LAND CRUISER

New Car Features Supplement

Jan., 1995

TOYOTA

Foreword

To assist you in your service activities, this manual explains the main characteristics of the new 75 and 80 series Land Cruiser, in particular providing a technical explanation of the construction and operation of new mechanisms and new technology used. This manual is written as a supplement to previously issued New Car Features manuals, for further reference you should refer to publications NCF064E and the supplement produced in October 1992.

APPLICABLE MODELS: FZJ75, HZJ75, FZJ80, HZJ80, HDJ80 SERIES

This manual is divided into four sections.

1. Introduction - New model line-up.
2. New Model Outline - Explanation of the product to give a general understanding of its features.
3. Technical Description - Technical explanation of the construction and operation of each new system and component.
4. Appendix - Technical specifications.

CAUTION, NOTICE, REFERENCE and NOTE are used in the following ways:

CAUTION	A potentially hazardous situation which could result in injury to people may occur if instructions on what to do or not do are ignored.
NOTICE	Damage to the vehicle or components may occur if instructions on what to do or not do are ignored.
REFERENCE	Explains the theory behind mechanisms and techniques.

For detailed service specifications and repair procedures, refer to the following Repair Manuals:

Manual Name	Pub. No.
• 1FZ-FE Engine Repair Manual Supplement	RM436E
• 1HD-FT Engine Repair Manual	RM437E
• Electrical Wiring Diagram	EWD232E
• Chassis and Body Repair Manual Supplement	RM434E

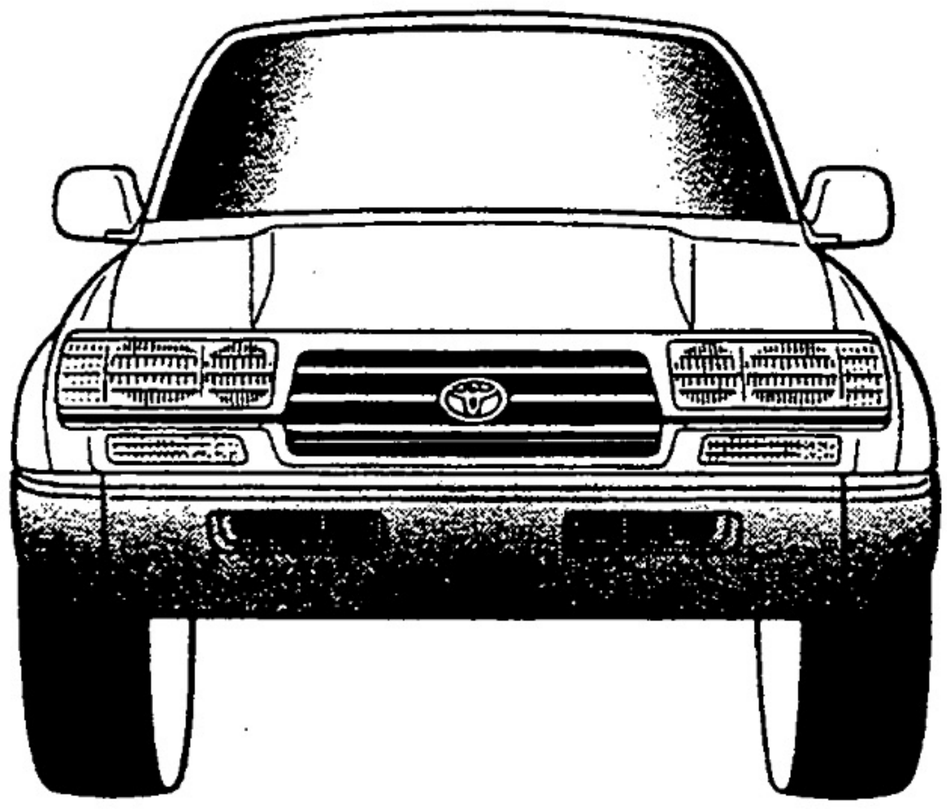
All information contained herein is the most up-to-date at the time of publication. We reserve the right to make changes without prior notice.

TOYOTA MOTOR CORPORATION

1. Introduction

EXTERIOR APPEARANCE

80 SERIES WAGON



MODEL CODE AND MODEL LINE-UP

80 SERIES

HDJ80 R - G N M N W Q

① ② ③ ④ ⑤ ⑥ ⑦ ⑧

①	BASIC MODEL CODE		
	HZJ80 :	With 1HD Engine
	HDJ80 :	With 1HD-FT Engine
	FZJ80 :	With 1FZ-FE Engine

②	STEERING WHEEL POSITION		
	R	:	Right-Hand Drive
	L	:	Left-Hand Drive

③	BODY TYPE		
	G	:	Wagon

④	BACK DOOR		
	C	:	Swing-Out
	N	:	Lift-Up

⑤	GEARSHIFT TYPE		
	M	:	5-Speed Manual
	P	:	4-Speed Automatic

⑥	GRADE		
	R	:	Standard
	N	:	GXL
	E	:	VX

⑦	ENGINE TYPE		
	S	:	Standard
	K	:	DOHC with EFI
	W	:	4-valve Turbo

⑧	DESTINATION		
	Q	:	Australia

MODEL LINE-UP

ENGINE	BACK DOOR	GRADE	5-SPEED MANUAL	4-SPEED AUTOMATIC
1HZ	Swing-Out	STD	HZJ80R-GCMRSQ	
1HD-FT	Lift-Up	GXL	HDJ80R-GNMNWQ	HDJ80R-GNPNWQ
		VX		HDJ80R-GNPEWQ
1FZ-FE	Lift-Up	GXL	FZJ80R-GNMNKQ	FZJ80R-GNPNKQ
		VX		FZJ80R-GNPEKO

MODEL CODE AND MODEL LINE-UP

75 SERIES

FZJ75 R P - M R K Q 3

① ② ③ ④ ⑤ ⑥ ⑦ ⑧

①	BASIC MODEL CODE		
	HZJ75	:	With 1HZ Engine
	FZJ75	:	With 1FZ-FE Engine

②	STEERING WHEEL POSITION		
	R	:	Right-Hand Drive
	L	:	Left-Hand Drive

③	BODY TYPE		
	Blank	:	Soft Top
	V	:	Hardtop, FRP Top
	P	:	Pickup

④	GEARSHIFT TYPE		
	M	:	5-Speed Manual

⑤	GRADE		
	R	:	Standard
	N	:	RV

⑥	ENGINE TYPE		
	Blank	:	Standard
	K	:	DOHC with EFI

⑦	DESTINATION		
	Q	:	Australia

⑧	PACKAGE MODEL		
	Blank	:	Complete
	3	:	Cab and Chassis

MODEL LINE-UP

ENGINE	BODY TYPE	GRADE	PACKAGE MODEL	5-SPEED MANUAL
1HZ	Hard Top	STD	Complete	HZJ75RV-MRQ
		RV		HZJ75RV-MNQ
	Pickup	STD	Complete	HZJ75RV-MRQ
			Cab and Chassis	HZJ75RP-MRQ3
1FZ-FE	Hardtop	STD	Complete	FZJ75RV-MRKQ
		RV		FZJ75RV-MNKQ
	Pickup	STD	Cab and Chassis	FZJ75RP-MRKQ3

2. New Model Outline

ENGINE

ENGINE LINE UP

The 1HD-FT diesel engine has been adopted for 80 Series to replace the previous 1HD-T. The 1HZ diesel engine remains unchanged while the 1FZ-FE gasoline engine has had some with minor changes.

Engine Type	Model	Displacement	Max. Output	Max. Torque
1HD-FT	80 Series	4.2	125kW @ 3600rpm [ECE]	380 Nm @ 2500rpm [ECE]
1HZ	80 Series	4.2	96 kW @ 4000rpm [ECE]	271 kW @ 2000rpm [ECE]
	75 Series			
1FZ-FE	80 Series	4.5	158 kW @ 4600rpm [ECE]	373 Nm @ 3200rpm [ECE]
	75 Series			

■ 1FZ-FE ENGINE

The construction and operation of the 1FZ-FE in the facelift Land Cruiser is basically the same as the previous model. There have however been some changes to the engine control system and emission control system, these changes are listed below.

- Hot wire type mass airflow meter is used instead of the vane type for 80 Series.
- TWC (Three Way Catalyst) and O_2 sensor have been eliminated on 80 Series.
- Engine ECU, Transmission ECU and Sub-fuel tank control ECU have been combined into one unit.

■ 1HD-FT ENGINE

The 1HD-FT has been newly developed to replace the 1HD-T engine used previously. This new engine has reduced exhaust emissions, improved performance and reduced levels of NVH (noise, vibration and harshness). The major changes are listed below.

- 4 valves are used for each cylinder with roller type rocker arm.
- Pistons are modified with a new type combustion chamber and cooling channel.
- Hydraulic type auto-tensioner is used for the timing belt.
- Intake heater similar to that used for 13B-T replaces the previous glow plug system.
- Injection pump is modified to include Diesel Smoke Control System (DSCS).
- Two stage type injection nozzle has been modified.

CHASSIS

80 SERIES

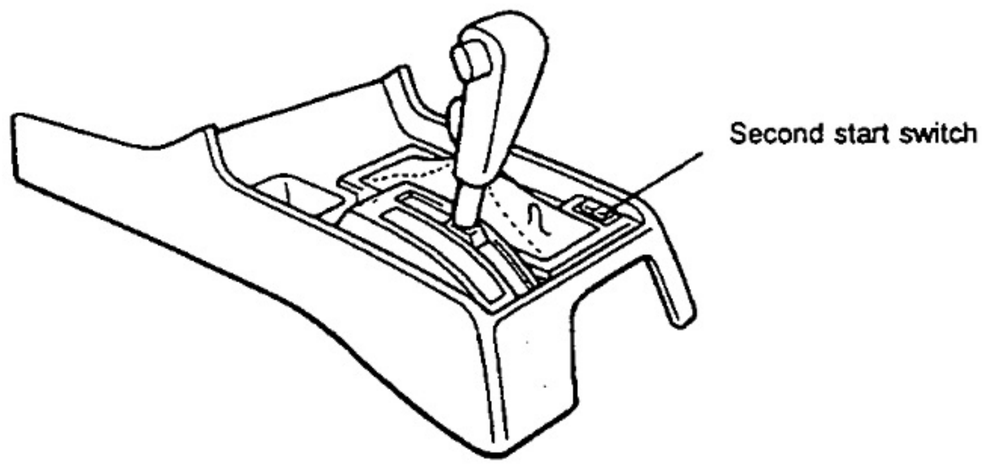
■ CLUTCH BOOSTER

The clutch booster fitted to VX has been replaced with a turn over mechanism clutch pedal.

■ 2ND START SYSTEM

A second start switch has been added to the automatic transmission to improve traction on slippery road surfaces such as sandy or snow covered roads. The effect this switch has on gear positions for each range is shown in the following table.

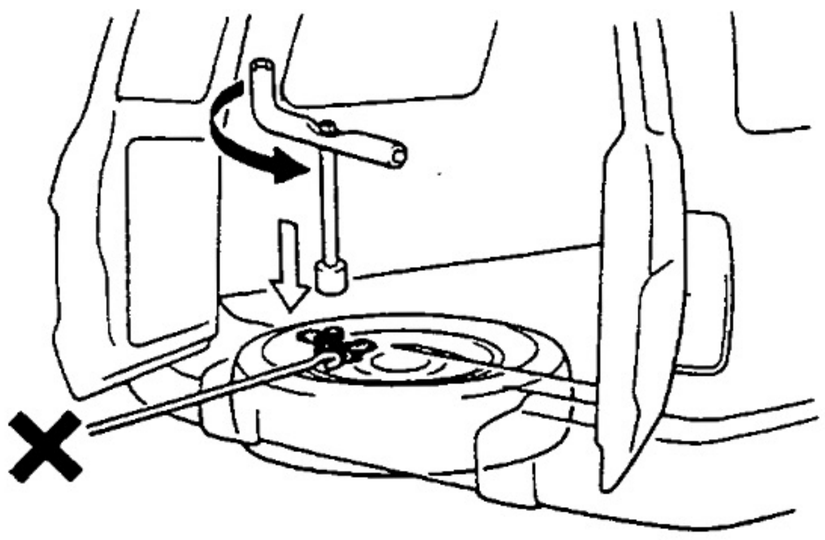
Mode / Shift Lever Position	Normal, Power	2nd Start
D range (O/D) Switch ON)	1⇦⇨2⇦⇨3⇦⇨O/D	2⇦⇨3⇦⇨O/D
2 range	1⇦⇨2⇦3	2⇦3
L range	1⇦2	1⇦2

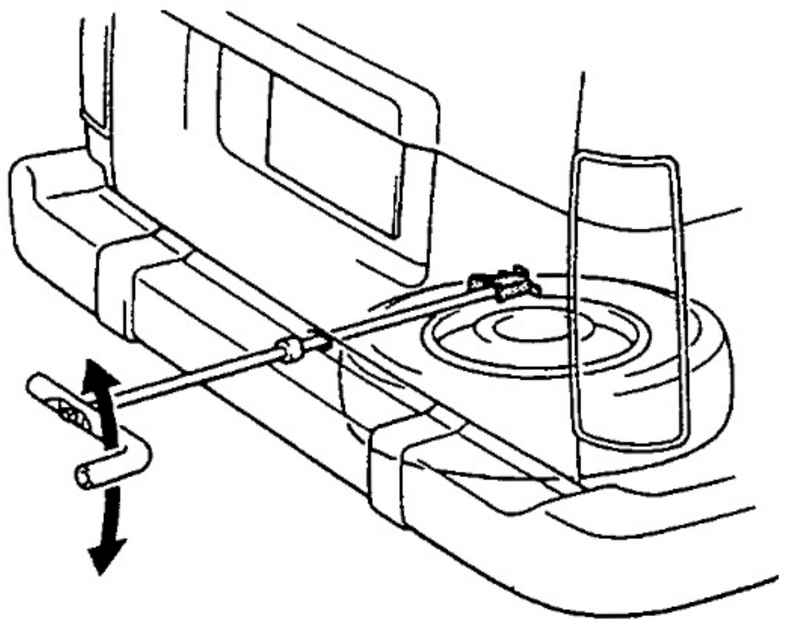


■ SPARE TIRE

- The theft deterrent properties of the spare tire have been improved by the addition of a lock mechanism

- Operation of the spare tire mechanism has been improved by the addition of a guide.





BODY

80 SERIES

■ RUST-RESISTANT STEEL

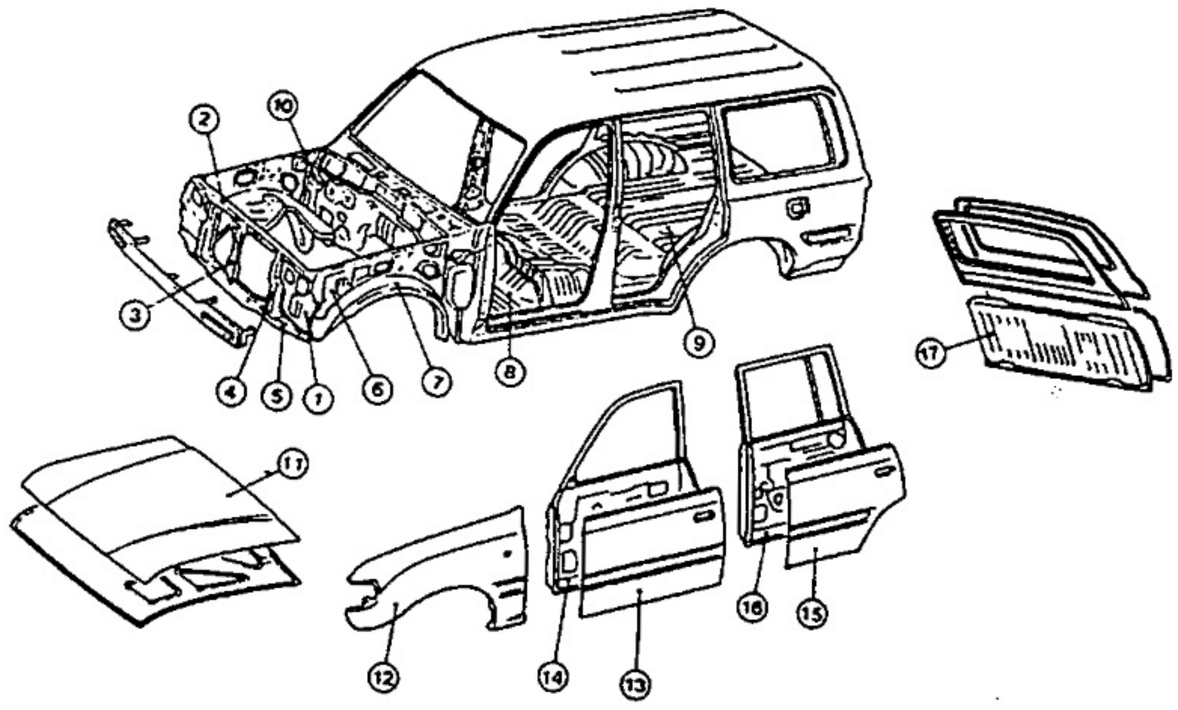
The use of rust resistant steel has been extended to further improve the corrosion performance of Land Cruiser.

Position No	Type of Material	
	Current	New
①	A	B
②	C	D
③	A	D
④	D	C
⑤	C	D
⑥	A	C
⑦	A	C
⑧	A	D
⑨	A	D

Position No	Type of Material	
	Current	New
⑩	A	C
⑪	B	E
⑫	E	E
⑬	B	E
⑭	C	D
⑮	B	E
⑯	C	D
⑰	C	D

Key to material type symbol

Symbol	Material Description	
	Inner Side	Outer Side
A	Normal sheet steel	Normal sheet steel
B	Dual layer zinc plate (20g/m^2)	Dual layer zinc plate (20g/m^2)
C	Single Layer zinc plate (45g/m^2) galvanealed steel	Single Layer zinc plate (45g/m^2) galvanealed steel
D	Single layer zinc plate (60g/m^2) galvanealed steel	Single layer zinc plate (60g/m^2) galvanealed steel
E	Dual layer zinc plate (60g/m^2) galvanealed steel	Dual layer zinc plate (30g/m^2) galvanealed steel



EXTERIOR

EXTERIOR EQUIPMENT

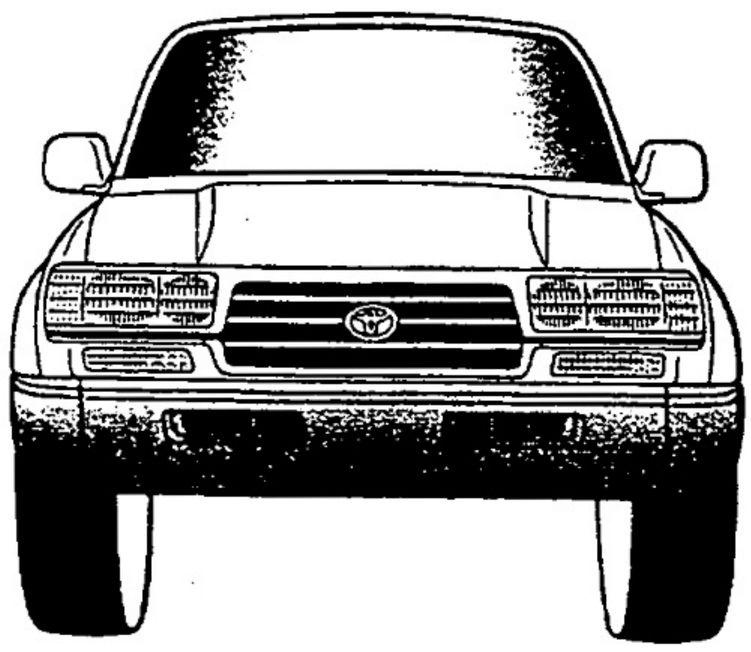
■ RADIATOR GRILLE AND FRONT BUMPER

- The front bumper on the 80 Series has been enlarged leading to the overall length of the vehicle being extended by 40 mm.

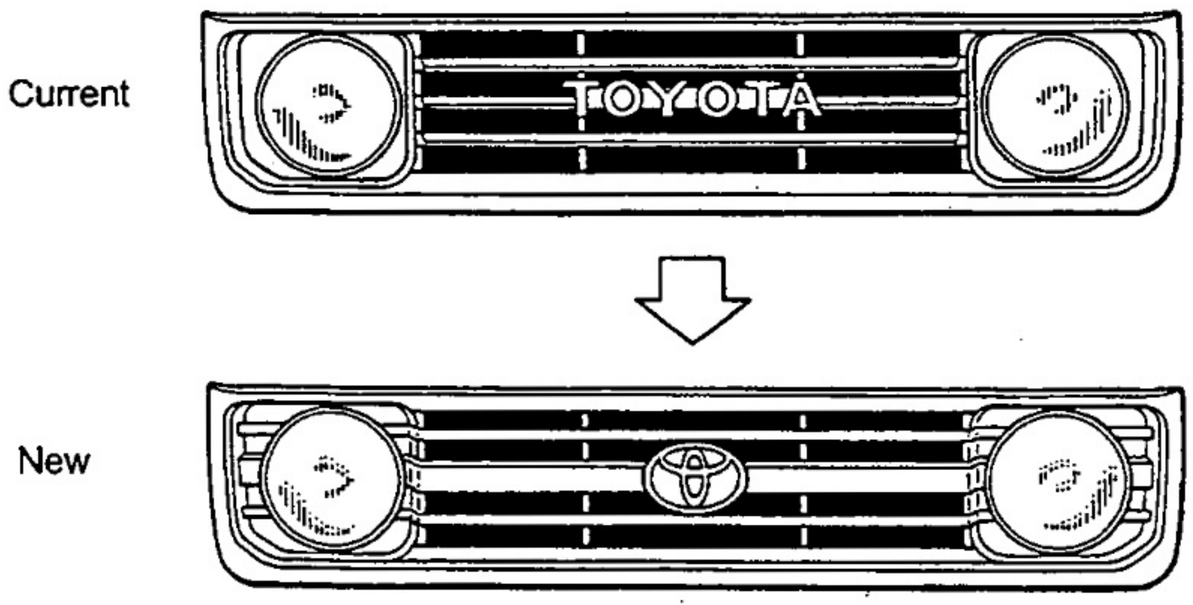
- The upper chrome bumper mouldings have been deleted on the GXL and VX grade 80 Series

- Both the 80 and 75 Series Land Cruiser have new radiator grills. The Toyota logo has been replaced by the Toyota symbol and the diesel and turbo marks have been deleted on models that previously displayed them.

◆ 80 Series ◆



◆ 75 Series ◆



EXTERIOR

TYRES

Tyres fitted to GXL and VX grade 80 Series have changed from 275/70 HR 16 type to 275/70 SR 16 type. These new tyres have the following features.

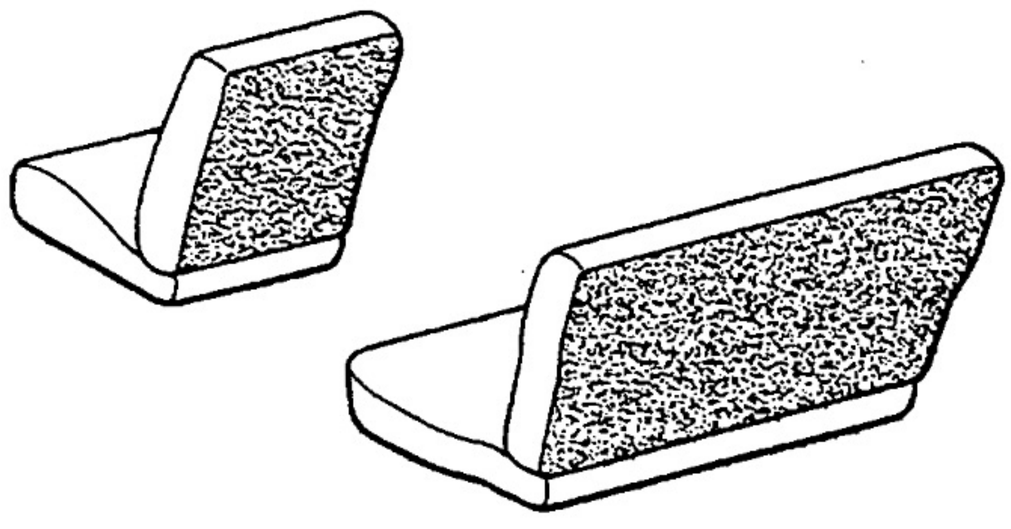
- Dual layer nylon full tyre width bands.
- Improved carcass cords.
- Improved steel belts.
- Protective ribs on side wall.
- Adoption of tubeless construction

INTERIOR

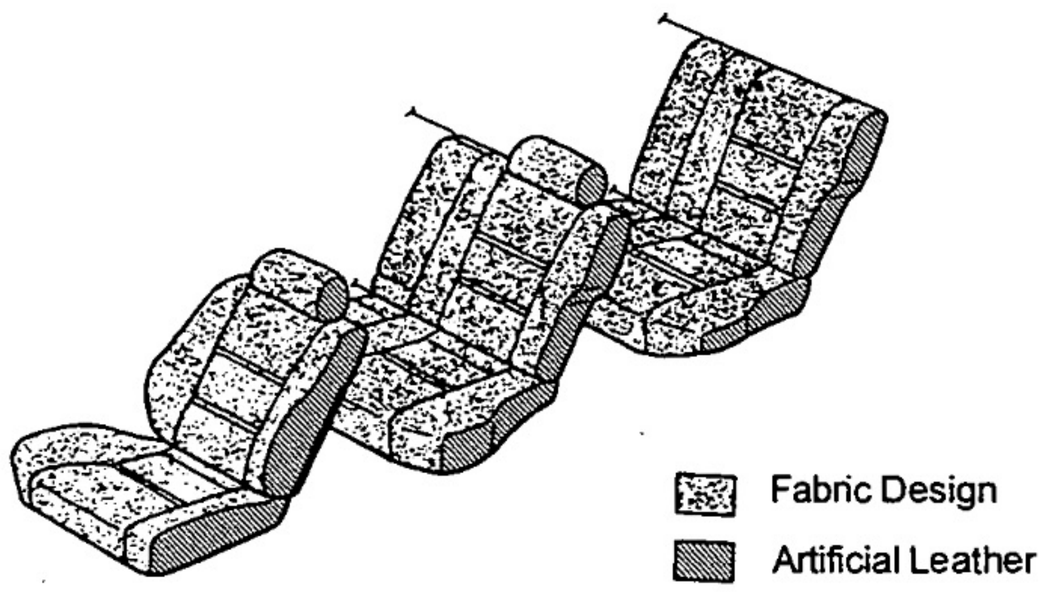
CABIN

■ SEAT

- The seat back material on standard grade 80 and 75 series has been changed from Vinyl chloride to Needle punch carpet.



- On VX 80 Series the seat edge material has been changed to artificial leather.

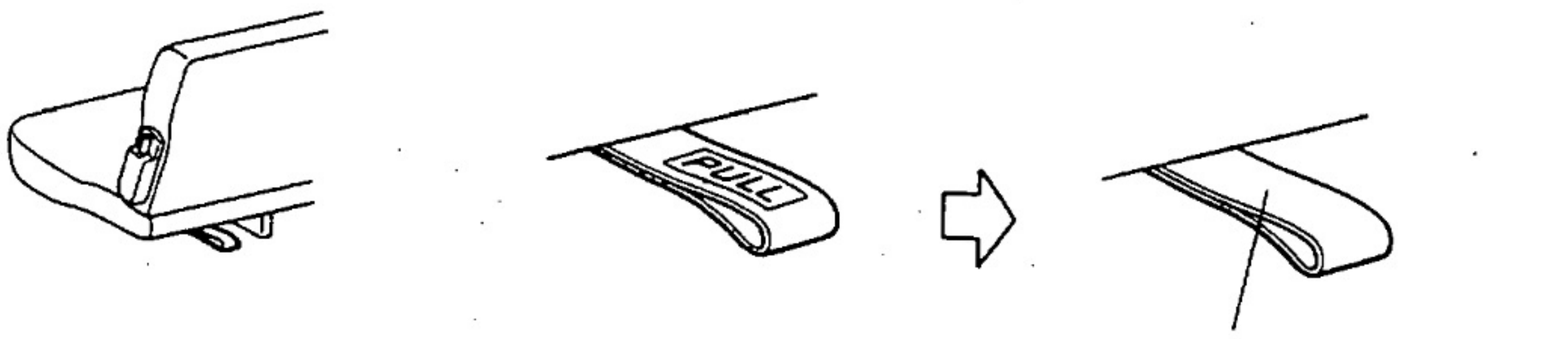


- GXL 80 series have a different fabric design applied to the seats.

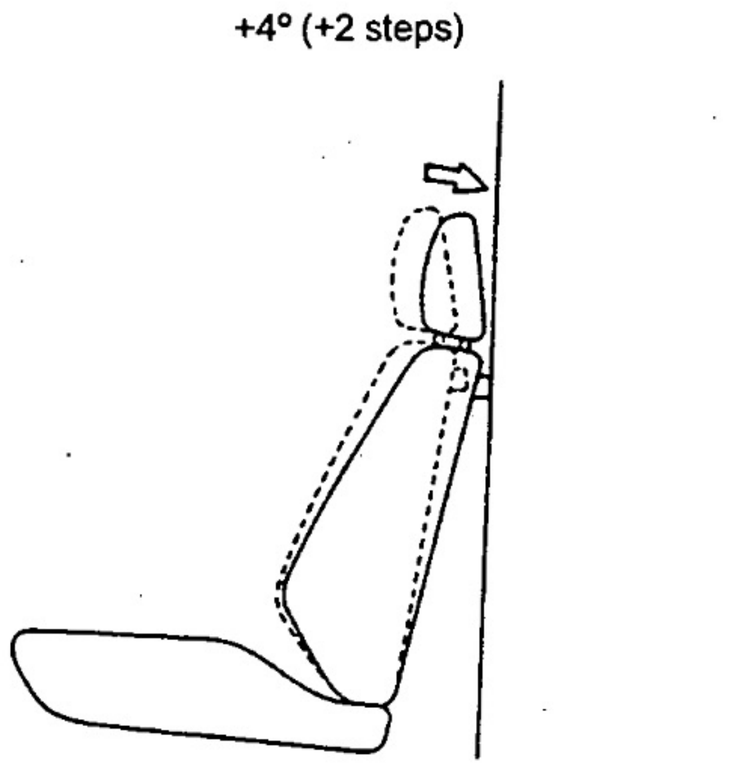
INTERIOR

- The instruction label "PULL" has been deleted from the third seat lock release band of appropriate model 80 series and from the rear seat of six seat 75 series Hardtop.

◆ 75 Series ◆



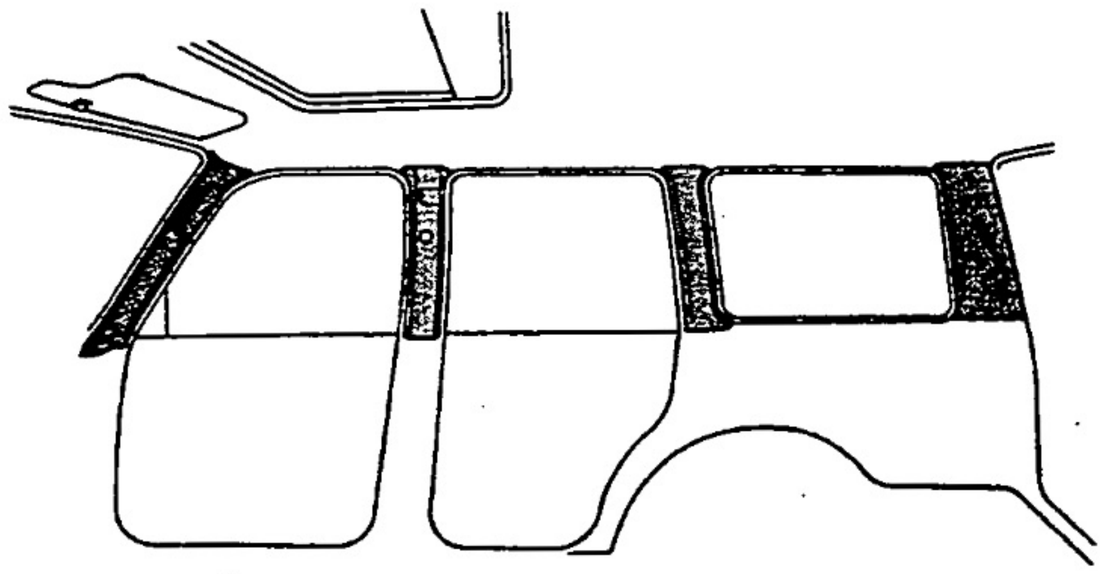
- The seat back reclining angle of 75 series pickups has been increased by 4° in two steps.



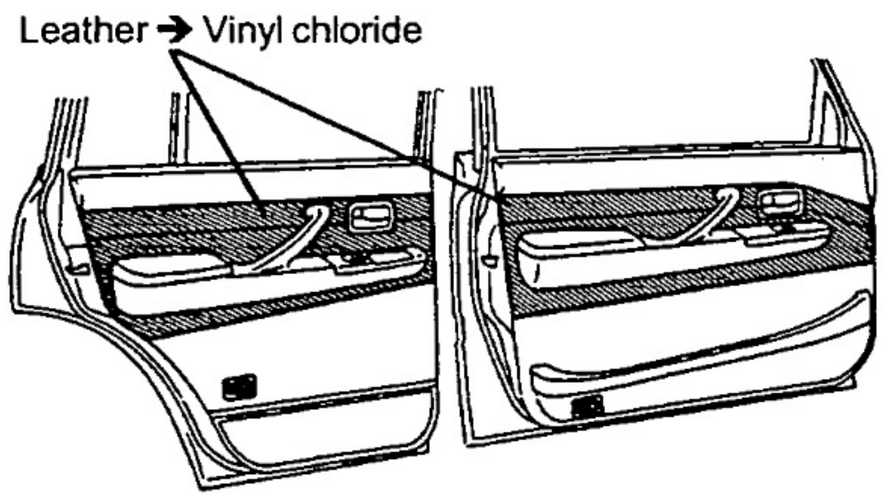
INTERIOR

■ TRIM

- Pillar garnishes have been adopted on all model 80 series.



- Door trim material for VX grade 80 series has changed from leather to vinyl chloride and door courtesy lamps have been added.



Newly added door courtesy lamps

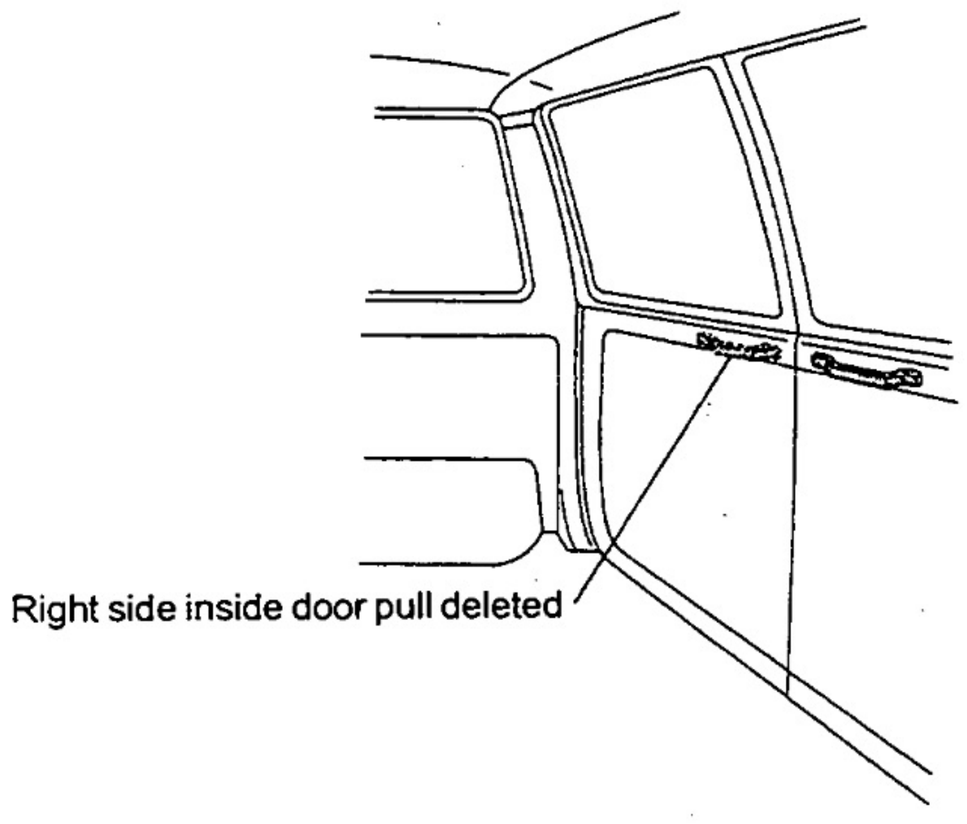
- The material used for the transmission and transfer shift lever knob has changed from vinyl chloride to urethane on all standard grade 80 series and 75 series.

- VX grade 80 series carpet material has changed from cut pile to fine velour.

- A passenger side assist grip has been added to VX grade 80 series.

INTERIOR

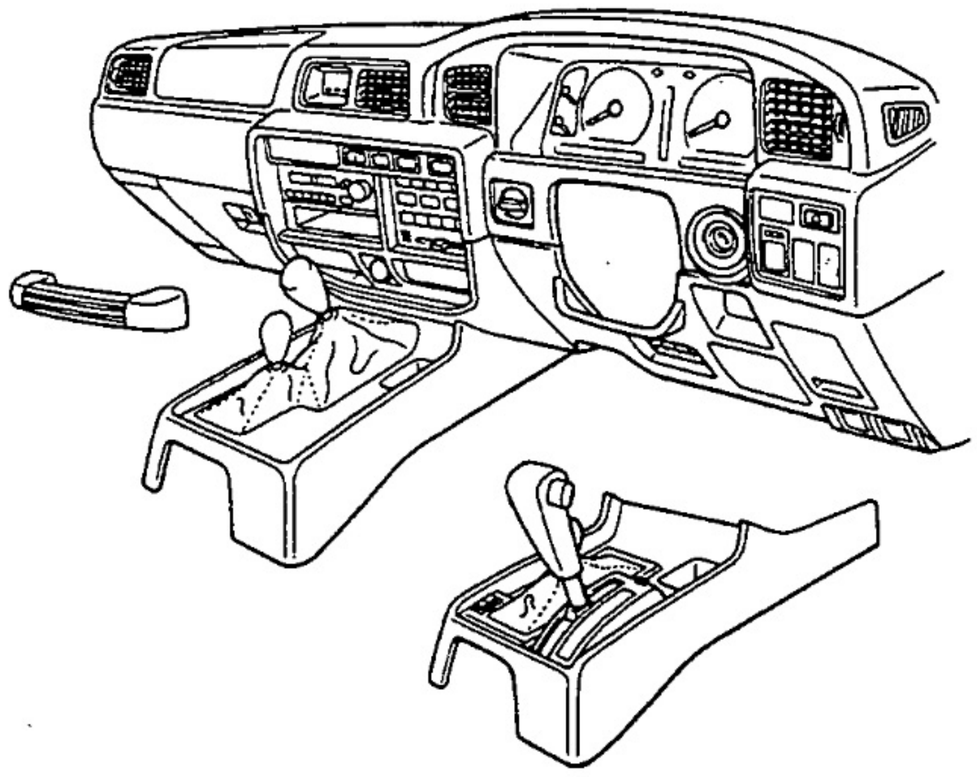
- The right side inside door pull has been deleted from the back door on 75 series Hard top.



INTERIOR

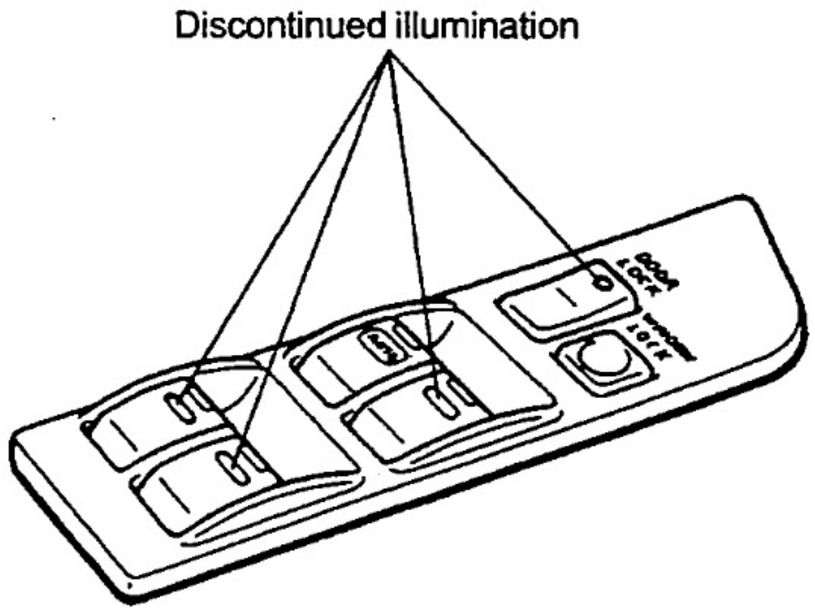
INSTRUMENT PANEL, SWITCH LAYOUT AND EQUIPMENT

The instrument panel for 80 series has been redesigned to give the cabin area a refreshing feel.



■ POWER WINDOW SYSTEM

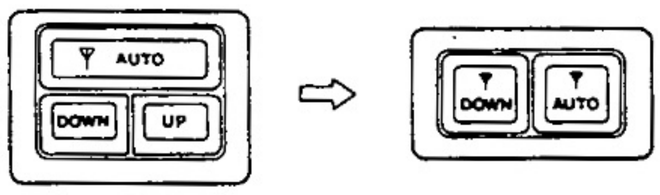
Night time illumination for the power window switches and door lock switch has been discontinued on all 80 series models with power windows.



INTERIOR

■ POWER ANTENNA SWITCH

- The power antenna switch fitted to 80 series models has been changed from a three button type to a two button type as shown.



- The DOWN switch is used to manually shorten the antenna length where as the AUTO switch will adjust the antenna to a specific length depending on the radio band selected.

Radio band	Antenna
AM reception	1200 mm
FM reception	750 mm

■ SRS AIRBAG

- A single sensor electric type SRS airbag is standard equipment on VX grade 80 series.

- An SRS airbag is installed in the steering wheel centre pad as a restraint system to supplement the drivers seat belt. This is designed to lessen the shock to the driver's upper body in a frontal impact in the event of a collision.

- When a frontal impact force instantaneously exceeds a set level, the airbag sensor detects it. This causes the airbag to inflate momentarily, reducing the shock to the driver.

■ CRUISE CONTROL SYSTEM

Cruise control has been adopted as standard equipment on GXL grade Turbo 80 series with manual transmission (HDJ80R-GNMNWQ).

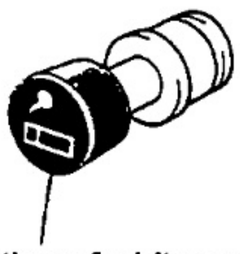
INTERIOR

■ TOYOTA VEHICLE SECURITY SYSTEM

An Alpine manufactured TVSS has been adopted as standard on VX and Turbo GXL grade 80 series, with all other grade 80 series with power windows being pre-wired to facilitate dealer fittment of the system.

■ CIGARETTE LIGHTER

The white paint for the cigarette symbol has been deleted from the cigarette lighter on all model 80 and 75 series.



3. Technical Description

ENGINE

1FZ-FE

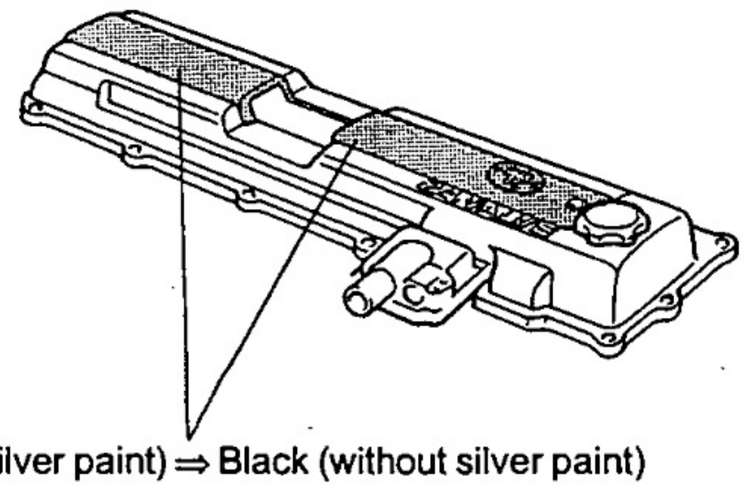
■ DESCRIPTION

The 1FZ-FE engine fitted to the face lift Land Cruiser is an in-line 6 cylinder, 4.5 litre 24 valve DOHC engine. Its construction and operation remain the same as the previous model with the exception of the engine control system on 80 series.

■ ENGINE

1. Cylinder Head Cover

The surface treatment applied to the centre section of the cylinder head cover has been changed from silver to black.



Silver (with silver paint) ⇒ Black (without silver paint)

■ ENGINE CONTROL SYSTEM

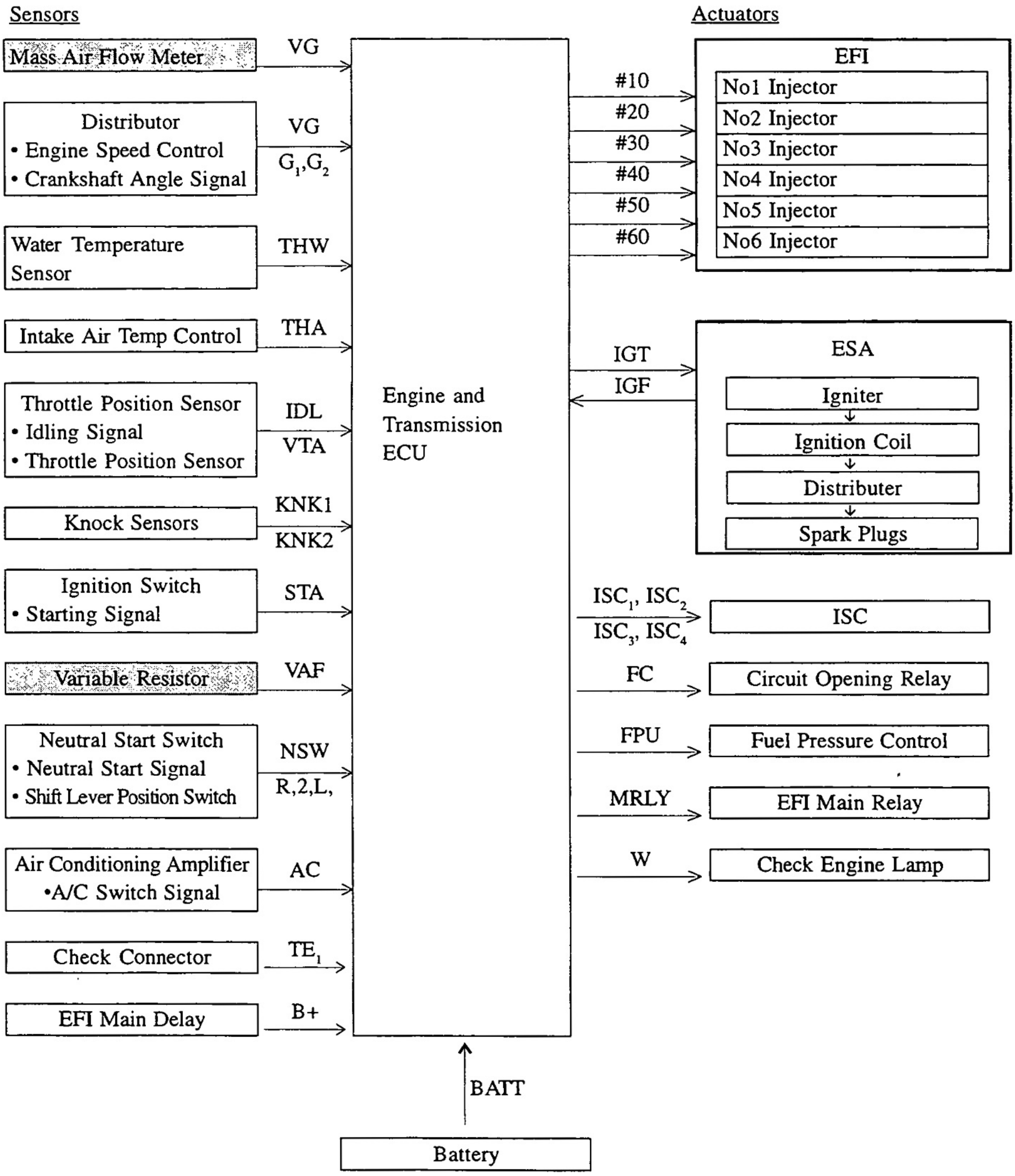
1. General

The construction and operation of the engine control system used in 75 series remains primarily unchanged compared to the previous model. The only change has been to combine the engine and sub fuel tank ECU into one unit, the 80 series also combines the ECT ECU. The 80 series has been changed, the following discussion of the 1FZ-FE engine control system pertains only to 80 series. The new 1FZ-FE engine uses a hot wire type mass airflow meter instead of the pervious vane type and the oxygen sensors and three way catalysts have been discontinued. A VAF variable resistor has been added so exhaust gas CO concentration can be adjusted at idle. The engine control systems of the new 1FZ-FE engine and previous 1FZ-FE engine are compared below.

System	Outline	New	Previous
	An L-type EFI system directly detects the intake of air volume with a hot-wire type mass air flow meter.	○	–
EFI	An L-type EFI system directly detects the intake air volume with a vane type volume air flow meter.	–	○
	A variable resister is used to adjust CO concentration in the exhaust.	○	–
	The fuel injection system is a sequential multipoint fuel injection system.	○	○
	Injection timing is determined by the ECU based on signals from various sensors. Corrects ignition timing in response to the engine knocking.	○	○
ESA	Torque control correction during automatic transmission gear shifting has been used to minimise the shift shock.	○	○
	2 knock sensors are used to further improve knock detection.	○	○
ISC	A step motor type ISC system controls the fast idle and idle speeds.	○	○
Oxygen Sensor	An oxygen sensor is used to provide exhaust mixture data to the engine ECU for control of the air fuel mixture.	–	○
Diagnosis	When the ECU detects a malfunction, the ECU diagnoses and memorises the failed section.	○	○
Fail-Safe	When the ECU detects the malfunction, the ECU stops or controls the engine according to the data already stored in memory.	○	○

2. Construction

The configuration of the engine control system in the 1FZ-FE engine is shown in the following chart. Shaded portions differ from the 1FZ-FE engine of the previous model.



3. Layout of components

4. Main Components of Engine Control System

The following table compares the main components of the new 1FZ-FE engine and previous 1FZ-FE engine.

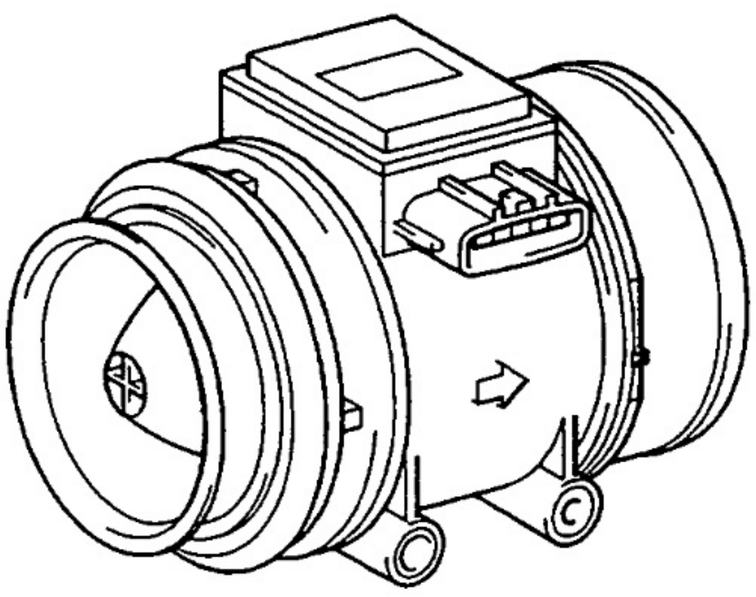
1FZ-FE Component	New	Previous
Mass Air Flow Meter	Hot-Wire Type	_
Volume Air Flow Meter	_	Vane Type
Distributer	Pick-Up Coil, 3 (G_1, G_2, and NE)	←
Throttle Position Sensor	Linear Type	←
Oxygen Sensor	_	Main Heated Oxygen Sensors, 2

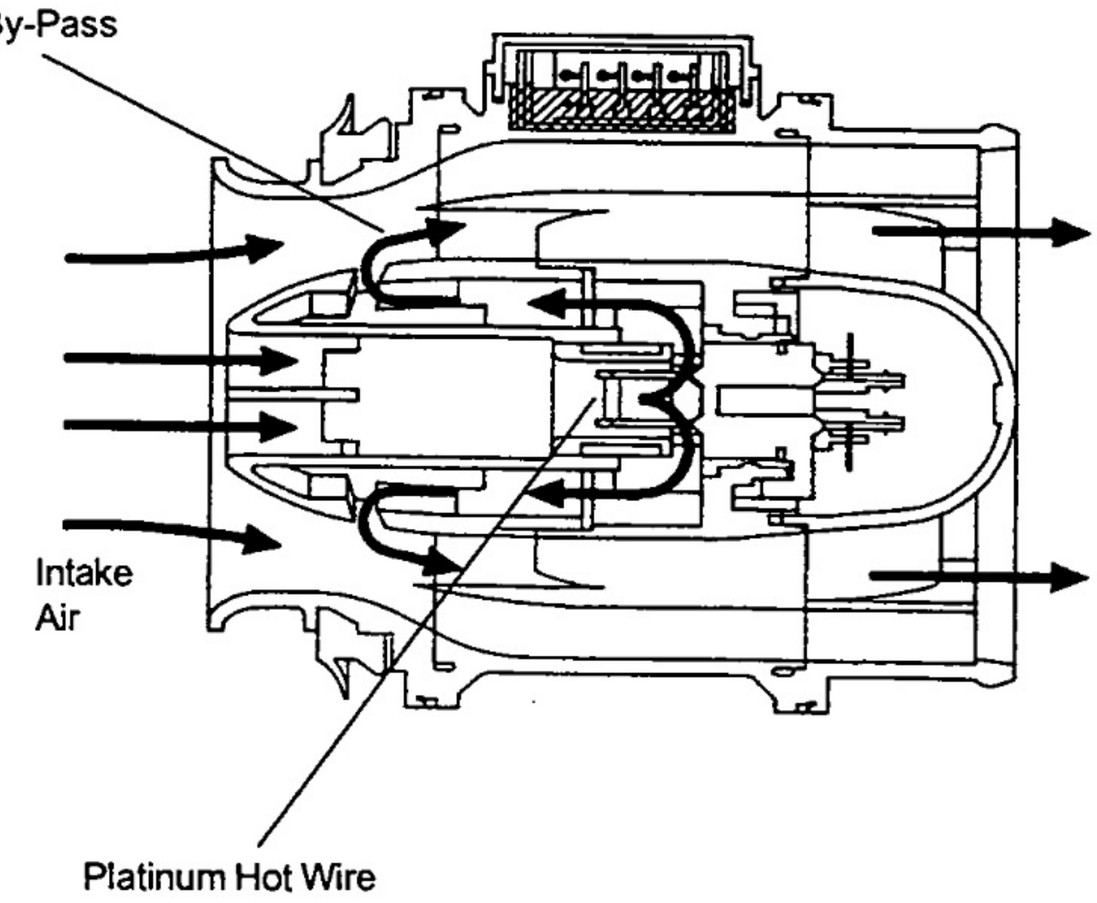
Mass Air Flow Meter

1) Description

The new 1 FZ-FE engine uses the hot-wire type air flow meter designed for direct electrical measurements of the intake air mass flow.
This air flow meter offers superior measuring precision and its plastic housing is shaped for minimal flow resistance. In addition to the sensor itself being minuscule, this system measures the bypass air, which is unlikely to be affected by the air cleaner drift current, and has the following features:

- Compact and lightweight, the pressure loss caused by this sensor is small, and offers only slight intake air flow resistance.
- Superior response and measuring accuracy.
- Ability to measure a wide airflow range.
- Having no mechanical functions, it has superior durability.





2) Principle

When the hot wire is placed in a constant gaseous current, the hot wire temperature varies in accordance with the amount of the air mass flow. If the temperature difference between the hot wire and air mass at that time is "ΔT", air mass flow is "G", and the dissipated heat is "Q", the relationship between them can be described with the following formula:

$$Q = (a + b\sqrt{G}) \bullet \Delta T$$ ("a" and "b" are constants)

Furthermore, this heat value can be electrically represented. If the hot wire resistance is "R", electrical current flowing through the hot wire is "I", the heat value "Q" can be described with the following formula:

$$Q = I^2R$$

Accordingly, the two formulas above can be described as follows:

$$I^2R = (a + b\sqrt{G}) \bullet \Delta T$$

If current "I" flows in order to make the temperature difference "ΔT" consistent, since "R", "a", "b" and "ΔT" are all constant, a proportional relationships created between the air mass flow "G" and the current "I", enabling the air mass flow "G" to be represented by the current "I". By converting this current "I" into voltage, the hot-wire type air flow meter outputs the air mass flow signals to the ECU.

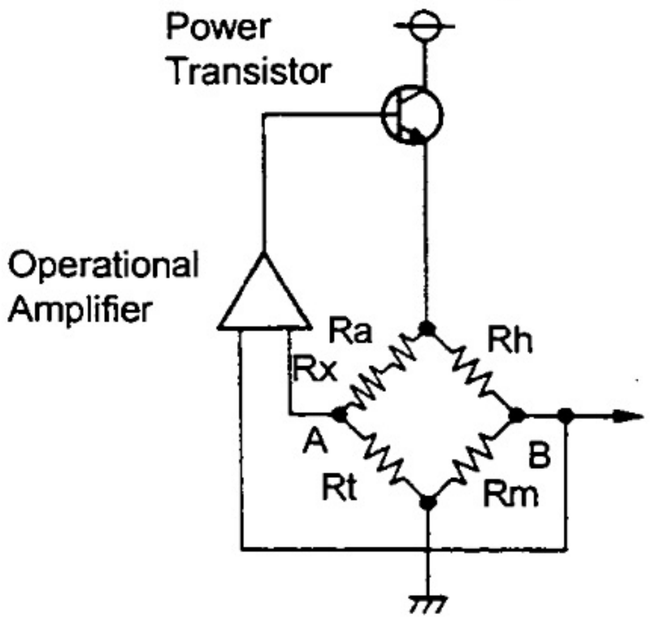
3) Construction and Operation

To keep the temperature of the platinum hot wire constant with the sum of the intake air temperature measured by the thermistor and the predetermined temperature difference (ΔT), this hot-wire type air flow meter has an electric bridge circuit which includes the hot wire and other resistance's. Combined with an operational amplifier and power transistor, the feedback loop, as described below is achieved.

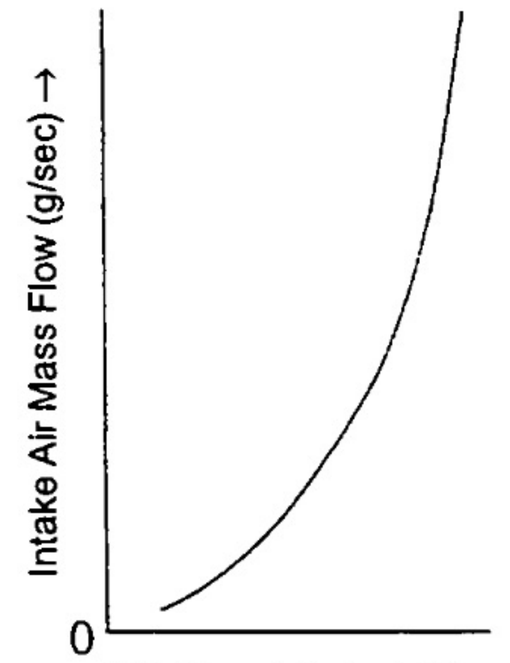
In this circuit, when the electrical potential at points "A" and "B" becomes equal, the resistors are selected to make the temperature difference between the hot wire and air mass constant. When the hot wire is cooled by the intake air, its resistance value decreases. As a result, the voltage at point "B" becomes higher than that of the point "A". At this time, the operational amplifier detects this electrical potential difference, and controls the power transistor so that the electrical potential of the points "A" and "B" become equal, and sends the current to the circuit.

The air flow meter outputs the voltage at point "B", immediately following the hot wire. The ECU uses this voltage (VG signal) to determine the intake air mass flow according to the aforementioned principle.

The VG signal, which varies in accordance with the intake air mass flow, is continuously output from the air flow meter. The relationship between the output voltage of the VG signal and the intake air mass flow can be represented as a parabolic curve show below.

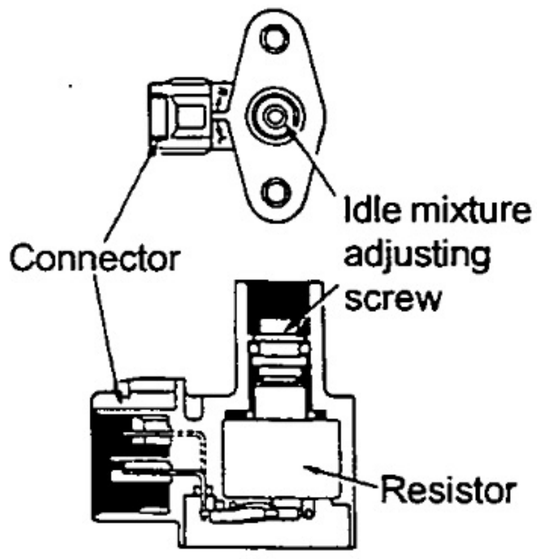


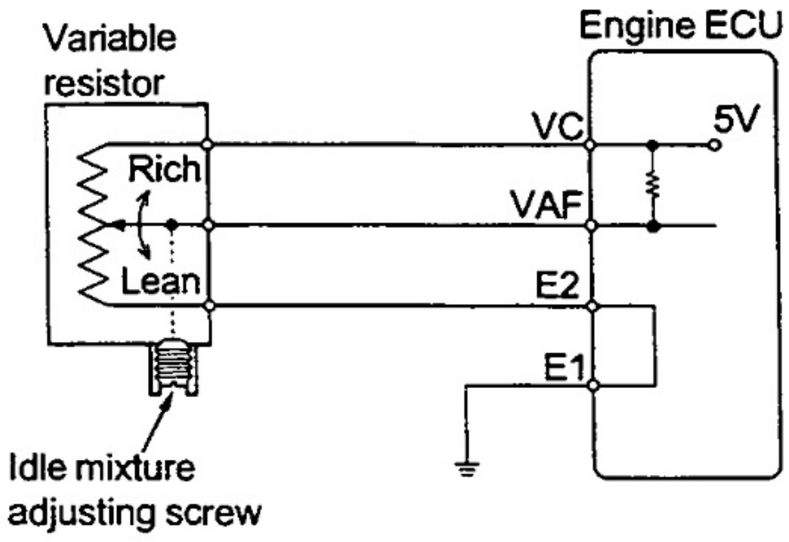
Rh : Measuring resistance (Hot Wire; Heater)
Ra : Thermometer resistance (Thermister)
Rx : ΔT Pre-determined resistance
Rt : Temperature Characteristics adjustment resistance
Rm : Output resistance



Variable Resistor

This resistor is provided in some engine control systems that do not have oxygen sensors so that the air-fuel ratio of the idle mixture can be changed.



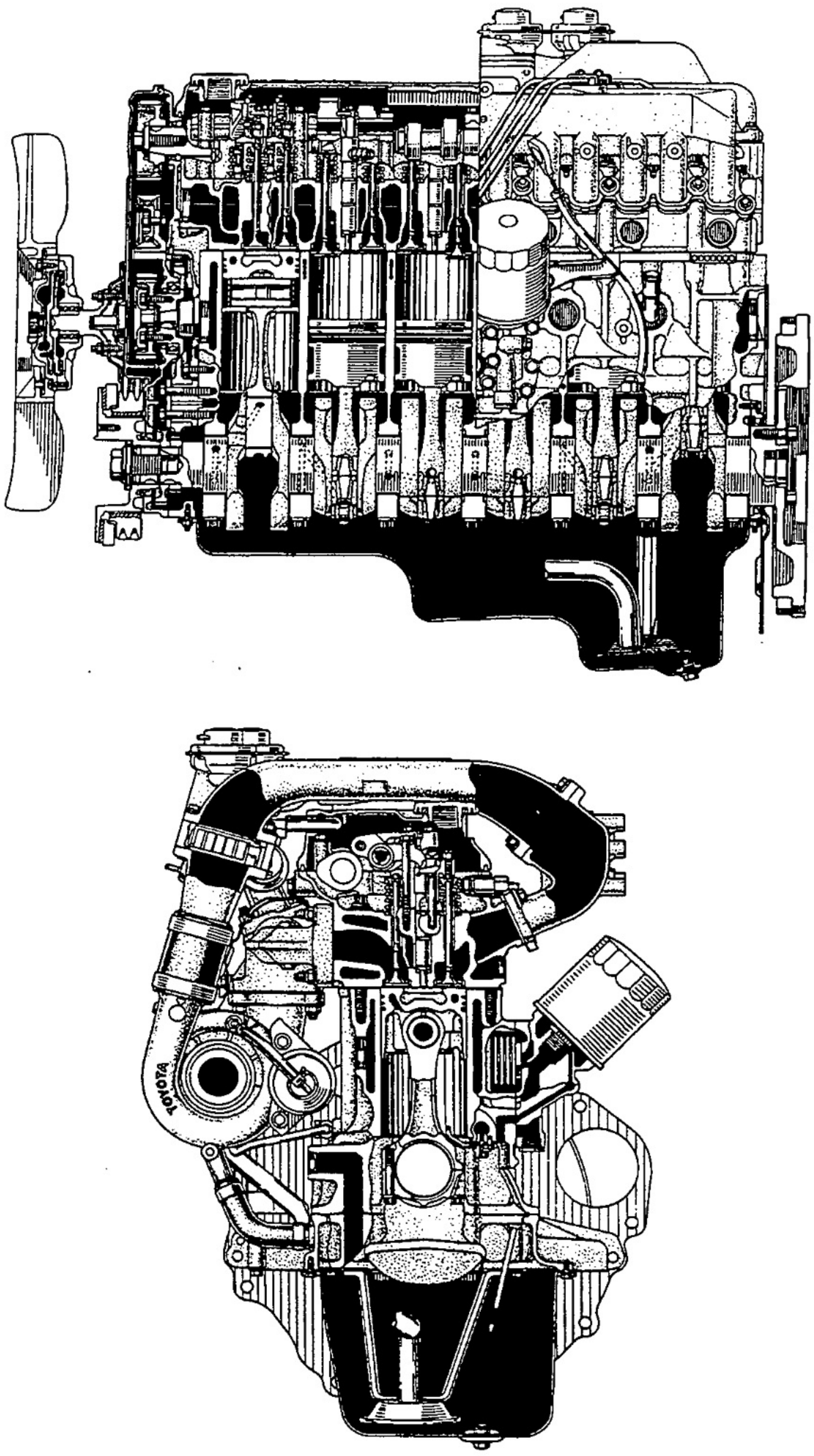


Turning the idle mixture adjusting screw clockwise moves the contacts inside the resistor, raising the VAF terminal voltage. Conversely, turning the screw counter clockwise lowers the VAF terminal voltage.
When the VAF terminal voltage rises, the ECU increases the injection volume slightly, making the air-fuel mixture a little richer.

1HD-FT ENGINE

■ DESCRIPTION

Previously the 80 series has been fitted with a 1HD-T engine in the new 80 series this has been replaced with the newly developed 1HD-FT. The 1HD-FT is a 4.2 L direct injection OHC diesel Turbo engine with four valves per cylinder. The injection nozzle has been placed upright in the centre of each cylinder to enhance the intake and exhaust/combustion efficiency and results in higher output, low fuel consumption and cleaner exhaust gas. The characteristics of the injection pump have been optimised and a Diesel Smoke Control System has been adopted to reduce black smoke emissions.

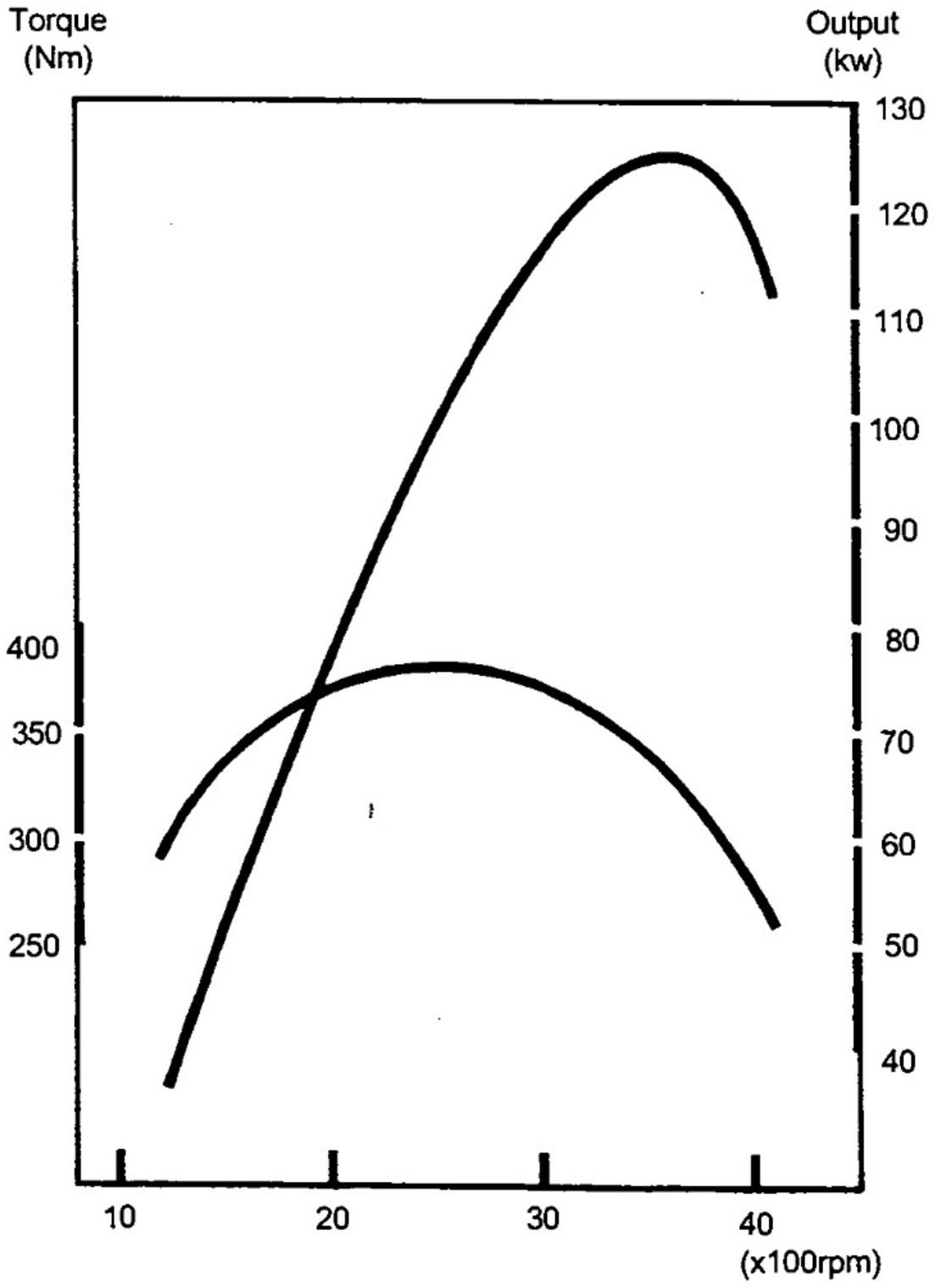


ENGINE SPECIFICATIONS AND PERFORMANCE CURVE

Engine Type Item	1HD-FT	1HD-T
No of Cyls and Arrangement	6-Cylinder, In-Line	←
Valve Mechanism	OHC, 4-Valve per Cylinder	OHC, 2-Valve per Cylinder
Combustion Chamber	Direct Injection	←
Manifold	Cross-Flow	←
Displacement - cc	4,164	←
Bore x Stroke - mm	94.0 x 100.0	←
Compression Ratio	18.6:1	←
Max Output [ECE]	~~125 kW @ 3,600 rpm~~	188 kW @ 3,600 rpm
Max Torque [ECE]	~~380 Nm @ 2,500 rpm~~	360 Nm @ 1,800 rpm
Engine Size - mm (LxWxH)	960x620x805	←
Fuel Cetane Number	50 or higher	←

* MAX POWER 118 KW @ 3600 RPM
MAX TORQUE 357 NM @ 1800 RPM

– FIGURE ON NEW CAR FEATURES BOOK WERE TARGETS ONLY!



MAJOR DIFFERENCES

Major differences between the 1HD-FT engine and 1HD-T engine are listed below.

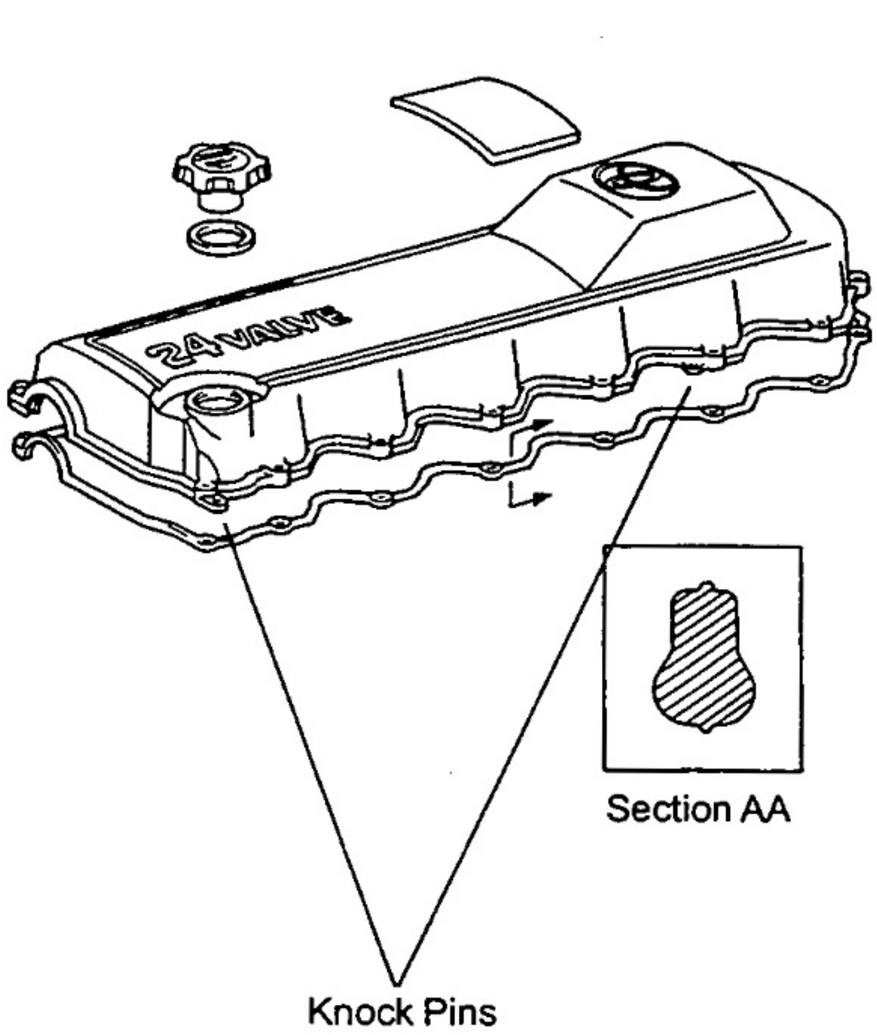
Item	Details
Engine Proper	• A roller type rocker arm with valve bridge and 2 adjusting screws OHV 4-valve per cylinder valve mechanism is used.
	• A hollow camshaft is now used.
	• Piston is modified to include a cooling channel and changed combustion chamber.
	• A hydraulic type auto-tensioner is used for the timing belt.
	• A crankshaft with dual mode damping has been adopted.
Turbocharger	• The turbine housing has been enlarged.
Preheating System	• An intake heater is now used in place of glow plugs.
Fuel System	• A 2 spring type injection nozzle is retained but it has been modified and located in the centre of the cylinder
	• DSCS (Diesel Smoke Control System) has been adopted to control black smoke emission at starting.

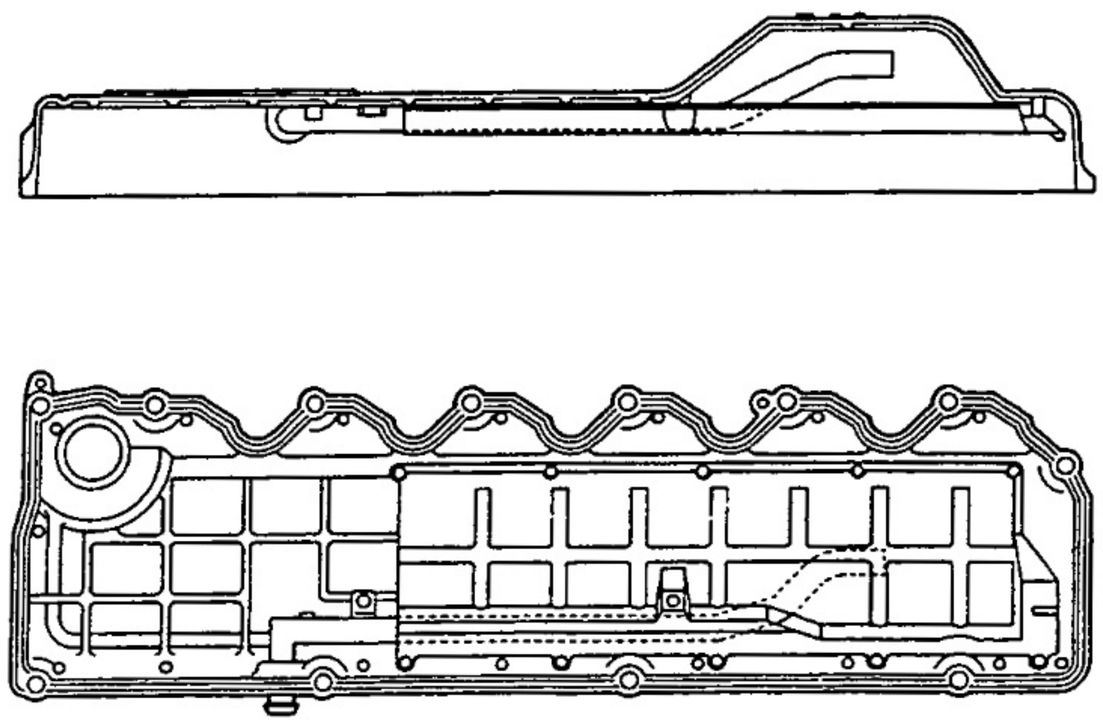
ENGINE PROPER

1. Cylinder Head Cover

- An aluminium die cast cylinder head cover is used.

- The cover is fastened around it's periphery using 12 bolts to ensure correct gasket compression is maintained. Two knock pins (dowel pins) are also used to ensure correct assembly.





2. Cylinder Head

- High strength alloy cast iron is used for the cylinder head. Four valves per cylinder are used to improve the intake and exhaust efficiency.

- An improved combustion rate, higher output and lower fuel consumption have been achieved by arranging injection nozzles in a serial position to the bore centre.

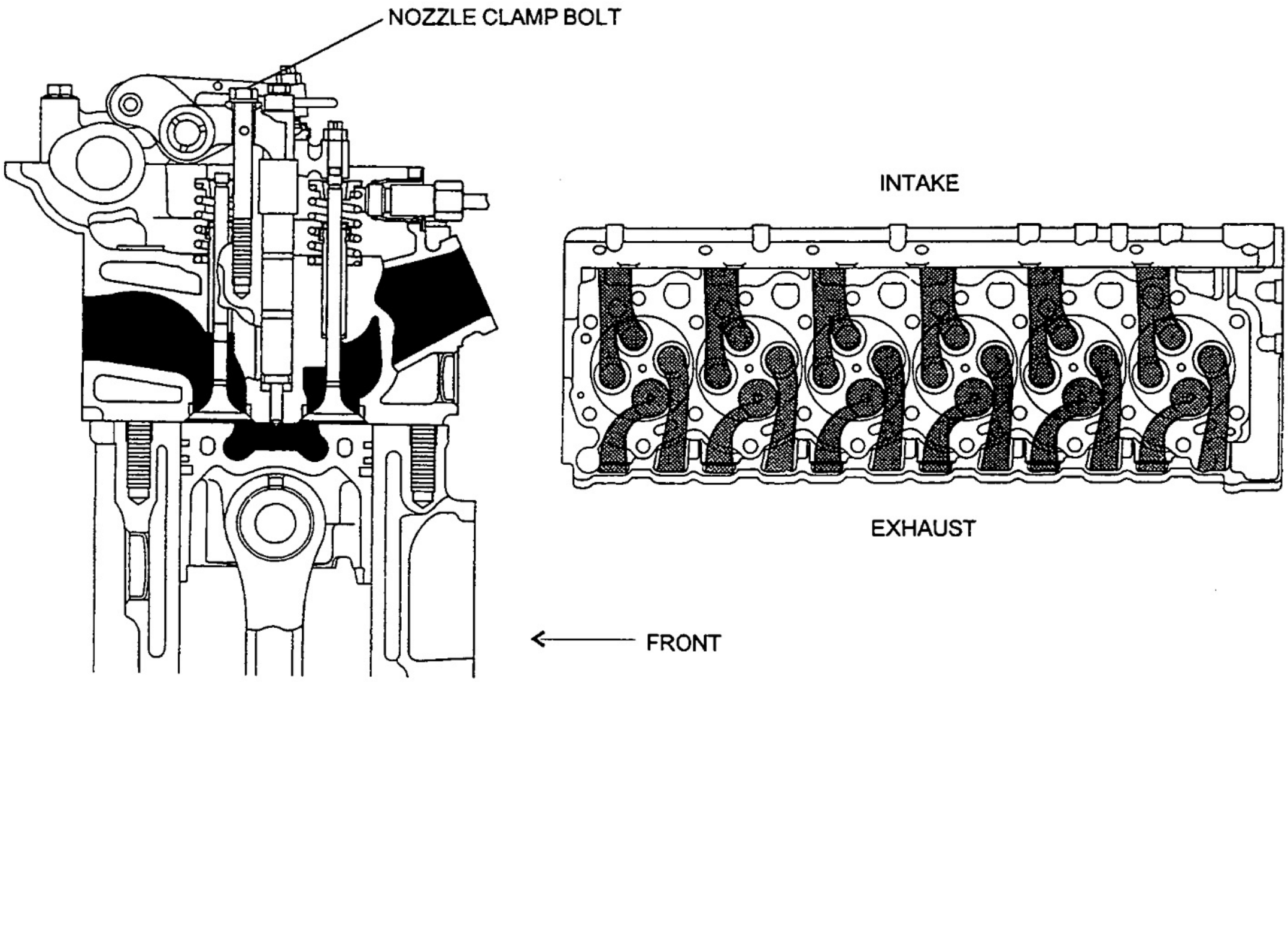
- Two different shaped intake ports are used to ensure optimum swirl formation within the cylinders, promoting complete mixing of fuel and air.

- Plastic region tightening is used for the cylinder head bolts to standardise the tightening force of the bolts.

- No 1 - No 7 cam journals are provided with bearings.

- Aluminium alloy is used for the cam bearing cap and rocker shaft support. The valve rocker shaft is clamped in the rocker shaft support using a slit in the support and a through bolt. In addition to this the rocker shaft is located in the No 7 rocker support by a small bolt.

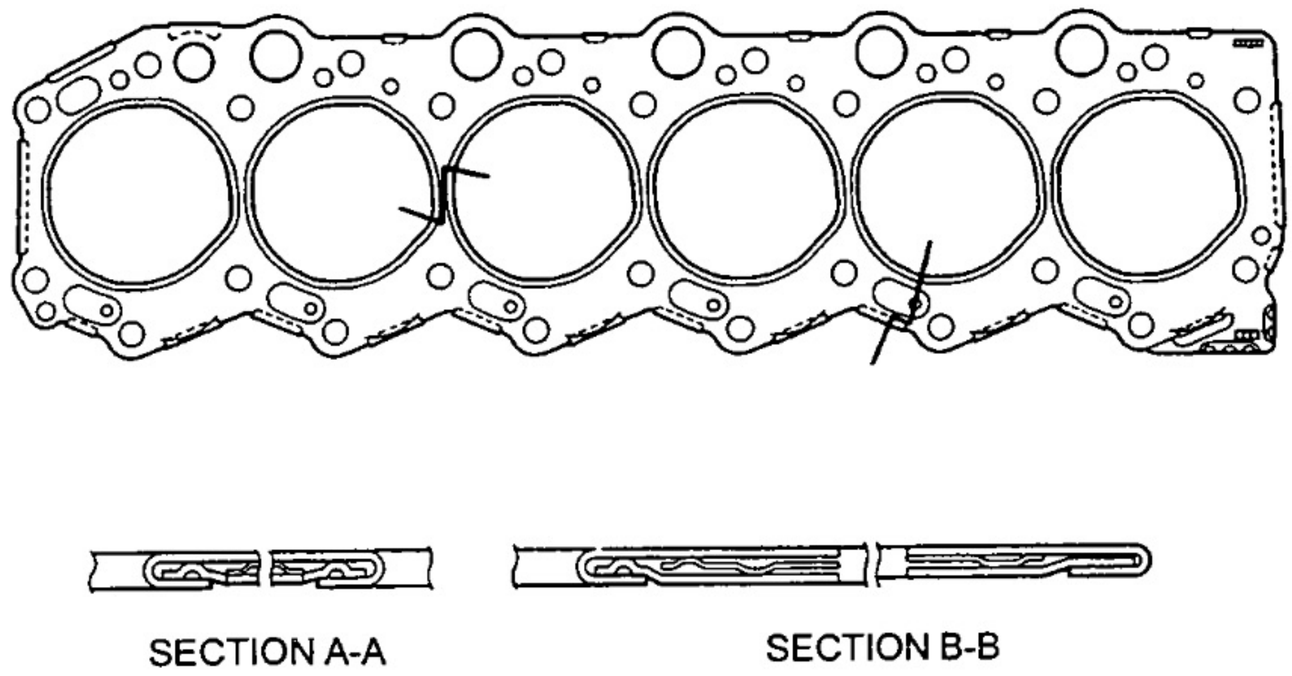
- As the injection nozzle is positioned centrally it is located inside the cylinder head cover. Fuel is supplied to the injection nozzle and bleed back fuel is taken away by steel pipes that pass through holes in the cylinder head side wall. These holes are fitted with seals to prevent any fluid leakage.



3. Cylinder Head Gasket

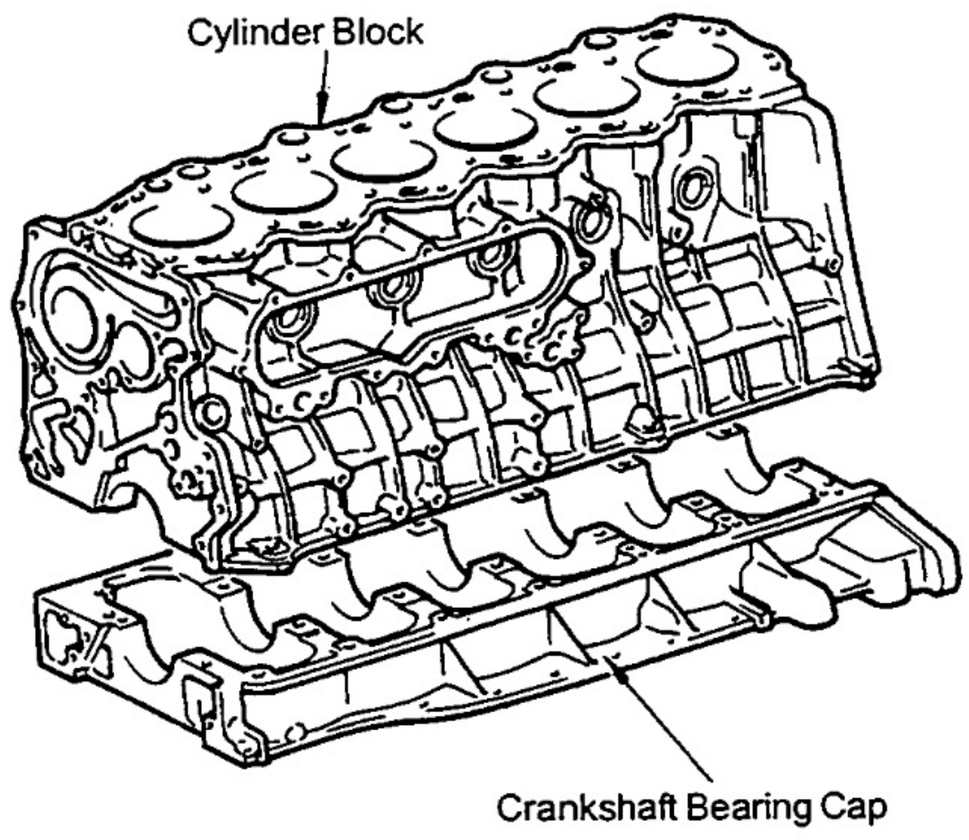
- A 3-layer steel laminate cylinder head gasket is used.

- A bead structure has been adopted for sealing as it optimises the distribution of pressure, thereby reducing cylinder bore distortion when the cylinder head is fitted.



4. Cylinder Block

- The cylinder block is made of alloy cast iron and has a linerless structure. Close attention has been given to the block design to ensure bore distortion is reduced.



5. Piston

- High pressure cast aluminium alloy is used to form the pistons. In addition newly developed FRM (Fibre Reinforced metal) ring carrier is used for the top ring groove for improved durability.

- A new shape TRB (Toyota Reflex Burn) combustion chamber has been developed and is located in the centre of the piston.

- A cooling channel is formed in the piston to improve cooling of ring groove area and the periphery of the combustion chamber.

- An oil Ring with a smaller contact surface is used to increase the ring surface pressure and in turn increase oil control efficiency for reduced oil consumption.

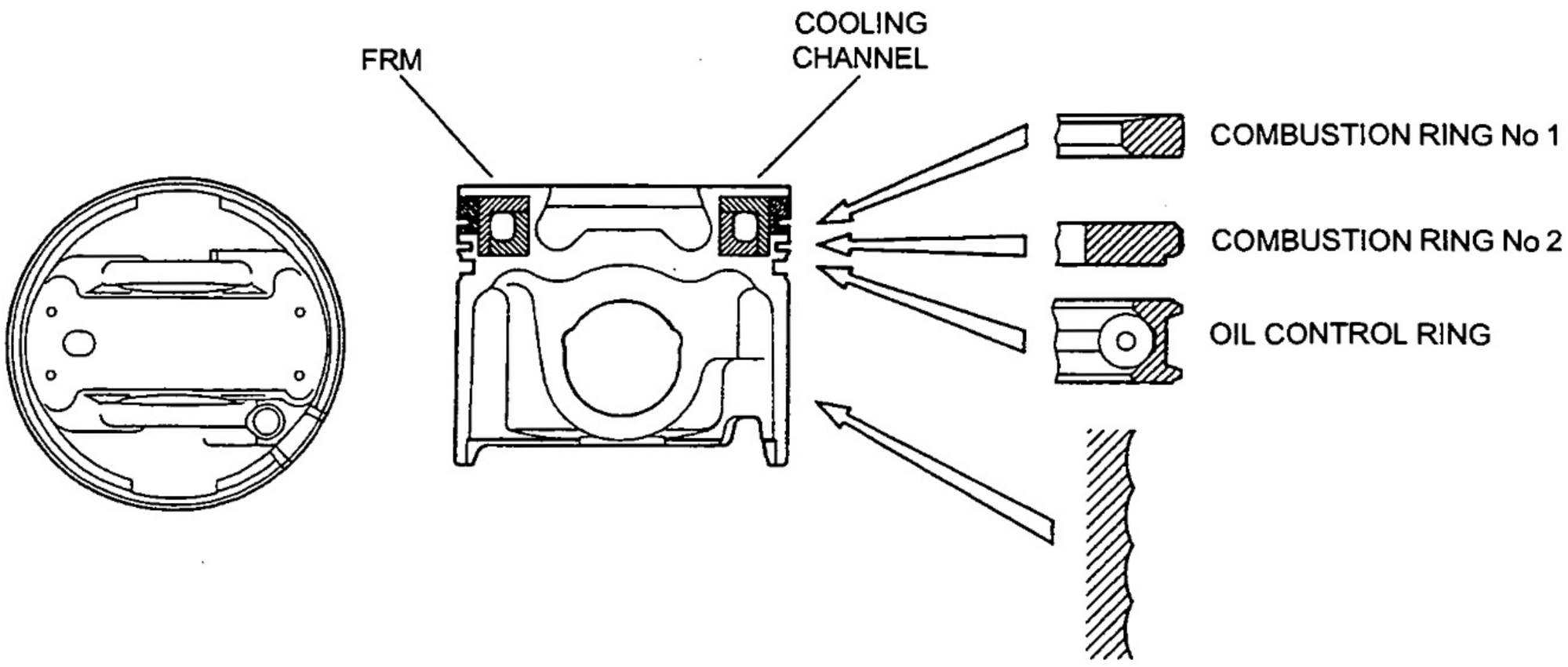
◆ Specifications ◆

Piston Ring	Material	Thickness	Ring Shape	Surface Treatment
Compression No 1	Stainless steel	2 mm	Half Keystone	Gas Nitriding
Compression No 2	Grey Cast Iron	2 mm	Tapered	Hard Chrome
Oil Control	—	4 mm	Coil Expander	Gas Nitriding

— REFERENCE —

TRB (Toyota Reflex Burn)

TRB is a combustion method used in direct injection diesel engines, which has the characteristic of the head of the piston being shaped like a cavity. Due to the shape of the cavity, fuel vapour arriving at the cavity walls is scattered in the air, creating complex eddies and great agitation as a result of the squish and swirl of the air in the cavity. This action accelerates the mixture of the air and fuel.



6. Connecting Rod

- Special carbon steel is used for the connecting rod. This design makes them both rigid and light weight, allowing them to safely operate at high engine rotation rate.

- The small end of the connecting rod is tapered to further reduce weight.

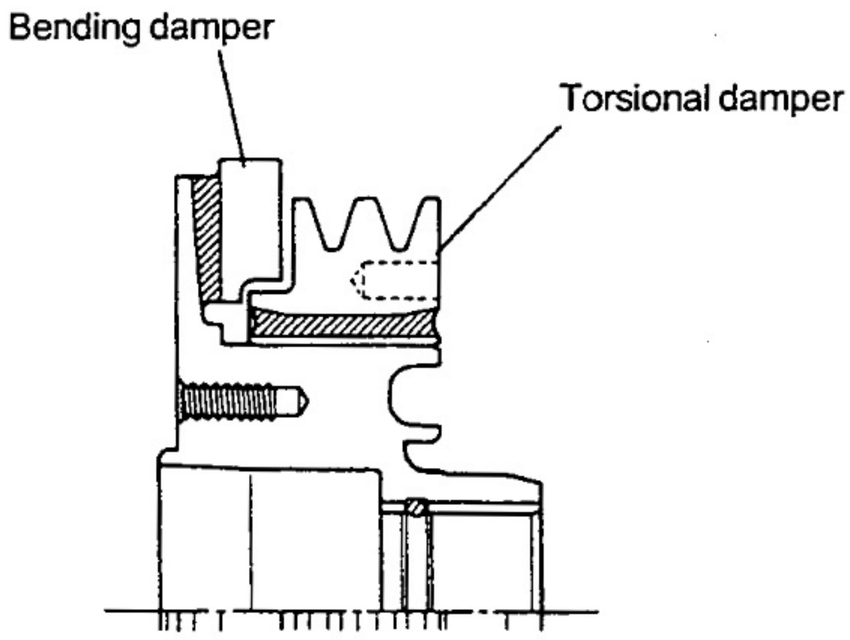
- Big end bearing material has been selected that is resistant to wear and metal fatigue so as to ensure high levels of durability.

7. Crankshaft

- The crankshaft is made of special carbon steel and is fully balanced with seven journals and twelve balance weights.

8. Crankshaft Pulley

- A crankshaft pulley is used that has a dual damper to reduce crankshaft torsional amplitude and thereby reduce vibration and noise.



9. Flywheel

- The flywheel used on the 1HD-FT is manufactured from grey cast iron. It is connected to the crankshaft with eight bolts.

■ VALVE MECHANISM

1. General

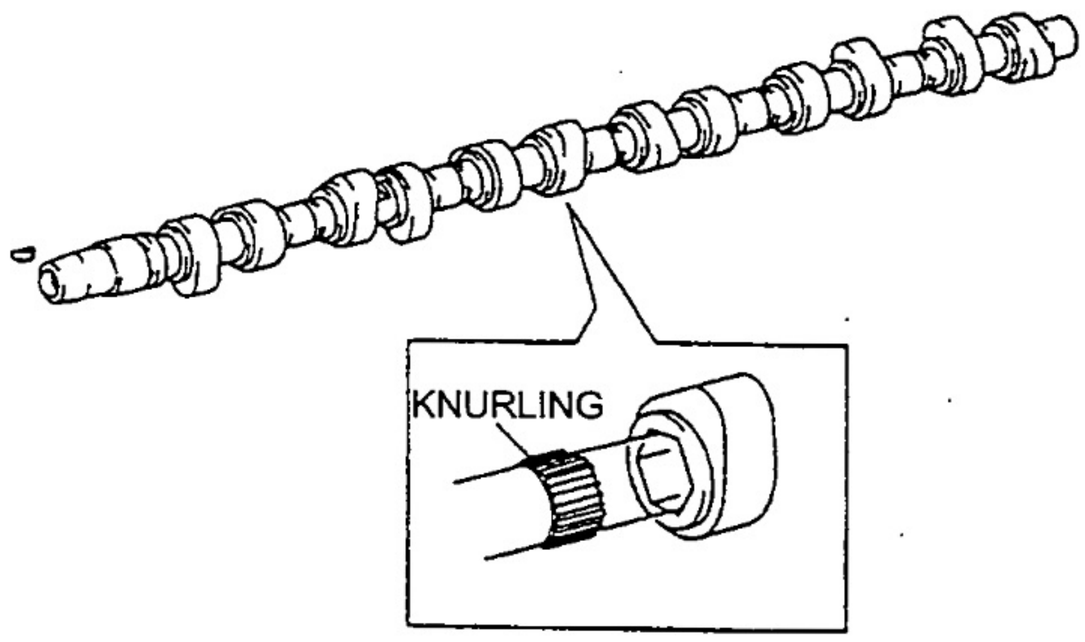
- A direct drive OHC is used for the valve drive mechanism. The camshaft is driven by a timing belt.

- The injection pump is driven by a gear as in the previous 1HD-T to minimise the load on the timing belt.

2. Camshaft

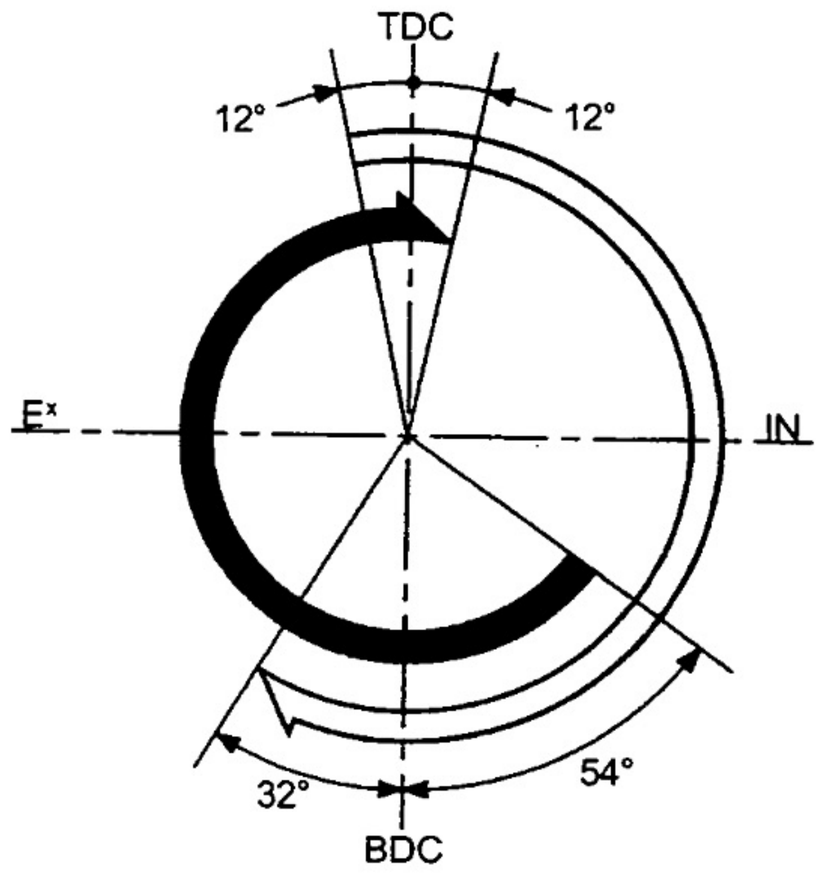
- A cam shaft assembly comprising of a shaft cut using a knurling method and with pressed-on cam piece has been adopted for the 1HD-FT.

- The camshaft is manufactured from carbon steel pipe. This process produces a shaft that is lighter in weight than a conventional camshaft.



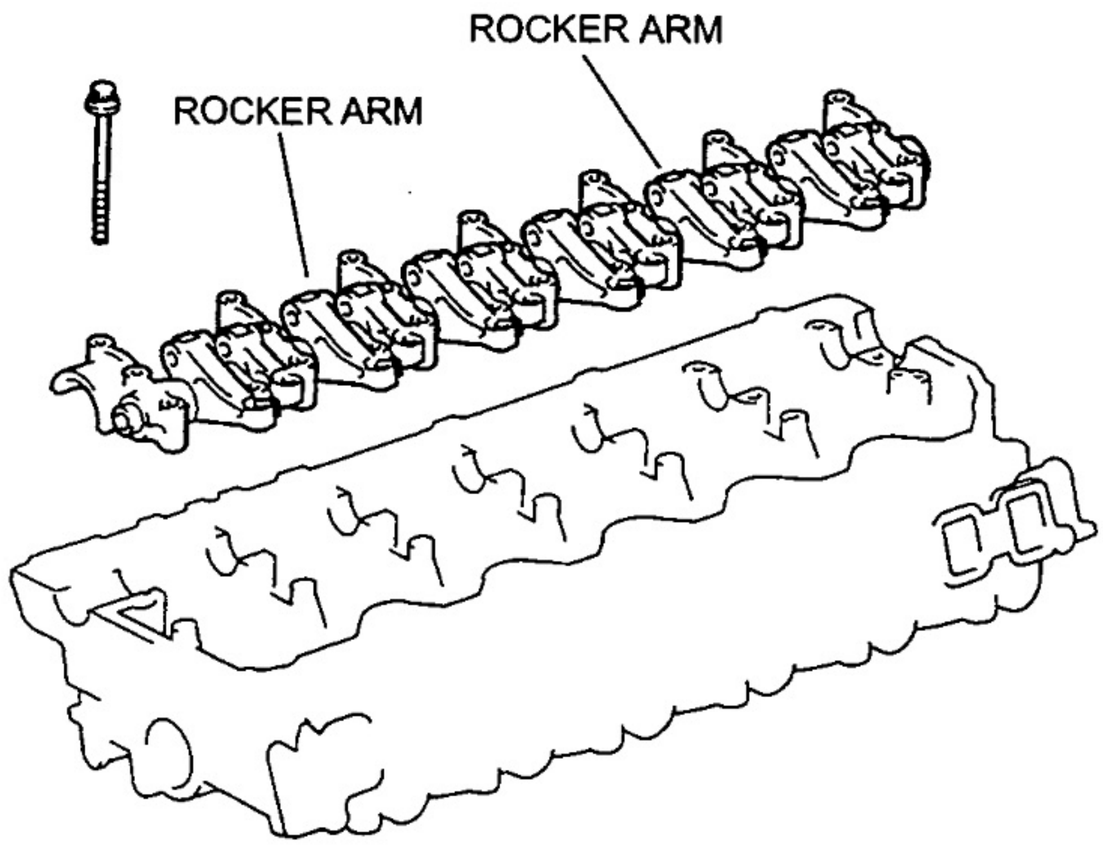
3. Valve Timing

- The valve timing for the 1HD-FT is shown in the diagram.



4. Rocker Shaft

- The rocker arm, nozzle holder clamp and upper cam bearing cap all fit onto the rocker shaft. The lower cam bearing cap is part of the cylinder head.



5. Rocker Arm and Valve Bridge

- A OHC 4 valve per cylinder valve train comprising of a Roller Rocker Arm and a Valve Bridge is used in the 1HD-FT.

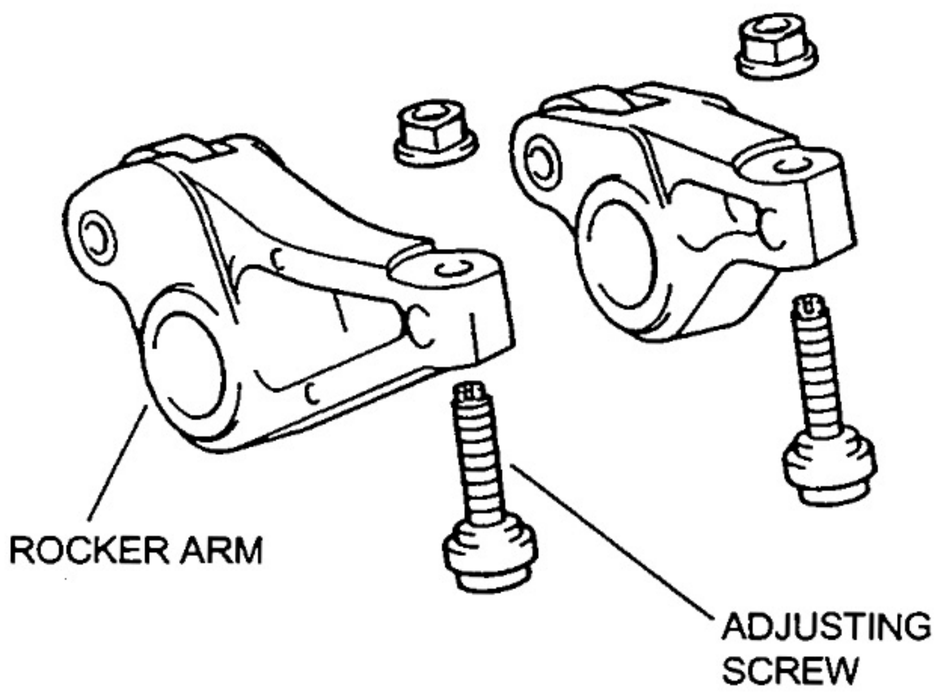
- Aluminium alloy is used for the rocker arm main body, rollers are used for better durability and reduced friction.

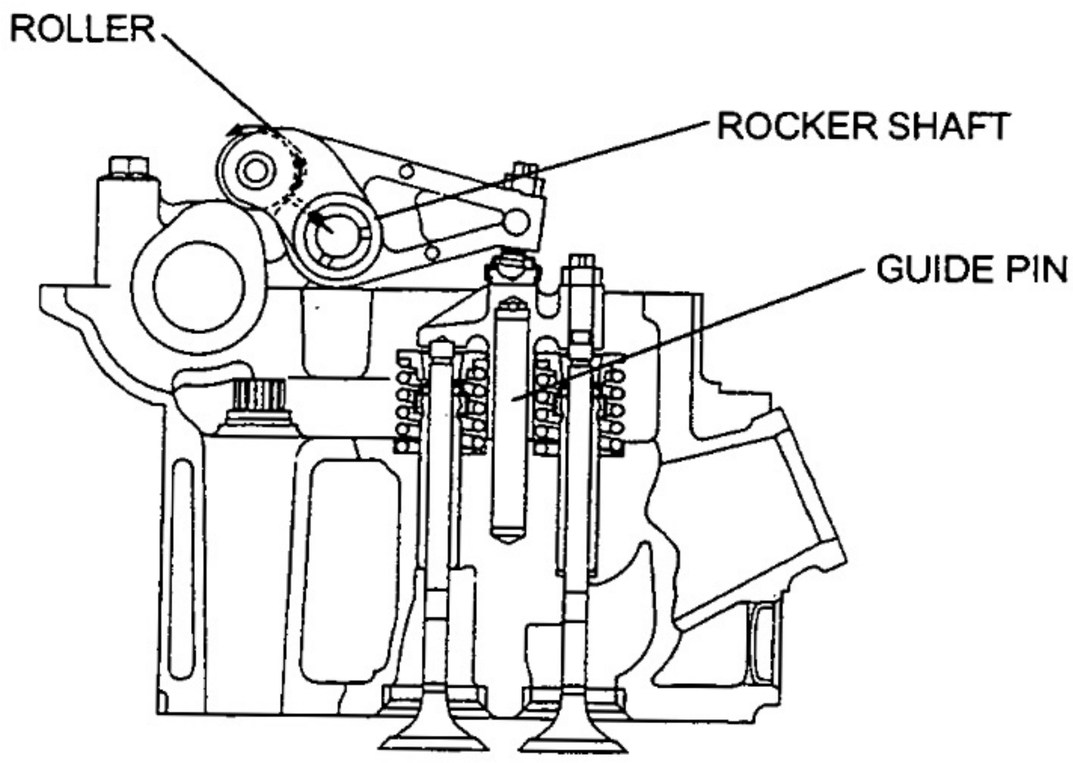
- The Rocker Arm Adjusting Screw comprises a screw, a socket and a cap but is formed into one unit by fixing the screw and socket together with the cap. This arrangement reduces the surface contact force between the socket and the valve bridge.

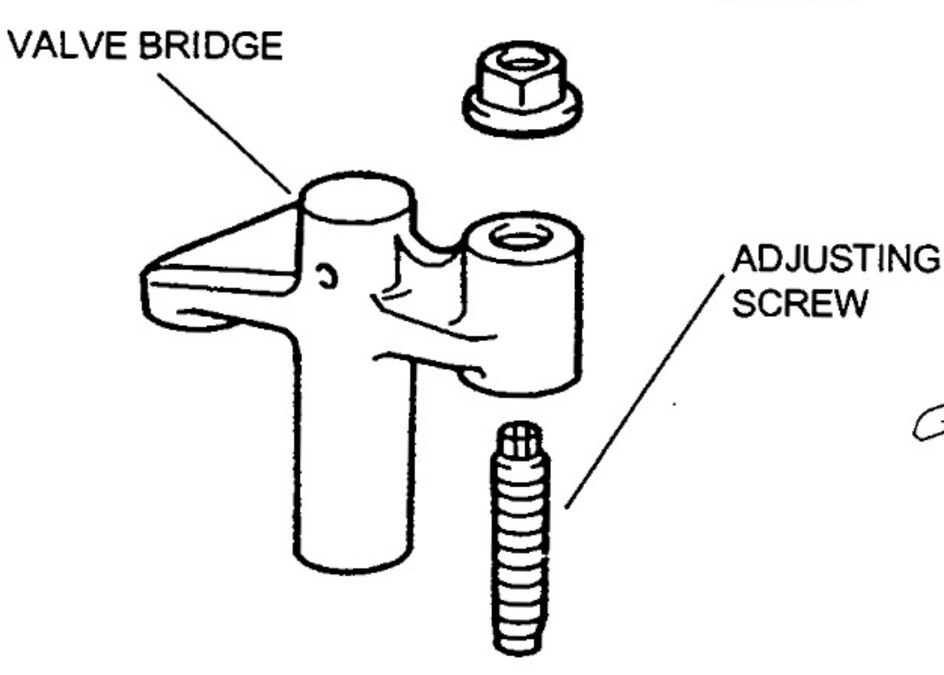
- Oil is supplied to the rollers from the rocker shaft when oil supply holes in the rocker shaft and the rocker arm line up.

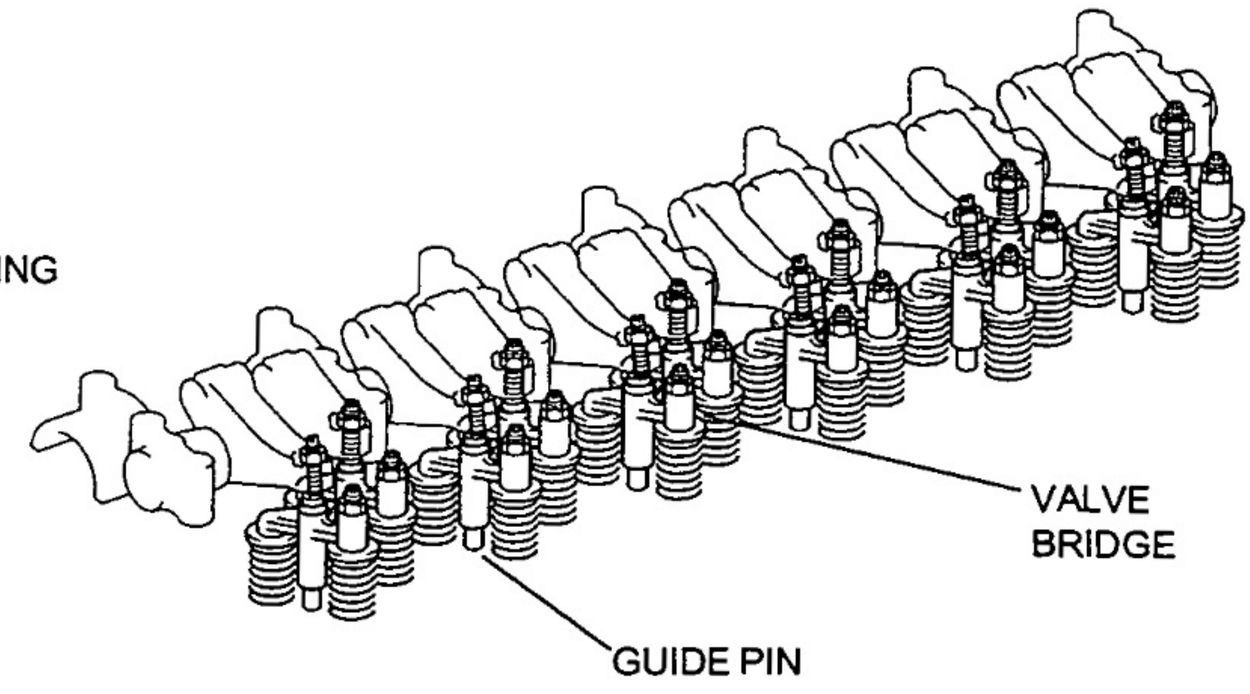
- The valve bridge is made from spherical graphite cast iron with hardened contact areas.

- The valve pair open simultaneously by the action of the valve Bridge. The bridge fits over the valve bridge guide pin that is a press fit into the cylinder head. and is in contact with the two valve stem ends in a parallel position. As the Cam lifts the rocker arm it transmits the movement to the Valve Bridge that is in contact with both valves, the bridge then slides down the guide pin and transmits the movement to the two valves.









6. Valve and Valve Spring

- Heat resistant steel valves with hardened shafts are used for both the intake and exhaust valves.

- Oil tempered silicone chrome steel wire is used for the valve spring.

- A sintered valve guide bush is used for both intake and exhaust valves.

◆Specifications ◆

	Intake Valve	Exhaust Valve
Material	Heat resistant steel	←
Length mm	127.15	126.93
Head Dia mm	ø33	ø30.4
Stem Dia	ø7	ø7

	Valve Spring
Material	Silicone Chrome Steel
Coil Dia. mm	ø18
Wire Dia. mm	ø3.5
Free Length mm	49.6

7. Auto Tensioner

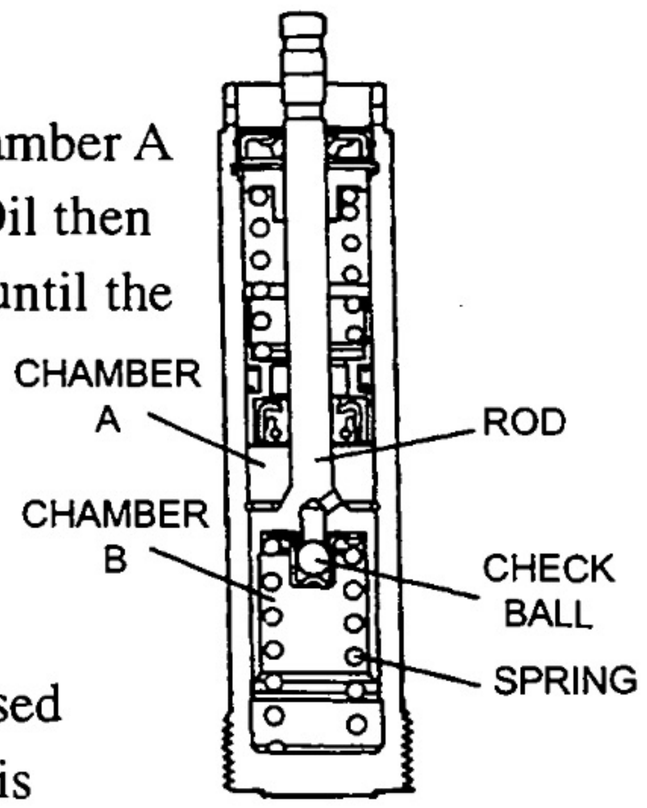
The auto tensioner mechanism used in the 1HD-FT engine has similar construction and operation to that used in the 1HD-T. However, for longer belt life and lower noise, an oil-pressurised auto-tensioner has been used in place of the previous spring.

The auto-tensioner consists of a rod, check ball, spring, seals and silicon oil.

Operation

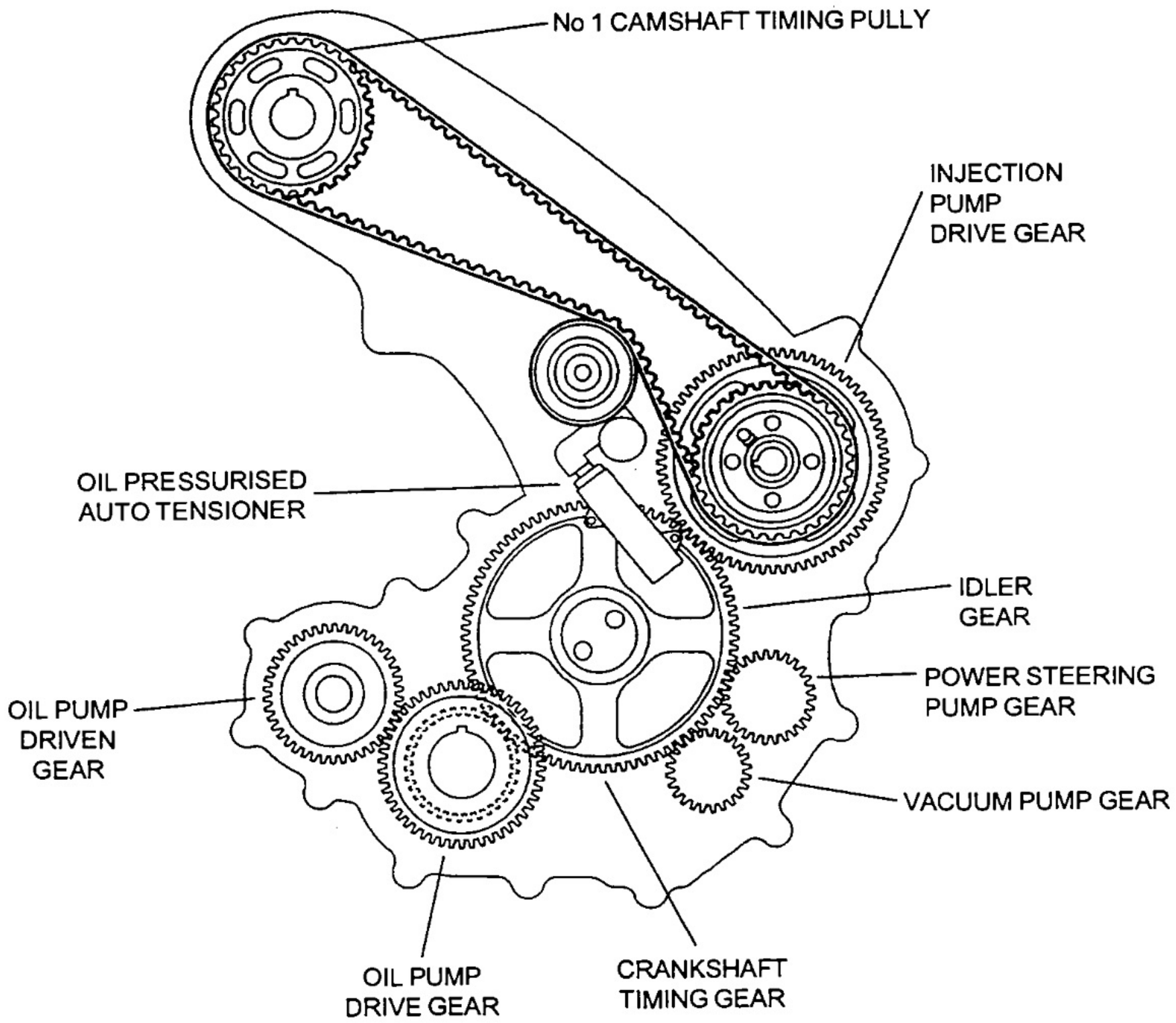
a. Belt Loosening

As the belt loosens the rod moves out under spring pressure to remove the looseness causing an increase in oil pressure in chamber A with a corresponding decrease in oil pressure in chamber B. Oil then flows from chamber A to chamber B through the check valve until the pressures in each chamber are equal.



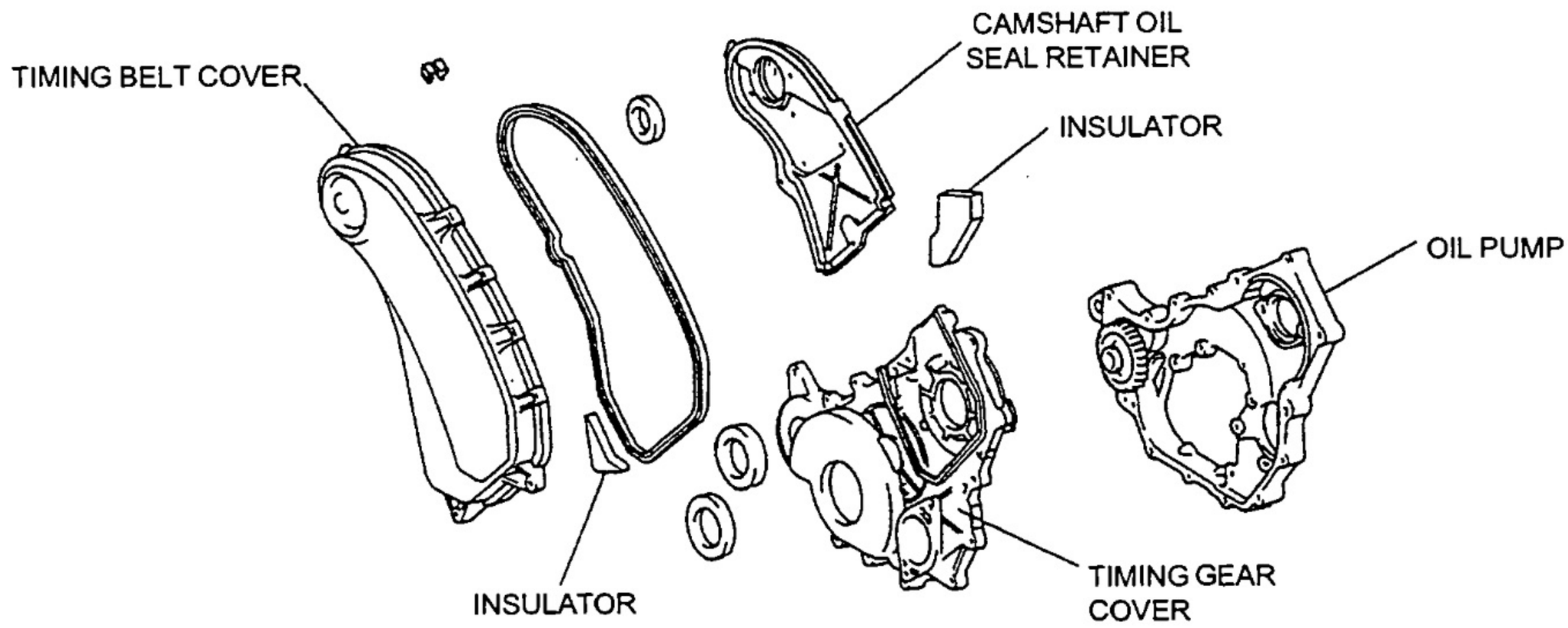
b. Belt Tightening

If the belt attempts to tighten, when the engine speed is increased suddenly for example, the belt attempts to push the rod in. This action closes the check valve, sealing chamber B and preventing any further movement of the rod by attempting to compress the oil.



8. Timing Belt Cover

A plastic timing belt cover for has been used to reduce weight and noise. Insulation has also been fitted between the timing belt cover and the gear cover, and between the cam shaft seal and the cylinder block retainer to further reduce noise.

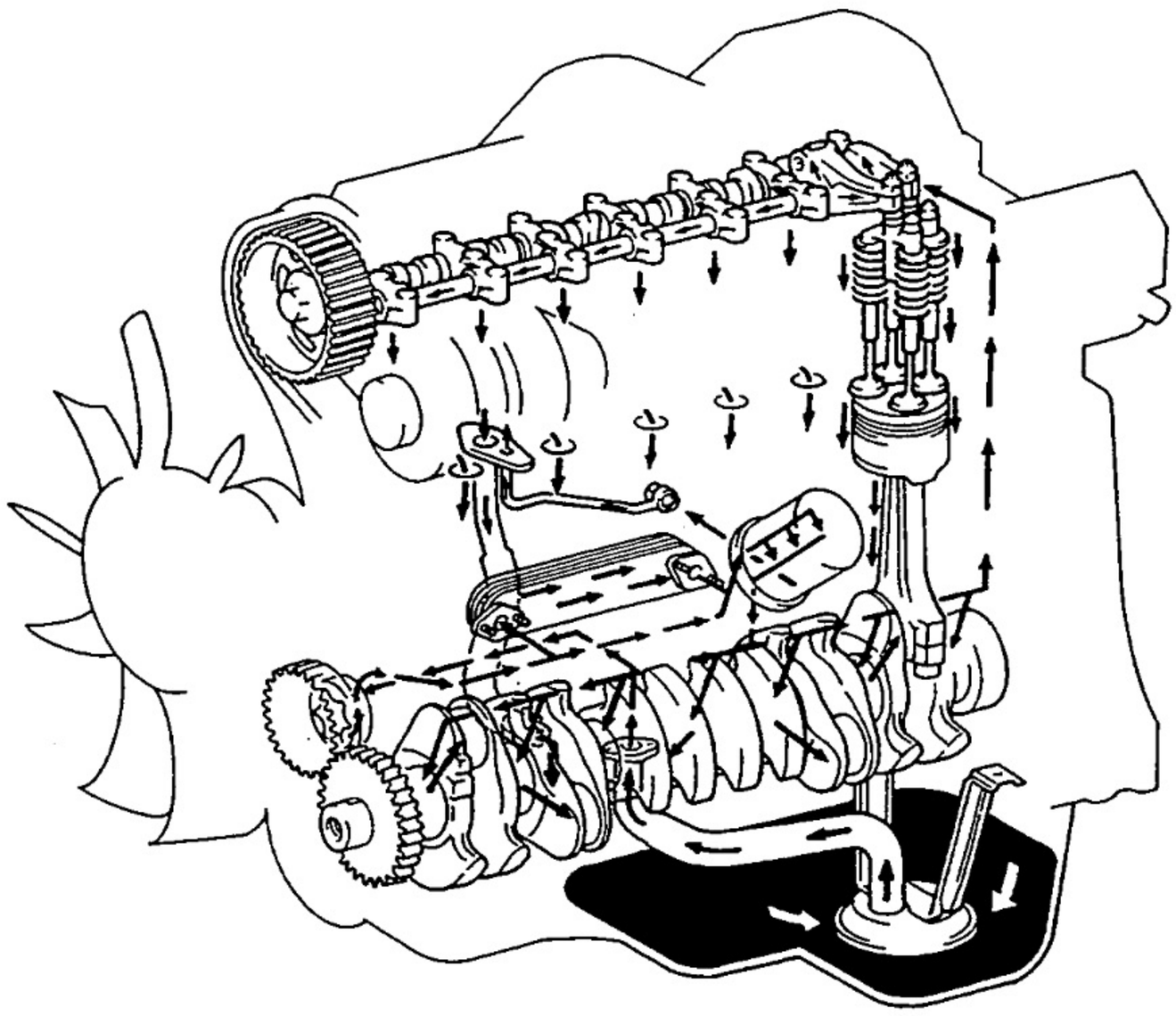


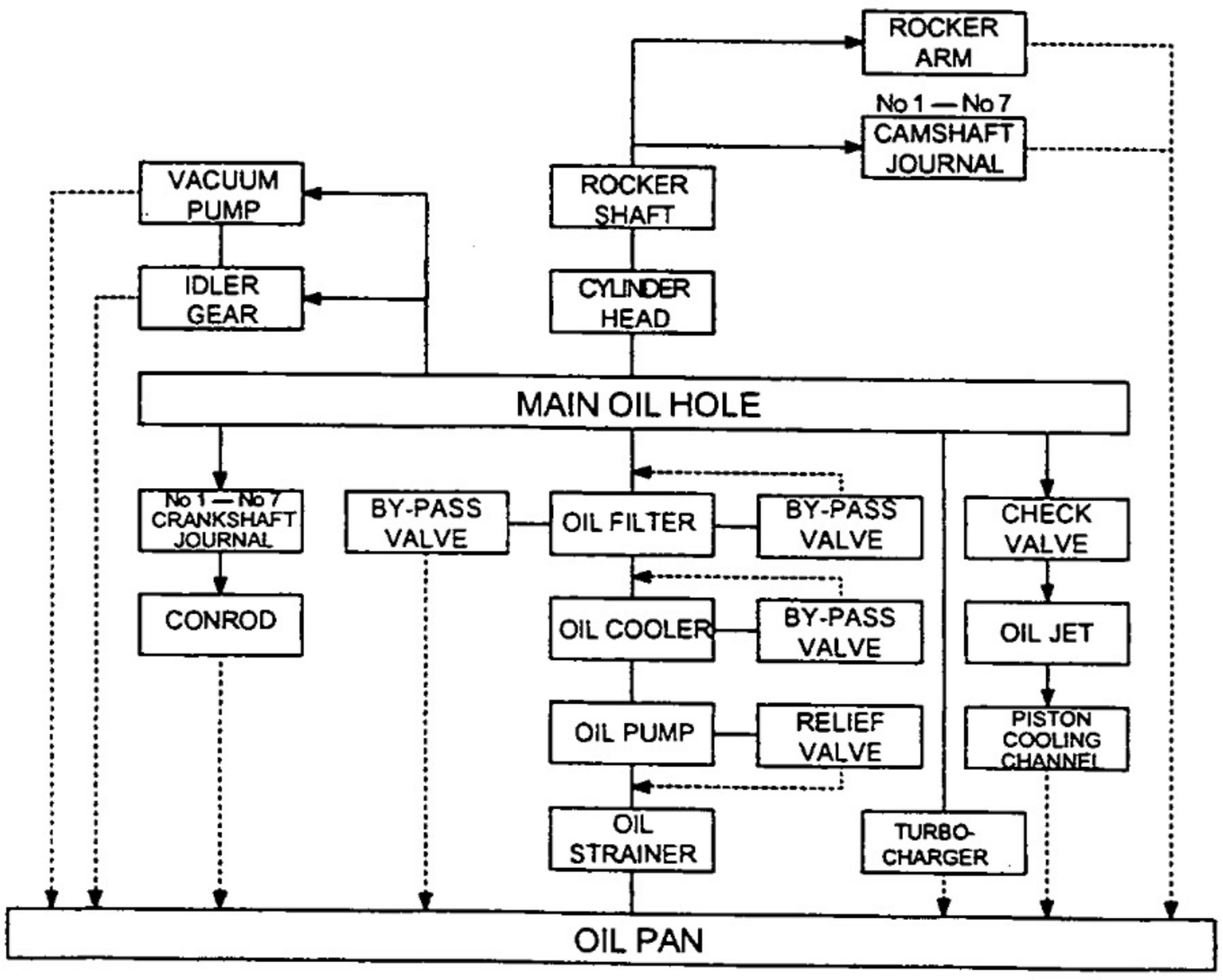
■ LUBRICATION SYSTEM

1. General

- A bypass valve is fitted to the oil filter bypass oil hole to reduce the time taken to build up oil pressure when starting the engine.

- Lubrication of the valve train is provided from the cylinder head via the No 7 camshaft bearing cap to oil hole into the rocker shaft and then distributed to each component.





2. Oil Pan and Oil Strainer

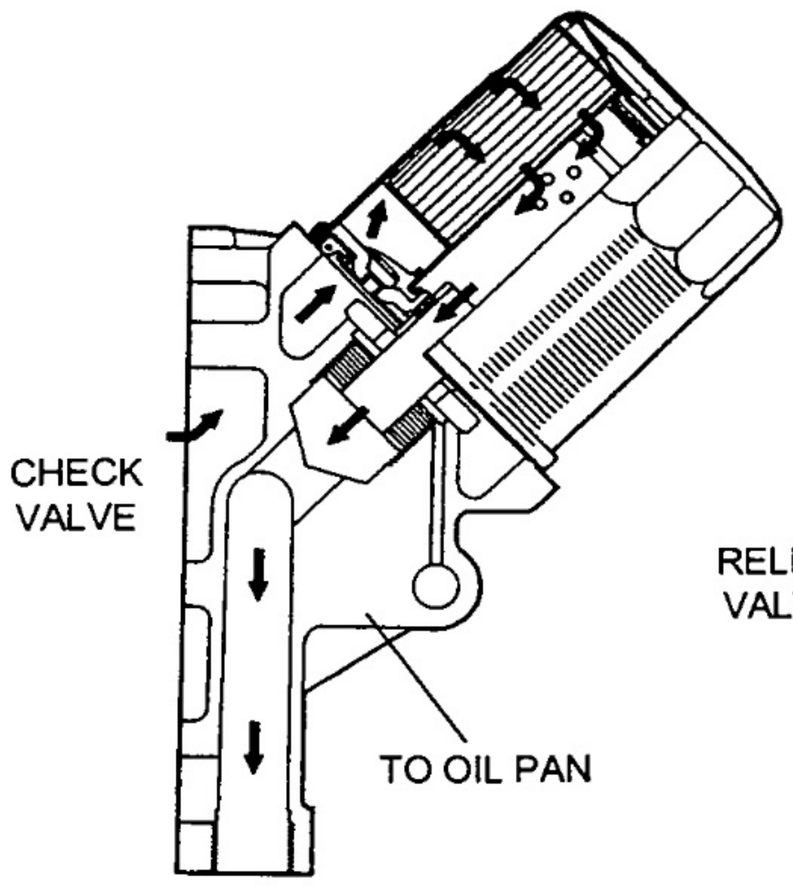
- Vibration damping steel sheet has been used for the oil pan to reduce noise.
- FIPG has been used for the oil pan gasket.
- Insulation is placed between the back of oil pan and the rear end plate to further reduce noise.

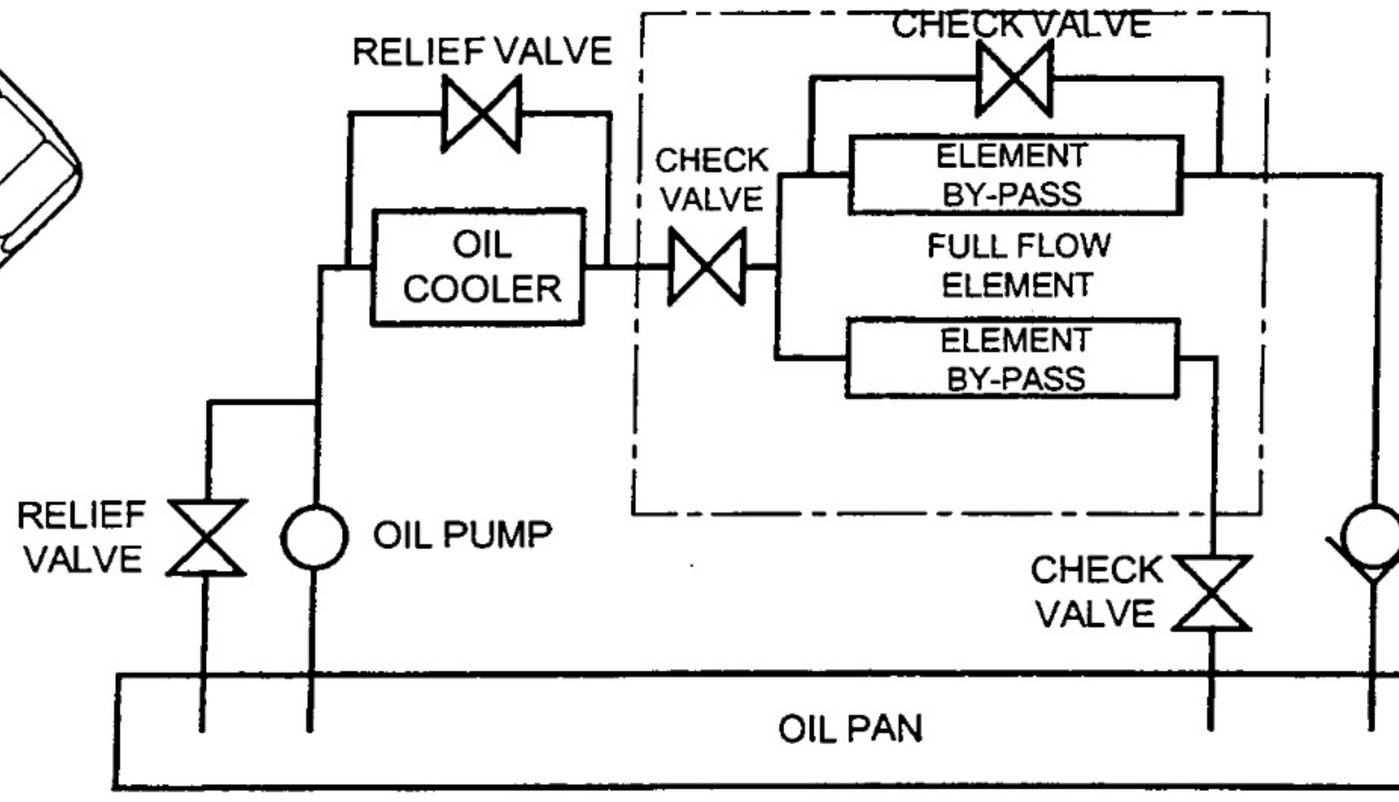
3. Oil Pump

A five-leaf, six-node trochoid pump is used for the 1HD-FT, the pump is integrated into the Timing Gear Case.

4. Oil Filter

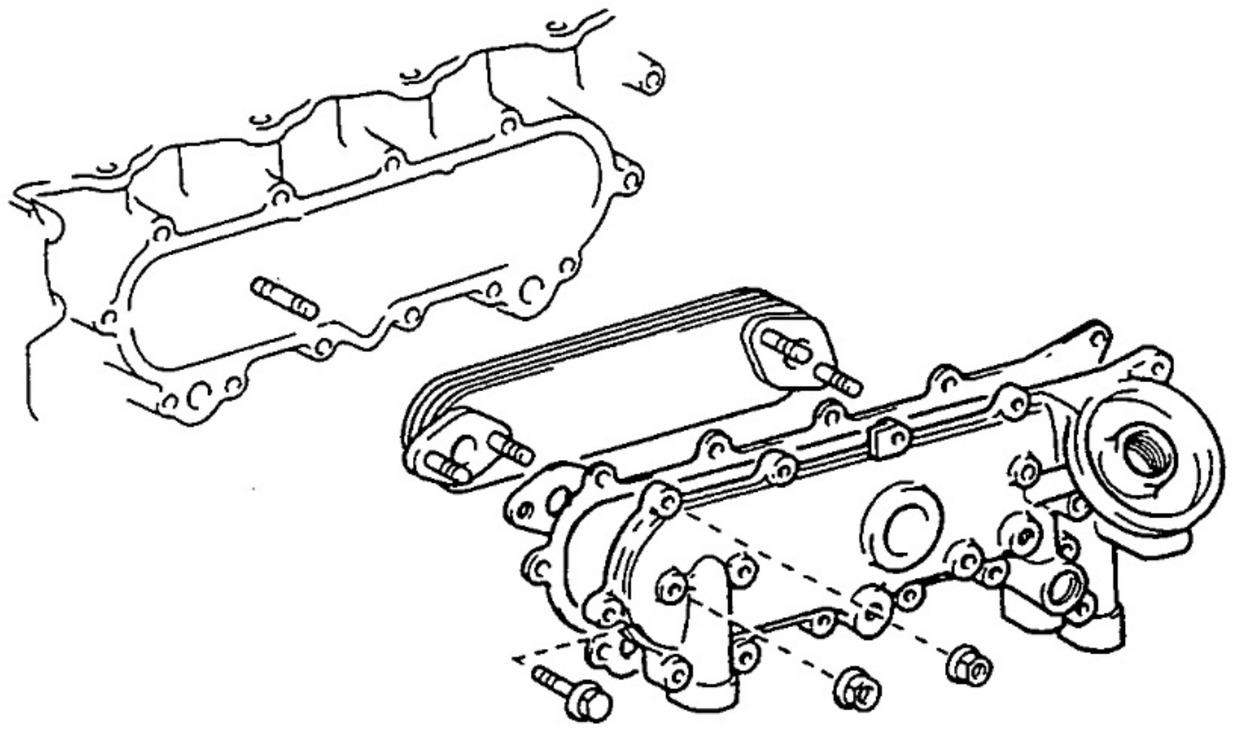
A twin element type oil filter with both full flow and bypass systems is used.





5. Oil Cooler

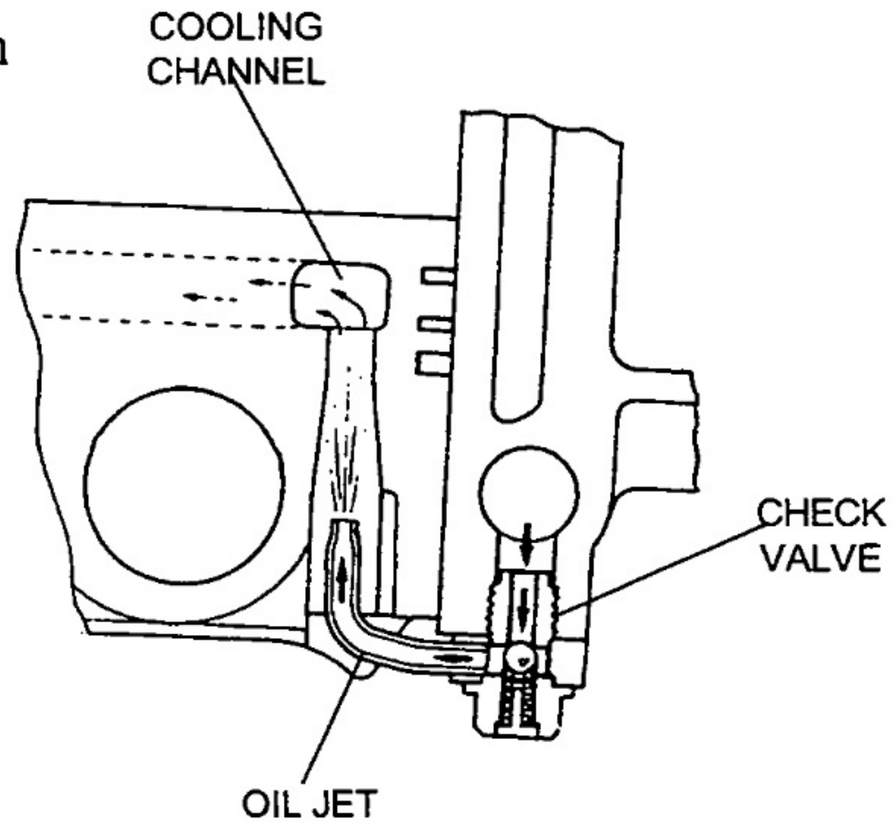
A water cooled multi plate four tiered element type oil cooler that is placed inside the cylinder block has been used in the 1HD-FT engine.



6. Oil Nozzle and Oil Check Valve

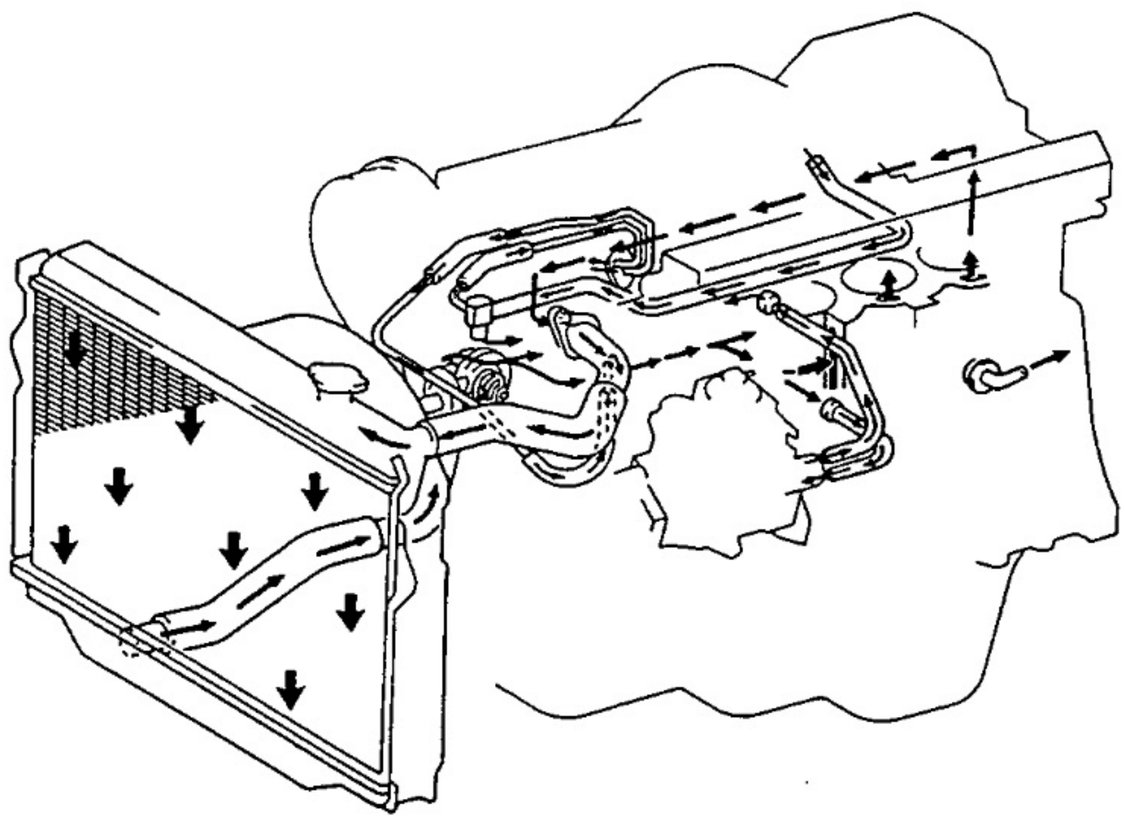
- Oil is supplied to the piston cooling channel by an oil jet, lubricating and cooling the piston and piston pin.

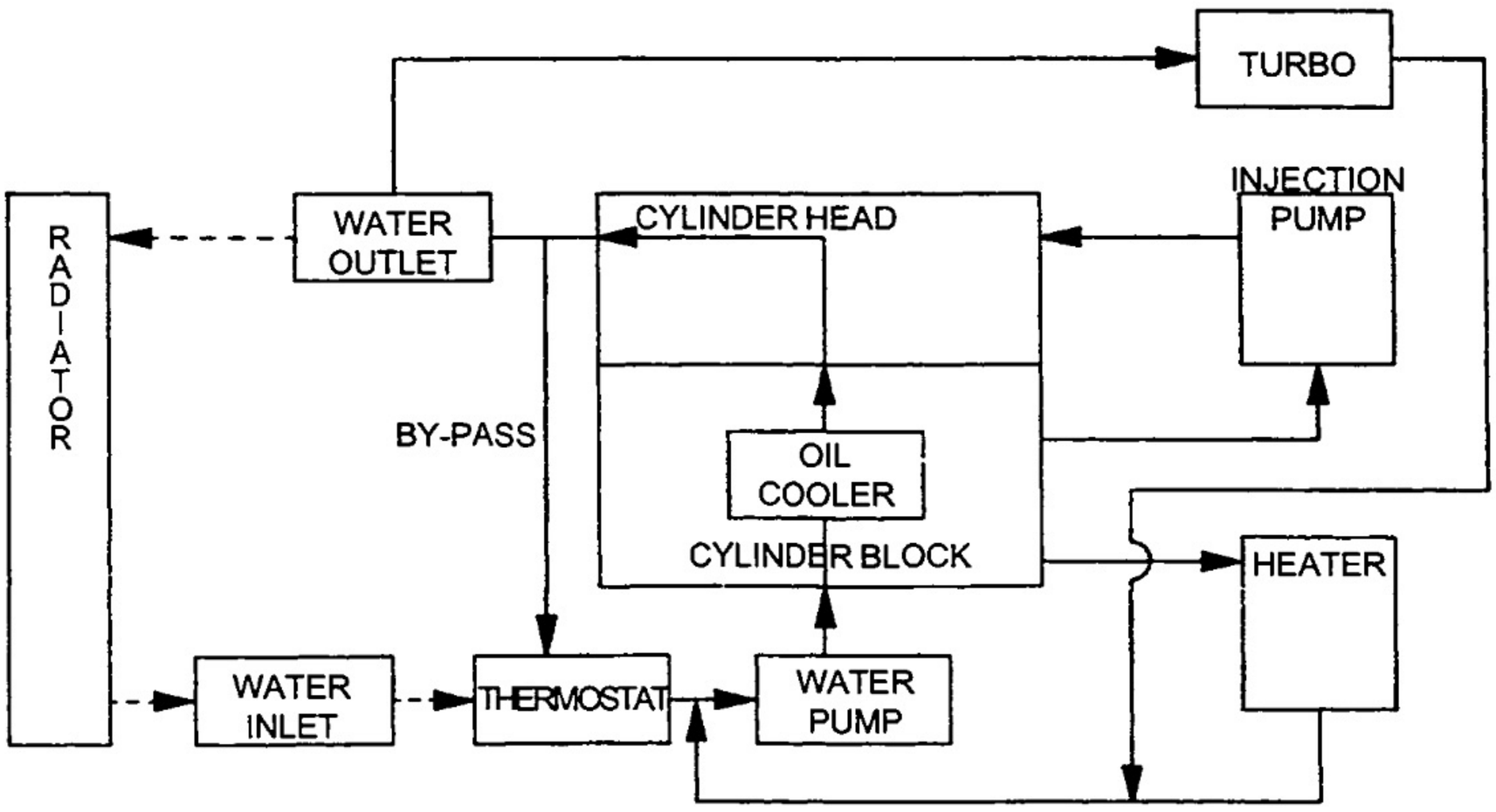
- The oil check valve cuts the oil flow to the oil nozzle when oil pressure is low, thereby preventing oil pressure inside the entire engine from dropping.



■ COOLING SYSTEM

A bottom bypass type cooling system is used in the 1HD-FT engine. This system uses pressure forced circulation with a bypass valve thermostat placed on the inlet side.





■ INTAKE AND EXHAUST SYSTEM

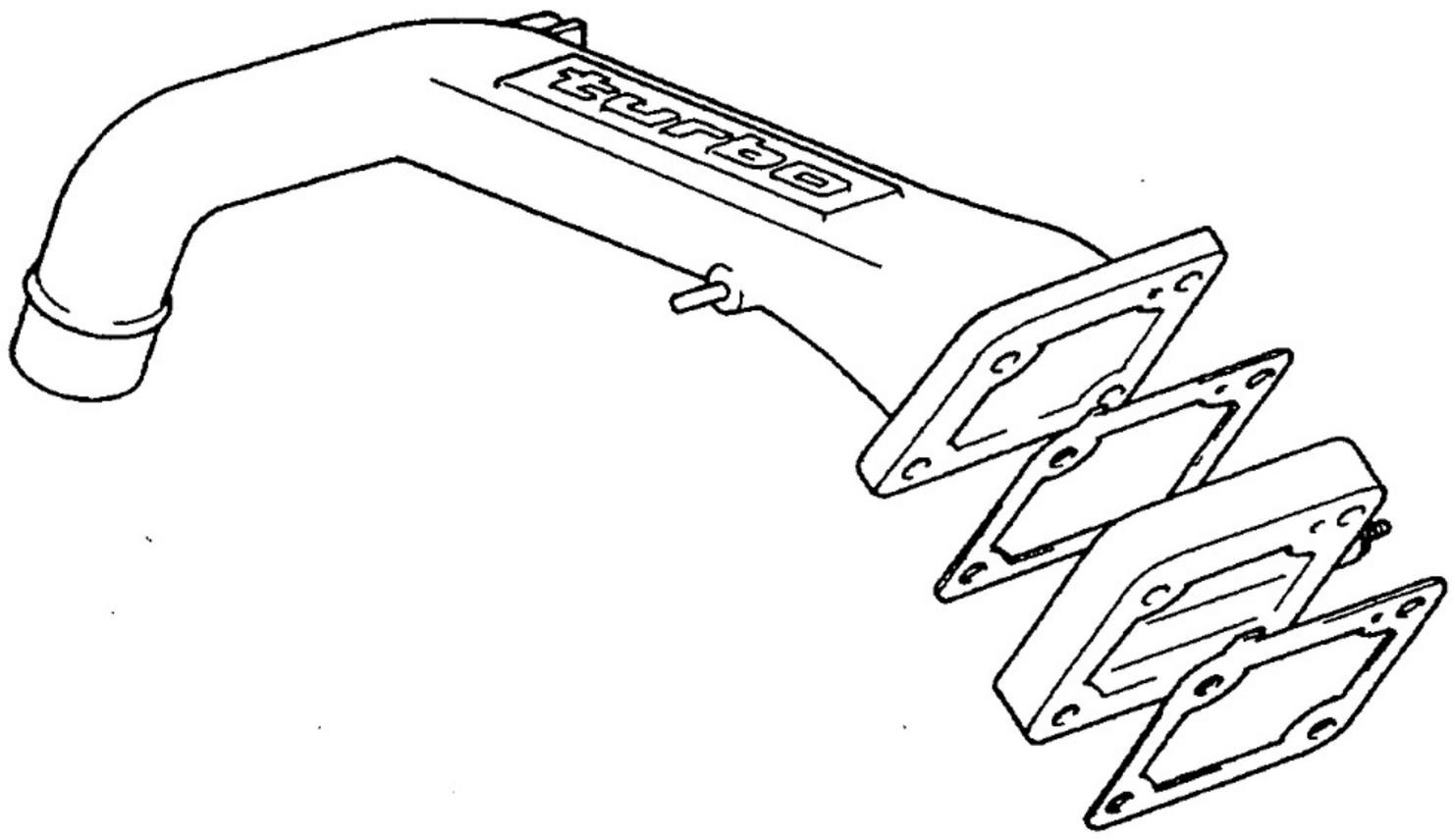
1. Intake Manifold

- The intake manifold gasket is made by vulcanising sandwiched sheets of stainless steel and rubber together. This produces a floating effect that reduces noise . A double lip seal is used for better sealing efficiency.

- Insulation is fitted over the intake manifold ports to further reduce noise.

2. Intake Pipe

The letters "TURBO" are embossed on the intake pipe to emphasise the fitment of the turbo charger and for good appearance.



3. Exhaust Manifold

- The port area is optimised for higher engine output and exhaust efficiency.

- The gasket is a five layer laminate type.

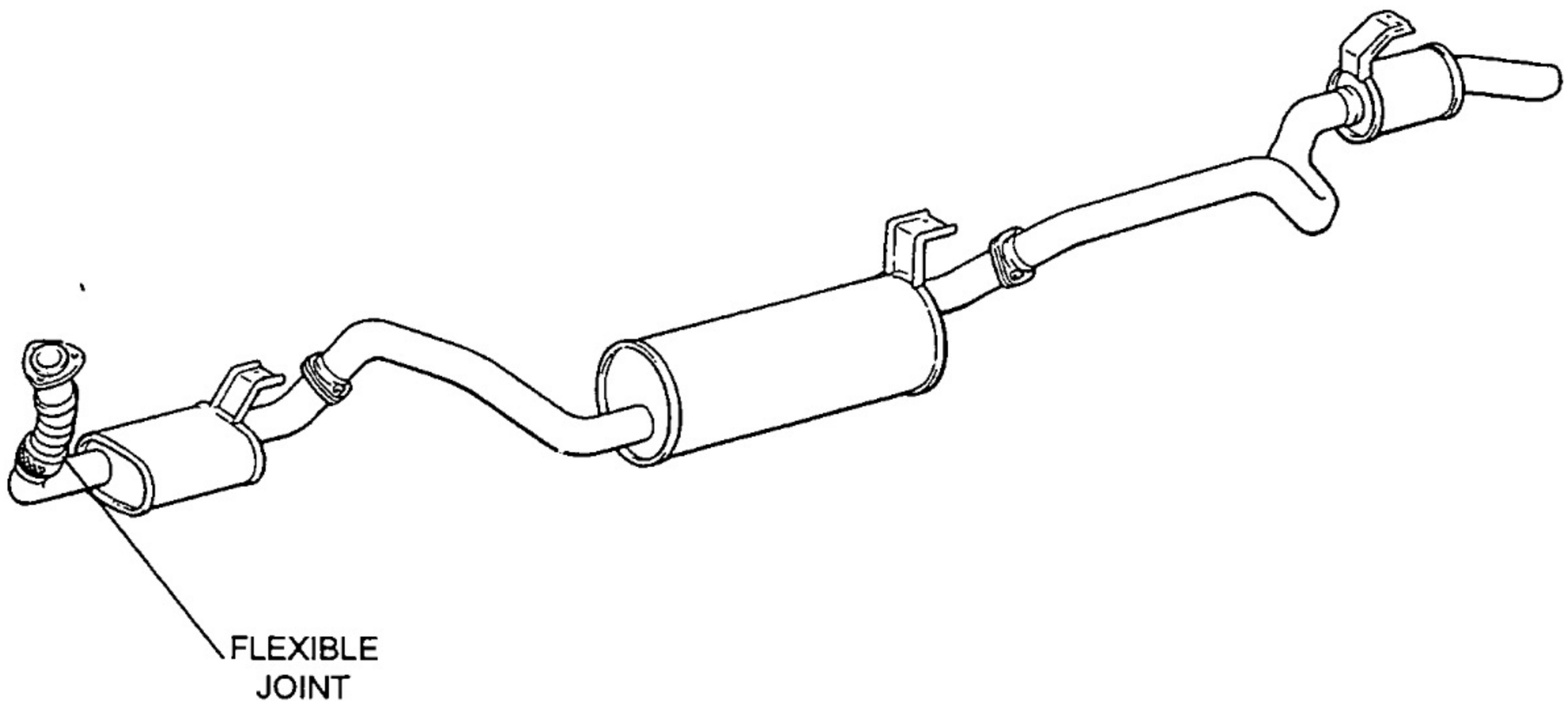
- To reduce noise the heat insulator fixing points have been relocated on the cylinder head and exhaust manifold flange to points where the effect of vibration is relatively small. Cooling efficiency has been improved by adding more vent louvers to the insulator.

4. Exhaust Pipe

- Pipe diameter, muffler capacity, etc. have been optimised in keeping with the other engine improvements.

- A flexible joint is incorporated in the engine pipe to reduce vibrations and idle booming noise.

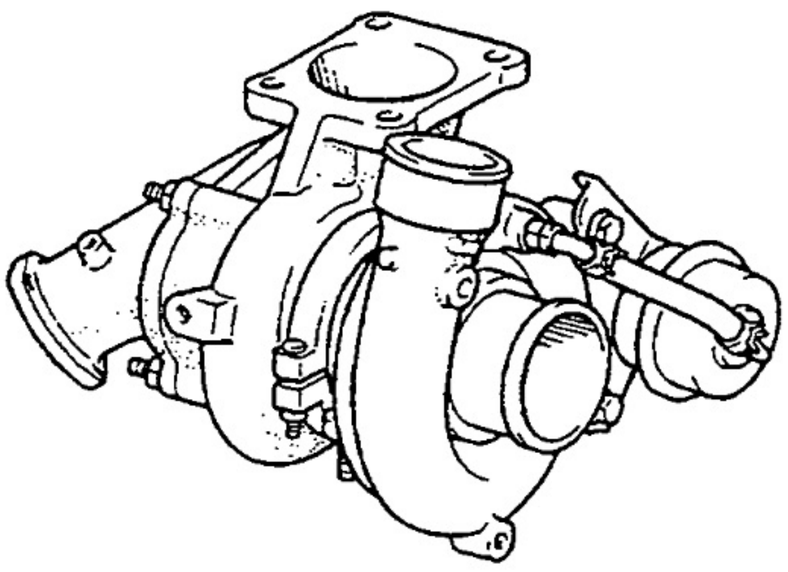
- The main and sub mufflers are of mutli-layer construction to reduce noise.



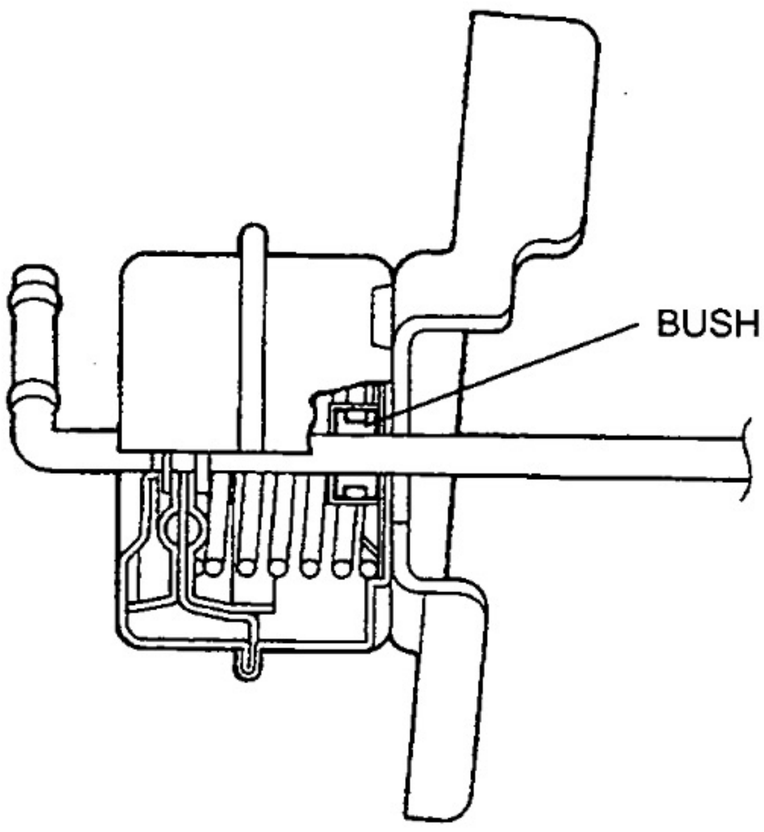
5. Turbocharger

- The turbocharger has been matched to the new engine. The turbine housing has a larger scroll area than the unit fitted to the previous 1HD-T engine to increase the charging pressure.

- A bush has been installed inside the actuator to reduce rod vibrations.



TURBOCHARGER



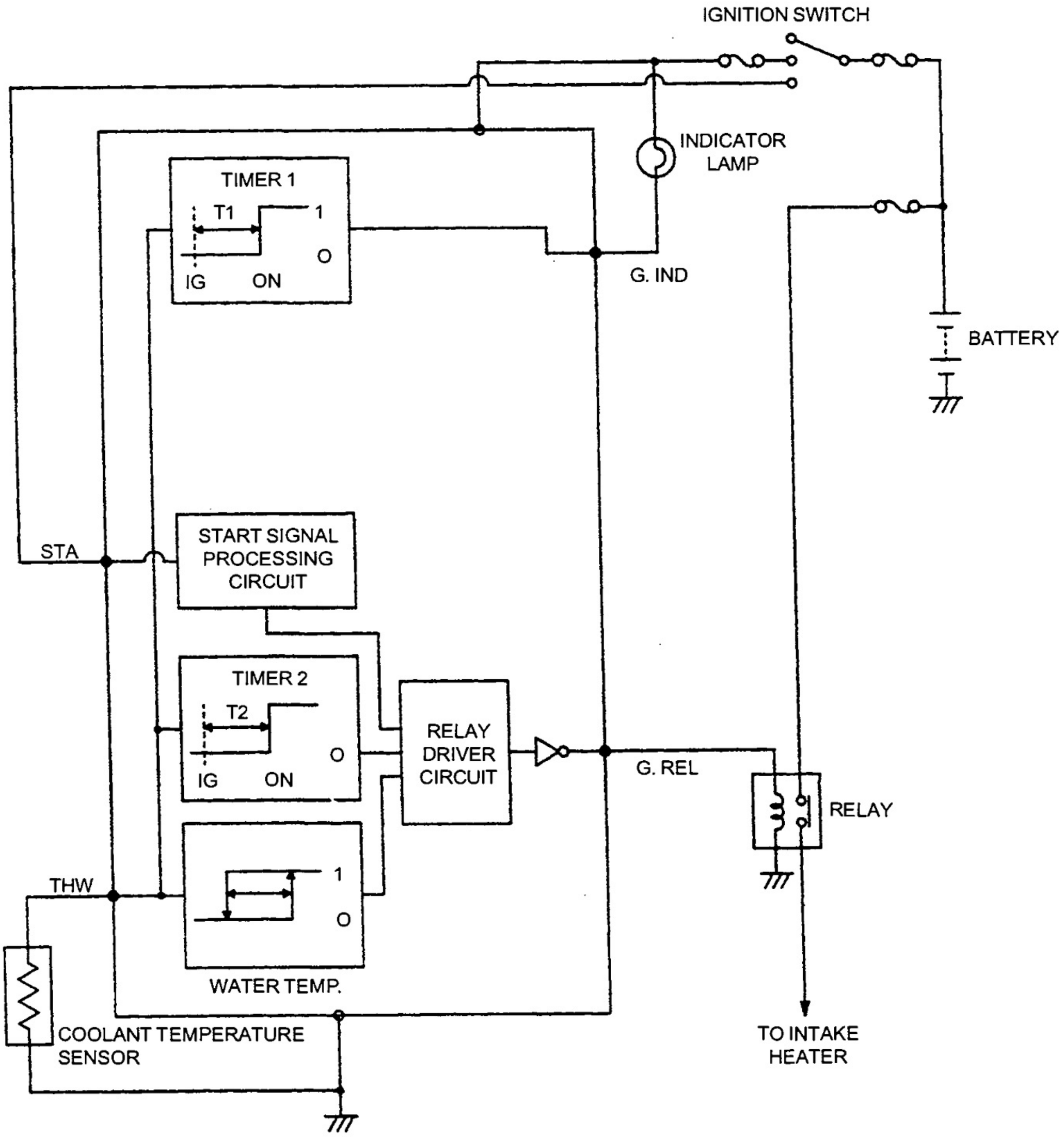
ACTUATOR

■ PREHEATING SYSTEM

1. General

The super glow control system used in the previous 1HD-T has been replaced by an intake heater system to assist engine startability. In addition to this the heater stays on for a set amount of time after starting to help reduce diesel knock and white smoke that can occur when starting a cold engine.

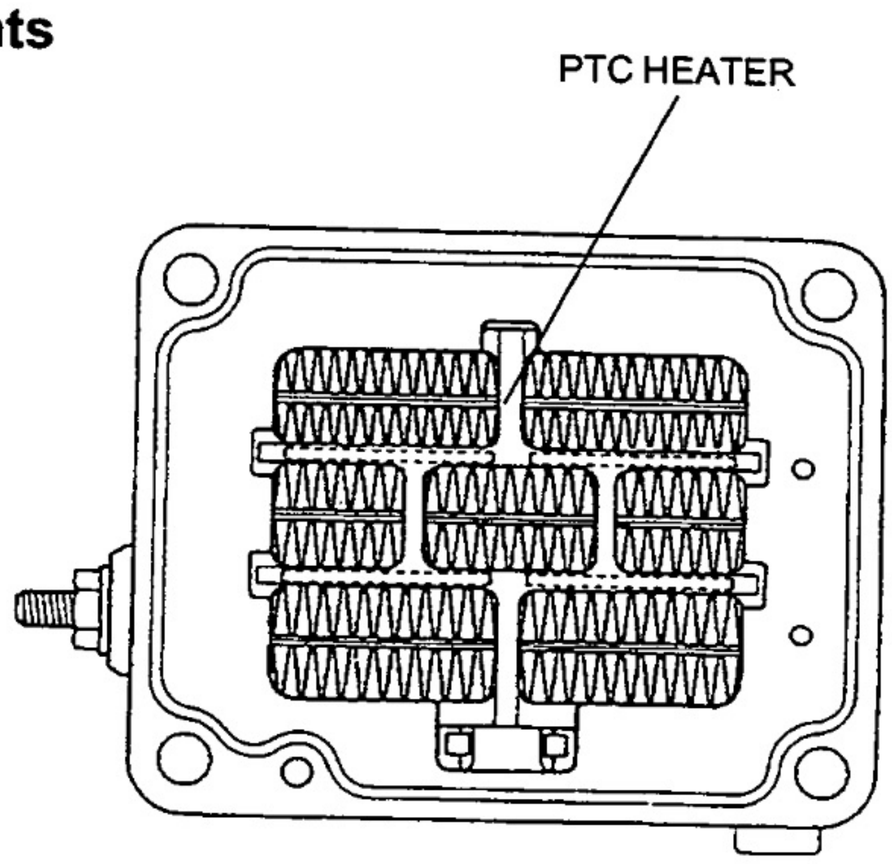
2. Wiring Diagram



3. Construction and Operation of Components

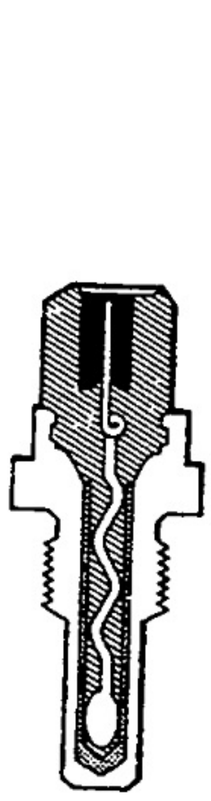
Intake Heater

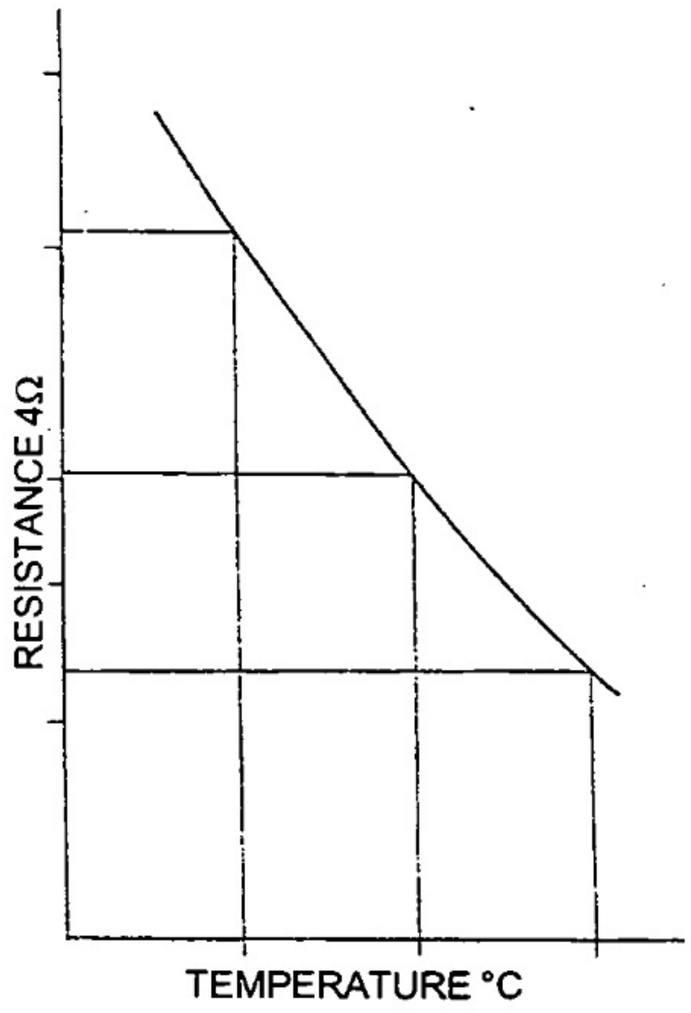
Electric current from the intake heater relay causes the PTC element of the intake heater to heat up, this in turn caused the temperature of the radiator fins to increase. Intake air is heated as it flows over the radiator fins.



Water Temperature Sensor

The water temperature sensor detects the temperature of the engine coolant and is located on the oil cooler cover. The sensor consists of a thermistor in a protective case, the thermistor's electric resistance varies in accordance with changes in water temperature. The engine coolant temperature is calculated by measuring the thermistor's resistance value.





Intake Heater Relay

The intake heater relay connects electric current from the battery to the intake heater in accordance with signals from the pre-heating timer.

Pre-heating Timer

The pre-heating timer controls the ON/OFF operation of the indicator lamp and the intake heater relay in accordance to the water temperature as detected by the water temperature sensor.

Operation

a. Coolant Temperature Below 4°C

When the ignition switch is turned on, the indicator lamp and intake heater relay comes on simultaneously allowing electric current to flow from the battery to the intake heater warming the intake air. Actual preheat time and after heat time vary according to the temperature of cooling water. If a starter signal is received by the preheat timer while it is controlling the intake heater the indicator lamp is turned off.

b. Coolant Temperature Above 4°C

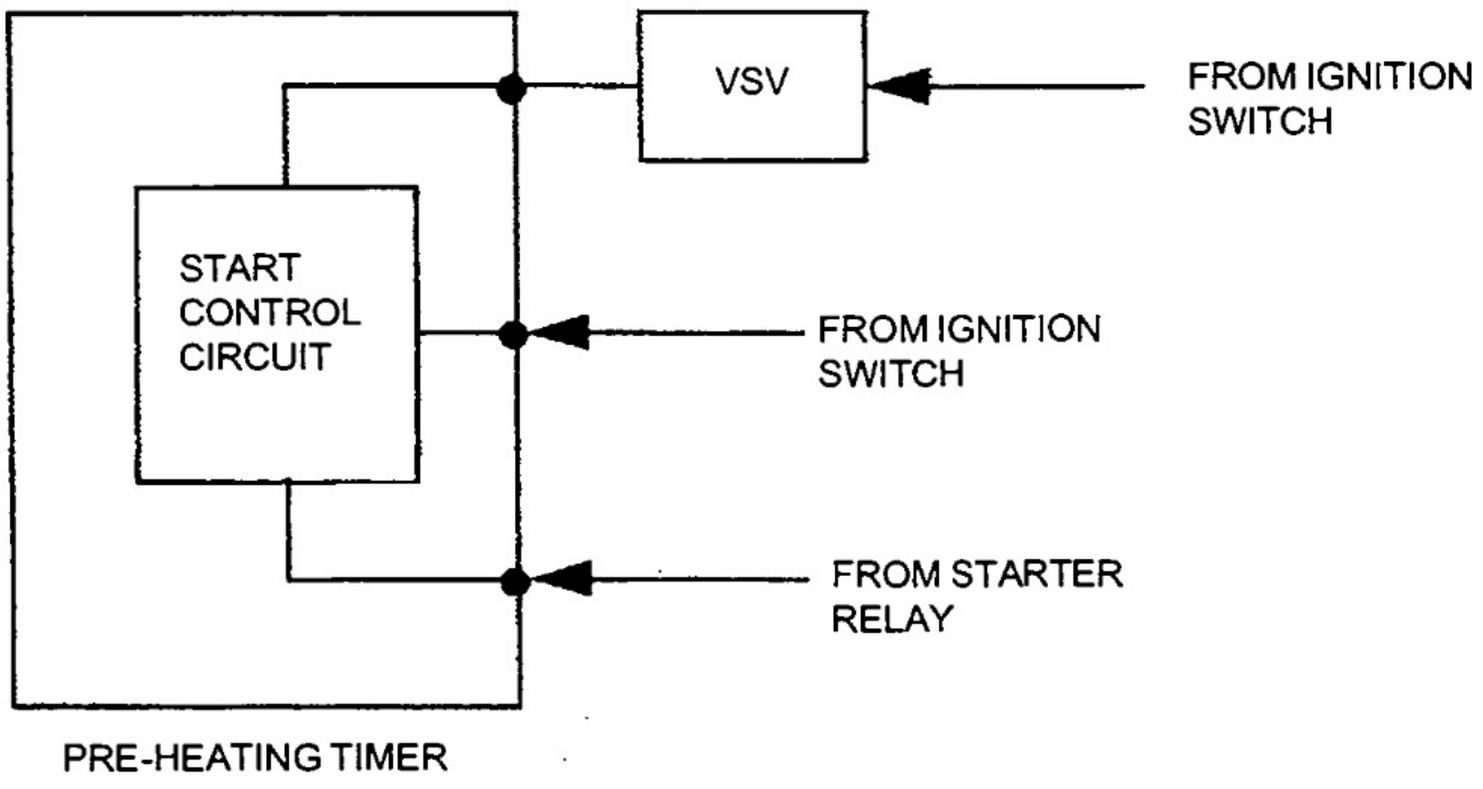
When the ignition switch is turned on, the indicator lamp comes on for 0.5 seconds but the intake heater does not operate.

■ DIESEL SMOKE CONTROL SYSTEM (DSCS)

1. General

A DSCS (Diesel Smoke Control System) consisting of a SICS (Starting Injection Control System) has been used on the 1HD-FT engine. This system operates to control the amount of fuel delivered at starting thereby limiting the amount of black smoke emitted.

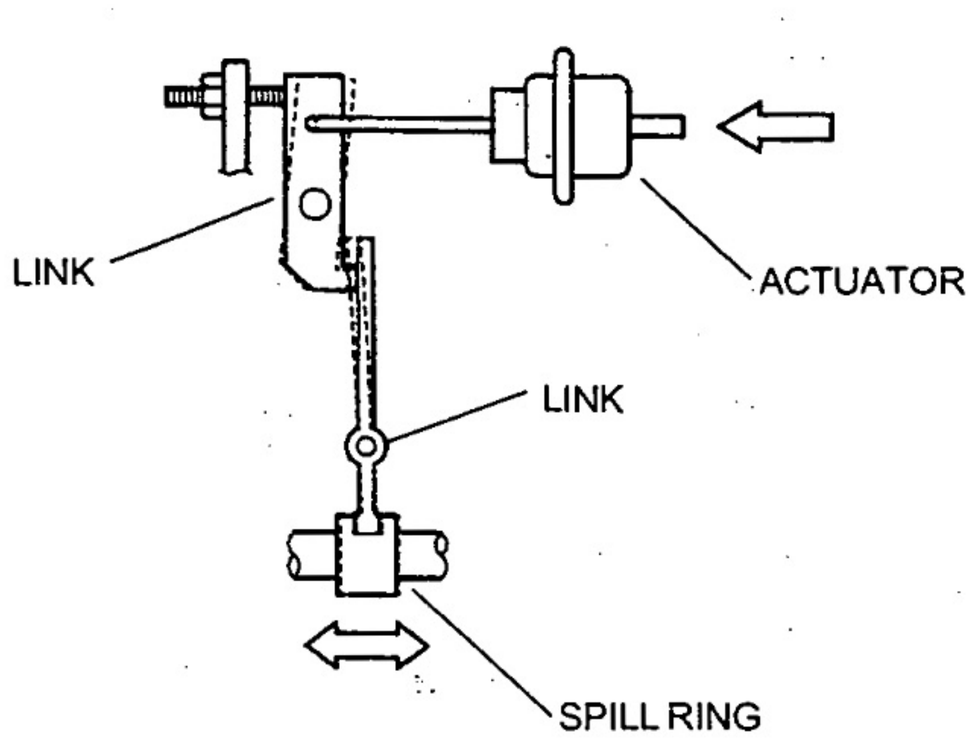
2. Circuit Diagram



2. Construction and Operation of Components

Actuator

The actuator is moved by vacuum in accordance with the operation of the VSV. The actuator diaphragm is connected to the spill ring via a system of levers.



VSV (Vacuum Switching Valve)

The SICS VSV is controlled by the pre-heating timer and is constructed to be open, that is allow vacuum to the actuator, when electric current is applied to it.

Pre-heating Timer

The pre-heating timer controls the ON/OFF operation of the SICS VSV in accordance to signals received from the starter relay.

Operation

a. Ignition Switch On

When the ignition switch is turned to the on position the control circuit in the pre-heating timer allows current to flow from the battery through the VSV to earth. This energises the coil in the VSV allowing vacuum to act on the actuator moving it to the right which in turn positions the spill ring in the run position.

b. Engine Cranking

When the ignition switch is moved to the start position the control circuit in the pre-heating timer cuts the circuit allowing current flow through the VSV. The coil in the VSV is therefore de energised stopping vacuum reaching the actuator, the actuator is moved to the left by an internal spring moving the spill ring in the reduced fuel direction for starting.

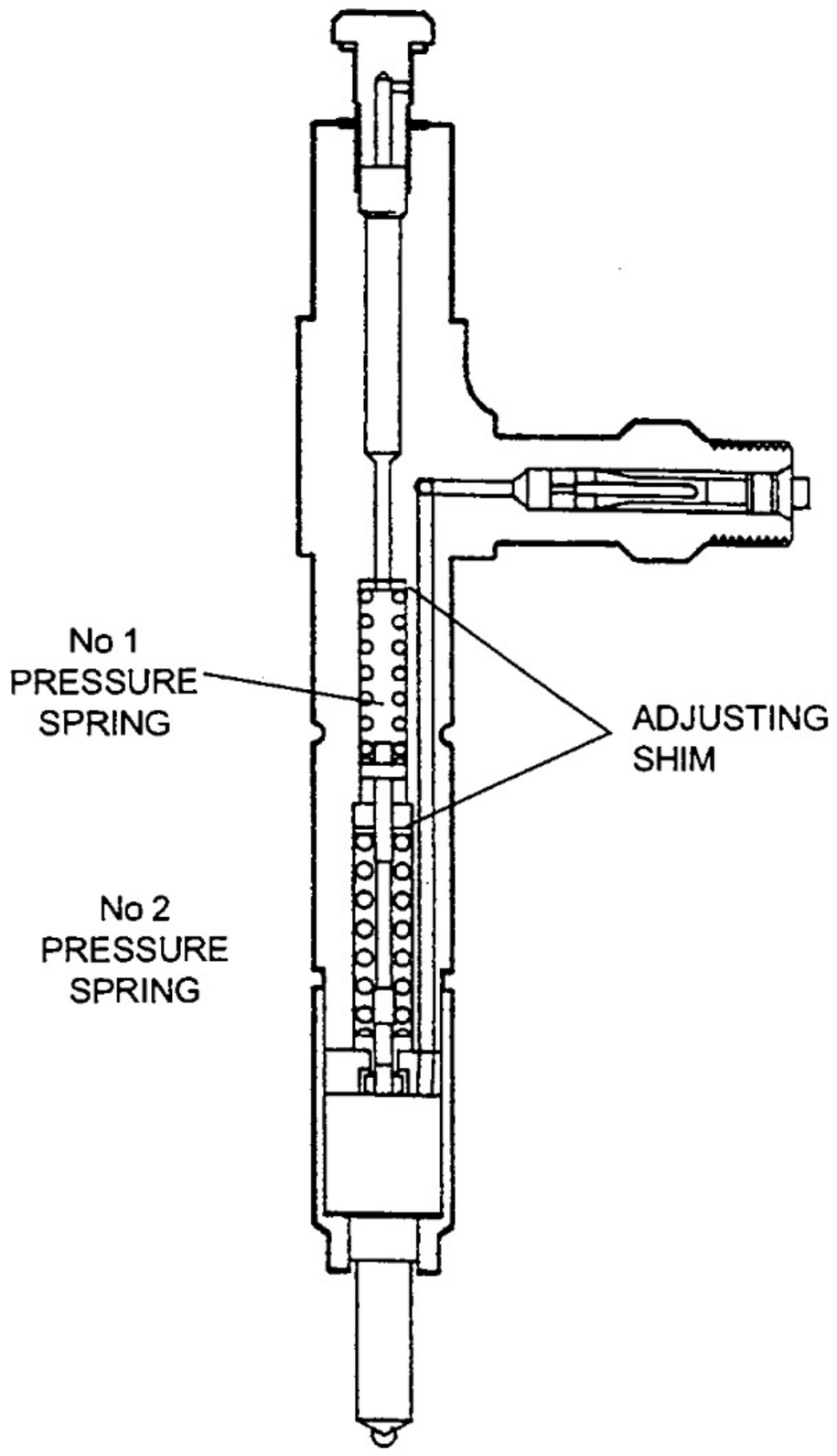
■ FUEL SYSTEM

1. Injection Nozzle

- A two spring type nozzle assembly is used in the 1HD-FT as was previously used in the 1HD-T.

- With the introduction of the 1HD-FT engine with 4-valves per cylinder and the central positioning of the injection nozzle the maximum outer diameter of the nozzle assembly has been reduced.

- The number of nozzle spray holes has been increased and their diameter decreased in order to produce a finer spray for better mixing of the fuel and air.



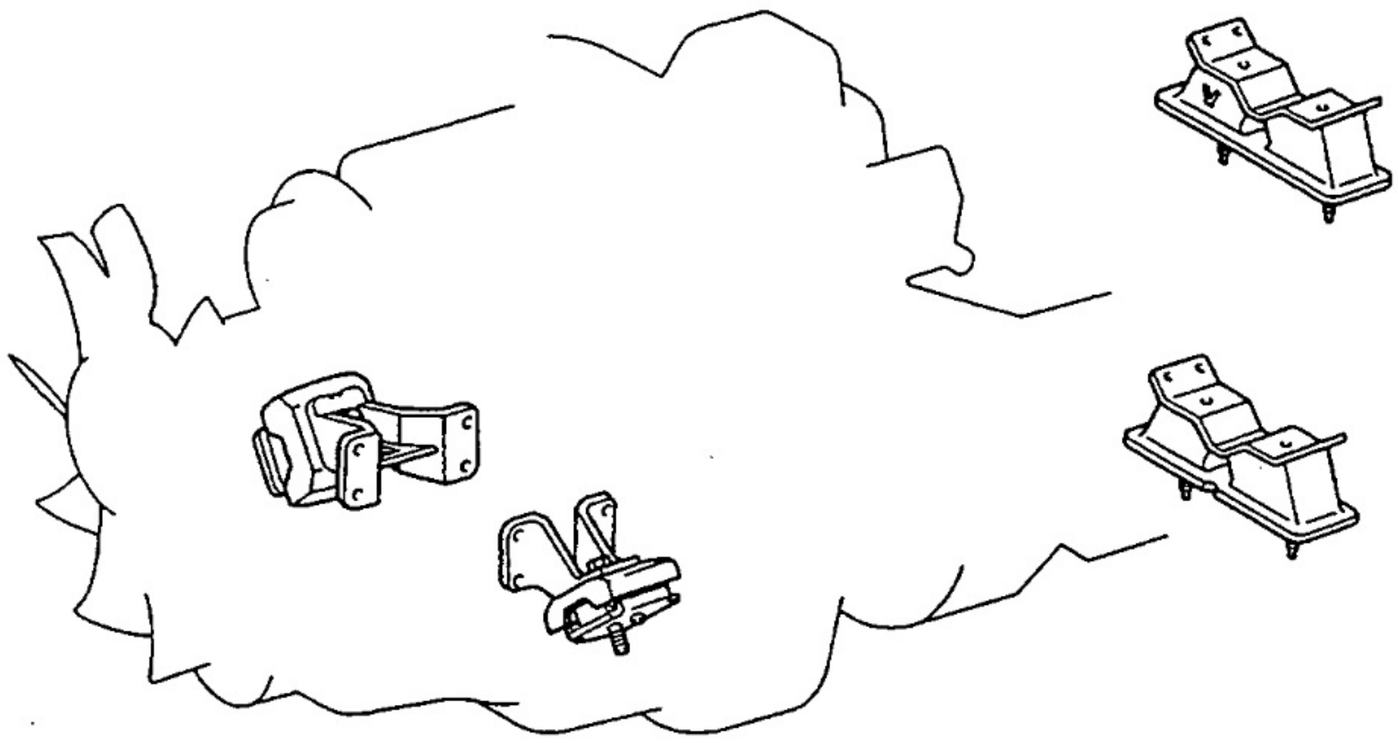
◆ **Specifications** ◆

Nozzle Type	2 Spring
No of Spray Holes	6
Dia. of Spray Hole (mm)	0.22

■ ENGINE MOUNTING

- Optimum tuning has been done to the engine mounting to reduce vibrations and noise.

- The front engine mounting bracket and engine mounting insulator are now secured by a bolt for improved serviceability.

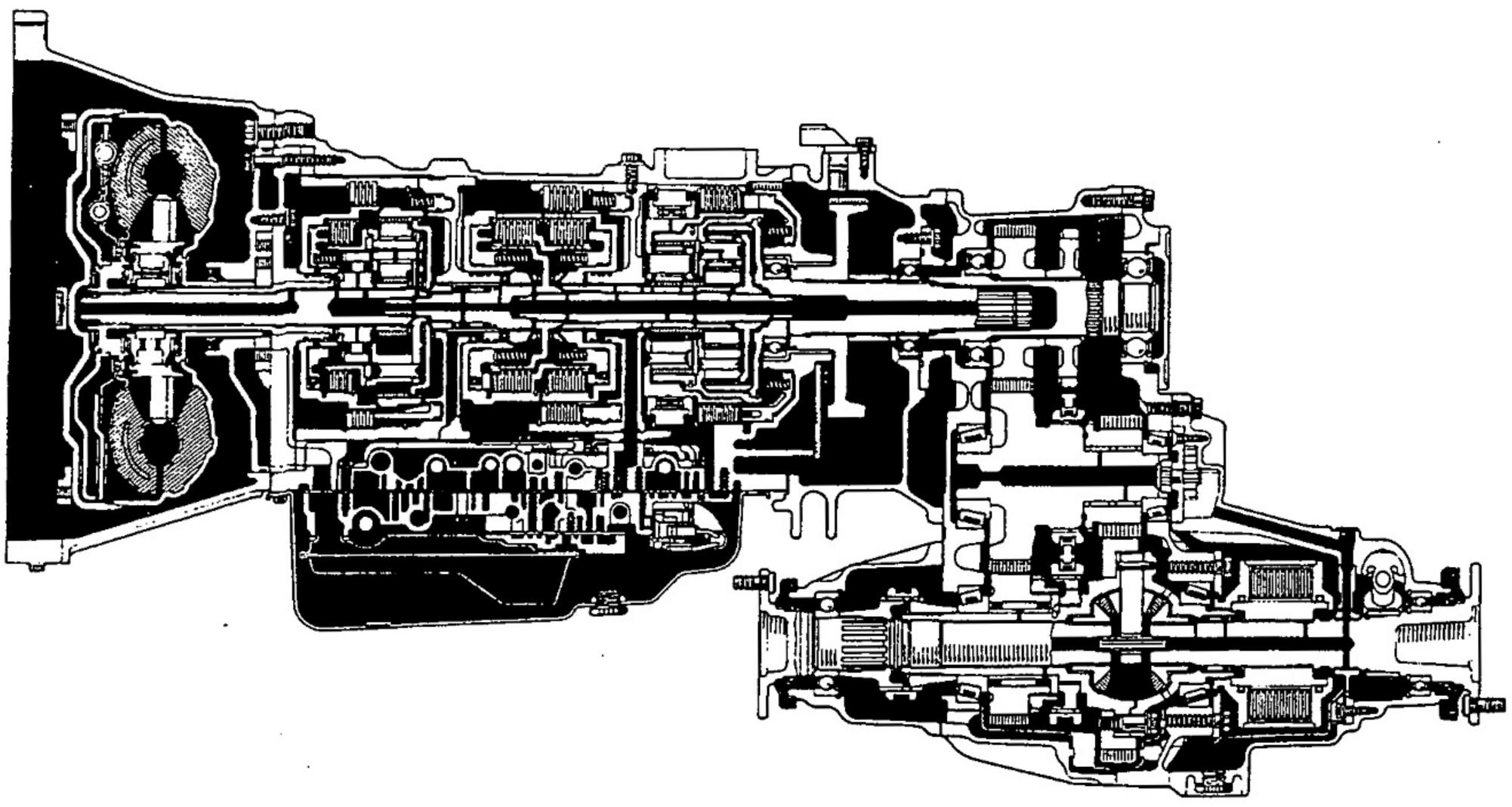


CHASSIS

AUTOMATIC TRANSMISSION (80 SERIES)

■ DESCRIPTION

The face-lift 80 series Land Cruiser uses the A442F automatic transmission as found in the previous model. Although the basic construction and operation are the same as the previous A442F a 2nd start system has been adopted in the electronic control system.



■ ELECTRONIC CONTROL SYSTEM

1. General

- The electronic control system of the A442F in the face-lift 80 series is basically the same in construction and operation as that of the previous model except for the following changes.

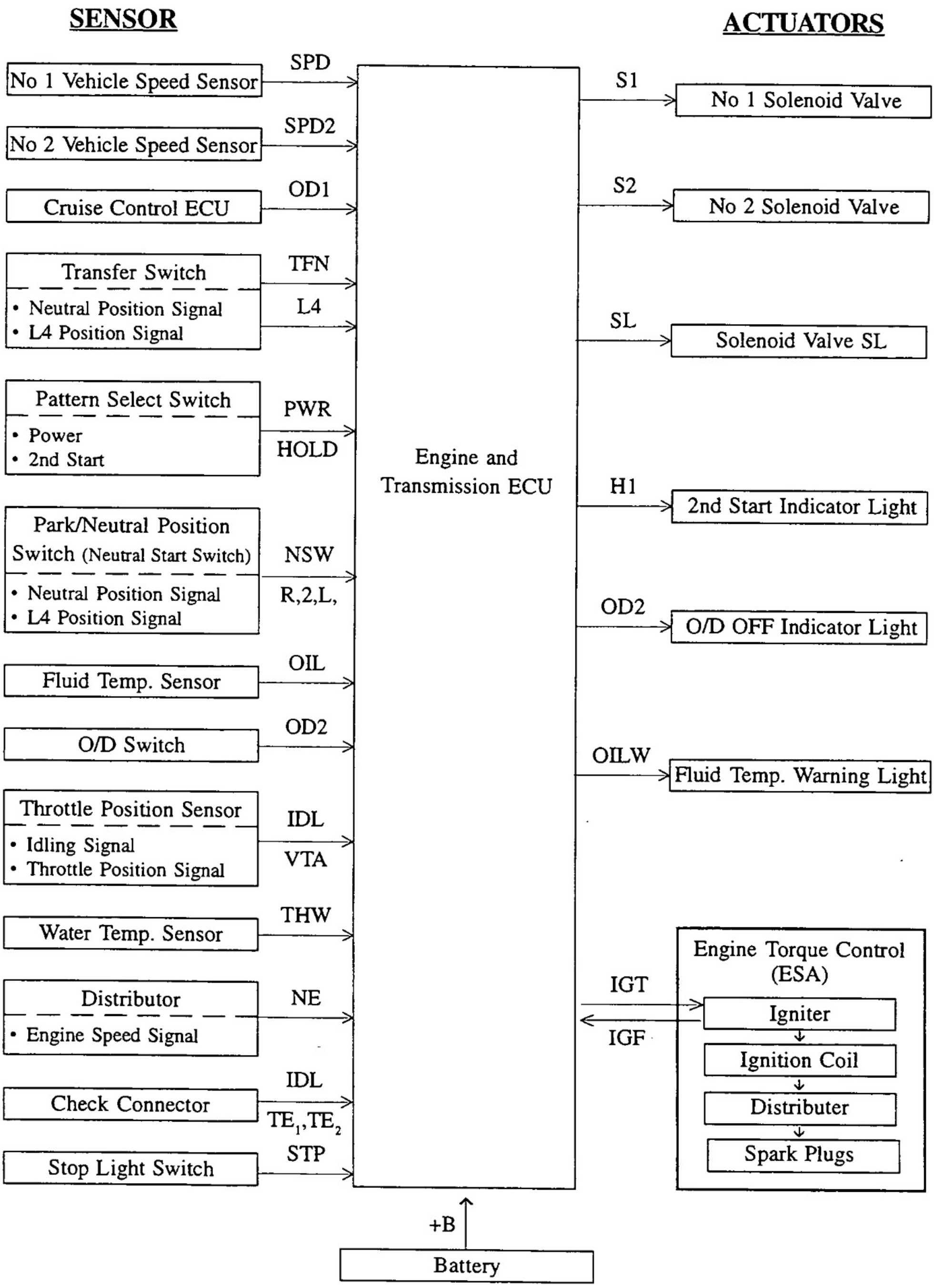
- A 2nd start system has been adopted, enabling the vehicle to take off in 2nd gear making it easy to take off on sandy or muddy terrain.

- The engine ECU and transmission ECU, which were separate on the previous model have been integrated into one unit.

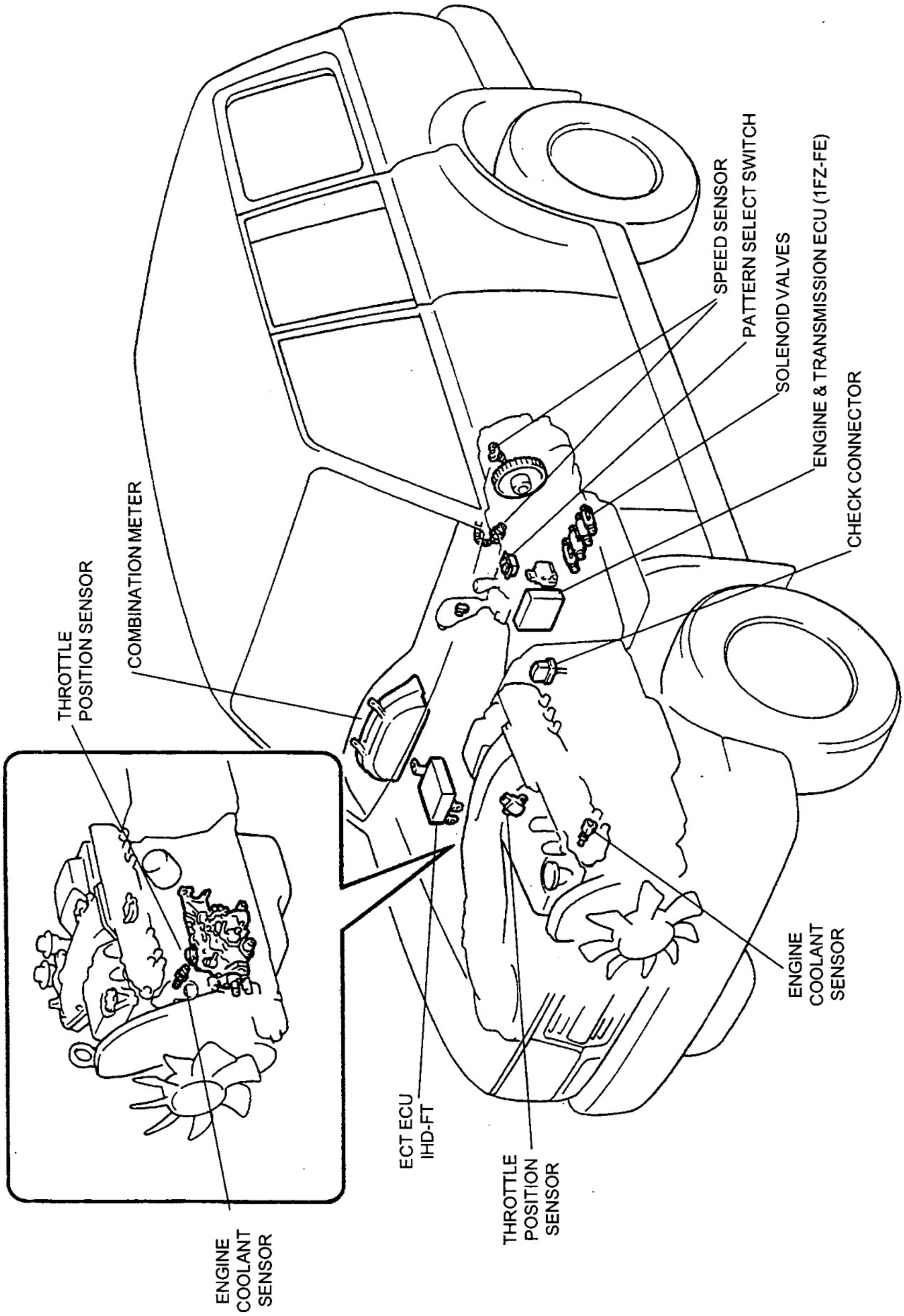
System	Function
Shift Timing Control	The optimum shift pattern is selected from 2 shift patterns in the engine ECU by the pattern select switch. The engine ECU sends current to the No 1 and/or No 2 solenoid valves based on signals from each sensor and shifts the gear.
Lock-Up Timing Control	The optimum lock-up pattern is selected from 2 lock-up patterns in the engine ECU by the pattern select switch. The engine ECU sends current to the solenoid valve No 3 based on signals from each sensor and engages or desengages the lock-up clutch.
Engine Torque Control	Retards the engine ignition timing temporarily to improve shift feeling during up or down shifting.
Self-Diagnosis	Causes the O/D OFF indicator light to blink to inform the driver when the engine ECU detects the electrical circuit malfunctions.
Fail-Safe	Controls other normally operating components, permitting continued driving when engine ECU detects a malfunction has occurred in an electrical circuit.

2. Construction

The configuration of the electronic control system in the A442F is shown in the following chart.



3. Layout of Components



4. Function of Engine ECU

2nd Start System

a. Outline

The 2nd start system enables the driver to use a pattern select switch to select the 2nd start mode, which allows the vehicle to take off in 2nd gear.

This system has been designed to make it easy for the vehicle to take off on sandy or muddy terrain.

b. Operation

- When the 2nd start mode is selected while the shift lever is in the "D" or "2" position, the vehicle will take off in 2nd gear. After a take off, if the shift lever is in the "D" position, the transmission will shift automatically into 3rd and overdrive gears, as usual. If the shift lever is in the "2" position, the transmission will continue to operate in the 2nd gear.

- When a vehicle is allowed to take off in 2nd gear under 2nd start mode, it accelerates more gently and provides better control. This also minimises the fluctuation of the drive force transmitted to the tyres, giving a smoother take off with minimum wheel slippage.

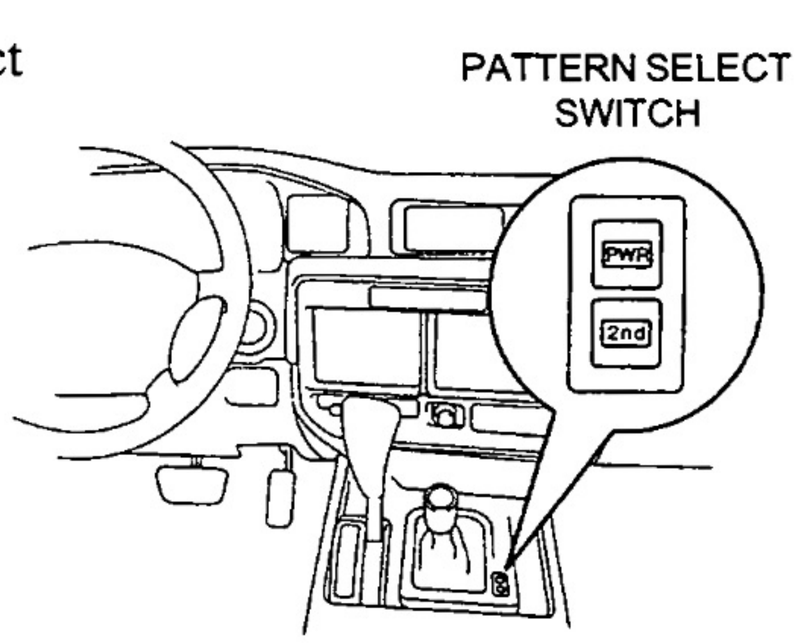
◆ **Shift Program** ◆

Mode Shift lever position	Normal, Power	2nd Start
D range (O/D Switch ON)	1 ⇐⇒ 2 ⇐⇒ 3 ⇐⇒ O/D	2 ⇐⇒ 3 ⇐⇒ O/D
2 range	1 ⇐⇒ 2 ⇐ 3	2 ⇐ 3
L range	1 ⇐ 2	1 ⇐ 2

c. Pattern Select Switch

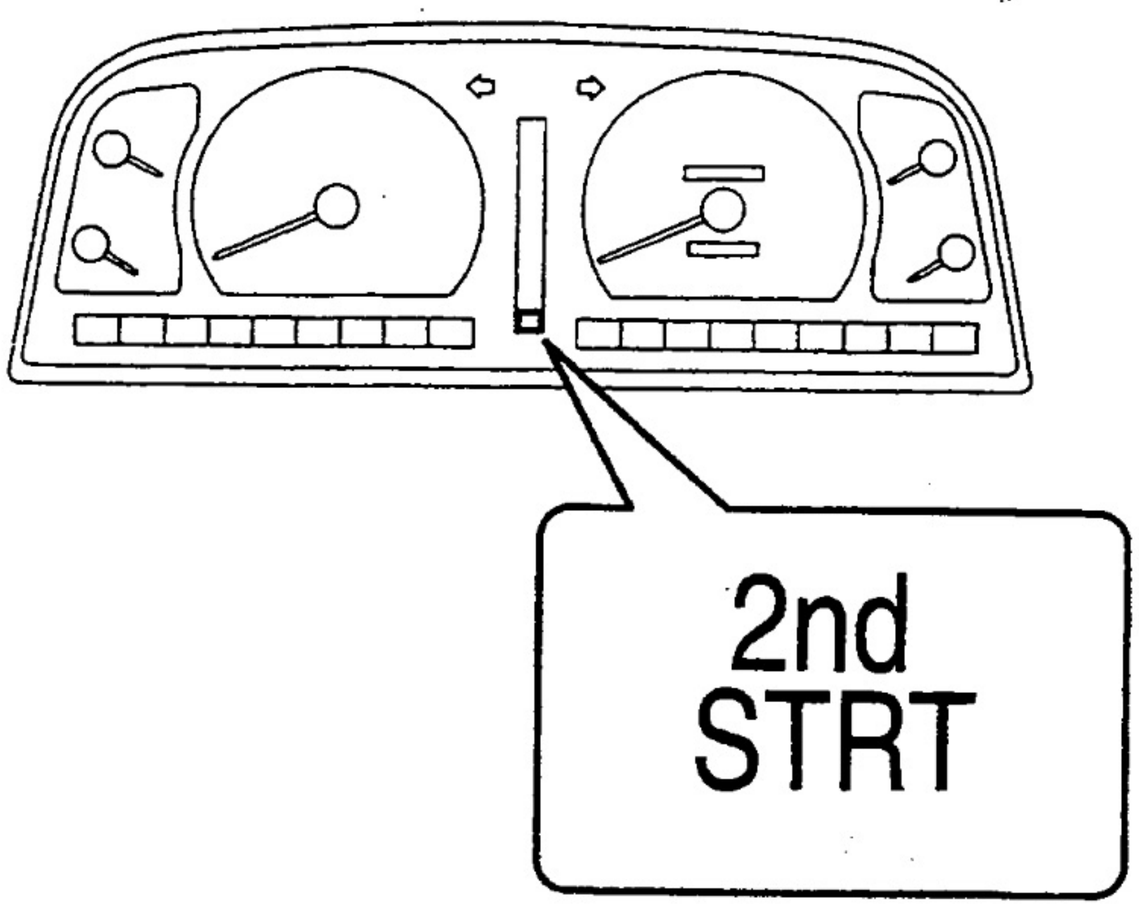
- A 2nd start mode has been provided in the pattern select switch. It is a momentary type switch which turns on when pressed once and turns off when pressed again. 2nd start mode is cancelled when the ignition switch is turned off returning to the normal mode.

- The 2nd start mode is also cancelled when the power mode is selected. Likewise, the power mode is cancelled when the 2nd start mode is selected.



d. 2nd Start Indicator Light

A 2nd start indicator light, that turns on when the 2nd start mode is selected, is provided in the combination meter.

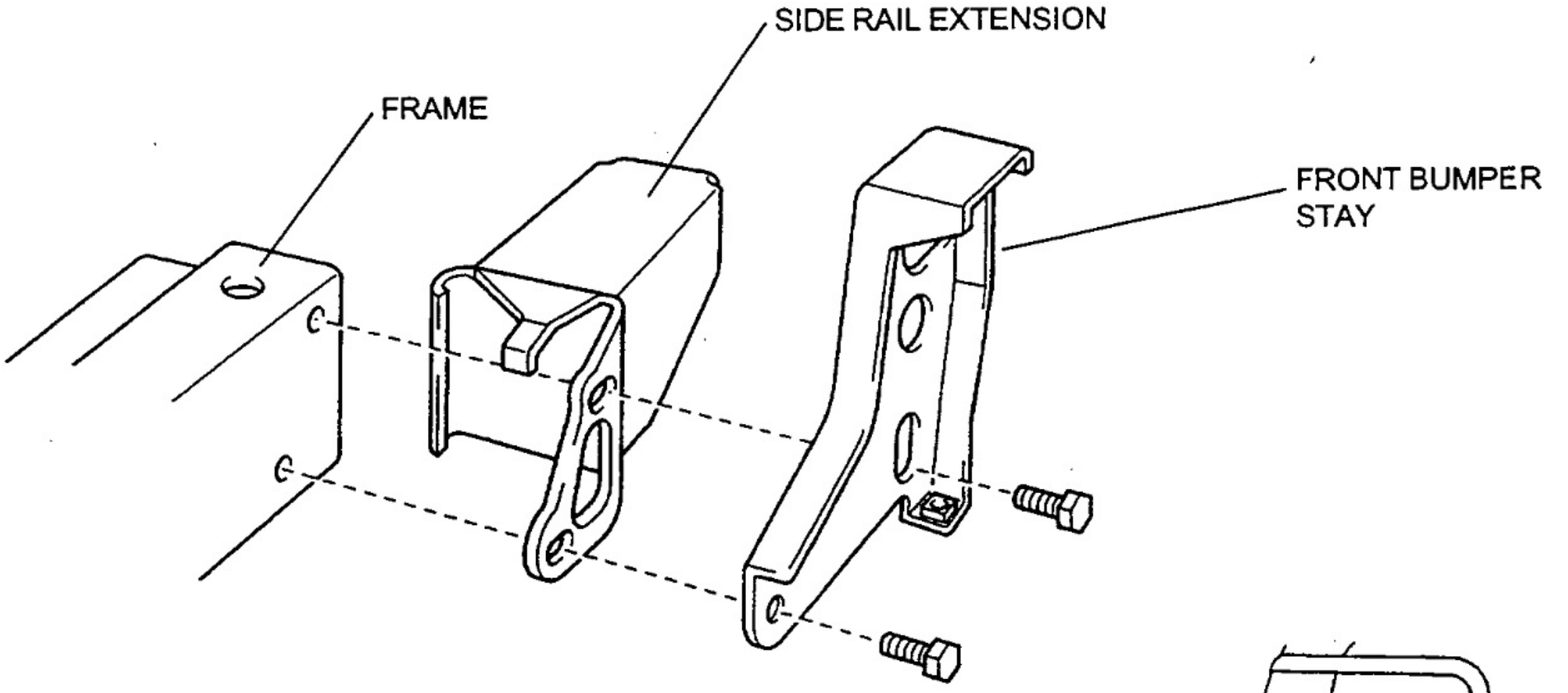


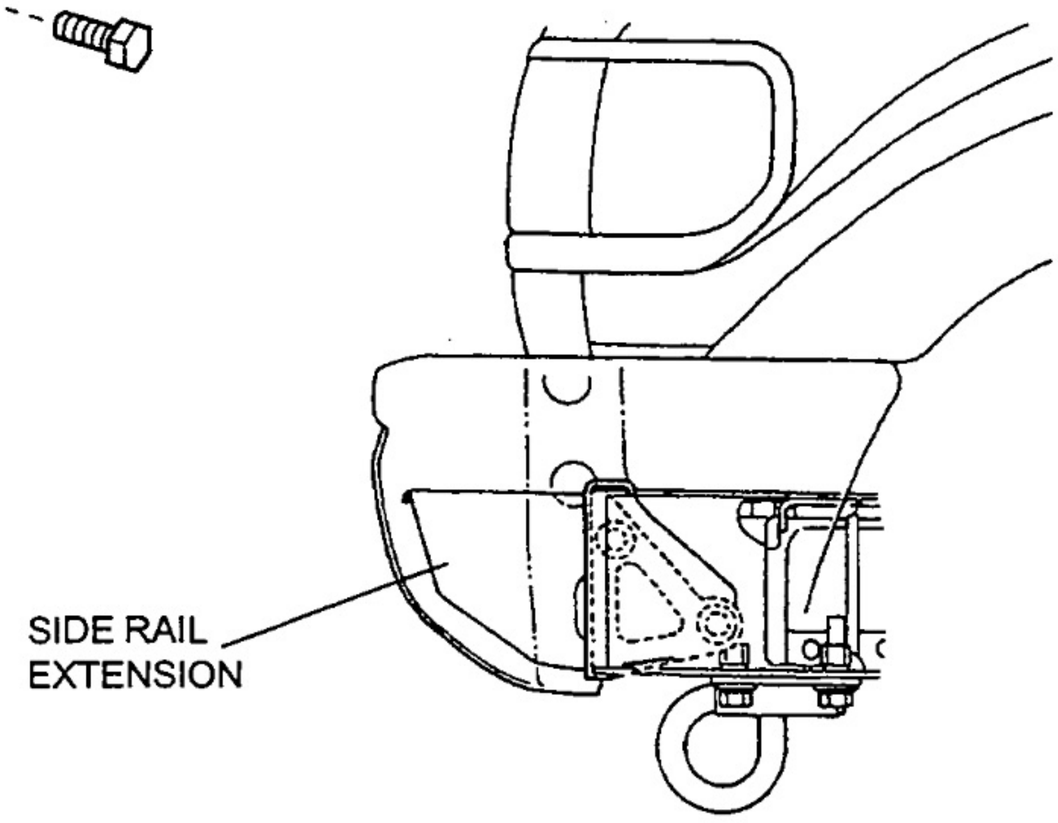
2ND START INDICATOR LIGHT

CHASSIS RAIL

■ SIDE RAIL EXTENSION

With the adoption of an SRS airbag for VX grade 80 series (refer to body electrical section of this manual) a side rail extension has been installed to the chassis. The side rail extension is bolted onto the front of the frame together with the front bumper stay. This extension helps to prevent unintended deployment of the airbag during a light frontal collision at low speeds.





BODY ELECTRICAL

■ SRS AIRBAG

General

- A electronic type SRS airbag has been made standard on the drivers side for VX grade 80 series Land Cruiser.

- The SRS (Supplemental Restraint System) airbag, together with the seat belt, is designed to help protect the driver.

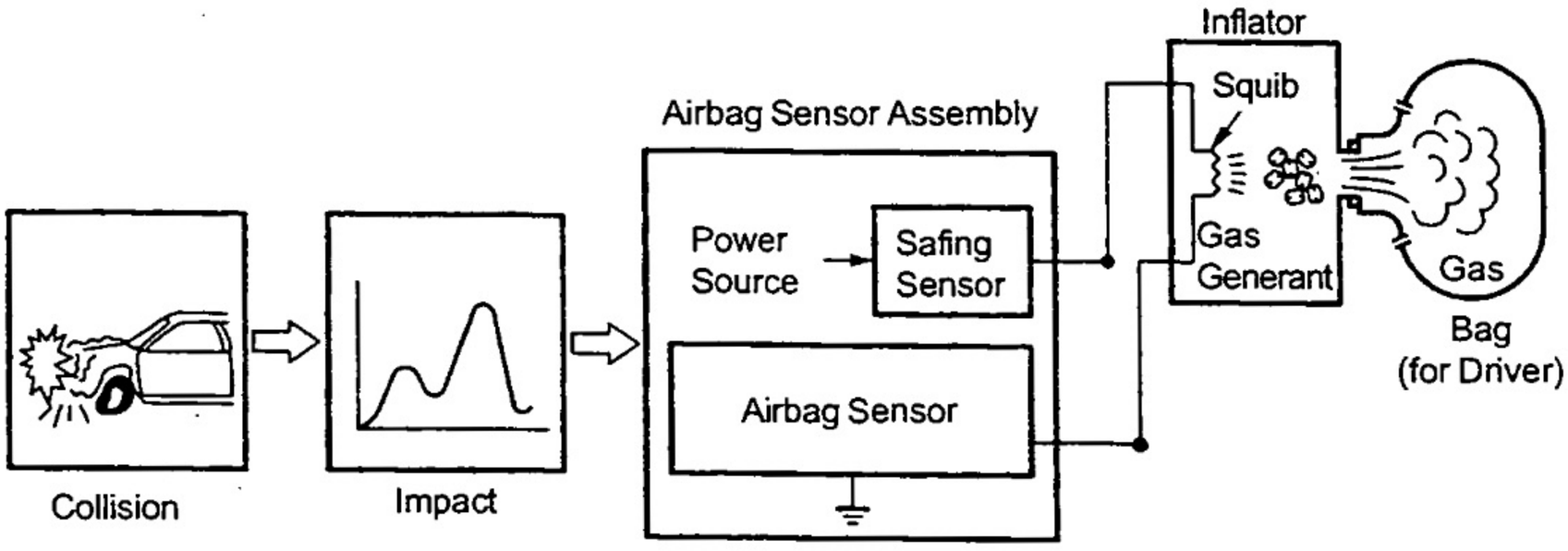
- In case of a frontal collision, the airbag senses the impact, and if the shock is higher than a predetermined level, it causes the airbag located in the steering wheel pad to inflate, easing the impact applied to the head and face of the driver.

- A 1 sensor type airbag system has been adopted. In this system, the detection of the deceleration rate in a collision is performed solely by the airbag sensor enclosed in the airbag sensor assembly.

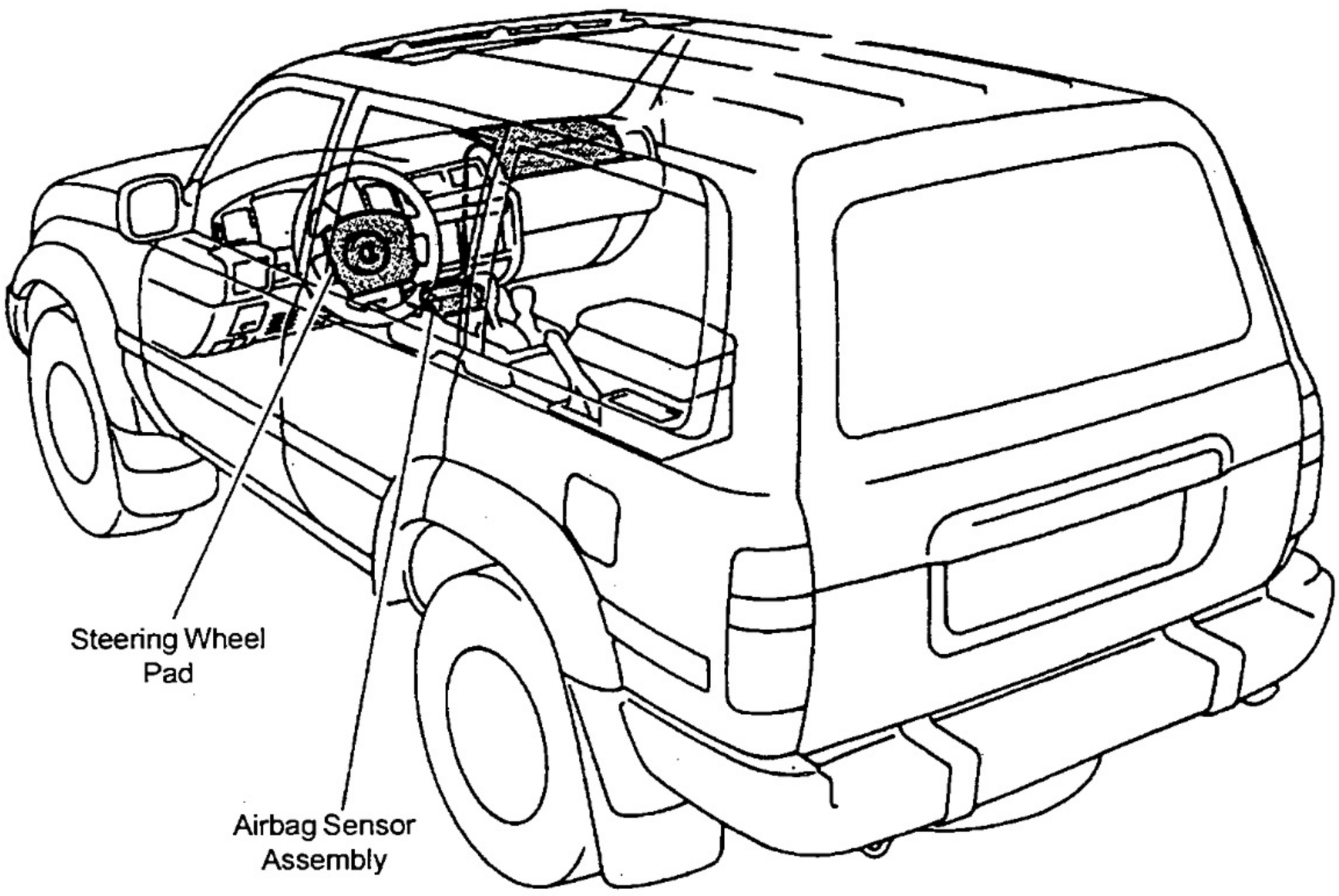
- The SRS airbag system is controlled by the airbag sensor assembly. It has a self-diagnosis function. When it detects a system malfunction, it lights up the SRS warning light on the combination meter to alert the driver.

◆ System Diagram ◆

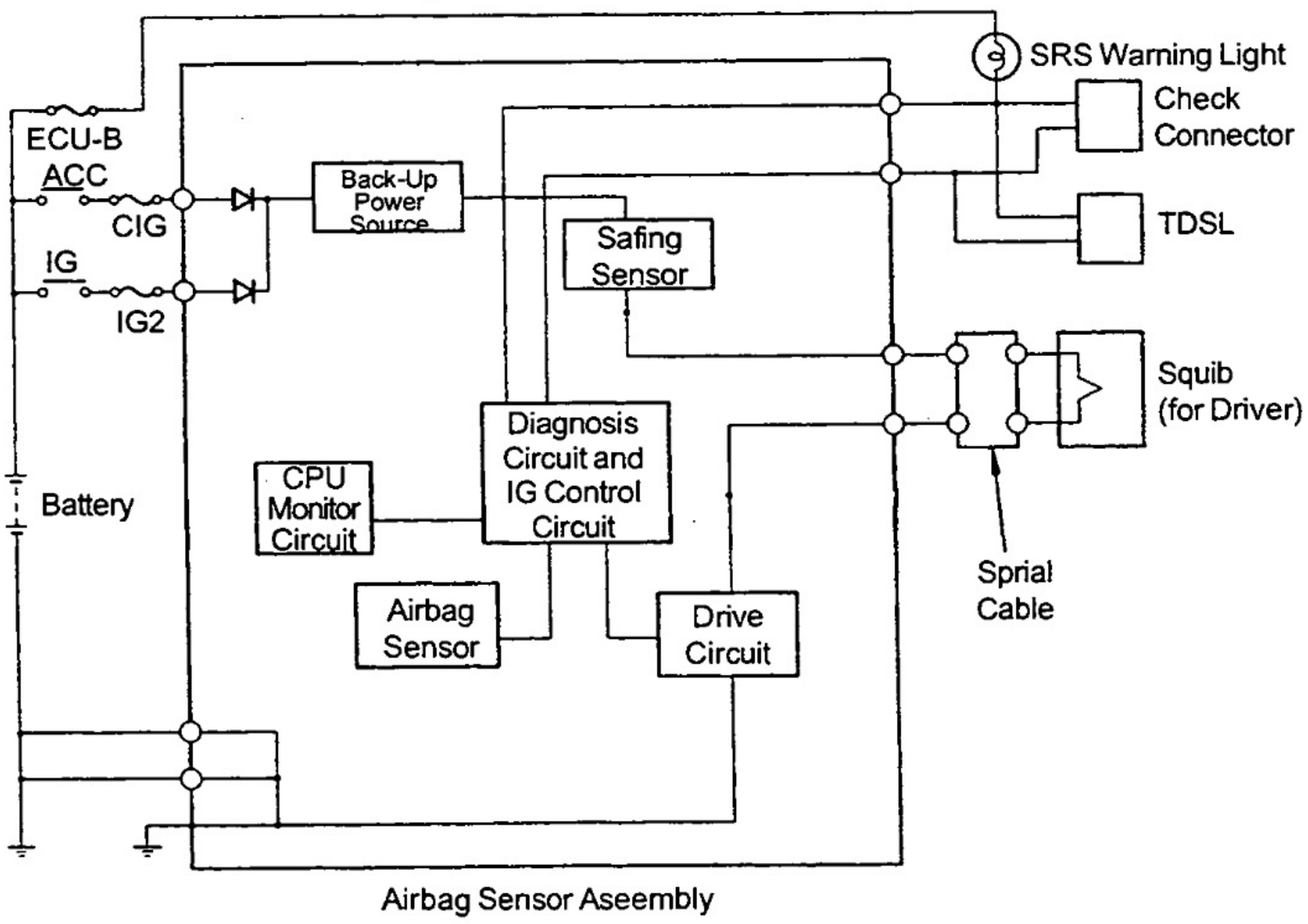
The activation process of the SRS airbag is illustrated below.



2. Layout of Components



3. Wiring Diagram



4. System Operation

1. Ignition Judgement and Conditions

- When the vehicle collides in the hatched area (Fig. 1) and the shock is larger than a predetermined level, the airbag is activated automatically. The airbag sensor is tuned so that it can judge the need for ignition in response to collisions within the hatched area.

- The safing sensor is designed to be turned on by a smaller deceleration rate than the airbag sensor. As illustrated in Fig. 2 below, ignition is caused when current flows to the squib, which happens when the safing sensor and the airbag sensor go on simultaneously.

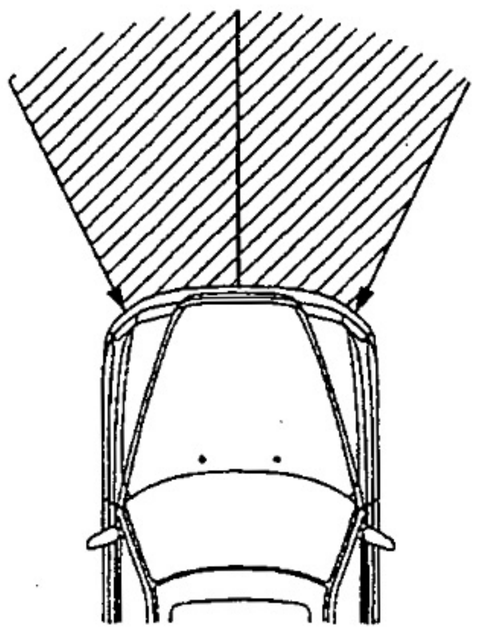


Fig. 1

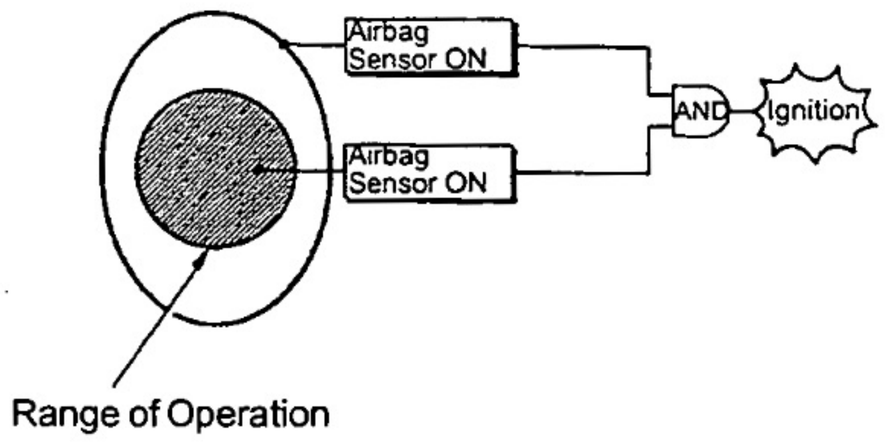


Fig. 2

2. Diagnostic trouble codes

The following trouble codes are available for diagnosis of the SRS airbag system.

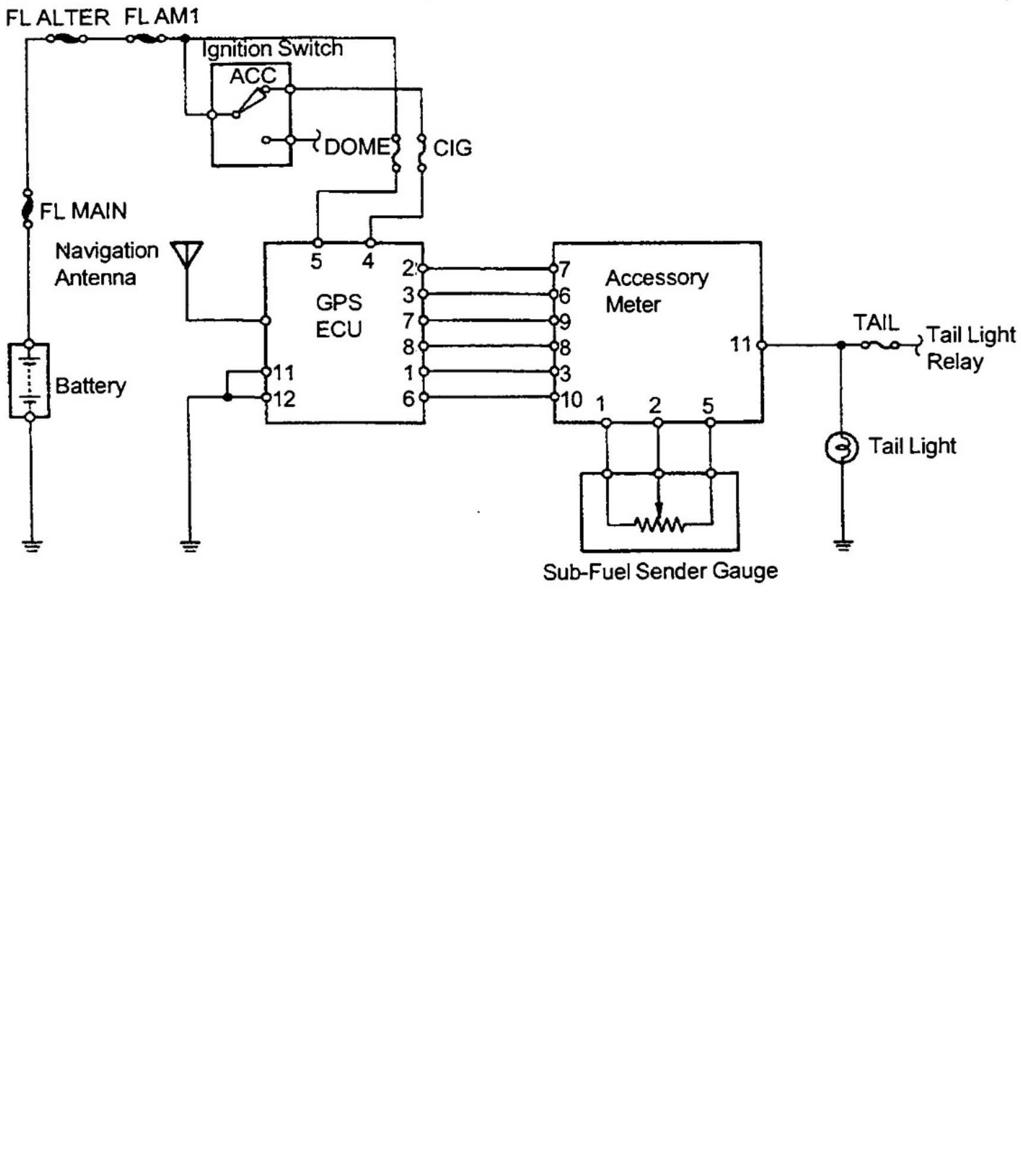
DTC No	Diagnosis	Trouble Area	SRS Warning Light
Normal	• System normal	—	OFF
	• Voltage source drop	• Battery • Airbag sensor assy	ON
11	• Short in squib circuit (to ground)	• Squib • Spiral cable • Airbag sensor assy. • Wire harness	ON
12	• Short in squib circuit (to B+)	• Squib • Spiral cable • Airbag sensor assy. • Wire harness	ON
14	• Open in squib circuit	• Squib • Spiral cable • Airbag sensor assy. • Wire harness	ON
31	• Airbag sensor assy. Malfunction	• Airbag sensor assy.	ON

■ SATELLITE NAVIGATION SYSTEM (SNS)

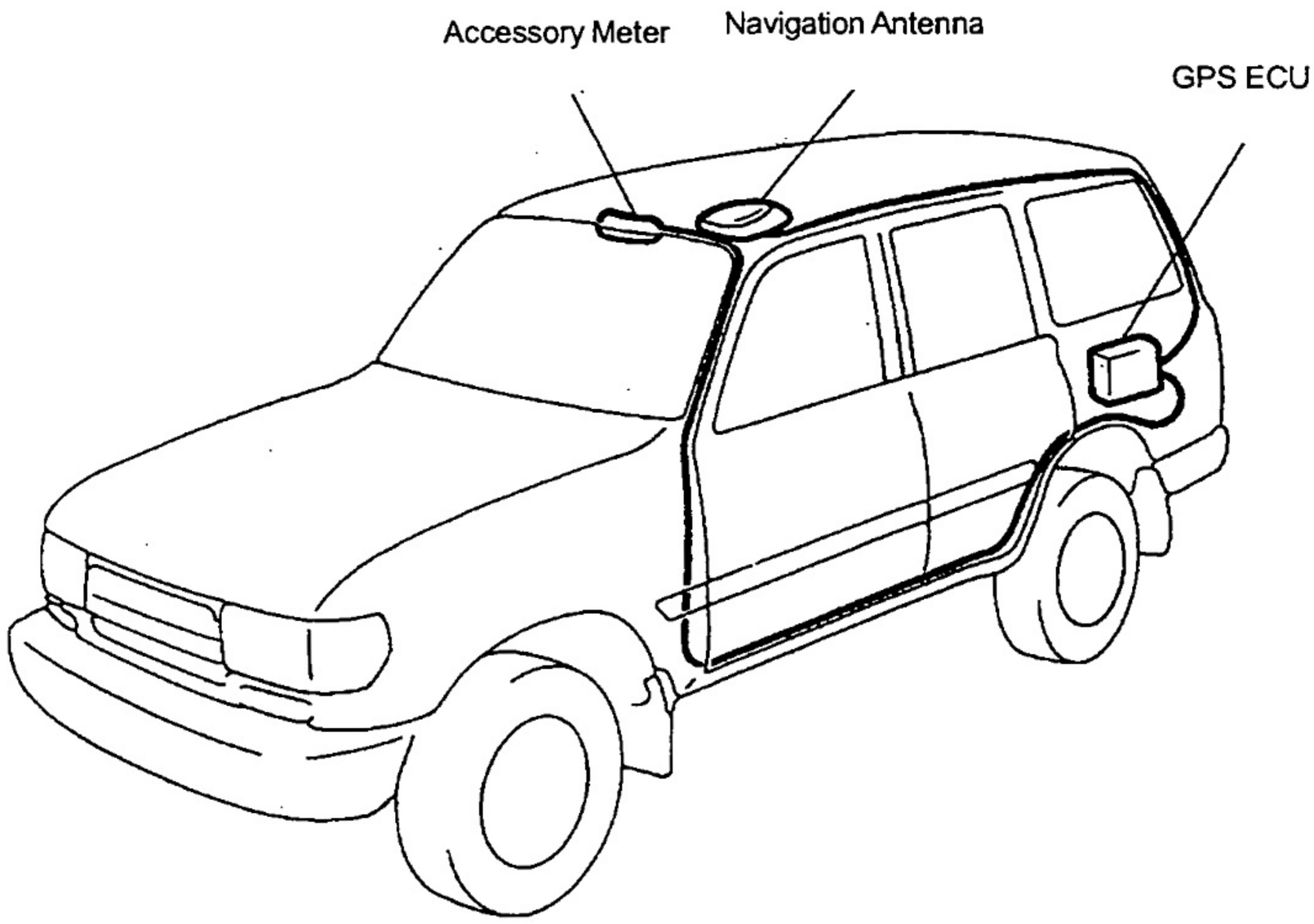
1. General

A SNS (Satellite Navigation System) is available in VX grade 80 series. It's construction and operation is the same as that of the previous model.
The SNS indicates the latitude, longitude and altitude of the vehicle using the GPS (Global Positioning System). The system will also inform the driver of the straight line distance between the vehicle and a programmed latitude and longitude.

2. Wiring Diagram



3. Location of Components



4. Function of Components

Component	Function
Navigation Antenna	Receives and amplifies signals from orbiting satellites.
GPS ECU	Calculates vehicle position from the received signals and stored data and supplies power to the accessory meter for display of the calculated data. The ECU has a diagnostic function to detect any malfunction with the components and circuits.
Accessory Meter	Displays longitude, latitude, altitude and level of fuel in the sub tank. This component also contains the switches used for inputting destination information and for the output of diagnostic codes.
Sub-fuel Tank Sender Gauge	Measures the amount of fuel remaining in the sub-tank.

5. Construction and Operation

General

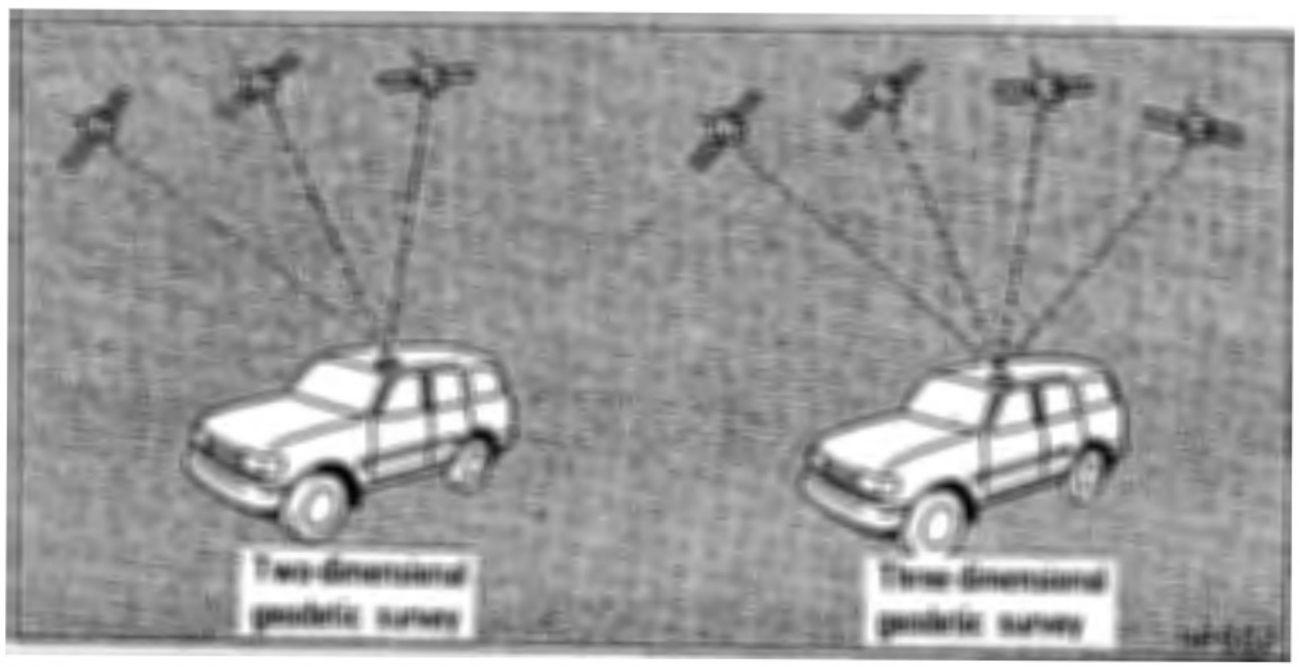
The GPS (Global Position System) is a satellite-based positioning system developed and maintained by the United States Department of Defence (DoD). The GPS satellites transmit coded signals while orbiting the earth at an altitude of about 20,000 km. When the GPS ECU receives and processes these signals, it determines the vehicles present latitude, longitude and altitude.

When 3 or more radio signals are received from GPS satellites, the GPS ECU calculates how many seconds it took the signals to reach the receiver from each satellite by generating the same code as the satellite and measuring the time shift between the two signals. Because radio signals travel at a constant speed (speed of light 3 x 10^8 m/s), the GPS ECU can then compute the distance between the satellites and itself by knowing the satellites exact expected position from data stored in the ECU. This calculated data is then used to determine the precise position of the satellites and the vehicle.

The number of satellite signals the GPS ECU receives determines the contents of the data displayed by the accessory meter.

◆ Specifications ◆

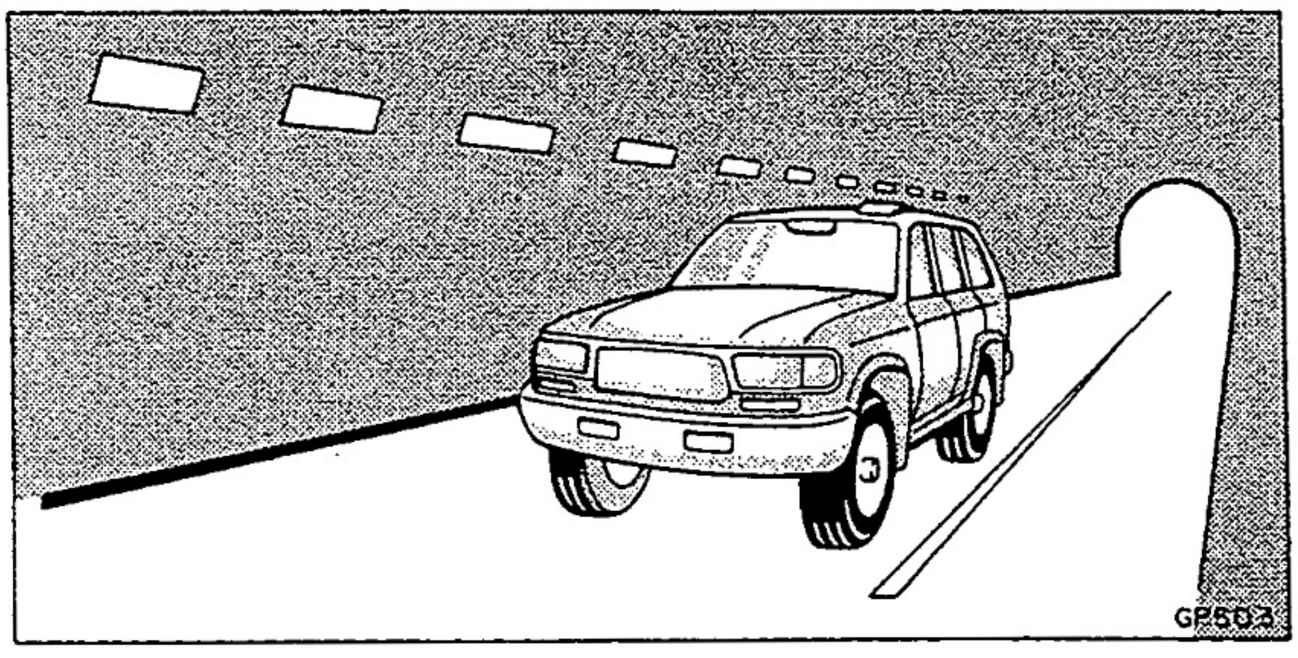
No of Satellite Signals Received	Data Displayed
0, 1 or 2	No data – calculation impossible
3	Latitude and longitude (two dimensional geodetic survey)
4 or more	Latitude, longitude and altitude (three dimensional geodetic survey)



Reception and Accuracy

It is not possible to receive GPS satellite signals under the following conditions:

- When satellite signals are blocked by large buildings, tunnels, etc.
- When there is no reception from at least 3 satellites at the same time.
- When the satellites do not transmit signals (The satellites are controlled by the United States Department of Defence, which may stop the signals without notice to modify or repair the satellites).

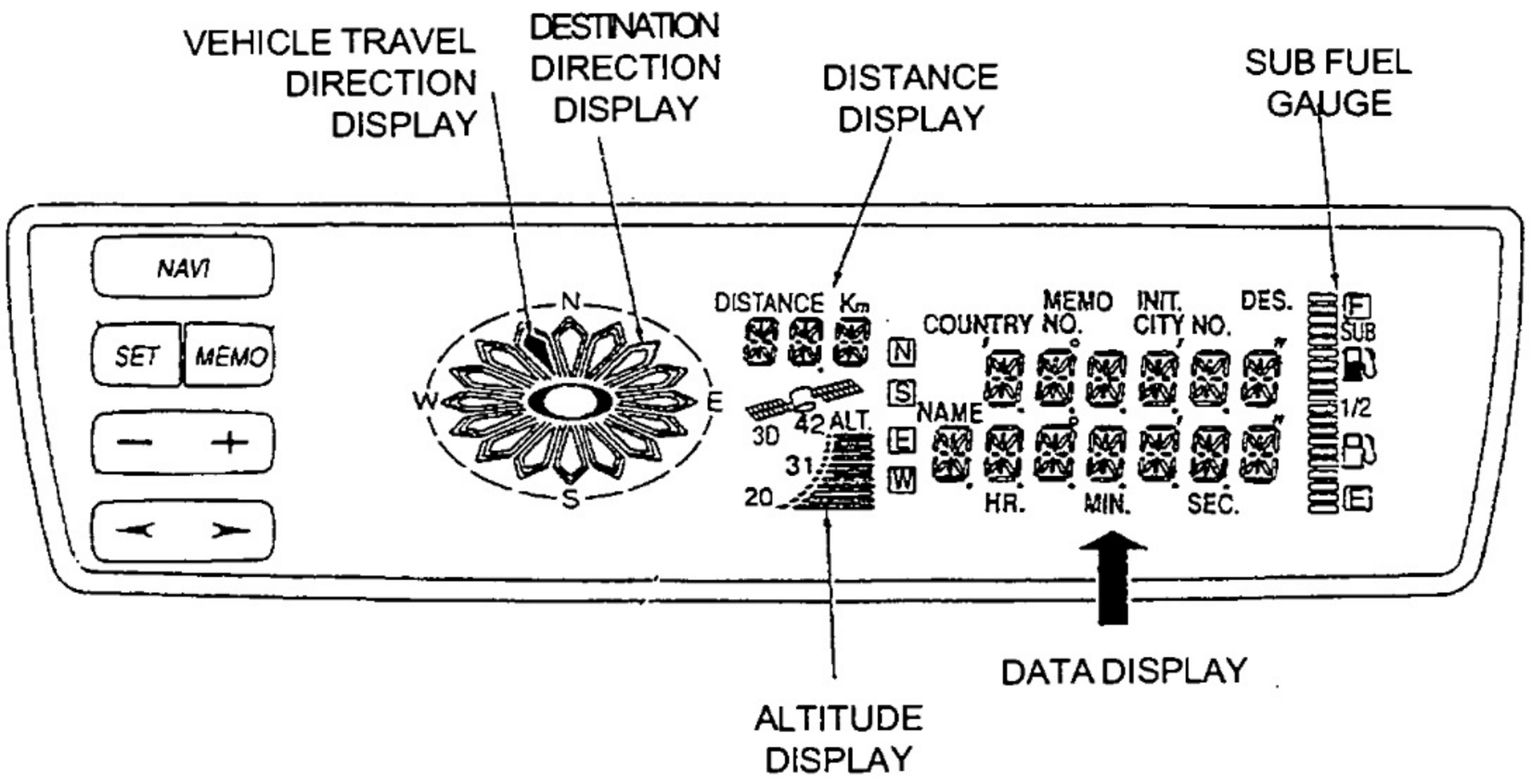


Calculation errors can occur due to the following reasons:

- Even though the satellites use atomic clocks their time can vary by a few nanoseconds causing an error in the output code that cannot be detected by the vehicle. The clock can however be corrected by a ground control station.
- Errors in satellite location called ephemeris errors can occur resulting in location errors. These errors are typically small and are generally ignored.
- ECU errors can be caused by electrical noise, computation errors or problems in matching the satellite code.
- The satellite signal is bent and slowed down as it passes through the ionosphere, as the density of the ionosphere varies between day and night and the seasons the degree of this error will also vary. This error can however be minimised by calculations within the ECU.
- An error can also be caused by the relative position of the satellites to the vehicle. Generally the closer together in angle the satellites are to the vehicle the greater this error.

Accessory Meter Display

The SNS starts automatically in navigation mode when you turn the ignition switch to either "ACC" or "ON".



Destination Direction Display

- This shows the direction of the vehicles destination.

- If data calculation becomes impossible due to poor reception of GPS signals, the last direction display recorded flickers. If the signal is not received within 3 minutes, the display goes off

Vehicle Travel Direction Display

- This shows the direction the vehicle is moving in. This display does not operate when the vehicle speed is below 20 km/h.

- If data calculation becomes impossible due to poor reception of GPS signals, the last direction display recorded flickers. If the signal is not received within 3 minutes, the display goes. off.

Distance Display

- This shows the straight-line distance to the selected destination from your present position. The actual distance travelled however may be considerably greater.

- The distance display unit changes accordingly to the distance remaining to the selected destination.

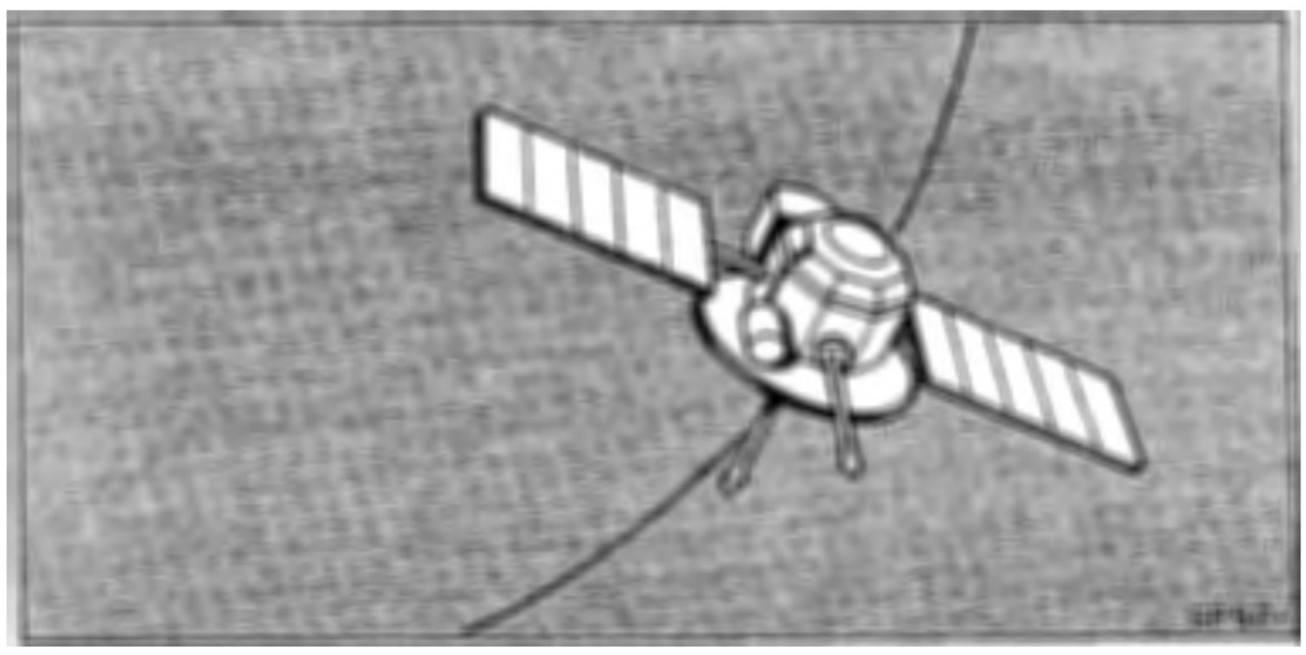
Distance	Display unit
0–99.9 km	100 m
100–999 km	Kilometre
1000 km or more	No display

- If data calculation becomes impossible due to poor reception of GPS signals, the last distance displayed flickers. If the signal is not received within 3 minutes, the display goes off.

Satellite Symbol

- This comes on when the GPS ECU receives GPS signals from 3 or more satellites. The "3D" sign (for three-dimensional geodetic survey) comes on as well when signals are received from 4 or more satellites.

- If data calculation becomes impossible due to poor reception of GPS signals, the satellite symbol flickers. If the signal is not received within 3 minutes, the symbol goes off.



Altitude Display

- This shows your present altitude during a three-dimensional geodetic survey. Satellite measurement of the vehicles altitude is not as precise as measurement of latitude and longitude. The altitude reading may at times only be accurate to within several hundred metres, so the altitude display should be used for reference only. (Display range : 0 - 4000 m)

- Depending on the vehicles present altitude, one of two scales appears on the display. The scales switch automatically at set heights.

- If three dimensional geodetic survey becomes impossible, the last altitude displayed flickers.

◆ **Specifications** ◆

Segment on Display	Altitude (m)	
	Reading 0 - 1 - 2	Reading 2 -3 - 4
1	0	2000
2	0 - 200	2000 - 2200
3	200 - 400	2200 - 2400
4	400 - 600	2400 - 2600
5	600 - 800	2600 - 2800
6	800 - 1000	2800 - 3000
7	1000 - 1200	3000 - 3200
8	1200 - 1400	3200 - 3400
9	1400 - 1600	3400 - 3600
10	1600 - 1800	3600 - 3800
11	1800 - 2000	3800 - 4000

Data Display

- This shows the data for each mode. In normal driving (navigation mode), the vehicles present latitude and longitude is shown.

Sub Fuel Gauge and Low Fuel Level Warning Light

- The gauge indicates the approximate quantity of fuel left in sub fuel tank.

- The low fuel level warning light comes on when the tank is less than 15% full.

6. Modes of Operation

The SNS has the following modes of operation:

- Navigation mode is the normal driving mode, this mode shows the vehicles present latitude, longitude, altitude and the direction it is travelling. When a destination has been preset the distance and direction of that destination is also displayed. Once a destination has been set the GPS ECU will notify the driver when the vehicle is within 5 km of the destination by sounding a beep 3 times and again when within 2 km by sounding a beep 5 times, the "DISTANCE" and distance direction displays will flash. This warning will only occur once.

- Destination and data storage mode is used for storing and deleting individual destination data using the "NAVI" ,"SET", "MEMO", "- + "and "◀ ▶" buttons, up to 250 destinations can be programmed. In this mode, the vehicles present position can be stored into the GPS ECU providing the GPS ECU is receiving enough signals.

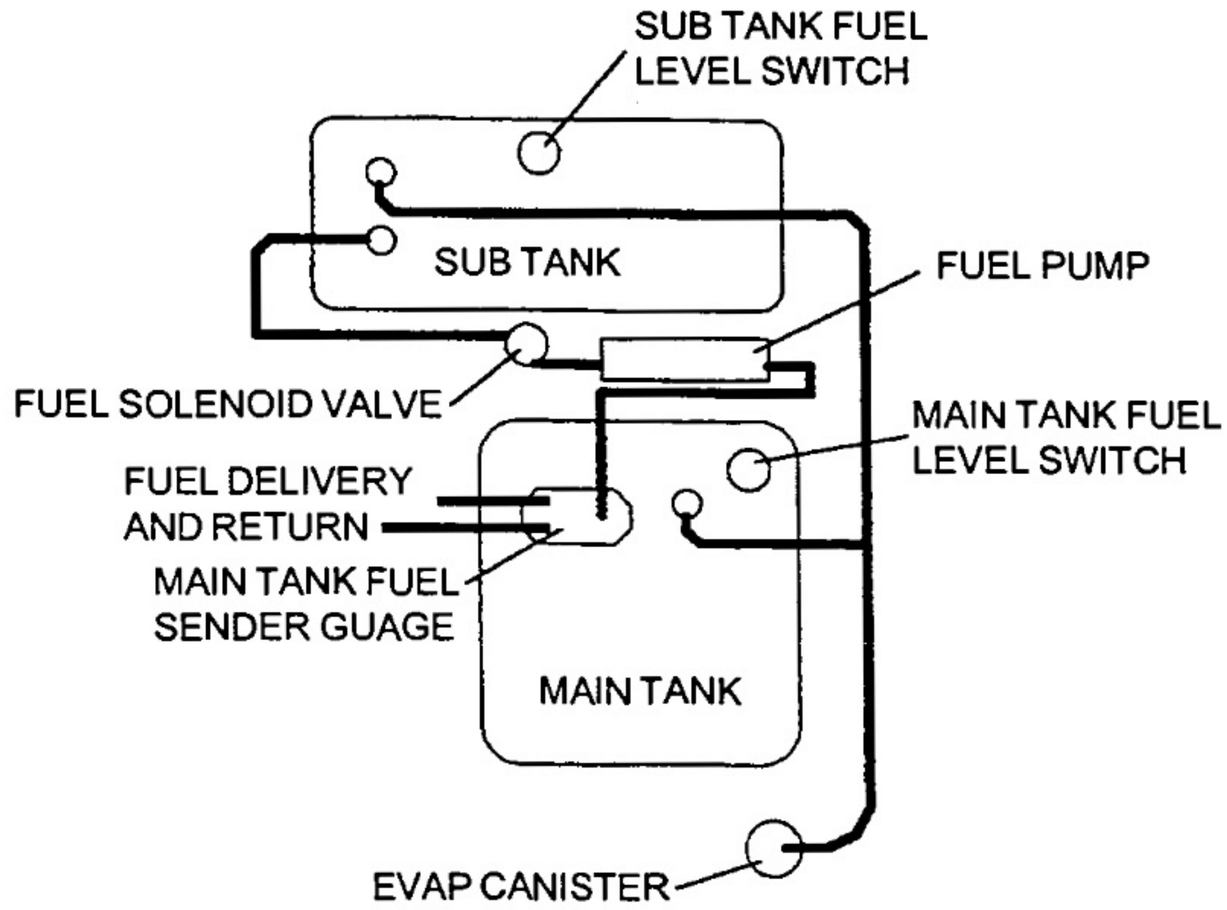
- Destination set mode is used to set a destination from the preset city data or individual destination data. Preset data can be retrieved by either specifying the initial letter of the location or by inputting the locations individual number that is listed in the SNS owners manual.

■ SUB TANK SYSTEM

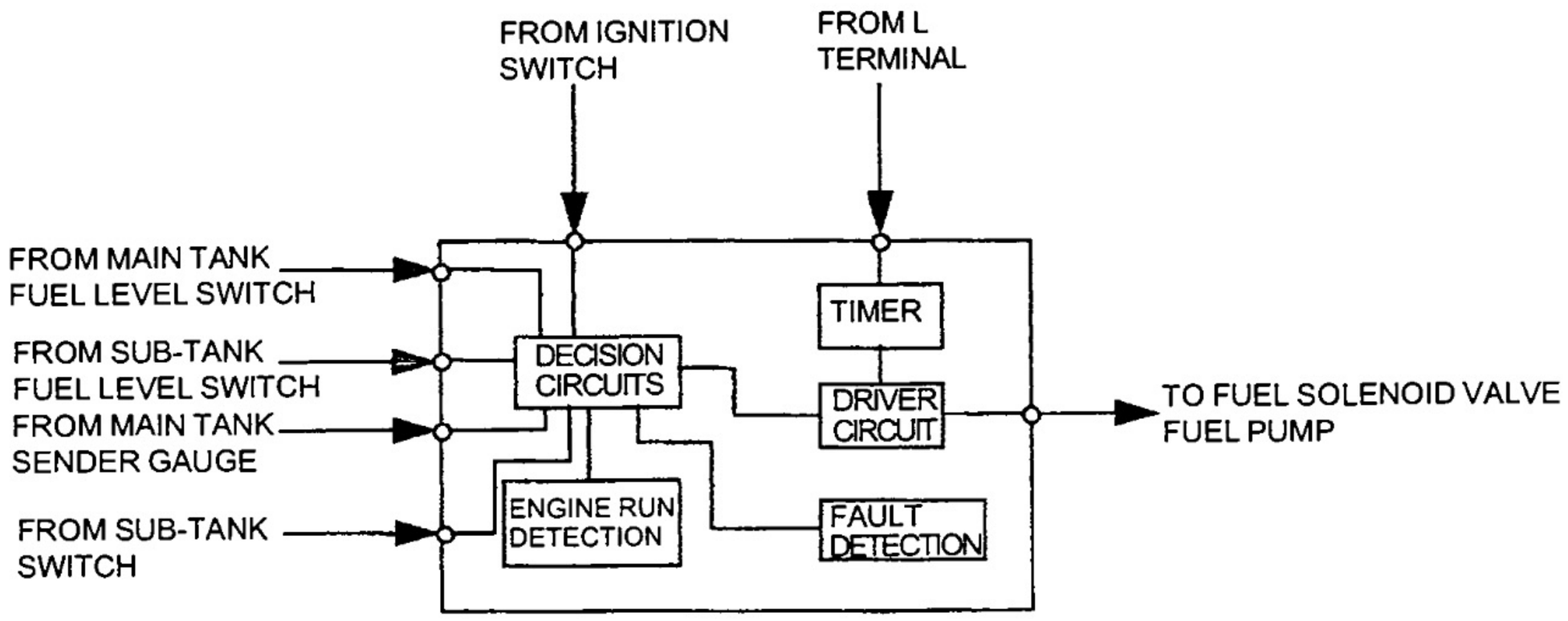
1. General

The current system used for transferring fuel from the sub to main tank on 75 and 80 series vehicles with 1FZ-FE engines has been carried over to the new vehicles. Although the construction and operation is similar to the previous models the fuel pump ECU has been combined with the engine and transmission ECU.

2. System Diagram

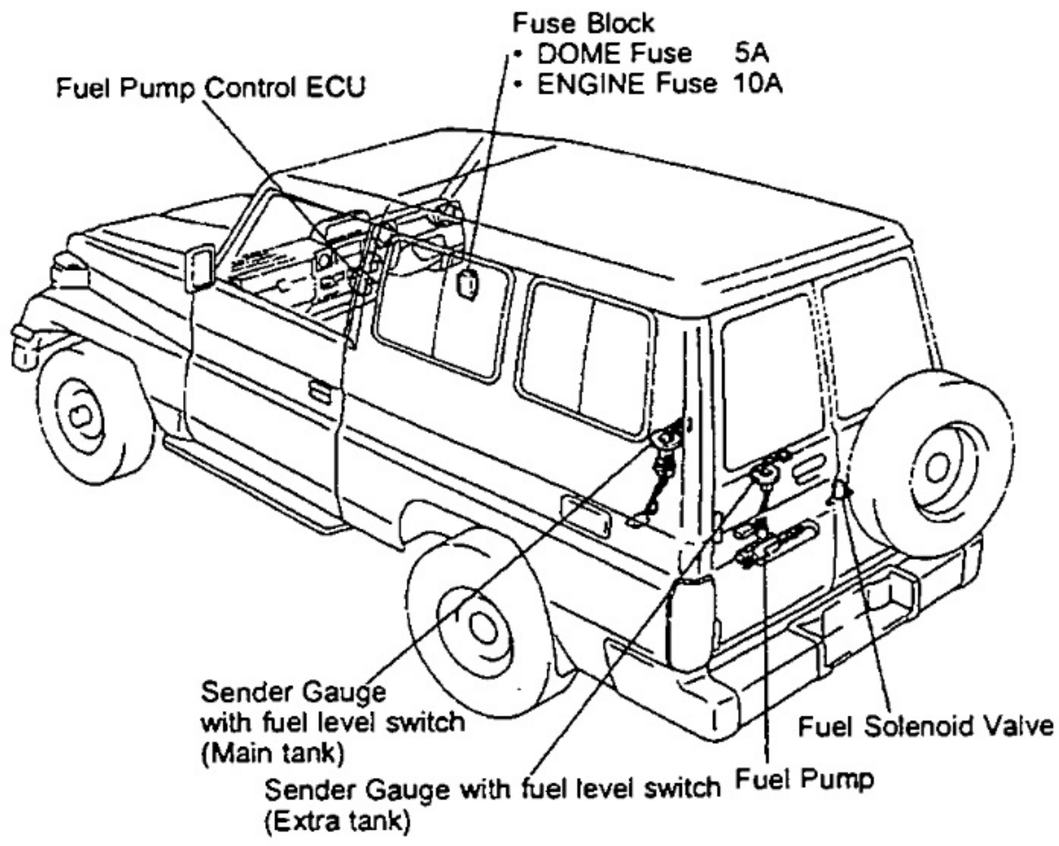


3. Wiring Diagram

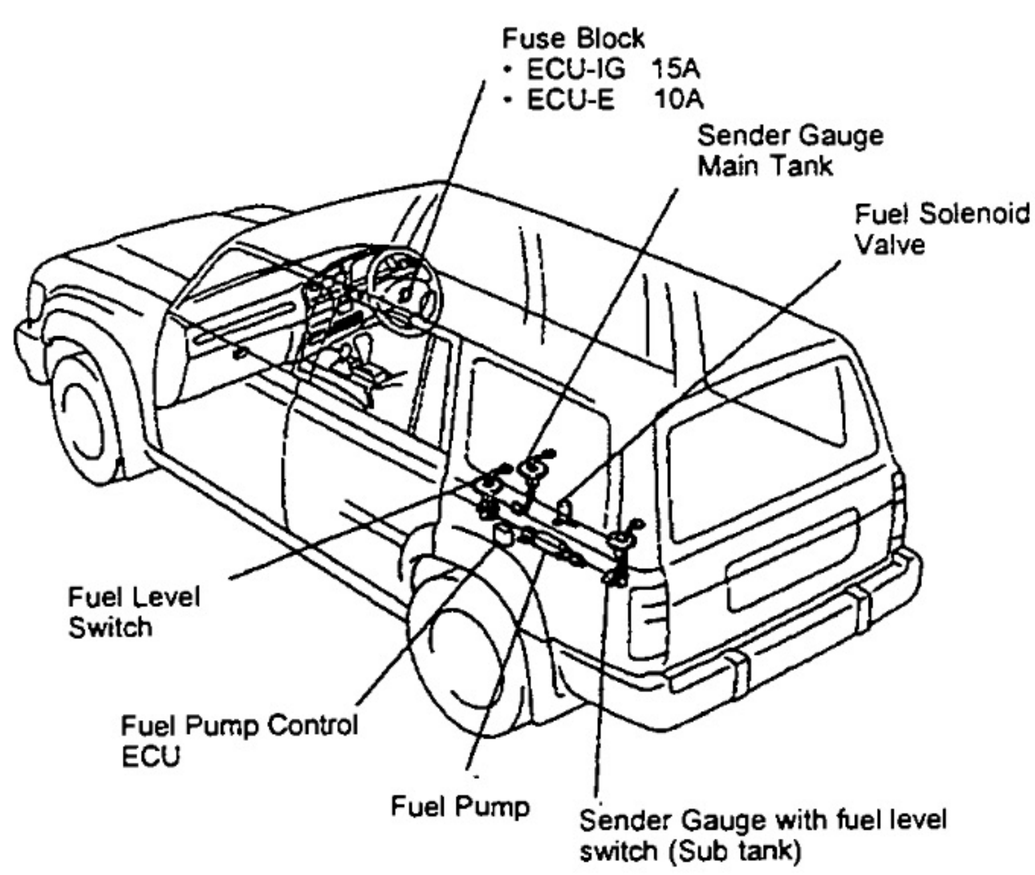


4. Layout of Components

◆ 75 Series ◆



◆ 80 Series ◆



5. Function of components

Component	Function
Main Tank Fuel Level Switch	Determines the level of fuel in the main tank by an ON/OFF signal. The switch is open (OFF) when the tank is full and closed (ON) when the fuel level is below ¾
Main Fuel Tank Sender Gauge	Works in conjunction with the main fuel tank level switch to determine the fuel level.
Sub Tank Fuel Level Switch	Determines the level of fuel in the sub tank by an ON/OFF signal. The switch is open (OFF) when the fuel level is above ¼ and closed (ON) when the tank is empty.
Fuel Solenoid Valve	Switched on by the engine and transmission ECU when the correct conditions are met to open a passage for fuel to pass from the sub tank to the main tank.
Fuel Pump	Switched on by the engine and transmission ECU when the correct conditions are met to pump fuel from the sub tank to the main tank via the fuel solenoid valve.
Sub Tank Switch	Operated by the driver to signal to the engine and transmission ECU to begin fuel transfer. While fuel is transferring the indicator light will be on. The indicator light will also output a diagnostic code.
Fuel Tank Warning Light	Lights up to allert the driver that malfunction has occurred in the sub tank fuel transfer system. The light will also output a diagnostic code.
Engine and Transmission ECU	Based on signals from the various sensors it calculates whether fuel can be transferred or not and sends signals to the fuel solenoid switch and fuel pump to transfer fuel. It also has a test and diagnosis function that monitors the system circuits and outputs codes.

6. Operation of System

General

The fuel transfer system will pump fuel from the sub tank to the main tank only. Fuel transfer will only occur when the sub tank switch is operated and the main and sub tank fuel levels are within the specified levels. The only exception to this is when the engine is started and the main and sub tank fuel quantaties are within specified levels, at this time the system will transfer fuel for approximately 5 seconds and then stop. This function allows the engine and transmission ECU to test and diagnose the system and prevents solenoid and pump sticking due to lack of use.

- The following cautions should be observed when operating the fuel transfer system:

- Fuel can be transferred as soon as the ignition switch is turned on for an emergency situation but this is not advisable as it will place a large draw on the vehicle battery.

- Fuel transfer should only occur when the vehicle is stationary on a level surface. If this is not observed fuel movement could give the fuel level switches incorrect signals and prematurely terminate the transfer process.

- Fuel will only transfer from the sub tank until the level switches indicate that the fuel level is out of specifications. The main tank will only fill to approximately the ¾ mark on the main gauge.

Transfer Process

a. Judgement of Fuel levels

Main Tank

The fuel level in the main tank is judged by signals from the level switch and the sender gauge. Judgement of the level switch is made by the engine and transmission ECU every 0.4 second, the ECU looks at the on/off duty cycle ratio and when this ratio is over 50% the fuel level is judged high (for reference this approximately equals ¾ on the gauge). Judgement of the sender gauge signal is made by reading the resistance of the gauge empty and full and are judged at particular threshold resistance's (for reference full is approximately the F mark and empty approximately ½ on the gauge).

Sub Tank

Judgement of the sub tank fuel level is based solely on the signal received from the level switch. The tank is determined empty when the switch turns on (for reference empty is approximately equal to the E mark on the gauge).

b. Beginning Transfer Process

The engine and transmission ECU will only judge that fuel transfer can commence when all the conditions in the following table are met.

Item	Condition
Ignition Switch	On
Main Tank Fuel Level	Empty
Sub Tank Fuel Level	Full
Diagnostic Check	No Fault
Sub Fuel Tank Switch	On

c. Transfer Process Terminated

The engine and transmission ECU will terminate the fuel transfer process when any one or more of the conditions listed in the following table are met:

Item	Condition
Ignition Switch	Off
Engine	Stalls
Main Tank Fuel Level	Full
Sub Tank Fuel Level	Empty
Diagnostic Check	Fault Found
Sub Fuel Tank Switch	Off

Diagnosis

The fuel transfer system uses two types of fault detection methods, test system and diagnosis system.

a. Test System

The engine and transmission ECU uses this system to detect any fault in the electrical circuits and sensors. If a fault is found an appropriate code will be output through the sub tank switch indicator light when terminals TC and E1 of the check connector are connected.

These fault codes are not stored in memory so only faults that are present when the check is conducted will be shown.

b. Diagnosis System

The engine and transmission ECU uses this system to detect any fault or conflict of signals in the electrical circuits and sensors. If a fault is found the FUEL TANK warning light in the combination meter will be illuminated to warn the driver of a malfunction and a diagnostic trouble code (DTC)will be stored in memory. Stored DTC can be retrieved by connecting terminals TC and E1 of the check connector and counting the flashes of the fuel tank warning light.

■ TOYOTA VEHICLE SECURITY SYSTEM (TVSS)

An Alpine brand TVSS has been adopted as standard equipment for VX and Turbo GXL 80 series, all other 80 series with power windows have been prewired for Dealer fit of the system. The construction and operation of the system is similar to that of ST204 ZR grade Celica. Diagnosis and adjustment of the radar field is exactly the same.

4 Appendix

TECHNICAL SPECIFICATIONS

■ 80 SERIES

The following table lists specifications that have changed from the previous model but have not been listed in this new car features manual.

Item		Specification
	Length mm	4,820
Overall	Width mm	1,830
	Height mm	1,875, 1,890*1
Tread	Front mm	1,535, 1,595*1
	Rear mm	1,540, 1,600*1
Overhang	Front mm	850
	Rear mm	1,120
Angle of approach		36°
Gross Vehicle Weight kg		2,960 (STD, GXL), 3,110 (VX)

*1 with 275/70 tire