

WORKSHOP MANUAL

TF SERIES

GASOLINE ENGINE (C24SE, C22NE, 22LE, 20LE)

SECTION

6, 6A, 6B, 6C, 6D, 6E, 6F, 6G, 6H & 6J

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THIS MANUAL INCLUDES FOLLOWING SECTIONS

SECTION	CONTENTS
6	Engine Diagnosis
6A	Engine Mechanical
6B	Engine Cooling
6C	Engine Fuel
6D1	Engine Electrical
6D2	Ignition System
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6E	Driveability and Emissions
6F	Engine Exhaust
6G	Engine Lubrication
6H	Engine Speed Control System
6J	Induction

NOTICE

Before using this Workshop Manual to assist you in performing vehicle service and maintenance operations, it is recommended that you carefully read and thoroughly understand the information contained in Section - 0A under the headings "GENERAL REPAIR INSTRUCTIONS" and "HOW TO USE THIS MANUAL".

All material contained in this Manual is based on the latest product information available at the time of publication.

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SECTION 6

ENGINE DIAGNOSIS

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Engine Diagnosis

Hard Starting

1.Starting Motor Does Not Turn Over

Trouble Shooting Procedure

Turn on headlights and starter switch.

Condition	Possible cause	Correction
Headlights go out or dim considerably	Battery run down or under charged	Recharge or replace battery
	Terminals poorly connected	Clean battery posts and terminals and connect properly
	Starting motor coil circuit shorted	Overhaul or replace
	Starting motor defective	Overhaul or replace

2.Ignition Trouble - Starting Motor Turns Over But Engine Does Not Start

Spark Test

Disconnect a high tension cable from any spark plug. Connect the spark plug tester (use commercially available tool), crank the engine, and check if a spark is generated in the spark plug tester. Before cranking the engine, make sure that the spark plug tester is properly grounded. To avoid electrical shock, do not touch the high tension cable while the engine is running.

Condition	Possible cause	Correction
Spark jumps across gap	Spark plug defective	Clean, adjust spark gap or replace
	Ignition timing incorrect	Refer to Ignition System
	Fuel not reaching fuel injector(s) or engine	Refer to item 3 (Trouble in fuel system)
	Valve timing incorrect	Adjust
	Engine lacks compression	Refer to item 4 (Engine lacks compression)
No sparking takes place	Ignition coil disconnected or broken	Connect properly or replace
	Electronic Ignition System with module	Replace
	Poor connections in engine harness	Correct
	Engine Control Module cable disconnected or defective	Correct or replace

3. Trouble in Fuel System

Condition	Possible cause	Correction
Starting motor turns over and spark occurs but engine does not start.	Fuel tank empty	Fill
	Water in fuel system	Clean
	Fuel filter clogged	Replace filter
	Fuel pipe clogged	Clean or replace
	Fuel pump defective	Replace
	Fuel pump circuit open	Correct or replace
	Evaporative Emission Control system circuit clogged	Correct or replace
	Multiport Fuel Injection System faulty	Refer to "Electronic Fuel Injection" section

4. Engine Lacks Compression

Condition	Possible cause	Correction
Engine lacks compression	Spark plug loosely fitted or spark plug gasket defective	Tighten to specified torque or replace gasket
	Valve timing incorrect	Adjust
	Cylinder head gasket defective	Replace gasket
	Valve incorrectly seated	Lap valve
	Valve stem seized	Replace valve and valve guide
	Valve spring weakened	Replace
	Cylinder or piston rings worn	Overhaul engine
	Piston ring seized	Overhaul engine.

Engine Compression Test Procedure

1. Start and run the engine until the engine reaches normal operating temperature.
2. Turn the engine off.
3. Remove all the spark plugs.
4. Remove ignition coil fuse (15A) and disable the ignition system.
5. Remove the fuel pump relay from the relay and fuse box.
6. Engage the starter and check that the cranking speed is approximately 300 rpm.
7. Install cylinder compression gauge into spark plug hole.
8. With the throttle valve opened fully, keep the starter engaged until the compression gauge needle reaches the maximum level. Note the reading.
9. Repeat the test with each cylinder. The pressure difference between the individual cylinders should not exceed 100kPa (14.5 psi).

Rough Engine Idling or Engine Stalling

Condition	Possible cause	Correction
Trouble in fuel injection system	Idle air control valve defective	Replace
	Throttle shutting off incomplete	Correct or replace
	Throttle position sensor circuit open or shorted	Correct or replace
	Fuel injector circuits open or shorted	Correct or replace
	Fuel injectors damaged	Replace
	Fuel pump relay defective	Replace
	Manifold Absolute Pressure Sensor cable disconnected or broken	Correct or replace
	Manifold Absolute Pressure Sensor defective	Replace
	Engine Coolant Temperature Sensor cable disconnected or broken	Correct or replace
	Engine Coolant Temperature Sensor defective	Replace
	Intake Air Temperature sensor cable disconnected or broken	Correct or replace
	Intake Air Temperature sensor defective	Replace
	Knock Sensor (KS) circuits open or shorted	Correct or replace
	KS defective	Replace
	KS Module circuits open or ground	Correct or replace
	KS Module defective	Replace
	Vehicle Speed Sensor circuit open or shorted	Correct or replace
	Vehicle Speed Sensor defective	Replace
Trouble in emission control system	Engine Control Module defective	Replace
	Canister purge solenoid circuit open	Correct
	Canister purge solenoid defective	Replace
	Evaporative Emission Canister Purge control valve defective	Replace
	Trouble in ignition system	Refer to Hard Start Troubleshooting Guide
Others	Engine lacks compression	Refer to Hard Start Troubleshooting Guide
	Valve incorrectly seated	Lap valve
	Air Cleaner Filter clogged	Replace filter element
	Valve timing incorrect	Readjust
	Idle air control valve broken	Replace

Rough Engine Running

Condition	Possible cause	Correction
Engine misfires regularly	Ignition coil layer shorted	Replace
	Spark plugs fouling	Clean or install hotter type plug
	Spark plug(s) insulator nose leaking	Replace
	Fuel injector(s) defective	Replace
	Engine control module faulty	Replace
Engine knocks regularly	Spark plugs running too hot	Install colder type spark plugs
	Powertrain control module faulty	Replace
Engine lacks power	Spark plugs fouled	Clean
	Fuel injectors defective	Replace
	Manifold Absolute Pressure (MAP) Sensor or Manifold Absolute Pressure Sensor circuit defective	Correct or replace
	Engine Coolant Temperature Sensor or Engine Coolant Temperature Sensor circuit defective	Correct or replace
	Engine Control Module faulty	Replace
	Intake Air Temperature Sensor or Intake Air Temperature Sensor circuit defective	Correct or replace
	Throttle Position Sensor or Throttle Position Sensor circuit defective	Correct or replace
	Knock Sensor or Knock Sensor circuits defective	Correct or replace
	Knock Sensor Module or Knock Sensor Module circuits defective	Correct or replace

Hesitation

Condition	Possible cause	Correction
Hesitation on acceleration	Throttle Position Sensor adjustment incorrect	Replace throttle valve assembly
	Throttle Position Sensor circuit open or shorted	Correct or replace
	Excessive play in accelerator linkage	Adjust or replace
	Manifold Absolute Pressure (MAP) Sensor circuit open or shorted	Correct or replace
	MAP Sensor defective	Replace
	Intake Air Temperature (IAT) Sensor circuit open or shorted	Correct or replace
	Knock Sensor (KS) Circuit open or shorted	Correct or replace
	KS defective	Replace
	KS Module circuits open or shorted	Correct or replace
	KS Module defective	Replace
	IAT Sensor defective	Replace
Hesitation at high speeds (Fuel pressure too low)	Fuel tank strainer clogged	Clean or replace
	Fuel pipe clogged	Clean or replace
	Fuel filter clogged	Replace
	Defective fuel pump system	Check and replace
	Fuel Pressure Control Valve leaking	Replace
Hesitation at high speeds (Fuel injector not working normally)	Power supply or ground circuit for Multiport Fuel Injection System shorted or open	Check and correct or replace
	Cable of Multiport Fuel Injection System disconnected or defective	Correct or replace
Hesitation at high speeds	Engine Control Module defective	Replace
	Throttle Position Sensor circuit open or shorted	Correct or replace
	Throttle Position Sensor defective	Replace
	Engine Coolant Temperature Sensor circuit open or shorted	Correct or replace
	Engine Coolant Temperature Sensor defective	Replace
	MAP Sensor cable open or shorted	Correct or replace
	MAP Sensor defective	Replace
	IAT Sensor circuit open or shorted	Correct or replace
	IAT Sensor defective	Replace
	KS Circuit open or shorted	Correct or replace
	KS defective	Replace
	KS Module circuit open or shorted	Correct or replace
	KS Module defective	Replace
	Throttle valve not wide opened	Check and correct or replace
	Air Cleaner Filter clogged	Replace filter element
	Power supply voltage too low	Check and correct or replace

Engine Lacks Power

Condition	Possible cause	Correction
Trouble in fuel system	Fuel Pressure Control Valve not working normally	Replace
	Fuel injector clogged	Clean or replace
	Fuel pipe clogged	Clean
	Fuel filter clogged or fouled	Replace
	Fuel pump drive circuit not working normally	Correct or replace
	Fuel tank not sufficiently breathing due to clogged Evaporative Emission Control System circuit	Clean or replace
	Water in fuel system	Clean
	Inferior quality fuel in fuel system	Use fuel of specified octane rating
	Engine Control Module supplied poor voltage	Correct circuit
	Throttle Position Sensor cable disconnected or broken	Correct or replace
	Throttle Position Sensor defective	Replace
	Manifold Absolute Pressure Sensor not working normally	Replace
	Intake Air Temperature sensor not working normally	Replace
	Engine Coolant Temperature Sensor circuit open or shorted	Correct or replace
	Engine Coolant Temperature Sensor defective	Replace
	Engine Control Module defective	Replace
Trouble in intake or exhaust system	Air Cleaner Filter clogged	Replace filter element
	Air duct kicked or flattened	Correct or replace
Ignition failure	-	Refer to Hard Start Troubleshooting Guide
	Heat range of spark plug inadequate	Install spark plugs of adequate heat range
	Electronic Ignition System with module	Replace

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Condition	Possible cause	Correction
Engine overheating	Level of Engine Coolant too low	Replenish
	Thermo switch or fan motor defective	Replace
	Thermostat defective	Replace
	Engine Coolant pump defective	Correct or replace
	Radiator clogged	Clean or replace
	Radiator filter cap defective	Replace
	Level of oil in engine crankcase too low or wrong oil in engine	Change or replenish
	Resistance in exhaust system increased	Clean exhaust system or replace defective parts
	Throttle Position Sensor adjustment incorrect	Adjust Wide Open Throttle switch setting
	Throttle Position Sensor circuit open or shorted	Correct or replace
	Cylinder head gasket damaged	Replace
	Cooling Fan clutch defective	Replace
	Fan belt slipping	Adjust tension of V-belt or replace V-belt
Engine overcooling	Thermostat defective	Replace (Use a thermostat set to open at 92°C (197.6°F))
Engine lacks compression	-	Refer to Hard Start
Others	Tire inflation pressure abnormal	Adjust to recommend pressures
	Brake drag	Adjust
	Clutch slipping	Adjust or replace
	Level of oil in engine crankcase too high	Correct level of engine oil

Engine Noisy

Abnormal engine noise often consists of various noises originating in rotating parts, sliding parts and other moving parts of the engine. It is, therefore, advisable to locate the source of noise systematically.

Condition	Possible cause	Correction
Noise from crank journals or from crank bearings (Faulty crank journals and crank bearings usually make dull noise that becomes more evident when accelerating)	Oil clearance increased due to worn crank journals or crank bearings	Replace crank bearings and crankshaft or regrind crankshaft and install the over size bearing
	Crankshaft out of round	Replace crank bearings and crankshaft or regrind crankshaft and install the over size bearing
	Crank bearing seized	Replace crank bearings and crankshaft or regrind crankshaft and install the over size bearing

Abnormal Noise Due to Hydraulic Lash Adjuster

Should abnormal noise due to the hydraulic lash adjuster trouble be heard immediately after the engine is started, inspect as follows:

Condition	Possible cause	Correction
Abnormal noise is heard	Air contaminated	Bleed
HLA is spongy	Check ball valve broken	Repair
	Safety valve in cylinder head broken	Replace
Valve clearance is not zero	HLA inside stick	Replace HLA assembly

Troubleshooting Procedure

Short out each spark plug in sequence using insulated spark plug wire removers. Locate cylinder with defective bearing by listening for abnormal noise that stops when spark plug is shorted out.

Condition	Possible cause	Correction
Noise from connecting rods or from connecting rod bearings (Faulty connecting rods or connecting rod bearings usually make an abnormal noise slightly higher than the crank bearing noise, which becomes more evident when engine is accelerated)	Bearing or crankshaft pin worn	Replace connecting rod bearings and crankshaft or regrind crankshaft and install the under size bearing
	Crankpin out of round	Replace connecting rod bearings and crankshaft or regrind crankshaft and install the under size bearing
	Connecting rod bent	Correct or replace
	Connecting rod bearing seized	Replace connecting rod bearings and crankshaft or regrind crankshaft and install the under size bearing

Troubleshooting Procedure

Abnormal noise stops when the spark plug on the cylinder with defective parts is shorted out.

Condition	Possible cause	Correction
Piston and cylinder (Faulty piston or cylinder usually makes a combined mechanical thumping noise which increases when engine is suddenly accelerated but diminishes gradually as the engine warms up)	Piston clearance increased due to cylinder wear	Replace piston and cylinder body
	Piston seized	Replace piston and cylinder body
	Piston ring broken	Replace piston and cylinder body
	Piston defective	Replace pistons and others

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Troubleshooting Procedure

Short out each spark plug and listen for change in engine noise.

Condition	Possible cause	Correction
Piston pin noise (Piston makes noise each time it goes up and down)	Piston pin or piston pin hole worn	Replace piston, piston pin and connecting rod assy

Troubleshooting Procedure

The slapping sound stops when spark plug on bad cylinder is shorted out.

Condition	Possible cause	Correction
Timing belt noise	Timing belt tension is incorrect	Replace pusher or adjust the tension pulley or replace timing belt
	Tensioner bearing defective	Replace
	Timing belt defective	Replace
	Timing wheels defective	Replace
	Timing belt comes in contact with timing cover	Replace timing belt and timing cover
Valve noise	Valve and valve guide seized	Replace valve and valve guide
	Valve spring broken	Replace
	Valve seat off-positioned	Correct
Crankshaft noise	Crankshaft end play excessive (noise occurs when clutch is engaged)	Replace thrust bearing
Engine knocking	Preignition due to use of spark plugs of inadequate heat range	Install Spark Plugs of adequate heat range
	Fuel too low in octane rating	Replace fuel
	Wide Open Throttle enrichment system failure	Refer to Section 6E
	Selection of transmission gear incorrect	Caution operator or incorrect gear selection
	Engine overheating	Refer to "Engine Lacks Power"
Others	Water pump defective	Replace
	V-belt slipping	Adjust tension of V-belt or replace V-belt

Abnormal Combustion

Condition	Possible cause	Correction
Trouble in fuel injection system	Fuel pressure control valve defective	Replace
	Fuel filter clogged	Replace
	Fuel pump clogged	Clean or replace
	Fuel tank or fuel pipe clogged	Clean or replace
	Fuel injector clogged	Clean or replace
	Fuel pump relay defective	Replace
	Power supply cable for fuel pump loosely connected or defective	Reconnect, correct or replace
	Manifold Absolute Pressure Sensor circuit open or shorted	Correct or replace
	Manifold Absolute Pressure Sensor defective	Replace
	Engine Coolant Temperature (ECT) Sensor circuit open or shorted	Correct or replace
	ECT Sensor defective	Replace
	Throttle Position Sensor adjustment incorrect	Reconnect
	Throttle Position Sensor defective	Replace
	Throttle Position Sensor connector loosely connected	Reconnect
	Vehicle Speed Sensor cable loosely connected or defective	Correct or replace
	Vehicle Speed Sensor loosely fixed	Fix tightly
	Vehicle Speed Sensor in wrong contact or defective	Replace
	Engine Control Module cable loosely connected or defective	Correct or replace
Trouble in emission control system	Heated Oxygen Sensor circuit open (If applicable)	Correct or replace
	Heated Oxygen Sensor defective (If applicable)	Replace
	Signal vacuum hose loosely fitted or defective	Correct or replace
	ECT Sensor circuit open or shorted	Correct or replace
	ECT Sensor defective	Replace
	Evaporative Emission Control system (If applicable)	Refer to Section 6E
Trouble in ignition system	-	Refer to "Engine Lacks Power"
Trouble in cylinder head parts	Carbon deposits in combustion chamber	Remove carbon
	Carbon deposit on valve, valve seat and valve guide	Remove carbon

Engine Oil Consumption Excessive

Condition	Possible cause	Correction
Oil leaking	Oil pan drain plug loose	Retighten or replace gasket
	Oil pan setting bolts loosened	Retighten
	Oil pan gasket broken	Replace gasket
	Front cover retaining bolts loose or gasket broken	Retighten or replace gasket
	Head cover retaining bolts loose or gasket broken	Retighten or replace gasket
	Oil filter adapter cracked	Replace
	Oil filter attaching bolt loose or rubber gasket broken	Retighten or replace oil filter
	Crankshaft front or rear oil seal defective	Replace oil seal
	Oil pressure unit loose or broken	Retighten or replace
	Blow-by gas hose broken	Replace hose
	Engine/Transmission coupling area	Replace oil seal
Oil leaking into combustion chambers due to poor seal in valve system	Valve stem oil seal defective	Replace
	Valve stem or valve guide worn	Replace valve and valve guide
Oil leaking into combustion chambers due to poor seal in cylinder parts	Cylinders and pistons worn excessively	Rebore cylinder and replace pistons and others
	Piston ring gaps incorrectly positioned	Correct
	Piston rings set with wrong side up	Correct
	Piston rings sticking	Rebore cylinder and replace pistons and others
	Piston ring and ring groove worn	Replace pistons and others
	Return ports in oil rings clogged	Clean piston and replace rings
Crank case ventilation, Positive Crankcase Ventilation System malfunctioning	Positive Crankcase Ventilation Hose clogged	Clean
Others	Improper oil viscosity	Use oil of recommended S.A.E. viscosity
	Continuous high speed driving and or severe usage such as trailer towing	Continuous high speed operation and or severe usage will normally cause increased oil consumption

Fuel Consumption Excessive

Condition	Possible cause	Correction
Trouble in fuel system	Mixture too rich or too lean due to trouble in fuel injection system	Refer to "Abnormal Combustion"
	Fuel cut function does not act	Refer to "Abnormal Combustion"
Trouble in ignition system	Misfiring or abnormal combustion due to trouble in ignition system	Refer to Hard Start or Abnormal Combustion Troubleshooting Guide
Others	Engine idle speed too high	Reset Idle Air Control Valve
	Returning of accelerator control sluggish	Correct
	Fuel system leakage	Correct or replace
	Clutch slipping	Correct
	Brake drag	Correct
	Selection of transmission gear incorrect	Caution operator of incorrect gear selection

Oil Problems

Condition	Possible cause	Correction
Oil pressure too low	Wrong oil in use	Replace with correct engine oil
	Relief valve sticking	Replace
	Oil pump not operating properly	Correct or replace
	Oil pump strainer clogged	Clean or replace strainer
	Oil pump worn	Replace
	Oil pressure gauge defective	Correct or replace
	Crankshaft bearing or connecting rod bearing worn	Replace
Oil contamination	Wrong oil in use	Replace with new engine oil
	Oil filter clogged	Replace oil filter
	Cylinder head gasket damage	Replace gasket
	Burned gases leaking	Replace piston and piston rings or rebore cylinders
Oil not reaching valve system	Oil passage in cylinder head or cylinder body clogged	Clean or correct

Engine Oil Pressure Check

- Check for dirt, gasoline or water in the engine oil.
 - Check the viscosity of the oil.
 - Change the oil if the viscosity is outside the specified standard.
 - Refer to the "Maintenance and Lubrication" section of this manual.
- Check the engine oil level.
The level should fall somewhere between the "ADD" and the "FULL" marks on the oil level dipstick.
If the oil level does not reach the "ADD" mark on the oil level dipstick, engine oil must be added.
- Remove the oil pressure unit.
- Install an oil pressure gauge.
- Start the engine and allow the engine to reach normal operating temperature (About 80°C).
- Measure the oil pressure.
**Oil pressure should be:
150 kPa(21.8 psi) at idle speed.**
- Stop the engine.
- Remove the oil pressure gauge
- Install the oil pressure unit.
- Start the engine and check for leaks.

Malfunction Indicator Lamp

The instrument panel "CHECK ENGINE" Malfunction Indicator lamp (MIL) illuminates by self diagnostic system when the system checks the starting of engine, or senses malfunctions.

Condition	Possible cause	Correction
"CHECK ENGINE" MIL does not illuminate at the starting of engine	Bulb defective	Replace
	MIL circuit open	Correct or replace
	Command signal circuit to operate self diagnostic system shorted	Correct or replace
	Engine Control Module (ECM) cable loosely connected, disconnected or defective	Correct or replace
	ECM defective	Replace
"CHECK ENGINE" MIL illuminates, and stays on	Deterioration heated oxygen sensor of internal element	Replace
	Heated oxygen sensor connector terminal improper contact (If applicable)	Reconnect properly
	Heated oxygen sensor lead wire shorted (If applicable)	Correct
	Heated oxygen sensor circuit open (If applicable)	Correct or replace
	Deterioration engine coolant temperature sensor of internal element	Replace
	Engine coolant temperature sensor connector terminal improper contact	Reconnect properly
	Engine coolant temperature sensor lead wire shorted	Correct
	Engine coolant temperature sensor circuit open	Correct or replace
	Throttle position sensor open or shorted circuits	Correct or replace
	Deterioration of crankshaft position sensor	Replace
	Crankshaft position sensor circuit open or shorted	Correct or replace
	Vehicle speed sensor circuit open	Correct or replace
	Manifold absolute pressure sensor circuit open or shorted	Correct or replace
	Intake air temperature sensor circuit open or shorted	Correct or replace
	Fuel injector circuit open or shorted	Correct or replace
	ECM driver transistor defective	Replace EPROM or ECM
	Malfunctioning of ECM RAM (Random Access Memory) or Malfunctioning of ECM PROM (Programmed Read Only Memory)	Replace EPROM or ECM

SECTION 6A

ENGINE MECHANICAL

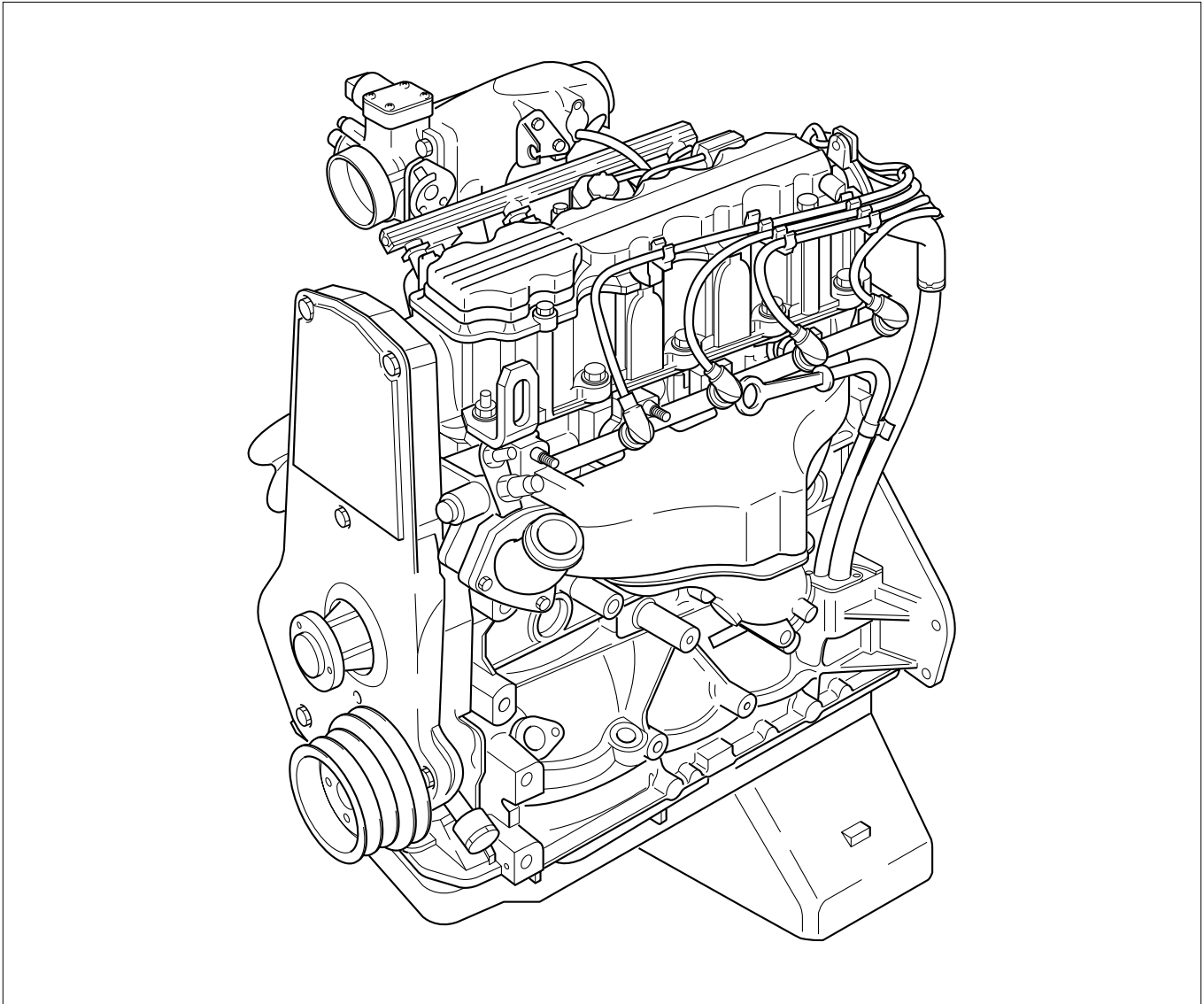
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GENERAL DESCRIPTION



Engine Cleanliness And Care

An automobile engine is a combination of many machined, honed, polished and lapped surfaces with tolerances that are measured in the thousandths of a millimeter (ten thousandths of an inch). Accordingly, when any internal engine parts are serviced, care and cleanliness are important. Throughout this section, it should be understood that proper cleaning and protection of machined surfaces and friction areas is part of the repair procedure. This is considered standard shop practice even if not specifically stated.

- A liberal coating of engine oil should be applied to all friction areas during assembly to protect and lubricate the surfaces on initial operation.
- Whenever valve train components, pistons, piston rings, connecting rods, rod bearings, and crankshaft journal bearings are removed for service, they should be retained in order.
- At the time of installation, they should be installed in the same locations and with the same mating surfaced as when removed.
- Battery cables should be disconnected before any major work is performed on the engine. Failure to disconnect cables may result in damage to wire harness or other electrical parts.
- The four cylinders of this engine are identified by numbers; cylinders 1, 2, 3 and 4, as counted from crankshaft pulley.

General Information on Engine Service

The following information on engine service should be noted carefully, as it is important in preventing damage and

contributing to reliable engine performance:

- When raising or supporting the engine for any reason, do not use a jack under the oil pan. Due to the small clearance between the oil pan and the oil pump strainer, jacking against the oil pan may cause damage to the oil pick up unit.
- The 12-volt electrical system is capable of damaging circuits. When performing any work where electrical terminals could possibly be grounded, the ground cable of the battery should be disconnected at the battery.
- Any time the intake air duct or air cleaner is removed, the intake opening should be covered. This will protect against accidental entrance of foreign material into the cylinder which could cause extensive damage when the engine is started.

Cylinder Block

The cylinder block is made of cast iron. The crankshaft is supported by five bearings. The bearing cap is made of nodular cast iron.

Cylinder Head

The cylinder head is made of aluminum alloy casting with a spark plug in the center.

Valve Train

Valve system is a single over head camshaft.

The valves clearance adjustment are hydraulic.

Hydraulic valve lifter adjustment, no adjustment necessary.

Intake Manifold

The intake manifold is made of aluminum alloy.

Exhaust Manifold

The exhaust manifold is made of high Si-Mo nodular iron.

Pistons and Connecting Rods

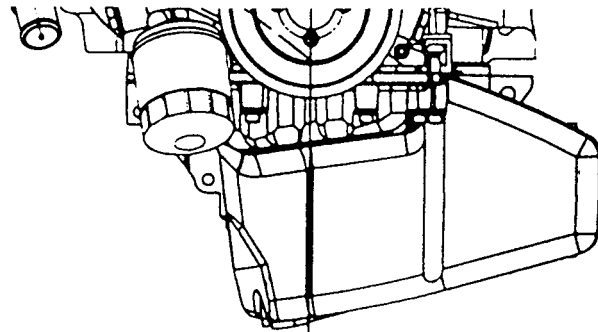
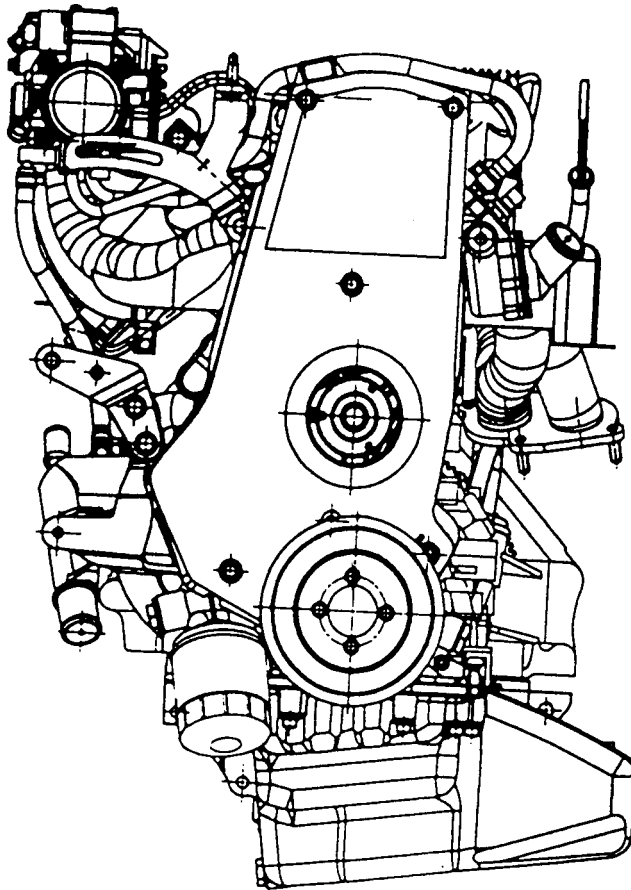
Aluminum pistons are used after selecting the grade that meets the cylinder bore diameter. Each piston has two compression rings and one oil ring. The piston pin is made of cast hardened steel. The connecting rod bearings are made of modular cast iron. The connecting rod bearings are made of steel backed with tri-metal babbitt metal.

Crankshaft and Bearings

The crank shaft is made of modular cast iron. Pins and journal are graded for correct size selection for their bearing.

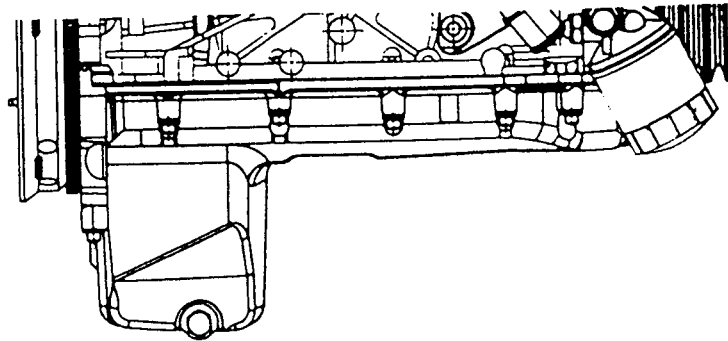
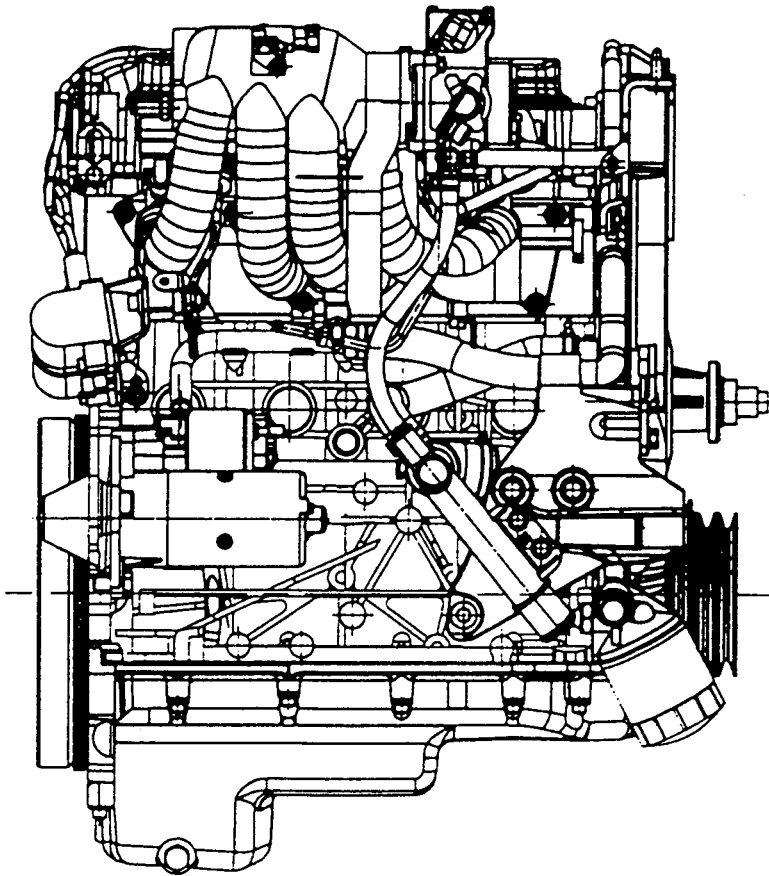
ENGINE PICTORIAL

Front View



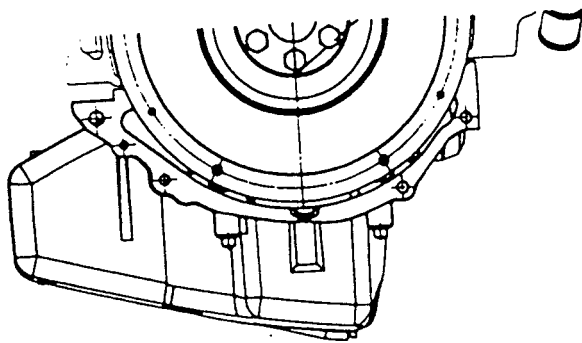
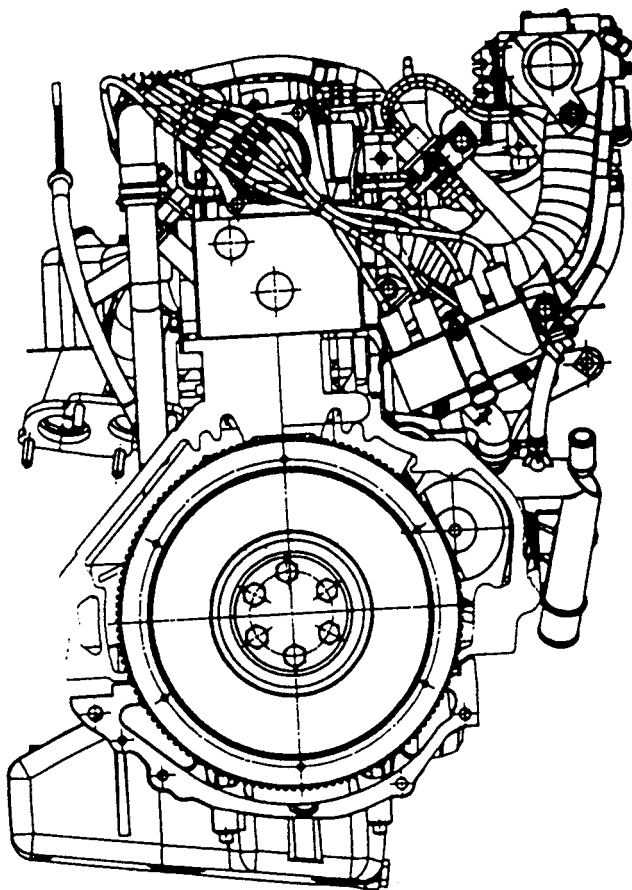
“4WD OIL PAN”

Inlet Side View



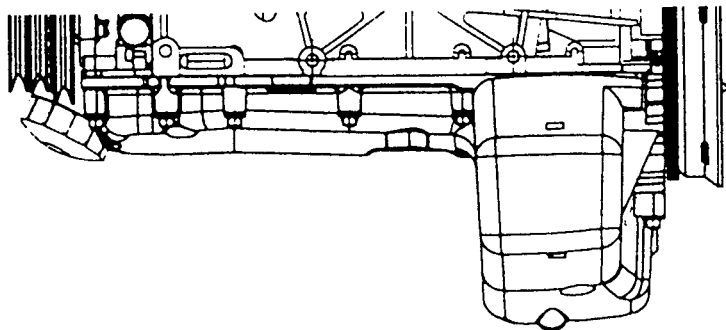
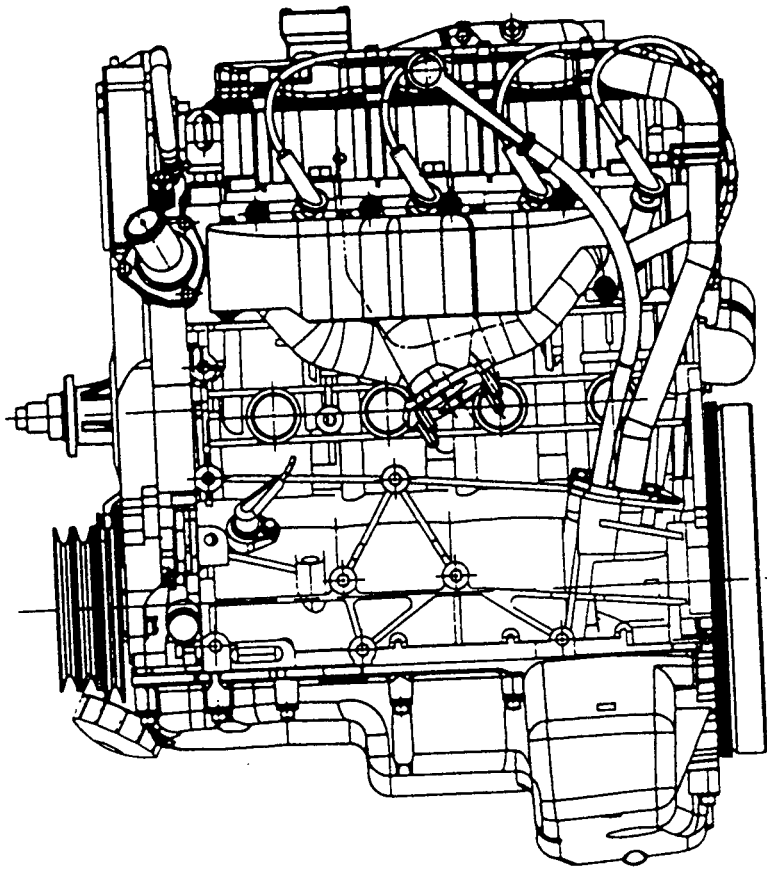
“4WD OIL PAN”

Rear View



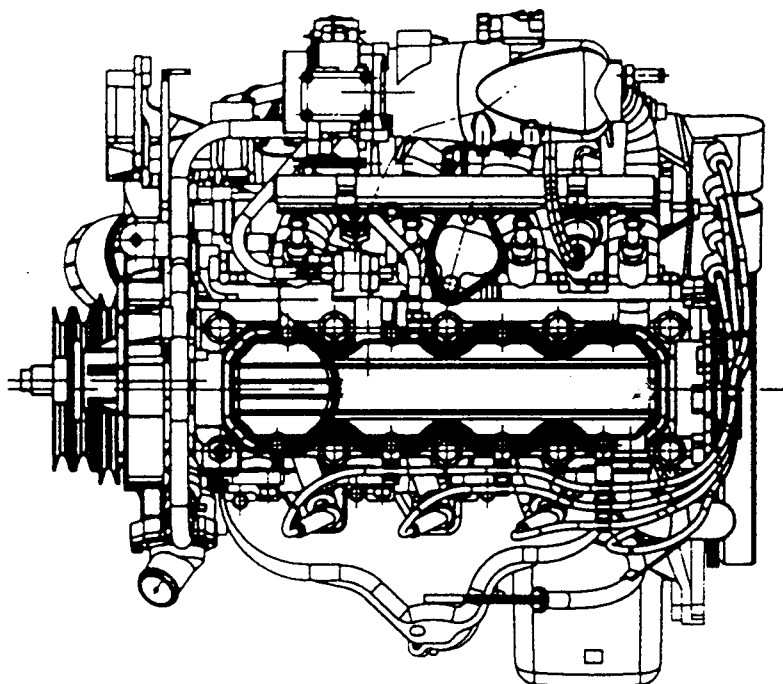
“4WD OIL PAN”

Exhaust Side View



"4WD OIL PAN"

Top View



Main Data and Specifications

Engine - General	C24SE	C22NE	22LE	20LE
Engine type	Four-cycle, water cooled cross-flow with single over head camshaft Micro-computer control, fuel injection			
Combustion chamber type (Volume)	Hemispherical (43.3cm ³)			
Timing train system	Belt drive			
No. of cylinders-bore × stroke mm (in)	4-87.5×100.0 (3.44×3.93)	4-86.0×94.6 (3.39×3.72)		
Bore Spacing(C/L to C/L)	93.0 mm (3.66 in)			
Firing Order	1-3-4-2			
Bore×Stroke mm (in)	87.5×100.0 (3.44×3.93)	86.0×94.6 (3.39×3.72)		
Total piston displacement cm ³ (in ³)	2,405(146.80)	2,198 (134.39)		1,998 (122.16)
Combustion Chamber Volume	43.3cm ³			
No. of piston ring	Compression ring: 2, Oil ring: 1			
Compression pressure kg/cm ² (psi/pa)	12.2-16.3 (174-232/1200-1600)	11.7-15.8 (166.8-224.8/1150-1550)		
Ignition timing (BTDC)	No adjustment			
Idling speed: rpm(WO/AC,W/AC) A/C off	825			
Valve clearances (At cold)				
Intake mm (in)	0 (0) (Hydraulic valve lash adjustment)			
Exhaust mm (in)	0 (0) (")			
Open at (BTDC) deg	17°30'	29		
Close at (ABDC) deg	76°30'	65		
Exhaust valves				
Open at (BBDC) deg	58°30'	66		
Close at (ATDC) deg	35°30'	29		
Ignition system	Fully transistorized battery ignition			
Distributor type	Not applicable, Electronic Spark Timing control			
Distributor advance type	Not applicable, Electronic Spark Timing control			
Spark plug type	RN9YC4			
Spark plug gap mm (in)	1.0--1.1 (0.039--0.043)			
Lubrication system				
Lubricating method	Fully flow pressure circulation			
Special engine oil (API grade)	SE, SF, SG or SH grade			
Oil pressure kg/cm ² (psi/Pa) rpm	4-4.6 (56.9-65.4/400-450)	1.5 (21.3/147) 825 (SAE 10W-30/API SE grade) engine oil after warm-up		
Oil pump type	Gear			
Oil filter type	Cartridge full flow			
Oil capacity lit. (US/UK gal.)	4.25	with Oil Filter change 4.5litres		

6A-12 ENGINE MECHANICAL (C24SE, C22NE, 22LE, 20LE)

Engine - General	C24SE	C22NE	22LE	20LE
Cooling system				
Radiator type	Corrugated fin with reserve tank			
Coolant capacity lit. (US/UK gal.)	2.3 (0.66/0.55)			
Water pump type	Centrifugal			
Thermostat	Wax pellet with jiggle hole			
Fuel system	Electronically controlled Multi Port Fuel Injection System			
Fuel pump type	Electric			
Fuel pressure kg/cm ² (psi/Pa)	3.4 (48.4/334)			
Fuel filter type	Cartridge paper element			
Air cleaner type	Dry paper element			
Battery Type/V-Ax No. of units	34B19L/50D20L	50D20L (STD)	34B19L	46B24L
Alternator				
Capacity V-A(W)	12-70 (840)			
Starter				
Output V-kW	1.4	1.2-1.4		
Exhaust system CO Adjustment	(1) Applicable to Open Loop System (Not equipped H2OS)			
	(2) Not applicable to Closed Loop System (Equipped H2OS)			
Compression Ratio (with Tolerance)	9.2:1±0.25	9.2:1±0.3	8.6:1±0.3	8.8:1±0.3
Cylinder Head Material	Aluminum Alloy (gravity cast)			
Cylinder Block Material	Cast Iron			
No. of Mounting Points (including trans.)	3			
Engine Installation Angles -Longitudinal	4° 60'	3° 30'		
-Lateral	7° 50' (towards exhaust side)			
Overall Dimensions (L x W xH):				
- TF (2.4Litre/2WD)	610×564×708mm			
- TF (2.4Litre/4WD)	610×564×746mm			
- TF (2.2Litre/2WD)		610×550×744 mm		
- TF (2.2Litre/4WD)		610×550×708 mm		
- TF (2.0Litre/2WD)		610×550×734 mm		

ENGINE MECHANICAL (C24SE, C22NE, 22LE, 20LE) 6A-13

Engine - General	C24SE	C22NE	22LE	20LE
Engine Weight				
Engine Weight	140kg			
- TF (2.4Liter/Man)				
- TF (2.2Liter/Man)				
- TF (2.0Liter/Man)		136kg		
		134kg		
Camshaft Type	SOHC			
No. of Valves per Cylinder	1			
- Inlet				
- Exhaust	1			
Spark Plug Location	Side			
Port Arrangement	Cross Flow			
Working Principle	Spark Ignition 4-stroke			

Valve System	C24SE	C22NE	22LE	20LE
Actuation Type	Direct-acting Inverted Bucked Tappet			
Valve Clearance Adjustment	Hydraulic			
Valve Rotor Type	None			
Inlet-Valve Material	Chromium Alloyed Steel			
-Seat Insert Material	Sintered Iron			
Exhaust-Valve Material	Head: Cr-Mn-Ni Alloyed Shaft: Cr-Si Alloyed &Cr plated			
-Seat Insert Material	Sintered Iron			
Valve Spring Material	GME 06 100-C1			
Valve Guide Material	QS 13 MR 00			
Valve Seal Type	Lip			

Water Pump	C24SE	C22NE	22LE	20LE
Type	Centrifugal			
Drive-Material &Type	HNBR Toothed-belt			
Bearing Type	Double Row Ball			
Shaft Seal Type	Mechanical Ceramic			

Thermostat-Coolant	C24SE	C22NE	22LE	20LE
Type	Bypass			

Oil Pump & Filter	C24SE	C22NE	22LE	20LE
Type	Gear Pump			
Location	Front of Engine			
Drive	Direct Crankshaft Driven			
Filter Type	Full Flow with Bypass for blocked filter			

6A-14 ENGINE MECHANICAL (C24SE, C22NE, 22LE, 20LE)

Oil & Oil Reservoir	C24SE	C22NE	22LE	20LE
Reservoir-Description & Location	1-piece below Engine			
Reservoir Material	Aluminum Alloy (pressure cast)			
Replacement Oil Fill Volume				
-With Filter change	4.25liters	4.50liters		
-Without Filter change	4.00liters	4.25liters		
Recommended Oil-Run-in	10W/30SG			
-Service (above-18°C)	10W/40SG			
-Service (below-18°C)	5W/30SG			
Oil Classification	API&CCMC			

Ignition Components	C24SE	C22NE	22LE	20LE
Spark Plugs	Conventional			
Type	Electronic Spark Control			
No. of Coils &Type	2 Solid State			
Coil Location	Engine-mounted			
Ignition Lead Type	Inductive (hi-resistance)			

Crankshaft	C24SE	C22NE	22LE	20LE
Material	Nodular Cast Iron			
Bearing subjected to End Thrust	Guide Bearing NO.3			
Main Bearing-Material &Type	Steel Backed Tri-metal Babbitt			
Front Seal-Diameter &Type	35.0mm Lip Seal			
Rear seal-Diameter &Type	90.0mm Micro-lip Seal			
Crankshaft Balancing	Individually Balanced			
No. of Counterweights	8			

Camshaft	C24SE	C22NE	22LE	20LE
Location	Overhead (Cylinder Head)			
Material	Grey Cast Iron			
Bearing Material	Aluminum			
No. of Bearings Camshaft Drive-Material &Type	200-250 HB5/750 (Camshaft drive type: toothed belt Camshaft drive material: rubber composite GD380)	HNB 5		

ENGINE MECHANICAL (C24SE, C22NE, 22LE, 20LE) 6A-15

Pistons	C24SE	C22NE	22LE	20LE
Material	Aluminum Alloy			
Finish & Type	Tin-coated Strutless			
Piston Rings	C24SE	C22NE	22LE	20LE
Function (top to bottom)	Compression Ring			
-Ring 1				
-Ring 2	Compression Ring			
-Ring 3	Oil Ring			
Description	-Ring 1	Rectangular		
-Ring 2	Taper Face			
-Ring 3	3-piece (2 Scrapers&1 Expander)			
Material	-Ring 1	Molybdenum Inlay Nodular Cast Iron		
-Ring 2	Cast Iron (individually cast)			
-Ring 3	Steel			
Material	Case Hardened Steel			
Retention	Locked in Rod			
Bearing	Machined in Piston Pin Boss			

Connecting Rod	C24SE	C22NE	22LE	20LE
Material	Nodular Cast Iron			
Bearing-Material &Type	Steel Backed Tri-metal Babbitt			

Inlet Manifold	C24SE	C22NE	22LE	20LE
Material	Aluminum Alloy			

Exhaust Manifold	C24SE	C22NE	22LE	20LE
Description	Dual Take-down			
Material	High Si-Mo Nodular Iron			

Engine Specification Matrix for destination

03 HEC FOR TF MODEL: VEHICLE MODEL TFR/S	2.4L			
Major Description	AUSTRALIA, CHILE, GULF, NEW ZEALAND, SAUDI ARABIA, SOUTH AFRICA	COLOMBIA, COSTA RICA, EQUADOR, GUATEMALA	BOLIVIA, GENERAL EXPORT, PERU, VENEZUELA	
VEHICLE TYPE	4×2	4x4	4×2	4×4
VEHICLE IDENT. CODE	TX	TY	TX	TY
ENGINE TYPE	C22NE	<--	<--	
FUEL CONTROL SYSYTEM	OPEN LOOP	CLOSED LOOP	CLOSED LOOP	
COMPRESSION RATIO	9.6:1	<--	<--	
FUEL OCTANE(ROD)	91RON	85RON	80RON	
FUEL TYPE	UN-LEADED	UN-LEADED	LEADED	
HO2	YES	YES	YES	YES
EVAP CANISTER	YES	YES	YES	YES
PURGE CONTROL SOLENOID	YES	YES	YES	YES
CHECK & RELIEF VALVE	YES	YES	YES	YES
ECM	YES	YES	YES	YES
EXHAUST SYSTEM				
FRONT PIPE				
SILENCER				
TWC	YES	YES	YES	YES
CO ADJUSTMENT	NO	NO	NO	NO
	Refer to 6A-81	Refer to 6A-81	Refer to 6A-81	

ENGINE MECHANICAL (C24SE, C22NE, 22LE, 20LE) 6A-17

99 HEC FOR TF MODEL: VEHICLE MODEL TFR/S	2.2L			
Major Description	AUSTRALIA NEW ZEALAND	CHILE GUATEMALA COSTA RICA		COLOMBIA
VEHICLE TYPE	4×2	4×2	4×4	4×2
VEHICLE IDENT. CODE	TA	TC	TD	TC
ENGINE TYPE	C22NE	<--		<--
FUEL CONTROL SYSYTEM	OPEN LOOP	CLOSED LOOP		CLOSED LOOP
COMPRESSION RATIO	9.2:1	<--		<--
FUEL OCTANE(ROD)	91RON	85RON		85RON
FUEL TYPE	UN-LEADED	UN-LEADED		UN-LEADED
HO2	NO	YES	YES	YES
EVAP CANISTER	YES	YES	YES	YES
PURGE CONTROL SOLENOID	YES	YES	YES	YES
CHECK & RELIEF VALVE	YES	YES	YES	YES
ECM	YES	YES	YES	YES
EXHAUST SYSTEM				
FRONT PIPE				
SILENCER				
TWC	YES	YES	YES	YES
CO ADJUSTMENT	YES	NO	NO	NO
	Refer to 6A-81	Refer to 6A-81		Refer to 6A-81

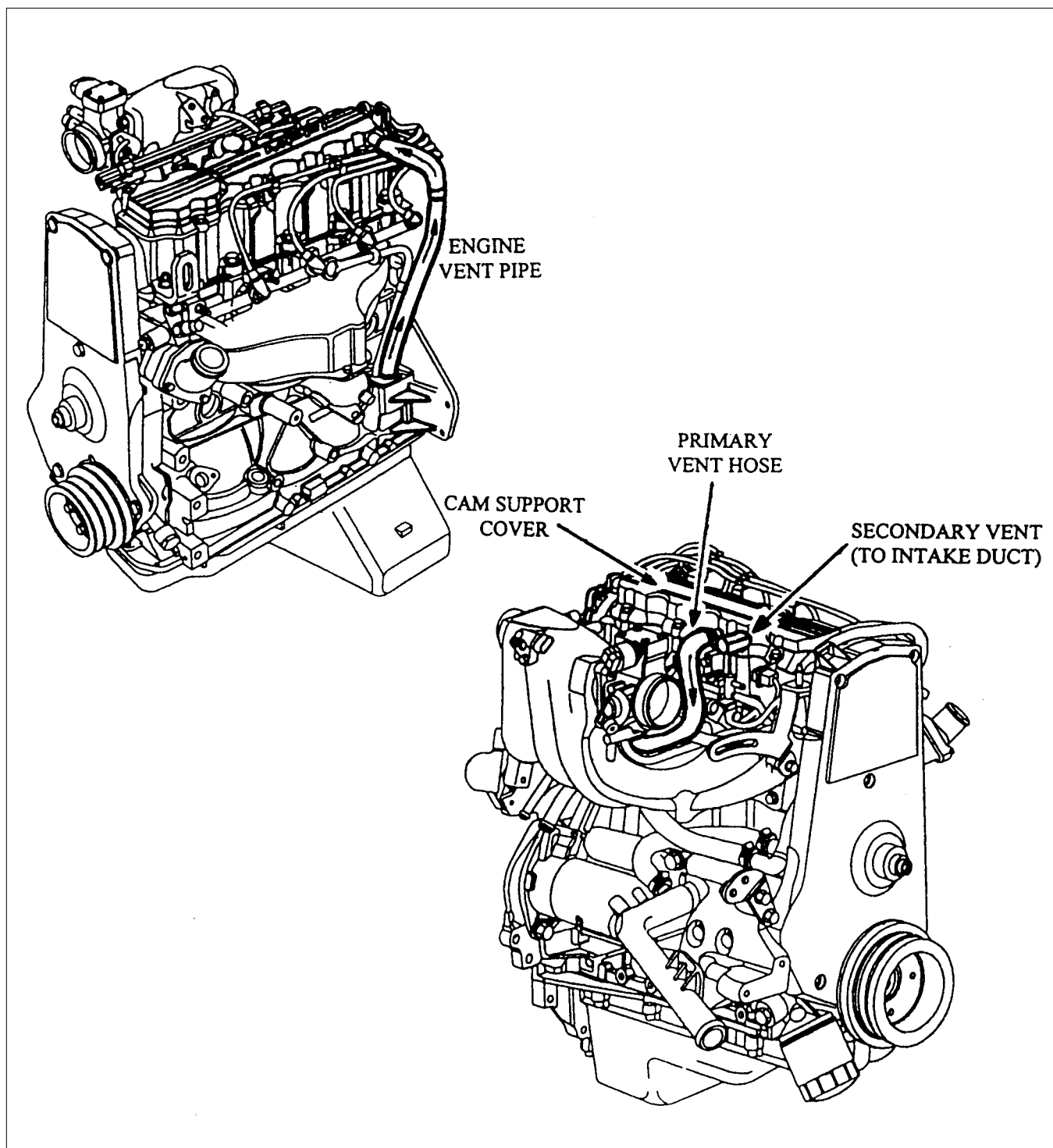
6A-18 ENGINE MECHANICAL (C24SE, C22NE, 22LE, 20LE)

99 HEC FOR TF MODEL: VEHICLE MODEL TFR/S	2.2L				
	COLOMBIA	SOUTH AFRICA			EQUADOR
VEHICLE TYPE	4×4	4×2	4×4	4×4	4×2
VEHICLE IDENT. CODE	TN	TN	TN	TN	TT
ENGINE TYPE	<--	<--		<--	22LE
FUEL CONTROL SYSYTEM	CLOSED LOOP	OPEN LOOP	OPEN LOOP	CLOSED LOOP	OPEN LOOP
COMPRESSION RATIO	<--	<--	<--	<--	80RON
FUEL OCTANE(ROD)	85RON	91RON	91RON	85RON	80RON
FUEL TYPE	UN-LEADED	LEADED	LEADED	LEADED	LEADED
		UN-LEADED	UN-LEADED	LN-LEADED	UN-LEADED
HO2	YES	NO	NO	NO	NO
EVAP CANISTER	YES	YES	NO	NO	YES
PURGE CONTROL SOLENOID	YES	NO	YES	YES	YES
CHECK RELIEF VALVE	YES	NO	NO	NO	YES
ECM	YES	YES	YES	YES	YES
EXHAUST SYSTEM					
FRONT PIPE					
SILENCER					
TWC	YES	NO	NO	YES	NO
CO ADJUSTMENT	NO	YES	YES	NO	YES
	Refer to 6A-81	Refer to 6A-81		Refer to 6A-81	Refer to 6A-81

99 HEC FOR TF MODEL: VEHICLE MODEL TFR/S	2.2L			2.0L
	EQUADOR	CHILE, GULF, KENYA, EGYPT CHINA, NIGERIA, PHILIPPINE		SOUTH AFRICA
VEHICLE TYPE	4×4	4×2	4×4	4×2
VEHICLE IDENT. CODE	TT	TT	TU	TP
ENGINE TYPE	22LE	<--		20LE
FUEL CONTROL SYSYTEM	OPEN LOOP	OPEN LOOP	OPEN LOOP	OPEN LOOP
COMPRESSION RATIO	8.6:1	<--		8.8:1
FUEL OCTANE(ROD)	80RON	80RON	80RON	91RON
FUEL TYPE	LEADED	LEADED	LEADED	LEADED
	<--	<--	<--	<--
HO2	NO	NO	NO	NO
EVAP CANISTER	YES	YES	YES	NO
PURGE CONTROL SOLENOID	YES	YES (*)	YES (*)	NO
CHECK RELIEF VALVE	YES	YES (*)	YES (*)	NO
ECM	YES	YES	YES	YES
EXHAUST SYSTEM				
FRONT PIPE				
SILENCER				
TWC	NO	NO	NO	NO
CD ADJUSTMENT	YES	YES	YES	YES
	Refer to 6A-81	Refer to 6A-81		Refer to 6A-81

NOTE: (*) for Chile and Gulf

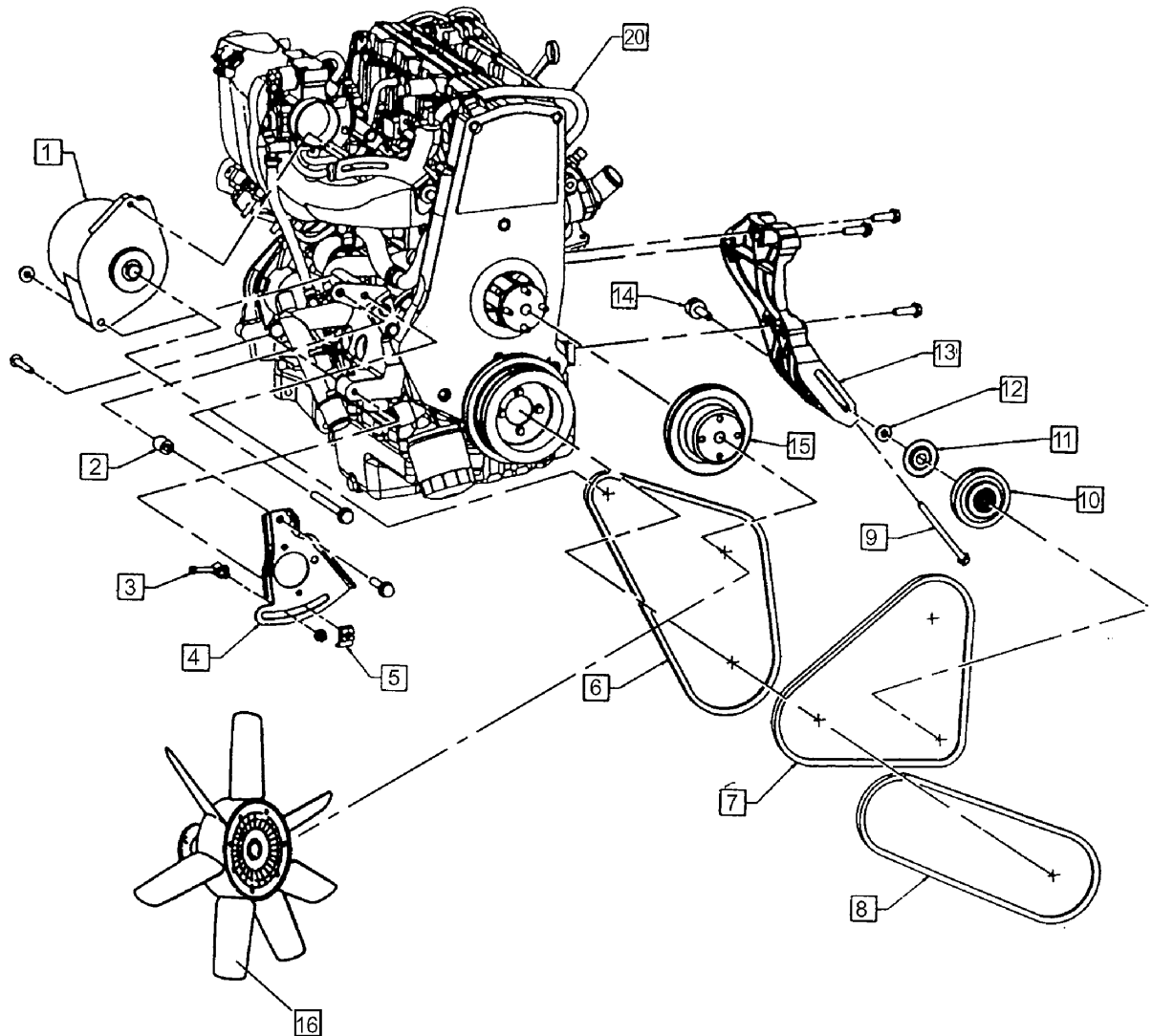
CRANKCASE VENTILATION SYSTEM



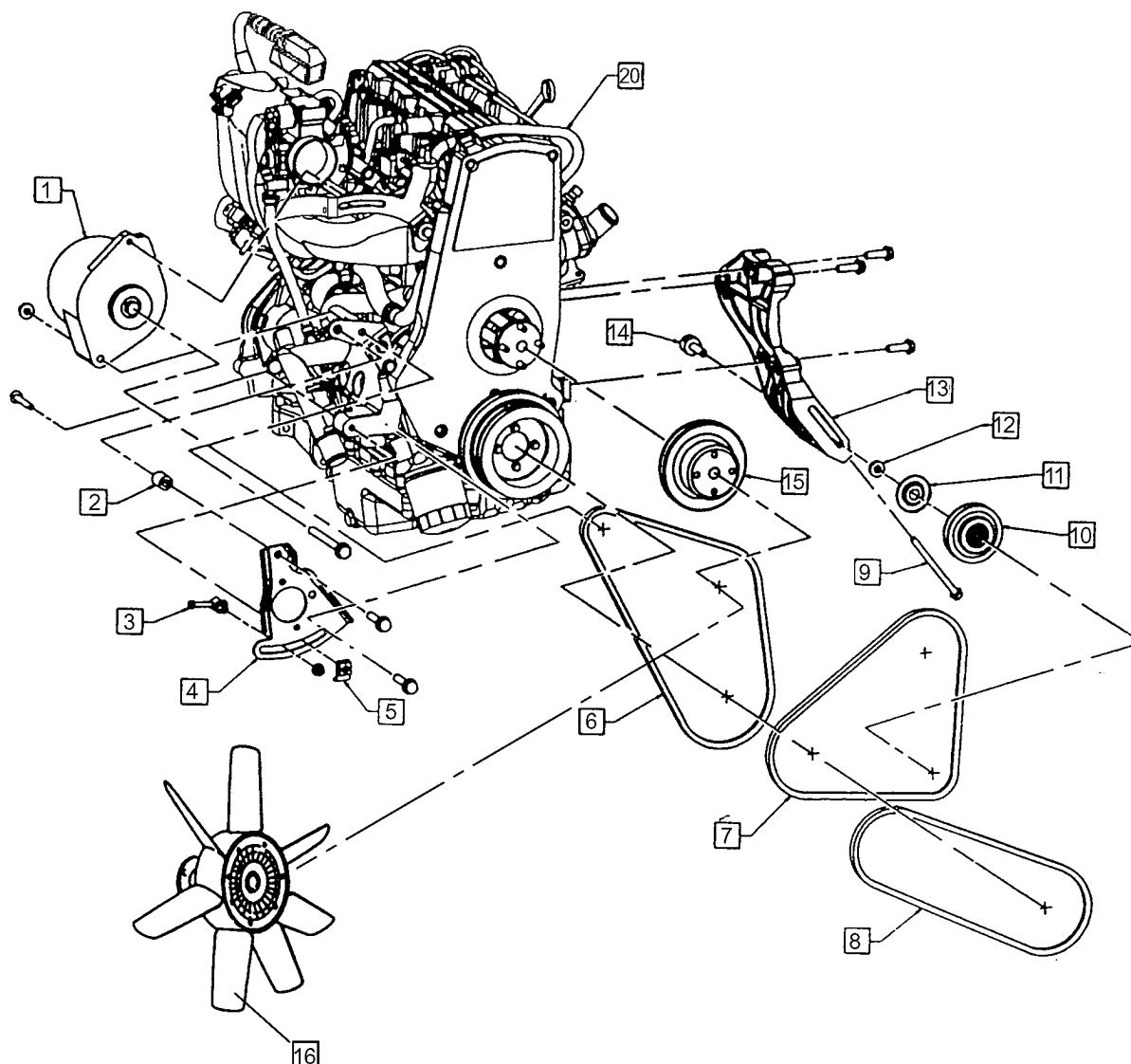
The Engine Ventilation System passes crankcase vapours, via the Engine Vent Pipe, to the Cam Support Cover, where separation of oil and exhaust gases occur. The oil drains into the Cylinder Head, via the Camshaft Support. The gases pass through the Primary and Secondary Vent Hoses to the intake system, and are consumed during the combustion process.

ENGINE ASSEMBLY & LOOSE PARTS

(2.2L & 2.0L Models)



(2.4L Model)



Loose Parts

- | | |
|-------------------------------|-----------------------------|
| 1 Alternator | 10 Tensioner Pulley |
| 2 P/S Pivot Spacer | 11 Pulley Dust Shield Cover |
| 3 P/S Adjusting Screw | 12 Pulley Spacer |
| 4 P/S Adjusting Plate | 13 A/C Compressor Bracket |
| 5 P/S Adjusting Nut | 14 Pulley Bolt |
| 6 Alternator & Fan Drive Belt | 15 Fan Pulley |
| 7 A/C Compressor Drive Belt | 16 Cooling Fan |
| 8 P/S Pump Drive Belt | |
| 9 Tensioner Bolt | |

Engine Assembly

20 C24SE, C22NE, 22LE, 20LE

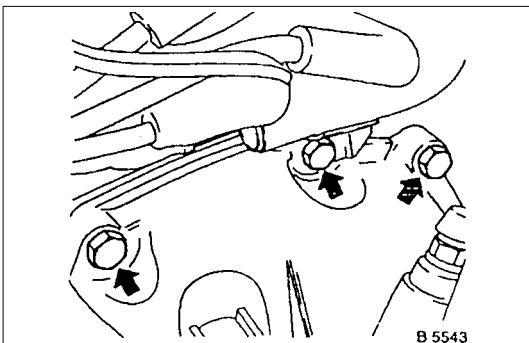
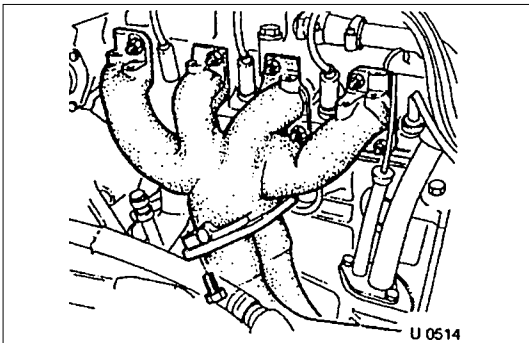
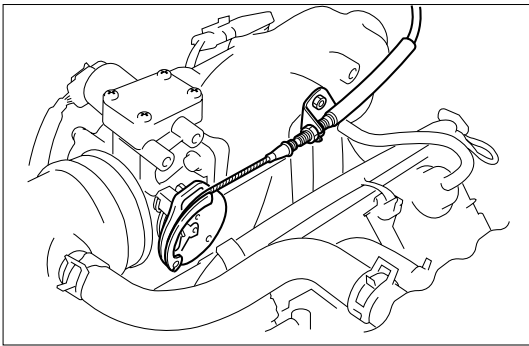
OPERATIONS ON ENGINE AGGREGATES

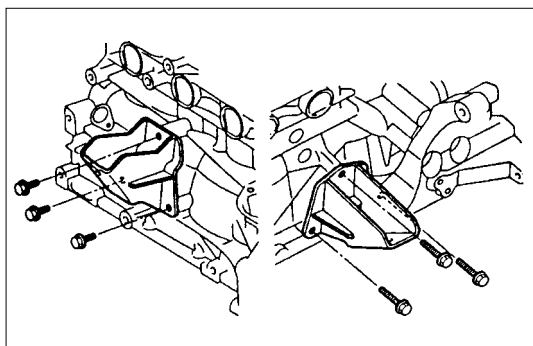
Engine Damping Blocks (Engine Without Transmission)



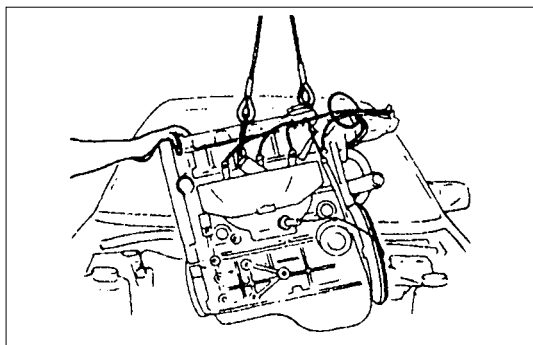
Removal

1. Remove bonnet.
2. Remove radiator.
3. Remove air inlet hose.
4. Remove power steering pump drive belt and power steering pump from engine.
5. Remove all cable connections, hoses and lines from engine.
6. Remove accelerator cable from inlet pipe.
7. Remove exhaust pipe from manifold.
8. Remove lower nine bolts and transmission from engine block.
9. Remove clutch slave cylinder and allow to hang free.
10. Remove starter from engine block.





11. Remove upper bolts of left and right engine mounting from damping blocks.
12. Raise engine slightly.
13. Remove lower bolts of left and right damping blocks.
14. Remove damping blocks.



Attach engine to cable, support transmission with car jack and remove upper transmission fastening bolt.

Press off engine from transmission and lift out of engine compartment.



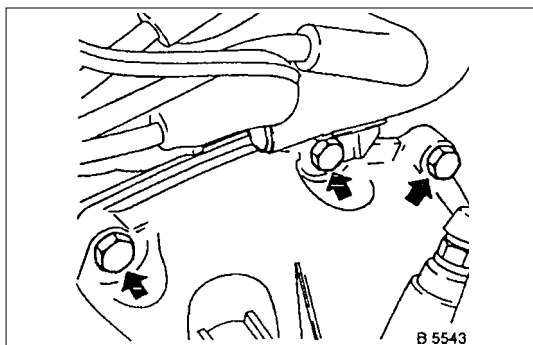
Installation

Lower engine into engine compartment and insert guide bushings on cylinder block into transmission.



Tighten (Torque)

Transmission to cylinder block (M10) -45 N·m (4.6 kgf·m)
Transmission to cylinder block (M12) -60 N·m (6.1 kgf·m)



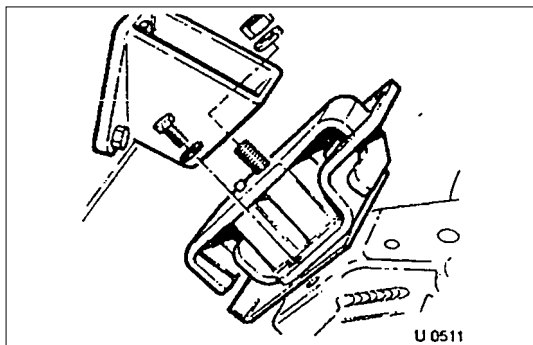
Installation

1. Install engine to vehicle and transmission.
2. Install clutch slave cylinder.



Tighten (Torque)

Transmission to engine block bolts - 76 N·m (7.6 kgf·m)

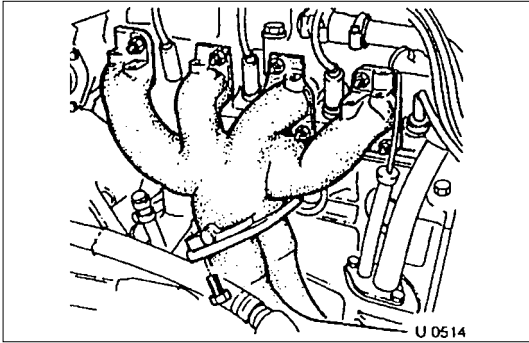


3. Install left engine damping block to sidemember.
4. Install left and right engine damping blocks to engine brackets.

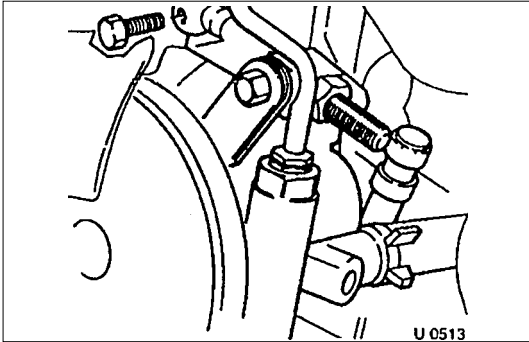


Tighten (Torque)

Engine damper block to sidemembr - 52 N·m (5.3 kgf·m)
Engine damper block to engine bracket - 85 N·m (8.6 kgf·m)



5. Install exhaust pipe to manifold.

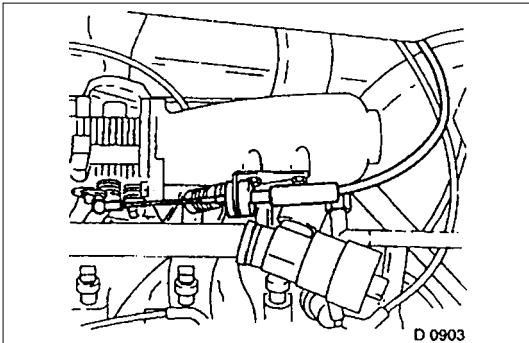


6. Install power steering pump and V-belt.



Adjust

Adjust power steering pump V-belt tension according to the corresponding operation.



Installation

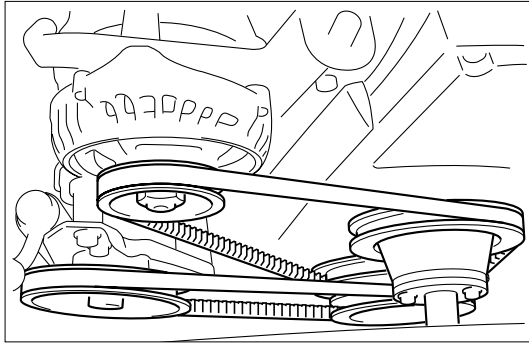
7. Install radiator according to the corresponding operation.
8. Install air inlet hose.
9. Install all electrical cable connections, hoses and lines to engine.
10. Install accelerator cable from inlet pipe.
11. Install bonnet.



Inspection

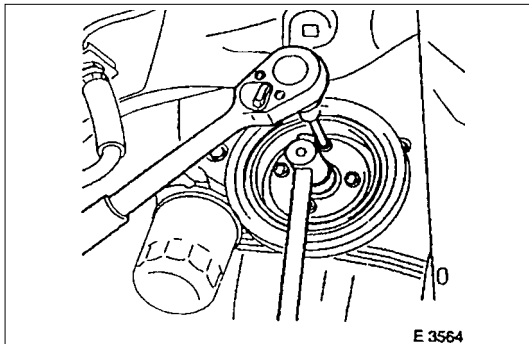
1. Check engine oil level.
2. Fill up cooling system and bleed according to the corresponding operation.

Toothed Belt and Timing Check

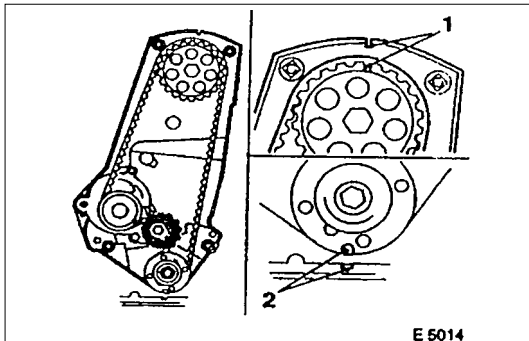


Removal

1. Remove the belts on the bracket for alternator.
2. Remove the fan.
3. Remove the V-belt for power steering.
4. Remove the V-belt for A/C.
5. Remove the fan belt.
6. Remove the fan shroud.
7. Remove the crankshaft pulley while counterholding on the fastening bolt of toothed belt drive gear.
8. Remove the toothed belt from cover.



E 3564

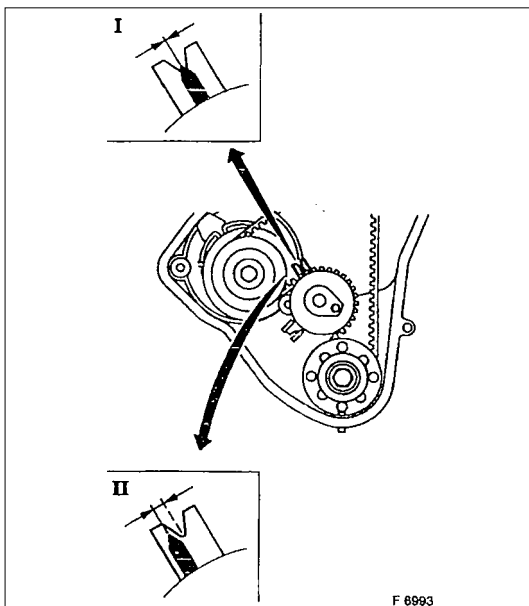


E 5014



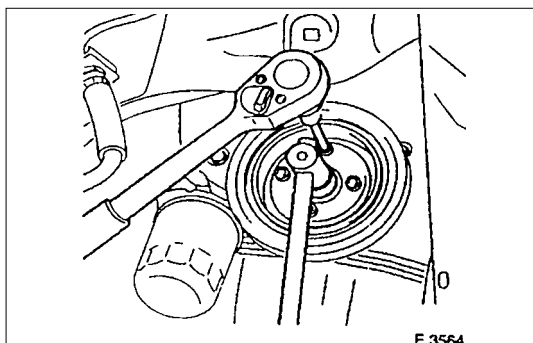
Inspection

1. Turn the crankshaft in the engine rotational direction mark(2) so that the notch (1) on the camshaft gear aligns with the mark on toothed belt rear cover.
2. Check the timing belt for worn, cracks or oil adhesion.



F 6993

3. Check that the cast on the water pump aligns with the counterpart on cylinder block (arrowed).
4. The tension of a toothed belt is correctly adjusted when the pointer and the center of the notch are aligned(I). The tension of a run-in toothed belt (regardless of mileage covered) is correctly adjusted when the pointer is positioned approx. 4mm (0.16 in.) to the left of the center of the notch(2).
Check the condition of the run-in toothed belt for suitability for reuse. Only toothed belts of the toothed belt tension rollers must be replaced and the source of oil contamination must be eliminated.



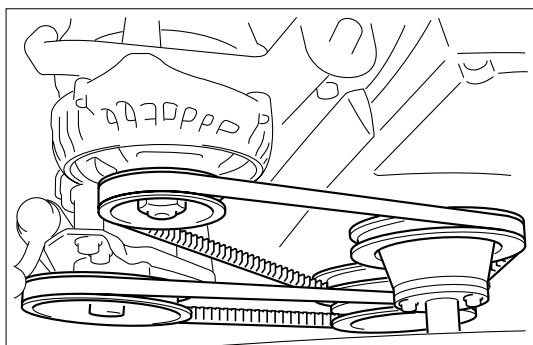
Installation

1. Install the toothed belt to the cover.
2. Install the crankshaft pulley while counterholding on the fastening bolt of toothed belt drive gear.
3. Install the fan shroud.



Tighten(Torque)

Crankshaft pulley bolts - 20 N·m (2.1 kgf·m)



4. Install the fan belt
5. Install the V-belt for A/C.
6. Install the V-belt for power steering.
7. Install the fan.
8. Install the belts on the bracket for alternator.

Toothed Belt Tension, Adjust (Engines with toothed belt tension roller)



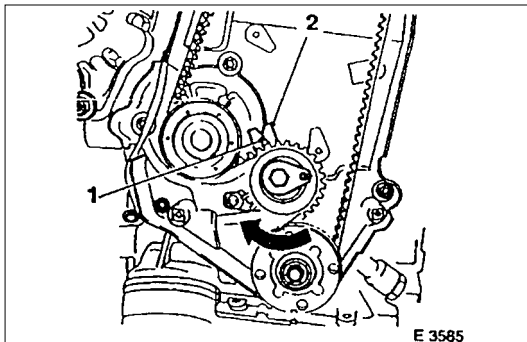
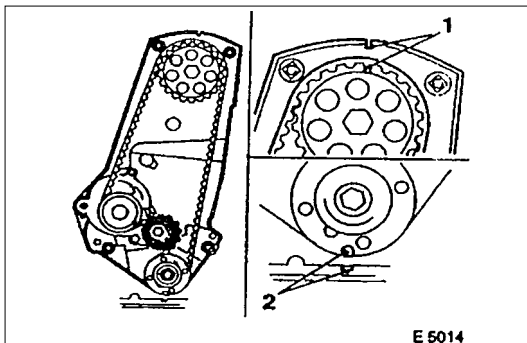
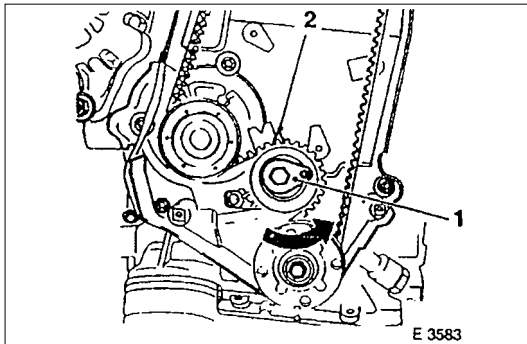
Removal

Refer to 6A-26. Toothed Belt and Timing check and removal steps.



Adjust

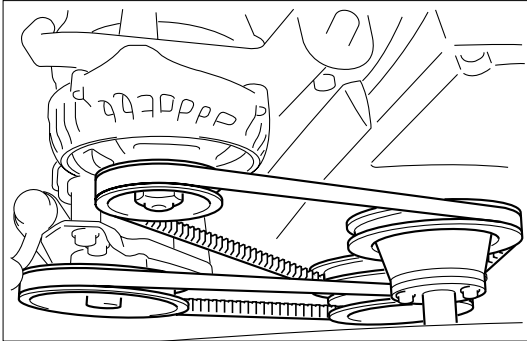
1. Loosen the fastening bolt of the toothed belt tension roller.
2. Turn the toothed belt tension roller at adjustment eccentric(1) in the direction of arrow (counterclockwise), until pointer (2) comes to the right stop.
3. If necessary tighten the fastening bolt of toothed belt tension roller.
4. Rotate the crankshaft twice (720°) in the engine rotational direction until marks (2) and (1) align again.
5. Turn the eccentric in the direction of arrow (clockwise) until pointer (1) and notch (2) are positioned to suit age of toothed belt.
6. Rotate the crankshaft twice (720°) in the engine rotational direction again and correct adjustment if necessary.



Installation

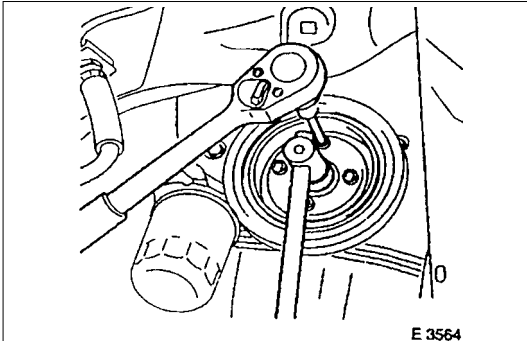
Refer to 6A-26 Toothed Belt and Timing check and installation steps.

Toothed Belt, Replace (Engine with toothed belt tension roller)

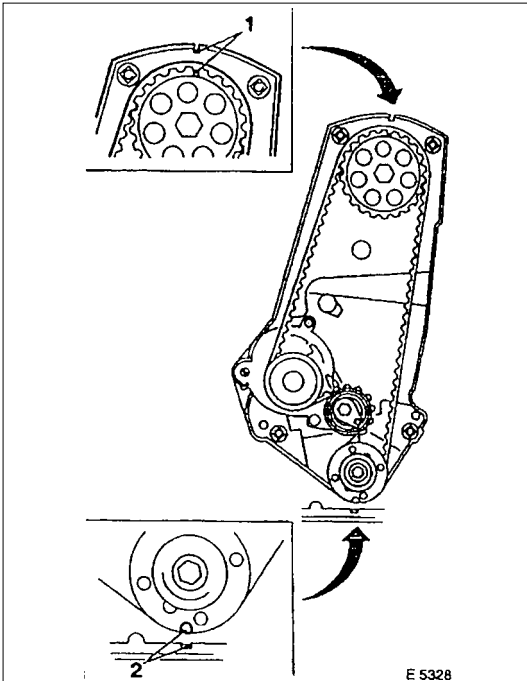


Removal

1. Remove the belts on the bracket for alternator.
2. Remove the fan.
3. Remove the V-belt for power steering.
4. Remove the V-belt for A/C.
5. Remove the fan belt.
6. Remove the fan shroud.



7. Remove the crankshaft pulley while counterholding on the fastening bolt of toothed belt drive gear.
8. Remove the toothed belt from cover.

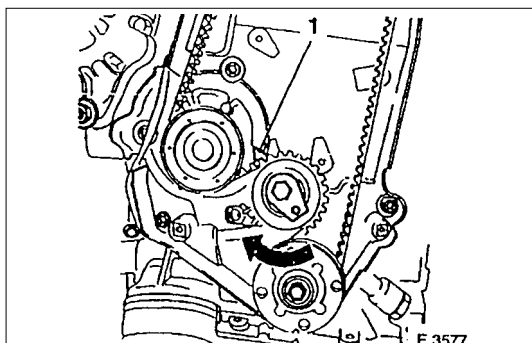


Adjust

Turn the crankshaft in the engine rotational direction to mark(2).

Align markings on toothed belt and on toothed belt rear cover. Simultaneously, notch (1) on camshaft gear must align with the mark on toothed belt rear cover.

Turn the crankshaft slowly and smoothly.



Adjust

Loosen the fastening bolt of the toothed belt tension roller and turn the adjustment eccentric in the direction of arrow (clockwise) until pointer (1) comes to the left stop. Remove the toothed belt.



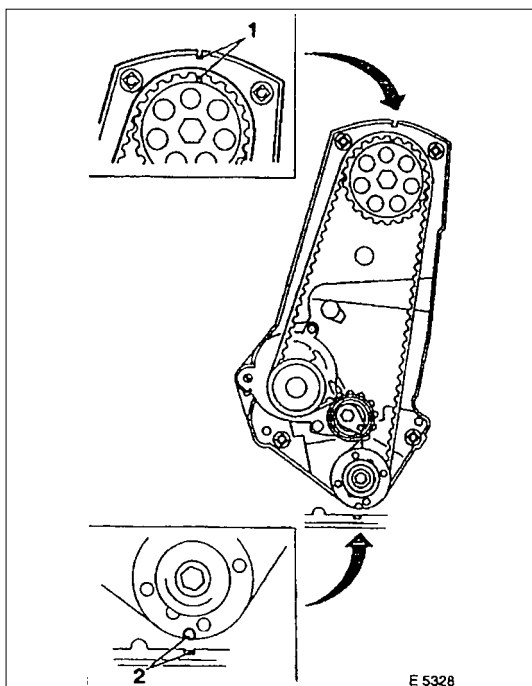
Installation

1. Install a new toothed belt while keeping tension side taut.



Adjust

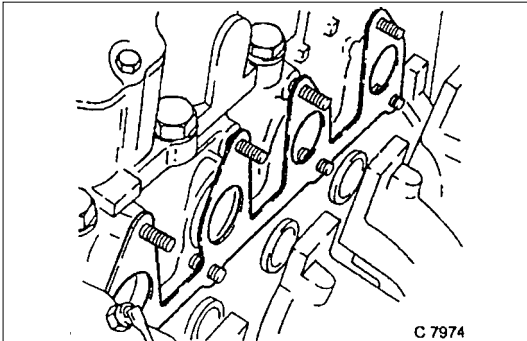
Toothed belt tension - see operation "Toothed Belt Tension".



2. Install the toothed belt to the cover.
3. Install the crankshaft pulley while counterholding on the fastening bolt of toothed belt drive gear.
4. Install the fan shroud.
5. Install the fan belt.
6. Install the V-belt for A/C.
7. Install the V-belt for power steering.
8. Install the fan.
9. Install the belts to the bracket for alternator.

OPERATIONS ON INSTALLED ENGINE

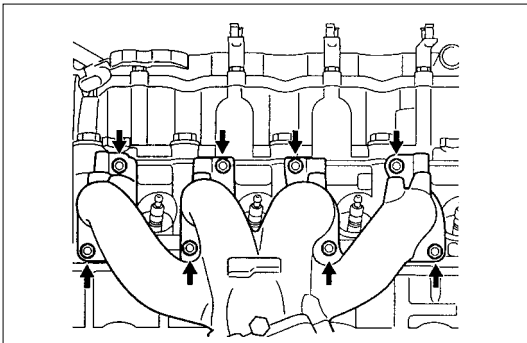
SEALING OPERATIONS



Gasket, Exhaust Manifold, Cylinder Head Removal



1. Remove front exhaust pipe from exhaust manifold.
2. Remove exhaust manifold heat shield.
3. Remove exhaust manifold retaining nut.
4. Remove exhaust manifold from cylinder head.



Clean

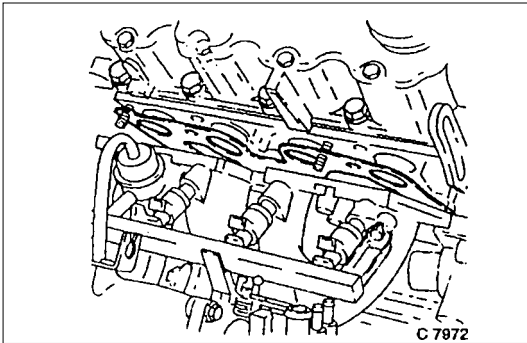
Sealing surfaces.



Tighten (Torque)

Exhaust manifold to cylinder head - 22 N·m (2.2 kgf·m)

Front exhaust pipe to exhaust manifold - 25 N·m (2.6 kgf·m)



Gasket, Intake Manifold, Cylinder Head Removal



1. Remove air intake hose.
2. Remove drive belt for alternator.
3. Remove bolt clamping bracket for alternator from intake manifold.
4. Remove intake manifold from cylinder head.



Clean

Sealing surfaces



Tighten (Torque)

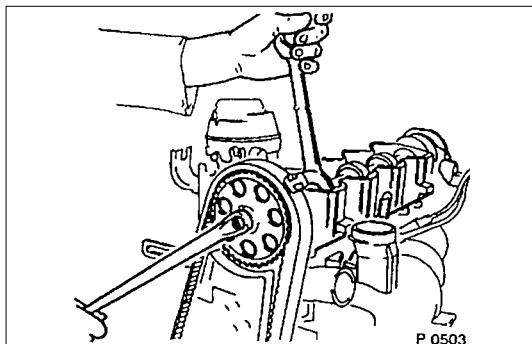
Intake manifold to cylinder head - 22 N·m (2.2 kgf·m)

Clamping bracket for alternator to intake manifold - 25 N·m (2.5 kgf·m)



Installation

1. Install V-belt according to the corresponding operation.
2. Install air intake hose.

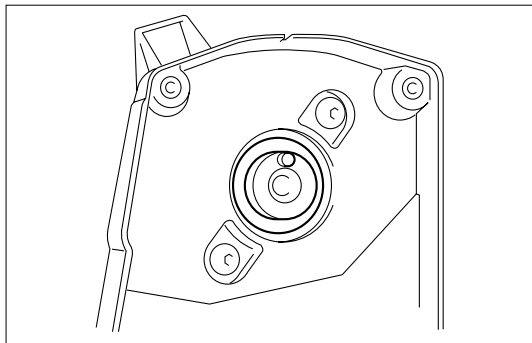


Seal Ring, Camshaft Housing, Timing Side



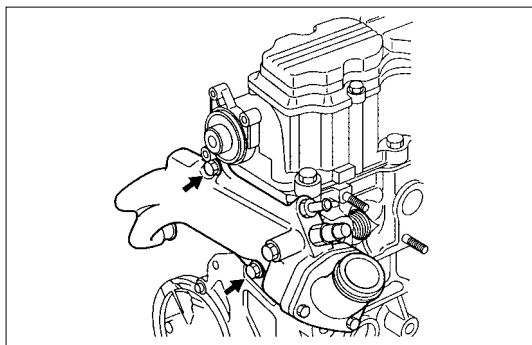
Removal

1. Remove front toothed belt cover toothed belt from camshaft timing gear according to the corresponding operation.
2. Remove camshaft housing cover and camshaft timing gear.
3. Remove sealing ring by making hole in middle of ring, turning in self-tapping screw and edging out.



Installation

1. Install sealing ring by using 5-8840-0451-0 with camshaft sprocket bolt and washer.
2. Install coat seal lips of shaft seal ring slightly.



Seal Ring, Thermostat Housing, Cylinder Head



Removal

1. Open radiator drain tap and collect coolant.
2. Remove toothed belt rear cover and toothed belt according to the corresponding operation.
3. Remove camshaft housing cover.
4. Remove camshaft timing gear by counterholding camshaft with a flat spanner.
5. Remove cable from temperature sensor.
6. Remove upper inner hex bolts of rear toothed belt cover.
7. Turn rear toothed belt cover to one side.
8. Remove thermostat housing.
9. Remove sealing ring from cylinder head.



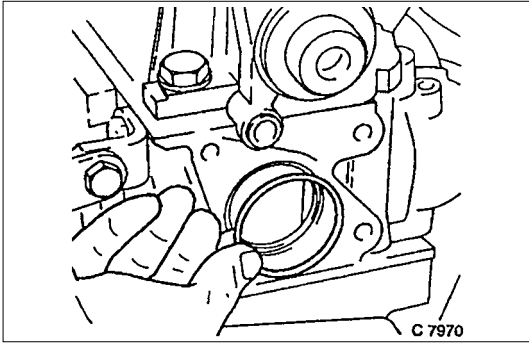
Clean

Sealing surfaces in cylinder head and thermostat housing.

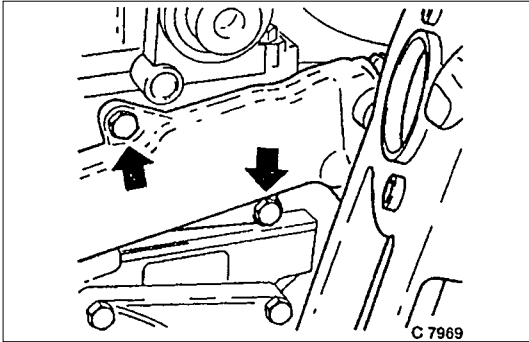


Installation

1. Install sealing ring in recess of cylinder head.

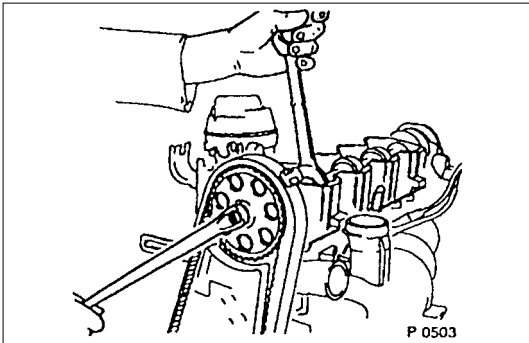


2. Install cable to temperature sensor.
3. Install upper bolts of rear toothed belt rear cover.
4. Install camshaft timing gear then check timing according to the corresponding operation.
5. Install camshaft housing cover.
6. Install toothed belt and front cover.
7. Fill up and bleed cooling system according to the corresponding operation.



Tighten (Torque)

Thermostat housing to cylinder head - 15 N·m/1.5 kgf·m.

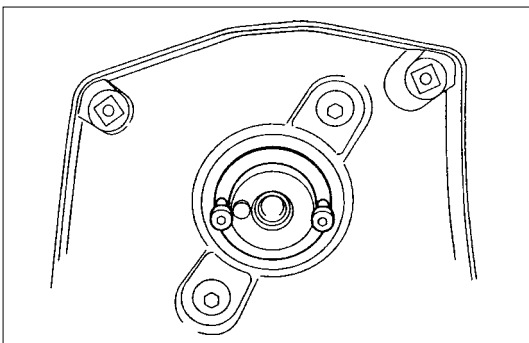


Seal Ring - Front Camshaft Housing, Replace Removal

Mark running direction of toothed belt.

Remove toothed belt-see operation "Toothed Belt, Replace".

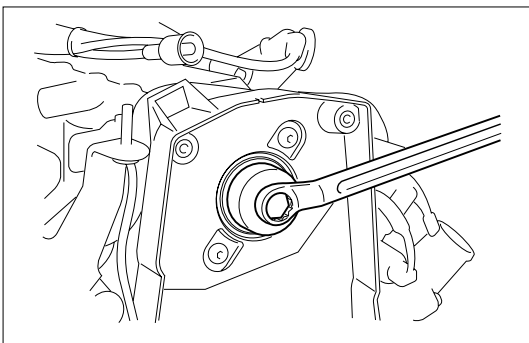
Camshaft housing cover, camshaft pulley-counterhold on hex of camshaft.



Removal

Screw self-tapping screw into seal ring.

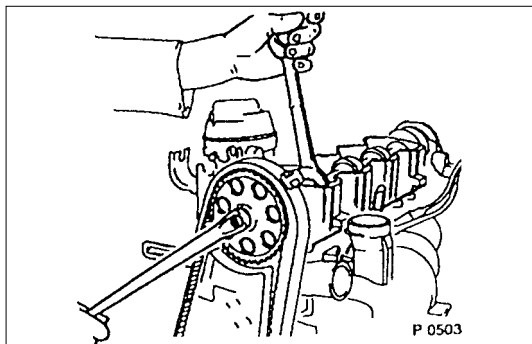
Edge out seal ring.



Installation

Lightly coat sealing lip of seal ring with protective grease.

Install seal ring with 5-8840-0451-0 into camshaft housing-use screw and washer of camshaft pulley.



Installation

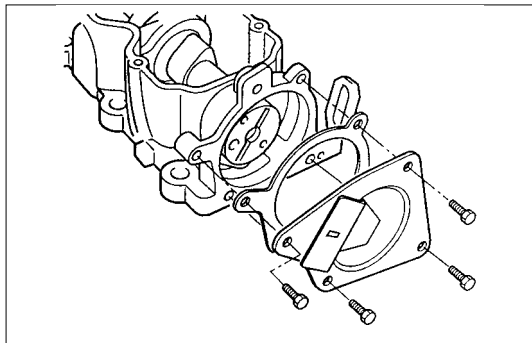
Camshaft pulley-counterhold at hex head of camshaft, camshaft housing cover.

Toothed belt-see operation "Toothed Belt, Replace".
Note operating erection of toothed belt.



Tighten (Torque)

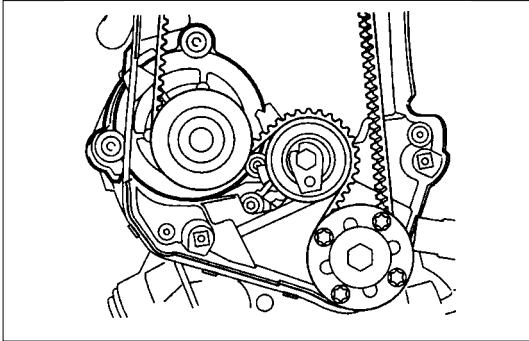
Camshaft pulley to camshaft-45 N·m (3.7 kgf·m)



Tighten (Torque)

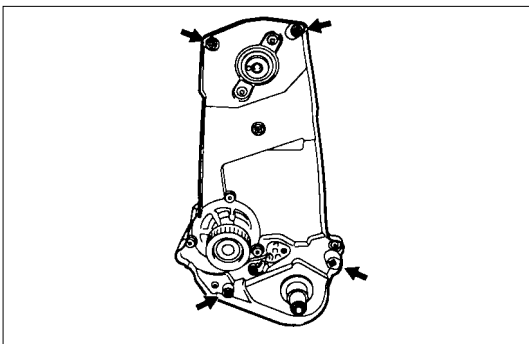
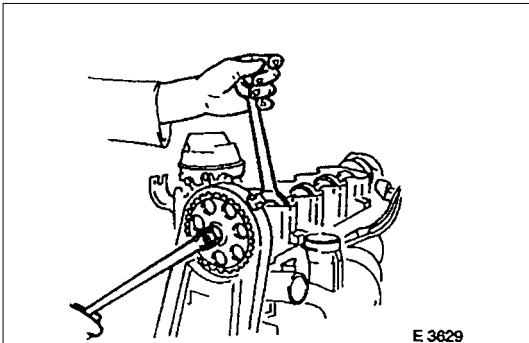
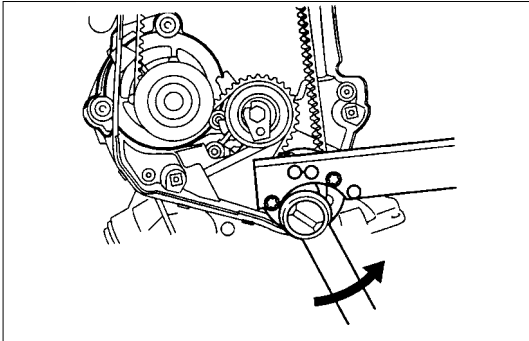
Camshaft housing cover to cover to housing-8 N·m (0.8 kgf·m)

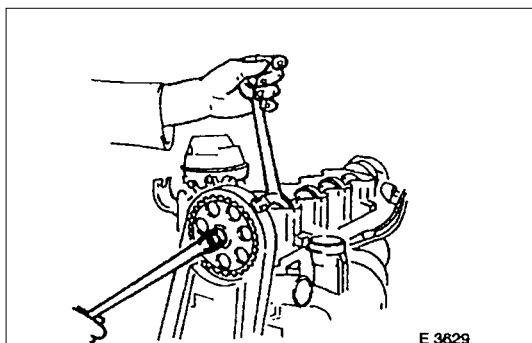
Toothed Belt Rear Cover (Engine with toothed belt tension roller)



Removal

1. Mark operating direction of toothed belt.
2. Remove toothed belt according to the operation "Toothed Belt".
3. Remove toothed belt tension roller according to the operation "Toothed Belt Tension Roller".
4. Remove fastening bolt while counterholding with 5-8840-2598-0 (Holding wrench).
5. Remove toothed belt drive gear while counterholding with 5-8840-2598-0 (Holding wrench).
6. Remove camshaft housing cover.
7. Remove camshaft pulley while counterholding at hex head of camshaft.
8. Remove toothed belt rear cover (arrows) from oil pump and camshaft housing.





Installation

1. Install toothed belt rear cover.
2. Install camshaft pulley while counterholding at camshaft hex head.
3. Install camshaft housing cover.

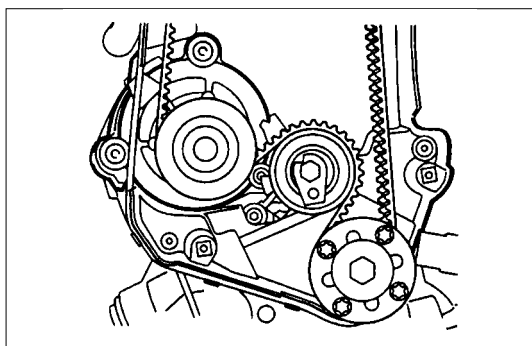


Tighten (Torque)

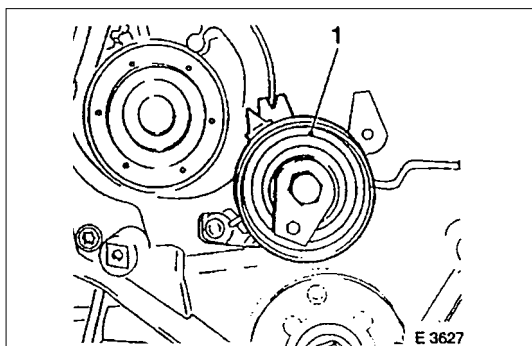
Toothed belt rear cover to oil pump and camshaft housing - 6 N·m/4 lbf ft.

Camshaft housing cover to housing - 6 N·m (0.6 kgf·m).

Camshaft pulley to camshaft - 45 N·m (4.6 kgf·m).



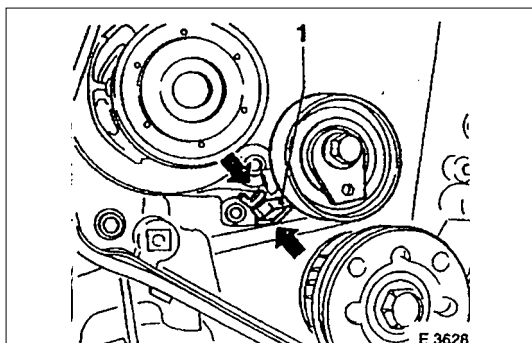
4. Install toothed belt drive gear to crankshaft - 130 N·m (13.3 kgf·m).
5. Install toothed belt according to the operation "Toothed Belt".



Toothed Belt Tension Roller

Removal

1. Mark operating direction of toothed belt.
2. Remove toothed belt according to the operation "Toothed Belt".
3. Remove toothed belt tension roller (1) from oil pump.



Installation

1. Install toothed belt tension roller and make sure that the locking lever (1) engages in the guide lugs (arrowed) on the oil pump housing.
2. Install toothed belt according to the operation "Toothed Belt" with paying attention to the operating direction of toothed belt.

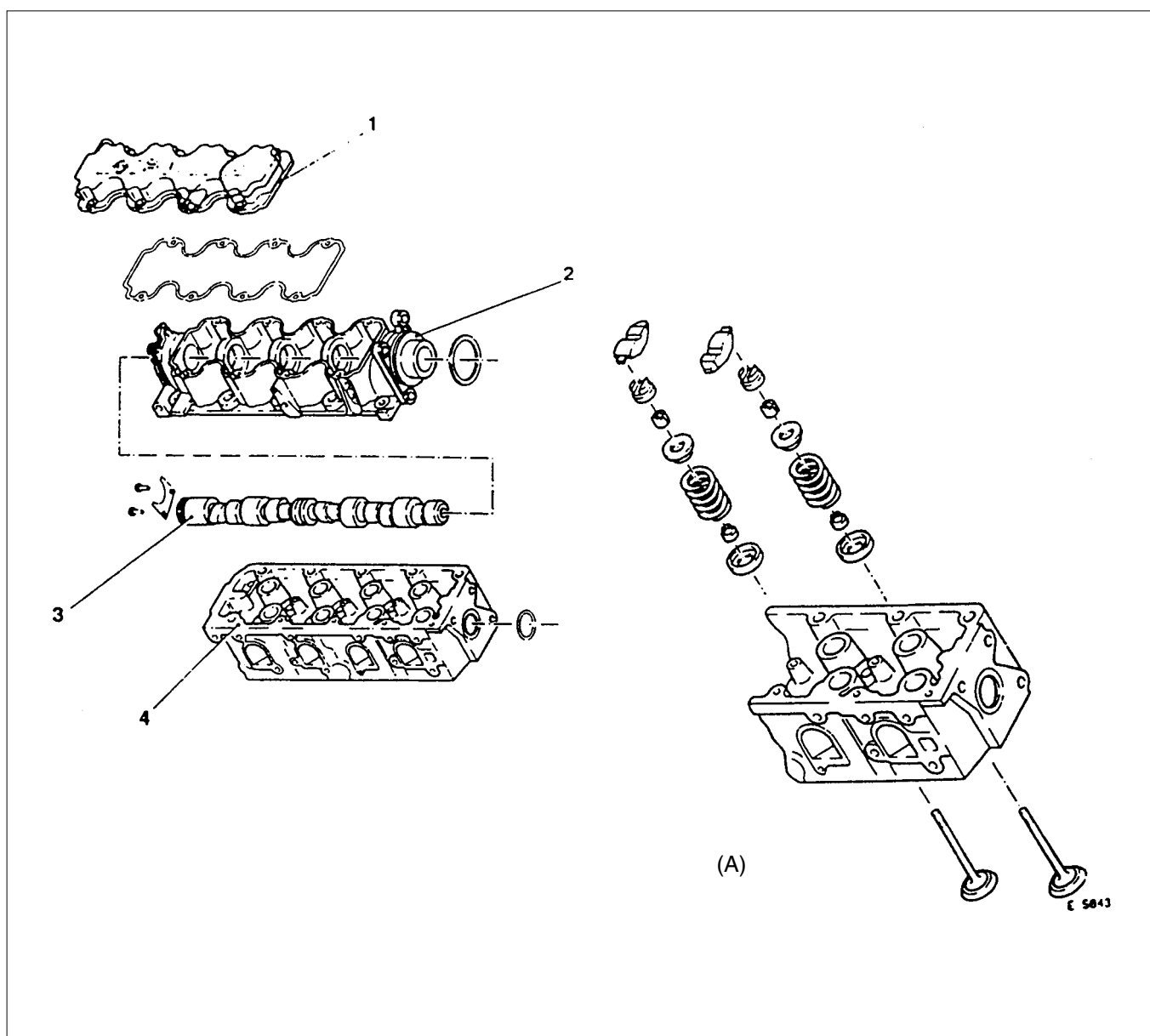


Tighten (Torque)

Toothed belt tension roller to oil pump - 25 N·m (2.5 kgf·m)

COMPONENT PARTS

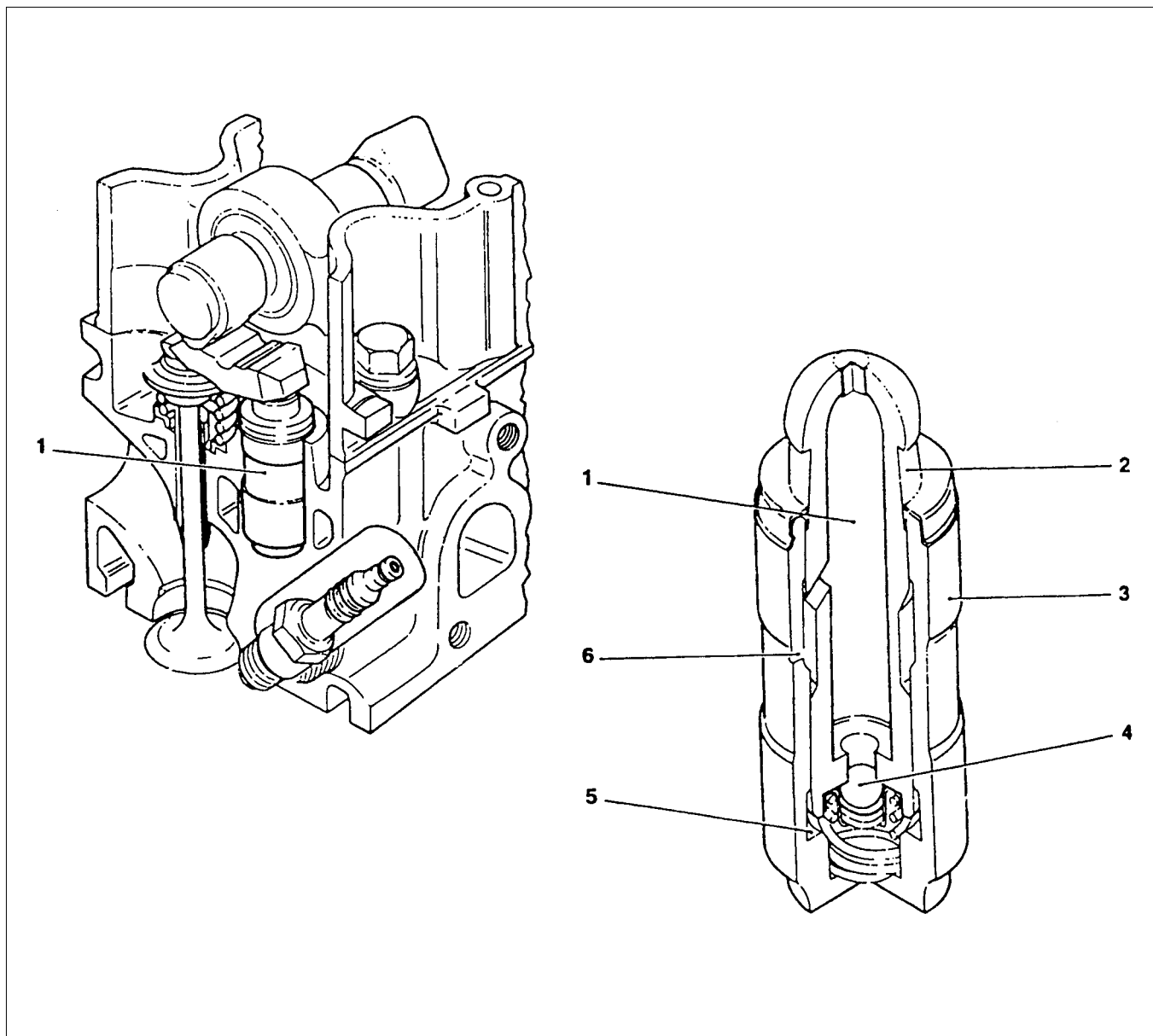
CYLINDER HEAD



1. Camshaft Housing Cover
2. Camshaft Housing
3. Camshaft
4. Cylinder Head

(A) Valve Drive

HYDRAULIC VALVE LIFTER

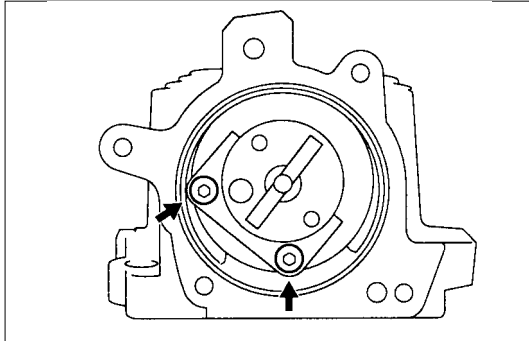


1. Hydraulic Valve Lifter

- 1. Oil reservoir
- 2. Piston with ball head (moving)
- 3. Pressure cylinder (fixed)
- 4. Check ball
- 5. Pressure chamber
- 6. Oil feed

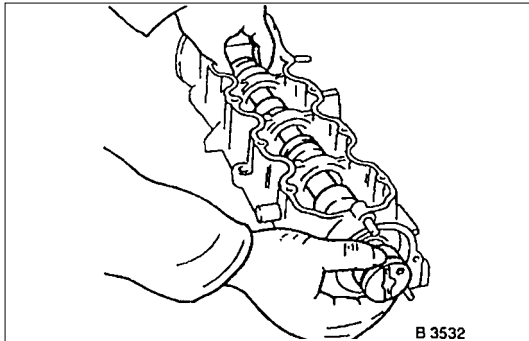
OPERATIONS ON CYLINDER HEAD AND CAMSHAFT HOUSING

Camshaft



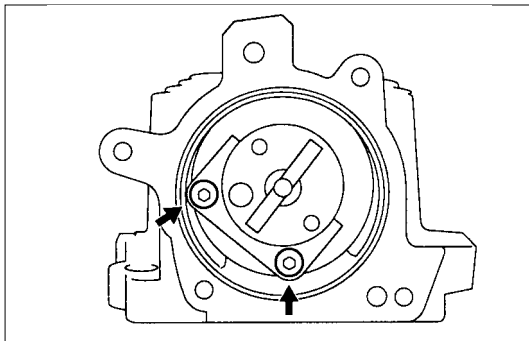
Removal

1. Remove cylinder head according to the corresponding operation.
2. Remove camshaft housing from cylinder head and lay housing on base provided
3. Remove rear sealing gasket and plate camshaft housing with taking care not to damage housing.
4. Remove thrust plate.
5. Remove camshaft.
6. Remove front sealing gasket and plate from camshaft housing with taking care not to damage housing.



Inspection

All parts.



Installation

1. Install camshaft.
2. Coat sliding surfaces with molybdenum disulphate paste.



Tighten (Torque)

Thrust plate for camshaft housing - 8 N·m (0.8 kgf·m)

Camshaft Housing, Removal and Installation

See operation Camshaft

Cylinder Head



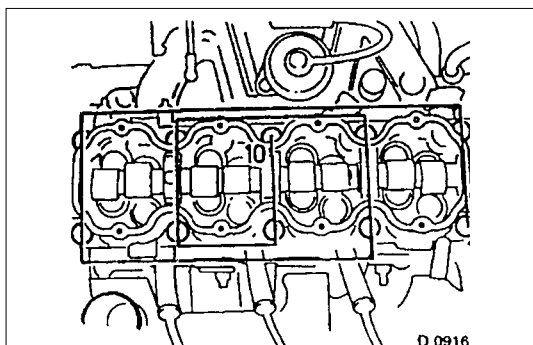
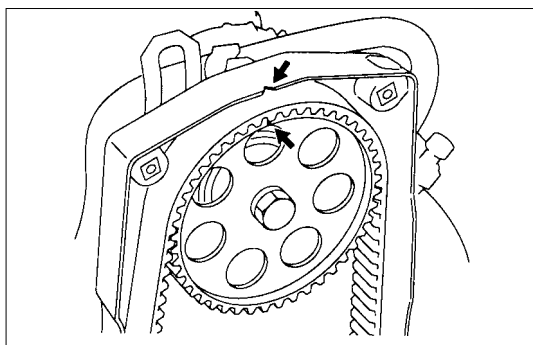
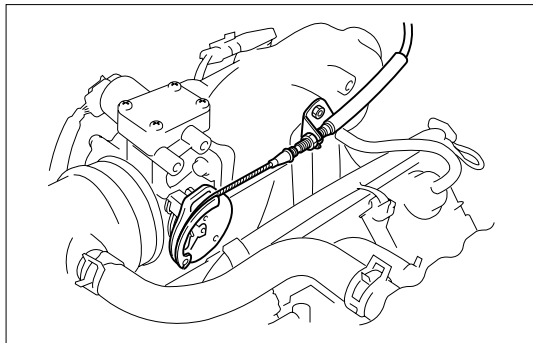
Important!

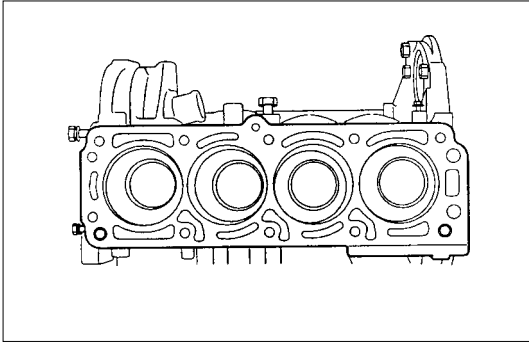
Remove cylinder head only from cold engine (room temperature).



Removal

1. Remove ground cable from battery.
2. Open radiator drain tap and collect coolant.
3. Remove air intake hose.
4. Remove all cable connections, hoses and lines to the cylinder head.
5. Remove accelerator cable on the throttle valve.
6. Remove V-belt for alternator.
7. Remove front toothed belt cover according to the corresponding operation.
8. Bring piston of 1st cylinder to TDC and mark the position.
9. Remove camshaft housing cover.
10. Remove camshaft timing gear after releasing tension on toothed belt.
11. Remove upper bolts of rear toothed belt cover.
12. Remove exhaust pipe from exhaust manifold.
13. Remove cylinder head after loosening bolts from outside inwards (at first quarter turn then half turn) in a spiral pattern.
14. Remove camshaft housing from cylinder head.
15. Remove rocker arm, pressure parts and hydraulic valve lifter adjuster.





Clean

All sealing surfaces, drill holes in cylinder head bolts.

Check cylinder block and cylinder head for plane surface according to the corresponding operations.



Installation

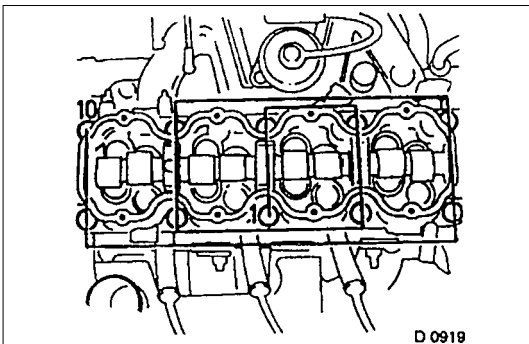
1. Install cylinder head sealing with marking "OBEN/TOP" facing upwards and to right side of engine.
2. Install cylinder head on cylinder block.
3. Install hydraulic valve lash adjuster, pressure parts and rocker arm - molybdenum disulphate paste.
4. Install camshaft housing-Sealing Compound TB-1207C or equivalent.



Important!

Use new cylinder head bolts.

Screw in bolts until they rest on cover.

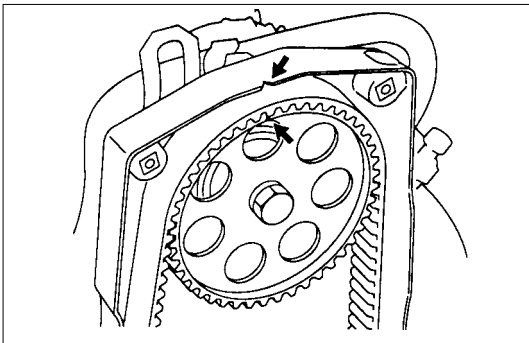


Torque - Angle Method

Cylinder head to cylinder block - 25 N·m (2.5 kgf·m)

Further turn angle $90^\circ + 90^\circ + 90^\circ$.

Tighten cylinder head bolts from inside outwards. In four stages in a spiral pattern.



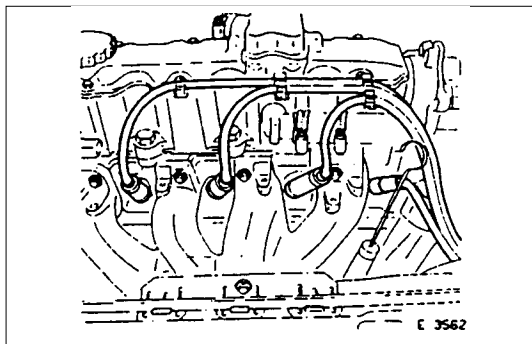
5. Install rear toothed belt cover onto camshaft housing.
6. Install toothed belt and apply tension according to the corresponding operation.



Tighten (Torque)

Camshaft timing gear to camshaft - 45 N·m (4.6 kgf·m)

7. Install camshaft housing cover and front toothed belt cover.
8. Install cable connections, all hoses and lines onto cylinder head.
9. Adjust accelerator cable for free of play.
10. Install V-belt according to the corresponding operation.
11. Install air intake hose.
12. Install front exhaust pipe.
13. Install ground cable onto battery.
14. Fill up cooling system and bleed according to the corresponding operation.

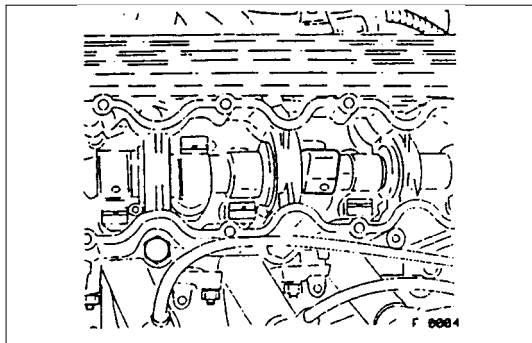


Hydraulic Valve Lifters, Replace



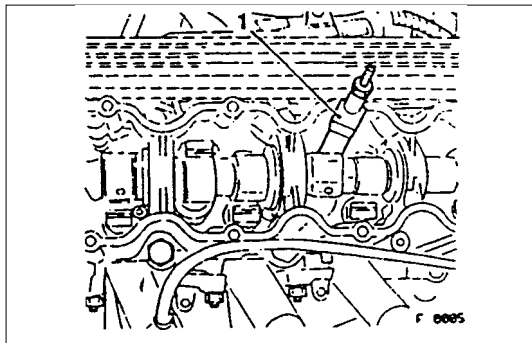
Removal

1. Remove the spark plug connectors and spark plugs.
2. Remove the camshaft housing cover.



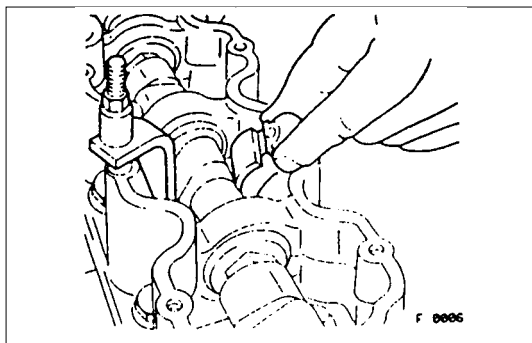
Removal

3. Turn the crankshaft at fastening bolt of toothed belt drive gear in the direction of the engine rotation until the cam of hydraulic valve lifter being replaced stands vertically.



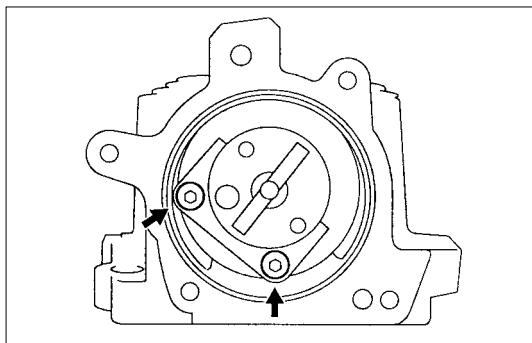
Removal

4. Apply 5-8840-0457-0 to the camshaft housing, valve spring cap and tension valve spring.



Removal

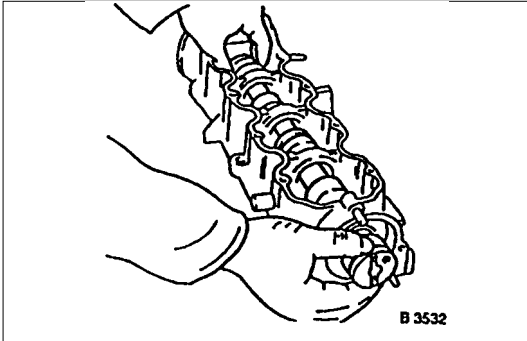
5. Remove the cam follower from camshaft housing.
Note thrust pieces.
6. Remove hydraulic valve lifter from camshaft housing.



Camshaft Housing, Replace

Removal

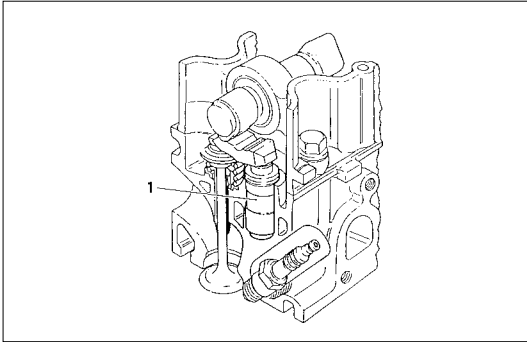
Cylinder head-see operation "Cylinder Head. Remove and Install".



Inspection

All parts, if necessary replace.

When replacing camshaft, always replace all cam followers.



Installation

Insert hydraulic valve lifter (1) in camshaft housing.

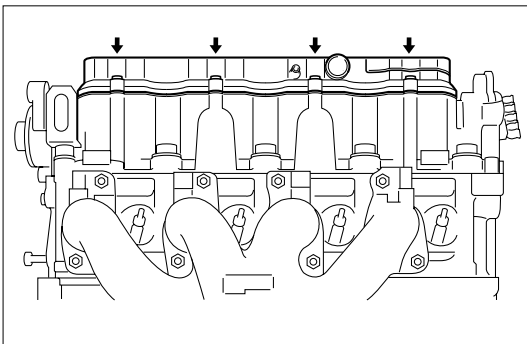
Coat sliding surfaces of rocker arm with Mcs, Paste and insert in camshaft housing.



Adjust

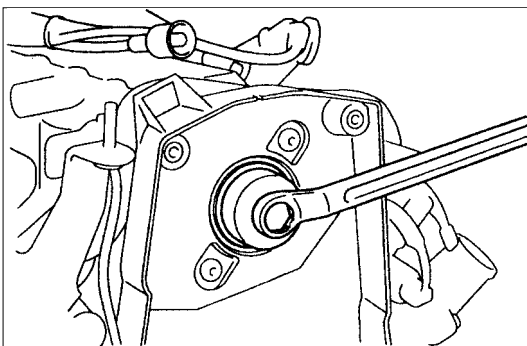
Adjustment of the hydraulic valve lifters is not required.

Pretension is provided by the design.



Installation

1. Remove 5-8840-0457-0 and install the camshaft housing cover.
2. Insert the spark plug connectors.



Tighten (Torque)

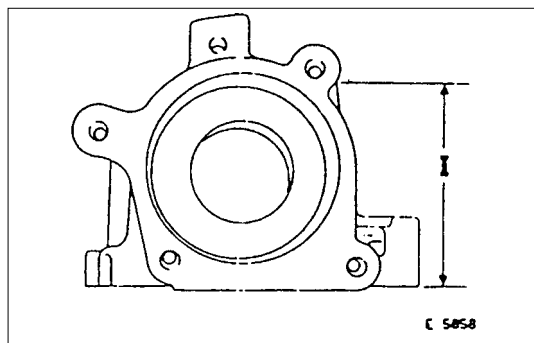
Guide plate to camshaft housing.

Insert camshaft with MoS₂ paste.



Installation

1. Install the front seal ring in camshaft housing with 5-8840-0451-0.
2. Install the camshaft housing rear cover.
3. Install the cylinder head.



Camshaft Housing, Check for Plane Surface Clean

Sealing surfaces.



Inspection

Check length and width of sealing surface for deformation and diagnosis for warpage and use straight edge feeler gauge.



Measure

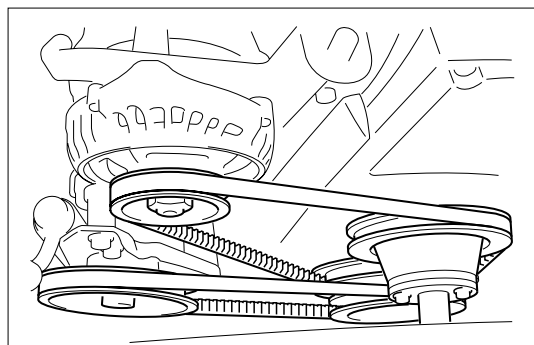
Height of camshaft housing (sealing surface to sealing surface).

Dimension I: (74.0 mm)



Cylinder Head, Removal and Installation Important

Only remove cylinder head with engine cold (room temperature).



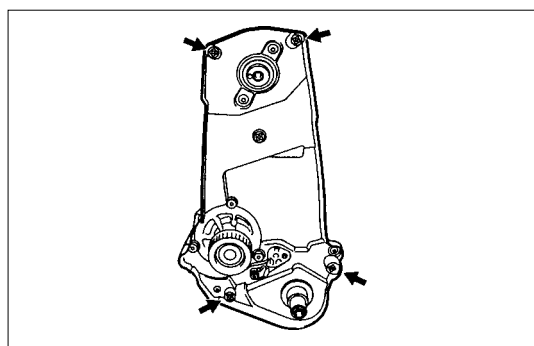
Removal

1. Remove the alternator, power steering and V-belts.



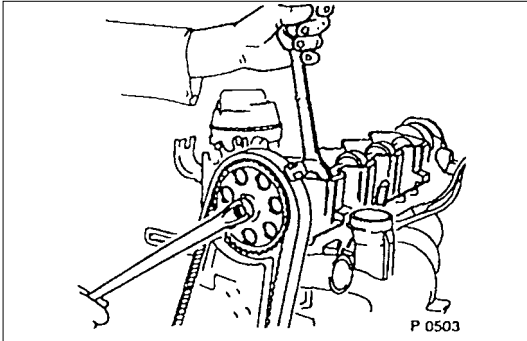
Removal

2. Loosen the fastening bolts from alternator.
3. Loosen the lower alternator fastening bolt by swinging the alternator to the rear.



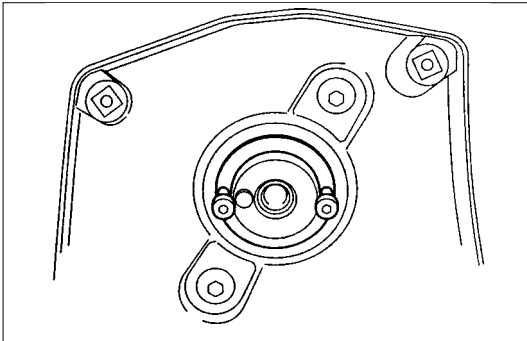
Removal

4. Remove the front toothed belt cover.
5. Remove the toothed belt from camshaft pulley.
See operation "Timing Check and Adjust".



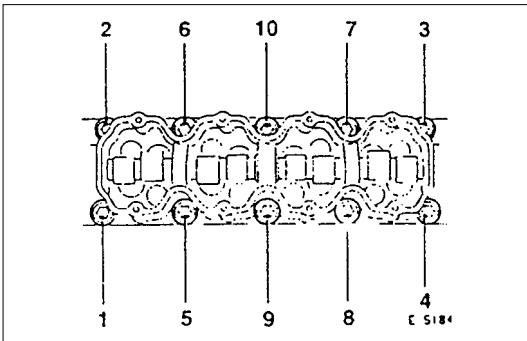
Removal

6. Remove the camshaft housing cover and camshaft pulley by counter-holding at the hex head of camshaft.



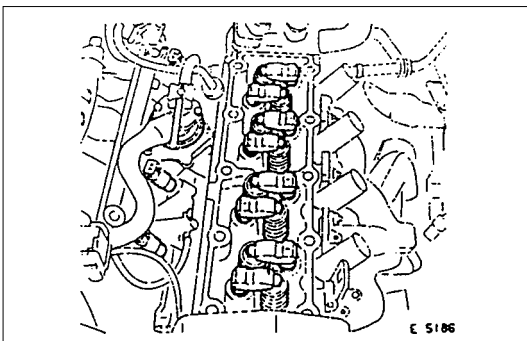
Removal

7. Remove the fastening bolts from camshaft housing.



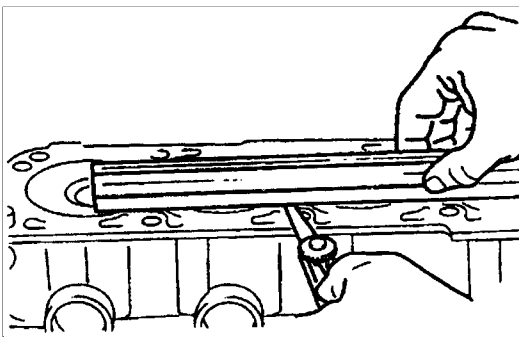
Removal

8. Remove the exhaust pipe from exhaust manifold.
9. Loosen the cylinder head bolts spirally from the outside inwards (first 1/4, then 1/2 revolution).



Removal

1. Remove the camshaft housing from cylinder head.
2. Remove the cam followers, thrust pieces and hydraulic valve lifters.
Note the allocation.
3. Remove the cylinder head.



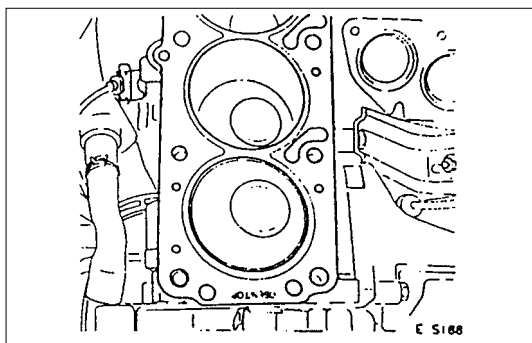
Clean

Sealing surfaces, bores and threads of cylinder head bolts.



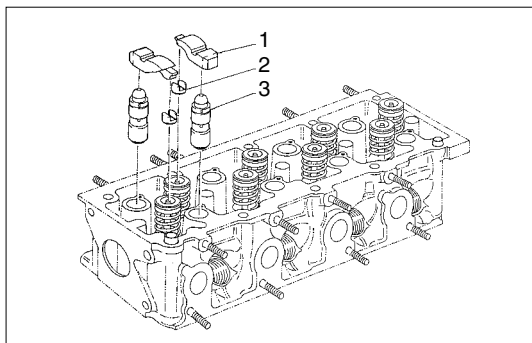
Inspection

Check cylinder head and cylinder block for plane surface-see operations "Cylinder Head, Check for Plane Surface" and "Cylinder Block, Check for Plane Surface."



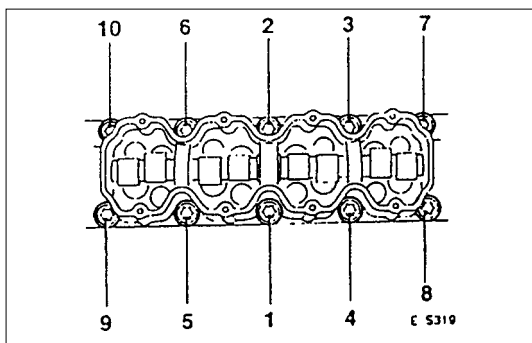
Installation

1. Install the cylinder head gasket.
Mark "OBEN/TOP" on top and turn it towards timing side of engine.
2. Place cylinder head on cylinder block.



Installation

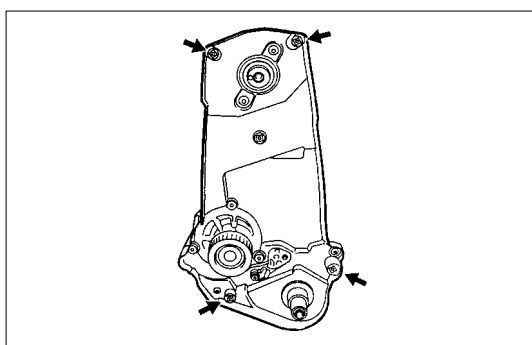
1. Insert the hydraulic valve lifters (3), thrust pieces (2) and cam followers (1) with MoS2 paste.
Note allocation.
2. Apply a bead of Sealing Compound TB1207C to sealing surface of cylinder head.
3. Install the camshaft housing on cylinder head.



Torque-Angle Method

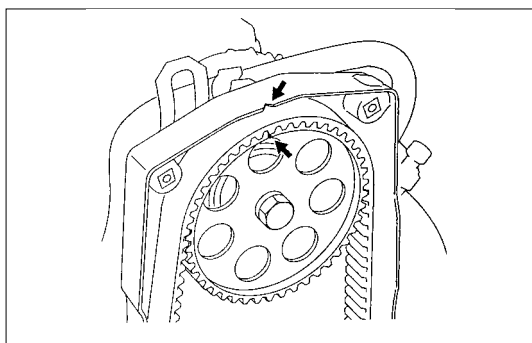
Cylinder head and camshaft housing with new cylinder head bolts to cylinder block.

Cylinder head bolts in sequence shown.



Installation

1. Install the rear toothed belt cover to camshaft housing.
2. Install the camshaft pulley to camshaft.
3. Install the camshaft housing cover to housing.



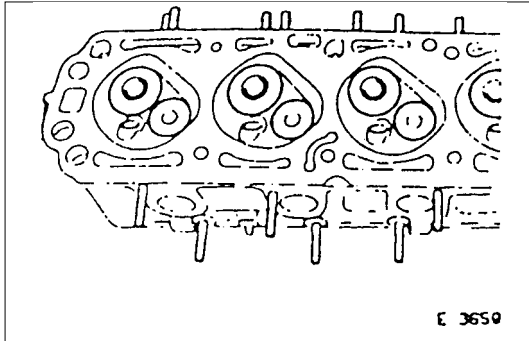
Installation

1. Install the toothed belt on camshaft pulley.
See operation "Timing Adjust".
2. Install the front toothed belt cover.



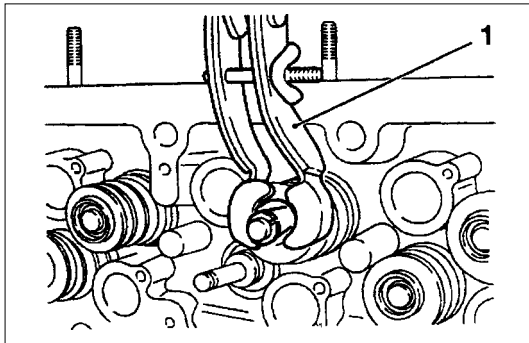
Installation

1. Install the fastening bolts.
2. Loosen the lower alternator fastening bolt.
3. Install the alternator, power steering and V-belts.



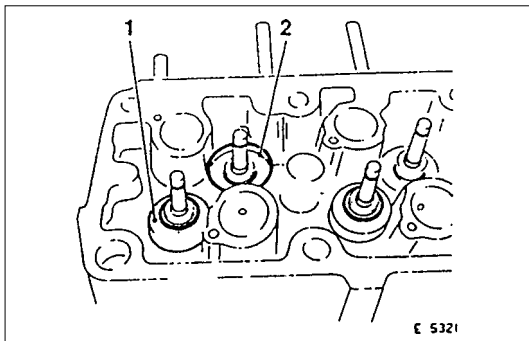
Cylinder Head, Disassemble and Assemble Removal

1. Remove the hydraulic valve lifters.
Lay aside in installation positions.
2. Remove the spark plugs, exhaust manifold and intake manifold from cylinder head.



Removal

1. Mark valves.
2. Remove the tension valve springs with 5-8840-2594-0 (1).
3. Remove valve keepers, valve spring cap and valve spring.



Removal

1. Remove the valve and valve stem seal.
2. Remove the valve spacer ring (1-exhaust) and valve spring seat (2-intake).
3. Remove valve from cylinder head.



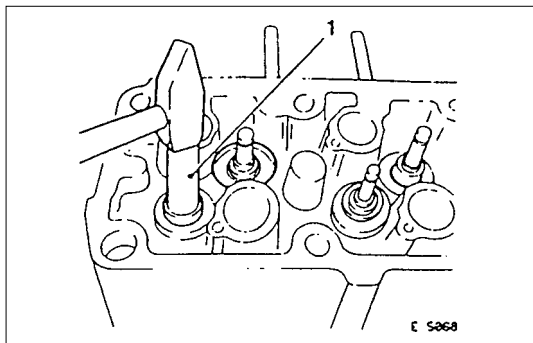
Clean

Sealing surfaces.



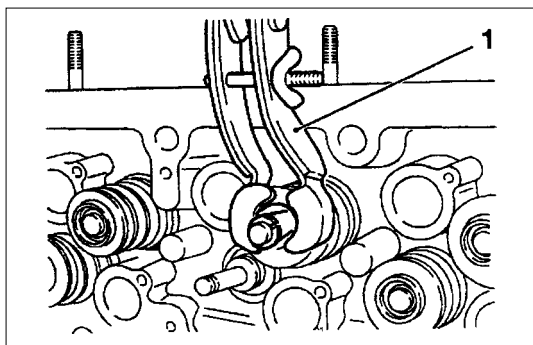
Inspection

Sealing surfaces for plane surface, guides, sliding and bearing points for wear-see operation "Cylinder Head. Overhaul".



Installation

1. Coat the valves with engine oil and insert in cylinder head.
2. Install the valve spacer ring or valve rotator(exhaust) and valve spring seal(intake).
3. Push the accompanying assembly sleeve onto valve stem and coat with engine oil.
4. Insert a new valve stem seal with 5-8840-2601-0 (1).
5. Drive the valve stem seal carefully in to stop with light hammer blow.



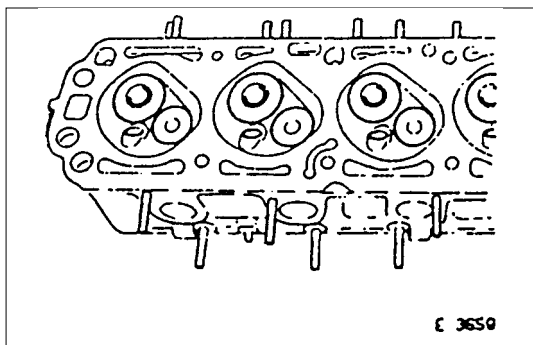
Installation

1. Install the valve springs and valve spring caps.
2. Install the tension valve springs with 5-8840-2594-0 (1), valve keeper.



Important!

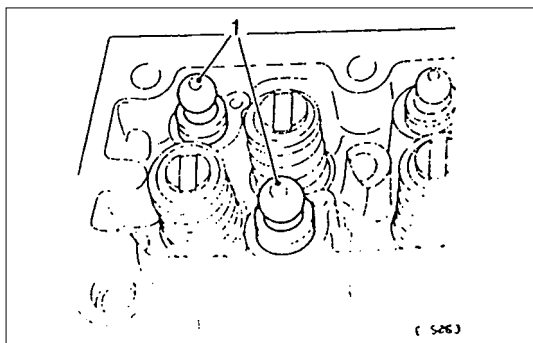
Note markings made on valves.



Tighten (Torque)

Exhaust manifold and intake manifold with new gaskets to cylinder head.

Thermostat housing with new seal ring to cylinder head:



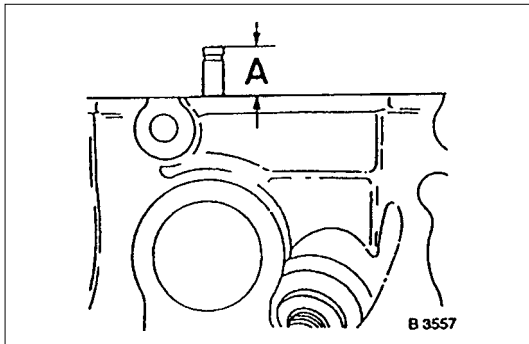
Tighten (Torque)

Spark plugs with spark plug wrench to cylinder head.



Installation

1. Coat hydraulic valves lifters (1) with oil.
2. Insert them in cylinder head.
Note installation position.



Valve, Grind

Valves can be reused once or twice after regrinding-only if there are no crater-like burns on the valve cone. Excessive grinding can cause the upper valve head edge to become too thin.

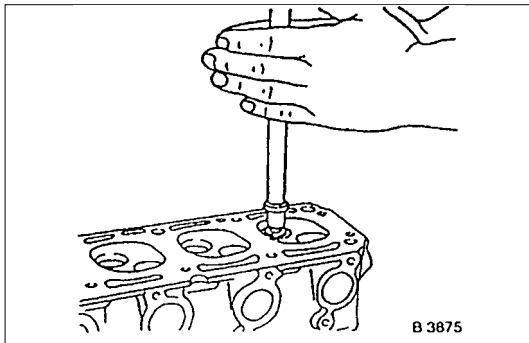


Important!

Valve stem protection must not exceed dimension "A"-use 5-8840-2596-0.

Do not regrind valve stem ends.

For all valve reworking note that angle of valve head is 44° and the valve seat 45°-see also "Technical Data".



Valve, Grind In

Grind-In the valve to improve valve seating.

Grind-In by rhythmically lifting valves and turning uniformly.

Use commercially available grinding tool.



Important!

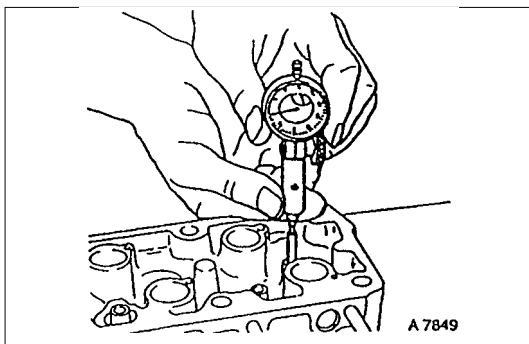
Use only fine-grained pastes for grinding.

Lubricate valve stem before grinding in.



Clean

After grinding, carefully clean valve and valve seat.



Valve Guide, Ream



Measure

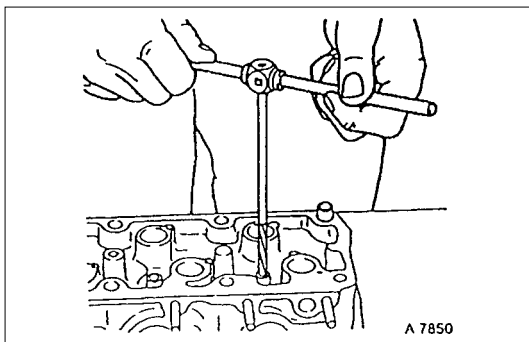
Diameter of valve guide-dial gauge and internal measuring instrument.



Important!

Valve oversizes are available ex-works.

Oversize identification, on the valve guide and on the valve stem end with the following specified identification figures/letters-see also "Technical Data".

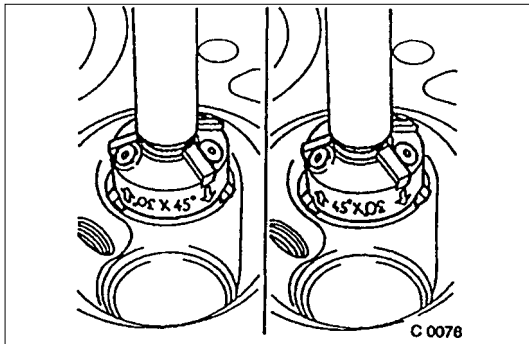


Identification Mark

Size	Production	Customer Service	Reamer
Normal	none	K	
0.075 mm	1	K1	
0.150mm	2	K2	

Ream valve guide from the upper side of the cylinder head to the next oversize (use 5-8840-2599-0).

After reaming, cross out identification mark and stamp in new identification mark.



Valve Seating, Mill

Place cylinder head on block of wood.

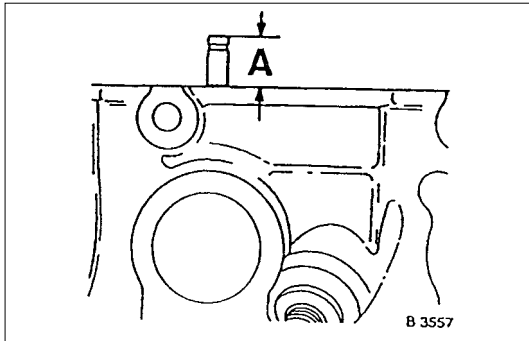
Inlet and exhaust, Guide Drift and Valve Seat Cutter 5-8840-2593-0.

Valve seat-45°, side face, upper correction-30°, side face (arrows on cutter).

Valve seat width:

Inlet-1.0 to 1.5 mm/0.04 to 0.06 in.

Exhaust-1.7 to 2.2 mm/0.072 to 0.088 in.



Inspection

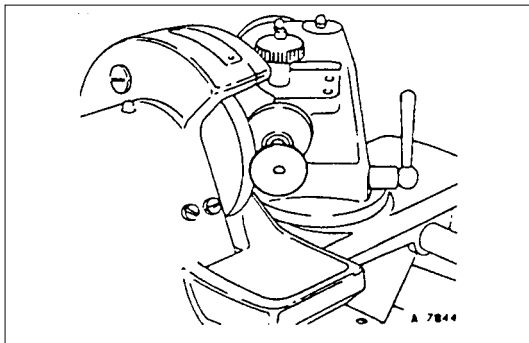
Valve stem projection-use 5-8840-2596-0.



Important!

If dimension "A" is exceeded, use new valves.

Check valve stem projection again. If dimension "A" is exceeded, replace cylinder head.



Cylinder Head, Overhaul

Cylinder head disassembled.



Valve, Grind

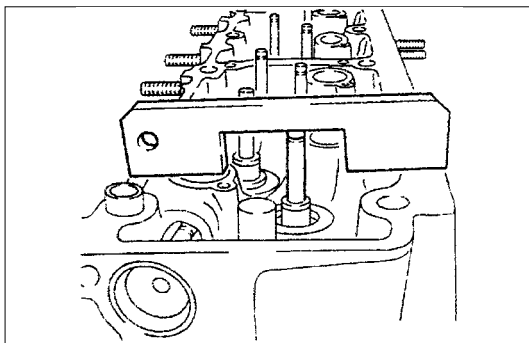
Important!

Ensure that there are no crater-like burns on the valve cone.

Regrinding possible once or twice.

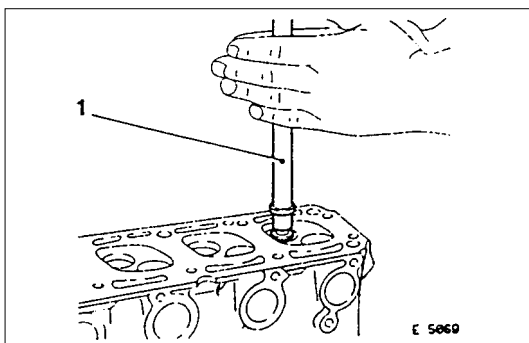
Grinding of valve stem end is not permitted.

Angle at valve head-44°



Inspection

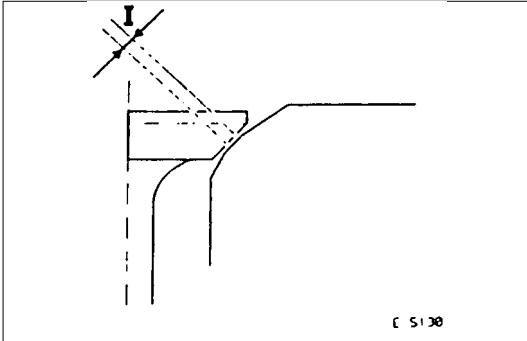
Check valve stem projection as shown 5-8840-2596-0.



Valve, Grind in

Lubricate valve stem, use fine-graining grinding paste.

Lift up valve from seat rhythmically using valve grinding tool (1) for distribution of grinding paste.



Inspection

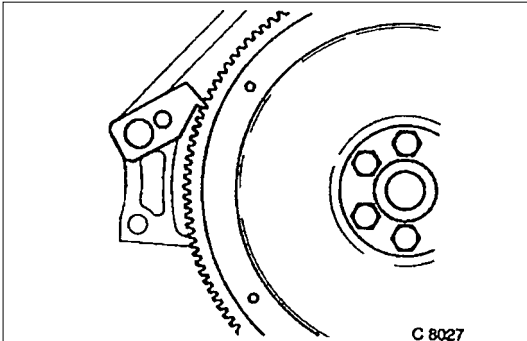
Check contact pattern (I) on valve seat and in cylinder head.



Clean

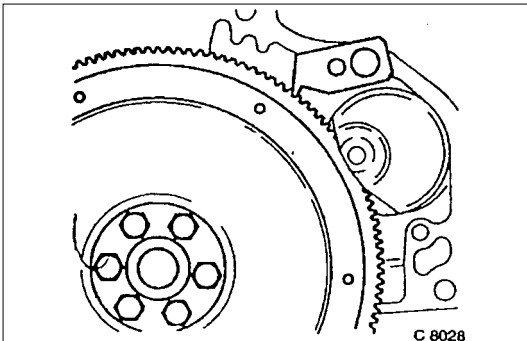
Valves, valve guides, cylinder head.

Flywheel



Removal

1. Remove transmission and clutch.
2. Remove flywheel while locking with 5-88400-446-0.



Torque - Angle Method

Flywheel to crankshaft - 65 Nm/6.5 kgf-m.+30° to 45°



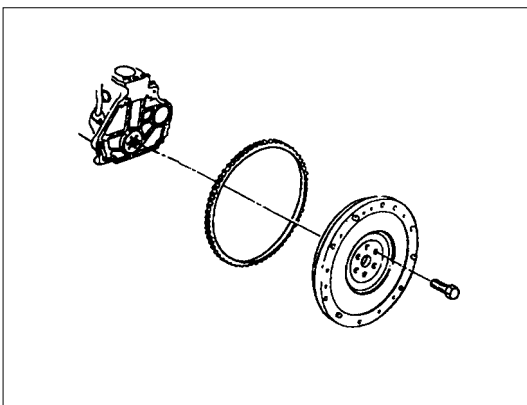
Important!

Use new bolts.
Do not apply grease to the thread.



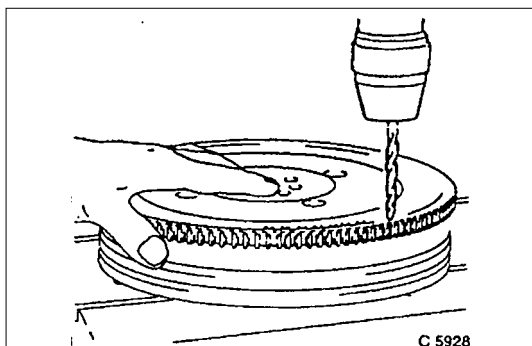
Installation

1. Install clutch and transmission.



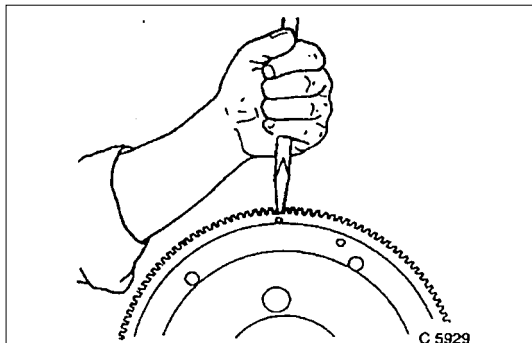
Component Parts

Flywheel and Ring gear. (Manual Transmission)

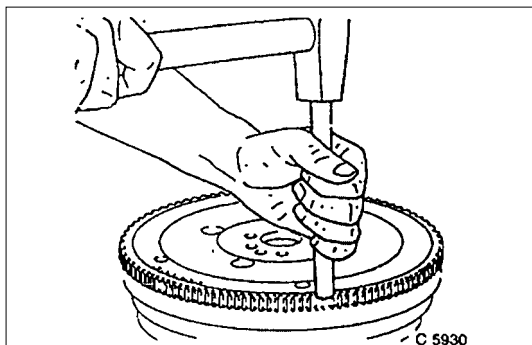


Starter Ring Gear (Manual Transmission) Removal

1. Remove flywheel according to the corresponding operation.
2. Drill starter ring gear underneath tooth gap approx. 8mm/0.30in. deep with 8mm/0.25in. diameter drill.

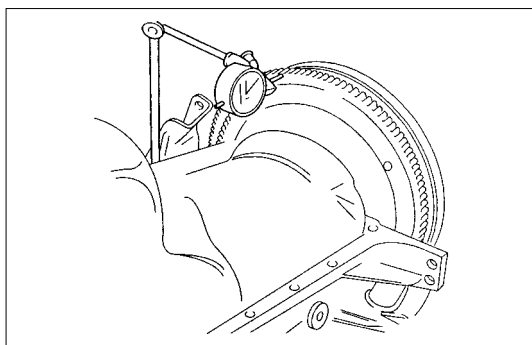


3. Separate starter ring gear with chisel on the drilling point.



Installation

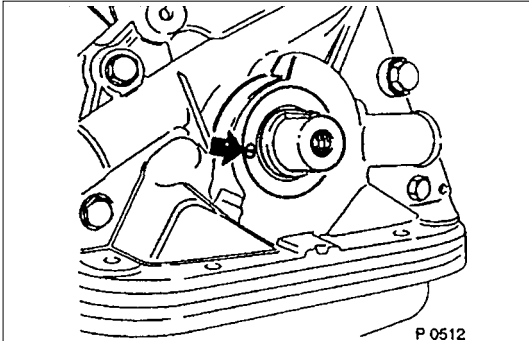
1. Install starter ring gear with inner chamfered edge to flywheel.
2. Heat starter ring gear evenly to 180°C /356°F to 230°C /446°F (yellow paint mark)
3. Install flywheel according to the corresponding operation.



Inspection

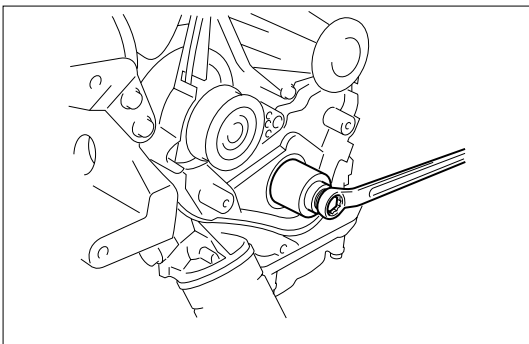
Lateral run-out of starter ring gear - max. 0.5mm/0.02in.

Seal Ring, Crankshaft (Oil Pump Housing)



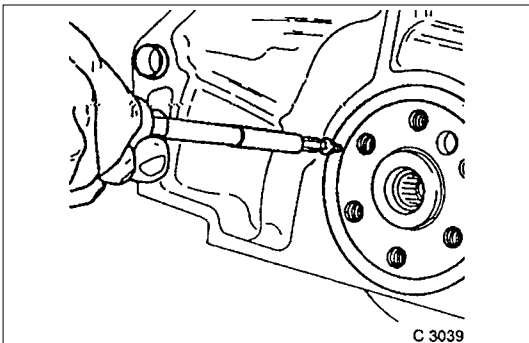
Removal

1. Remove toothed belt rear cover according to the corresponding operation.
2. Remove sealing ring by making hole in middle of ring, turning in self-tapping screw and edging out.



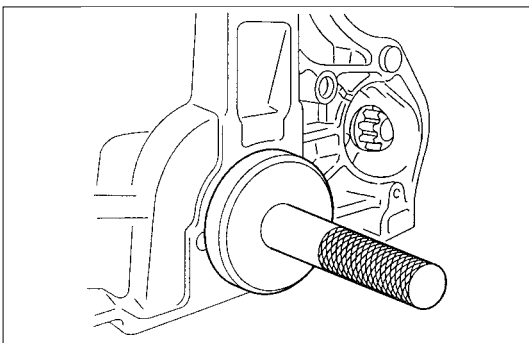
Installation

1. Install the protective sleeve to the crankshaft.
2. Coat the sealing lip with protective grease.
3. Install the sealing ring.
4. Install the sealing ring using 5-8840-0455-0.
5. Install the rear toothed belt cover and toothed belt according to the corresponding operations.
6. Replace the sealing ring with a new one.
7. Tighten the belt to the crankshaft.



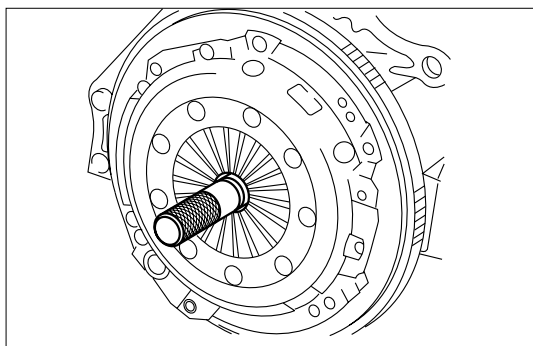
Seal Ring, Crankshaft Rear Removal

1. Remove transmission and clutch.
2. Remove flywheel or flex plate according to the corresponding operations.
3. Make hole in middle of sealing ring, turn in self-tapping screw and edge out.



Installation

1. Install protective sleeve.
2. Coat sealing lip with Protective Grease.
3. Install sealing ring using 5-8840-0459-0 and 5-8840-2597-0.
4. Install flywheel, clutch and transmission.



Reassembly

Reassemble clutch assembly.



Disassembly

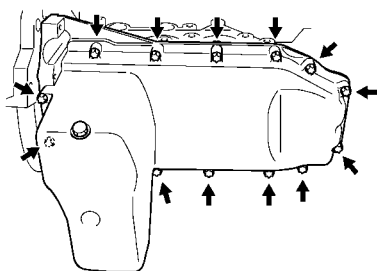
Disassemble clutch assembly to flywheel using 5-8840-2634-0



Torque Angle-Method

Clutch assembly to flywheel-17.6Nm/1.8 kgf·m.

(2.2L & 2.0L Models and 2.4L(4X2) Model)

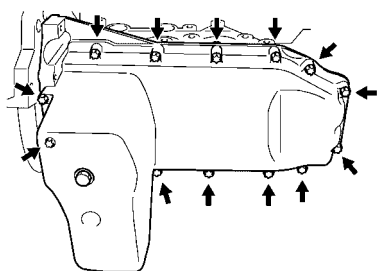


Gasket, Oil Pan

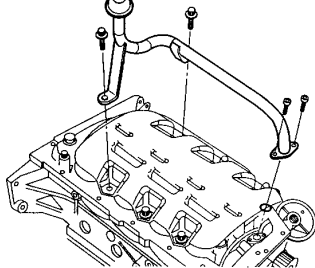
Removal

1. Loosen fixing bolts.
2. Remove oil pan from oil pump and cylinder block.

(2.4L(4X4) Model)



(2.2L & 2.0L Models)



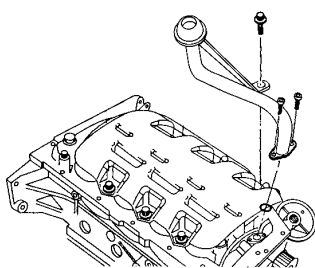
3. Remove oil intake pipe, oil intake pipe bracket, and oil baffle plate.



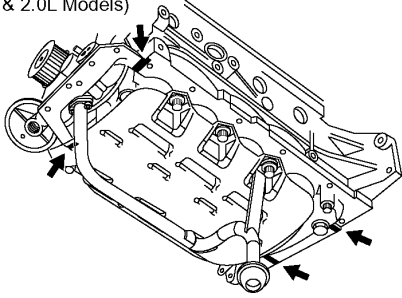
Clean

Sealing surfaces.

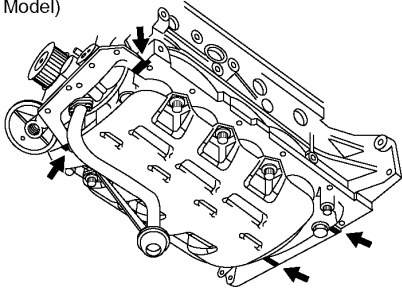
(2.4L Model)



(2.2L & 2.0L Models)



(2.4L Model)



Installation

1. Apply a bead of Sealing Compound, TB120TC or equivalent to joint of oil pump.
2. Install baffle plate, or reuse baffle plate with valcanized gasket.



Caution

Baffle plates with valcanized gasket can be retrofitted without difficulty - replace baffle plate with gasket.

3. Install oil intake pipe to oil pump and oil intake pipe bracket to cylinder block.
4. Install oil pan and new gasket to cylinder block and insert bolts with Locking Compound 15 10 177 (90 167 347). Maximum assembly time including torque check is 10 min.



Tighten (Torque)

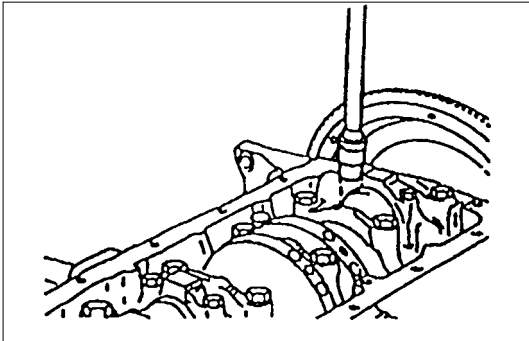
Oil intake pipe to oil pump -8N·m (0.8 kgf·m)

Oil intake pipe bracket to cylinder block - 6 N·m (0.6 kgf·m)

Oil pan to cylinder block - 8 N·m (0.8 kgf·m) with vulcanized gasket - 15 N·m (1.5 kgf·m)

OPERATIONS ON CRANK DRIVE

Con-Rod Bearing



Removal

1. Remove oil pan according to the corresponding operation.
2. Remove con-rod bearing cap and con-rod bearing after marking both sides.



Clean

Con-rod journal, con-rod bearing cap



Installation

1. Install new bearing shafts lightly coated with engine oil.
2. Install con-rod bearing cap.



Torque-Angle Method

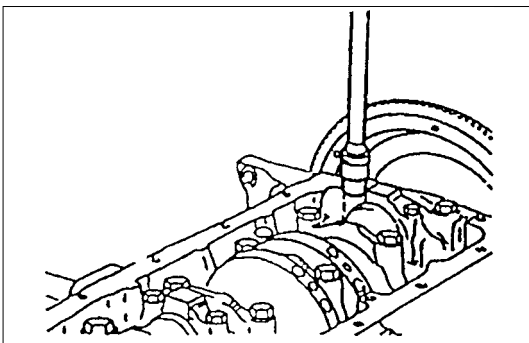
Con-rod bearing cap to con-rod - 35N·m (3.5 kgf·m) +45° to 60°



Important!

Use new bolts.

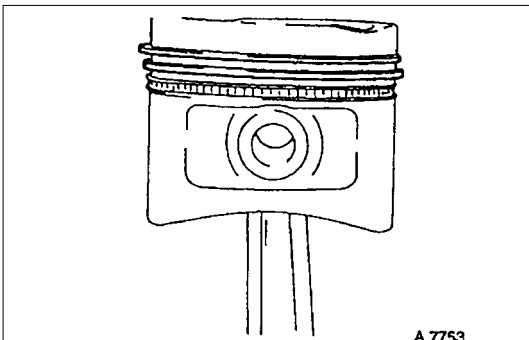
3. Install oil pan according to the corresponding operation.



Piston with Con-Rod

Removal

1. Remove cylinder head and oil pan according to the corresponding operations.
2. Remove piston with con-rod after marking con-rod bearing cap.



Inspection

Remove and install all parts, if applicable.

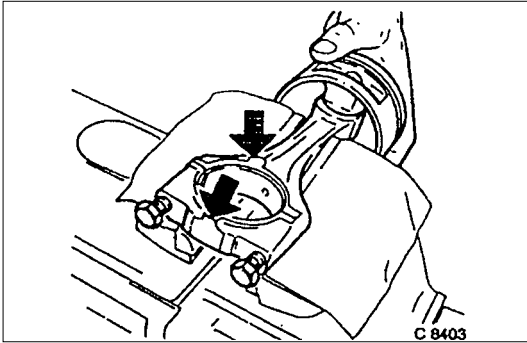


Important!

Ring gap offset:

Piston rings - 180°.

Oil scraper rings - 25 to 50 mm/1 to 2 in. from gap of intermediate ring to the left and to the right.



Installation

1. Install piston with con-rod by inserting with engine oil.
2. Coat piston rings with engine oil and compress with piston ring compressor.

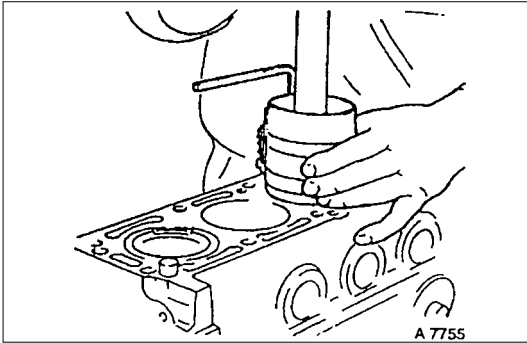


Important!

Installation position:

Arrow / notch on piston head on timing side of engine

Beads on con-rod on clutch side



Torque-Angle Method

Piston to cylinder block.

Con-rod bearing cap to con-rod-35N·m (3.5 kgf·m) +45° to 60°



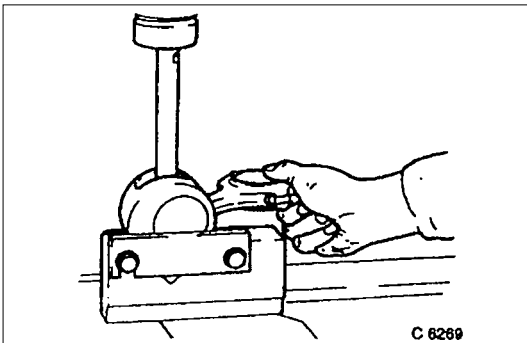
Important!

Use new bolts.



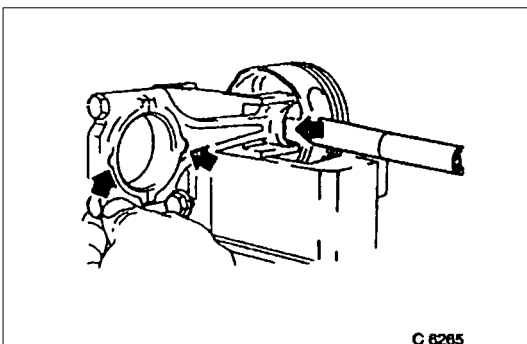
Installation

1. Install oil pan and cylinder head according to the corresponding operations.
2. Install sealing Gasket or replace if damaged.
3. Install camshaft housing to cylinder head.
4. Install cylinder head according to the corresponding operation.



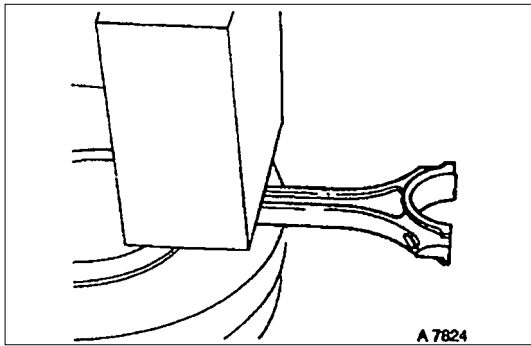
Con-Rod Removal

1. Remove piston with con-rod according to the corresponding operation.
2. Disassemble con-rod piston assembly by pressing out piston pin, using 5-8840-0468-0.

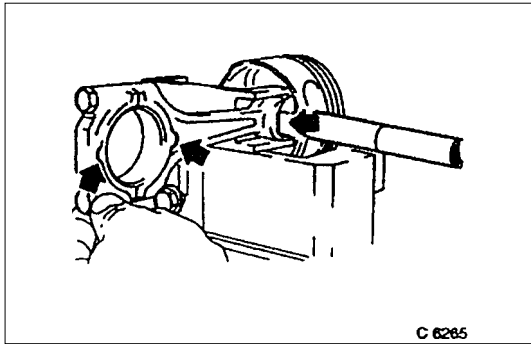


Installation

1. Slide guide drift (5-8840-0468-0) in horizontal position through piston and con-rod as far as side plate stops.
2. Tighten bolts evenly so that the piston rests flush on the rear plate.
3. Remove centre piece from guide drift and insert piston bolts (lubricated) into guide drift.



4. Heat a new con-rod to 280°C in the oil bath.
5. Install the con-rod to the piston and insert the piston pin.



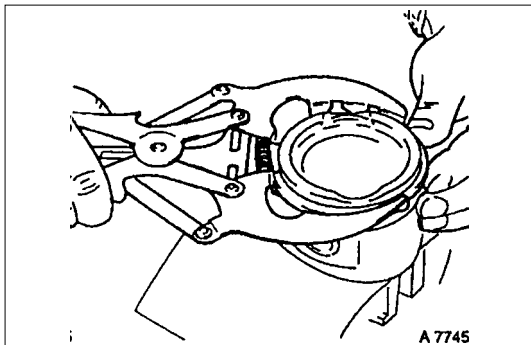
Important!

Since the con-rods have no weight balancing studs, re-working is not possible.

Exchange con-rods in sets only.

Installation position, beads on con-rod point to the flattening on the piston pin eye.

Firmly seated piston pin cannot be pushed in. Carry out installation quickly.



Piston Rings

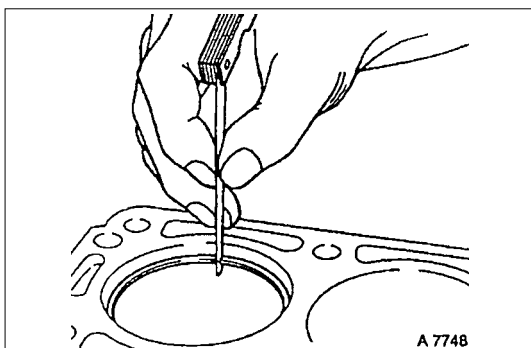
Removal

1. Remove piston with con-rod according to the corresponding operation.
2. Remove piston rings using commercially available ring installer or piston ring clamp pliers.



Clean

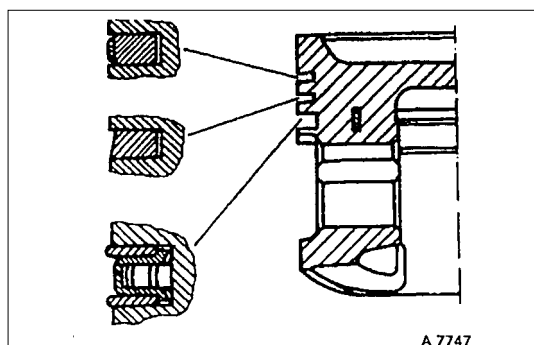
Piston ring grooves - ground piece of old piston ring



Inspection

Piston ring gap

For piston ring sizes, permissible piston ring gaps - see "Technical Data"

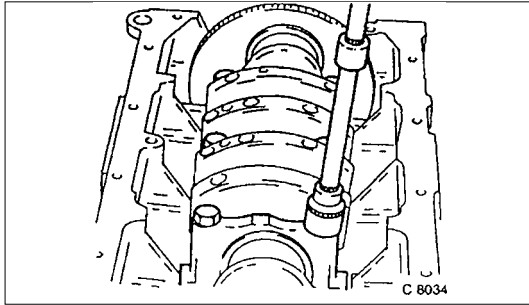


Installation

1. Install oil scraper ring.
2. Offset ring gaps of steel band rings each 25 to 50 mm/1 to 2in. to the left or right of the intermediate ring gap.
3. Install piston rings.
4. Offset ring gaps by approx. 180°.
5. Install second piston ring with identification mark "TOP" facing upwards.
6. Install piston with con-rod according to the corresponding operation.

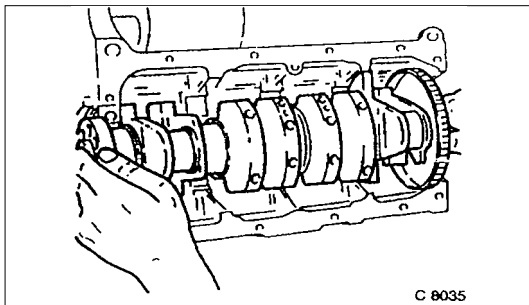
OPERATIONS ON REMOVED ENGINE

Crankshaft



Removal

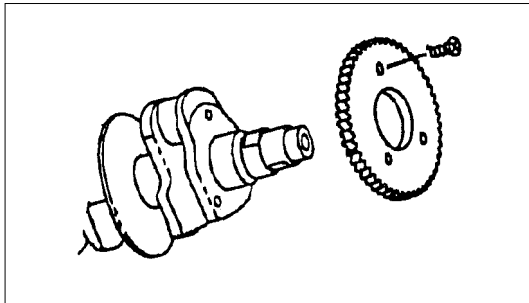
1. Mount the engine on an engine overhaul stand with appropriate adapters.
2. Remove the aggregates, flywheel/drive disc, oil pan, and oil pump according to the corresponding operation.
3. Mark the con-rod bearing cover.
4. Remove the crankshaft bearing cover.
5. Remove the crankshaft from cylinder block.



Inspection

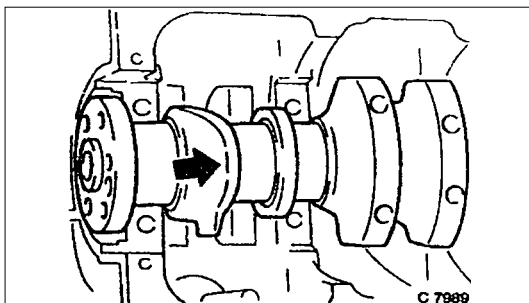
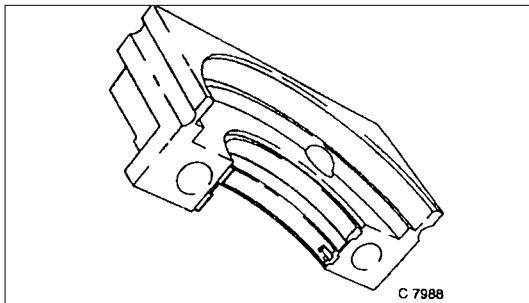
Remove and install all parts if necessary.

Crankshaft pulse pickup sensor rotor inspection and repair.
Inspect the crankshaft pulse pickup sensor rotor for excessive wear and damage.
Replace the crankshaft pulse pickup rotor if the inspection results exceed wear and damage limits.



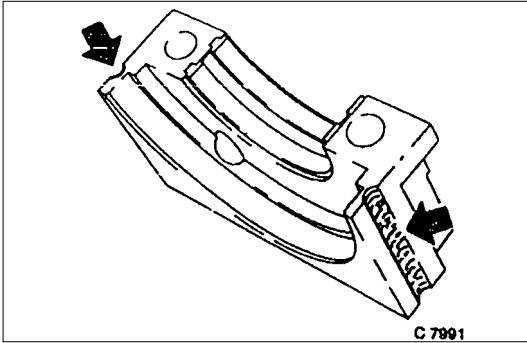
Installation

1. Install the crankshaft pulse pickup sensor.
Torque: 13N·m (1.3 kgf·m)
2. Install new bearing shells into the cylinder block and bearing cover.
3. Coat the bearing shafts with engine oil.
For oversizes-see "Technical Data"
4. Install a new crankshaft into the cylinder block.



Note

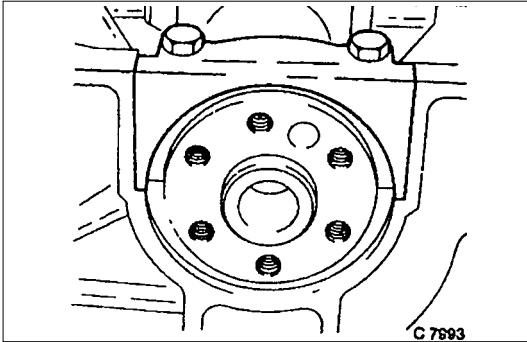
The sealing of the crankshaft can be corrected with light blows with a rubber hammer on the crank arm (arrowed).



5. Apply a bead of sealant (TB-1207C or equivalent) in the grooves of both bearing shells.

⚠ Important!

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

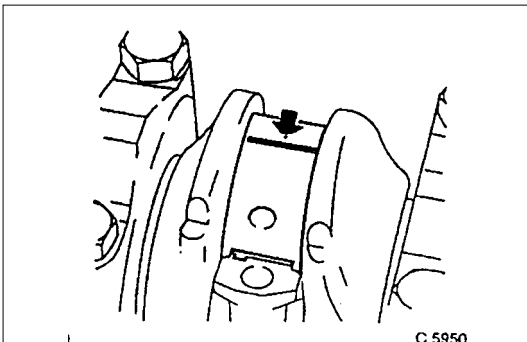


⚙ Torque - Angle Method

Bearing cover to cylinder block - 50 N·m (5.1 kgf·m) +40° to 50°
Con-rod bearing cover to con-rod - 35 N·m (3.5 kgf·m) +45° to 60°.

Use new bolts.

6. Install oil pump, oil pan, rear crankshaft sealing, flywheel/drive plate, and aggregates according to the corresponding operations.



🔍 Inspection

Bearing play - bearing cover removed

📏 Measure

With "Plastigage" (ductile plastic threads)
Cut threads to length of bearing width and lay axiaity between crankshaft journal and bearing shell (arrowed).
Install bearing cover with correct torque.

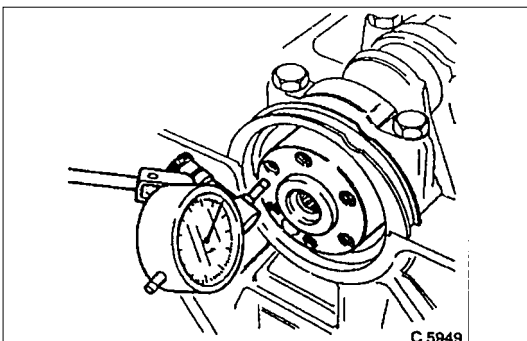
⚠ Important!

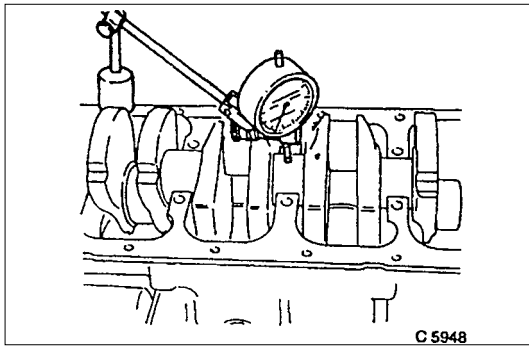
Grease crankshaft journal and lubricate bearing shell slightly so that the thread does not tear when the bearing cover is moved.

Crankshaft

🔍 Inspection

End play when bearing shells are installed.
Front end contact surfaces of flywheel/flexible plate.
Permissible end play - see "Technical Data "

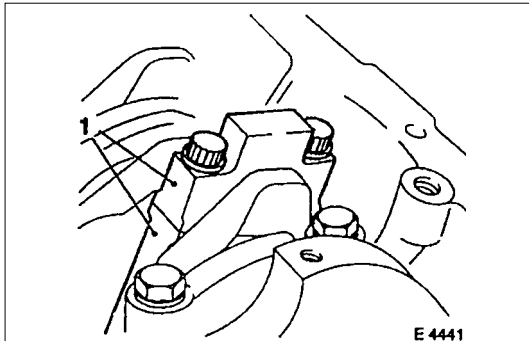




Inspection

Out-of-round (run-out)-middle bearing shell removed when mounting on front and rear bearing.

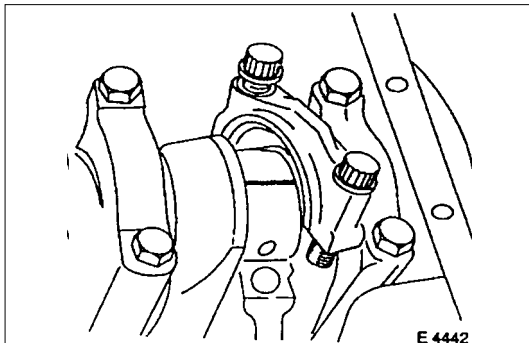
Permissible out-of-round - see "Technical Data"



Bearing Free Play Measurement

Two methods for measuring bearing free play are described - 1. Plastigage method and 2. micrometer and gauge method. The two procedures are suitable for measuring both con-rod and main bearing free play.

For both methods ensure con-rod and main bearing caps are identified (1) prior to removal as they are machine matched.



1. Plastigage Method

Removal

1. Remove bearing cap and shell.
2. Lightly coat journals and bearings with engine oil to prevent Plastigage from tearing when cap is removed.



Installation

1. Lay a length of Plastigage across width of crank pin and fit bearing cap and shell using old bolts at this stage.



Important!

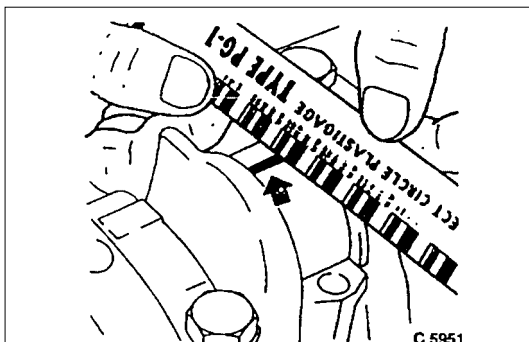
Do not allow crankshaft to rotate.



Torque - Angle Method

Main bearing cap bolt - 60 N·m (6.1 kgf·m) +40° + to 50°.

Con-rod bearing cap bolts - 35 N·m (3.6 kgf·m) +45°.



Removal

1. Remove bearing cap and shell.

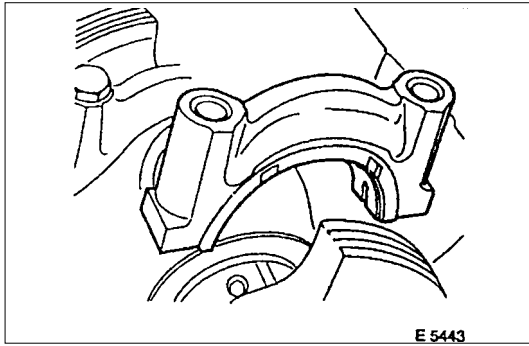


Measure

Width of Plastigage -use scale supplied with Plastigage.

If con-rod bearing clearance exceeds 0.031mm/0.001in or main journal bearing clearance exceeds 0.04mm/0.02in. - check crankshaft journal diameters - see corresponding operation.

Replace bearing if crankshaft is within specification - see "Technical Data"



Clean

Plastigage from journals.

Lightly coat journals and bearings with engine oil.



Installation

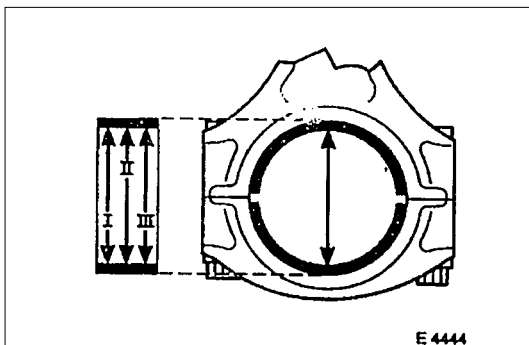
Install bearing cap and shell using new bolts.



Torque - Angle Method

Main bearing cap bolt - 60 N·m (6.1 kgf·m) +40° to 50°.

Con-rod bearing cap bolts - 35 N·m (3.9 kgf·m) +45°.



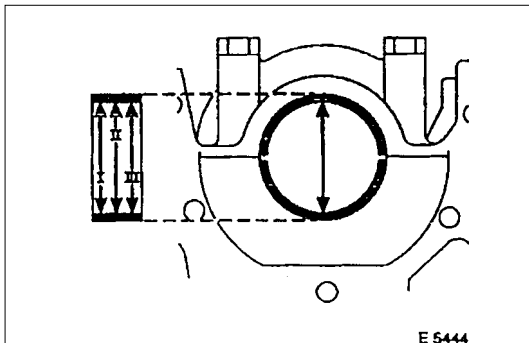
2.Micrometer and gauge method.

Crankshaft removed.



Installation

1. Install caps and bearing shells to con-rods and cylinder block.



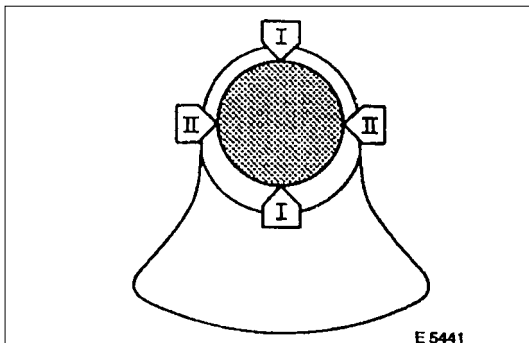
Measure

Con-rod and main bearing diameters at three points I, II, III (arrowed).

Divide the sum of the three measurements by three to obtain a mean diameter.

The top illustration shows con-rod measuring points.

The second illustration shows main bearing measuring points.



Measure

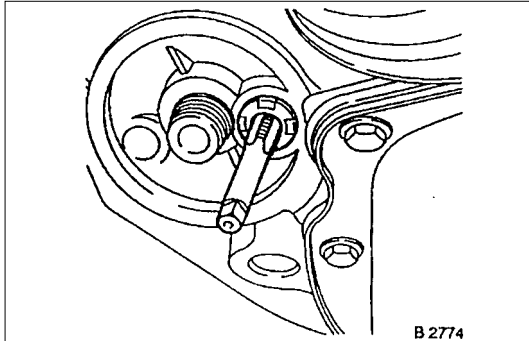
Crankshaft main and con-rod bearing journals at points I and II. Divide the sum of both measurements to obtain a mean diameter.

Crankshaft must be replaced if mean diameter of main or con-rod journals is below specified limit - see "Technical Data".

If crankshaft is serviceable subtract crankshaft mean journal diameters from corresponding shell bearing mean diameters to determine bearing clearance.

Permissible main bearing clearance - 0.015 to 0.04mm/0.0006 to 0.002in.

Permissible con-rod bearing clearance - 0.006 to 0.031mm/0.002 to 0.001in.



Bypass Valve



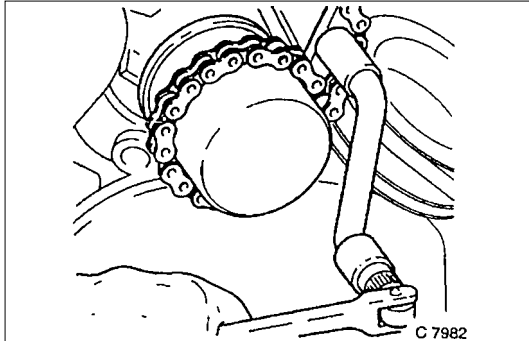
Removal

1. Remove oil filter.
2. Remove bypass valve by cutting thread in locking disc with M 10 tap (3rd stage), turning in M 10 bolt and taking out bypass valve from seating.



Installation

1. Install bypass valve using drift (diameter approx. 15mm/0.6in.).



Oil Filter



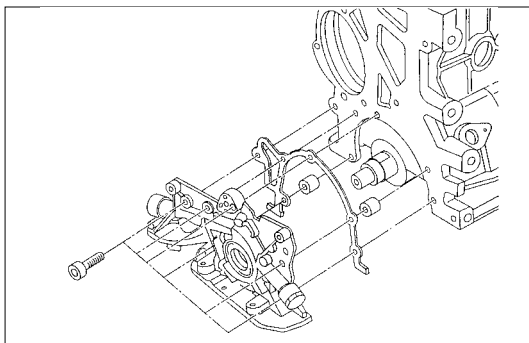
Removal

1. Remove oil filter using commercially available tool.



Installation

1. Install oil filter by hand and oil seal ring.
2. Fill up engine oil while preventing overflow.

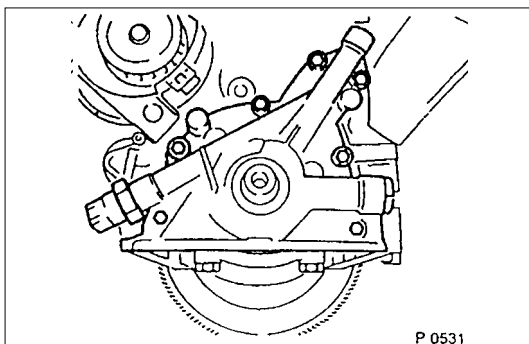


Oil Pump



Removal

1. Remove rear toothed belt cover, and oil pan according to the corresponding operations.
2. Remove oil filter, wiring plug from oil pressure switch, oil pump from cylinder block, and oil pressure switch from oil pump.



Clean

Sealing surfaces



Installation

1. Install oil pressure switch to oil pump, oil pump to cylinder block, oil pan, wiring plug, oil filter and toothed belt cover.



Tighten (Torque)

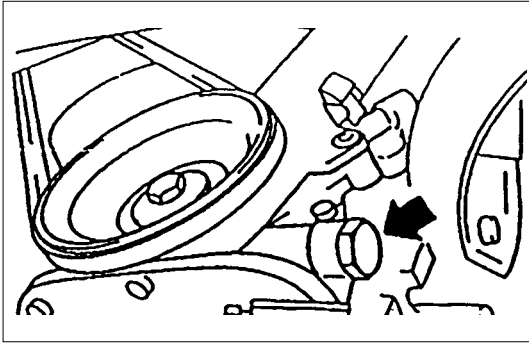
Oil pressure switch to oil pump - 30 N·m (3.2 kgf·m)

Oil pump to cylinder block - 6 N·m (0.6 kgf·m)

Oil intake pipe to oil pump - 8 N·m (0.8 kgf·m)

Intake pipe bracket to cylinder block - 8 N·m (0.8 kgf·m)

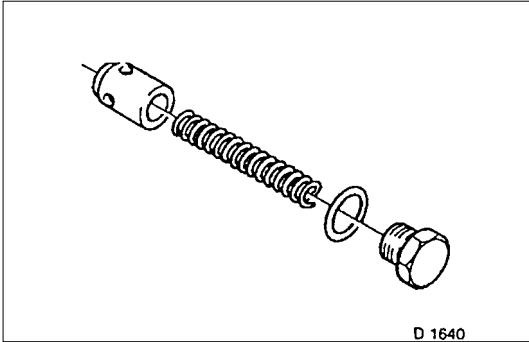
*Insert bolts with Locktite (Refer to General Description Recommended Liquid Gasket)



Oil Pump Safety Valve

Removal

1. Remove closure plug.
2. Remove seal ring.
3. Remove spring.
4. Remove piston.



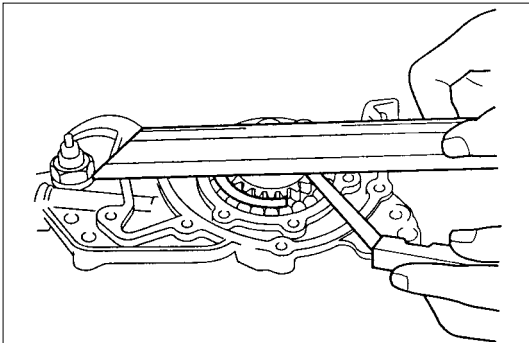
Installation

1. Install piston (observe installation position).
2. Install spring.
3. Install seal ring.
4. Install closure plug.



Tighten (Torque)

Closure plug - 30 N·m (3.0 kgf·m)



Oil Pump (Overhaul)

Removal

1. Remove oil pump according to the corresponding operation.
2. Remove oil cover and pressure control valve.



Inspect

Clearance between gear pair and housing upper edge - see "Technical Data".

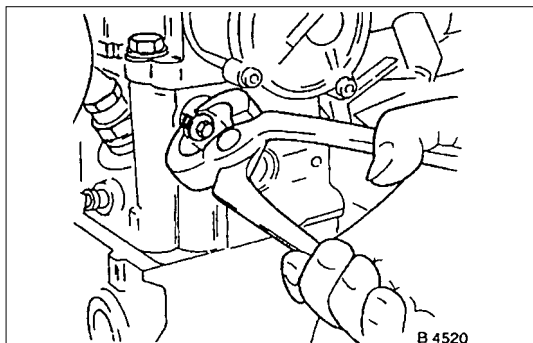
Check housing, cover and pressure control valve.



Installation

1. Install pump cover with Sealing Compound 15 03 166 (90 094 714).
2. Install oil pump safety valve according to the corresponding operation.
3. Install oil pump according to the corresponding operation.

OPERATIONS ON OIL CIRCULATION



Cylinder Head Safety Valve

Removal

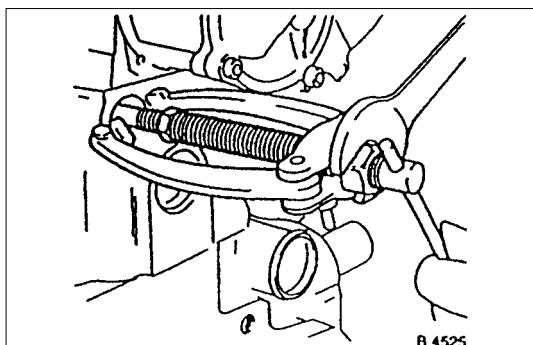
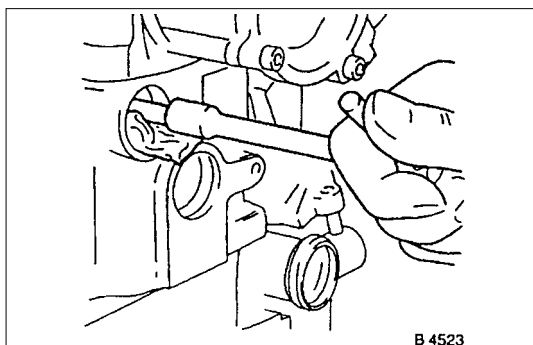
1. Remove cylinder head according to the corresponding operation.
2. Make hole in core plugs with pointed drift, turn in self tapping screw and edge out.



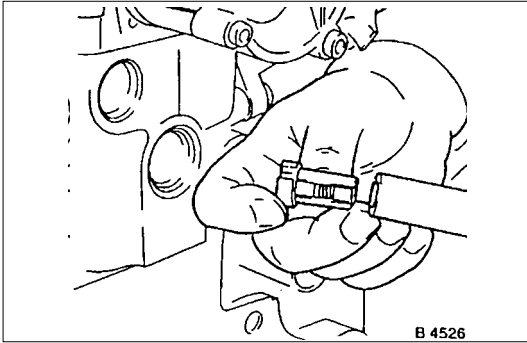
Important!

Cover oil duct in cylinder head with piece of cloth.

3. Pull out valve retainer, using commercially available tool.
4. Remove ball and spring.
5. Cut three threads in the ball seating with M 10 tap (3rd stage).
6. Coat tap with grease.

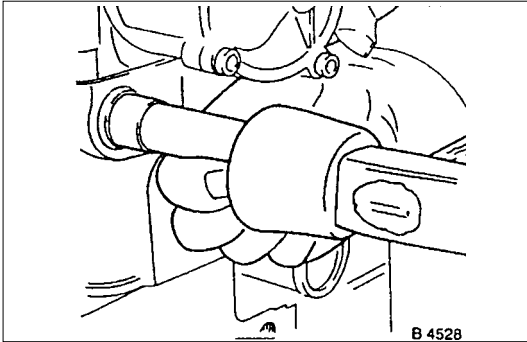


7. Remove ball seating from cylinder head with commercially available tool.
Do not damage cylinder head.



Installation

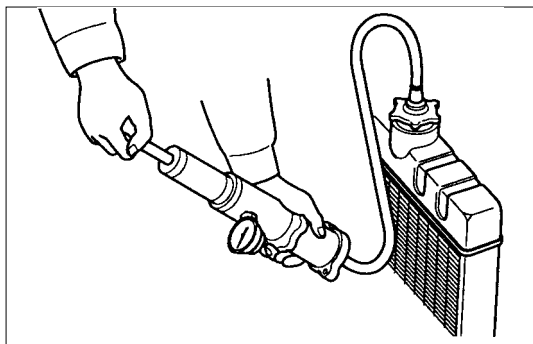
1. Install new pressure valve into cylinder head - with suitable pipe until stop.
2. Install core hole plugs into cylinder head - with suitable pipe to end of chamfer.



OPERATIONS ON COOLING SYSTEM

Caution!

Before working with the cooling system, be sure to confirm that the temperature of the engine is cooled down.
Failure to observe this may cause burn.



Cooling System, Check for Leaks

Installation

1. Install commercially available coolant checking instrument onto compensation tank (Refer to section 6B; Engine cooling).
2. Check coolant level.

Inspection

Use 5-8840-0277-0 tester & 5-8840-2603-0 adaptor.

Cooling System, Fill Up and Bleed

Important!

Radiator and heater core are made from aluminium.
To avoid corrosion, use only anti-freeze with corrosion protection.

Replace Coolant

1. Confirm the engine is cold enough.
2. Open the radiator cap, pour coolant to the filler neck level and close the cap.
3. Pour coolant into the reservoir until MAX line is reached.
4. Start the engine, run 2 ~ 3 minutes at idling speed and switch off the engine.
5. Refill coolant if the coolant level is lowered.



Important!

Do not loosen or open the radiator cap when coolant is hot. Doing so may cause hot water or steam to splash out, resulting in burn. When opening the radiator cap, be sure to confirm the coolant is cold. Cover a thick cloth over the cap and loosen it slowly to reduce pressure, then open the cap.

6. Close the radiator cap firmly and run the engine at approx. 2000 rpm. In addition, set the heater temperature adjuster to the max position to circulate coolant in the heater conduit system.
7. Confirm that the temperature gauge reads half or more of full scale and that the thermostat is activated. Then continue idling 5 minutes more and switch off the engine, and allow it to cool.
8. After the engine cools down, check the coolant level and refill it if necessary. When the level is lowered extremely, check the coolant conduit system and reservoir hose for leak.
9. Pour coolant into the reservoir to MAX level.

Refill Coolant



Important!

After closing the cooling system, let engine run warm until thermostat opens (coolant approx. 92°C/197.6F)



Inspection

Coolant level

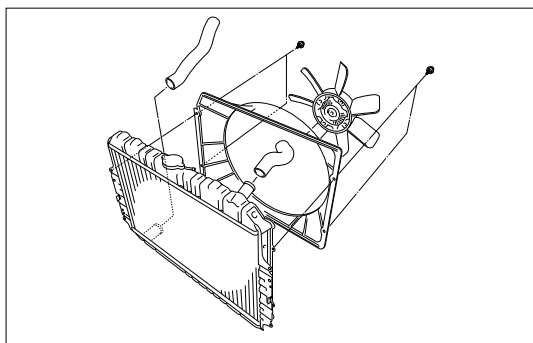
Allow engine to cool. If necessary, refill coolant.

Check that cooling system self-bleeds during engine warming-up phase.

**Ignition Timing, Check
No Adjustment**

ENGINE EXTERNAL PARTS

Radiator



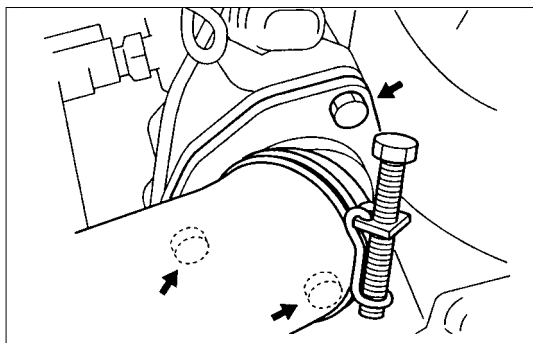
Removal

1. Remove the upper hose and lower hose.
2. Remove all V-belts.
3. Remove the cooling fan.
4. Remove the fan guide.
5. Remove the radiator.



Installation

1. Install the radiator.
2. Install the fan guide.
3. Install the cooling fan.
4. Install all V-belts.
5. Install the lower and upper hose.



Thermostat

Removal

1. Remove water outlet nozzles with thermostat from thermostat housing.
2. Remove coolant hose and collect coolant.



Important!

Remove and Install thermostat only together with water outlet nozzles.



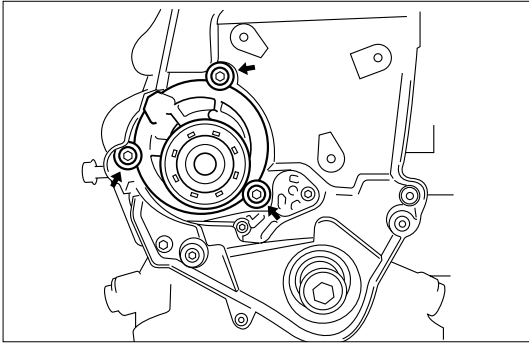
Tighten (Torque)

Water outlet nozzles to thermostat housing - 8 N·m (0.8 kgf·m)



Installation

1. Install coolant hose.
2. Fill cooling system and bleed according to the corresponding operation.



Water Pump



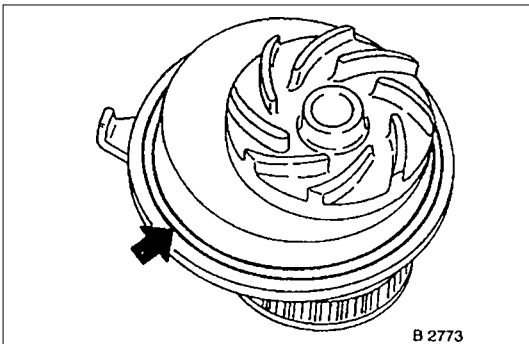
Removal

1. Remove lower hose band from pipe band and collect coolant.
2. Remove front toothed belt cover according to the corresponding operation.
3. Remove water pump from cylinder block after releasing tension on toothed belt.



Clean

Sealing surfaces

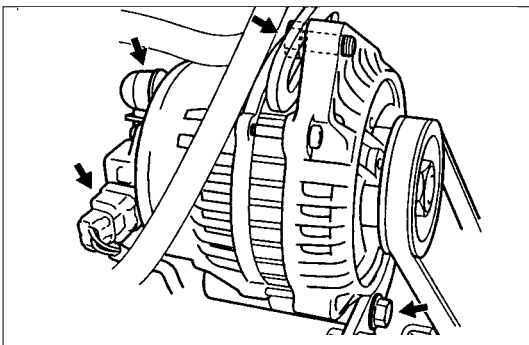


Coating sealing surfaces with Silicone Grease



Installation

1. Install water pump to cylinder block with new rubber O-ring.
2. Apply tension to toothed belt according to the corresponding operation.
3. Install coolant hoses.
4. Fill cooling system and bleed according to the corresponding operation.



Alternator



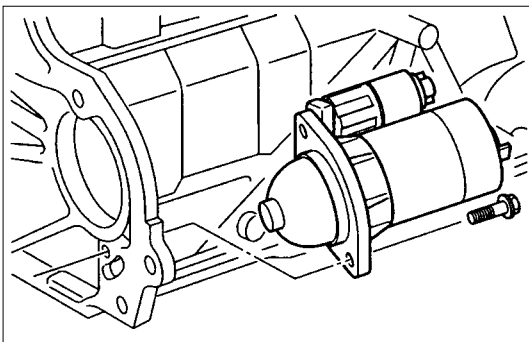
Removal

1. Remove ground cable from battery.
2. Remove cable connection from alternator and V-belt.
3. Remove alternator from retaining strap and lower fastening.



Installation

1. Install alternator by tightening firmly by hand.
2. Install V-belt and apply tension according to the corresponding operation.
3. Install cable connections to alternator.
4. Install ground cable to battery.



Starter



Removal

1. Remove cable connections from starter.
2. Remove upper bolt of transmission side.
3. Remove lower bolt of engine side.



Tighten (Torque)

Starter to cylinder block:

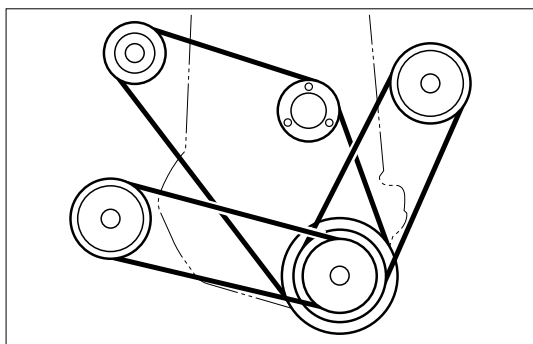
Engine side - 45 N·m (4.6 kgf·m)

Transmission side - 75 N·m (7.6 kgf·m)

Starter support to cylinder block - 25 N·m (2.5 kgf·m)

Re-connect cables.

V-belt Tension of Alternator



Measure

Measure V-belt tension of alternator.

Permitted values for new V-belt are approx. 311-489N (31-50 kgf).

Note:

V-belt to deflection as loaded with 10kg : 8-12mm.



Adjust

Adjust V-belt tension by loosening clamping bracket and lower alternator bracket and moving alternator.



Tighten (Torque)

Clamping bracket to alternator - 25 N·m (2.6 kgf·m)

Lower alternator bracket - 25 N·m (2.6 kgf·m)

V-Belt Tension of Power Steering Pump



Measure

Measure V-belt tension of power steering pump. Permitted values for new belt are approx. 578-712N (59-73 kgf) and 534-667N (54-68 kgf) for used belt.

Note:

V-belt to deflection as loaded with 10kg : 8-12mm.



Adjust

Adjust V-belt tension by loosening clamping bolt, lower pump bracket, and adjusting nuts and moving steering pump.



Tighten (Torque)

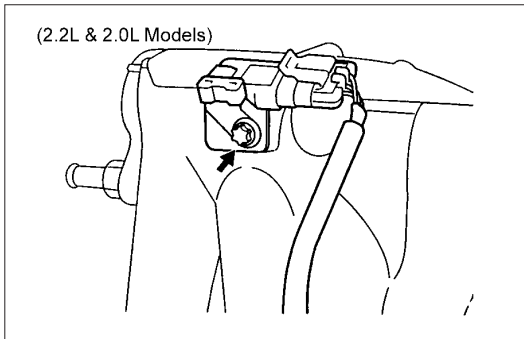
Adjusting nuts - 18 N·m (1.8 kgf·m)

Clamping bolt - 25 N·m (2.6 kgf·m)

Lower pump bracket - 26 N·m (2.6 kgf·m)

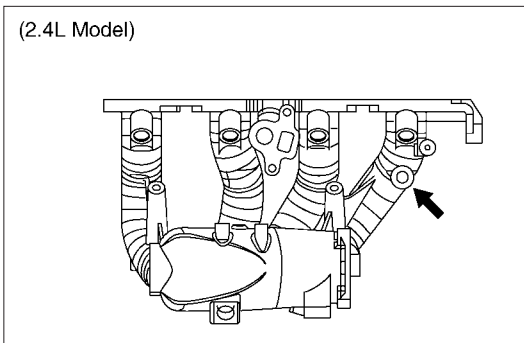
FUEL INJECTION SYSTEM

MAP SENSOR



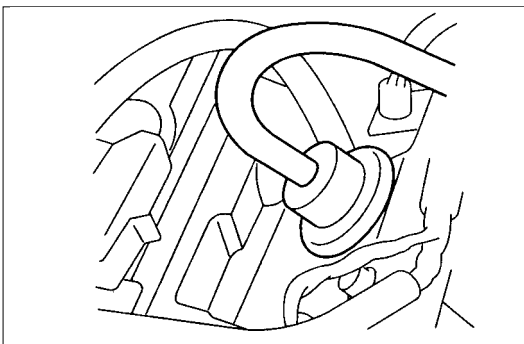
Removal

1. Disconnect the battery cable.
2. Disconnect the electrical connector from the sensor.
3. Remove the mounting bolts securing the sensor to the manifold.
4. Remove the sensor from the intake manifold.



Installation

1. Push MAP sensor into the manifold.
2. Install the mounting bolts and tighten them.
3. Connect electrical connector.
4. Connect the battery cable.



Pressure Regulator



Removal

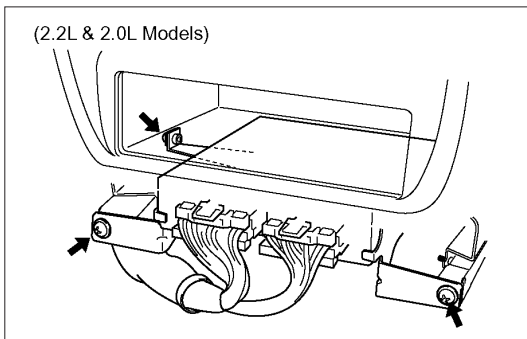
1. Remove vacuum hose.
2. Remove fuel hoses.
3. Remove pressure regulator.



Installation

1. Install pressure regulator.
2. Install fuel hoses.
3. Install vacuum hoses.

(2.2L & 2.0L Models)



ECM (Engine Control Module)

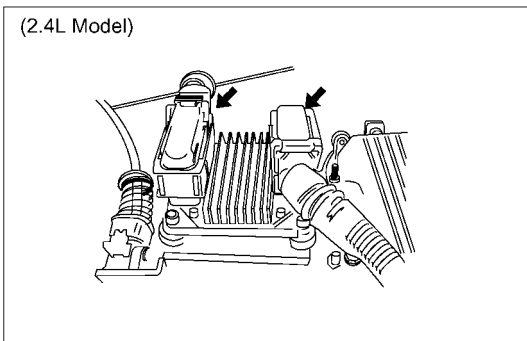


Removal

(2.2L & 2.0L)

1. Remove the center console assembly.
2. Remove the ECM cover.
3. Remove three screws for the bracket.
4. Pull ECM out.
5. Disconnect the connectors.

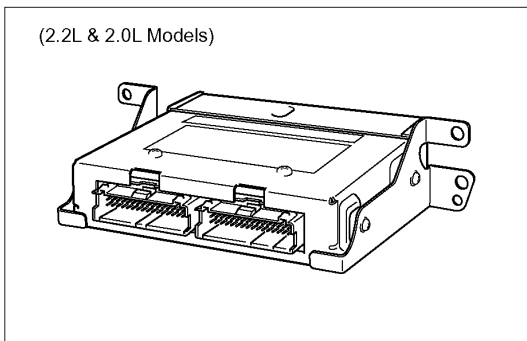
(2.4L Model)



(2.4L)

1. Disconnect the ECM connector.
2. Remove the four hex bolts and nuts.
3. Remove the ECM from the ECM bracket on engine.

(2.2L & 2.0L Models)

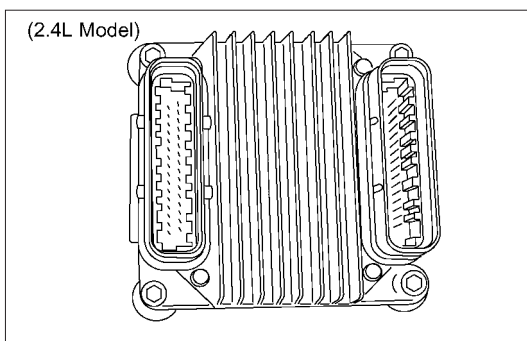


Installation

(2.2L & 2.0L)

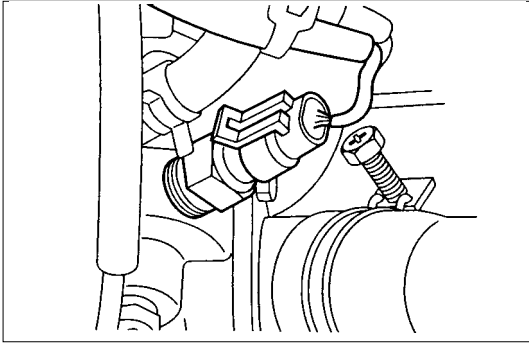
1. Connect the connectors.
2. Install the ECM to the proper position.
3. Tighten the four screws to the bracket.
4. Install the ECM cover.
5. Install the center console assembly.

(2.4L Model)



(2.4L)

1. Install the ECM to the ECM bracket on engine.
2. Tighten the four screws to the bracket.
3. Connect the connector.



ECT



Removal

1. Remove wiring harness plug and coolant temperature sensor.



Tighten (Torque)

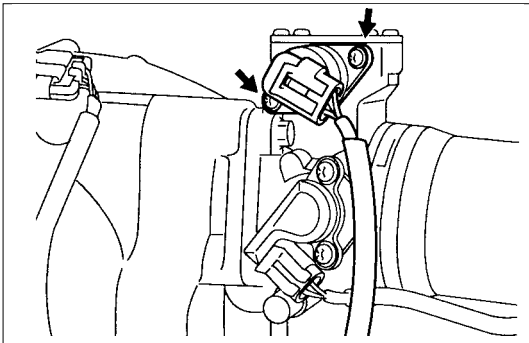
Temperature sensor to intake pipe - 10 N·m (1.0 kgf·m)

Wiring harness plug to temperature sensor



Inspection

Coolant level



Idle Air Control (IAC) Valve



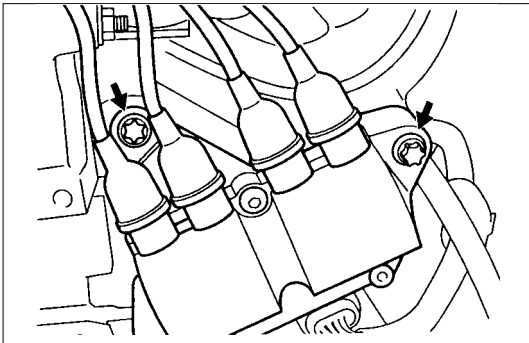
Removal

1. Remove wiring harness plug, hose clamps and idle speed adjuster.



Installation

1. Install idle speed adjuster, hose clamps and wiring harness plug.



Ignition Coil



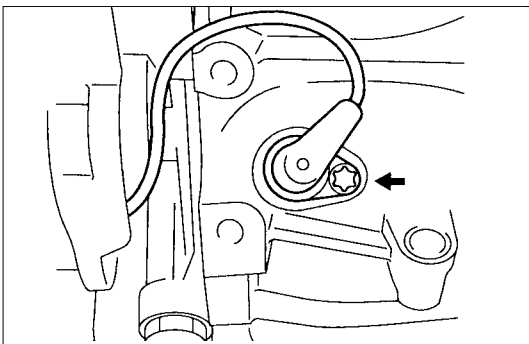
Removal

1. Remove 2 bolts, plug and ignition coil.



Installation

1. Install ignition coil, plug and bolts.



Crank Position Sensor



Removal

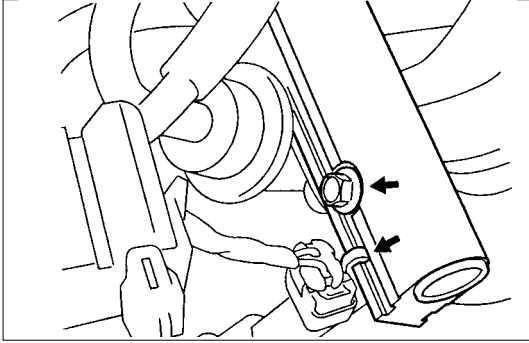
1. Remove crank position sensor.



Installation

1. Install crank position sensor.

FUEL INJECTOR



Removal

Caution: To reduce the risk of fire and personal injury, it is necessary to relieve the fuel system pressure before servicing the fuel system components.

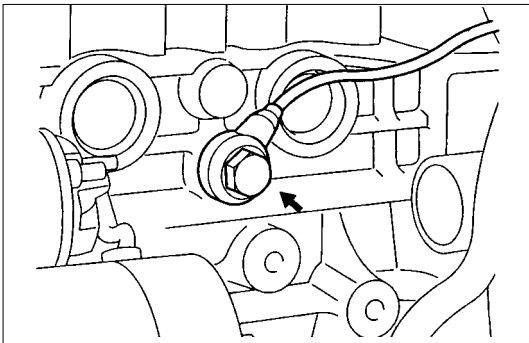
Caution: After relieving the fuel system pressure, a small amount of fuel may be released when servicing fuel lines or connections. Reduce the chance of personal injury by covering the fuel line fitting with a shop towel before disconnecting the fittings. The towel will absorb any fuel that may leak out. When the disconnect is completed, place the towel in an approved container.

1. Depressurize the fuel system.
2. Disconnect the fuel inlet.
3. Disconnect the fuel return line.
4. Remove the fuel rail from the intake manifold.
5. Remove the fuel injector from the fuel rail by disengaging claws.



Installation

1. Install the fuel injector to the fuel rail by engaging claws.
2. Install the fuel rail to the intake manifold.
3. Connect the fuel return line firmly.
4. Connect the fuel supply line firmly.



Knock sensor Removal

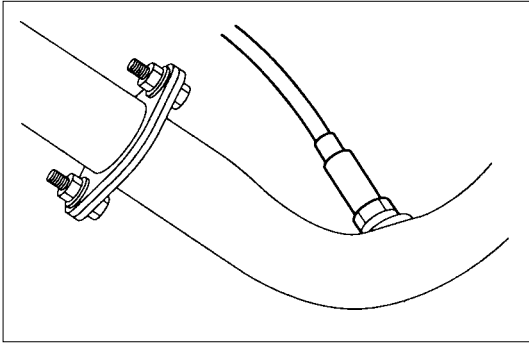
1. Remove fixing bolts.
2. Disconnect the connector at the other side.



Tighten (Torque)

Oxygen sensor in exhaust pipe - 30N·m (3.2 kgf·m)

When re-using, insert oxygen sensor.



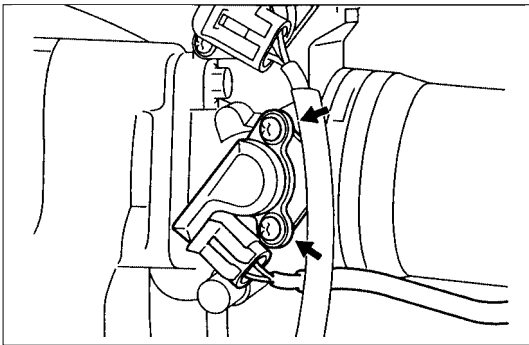
Oxygen Sensor (If applicable) Removal

1. Remove wiring harness plug.
2. Remove oxygen sensor from the front exhaust pipe.



Tighten (Torque)

Oxygen sensor in exhaust pipe - 30 N·m (3.1 kgf·m)



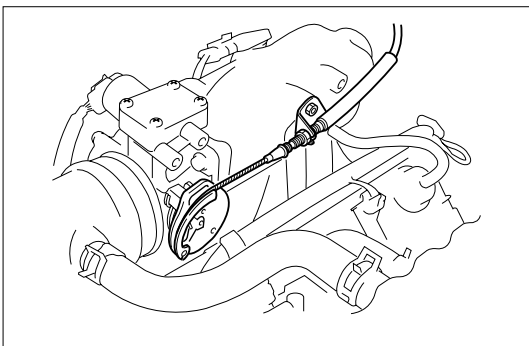
Throttle Valve Position Sensor Removal

1. Remove wiring harness connector.
2. Remove throttle valve position sensor.



Installation

1. Install throttle valve position sensor.
2. Install wiring harness connector.



Accelerator Pedal and Cable Removal

1. Remove pad stopper from pedal stop bolt.



Measure

Dimension "A":

RD=15mm ± 0.5mm/0.59in. ± 0.02in.

LD=14mm ± 0.5mm/0.55in. ± 0.02in.



Installation

1. Install pad stopper.



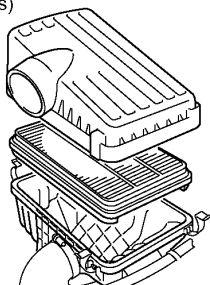
Inspection

Ensure that accelerator pedal is fully in idle position and accelerator level at engine is in closed position.

Pull outer sleeve of accelerator cable towards pedal and check that clip on sleeve is in slot nearest to grommet.

Reposition clip if necessary, and check that full throttle and idle positions are obtained at engine lever.

(2.2L & 2.0L Models)



Air Cleaner Filter

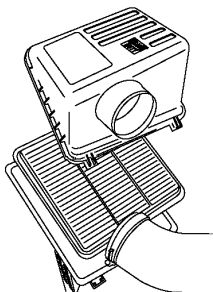


Removal

(2.2L & 2.0L)

1. Remove positive ventilation hose connector.
2. Remove intake air temperature sensor.
3. Remove mass air flow sensor.
4. Remove air cleaner duct assembly.
5. Remove air cleaner element.

(2.4L Model)



(2.4L)

1. Remove air cleaner cover and air cleaner element.
2. Remove air intake nose.
3. Remove lower air cleaner.
4. Remove mud guard.
5. Remove front fender cover.
6. Remove outside air intake duct.



Inspection

Check the air cleaner filter for damage or dust clogging. Replace if it is damaged, or clean if it is clogged.



Cleaning Method

Tap the air cleaner filter gently so as not to damage the paper filter, or clean the element by blowing with compressed air of about 490 kPa (71 psi) from the clean side if it is extremely dirty.



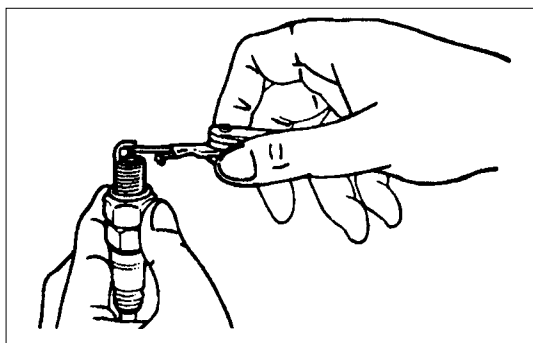
Installation

(2.2L & 2.0L)

1. Install air cleaner element.
2. Attach the air cleaner duct cover to the body completely, then clamp it with the clip.
3. Install mass air flow sensor.
4. Install mass air temperature sensor.
5. Install positive crankcase ventilation hose connector.

(2.4L)

1. Install outside air intake duct.
2. Install front fender cover.
3. Install mud guard.
4. Install lower air cleaner.
5. Install air intake hose.
6. Install air cleaner element and air cleaner cover.



Spark Plug Thread Recondition

Ream thread and recut using commercially available spark plug thread drill (observe manufacturer's instructions).



Removal

Remove thread bush on spark plug. (dimensions (A) = 17mm/0.67in.)



Tighten (Torque)

Spark plug with thread bush into cylinder head - 25N·m (2.5 kgf·m) - use.

TECHNICAL DATA

SOHC Gasoline Engine C24SE/C22NE/22LE/20LE

Engine Oil Viscosity

The following engine oils can be used:

A = single-grade oils

B = multigrade oils

C = easy run oils

depending on the outside temperature.

Engine Oil Quality

It is important that the following API and CCMC classes are used:

Engines	Single and multigrade oils	Easy run oils
Petrol	API-SF/CC, SF/CD, SG/CC, SG/CD, CCMC/G4	API-SF/CC, SF/CD, SG/CD CCMC-G5/PD2

Important!

CD engine oils designed by manufacturers specially for diesel engines are not suitable for petrol engines, unless a sufficient performance class for petrol engines (e.g. API-SF/CCMC-G4) is also indicated.

Disposal.

Observe the relevant national regulations when disposing of used oil.

Engine Oil Filling Quantities

Engine Model	Initial filling (litres)	Filling quantity with filter change* (litres)	MIN to MAX (litres)
2.2L & 2.0L	4.25	4.5	1.00
2.4L	4.80	4.25	1.00

*Up to mark "MAX" on oil dipstick

Oil Pump

Backlash	0.1 to 0.2mm
Gaps in gears opposite housing	0.03 to 0.1mm
Oil pressure at idle speed	Engine at operating temperature (>70°C oil and approx. 80°C coolant) 150 kPa/1.5 bar
Oil drain plug	M14 × 1.5

Cooling System

Radiator

Type: Cross-flow

Radiator core surface in cm²: 2000

Cooling system capacity (in litres): 7.2

Anti-freeze Mixture

Anti-freeze Mixture

Required Quantity (in litres)	Up to-10°C Quantity in litres		Up to-20°C Quantity in litres		Up to-30°C Quantity in litres		Up to-40°C Quantity of litres	
	Water (80%)	Anti-Freeze (20%)	Water (66%)	Anti-Freeze (34%)	Water (56%)	Anti-Freeze (44%)	Water (48%)	Anti-Freeze (52%)
7.2	5.7	1.5	4.7	2.5	4.0	3.2	3.4	3.8

Cooling System (continued)

Fan

Type: Visco Clutch Fan

Number of blades: 5

Distribution of blades: asymmetric

Diameter mm

Radiator cap

Boiling point: 123°C

Opening pressure kPa (bar): 120 to 135 (1.20 to 1.35)

Thermostat

Start of opening: 92°C

Fully opened: 107°C

Type: Bypassed

Idle Speeds, CO Content, Ignition Adjustment

Applicable System	Idle speed in min ⁻¹ (rpm) Manual	CO content in vol. %	Ignition timing in CA BTDC (adjustment ensues at idle speed, ignition marks must align) with TDC sensor measuring instrument:
Closed Loop System	825	* <0.4	*** 8 to 12
Open Loop System	825	** 1.0 ^{+0.2} _{-0.5}	*** 8 to 12

Note) * CO content adjustment not applicable.

** CO content adjustment refer to Section 6E1 (Except Australia)

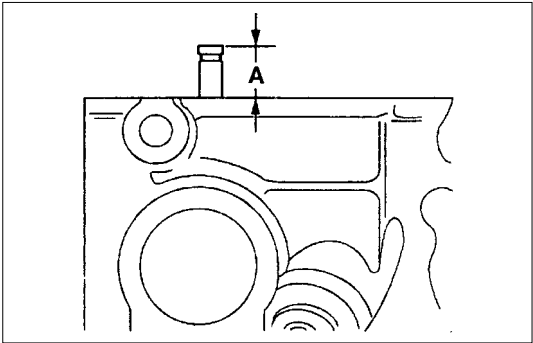
*** Ignition timing adjustment not possible.

Adjustment Values/Checking Values

Valve clearance	
Inlet	Hydraulic valve lash adjustment
Outlet	No adjustment necessary
Spark plugs - electrode gap	1.0 ~ 1.1mm
Compression	The difference in compression between the individual cylinders in the engine must not exceed 100 kPa (1 bar).
Pressure loss	The pressure loss of an engine in perfect condition per cylinder is not more than max. 25%

Cylinder Head

Cylinder Head Gasket		
Thickness - installed	mm	1.15 to 1.30
Valve seat width at cylinder head		
inlet	mm	1.0 to 1.5
outlet	mm	1.7 to 2.2
Valve stem play inlet	mm	0.018 to 0.052
outlet	mm	0.038 to 0.072
Permissible valve stem to cone runout		
inlet	mm	0.03
outlet	mm	0.33
Overall height of cylinder head		
(Sealing surface to sealing surface)	mm	96.00 ± 0.25
Installation height		
inlet and		
outlet valves	mm	17.85 to 18.25
dimension "A"		Distance Gauge 5-8840-2596-0
Installation height valve guide	mm	83.50 to 83.80
Sealing surface peak-to-valley height	mm	max. 0.025



Cylinder Head (continued)

Valve System

Valve lifter	valve play compensator (hydraulic)
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Valve rotators (inlet or outlet)	outlet
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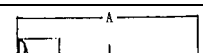
Valve play (warm or cold)	inlet	mm	0
	outlet	mm	0

Cylinder head height	mm	280.3±0.075
----------------------	----	-------------

Cylinder head bottom, face parallelism	mm	0.05
--	----	------

Cylinder Head (continued)

Valve Dimensions

	C24SE, C22NE, 22LE, 20LE							
	A in mm		B in mm	C(diameter in mm) and identification mark				D
	1)	2)		Normal K	Oversize K1 0.075	Oversize K2 0.150	Oversize A 0.250	
Inlet valve	104.2	103.8	41.8	7.012 6.998	7.087 7.073	7.162 7.148	7.262 7.248	44°
Outlet valve	104.0	103.6	36.5	6.992 6.978	7.087 7.053	7.142 7.128	7.242 7.228	44°
Valve stem bore	-			7.050 7.030	7.125 7.105	7.200 7.180	7.300 7.280	-

1) Production

2) Customer service

The P and A department only supplies valves with a length of 103.8mm (inlet valve) and 103.6mm (outlet valve) only

Camshaft

		2.2L& 2.0L	2.4L
Identification letter		J	K
Colour code	Normal size	-	
	0.1mm undersize	violet	
Radial runout	mm	0.03	
End play	mm	0.09 to 0.21	
Cam lift	Inlet and outlet valve	mm	6.67

Grinding Dimension for Camshaft Bearing Position

Bearing	Bearing journal diameter in mm		Diameter in housing	
	normal	-0.1mm	normal	-0.1mm
1	42.470	42.370	42.525	42.500
	42.455	42.355	42.425	42.400
2	42.720	42.620	42.775	42.675
	42.705	42.605	42.750	42.650
3	42.970	42.870	43.025	42.925
	42.955	42.855	43.000	42.900
4	43.220	43.120	43.275	43.175
	43.205	43.105	43.250	43.150
5	43.470	43.370	43.525	43.425
	43.455	43.355	43.500	43.400

Crankshaft, Cylinder Block

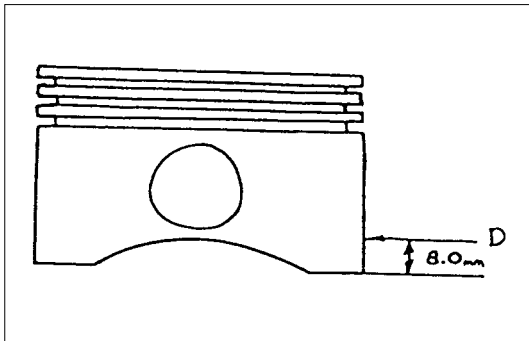
Cylinder Grinding and Piston dimensions

Cylinder Grinding and Piston Dimensions

	Size	Cylinder bore dia. in mm		Cylinder to Crankshaft housing co-efficient	Related piston dia. in mm		Piston head co- efficient
		over	to		over	to	
Production (2.2L & 2.0L)	1	85.97*	85.89	8	85.95	85.96	8
	2	85.98	85.99	99	85.96	85.97	99
		85.99	86.00	00	85.97	85.98	00
		86.00	86.01	01	85.98	85.99	01
		86.01	86.02	02	85.99	86.00	02
Production (2.4L)	1	87.48 87.49	87.49 87.50	99 00	87.46 87.47	87.47 87.48	99 00
Customer service (2.2L & 2.0L)	Oversize 0.5mm	8.46	86.47	7+0.5	86.44	86.45	7+0.5
Customer service (2.4L)	-	87.99	88.00	0+0.5	87.97	87.98	7+0.5

Piston diameter must be measured at the position "D".

*inclusive



Crankshaft, Cylinder Block (continued)

Cylinder Bore

Rebore cylinder Permissible oversize to 0.5mm (see parts microfiche)

After reboring, invalidate original crankcase housing coefficient and drive in new oversize coefficient

Permissible out-of-round: 0.013mm

Permissible taper: 0.013mm

Measure out-of-round in bore at 4 different heights

Piston projection above upper edge of cylinder block
0.40mm

Piston Type Recessed pistons

Clearance For short-blocks and cylinder blocks with complete pistons, the clearance is 0.02 to 0.04mm

For replacement (oversize), depending on available pistons, a clearance of 0.02 to 0.04mm is permissible

Crankshaft, Cylinder Block (continued)
Piston Rings

Square ring	Height	mm	2.2 & 2.0L 1.5	2.4L 1.2
Tapered ring	Height	mm	1.5	1.5
Oil scraper	Height	mm	3	2.5
Ring gap offset			180°	

Note that the upper steel band ring gap is offset 25 to 50mm to the left and the lower 25 to 50mm to the right opposite the intermediate ring gap.

Piston Pin

Length	mm	61.5	
Diameter	mm	21	
Type		Shrunk into con-rod	
Play	mm	2.2 & 2.0L	2.4L
	in piston	0.011 to 0.014	0.010-0.015
	in con-rod	none	
Installation		When installing piston pins, heat con-rods to approx. 280°C in oil bath. This temperature should under no circumstances be exceeded.	

Crankshaft, Cylinder Block (continued)

The permissible weight variation of con-rods without piston and bearing shell inside an engine is 8 g.
As the con-rods do not have balancing studs, reworking is not possible.
Con-rods can only be replaced in sets.

Crankshaft, Cylinder Block (continued)

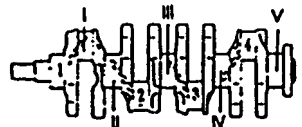
Crankshaft Grinding Dimensions

	Crankshaft journal I, II, IV, V Diameter mm	Guide bearing III Width mm	Con-rod journal 1 to 4 Diameter mm Width mm		Con-rod width mm
	Normal size				
Bearing journal and colour code	from 57.9820 green to 57.9885 > 57.9885 brown to 57.9950	25.900 25.850	48.988 48.970	26.580 26.460	26.390 26.338

Bearing shell identification mark Colour code and embossed Identification mark	Crankshaft bearing I, II, IV, V	Guide bearing III	Con-rod bearing 1 to 4	
	brown-662N green-663N	brown-655N green-658N		

	Crankshaft journal I, II, IV, V Diameter mm	Guide bearing III Widtht mm	Con-rod journal 1 to 4 Diameter mm		Width mm	Con-rod width mm
	0.25mm Undersize for Production and Customer Service					
Bearing journal and colour code	from 57.7320 green/ to 57.7385 blue > 57.7385 brown/ to 57.7450 blue	26.100 26.050	48.738 48.720			26.580 26.460

Bearing shell identification mark Colour code and embossed Identification mark	Crankshaft bearing I, II, IV, V	Guide bearing III	Con-rod bearing 1 to 4	
	brown/blue-664 A green/blue-655 A	brown/blue-657 A green/blue-658 A		

	Crankshaft journal I, II, IV, V Diameter mm	Guide bearing III Widtht mm	Con-rod journal 1 to 4 Diameter mm Width mm		Con-rod width mm
	0.50mm Undersize Customer Service				
Bearing journal and colour code	from 57.4820 green/ to 57.4885 blue > 57.4885 brown/ to 57.4950 blue	26.300 26.250	48.488 48.470		26.580 26.460

Bearing shell identification mark Colour code and embossed Identification mark	Crankshaft bearing I, II, IV, V	Guide bearing III	Con-rod bearing 1 to 4	
	brown/white-666 B green/white-667 B	brown/blue-659 B green/blue-660 B		

Piston Pins

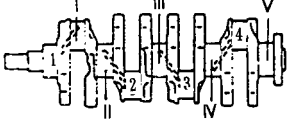
Dimensions		
Length	mm	61.5
Diameter	mm	21
Type		Shank-fit in con-rod
Clearance		2.2L & 2.0L2.4L
In piston	mm	0.011 to 0.0140.010 to 0.015
In con-rod	mm	00
Installation		See operation "Con-rod, Replace"

Con-rod

Permissible, weight variation of con-rods without pistons and bearing shells within an engine 8 g.

As the con-rods have no counterweights, re-working is not possible.

Con-rods must be replaced only as a set.

Crankshaft Grinding Dimensions					
	Crankshaft bearing journals I, II, III, IV, V	Guide bearings III	Con-Rod bearing journals 1 to 4		Con-rod
	diameter in mm/colour code	width in mm	diameter in mm	width in mm	width in mm
	Standard Size for Production and Service				
	from 57.974 white to 57.981 over 57.981 green to 57.988 over 57.988 brown to 57.995	$\frac{26.002}{25.950}$	$\frac{48.988}{48.970}$	$\frac{26.580}{26.450}$	$\frac{26.390}{26.338}$

Crankshaft, Cylinder Block (continued)

Crankshaft and con-rod journal Permissible out-of-round:
0.04mm

Out-of-round Permissible variation of middle
crankshaft bearing journal
when seating shaft into
cylinder block: 0.03mm

Permissible end play 0.05 to 0.152mm

Permissible main bearing play Bearing I to V 0.015 to 0.04mm

Permissible con-rod play 0.006 to 0.031mm

Permissible con-rod and play 0.07 to 0.24mm

Crankshaft, Cylinder Block (continued)

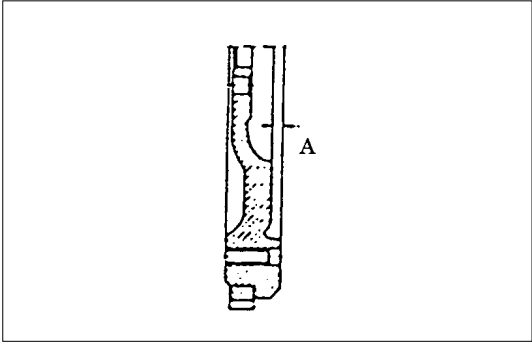
Flywheel

Starter ring gear Before fitting, heat ring gear to 180°C - 230°C

Lateral run-out Permissible lateral run-out of installed starter ring gear to flywheel: 0.5mm

Precision turning Permissible removal of material in clutch disc lining surface area: 0.3mm

In order to achieve the functional relationship again after removal of material, the same removal of material must take place on the fore part of the flywheel (contact for clutch assembly)



Dimension A: 2.1 to 2.2mm

Cylinder block

Top deck flatness mm 0.05

Cylinder block height mm 271±0.075

Recommended Torque Values

	N·m (kgf·m)		
Bearing cover to cylinder block	60 ¹⁾	6.1	+40° to 50°
Bracket for alternator to cylinder block	40	4.1	
Bracket for engine damping block to transmission	60 ²⁾	6.1	
Bracket for engine damping block to engine block	60	6.1	
Bracket for pump/compressor to engine block	35	3.6	
Camshaft housing cover to housing	8	0.8	
Camshaft timing gear to camshaft	50	5.1	
Clamping bracket for alternator to intake manifold	25	2.5	
Clamping bracket to alternator	25	2.5	
Con-rod bearing cap to con-rod	35 ¹⁾	3.5	+45° to 60°
Crankshaft pulley bolts	20	2.0	
Cylinder head to cylinder block	25 ¹⁾²⁾	2.5	+90° +90°
	+90°		
Engine damping block to engine bracket	8.5	8.7	
Engine damping block to side member	52 ¹⁾	5.3	
Exhaust manifold to cylinder head	22	2.2	

1) Use new bolts

2) Use new locking plates

Recommended Torque Values

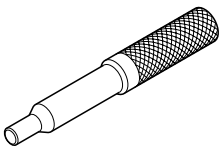
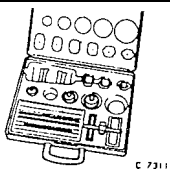
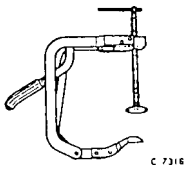
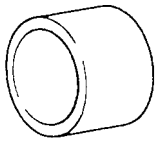
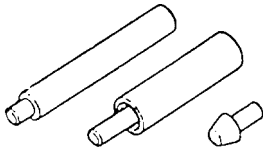
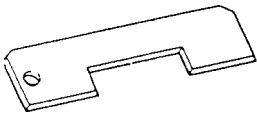
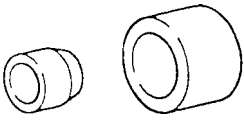
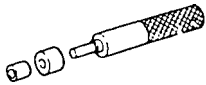
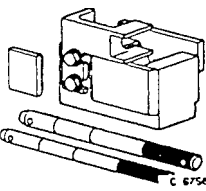
	N·m (kgf·m)		
Flywheel to crankshaft	65 ¹⁾	6.6	+30° to 45°
Front exhaust pipe to exhaust manifold	25	2.5	
Guide sleeve for pressure bearing to transmission	22	2.2	
Intake manifold to cylinder head	22	2.2	
Lower alternator bracket	25	2.5	
Oil drain plug to oil pan	45	4.6	
Oil intake pipe bracket to cylinder block	6 ²⁾	0.6	
Oil intake pipe to oil pump	8	0.8	
Oil pan to cylinder block	8 ²⁾³⁾	0.8	
Oil pan to cylinder block (vulcanized gasket)	20 ²⁾³⁾	2.3	
Oil pressure switch to oil pump	30	3.2	
Pump for power steering (ribbed V-belt) to engine block	30	3.2	
Spark plugs in cylinder head	20	2.3	
Starter support to cylinder block	25	2.5	
Starter to cylinder block - engine side	45	4.6	
Starter to cylinder block - transmission side	75	7.6	
Thermostat housing to cylinder head	15	1.5	
Toothed belt drive gear to crankshaft	130 ¹⁾	13.3	
Toothed belt front cover	4	0.4	
Toothed belt rear cover	6	0.6	
Toothed belt tension roller to oil pump	20	2.3	
Transmission to engine block {	(M10)	45	4.6
		76	7.7
	(M12)	60	6.1
Water pump to cylinder block	17	1.7	

1) Use new bolts

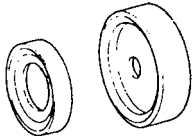
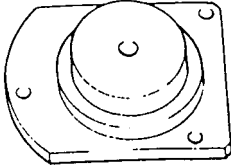
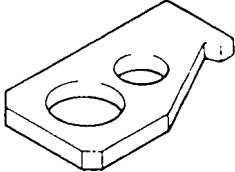
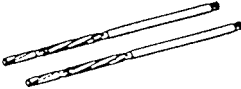
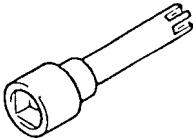
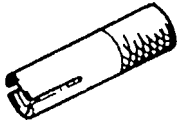
2) Use Locking Compound

3) Maximum installation time - 10 minutes

SPECIAL SERVICE TOOLS

ITEM NO.	ILLUSTRATION	PART NO.	PART NAME
		5-8840-2634-0	Aligner
		5-8840-2593-0	Cutter set
		5-8840-2594-0	Spring Compressor
		5-8840-0451-0	Installer
		5-8840-0452-0	Remover / Installer
		5-8840-2596-0	Distance Gauge
		5-8840-0455-0	Assembly Sleeves
		5-8840-2597-0	Installer
		5-8840-0457-0	Remover / Installer
		5-8840-0468-0	Remover / Installer

ENGINE MECHANICAL (C24SE, C22NE, 22LE, 20LE) 6A-93

ITEM NO.	ILLUSTRATION	PART NO.	PART NAME
		5-8840-0459-0	Installer
		5-8840-0460-0	Installer
		5-8840-0446-0	Flywheel Holder
		5-8840-2598-0	Holding Wrench
		5-8840-2599-0	Reamer Set
		5-8840-2600-0	Socket Wrench
		5-8840-2601-0	Installer

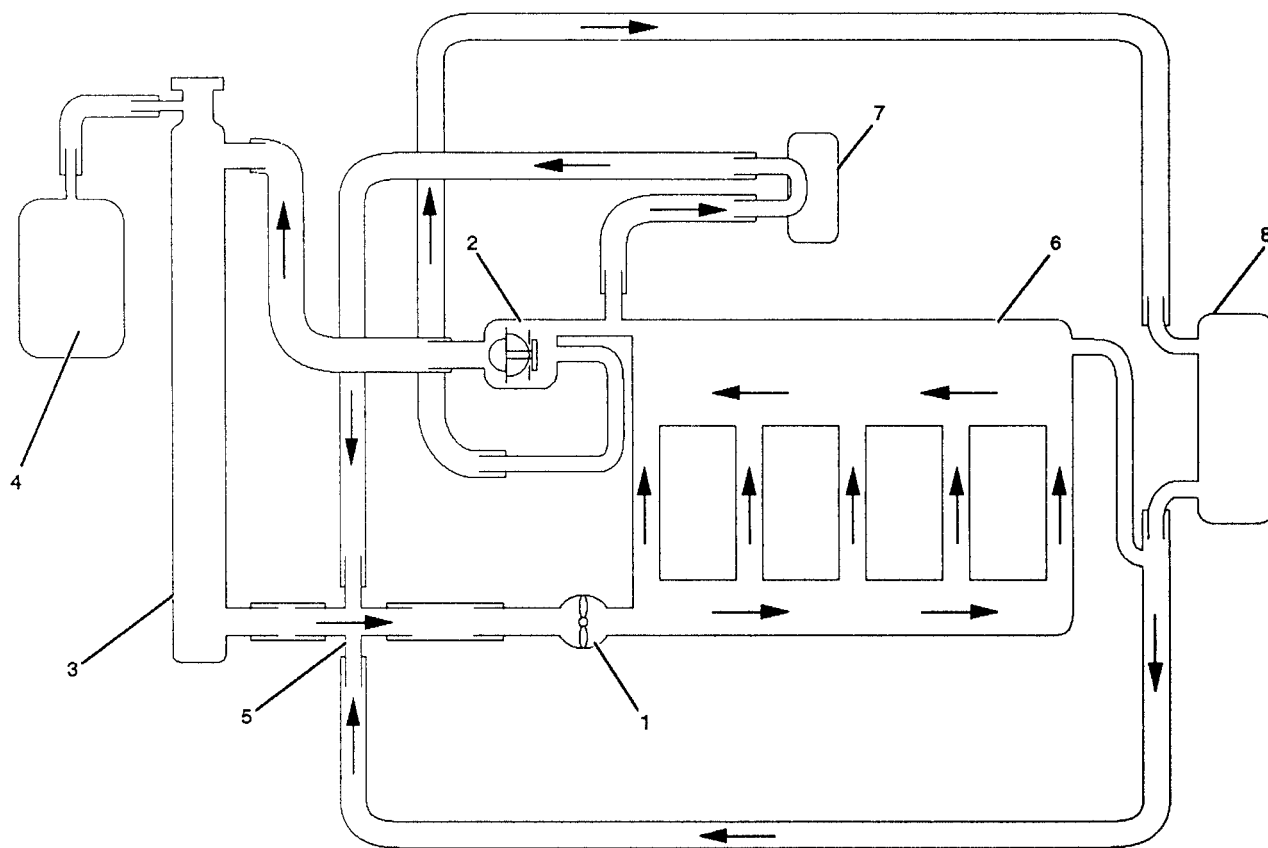
SECTION 6B

ENGINE COOLING

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General Description



Legend

- 1 Water Pump
- 2 Thermostat
- 3 Radiator
- 4 Reserve Tank

- 5 Coolant Distributor
- 6 Cylinder Block and Head
- 7 Throttle Body
- 8 Heater

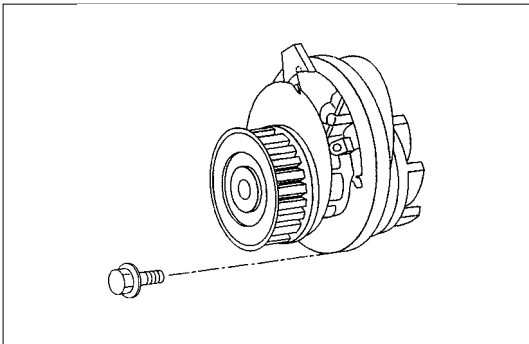
The Cooling System is a pressurized type, where the water pump, which is cambelt driven, forces the circulation of the coolant through the cylinder block and head. The thermostat regulates the flow of coolant between the radiator and the bypass circuit. The heater is part of the bypass circuit. The throttle body pre-heat is a separate circuit which is not regulated by the thermostat. An oil cooler may be fitted as part of this circuit.

Service Precaution



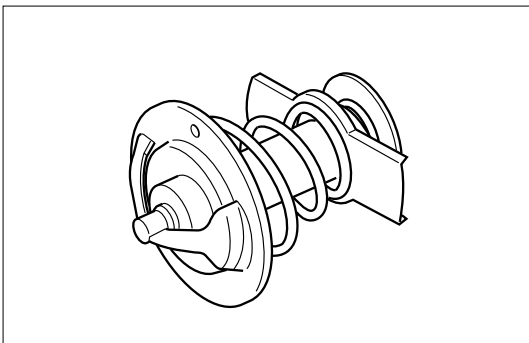
CAUTION:

Always use the correct fastener in the proper location. When you replace a fastener, use **ONLY** the exact part number for that application. ISUZU will call out those fasteners that require a replacement after removal. ISUZU will also call out the fasteners that require thread lockers or thread sealant. **UNLESS OTHERWISE SPECIFIED**, do not use supplemental coatings (Paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.



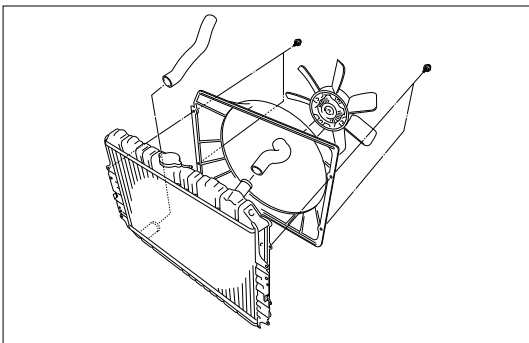
Water pump

The water pump is centrifugal type and is driven by timing belt.



Thermostat

The thermostat is a bypass type and is a wax pellet type with a air hole.



Radiator

The radiator is a flow type with corrugated fins.

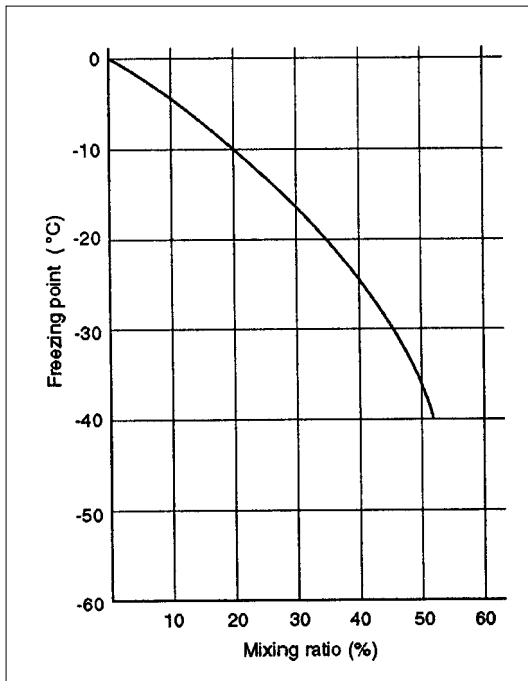
Antifreeze Solution

- Relation between Mixing ratio and Freezing temperature of the engine coolant varies with the ratio of antifreeze solution in water. Proper mixing ratio can be determined by referring to the chart. Supplemental inhibitors or additives claiming to increase cooling capability that have not been specifically approved by Isuzu are not recommended for addition to the cooling system.
 - Calculating mixing ratio
- Mixing ratio

$$= \frac{\text{Antifreeze solution (Lit/gal.)}}{\text{Antifreeze solution (Lit/gal.)} + \text{Water (Lit/gal.)}}$$

NOTE: Antifreeze solution + Water = Total cooling system capacity.

- **Total Cooling System Capacity**
5.7Lit



- Mixing ratio
Check the specific gravity of engine coolant in the cooling system temperature ranges from 0°C to 50°C using a suction type hydrometer, then determine the density of the engine coolant by referring to the table.

NOTE:

1. Even in the areas where the atmospheric temperature is higher than 0°C, be sure not to use antifreeze solution at a mixing ratio lower than 20% so that the inside of the engine may not be corroded.
2. If antifreeze solution is used at a mixing ratio higher than 60%, the specific heat of the coolant falls and the engine may be overheated. Moreover, antifreeze performance drop and the coolant may be frozen. The density of the solution must be adjusted as occasion calls.

Antifreeze solution lower than 20% may not have sufficient anticorrosive performance, and therefore, please never fail to adjust as occasion demands within the range of 20% to 60%.

Diagnosis

Engine Cooling Trouble

Condition	Possible cause	Correction
Engine overheating	Low Engine Coolant level	Replenish
	Thermo mater unit faulty	Replace
	Faulty thermostat	Replace
	Faulty Engine Coolant temperature sensor	Repair or replace
	Clogged radiator	Clean or replace
	Faulty radiator cap	Replace
	Low engine oil level or use of improper engine oil	Replenish or change oil
	Clogged exhaust system	Clean exhaust system or replace faulty parts
	Faulty Throttle Position sensor	Replace throttle valve assembly
	Open or shorted Throttle Position sensor circuit	Repair or replace
	Damaged cylinder head gasket	Replace
	Loosen V-belt tension	Adjust belt tension or replace.
	Collapsed hoses	Replace
	Faulty Fan clutch	Replace
Engine overcooling	Faulty thermostat	Replace
Engine slow to warm-up	Faulty thermostat	Replace
	Thermo unit faulty	Replace

Draining and Refilling Cooling System

Before draining the cooling system, inspect the system and perform any necessary service to ensure that it is clean, does not leak and is in proper working order. The engine coolant (EC) level should be between the "MIN" and "MAX" lines of reserve tank when the engine is cold. If low, check for leakage and add EC up to the "MAX" line. There should not be any excessive deposit of rust or scales around the radiator cap or radiator filler hole, and the EC should also be free from oil. Replace the EC if excessively dirty.

1. Completely drain the cooling system by opening the drain plug at the bottom of the radiator.
2. Remove the radiator cap.

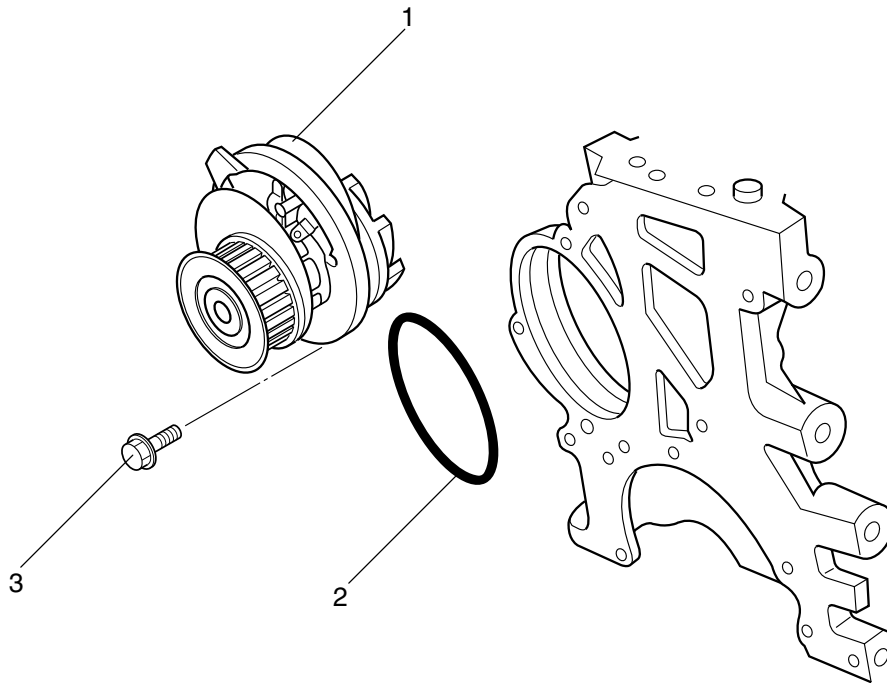


WARNING: TO AVOID THE DANGER OF BEING BURNED, DO NOT REMOVE THE CAP WHILE THE ENGINE AND RADIATOR ARE STILL HOT. SCALDING FLUID AND STEAM CAN BE BLOWN OUT UNDER PRESSURE.

3. Disconnect all hoses from the EC reserve tank.
Scrub and clean the inside of the reserve tank with soap and water. Flush it well with clean water, then drain it. Install the reserve tank and hoses.
4. Refill the cooling system with the EC using a solution that is at least 50 percent antifreeze but no more than 70 percent antifreeze.
5. Fill the radiator to the base of the filler neck.
Fill the EC reserve tank to "MAX" line when the engine is cold.
6. Block the drive wheels and firmly apply the parking brake. Shift an automatic transmission to "P" (Park) or a manual transmission to neutral.
7. Remove the radiator cap. Start the engine and warm it up at 2,500 - 3,000 rpm for about 30 minutes.
8. When the air comes out from the radiator filler neck and the EC level has gone down, replenish with the EC. Repeat this procedure until the EC level does not go down. Then stop the engine and install the radiator cap. Let the engine cool down.
9. After the engine has cooled, replenish with EC up to the "MAX" line of the reserve tank.
10. Start the engine. With the engine running at 3,000 rpm, make sure there is no running water sound from the heater core (behind the center console).
11. If the running water sound is heard, repeat steps 8 to 10.

Water Pump

Water Pump and Associated Parts



Legend

1 Water Pump Assembly

2 O-Ring

3 Bolt



Removal

1. Disconnect battery ground cable.
2. Drain coolant.
3. Disconnect radiator hose (on inlet pipe side).
4. Remove timing belt, refer to "Timing Belt" in this manual.
5. Remove water pump assembly.



Inspection

Make necessary repair and parts replacement if extreme wear or damage is found during inspection. Should any of the following problems occur, the entire water pump assembly must be replaced:

- Crack in the water pump body
- EC leakage from the seal unit

- Play or abnormal noise in the bearing
- Cracks or corrosion in the impeller



Installation

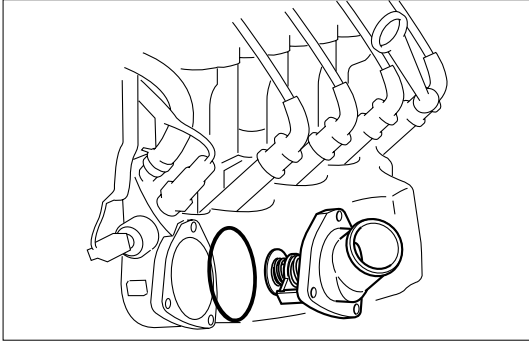
1. Before installing water pump, coat sealing surface with silicon grease.
2. Install water pump assembly and tighten bolts to the specified torque.



Torque: 25 N·m (2.5 kgf·m)

3. Timing belt
 - Install timing belt, refer to timing belt installation step in "Timing Belt" in this manual.
4. Connect radiator hose and replenish EC.
5. Connect battery ground cable.

Thermostat



Removal

1. Disconnect battery ground cable.
2. Drain engine coolant from the radiator and engine.
3. Disconnect radiator hose from the inlet pipe.
4. Remove thermostat housing.
5. Remove thermostat from thermostat housing.



Inspection

Suspend the thermostat in a water-filled container using thin wire. Place a thermometer next to the thermostat.

Do not directly heat the thermostat.

Gradually increase the water temperature. Stir the water so that the entire water is same temperature.

Confirm the temperature when the valve first begins to open.

Valve opening temperature 92°C (197.6°F)

Confirm the temperature when the valve is fully opened.

Valve full open temperature 107°C(224.6°F)

Make necessary repair and parts replacement if extreme wear or damage is found during inspection.

Installation



1. Before installing thermostat, coat sealing surface with silicon grease.
2. Install O-ring.
3. Install thermostat housing and tighten bolts to the specified torque.

Torque: 15 N·m (1.5 kgf·m)



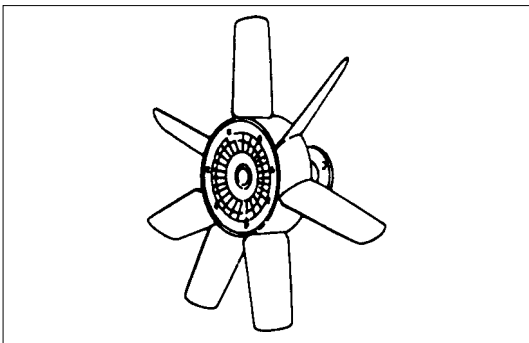
4. Installation rubber hose.
5. Replenish engine coolant (EC).
6. Start engine and check for EC leakage.

Fan Clutch with Cooling Fan



Inspection and Repair

Make necessary correction or parts replacement if wear, damage or any other abnormal condition are found through inspection.



Visually inspect for damage, leak (silicon grease) or other abnormal conditions.

1. Inspection (on-vehicle)

- 1) Turn the fan clutch by hand when in a low temperature condition before starting the engine, and confirm that it can be turned readily.
- 2) Start the engine to warm it up until the temperature at the fan clutch portion gets to around 80°C. Then stop the engine and confirm that the fan clutch can be turned with considerable effort (clutch torque) when turned by hand.

If the fan clutch rotates more readily, however, this indicates that the silicon grease is leaking internally. Replace the fan clutch with a new one.

2. Inspection (in unit)

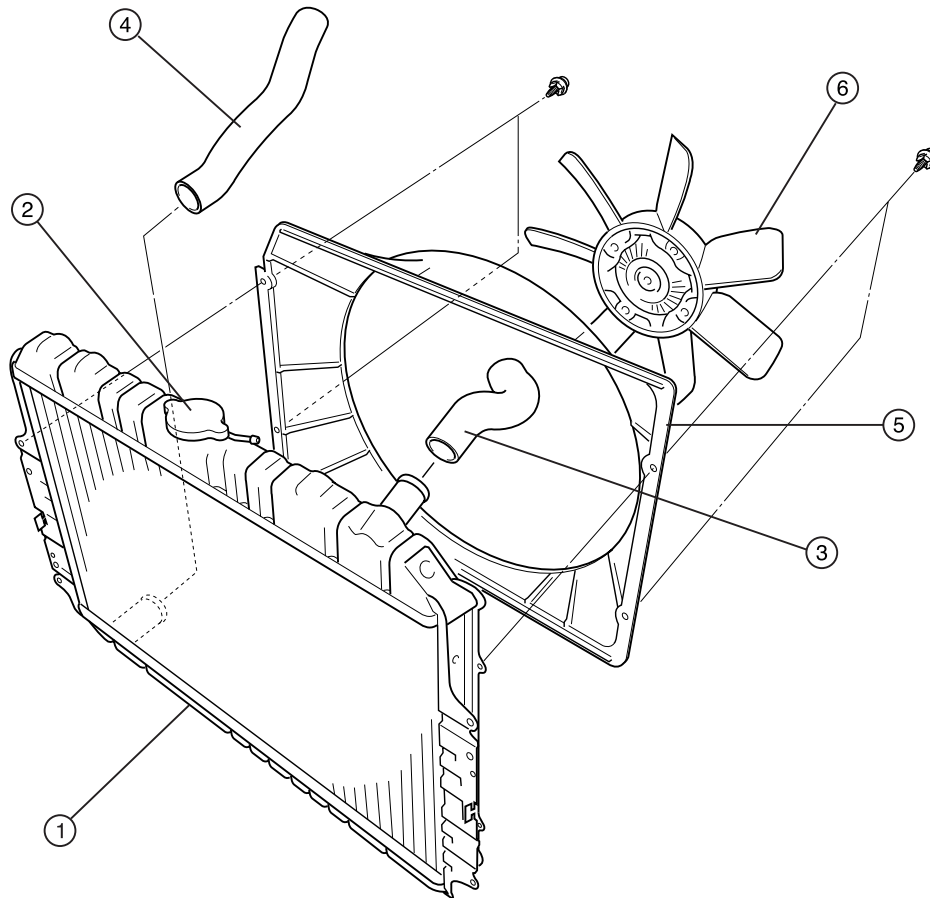
Warm up the bimetal of the fan clutch by using the heat gun until the temperature gets to about 80°C when measured with the thermistor. Then confirm that the fan clutch can be turned with considerable effort (clutch torque).

If the fan clutch rotates more readily at this time, this indicates that the silicon grease is leaking internally.

Replace the fan clutch with a new one.

Radiator

Radiator and Associated Parts



Legend

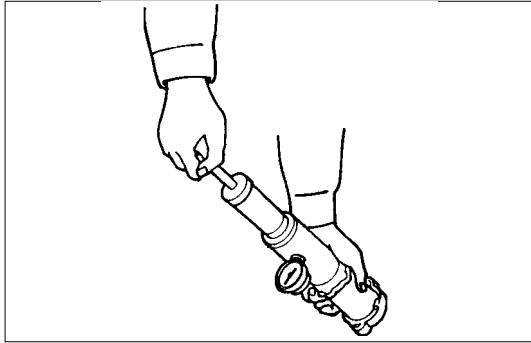
- 1 Radiator
- 2 Radiator Cap
- 3 Radiator Upper Hose

- 4 Radiator Lower Hose
- 5 Cooling Fan Shroud
- 6 Cooling Fan



Removal

1. Disconnect battery ground cable.
2. Loosen a drain plug to drain engine coolant (EC).
3. Disconnect radiator inlet hose and outlet hose.
4. Disconnect the reserve tank hose from radiator.
5. Lift out the radiator assembly, taking care not to damage the radiator core.



Inspection

Radiator Cap

Measure the valve opening pressure of the pressurizing valve with a radiator filler cap tester.

Replace the cap if the valve opening pressure is outside the standard range.

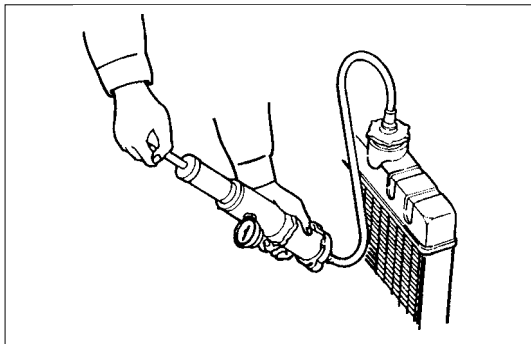
**Valve opening pressure kPa (psi) 88.3 - 1117.7
(13.5 - 17.8)**

Cap tester: 5-8840-0277-0

Adapter: 5-8840-2603-0

Check the condition of the vacuum valve in the center of the valve seat side of the cap. If considerable rust or dirt is found, or if the valve seat cannot be moved by hand, clean or replace the cap.

**Valve opening vacuum kPa (psi) 1.9 - 4.9
(0.28 - 0.71)**



Radiator Core

1. A bent fin may result in reduced ventilation and overheating may occur. All bent fins must be straightened. Pay close attention to the base of the fin when it is being straightened.
2. Remove all dust, bugs and other foreign material.

Flushing the Radiator

Thoroughly wash the inside of the radiator and the engine coolant passages with cold water and mild detergent. Remove all sign of scale and rust.

Cooling System Leakage Check

Use a radiator cap tester to force air into the radiator through the filler neck at the specified pressure of 196 kPa (28.5 psi) with a cap tester:

- Leakage from the radiator
- Leakage from the coolant pump
- Leakage from the water hoses
- Check the rubber hoses for swelling.

Cap tester: 5-8840-0277-0

Adapter: 5-8840-2603-0



Installation

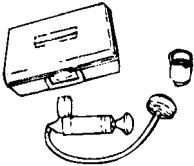
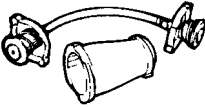
1. Install radiator assembly, taking care not to damage the radiator core.
2. Install the radiator assembly.
3. Connect reserve tank hose.
4. Connect radiator inlet hose and outlet hose.
5. Pour engine coolant up to filler neck of radiator, and up to MAX mark of reserve tank.
Important operation (in case of 100% engine coolant change) procedure for filling with engine coolant.
 - Remove radiator cap.
 - Fill with engine coolant (EC) to the radiator filler neck.
 - Fill with EC to the "MAX" line on the reservoir tank.
 - Start the engine with the radiator cap removed and bring to operating temperature by running engine at 2,500 - 3,000 rpm for 30 minutes.
 - By EC temperature gauge reading make sure that the thermostat is open.
 - If air bubbles come up to the radiator filler neck, replenish with EC. Repeat until the EC level does not drop any further. Install the radiator cap and stop the engine.
 - Replenish EC to the "MAX" line on the reservoir tank and leave as it is until the engine gets cool.
 - After the engine gets cool, start the engine and make sure there is no water running noise heard from the heater core while the engine runs at 3000 rpm.
 - Should water running noise be heard, repeat the same procedure from the beginning.

Main Data and Specifications

General Specifications

Cooling system	Engine Coolant forced circulation
Radiator	Tube type corrugated (2 tube in row)
Heat radiation capacity	59.100 kcal/h
Heat radiation area	10.915
Radiator front area	0.228
Radiator dry (weight)	66.6N, 6.9kg
Radiator cap valve opening pressure	88.3 - 117.7kpa
Engine coolant capacity	2.3L
Engine coolant pump	Centrifugal type
Thermostat	Bypass type
Engine coolant total capacity	5.7lit

SPECIAL SERVICE TOOL

ITEM NO.	ILLUSTRATION	PART NO.	PART NAME
1	 901RW072	5-8840-0277-0	Tester; radiator cap
2	 901RW073	5-8840-2603-0	Adapter; radiator cap

SECTION 6C

ENGINE FUEL

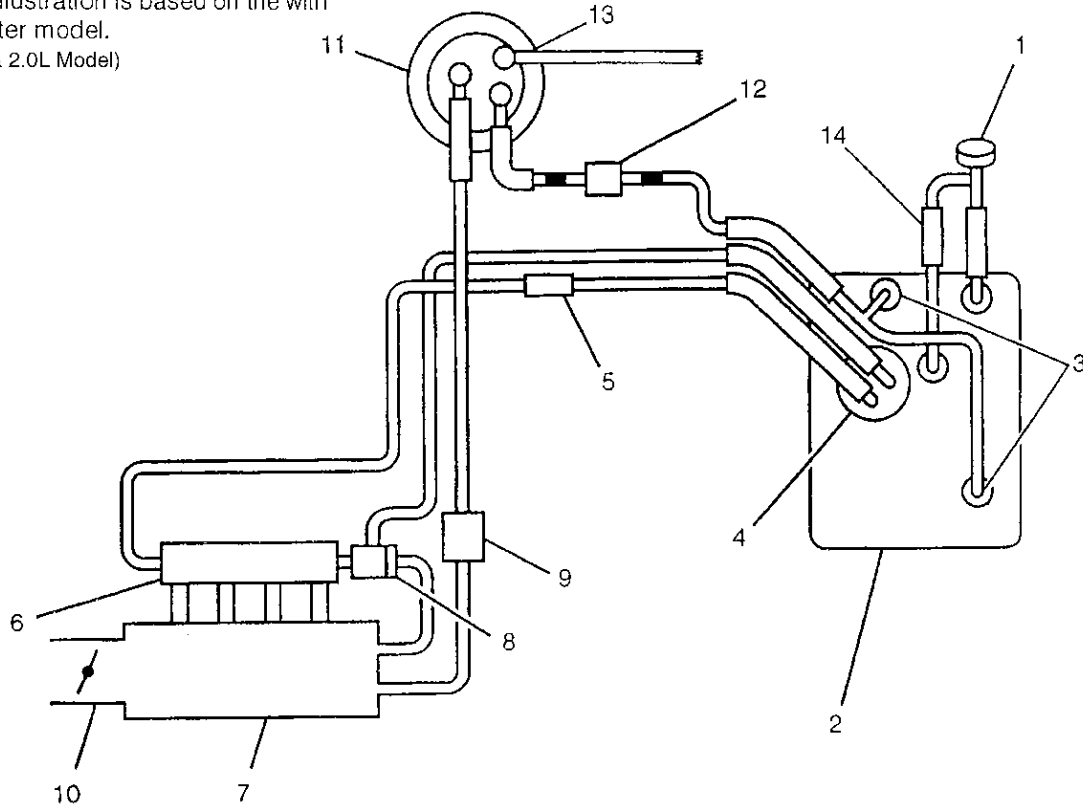
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General Description

This illustration is based on the with canister model.
(2.2L & 2.0L Model)

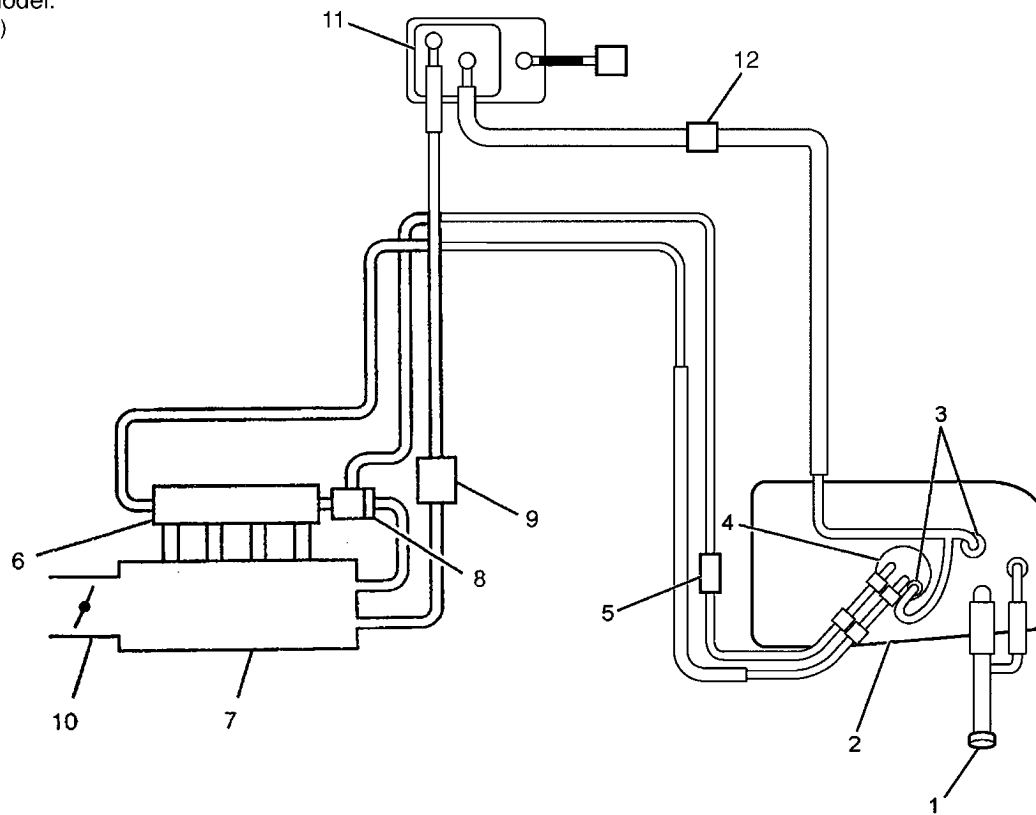


Legend

- | | |
|--------------------|-------------------------------|
| 1 Filter Cap | 8 Fuel Pressure Control Valve |
| 2 Fuel Tank | 9 Duty Solenoid Valve |
| 3 Rollover Valve * | 10 Throttle Valve |
| 4 Fuel Pump | 11 Canister * |
| 5 Fuel Filter | 12 Check and Relief Valve * |
| 6 Fuel Rail | 13. Drain hose * |
| 7 Intake Manifold | 14. 2 Way Valve ** |

6C-4 ENGINE FUEL

This illustration is based on the with canister model.
(2.4L Model)



Legend

- 1 Fuel Filter Cap
- 2 Fuel Tank
- 3 Rollover Valve*
- 4 Fuel Pump and Sender Assembly
- 5 Fuel Filter
- 6 Fuel Rail
- 7 Intake

- 8 Fuel Pressure Control Valve
- 9 Duty Solenoid Valve
- 10 Throttle Valve
- 11 Canister *
- 12 Check and Relief Valve *

* Applicable to EVAP Emission Control System

** Not applicable to EVAP Emission Control System

When working on the fuel system, there are several things to keep in mind:

- Any time the fuel system is being worked on, disconnect the negative battery cable except for those tests where battery voltage is required.
- Always keep a dry chemical (Class B) fire extinguisher near the work area.
- Replace all pipes with the same pipe and fittings that were removed.
- Clean and inspect "O" rings. Replace if required.
- Always relieve the line pressure before servicing any fuel system components.
- Do not attempt repairs on the fuel system until you have read the instructions and checked the pictures relating to that repair.
- Adhere to all Notices and Cautions.

All gasoline engines are designed to use only unleaded gasoline. Unleaded gasoline must be used for proper emission control system operation.

Its use will also minimize spark plug fouling and extend engine oil life. Using leaded gasoline can damage the emission control system and could result in loss of emission warranty coverage.

All cars are equipped with an Evaporative Emission Control System. The purpose of the system is to minimize the escape of fuel vapors to the atmosphere.

Service Precaution



CAUTION:

Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. ISUZU will call out those fasteners that require a replacement after removal. ISUZU will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (Paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

Fuel Metering

Engine Control Module (ECM) is in complete control of this fuel delivery system during normal driving conditions.

The intake manifold function, like that of a diesel, is used only to let air into the engine. The fuel is injected by separate injectors that are mounted over the intake manifold.

The Manifold Absolute Pressure (MAP) sensor measures the changes in the intake manifold pressure which result from engine load and speed changes, which the MAP sensor converts to a voltage output.

This sensor generates the voltage to change corresponding to the flow of the air drawn into the engine.

The changing voltage is transformed into an electric signal and provided to the ECM.

With receipt of the signals sent from the MAP sensor, Intake Air Temperature sensor and others, the ECM determines an appropriate fuel injection pulse width feeding such information to the fuel injector valves to effect an appropriate air/fuel ratio.

The Multiport Fuel Injection system utilizes an injection system where the injectors turn on at every crankshaft revolution. The ECM controls the injector on time so that the correct amount of fuel is metered depending on driving conditions.

Two interchangeable "O" rings are used on the injector that must be replaced when the injectors are removed.

The fuel rail is attached to the top of the intake manifold and supplies fuel to all the injectors.

Fuel is recirculated through the rail continually while the engine is running. This removes air and vapors from the fuel as well as keeping the fuel cool during hot weather operation.

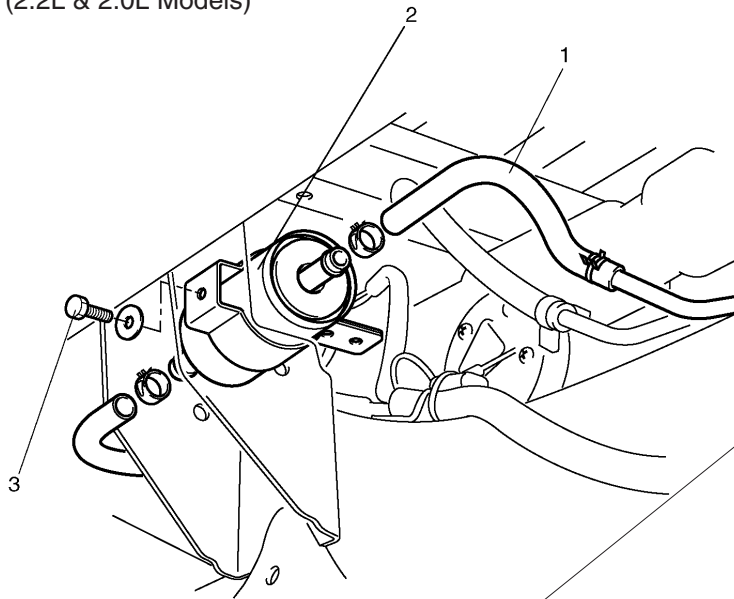
The fuel pressure control valve that is mounted on the fuel rail maintains a pressure differential across the injectors under all operating conditions. It is accomplished by controlling the amount of fuel that is recirculated back to the fuel tank based on engine demand.

See Section "Driveability and Emission" for more information and diagnosis.

Fuel Filter

Fuel Filter and Associated Parts

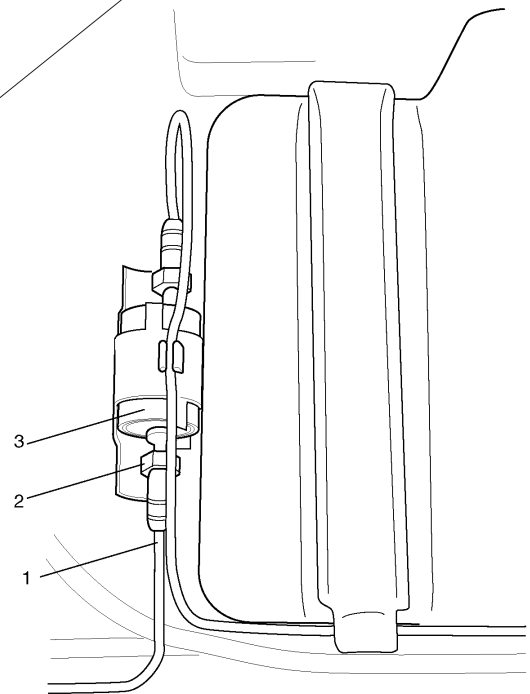
(2.2L & 2.0L Models)



Legend

- 1 Fuel Hose
- 2 Fuel Filter
- 3 Fixing bolt

(2.4L Model)



Legend

- 1 Fuel Hose
- 2 Quick Connector
- 3 Fuel Filter



Removal

CAUTION: When repair to the fuel system has been completed, start engine and check the fuel system for loose connections or leakage. For the fuel system diagnosis, see Section "Driveability and Emissions".

(2.2L & 2.0L)

1. Disconnect battery ground cable.
2. Remove fuel filler cap.
3. Loosen the fixing bolt and disconnect fuel hoses (1).
4. Remove fuel filter (2).

(2.4L)

1. Disconnect battery ground cable.
2. Disconnect the quick connector from the fuel filter.
3. Pull off fuel filter from the holder to side member side.
4. Remove the fuel filter.



Inspection

1. Replace the fuel filter if the fuel leaks from fuel filter body or if the fuel filter body itself is damaged.
2. Replace the filter if it is clogged with dirt or sediment.
3. Check the drain and if it is clogged with dust, clean it out with air.



Installation

(2.2L & 2.0L)

1. Install the fuel filter in the proper direction.
2. Install fuel filter holder fixing bolt.
3. Connect fuel hoses on engine side and fuel tank side.
4. Install fuel filler cap
5. Connect the battery ground cable.

(2.4L)

1. Install the fuel filter.
2. Install the quick connectors.
3. Connect the battery ground cable.



Inspection

After installation, start engine and check for fuel leakage.

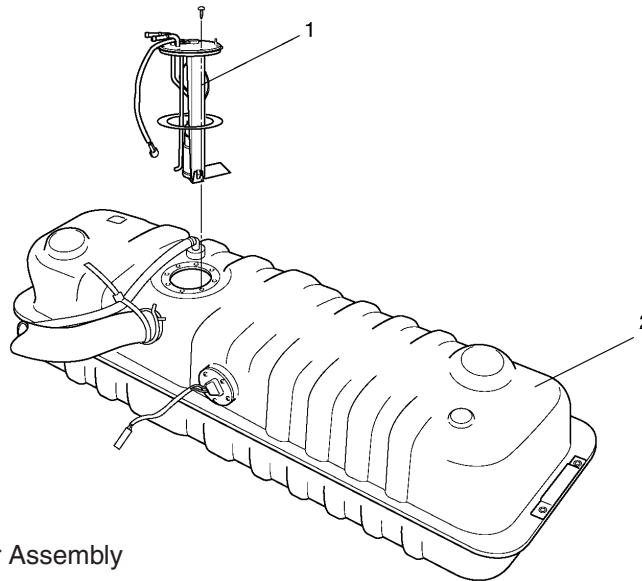
In-Tank Fuel Filter

The filter is located on the lower end of the fuel pickup tube in the fuel tank. It prevents dirt from entering the fuel pipe and also stops water unless the filter is completely submerged in the water. It is a self cleaning type, not requiring scheduled maintenance. Excess water and sediment in the tank restricts fuel supply to the engine, resulting in engine stop. In such a case, the tank must be cleaned thoroughly.

Fuel Pump

Fuel Pump and Associated Parts

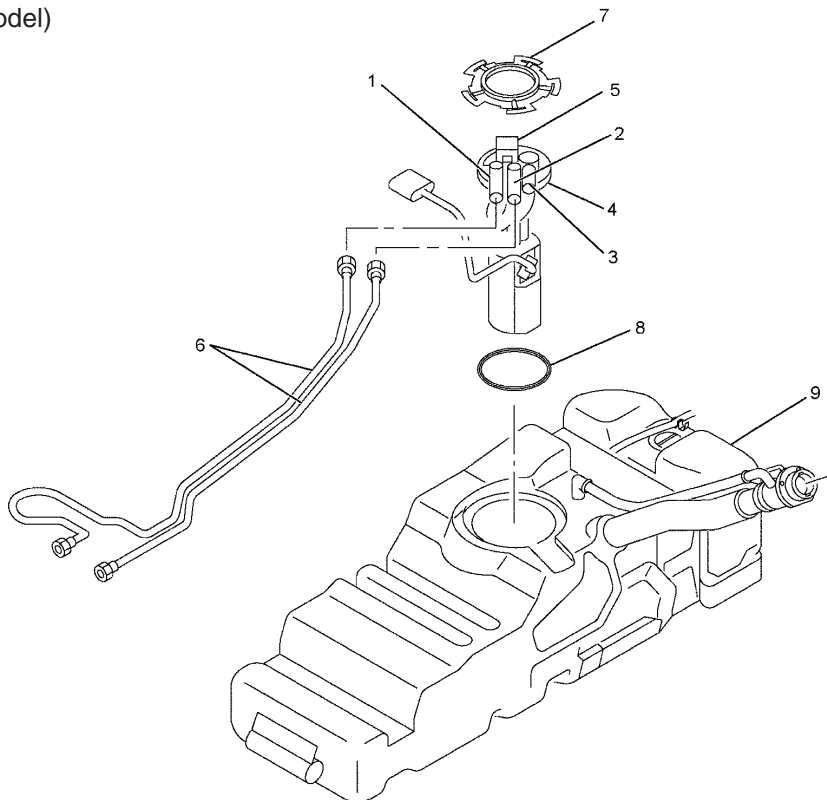
(2.2L & 2.0L Models)



Legend

- 1 Fuel Pump and Sender Assembly
- 2 Fuel Tank Assembly

(2.4L Model)



Legend

- | | | |
|----------------------|---------------------------------------|-----------------------------|
| 1 Fuel Feed Port | 4 Fuel Pump and Sender Assembly | 7 Retainer (Fuel Pump Lock) |
| 2 Fuel Return Port | 5 Connector ; Fuel Feed Pump & Sender | 8 Seal ; Fuel Pump |
| 3 Fuel Emission Port | 6 Fuel Tube / Quick Connector | 9 Fuel Tank Assembly |



Removal



CAUTION: When repair to the fuel system has been completed, start engine and check the fuel system for loose connection or leakage. For the fuel system diagnosis, see Section “Driceability and Emission”.

1. Disconnect battery ground cable.
2. Loosen fuel filler cap.
3. Support underneath of the fuel tank assembly (2) with a lifter.
4. Remove fuel tank assembly (2). Refer to “Fuel Tank Removal” in this section.
5. Remove fuel pump and sender (FPAS) assembly (1) fixing snapping and remove the FPAS assembly.

NOTE:

- After removing pump assembly (1), cover fuel tank to prevent any dust entering.
- Remove the fuel pump lock.



Installation

1. Install FPAS assembly (1).
2. Install fuel tank assembly (2). Refer to “Fuel Tank Installation”.
3. Fill the tank with fuel and tighten fuel filler cap.
4. Connect battery ground cable.

Fuel Tube/Quick-Connector Fittings

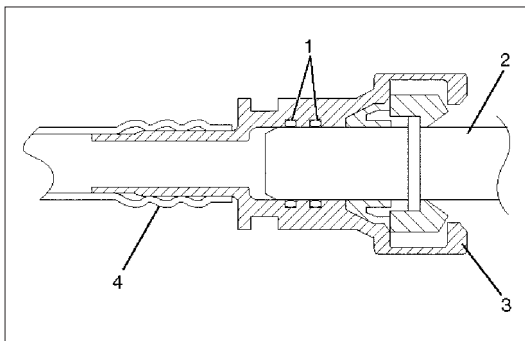
Precautions

- Do not light a match or create a flame.
- Keep flames away from your work area to prevent flammable materials from catching fire.
- Disconnect battery ground cable to prevent electrical shorts.
- Pre-treat piping system or associated parts from thermal damage or from spattering when welding or similar heat-generating work.

Cautions During Work

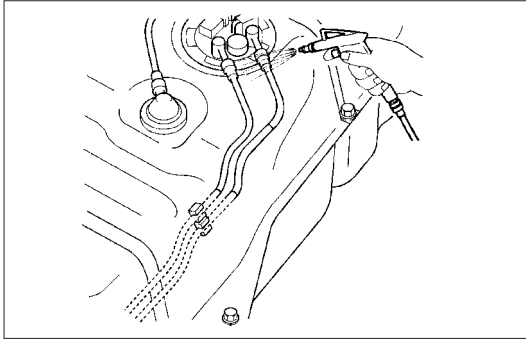
Do not expose the assembly to battery electrolyte or do not wipe the assembly with a cloth used to wipe off spilt battery electrolyte.

Piping that has been splattered with battery electrolyte or battery electrolyte soaked cloth that was wiped on the piping cannot be used.



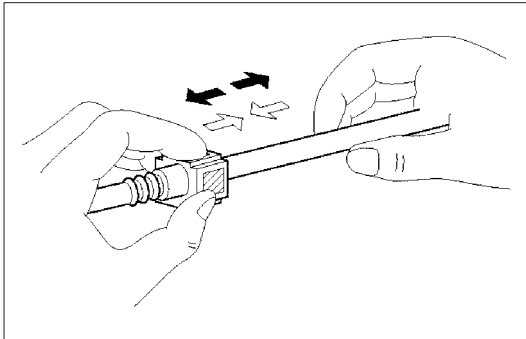
Legend

- (1) O-ring
- (2) Port
- (3) Connector
- (4) Plastic Tube



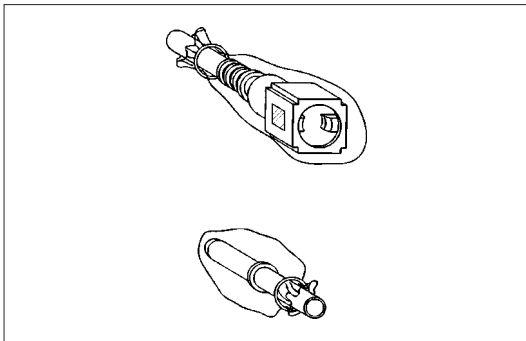
Removal

1. Open the fuel cap to relieve the fuel pressure in the tank. Use compressed air to remove any dirt on the fuel quick connect fittings prior to disconnecting the fittings. When disconnecting the fuel pipe, cover the area with a cloth to prevent fuel from splashing as the fuel pipe may still have some pressure in it.

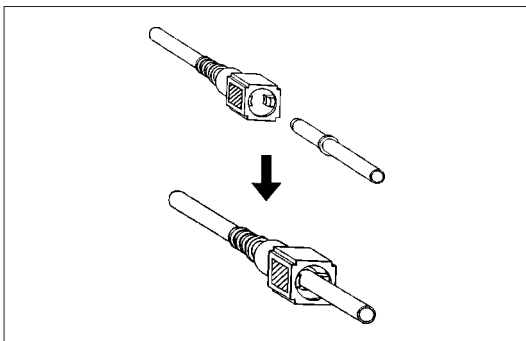


2. For removal of the quick connector, hold the quick connector in one hand, and pull out the connector with the other hand while pressing the square relieve button of the connector, as illustrated.

NOTE: Do not use tools of any kind. Only use bare hands when disconnecting the connector. Use a lubricant (light oil) and/or push and pull the connector until the pipe is disconnected.



Cover the connectors that was removed with a plastic bag, to prevent dust or rain water from entering.



Reuse of Quick-Connector

- Replace the port and connector if scratch, dent or crack is found.
- Remove any dirt build up on the port when installing the connector. Replace the connector, if there is any forms of rust, dent, scratch.
- After cleaning the port, insert it straight into the connector until it clicks. After it clicks, try pulling at 49N (5kgf) it out to make sure that it is not drawn and is securely locked.

Assembling Advice

By applying engine oil light oil to the pipe, port makes pipe assembly easier. The pipe assembly should take place immediately after applying oil (to prevent dust from sticking to the pipe surface-which may decrease sealing ability).

Test/Inspection After Assembling

1. Reconnect the battery negative cable.
2. Turn the ignition key to the "ON" position and listen for pump start-up sound. Inspect for leaks, the fuel pressure will increase as the fuel pump is actuated.
3. Perform leak inspection (step 2) several times.
4. Start the engine and observe the engine idle speed. The presence of dirt in the fuel system may affect the fuel injection system.

Fuel Pump Relay

General Description

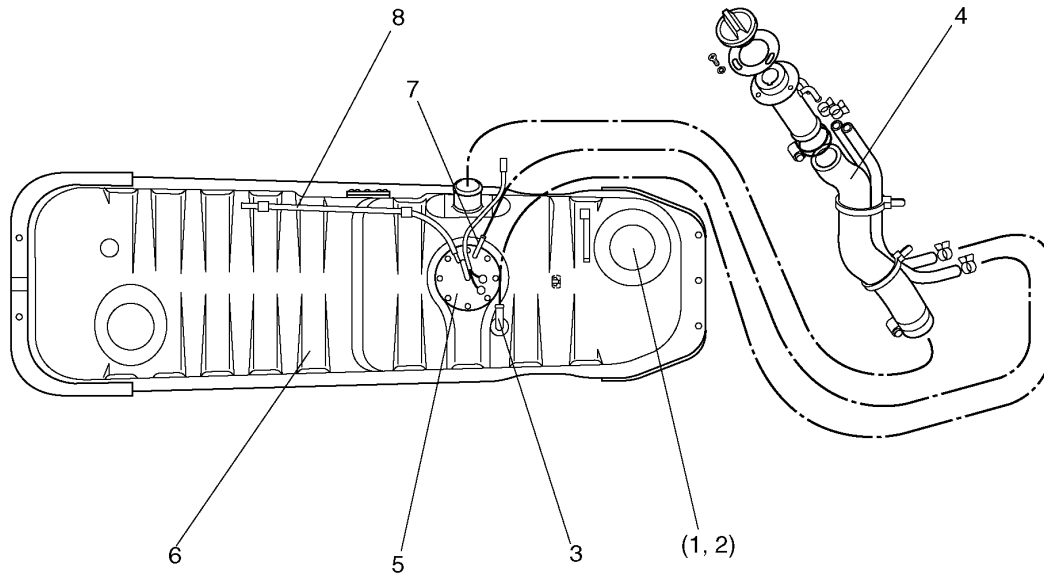
In order to control the FPAS operation, the FPAS relay is provided. When the starter switch is turned to "ON" position, the FPAS relay operates the FPAS for 2 seconds.

When it is turned to "START" position, the Engine Control Module receives the reference pulse from the Ignition Control Module and it operates the relay, again causing the FPAS to feed fuel.

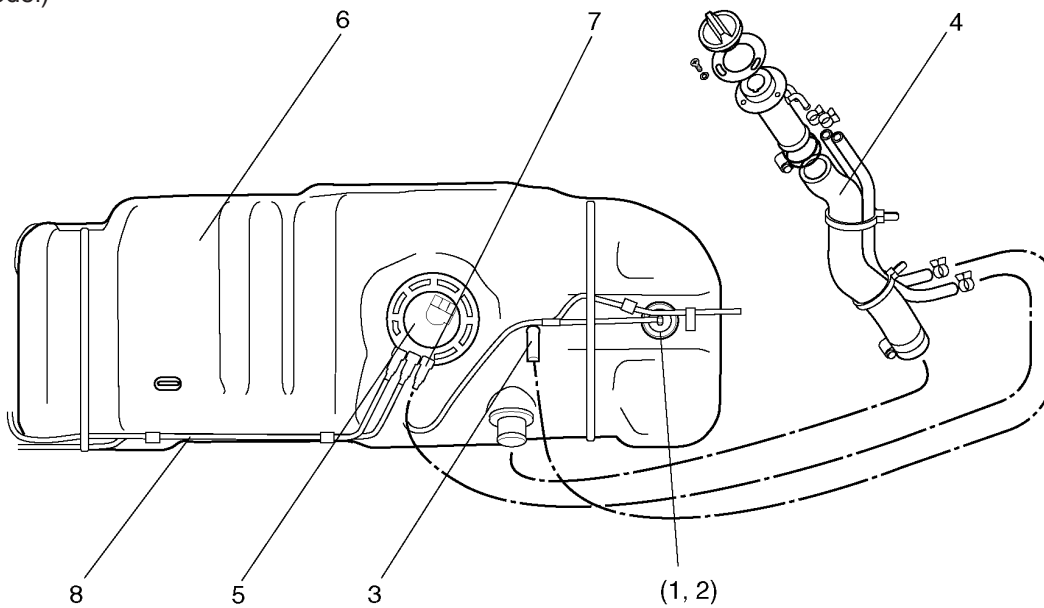
Fuel Tank

Fuel Tank and Associated Parts

(2.2L & 2.0L Models)



(2.4L Model)



Legend

- 1 Roll Over&Float Valve (If applicable)
- 2 Hose; Evaporative Fuel (If applicable)
- 3 Hose; Air Breather
- 4 Hose; Fuel Filter

- 5 Fuel Pump and Sender Assembly
- 6 Fuel Tank Assembly
- 7 Hose; Fuel Delivery
- 8 Hose; Fuel Return



Removal



CAUTION: When repair to the fuel system has been completed, start engine and check the fuel system for loose connection or leakage. For the fuel system diagnosis, see Section "Driveability and Emission".

1. Disconnect battery ground cable.
2. Loosen fuel filler cap.
3. Support underneath of the fuel tank protector with a lifter.
4. Disconnect evaporative fuel hose at the canister.
5. Disconnect fuel delivery hose and fuel return hose near the fuel filter.

NOTE: Plug both ends of the fuel hoses to prevent fuel leakage.

6. Disconnect air breather hose (3) and fuel filler hose (4) at the fuel filler neck.

NOTE: Cover fuel hose to prevent any dust entering.

7. Remove the four fuel tank assembly fixing bolts at four corners of the tank.
8. Let down the tank and disconnect the wiring connectors and the emission hose at the emission port on the fuel pump and sending assembly (5).
9. Remove fuel tank assembly along with protectors.
10. Remove roll over&float valve (1) along with the evaporative fuel hose and pipe (2).
11. Remove fuel pump and sender assembly (5) by removing the snap ring along with the fuel hoses (7, 8).
12. Remove tank protector by removing the fixing bolts.



Installation

1. Install protectors and tighten the fixing bolts to the specified torque.

Torque: 68 N·m (6.9 kgf·m)

2. Install fuel pump and sender assembly by fitting in the snap ring.
3. Install roll over&float valve (1).
4. Lift up fuel tank assembly and connect the emission hose to the emission port and the wiring connectors on the fuel pump and sending assembly (5).
5. Install fuel tank assembly along with protectors and tighten the four fixing bolts to the specified torque.

Torque: 68 N·m (6.9 kgf·m)

6. Connect fuel filler hose (4) and air breather hose (3), and clip them firmly.
7. Connect fuel delivery hose (7) and fuel return hose (8), and clip them firmly.
8. Connect evaporative fuel hose (2).
9. Tighten fuel filler cap.
10. Connect battery ground cable.

Fuel Gage Unit

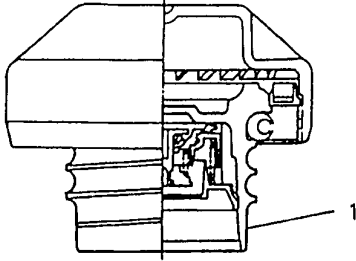


Removal and Installation



As for removal and installation of the Fuel Gauge Unit, refer to "Fuel Tank" of this section 6C as the fuel gauge unit is combined with the fuel pump and sender assembly.

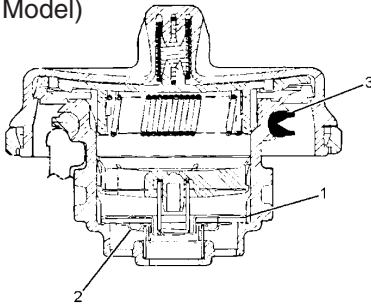
(2.2L & 2.0L Model)



Legend

1 Fuel Filler Cap

(2.4L Model)



Legend

- 1 Vacuum Valve
- 2 Pressure Valve
- 3 Seal Ring

Fuel Filler Cap

General Description

Fuel filler cap includes vacuum valve.

In case any high vacuum happen in tank, the valve works to adjust the pressure to prevent the tank from being damaged.

Inspection

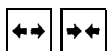


Check the seal ring in the filler cap for presence of any abnormality and for seal condition.

Replace the filler cap, if abnormal.

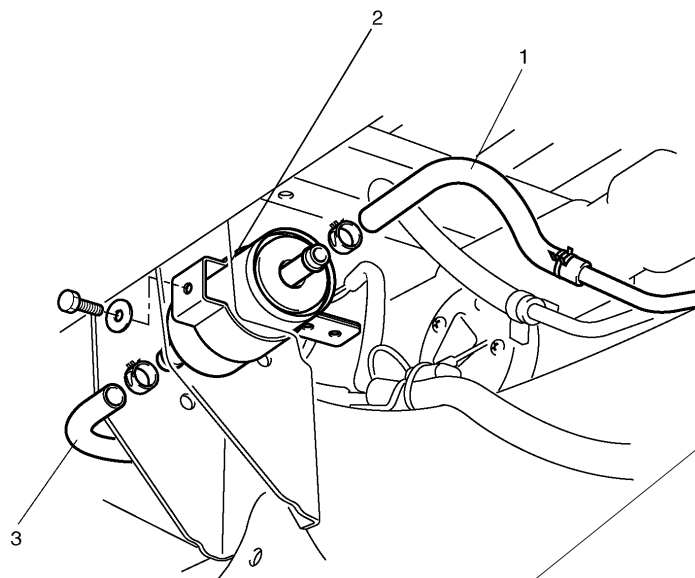
CAUTION: The fuel filler cap valve has characteristics. A defective valve, no valve at all or a valve with the wrong characteristics will do a lot of harm to engine operating characteristics; be sure to use the same fuel filler cap as installed in this vehicle.

Fuel Filter

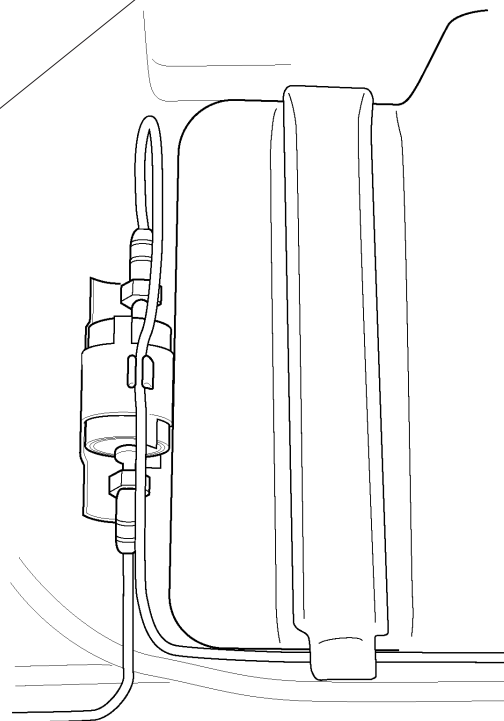


Removal and Installation

(2.2L & 2.0L Models)



(2.4L Model)



Removal

1. Inlet and outlet fuel hose
2. Fuel filter



Installation

2. Fuel filter
1. Inlet and outlet fuel hose

**Important Operations - Removal****1. Inlet and Outlet Fuel Hose**

Use a rag to prevent the fuel from flowing from the fuel hoses.

NOTE:

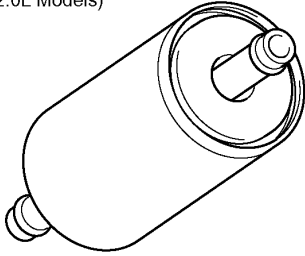
Immediately plug the fuel hoses.

Do not work in close proximity to sparks or an open flame.

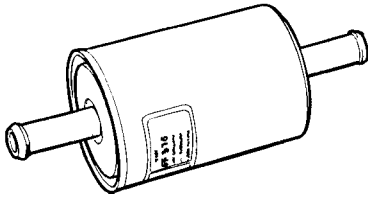
**Important Operations - Installation****1. Fuel Filter**

- 1) Install the fuel filter to the fuel pump in the direction indicated by the arrow stamped on the side of the fuel filter.
- 2) Start the engine.
Check for fuel leakage from the fuel hose joints.

(2.2L & 2.0L Models)



(2.4L Model)

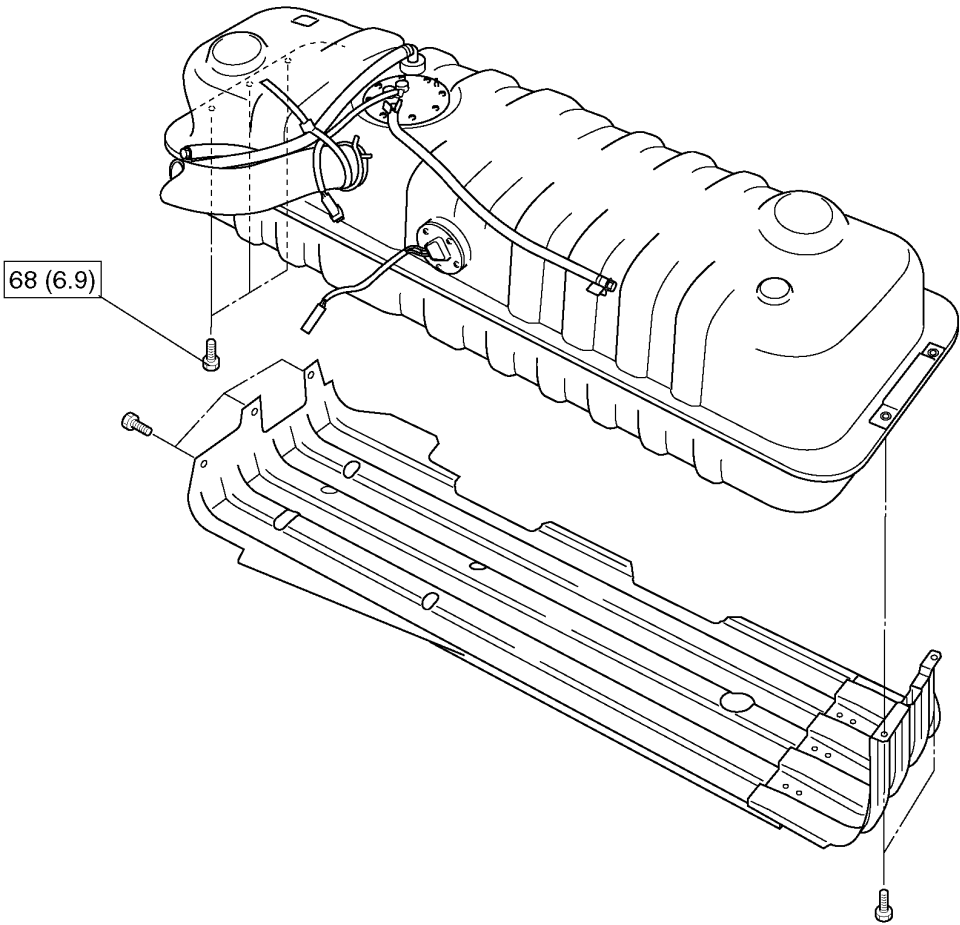


Main Data and Specification

Torque Specification

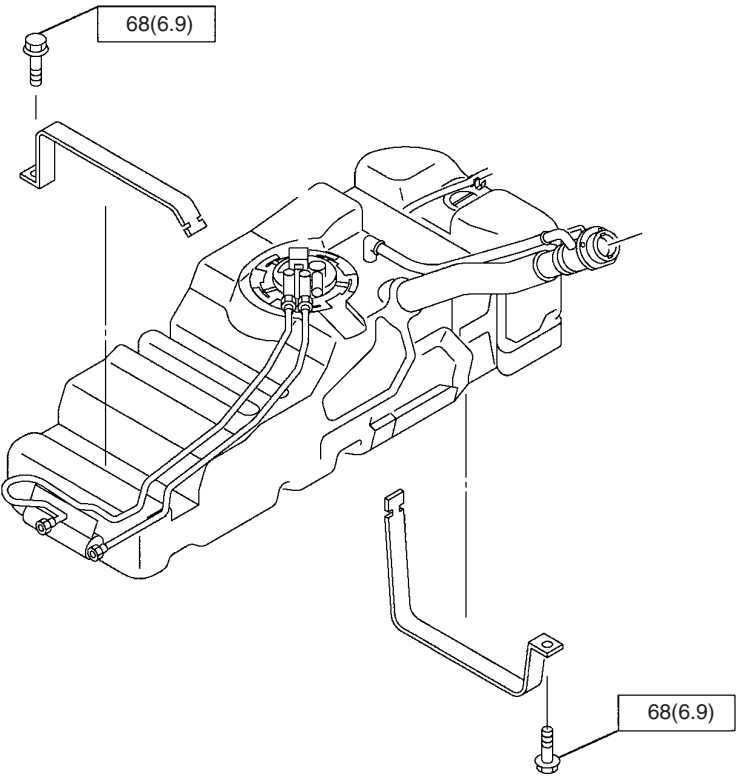
N·m (kgf·m)

(2.2L & 2.0L Models)



N·m (kgf·m)

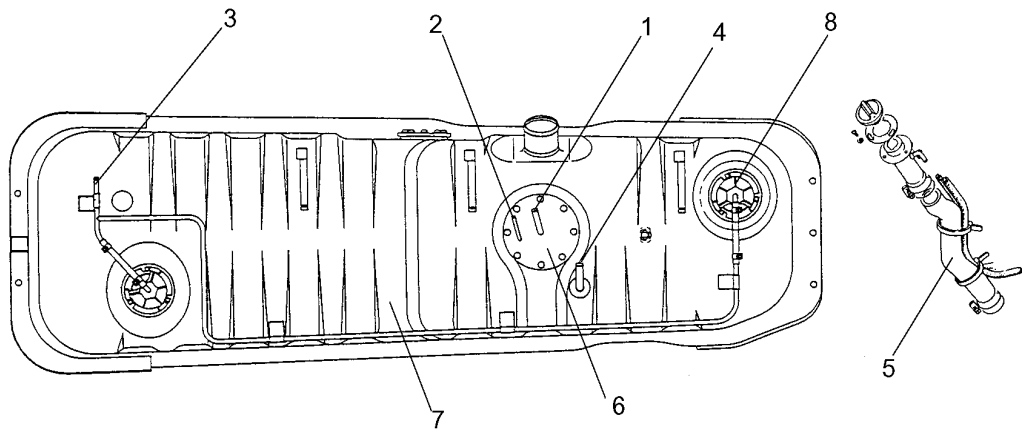
(2.4L Model)



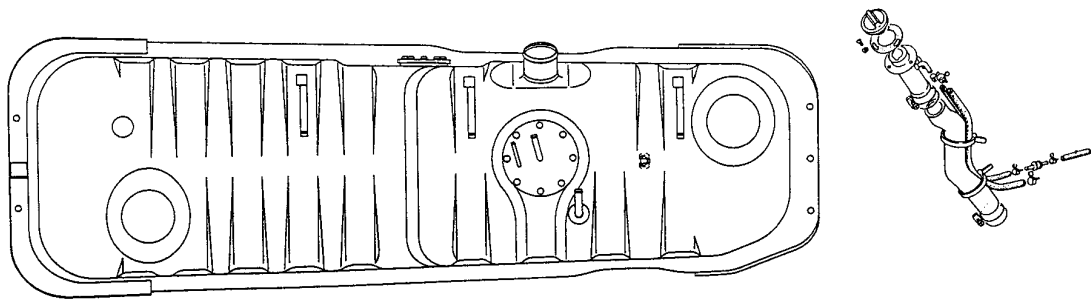
Fuel Tank

↔ ↔ Removal and Installation

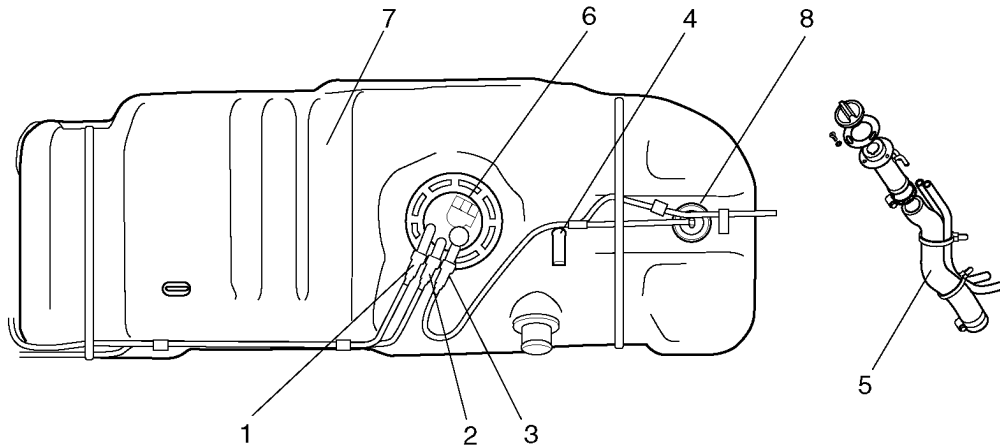
(2.2L & 2.0L Models)
WITH CANISTER APPLICABLE TO ROLLOVER VALVE



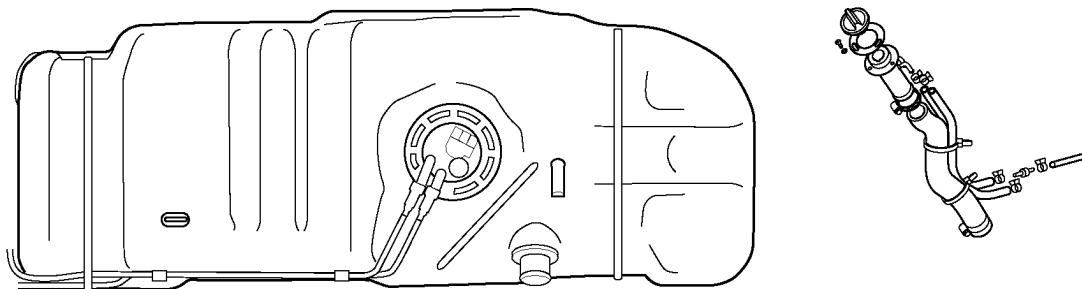
WITH CANISTER & ROLLOVER VALVE



(2.4L Model)
WITH CANISTER APPLICABLE TO ROLLOVER VALVE



WITH CANISTER & ROLLOVER VALVE



↔ Removal

1. Fuel hose (Delivery)
2. Fuel hose (Return)
3. Evapo fuel hose
4. Breather hose
5. Fuel filler hose
6. Fuel Pump
7. Fuel tank
8. Roll over valve

↔ Installation

To install, follow the removal steps in the reverse order.



Removal

Preparation

- Disconnect battery ground cable.
- Loosen fuel filler cap.
- Drain fuel.
Tighten drain plug to the specified torque after drain fuel.



	N·m (kgf·m)
20 (2.0)	

NOTE:
Cover fuel hose with waste to prevent any dust entering.



Installation

7. Fuel Tank

- Tighten fuel tank bolt.



	N·m (kgf·m)
26.5 (2.7)	

SECTION 6D1
ENGINE ELECTRICAL

CONTENTS

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Jump Starting.....	6D1- 4
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Installation.....	6D1- 6
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Battery

General Description

There are six battery fluid caps on top of the battery.

These are covered by a paper label.

The battery is completely sealed except for the six small vent holes on the side. These vent holes permit the escape of small amounts of gas generated by the battery.

This type of battery has the following advantages over conventional batteries:

1. There is no need to add water during the entire service life of the battery.
2. The battery protects itself against overcharging.
The battery will refuse to accept an extensive charge.
(A conventional battery will accept an excessive charge, resulting in gassing and loss of battery fluid.)
3. The battery is much less vulnerable to self discharge than a conventional type battery.

Service Precaution



CAUTION:

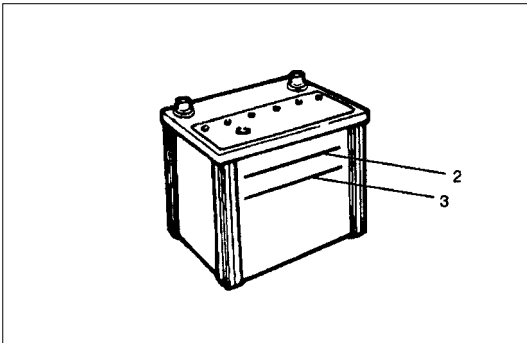
Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. ISUZU will call out those fasteners that require a replacement after removal. ISUZU will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (Paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

Diagnosis

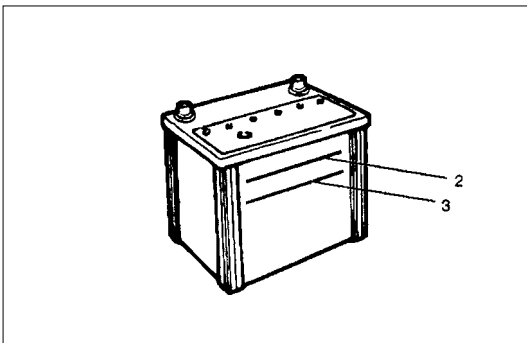
1. Visual Inspection

Inspect the battery for obvious physical damage, such as a cracked or broken case, which would permit electrolyte loss. Replace the battery if obvious physical damage is discovered during inspection.

Check for any other physical damage and correct it as necessary.



2. Hydrometer Check



3. Fluid Level Check

The fluid level should be between the upper level line (2) and lower level line (3) on side of battery.

- a. CORRECT FLUID LEVEL - Charge the battery.
- b. BELOW LOWER LEVEL - Replace battery.

4. Voltage Check

1. Put voltmeter test leads to battery terminals.
 - a. VOLTAGE IS 12.4V OR ABOVE - Go to Step 5.
 - b. VOLTAGE IS UNDER 12.4V - Go to procedure (2) below.
2. Determine fast charge amperage from specification.
(See Main Data and Specifications in this section).
Fast charge battery for 30 minutes at amperage rate no higher than specified value.
Take voltage and amperage readings after charge.
 - a. VOLTAGE IS ABOVE 16V AT BELOW 1/3 OF AMPERAGE RATE - Replace battery.
 - b. VOLTAGE IS ABOVE 16V AT ABOVE 1/3 OF AMPERAGE RATE - Drop charging voltage to 15V and charge for 10 - 15 hours. Then go to Step 5.
 - c. VOLTAGE IS BETWEEN 12V AND 16V - Continue charging at the same rate for an additional 3-1/2 hours. Then go to Step 5.
 - d. VOLTAGE BELOW 12V - Replace Battery.

Battery Charging

Observe the following safety precautions when charging the battery:

1. Never attempt to charge the battery when the fluid level is below the lower level line on the side of the battery. In this case, the battery must be replaced.
2. Pay close attention to the battery during charging procedure.

Battery charging should be discontinued or the rate of charge reduced if the battery feels hot to the touch.

Battery charging should be discontinued or the rate of charge reduced if the battery begins to gas or spew electrolyte from the vent holes.

3. In order to more easily view the hydrometer blue dot or ring, it may be necessary to jiggle or tilt the battery.
4. Battery temperature can have a great effect on battery charging capacity.
5. The sealed battery used on this vehicle may be either quick charged or slow charged in the same manner as other batteries.

Whichever method you decide to use, be sure that you completely charge the battery. Never partially charge the battery.

Jump Starting

Jump Starting with an Auxiliary (Booster) Battery

CAUTION: Never push or tow the vehicle in an attempt to start it. Serious damage to the emission system as well as other vehicle parts will result.

Treat both the discharged battery and the booster battery with great care when using jumper cables.

Carefully follow the jump starting procedure, being careful at all times to avoid sparking.

WARNING: FAILURE TO CAREFULLY FOLLOW THE JUMP STARTING PROCEDURE COULD RESULT IN THE FOLLOWING:

1. Serious personal injury, particularly to your eyes.
2. Property damage from a battery explosion, battery acid, or an electrical fire.
3. Damage to the electronic components of one or both vehicles particularly.

Never expose the battery to an open flame or electrical spark.

Gas generated by the battery may catch fire or explode.

Remove any rings, watches, or other jewelry before working around the battery. Protect your eyes by wearing an approved set of goggles.

Never allow battery fluid to come in contact with your eyes or skin.

Never allow battery fluid to come in contact with fabrics or painted surfaces.

Battery fluid is a highly corrosive acid.

Should battery fluid come in contact with your eyes, skin, fabric, or a painted surface, immediately and thoroughly rinse the affected area with clean tap water.

Never allow metal tools or jumper cables to come in contact with the positive battery terminal, or any other metal surface of the vehicle. This will protect against a short circuit.

Always keep batteries out of reach of young children.

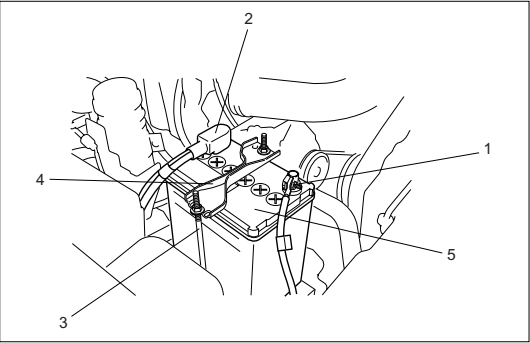
Jump Starting Procedure

1. Set the vehicle parking brake.
If the vehicle is equipped with an automatic transmission, place the selector level in the "PARK" position.
If the vehicle is equipped with a manual transmission, place the shift lever in the "NEUTRAL" position.
Turn "OFF" the ignition.
Turn "OFF" all lights and any other accessory requiring electrical power.
2. Look at the built-in hydrometer.
If the indication area of the built-in hydrometer is completely clear, do not try to jump start.
3. Attach the end of one jumper cable to the positive terminal of the booster battery.
Attach the other end of the same cable to the positive terminal of the discharged battery.
Do not allow the vehicles to touch each other. This will cause a ground connection, effectively neutralizing the charging procedure.
Be sure that the booster battery has a 12 volt rating.
4. Attach one end of the remaining cable to the negative terminal of the booster battery.
Attach the other end of the same cable to a solid engine ground (such as the air conditioning compressor bracket or the generator mounting bracket) of the vehicle with the discharged battery.
The ground connection must be at least 450 mm (18 in.) from the battery of the vehicle whose battery is being charged.



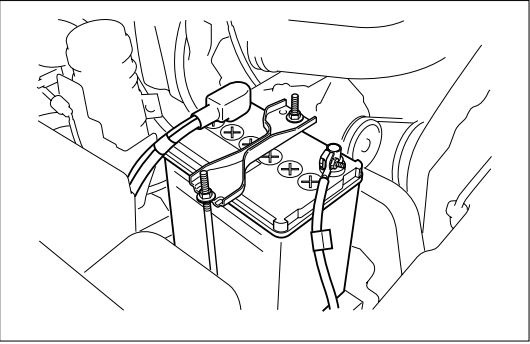
WARNING: NEVER ATTACH THE END OF THE JUMPER CABLE DIRECTLY TO THE NEGATIVE TERMINAL OF THE DEAD BATTERY.

5. Start the engine of the vehicle with the good battery.
Make sure that all unnecessary electrical accessories have been turned "OFF".
6. Start the engine of the vehicle with the dead battery.
7. To remove the jumper cables, follow the above directions in reverse order.
Be sure to first disconnect the negative cable from the vehicle with the discharged battery.



Removal

1. Remove negative cable (1).
2. Remove positive cable (2).
3. Remove retainer screw and rods (3).
4. Remove retainer (4).
5. Remove battery (5).



Installation

1. Install battery.
 2. Install retainer.
 3. Instal retainer screw and rods.
- NOTE: Make sure that the rod is hooked on the body side.
4. Install positive cable.
 5. Install negative cable.

Main Data and Specifications
General Specifications

Model (JIS)	34B19L	46B19L	50D20L
Voltage (V)	12	12	12
Cold Cranking Performance (Amp)	272	325	306
Reserve Capacity (Min)	49	71	78

SECTION 6D2

IGNITION SYSTEM

CONTENTS

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Spark Plug.....	6D2- 3
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Installation.....	6D2- 4
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General Description

Ignition is done by the Ignition Module that fires.

Since the cylinder on exhaust stroke requires less energy to fire its spark plug, energy from the ignition coils can be utilized to fire the mating cylinder on compression stroke.

A notch in the timing disc on the crankshaft activates the crank angle sensor which then sends information such as firing order and starting timing of ignition coil to the ECM.

By receiving signals such as crank position, engine speed, water temperature and Manifold Absolute Pressure (MAP), the ECM controls the ignition timing.

Service Precaution



CAUTION:

Always use the correct fastener in the proper location. When you replace a fastener, use **ONLY** the exact part number for that application. ISUZU will call out those fasteners that require a replacement after removal. ISUZU will also call out the fasteners that require thread lockers or thread sealant. **UNLESS OTHERWISE SPECIFIED**, do not use supplemental coatings (Paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

Diagnosis

Refer to Section Drivability and Emissions for the diagnosis to electronic ignition system (EI system).

Ignition Coil



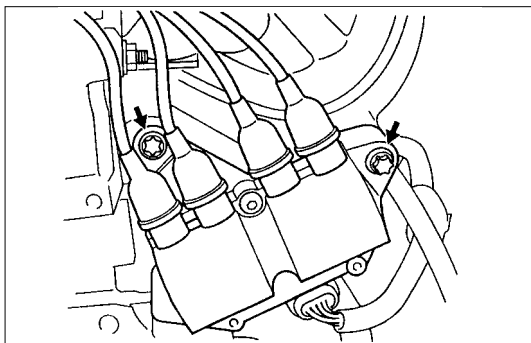
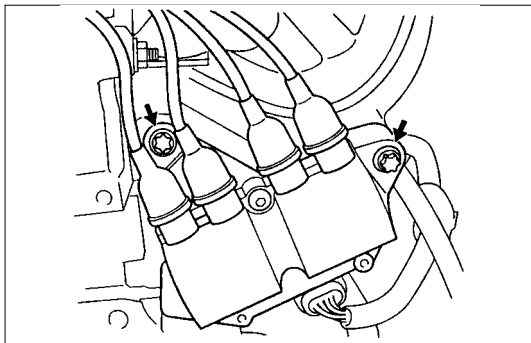
Removal

1. Disconnect battery ground cable.
2. Disconnect the Ignition coil connector.
3. Remove the ignition coil.



Installation

1. Install the ignition coil.
Connect ignition coil connector and ignition coil, then tighten bolt to the specified torque.
Torque: 20 N·m (2.0 kgf·m)
2. Connect battery ground cable.



Spark Plug



Removal

1. Remove spark plugs.



Inspection and Repair

The spark plug affects entire engine performance and therefore its inspection is very important.

- Check electrode and insulator for presence of cracks, and replace if any.
- Check electrode for wear, and replace if necessary.
- Check gasket for damage, and replace if necessary.
- Measure insulation resistance with an ohmmeter, and replace if faulty.
- Adjust spark plug gap to 1.0 - 1.1 mm (0.027 in) - 0.8 mm (0.031 in).
- Check fuel and electrical systems if spark plug is extremely dirty.
- Use spark plugs having low heat value (hot type plug) if fuel and electrical systems are normal.
- Use spark plugs having high heat value (cold type plug) if insulator and electrode are extremely burned.

Sooty Spark Plugs

Much deposit of carbon or oil on the electrode and insulator of spark plug reduces the engine performance.

Possible causes:

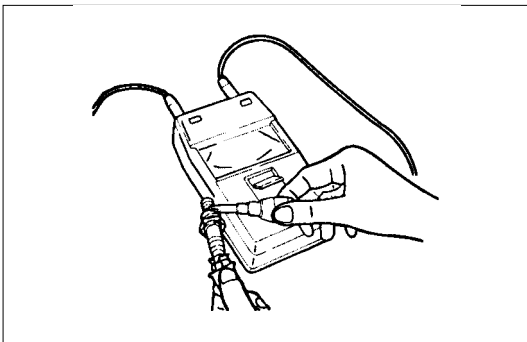
- Too rich mixture
- Presence of oil in combustion chamber
- Incorrectly adjusted spark plug gap

Burning Electrodes

This fault is characterized by scorched or heavily oxidized electrode or blistered insulator nose.

Possible causes:

- Too lean mixture
- Improper heat value



Measuring Insulation Resistance

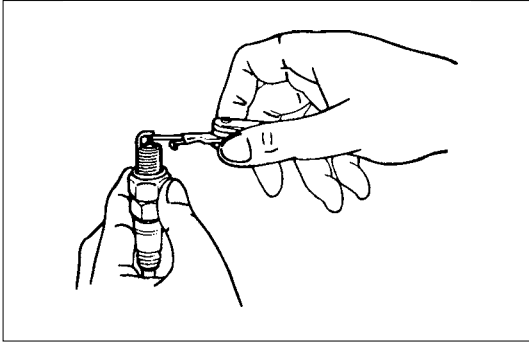
- Measure insulation resistance using a 500 volt megaohm meter.
- Replace spark plugs if measured value is out of standard.

Insulation resistance: 50 MΩ or more



Cleaning Spark Plugs

- Clean spark plugs with a spark plug cleaner.
- Raise the ground electrode to an angle of 45 to 60 degrees. if electrode is wet, dry it before cleaning.
- After spark plug is thoroughly cleaned, check insulator for presence of cracks.

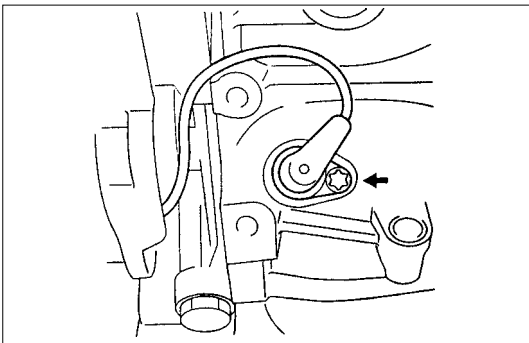


- Clean threads and metal body with a wire brush.
- File the electrode tip if electrode is extremely worn.
- Bend the ground electrode to adjust the spark plug gap.



Installation

1. Spark plugs
 - Tighten spark plugs to the specified torque.
Torque: 25 N·m (2.5 kgf·m)



Crankshaft Angle Sensor



Removal

1. Disconnect battery ground cable
2. Disconnect the wiring connector from crankshaft angle sensor.
3. Remove crankshaft angle sensor from cylinder block.



Installation

1. Install crankshaft angle sensor into the cylinder block.
Before installation, apply small amount of engine oil to the O-ring.
Torque: 6 N·m (0.6 kgf·m)
2. Reconnect wiring connector to crankshaft angle sensor.

Main Data and Specifications

General Specifications

Ignition System	
Ignition Form	Electronic Ignition System (EI system) with Crankshaft angle Sensor
Spark Plug	
Type	Electronic Spark Control
No. of Coils and Type	2 Solid State
Coil Location	Engine-mounted
Torque	20 N·m (2.0 kgf·m)

SECTION 6D3

STARTING AND CHARGING SYSTEM

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Starting System

General Description

Cranking Circuit

The cranking system consists of a battery, starter, starter switch, starter relay, etc. These main components are connected.

Starter

The cranking system employs a magnetic type reduction starter in which the motor shaft is also used as a pinion shaft. When the starter switch is turned on, the contacts of magnetic switch are closed, and the armature rotates. At the same time, the plunger is attracted, and the pinion is pushed forward by the shift lever to mesh with the ring gear.

Then, the ring gear runs to start the engine. When the engine starts and the starter switch is turned off, the plunger returns, the pinion is disengaged from the ring gear, and the armature stops rotation. When the engine speed is higher than the pinion, the pinion idles, so that the armature is not driven.

Service Precaution

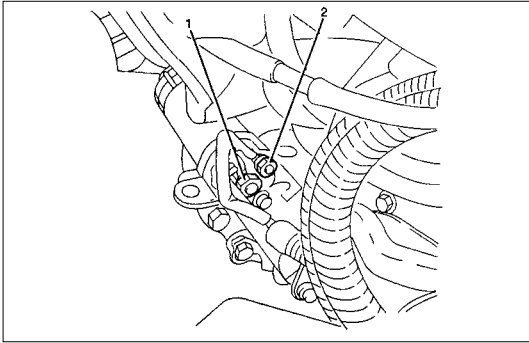


CAUTION:

Always use the correct fastener in the proper location. When you replace a fastener, use **ONLY** the exact part number for that application. ISUZU will call out those fasteners that require a replacement after removal. ISUZU will also call out the fasteners that require thread lockers or thread sealant. **UNLESS OTHERWISE SPECIFIED**, do not use supplemental coatings (Paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

Diagnosis

Condition	Possible cause	Correction
Starter does not run	Charging failure	Repair charging system
	Battery Failure	Replace Battery
	Terminal connection failure	Repair or replace terminal connector and/or wiring harness
	Starter switch failure	Repair or replace starter switch
	Starter failure	Repair or replace starter

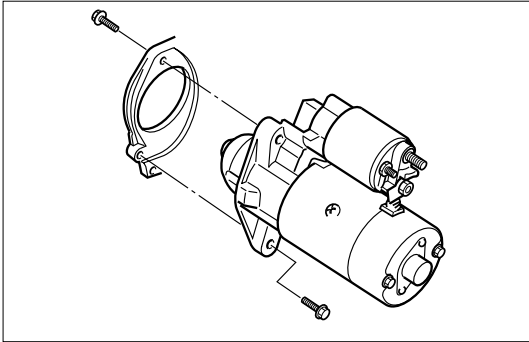


Starter

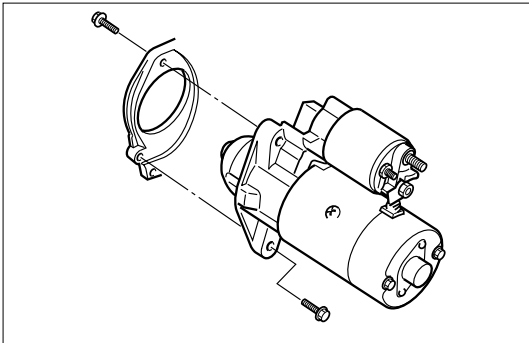


Removal

1. Remove the battery ground cable.
2. Remove harness connectors (1) and (2).



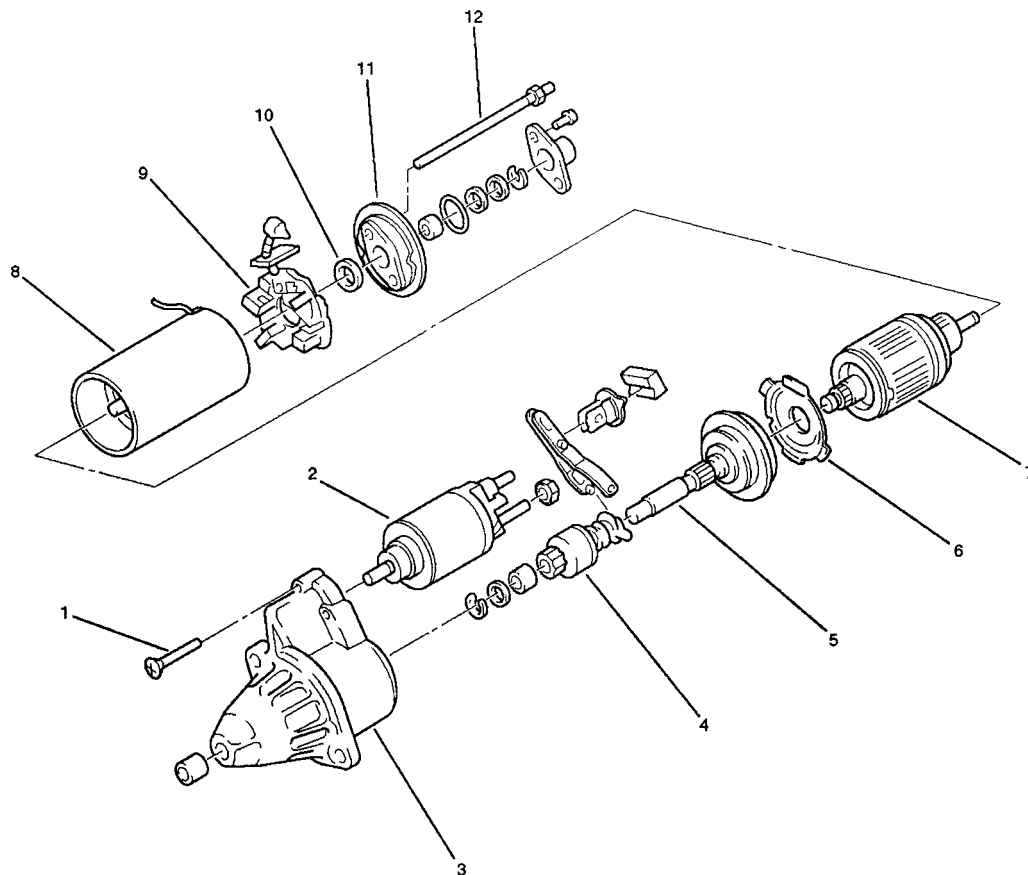
3. Remove bolts from starter.



Installation

1. Install starter assembly.
2. Install mounting bolts and tighten bolts to specified torque.
Torque: 51 N·m (5.2 kgf·m)
3. Connect harness.
4. Reconnect the battery ground cable.

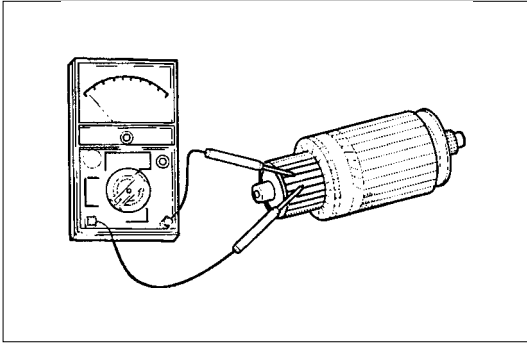
Disassembled View



Legend

- 1 Bolt
- 2 Magnetic Switch
- 3 Gear Case
- 4 Piston
- 5 Piston Shaft
- 6 Center Bracket

- 7 Armature
- 8 Yoke Assembly
- 9 Brush and Brush Holder
- 10 Washer
- 11 Rear Cover
- 12 Through Bolt

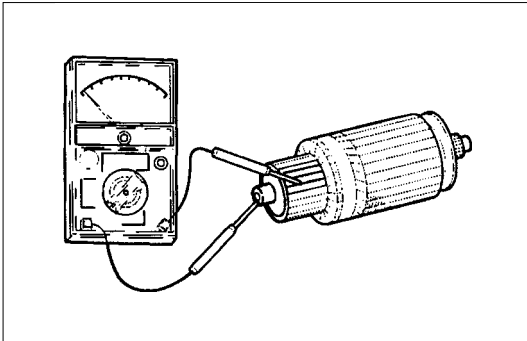


Inspection and Repair

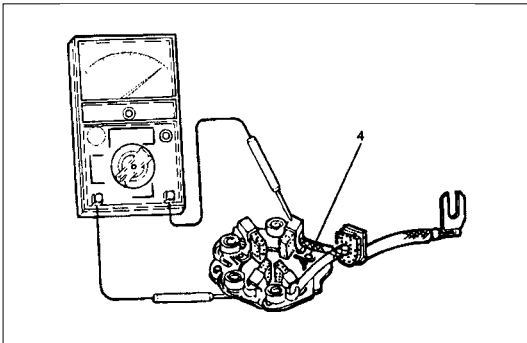
Repair or replace necessary parts if extreme wear or damage is found during inspection.

Armature

Check for continuity between commutator and segment.
Replace commutator if there is no continuity (i.e., disconnected).



Check for continuity between commutator and shaft.
Also, check for continuity between commutator and armature core, armature core and shaft. Replace commutator if there is continuity (i.e., internally grounded).

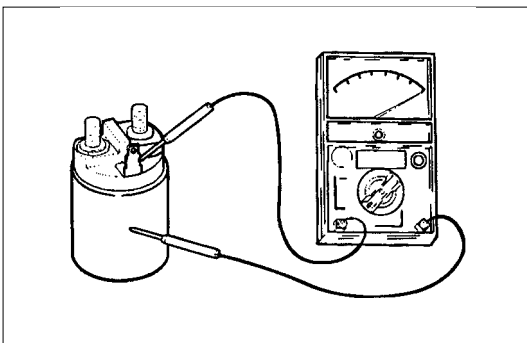


Brush

Measure the length of brush.
Replace with a new one, if it is below the limit.

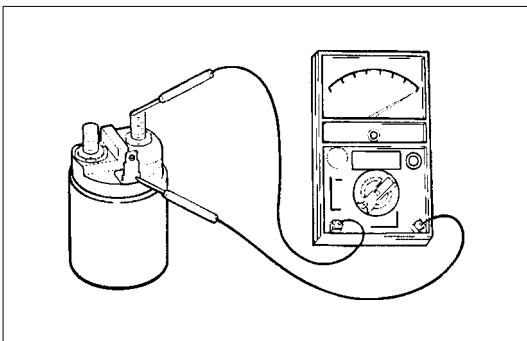
Brush Holder

Check for continuity between brush holder (+) (4) and base (-).
Replace, if there is continuity (i.e., insulation is broken).



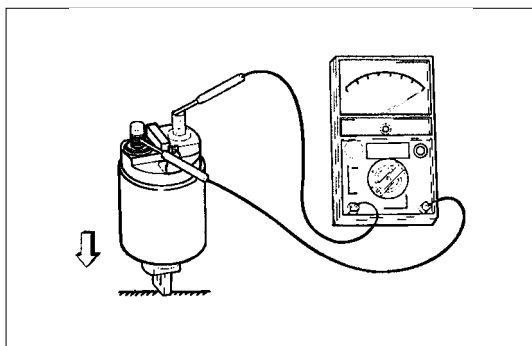
Magnetic Switch

Check for continuity of shunt coil between terminals S and M.
Replace, if there is no continuity (i.e., coil is disconnected).



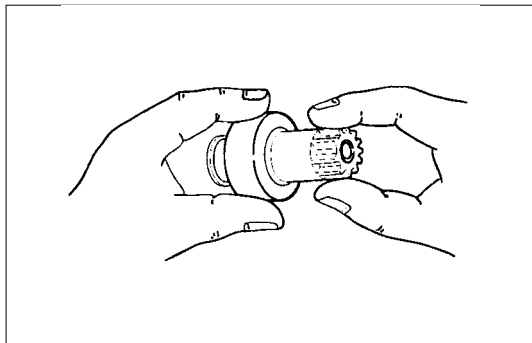
Continuity of Series Coil

Check for continuity between terminals S and M.
Replace, if there is no continuity (i.e., coil is disconnected).



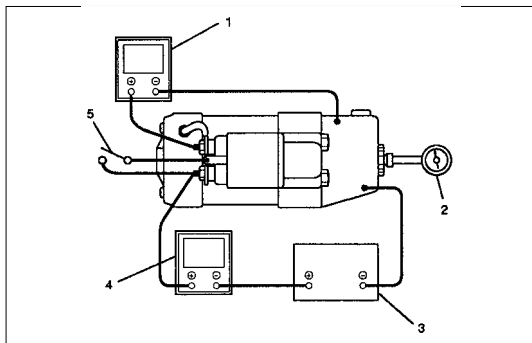
Continuity of Contacts

With the plunger faced downward, push down the magnetic switch. In this state, check for continuity between terminals B and M. Replace, if there is no continuity (i.e., contacts are faulty).



Pinion

Check if the pinion rotates smoothly in drive direction by hand, or if it is locked when it is rotated in reverse. If not, replace the pinion.



Characteristic Test

For easily confirming the characteristics, conduct the no-load test as follows:

Rating as short as 30 seconds requires rapid testing.

Fix the starter on the test bench, and wire as shown in illustration. When the switch is closed, the current flows and the starter runs under no load. At this time, measure current, voltage and speed to check if they satisfy the standard.

Legend

- 1 Volt Meter
- 2 Revolution Indicator
- 3 Battery
- 4 Ammeter
- 5 Switch

Charging System

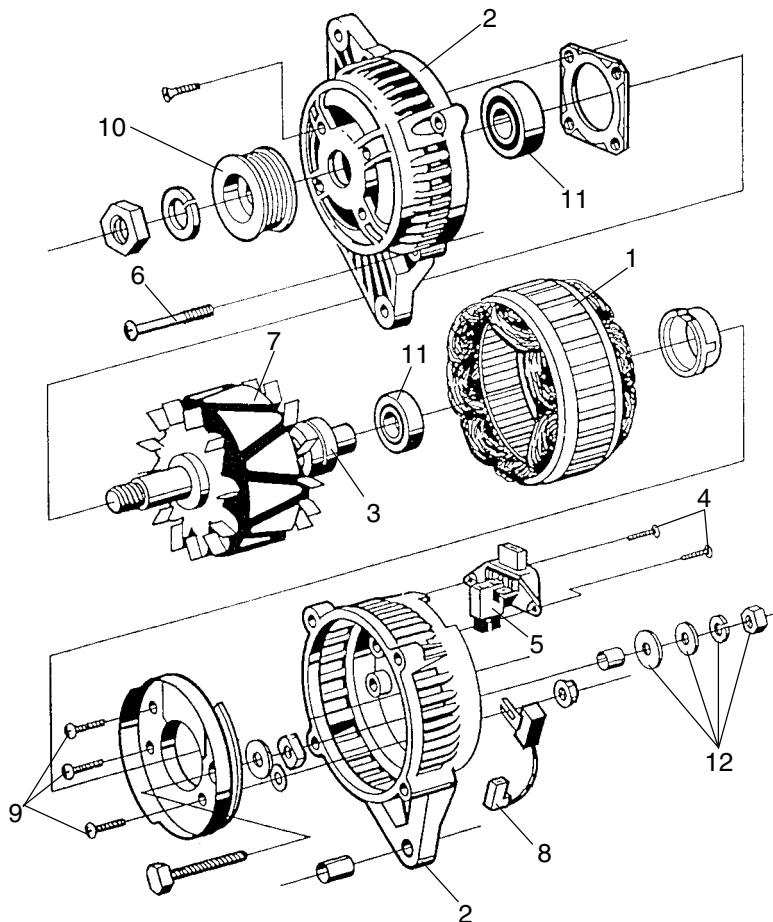
General Description

The charging system is an IC integral regulator charging system and its main components are connected as shown in illustration.

The regulator is a solid state type and it is mounted along with the brush holder assembly inside the generator installed on the rear end cover.

The generator does not require particular maintenance such as voltage adjustment. The rectifier connected to the stator coil has eight diodes to transform AC voltage into DC voltage.

This DC voltage is connected to the output terminal of generator.



Legend

- 1 Stator assembly
- 2 Housing
- 3 Slipring
- 4 Screws (2)
- 5 Regulator
- 6 Bolt (4)

- 7 Rectifier assembly
- 8 Retaining assembly
- 9 B+ terminal nut and washer
- 10 Pulley
- 11 Rotor assembly
- 12 Ball bearing

General On-Vehicle Inspection

The operating condition of charging system is indicated by the charge warning lamp. The warning lamp comes on when the starter switch is turned to "ON" position. The charging system operates normally if the lamp goes off when the engine starts. If the warning lamp shows abnormality or if undercharged or overcharged battery condition is suspected, perform diagnosis by checking the charging system as follows:

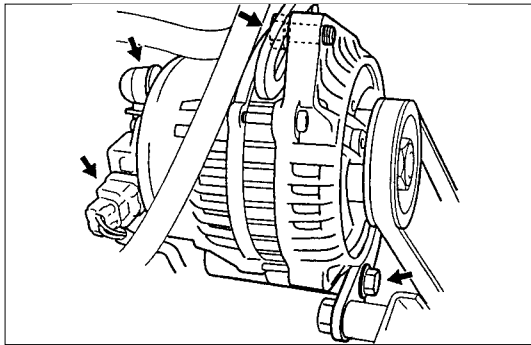
1. Check visually the belt and wiring connector.
2. With the engine stopped, turn the stator switch to "ON" position and observe the warning lamp.

If lamp does not come on:

Disconnect wiring connector from generator, and ground the terminal "L" on connector side.

If lamp comes on:

Repair or replace the generator.



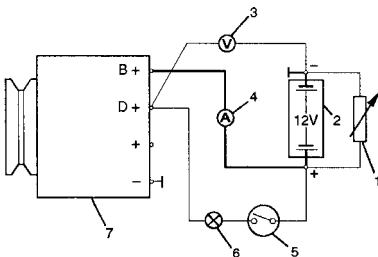
Generator



Removal

1. Disconnect battery ground cable.
2. Move drive belt tensioner to loose side using wrench then remove drive belt.
3. Disconnect terminal "B" wiring connector and connector.
4. Remove generator assembly.

Generator Power and Circuit Diagram

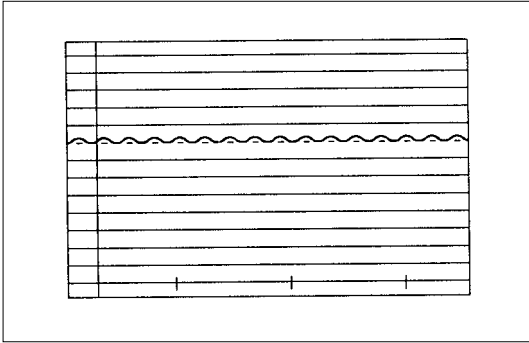


Inspection

Legend

- 1 Load resistor, set parallel to battery
- 2 Battery
- 3 Voltmeter
- 4 Ammeter
- 5 Ignition Lock
- 6 Charge Telltale
- 7 Generator

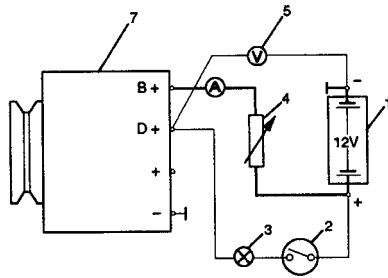
1. Disconnect battery.
2. Close off connecting cable from alternator terminal "B+".
3. Set ammeter (measuring range 100A) in disconnected line.
4. Connect controllable load resistor to battery terminal.
5. Set resistor in front of connection to "O"; connect first to battery, then to resistor.
6. Connect tachometer.
7. Connect oscilloscope according to manufacturer's instructions.
8. Connect battery.
9. Start engine and read off resulting current at various engine speeds.



Generator Power

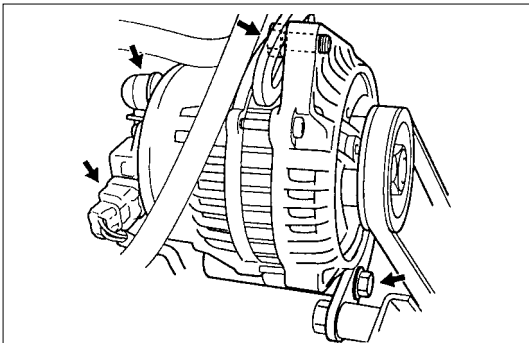
1. Adjust load resistor, if the required load currents are not attained.
2. The shape of the voltage curves on oscilloscope curve should be regular.
3. Test value: 5 to 7A.
4. If the required minimum current intensity is not attained, or if the oscilloscope picture shows variations, the alternator should be overhauled.

Regulated Voltage Circuit Diagram



Legend

- 1 Battery
- 2 Ignition Lock
- 3 Charge Telltale
- 4 Resistor, for attainment of load current with the battery set in series
- 5 Voltmeter
- 6 Ammeter
- 7 Generator



Installation

1. Install generator assembly and bring generator assembly to the position to be installed.
2. Install generator assembly and tighten to the specified torque.

Torque:

Long bolt: 35 N·m (3.6 kgf·m)

Short bolt: 20 N·m (2.0 kgf·m)

3. Connect wiring harness connector.
4. Move drive belt tensioner to loose side using a wrench, then install drive belt to normal position.
5. Reconnect battery ground cable.

The generator has four external connections; the "B+" lead to battery positive, "L" lead to the warning lamp circuit(max. 2 watts), "S" lead to battery positive terminal for battery sensing and an earth connection.

Explanation of type inscription

Example:KC-A--> 14V 50-90A.

K = Code for Stator OD(126mm OD).

C = Compact Generator.

A = Ausland (countries other than Germany)

> = Direction of rotation(clockwise).

14V = Generator Operating Voltage.

50A = Stabilised output at 25 C at 1800 RPM./13.5 Volts.

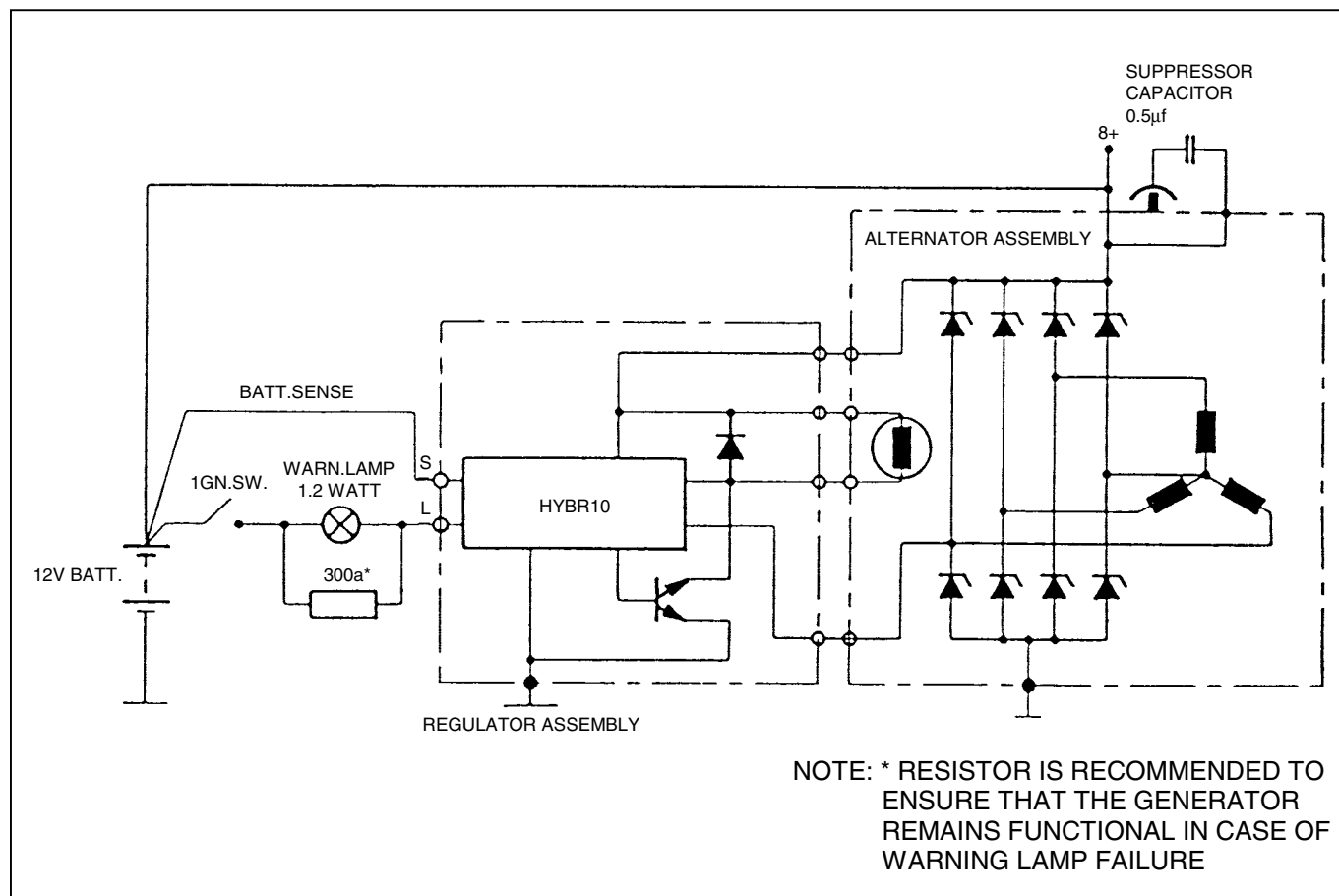
90A = Stabilised output at 25 C at 1800 RPM./13.5 Volts.

Generator Connctions.

B+ : Battery Main Connection (battery positive)

S : Battery Sense Connection(battery positive)

L : Waring lamp(via warning lamp to Ignition switch)



**Warning**

Do not reverse S and L connections as this will destroy the warning lamp circuit of the regulator.
Ensure good electrical contact between generator earth and battery negative,

Operation

With the Ignition switch turned "ON", current is supplied via the warning lamp to the "L" terminal of the regulator. Base current is fed to T15 causing it to turn on, current then flows from B+ through the rotor winding via the regulator brushes and the collector emitter junction of T15 to earth completing the circuit. The current in the rotor causes a magnetic field between adjacent poles to be created, this field is rotated and cuts the windings of the stator at right angles inducing a voltage into them.

As the speed is increased this induced voltage increases and results in current being rectified in the 3 phase diode bridge and supplied as DC to the B+ output and hence to the battery.

When the voltage at the B+ terminal of the battery reaches around 14.2 volts, this voltage is monitored by the "S" lead and turns the regulator Hybrid base current to T15 OFF removing rotor current, resulting in a decrease in output voltage to below the regulating voltage, T15 base current turns ON and the whole cycle is repeated very rapidly.

D38 protects T15 and the regulator against the back voltage developed across the rotor winding when T15 turns OFF.

The new generated EP regulators incorporate current limiting in the warning lamp circuit.

Backup Regulation

The EP regulator will limit the output voltage to a safe level should either the main B+ cable or the battery sense wire become decoupled, the output voltage will be slightly above the normal setting(1-3 volts).

Start up phase

When the Ignition switch is turned on and the engine is not running, the current to the rotor is reduced by switching it on and off at a 50% duty cycle, the frequency is approximately 4 KHz and may be audible at times.

This is quite normal, once the engine is started normal regulation commences.

**Warning lamp failure**

Should the warning lamp fail, the generator will self excite by deriving a small current from the phase connection allowing the voltage to build up to regulating level.

Note: no field current will flow when the engine is cranking.

Diagnosis

The EP regulator incorporates diagnostics which will illuminate the warning lamp as a result of fault conditions in the generator and external circuitry.

These conditions include:

1. An open circuit in the regulator battery sensing wire (S Terminal)
2. An open circuit or excessive voltage drop in the B+ cable.
3. An open circuit in the generator phase connection.
4. Overcharging of the battery.
5. Regulator output stage short circuit.
6. Open circuit rotor.

The regulator compares the voltage at B+ with the voltage at the "S" terminal connected to battery positive. If the voltage differential exceeds a predetermined threshold, the regulator will operate in backup mode to limit the output voltage to a safe level. The warning lamp; will remain illuminated as long as these conditions prevail.

Sources of high resistance which will trigger the warning lamp are:

- a. Poor contact in wiring harness connectors.
- b. Poor contact between rectifier and regulator.
- c. High resistance in fusible link assembly.



Caution:

When bench testing the generator it is important that the warning lamp wattage of 2 watts is not exceeded.

Reversal of the "S" and "L" on the regulator will damage the regulator.

The correct plug for the regulator is a 9 122 067 011 for the Bosch type and for the Shinagawa connector the number is X02FW.

See appendix 1 for diagnostic matrix.

Before testing or disassembling the generator please observe the following points.

1. When testing the diodes with AC type testers the RMS. Voltage output must not exceed 12.0 volts, it is recommended that the stator should be disconnected during this test.
2. Where zener power diodes are used, the breakdown voltage should be tested to ensure all diodes have the same zener voltage.
3. Insulation tests on the rotor and stator should use a voltage not exceeding 110v for a series test lamp. The rectifier must be disconnected from the stator prior to testing.
4. When carrying out repairs to the charging system always disconnect the battery negative first, and reconnect it last.

5. During current output tests please make sure that the ammeter is securely connected into the charge circuit.
6. Some battery powered timing lights can produce high transient voltages when connected or disconnected. Only disconnect or connect timing lights when the engine is switched off.
7. Make sure the warning lamp circuit is functioning normally before commencing tests.
8. Battery isolation switches must only be operated when the engine is stopped.
9. To protect the charging system when using 240 volt chargers it is recommended that the battery is disconnected whilst charging.
10. Due to the very low resistance value of the stator winding it may not be possible to obtain accurate readings without special equipment.
11. 12 volts must never be connected to the "L" terminal of the regulator as this will damage the lamp driver circuit.
12. No loads apart from the warning lamp can be connected to the "L" terminal. The "W" terminal is provided for this purpose.



Disassembly

1. Mark the relative positions of the end housings in relation to the stator assembly to aid reassembly. Use a permanent marking pen do not use centre punched as this can cause misalignment of the housings.
2. Remove the EP regulator from the slipring end housing by removing the two screws. Tilt the regulator slightly from the plug connection until the regulator clears the housing, then lift clear.
3. Remove the four through bolts.
4. Carefully remove the stator assembly along with the slipring end housing taking care not to put strain on the stator wires.
5. To disconnect the stator from the rectifier assembly, grasp the stator wires close to the wire loop with a pair of long nosed pliers, heat the joint with a soldering iron, when the point becomes plastic apply a slight twisting motion to the wires, then pull upwards to release the wires. Remove the stator.

This procedure opens the wire loop to release the stator connections easily.
6. To remove the rectifier remove the three retaining screw and the B+ terminal nut and washers.

Note: the B+ bolt and the positive heatsink retaining screw are fitted with mica insulating washers. These must be discarded and replaced with new washers and heatsink compound.

7. To remove the pulley, mount an 8mm Allen key in the vice with the short end upwards, place a 24mm ring spanner on the pulley nut, position the internal hexagon of the rotor shaft onto the Allen key, loosen the nut and remove the pulley.

Note: the pulley has an integral boss which locks up against the bearing, therefore no thrust collar is provided.

8. Removing the rotor assembly. Remove the four retaining screws from the drive end housing, withdraw the rotor complete with the bearing.

Note: the rotor must not be pressed from the drive end housing using a press as the bearing retaining plate and drive end housing will be damaged or distorted. Parts removed in this way must be replaced if the integrity of the generator is to be maintained.

9. Remove the drive end bearing from the rotor shaft using a chuck type pulser, take care not to distort the fan assembly during this process.
10. Remove the slipring end bearing using the same method as in 9.



Clean

Thoroughly clean all components except the rotor and stator with an approved cleaning agent. Ensure that all traces of oil and dirt are removed. If an abrasive cleaner is used to remove scale and paint from the housings take care not to abrade the bearing and mounting spigot surfaces. The rotor and stator must be cleaned with compressed air only, the use of solvents could cause damage to the insulating materials.



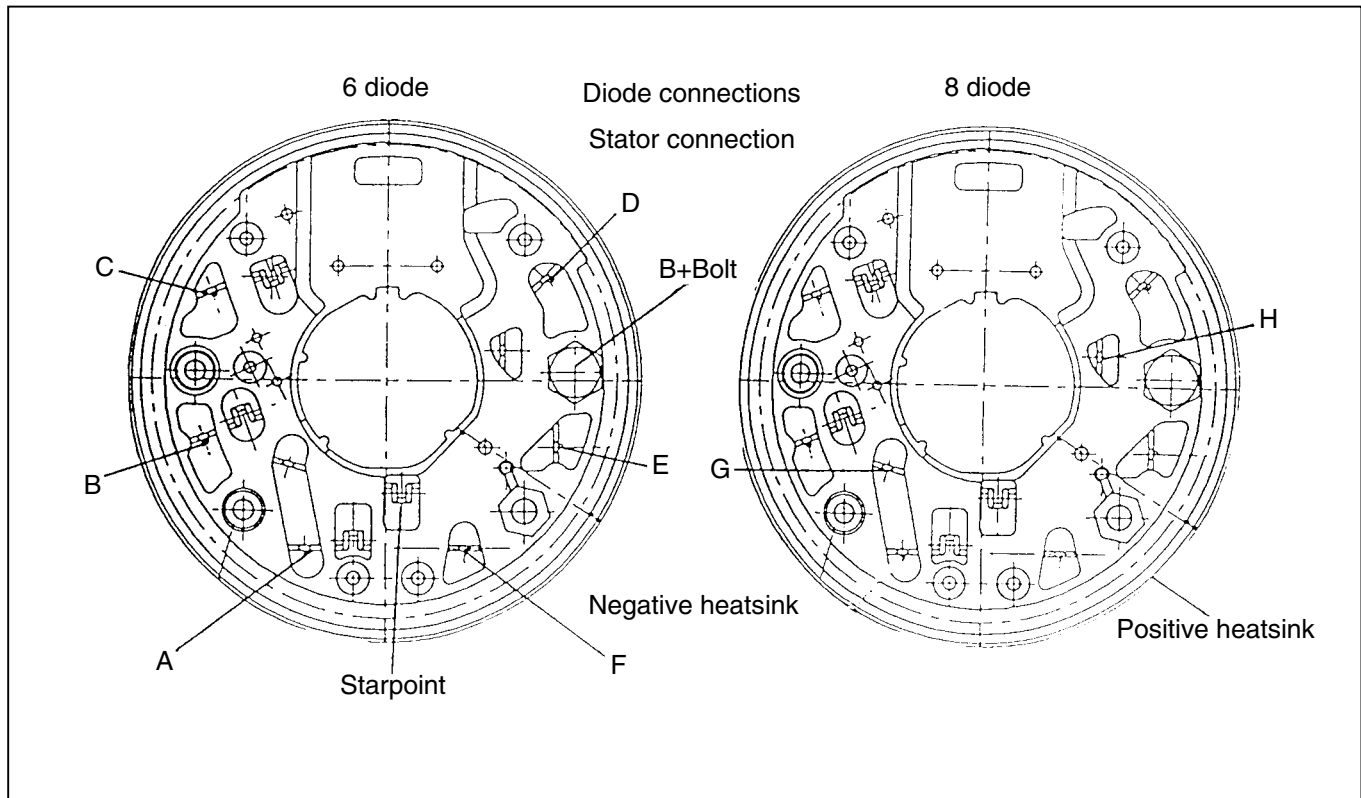
Inspection

1. Rectifier assembly

The following test equipment is required.

The rectifier assembly is not repairable and must be replaced if a faulty diode is detected during inspection.

- (a) A diode tester where the DC output at the test probes does not exceed 14 volts or in the case of AC testers 12 volts RMS. This is to ensure that when inspecting rectifiers fitted with zener power diodes the forward and reverse checks are complete and are not masked by the diode turning on due to the zener breakdown voltage.
- (b) A zener diode tester with a DC output in excess of 30 volts, the tester should also incorporate internal current limiting set to 5 Ma. to prevent high currents during inspection.
- (c) Diodes can be destroyed during service due to high temperature and overload, open circuits are usually a result of excessive voltage.



1.1 Power Diodes.

Apply the negative test probe of the diode tester or a multimeter with a diode test feature to the positive heatsink and the positive probe alternatively to A,B,C, a low resistance reading, or the forward voltage drop across the diode should be obtained. Reverse the test probes, a high resistance reading or a higher reverse voltage should be obtained.

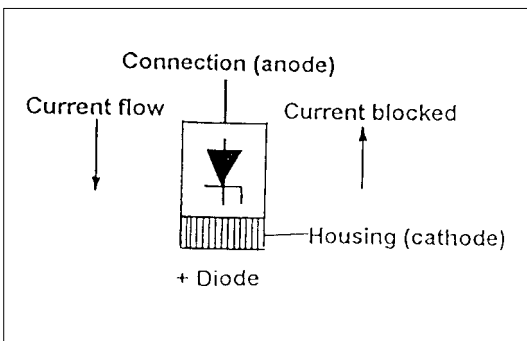
Now connect the positive test probe to the negative heatsink and the negative alternatively to D,E,F, a low resistance or forward voltage drop across the diode should be obtained. Reverse the test probes, a high resistance reading or a higher reverse voltage should be obtained.

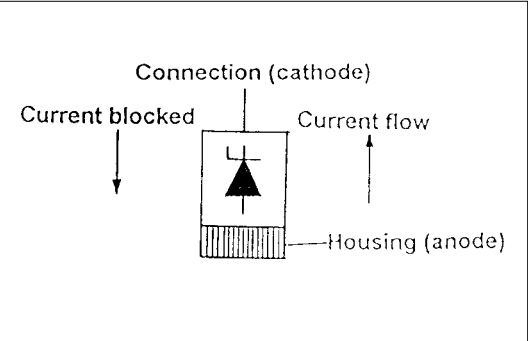
For 8 diode rectifier plates tests for G and H should be included. When the reverse voltage test is done the applied voltage should be less than 14 volts DC or 12 volts RMS for AC testers.

1.2 Zener Diode

The basic tests in 1.1 should be undertaken first before the diode zener voltage is tested. Diodes are grouped together according to their zener voltage i.e. all diodes within a rectifier must have the same zener voltage.

Connect the test probes as for the reverse test listed above i.e. reverse biased apply the test voltage from the zener diode tester (current limited to 5ma) and read to zener breakdown voltage this should be a steady reading and not increase with increased voltage from the tester.

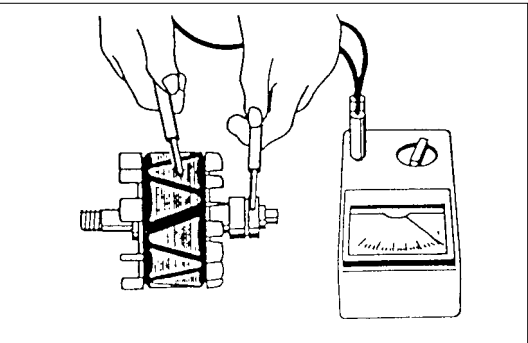
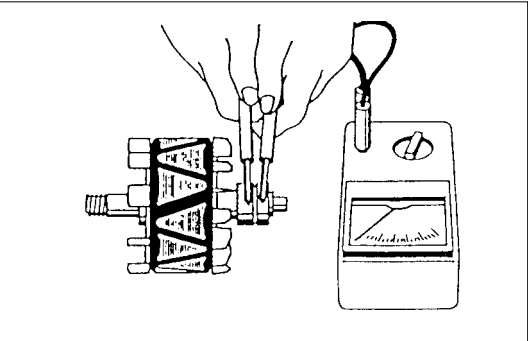




Readings for Zener diode groups 011 to 042

Zener voltage at 5Ma.	Positive diode	Negative diode	Fordward current Rating
17.8v-19.2v	011	012	25A
18.8v-20.2v	013	014	25A
19.8v-21.2v	015	016	25A
20.8v-22.2v	017	018	25A
21.8v-23.2v	019	020	25A
22.8v-24.2v	021	022	25A
17.8v-19.2v	031	032	35A
18.8v-20.2v	033	034	35A
19.8v-21.2v	035	036	35A
20.8v-22.2v	037	038	35A
21.8v-23.2v	039	040	35A
22.8v-24.2v	041	042	35A

Note: Diode number is stamped on the rear of the diode.



2. Stator

Inspect the stator insulation resistance to ground with an insulation tester or a series test lamp up to 110 volts. The insulation resistance must be greater than 1 megohm. The winding reisistance is measured between phases using a low reading ohmmeter designed for this purpose, the values are given at the rear of this instruction.

3. Rotor

Inspect the rotor for insulation resistance to ground using an insulation tester or a series test lamp up to 110 volts. The insulation resistance must be grater than 1 megohm. Measure the rotor resistance between the sliprings using an ohmmeter or apply 12 volts across the sliprings and measure the rotor current flow, then divide 12 by the measured current, the results is the rotor resistance in ohms. values are given at the rear of this instruction.

If the sliprings are worn or out of round they must be re-machined to a minimum diameter or 26.7 mm and should have a runout not exceeding 0.060mm. If the slipring is below these limits it must be replaced with a new one.



Warning; extreme care must be exercised when machining the slipring as it is possible for the turning tool to foul the fan.

4. Replacing the brushes (inbuilt regulator)

Check the brushes for length, this is measured from the brush holder to the end of the brush along its centre line. Also inspect for any sideways wear. If worn replace both brushes. The minimum length is 3.8mm. Inspect the brush springs for signs of corrosion or loss of tension or uneven tension.

Replacing the brushes, using a soldering iron apply heat to the soldered joints on the rear of the brush holder of the regulator, using a small lever prise up the retaining tabs to release the brush lead and spring. Thread the new brush lead up the brush holder along with the spring, pull the lead through the tabs until the brush is protruding 12mm from the holder. Bend down the tabs and solder the brush lead taking care not to allow the solder to run up the lead which will reduce flexibility. Use 60/40 resin cored solder.

5. Ball bearing

Please note the bearings used in this KCA generator are a high tolerance type, only fully sealed bearings of the same specification are to be used as replacements. It is recommended that the bearings be replaced during the reconditioning process to restore the unit to original specification.

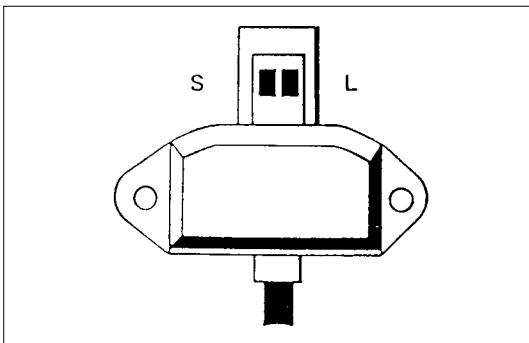
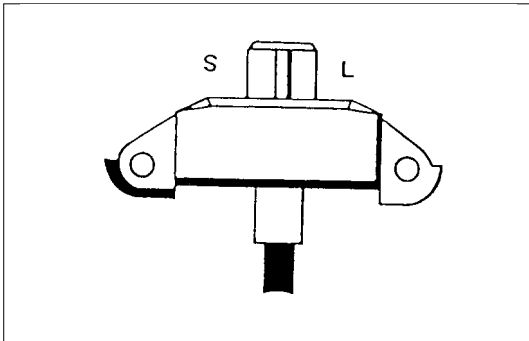
6. Regulator

The regulator can only be tested when fitted into an alternator.



Warning: do not reverse "S" and "L" connections or put 12 volt supply to "L" terminal, this connection must not be used as a supply source other than to supply the requirements of the warning lamp 2(watts). Such action will destroy the regulator warning lamp circuit.

For test voltages refer to Generator output testing section. See also additional information on regulator function earlier in this instruction.





Reassembly Generator

- (a) Press new bearing onto slipring end of the rotor taking care to apply the force to the bearing inner race only, otherwise the bearing will be noisy and its life will be shortened.
- (b) Fit a new bearing to the drive end housing, fit the bearing plate, and four retaining screws, press the rotor into the bearing, using a support tool to take the thrust against the bearing inner.
The support is fitted from the pulley side of the bearing. In this way the thrust is not taken by the drive end housing.
- (c) To fit pulley, mount an 8mm Allen key in the vice with the short end upwards, place a 24mm ring spanner on the shaft nut, position the internal hexagon of the rotor shaft onto the Allen key, tighten the nut to the required torque (See torque chart)
- (d) Inspect the bearing support ring for signs of damage, if in doubt replace the ring by pressing it into the housing by hand, do not use excessive force.
- (e) To refit the rectifier, fit new mica washers to the positive heatsink B+ bolt and retaining screw each washer must have heatsink compound applied to both surfaces before fitting.
Fit the three retaining screws to the rectifier then install into slipring end housing. Tighten the B+ bolt to the required torque.
- (f) To refit the stator, make sure the spigot surface are clean and free from damage, fit the stator into the slipring end housing noting the correct lead connection positioning. Fit the stator leads into the wire loops in the rectifier. Using a pair of pliers squeeze the loop to retain the stator lead prior to soldering. Repeat for each lead in turn, solder the leads into position using 60/40 resin cored solder. Make sure the leads will be clear of the internal fan when the rotor is assembled into the stator.
- (g) Carefully install the rotor into the stator/slipring end housing assembly, noting the alignment of the housings and through bolt holes. Fit the through bolts making sure the stator is seated correctly, tighten the through bolts to the correct torque setting (uneven torque can produce magnetic noise levels above normal).
- (h) Fitting the regulator. Compress the brushes into the brush holder by hand, slip the regulator through the opening in the rear of the slipring end housing until the brushes come in contact with the slipring. Press the regulator towards the slipring until the holes are aligned then fit the retaining screws and tighten.



Inspection

Generator

Before any in field testing can be undertaken it is important that the battery's conditions is established and the terminals are clean and tight.

Check the condition of the generator drive belt and ensure that it is adjusted in accordance with the engine manufacturer's recommendations.

Battery conditions:

Note: This assessment may be difficult with maintenance free assemblies.

Test the specific gravity of the individual cells the readings should be within 10 points of each other, it is recommended that the average SG should be 1.260 or higher.

A load test should be carried out to determine the ability of the battery to supply and accept current. This is a good indicator as to the general condition of the battery.

A load equal to the normal starting current should be placed across the battery, the duration of this load test should not exceed 10 seconds, during this time the terminal voltage across the battery should not drop below 9.6 volts. Observe each cell for signs of excessive gas liberation, usual an indication of cell failure.

If the battery test is clear proceed with the Generator tests as follows.

Care should be taken when making the following connections. It is recommended that the battery negative terminal be disconnected before the test meters are connected, and reconnecting the negative terminal when the meters are inserted into the circuit under test. The warning lamp in the D+ circuit should not exceed 2 watts.

Regulating voltage test on the vehicle.

Connect a voltmeter to the generator, the positive lead to the B+ terminal and the negative lead to the generator casing.

Select the voltage range to suit the system, i.e. 20v for 12 volt systems or 40v for 24 volt systems. Connect an ammeter in series with the main output cable from the B+ terminal on the generator, the range selected must be capable of reading the maximum output from the generator.

Note the voltmeter reading before starting the engine. This reading should increase when the engine is running indicating generator output, start the engine and increase the engine speed until the generator is running at 4000 rpm, switch on vehicle loads of 5-10 A is indicated on the ammeter, the voltmeter should read 14.0-14.2 v for a 12 volt system, for a 24 volt system the readings should be 27.7-28.5 volts.

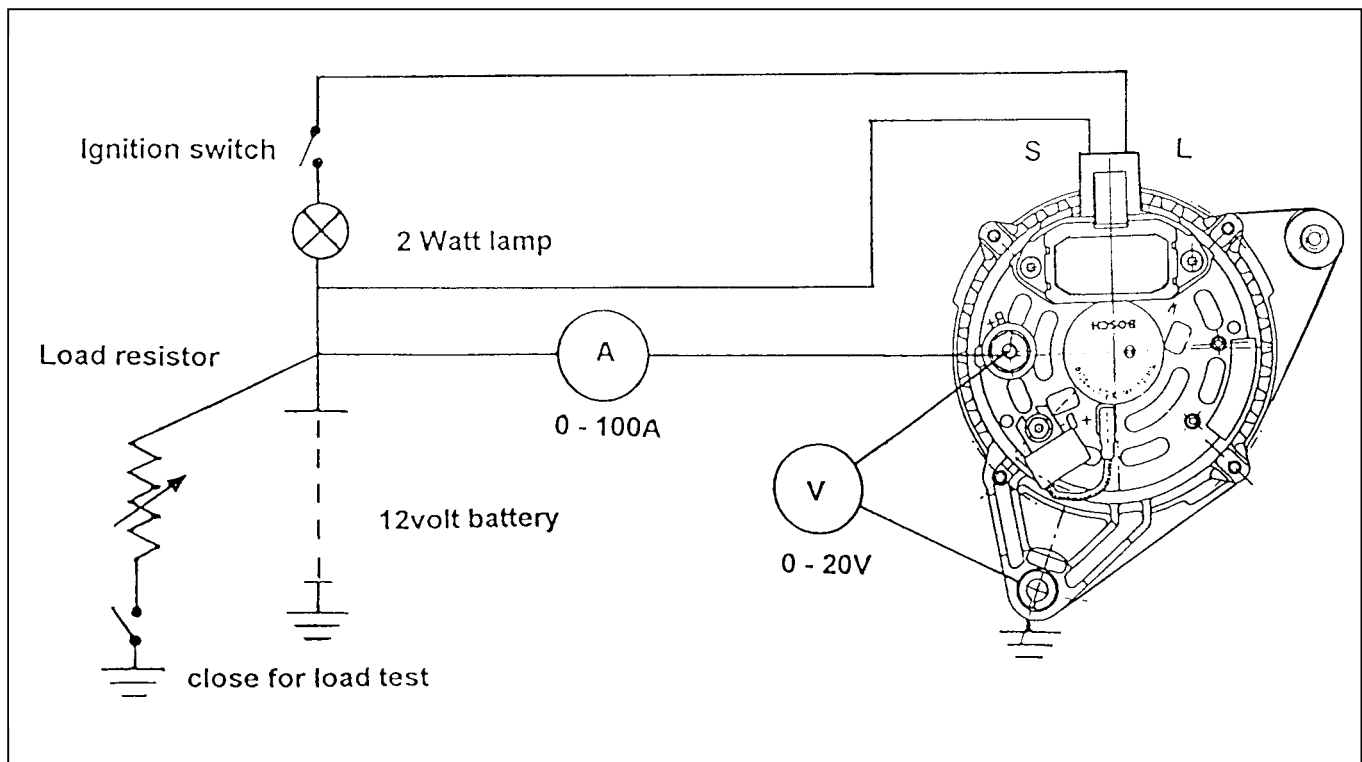
Load regulation test

Increase the engine speed until the generator is running at 6000 rpm, increase the load to 90% of full output and decrease in the regulating voltage should not exceed 0.50 volts for 12 v and 0.70 v for 24 v regulators of the readings obtained in the previous test. If so, the regulator is defective.

Generator output test at full load

Increase engine speed until the alternator is running at 6000 rpm, switch on electrical loads until the generator voltage drops to 13.5 volts for 12 v systems and 26 volts for 24 v systems, full output should be obtained under these conditions. It may be necessary to adjust engine speed to maintain alternator speed. If sufficient electrical loads are not available a carbon pile resistance can be connected across the battery and adjusted until maximum output is obtained.

Keep the time for this test to a minimum to avoid undue heating and high engine speeds.



Technical Data

(mm)

Brush wear	-	Minimum Length	3.8
Sliprings	-	Minimum Diameter	26.7
Sliprings	-	Trueness	<0.06
Pole claws	-	Trueness	<0.05(93.25±0.05)

Torque

N.m(kgf·m)

Pulley retaining nut	54-68(5.5-6.9)
Capacitor retaining screw	2.7-3.8(0.3-0.4)
Capacitor whiz nut	1.5-2.2(0.1-0.2)
B+ terminal nut M8	7.5-8.5(0.8-0.9)
B+ terminal rectifier nut	6.0-7.5(0.6-0.8)
Regulator retaining screw	1.6-2.3(0.1-0.2)
Rectifier retaining screw	1.6-2.3(0.1-0.2)
Bearing retaining plate screw	2.1-3.0(0.2-0.3)
Through bolt	3.8-5.5(0.4-0.6)

Winding resistance(between phases)

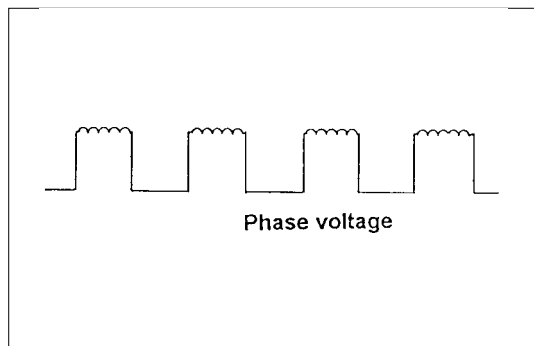
(Ω)

		Stator	Rotor
70 Amp generator	0.086+10%	2.6±0.13	
85 Amp generator	0.058+10%	2.6±0.13	
90 Amp generator	0.056+10%	2.6±0.13	

Warning lamp fault indication

Fault running	Generator not running Ignition ON	Generator Ignition ON
Generator out cable O/C	ON	ON
Battery "S" cable O/C	ON	ON
Battery overcharged	ON	ON
Positive diode short	OFF	ON
Negative diode short	ON	ON
Positive diode open	ON	OFF
Negative diode open	ON	OFF
Phase voltage sensing cable open circuit	ON	ON
Power transistor shorted	ON	ON
Warning lamp driver O/C	OFF	OFF

6D3-22 STARTING AND CHARGING SYSTEM



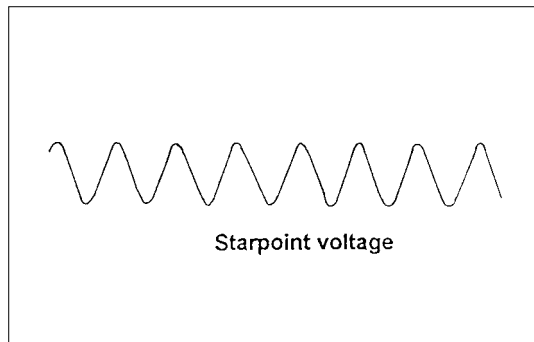
Output wave forms for phase and startpoint connections.

Note; the average of these two waveforms are identical from no load to 100% output of rated load.

Voltage phase = Voltage startpoint

6.9v@ rated output 7.2v@ Zero output

Note: The phase frequency is one third of the startpoint frequency.



SECTION 6F

ENGINE EXHAUST

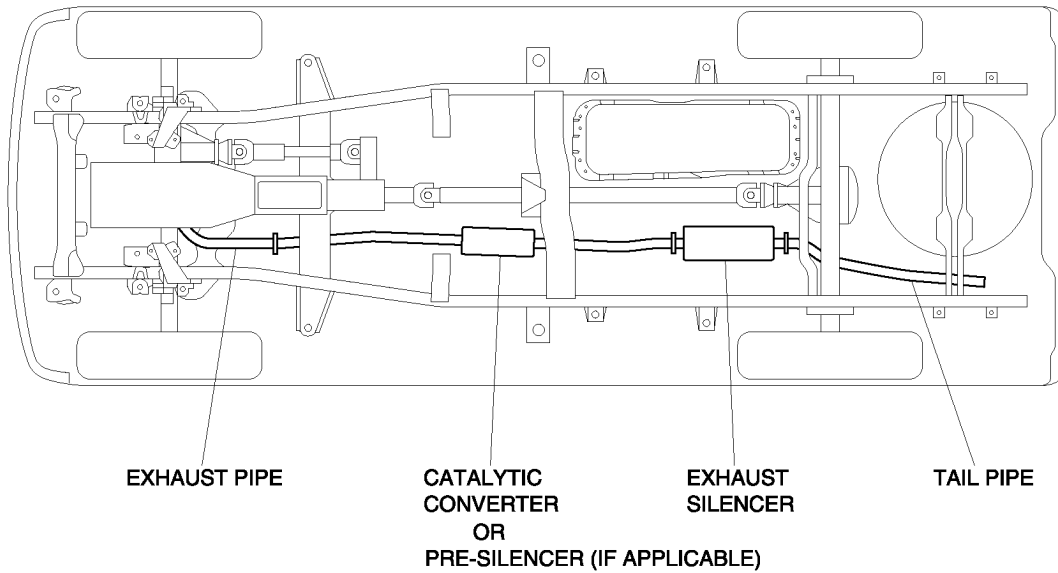
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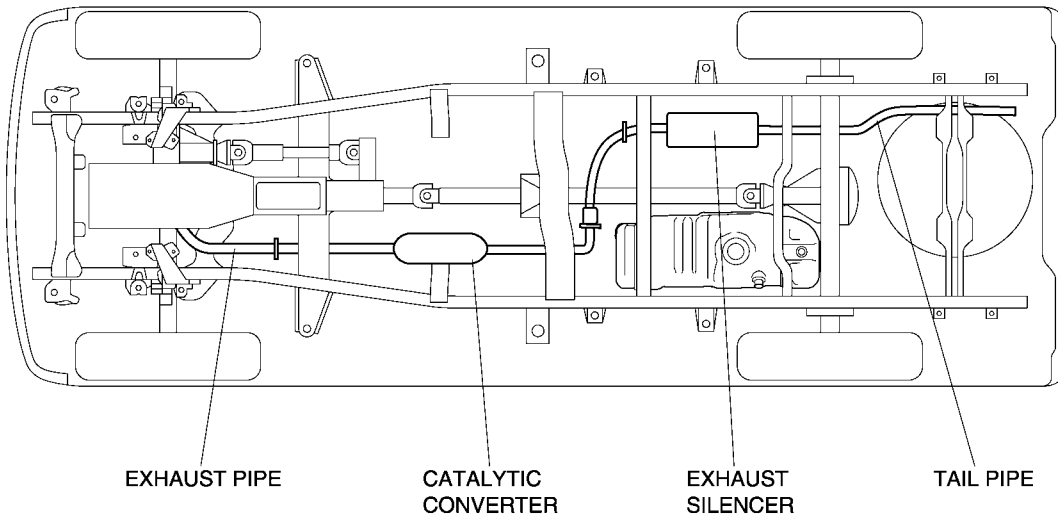
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General Description

This illustration is based on the 4×4 with TWC model.
(2.2L & 2.0L Models)



(2.4L Model)



When inspecting or replacing exhaust system components, make sure there is adequate clearance from all points on the underbody to prevent overheating the floor pan and possible damage to the passenger compartment insulation and trim materials.

Check complete exhaust system and nearby body areas and rear compartment lid for broken, damaged, missing or mispositioned parts, open seams, holes, loose connections or other deterioration which could permit exhaust fumes to seep into the rear compartment or passenger compartment. Dust or water in the rear compartment may be an indication of a problem in one of these areas. Any faulty areas should be corrected immediately.

Hangers

Various types of hangers are used to support exhaust system(s). These include conventional rubber straps, rubber rings, and rubber blocks.

The installation of exhaust system supports is very important, as improperly installed supports can cause annoying vibrations which can be difficult to diagnose.

Three Way Catalytic Converter (If applicable)

The three way catalytic converter is an emission control device added to the exhaust system to reduce pollutants from the exhaust gas stream.



CAUTION: The catalytic converter requires the use of unleaded fuel only.

Periodic maintenance of the exhaust system is not required. If the vehicle is raised for other service, it is advisable to check the condition of the complete exhaust system.

A dual bed monolith catalytic converter is used in combination with three way catalytic converter.

Catalytic Types:

Three way (Reduction/Oxidation) catalyst

The catalyst coating on the three way (reduction) converter contains platinum and rhodium which lowers the levels of nitrous oxide (NOx) as well as hydrocarbons (HC) and carbon monoxide (Co).

Gasket

The gasket must be replaced whenever a new exhaust pipe, muffler or catalytic converter is installed.

Service Precaution

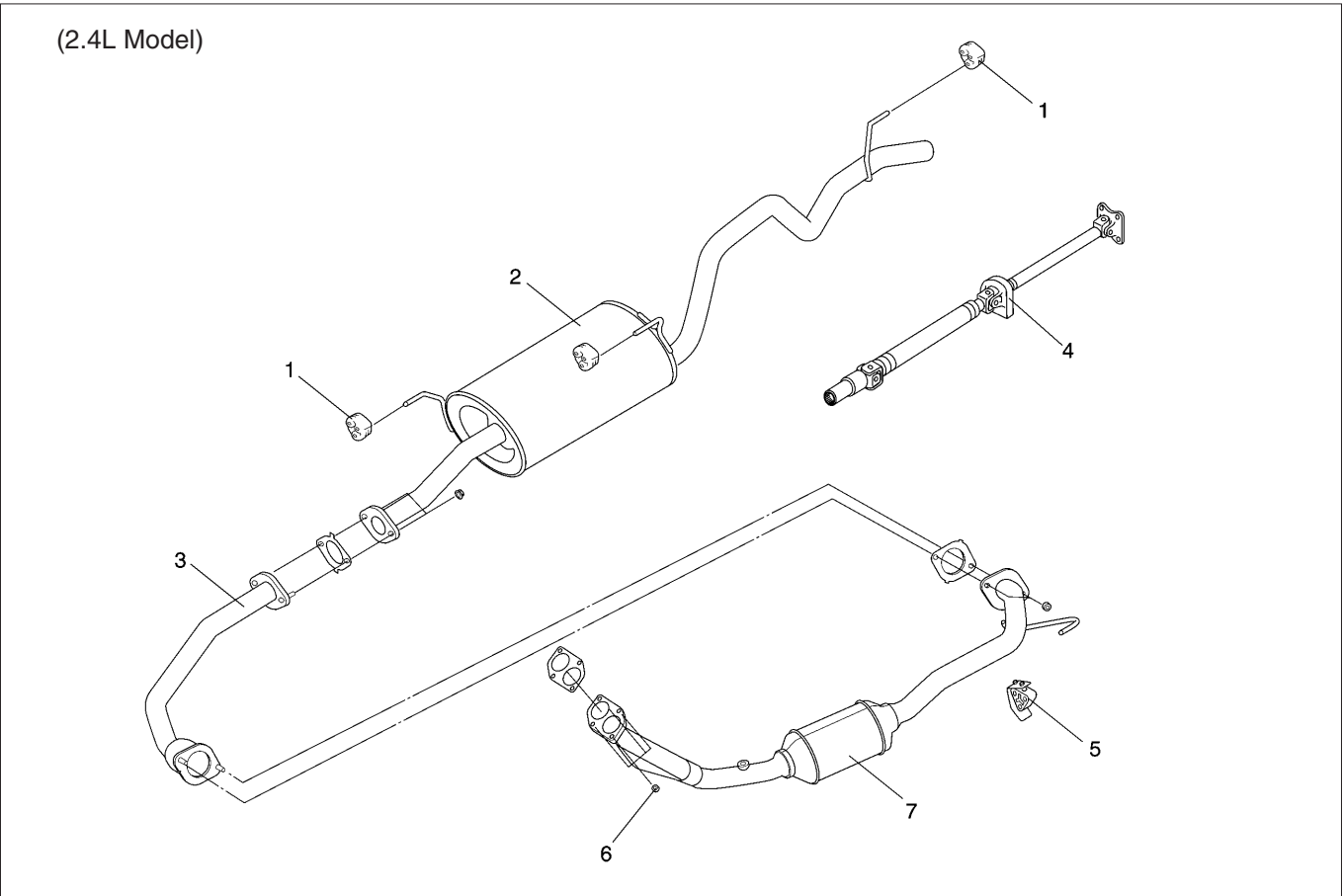
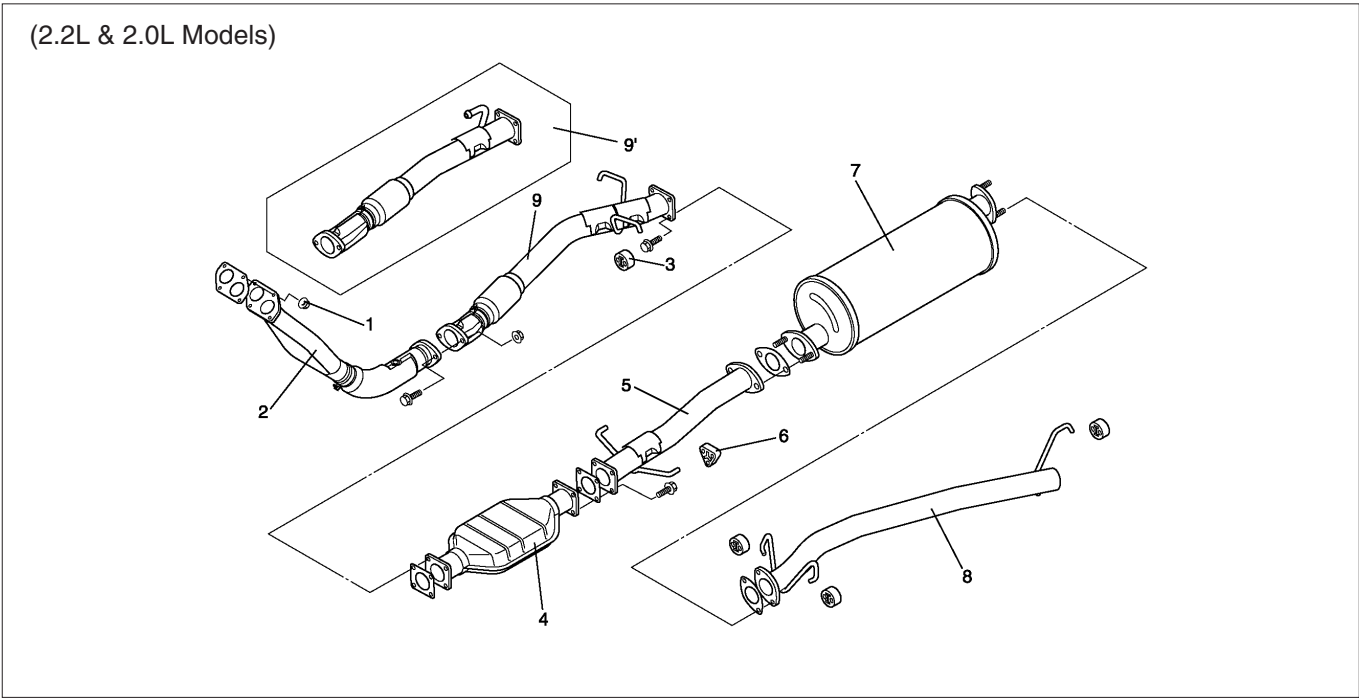


CAUTION:

Always use the correct fastener in the proper location. When you replace a fastener, use **ONLY** the exact part number for that application. ISUZU will call out those fasteners that require a replacement after removal. ISUZU will also call out the fasteners that require thread lockers or thread sealant. **UNLESS OTHERWISE SPECIFIED**, do not use supplemental coatings (Paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

Exhaust Pipe

Exhaust Pipe and Associated parts





Removal

(2.2L & 2.0L)

1. Front exhaust pipe fixing nut
2. Front exhaust pipe
3. Center exhaust pipe damper rubber
4. Catalytic converter (If applicable)
5. Center exhaust pipe
6. Rear exhaust pipe damper rubber
7. Exhaust silencer with rear exhaust pipe
8. Rear exhaust pipe
9. Mid pipe (for 4×4)
- 9'. Mid pipe (for 4×2)

(2.4L)

CAUTION

When you remove or install the front exhaust pipe, make sure not to damage the fuel evaporative pipe.

1. Damper rubber
2. Exhaust silencer
3. Mid pipe
4. Propeller shaft assy
5. Damper rubber
6. Front exhaust pipe fixing nut
7. Catalytic converter (If applicable)



Installation

To install, follow the removal steps in the reverse order.



Important - Installation

1. Front Exhaust Pipe Flange Nut

Connect the exhaust pipe to the exhaust manifold.

Front exhaust pipe to manifold nut.

Torque



N·m (kgf·m)

28 (2.9)



Inspection

Make the necessary adjustments, and part replacements if excessive wear or damage is discovered during inspection.

1. Front Exhaust Pipe
2. Center Exhaust Pipe and Catalytic Converter Flange Nut
3. Exhaust Pipe Damper Rubber
4. Exhaust Silencer with Rear Exhaust Pipe

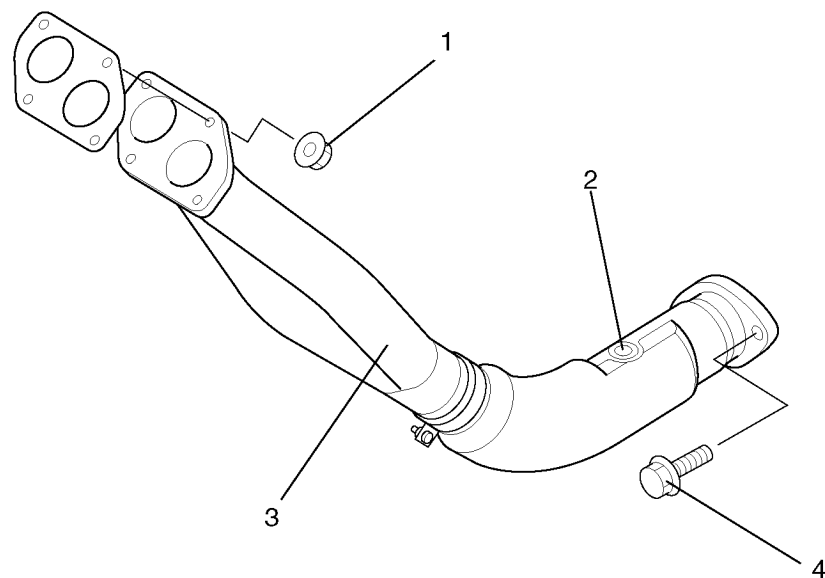
Check the pipes for corrosion, cracking, damage or misalignment and repair if required.

Check the damper rubber for deterioration or damage and repair if required.

Front Exhaust Pipe

Front Exhaust Pipe and Associated Parts

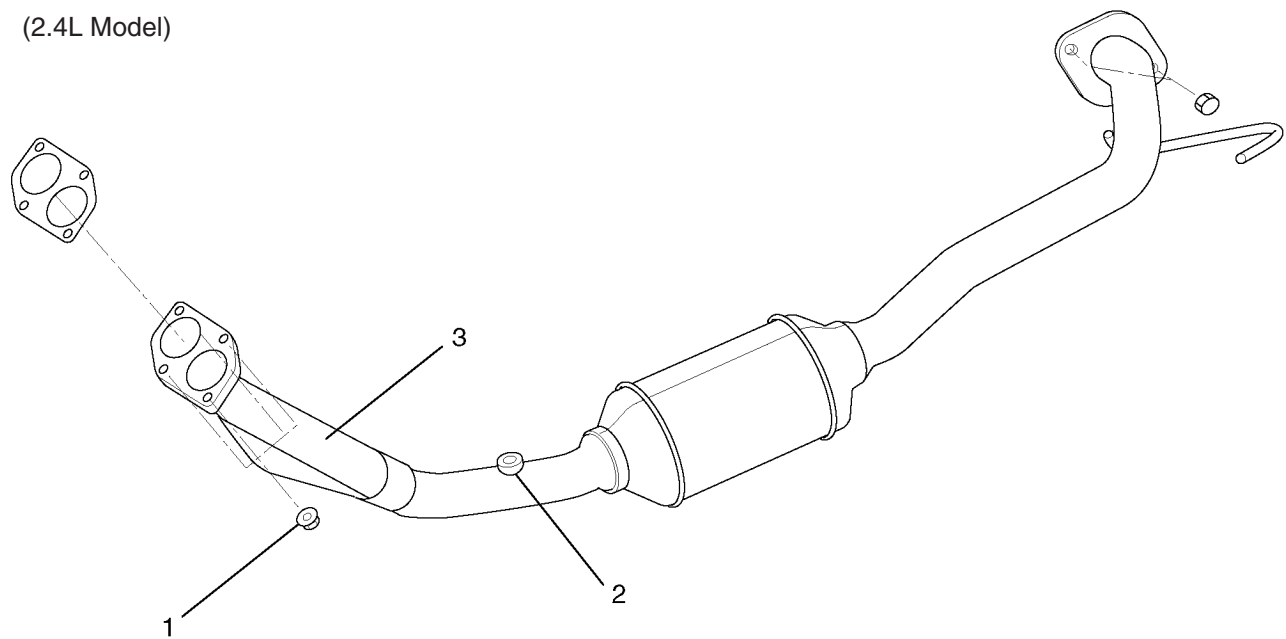
(2.2L & 2.0L Models)



Legend

- | | |
|---|--|
| 1 Front Exhaust Pipe Fixing Nuts | 3 Front Exhaust Pipe |
| 2 O ₂ Sensor (If applicable) | 4 Front Exhaust Pipe Fixing Bolts and Nuts |

(2.4L Model)



Legend

- | | |
|---|----------------------|
| 1 Front Exhaust Pipe Fixing Nuts | 3 Front Exhaust Pipe |
| 2 O ₂ Sensor (If applicable) | |



Removal

(2.2L & 2.0L)

1. Disconnect battery ground cable.
2. Raise the vehicle and support with suitable safety stands.
3. Disconnect O₂ sensor harness connector and remove front side O₂ sensor (2). (If applicable)
4. Remove front exhaust pipe fixing bolts and nuts (4).
5. Remove front exhaust pipe fixing four stud nuts from exhaust manifold (1).
6. Remove front exhaust pipe (3)

(2.4L)

1. Disconnect battery ground cable.
2. Raise the vehicle and support with suitable safety stands.
3. Remove the exhaust silencer.
4. Remove mid pipe.
5. Remove the propeller shaft assy.
6. Remove the O₂ sensor.
7. Remove front exhaust pipe.



Installation

1. Install front exhaust pipe (3) and tighten four stud nuts.



Torque:

Stud Nuts: 28 N·m (2.9 kgf·m)

Nuts: 43 N·m (4.4 kgf·m)

2. Tighten front side O₂ sensor and reconnect O₂ sensor harness connector. (If applicable)

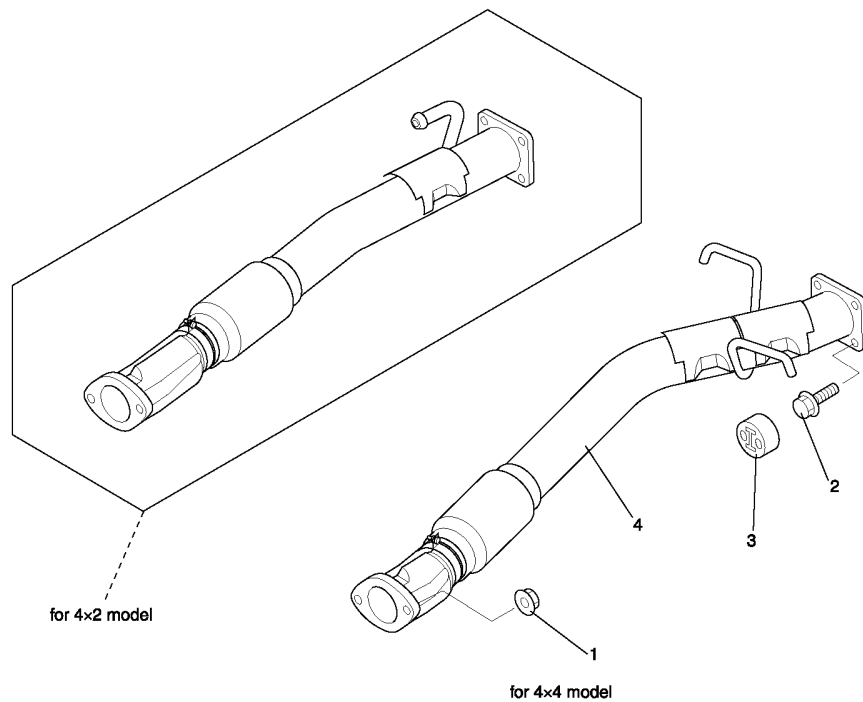


Torque: 55 N·m (5.6 kgf·m)

Mid Pipe

Mid Pipe and Associated Parts

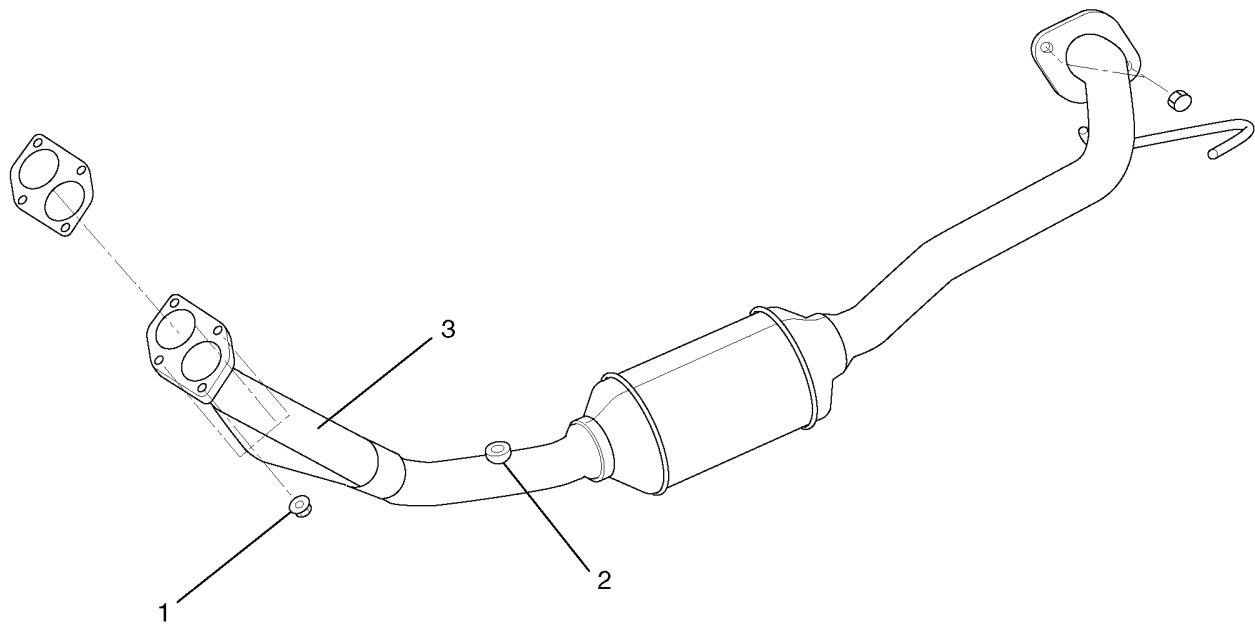
(2.2L & 2.0L Models)



Legend

1. Front Exhaust Pipe Fixing Nuts
2. Mid Pipe Fixing Bolts
3. Mid Exhaust Pipe Mounting Rubber
4. Mid Pipe

(2.4L Model)

**Legend**

- 1. Front Exhaust Pipe Fixing Nuts
- 2. O₂ Sensor
- 3. Front Exhaust Pipe

**Removal**

(2.2L & 2.0L)

1. Disconnect battery ground cable.
2. Raise the vehicle and support with suitable safety stands.
3. Remove front exhaust pipe fixing bolts and nuts (1).
4. Remove mid pipe fixing four stud nuts from Catalytic Converter.
5. Remove mid pipe (4)

(2.4L)

1. Disconnect battery ground cable.
2. Raise the vehicle and support with suitable safety stands.
3. Remove exhaust silencer.
4. Remove mid pipe.

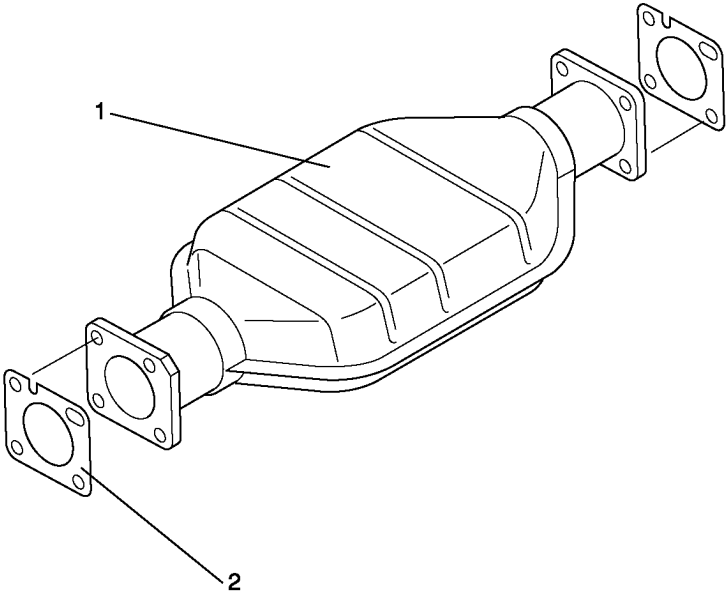
**Installation**

1. Install center exhaust pipe (4) and tighten four fixing bolts (2) and two bolts and nuts (1) to the specified torque:

**Torque:****Fixing bolts: 43 N·m (4.4 kgf·m)****Bolts: 43 N·m**

Catalytic Converter (If applicable)
Catalytic Converter and Associated Parts

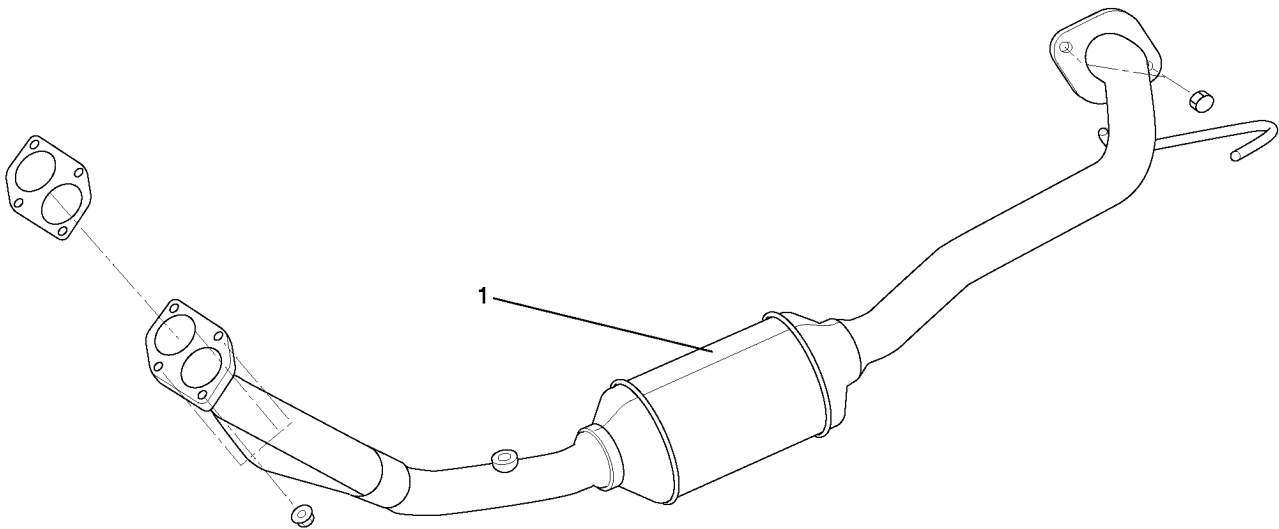
(2.2L & 2.0L Models)



Legend

- 1. Catalytic Converter
- 2. Gasket

(2.4L Model)



Legend

- 1. Catalytic Converter



Removal

(2.2L & 2.0L)

1. Disconnect battery ground cable.
2. Raise the vehicle and support with suitable safety stands.
3. Remove center exhaust pipe fixing bolts.
4. Remove exhaust silencer fixing bolts.
5. Remove Catalytic Converter (1).

(2.4L)

1. Disconnect battery ground cable.
2. Raise the vehicle and support with suitable safety stands.
3. Remove exhaust silencer.
4. Remove mid pipe.
5. Remove the propeller shaft assy.
6. Remove the O₂ sensor.
7. Remove the front exhaust pipe with catalytic converter.



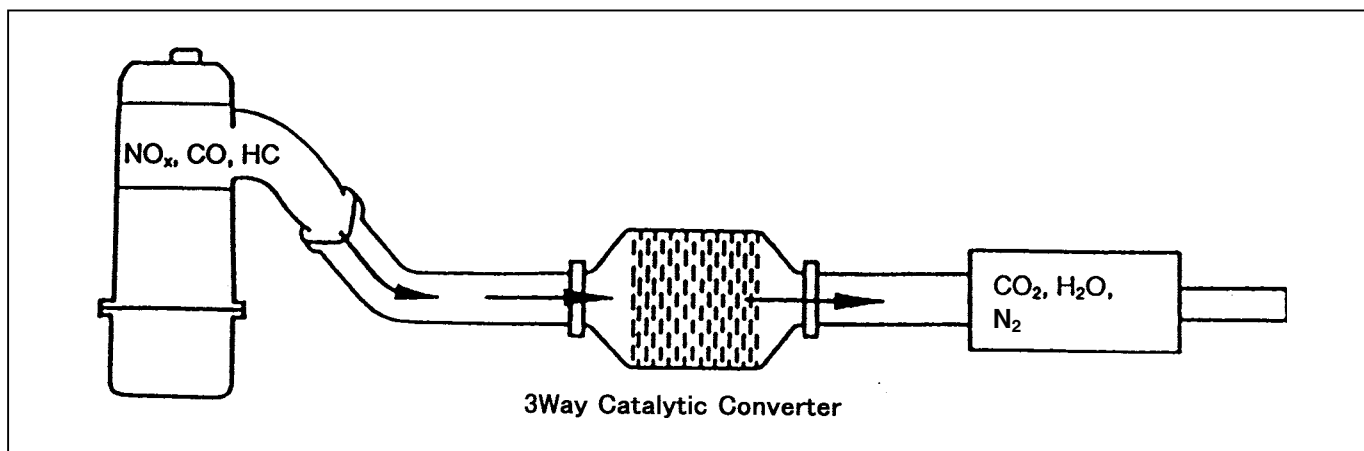
Installation

1. Install Catalytic Converter (1) and tighten four exhaust silencer fixing bolts and center exhaust pipe fixing bolts to the specified torque:

Torque:

Fixing bolts: 43 N·m (4.4 kgf·m)

3 WAY CATALYTIC CONVERTER SYSTEM (If applicable)



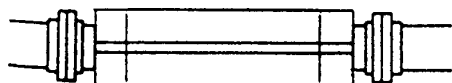
Inspection

Make the necessary adjustments, and part replacements if excessive or damage is discovered during inspection.

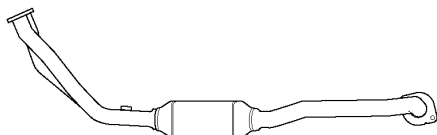
Exhaust Pipe Assembly

1. Check connections for looseness or damage.
2. Check clamps for weakness, crack, or damage.

(2.2L & 2.0L Models)



(2.4L Model)

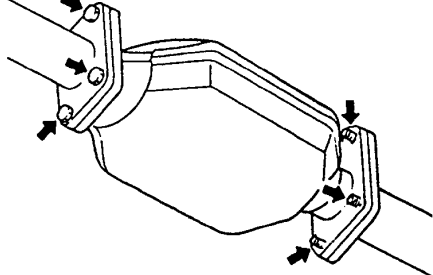


Catalytic Converter

Check for dents or damage.

If any part of the converter is damaged or dented, repair or replace it.

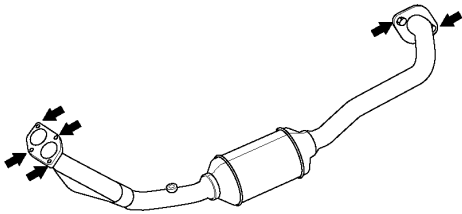
(2.2L & 2.0L Models)



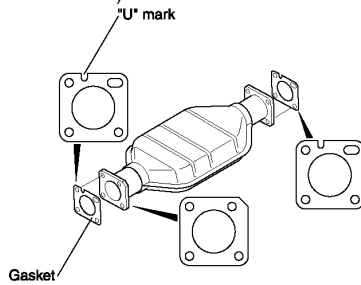
Removal

1. Jack up the vehicle.
2. Check that the converter is cool.
3. Remove the bolts at the front and rear of the converter.
4. Remove the converter and gaskets.

(2.4L Model)



(2.2L & 2.0L Models)



Installation

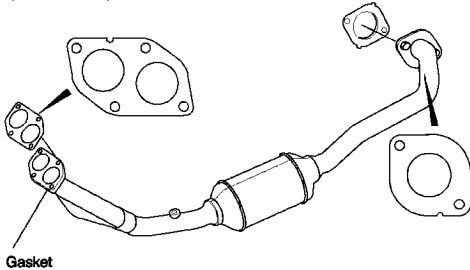
1. Place new gaskets on the converter front and rear pipes, and connect the converter to the exhaust pipes.

Note:

When placing new gaskets, check that “U” mark on the gasket is upside.

2. Tighten the bolts with the specified torque.
3. Reinstall the bracket bolts and tighten them.

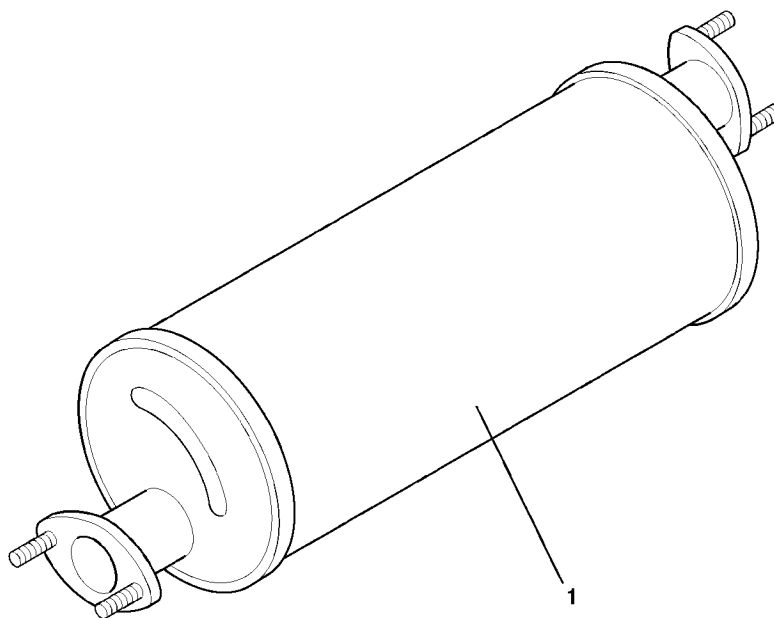
(2.4L model)



Exhaust Silencer

Exhaust Silencer and Associated Parts

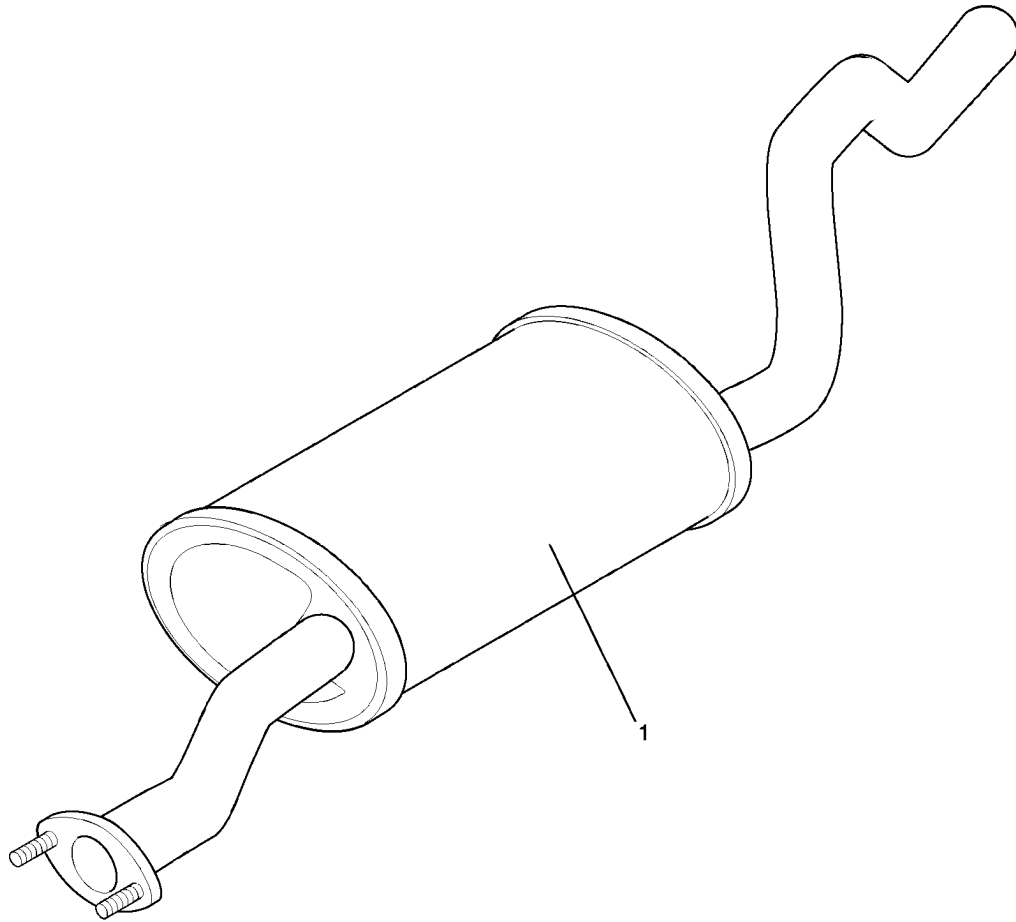
(2.2L & 2.0L Models)



Legend

1. Exhaust Silencer

(2.4L Model)

**Legend**

1. Exhaust Silencer

**Removal**

(2.2L & 2.0L)

1. Disconnect battery ground cable.
2. Raise the vehicle and support with suitable safety stands.
3. Remove four exhaust silencer fixing bolts and two rear exhaust pipe fixing bolts and nuts then disconnect rear exhaust silencer from rear exhaust pipe
4. Remove exhaust silencer mounting rubbers from chassis side then remove exhaust silencer.

(2.4L)

1. Disconnect battery ground cable.
2. Raise the vehicle and support with suitable safety stands.
3. Remove the damper rubber and nut.
4. Remove exhaust silencer.



Installation

(2.2L & 2.0L)

1. Install the exhaust silencer and tighten two bolts and nuts on rear exhaust pipe to specified torque then tighten four bolts on Catalytic Converter to specified torque.

(2.4L)

1. Install the exhaust silencer and tighten two bolts and nuts.



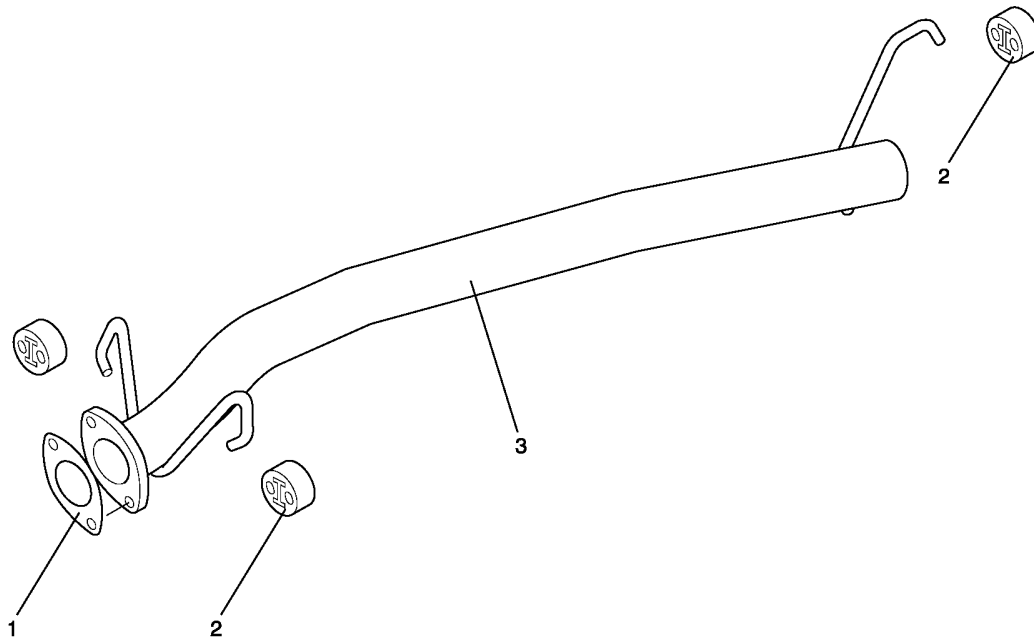
Torque:

Bolts: 43 N·m (4.4 kgf·m)

Rear Exhaust pipe

Rear Exhaust pipe and Associated Parts

(2.2L & 2.0L Models)



Legend

- 1 Gasket
- 2 Mounting Rubber
- 3 Rear Exhaust Pipe



Removal

(2.2L & 2.0L)

1. Disconnect battery ground cable
2. Raise the vehicle and support with suitable safety stands.
3. Remove rear exhaust pipe fixing bolts and nuts, then disconnect rear exhaust pipe from exhaust silencer.
4. Remove mounting rubber.
5. Remove rear exhaust pipe.



Installation

- 1. Install the mounting rubber.
- 2. Install the exhaust pipe and tighten two bolts and nuts on exhaust silencer to specified torque.



Torque:
Nuts: 43 N.m (4.4 kgf·m)

Main Data and Specifications

Exhaust system			
Pipe outside diameter × thickness			
Front pipe	mm(in)	2.2L & 2.0L 42.7 × 1.5 (1.68×0.059) <Flange> 54.0 × 1.5 (2.13 × 0.059)	2.4L 44.5 × 1.5 (1.75×0.059) <Flange> 50.8 × 1.5 (2.00 × 0.059)
Middle pipe	mm(in)		
Rear pipe	mm(in)	50.8 × 1.5 (2.0 × 0.059)	
Silencer			
Type		Circular section-shell construction of triple (for 2.4L & 2.0L); double (for 2.4L) skin and end plates, internal construction of baffles and perforated tubes.	
Inside diameter		2.2L & 2.0L Approximately 180 (7.09)	2.4L —
Length		Approximately 525 (20.67)	—
Mounting			
Number of suspension points		4	
Type		Rubber	
Catalytic converter type		Three way Catalytic Converter	

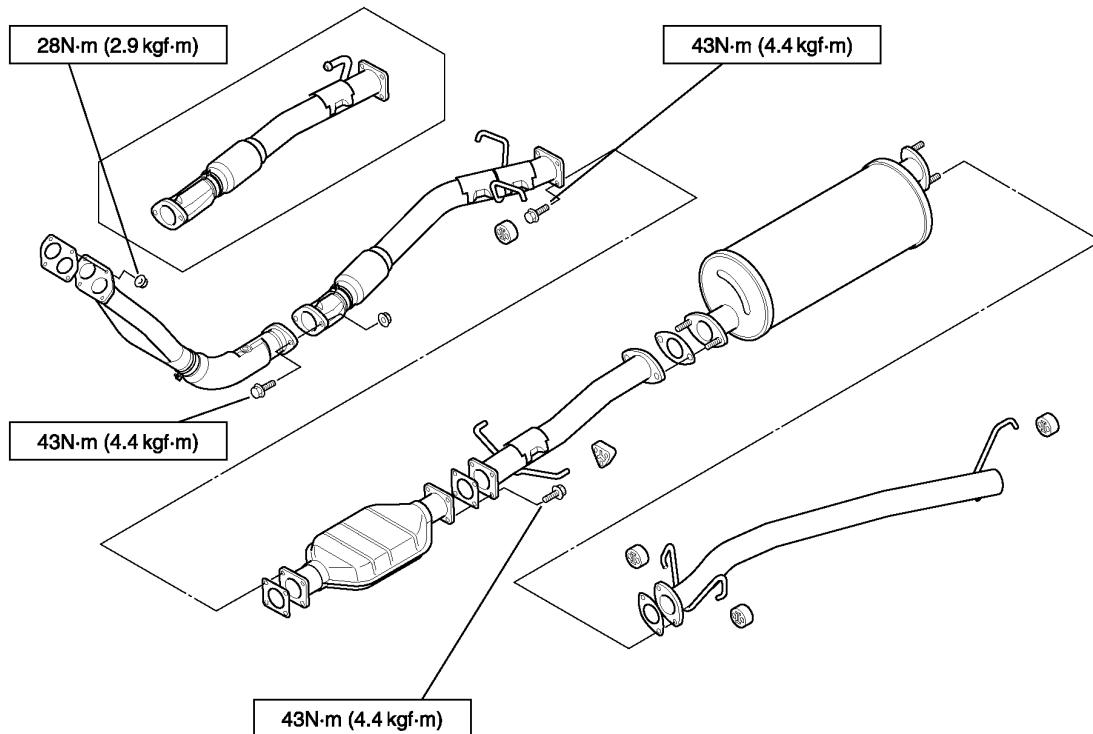
Main Data and Specifications



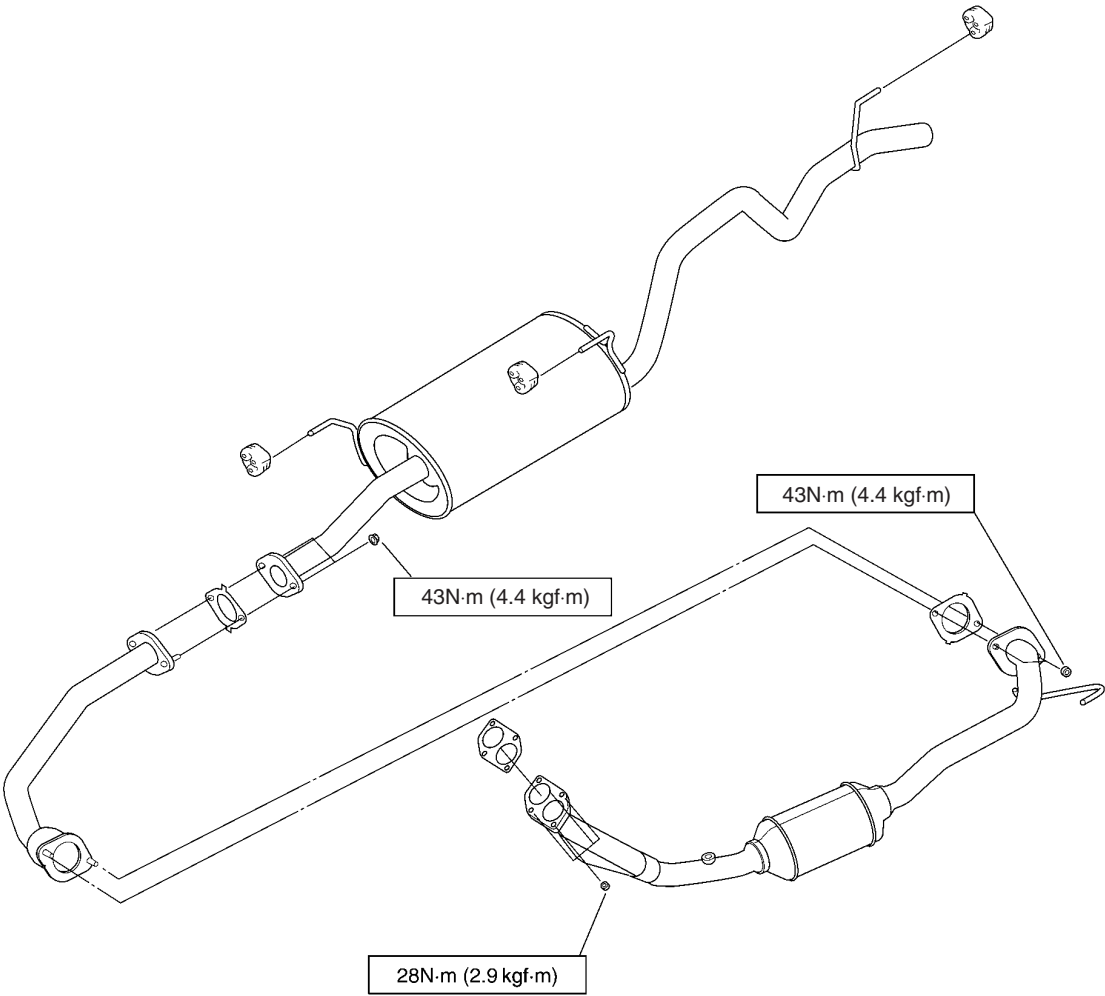
Torque Specification

N·m (kgf·m)

(2.2L & 2.0L Models)



(2.4L Model)



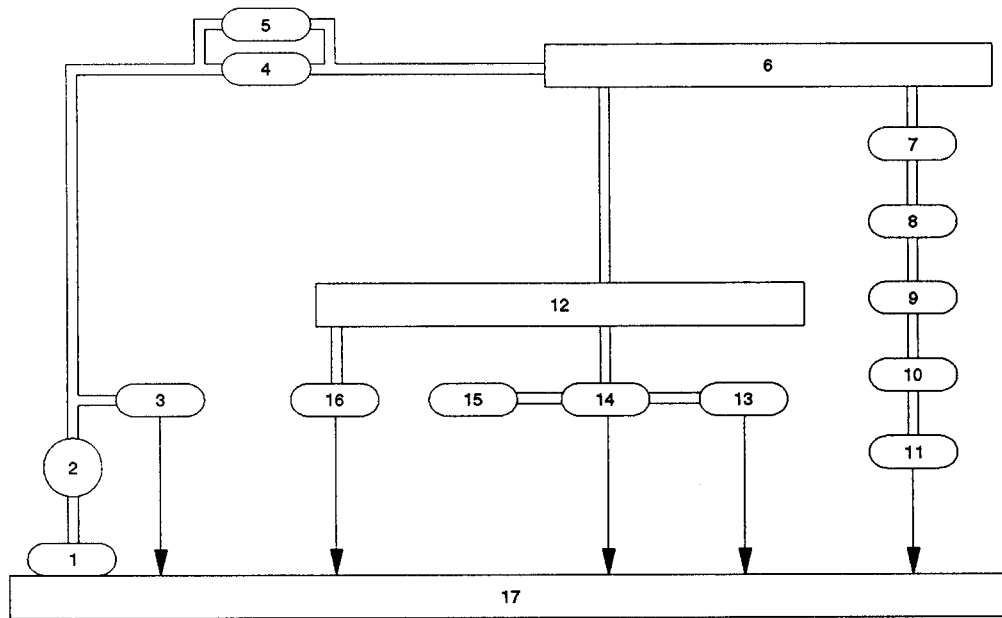
SECTION 6G

ENGINE LUBRICATION

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General Description



Legend

- 1 Oil Strainer
- 2 Oil Pump
- 3 Relief Valve
- 4 Oil Filter
- 5 Safety Valve
- 6 Oil Gallery
- 7 Crankshaft Bearing
- 8 Crankshaft

- 9 Connecting Rod Bearing
- 10 Connecting Rod
- 11 Piston
- 12 Oil Gallery; Cylinder Head
- 13 Camshaft
- 14 Camshaft Journal
- 15 HLV
- 16 Check relief valve
- 17 Oil Pan

A gear-type oil pump is directly driven by the crankshaft and draws oil from the oil pan, via the suction pipe. It then passes the pressurized oil through a full-flow disposable oil filter, to the main oil gallery in the cylinder block. An oil pump pressure relief valve and oil filter bypass valve are incorporated in the system.

From the main oil gallery in the cylinder block, the cylinder head and crankshaft main bearings are supplied with oil. The camshaft bearings and hydraulic tappets are supplied through the main feed galleries in the cylinder head. Vent valves allow air to be expelled from the oil galleries in the cylinder head. The balance shaft journals are directly fed from the crankshaft main bearings. The connecting rod bearings are fed via passages in the crankshaft. The oil returns to the oil pan via passages in the cylinder block.

Service Precaution

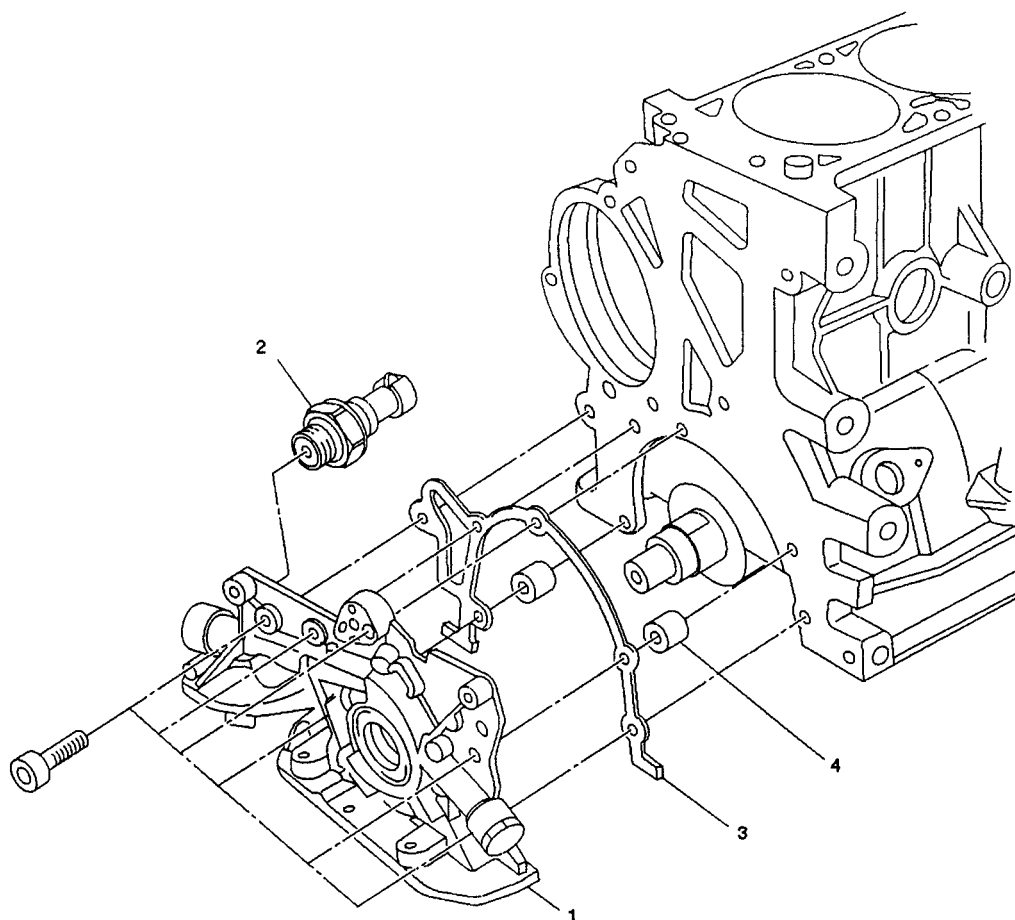


CAUTION:

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Oil Pump

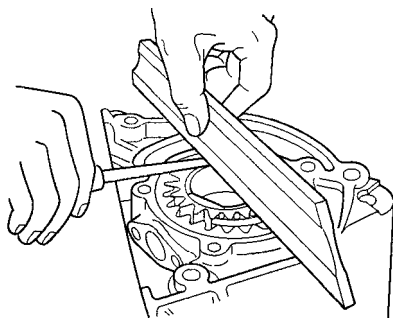
Oil Pump and Associated Parts



Legend

- 1 Oil Pump Assembly
- 2 Oil Pressure Switch

- 3 Gasket
- 4 Sleeve



Disassembly

1. Remove crankshaft timing pulley.
2. Remove oil pan.
3. Remove oil strainer.
4. Remove oil pump assembly.
5. Remove oil pressure switch.
6. Remove gasket.
7. Remove sleeve.



Inspection and Repair

CAUTION: Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.

Body and Gears

The pump assembly must be replaced if one or more of the conditions below is discovered during inspection:

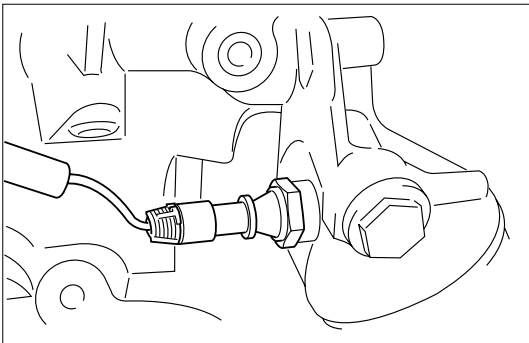
Indentation of gear pair - Use feeler strip and straight edge.

Dimension: 0.03 mm to 0.10 mm

(0.0012 to 0.0039 in)

Oil Strainer

Check the oil strainer for cracking and scoring. If cracking and scoring are found, the oil strainer must be replaced.



Reassembly

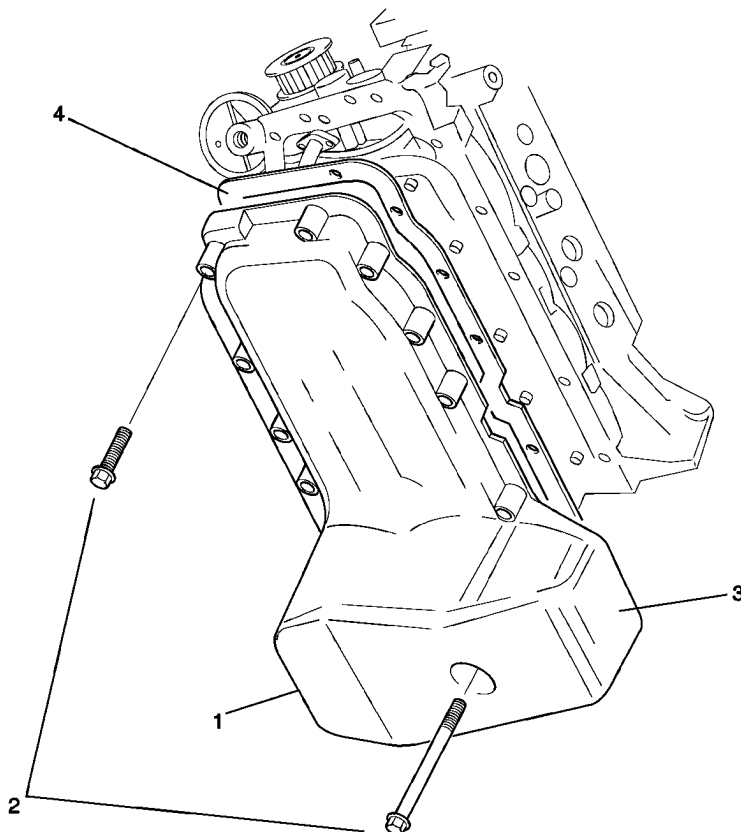
1. Install oil pressure switch to the oil pump.
Torque: 40 N·m (4.1 kgf·m)
2. Install the oil pump with the sleeve and the gasket.
Torque: 6 N·m (0.6 kgf·m)
3. Install oil strainer.
Torque: 8 N·m (0.8 kgf·m)
4. Install the oil pan.
Tighten the bolts:
15 N·m (1.5 kgf·m)
5. Install crankshaft timing pulley.
Tighten the bolts:
20 N·m (2.0 kgf·m)



Oil Pan

Oil Pan and Associated Parts

(2.2L & 2.0L Models)



Legend

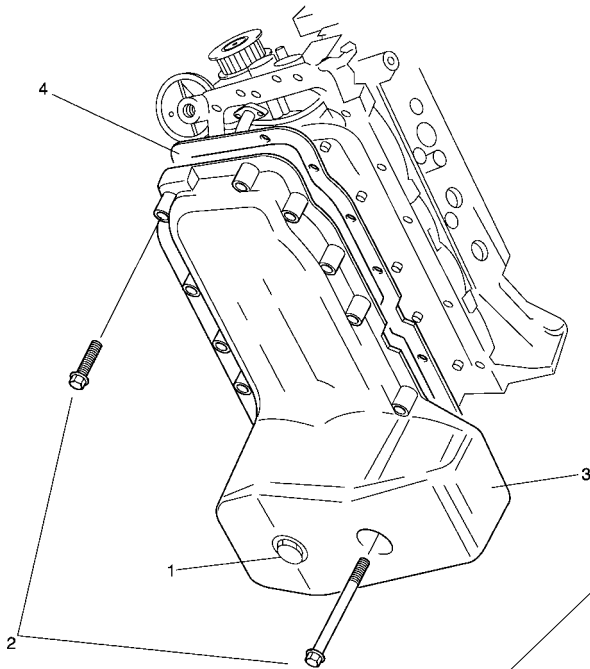
1 Drain Plug

2 Bolts

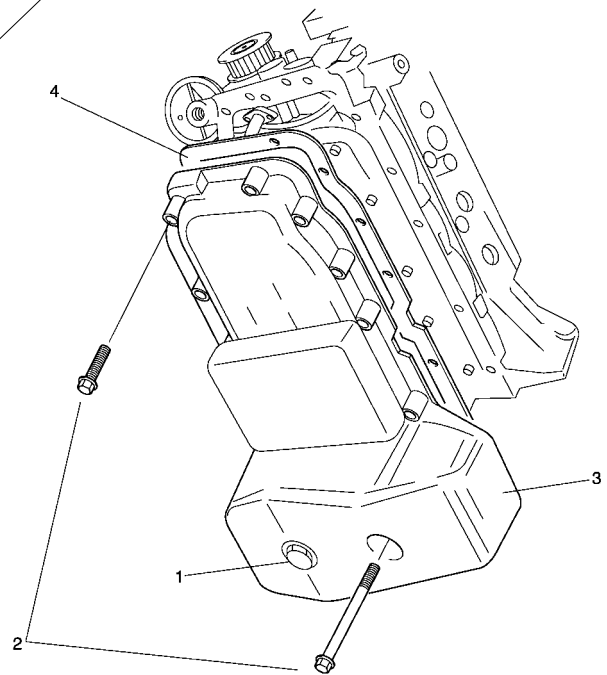
3 Oil Pan

4 Oil Pan Gasket

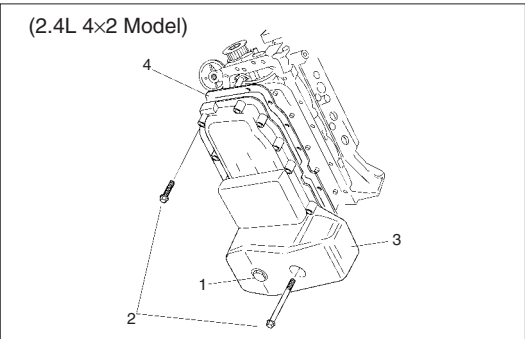
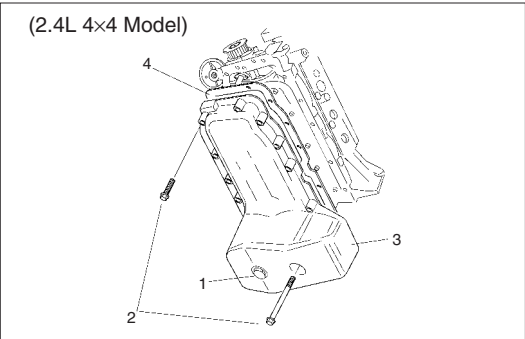
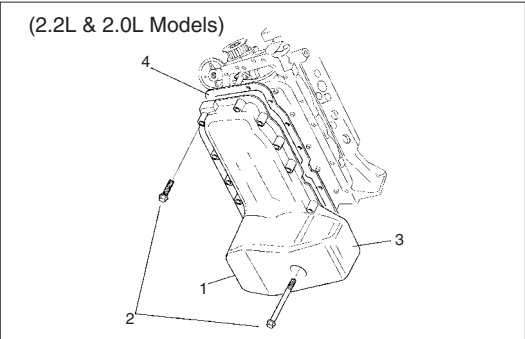
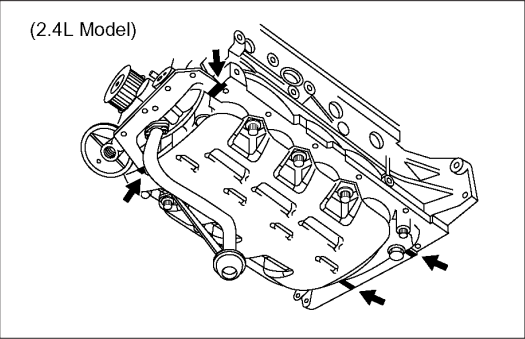
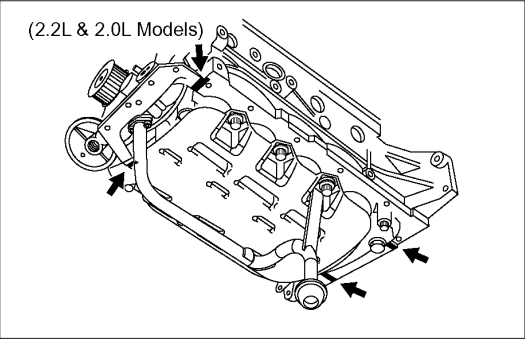
(2.4L 4×4 Model)



(2.4L 4×2 Model)

**Important****Disassembly**

1. Loosen a drain plug to drain oil.
2. Remove engine hood.
3. Remove engine rear mounting.
4. Remove transmission assembly.
5. Remove engine front mounting.
6. Raise the vehicle and support with switch stands, and then remove engine.
7. Remove oil pan.



Inspection and Repair



CAUTION: Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.



Reassembly

To install, follows the disassembly steps in the reverse order.



Important

Sealer - Apply silicon into groove in oil pan lugs prior to fitment of oil pan to block, remove excess sealer after oil pan is bolted to block.



Torque

Bolts - Tighten bolts to the specified torque.

Torque : 20 N·m (2.0 kgf·m)

Engine oil - Refill engine oil to the oil pan.

(Lit)

Replacement Oil Fill Volume	2.2L & 2.0L	2.4L
Without filter change	4.25	4.00
With filter change	4.50	4.25

SECTION 6H

ENGINE SPEED CONTROL SYSTEM

CONTENTS

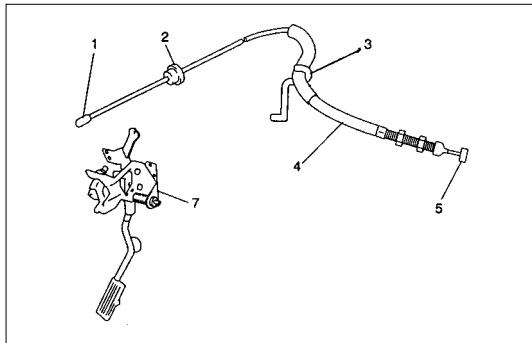
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Inspection.....	6H- 2
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Accelerator Pedal	6H- 3
Accelerator pedal and Associated Parts	6H- 3
Removal.....	6H- 3
Installation.....	6H- 3
Adjustment	6H- 3

Service Precaution



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Accelerator Pedal Control Cable

Removal

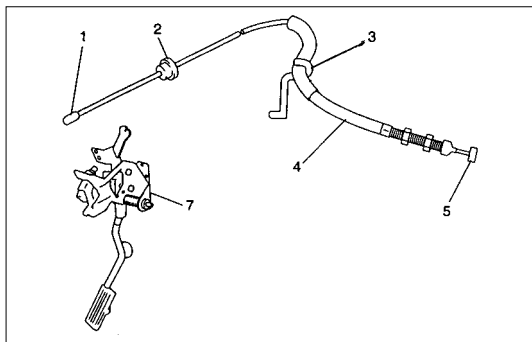
1. Loosen the adjust nut on the cable bracket mounted.
2. Remove cable clip (3).
3. Disconnect accelerator pedal (AP) control cable (5). (on throttle valve side)
4. Disconnect AP control cable (1). (on AP pedal (7) side)
5. Remove grommet (2).
6. Remove AP control cable (4).



Inspection

Check the following items, and replace the control cable if any abnormality is found:

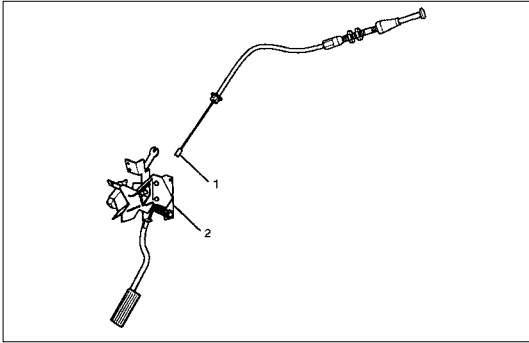
- The control cable should move smoothly.
- The control cable should not be bent or kinked.
- The control cable should be free of damage and corrosion.



Installation

1. Install AP control cable (4).
2. Install grommet (2).
3. Connect AP control cable (1). (on AP (7) side)
4. Connect AP control cable (5). (on throttle valve side)
5. Install cable clip (3).
6. Install adjusting nut.
7. Confirm the free play of throttle valve and control valve.

Free Play: 3 to 8 mm (0.117 to 0.312 in)



Accelerator Pedal

Accelerator Pedal and Associated Parts

Legend

- 1 Accelerator Pedal Control Cable
- 2 Accelerator Pedal Assembly



Removal

1. Accelerator pedal control cable (1).
2. Accelerator pedal assembly (2).



Installation

1. Accelerator pedal assembly (2).
2. Accelerator pedal control cable (1).



Adjustment

Manual Transmission:

- Rotate counterclockwise to loosen the locked nut and screw the stopper bolt in sufficiently.
- Fully depress the pedal and hold it there by hand. Next, rotate the stopper bolt until it hits the stopper of pedal bracket. Then, lock the stopper bolt there.

SECTION 6J

INDUCTION

CONTENTS

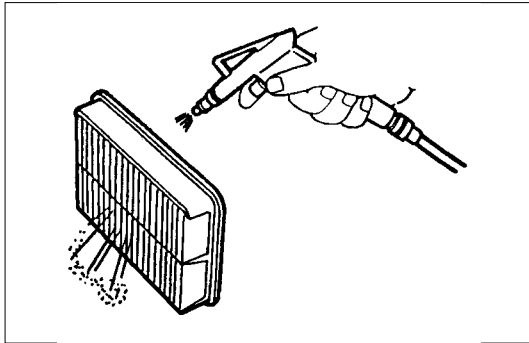
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Installation.....	6J- 2

Service Precaution



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Air Cleaner Filter



Removal

1. Remove positive ventilation hose connector.
2. Remove intake air temperature sensor.
3. Remove mass air flow sensor.
4. Remove air cleaner duct assembly.
5. Remove air cleaner element.



Inspection

Check the air cleaner filter for damage or dust clogging. Replace if it is damaged, or clean if it is clogged.



Cleaning Method

Tap the air cleaner filter gently so as not to damage the paper filter, or clean the element by blowing with compressed air of about 490 kPa (71 psi) from the clean side if it is extremely dirty.



Installation

1. Install air cleaner element.
2. Attach the air cleaner duct cover to the body completely, then clamp it with the clip.
3. Install mass air flow sensor.
4. Install mass air temperature sensor.
5. Install positive crankcase ventilation hose connector.

TFHEC-WE-9821

You are requested to order this manual using the manual number that is shown above.

This manual is applicable for vehicles in all countries except the USA, Canada, Europe and Thailand.

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