NO.19 EXHAUST SMOKE [SKYACTIV-G 2.0, SKYACTIV-G 2.5]

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19	EXHAUST SMOKE
DESCRIPTION	• Blue, black, or white smoke from exhaust system.
POSSIBLE CAUSE	**Blue smoke (Burning oil):** • PCV valve malfunction • Engine internal oil leakage **White smoke (Water in combustion):** • Cooling system malfunction (coolant loss) • Engine internal coolant leakage **Black smoke (Rich fuel mixture):** • Erratic signal to PCM — APP sensor or related circuit malfunction — ECT sensor or related circuit malfunction — IAT sensor No.1 (integrated in MAF sensor/IAT sensor No.1) or related circuit malfunction — MAF sensor or related circuit malfunction — MAP sensor or related circuit malfunction — A/F sensor or related circuit malfunction — HO2S or related circuit malfunction — TP sensor or related circuit malfunction • Improper fuel injection timing and amount • Air cleaner restriction • Intake-air system is collapsed or restricted • Leakage at engine intake manifold and/or exhaust manifold • Inadequate/Excessive fuel pressure — Fuel pressure sensor malfunction — High pressure fuel pump malfunction — Spill valve control solenoid valve control circuit malfunction (damage to driver in PCM caused by short circuit to ground system) — Spill valve control solenoid valve (built-into high pressure fuel pump) malfunction — Relief valve (built-into high pressure fuel pump) malfunction — Fuel line restricted — Fuel pump unit malfunction • Ignition system malfunction • Improper engine compression • Improper intake valve timing • Improper exhaust valve timing • Injector driver (built-into PCM) malfunction **Warning** **The following troubleshooting flow chart contains the fuel system diagnosis and repair procedures. Read the following warnings before performing the fuel system services:** **• Fuel vapor is hazardous. It can easily ignite, causing serious injury and damage. Always keep sparks and flames away from fuel.** **• Fuel line spills and leakage are dangerous. Fuel can ignite and cause serious injury or death and damage. Fuel can also irritate skin and eyes. To prevent this, always complete "BEFORE SERVICE PRECAUTION" and "AFTER SERVICE PRECAUTION" described in this manual. (See BEFORE SERVICE PRECAUTION [SKYACTIV-G 2.0, SKYACTIV-G 2.5].) (See AFTER SERVICE PRECAUTION [SKYACTIV-G 2.0, SKYACTIV-G 2.5].)** **Caution** **• Disconnecting/connecting the quick release connector without cleaning it may possibly cause damage to the fuel pipe and quick release connector. Always clean the quick release connector joint area before disconnecting/connecting, and make sure that it is free of foreign matter.**

Diagnostic Procedure

STEP	INSPECTION	RESULTS	ACTION
1	**VERIFY EXHAUST COLOR** • What color is smoke coming from the exhaust system?	Blue	Burning oil is indicated. • Go to the next step.
		White	Water in combustion is indicated. • Go to Step 4.
		Black	Rich fuel mixture is indicated. • Go to Step 5.

STEP	INSPECTION	RESULTS	ACTION
2	**INSPECT PCV VALVE** • Inspect the PCV valve. (See POSITIVE CRANKCASE VENTILATION (PCV) VALVE INSPECTION [SKYACTIV-G 2.0, SKYACTIV-G 2.5].) • Is there any malfunction?	Yes	Replace the PCV valve. (See POSITIVE CRANKCASE VENTILATION (PCV) VALVE REMOVAL/INSTALLATION [SKYACTIV-G 2.0, SKYACTIV-G 2.5].)
		No	Go to the next step.
3	**INSPECT ENGINE INTERNAL PARTS** • Inspect for the following engine internal parts: — Damaged valve guide, stems or valve seals — Blocked oil drain passage in cylinder head — Piston ring is not seated, seized or worn — Damage cylinder bore • Is there any malfunction?	Yes	Repair or replace the malfunctioning part according to the inspection results.
		No	Engine internal parts are normal. • If other driveability symptoms are present: — Return to the diagnostic index to service additional symptoms. (See SYMPTOM DIAGNOSTIC INDEX [SKYACTIV-G 2.0, SKYACTIV-G 2.5].)
4	**INSPECT ENGINE FOR ENGINE COOLANT LEAKAGE** • Does the cooling system hold the coolant pressure? (See ENGINE COOLANT LEAKAGE INSPECTION [SKYACTIV-G 2.0, SKYACTIV-G 2.5].)	Yes	Inspect the following: • Cylinder head gasket leakage • Intake manifold gasket leakage • Cracked or porous engine block Repair or replace the malfunctioning part according to the inspection results. • If other driveability symptoms are present: — Return to the diagnostic index to service additional symptoms. (See SYMPTOM DIAGNOSTIC INDEX [SKYACTIV-G 2.0, SKYACTIV-G 2.5].)
		No	Inspect for the cause. Repair or replace the malfunctioning part according to the inspection results.

STEP	INSPECTION	RESULTS	ACTION
5	**VERIFY CURRENT INPUT SIGNAL STATUS** **Caution** **• While performing this step, always operate the vehicle in a safe and lawful manner.** **• When the M-MDS is used to observe monitor system status while driving, be sure to have another technician with you, or record the data in the M-MDS using the PID/DATA MONITOR AND RECORD capturing function and inspect later.** • Access the following PIDs using the M-MDS: (See ON-BOARD DIAGNOSTIC TEST [SKYACTIV-G 2.0, SKYACTIV-G 2.5].) — APP1 — APP2 — ECT — IAT — MAF — MAP — TP REL — O2S11 — O2S12 — SHRTFT1 — LONGFT1 • Monitor the PIDs under the black smoke appeared engine condition. • Do the PIDs indicate normal according to engine conditions? (See PCM INSPECTION [SKYACTIV-G 2.0, SKYACTIV-G 2.5].)	Yes	Go to the next step.
		No	APP1, APP2 PIDs are not as specified: • Inspect the APP sensor. (See ACCELERATOR PEDAL POSITION (APP) SENSOR INSPECTION [SKYACTIV-G 2.0, SKYACTIV-G 2.5].) ECT PID is not as specified: • Inspect the ECT sensor. (See ENGINE COOLANT TEMPERATURE (ECT) SENSOR INSPECTION [SKYACTIV-G 2.0, SKYACTIV-G 2.5].) IAT PID is not as specified: • Inspect the IAT sensor No.1. (See INTAKE AIR TEMPERATURE (IAT) SENSOR INSPECTION [SKYACTIV-G 2.0, SKYACTIV-G 2.5].) MAF PID is not as specified: • Inspect the MAF sensor. (See MASS AIR FLOW (MAF) SENSOR INSPECTION [SKYACTIV-G 2.0, SKYACTIV-G 2.5].) MAP PID is not as specified: • Inspect the MAP sensor. (See MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR INSPECTION [SKYACTIV-G 2.0, SKYACTIV-G 2.5].) TP REL PID is not as specified: • Inspect the TP sensor. (See THROTTLE POSITION (TP) SENSOR INSPECTION [SKYACTIV-G 2.0, SKYACTIV-G 2.5].) O2S11, SHRTFT1, LONGFT1 PIDs are not as specified: • Inspect the A/F sensor. (See AIR FUEL RATIO (A/F) SENSOR INSPECTION [SKYACTIV-G 2.0, SKYACTIV-G 2.5].) O2S12 PID is not as specified: • Inspect the HO2S. (See HEATED OXYGEN SENSOR (HO2S) INSPECTION [SKYACTIV-G 2.0, SKYACTIV-G 2.5].) Repair or replace the malfunctioning part according to the inspection results. • If the malfunction remains: — Perform the “INTERMITTENT CONCERN TROUBLESHOOTING” procedure. (See INTERMITTENT CONCERN TROUBLESHOOTING [SKYACTIV-G 2.0, SKYACTIV-G 2.5].)
6	**INSPECT FUEL INJECTOR OPERATION** • Perform the Fuel Injector Operation Inspection. (See ENGINE CONTROL SYSTEM OPERATION INSPECTION [SKYACTIV-G 2.0, SKYACTIV-G 2.5].) • Do the fuel injectors operate properly?	Yes	Go to the next step.
		No	Repair or replace the malfunctioning part according to the inspection results.
7	**INSPECT INTAKE AIR SYSTEM** • Inspect the following for intake-air system: — Air cleaner restriction — Collapsed or restricted air hose — Leakage • Is there any malfunction?	Yes	Repair or replace the malfunctioning part according to the inspection results.
		No	Go to the next step.
8	**INSPECT EXHAUST SYSTEM FOR LEAKAGE** • Visually inspect for exhaust leakage from exhaust manifold. • Is there any leakage?	Yes	Repair or replace the malfunctioning part according to the inspection results.
		No	Go to the next step.

STEP	INSPECTION	RESULTS	ACTION
9	**INSPECT FUEL PRESSURE (HIGH-SIDE)** • Start the engine and warm it up completely. • Access the FUEL_PRES PID using the M-MDS at idle. (See ON-BOARD DIAGNOSTIC TEST [SKYACTIV-G 2.0, SKYACTIV-G 2.5].) • Is the FUEL_PRES PID value **approx. 3 MPa {31 kgf/cm^2, 435 psi}**?	Yes	Go to Step 13.
		No	Lower than **3 MPa {31 kgf/cm2, 435 psi}**: • Inspect the following: — Fuel leakage at the fuel line and fuel injector — Fuel pump • Perform the Fuel Pump (Low-pressure Side) Operation Inspection. (See ENGINE CONTROL SYSTEM OPERATION INSPECTION [SKYACTIV-G 2.0, SKYACTIV-G 2.5].) — Fuel pressure sensor (See FUEL PRESSURE SENSOR INSPECTION [SKYACTIV-G 2.0, SKYACTIV-G 2.5].) — High pressure fuel pump (See HIGH PRESSURE FUEL PUMP INSPECTION [SKYACTIV-G 2.0, SKYACTIV-G 2.5].) • If there is any malfunction: — Repair or replace the malfunctioning part according to the inspection results. • If there is no malfunction: — Go to Step 12. Higher than **3 MPa {31 kgf/cm2, 435 psi}**: • Go to the next step.
10	**DETERMINE IF MALFUNCTION CAUSE IS FUEL PRESSURE SENSOR OR HIGH PRESSURE FUEL PUMP** • Is the vehicle acceleration performance normal?	Yes	Go to the next step.
		No	Go to Step 12.
11	**INSPECT FUEL PRESSURE SENSOR** • Inspect the fuel pressure sensor. (See FUEL PRESSURE SENSOR INSPECTION [SKYACTIV-G 2.0, SKYACTIV-G 2.5].) • Is there any malfunction?	Yes	Replace the fuel distributor. (See FUEL INJECTOR REMOVAL/INSTALLATION [SKYACTIV-G 2.0, SKYACTIV-G 2.5].)
		No	Go to Step 13.
12	**INSPECT SPILL VALVE CONTROL SOLENOID VALVE CONTROL CIRCUIT FOR SHORT TO GROUND** • Switch the ignition off. • Disconnect the high pressure fuel pump and PCM connectors. • Inspect for continuity between high pressure fuel pump terminal A (wiring harness-side) and body ground. • Is there continuity?	Yes	Repair or replace the wiring harness for a possible short to ground. • If the malfunction remains: — Replace the PCM. (damage to driver in PCM) (See PCM REMOVAL/INSTALLATION [SKYACTIV-G 2.0, SKYACTIV-G 2.5].)
		No	Replace the high pressure fuel pump. (See HIGH PRESSURE FUEL PUMP REMOVAL/INSTALLATION [SKYACTIV-G 2.0, SKYACTIV-G 2.5].)
13	**INSPECT FUEL PRESSURE (LOW-SIDE)** • Connect the fuel pressure gauge between fuel pump and high pressure fuel pump. • Measure the low side fuel pressure. (See FUEL LINE PRESSURE INSPECTION [SKYACTIV-G 2.0, SKYACTIV-G 2.5].) • Is the low side fuel pressure within specification? **Specification:** • **405—485 kPa {4.13—4.94 kgf/cm^2, 58.8—70.3 psi}**	Yes	Go to the next step.
		No	Inspect the following: • Fuel line restriction • Fuel filter clogged — If there is any malfunction: • Repair or replace the malfunctioning part according to the inspection results. — If there is no malfunction: • Replace the fuel pump unit. (See FUEL PUMP UNIT REMOVAL/INSTALLATION [SKYACTIV-G 2.0, SKYACTIV-G 2.5].)
14	**INSPECT IGNITION SYSTEM OPERATION** • Perform the Spark Test. (See ENGINE CONTROL SYSTEM OPERATION INSPECTION [SKYACTIV-G 2.0, SKYACTIV-G 2.5].) • Is a strong blue spark visible at each cylinder?	Yes	Go to the next step.
		No	Repair or replace the malfunctioning part according to the inspection results.

<table>
<tr><th>STEP</th><th>INSPECTION</th><th>RESULTS</th><th>ACTION</th></tr>
<tr><td rowspan="2">15</td><td rowspan="2">INSPECT IF MALFUNCTION CAUSE IS ENGINE COMPRESSION OR INJECTOR DRIVER (PCM INTEGRATED)
• Measure the compression pressure for each cylinder.
(See COMPRESSION INSPECTION [SKYACTIV-G 2.0, SKYACTIV-G 2.5].)
• Are compression pressures within specification?
Specification:
• Compression [SKYACTIV-G 2.0, European (L.H.D. U.K.) specs.]
— Standard: 978 kPa {9.97 kgf/cm^2, 142 psi} (300 rpm)
— Minimum: 783 kPa {7.98 kgf/cm^2, 114 psi} (300 rpm)
— Maximum difference between cylinders: 166 kPa {1.69 kgf/cm^2, 24.1 psi} (300 rpm)
• Compression [SKYACTIV-G 2.0, Except European (L.H.D. U.K.) specs.]
— Standard: 885 kPa {9.02 kgf/cm^2, 128 psi} (300 rpm)
— Minimum: 708 kPa {7.22 kgf/cm^2, 103 psi} (300 rpm)
— Maximum difference between cylinders: 150 kPa {1.53 kgf/cm^2, 21.8 psi} (300 rpm)
• Compression [SKYACTIV-G 2.5]
— Standard: 954 kPa {9.73 kgf/cm^2, 138 psi} (300 rpm)
— Minimum: 763 kPa {7.78 kgf/cm^2, 111 psi} (300 rpm)
— Maximum difference between cylinders: 161 kPa {1.64 kgf/cm^2, 23.4 psi} (300 rpm)

Note
• Because the SKYACTIV-G 2.0 and SKYACTIV-G 2.5 retards the intake valve closing timing, compression pressure is low.</td><td>Yes</td><td>Injector driver malfunction.
• Replace the PCM.
(See PCM REMOVAL/INSTALLATION [SKYACTIV-G 2.0, SKYACTIV-G 2.5].)
If the problem remains, overhaul the engine.</td></tr>
<tr><td>No</td><td>Inspect the following:
• Damaged valve seat
• Worn valve stem and valve guide
• Worn or stuck piston ring
• Worn piston, piston ring or cylinder
• Improper intake valve timing
• Improper exhaust valve timing
Service if necessary.</td></tr>
<tr><td>16</td><td colspan="3">Verify the test results.
• If normal, return to the diagnostic index to service any additional symptoms.
(See SYMPTOM DIAGNOSTIC INDEX [SKYACTIV-G 2.0, SKYACTIV-G 2.5].)
• If a malfunction remains, inspect the related Service Information and perform the repair or diagnosis.
— If the vehicle is repaired, troubleshooting is completed.
— If the vehicle is not repaired or additional diagnostic information is not available, replace the PCM.
(See PCM REMOVAL/INSTALLATION [SKYACTIV-G 2.0, SKYACTIV-G 2.5].)</td></tr>
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