ON-CAR SERVICES 2-2

1. Foreword

This chapter describes major inspection and service procedures for the engine mounted on the body. For procedures not found in this chapter, refer to the service procedure section in the applicable chapter.

2. Ignition Timing

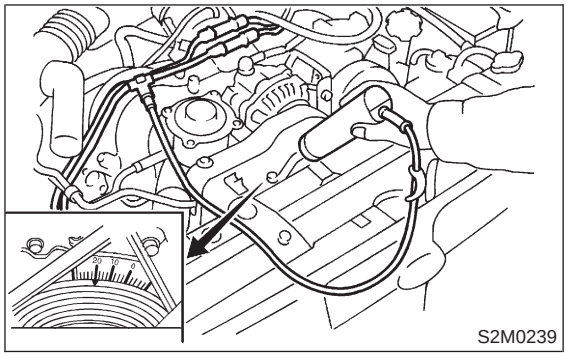
A: IGNITION TIMING

1. MEASUREMENT

CAUTION:
After warming-up, engine becomes very hot. Be careful not to burn yourself during measurement.

1) Warm-up the engine.
2) To check the ignition timing, connect a timing light to #1 cylinder spark plug cord, and illuminate the timing mark with the timing light.
3) Start the engine at idle speed and check the ignition timing.
If the timing is not correct, check the ignition control system. <Refer to 2-7 On-board Diagnostic II System.>

Ignition timing [BTDC/rpm]:
14°±8°/700 (2200 cc MT vehicles)
20°±8°/700 (2200 cc AT vehicles)
15°±8°/700 (2500 cc models)

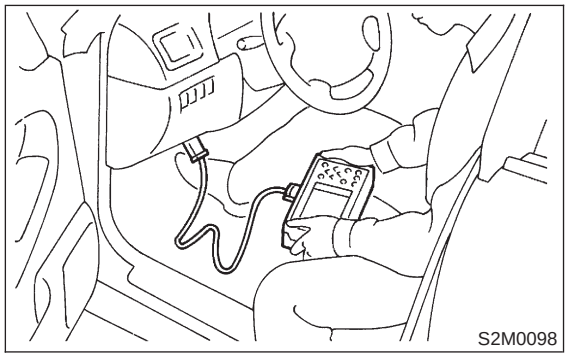


NOTE:
To improve stability, ignition timing while engine is idling is also controlled. For this reason specified ignition timing range is increased somewhat, to ±8°.

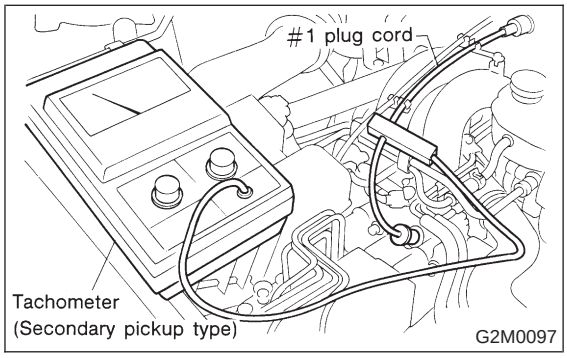
3. Engine Idle Speed

A: MEASUREMENT

1) Before checking idle speed, check the following:
(1) Ensure that air cleaner element is free from clogging, ignition timing is correct, spark plugs are in good condition, and that hoses are connected properly.
(2) Ensure that malfunction indicator light (CHECK ENGINE light) does not illuminate.
2) Warm-up the engine.
3) Stop the engine, and turn igintion switch to OFF.
4) When using SUBARU SELECT MONITOR;
(1) Insert the cartridge to SUBARU SELECT MONITOR.
(2) Connect SUBARU SELECT MONITOR to the data link connector.
(3) Turn igintion switch to ON, and SUBARU SELECT MONITOR switch to ON.
(4) Select {2. Each System Check} in Main Menu.
(5) Select {EGI/EMPI} in Selection Menu.
(6) Select {1. Current Data Display & Save} in EGI/EMPI Diagnosis.
(7) Select {1.12 Data Display} in Data Display Menu.
(8) Start the engine, and read engine idle speed.


S2M0098

5) When using tachometer (Secondary pick-up type).
(1) Attach the pick-up clip to No. 1 cylinder spark plug cord.
(2) Start the engine, and read engine idle speed.



NOTE:
● When using the OBD-II general scan tool, carefully read its operation manual.
● This ignition system provides simultaneous ignition for #1 and #2 plugs. It must be noted that some tachometers may register twice that of actual engine speed.

6) Check idle speed when unloaded. (With headlights, heater fan, rear defroster, radiator fan, air conditioning, etc. OFF)

Idle speed (No load and gears in neutral (MT), or N or P (AT) position):
700±100 rpm

7) Check idle speed when loaded. (Turn air conditioning switch to “ON” and operate compressor for at least one minute before measurement.)

Idle speed [A/C “ON”, no load and gears in neutral (MT) or N or P (AT) position]:
850±50 rpm

CAUTION:
Never rotate idle adjusting screw. If idle speed is out of specifications, refer to General On-board Diagnosis Table under “2-7 On-Board Diagnostics II System”.

4. Engine Compression

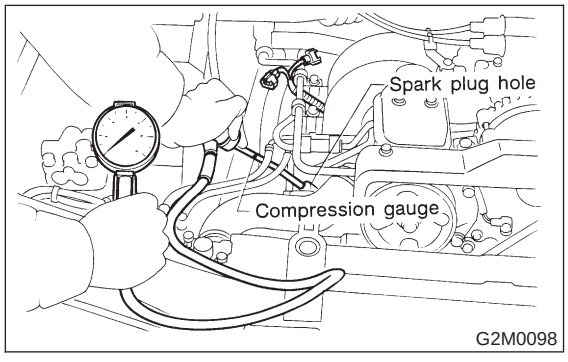
A: ENGINE COMPRESSION

1. MEASUREMENT

1) After warming-up the engine, turn ignition switch to OFF.
2) Make sure that the battery is fully charged.
3) Disconnect battery ground cable.
4) Remove all the spark plugs.
5) Disconnect connectors from fuel injectors.
6) Connect battery ground cable.
7) Fully open throttle valve.
8) Check the starter motor for satisfactory performance and operation.
9) Hold the compression gauge tight against the spark plug hole.

CAUTION:
When using a screw-in type compression gauge, the screw (put into cylinder head spark plug hole) should be less than 18 mm (0.71 in) long.

10) Crank the engine by means of the starter motor, and read the maximum value on the gauge when the pointer is steady.



11) Perform at least two measurements per cylinder, and make sure that the values are correct.

2200 cc models:

Compression (200 — 300 rpm and fully open throttle):
Standard:
1,079 — 1,275 kPa (11.0 — 13.0 kg/cm^2, 156 — 185 psi)
Limit:
883 kPa (9.0 kg/cm^2, 128 psi)
Difference between cylinders:
196 kPa (2.0 kg/cm^2, 28 psi)

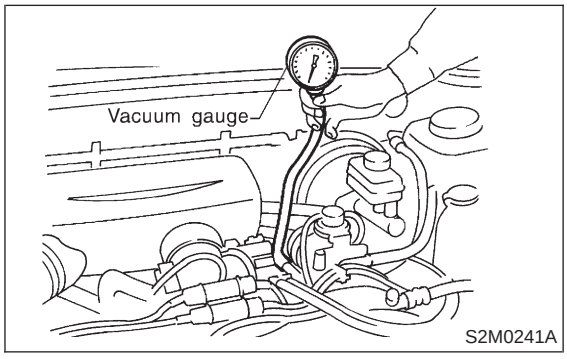
2500 cc models:

Compression (350 rpm and fully open throttle):
Standard;
1,216 kPa (12.4 kg/cm^2, 176 psi)
Limit;
941 kPa (9.6 kg/cm^2, 137 psi)
Difference between cylinders;
49 kPa (0.5 kg/cm^2, 7 psi), or less

5. Intake Manifold Vacuum

A: MEASUREMENT

1) Warm-up the engine.
2) Disconnect the brake vacuum hose and install the vacuum gauge to the hose fitting on the manifold.
3) Keep the engine at the idle speed and read the vacuum gauge indication.
By observing the gauge needle movement, the internal condition of the engine can be diagnosed as described below.



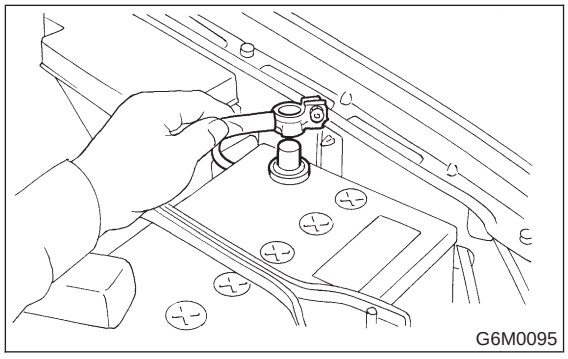
Vacuum pressure (at idling, A/C "OFF"):
Less than −60.0 kPa (−450 mmHg, −17.72 inHg)

Diagnosis of engine condition by measurement of manifold vacuum	
Vacuum gauge indication	Possible engine condition
1. Needle is steady but lower than normal position. This tendency becomes more evident as engine temperature rises.	Leakage around intake manifold gasket or disconnection or damaged vacuum hose
2. When engine speed is reduced slowly from higher speed, needle stops temporarily when it is lowering or becomes steady above normal position.	Back pressure too high, or exhaust system clogged
3. Needle intermittently drops to position lower than normal position.	Leakage around cylinder
4. Needle drops suddenly and intermittently from normal position.	Sticky valves
5. When engine speed is gradually increased, needle begins to vibrate rapidly at certain speed, and then vibration increases as engine speed increases.	Weak or broken valve springs
6. Needle vibrates above and below normal position in narrow range.	Defective ignition system or throttle chamber idle adjustment

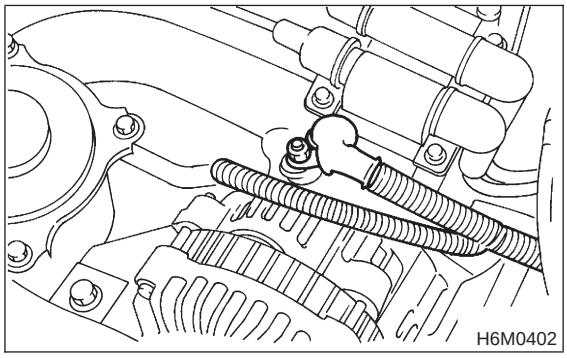
6. Engine Oil Pressure

A: MEASUREMENT

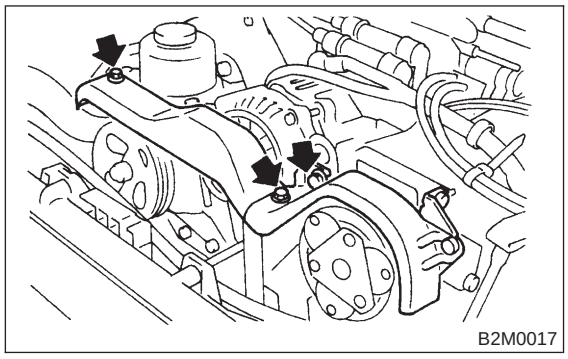
1) Disconnect battery ground cable.



2) Remove generator from bracket.
(1) Disconnect connector and terminal from generator.



(2) Remove V-belt cover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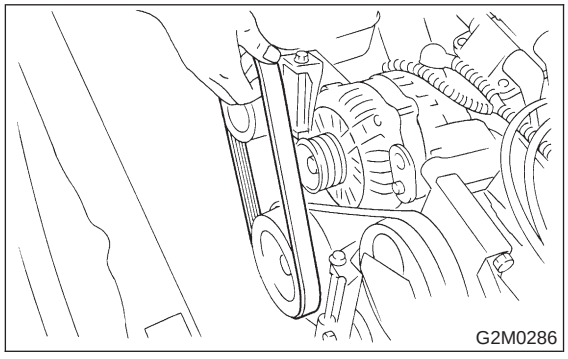
(3) Loosen lock bolt and slider bolt, and remove front side V-belt.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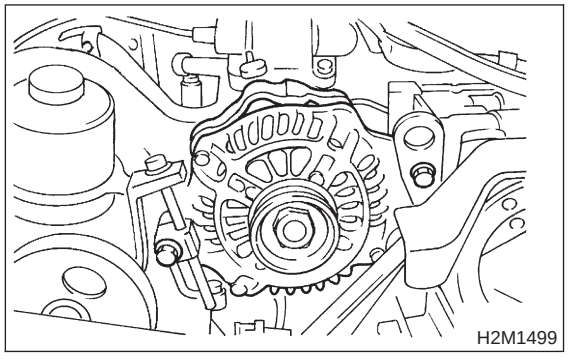
(4) Remove generator lock bolt.
(5) Remove bolt which install generator on bracket.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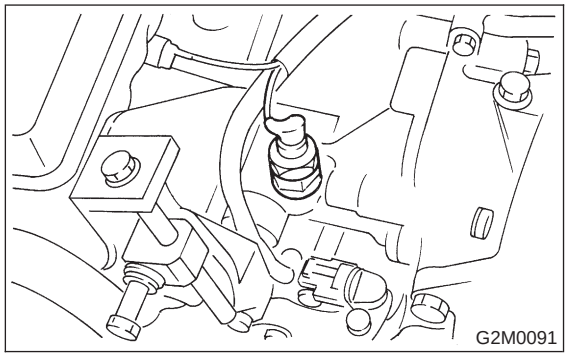
3) Disconnect connector from oil pressure switch.
4) Remove oil pressure switch from engine cylinder block. <Ref. to 2-4 [W3A0].>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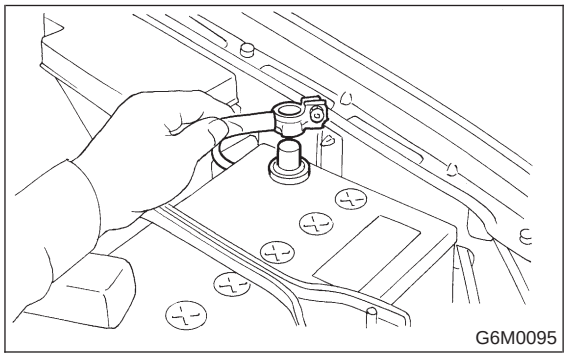
5) Connect oil pressure gauge hose to cylinder block.
6) Connect battery ground cable.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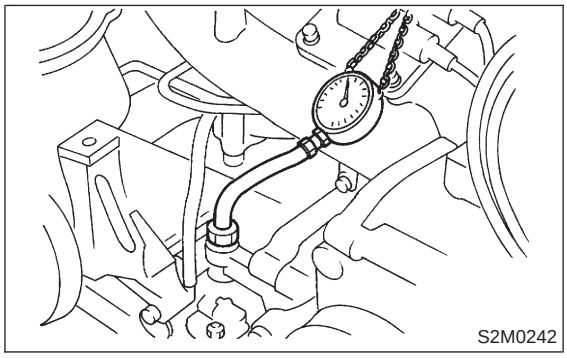
7) Start the engine, and measure oil pressure.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Oil pressure:
98 kPa (1.0 kg/cm^2,14 psi) or more at 800 rpm
294 kPa (3.0 kg/cm^2, 43 psi) or more at 5,000 rpm

CAUTION:
● If oil pressure is out of specification, check oil pump, oil filter and lubrication line. <Ref. to 2-4 ENGINE LUBRICATION SYSTEM.>
● If oil pressure warning light is turned ON and oil pressure is in specification, replace oil pressure switch. <Ref. to 2-4 ENGINE LUBRICATION SYSTEM.>

NOTE:
The specified data is based on an engine oil temperature of 80°C (176°F).

8) After measuring oil pressure, install oil pressure switch. <Ref. to 2-4 [W3B0].>

Tightening torque:
25±3 N·m (2.5±0.3 kg-m, 18.1±2.2 ft-lb)

9) Install generator and V-belt in the reverse order of removal, and adjust the V-belt deflection. <Ref. to 1-5 [G2A0].>

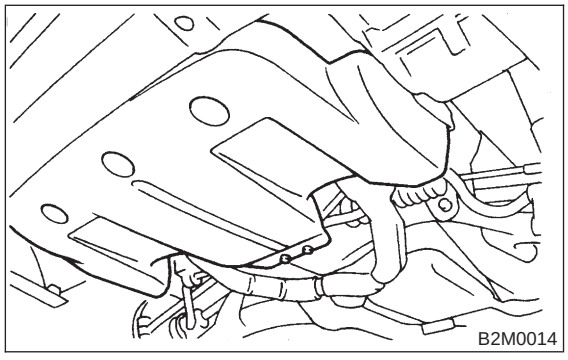
7. Valve Clearance

A: INSPECTION

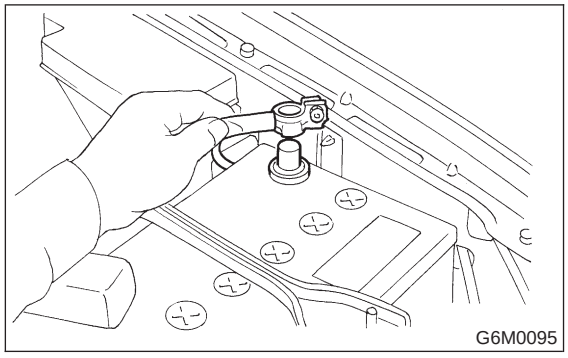
1. 2200 cc MODEL

CAUTION:
Inspection and adjustment of valve clearance should be performed while engine is cold.

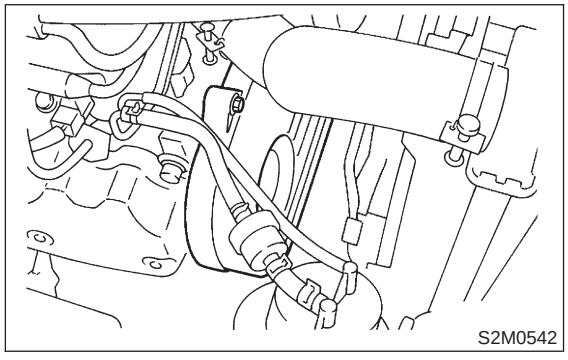
1) Set the vehicle onto the lift.
2) Lift-up the vehicle.
3) Remove under cover.



4) Disconnect battery ground cable.



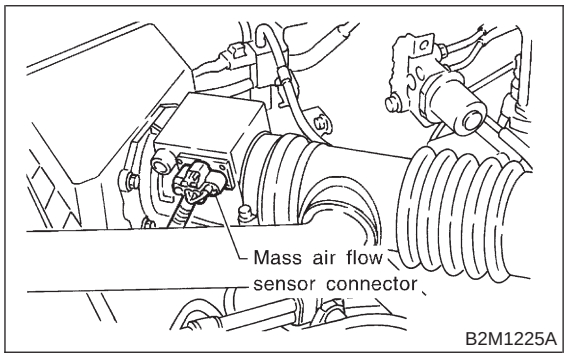
5) Lower the vehicle.
6) Remove timing belt cover (RH).



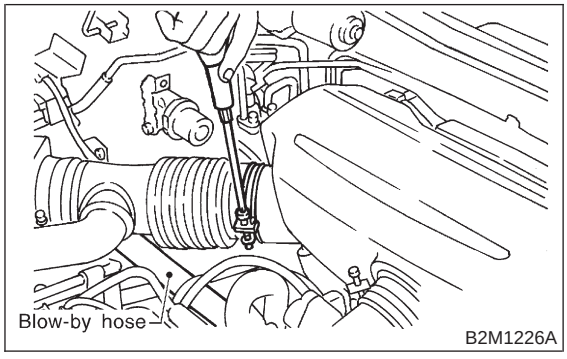
7) Remove rocker cover.

- When inspecting #1 and #3 cylinders;

(1) Disconnect connector from mass air flow sensor.



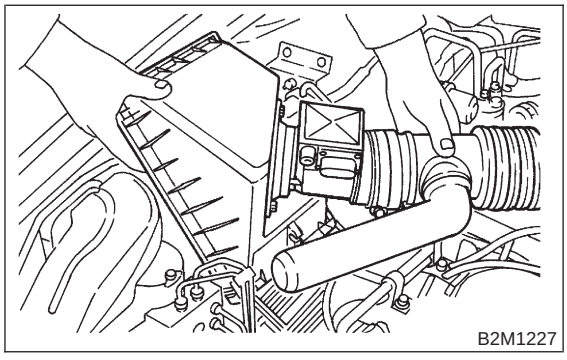
(2) Loosen clamp which connectors air intake duct to air intake chamber.



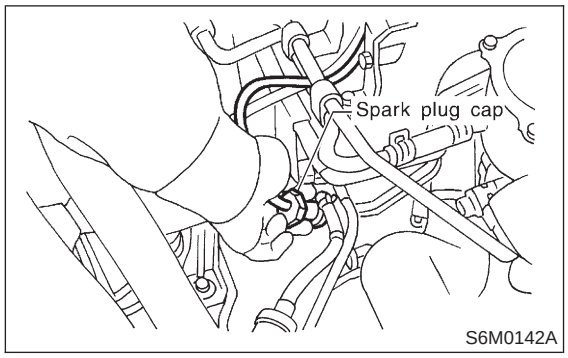
(3) Remove the two clips from air cleaner upper cover.

CAUTION:
Before installing air cleaner upper cover, align hole(s) with protruding portions of air cleaner lower case, then secure upper cover.

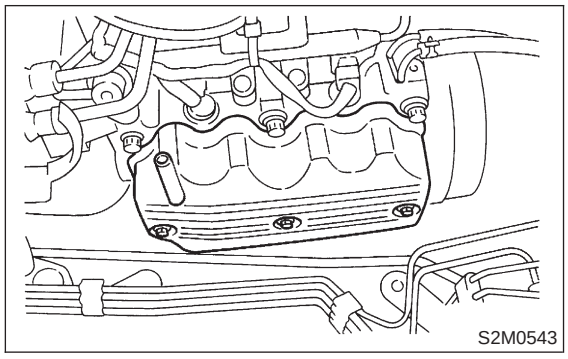
(4) Disconnect blow-by hose from air intake duct.
(5) Remove air intake duct and air cleaner upper cover as a unit.



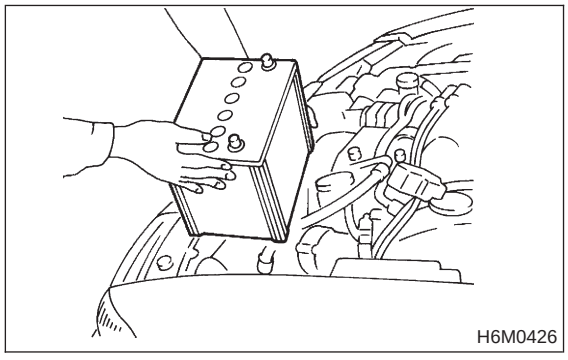
(6) Disconnect spark plug cords from spark plugs (#1 and #3 cylinders).



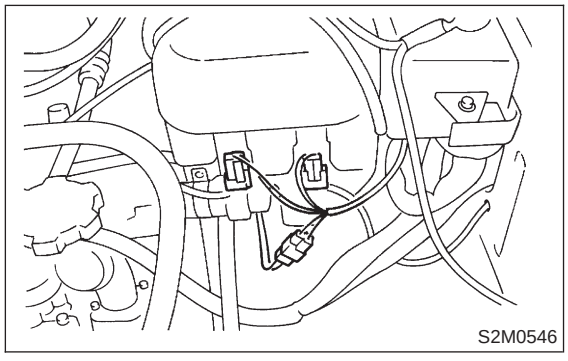
(7) Disconnect PCV hose from rocker cover (RH).
(8) Remove bolts, then remove rocker cover (RH).



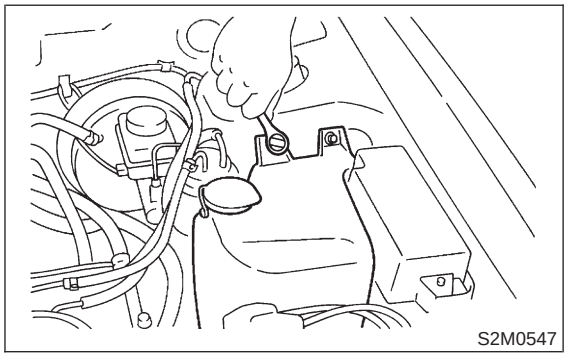
- When inspecting #2 and #4 cylinders;
  (1) Disconnect battery cables, and then remove battery and battery carrier.



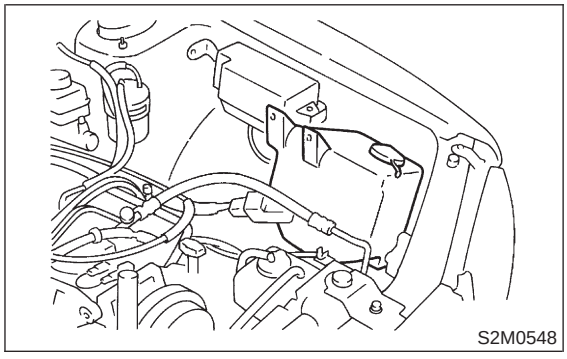
(2) Disconnect washer motor connectors.



(3) Remove the two bolts which hold washer tank.

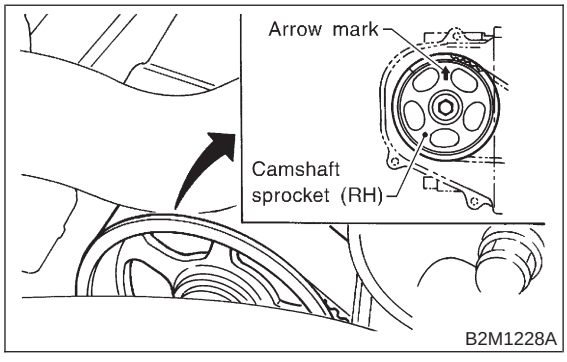


(4) Move washer tank to forward.



(5) Disconnect spark plug cords from spark plugs (#2 and #4 cylinders).
(6) Disconnect PCV hose from rocker cover (LH).
(7) Remove bolts, then remove rocker cover (LH).
8) Set #1 cylinder piston to top dead center of compression stroke by rotating crankshaft pulley clockwise.

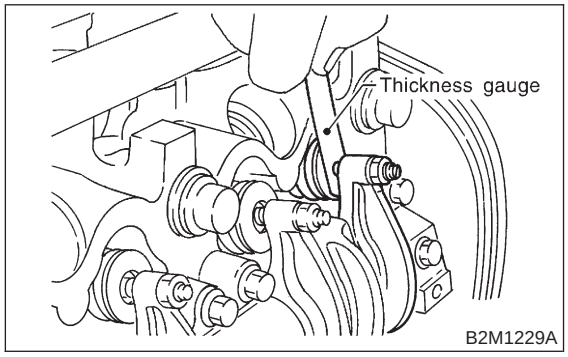
NOTE:
When arrow mark on camshaft sprocket (RH) comes exactly to the top, #1 cylinder piston is brought to the top dead center of compression stroke.



9) Measure #1 cylinder valve clearance by using thickness gauge.

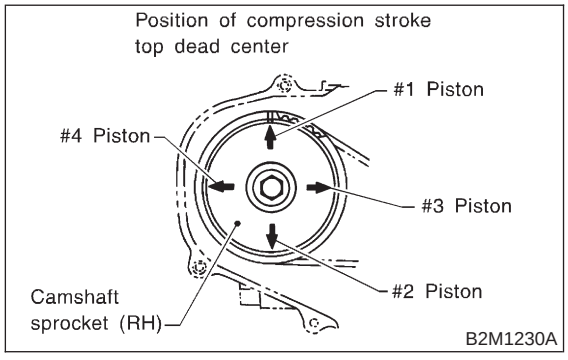
CAUTION:
● Insert the thickness gauge in as horizontal a direction as possible with respect to the valve stem end face.
● Measure exhaust valve clearances while lifting-up the vehicle.

Valve clearance:
Intake:
0.20±0.02 mm (0.0079±0.0008 in)
Exhaust:
0.25±0.02 mm (0.0098±0.0008 in)



10) If necessary, adjust the valve clearance. <Ref. to 2-2 [W7B1].>
11) Similar to measurement procedures used for #1 cylinder, measure #2, #3 and #4 cylinder valve clearances.

NOTE:
● Be sure to set cylinder pistons to their respective top dead centers on compression stroke before measuring valve clearances.
● To set #3, #2 and #4 cylinder pistons to their top dead centers on compression stroke, turn crankshaft pulley clockwise 90° at a time starting with arrow mark on right-hand camshaft sprocket facing up.

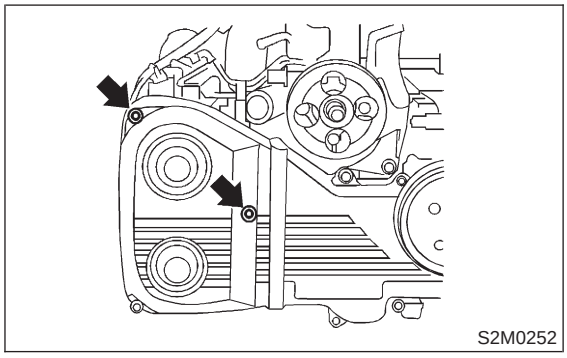


12) After inspection, install the related parts in the reverse order of removal.

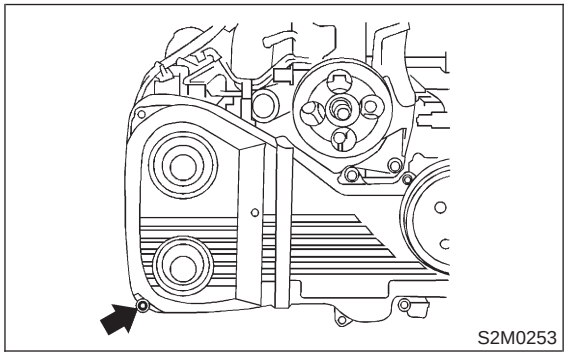
2. 2500 cc MODEL

CAUTION:
Inspection and adjustment of valve clearance should be performed while engine is cold.

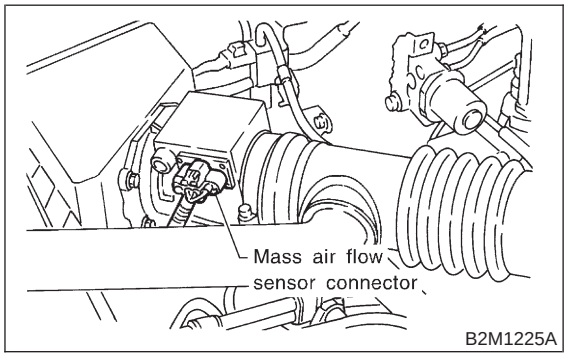
1) Set the vehicle onto the lift.
2) Disconnect battery ground cable.
3) Remove bolts which secure the upper and center side of timing belt cover (RH).



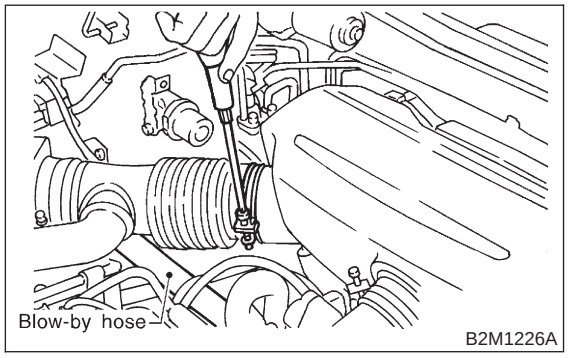
4) Lift-up the vehicle.
5) Remove under cover.
6) Remove bolt which secures the under side of timing belt cover (RH), then remove belt cover.



7) Lower the vehicle.
8) Remove rocker cover.
● When inspecting #1 and #3 cylinders;
(1) Disconnect connector from mass air flow sensor.



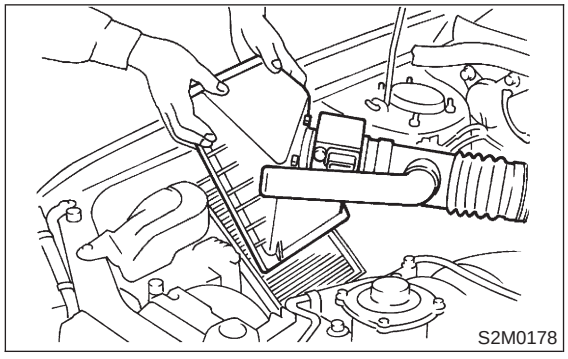
(2) Loosen clamp which connects air intake duct to air intake chamber.



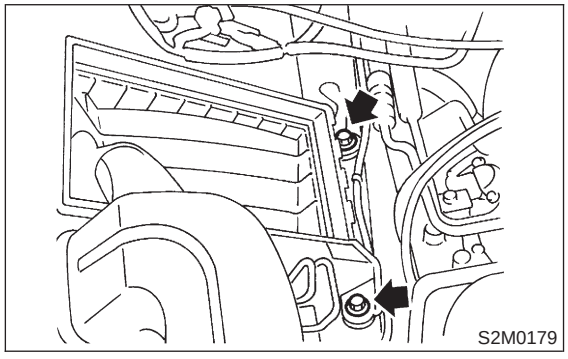
(3) Remove the two clips from air cleaner upper cover.

CAUTION:
Before installing air cleaner upper cover, align hole(s) with protruding portions of air cleaner lower case, then secure upper cover.

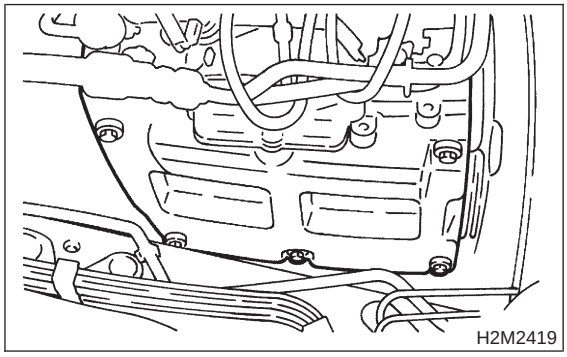
(4) Disconnect blow-by hose from air intake duct.
(5) Remove air intake duct and air cleaner upper cover as a unit.



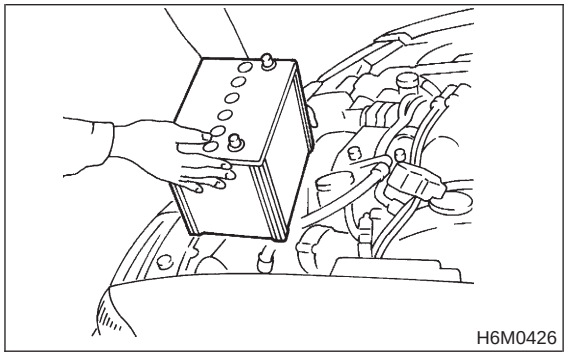
(6) Remove air cleaner element.
(7) Remove air cleaner lower case.



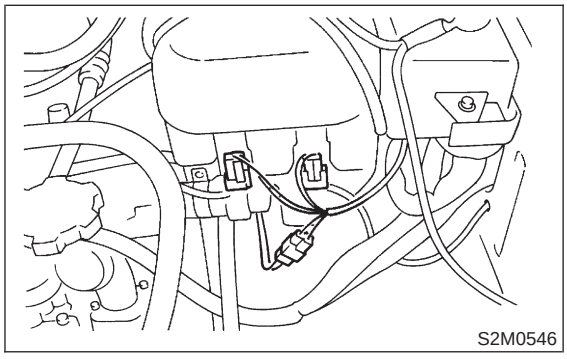
(8) Disconnect spark plug cords from spark plugs (#1 and #3 cylinders).
(9) Place suitable container under the vehicle.
(10) Disconnect PCV hose from rocker cover (RH).
(11) Remove bolts, then remove rocker cover (RH).



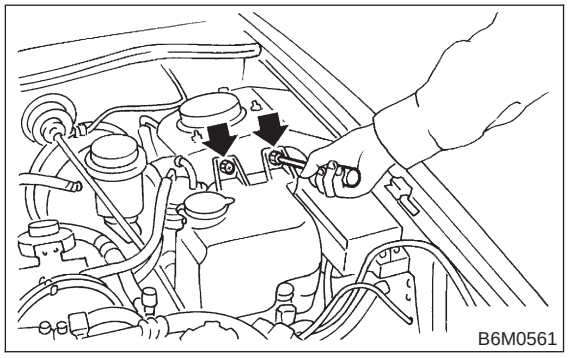
- When inspecting # 2 and #4 cylinders;
  (1) Disconnect battery cables, and then remove battery and battery carrier.



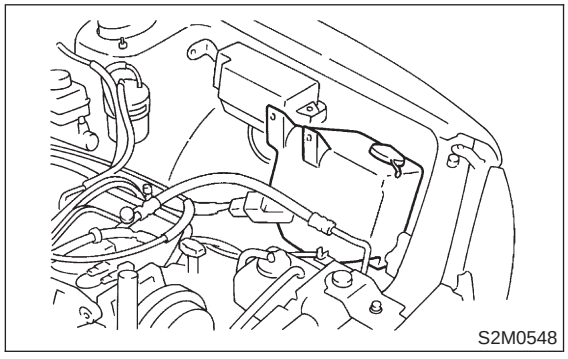
(2) Disconnect washer motor connectors.



(3) Remove bolts which install washer tank to body.

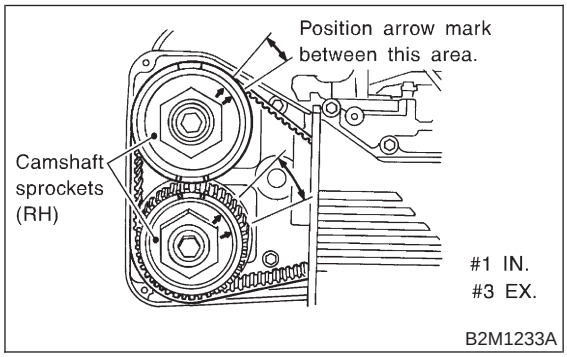


(4) Move washer tank to forward.



(5) Disconnect spark plug cords from spark plugs (#2 and #4 cylinders).
(6) Place suitable container under the vehicle.
(7) Disconnect PCV hose from rocker cover (LH).
(8) Remove bolts, then remove rocker cover (LH).

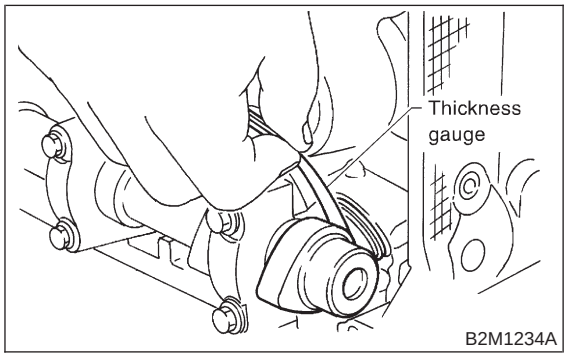
9) Turn crankshaft pulley clockwise until arrow mark on camshaft sprocket is set to position shown in figure.



10) Measure #1 cylinder intake valve and #3 cylinder exhaust valve clearances by using thickness gauge.

CAUTION:
● Insert the thickness gauge in as horizontal a direction as possible with respect to the shim.
● Measure exhaust valve clearances while lifting-up the vehicle.

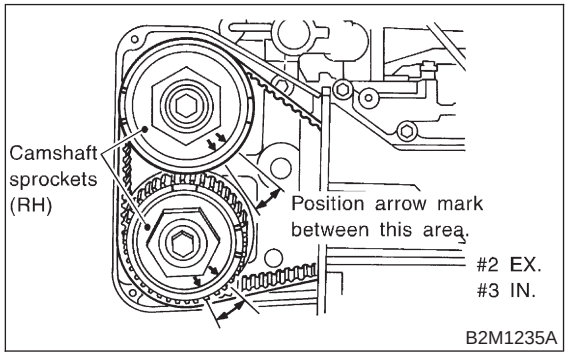
Valve clearance:
Intake: 0.20±0.02 mm (0.0079±0.0008 in)
Exhaust: 0.25±0.02 mm (0.0098±0.0008 in)



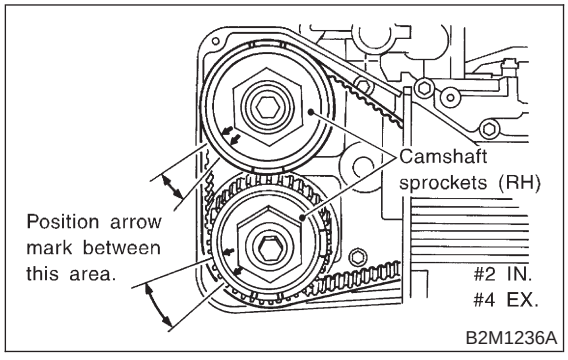
11) If necessary, adjust the valve clearance. <Ref. to 2-2 [W7B2].>

12) Further turn crankshaft pulley clockwise. Using the same procedures as in step 10) above, measure valve clearances.

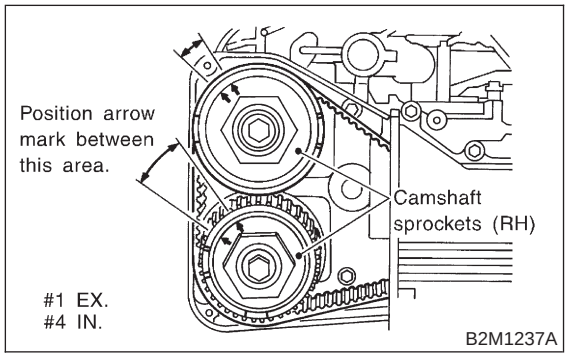
(1) Set arrow mark on camshaft sprocket to position shown in figure, and measure #2 cylinder exhaust valve and #3 cylinder intake valve clearances.



(2) Set arrow mark on camshaft sprocket to position shown in figure, and measure #2 cylinder intake valve and #4 cylinder exhaust valve clearances.



(3) Set arrow mark on camshaft sprocket to position shown in figure, and measure #1 cylinder exhaust valve and #4 cylinder intake valve clearances.



13) After inspection, install the related parts in the reverse order of removal.

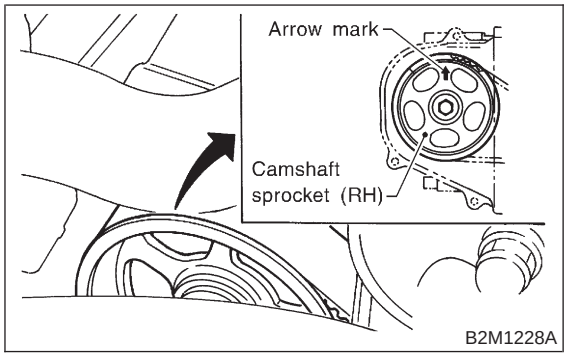
B: ADJUSTMENT

1. 2200 cc MODEL

CAUTION:
Adjustment of valve clearance should be performed while engine is cold.

1) Set #1 cylinder piston to top dead center of compression stroke by rotating crankshaft pulley clockwise.

NOTE:
When arrow mark on camshaft sprocket (RH) comes exactly to the top, #1 cylinder piston is brought to the top dead center of compression stroke.

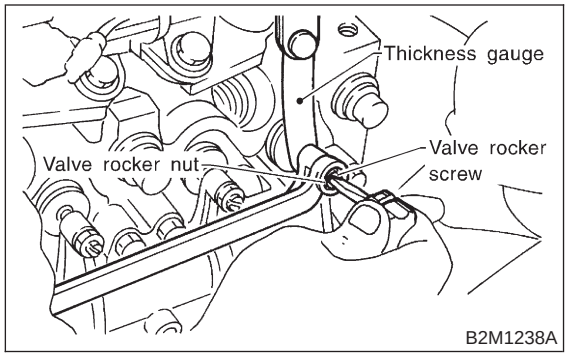


2) Adjust the #1 cylinder valve clearance.
(1) Loosen the valve rocker nut and screw.
(2) Place suitable thickness gauge.
(3) While noting valve clearance, tighten valve rocker adjust screw.
(4) When specified valve clearance is obtained, tighten valve rocker nut.

Tightening torque:
10±1 N·m (1.0±0.1 kg-m, 7.2±0.7 ft-lb)

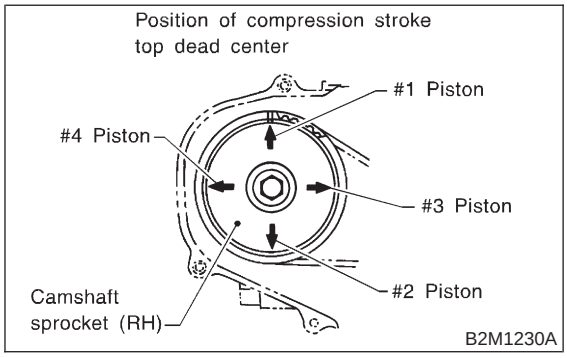
CAUTION:
● Insert the thickness gauge in as horizontal a direction as possible with respect to the valve stem end face.
● Adjust exhaust valve clearances while lifting-up the vehicle.

Valve clearance:
Intake:
0.20±0.02 mm (0.0079±0.0008 in)
Exhaust:
0.25±0.02 mm (0.0098±0.0008 in)



3) Ensure that valve clearances are within specifications.
4) Turn crankshaft two complete rotations until #1 cylinder piston is again set to top dead center on compression stroke.
5) Ensure that valve clearances are within specifications. If necessary, re-adjust valve clearances.
6) Similar to adjustment procedures used for #1 cylinder, adjust #2, #3 and #4 cylinder valve clearances.

NOTE:
● Be sure to set cylinder pistons to their respective top dead centers on compression stroke before adjusting valve clearances.
● To set #3, #2 and #4 cylinder pistons to their top dead centers on compression stroke, turn crankshaft pulley clockwise 90° at a time starting with arrow mark on right-hand camshaft sprocket facing up.

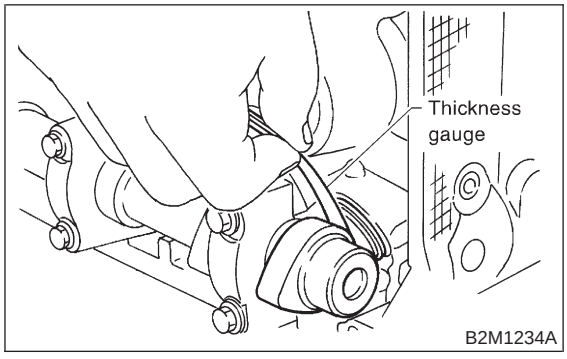


2. 2500 cc MODEL

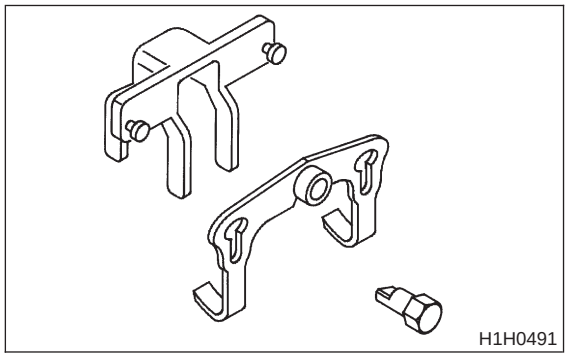
CAUTION:
Adjustment of valve clearance should be performed while engine is cold.

1) Measure all valve clearances. <Ref. to 2-2 [W7A2].>

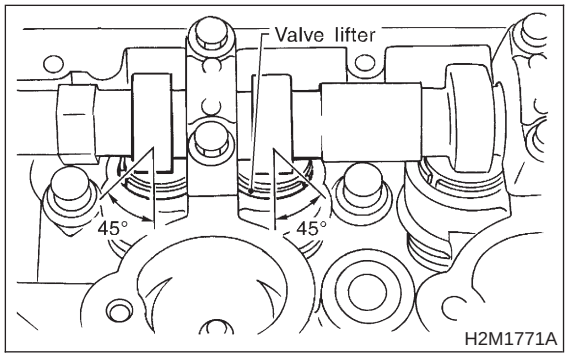
NOTE:
Record each valve clearance after it has been measured.



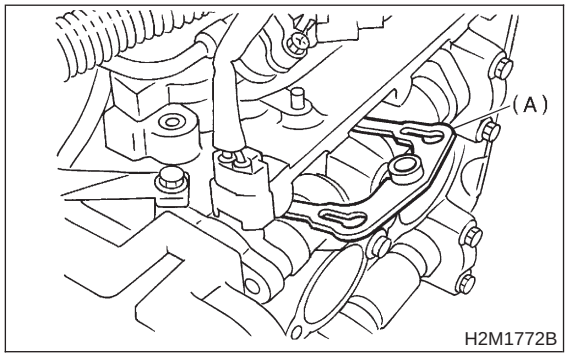
2) Remove shim of intake side.
(1) Prepare the ST.
ST 498187100 SHIM REPLACER KIT



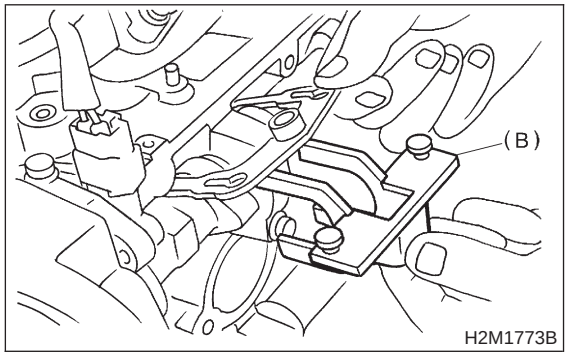
(2) Rotate the notch of the valve lifter outward by 45°.



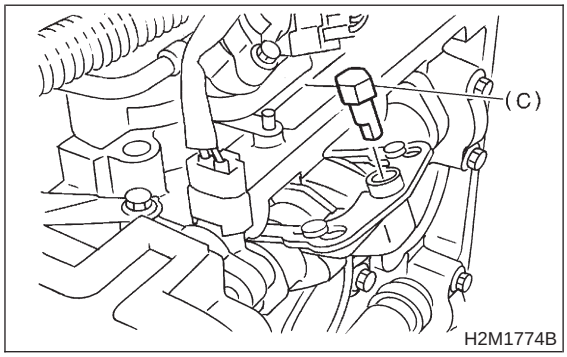
(3) Set REPLACER No. 1 (A) to intake camshaft.



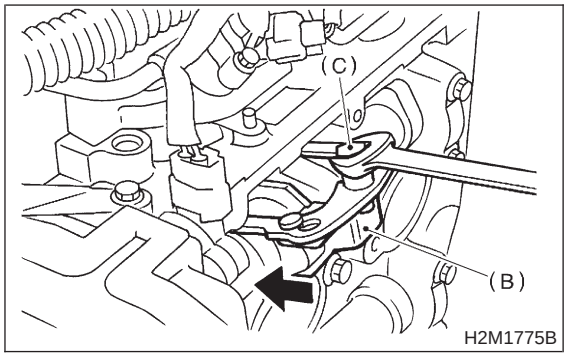
(4) Set REPLACER No. 2 (B).



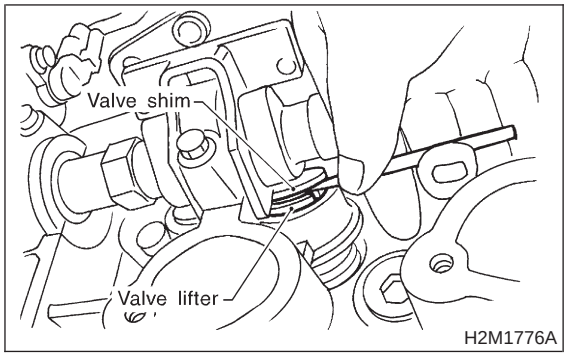
(5) Set REPLACER No. 3 (C) to hole of REPLACER No. 1.



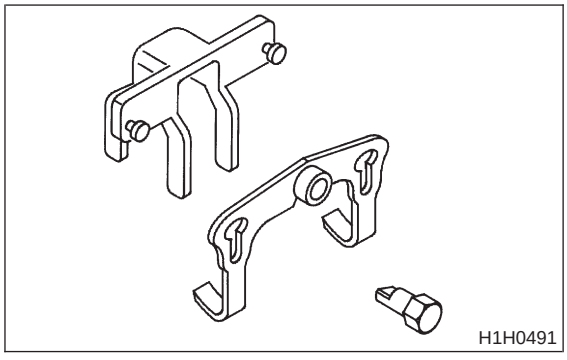
(6) Rotate REPLACER No. 3 (C) until REPLACER No. 2 (B) pushes away valve lifter.



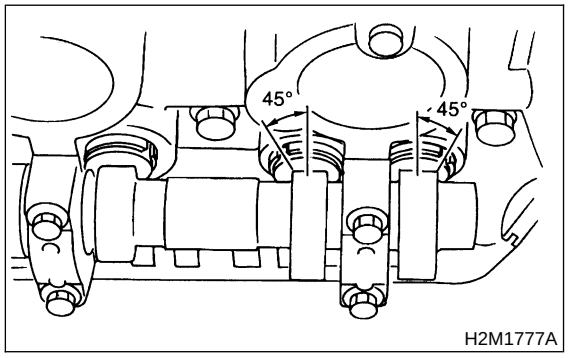
(7) Insert tweezers into the notch of the valve lifter, and take the shim out.



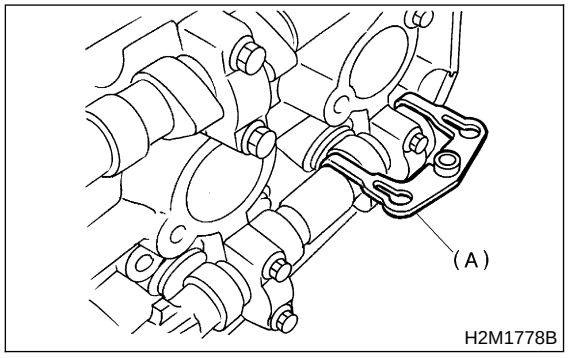
3) Remove shim of exhaust side.
(1) Prepare the ST.
ST 498187100 SHIM REPLACER KIT



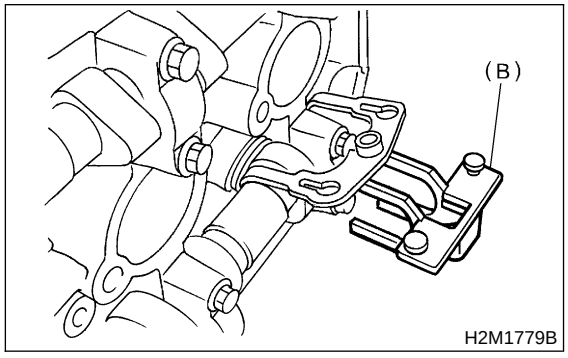
(2) Rotate the notch of the valve lifter outward by 45°.



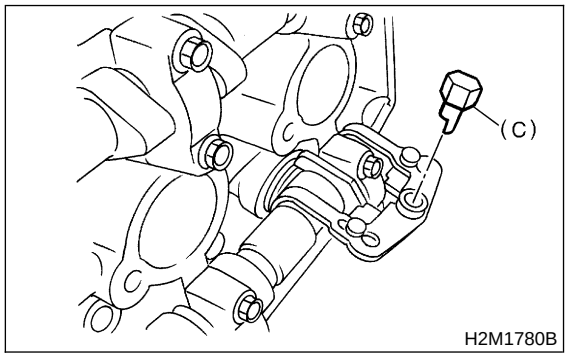
(3) Set REPLACER No. 1 (A) to exhaust camshaft.



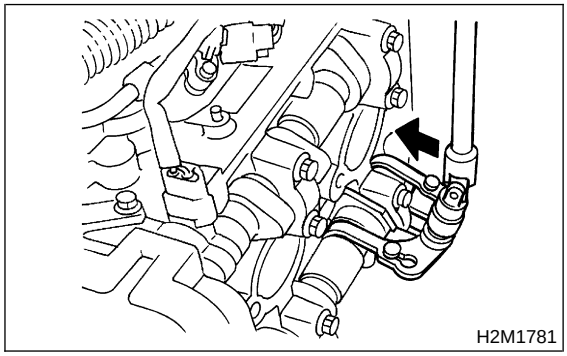
(4) Set REPLACER No. 2 (B).



(5) Set REPLACER No. 3 (C) to hole of REPLACER No. 1.

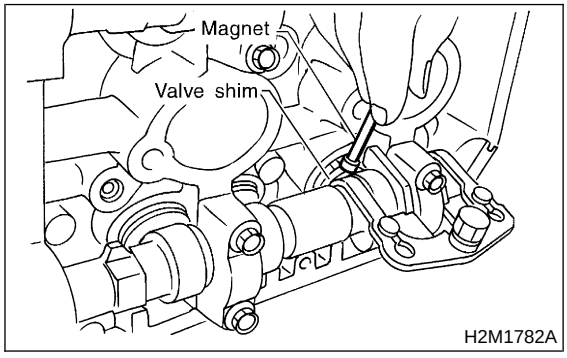


(6) Rotate REPLACER No. 3 until REPLACER No. 2 pushes away valve lifter.

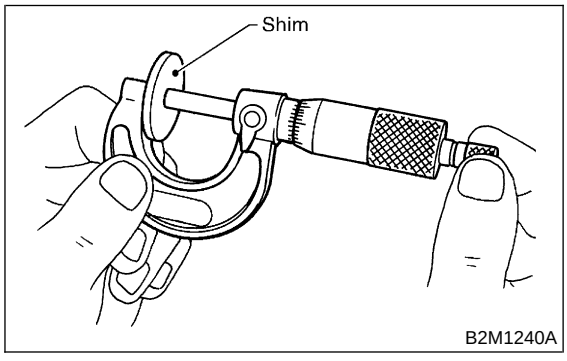


(7) Insert tweezers into the notch of the valve lifter, and take the shim out.

NOTE:
By using a magnet, the shim can be taken out without dropping it.



4) Measure thickness of shim with micrometer.



5) Select a shim of suitable thickness using measured valve clearance and shim thickness, using the following table.

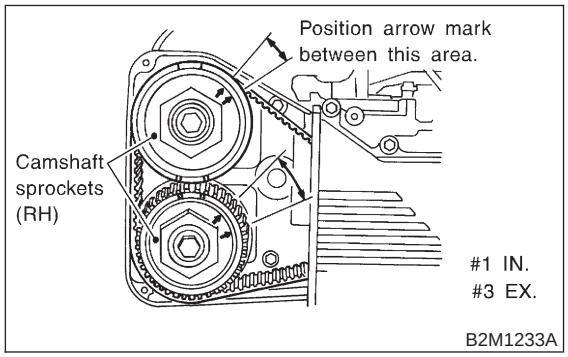
Intake valve (mm): S = (V + T) − 0.20
Exhaust valve (mm): S = (V + T) − 0.25

S: Shim thickness to be used
V: Measured valve clearance
T: Shim thickness required

Part No.	Thickness mm (in)	Part No.	Thickness mm (in)
13218AC230	2.22 (0.0874)	13218AC480	2.52 (0.0992)
13218AE000	2.23 (0.0878)	13218AC490	2.53 (0.0996)
13218AC240	2.24 (0.0882)	13218AC500	2.54 (0.1000)
13218AE010	2.25 (0.0886)	13218AC510	2.55 (0.1004)
13218AC250	2.26 (0.0890)	13218AC520	2.56 (0.1008)
13218AE020	2.27 (0.0894)	13218AC530	2.57 (0.1012)
13218AC260	2.28 (0.0898)	13218AC540	2.58 (0.1016)
13218AE030	2.29 (0.0902)	13218AC550	2.59 (0.1020)
13218AC270	2.30 (0.0906)	13218AC560	2.60 (0.1024)
13218AE040	2.31 (0.0909)	13218AC570	2.61 (0.1028)
13218AC280	2.32 (0.0913)	13218AC580	2.62 (0.1031)
13218AC290	2.33 (0.0917)	13218AC590	2.63 (0.1035)
13218AC300	2.34 (0.0921)	13218AC600	2.64 (0.1039)
13218AC310	2.35 (0.0925)	13218AC610	2.65 (0.1043)
13218AC320	2.36 (0.0929)	13218AC620	2.66 (0.1047)
13218AC330	2.37 (0.0933)	13218AC630	2.67 (0.1051)
13218AC340	2.38 (0.0937)	13218AC640	2.68 (0.1055)
13218AC350	2.39 (0.0941)	13218AC650	2.69 (0.1059)
13218AC360	2.40 (0.0945)	13218AC660	2.70 (0.1063)
13218AC370	2.41 (0.0949)	13218AE050	2.71 (0.1067)
13218AC380	2.42 (0.0953)	13218AC670	2.72 (0.1071)
13218AC390	2.43 (0.0957)	13218AE060	2.73 (0.1075)
13218AC400	2.44 (0.0961)	13218AC680	2.74 (0.1079)
13218AC410	2.45 (0.0965)	13218AE070	2.75 (0.1083)
13218AC420	2.46 (0.0969)	13218AC690	2.76 (0.1087)
13218AC430	2.47 (0.0972)	13218AE080	2.77 (0.1091)
13218AC440	2.48 (0.0976)	13218AC700	2.78 (0.1094)
13218AC450	2.49 (0.0980)	13218AE090	2.79 (0.1098)
13218AC460	2.50 (0.0984)	13218AC710	2.80 (0.1102)
13218AC470	2.51 (0.0988)	13218AE100	2.81 (0.1106)

6) Set suitable shim selected in one step before, to valve lifter.

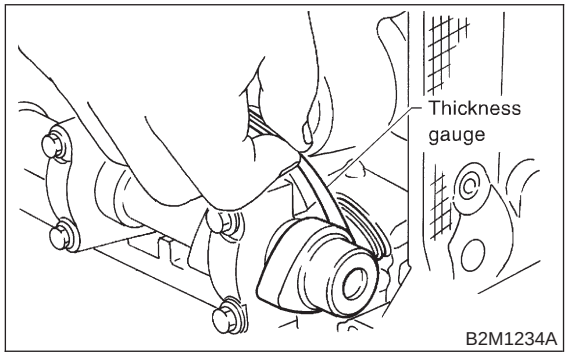
7) Turn crankshaft pulley clockwise until arrow mark on camshaft sprocket is set to position shown in figure.



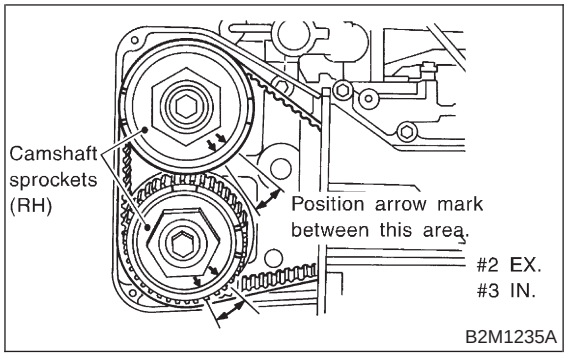
8) Ensure that #1 cylinder intake valve and #3 cylinder exhaust valve are adjusted to specifications.

CAUTION:
● Insert the thickness gauge in as horizontal a direction as possible with respect to the shim.
● Adjust exhaust valve clearances while lifting-up the vehicle.

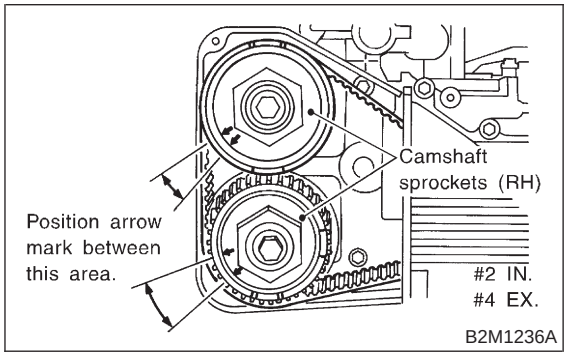
Valve clearance:
Intake: 0.20±0.02 mm (0.0079±0.0008 in)
Exhaust: 0.25±0.02 mm (0.0098±0.0008 in)



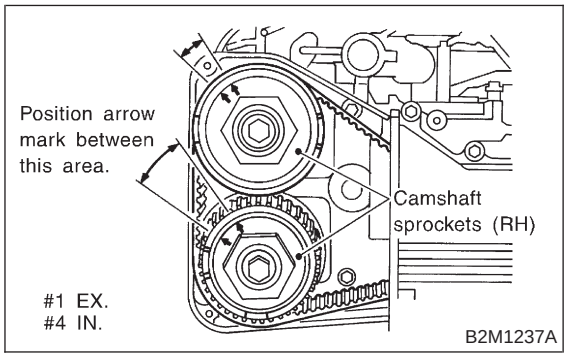
9) Turn crankshaft two complete rotations. Check again to ensure that #1 cylinder intake valve and #3 cylinder exhaust valve clearances are within specifications. If necessary, re-adjust valve clearances.
10) Further turn crankshaft pulley clockwise. Using the same procedures as in two steps before, measure valve clearances.
(1) Set arrow mark on camshaft sprocket to position shown in figure, and check #2 cylinder exhaust valve and #3 cylinder intake valve clearances.



(2) Set arrow mark on camshaft sprocket to position shown in figure, and check #2 cylinder intake valve and #4 cylinder exhaust valve clearances.



(3) Set arrow mark on camshaft sprocket to position shown in figure, and check #1 cylinder exhaust valve and #4 cylinder intake valve clearances.



MEMO: