### Calculate Load

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Calculate Load | Calculated load by ECM/ Min.: 0%, Max.: 100% | • Idling: 15.4 to 20.4%<br>• Running without load (2500 rpm): 20.1 to 25.9%<br>• Driving with the accelerator fully open at 3000 rpm: 80.3 to 99.6%<br>• Driving with the accelerator fully open at 4000 rpm: 96.4 to 98% | Calculated by ECM | Malfunction in which turbo pressure or Mass Air Flow (MAF) decreases |
| | Results of real-vehicle check:<br><br>• Engine switch on (IG): 0%<br>• Cranking: 70%<br>• Idling (warm up the engine): 18% (2 minutes after starting the vehicle)<br>• Running without load (2500 rpm): 22%<br>• Driving with the accelerator fully open at 2000 rpm: 99%<br>• Driving with the accelerator fully open at 3000 rpm: 100% | | | |
| | Diagnostic Note:<br>Calculate load = (Final injection volume / max. injection volume at current engine speed) x 100. | | | |

### MAF

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| MAF | Air flow rate from MAF meter/ Min.: 0 gm/sec., Max.: 400 gm/sec. | w/ EGR (depending on EGR rate)<br><br>• Idling: 5 to 12 g/sec.<br>• Running without load (2000 rpm): 28.2 to 130 g/sec.<br><br>w/o EGR<br><br>• Idling: 20 to 28 g/sec.<br>• Running without load (2000 rpm): 90 to 130 g/sec. | Sensor output (MAF meter) | • MAF meter<br>• MAF meter circuit<br>• Intake related clog or leak<br>• Exhaust related clog<br>• Turbocharger sub-assembly<br>• Leak or clog in passages for turbocharger<br>• Malfunction in which EGR valve does not close |
| | Results of real-vehicle check: | | | |

| | |
|---|---|
| | w/ EGR:<br><br>• Engine switch on (IG): 1.54 g/sec.<br>• Cranking: 15 g/sec.<br>• Idling (warm up the engine): 9 g/sec. (2 minutes after starting the vehicle)<br>• Running without load (2500 rpm): 80 g/sec.<br>• Driving with the accelerator fully open at 2000 rpm: 110 g/sec.<br>• Driving with the accelerator fully open at 3000 rpm: 230 g/sec. |
| | Symptoms when out of range:<br>Rough idling |
| | Diagnostic Note:<br><br>• Based on the MAF, the ECM controls the fuel injection volume, injection timing, EGR, etc.<br>• If the value is always approximately 0 g/sec.:<br>  • Mass air flow meter power source circuit is open.<br>  • VG circuit is open or shorted.<br>• If the value is always 200 g/sec. or more:<br>  • EVG circuit is open. |

**Engine Speed**

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Engine Speed | Engine speed/ Min.: 0 rpm, Max.: 6000 rpm | • Idling: 550 to 650 rpm (A/T)<br>• Idling: 500 to 600 rpm (M/T) | Sensor output (crankshaft position sensor) | • Crankshaft position sensor<br>• Crankshaft position sensor circuit |
| | Symptoms when out of range:<br>- | | | |
| | Diagnostic Note:<br>When the crankshaft position sensor is malfunctioning, "Engine speed" is approximately 0 or varies greatly from the actual engine speed. | | | |

**MAP**

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| MAP | Absolute pressure inside intake manifold/ Min.: 0 kPa, Max.: 255 kPa | • Idling: 90 to 102 kPa (depending on barometric pressure)<br>• Engine running at 3000 rpm: 100 to 150 kPa | Sensor output (manifold absolute pressure sensor) | • Manifold absolute pressure sensor<br>• Intake related clog or leak<br>• Exhaust related clog<br>• Turbocharger sub-assembly<br>• Leak or clog in passages |

| | | | | |
|---|---|---|---|---|
| | | | | for turbocharger<br>• EGR valve stuck open<br>• Exhaust leak<br>• Throttle valve stuck closed |
| | Results of real-vehicle check:<br><br>• Engine switch on (IG): 99 kPa<br>• Cranking: 99 kPa<br>• Idling (warm up the engine): 99 kPa (2 minutes after starting the vehicle)<br>• Running without load (2500 rpm): 113 kPa<br>• Running without load (4000 rpm): 150 kPa<br>• Driving with the accelerator fully open at 2000 rpm: 143 kPa<br>• Driving with the accelerator fully open at 3000 rpm: 209 kPa | | | |
| | Symptoms when out of range:<br>Lack of power | | | |
| | Diagnostic Note:<br><br>• When the engine switch is on (IG) or the vehicle is idling, the intake manifold absolute pressure and atmospheric pressure are approximately the same (standard atmospheric pressure = 101 kPa).<br>Above approximately 1500 rpm, the turbo becomes effective, and the pressure becomes higher than atmospheric pressure.<br>• Inspect while comparing with "Target Booster Pressure".<br>• With the accelerator fully open, if the actual manifold absolute pressure (MAP) is low compared to the target booster pressure by at least 20 kPa for 5 seconds or more, a feeling of insufficient power will occur. | | | |

### Vehicle Speed

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Vehicle Speed | Vehicle speed/<br>Min.: 0 km/h,<br>Max.: 255 km/h | Actual vehicle speed | Sensor output (speed sensor) | • Speed sensor<br>• Speed sensor circuit |
| | Symptoms when out of range:<br>- | | | |
| | Diagnostic Note:<br>- | | | |

### Coolant Temp

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| Coolant Temp | Engine coolant temperature/ Min.: -40°C, Max.: 140°C | After warming up engine: 75 to 90°C (167 to 194°F) | Sensor output (engine coolant temperature sensor) | • Engine coolant temperature sensor<br>• Thermostat |
| | Symptoms when out of range:<br>Difficult starting when engine is cold, rough idle, black smoke, lack of power | | | |
| | Diagnostic Note:<br>• If the value is -40°C (-40°F) or 140°C (284°F), the sensor circuit is open or shorted.<br>• After a long soak, the coolant temperature, intake air temperature, and ambient air temperature are approximately equal. | | | |

### Intake Air

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Intake Air | Intake air temperature/ Min.: -40°C, Max.: 140°C | Equivalent to temperature at intake manifold | Sensor output (intake air temperature sensor (built into MAF meter)) | Intake air temperature sensor |
| | Symptoms when out of range:<br>- | | | |
| | Diagnostic Note:<br>• After a long soak, the engine coolant temperature, intake air temperature, and ambient air temperature are approximately equal.<br>• If the value is -40°C (-40°F) or 140°C (284°F), the sensor circuit is open or shorted. | | | |

### Initial Engine Coolant Temp

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Initial Engine Coolant Temp | Initial engine coolant temperature/ Min.: -40°C, Max.: 120°C | Engine coolant temperature when engine started | Sensor output when engine started | - |
| | Diagnostic Note:<br>For Freeze Frame Data, this tells whether the malfunction happened at a cold start or with a warm engine. | | | |

### Initial Intake Air Temp

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| Initial Intake Air Temp | Initial intake air temperature/ Min.: -40°C, Max.: 120°C | Intake air temperature when engine started | Sensor output when engine started | - |
| | Diagnostic Note:<br>- | | | |

### Intake Air Temp (Turbo)

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Intake Air Temp (Turbo) | Intake air temperature after intercooler/ Min.: -40°C, Max.: 190°C | 70°C (158°F) or less | Sensor output (intake air temperature sensor after intercooler) | Decreased cooling efficiency of intercooler (contamination, clogging) |
| | Diagnostic Note:<br>• Intake air temperature at the intake manifold (after intercooler).<br>• During fail-safe operation, the value is set to 165°C (329°F). As the value is set to a high temperature, the turbo pressure may be suppressed and there may be a lack of power. | | | |

### Alternate Duty Ratio

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Alternate Duty Ratio | Alternator generation duty ratio/ Min.: 0%, Max.: 100% | • No electrical load at idling: 10 to 60%<br>• High electrical load at idling: 100% | Duty value from ALT terminal | • Battery deterioration<br>• Alternator malfunction<br>• Check for accessory lights, malfunctions, etc. |
| | Results of real-vehicle check:<br>• Idling (No electrical load) (warm up the engine): 30% (2 minutes after starting the vehicle) | | | |
| | Symptoms when out of range:<br>- | | | |
| | Diagnostic Note:<br>• Outputs the alternator generation duty in order to see the electrical load.<br>• Can be used to determine whether a higher-than-normal injection volume at idle, etc. is resulting from electrical loading or from | | | |

| | |
|---|---|
| | some other source. For example, when the duty is not high but the idling injection volume is high, there is injector volume degradation or high engine friction.<br>• Can be used for judging whether or not a malfunctioning component in the electrical system is generating continual generation requests (ex. battery deterioration is causing an unending full recharge request, etc.). Regardless of whether or not an auxiliary device like the A/C or heater is active, the alternator duty is always at MAX status. There is an electrical system abnormality, like battery deterioration. |

**Starter Signal**

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Starter Signal | Starter signal/ ON or OFF | ON: Cranking | - | • OFF malfunction (engine switch (STA) is ON but the signal is OFF and the starter is operating): Wire harness is open or shorted to ground<br>• ON malfunction (engine switch (STA) is OFF but the signal is ON and the starter is not operating): Wire harness is shorted to +B<br>• Operation malfunction: Engine switch malfunction, starter relay malfunction, starter malfunction, battery or battery cable is defective, or wire harness is open or shorted |
| | Symptoms when out of range:<br>• Engine switch is on (IG) but the starter does not operate: Starting is not possible<br>• Engine switch is off but the starter continues to operate: STA signal malfunction (P0617) is stored | | | |
| | Diagnostic Note:<br>• Engine switch (STA) output:<br>  • ON: Starter is operating.<br>  • OFF: Starter is not operating. | | | |

**Power Steering Switch**

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Power Steering Switch | Power steering switch status/ ON or OFF | ON: Power steering operation | Switch output (power steering switch) | • OFF malfunction: Wire harness (power steering switch to ECM) is open or shorted to ground<br>• ON malfunction: Wire harness (power steering switch to ECM) is shorted to +B<br>• Power steering switch |

| | | | | |
|---|---|---|---|---|
| | | | | malfunction |
| | Symptoms when out of range:<br><br>• OFF malfunction (OFF during power steering operation): Engine speed decreases temporarily when power steering is operating | | | |
| | Diagnostic Note:<br>- | | | |

**Power Steering Signal**

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Power Steering Signal | Power steering switch status history/<br>ON or OFF | ON: When steering wheel first turned after engine switch on (IG) | Power steering switch output history (after disconnecting and reconnecting the battery) | - |
| | Diagnostic Note:<br><br>• Power steering switch output history (after disconnecting and reconnecting the battery):<br>  • ON: Power steering operated in the past.<br>  • OFF: Power steering did not operate in the past. | | | |

**A/C Signal**

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| A/C Signal | A/C (Air Conditioner) signal/<br>ON or OFF | ON: A/C on | A/C operation signal output from A/C amplifier<br><br>• ON: Operating<br>• OFF: Not operating | • A/C switch<br>• A/C amplifier<br>• A/C system malfunction, wire harness between A/C amplifier and ECU open or shorted |
| | Symptoms when out of range:<br><br>• OFF malfunction (OFF even when A/C switch is turned on):<br>  • Engine speed decreases temporarily when the A/C is operating. | | | |
| | Diagnostic Note:<br>- | | | |

**Stop Light Switch**

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| Stop Light Switch | Stop light switch/<br>ON or OFF | • ON: Brake pedal depressed<br>• OFF: Brake pedal released | Switch output (stop light switch) | • OFF malfunction: Wire harness (stop light switch to ECM, stop light switch to +B) open or shorted to ground<br>• ON malfunction: Wire harness (stop light switch to ECM) shorted to +B<br>• Stop light switch |
| | Symptoms when out of range:<br>• Stop light switch malfunction DTC P0504 is stored | | | |
| | Diagnostic Note:<br>• Stop light switch (STP) operation condition:<br>  • ON: Light is on (Brake pedal is depressed).<br>  • OFF: Light is off (Brake pedal is released). | | | |

## Intank Fuel Pump

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Intank Fuel Pump | Intank fuel pump status/<br>ON or OFF | Operates according to fuel consumption amount (Operates after about 10 minutes of driving) | Operation command | - |
| | Symptoms when out of range:<br>- | | | |
| | Diagnostic Note:<br>• ON: Intank fuel pump is operating.<br>• Only for vehicles equipped with a double tank. | | | |

## Immobiliser Communication

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Immobiliser Communication | Immobiliser communication/<br>ON or OFF | ON: Normal | - | • Use of a non-registered key<br>• Key battery is fully depleted |
| | Symptoms when out of range:<br>- | | | |
| | Diagnostic Note:<br>- | | | |

## Low Gear Switch

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Low Gear Switch | Shift position switch/<br>ON or OFF | ON: First position | Switch output (low gear switch) | - |
| | Symptoms when out of range:<br>• When OFF with the shift lever in 1, the torque increases like the other gears<br>• When OFF with the shift lever not in 1, the torque decreases like 1st gears | | | |
| | Diagnostic Note:<br>The shift position switch is used to limit torque for manual transmissions | | | |

### Neutral Position SW Signal

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Neutral Position SW Signal | Neutral position switch status/<br>ON or OFF | ON: Neutral position | Switch output (neutral position switch) | - |
| | Symptoms when out of range:<br>- | | | |
| | Diagnostic Note:<br>- | | | |

### Clutch Switch

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Clutch Switch | Clutch switch/<br>ON or OFF | ON: Clutch pedal depressed | Switch output (clutch switch) | - |
| | Symptoms when out of range:<br>When OFF with the clutch pedal depressed, the engine does not start. | | | |
| | Diagnostic Note:<br>- | | | |

### Battery Voltage

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Battery Voltage | Battery voltage/<br>Min.: 0 V, Max.: 15 V | 11 to 14 V | - | - |
| | Results of real-vehicle check:<br>• Engine switch on (IG): 12.5 V<br>• Cranking (with engine warmed up): 9.0 V<br>• Idling (warm up the engine): 13.4 V<br>• Running without load (2500 rpm): 13.5 V<br>• Driving with the accelerator fully open at 2000 rpm: 13 V<br>• Driving with the accelerator fully open at 3000 rpm: 13.2 V | | | |

| | |
|---|---|
| | Symptoms when out of range:<br>If 5 V or less, starting becomes difficult |
| | Diagnostic Note:<br>If 11 V or less, characteristics of some electrical components change. |

**Atmosphere Pressure**

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Atmosphere Pressure | Atmospheric pressure value/<br>Min.: 50 kPa, Max.: 120 kPa | Actual atmospheric pressure | Sensor output (atmospheric pressure sensor (built into ECM)) | Atmospheric pressure sensor itself has failed (atmospheric pressure sensor is inside the ECM) |
| | Symptoms when out of range:<br>- | | | |
| | Diagnostic Note:<br>• With the engine switch on (IG), when the difference between the atmospheric pressure sensor and intake manifold absolute pressure is 10 kPa or higher, there is a malfunction in one of the sensors.<br>• With the engine switch on (IG), when the atmospheric pressure is 0 kPa or 140 kPa, there is a malfunction in the sensor circuit.<br>• Standard atmospheric pressure: 101 kPa.<br>• For every 100 m increase in altitude, pressure drops by 1 kPa. Varies by weather (high atmospheric pressure, low atmospheric pressure). | | | |

**ACT VSV**

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| ACT VSV | A/C cut status for Active Test/<br>ON or OFF | - | - | - |
| | Diagnostic Note:<br>Active Test "Control the A/C Cut Signal" support data. | | | |

**ACM Inhibit**

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| ACM Inhibit | VSV for engine mount status/<br>ON or OFF | - | - | - |
| | Diagnostic Note:<br>• VSV for engine mount status:<br>  • Engine switch is on (IG): OFF.<br>  • Idling: ON.<br>• Active Test "Control the ACM Inhibit" support data. | | | |

### TC and TE1

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| TC and TE1 | Connect the TC and TE1 status for Active Test/<br>ON or OFF | - | - | - |
| | Diagnostic Note:<br>• When the Active Test "Connect the TC and TE1" is performed, the system behaves as if TC and CG were connected. | | | |

### # Codes

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| # Codes | Number of codes/<br>Min.: 0, Max.: 255 | - | - | - |
| | Diagnostic Note:<br>Number of DTCs appearing at least once during the last 40 times the vehicle was warmed up. | | | |

### Check Mode

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Check Mode | Check mode/<br>ON or OFF | ON: Check mode ON | - | - |
| | Diagnostic Note:<br>Check Mode: The mode in which certain DTCs can be detected more easily and with higher sensitivity. | | | |

### SPD Test

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| SPD Test | Check mode result for vehicle speed sensor/<br>Compl or Incompl | - | - | - |
| | Diagnostic Note:<br>SPD Test: Check mode result for vehicle speed sensor. | | | |

### MIL

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| MIL | MIL status/<br>ON or OFF | ON: MIL on | - | - |

### MIL ON Run Distance

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| MIL ON Run | MIL on run | Distance | Result of ECU calculations | - |

| | | | | |
|---|---|---|---|---|
| Distance | distance/<br>Min.: 0 km,<br>Max.: 65535 km | after DTC stored | (using the vehicle speed) | |
| | Diagnostic Note:<br>• Distance traveled after a DTC is stored.<br>• Cleared when the negative (-) battery cable is disconnected or when the DTC is cleared using the intelligent tester. | | | |

### Running Time from MIL ON

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Running Time from MIL ON | Running time from MIL on/<br>Min.: 0 min., Max.: 65535 min. | Running time after MIL turns on | - | - |
| | Diagnostic Note:<br>• Engine run time since the MIL illumination.<br>• Cleared when the negative (-) battery cable is disconnected or when the DTC is cleared using the intelligent tester. | | | |

### Engine Run Time

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Engine Run Time | Engine run time/<br>Min.: 0 sec.,<br>Max.: 65535 sec. | Time after the engine switch turned on (IG) | ECU calculations (using the engine speed) | - |
| | Diagnostic Note:<br>Time passed since the engine switch was turned on (IG). | | | |

### Time after DTC Cleared

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Time after DTC Cleared | Time after DTC cleared/<br>Min.: 0 min., Max.: 65535 min. | Time after DTCs cleared | - | - |
| | Diagnostic Note:<br>Time elapsed since the DTCs were cleared (or shipment from the factory). | | | |

### Distance from DTC Cleared

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Distance from | Distance after DTC | Driving distance after DTCs | - | - |

| | | | | |
|---|---|---|---|---|
| DTC Cleared | cleared/<br>Min.: 0 km, Max.: 65535 km | were cleared | | |
| | Diagnostic Note:<br><br>• Distance driven since the DTCs were cleared.<br>• (Data List's "Distance from DTC clear") - (Freeze frame data's "Distance from DTC clear") = Distance driven since the abnormality occurred. | | | |

## Warmup Cycle Cleared DTC

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Warmup Cycle Cleared DTC | Warmup cycle after DTC cleared/<br>Min.: 0, Max.: 255 | - | - | - |
| | Diagnostic Note:<br><br>• Number of engine warm ups since DTCs were cleared.<br>• (Data List "Warmup Cycle Cleared DTC") - (Freeze frame data "Warmup Cycle Cleared DTC") = Warmup cycles since the abnormality occurred. | | | |

## OBD Requirements

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| OBD Requirements | Identifying OBD requirement | - | - | - |
| | Diagnostic Note:<br>Euro-OBD. | | | |

## Number of Emission DTC

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Number of Emission DTC | Number of emission DTCs | - | - | |
| | Diagnostic Note:<br>- | | | |

## Complete Parts Monitor

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Complete Parts Monitor | Complete parts monitor/<br>Not Avl or Avail | - | - | - |
| | Diagnostic Note:<br>- | | | |

## Engine Start Time

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Engine Start Time | Engine start time/<br>Min.: 0 ms,<br>Max.: 267000 ms | - | - | - |
| | Diagnostic Note:<br>Time necessary for the engine to start.<br>**CAUTION:**<br>This Data List item cannot be used. | | | |

### ACC Relay

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| ACC Relay | ACC (accessory) relay/<br>ON or OFF | ON: Cranking | - | - |
| | Diagnostic Note:<br>- | | | |

### Starter Relay

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Starter Relay | Starter relay/<br>ON or OFF | ON: Cranking | - | - |
| | Diagnostic Note:<br>- | | | |

### Accel Position

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Accel Position | Accelerator position status/<br>Min.: 0%,<br>Max.: 100% | • Accelerator pedal released: 0%<br>• Accelerator pedal fully depressed: 100% | • Accelerator pedal position sensor opening position<br>• ETC request opening position<br>• Cruise request opening position<br>• VSC request opening position | - |
| | Results of real-vehicle check:<br>• Engine switch on (IG): 0% (accelerator pedal released)<br>• Running without load (2500 rpm): 24.6%<br>• Running without load (4700 rpm): 99.6% (accelerator pedal fully depressed) | | | |
| | Symptoms when out of range:<br>- | | | |
| | Diagnostic Note:<br>• "Accel Position" is the accelerator opening angle (%) for engine | | | |

| | |
|---|---|
| | control use.<br>• When the MIL is illuminated, even with the accelerator pedal fully depressed and an "Accel Position" of around 10% or 25%, it means the fail-safe is restricting the accelerator.<br>• When the accelerator pedal position sensor output itself (Accelerator Position 1, Accelerator Position 2) is in the normal voltage range, another actuator malfunction has caused the fail-safe to restrict the accelerator.<br>• Without cruise or ETC, VSC requests, and without accelerator restriction by the fail-safe, this is adjusted proportionally to the depressing of the accelerator pedal by the driver.<br>• Accelerator fully closed: 0%<br>• Accelerator fully open: 100% |

**HINT:**

Accel Position 1 and Accel Position 2 express the value obtained by dividing the output voltage from the accelerator pedal position sensor by 5. This is used only for diagnosing malfunctions in the accelerator pedal position sensor. Under normal conditions, it is sufficient to only check the accelerator opening angle final value "Accel Position".

## Compression

### Engine Speed of Cyl #1

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Engine Speed of Cyl #1 | Engine speed for No. 1 cylinder/ Min.: 0 rpm, Max.: 6000 rpm | "Engine speed" of all cylinders almost same | - | Cyl #1 compression goes down |
| | Symptoms when out of range:<br>When the engine speed of all cylinders is not equal, idling will be rough. | | | |
| | Diagnostic Note:<br>• Output only when the Active Test "Check the Cylinder Compression" is performed.<br>• Indicates the speed of each cylinder when cranking.<br>Example - Normal: Engine speed of all cylinders is approximately equal.<br>When No. 1 cylinder compression is low, "Engine speed of Cyl #1" is approximately 300 rpm, and "Engine speed of Cyl #2 to #8" is approximately 200 rpm. | | | |

### Engine Speed of Cyl #2

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Engine Speed of Cyl #2 | Engine speed for No. 2 cylinder/ Min.: 0 rpm, Max.: 6000 rpm | - | - | - |

### Engine Speed of Cyl #3

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Engine Speed of Cyl #3 | Engine speed for No. 3 cylinder/ Min.: 0 rpm, Max.: 6000 rpm | - | - | - |

### Engine Speed of Cyl #4

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Engine Speed of Cyl #4 | Engine speed for No. 4 cylinder/ Min.: 0 rpm, Max.: 6000 rpm | - | - | - |

### Engine Speed of Cyl #5

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Engine Speed of Cyl #5 | Engine speed for No. 5 cylinder/ Min.: 0 rpm, Max.: 6000 rpm | - | - | - |

### Engine Speed of Cyl #6

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Engine Speed of Cyl #6 | Engine speed for No. 6 cylinder/ Min.: 0 rpm, Max.:6000 rpm | - | - | - |

### Engine Speed of Cyl #7

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Engine Speed of Cyl #7 | Engine speed for No. 7 cylinder/ Min.: 0 rpm, Max.: 6000 rpm | - | - | - |

### Engine Speed of Cyl #8

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Engine Speed of Cyl #8 | Engine speed for No. 8 cylinder/ Min.: 0 rpm, Max.: 6000 rpm | - | - | - |

### Av Engine Speed of All Cyl

| Tester Display | Measurement Item/Range | Normal | Type | Cause of Out of |
|---|---|---|---|---|

| | | Condition | | Range |
|---|---|---|---|---|
| Av Engine Speed of All Cyl | Engine speed for all cylinders/<br>Min.: 0 rpm, Max.: 6000 rpm | - | - | - |
| | Diagnostic Note:<br>• Output only when the Active Test "Check the Cylinder Compression" is performed.<br>• Indicates the average engine speed of all cylinders during cranking. | | | |

## Vehicle Information

### Model Code

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Model Code | Model code | - | - | - |
| | Diagnostic Note:<br>• Identifying model code: | | | |

### Engine Type

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Engine Type | Engine type | - | - | - |
| | Diagnostic Note:<br>• Identifying engine type: 1VDFTV | | | |

### Cylinder Number

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Cylinder Number | Cylinder number/<br>Min.: 0, Max.: 255 | - | - | - |
| | Diagnostic Note:<br>• Identifying cylinder number: 8 | | | |

### Transmission Type

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Transmission Type | Transmission type/<br>MT or ECT 6th | - | - | - |
| | Diagnostic Note: | | | |

| | |
|---|---|
| | Identifying transmission type:<br><br>• MT: Manual transmission<br>• ECT 6th: Automatic transmission |

### Destination

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Destination | Destination | - | - | - |
| | Diagnostic Note:<br><br>• Identifying destination: | | | |

### Model Year

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Model Year | Model year/<br>Min.: 1900, Max.: 2155 | - | - | - |
| | Diagnostic Note:<br><br>• Identifying model year: 200# | | | |

### System Identification

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| System Identification | System identification | - | - | - |
| | Diagnostic Note:<br><br>• Identifying engine type: Diesel | | | |

## Diesel Injection

### Target Common Rail Pressure

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Target Common Rail Pressure | Target common rail pressure/<br>Min.: 0 kPa, Max.: 250000 kPa | 25000 to 180000 kPa when engine running | Target common rail pressure (ECU calculated value) | - |
| | Results of real-vehicle check:<br><br>• Engine switch on (IG): 32000 kPa | | | |

| | |
|---|---|
| | • Cranking: 29000 kPa<br>• Idling (warm up the engine): 32000 kPa (2 minutes after starting the vehicle)<br>• Running without load (2500 rpm): 62000 kPa<br>• Running without load (3500 rpm): 80200 kPa<br>• Driving with the accelerator fully open at 2000 rpm: 95000 kPa<br>• Driving with the accelerator fully open at 3000 rpm: 155000 kPa |
| | Symptoms when out of range:<br>- |
| | Diagnostic Note:<br><br>• Inspect the (actual) fuel pressure, comparing it against the common rail target value.<br>• Considered normal when the actual fuel pressure is within +/-5 MPa of the target fuel pressure under stable conditions. |

**Fuel Press**

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Fuel Press | Fuel pressure/ Min.: 0 kPa, Max.: 250000 kPa | Idling: 27000 to 37000 kPa | Sensor output (fuel pressure sensor) | • Fuel supply pump<br>• High pressure pipes<br>• Fuel pressure sensor<br>• Fuel injector<br>• Feed pump (fuel supply pump)<br>• Fuel filter<br>• Pressure limmiter<br>• Air bleed to the fuel<br>• Lack of fuel |
| | Results of real-vehicle check:<br><br>• Engine switch on (IG): 0 kPa<br>• Cranking: 29000 kPa<br>• Idling (warm up the engine): 32000 kPa (2 minutes after starting the vehicle)<br>• Running without load (2500 rpm): 62000 kPa<br>• Driving with the accelerator fully open at 2000 rpm: 92000 kPa<br>• Driving with the accelerator fully open at 3000 rpm: 155000 kPa | | | |
| | Symptoms when out of range:<br><br>• Difficult to start, poor driveability, lack of power, abnormal combustion noise | | | |
| | Diagnostic Note: | | | |

| | |
|---|---|
| | • Fuel pressure is the actual common rail fuel pressure.<br>• Inspect by comparing the fuel pressure with the target fuel pressure.<br>• When in a stable condition such as when idling, the fuel pressure is within +/-5 MPa of the target fuel pressure.<br>• The ECM uses fuel pressure for feedback control of the target fuel pressure via the supply pump.<br>The injection amount is determined based on the injection timing and fuel pressure.<br>Also, the spray pattern is selected based on the fuel pressure.<br>• For startup, at least 25 MPa of fuel pressure is needed (take care as there is a response lag when the pressure rises).<br>• When the fuel pressure is below 25 MPa, it may cause rough idling.<br>• When the fuel pressure has decreased by 20 MPa from the target fuel pressure, there may be a lack of power.<br>• If actual fuel pressure is 40 MPa higher than the target fuel pressure, P1229 will be stored. When it is lower than the target fuel pressure, "Lack of Power" will occur, but a DTC will not be stored.<br>• When the fuel pressure is higher than 200 MPa, DTC P0088 will be stored. |

**Target Pump SCV Current**

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Target Pump SCV Current | Pump current target final value/ Min.: 0 mA, Max.: 4000 mA | Idling: 923 to 1123 mA | Control target (pump current) | • Suction control valve malfunction<br>• Clogged fuel filter |
| | Results of real-vehicle check:<br>• Engine switch on (IG): 0 mA<br>• Cranking: 1200 mA<br>• Running without load (2500 rpm): 1300 mA<br>• Driving with the accelerator fully open at 2000 rpm: 1440 mA<br>• Driving with the accelerator fully open at 3000 rpm: 1560 mA | | | |
| | Symptoms when out of range:<br>Difficult starting, lack of power, or rough idling | | | |
| | Diagnostic Note:<br>• ECU-calculated value for the suction control valve actuation target current.<br>• Value is large when a high fuel pressure is desired.<br>• Value becomes stuck at 3 A or more or operation is poor (poor movement due to deposits, etc.).<br>• When this deviates from the standard value, it indicates that for some reason, even though the pump is running hard, the actual fuel pressure is inconsistent with the target fuel pressure. | | | |

## Inj. FB Vol. for Idle

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Inj. FB Vol. for Idle | Idle stability status integral control volume/ Min.: -80 $mm^3$/st, Max.: 79 $mm^3$/st | -10 to 10 $mm^3$/st | - | - |
| | Results of real-vehicle check:<br>• Idling (warm up the engine): -0.57 $mm^3$/st | | | |
| | Symptoms when out of range:<br>Engine friction problem, compression problem, or injector breakdown | | | |
| | Diagnostic Note:<br>• When the actual engine speed does not match the target idling RPM, this corrects the injection volume. Abnormal if +/-10 $mm^3$/st or more.<br>• Only calculated and reflected at idle. | | | |

## Injection Volume

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Injection Volume | Injection volume/ Min.: 0 $mm^3$/st, Max.: 1279.98 $mm^3$/st | Idling: 3.0 to 10 $mm^3$/st | Calculated value | - |
| | Results of real-vehicle check:<br>• Cranking: 21 $mm^3$/st<br>• Idling (warm up the engine): 6 $mm^3$/st<br>• Running without load (2500 rpm): 9 $mm^3$/st<br>• Running without load (4700 rpm): 16 $mm^3$/st<br>• Driving with the accelerator fully open at 2000 rpm: 50 $mm^3$/st<br>• Driving with the accelerator fully open at 3000 rpm: 70 $mm^3$/st | | | |
| | Symptoms when out of range:<br>- | | | |
| | Diagnostic Note:<br>• Injection amount for each combustion.<br>• If injectors are clogged, fuel quality is poor, the fuel filter is clogged, or engine friction increases, "Injection Volume" will increase.<br>• If there is a malfunction due to low turbocharger pressure or a low intake air volume, the injection volume is limited and there is a lack of power. | | | |

## Injection Pressure Correction

| Tester Display | Measurement | Normal Condition | Type | Cause of Out of |
|---|---|---|---|---|

| | Item/Range | | | Range |
|---|---|---|---|---|
| Injection Pressure Correction | Injection pressure feedback compensation volume/ Min.: -500 $mm^3$/st, Max.: 780 $mm^3$/st | -20 to 20 $mm^3$/st at standard temperature | Calculated value | • Suction control valve malfunction<br>• Clogged fuel filter |
| | Results of real-vehicle check:<br><br>• Engine switch on (IG): 0 $mm^3$/st<br>• Cranking: 0 $mm^3$/st<br>• Idling (warm up the engine): 8 $mm^3$/st (2 minutes after starting the vehicle)<br>• Running without load (2500 rpm): 11 $mm^3$/st<br>• Driving with the accelerator fully open at 2000 rpm: 44 $mm^3$/st<br>• Driving with the accelerator fully open at 3000 rpm: 71 $mm^3$/st | | | |
| | Symptoms when out of range:<br>- | | | |
| | Diagnostic Note:<br><br>• When the (actual) fuel pressure is equal to the target fuel pressure, this value becomes 0.<br>• This indicator can be used for diagnosing supply pump related malfunctions.<br>• When this value (absolute value) is large, it indicates that the difference between the actual and target fuel pressure is also large. A positive value indicates that the pressure feed is being increased due to insufficient pressure. A negative value indicates that pressure is being reduced due to excessive rail pressure.<br>When the suction control valve does not close properly, it causes rail overpressure, and this value and the "Pump SCV Learning Value" slip to the negative volume side. | | | |

### Injection Feedback Val #1

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Injection Feedback Val #1 | Injection volume correction for No. 1 cylinder/ Min.: -10 $mm^3$/st, Max.: 10 $mm^3$/st | Idling: -3.0 to 3.0 $mm^3$/st | Learned value | • Injector clogging<br>• Injector deterioration<br>• Decrease in cylinder compression<br>• Injector compensation code is incorrectly set (forgot to input code after replacement or made mistake during setting of code after replacing ECM with one from another vehicle) |
| | Results of real-vehicle check:<br>Idling: | | | |
| | Symptoms when out of range:<br>Rough idling, black smoke, white smoke, poor driveability, lack of power, abnormal combustion noise, difficult to start | | | |
| | Diagnostic Note: | | | |

| | |
|---|---|
| | • When idling after warm up, the injection amount for each cylinder is corrected to optimize the difference between the engine speed of each cylinder.<br>Example: For cylinders that are slowing the engine speed compared to other cylinders, the injection volume is increased.<br>• "Injection Feedback Val" more than 3.0 $mm^3$/st: Injector breakdown is causing injection volume deviation, or insufficient compression is causing poor combustion. |

**Injection Feedback Val #2**

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Injection Feedback Val #2 | Injection volume correction for No. 2 cylinder/ Min.: -10 $mm^3$/st, Max.: 10 $mm^3$/st | Idling: -3.0 to 3.0 $mm^3$/st | Learned value | • Injector clogging<br>• Injector deterioration<br>• Decrease in cylinder compression<br>• Injector compensation code is incorrectly set (forgot to input code after replacement or made mistake during setting of code after replacing ECM with one from another vehicle) |
| | Diagnostic Note:<br>The intelligent tester display number and the cylinder number do not match. | | | |

**Injection Feedback Val #3**

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Injection Feedback Val #3 | Injection volume correction for No. 6 cylinder/ Min.: -10 $mm^3$/st, Max.: 10 $mm^3$/st | Idling: -3.0 to 3.0 $mm^3$/st | Learned value | • Injector clogging<br>• Injector deterioration<br>• Decrease in cylinder compression<br>• Injector compensation code is incorrectly set (forgot to input code after replacement or made mistake during setting of code after replacing ECM with one from another vehicle) |
| | Diagnostic Note:<br>The intelligent tester display number and the cylinder number do not match. | | | |

**Injection Feedback Val #4**

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Injection Feedback Val #4 | Injection volume correction for No. 7 cylinder/ Min.: -10 $mm^3$/st, Max.: 10 $mm^3$/st | Idling: -3.0 to 3.0 $mm^3$/st | Learned value | • Injector clogging<br>• Injector deterioration<br>• Decrease in cylinder compression<br>• Injector compensation code is incorrectly set (forgot to input code after replacement or made mistake during setting of code after replacing ECM with one from another vehicle) |

| | |
|---|---|
| | Diagnostic Note:<br>The intelligent tester display number and the cylinder number do not match. |

### Injection Feedback Val #5

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Injection Feedback Val #5 | Injection volume correction for No. 3 cylinder/ Min.: -10 $mm^3$/st, Max.: 10 $mm^3$/st | Idling: -3.0 to 3.0 $mm^3$/st | Learned value | • Injector clogging<br>• Injector deterioration<br>• Decrease in cylinder compression<br>• Injector compensation code is incorrectly set (forgot to input code after replacement or made mistake during setting of code after replacing ECM with one from another vehicle) |
| | Diagnostic Note:<br>The intelligent tester display number and the cylinder number do not match. | | | |

### Injection Feedback Val #6

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Injection Feedback Val #6 | Injection volume correction for No. 4 cylinder/ Min.: -10 $mm^3$/st, Max.: 10 $mm^3$/st | Idling: -3.0 to 3.0 $mm^3$/st | Learned value | • Injector clogging<br>• Injector deterioration<br>• Decrease in cylinder compression<br>• Injector compensation code is incorrectly set (forgot to input code after replacement or made mistake during setting of code after replacing ECM with one from another vehicle) |
| | Diagnostic Note:<br>The intelligent tester display number and the cylinder number do not match. | | | |

### Injection Feedback Val #7

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Injection Feedback Val #7 | Injection volume correction for No. 5 cylinder/ Min.: -10 $mm^3$/st, Max.: 10 $mm^3$/st | Idling: -3.0 to 3.0 $mm^3$/st | Learned value | • Injector clogging<br>• Injector deterioration<br>• Decrease in cylinder compression<br>• Injector compensation code is incorrectly set (forgot to input code after replacement or made mistake during setting of code after replacing ECM with one from another vehicle) |
| | Diagnostic Note:<br>The intelligent tester display number and the cylinder number do not match. | | | |

### Injection Feedback Val #8

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Injection | Injection | Idling: - | Learned | • Injector clogging |

| | | | | |
|---|---|---|---|---|
| Feedback Val #8 | volume correction for No. 8 cylinder/ Min.: -10 $mm^3$/st, Max.: 10 $mm^3$/st | 3.0 to 3.0 $mm^3$/st | value | • Injector deterioration<br>• Decrease in cylinder compression<br>• Injector compensation code is incorrectly set (forgot to input code after replacement or made mistake during setting of code after replacing ECM with one from another vehicle) |
| | Diagnostic Note:<br>The intelligent tester display number and the cylinder number do not match. | | | |

## Pilot 1 Injection Period

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Pilot 1 Injection Period | Pilot 1 injection period/ Min.: 0 µs, Max.: 65535 µs | Idling: 0 µs | Calculated value | - |
| | Results of real-vehicle check:<br>• Cranking: 0 µs<br>• Idling (warm up the engine): 0 µs<br>• Running without load (2500 rpm): 0 µs<br>• Running without load (3500 rpm): 363 µs<br>• Driving with the accelerator fully open at 2000 rpm: 380 µs<br>• Driving with the accelerator fully open at 3000 rpm: 0 µs | | | |
| | Symptoms when out of range:<br>Combustion noise, poor driveability, white smoke. | | | |
| | Diagnostic Note:<br>Check to see if "Pilot 1 Injection Period" is not zero when the symptoms occur. | | | |

## Pilot 2 Injection Period

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Pilot 2 Injection Period | Pilot 2 injection period/ Min.: 0 µs, Max.: 65535 µs | Idling: 390 to 490 µs | Calculated value | - |
| | Results of real-vehicle check:<br>• Engine switch on (IG): 0 µs<br>• Cranking: 660 µs<br>• Idling (warm up the engine): 440 µs (2 minutes after starting the vehicle)<br>• Running without load (2500 rpm): 380 µs<br>• Driving with the accelerator fully open at 2000 rpm: 0 µs<br>• Driving with the accelerator fully open at 3000 rpm: 0 µs | | | |
| | Symptoms when out of range:<br>Combustion noise, poor driveability, white smoke. | | | |
| | Diagnostic Note: | | | |

| | |
|---|---|
| | Check to see if "Pilot 2 Injection Period" is not zero when the symptoms occur. |

### Main Injection Period

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Main Injection Period | Main injection period/ Min.: 0 µs, Max.: 65535 µs | Idling: 490 to 690 µs | Calculated value | - |
| | Results of real-vehicle check:<br>• Cranking: 1250 µs<br>• Idling (warm up the engine): 630 µs (2 minutes after starting the vehicle)<br>• Running without load (2500 rpm): 515 µs<br>• Driving with the accelerator fully open at 2000 rpm: 980 µs<br>• Driving with the accelerator fully open at 3000 rpm: 1010 µs | | | |
| | Symptoms when out of range:<br>- | | | |
| | Diagnostic Note:<br>• When the fuel pressure becomes 15 MPa or less, "Main Injection Period" is set to 0.<br>• When the engine will not start, confirm that injection is performed.<br>• When P0093, P0607, P0627, P062D or P062E is stored, there is an engine stall request. At that time, "Main Injection Period" equals 0.<br><br>**HINT:**<br>As the engine stalls 1 minute after the MIL illuminates, freeze frame data cannot be checked. | | | |

### After Injection Period

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| After Injection Period | After injection period/ Min.: 0 µs, Max.: 65535 µs | - | Calculated value | - |
| | Symptoms when out of range:<br>- | | | |
| | Diagnostic Note:<br>Check to see if "After Injection Period" is not zero when the following symptoms occur:<br>Black smoke, poor driveability. | | | |

### Pilot 1 Injection Timing

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Pilot 1 Injection Timing | Pilot 1 injection timing/ | Idling after engine warmed up and vehicle under normal atmospheric pressure: 0°CA | Calculated value | - |

| | | | | |
|---|---|---|---|---|
| | Min.: -70°CA, Max.: 20°CA | | | |
| | Symptoms when out of range:<br>- | | | |
| | Diagnostic Note:<br>- | | | |

### Pilot 2 Injection Timing

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Pilot 2 Injection Timing | Pilot 2 injection timing/ Min.: -50°CA, Max.: 20°CA | Idling after engine warmed up and vehicle under normal atmospheric pressure: -6 to -2°CA | Calculated value | - |
| | Results of real-vehicle check:<br>• Engine switch on (IG): 0°CA<br>• Cranking: -6.0°CA<br>• Idling (warm up the engine): -3.7°CA<br>• Running without load (2500 rpm): -18°CA<br>• Driving with the accelerator fully open at 2000 rpm: -35.8°CA<br>• Driving with the accelerator fully open at 3000 rpm: -35.8°CA | | | |
| | Symptoms when out of range:<br>- | | | |
| | Diagnostic Note:<br>- | | | |

### Main Injection Timing

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Main Injection Timing | Main injection timing/ Min.: -90°CA, Max.: 90°CA | Idling after engine warmed up and vehicle under normal atmospheric pressure: -0.5 to 4°CA | Calculated value | - |
| | Results of real-vehicle check:<br>• Engine switch on (IG): -3.4°CA<br>• Cranking: -3.0°CA<br>• Idling (warm up the engine): 1.0°CA<br>• Running without load (2500 rpm): 0°CA<br>• Driving with the accelerator fully open at 2000 rpm: -7.6°CA<br>• Driving with the accelerator fully open at 3000 rpm: -4.5°CA | | | |

| | |
|---|---|
| | Symptoms when out of range:<br>- |
| | Diagnostic Note:<br>Use "Main Injection Timing" to check poor drivability when the following symptoms are present: Bad injection timing, black smoke, and white smoke. |

### After Injection Timing

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| After Injection Timing | After injection timing/ Min.: -10°CA, Max.: 50°CA | - | Calculated Value | - |
| | Results of real-vehicle check:<br>• Engine switch on (IG): 0°CA<br>• Cranking: 0°CA<br>• Idling (warm up the engine): 0°CA<br>• Running without load (2500 rpm): 21.9°CA<br>• Driving with the accelerator fully open at 2000 rpm: 17°CA<br>• Driving with the accelerator fully open at 3000 rpm: 22°CA | | | |
| | Symptoms when out of range: | | | |
| | Diagnostic Note:<br>Use "Main Injection Timing" to check poor drivability when the following symptoms are present: Bad injection timing, black smoke, and white smoke. | | | |

### Fuel Temperature

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Fuel Temperature | Fuel temperature/ Min.: -40°C, Max.: 140°C | Actual fuel temperature | Sensor output (fuel temperature sensor) | - |
| | Symptoms when out of range:<br>- | | | |
| | Diagnostic Note:<br>After fully cold soaking, the fuel temperature is the same as the outside air temperature. | | | |

### Fuel System Monitor

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Fuel System Monitor | Fuel system monitor/ Not Avl or Avail | - | - | - |
| | Symptoms when out of range:<br>- | | | |
| | Diagnostic Note:<br>This item does not apply to diesel engines. | | | |

## EGR system

### Target EGR Valve Pos.

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Target EGR Valve Pos. | No. 1 EGR valve target opening angle/ Min.: 0%, Max.: 100% | Idling after engine warmed up: 0 to 80% | ECU-calculated value based on sensors (MAF meter, manifold absolute pressure sensor, intake air temperature (built into MAF meter), etc.) | - |
| | Results of real-vehicle check:<br>• Engine switch on (IG): 0%<br>• Cranking: 0%<br>• Idling (warm up the engine): 43%<br>• Running without load (2500 rpm): 22%<br>• Driving with the accelerator fully open at 2000 rpm: 0%<br>• Driving with the accelerator fully open at 3000 rpm: 0% | | | |
| | Symptoms when out of range:<br>• When value is out of range and approaching 0%: MAF meter degradation, intake or exhaust system blockage<br>• When value is out of range and approaching 100%: EGR pipe blockage | | | |
| | Diagnostic Note:<br>• Fully open: 100%.<br>• Fully closed: 0%.<br>• Used for comparison to "Actual EGR Valve Pos.". | | | |

### Target EGR Valve Pos. #2

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Target EGR Valve Pos. #2 | No. 2 EGR valve target opening angle/ Min.: 0%, Max.: 100% | Idling after engine warmed up: 0 to 80% | ECU-calculated value based on sensors (MAF meter, manifold absolute pressure sensor, intake air temperature (built into MAF meter), etc) | - |
| | Diagnostic Note:<br>Used for comparison to "Actual EGR Valve Pos #2". | | | |

### Actual EGR Valve Pos.

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Actual EGR Valve Pos. | No. 1 EGR valve position/ Min.: 0%, Max.: 100% | Idling after engine warmed up: 0 to 80% | Calculated from EGR valve opening position sensor | |
| | Results of real-vehicle check:<br>• Engine switch on (IG): 0%<br>• Cranking: 0%<br>• Idling (warm up the engine): 84%<br>• Running without load (2500 rpm): 34%<br>• Driving with the accelerator fully open at 2000 rpm: 0%<br>• Driving with the accelerator fully open at 3000 rpm: 0% | | | |
| | Symptoms when out of range:<br>• EGR valve stuck open: Poor starts (engine does not stop), black smoke, white smoke, lack of power<br>• EGR valve stuck closed: Increased turbo booster noise | | | |
| | Diagnostic Note:<br>• Fully open: 100%.<br>• Fully closed: 0%.<br>• Inspect while comparing to "Target EGR Valve Pos.".<br>• Check the valve movement via the Active Test.<br>• Sometimes the malfunction only occurs around a certain temperature, so refer to the engine coolant temperature and outside temperature at the time the malfunction occurred. | | | |

### Actual EGR Valve Pos. #2

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Actual EGR Valve Pos. #2 | No. 2 EGR valve position/ Min.: 0%, Max.: 100% | Idling after engine warmed up: 0 to 80% | Calculated from EGR valve opening position sensor | - |
| | Results of real-vehicle check:<br>Same as Actual EGR Valve Pos. | | | |
| | Symptoms when out of range:<br>Same as Actual EGR Valve Pos. | | | |
| | Diagnostic Note:<br>Inspect while comparing to "Target EGR Valve Pos. #2". | | | |

### EGR Lift Sensor Output

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| EGR Lift Sensor Output | EGR lift position/ Min.: 0%, Max.: 100% | Idling: 0 to 80% | Calculated from EGR valve opening position sensor | - |
| | Results of real-vehicle check:<br>• Engine switch on (IG): 77%<br>• Cranking: 77%<br>• Idling (warm up the engine): 53%<br>• Running without load (2500 rpm): 65%<br>• Driving with the accelerator fully open at 2000 rpm: 77%<br>• Driving with the accelerator fully open at 3000 rpm: 77% | | | |
| | Symptoms when out of range:<br>- | | | |
| | Diagnostic Note:<br>• EGR lift sensor output is calculated from the EGR position sensor output voltage.<br>Value is 0 to 5 V converted to 0 to 100%.<br>• Fully open: 33.5 to 35.5%.<br>• Fully closed: 76.9 to 77.3%. | | | |

### EGR Operation Prohibit

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| EGR Operation Prohibit | EGR operation prohibit/ OK or NG | OK: Active Test item "Control the EGR Step Position" can be performed | - | - |
| | Symptoms when out of range:<br>- | | | |
| | Diagnostic Note:<br>• OK: "EGR Valve Control Active Test Possible" Condition.<br>• NG: "Not Possible" Condition. | | | |

### EGR Close Lrn. Val.

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| EGR Close Lrn. Val. | EGR fully closed position learned value/ Min.: 0 V, Max.: 5 V | 3.5 to 4.5 V | EGR valve position sensor value when EGR valve fully closed | - |
| | Results of real-vehicle check:<br>3.85 V | | | |
| | Symptoms when out of range:<br>- | | | |

| | |
|---|---|
| | Diagnostic Note:<br><br>• This value is the EGR position sensor output voltage.<br>• At the upper and lower limits of the normal range, it is possible that a foreign object is lodged in the EGR valve seat area.<br>• As the lower and upper limits are 3.5 V and 4.5 V respectively, if the value becomes stuck at either of these values, there is a malfunction in the lift sensor or the valve position may be misaligned (foreign matter is present, etc.). |

**EGR Close Learn Val.**

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| EGR Close Learn Val. | No. 1 EGR valve lift volume learned value/<br>Min.: 0 V, Max.: 5 V | Idling:<br>3.5 to 4.5 V | No. 1 EGR valve position sensor value when EGR valve fully closed | - |
| | Results of real-vehicle check:<br>3.85 V | | | |
| | Symptoms when out of range:<br>- | | | |
| | Diagnostic Note:<br>At the upper and lower limits of the normal range, it is possible that a foreign object is lodged in the EGR valve seat area. | | | |

**EGR Close Lrn. Val. #2**

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| EGR Close Lrn. Val. #2 | No. 2 EGR valve lift volume learned value/<br>Min.: 0 V, Max.: 5 V | Idling:<br>3.5 to 4.5 V | No. 2 EGR valve position sensor value when EGR valve fully closed | - |
| | Results of real-vehicle check:<br>3.85 V | | | |
| | Symptoms when out of range:<br>- | | | |
| | Diagnostic Note:<br><br>• This value is the EGR position sensor output voltage.<br>• At the upper and lower limits of the normal range, it is possible that a foreign object is lodged in the EGR valve seat area. | | | |

**EGR Close Lrn. Status**

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| EGR Close Lrn. | EGR valve fully closed position | OK | - | - |

| | | | | |
|---|---|---|---|---|
| Status | learning status/<br>OK or NG | | | |
| | Symptoms when out of range:<br>- | | | |
| | Diagnostic Note:<br><br>• "OK" means the fully closed position learning has completed normally.<br>• When NG, the learned fully closed position may be outside of the normal range.<br>When NG, there may be foreign matter stuck in the valve.<br><br>**HINT:**<br>After disconnecting and reconnecting the battery cable, if the engine switch has not been turned off once, learning may not be completed. | | | |

**EGR Monitor**

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| EGR Monitor | EGR Monitor/<br>Not Avl or Avail | - | Result of ECU calculations | - |
| | Symptoms when out of range:<br>- | | | |
| | Diagnostic Note:<br>EGR monitor indicates that the storage of related DTCs is complete. | | | |

## Diesel throttle system

**Throttle Pos. Sensor Output**

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Throttle Pos. Sensor Output | Absolute throttle position sensor (bank 1)/<br>Min.: 0%, Max.: 100% | • Engine switch on (IG): 60 to 80%<br>• Warmed-up and idling: 10 to 80% | Sensor output (throttle position sensor (bank 1)) | - |
| | Results of real-vehicle check:<br><br>• Engine switch on (IG): 70%<br>• Cranking: 70%<br>• Idling (warm up the engine): 21.9%<br>• Running without load (2500 rpm): 51%<br>• Driving with the accelerator fully open at 2000 rpm: 69.8%<br>• Driving with the accelerator fully open at 3000 rpm: 69.8% | | | |
| | Symptoms when out of range: | | | |

| | |
|---|---|
| | • Stuck closed: Engine stall, difficult to start, rough idling, lack of power, black smoke, white smoke<br>• Stuck open: Loud turbocharging sound, bad vibration when engine stopped<br>• When the ECM detects a malfunction with the diesel throttle (MIL on), engine power is restricted but city driving is possible. |
| | Diagnostic Note:<br><br>• Throttle position sensor output voltage is converted using 5 V = 100%.<br>• When fully closed: 14%.<br>• When fully open: 70%.<br>• When the engine switch is turned from off to on (IG), the throttle valve fully opens once.<br>• When the engine switch is turned from on (IG) to off, the throttle valve fully closes once. |

### Throttle Pos. Sensor Output #2

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Throttle Pos. Sensor Output #2 | Absolute throttle position sensor (bank 2)/ Min.: 0%, Max.: 100% | • Engine switch on (IG): 60 to 80%<br>• Warmed-up and idling: 10 to 80% | Sensor output (throttle position sensor (bank 2)) | Same as Throttle Pos. Sensor Output |

### Actual Throttle Position

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Actual Throttle Position | Actual diesel throttle (bank 1) angle/ Min.: -20%, Max.: 120% | Idling after engine warmed-up: 0 to 90% | - | - |
| | Results of real-vehicle check:<br><br>• Engine switch on (IG): 0%<br>• Cranking: 0%<br>• Idling (warm up the engine): 84%<br>• Running without load (2500 rpm): 32%<br>• Driving with the accelerator fully open at 2000 rpm: 0%<br>• Driving with the accelerator fully open at 3000 rpm: 0% | | | |
| | Symptoms when out of range:<br><br>• Stuck closed: Engine stall, difficult to start, lack of power, black smoke, rough idle<br>• Stuck open: Loud turbocharging sound, bad vibration when engine stopped<br>• When ECM detects a malfunction of diesel throttle (MIL on), engine | | | |

| | |
|---|---|
| | power is restricted so that the vehicle can drive with a maximum speed of 80 to 120 km/h. |
| | Diagnostic Note:<br>Closing percentage of the throttle valve.<br><br>• Fully closed: 100%.<br>• Fully open: 0%.<br><br>**HINT:**<br>There is no connection with the accelerator. However, under full load, the throttle is usually fully open (0%). |

### Actual Throttle Position #2

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Actual Throttle Position #2 | Actual diesel throttle (bank 2) angle/ Min.: -20%, Max.: 120% | Idling after engine warmed-up: 0 to 90% | - | - |

### Throttle Motor Duty #1

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Throttle Motor Duty #1 | Diesel throttle motor actuate duty (bank 1)/ Min.: 0%, Max.: 100% | Idling after engine warmed-up: 10 to 90% | - | - |
| | Results of real-vehicle check:<br><br>• Engine switch on (IG): 61.5%<br>• Cranking: 63%<br>• Idling (warm up the engine): 37%<br>• Running without load (2500 rpm): 53%<br>• Driving with the accelerator fully open at 2000 rpm: 62.5%<br>• Driving with the accelerator fully open at 3000 rpm: 64% | | | |
| | Symptoms when out of range:<br>- | | | |
| | Diagnostic Note:<br><br>• To 0%: Closed side diesel throttle actuation.<br>• To 100%: Open side diesel throttle actuation.<br>• When this value is large but the actual opening angle does not reach the target opening angle, there is an unable to close malfunction.<br>• If it is small, but the actual opening angle does not reach the target opening angle, there is an unable to open malfunction.<br>• Usually this value is at approximately 50 +/-20%, but momentary jumps outside this range do occur.<br>• If a duty outside 50 +/-40% continues for several seconds, it will be judged that the diesel throttle does not move properly and the MIL will be illuminated. | | | |

### Throttle Motor Duty #2

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Throttle Motor Duty #2 | Diesel throttle motor actuate duty (bank 2)/ Min.: 0%, Max.: 100% | Idling after engine warmed-up: 10 to 90% | - | - |

### Throttle Close Learning Val.

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Throttle Close Learning Val. | Throttle fully closed position learned value/ Min.: 0 deg, Max.: 84 deg | 14 to 22 deg | - | - |
| | Results of real-vehicle check:<br>17 deg | | | |
| | Symptoms when out of range:<br>Engine switch on (IG): 17 deg | | | |
| | Diagnostic Note:<br>• When the engine is turned from switch on (IG) to off and 5 seconds elapse, learning of "Throttle Close Learning Val." will be complete.<br>• When "Throttle Close Learning Val." is outside of the normal range, a foreign object may lodged in the throttle valve.<br>• Fully closed: 17.25 deg.<br>• Fully open: 87.25 deg.<br>• If the value is stuck at the upper limit of 21.25 deg, there is a chance that a malfunction is present.<br>However, as the initial value for the learned value is 21.25 deg, it is necessary to check the value after learning is completed. | | | |

### Diesel Throttle Learn Status

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Diesel Throttle Learn Status | Diesel throttle learning history/ OK or NG | OK | - | - |
| | Symptoms when out of range:<br>- | | | |
| | Diagnostic Note:<br>• If the system is functioning properly, learning will be performed when the engine switch is turned from on (IG) to off.<br>• NG indicates that a foreign object may be lodged in the throttle valve or actuator components, or a disconnect/short exists in the signal wires. | | | |

## VN Turbo system

### Target Booster Pressure

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Target Booster Pressure | Target boost pressure/ Min.: 0 kPa, Max.: 320 kPa | Idling and vehicle under normal atmospheric pressure: 87 to 103 kPa | Calculated Value by ECM | - |
| | Results of real-vehicle check:<br>• Engine switch on (IG): 96 kPa<br>• Cranking: 100 kPa<br>• Idling (warm up the engine): 99.5 kPa<br>• Running without load (2500 rpm): 119 kPa<br>• Running without load (4700 rpm): 151 kPa (accelerator pedal depressed)<br>• Driving with the accelerator fully open at 2000 rpm: 185 kPa<br>• Driving with the accelerator fully open at 3000 rpm: 222 kPa | | | |
| | Symptoms when out of range:<br>- | | | |
| | Diagnostic Note:<br>• Inspect while comparing with "MAP".<br>• With the accelerator fully open, if the actual manifold absolute pressure (MAP) is low compared to the target booster pressure by at least 20 kPa for 5 sec. or more, a feeling of a lack of power will occur. | | | |

### Boost Pressure Deviation

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Boost Pressure Deviation | Boost pressure deviation/ Min.: -320 kPa, Max.: 320 kPa | Idling after engine warmed up and vehicle under normal atmospheric pressure: -3 to 10 kPa | - | - |
| | Diagnostic Note:<br>Difference between target and actual supercharging pressure. | | | |

### VN Turbo Command

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| VN Turbo Command | VN turbo command value/ Min.: 20%, Max.: 100% | 20 to 100% | Controls the VN turbo vane opening position. | - |
| | Results of real-vehicle check: | | | |

| | |
|---|---|
| | • Engine switch on (IG): 100%<br>• Cranking: 100%<br>• Idling (warm up the engine): 88%<br>• Running without load (2500 rpm): 76%<br>• Running without load (4700 rpm): 50% (accelerator pedal depressed)<br>• Driving with the accelerator fully open at 2000 rpm: 85%<br>• Driving with the accelerator fully open at 3000 rpm: 46% |
| | Symptoms when out of range:<br>- |
| | Diagnostic Note:<br>• "VN Turbo command" is a command value.<br>• 0%: Full open vanes (contraction of actuation-use rods)<br>• 90% or more: Full closed vanes (extension of actuation-use rods)<br>• When this value is large, the turbo works well.<br>• There is no actual opening angle data to handle the VN Turbo command value. |

### VN Turbo Error Level

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| VN Turbo Error Level | VN turbo driver opening angle level when abnormality detected/<br>1, 2 or 3 | 0: Normal | - | - |
| | Symptoms when out of range:<br>- | | | |
| | Diagnostic Note:<br>• 3: Nearly fully closed (supercharging pressure and pre-turbine pressure are incredibly high and there is a risk of engine damage).<br>• 2: Roughly intermediate opening angle (not as bad as "3", but long-term usage is problematic).<br>• 1: Nearly fully open (will not cause engine damage, but at a low RPM, turbocharging pressure will not rise and insufficient power will be felt). | | | |

### VN Turbo Max Angle

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| VN Turbo Max Angle | VN turbo maximum opening angle/<br>Min.: 0%,<br>Max.: 100% | 100%<br>**HINT:**<br>As this value displays the ideal constant upper limit, no matter what happens, this value should not change. | - | - |
| | Results of real-vehicle check: | | | |

| | |
|---|---|
| | • Engine switch on (IG): 99.6% |
| | Symptoms when out of range:<br>- |
| | Diagnostic Note:<br>• Vane maximum angle expressed in % (Fully open: to 100%).<br>• VD engine is usually 100%. |

**VN Turbo Min Angle**

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| VN Turbo Min Angle | VN turbo minimum opening angle/<br>Min.: 0%,<br>Max.: 100% | 0%<br>**HINT:**<br>As this value displays the ideal constant lower limit, no matter what happens, this value should not change. | - | - |
| | Results of real-vehicle check:<br>• Engine switch on (IG): 51.9% | | | |
| | Symptoms when out of range:<br>- | | | |
| | Diagnostic Note:<br>• Vane maximum angle expressed in % (Fully open: to 100%).<br>• VD engine is usually 52%. | | | |

**VN Turbo Operation prohibit**

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| VN Turbo Operation prohibit | VN turbo operation prohibit/<br>OK or NG | OK: Active Test item "Test the Turbo Charger Step Motor" can be performed | - | - |
| | Symptoms when out of range:<br>- | | | |
| | Diagnostic Note:<br>When NG, indicates a condition where the engine software does not allow the VN turbo Active Test. | | | |

**VN Turbo Type**

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| VN Turbo Type | VN turbo type/<br>Not, Commo or Vacuum | Commo | - | - |
| | Symptoms when out of range:<br>- | | | |
| | Diagnostic Note:<br>Indicates the VN turbo vane actuation method.<br><br>• DC motor system.<br>• Negative-pressure diaphragm system.<br>• Step motor system. | | | |

## Diesel Starting

### Engine Speed (Starter Off)

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Engine Speed (Starter Off) | Engine speed when starter off/<br>Min.: 0 rpm,<br>Max.: 1594 rpm | - | - | - |
| | Diagnostic Note:<br>Engine speed immediately after starting the engine. | | | |

### Starter Count

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Starter Count | Starter on count/<br>Min.: 0, Max.: 255 | - | - | - |
| | Diagnostic Note:<br>Number of times the starter turned on from the time the engine switch was turned on (IG). | | | |

### Run Dist of Previous Trip

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| Run Dist of Previous Trip | Distance driven during previous trip/<br>Min.: 0 km, Max.: 261 km | - | - | - |
| | Diagnostic Note:<br>Used to confirm the driving conditions of the previous trip (before the malfunction occurred). | | | |

## Diesel Rough

### Electric Duty Feedback Value

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| Electric Duty Feedback Value | Electric load feedback value/ Min.: 0 $mm^3$/st, Max.: 39.8 $mm^3$/st | 0 to 2.5 $mm^3$/st | - | - |
| | Symptoms when out of range:<br>- | | | |
| | Diagnostic Note:<br>Expected injection volume increase after the electrical load turns from off to on. | | | |

### A/C Duty Feedback Value

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| A/C Duty Feedback Value | A/C load feedback value/ Min.: 0 $mm^3$/st, Max.: 39.8 $mm^3$/st | • 0 to 4.1 $mm^3$/st (A/T)<br>• 0 to 2.6 $mm^3$/st (M/T) | - | - |
| | Symptoms when out of range:<br>- | | | |
| | Diagnostic Note:<br>Expected injection volume increase after the A/C turns from off to on. | | | |

### PS Duty Feedback Value

| Tester Display | Measurement Item/Range | Normal Condition | Type | Cause of Out of Range |
|---|---|---|---|---|
| PS Duty Feedback Value | Power steering load feedback value/ Min.: 0 $mm^3$/st, Max.: 39.8 $mm^3$/st | 0 $mm^3$/st | - | - |
| | Symptoms when out of range:<br>- | | | |
| | Diagnostic Note:<br>Expected injection volume increase after the power steering turns from off to on. | | | |

## ACTIVE TEST

**HINT:**

Using the intelligent tester to perform Active Tests allows relays, VSVs, actuators and other items to be operated without removing any parts. This non-intrusive functional inspection can be very useful because intermittent operation may be discovered before parts or wiring is disturbed. Performing Active Tests early in troubleshooting is one way to save diagnostic time. Data List information can be displayed while performing Active Tests.

**a.** Connect the intelligent tester to the DLC3.
**b.** Turn the engine switch on (IG).
**c.** Turn the intelligent tester on.
**d.** Enter the following menus: Powertrain / Engine / Active Test.
**e.** Perform the Active Test.

| Tester Display | Test Part | Control Range | Diagnostic Note |
|---|---|---|---|
| Control the A/C Cut Signal | Control the A/C signal | ON/OFF | - |
| Control the ACM Inhibit | Control the VSV for engine mount | ON/OFF | - |
| Connect the TC and TE1 | Turn on TC and TE1 connection | ON/OFF | - |
| Activate the ACC Cut Relay | Activate ACC (accessory) relay | ON/OFF | - |
| Activate the Starter Relay | Activate Starter relay | ON/OFF | - |
| Control the EGR Step Position | Control the No. 1 EGR valve | 0 to 100% | Test is possible when the following conditions are met:<br>• Engine switch is on (IG).<br>• Engine is stopped. |
| Control the EGR Step Position #2 | Control the No. 2 EGR valve | 0 to 100% | Test is possible when the following conditions are met:<br>• Engine switch is on (IG).<br>• Engine is stopped. |
| Test the Turbo Charger Step Motor | Activate the turbocharger (for Bank 1) | 52 to 100% | Test is possible when the following conditions are met:<br>• Engine switch is on (IG).<br>• Engine is stopped. |
| Test the Turbo Charger Step Motor #2 | Activate the turbocharger (for Bank 2) | 52 to 100% | Test is possible when the following conditions are met:<br>• Engine switch is on (IG).<br>• Engine is stopped. |
| Test the Fuel Leak | Pressurizes common rail internal fuel pressure, and checks for fuel leaks | Stop/Start | Performs inspection of the high pressure fuel system.<br>• Engine Speed: 2050 rpm<br>• Fuel Pressure: 172000 kPa<br>• Target Common Rail Pressure: 176000 kPa<br>• Target Pump SCV Current: 1.4 A<br>• MAP: 176 kPa<br>• MAF: 39 g/sec. |
| Diesel Throttle Target Angle | Control the diesel throttle valve (bank 1) | 0 to 90% | Test is possible when the following conditions are met:<br>• Engine switch is on (IG). |

| | | | |
|---|---|---|---|
| | | | • Engine is stopped. |
| Diesel Throttle Target Angle #2 | Control the diesel throttle valve (bank 2) | 0 to 90% | Test is possible when the following conditions are met:<br>• Engine switch is on (IG).<br>• Engine is stopped. |
| Activate the Intank Fuel Pump Relay | Activate SUB PUMP relay | ON/OFF | • Engine is stopped.<br>• This test activates the relay for only 60 seconds.<br>• After finishing this test, the vehicle does not permit activating the relay again within 60 seconds. |
| Control the Cylinder#1 Fuel Cut | Cut off fuel injection from No. 1 injector | ON/OFF | Fuel injection is stopped while the test is ON.<br>• Confirm that the vehicle is stopped and the engine is idling.<br>• If the running condition of the engine does not worsen even though injection of the designated cylinder is stopped, the cylinder can be confirmed to be malfunctioning. |
| Control the Cylinder#2 Fuel Cut | Cut off fuel injection from No. 2 injector | ON/OFF | Fuel injection is stopped while the test is ON.<br>• Confirm that the vehicle is stopped and the engine is idling.<br>• If the running condition of the engine does not worsen even though injection of the designated cylinder is stopped, the cylinder can be confirmed to be malfunctioning. |
| Control the Cylinder#3 Fuel Cut | Cut off fuel injection from No. 3 injector | ON/OFF | Fuel injection is stopped while the test is ON.<br>• Confirm that the vehicle is stopped and the engine is idling.<br>• If the running condition of the engine does not worsen even though injection of the designated cylinder is stopped, the cylinder can be confirmed to be |

| | | | |
|---|---|---|---|
| | | | malfunctioning. |
| Control the Cylinder#4 Fuel Cut | Cut off fuel injection from No. 4 injector | ON/OFF | Fuel injection is stopped while the test is ON.<br>• Confirm that the vehicle is stopped and the engine is idling.<br>• If the running condition of the engine does not worsen even though injection of the designated cylinder is stopped, the cylinder can be confirmed to be malfunctioning. |
| Control the Cylinder#5 Fuel Cut | Cut off fuel injection from No. 5 injector | ON/OFF | Fuel injection is stopped while the test is ON.<br>• Confirm that the vehicle is stopped and the engine is idling.<br>• If the running condition of the engine does not worsen even though injection of the designated cylinder is stopped, the cylinder can be confirmed to be malfunctioning. |
| Control the Cylinder#6 Fuel Cut | Cut off fuel injection from No. 6 injector | ON/OFF | Fuel injection is stopped while the test is ON.<br>• Confirm that the vehicle is stopped and the engine is idling.<br>• If the running condition of the engine does not worsen even though injection of the designated cylinder is stopped, the cylinder can be confirmed to be malfunctioning. |
| Control the Cylinder#7 Fuel Cut | Cut off fuel injection from No. 7 injector | ON/OFF | Fuel injection is stopped while the test is ON.<br>• Confirm that the vehicle is stopped and the engine is idling.<br>• If the running condition of the engine does not worsen even though injection of the designated cylinder is stopped, the cylinder can be confirmed to be |

| | | | |
|---|---|---|---|
| | | | malfunctioning. |
| Control the Cylinder#8 Fuel Cut | Cut off fuel injection from No. 8 injector | ON/OFF | Fuel injection is stopped while the test is ON.<br>• Confirm that the vehicle is stopped and the engine is idling.<br>• If the running condition of the engine does not worsen even though injection of the designated cylinder is stopped, the cylinder can be confirmed to be malfunctioning. |
| Check the Cylinder Compression* | Check the cylinder compression pressure | ON/OFF | Fuel injection stop in all cylinders. |

**HINT:**

*: When cranking the engine, the Active Test measures the speed of each cylinder. In this Active Test, the fuel of all cylinders is cut, and cranking occurs for approximately 10 seconds. At this time, the speed of each cylinder is measured. If the speed of one cylinder is higher than the other cylinders, the compression pressure of that cylinder is determined to be lower than the other cylinders.

1. Warm up the engine.
2. Turn the engine switch off.
3. Connect the intelligent tester to the DLC3.
4. Turn the engine switch on (IG) and turn the tester on.
5. Enter the following menus: Powertrain / Engine / Active Test / Check the Cylinder Compression.

**HINT:**

If the results are not displayed normally, select the display items from the Data List before performing the Active Test. Enter the following menus: Powertrain / Engine / Data List / Compression / Engine Speed of Cyl #1, Engine Speed of Cyl #2, Engine Speed of Cyl #3, Engine Speed of Cyl #4, Engine Speed of Cyl #5, Engine Speed of Cyl #6, Engine Speed of Cyl #7, Engine Speed of Cyl #8 and Av Engine Speed of All Cyl.

6. While the engine is not running, press the RIGHT or LEFT button to change Check the Cylinder Compression to ON.

**HINT:**

After performing the above procedure, the Active Test Check the Cylinder Compression will start. Fuel injection for all cylinders is prohibited, and the engine speed measurement of each cylinder will enter standby mode.

7. Crank the engine for about 10 seconds.
8. Monitor the engine speed (Engine Speed of Cyl #1 to #8, Av Engine Speed of All Cyl) displayed on the tester.

**HINT:**

At first, the tester's display will show the engine speed measurement of each cylinder to be extremely high. After approximately 10 seconds of engine cranking, the engine speed measurement of each cylinder will change to the actual engine speed.

**NOTICE:**

- **After the Active Test Check the Cylinder Compression is turned on, it will automatically turn off after 255 seconds.**
- **When the Check the Cylinder Compression test is off and the engine is cranked, the engine will start.**
- **If the Check the Cylinder Compression test needs to be performed after it is turned on and performed once, press EXIT to return to the Active Test menu screen. Then perform the Check the Cylinder Compression test again.**
- **Use a fully-charged battery.**