

RODEO

ENGINE

ENGINE MECHANICAL (Y22SE 2.2L)

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Service Precaution

WARNING: THIS VEHICLE HAS A SUPPLEMENTAL RESTRAINT SYSTEM (SRS). REFER TO THE SRS COMPONENT AND WIRING LOCATION VIEW IN ORDER TO DETERMINE WHETHER YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING. WHEN YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING, REFER TO THE SRS SERVICE INFORMATION. FAILURE TO FOLLOW WARNINGS COULD RESULT IN POSSIBLE AIR BAG DEPLOYMENT, PERSONAL INJURY, OR OTHERWISE UNNEEDED SRS SYSTEM REPAIRS.

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.

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 surfaces 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 modular 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 direct-acting inverted bucket tappet. The valves clearance adjustment are hydraulic. Hydraulic valve lash 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 modular 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 case-hardened steel. The connecting rods are made of cast iron. The connecting rod bearings are made of steel backed with babbitt metal.

Crankshaft and Bearings

The crankshaft is made of modular cast iron. Pins and journals are graded for correct size selection for their bearing.

Balance Shaft

Type is lanchester (twin counter-rotating shafts). The balance shafts are made of cast iron and gears are hard faced. The housing is made of cast iron. Backlash adjustment method is shim-balancer housing to block (selective fit).

Engine Diagnosis

First of all the engine diagnose to check fuel quantity, engine oil level and engine coolant level.

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 (for example J-26792), 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
	Powertrain Control Module cable disconnected or defective	Correct or replace

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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 gage 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 100 kPa (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	Powertrain Control Module defective	Replace
	Exhaust Gas Recirculation Valve faulty	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 kinked 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

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 filler 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
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
	Exhaust Gas Recirculation Valve defective	Replace

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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 under size bearing
	Crankshaft out of round	Replace crank bearings and crankshaft or regrind crankshaft and install the under size bearing
	Crank bearing seized	Crank bearing seized, replace crank bearings and crankshaft or regrind crankshaft and install the under size bearing

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 part 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

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 assembly

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 of incorrect gear selection
	Engine overheating	Refer to "Engine Lacks Power"
Others	Water pump defective	Replace
	Drive belt slipping	Adjust tension of drive belt or replace drive 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	Correct or replace
	Heated Oxygen Sensor defective	Replace
	Signal vacuum hose loosely fitted or defective	Correct or replace
	Exhaust Gas Recirculation Valve defective	Replace
	ECT Sensor circuit open or shorted	Correct or replace
	ECT Sensor defective	Replace
	Evaporator system	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 attachings 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 ring 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

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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
	Excessive Exhaust Gas Recirculation flow due to trouble in Exhaust Gas Recirculation system	Refer to Abnormal Combustion

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

1. Check for dirt, gasoline or water in the engine oil.
 - a. Check the viscosity of the oil.
 - b. Change the oil if the viscosity is outside the specified standard.
 - c. Refer to the "Maintenance and Lubrication" section of this manual.
2. 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.

3. Remove the oil pressure unit.
4. Install an oil pressure gauge.
5. Start the engine and allow the engine to reach normal operating temperature (About 80°C).
6. Measure the oil pressure.

Oil pressure should be:
150 kPa (21.8 psi) at idle speed.
7. Stop the engine.
8. Remove the oil pressure gauge.
9. Install the oil pressure unit.
10. Start the engine and check for leaks.

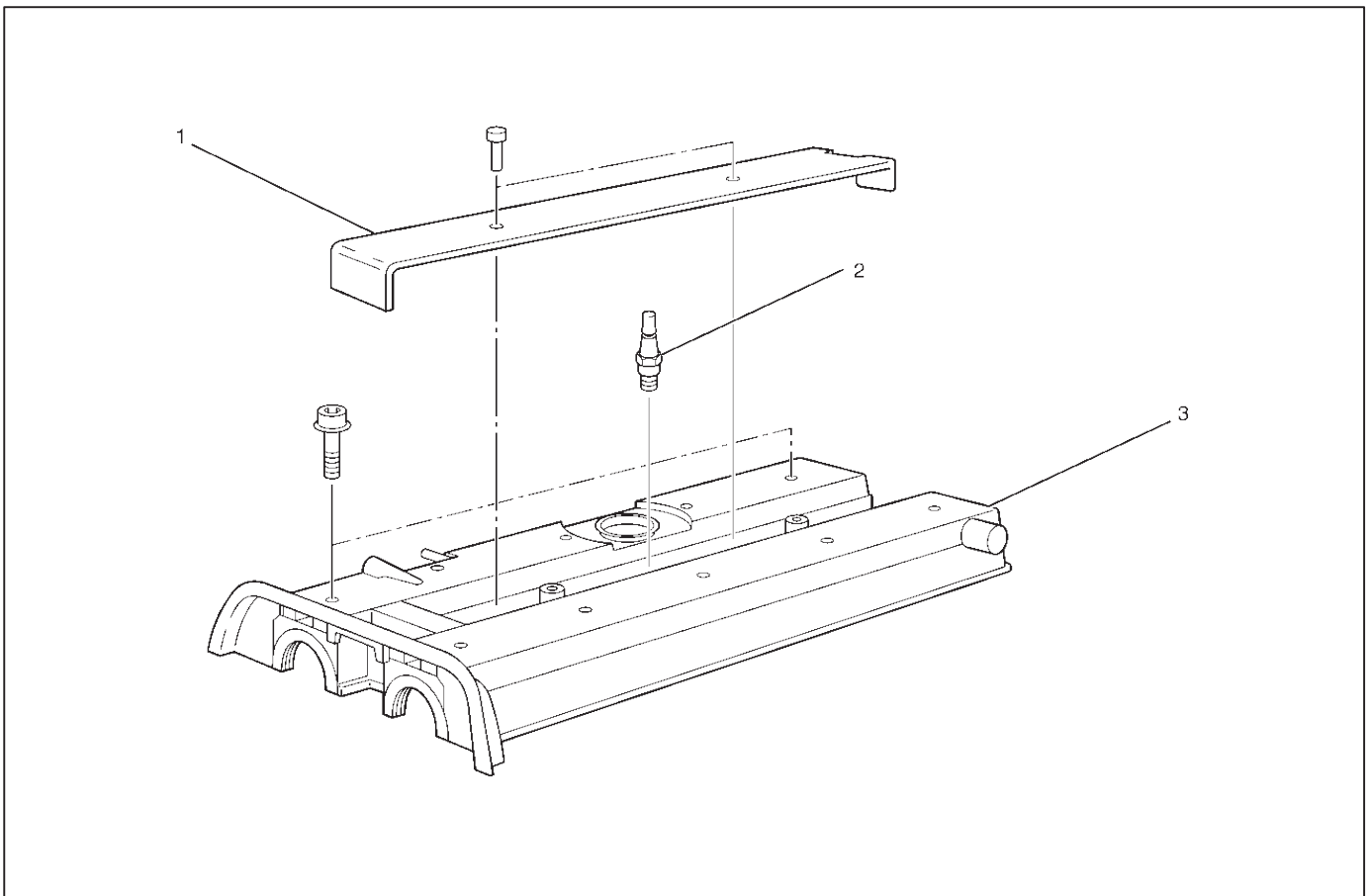
Malfunction Indicator Lamp

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
	Powertrain Control Module (PCM) cable loosely connected, disconnected or defective	Correct or replace
	PCM defective	Replace
"CHECK ENGINE" MIL illuminates, and stays on	Deterioration heated oxygen sensor of internal element	Replace
	Heated oxygen sensor connector terminal improper contact	Reconnect properly
	Heated oxygen sensor lead wire shorted	Correct
	Heated oxygen sensor circuit open	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
	PCM driver transistor defective	Replace PCM
	Malfunctioning of PCM RAM (Random Access Memory) or ROM (Read Only Memory)	Replace PCM

Cylinder Head Cover

Cylinder Head Cover and Associated Parts



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Legend

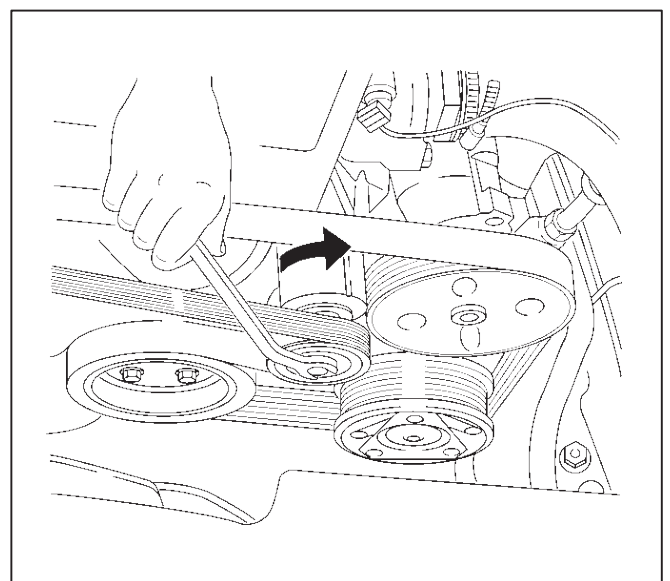
(1) Ignition Cable Cover

(2) Spark Plug

(3) Cylinder Head Cover

Removal

1. Disconnect battery ground cable.
2. Disconnect PCV hose from cylinder head cover.
3. Remove intake duct.
4. Remove left side ground cable from cylinder head cover and disconnect ground cable connector on the left side wheel arch. Remove right side ground cable from generator stay and disconnect ground cable connector on the right side wheel arch.
5. Disconnect three (black, green and blue colors) engine wire harness connectors from chassis harness of left rear side of compartment.
6. Disconnect cooling fan wire harness connector from cooling fan on left side top of fan shroud.
7. Move drive belt tensioner to loose side using wrench then remove drive belt.



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8. Remove PCV hose from cylinder block.
9. Remove intake duct stay from cylinder head.
10. Remove two bolts for remove ignition cable cover from cylinder head cover.

11. Disconnect ignition cable from ignition plug.
12. Disconnect camshaft position sensor harness and crankshaft angle sensor harness from behind generator.
13. Remove four bolts and remove the crankshaft pulley



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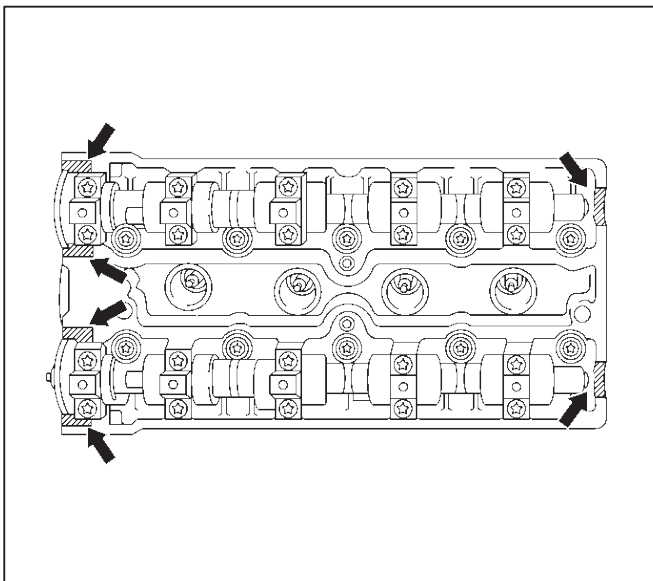
14. Remove timing belt front cover.
15. Loose fixing bolt then remove the camshaft angle sensor.
16. Remove ten cylinder head cover fixing bolts and remove the cylinder head cover.

Installation

1. Install the camshaft position sensor and tighten the bolt.

Torque: 6 N·m (52 lb in)

2. Clean sealing surfaces and apply the liquid gasket.



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3. Install the cylinder head cover and tighten bolts to the specified torque. (use thread sealant)

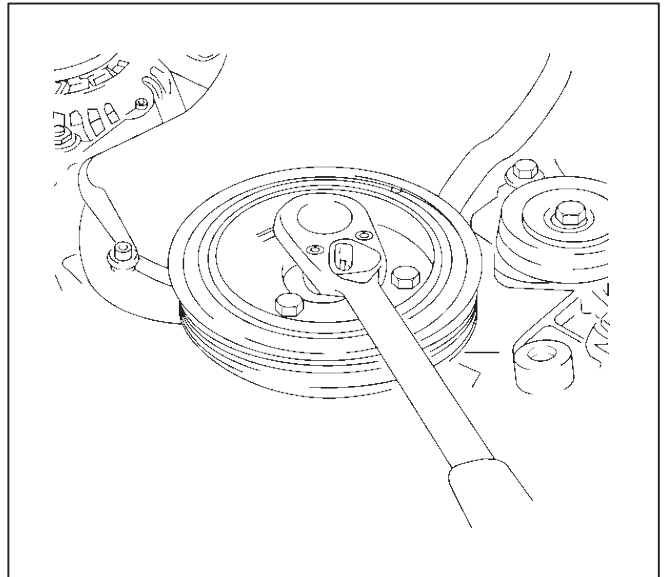
Torque: 6 N·m (52 lb in)

4. Install the timing belt front cover then tighten fixing bolts to the specified torque.

Torque: 6 N·m (52 lb in)

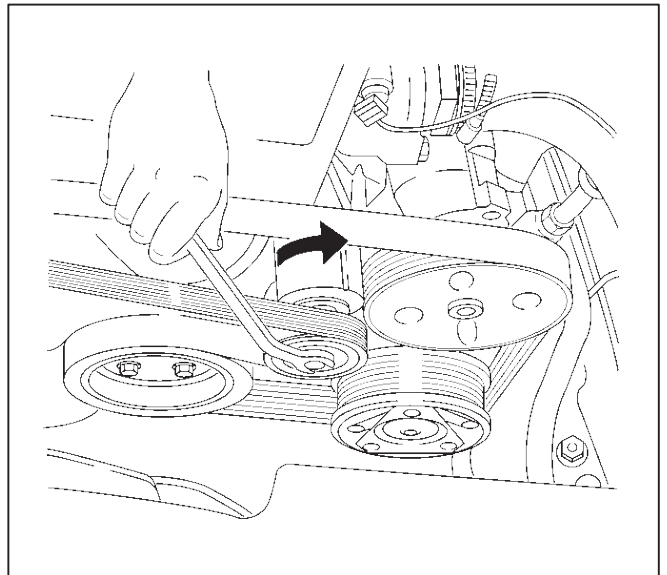
5. Install the crankshaft pulley, tighten fixing bolts to the specified torque.

Torque: 20 N·m (14 lb ft)



020RW014

6. Move drive belt tensioner to loose side using wrench then install the drive belt to normal position.



033RW001

7. Connect ignition cable to ignition plug.
8. Install ignition cable cover to cylinder head cover and tighten two bolts to the specified torque.

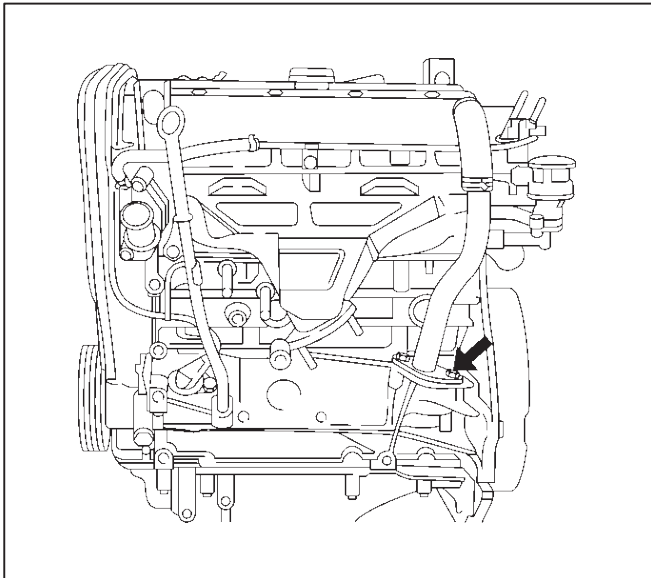
Torque: 3 N·m (17 lb in)

9. Install intake duct bracket to cylinder block.

6A-18 ENGINE MECHANICAL (Y22SE 2.2L)

10. Install PCV hose flange to cylinder block to the specified torque.

Torque: 25 N·m (18 lb ft)



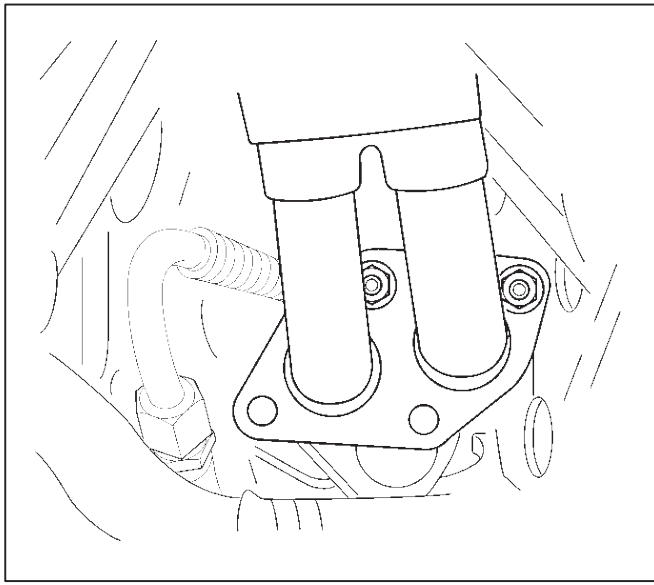
020RV015

11. Connect cooling fan wire harness connector to cooling fan on left side top of fan shroud.
12. Connect left side ground cable to cylinder head cover and connect other side connector to left side wheel arch terminal.
Connect right side ground cable to generator stay and connect other side connector to right side wheel arch terminal.
13. Connect three (black, green and blue colors) engine wire harness connector to chassis harness of left rear side of engine compartment.
14. Install intake duct.
15. Connect PCV hose to cylinder head cover.
16. Connect battery ground cable.

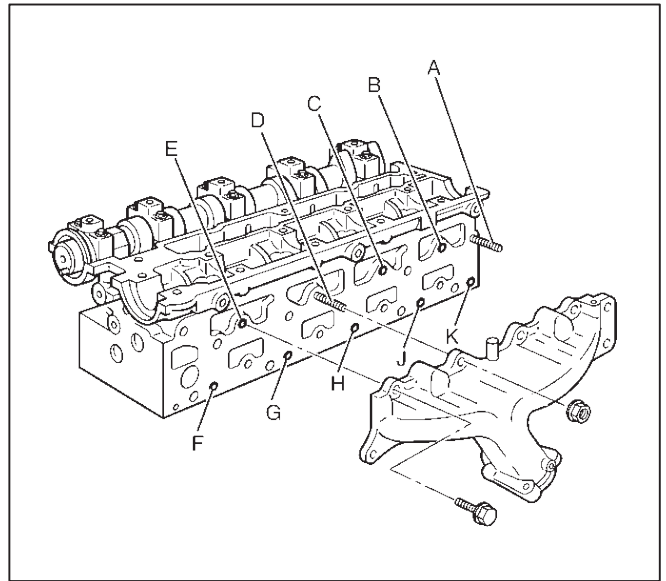
Exhaust Manifold

Removal

1. Disconnect battery ground cable.
2. Disconnect PCV hose from air intake duct.
3. Remove a nut from air intake duct bracket and loosen hose clamp on throttle body. Remove air intake duct assembly with air cleaner cover.
4. Remove air intake duct bracket with ground cable.
5. Remove four fixing bolts on exhaust manifold heat protector.
6. Remove fixing four nuts from flange of front exhaust pipe and remove fixing bolts from silencer side.



7. Remove ten exhaust manifold fixing nuts then remove exhaust manifold.



2. Install front exhaust pipe to exhaust manifold and tighten fixing nut to the specified torque.

Torque: 25 N·m (18 lb ft)

Installation

1. Install exhaust manifold and tighten fixing nuts and bolts to be tightened in three steps.

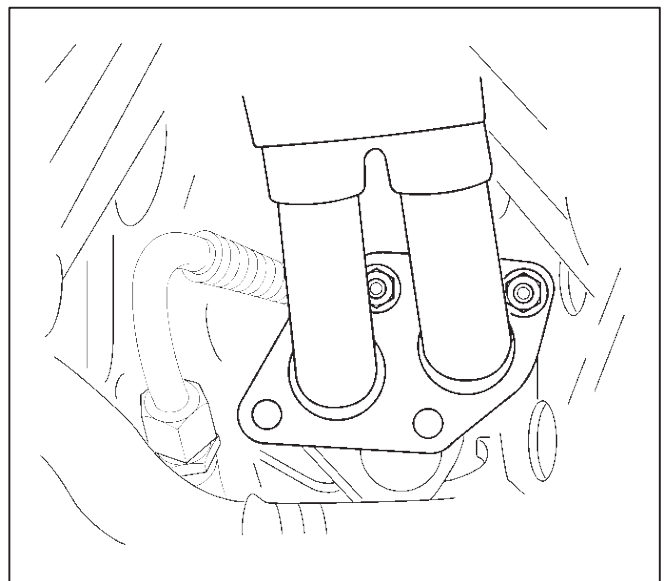
• **Tightening sequence:**

- **Step1:** J G H B D C J G B D
- **Step2:** A B C D E F G H J K
- **Step3:** A B C D E F G H J K

• **Tightening torque:**

- **Step1:** 19 N·m (14 lb ft)
- **Step2:** 15 N·m (11 lb ft)
- **Step3:** 15 N·m (11 lb ft)

NOTE: Do not re-use the nuts and bolts.



3. Tighten silencer side bolt to the specified torque.

Torque: 59 N·m (43 lb ft)

4. Install exhaust manifold heat protector and tighten bolt.

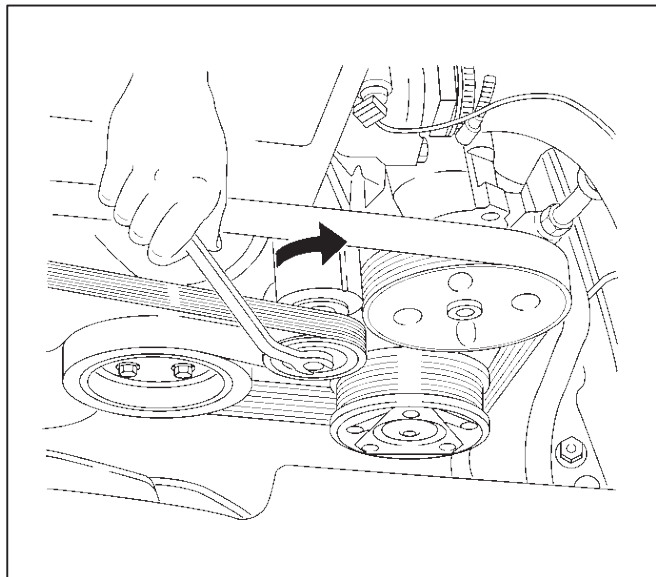
Torque: 8 N·m (69 lb in)

5. Install intake duct bracket with ground cable.
6. Install intake duct assembly to throttle body and air cleaner then tighten nut to the intake duct bracket and clamp on the throttle body side, also clamp air cleaner cover.
7. Connect PCV hose to air intake duct.
8. Connect battery ground cable.

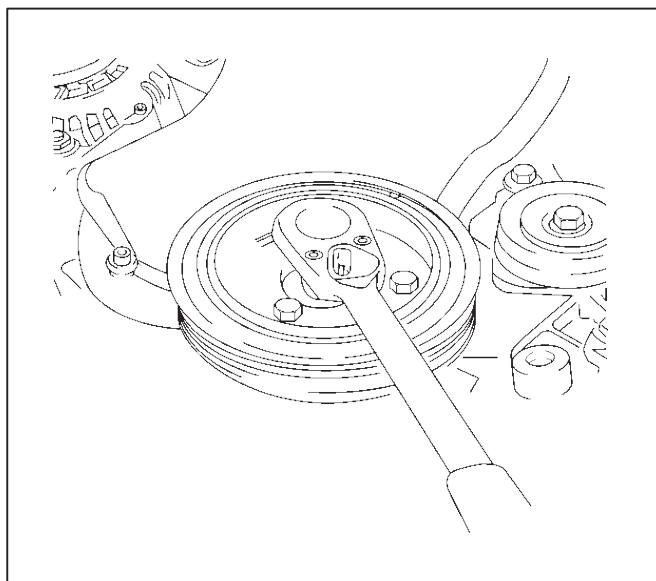
Crankshaft Pulley

Removal

1. Disconnect battery ground cable.
2. Move drive belt tensioner to loose side by using wrench then remove drive belt.



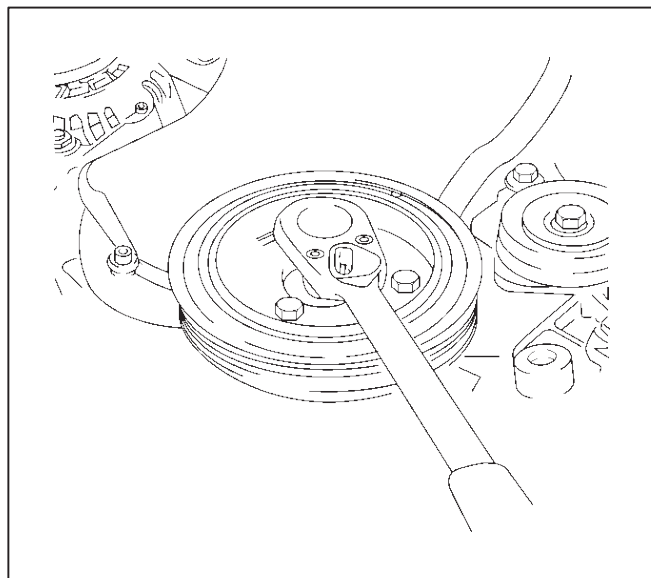
3. Remove four crankshaft pulley fixing bolts, remove crankshaft pulley.



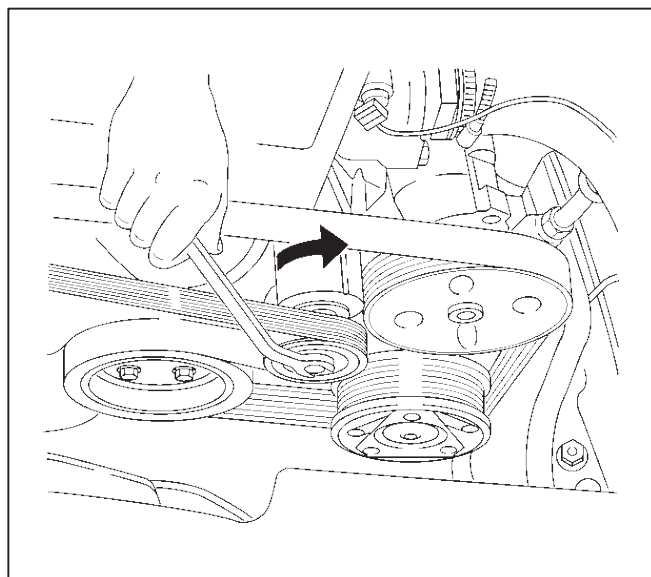
Installation

1. Install the crankshaft pulley to crankshaft flange.
2. Tighten four bolt to the specified torque.

Torque: 20 N·m (14 lb ft)



3. Move drive belt tensioner to loose side by using wrench, then install drive belt to normal position.

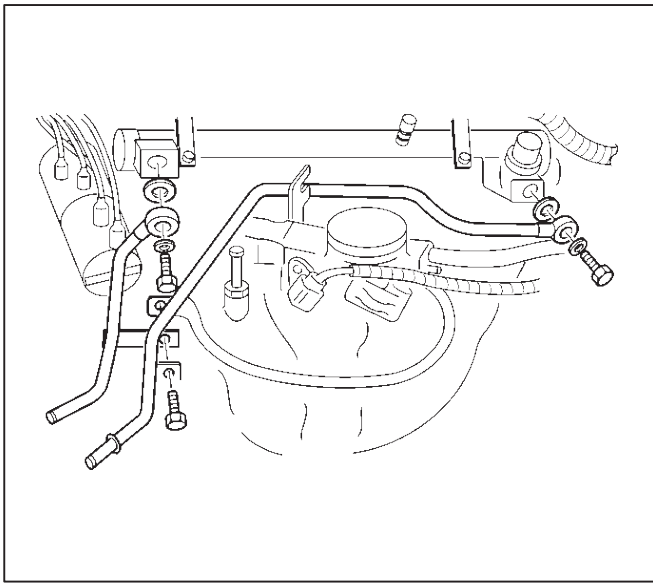


4. Connect battery ground cable.

Intake Manifold

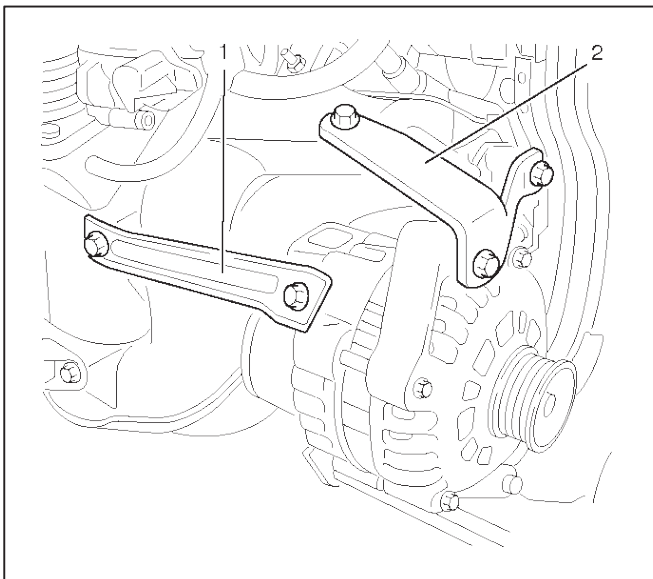
Removal

1. Disconnect battery ground cable.
2. Remove PCV hose from air intake duct.
3. Remove a nut from air intake duct bracket and loosen hose clamp on throttle body. Remove air intake duct assembly with air cleaner cover.
4. Drain engine coolant.
5. Remove water hoses from throttle body.
6. Disconnect the connector for throttle position sensor, idle air control valve sensor from throttle body.
7. Remove fuel pipe joint eye bolts from fuel rail and disconnect wire harness from fuel injector.



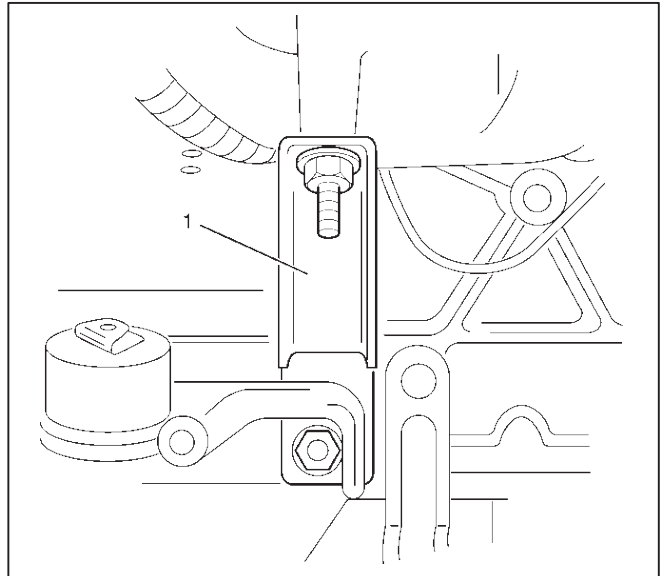
042RW001

8. Disconnect hose from fuel pressure regulator then remove fuel rail assembly.
9. Remove throttle valve control cable from throttle body.
10. Remove fixing bolts for generator bracket.



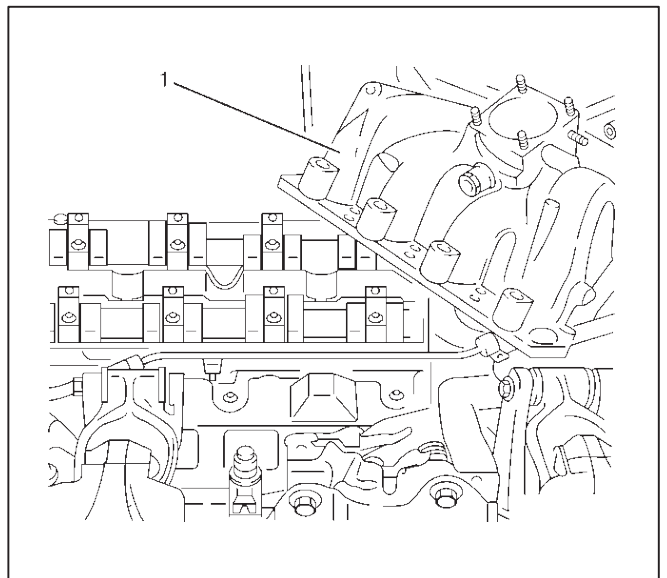
065RW025

11. Remove water pipe fixing bolt then remove water pipe.
12. Remove fixing bolt from bracket (Between cylinder block and intake manifold) of intake manifold side.



025RW002

13. Remove ignition coil bracket fixing bolt.
14. Remove the brake booster vacuum hose.
15. Remove the four throttle body nuts.
16. Remove bolt and seven nuts, and remove intake manifold.



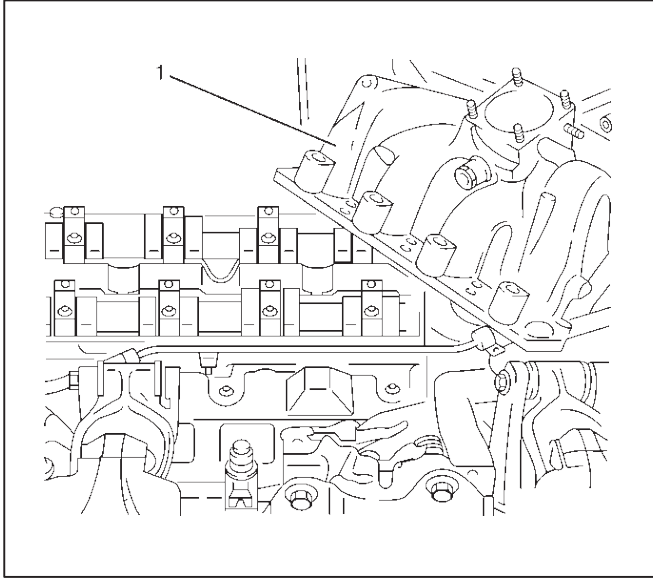
027RW002

Installation

1. Install intake manifold with gasket to cylinder head, tighten bolt and nuts to the specified torque.

Torque: 22 N·m (16 lb ft)

NOTE: Do not re-use the bolts and nuts.

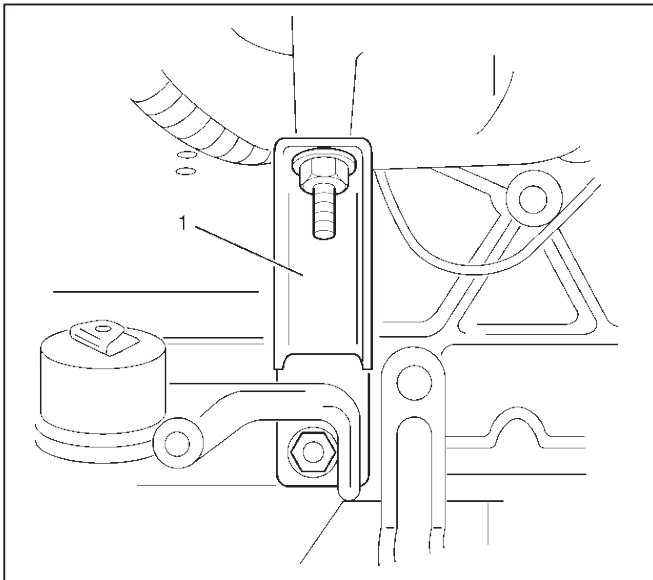


2. Install ignition coil bracket fixing bolt.

Torque: 20 N·m (14 lb ft)

3. Install intake manifold bracket, tighten bolt.

Torque: 25 N·m (18 lb ft)



4. Install water pipe to intake manifold.

5. Install the throttle body with paper gasket to the intake manifold, tighten the four nuts.

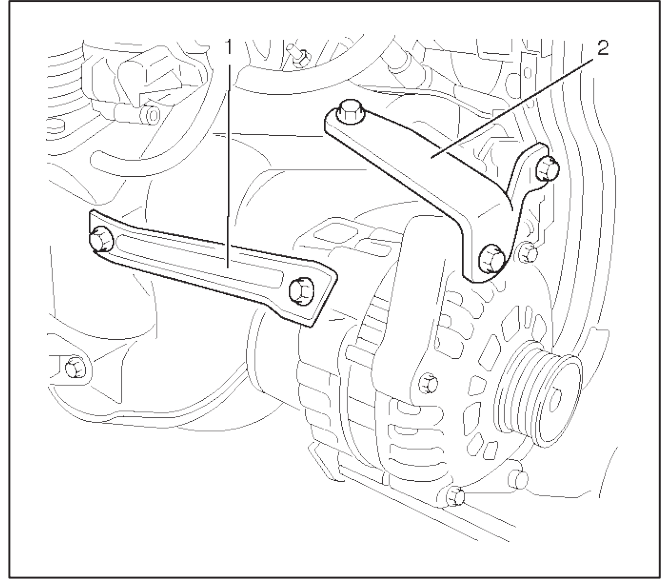
Torque: 9 N·m (78 lb in)

6. Install generator bracket and tighten generator bracket bolts.

Torque

Long bolts: 35 N·m (25 lb ft)

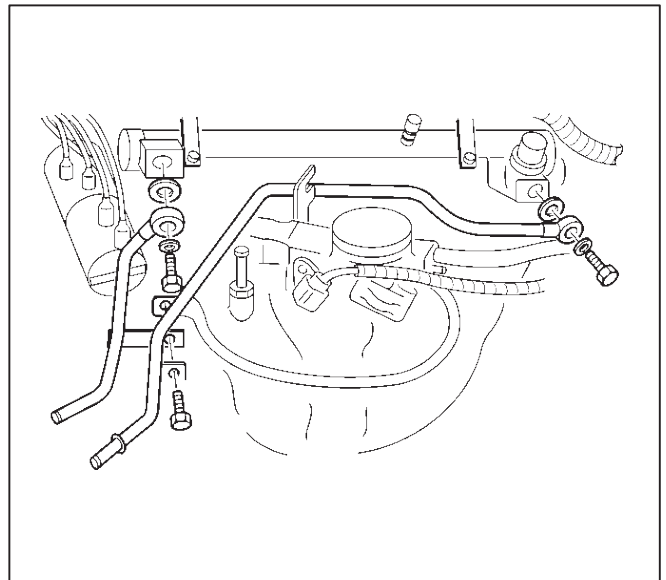
Short bolts: 20 N·m (14 lb ft)



7. Install fuel rail assembly to intake manifold and connect hose between fuel pressure regulator and throttle body.

8. Install fuel pipe and tighten joint eye bolt and connect fuel injector harness.

Torque: 25 N·m (18 lb ft)



-
9. Connect the connector for throttle position sensor and idle air control valve sensor to throttle body.
 10. Install water hoses to throttle body.
 11. Install intake duct assembly to throttle body and air cleaner then tighten nut to the intake duct bracket and clamp on the throttle body side and air cleaner side.

Torque: 7 N·m (61 lb in)

12. Install PCV hose to air intake duct.
13. Install throttle valve control cable to throttle body.
14. Confirm the free play of throttle valve control cable.

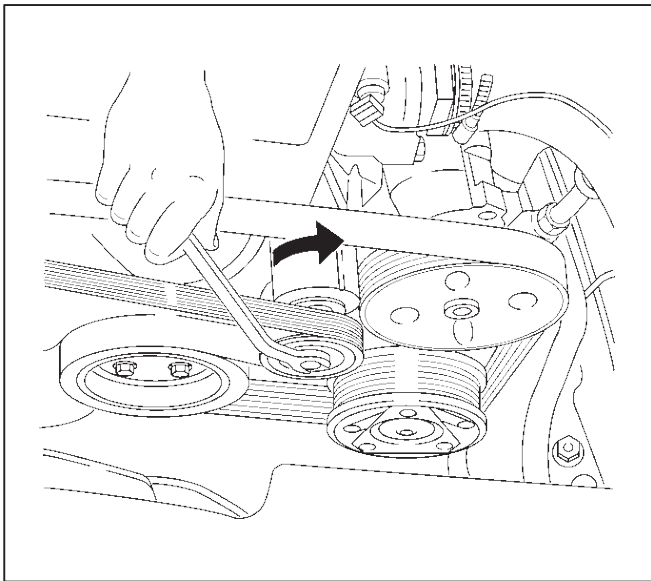
Free play: 5.7 to 6.3 mm

15. Fill engine coolant to full level from radiator filler neck.
16. Connect battery ground cable.

Cylinder Head Assembly

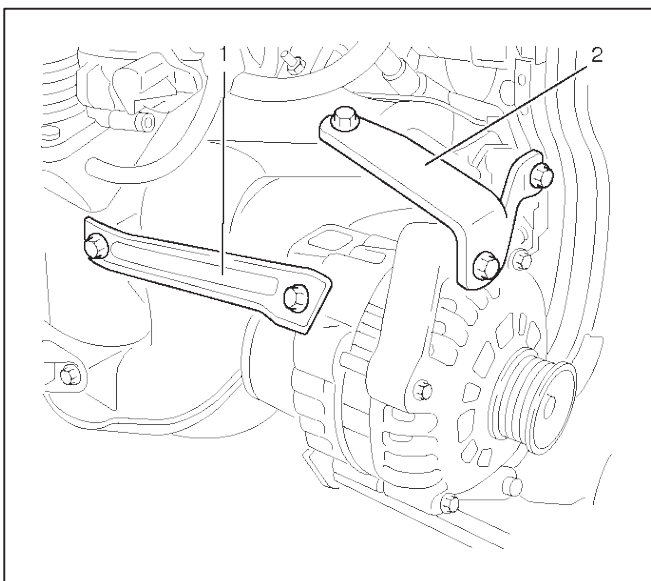
Removal

1. Disconnect battery ground cable.
2. Disconnect connector of intake air temperature sensor from intake air duct.
3. Remove PCV hose from air intake duct.
4. Remove nut from air intake duct bracket and loosen hose clamp on throttle body. Remove air intake duct assembly with air cleaner cover.
5. Remove intake air duct bracket from cylinder head.
6. Drain engine coolant.
7. Move drive belt tensioner to loose side using wrench then remove drive belt.



033RW001

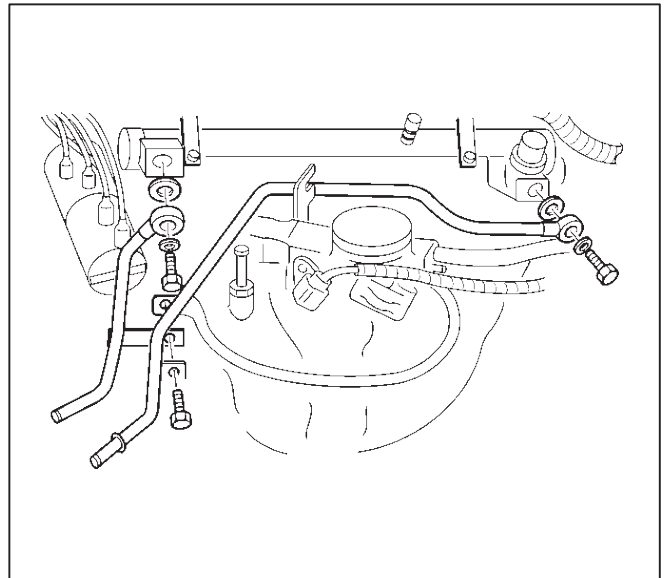
8. Remove radiator upper hose from engine side.
9. Remove four nuts of exhaust front pipe.
10. Remove three bolts from generator bracket then remove the generator with brackets.



065RW025

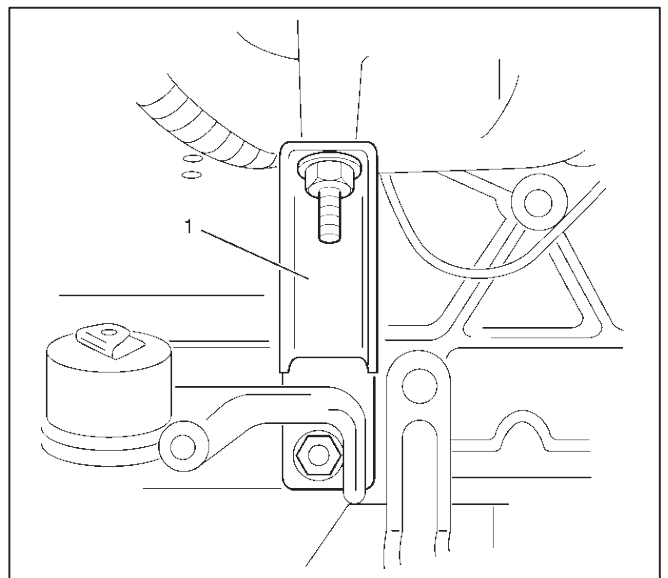
11. Disconnect crankshaft angle sensor connector.
12. Disconnect knock sensor connector.

13. Remove heater hose from adapter side.
14. Remove heater hose from water pipe side.
15. Remove water hose between water pipe and throttle body.
16. Remove fuel pipe joint eye bolts from fuel rail assembly and remove fuel pipe bracket with electric ground cable.



042RW001

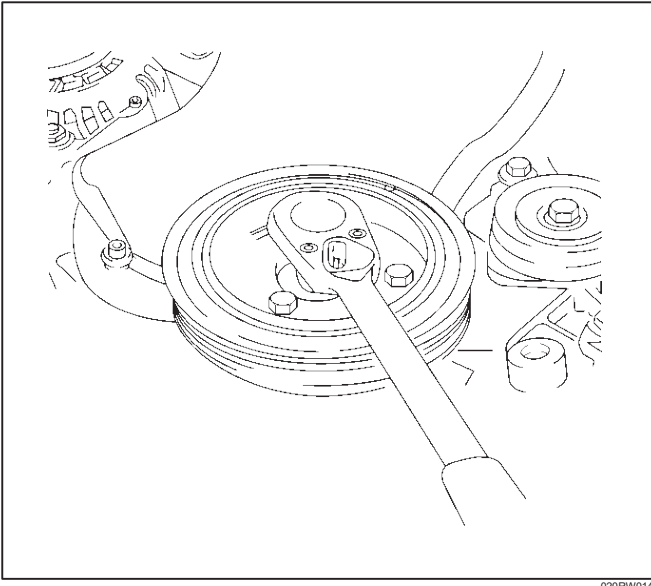
17. Disconnect connector for evaporation valve.
18. Remove canister hose.
19. Remove fixing nut of intake manifold stay from cylinder block side.



025RW002

20. Remove two bolts from intake manifold for water pipe support and remove cylinder head assembly.
21. Remove engine harness cover and disconnect three connectors from chassis harness on left rear side engine compartment.
22. Disconnect connector for power steering pump pressure switch.

23. Remove four bolts and remove crankshaft pulley.



020RW014

24. Remove two bolts and nut then remove timing belt front cover.

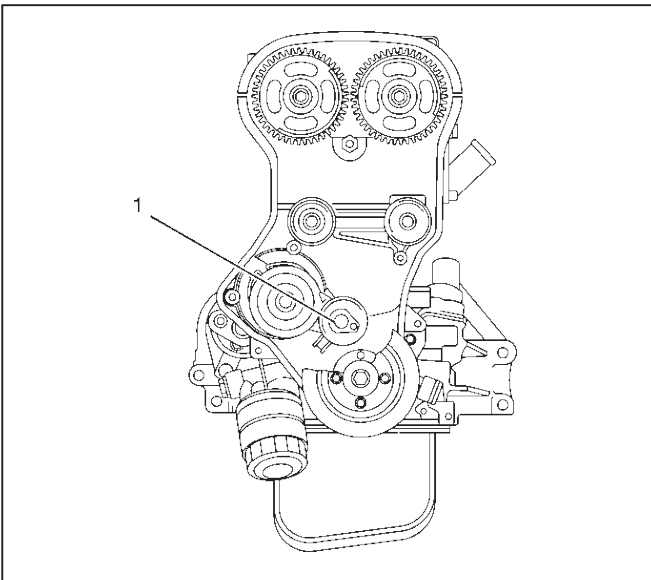
25. Remove ventilation hose from cylinder block side and from cylinder head side.

26. Remove two bolts, ignition cable cover and remove ignition cables from spark plug.

27. Disconnect camshaft angle sensor connector.

28. Remove ten bolts and remove cylinder head cover.

29. Remove fixing bolt of timing belt tensioner then remove timing belt tensioner.



020RW010

30. Remove timing belt.

CAUTION:

- Do not bend or twist belt, otherwise its core could be damaged. The belt should not be bent at a radius less than 30 mm.
- Timing belt drive pulley counterhold with J-42620.

- Do not allow oil or other chemical substances to come in contact with the belt. They will shorten the life.

- Do not attempt to pry or stretch the belt with a screw driver or any other tool during installation.

- Store timing belt in cool and dark place. Never expose the belt direct sunlight or heat.

31. Use adjustable wrench to hexagonal portion of camshaft and remove fixing bolts from front end of camshaft.

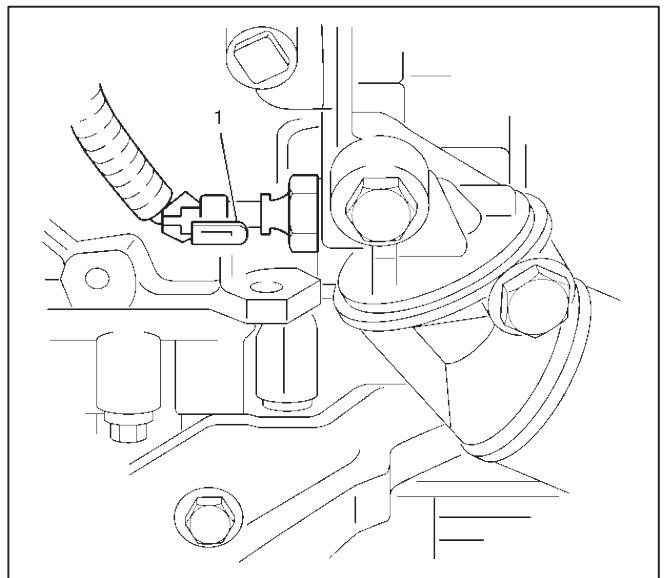
32. Remove camshaft drive pulley from intake and exhaust camshaft.

33. Remove two idle pulleys, the left side with idle pulley bracket.

34. Remove two bolts and stud bolt and remove timing belt rear cover.

35. Remove camshaft angle sensor

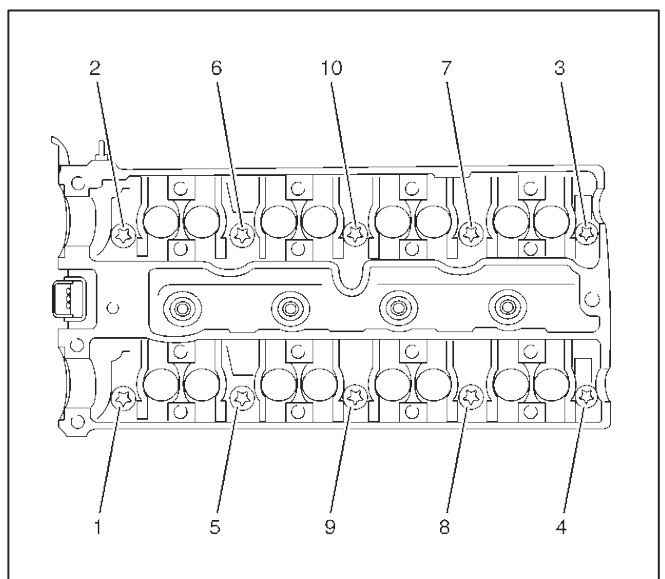
36. Disconnect engine oil pressure switch connector.



050RW005

37. Remove camshaft assembly exhaust side.

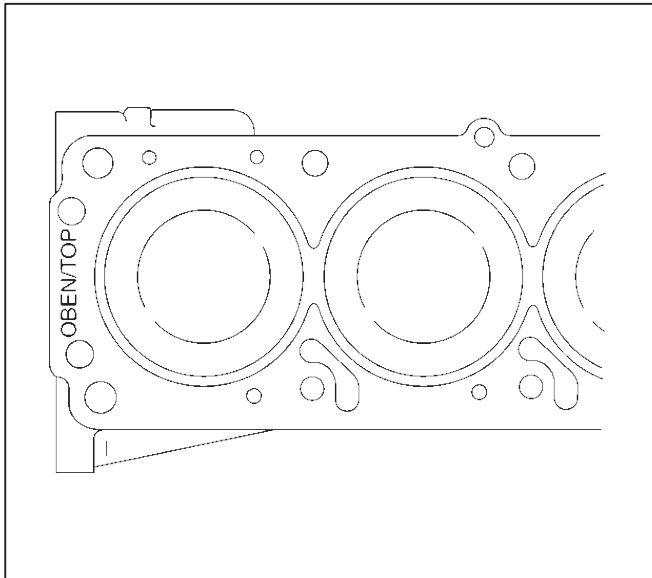
38. Use J-42623 to remove ten cylinder head fixing bolts



012RW007

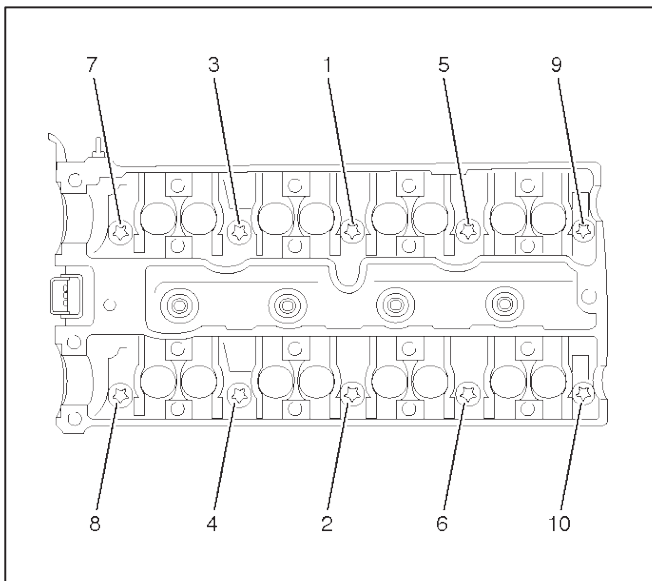
Installation

1. Clean sealing surface.
Put new cylinder head gasket on the cylinder block.



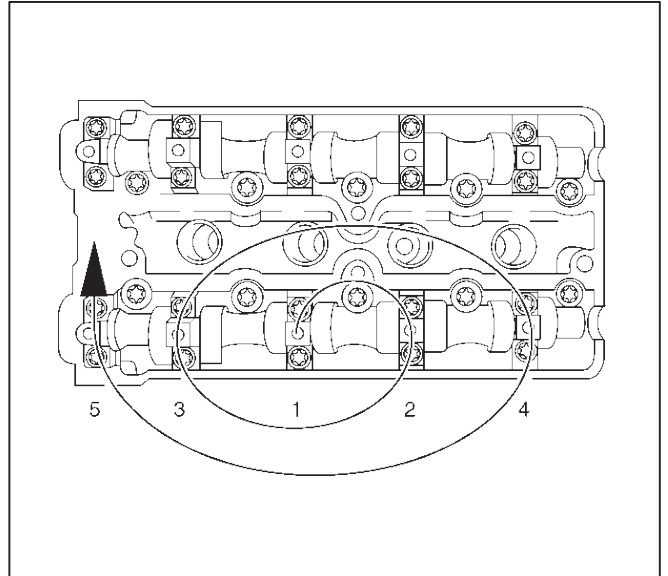
2. Install the cylinder head assembly, tighten cylinder head bolts by four steps tightening method in the following sequence to the specified torque.(use J-42623). New bolts must be used.

Torque: 25 N·m (18 lb ft) + 90° + 90° + 90°



3. Install camshaft assembly exhaust side and tighten camshaft bracket bolts in the sequence to the specified torque.

Torque: 8 N·m (69 lb in)



4. Install the camshaft drive pulley, align a guide hole on the camshaft drive pulley marked "IN" for in take and "EX" for exhaust to guide pin on the camshaft.
Tighten drive pulley fixing bolt to the specified torque.

Torque: 50 N·m (37 lb ft) + 60°

New bolts must be used.

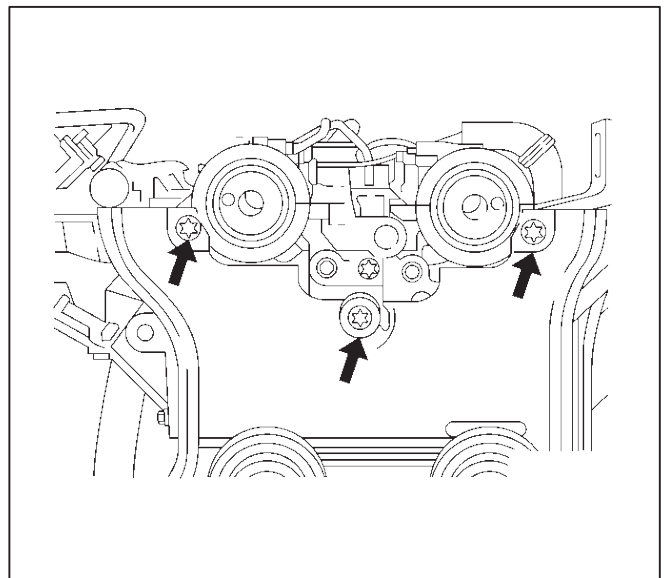
5. Connect engine oil pressure switch connector.
6. Install camshaft angle sensor and bolt.

Torque: 6 N·m (52 lb in)

7. Install the timing belt rear cover and tighten three bolts with apply thread sealant to the specified torque.

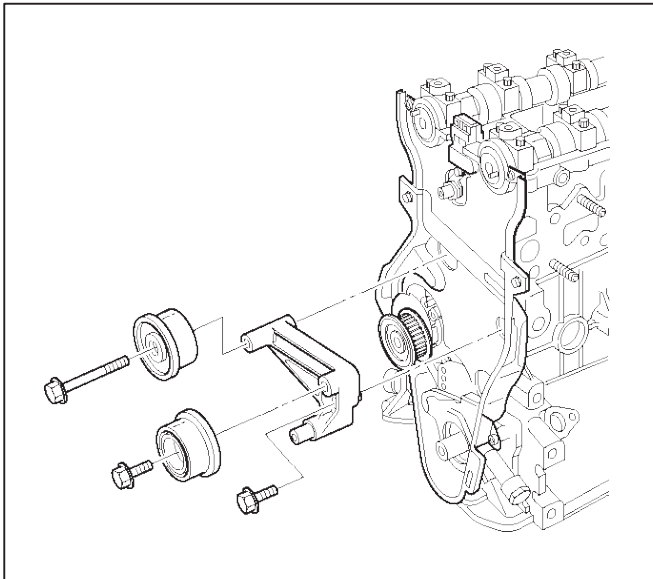
Torque

M6 bolt: 6 N·m (52 lb in)



8. Install left side idle pulley with idle pulley bracket, tighten to the specified torque and install right side idle pulley and tighten to the specified torque.

Torque: 25 N·m (18 lb ft)



020RW016

9. Install timing belt tensioner then tighten it temporarily until make alignment timing belt.
 10. Install the cylinder head cover and tighten fixing bolt temporarily.
 11. Install the timing belt and perform timing belt setting refer to the timing belt in this manual.

NOTE: The tensioner setting is critical to reliable engine running, refer to Timing belt tensioner setting.

12. Tighten cylinder head cover to the specified torque.

Torque: 6 N·m (52 lb in)

13. Connect camshaft angle sensor connector.
 14. Install the ignition cable to spark plug.
 15. Install ignition cable cover and tighten two bolts.

Torque: 3 N·m (26 lb in)

16. Install ventilation hoses to cylinder block side and cylinder head side.
 17. Install timing belt front cover and tighten two bolts to the specified torque.

Torque: 6 N·m (52 lb in)

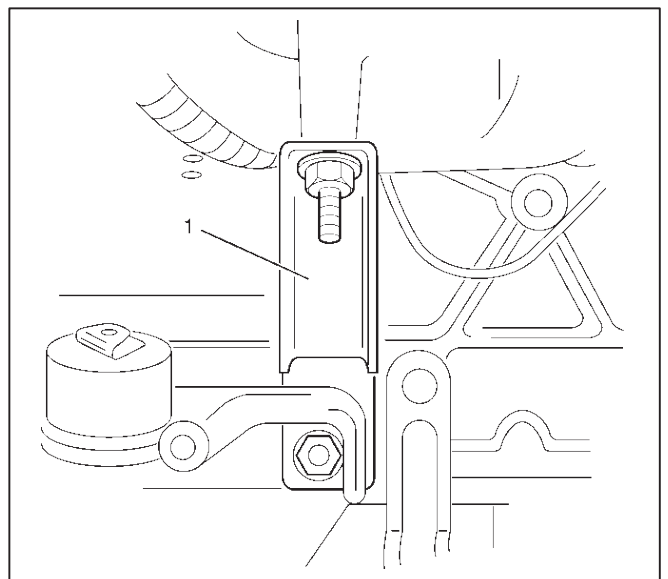
18. Install crankshaft pulley and tighten four bolts.

Torque: 20 N·m (14 lb ft)



020RW014

19. Connect connector for power steering pump pressure switch.
 20. Connect engine harness connector to chassis harness of the left rear of engine compartment and install engine harness cover.
 21. Install two bolts to intake manifold for water pipe support.
 22. Install fixing nut of intake manifold stay (1) to cylinder block.



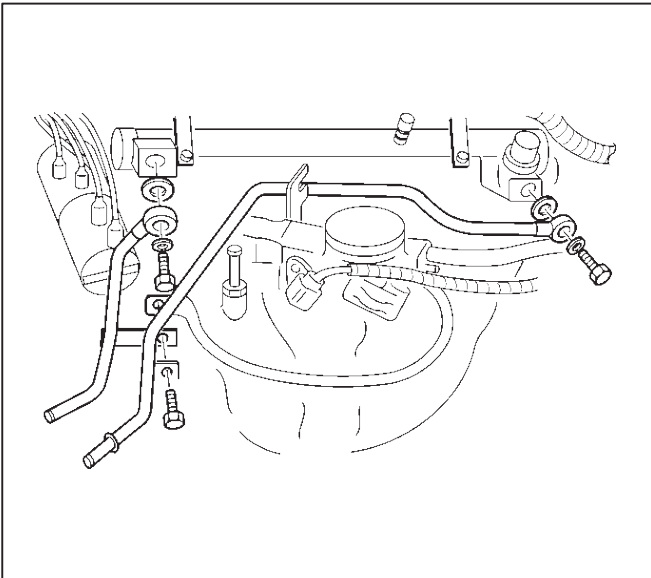
025RW002

23. Install canister hose.
 24. Connect connector for evaporation valve.

6A-28 ENGINE MECHANICAL (Y22SE 2.2L)

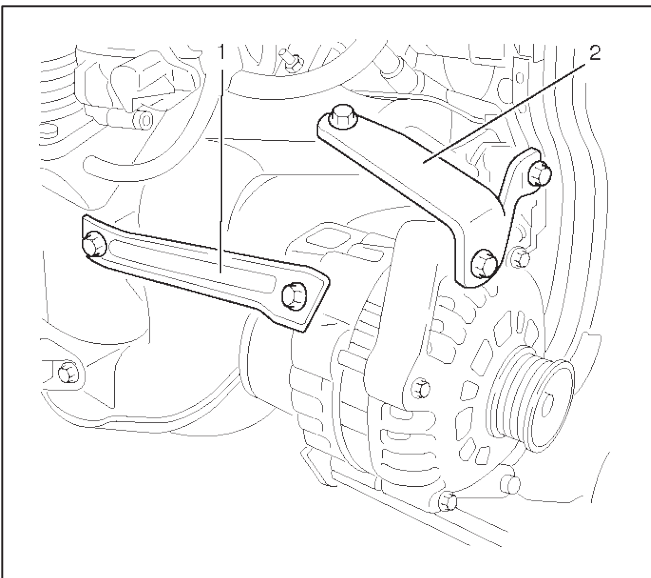
25. Install fuel pipe joint eye bolts to fuel rail assembly and install fuel pipe bracket with electric ground cable.

Torque: 25 N·m (18 lb ft)



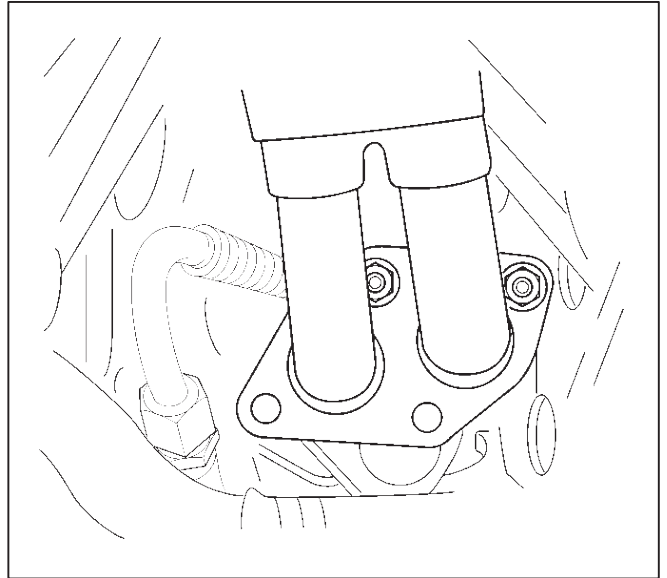
26. Install water hose between water pipe and throttle body.
27. Install heater hose to water pipe side.
28. Install heater hose to adapter side.
29. Connect knock sensor connector.
30. Connect crankshaft angle sensor connector.
31. Install generator with bracket and tighten three bolts.

Torque: 20 N·m (14 lb ft)



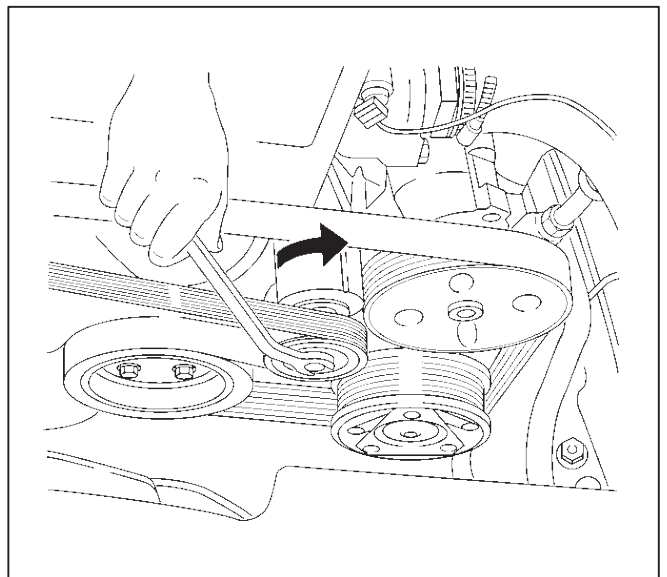
32. Install exhaust front pipe to exhaust manifold and tighten four nuts to the specified torque.

Torque: 25 N·m (18 lb ft)



33. Install radiator upper hose to engine.

34. Move drive belt tensioner to loose side using wrench then install the drive belt to normal position.



35. Install intake air duct bracket to cylinder head.

36. Install air intake duct assembly with air cleaner cover to throttle body and tighten nut to the air intake duct bracket then tighten hose clamp.

Torque

7 N·m (61 lb in) for nut

3 N·m (26 lb in) for hose clamp bolt

37. Install PCV hose to air intake duct.

38. Connect connector of intake air temperature sensor on intake air duct.

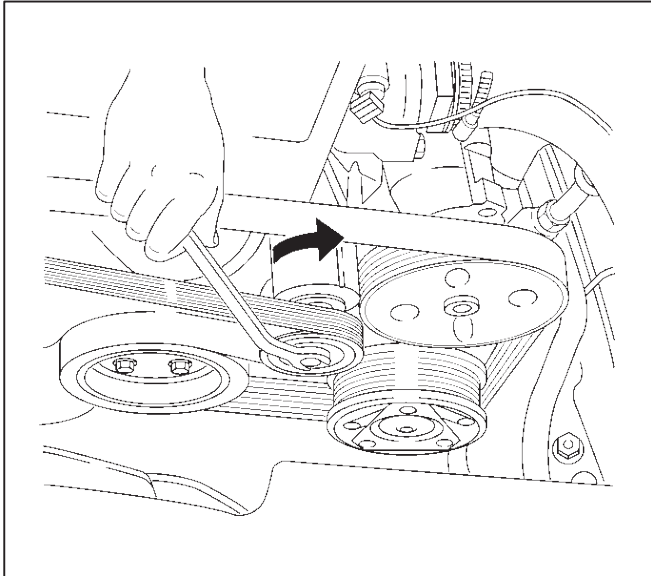
39. Connect battery ground cable.

40. Fill engine coolant to full level in the engine coolant reservoir tank.

Timing Belt

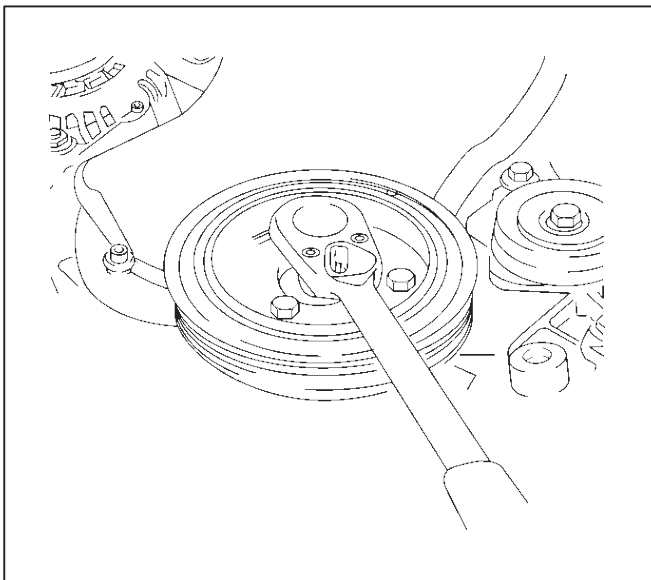
Removal

1. Disconnect battery ground cable.
2. Move drive belt tensioner to loose side using wrench then remove drive belt.



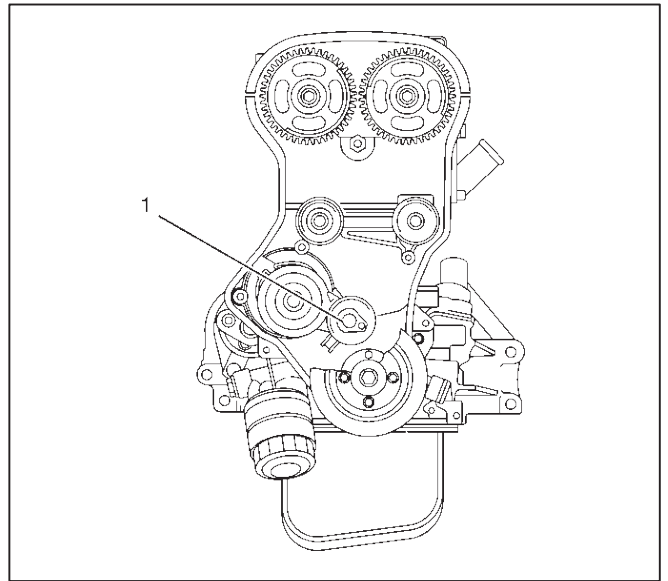
033RW001

3. Remove engine harness cover and disconnect three connectors from left rear side of engine compartment.
4. Remove four bolts and remove crankshaft pulley.



020RW014

5. Disconnect three connectors of engine harness from chassis harness of left rear side of engine compartment.
6. Remove nut and remove engine harness cover from front of engine.
7. Remove two bolts then remove timing belt front cover.
8. Remove fixing bolt of timing belt tensioner then remove timing belt tensioner (1).



020RW010

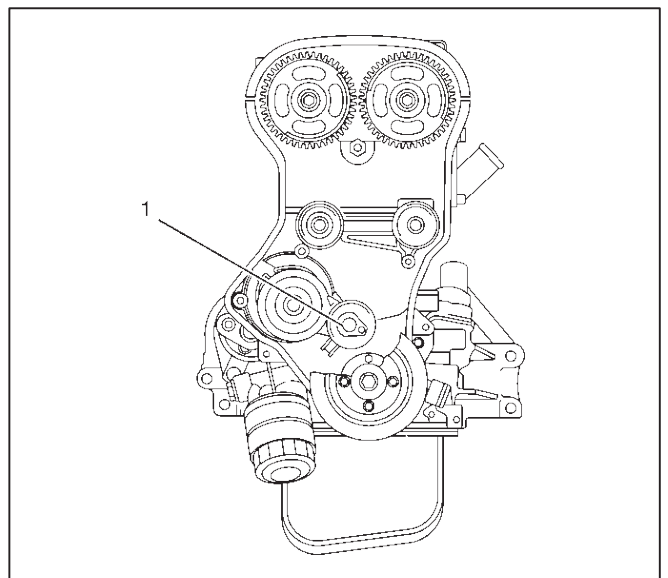
9. Remove timing belt.

CAUTION:

- Do not bend or twist belt, otherwise its core could be damaged. The belt should not be bent at a radius less than 30 mm.
- Timing belt drive pulley counterhold with J-42620.
- Do not allow oil or other chemical substances to come in contact with the belt. They will shorten the life.
- Do not attempt to pry or stretch the belt with a screw driver or any other tool during installation.
- Store timing belt in cool and dark place. Never expose the belt direct sunlight or heat.

Installation

1. Install timing belt tensioner then tighten it temporarily until make alignment timing belt.



020RW010

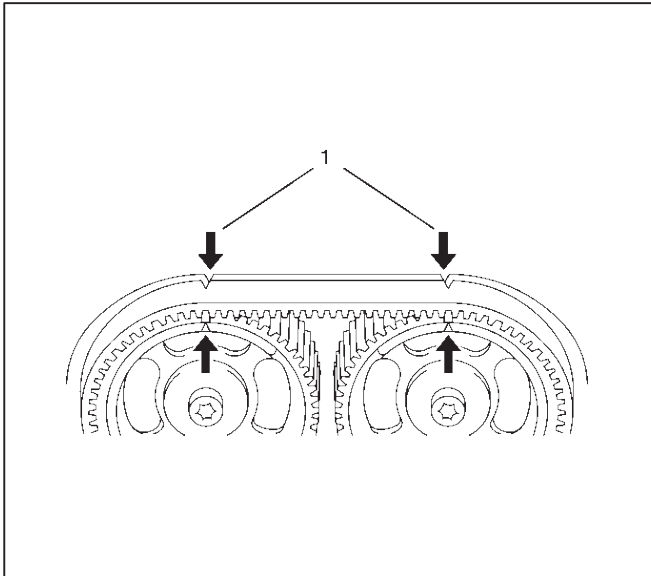
6A-30 ENGINE MECHANICAL (Y22SE 2.2L)

2. Install the timing belt and perform timing belt setting procedure as follows:

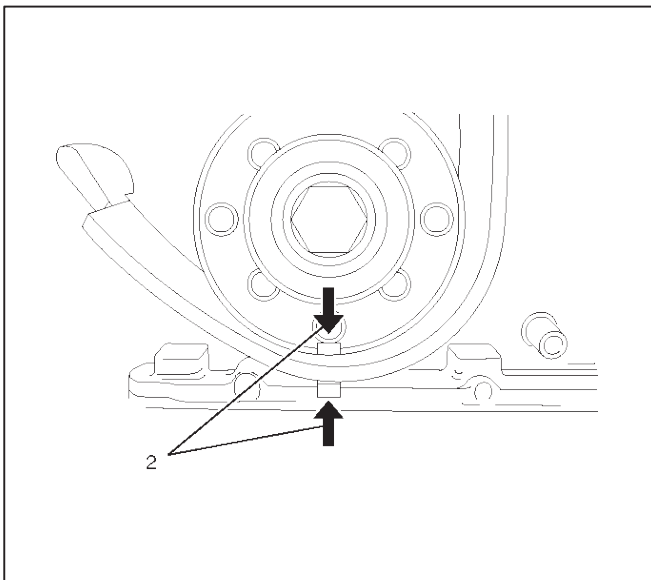
- a. Bring the engine top dead center No.1 cylinder compression stroke by rotating the engine in the direction of normal operation.

If rotated too far, do not turn backwards, always rotate crank in a clockwise direction otherwise tensioner setting will not be correct.

The engine is in this position when the notches on the camshaft pulleys align with the marks on the cylinder head cover(1), Check the crankshaft pulley timing mark is aligned (2).



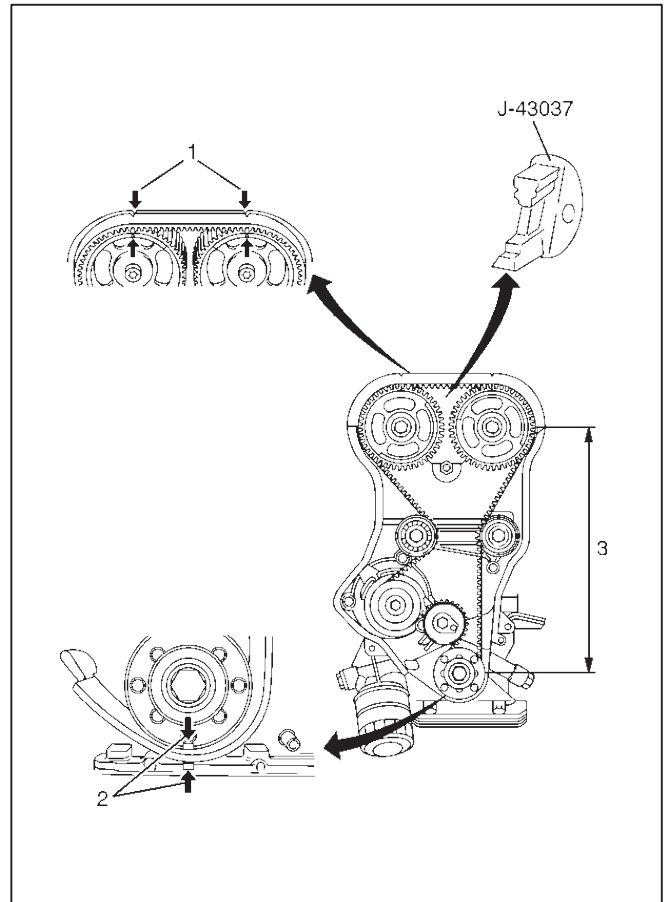
014RW067



014RW066

- b. Place J-43037 between intake and exhaust of camshaft drive gear for prevent to camshaft drive gear movement during timing belt setting.

- c. Set the timing belt shown in the illustration, ensure that tension side of the timing belt is taut and move the timing belt tension adjustment lever clockwise, until the pointer of the tensioner is flowing.



014R100005

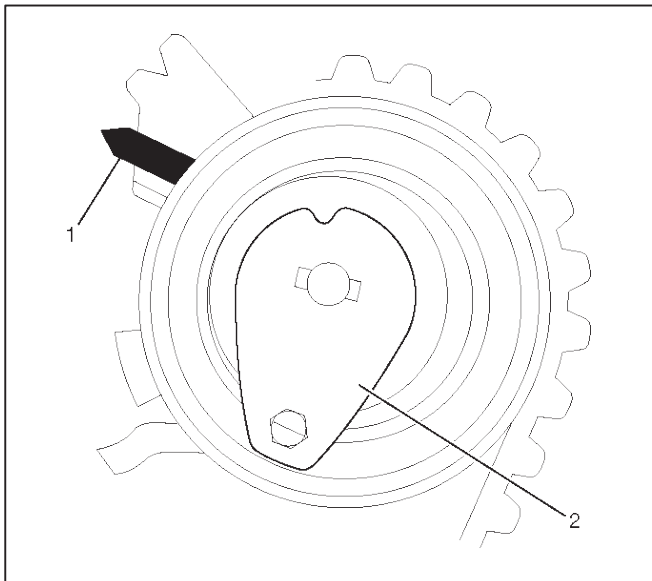
3. Adjust the timing belt tension.

Must be done with engine cold at least 8hr cool down.
Setting tensioner hot will result in incorrect tensioner setting.

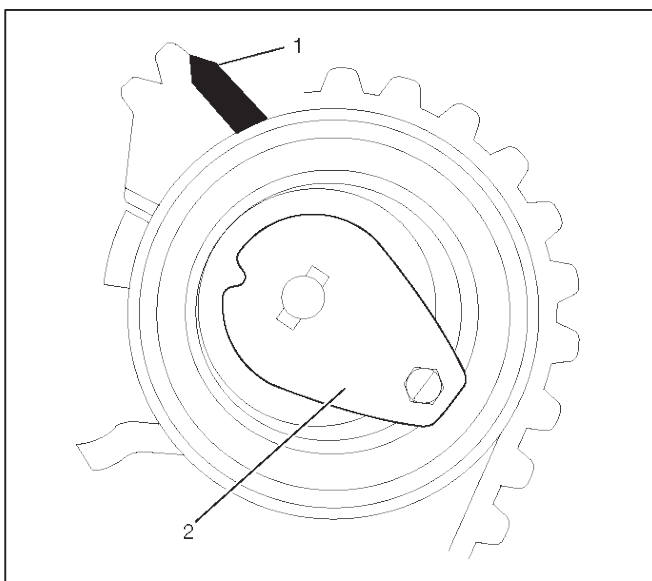
The timing belt tension adjusting procedure as follows.

Per Setting

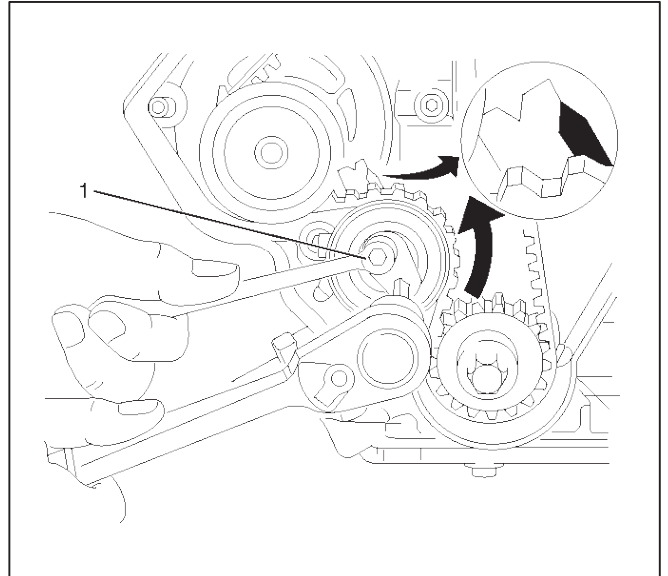
- a. In the state that the tensioner bolt and timing belt are loose, pointer (1) is anywhere to the left of center V notch (Note: The tensioner adjuster (2) is at the 7 o'clock position); Viewed from in front of the engine or vehicle.



- b. Turn the tensioner adjuster (2) with wrench to anticlockwise direction so that the pointer moves to the right edge of the plate, the pointer (1) should not pass the right hand edge of the plate during installation.



- c. Tighten the tensioner bolt to 15 N·m (11 lb ft)(with left hand) whilst keeping the adjuster in control (with right hand).



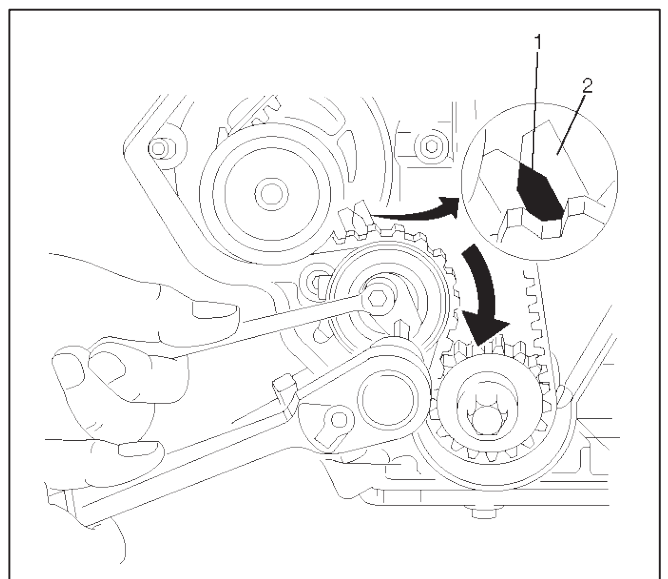
CAUTION: Check engine timing. All engine timing marks (two camshaft pulley and crankshaft pulley) must be aligned. If all three timing marks are not aligned the timing belt must be removed and reinstalled.

- d. Remove the fixing tool J-43037.
- e. Manual rotate the crankshaft two turns (720°) clockwise so that marks in timing gear will align again with the mark on cylinder head cover and all three timing marks are aligned.
Remainder: If accidentally turn too far, do not turn backward. Continue turn in the same direction. Turning backwards will cause incorrect setting.

New Belt

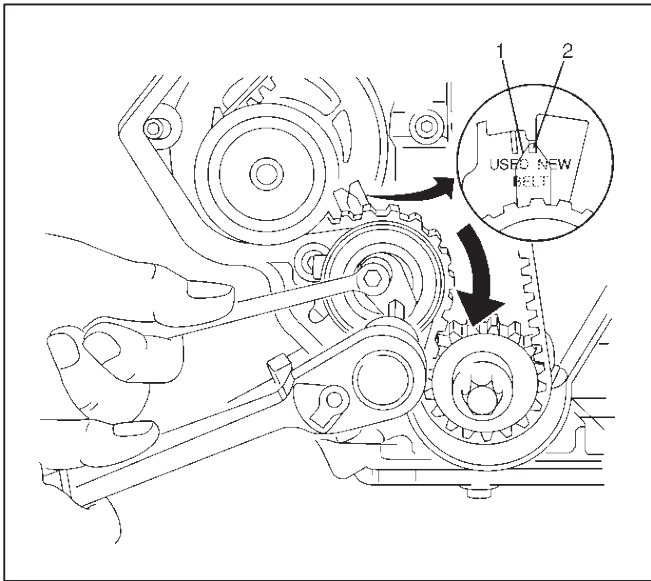
Adjustment of the new timing belt.

- a. Slightly loosen the fastening bolt of the timing belt tension roller, depending on the version, rotate the adjustment cam in direction of arrow (clockwise) until:
Version 1: Pointer (1) of the timing belt tension roller aligns with the notch (2).



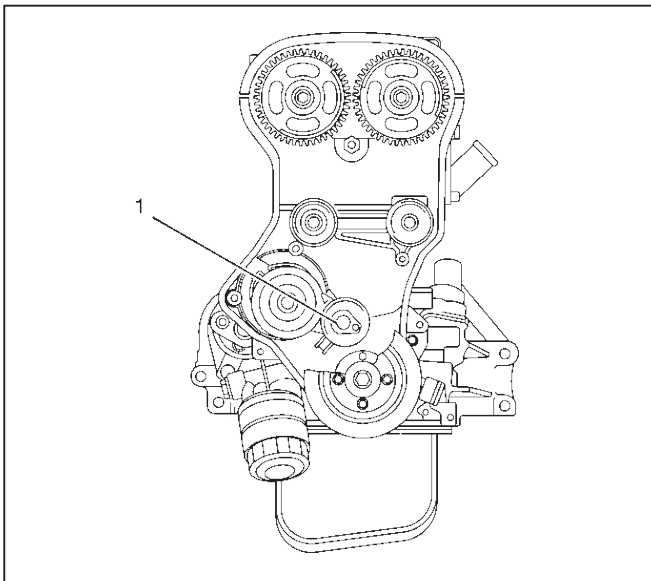
6A-32 ENGINE MECHANICAL (Y22SE 2.2L)

- b. Version 2: Pointer (1) of the timing belt tension roller aligns with the "NEW" notch (2).



- c. Tighten the fastening bolt (1) of the timing tension roller.

Torque: 25 N·m (18 lb ft)



- d. Turn the crankshaft another two turns (720°) in engine rotational direction to mark 1st cylinder TDC and check adjustment of the timing belt tension roller. Do not turn crankshaft anti clockwise, this will result in incorrect tensioner setting. If the marks do not align, so repeat the adjustment procedure.

Used Belt

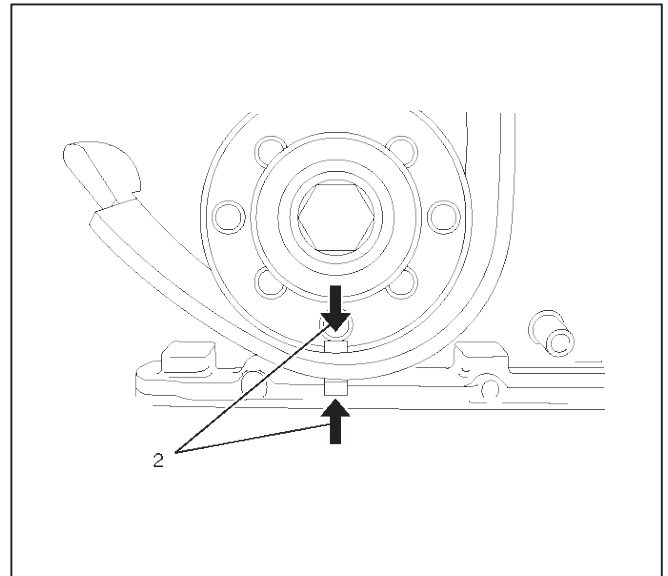
NOTE: Used belt which has been used for more than 2 hours.

Adjustment of the used timing belt.

Make the adjustment with engine cold.

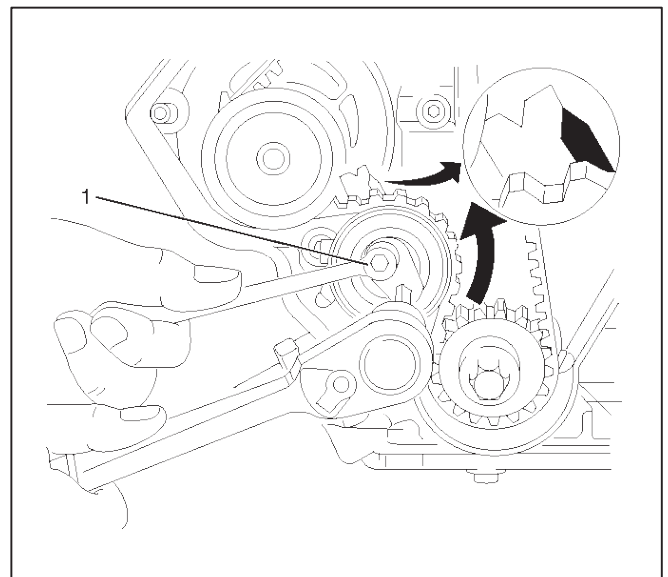
Must be done with engine cold at least 8hr cool down.

- a. A prerequisite of this operation is that the timing belt timing has been checked. This means that the crankshaft is at 1st cylinder TDC (2) and the camshaft pulleys are fixed with special tool J-43037.



Rotate crankshaft clockwise only, if rotated too far, do not turn back this will result in incorrect tensioner setting.

- b. Loosen fastening bolt (1) of the timing belt tension roller. Apply counterclockwise tension to the timing belt tension roller until the pointer is right at the right edge of the mark (see diagram below). Tighten the fastening bolt (1) of the timing belt tension roller.

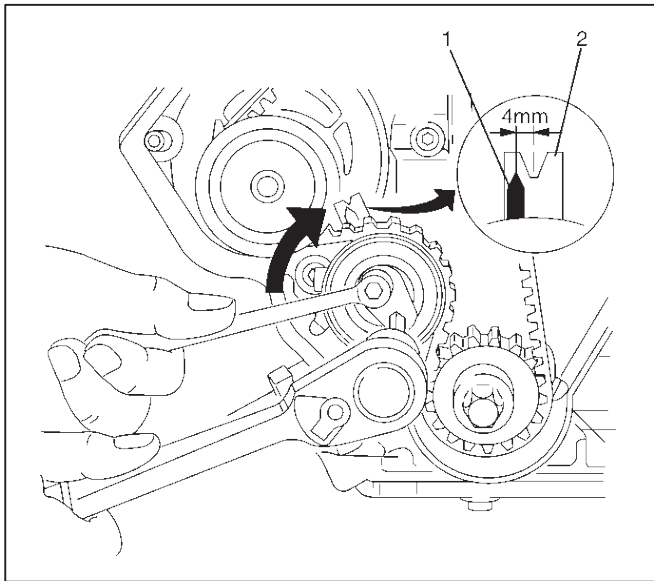


Rotate camshaft 720° clockwise only until timing marks align.

If accidentally rotated too far, not turn anti clockwise, this will result in incorrect tensioner setting

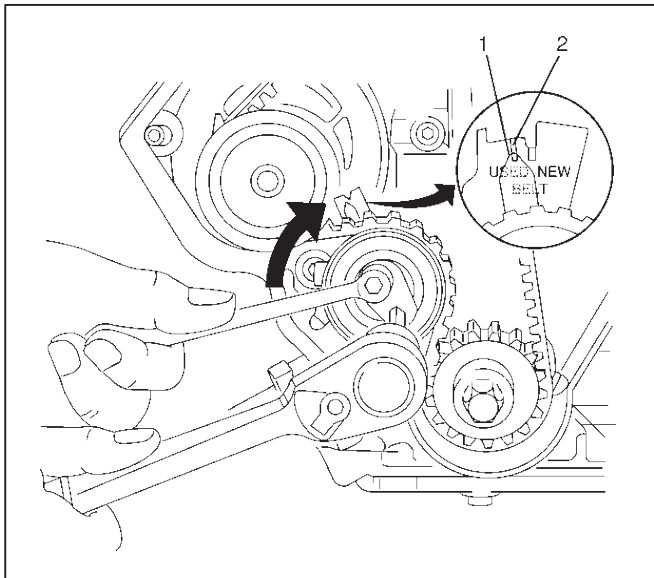
- c. Slightly loosen the fastening bolt of the timing belt tension roller, depending on the version, rotate the adjustment cam in direction of arrow (clockwise) until:

Version 1: Pointer (1) of the timing belt tension roller is approx. 4 mm to the left of the notch (2).



014R100008

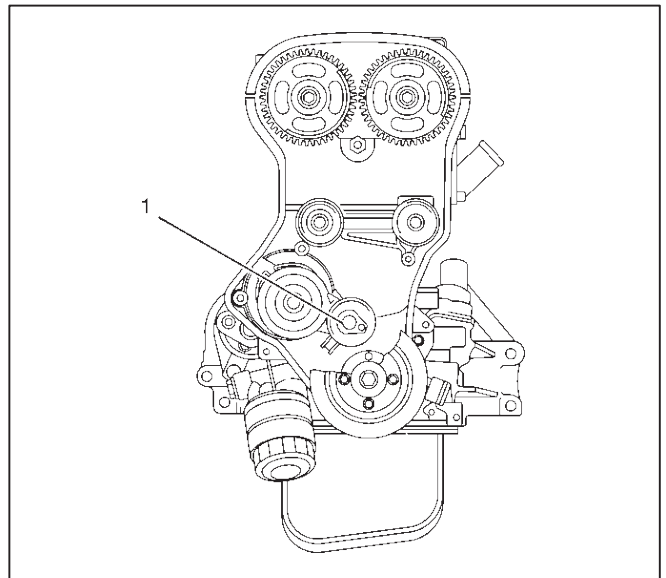
- d. Version 2: Pointer (1) of the timing belt tension roller aligns with the "USED" notch (2).



014R100009

- e. Tighten the fastening bolt (1) of the timing tension roller.

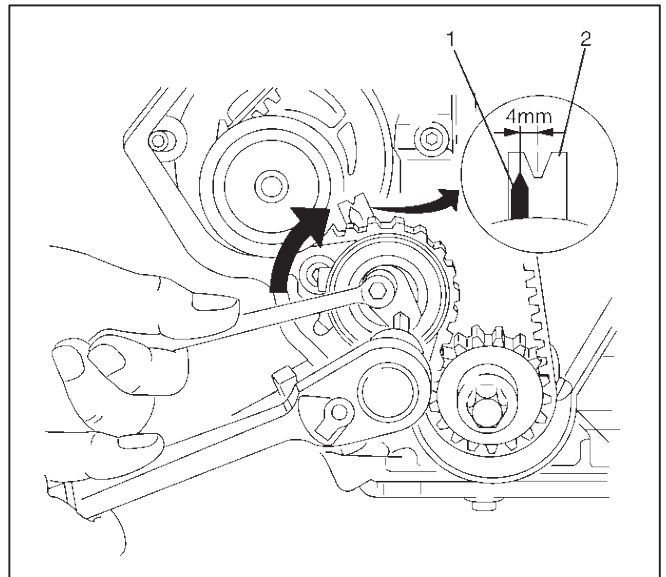
Torque: 25 N·m (18 lb ft)



020RW010

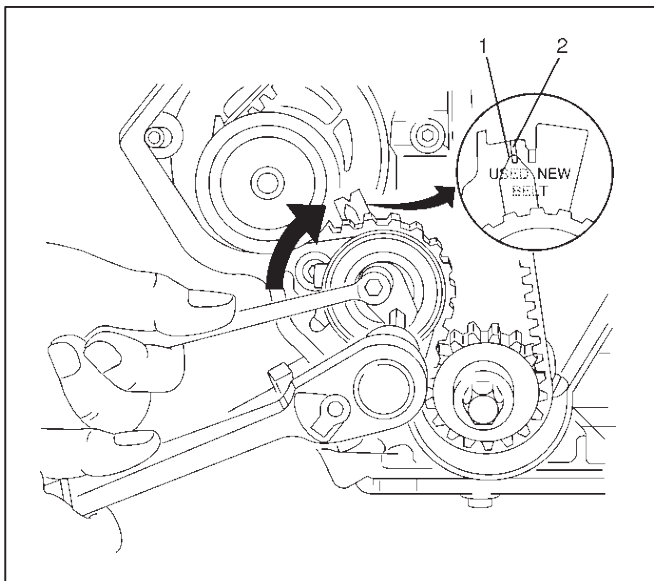
- f. Remove the fixing tool J-43037.

- g. Turn the crankshaft another two turns (720°) in engine rotational direction to mark 1st cylinder TDC and check adjustment of the timing belt tension roller. Ensure crankshaft is only turned clockwise, do not turn back, this will result in incorrect tensioner setting. If the pointer (1) of the timing belt tension roller does not align with the corresponding mark (2), the adjustment procedure must be repeated.



014R100006

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4. Install timing belt front cover and tighten two bolts to the specified torque.

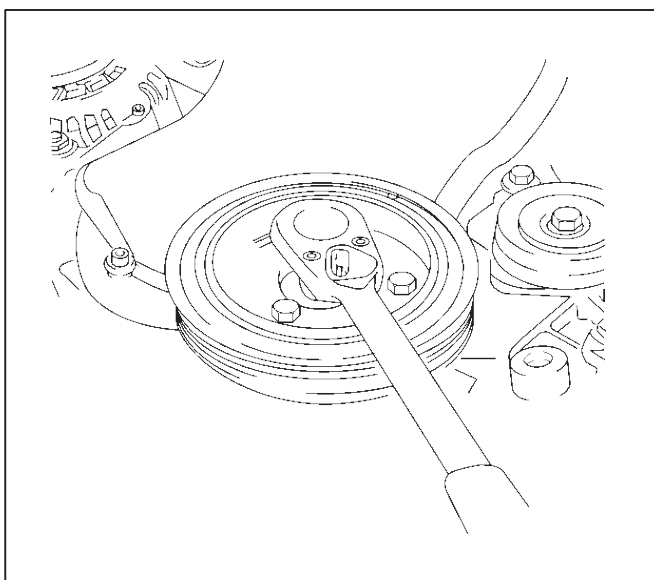
Torque: 6 N·m (52 lb in)

5. Install engine harness cover to front top of engine and tighten nut to the specified torque.

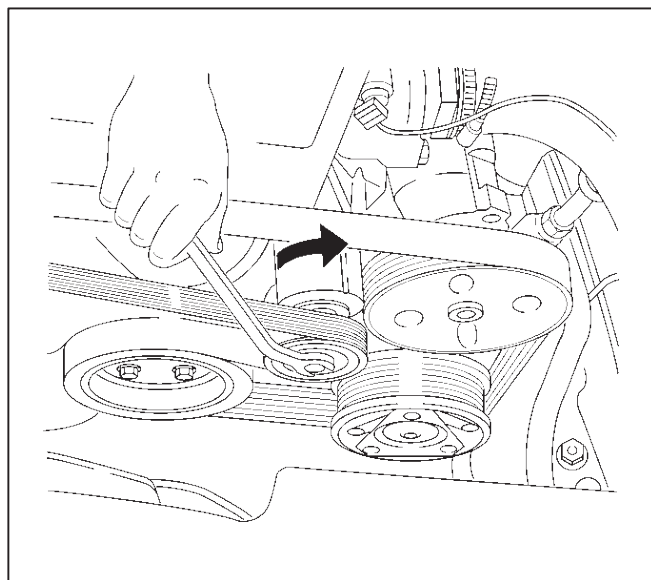
Torque: 6 N·m (52 lb in)

6. Install crankshaft pulley and tighten four bolts.

Torque: 20 N·m (14 lb ft)



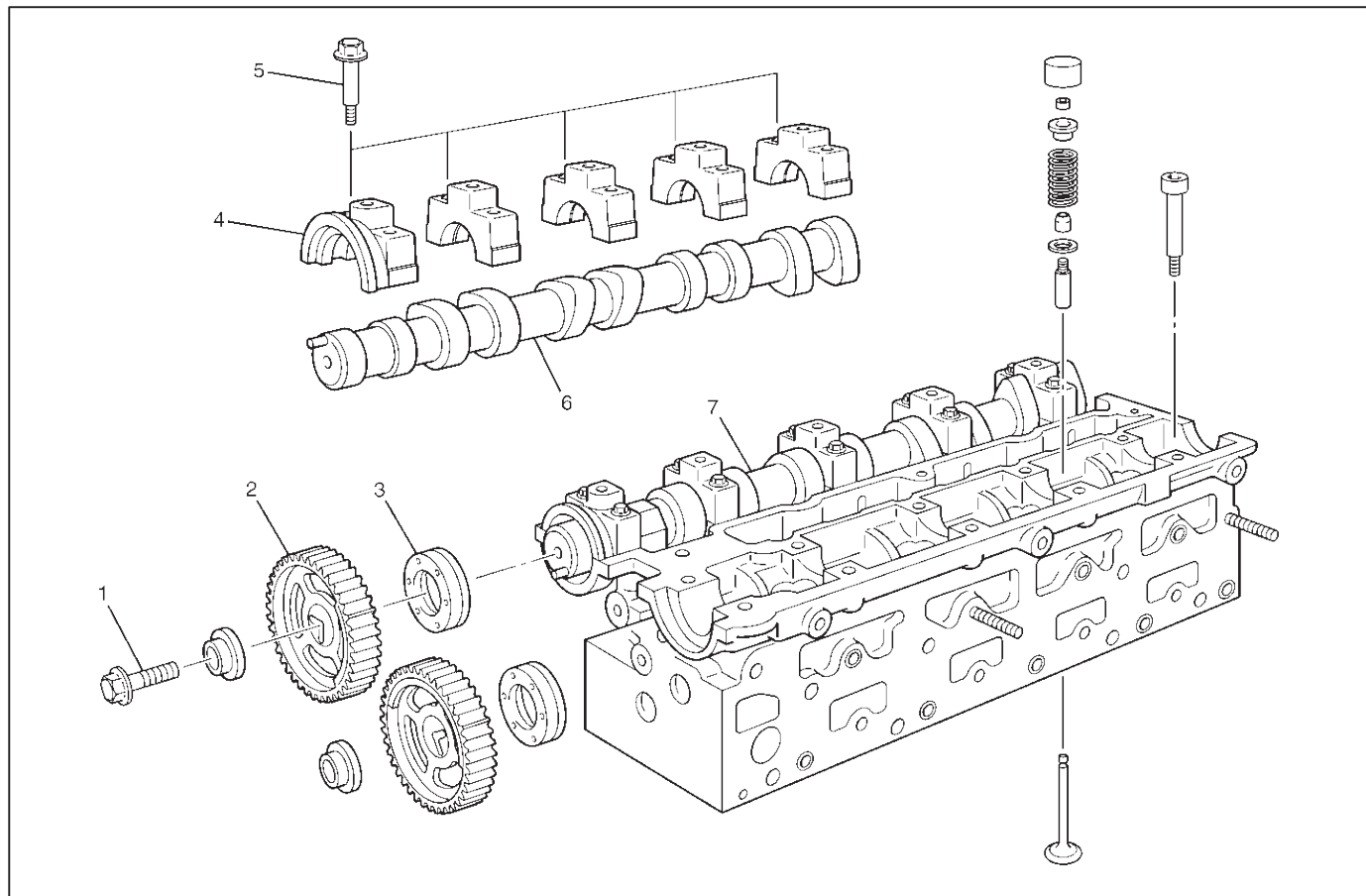
7. Move drive belt tensioner to loose side using wrench then install drive belt to normal position.



8. Connect engine harness three connector to chassis harness of left rear side of engine compartment.
9. Connect battery ground cable.

Camshaft

Camshaft and Associated Parts



011R100005

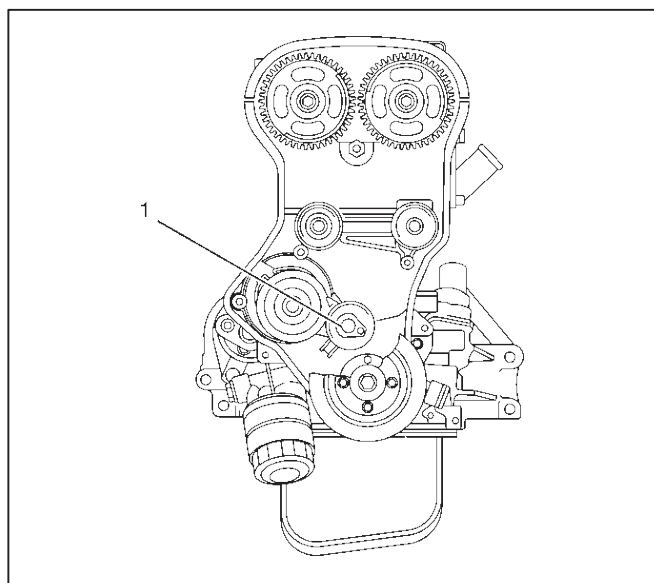
Legend

- (1) Camshaft Pulley Fixing Bolt
- (2) Camshaft Pulley
- (3) Oil Seal

- (4) Camshaft Bracket
- (5) Camshaft Bracket Fixing Bolt
- (6) Camshaft Assembly Exhaust
- (7) Camshaft Assembly Intake

Removal

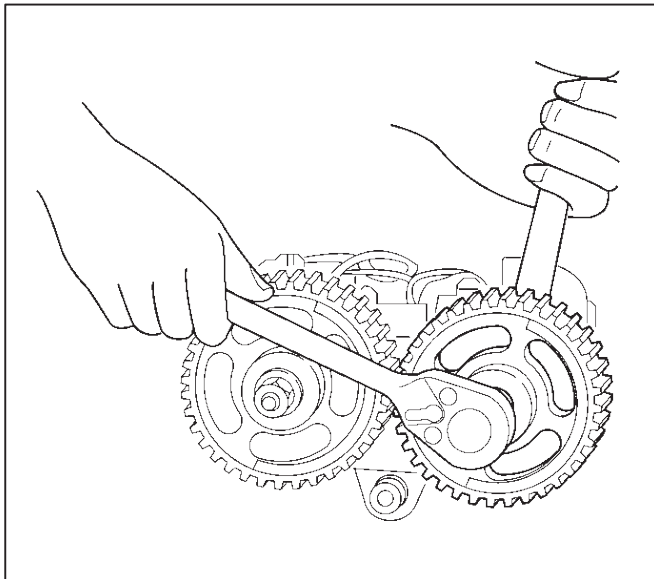
1. Disconnect battery ground cable.
2. Remove cylinder head cover.
Refer to removal procedure for Cylinder Head Cover in this manual.
3. Remove timing belt tensioner and remove timing belt.



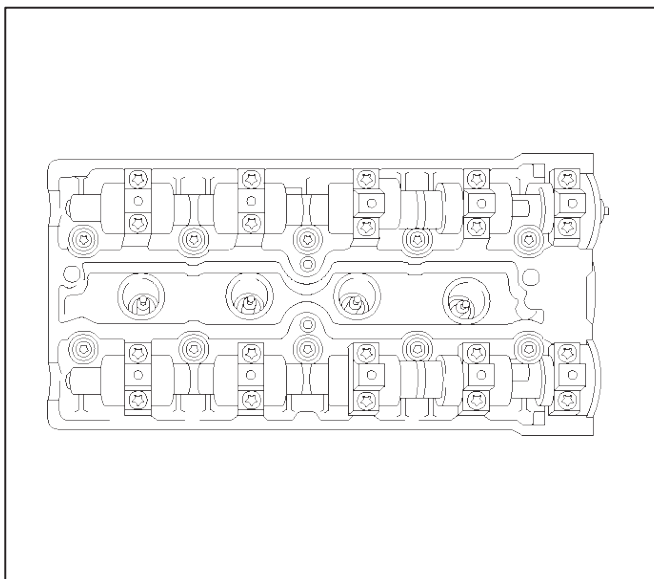
020RW010

6A-36 ENGINE MECHANICAL (Y22SE 2.2L)

4. Use adjustable wrench to hexagonal portion of camshaft, and remove fixing bolt for camshaft pulley from front end of camshaft.



5. Remove camshaft drive pulley from intake and exhaust camshaft.
6. Remove twenty fixing bolts from intake and exhaust camshaft bracket on the cylinder head, then remove camshafts.

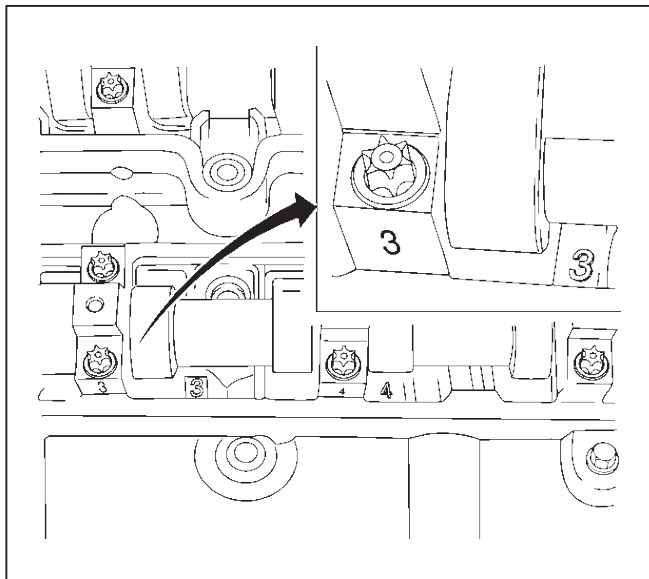


CAUTION:

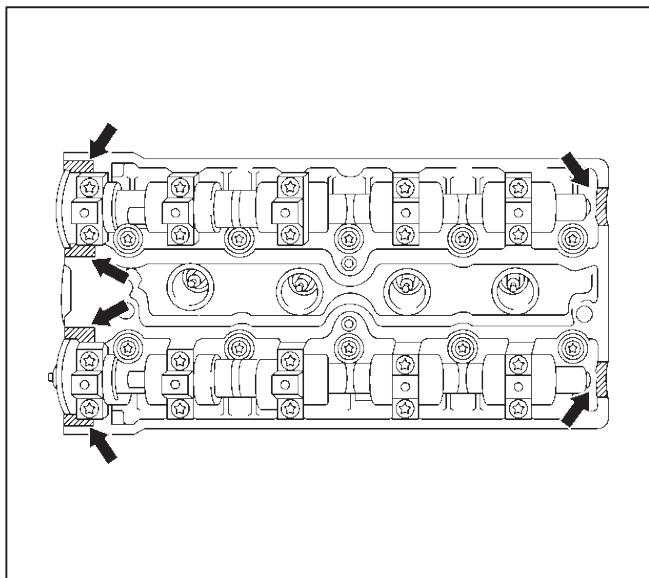
- Do not damage camshaft lobe and journal.
 - Do not damage hydraulic lash adjuster(HLA) and do not allow into foreign materials into cylinder head.
7. Remove oil seal from camshaft.

Installation

1. Clean surface of camshaft bracket and HLA.
2. Apply engine oil to journal surface of camshaft bracket and HLA.
3. Install camshaft to cylinder head.
4. Install camshaft bracket according to numerical as shown in the illustration.
The bracket number is:
 - Exhaust: 1 to 5 from front
 - Intake: 6 to 10 from front.

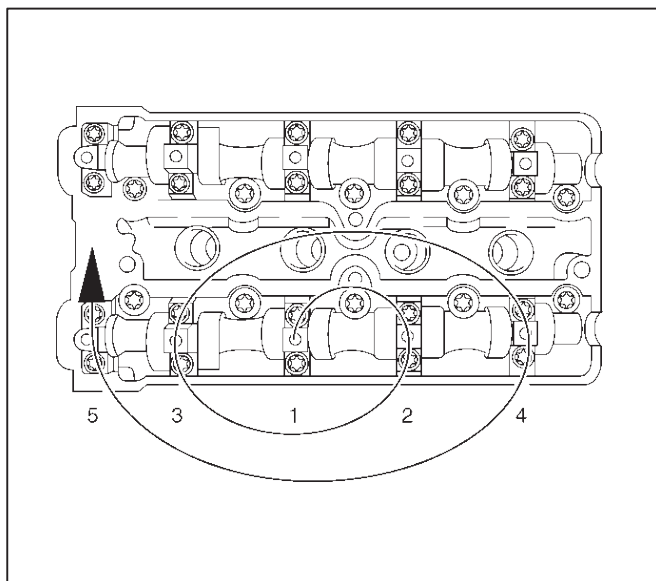


Camshaft oil seal installation area on the cylinder head of No.1, No.6 and camshaft bracket rear side plug portion must be applied HN1023 or equivalent as in the illustration.



5. Tighten ten camshaft bracket bolts to the specified torque by sequence in the illustration.

Torque: 8 N·m (69 lb in)



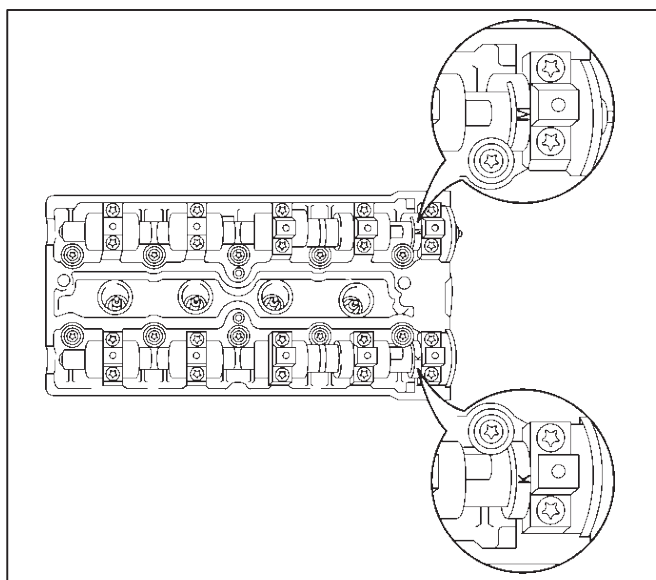
015RW014

NOTE: Camshaft bearing brackets can be identified by number 1 through 10.

Camshaft can be identified by stamping.

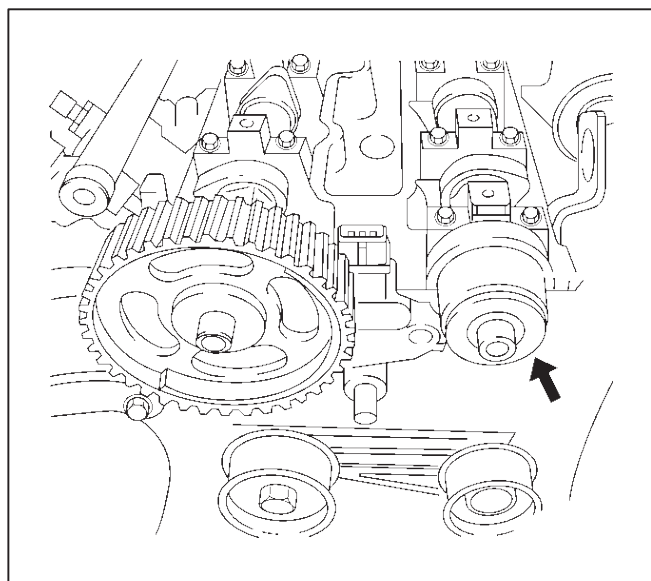
M: Exhaust camshaft

K: Intake camshaft

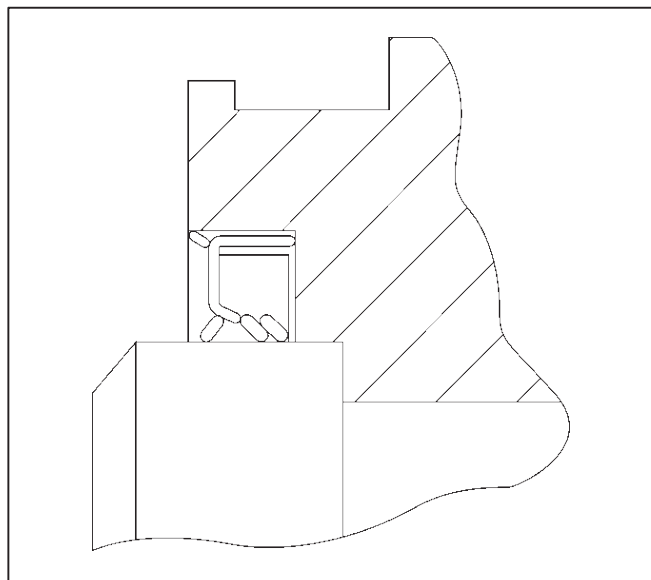


011R100011

6. Use J-42609 for installation camshaft oil seal.



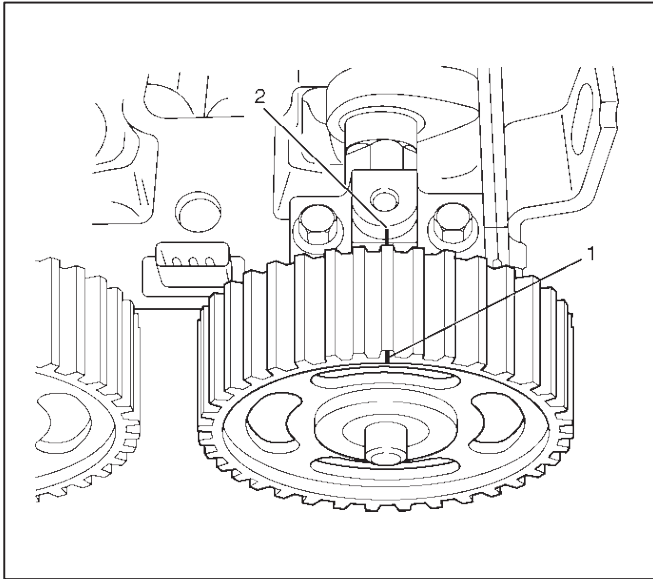
014RW075



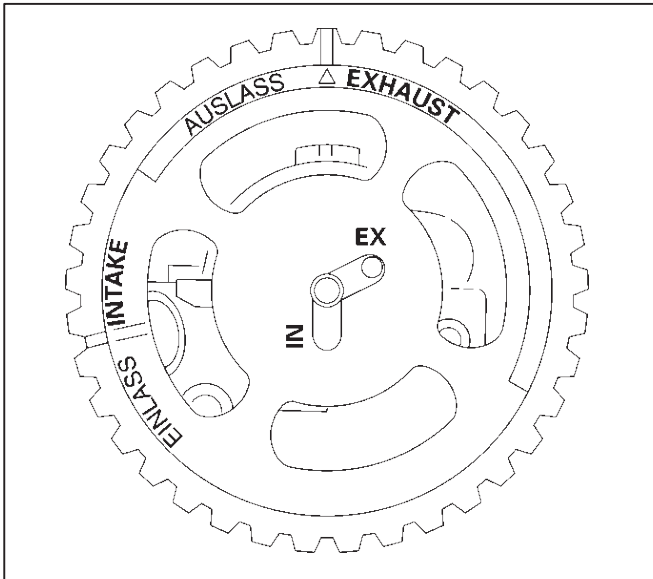
014RW071

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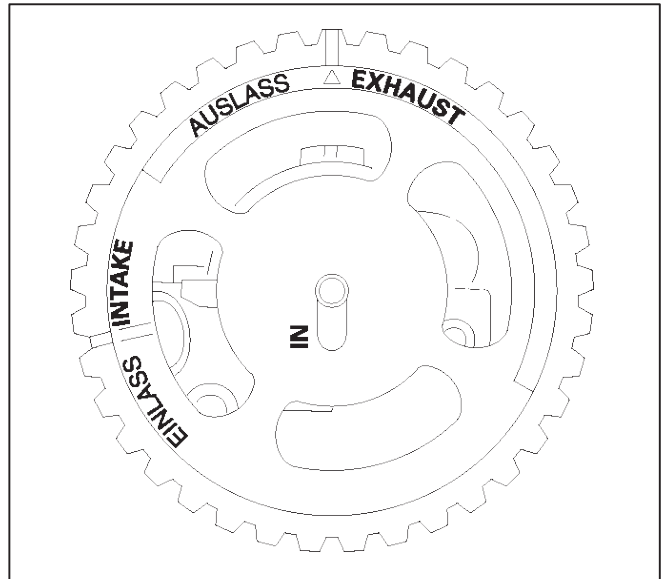
7. Install the camshaft drive pulley. Align the timing mark between notch on the camshaft drive pulley(1) and lug on the camshaft bracket(2).



Also align a guide hole on the camshaft drive pulley marked "IN" for intake and "EX" for exhaust to guide pin on the camshaft when installing the camshaft drive pulley.

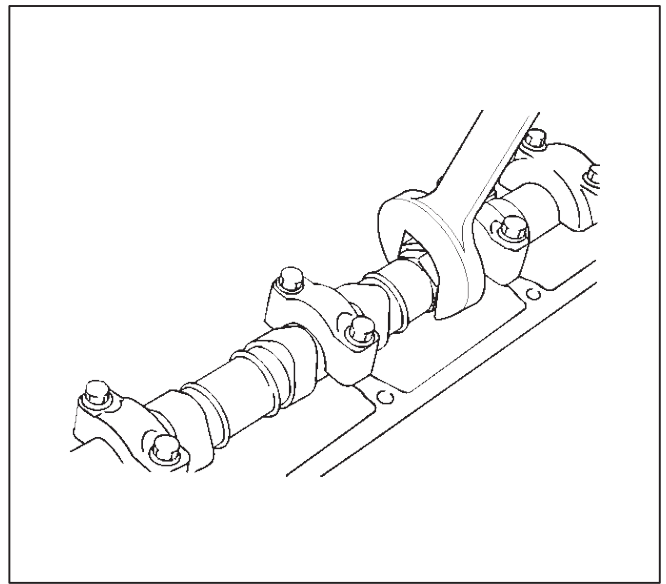


Optional pulley: Must be used on intake camshaft only.



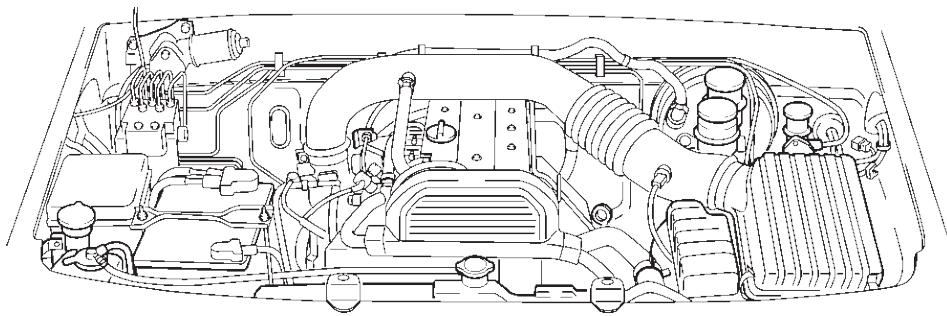
8. Tighten camshaft drive pulley fixing bolt to the specified torque.
New bolts must be used.

Torque: 50 N·m (37 lb ft) + 60°



9. Install timing belt.
Refer to installation procedure for Timing Belt in this manual.
10. Install cylinder head cover.
Refer to installation procedure for Cylinder Head Cover in this manual.
11. Connect battery ground cable.

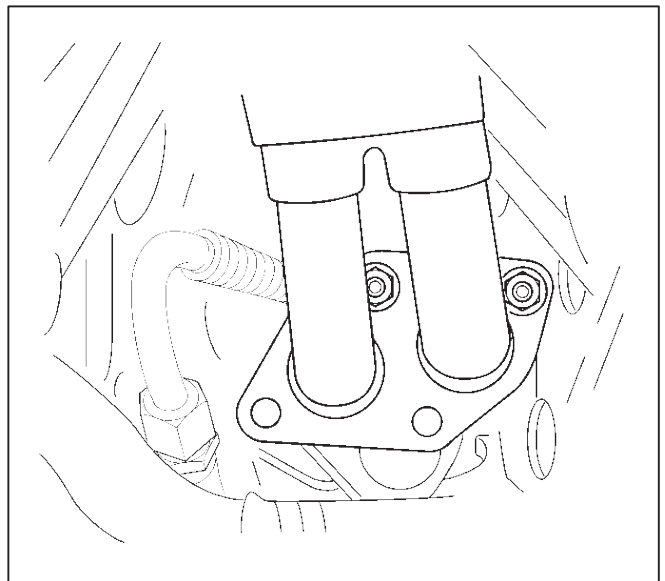
Engine Assembly



515RX002

Removal

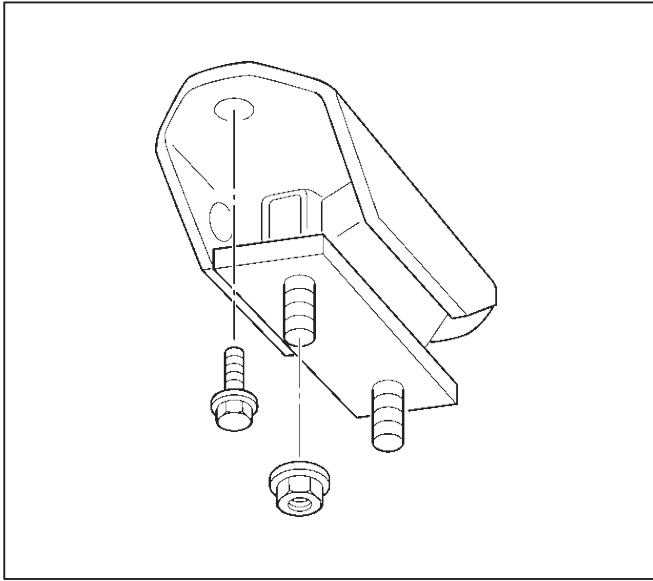
1. Disconnect battery ground and positive cable.
2. Remove battery.
3. Make alignment mark on the engine hood and hinges before removal in order to return the hood to original position exactly.
4. Remove engine hood.
5. Drain engine coolant from radiator.
6. Disconnect throttle valve control cable from throttle valve on intake manifold.
7. Remove air duct with air cleaner cover.
8. Remove air cleaner assembly.
9. Disconnect three engine harness connectors from chassis harness of left rear side engine compartment.
10. Disconnect vacuum hose on the brake booster.
11. Disconnect cooling fan harness connector on the left of fan shroud.
12. Disconnect ground cable connector from left and right of front wheel arch upper side.
13. Remove clutch piping bracket from right side of clutch housing.
14. Remove fuel piping bracket from transmission.
15. Remove four nuts from exhaust front pipe exhaust manifold side and remove two bolts from rear side of exhaust front pipe. Remove exhaust front pipe.



150R100004

6A-40 ENGINE MECHANICAL (Y22SE 2.2L)

16. Remove transmission mounting fixing bolts and nut from cross member.

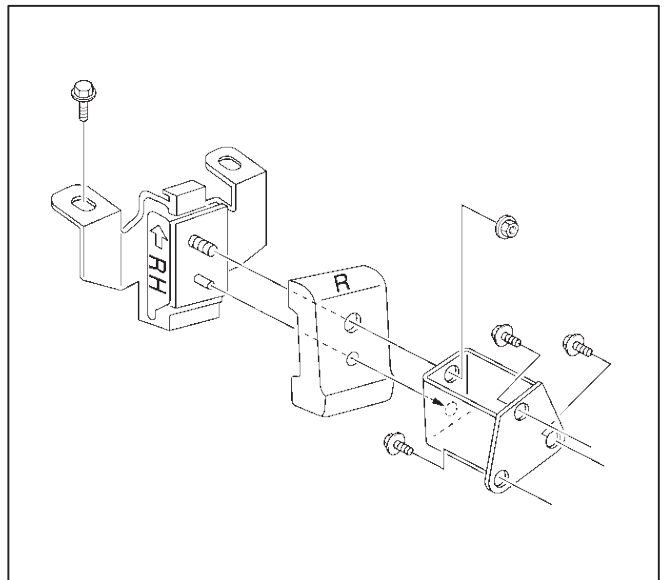
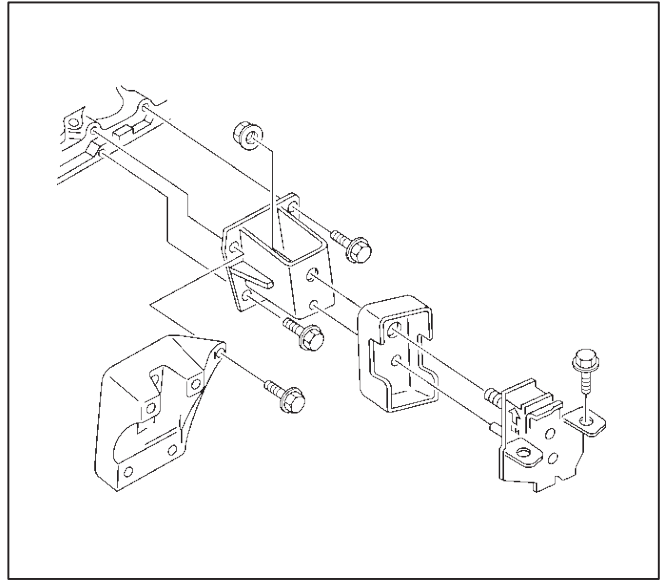


17. Remove transmission front under cover from front portion of clutch housing.
18. Disconnect two fuel pipes at right side of transmission by quick type fuel hose connector.

CAUTION: Plug fuel pipe on engine side and fuel hose from fuel tank.

19. Disconnect canister hose next to fuel piping connector.
20. Remove propeller shaft fixing bolt from rear side transmission.
21. Remove fixing bolts between clutch housing and transmission, then move transmission.
22. Remove power steering pump assembly then place the power steering pump along with piping.
23. Disconnect two chassis harness connectors from right rear side engine compartment (under fuse box) and remove two harness clips.
24. Remove engine ground cable from chassis frame.
25. Remove radiator lower hose from engine side.
26. Remove two heater hoses from right side panel.
27. Remove radiator grille.
28. Remove harness clip from behind right horn.

29. Remove engine mounting bolt from chassis frame side.



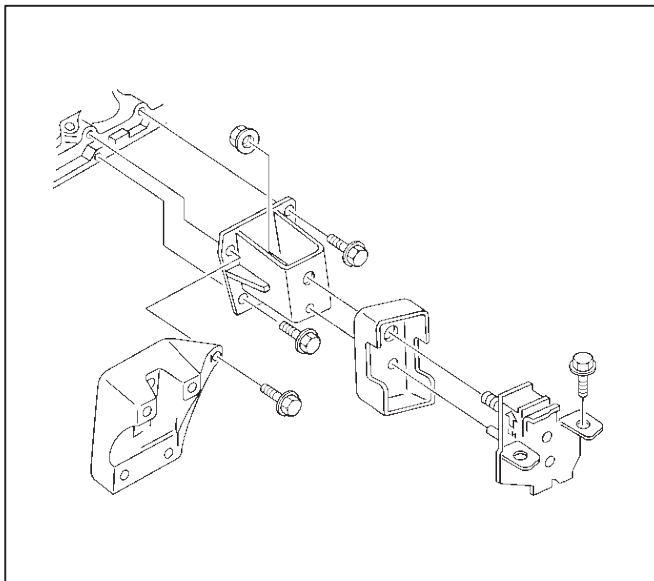
30. Lift up the engine assembly.

Installation

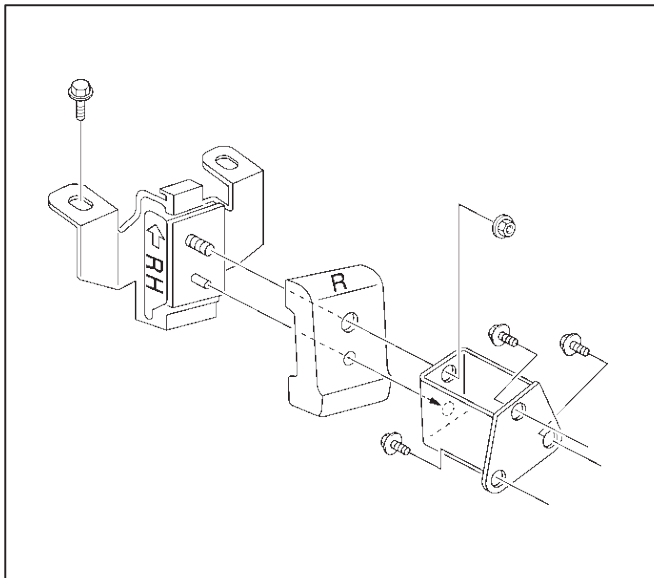
CAUTION: When assembling the engine and transmission, confirm that dowels have been mounted in the specified positions at the engine side. If assembled in the condition that dowels have not been mounted in the specified position, transmission damage can result.

1. Position the engine assembly in the engine compartment.
2. Tighten engine mounting bolt to frame side to the specified torque.

Torque: 41 N·m (30 lb ft)



022RW005

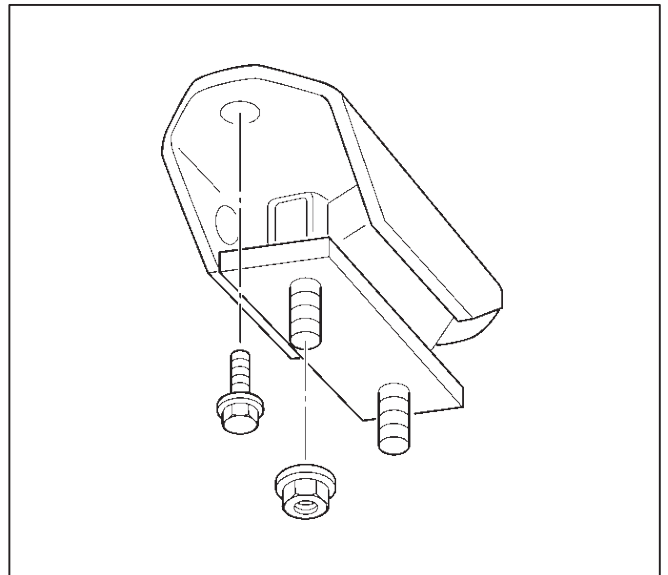


022RW006

3. Install harness clip behind right horn.
4. Install the radiator grille and install flasher lamp assembly.
5. Install two heater hoses to right side panel.
6. Install radiator lower hose to engine.
7. Install engine ground cable to chassis frame.

8. Connect two chassis harness connectors to right rear side engine room (under fuse box) and install two harness clips.
9. Install power steering pump assembly and tighten fixing bolts.
10. Install transmission assembly, refer to installation procedure for Transmission section in this manual.
11. Install propeller shaft, refer to installation procedure for Propeller section in this manual.
12. Connect canister hose next to fuel piping connector.
13. Connect two fuel pipes at right side transmission by quick type connector.
14. Install transmission front under cover to front portion of clutch housing.
15. Install transmission mounting fixing bolts and nuts to cross member.

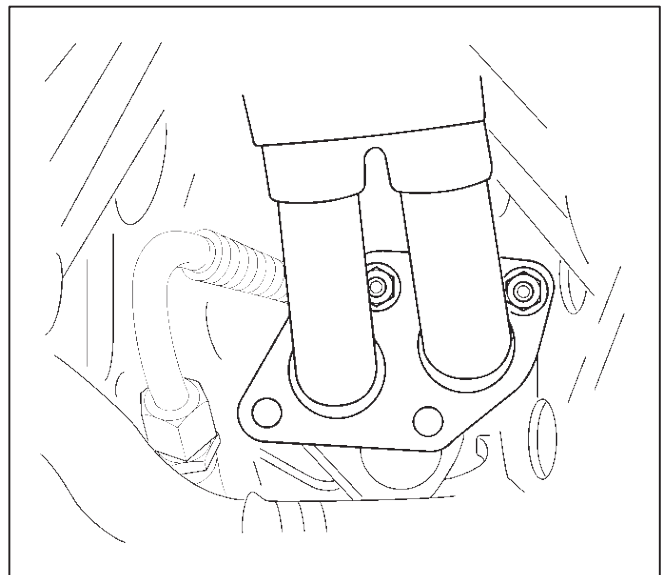
Torque: 50 N·m (37 lb ft)



022R100006

16. Install exhaust front pipe with three way catalytic convertor to exhaust manifold, then tighten fixing nuts to the specified torque.

Torque: 28 N·m (21 lb ft)



150R100004

6A-42 ENGINE MECHANICAL (Y22SE 2.2L)

17. Install fuel piping bracket to transmission.
18. Install clutch piping bracket to right side of clutch housing.
19. Connect ground cable connector to left and right of front wheel arch upper side.
20. Connect cooling fan harness connector on the fan shroud.
21. Connect vacuum hose to the brake booster.
22. Connect three engine harness connectors to chassis harness of left rear side of engine compartment.
23. Install air cleaner assembly.
24. Install air duct with air cleaner cover to specified torque.

Torque

7 N·m (61 lb in) for air duct fixing

3 N·m (36 lb in) for air duct clamp bolt

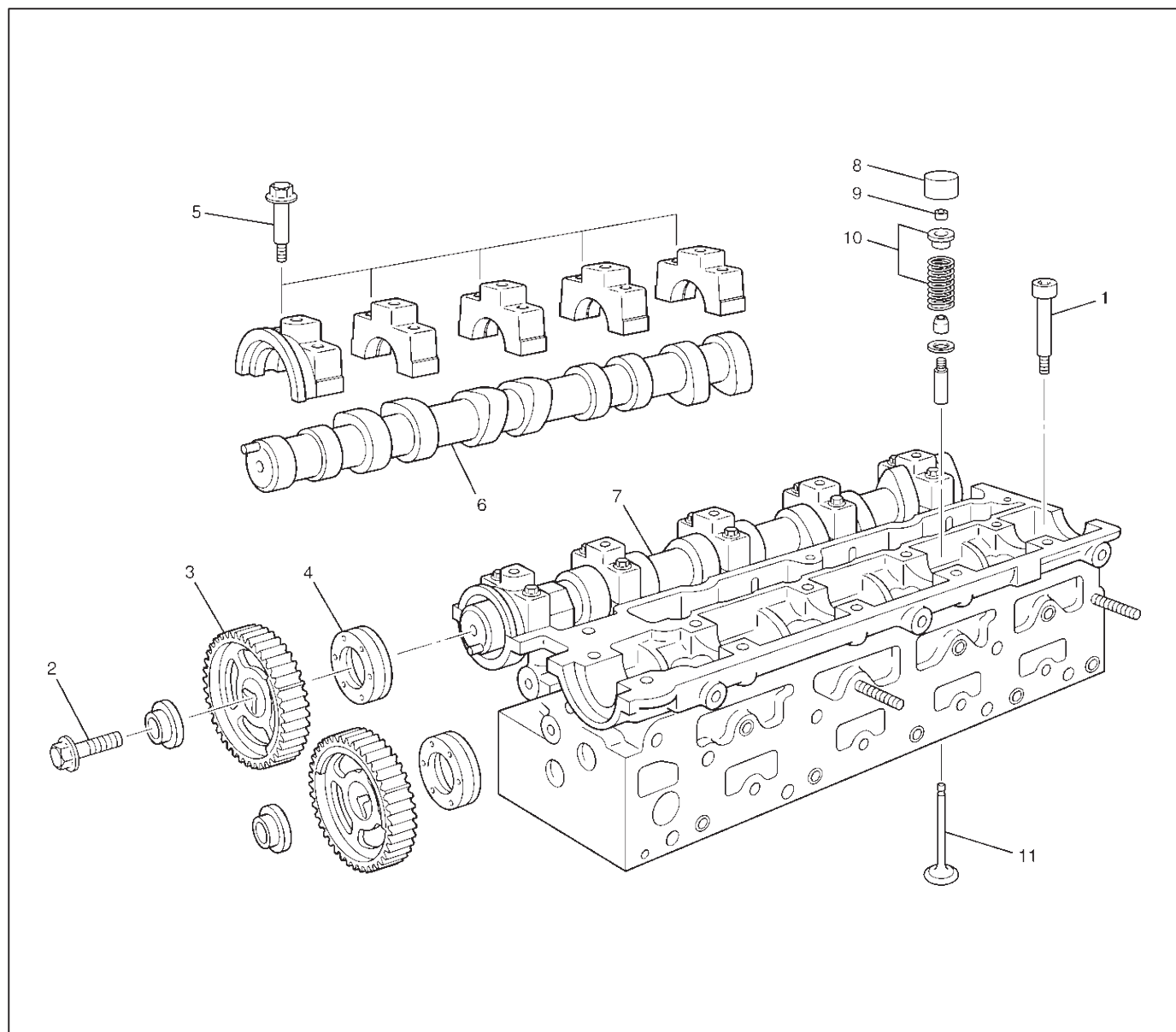
25. Connect throttle valve control cable to throttle valve on the intake manifold.
Confirm the free play of throttle valve control cable.

Free play: 5.7 to 6.3 mm

26. Install engine hood to original position.
Refer to installation procedure for Body section in this manual.
27. Install battery, connect positive cable and ground cable.
28. Fill engine coolant to full level in the coolant reservoir tank.

Cylinder Head

Cylinder Head and Associated Parts



011R100006

Legend

- | | |
|---------------------------------|--|
| (1) Cylinder Head Bolt | (6) Camshaft Exhaust |
| (2) Camshaft Pulley Fixing Bolt | (7) Camshaft Intake |
| (3) Camshaft Pulley | (8) Tappet (HLA = Hydraulic Lash Adjuster) |
| (4) Camshaft Oil Seal | (9) Split Collar |
| (5) Camshaft Bracket Bolt | (10) Valve Spring and Spring Upper Seat |
| | (11) Valve |

Disassembly

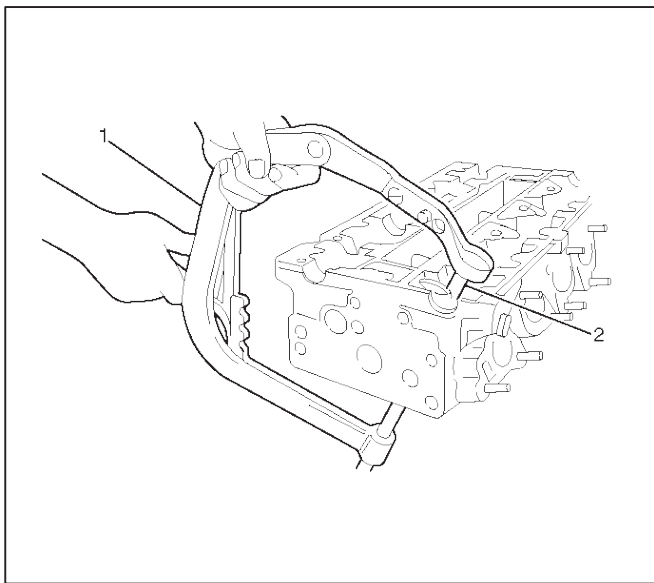
NOTE:

- During disassembly, be sure that the valve train components are kept together and identified so that they can be reinstalled in their original locations.
- Before removing the cylinder head from the engine and before disassembling the valve mechanism, perform a compression test and note the results.

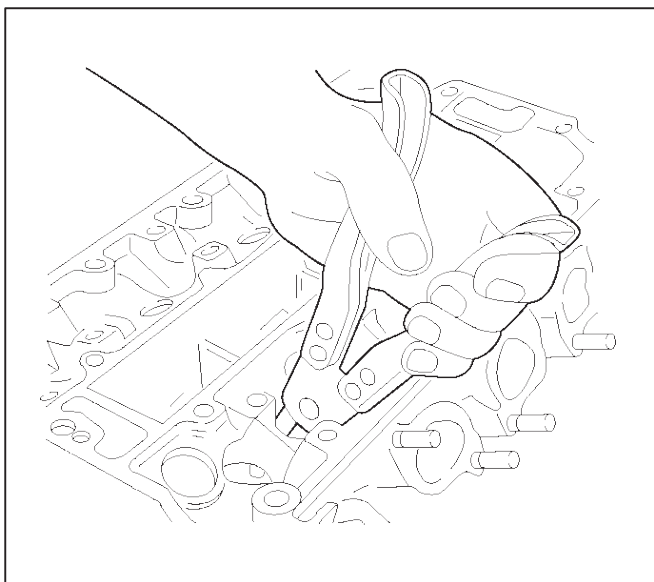
1. Remove camshaft pulley fixing bolt (2), then pulley (3).
2. Remove camshaft bracket fixing bolt (5), camshaft bracket, then camshaft exhaust (6), and intake side (7).

6A-44 ENGINE MECHANICAL (Y22SE 2.2L)

3. Remove cylinder head.
Use J-42623.
4. Remove tappets (HLA).
5. Valve spring, valve spring seat, compress valve spring — use J-8062 (1) and Adapter J-42619 (2).
Valve keepers.

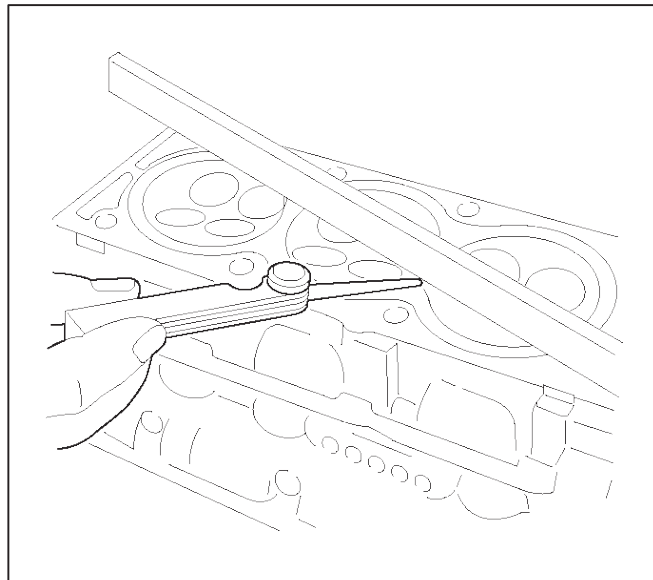


6. Valves, valve stem seals — use commercially available remover pliers. Valve spring seats from cylinder head.



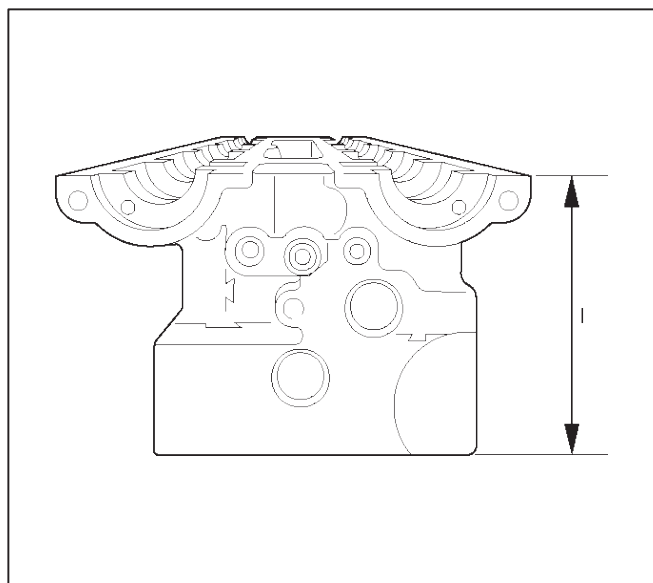
Inspection and Repair

1. Check length and width of cylinder head sealing surfaces for deformation and diagonals for warpage — use straight edge and feeler gauge.
Maximum limit is 0.025 mm (0.001 mm)



2. Height of cylinder head (sealing surface to sealing surface).

Dimension (I) – 134 mm (5.2756 in)



Reassembly

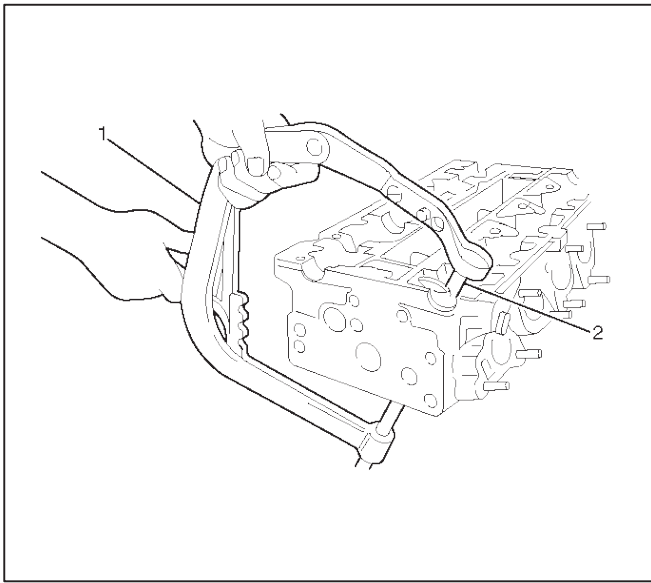
1. Valves, valve stem seals. Refer to Valve Spring, Valve, Valve Guide in this section.
2. Valve seat, valve spring. Refer to Valve Spring, Valve, Valve Guide in this section.
3. Install tappet (HLA).
4. Cylinder head with new cylinder head bolts to cylinder block.
Tighten the bolts in 4 steps.

1st step: 25 N·m (18 lb ft)

2nd step: 90°

3rd step: 90°

4th step: 90°

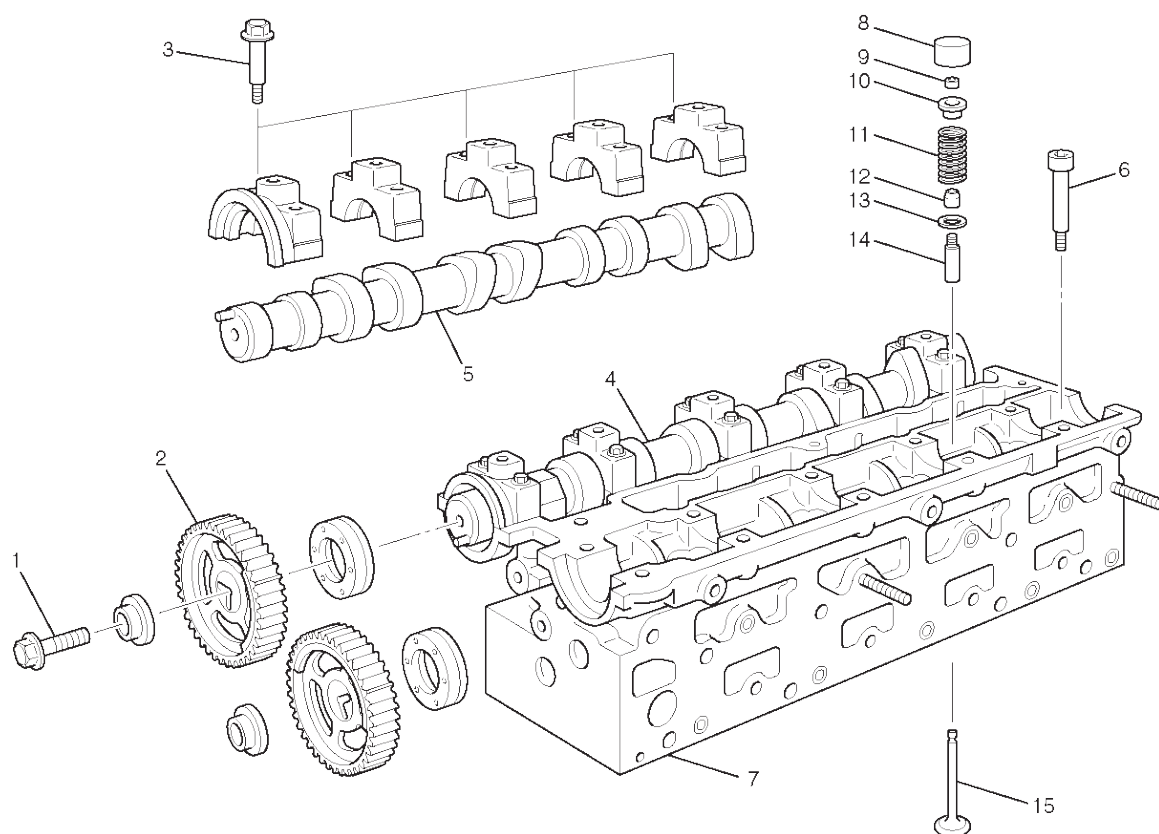


011RW014

5. Camshaft in cylinder head. Refer to Camshaft in this section.
6. Camshaft pulley. Refer to Camshaft in this section.

Valve Spring, Valve, Valve Guide

Valve Spring, Valve, Valve Guide and Associated Parts



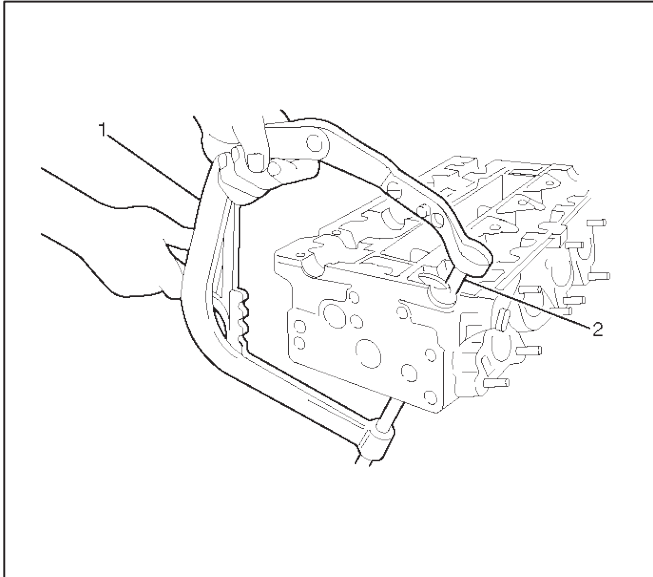
011R100013

Legend

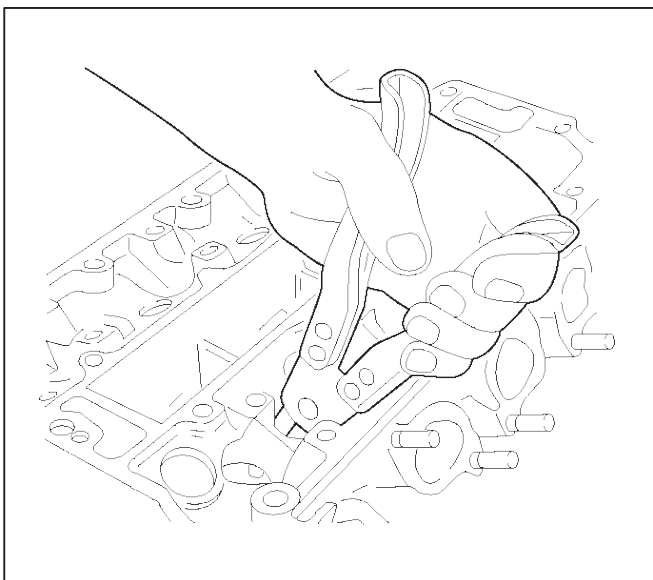
- | | |
|----------------------------------|--|
| (1) Camshaft Pulley Fixing Bolts | (8) Tappet (HLA = Hydraulic Lash Adjuster) |
| (2) Camshaft Pulley | (9) Split Collar |
| (3) Camshaft Bracket Fixing Bolt | (10) Spring Upper Seat |
| (4) Camshaft Assembly Intake | (11) Valve Spring |
| (5) Camshaft Assembly Exhaust | (12) Oil Seal |
| (6) Cylinder Head Bolt | (13) Spring Lower Seat |
| (7) Cylinder Head | (14) Valve Guide |
| | (15) Valve |

Disassembly

1. Remove camshaft pulley (1), (2).
2. Remove camshaft assembly (Intake) (3), (4).
3. Remove camshaft assembly (Exhaust side) (5).
4. Remove cylinder head (6), (7).
5. Remove tappet (8).
6. Use J-8062 valve spring compressor and J-42619 adapter to remove split collar (9).



7. Remove spring upper seat and valve spring (10), (11).
 8. Valve, valve guide – use commercially available remover pliers.
- Valve spring lower seat from cylinder head.



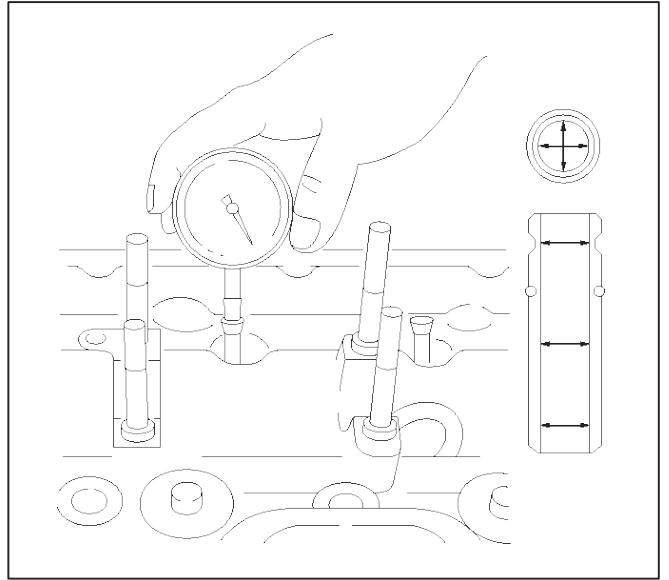
Inspection and Repair

1. Use a internal micrometer to measure the diameter valve guide.

Valve stem play

Intake : 0.03 to 0.057 mm (0.0012 to 0.0022 in)

Exhaust : 0.04 to 0.067 mm (0.0016 to 0.0026 in)



Valve Guide

CAUTION: Taking care not to damage the valve seat contact surface, when removing carbon adhering to the valve head. Carefully inspect the valve stem for scratching or abnormal wear. If these conditions are present, the valve and the valve guide must be replaced as a set.

Valve Seat

Valve seat width in cylinder head

Intake: 1.0 to 1.5 mm (0.039 to 0.0585 in)

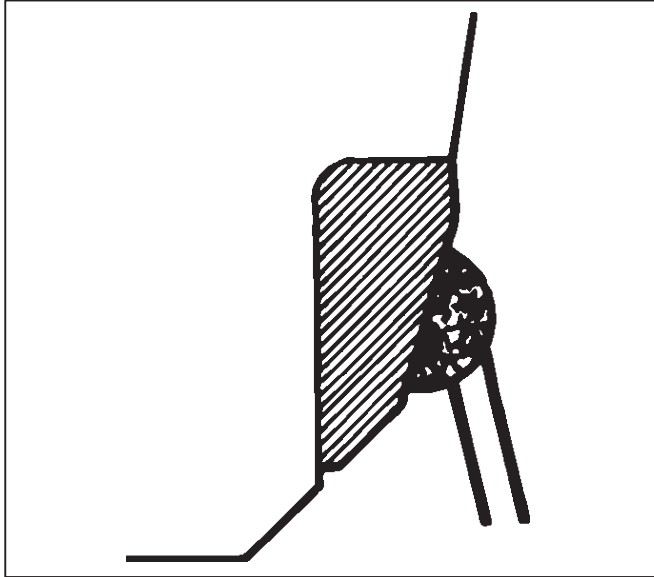
Exhaust: 1.7 to 2.2 mm (0.0663 to 0.0858 in)

Valve Seat Insert Correction

Remove the carbon from the valve seat insert surface.

Valve Seat Insert Replacement

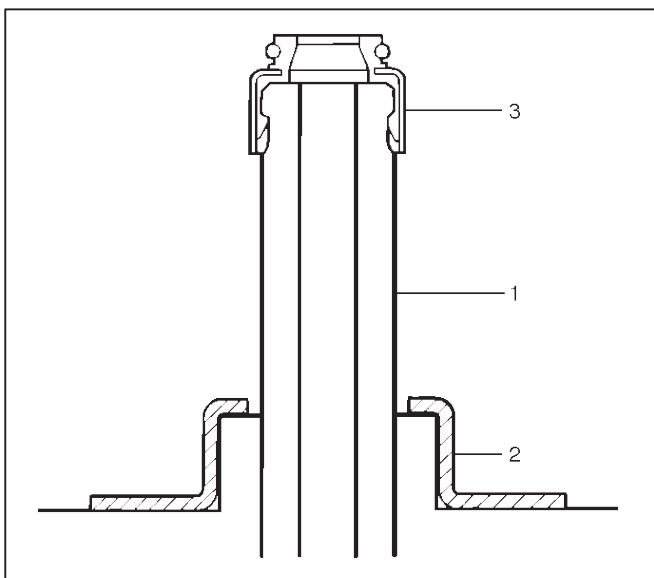
1. Arc weld the rod at several points. Be careful not to damage the aluminum section.
2. Allow the rod to cool for a few minutes. This will cause the valve seat to shrink.
3. Strike the rod and pull it out.



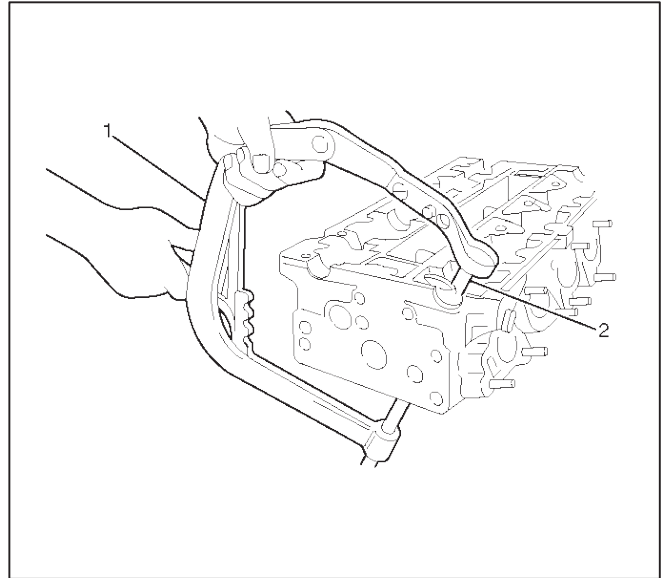
4. Carefully clean the valve seat press-fit section on the cylinder head side.
5. Heat the press-fit section with steam or some other means to cause expansion. Cool the valve seat with dry ice or some other means.
6. Insert the press-fit section into the valve seat horizontally.
7. Lap the valve and the seat.

Reassembly

1. Install oil seal (3) and spring lower seat (2). Using oil seal replacer J-42622, drive in a new oil seal.



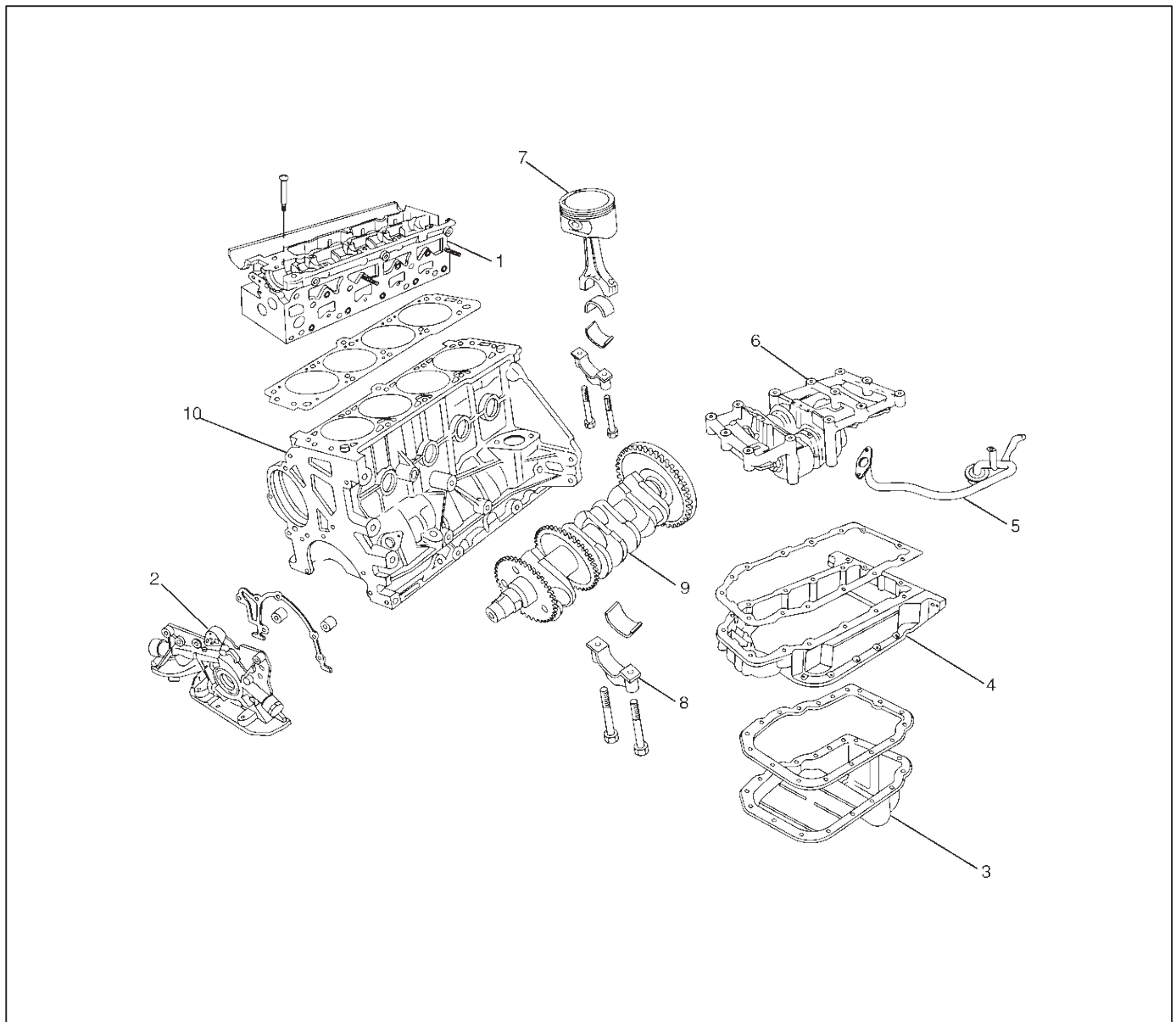
2. Install valve to valve guide. Before install valve apply engine oil to the outside of the valve stem.
3. Install lower valve spring seat, valve spring and upper valve spring seat then put split collars on the upper spring seat, using J-8062 valve spring compressor for install the split collars.



4. Install tappet. (HLA)
Apply engine oil around the outside of tappets.
(HLA = Hydraulic Lash Adjuster)
5. Install camshaft assembly.
 - Refer to installation procedure for Camshaft in this manual.

Crankshaft

Crankshaft and Associated Parts



015R100024

Legend

- | | |
|----------------------------|--|
| (1) Cylinder Head Assembly | (6) Balance Unit Assembly |
| (2) Oil Pump Assembly | (7) Piston and Connecting Rod Assembly |
| (3) Pan | (8) Main Bearing Cap |
| (4) Pan Support | (9) Crankshaft |
| (5) Oil Strainer | (10) Cylinder Block Assembly |

Disassembly

1. Remove cylinder head assembly (1). Refer to "Cylinder head" in this manual.
2. Remove oil pan (3).

CAUTION: Take care not to damage or deform the sealing flange surface of crankcase.

3. Remove oil pan support (4).

4. Remove oil strainer (5).
5. Remove oil pump assembly (2).
6. Balance unit assembly (6).
7. Remove piston and connecting rod assembly (7). Refer to "Piston, Piston Ring and Connecting Rod" in this manual.
8. Remove flywheel.
9. Remove rear oil seal and oil baffle plate.

10. Remove main bearing cap (8).
11. Remove crankshaft (9).
12. Remove crankshaft pulse pickup sensor disc.

Inspection and Repair for Bearing

1. Crankshaft

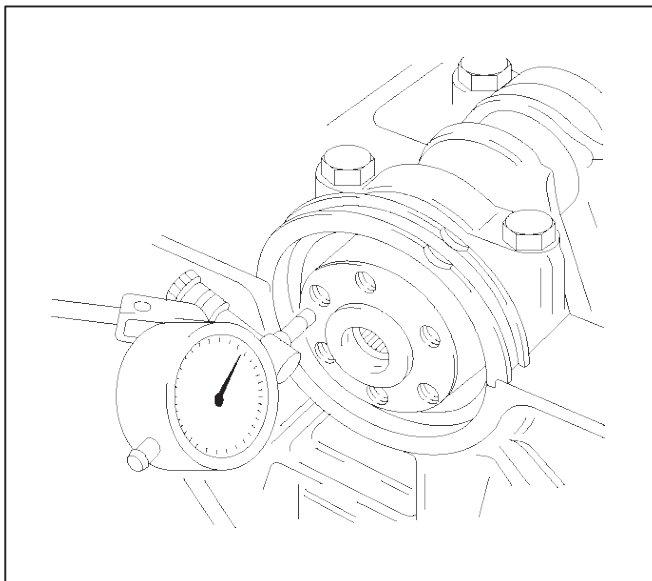
Set the dial indicator as shown in the illustration and measure the crankshaft thrust clearance. If the thrust clearance exceeds the specified limit, replace the thrust bearings as a set.

Thrust Clearance

Standard : 0.01 mm–0.02 mm

(0.0004 in–0.0008 in)

Limit : 0.21 mm (0.0083 in)

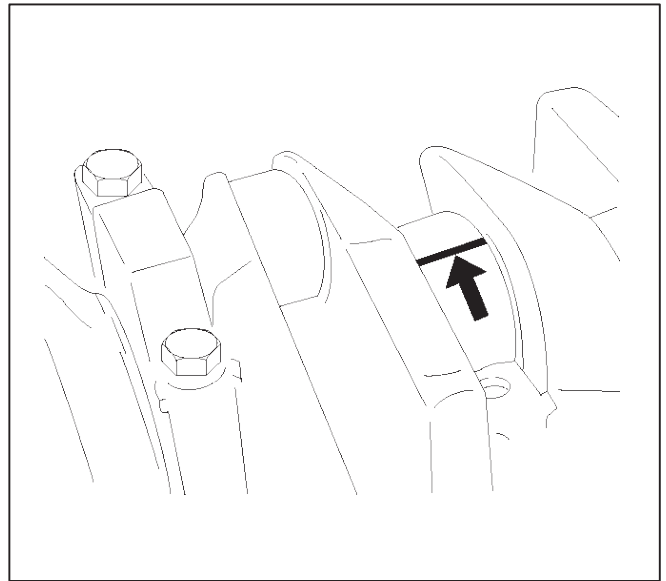


014RW079

Main Bearing Clearance

1. Remove the bearing caps and measure the oil clearance.
2. Remove the main bearing cap fixing bolts.
Arrange the removed main bearing caps in the cylinder number order.
Remove the main bearings.
3. Remove the crankshaft.
Remove the main bearings.
4. Clean the upper and lower bearings as well as the crankshaft main journal.
5. Check the bearings for damage or excessive wear.
The bearings must be replaced as a set if damage or excessive wear is discovered during inspection.
6. Set the upper bearings and the thrust washers to their original positions.
Carefully install the crankshaft.
7. Set the lower bearings to the bearing cap original position.

8. Apply plastigage to the crankshaft journal unit as shown in the illustration.



014RW055

9. Install main bearing caps, and tighten each bolt to the specified torque.

Main bearing caps bolts.

Torque:

1st step: 50 N·m (37 lb ft)

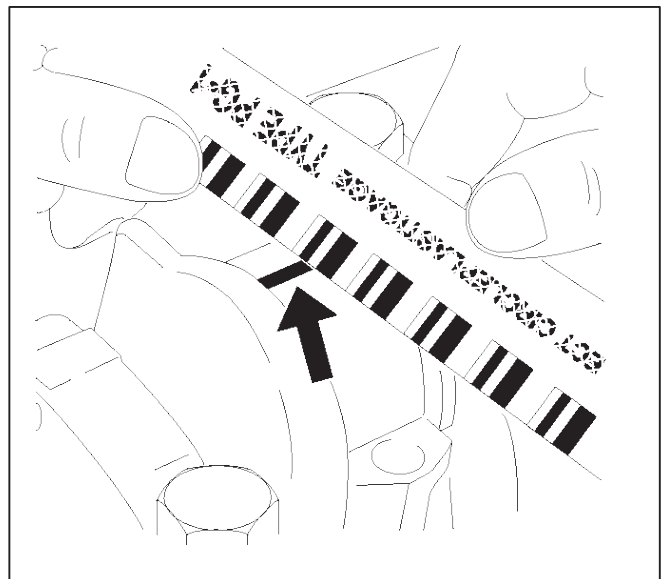
2nd step: 45°

10. Measure the plastigage width and determine the oil clearance. If the oil clearance exceeds the specified limit, replace the main bearings as a set and/or replace the crankshaft.

Standard : 0.015 mm–0.04 mm

(0.0006 in–0.0016 in)

Limit : 0.12 mm (0.0047 in)



014RW077

11. Clean the plastigage from the bearings and the crankshaft.

Remove the crankshaft and the bearings.

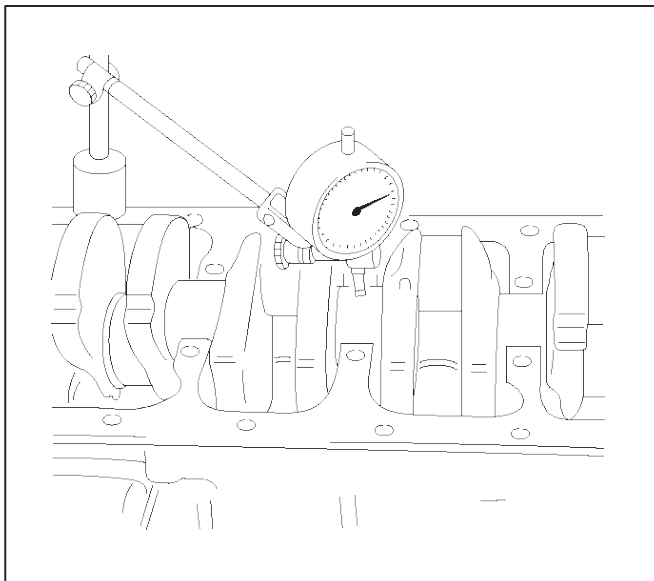
Crankshaft Inspection

Inspect the surface of the crankshaft journal and crank pins for excessive wear and damage. Inspect the oil seal fitting surfaces for excessive wear and damage. Inspect the oil ports for obstructions.

Inspection and Repair for Crankshaft

1. Carefully set the crankshaft. Slowly rotate the crankshaft and measure the runout. If the crankshaft runout exceeds the specified limit, the crankshaft must be replaced.

Runout : 0.03 mm (0.0012 in)



014RW078

2. Measure the diameter and the uneven wear of main journal and crank pin. If the crankshaft wear exceeds the specified limit, crankshaft must be replaced.

Main journal diameter

White color 57.974 to 57.981 mm
(2.2824 to 2.2871 in)

Green color 57.981 to 57.988 mm
(2.2871 to 2.2830 in)

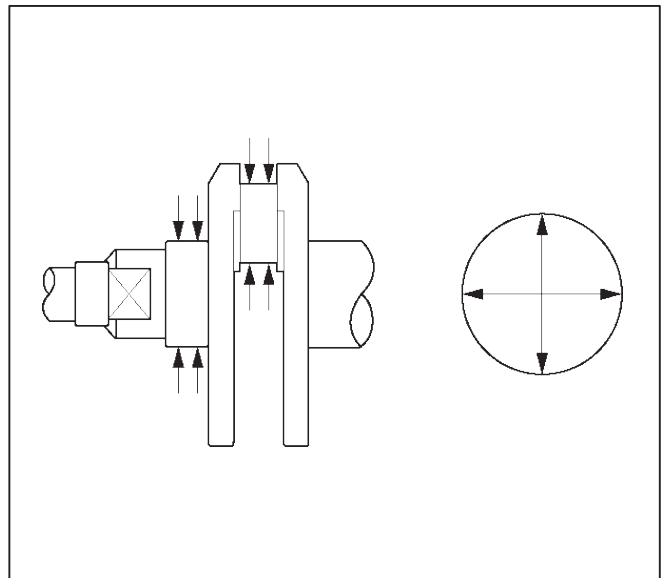
Brown color 57.988 to 57.995 mm
(2.2830 to 2.2833 in)

Crank pin diameter

Standard (No color) 48.970 to 48.988 mm
(1.9279 to 1.9287 in)

Blue (U/S 0.25) 48.720 to 48.738 mm
(1.9181 to 1.9188 in)

White (U/S 0.5) 48.470 to 48.488 mm
(1.9083 to 1.9090 in)



015RS009

NOTE: Take average of several measurements at different points.

Crankshaft Bearing Selection

When installing new crankshaft bearings or replacing bearings, refer to the selection table below. Select and install the new crankshaft bearings.

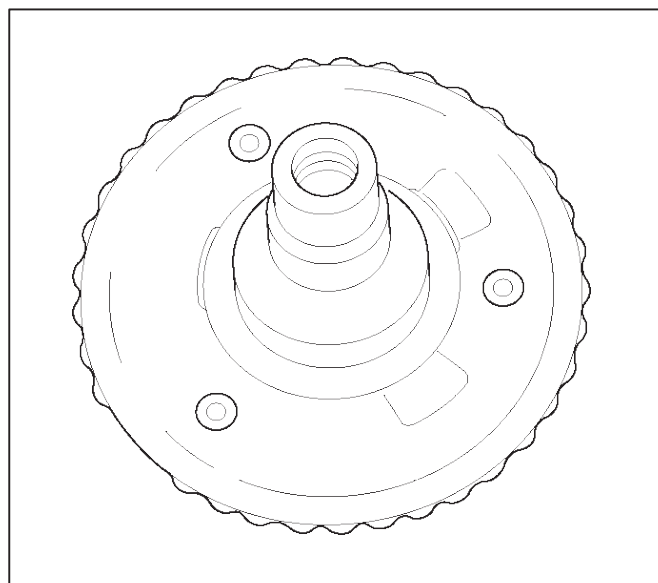
Crankshaft grinding dimensions	mm (in)
Production and Service	
Crankshaft bearing journal dia.	
Standard size	
white	57.974 to 57.981 (2.2824–2.2871)
green	57.981 to 57.988 (2.2871–2.2830)
brown	57.988 to 57.995 (2.2830–2.2833)
Undersize 0.25 (0.0098)	
green/blue	57.731 to 57.738 (2.2729–2.2731)
brown/blue	57.738 to 57.745 (2.2731–2.2734)
Undersize 0.5 (0.0197)	
green/white	57.481 to 57.488 (2.2630–2.2633)
brown/white	57.488 to 57.495 (2.2633–2.2636)
Guide bearing width	
Standard size	25.950 to 26.002 (1.0217–1.0237)
Oversize 0.25 (0.0098)	26.200 to 26.252 (1.0315–1.0335)
Oversize 0.5 (0.0197)	26.450 to 26.502 (1.0413–1.0434)

NOTE: Take care to ensure the bearings are positioned correctly.

Crankshaft pulse pickup sensor disc inspection and repair.

Inspect the crankshaft pulse pickup sensor disc for excessive wear and damage.

Replace the crankshaft pulse pickup sensor disc if the inspection exceeds wear and damage.



Reassembly

1. Crankshaft (12).

- Install the crankshaft pulse pickup sensor disc.

Torque: 13 N·m (113 lb in)

- Install the main bearings to the cylinder block and the main bearing caps.
- Be sure that they are positioned correctly.
- Apply new engine oil to the upper and lower main bearing faces.

NOTE: Do not apply engine oil to the main bearing back faces.

- Carefully mount the crankshaft.
- Apply engine oil to the thrust washer.
- Assemble the thrust washer to the No.3 bearing journal. The oil grooves must face the crankshaft.
Apply the liquid gasket to rear bearing cap (In grooves provided).
- Tighten the crankshaft bearing cap bolts in 2 steps:

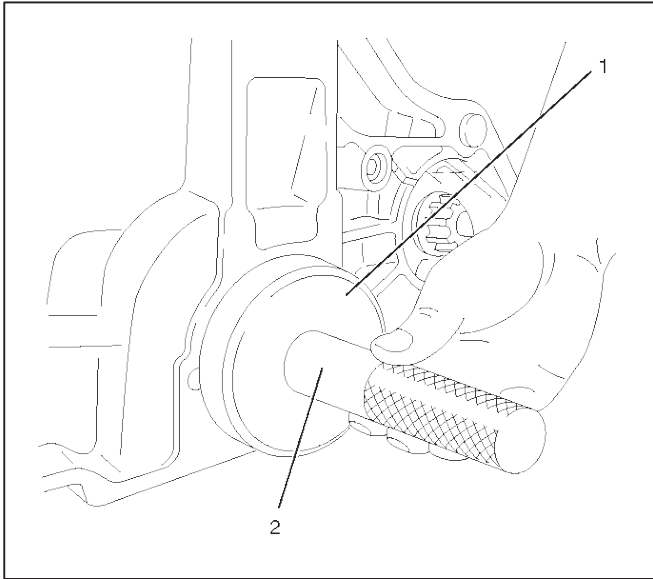
1st step: 50 N·m (37 lb ft)

2nd step: 45°

The new bolts must be used.

2. Rear oil seal (10).

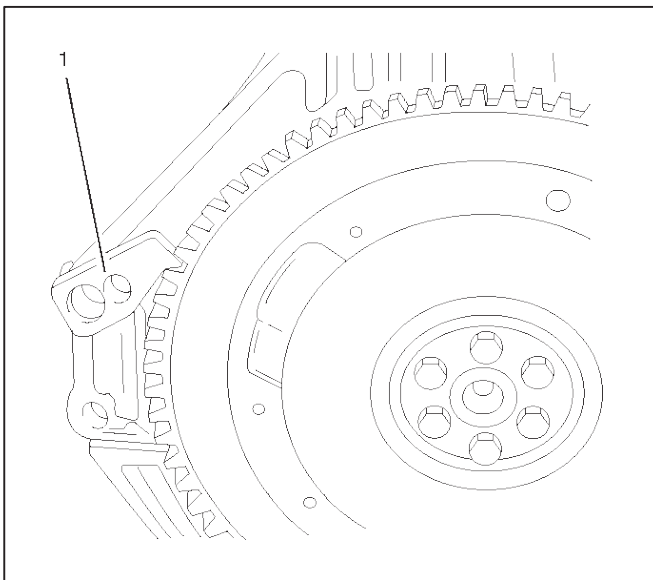
- Coat lip of seal rings thinly with protective grease.
- Install seal ring into cylinder block, use J-42616 (1) and J-42613 (2).



015RW009

3. Flywheel (9).

1. Thoroughly clean and remove the oil from the threads of crankshaft.
2. Remove the oil from the crankshaft and flywheel mounting faces.
3. Mount the flywheel on the crankshaft and then install the washer.
4. Use stopper (J-42618) to hold the flywheel for prevent from rotating.



015RW010

5. Tighten the flywheel bolts in 2 steps:

1st step: 65 N·m (48 lb ft)**2nd step: 30° – 45°**

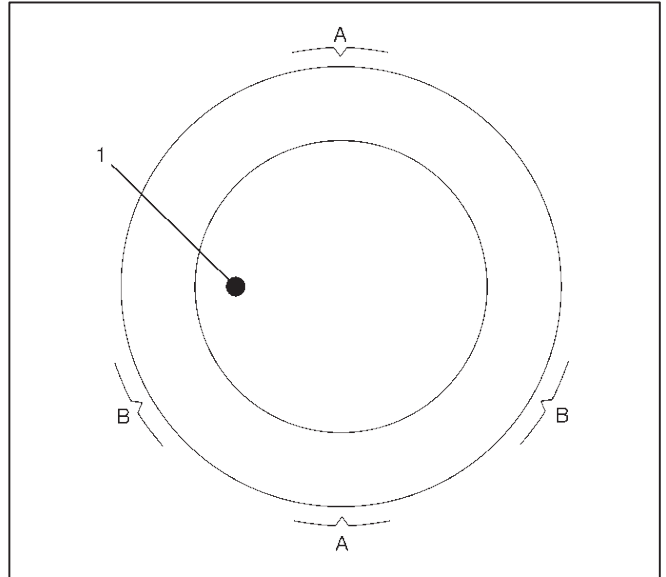
NOTE: Do not reuse the bolt.

6. Piston and connecting rod assembly.

- Apply engine oil to the cylinder bores, the connecting rod bearings and the crankshaft pins. Check to see that the piston ring end gaps are correctly positioned.

- Piston rings position (A) every 180°.

Oil scraper rings (B) — offset 25 to 50 mm (1 to 2 in). to left and right from gap of intermediate ring.

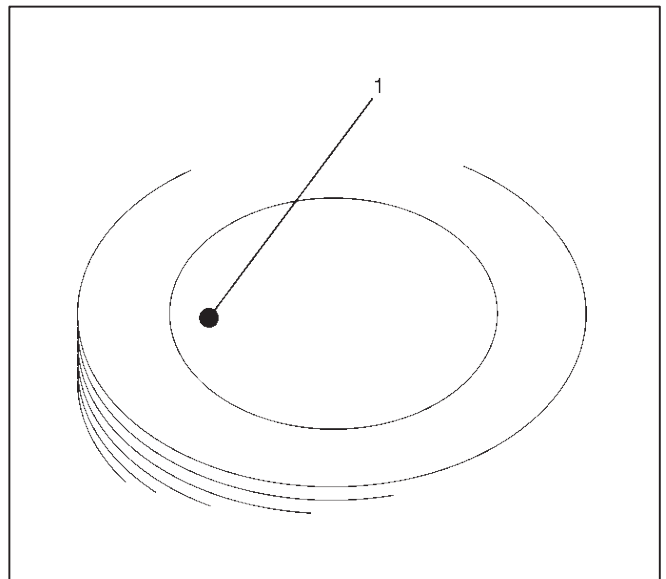


015R100025

- Insert the piston/connecting rod assemblies into each cylinder with the piston ring compressor. The front marks (1) must be facing the front of the engine.

- Match the numbered caps with the numbers on the connecting rods. Align the punched marks on the connecting rods and caps.

- Dot (1) on piston head points to engine timing side, bead on connecting rod points to flywheel side.



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- Tighten the connecting bearing cap bolts in 2 steps:

1st step: 35 N·m (26 lb ft)

2nd step: 45°

New bolts must be used.

7. Install the balance unit assembly and tighten the bolts in 2 steps:

1st step: 20 N·m (14 lb ft)

2nd step: 45°

Refer to the “Balance Unit Assembly” section of this manual.

8. Install oil pump assembly, refer to “Oil Pump” in this manual.
9. Install oil strainer.

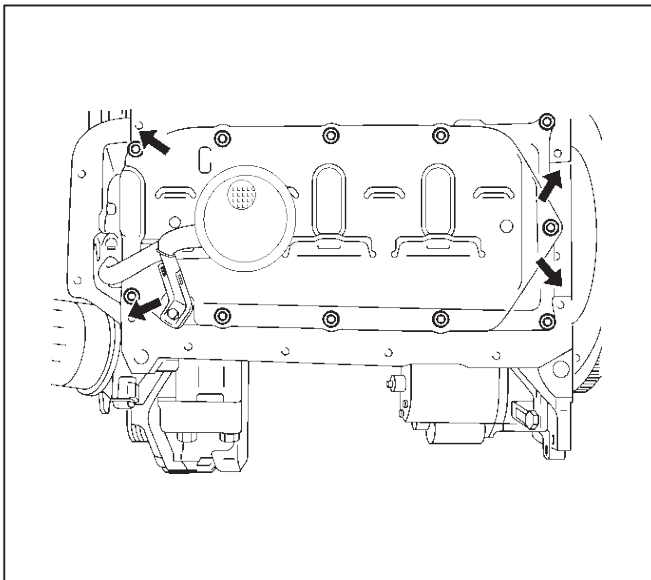
Torque: 8 N·m (69 lb in)

Ensure thread locking compound (Locktite) is used.

10. Install oil pan support and tighten the bolts to the specified torque.

Clean sealing surface before assembly, and apply four beads of sealant as shown.

Torque: 20 N·m (14 lb ft)



013R10003

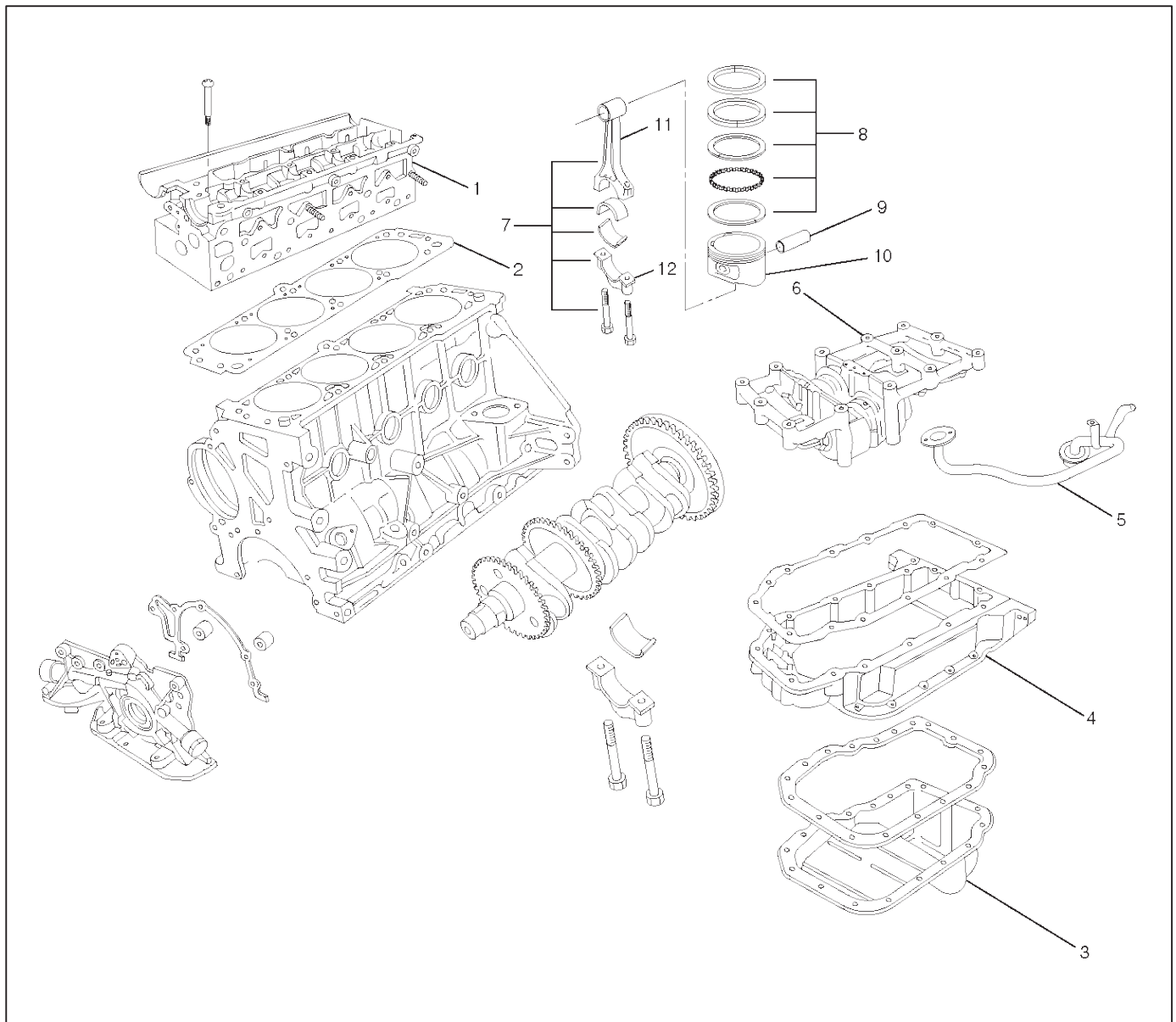
11. Install oil pan.
Tighten the oil pan bolts.

Torque: 8 N·m (69 lb in)

12. Install cylinder head assembly, refer to “Cylinder Head” in this manual.

Piston and Connecting Rod

Piston, Connecting Rod and Associate Parts



015R100032

Legend

- | | |
|----------------------------|-----------------------------|
| (1) Cylinder Head Assembly | (7) Connecting Rod Assembly |
| (2) Cylinder Head Gasket | (8) Piston Ring |
| (3) Oil Pan Assembly | (9) Piston Pin |
| (4) Pan Support | (10) Piston |
| (5) Oil Strainer | (11) Connecting Rod |
| (6) Balance Unit Assembly | (12) Connecting Rod Cap |

Disassembly

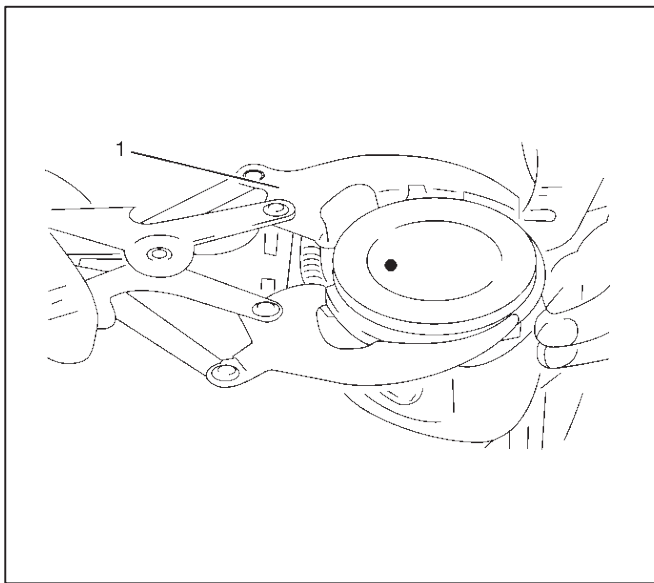
1. Remove cylinder head assembly (1), refer to "Cylinder Head Assembly" in this manual.
2. Remove cylinder head gasket (2).
3. Remove oil pan assembly (3) and oil pan support (4).
4. Remove oil strainer.
5. Remove balance unit assembly.

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6. Remove connecting rod cap with connecting rod lower bearing.
7. Remove piston and connecting rod assembly.

NOTE: Before removing piston and connecting rod assembly, measure thrust clearance.

- Remove any ridge or carbon build up from the top end of the cylinder.
8. Remove the piston rings with a piston ring expander (1). Arrange the removed piston rings in the cylinder number order.



015R100031

NOTE: Keep the parts removed from each cylinder separate. All parts must be reinstalled in their original positions.

Inspection and Repair

Pistons

Carefully clean away all the carbon adhering to the piston head and the piston ring grooves.

NOTE: Never use a wire brush to clean the pistons. Damage will result. Visually check each piston for cracking, scoring, and other signs of excessive wear. If any of the above conditions are found, the piston must be replaced.

Grade number	Piston out side diameter
99	85.970 – 85.980 mm (3.3846 – 3.3850 in)
00	85.990 – 86.470 mm (3.3854 – 3.4043 in)
O/S 0.5	86.470 – 86.490 mm (3.4043 – 3.4051 in)

Piston Rings

Any worn or damaged part discovered during engine overhaul must be replaced with a new one.

1. Ring end gap measurement
 - Insert the piston ring into the bore.
 - Push the ring by the piston, at a right angle to the wall, into the point at which the cylinder bore diameter is the smallest.
 - Measure the ring end gap.

Compression Ring

1st ring

Standard: 0.20 mm–0.35 mm
(0.0079 in–0.0138 in)

2nd ring

Standard: 0.30 mm–0.50 mm
(0.0118 in–0.0197 in)

Oil ring

Standard: 0.25 mm–0.76 mm
(0.0098 in–0.0299 in)

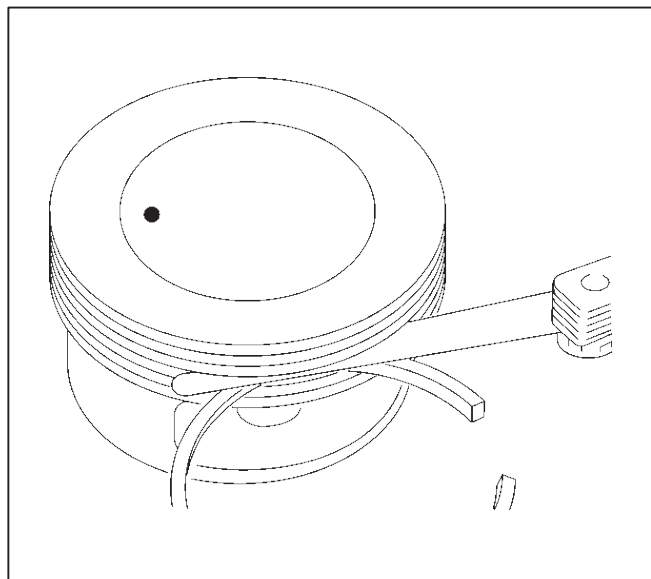
2. Measure the clearance between the piston ring groove and the piston ring with a feeler gauge. If the piston ring groove / piston ring clearance exceeds the specified limit, the piston must be replaced.

Compression Ring Clearance (1st and 2nd):

0.02 mm–0.04 mm
(0.0008 in.–0.0016 in)

Oil Ring Clearance:

0.01 mm–0.03 mm
(0.0004 in.–0.0012 in)



015R100028

Piston Pin

NOTE: Do not reuse the old piston pin.

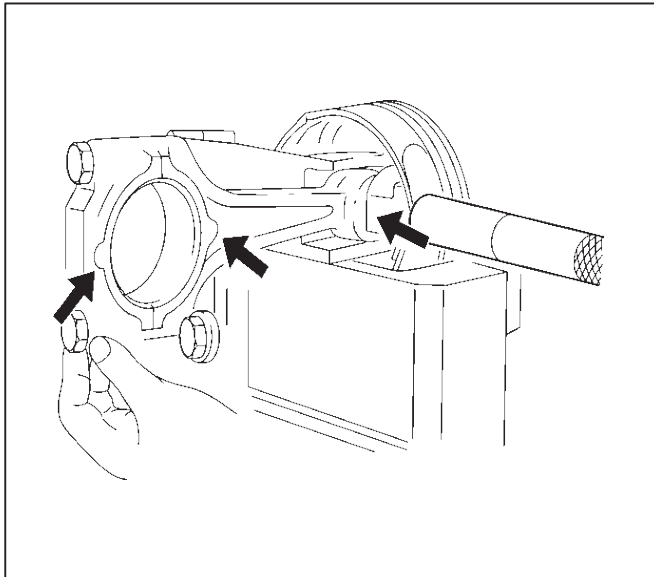
1. Use a micrometer to measure the new piston pin outside diameter in both directions at three different positions.

Standard diameter: 21 mm (0.8268 in)

2. Install the new piston pin.

Coat connecting rod boss and upper part of connecting rod stem with thermo-color pencil. When the required assembly temperature is attained, green color turns black. The colored line (arrow) must not change colors over the entire length, but only up to the start of the connecting rod stem. Heat upper connecting rod boss of new connecting.

Assembly temperature: 280 to maximum 320 °C (536 to maximum 608 °F).



015R100029

6. Measure the width of the plastigage and determine the oil clearance. If the oil clearance exceeds the limit, replace the rod bearing as a set.

Standard : 0.006 mm–0.031 mm (0.0002 in–0.0012 in)

Limit : 0.12 mm (0.0047 in)

7. Clean the plastigage from the bearings and the crankshaft pins.

Connecting Rod Bearings Clearance

1. Measure the oil clearance between the connecting rod and the crankshaft.
 1. Remove the connecting rod cap bolts and the rod caps. Arrange the removed rod caps in the cylinder number order.
2. Clean the rod bearings and the crankshaft pins.
3. Carefully check the rod bearings. If even one bearing is found to be damaged or badly worn, the entire bearing assembly must be replaced as a set. Reinstall the bearings in their original positions. Apply plastigage to the crank pin.
4. Reinstall the rod caps to their original positions. Tighten the rod cap bolts.

1st step: 35 N·m (26 lb ft)

2nd step: 45°

NOTE: Do not allow the crankshaft to rotate.

5. Remove the rod caps.

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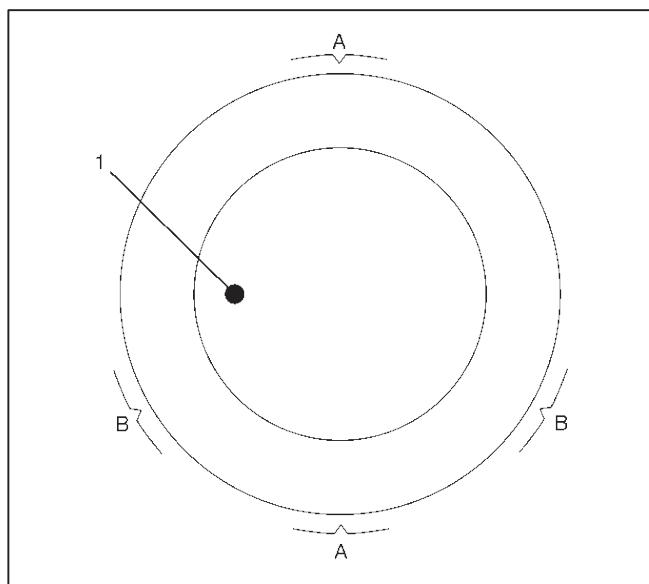
Crankshaft grinding dimensions	mm (in)
(continued)	
Production and Service	
Con-rod bearing journal dia.	
Standard size	
(no color code)	48.970 to 48.988 (1.9279–1.9287)
Undersize 0.25 (0.0098)	
blue	48.720 to 48.738 (1.9181–1.9188)
Undersize 0.5 (0.0197)	
white	48.470 to 48.488 (1.9083–1.9090)
Con-rod bearing journal width	
Standard size	
(no color code)	26.460 to 26.580 (1.0417–1.0465)
Undersize 0.25 (0.0098)	
blue	26.210 to 26.330 (1.0319–1.0366)
Undersize 0.5 (0.0197)	
white	25.960 to 26.080 (1.0220–1.0268)
Con-rod width	26.338 to 26.390 (1.0369–1.0390)

Reassembly

1. Install connecting rod
2. Install piston
3. Install piston pin, refer to “piston pin”.

NOTE: When changing piston / connecting rod combinations, do not change the piston / piston pin combination and do not reuse the old piston pin.

4. Install piston ring with the piston ring expander.
 - New piston rings with “Top” uppermost — use commercially available pliers.
 - Position ring gaps:
 - 1 — Compression rings 180° to each other as illustrated (A).
 - 2 — Offset oil control rings (B) or (B) 25 to 50 mm (1 to 2 in). from gap of second compression ring.



- After installation, apply engine oil to the entire circumference of the piston rings. Check to see that all the rings rotate smoothly.

5. Install piston and connecting rod assembly.

- Insert the bearings into the connecting rods and caps. Apply new engine oil to the bearing faces and bolts.
- Tighten the connecting rod cap bolts in 2 steps:

1st step : 35 N·m (26 lb ft)

2nd step: 45°

NOTE: Do not apply engine oil to the bearing back faces.

6. Install balance unit assembly, refer to "Balance Unit Assembly" in this manual.

7. Install balance unit assembly, refer to "Balance Unit Assembly" in this manual.

8. Oil strainer and O-ring.

9. Install oil pan support assembly, refer to "Reassembly of Crankshaft" in this manual.

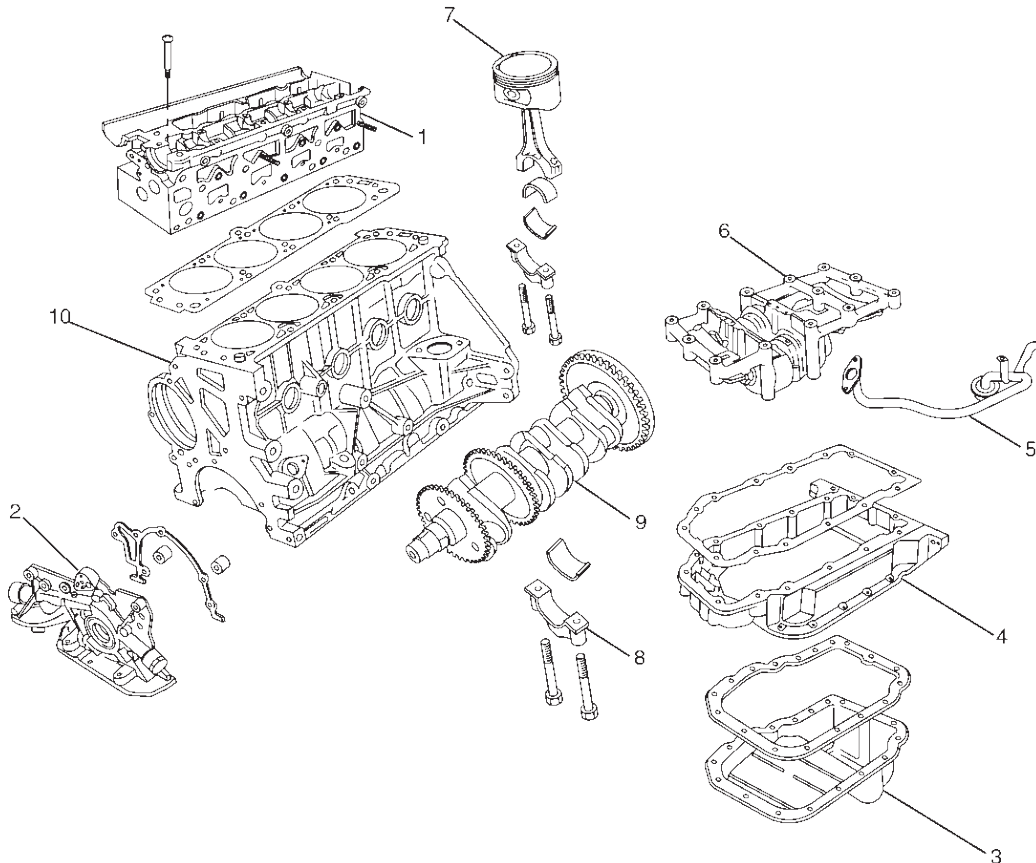
10. Install cylinder head gasket.

11. Install cylinder head assembly.

- Refer to "Cylinder Head Assembly" in this manual.

Cylinder Block

Cylinder Block and Associated Parts



015R100024

Legend

- | | |
|----------------------------|--|
| (1) Cylinder Head Assembly | (6) Balance Unit Assembly |
| (2) Oil Pump Assembly | (7) Piston and Connecting Rod Assembly |
| (3) Oil Pan | (8) Main Bearing Cap |
| (4) Oil Pan Support | (9) Crankshaft |
| (5) Oil Strainer | (10) Cylinder Block |

Disassembly

1. Remove cylinder head assembly.
2. Remove cylinder head gasket.
3. Remove oil pan assembly.
4. Remove oil pan support.
5. Remove oil strainer.
6. Remove oil pump assembly.
7. Remove balance unit assembly.
8. Remove piston and connecting rod assembly.
9. Remove flywheel.
10. Remove rear oil seal retainer assembly.
11. Remove main bearing cap.
12. Remove crankshaft.
13. Cylinder block.

Inspection and Repair

1. Inspect the cylinder head gasket and any other material adhering to the upper surface of the cylinder block.

CAUTION: Be very careful not to allow any material to accidentally drop into the cylinder block. Be very careful not to scratch the cylinder block.

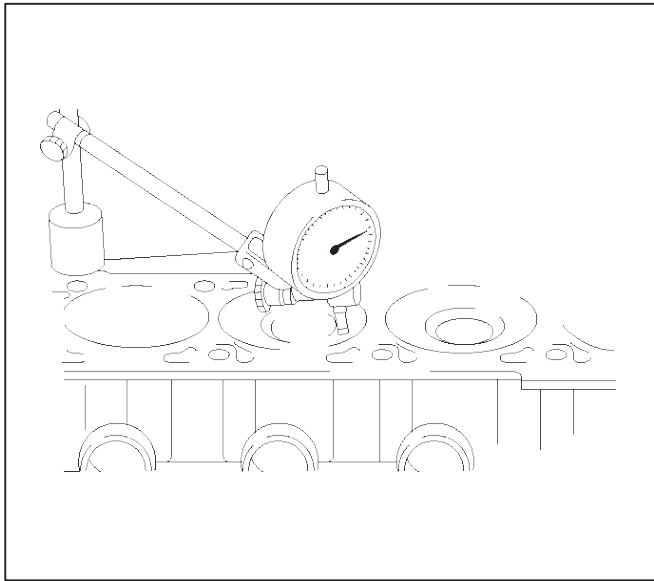
2. Carefully inspect the oil pump, rear oil seal retainer, and crankcase assembly installation surface seal.
3. Wipe the cylinder block clean.
4. Visually inspect the cylinder block. If necessary, use a flaw detector to perform a dye penetrate and hydraulic (or air pressure) test. If cracking or other damage is discovered, the cylinder block must either be repaired or replaced.

Flatness

1. Using a straight edge and feeler gauge, check that the upper surface of the cylinder block is not warped.

CAUTION: Be very careful not to allow any material to accidentally drop into the upper surface of the cylinder block. Be very careful not to scratch the upper surface of the cylinder block.

2. After re-grinding cylinder block maximum piston protrusion 0.4 mm (0.0157 in).



012RW013

Cylinder Bore

Use a cylinder gauge to measure the cylinder bore diameter in both the axial and thrust directions. Each measurement should be made at six points.

CAUTION: Be very careful not to allow any material to accidentally drop into the upper surface of the cylinder block. Be very careful not to scratch the upper surface of the cylinder block.

If the measurement exceeds the specified limit, the cylinder block must be replaced.

Grade number	Cylinder bore
99	85.985 – 85.995 mm (3.3852 – 3.3856 in)
00	85.995 – 86.005 mm (3.3856 – 3.3860 in)
O/S 0.5	86.495 – 86.505 mm (3.4053 – 3.4057 in)

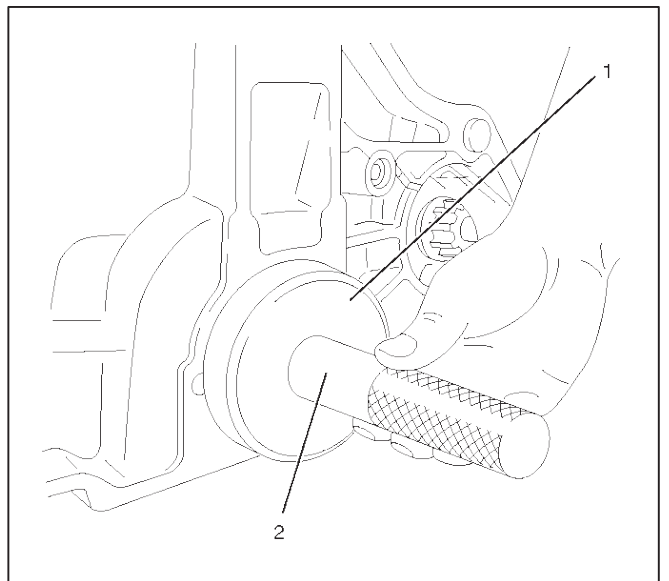
NOTE: For information on piston diameter, please refer to the section “Inspection and repair of the Piston and Connecting Rod” in this manual.

Reassembly

1. Cylinder block.
2. Install crankshaft.
 - Install the main bearings to the cylinder block and the main bearing caps.
 - Apply liquid gasket to rear bearing cap in slots provided.
 - Be sure that they are positioned correctly.
 - Apply new engine oil to the upper and lower main bearing faces.

NOTE: Do not apply engine oil to the bearing back faces.

- Carefully mount the crankshaft.
 - Apply engine oil to the thrust washer.
3. Install rear oil seal.
 - Coat lip of seal rings thinly with protective grease.
 - Install seal ring into cylinder block, use J-42616 (1) and J-42613 (2).



015RW009

Refer to “Crankshaft” in this manual.

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4. Install flywheel

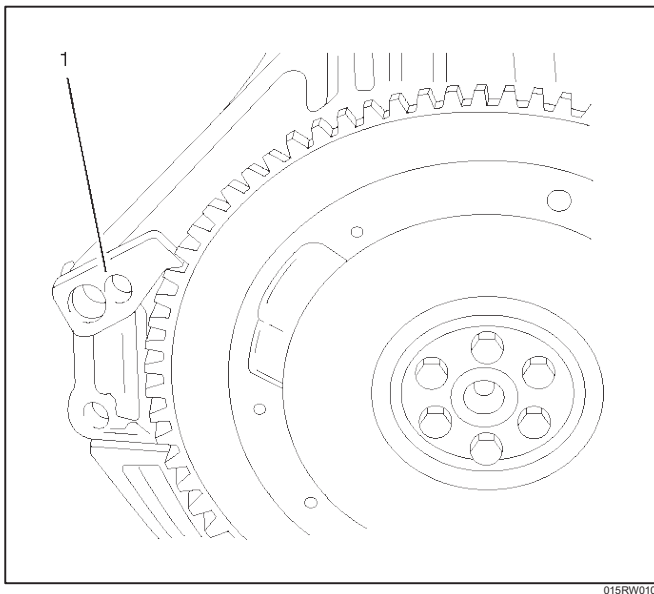
1. Thoroughly clean and remove the oil from the threads of crankshaft.
2. Remove the oil from the crankshaft and flywheel mounting faces.
3. Mount the flywheel on the crankshaft then install the washer and temporarily hand tighten bolts.
4. Use stopper (J-42618) to prevent the crankshaft from rotating.

Tighten the flywheel bolts in 2 steps:

1st step: 65 N·m (48 lb ft)

2nd step: 30° – 45°

NOTE: Do not reuse the bolt.



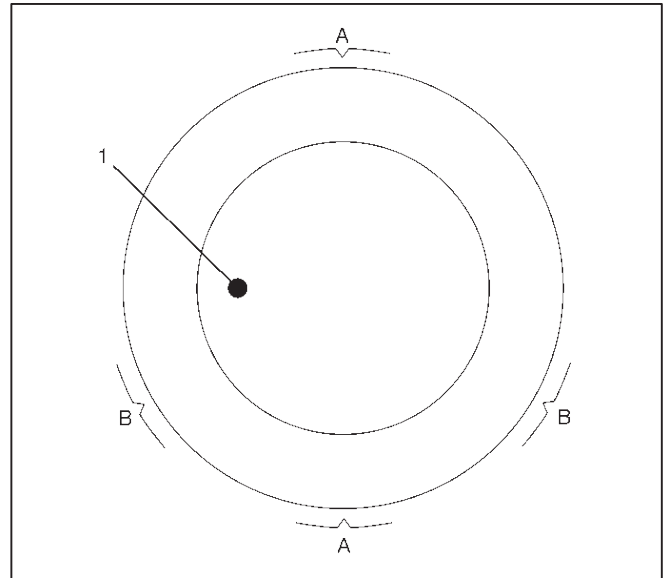
5. Install piston and connecting rod assembly.

- Apply engine oil to the cylinder bores, the connecting rod bearings and the crankshaft pins.

NOTE: Do not apply engine oil to the bearing back faces.

- Position ring gaps:

- 1 — Compression rings 180° to each other as illustrated (A).
- 2 — Offset oil control rings 25 to 50 mm (1 to 2 in) from gap of second compression ring (B).



Refer to "Piston and Connecting Rod" in this manual.

6. Install balance unit assembly and tighten the bolts.

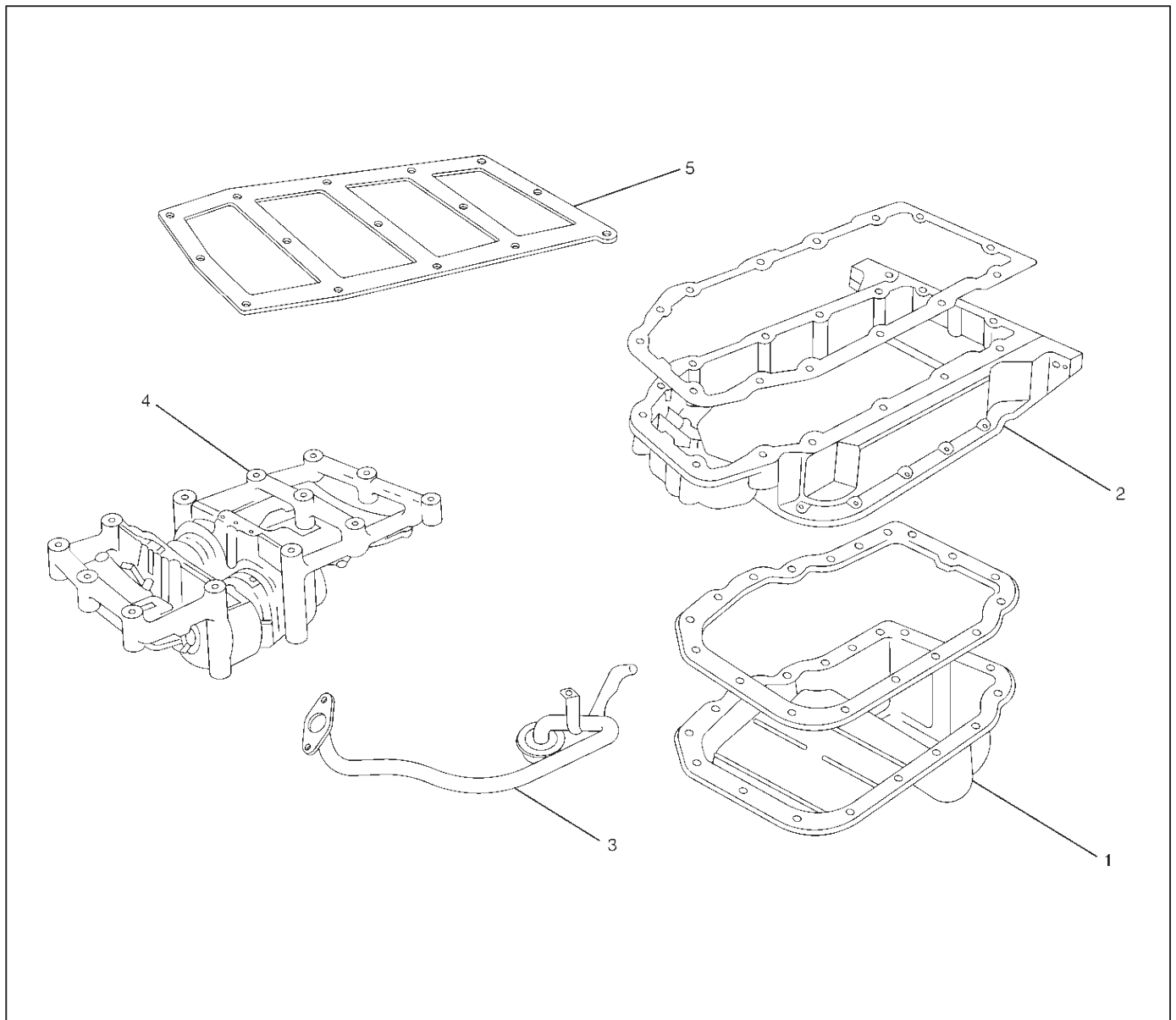
Torque : 30 N·m (22 lb ft)

7. Install oil pump assembly, refer to section 6G "Oil Pump" in this manual.
8. Install oil strainer.
9. Install oil pan support.
10. Install oil pan assembly.

Refer to "Crankshaft" in this manual.

Balance Unit Assembly

Balance Unit Assembly and Associated Parts



051R100007

Legend

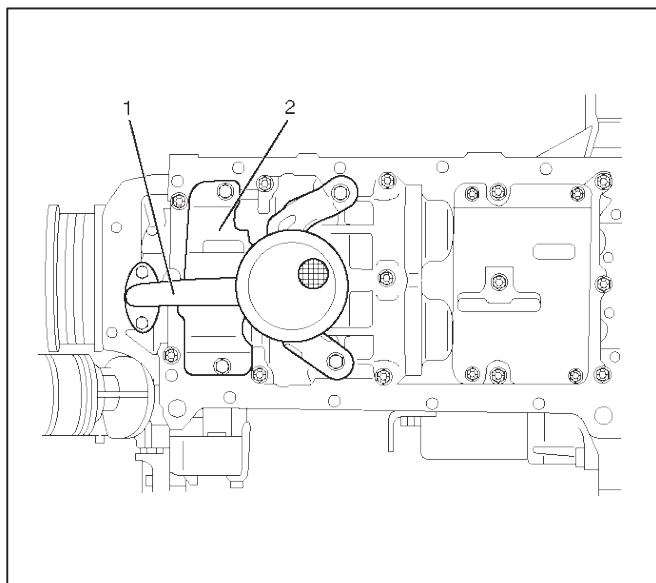
- | | |
|---------------------|---------------------------|
| (1) Oil Pan | (3) Oil Strainer |
| (2) Oil Pan Support | (4) Balance Unit Assembly |
| | (5) Shim |

Disassembly

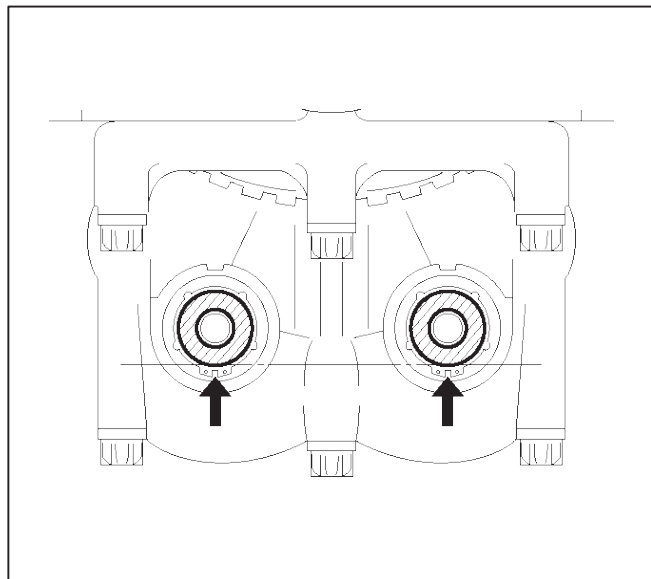
1. Remove the oil pan.
2. Remove the oil pan support.

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3. Remove the oil strainer (1) from oil pump and the oil baffle plate (2).

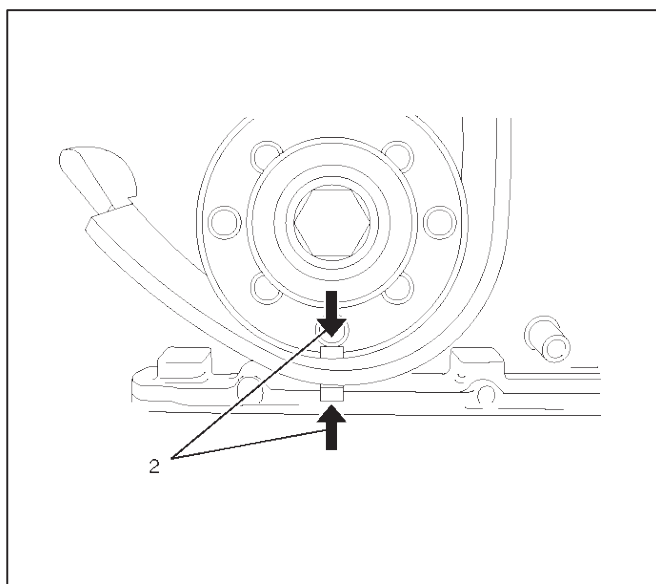


2. In this crankshaft position, the flattened side (arrows) of both balancer shafts must face downward and must be on a horizontal line.

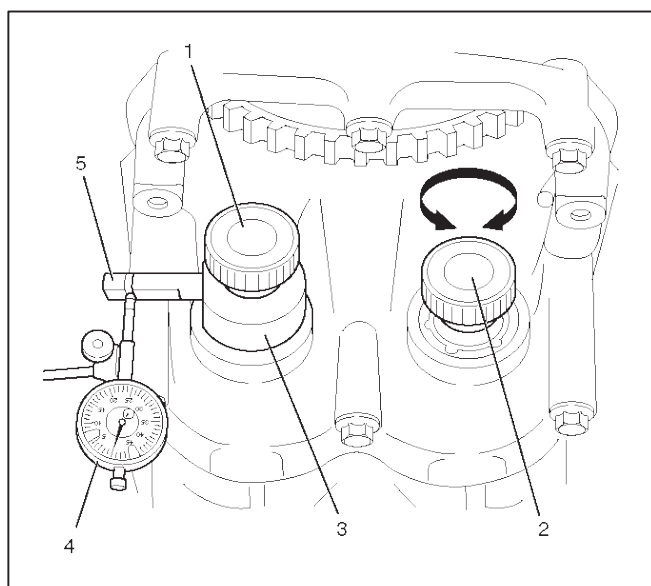


Adjustment

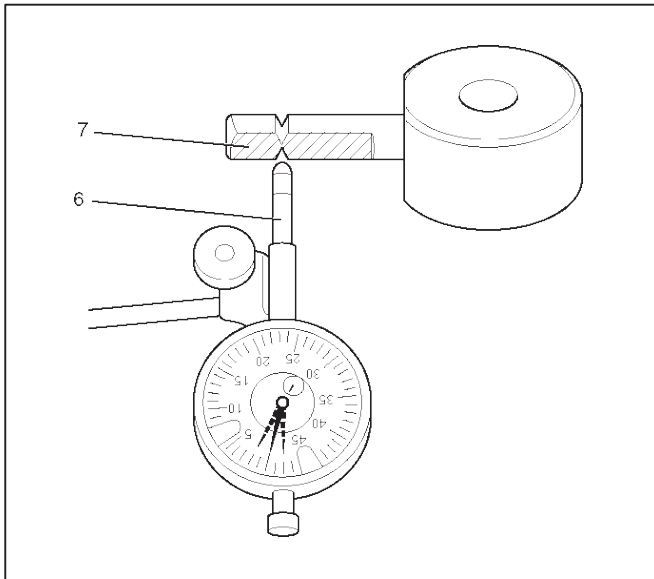
1. Turn crankshaft in engine rotational direction to align the alignment mark (2) at 1st cylinder "TDC".



3. Screw measuring device J-43038 (3) with long knurled bolt (1) into 1st balancer shaft (intake side) and tighter hand-tight measuring arm (5) must point in "9 o'clock" direction shown in this illustration. Install dial gauge holder with dial gauge (4) on cylinder block.



4. Place pre tensioned probe (6) of gauge on measuring arm of measuring device J-43038. The probe must be set precisely between the notch marks, square to the plane surface (7).



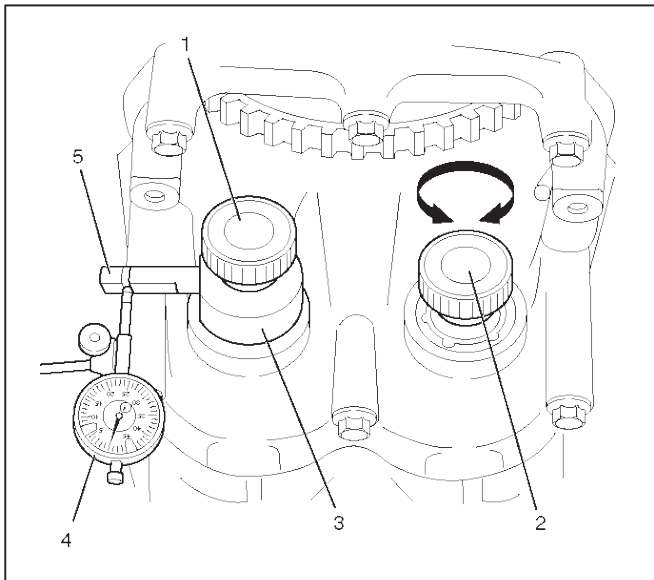
051RW006

5. Determine the left and right stops by turning the knurled bolt (2).

Set the dial of the gauge to zero.

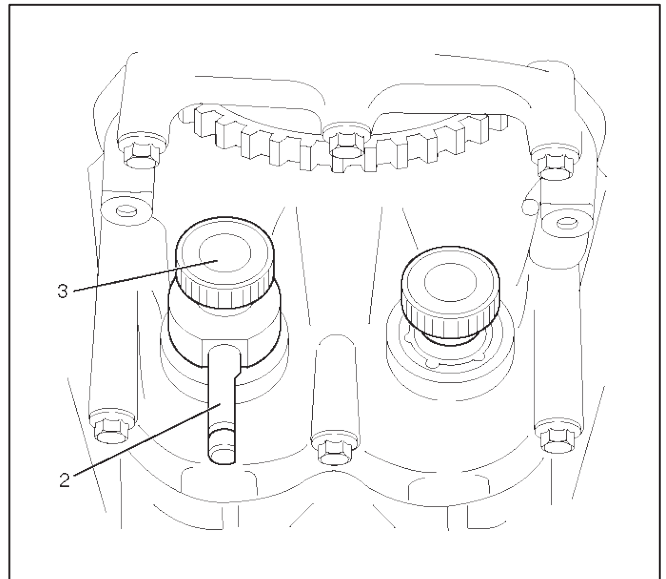
Use the knurled bolt (2) to move the 2nd balancer shaft (exhaust side) back and forth. Again — simultaneously read off the tooth backlash from the gauge.

The permissible tooth backlash is: 0.02 mm to 0.06 mm (0.0008 to 0.0024 in).



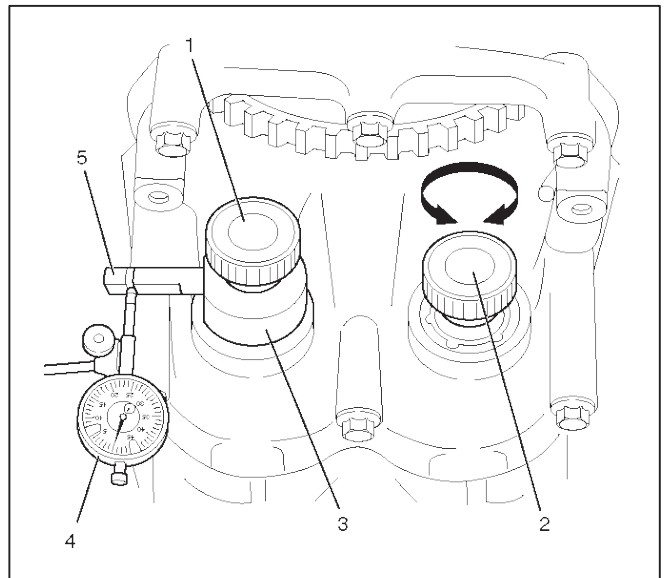
051RW007

6. The tooth backlash must be measured in 4 different positions — turn the crankshaft further at the fastening bolt of the timing belt drive gear by 45° in the engine rotational direction until the measuring arm (2) is at “6 o’clock”.



051RW008

7. Then loosen the knurled bolt (1) fix the measuring arm at “9 o’clock” again and repeat the measurement.



051RW007

8. If the value determined in one of the 4 measurements lies outside the tolerance 0.02 mm to 0.06 mm (0.0008 to 0.0024 in), the tooth backlash must be adjusted.

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9. Remove balance unit from cylinder block/crankshaft bearing caps and remove with balancer piece. The balancer piece has a number (code), for easy assignment. The tooth backlash can be adjusted by using a balancer piece with a different thickness.

Code	Thickness of balancer piece in mm
55	0.535 to 0.565
58	0.565 to 0.595
61	0.595 to 0.625
64	0.625 to 0.655
67	0.655 to 0.685
70	0.685 to 0.715
73	0.715 to 0.745
76	0.745 to 0.775
79	0.775 to 0.805
82	0.805 to 0.835
85	0.835 to 0.865

NOTE: The next larger or smaller balancer alters the tooth backlash by 0.02 mm (0.0008 in).

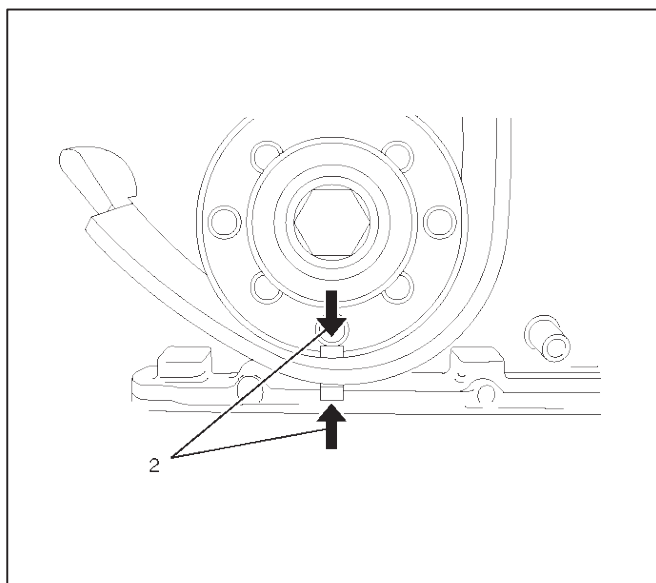
Example for selection of balancer piece: The installed balancer piece with the code “70” gave a tooth backlash of 0.08 mm (0.0031 in).

If a balancer piece with the code “67” is now installed, the tooth backlash will be approx. 0.06 mm (0.0024 in).

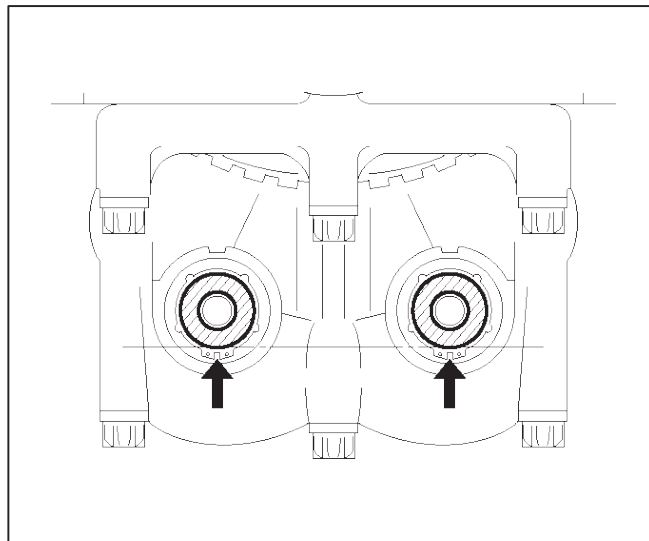
CAUTION: Only one balancer piece may be installed.

Reassembly

1. Turn crankshaft in engine rotational direction to align the alignment mark (2) at 1st cylinder “TDC”.



2. Turn balancer shafts until the flattened sides (arrows) of both balancer shafts face downward and are on a horizontal line.



3. Install selected balancer piece (2) with balancer shaft unit to cylinder block/crankshaft bearing cap — tighten all fixing bolts to the specified torque.

Torque: 30 N·m (22 lb ft)

CAUTION: Take great care not to chip or dent teeth when meshing gear sets on assembly.

4. After installing the balancer shaft unit, recheck the tooth backlash and readjust if necessary.

NOTE: If the balancer shaft unit has to be replaced, use the thickest balancer piece with the code “85” for the initial assembly — this guarantees tooth backlash in all conditions.

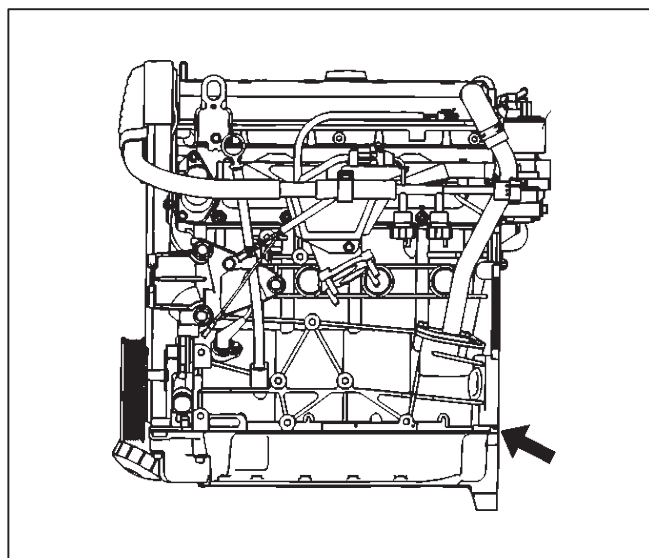
5. Install oil strainer to oil pump with new seal ring and insert fixing bolts with locking agent to the specified torque.

Torque: 8 N·m (69 lb in)

6. Install oil pan support.

Torque: 20 N·m (14 lb ft)

- Adjust surfaces of the cylinder block and the oil pan support.



7. Install oil pan.

Torque: 8 N·m (69 lb in)

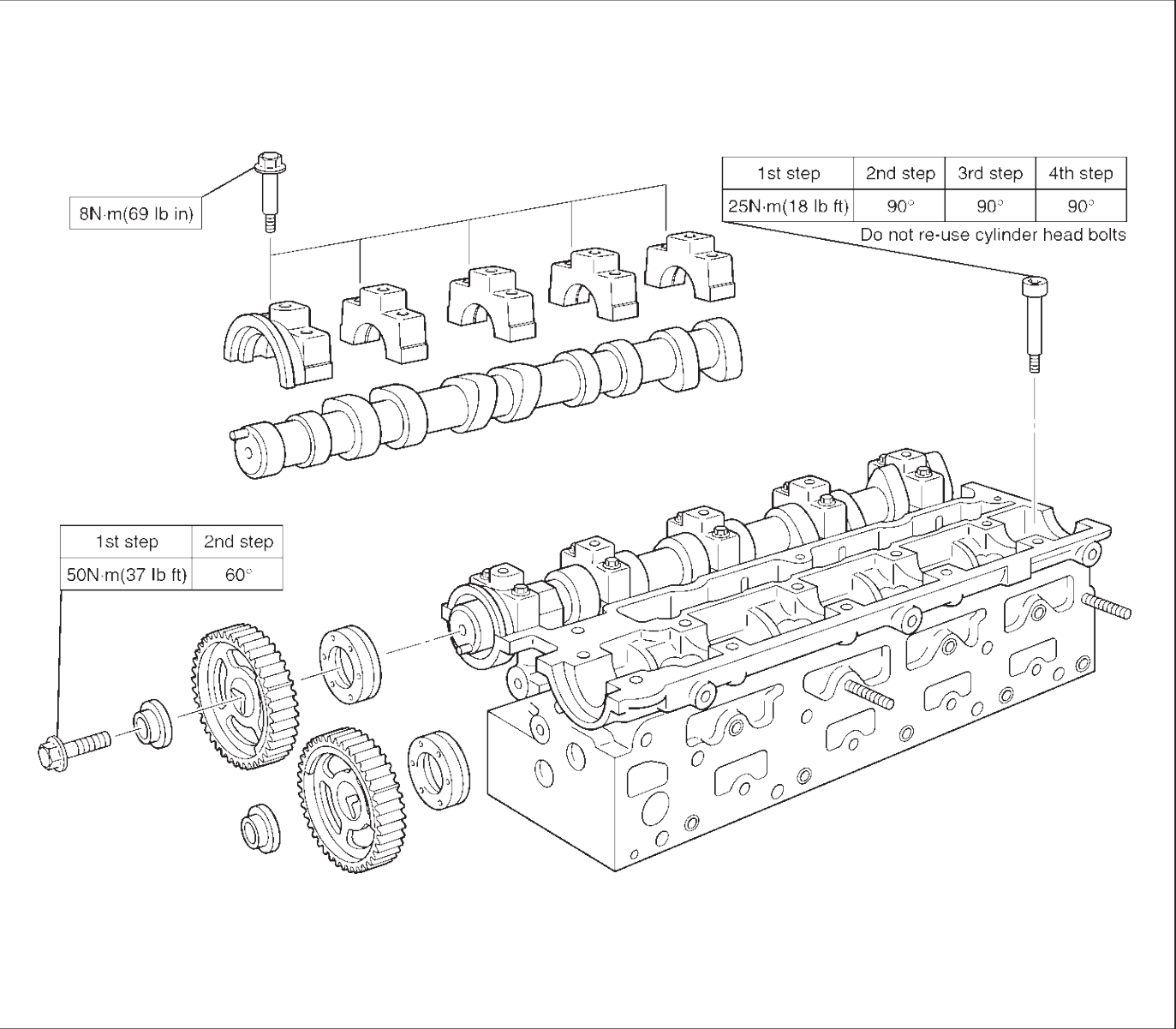
Main Data and Specifications

Engine Main Specifications

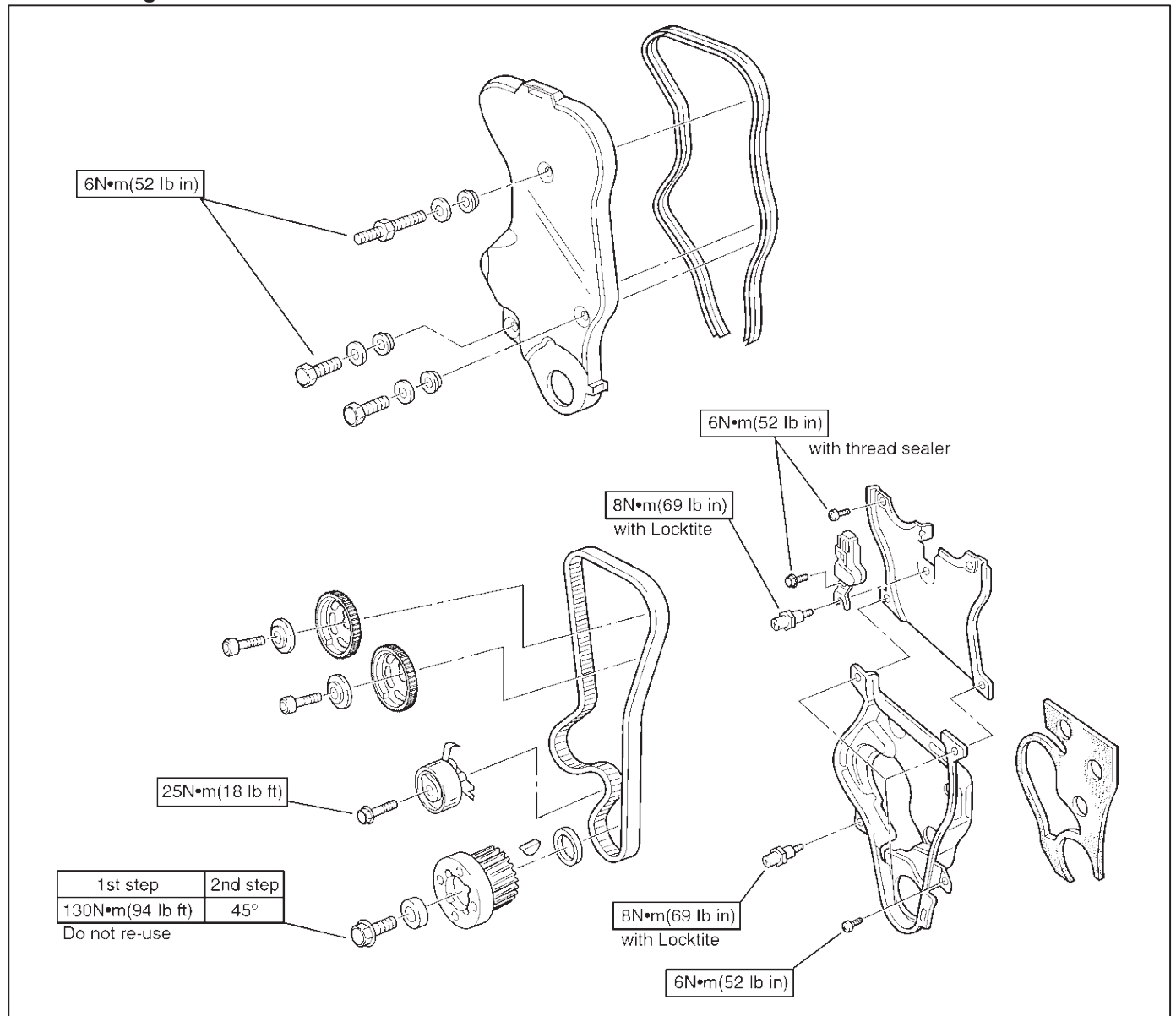
MODEL	Y22SE
TYPE	Four cycle, Overhead Camshaft, Water cooled
BORE × STROKE	86 × 94.6 mm (3.39 × 3.72 in)
DISPLACEMENT	2198 cc (134.1 in ³)
COMPRESSION RATIO	10 : 1
MAIN BEARINGS	5
VALVE LIFTERS AND GAP	Hydraulic, No adjustment necessary
SPARK PLUGS AND GAP	Platinum Tipped, 1.05 mm (0.04 in)
ENGINE OIL CAPACITY	
Factory fill or Rebuilt engine	5.0 liters (5.3 US quarts)
With Filter Replacement	4.5 liters (4.8 US quarts)
Without Filter Replacement	4.2 liters (4.4 US quarts)
IDLING SPEED	800 rpm
RADIATOR TYPE	Tube and Corrugated Fin Pressure Type
COOLANT CAPACITY	6.9 liters (7.3 US quarts) for MT 7.0 liters (7.4 US quarts) for AT
THERMOSTAT	Wax Pellet Type
FUEL CAPACITY	74 liters (19.5 US gallons) for Rodeo 67 liters (17.7 US gallons) for Rodeo Sport

Torque Specifications

Camshaft bracket, Timing gear camshaft side, Cylinder head

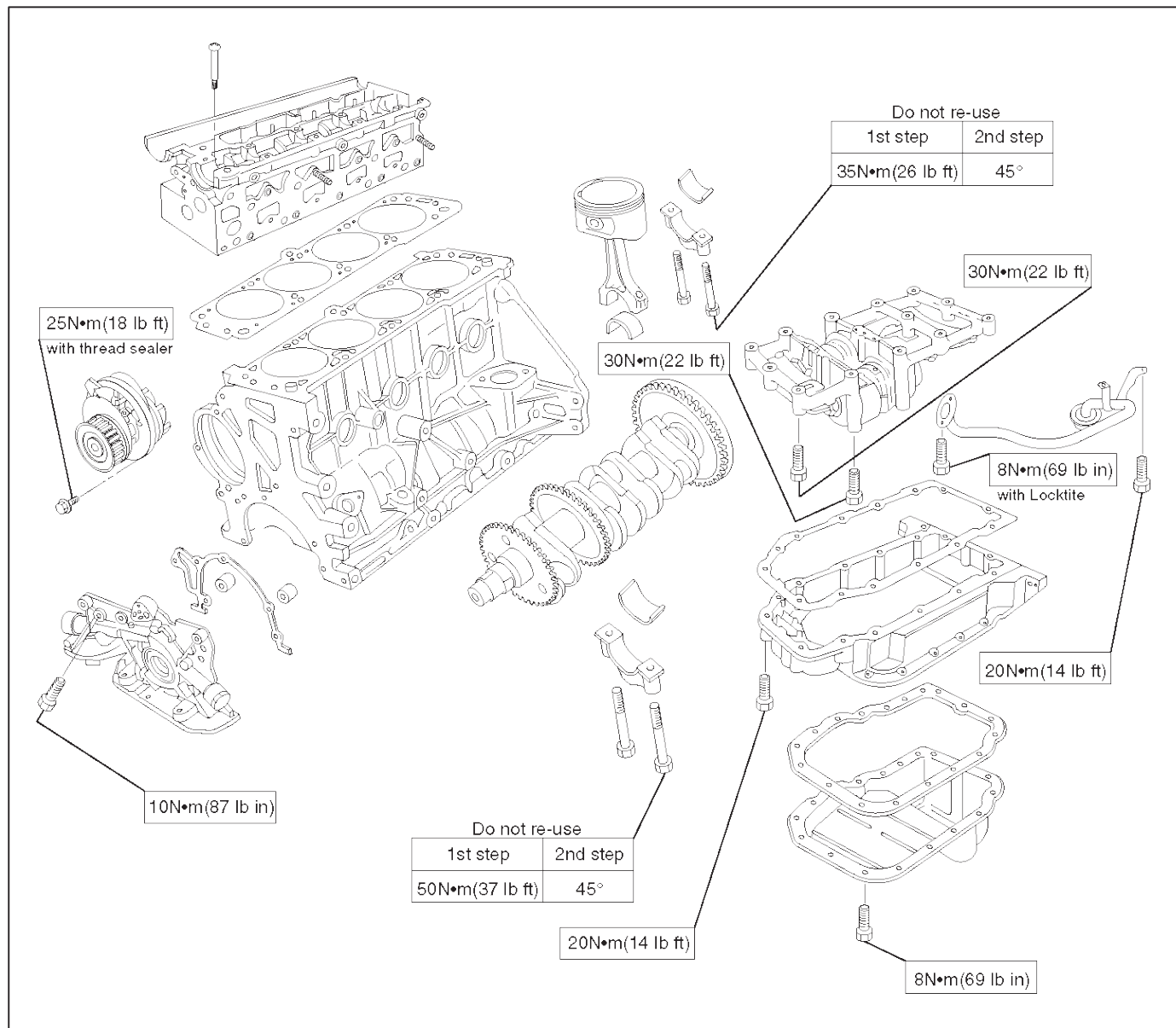


Timing gear crankshaft (center bolt), Timing belt cover front, Timing belt cover rear, Timing belt tensioner, Camshaft angle sensor

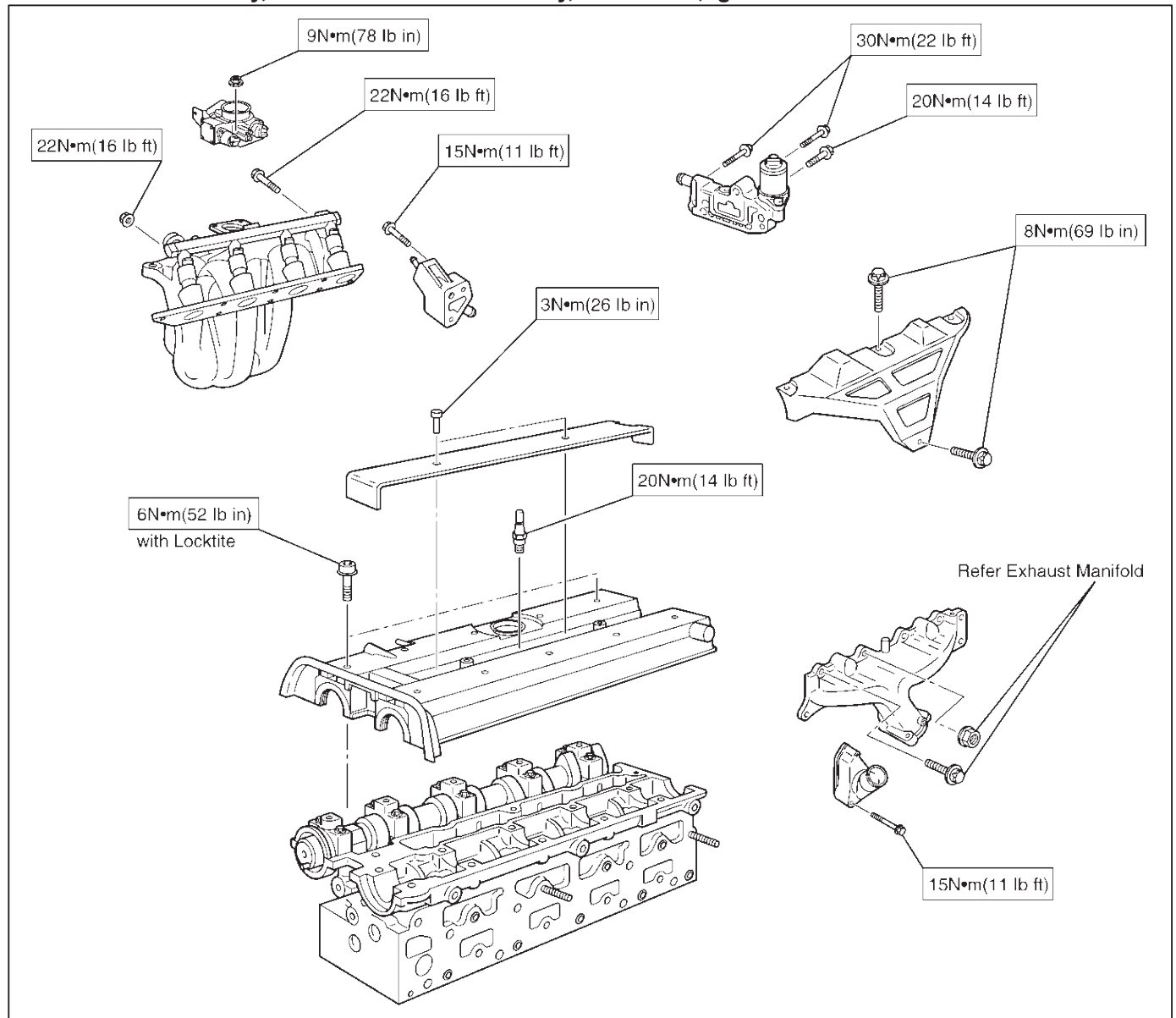


6A-70 ENGINE MECHANICAL (Y22SE 2.2L)

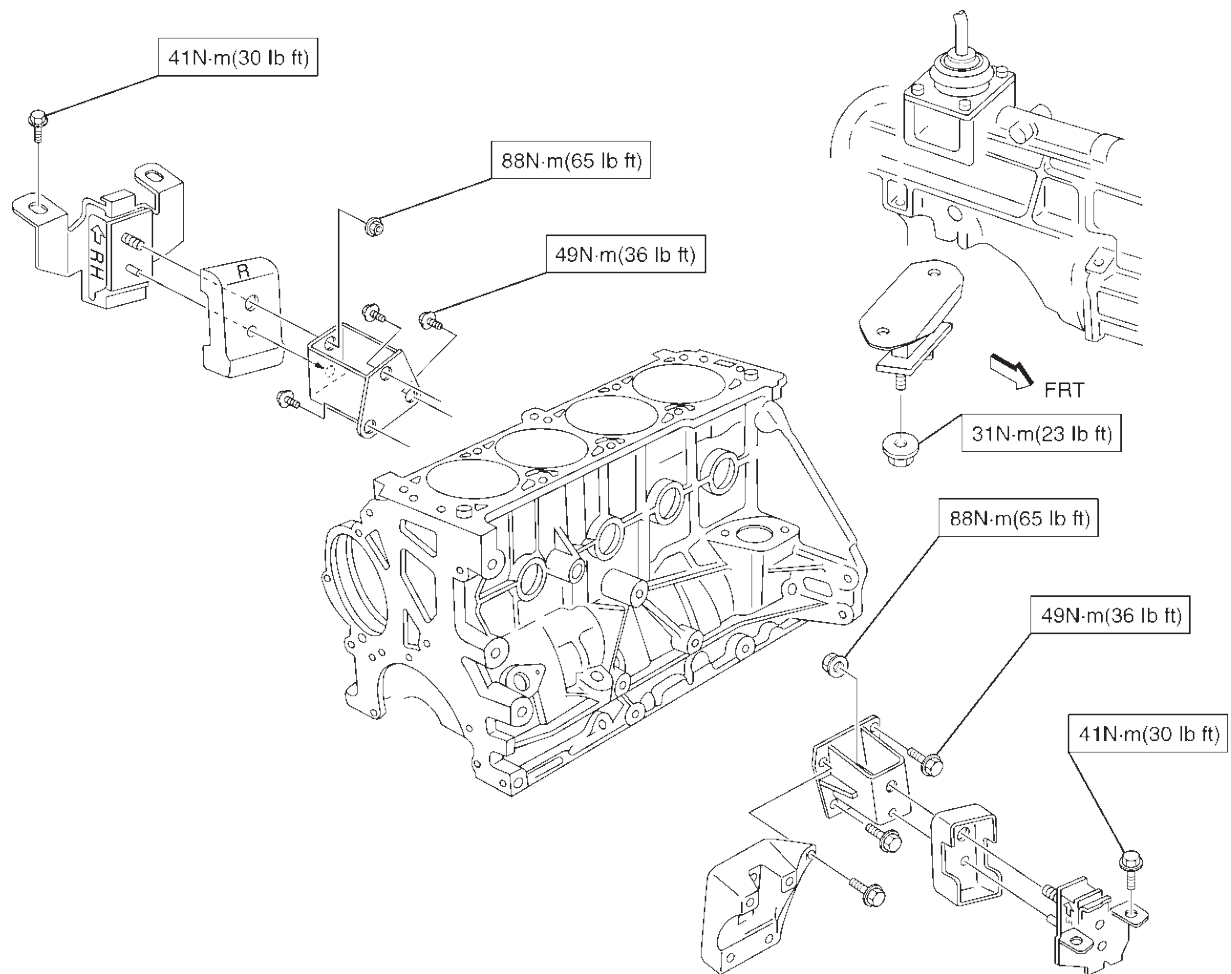
Crankshaft main bearing, Oil pan support, Oil pan, Balance unit assembly, Connrod Cap, Oil pump, Oil strainer



Spark plug, Throttle body, EGR valve adaptor assembly, Bypass housing assembly, Thermostat assembly, inlet manifold assembly, Exhaust manifold assembly, heat shield, Ignition cable cover



Engine mount



Special Tools

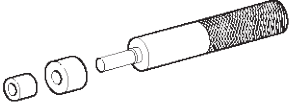
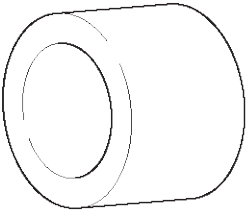
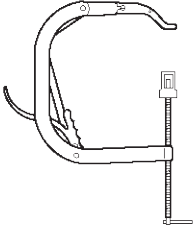
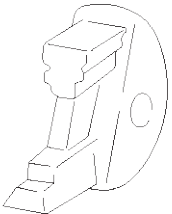
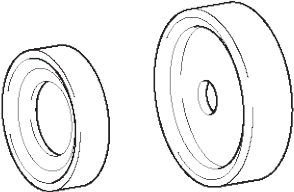
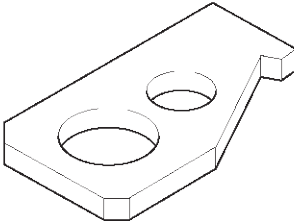
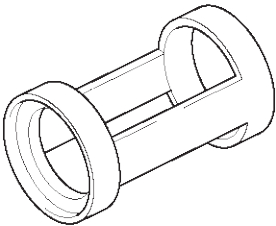
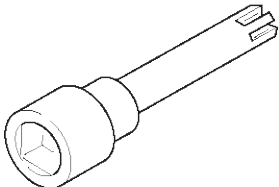
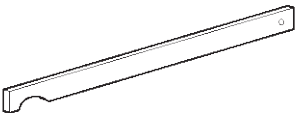
ILLUSTRATION	TOOL NO. TOOL NAME
 015RW027	J-42613 Installer; Rear crankshaft seal ring
 015RW030	J-42609 Remover/Installer; Crankshaft carrier seal
 901RW108	J-8062 Compressor; Valve spring (Use with J-3289-20 base)
 901RW165	J-43037 Locking tool camshaft gear
 015RW031	J-42616 Installer; Rear crankshaft seal
 015RW035	J-42618 Locking device; Flywheel

ILLUSTRATION	TOOL NO. TOOL NAME
 015RW034	J-42619 Adapter; Valve spring
 011RW025	J-42622 Installer sleeve; Valve stem seal
 015RW028	J-42623 Socket wrench; Cylinder head bolt
 015RW033	J-42620 Holding wrench; Driven gear fix