

ENGINE

Engine Mechanical (4HK1-TC)

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ISUZU DIESEL ENGINE (4HK1-TC)

Service Precautions

Matters that require attention in terms of maintenance

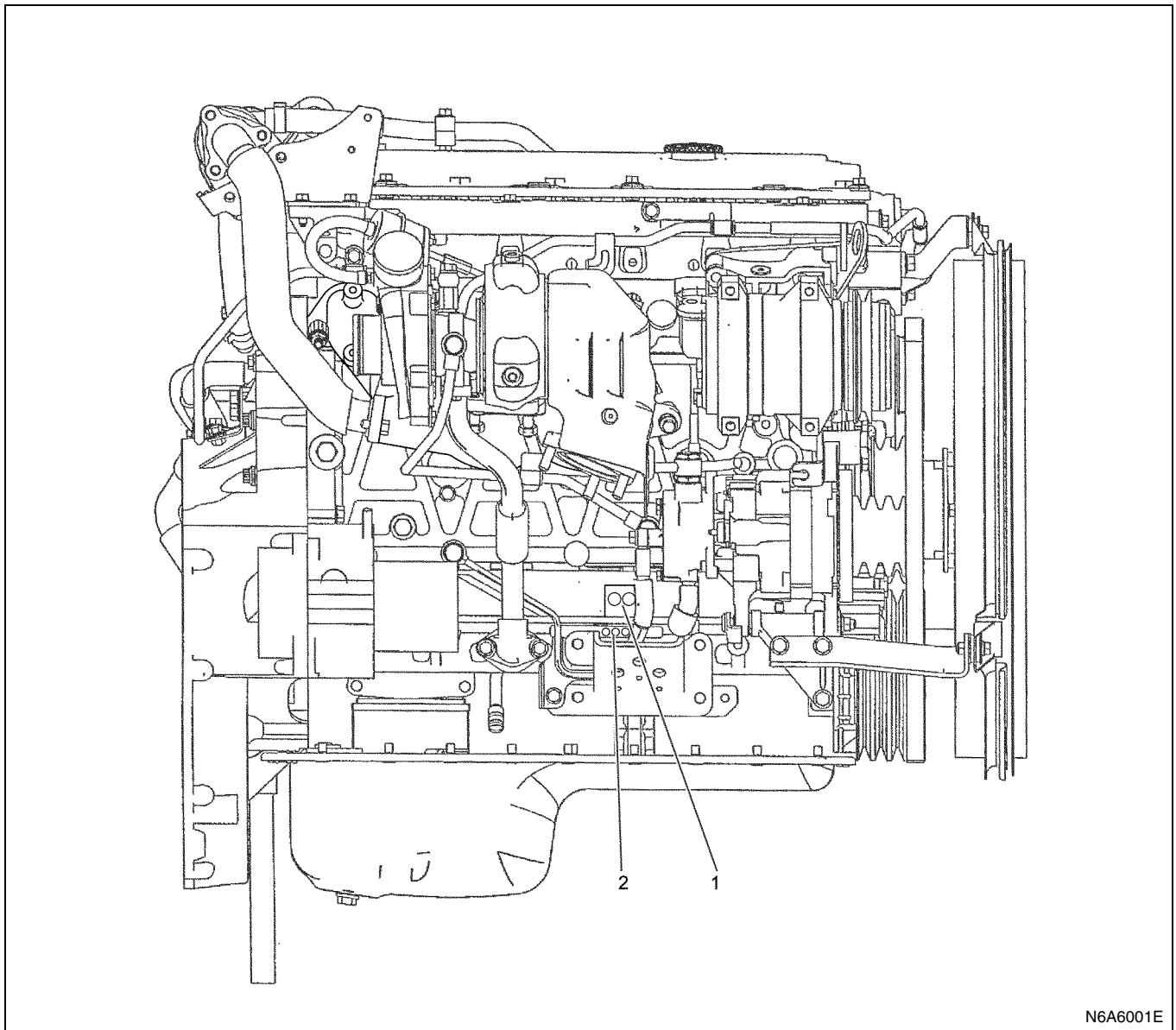
To prevent damage to the engine and ensure reliability of its performance, pay attention to the following in maintaining the engine:

- When lifting up or supporting the engine, do not apply a jack on the oil pan.
When taking down the engine on the ground, do not make the bearing surface of the oil pan touch directly the ground. Use a wood frame, for example, to support the engine with the engine foot and the flywheel housing.
Because there is only a small clearance between the oil pan and the oil pump strainer, it can damage the oil pan and the oil strainer.
- When the air duct or air cleaner is removed, cover the air intake opening to prevent foreign matter from getting into the cylinder. If it gets into it, it can considerably damage the cylinder and others while the engine is operating.
- When maintaining the engine, never fail to remove the battery earth cable. If not, it may damage the wire harness or electrical parts. If you need electricity on for the purpose of inspection, for instance, watch out for short circuits and others.
- To protect and lubricate the rotational surface during the initial operation, apply plenty of engine oil to it.
- When valve train parts, pistons, piston rings, connecting rods, connecting rod bearings or crankshaft journal bearings are removed, put them in order and keep them.
- When installing them, put them back to the same location as they were removed.
- Parts, such as gaskets, oil seals and O-rings, have to be replaced by brand-new ones every time the engine is dismantled.
- As for parts where a liquid gasket is used, remove an old liquid gasket completely and clean it up thoroughly so that no oil, water or dust may be clung to them. Then, apply the designated liquid gasket to each place anew before assembly.
- Assemble it within 7 minutes after applying the liquid gasket.
If 7 minutes or longer passed, remove the liquid gasket and apply it again.
- When assembling or installing parts, fasten them with the prescribed tightening torque so that they may be installed properly.

Matters that require attention in specifically dealing with this engine

Holes or clearances in the fuel system which serve as a passage of fuel, including the inside of injector, are finished extremely precisely. For this reason, they are highly sensitive to foreign matter. If it gets inside, it can lead to breakdown on the road. Be sure to prevent it from getting inside.

How To Read The Model



Legend

1. Engine Model

2. Engine Serial Number

Explanation of Functions and Operations

Electronic Engine Control

With the control unit, the range from injection to air intake/exhaust, including fuel injection quantity, injection timing, intake air restriction, EGR, and idling rpm, is controlled.

Cylinder Block

The cylinder block is cast-iron with the center distance of each bore being equal and is of the highly rigid, symmetrical structure with the crankshaft center being the center. The bearing cap is of the ladder frame structure and tightened up under the plastic range rotation angle method.

Cylinder Liner

The cylinder liner is selected to match an internal diameter of a bore of the cylinder block and built, which is imprinted on the left side of the cylinder.

Piston

The piston is aluminum-alloy and an autothermic piston with a strut cast, while the combustion chamber is a round reentrant type.

Cylinder Head

The cylinder head is cast-iron and there are 4 valves per cylinder. The angular tightening method of the cylinder head bolt further increases reliability and durability.

Crankshaft

Tuftriding is given, while on the No. 1 balance weight imprinted is the grade of each journal diameter.

EGR System

Based upon data, including water temperature, engine speeds or engine loads, it is controlled via Engine Control Module (ECM) to purify exhaust by recycling part of it.

Its main components include an EGR valve, an EGR cooler and various sensors.

Connecting Rod Cap Bolt

The angular tightening method of the connecting rod cap bolt further increases reliability and durability.

Common Rail-type Electronic Control Injection System

The common rail-type electronic control injection system is composed of a fuel supply pump that sets the target pressure of high-pressure fuel and supply it, a fuel rail that measures such high-pressure fuel and an fuel injector that turns it into a fine spray and injects it. Each is controlled via ECM based upon various signals, while injection timing or fuel injection quantity is controlled under every possible driving condition.

Fuel Injector

The fuel injector is a 7-hole nozzle that adjusts fuel injection quantity or injection timing by opening or closing an electromagnetic valve on the head of the fuel injector.

ECM corrects the dispersion of fuel injection quantity between fuel injectors according to ID code data in memory. At the replacement of fuel injectors, ID code data should be stored in ECM.

Fuel Filter with Sedimenter

It is a fuel filter with sedimenter that gets rid of water by making use of the difference in specific gravity between light oil and water, which comes with an indicator that notifies you that it is filled with water.

Preheating System

The preheating system consists the ECM, the glow relay, glow plugs and the glow indicator lamp. The preheating system is operated when the engine coolant temperature is low, and make the engine easy to start.

Lubrication System

It is an oil filter with full-flow bypass, which uses a water-cool oil cooler and oil jet to cool the piston.

Functional Inspection**Inspection/adjustment of valve clearance**

1. Inspection of valve clearance
 - a. Remove the cylinder head cover.
 - b. Remove the fuel injector harness assembly.
 - c. Loosen the terminal nuts alternately to remove.
 - d. Remove the leak-off pipe.

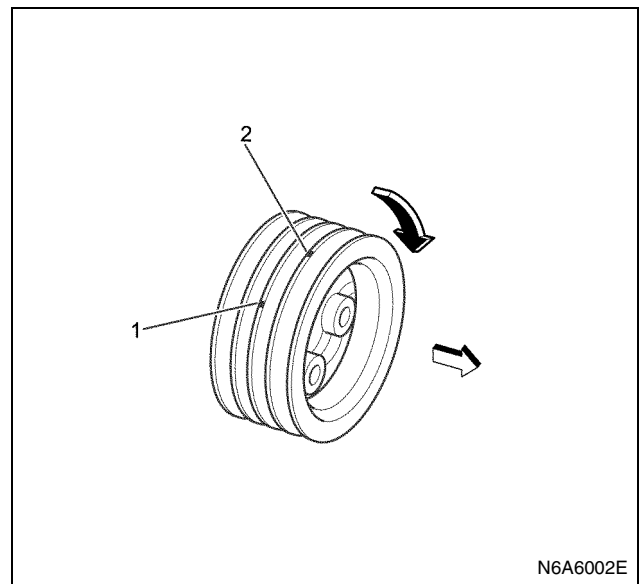
- e. Rotate the crankshaft to make the No.1 cylinder meet the compression top dead center (TDC).

Notice:

There are 2 timing marks on the crankshaft pulley. Mark (1) is near the cylinder block and is used to bring the 4HK1-TC engine to TDC.

Mark (2) is not applicable to this engine.

Be sure to use mark (1) when bringing the engine to TDC.



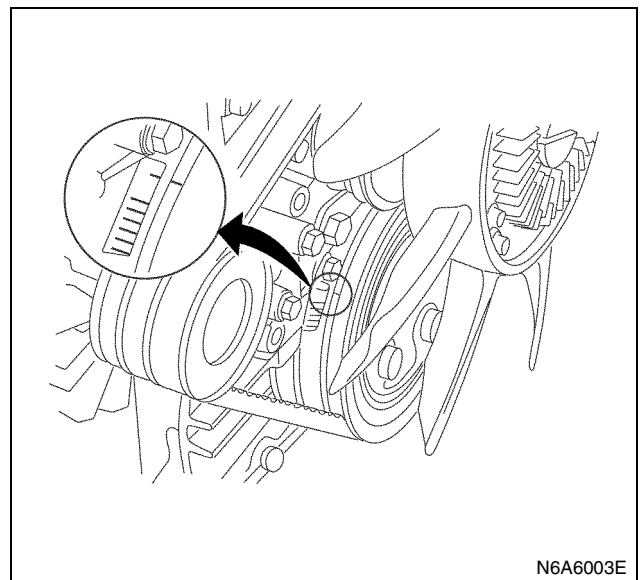
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- Insert a 0.4 mm (0.016 in) thickness gauge into a clearance between the rocker arm and the bridge to check it and adjust it if needed.

Valve clearance		mm (in)
Intake valve		0.4 (0.016)
Exhaust valve		0.4 (0.016)

Caution:

Adjust while being cold.



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2. Adjustment of valve clearance

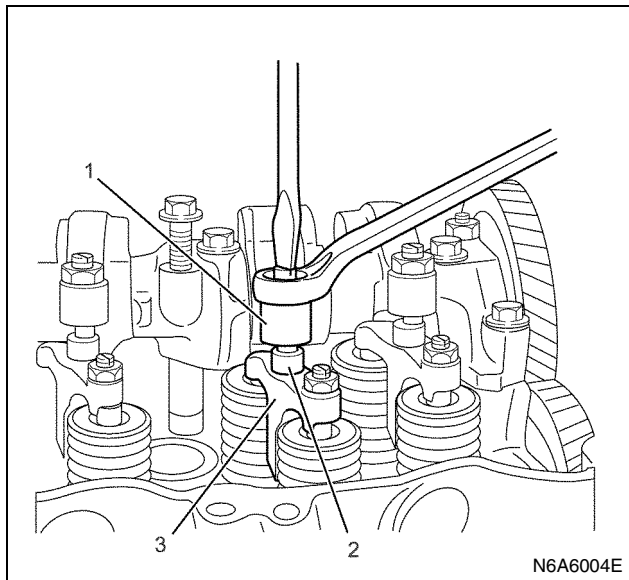
Caution:

Adjust valve clearance carefully so that the bridge contacts the end of the 2 valve stem.

- Completely loosen all of the bridge and rocker arm adjusting nuts and adjusting screws (8 nuts and 8 screws).
- Place a 0.4 mm (0.016 in) thickness gauge between the No. 1 cylinder rocker arm end and the bridge cap.
- Tighten the rocker arm adjusting screw until the thickness gauge is snug (not tight) between the rocker arm end and the bridge cap.
- Tighten the rocker arm lock nut.
- Tighten the bridge adjusting screw until the bridge contacts the valve head.
- Tighten the bridge lock nut.
- Check that the thickness gauge is still held snugly between the rocker arm end and the bridge cap. If it is too tight, slightly loosen the bridge adjusting screw and lock nut to restore snugness.
- Remove the thickness gauge.
- Repeat Steps b through h for the remaining cylinders.

Tighten:

Bridge lock nut to 22 N·m (2.2 kg·m/16 lb·ft)



Legend

- Rocker Arm
- Bridge Cap
- Bridge

- With a thickness gauge kept inserted, tighten an adjusting screw of the bridge lightly and make sure that the tip of the adjusting screw touches the end of valve

stem and the movement of the thickness gauge has become tight.

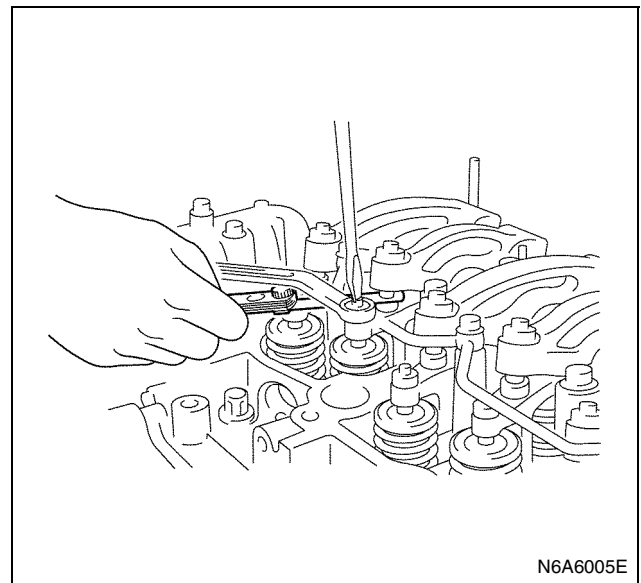
- Then, check if the end of the valve stem on the opposite side is unstable or hits diagonally. If so, loosen the bridge adjusting screw a little so that the end of the valves on both sides may touch properly.
Valve bridge clearance: ± 0.1 mm (0.0039 in) or less
- After making an adjustment so that the end of the valves on both sides may touch properly, tighten up an adjusting screw nut of the bridge with a minus driver so that the bridge adjusting screw may not rotate.

Tighten:

Adjusting screw nut to 22 N·m (2.2 kg·m/16 lb·ft)

Caution:

If the adjusting screw of the bridge is poorly adjusted, the bridge would tilt and be pushed down and seized, which may damage the bridge guide, for example. Thus, adjust it accurately.



Tighten:

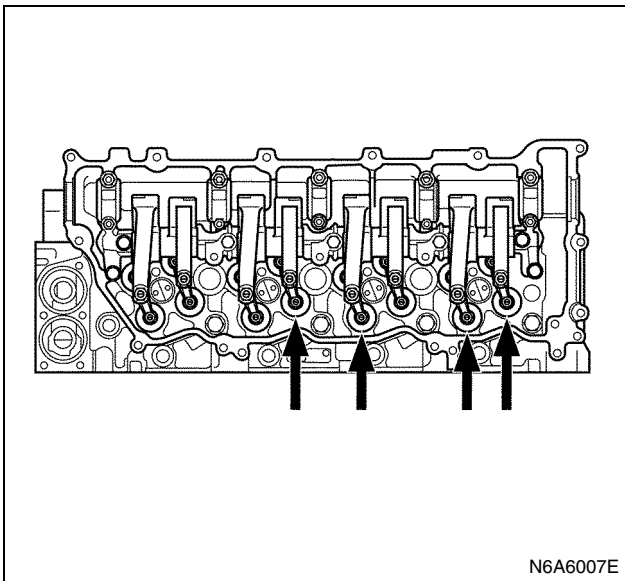
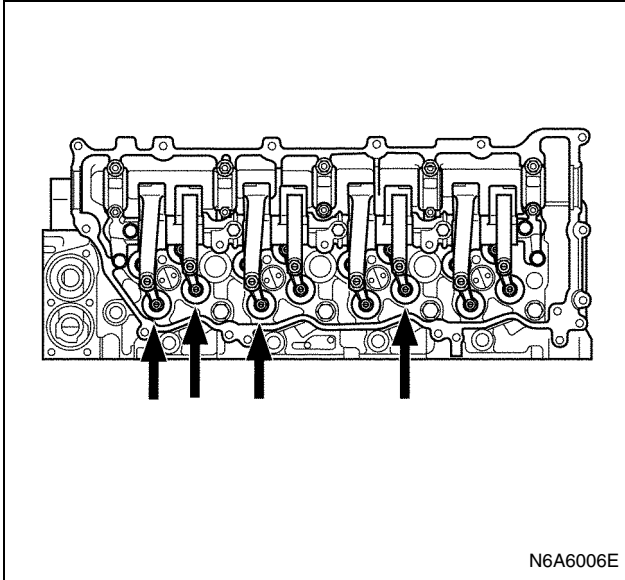
Rocker arm adjustment screw nut to 22 N·m (2.2 kg·m/16 lb·ft)

Bridge adjustment screw nut to 22 N·m (2.2 kg·m/16 lb·ft)

Adjustment table

Cylinder No.	1		2		3		4	
Valve arrangement	IN	EX	IN	EX	IN	EX	IN	EX
No. 1 cylinder Compression TDC	○	○	○			○		
No. 4 cylinder Compression TDC				×	×		×	×

- If the No. 1 cylinder is the compression TDC, adjust a valve clearance with ○ mark given on the table and if the No. 4 cylinder is the compression top dead center, that with × mark.



- Attach the harness assembly to the fuel injector.
Tighten the harness bracket with the designated torque.

Tighten:

Harness bracket to 48 N·m (4.9 kg·m/35 lb·ft)

- Attach the terminal nuts to the fuel injector.

Tighten:

Terminal nuts to 2 N·m (0.2 kg·m/17 lb·in)

Notice:

- Tighten the terminal nuts alternately in order to prevent imbalance in tightening because they are unified.
- Do not tighten the nuts too tightly because it leads to damage to the terminal studs.

- Install the cylinder head cover.
Refer to "Cylinder Head Cover."

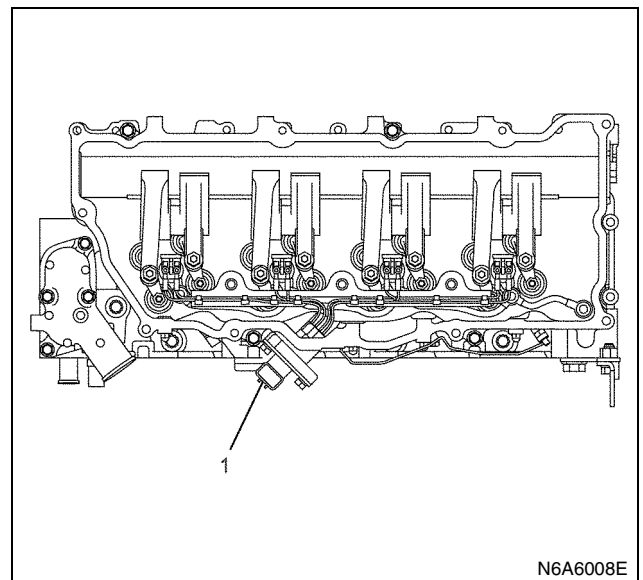
Compression pressure inspection

- Warm up the engine.
- Remove a minus terminal of the battery and remove all the glow plugs.
- Remove the harness connector for the fuel injector built on the lower head cover (no fuel will be injected).

Caution:

When the harness connector is removed, ECM judges that it broke down and DTC is recorded. Upon completion of measurement, never fail to clear memory of ECM.

(For how to clear memory of ECM, refer to Section 6E)



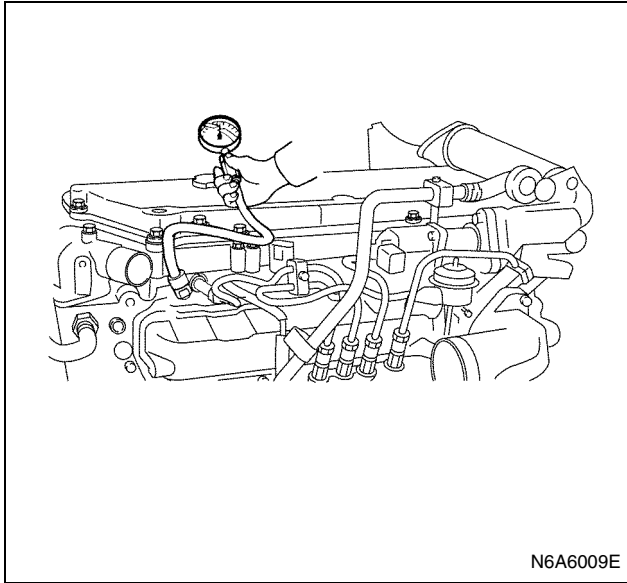
Legend

1. Fuel Injector Harness Connector

- Install the minus terminal of the battery.
- Turn on the starter to emit foreign matter within the cylinders.

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- Install an adapter and a gauge of a compression gauge of the special tool.



Compression gauge set: 5-8840-2008-0
(Compression gauge: J-26999-12,
Gauge adapter: EN-46722)

- Turn on the starter to inspect compression pressure.

Compression pressure	MPa (kg/cm ² / psi) / 220 rpm
Standard	2.60 – 2.89 (26.5 – 29.5 / 377 – 419)
Limit	1.96 (20.0 / 284)
Differences among the cylinders	294 kPa (3.0 kg/cm ² / 43 psi)

- Measure each cylinder one by one.

Caution:

To keep engine speed at 220 rpm or more, use fully charged batteries.

- Remove a compression gauge of the special tool.
- Remove a minus terminal of the batteries.
- Install a harness connector for the fuel injector built on the lower head cover.
- Install all the glow plugs.

Tighten:

Glow plugs to 20 N·m (2.0 kg·m/15 lb·ft)

- Install a minus terminal of the batteries.

A list of defective phenomena

- Engine does not turn over.
- Engine turns over but does not start.
- Excessive black exhaust smoke.
- Excessive white exhaust smoke.
- Engine knocking.
- Abnormal engine rotation.
- Abnormal battery charging.

Trouble Shooting**Engine does not turn over**

Condition	Possible Cause	Correction
Starter motor does not rotate	Dead or weak battery	Charge or Replace battery
	Incomplete circuit	Connect Repair
	Starter relay	Replace starter relay
	Starter motor brushes stuck, worn, or broken	Replace brushes
	Starter motor internal damage	Repair motor
Starter motor not meshed with flywheel	Ring gear abrasion	Replace ring gear
	Pinion gear abrasion	Replace pinion gear
	Magnetic switch (starter motor) not properly adjusted	Adjust
Starter motor pinion meshed with ring gear but does not rotate	Dead or weak battery	Charge battery Replace battery
	Insufficient contact pressure between starter motor brushes and commutator	Adjust pressure
	Armature (starter motor) stuck	Repair armature
	Engine internal damage (Seizure)	Repair engine

Engine turns over but does not start

Condition	Possible Cause	Correction
Fuel is not delivered to fuel supply pump	Air in fuel system	Bleed air from fuel system
	Air entering fuel pipe	Replace pipe and bleed air from fuel system
	Empty fuel tank	Replenish fuel
	Clogged strainer (fuel suction)	Clean or replace strainer
	Clogged fuel pipe	Clean or replace pipe
	Use of wrong fuel for prevailing temperatures	Drain existing fuel and replace with appropriate fuel
	Clogged fuel filter	Replace filter
Fuel is delivered to fuel supply pump	Loose injection pipe connections	Tighten connections
	Loose or broken electrical connectors	Tighten and/or replace connectors
	Bad rotational sensor	Replace sensor
	Engine control system malfunction	System diagnosis
Insufficient or unstable fuel delivery volume	Air in fuel system	Bleed air from fuel system
	Feed pump malfunction	Repair pump
	Loose or broken electrical connectors	Tighten and/or replace connectors
	Clogged fuel filter	Replace filter
	Engine control system malfunction	System diagnosis

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Excessive black exhaust smoke

Condition	Possible Cause	Correction
Bad injection timing	Engine control system malfunction	System diagnosis
Bad injection nozzle condition	Carbon deposit at nozzle tip	Clean nozzle tip
	Sticking nozzle	Replace fuel injector assembly
	Engine control system malfunction	System diagnosis
Insufficient compression pressure	Excessive valve clearance	Adjust clearance
	Sticking valve stem (valve open)	Repair or replace valve
	Damaged valve spring	Replace spring
	Valve seat abrasion	Repair valve seat
	Compression leakage due to damaged piston ring	Replace piston ring
	Damaged gasket	Replace gasket
	Piston scoring	Replace piston
Fuel condition	Water in fuel	Drain existing fuel and replace with new fuel
	Poor fuel quality	Drain existing fuel and replace with new fuel
Poor engine aspiration	Clogged intake pipes	Clean or replace pipes
	Clogged air cleaner element	Clean or replace element
Malfunction detected by engine control system	Defective sensor	Replace sensor
	Engine control system malfunction	System diagnosis
EGR valve and/or intake throttle valve malfunction	Intake throttle valve sticking	Repair or replace valve
	EGR valve sticking	Repair or replace valve
	Exhaust brake valve sticking	Repair or replace valve
	Engine control system malfunction	System diagnosis
Turbocharger malfunction	Damaged turbocharger fan	Replace turbocharger
	Rough turbocharger shaft rotation	Replace turbocharger
	Oil leakage from oil seal	Replace turbocharger
	Defective booster sensor	Replace sensor

Excessive white exhaust smoke

Condition	Possible Cause	Correction
Bad injection timing	Engine control system malfunction	System diagnosis
Malfunction detected by engine control system	Engine control system malfunction	System diagnosis
	Control unit malfunction	Replace unit
	Defective sensor	Replace sensor
Insufficient compression pressure	Excessive valve clearance	Adjust clearance
	Sticking valve stem (valve open)	Repair or replace valve
	Damaged valve spring	Replace spring
	Valve seat abrasion	Repair valve seat
	Compression leakage due to damaged piston ring	Replace piston ring
	Damaged gasket	Replace gasket
	Piston scoring	Replace piston

Condition	Possible Cause	Correction
Fuel condition	Water in fuel	Drain existing fuel and replace with new fuel
Excessive oil consumption	Worn or damaged piston ring(s)	Replace ring(s)
	Defective valve stem oil seal	Replace oil seal
	Defective turbocharger oil seal	Replace turbocharger
	Clogged turbocharger oil return pipe	Repair pipe

Engine knocking

Condition	Possible Cause	Correction
Bad timing	Engine control system malfunction	System diagnosis
Malfunction detected by engine control system	Defective sensor	Replace sensor
	Control unit malfunction	Replace unit
	Engine control system malfunction	System diagnosis
Fuel condition	Poor quality fuel	Drain existing fuel and replace with new fuel
Poor engine aspiration	Clogged intake pipes	Clean or replace pipes
	Engine control system malfunction	System diagnosis
Engine break-down	Foreign material in cylinders	Engine overhaul
	Scored pistons and/or bearings	Replace pistons and/or bearings

Abnormal engine rotation

Condition	Possible Cause	Correction
Engine speed cannot be increased	Engine control system malfunction	System diagnosis
	Defective control unit	Replace unit
Engine speed unstable	Defective control unit	Replace unit
	Engine control system malfunction	System diagnosis
	Clogged fuel filter element	Replace element
	Defective fuel injector nozzle(s)	Replace fuel injector assembly
	Water in fuel	Drain existing fuel and replace with new fuel
	Air in fuel system	Bleed air from fuel system
	Exhaust brake valve sticking	Repair or replace valve
Turbocharger malfunction	Damaged turbocharger fan	Replace turbocharger
	Rough turbocharger shaft rotation	Replace turbocharger
	Defective booster sensor	Replace sensor

Abnormal battery charging

Condition	Possible Cause	Correction
No charging	Open or shorted wiring and/or connectors	Repair or replace wiring and/or connectors
	Defective generator	Repair or replace generator
	Defective battery	Replace battery

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Condition	Possible Cause	Correction
Insufficient charging	Open or shorted wiring and/or connectors	Repair or replace wiring and/or connectors
	Defective generator	Repair or replace generator
	Loose generator drive belt	Adjust belt tension or replace belt
	Defective battery	Replace battery
Excessive charging	Shorted wiring	Repair or replace wiring
	Defective generator	Repair or replace generator
	Defective battery	Replace battery

Turbocharger Troubleshooting

Condition	Possible Cause	Correction
Engine has less than normal power	Air leakage from intake pipe rubber hose	Repair
	Air leakage from inlet cover	Repair
	Clogged intercooler cooling section	Clean
	Clogged air cleaner element	Clean or replace
	Exhaust brake valve stuck	Repair or replace
	Turbine and housing contact (Interference)	Replace
	Excessive carbon deposit near turbine exhaust port that interferes with turbine	Clean or repair
	Rough turbine shaft rotation	Repair or replace
	Damaged turbine fan	Repair or replace
Blue exhaust smoke	Oil leakage from turbocharger oil seal	Repair or replace
	Clogged turbocharger oil return pipe	Repair
	Clogged center housing oil passages	Repair or replace
	Engine oil deterioration	Change engine oil
Noisy turbocharger operation	Gas leakage from intake or exhaust system	Repair
	Turbine and housing contact (Interference)	Repair or replace
	Damaged turbine fan	Replace
	Turbine shaft bearing abrasion or scoring	Repair or replace
Excessive rotating part wear	Engine oil deterioration	Change engine oil
	Clogged turbocharger oil feed pipe	Repair
	Low engine oil pressure	Repair

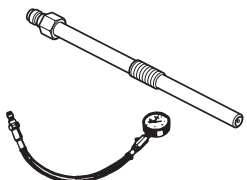
Main Data and Specifications

Item		Engine model 4HK1-TCS	Engine model 4HK1-TCN
Type		Diesel/4-cycle/water cooling type in-line OHC	Diesel/4-cycle/water cooling type in-line OHC
Combustion chamber type		Direct injection type	Direct injection type
Cylinder liner type		Dry type	Dry type
Number of cylinders -cylinder bore × strokes	mm (in)	4-115 (4.53) × 125 (4.92)	4-115 (4.53) × 125 (4.92)
Displacement	cc (cu.in)	5193(317)	5193(317)
Compression ratio		17.5	17.5
Compression pressure	MPa (kg/cm ² /psi)/rpm	2.60 – 2.89 (26.5 – 29.5/377 – 419)/220	2.60 – 2.89 (26.5 – 29.5/377 – 419)/220
Idling speed	rpm	650	650
Valve clearance mm (in)	Intake	0.4 (0.016) (cold)	0.4 (0.016) (cold)
	Exhaust	0.4 (0.016) (cold)	0.4 (0.016) (cold)
Ignition type		Compressed ignition	Compressed ignition
Injection order		1 - 3 - 4 - 2	1 - 3 - 4 - 2
Lubricating system			
Lubricating type		Pressure type	Pressure type
Oil pump type		Gear type	Gear type
Volume of lubricating oil	Liters (US/Imp gal.)	13.0 (3.43/2.86)	13.0 (3.43/2.86)
Oil filter type		Full flow filter (cartridge type)	Full flow filter (cartridge type)
Oil cooling type		Built-in-type, water cooling	Built-in-type, water cooling
Cooling system			
Cooling type		Water cooling type	Water cooling type
Radiator type		Corrugated fin(pressure type)	Corrugated fin(pressure type)
Water pump type		Centrifugal, belt type	Centrifugal, belt type
Thermostat type		2 wax-type units	2 wax-type units
Thermostat valve-opening temperature	°C (°F)	82 (180), 85 (185)	82 (180), 85 (185)
Volume of coolant	Liters (US/Imp gal.)	17.6 (4.65/3.87) (incl. radiator)	17.6 (4.65/3.87) (incl. radiator)
Fuel system			
Injection pump type		Electronic control common rail type	Electronic control common rail type
Governor type		Electronic type	Electronic type
Timer type		Electronic type	Electronic type
Injection nozzle type		Multi-hole type 7-holes φ0.14 mm (0.0055 in) inside diameter	Multi-hole type 7-holes φ0.14 mm (0.0055 in) inside diameter

6A-14 Engine Mechanical (4HK1-TC)

Item	Engine model 4HK1-TCS	Engine model 4HK1-TCN
Charging system		
Generator type	AC type	AC type
Power output V-A	24 - 80, 24 - 60, 24 - 50	24 - 80, 24 - 60, 24 - 50
Regulator type	IC	IC
Starting system		
Starter type	Reduction type	Reduction type
Power output V-kw	24 - 4.5	24 - 4.5
Preheat system type	Glow plug	Glow plug
Glow plug standard voltage/ electric current V	24	24

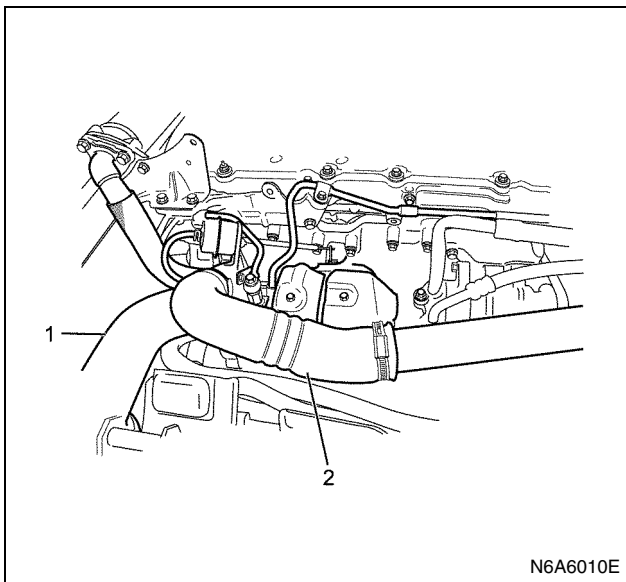
Special Tool

Illustration	Tool Number / Description / Remarks
 5884020080	5-8840-2008-0 Compression Gauge Set (J-26999-12 / Compression Gauge, EN-46722 / Gauge Adapter)

Engine Assembly

Removal

1. Remove a minus (-) terminal of the battery.
2. Drain the coolant.
3. Remove the starter motor.
 - Disconnect the front frame harness connector in the vicinity of the control box of the transmission and remove each clip that fixes the harness.
 - Remove 2 bolts that fasten the starter and remove the starter from the clutch housing.
 - Fix the starter motor with wire, for instance, in a place that does not get in the way in removing the transmission.
4. Remove the transmission assembly.
Refer to "Transmission Assembly"
5. Remove the charge air hose (between turbocharger and inlet pipe).

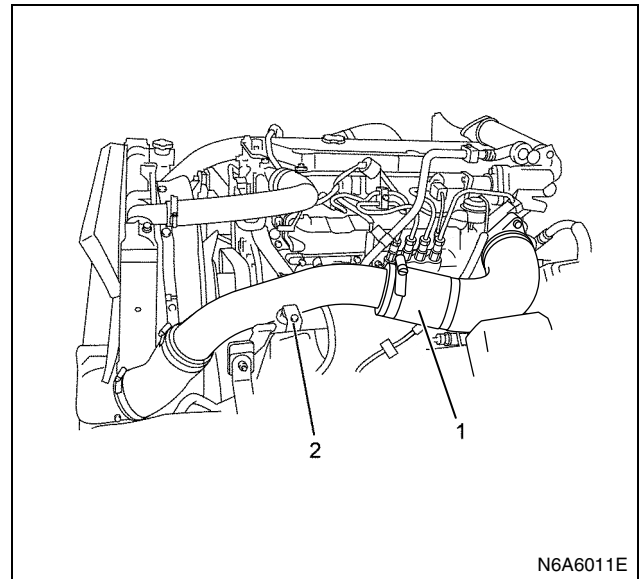


Legend

1. Duct
2. Charge Air Hose

6. Remove the inlet hose (between air cleaner and turbocharger).
7. Remove the charge air hose (between intercooler and inlet duct).

- Remove the connector of the boost pressure sensor.



Legend

1. Charge Air Hose
2. Boost Pressure Sensor

8. Remove the upper hose of the radiator.
 - Remove the band clip and VSV vacuum hose.



9. Remove a bracket of the fan guide.
10. Remove the fan assembly.
 - Remove the nuts and pull them out upward.
11. Remove the heater hoses.

6A-16 Engine Mechanical (4HK1-TC)

- Remove 2 hoses on the engine side.

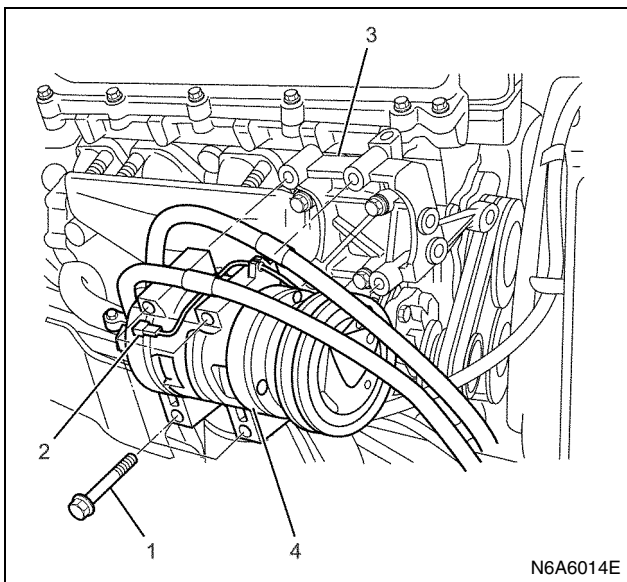


12. Remove the engine harness.

- Remove the ECM.
- Disconnect the two main harness connectors from the ECM (For SLD equipped, disconnect the unsealed connector.)
- Remove the engine ground cable.

13. Remove the A/C compressor.

- Remove the drive belt.
- Remove the connector.
- Remove the A/C compressor and fix it with wire, for example, to an appropriate place along with hoses and others.



Legend

1. Fixing Bolt
2. Connector
3. Bracket
4. A/C Compressor

14. Remove the AC generator harness.

- Remove the terminal B cable and harness connector from the generator.

15. Remove the vacuum hose on the vacuum pump side.

16. Remove a bracket by the blow-by separator and remove the harness connector and HBB oil hose bracket.

17. Remove the blow-by separator hose.

18. To prevent oil from flowing out when the hydraulic booster brake hose is removed, remove the fastening bolts for the hydraulic booster brake tank to lower the tank.

19. Remove one side of the hydraulic booster brake hose on the high-pressure side.

20. To prevent oil from flowing out when the power steering oil hose is removed, remove the fastening bolts for the power steering reserve tank to lower the tank.

21. Remove the power steering oil hose.

22. Remove the lower hose of the radiator on the engine side.

23. Hang wire on the engine hanger and hoist to lift up the engine slightly.

24. Remove the front exhaust pipe.

- Remove the front exhaust pipe from the turbo and exhaust brake.

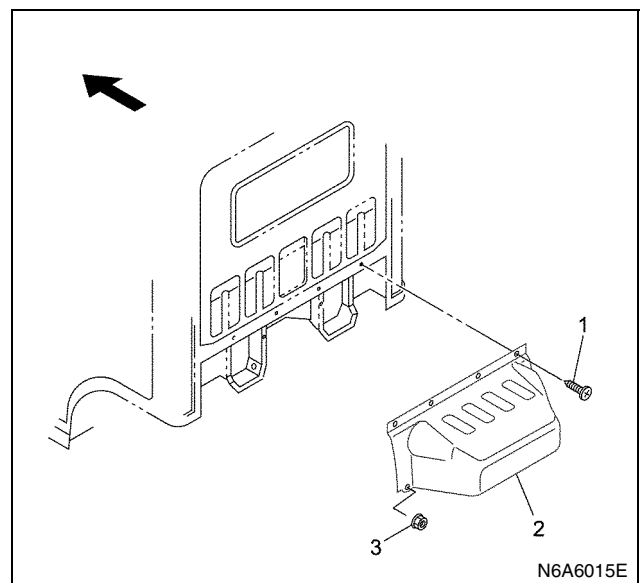
25. Remove the fuel hose on the feed and return sides.

26. Remove the engine mount.

- Remove the fastening bolts for the engine mount on the chassis frame side.

27. Remove the engine assembly.

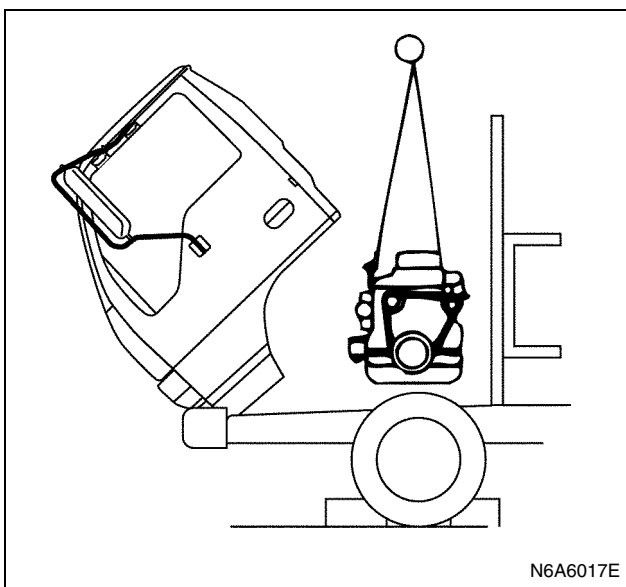
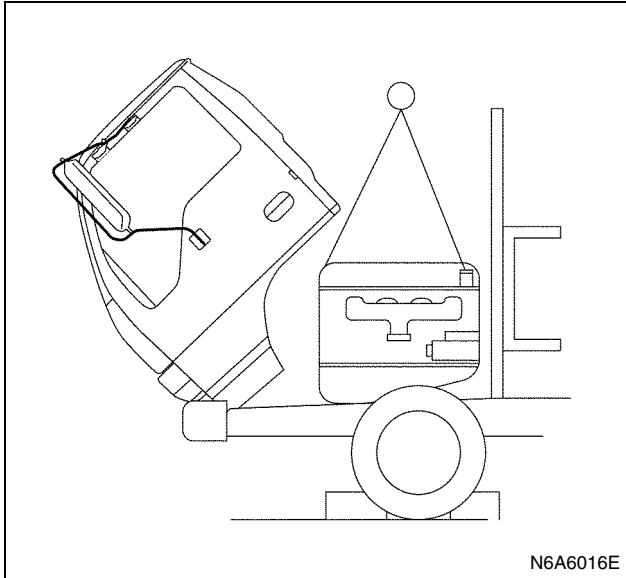
- Remove the cab back cover.



Legend

1. Screw
2. Cab Back Cover
3. Nut

- Operate a hoist slowly and hoist the engine until it comes up to the surface of the chassis frame.
- Turn the engine at an angle of 90 degrees to move from the surface of the chassis frame and remove the engine assembly.



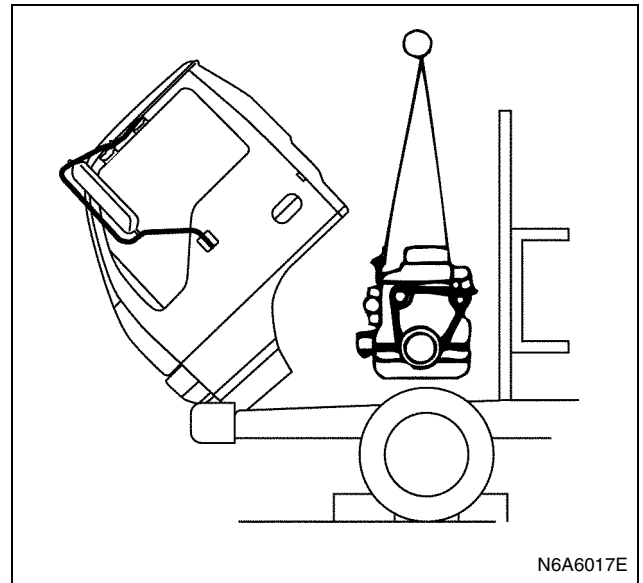
Installation

Notice:

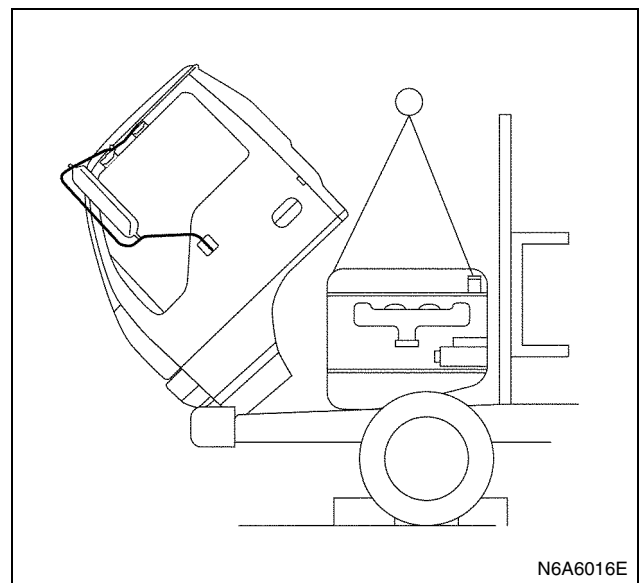
Be absolutely sure that each harness is reconnected to its original position.

1. Install the engine assembly.
 - Hang wire on the engine hanger and hoist to lift up the engine.

- Operate a hoist slowly to move the engine to the place where it is to be installed.



- Turn the engine at an angle of 90 degrees to lower the engine slowly to the place it is to be installed.



- Make the transmission side lower and operate a hoist slowly, pulling it backward to the engine.
2. Install the engine mount.
 - Install the engine mount to fit into the holes of the engine mounting cross member and tighten it up with the specified torque.

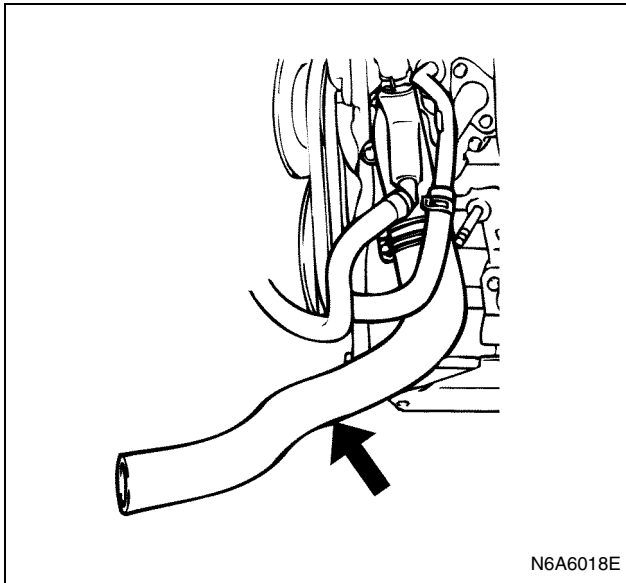
Tighten:

Cross member to 48 N·m (4.9 kg·m/35 lb·ft)

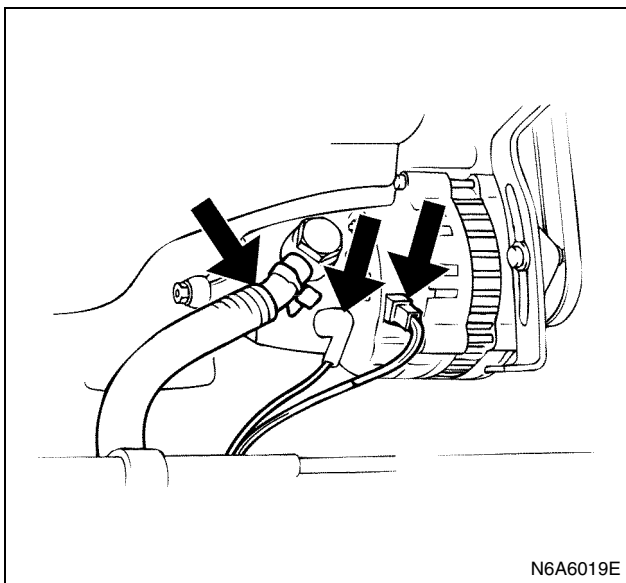
3. Install the feed and return sides of the fuel hose.
4. Install the front exhaust pipe.

6A-18 Engine Mechanical (4HK1-TC)

5. Install the lower hose of the radiator.

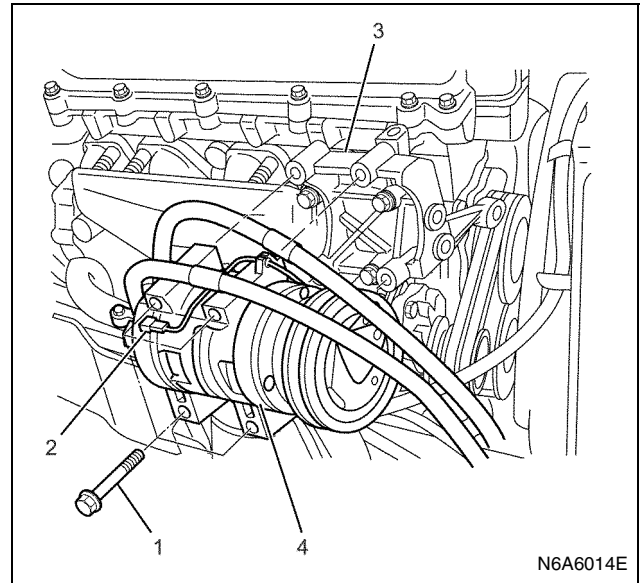


6. Install the power steering oil hose.
7. Install the power steering reserve tank.
8. Install the hydraulic booster brake hose on the high-pressure side.
9. Install the hydraulic booster brake tank.
10. Install the blow-by separator hose.
11. Install a bracket by the blow-by separator and install the harness connector and HBB oil hose bracket.
12. Install a vacuum hose to the vacuum pump.



13. Install the AC generator harness.
 - Install the terminal B cable and the harness connector to the generator.
14. Install the A/C compressor.

- Install the connector.

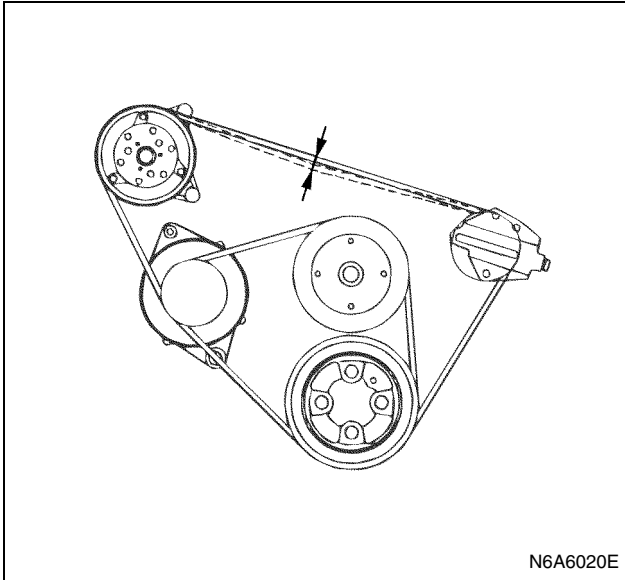


Legend

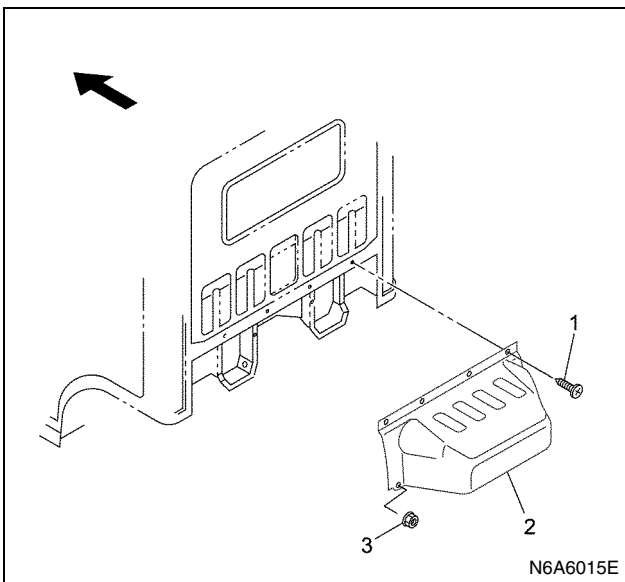
1. Fixing Bolt
2. Connector
3. Bracket
4. A/C Compressor

- Install the drive belt.
- Hang the drive belt to adjust its tension with an adjusting bolt of the tension pulley.
- For further details for adjusting tension of the belt, refer to "Drive Belt" in Section 6B.
- Check if a flexure is within the specified range when the center part is pressed by the hand with 98 N (22 lb) by using a scale, for instance. In addition, check if it is not damaged as well.
- Flexure of the A/C compressor belt.
 - 16 – 20 mm (0.62 – 0.79 in) (when the belt is new)
 - 18 – 22 mm (0.71 – 0.87 in) (when the belt is reused)

- After adjusting tension of the belt, tighten up the lock nut of the tension pulley.



15. Install the cab back cover.



Legend

1. Screw
2. Cab Back Cover
3. Nut

16. Install the engine harness.
17. Install the heater hoses.

- Install 2 hoses.



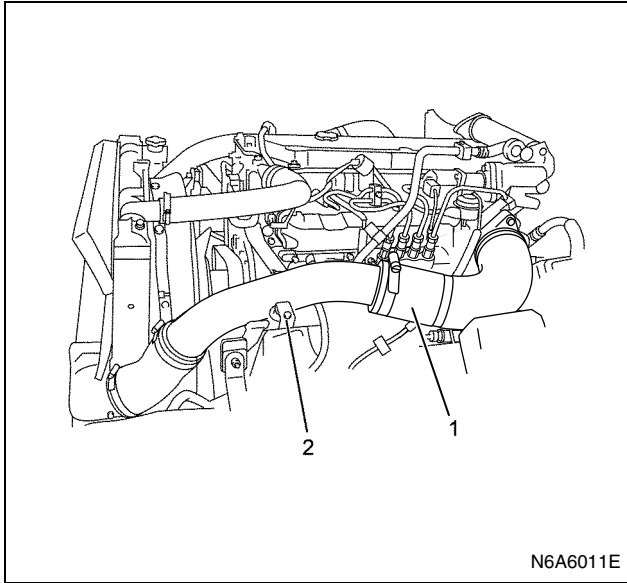
18. Install the fan assembly.
19. Install a bracket for the fan guide.
20. Install an upper hose of the radiator.
 - Install the VSV vacuum hose and bundle it and upper hose with a band clip.



21. Install the charge air hose (between intercooler and inlet duct).

6A-20 Engine Mechanical (4HK1-TC)

- Install the connector of the boost pressure sensor.



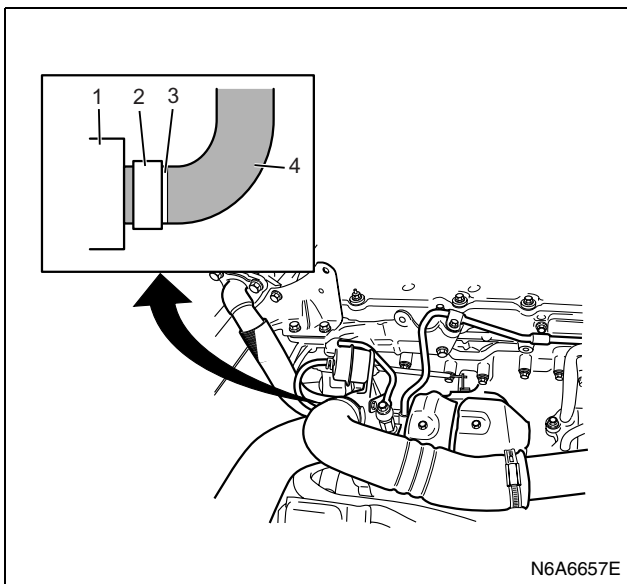
Legend

1. Charge Air Hose
2. Boost Pressure Sensor

22. Install the inlet hose (between air cleaner and turbocharger).

- Hose is inserted until bumping to turbocharger.
- Clip assembled along the white line on hose.

Clip Tightening torque: 6.3 N·m (56 lb ft)



Legend

1. Turbocharger
2. Clip
3. White Line
4. Hose

23. Install the charge air hose (between turbocharger and intercooler).

24. Install the transmission assembly.

Refer to "Transmission Assembly".

25. Install the starter motor.

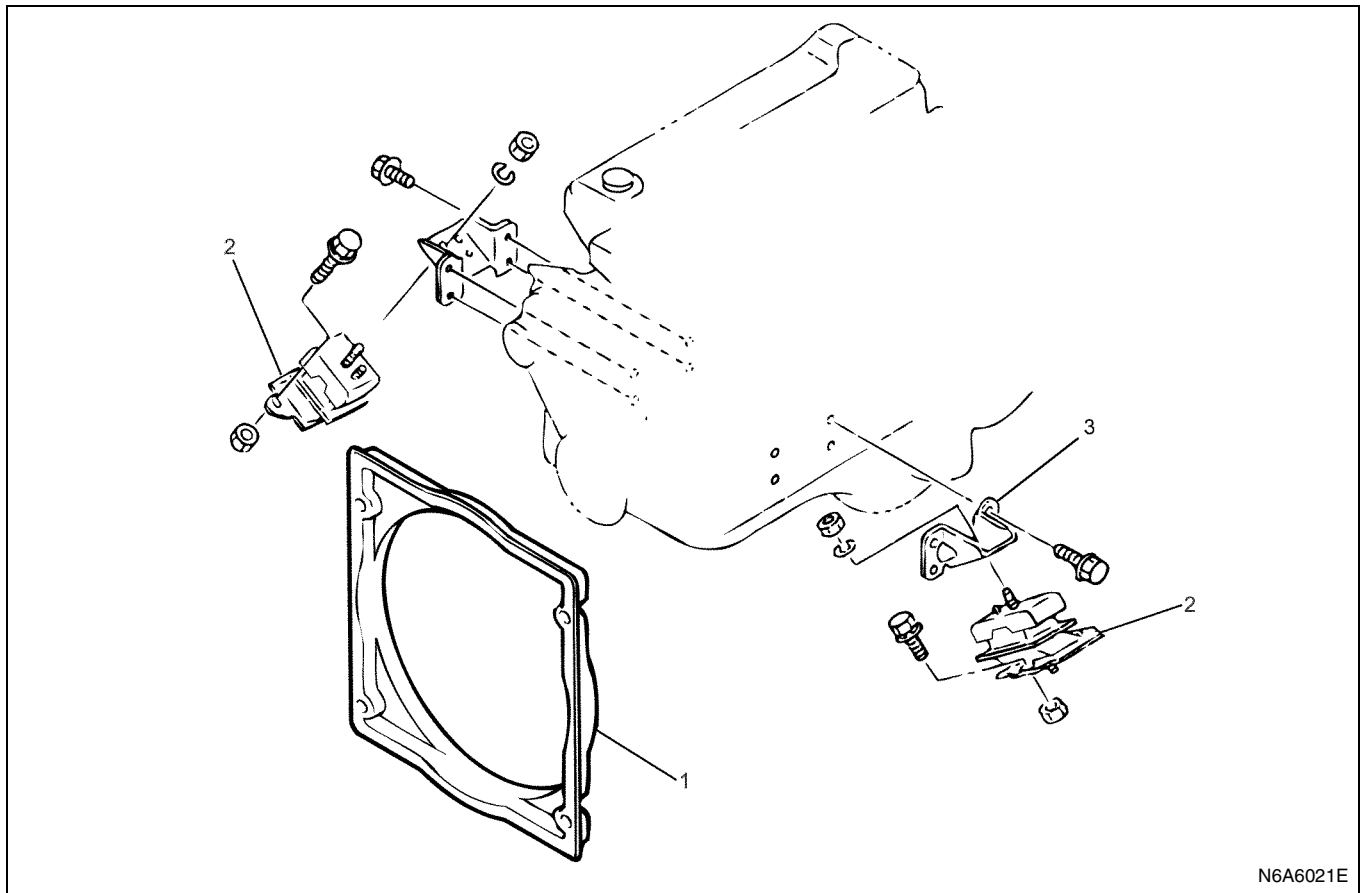
- Install 2 up and down bolts to fasten the starter.
- Connect the front frame harness connector and install each clip which fixes the harness.

26. Replenish the coolant.

27. Install a minus (–) terminal of the battery.

Engine Mount

Component



Legend

- 1. Fan Guide
- 2. Engine Mount

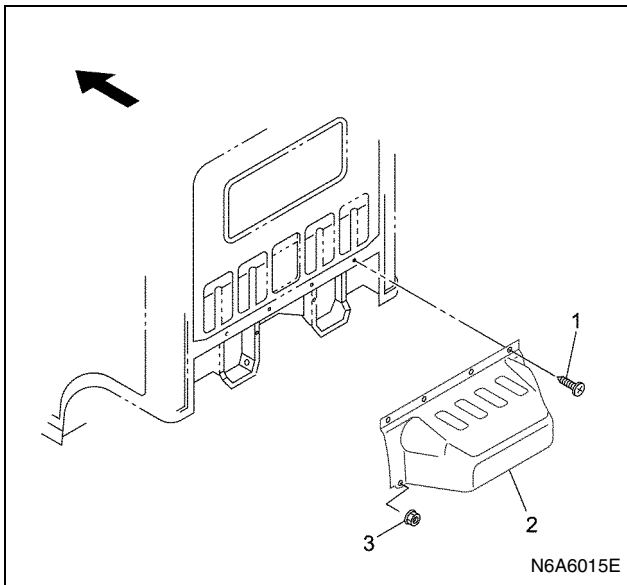
- 3. Engine Foot

Removal

- 1. Remove the fan guide bracket.
- 2. Remove the engine mount.

6A-22 Engine Mechanical (4HK1-TC)

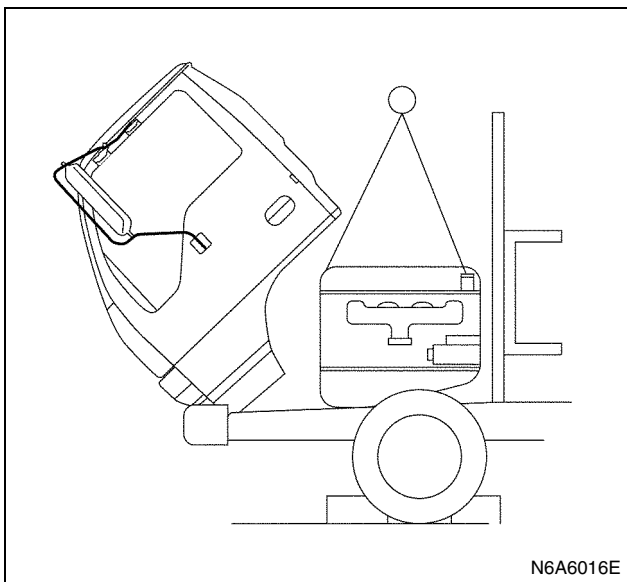
- Remove the cab back cover.



Legend

1. Screw
2. Cab Back Cover
3. Nut

- Before removing the engine mount, hang the engine with a hoist.
- Remove the nuts fastened to the engine foot and engine mount.
- Remove the bolts fastened to the engine mount on the chassis frame side.
- Hoist the engine assembly slightly to remove the engine mount.



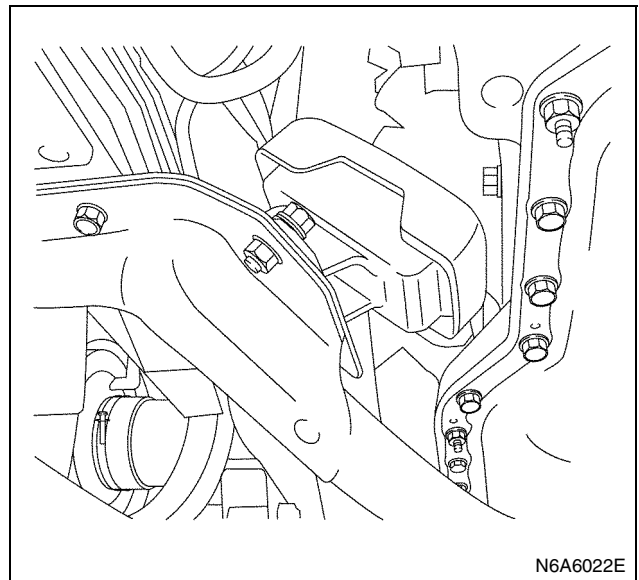
Installation

1. Install the engine mount and tighten up with the specified torque.

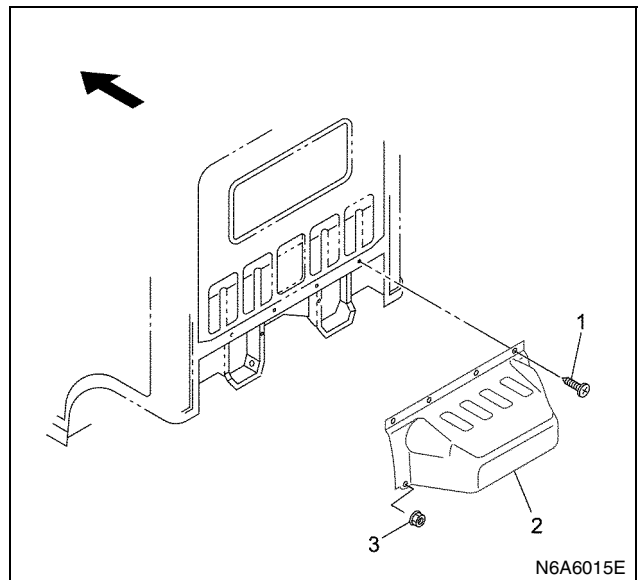
Tighten:

The nuts on the chassis frame side to 82 N·m (8.4kg·m/ 61 lb·ft)

The bolts on the engine foot side to 51 N·m (5.2kg·m/38 lb·ft)



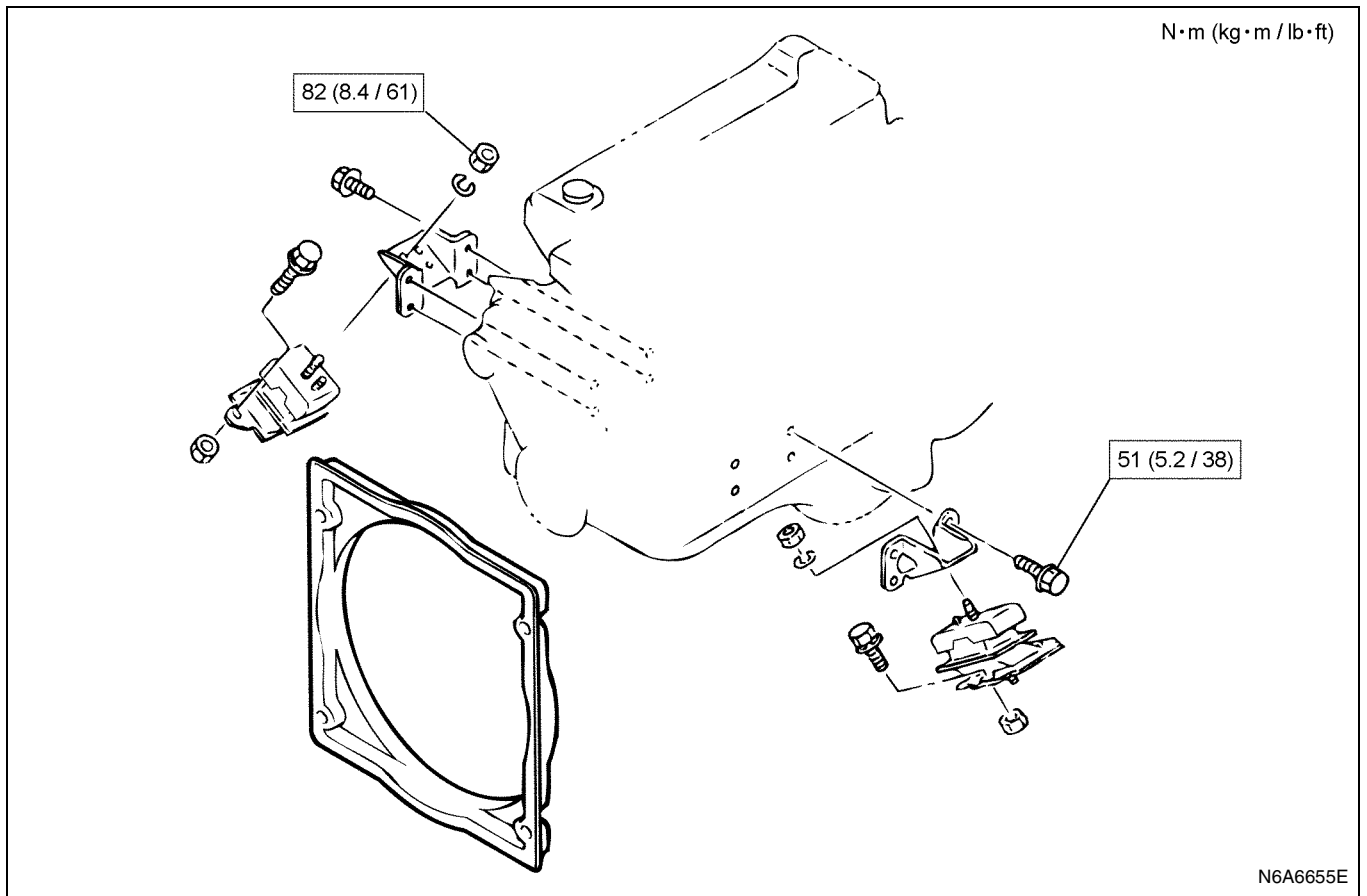
2. Install the fan guide bracket.
 - Check if nothing is wrong with the engine mount by starting the engine.
3. Install the cab back cover.



Legend

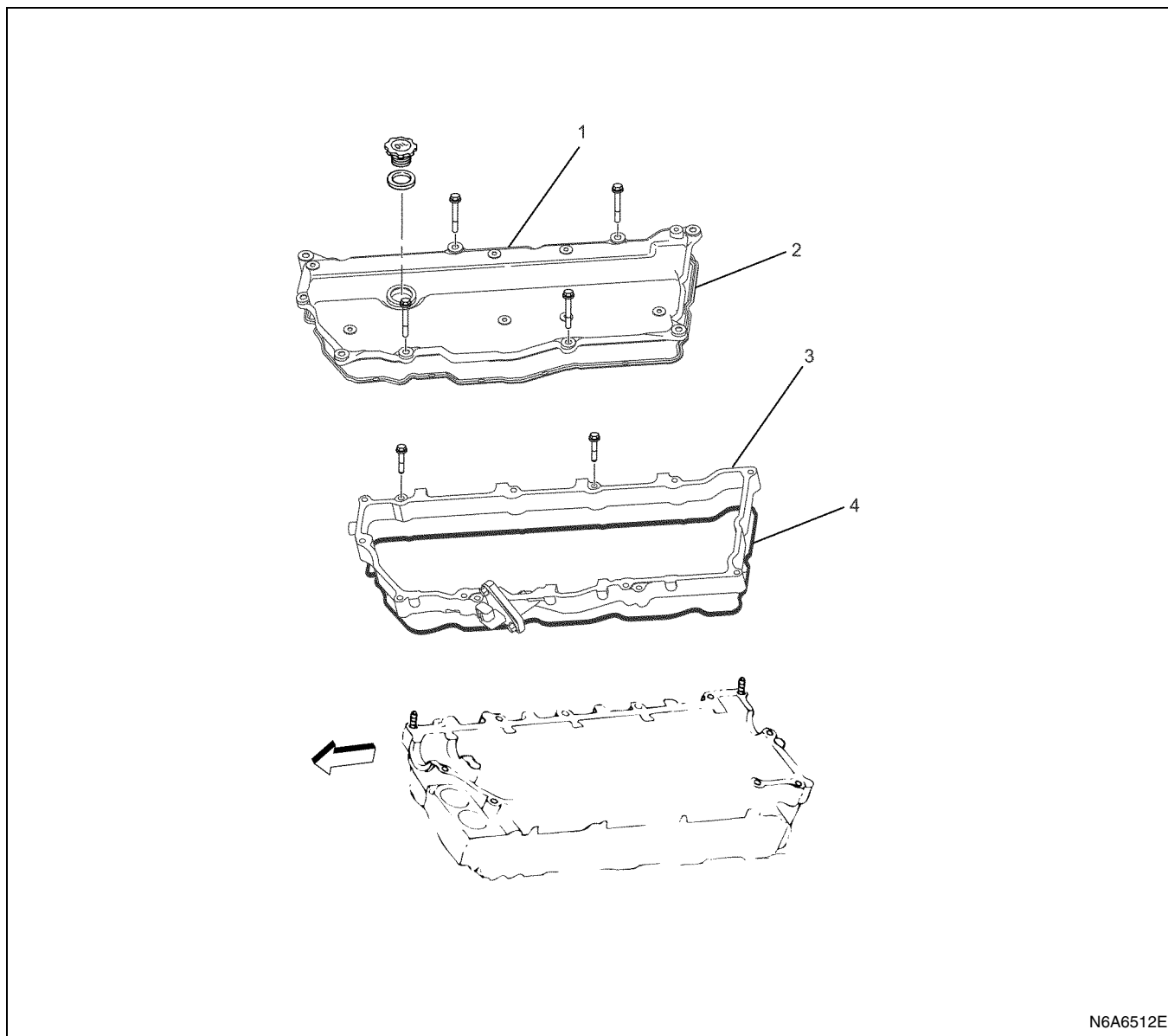
1. Screw
2. Cab Back Cover
3. Nut

Torque Specifications



Cylinder Head Cover (Except Europe)

Component



N6A6512E

Legend

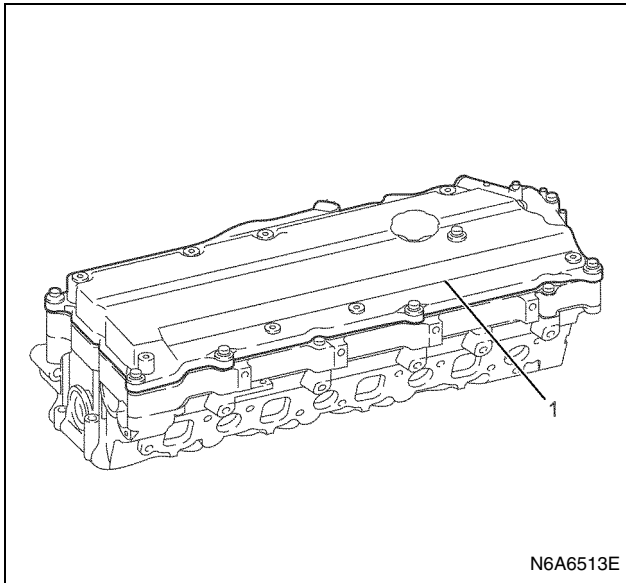
- 1. Head Cover
- 2. Gasket

- 3. Head Cover Case
- 4. Gasket

Removal

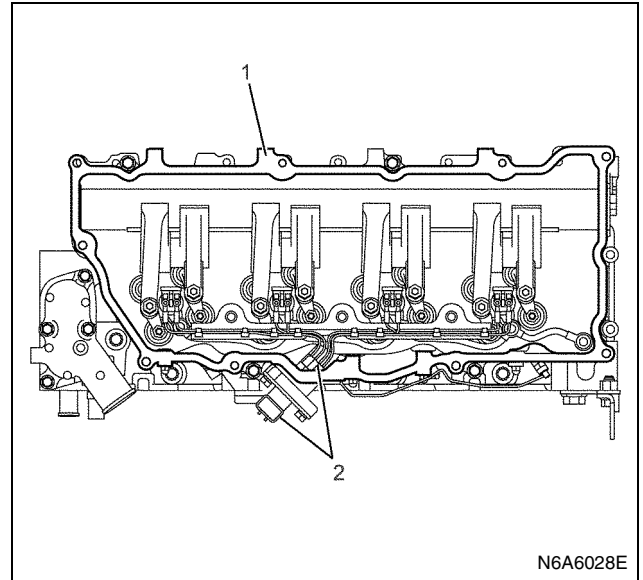
1. Remove the head cover.

2. Remove the gasket.



Legend

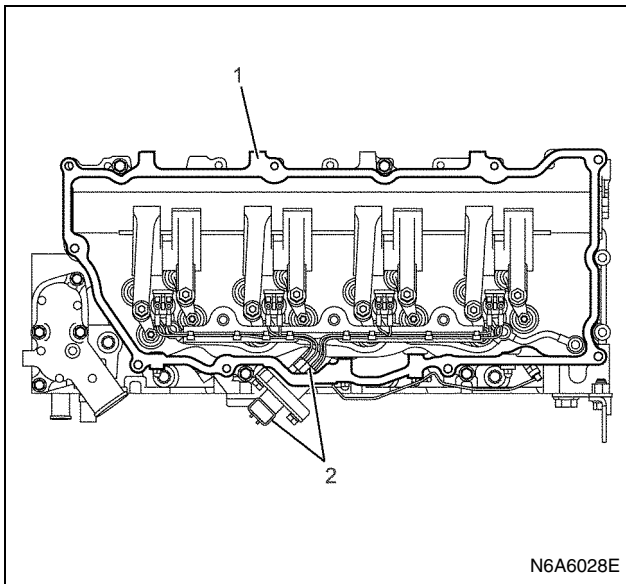
1. Head Cover



Legend

1. Head Cover Case
2. Fuel Injector Harness Connector

3. Remove the fuel injector harness connector.
4. Remove the head cover case.
5. Remove the gasket.



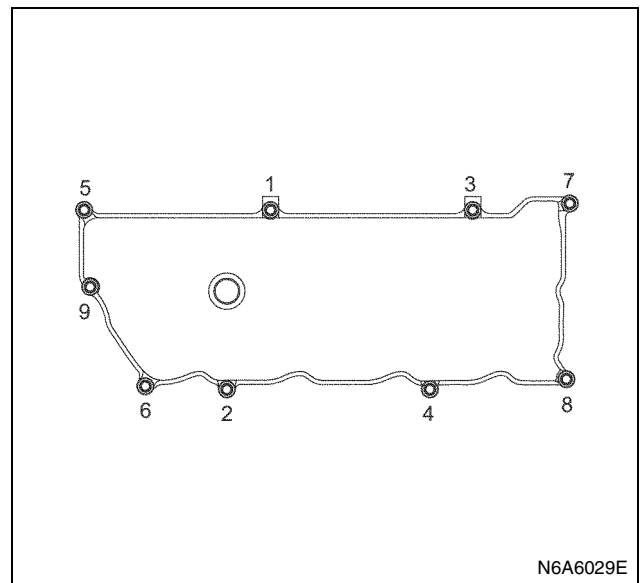
Legend

1. Head Cover Case
2. Fuel Injector Harness Connector

4. Install the gasket on the head cover.
5. Install the head cover and tighten up according to the orders given on the figure.

Tighten:

Bolts to 18 N·m (1.8 kg·m/13 lb·ft)



Installation

1. Install the gasket on the lower cover.
2. Install the head cover case.

Tighten:

Bolts to 18 N·m (1.8 kg·m/13 lb·ft)

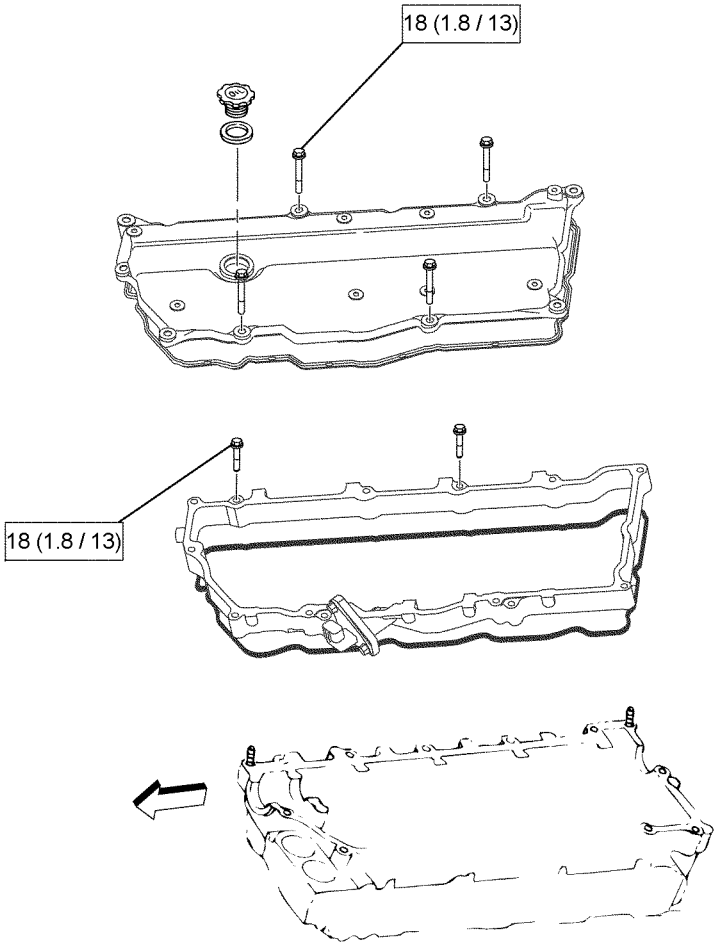
3. Install the fuel injector harness connector.

Caution:

Push it in thoroughly until the claws of the lock raise.

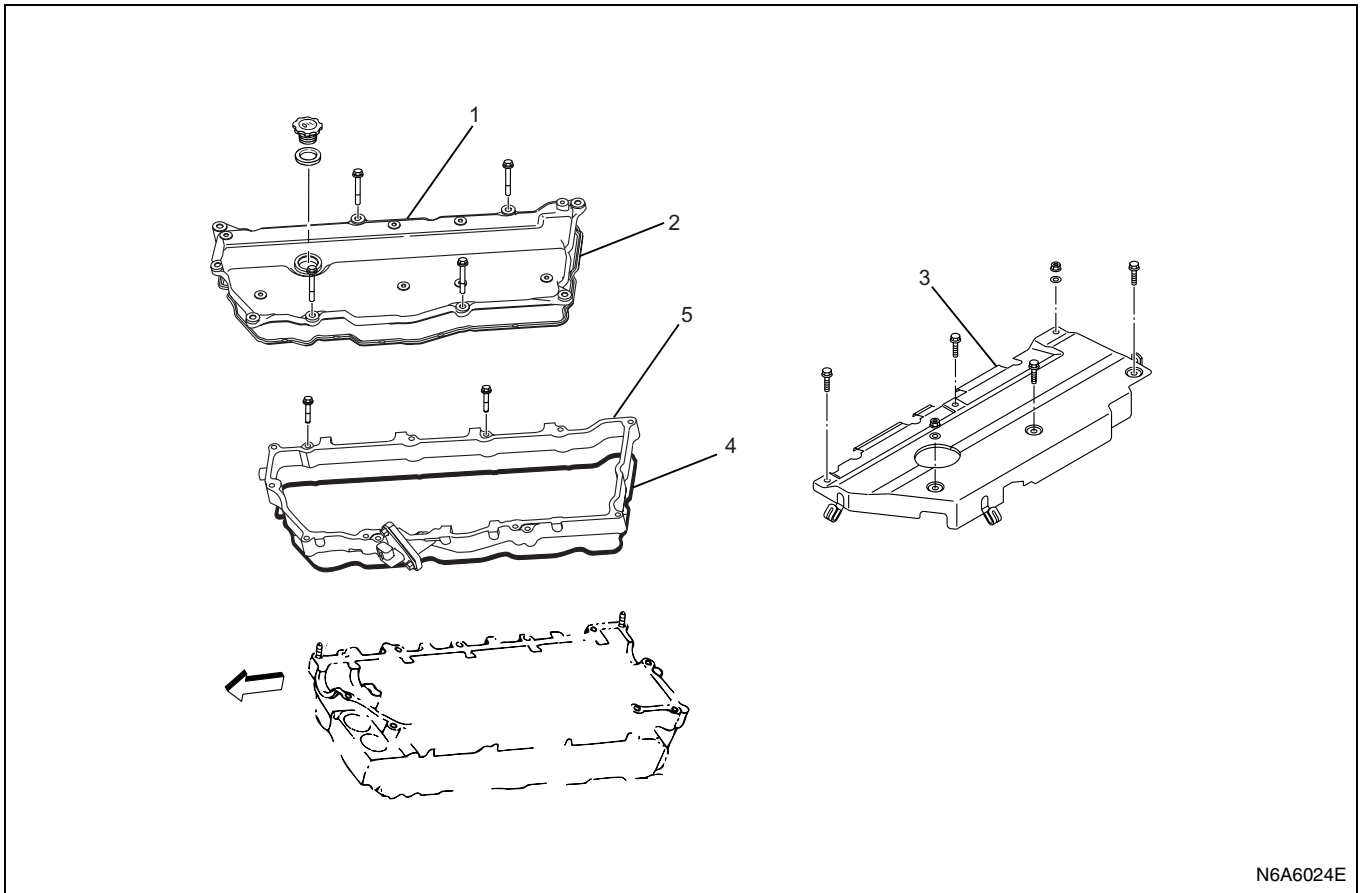
Torque Specifications

N·m (kg·m / lb·ft)



Cylinder Head Cover (For Europe)

Components



Legend

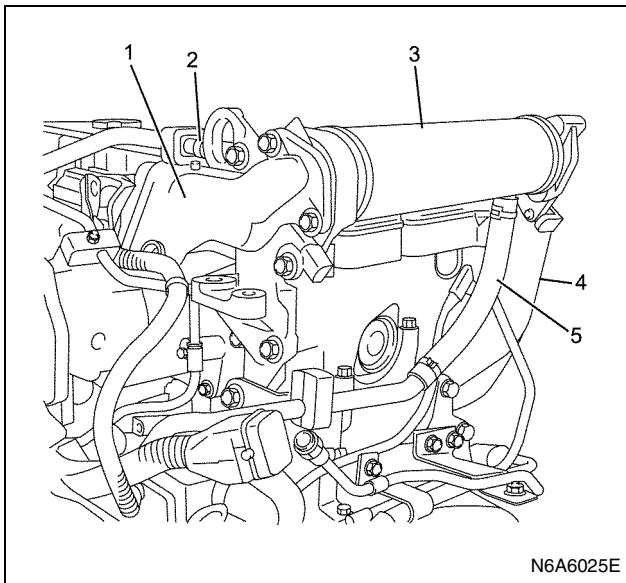
- | | |
|---------------------------|---------------------|
| 1. Head Cover | 4. Gasket |
| 2. Gasket | 5. Head Lower Cover |
| 3. Sound Insulation Cover | |

Removal

1. Drain engine coolant. Refer to Engine Cooling System section.
2. Remove EGR valve connector.

6A-28 Engine Mechanical (4HK1-TC)

3. Remove the EGR pipe.



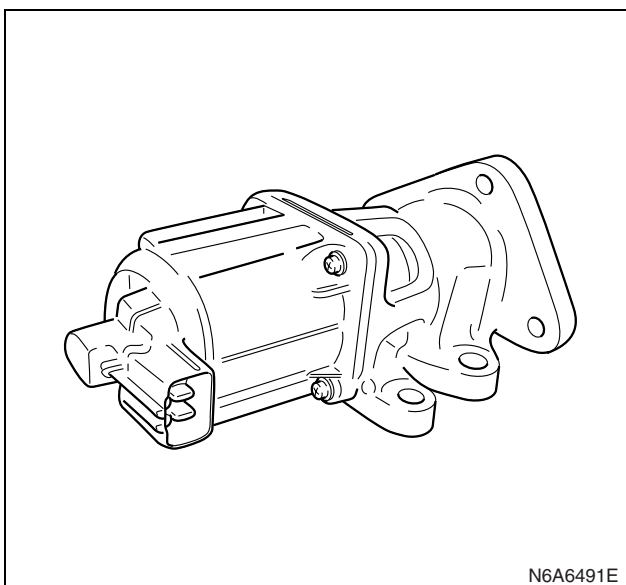
Legend

1. EGR Adapter
2. Water Return Pipe
3. EGR Cooler
4. EGR Pipe
5. Water Feed Pipe

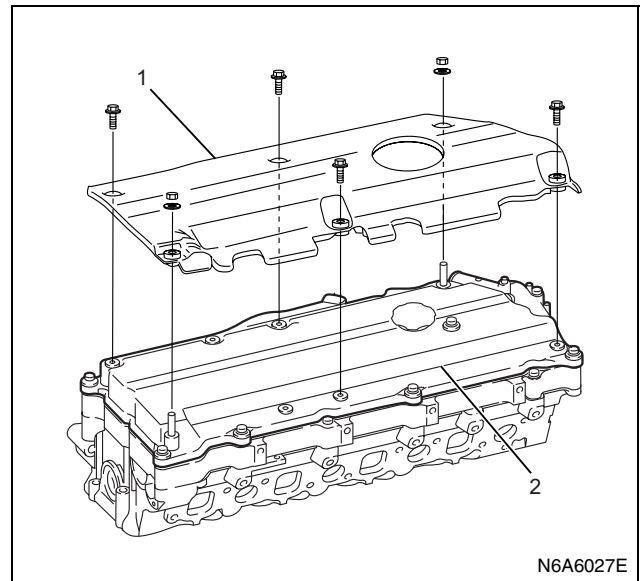
4. Remove the cooling water pipes.
5. Remove the EGR adapter.
6. Remove the EGR cooler.
7. Remove the EGR valve.

Caution:

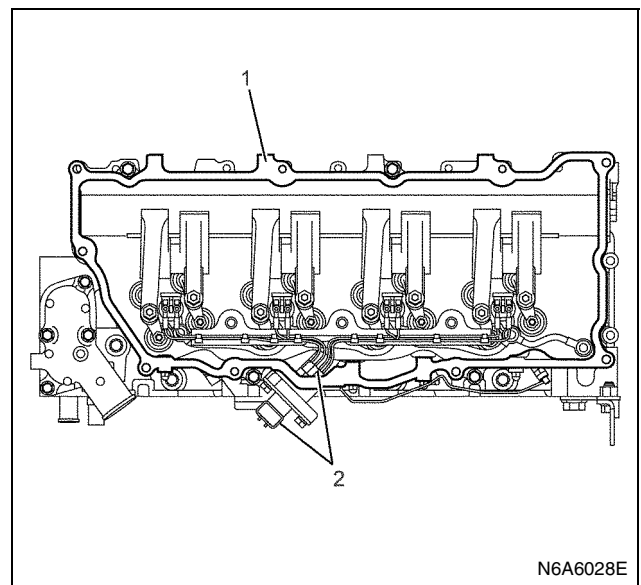
After removing the EGR valve and EGR adapter, seal the opening so that foreign matter does not enter.



8. Remove the sound insulation cover (1).
9. Remove the head cover (2)
10. Remove the gasket.



11. Remove the fuel injector harness connector (2).
12. Remove the head lower cover (1).
13. Remove the gasket.



Installation

1. Install the gasket on the head lower cover (1).
2. Install the head lower cover (1).

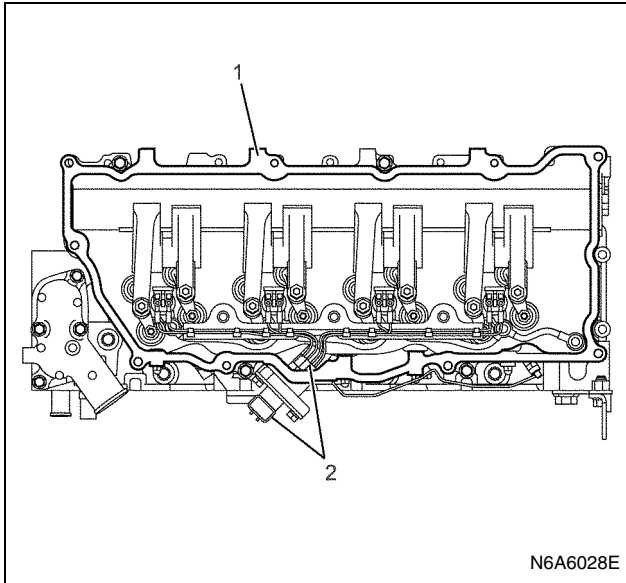
Tighten:

Bolts to 18 N·m (1.8 kg·m/13 lb·ft)

3. Install the fuel injector harness connector (2).

Caution:

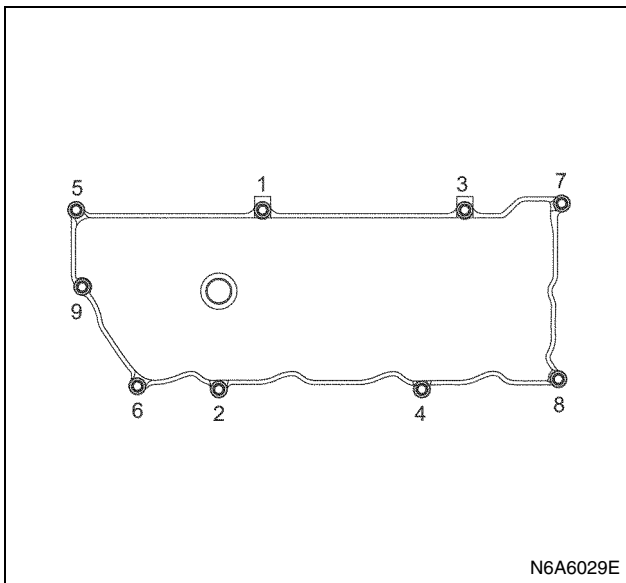
Push it in thoroughly until the claws of the lock raise.



4. Install the gasket on the head cover.
5. Install the head cover and tighten up according to the orders given on the figure.

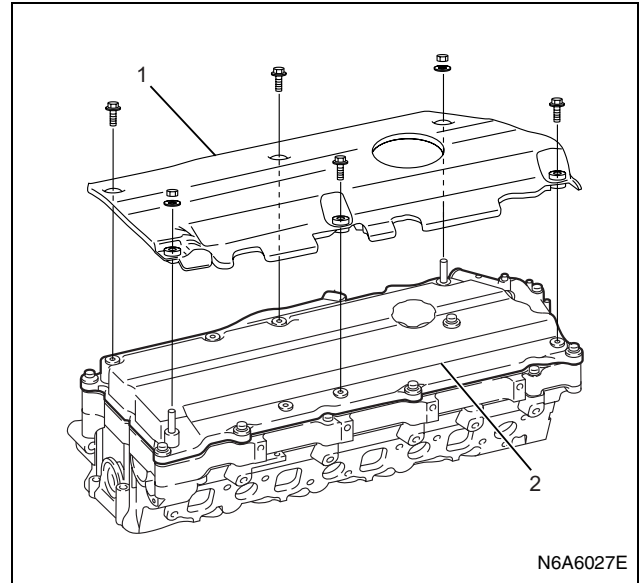
Tighten:

Bolts to 18 N·m (1.8 kg·m/13 lb·ft)



6. Install the sound insulation cover.

Tightening torque: 8 N·m (0.8 kg·m/6 lb·ft)



Legend

1. Sound Insulation Cover
2. Head Cover

7. Mount the EGR valve.

- Insert the gasket and temporarily fit the EGR valve.

Notice:

Temporarily tighten the bolts.

8. Install the EGR cooler.

- Temporarily fit the EGR cooler to the bracket.

Notice:

Temporarily tighten the bolts.

9. Install the EGR adapter.

- Temporarily fit the EGR adapter between the EGR cooler and exhaust manifold.

Notice:

Temporarily tighten the bolts.

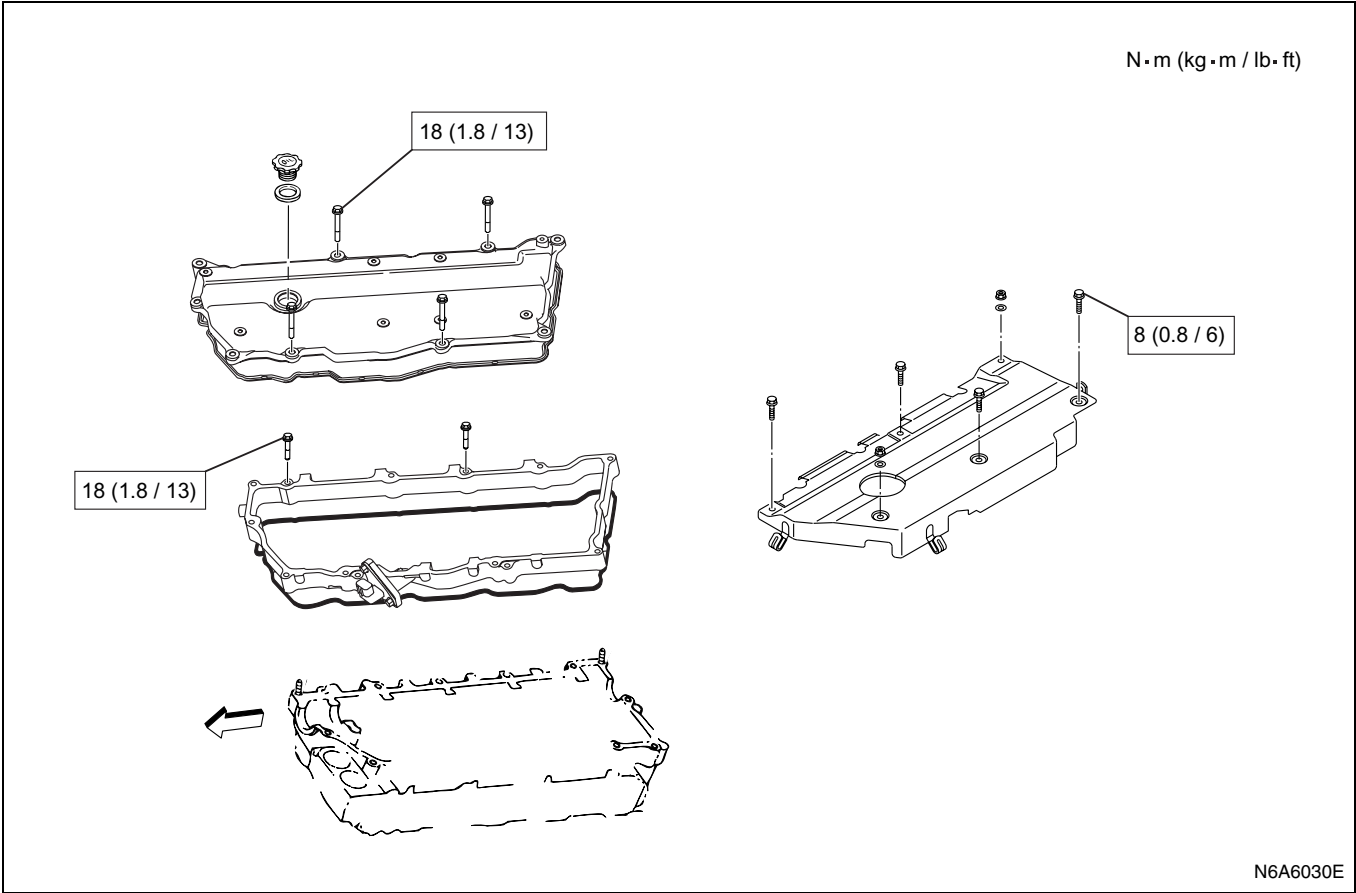
10. Install the EGR pipe.

- Insert the gasket between the two ends of the EGR pipe and temporarily fit it.

Notice:

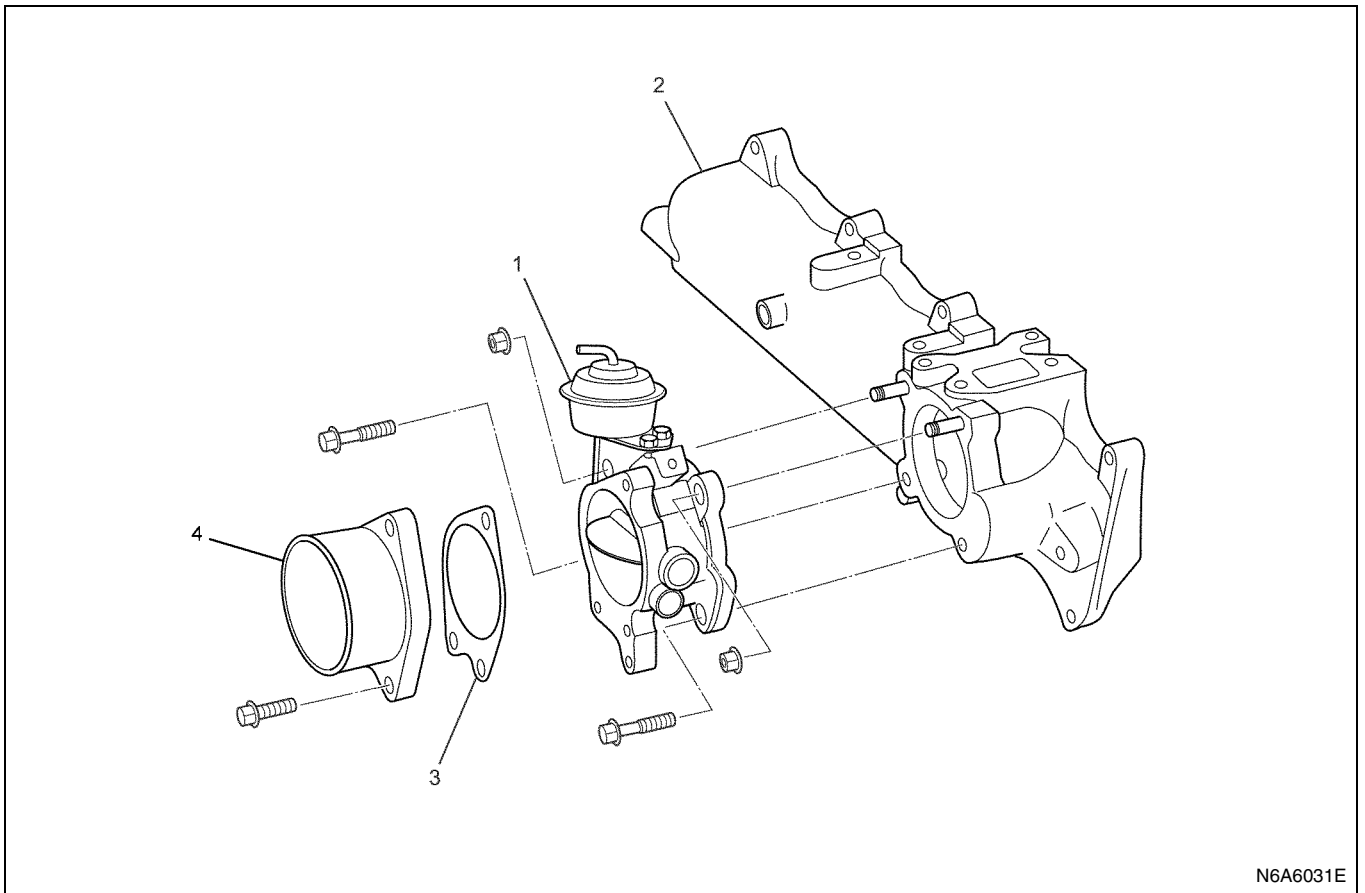
Temporarily tighten the bolts.

Tightening Torque Specifications



Inlet Cover

Component



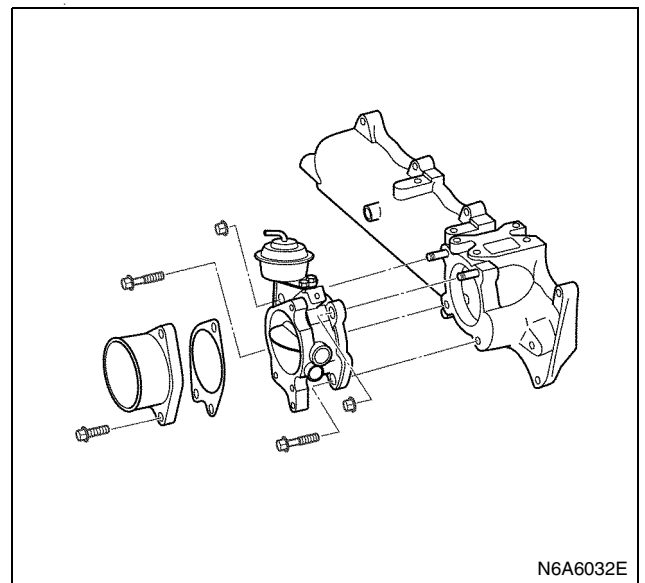
N6A6031E

Legend

- | | |
|----------------------|----------------------|
| 1. Throttle Assembly | 3. Inlet Pipe Gasket |
| 2. Inlet Cover | 4. Inlet Pipe |

Removal

1. Remove the fuel rail.
Refer to "Fuel Rail" in Section 6C.
2. Remove the EGR valve.
Refer to "EGR Valve and EGR Cooler" in Section 6F.
3. Remove the inlet pipe.
4. Remove the throttle assembly.

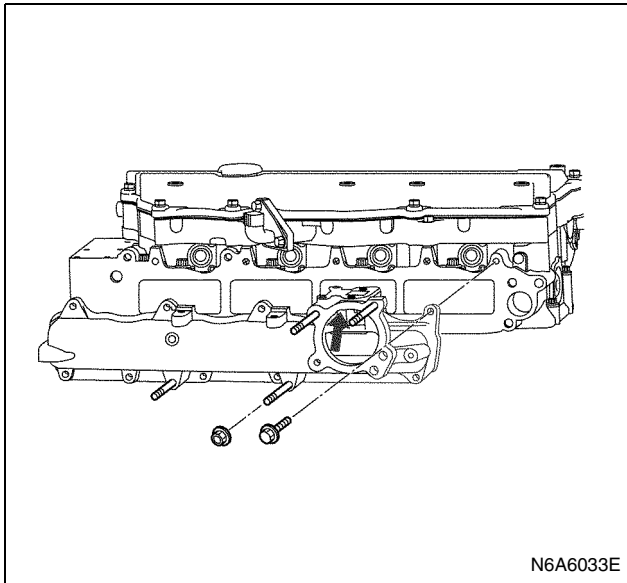


N6A6032E

5. Remove the inlet cover.

6A-32 Engine Mechanical (4HK1-TC)

- On the place where the throttle assembly is to be installed inside the inlet cover (arrow) is a bolt. Be careful not to forget to remove it.
- Peel the liquid gasket off carefully.



Installation

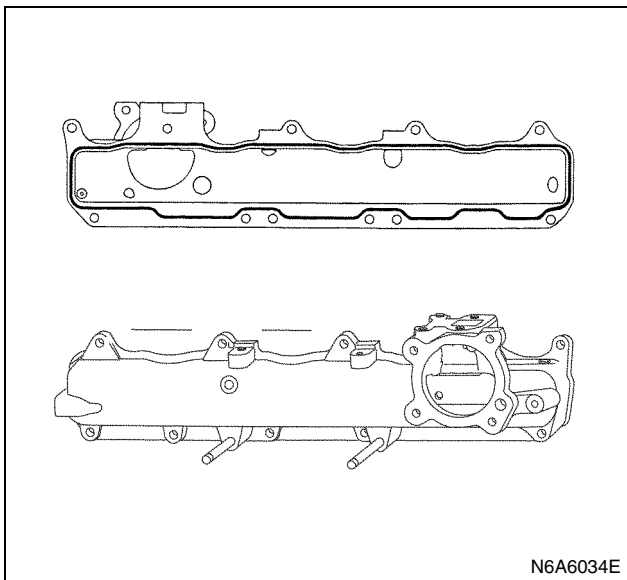
1. Install the inlet cover.
 - Apply the liquid gasket (ThreeBond 1207C or equivalent) keeping a bead diameter of 2.5–5.5 mm (0.1–0.2 in) along the groove of the inlet cover.
 - Install it within 7 minutes after applying the liquid gasket.

Tighten:

Bolt and nut to 22 N·m (2.2 kg·m/16 lb·ft)

Caution:

- Be careful not to forget to fasten the bolt indicated with an arrow.
- Tighten up the stud part together with the fuel rail.

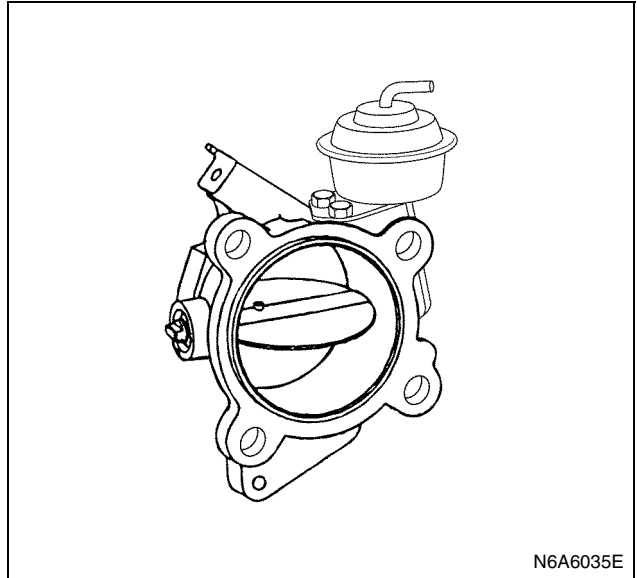


2. Install the throttle assembly.

- Apply the liquid gasket and mount within 7 minutes.

Tighten:

Bolt and nut to 24 N·m (2.4 kg·m/17 lb·ft)



3. Install the gasket on the inlet pipe and tighten up with the prescribed torque.

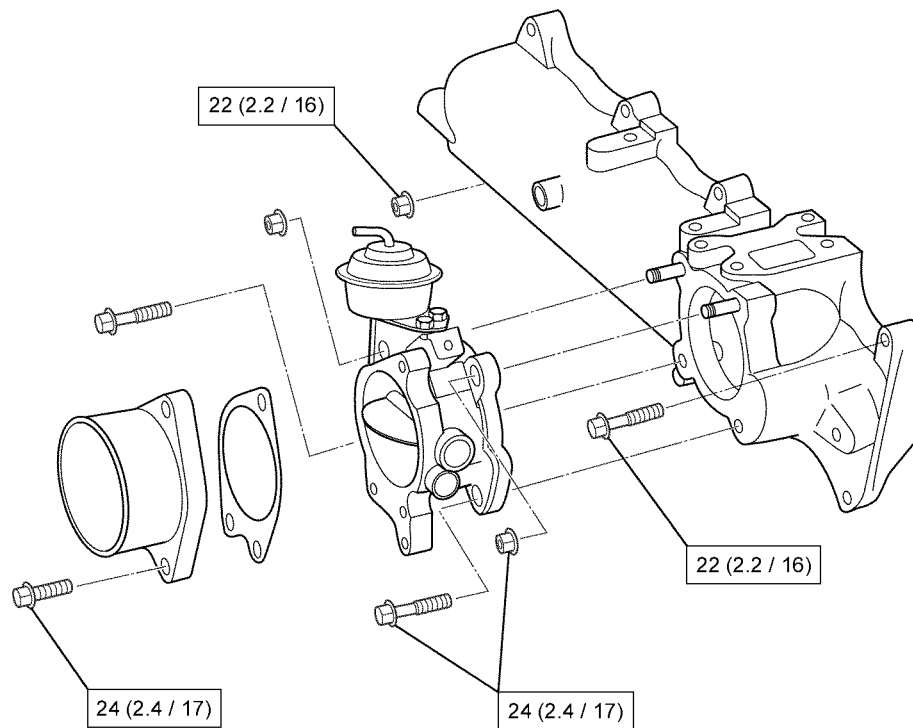
Tighten:

Bolt to 24 N·m (2.4 kg·m/17 lb·ft)

4. Install the EGR valve.
Refer to "EGR Valve and EGR Cooler" in Section 6F.
5. Install the fuel rail.
Refer to "Fuel Rail" in Section 6C.

Torque Specifications

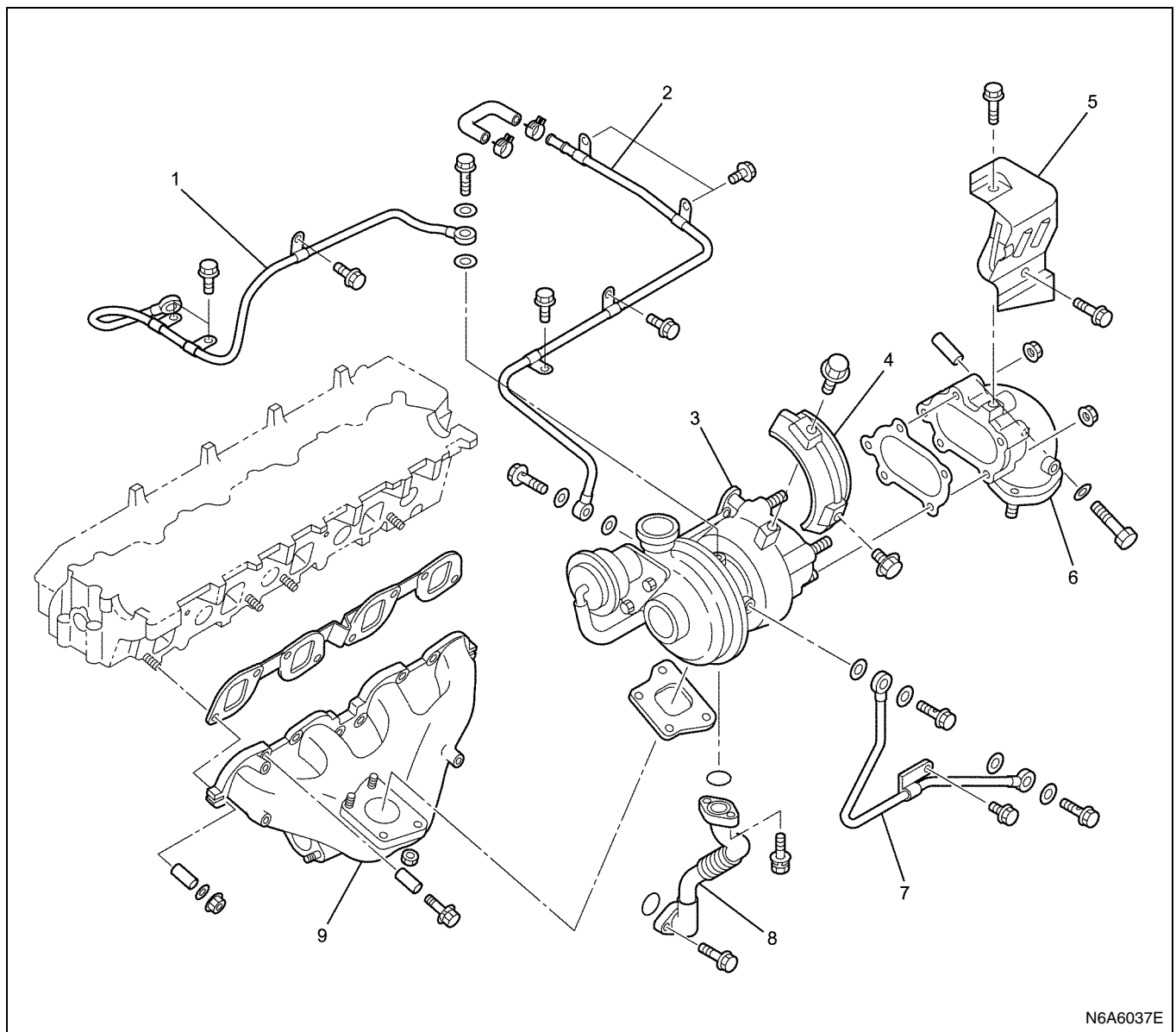
N·m (kg·m / lb·ft)



N6A6036E

Turbocharger and Exhaust Manifold

Component



N6A6037E

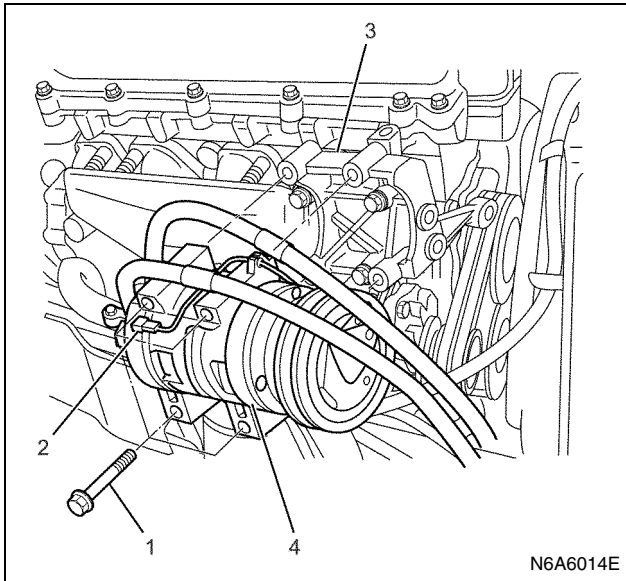
Legend

- | | |
|--------------------------|---------------------|
| 1. Oil Feed Pipe | 6. Exhaust Adapter |
| 2. Water Return Pipe | 7. Water Feed Pipe |
| 3. Turbocharger Assembly | 8. Oil Return Pipe |
| 4. Heat Protector | 9. Exhaust Manifold |
| 5. Heat Protector | |

Removal

1. Loosen the radiator drain cock to drain coolant.
2. Remove the air intake duct from the turbocharger and the air cleaner.
3. Remove the charge air pipe from the turbocharger and the charge air cooler.
4. Remove the front exhaust pipe.
5. Remove the EGR pipe.
6. Remove the A/C compressor harness.
7. Remove the A/C compressor bracket.

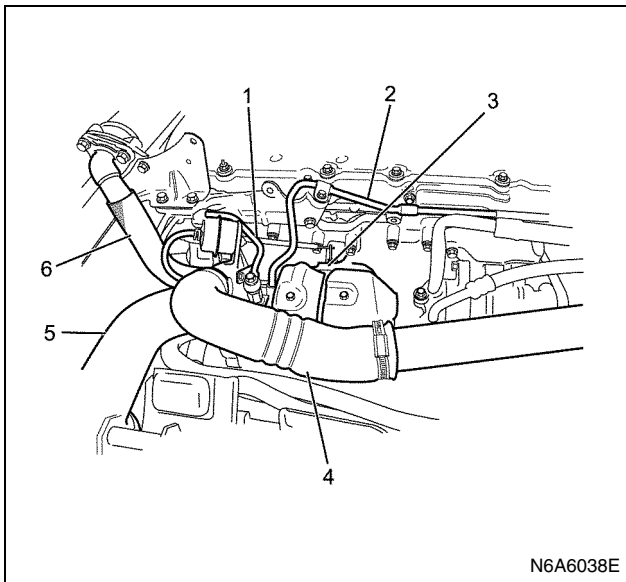
- Without disconnecting the hose of the A/C compressor, remove the compressor from the bracket and remove the compressor bracket from the cylinder head.



Legend

1. Fixing Bolt
2. A/C Compressor Harness
3. A/C Compressor Bracket
4. A/C Compressor

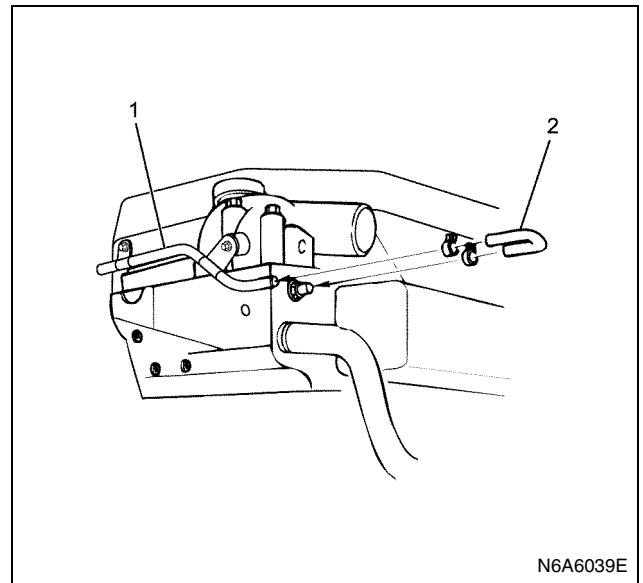
- Remove the oil feed pipe.
- Remove the oil return pipe.
- Remove the oil feed pipe.



Legend

1. Oil Feed Pipe
2. Water Return Pipe
3. Heat Protector
4. Charge Air Hose
5. Inlet Duct
6. EGR Pipe

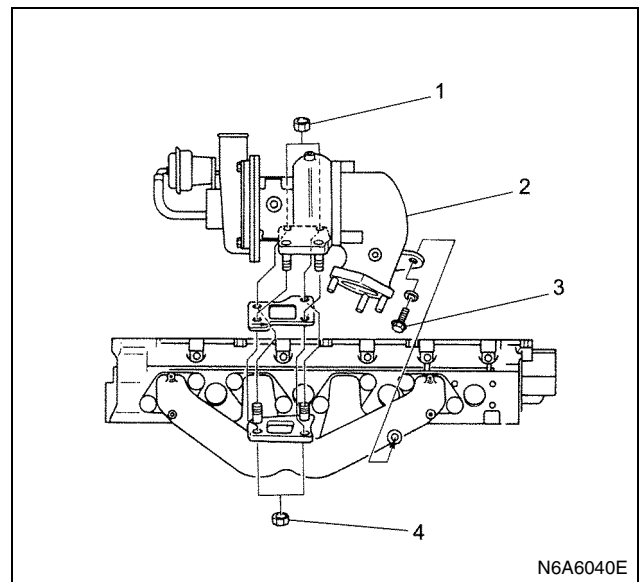
- Remove the water return pipe.



Legend

1. Water Return Pipe
2. Rubber Hose

- Remove the heat protector on the turbocharger.
- Remove the exhaust adapter bolts.
- Remove the four turbocharger clamping nuts.
- Remove the turbocharger from the exhaust manifold.



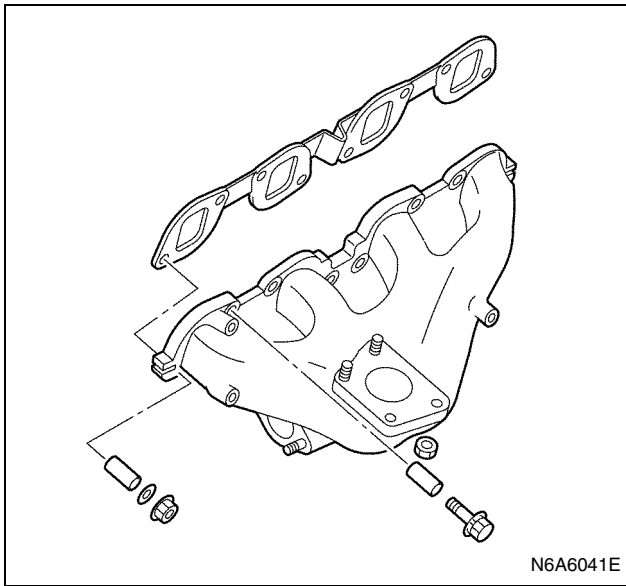
Legend

1. Fixing Nut
2. Exhaust Adapter
3. Fixing Bolt
4. Fixing Nut

8. Remove the exhaust manifold.

6A-36 Engine Mechanical (4HK1-TC)

- Remove the 2 nuts and 6 bolts to remove the exhaust manifold.



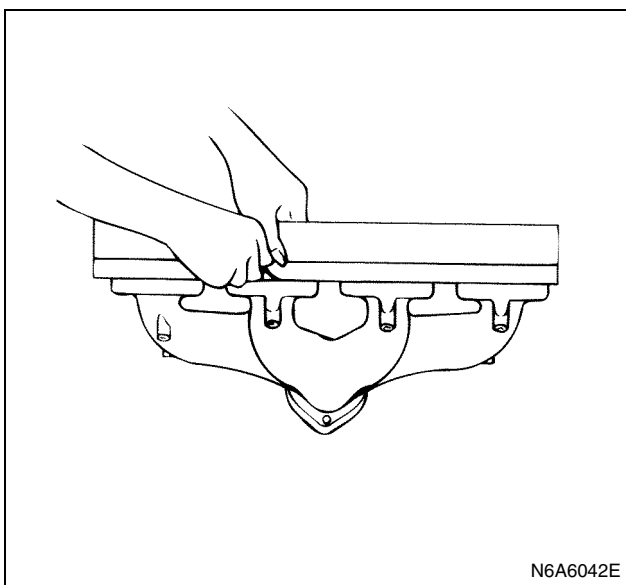
Inspection

- Inspection of the exhaust manifold
Inspect the plane surface of the plane on which the manifold and the cylinder head are to be installed.

Manifold installation plane surface		mm (in)
Standard		0.3 (0.01) or lower
Limit		0.5 (0.02)

Caution:

If the plane surface exceeds the limit, replace it.

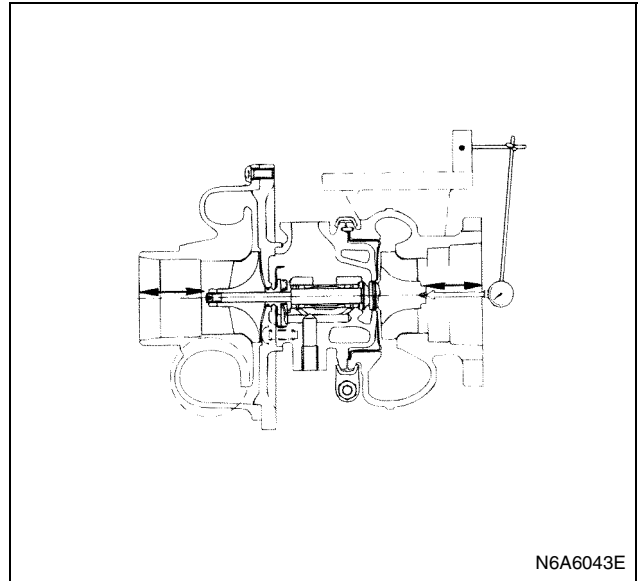


- Check a crack in the exhaust manifold visually.
Carefully inspect the turbocharger for abrasion and/or excessive wear. Make any necessary adjustments, repairs, and/or part replacements.

Wheel shaft axle play

Use a dial gauge to measure the wheel axle shaft play when a fore of 12 N (2.6 lb) is alternately applied to both sides of the compressor wheel.

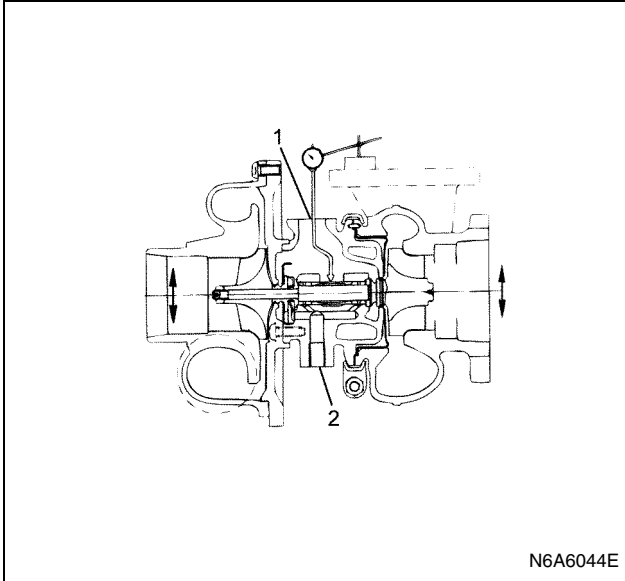
Axle play		mm (in)
Standard		0.013 – 0.097 (0.0005 – 0.0038)
Limit		0.100 (0.0039)



Wheel shaft and bearing clearance

Use a dial gauge to measure the clearance between the wheel shaft and the bearing.

Clearance		mm (in)
Standard		0.069 – 0.140 (0.0027 – 0.0055)
Limit		0.15 (0.0059)

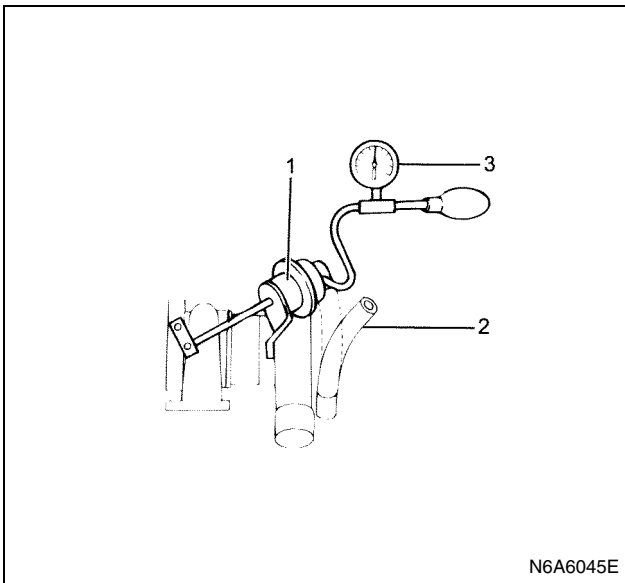


Legend

1. Oil Outlet
2. Oil Inlet

Waste gate operation (absolute pressure)

1. Remove the hose from the waste gate actuator.
2. Install the pressure gauge (general tool). Refer to the illustration.



Legend

1. Waste Gate Actuator
2. Waste Gate Hose
3. Pressure Gauge (General Tool)

3. Use the pressure gauge pump to apply pressure (load) to the waste gate actuator (the engine must be off).
4. Check the pressure and control rod movement.

Movement, mm (in)	0.38 (0.0150)	4.00 (0.1575)
Pressure, kPa (psi)	160 (23)	180 (26)

5. Inspect the hose for cracks and other damage. Replace the hose if necessary.
6. Do not apply a pressure of more than 200 kPa (1.2 kg/cm² / 29 psi) to the waste gate actuator.

Installation

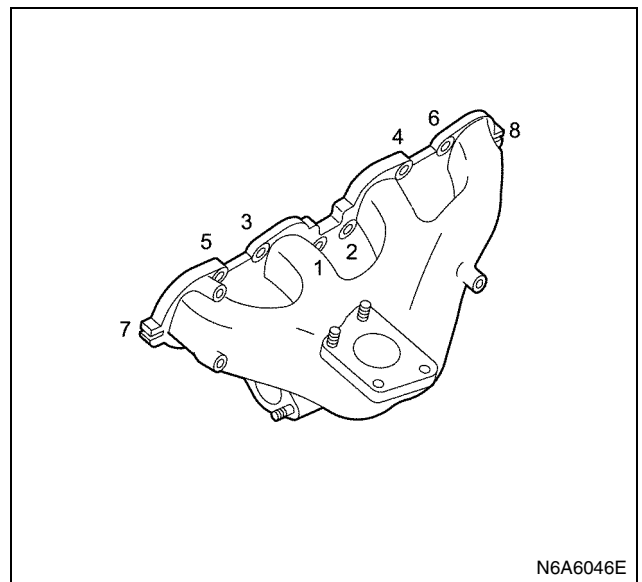
1. Put the gasket in to install the exhaust manifold.
 - Tighten up with the 2 nuts and 6 bolts according to the order given on the figure.

Tighten:

Bolts (1), (2), (3), (4), (5), (6) and Nuts (7), (8) to 34 N·m (3.5 kg·m/25 lb·ft)

Caution:

Do not tighten up too much because it hampers expansion and contraction due to the heat from the manifold.



2. Install the gasket and turbocharger to the exhaust manifold. Tighten the nuts to the specified torque.

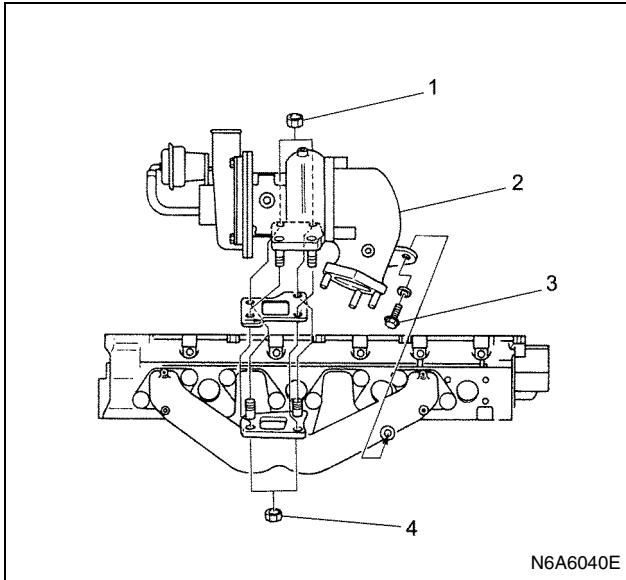
Tighten:

Nuts to 52 N·m (5.3 kg·m/38 lb·ft)

3. Tighten the adapter bolts (exhaust manifold side) to the specified torque.

Tighten:

Bolts to 25 N·m (2.5 kg·m/19 lb·ft)



Legend

1. Fixing Nut
2. Exhaust Adapter
3. Fixing Bolt
4. Fixing Nut

4. Install the water feed pipe to the turbocharger.
 - Tighten the joint bolts to the specified torque.

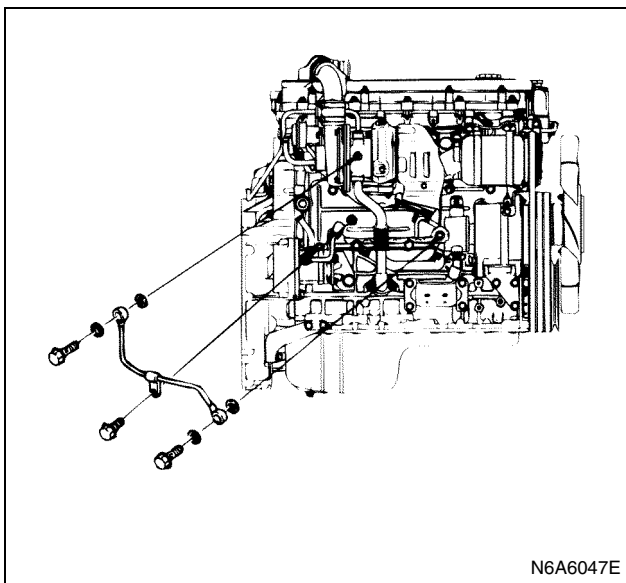
Tighten:

Joint bolts to 41 N·m (4.2 kg·m/30 lb·ft)

- Install the pipe bracket and tighten the bolts to the specified torque.

Tighten:

Bolts to 24 N·m (2.4 kg·m/17 lb·ft)



5. Install the water return pipe. Tighten the joint bolts to the specified torque.

Tighten:

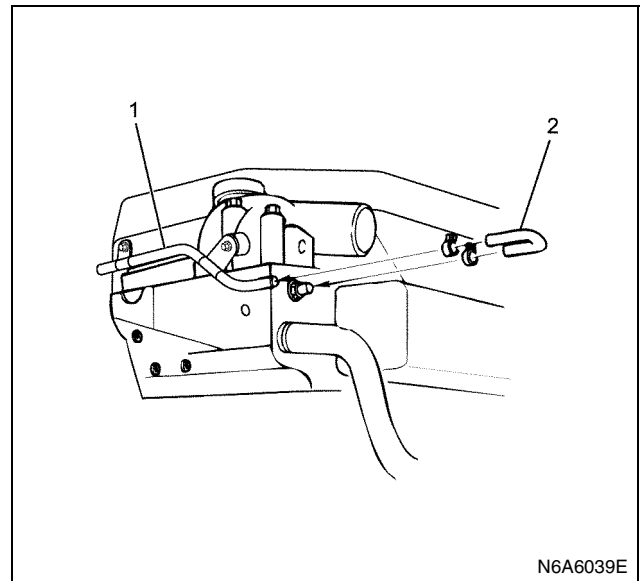
Joint bolts to 41 N·m (4.2 kg·m/30 lb·ft)

6. Install the water return pipe bracket. Tighten the bolts to the specified torque.

Tighten:

Bolts to 24 N·m (2.4 kg·m/17 lb·ft)

- Install the rubber hose between the water return pipe and the thermostat housing.



Legend

1. Water Return Pipe
2. Rubber Hose

7. Install the turbocharger oil feed pipe to the top of the turbocharger. Tighten the joint bolts to the specified torque.

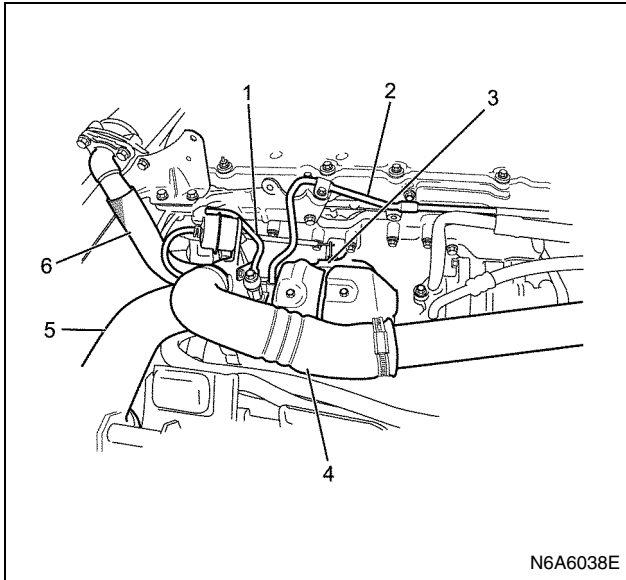
Tighten:

Joint bolts to 27 N·m (2.8 kg·m/19.9 lb·ft)

- Install the pipe bracket and tighten the bolts to the specified torque.

Tighten:

Bolts to 24 N·m (2.4 kg·m/17 lb·ft)



Legend

1. Oil Feed Pipe
2. Water Return Pipe
3. Heat Protector
4. Charge Air Hose
5. Inlet Duct
6. EGR Pipe

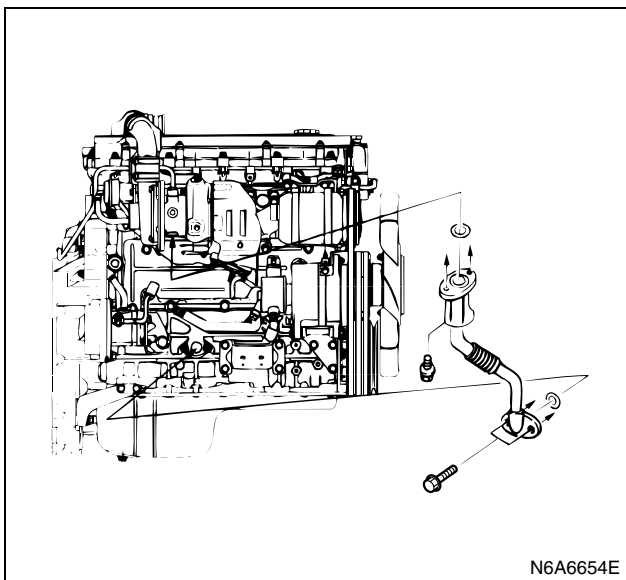
8. Tighten the oil return pipe bolts to the specified torque.

Tighten:

Bolts to

Turbocharger side: 9 N·m (0.9 kg·m/78 lb·in)

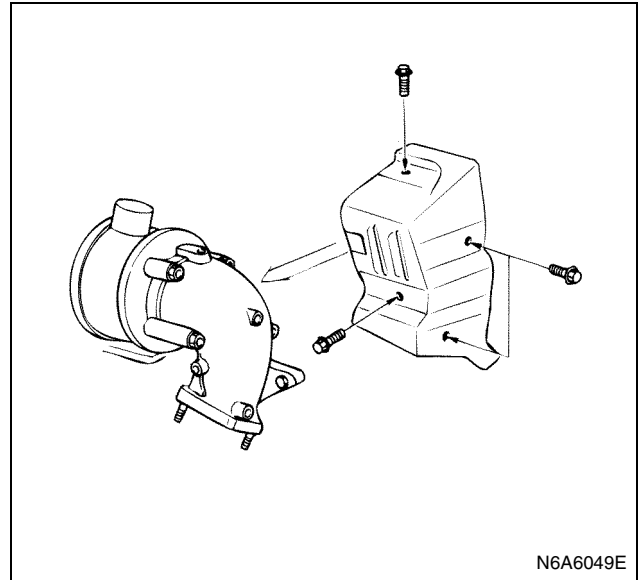
Cylinder block side: 22 N·m (2.2 kg·m/15 lb·ft)



9. Install the heat protector and tighten the bolts to the specified torque.

Tighten:

Bolts to 10 N·m (1.0 kg·m/87 lb·in)



10. Install the air intake duct and tighten the bolts to the specified torque.

Tighten:

Bolts to 10 N·m (1.0 kg·m/87 lb·in)

11. Install the charge air pipe in the turbo charger and the charge air cooler.

Tighten:

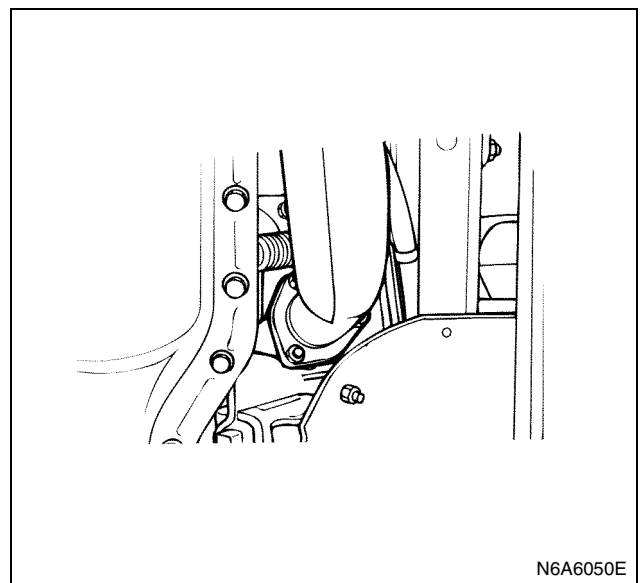
Duct bolt to 21 N·m (2.1 kg·m/15 lb·ft)

Duct clip to 6 N·m (0.6 kg·m/52 lb·in)

12. Install the front exhaust pipe to the turbocharger and tighten the nuts to the specified torque.

Tighten:

Nuts to 67 N·m (6.8 kg·m/49 lb·ft)



13. Add cooling water to the radiator.

14. Install the A/C compressor bracket.

- Install the A/C compressor bracket on the cylinder head and tighten up with the prescribed torque.

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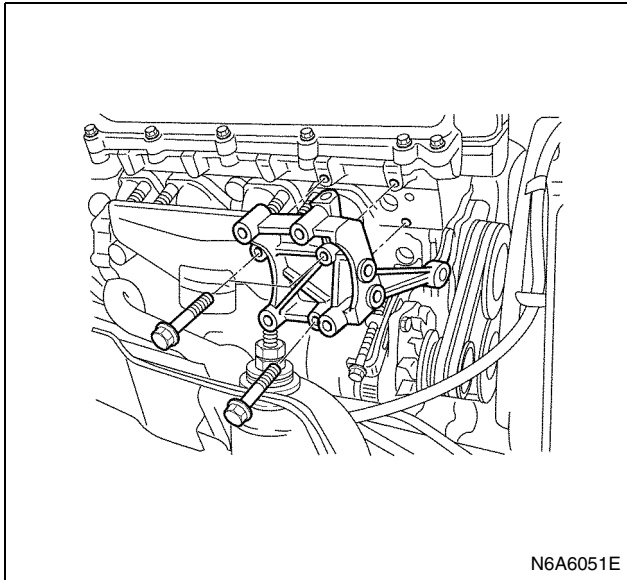
Tighten:

Bolts to 48 N·m (4.9 kg·m/35 lb·ft)

- Install the A/C compressor on the bracket and tighten up with the prescribed torque.

Tighten:

Bolts to 24 N·m (2.4 kg·m/17 lb·ft)



15. Install the EGR pipe.

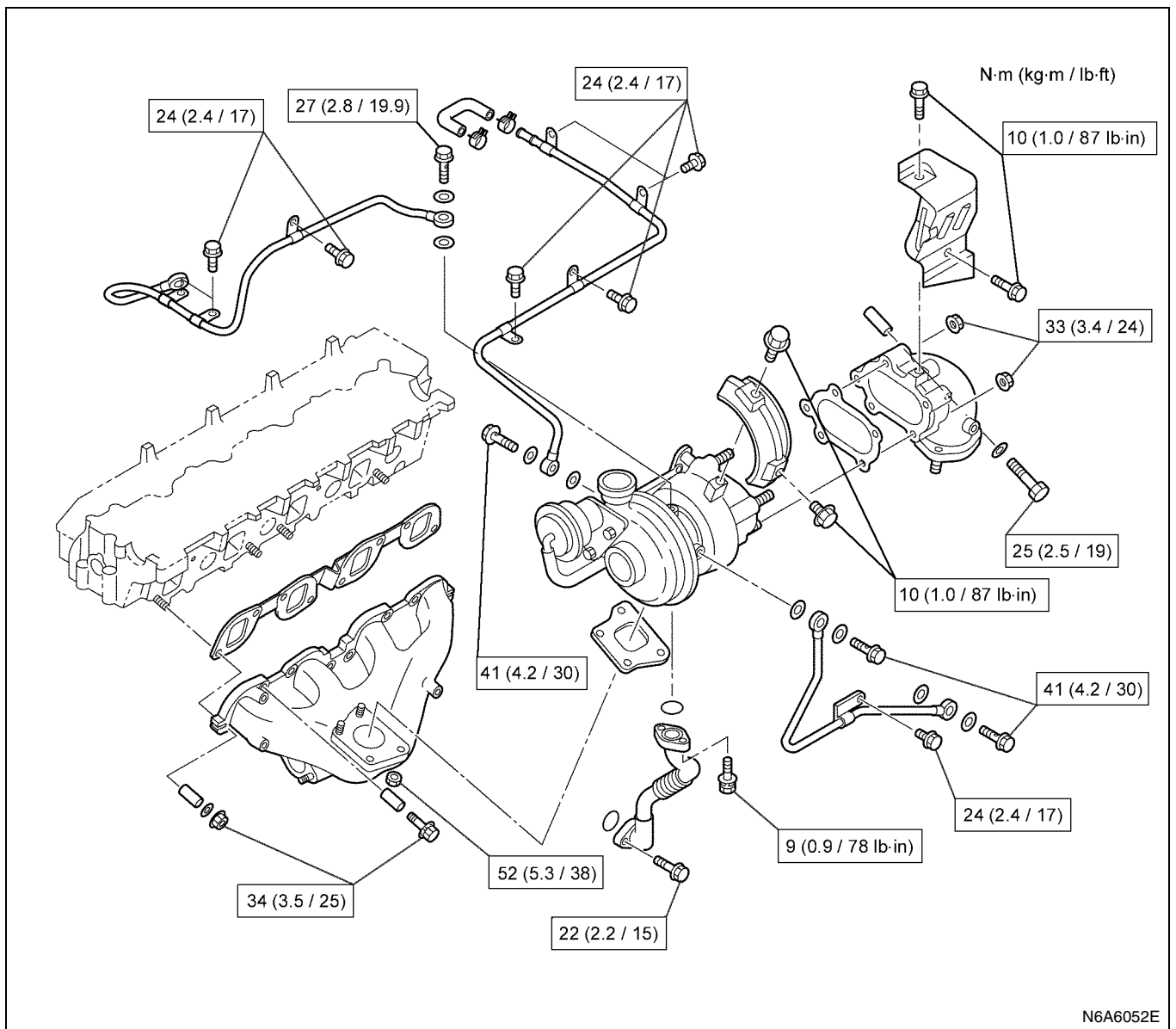
- Put the gasket between both ends of the EGR pipe and install to the specified torque.

Tighten:

Bolts to 24 N·m (2.4 kg·m/17 lb·ft)

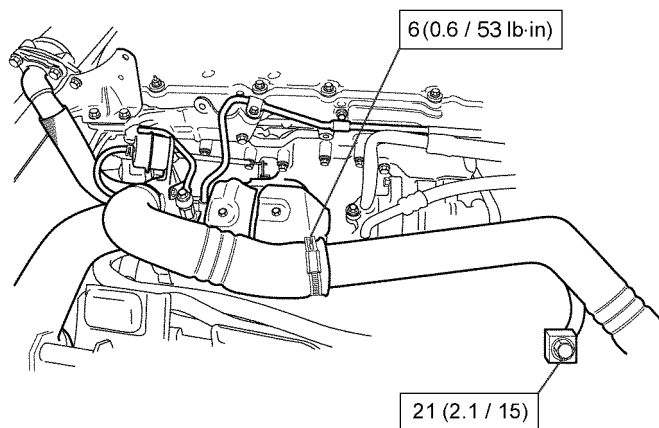
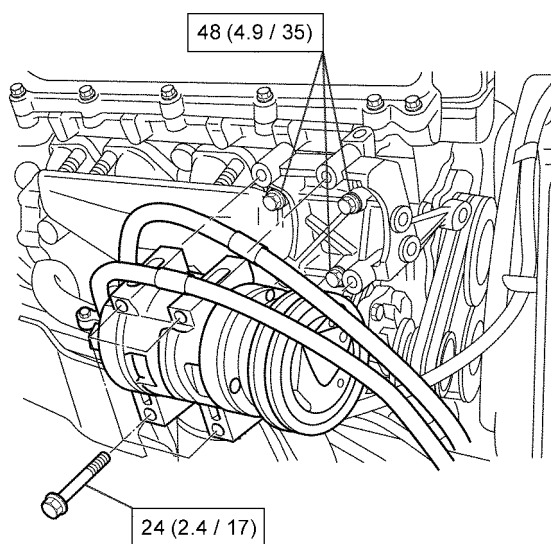
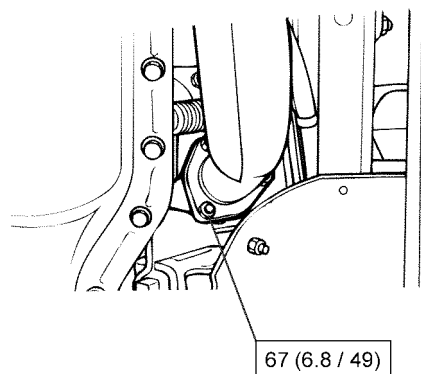
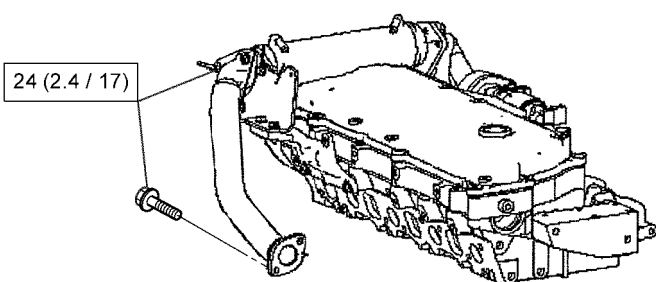
16. Replenish the coolant.

Torque Specifications



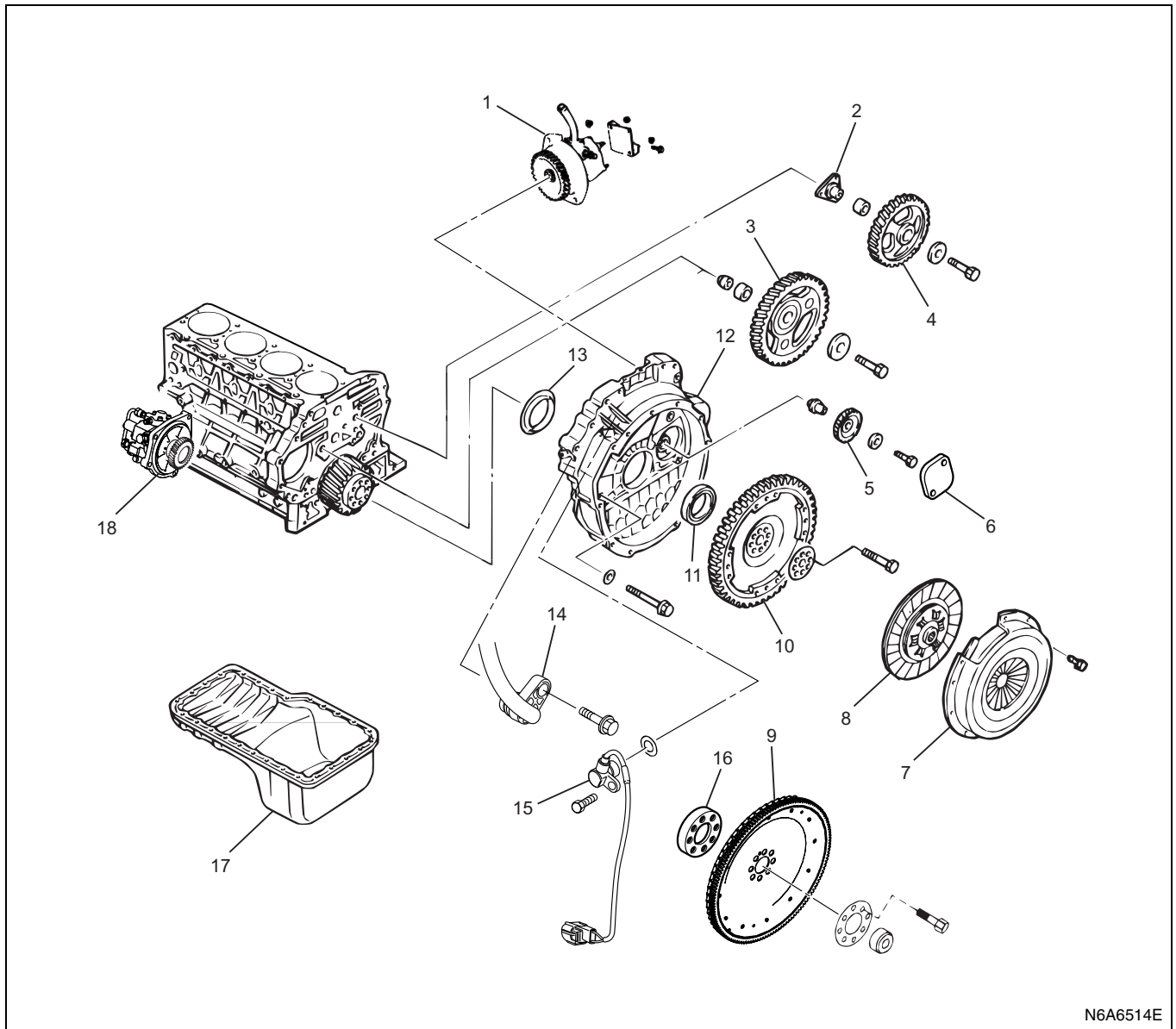
N6A6052E

N·m (kg·m / lb·ft)



Timing Gear Train

Component



N6A6514E

Legend

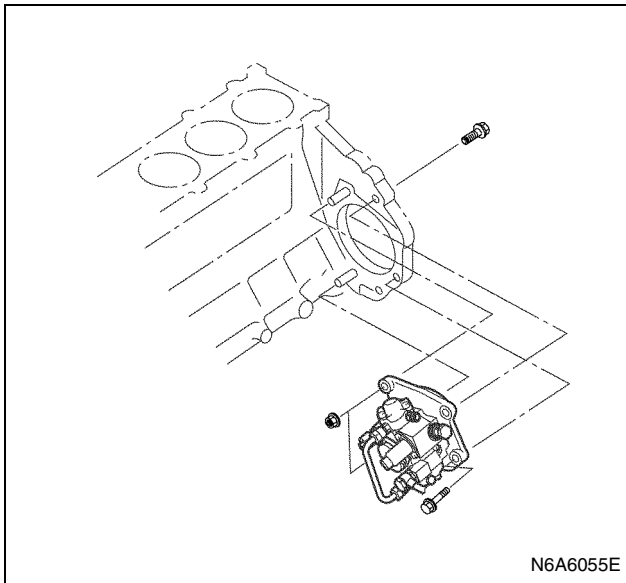
- | | |
|--|---------------------------------------|
| 1. Power Steering Pump | 10. Flywheel (M/T) |
| 2. Idle Gear B Shaft | 11. Rear Oil Seal |
| 3. Idle Gear A | 12. Flywheel Housing |
| 4. Idle Gear B | 13. Slinger |
| 5. Power Steering Pump Idle Gear | 14. Plug |
| 6. Power Steering Pump Idle Gear Cover | 15. Crankshaft Position Sensor |
| 7. Clutch Pressure Plate | 16. Crank shaft End Spacer (Smoother) |
| 8. Driven Plate | 17. Oil Pan |
| 9. Flexible Plate (Smoother) | 18. Fuel Supply Pump |

Removal

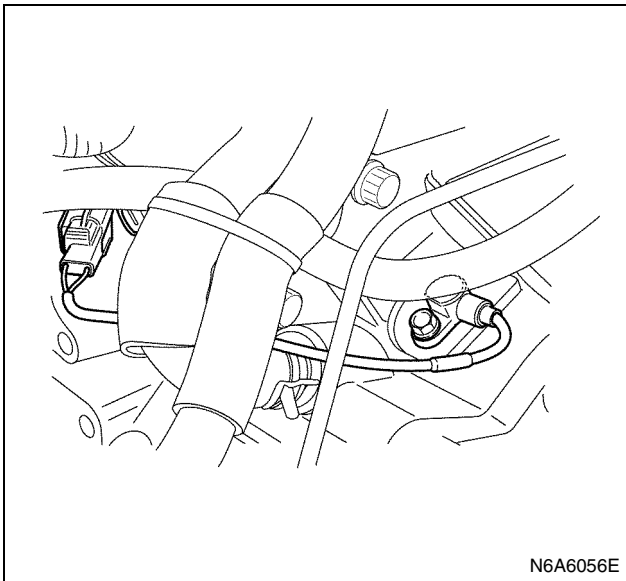
1. Remove the cylinder head cover.
Refer to "Cylinder Head Cover".
2. Remove the rocker arm shaft assembly.
Refer to "Rocker Arm Shaft Assembly".
3. Remove the camshaft assembly.
Refer to "Camshaft Assembly".
4. Remove the cylinder head assembly.
Refer to "Cylinder Head".

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5. Remove the fuel supply pump assembly.
Refer to "Fuel Supply Pump" in Section 6C.



6. Remove the crankshaft position sensor.
- Remove the crankshaft position sensor before remove flywheel.

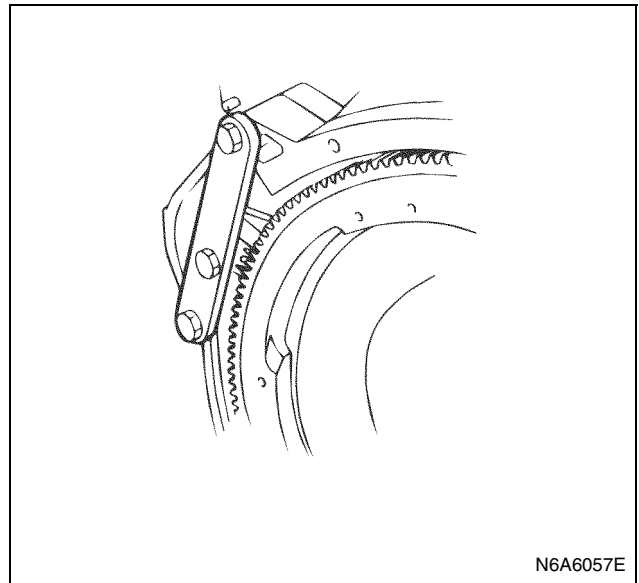


7. Remove the flywheel.
- Install the crankshaft stopper on the starter part of the flywheel housing to stop the crankshaft from rotating.

Caution:

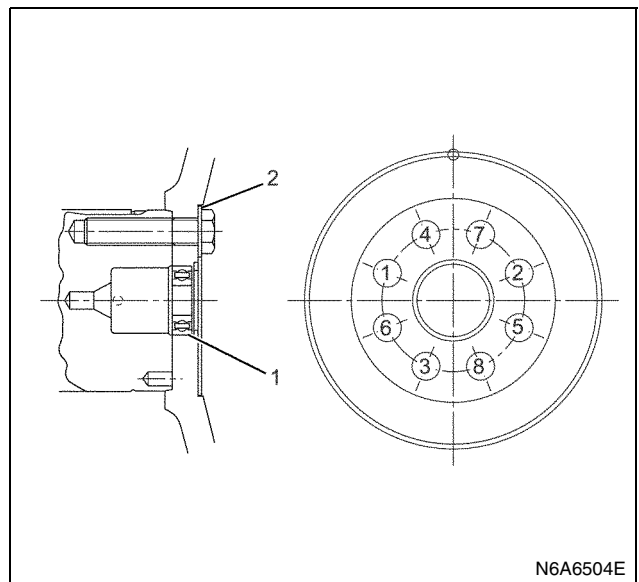
Check if the stopper meshes with the ring gear without fail and is installed properly.

Special tool
Crankshaft stopper: 5-8840-2230-0 (EN-47680)



- Loosen the fastening bolts of the flywheel little by little according to the order given on the figure.
- After loosening all the bolts, remove the stopper to remove the flywheel.

In the case of smoother vehicle, after loosening the bolts to fasten the flexible plate, remove the washer, the flexible plate, the spacer according to this order.

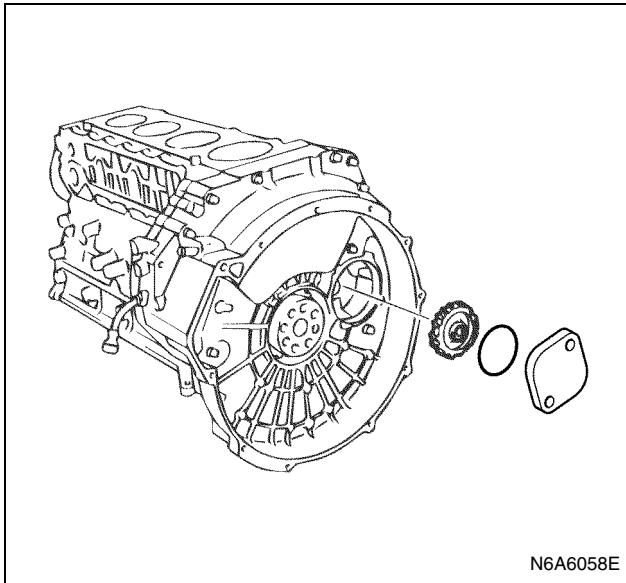


Legend

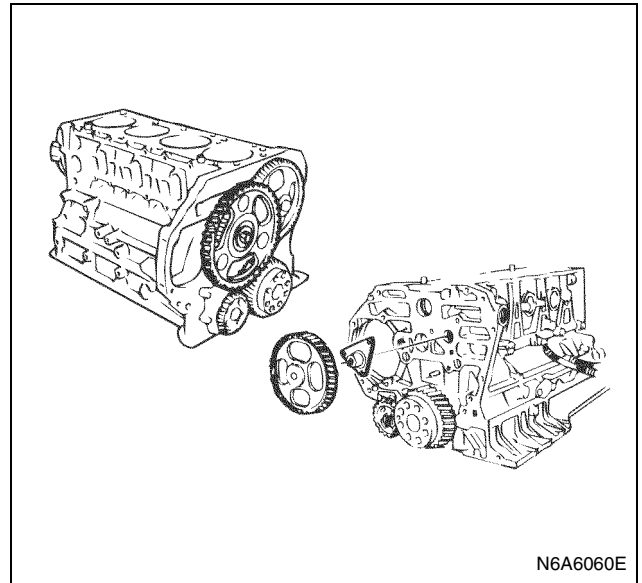
- Pilot Bearing
- Washer

- Remove the rear oil seal and the slinger.
Refer to "Crankshaft Rear Oil Seal".
- Remove the oil pan.
- Remove the power steering pump.
- Remove the power steering pump idle gear cover.

12. Remove the power steering pump idle gear.

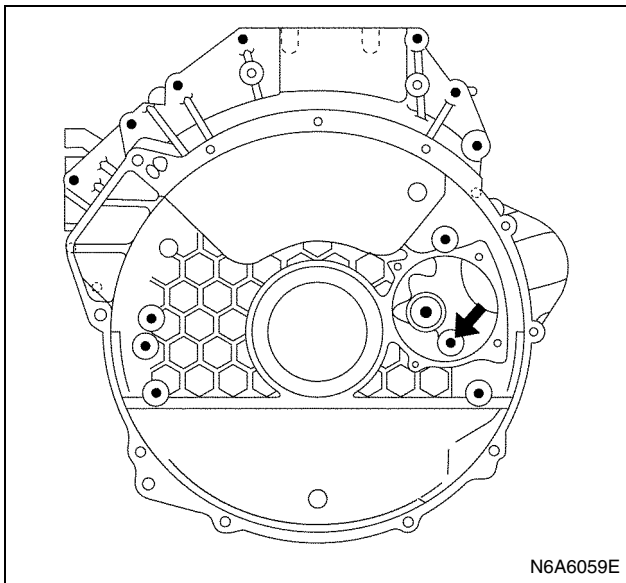


16. Remove the idle gear B shaft.



13. Remove the flywheel housing.

- Never fail to remove the bolt(s) given on the figure.



14. Remove the idle gear A.

15. Remove the idle gear B.

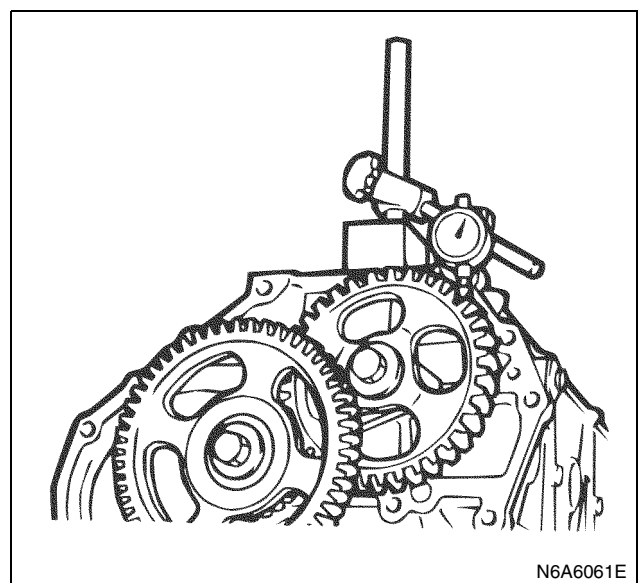
Inspection

1. Measurement of idle gear backlash

- Apply a dial gauge on the teeth of the idle gear to be measured and move the gear to right and left lightly to read how much the dial gauge shook (never fail to fix the gear).
- If the measurement exceeds the limit, replace the idle gear.

Backlash of the timing gear		mm(in)
Standard	0.10 – 0.17	(0.004 – 0.006)
Limit	0.30	(0.01)

- Measure backlash of the idle gear before removing the idle gear A.



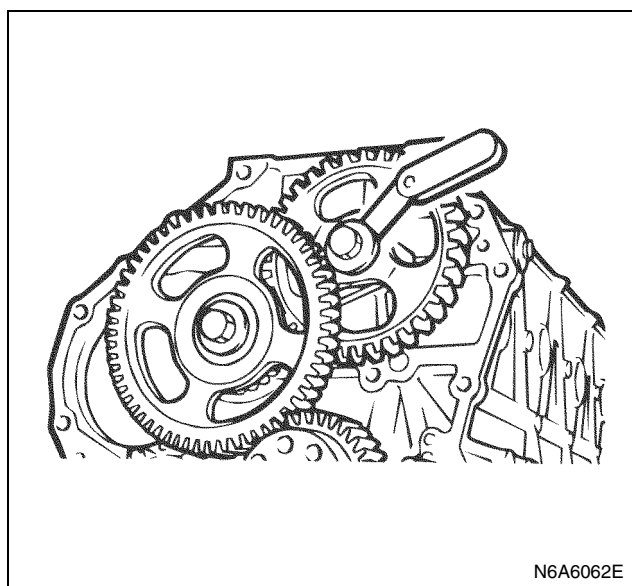
2. Measurement of end clearance of the idle gear.

6A-46 Engine Mechanical (4HK1-TC)

- Insert a thickness gauge between the idle gear and the thrust collar to measure a clearance.
- If the measurement exceeds the limit, replace either the idle gear or the thrust collar.

End clearance of the idle gear		mm (in)
Standard		0.080 – 0.155 (0.003 – 0.006)
Limit		0.20 (0.008)

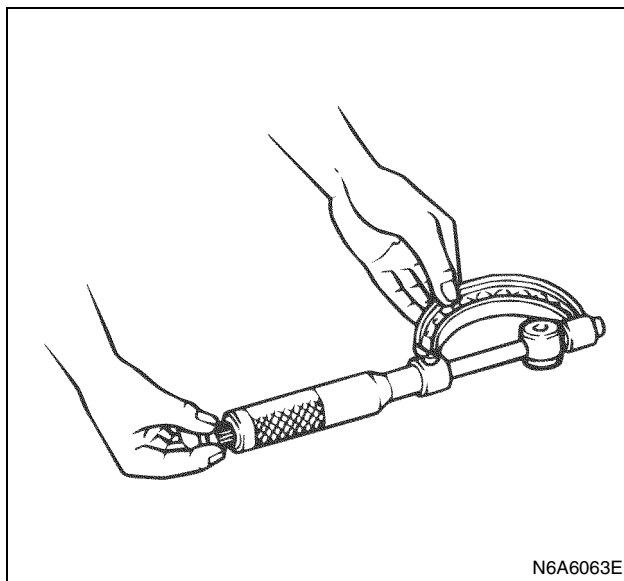
- Measure an end clearance of the idle gear before removing the idle gear B.



3. External diameter of the idle gear shaft

- Use a micrometer to measure an external diameter of each idle gear shaft.
- If the measurement exceeds the limit, replace the shaft.

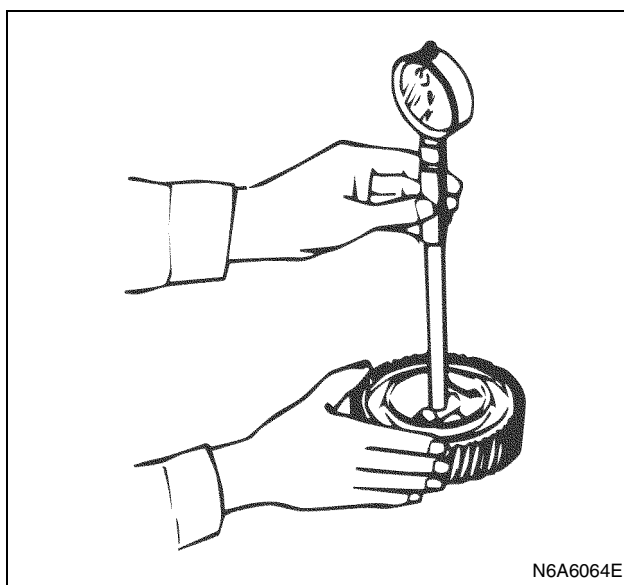
External diameter of the idle gear shaft		mm (in)
Standard		29.959 – 29.980 (1.179 – 1.180)
Limit		29.80 (1.173)



4. Clearance between the idle gear and the idle gear shaft

- Measure an inside diameter of the idle gear bush to calculate a clearance between the idle gear and the idle gear shaft.
- If the measurement exceeds the limit, replace either the idle gear or the shaft.

Clearance between the idle gear and the shaft		mm (in)
Standard		0.020 – 0.062 (0.0007 – 0.0024)
Limit		0.200 (0.0079)



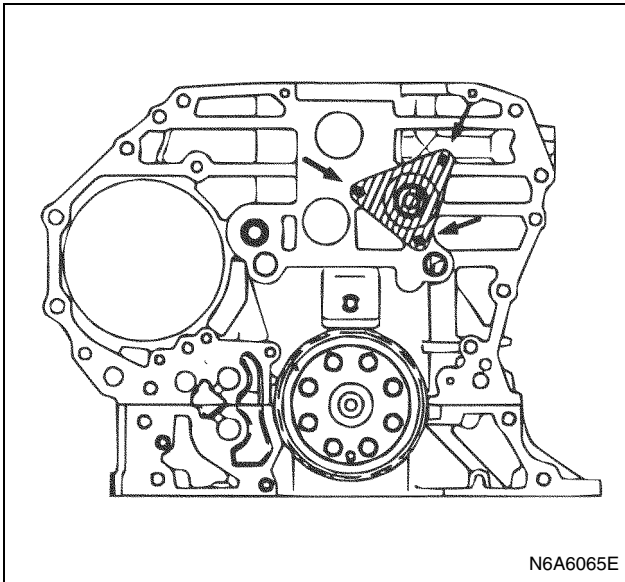
Installation

1. Install the idle gear B shaft.
 - Tighten up the idle gear B shaft with the prescribed torque.

Tighten:

Bolts to 31 N·m (3.2 kg·m/23 lb·ft)

- After installation, apply engine oil over the shaft.

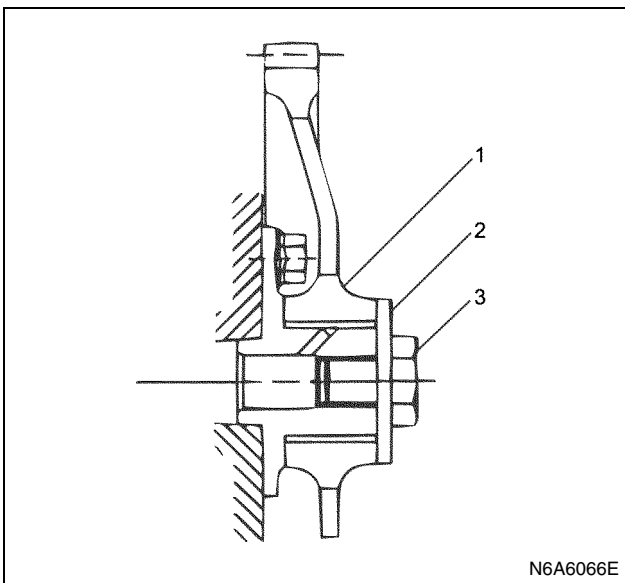


2. Install the idle gear B.

- Install the idle gear B in the direction given on the figure and tighten up the fastening bolts with the prescribed torque.

Tighten:

Bolts to 110 N·m (11.2 kg·m/81 lb·ft)



Legend

1. Idle Gear
2. Thrust Collar
3. Bolt

3. Install the idle gear A.

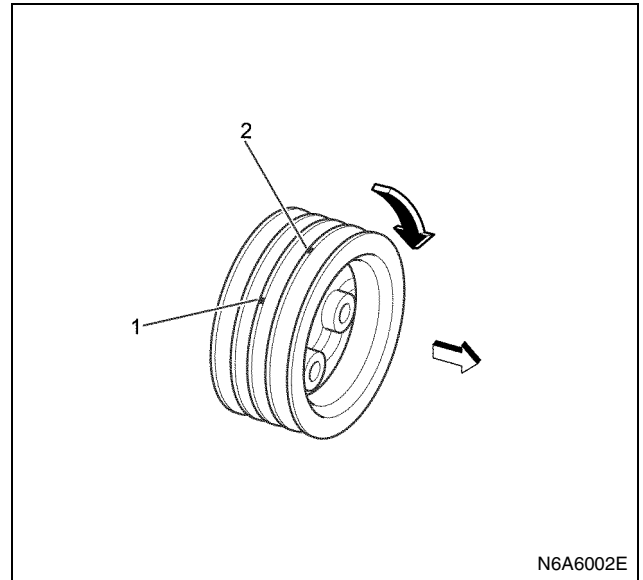
- Turn the crankshaft in the normal direction of engine rotation until the No. 1 or No. 4 cylinder is at TDC on the compression stroke.

Notice:

There are 2 timing marks on the crankshaft pulley. Mark (1) is near the front cover and is used to bring the 4HK1-TC engine to TDC.

Mark (2) is not applicable to this engine.

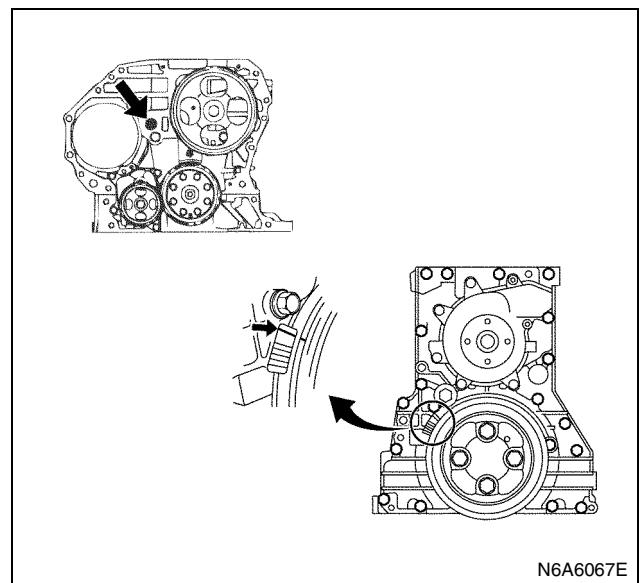
Be sure to use mark (1) when bringing the engine to TDC.

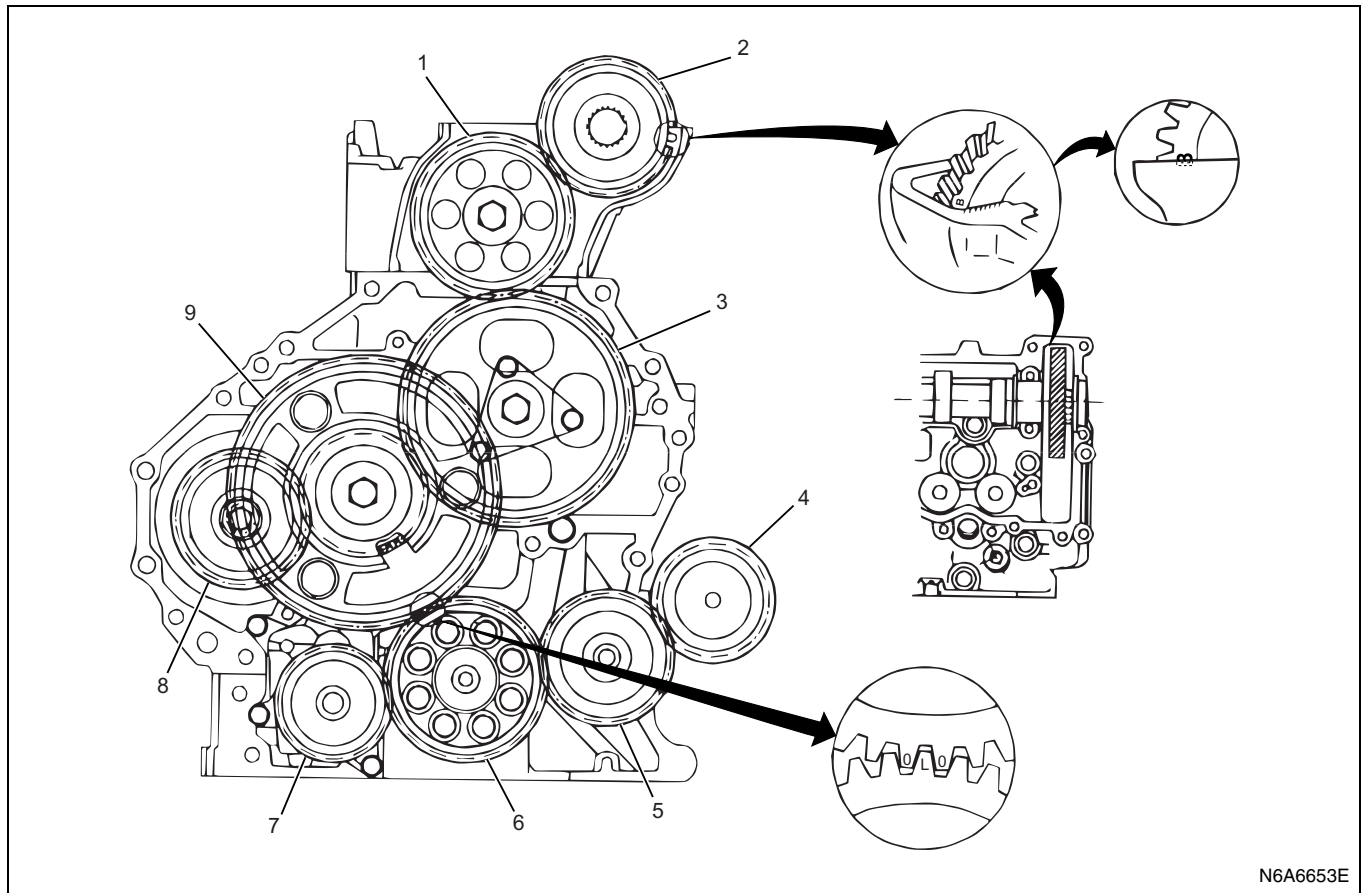


- Make the meeting marks of the crankshaft gear and the idle gear A meet and install it on the cylinder block.
- Tighten up the fastening bolts with the prescribed torque.

Tighten:

Bolts to 133 N·m (13.6 kg·m/98 lb·ft)





N6A6653E

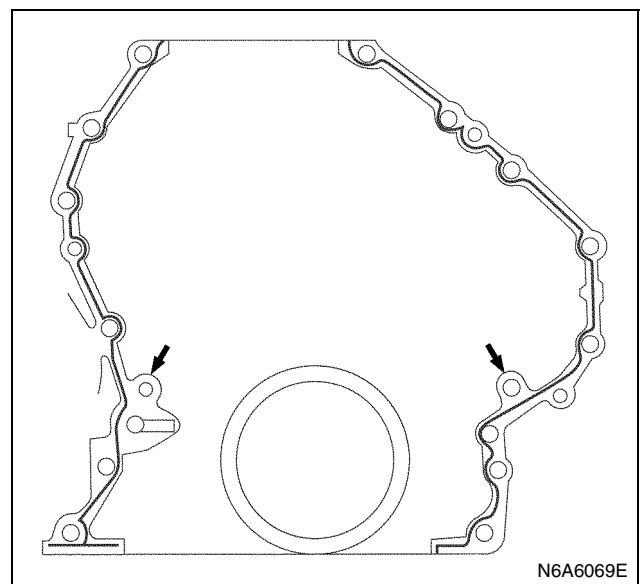
Legend

- | | |
|----------------------------------|--------------------------|
| 1. Idle Gear C | 6. Crankshaft Gear |
| 2. Camshaft Gear | 7. Oil pump Drive Gear |
| 3. Idle Gear B | 8. Fuel Supply Pump Gear |
| 4. Power Steering Pump Gear | 9. Idle Gear A |
| 5. Power Steering Pump Idle Gear | |

4. Install the flywheel housing.

- Clean the rear side of the cylinder block. In particular, remove overflow liquid gasket thoroughly when the crankcase is installed.

- As the figure shows, apply the liquid gasket (ThreeBond 1207C or equivalent) inside a hole of the bolt (except the bolt holes indicated with an arrow) evenly.



N6A6069E

- Along with the dowel pin of the cylinder block, install the flywheel housing.

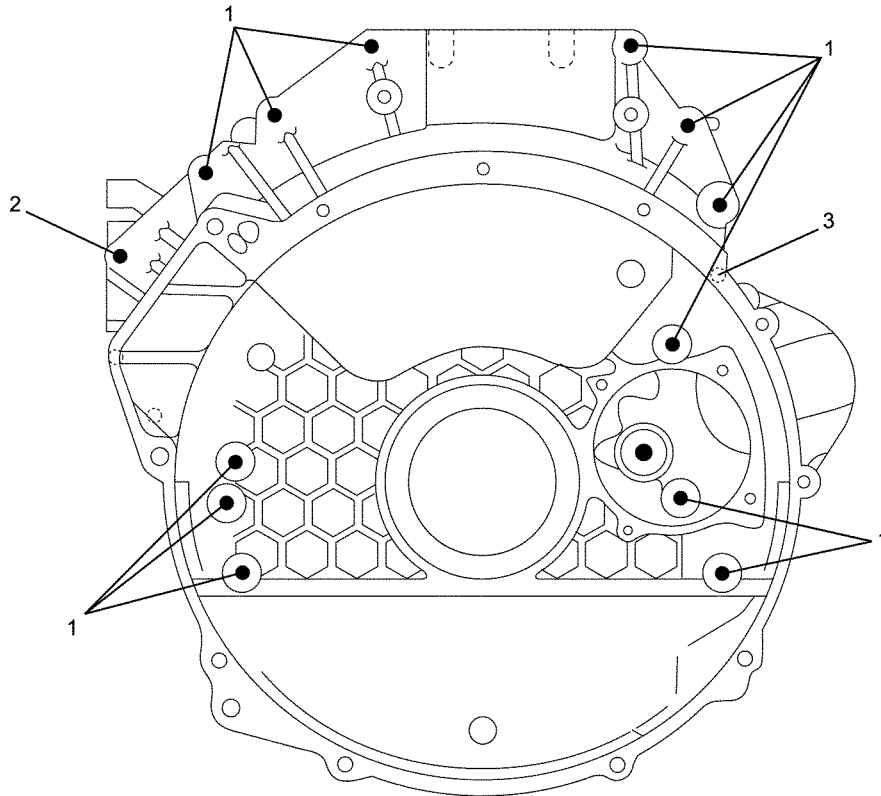
Tighten:

Bolts (1) to 96 N·m (9.8 kg·m/71 lb·ft)

Bolts (2) to 77 N·m (7.9 kg·m/57 lb·ft)

Bolts (3) to 38 N·m (3.9 kg·m/28 lb·ft)

- Tighten up the Mark 3 from the cylinder block side.



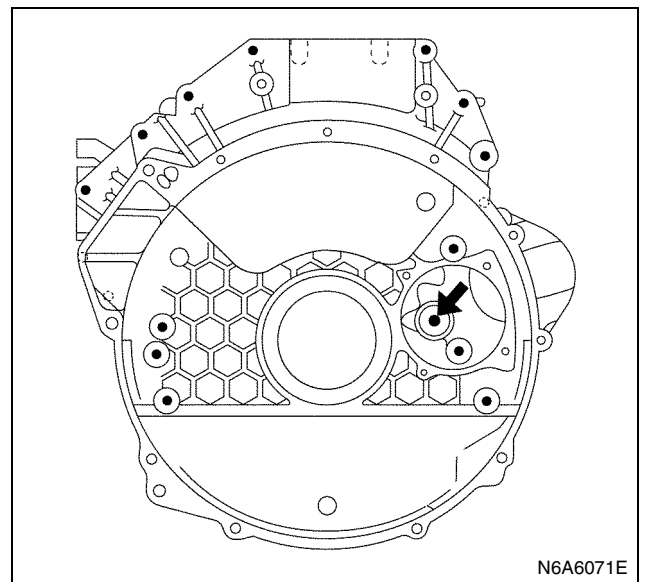
N6A6070E

5. Install the power steering pump idle gear.

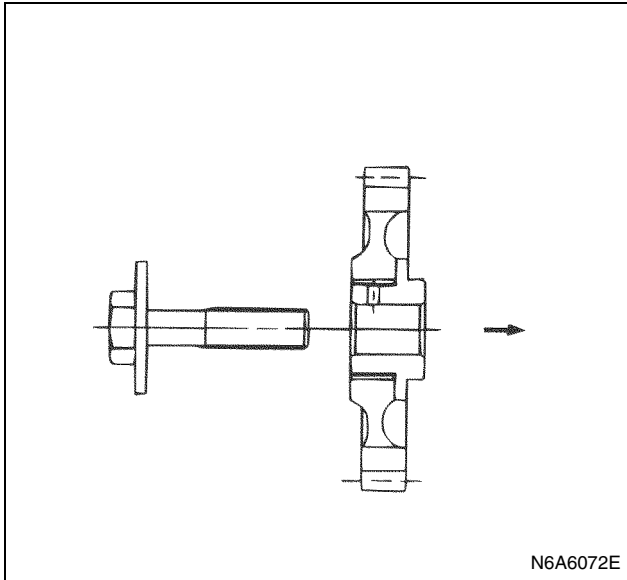
- Apply engine oil over the part where the gear of the idle gear shaft is to be put together.
- Put the idle gear and the shaft together and install it on the location given on the figure and tighten up with the prescribed torque.

Tighten:

Bolts to 133 N·m (13.6 kg·m/98 lb·ft)



N6A6071E

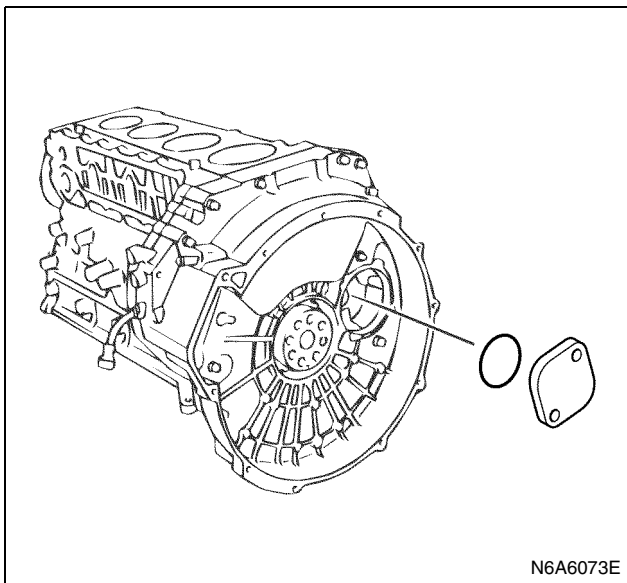


6. Install the power steering pump idle gear cover.

- Install the O-ring on the cover and install it on the flywheel housing and tighten up the tightening bolts with the prescribed torque.

Tighten:

Bolts to 19 N·m (1.9 kg·m/14 lb·ft)



7. Install the power steering pump.

- Install the power steering pump and tighten up with the prescribed torque.

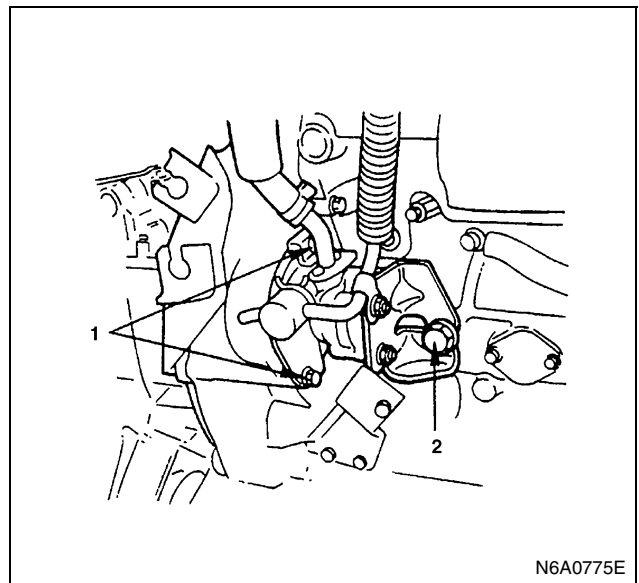
Tighten:

Fixing bolts to

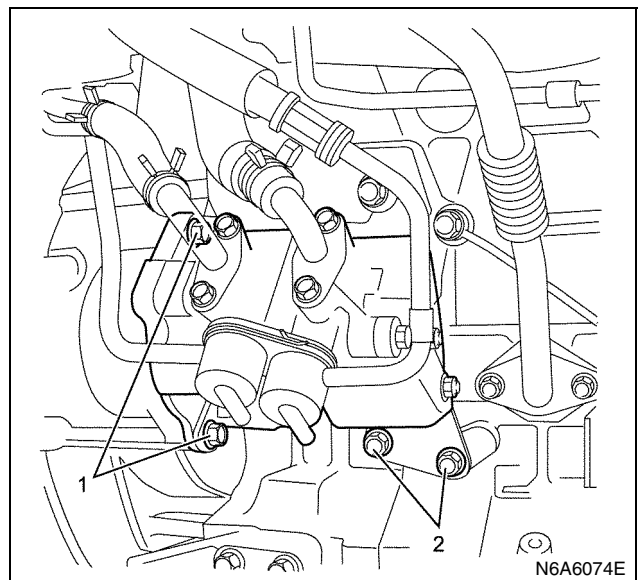
Flywheel housing side (1): 43 N·m (4.4 kg·m/32 lb·ft)

Cylinder block side (2): 44 N·m (4.5 kg·m/32 lb·ft)

Without HBB



With HBB



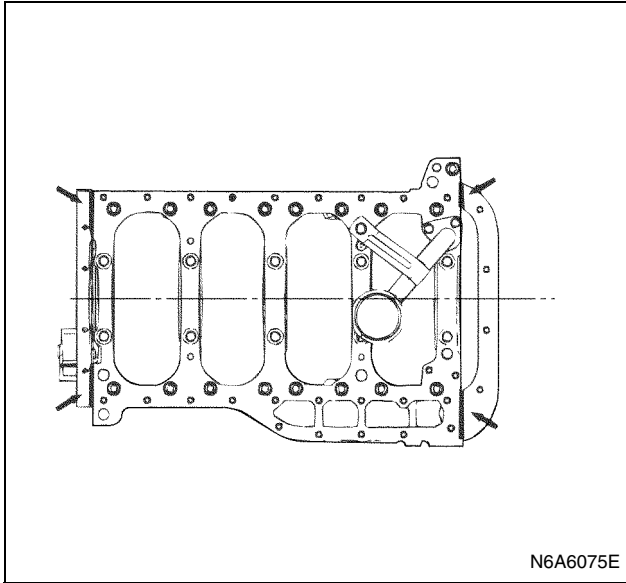
Legend

1. Flywheel Housing Fixing Bolt
2. Cylinder Block Fixing Bolt

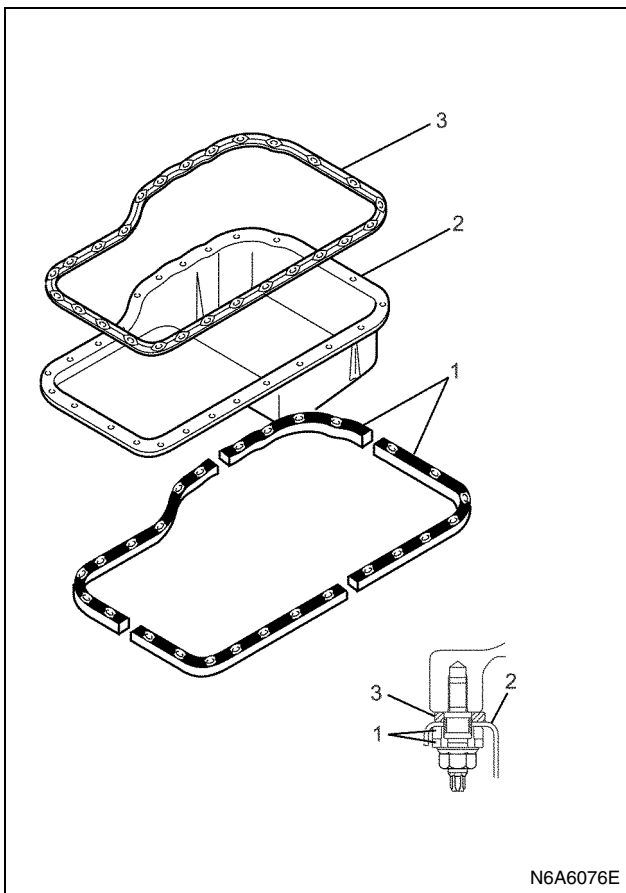
8. Install the oil pan

- Apply the liquid gasket (ThreeBond1207C or equivalent) on a joint between the cylinder block, the front cover and the flywheel housing with a beat diameter of 3 mm (0.1 in).

- Install the oil pan within 7 minutes after applying the liquid gasket.



- With the flywheel housing, the front cover and the stud of the crankcase as a guide, put together the gasket and put the oil pan on it. Then, put the rubber assembly on the oil pan and fix it by fastening bolts and nuts.



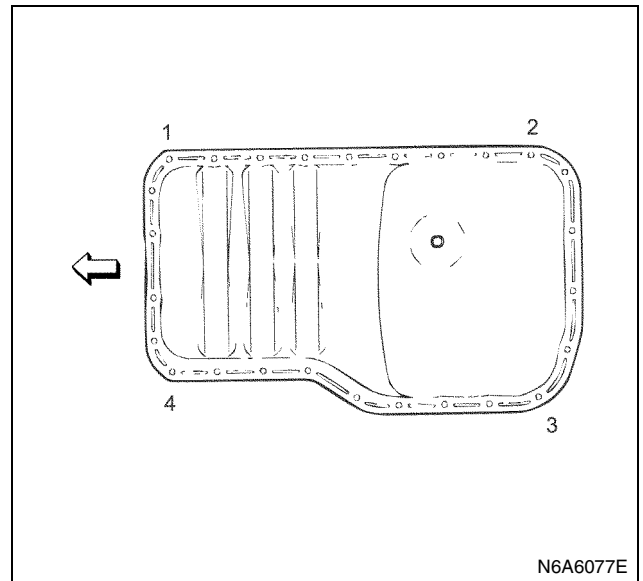
Legend

1. Rubber Assembly
2. Oil Pan
3. Gasket

- After fastening the oil pan at the respective points of (1), (2), (3), and (4), fasten other parts.

Tighten:

Bolts and nuts to 11 N·m (1.1 kg·m/95 lb·in)



9. Install the rear slinger and the oil seal. Refer to "Crankshaft Rear Oil Seal".

10. Install the flywheel.

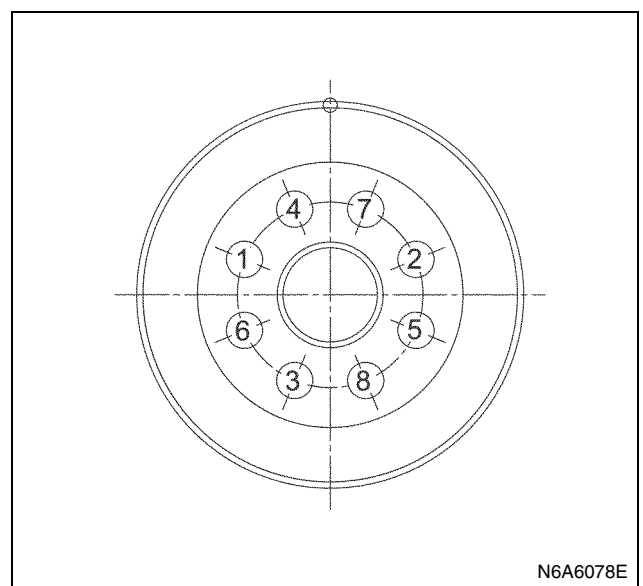
- Along with the knock pin of the crankshaft, install the flywheel and tighten up with the prescribed torque according to the order given on the figure.

Tighten:

Bolts to

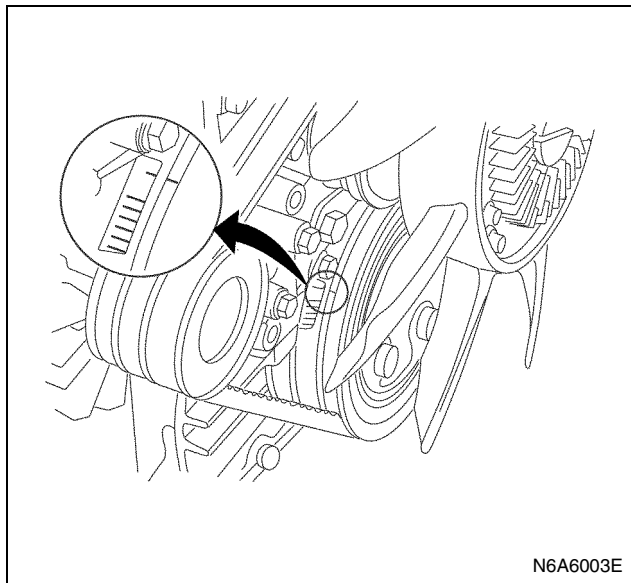
1st step: 78 N·m (8.0 kg·m/57 lb·ft)

2nd step: 120° – 150° (degrees)



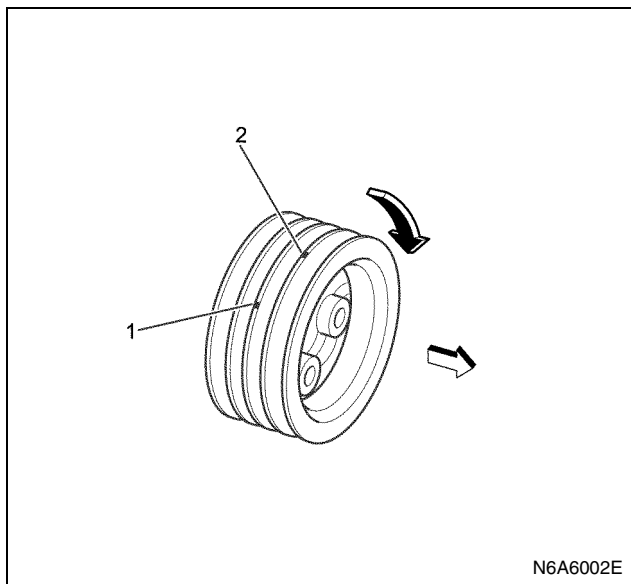
6A-52 Engine Mechanical (4HK1-TC)

11. Turn the crankshaft in the normal direction of engine rotation until the No. 1 or No. 4 cylinder is at TDC on the compression stroke. Refer to illustration.



Notice:

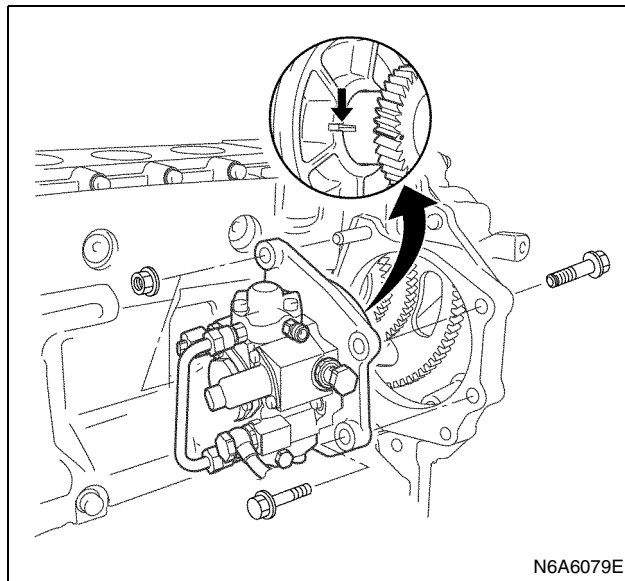
There are 2 timing marks on the crankshaft pulley. Mark (1) is near the front cover and is used to bring the 4HK1-TC engine to TDC. Mark (2) is not applicable to this engine. Be sure to use mark (1) when bringing the engine to TDC.



12. Remove the oil drain adapter.
13. Install the O-ring on the fuel supply pump.
14. Align the slits as shown in the illustration.
15. Insert the stud bolts into the guides and temporarily tighten them.

Caution:

- If the stud bolts (cylinder block side) have been loosened or replaced, apply Loctite No. 262 to the recessed portion of the bolts.



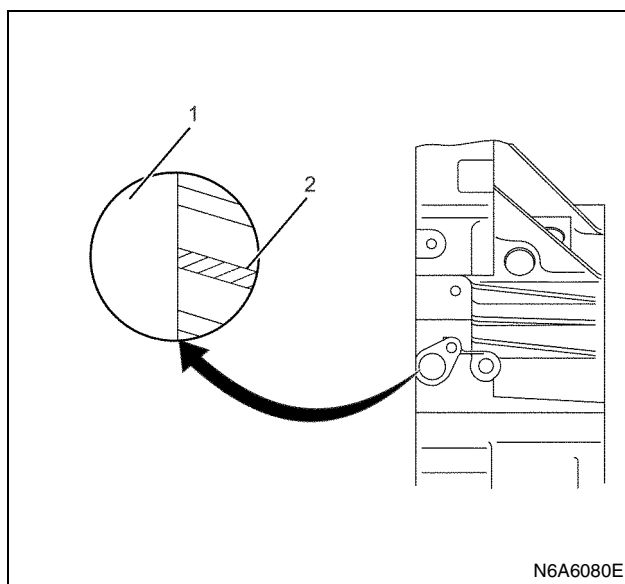
- Check if the meeting mark of the gear painted white is at the location given on the figure when viewed from the plug hole and tighten up with the prescribed torque.

Tighten:

Nut to 50 N·m (5.1 kg·m/36 lb·ft)

Bolt to 76 N·m (7.7 kg·m/56 lb·ft)

- If the location of the teeth of the painted gear is not in the right place, put it together all over again.



Legend

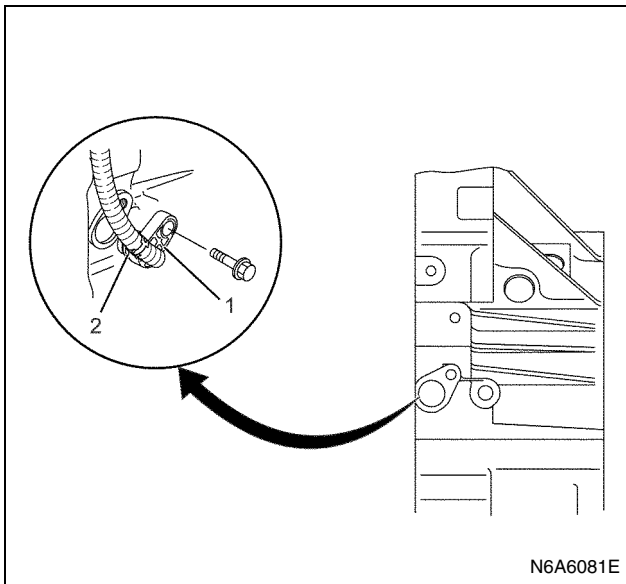
1. Plug Hole
2. Meeting Mark

16. Install the adapter assembly: oil drain on the plug hole and tighten up with the prescribed torque.

Tighten:

Bolt to 8 N·m (0.8 kg·m/69 lb·in)

- Apply engine oil over the O-ring nice and thin and install it.

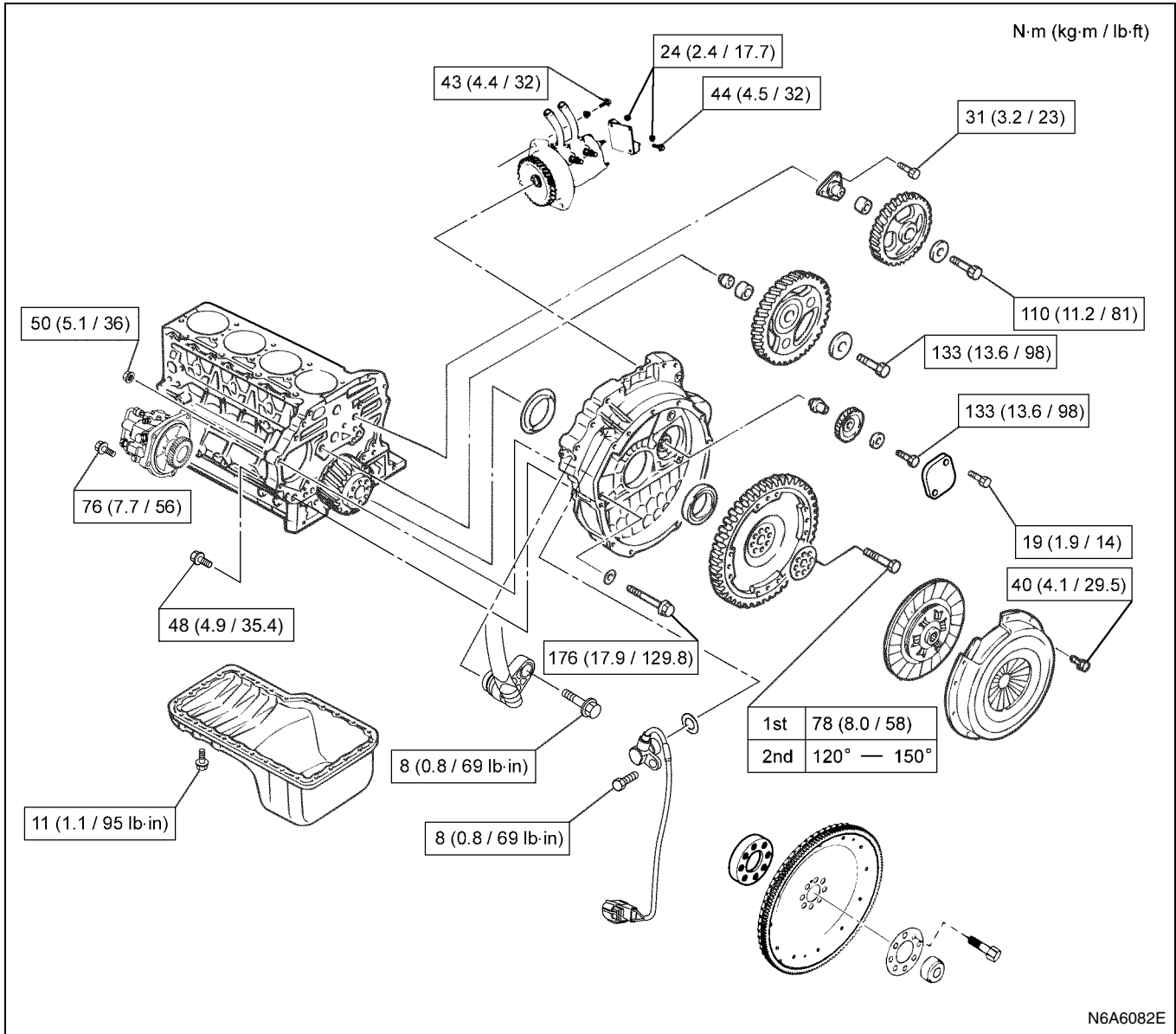


Legend

1. Adapter
2. O-ring

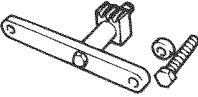
17. Install the cylinder head assembly.
Refer to "Cylinder Head".
18. Install the camshaft assembly.
Refer to "Camshaft Assembly".
19. Install the rocker arm shaft assembly.
Refer to "Rocker Arm Shaft Assembly".
20. Install the cylinder head cover.
Refer to "Cylinder Head Cover".

Torque Specifications



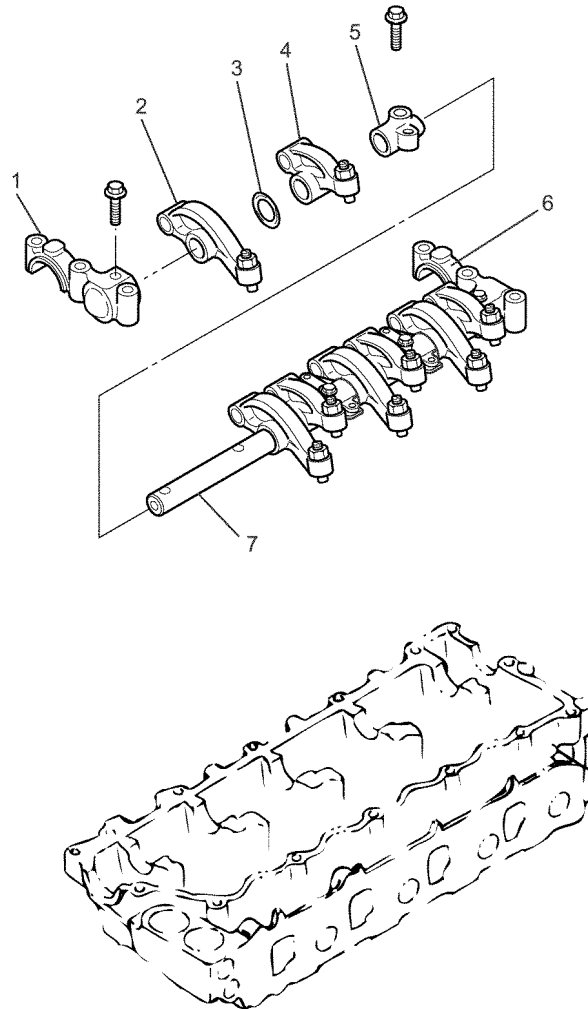
N6A6082E

Special Tool

Illustration	Tool Number / Description / Remarks
 5884022300	5-8840-2230-0 (EN-47680) Crankshaft Stopper

Rocker Arm Shaft Assembly

Component



N6A6083E

Legend

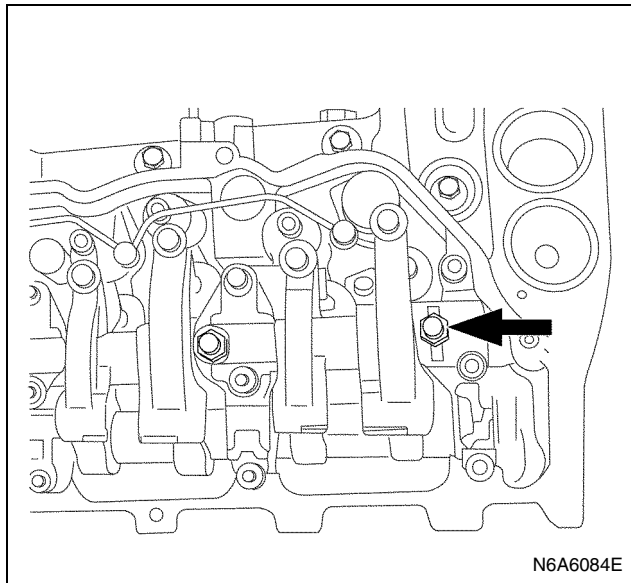
- | | |
|---------------------|-----------------------|
| 1. Camshaft Bracket | 5. Rocker Arm Bracket |
| 2. Rocker Arm | 6. Camshaft Bracket |
| 3. Wave Washer | 7. Rocker Arm Shaft |
| 4. Rocker Arm | |

Removal

1. Remove the cylinder head cover.
Refer to "Cylinder Head Cover".
2. Remove the rocker arm shaft assembly.
 - Along with the camshaft bracket, remove the rocker arm shaft assembly.

6A-56 Engine Mechanical (4HK1-TC)

- Keep the 2-bolts (arrowed in the figure) fixing the rocker arm shaft to the camshaft bracket, before removal of all the rocker arm brackets



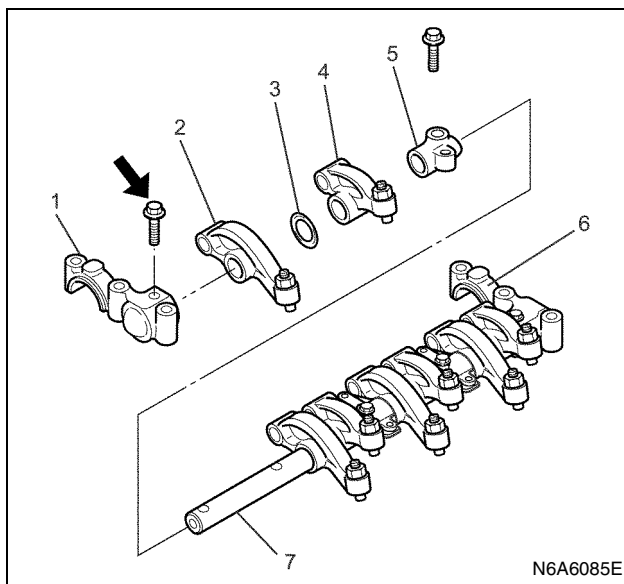
Caution:

Pay full attention so as not to drop the bridge cap in the gear case of the rear part of the cylinder head or the hole into which oil pours back in the front.

Dismount

1. Remove the camshaft bracket.
2. Remove the rocker arm.
3. Remove the wave washer.
4. Remove the rocker arm.
5. Remove the rocker arm bracket.
 - Repeat the procedure of (2) to (5).

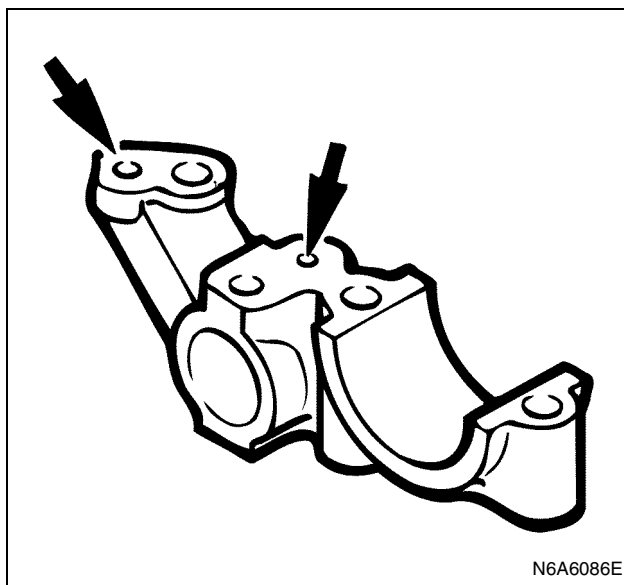
6. Remove the camshaft bracket to take the shaft out.



Legend

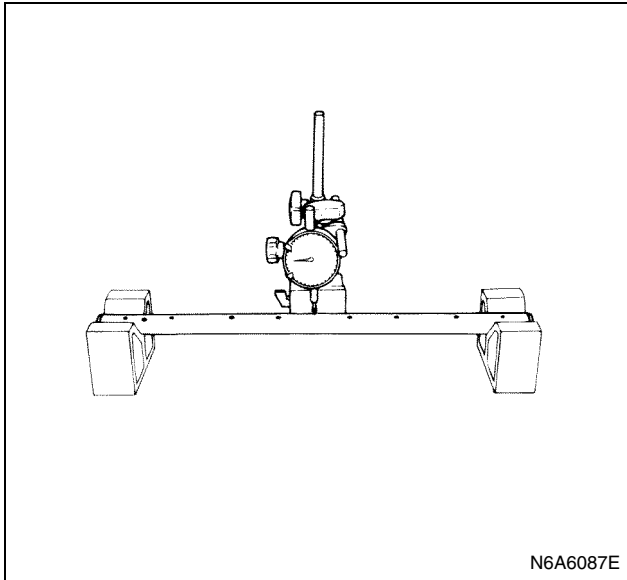
1. Camshaft Bracket
2. Rocker Arm
3. Wave Washer
4. Rocker Arm
5. Rocker Arm Bracket
6. Camshaft Bracket
7. Rocker Arm Shaft

7. Check if the oil hole of the camshaft bracket (on the rear side) is clogged.



8. Check if the rocker arm shaft is warpage.
 - Place the rocker arm shaft on a V block.
 - Mesure the runout of the rocker arm shaft with a dial gauge on the center of the shaft.
 - As a result of measurement, if its bend is slight, press it to rectify it (do not heat).
 - If the warpage of the shaft exceeds the limit, replace the shaft.

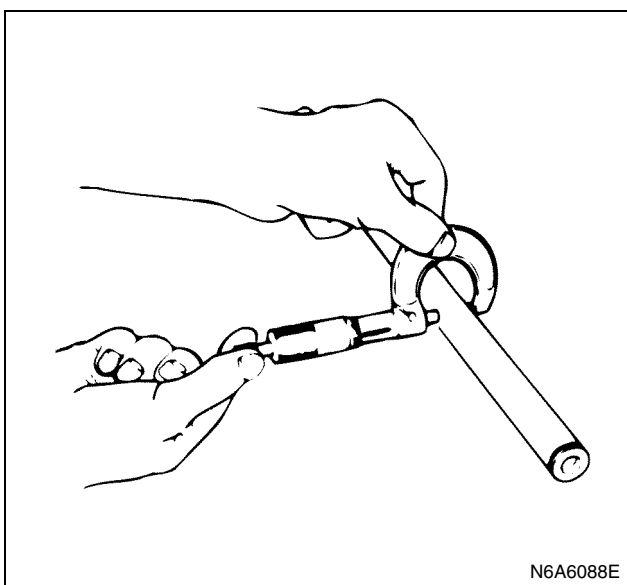
Bend of the rocker arm shaft mm (in)	
Limit	0.3 (0.012)



9. Check if the rocker arm shaft is worn.

- Use a micrometer to measure 8 places rubbed by the rocker arms.
- Replace the shaft if the diameter is less than the limit.

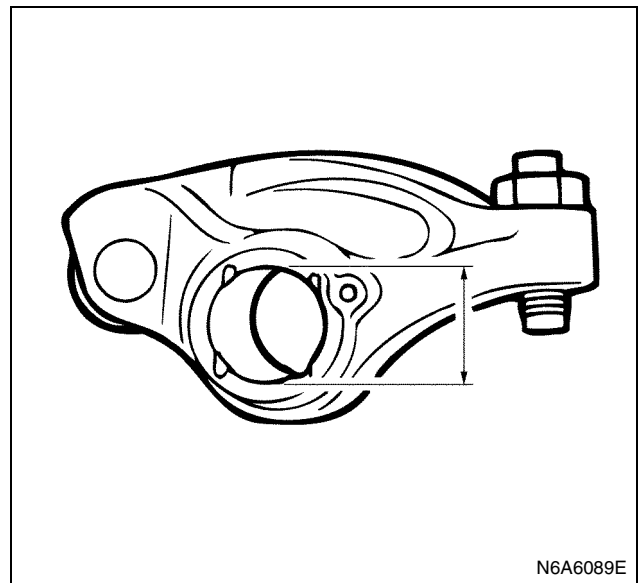
External diameter of the rocker arm shaft mm (in)	
Standard	21.979 – 22.000 (0.865 – 0.866)
Limit	21.85 (0.860)



10. Inspect a clearance between the rocker arm and the rocker arm shaft.

- Use a cylinder gauge to measure an inside diameter of the bush of the rocker arm to measure a clearance between the external diameter of the shaft.
- If the measurement exceeds the limit, replace the rocker arm and the shaft.

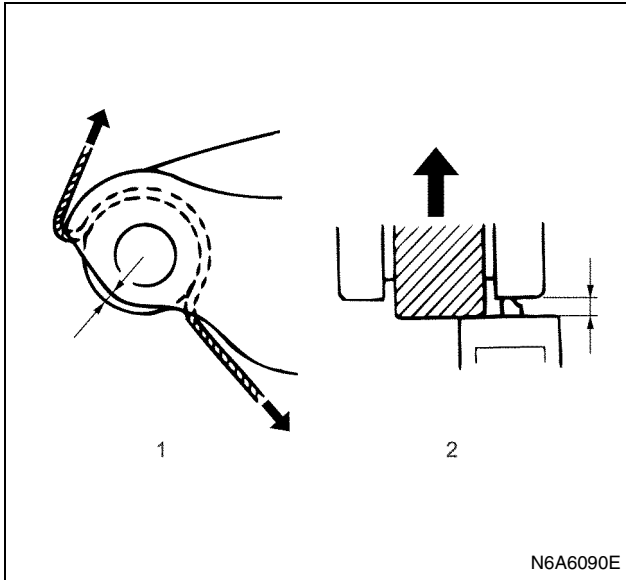
Clearance between the rocker arm and rocker arm shaft mm (in)	
Standard	0.010 – 0.056 (0.0004 – 0.0022)
Limit	0.2 (0.0079)



11. Inspect a clearance between the roller of the rocker arm and the rocker arm pin.

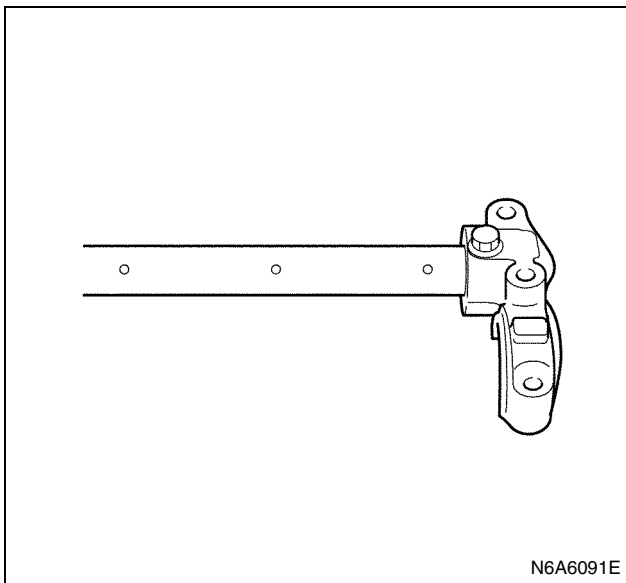
- Pass a string, through the opening between the rocker arm and the roller, pull it strongly in the direction indicated with arrows and measure the gap between the rocker arm and the roller with the roller being hulled out. (Figure 1)
- After marking the measuring point, pull the string out push the roller fully into the rocker arm, and measure the gap of the marked place. (Figure 2)
- The gap between the measurement taken under a. and that under b. Is the a clearance between the roller and the rocker arm pin. If it exceeds the limit, replace the rocker arm.

Clearance between the roller and the rocker arm pin mm (in)	
Standard	0.068 – 0.100 (0.0026 – 0.0039)
Limit	0.2 (0.0079)



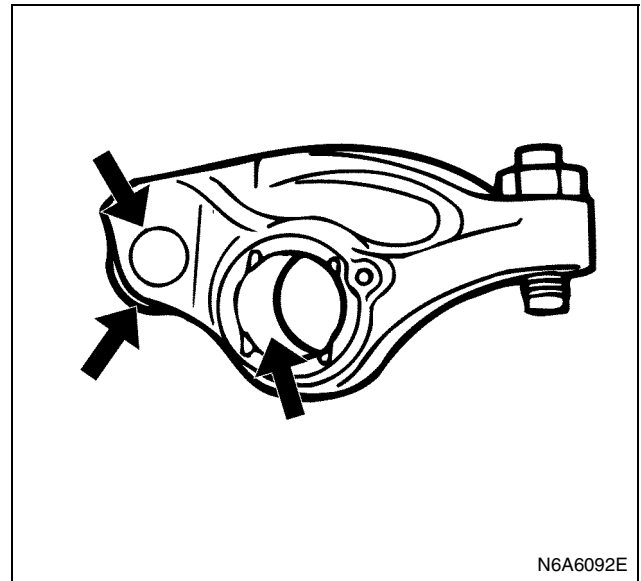
Reassembly

1. Install the camshaft bracket to one side of the rocker arm shaft tentatively first. (Tighten them up, after the rocker arm shaft assembly is installed on the cylinder head.)
 - Assemble in the reverse order to dismantling.

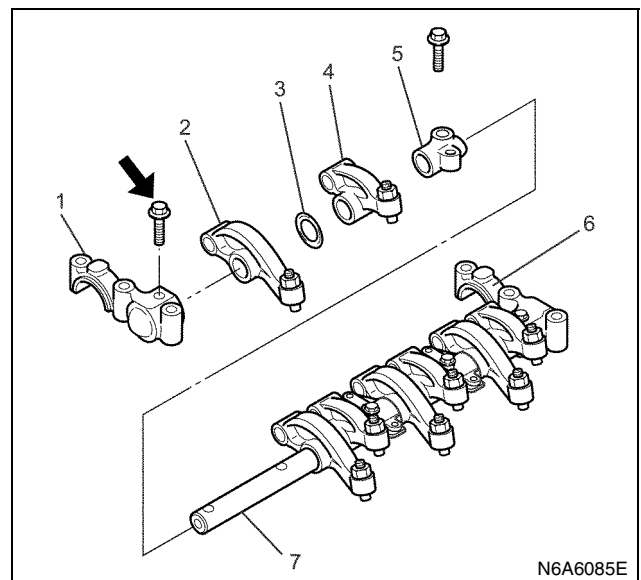


2. Install the rocker arm.

- Apply engine oil to the hole of the rocker arm, the roller and the rocker arm pin.



3. Install the wave washer between the rocker arm.
4. Install the rocker arm bracket.
 - Paying attention to the direction of the rocker arm bracket, repeat the step 2 to 4.
5. Install the camshaft bracket.
 - Install the camshaft bracket on the rocker arm shaft with the bolts indicated with an arrow tightened tentatively. (Tighten them up, after the rocker arm shaft assembly is installed on the cylinder head.)



Legend

1. Camshaft Bracket
2. Rocker Arm
3. Wave Washer
4. Rocker Arm
5. Rocker Arm Bracket
6. Camshaft Bracket
7. Rocker Arm Shaft

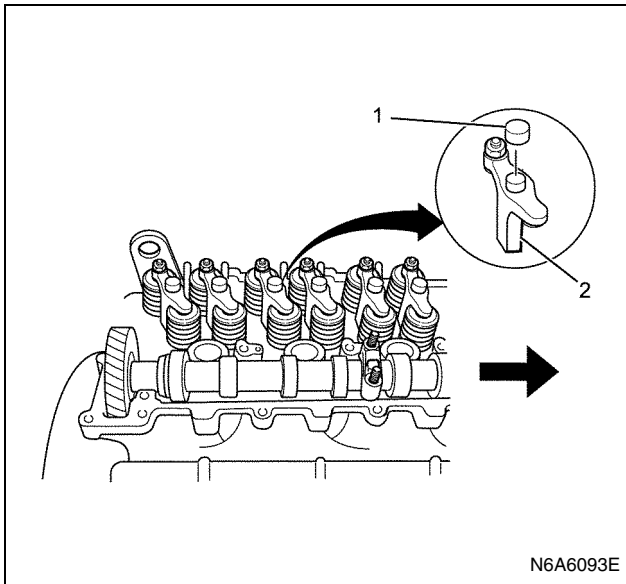
Installation

1. Install the rocker arm shaft assembly.

- If the bridge cap comes off, apply engine oil over the inside of the bridge cap and put it together with the bridge.

Caution:

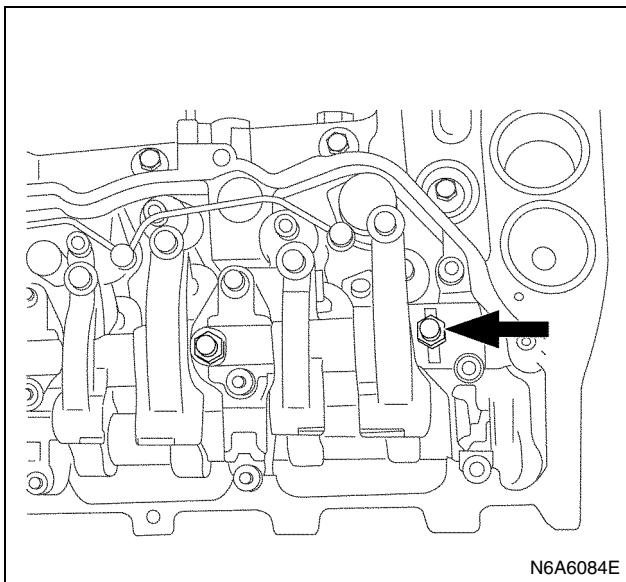
Pay full attention so as not to drop the bridge cap in the gear case of the rear part of the cylinder head or the hole into which oil pours back in the front.



Legend

1. Bridge Cap
2. Bridge

- 1) Temporarily tighten the bolts marked with the arrow in the illustration.
- 2) Loosen the rocker arm adjust screws and apply engine oil to the rocker arm roller portions.
- 3) Install the rocker arm assembly on the cylinder head.



- Apply engine oil on threads of the bolts and nuts, and fix them tentatively (about tighten up).
- Tighten them up according to the order specified below gradually, taking care not to incline the entire rocker arm assembly.

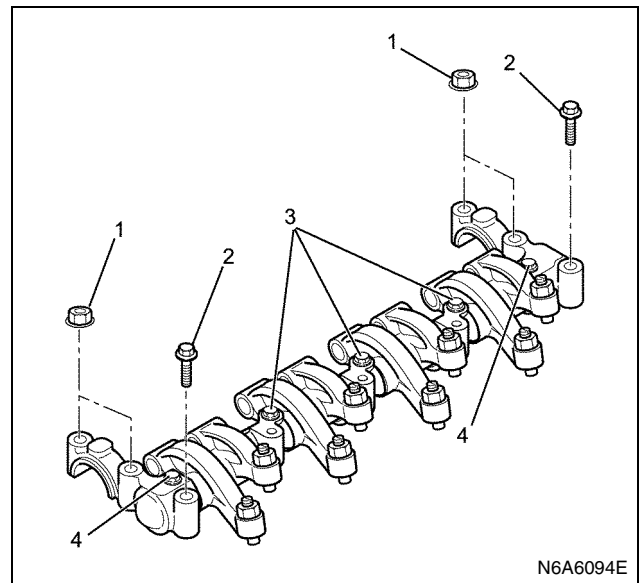
Tightening order:

1. Nuts (1) from near side of the rocker arm shaft
2. Bolts (2)
3. Bolts (3) from out side
4. Bolts (4)

Tighten:

Bolt (3) to 56 N·m (5.7 kg·m/41 lb ft)

Nut (1), Bolt (2), (4) to 27 N·m (2.8 kg·m/20 lb ft)

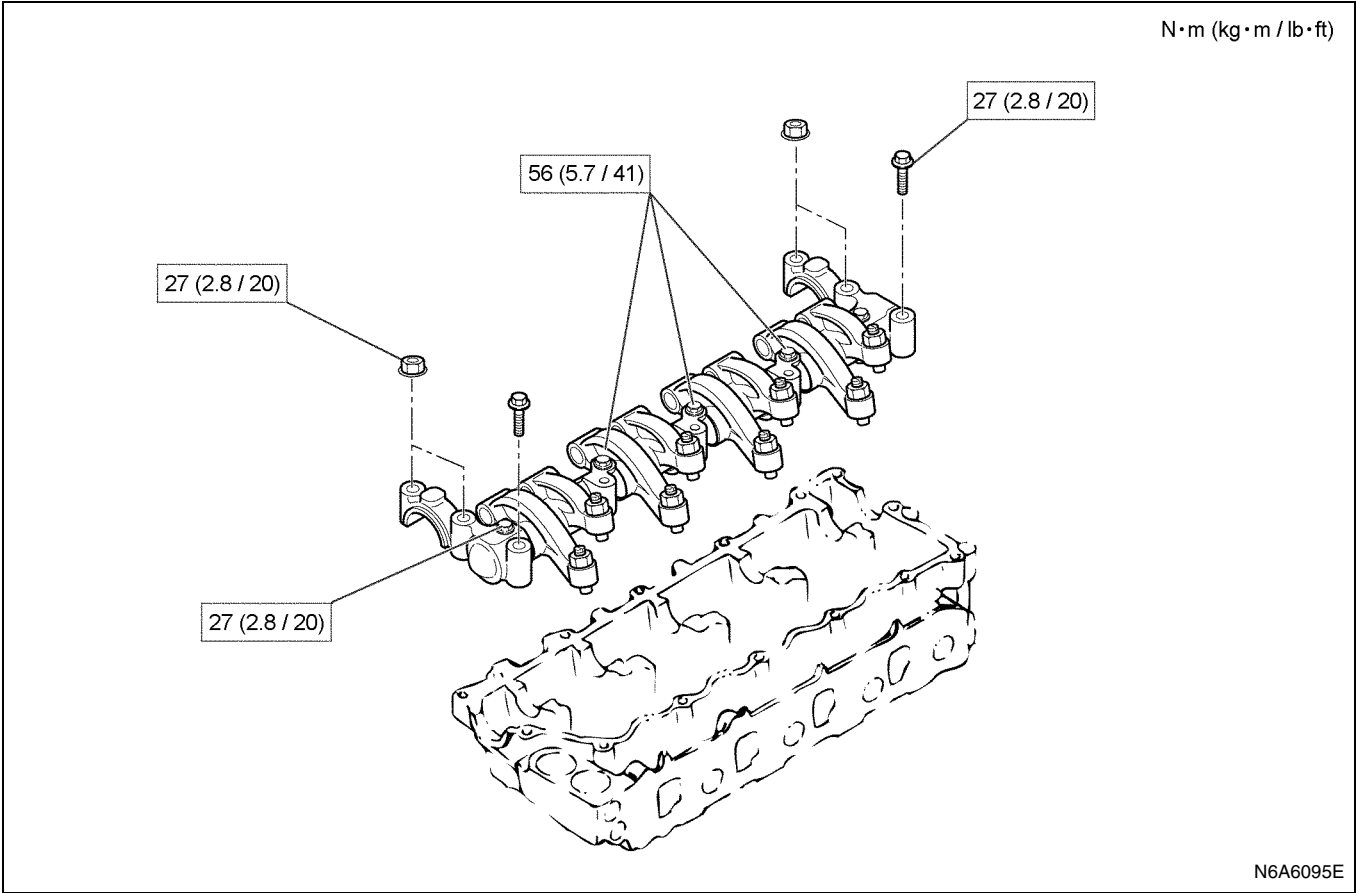


Legend

1. Camshaft Bracket Fixing Nut
2. Camshaft Bracket Fixing Bolt
3. Rocker Arm Bracket Fixing Bolt
4. Rocker Arm Shaft Set Bolt

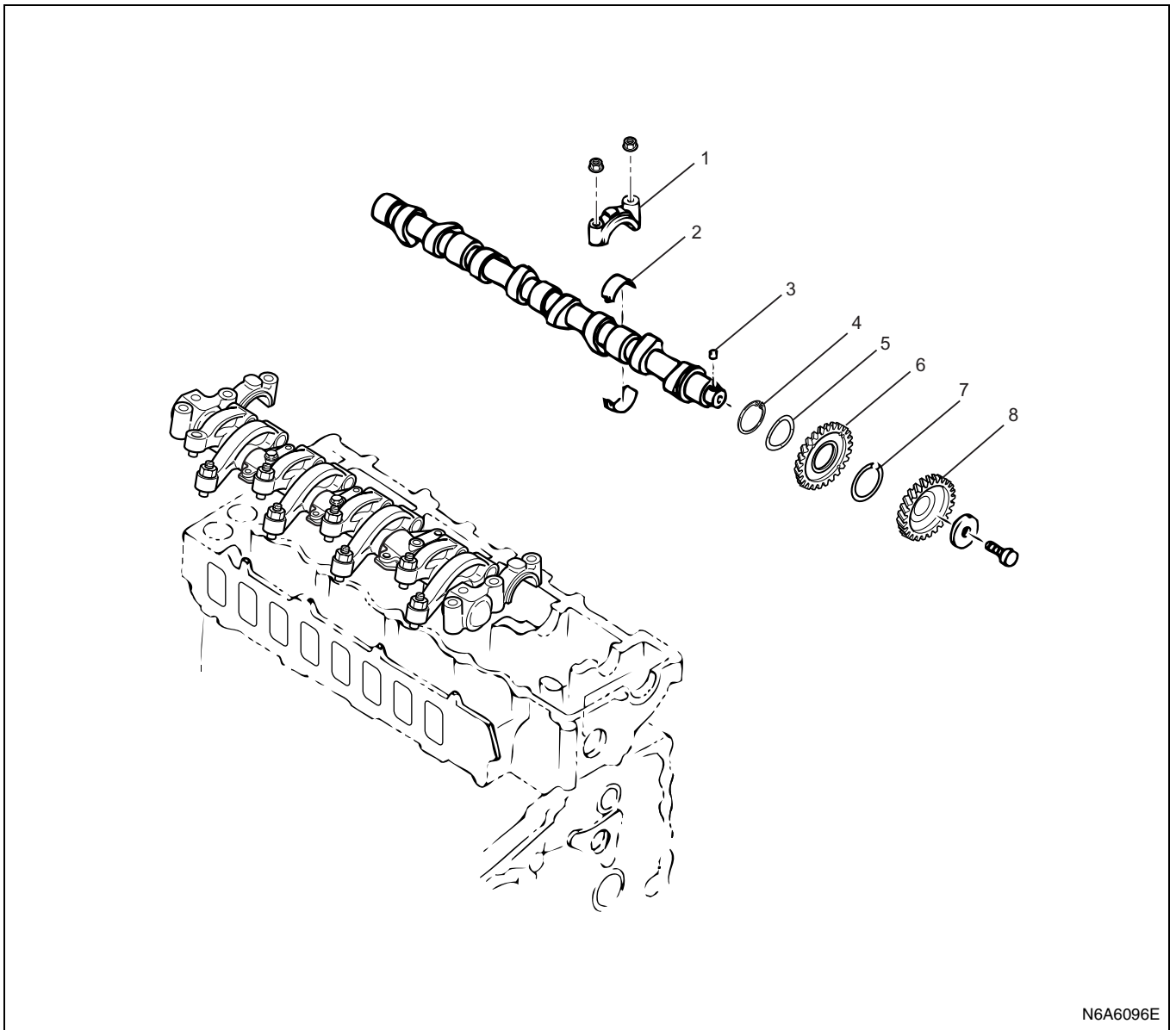
- Adjust valve clearance.
Refer to "Functional Inspection".
2. Install the cylinder head cover.
Refer to "Cylinder Head Cover".

Torque Specifications



Camshaft Assembly

Component



N6A6096E

Legend

- | | |
|----------------|------------------|
| 1. Bearing Cap | 5. Dish Washer |
| 2. Bearing | 6. Sub Gear |
| 3. Knock Pin | 7. Spring |
| 4. Snap Ring | 8. Camshaft Gear |

Removal

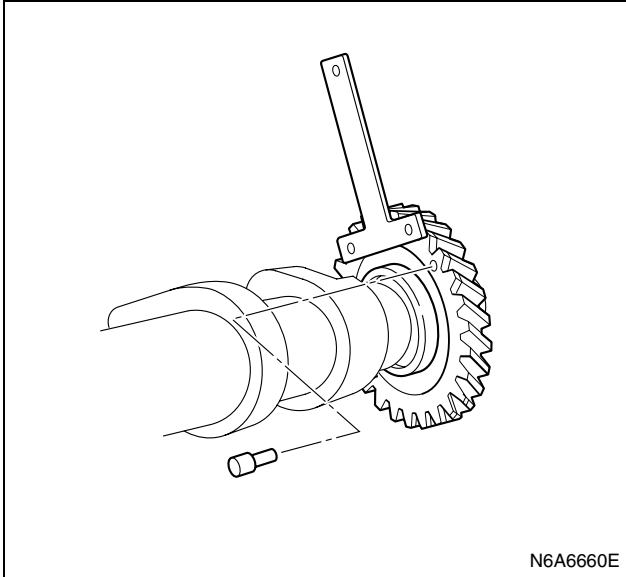
1. Rotate the crank shaft to make the No. 1 cylinder meet the compression TDC.
2. Remove the cylinder head cover.
Refer to the "cylinder head cover."
3. Remove the rocker arm shaft assembly.
Refer to the "rocker arm shaft assembly."
4. Remove the camshaft bearing cap.

6A-62 Engine Mechanical (4HK1-TC)

- Before removing the camshaft from the cylinder head, rotate the sub gear using the special tool to prevent the spring force which acts on the sub gear from affecting. Align the hole of the sub gear with the camshaft main gear and install the phase alignment pin from the sub gear side to match the teeth.

Special tool

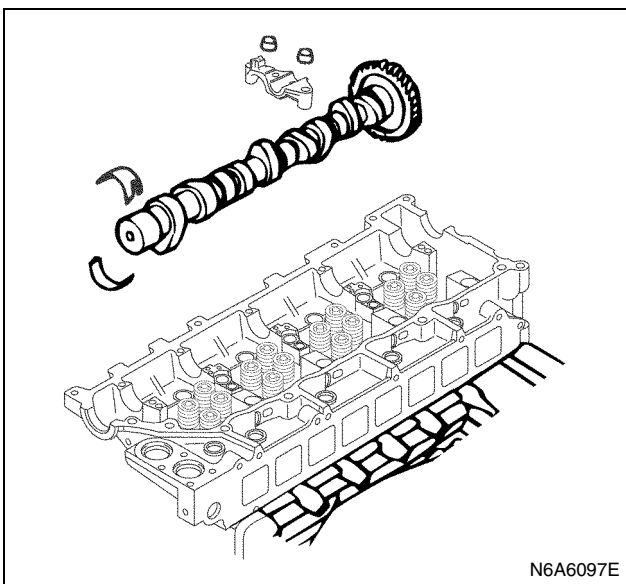
Scissors gear spring wrench: 5-8840-2674-0



5. Remove the bearing upper.
6. Remove the camshaft assembly.
7. Remove the bearing lower.

Caution:

Put the removed bearings in order with a tag, for example, by cylinder.



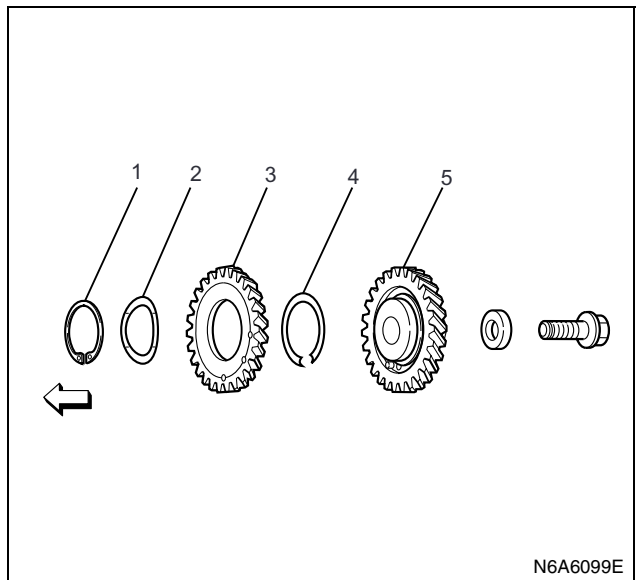
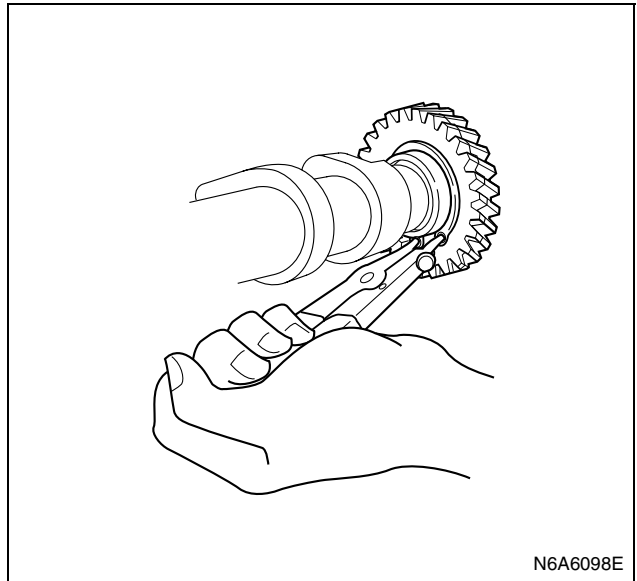
Disassembly

1. Remove the scissors gear assembly.

- Fix the hexagon portion of the camshaft in a vise using a mouth ring. Use snap ring pliers to remove the sub gear.

Caution:

Take care not to damage to the cam portion and the journal portion of the camshaft.

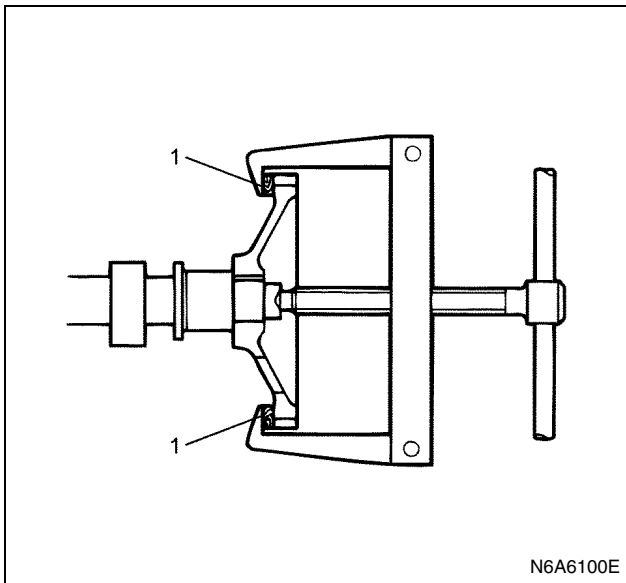


Legend

1. Snap Ring
2. Dish Washer
3. Sub Gear
4. Spring
5. Camshaft Gear

2. Remove the camshaft gear.

- Remove the fastening bolts of the camshaft gear and put the block of wood in a puller to remove the camshaft gear.



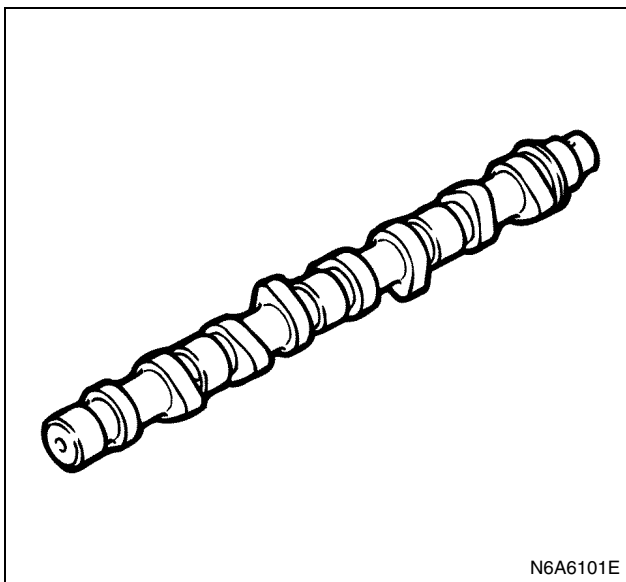
Legend

1. Wood

3. Remove the dowel pin.

4. Inspect the camshaft visually.

- Check if the journal and cam parts of the camshaft are worn or damaged, if so, replace it.



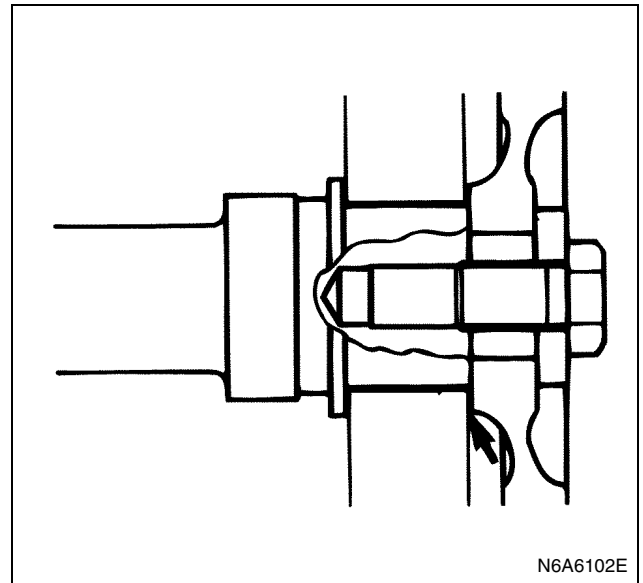
5. Inspect an end clearance of the camshaft.

- Use a thickness gauge to measure an end clearance of the camshaft gear and the camshaft bracket.
- If the measurement exceeds the limit, replace the camshaft gear or the camshaft.

End clearance of the camshaft		mm (in)
Standard	0.085 – 0.205	(0.033 – 0.008)
Limit	0.25	(0.009)

Caution:

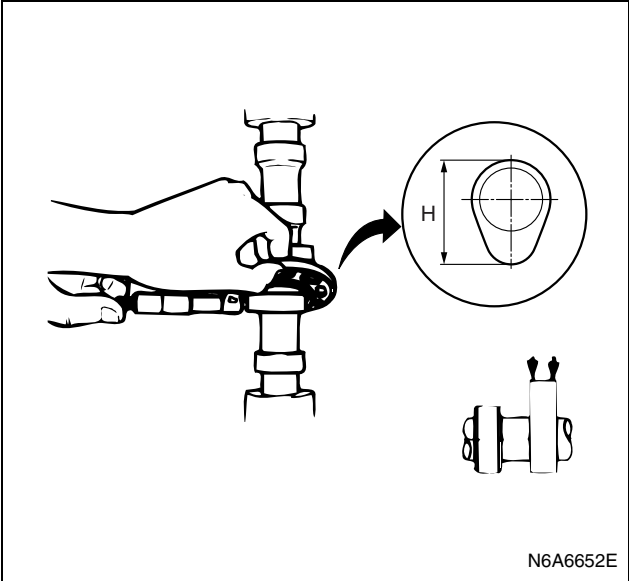
Measure an end clearance of the camshaft before disassembling.



6. Check if the cam lobe is worn.

- Measure the height "H" of the cam lobe with a micrometer.
- If the height of the cam lobe is the limit or less, replace the camshaft.

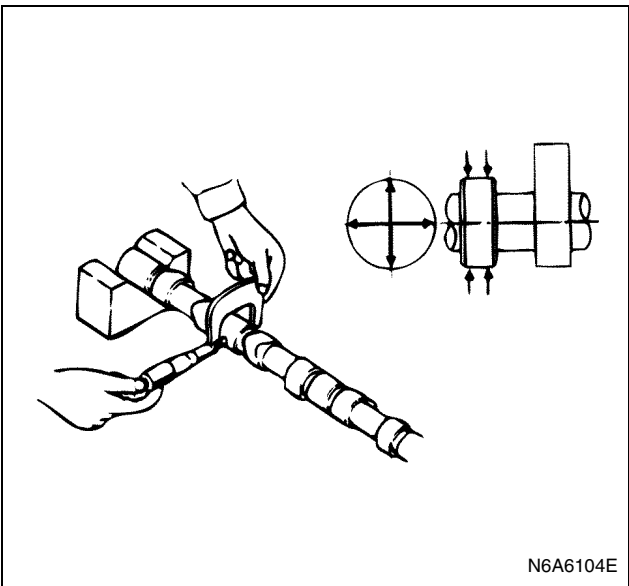
Height of the cam lobe			mm (in)
	Inlet	Exhaust	
Standard	52.8	54.5	(2.08) (2.15)
Limit	51.8	53.5	(2.04) (2.11)



7. Check if the camshaft journal is worn.
- Use a micrometer to measure wear which is not even with a diameter of the camshaft journal.
 - If the measured uneven wear exceeds the limit, replace the camshaft.

External diameter of the camshaft journal part		mm (in)
Standard	39.950 – 39.975	(1.5728 – 1.5738)
Limit	39.850	(1.5688)

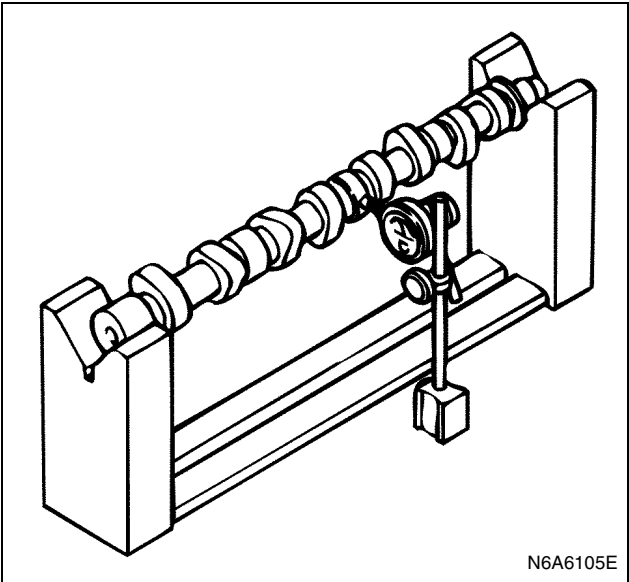
Partial wear of the camshaft journal part		mm (in)
Limit	0.05	(0.0019)



8. Check if the camshaft is warpage.
- Place the camshaft on a V block to measure a runout with a dial gauge.

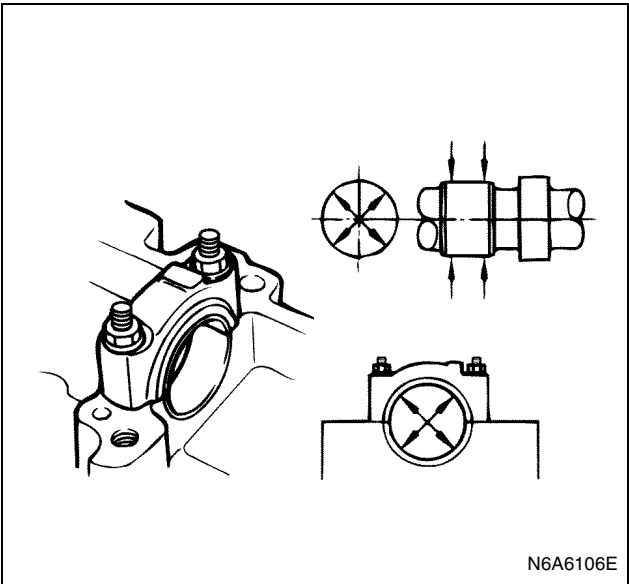
- Rotate the camshaft slowly and measure the range of fluctuation. If it exceeds the limit, replace the camshaft.

Warpage of the camshaft		mm (in)
Limit	0.05	(0.0019)



9. Measure camshaft journal oil clearance.
- Measure the inside diameter of the camshaft bearing with a dial gauge.
 - Read the difference between the inside diameter of the camshaft bearing and the diameter of the camshaft journal.
If the measured oil clearance exceeds the limit, replace the camshaft bearing.

Clearance of the journal part		mm (in)
Standard	0.025 – 0.087	(0.0009 – 0.0034)
Limit	0.15	(0.0059)



Reassembly

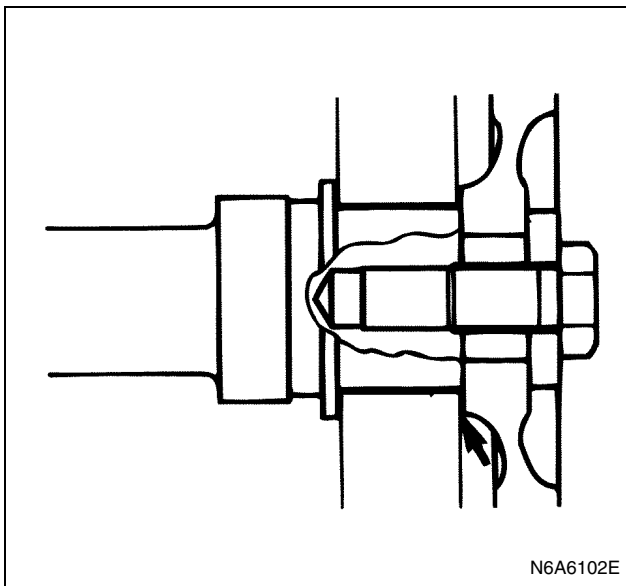
1. Install the knock pin.
2. Install the camshaft gear.
 - With the side of the camshaft gear center boss part stuck out being on the camshaft side, install the camshaft gear along with the knock pin.

Tighten:

Bolt to 142 N·m (14.5 kg·m/105 lb·ft)

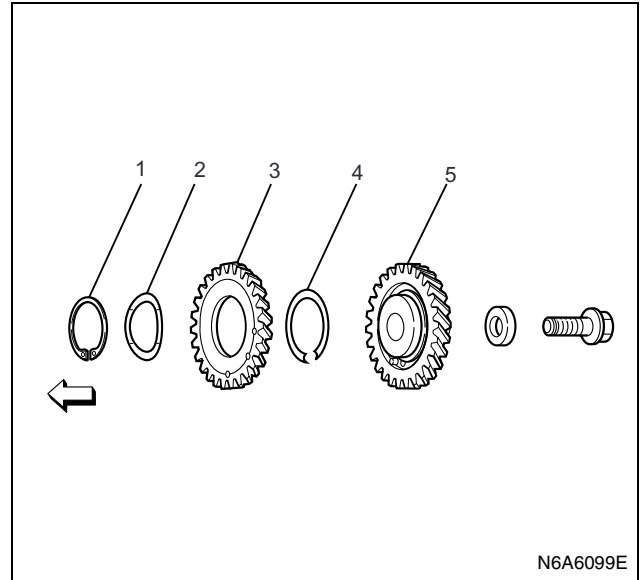
Caution:

Be careful not to damage the cam and journal parts when tightening up the gear.



3. Install the scissors gear assembly.

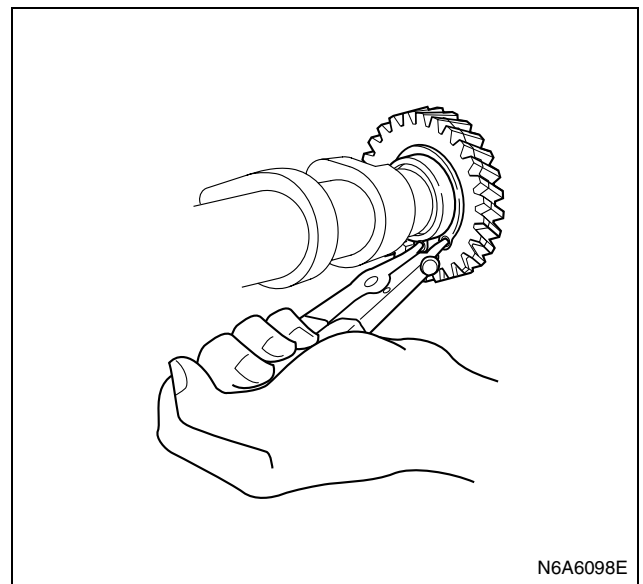
- Fix the hexagon portion of the camshaft in a vise using a mouth ring. Assemble the spring with its left end contacting the pin of camshaft main gear to make a gap on the right.
- Assemble the sub gear so that its pin is inserted into the gap between the right side of pin of the camshaft main gear and the right end of the spring.



Legend

1. Snap Ring
2. Dish Washer
3. Sub Gear
4. Spring
5. Camshaft Gear

- Use snap ring pliers to assemble the snap ring and the dish washer securely.

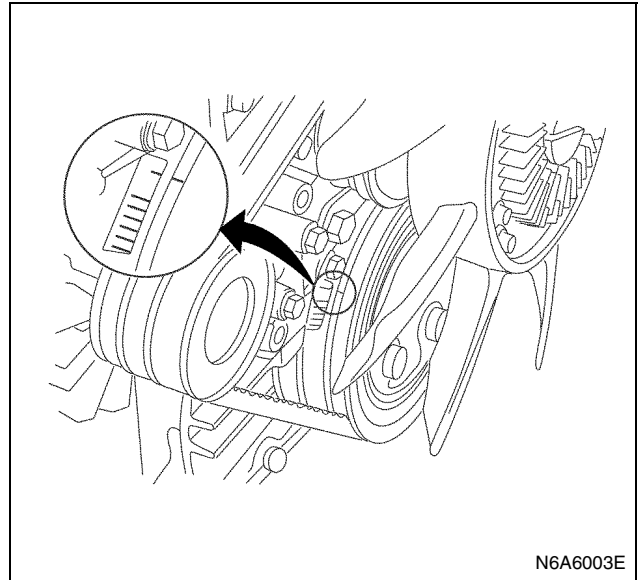
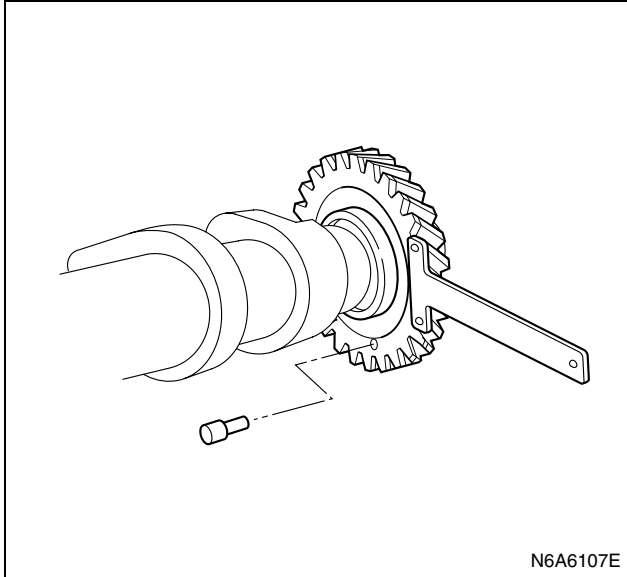


6A-66 Engine Mechanical (4HK1-TC)

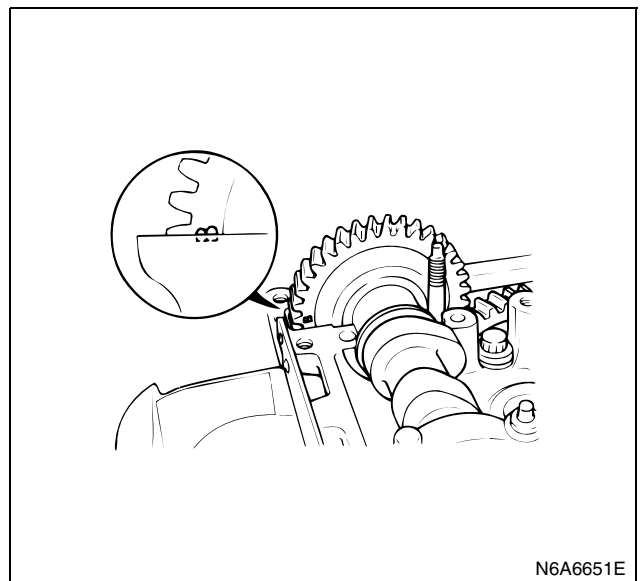
- Before installing the camshaft to the cylinder head, rotate the sub gear using the special tool to prevent the spring force which acts on the sub gear from affecting. Align the hole of the sub gear with the camshaft main gear and install the phase alignment pin from the sub gear side to match the teeth.

Special tool

Scissors gear spring wrench: 5-8840-2674-0



2. Install the camshaft bearing lower.
 - Apply engine oil over the camshaft bearing lower and install it on the cylinder head.
3. Install the camshaft assembly.
 - The camshaft assembly 'B' mark must be facing the cylinder head upper face. If not, serious engine damage will result.



Installation

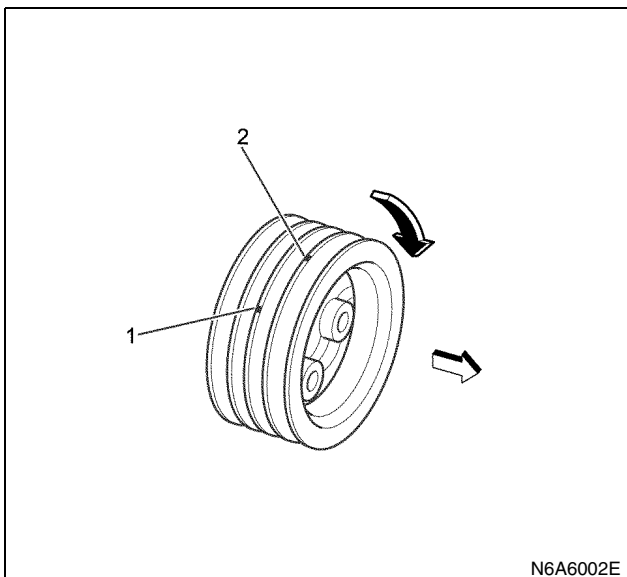
1. Turn the crankshaft in the normal direction of engine rotation until the No. 1 or No. 4 cylinder is at TDC on the compression stroke.

Notice:

There are 2 timing marks on the crankshaft pulley. Mark (1) is near the cylinder block and is used to bring the 4HK1-TC engine to TDC.

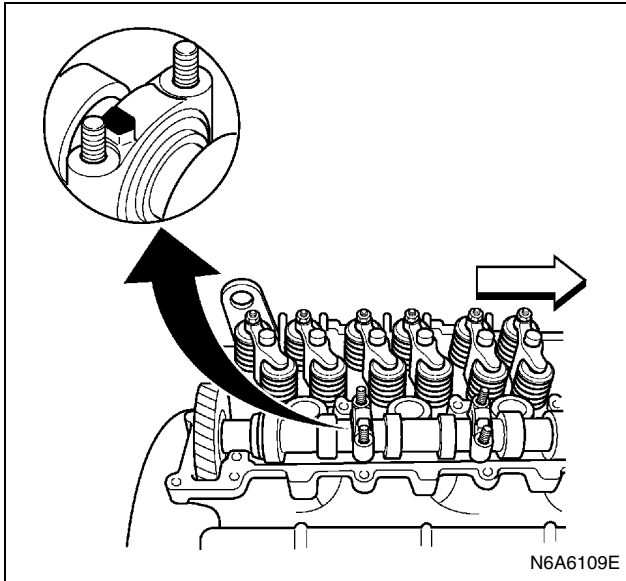
Mark (2) is not applicable to this engine.

Be sure to use mark (1) when bringing the engine to TDC.



4. Install the bearing upper to the bearing cap.
5. Install the bearing cap.
 - Apply engine oil on the bearing upper.

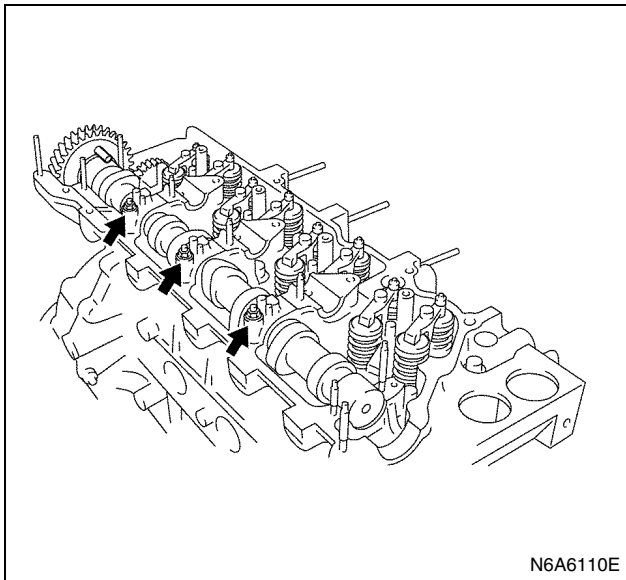
- Direct the front mark of the bearing cap toward the front of the engine and put it together with the cylinder head in numerical order.



- Apply engine oil to the thread and tighten up the bearing cap with the prescribed torque.

Tighten:

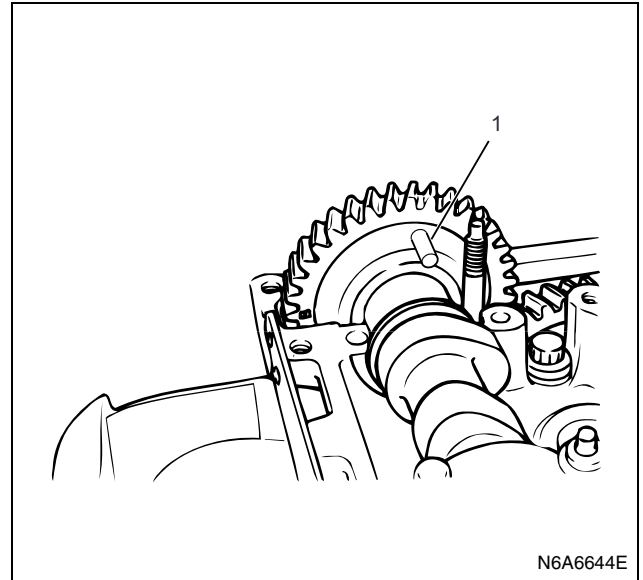
Nut to 27 N·m (2.8 kg·m/20 lb·ft)



- Pull out the phase alignment pin of the gear (1) carefully so that it does not fall into inside the engine.

Caution:

Be careful not to forget to pull out the phase alignment pin of the gear.

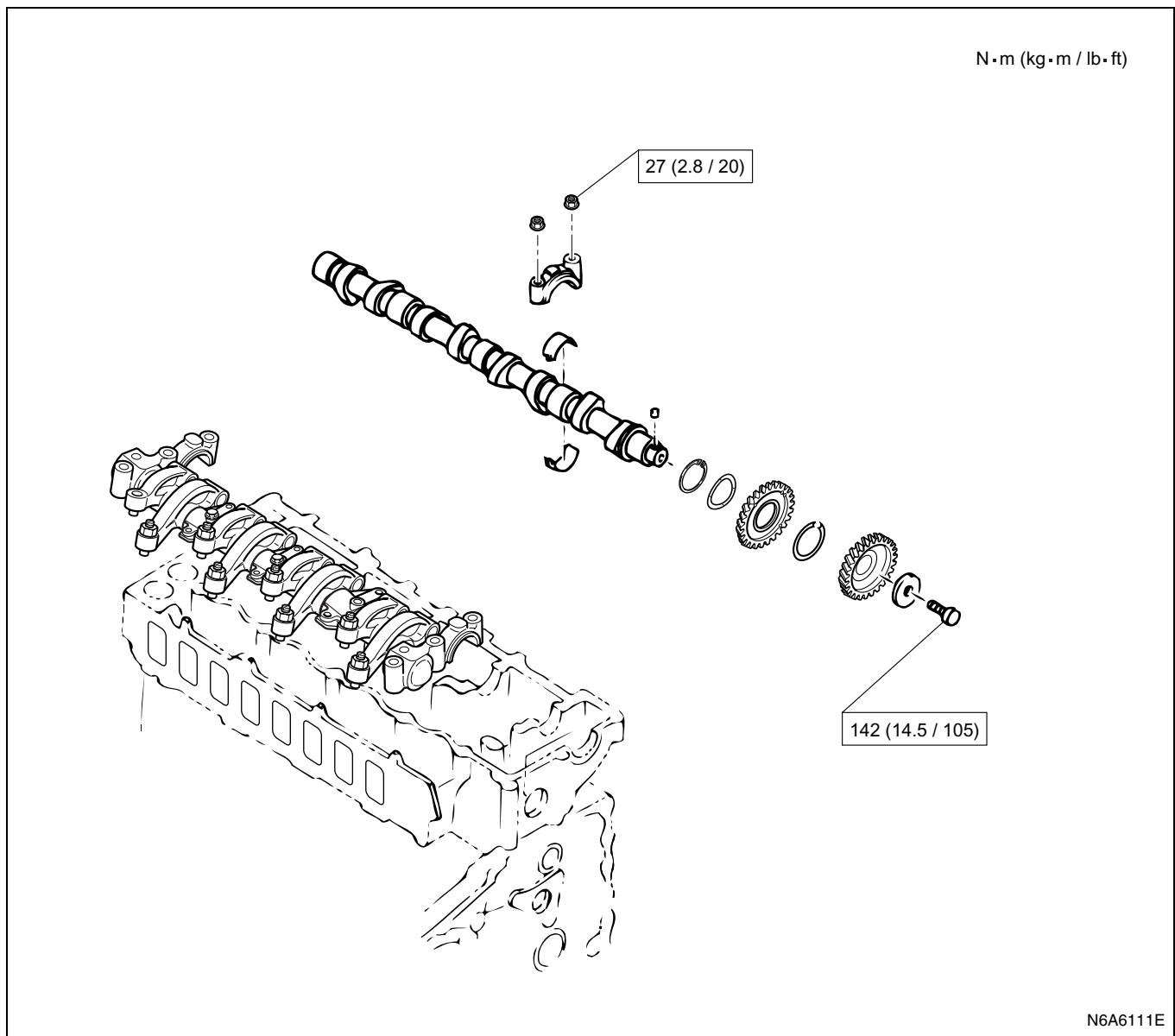


Legend

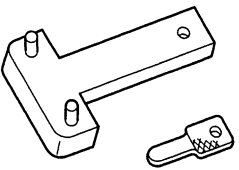
1. Phase Alignment Pin

6. Install the rocker arm shaft assembly.
Refer to "Rocker Arm Shaft Assembly".
7. Install the cylinder head cover.
Refer to "Cylinder Head Cover".

Torque Specifications

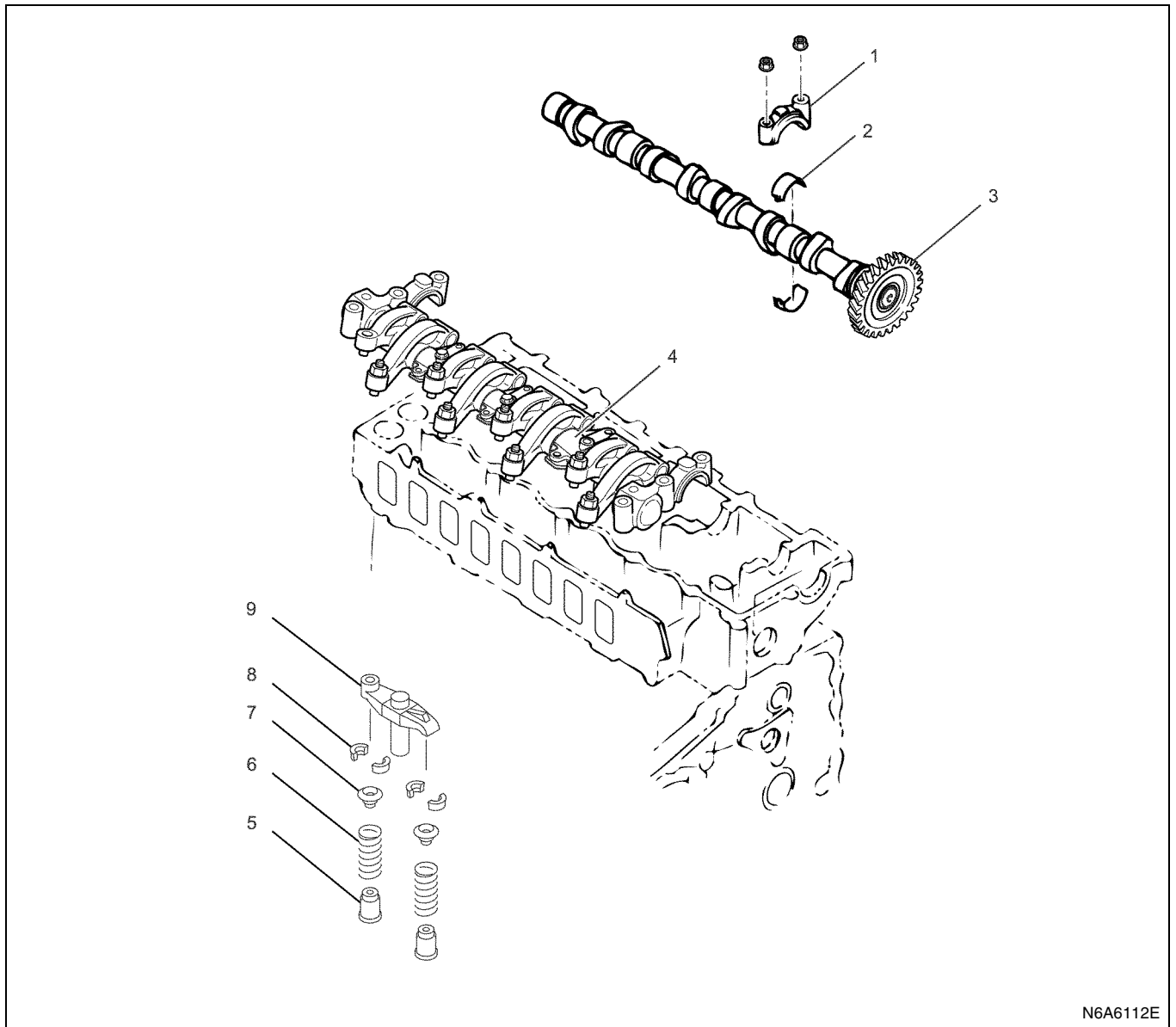


Special Tool

Illustration	Tool Number / Description / Remarks
 5884026740	5-8840-2674-0 Scissors Gear Spring Wrench

Valve Stem Seal and Valve Spring

Component



Legend

- | | |
|------------------------------|----------------------|
| 1. Camshaft Bearing Cap | 6. Valve Spring |
| 2. Camshaft Bearing | 7. Spring Upper Seat |
| 3. Camshaft Assembly | 8. Split Collar |
| 4. Rocker Arm Shaft Assembly | 9. Bridge |
| 5. Valve Stem Oil Seal | |

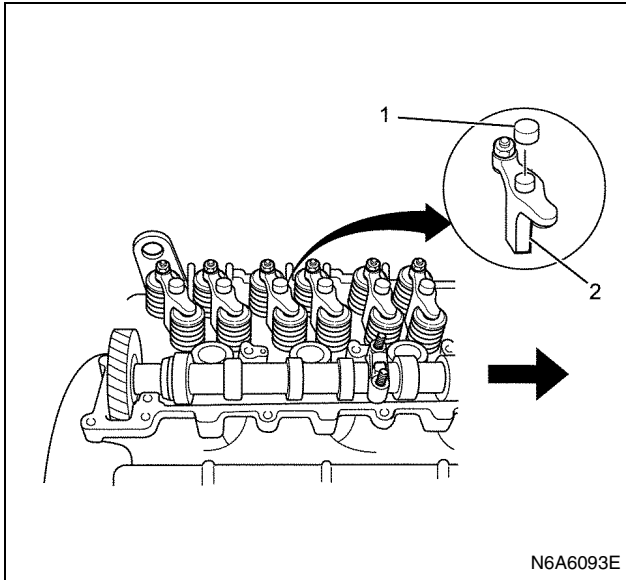
Removal

1. Remove the cylinder head cover.
Refer to "Cylinder Head Cover".
2. Remove the rocker arm shaft assembly.
Refer to "Rocker Arm Shaft Assembly".
3. Remove the camshaft assembly.
Refer to "Camshaft Assembly".
4. Remove the bridge cap (1).

5. Remove the bridge (2).

Caution:

Keep the removed bridge and bridge cap properly so that they may be put back to the original position.



Legend

1. Bridge Cap
2. Bridge

Caution:

Pay full attention so as not to drop the bridge cap in the gear case of the rear part of the cylinder head or a hole into which oil pours back in the front.

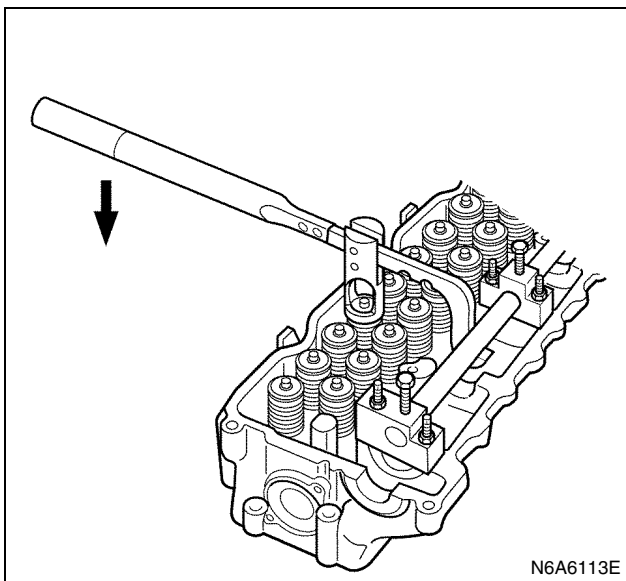
6. Remove the split collar.

- Apply compressed air over the cylinder from a glow plug hole to keep the valve at the home position.
- Use a replacer to compress the valve spring to remove the split collar.

Special tool

Valve spring replacer: 5-8840-2621-0 (J-43263)

Pivot: 5-8840-2808-0 (EN-46721)



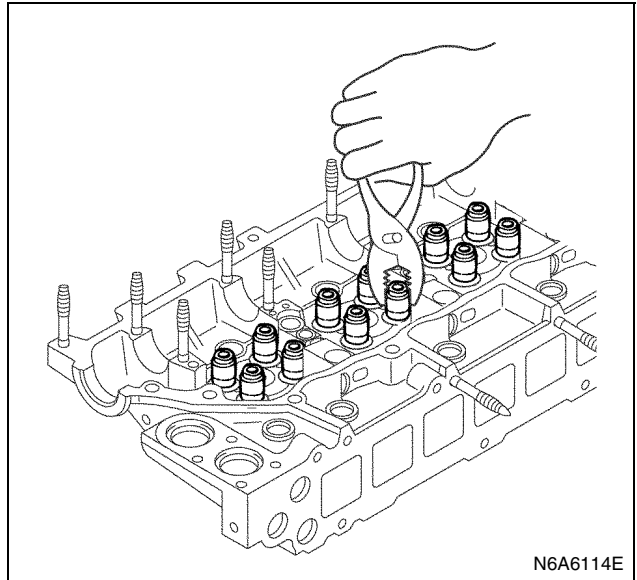
7. Remove the spring upper seat.

- Remove the special tool to remove the upper seat.

8. Remove the valve spring.
Put the removed valve springs in order by cylinder number.

9. Remove the valve stem oil seal.

- Use pliers to remove the oil seal.



Caution:

Do not use the removed oil seal again.

Inspection

Inspect the valve spring

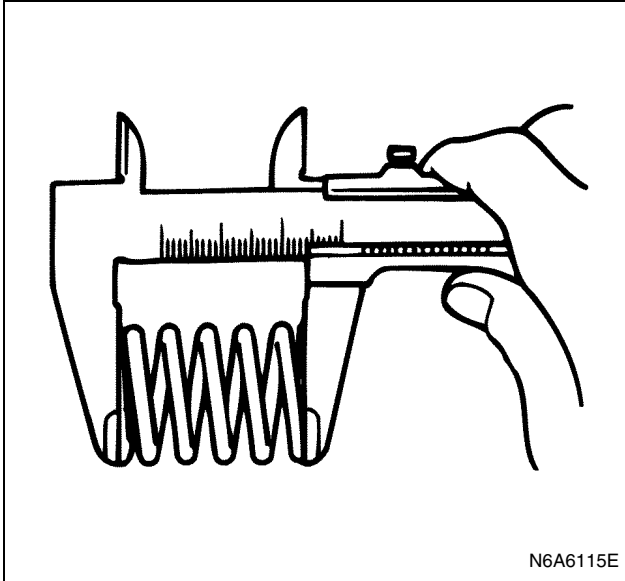
Caution:

Check the valve spring visually and if there is clear damage or wear-out, replace it.

1. Free length

- Measure free length of the spring and if it is shorter than the prescribed limit, replace the spring.

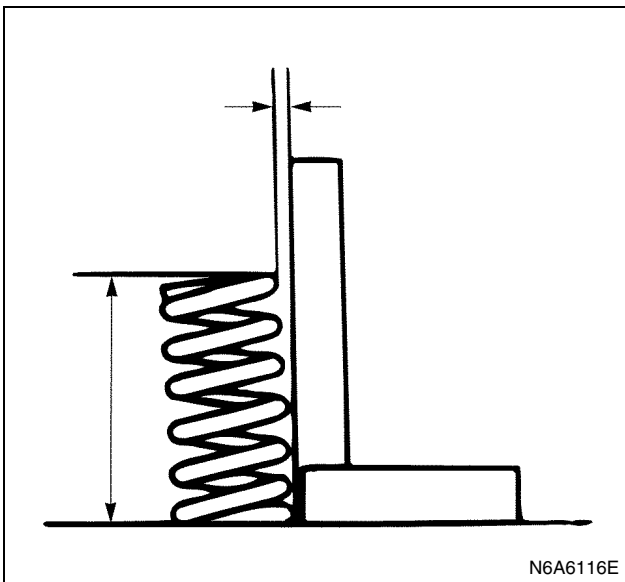
Free length of the valve spring		mm (in)
	Inlet	Exhaust
Standard	59.9 (2.36)	70.3 (2.76)
Limit	56.9 (2.24)	67.3 (2.65)



2. Valve spring squareness

- Use a surface plate and a square to measure the valve spring squareness. If the measured value exceeds the specified limit, replace the valve spring.

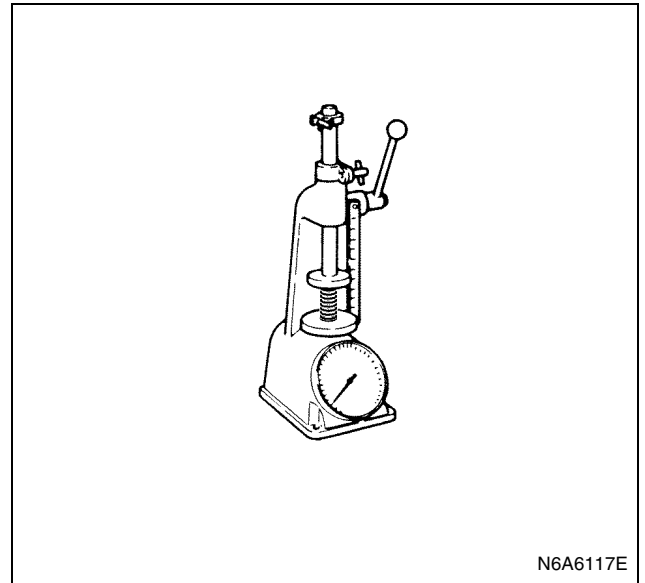
Valve spring squareness		mm (in)
Limit		1.0 (0.04)



3. Tension

- Use a spring tester to compress the spring to the installation height. Measure tension of the compressed spring. If the measurement is lower than the limit, replace the spring.

Tension of the valve spring		
	Inlet	Exhaust
Installation length mm (in)	47.0 (1.85)	47.0 (1.85)
Standard N (lb)	333 (74.9)	490 (110.2)
Limit N (lb)	315 (71.0)	463 (104.3)



Installation

1. Install the valve stem oil seal.

- Apply engine oil over the peripheral part of the valve guide and install the oil seal by using a valve stem seal installer.

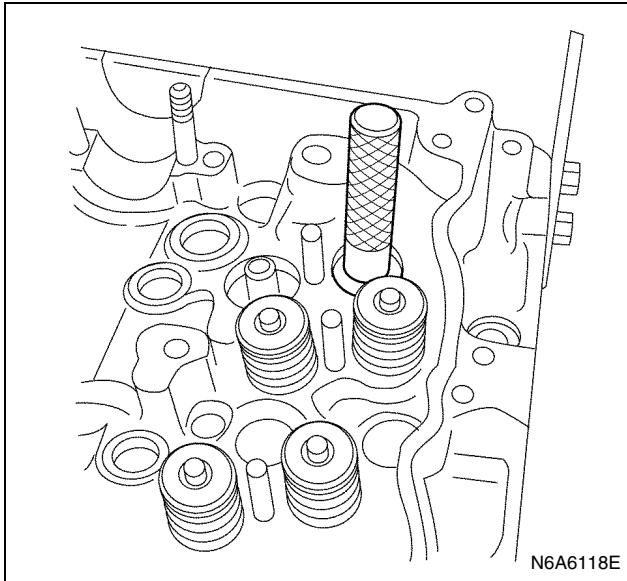
Caution:

After installing the valve stem oil seal, check if it is inserted deeply enough and the oil seal is not tilted or the garter spring has not come off.

6A-72 Engine Mechanical (4HK1-TC)

Special tool

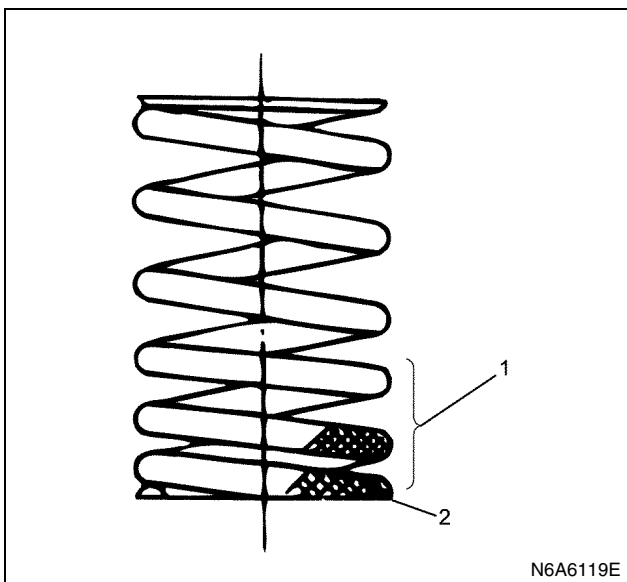
Valve stem seal installer: 5-8840-2833-0
(EN-47685)



2. Install the valve spring.

- Install it with the paint mark or the narrow side of the spring pitch being the lower side (cylinder head side).

	Paint mark
Inlet	Blue
Exhaust	Red



Legend

1. Spring Pitch
2. Paint Mark

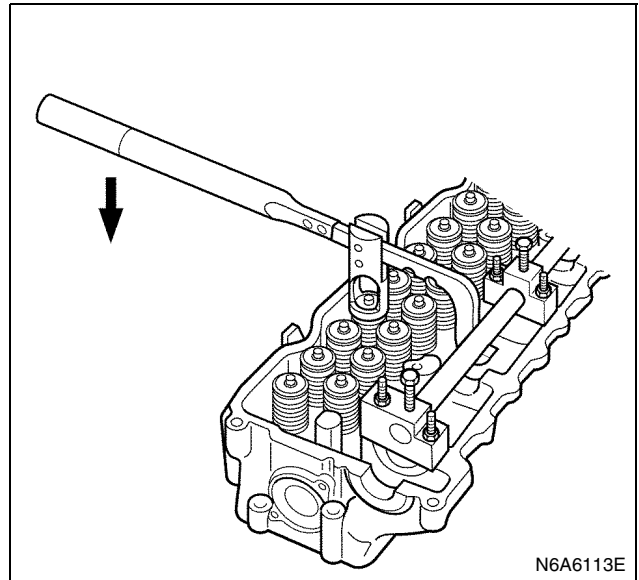
3. Install the spring upper seat.

4. Install the split collar.

- Apply compressed air over the cylinder from the glow plug holes to keep the valve at the home position.
- Use a replacer to compress the valve spring and install the split collar.

Special tool

Valve spring replacer: 5-8840-2621-0 (J-43263)
Pivot: 5-8840-2808-0 (EN-46721)



5. Apply engine oil over the bridge and install it.

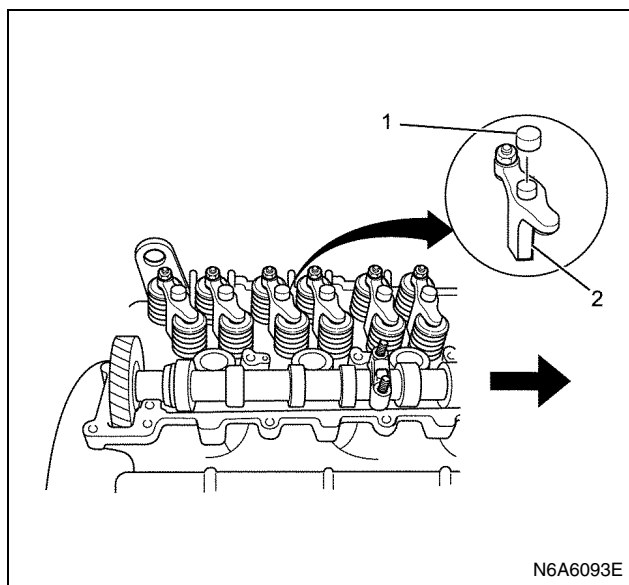
Caution:

Move it up and down to check if them moves smoothly.

6. Apply engine oil over the bridge cap and install it.

Caution:

Pay full attention so as not to drop the bridge cap in the gear case of the rear part of the cylinder head or the hole into which oil pours back in the front.



Legend

1. Bridge Cap
2. Bridge

7. Install the camshaft assembly.
Refer to "Camshaft Assembly".
8. Install the rocker arm shaft assembly.
Refer to "Rocker Arm Shaft Assembly".
9. Install the cylinder head cover.
Refer to "Cylinder Head Cover".

Special Tool

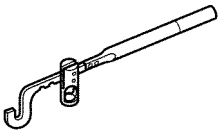
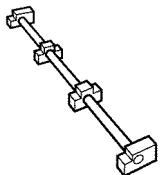
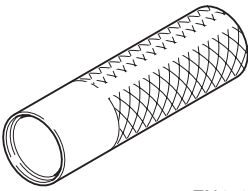
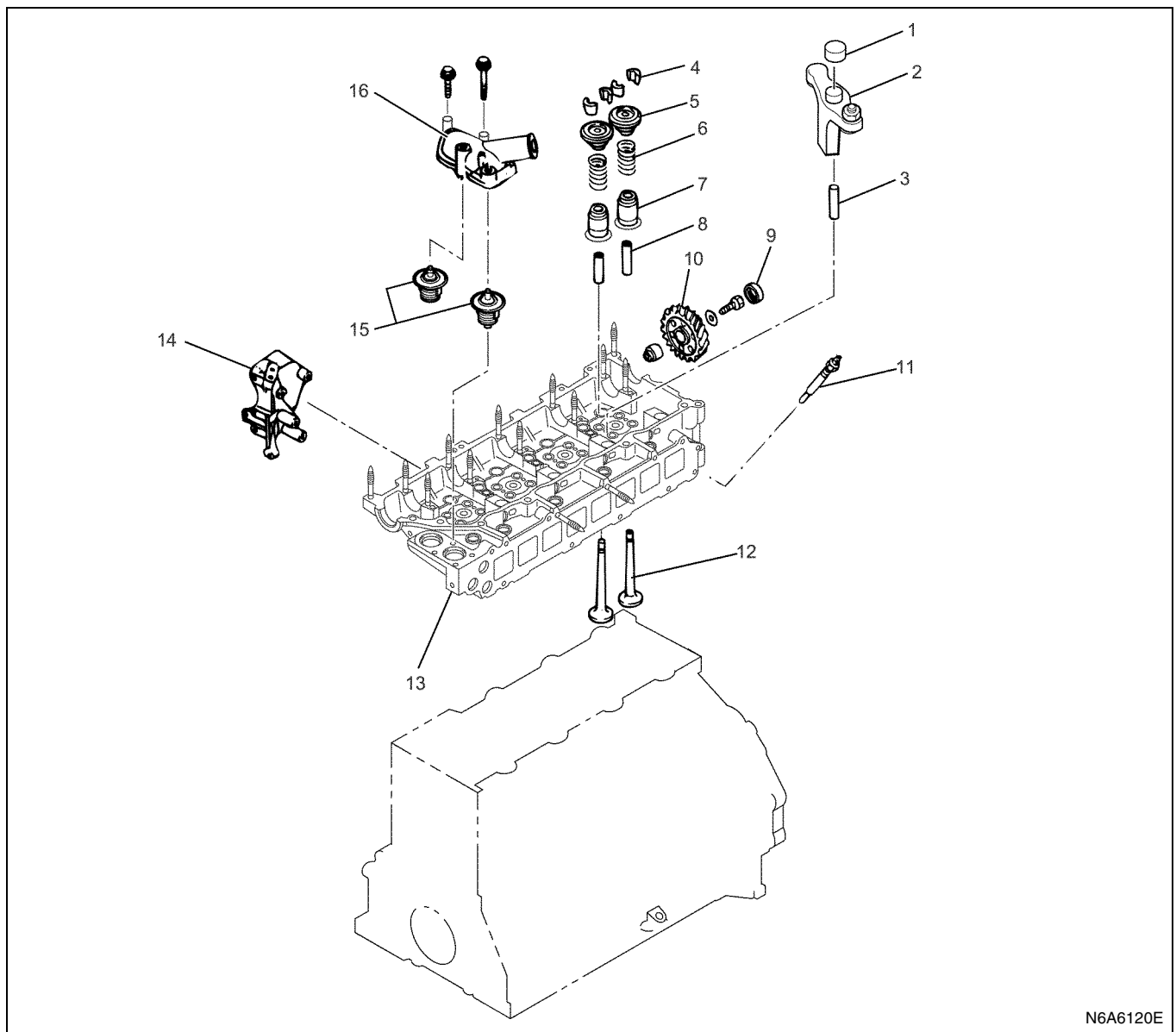
Illustration	Tool Number / Description / Remarks
 5884026210	5-8840-2621-0 (J-43263) Valve Spring Replacer
 8943968620	5-8840-2808-0 (EN-46721) Pivot Assembly

Illustration	Tool Number / Description / Remarks
 EN47685	5-8840-2833-0 (EN-47685) Valve Stem Seal Installer

Cylinder Head

Component



N6A6120E

Legend

- | | |
|------------------------|-------------------------------|
| 1. Bridge Cap | 9. Idle Gear C Cover |
| 2. Bridge | 10. Idle Gear C |
| 3. Bridge Guide | 11. Glow Plug |
| 4. Split Collar | 12. Intake and Exhaust Valves |
| 5. Spring Upper Sheet | 13. Cylinder Head |
| 6. Valve Spring | 14. A/C Compressor Bracket |
| 7. Valve Stem Oil Seal | 15. Thermostat |
| 8. Valve Guide | 16. Water Outlet Pipe |

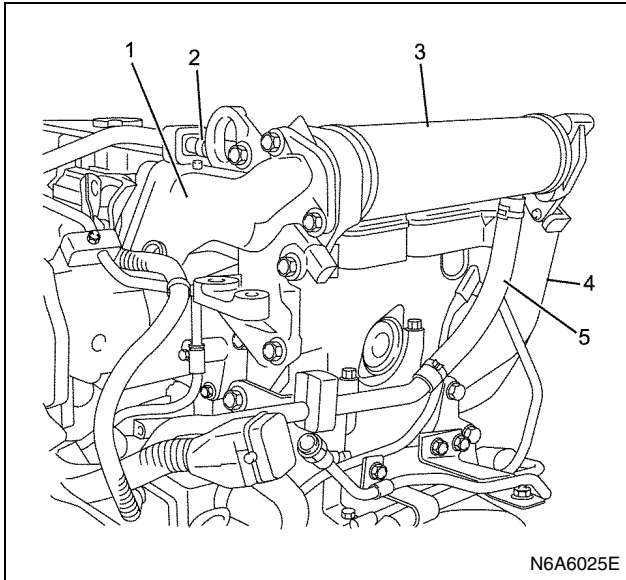
Caution:

To avoid electric shock;
Set the switch to the 'OFF' position and disconnect battery negative cable before checking or repairing the fuel injector, wiring or/and connectors.

Removal

1. Drain the coolant.
2. Remove the engine harness.
3. Remove the front exhaust pipe.
4. Remove the turbocharger.
Refer to "Turbocharger and Exhaust Manifold".

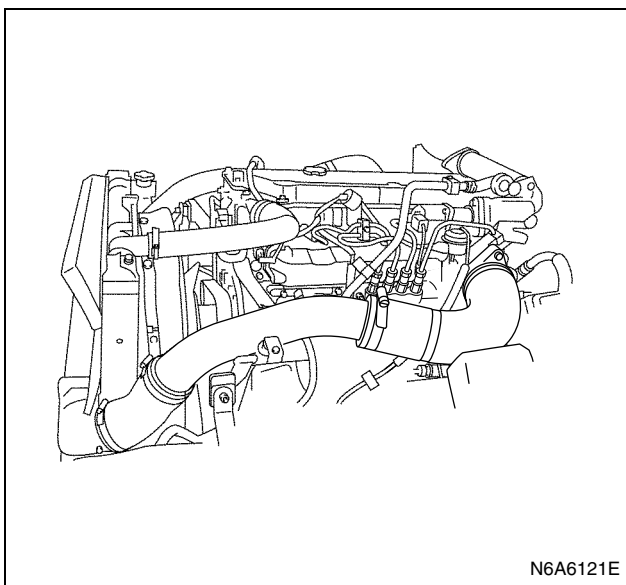
5. Remove the left-hand EGR adapter and right-hand EGR pipe.
6. Remove the EGR water feed pipe.
7. Remove the EGR water return pipe.
8. Remove the EGR cooler.
9. Remove the water feed pipe for coolant water for the EGR cooler and the water return pipe.



Legend

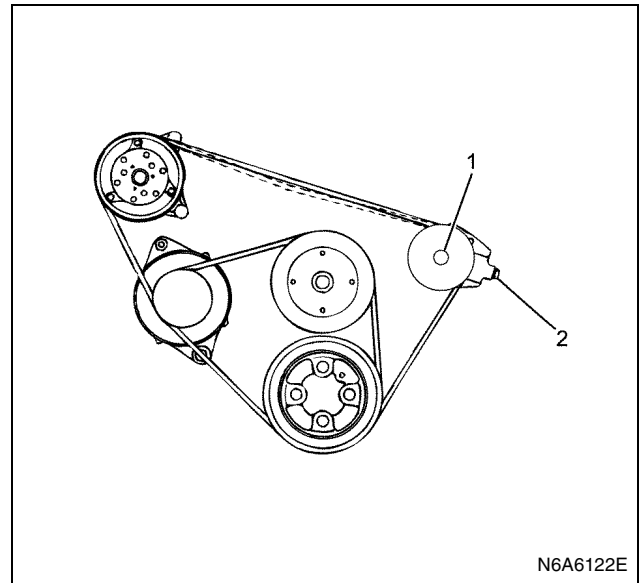
1. EGR Adapter
2. Water Return Pipe
3. EGR Cooler
4. EGR Pipe
5. Water Feed Pipe

10. Remove the fan guide bracket.
11. Remove the left-hand intake pipe between the inter-cooler and the inlet duct.



12. Remove the A/C compressor drive belt.

- Loosen the tension pulley nut and the adjust bolt and remove the drive belt.

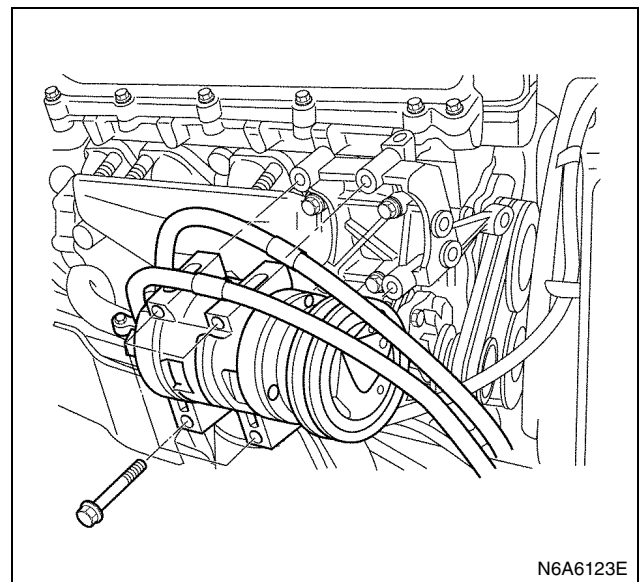


Legend

1. Tension Pulley Nut
2. Adjust Bolt

13. Remove the A/C compressor.

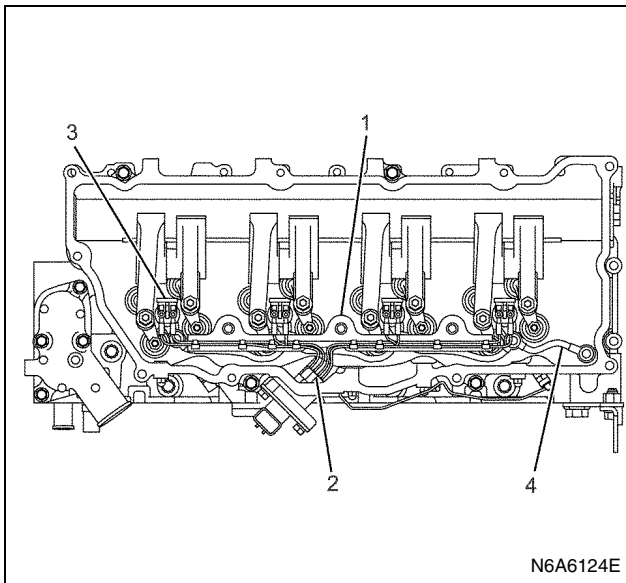
- Remove the A/C compressor harness connector, remove the compressor from the A/C compressor bracket, and fix it with wires and others.



14. Remove the cylinder head cover.
Refer to "Cylinder Head Cover."
15. Remove radiator upper hose.
16. Loosen the fuel injector terminal nuts alternately to the same level, and remove the terminal.
17. Loosen the fuel injector harness bracket bolt, remove the inside connector, and remove the harness bracket.

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18. Remove the nozzle leak-off pipe (4).

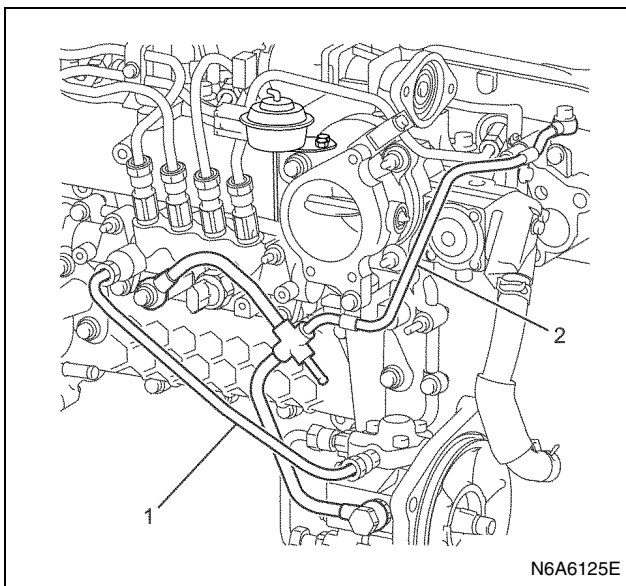


Legend

1. Harness Bracket
2. Harness Connector
3. Fuel Injector Terminal Nut
4. Nozzle Leak-off Pipe

19. Remove the fuel leak-off hose.

20. Remove the fuel leak-off pipe (2).

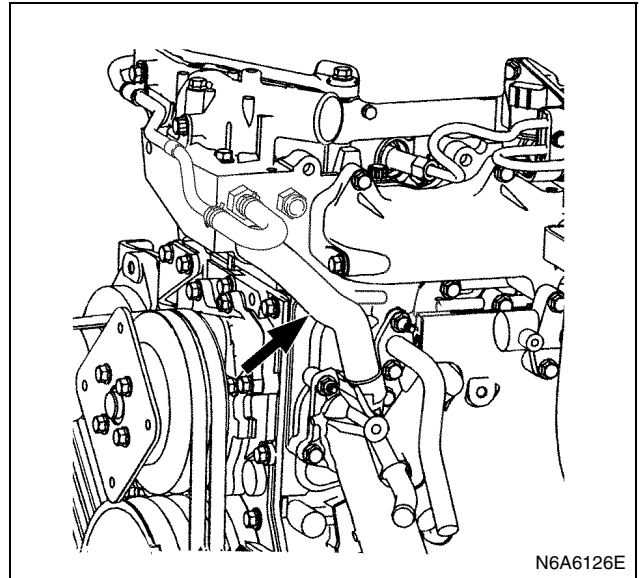


Legend

1. High Pressure Pipe
2. Leak-off Pipe

21. Remove the water bypass hose from the cylinder head side.

- Remove the engine coolant temperature sensor connector.



22. Remove the EGR valve and EGR valve connector.

23. Remove the camshaft position sensor connector.

24. Remove the rocker arm shaft assembly.
Refer to "Rocker Arm Shaft Assembly".

25. Remove the camshaft assembly.
Refer to "Camshaft Assembly".

26. Remove the bridge cap carefully so that it does not fall into inside the engine.

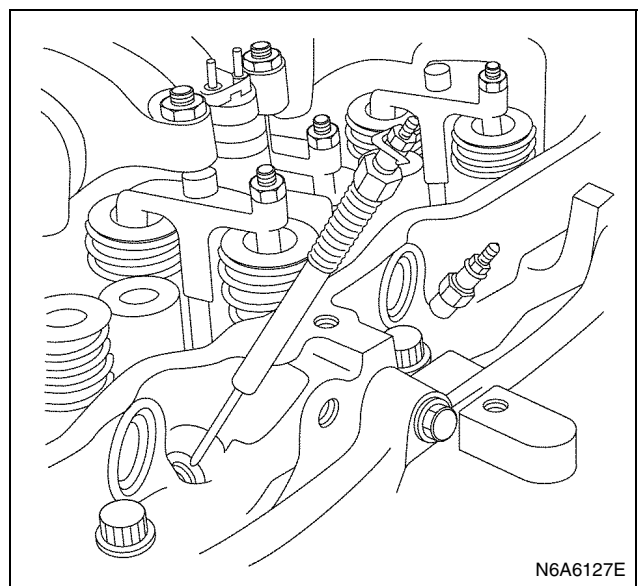
27. Remove the bridge.

Caution:

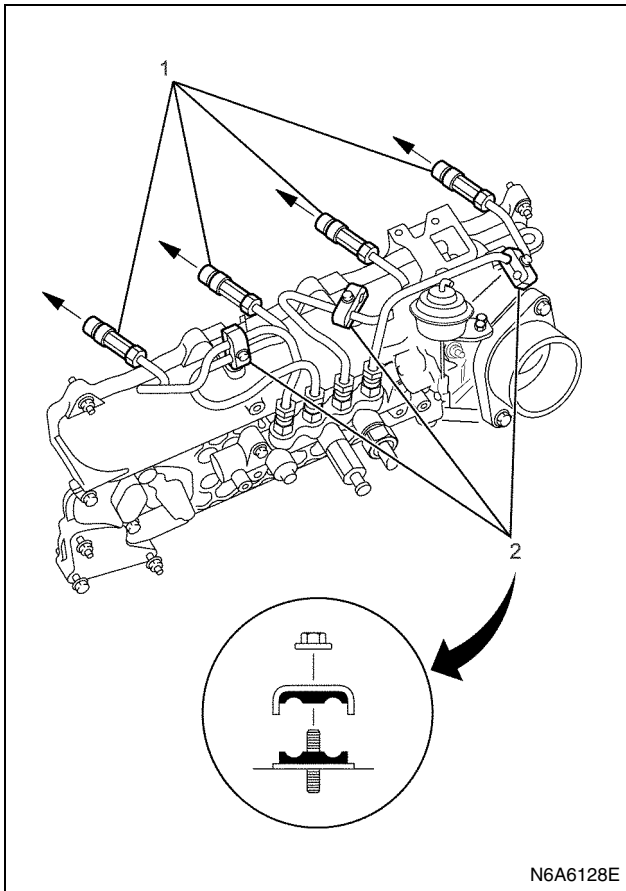
Store the removed bridge and bridge cap so that they can be placed in their original locations.

28. Remove the glow plug connector.

29. Remove the glow plug.



30. Remove the injection pipe clip, and remove the injection pipes.



N6A6128E

Legend

1. Fuel Injection Pipe
2. Fuel Injection Pipe Clip

31. Remove the fuel rail.
- Remove the fuel rail pressure sensor connector.
32. Remove the fuel injector bracket.
33. Loosen the fuel injector clamp fixing bolts and remove the fuel injectors.

If the fuel injectors are difficult to remove, use the fuel injector remover. Install the fuel injector remover to the leak-off pipe attachment part on the fuel injector. Use a sliding hammer to force the fuel injector clamp off the fuel injector.

Caution:

Do not remove the fuel injector sleeve.

Special tool

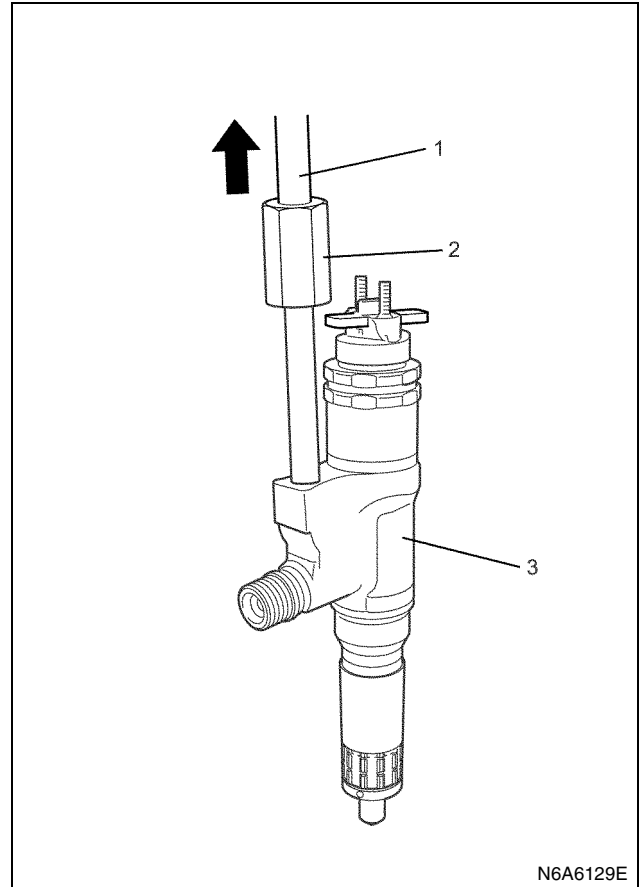
Fuel injector remover: 5-8840-2826-0 (EN-46720)

Sliding hammer: 5-8840-0019-0 (J-23907)

34. Mark each fuel injector with the number of the cylinder from which it was removed. Store the fuel injectors in a safe place. Position the fuel injector so that the nozzle is protected.

Caution:

- Do not tamper with the electromagnetic portion of the fuel injector. Reduced electromagnetic function will result in injector failure.



N6A6129E

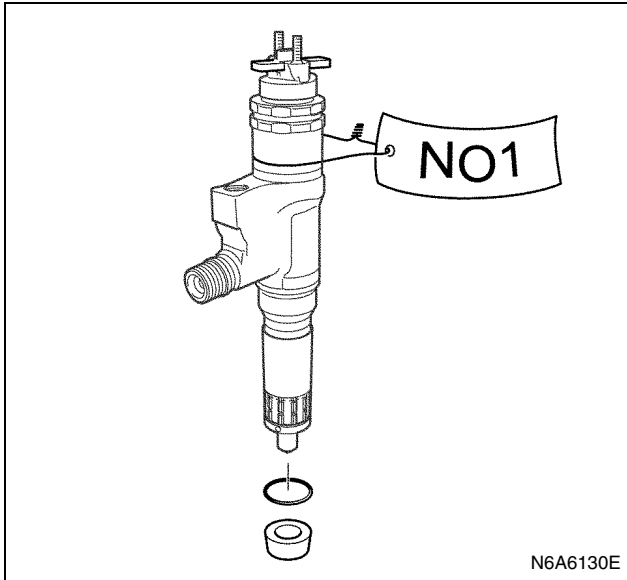
Legend

1. Sliding Hammer
2. Fuel Injector Remover
3. Fuel Injector Assembly

Caution:

Attach a cylinder number to the removed fuel injectors til re-install them.

Be sure not to make the nozzle touch something.



35. Remove the lower head cover.

36. Remove the cylinder head assembly.

- Loosen the cylinder head bolts in the described order in the drawing.

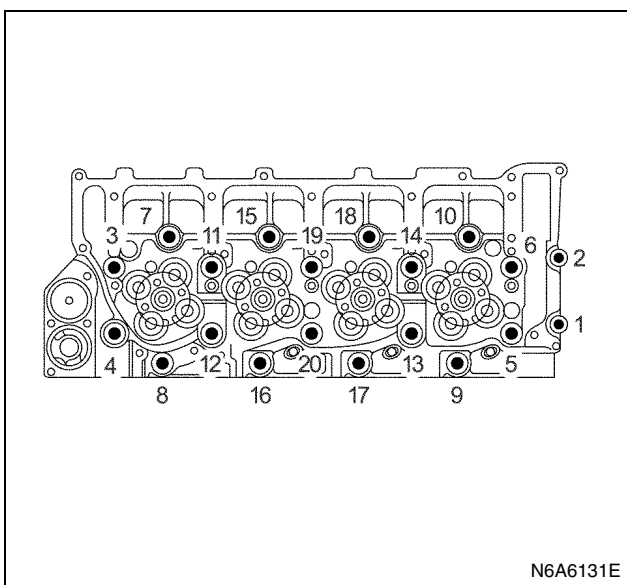
Caution:

Be sure not to overlook (1) and (2) because they are attached with the flywheel housing with M10 bolts.

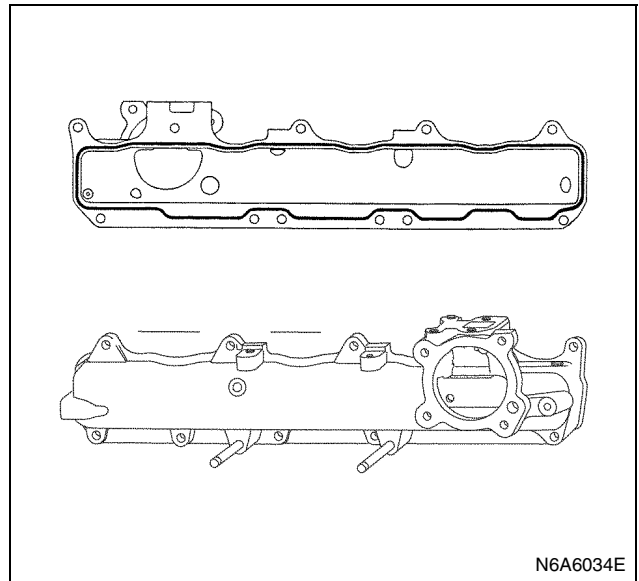
- Remove the cylinder head gasket.

Caution:

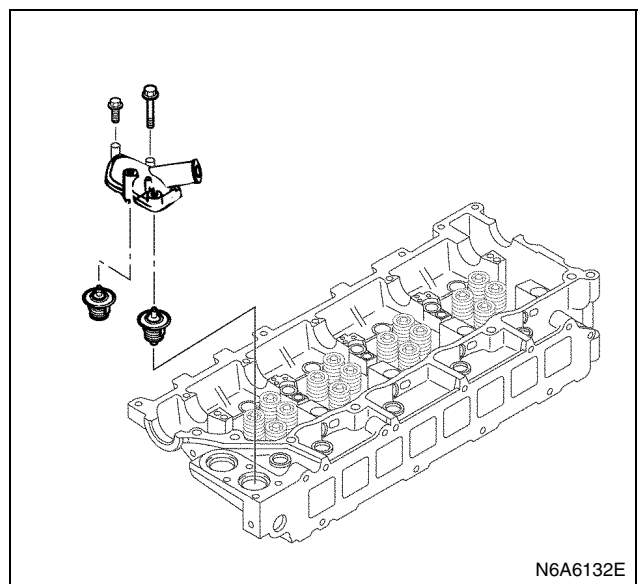
Replace the head gasket with a new one once it was removed.



- Remove liquid gasket adherent to the removed inlet cover.



3. Remove the A/C compressor bracket.
4. Remove the exhaust manifold.
Refer to "Exhaust".
5. Remove the exhaust gasket.
6. Remove the water outlet pipe.
7. Remove the thermostat.

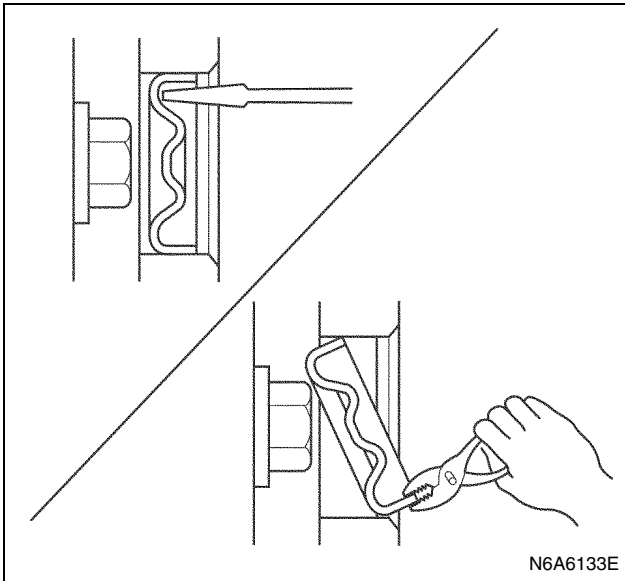


8. Remove the idle gear C cover.

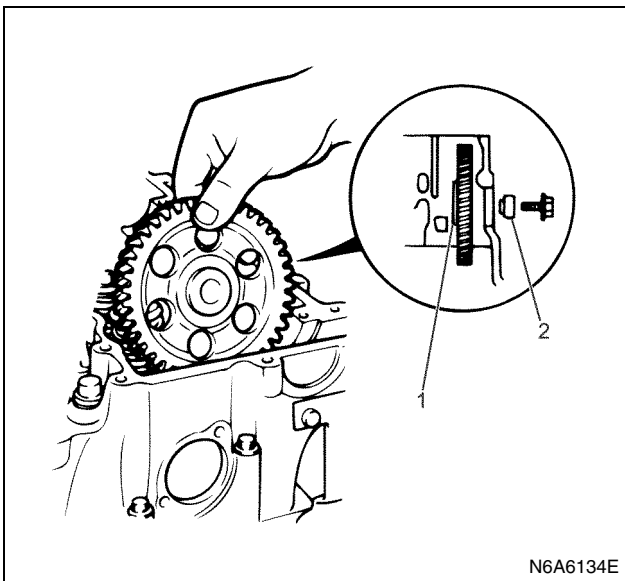
Disassembly

1. Remove the throttle assembly.
 - Remove the intake throttle valve connector.
2. Remove the inlet cover.

- Put the edge of a driver on the outer circle of the sealing cup as shown in the drawing, tap it lightly, reverse it, then pull it out with pliers or other equipment.



9. Remove the idle gear C.



Legend

- Idle Gear C
- Shaft

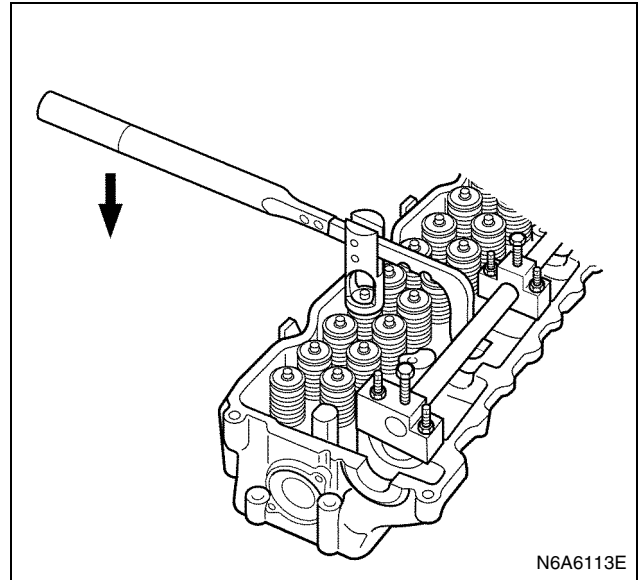
- Remove the split collar.
- Remove the spring upper sheet.
- Remove the valve spring.
 - Use a replacer to compress the valve spring, then remove the split collar.

Special tool

Valve spring replacer: 5-8840-2621-0 (J-43263)
Pivot: 5-8840-2808-0 (EN-46721)

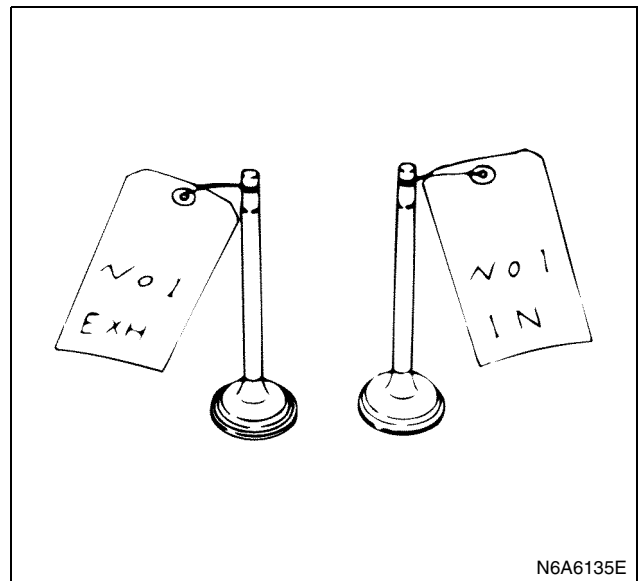
- Remove the special tool, then remove the upper sheet and springs.

Sort the removed valve springs by cylinder number.



13. Remove the intake and exhaust valves.

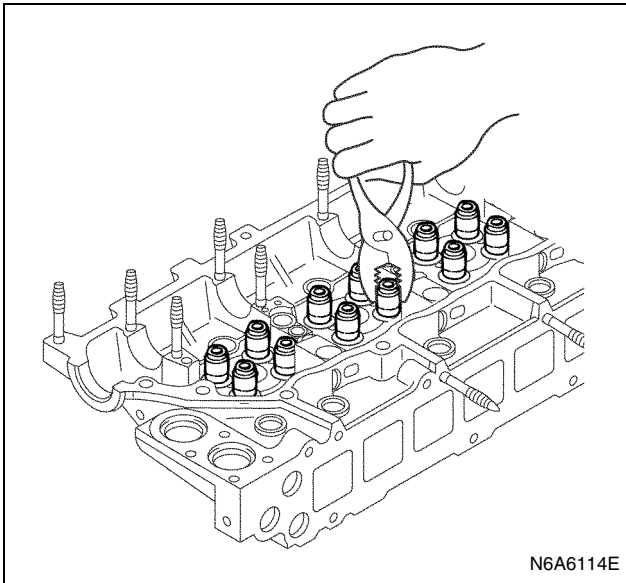
- Sort the removed valves according to cylinders by using tags and others.



14. Remove the valve stem oil seals.

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- Use pliers to remove the oil seals.

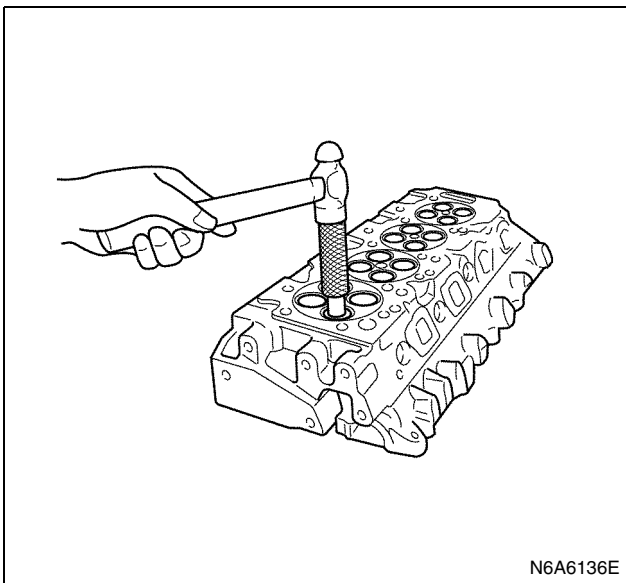


15. Remove the valve guides.

- Use the valve guide replacer to press out the valve guides from the bottom side of the cylinder head.

Special tool

Valve guide replacer: 5-8840-2628-0 (J-43272)



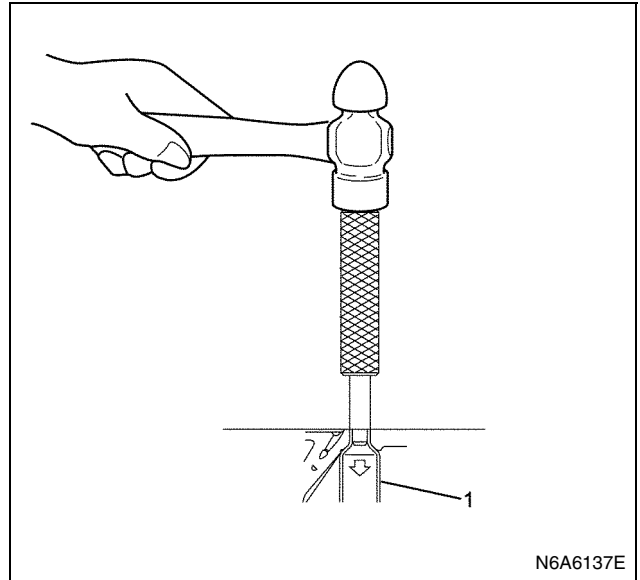
16. Put the nozzle sleeve remover on the nozzle sleeve from the bottom side of the cylinder head, then pull out the nozzle sleeve.

Special tool

Nozzle sleeve remover: 5-8840-2623-0 (J-43265)

Caution:

- Be sure not to scratch the bottom side of the cylinder head.
- Do not reuse the removed nozzle sleeve.
- Carefully remove sawdust in the screw groove.

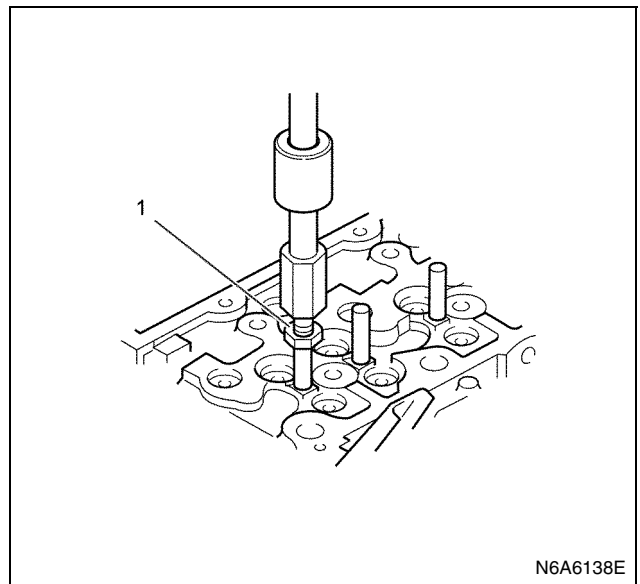


Legend

1. Nozzle Sleeve

17. Remove the bridge guide.

- Electrically weld the nut on the head of the bridge guide, attach the sliding hammer and pull it out.

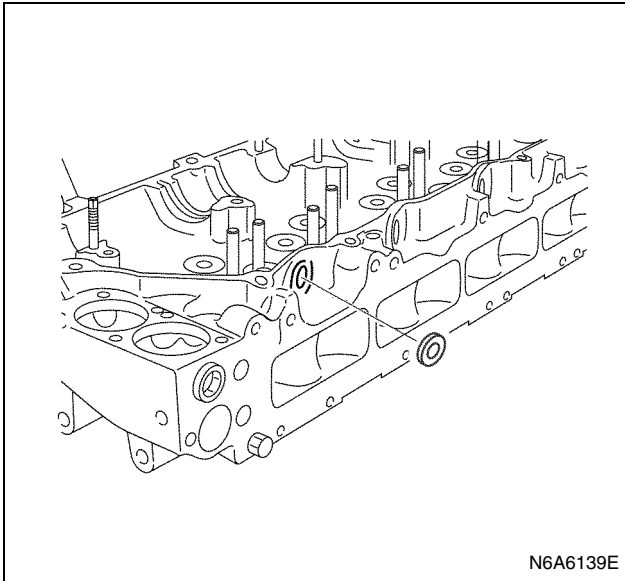


Legend

1. Nut

18. Remove the oil seal.

- Press the tool against the oil seal. Strike the tool to remove the seal from the inside of the cylinder head.



Inspection

1. Inspect the cylinder head assembly.

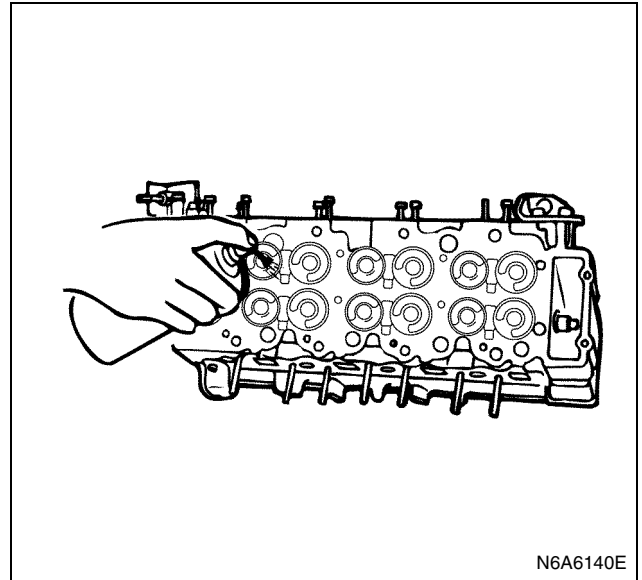
- Remove varnish, soot and others adhered on the metal surface completely. Use metal brush and others so that the seal surface of the surface where the gasket is installed is not damage.
- Check the following causes in the case of leak of the seal surface of the cylinder head, corrosion, air leak and defective gasket.
 - Defective installation.
 - Defective tightening of the cylinder head.
 - Winding seal surface of the cylinder block.
- a. Damage on the screw surface or extracted cylinder head bolt due to extra tightening torque

Caution:

Replace suspicious bolt.

- b. Inside the combustion chamber, glow plug hole.

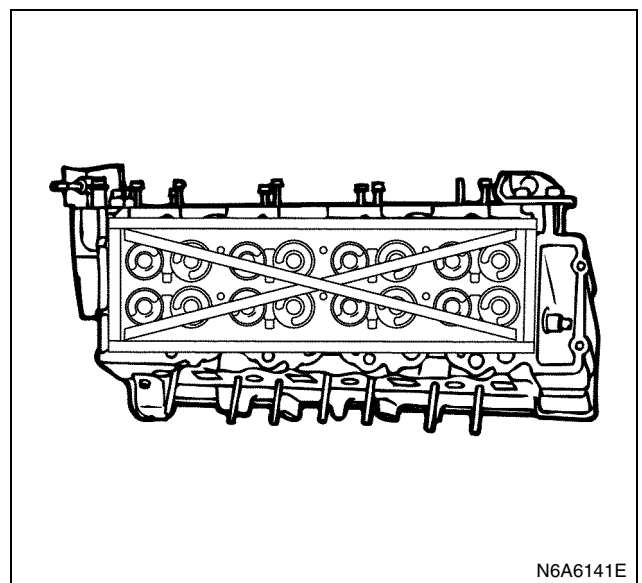
- Check whether there is a crack between the valve sheets and in the cylinder head of the exhaust port part, and replace the cylinder head if there is serious damage or crack. Check the collar if necessary.



c. Flatness of the under surface of the cylinder head

- Use a straight edge ruler and thickness gauge to measure the four sides and diagonal lines as shown in the drawing, and replace if they exceed the limit.

Distortion of the under surface of the cylinder head		mm (in)
Standard	0.05 (0.002) or less	
Limit	0.20 (0.0079)	

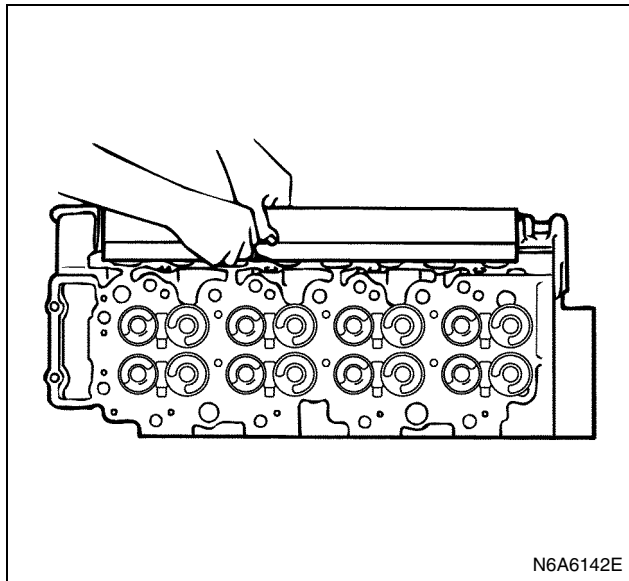


d. Flatness of the surface where the exhaust manifold and inlet cover are installed

6A-82 Engine Mechanical (4HK1-TC)

- Use a straight edge ruler and thickness gauge to measure the four sides and diagonal lines as shown in the drawing, and replace if they exceed the limit.

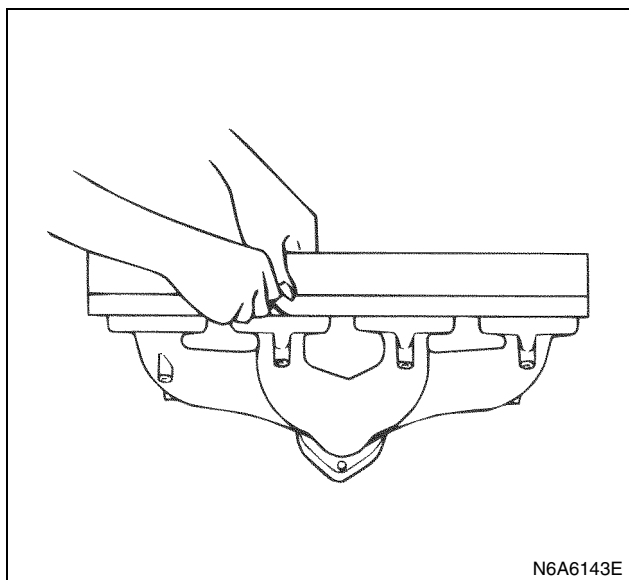
Distortion of the surface where the manifold and cover are installed		mm (in)
Standard		0.05 (0.002) or less
Limit		0.2 (0.0079)



e. Flatness of the exhaust manifold

- Use a straight edge ruler and thickness gauge to measure the flatness. If it exceeds the limit, replace the exhaust manifold.

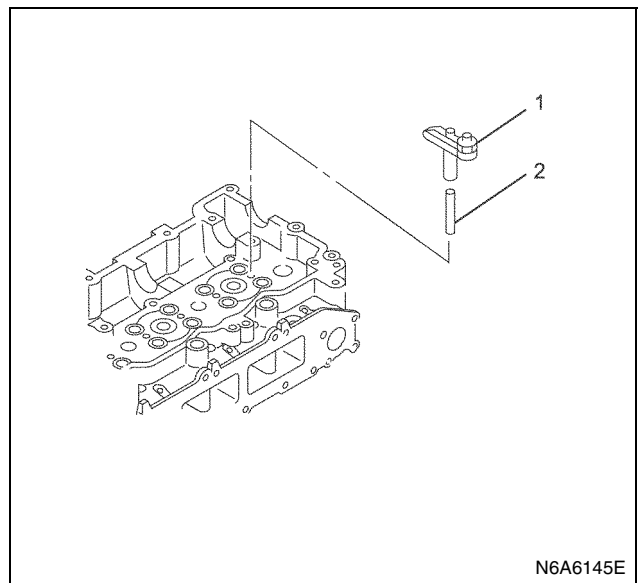
Distortion of the exhaust manifold		mm (in)
Standard		0.3 (0.0118) or less
Limit		0.5 (0.0197)



2. Bridge

- Make sure the bridge moves smoothly along the bridge guide.
- Measure the gap between the bridge and bridge guide.

Gap between the bridge guide and bridge guide		mm (in)
Assembly standard		0.020 (0.00079) – 0.056 (0.00220)
Usage limit		0.1 (0.0039)



Legend

1. Bridge
2. Bridge Guide

3. Inspect the valve guide.

Caution:

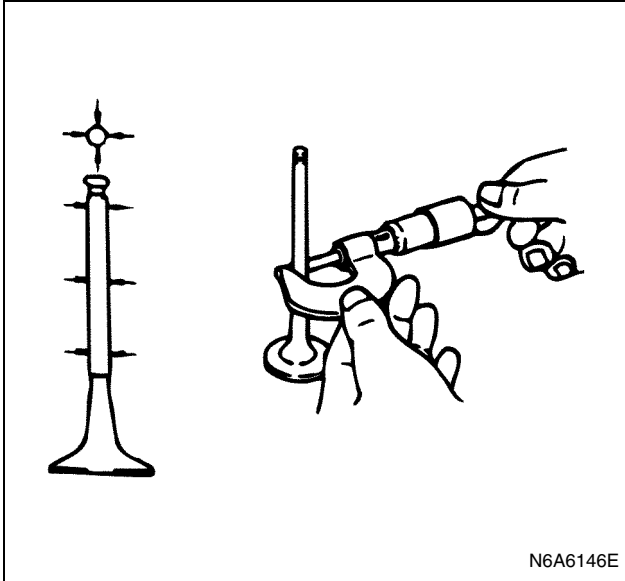
If there is a scratch or abnormal abrasion in the valve stem and the inner diameter part of the valve guide, replace it with new one along with valve guide.

a. Measure the valve guide clearance.

- Measure the diameter of the valve stem with a micro meter.

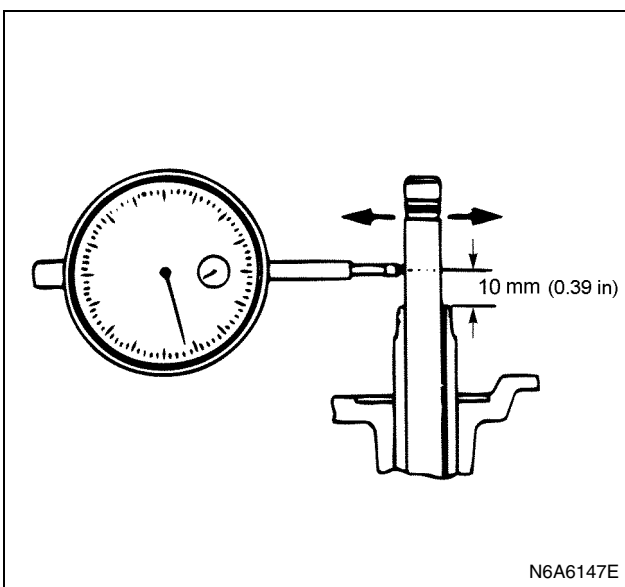
If the diameter of the valve stem is smaller than the limit, replace the valve and valve stem altogether.

The external diameter of the valve stem		mm (in)
	Standard	Limit
Intake valve	7.946 (0.3128) – 7.961 (0.3134)	7.88 (0.3102)
Exhaust valve	7.921 (0.3118) – 7.936 (0.3124)	7.80 (0.3071)



- Measure the gap between the valve guide and valve stem within 10 mm (0.39 in) from the valve guide, using a dial gauge.
- If the measured value exceeds the limit, replace the valve guide and valve altogether.

Gap between the valve guide and valve stem			mm (in)
	Standard	Limit	
Intake valve	0.039 (0.00153) – 0.071 (0.00280)	0.20 (0.00787)	
Exhaust valve	0.064 (0.00252) – 0.096 (0.00378)	0.25 (0.00984)	

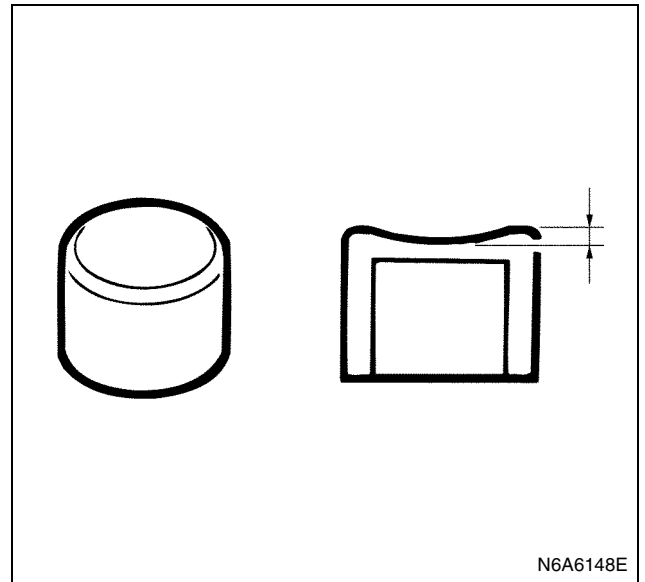


4. Inspect abrasion of the bridge gap.

- Measure the contact surface of bridge cap and the rocker arm, using a dial gauge.

- If the abrasion exceeds the limit, or there is an abnormal abrasion (zonal abrasion), replace the bridge cap.

Abrasion of the bridge cap		mm (in)
Limit		0.1 (0.00394)

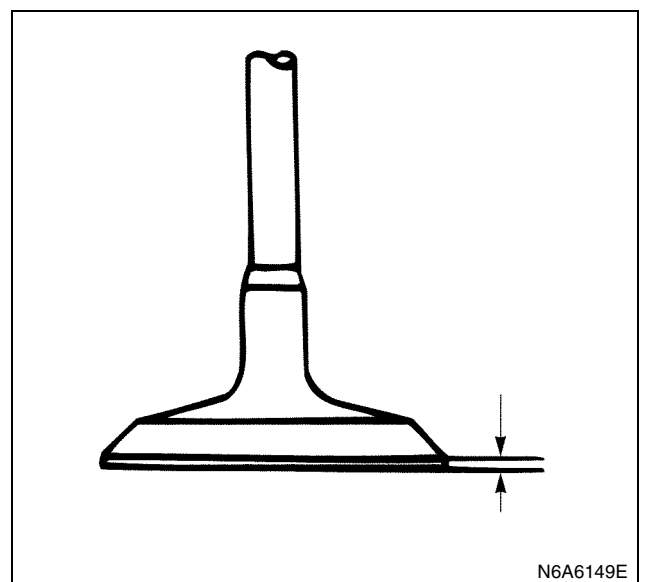


5. Inspect the valve.

Thickness of the valve

- Measure the thickness of the valve.
- If the measured value exceeds the limit, replace the valve and valve guide altogether.

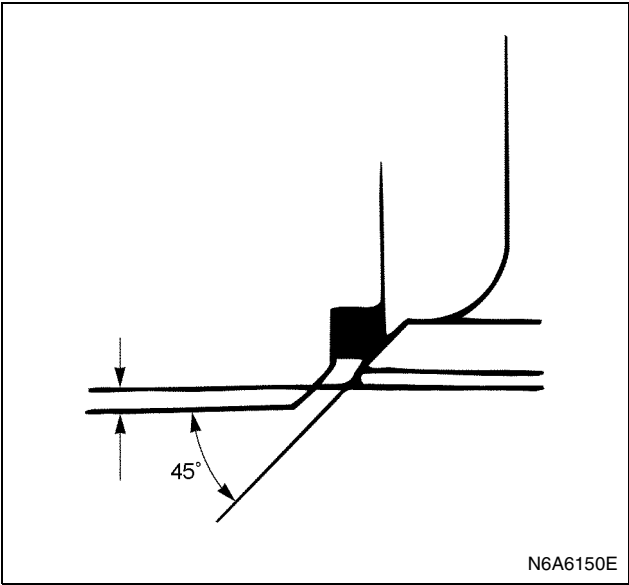
Thickness of the valve			mm (in)
	Standard	Limit	
Intake valve	1.71 (0.0673)	1.3 (0.0512)	
Exhaust valve	1.75 (0.0689)	1.3 (0.0512)	



Valve sheet

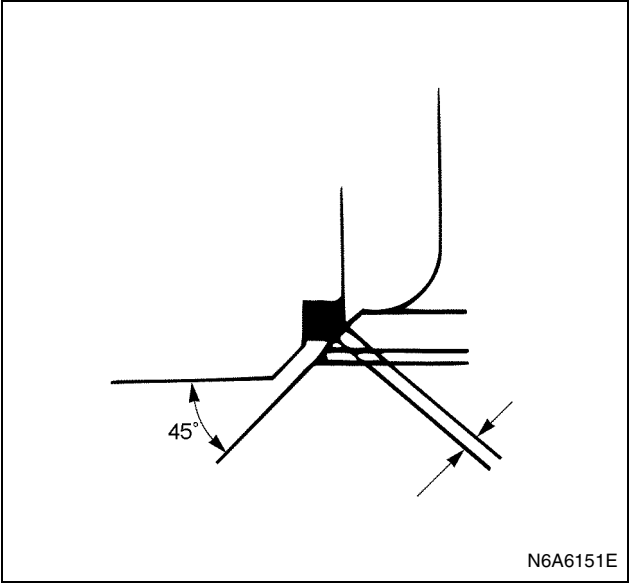
- Remove carbon, water stain and others on the under surface of the cylinder head.
Install the valve in the cylinder head.
Measure the depth of the valve from the under surface of the cylinder head, using a depth gauge or straight edge ruler.
If it exceeds the limit, replace the valve insert or cylinder head assembly.

Depth of the valve		mm (in)
Standard		0.7 (0.0276) – 1.2 (0.0472)
Limit		2.5 (0.0984)



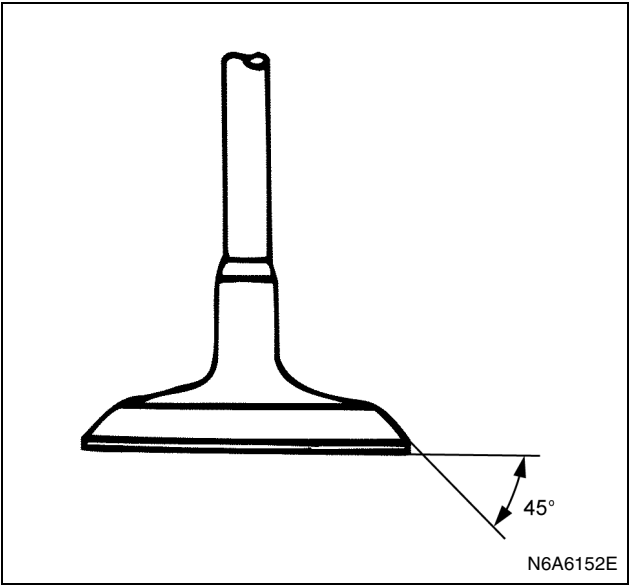
- Measure the contact width of the valve seat. If the seat contact surface has a scratch or is rough, or if the abrasion of the contact surface exceeds the limit, modify or replace it.

Contact width of the valve seat			mm (in)
	Standard	Limit	
Intake valve	2.5 (0.0984)	3.0 (0.1181)	
Exhaust valve	2.0 (0.0787)	2.5 (0.0984)	



Contact surface of the valve seat

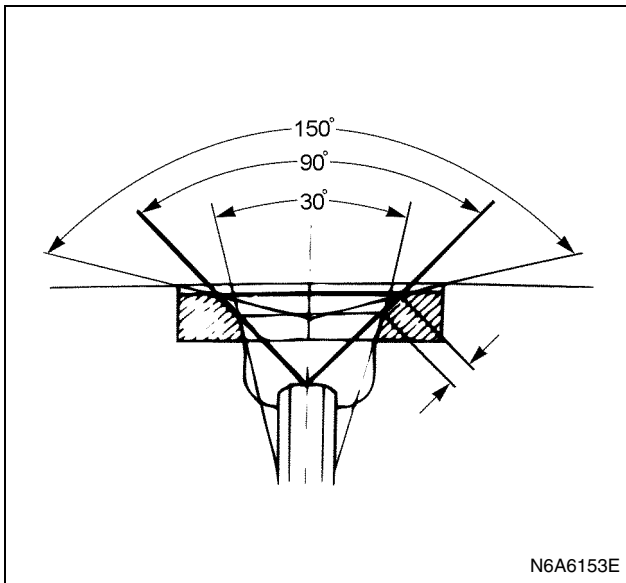
- If the contact surface of the valve seat is defective, modify it or replace the valve, valve guide and valve seat altogether.
Angle of the contact surface: 45° (degrees)



Repair of the seat surface

- Remove carbon from the surface of the valve insert seat.

- Use a seat cutter to minimize the scratch and other roughness (15/45/75 degree-blade), thereby returning the contact width to the standard value.

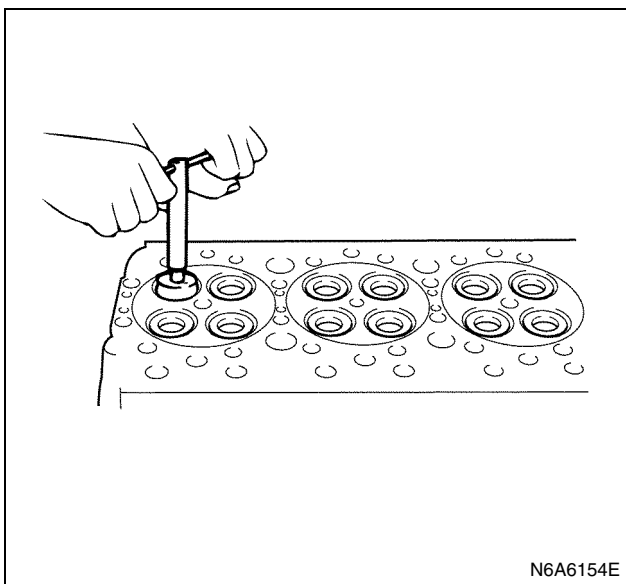


Caution:

Remove only scratches and roughness, and do not cut the surface too much.

Use the free adjustment valve cutter pilot.

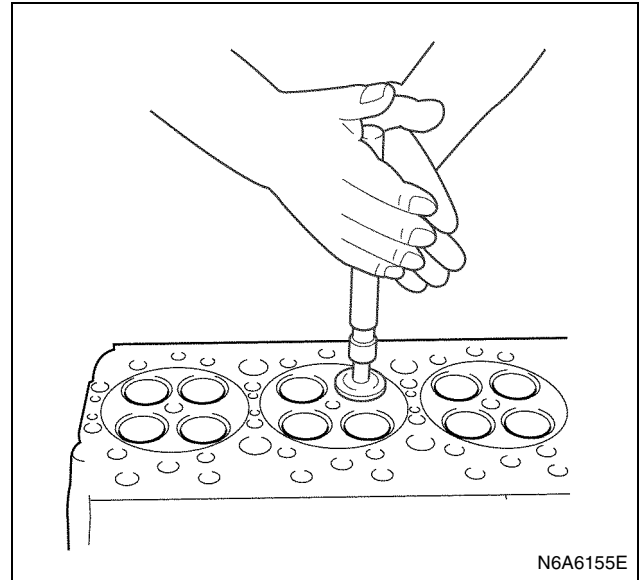
Do not let the valve cutter pilot waver inside the valve guide.



- Attach abrasives in the valve insert seat.
- Insert the valve into the valve guide.
- Attach abrasives on the valve seat surface, rotate the valve and hit it lightly to grind them, and confirm that it has even contact all round.

Caution:

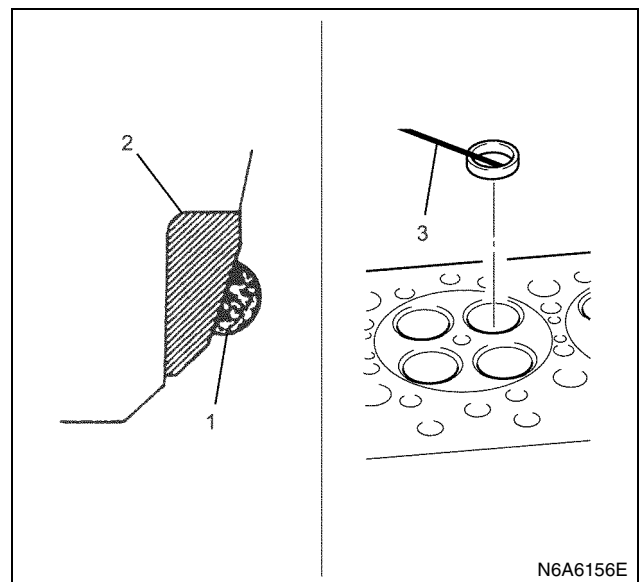
Remove abrasives completely after grinding.



Replace the valve seat insert

Remove the valve seat insert

- Arc-weld the entire inner diameter of the valve seat insert.
- Cool the valve seat insert for two to three minutes. Contraction due to cooling makes it easier to remove the valve seat insert.
- Remove the valve seat insert, using a screw driver. Be sure not to damage the cylinder head.



Legend

1. Arc-weld
2. Valve Seat Insert
3. Screw Driver

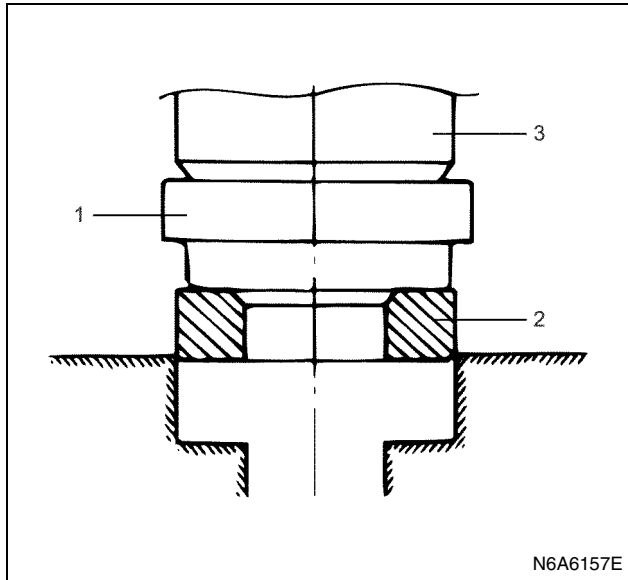
Install the valve seat insert

- Carefully place an attachment (the outer diameter is smaller than the valve seat insert) on the valve seat insert.
- Use the press to apply pressure gradually on the washer, thereby pushing the valve seat insert.

6A-86 Engine Mechanical (4HK1-TC)

Caution:

Do not apply too much pressure with the press. Attach compound on the valve seat surface, rotate the valve and hit it lightly to grind them, and confirm that it has even contact all round.



Legend

1. Attachment
2. Valve Seat Insert
3. Press

Reassembly

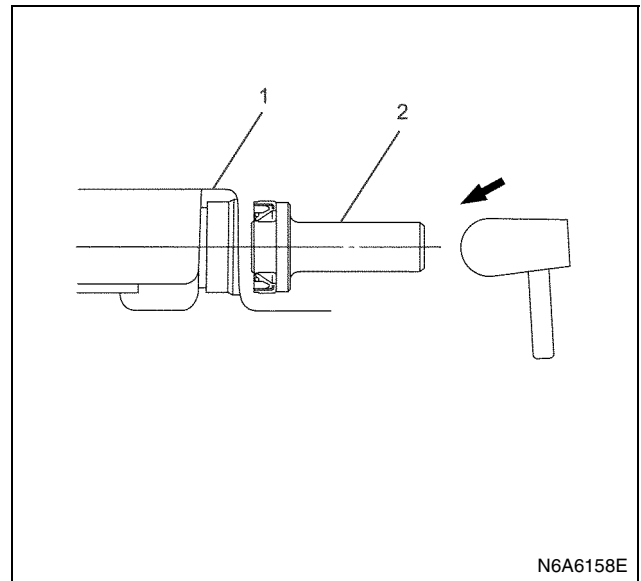
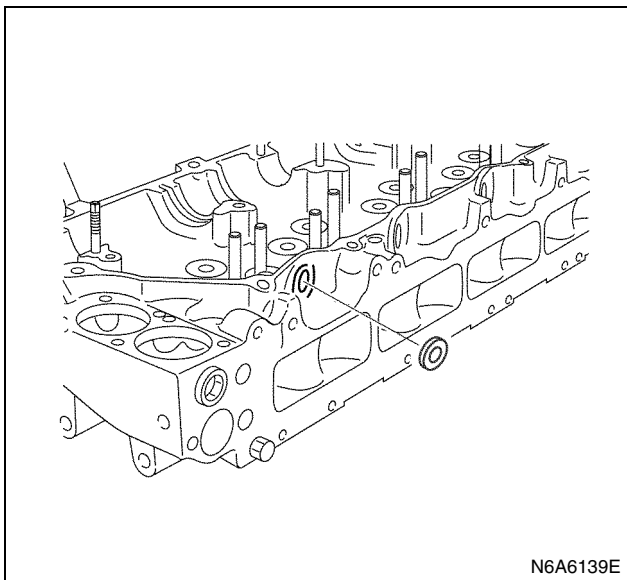
1. Install the oil seal.
 - Install on the surface of injection pipe insert.
 - Hammer it in so that the seal does not incline.

Caution:

Be sure not to damage the rip.

Special tool

Oil seal installer: 5-8840-2627-0 (J-43269)



Legend

1. Cylinder Head
2. Oil Seal Installer

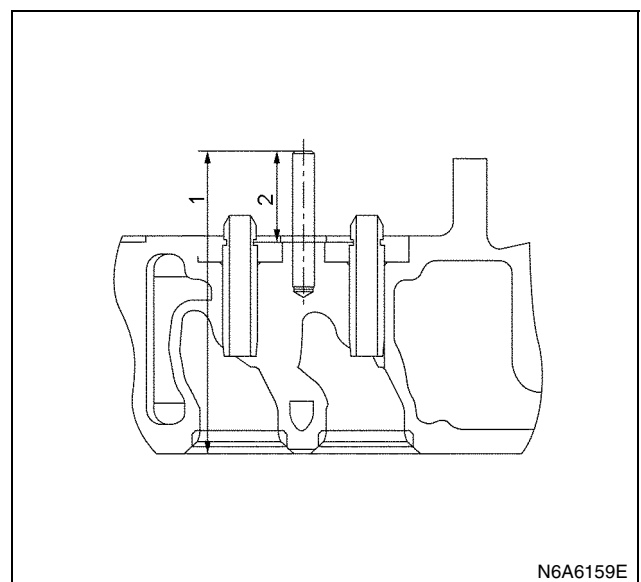
2. Install the bridge guide.

- Apply engine oil on the outer diameter of the guide, then use the installer to hammer it into the depth of the finishing part of the hole of the cylinder head.

(Note: the height of the bridge guide is about 37.5 mm (1.48 in) from the upper surface of the head)

Special tool

Bridge guide installer: 5-8840-2626-0 (J-43268)



Legend

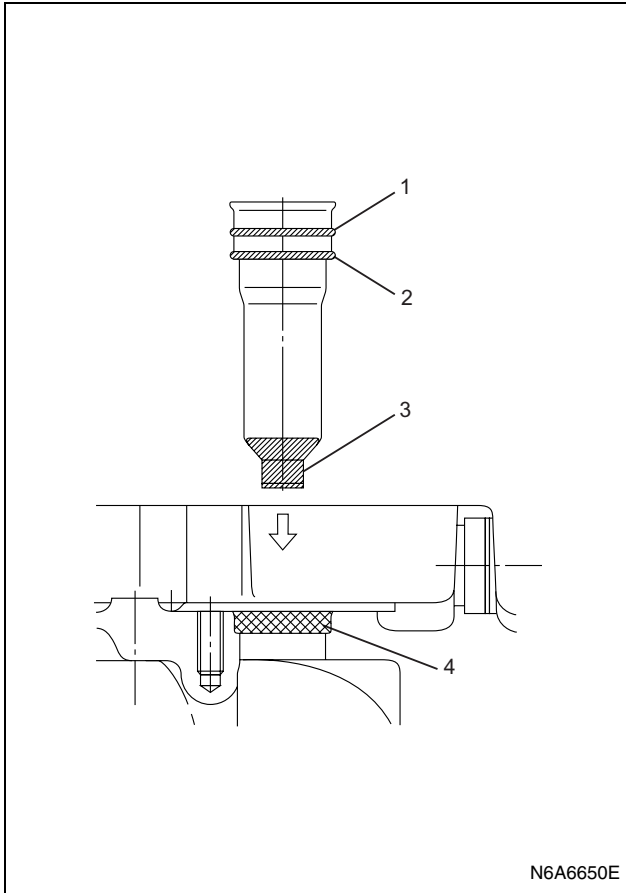
1. 122.5 ± 0.5 mm (4.82 ± 0.02 in)
2. 37.5 mm (1.48 in)

3. Install the nozzle sleeve.

- Install the O-ring on the nozzle sleeve, apply engine oil.

- Apply seal material on the taper section.

Loctite No.TL290



Legend

1. O-ring (White Paint)
2. O-ring
3. Apply the Loctite
4. Engine Oil

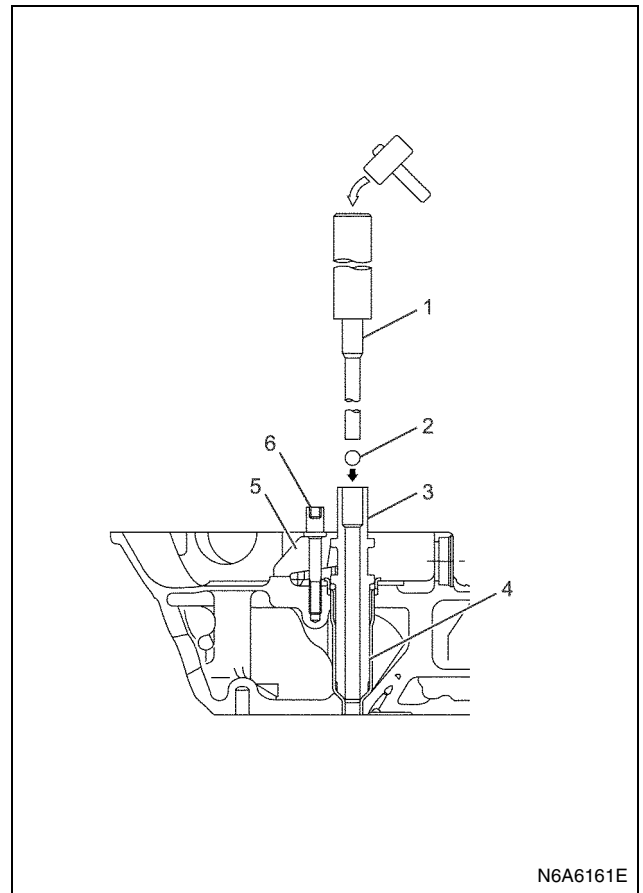
- Install the nozzle sleeve on the cylinder head, insert the guide sleeve.
- Use the guide sleeve to push in so that the nozzle sleeve fully contacts with the under surface of the cylinder head.
- Insert the sleeve and fix it with the tighten and bolt.
- Insert the ball (bearing steel ball 9.525 mm (0.375 in)) into the guide sleeve, attach the punch bar and hammer out the ball.

Caution:

- Leave the cylinder head floating so that the ball comes off from the under surface.

Special tool

Nozzle sleeve installer: 5-8840-2624-0
(J-43266)



Legend

1. Punch Bar
2. Ball
3. Guide Sleeve
4. Nozzle Sleeve
5. Bracket
6. Bolt

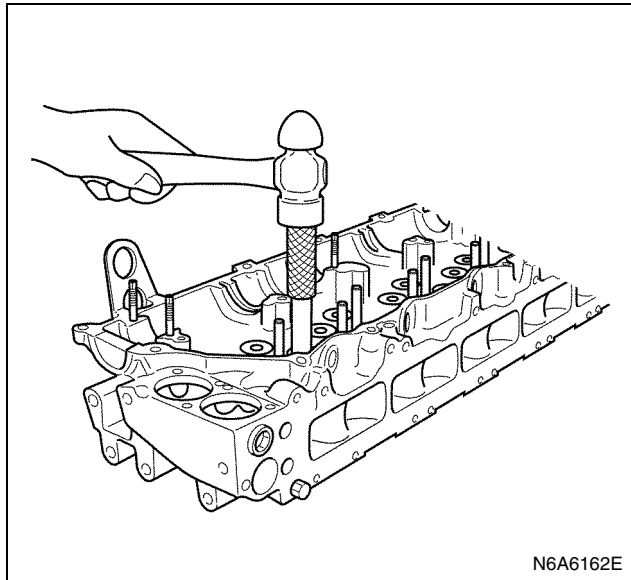
4. Install the valve guide.

6A-88 Engine Mechanical (4HK1-TC)

- Hammer in the valve guide from the upper surface of the cylinder head, using the valve guide replacer.

Special tool

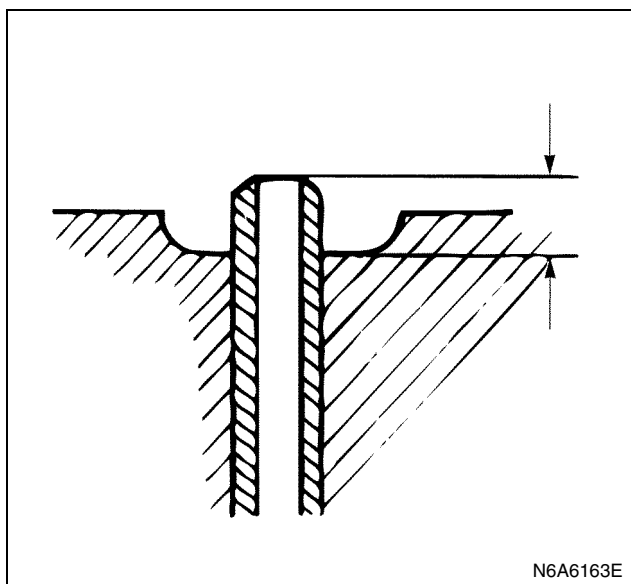
Valve guide replacer: 5-8840-2628-0 (J-43272)



Height from the upper surface of the cylinder head to the edge surface of the valve guide:
18.75 – 19.25 mm (0.7381 – 0.7578 in)

Caution:

When replacing the valve guide, it must be replaced together with the valve.



5. Install the valve stem oil seal.

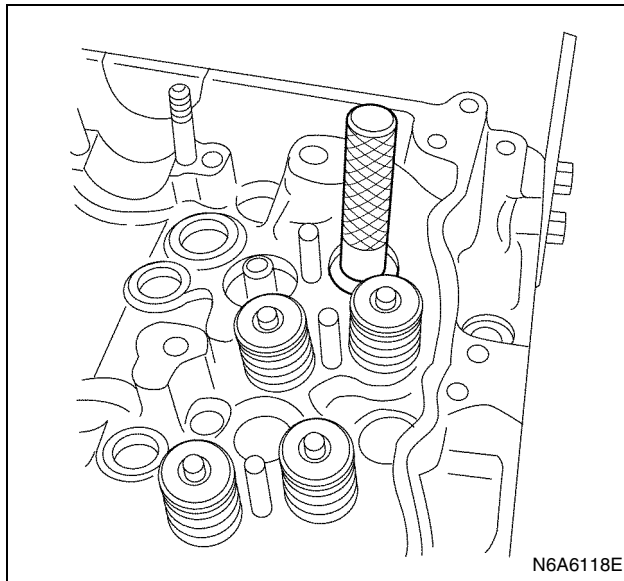
- Apply engine oil on the outer diameter of the valve guide, use the valve stem seal installer to install the oil seal.

Caution:

After installation of the valve stem seal, confirm that the oil seal is not inclining and the garter spring is in place.

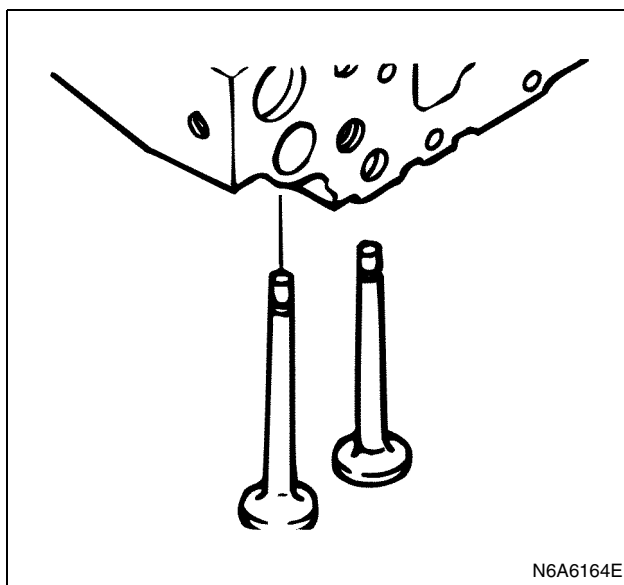
Special tool

Valve stem seal installer: 5-8840-2833-0 (EN-47685)



6. Install the intake and exhaust valves.

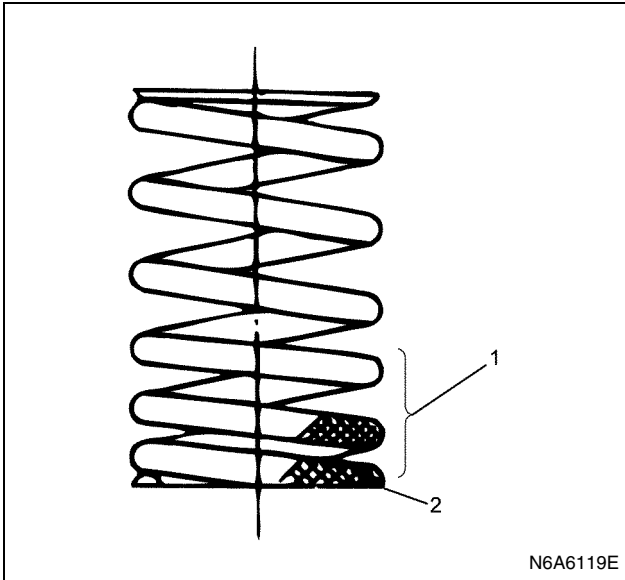
- Apply engine oil on the valve stem part and install the valve.



7. Install the valve spring.

- Install the valve spring with the paint mark or the narrower side of the spring pitch on the under side (the cylinder head side).

	Paint mark
Intake side	Blue
Exhaust side	Red



N6A6119E

Legend

1. Spring Pitch
2. Paint Mark

8. Install the spring upper sheet.

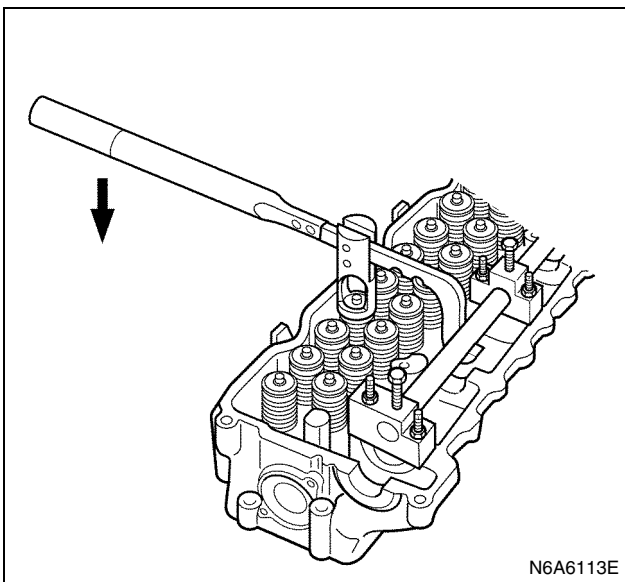
9. Install the split collar.

- Use the replacer to compress the valve spring and install the split collar.

Special tool

Valve spring replacer: 5-8840-2621-0 (J-43263)

Pivot: 5-8840-2808-0 (EN-46721)



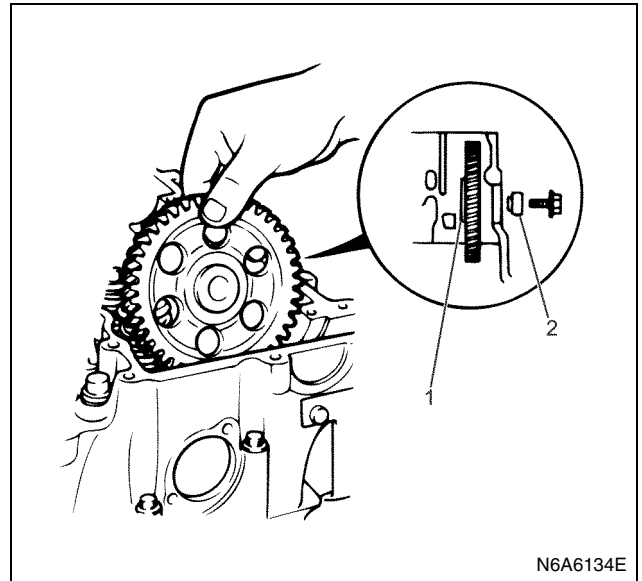
N6A6113E

10. Install the idle gear C.

- Apply engine oil on the idle gear C shaft and the inner diameter of the idle gear, install the idle gear C so that the side with gear groove is on the side of the rear surface of the engine.
- Tighten the idle gear C with the designated torque.
- Do not use impact wrench and like.

Tighten:

Bolt to 95 N·m (9.7 kg·m/70 lb·ft)



N6A6134E

Legend

1. Idle Gear C
2. Shaft

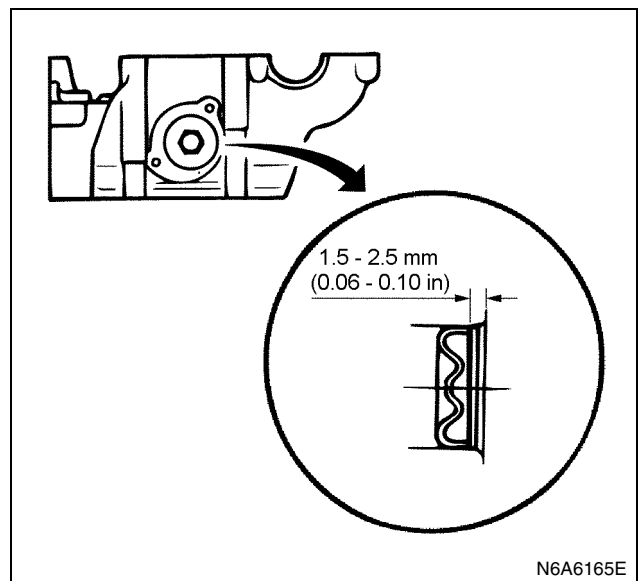
11. Install the idle gear C cover.

- Apply liquid gasket (Loctite 262) on the outer diameter of the idle gear C cover, use the sealing cup setting tool to hammer it in so that the measurements follow the drawing.

Special tool

Sealing cup installer: 5-8840-2222-0

(EN-47690)

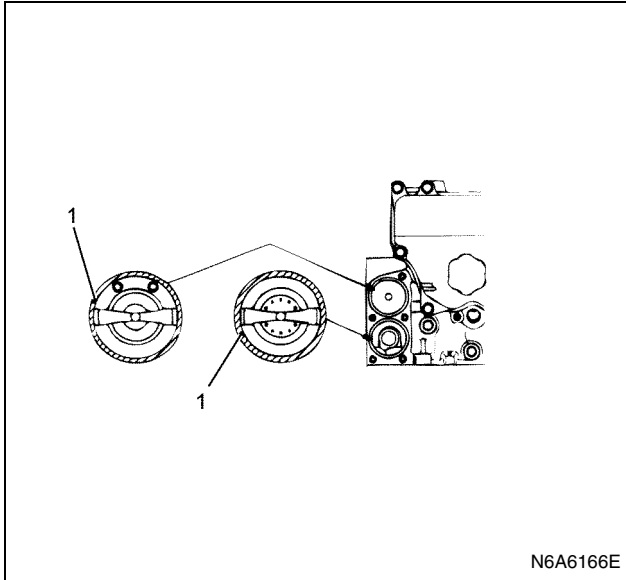


N6A6165E

12. Install the thermostat.

6A-90 Engine Mechanical (4HK1-TC)

- Install the thermostat on the position shown in the drawing.



Legend

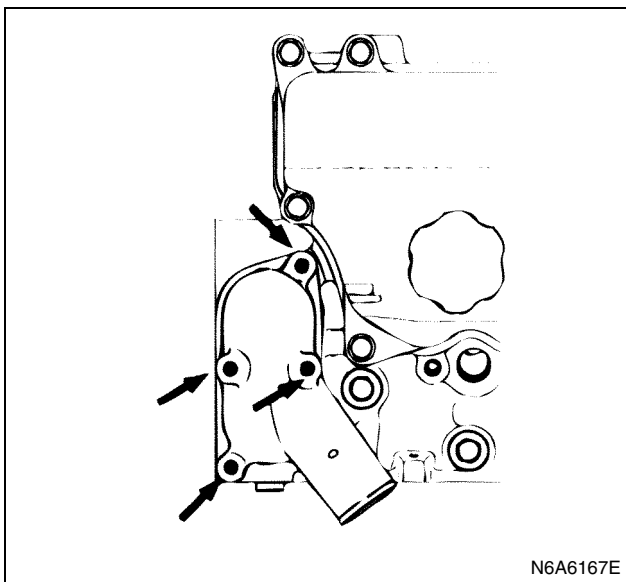
1. Thermostat

13. Install the water outlet pipe.

- Tighten the water outlet pipe with the designated torque.

Tighten:

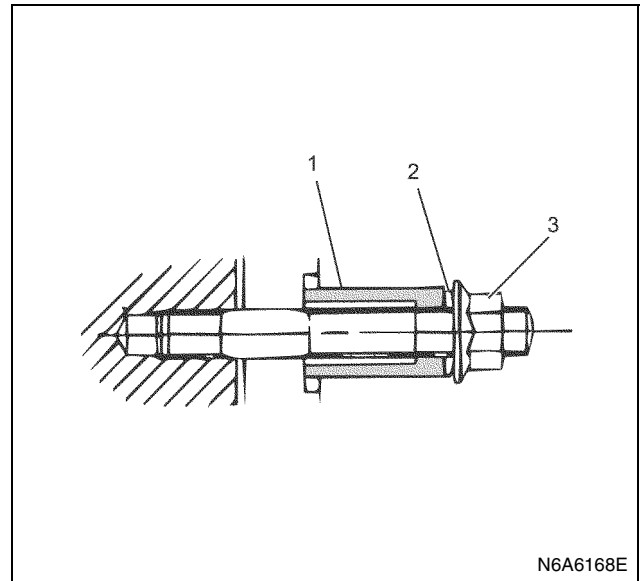
Bolts to 24 N·m (2.4 kg·m/17 lb·ft)



14. Install the exhaust gasket.

15. Install the exhaust manifold.

- Install the distance tube conical spring and the nut on the stud of the cylinder head in this order.



Legend

1. Distance Tube
2. Conical Spring
3. Nut

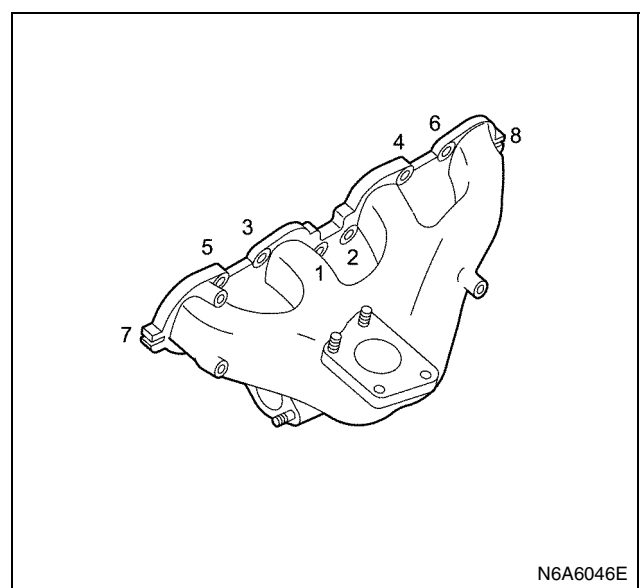
- Tighten the exhaust manifold in the order described in the drawing.

Tighten:

Bolt (1),(2),(3),(4),(5),(6) and Nut (7), (8) to 34 N·m (3.5 kg·m/25 lb·ft)

Caution:

Do not tighten it too much so that it hinders extraction and contraction of the manifold due to heat.



- Install the heat protector.

Tighten:

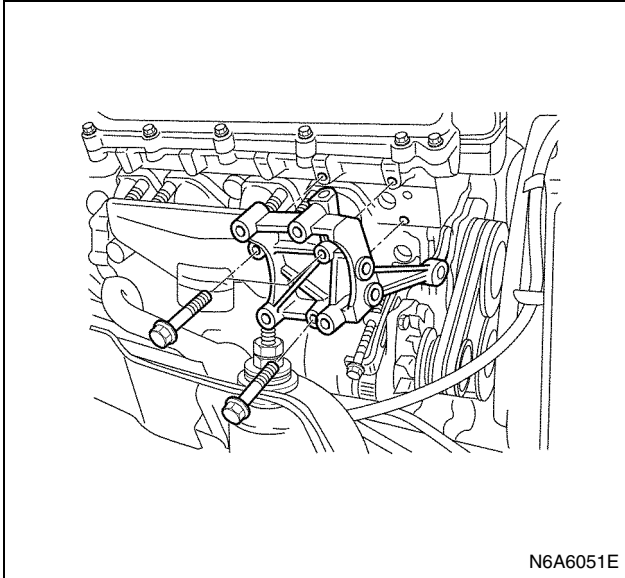
Bolts to 10 N·m (1.0 kg·m/87 lb·ft)

16. A/C compressor bracket.

Install the bracket, tighten the bolt with the designated torque.

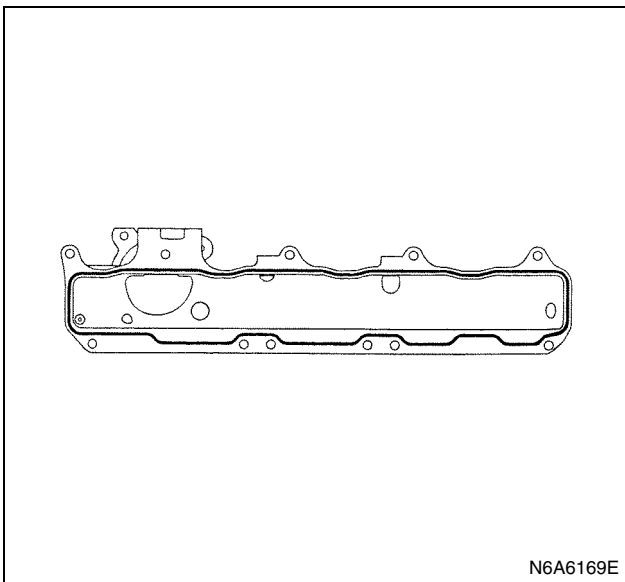
Tighten:

Bolts to 48 N·m (4.9 kg·m/35 lb·ft)



17. Install the inlet cover.

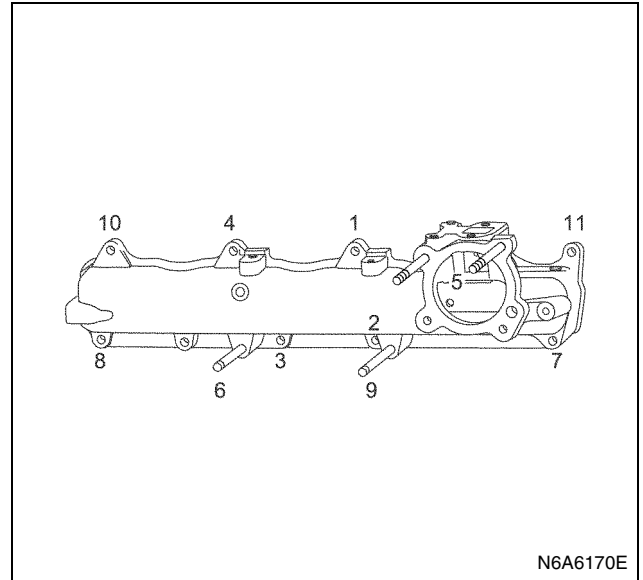
- Apply liquid gasket (ThreeBond1207C or equivalent) in accordance with the groove of the inlet cover, with the bead diameter of $\phi 2.5 - 5.5$ mm (0.0984 - 0.2165 in).



- Tighten in the order described in the drawing.
- Tighten the stud bolts (6) and (9) jointly with the fuel rail.

Tighten:

Stud bolts to 22 N·m (2.2 kg·m/16 lb·ft)



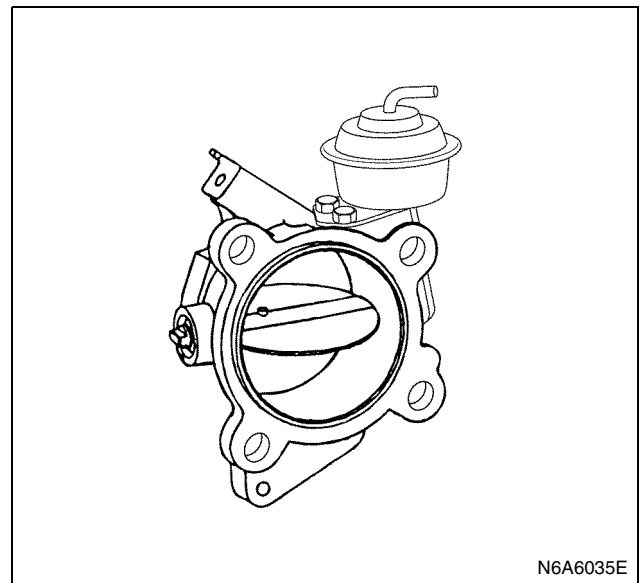
18. Install the throttle assembly.

- Coat the liquid gasket and mount within 7 minutes.

Tighten:

Bolt and nut to 24 N·m (2.4 kg·m/17 lb·ft)

- Install the intake throttle valve connector.



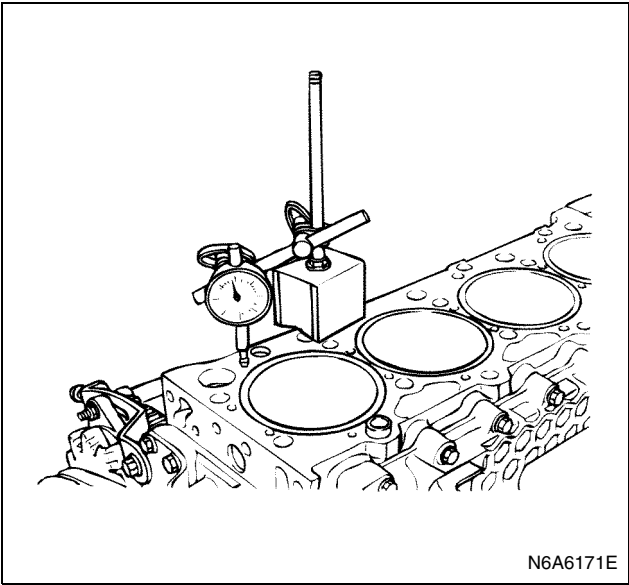
Installation

1. Install the cylinder head gasket.

- Select the cylinder head gasket.
- Clean the head of the piston and the upper surface of the cylinder block.
- Use a dial gauge to measure the extrusion of the piston. Measure at two points of each cylinder.

6A-92 Engine Mechanical (4HK1-TC)

- The following drawing shows the measurement points and the standard point of the cylinder block.

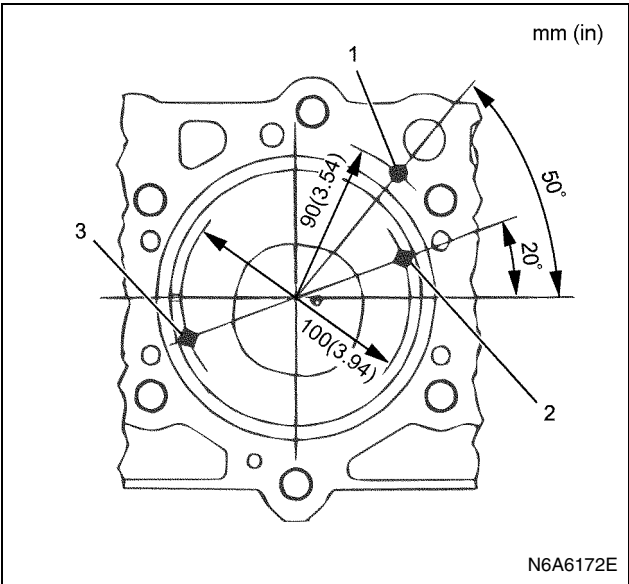


Measurement points:	Head of the piston	(2) and (3)
Standard point:	Upper surface of the cylinder block	(1)

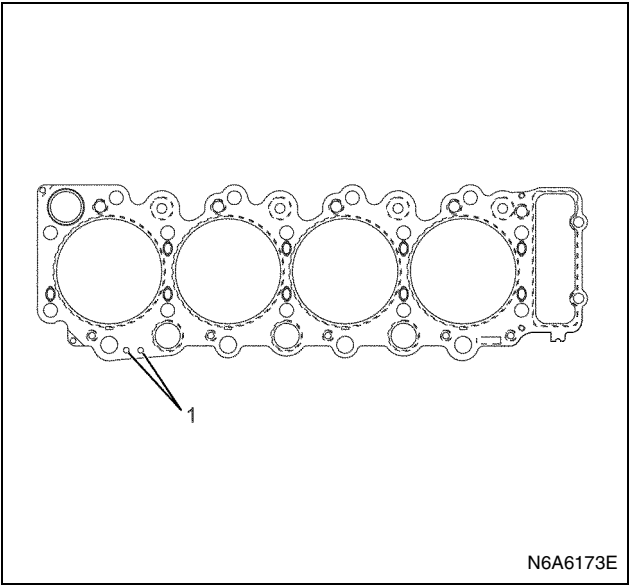
Caution:

Note that there are three options for the head gasket according to the amount of extrusion of piston shown in the following table.

- Calculate the average piston extrusion amount of each cylinder.
- Calculate the maximum amount of the average amount of each cylinder.
- Select a gasket of an appropriate grade based on Timax.



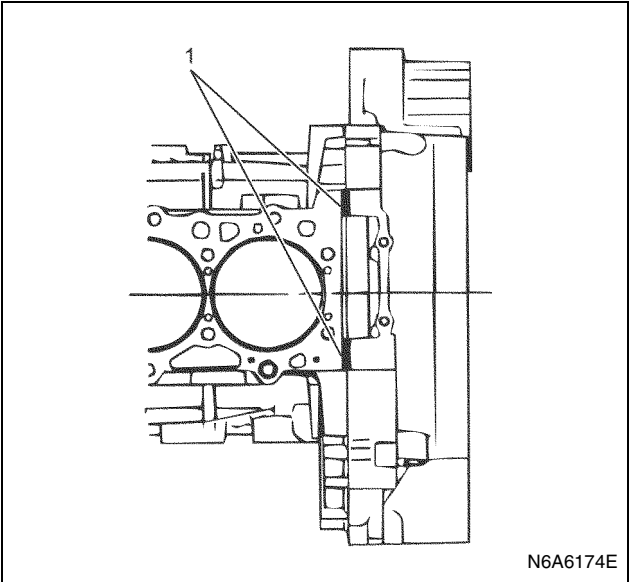
Gasket Grade	Recognized by	Piston extrusion amount mm (in)
A	(no hole)	0.439 (0.01728) – 0.519 (0.02043)
B	(1 hole)	0.519 (0.02043) – 0.589 (0.02319)
C	(2 holes)	0.589 (0.02319) – 0.669 (0.02633)



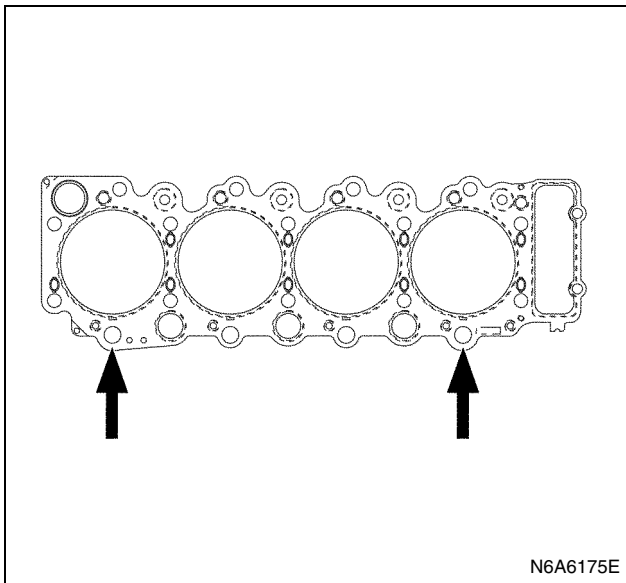
Legend

1. Grade Recognition Hole

- Apply liquid gasket
- Apply liquid gasket (ThreeBond 1207C or equivalent) on the joint (1) of the cylinder block and the flywheel housing with the bead diameter of 3 mm (0.118 in).
- Install the cylinder head within seven minutes after applying liquid gasket.



- Install the cylinder head gasket.
- Install the cylinder head gasket with the parts number upside, along with the cylinder head rear gear case and dowel.

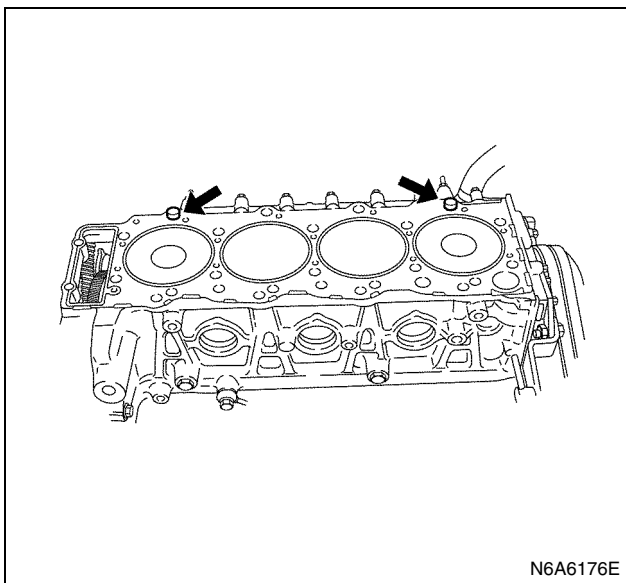


2. Install the cylinder head assembly.

- Install the cylinder head, adjusting the dowel of the cylinder block.

Caution:

Be sure not to damage the head gasket when installing it.



- Apply molybdenum disulfide on the thread and setting face of the head bolt of M14, and apply engine oil on the thread and setting face of the head bolt of M10.
- Use a torque wrench and angle gauge to tighten the head bolts in the order described in the drawing.

Tighten:

M14 bolts (1 – 18) to

1st step: 98 N·m (10.0 kg·m/72 lb·ft)

2nd step: 147 N·m (15.0 kg·m/108 lb·ft)

3rd step: 30° – 60° (degrees)

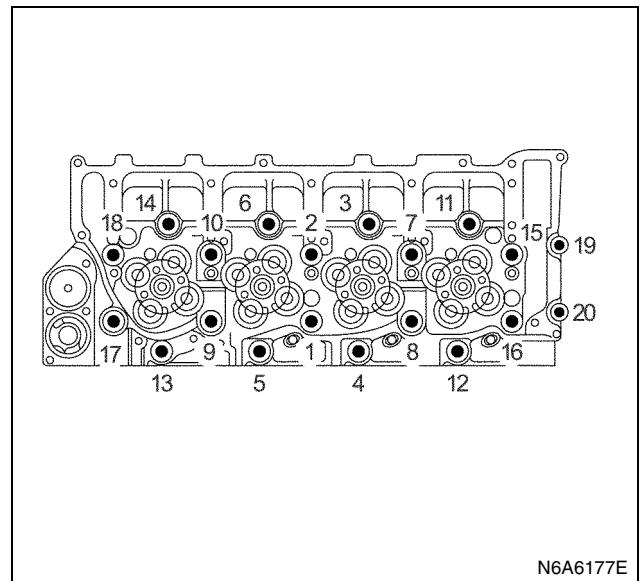
M10 bolts (19, 20) to

4th step: 38 N·m (3.9 kg·m/28 lb·ft)

- Tighten bolts from 1-18 (M14) and confirm that they are tightened to a torque of 167 N·m (17.0 kg·m/123 lb·ft) or more.

Special tool

Angle gauge: 5-8840-0266-0 (J-45059)

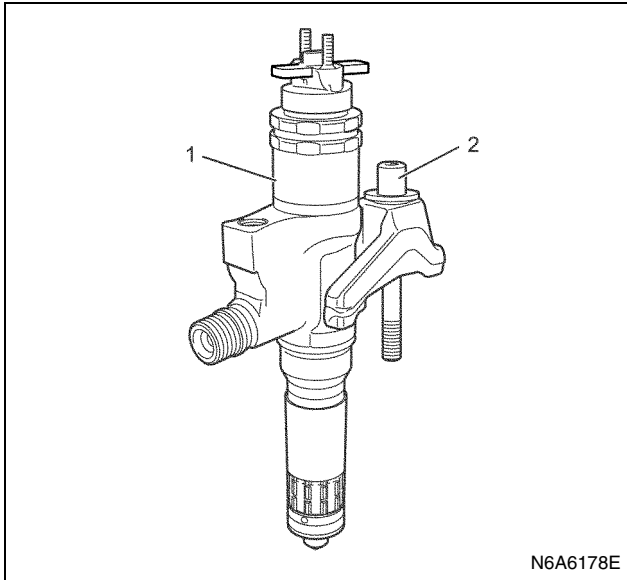


3. Install the fuel injector on the cylinder head.

4. Apply molybdenum disulfide on the thread and setting face of the fuel injector tighten bolt and tighten it tentatively.

Important:

Reinstall each fuel injector to the original cylinder from which it was removed during the disassembly procedure.



Legend

1. Fuel Injector Assembly
2. Fuel Injector Tighten Bolt

5. Install the fuel rail.

Tighten:

Fuel rail to 19 N·m (1.9 kg·m/14 lb·ft)

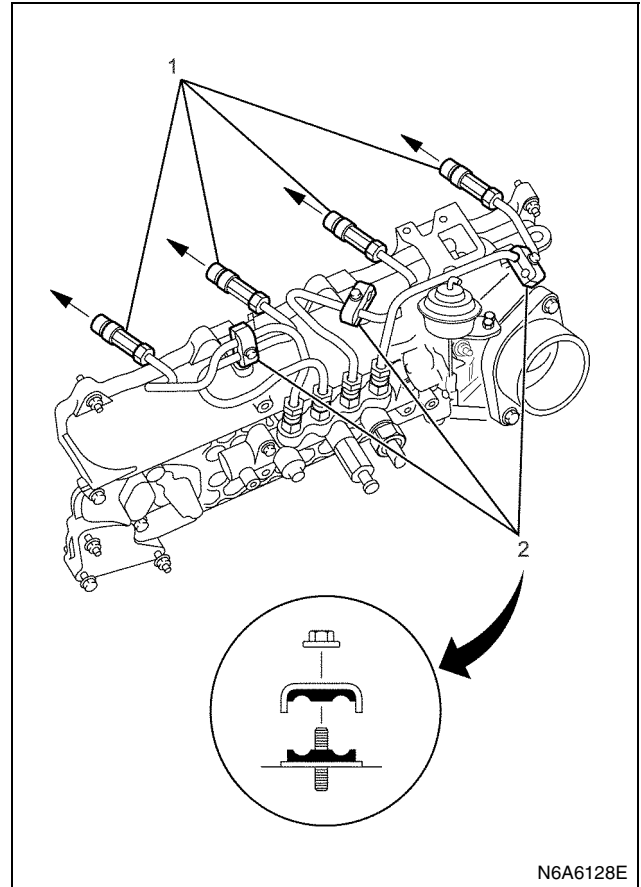
- Install the fuel rail pressure sensor.

6. Install the injection pipe.

- Apply a thin coat of engine oil on the outer diameter of the sleeve nut on the side of the fuel injector and install the injection pipe.
- Use a spanner to tighten the sleeve nut until it completely contacts both on the fuel injector and fuel rail.
- Tighten the injection pipe clip with the designated torque.

Tighten:

Clip to 6 N·m (0.6 kg·m/52 lb·in)



Legend

1. Fuel Injection Pipe
2. Fuel Injection Pipe Clip

7. Final tighten the injection clamp bolts to the specified torque.

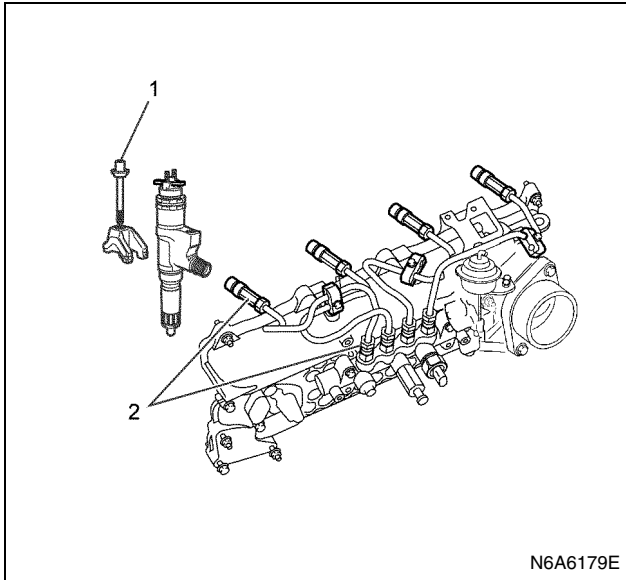
Tighten:

Bolts to 30 N·m (3.0 kg·m/22 lb·ft)

8. Tighten the injection pipes to the specified torque.

Tighten:

Nuts to 44 N·m (4.5 kg·m/33 lb·ft)



Legend

1. Injection Clamp Bolt
2. Injection Pipe Sleeve Nut

9. Install the glow plug.

Tighten:

Glow plug to 20 N·m (2.0 kg·m/15 lb·ft)

10. Install and tighten the glow connector with the designated torque.

Tighten:

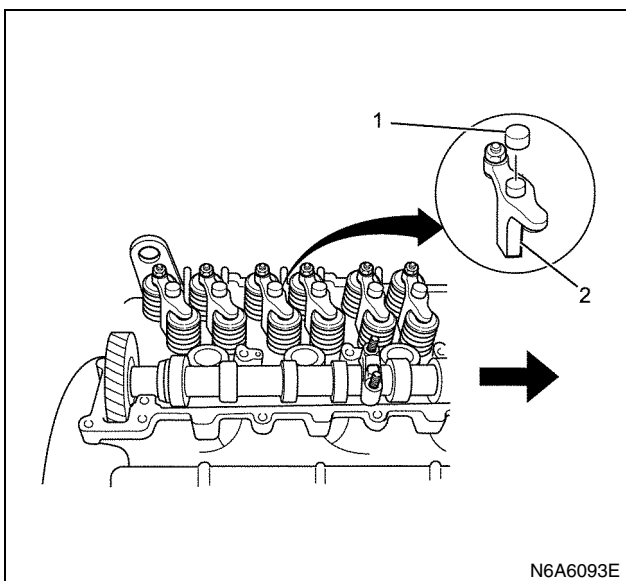
Glow connector to 1.2 N·m (0.1 kg·m/10.5 lb·in)

11. Apply engine oil on the bridge, install it.

Caution:

Move it up and down to confirm that it moves smoothly.

12. Apply a thin coat of engine oil inside the bridge cap, install it.



Legend

1. Bridge Cap
2. Bridge

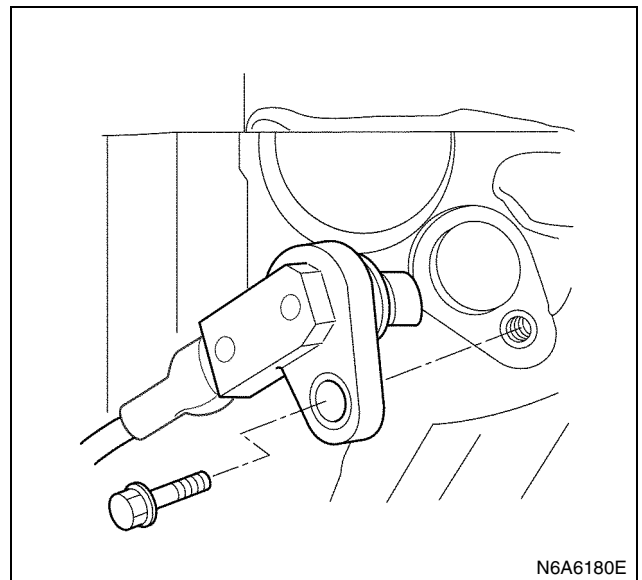
13. Install the camshaft assembly.
Refer to "Camshaft Assembly".

14. Install the rocker arm shaft assembly.
Refer to "Rocker Arm Shaft Assembly".

15. Install and tighten the camshaft position sensor with the designated torque.

Tighten:

Bolt to 8 N·m (0.8 kg·m/69 lb·in)



16. Install the water bypass hose.

17. Install the engine coolant temperature sensor on the thermostat housing.

Tighten:

Engine coolant temperature sensor to 25 N·m (2.5 kg·m/18.4 lb·ft)

18. Install the leak-off pipe.

Tighten:

Leak-off pipe to 12 N·m (1.2 kg·m/104 lb·in)

19. Install the fuel leak-off hose.

20. Clip a new gasket to the fuel nozzle leak-off pipe and install the fuel leak-off pipe.

Tighten:

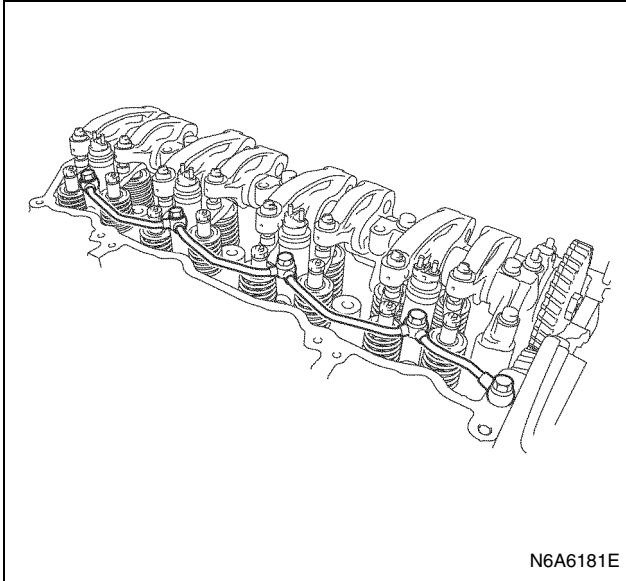
Nozzle leak-off pipe (injector to cylinder head) to 12 N·m (1.2 kg·m/104 lb·in)

Fuel leak-off pipe (cylinder head side) 12 N·m (1.2 kg·m/104 lb·in)

Fuel leak-off pipe (supply pump side) 18 N·m (1.8 kg·m/13.3 lb·ft)

Caution:

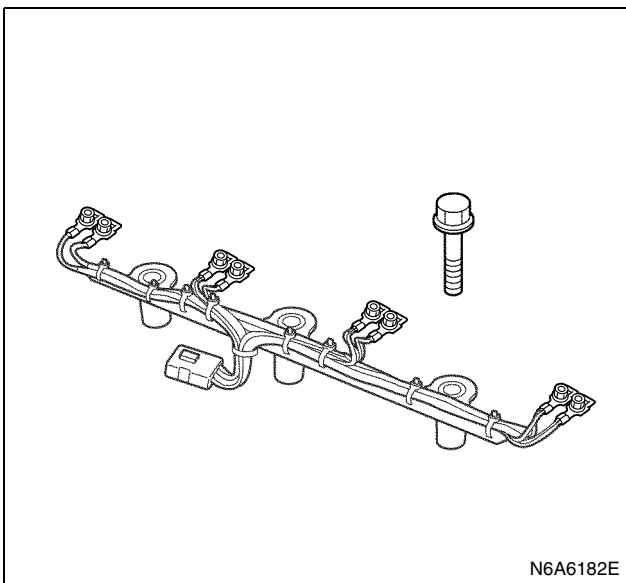
Use new gaskets.



21. Install the fuel injector harness connectors.
22. Install the harness bracket and tighten the bolts to the specified torque.

Tighten:

Bolt to 48 N·m (4.9 kg·m/35 lb·ft)



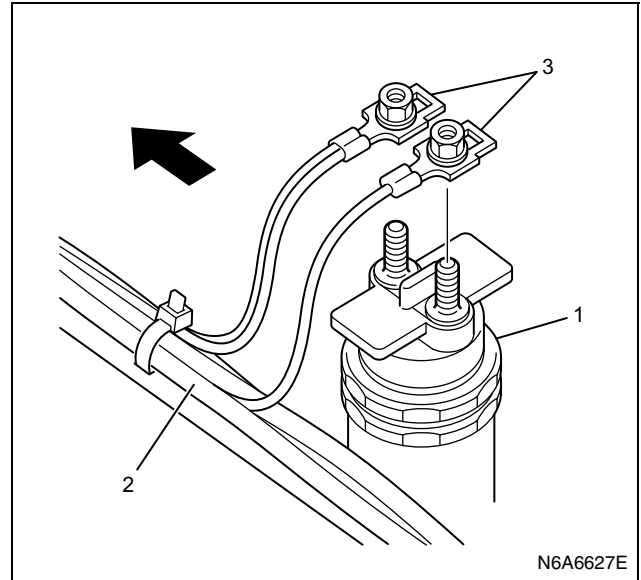
23. Install the terminal nuts on the fuel injector.

Tighten:

Terminal nuts to 2 N·m (0.2 kg·m/17 lb·in)

Caution:

- Do not over tighten the nuts. Damage to the terminal studs will result.
- The terminal nut with two wires is engine front side.



Legend

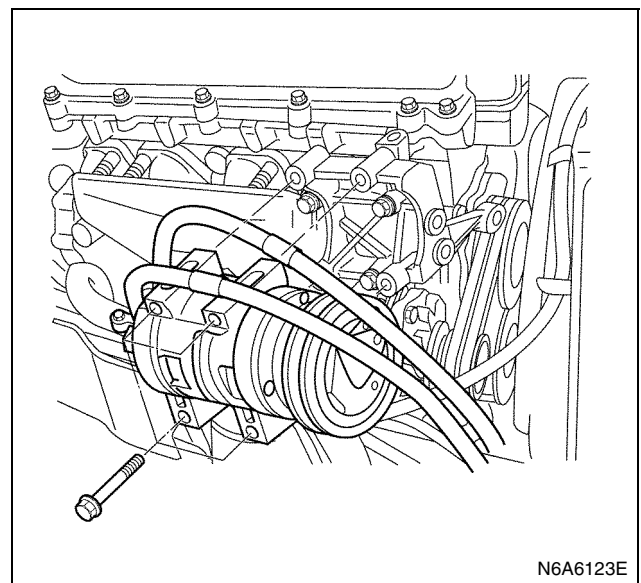
1. Fuel Injector
2. Fuel Injector Harness
3. Fuel Injector Terminal Nut

24. Install the cylinder head cover.
Refer to "Cylinder Head Cover".
25. Install the radiator upper hose.
26. Install the A/C compressor.
 - Install the A/C compressor bracket on the A/C compressor and tighten it with the designated torque.

Tighten:

Bolt to 24 N·m (2.4 kg·m/18 lb·ft)

- Install the A/C compressor harness connector.



27. Install the A/C compressor drive belt.
 - Place the drive belt and adjust its tension with the adjust bolt of the tension pulley.

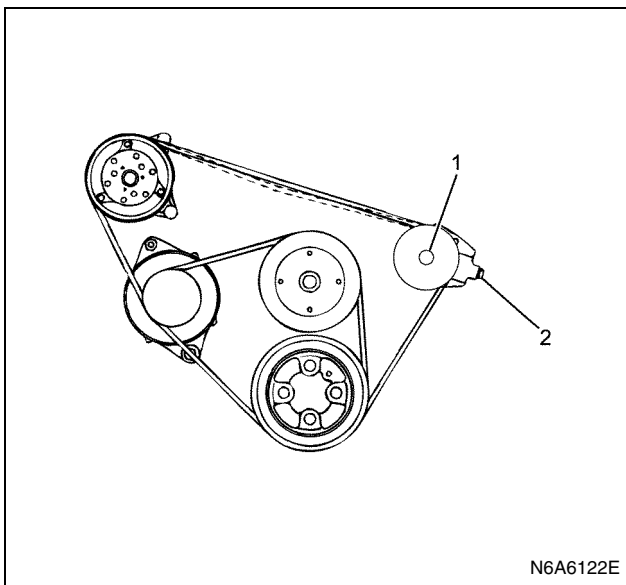
- Use a scale or other equipment to inspect whether the flexure of the belt when it was pushed by hand with pressure of 98 N (22 lb) is within the designated range.

A/C belt flexure		mm (in)
New belt		16 (0.63) – 20 (0.79)
Reused belt		18 (0.71) – 22 (0.87)

- Tighten the locknut of the tension pulley with the designated torque after adjusting the tension of the belt.

Tighten:

Lock nut to 27 N·m (2.8 kg·m/20 lb·ft)



Legend

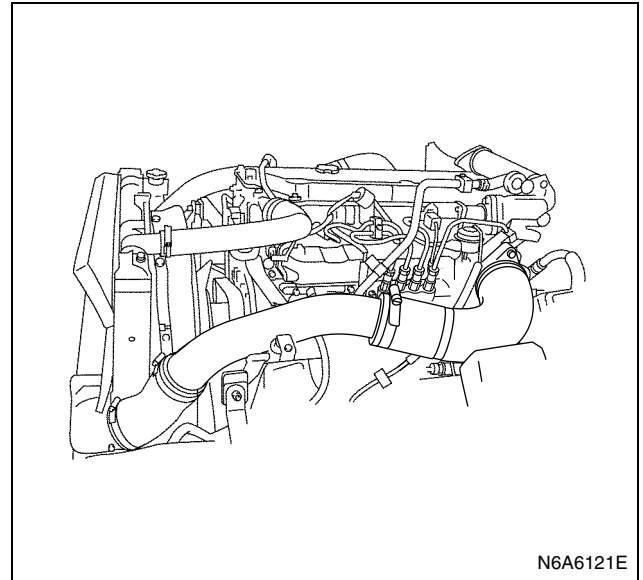
1. Tension Pulley Lock Nut
2. Tension Pulley Adjusting Bolt

28. Install the intake pipe.

- Install the bolt and clip band, tighten the bolt with the designated torque.

Tighten:

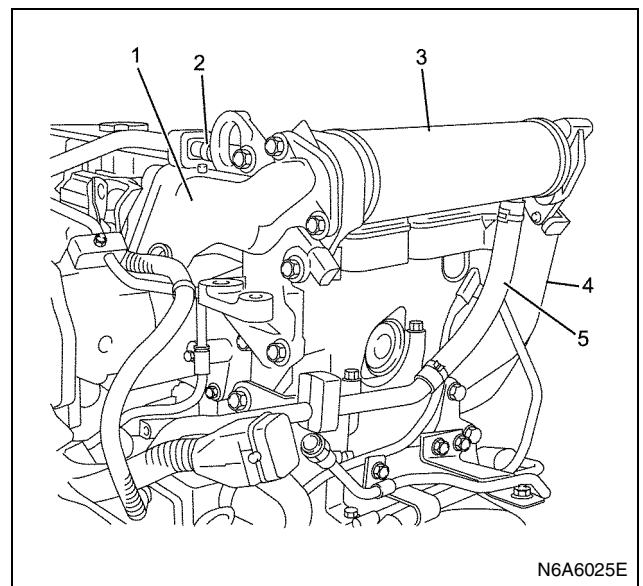
Bolt to 10 N·m (1.0 kg·m/87 lb·in)



- Install the fan guide bracket.

29. Install the EGR valve and EGR cooler.

For details of installation, refer to "EGR Valve and EGR Cooler" in Section 6F.



Legend

1. EGR Adapter
2. Water Return Pipe
3. EGR Cooler
4. EGR Pipe
5. Water Feed Pipe

30. Install the oil level gauge and guide tube.

31. Install the exhaust pipe.

- Install the front exhaust pipe and tighten with the designated torque.

Tighten:

Nuts to

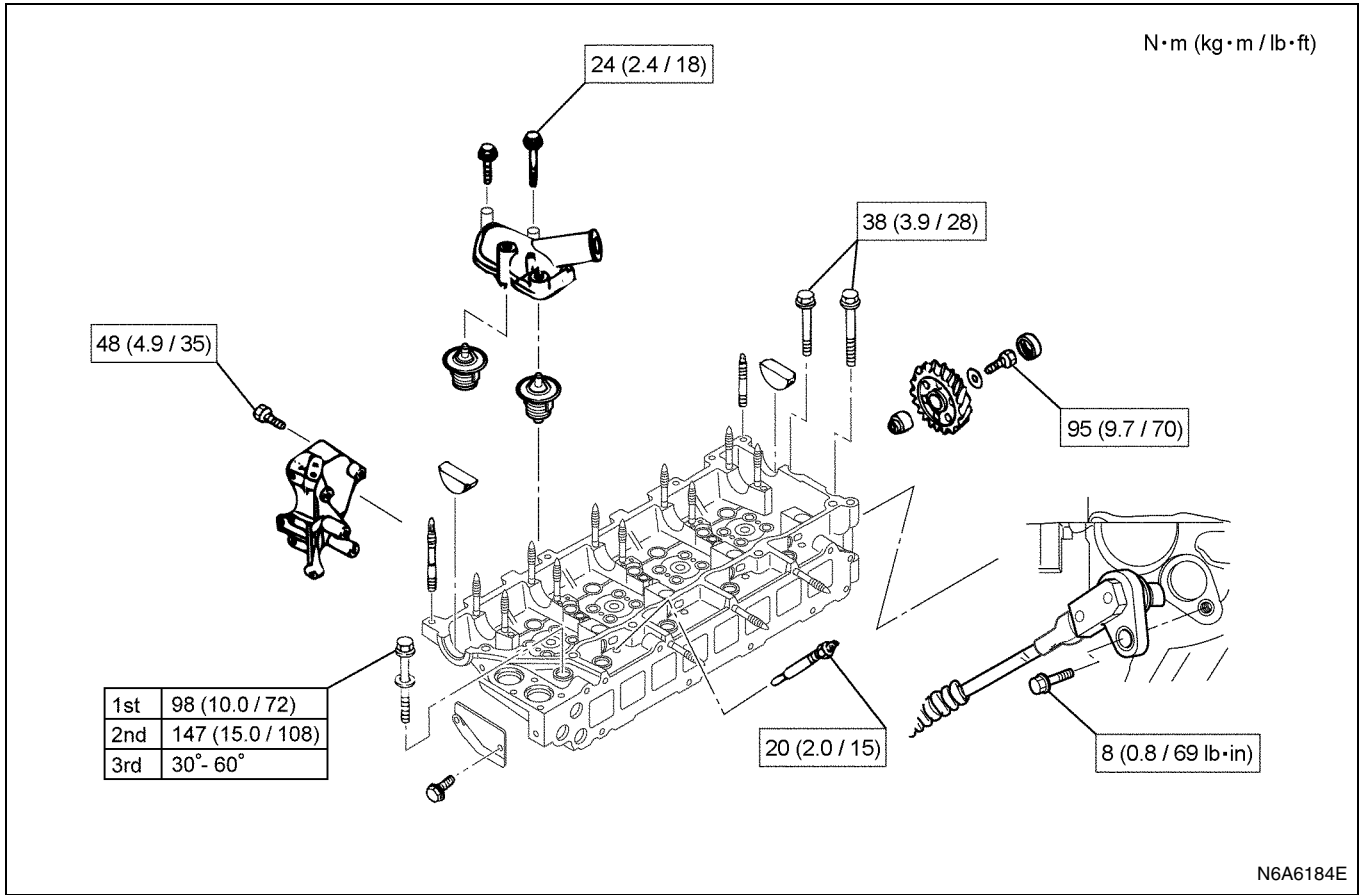
Exhaust manifold side: 67 N·m (6.8 kg·m/49 lb·ft)

Exhaust brake side: 17 N·m (1.7 kg·m/13 lb·ft)

32. Install the engine harness.

33. Replenish the coolant.

Torque Specifications



Special Tool

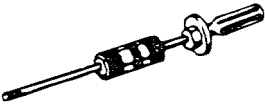
Illustration	Tool Number / Description / Remarks
 584000190	5-8840-0019-0 (J-23907) Sliding Hammer
 5884022270	5-8840-2628-0 (J-43272) Valve Guide Replacer

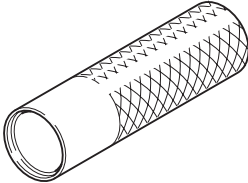
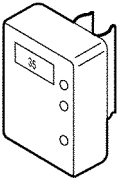
Illustration	Tool Number / Description / Remarks
 EN47685	5-8840-2833-0 (EN-47685) Valve Stem Seal Installer
 J45059	5-8840-0266-0 (J-45059) Angle Gauge

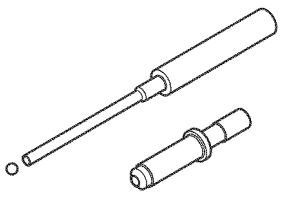
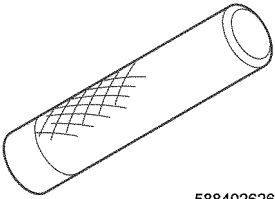
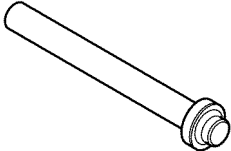
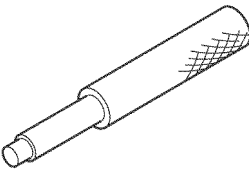
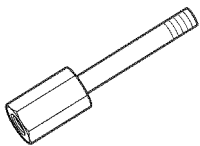
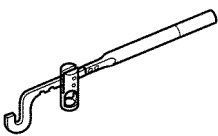
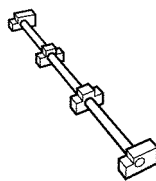
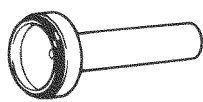
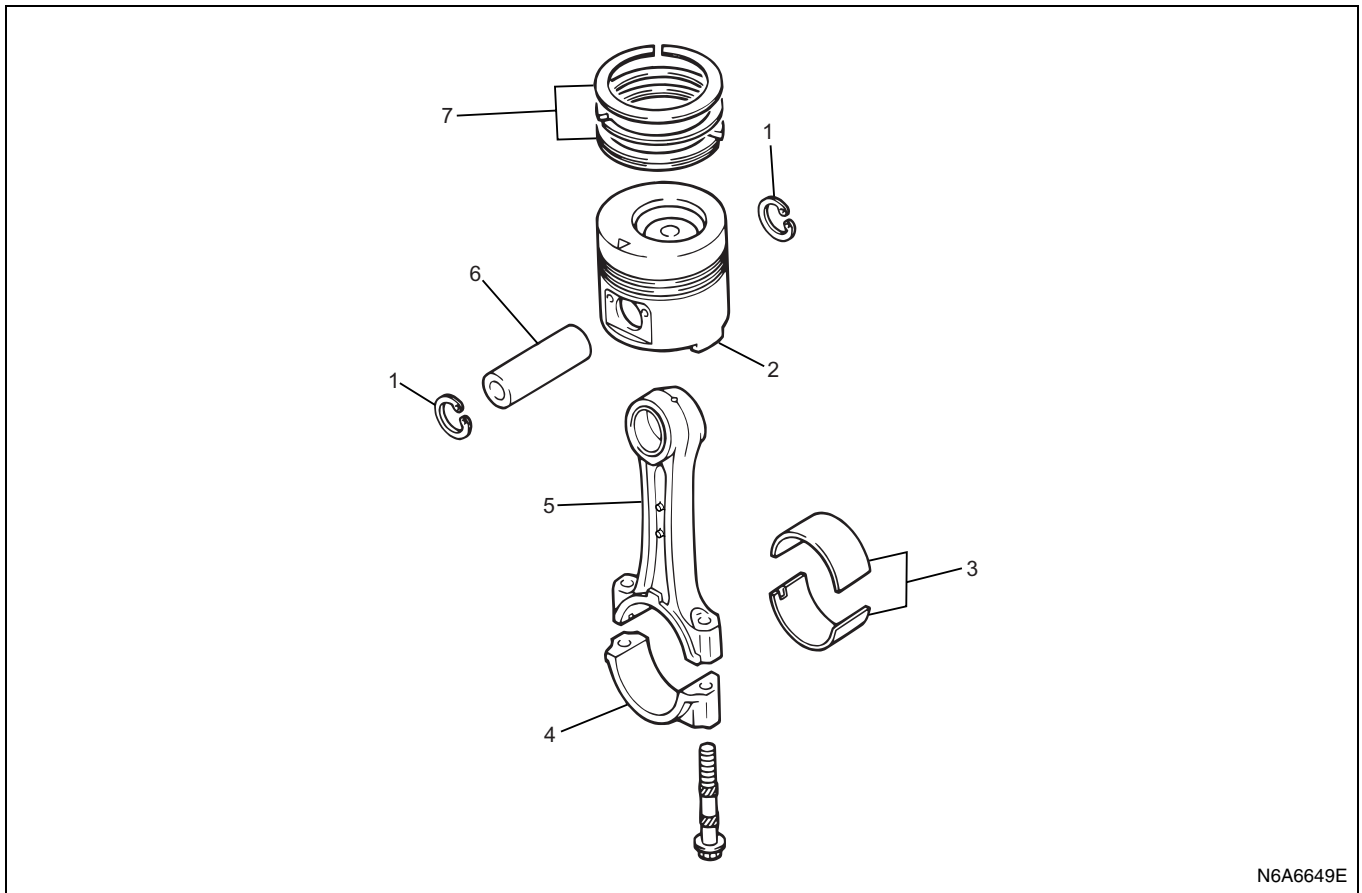
Illustration	Tool Number / Description / Remarks
 5884026240	5-8840-2624-0 (J-43266) Nozzle Sleeve Installer
 5884026260	5-8840-2626-0 (J-43268) Bridge Guide Installer
 5884026270	5-8840-2627-0 (J-43269) Oil Seal Installer
 5884026230	5-8840-2623-0 (J-43265) Nozzle Sleeve Remover
 EN46720	5-8840-2826-0 (EN-46720) Fuel Injector Remover
 5884026210	5-8840-2621-0 (J-43263) Valve Spring Replacer

Illustration	Tool Number / Description / Remarks
 8943968620	5-8840-2808-0 (EN-46721) Pivot Assembly
 5884022220	5-8840-2222-0 (EN-47690) Sealing Cup Installer

Piston and Connecting Rod

Component



Legend

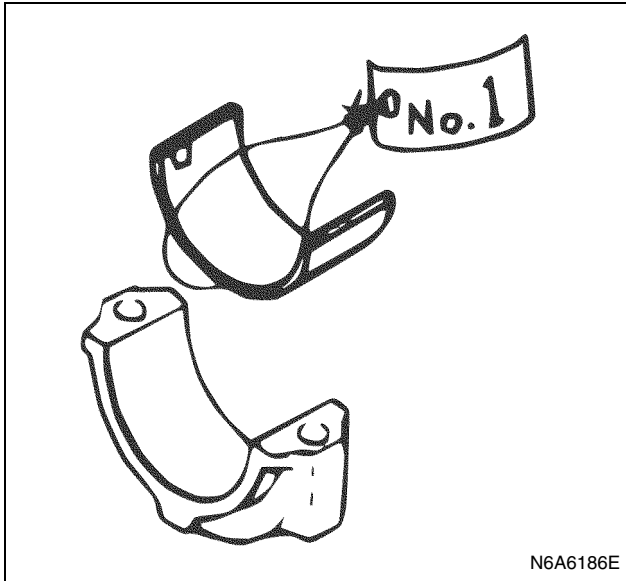
- | | |
|-----------------------|-------------------|
| 1. Snap Ring | 5. Connecting Rod |
| 2. Piston | 6. Piston Pin |
| 3. Bearing | 7. Piston Ring |
| 4. Connecting Rod Cap | |

Removal

1. Remove the oil pan.
Refer to "Oil Pan".
2. Remove the cylinder head cover.
Refer to "Cylinder Head Cover".
3. Remove the rocker arm shaft assembly.
Refer to "Rocker Arm Shaft Assembly".
4. Remove the camshaft assembly.
Refer to "Camshaft Assembly".
5. Remove the cylinder head.
Refer to "Cylinder Head".
6. Remove the connecting rod cap.

Caution:

Sort the removed bearings according to cylinders by using tags.



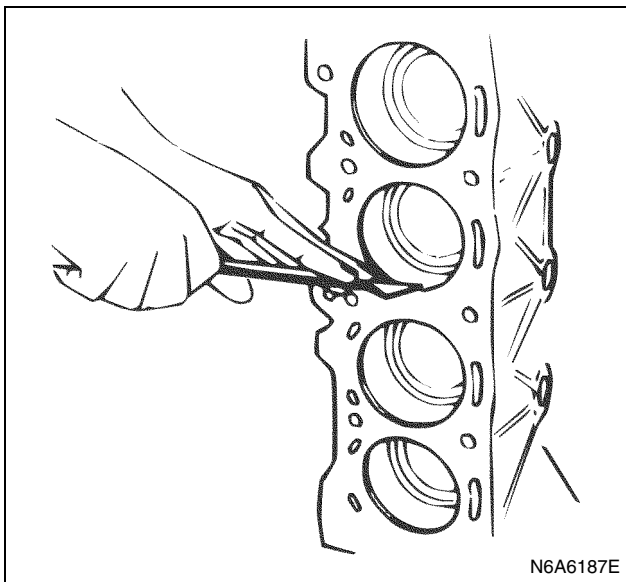
N6A6186E

7. Remove the piston and connecting rod.

- Remove carbon on the upper side of the cylinder liner with a scraper.
- Pull out the piston and connecting rod towards the cylinder head.

Caution:

Be sure not to damage the oil jet and cylinder liner when pushing out the connecting rod.



N6A6187E

8. Remove the connecting rod bearing.

Caution:

Arrange the bearings in the order of cylinders. Be sure to put them back to the original cylinders.

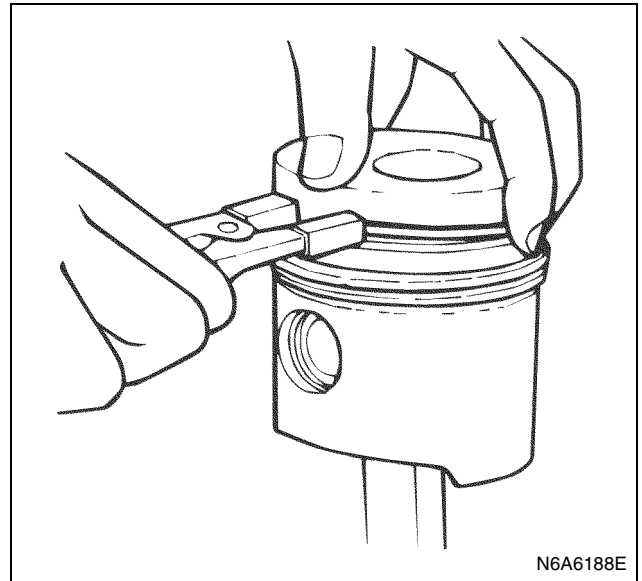
Disassembly

1. Remove the piston ring.

- Use ring pliers to remove the piston ring.

Caution:

Sort the piston rings in the order of cylinders when reusing them so that they will not be confused with the pistons and piston rings of other cylinders.



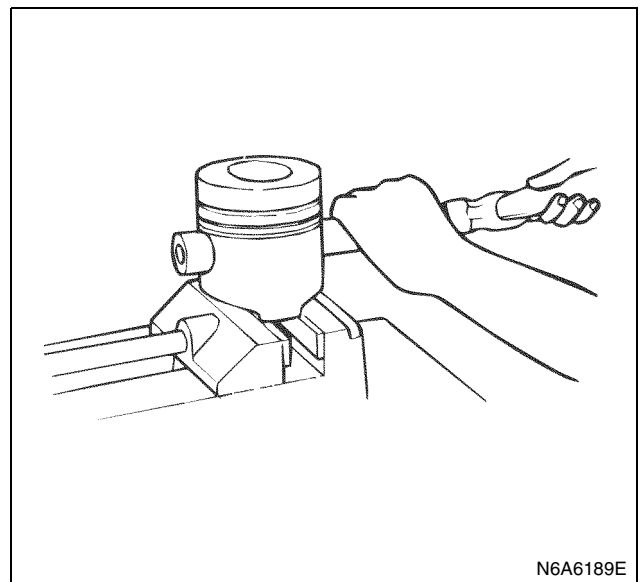
N6A6188E

2. Remove the snap ring.

3. Remove the piston pin.

Caution:

Sort the disassembled piston pins, pistons and connecting rods together in the order of cylinders.



N6A6189E

4. Remove the connecting rods from the piston.

5. Piston

- Clean carbon carefully that is adhered to the head of the piston and the groove of the piston ring.

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Caution:

Do not use wire brush to clean the piston because it scratches the piston.

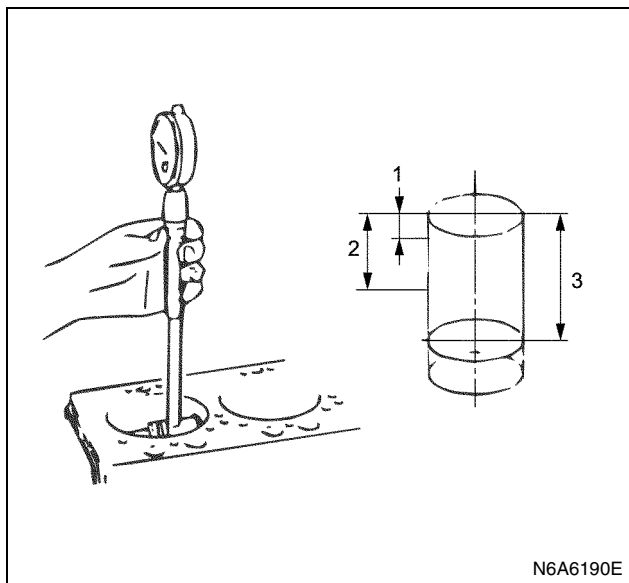
Inspect the piston with eyes for cracks, burns and other excessive wear, and replace it if there is any abnormality.

6. Measure the gap between the piston and the inner diameter of the cylinder liner.

Inner diameter of the cylinder liner.

- Use a cylinder bore dial indicator to measure the liner inner diameter both in the thrust and radial directions in the designated position.
- Measurement position (from the upper surface of the cylinder block)
 1. 20 mm (0.79 in)
 2. 110 mm (4.33 in)
 3. 190 mm (7.48 in)
- Measure the liner inner diameter based on the average value of the actual measurement values on 6 positions.

Cylinder liner inner diameter	mm (in)
115.021 – 115.050 (4.52838 – 4.52952)	



Legend

1. 20 mm (0.79 in)
2. 110 mm (4.33 in)
3. 190 mm (7.48 in)

Piston outside diameter

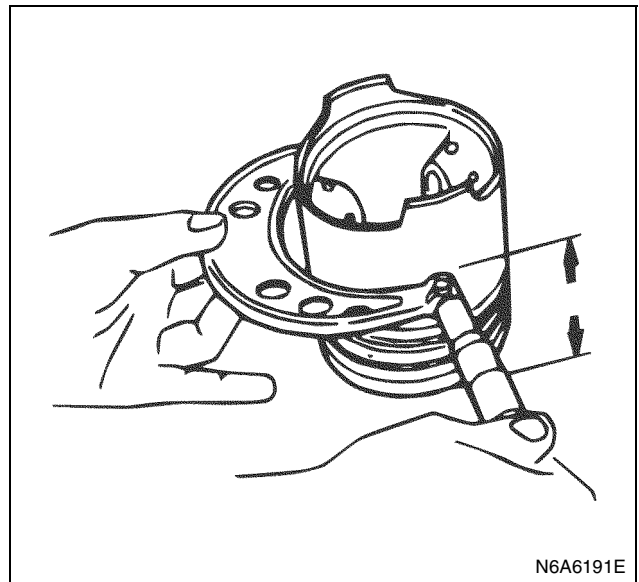
- Use a micrometer to measure the outside diameter of the piston in the right angle to the piston pin in the designated position.
- Measurement position (from the upper surface of the piston) 82 mm (3.2 in).

Piston diameter	mm (in)
Standard	114.924 – 114.939 (4.52456 – 4.52515)

Gap between the piston and the inner diameter of the cylinder liner	mm (in)
Standard	0.082 – 0.126 (0.0032 – 0.0050)

Caution:

If it is found that the gap between the cylinder liner inner diameter and the piston exceeds the standard value, replace the piston or cylinder liner.

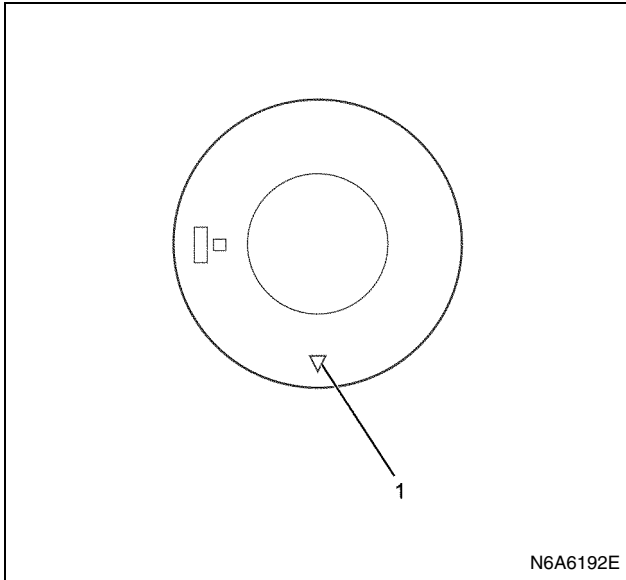


7. Piston replacement

- You do not need to select grades because there is only one grade for each of the piston and the cylinder liner inner diameter. If you replace the cylinder liner, you must select the cylinder block (1, 2, 3) because there are two types of the liner outer diameter.
- Refer to "Cylinder Block" if you replace the cylinder liner.

Caution:

The head of piston has a marking of grade B or C when it is shipped from the factory.



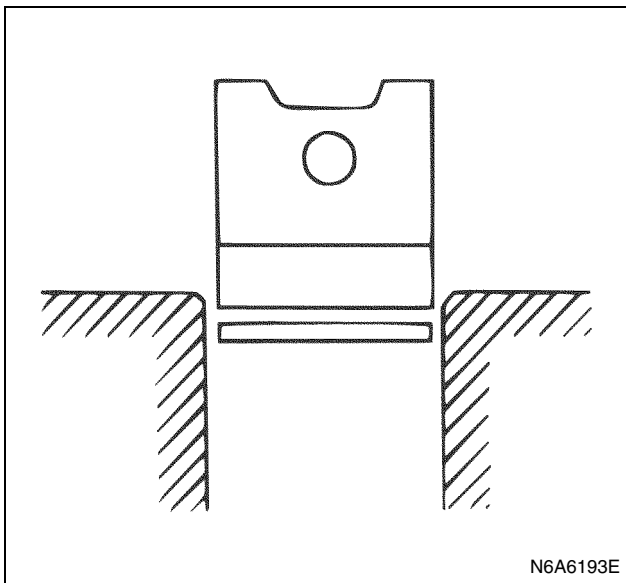
Legend

1. Front Mark Cut

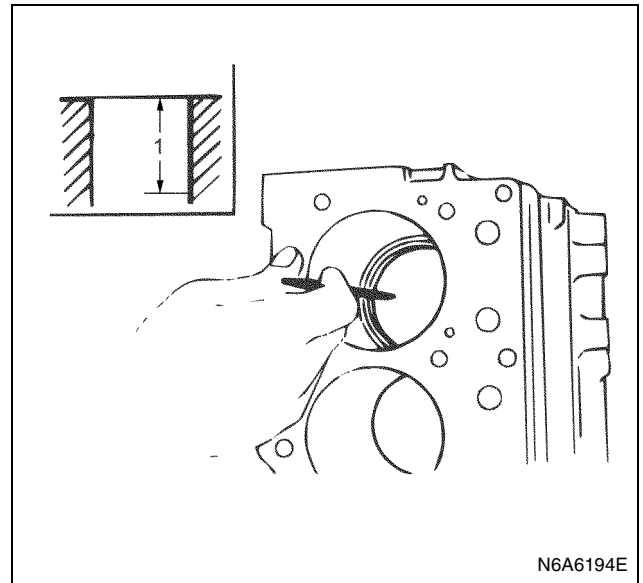
8. Inspect the piston ring.

Measure the joint of the piston ring (remove carbon on the ring joint)

- Insert the piston ring into the cylinder liner.
- Use the piston to push the ring to reach the under edge of the cylinder liner.



- Use a thickness gauge to measure the gap of the ring joint.



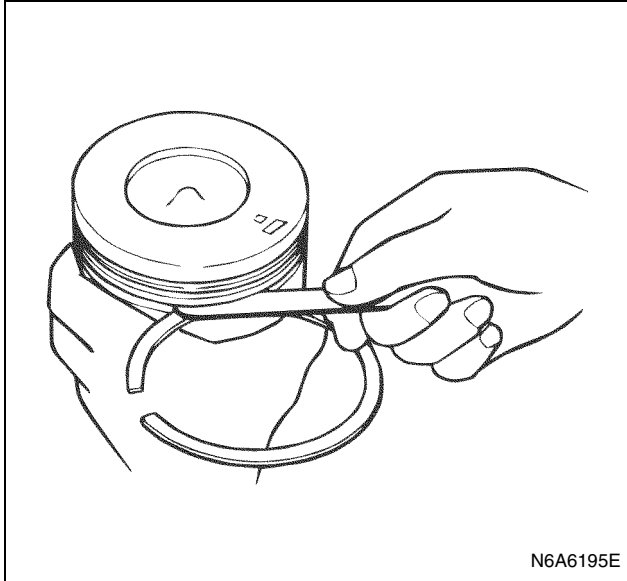
- If the measurement exceeds the limit, replace the piston ring.

Piston ring gap		mm (in)
	Standard	Limit
1st compression ring	0.20 – 0.30 (0.0079 – 0.0118)	1.20 (0.047)
2nd compression ring	0.30 – 0.45 (0.0118 – 0.0177)	1.20 (0.047)
Oil ring	0.20 – 0.40 (0.0079 – 0.0157)	1.20 (0.047)

Measure the clearance between the piston ring groove and the piston.

- Remove carbon in the piston ring groove.
- Put the piston ring in the piston ring groove, use a thickness gauge to measure the gap between them.
- If the clearance between the piston ring groove and the piston exceeds the limit, replace the piston and the piston ring.

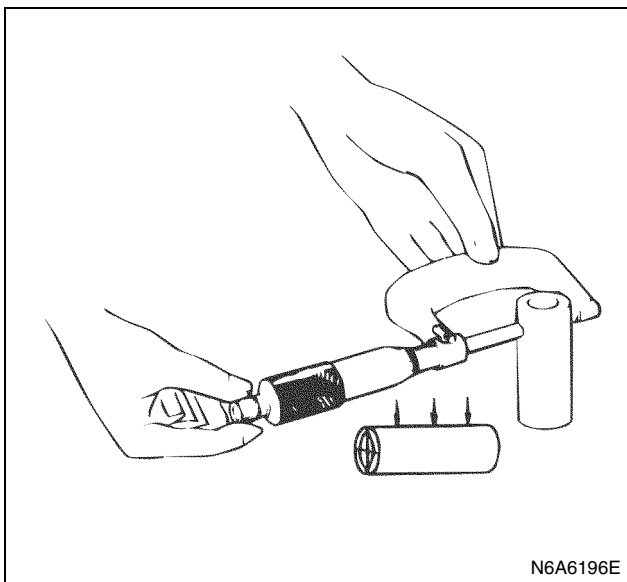
Piston ring and piston ring groove clearance		mm (in)
Piston ring	Standard	Limit
1st compression ring	0.07 – 0.11 (0.0028 – 0.0043)	0.20 (0.0079)
2nd compression ring	0.03 – 0.07 (0.0012 – 0.0028)	0.15 (0.0059)
Oil ring	0.03 – 0.07 (0.0012 – 0.0028)	0.15 (0.0059)



9. Inspect the piston pin.

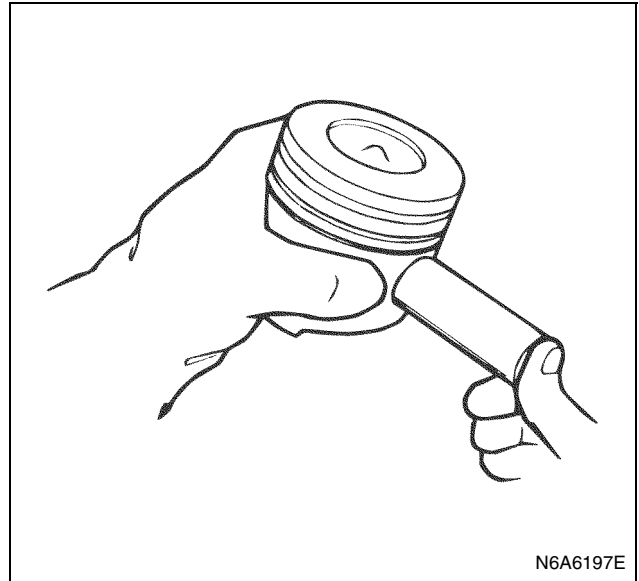
- Inspect the piston pin with eyes for cracks, scratches and other damages, replace it if necessary.
- Use a micrometer to measure the outer diameter of the piston pin. If the measured value exceeds the limit, replace the piston pin.

Piston pin outer diameter		mm (in)
Standard	39.995 – 40.000	(1.5746 – 1.5748)
Limit	39.970	(1.5736)



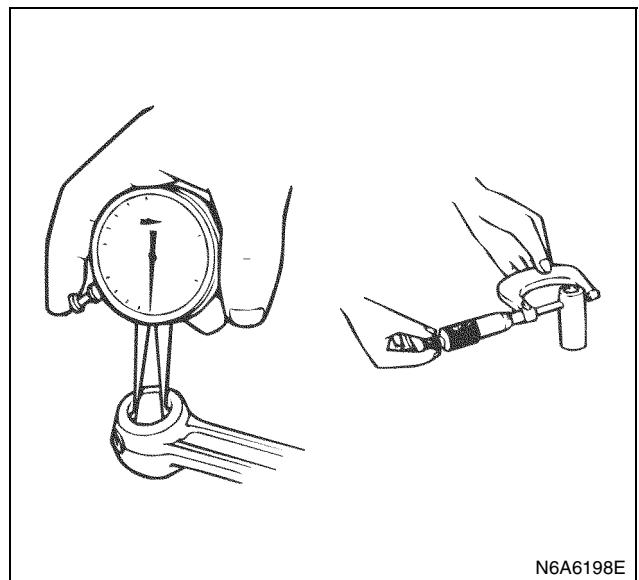
- Inspect to make sure that there is a resistance to the extent which the piston can push the piston pin lightly in normal temperatures.

- If it feels a large looseness or instability in normal temperatures, replace the piston or piston pin.



- Measure the bush of the small edge of the connecting rod. If the clearance of the bush inner diameter and the pin diameter exceeds the limit, replace the bush or connecting rod assembly, and the pin.

Piston pin and connecting rod small end bushing clearance		mm (in)
Standard	0.012 – 0.027	(0.0005 – 0.0011)
Limit	0.05	(0.0020)



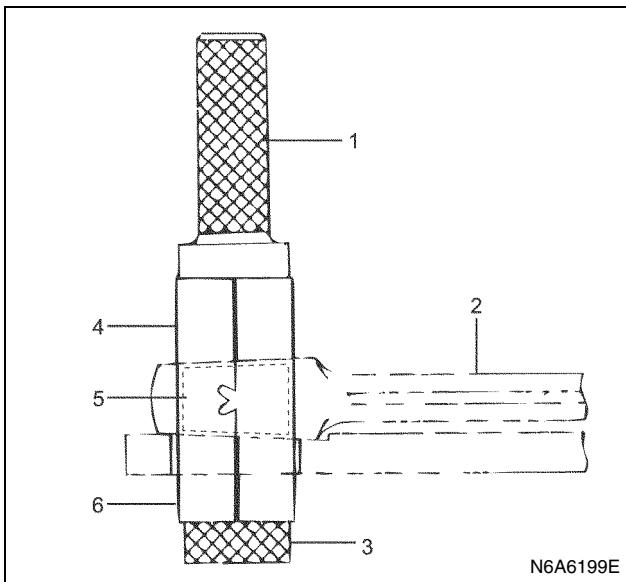
- #### 10. Measure the clearance between the piston and the piston pin.

- Apply engine oil on the piston pin. Use your finger to push it in hole of the piston and rotate it. If the pin smoothly rotates without instability, the clearance is normal. If there is instability, measure the clearance. If the clearance exceeds the limit, replace the piston and the piston pin.

Piston pin and piston pin hole clearance		mm (in)
Standard	0.004 – 0.017 (0.00016 – 0.00067)	
Limit	0.04 (0.0016)	

11. Remove the bush.

- Set the collar, connecting rod and collar on the setting bar as shown in the drawing.
- Tighten the nut.



Legend

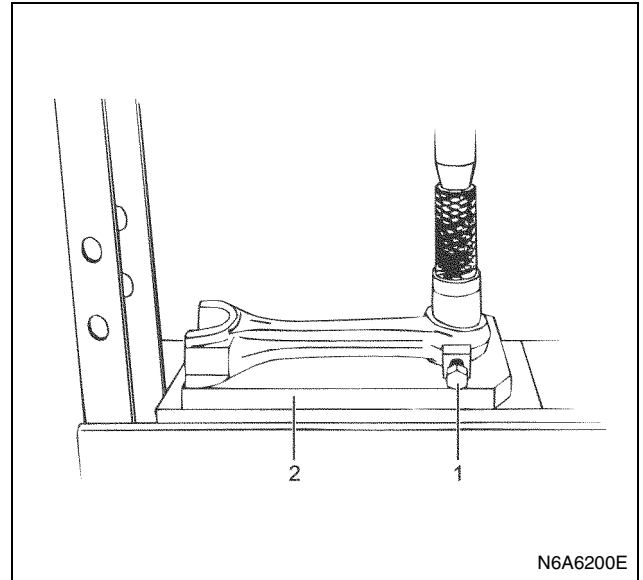
1. Setting Bar
2. Connecting Rod
3. Nut
4. Collar
5. Bush
6. Collar

- Place the connecting rod bush replacer base on press, tighten the fixation bolt.

- Use the bench press to replace the bush.

Special tool

Connecting rod bush replacer: 5-8840-2340-0 (EN-47682)



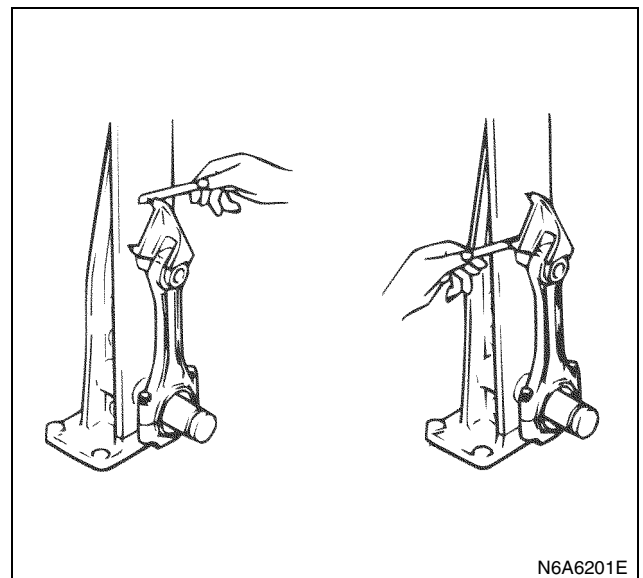
Legend

1. Bolt
2. Connecting Rod Bush Replacer

12. Measure the connecting rod alignment.

- Use a connecting rod aligner to measure the parallelism of the big end hole and the small end hole. If the measured value exceeds the limit, replace it.

Connecting rod alignment (par length of 100 mm (3.94 in))		mm (in)
	Standard	Limit
Distortion and Parallelism	0.05 (0.002)	0.20 (0.008)



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13. Measure the bearing oil clearance.

- Measure the oil clearance between the connecting rod bearing and the crank pin with the following method.
 - Remove the connecting rod cap. Sort the removed caps according to the cylinder number.
 - Clean the bearing and the shaft pin.
 - Inspect the bearing. If it is damaged or worn seriously, replace the entire bearing.
- Place the plastigauge on the crankshaft pin.
- Install the bearing cap and tighten the bolt with the designated torque.
Apply molybdenum disulfide on the screw part and the bearing surface.

Tighten:

Connecting rod bearing cap bolt to

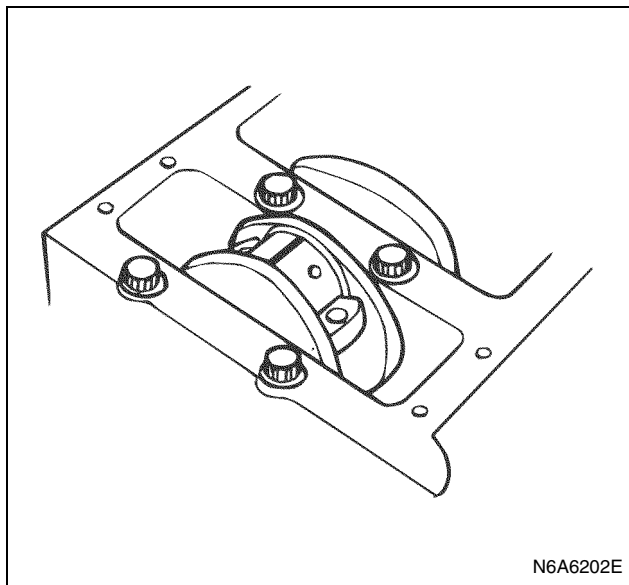
1st step: 39 N·m (4.0 kg·m/29 lb·ft)

2nd step: 60° (degrees)

3rd step: 30° (degrees)

Caution:

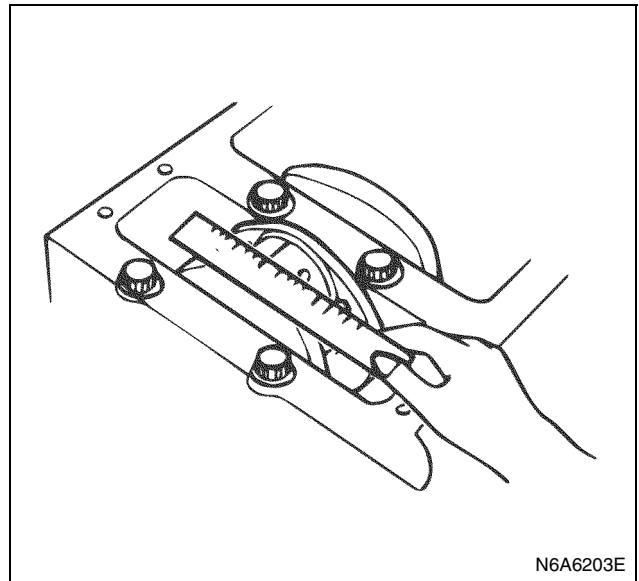
Do not rotate the crankshaft.



- Remove the cap.
- Measure the largest width of the plastigauge to calculate the oil clearance. If the clearance exceeds the limit, replace the entire bearing.

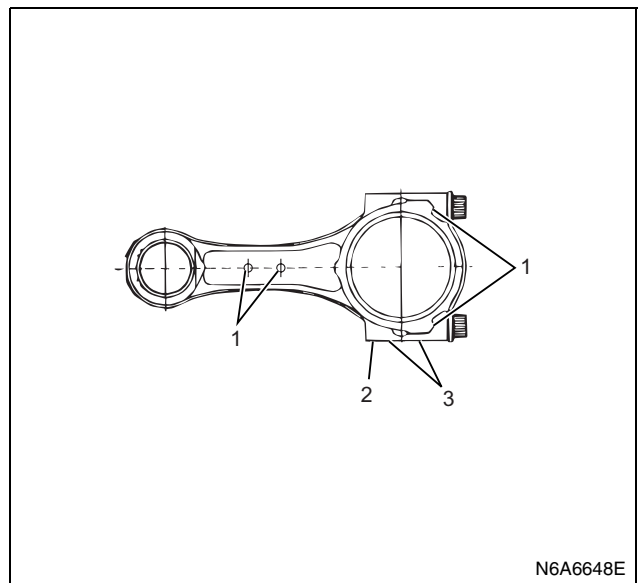
Crankpin and bearing clearance		mm (in)
Standard	0.037 – 0.077 (0.0015 – 0.0030)	
Limit	0.10 (0.0039)	

- Remove the plastigauge from the bearing and crankpin.



14. Select the connecting rod bearing.

- Select bearings carefully by the grade of big end hole diameter of the connecting rod according to the selection table.

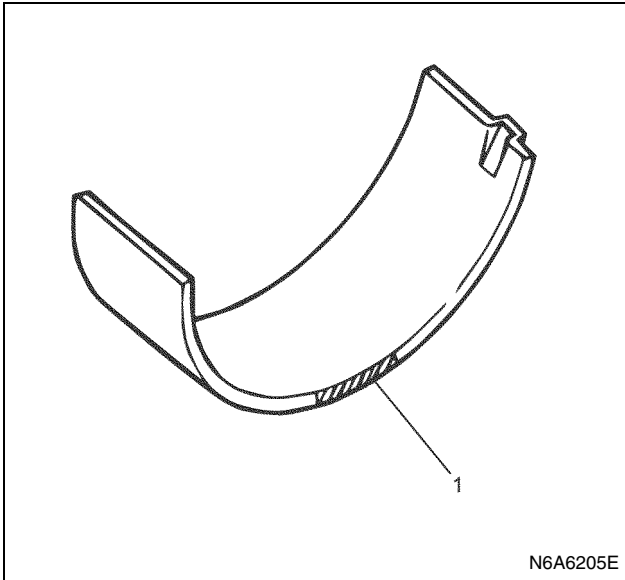


Legend

1. Top and Back Recognition Boss
2. Big End Diameter Grade Mark
3. Cylinder Number

Bearing selection table

Big end hole diameter Grade	Bearing recognition color	Oil clearance mm (in)
A	Green	0.037 – 0.077 (0.0015 – 0.0030)
B	Yellow	0.037 – 0.077 (0.0015 – 0.0030)



Legend

1. Grade Recognition Color

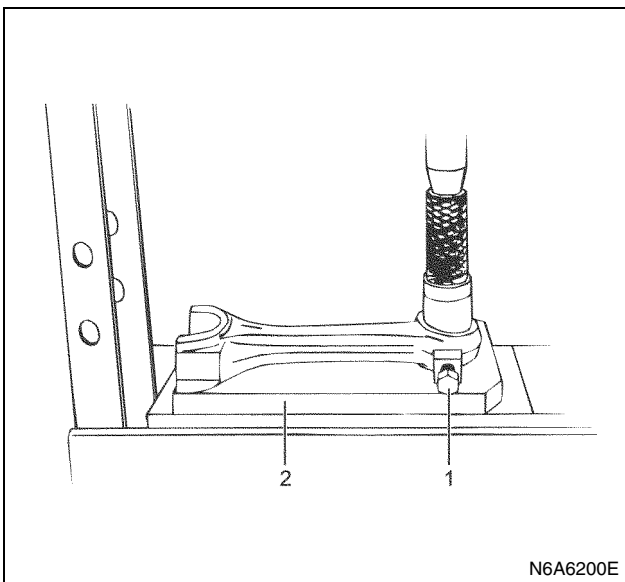
Reassembly

1. Install the bush

- Place the connecting rod bush replacer base on a press, set the connecting rod and tighten the fixation bolt.

Special tool

Connecting rod bush replacer: 5-8840-2340-0 (EN-47682)

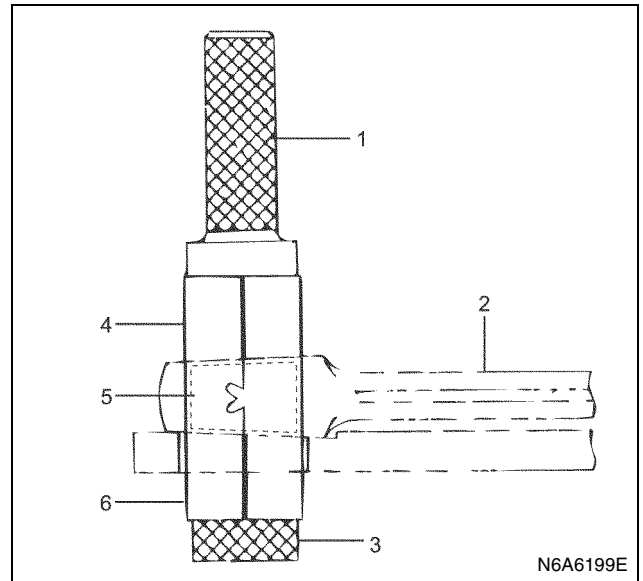


Legend

1. Bolt
2. Connecting Rod Bush Replacer

- Set the collar, new bush and collar on the setting bar as shown in the drawing.
- Tighten the nut.

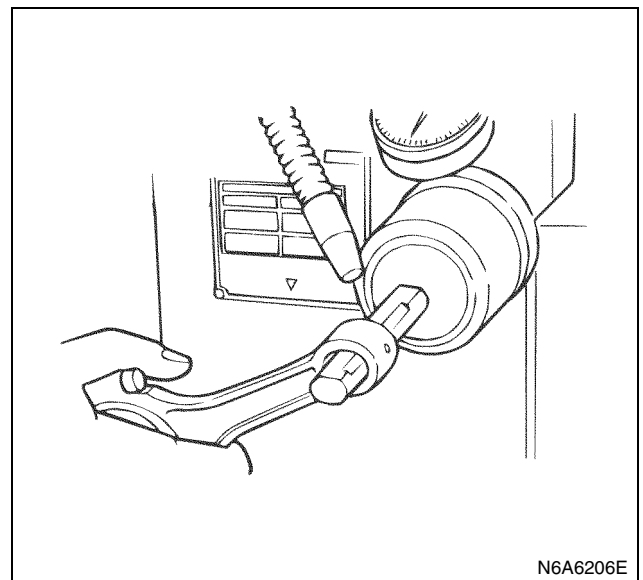
- Adjust the oil hole of the connecting rod and the oil hole of the bush, and use the bench press to install the bush.



Legend

1. Setting Bar
2. Connecting Rod
3. Nut
4. Collar
5. Bush
6. Collar

- After installing the new bush, use a grinder to machine the pin hole so that the pin clearance equals the standard value.



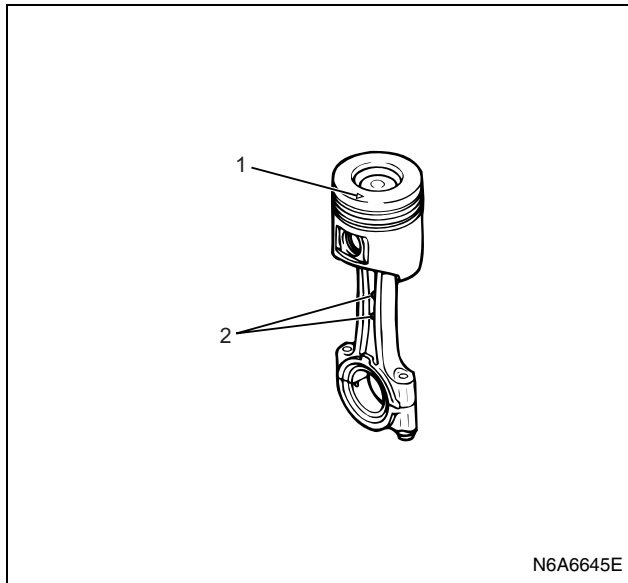
2. Install the piston.

3. Install the connecting rod.

- Install it so that the front mark of the head of the piston and the connecting rod forging mark (projecting) on the connecting rod face the same direction.

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- Use snap ring pliers to install the snap ring of one side.



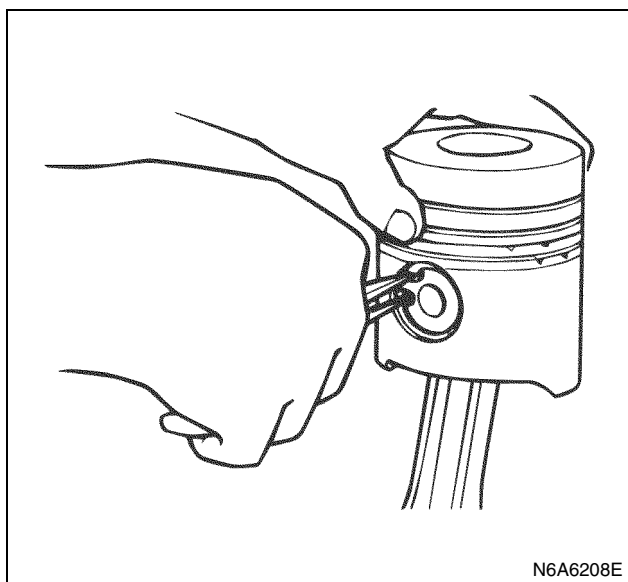
Legend

1. Front Mark
2. Forging Mark (Projecting)

4. Apply enough engine oil on the piston pin, push it in the piston and the connecting rod small edge.
5. Use snap ring pliers to install the snap ring.

Caution:

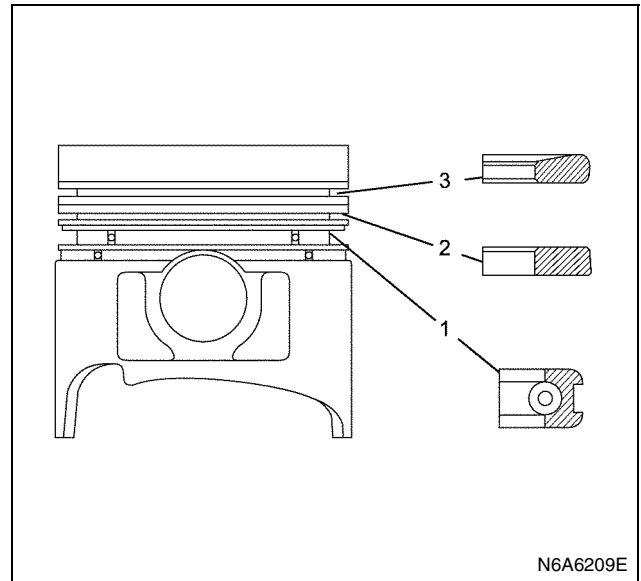
Make sure that the snap ring is installed in the ring groove properly. Make sure that the connecting rod moves smoothly.



6. Use ring pliers to install the piston ring.

- Install the oil ring so that the joint angle of the ring and coil expander is in the opposite 180° direction.

- Install 2nd and 1st compression rings in this order so that the marks "2T" and "1T" face upward.



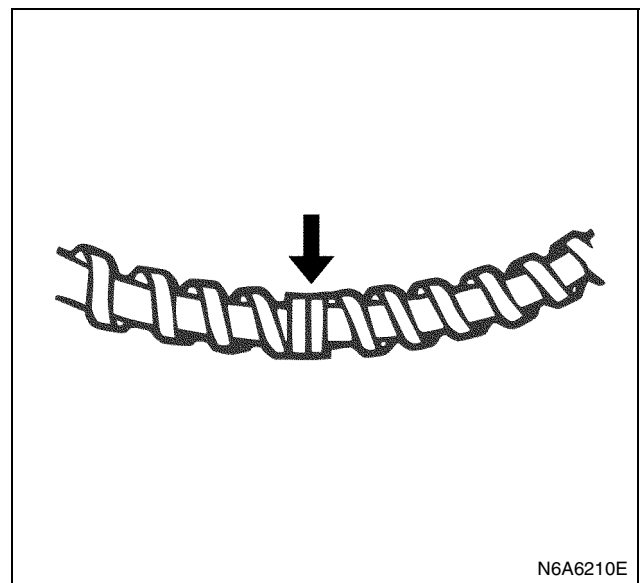
Legend

1. Oil ring
2. Compression Ring 2nd
3. Compression Ring 1st

Caution:

Note that the shapes of compression rings 1st and 2nd are different.

Make sure that there is no gap in the position indicated in the drawing when the oil ring coil expander was installed.



Installation

1. Install the connecting rod bearing.
 - Install the bearing on the connecting rod, apply engine oil on the bearing.
2. Install the piston and connecting rod assembly.

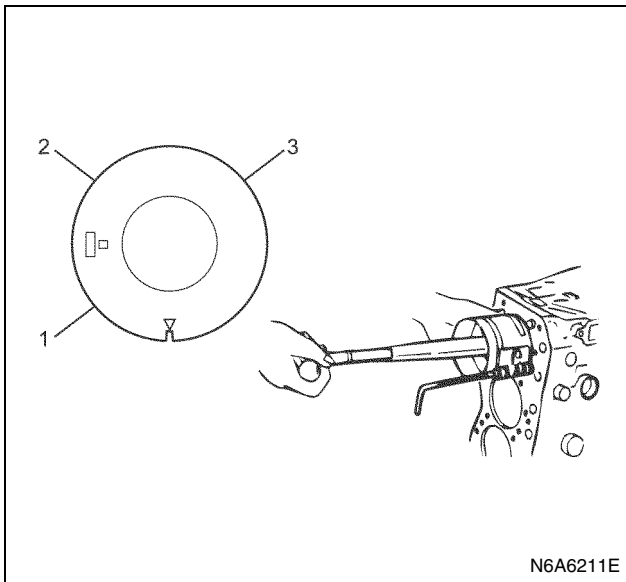
- Apply enough engine oil on the piston ring, ring groove and piston side surface.
- Dislocate the piston ring joint so that (1) is 1st ring, (3) is 2nd ring and (2) is oil ring, as shown in the drawing.
- Face the piston front mark cut to forward, use the piston ring compressor to insert the piston in the cylinder liner.

Caution:

- Be sure not to make the connecting rod touch the oil jet when pushing in the piston.
- Be sure not to damage the inside of the liner when pushing in the piston.

Special tool

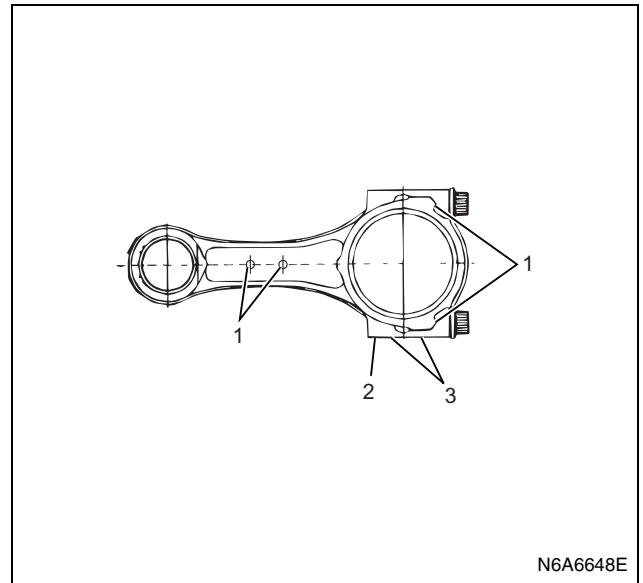
Piston ring compressor: 5-8840-9018-0 (J-8037)



3. Install the connecting rod cap.

- Install the bearing on the connecting rod cap and apply engine oil.

- Install the cap, matching the numbers (1, 2, 3, 4) of the caps and connecting rods.



Legend

1. Back and Top Recognition Boss
2. Big End Hole Diameter Grade Mark
3. Cylinder Number

- Apply molybdenum disulfide on the screw part and the setting face of the tightening bolt and tighten it with the designated torque.
- Tighten two bolts alternately in each step.

Tighten:

Tightening bolt to

1st step: 39 N·m (4.0 kg·m/29 lb·ft)

2nd step: 60° (degrees)

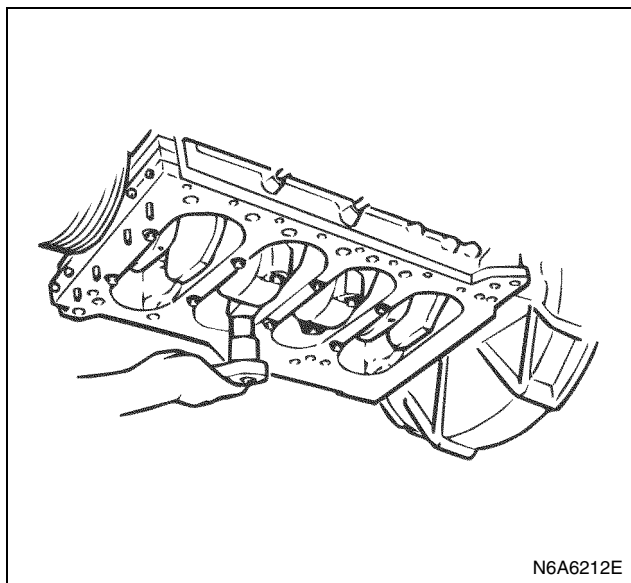
3rd step: 30° (degrees)

Special tool

Angle gauge: 5-8840-0266-0 (J-45059)

Caution:

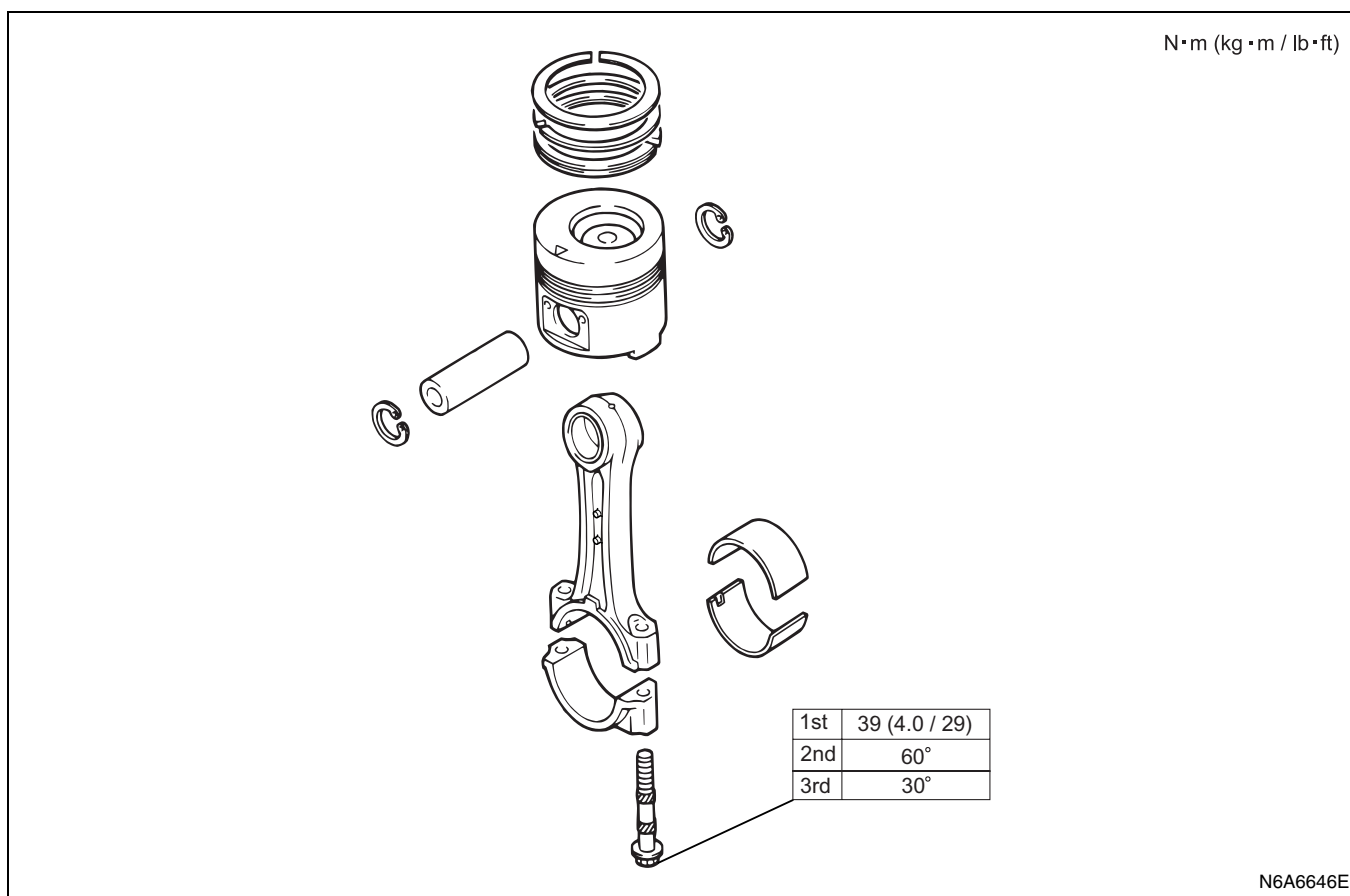
Make sure that the crankshaft smoothly rotates.



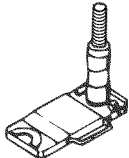
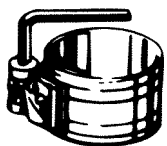
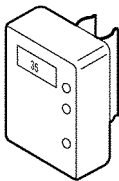
6. Install the rocker arm shaft assembly.
Refer to "Rocker Arm Shaft Assembly".
7. Install the cylinder head cover.
Refer to "Cylinder Head Cover".
8. Install the oil pan.
Refer to "Oil Pan".

4. Install the cylinder head.
Refer to "Cylinder Head".
5. Install the camshaft assembly.
Refer to "Camshaft Assembly".

Torque Specifications

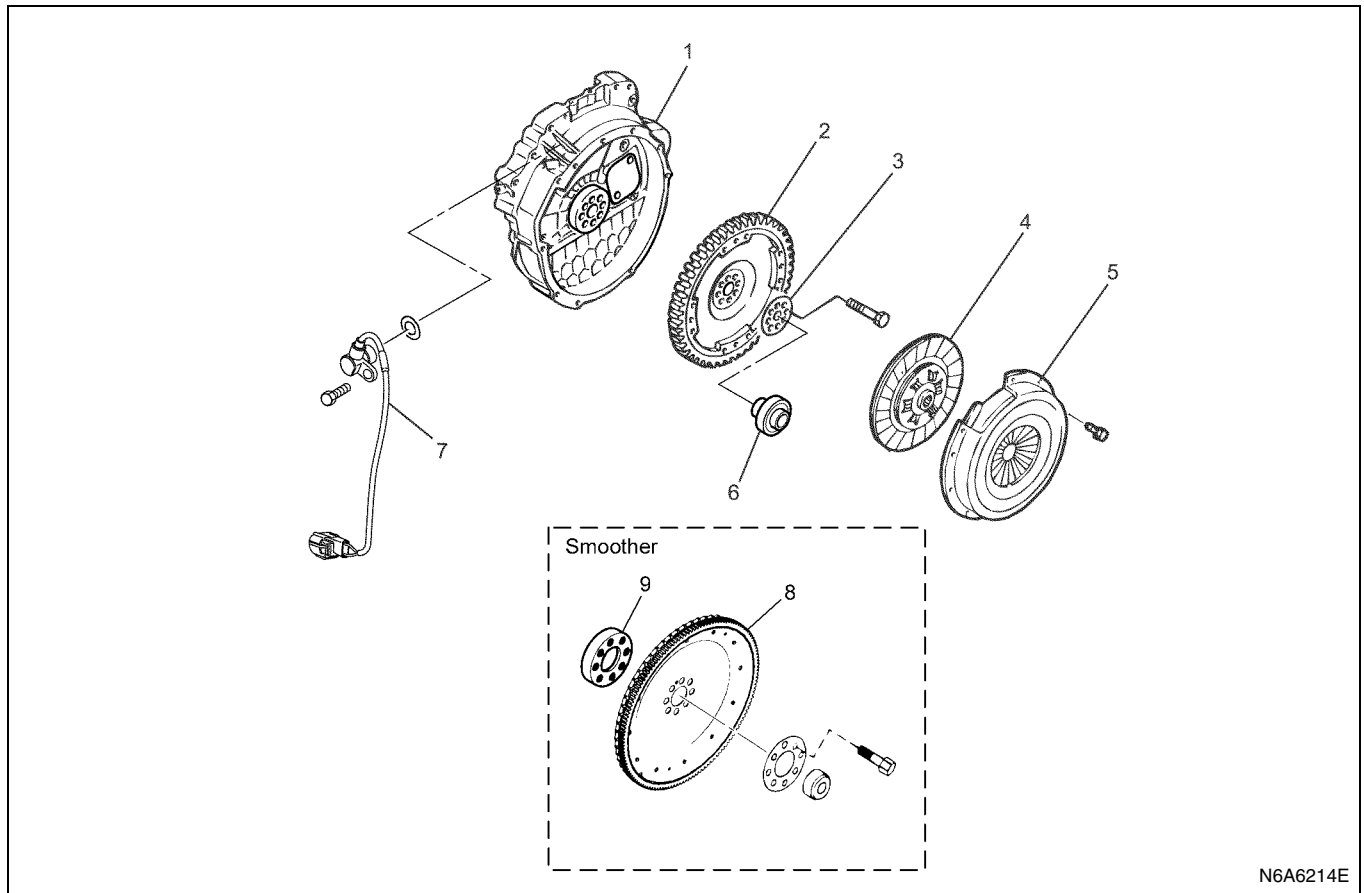


Special Tool

Illustration	Tool Number / Description / Remarks
 5884023400	5-8840-2340-0 (EN-47682) Connecting Rod Bush Replacer
 5884090180	5-8840-9018-0 (J-8037) Piston Ring compressor
 J45059	5-8840-0266-0 (J-45059) Angle Gauge

Flywheel

Component



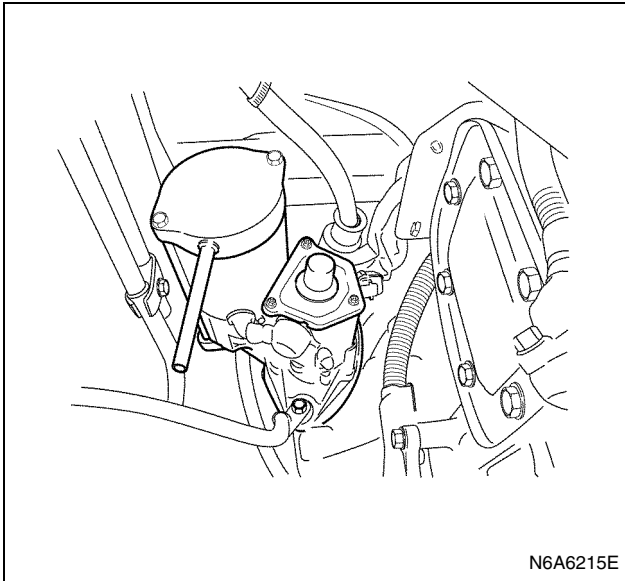
Legend

- | | |
|--|-------------------------------------|
| 1. Flywheel Housing | 6. Pilot Bearing (MT) |
| 2. Flywheel Assembly (MT) | 7. Crankshaft Position Sensor |
| 3. Washer | 8. Flexible Plate (Smoother) |
| 4. Clutch Assembly (MT) | 9. Crankshaft End Spacer (Smoother) |
| 5. Clutch Pressure Plate Assembly (MT) | |

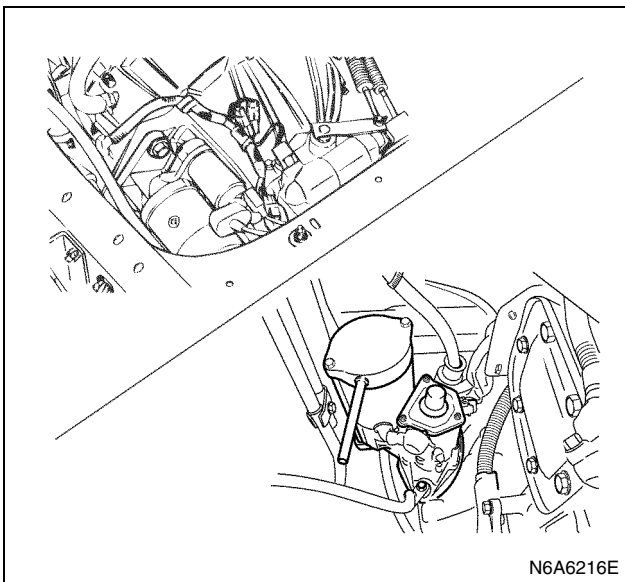
Removal

1. Remove the starter motor.
 - Remove the earth cable of the starter motor.

- Disconnect the front frame harness connector near the control box of the transmission, remove the clips that fix the harness.

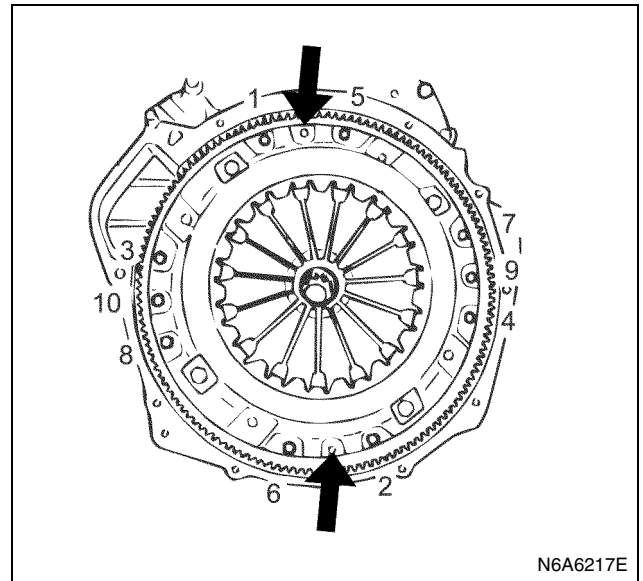


- Remove the two bolts on the upper side and lower side that fix the starter, remove the starter from the clutch housing.
- Use wire to secure the starter to the transmission. Position the wire and starter so that it does not interfere with the transmission removal procedure.

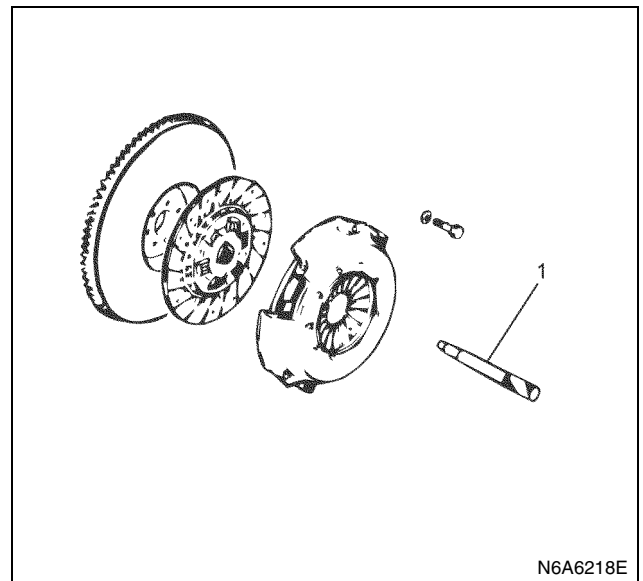


2. Remove the transmission assembly. Refer to "Engine Assembly".
3. Remove the clutch pressure plate assembly.
 - Insert the clutch aligner on the spline of the driven plate.
 - Remove the clutch pressure plate assembly installation bolts in the order shown in the drawing.

- Remove the clutch pressure plate assembly from the flywheel.



4. Remove the clutch plate assembly.
 - Remove the clutch plate assembly from the flywheel along with the clutch aligner (1).



Legend

1. Clutch Aligner

- Install the crankshaft stopper in the starter installation part of the flywheel housing.

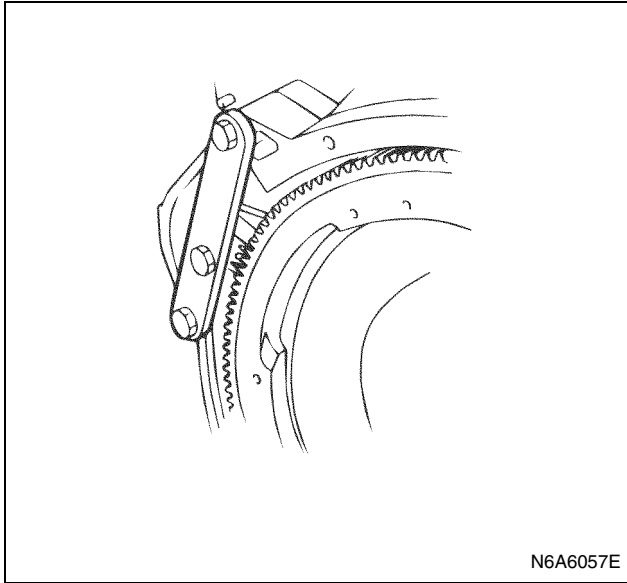
Caution:

Make sure that the stopper is applied with the ring gear and installed properly.

6A-114 Engine Mechanical (4HK1-TC)

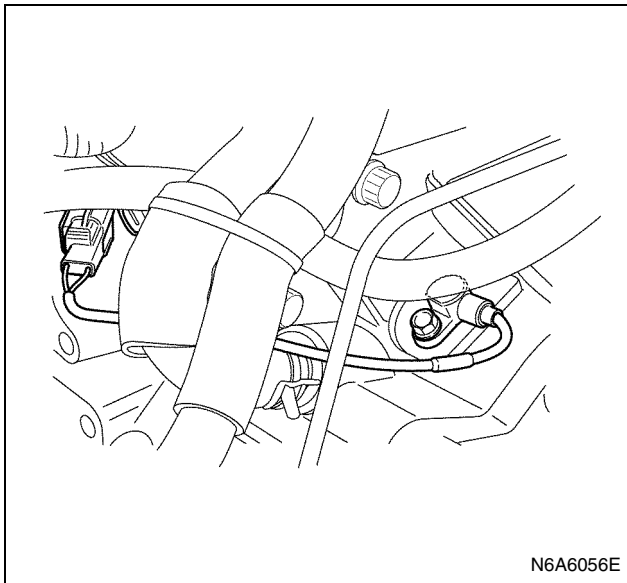
Special tool

Crankshaft stopper: 5-8840-2230-0 (EN-47680)



5. Remove the crankshaft position sensor.

- Remove to prevent contact damage when the flywheel is removed.
- Do not throw or drop because it is vulnerable to shock.

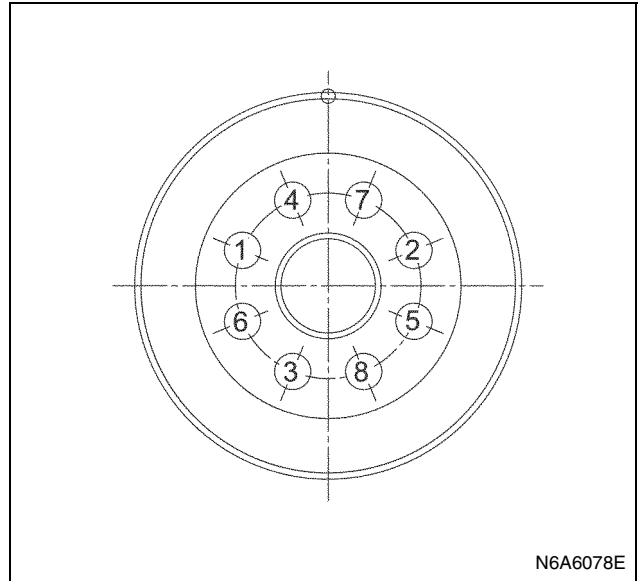


6. Remove the washer.

7. Remove the flywheel.

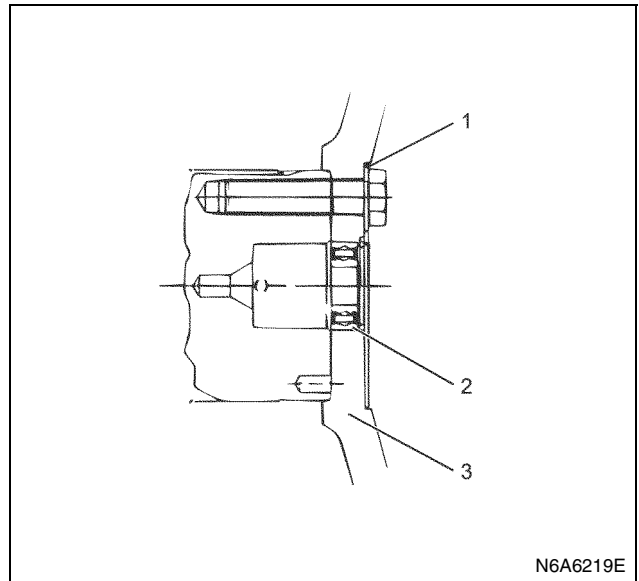
- Gradually loosen the flywheel installation bolts in the order shown in the drawing so that the flywheel does not rotate.
- After loosening the bolts, remove the stopper and remove the flywheel.

- In the case of smoother vehicle, after loosening the flexible plate installation bolts, remove the washer, flexible plate, spacer in this order.



8. Remove the pilot bearing.

- Remove the pilot bearing from the flywheel.

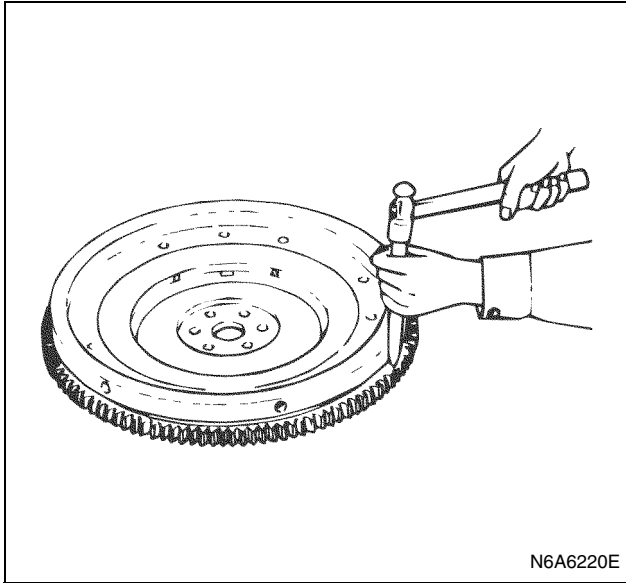


Legend

- 1. Washer
- 2. Pilot Bearing
- 3. Flywheel

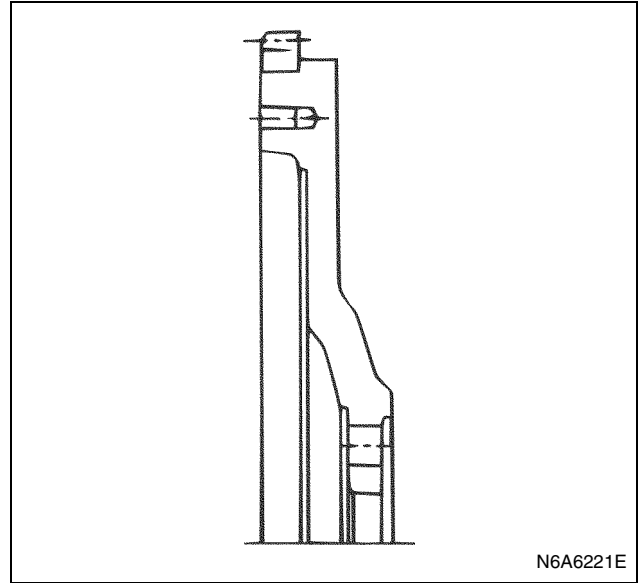
9. Remove the ring gear.

- Put a bar on the ring gear and hit it with a hammer to remove it.



N6A6220E

Depth = From the pressure installation surface to the friction surface.



N6A6221E

Inspection

- Inspection with eyes
 - Inspect the flywheel friction surface for cracks and damages, and replace it if it has abnormality.
 - Inspect the tooth part of the ring gear, replace the ring gear if it has damage or serious wear.
- Measurement of the friction surface
 - Measure the depth of the friction surface of the flywheel.
 - Adjust it if the measured value is between the standard value and the limit.
 - If the measured value exceeds the limit, replace the flywheel.

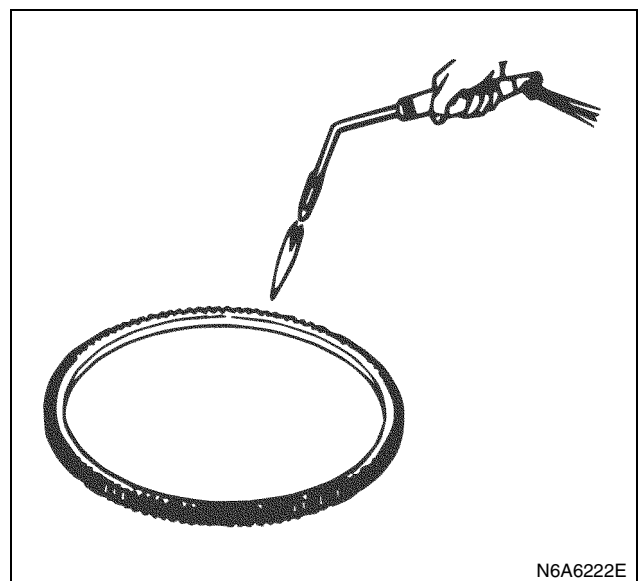
Depth of the friction surface of the flywheel		mm (in)
Standard		19 (0.75)
Limit		20 (0.79)

Installation

- Install the ring gear.
 - After heating the ring gear with a gas burner equally, install it in the flywheel.
 - During shrinkage cooling of the ring gear, maintain the flatness by applying force of 68.6 kN (15,400 lbf).

Caution:

- Install the ring gear in the direction within the chamfered face comes to the side of pressure installation surface.
- Shrink fit the ring gear to the flywheel. Make sure that flywheel and ring gear adhesion is complete.



N6A6222E

- Install the flywheel.
- Install the washer.

6A-116 Engine Mechanical (4HK1-TC)

M/T specification

- 1) Align the flywheel with the crankshaft knock pin and temporarily tighten the flywheel bolts.
- 2) Use the crankshaft stopper to prevent the crankshaft from turning.
Crankshaft stopper: 5-8840-2230-0 (EN-47680)
 - Apply molybdenum disulfide on the thread and setting face of the bolt.
- 3) Install the washer and the flywheel bolts and tighten to the specified torque in numerical order show in the illustration.

Tighten:

Bolts to

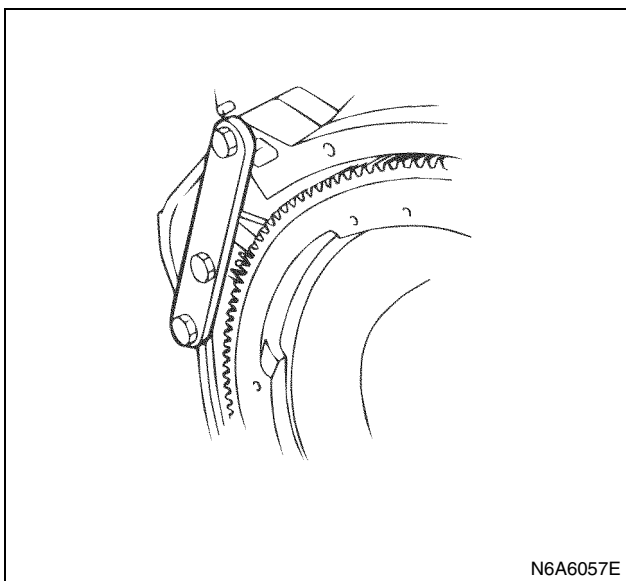
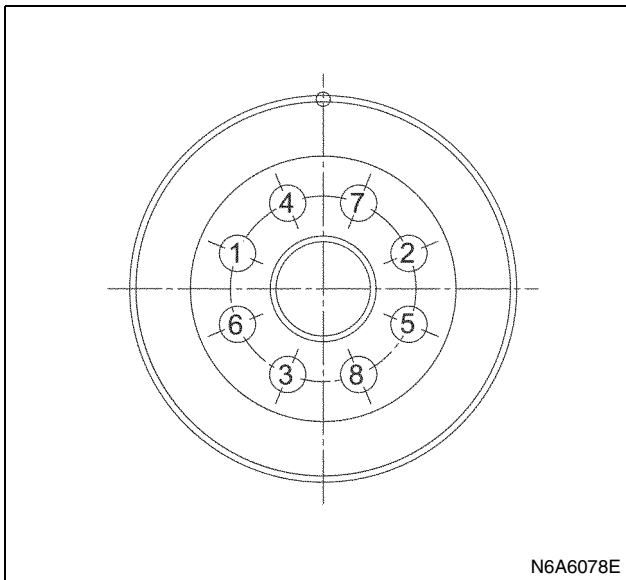
1st step: 78 N·m (8.0 kg·m/58 lb·ft)

2nd step: 120° – 150° (degrees)

Special tool

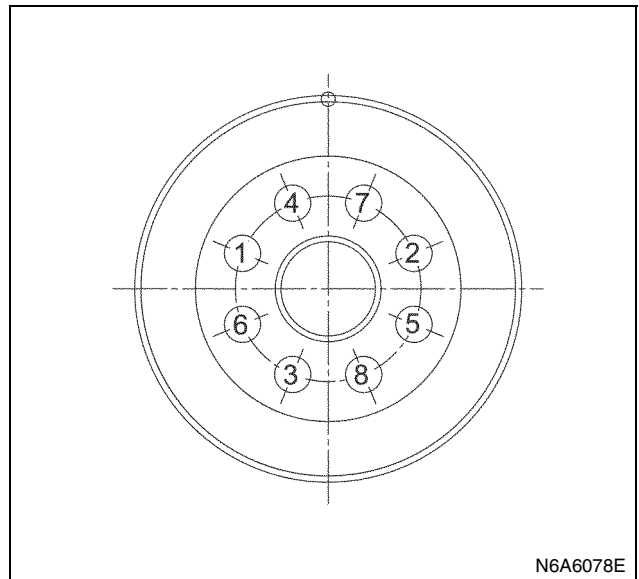
Crankshaft stopper: 5-8840-2230 (EN-47680)

Angle gauge: 5-8840-0266-0 (J-45059)



Smoother specification

- 1) Align the knock pin on the crankshaft to install the spacer.
- 2) Install the flexible plate and washer, also aligning to the knock pin on the crankshaft.
- 3) Apply molybdenum disulfide grease to the bolt thread and seat to install the flywheel fixing hole. Tighten bolt to two stage tightening method in the numerical order.
1st step; 78 N·m (8.0 kg·m/58 lb·ft)
2nd step; 90° – 120° (degrees)



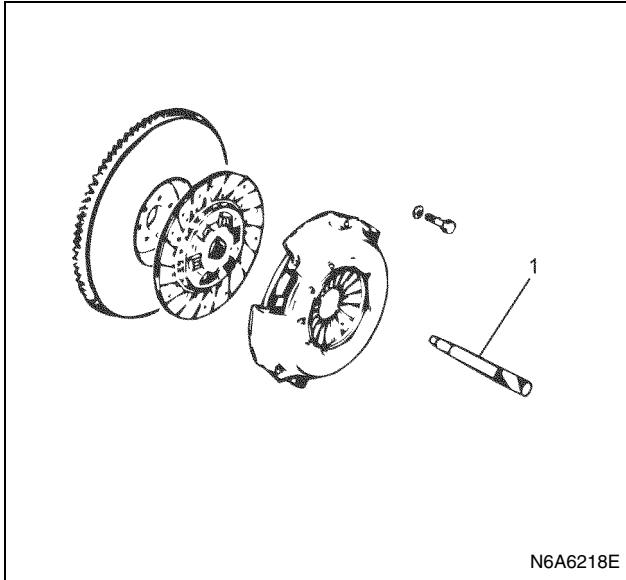
4. Install and tighten the crankshaft position sensor with the designated torque.

Tighten:

Bolt to 8 N·m (0.8 kg·m/69 lb·in)

5. Hammer in the pilot bearing until it reaches the edge surface of the crank.
6. Install the clutch plate assembly.

- Use a clutch aligner to install the clutch plate assembly on the flywheel.



Legend

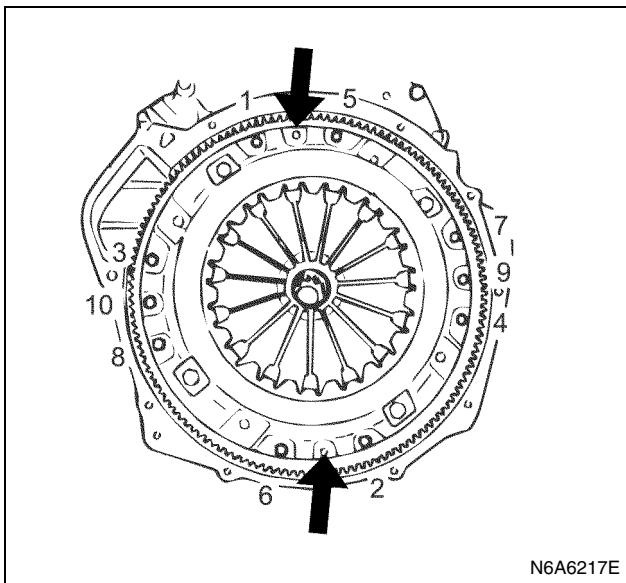
1. Clutch Aligner

7. Install the clutch pressure plate assembly.

- Install the clutch pressure plate assembly on the flywheel so that the installation hole of the clutch pressure plate assembly matches with the dowel pins of the flywheel.
- Tighten the clutch pressure plate assembly in the order shown in the drawing.

Tighten:

Bolts to 40 N·m (4.1 kg·m/30 lb·ft)



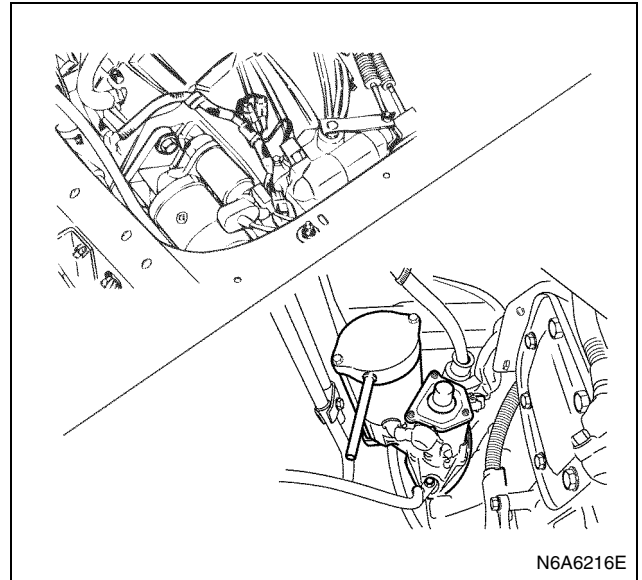
8. Install the transmission assembly.

Refer to "Engine Assembly".

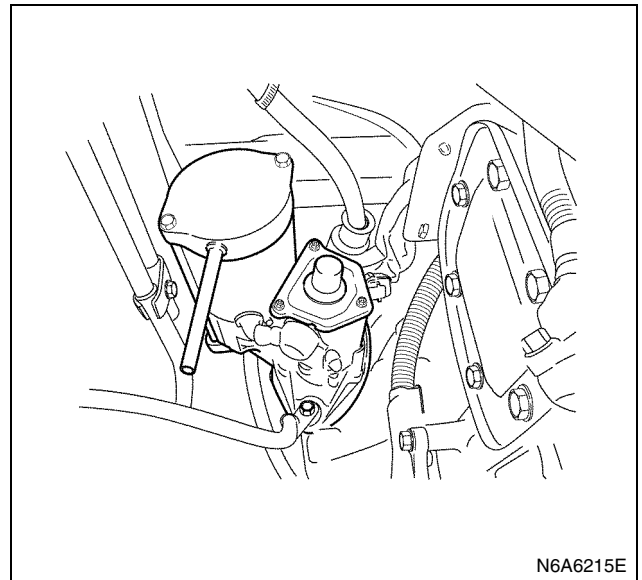
9. Install the starter motor on the clutch housing with bolts.

Tighten:

Bolts to 76 N·m (7.7 kg·m/56 lb·ft)



- Install the earth cable of the starter motor.
- Connect the front frame harness connector.



Torque Specifications

N·m (kg·m / lb·ft)

1st	78 (8.0 / 58)
2nd	120° — 150°

1st	78 (8.0 / 58)
2nd	120° — 150°

8 (0.8 / 69 lb·in)

40 (4.1 / 30)

Smoother

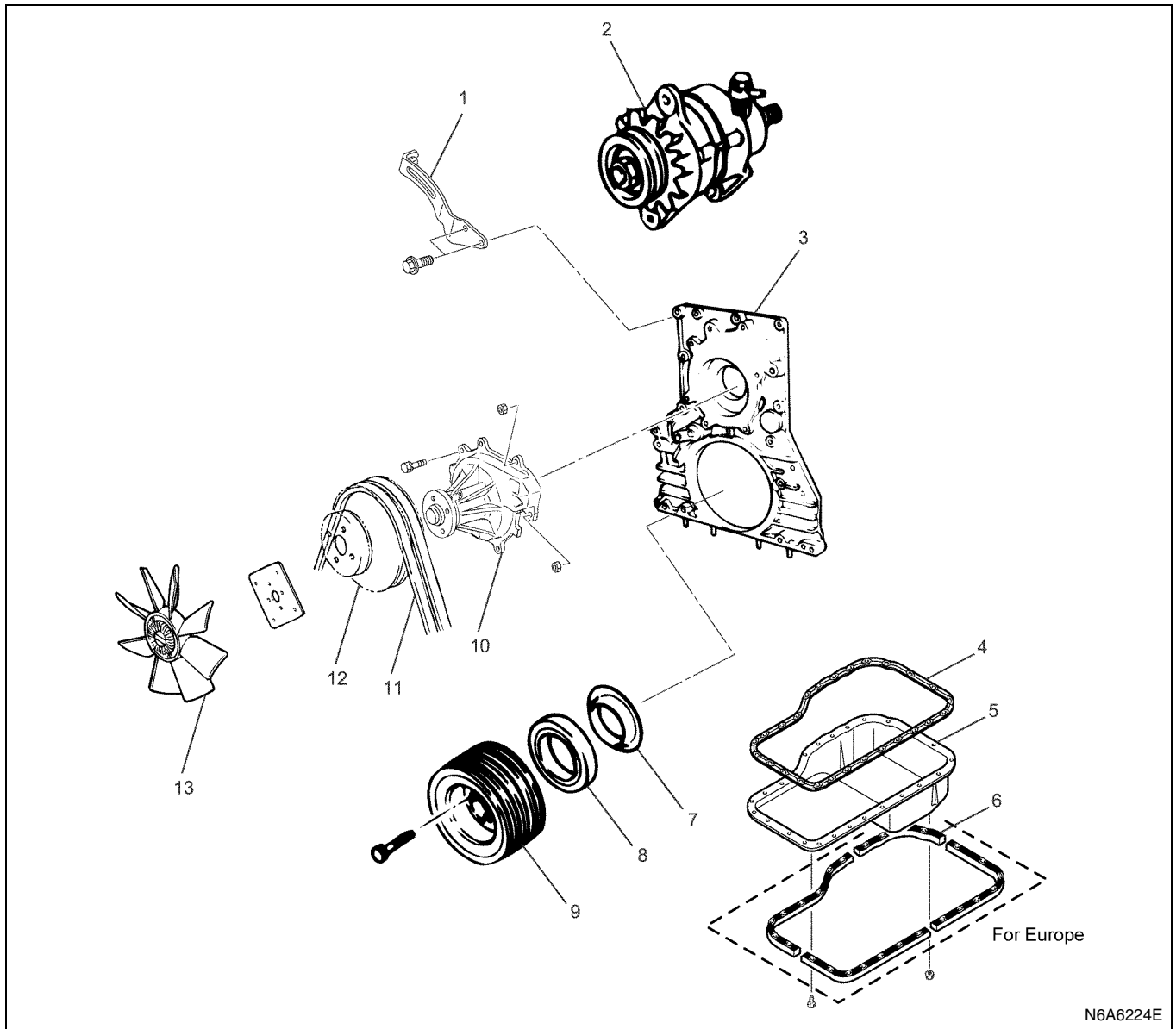
N6A6223E

Special Tool

Illustration	Tool Number / Description / Remarks
5884022300	5-8840-2230-0 (EN-47680) Crankshaft Stopper
J45059	5-8840-0266-0 (J-45059) Angle Gauge

Front Cover

Component



N6A6224E

Legend

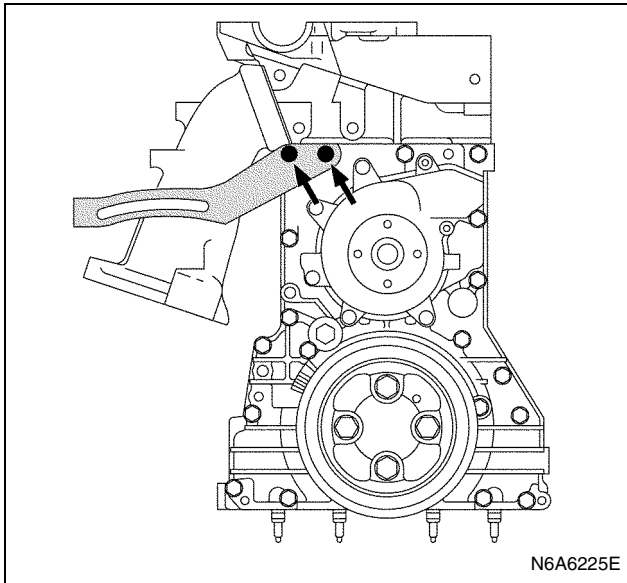
- | | |
|---------------------------------|-------------------------|
| 1. Adjust Plate | 8. Front Oil Seal |
| 2. Generator | 9. Crankshaft Pulley |
| 3. Front Cover | 10. Water Pump Assembly |
| 4. Oil Pan Gasket | 11. Fan Belt |
| 5. Oil Pan | 12. Water Pump Pulley |
| 6. Rubber Assembly (For Europe) | 13. Fan Assembly |
| 7. Front Slinger | |

Removal

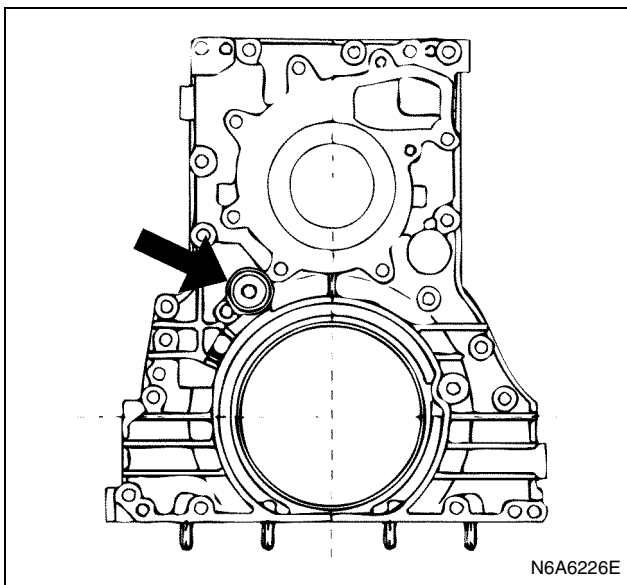
1. Remove the front oil seal.
Refer to "Crankshaft Front Oil Seal".
2. Remove the oil pan
Refer to "Oil Pan".
3. Remove the water pump.
Refer to "Water Pump" in Section 6B.
4. Remove the front cover.

6A-120 Engine Mechanical (4HK1-TC)

- Remove the generator adjust plate.

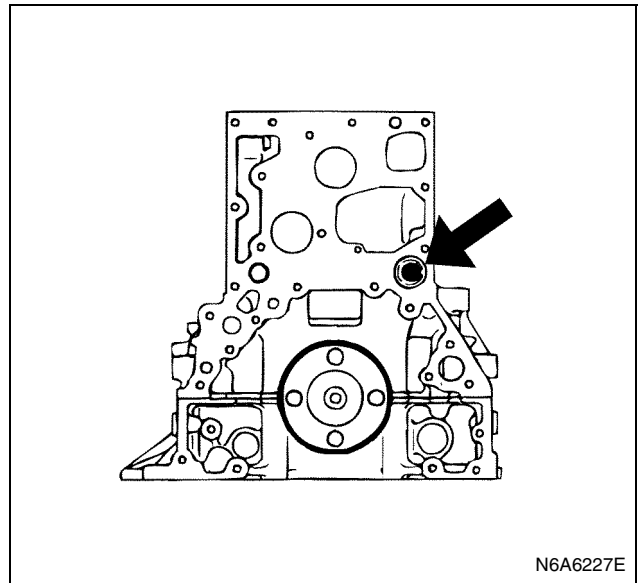


- Remove the oil relief valve (arrowed), loosen the front cover installation bolts and remove the front cover.



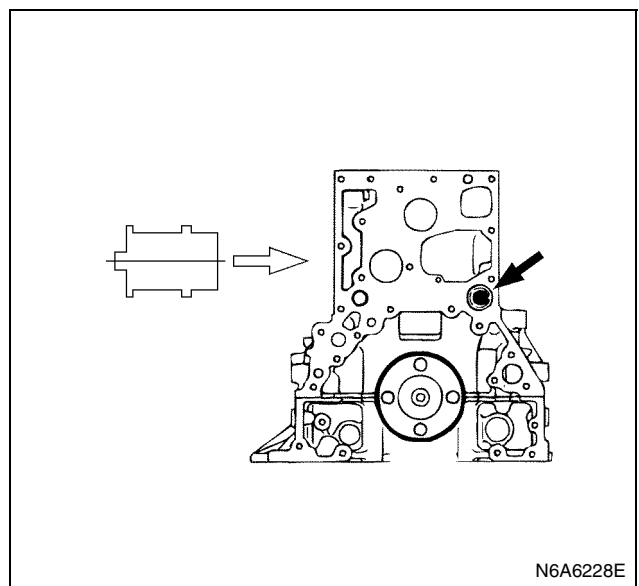
5. Remove the oil cooler bypass valve.

- Pull out the oil cooler bypass valve from the cylinder block.



Installation

1. Install the oil cooler bypass valve.
 - Insert the oil cooler bypass valve into the cylinder block. Be sure not to insert in a wrong direction.



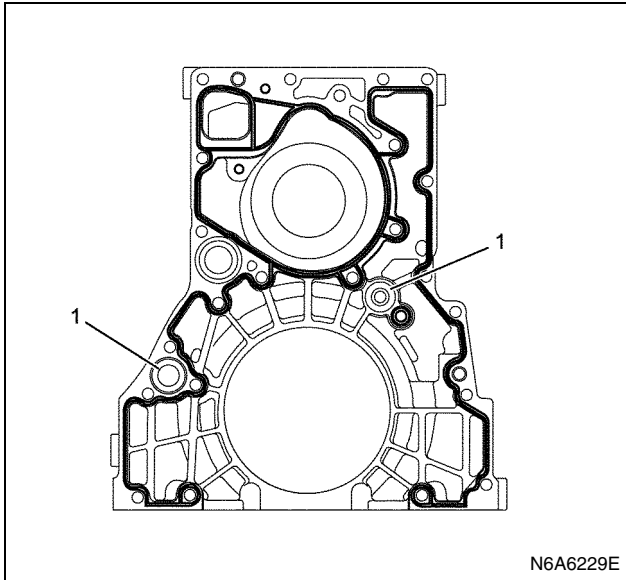
2. Install the front cover.
 - Clean the cylinder block front surface. In particular, remove liquid gasket leaked during installation of the crankcase.
 - Install two O-rings and apply liquid gasket (ThreeBond 1207B, 1207C, 1207F or equivalent) along with the groove of the front cover installation surface.

Beat width: 1.5 – 5mm (0.059 – 0.20 in)
Beat height: 0.3 – 1.5mm (0.012 – 0.059 in) from the joint surface

- Install within seven minutes after applying liquid gasket.

Caution:

Apply liquid gasket so that it does not adhere to the O-ring.



Legend

1. O-ring

- Install the front cover to match with the dowel pins of the cylinder block.

Caution:

Along with the front cover, install the water pump assembly (before liquid gasket becomes dry)

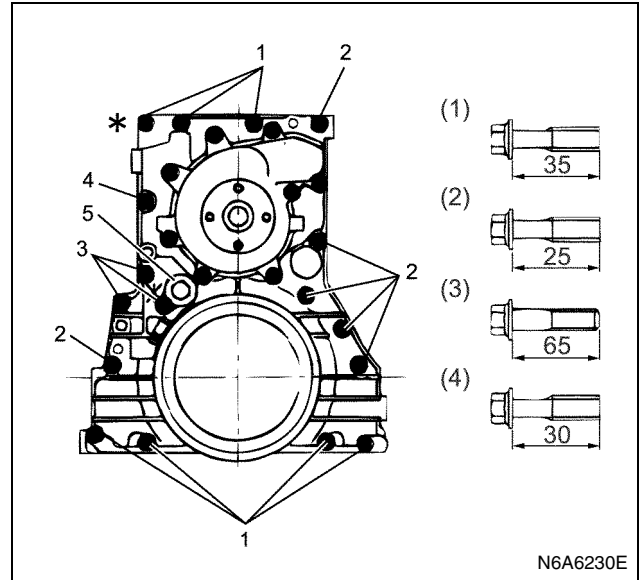
Tighten:

Front cover bolt to 24 N·m (2.4 kg·m/18 lb·ft)

- Tighten bolts with (*) mark together with the adjust plate of the generator.
- Tighten the oil relief valve (5) with the designated torque.

Tighten:

Oil relief valve to 39 N·m (4.0 kg·m/29 lb·ft)

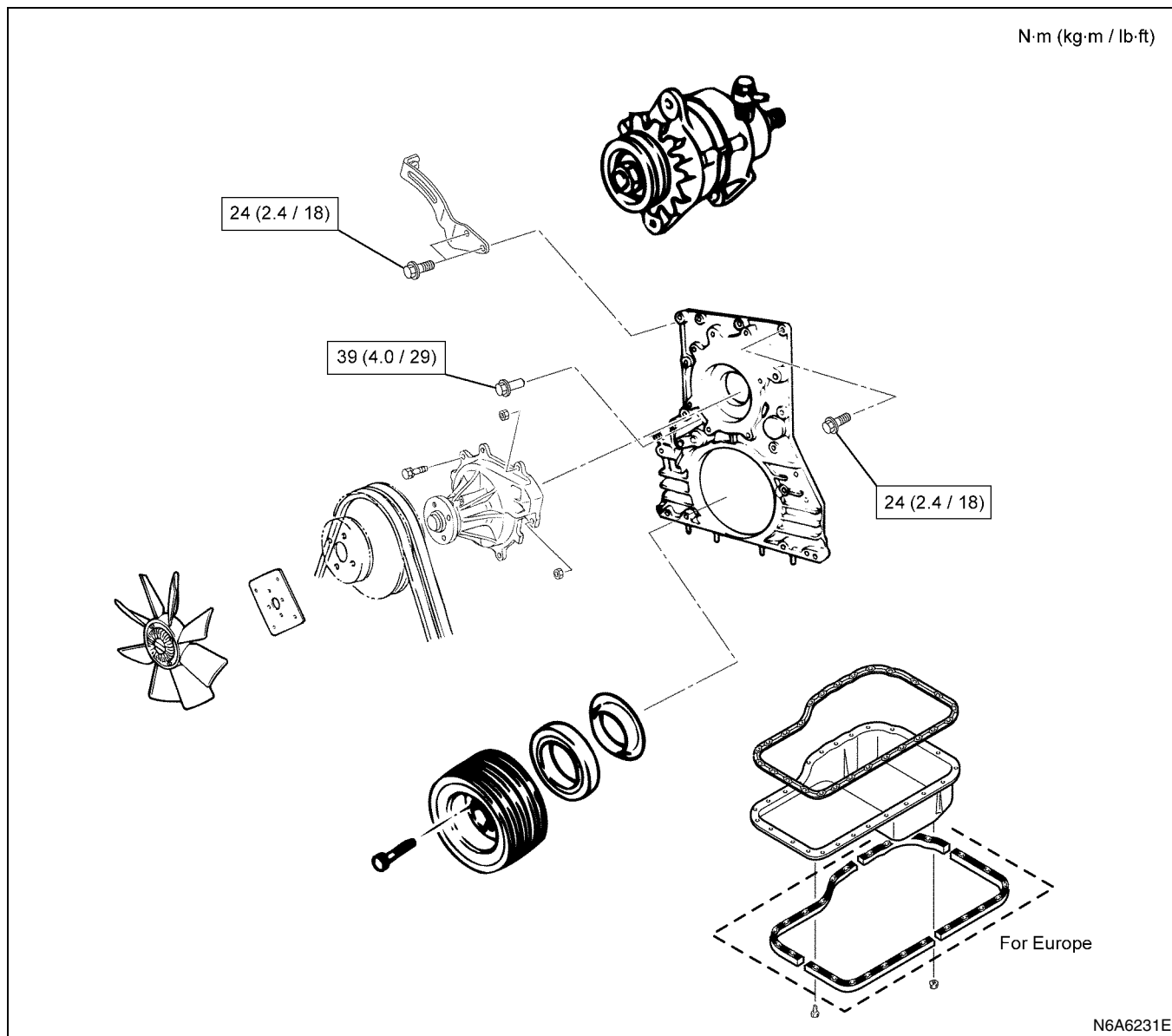


Legend

1. BOLT : L = 35 mm (1.38 in)
2. BOLT : L = 25 mm (0.98 in)
3. BOLT : L = 65 mm (2.56 in)
4. BOLT : L = 30 mm (1.18 in)
5. Oil Relief Valve

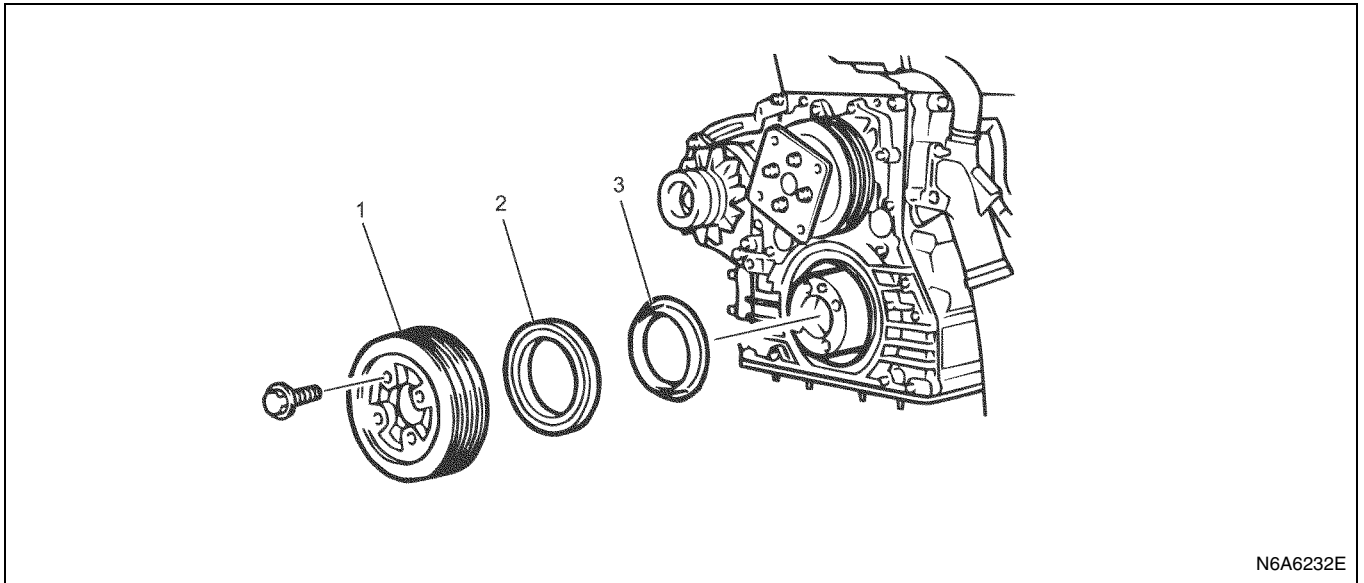
3. Install the water pump.
Refer to "Water Pump" in Section 6B.
4. Install the oil pan.
Refer to the "Oil Pan".
5. Install the front oil seal.
Refer to the "Crankshaft Front Oil Seal".

Torque Specifications



Crankshaft Front Oil Seal

Component



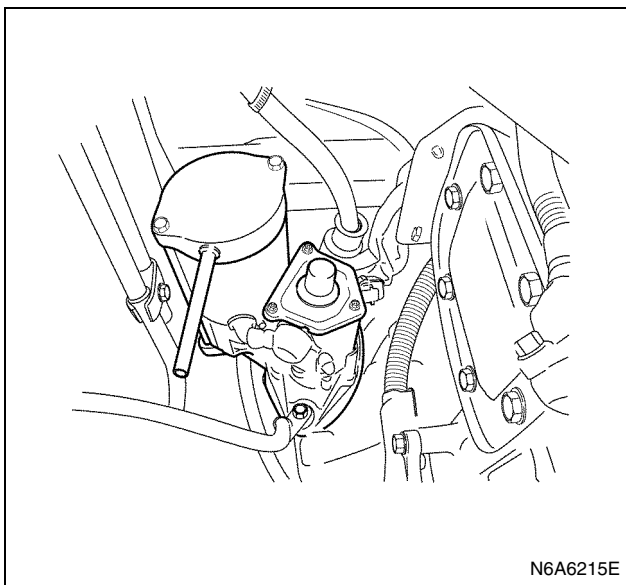
N6A6232E

Legend

- | | |
|------------------------------|-----------------------------|
| 1. Crankshaft Pulley | 3. Crankshaft Front Slinger |
| 2. Crankshaft Front Oil Seal | |

Removal

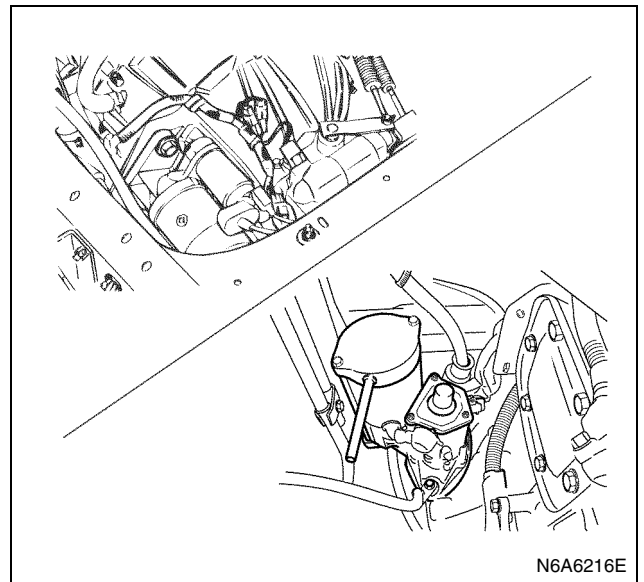
1. Drain coolant.
2. Remove the starter.
 - Disconnect the starter ground cable.
 - Disconnect the front frame harness connector at a position near the transmission control box and unlatch fixing clips from the harness.



N6A6215E

- Remove two mounting bolts.

- Fix the detached starter with a wire or the like at a position where it will not be a hindrance to removing the transmission.



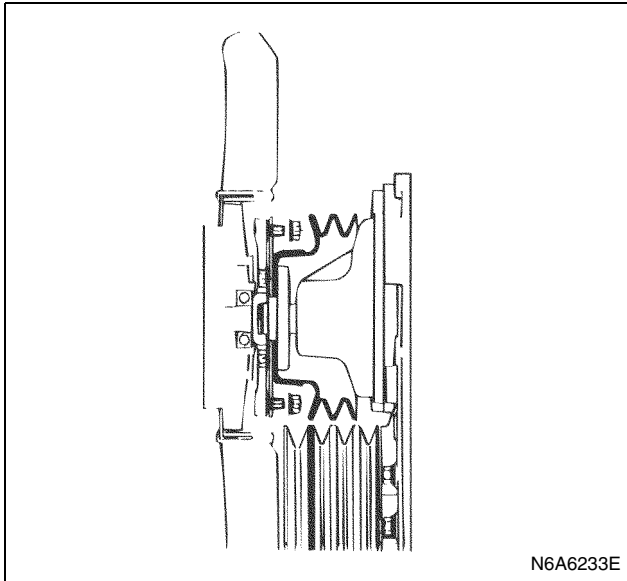
N6A6216E

3. Disconnect the upper radiator hose on the engine side.
4. Disconnect the coolant reserve tank hose on the radiator side.
5. Disconnect the lower radiator hose on the engine side.
6. Remove the radiator (with the fan guide) detaching right and left brackets.
7. Remove the fan assembly.

6A-124 Engine Mechanical (4HK1-TC)

- Remove the fan assembly unscrewing four mounting nuts.

8. Remove the fan belt.



9. Remove the crankshaft pulley.

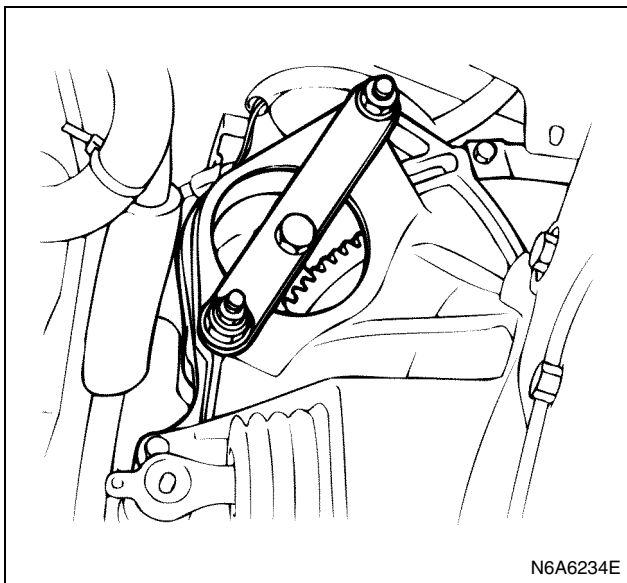
- Loosen the pulley bolts blocking the crankshaft from turning by placing a crankshaft stopper on the starter mounting position on the flywheel housing.

Caution:

Make sure that the stopper is properly fitted and engaged with the ring gear.

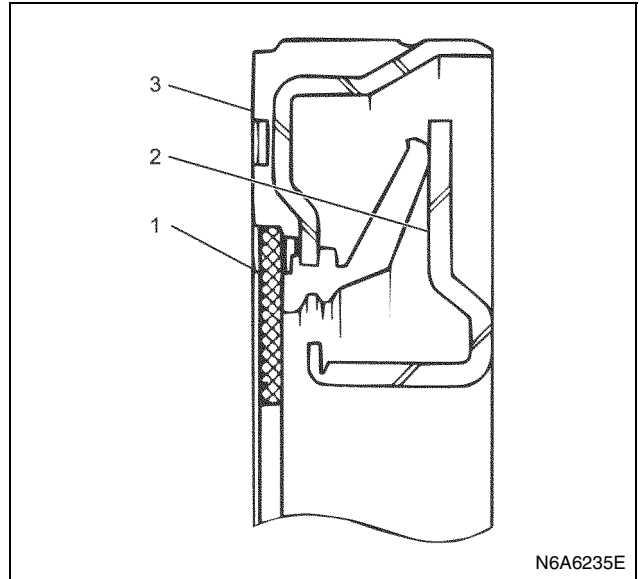
Special tool

Crankshaft stopper: 5-8840-2230-0 (EN-47680)



10. Remove the crankshaft front oil seal.

- Remove only the oil seal off with a screwdriver or the like avoiding damage to the oil seal contact surface on the front cover and the shaft.



Legend

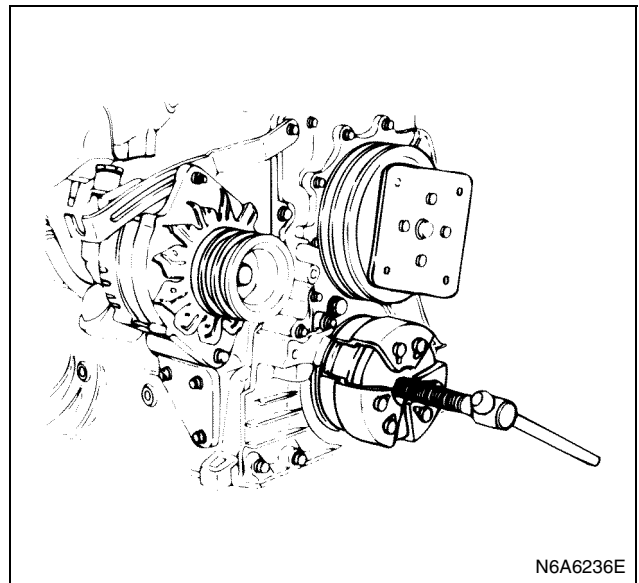
- Felt
- Slinger
- Oil Seal

11. Remove the crankshaft front slinger.

- Pull out the slinger using a slinger puller. (Fixing the circumference of the puller with a clip band will make the procedure easier.)

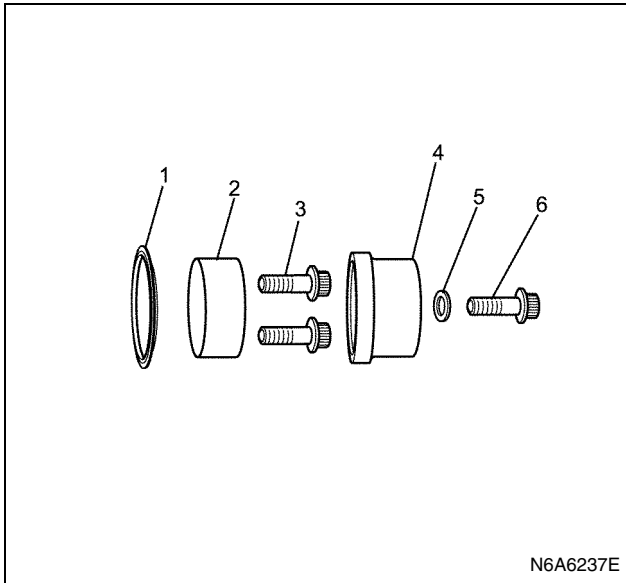
Special tool

Slinger puller: 8-9439-6858-0 (J-43285)



Installation

1. Install the crankshaft front slinger.
 - Press-fit the slinger using an oil seal installer kit.



N6A6237E

Legend

1. Front Slinger
2. Adapter (Front)
3. Fixing Bolt
4. Sleeve (Front)
5. Washer (Front)
6. Center Bolt

Special tool

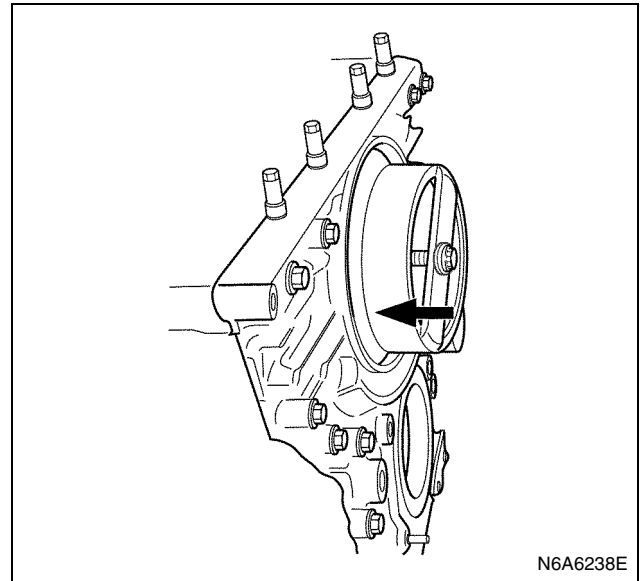
Oil seal installer kit: 5-8840-2703-0 (J-43282)

(Use the parts listed below for the front oil seal.)

No.	Part Name	Slinger	Oil seal
1	Sleeve (front)	○	○
2	Adapter (front)	○	○
3	Adapter ring (front)	—	○
4	Washer (front)	○	○
5	Center bolt	○	○
6	Fixing bolt	○	○

- Insert the front slinger into the end of the adapter and fit them on the crankshaft.

- Put the sleeve over the adapter, place a washer on the center bolt and tighten the bolt until the sleeve touches the adapter to press fit the front slinger.

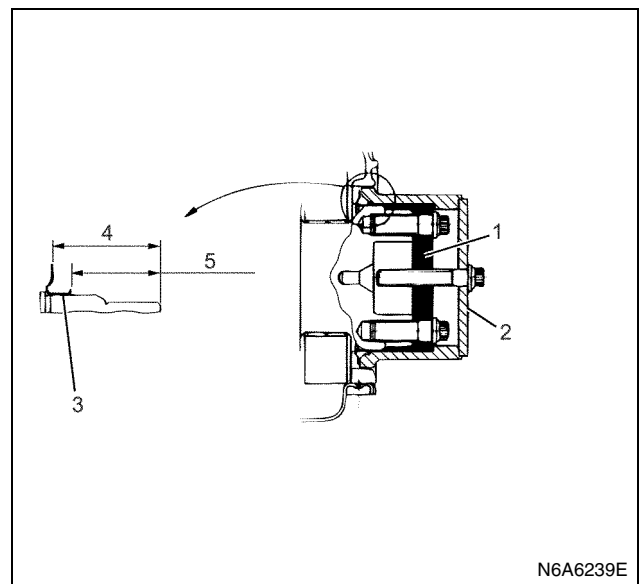


N6A6238E

- After you have pressed the front slinger, confirm the measurement shown (depth from the end surface of the crankshaft to the flange of the slinger) and check for deflection of the slinger.

Caution:

Be careful not to put the slinger inside out or mistake front side slinger for rear one, and vice versa. Rear side slinger has four right-hand threads on it while front one has four left-hand threads. Slinger and oil seal should always be replaced in pairs.



N6A6239E

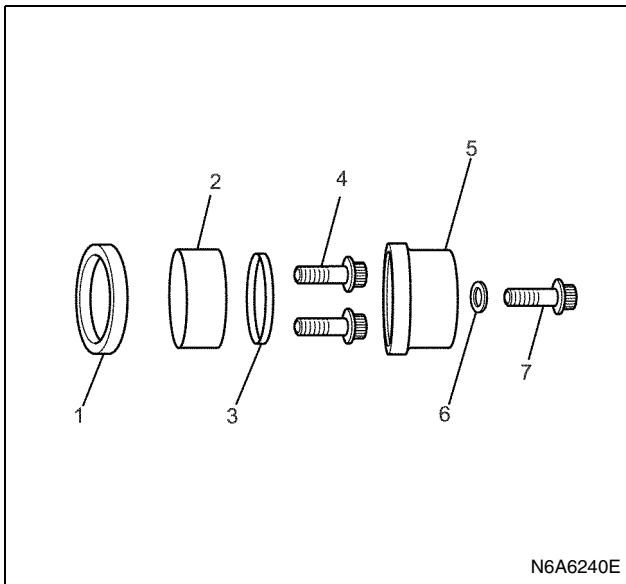
Legend

1. Adapter
2. Sleeve
3. Slinger
4. 40.5 ± 0.3 mm (1.594 ± 0.012 in)
5. 34 ± 0.1 mm (1.339 ± 0.004 in)

6A-126 Engine Mechanical (4HK1-TC)

2. Install the crankshaft front oil seal.

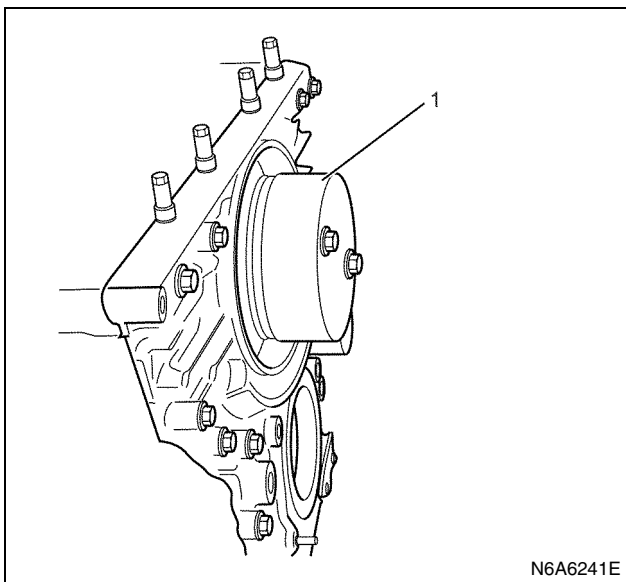
- Press fit the oil seal using an oil seal installer kit.



Legend

1. Oil Seal
2. Adapter (Front)
3. Adapter Ring (Front)
4. Fixing Bolt
5. Sleeve (Front)
6. Washer (Front)
7. Center Bolt

- Mount the adapter onto the crankshaft with fixing bolts.

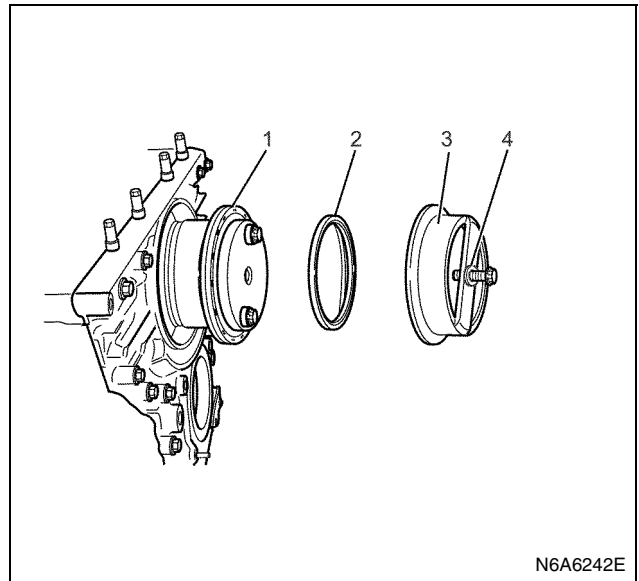


Legend

1. Adapter

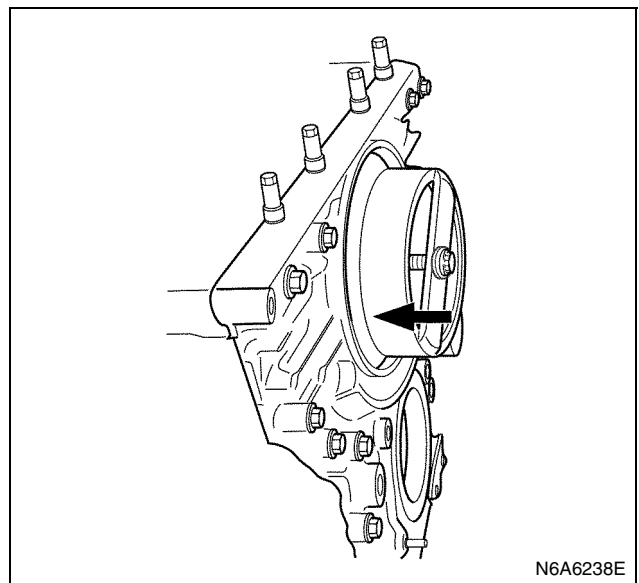
- Apply engine oil to the lip of the oil seal and place it on the front side adapter.
- Put the front side adapter ring in the sleeve and fix the sleeve on the adapter with the center bolt and a washer.

- Tighten the bolt until the sleeve touches the adapter to press fit the front oil seal.

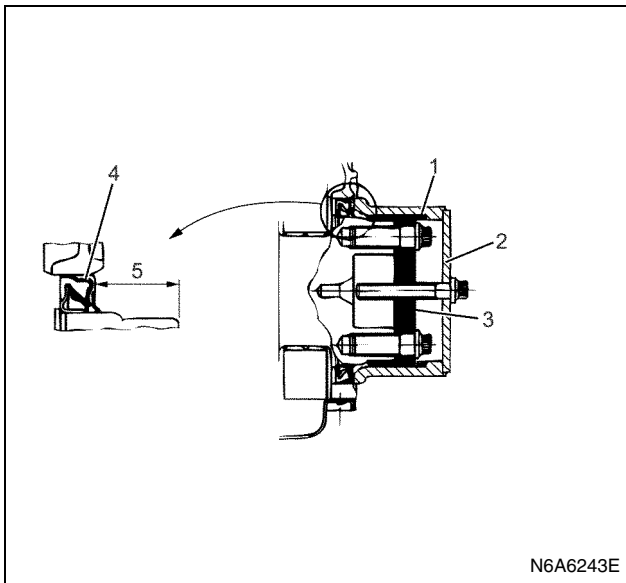


Legend

1. Oil Seal
2. Adapter Ring
3. Sleeve
4. Bolt and Washer



- After you have press-fitted the front oil seal, confirm the measurement shown (depth from the end surface of the crankshaft to the oil seal) and check for deflection of the oil seal.



N6A6243E

Legend

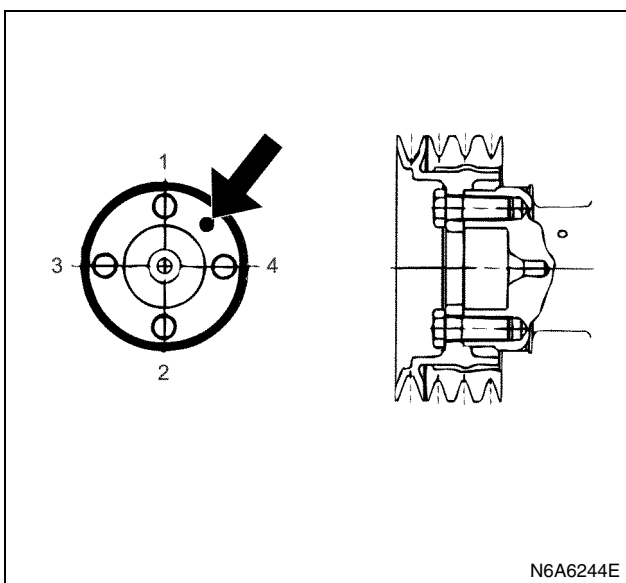
- Adapter Ring
- Sleeve
- Adapter
- Oil Seal
- $31 \pm 0.3 \text{ mm}$ ($1.220 \pm 0.012 \text{ in}$)

3. Install the crankshaft pulley.

- Apply engine oil to the threads of the fastening bolts.
- Install the crankshaft pulley aligning with the dowel pins on the crankshaft.
- Tighten in the sequence shown.

Tighten:

Bolt to 200 N·m (20.4 kg·m/148 lb·ft)



N6A6244E

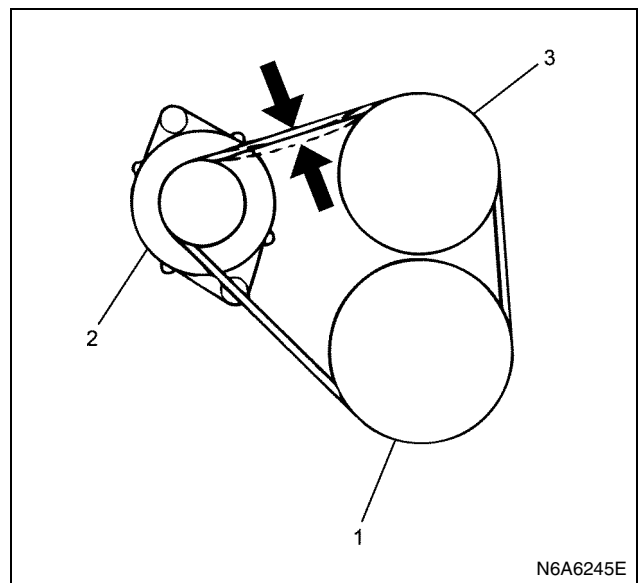
4. Install the fan belt.

- When adjusting the fan belt, you should also adjust A/C belt and air conditioner belt at the same time.
- Fit the fan belt and adjust the tension following the below procedures.
- Refer to "Drive Belt" in Section 6B for details of the belt tension adjustment.

a. Inspection of fan belt deflection

- Check with a scale if the belt deflection is within the specified limits when pressure of 98 N (22 lb) is applied mid-way along the belt's longest run. Also check the belt for damage.

Fan belt deflection		mm (in)
New belt		8 – 12 (0.31 – 0.47)
Reused belt		10 – 14 (0.39 – 0.55)
A/C belt deflection		mm (in)
New belt		16 – 20 (0.630 – 0.787)
Reused belt		18 – 22 (0.709 – 0.866)



N6A6245E

Legend

- Crankshaft Pulley
- Generator
- Fan Pulley

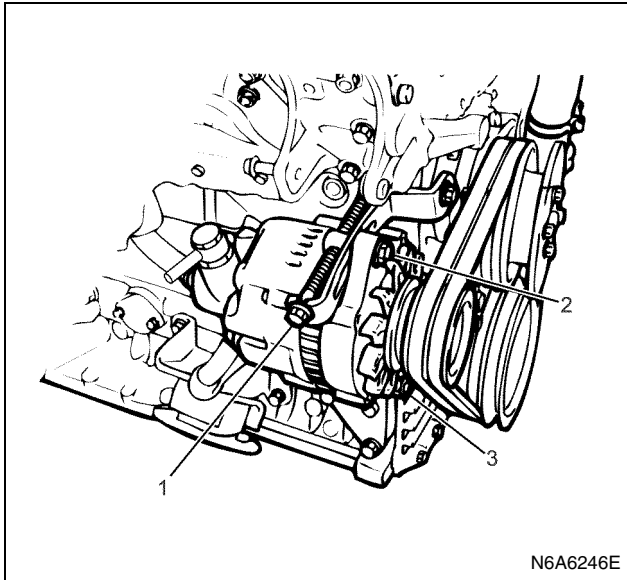
b. Adjustment of the fan belt

- Loosen (2) and (3), adjust the fan belt moving the generator.

Tighten:

Bolt (2) to 24 N·m (2.4 kg·m/18 lb·ft)

Bolt (3) to 40 N·m (4.1 kg·m/30 lb·ft)



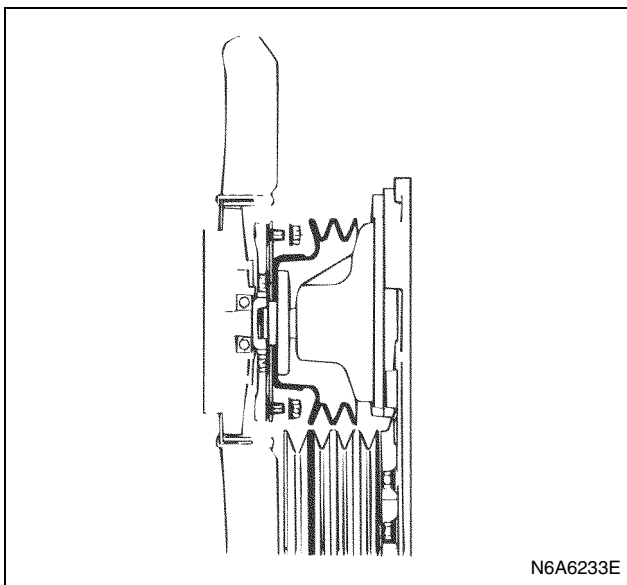
Legend

1. Adjustment Bolt
2. Fixing Nut
3. Fixing Bolt

5. Tighten the fan assembly to the specified tightening torque.

Tighten:

Nuts to 24 N·m (2.4 kg·m/18 lb·ft)



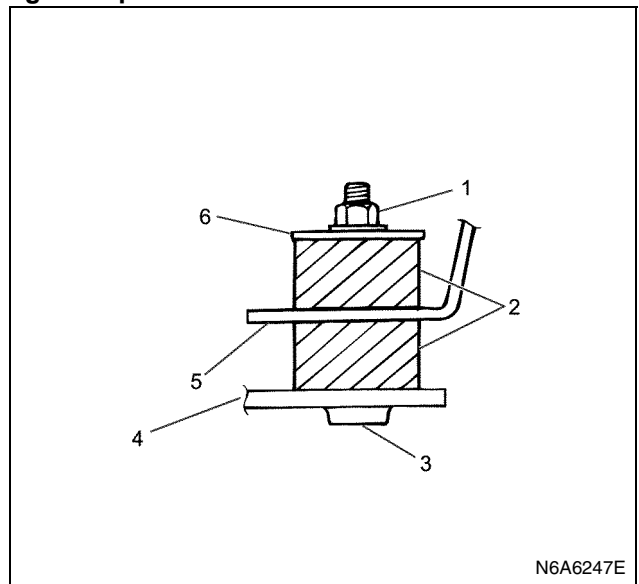
6. Install the radiator.

- Attach right and left brackets of the radiator to the brackets on the frame as illustrated.

Tighten:

Brackets to 55 N·m (5.6 kg·m/41 lb·ft)

Rigid suspension model



Legend

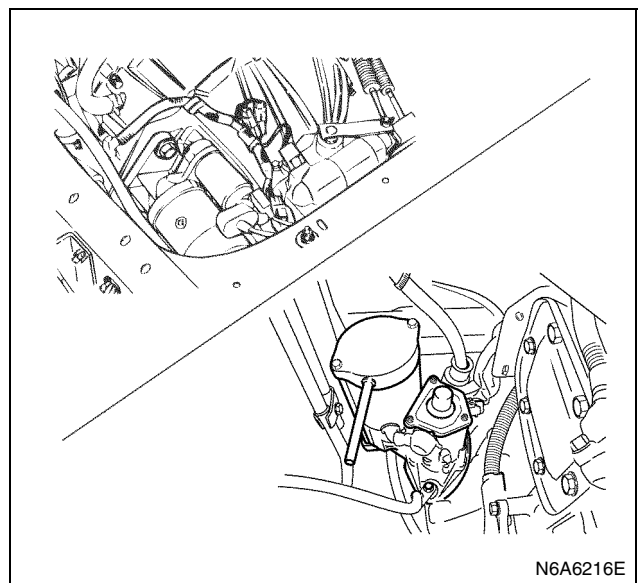
1. Flange Nut
2. Rubber
3. Stud Bolt
4. Frame Side Bracket
5. Radiator Side Bracket
6. Washer

7. Connect the lower radiator hose.
8. Connect the coolant reserve tank hose.
9. Connect the upper radiator hose.
10. Install the starter in the clutch housing with bolts and tighten to the specified tightening torque.

Tighten:

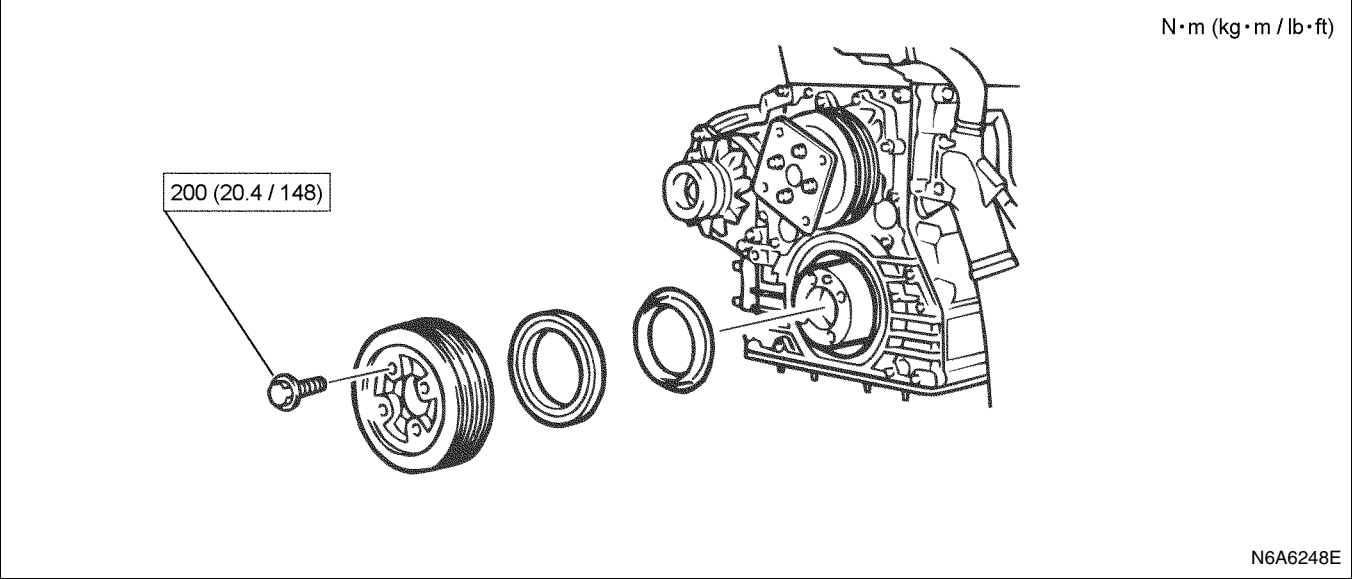
Bolt to 76 N·m (7.7 kg·m/56 lb·ft)

- Connect the starter ground cable.
- Connect the front frame harness connector.

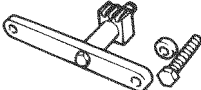
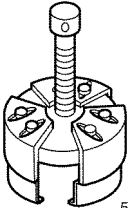
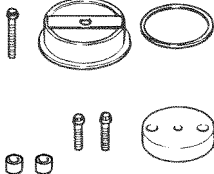


11. Refill the radiator with coolant.

Torque Specifications

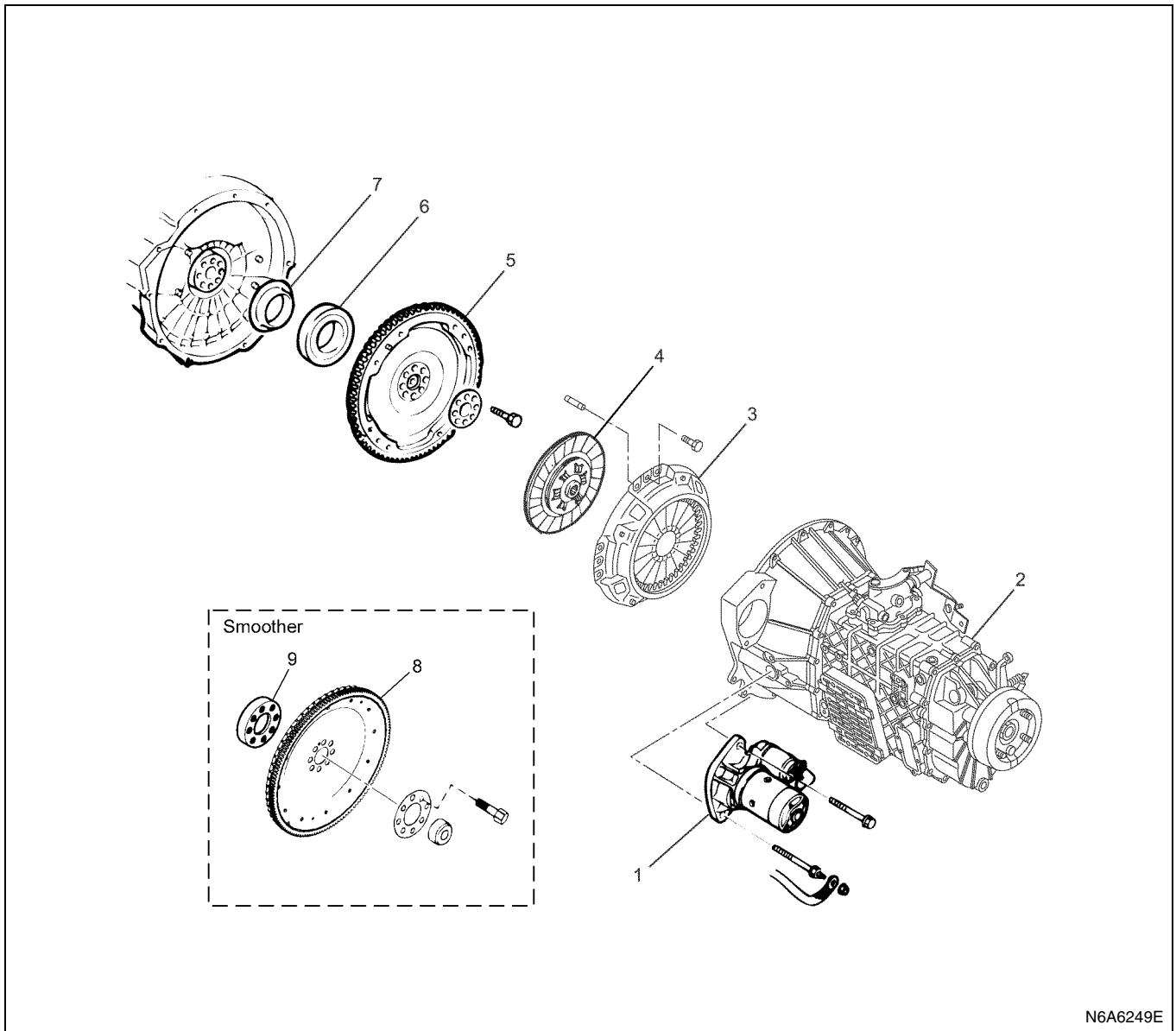


Special Tool

Illustration	Tool Number / Description / Remarks
 5884022300	5-8840-2230-0 (EN-47680) Crankshaft Stopper
 5884023600	8-9439-6858-0 (J-43285) Slinger Puller
 5884027030	5-8840-2703-0 (J-43282) Oil Seal Installer Kit

Crankshaft Rear Oil Seal

Component



N6A6249E

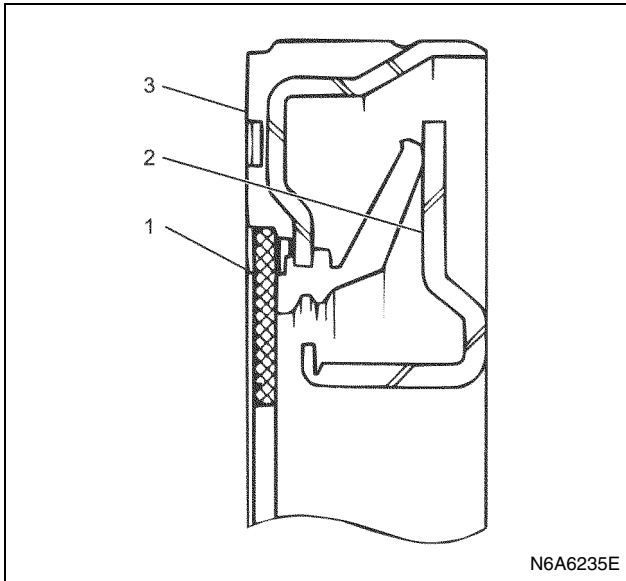
Legend

- | | |
|--|-------------------------------------|
| 1. Starter | 6. Crankshaft Rear Oil Seal |
| 2. Transmission Assembly | 7. Crankshaft Rear Slinger |
| 3. Clutch Pressure Plate Assembly (MT) | 8. Flexible Plate (Smoother) |
| 4. Clutch Plate Assembly (MT) | 9. Crankshaft End Spacer (Smoother) |
| 5. Flywheel (MT) | |

Removal

1. Remove the flywheel.
Refer to "Flywheel".
2. Remove the crankshaft rear oil seal.

- Remove only the oil seal off with a screwdriver or the like avoiding damage to the oil seal contact surface on the flywheel housing and the shaft.



N6A6235E

Legend

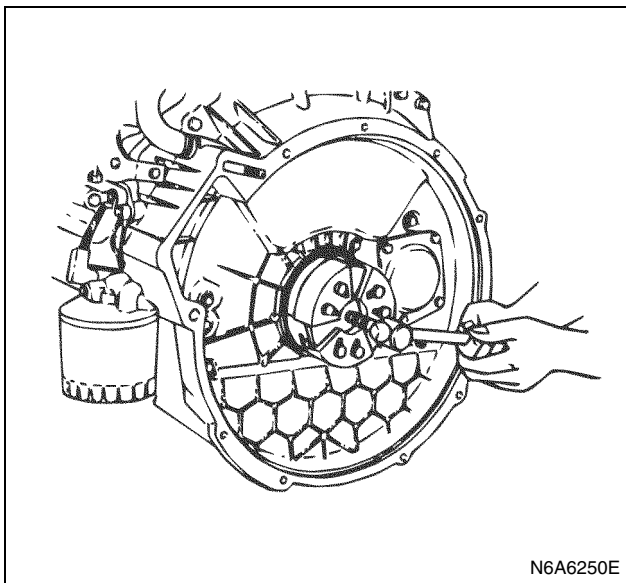
- Felt
- Slinger
- Oil Seal

3. Remove the crankshaft slinger.

- Pull out the slinger using a slinger puller. (Fixing the circumference of the puller with a clip band will make the procedure easier.)

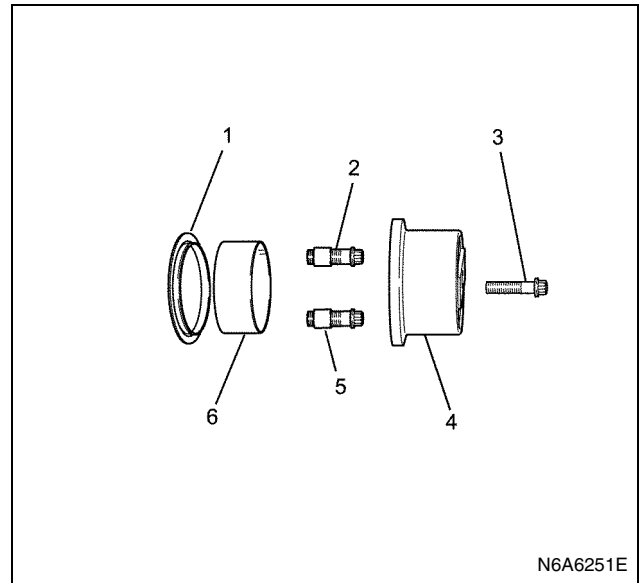
Special tool

Slinger puller: 8-9439-6858-0 (J-43285)



N6A6250E

- Press fit the rear sling using the oil seal installer kit.



N6A6251E

Legend

- Rear Slinger
- Fixing Bolt
- Center Bolt
- Sleeve (Rear)
- Collar (Rear)
- Adapter (Rear)

Special tool

Oil seal installer kit: 5-8840-2703-0 (J-43282)

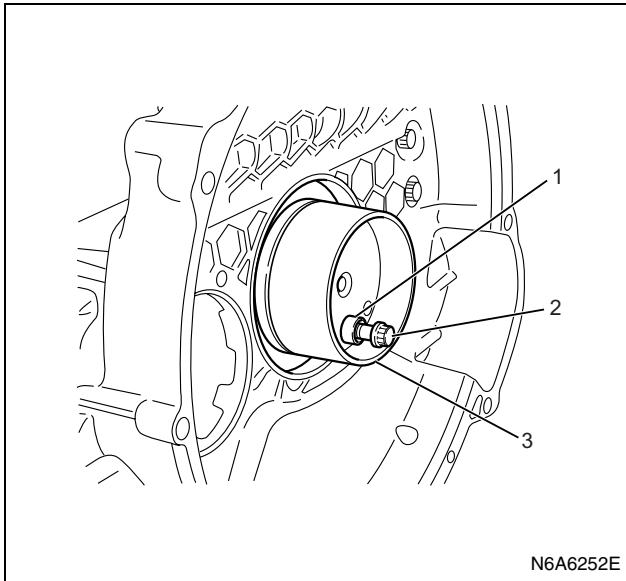
No.	Part Name	Slinger	Oil seal
1	Sleeve (rear)	○	○
2	Adapter (rear)	○	○
3	Collar (rear)	○	○
4	Adapter ring (rear)	—	○
5	Center bolt	○	○
6	Fixing bolt	○	○

Installation

- Install the crankshaft rear slinger.

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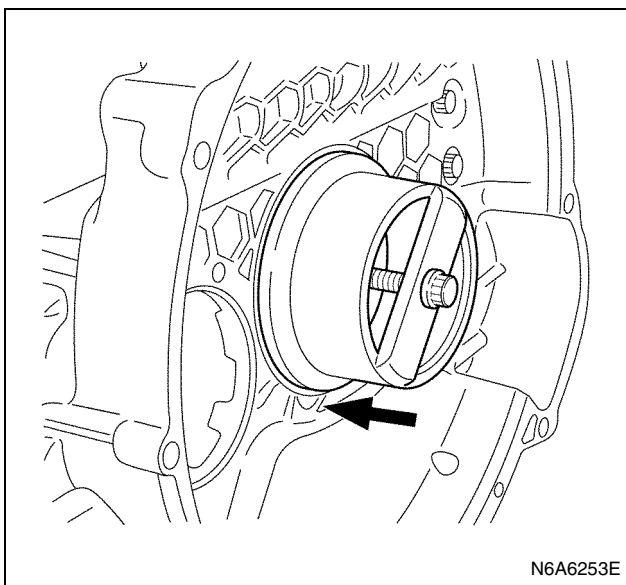
- Insert the rear slinger into the end of the rear side adapter and mount the adapter on the crankshaft with the fixing bolt with a collar placed on it.



Legend

- Collar
- Fixing Bolt
- Adapter

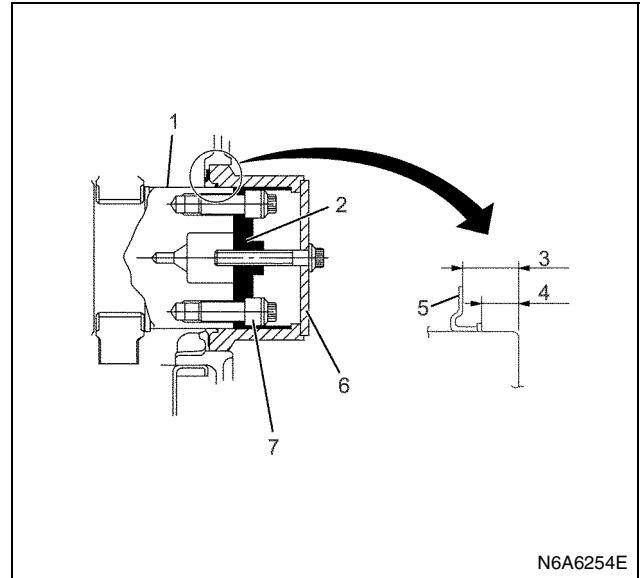
- Put a sleeve over the adapter and tighten the center bolt until the sleeve touches the adapter to press fit the rear slinger.



- After you have press-fitted the rear slinger, confirm the measurement shown (depth from the end surface of the crankshaft to the slinger) and check for deflection of the slinger.

Caution:

Be careful not to put the slinger inside out or mistake the front slinger for the rear one, and vice versa. Rear side slinger has four right-hand threads on it while front one has four left-hand threads. Slinger and oil seal should always be replaced in pairs.

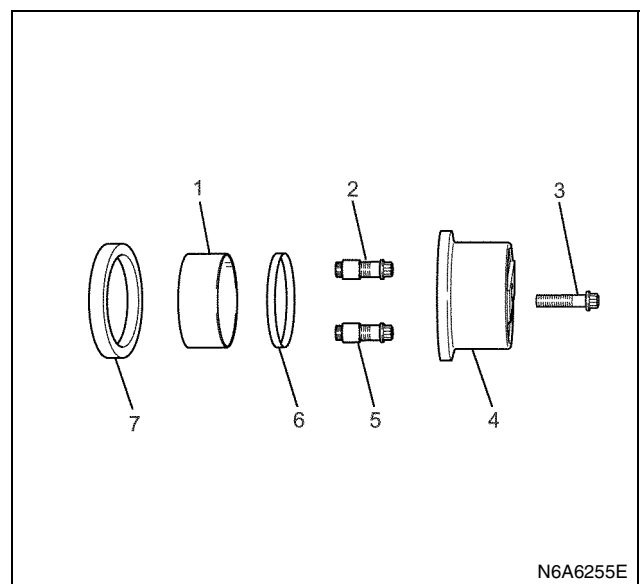


Legend

- Rear Part of The Crankshaft
- Adapter
- 17.3 ± 0.3 mm (0.681 ± 0.012 in)
- 10.8 ± 0.1 mm (0.425 ± 0.004 in)
- Slinger
- Sleeve
- Collar

2. Install the crankshaft rear oil seal.

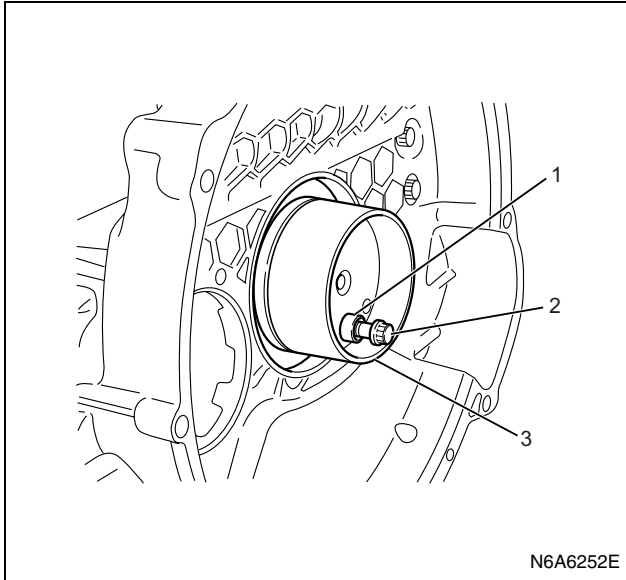
- Press-fit the rear oil seal using an oil seal installer kit.



Legend

- Adapter (Rear)
- Fixing Bolt
- Center Bolt
- Sleeve (Rear)
- Collar (Rear)
- Adapter Ring (Rear)
- Oil Seal

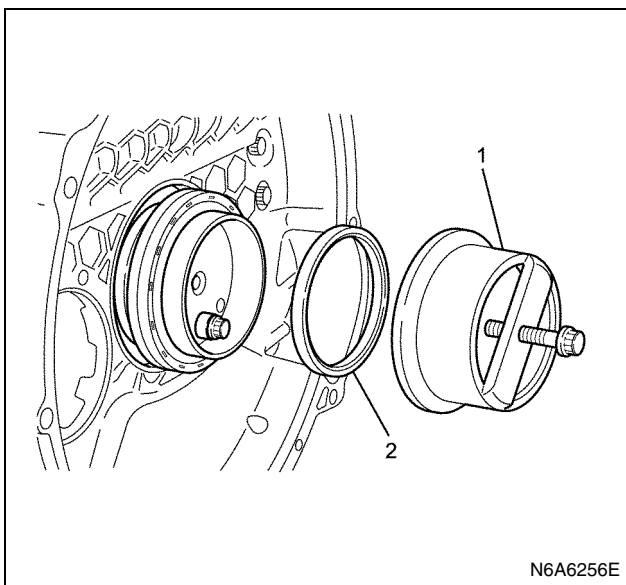
- Put a collar on the fixing bolt and mount the adapter onto the crankshaft.



Legend

- Collar
- Fixing Bolt
- Adapter

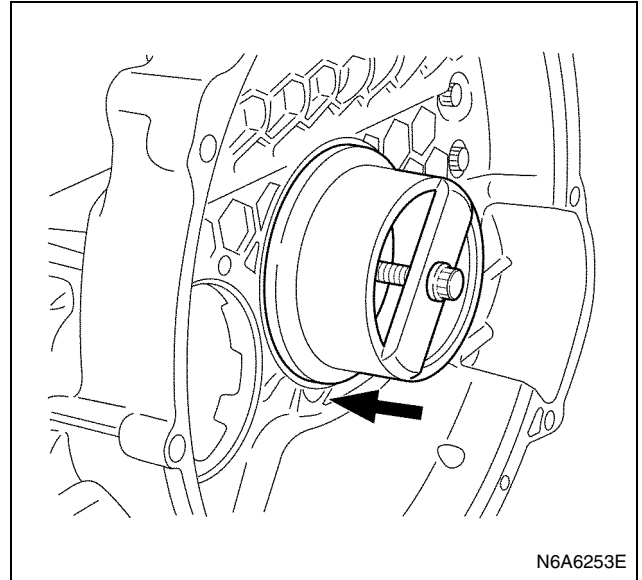
- Apply engine oil to the lip of the oil seal and place it in the rear side adapter.
- Put the rear side adapter ring in the sleeve and put the sleeve on the adapter and fix with the center bolt.



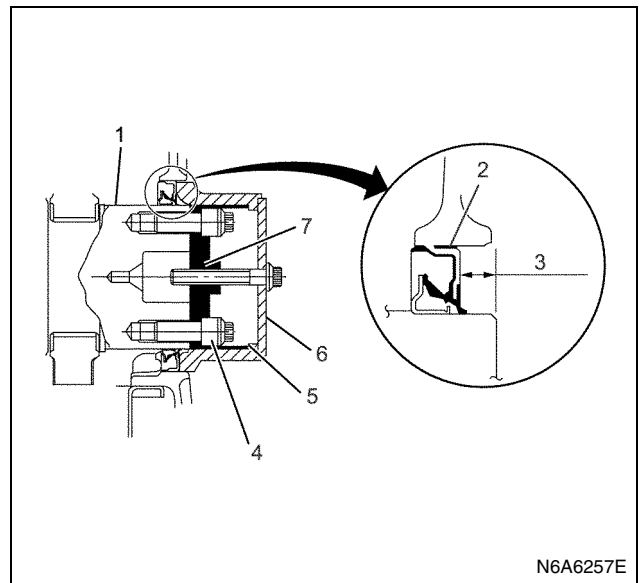
Legend

- Sleeve
- Adapter Ring

- Tightening the center bolt until the sleeve touches the adapter to press fit the oil seal.



- After you have pressed in the rear oil seal, confirm the measurement shown (depth from the end surface of the crankshaft to the oil seal).

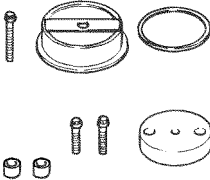
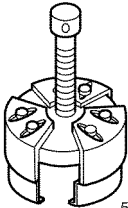


Legend

- Rear Part of The Crankshaft
- Oil Seal
- 7.8 ± 0.3 mm (0.31 ± 0.012 in)
- Collar
- Adapter Ring
- Sleeve
- Adapter

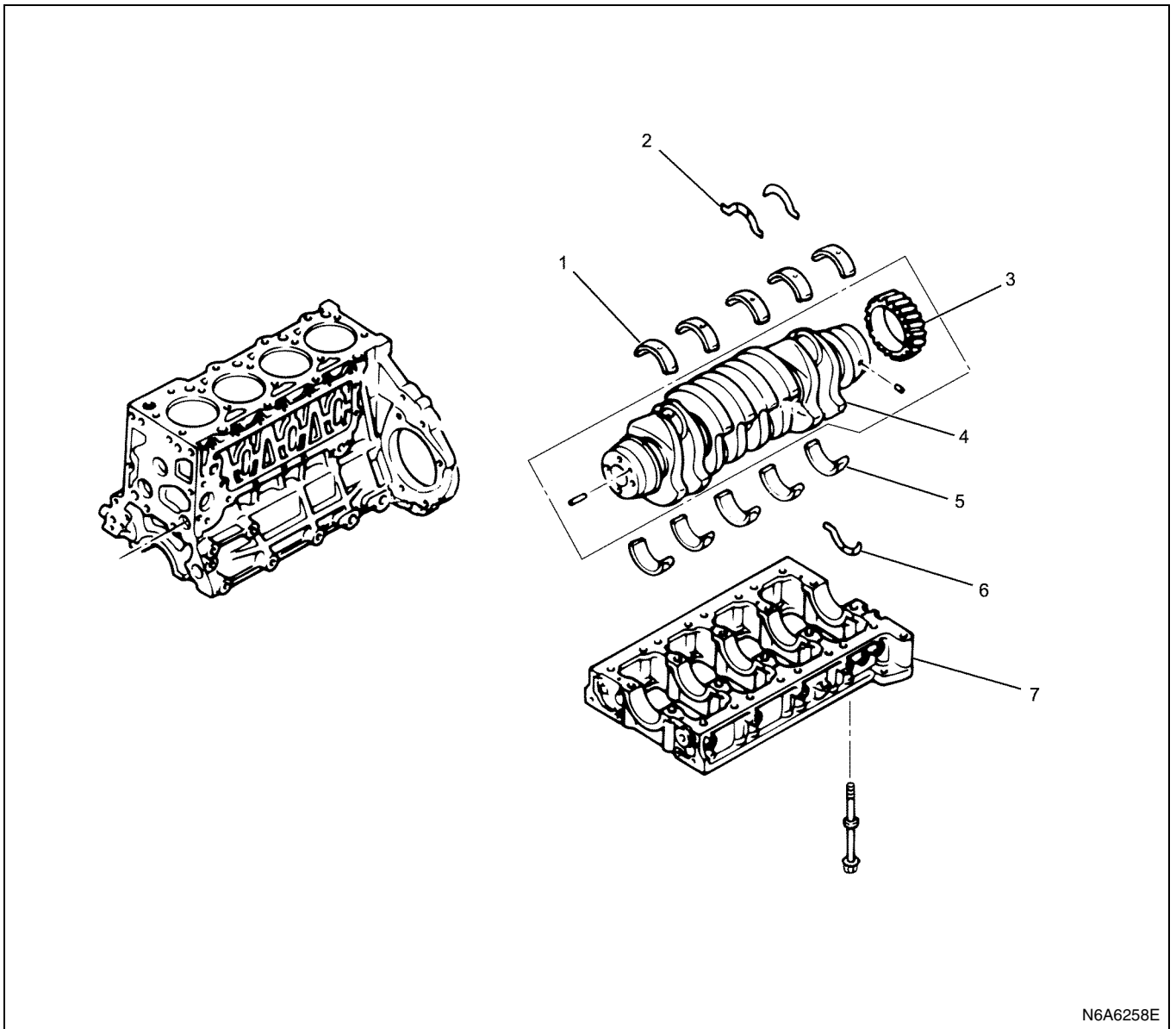
- Install the flywheel.
Refer to "Flywheel".

Special Tool

Illustration	Tool Number / Description / Remarks
 5884027030	5-8840-2703-0 (J-43282) Oil Seal Installer Kit
 5884023600	8-9439-6858-0 (J-43285) Slinger Puller

Crankshaft

Component



N6A6258E

Legend

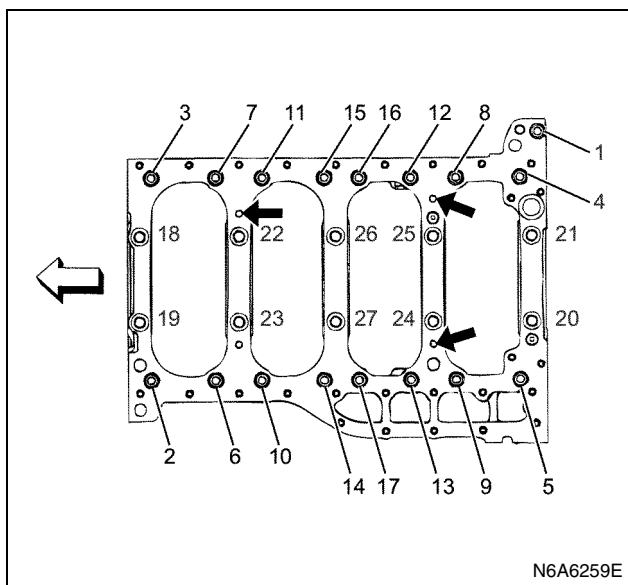
- | | |
|-------------------------|-------------------------|
| 1. Upper Bearing | 5. Lower Bearing |
| 2. Upper Thrust Bearing | 6. Lower Thrust Bearing |
| 3. Gear | 7. Crankcase |
| 4. Crankshaft | |

Removal

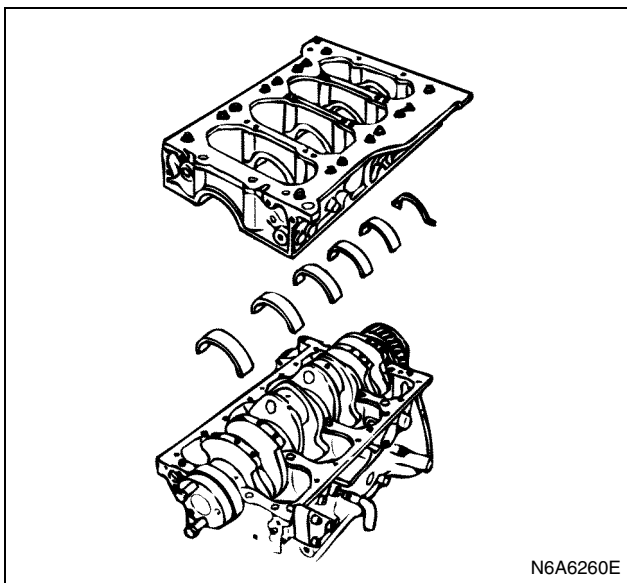
1. Demount the engine assembly.
Refer to "Engine Assembly".
2. Remove the cylinder head cover.
Refer to "Cylinder Head Cover".
3. Remove the rocker arm shaft.
Refer to "Rocker Arm Shaft Assembly".
4. Remove the camshaft.
Refer to "Camshaft Assembly".
5. Remove the cylinder head.
Refer to "Cylinder Head".
6. Remove the fuel supply pump.
Refer to "Fuel Supply Pump" in Section 6C.
7. Remove the crankshaft front oil seal.
Refer to "Crankshaft Front Oil Seal".
8. Remove the crankshaft rear oil seal.
Refer to "Crankshaft Rear Oil Seal".
9. Remove the oil pan.
Refer to the "Oil Pan".

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10. Remove the water pump.
Refer to "Water Pump" in Section 6B.
11. Remove the front cover.
Refer to "Front Cover".
12. Remove the timing gear train.
Refer to "Timing Gear Train".
13. Remove the oil pump.
Refer to "Oil Pump".
14. Remove pistons and connecting rods.
Refer to "Pistons and Connecting Rod".
15. Remove the crankcase.
 - Gradually loosen crankcase mounting bolts in the sequence shown and remove the crankcase using the three replacer holes (arrowed holes in the figure).

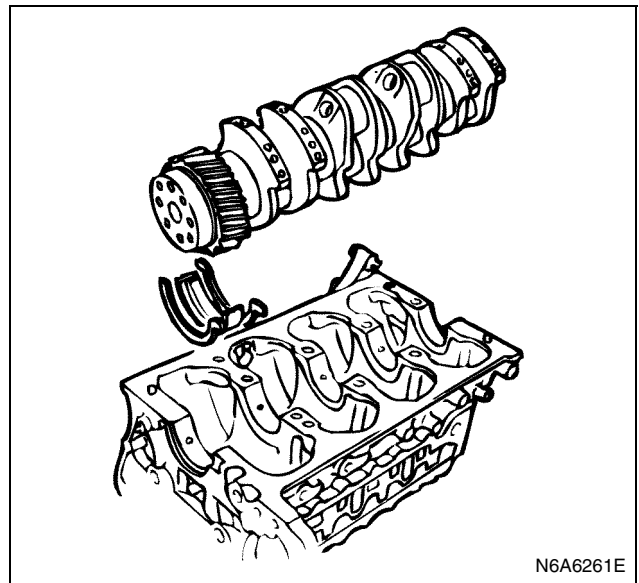


16. Remove the lower thrust bearing.
17. Remove the lower crankshaft bearings.



18. Remove the crankshaft assembly.
19. Remove the upper thrust bearing.

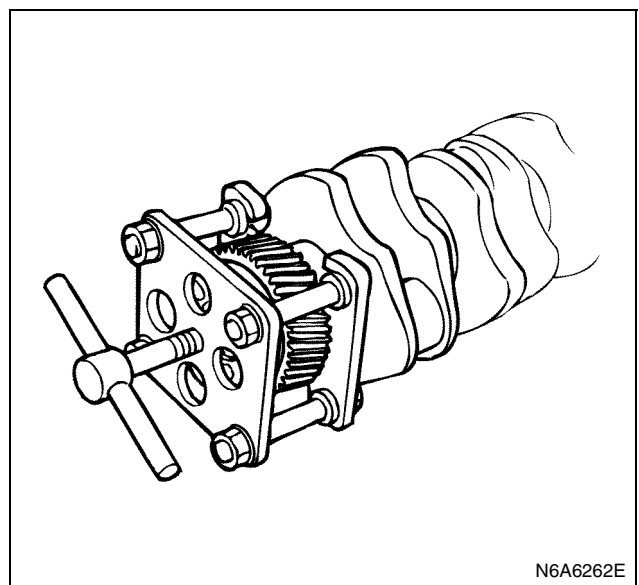
20. Remove the upper crankshaft bearings.



Disassembly

1. Remove the gear.
 - Remove the gear using a gear puller.

Special tool
Crankshaft gear puller: 8-9439-1097-0
(EN-47684)



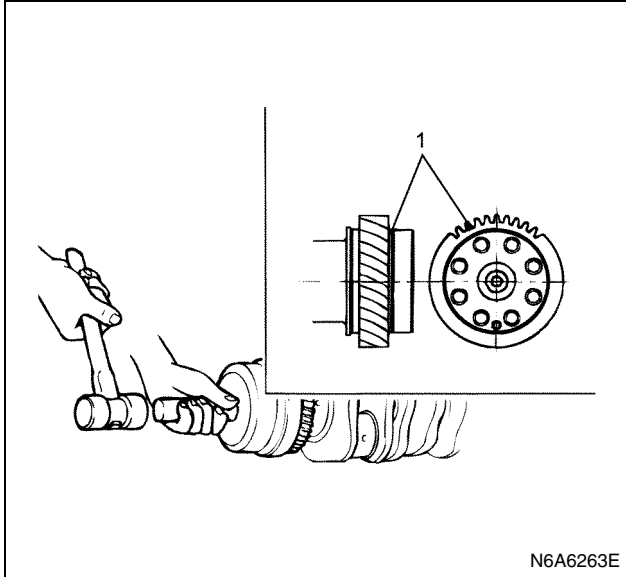
Reassembly

1. Install the gear.
 - Heat the gear to 170 – 250°C (338 – 482°F) and install it aligning the groove on the gear with the pin on the crankshaft.

- Insert the gear at one push into the flange with its end side with the alignment mark "S" facing outward. If you are fitting the gear while it is cold, beat the gear in until it impinges on the end using the installer.

Special tool

Crankshaft gear installer: 5-8840-2667-0 (J-41222)



Legend

- Alignment Mark

Inspection

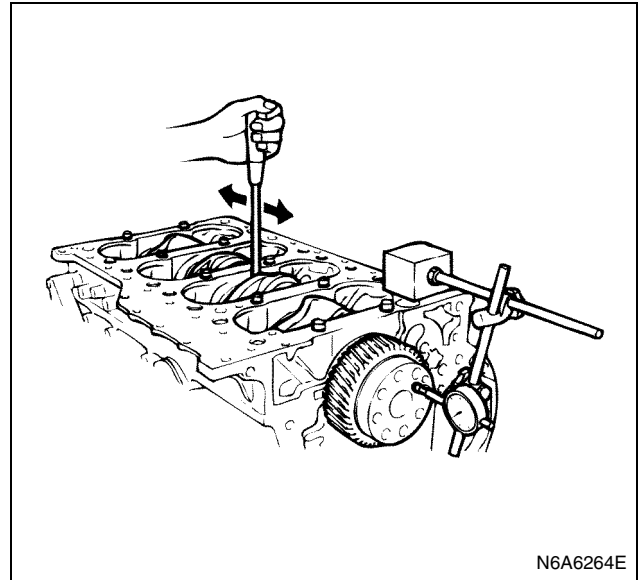
1. Thrust clearance

- Set a dial gauge as shown and measure the crankshaft thrust clearance.
- If the thrust clearance exceeds the limit, replace the thrust bearings in a pair.

Axial play of the crankshaft		mm (in)
Standard	0.104 – 0.205	(0.0041 – 0.0081)
Limit	0.35	(0.0138)

Caution:

Measure the thrust clearance before dismounting.

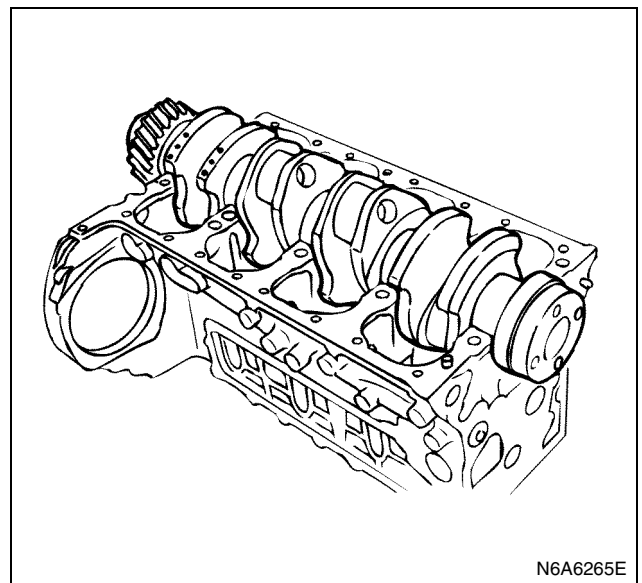


2. Main bearing clearance

- Remove the crankshaft. Remove the main bearings. Set out disassembled main bearings in the order of the numbers.
- Clean the crankshaft journal upper and lower bearings and upper and lower thrust bearings.
- Check the bearings for damage or excessive wear. If you find damage or excessive wear in the check, replace the bearings in pairs.
- Place the upper bearings and the crankshaft on the cylinder block. Install the crankshaft so that it becomes horizontal.

Caution:

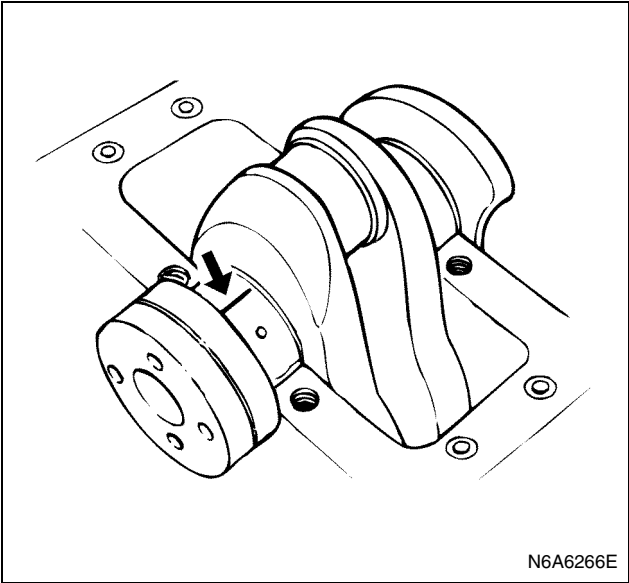
Turn the crankshaft about 30 degrees to allow the bearings to settle in.



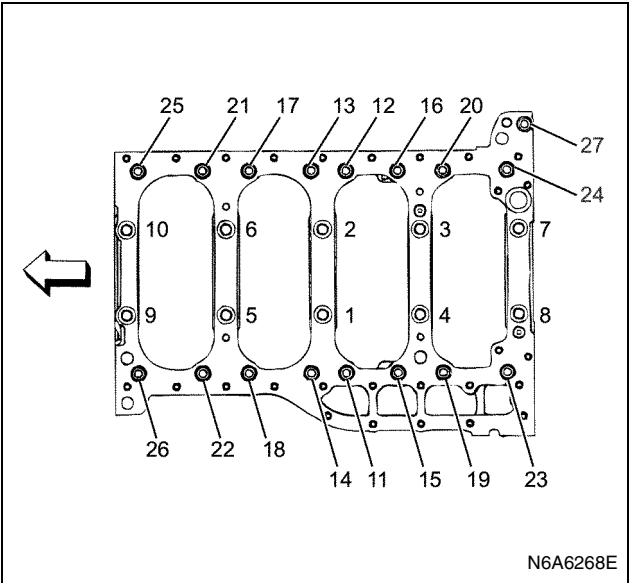
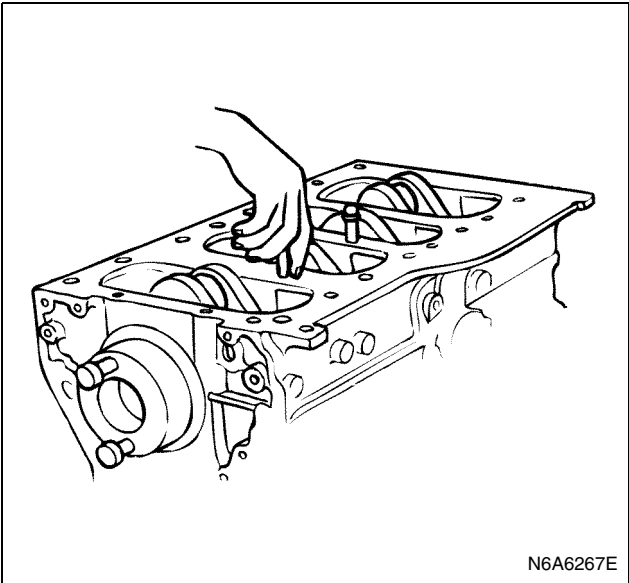
- Place Plastigage on the crankshaft journal as shown.

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- Place the lower bearings at original positions on the crankcase.



- Install the crankcase and tighten bolts to the specified tightening torque.
- Tighten the crankcase in the sequence shown using a torque wrench and an angle gauge.



Tighten:

M14 bolts (1 – 10) to

1st step: 98 N·m (10.0 kg·m/72 lb·ft)

2nd step: 132 N·m (13.5 kg·m/97 lb·ft)

3rd step: 30° – 60° (degrees)

M10 bolts (11 – 27) to

4th step: 38 N·m (3.9 kg·m/28 lb·ft)

- Tighten the bolts (M14) from 1-10 and confirm that they are tightened to a torque of 167 N·m (17.0 kg·m/123 lb·ft) or more.

Special tool

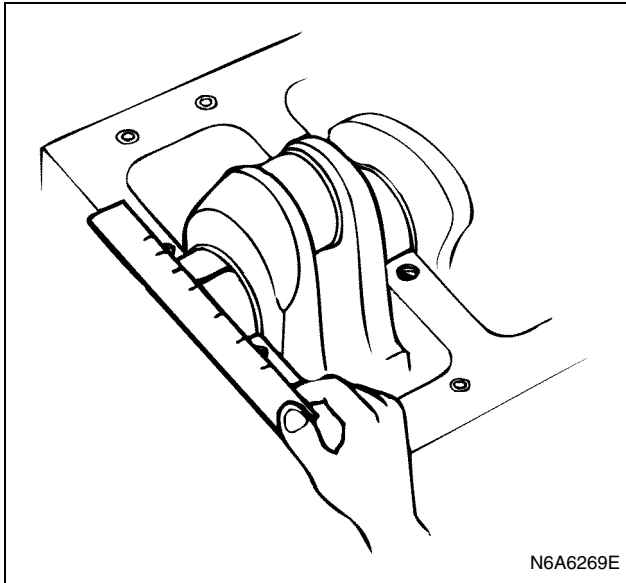
Angle gauge: 5-8840-0266-0 (J-45059)

Caution:

Do not turn the crankshaft after you have tightened the crankcase.

- Loosen the bolts and gently remove the crankcase.
- Measure the widest part of the Plastigage flattened by tightening the crankcase to determine the clearance.

Journal oil clearance		mm (in)
	Standard	Limit
No.1, 2, 4, 5	0.039 – 0.070 (0.0015 – 0.0028)	0.11 (0.0043)
No.3	0.053 – 0.084 (0.0021 – 0.0033)	0.11 (0.0043)

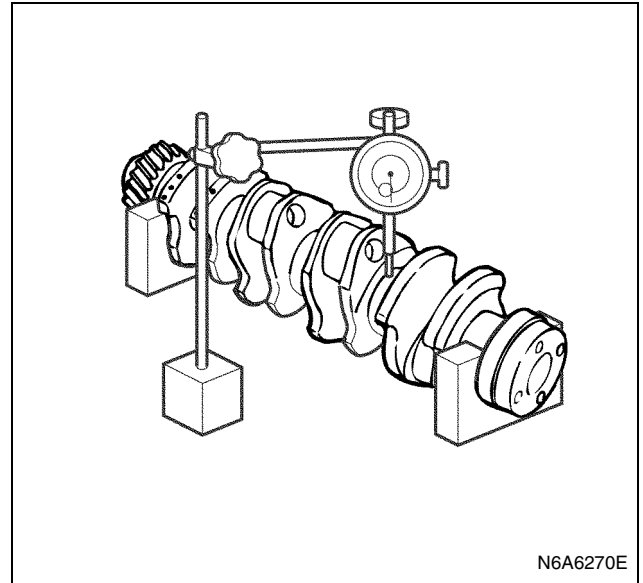


- If the journal oil clearance exceeds the limit, replace the main bearings altogether or the crankshaft.
- Remove the Plastigage from the bearings and the crankshaft.

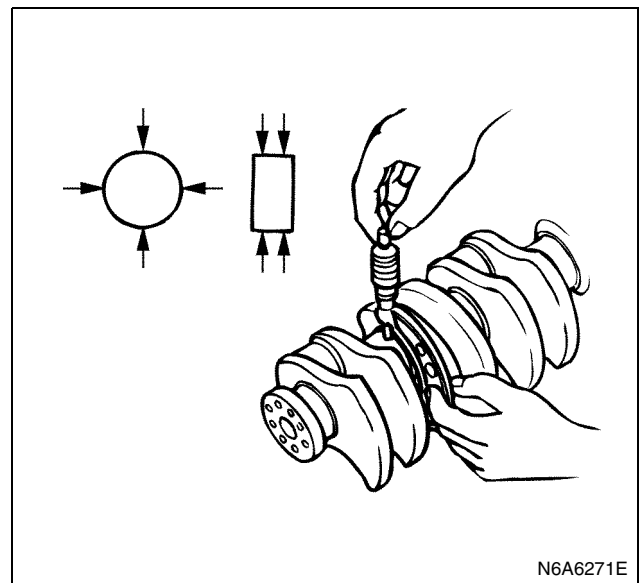
Inspection of the crankshaft

- Check the crankshaft journal and crank pin surfaces for wear and damage. Check the oil seal contact surface for excessive wear and damage.
 - Check the oil port for clogging.
3. Crankshaft run-out
Carefully set the crankshaft on the V block. Slowly turn the crankshaft to measure the run-out. If the crankshaft run-out exceeds the limit, replace the crankshaft.

Crankshaft run-out		mm (in)
Standard	0.05 or less (0.0020 or less)	
Limit	0.30 (0.012)	



4. Measure the journal and the crankpin diameters and uneven wear.
- Measure outer diameters of the journal and the pin and calculate differences between the maximum and the minimum values. Take measurements at four positions for both the journal and the pin.



Crankshaft outside diameter		mm (in)
	Standard	Limit
Journal #1, 2, 4, 5	81.905 – 81.925 (3.22460 – 3.22538)	81.85 (3.222)
Journal #3	81.891 – 81.911 (3.22408 – 3.22483)	81.85 (3.222)
Pin	72.902 – 72.922 (2.87015 – 2.87094)	72.850 (2.8681)

Difference		mm (in)
Limit	0.005 (0.0002)	

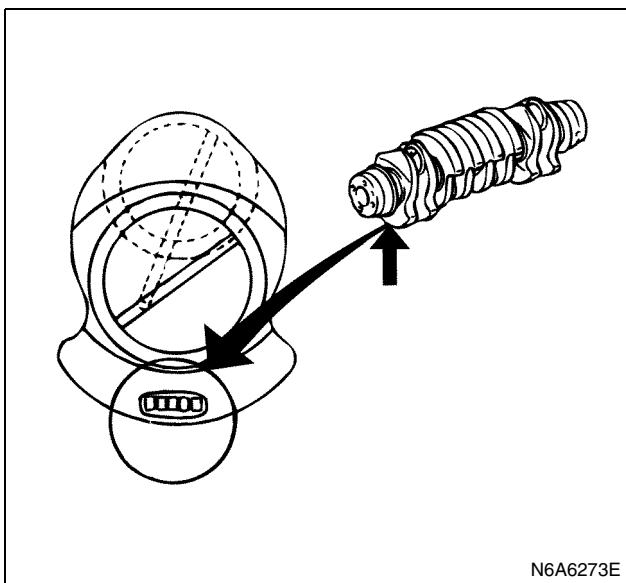
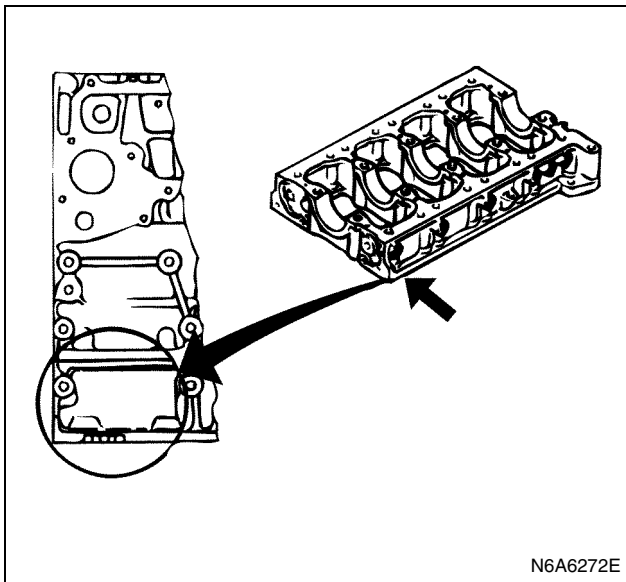
6A-140 Engine Mechanical (4HK1-TC)

Caution:

Tufftriding (soft nitriding treatment) is applied to enhance strength of the crankshaft. Therefore, do not polish the surface of the crankshaft.

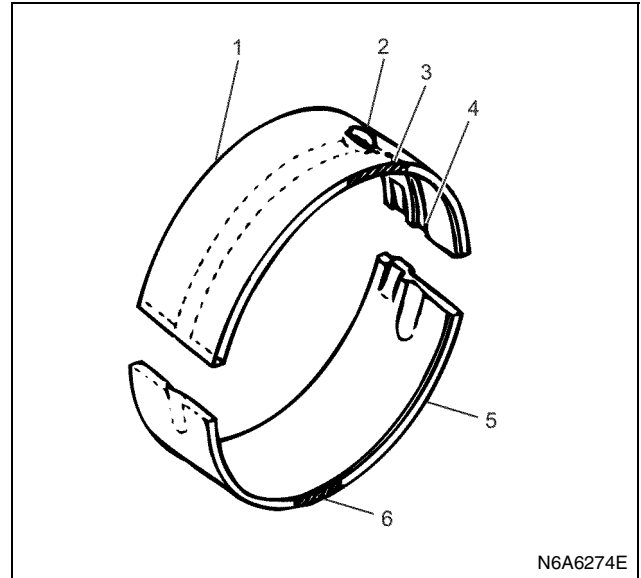
Crankshaft bearing selection

- When installing new crankshaft bearings or replacing bearings in use, make reference to the Bearing Selection Table.
- Select and install new bearings paying close attention to the cylinder block journal internal diameter grade and the crankshaft journal diameter grade.
- Journals are numbered from 1 to 5 from left to right when viewed so that the numbers are in normal reading orientation.



Caution:

Be careful about difference in the shape of the bearings when installing them.



Legend

1. Upper Bearing
2. Oil Gallery
3. Grade Identification Color
4. Oil Groove
5. Lower Bearing
6. Grade Identification Color

Bearing Selection Table

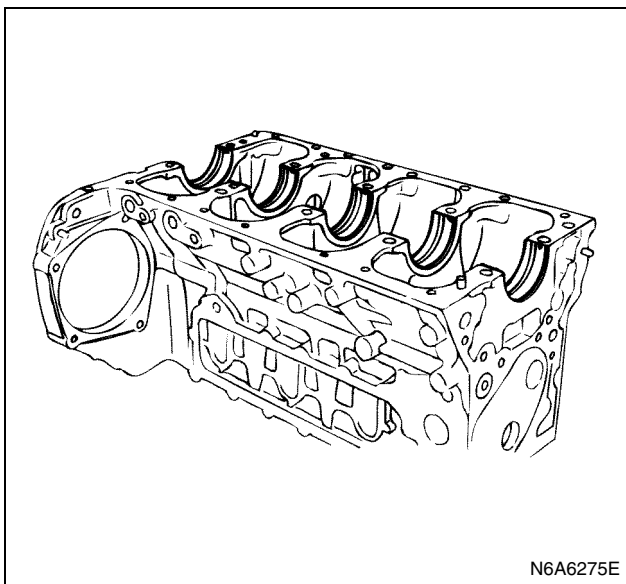
Combination of grades			Oil clearance mm (in)	
Cylinder block Grade	Crank journal Grade	Bearing identification color	#1, 2, 4, 5	#3
1	1	Black	0.039 – 0.070 (0.00154 – 0.00276)	0.053 – 0.084 (0.00209 – 0.00331)
1	2	Brown	0.037 – 0.068 (0.00146 – 0.00267)	0.051 – 0.082 (0.00201 – 0.00323)
2	1	Blue	0.041 – 0.072 (0.00161 – 0.00283)	0.055 – 0.086 (0.00217 – 0.00339)
2	2	Black	0.039 – 0.070 (0.00154 – 0.00276)	0.053 – 0.084 (0.00209 – 0.00331)

Installation

1. Install the crankshaft upper bearing.
 - Install the upper bearing in the cylinder block and apply oil.

Caution:

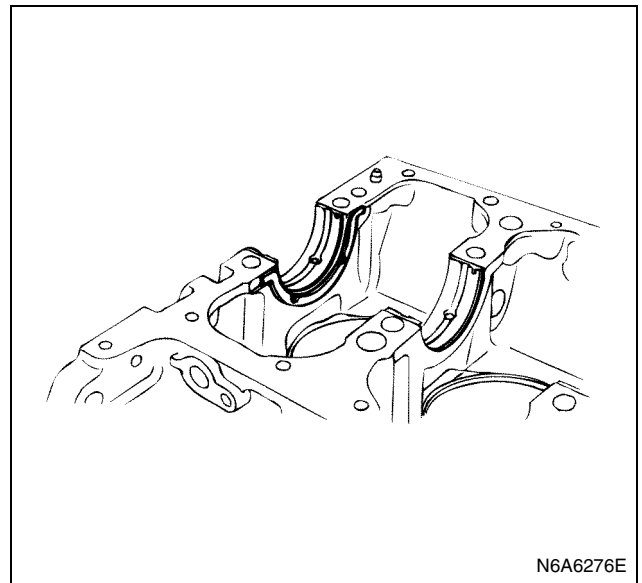
When replacing the crankshaft bearings, select grades referring to the Bearing Selection table. Do not apply oil to the bearing installation surface on the cylinder block and external surface of the bearing.



2. Install the upper thrust bearing.
 - Install the upper thrust bearing in the front side of the cylinder block journal No.5. In doing this, you may attach the upper thrust bearing to the cylinder block with grease. Then, be sure to wipe up excess grease.

Caution:

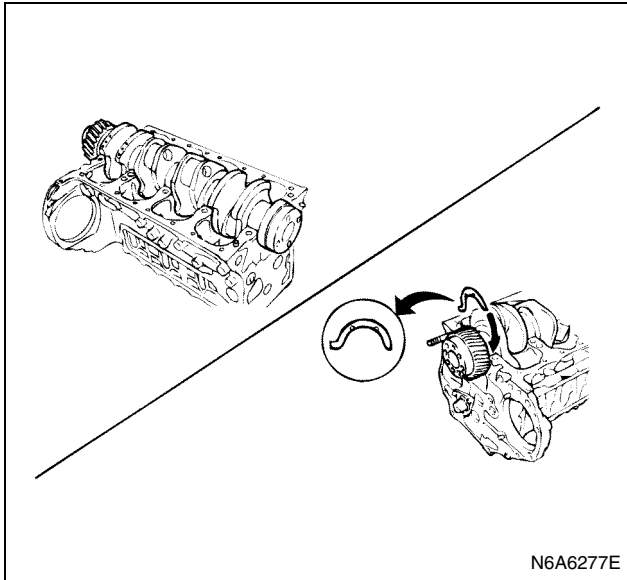
Install the thrust bearing so that the oil groove contacts the crankshaft.



3. Install the crankshaft assembly.
 - Apply engine oil to the crankshaft journal and gently place the crankshaft on the cylinder block.
 - Press the crankshaft to the rear and insert the upper thrust bearing in the rear side of the cylinder block journal No.5.

Caution:

Install the thrust bearing so that the oil groove contacts the crankshaft.

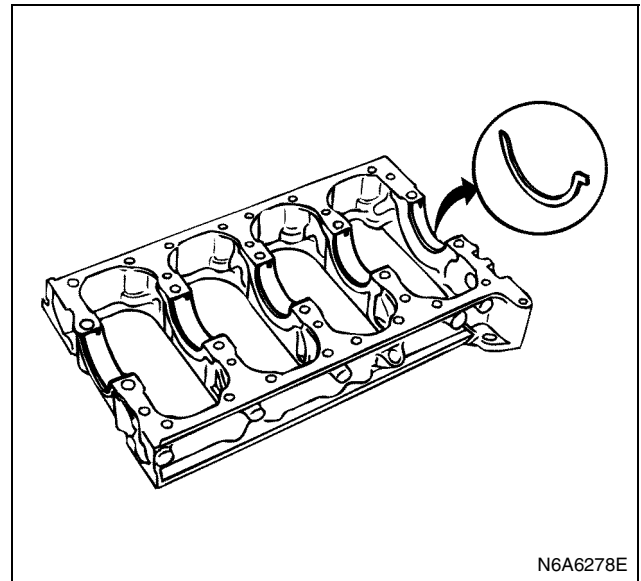


4. Install the lower crankshaft bearing.

5. Install the lower thrust bearing.

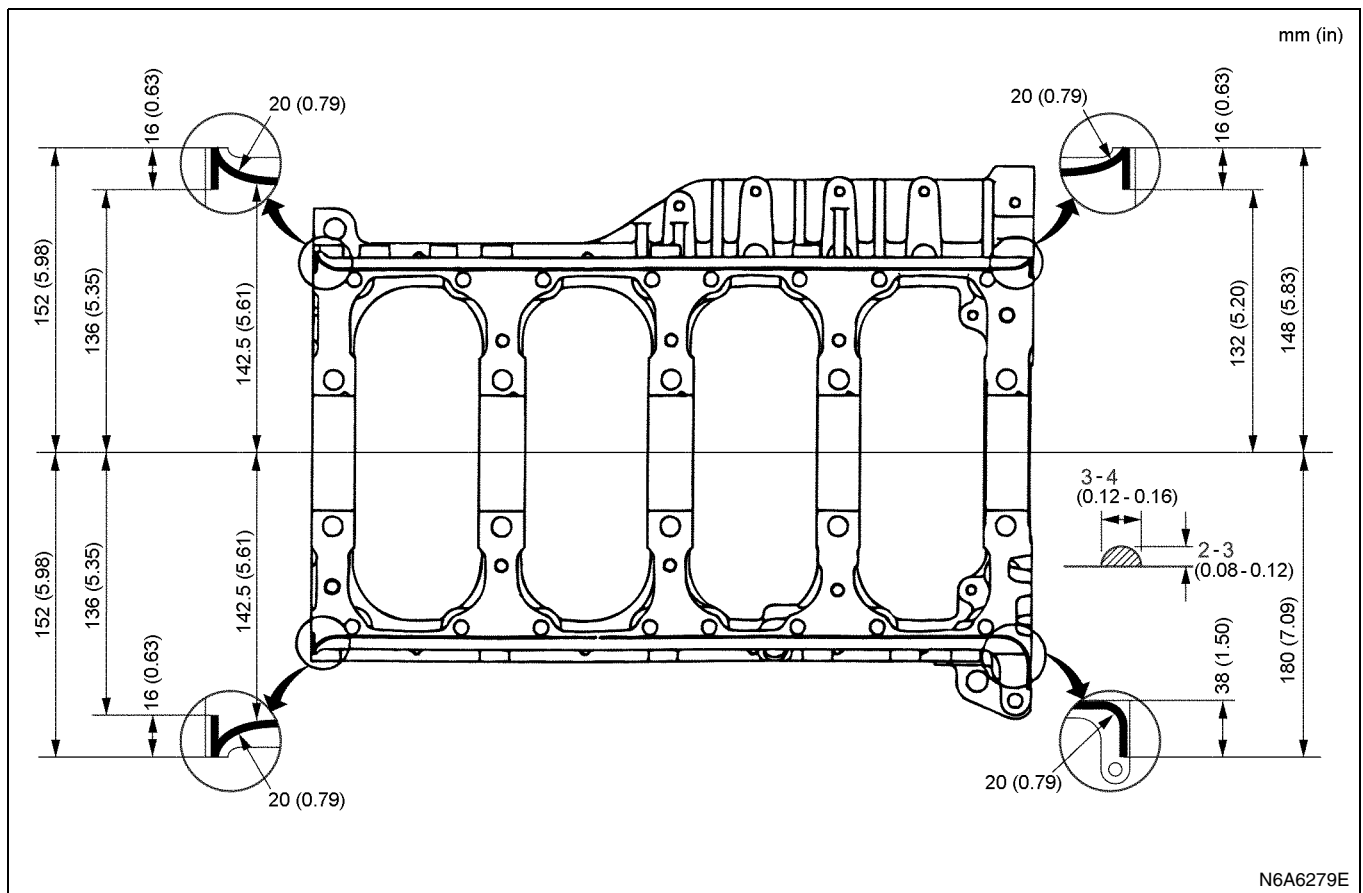
- Install the lower thrust bearing in the rear side of the crankcase journal No.5.

- Install the thrust bearing so that the oil groove contacts the crankshaft.



6. Install the crankcase.

- Apply liquid gasket (ThreeBond 1207C or equivalent) to the crankcase forming beads with diameters of 3 – 4 mm (0.12 – 0.16 in).
- Install the crankcase within 7 minutes after you have applied the liquid gasket.
- Gently place the crankcase on the cylinder block.



- Apply Molybdenum Disulfide to M14 bolt's threads and setting faces and tighten them to

the specified tightening torque in the sequence shown.

- Do not apply any oil to M10 bolts.

Tighten:

M14 bolts (1 – 10) to

1st step: 98 N·m (10.0 kg·m/72 lb·ft)

2nd step: 132 N·m (13.5 kg·m/97 lb·ft)

3rd step: 30° – 60° (degrees)

M10 bolts (11 – 27) to

4th step: 38 N·m (3.9 kg·m/28 lb·ft)

- Tighten bolts from 1-10 (M14) and confirm that they are tightened to a torque of 167 N·m (17.0 kg·m/123 lb ft) or more.

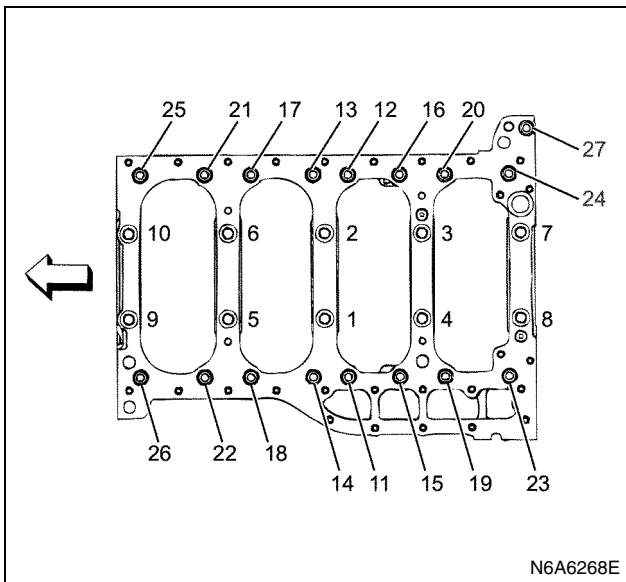
Special tool

Angle gauge: 5-8840-0266-0 (J-45059)

Caution:

Confirm that the crankshaft turns smoothly.

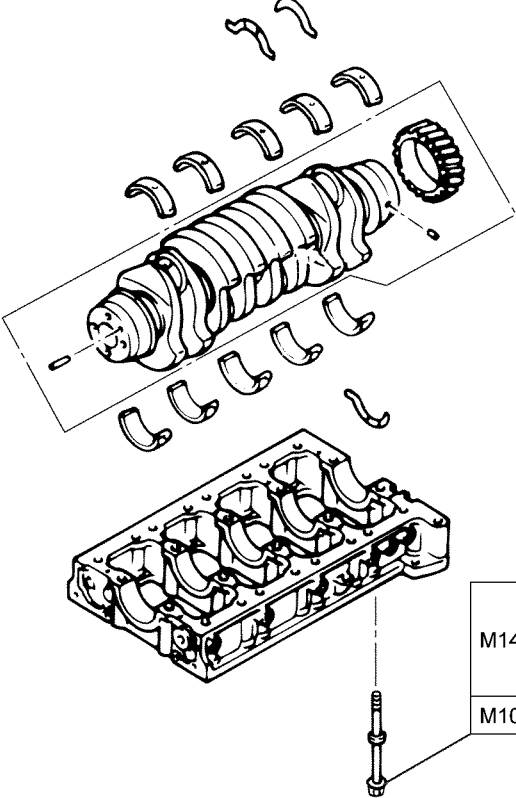
17. Install the camshaft assembly.
Refer to "Camshaft Assembly".
18. Install the rocker arm shaft assembly.
Refer to "Rocker Arm Shaft Assembly".
19. Install the cylinder head cover.
Refer to "Cylinder Head Cover".
20. Mount the engine assembly on the chassis.
Refer to "Engine Assembly".



7. Install pistons and connecting rods.
Refer to "Piston and Connecting Rod".
8. Install the oil pump.
Refer to "Oil Pump".
9. Install the timing gear train.
Refer to "Timing Gear Train".
10. Install the front cover.
Refer to the "Front Cover".
11. Install the water pump.
Refer to "Water Pump" in Section 6B.
12. Install the oil pan.
Refer to "Oil Pan".
13. Install the crankshaft rear oil seal.
Refer to "Crankshaft Rear Oil Seal".
14. Install the crankshaft front oil seal.
Refer to "Crankshaft Front Oil Seal".
15. Install the fuel supply pump.
Refer to "Fuel Supply Pump" in Section 6C.
16. Install the cylinder head.
Refer to "Cylinder Head".

Torque Specifications

N·m (kg·m / lb·ft)



M14	1st	98 (10.0 / 72)
	2nd	132 (13.5 / 97)
	3rd	30° — 60°
M10	38 (3.9 / 8)	

N6A6280E

Special Tool

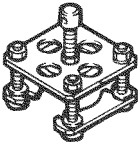
Illustration	Tool Number / Description / Remarks
 8943968180	8-9439-1097-0 (EN-47684) Crankshaft Gear Puller

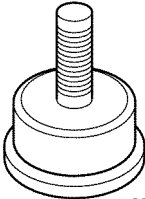
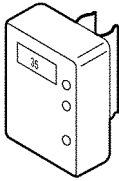
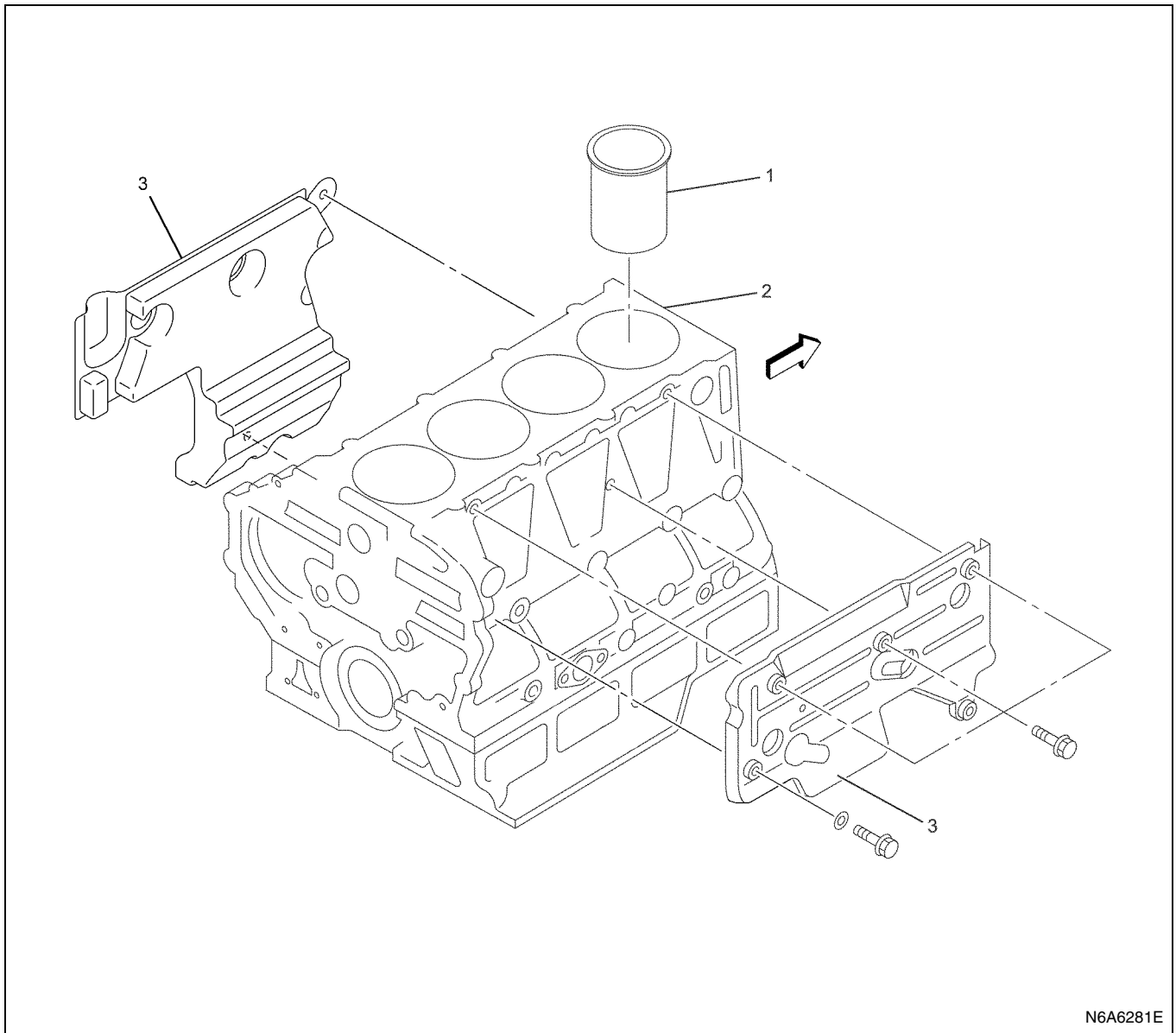
Illustration	Tool Number / Description / Remarks
 8943968190	5-8840-2667-0 (J-41222) Crankshaft Gear Installer

Illustration	Tool Number / Description / Remarks
 J45059	5-8840-0266-0 (J-45059) Angle Gauge

Cylinder Block

Component



N6A6281E

Legend

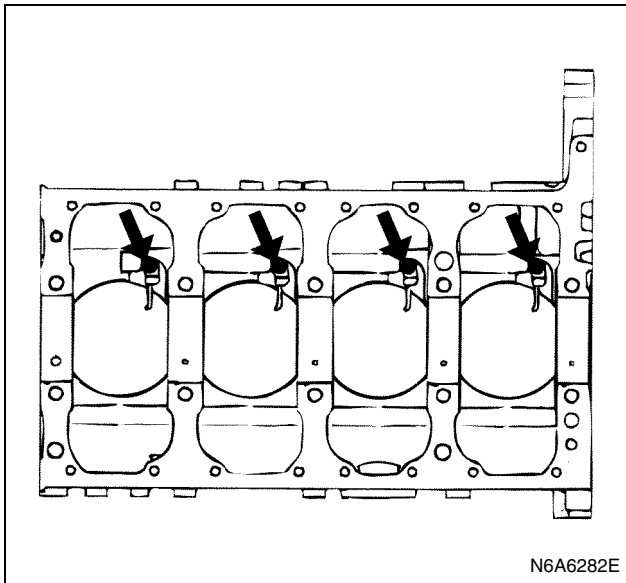
- 1. Cylinder Liner
- 2. Cylinder Block

- 3. Cover (For Europe)

Removal

1. Demount the engine assembly.
Refer to "Engine Assembly".
2. Remove the cylinder head cover.
Refer to "Cylinder Head Cover".
3. Remove the rocker arm shaft assembly.
Refer to "Rocker Arm Shaft Assembly".
4. Remove the camshaft assembly.
Refer to "Camshaft Assembly".
5. Remove the cylinder head.
Refer to "Cylinder Head".
6. Remove the fuel supply pump.
Refer to "Fuel Supply Pump" in Section 6C.
7. Remove the crankshaft front oil seal.
Refer to "Crankshaft Front Oil Seal".
8. Remove the crankshaft rear oil seal.
Refer to "Crankshaft Rear Oil Seal".
9. Remove the oil pan.
Refer to "Oil Pan".
10. Remove the water pump.
Refer to "Water Pump" in Section 6B.
11. Remove the front cover.
Refer to the "Front Cover".

12. Remove the timing gear train.
Refer to "Timing Gear Train".
13. Remove the oil pump.
Refer to "Oil Pump".
14. Remove pistons and connecting rods.
Refer to "Pistons and Connecting Rod".
15. Remove the crankshaft.
Refer to "Crankshaft".
16. Remove piston oil jet.

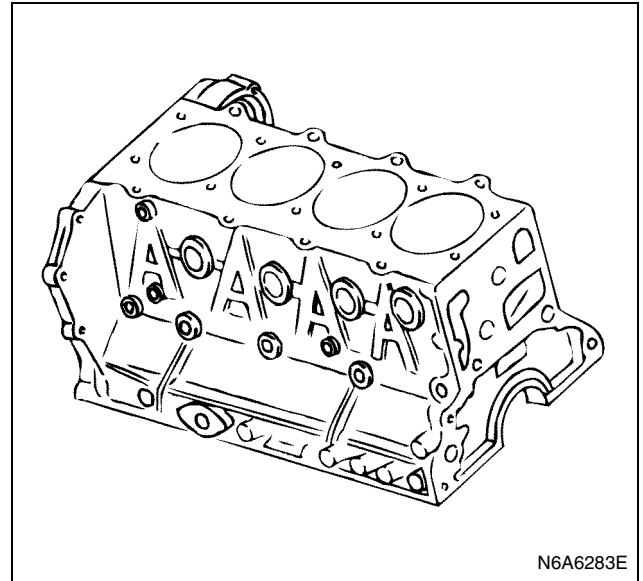


17. Remove the cylinder liner.
If the cylinder liner cannot be pulled free by hand, tap around the lower side of the liner with a hammer grip or similar object loosen it.

Inspection

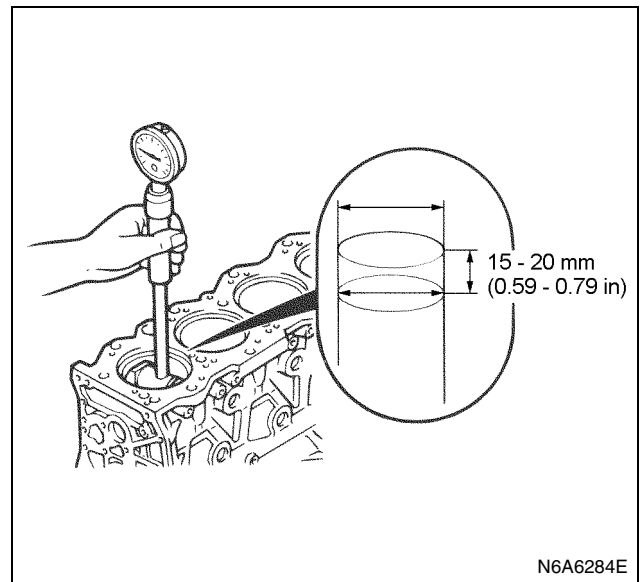
1. Carefully remove water stains or other foreign matters on the surface of the cylinder block.
 - Be careful not to damage the cylinder block.
2. Carefully remove the liquid gasket on the crankcase mounting surface.
3. Clean up the cylinder block.
4. Visually inspect the cylinder block.

- Conduct color check and hydraulic (or pneumatic) test and if you find crack or other damage, replace the cylinder block.



5. Cylinder liner wear measurement

- Check the internal surface of the liner for flaw or damage.
- Measure the liner bore diameter at the most worn part (it wears more in the rotation direction) at 15 – 20 mm (0.59 – 0.79 in) from the top end of the liner with the liner installed in the cylinder block. If the wear is over the application limit, replace it.



Cylinder liner bore diameter		mm (in)
Standard	115.021 – 115.050 (4.52837 – 4.52952)	
Limit	115.20 (4.5354)	

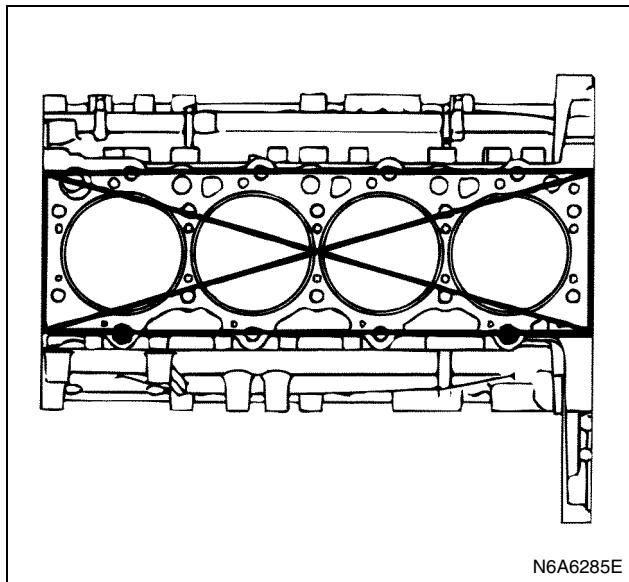
Caution:

You need not select piston grade since cylinder liner bore is only available in one size against the liner grade selection of its outer diameter.

6. Cylinder block upper face warpage

- Pull out the cylinder liners and remove water stains on the cylinder block.
- Measure four sides and two diagonals of the top surface of the cylinder block using a straight edge and a thickness gauge.
- Replace the cylinder block if the measurements exceed limit values.

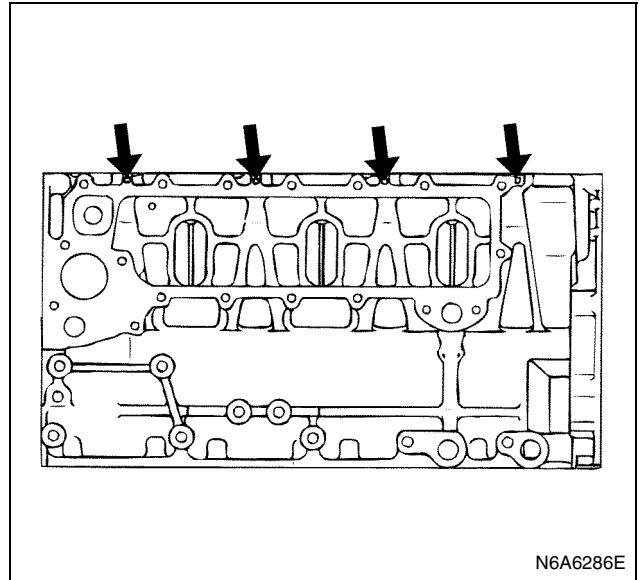
Cylinder block upper face warpage		mm (in)
Standard	0.05 or less (0.002 or less)	
Limit	0.20 (0.079)	

**Installation**

1. Cylinder liner grade selection

- Select liner outer diameter grades according to the cylinder block bore grades stamped on the cylinder block at arrowed positions in the figure.

Grade matching of cylinder block and liner		
Grade of Cylinder block (stamp)	1, 2	3
Grade of Liner outside diameter	1X	3X



Cylinder block bore and liner grade (for reference)			mm (in)
Grade	(1,2)/(1X)	(3)/(3X)	
Cylinder block Bore diameter	118.001 – 118.020 (4.64699 – 4.64654)	118.021 – 118.030 (4.64649 – 4.64684)	
Liner outside diameter	117.991 – 118.000 (4.64531 – 4.64566)	118.001 – 118.010 (4.64570 – 4.64605)	

(Reference)

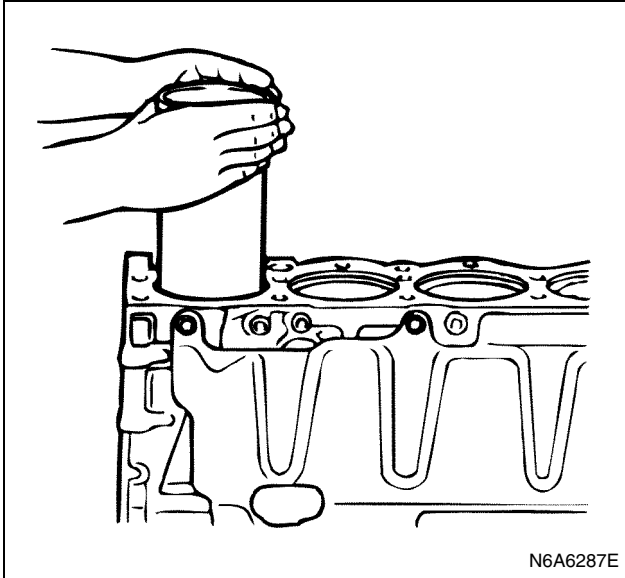
When replacing liners, a “liner set” let you obtain a piston of proper grade for a given liner bore diameter only by specifying a liner outside diameter grade.

2. Install the cylinder liners.

- Install the cylinder liners perpendicular to the cylinder block.
- Do not hammer the liner or apply excessive force to insert it.

Caution:

Clean up and blow with compressed air the cylinder block and the cylinder liners before installing them.

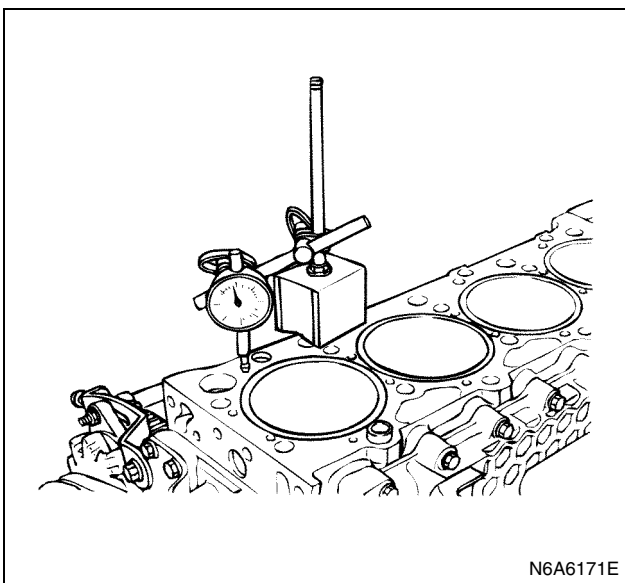


3. Amount of the cylinder liner extrusion
Measure the amount of the cylinder liner extrusion using a dial gauge.
Difference of the amount of the extrusion between adjacent two cylinders should be within 0.03 mm (0.0012 in).

Amount of the cylinder liner extrusion		mm (in)
Standard	0.05 – 0.10	(0.0020 – 0.0039)

Caution:

Be sure to measure the cylinder liner extrusion whenever you have replaced cylinder liners.



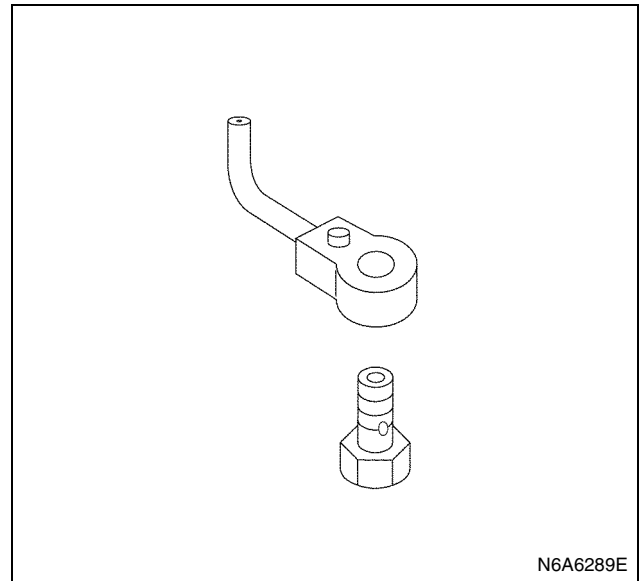
4. Install the piston oil jet.
- Align the dowel pin of the oil jet with the pin hole on the cylinder block and tighten with the check valve.

Tighten:

Bolts to 21 N·m (2.1 kg·m/15 lb·ft)

Caution:

Be careful not to deform or damage the oil jet nozzle.



- Install the crankshaft.
Refer to "Crankshaft".
- Install pistons and connecting rods.
Refer to "Pistons and Connecting Rod".
- Install the oil pump.
Refer to "Oil Pump".
- Install the timing gear train.
Refer to "Timing Gear Train".
- Install the front cover.
Refer to "Front Cover".
- Install the water pump.
Refer to "Water Pump" in Section 6B.
- Install the oil pan.
Refer to "Oil Pan".
- Install the crankshaft rear oil seal.
Refer to "Crankshaft Rear Oil Seal".
- Install the crankshaft front oil seal.
Refer to "Crankshaft Front Oil Seal".
- Install the fuel supply pump.
Refer to "Fuel Supply Pump" in Section 6C.
- Install the cylinder head.
Refer to "Cylinder Head".
- Install the camshaft assembly.
Refer to "Camshaft Assembly".
- Install the rocker arm shaft assembly.
Refer to "Rocker Arm Shaft Assembly".
- Install the cylinder head cover.
Refer to "Cylinder Head Cover".
- Mount the engine assembly on the chassis.
Refer to "Engine Assembly".

Lubrication System

Service Precautions

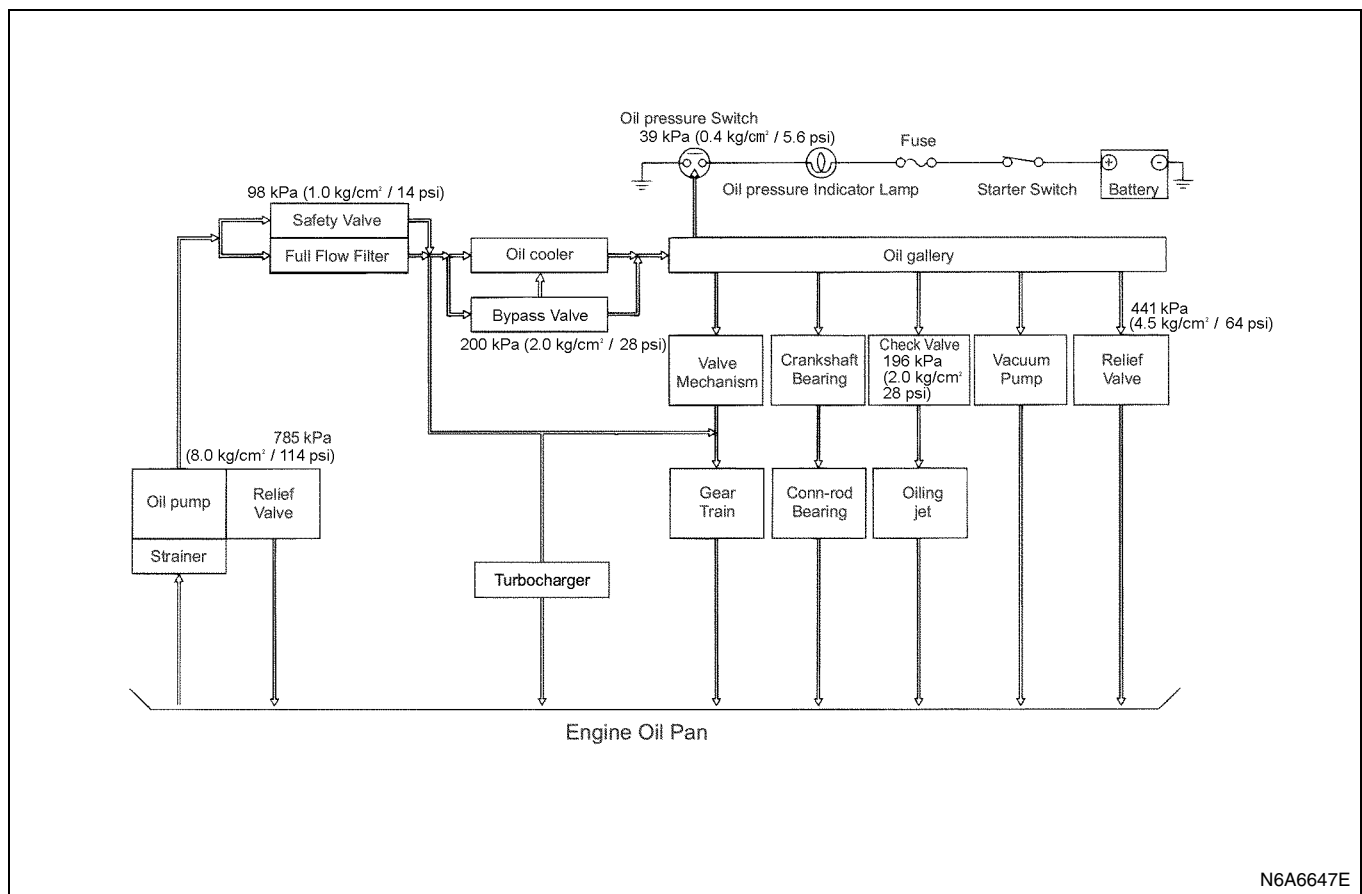
- During each disassembly, remove the old gasket adhering to each part and mating part completely using a scraper at the location, where the fluid gasket is to be used, clean the traces of oil, moisture, and dirt completely using waste cotton and apply the specified new fluid gasket at each location.

- Avoid excessive or insufficient coating amount. Note that seizure may occur in case of excessive coating due to clogging of the oil gallery and oil jet, and oil and water leakage may occur if the coating is insufficient.
- Always, the starting and ending piston of application should be overlapped.

Explanations on Functions and Operation

The lubrication system uses the filter element combined with a full flow bypass, water-cooled oil cooler, and oil jet for piston cooling.

Lubricating System Diagram



N6A6647E

Functional Check

Oil pressure check

- Check whether the engine oil is contaminated with dirt, fuel or water. If contaminated with dirt, fuel, or water (after examining the cause and taking the appropriate measures for fuel or water contamination), replace the oil.
- Check the engine oil level. The oil level should be between the two holes of the level gauge. If the oil level is insufficient, replenish it.
- Remove the oil pressure switch on the oil filter body.

4. Install the oil pressure gauge on the oil filter body.

Special tool

Oil pressure gauge set:

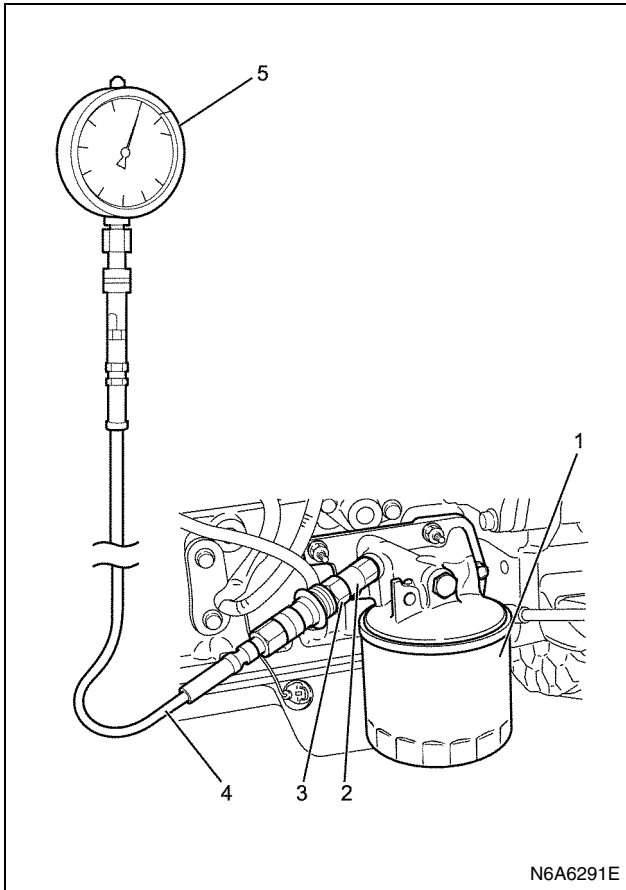
5-8840-2843-0

(Oil pressure gauge: J-43630-20)

(Hose: J-43630)

(Connector: J-43630-14)

(Oil pressure testing adapter: EN-46333)



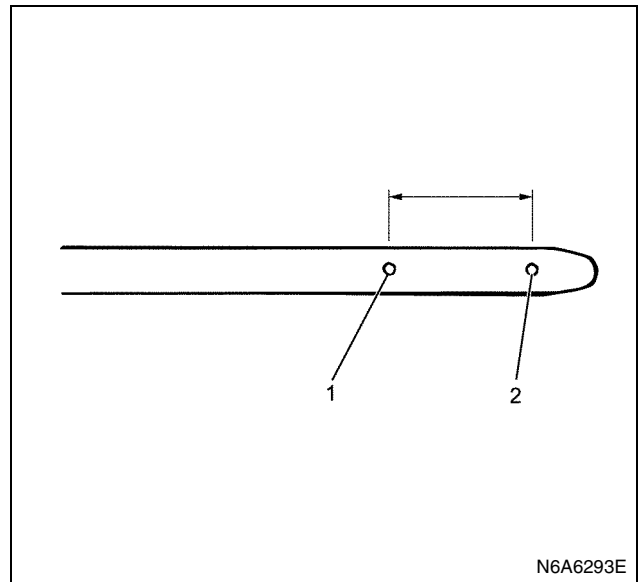
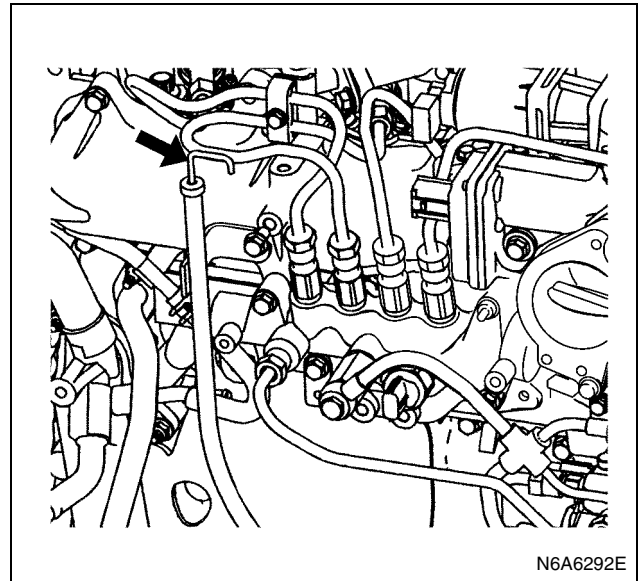
Legend

1. Oil Filter Cartridge
2. Oil Pressure Testing Adapter
3. Connector
4. Hose
5. Oil Pressure Gauge

5. Warm the engine.
6. Measure the oil pressure, to check whether it is more than 343 kPa (3.5 kg/cm² / 50 psi) at 3200 rpm.
7. Stop the engine.
8. Remove the oil pressure gauge.
9. Install the oil pressure switch.
10. Start the engine and check for oil leakage.

Engine oil

- Ensure the car is at a level ground. Before starting the engine or when 5 minutes or more have elapsed after stopping the engine, check the engine oil volume using the level gauge. The volume is appropriate if the engine oil is between the upper and lower limits of the level gauge. Replenish the engine oil, if level is below the lower limit. Also, check for contamination of the engine oil.



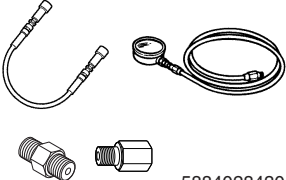
Legend

1. Upper Limit
2. Lower Limit

Engine oil leakage

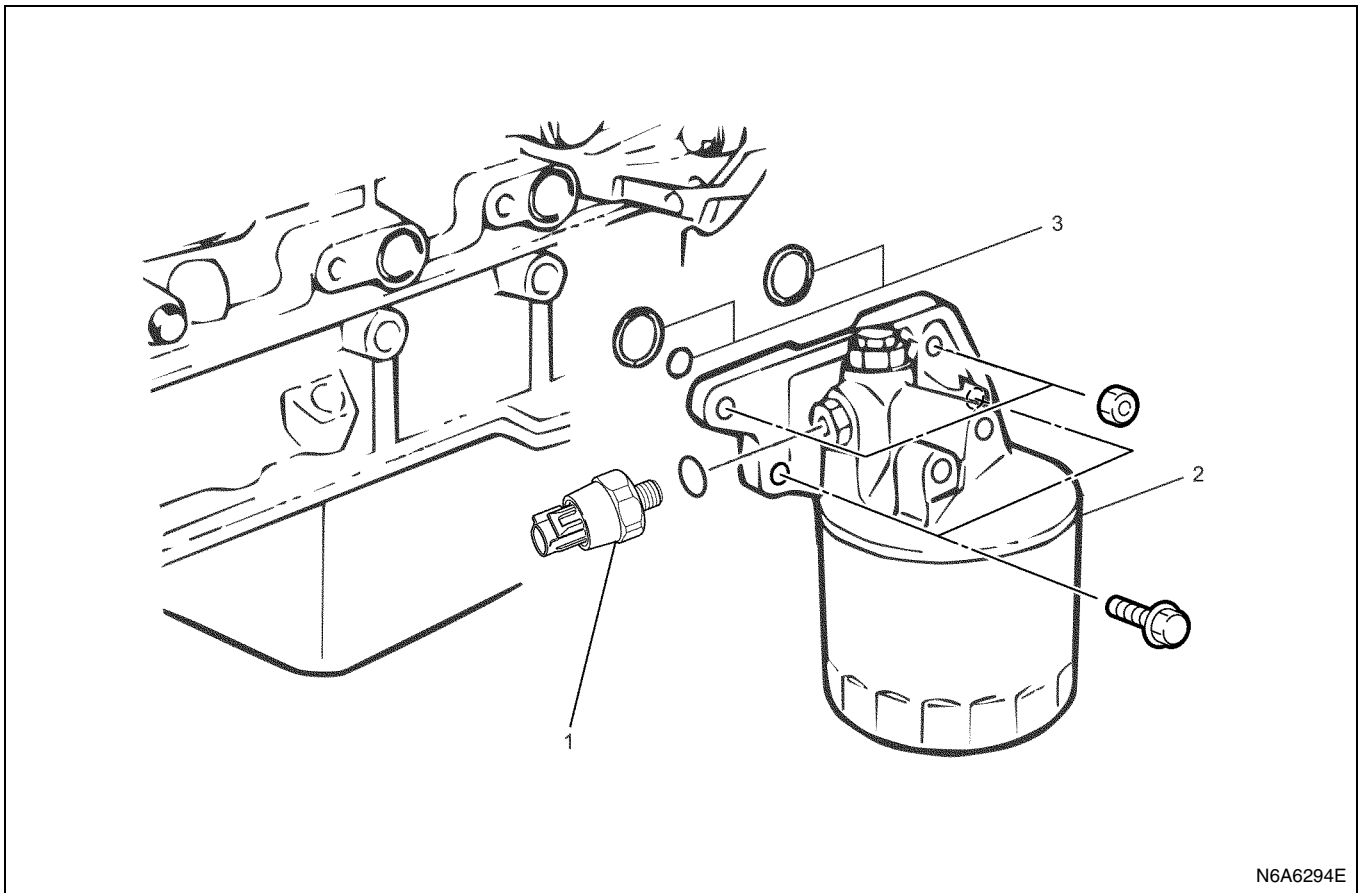
- In the lift up condition, confirm that there are no leaks from the cylinder head cover and oil pan.

Special Tool

Illustration	Tool Number / Description / Remarks
 5884028430	5-8840-2843-0 Oil Pressure Gauge Set (J-43630-20 / Oil Pressure Gauge, J-43630 / Hose, J-43630-14 / Connector, EN-46333 / Oil Pressure Testing Adapter)

Oil Filter Assembly

Components



N6A6294E

Legend

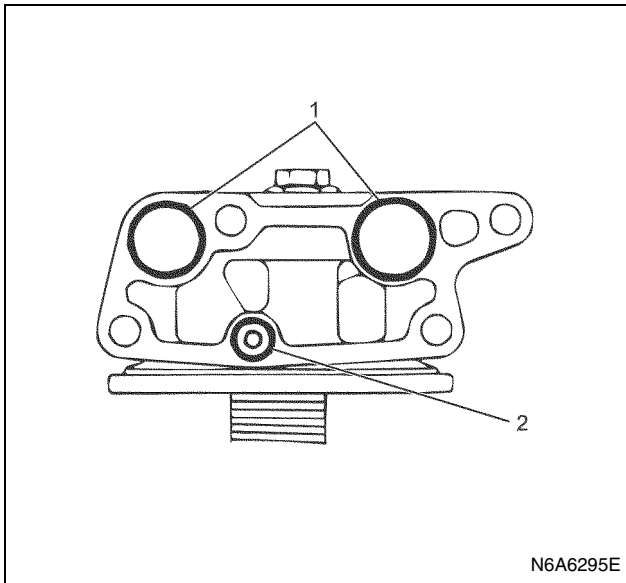
- | | |
|------------------------|-----------|
| 1. Oil Pressure Switch | 3. O-ring |
| 2. Oil Filter Body | |

Removal

1. Place a tray under the oil filter cartridge.
2. Remove the oil filter cartridge.
3. Remove the oil pressure switch.
4. Remove the oil filter body.
5. Remove the O-ring.

Installation

1. Install the O-rings on the oil filter body.



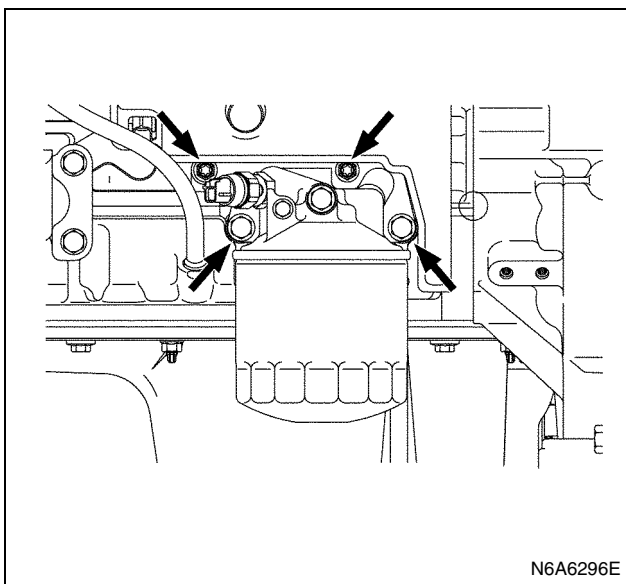
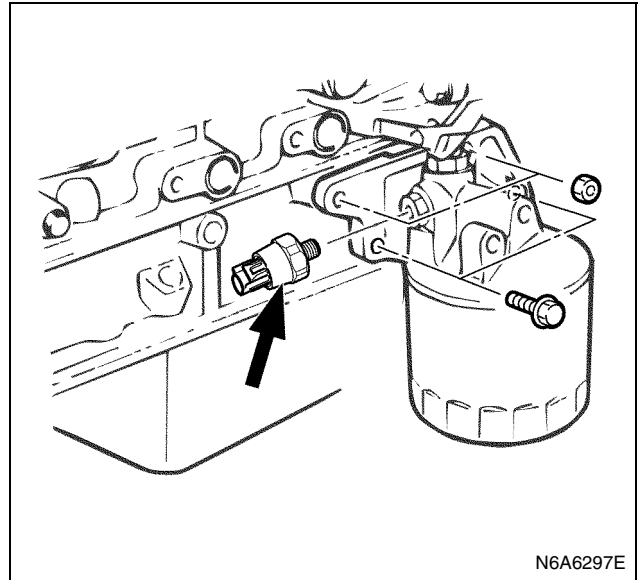
Legend

1. O-ring
2. O-ring

2. Install the oil filter on the cylinder block and tighten it using the specified torque.

Tighten:

Nuts and bolts to 48 N·m (4.9 kg·m/35 lb·ft)



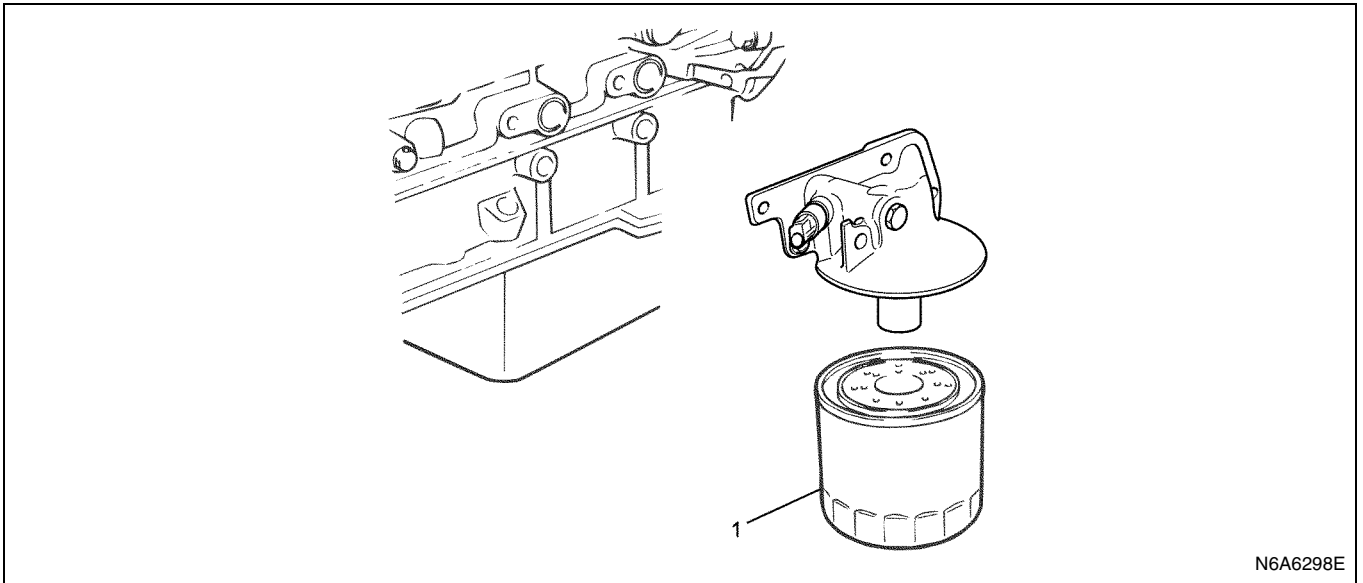
3. Install the oil pressure switch on the oil filter body.
 - Apply the liquid gasket (Loctite 262) on 2 to 3 peaks from the tip of the threaded part of the oil pressure switch and install it at the position shown in the figure.

Tighten:

Oil pressure switch to 13 N·m (1.3 kg·m/113 lb·in)

Oil Filter Cartridge

Components



Legend

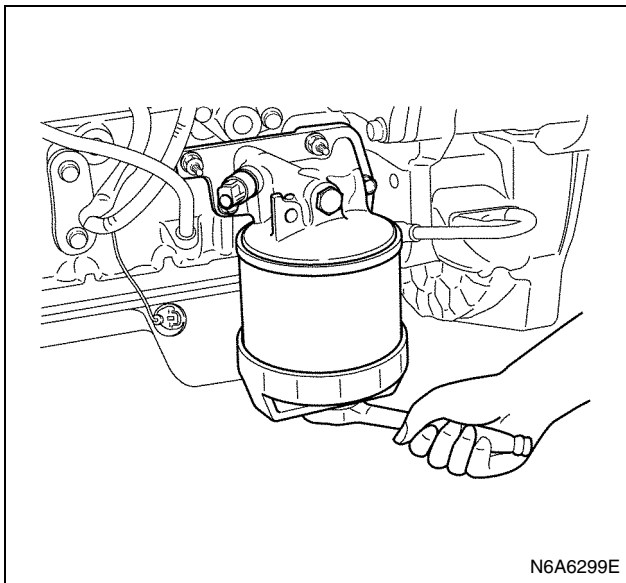
1. Oil Filter Cartridge

Removal

1. Place a tray under the oil filter cartridge.
2. Remove the oil filter cartridge using the oil filter wrench.

Special tool

Oil filter wrench: 1-8522-1097-0 (EN-47683)



- Tighten the cartridge using the specified torque.

Tighten:

Cartridge to 20 N·m (2.0 kg·m/14 lb·ft)

After it comes in contact with the oil seal, tighten it through an additional turn of 1 and 1/4.

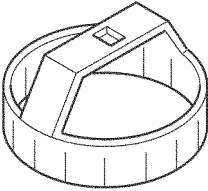
Special tool

Oil filter wrench: 1-8522-1097-0 (EN-47683)

Installation

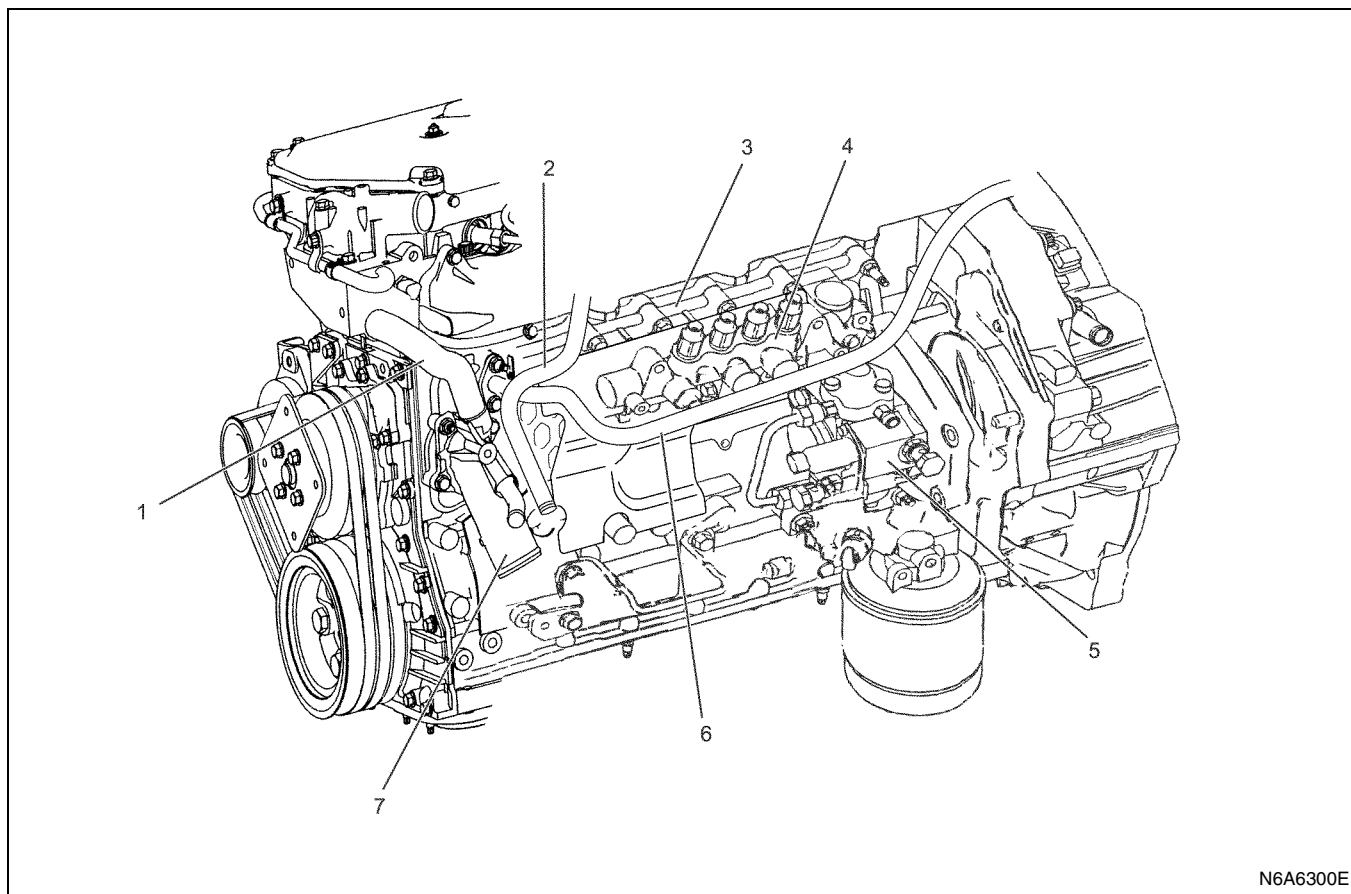
1. Install the oil filter cartridge.
 - Apply grease or engine oil to the seal in the cartridge and install it using the oil filter wrench.

Special Tool

Illustration	Tool Number / Description / Remarks
 1852210970	1-8522-1097-0 (EN-47683) Oil Filter Wrench

Oil Cooler

Components



N6A6300E

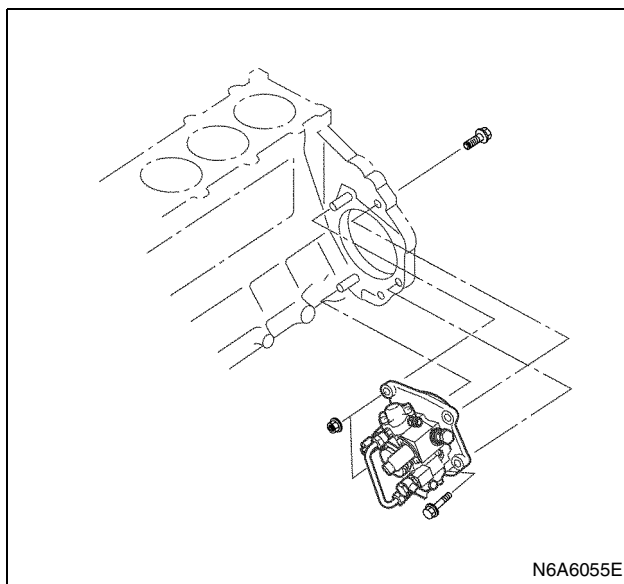
Legend

- | | |
|---------------------------------|-------------------------------|
| 1. Bypass Hose | 5. Fuel Supply Pump |
| 2. EGR Cooler Water Return Pipe | 6. EGR Cooler Water Feed Pipe |
| 3. Oil Cooler | 7. Suction Pipe |
| 4. Fuel Rail | |

Removal

1. Remove the fuel rail.
Refer to "Fuel Rail" in Section 6C.

2. Remove the fuel supply pump.

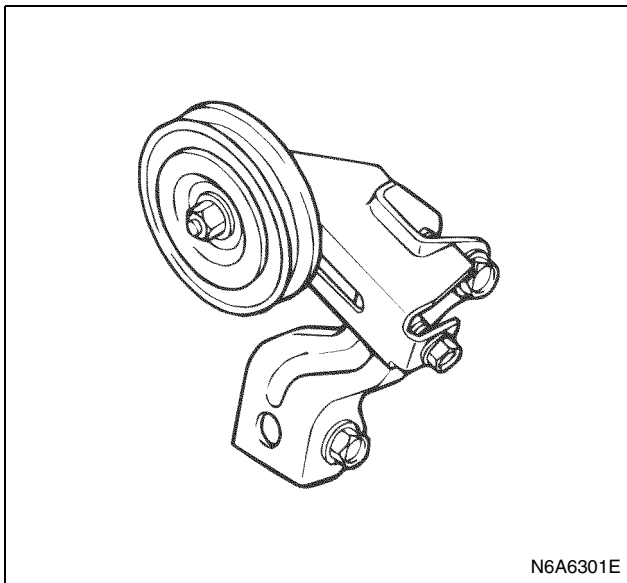


N6A6055E

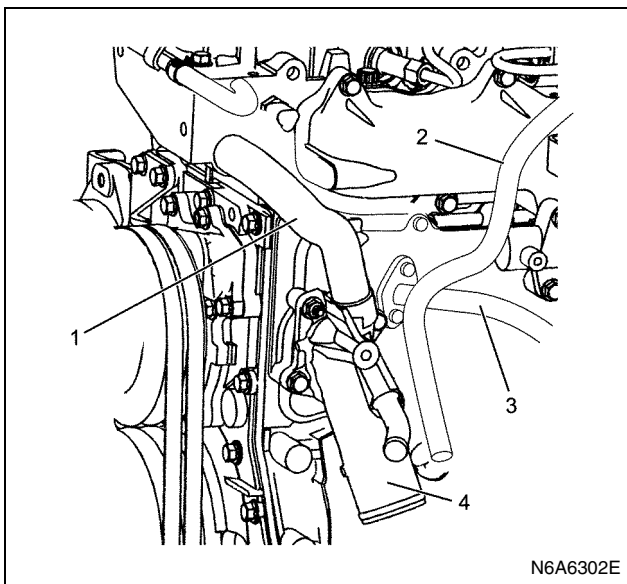
3. Remove the A/C drive belt.

6A-158 Engine Mechanical (4HK1-TC)

4. Remove the idling pulley bracket.
 - Remove the drive belt for A/C and the bracket fixing bolts, and then remove the bracket along with tensioner and idling pulley.



5. Remove the EGR cooler water return pipe.
 - Remove the brackets to the water pipe at three locations to make the pipe unsupported.
6. Remove the EGR cooler water feed pipe.
7. Remove the clip on the head side of the water bypass hose and remove the hose from the suction pipe and assembly.

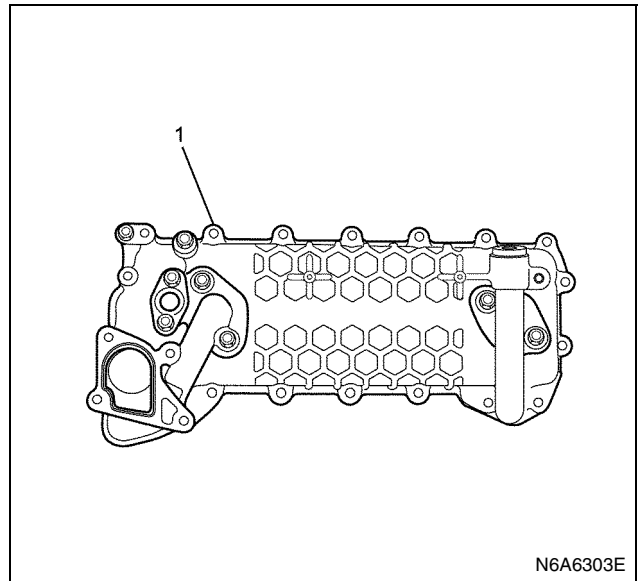


Legend

1. Bypass Hose
2. EGR Cooler Water Return Pipe
3. EGR Cooler Water Feed Pipe
4. Suction Pipe

8. Remove the oil cooler assembly.

- Screw the removed fixing bolt of the oil cooler into the replacer hole at the location 1 of the figure and remove the oil cooler.



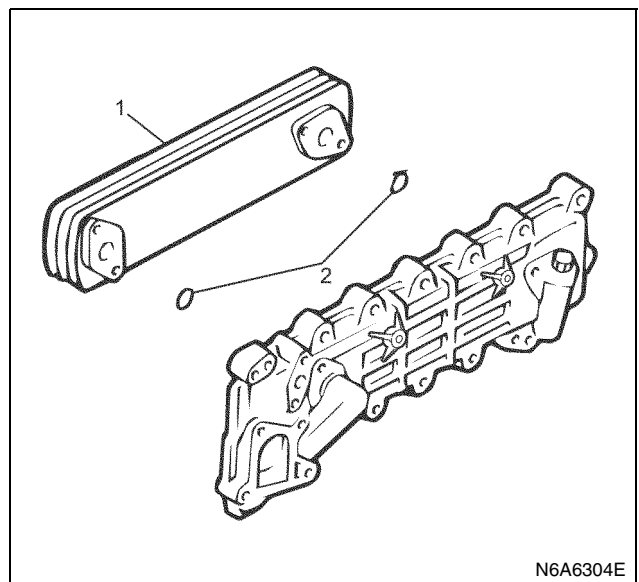
Legend

1. Oil Cooler Assembly

9. Remove the O-ring.

Disassembly

1. Remove the element mounting bolts.
2. Remove the element.
3. Remove the O-ring.



Legend

1. Element
2. O-ring

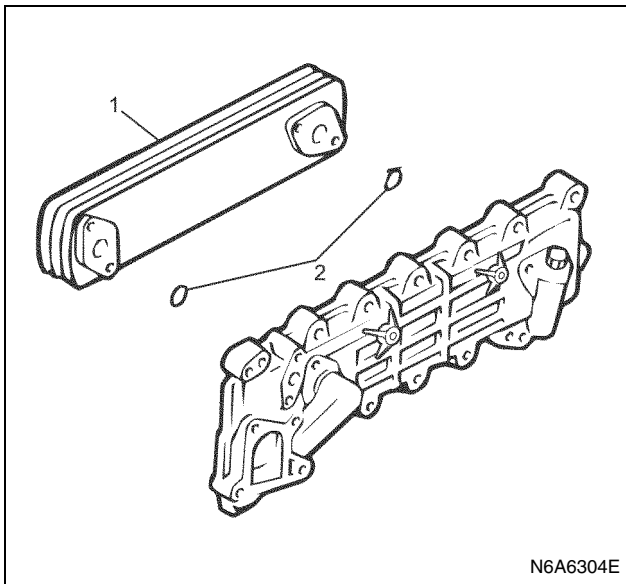
Reassembly

1. Install the O-ring on the oil cooler case.
2. Install the element.

3. Tighten the element fixing bolts using the specified torque.

Tighten:

Bolts to 20 N·m (2.0 kg·m/15 lb·ft)



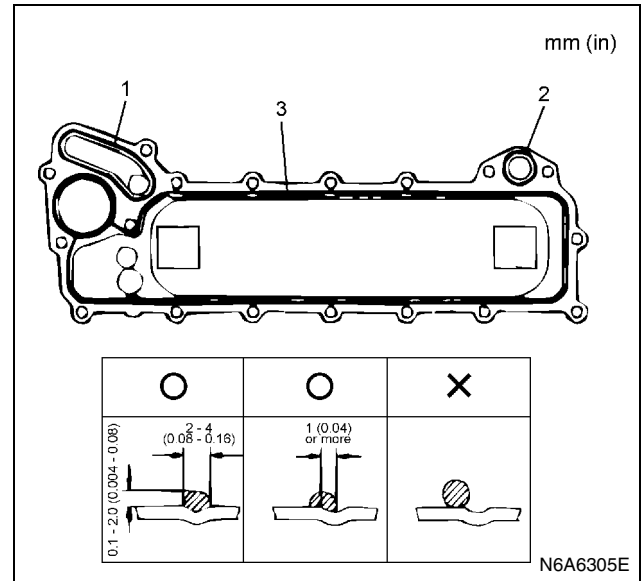
Legend

1. Element
2. O-ring

Installation

1. Install the oil cooler assembly.
 - Apply liquid gasket (ThreeBond1207C or equivalent) to the flange surface groove (cylinder block). Bead diameter must be between 2 and 4 mm (0.08 and 0.16 in). Refer to the illustration for the offset position (no more than 1 mm (0.04 in)).

- Install the O-rings (1) and (2) to the oil passage inlet and outlet. Do not allow the liquid gasket to contact the O-ring.



Legend

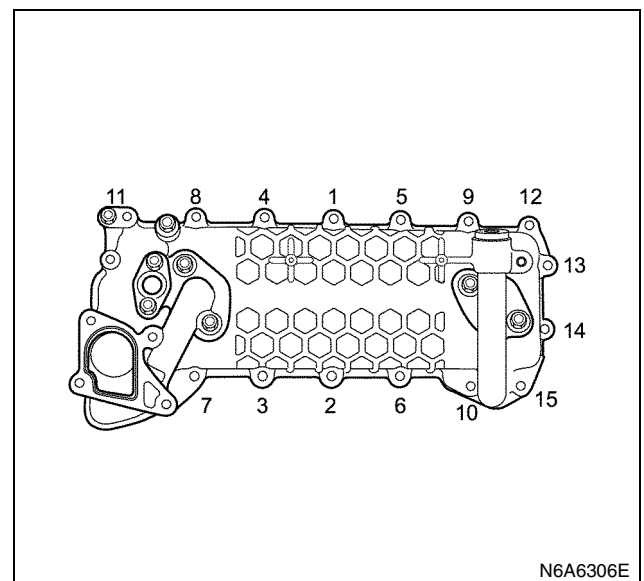
1. O-ring
2. O-ring
3. Liquid Gasket

- Align the oil cooler holes with the cylinder block studs.
- Install the oil cooler and glow plug controller bracket to the cylinder block.
- Tighten the bolts to the specified torque in the order shown in the illustration.

Tighten:

Bolts to 24 N·m (2.4 kg·m/18 lb·ft)

- Liquid gasket quickly hardens. Make it complete within 7 minutes after applying the liquid gasket.



Legend

1. Oil Cooler Assembly

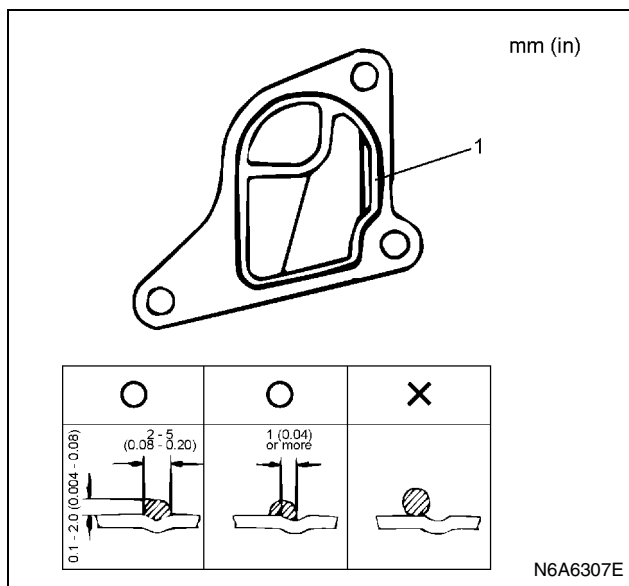
6A-160 Engine Mechanical (4HK1-TC)

2. Install the water suction pipe.

- Apply liquid gasket (ThreeBond 1207C) to the flange of the water suction pipe. Bead diameter must be between 2 and 5 mm (0.008 and 0.20 in). Refer to the illustration for the offset position (no more than 1 mm (0.04 in)).
- Install the water suction pipe to the oil cooler. Refer to the illustration.
- Tighten the bolts to the specified torque.

Tighten:

Bolts to 24 N·m (2.4 kg·m/18 lb·ft)

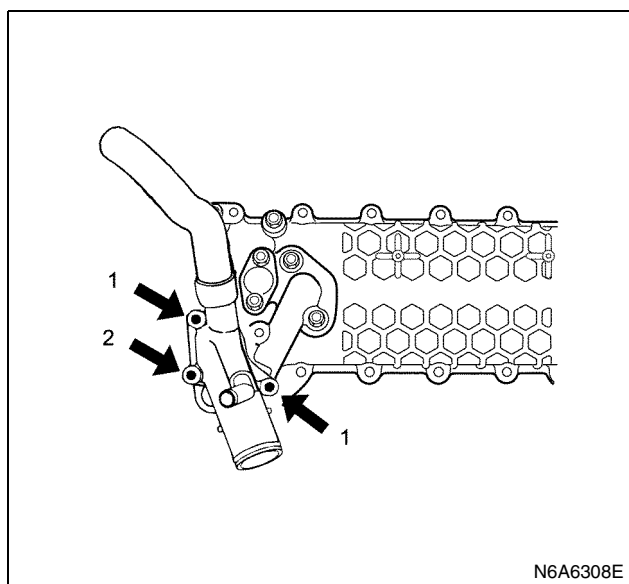


Legend

1. Liquid Gasket

Caution:

The water suction pipe must be installed immediately after the oil cooler (the pipe and cooler use the same liquid gasket).

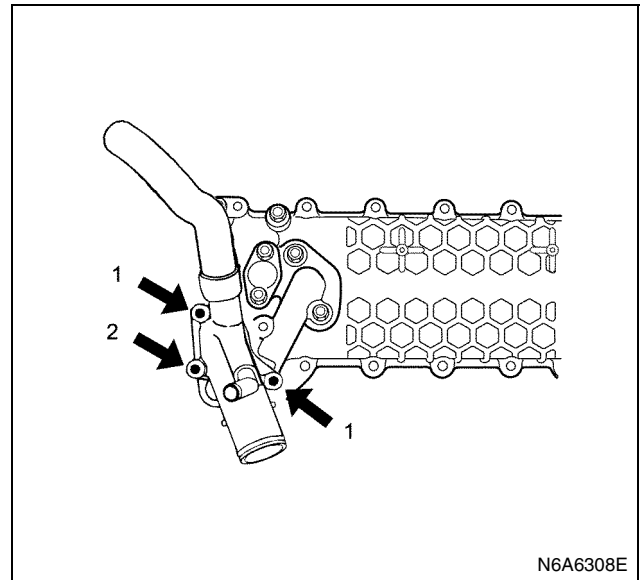


3. Install the EGR cooler water feed pipe.

- Install the O-ring on the EGR cooler water feed pipe.
- Install at the position shown in the figure and tighten using the specified torque.

Tighten:

Bolts to 24 N·m (2.4 kg·m/18 lb·ft)



4. Install the EGR cooler water pipe.

5. Install the body cover assembly LH on the surface of the oil cooler and cylinder block and tighten it using the specified torque.

Tighten:

Body cover assembly LH to 19 N·m (1.9 kg·m/14 lb·ft)

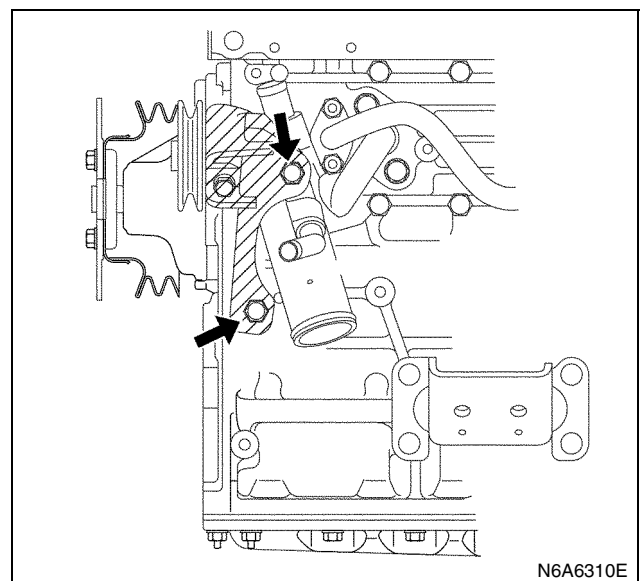
6. Install the idling pulley bracket and tighten it using the specified torque.

Tighten:

Idling pulley bracket to 24 N·m (2.4 kg·m/18 lb·ft)

7. Install the A/C drive belt.

Refer to "Drive Belt" in Section 6B.

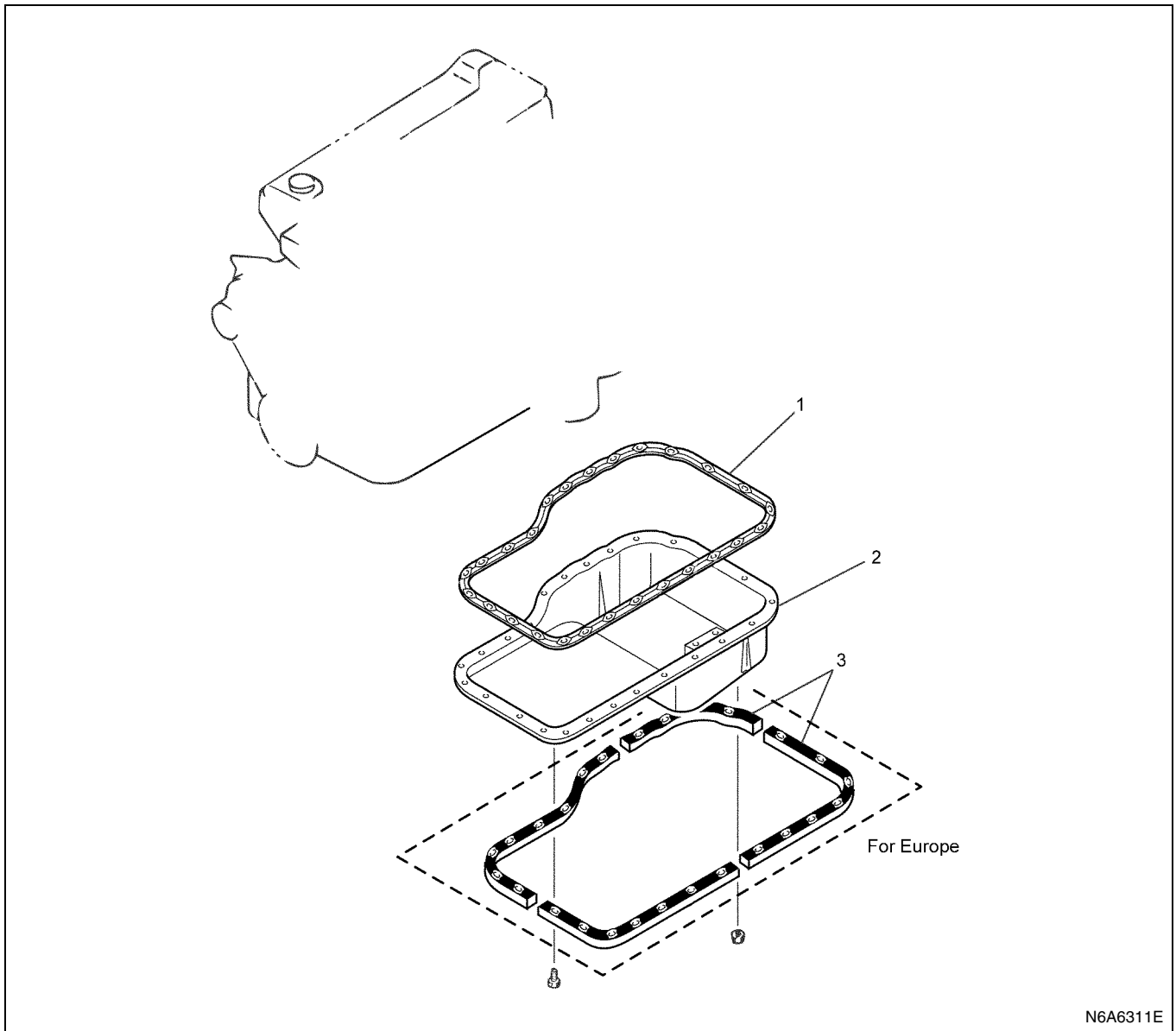


8. Remove the oil drain adapter.

9. Install the fuel supply pump.
 - Refer to “Fuel Supply Pump” in Section 6C.
10. Install the fuel rail.
 - Refer to “Fuel Rail” in Section 6C.

Oil Pan

Components



Legend

- 1. Oil Pan Gasket
- 2. Oil Pan

- 3. Oil Pan Rubber (For Europe)

Removal

1. Drain out the engine oil.
 - Install the drain plug.

Tighten:

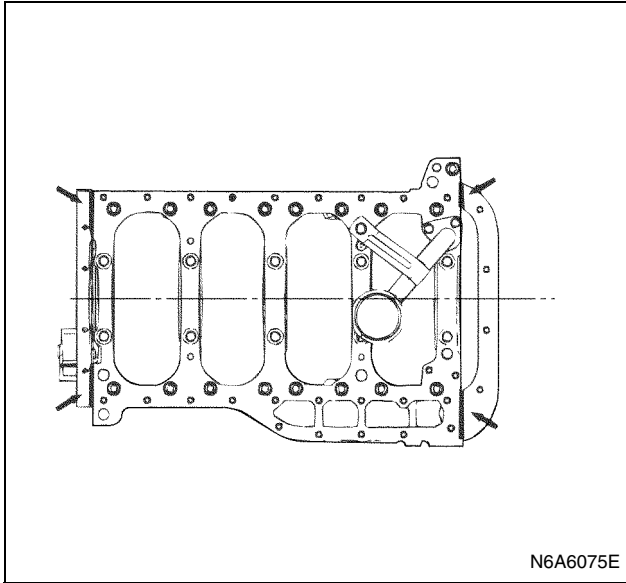
Drain plug to 8.5 N·m (0.9 kg·m/61 lb·ft)

2. Remove the oil pan.

Installation

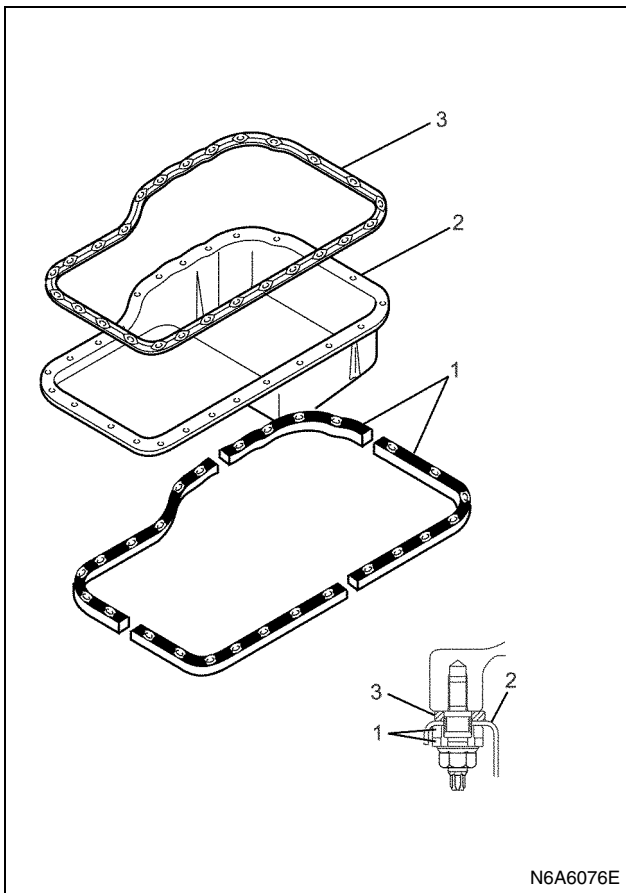
1. Install the oil pan.
 - At the seam between the cylinder block and the front cover with the flywheel housing, apply the liquid gasket (ThreeBond 1207C or equivalent) to a bead diameter of 3 mm (0.12 in).

- Apply the liquid gasket and install the oil pan within 7 minutes.



For Europe

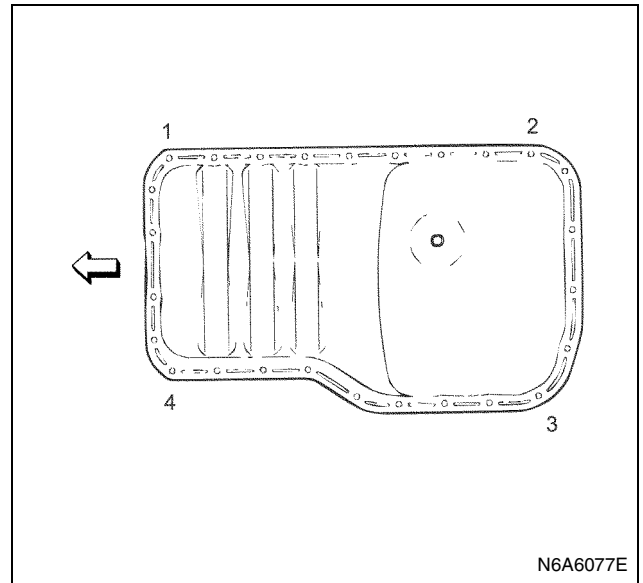
- Install the gasket using the studs of the crankcase, flywheel housing, and front cover as guide and mount the oil pan. Install the rubber assembly on the oil pan and secure it using nuts and bolts.



Legend

1. Rubber Assembly (For Europe)
2. Oil Pan
3. Gasket

- Tighten the locations (1), (2), (3), and (4) as shown in the figure and then tighten others. (In any sequence)

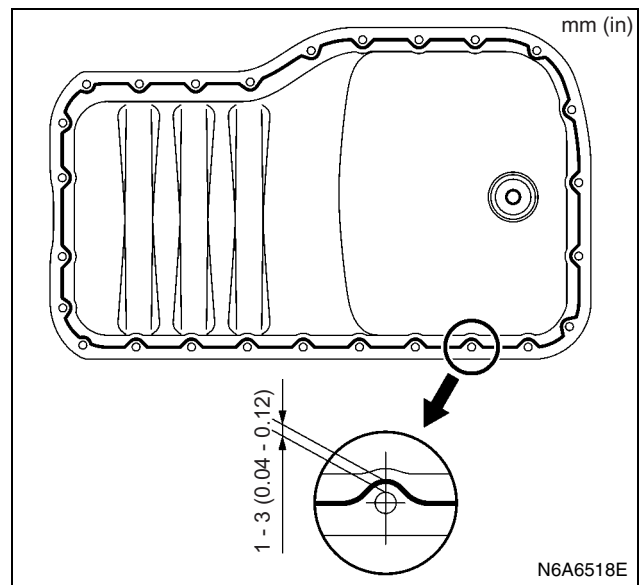


Tighten:

Nuts and bolts to 11 N·m (1.1 kg·m/95 lb·in)

Except Europe

- As the figure shows, apply the liquid gasket (Three bond 1207C or equivalent) inside a hole of the bolt evenly.



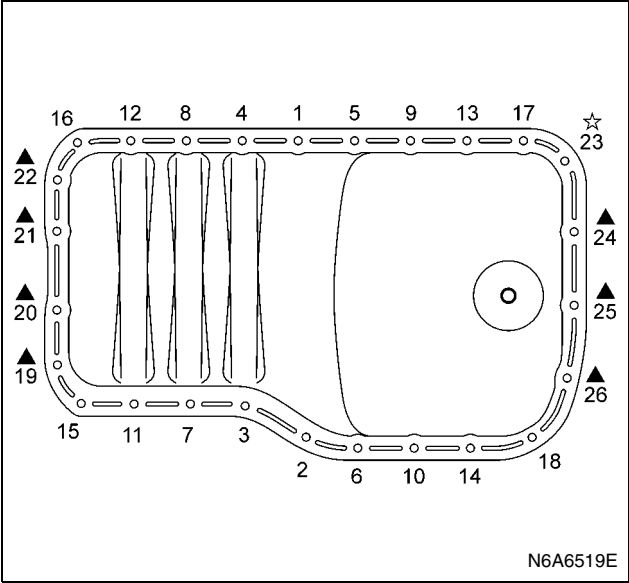
- Tighten the oil pan nut and bolts to the specified torque in the numerical order as shown in the figure.

▲ marks are located on nut positions.

Tighten:

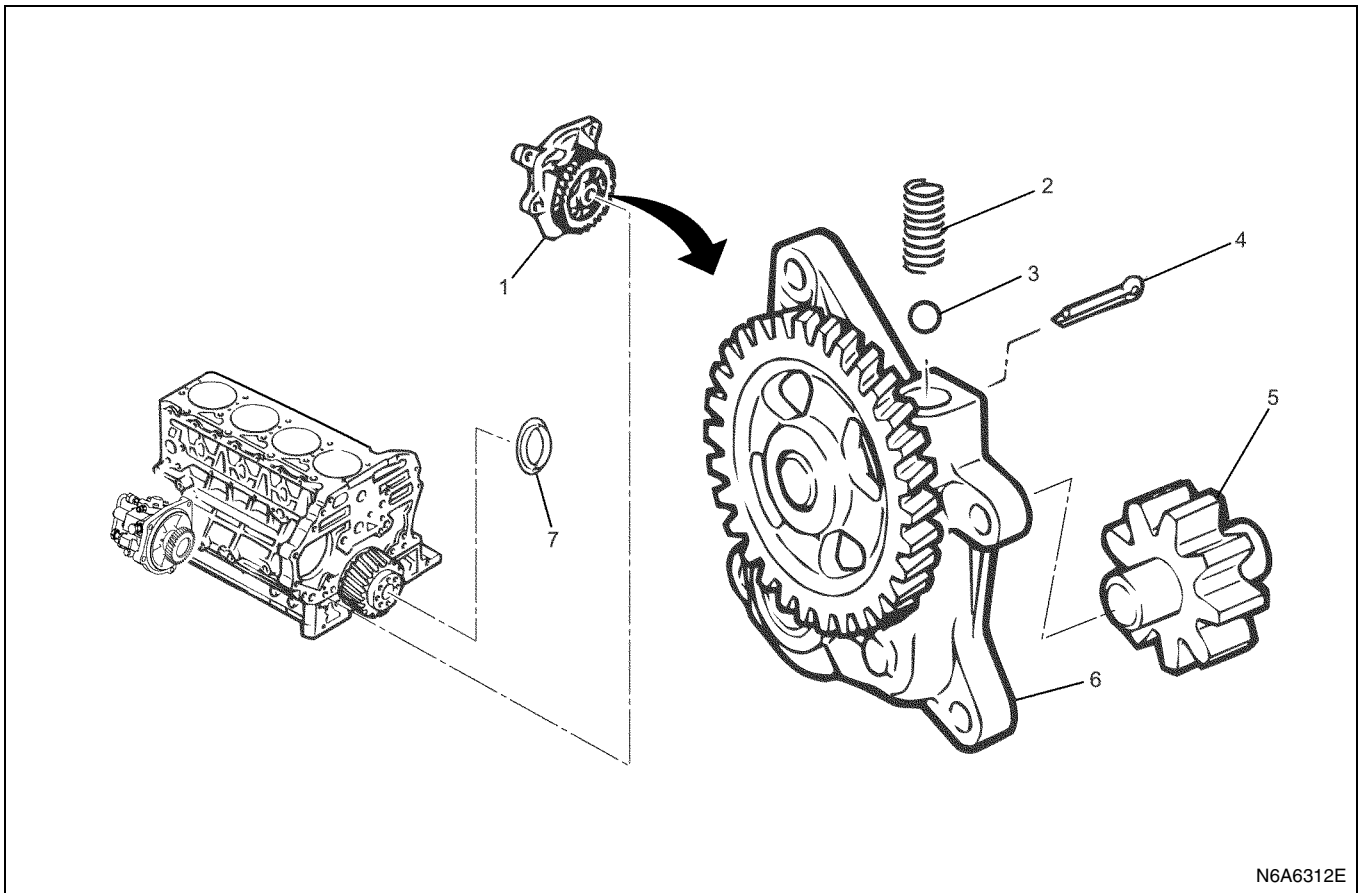
Star mark bolt to 18 N·m (1.8 kg·m/13 lb·ft)

Other bolts and nuts to 24N·m (2.4 kg·m/17 lb·ft)



Oil Pump

Components



N6A6312E

Legend

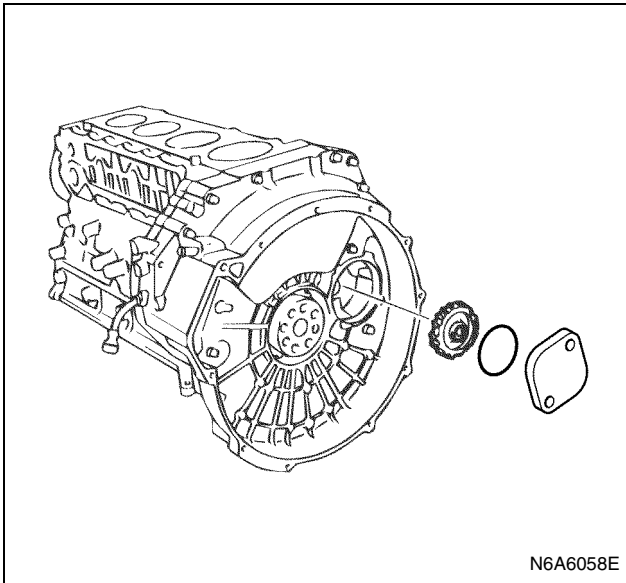
- | | |
|----------------------|--------------------------|
| 1. Oil Pump Assembly | 5. Driven Gear and Shaft |
| 2. Spring | 6. Oil Pump Body |
| 3. Ball | 7. Slinger |
| 4. Split Pin | |

Removal

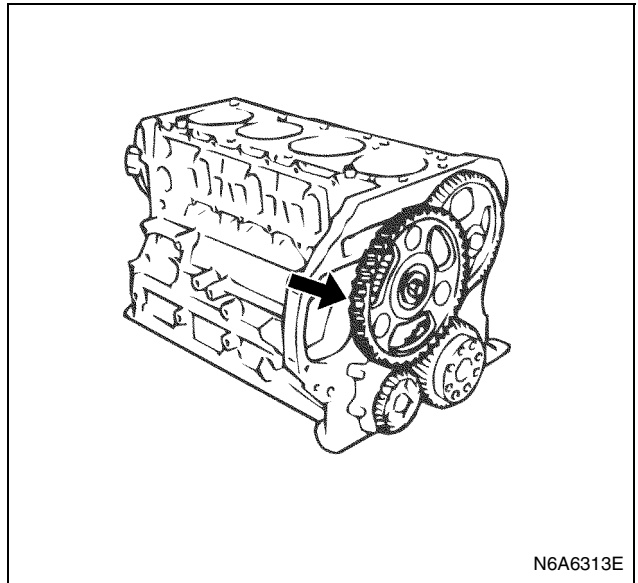
1. Drain out the engine oil.
2. Drain out the cooling water.
3. Remove the cylinder head cover.
Refer to "Cylinder Head Cover".
4. Remove the rocker arm shaft assembly.
Refer to "Rocker Arm Shaft Assembly".
5. Remove the camshaft assembly.
Refer to "Camshaft Assembly".
6. Remove the cylinder head assembly.
Refer to "Cylinder Head".
7. Clutch pressure plate assembly
Refer to "Flywheel".
8. Driven plate
Refer to "Flywheel".
9. Remove the fuel supply pump assembly.
Refer to "Fuel Supply Pump" in Section 6C.
10. Remove the flywheel.
Refer to "Flywheel".
11. Remove the rear oil seal of the crankshaft.
Refer to "Crankshaft Rear Oil Seal".
12. Remove the oil pan.
13. Remove the power steering pump.
14. Remove the idle gear cover of the power steering pump.

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15. Remove the idle gear of the power steering pump.

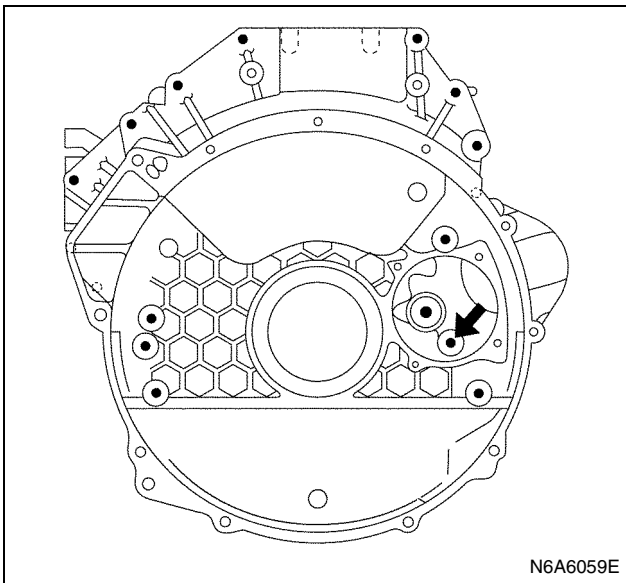


17. Remove the idle gear A.

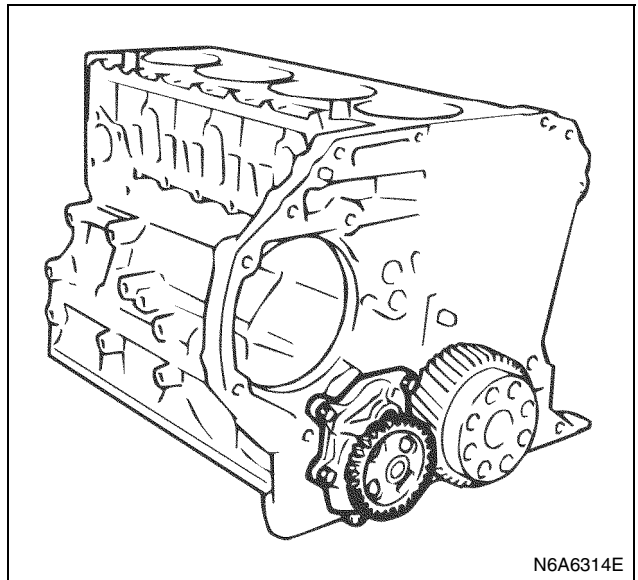


16. Remove the flywheel housing.

- Make sure you remove the bolts shown in the figure.



18. Remove the oil pump assembly.



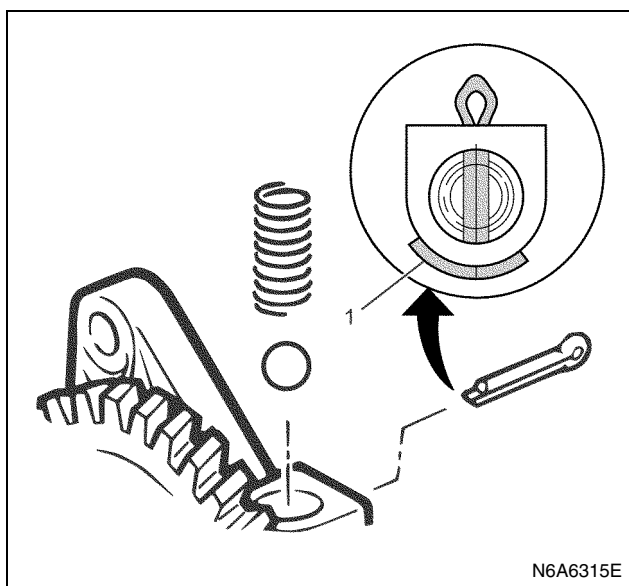
Disassembly

1. Remove the driven gear and shaft.
2. Remove the split pin.
3. Remove the spring.
4. Remove the ball.

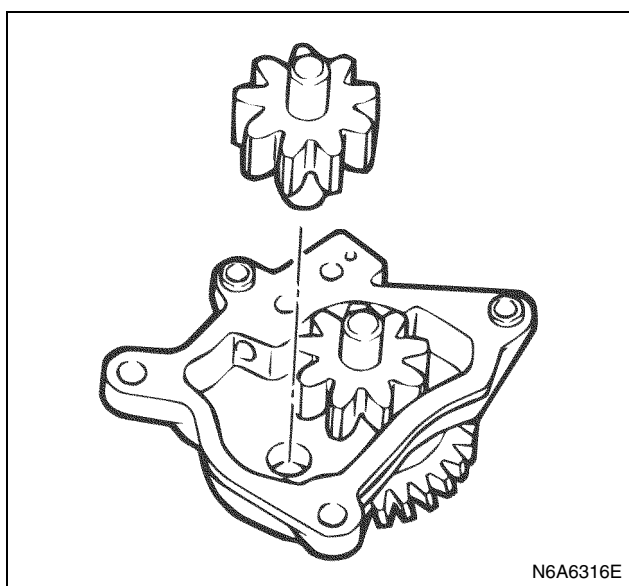
Reassembly

1. Install the ball.
2. Install the spring.

3. Install the split pin and fold it according to (1).



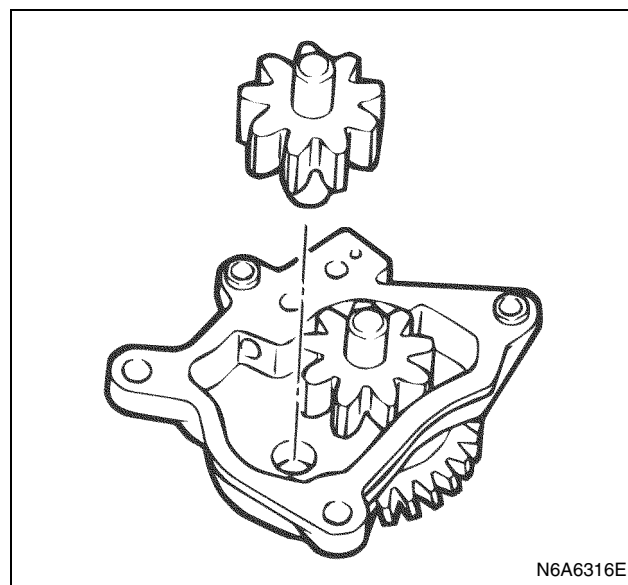
4. Apply engine oil on the driven gear and shaft and mount them on the oil pump body.



Inspection

1. Measure the clearance between the gear and the inner wall of the oil pump body.
 - Measure the clearance between the gear and oil pump body using a thickness gauge.
 - If the clearance between the gear and inner wall of the body exceeds the limit, replace the gear assembly or the driven gear assembly.

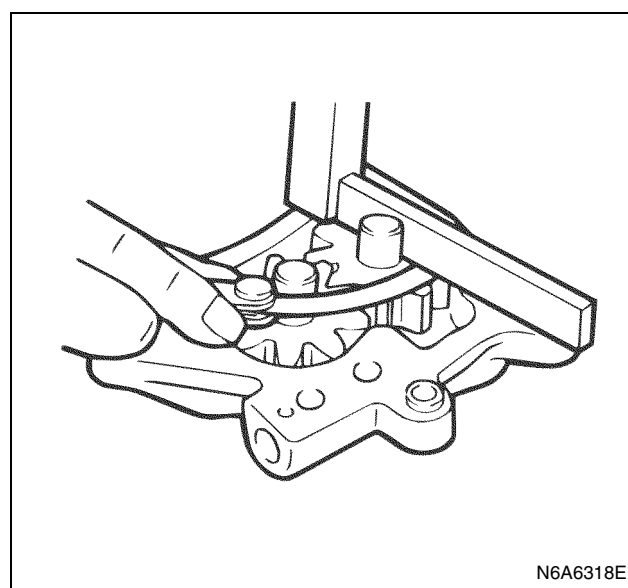
Clearance between the gear and inner wall of the body		mm (in)
Standard	0.125 – 0.220 (0.0049 – 0.0087)	
Limit	0.30 (0.0118)	



2. Measure the clearance between the gear side surface and the upper surface of the oil pump body.

- Measure the clearance between the gear surface and the upper surface of the oil pump body using the thickness gauge and square.
- If the clearance between the gear and inner wall of the body exceeds the limit, replace the gear assembly or the driven gear assembly.

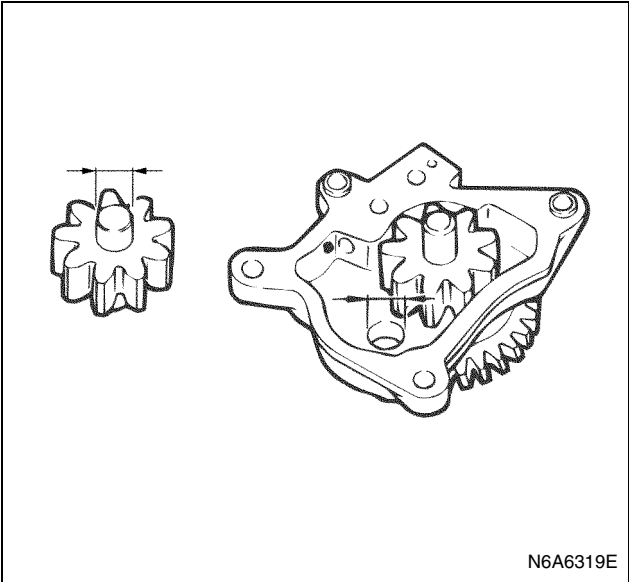
Clearance between the gear side surface and the upper surface of the oil pump body		mm (in)
Standard	0.064 – 0.109 (0.0025 – 0.0043)	
Limit	0.20 (0.0079)	



3. Measure the clearance between the driven gear shaft and the bush.

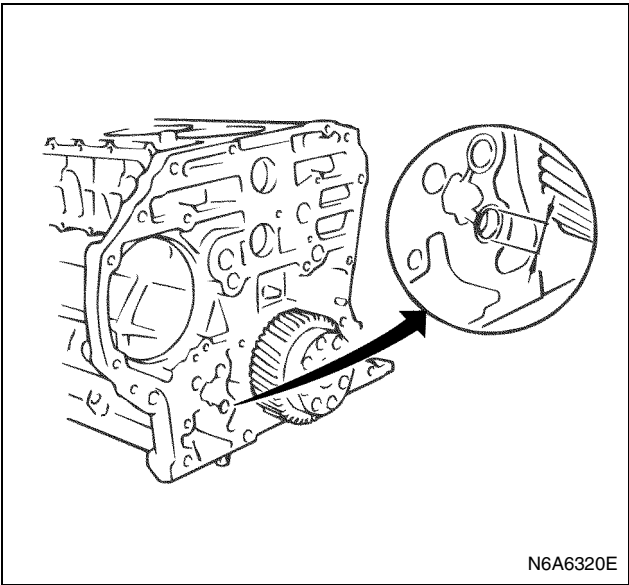
- Measure the outside diameter of the driven gear shaft using a micrometer.

Outside diameter of the driven gear shaft mm (in)	
Standard	15.989 – 16.000 (0.62949 – 0.62992)
Limit	15.900 (0.62598)



- Measure the inside diameter of the bushes of the oil pump body and cylinder block using the dial gauge.
- If the clearance between the driven gear shaft and bush exceeds the limit, replace the driven gear assembly.

Clearance between the driven gear shaft and bush mm (in)	
Standard	0.04 – 0.07 (0.0016 – 0.0028)
Limit	0.20 (0.0079)

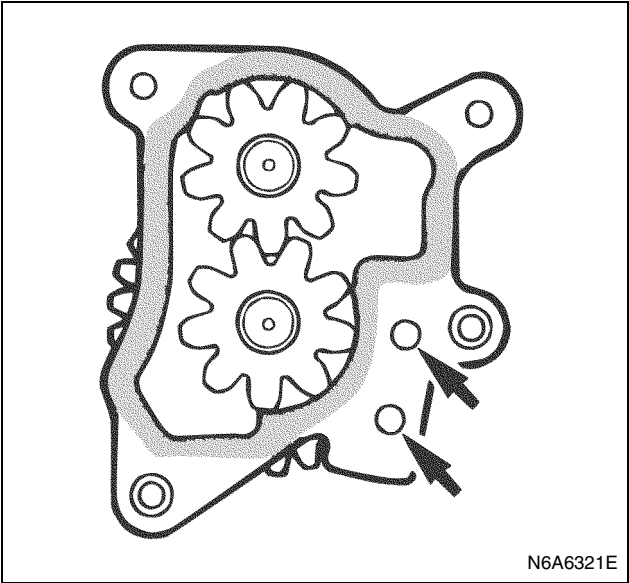


Installation

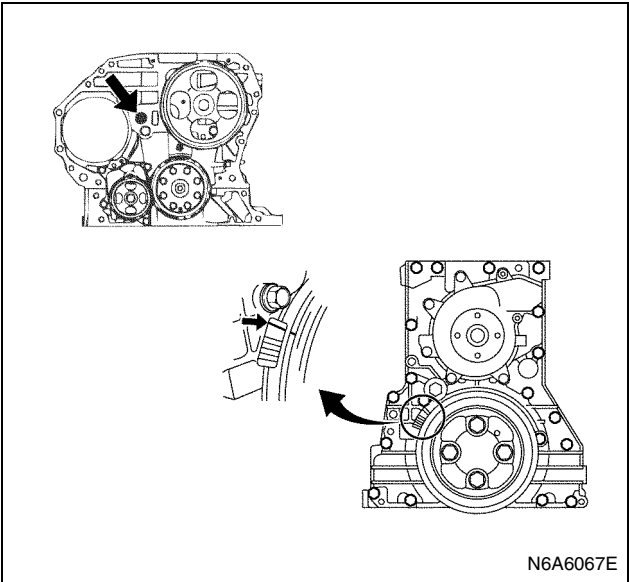
1. Install the oil pump assembly.
 - Apply the liquid gasket (ThreeBond 1141E or equivalent) as shown in the figure, mount it on the cylinder block within one hour, and tighten it using the specified torque.

Tighten:
Oil pump assembly to 24 N·m (2.4 kg·m/17 lb·ft)

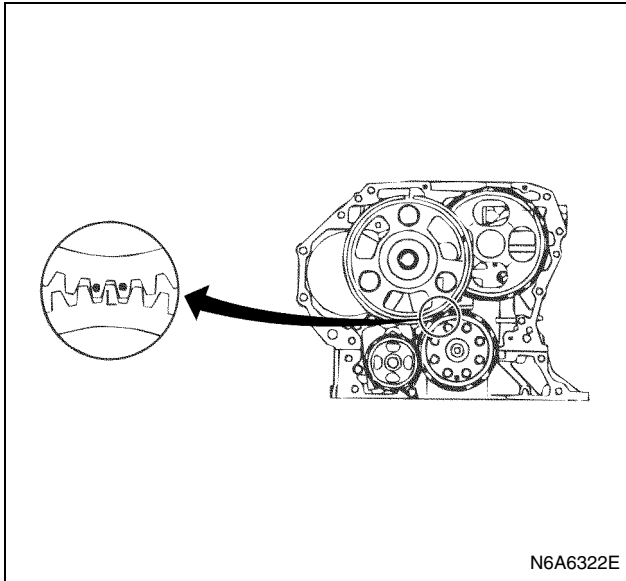
Caution:
Apply the fluid gasket such that it does not enter the holes shown by arrows in the figure, gear, and the oil pump body.



2. Install the idling gear A.
 - Install the idling gear shaft at the position shown in the figure and apply engine oil on the shaft.
 - Rotate the crankshaft clockwise and bring the piston of the No.1 cylinder to the top dead center.



- Match the coincidence marks of the crankshaft gear and the idle gear A, and install them on the cylinder block.

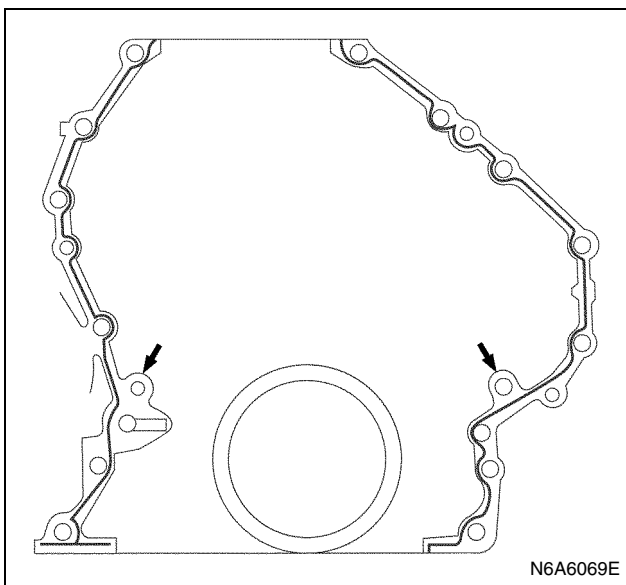


- Tighten the mounting bolts using the specified torque.

Tighten:

Bolts to 133 N·m (13.6 kg·m/98 lb·ft)

3. Install the flywheel housing.
 - Clean properly the rear surface of the cylinder block. Remove the protruding fluid gasket thoroughly, especially, when mounting the crankcase.
 - Apply the liquid gasket (ThreeBond1207C) uniformly on the inside surface of the bolt holes (excluding the bolt holes indicated by arrows) as shown in the figure.
 - After applying the liquid gasket, quickly install it.



- Match the dowel pin of the cylinder block and then install the flywheel housing.

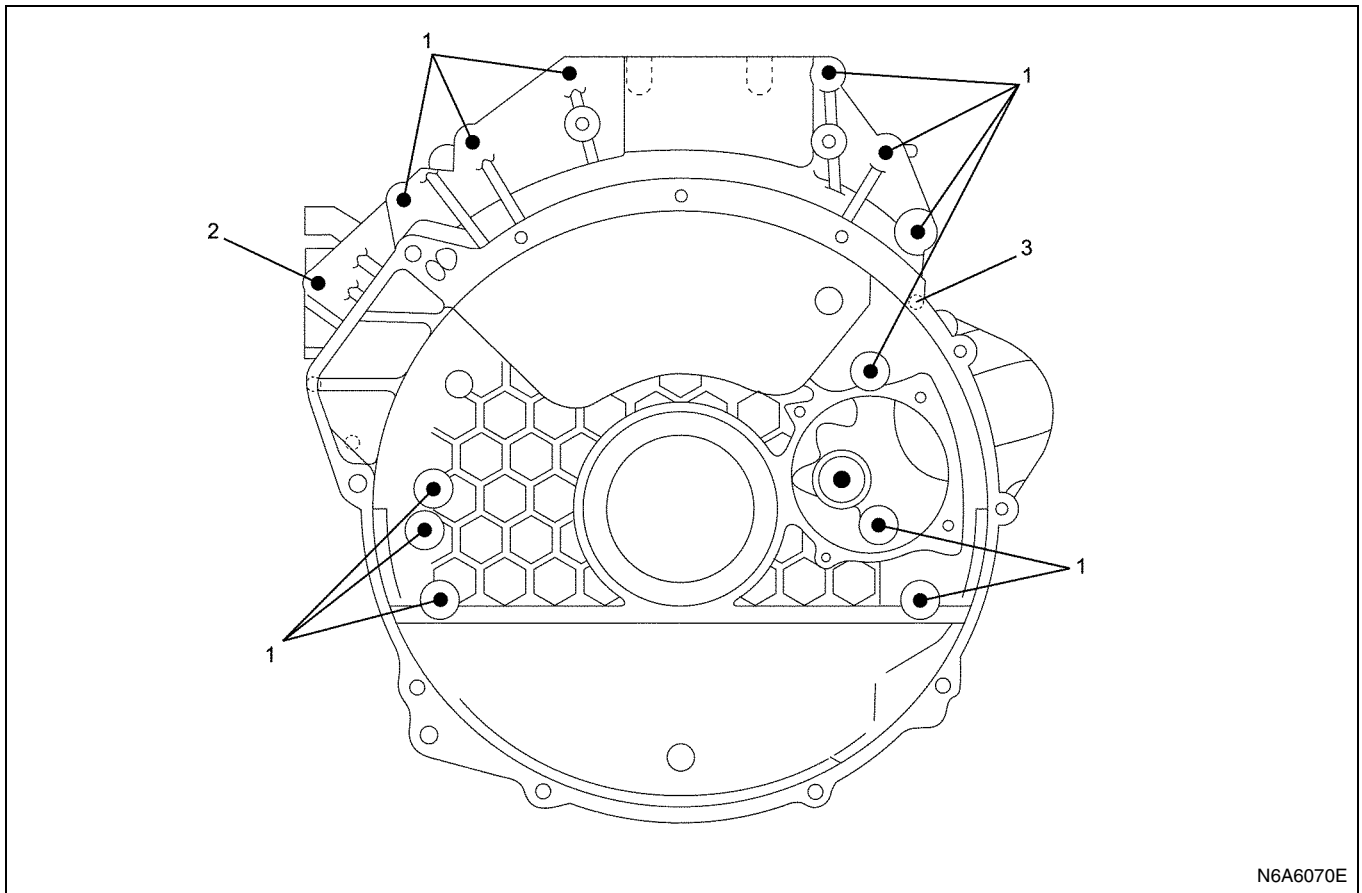
Tighten:

Bolts (1) to 96 N·m (9.8 kg·m/71 lb·ft)

Bolts (2) to 77 N·m (7.9 kg·m/57 lb·ft)

Bolts (3) to 38 N·m (3.9 kg·m/28 lb·ft)

- The seal is tightened from the cylinder block side.

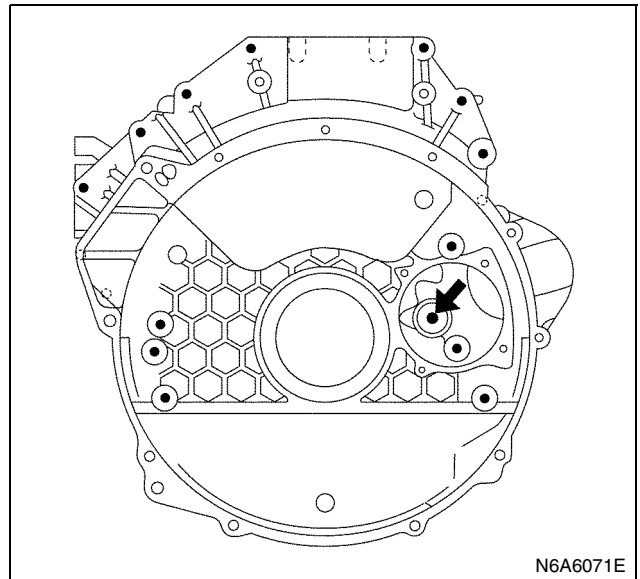
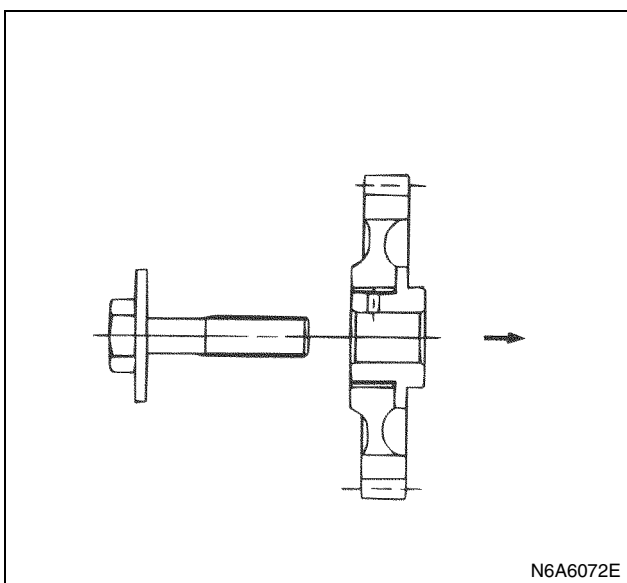


4. Install the power steering pump idling gear.

- Apply the engine oil on the gear assembly unit of the idling gear shaft.
- Assemble the idling gear and the shaft in the direction shown in the figure, mount it on the flywheel housing, and tighten it using the specified torque.

Tighten:

Bolt to 133 N·m (13.6 kg·m/98 lb·ft)

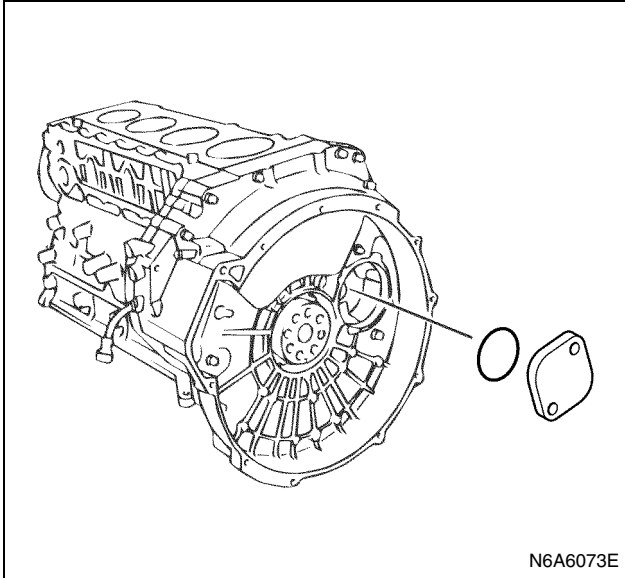


5. Install the idling gear cover of the power steering pump.

- Install the O-ring on the cover and on the flywheel housing, and tighten the fixing bolts using the specified torque.

Tighten:

Bolt to 19 N·m (1.9 kg·m/14 lb·ft)



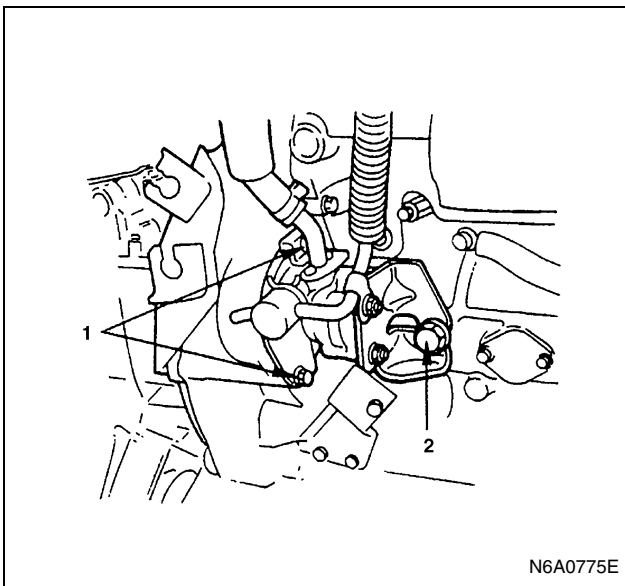
6. Install the power steering pump and tighten it using the specified torque.

Tighten:

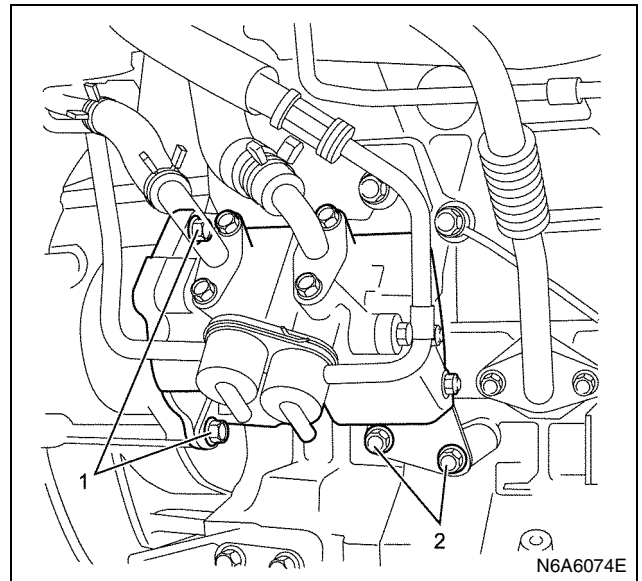
Flywheel housing fixing bolt (1) to 43 N·m (4.4 kg·m/32 lb·ft)

Cylinder block fixing bolts (2) to 44 N·m (4.5 kg·m/33 lb·ft)

Without HBB



With HBB



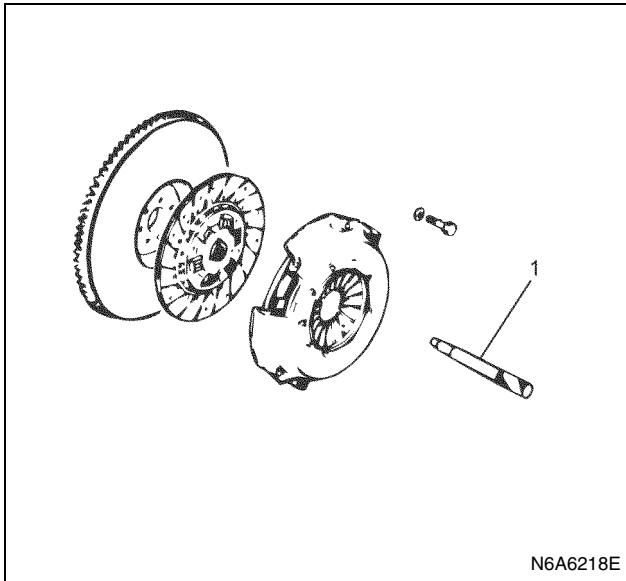
Legend

1. Flywheel Housing Bolt
2. Cylinder Block Bolt

7. Install the oil pan.
Refer to "Oil Pan".
8. Install the rear seal of the crankshaft.
Refer to "Crankshaft Rear Oil Seal".
9. Install the flywheel.
Refer to "Flywheel".
10. Install the fuel supply pump assembly.
Refer to "Fuel Supply Pump" in Section 6C.
11. Install the clutch plate assembly.
12. Install the clutch pressure plate assembly.
 - Insert the clutch aligner in the spline of the clutch plate assembly.
 - Install the clutch plate assembly on the flywheel.

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- Match the mounting hole of the clutch pressure plate assembly with the dowel pin of the flywheel, and install the clutch pressure plate assembly on the flywheel.



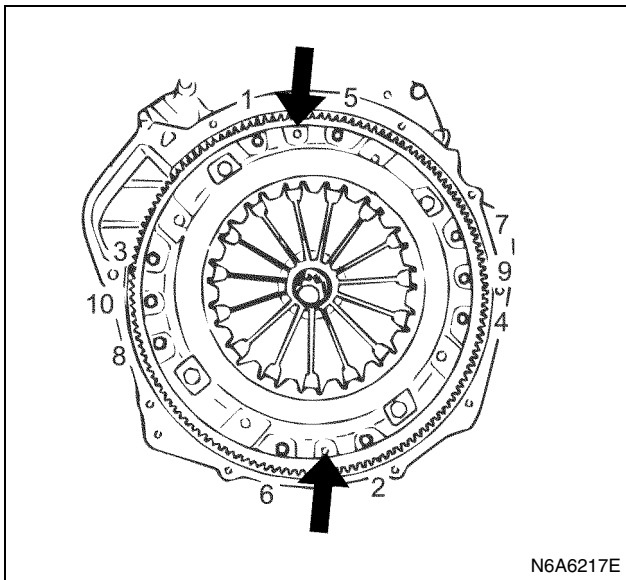
Legend

1. Clutch Aligner

- Tighten the clutch pressure plate assembly in the sequence shown in the figure using the specified torque.

Tighten:

Bolts to 40 N·m (4.1 kg·m/30 lb·ft)



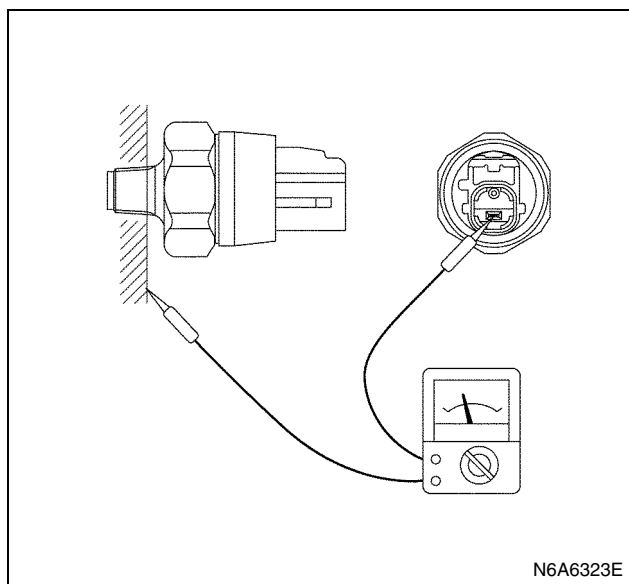
13. Install the cylinder head assembly.
Refer to "Cylinder Head".
14. Install the camshaft assembly.
Refer to "Camshaft Assembly".
15. Install the rocker arm shaft assembly.
Refer to "Rocker Arm Shaft Assembly".
16. Tighten the cylinder head cover.
Refer to "Cylinder Head Cover".

Oil Pressure Switch

Inspection

Check the continuity between the switch terminal and the body grounding in the no-load condition.

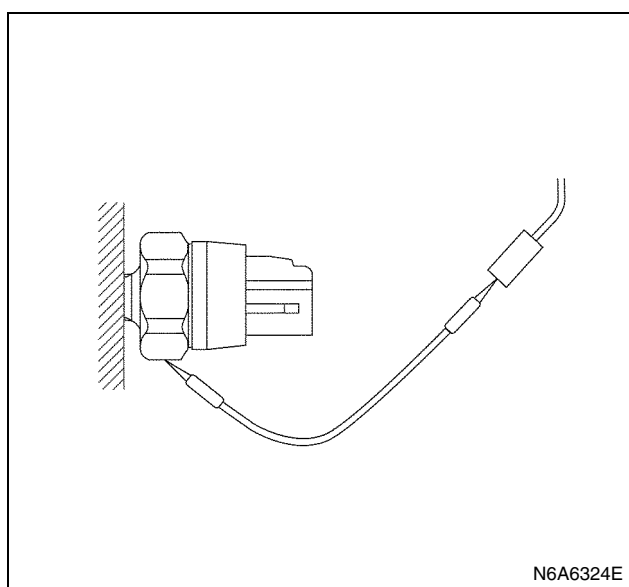
If there is no connectivity, replace with normal parts.
(Refer to "Oil Filter Assembly")



Circuit check

1. Turn the starter switch to ON.
2. Disconnect the oil pressure switch connector, and confirm that the oil pressure-warning lamp lights when the connector on the harness side is grounded.

If the warning lamp does not light up, check the circuit between the meter and the oil pressure switch, and repair the disconnected locations.



Air Cleaner Element

Removal

1. Remove the air cleaner cover fixing bolt.
2. Remove the air cleaner element assembly.

Inspection

- Check for damage to the element or clogging due to dirt. If the element is damaged, then replace it. If clogged, then clean it.
- The viscous-type (wet type) element cannot be cleaned; therefore, it has to be replaced if it is very dirty.

Replacement period Every 40,000 km (24,000
 miles) or every two years

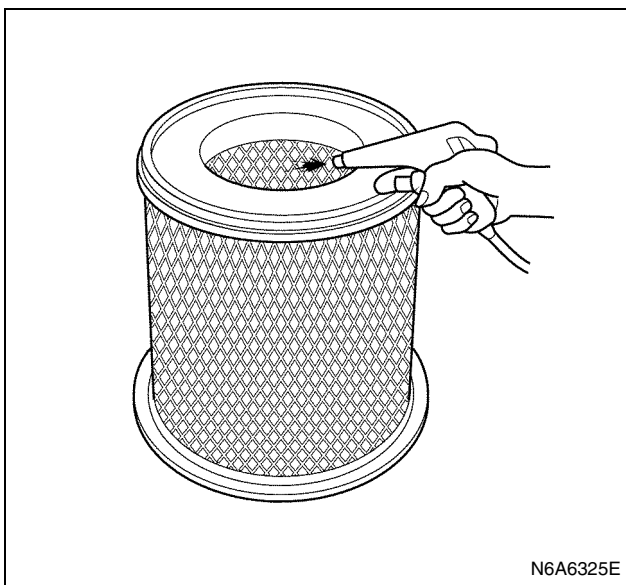
Installation

1. Install the air cleaner element assembly.
2. Tighten the air cleaner cover fixing bolt.

Cleaning

Dry type element

- While rotating the element, blow air under 690 kPa (7.0 kg/cm² / 100 psi) and remove the dust.



- Dissolve the filter cleaner ND1500 in water and soak the element for approximately 30 minutes. Then wash it properly with water and allow it to dry in natural conditions (two to three days.)