

# ON-CAR SERVICES

**2-2**

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## 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.

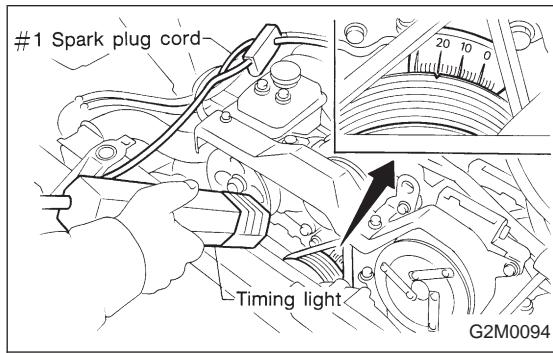
## 2. Ignition Timing

### A: 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. <Ref. to 2-7 [T8D0].>

#### *Ignition timing [BTDC/rpm]:*

*16°±8°/700 (1800 cc MT vehicles)*

*14°±8°/700 (2200 cc MT vehicles)*

*20°±8°/700 (2200 cc AT vehicles)*

#### NOTE:

To improve stability, ignition timing while engine is idling is also controlled. For this reason specified ignition timing range is increased somewhat, to  $\pm 8^\circ$ .

### 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 lamp (CHECK ENGINE light) does not illuminate.

2) Warm-up the engine.

3) Connect Subaru Select Monitor or the OBD-II general scan tool to data link connector.

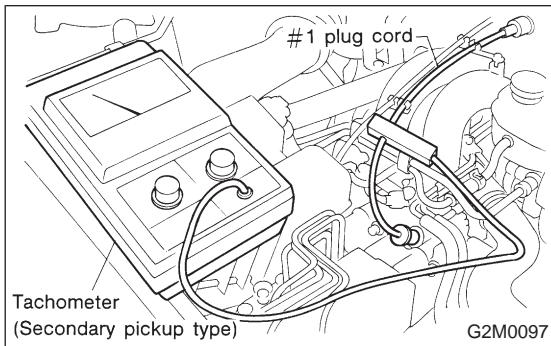
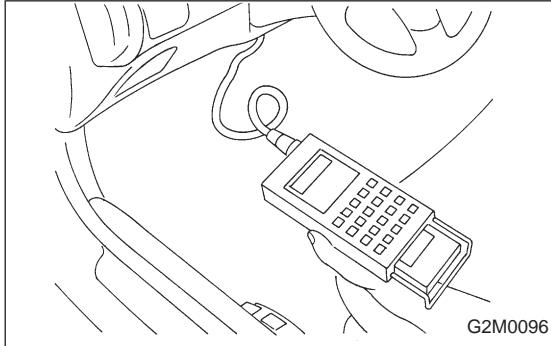
#### CAUTION:

**When connecting Subaru Select Monitor, turn ignition switch to OFF.**

4) Start the engine and measure engine speed.

#### NOTE:

Engine speed is indicated on Subaru Select Monitor by selecting "MODE F04".



#### NOTE:

- When using the OBD-II general scan tool, carefully read its operation manual.
- When Subaru Select Monitor is not used, attach the pickup sensor on tachometer (Secondary pickup type) to #1 spark plug cord.
- 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.

5) 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***

6) 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 switch "ON", no load and gears in neutral (MT) or N or P (AT) position]:***

***850±100 rpm***

#### CAUTION:

Never rotate idle adjusting screw, if idle speed is outside specifications, refer to General On-board Diagnosis Table under "2-7 On-Board Diagnostics II System".

## 4. Engine Compression

### A: MEASUREMENT

- 1) After warming-up the engine, turn ignition switch to OFF.
- 2) Make sure that the battery is fully charged.
- 3) Remove all the spark plugs.
- 4) Disconnect connectors from fuel injectors.
- 5) Fully open throttle valve.
- 6) Check the starter motor for satisfactory performance and operation.
- 7) 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.**

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

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

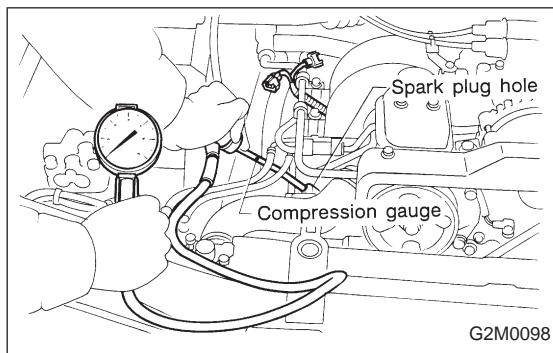
**Compression (200 — 300 rpm and fully open throttle):**

**Standard: 1,079 — 1,275 kPa**

**(11.0 — 13.0 kg/cm<sup>2</sup>, 156 — 185 psi)**

**Limit: 883 kPa (9.0 kg/cm<sup>2</sup>, 128 psi)**

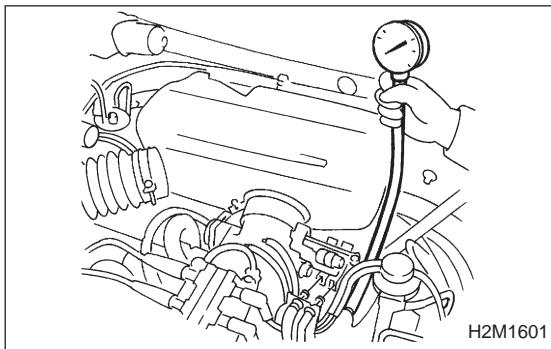
**Difference between cylinders: 196 kPa (2.0 kg/cm<sup>2</sup>, 28 psi)**



## 5. Intake Manifold Vacuum

### A: MEASUREMENT

- 1) Warm-up the engine.
- 2) Disconnect the 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”):**

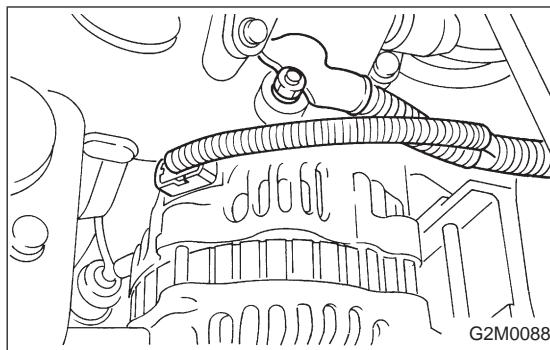
**1800 cc:**

**Less than -66.7 kPa  
(-500 mmHg, -19.69 inHg)**

**2200 cc:**

**Less than -60.0 kPa  
(-450 mmHg, -17.72 inHg)**

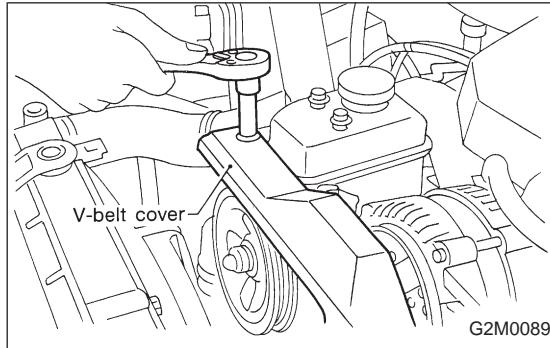
Diagnosis of engine condition by measurement of manifold vacuum	
Vacuum gauge indication	Possible engine condition
1. Needle is steady but lower than normal position. This tendency becomes more evident as engine temperature rises.	Leakage around intake manifold gasket/throttle chamber gasket or disconnection/damaged 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



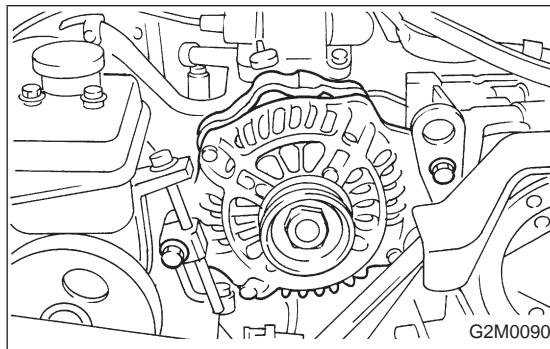
## 6. Engine Oil Pressure

### A: MEASUREMENT

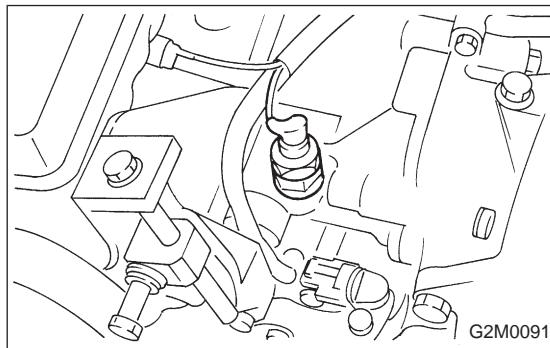
- 1) Remove generator from bracket.
  - (1) Disconnect connector and terminal from generator.



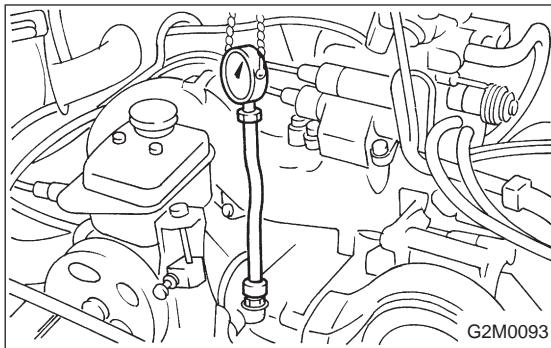
- (2) Remove V-belt cover.
- (3) Loosen lock bolt and slider bolt, and remove front side V-belt.



- (4) Remove lock bolt.
- (5) Remove bolts which install generator on bracket.



- 2) Disconnect connector from oil pressure switch.
- 3) Remove oil pressure switch from engine block.



- 4) Connect oil pressure gauge hose.
- 5) Start the engine, and measure oil pressure.

**Oil pressure:**

**98 kPa (1.0 kg/cm<sup>2</sup>, 14 psi) or more at 600 rpm**  
**294 kPa (3.0 kg/cm<sup>2</sup>, 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 [W1A0].>**

- If oil pressure warning light is turned ON and oil pressure is in specification, replace oil pressure switch.

**<Ref. to 2-4 [W3A0].>**

**NOTE:**

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

- 6) After measuring oil pressure, install oil pressure switch.

**Tightening torque:**

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

- 7) Install generator and V-belt in the reverse order of removal, and adjust the V-belt deflection.

## 7. Valve Clearance

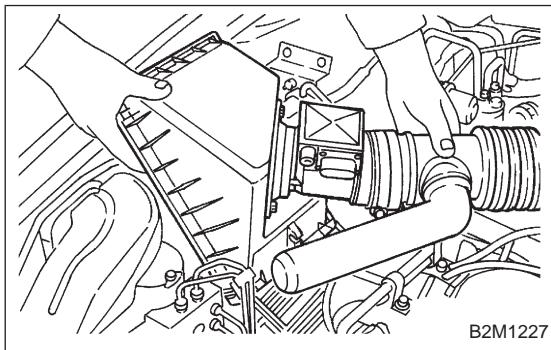
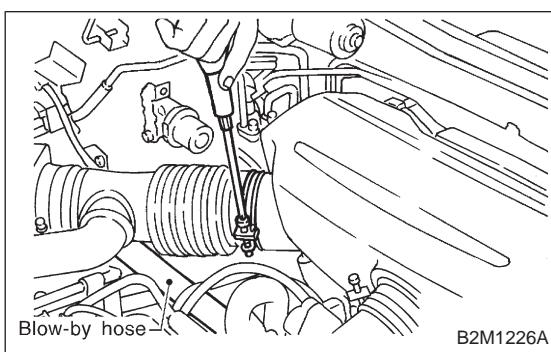
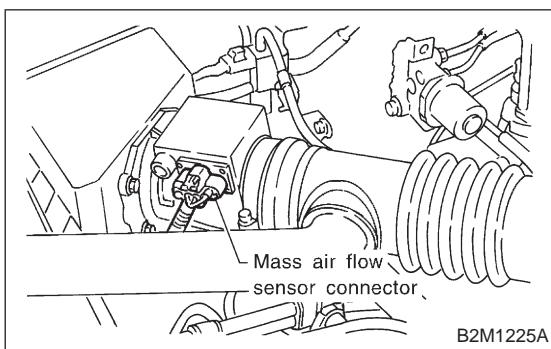
### A: INSPECTION

#### 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 timing belt cover (RH).
- 4) 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.

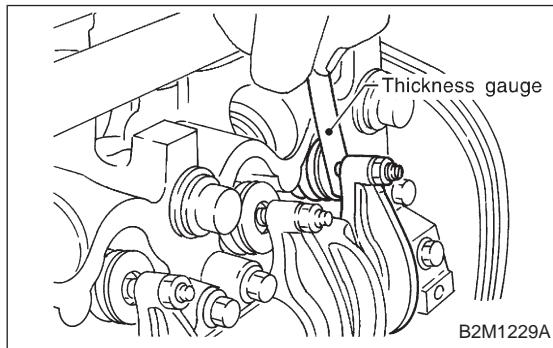
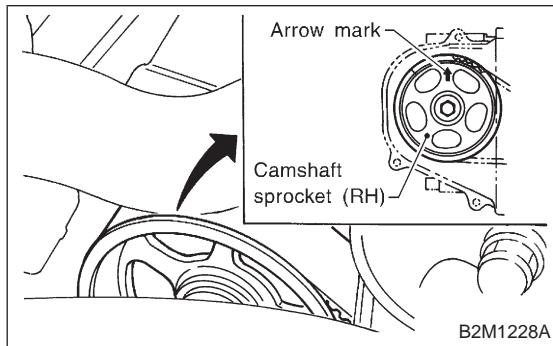
#### CAUTION:

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) Disconnect spark plug cords from spark plugs (#1 and #3 cylinders).
- (8) Remove under cover (RH).
- (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) Disconnect rear window glass washer hose from washer motor, then plug connection with a suitable cap.
  - (4) Remove the two bolts which holds washer tank, then secure the tank away from working area.
  - (5) Disconnect spark plug cords from spark plugs (#2 and #4 cylinders).
  - (6) Remove under cover (LH).
  - (7) Place suitable container under the vehicle.
  - (8) Disconnect PCV hose from rocker cover (LH).
  - (9) Remove bolts, then remove rocker cover (LH).



- 5) 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.

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

**CAUTION:**

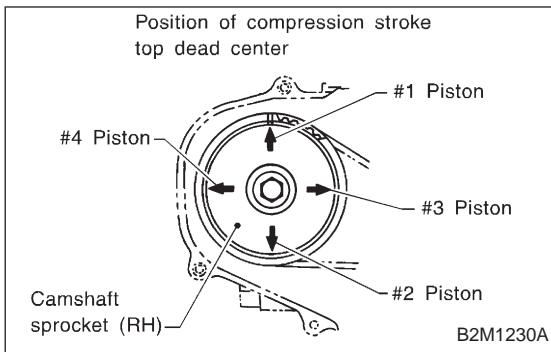
- Insert the thickness gauge in as horizontal a direction as possible with respect to the valve stem end face.
- Measure exhaust valve clearances while lifting-up the vehicle.

**Valve clearance:**

**Intake:  $0.20 \pm 0.02$  mm ( $0.0079 \pm 0.0008$  in)**

**Exhaust:  $0.25 \pm 0.02$  mm ( $0.0098 \pm 0.0008$  in)**

- 7) If necessary, adjust the valve clearance. <Ref. to 2-2 [07B0].>



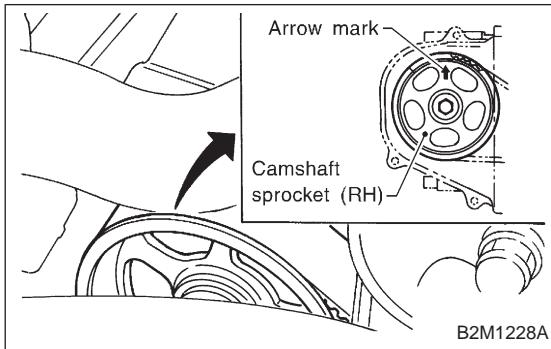
8) Similar to measurement procedures used for #1 cylinder, measure #2, #3 and #4 cylinder valve clearances.

**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.

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



## B: ADJUSTMENT

**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:**

**$10\pm1\text{ N}\cdot\text{m}$  (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:  $0.20\pm0.02\text{ mm}$  (0.0079±0.0008 in)**

**Exhaust:  $0.25\pm0.02\text{ mm}$  (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.