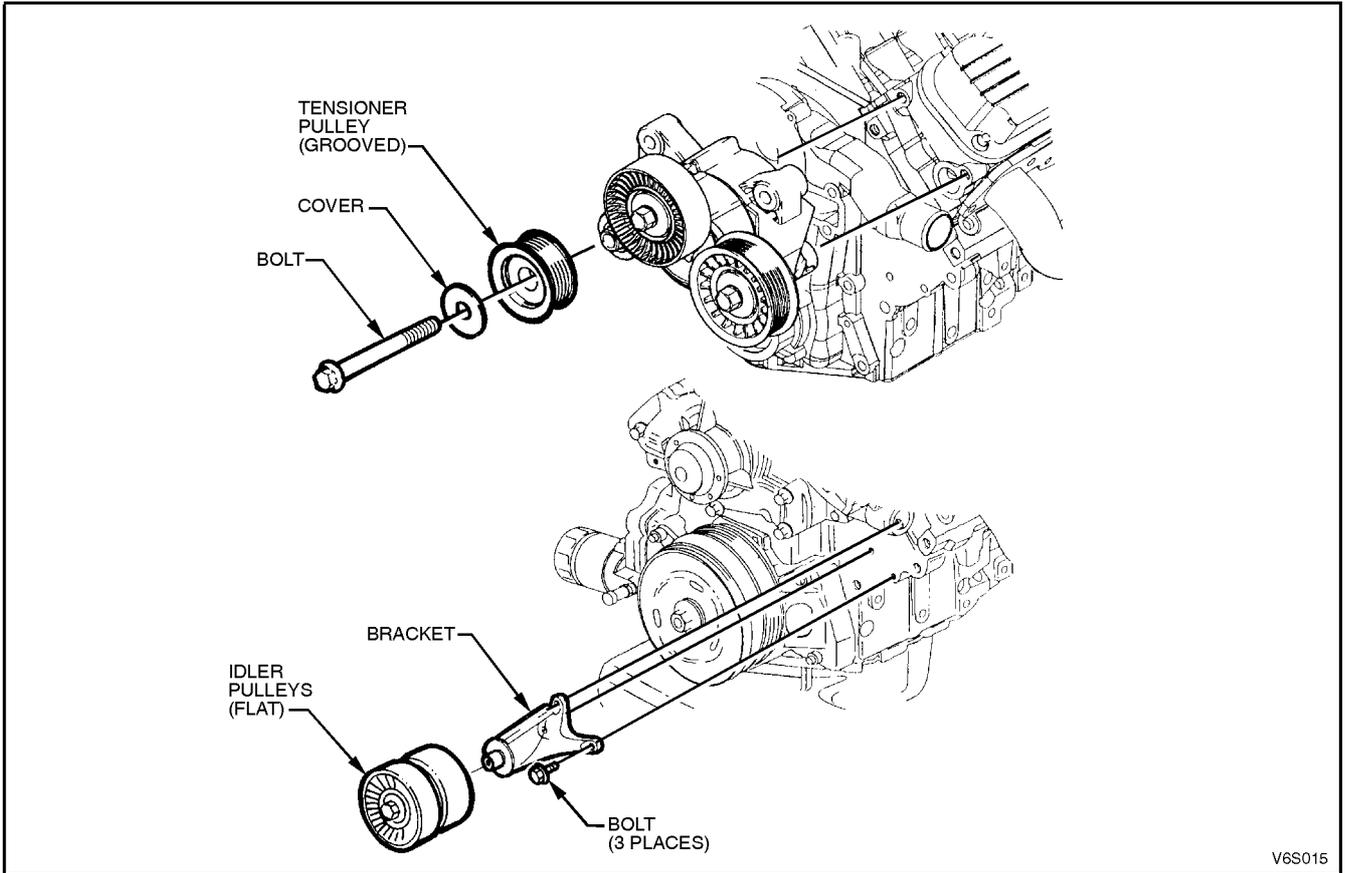


Figure 6A1-2-15

## 1.19 FLEXPLATE

The flexplate for the supercharged engine has revised balancing.

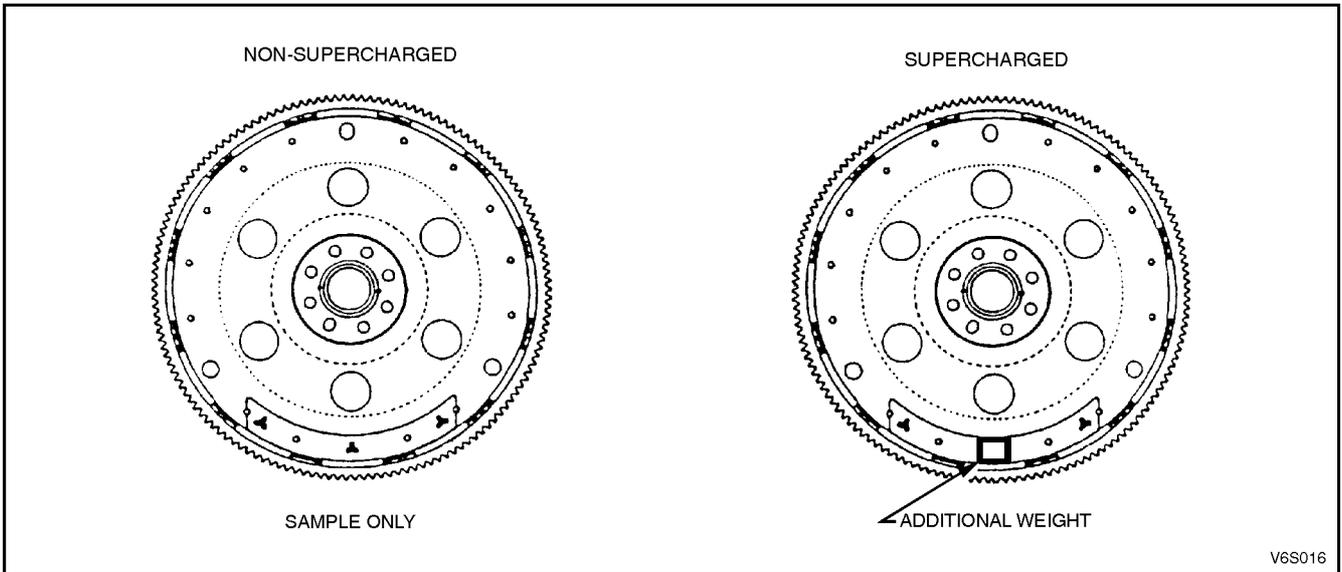


Figure 6A1-2-16

## **1.20 PCM CALIBRATION**

The supercharged engine PROM has revised calibration. For further information, refer to [Section 6C1 POWERTRAIN MANAGEMENT - V6 ENGINE](#).

## **1.21 HIGH TENSION LEADS**

The high tension leads are of low impedance for high energy coils with specific routing and retention. For high tension lead routing, refer to [Section 6D1-3 IGNITION SYSTEM - V6 ENGINE](#).

## **1.22 DIS COILS & SPARK PLUGS**

The coil and module assembly is a Delco-high energy unit with specific bracketing. The spark plugs are a specific heat range and design for the supercharged engine.

## 2. SERVICE OPERATIONS

### 2.1 SUPERCHARGER OIL LEVEL CHECK

#### NOTE:

A small amount of oil weepage through the front seal, (behind the pulley) of the supercharger assembly is normal. This oil weepage is caused by minute traces of oil escaping around the seal. A build up of airborne dust can adhere to the thin oil film which causes oil weepage to appear worse than it really is. The supercharger assembly should not be replaced due to weepage. If supercharger oil is visually dripping or puddling from the supercharger front seal, the supercharger assembly will need to be replaced. Refer to [2.2 SUPERCHARGER AND GASKET](#) in this Section.

#### CAUTION:

**Do not remove the oil plug when engine is warm. Engine should be cool to the touch. Approximately 2 -3 hours after running. Removing oil plug at warm engine temperatures can cause hot oil to overflow. This could result in oil loss and possible personal injury.**

Lubricant level is to be checked at the specified service intervals outlined in the VT Series Owner's Handbook.

#### REMOVE

1. Remove the four dome nuts securing the engine dress cover assembly to the mounting bracket studs, refer to Fig. 6A1-2-17, lift off and remove the cover assembly.

#### NOTE:

To prevent contamination of the supercharger oil, clean the area around the oil filler plug before removing.

2. Using a 3/16 inch Allen key socket, remove supercharger filler plug.
3. Check oil level.

#### NOTE:

The oil level should be maintained to a level at the bottom of the threads in the oil filler plug inspection hole in the supercharger housing.

#### IMPORTANT:

Do not use petroleum based oil. Use only GM p/no. 12345982 synthetic oil. Use of other oil may cause supercharger failure.

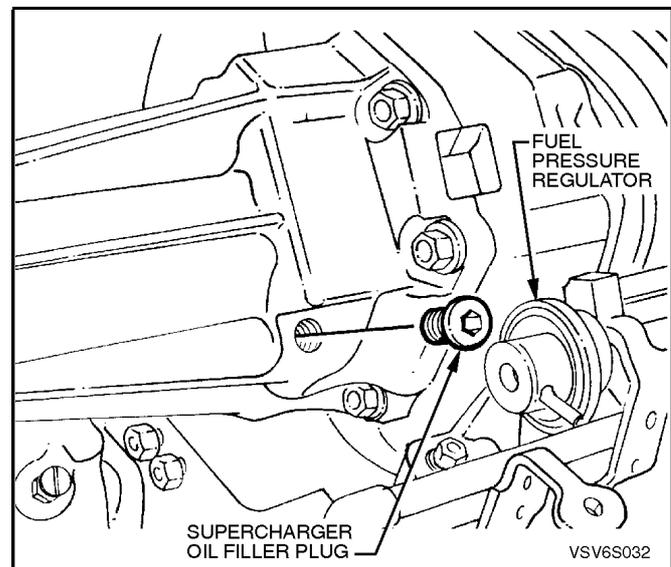


Figure 6A1-17

## REINSTALL

1. Reinstall the oil filler plug, ensuring sealing cap O - ring is in place on plug.  
Tighten plug to the correct torque specification.

SUPERCHARGER OIL FILLER PLUG TORQUE SPECIFICATION	10 Nm
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2. Reinstall engine dress cover to the mounting brackets, ensuring that stud grommets in the dress cover remain in place. Tighten securing dome nuts to the correct torque specification.

ENGINE DRESS COVER SECURING DOME NUT TO MOUNTING BRACKET TORQUE SPECIFICATION	4.0 - 6.0 Nm
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## 2.2 SUPERCHARGER AND GASKET

### REMOVE

#### NOTE:

Servicing of the supercharger unit itself is limited to replacement only. No attempt should be made to disassemble the supercharger as parts damage may result.

1. Disconnect the negative cable from the battery terminal.
2. Remove the four engine dress cover dome nuts and remove the cover.

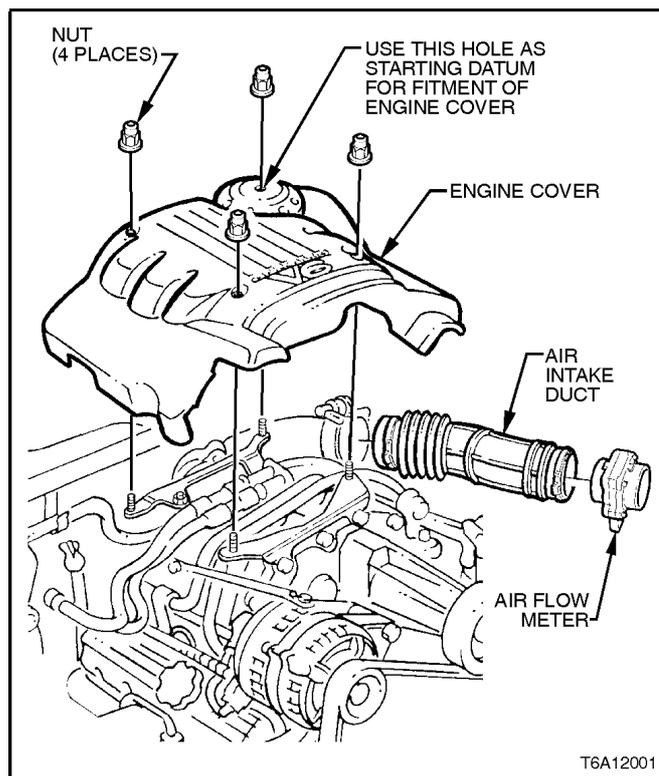


Figure 6A1-2-18

3. Disconnect the electrical connectors from the IAC, MAF, IAT, TP sensors and place harness to one side.
4. Remove the clamps securing air intake duct/air flow meter assembly to throttle body and air filter, removing assembly.

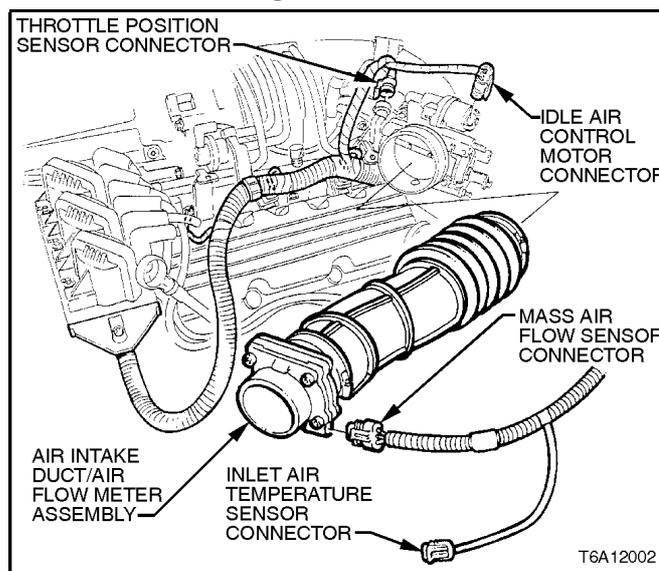


Figure 6A1-19

5. Remove the screws securing rear dress cover bracket and boost solenoid harness.
6. Disconnect supercharger vacuum connections from heating/ventilation system, throttle body, fuel pressure regulator, boost solenoid harness and engine ventilation hose.
7. Remove bypass solenoid harness, refer to [2.3 BYPASS SOLENOID HARNESS ASSEMBLY](#) in this Section, and BYPASS VALVE ACTUATOR in [Section 6C1 POWERTRAIN MANAGEMENT - V6 ENGINE.](#)

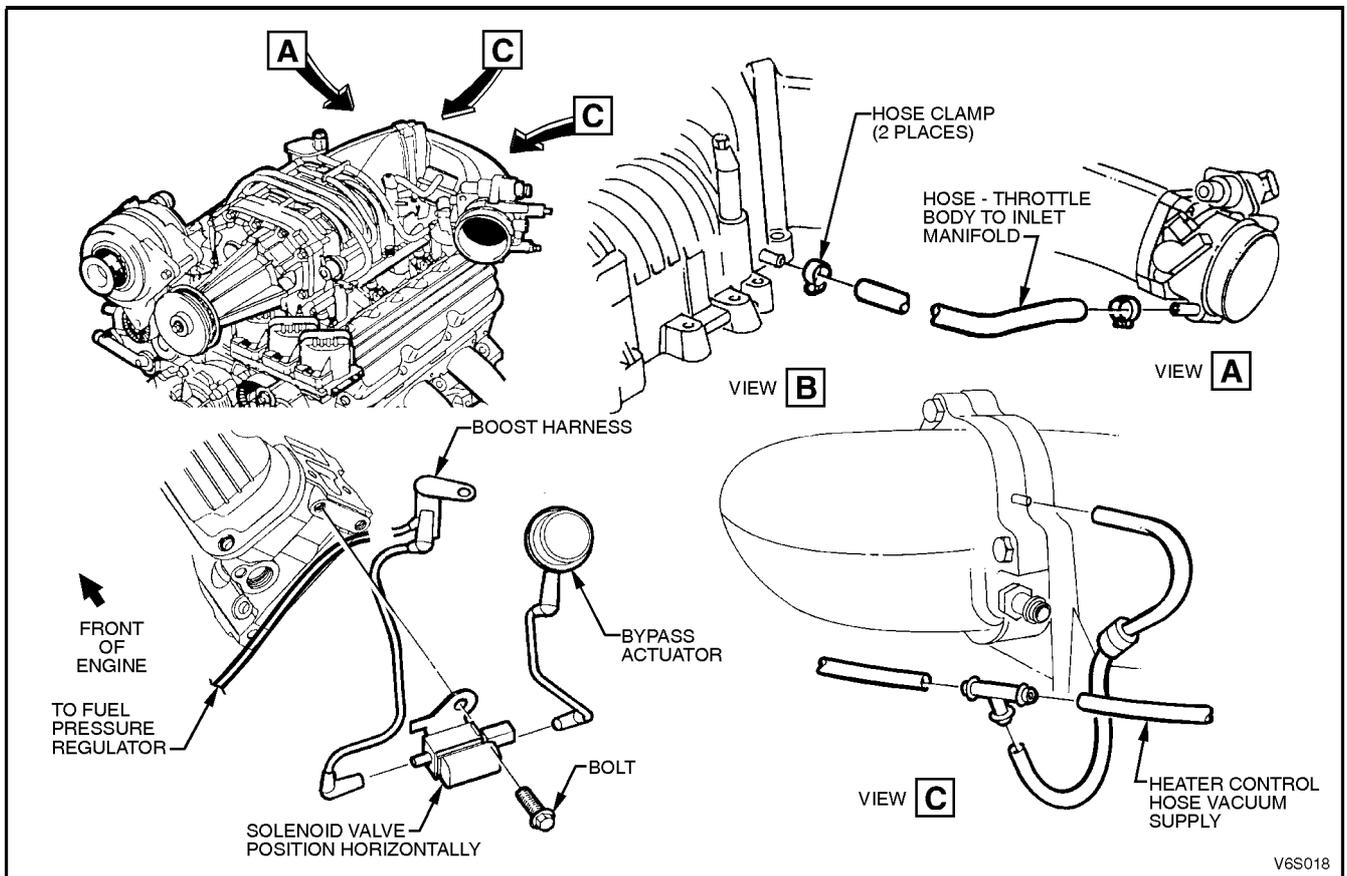


Figure 6A1-2-20

8. Depressurise the fuel rail, refer to [Section 6C1 POWERTRAIN MANAGEMENT - V6 ENGINE](#) and disconnect the electrical connectors from injectors.
9. Remove the generator support bracket.
10. Disconnect the fuel lines from the fuel rail assembly and remove the fuel rail, refer to [Section 6C1 SERVICE OPERATIONS](#).

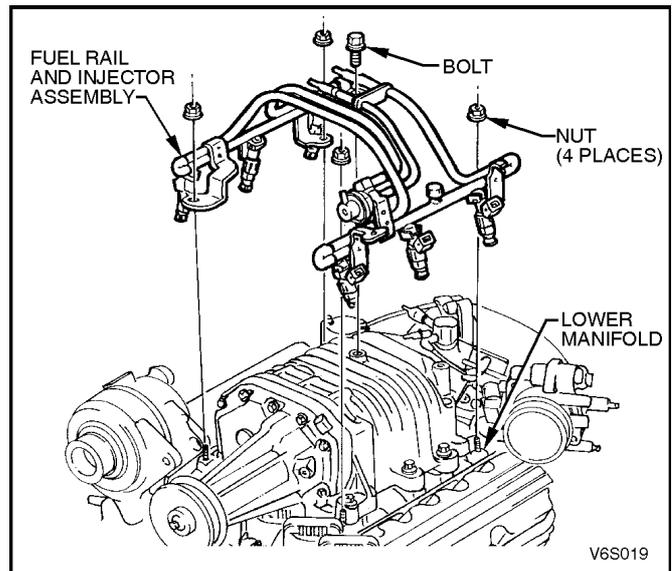
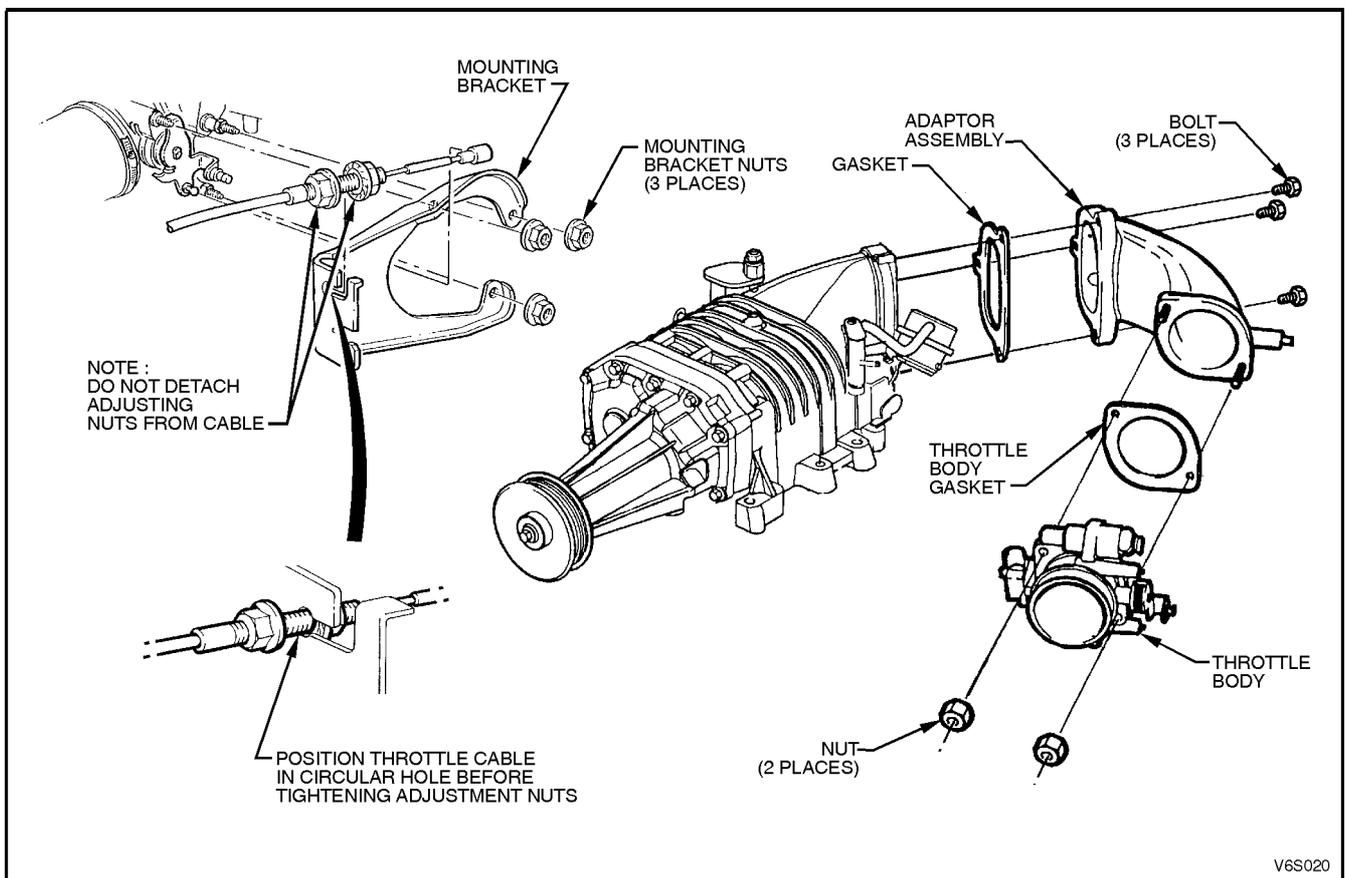


Figure 6A1-2-21



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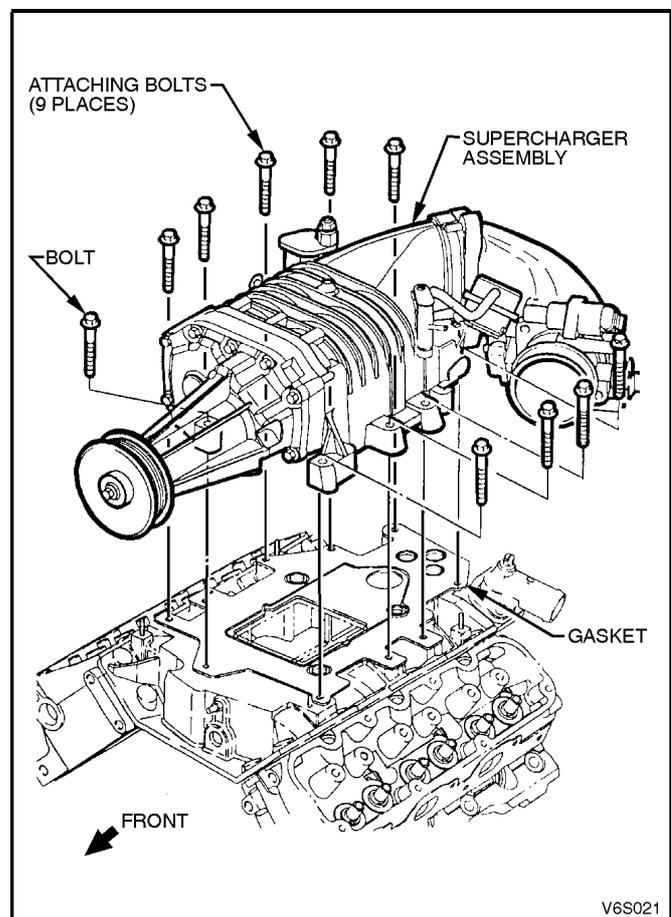
Figure 6A1-2-22

11. Disconnect throttle cable and where fitted cruise control cable.
12. Remove throttle body from throttle body adaptor, refer to [2.4 THROTTLE BODY](#) in this Section.
13. Remove the drive belt from supercharger pulley, refer to [2.9 SUPERCHARGER DRIVE BELT](#) in this Section.
14. Remove supercharger to inlet manifold bolts and remove the supercharger.

**CAUTION:**

Do not place fingers or foreign objects near supercharger vanes as personal injury or damage to supercharger vanes can result.

15. Remove supercharger gasket and O - rings.



V6S021

Figure 6A1-2-23

## REINSTALL

1. That all mating surfaces are clean.
2. Supercharger to intake manifold gasket and O - rings are replaced.
3. Torque sequence is maintained.

### SUPERCHARGER ATTACHING BOLT TORQUE SPECIFICATION

FIRST STAGE	$14 \pm 4.0$ Nm
SECOND STAGE	$24 \pm 3.0$ Nm

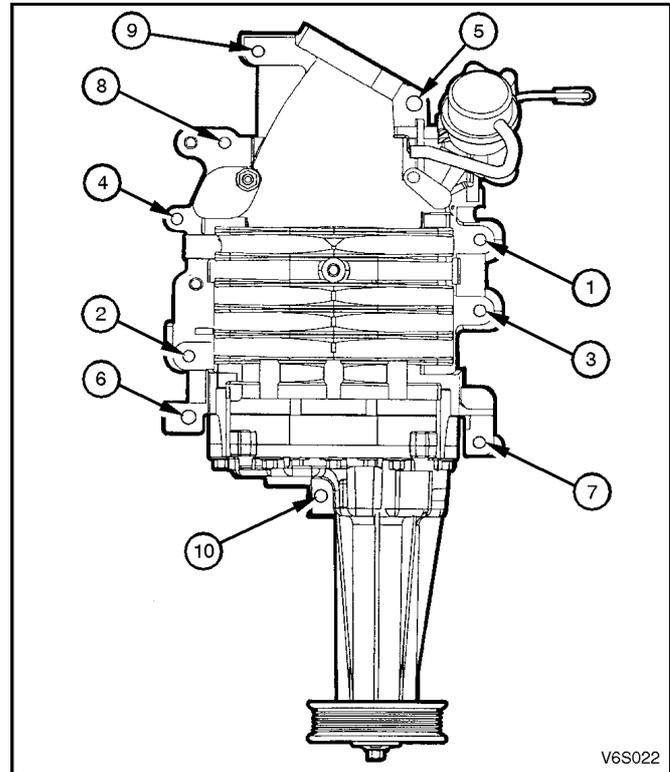


Figure 6A1-2-24

Installation of the supercharger is the reverse of removal operations noting the following points:

## 2.3 BYPASS SOLENOID HARNESS ASSEMBLY

### REMOVE

1. Disconnect the negative cable from the battery terminal.
2. Remove the four engine dress cover dome nuts and remove the cover.
3. Disconnect vacuum connections from fuel pressure regulator and bypass solenoid.

### REINSTALL

Reverse removal operations.

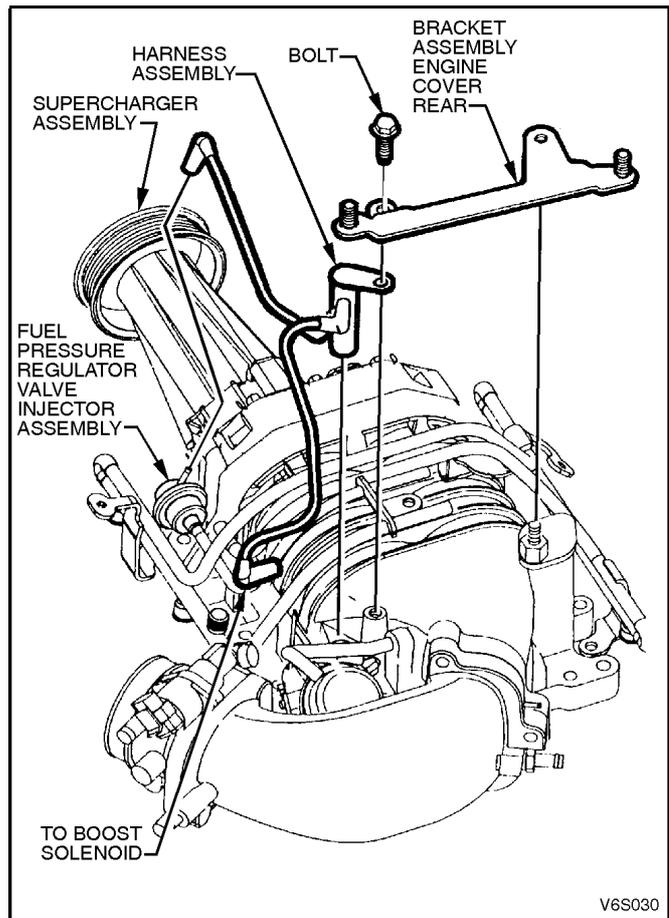


Figure 6A1-2-25

## 2.4 THROTTLE BODY

### REMOVE

1. Disconnect the negative cable from the battery terminal.
2. Disconnect the electrical connectors from the IAC, MAF, IAT, TP Sensor and place harness to one side.
3. Remove the clamps securing air intake duct/air flow meter assembly to throttle body and air filter and remove the assembly.
4. Remove the two nuts securing the throttle body assembly to the throttle body adaptor and remove the assembly.

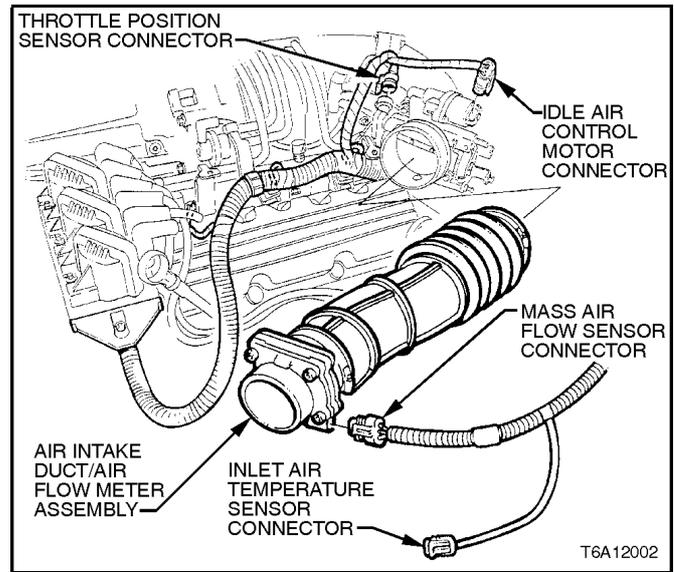


Figure 6A1-2-26

### REINSTALL

Reverse removal operations.

THROTTLE BODY NUT TORQUE SPECIFICATION	15 - 20 Nm
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ENGINE DRESS COVER NUT TORQUE SPECIFICATION	4.0 - 6.0 Nm
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## 2.5 THROTTLE BODY ADAPTOR

### REMOVE

1. Disconnect the negative cable from the battery terminal.
2. Remove the four engine dress cover dome nuts and remove the cover.
3. Remove the Throttle Body, refer to [2.4 THROTTLE BODY](#) in this Section.
4. Remove the bypass solenoid harness and bypass valve actuator, refer to [2.3 BYPASS SOLENOID HARNESS ASSEMBLY](#) in this Section.
5. Disconnect the vacuum lines from the throttle body adaptor.
6. Remove the two bolts and one nut securing the throttle body adaptor to the supercharger.

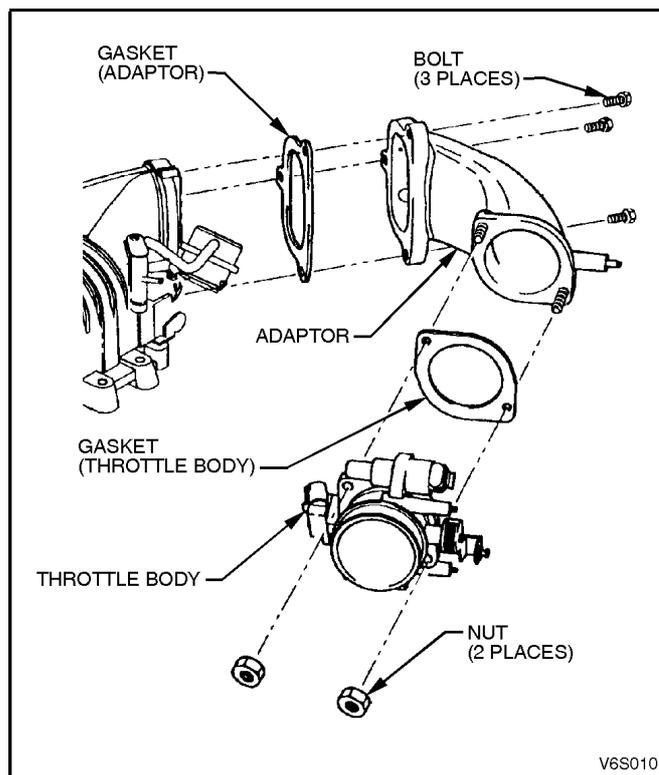


Figure 6A1-2-27

### REINSTALL

Reverse removal operations, noting the following.

- a. Ensure bypass valve actuator preload is adjusted correctly.
- b. Ensure all vacuum lines are connected correctly.

THROTTLE BODY NUT TORQUE SPECIFICATION	15 - 20 Nm
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ENGINE DRESS COVER NUT TORQUE SPECIFICATION	4.0 - 6.0 Nm
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## **2.6 ENGINE VENTILATION SYSTEM**

The engine ventilation system, utilises engine vacuum to draw blow-by gasses into the combustion chambers where they are recycled through the combustion process. The ventilation system should be checked at the specified time or distance intervals in the VT Series Owner's Handbook.

## **2.7 FUNCTIONAL CHECK OF CRANKCASE VENTILATION VALVE**

If an engine is idling rough, check for a clogged crankcase ventilation valve. Replace as required using the following procedure:

1. Remove crankcase ventilation valve from rear of supercharger, refer to [2.8 CRANKCASE VENTILATION VALVE](#) in this Section.
2. Shake valve and listen for the rattle of needle inside valve. If valve does not rattle, replace valve.

## 2.8 CRANKCASE VENTILATION VALVE

### REMOVE

1. Remove the four engine dress cover dome nuts and remove the cover.
2. Hold down the crankcase ventilation valve cover and remove the two cover retainer screws.
3. Remove the crankcase ventilation valve cover, gasket, crankcase ventilation valve, spring and O - ring.

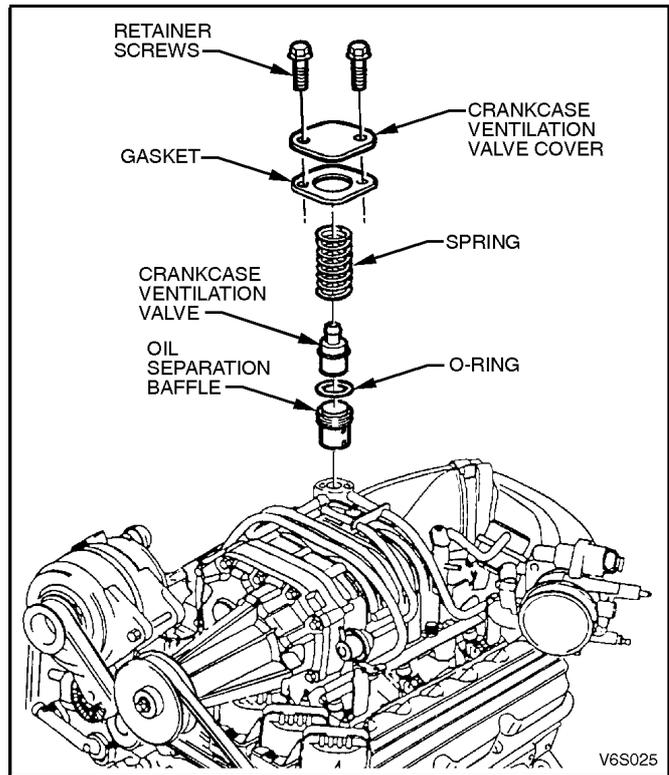


Figure 6A1-2-28

### REINSTALL

Reverse removal operations using new O - rings and gasket as necessary.

CRANKCASE VENTILATION VALVE COVER SCREW TORQUE SPECIFICATION	4.0 - 6.0 Nm
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## 2.9 SUPERCHARGER DRIVE BELT

### TENSION CHECK

1. Inspect tensioner markings to see if belt is within operating limits. Replace belt if excessively worn or outside tensioner's operating range.

Refer to [Section 6A1-1 ENGINE MECHANICAL - V6 ENGINE](#) for checking procedure.

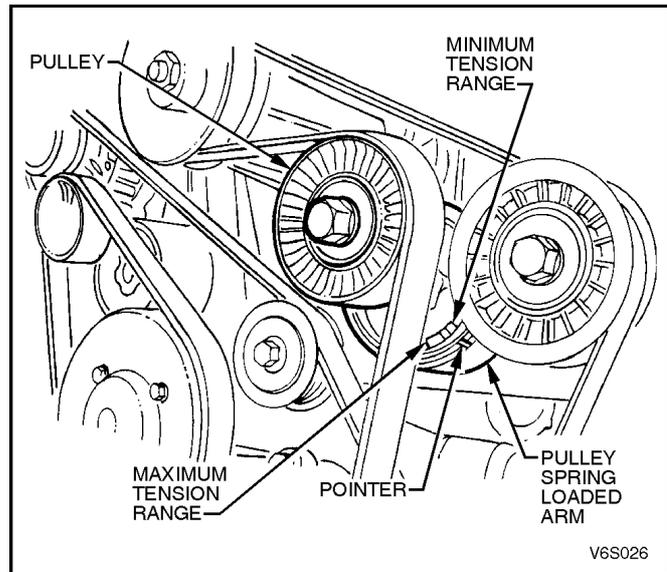


Figure 6A1-2-29

### INSPECT

Refer to [Section 6A1-1 ENGINE MECHANICAL - V6 ENGINE](#).

### REMOVE

1. Disconnect the negative cable from the battery terminal.
2. Remove the four engine dress cover dome nuts and remove the cover.
3. Using a 15 mm ring spanner on supercharger drive belt tensioner pulley pivot bolt, rotate tensioner pulley assembly anti-clockwise and remove drive belt from supercharger. Release tensioner pulley assembly and remove drive belt from remaining drive pulleys.

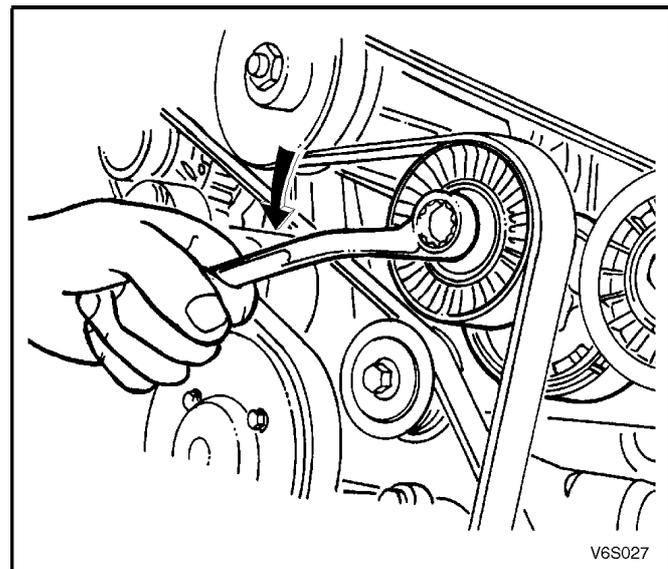


Figure 6A1-2-30

## REINSTALL

1. Inspect drive belt condition, refer to [Section 6A1-1 ENGINE MECHANICAL - V6 ENGINE](#).

### NOTE:

Ensure drive belt ribs are aligned into all pulleys and crankshaft balancer drive belt grooves.

2. Using a 15 mm ring spanner, rotate supercharger drive belt tensioner pulley anti-clockwise and feed drive belt over supercharger pulley. Return tensioner to its normal position.
3. Reconnect battery negative cable, start engine and check drive belt operation.

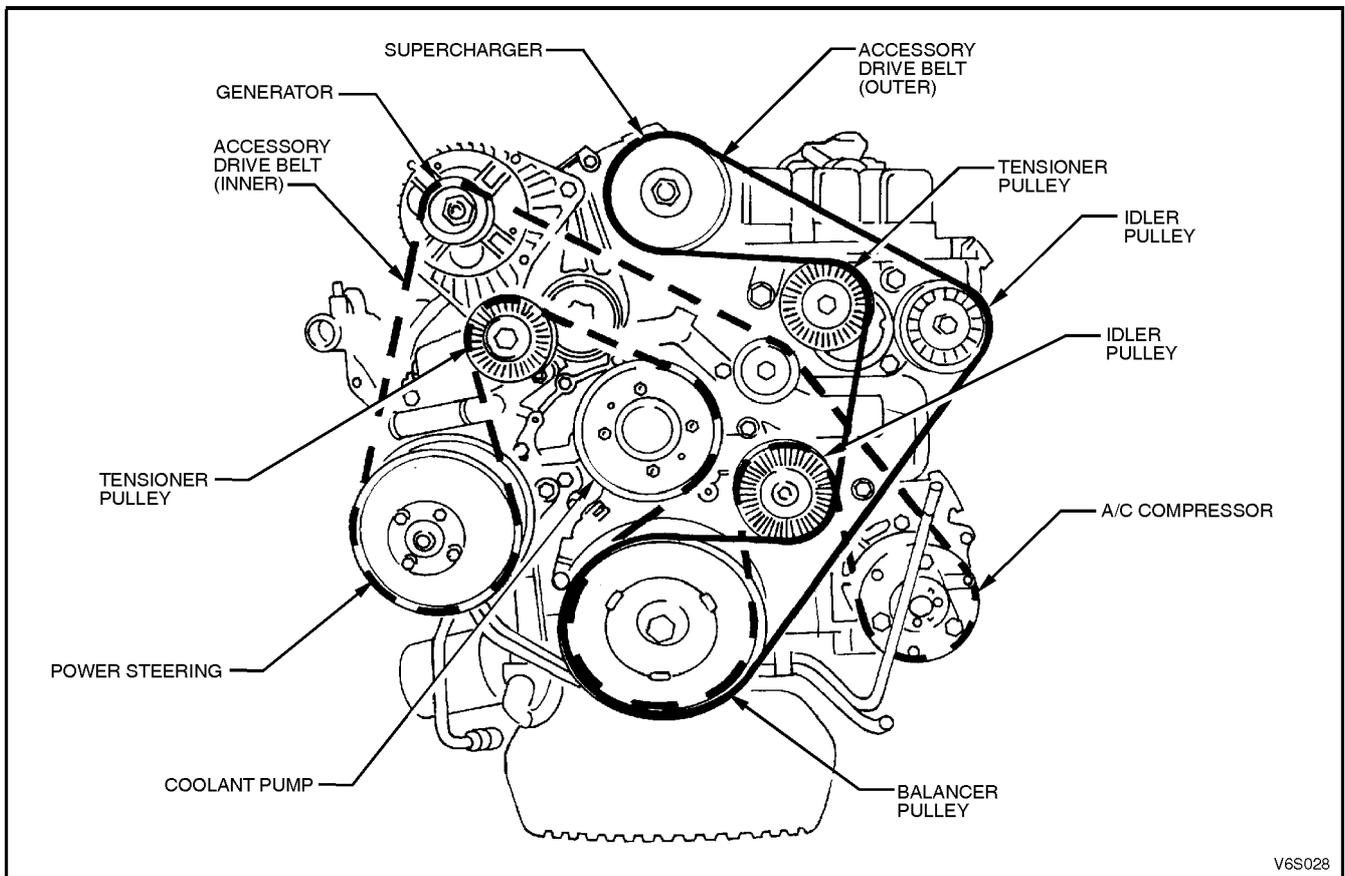


Figure 6A1-2-31

## 2.10 SUPERCHARGER DRIVE BELT TENSIONER ASSEMBLY

### REMOVE

1. Disconnect the negative cable from the battery terminal.
2. Remove the four engine dress cover dome nuts and remove the cover.
3. Using a 15 mm ring spanner on supercharger drive belt tensioner pulley pivot bolt, rotate tensioner pulley assembly anti-clockwise and remove drive belt from supercharger. Release tensioner pulley assembly and remove drive belt from remaining drive pulleys.

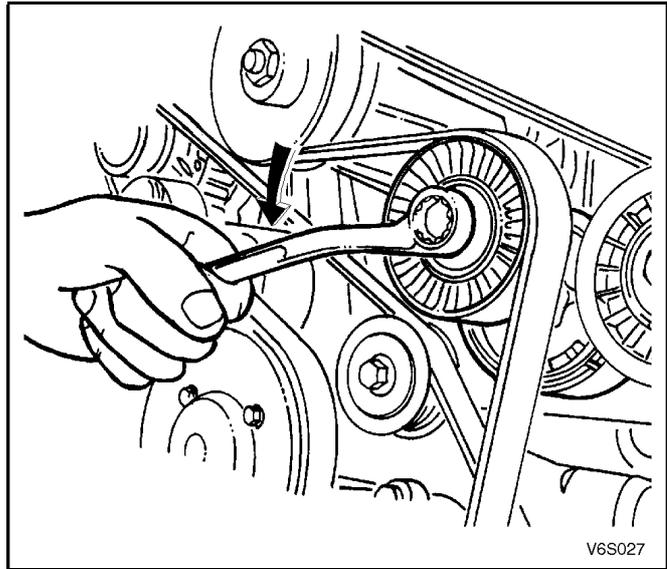


Figure 6A1-2-32

4. Using a 15 mm ring spanner on accessory drive belt tensioner pulley pivot bolt, rotate tensioner pulley assembly anti-clockwise and remove drive belt from supercharger drive belt tensioner idler pulley. Release tensioner pulley assembly and remove drive belt from remaining drive pulleys.

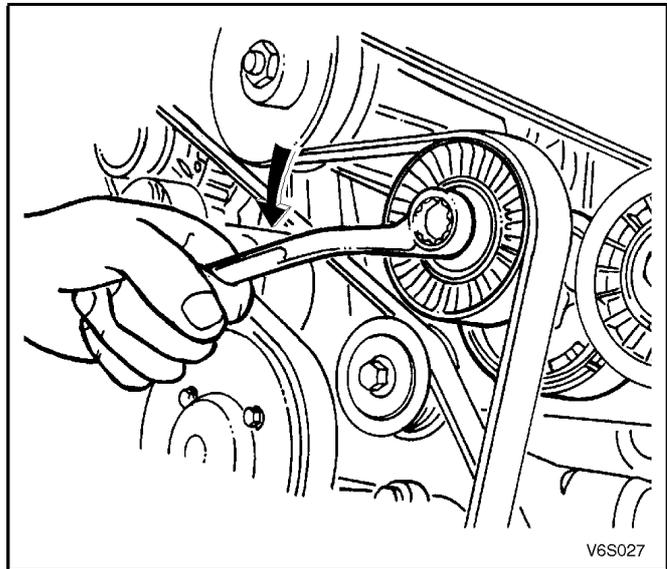


Figure 6A1-2-33

5. Remove the bolts securing the coil pack to the drive belt tensioner assembly.
6. Remove the bolts securing the drive belt tensioner assembly to the cylinder head.

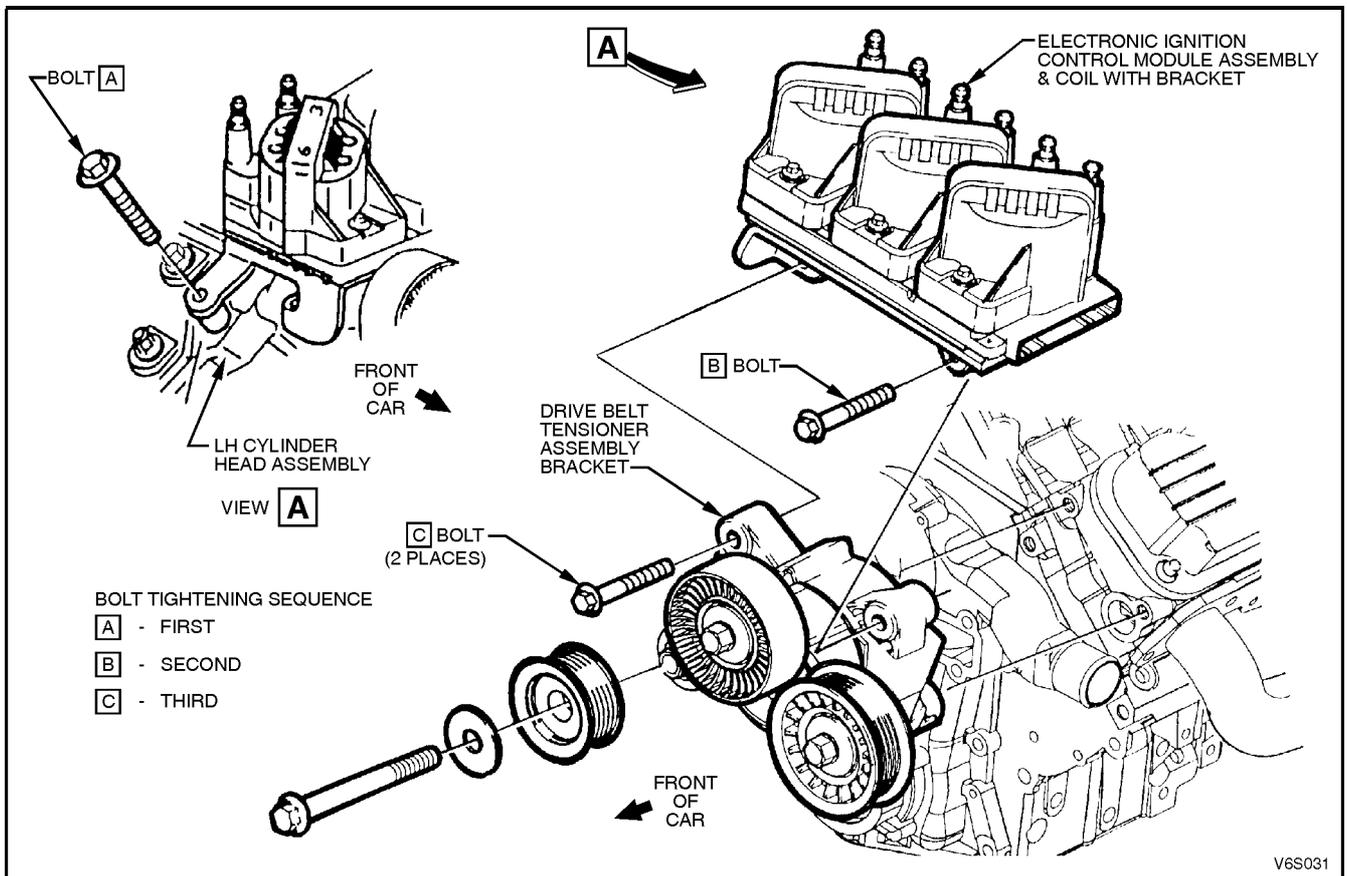


Figure 6A1-2-34

## REINSTALL

1. Ensure all fasteners are tightened to the correct torque sequence specification, refer to [4. TORQUE WRENCH SPECIFICATIONS](#) in this Section.  
Refer to [Fig. 6A1-2-34](#) for coil pack tightening sequence.
2. Start engine and check drive belt operation.

### 3. SPECIFICATIONS

#### GENERAL

Engine Type	90 degree V6 supercharged, OHV
Piston Displacement Nom. - cm <sup>3</sup>	3791
Compression Ratio	8.5:1
Number of Cylinders	6
Bore x Stroke - mm	96.5 X 86.3
Taxable H.P.RAC OR SAE	34
Power kW DIN @ RPM	171 kw @ 5200
Torque Nm DIN @ RPM	375 Nm @ 3000

## 4. TORQUE WRENCH SPECIFICATIONS

	Nm
Supercharger drive belt tensioner attaching bolt	40 - 50
Supercharger drive belt tensioner pulley bolt	40 - 50
Supercharger drive belt idler pulley bolt	40 - 60
Supercharger drive belt idler pulley bracket bolt	25 - 35
Supercharger attaching bolts	
First stage	14 ± 4.0
Second stage	24 ± 3.0
Supercharger oil filler plug	10
Engine dress cover attaching nut	4.0 - 6.0
Engine dress cover bracket attaching bolt/nut	15 - 20
Coil pack attaching bolts (tighten coil pack in A,B,C sequence refer to <a href="#">Figure 6A1-2-34</a> )	40 - 50
Throttle body adaptor attaching bolts	20 - 28
Throttle body nuts	15 - 20
Crankshaft balancer attaching bolt	270 - 325
Bypass valve actuator attaching bolts	26
Bypass harness attaching bolt	15 - 20
Boost reduction solenoid bolt	30 - 40
Fuel rail attaching bolt	20 - 30
Fuel rail attaching nut	8.0 - 12
Thermostat housing water outlet hose clamp	2.0 - 5.0
Radiator inlet pipe attaching bolt	20 - 27
Bypass actuator solenoid valve attaching bolts	30 - 40
Throttle body to inlet manifold hose clamp	2.0 - 4.0
Throttle cable adjusting nuts	2.0 - 4.0
Crankcase ventilation valve cover retainer screws	4.0 - 6.0