NO.4 HARD TO START/LONG CRANK/ERRATIC START/ERRATIC CRANK [SKYACTIV-G 2.0]

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4	HARD TO START/LONG CRANK/ERRATIC START/ERRATIC CRANK
DESCRIPTION	• Starter cranks engine at normal speed but engine requires excessive cranking time before starting. • Battery is operating normally.
POSSIBLE CAUSE	**Note** • If the ignition is not switched off (to LOCK or ACC) after the engine stalls, and then an engine restart is attempted, the PCM corrects the difference between CKP sensor and CMP sensor signals caused by engine stalling, which may result in more time needed to restart the engine. • Engine overheating • PCM DTC is stored • Erratic signal to PCM — ECT sensor 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 — Improper air/fuel mixture ratio control • Improper operation of drive-by-wire control system • Incorrect fuel injection timing • Fuel injector malfunction • Purge solenoid valve malfunction • Contamination in MAF sensor • Under the condition in which the engine starts and stops repeatedly while the vehicle is not driven, the fuel injected prior to complete ignition during engine start may drop into the oil pan from the cylinder and mix with the engine oil. The situation in which excess quantities of fuel continue to be injected due to an engine coolant temperature signal error is the same. • Intermittent open circuit in PCM ground circuit • Poor fuel quality • Fuel leakage • Air leakage from intake-air system • Intake-air system restriction • Vacuum leakage • Improper engine oil viscosity • Erratic signal from CMP sensor — Loose installation — Damaged trigger wheel (intake camshaft and/or exhaust camshaft) — Open or short circuit in related wiring harness • Erratic signal from CKP sensor — Loose installation — Damaged trigger wheel (crankshaft pulley) — Open or short circuit in related wiring harness • Inadequate fuel pressure (high or low pressure side) — 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 malfunction (built-into high pressure fuel pump) — Relief valve (built-into high pressure fuel pump) malfunction — Fuel line restriction — Fuel filter clogged — Fuel pump unit malfunction • Starting system malfunction • Low engine compression • Improper intake valve timing • Improper exhaust valve timing • Spark plug malfunction • Erratic signal to ignition coils • Exhaust system or TWC restriction • PCV valve malfunction • Injector driver (built-into PCM) malfunction

4	HARD TO START/LONG CRANK/ERRATIC START/ERRATIC CRANK
POSSIBLE CAUSE	**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].) (See AFTER SERVICE PRECAUTION [SKYACTIV-G 2.0].)** **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 material.**

Diagnostic Procedure

STEP	INSPECTION	RESULTS	ACTION
1	**DETERMINE IF MALFUNCTION CAUSE IS OVERHEATING OR OTHER** **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 ECT PID using the M-MDS. (See ON-BOARD DIAGNOSTIC TEST [SKYACTIV-G 2.0].) • Is the ECT PID value **less than 116 °C {241 ° F}** during driving?	Yes	Go to the next step.
		No	The cause of this concern could be from the cooling system overheating. • Perform the symptom troubleshooting "NO.17 COOLING SYSTEM CONCERNS-OVERHEATING". (See NO.17 COOLING SYSTEM CONCERNS-OVERHEATING [SKYACTIV-G 2.0].)
2	**VERIFY PCM DTC** • Retrieve any DTCs using the M-MDS. (See ON-BOARD DIAGNOSTIC TEST [SKYACTIV-G 2.0].) • Are any DTCs present?	Yes	Go to the applicable DTC inspection. (See DTC TABLE [SKYACTIV-G 2.0].)
		No	Go to the next step.

STEP	INSPECTION	RESULTS	ACTION
3	**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].) — ECT — MAF — MAP — O2S11 — O2S12 — SHRTFT1 — LONGFT1 • Do the PIDs indicate the correct values under the trouble condition? (See PCM INSPECTION [SKYACTIV-G 2.0].)	Yes	Go to the next step.
		No	ECT PID is not as specified: • Inspect the ECT sensor. (See ENGINE COOLANT TEMPERATURE (ECT) SENSOR INSPECTION [SKYACTIV-G 2.0].) MAF PID is not as specified: • Inspect the MAF sensor. (See MASS AIR FLOW (MAF) SENSOR INSPECTION [SKYACTIV-G 2.0].) MAP PID is not as specified: • Inspect the MAP sensor. (See MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR INSPECTION [SKYACTIV-G 2.0].) 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].) O2S12 PID is not as specified: • Inspect the HO2S. (See HEATED OXYGEN SENSOR (HO2S) INSPECTION [SKYACTIV-G 2.0].) 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].)
4	**DETERMINE IF MALFUNCTION CAUSE IS DRIVE-BY-WIRE CONTROL SYSTEM OR OTHER** • Will the engine run smoothly at part throttle?	Yes	Go to the next step.
		No	Go to Step 6.
5	**INSPECT DRIVE-BY-WIRE CONTROL SYSTEM OPERATION** • Perform the TP sweep inspection. (See ENGINE CONTROL SYSTEM OPERATION INSPECTION [SKYACTIV-G 2.0].)	Yes	Visually inspect the throttle body (damage/scratching). • If there is any malfunction: — Repair or replace the malfunctioning part according to the inspection results. • If there is no malfunction: — Go to the next step.
	• Does the drive-by-wire control system work properly?	No	Repair or replace the malfunctioning part according to the inspection results.
6	**INSPECT FUEL INJECTOR OPERATION** • Perform the Fuel Injector Operation Inspection. (See ENGINE CONTROL SYSTEM OPERATION INSPECTION [SKYACTIV-G 2.0].) • 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 PURGE CONTROL SYSTEM OPERATION** • Perform the Purge Control System Inspection. (See ENGINE CONTROL SYSTEM OPERATION INSPECTION [SKYACTIV-G 2.0].) • Does the purge solenoid valve work properly?	Yes	Go to the next step.
		No	Repair or replace the malfunctioning part according to the inspection results.
8	**INSPECT MAF SENSOR** • Inspect the MAF sensor for the following: — Contamination • Is there any malfunction?	Yes	Repair or replace the malfunctioning part according to the inspection results.
		No	Go to the next step.
9	**INSPECT PCM FOR POOR GROUND** • Verify the PCM ground point condition. • Is there any ground point loose or lifting in the PCM?	Yes	Repair the ground point.
		No	Go to the next step.

STEP	INSPECTION	RESULTS	ACTION
10	**INSPECT RELATED PART CONDITION** • Inspect the following: — Fuel quality (proper octane, contamination, winter/summer blend) — Fuel leakage — Intake-air system leakage or restriction — Vacuum leakage — Engine oil viscosity — CKP sensor, intake CMP sensor and exhaust CMP sensor • Installation condition (See CRANKSHAFT POSITION (CKP) SENSOR REMOVAL/INSTALLATION [SKYACTIV-G 2.0].) (See CAMSHAFT POSITION (CMP) SENSOR REMOVAL/INSTALLATION [SKYACTIV-G 2.0].) • Damaged trigger wheel, intake camshaft and exhaust camshaft • Is there any malfunction?	Yes	Service if necessary. • Repeat this step.
		No	Go to the next step.
11	**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].) • Is the FUEL_PRES PID value **approx. 3 MPa {31 kgf/cm^2, 435 psi}**?	Yes	Go to Step 15.
		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].) — Fuel pressure sensor (See FUEL PRESSURE SENSOR INSPECTION [SKYACTIV-G 2.0].) — High pressure fuel pump (See HIGH PRESSURE FUEL PUMP INSPECTION [SKYACTIV-G 2.0].) • If there is any malfunction: — Repair or replace the malfunctioning part according to the inspection results. • If there is no malfunction: — Go to Step 14. Higher than **3 MPa {31 kgf/cm2, 435 psi}**: • Go to the next step.
12	**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 14.
13	**INSPECT FUEL PRESSURE SENSOR** • Inspect the fuel pressure sensor. (See FUEL PRESSURE SENSOR INSPECTION [SKYACTIV-G 2.0].) • Is there any malfunction?	Yes	Replace the fuel distributor. (See FUEL INJECTOR REMOVAL/INSTALLATION [SKYACTIV-G 2.0].)
		No	Go to Step 15.
14	**INSPECT SPILL VALVE CONTROL SOLENOID VALVE CONTROL CIRCUIT FOR SHORT TO GROUND** • Switch the ignition to off. • Disconnect the high pressure fuel pump and PCM connectors.	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].)
	• Inspect for continuity between high pressure fuel pump terminal A (wiring harness-side) and body ground. • Is there continuity?	No	Replace the high pressure fuel pump. (See HIGH PRESSURE FUEL PUMP REMOVAL/INSTALLATION [SKYACTIV-G 2.0].)

STEP	INSPECTION	RESULTS	ACTION
15	**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].) • 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].)
16	**INSPECT STARTING SYSTEM** • Inspect the starting system. (See STARTER INSPECTION [SKYACTIV-G 2.0].) • Does the starting system work properly?	Yes	Go to the next step.
		No	Repair or replace the malfunctioning part according to the inspection results.
17	**INSPECT ENGINE COMPRESSION** • Measure the compression pressure for each cylinder. (See COMPRESSION INSPECTION [SKYACTIV-G 2.0].) • Are compression pressures within specification? **Specification:** • Compression [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}** • Compression [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}** **Note** • Because the SKYACTIV-G 2.0 retards the intake valve closing timing, compression pressure is low.	Yes	Go to the next step.
		No	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.
18	**INSPECT IGNITION SYSTEM OPERATION** • Perform the Spark Test. (See ENGINE CONTROL SYSTEM OPERATION INSPECTION [SKYACTIV-G 2.0].) • 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.
19	**INSPECT EXHAUST SYSTEM FOR RESTRICTION** • Inspect for restriction in the exhaust system and the TWC. • Is there any restriction?	Yes	Repair or replace the malfunctioning part according to the inspection results.
		No	Go to the next step.

STEP	INSPECTION	RESULTS	ACTION
20	**INSPECT IF MALFUNCTION CAUSE IS PCV VALVE OR INJECTOR DRIVER (PCM INTEGRATED)** • Inspect the PCV valve. (See POSITIVE CRANKCASE VENTILATION (PCV) VALVE INSPECTION [SKYACTIV-G 2.0].) • Is there any malfunction?	Yes	Replace the PCV valve. (See POSITIVE CRANKCASE VENTILATION (PCV) VALVE REMOVAL/INSTALLATION [SKYACTIV-G 2.0].)
		No	Injector driver malfunction. • Replace the PCM. (See PCM REMOVAL/INSTALLATION [SKYACTIV-G 2.0].) If the problem remains, overhaul the engine.
21	Verify the test results. • If normal, return to the diagnostic index to service any additional symptoms. (See SYMPTOM DIAGNOSTIC INDEX [SKYACTIV-G 2.0].) • 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].)		