

ST - GENERIC SCAN TOOL

ON BOARD DIAGNOSTIC (OBD)

On Board Diagnostic (OBD)

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Generic Scan Tool Manual Contents

GST is an acronym for Generic Scan Tool Manual.

Included in the contents of this GST manual is a summary table of the vehicle specific OBD II Emission Related Engine and Transmission DTCs. This table contains all necessary Malfunction Criteria, Threshold Values, Secondary Parameters, Enabling Conditions, Monitoring Time Length, Frequency of Checks, and MIL Illumination to accurately monitor and diagnose the Engine Emissions and Transmission and perform all functions required to run Modes 01 through 09 with a hand held scan tool. For a further description of the monitor strategies, a document reference has been provided throughout this GST manual to the applicable OBD System Strategy document.

This GST manual also contains the step by step pin point test procedures to accurately diagnose the suspected component or system once a DTC has been set. All references to repair procedures and wiring diagrams will be found within the diagnostic test procedure.

OBD Systems

OBD II

OBD is an acronym for the On Board Diagnostic System.

California OBD II applies to all gasoline engine vehicles up to 14,000 lbs. Gross Vehicle Weight Rating (GVWR) starting in the 1996 MY and all diesel engine vehicles up to 14,000 lbs. GVWR starting in the 1997 MY.

Several states in the Northeastern United States have chosen to adopt the California emission regulations starting in the 1998 MY and are known as "Green States".

Green States receive California-certified vehicles for passenger cars and light trucks up to 6,000 lbs. GVWR. Starting in the 2004 MY, Federal vehicle over 8,500 lbs. will start phasing in OBD II.

Starting in 2004 MY, gasoline-fueled Medium Duty Passenger Vehicles (MDPVs) are required to have OBD II. Federal OBD II applies to all gasoline engine vehicles up to 8,500 lbs. GVWR starting in the 1996 MY and all diesel engine vehicles up to 8,500 lbs. GVWR starting in the 1997 MY.

OBD II system implementation and operation is described in the remainder of this document.

Malfunction Indicator Lamp Illumination

MIL is an acronym for the Malfunction Indicator Lamp.

If the ECM recognizes a malfunction that leads to increased emissions values, it indicates them by lighting the MIL which is located in the instrument cluster.

The ECM switches on the MIL after the ignition is switched on. Shortly after the engine is started, The MIL goes out if the ECM does not detect a malfunction that increases the emissions values.

If the ECM recognizes a malfunction that leads to increased emissions during the operation of the engine, the ECM switches on the MIL and an entry is stored in the DTC memory of the ECM.

CAN Data Link

CAN is an acronym for Controller Area Network.

The ECM communicates with all databus capable control modules by a CAN Data Link.

The databus capable control modules (i.e. Engine Coolant temperature Sensor) are connected by two data bus wires which are twisted together (CAN_High and CAN_Low), and exchange information (messages) to the ECM. Missing information on the databus is then recognized and stored as a malfunction.

The ECM illuminates the MIL through the CAN data link and tells the MIL to turn on, turn off, or blink.

Electronic Power Control Warning Lamp

EPC is an acronym that stands for the Electronic Power Control (E-gas).

The ECM monitors all EPC components after the ignition is switched on.

If a malfunction is recognized in the EPC system during the operation of the engine, the ECM switches on the EPC which is located in the instrument cluster and an entry is stored in the DTC memory of the ECM.

DIAGNOSTIC MODES

Diagnostic Modes

--> **Diagnostic Modes Description**

--> **Diagnostic Mode 01: Obtain Data**

--> **Diagnostic Mode 02: Obtain Operating Conditions**

--> **Diagnostic Mode 03: Interrogating Fault Memory**

--> **Diagnostic Mode 04: Reset/delete Diagnostic Data**

--> **Diagnostic Mode 06: Checking Test Results of Components that are not Continuously Monitored**

--> **Diagnostic Mode 07: Check Test Results of Components that are Continuously Monitored**

--> **Diagnostic Mode 08: Tank Leak Test**

--> **Diagnostic Mode 09: Vehicle Information**

Diagnostic Modes Description

The information provided in Modes 01 through 09 displays the various levels of emission related data that may be monitored, as well as the ability to retrieve and read stored DTC trouble codes, erase stored DTC trouble codes, generate readiness codes, and select the various PIDs and Test-IDs used within the modes to monitor the engine, and emission related component parameters.

The following table provides a link to all diagnostic modes that monitor all components and systems which influence the emission quality.

NOTE:

- Depending on scan tool and protocol used, the information displayed may be referred to by different names such as Test-ID (TID), Hex-ID, Component-ID (CID), On-Board Diagnostic Monitor Identifier (OBDMID), or contain no name at all and be referenced by only a number.

Selectable diagnostic modes
Mode 1: Obtain data --> <u>Diagnostic Mode 01: Obtain Data.</u>
Mode 2: Obtain operating conditions --> <u>Diagnostic Mode 02: Obtain Operating Conditions.</u>
Mode 3: Interrogating fault memory --> <u>Diagnostic Mode 03: Interrogating Fault Memory.</u>
Mode 4: Reset/delete diagnostic data --> <u>Diagnostic Mode 04: Reset/delete Diagnostic Data.</u>
Mode 6: Checking test results of components that are not continuously monitored --> <u>Diagnostic Mode 06: Checking Test Results of Components that are not Continuously Monitored.</u>
Mode 7: Checking test results of components that are continuously monitored --> <u>Diagnostic Mode 07: Check Test Results of Components that are Continuously Monitored.</u>
Mode 8: Tank leak test --> <u>Diagnostic Mode 08: Tank Leak Test.</u>
Mode 9: Vehicle information --> <u>Diagnostic Mode 09: Vehicle Information.</u>

Diagnostic Mode 01: Obtain Data

Diagnostic Mode 01 is used to display and monitor all emissions related measured values.

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Test requirement

- Coolant temperature at least 80°C.

Procedure

- Connect the diagnostic tester.
- Start the engine and run at idle.
- Select "Diagnostic Mode 1: Obtain data."
- From the following table, select the desired the "PID" that is to be monitored, e.g. "PID 05-Coolant temperature".

NOTE:

- More than one "PID" may be selected and monitored.

The current values of the component or system that is being monitored will be displayed on the diagnostic tester screen.

PID	Component or System
01:	Monitoring status since erasing DTC memory
03:	Condition of fuel system
04:	Calculated load condition value
05:	Coolant temperature
06:	Short term gasoline-air ratio bank 1
07:	Gasoline-air ratio bank 1
12:	Engine rotations per minute (RPM)
13:	Vehicle speed
14:	Ignition timing adjustment at 1. cyl. in direction
15:	Intake air temperature (IAT)
16:	Air flow quantity at Mass Air Flow (MAF) sensor
17:	Throttle valve position (absolute)
19:	Existing oxygen B1 to B2-S2 to (exist./nonexist.)
21:	Bank 1 - sensor 2
28:	OBD request is designed for diagnostic of this vehicle
31:	Time after engine on
33:	Driven distance after MIL on
35:	Fuel Rail Pressure
46:	Commanded Evaporative Purge
48:	Number of warm ups since diagnostic trouble codes
49:	Distance since diagnostic trouble codes cleared
51:	Barometric Pressure
52:	Bank 1 - sensor 1

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56:	Bank 2- sensor 1
60:	Catalyst Temperature Bank 1, Sensor 1
65:	Monitor status this driving cycle
66:	Control module voltage
67:	Absolute Load Value
68:	Commanded Equivalence Ratio
69:	Relative Throttle Position
70:	Ambient air temperature
71:	Absolute Throttle Position B
73:	Accelerator Pedal Position D
74:	Accelerator Pedal Position E
76:	Commanded Throttle Actuator Control

- Switch the ignition off.
- **End of diagnosis.**

Diagnostic Mode 02: Obtain Operating Conditions

Diagnostic Mode 02 is used to monitor the operating conditions under which the Engine Control Module (ECM) has detected and stored an emissions related DTC.

Procedure

- Connect the diagnostic tester.
- Start the engine and run at idle.

NOTE:

- **If the engine does not start, crank the engine using starter for at least 5 seconds, do not switch the ignition off afterward under any circumstances.**

- Select "Diagnostic Mode 2: Obtain operating conditions."
- From the following table, select the desired the "PID" , e.g. "PID 05-Coolant temperature" that is to be monitored.

NOTE:

- **More than one "PID" may be selected and monitored.**

The current values of the component or system that is being monitored will be displayed on the diagnostic tester screen.

PID	Component or System
02:	DTC which triggered the current reception of all control module information

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03:	Condition of fuel system
04:	Calculated load condition value
05:	Coolant temperature
06:	Short term gasoline-air ratio bank 1
07:	Gasoline-air ratio bank 1
12:	Engine rotations per minute (RPM)
13:	Vehicle speed
14:	Ignition timing adjustment at 1. cyl. in direction
15:	Intake air temperature (IAT)
16:	Air stream amount at Mass Air Flow (MAF) sensor
17:	Throttle valve position (absolute)
31:	Time after engine on
35:	Fuel Rail Pressure
46:	Commanded Evaporative Purge
51:	Barometric Pressure
66:	Control module voltage
67:	Absolute Load Value
68:	Commanded Equivalence Ratio
69:	Relative Throttle Position
70:	Ambient air temperature
71:	Absolute Throttle Position B
73:	Accelerator Pedal Position D
74:	Accelerator Pedal Position E
76:	Commanded Throttle Actuator Control

- Switch the ignition off.
- **End of diagnosis.**

Diagnostic Mode 03: Interrogating Fault Memory

Description

When the Engine Control Module (ECM) recognizes an emission related fault it turns on the Malfunction Indicator Lamp (MIL) or if a Electronic Throttle Malfunction is recognized, the Engine Control Module (ECM) turns on the Electronic Power Control (EPC) Warning Lamp which are both located in the instrument cluster.

Diagnostic Mode 03 is used to retrieve and view any DTC which may be stored in the Engine Control Module (ECM).

The DTCs are sorted by SAE code with the DTC tables consisting of a 5-digit alpha-numeric value.

The following tables provide a breakdown and explanation of the DTC code.

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P-Codes

Component group					
P	x	x	x	x	DTC for the drivetrain
Norm-Code					
P	0	x	x	x	Trouble codes defined by SAE with specified malfunction texts
P	1	x	x	x	Additional emission relevant DTCs provided by the manufacturer
P	2	x	x	x	DTCs defined by SAE with specified texts, from MY 2000
P	3	x	x	x	Additional emission relevant DTCs provided by the manufacturer from MY 2000

Component group					
P	x	0	x	x	Fuel and air mixture and additional emission regulations
P	x	1	x	x	Fuel and air ratios
P	x	2	x	x	Fuel and air ratios
P	x	3	x	x	Ignition system
P	x	4	x	x	Additional exhaust system
P	x	5	x	x	Speed and idle control
P	x	6	x	x	Control module and output signals

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P	x	7	x	x	Transmission
P	x	8	x	x	Transmission
P	x	9	x	x	Control modules, input and output signals

U-Codes

Component group					
U	x	x	x	x	DTC for network (CAN bus)
Norm-Code					
U	0	x	x	x	Trouble codes defined by SAE with specified malfunction texts

Interrogating Fault Memory

Procedure

- Connect the diagnostic tester.
- Switch the ignition to the "ON" position.
- Select "Diagnostic Mode 03: Interrogating fault memory".
- The stored DTC or DTCs will be displayed on the diagnostic tester screen.

The following table is an example of the DTC information that may be displayed on the diagnostic tester screen:

Indication example	Explanation
P0444	SAE Diagnostic Trouble Code (DTC)
Evaporative Emission (EVAP) Canister Purge Regulator Valve	Malfunctioning wiring path or malfunctioning component
Circuit Open	Malfunction type as next

- Refer to the following DTC tables for the diagnostic repair procedure:
- SAE P0xxxDTCs. --> **SAE P0xxx DTCs.**
- SAE P1xxx-DTCs --> **SAE P1xxx DTCs.**
- SAE P2xxxDTCs. --> **SAE P2xxx DTCs.**
- SAE P3xxxDTCs. --> **SAE P3xxx DTCs.**

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- SAE U0xxxDTCs, --> **SAE U0xxx DTCs**.
- Switch the ignition off.
- **End of diagnosis.**

Diagnostic Mode 04: Reset/delete Diagnostic Data

Diagnostic Mode 04 is used to reset or delete the following stored information:

- All emission related malfunctions in the DTC memory.
- The operating conditions at which a malfunction was stored will be reset.
- All adaptation values.
- The test results of all diagnostic functions.

Procedure

- Connect the diagnostic tester.
- Switch the ignition to the "ON" position.
- Select "Diagnostic Mode 03: Interrogating fault memory".
- Then select "Mode 4: Reset/delete diagnostic data".

The diagnostic tester will display: "Diagnostic data are being erased".

- Switch the ignition off.
- **End of diagnosis.**

Diagnostic Mode 06: Checking Test Results of Components that are not Continuously Monitored

Diagnostic Mode 06 displays the test results of emission related components and systems which are not continuously monitored.

The values of the individual test results must reach the specified value or must be within the min. and max. limits.

NOTE:

- Depending on diagnostic tester and protocol used, the information displayed in diagnostic mode 06 may be referred to by different names such as Test-ID (TID), Hex-ID, Component-ID (CID), or On-Board Diagnostic Monitor Identifier (OBDMID).

Test requirements

- Exhaust system must be properly sealed between catalytic converter and cylinder head.
- No DTCs in the DTC memory.

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- Coolant temperature at least 80°C.

Work procedure

- Connect the diagnostic tester.
- Start the engine and let run at idle speed.
- Select "Mode 6: Check test the results of components that are not continuously monitored".

Select the desired "Test-ID".

The current minimum and maximum values will be displayed on the diagnostic tester screen.

Test-ID (Hex-ID)	Component or System
01 (\$01): <u>Test-ID 01 (\$01): Oxygen Sensor Monitor Bank 1 - Sensor 1</u>	Oxygen Sensor Monitor Bank 1 - Sensor 1
02 (\$02): <u>Test-ID 02 (\$02): Oxygen Sensor Monitor Bank 1 - Sensor 2</u>	Oxygen Sensor Monitor Bank 1 - Sensor 2
05 (\$05): <u>Test-ID 05 (\$05): Oxygen Sensor Monitor Bank 2 - Sensor 1</u>	Oxygen Sensor Monitor Bank 2 - Sensor 1
06 (\$06): <u>Test-ID 06 (\$06): Oxygen Sensor Monitor Bank 2 - Sensor 2</u>	Oxygen Sensor Monitor Bank 2 - Sensor 2
33 (\$21): <u>Test-ID 33 (\$21): Catalyst Monitor Bank 1</u>	Catalyst Monitor Bank 1
34 (\$22): <u>Test-ID 34 (\$22): Catalyst Monitor Bank 2</u>	Catalyst Monitor Bank 2
\$3A (58): <u>\$3A (58): Fuel Tank EVAP System Leak Test (0.090)</u>	Fuel Tank EVAP System Leak Test (0.090)
59 (3B): <u>Test-ID 59 (3B): EVAP Monitor (0.040)</u>	EVAP Monitor (0.40)
60 (3C): <u>Test-ID 60 (3C): EVAP Monitor (0.020)</u>	EVAP Monitor (0.20)
61 (3D): <u>Test-ID 61 (3D): Purge Flow Monitor</u>	Purge Flow Monitor
65 (\$41): <u>Test-ID 65 (\$41): Oxygen Sensor Heater Monitor Bank 1 - Sensor 1</u>	Oxygen Sensor Heater Monitor Bank 1 - Sensor 1
66 (\$42): <u>Test-ID 66 (\$42): Oxygen Sensor Heater Monitor Bank 1 - Sensor 2</u>	Oxygen Sensor Heater Monitor Bank 1 - Sensor 2
69 (\$45): <u>Test-ID 69 (\$45): Oxygen Sensor Heater Monitor Bank 2 - Sensor 1</u>	Oxygen Sensor Heater Monitor Bank 2 - Sensor 1
70 (\$46): <u>Test-ID 70 (\$46): Oxygen Sensor Heater Monitor Bank 2 - Sensor 2</u>	Oxygen Sensor Heater Monitor Bank 2 - Sensor 2
162 (\$A2): <u>Test-ID 162 (\$A2): Mis-Fire Cylinder 1 Data</u>	Mis-Fire Cylinder 1 Data
163 (\$A4): <u>Test-ID 163 (\$A4): Mis-Fire Cylinder 2 Data</u>	Mis-Fire Cylinder 2 Data
164 (\$A4): <u>Test-ID 164 (\$A4): Mis-Fire Cylinder</u>	Mis-Fire Cylinder 3 Data

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3 Data

165 (\$A5): **Test-ID 165 (\$A5): Mis-Fire Cylinder** Mis-Fire Cylinder 4 Data

4 Data

166 (\$A4): **Test-ID 166 (\$A4): Mis-Fire Cylinder** Mis-Fire Cylinder 5 Data

5 Data

167 (\$A7): **Test-ID 167 (\$A7): Mis-Fire Cylinder** Mis-Fire Cylinder 6 Data

6 Data

Test-ID 01 (\$01): Oxygen Sensor Monitor Bank 1 - Sensor 1

- Connect the diagnostic tester.
- Start the engine and let run at idle speed.
- Select "Mode 6: Check test the results of components that are not continuously monitored".

Select "Test-ID 01 (\$01)".

- Select the desired "Test-ID".
- Check specified values at idle.

Test-ID (TID) (Hex-ID)	DTC	Component or System	Min.	Max.	Additional Information
131 (\$83)	P0133	Response Check.	---	0.205	Refer to DTC P0133 in Fuel and air ratios .

- If any component or system fails to meet the specified values, refer to Diagnostic "Mode 03: Interrogating Fault Memory" to check for stored DTCs or the corresponding diagnostic repair procedure.
- Switch the ignition off.
- **End of diagnosis.**

Test-ID 02 (\$02): Oxygen Sensor Monitor Bank 1- Sensor 2

- Connect the diagnostic tester.
- Start the engine and let run at idle speed.
- Select "Mode 6: Check test the results of components that are not continuously monitored".

Select "Test-ID 02 (\$02)".

- Select the desired "Test-ID".
- Check specified values at idle.

Test-ID (TID) (Hex-ID)	DTC	Component or System	Min.	Max.	Additional Information

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01 (\$01)		Voltage barrier from rich to lean (fixed value) Oxygen sensor behind cat., bank 1.	708 mV	708 mV	
02 (\$02)		Voltage barrier from lean to rich (fixed value) Oxygen sensor behind cat., bank 1.	708 mV	708 mV	
07 (\$07)		Minimum sensor voltage in this driving cycle Oxygen sensor behind cat., bank 1.	1.0 V	5 V	
08 (\$08)		Maximum sensor voltage in this driving cycle Oxygen sensor behind cat., bank 1.	0 V	0.009 V	
129 (\$81)	P0136	Signal activity check.	0.542 V	5 V	Refer to DTC P0136 in Fuel and air ratios .
130 (\$82)	P0136	Signal activity check.	0 V	1.039 V	Refer to DTC P0136 in the DTC table Fuel and air ratios .
131 (\$83)	P0136	Fuel cut off Check.	0 V	200.0 mV	Refer to DTC P0136 in Fuel and air ratios .

- If any component or system fails to meet the specified values, refer to Diagnostic "Mode 03: Interrogating Fault Memory" to check for stored DTCs or the corresponding diagnostic repair procedure.
- Switch the ignition off.
- **End of diagnosis.**

Test-ID 05 (\$05): Oxygen Sensor Monitor Bank 2 - Sensor 1

- Connect the diagnostic tester.
- Start the engine and let run at idle speed.
- Select "Mode 6: Check test the results of components that are not continuously monitored".

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Select "Test-ID 05 (\$05)".

- Select the desired "Test-ID".
- Check specified values at idle.

Test-ID (TID) (Hex-ID)	DTC	Component or System	Min.	Max.	Additional Information
131 (\$83)	P0153	Response Check.	---	0.205	Refer to DTC P0153 in <u>Fuel and air ratios</u> .

- If any component or system fails to meet the specified values, refer to Diagnostic "Mode 03: Interrogating Fault Memory" to check for stored DTCs or the corresponding diagnostic repair procedure.
- Switch the ignition off.
- **End of diagnosis.**

Test-ID 06 (\$06): Oxygen Sensor Monitor Bank 2 - Sensor 2

- Connect the diagnostic tester.
- Start the engine and let run at idle speed.
- Select "Mode 6: Check test the results of components that are not continuously monitored".

Select "Test-ID 06 (\$06)".

- Select the desired "Test-ID".
- Check specified values at idle.

Test-ID (TID) (Hex-ID)	DTC	Component or System	Min.	Max.	Additional Information
01 (\$01)		Voltage barrier from rich to lean (fixed value) Oxygen sensor behind cat., bank 2.	708 mV	708 mV	
02 (\$02)		Voltage barrier from lean to rich (fixed value) Oxygen sensor behind cat., bank 2.	708 mV	708 mV	
07 (\$07)		Minimum sensor voltage in this driving cycle	1.0 V	5 V	

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		Oxygen sensor behind cat., bank 2.			
08 (\$08)		Maximum sensor voltage in this driving cycle Oxygen sensor behind cat., bank 2.	0 V	0.009 V	
129 (\$81)	P0156	Signal activity check.	0.542 V	5 V	Refer to DTC P0156 in <u>Fuel and air ratios</u> .
130 (\$82)	P0156	Signal activity check.	0 V	1.039 V	Refer to DTC P0156 in <u>Fuel and air ratios</u> .
131 (\$83)	P0156	Fuel cut off Check.	0 V	200.0 mV	Refer to DTC P0156 in <u>Fuel and air ratios</u> .

- If any component or system fails to meet the specified values, refer to Diagnostic "Mode 03: Interrogating Fault Memory" to check for stored DTCs or the corresponding diagnostic repair procedure.
- Switch the ignition off.
- **End of diagnosis.**

Test-ID 33 (\$21): Catalyst Monitor Bank 1

- Connect the diagnostic tester.
- Start the engine and let run at idle speed.
- Select "Mode 6: Check test the results of components that are not continuously monitored".

Select "Test-ID 33 (\$21)".

- Select the desired "Test-ID".
- Check specified values at idle.

Test-ID (TID) (Hex-ID)	DTC	Component or System	Min.	Max.	Additional Information
132 (\$84)	P0421	Conversion Capability (storage) Check.	0	0.797	Refer to DTC P0421 in <u>Additional exhaust regulation</u> .

- If any component or system fails to meet the specified values, refer to Diagnostic "Mode 03: Interrogating Fault Memory" to check for stored DTCs or the corresponding diagnostic repair procedure.

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- Switch the ignition off.
- **End of diagnosis.**

Test-ID 34 (\$22): Catalyst Monitor Bank 2

- Connect the diagnostic tester.
- Start the engine and let run at idle speed.
- Select "Mode 6: Check test the results of components that are not continuously monitored".

Select "Test-ID 34 (\$22)".

- Select the desired "Test-ID".
- Check specified values at idle.

Test-ID (TID) (Hex-ID)	DTC	Component or System	Min.	Max.	Additional Information
132 (\$84)	P0431	Catalytic converter monitoring, Bank 1.	0	0.797	Refer to DTC P0431 in <u>Additional exhaust regulation</u> .

- If any component or system fails to meet the specified values, refer to Diagnostic "Mode 03: Interrogating Fault Memory" to check for stored DTCs or the corresponding diagnostic repair procedure.
- Switch the ignition off.
- **End of diagnosis.**

\$3A (58): Fuel Tank EVAP System Leak Test (0.090)

- Connect the diagnostic tester.
- Start the engine and let run at idle speed.
- Select "Mode 6: Check test the results of components that are not continuously monitored".

Select "Test-ID 59 (\$3B)".

- Select the desired "Test-ID".
- Check specified values at idle.

Test-ID (TID) (Hex-ID)	DTC	Component or System	Min.	Max.	Additional Information
129 (\$81)	P0455	Tank leak test: Large leak.	700 ms		Refer to DTC P0455 in <u>Additional exhaust</u>

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regulation .

- If any component or system fails to meet the specified values, refer to Diagnostic "Mode 03: Interrogating Fault Memory" to check for stored DTCs or the corresponding diagnostic repair procedure.
- Switch the ignition off.
- **End of diagnosis.**

Test-ID 59 (3B): EVAP Monitor (0.040)

- Connect the diagnostic tester.
- Start the engine and let run at idle speed.
- Select "Mode 6: Check test the results of components that are not continuously monitored".

Select "Test-ID 59 (\$3B)".

- Select the desired "Test-ID".
- Check specified values at idle.

Test-ID (TID) (Hex-ID)	DTC	Component or System	Min.	Max.	Additional Information
129 (\$81)	P0442	Tank leak test: Small leak (1.0 mm).	1210 ms		Refer to DTC P0442 in <u>Additional exhaust regulation .</u>

- If any component or system fails to meet the specified values, refer to Diagnostic "Mode 03: Interrogating Fault Memory" to check for stored DTCs or the corresponding diagnostic repair procedure.
- Switch the ignition off.
- **End of diagnosis.**

Test-ID 60 (3C): EVAP Monitor (0.020)

- Connect the diagnostic tester.
- Start the engine and let run at idle speed.
- Select "Mode 6: Check test the results of components that are not continuously monitored".

Select "Test-ID 60 (\$3C)".

- Select the desired "Test-ID".
- Check specified values at idle.

Test-ID (TID)	DTC	Component or	Min.	Max.	Additional
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(Hex-ID)		System			Information
130 (\$82)	P0456	Tank leak test: Small leak (0.5 mm).	4280 ms		Refer to DTC P0456 in <u>Additional exhaust regulation</u> .

- If any component or system fails to meet the specified values, refer to Diagnostic "Mode 03: Interrogating Fault Memory" to check for stored DTCs or the corresponding diagnostic repair procedure.
- Switch the ignition off.
- **End of diagnosis.**

Test-ID 61 (3D): Purge Flow Monitor

- Connect the diagnostic tester.
- Start the engine and let run at idle speed.
- Select "Mode 6: Check test the results of components that are not continuously monitored".

Select "Test-ID 61 (\$3D)".

- Select the desired "Test-ID".
- Check specified values at idle.

Test-ID (TID) (Hex-ID)	DTC	Component or System	Min.	Max.	Additional Information
128 (\$80)	P0441	Function Check.	0	4.849%	Refer to DTC P0441 in <u>Additional exhaust regulation</u> .
130 (\$82)		Function Check.	3.5%		
131 (\$83)		Function Check.	0.04		

- If any component or system fails to meet the specified values, refer to Diagnostic "Mode 03: Interrogating Fault Memory" to check for stored DTCs or the corresponding diagnostic repair procedure.
- Switch the ignition off.
- **End of diagnosis.**

Test-ID 65 (\$41): Oxygen Sensor Heater Monitor Bank 1 - Sensor 1

- Connect the diagnostic tester.
- Start the engine and let run at idle speed.
- Select "Mode 6: Check test the results of components that are not continuously monitored".

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Select "Test-ID 65 (\$41)".

- Select the desired "Test-ID".
- Check specified values at idle.

Test-ID (TID) (Hex-ID)	DTC	Component or System	Min.	Max.	Additional Information
133 (\$85)	P0135	Oxygen sensor heating in front of catalytic converter, diagnosis, Bank 1.	680°C	> 860°C	Refer to DTC P0135 in <u>Fuel and air ratios</u> .

- If any component or system fails to meet the specified values, refer to Diagnostic "Mode 03: Interrogating Fault Memory" to check for stored DTCs or the corresponding diagnostic repair procedure.
- Switch the ignition off.
- **End of diagnosis.**

Test-ID 69 (\$45): Oxygen Sensor Heater Monitor Bank 2 - Sensor 1

- Connect the diagnostic tester.
- Start the engine and let run at idle speed.
- Select "Mode 6: Check test the results of components that are not continuously monitored".

Select "Test-ID 69 (\$45)".

- Select the desired "Test-ID".
- Check specified values at idle.

Test-ID (TID) (Hex-ID)	DTC	Component or System	Min.	Max.	Additional Information
129 (\$81)	P0155	Oxygen sensor heating behind catalytic converter, diagnosis, Bank 2 Nernst cell internal resistance test.	680°C	> 860°C	Refer to DTC P0155 in <u>Fuel and air ratios</u> .

- If any component or system fails to meet the specified values, refer to Diagnostic "Mode 03: Interrogating Fault Memory" to check for stored DTCs or the corresponding diagnostic repair procedure.
- Switch the ignition off.

- **End of diagnosis.**

Test-ID 66 (\$42): Oxygen Sensor Heater Monitor Bank 1 - Sensor 2

- Connect the diagnostic tester.
- Start the engine and let run at idle speed.
- Select "Mode 6: Check test the results of components that are not continuously monitored".

Select "Test-ID 66 (\$42)".

- Select the desired "Test-ID".
- Check specified values at idle.

Test-ID (TID) (Hex-ID)	DTC	Component or System	Min.	Max.	Additional Information
129 (\$81)	P0141	Oxygen sensor heating behind catalytic converter, diagnosis, Bank 1 Nernst cell internal resistance test.	0 ohms	43320 ohms	Refer to DTC P0141 in <u>Fuel and air ratios</u> .

- If any component or system fails to meet the specified values, refer to Diagnostic "Mode 03: Interrogating Fault Memory" to check for stored DTCs or the corresponding diagnostic repair procedure.
- Switch the ignition off.
- **End of diagnosis.**

Test-ID 70 (\$46): Oxygen Sensor Heater Monitor Bank 2 - Sensor 2

- Connect the diagnostic tester.
- Start the engine and let run at idle speed.
- Select "Mode 6: Check test the results of components that are not continuously monitored".

Select "Test-ID 70 (\$46)".

- Select the desired "Test-ID".
- Check specified values at idle.

Test-ID (TID) (Hex-ID)	DTC	Component or System	Min.	Max.	Additional Information
129 (\$81)	P0161	Oxygen sensor heating behind	0 ohms	43320 ohms	Refer to DTC P0161 in <u>Fuel</u>

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catalytic
converter,
diagnosis, Bank
2 Nernst cell
internal
resistance test.

and air ratios .

- If any of the components or systems fail to meet the specified values, refer to Diagnostic "Mode 03: Interrogating Fault Memory" to check for stored DTCs or the corresponding diagnostic repair procedure.
- Switch the ignition off.
- **End of diagnosis.**

Test-ID 162 (\$A2): Mis-Fire Cylinder 1 Data

- Connect the diagnostic tester.
- Start the engine and let run at idle speed.
- Select "Mode 6: Check test the results of components that are not continuously monitored".

Select "Test-ID 162 (\$A2)".

- Select the desired "Test-ID (TID)" or "Hex-ID".
- Check specified values at idle.

Test-ID (TID) (Hex- ID)	DTC	Component or System	Min.	Max.	Additional Information
11 (\$0B)	P0301	Burn misfire cylinder 1 average value over 10 driving cycles.	0	65535 (counts)	Refer to DTC P0301 in <u>Ignition system</u> .
12 (\$0C)	P0301	Burn misfire cylinder 1 during this driving cycle.	0	65535 (counts)	Refer to DTC P0301 in <u>Ignition system</u> .

- If any of the components or systems fail to meet the specified values, refer to Diagnostic "Mode 03: Interrogating Fault Memory" to check for stored DTCs or the corresponding diagnostic repair procedure.
- Switch the ignition off.
- **End of diagnosis.**

Test-ID 163 (\$A4): Mis-Fire Cylinder 2 Data

- Connect the diagnostic tester.

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- Start the engine and let run at idle speed.
- Select "Mode 6: Check test the results of components that are not continuously monitored".

Select "Test-ID 163 (\$A4)".

- Select the desired "Test-ID (TID)" or "Hex-ID".
- Check specified values at idle.

Test-ID (TID) (Hex-ID)	DTC	Component or System	Min.	Max.	Additional Information
11 (\$0B)	P0302	Burn misfire cylinder 2 average value over 10 driving cycles.	0	65535 (counts)	Refer to DTC P0302 in <u>Ignition system</u> .
12 (\$0C)	P0302	Burn misfire cylinder 2 during this driving cycle.	0	65535 (counts)	Refer to DTC P0302 in <u>Ignition system</u> .

- If any of the components or systems fail to meet the specified values, refer to Diagnostic "Mode 03: Interrogating Fault Memory" to check for stored DTCs or the corresponding diagnostic repair procedure.
- Switch the ignition off.
- **End of diagnosis.**

Test-ID 164 (\$A4): Mis-Fire Cylinder 3 Data

- Connect the diagnostic tester.
- Start the engine and let run at idle speed.
- Select "Mode 6: Check test the results of components that are not continuously monitored".

Select "Test-ID 164 (\$A4)".

- Select the desired "Test-ID (TID)" or "Hex-ID".
- Check specified values at idle.

Test-ID (TID) (Hex-ID)	DTC	Component or System	Min.	Max.	Additional Information
11 (\$0B)	P0303	Burn misfire cylinder 3 average value over 10 driving cycles.	0	65535 (counts)	Refer to DTC P0303 in <u>Ignition system</u> .
12 (\$0C)	P0303	Burn misfire	0	65535 (counts)	Refer to DTC

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cylinder 3
during this
driving cycle.

P0303 in
Ignition
system .

- If any of the components or systems fail to meet the specified values, refer to Diagnostic "Mode 03: Interrogating Fault Memory" to check for stored DTCs or the corresponding diagnostic repair procedure.
- Switch the ignition off.
- **End of diagnosis.**

Test-ID 165 (\$A5): Mis-Fire Cylinder 4 Data

- Connect the diagnostic tester.
- Start the engine and let run at idle speed.
- Select "Mode 6: Check test the results of components that are not continuously monitored".

Select "Test-ID 165 (\$A5)".

- Select the desired "Test-ID (TID)" or "Hex-ID".
- Check specified values at idle.

Test-ID (TID) (Hex-ID)	DTC	Component or System	Min.	Max.	Additional Information
11 (\$0B)	P0304	Burn misfire cylinder 4 average value over 10 driving cycles.	0	65535 (counts)	Refer to DTC P0304 in <u>Ignition</u> <u>system</u> .
12 (\$0C)	P0304	Burn misfire cylinder 4 during this driving cycle.	0	65535 (counts)	Refer to DTC P0304 in <u>Ignition</u> <u>system</u> .

- If any of the components or systems fail to meet the specified values, refer to Diagnostic "Mode 03: Interrogating Fault Memory" to check for stored DTCs or the corresponding diagnostic repair procedure.
- Switch the ignition off.
- **End of diagnosis.**

Test-ID 166 (\$A4): Mis-Fire Cylinder 5 Data

- Connect the diagnostic tester.
- Start the engine and let run at idle speed.
- Select "Mode 6: Check test the results of components that are not continuously monitored".

Select "Test-ID 166 (\$A4)".

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- Select the desired "Test-ID (TID)" or "Hex-ID".
- Check specified values at idle.

Test-ID (TID) (Hex-ID)	DTC	Component or System	Min.	Max.	Additional Information
11 (\$0B)	P0305	Burn misfire cylinder 5 average value over 10 driving cycles.	0	65535 (counts)	Refer to DTC P0305 in <u>Ignition system</u> .
12 (\$0C)	P0305	Burn misfire cylinder 5 during this driving cycle.	0	65535 (counts)	Refer to DTC P0305 in <u>Ignition system</u> .

- If any of the components or systems fail to meet the specified values, refer to Diagnostic "Mode 03: Interrogating Fault Memory" to check for stored DTCs or the corresponding diagnostic repair procedure.
- Switch the ignition off.
- **End of diagnosis.**

Test-ID 167 (\$A7): Mis-Fire Cylinder 6 Data

- Connect the diagnostic tester.
- Start the engine and let run at idle speed.
- Select "Mode 6: Check test the results of components that are not continuously monitored".

Select "Test-ID 167 (\$A7)".

- Select the desired "Test-ID (TID)" or "Hex-ID".
- Check specified values at idle.

Test-ID (TID) (Hex-ID)	DTC	Component or System	Min.	Max.	Additional Information
11 (\$0B)	P0306	Burn misfire cylinder 6 average value over 10 driving cycles.	0	65535 (counts)	Refer to DTC P0306 in <u>Ignition system</u> .
12 (\$0C)	P0306	Burn misfire cylinder 6 during this driving cycle.	0	65535 (counts)	Refer to DTC P0306 in <u>Ignition system</u> .

- If any of the components or systems fail to meet the specified values, refer to Diagnostic "Mode 03:

Interrogating Fault Memory" to check for stored DTCs or the corresponding diagnostic repair procedure.

- Switch the ignition off.
- **End of diagnosis.**

Diagnostic Mode 07: Check Test Results of Components that are Continuously Monitored

Diagnostic Mode 07 displays all stored DTCs of emission related components and systems which are continuously monitored.

Test requirements

- No DTCs stored in the DTC memory.
- Coolant temperature at least 80°C.

Procedure

- Connect the diagnostic tester.
- Start the engine and run at idle.

NOTE:

- **If the engine does not start, crank the engine using starter for at least 5 seconds, do not switch the ignition off afterward under any circumstances.**

- Select "Mode 7: Check test results of components that are continuously monitored".

The number of stored DTCs or "0 malfunctions detected" will be displayed diagnostic tester screen.

- Switch the ignition off.
- Refer to the following DTC tables for the diagnostic repair procedure:

- SAE P0xxxDTCs. --> **SAE P0xxx DTCs.**
- SAE P1xxx-DTCs --> **SAE P1xxx DTCs.**
- SAE P2xxxDTCs. --> **SAE P2xxx DTCs.**
- SAE P3xxxDTCs. --> **SAE P3xxx DTCs.**
- SAE U0xxxDTCs, --> **SAE U0xxx DTCs.**

- Switch the ignition off.
- **End of diagnosis.**

Diagnostic Mode 08: Tank Leak Test

Diagnostic Mode 08 is used to determine if the fuel system may be leaking.

Depending on the scan tool being used, the function test in Diagnostic Mode 08 may or may not be able to be performed.

If the scan tool being used will operate Diagnostic Mode 08, perform the test below **Function test**.

If the scan tool being used will not operate Diagnostic Mode 08, refer to --> **EVAP System, Leak Detection**.

NOTE: • **Always follow the manufacturers instructions for the scan tool being used.**

Test requirements

- No DTCs stored in the DTC memory.
- Intake Air Temperature (IAT) maximum 60°C.
- Coolant temperature 80 -110°C.
- Throttle valve angle 12.0 - 16.0%.

Function test

NOTE: • **If the accelerator pedal is depressed during the test, the test will be aborted.**

- Connect the scan tool.
- Start the engine and run at idle for at least 15 minutes.
- Select "Diagnostic Mode 08 - Tank Leak Test".
- Select " Tank Leak Test".
- Check the specified value of the tank leak test at idle.
- The following may be displayed on the scan tool screen:

Tank leak test	Specified value
• Test function active • Test function is being initiated, please wait • Test off • Test aborted	Test OK

- Switch the ignition off.

If the specified result is obtained:

System OK.

If the specified result is not obtained:

- Repeat the tank leak test, switch the ignition off and start the engine again and let run for 15 minutes at idle.
- Switch the ignition off.

If the specified result is again not obtained:

- A leak may be present. Refer to --> **EVAP System, Leak Detection**.

End of diagnosis.

Diagnostic Mode 09: Vehicle Information

NOTE: • **For all calibration and immobilizer information.**

Diagnostic Mode 09 is used to display vehicle specific information, e.g. the different Engine Control Module (ECM) versions.

Test requirement

- No DTCs stored in the DTC memory.

Procedure

- Connect the diagnostic tester.
- Switch the ignition on.
- Select "Mode 09: Vehicle information".
- Select the desired "Test-ID".

- The information requested will be displayed on the diagnostic tester screen.

The following table is a numerical list of all "Test-IDs" that may be selected.

Test-ID	Diagnostic text
02:	Vehicle identification number e.g.
	• A different 17 digit number will be displayed for each vehicle
04:	Calibration identification e.g.
	• Engine Control Module (ECM) • Transmission Control Module (TCM)
06:	CVN (check sum) e.g.
	• EC5AE460 the check sum is different for

	every control module version
	• 000D105

- Switch the ignition off.
- **End of diagnosis.**

GENERAL DIAGNOSIS

General Diagnosis

The following table provides quick links to all chapters in this section.

Preliminary Check

Before performing any pin point test or component diagnosis, a preliminary check must be performed.

Check the Technical Bulletins for information that may supersede any information included in this article.

- Connect the scan tool.
- Switch the ignition on.
- Using the scan tool, check for any stored or related DTCs.

If other DTCs are stored:

- Repair these DTCs first before performing the following procedure.

If no other DTCs are stored:

- Using the scan tool, erase the DTC memory. Refer to --> **Diagnostic Mode 04: Reset/delete Diagnostic Data.**
- Perform a road test to attempt to duplicate the customers complaint.

If the DTC returns:

- Perform the diagnostic procedure.

If the DTC does not return:

- The fault is intermittent or a sporadic condition may exist.
- Check the suspected component, electrical harness and electrical harness connectors for damage, corrosion, loose or broken terminals.
- If necessary, repair the faulty wiring connection.
- Perform a road test to verify the repair.

If the DTC returns:

- Perform the diagnostic procedure.

If the DTC does not return:

The fault may have been the result of a loose electrical connection.

- Generate readiness code. Refer to --> **Readiness Code**.
- **End of diagnosis.**

READINESS CODE

Readiness Code

Readiness Code Description

Diagnostics are performed at regular intervals during normal vehicle operation. After repairing an emissions related system, a readiness code is generated by road testing the vehicle.

If a malfunction is recognized during the drive cycle, it will be stored in the DTC memory.

The OBD drive cycle operation will be monitored with a hand held diagnostic tool. Consult the manufacturers instruction manual for correct tool operation.

The readiness code is erased every time the DTC memory is erased or any time the battery is disconnected. If the DTC memory has been erased or the battery is disconnected, a new readiness code must be generated.

Only erase the DTC memory if a DTC has been stored.

General Recommendations

Most monitors will complete easier and quicker using a steady-foot and smooth acceleration during the drive cycle operation, cruise, and acceleration modes.

Operating Conditions

For the EVAP monitor test, the coolant temperature and the ambient air temperature must be between 10°C and 35°C with a difference between them no greater than 4°C. The ambient air temperature must not change more than 4°C during the drive cycle procedure (e.g. when driving out of a heated workshop in the winter).

Test requirements

- Erase the DTC memory.
- Coolant temperature must be between 80°C and 110°C.
- The Intake Air Temperature (IAT) must be between 10°C and 35°C.

- Battery voltage must be a minimum of 12.5 volts.
- Fuel tank level 1/4 to 3/4 full.

CAUTION: When performing the drive cycle operation, pay strict attention to driving conditions and please observe and obey all posted speed limits. Failure to follow these instructions may result in personal injury or possible death.

Drive Cycle Procedure

- Connect the diagnostic tester.
- Switch the ignition on and start the vehicle.
- Idle the vehicle for 2-3 minutes. This executes the O2S Heater, Misfire, Secondary AIR, Fuel Trim, and Purge system monitors.
- Drive the vehicle at 45-55 mph for a continuous 7-minute period, avoid stopping. This executes the EVAP, O2S, Fuel Trim, and Misfire monitors.
- Accelerate the vehicle to an engine speed of 5000 RPM (with automatic transmission use the tip-tronic mode); lift off the throttle until the engine speed is around 1200 rpm. This executes the fuel cut off
- Accelerate the vehicle smoothly to 60-65 mph, cruise constantly for 5 min, this executes the Catalyst; O2S, Misfire, Fuel Trim, and Purge System monitors.
- Decelerate and idle the vehicle again for 3 minutes. This executes the Misfire, Secondary AIR, Fuel Trim, and Purge system monitors.
- Check the status of the readiness code.

NOTE:

- Depending on the diagnostic tester used. The readiness code status may be displayed as complete, passed or OK.

- If any engine monitor fails the drive cycle test. Repeat the drive cycle test until all engine monitors have successfully run through and passed.

NOTE:

- When repeating the drive cycle operation for a failed EVAP monitor or thermostat-monitor, allow the engine to cool until the coolant temperature and the ambient air temperature are between 10°C and 35°C with a difference between them no greater than 4°C is observed and repeat the drive cycle operation.

If the drive cycle operation fails again.

- Check the DTC memory for stored DTCs.

Repair the vehicle if necessary.

- Repeat the drive cycle operation until all engine monitors have successfully run through and passed.
- Remove the diagnostic tester and switch the ignition off.
- End of operation.

DIAGNOSTIC TROUBLE CODE (DTC) TABLES

Diagnostic Trouble Code (DTC) tables

--> SAE P0xxx DTCs

--> SAE P0xxx DTCs

--> SAE P1xxx DTCs

--> SAE P2xxx DTCs

--> SAE P3xxx DTCs

--> SAE U0xxx DTCs

SAE P0xxx DTCs

Fuel, air mixture, and additional emissions regulations

DTC	Error Message	Diagnostic Procedure	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	Frequency of checks, MIL Illum
P000A	Intake (A) Camshaft Position Slow Response Bank 1	○ Check the Camshaft Position (CMP) Sensor G40. Refer to --> <u>Camshaft Position (CMP) Sensors, Checking.</u> ○ Check the Camshaft Adjustment Valve 1 N205. Refer to --> <u>Camshaft</u>	• Signal change, 10°CA • Number of checks, 15	• Engine speed, >700 rpm • Set point change behavior check, 3° CA for 1.2 sec. • Set point change, >15°CA	1 Second	• Continuous • 2 DCY

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		<u>Adjustment Valve, Checking.</u> ○ Check the Engine Speed (RPM) Sensor G28. Refer to --> <u>Engine Speed (RPM) Sensor G28, Checking.</u>				
P000B	Intake (B) Camshaft Position Slow Response Bank 1	○ Check the Camshaft Position (CMP) Sensor 3 G300. Refer to --> <u>Camshaft Position (CMP) Sensors, Checking.</u> ○ Check the Engine Speed (RPM) Sensor G28. Refer to --> <u>Engine Speed (RPM) Sensor G28, Checking.</u>	• Signal change, 10°CA • Number of checks, 15	• Engine speed, >700 rpm • Set point change behavior check, 3° CA for 1.2 sec. • Set point change, >15°CA	1 Second	• Continuous • 2 DCY
P000C	Intake (A) Camshaft Position Slow Response Bank 2	○ Check the Camshaft Position (CMP) Sensor 2 G163. Refer to --> <u>Camshaft Position (CMP)</u>	• Signal change, 10°CA • Number of checks, 15	• Engine speed, >700 rpm • Set point change behavior check, 3° CA for 1.2 sec.	1 Second	• Continuous • 2 DCY

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		<u>Sensors, Checking.</u> ○ Check the Camshaft Adjustment Valve 2 N208. Refer to --> <u>Camshaft Adjustment Valve, Checking.</u> ○ Check the Engine Speed (RPM) Sensor G28. Refer to --> <u>Engine Speed (RPM) Sensor G28, Checking.</u>		• Set point change, >15°CA		
P000D	Intake (B) Camshaft Position Slow Response Bank 2	○ Check the Camshaft Position (CMP) Sensor 4 G301. Refer to --> <u>Camshaft Position (CMP) Sensors, Checking.</u> ○ Check the Engine Speed (RPM) Sensor G28. Refer to --> <u>Engine Speed (RPM) Sensor G28, Checking.</u>	• Signal change, 10°CA • Number of checks, 15	• Engine speed, >700 rpm • Set point change behavior check, 3° CA for 1.2 sec. • Set point change, >15°CA	1 Second	• Continuous • 2 DCY
P0010	Intake (A)	○ Check the	Signal current, >	Camshaft valve,	2 Seconds	• Continuous

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	Camshaft Position Actuator Circuit/Open (Bank 1)	Camshaft Adjustment Valve 1 N205. Refer to --> <u>Camshaft Adjustment Valve, Checking.</u>	0.8 mA	commanded on		• 2 DCY
P0011	(A) Camshaft Position - Timing Over-Advanced or System Performance, Bank 1	○ Check the Camshaft Adjustment Valve 1 N205. Refer to --> <u>Camshaft Adjustment Valve, Checking.</u>	• Adjustment Angle difference, > 12°CA for more than 3 seconds • Number of checks, 3 times	• Engine speed 700 rpm • Oil temperature 15 -130°C • Delta set point 3°CA, then wait 3 - 6 seconds	3 Seconds	• Continuous • 2 DCY
P0013	B Camshaft Position Actuator Circuit/Open, Bank 1	○ Check the Camshaft Adjustment Valve 1 (exhaust) N318. Refer to --> <u>Camshaft Adjustment Valve, Checking.</u>	Signal current, > 0.8 mA	Camshaft valve, Commanded on	2 Seconds	• Continuous • 2 DCY
P0014	B Camshaft Position - Timing Over-Advanced or System Performance, Bank 1	○ Check the Camshaft Adjustment Valve 1 (exhaust) N318. Refer to --> <u>Camshaft Adjustment Valve, Checking.</u>	• Adjustment Angle difference, > 12°CA for more than 3 seconds • Number of checks, 3 times	• Engine speed 700 rpm • Oil temperature 15 -130°C • Delta set point 3°CA, then wait 3 - 6 seconds	3 Seconds	• Continuous • 2 DCY
P0020	Intake (A) Camshaft Position	○ Check the Camshaft Adjustment	Signal current, > 0.8 mA	Camshaft valve, Commanded on	2 Seconds	• Continuous • 2 DCY

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	Actuator Circuit/Open (Bank 1)	Valve 1 N205. Refer to --> <u>Camshaft Adjustment Valve, Checking.</u>				
P0021	(A) Camshaft Position - Timing Over- Advanced or System Performance, Bank 2)	Check the Camshaft Adjustment Valve 1 N205. Refer to --> <u>Camshaft Adjustment Valve, Checking.</u>	- Adjustment Angle difference, > 12°CA for more than 3 seconds - Number of checks, 3 times	- Engine speed 700 rpm - Oil temperature 15 -130°C - Delta set point 3°CA, than wait 3 - 6 seconds	3 Seconds	- Continuous 2 DCY
P0023	B Camshaft Position Actuator Circuit/Open, Bank 2	Check the Camshaft Adjustment Valve 2 (exhaust) N319. Refer to --> <u>Camshaft Adjustment Valve, Checking.</u>	Signal current, > 0.8 mA	Camshaft valve, Commanded on	2 Seconds	- Continuous 2 DCY
P0024	B Camshaft Position - Timing Over- Advanced or System Performance, Bank 2	Check the Camshaft Adjustment Valve 2 (exhaust) N319. Refer to --> <u>Camshaft Adjustment Valve, Checking.</u>	- Adjustment Angle difference, > 12°CA for more than 3 seconds - Number of checks, 3 times	- Engine speed 700 rpm - Oil temperature 15 -130°C - Delta set point 3°CA, than wait 3 - 6 seconds	3 Seconds	- Continuous 2 DCY
P0030	HO2S Heater control circuit, Bank 1 Sensor 1	Check the Oxygen Sensor (O2S) Heater Z19. Refer to -->	Heater current, 8 - 40 mA	- Heater, Commanded on - Duty cycle, 0.4 - 99.6%	5.2 Seconds	- Continuous 2 DCY

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		<u>Oxygen Sensor (O2S) Heaters before Catalytic Converter, Checking.</u>				
P0031	HO2S Heater control circuit low, Bank 1 Sensor 1	Check the Oxygen Sensor (O2S) Heater Z19. Refer to --> <u>Oxygen Sensor (O2S) Heaters before Catalytic Converter, Checking.</u>	Heater voltage, 1.9 - 2.22 V	- Heater, Commanded off - Duty cycle, 99.6%	5.2 Seconds	- Continuous 2 DCY
P0032	HO2S Heater control circuit high, Bank 1 Sensor 1	Check the Oxygen Sensor (O2S) Heater Z19. Refer to --> <u>Oxygen Sensor (O2S) Heaters before Catalytic Converter, Checking.</u>	Heater current >8 - 11 A	- Heater, Commanded off - Duty cycle, >0.4%	5.2 Seconds	- Continuous 2 DCY
P0036	HO2S Heater control circuit, Bank 1 Sensor 2	Check the Oxygen Sensor (O2S) Heater Z29. Refer to --> <u>Oxygen Sensor (O2S) 1 (behind Three Way Catalytic Converter (TWC) Heater, Checking.</u>	Heater current, 8 - 40 mA	- Heater, Commanded on - Duty cycle, 0.4 - 99.6%	5.2 Seconds	- Continuous 2 DCY
P0037	HO2S Heater	Check the	Heater voltage,	Heater,	5.2 Seconds	Continuous

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	control circuit low, Bank 1 Sensor 2	Oxygen Sensor (O2S) Heater Z29. Refer to --> <u>Oxygen Sensor (O2S) 1 (behind Three Way Catalytic Converter (TWC) Heater, Checking.</u>	1.9-2.22 V	Commanded off • Duty cycle, 99.6%		• 2 DCY
P0038	HO2S Heater control circuit high, Bank 1 Sensor 2	○ Check the Oxygen Sensor (O2S) Heater Z29. Refer to --> <u>Oxygen Sensor (O2S) 1 (behind Three Way Catalytic Converter (TWC) Heater, Checking.</u>	Heater current bank 1, > 8-11 A	• Heater, Commanded off • Duty cycle, >0.4%	5.2 Seconds	• Continuous • 2 DCY
P0040	O2 Sensor Signals Swapped Bank 1 Sensor 1, Bank 2 Sensor 1	○ Check the oxygen sensors for swapping.	Deviation lambda control • Sensor 1 > 24% and sensor 2 - 24% or • Sensor 1 - 24% and sensor 2 > 24%	Lambda control, active	50 Seconds	• Continuous • 2 DCY
P0041	O2 Sensor Signals Swapped Bank 1 Sensor 2,	○ Check the oxygen sensors for swapping.	• Sensor 1 > 0.830 V and sensor 2 0.156 V	• Mass air flow integrated, > 400 G • O2S rear, no	50 Seconds	• Continuous • 2 DCY

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	Bank 2 Sensor 2		or	other faults		
			Sensor 1 0.156 and sensor 2 > 0.830 V	O2S rear, closed loop		
P0050	HO2S Heater control circuit, Bank 1 Sensor 1	Check the Oxygen Sensor (O2S) Heater Z19. Refer to --> <u>Oxygen Sensor (O2S) Heaters before Catalytic Converter, Checking.</u>	Heater current, 8 - 40 mA	- Heater, Commanded on - Duty cycle, 0.4 - 99.6%	5.2 Seconds	- Continuous 2 DCY
P0051	HO2S Heater control circuit low, Bank 1 Sensor 1	Check the Oxygen Sensor (O2S) Heater Z19. Refer to --> <u>Oxygen Sensor (O2S) Heaters before Catalytic Converter, Checking.</u>	Heater voltage, 1.9 - 2.22 V	- Heater, commanded off - Duty cycle, 99.6%	5.2 Seconds	- Continuous 2 DCY
P0052	HO2S Heater control circuit high, Bank 1 Sensor 1	Check the Oxygen Sensor (O2S) Heater Z19. Refer to --> <u>Oxygen Sensor (O2S) Heaters before Catalytic Converter, Checking.</u>	Heater current >8 - 11 A	- Heater, commanded off - Duty cycle, >0.4%	5.2 Seconds	- Continuous 2 DCY
P0056	HO2S Heater control circuit, Bank 1 Sensor 2	Check the Oxygen Sensor (O2S) Heater Z29.	Heater current, 8 - 40 mA	Heater, commanded on	5.2 Seconds	- Continuous 2 DCY

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		Refer to --> <u>Oxygen Sensor (O2S) 1 (behind Three Way Catalytic Converter (TWC) Heater , Checking.</u>		Duty cycle, 0.4 - 99.6%		
P0057	HO2S Heater control circuit low, Bank 1 Sensor 2	Check the Oxygen Sensor (O2S) Heater Z29. Refer to --> <u>Oxygen Sensor (O2S) 1 (behind Three Way Catalytic Converter (TWC) Heater , Checking.</u>	Heater voltage, 1.9-2.22 V	- Heater, commanded off - Duty cycle, 99.6%	5.2 Seconds	- Continuous 2 DCY
P0058	HO2S Heater control circuit high, Bank 2 Sensor 2	Check the Oxygen Sensor (O2S) Heater Z30. Refer to --> <u>Oxygen Sensor (O2S) 1 (behind Three Way Catalytic Converter (TWC) Heater , Checking.</u>	Heater current bank 2, > 35 A	- Heater, commanded off - Duty cycle, >0.4%	5.2 Seconds	- Continuous 2 DCY
P0068	MAP/MAF Throttle Position Correlation	Check the Intake Air Temperature (IAT) Sensor G42. Refer to --> <u>Intake Air Temperature</u>	Deviation throttle excitations -43 or >43% -33 or >33%	- Pressure quotient, 0.53 - Time after engine start, >70 seconds - Fuel cut off,	3 Seconds	- Continuous 2 DCY

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		<u>(IAT) Sensor G42, Checking.</u> ○ Check the intake system for leaks (false air). Refer to --> <u>Checking Intake System for Leaks.</u>	Deviation throttle excitations • -39 - >21% or 2% • -40 - >28% or 2%	Not active • Fuel trim activity, -23->23% • Pressure quotient, 0.63		
P0069	Manifold Absolute Pressure (MAP) - Barometric Pressure Correlation	○ Check the Intake Air Temperature (IAT) Sensor G42. Refer to --> <u>Intake Air Temperature (IAT) Sensor G42, Checking.</u> ○ Check the intake system for leaks (false air). Refer to --> <u>Checking Intake System for Leaks.</u>	Altitude sensor signal vs IM pressure >27 kPa or	• Modeled pressure ratio at throttle 0.05 • Throttle position, 28-81° • Engine speed, 600 - 4000 RPM	3 Seconds	• Continuous • 2 DCY
P0087	Fuel/Rail System Pressure - Too Low	○ Check the Low Fuel Pressure Sensor G410. Refer to --> <u>Low Fuel Pressure Sensor G410, Checking.</u>	• Deviation fuel rail pressure control, 0.025 G • Deviation lambda control, -10 +10%	• Fuel cut off, Not active • Engine speed, 640-3480 RPM • Time after engine start, >250 seconds • High pressure pump set	5 Seconds	• Continuous • 2 DCY

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				point, 0.005-0.05 G		
				• Lambda control, Closed loop • EVAP canister load, 25%		
P0088	Fuel/Rail System Pressure - Too High	○ Check the Low Fuel Pressure Sensor G410. Refer to --> <u>Low Fuel Pressure Sensor G410, Checking.</u>	Actual pressure, >13.5 PSI	• Engine speed, 640-6000 RPM • Time after engine start, >250 seconds	5 Seconds	• Continuous • 2 DCY
P0089	Fuel Pressure Regulator 1 Performance	○ Check the Low Fuel Pressure Sensor G410. Refer to --> <u>Low Fuel Pressure Sensor G410, Checking.</u>	Deviation fuel pressure control (LP), 28% - >35%	• Engine speed, 500-3000 RPM • Time after engine start, >30 seconds • ECT, 70-95°C • Delta fuel pressure low, 25 kPa • Fuel cut off, Not active	5 Seconds	• Continuous • 2 DCY
P0090	Fuel Pressure regulator 1 Control Circuit	○ Check the Fuel pressure and residual pressure. Refer to --> <u>Fuel pressure and residual pressure before high</u>	Signal voltage, 3 V	Camshaft valve, Commanded off	2 Seconds	• Continuous • 2 DCY

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		<u>pressure pump , Checking.</u> ○ Check the Fuel Pressure Sensor G247. Refer to --> <u>Fuel Pressure Sensor G247, Checking.</u>				
P0091	Fuel Pressure regulator 1 Control Circuit Low	○ Check the Fuel pressure and residual pressure. Refer to --> <u>Fuel pressure and residual pressure before high pressure pump , Checking.</u> ○ Check the Fuel Pressure Sensor G247. Refer to --> <u>Fuel Pressure Sensor G247, Checking.</u>	Signal current, >1 Amp	Camshaft valve, Commanded on	2 Seconds	• Continuous • 2 DCY
P0094	Fuel System Leak Detected - Small Leak	○ Check the Fuel pressure and residual pressure. Refer to --> <u>Fuel pressure and residual pressure before high pressure pump ,</u>	Signal voltage, 3 V	Camshaft valve, Commanded off	2 Seconds	• Continuous • 2 DCY

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		<u>Checking.</u> ○ Check the Fuel Pressure Sensor G247. Refer to --> <u>Fuel Pressure Sensor G247, Checking.</u>				
P0095	Intake Air Temperature Sensor 2 Circuit	○ Check the Intake Air Temperature (IAT) Sensor G42. Refer to --> <u>Intake Air Temperature (IAT) Sensor G42, Checking.</u> ○ Check the intake system for leaks (false air). Refer to --> <u>Checking Intake System for Leaks.</u>	Signal current, >1 Amp	Camshaft valve, Commanded on	2 Seconds	• Continuous • 2 DCY

SAE P0xxx DTCs

Fuel and air ratios

DTC	Error Message	Diagnostic Procedure	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	Frequency checks Illum
P0106	Manifold Absolute Pressure/BARO Sensor Range/Performance	○ Check the Intake Air Temperature (IAT) Sensor G42. Refer to --> <u>Intake Air Temperature (IAT) Sensor</u>	• Altitude sensor signal vs. IM pressure, >20 kPa • Boost	• Engine speed, 0 RPM • Time after engine start, 0 sec.	3 Seconds	• 0 • 2

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		<u>G42 , Checking.</u> ○ Check the intake system for leaks (false air). Refer to --> <u>Checking Intake System for Leaks.</u>	pressure signal, >23 kPa	• Throttle position, 28-81° • Engine speed, 600-4000 RPM		
P0107	Manifold absolute pressure/Barometric pressure circuit low input	○ Check the Intake Air Temperature (IAT) Sensor G42. Refer to --> <u>Intake Air Temperature (IAT) Sensor G42 , Checking.</u> ○ Check the intake system for leaks (false air). Refer to --> <u>Checking Intake System for Leaks.</u>	Signal voltage, 0.2 V	---	2 Seconds	• C • 2
P0108	Manifold absolute pressure/Barometric pressure circuit high input	○ Check the Intake Air Temperature (IAT) Sensor G42. Refer to --> <u>Intake Air Temperature (IAT) Sensor G42 , Checking.</u> ○ Check the intake system for leaks (false air). Refer to --> <u>Checking Intake System for Leaks.</u>	Signal voltage, > 4.8 V	---	2 Seconds	• C • 2
P0112	Intake Air Temperature Sensor 1 Circuit Low Input	○ Check the Intake Air Temperature (IAT) Sensor G42. Refer to --> <u>Intake Air Temperature (IAT) Sensor G42 , Checking.</u> ○ Check the intake system for leaks	IAT, > 141.0°C	---	2 Seconds	• C • 2

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		(false air). Refer to --> <u>Checking Intake System for Leaks.</u>				
P0113	Intake Air Temperature Sensor 1 Circuit High Input	○ Check the Intake Air Temperature (IAT) Sensor G42. Refer to --> <u>Intake Air Temperature (IAT) Sensor G42 , Checking.</u> ○ Check the intake system for leaks (false air). Refer to --> <u>Checking Intake System for Leaks.</u>	IAT, 45.75°C	---	2 Seconds	• C • 2
P0116	Engine Coolant Temperature Sensor 1 Circuit Range/Performance	○ Check the Engine Coolant Temperature (ECT) Sensor G62. Refer to --> <u>Engine Coolant Temperature (ECT) Sensor G62 , Checking.</u> ○ Check the coolant regulator --> <u>19 - ENGINE - COOLING SYSTEM .</u>	• Delta ECT, 77°C	ECT at start- 75 - 141°C Driving condition 1 • >22 sec. • Vehicle speed, >12.5 mph • Engine speed, >2500 rpm • Mass air flow, >60 kg/h and Driving condition 2 • >22 sec. • Fuel cut off, Active • Or Vehicle speed, >65 mph • Engine	155 Seconds 400 sec. after DCY 30 Seconds	• C • 2

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				speed, Idle • And if no pass cond. 1 2400 sec. • Ignition, off >400 sec. • ECT at start, 80-110°C • Delta modeled ECT, 13 K • ECT T start, 40-75°C		
P0117	Engine Coolant Temperature Sensor 1 Circuit Low Input	○ Check the Engine Coolant Temperature (ECT) Sensor G62. Refer to --> <u>Engine Coolant Temperature (ECT) Sensor G62 , Checking.</u> ○ Check the coolant regulator --> <u>19 - ENGINE - COOLING SYSTEM .</u>	ECT, >141°C		2 Seconds	• C • 2
P0118	Engine Coolant Temperature Sensor 1 Circuit High Input	○ Check the Engine Coolant Temperature (ECT) Sensor G62. Refer to --> <u>Engine Coolant Temperature (ECT) Sensor G62 , Checking.</u> ○ Check the coolant regulator --> <u>19 - ENGINE - COOLING</u>	ECT, 43.5°C		2 Seconds	• C • 2

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		<u>SYSTEM .</u>				
P0121	Throttle/Pedal Position Sensor A Circuit Range/Performance	Check the Throttle Position (TP) Sensor G79/Accelerator Pedal Position Sensor 2 G185. Refer to --> <u>Throttle Position (TP) Sensor G79/Accelerator Pedal Position Sensor 2 G185 , Checking.</u>	- TPS 1-TPS 2, >5.79% - Relative mass air integral, >100 at 0.45 sec.	- Engine start, Completed - TPS, No fault	0.2 Seconds	1 2
P0122	Throttle/Pedal Position Sensor A Circuit Low Input	Check the Throttle Position (TP) Sensor G79/Accelerator Pedal Position Sensor 2 G185. Refer to --> <u>Throttle Position (TP) Sensor G79/Accelerator Pedal Position Sensor 2 G185 , Checking.</u>	Signal voltage, 0.117 V		0.2 Seconds	1 2
P0123	Throttle/Pedal Position Sensor A Circuit High Input	Check the Throttle Position (TP) Sensor G79/Accelerator Pedal Position Sensor 2 G185. Refer to --> <u>Throttle Position (TP) Sensor G79/Accelerator Pedal Position Sensor 2 G185 , Checking.</u>	Signal voltage, > 4.88 V		0.2 Seconds	1 2
P0131	O2 Circuit Low Voltage (Bank 1, Sensor 1)	Check the Heated Oxygen Sensor (HO2S)	Short to ground, 0.13 V		3 Seconds	1 2

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		G39. Refer to --> <u>Heated Oxygen Sensor (HO2S) before Catalytic Converter, Checking.</u>				
P0132	O2 Circuit High Voltage (Bank 1, Sensor 1)	Check the Heated Oxygen Sensor (HO2S) G39. Refer to --> <u>Heated Oxygen Sensor (HO2S) before Catalytic Converter, Checking.</u>	Short to battery + >5.5 V		3 Seconds	0 2
P0133	O2 Circuit Slow Response (Bank 1, Sensor 1)	Check the Heated Oxygen Sensor (HO2S) G39. Refer to --> <u>Heated Oxygen Sensor (HO2S) before Catalytic Converter, Checking.</u>	Lambda value vs. modeled lambda value >0.8	- Modeled temp, 500 - 950°C - ECT, >60°C - Engine speed, 700 - 3000 rpm - Engine speed deviation, 518 rpm - Mass air flow, 0.426 - 1.2 g/rev - Delta mass air flow, 0.264 g/rev - EVAP canister load, 40%	65 Seconds	0 2
P0135	O2 Heater Circuit (Bank 1, Sensor 1)	Check the Oxygen Sensor (O2S) Heater Z19. Refer to --> <u>Oxygen Sensor (O2S) Heaters before Catalytic</u>	- O2S not ready after dew-point exceeded >40 sec. - UEGO ceramic	- O2S front dew-point, Exceeded - Heater control, Active	40 Seconds 120 Seconds	0 2 0 2

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		<u>Converter, Checking.</u>	temperature 680 or > 860° C	• O2S front, No other faults • O2S front dew-point, Exceeded • Heater control, Active • Lambda control, Active • O2S front, No other faults		
P0136	O2 Circuit (Bank 1, Sensor 2)	○ Check the Oxygen Sensor (O2S) Behind Three Way Catalytic Converter (TWC) G130. Refer to --> <u>Oxygen Sensors (O2S) Behind Three Way Catalytic Converter (TWC) behind Catalytic Converter, Checking.</u>	• O2S signal rear 0.708 V Not oscillating at reference • Signal voltage >0.2 V	• O2S rear, Ready • Trim control post cat, Closed loop • Integrated mass air flow, 20 - 150 g Fuel cut off-Active	5 Seconds	• C • 2
P0137	O2 Circuit Low Voltage (Bank 1, Sensor 2)	○ Check the Oxygen Sensor (O2S) Behind Three Way Catalytic Converter (TWC) G130. Refer to --> <u>Oxygen Sensors (O2S) Behind Three Way Catalytic</u>	• Signal voltage-20 mV • and Internal resistance-10 Ohms	• O2S rear dewpoint, exceeded • O2S rear, fully heated up • Mass air flow, >12 kg/h	5 Seconds	• C • 2

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		<u>Converter (TWC) behind Catalytic Converter, Checking.</u>				
P0138	O2 Circuit High Voltage (Bank 1, Sensor 2)	Check the Oxygen Sensor (O2S) Behind Three Way Catalytic Converter (TWC) G130. Refer to --> <u>Oxygen Sensors (O2S) Behind Three Way Catalytic Converter (TWC) behind Catalytic Converter, Checking.</u>	Signal voltage 1.5 V		5 Seconds	• C • 2
P0140	O2 Circuit No Activity Detected (Bank 1, Sensor 2)	Check the Oxygen Sensor (O2S) Behind Three Way Catalytic Converter (TWC) G130. Refer to --> <u>Oxygen Sensors (O2S) Behind Three Way Catalytic Converter (TWC) behind Catalytic Converter, Checking.</u>	Signal voltage, 0.370.47mV	Modeled exhaust gas temp. >555° C	5 Seconds	• C • 2
P0141	O2 Heater Circuit (Bank 1, Sensor 2)	Check the Oxygen Sensor (O2S) Heater Z29. Refer to --> <u>Oxygen Sensor (O2S) 1 (behind Three Way</u>	Heater resistance, >10K Ohm	- Modeled exhaust gas temp, 300-400°C - Heater duty cycle, 0.8 - 99.2%	60 Seconds	• C • 2

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		<u>Catalytic Converter (TWC) Heater, Checking.</u>				
P0151	Bank 2 sensor 1 Voltage too low	Check the Heated Oxygen Sensor (HO2S) 2 G108. Refer to -- > <u>Heated Oxygen Sensor (HO2S) before Catalytic Converter, Checking.</u>	Short to ground- 0.13 V		3 Seconds	• C • 2
P0152	O2 Sensor Circuit, Bank 2 - Sensor 1 High Voltage	Check the Heated Oxygen Sensor (HO2S) 2 G108. Refer to -- > <u>Heated Oxygen Sensor (HO2S) before Catalytic Converter, Checking.</u>	Short to battery+>5.5 V		3 Seconds	• C • 2
P0153	O2 Sensor Circuit, Bank 2 - Sensor 1 Slow Response	Check the Heated Oxygen Sensor (HO2S) 2 G108. Refer to -- > <u>Heated Oxygen Sensor (HO2S) before Catalytic Converter, Checking.</u>	Lambda value vs. modeled lambda value, >0.8	- Modeled temp, 500 - 950°C - ECT, >60°C - Engine speed, 700 - 3000 rpm - Engine speed deviation, 518 rpm - Mass air flow, 0.426 - 1.2 g/rev - Delta mass air flow, 0.264 g/rev - EVAP	65 Seconds	• C • 2

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				canister load, 40%		
P0155	O2 Sensor Heater Circuit, Bank 2 Sensor 1 Electrical Fault	○ Check the Oxygen Sensor (O2S) 2 Heater Z28. Refer to --> <u>Oxygen Sensor (O2S) Heaters before Catalytic Converter, Checking.</u>	• O2S not ready after dew-point exceeded->40 sec. • UEGO ceramic temperature-680 or > 860° C	• O2S front dew-point, Exceeded • Heater control, Active • O2S front, No other faults • O2S front dew-point, Exceeded • Heater control, Active • Lambda control, Active • O2S front, No other faults	40 Seconds 120 Seconds	• C • 2 • C • 2
P0156	O2 Sensor Circuit, Bank 2 - Sensor 2 Malfunction	○ Check the Oxygen Sensor (O2S) 2 Behind Three Way Catalytic Converter (TWC) G131. Refer to --> <u>Oxygen Sensors (O2S) Behind Three Way Catalytic Converter (TWC) behind Catalytic Converter, Checking.</u>	• O2S signal rear 0.708 V • Not oscillating at reference • Signal voltage >0.2 V	• O2S rear, Ready • Trim control post cat, Closed loop • Integrated mass air flow, 20-150 g • Fuel cut off, Active	5 Seconds	• C • 2
P0157	O2 Sensor Circuit, Bank 2 - Sensor 2	○ Check the Oxygen Sensor	• Signal voltage-20	• O2S rear dew point,	5 Seconds	• C • 2

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	Low Voltage	(O2S) 2 Behind Three Way Catalytic Converter (TWC) G131. Refer to --> <u>Oxygen Sensors (O2S) Behind Three Way Catalytic Converter (TWC) behind Catalytic Converter, Checking.</u>	mV And Internal resistance 10 Ohms	Exceeded - O2S rear, Fully heated up - Mass air flow, >12 kg/h		
P0158	O2 Sensor Circuit, Bank 2 - Sensor 2 High Voltage	Check the Oxygen Sensor (O2S) 2 Behind Three Way Catalytic Converter (TWC) G131. Refer to --> <u>Oxygen Sensors (O2S) Behind Three Way Catalytic Converter (TWC) behind Catalytic Converter, Checking.</u>	Signal voltage >1.5 V		5 Seconds	(2
P0160	O2 Sensor Circuit No Activity Detected (Bank 2 Sensor 2)	Check the Oxygen Sensor (O2S) 2 Behind Three Way Catalytic Converter (TWC) G131. Refer to --> <u>Oxygen Sensors (O2S) Behind Three Way Catalytic Converter (TWC) behind</u>	Signal voltage 0.376 - 0.474 V	Modeled exhaust temperature >555° C	5 Seconds	(2

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		<u>Catalytic Converter, Checking.</u>				
P0161	HO2S Heater Control Circuit (Bank 2 Sensor 2)	Check the Oxygen Sensor (O2S) 2 (behind Three Way Catalytic Converter (TWC)) Heater Z30. Refer to --> <u>Oxygen Sensor (O2S) 1 (behind Three Way Catalytic Converter (TWC) Heater, Checking.</u>	Internal resistance >10K Ohms	- Modeled exhaust gas temp, 300 - 400°C - Heater duty cycle, 0.8 - 99.2%	60 Seconds	• (• 2
P0171	System Too Lean (Bank 1)	- Check the fuel pump delivery and quantity. Refer to --> <u>Fuel Pump Delivery Quantity, Checking.</u> - Check the Fuel pressure regulator and residual pressure. Refer to --> <u>Fuel pressure and residual pressure before high pressure pump, Checking.</u> - Check Fuel Pressure Sensor G247 --> <u>Fuel Pressure Sensor G247, Checking.</u> - Check the fuel injectors. Refer to --> <u>Fuel</u>	- Additive system too rich Adaptive value->25% - Multiplicative system too rich Adaptive value->22%	- Lambda control, Closed loop - EVAP purge valve, Closed - ECT or Sub. ECT, >70°C - Mass fuel flow, 0.04 g/rev - Engine speed, 864 RPM - Delta mass air flow, 7.5 kg/h - Accelerator PP value, 250%/sec. - Integrated mass air flow, >25 g	35 Seconds	• (• 2

		<u>Injectors , Checking.</u> ○ Check the Heated Oxygen Sensor (HO2S) G39. Refer to --> <u>Heated Oxygen Sensor (HO2S) before Catalytic Converter, Checking.</u> ○ Check the Oxygen Sensor (O2S) Behind Three Way Catalytic Converter (TWC) G130. Refer to --> <u>Oxygen Sensors (O2S) Behind Three Way Catalytic Converter (TWC) behind Catalytic Converter, Checking.</u> ○ Check the Evaporative Emission (EVAP) Canister Purge Regulator Valve N80. Refer to --> <u>Evaporative Emission (EVAP) Canister Purge Regulator Valve N80 , Checking.</u> ○ Check the intake system for leaks (false air). Refer to --> <u>Checking</u>		• Lambda control, Closed loop • EVAP purge valve, Closed • ECT or Sub. ECT, >70°C • Engine speed, 9924500 RPM • Mass air flow, 34450 kg/h • Delta mass air flow, 7.5 kg/h • Accelerator PP value, 250%/sec. • Integrated mass air flow, >25 g	
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		<u>Intake System for Leaks.</u> ○ Check exhaust system for proper seal. ○ Check vacuum lines for leaks				
P0172	System Too Rich (Bank 1)	○ Check the Fuel pressure regulator and residual pressure. Refer to --> <u>Fuel pressure and residual pressure before high pressure pump, Checking.</u> ○ Check the fuel injectors. Refer to --> <u>Fuel Injectors, Checking.</u> ○ Check the Evaporative Emission (EVAP) Canister Purge Regulator Valve N80. Refer to --> <u>Evaporative Emission (EVAP) Canister Purge Regulator Valve N80, Checking.</u> ○ Check the Heated Oxygen Sensor (HO2S) G39. Refer to --> <u>Heated Oxygen Sensor (HO2S) before Catalytic Converter,</u>	● Additive system too rich Adaptive value -25% ● Multiplicative system too rich Adaptive value -25%	● Lambda control, Closed loop ● EVAP purge valve, Closed ● ECT or Sub. ECT, >70°C ● Mass fuel flow, 0.04 g/rev ● Engine speed, 864 RPM ● Delta mass air flow, 7.5 kg/h ● Accelerator PP value, 250%/sec. ● Integrated mass air flow, >25 g ● Lambda control, Closed loop ● EVAP purge valve, Closed ● ECT or Sub. ECT, >70°C ● Engine	35 Seconds	● C ● 2

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		<u>Checking.</u> ○ Check the Oxygen Sensor (O2S) Behind Three Way Catalytic Converter (TWC) G130. Refer to --> <u>Oxygen Sensors (O2S) Behind Three Way Catalytic Converter (TWC) behind Catalytic Converter, Checking.</u>		speed, 9924500 RPM • Mass air flow, 34450 kg/h • Delta mass air flow, 7.5 kg/h • Accelerator PP value, 250%/sec. • Integrated mass air flow, >25 g		
P0174	System too Lean, Bank 2	○ Check the fuel pump delivery and quantity. Refer to --> <u>Fuel Pump Delivery Quantity, Checking.</u> ○ Check the Fuel pressure regulator and residual pressure. Refer to --> <u>Fuel pressure and residual pressure before high pressure pump, Checking.</u> ○ Check Fuel Pressure Sensor G247 --> <u>Fuel Pressure Sensor G247, Checking.</u> ○ Check the fuel injectors. Refer	• Additive system too rich Adaptive value >22% • Multiplicative system too rich Adaptive value >22%	• Lambda control, Closed loop • EVAP purge valve, Closed • ECT or Sub. ECT, >70°C • Mass fuel flow, 0.04 g/rev • Engine speed, 864 RPM • Delta mass air flow, 7.5 kg/h • Accelerator PP value, 250%/sec. • Integrated mass air flow, >25 g	35 Seconds	• C • 2

		to --> <u>Fuel Injectors, Checking.</u> ○ Check the Heated Oxygen Sensor (HO2S) 2 G108. Refer to --> <u>Heated Oxygen Sensor (HO2S) before Catalytic Converter, Checking.</u> ○ Check the Oxygen Sensor (O2S) 2 Behind Three Way Catalytic Converter (TWC) G131. Refer to --> <u>Oxygen Sensors (O2S) Behind Three Way Catalytic Converter (TWC) behind Catalytic Converter, Checking.</u> ○ Check the Evaporative Emission (EVAP) Canister Purge Regulator Valve N80. Refer to --> <u>Evaporative Emission (EVAP) Canister Purge Regulator Valve N80 , Checking.</u> ○ Check the intake system for leaks		• Lambda control, Closed loop • EVAP purge valve, Closed • ECT or Sub. ECT, >70°C • Engine speed, 9924500 RPM • Mass air flow, 34450 kg/h • Delta mass air flow, 7.5 kg/h • Accelerator PP value, 250%/sec. • Integrated mass air flow, >25 g	
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		(false air). Refer to --> <u>Checking Intake System for Leaks.</u> ○ Check exhaust system for proper seal. ○ Check vacuum lines for leaks				
P0175	System too Rich, Bank 2	○ Check the fuel pump delivery and quantity. Refer to --> <u>Fuel Pump Delivery Quantity, Checking.</u> ○ Check the Fuel pressure regulator and residual pressure. Refer to --> <u>Fuel pressure and residual pressure before high pressure pump, Checking.</u> ○ Check Fuel Pressure Sensor G247 --> <u>Fuel Pressure Sensor G247, Checking.</u> ○ Check the fuel injectors. Refer to --> <u>Fuel Injectors, Checking.</u> ○ Check the Heated Oxygen Sensor (HO2S) 2 G108. Refer to --> <u>Heated</u>	● Additive system too rich Adaptive value -25% ● Multiplicative system too rich Adaptive value -25%	● Lambda control, Closed loop ● EVAP purge valve, Closed ● ECT or Sub. ECT, >70°C ● Mass fuel flow, 0.04 g/rev ● Engine speed, 864 RPM ● Delta mass air flow, 7.5 kg/h ● Accelerator PP value, 250%/sec. ● Integrated mass air flow, >25 g ● Lambda control, Closed loop ● EVAP purge valve, Closed ● ECT or Sub.	35 Seconds	● C ● 2

		<u>Oxygen Sensor (HO2S) before Catalytic Converter, Checking.</u> ○ Check the Oxygen Sensor (O2S) 2 Behind Three Way Catalytic Converter (TWC) G131. Refer to --> <u>Oxygen Sensors (O2S) Behind Three Way Catalytic Converter (TWC) behind Catalytic Converter, Checking.</u> ○ Check the Evaporative Emission (EVAP) Canister Purge Regulator Valve N80. Refer to --> <u>Evaporative Emission (EVAP) Canister Purge Regulator Valve N80 , Checking.</u> ○ Check the intake system for leaks (false air). Refer to --> <u>Checking Intake System for Leaks.</u> ○ Check exhaust system for proper seal.	ECT, >70°C ● Engine speed, 9924500 RPM ● Mass air flow, 34450 kg/h ● Delta mass air flow, 7.5 kg/h ● Accelerator PP value, 250%/sec. ● Integrated mass air flow, >25 g	
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		○ Check vacuum lines for leaks				
P0190	Fuel Rail Pressure Sensor A Circuit	○ Check the Fuel Pressure Sensor G247. Refer to --> <u>Fuel Pressure Sensor G247, Checking.</u>	Signal voltage > 4.8 V		2 Seconds	• C • 2
P0192	Fuel Rail Pressure Sensor A Circuit Low Input	○ Check the Fuel Pressure Sensor G247. Refer to --> <u>Fuel Pressure Sensor G247, Checking.</u>	Signal voltage 0.2 V		2 Seconds	• C • 2
P0201	Injector Circuit/Open - Cylinder 1	○ Check the fuel injectors. Refer to --> <u>Fuel Injectors, Checking.</u>	• Signal current, 10 A • And Signal voltage, >3.5 V	• Injection valve, Commanded on • Injection valve, Commanded off	3 Seconds	• C • 2
P0202	Injector Circuit/Open - Cylinder 2	○ Check the fuel injectors. Refer to --> <u>Fuel Injectors, Checking.</u>	• Signal current, 10 A • And Signal voltage, >3.5 V	• Injection valve, Commanded on • Injection valve, Commanded off	3 Seconds	• C • 2
P0203	Injector Circuit/Open - Cylinder 3	○ Check the fuel injectors. Refer to --> <u>Fuel Injectors, Checking.</u>	• Signal current, 10 A • And Signal voltage, >3.5 V	• Injection valve, Commanded on • Injection valve, Commanded off	3 Seconds	• C • 2
P0204	Injector Circuit/Open - Cylinder 4	○ Check the fuel injectors. Refer to --> <u>Fuel Injectors, Checking.</u>	• Signal current, 10 A • And Signal voltage, >3.5 V	• Injection valve, Commanded on • Injection	3 Seconds	• C • 2

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				valve, Commanded off		
P0205	Injector Circuit/Open - Cylinder 5	Check the fuel injectors. Refer to --> <u>Fuel Injectors, Checking.</u>	- Signal current, 10 A - And Signal voltage, >3.5 V	- Injection valve, Commanded on - Injection valve, Commanded off	3 Seconds	• (• 2
P0206	Injector Circuit/Open - Cylinder 6	Check the fuel injectors. Refer to --> <u>Fuel Injectors, Checking.</u>	- Signal current, 10 A - And Signal voltage, >3.5 V	- Injection valve, Commanded on - Injection valve, Commanded off	3 Seconds	• (• 2
P0219	Engine Overspeed Condition	Inspect and repair mechanical damage as necessary.	Engine speed, >6750 RPM	- Range position, Not P,R,N - Position sensor, Status OK - Engine speed, Status OK - Time since range position not P,R,N, 2 Sec.	0.5 Seconds	• (• 2
P0221	Throttle/Pedal Position Sensor/Switch B Circuit Range/Performance	Check the Throttle Position (TP) Sensor G79/Accelerator Pedal Position Sensor 2 G185. Refer to --> <u>Throttle Position (TP) Sensor</u>	- TPS 1-TPS 2, >5.79° - And Relative mass air integral >100 at 0.45 sec.	- Engine start, Completed - TPS, No fault	0.2 Seconds	• (• 2

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		<u>G79/Accelerator Pedal Position Sensor 2 G185, Checking.</u>				
P0222	Throttle/Pedal Position Sensor/Switch B Circuit Low Input	Check the Throttle Position (TP) Sensor G79/Accelerator Pedal Position Sensor 2 G185. Refer to --> <u>Throttle Position (TP) Sensor G79/Accelerator Pedal Position Sensor 2 G185, Checking.</u>	Signal voltage, 0.117 V		0.2 Seconds	• C • 2
P0223	Throttle/Pedal Position Sensor/Switch B Circuit High Input	Check the Throttle Position (TP) Sensor G79/Accelerator Pedal Position Sensor 2 G185. Refer to --> <u>Throttle Position (TP) Sensor G79/Accelerator Pedal Position Sensor 2 G185, Checking.</u>	Signal voltage, > 4.88 V		0.2 Seconds	• C • 2
P0261	Cylinder 1 Injector Circuit Low	Check the fuel injectors. Refer to --> <u>Fuel Injectors, Checking.</u>	- Signal current, 10 A - And Signal voltage, >3.5 V	- Injection valve, Commanded on - Injection valve, Commanded off	3 Seconds	• C • 2
P0262	Cylinder 1 Injector Circuit High	Check the fuel injectors. Refer to --> <u>Fuel Injectors, Checking.</u>	Signal current, >16 A	Injection valve, Commanded on	3 Seconds	• C • 2

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P0264	Cylinder 2 Injector Circuit Low	○ Check the fuel injectors. Refer to --> <u>Fuel Injectors, Checking.</u>	• Signal current, 10 A • And Signal voltage, >3.5 V	• Injection valve, Commanded on • Injection valve, Commanded off	3 Seconds	• C • 2
P0265	Cylinder 2 Injector Circuit High	○ Check the fuel injectors. Refer to --> <u>Fuel Injectors, Checking.</u>	• Signal current, >16 A	• Injection valve, Commanded on	3 Seconds	• C • 2
P0267	Cylinder 3 Injector Circuit Low	○ Check the fuel injectors. Refer to --> <u>Fuel Injectors, Checking.</u>	• Signal current, 10 A • And Signal voltage, >3.5 V	• Injection valve, Commanded on • Injection valve, Commanded off	3 Seconds	• C • 2
P0268	Cylinder 3 Injector Circuit High	○ Check the fuel injectors. Refer to --> <u>Fuel Injectors, Checking.</u>	• Signal current, >16 A	• Injection valve, Commanded on	3 Seconds	• C • 2
P0270	Cylinder 4 Injector Circuit Low	○ Check the fuel injectors. Refer to --> <u>Fuel Injectors, Checking.</u>	• Signal current, 10 A • And Signal voltage, >3.5 V	• Injection valve, Commanded on • Injection valve, Commanded off	3 Seconds	• C • 2
P0271	Cylinder 4 Injector Circuit High	○ Check the fuel injectors. Refer to --> <u>Fuel Injectors, Checking.</u>	• Signal current, >16 A	• Injection valve, Commanded on	3 Seconds	• C • 2
P0273	Cylinder 5 Injector Circuit Low	○ Check the fuel injectors. Refer to --> <u>Fuel Injectors, Checking.</u>	• Signal current, 10 A • And Signal voltage, >3.5	• Injection valve, Commanded on	3 Seconds	• C • 2

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			V	Injection valve, Commanded off		
P0274	Cylinder 5 Injector Circuit High	Check the fuel injectors. Refer to --> <u>Fuel Injectors, Checking.</u>	Signal current, >16 A	Injection valve, Commanded on	3 Seconds	- C 2
P0276	Cylinder 6 Injector Circuit Low	Check the fuel injectors. Refer to --> <u>Fuel Injectors, Checking.</u>	- Signal current, 10 A - And Signal voltage, >3.5 V	- Injection valve, Commanded on - Injection valve, Commanded off	3 Seconds	- C 2
P0277	Cylinder 6 Injector Circuit High	Check the fuel injectors. Refer to --> <u>Fuel Injectors, Checking.</u>	Signal current, >16 A	Injection valve, Commanded on	3 Seconds	- C 2

Ignition system

DTC	Error Message	Diagnostic Procedure	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	Frequency of checks, MIL Illum
P0300	Random Misfire Detected	- Check the Spark plugs. - Check the intake system for leaks (false air). Refer to --> <u>Checking Intake System for Leaks.</u>	- Emission threshold 1st interval %(MR), >1.3% - Emission threshold misfire rate (MR), > 1.3% - Catalyst damage misfire rate (MR), >	- Time after engine start, idle-150 RPM - Camshaft revolutions, 1 - Engine speed range, idle, 6850 RPM - Engine torque, > 0 torque (Nm)	1000 Rev. 200 Rev.	- Continuo 2 DCY - Immed.

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		○ Check the Fuel pressure regulator and residual pressure. Refer to --> <u>Fuel pressure and residual pressure before high pressure pump, Checking.</u> ○ Check the fuel injectors. Refer to --> <u>Fuel Injectors, Checking.</u> ○ Check the Ignition Coil with Power Output Stage. Refer to --> <u>Ignition Coil with Power Output Stage, Checking.</u>	1.315%	● Fuel cut off, not active		
P0301	Cylinder 1 Misfire Detected	○ Check the Spark plugs. ○ Check the intake system for leaks	● Emission threshold 1st interval %(MR), >1.3% ● Emission threshold	● Time after engine start, idle-150 RPM ● Camshaft revolutions, 1	● 1000 Rev. ● 200 Rev.	● Continuo ● 2 DCY ● Immed.

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		(false air). Refer to --> <u>Checking Intake System for Leaks.</u> ○ Check the Fuel pressure regulator and residual pressure. Refer to --> <u>Fuel pressure and residual pressure before high pressure pump, Checking.</u> ○ Check the fuel injectors. Refer to --> <u>Fuel Injectors, Checking.</u> ○ Check the Ignition Coil with Power Output Stage. Refer to --> <u>Ignition Coil with Power Output Stage, Checking.</u>	misfire rate (MR), > 1.3% ● Catalyst damage misfire rate (MR), > 1.315%	● Engine speed range, idle, 6850 RPM ● Engine torque, > 0 torque (Nm) ● Fuel cut off, not active		
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P0302	Cylinder 2 Misfire Detected	○ Check the Spark plugs. ○ Check the intake system for leaks (false air). Refer to -- > <u>Checking Intake System for Leaks.</u> ○ Check the Fuel pressure regulator and residual pressure. Refer to -- > <u>Fuel pressure and residual pressure before high pressure pump, Checking.</u> ○ Check the fuel injectors. Refer to -- > <u>Fuel Injectors, Checking.</u> ○ Check the Ignition Coil with Power Output	● Emission threshold 1st interval %(MR), >1.3% ● Emission threshold misfire rate (MR), > 1.3% ● Catalyst damage misfire rate (MR), > 1.315%	● Time after engine start, idle-150 RPM ● Camshaft revolutions, 1 ● Engine speed range, idle, 6850 RPM ● Engine torque, > 0 torque (Nm) ● Fuel cut off, not active	● 1000 Rev. ● 200 Rev.	● Continuo ● 2 DCY ● Immed.
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		Stage. Refer to -- > <u>Ignition Coil with Power Output Stage, Checking.</u>				
P0303	Cylinder 3 Misfire Detected	○ Check the Spark plugs. ○ Check the intake system for leaks (false air). Refer to --> <u>Checking Intake System for Leaks.</u> ○ Check the Fuel pressure regulator and residual pressure. Refer to --> <u>Fuel pressure and residual pressure before high pressure pump, Checking.</u> ○ Check the fuel injectors. Refer to --> <u>Fuel</u>	• Emission threshold 1st interval %(MR), >1.3% • Emission threshold misfire rate (MR), > 1.3% • Catalyst damage misfire rate (MR), > 1.315%	• Time after engine start, idle-150 RPM • Camshaft revolutions, 1 • Engine speed range, idle, 6850 RPM • Engine torque, > 0 torque (Nm) • Fuel cut off, not active	• 1000 Rev. • 200 Rev.	• Continuo • 2 DCY • Immed.

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		<u>Injectors , Checking.</u> ○ Check the Ignition Coil with Power Output Stage. Refer to -- > <u>Ignition Coil with Power Output Stage , Checking.</u>				
P0304	Cylinder 4 Misfire Detected	○ Check the Spark plugs. ○ Check the intake system for leaks (false air). Refer to -- > <u>Checking Intake System for Leaks.</u> ○ Check the Fuel pressure regulator and residual pressure. Refer to -- > <u>Fuel pressure and residual pressure before high pressure</u>	● Emission threshold 1st interval %(MR), >1.3% ● Emission threshold misfire rate (MR), > 1.3% ● Catalyst damage misfire rate (MR), > 1.315%	● Time after engine start, idle-150 RPM ● Camshaft revolutions, 1 ● Engine speed range, idle, 6850 RPM ● Engine torque, > 0 torque (Nm) ● Fuel cut off, not active	● 1000 Rev. ● 200 Rev.	● Continuo ● 2 DCY ● Immed.

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		<u>pump, Checking.</u> ○ Check the fuel injectors. Refer to -- > <u>Fuel Injectors, Checking.</u> ○ Check the Ignition Coil with Power Output Stage. Refer to -- > <u>Ignition Coil with Power Output Stage, Checking.</u>				
P0305	Cylinder 5 Misfire Detected	○ Check the Spark plugs. ○ Check the intake system for leaks (false air). Refer to -- > <u>Checking Intake System for Leaks.</u> ○ Check the Fuel pressure regulator and residual pressure. Refer to --	• Emission threshold 1st interval %(MR), >1.3% • Emission threshold misfire rate (MR), > 1.3% • Catalyst damage misfire rate (MR), > 1.315%	• Time after engine start, idle-150 RPM • Camshaft revolutions, 1 • Engine speed range, idle, 6850 RPM • Engine torque, > 0 torque (Nm) • Fuel cut off, not active	• 1000 Rev. • 200 Rev.	• Continuo • 2 DCY • Immed.

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		> <u>Fuel pressure and residual pressure before high pressure pump, Checking.</u> ○ Check the fuel injectors. Refer to --> <u>Fuel Injectors, Checking.</u> ○ Check the Ignition Coil with Power Output Stage. Refer to --> <u>Ignition Coil with Power Output Stage, Checking.</u>				
P0306	Cylinder 6 Misfire Detected	○ Check the Spark plugs. ○ Check the intake system for leaks (false air). Refer to --> <u>Checking Intake System for Leaks.</u>	• Emission threshold 1st interval %(MR), >1.3% • Emission threshold misfire rate (MR), > 1.3% • Catalyst damage misfire rate (MR), >	• Time after engine start, idle-150 RPM • Camshaft revolutions, 1 • Engine speed range, idle, 6850 RPM • Engine torque, > 0 torque (Nm)	• 1000 Rev. • 200 Rev.	• Continuo • 2 DCY • Immed.

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		○ Check the Fuel pressure regulator and residual pressure. Refer to --> <u>Fuel pressure and residual pressure before high pressure pump, Checking.</u> ○ Check the fuel injectors. Refer to --> <u>Fuel Injectors, Checking.</u> ○ Check the Ignition Coil with Power Output Stage. Refer to --> <u>Ignition Coil with Power Output Stage, Checking.</u>	1.315%	● Fuel cut off, not active		
P0326	Knock Sensor 1 Circuit Range/Performance	○ Check the Knock Sensor (KS) 1 G61. Refer to --> <u>Knock</u>	Lower threshold, 0.03 V	● Engine speed, > 2656 RPM ● Mass air flow, >0.75 g/rev	40 Times	● Continuo ● 2 DCY

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		<u>Sensor (KS), Checking.</u>				
P0327	Knock Sensor 1 Circuit Low Input (Bank 1)	○ Check the Knock Sensor (KS) 1 G61. Refer to -- > <u>Knock Sensor (KS), Checking.</u>	Lower threshold, 0.18 V	• Engine speed, > 2656 RPM • Mass air flow, >0.75 g/rev	40 Times	• Continuo • 2 DCY
P0328	Knock Sensor 1 Circuit High Input (Bank 1)	○ Check the Knock Sensor (KS) 1 G61. Refer to -- > <u>Knock Sensor (KS), Checking.</u>	Upper threshold, 4.8 V	• Engine speed, > 2656 RPM • Mass air flow, >0.75 g/rev	40 Times	• Continuo • 2 DCY
P0331	Knock Sensor 2 Circuit Range/Performance	○ Check the Knock Sensor (KS) 2 G66. Refer to -- > <u>Knock Sensor (KS), Checking.</u>	Upper threshold, >1.99 V	• Engine speed, > 2656 RPM • Mass air flow, >0.75 g/rev	40 Times	• Continuo • 2 DCY
P0332	Knock Sensor 2 Circuit Low Input (Bank 2)	○ Check the Knock Sensor (KS) 2 G66. Refer to -- > <u>Knock Sensor (KS), Checking.</u>	Lower threshold, 0.18 V	• Engine speed, > 2656 RPM • Mass air flow, >0.75 g/rev	40 Times	• Continuo • 2 DCY
P0333	Knock Sensor 2 Circuit High Input	○ Check the Knock	Upper threshold, 4.8 V	• Engine speed, >	40 Times	• Continuo • 2 DCY

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	(Bank 2)	Sensor (KS) 2 G66. Refer to -- > <u>Knock Sensor (KS), Checking.</u>		2656 RPM • Mass air flow, >0.75 g/rev		
P0335	Crankshaft Position Sensor (A) Circuit- G28 Malfunction	○ Check the Engine Speed (RPM) Sensor G28. Refer to -- > <u>Engine Speed (RPM) Sensor G28 , Checking.</u>	• Delta signal voltage > 1 V • Internal signal voltage 1.5 V • Internal voltage >3.5 VRPM signal- no signal	Engine speed, > 32 RPM	0.4 Seconds	• Continuo • 2 DCY
P0336	Crankshaft Position Sensor (A) Circuit Range/Performance	○ Check the Engine Speed (RPM) Sensor G28. Refer to -- > <u>Engine Speed (RPM) Sensor G28 , Checking.</u>	• RPM signal comparison with phase sensor-not synchronous • Counted versus reference teeth->1 • Actual time value vs. modeled time value- >1.375	• Engine speed, >32 rpm • Engine speed, >416 rpm • Engine speed, >480 rpm	0.4 Seconds 0.3 Seconds 25 Seconds	• Continuo • 2 DCY
P0340	Camshaft Position Sensor A Circuit (Bank 1 or single sensor)	○ Check the Camshaft Position (CMP) Sensor G40. Refer to -- > <u>Camshaft</u>	Signal voltage, no altering at 4 revs	• Engine speed, >416 rpm	0.4 Seconds	• Continuo • 2 DCY

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		<u>Position (CMP) Sensors, Checking.</u>				
P0341	Camshaft Position Sensor A Circuit Range/Performance (Bank 1 or single sensor)	○ Check the Camshaft Position (CMP) Sensor G40. Refer to -- > <u>Camshaft Position (CMP) Sensors, Checking.</u>	• Actual time value-1 vs. min time value • Adaptive value vs. target value >21°CA • Actual time value vs. modeled time value 1-3.5	• Engine speed, >416 rpm • Duty cycle, Commanded off	0.1 Seconds 2 Seconds 3 Seconds	• Continuo • 2 DCY
P0345	Camshaft Position Sensor (A) Circuit	○ Check the Camshaft Position (CMP) Sensor G40. Refer to -- > <u>Camshaft Position (CMP) Sensors, Checking.</u>	Signal voltage, no altering at 4 revs	• Engine speed, >416 rpm	0.4 Seconds	• Continuo • 2 DCY
P0346	Camshaft Position Sensor A Circuit Range/Performance	○ Check the Camshaft Position (CMP) Sensor G40. Refer to -- > <u>Camshaft Position (CMP) Sensors, Checking.</u>	• Actual time value-1 vs. min time value • Adaptive value vs. target value >21°CA • Actual time value vs. modeled time value 1-3.5	• Engine speed, >416 rpm • Duty cycle, Commanded off	0.1 Seconds 2 Seconds 3 Seconds	• Continuo • 2 DCY

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P0351	Ignition Coil A Primary/Secondary Circuit	○ Check the Ignition Coil with Power Output Stage. Refer to -- > <u>Ignition Coil with Power Output Stage, Checking.</u>	• Open circuit 0.05 - 0.2 mA • Short to ground/B+ >0.04-0.2 mA	Engine speed, 512 RPM	2 Seconds	• Continuo • 2 DCY
P0352	Ignition Coil B Primary/Secondary Circuit	○ Check the Ignition Coil with Power Output Stage. Refer to -- > <u>Ignition Coil with Power Output Stage, Checking.</u>	• Signal current, 4.95-8.82 mA • Internal fault, changing error	Engine speed, 5000 RPM	2 Seconds	• Continuo • 2 DCY
P0353	Ignition Coil C Primary/Secondary Circuit	○ Check the Ignition Coil with Power Output Stage. Refer to -- > <u>Ignition Coil with Power Output Stage, Checking.</u>	• Signal current, 4.95-8.82 mA • Internal fault, changing error	Engine speed, 5000 RPM	2 Seconds	• Continuo • 2 DCY
P0354	Ignition Coil D Primary/Secondary Circuit	○ Check the Ignition Coil with Power Output Stage. Refer to --	• Signal current, 4.95-8.82 mA • Internal fault,	Engine speed, 5000 RPM	2 Seconds	• Continuo • 2 DCY

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		> <u>Ignition Coil with Power Output Stage, Checking.</u>	changing error			
P0355	Ignition Coil E Primary/Secondary Circuit	Check the Ignition Coil with Power Output Stage. Refer to --> <u>Ignition Coil with Power Output Stage, Checking.</u>	- Signal current, 4.95-8.82 mA - Internal fault, changing error	Engine speed, 5000 RPM	2 Seconds	- Continuo 2 DCY
P0356	Ignition Coil F Primary/Secondary Circuit	Check the Ignition Coil with Power Output Stage. Refer to --> <u>Ignition Coil with Power Output Stage, Checking.</u>	- Signal current, 4.95-8.82 mA - Internal fault, changing error	Engine speed, 5000 RPM	2 Seconds	- Continuo 2 DCY
P0365	Camshaft Position Sensor (B) Circuit (Bank 1) Malfunction	Check the Camshaft Position (CMP) Sensor 2 G163. Refer to --> <u>Camshaft Position (CMP) Sensors, Checking.</u>	Signal voltage, no altering at 4 revs	Engine speed, >416 rpm	0.4 Seconds	- Continuo 2 DCY
P0366	Camshaft Position	Check the	Actual time	Engine	0.1 Seconds	Continuo

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Additional exhaust regulation

DTC	Error Message	Diagnostic Procedure	Malfunction Criteria and Threshold	Secondary Parameters with Enable	Monitoring Time Length	Frequency of checks, MIL Illum
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			Value	Conditions		
P0421	Catalyst System Efficiency Below Threshold (Bank 1)	○ Check the Heated Oxygen Sensor (HO2S) G39. Refer to --> <u>Heated Oxygen Sensor (HO2S) before Catalytic Converter, Checking.</u> ○ Check the Oxygen Sensor (O2S) Behind Three Way Catalytic Converter (TWC) G130. Refer to --> <u>Oxygen Sensors (O2S) Behind Three Way Catalytic Converter (TWC) behind Catalytic Converter, Checking.</u> ○ Check the catalytic converter. Refer to --> <u>Exhaust System Components, Removing and Installing.</u>	Amplitude ratio O2S >0.8	• Modeled exhaust temp, 630 - 900°C • ECT, >60°C • Engine speed, 1100 - 3500 rpm • Delta engine speed, 350 rpm • Mass air flow, 0.36 - 1.4 g/rev • Delta mass air flow , 2.25 g/rev/s • EVAP canister load, low	70 Sec.	• Once/DCY • 2 DCY

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P0431	Catalyst System Efficiency Below Threshold (Bank 2)	○ Check the Heated Oxygen Sensor (HO2S) 2 G108. Refer to --> <u>Heated Oxygen Sensor (HO2S) before Catalytic Converter, Checking.</u> ○ Check the Oxygen Sensor (O2S) 2 Behind Three Way Catalytic Converter (TWC) G131. Refer to --> <u>Oxygen Sensors (O2S) Behind Three Way Catalytic Converter (TWC) behind Catalytic Converter, Checking.</u> ○ Check the catalytic converter. Refer to --> <u>Exhaust System Components, Removing and Installing.</u>	Amplitude ratio O2S >0.8	• Modeled exhaust temp, 630 - 900°C • ECT, >60°C • Engine speed, 1100 - 3500 rpm • Delta engine speed, 350 rpm • Mass air flow, 0.36 - 1.4 g/rev • Delta mass air flow , 2.25 g/rev/s • EVAP canister load, low	70 Sec.	• Once/DCY • 2 DCY
P0441	Evaporative				25 Seconds	

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	Emission System Incorrect Purge Flow	○ Check the Evaporative Emission (EVAP) Canister Purge Regulator Valve N80. Refer to --> <u>Evaporative Emission (EVAP) Canister Purge Regulator Valve N80, Checking.</u> ○ Check the Leak Detection Pump (LDP) V144. Refer to --> <u>Leak Detection Pump (LDP) V144, Checking</u> ○ Check the Evaporative Emission (EVAP) Canister System for proper seal. Refer to --> <u>EVAP System, Checking for Leaks.</u>	• Deviation lambda control 7% • Deviation idle control 9.7%	• Engine speed, Idle • Engine speed deviation, 80 RPM • ECT, >69.75°C • Sub. ECT, >69.75°C • IAT, >5°C • IAT, at engine start- >5°C • Altitude, 2500 M		• Once/DCY • 2 DCY
P0442	Evaporative Emission System Leak Detected (Small Leak)	○ Check the Evaporative Emission (EVAP) Canister Purge	Time for pressure drop 1.0-1.3 Sec.	• EVAP purge valve, Closed • LDP, Activated	140 Seconds	• Once/DCY • 2 DCY

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		Regulator Valve N80. Refer to --> <u>Evaporative Emission (EVAP) Canister Purge Regulator Valve N80 , Checking.</u> ○ Check the Leak Detection Pump (LDP) V144. Refer to --> <u>Leak Detection Pump (LDP) V144 , Checking</u> ○ Check the Evaporative Emission (EVAP) Canister System for proper seal. Refer to --> <u>EVAP System, Checking for Leaks.</u>		• Altitude, 2500 M • Number of diagnostic attempts, 2 • IAT, >5.25° C • Delta ambient pressure, 0.3 kPa • IAT drop after engine start, 9.75 K • Time after engine start, >2101200 Sec. • ECT at start, 4.5-35°C • Vehicle speed, >6 MPH		
P0444	Evaporative Emission System Purge Control Valve Circuit Open	○ Check the Evaporative Emission (EVAP) Canister Purge Regulator Valve N80. Refer to --> <u>Evaporative Emission (EVAP) Canister</u>	Open circuit >0.8 mA	• EVAP purge valve, Commanded off • Engine start, Completed	2 Seconds	• Continuous • 2 DCY

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		<u>Purge Regulator Valve N80, Checking.</u> ○ Check the Leak Detection Pump (LDP) V144. Refer to --> <u>Leak Detection Pump (LDP) V144, Checking</u> ○ Check the Evaporative Emission (EVAP) Canister System for proper seal. Refer to --> <u>EVAP System, Checking for Leaks.</u>				
P0455	Evaporative Emission System Leak Detected (gross leak/no flow)	○ Check the Evaporative Emission (EVAP) Canister Purge Regulator Valve N80. Refer to --> <u>Evaporative Emission (EVAP) Canister Purge Regulator Valve N80, Checking.</u> ○ Check the Leak	Time for pressure drop 0.65-0.8 Sec.	• EVAP purge valve, Closed • LDP, Activated • Altitude, 2500 M • Number of diagnostic attempts, 2 • IAT, >5.25° C • Delta ambient pressure, 0.3 kPa	140 Seconds	• Once/DCY • 2 DCY

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		Detection Pump (LDP) V144. Refer to --> <u>Leak Detection Pump (LDP) V144, Checking</u> ○ Check the Evaporative Emission (EVAP) Canister System for proper seal. Refer to --> <u>EVAP System, Checking for Leaks.</u>		• IAT drop after engine start, 9.75 K • Time after engine start, >2101200 Sec. • ECT at start, 4.5-35°C • Vehicle speed, >6 MPH		
P0456	Evaporative Emission System Leak Detected (very small leak)	○ Check the Evaporative Emission (EVAP) Canister Purge Regulator Valve N80. Refer to --> <u>Evaporative Emission (EVAP) Canister Purge Regulator Valve N80, Checking.</u> ○ Check the Leak Detection Pump (LDP) V144. Refer to --> <u>Leak Detection Pump (LDP) V144,</u>	Time for pressure drop 4.5 5.5 sec.	• EVAP purge valve, Closed • LDP, Activated • Altitude, 2500 M • Number of diagnostic attempts, 10 • IAT, >5.25° C • Delta ambient pressure, 0.2 kPa • IAT drop after engine start, 9.75 K • Time after engine start, >2101200	140 Seconds	• Once/DCY • 2 DCY

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		<u>Checking</u> ○ Check the Evaporative Emission (EVAP) Canister System for proper seal. Refer to --> <u>EVAP System, Checking for Leaks.</u>		Sec. • ECT at start, 4.5-35°C • Vehicle speed, 680.7 MPH • Vehicle acceleration, 2.1 m/s2		
P0458	Evaporative Emission System Purge Control Valve Circuit Low	○ Check the Evaporative Emission (EVAP) Canister Purge Regulator Valve N80. Refer to --> <u>Evaporative Emission (EVAP) Canister Purge Regulator Valve N80, Checking.</u> ○ Check the Leak Detection Pump (LDP) V144. Refer to --> <u>Leak Detection Pump (LDP) V144, Checking</u> ○ Check the Evaporative Emission (EVAP) Canister	Signal voltage, 3.2 V	• EVAP purge valve, Commanded off • Engine start, Completed	2 Seconds	• Continuous • 2 DCY

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		System for proper seal. Refer to --> <u>EVAP System, Checking for Leaks.</u>				
P0459	Evaporative Emission System Purge Control Valve Circuit High	○ Check the Evaporative Emission (EVAP) Canister Purge Regulator Valve N80. Refer to --> <u>Evaporative Emission (EVAP) Canister Purge Regulator Valve N80, Checking.</u> ○ Check the Leak Detection Pump (LDP) V144. Refer to --> <u>Leak Detection Pump (LDP) V144, Checking</u> ○ Check the Evaporative Emission (EVAP) Canister System for proper seal. Refer to --> <u>EVAP System, Checking for Leaks.</u>	Signal current, > 1.0 A	• EVAP purge valve, Commanded on • Engine start, Completed	2 Seconds	• Continuous • 2 DCY

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Speed and idle control

DTC	Error Message	Diagnostic Procedure	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	Frequency of checks, MIL Illum
P0501	Vehicle Speed Sensor A Range/Performance	Check the vehicle speed signal. Refer to --> <u>Speed Signal, Checking.</u>	VSS signal, >184 MPH	Time after start, 3 sec.	5 Seconds	- Multiple 2 DCY
P0506	Idle Air Control System RPM Lower Than Expected	Check the Throttle Valve Control Module J338. Refer to --> <u>Throttle Valve Control Module J338, Checking.</u>	Engine speed deviation, -80 RPM	- Engine speed, Idle - Vehicle speed, 0 MPH - Mass air flow, 0.05 g/rev - EVAP purge flow, 1 kg/h - ECT, 60 - 110°C	13 Seconds	- Multiple 2 DCY
P0507	Idle Air Control System RPM Higher Than Expected	Check the Throttle Valve Control Module J338. Refer to --> <u>Throttle Valve Control Module J338, Checking.</u>	Engine speed deviation >80 RPM	- Engine speed, Idle - Vehicle speed, 0 MPH - Mass air flow, 0.05 g/rev - EVAP purge flow, 1 kg/h	13 Seconds	- Multiple 2 DCY

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				ECT, 60 - 110°C		
P0562	System Voltage Low	Check the Transmission Control Module (TCM) J217 voltage supply. Refer to --> <u>Transmission Control Module (TCM) J217, Voltage Supply, Checking.</u>	- Battery voltage to low 78.4 V - Battery voltage to low to operate solenoids, but able to maintain the present solenoid state 9 V	- Engine speed or input speed, > 1400 RPM - And position, N or P - Or Engine speed, >500 RPM - And position, Not (P or N) - FET, Enabled	0.05 Seconds 2.5 Seconds	- Continuous 2 DCY
P0563	System Voltage High	Check the Transmission Control Module (TCM) J217 voltage supply. Refer to --> <u>Transmission Control Module (TCM) J217, Voltage Supply, Checking.</u>	Battery voltage to high >16 V	- FET, Enabled - Engine speed, >400 RPM - Jump start, No	2.5 Seconds	- Continuous 2 DCY

Control module and output signals

DTC	Error Message	Diagnostic Procedure	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable	Monitoring Time Length	Frequ check Illum

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				Conditions		
P0600	Serial Communication Link	Eliminate malfunction in Can-bus components according to the wiring diagram --> Electrical Wiring Diagrams, Troubleshooting and Component Locations	CAN Bus no message		0.51 Seconds	• •
P0601	Internal Control Module Memory Check Sum Error	Replace the Engine Control Module (ECM) J623. Refer to --> <u>Engine Control Module (ECM) J623, Removing and Installing.</u>	Internal check sum, incorrect		2 Seconds	• •
P0603	Internal Control Module Keep Alive Memory (KAM) Error	Replace the Engine Control Module (ECM) J623. Refer to --> <u>Engine Control Module (ECM) J623, Removing and Installing.</u>	SPI communication-lost		1.5 Seconds	• •
P0604	Internal Control Module Random Access Memory (RAM) Error	Replace the Engine Control Module (ECM) J623. Refer to --> <u>Engine Control Module (ECM) J623, Removing and Installing.</u>	- Write ability check, failed - Check, Failed - SW verify of EEPROM emulation Negative		2 Seconds 0 Seconds	• • • •
P0605	Internal Control Module Read Only Memory (ROM) Error	Replace the Engine Control Module (ECM) J623. Refer to --> <u>Engine</u>	ROM Check, failed		2 Seconds	• • • •

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		<u>Control Module (ECM) J623 , Removing and Installing.</u>				
P0606	ECM/PCM Processor	○ Replace the Engine Control Module (ECM) J623. Refer to -- > <u>Engine Control Module (ECM) J623 , Removing and Installing.</u>	• SPI communication lost • Signal voltage 4.5 V • Signal voltage 0.5 V • Boost voltage-30 or 75 V • EEPROM check-failed • Drive by wire module check-failed • Engine torque-out of range • Engine operation-out of range • CAN bus no message		10 ms 2 Seconds 0.2 Seconds 2 Seconds 0.51 Seconds	• • • • • • • •
P0607	Control Module Performance	○ Replace the Engine Control Module (ECM) J623. Refer to -- > <u>Engine Control Module (ECM) J623 , Removing and Installing.</u>	SW functions actuating solenoid valves colliding of 2 substitute functions same priority driven solenoid valves have short circuit to supply or interruption		0.02 Seconds	• •
P060A	Watchdog	○ Replace the Engine Control Module (ECM) J623. Refer to -- > <u>Engine Control Module (ECM) J623 ,</u>	• Check Failed • CAN Feedback, Incorrect	CAN Bus, Status OK	0 Seconds 0.2 Seconds	• •

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		<u>Removing and Installing.</u>				
P0613	TCM Processor	○ Replace the Transmission Control Module (TCM) J217. Refer to --> <u>Transmission Control Module (TCM) J217, Replacing.</u>	Check Failed		0 Seconds	• •
P0614	ECM/TCM Incompatible	○ Replace the Engine Control Module (ECM) J623. Refer to --> <u>Engine Control Module (ECM) J623, Removing and Installing.</u> ○ Replace the Transmission Control Module (TCM) J217. Refer to --> <u>Transmission Control Module (TCM) J217, Replacing.</u>	CAN level engine does not fit to CAN level transmission	• CAN Bus, No error and ready to transmit • Ignition, Status on	0 Seconds	• •
P0634	PCM/ECM/TCM Internal Temperature Too High	○ Replace the Engine Control Module (ECM) J623. Refer to --> <u>Engine Control Module (ECM) J623, Removing and Installing.</u> ○ Replace the Transmission Control Module (TCM) J217. Refer to --> <u>Transmission Control Module</u>	Maximum TCU temperature dependent on battery voltage V		1.5 Seconds	• •

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		<u>(TCM) J217, Replacing.</u>				
P0638	Throttle Actuator Control Range/Performance - Bank 1	○ Check the Throttle Valve Control Module J338. Refer to --> <u>Throttle Valve Control Module J338, Checking.</u> ○ Check the Throttle Position (TP) Sensor G79/Accelerator Pedal Position Sensor 2 G185. Refer to --> <u>Throttle Position (TP) Sensor G79/Accelerator Pedal Position Sensor 2 G185, Checking.</u>	• Duty cycle > 0.4 sec. at > 98 ° • Actual TPS ref point 1.5 ° • Open to 15° > 1.275 sec. Then close to ref. point- > 1.28 sec. Gradient- 7 %/s • Close to 1.99° > 1.275 sec. Then open to ref. point > 1.28 sec. Gradient 7 %/s • TPS 1 signal voltage 0.208 - 0.852 V OR TPS 2 signal voltage 4.158 - 4.802 V	• Engine start- not active • ECT- 6 - 105°C • IAT- > 5°C • Engine speed- 320 rpm • Vehicle speed- 1 mph	0.45 Seconds	• •
P0641	Sensor Reference Voltage A Circuit/Open	○ Check the Transmission Control Module (TCM) J217 voltage supply. Refer to --> <u>Transmission Control Module (TCM) J217, Voltage Supply, Checking.</u>	Sensor supply voltage to high > 10 V	Battery voltage, > 6.51 + 1.3 V	0.1 Second	• •
P0642	Sensor Reference Voltage A Circuit Low	○ Check the Transmission Control Module (TCM) J217 voltage supply. Refer to --> <u>Transmission Control Module</u>	• Short to ground 4.898 V • Sensor supply voltage to low 6.51 V	Battery voltage, > 6.51 + 1.3 V	2 Seconds 0.1 Second	• •

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		<u>(TCM) J217 , Voltage Supply, Checking.</u>				
P0643	Sensor Reference Voltage A Circuit High	Replace the Engine Control Module (ECM) J623. Refer to --> <u>Engine Control Module (ECM) J623 , Removing and Installing.</u>	Short to battery + >5.102 V		2 Seconds	• •
P0652	Sensor Reference Voltage B Circuit Low	Replace the Engine Control Module (ECM) J623. Refer to --> <u>Engine Control Module (ECM) J623 , Removing and Installing.</u>	Short to ground 4.898 V		2 Seconds	• •
P0653	Sensor Reference Voltage B Circuit High	Replace the Engine Control Module (ECM) J623. Refer to --> <u>Engine Control Module (ECM) J623 , Removing and Installing.</u>	Short to battery + >5.102 V		2 Seconds	• •
P0657	Actuator Supply Voltage A Circuit/Open	Check the Engine Control Module (ECM) Power Supply Relay J271. Refer to --> <u>Engine Control Module (ECM) J623 Voltage Supply, Checking.</u>	Signal voltage >0.8 mA	Relay, commanded on	1.5 Seconds	• •
P0658	Actuator Supply Voltage A Circuit Low	Check the Engine Control Module (ECM) Power Supply	Signal voltage >3.2 V	Relay, commanded off	1.5 Seconds	• •

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Transmission O9L

DTC	Error Message	Diagnostic Procedure	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable	Monitoring Time Length	Frequent checks Illum
		12:30:26 AM	Page 94			

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				Conditions		
P0705	Transmission Range Sensor Circuit Malfunction (PRNDL Input)	Check Multi-Function Transmission Range (TR) Switch F125 - -> <u>Multi-Function Transmission Range (TR) Switch F125, Checking.</u>		- Sensor supply, > 6.5110 V - Status, OK	0.1 Seconds	• (• :
P0706	Transmission Range Sensor A Circuit Range/Performance	Check Multi-Function Transmission Range (TR) Switch F125 - -> <u>Multi-Function Transmission Range (TR) Switch F125, Checking.</u>	4 bit position code, incorrect	- Sensor supply, > 6.5110 V - Status, OK	0.1 Seconds	• (• :
P0707	Transmission Range Sensor Circuit Low	Check Multi-Function Transmission Range (TR) Switch F125 - -> <u>Multi-Function Transmission Range (TR) Switch F125, Checking.</u>		- Sensor supply, > 6.5110 V - Status, OK	0.1 Seconds	• (• :
P0708	Transmission Range Sensor Circuit High	Check Multi-Function Transmission Range (TR) Switch F125 - -> <u>Multi-Function Transmission Range (TR) Switch F125, Checking.</u>		- Sensor supply, > 6.5110 V - Status, OK	0.1 Seconds	• (• :

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P0710	Transmission Fluid Temperature Sensor A Circuit	- Check ATF level: --> <u>37 CONTROLS, HOUSING</u> - Check the Transmission Fluid Temperature Sensor G93. Refer to --> <u>Transmission Fluid Temperature Sensor G93, Checking.</u>	Sensor short circuit: U_sensor (+), and U_sensor (-) diagnosis by ASIC		1.5 Seconds	
P0711	Transmission Fluid Temperature Sensor A Circuit Range/Performance	- Check ATF level: --> <u>37 CONTROLS, HOUSING</u> - Check the Transmission Fluid Temperature Sensor G93. Refer to --> <u>Transmission Fluid Temperature Sensor G93, Checking.</u>	Discontinual temperature: - ATF temperature delta T between 2 measurements, >20°C Sensor stuck: - Comparison ATF vs. chip temperature, ATF temp. must follow chip temp. in certain ranges, 25-40°C	- Temperature fault, no other fault detected - Chip temperature, status OK - Engine speed or input speed, > 400 RPM - Signal status, status, OK	1.5 Seconds	
P0712	Transmission Fluid Temperature Sensor A Circuit Low	- Check ATF level: --> <u>37 CONTROLS, HOUSING</u> - Check the Transmission Fluid Temperature Sensor G93. Refer to --> <u>Transmission</u>	Circuit low: U_sensor (+), and U_sensor (-) diagnosis by ASIC		1.5 Seconds	

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		<u>Fluid Temperature Sensor G93, Checking.</u>				
P0713	Transmission Fluid Temperature Sensor A Circuit High	○ Check ATF level: --> <u>37 CONTROLS, HOUSING</u> ○ Check the Transmission Fluid Temperature Sensor G93. Refer to --> <u>Transmission Fluid Temperature Sensor G93, Checking.</u>	Circuit high: • U_sensor (+), and U_sensor (-) diagnosis by ASIC		1.5 Seconds	• (• :
P0714	Transmission Fluid Temperature Sensor A Circuit Intermittent	○ Check ATF level: --> <u>37 CONTROLS, HOUSING</u> ○ Check the Transmission Fluid Temperature Sensor G93. Refer to --> <u>Transmission Fluid Temperature Sensor G93, Checking.</u>	Circuit high: • U_sensor (+), and U_sensor (-) diagnosis by ASIC		1.5 Seconds	• (• :
P0716	Input/Turbine Speed Sensor A Circuit Range/Performance	○ Check the Transmission Input Speed (RPM) Sensor G182. Refer to --> <u>Transmission Input Speed (RPM) Sensor G182,</u>	Signal higher or lower than threshold • Higher, > + 8000 RPM • Lower, 20 RPM	Higher: • Sensor supply, OK • Sensor, no electrical error Lower: • Sensor	0.6 Seconds	• (• :

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		<u>Checking.</u>		- supply, OK • Engine speed, >600 RPM • Status engine speed, OK • Output speed, >500 RPM • Status output speed, OK or substitute value • Range position, OK or substitute value • Sensor, no electrical error • Transmission condition, friction-locked • Error flag fnabvra_err, not set		
P0717	Input/Turbine Speed Sensor A Circuit No Signal	○ Check the Transmission Input Speed (RPM) Sensor G182. Refer to --> <u>Transmission Input Speed (RPM) Sensor G182, Checking.</u>	Hardware detection	Sensor supply, OK	0.6 Seconds	• (• :
P0721	Output Speed Sensor Circuit	○ Check the Transmission	• Signal> threshold, >	• Sensor supply, OK	• 0.8 Seconds	• (• :

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	Range/Performance	Output Speed (RPM) Sensor G195. Refer to --> <u>Transmission Output Speed (RPM) Sensor G195, Checking.</u>	10000 RPM • Difference between last and actual value >threshold, - 1000 RPM • Difference to wheel speeds, > 500 RPM and input speed, > 200 RPM	• Sensor, no electrical error • Transmission condition, friction-locked • Input speed sensor, OK • Difference between output speed and input speed, > 200 RPM • Transmission condition, friction-locked backwards or forwards • Shift flag, = 0 (no shift) • Input speed, OK • Sensor supply, OK • Wheel speeds, OK	• 1 Second	
P0722	Output Speed Sensor Circuit No Signal	○ Check the Transmission Output Speed (RPM) Sensor G195. Refer to --> <u>Transmission Output Speed (RPM) Sensor G195, Checking.</u>	Hardware detection	Sensor supply, OK	0.6 Seconds	• (• :

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P0727	Engine Speed Input Circuit No Signal	○ Check the wiring connection Between Engine Control Module (ECM) J623 and the Transmission Control Module (TCM) J217. ○ Check the Engine Speed (RPM) Sensor G28. Refer to --> <u>Engine Speed (RPM) Sensor G28, Checking.</u>	CAN message signal error flag, =1	• Ignition, on • CAN Bus, OK • DME CAN connection, OK	1 Second	• (•]
P0741	Torque Converter Clutch Circuit Performance or Stuck Off	○ Check the Engine Speed (RPM) Sensor G28. Refer to --> <u>Engine Speed (RPM) Sensor G28, Checking.</u> ○ Check the Transmission Input Speed (RPM) Sensor G182. Refer to --> <u>Transmission Input Speed (RPM) Sensor G182, Checking.</u> ○ Check the Automatic Transmission Pressure	Rate of (setting of nominal value) - actual value, > 50 RPM	Status of clutch, closed or closed loop control	15 Seconds	• (•]

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		Regulating Valve 6 N371. Refer to --> <u>Automatic Transmission Pressure Regulating Valves, Checking.</u>				
P0746	Pressure Control Solenoid 'A' Performance or Stuck Off	Check the Automatic Transmission Pressure Regulating Valve 1 N215. Refer to --> <u>Automatic Transmission Pressure Regulating Valves, Checking.</u>	PWM hardware detection, 0 or 100%	- Low side and high side FET, activated - Power supply, > 8.7 V - Voltage drop at FET, = 1 V - Solenoid supply, > 9 V	0.05 Seconds	
P0747	Pressure Control Solenoid 'A' Stuck On	Check the Automatic Transmission Pressure Regulating Valve 1 N215. Refer to --> <u>Automatic Transmission Pressure Regulating Valves, Checking.</u>	PWM hardware detection, 0 or 100%	- Low side and high side FET, activated - Power supply, > 8.7 V - Voltage drop at FET, = 1 V - Solenoid supply, > 9 V	0.05 Seconds	
P0748	Pressure Control Solenoid 'A' Electrical	Check the Automatic Transmission Pressure Regulating Valve 1 N215. Refer to --> <u>Automatic</u>	- Current higher or lower than threshold, > 220 mA - EDS output voltage at short to ground or	Off operation mode	0.05 Seconds	

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		<u>Transmission Pressure Regulating Valves, Checking.</u>	open circuit ~ 0,5 V smaller than EDS supply voltage			
P0751	Shift Solenoid A Performance or Stuck Off	○ Check the Solenoid Valve 1 N88. Refer to --> <u>Solenoid Valve 1 N88, Checking.</u>	• Static leakage current flow • If PWM = 0%, diagnosis by ASIC • if 0% = PWM , 7.6% voltage return lead (low), 0.75 V • if 7.6% = PWM , 92.4% voltage return lead (high), 0.75 V • if 7.6% = PWM , 92.4% voltage return lead (low), 0.75 V	• High side FET voltage drop, = 1 V • High side FET, enabled • Low side FET, enabled	0.05 Seconds	• (• :
P0752	Shift Solenoid Stuck On	○ Check the Solenoid Valve 1 N88. Refer to --> <u>Solenoid Valve 1 N88, Checking.</u>	• If PWM = 100%, diagnosis by ASIC • if 7.6% = PWM = 100% voltage return lead (high), >0.3 V	• High side FET voltage drop, = 1 V • High side FET, enabled • Low side FET, enabled	0.05 Seconds	• (• :
P0754	Shift Solenoid "A" Intermittent	○ Check the Solenoid Valve 1 N88. Refer to --> <u>Solenoid Valve 1 N88, Checking.</u>	• If PWM = 0%, diagnosis by ASIC • if 0% = PWM , 7.6% voltage return lead (low), 0.75 V • if 7.6% =	• High side FET voltage drop, = 1 V • High side FET, enabled • Low side FET, enabled	0.05 Seconds	• (• :

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			PWM , 92.4% voltage return lead (high), 0.75 V • if 7.6% = PWM , 92.4% voltage return lead (low), 0.75 V			
P0776	Pressure Control Solenoid B Performance or Stuck Off	○ Check ATF level: --> <u>37 CONTROLS, HOUSING</u> ○ Check the Automatic Transmission Pressure Regulating Valves. Refer to --> <u>Automatic Transmission Pressure Regulating Valves, Checking.</u>	PWM hardware detection, 0 or 100%	• Low side and high side FET, activated • Power supply, > 8.7 V • Voltage drop at FET, = 1 V • Solenoid supply, > 9 V	0.05 Seconds	• (
P0777	Pressure Control Solenoid B Stuck On	○ Check ATF level: --> <u>37 CONTROLS, HOUSING</u> ○ Check the Automatic Transmission Pressure Regulating Valves. Refer to --> <u>Automatic Transmission Pressure Regulating Valves, Checking.</u>	PWM hardware detection, 0 or 100%	• Low side and high side FET, activated • Power supply, > 8.7 V • Voltage drop at FET, = 1 V • Solenoid supply, > 9 V	0.05 Seconds	• (
P0778	Pressure Control Solenoid B	○ Check ATF level: --> <u>37</u>	• Current higher or lower than	• Off operation	0.05 Seconds	• (

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	Electrical	<u>CONTROLS, HOUSING</u> Check the Automatic Transmission Pressure Regulating Valves. Refer to --> <u>Automatic Transmission Pressure Regulating Valves, Checking.</u>	threshold, 730 mA - EDS output voltage at short to ground or open circuit ~ 0,5 V smaller than EDS supply voltage - Static leakage current flow	mode		
P0796	Pressure Control Solenoid C Performance or Stuck Off	Check the Automatic Transmission Pressure Regulating Valve 3 N217. Refer to --> <u>Automatic Transmission Pressure Regulating Valves, Checking.</u>	PWM hardware detection, 0 or 100%	- Low side and high side FET, activated - Power supply, > 8.7 V - Voltage drop at FET, = 1 V - Solenoid supply, > 9 V	0.05 Seconds	• (• :
P0797	Pressure Control Solenoid C Stuck On	Check the Automatic Transmission Pressure Regulating Valve 3 N217. Refer to --> <u>Automatic Transmission Pressure Regulating Valves, Checking.</u>	PWM hardware detection, 0 or 100%	- Low side and high side FET, activated - Power supply, > 8.7 V - Voltage drop at FET, = 1 V - Solenoid supply, > 9 V	0.05 Seconds	• (• :
P0798	Pressure Control Solenoid C	Check the Automatic	Current higher or lower than	Off operation	0.05 Seconds	• (

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	Electrical	Transmission Pressure Regulating Valve 3 N217. Refer to --> <u>Automatic Transmission Pressure Regulating Valves , Checking.</u>	threshold, >220 mA • EDS output voltage at short to ground or open circuit ~ 0,5 V smaller than EDS supply voltage • Static leakage current flow	mode		• :
P0889	TCM Power Relay Sense Circuit Range/Performance	○ Check the Automatic Transmission Pressure Regulating Valves. Refer to --> <u>Automatic Transmission Pressure Regulating Valves , Checking.</u> ○ Check the Solenoid Valve 1 N88. Refer to --> <u>Solenoid Valve 1 N88 , Checking.</u>	FET drive, not possible	• Filtered battery voltage, >6.75 V • High side and low side FET, enabled • Status counter initialization, 0 or 1	0.03 Seconds	• (• :
P0890	TCM Power Relay Sense Circuit Low	○ Check the Automatic Transmission Pressure Regulating Valves. Refer to --> <u>Automatic Transmission Pressure Regulating Valves , Checking.</u>	• Solenoid power supply voltage, 1.4 V • Drop voltage over high side FET, > 1 V	• Filtered battery voltage, >6.75 V • High side and low side FET, enabled • Status counter initialization, 0 or 1	0.03 Seconds	• (• :

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		○ Check the Solenoid Valve 1 N88. Refer to --> <u>Solenoid Valve 1 N88, Checking.</u>				
P0891	TCM Power Relay Sense Circuit High	○ Check the Automatic Transmission Pressure Regulating Valves. Refer to --> <u>Automatic Transmission Pressure Regulating Valves, Checking.</u> ○ Check the Solenoid Valve 1 N88. Refer to --> <u>Solenoid Valve 1 N88, Checking.</u>	Hardware detection	● Filtered battery voltage, >6.75 V ● High side and low side FET, enabled ● Status counter initialization, 0 or 1	0.03 Seconds	● (● :
P0892	TCM Power Relay Sense Circuit Intermittent	○ Check the Automatic Transmission Pressure Regulating Valves. Refer to --> <u>Automatic Transmission Pressure Regulating Valves, Checking.</u> ○ Check the Solenoid Valve 1 N88. Refer to --> <u>Solenoid Valve 1 N88, Checking.</u>	Hardware detection	● Filtered battery voltage, >6.75 V ● High side and low side FET, enabled ● Status counter initialization, 0 or 1	0.03 Seconds	● (● :

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ENGINE PERFORMANCE 3.2 V6 4V Generic Scan Tool, Engine Code: BKH

Checking.

SAE P1xxx DTCs

Fuel and Air Ratios, Control Module

DTC	Error Message	Diagnostic Procedure	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	Frequency of checks, MIL Illum
P12A1	Fuel Rail Pressure Sensor Inappropriately High	Check the Fuel Pressure Sensor G247. Refer to -- > <u>Fuel Pressure Sensor G247, Checking.</u>	- Deviation fuel rail pressure control - 0.015 g - And Deviation lambda control - 25%	- Fuel cut off, Not active - Engine speed, 640-3480 rpm - Time after engine start, >250 sec. - High pressure pump set point, 0.005-0.05 g - Lambda control, Closed loop - EVAP canister load, 25%	5 Seconds	- Continuous 2 DCY
P12A2	Fuel Rail Pressure Sensor Inappropriately High	Check the Fuel Pressure Sensor	Deviation fuel rail pressure control -	- Fuel cut off, Not active - Engine	5 Seconds	- Continuous 2 DCY

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		G247. Refer to -- > <u>Fuel Pressure Sensor G247, Checking.</u>	0.01 g • And Deviation lambda control >30%	speed, 640-3480 rpm • Time after engine start, >250 sec. • High pressure pump set point, 0.005-0.05 g • Lambda control, Closed loop • EVAP canister load, 25%		
P12A4	Fuel Rail Pump Control Valve Stuck Closed	○ Check the Low Fuel Pressure Sensor G410. Refer to -- > <u>Low Fuel Pressure Sensor G410, Checking.</u>	• Deviation fuel rail pressure control - 0.025 g • And Deviation lambda control - 1010%	• Fuel cut off, Not active • Engine speed, 640-3480 rpm • Time after engine start, >250 sec. • High pressure pump set	5 Seconds	• Continuous • 2 DCY

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				point, 0.005- 0.05 g		
				• Lambda control, Closed loop • EVAP canister load, 25%		

Transmission O9L

DTC	Error Message	Diagnostic Procedure	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	Frequency of checks, MIL Illum
P1702	Impossible combination of substitute functions or not allowed actuating of valves	○ Replace the Transmission Control Module (TCM) J217. Refer to --> <u>Transmission Control Module (TCM) J217, Replacing.</u>	SW functions: actuating solenoid valves colliding with 2 substitute functions with same priority as driven solenoid valves that have short circuit to supply or interruption	---	0.02 Seconds	• Continuous • 2 DCY

SAE P2xxx DTCs

Fuel and air mixture, additional emissions regulations

DTC	Error Message	Diagnostic Procedure	Malfunction Criteria and Threshold	Secondary Parameters with Enable Conditions	Monitoring Time Length	Frequency of checks, MIL Illum

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			Value			
P2004	Intake Manifold Runner Control Stuck Open (Bank 1)	Check the Intake Manifold Runner Position Sensor G336. Refer to --> <u>Intake Manifold Runner Position Sensor G336 , Checking.</u>	Signal voltage 2.65 V	- Time after engine start, 15 sec. - Duty cycle, Commanded open	8 Seconds	- Continuous 2 DCY
P2005	Intake manifold flap for air stream regulation, (Bank 2) Stuck open	Check the Intake Manifold Runner Position Sensor 2 G512. Refer to --> <u>Intake Manifold Runner Position Sensor 2 G512 , Checking.</u>	Signal voltage 2.65 V	- Time after engine start, 15 sec. - Duty cycle, Commanded open	8 Seconds	- Continuous 2 DCY
P2006	Intake manifold flap for air stream regulation, bank 1 Stuck closed	Check the Intake Manifold Runner Position Sensor G336. Refer to --> <u>Intake Manifold Runner Position Sensor G336 , Checking.</u>	Signal voltage > 4 V	- Time after engine start, 15 sec. - Duty cycle, Commanded closed	8 Seconds	- Continuous 2 DCY

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P2007	Intake manifold flap for air stream regulation, bank 2 Stuck closed	Check the Intake Manifold Runner Position Sensor 2 G512. Refer to --> <u>Intake Manifold Runner Position Sensor 2 G512, Checking.</u>	Signal voltage > 4 V	- Time after engine start, 15 sec. - Duty cycle, Commanded closed	8 Seconds	- Continuous 2 DCY
P2008	Intake Manifold Runner Control Circuit/Open Bank 1	Check the Intake Manifold Runner Position Sensor G336. Refer to --> <u>Intake Manifold Runner Position Sensor G336, Checking.</u>	Signal current >0.8 mA	Duty cycle, Commanded On	2 Seconds	- Continuous 2 DCY
P2009	Intake Manifold Runner Bank 1 Short to ground	Check the Intake Manifold Runner Position Sensor G336. Refer to --> <u>Intake Manifold Runner Position Sensor G336, Checking.</u>	Signal voltage >2 V	Duty cycle, Commanded Off	2 Seconds	- Continuous 2 DCY
P2010	Intake Manifold	Check the	Signal	Duty cycle,	2 Seconds	Continuous

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	Runner Bank 1 Short to Battery +	Intake Manifold Runner Position Sensor G336. Refer to --> <u>Intake Manifold Runner Position Sensor G336, Checking.</u>	current >1 A	Commanded On		• 2 DCY
P2014	Intake Manifold Runner Position Sensor/Switch Circuit Bank 1	○ Check the Intake Manifold Runner Position Sensor G336. Refer to --> <u>Intake Manifold Runner Position Sensor G336, Checking.</u>	Signal voltage, 0.2 V		2 Seconds	• Continuous • 2 DCY
P2015	Intake Manifold Runner Position Sensor/Switch Circuit Range/Performance Bank 1	○ Check the Intake Manifold Runner Position Sensor G336. Refer to --> <u>Intake Manifold Runner Position Sensor G336, Checking.</u>	Signal voltage • 4.5 - 4.8 V • 0.5 - 0.2 V	• ECT, >6°C • IAT, >6°C	0.5 Seconds	• Continuous • 3 DCY
P2017	Intake Manifold Runner Position	○ Check the Intake	Signal voltage >4.8		2 Seconds	• Continuous • 2 DCY

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	Sensor Short to B+	Manifold Runner Position Sensor G336. Refer to --> <u>Intake Manifold Runner Position Sensor G336, Checking.</u>	V			
P2019	Sensor for intake manifold flap position 2 Electrical Malfunction	Check the Intake Manifold Runner Position Sensor 2 G512. Refer to --> <u>Intake Manifold Runner Position Sensor 2 G512, Checking.</u>	Signal voltage, 0.2 V		2 Seconds	- Continuous 2 DCY
P2020	Sensor for intake manifold flap position 2 Range/Performance	Check the Intake Manifold Runner Position Sensor 2 G512. Refer to --> <u>Intake Manifold Runner Position Sensor 2 G512, Checking.</u>	Signal voltage 4.5 - 4.8 V 0.5 - 0.2 V	- ECT, >6°C - IAT, >6°C	0.5 Seconds	- Continuous 3 DCY
P2022	Intake Manifold Runner Position Sensor 2 Short to	Check the Intake Manifold	Signal voltage >4.8 V		2 Seconds	- Continuous 2 DCY

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	Battery +	Runner Position Sensor 2 G512. Refer to --> <u>Intake Manifold Runner Position Sensor 2 G512 , Checking.</u>				
P2088	A Camshaft Position Actuator Control Circuit Low (Bank 1)	Check the Camshaft Adjustment Valve 1 N205. Refer to --> <u>Camshaft Adjustment Valve , Checking.</u>	Signal voltage, 3 V	Camshaft valve, commanded off	2 Seconds	- Continuous 2 DCY
P2089	A Camshaft Position Actuator Control Circuit High (Bank 1)	Check the Camshaft Adjustment Valve 1 N205. Refer to --> <u>Camshaft Adjustment Valve , Checking.</u>	Signal current, >1 A	Camshaft valve, commanded on	2 Seconds	- Continuous 2 DCY
P2090	"B" Camshaft Position Actuator Control Circuit Low (Bank 1)	Check the Camshaft Adjustment Valve 1 (exhaust) N318. Refer to --> <u>Camshaft Adjustment Valve , Checking.</u>	Short to ground 3 V	Camshaft valve, commanded off	2 Seconds	- Continuous 2 DCY
P2091	"B" Camshaft Position Actuator Control Circuit	Check the Camshaft Adjustment	Short to battery + >1 A	Camshaft valve, commanded	2 Seconds	- Continuous 2 DCY

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	High (Bank 1)	Valve 1 (exhaust) N318. Refer to --> <u>Camshaft Adjustment Valve, Checking.</u>		on		
P2092	A Camshaft Position Actuator Control Circuit Low (Bank 2)	Check the Camshaft Adjustment Valve 2 N208. Refer to --> <u>Camshaft Adjustment Valve, Checking.</u>	Signal voltage- 3 V	Camshaft valve, commanded off	2 Seconds	- Continuous 2 DCY
P2093	A Camshaft Position Actuator Control Circuit High (Bank 2)	Check the Camshaft Adjustment Valve 2 N208. Refer to --> <u>Camshaft Adjustment Valve, Checking.</u>	Signal current > 1 Amp	Camshaft valve, commanded on	2 Seconds	- Continuous 2 DCY
P2094	"B" Camshaft Position Actuator Control Circuit Low (Bank 2)	Check the Camshaft Adjustment Valve 2 (exhaust) N319. Refer to --> <u>Camshaft Adjustment Valve, Checking.</u>	Short to ground 3 V	Camshaft valve, commanded off	2 Seconds	- Continuous 2 DCY
P2095	"B" Camshaft Position Actuator Control Circuit High (Bank 2)	Check the Camshaft Adjustment Valve 2 (exhaust) N319. Refer to -->	Short to battery + >1 A	Camshaft valve, commanded on	2 Seconds	- Continuous 2 DCY

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		<u>Camshaft Adjustment Valve, Checking.</u>				
P2096	Post Catalyst Fuel Trim System Too Lean Bank 1	○ Check the Heated Oxygen Sensor (HO2S) G39. Refer to --> <u>Heated Oxygen Sensor (HO2S) before Catalytic Converter, Checking.</u> ○ Check the Oxygen Sensor (O2S) Behind Three Way Catalytic Converter (TWC) G130. Refer to --> <u>Oxygen Sensors (O2S) Behind Three Way Catalytic Converter (TWC) behind Catalytic Converter, Checking.</u>	Integral part of lambda control post cat, >10%	• Lambda control, Closed loop • Lambda control post cat, Closed loop • Engine speed, 640-4512 rpm • Engine load, 15 - 70% • Modeled catalyst temp, >400° C • -Set value, 0.96 - 1.04 • Delta engine speed, 7500 rpm/s • Delta mass air flow, 15 g/rev/s • Accelerator PP value, 1000%/s • Mass air flow, 9.4-528 kg/h	120 Seconds	• Continuous • 2 DCY
P2097	Post Catalyst Fuel Trim System Too Rich Bank 1	○ Check the Heated Oxygen Sensor	Integral part of lambda control post cat, -10%	• Lambda control, Closed loop • Lambda	120 Seconds	• Continuous • 2 DCY

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		(HO2S) G39. Refer to --> <u>Heated Oxygen Sensor (HO2S) before Catalytic Converter, Checking.</u> ○ Check the Oxygen Sensor (O2S) Behind Three Way Catalytic Converter (TWC) G130. Refer to --> <u>Oxygen Sensors (O2S) Behind Three Way Catalytic Converter (TWC) behind Catalytic Converter, Checking.</u>		control post cat, Closed loop • Engine speed, 640-4512 rpm • Engine load, 15 - 70% • Modeled catalyst temp, >400° C • -set value, 0.96 - 1.04 • Delta engine speed, 7500 rpm/s • Delta mass air flow, 15 g/rev/s • Accelerator PP value, 1000%/s • Mass air flow, 9.4-528 kg/h		
P2098	Bank 2, oxygen sensor correction behind cat Lean control limit exceeded	○ Check the Heated Oxygen Sensor (HO2S) 2 G108. Refer to --> <u>Heated Oxygen Sensor (HO2S) before Catalytic</u>	Integral part of lambda control post cat, >10%	• Lambda control, Closed loop • Lambda control post cat, Closed loop • Engine speed, 640-4512 rpm • Engine load,	120 Seconds	• Continuous • 2 DCY

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ENGINE PERFORMANCE 3.2 V6 4V Generic Scan Tool, Engine Code: BKH

		<u>Converter, Checking.</u> ○ Check the Oxygen Sensor (O2S) 2 Behind Three Way Catalytic Converter (TWC) G131. Refer to --> <u>Oxygen Sensors (O2S) Behind Three Way Catalytic Converter (TWC) behind Catalytic Converter, Checking.</u>		15 - 70% • Modeled catalyst temp, >400° C • -set value, 0.96 - 1.04 • Delta engine speed, 7500 rpm/s • Delta mass air flow, 15 g/rev/s • Accelerator PP value, 1000%/s • Mass air flow, 9.4-528 kg/h		
P2099	Bank 2, oxygen sensor correction behind cat Rich control limit exceeded	○ Check the Heated Oxygen Sensor (HO2S) 2 G108. Refer to --> <u>Heated Oxygen Sensor (HO2S) before Catalytic Converter, Checking.</u> ○ Check the Oxygen Sensor (O2S) 2 Behind Three Way	Integral part of lambda control post cat, -10%	• Lambda control, Closed loop • Lambda control post cat, Closed loop • Engine speed, 640-4512 rpm • Engine load, 15 - 70% • Modeled catalyst temp, >400° C • -set value, 0.96 - 1.04	120 Seconds	• Continuous • 2 DCY

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		Catalytic Converter (TWC) G131. Refer to --> <u>Oxygen Sensors (O2S) Behind Three Way Catalytic Converter (TWC) behind Catalytic Converter, Checking.</u>	• Delta engine speed, 7500 rpm/s • Delta mass air flow, 15 g/rev/s • Accelerator PP value, 1000%/s • Mass air flow, 9.4-528 kg/h	
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Fuel and air ratio

DTC	Error Message	Diagnostic Procedure	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	Frequency of checks, MIL Illum
P2101	Throttle Actuator Control Motor Circuit Range/Performance	○ Check the Throttle Valve Control Module J338. Refer to --> <u>Throttle Valve Control Module J338, Checking.</u>	• Duty cycle->0.4 sec. at >98% • And Actual TPS-ref. point->1.5° • Or Actual TPS-calc. value->0.4 at >8°	Engine start, Not active	0.45 Seconds	• Contin • 2 DCY
P2106	Throttle Actuator Control System - Forced Limited Power	○ Check the Throttle Valve Control Module J338. Refer to --> <u>Throttle Valve Control Module J338, Checking.</u>	ECM power stage, Failure	Engine start, Completed	0.45 Seconds	• Contin • 2 DCY

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		<u>Checking.</u>				
P2122	Throttle/Pedal Position Sensor/Switch D Circuit Low Input	Check the Throttle Position (TP) Sensor G79/Accelerator Pedal Position Sensor 2 G185. Refer to --> <u>Throttle Position (TP) Sensor G79/Accelerator Pedal Position Sensor 2 G185, Checking.</u>	Signal voltage 0.4 V		0.2 Seconds.	- Contin 2 DCY
P2123	Throttle/Pedal Position Sensor/Switch D Circuit High Input	Check the Throttle Position (TP) Sensor G79/Accelerator Pedal Position Sensor 2 G185. Refer to --> <u>Throttle Position (TP) Sensor G79/Accelerator Pedal Position Sensor 2 G185, Checking.</u>	Signal voltage >4.84 V		0.2 Seconds.	- Contin 2 DCY
P2127	Throttle/Pedal Position Sensor/Switch E Circuit Low Input	Check the Throttle Position (TP) Sensor G79/Accelerator Pedal Position Sensor 2 G185. Refer to --> <u>Throttle Position (TP) Sensor G79/Accelerator Pedal Position Sensor 2 G185, Checking.</u>	Signal voltage 0.2 V		0.2 Seconds.	- Contin 2 DCY
P2128	Throttle/Pedal Position Sensor/Switch E	Check the Throttle Position (TP) Sensor	Signal voltage >2.8 V			

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	Circuit High Input	G79/Accelerator Pedal Position Sensor 2 G185. Refer to --> <u>Throttle Position (TP) Sensor G79/Accelerator Pedal Position Sensor 2 G185, Checking.</u>				
P2138	Throttle/Pedal Position Sensor/Switch D/E Voltage Correlation	Check the Throttle Position (TP) Sensor G79/Accelerator Pedal Position Sensor 2 G185. Refer to --> <u>Throttle Position (TP) Sensor G79/Accelerator Pedal Position Sensor 2 G185, Checking.</u>	Delta signal voltage sensor 1 vs. sensor 2 >0.244 V		0.35 Seconds.	- Contin 2 DCY
P2147	Fuel Injector Group A Supply Voltage Circuit Low	Check the fuel injectors. Refer to --> <u>Fuel Injectors, Checking.</u>	Signal current >12 A	Injection valve, Commanded on	3 Seconds	- Contin 2 DCY
P2148	Fuel Injector Group A Supply Voltage Circuit High	Check the fuel injectors. Refer to --> <u>Fuel Injectors, Checking.</u>	Signal current >33 A	Injection valve, Commanded on	3 Seconds	- Contin 2 DCY
P2150	Fuel Injector Group B Supply Voltage Circuit Low	Check the fuel injectors. Refer to --> <u>Fuel Injectors, Checking.</u>	Signal current >12 A	Injection valve, Commanded on	3 Seconds	- Contin 2 DCY
P2151	Fuel Injector Group "B" Supply Voltage Circuit High	Check the fuel injectors. Refer to --> <u>Fuel Injectors, Checking.</u>	Signal current >33 A	Injection valve, Commanded on	3 Seconds	- Contin 2 DCY

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P2153	Fuel Injector Group "C" Supply Voltage Circuit Low	Check the fuel injectors. Refer to --> <u>Fuel Injectors, Checking.</u>	Signal current >12 A	Injection valve, Commanded on	3 Seconds	- Contin 2 DCY
P2154	Fuel Injector Group "C" Supply Voltage Circuit High	Check the fuel injectors. Refer to --> <u>Fuel Injectors, Checking.</u>	Signal current >33 A	Injection valve, Commanded on	3 Seconds	- Contin 2 DCY
P2181	Cooling System Performance	- Check the Engine Coolant Temperature (ECT) Sensor G62. Refer to --> <u>Engine Coolant Temperature (ECT) Sensor G62, Checking.</u> - Check Coolant Pump V50 --> <u>19 - ENGINE - COOLING SYSTEM</u> - Check Coolant Thermostat. --> <u>19 - ENGINE - COOLING SYSTEM .</u>	- ECT 75°C - Mass air integral 3.524.0 Kg	- ECT at start, - 757°C - Accum. fuel shut off, 120 Sec. - Delta ambient pressure, 1.5 kPa - Vehicle speed, 19 - 75 mph - Mass air flow, 50200 kg/h	500 Seconds	- Once/E 2 DCY
P2195	O2 Sensor Signal Biased/Stuck Lean - Bank 1, Sensor 1	Check the Heated Oxygen Sensor (HO2S) G39. Refer to --> <u>Heated Oxygen Sensor (HO2S) before Catalytic Converter, Checking.</u>	Lambda value >1.1	- Lambda control-Closed loop - Lambda control post cat, Closed loop - ECT, >60°C - Engine speed,	100 seconds.	- Contin 2 DCY

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				>992 rpm • Engine speed deviation, 150 rev. • Engine load, 30 - 300 kg/h • Delta engine load, 0.15 g/rev • Lambda deviation, 3% • Integrated mass air flow, 150 g • Modeled exhaust temp, 500 - 750°C • O2S signal rear, >0.852 V • Deviation lambda control, >35%		
P2196	O2 Sensor Signal Biased/Stuck Rich - Bank 1, Sensor 1	○ Check the Heated Oxygen Sensor (HO2S) G39. Refer to --> <u>Heated Oxygen Sensor (HO2S) before Catalytic Converter, Checking.</u>	Lambda value 0.9	• Lambda control-Closed loop • Lambda control post cat, Closed loop	100 seconds.	• Contin • 2 DCY
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				- ECT, >60°C - Engine speed, >992 rpm - Engine speed deviation, 150 rev. - Engine load, 30 - 300 kg/h - Delta engine load, 0.15 g/rev - Lambda deviation, 3% - Integrated mass air flow, 150 g - Modeled exhaust temp, 500 - 750°C - O2S signal rear, >0.049 V - Deviation lambda control, >35%		
P2197	O2 Sensor Signal Stuck Lean Bank 2 Sensor 1	Check the Heated Oxygen Sensor (HO2S) 2 G108. Refer to -- > <u>Heated Oxygen Sensor</u>	Lambda value >1.1	- Lambda control-Closed loop - Lambda control	100 seconds.	- Contin 2 DCY

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		<u>(HO2S) before Catalytic Converter, Checking.</u>		post cat, Closed loop - ECT, >60°C - Engine speed, >992 rpm - Engine speed deviation, 150 rev. - Engine load, 30 - 300 kg/h - Delta engine load, 0.15 g/rev - Lambda deviation, 3% - Integrated mass air flow, 150 g - Modeled exhaust temp, 500 - 750°C - O2S signal rear, >0.852 V - Deviation lambda control, >35%		
P2198	O2 Sensor Signal Stuck Rich Bank 2 Sensor 1	Check the Heated Oxygen	Lambda value 0.9	Lambda control-	100 seconds.	- Continu 2 DCY

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Sensor (HO2S) 2
G108. Refer to --
> **Heated**
Oxygen Sensor
(HO2S) before
Catalytic
Converter,
Checking.

Closed
loop

- Lambda control post cat, Closed loop
- ECT, >60°C
- Engine speed, >992 rpm
- Engine speed deviation, 150 rev.
- Engine load, 30 - 300 kg/h
- Delta engine load, 0.15 g/rev
- Lambda deviation, 3%
- Integrated mass air flow, 150 g
- Modeled exhaust temp, 500 - 750°C
- O2S signal rear, >0.049 V
- Deviation lambda

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				control, >35%		
P2237	O2 Sensor Positive Current Control Circuit/Open - Bank 1, Sensor 1	Check the Heated Oxygen Sensor (HO2S) G39. Refer to --> <u>Heated Oxygen Sensor (HO2S) before Catalytic Converter, Checking.</u>	Signal activity check-failed	O2S front-no other faults	65 Seconds	- Contin 2 DCY
P2240	O2 Sensor Positive Current Control Circuit/Open - Bank 2, Sensor 1	Check the Heated Oxygen Sensor (HO2S) 2 G108. Refer to --> <u>Heated Oxygen Sensor (HO2S) before Catalytic Converter, Checking.</u>	Signal activity check-failed	O2S front-no other faults	65 Seconds	- Contin 2 DCY
P2243	O2 Sensor Reference Voltage Circuit Open - Bank 1, Sensor 1	Check the Heated Oxygen Sensor (HO2S) G39. Refer to --> <u>Heated Oxygen Sensor (HO2S) before Catalytic Converter, Checking.</u>	- Functional check, heater-failed - And Intrusive check, heater-failed		130 Seconds	- Contin 2 DCY
P2247	O2 Sensor Reference Voltage Circuit (Bank 2 Sensor 1) Open	Check the Heated Oxygen Sensor (HO2S) 2 G108. Refer to --> <u>Heated Oxygen Sensor (HO2S) before Catalytic Converter, Checking.</u>	- Functional check, heater-failed - And Intrusive check, heater-failed		130 Seconds	- Contin 2 DCY
P2251	O2 Sensor Negative Current Control Circuit (Bank 1 Sensor 1) Open	Check the Heated Oxygen Sensor (HO2S) G39. Refer to --> <u>Heated Oxygen</u>	- Functional check, heater-failed - And		162 Seconds	- Contin 2 DCY

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ENGINE PERFORMANCE 3.2 V6 4V Generic Scan Tool, Engine Code: BKH

		<u>Sensor (HO2S) before Catalytic Converter, Checking.</u>	Intrusive check, heater-failed			
P2254	O2 Sensor Negative Current Control Circuit/Open (Bank 2 Sensor 1)	Check the Heated Oxygen Sensor (HO2S) 2 G108. Refer to --> <u>Heated Oxygen Sensor (HO2S) before Catalytic Converter, Checking.</u>	- Functional check, heater-failed - And Intrusive check, heater-failed		162 Seconds	- Contin 2 DCY
P2270	O2 Sensor Signal Stuck Lean Bank 1 Sensor 2	Check the Oxygen Sensor (O2S) Behind Three Way Catalytic Converter (TWC) G130. Refer to --> <u>Oxygen Sensors (O2S) Behind Three Way Catalytic Converter (TWC) behind Catalytic Converter, Checking.</u>	Signal voltage-0.718 V While stet-value 0.85	- Fault code detected, P2096 or P2097 or P2098 or P2099 - O2S rear, Ready - Exhaust mass air integral, >0.1 kg	25 Seconds	- Once/T 2 DCY
P2271	O2 Sensor Signal Stuck Rich Bank 1 Sensor 2	Check the Oxygen Sensor (O2S) Behind Three Way Catalytic Converter (TWC) G130. Refer to --> <u>Oxygen Sensors (O2S) Behind Three Way Catalytic Converter (TWC) behind Catalytic</u>	Signal voltage->0.298 V While set-value 1.15	- Fault code detected, P2096 or P2097 or P2098 or P2099 - O2S rear, Ready - Exhaust mass air integral, >0.1 kg	25 Seconds	- Once/T 2 DCY

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		<u>Converter, Checking.</u>				
P2272	O2 Sensor Signal Stuck Lean Bank 2 Sensor 2	Check the Oxygen Sensor (O2S) 2 Behind Three Way Catalytic Converter (TWC) G131. Refer to --> <u>Oxygen Sensors (O2S) Behind Three Way Catalytic Converter (TWC) behind Catalytic Converter, Checking.</u>	Signal voltage- 0.718 V While stet-value 0.85	- Fault code detected, P2096 or P2097 or P2098 or P2099 - O2S rear, Ready - Exhaust mass air integral, >0.1 kg	25 Seconds	- Once/E 2 DCY
P2273	O2 Sensor Signal Stuck Rich Bank 2 Sensor 2	Check the Oxygen Sensor (O2S) 2 Behind Three Way Catalytic Converter (TWC) G131. Refer to --> <u>Oxygen Sensors (O2S) Behind Three Way Catalytic Converter (TWC) behind Catalytic Converter, Checking.</u>	Signal voltage- >0.298 V While set-value 1.15	- Fault code detected, P2096 or P2097 or P2098 or P2099 - O2S rear, Ready - Exhaust mass air integral, >0.1 kg	25 Seconds	- Once/E 2 DCY
P2294	Fuel Pressure Regulator 2 Control Circuit	Check the Fuel Pressure Sensor G247. Refer to --> <u>Fuel Pressure Sensor G247, Checking.</u>	Signal current 0.8 mA	Time after engine start, 100 - 400 sec.	2 Seconds	- Contin 2 DCY
P2295	Fuel Pressure Regulator 2 Control Circuit Low	Check the Fuel Pressure Sensor G247. Refer to --> <u>Fuel Pressure</u>	Signal voltage 3.2 V	Time after engine start, 100 - 400 sec.	2 Seconds	- Contin 2 DCY

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		<u>Sensor G247 , Checking.</u>				
P2296	Fuel Pressure Regulator 2 Control Circuit High	Check the Fuel Pressure Sensor G247. Refer to --> <u>Fuel Pressure Sensor G247 , Checking.</u>	Signal current >8 Amps	Time after engine start, 100 - 400 sec.	2 Seconds	- Contin 2 DCY

Additional emission regulations

DTC	Error Message	Diagnostic Procedure	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	Frequency of checks, MIL Illum
P2400	Evaporative Emission System Leak Detection Pump Control Circuit/Open	- Check the Leak Detection Pump (LDP) V144. Refer to --> <u>Leak Detection Pump (LDP) V144 , Checking</u> - Check the Evaporative Emission (EVAP) Canister System for proper seal. Refer to --> <u>EVAP System, Checking for Leaks.</u>	Open circuit >0.8 mA	- LDP, Commanded on - Engine speed >416 RPM	2 Seconds	- Continuous 2 DCY
P2401	Evaporative Emission System Leak Detection Pump Control Circuit Low	Check the Leak Detection Pump	Short to ground >2 V	- LDP, Commanded off - Engine	2 Seconds	- Continuous 2 DCY

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		(LDP) V144. Refer to --> <u>Leak Detection Pump (LDP) V144, Checking</u> ○ Check the Evaporative Emission (EVAP) Canister System for proper seal. Refer to --> <u>EVAP System, Checking for Leaks.</u>		speed >416 RPM		
P2402	Evaporative Emission System Leak Detection Pump Control Circuit High	○ Check the Leak Detection Pump (LDP) V144. Refer to --> <u>Leak Detection Pump (LDP) V144, Checking</u> ○ Check the Evaporative Emission (EVAP) Canister System for proper seal. Refer to --> <u>EVAP System, Checking for Leaks.</u>	Signal current > 1 A	• LDP, Commanded on • Engine speed >416 RPM	2 Seconds	• Continuous • 2 DCY

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P2403	Evaporative Emission System Leak Detection Pump Sense Circuit/Open	○ Check the Leak Detection Pump (LDP) V144. Refer to --> <u>Leak Detection Pump (LDP) V144, Checking</u> ○ Check the Evaporative Emission (EVAP) Canister System for proper seal. Refer to --> <u>EVAP System, Checking for Leaks.</u>	Low signal voltage > 1 time Sec.	• LDP Commanded on • EVAP purge valve, Closed • LDP, Activated • Altitude, 2500 M • Number of diagnostic attempts, 2 • IAT, >5.25° C • Delta ambient pressure, 0.3 kPa • IAT drop after engine start, 9.75 K • Time after engine start, >2101200 Sec. • ECT at start, 4.5-35°C • Vehicle speed, >6 MPH	10 Seconds	• Once/DCY • 2 DCY
P2404	Evaporative Emission System Leak Detection Pump Sense Range/Performance	○ Check the Leak Detection Pump (LDP) V144. Refer to --> <u>Leak Detection</u>	High signal voltage > 0.36 time Sec.	• LDP Commanded on • EVAP purge valve, Closed • LDP, Activated	10 Seconds	• Once/DCY • 2 DCY

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		<u>Pump (LDP) V144, Checking</u> ○ Check the Evaporative Emission (EVAP) Canister System for proper seal. Refer to --> <u>EVAP System, Checking for Leaks.</u>		• Altitude, 2500 M • Number of diagnostic attempts, 2 • IAT, >5.25° C • Delta ambient pressure, 0.3 kPa • IAT drop after engine start, 9.75 K • Time after engine start, >2101200 Sec. • ECT at start, 4.5-35°C • Vehicle speed, >6 MPH		
P2414	O2 Sensor Exhaust Sample Error Bank 1, Sensor 1	○ Check the Heated Oxygen Sensor (HO2S) G39. Refer to --> <u>Heated Oxygen Sensor (HO2S) before Catalytic Converter, Checking.</u>	O2S signal front >3.1 V	• Lambda control, Active • Engine torque, Positive • Engine speed, No idle	25 Seconds	• Continuous • 2 DCY
P2415	O2 Sensor Exhaust Sample Error Bank 2, Sensor 1	○ Check the Heated Oxygen	O2S signal front >3.1 V	• Lambda control, Active	25 Seconds	• Continuous • 2 DCY

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		Sensor (HO2S) 2 G108. Refer to --> <u>Heated Oxygen Sensor (HO2S) before Catalytic Converter, Checking.</u>		- Engine torque, Positive - Engine speed, No idle		
P2539	Low Pressure Fuel System Sensor Circuit	Check Low Fuel Pressure Sensor G410. Refer to --> <u>Low Fuel Pressure Sensor G410, Checking.</u>	Signal voltage > 4.8 V		2 Seconds	- Continuous 2 DCY
P2540	Low Pressure Fuel System Sensor Circuit Range/Performance	Check Low Fuel Pressure Sensor G410. Refer to --> <u>Low Fuel Pressure Sensor G410, Checking.</u>	Actual pressure 0.08 or >0.8 Mpa	- Engine speed, 500-6000 rpm - Time after engine start, >30 sec.	5 Seconds	- Continuous 2 DCY
P2541	Low Pressure Fuel System Sensor Circuit Low	Check Low Fuel Pressure Sensor G410. Refer to --> <u>Low Fuel Pressure Sensor G410, Checking.</u>	Signal voltage 0.2 V		5 Seconds	- Continuous 2 DCY
P2626	O2 Sensor	Check the	O2S signal	Fuel cut off,	4 Seconds	Continuous

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	Pumping Current Trim Circuit/Open Bank 1 Sensor 1	Heated Oxygen Sensor (HO2S) G39. Refer to --> <u>Heated Oxygen Sensor (HO2S) before Catalytic Converter, Checking.</u>	front >4.7 V	>2 sec. • Modeled exhaust gas temp, >380° C		• 2 DCY
P2629	O2 Sensor Pumping Current Trim Circuit/Open Bank 2 Sensor 1	○ Check the Heated Oxygen Sensor (HO2S) 2 G108. Refer to --> <u>Heated Oxygen Sensor (HO2S) before Catalytic Converter, Checking.</u>	O2S signal front >4.7 V	• Fuel cut off, >2 sec. • Modeled exhaust gas temp, >380° C	4 Seconds	• Continuous • 2 DCY

Transmission O9L

DTC	Error Message	Diagnostic Procedure	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	Frequency of checks, MIL Illum
P2637	Torque management Feedback Signal A	○ Check the CAN-Bus terminal resistance, Transmission Control Module (TCM) J217 to Engine Control	CAN message signal error flag, = 1	• Ignition, on • CAN Bus, OK • DME CAN connection, OK	0.5 Seconds	• Continuous • 2 DCY

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		Module (ECM) J623. Refer to --> <u>Terminal Resistance for Can-Bus, Checking.</u>				
P2714	Pressure Control Solenoid D Performance or Stuck off	Check the Automatic Transmission Pressure Regulating Valve 4 N218. Refer to --> <u>Automatic Transmission Pressure Regulating Valves, Checking.</u>	PWM hardware detection, 0 or 100%	- Low side and high side FET, activated - Power supply, > 8.7 V - Voltage drop at FET, = 1 V - Solenoid supply, > 9 V	0.05 Seconds	- Continuous 2 DCY
P2715	Pressure Control Solenoid D Stuck On	Check the Automatic Transmission Pressure Regulating Valve 4 N218. Refer to --> <u>Automatic Transmission Pressure Regulating Valves, Checking.</u>	PWM hardware detection, 0 or 100%	- Low side and high side FET, activated - Power supply, > 8.7 V - Voltage drop at FET, = 1 V - Solenoid supply, > 9 V	0.05 Seconds	- Continuous 2 DCY
P2716	Pressure Control Solenoid D Electrical	Check the Automatic Transmission Pressure Regulating Valve 4 N218. Refer to --> <u>Automatic Transmission</u>	- Current higher or lower than threshold, 730 mA - EDS output voltage at short to	Off operation mode	0.05 Seconds	- Continuous 2 DCY

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		<u>Pressure Regulating Valves, Checking.</u>	ground or open circuit ~ 0,5 V smaller than EDS supply voltage • Static leakage current flow			
P2723	Pressure Control Solenoid E Performance or Stuck off	Check the Automatic Transmission Pressure Regulating Valve 5 N233. Refer to --> <u>Automatic Transmission Pressure Regulating Valves, Checking.</u>	PWM hardware detection, 0 or 100%	- Low side and high side FET, activated - Power supply, > 8.7 V - Voltage drop at FET, = 1 V - Solenoid supply, > 9 V	0.05 Seconds	- Continuous 2 DCY
P2725	Pressure Control Solenoid "E" Electrical	Check the Automatic Transmission Pressure Regulating Valve 5 N233. Refer to --> <u>Automatic Transmission Pressure Regulating Valves, Checking.</u>	- Current higher or lower than threshold, 730 mA - EDS output voltage at short to ground or open circuit ~ 0,5 V smaller than EDS supply voltage	Off operation mode	0.05 Seconds	- Continuous 2 DCY

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			Static leakage current flow			
P2732	Pressure Control Solenoid F Performance or Stuck off	Check the Automatic Transmission Pressure Regulating Valve 6 N371. Refer to --> <u>Automatic Transmission Pressure Regulating Valves, Checking.</u>	PWM hardware detection, 0 or 100%	- Low side and high side FET, activated - Power supply, > 8.7 V - Voltage drop at FET, = 1 V - Solenoid supply, > 9 V	0.05 Seconds	- Continuous 2 DCY
P2733	Pressure Control Solenoid F Stuck On	Check the Automatic Transmission Pressure Regulating Valve 6 N371. Refer to --> <u>Automatic Transmission Pressure Regulating Valves, Checking.</u>	PWM hardware detection, 0 or 100%	- Low side and high side FET, activated - Power supply, > 8.7 V - Voltage drop at FET, = 1 V - Solenoid supply, > 9 V	0.05 Seconds	- Continuous 2 DCY
P2734	Pressure Control Solenoid "F" Electrical	Check the Automatic Transmission Pressure Regulating Valve 6 N371. Refer to --> <u>Automatic Transmission Pressure Regulating Valves,</u>	EDS output voltage at short to ground or open circuit ~ 0,5 V smaller than EDS supply voltage	Off operation mode	0.05 Seconds	- Continuous 2 DCY

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		<u>Checking.</u>	Static leakage current flow			
P2735	Pressure Control Solenoid "F" Intermittent	Check the Automatic Transmission Pressure Regulating Valve 6 N371. Refer to --> <u>Automatic Transmission Pressure Regulating Valves, Checking.</u>	PWM hardware detection, 0 or 100%	- Low side and high side FET, activated - Power supply, > 8.7 V - Voltage drop at FET, = 1 V - Solenoid supply, > 9 V	0.05 Seconds	- Continuous 2 DCY

SAE P3xxx DTCs

Fuel and air mixture, additional emissions regulations

DTC	Error Message	Diagnostic Procedure	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	Frequency of checks, MIL Illum
P3081	Engine Temperature Too Low	Check the Engine Coolant Temperature (ECT) Sensor G62. Refer to --> <u>Engine Coolant Temperature (ECT) Sensor G62, Checking.</u>	- Step 1 modeled ECT >40°C - And ECT40°C	Step 1 passed	2 Seconds	- Continuous 2 DCY

SAE U0xxx DTCs

Control module and output signals

DTC	Error Message	Diagnostic	Malfunction	Secondary	Monitoring	Frequency of

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ENGINE PERFORMANCE 3.2 V6 4V Generic Scan Tool, Engine Code: BKH

		Procedure	Criteria and Threshold Value	Parameters with Enable Conditions	Time Length	checks, MIL Illum
U0001	High Speed CAN Communication Bus	Check the CAN-Bus terminal resistance. Refer to --> <u>Terminal Resistance for Can-Bus, Checking.</u>	- CAN message, No feedback - CAN level, Incorrect	- Battery voltage, >9 V - Delay after ignition on, 0.5 Sec. - Ignition status, On	0.3 Seconds 0.06 Seconds	- Continuous - Immed.
U0100	Lost Communication With ECM/PCM A	Check the CAN-Bus terminal resistance. Refer to --> <u>Terminal Resistance for Can-Bus, Checking.</u>	No message received from DME, Timeout	- CAN Bus, No error and ready to transmit - Delay after ignition on, 0.53 Sec. - Battery voltage, >9 V	0.5 Seconds	- Continuous 2 DCY
U0101	Lost Communication with TCM	CAN-Bus terminal resistance, Transmission Control Module (TCM) J217 to Engine Control Module (ECM) J623. Refer to --> <u>Terminal Resistance for Can-Bus,</u>	CAN message, No message		0.51 Seconds	- Continuous 2 DCY

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U0302	Software Incompatibility with Transmission Control Module	<u>Checking.</u> ○ Replace the Transmission Control Module (TCM) J217. Refer to --> <u>Transmission Control Module (TCM) J217, Replacing.</u>	AT vehicle ECM coded as MT vehicle		5 sec.	• Continuous • 2 DCY
U0401	Invalid Data Received From ECM/PCM	○ Replace the Engine Control Module (ECM) J623. Refer to --> <u>Engine Control Module (ECM) J623, Removing and Installing.</u>	Invalid data.	• CAN Bus, No error and ready to transmit • Delay after ignition on, 0.53 Sec. • Battery voltage, >9 V	0.5 Seconds	• Continuous • 2 DCY
U0402	Invalid Data Received from Transmission Control Module	○ CAN-Bus terminal resistance, Transmission Control Module (TCM) J217 to Engine Control Module (ECM) J623. Refer to --> <u>Terminal Resistance for Can-Bus, Checking.</u>	AT vehicle ECM coded as MT vehicle CAN message Implausible message		5 Sec.	• Continuous • 2 DCY

20 - FUEL SUPPLY

FUEL SUPPLY SYSTEM

Fuel Supply System

For all Fuel Supply system component locations. Refer to --> **20 - FUEL SUPPLY SYSTEM**

For all Fuel supply system removal/installation procedures and torque specifications. Refer to --> **20 - FUEL SUPPLY SYSTEM**

Check the Technical Bulletins for information that may supersede any information included in this article.

NOTE:

- All manufacturers special tools as well as common tools may contain a manufacturer specific part number. These tools may be substituted with an equivalent aftermarket tool or are available for purchase through Audi.
- Manufacturers special tools as well as common tools that contain a manufacturer specific part number may be referenced in the test procedure illustrations showing the tool use or installation. If the manufacturer specific tool is not being used, an equivalent aftermarket tool may be installed in the same manner as the manufacturers special tool.

--> **Safety Precautions**

--> **Rules for Cleanliness**

--> **Fuel System, Bleeding**

--> **Fuel Pump Delivery Quantity, Checking**

--> **Fuel Pump Electrical, Checking**

Safety Precautions

CAUTION:

- The fuel system is under pressure! Before opening the system, place rags around the connection area. Then release the pressure by carefully loosening the connection.
- The engine section of the fuel system, after the high pressure pump, is under extremely high pressure! When working on the engine or the fuel injection system, the pressure must be relieved to residual pressure before opening the high pressure components --> **24 - FUEL INJECTION SYSTEM** .
- Place sources of flame, e.g. cigarette lighters, as well as those sources of others in the area, out of reach. These can ignite fuel

vapors.

- The use of nails, paper clips, or another unauthorized materials to back-probe electrical harness connectors is strictly prohibited and may cause damage to the electrical harness connectors, terminal ends or damage to a component. Use only the manufacturers test lead kit or an equivalent aftermarket test lead kit for back-probing all electrical harness connectors.

Perform the following steps before beginning work on the fuel supply system:

- Disconnect the battery Ground (GND) cable with the ignition switched off -->
 - 27 BATTERY, STARTER, GENERATOR, CRUISE CONTROL
 - 27 BATTERY, STARTER, GENERATOR, CRUISE CONTROL for ELECTRICAL EQUIPMENT, CABRIOLET
- Open the fuel filler flap briefly and then close again.

When removing and installing components from full or partially full fuel tanks, observe the following:

- The fuel tank must only be partially full. How much fuel can remain in the fuel tank may be read in the respective work description. Empty the fuel tank if necessary.
- Before starting work, switch on the exhaust extraction system and place an extraction hose close to the installation opening of the fuel tank to extract escaping fuel fumes. If no exhaust extraction system is available, a radial fan (as long as motor is not in air flow) with a displacement greater than 15 m³/h can be used.
- Prevent fuel from contacting the skin! Wear fuel-resistant gloves!

Observe the following when removing and installing the fuel tank:

- Empty the fuel tank for weight reasons.

Rules for Cleanliness

When working on the fuel supply/injection system, pay careful attention to the following rules of cleanliness:

- Thoroughly clean all connections and the surrounding area before disconnecting.
- Place parts that have been removed on a clean surface and cover them. Do not use fluffy cloths!
- Carefully cover over opened components or seal, if repairs are not performed immediately.
- Only install clean components: Only unpack replacement parts immediately prior to installation. Do not use parts that have been stored unpacked (e.g. in tool boxes etc.).
- When the system is open: Do not work with compressed air. Do not move vehicle unless absolutely necessary.

Fuel System, Bleeding

To prevent damage to the catalytic converter the fuel system must be bled after repair work on fuel lines or on the fuel filter.

Fuel system, bleeding --> **24 - FUEL INJECTION SYSTEM** .

Fuel Pump Delivery Quantity, Checking**Special tools, testers and auxiliary items required**

- Hand held remote control (jumper).
- Multimeter.
- Electrical connector test lead set.
- Pressure gauge (High pressure)
- Measuring container (fuel resistant).

Test conditions

- Battery voltage at least 12.5 V.
- The fuel filter OK
- Fuse S228 OK.
- Fuel Pump (FP) Control Module J538 OK --> **20 - FUEL SUPPLY SYSTEM** .
- Fuel tank at least $\frac{1}{4}$ filled.
- The ignition switched off.

Test sequence

- Remove the rear seat bench -->
 - **72 - SEAT - FRAMES**
 - **72 - SEAT - FRAMES** for BODY INTERIOR - CABRIOLET

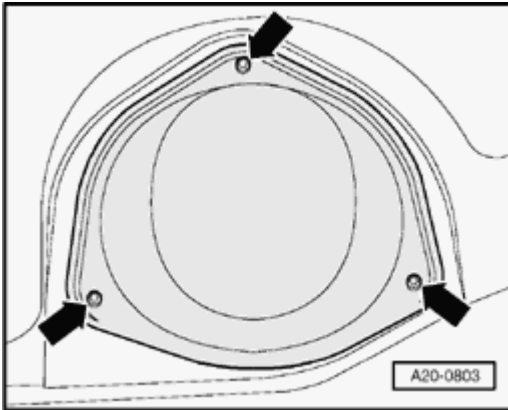


Fig. 1: Removing/Installing Cover Bolts For Locking Flange
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove the right locking flange cover and bolts - **arrows** -.

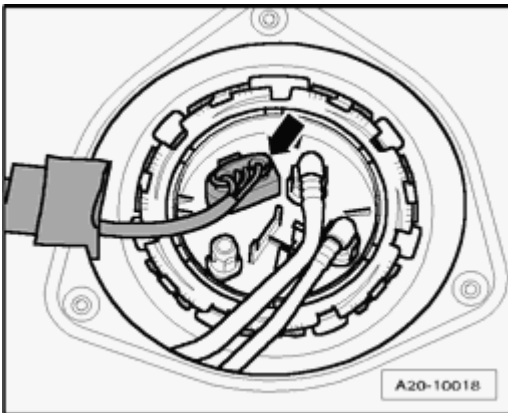


Fig. 2: Disconnecting/Connecting Electrical Harness Connector At Right Locking Flange
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect the electrical harness connector - **arrow** - at the right locking flange.
- Connect a Hand held remote control (jumper) to terminal - **1** - of the fuel delivery unit and to vehicle battery (+).

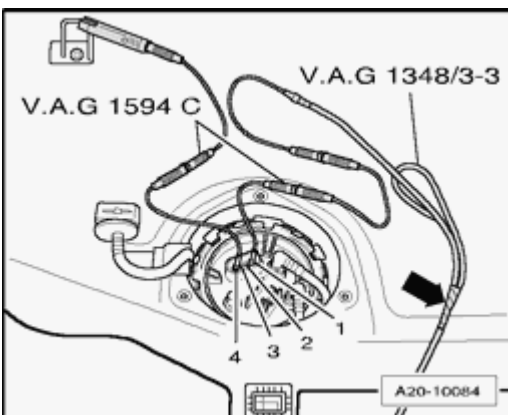


Fig. 3: Connecting Other End Of Hand Held Remote Starter (Jumper) To Vehicle Battery (+)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect a jumper cable from a Electrical connector test lead set to terminal - **4** - of the fuel delivery unit and to vehicle Ground (GND).
- Remove the fuel filler cap.

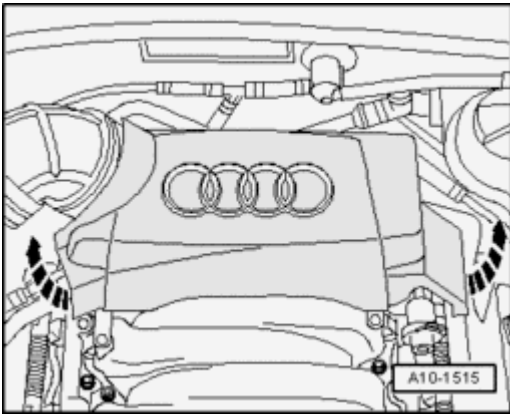


Fig. 4: Removing/Installing Rear Engine Cover
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove the rear engine cover - **arrows** -.

CAUTION: The fuel system is under pressure! Before opening system, place rags around the connection area. Then release pressure by carefully loosening the connection.

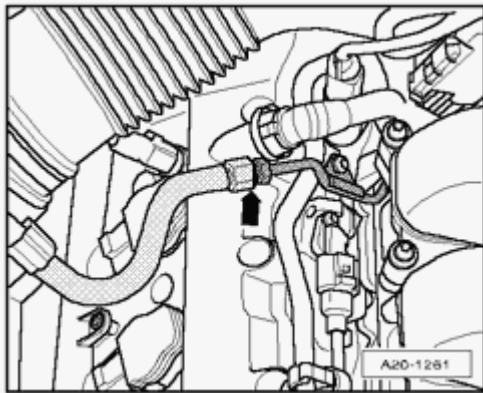


Fig. 5: Disconnecting/Connecting Fuel Line
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect the fuel line - **arrow** -.
- Connect a Pressure gauge (High pressure) to the fuel line.
- Connect the extension hose - **arrow** - to the pressure gauge and hold it in a measuring container.

- Open the pressure gauge shut-off valve. The lever points in the direction of flow.
- Create fuel system pressure by pressing the switch on the Hand held remote control (jumper) in and slowly closing the shut-off valve of the pressure gauge.

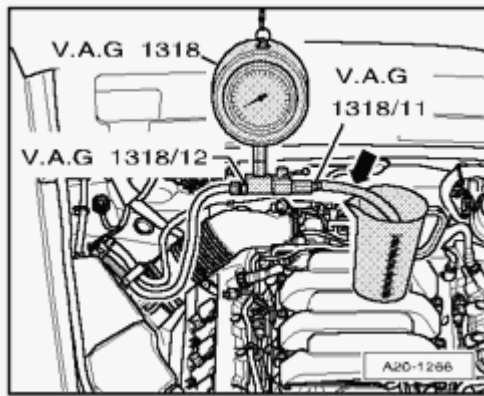


Fig. 6: Connecting Pressure Gauge V.A.G 1318 To Fuel Line Using Adapter V.A.G 1318/11 And V.A.G 1318/12

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pump the fuel
- Specification: 4 bar positive pressure.
- Do not move the position of the shut-off valve.
- Empty the measuring container.

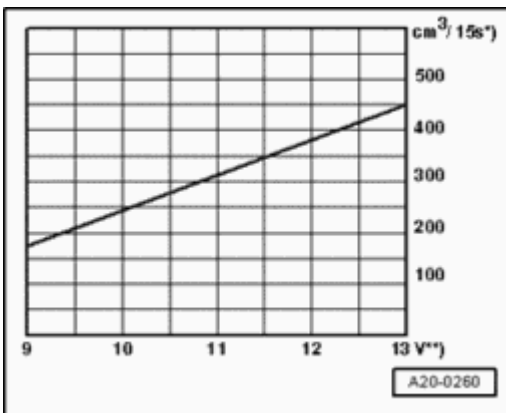


Fig. 7: Delivery Rate Diagram

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Press the switch on the Hand held remote control (jumper) in for 15 seconds.
- Compare the quantity of fuel delivered with the minimum delivery rate in the diagram (cm³/15s).

NOTE:

- Voltage at the fuel pump with the engine stopped and the pump running is approx. 2 volts less than the battery voltage.

If the minimum delivery quantity is not obtained, the following malfunctions may be present:

- Fuel lines pinched.
- Fuel filter clogged.
- Fuel pump faulty.

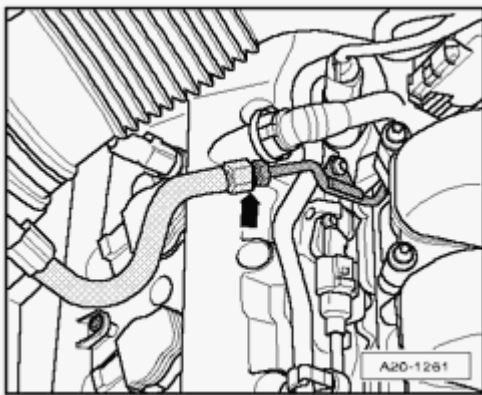
Installation

Fig. 8: Disconnecting/Connecting Fuel Line

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect the fuel line - **arrow** -.

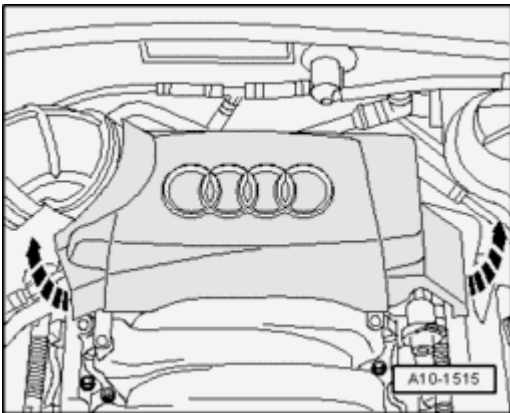


Fig. 9: Removing/Installing Rear Engine Cover

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install the rear engine cover - **arrows** -.

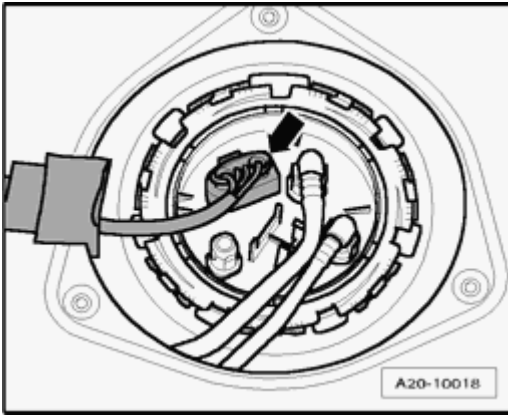


Fig. 10: Disconnecting/Connecting Electrical Harness Connector At Right Locking Flange
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect the electrical harness connector - **arrow** - at the right locking flange.

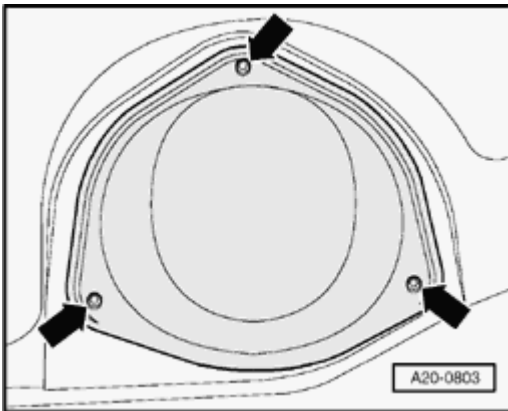


Fig. 11: Removing/Installing Cover Bolts For Locking Flange
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install the right locking flange cover and bolts - **arrows** -.
- Install the rear seat bench -->
 - **72 - SEAT - FRAMES**
 - **72 - SEAT - FRAMES** for BODY INTERIOR - CABRIOLET

Torque specifications

Component	Nm
Fuel line to fuel rail	22

Fuel Pump Electrical, Checking

Special tools, testers and auxiliary items required

12:29:55 AM	Page 8	

- Hand held remote control (jumper).
- Multimeter.
- Electrical connector test lead set.
- Pressure gauge (High pressure)

Test conditions

- Battery voltage at least 12.5 V.
- The fuel pump fuse OK.
- The Fuel Pump (FP) Control Module J538 OK.
- The fuel filter OK
- The ignition switched off.

Test sequence

- Remove the rear seat bench -->
 - **72 - SEAT - FRAMES**
 - **72 - SEAT - FRAMES** for BODY INTERIOR - CABRIOLET

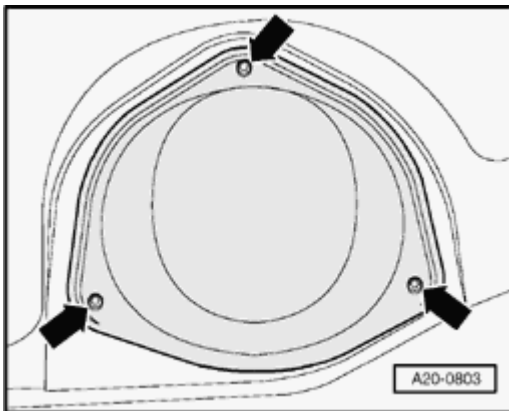


Fig. 12: Removing/Installing Cover Bolts For Locking Flange
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove the right locking flange cover and bolts - **arrows** -.

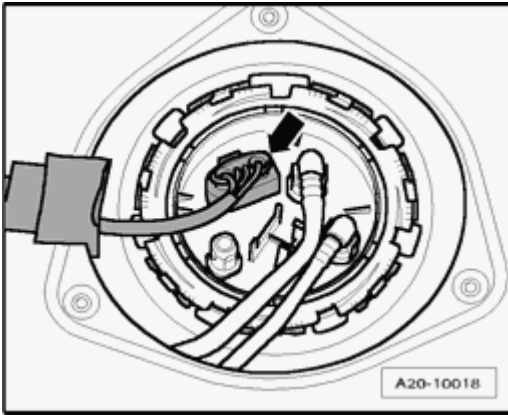


Fig. 13: Disconnecting/Connecting Electrical Harness Connector At Right Locking Flange
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect the electrical harness connector - **arrow** - at the right locking flange.
- Connect a Hand held remote control (jumper) to terminal - **1** - of the fuel delivery unit and to vehicle battery (+).

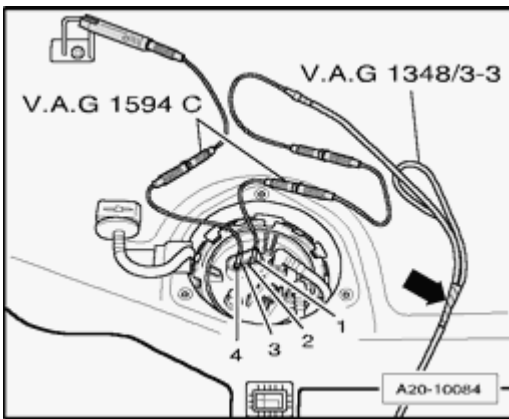


Fig. 14: Connecting Other End Of Hand Held Remote Starter (Jumper) To Vehicle Battery (+)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect a jumper cable from a Electrical connector test lead set to terminal - **4** - of the fuel delivery unit and to vehicle Ground (GND).
- Press the switch on the Hand held remote control (jumper) in.

NOTE:

- **The Fuel Pump (FP) runs quietly. Avoid surrounding noises while testing the fuel pump.**

The fuel pump must run and an audible noise of the fuel pump running should be heard.

If no operating noise can be heard:

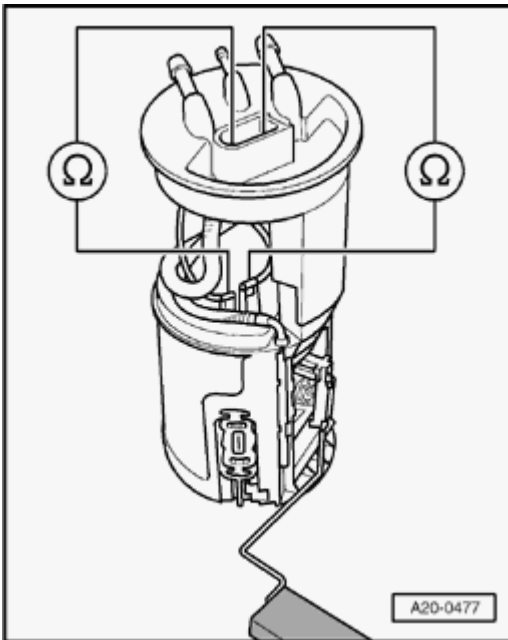


Fig. 15: Checking Electrical Circuit Between Terminals Of Fuel Delivery Unit And Fuel Pump For Continuity

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Using a Multimeter , check the electrical circuit between terminals - 1 - and - 5 - of the fuel delivery unit for continuity.

Specified value: 0 ohms.

If a malfunction is detected in the electrical circuit:

- Check the wiring for a short circuit to Battery positive (+) or an open circuit.
- Check the electrical harness connector for damage, corrosion, loose or broken terminals.
- If necessary, repair the electrical circuit.

If no malfunction is detected in the wiring, replace the fuel pump. --> **20 - FUEL SUPPLY SYSTEM** .

- Install the fuel delivery unit --> **20 - FUEL SUPPLY SYSTEM** .

Final procedures

After the repair work, the following work steps must be performed in the following sequence:

1. Check the DTC memory.
2. If necessary, erase the DTC memory.
3. If the DTC memory was erased, generate readiness code.

- **End of diagnosis.**

EVAPORATIVE EMISSIONS (EVAP) SYSTEM

Evaporative Emissions (EVAP) System

--> EVAP System, Leak Detection

--> EVAP System, Checking for Leaks

--> Evaporative Emission (EVAP) Canister Purge Regulator Valve N80 , Checking

--> Leak Detection Pump (LDP) V144 , Checking

EVAP System, Leak Detection

Function

The leak detection system recognizes leaks in the complete fuel system, including the fuel tank, EVAP canister and the Evaporative Emission (EVAP) Canister Purge Regulator Valve N80.

On the mechanical side, the leak detection system consists mainly of a vacuum-driven diaphragm pump equipped with a reed contact on the actuation rod of the pump diaphragm. The pump is supplied with vacuum via the engine intake stroke.

- When leak detection is activated, the diaphragm pump pumps the fuel system up to 20 - 30 mbar. The pump diaphragm is then moved out so that the reed contact at the operating rod remains in the "open" position.
- During the leak diagnosis, the reed contact is monitored to check if it remains open within 10 seconds. This indicates the system is sealed.
- If the pressure falls (indicating a leak), the diaphragm moves back and the reed contact closes.
- If the reed contact closes within 10 seconds of leak detection time, a further test is performed: In this case the diaphragm pump pumps four times again. The Engine Control Module (ECM) J623 measures the time for each of the four pumps until the reed contact is closed again. From that, the control module can recognize a "small leak" (greater than 1 mm in diameter) or a "large leak".

Leak diagnosis is activated automatically shortly following every engine start. If a malfunction is determined, an entry is made to the Diagnostic Trouble Code (DTC) memory. The Malfunction Indicator Lamp (MIL) K83 in the instrument cluster lights up if the malfunction is recognized for two subsequent starts.

EVAP System, Checking for Leaks

Special tools, testers and auxiliary items required

- Smoke tester.
- EVAP and Fuel Supply System Vacuum hose and line routing diagram.

NOTE:

- Secure all hose connections using hose clamps appropriate for the model

type .

- Replace seals and gaskets when performing repair work.

Leak checking

- Using a Smoke tester , check the Evaporative Emission (EVAP) canister system for leaks.

NOTE:

- Always follow the manufacturers directions for the proper installation and operation of the Smoke tester being used.

If a leak is found:

- Check the fuel filler cap seal for damage and for proper installation. Replace if necessary.
- Check the seals under the locking flanges and the union nuts are properly tightened on the fuel tank.
- Check all hose connections of the fuel supply system and replace or repair any leaking lines.
- Check all hose connections of the EVAP system and replace or repair any leaking lines.
- Repair or replace any damaged component.

If no leaks are found in the EVAP and Fuel Supply System:

- Erase the DTC memory if a DTC was set. Refer to --> **Diagnostic Mode 04: Reset/delete Diagnostic Data.**
- Perform a road test to verify repair.

If a DTC was set and does not return:

Repair complete, Generate readiness code. Refer to --> **Readiness Code.**

- End diagnosis.

If the DTC returns and no leaks are found in the EVAP and Fuel Supply System:

- Check the DTC memory for any DTC codes pertaining to the EVAP and Fuel Supply Systems. If a DTC is stored, perform the diagnostic test procedure for the suspected component. Refer to --> **Diagnostic Mode 03: Interrogating Fault Memory.**

End diagnosis.

Evaporative Emission (EVAP) Canister Purge Regulator Valve N80 , Checking

Special tools, testers and auxiliary items required

- Multimeter.

- Wiring diagram.

Test requirements

- The Evaporative Emission (EVAP) Canister Purge Regulator Valve N80 fuse OK.
- The ignition switched off.

NOTE:

- Voltage for the Evaporative Emission (EVAP) Canister Purge Regulator Valve N80 is supplied via the Engine Component Power Supply Relay J757.

Test procedure

- Perform a preliminary check to verify the customers complaint. Refer to --> General Diagnosis.

Start diagnosis

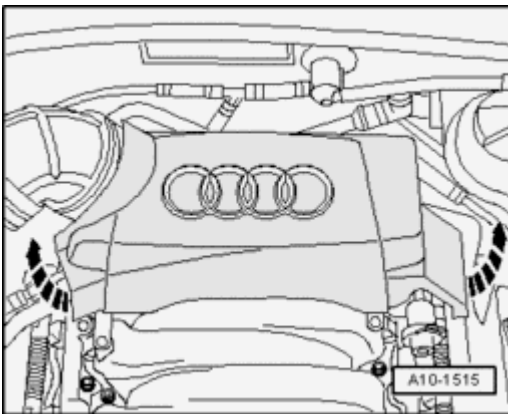


Fig. 16: Removing/Installing Rear Engine Cover

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove the rear engine cover - **arrows** -.

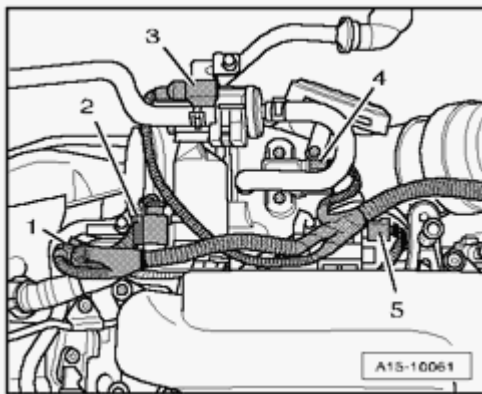
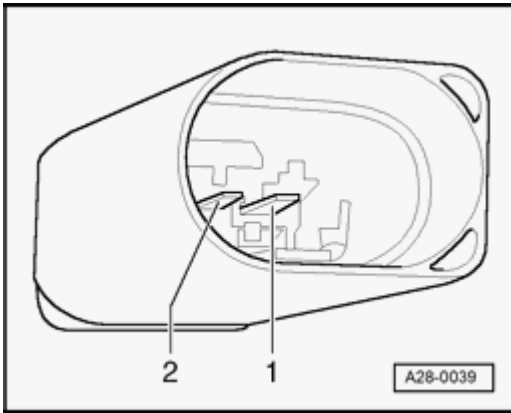


Fig. 17: Identifying Electrical Harness Connectors

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect the Evaporative Emission (EVAP) Canister Purge Regulator Valve N80 electrical harness connector - 3 -.

Checking internal resistance**Fig. 18: Identifying 2-Pin Electrical Harness Connector**

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Using a Multimeter , check the Evaporative Emission (EVAP) Canister Purge Regulator Valve N80 terminals 1 and 2 for resistance.

Specified value: 22,0 to 30,0 ohms.

Engine Component Power Supply Relay J757

- Replace the Evaporative Emission (EVAP) Canister Purge Regulator Valve N80.

If the specification is obtained:

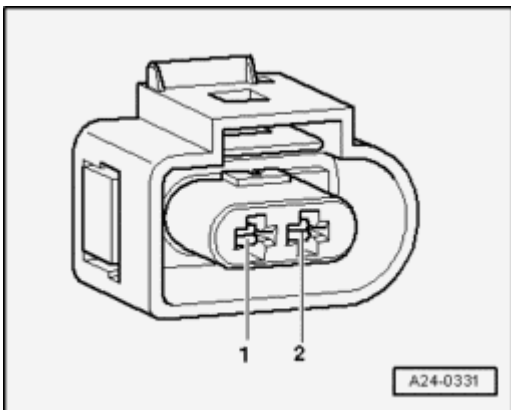
Checking voltage supply

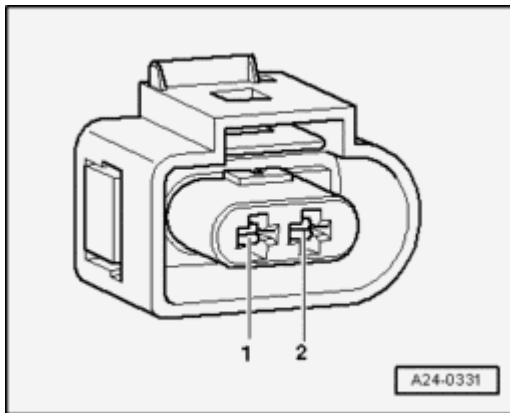
Fig. 19: Identifying 2-Pin Electrical Harness Connector & Terminals

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Using a Multimeter , check the electrical harness connector terminal 1 to 2 for voltage.
- Operate the starter briefly.

Specified value: battery voltage.

If the specified value was not obtained:

**Fig. 20: Identifying 2-Pin Electrical Harness Connector & Terminals**

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Using a Multimeter , check the electrical harness connector terminal 1 to Ground (GND) for voltage.

Evaporative Emission (EVAP) Canister Purge Regulator Valve N80 electrical harness connector terminal	Measure to
1	Engine Ground (GND)

- Operate the starter briefly.

Specified value: battery voltage.

If the specified value is not obtained:

- Check the wiring connection from the electrical harness connector terminal 1 to the Engine Component Power Supply Relay J757 terminal 2/87 for an open circuit or short to Ground (GND).
- Check the electrical harness connector for damage, corrosion, lose or broken terminals.
- If necessary, repair the wiring connection.

If the specified value was obtained:

Check Ground (GND) activation

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If the manufacturers test box is being used. Perform the following step.

- Install the test box. Refer to --> **24 - FUEL INJECTION SYSTEM** .

If the manufacturers test box is not being used. Perform the following step.

- Remove the Engine Control Module (ECM) J623. Refer to --> **Engine Control Module (ECM) J623 , Removing and Installing.**

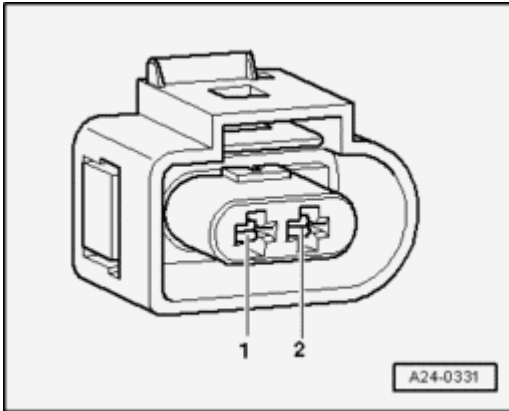


Fig. 21: Identifying 2-Pin Electrical Harness Connector & Terminals
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Using a Multimeter , check the Evaporative Emission (EVAP) Canister Purge Regulator Valve N80 electrical connector terminal 2 to Engine Control Module (ECM) J623 electrical connector T94 terminal 49 for an open circuit.

Evaporative Emission (EVAP) Canister Purge Regulator Valve N80 electrical harness connector terminal	Engine Control Module (ECM) J623 electrical connector T60 terminal test box socket
2	49

Specified value: 1.5 ohms max.

If the specification is not obtained:

- Check the wiring for a short circuit to Battery positive (+), Ground (GND) or an open circuit.
- Check the electrical harness connector for damage, corrosion, lose or broken terminals.
- If necessary, repair the wiring connection.

If the specification was obtained:

- Replace the Engine Control Module (ECM) J623. Refer to --> **Engine Control Module (ECM) J623 , Removing and Installing.**

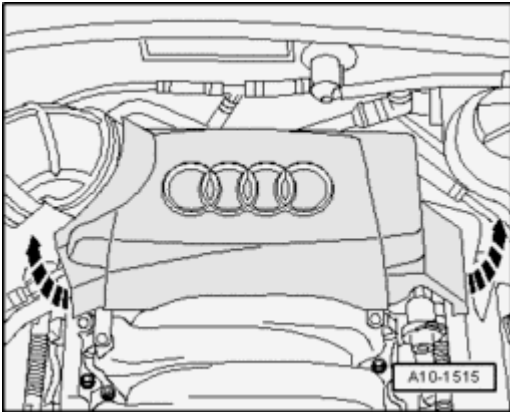


Fig. 22: Removing/Installing Rear Engine Cover
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install the rear engine cover - **arrows** -.

Final procedures

After the repair work, the following work steps must be performed in the following sequence:

1. Check the DTC memory.
 2. If necessary, erase the DTC memory. Refer to **Diagnostic Mode 04: Reset/delete Diagnostic Data**.
 3. If the DTC memory was erased, generate readiness code. Refer to **Readiness Code**.
- **End of diagnosis.**

Leak Detection Pump (LDP) V144 , Checking

Special tools, testers and auxiliary items required

- Multimeter.
- Wiring diagram.

Test requirements

- The Leak Detection Pump (LDP) V144 fuse OK.
- The ignition switched off.

Procedure

- Remove the left rear wheel housing liner. -->
 - **66 EXTERIOR EQUIPMENT**
 - **66 - EXTERIOR EQUIPMENT** for BODY EXTERIOR - CABRIOLET

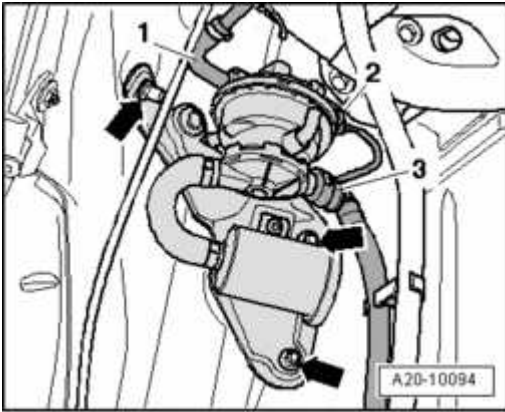


Fig. 23: Identifying Vacuum Line, Electrical Connector, Vent Line & Nuts
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect the Leak Detection Pump (LDP) V144 electrical harness connector - 2 -.

Checking internal resistance

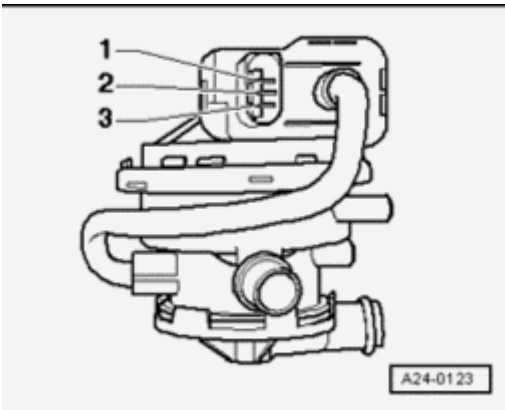


Fig. 24: Locating 3-Pin Connector At Fuel System Leak Detection Pump V144
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Using a Multimeter , check the Leak Detection Pump (LDP) V144 for resistance as follows:

Leak Detection Pump (LDP) V144 electrical harness connector terminals	Specified values
- 1 - + - 3 -	640 to 720 ohms
- 2 - + - 3 -	15 to 17 ohms

If any of the specifications are not obtained:

- Replace the Leak Detection Pump (LDP) -V144-. --> **20 - FUEL SUPPLY SYSTEM** .

If the specified values are obtained:

Checking voltage supply

NOTE:

- The voltage for the Leak Detection Pump (LDP) -V144- is supplied by the Engine Component Power Supply Relay J757.

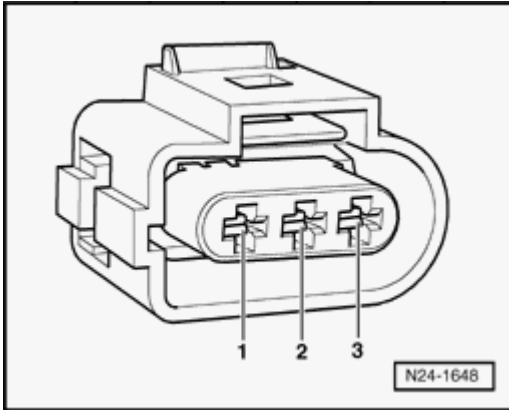


Fig. 25: Identifying 3-Pin Electrical Connector & Terminals
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Using a Multimeter , check the Leak Detection Pump (LDP) -V144- electrical harness connector terminal 3 to Ground (GND) for voltage.

Leak Detection Pump (LDP) -V144- electrical harness connector terminal	Measure to
- 3 -	Engine Ground (GND)

- Operate the starter briefly.

Specified value: battery voltage.

- Switch the ignition off.

If the specified value was not obtained:

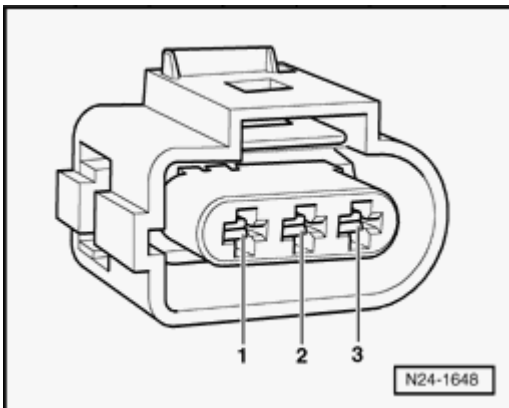


Fig. 26: Identifying 3-Pin Electrical Connector & Terminals

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Using a Multimeter , check the Leak Detection Pump (LDP) -V144- electrical harness connector terminal 3 to the Engine Component Power Supply Relay J757 terminal 2/87 for resistance.

Specified value: 1.5 Ohms

If the specified value was not obtained:

- Check the wiring for a short circuit to Ground (GND) or an open circuit.
- Check the electrical harness connector for damage, corrosion, lose or broken terminals.
- If necessary, repair the faulty wiring connection.

If no malfunction is detected in the wiring and if the voltage supply was OK:

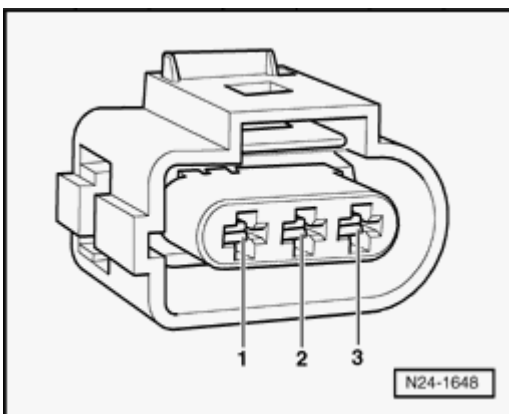
Checking wiring

If the manufacturers test box is being used. Perform the following step.

- Install the test box. Refer to --> **24 - FUEL INJECTION SYSTEM** .

If the manufacturers test box is not being used. Perform the following step.

- Remove the Engine Control Module (ECM) J623. Refer to --> **Engine Control Module (ECM) J623 , Removing and Installing.**
- Using a Multimeter , check the Leak Detection Pump (LDP) -V144- electrical connector terminal 1 to Engine Control Module (ECM) J623 electrical connector T94 terminal 20 for an open circuit.

**Fig. 27: Identifying 3-Pin Electrical Connector & Terminals**

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Using a Multimeter , check the Leak Detection Pump (LDP) -V144- electrical connector terminal 2 to Engine Control Module (ECM) J623 electrical connector T94 terminal 24 for an open circuit.

2005 Audi A4 Quattro

ENGINE PERFORMANCE 3.2 V6 4V Generic Scan Tool, Engine Code: BKH

Leak Detection Pump (LDP) -V144- electrical harness connector terminals	Engine Control Module (ECM) J623 electrical connector T94 terminals or test box sockets
- 1 -	20
- 2 -	24

Specified value: 1.5 ohms max.

If the specification was not obtained:

- Check the wiring for a short circuit to Battery positive (+), or an open circuit.
- Check the electrical harness connector for damage, corrosion, loose or broken terminals.
- If necessary, repair the faulty wiring connection.

If no malfunction is found in wiring:

- Replace the Engine Control Module (ECM) J623. Refer to --> **Engine Control Module (ECM) J623, Removing and Installing.**

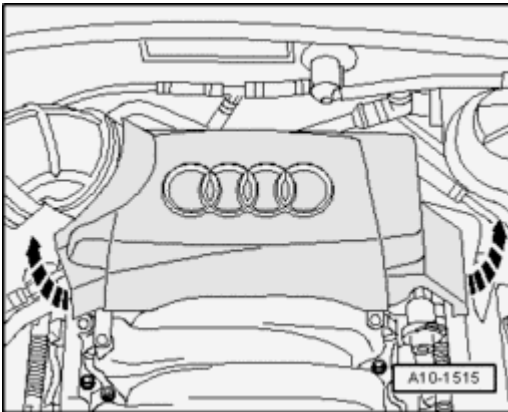


Fig. 28: Removing/Installing Rear Engine Cover
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Install the rear engine cover - **arrows** -.

Final procedures

After the repair work, the following work steps must be performed in the following sequence:

1. Check the DTC memory.
 2. If necessary, erase the DTC memory. Refer to **Diagnostic Mode 04: Reset/delete Diagnostic Data.**
 3. If the DTC memory was erased, generate readiness code. Refer to **Readiness Code.**
- **End of diagnosis.**

ELECTRONIC POWER CONTROL (EPC)**Electronic Power Control (EPC)****--> Throttle Position (TP) Sensor G79/Accelerator Pedal Position Sensor 2 G185 , Checking****Throttle Position (TP) Sensor G79/Accelerator Pedal Position Sensor 2 G185 , Checking****Special tools, testers and auxiliary items required**

- Multimeter.
- Wiring diagram

Test requirement

- The Engine Control Module (ECM) J623 fuses OK.
- Battery voltage at least 12.5 volts.
- All electrical consumers such as, lights and rear window defroster, switched off.
- Vehicles with automatic transmission, shift selector lever into position "P" or "N".
- A/C switched off.
- Ground (GND) connections between engine/transmission/chassis OK.

NOTE:

- **Use only gold-plated terminals when servicing the electrical harness connector terminals in Throttle Position (TP) Sensor G79/Accelerator Pedal Position Sensor 2 G185.**
- **The Throttle Position (TP) Sensor G79/Accelerator Pedal Position Sensor 2 G185 is located in the accelerator pedal module and communicate the drivers intensions to the Engine Control Module (ECM) J623 completely independently of each other. Both sensors are located in the accelerator pedal module and replaced as an entire assembly.**

Test sequence

- Remove the left knee panel -->
 - **68 - INTERIOR EQUIPMENT**
 - **68 - INTERIOR EQUIPMENT** for BODY INTERIOR - CABRIOLET

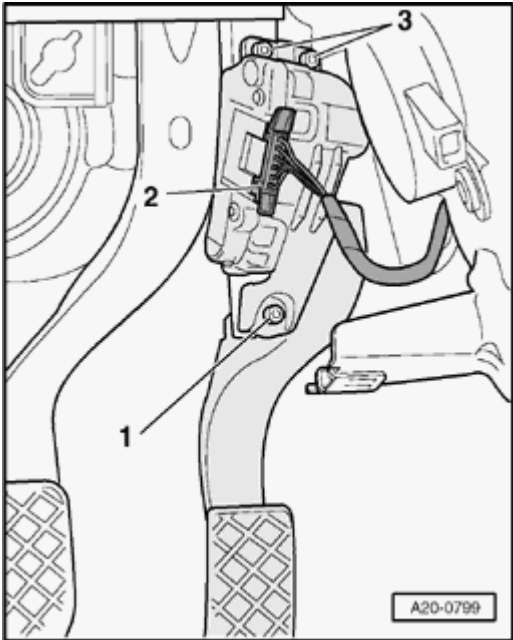


Fig. 29: Checking Electrical Harness Connector For Damage, Corrosion, Lose Or Broken Terminals
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect the Throttle Position (TP) Sensor G79/Accelerator Pedal Position Sensor 2 G185 electrical harness connector - 2 -.

Checking voltage supply

- Switch the ignition on.

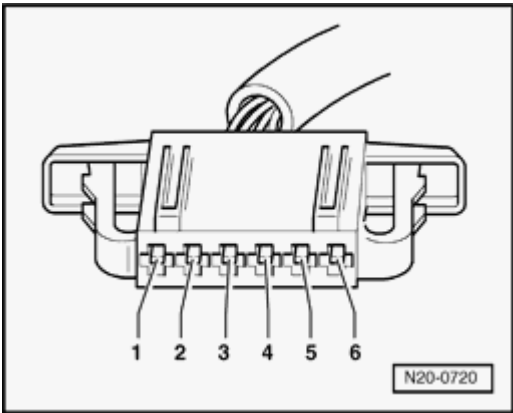


Fig. 30: Identifying 6-Pin Electrical Harness Connector & Terminals
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Using a Multimeter , check the following wiring connections for voltage.

Throttle Position (TP) Sensor G79/Accelerator Pedal Position Sensor 2 G185 electrical harness	Specified value
12:29:55 AM	Page 24

connector terminals	
1 to Ground (GND)	about 5 V
1 to 5	about 5 V
2 to Ground (GND)	about 5 V
2 to 3	about 5 V

- Switch the ignition off.

If the specification was not obtained:

Checking wiring

If the manufacturers test box is being used. Perform the following step.

- Install the test box. Refer to --> **24 - FUEL INJECTION SYSTEM** .

If the manufacturers test box is not being used. Perform the following step.

- Remove the Engine Control Module (ECM) J623. Refer to --> **Engine Control Module (ECM) J623, Removing and Installing.**

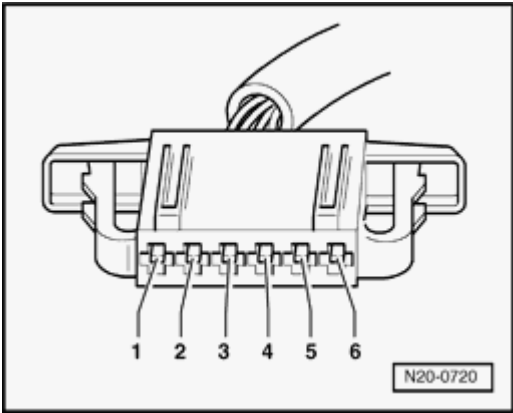


Fig. 31: Identifying 6-Pin Electrical Harness Connector & Terminals
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Using a Multimeter , check the Throttle Position (TP) Sensor G79/Accelerator Pedal Position Sensor 2 G185 electrical harness connector terminals to the Engine Control Module (ECM) J623 electrical connector T94 for an open circuit.

Throttle Position (TP) Sensor G79/Accelerator Pedal Position Sensor 2 G185 electrical harness connector terminals	Engine Control Module (ECM) J623 electrical connector T94 terminals or test box sockets
1	58
2	80
3	56

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ENGINE PERFORMANCE 3.2 V6 4V Generic Scan Tool, Engine Code: BKH

4	57
5	78
6	79

Specified value: 1.5 ohms max.

If the specification was not obtained:

- Check the wiring for a short circuit to each other, Battery (+), and Ground (GND).
- Check the electrical harness connector for damage, corrosion, loose or broken terminals.
- If necessary, repair the faulty wiring connection.

If no malfunction is detected in the wiring and if the voltage supply was OK:

- Replace the Throttle Position (TP) Sensor G79/Accelerator Pedal Position Sensor 2 G185. --> **20 - FUEL SUPPLY SYSTEM** .

If no malfunction is detected in the wiring and if the voltage supply was not OK:

- Replace the Engine Control Module (ECM) J623. Refer to --> **Engine Control Module (ECM) J623, Removing and Installing.**
- Install the left knee panel -->
 - **68 - INTERIOR EQUIPMENT**
 - **68 - INTERIOR EQUIPMENT** for BODY INTERIOR - CABRIOLET

Final procedures

After repair work, the following work steps must be performed in the following sequence:

1. Check the DTC memory.
2. If necessary, erase the DTC memory. Refer to **Diagnostic Mode 04: Reset/delete Diagnostic Data.**
3. If the DTC memory was erased, generate readiness code. Refer to **Readiness Code.**
 - End diagnosis and switch the ignition off.

24 - FUEL INJECTION SYSTEM

SIMOS FUEL INJECTION SYSTEM, SERVICING

Safety precautions

To reduce the risk of personal injury and/or damage to the fuel injection and ignition system, always observe the following:

CAUTION:

- Fuel system is under high pressure! Before opening high pressure components of the fuel injection system, pressure must be relieved to residual pressure --> Procedure that must be performed before opening the high-pressure fuel injection system. Pay close attention!
- Then wrap a clean rag around the connection and relieve residual pressure by carefully loosening the connection.
- The ignition must be switched off before connecting or disconnecting injection and ignition system wiring or tester cables.
- It is possible that the control module will recognize a malfunction and store a DTC during some tests. Therefore, when all tests and repairs are completed, the DTC memory must be checked and, if necessary, erased. After DTC memory is erased, a readiness code must be generated for the engine control module using operating mode "Guided Fault-Finding".
- Clean engine only with the ignition switched off.

CAUTION:

- The battery must only be disconnected and connected with the ignition switched off, since the Engine Control Module (ECM) can otherwise be damaged.
- Observe safety precautions when disconnecting the battery -->
 - 27 BATTERY, STARTER, GENERATOR, CRUISE CONTROL
 - 27 BATTERY, STARTER, GENERATOR, CRUISE CONTROL for ELECTRICAL EQUIPMENT, CABRIOLET

Observe the following if test and measuring instruments are required during a test drive:

CAUTION:

- Test and measuring equipment must always be secured to the rear seat and be operated from there by a second person.
- If test and measuring instruments are operated from the front passengers seat and the vehicle is involved in an accident, there is a possibility that the person sitting in this seat may receive serious injuries when the airbag is triggered.

Rules of cleanliness for performing work on fuel injection system

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Even minor contaminations can lead to malfunctions in the fuel injection system. Therefore when working on the fuel supply/injection system, pay careful attention to the following rules of cleanliness:

- Before loosening, connections and surrounding areas must be cleaned thoroughly with engine or brake cleaner, and then cleaned area must be dried completely.
- Plug open lines and connections immediately with appropriate protective caps.
- Place parts that have been removed on a clean surface and cover them. Do not use fluffy cloths!
- Only install clean components: Only unpack replacement parts immediately prior to installation. Do not use parts that have been stored unpackaged (e.g. in tool boxes etc.).
- When the system is open: Do not work with compressed air. Do not move vehicle unless absolutely necessary.

Procedure that must be performed before opening the high-pressure fuel injection system. Pay close attention!

- The fuel injection system is separated into a high-pressure section (max. approx. 110 bar) and a low-pressure section (approx. 6 bar).
- Before opening the high-pressure section - e.g. removing high-pressure pump, fuel rail, fuel injectors, the motor for intake manifold runner control valve or any other component or fuel line that is located in the high-pressure section of the fuel injection system - the fuel pressure in the high-pressure section must be relieved to a residual pressure of approx. 8 bar. The procedure for this is as follows.

Special tools, testers and auxiliary items required



Fig. 1: Identifying Vehicle Diagnosis, Testing And Information System VAS 5051B
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Vehicle Diagnostic, Testing and Information System VAS 505 with Diagnostic Cable VAS 5051/5A (VAS 5051 B version shown as example only)

Work procedure

- Start engine and run at idle speed.

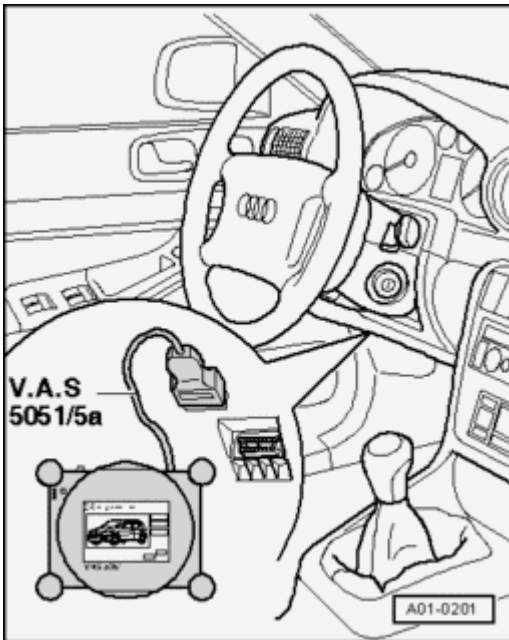


Fig. 2: Connecting Data Link Connector (DLC)

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect Vehicle Diagnosis, Testing and Information System VAS 5051 with Diagnostic Cable VAS 5051/5A.

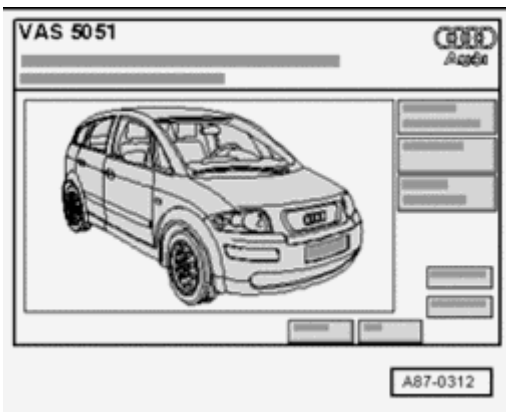


Fig. 3: Diagnostic System VAS 5051: Display

Courtesy of VOLKSWAGEN UNITED STATES, INC.

Display on VAS 5051 :

- Click on Vehicle Self-Diagnosis button.

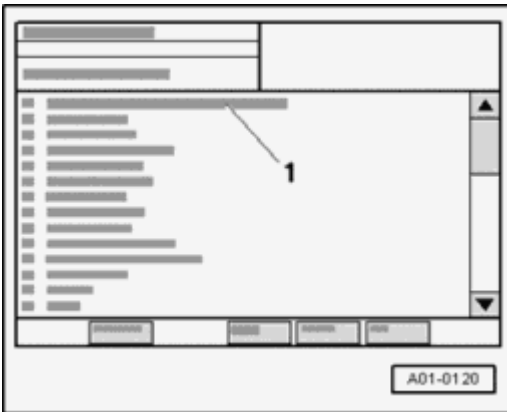


Fig. 4: Diagnostic System VAS 5051: Display
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Display on VAS 5051 :

- In selection - 1 - , press vehicle system "01 - Engine electronics".
- Wait until next display appears.

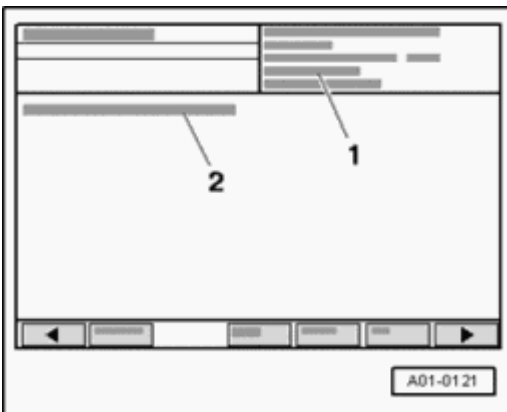


Fig. 5: VAS 5051 Tester Displaying Control Module Identification And Coding
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Display on VAS 5051 :

1 - Control module identification of engine control module (ECM)

- Click on --> button.

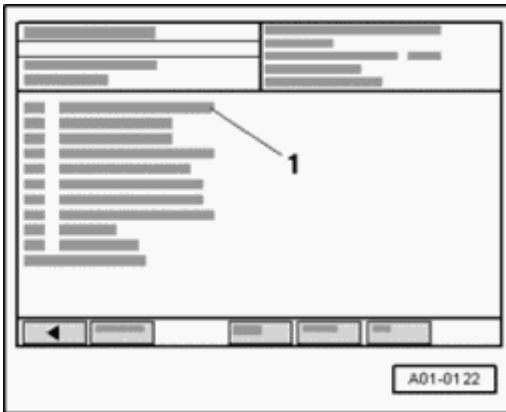


Fig. 6: Diagnostic System VAS 5051: Display
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Display on VAS 5051 :

1 - Selection of diagnostic functions

- In selection - 1 - , press diagnostic function "04- Basic Setting".



Fig. 7: Diagnostic System VAS 5051: Display
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Display on VAS 5051 :

- Select "140" in button field - 2 - for "display group 140" and confirm input by pressing Q button.

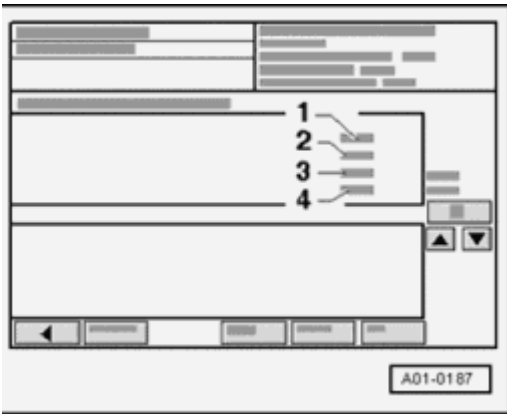


Fig. 8: Diagnostic System VAS 5051: Display
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Display on VAS 5051 :

Example:

1. 42%
2. 39.76 bar
3. 40.63 bar
4. Inactive

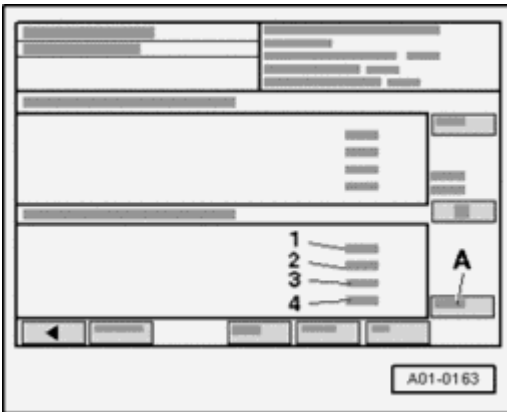


Fig. 9: Diagnostic System VAS 5051: Display - Display Fields
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Activate basic setting by pressing button A.

Display on VAS 5051 :

Example:

1. 0%
2. 0 bar

2005 Audi A4 Quattro

ENGINE PERFORMANCE 3.2 V6 4V Fuel Injection Ignition, Engine Code(s): BKH

3. 5.46 bar
4. Lower

The fuel rail will continue to be filled with fuel, but it will no longer be under high pressure.

Now components or lines can be opened. A clean rag must be placed around the connection points. Escaping fuel must be absorbed.

- In operating mode "Guided Fault-Finding" , generate readiness code for engine control module (ECM).

Technical data

Engine code	BKH (3.2 l/4V/188 kW engine)
Idle speed ¹⁾	650 to 750/min
Fuel pressure before high-pressure pump	approx. 6 bar positive pressure
Fuel pressure after high-pressure pump	approx. 35 bar positive pressure
• ¹⁾ Not adjustable.	

Component location, overview

Engine compartment, right side

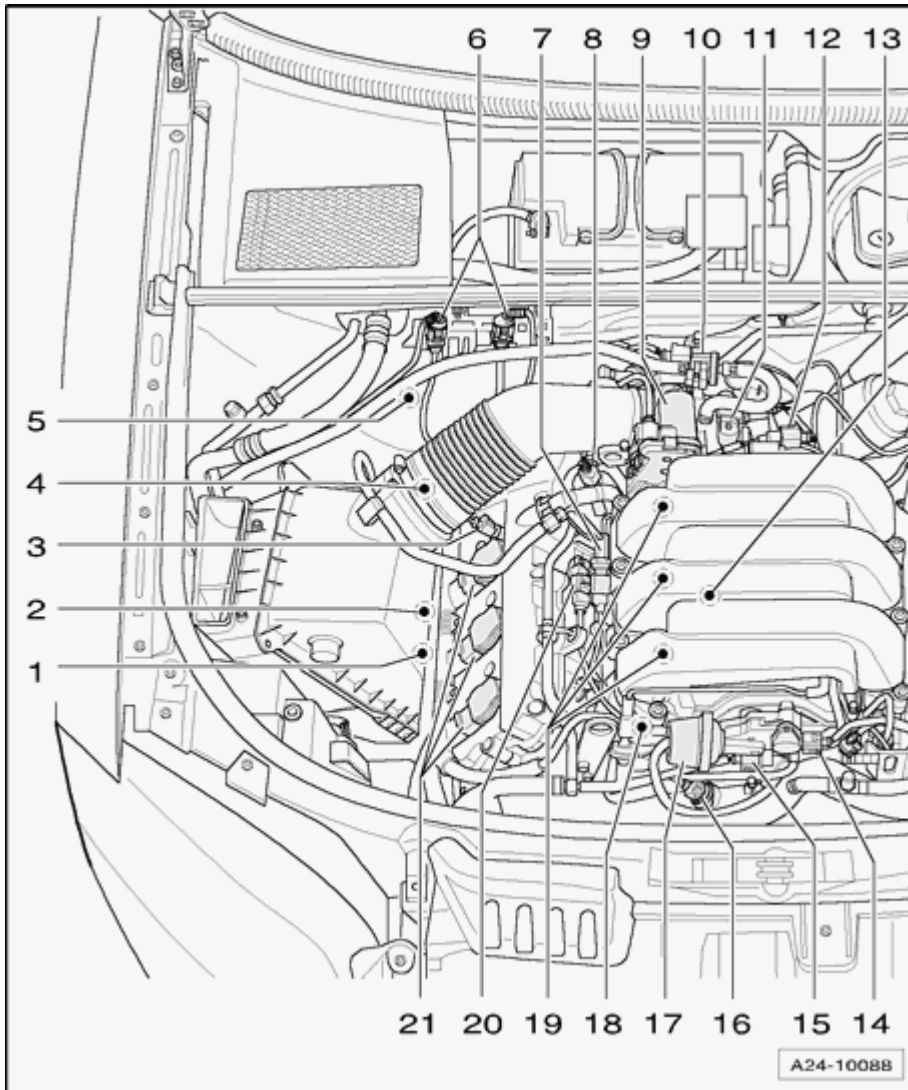


Fig. 10: Engine Compartment, Right Side Component Location, Overview
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Right Electro-Hydraulic Engine Mount Solenoid Valve N145

- Only vehicles with automatic transmission
- Component location **or** under **Left Electro-Hydraulic Engine Mount Solenoid Valve N144 or Right Electro-Hydraulic Engine Mount Solenoid Valve N145 installation location**

2 - Camshaft position (CMP) sensor 3 G300

- Component location **Hall sensor and valve for camshaft adjustment, bank 1**

3 - Camshaft Adjustment Valve 1 N205

- Component location **Hall sensor and valve for camshaft adjustment, bank 1**

4 - Oxygen sensor G39

- Component location **Oxygen sensors location, cylinder bank 1 (right)**
- Connector location **Right holder for connectors on bulkhead**
- Removing and installing --> **Oxygen sensor before catalytic converter, bank 1 (right side), removing and installing**

5 - Oxygen Sensor (O2S) Behind Three Way Catalytic Converter (TWC) G130

- Component location **Oxygen sensors location, cylinder bank 1 (right)**
- Connector location **Right holder for connectors on bulkhead**
- Removing and installing --> **Oxygen sensor behind catalytic converter, bank 1 (right side), removing and installing**

6 - Right holder for connectors

- Connector locations **Right holder for connectors on bulkhead**

7 - Low Fuel Pressure Sensor G410

- Component location --> **Low Fuel Pressure Sensor G410 installation location**

8 - Camshaft Adjustment Valve 1 (exhaust) N318

- Component location **Hall sensor and valve for camshaft adjustment, bank 1**

9 - Throttle valve control module J338

- After replacement, adapt in operating mode "Guided Fault-Finding" in "Adapting throttle valve control module"

10 - Evaporative Emission (EVAP) Canister Purge Solenoid Valve 1 N80**11 - Intake Air Temperature (IAT) Sensor G42/Manifold Absolute Pressure (MAP) Sensor G71**

- Component location **Component location on rear of intake manifold**

12 - Intake Manifold Runner Control (IMRC) Valve N316

Component location **Component location on rear of intake manifold**

13 - Knock sensor 1 G61

- Component location **Component location under intake manifold, cylinder bank 1 (right)**
- Connector location **Electrical connectors on left rear of engine**

14 - Intake Manifold Tuning (IMT) Valve Position Sensor G513

- Component location **Component location front on engine**

15 - Change-over valve for intake manifold flap N239

- Component location **Component location front on engine**

16 - Engine Coolant Temperature (ECT) Sensor G62

- Component location **Component location front on engine**

17 - Actuator for intake manifold change-over**18 - Intake Manifold Runner Position Sensor G336**

- Component location **Component location under intake manifold, cylinder bank 1 (right)**
- After replacing, adapt in "Guided Fault Finding" operating mode under "Adapting intake manifold runner position sensor"

19 - Fuel injectors, Cylinder bank 1

- Cylinder 1 Fuel Injector N30
- Cylinder 2 Fuel Injector N31
- Cylinder 3 Fuel Injector N32
- Removing and installing --> **Fuel injectors, removing and installing**

20 - Camshaft Position (CMP) sensor G40

- Component location **Hall sensor and valve for camshaft adjustment, bank 1**

21 - Ignition coils, Cylinder bank 1

- Ignition Coil 1 with Power Output Stage N70
- Ignition Coil 2 with Power Output Stage N127
- Ignition Coil 3 with Power Output Stage N291
- Removing and installing --> **Ignition coils, removing and installing**

Engine compartment, left side

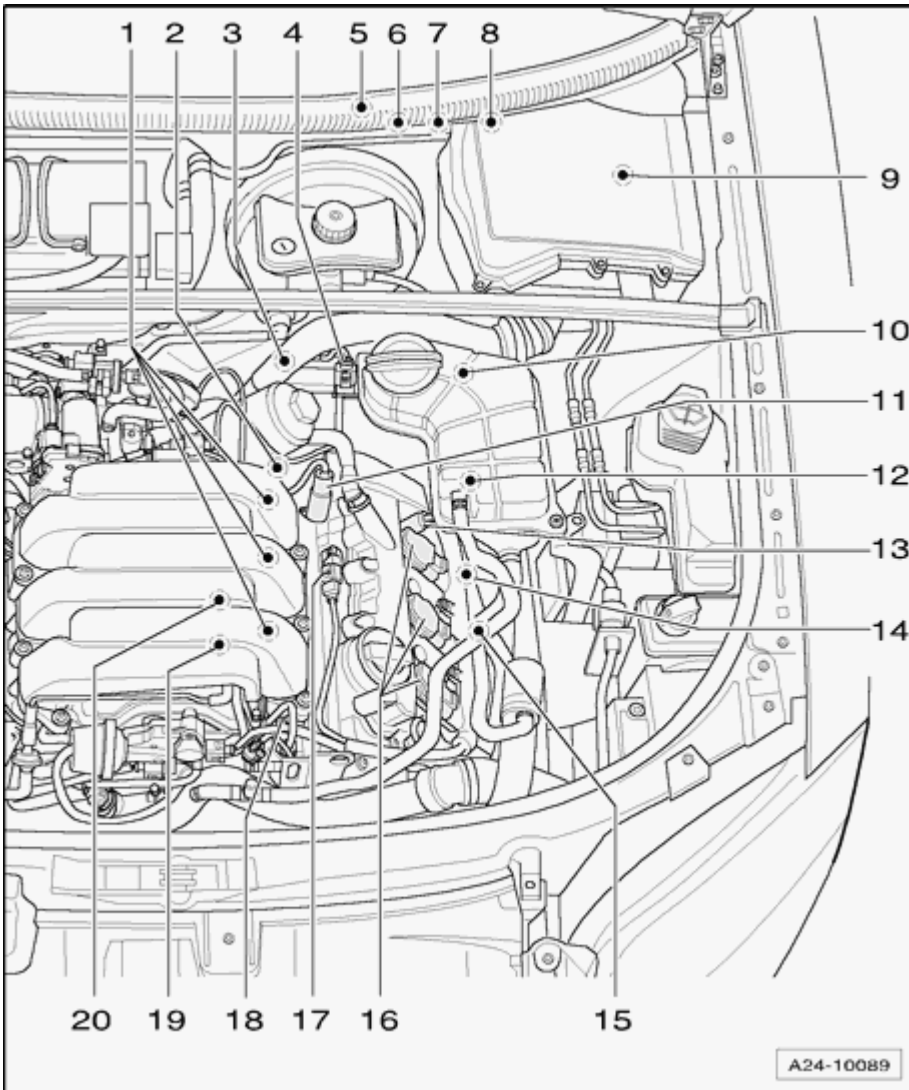


Fig. 11: Engine Compartment, Left Side Component Location, Overview
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Fuel injectors, Cylinder bank 2

- Cylinder 4 Fuel Injector N33
- Cylinder 5 Fuel Injector N83
- Cylinder 6 Fuel Injector N84
- Removing and installing --> **Fuel injectors, removing and installing**

2 - Intake Manifold Runner Position Sensor 2 G512

- Component location **Component location under intake manifold, cylinder bank 2 (left)**
- After replacing, adapt in "Guided Fault-Finding" operating mode under "Adapting intake manifold runner position sensor"

3 - Engine speed (RPM) sensor G28

- Component location --> **Location Engine Speed (RPM) Sensor G28**

4 - Left holder for connectors

- Connector locations **Left holder for connectors on bulkhead**

5 - Instrument cluster

- With Malfunction Indicator Lamp (MIL) K83 and Electronic Power Control (EPC) Warning Lamp K132

6 - Throttle Position (TP) Sensor G79/Accelerator Pedal Position Sensor 2 G185

- In accelerator pedal module, component location --> **Location Throttle Position (TP) Sensor G79/Accelerator Pedal Position Sensor 2 G185**

7 - Brake light switch F/Brake pedal switch F47 and Clutch pedal switch F36

- Component location --> **Installed location Brake light switch F/Brake pedal switch F47 , Clutch pedal switch F36**

8 - Clutch Pedal Starter Interlock Switch F194

- Component location --> **Clutch Pedal Starter Interlock Switch F194**

9 - SIMOS Control Module J361

- Component location --> **Component location SIMOS Control Module J361**
- Removing and installing --> **Engine Control Module (ECM), removing and installing**
- After replacement, adapt throttle valve control module in operating mode "Guided Fault-Finding" in "Adapting throttle valve control module"
- After replacement on vehicles with automatic transmissions, also perform kick-down adaptation in the operating mode "Guided Fault-Finding" in "Kick-down adaptation"

10 - Oxygen Sensor (O2S) 2 Behind Three Way Catalytic Converter (TWC) G131

- Component location **Oxygen sensors location, cylinder bank 2 (left)**
- Connector location **Left holder for connectors on bulkhead**
- Removing and installing --> **Oxygen sensor behind catalytic converter, bank 2 (left side), removing and installing**

11 - Camshaft Adjustment Valve 2 N208

Component location **Hall sensor and valve for camshaft adjustment, bank 2**

12 - Heated Oxygen Sensor (HO2S) 2 G108

- Component location **Oxygen sensors location, cylinder bank 2 (left)**
- Connector location **Left holder for connectors on bulkhead**
- Removing and installing --> **Oxygen sensor before catalytic converter, bank 2 (left side), removing and installing**

13 - Camshaft Adjustment Valve 2 (exhaust) N319

- Component location **Hall sensor and valve for camshaft adjustment, bank 2**

14 - Camshaft position (CMP) sensor 4 G301

- Component location **Hall sensor and valve for camshaft adjustment, bank 2**

15 - Left Electro-Hydraulic Engine Mount Solenoid Valve N144

- Only vehicles with automatic transmission
- Component location or under **Left Electro-Hydraulic Engine Mount Solenoid Valve N144 or Right Electro-Hydraulic Engine Mount Solenoid Valve N145 installation location**

16 - Ignition coils, Cylinder bank 2

- Ignition Coil 4 with Power Output Stage N292
- Ignition Coil 5 with Power Output Stage N323
- Ignition Coil 6 with Power Output Stage N324
- Removing and installing --> **Ignition coils, removing and installing**

17 - Camshaft position (CMP) sensor 2 G163

- Component location **Hall sensor and valve for camshaft adjustment, bank 2**

18 - High pressure pump

- With Fuel Metering Valve N290
- Component location **Component location on the high pressure pump**

19 - Fuel Pressure Sensor G247

- Component location **Component location under intake manifold, cylinder bank 2 (left)**

20 - Knock sensor 2 G66

- Component location **Component location under intake manifold, cylinder bank 2 (left)**
- Connector location **Electrical connectors on left rear of engine**

Component location SIMOS Control Module J361

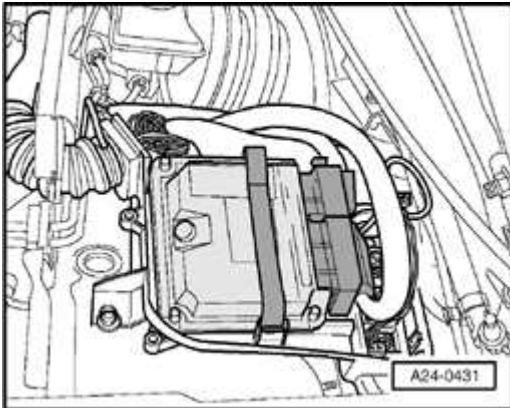


Fig. 12: Component Location SIMOS Control Module J361
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- In E-box, plenum chamber.

Location Throttle Position (TP) Sensor G79/Accelerator Pedal Position Sensor 2 G185

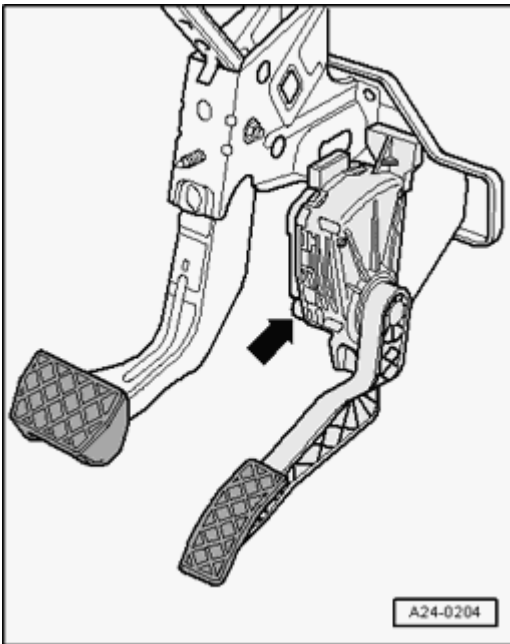


Fig. 13: Location Throttle Position (TP) Sensor G79/Accelerator Pedal Position Sensor 2 G185
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- In accelerator pedal module - **arrow** -.

NOTE:

- The Throttle Position (TP) Sensor G79 and Accelerator Pedal Position Sensor 2 G185 are integrated in the gas pedal module and cannot be replaced individually.

Installed location Brake light switch F/Brake pedal switch F47 , Clutch pedal switch F36

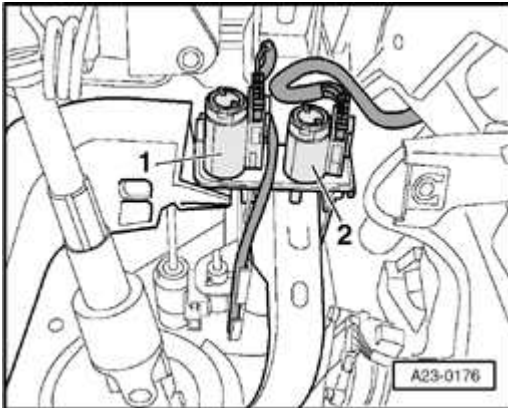


Fig. 14: Installed Location Brake Light Switch F/Brake Pedal Switch F47 , Clutch Pedal Switch F36
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- On pedal bracket.
1. Brake light switch F , Brake pedal switch F47
 2. Clutch pedal switch F36

NOTE: • To ensure that they are absolutely securely seated, the switches may only be installed once.

Clutch Pedal Starter Interlock Switch F194

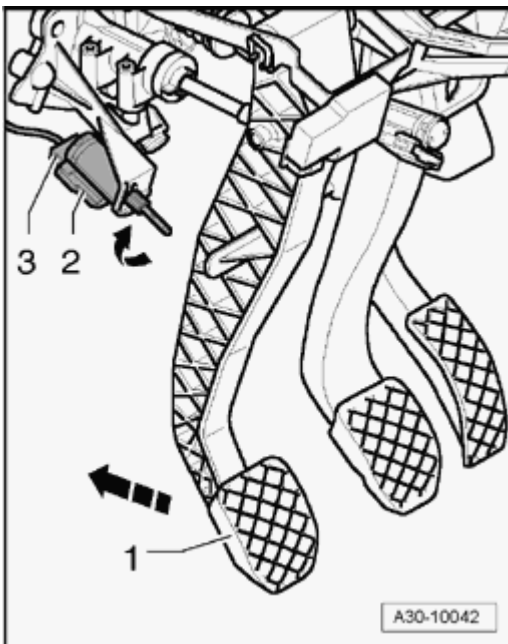


Fig. 15: Installing and Adjusting Clutch Pedal Starter Interlock Switch F194
Courtesy of VOLKSWAGEN UNITED STATES, INC.

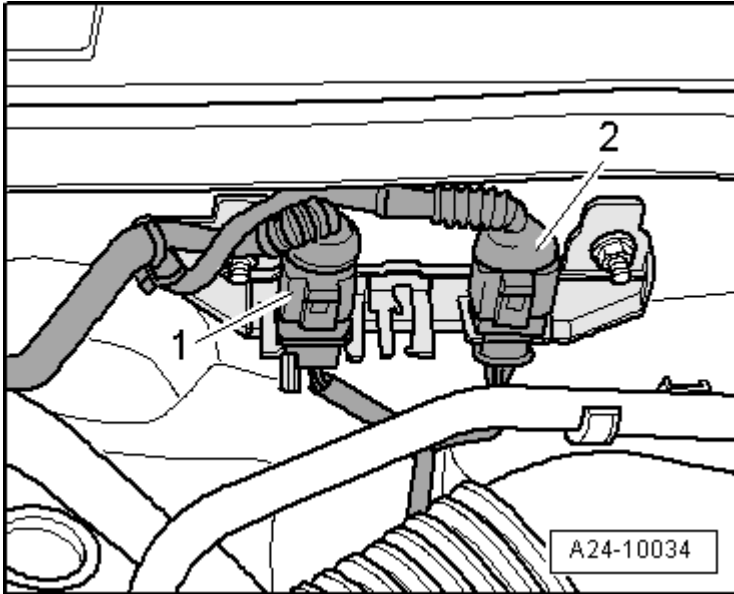
2 - Clutch Pedal Starter Interlock Switch F194**Right holder for connectors on bulkhead**

Fig. 16: Right Holder For Connectors On Bulkhead
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1. To Heated Oxygen Sensor (HO2S) G39
2. To Oxygen Sensor (O2S) Behind Three Way Catalytic Converter (TWC) G130

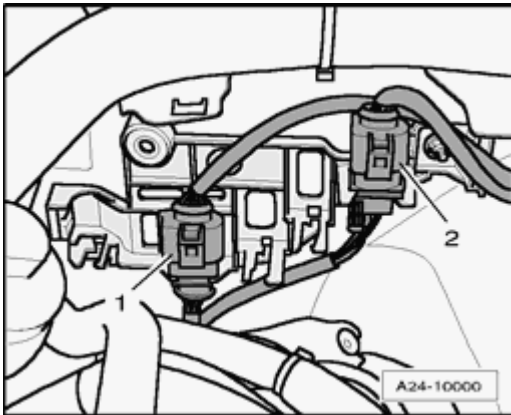
Left holder for connectors on bulkhead

Fig. 17: Left Holder For Connectors On Bulkhead
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1. To Oxygen Sensor (O2S) 2 Behind Three Way Catalytic Converter (TWC) G131
2. To Heated Oxygen Sensor (HO2S) 2 G108

Oxygen sensors location, cylinder bank 1 (right)

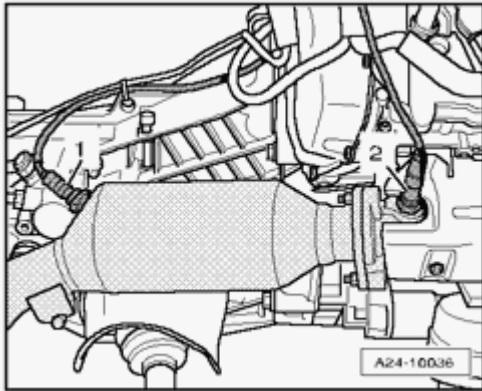


Fig. 18: Oxygen Sensors Location, Cylinder Bank 1 (Right)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1. Oxygen Sensor (O2S) Behind Three Way Catalytic Converter (TWC) G130
2. Oxygen sensor G39

Oxygen sensors location, cylinder bank 2 (left)

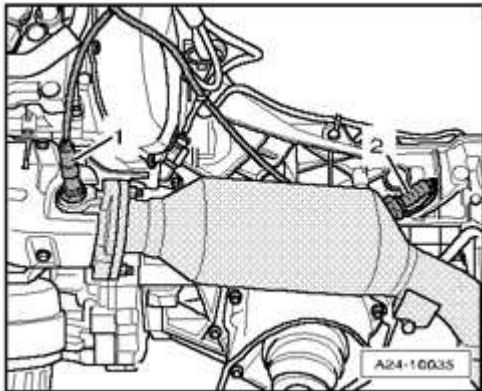


Fig. 19: Removing Oxygen Sensor Using Ring Spanner Set 3337
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1. Heated Oxygen Sensor (HO2S) 2 G108
2. Oxygen Sensor (O2S) 2 Behind Three Way Catalytic Converter (TWC) G131

Electrical connectors on right rear of engine

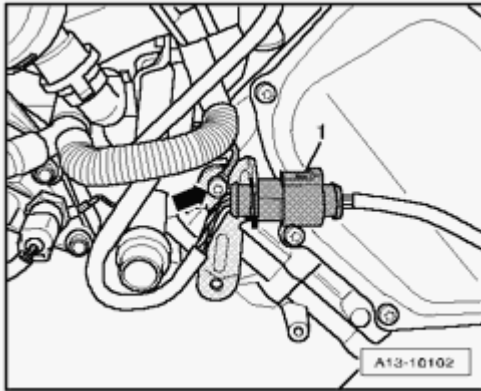


Fig. 20: Electrical Connectors On Right Rear Of Engine
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1. To fuel injectors, cylinder bank 1

NOTE: • - Arrow - indicates Ground (GND) point

Electrical connectors on left rear of engine

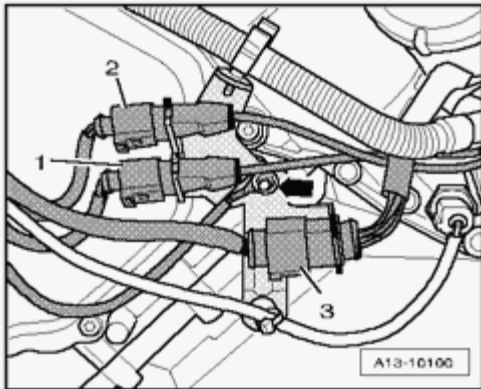


Fig. 21: Electrical Connectors On Left Rear Of Engine
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1. Green; to Knock Sensor (KS) 1 G61
2. Grey; to Knock sensor (KS) 2 G66
3. To cylinder bank 2 fuel injectors and to Fuel Pressure Sensor G247

NOTE: • - Arrow - indicates Ground (GND) point

Hall sensor and valve for camshaft adjustment, bank 1

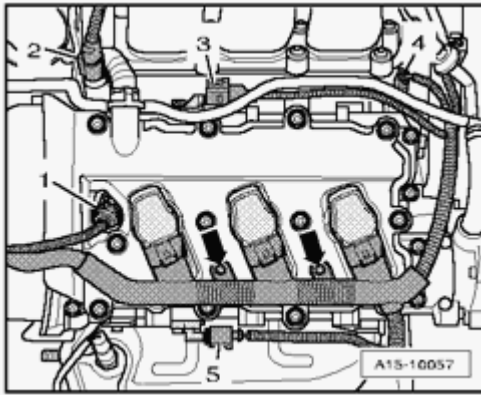


Fig. 22: Disconnecting Electrical Harness Connectors
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1. Camshaft Adjustment Valve 1 (exhaust) N318
2. Valve 1 for camshaft adjustment N205
3. Camshaft Position (CMP) sensor G40
4. Intake Manifold Runner Position Sensor G336
5. Camshaft position (CMP) sensor 3 G300

NOTE: • Ignore - arrows -.

Hall sensor and valve for camshaft adjustment, bank 2

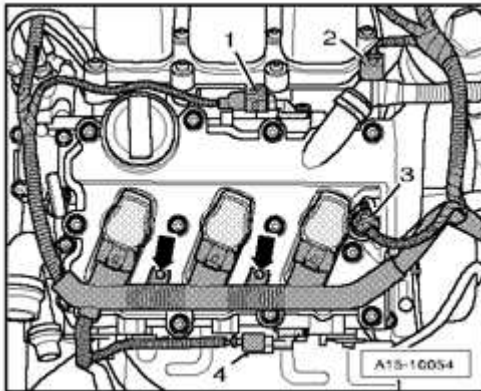


Fig. 23: Disconnecting Electrical Harness Connectors
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1. Camshaft position (CMP) sensor 2 G163
2. Camshaft Adjustment Valve 2 N208
3. Camshaft Adjustment Valve 2 (exhaust) N319
4. Camshaft position (CMP) sensor 4 G301

NOTE:

- Ignore - arrows -.

Low Fuel Pressure Sensor G410 installation location

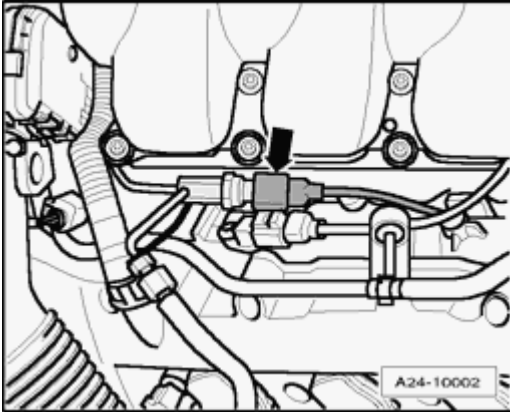


Fig. 24: Low Fuel Pressure Sensor G410 Installation Location
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- On right cylinder head - **arrow** -.

Component location front on engine

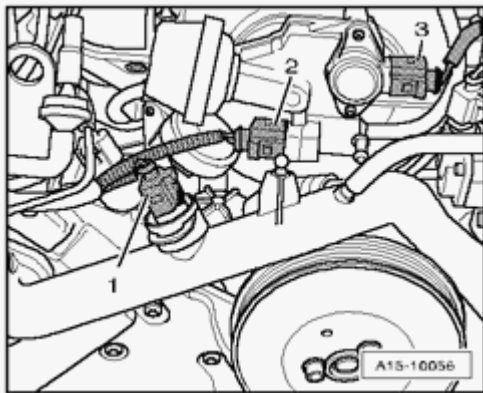


Fig. 25: Component Location Front On Engine
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1. Engine Coolant Temperature (ECT) Sensor G62
2. Change-over valve for intake manifold flap N239
3. Intake Manifold Tuning (IMT) Valve Position Sensor G513

Component location on rear of intake manifold

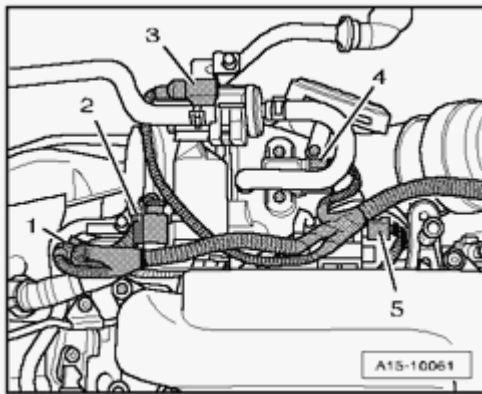


Fig. 26: Identifying Electrical Harness Connectors
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1. Camshaft Adjustment Valve N205
2. Throttle valve control module J338
3. Evaporative Emission (EVAP) Canister Purge Solenoid Valve N80
4. Intake Air Temperature (IAT) Sensor G42/Manifold Absolute Pressure (MAP) Sensor G71
5. Intake Manifold Runner Control (IMRC) Valve N316

Component location on the high pressure pump

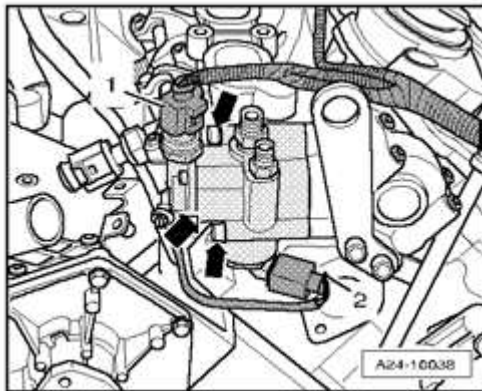


Fig. 27: Disconnecting Electrical Connector
Courtesy of VOLKSWAGEN UNITED STATES, INC.

2 - Fuel Metering Valve N290

NOTE:

- - 1 - not installed.
- Ignore - arrows -.

Left Electro-Hydraulic Engine Mount Solenoid Valve N144 or Right Electro-Hydraulic Engine Mount Solenoid Valve N145 installation location

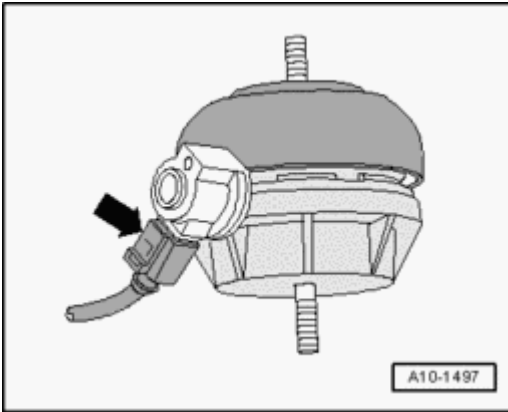


Fig. 28: Left Electro-Hydraulic Engine Mount Solenoid Valve N144 Or Right Electro-Hydraulic Engine Mount Solenoid Valve N145 Installation Location
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Only for vehicles with automatic transmission: On left and right engine mounts - **arrow** -.

Component location under intake manifold, cylinder bank 1 (right)

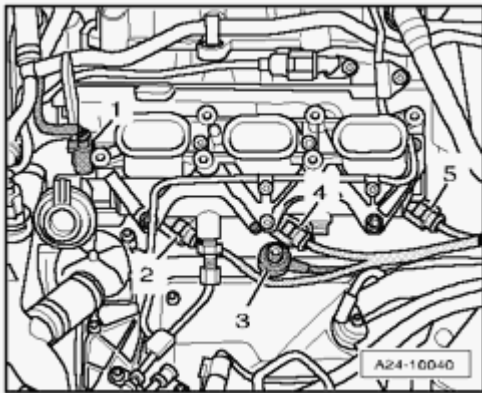


Fig. 29: Component Location Under Intake Manifold, Cylinder Bank 1 (Right)
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

1. Intake Manifold Runner Position Sensor G336
2. Cylinder 1 Fuel Injector N30
3. Knock sensor 1 G61
4. Cylinder 2 Fuel Injector N31
5. Cylinder 3 Fuel Injector N32

Component location under intake manifold, cylinder bank 2 (left)

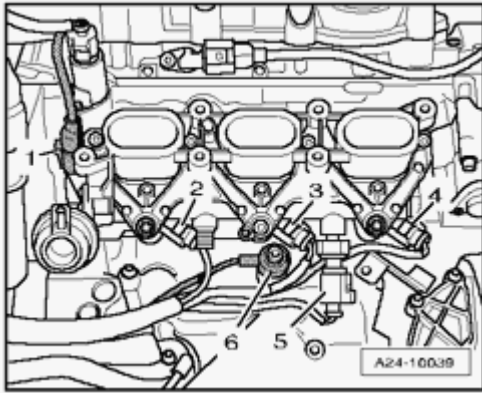


Fig. 30: Component Location Under Intake Manifold, Cylinder Bank 2 (Left)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1. Intake Manifold Runner Position Sensor 2 G512
2. Cylinder 6 Fuel Injector N84
3. Cylinder 5 Fuel Injector N83
4. Cylinder 4 Fuel Injector N33
5. Fuel Pressure Sensor G247
6. Knock sensor 2 G66

Location Engine Speed (RPM) Sensor G28

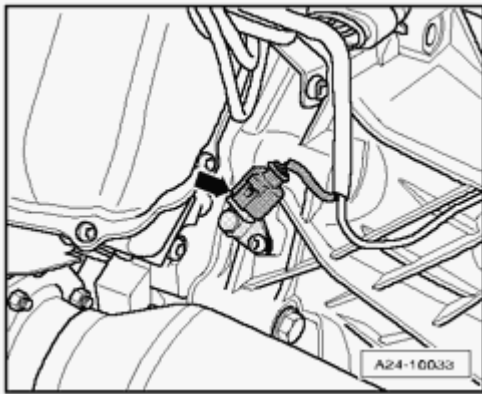


Fig. 31: Location Engine Speed (RPM) Sensor G28
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- At left front of transmission housing - **arrow** -.

Air filter, component overview

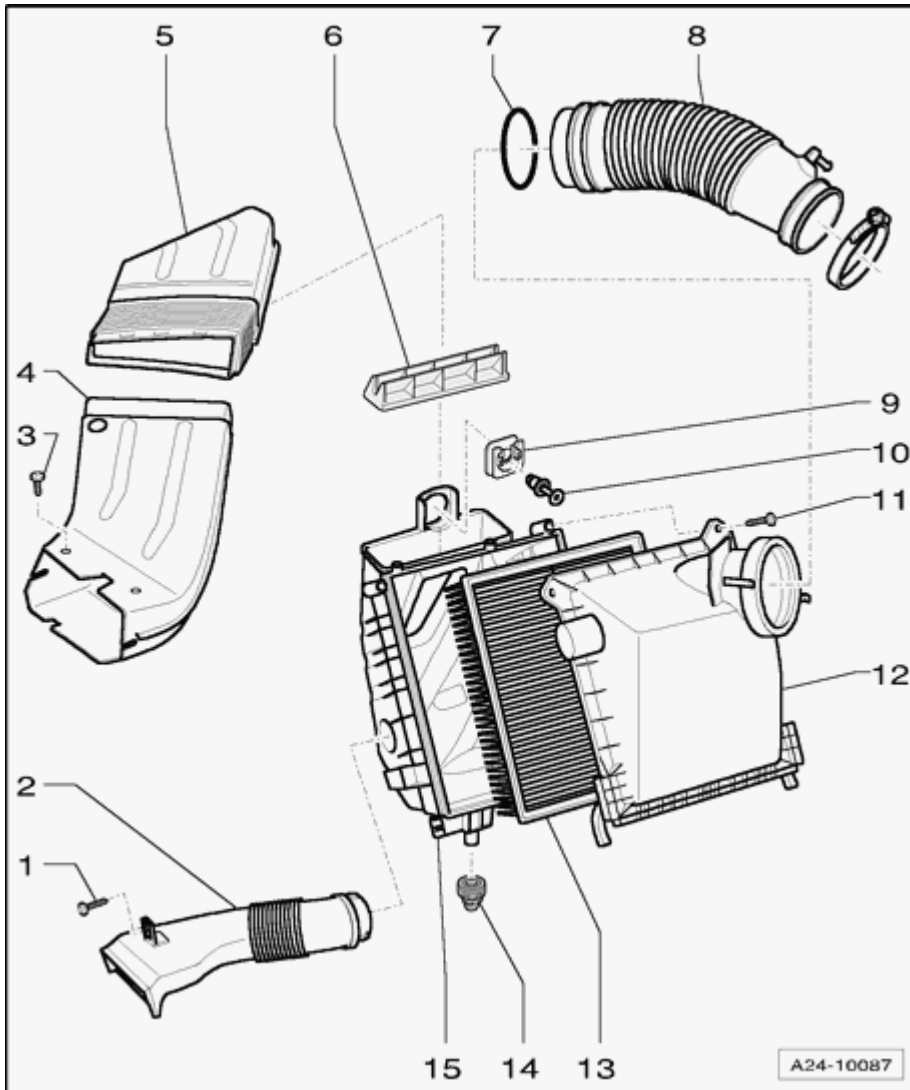


Fig. 32: Air Filter, Component Overview

Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - 1.5 Nm

2 - Air duct

- Clipped into lower part of air filter housing
- Clean air duct of dirt and leaves

3 - 1.5 Nm

4 - Air duct

- To lock carrier
- Clean air duct of dirt and leaves

5 - Air duct

- Clean air duct of dirt and leaves

6 - Strainer

7 - O-ring

- Replace

8 - Air duct hose to Throttle Valve Control Module J338

9 - Rubber grommet

10 - Spreader clip

11 - 1.5 Nm

12 - Upper part of air filter housing

- Clean air filter housing-upper part of salt residue, dirt and leaves

13 - Air filter element

- Always use a genuine air filter element
- Removing and installing --> **Air filter element, removing and installing**
- Maintenance intervals

14 - Rubber grommet

15 - Lower part of air filter housing

- Clean air filter housing-lower part of salt residue, dirt and leaves

Air filter element, removing and installing**Removing**

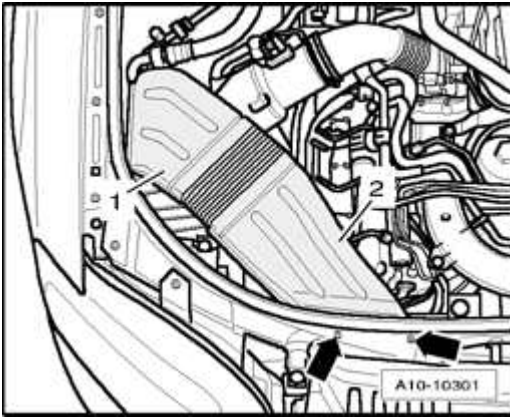


Fig. 33: Identifying Bolts & Air Duct

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **arrows** -.
- Remove air duct - **1** - and - **2** -.

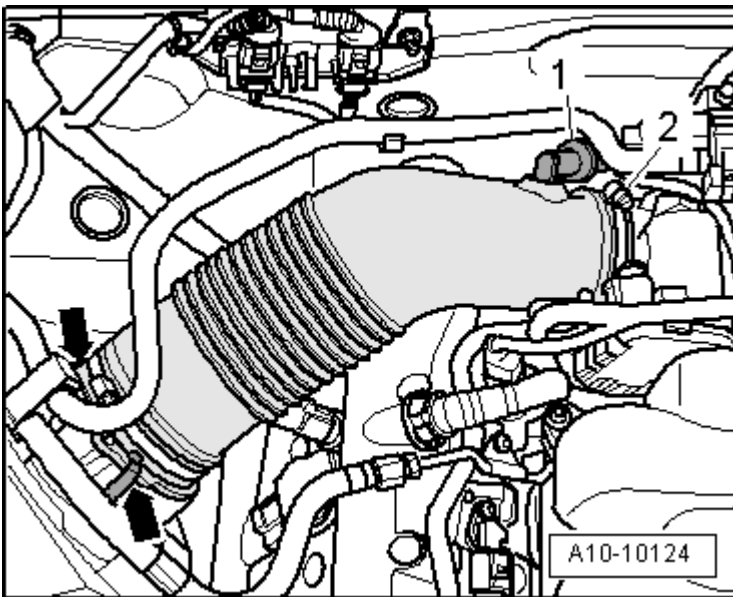


Fig. 34: Disconnecting Check Valve From Connection At Air Duct Hose

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect check valve - **1** - from air duct hose.
- Remove air duct hose, thereby loosening hose clamp - **2** - and opening clips - **arrows** -.

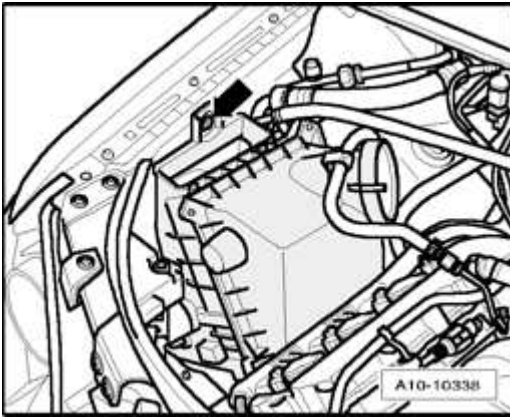


Fig. 35: Removing Upper Part Of Air Filter Housing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts for upper part of air filter housing.
- Remove upper part of air filter housing.

NOTE:

- **Disregard - arrow -.**

- Remove air filter element.

Installing

NOTE:

- **Always use an original equipment air filter element.**
- **Hose connections and hoses in intake area must be free of oil and grease before installing. When installing, do not use any lubricants containing silicone.**
- **Air filter housing must always be clean.**
- **Secure all hose connections using hose clamps appropriate for the model type .**
- **Note the following when blowing out air filter housing with compressed air: To prevent malfunctions, cover critical air-flow engine components such as air duct pipes, etc. with a clean cloth.**
- **Observe disposal regulations!**

- Clean air filter housing (upper and lower sections) of salt residue, dirt or leaves (use vacuum cleaner if necessary).
- Check air duct hose (clean air side) for salt residue, dirt and leaves.
- Check intake ducting up to air filter element for dirt.
- Make sure that air filter element is properly centered when placed into mounting of lower part of air filter housing.
- Set upper part of air filter housing onto lower part of air filter housing. without using much force. When

doing this, make sure that the upper part of air filter housing is not placed crooked onto air filter element. Pay attention to sealing lip of air filter element (false air).

- Then, fasten upper part of air filter housing to lower part of air filter housing.
- Further installation is performed in reverse order.

Intake manifold upper-part, component overview

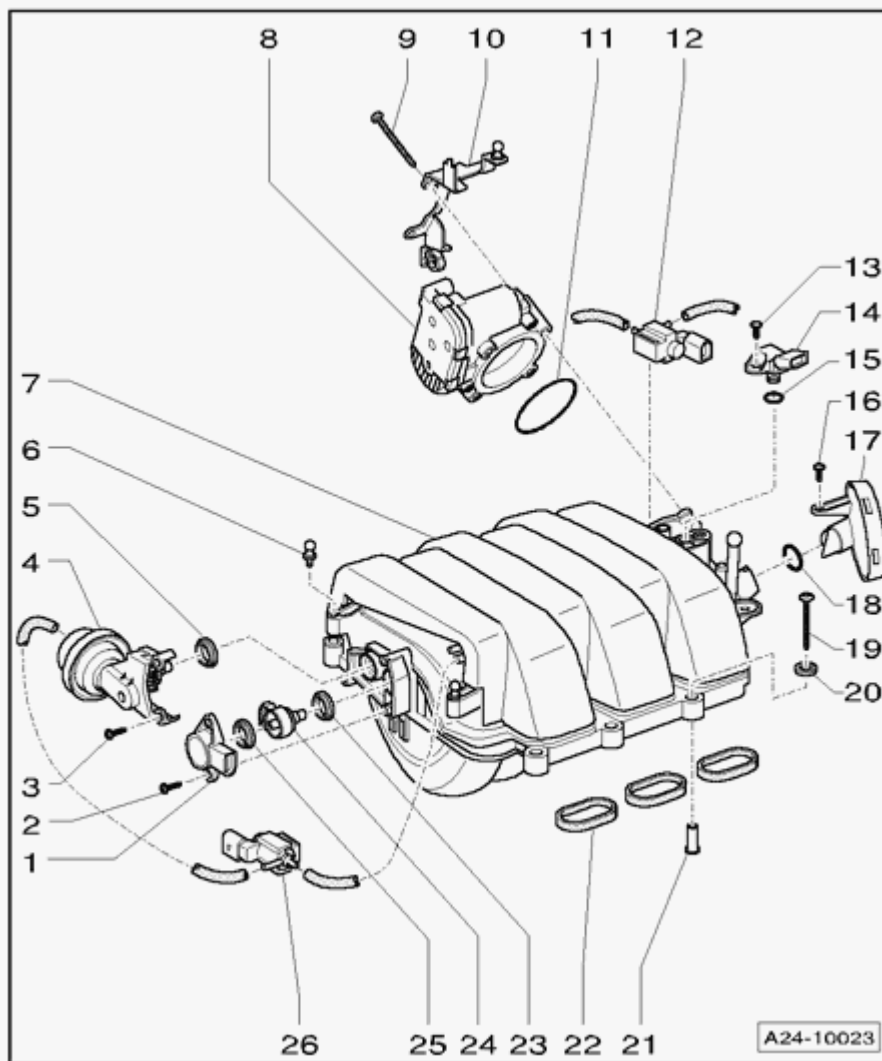


Fig. 36: Intake Manifold Upper-Part, Component Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Intake Manifold Tuning (IMT) Valve Position Sensor G513

2 - 2.5 Nm

3 - 2.5 Nm

4 - Actuator for intake manifold change-over

- Installed location of tooth segments for variable intake manifold **Installed location of tooth segments for variable intake manifold**
- As replacement part together with - 24 -

5 - Seal

- Replace if damaged
- Lift out with screwdriver to replace
- Press in by hand

6 - Ball pin, 2.5 Nm

7 - Intake manifold upper part

- Removing and installing --> **Intake manifold upper-part, removing and installing**

8 - Throttle valve control module J338

9 - 5 Nm

10 - Wire harness retainer

11 - Seal

- Replace

12 - Intake Manifold Runner Control (IMRC) Valve N316

13 - 2.5 Nm

14 - Intake Air Temperature (IAT) Sensor G42/Manifold Absolute Pressure (MAP) Sensor G71

15 - O-ring

- Replace

16 - 2.5 Nm

17 - Crankcase housing ventilation pressure regulator valve

18 - O-ring

- Replace

19 - 6 Nm

20 - Washer

21 - Sleeve

22 - Seals

- Replace

23 - Seal

- Replace if damaged
- Lift out with screwdriver to replace
- Press in by hand

24 - Lever with tooth segment

- For variable intake manifold
- Installed location of tooth segments **Installed location of tooth segments for variable intake manifold**
- As replacement part together with - 4 -

25 - Seal

- Replace if damaged
- Lift out with screwdriver to replace
- Press in by hand

26 - Change-over valve for intake manifold flap N239

Installed location of tooth segments for variable intake manifold

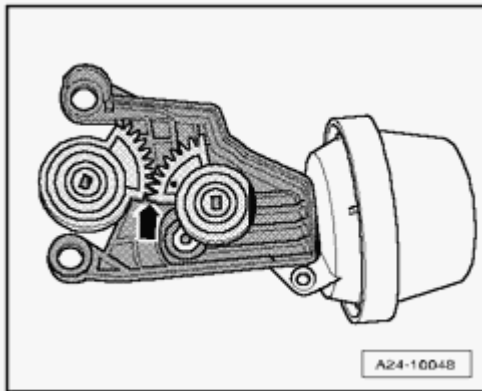


Fig. 37: Installed Location Of Tooth Segments For Variable Intake Manifold
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- The lower edges of tooth segments must be flush with one another - **arrows** -.

Intake manifold upper-part, removing and installing

Removing

NOTE:

- All cable ties which are opened or cut open when removing, must be replaced in the same position when installing.

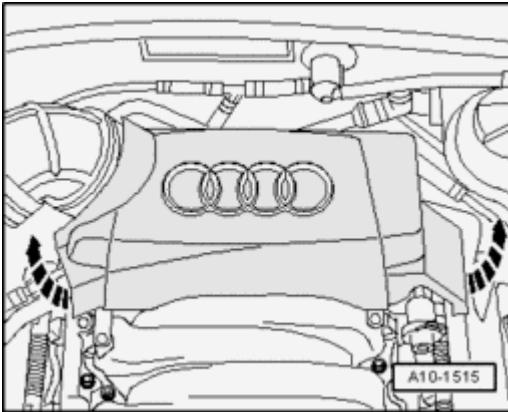


Fig. 38: Removing Rear Engine Cover

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pull rear engine cover off - **arrows** -.

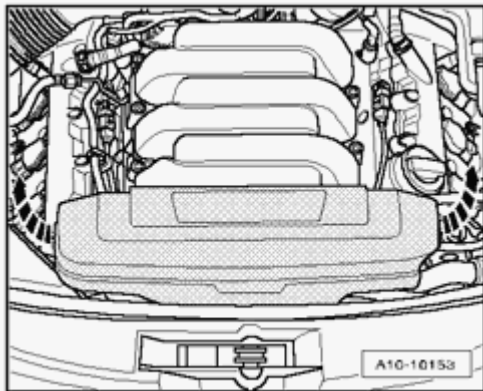


Fig. 39: Identifying Front Engine Cover

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pull front engine cover off - **arrows** -.

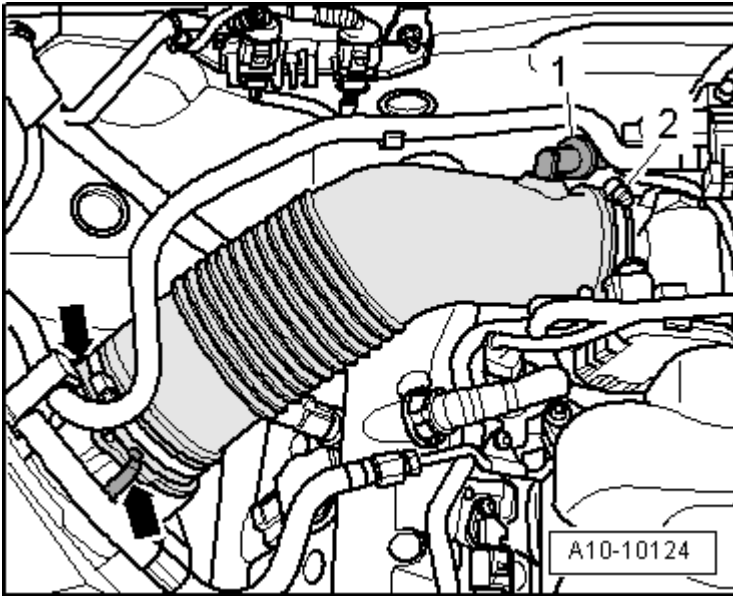


Fig. 40: Disconnecting Check Valve From Connection At Air Duct Hose
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect check valve - **1** - from connection at air duct hose.
- Remove air duct hose, thereby loosening hose clamp - **2** - and opening clips - **arrows** -.

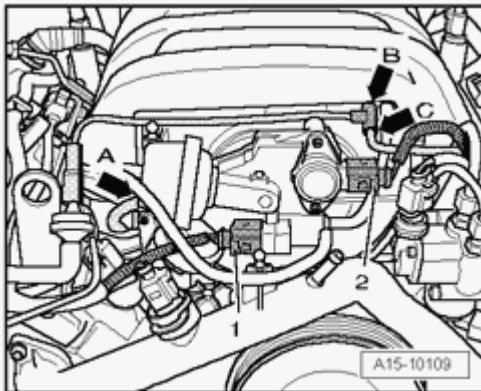


Fig. 41: Disconnecting Electrical Harness Connectors
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect electrical harness connectors.
1. Intake Manifold Flap Change-over Valve N239
 2. Intake Manifold Tuning (IMT) Valve Position Sensor G513
- Remove vacuum lines - **arrow A** - and - **arrow B** -.
 - Disconnect vacuum hose - **arrow C** - at leak detection pump.

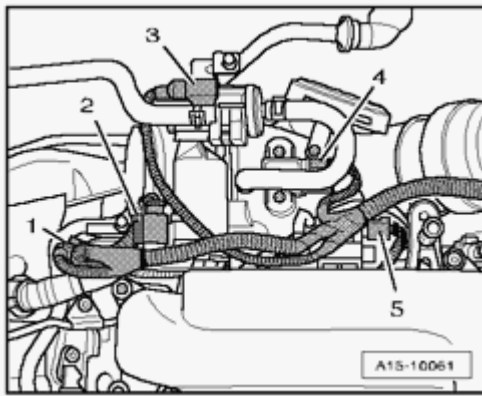


Fig. 42: Identifying Electrical Harness Connectors
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect electrical harness connectors.
- 1. Camshaft Adjustment Valve 1 N205
- 2. Throttle valve control module J338
- 3. Evaporative Emission (EVAP) Canister Purge Solenoid Valve N80
- 4. Intake Air Temperature (IAT) Sensor G42/Manifold Absolute Pressure (MAP) Sensor G71
- 5. Intake Manifold Runner Control (IMRC) Valve N316
- Free up wiring harness.

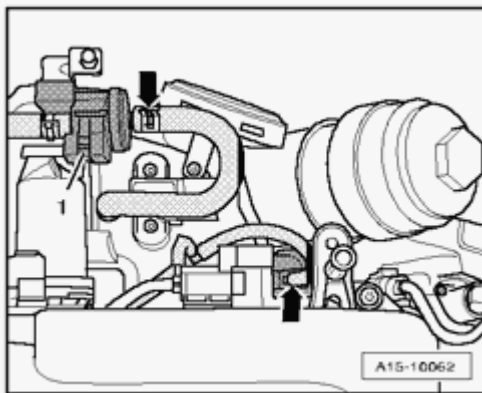


Fig. 43: Disconnecting Vacuum Hose
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect vacuum hoses - **arrows** -.
- Remove Evaporative Emission (EVAP) Canister Purge Regulator Valve N80 - **1** - from Throttle Valve Control Module J338.

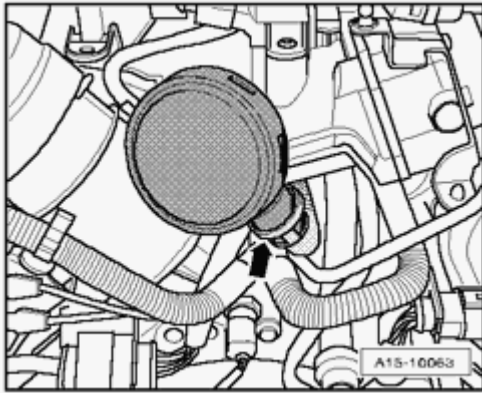


Fig. 44: Disconnecting Crankcase Breather Hose At Pressure Regulator Valve
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect crankcase breather hose at pressure regulator valve - **arrow** -.

NOTE:

- To improve clarity, the removed engine is shown from the rear.

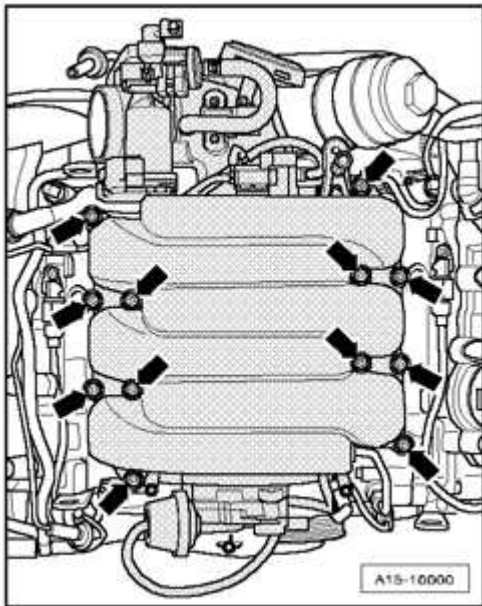


Fig. 45: Removing Bolts And Intake Manifold Upper-Part
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **arrows** - and remove intake manifold upper-part.

NOTE:

- Plug intake ports of the cylinder head with clean rags.

Installing

2005 Audi A4 Quattro

ENGINE PERFORMANCE 3.2 V6 4V Fuel Injection Ignition, Engine Code(s): BKH

Installation is in reverse order of removal, note the following:

NOTE:

- Replace gaskets and O-rings.
- During installation, all cable ties must be re-installed at the same location.
- Secure all hose connections using hose clamps appropriate for the model type .

Torque specifications

Component	Nm
Intake manifold upper-part to intake manifold lower-part	6 ¹⁾
Hose clamps 9 mm wide	3
• ¹⁾ Tighten diagonally in stages.	

Intake manifold lower-part, component overview

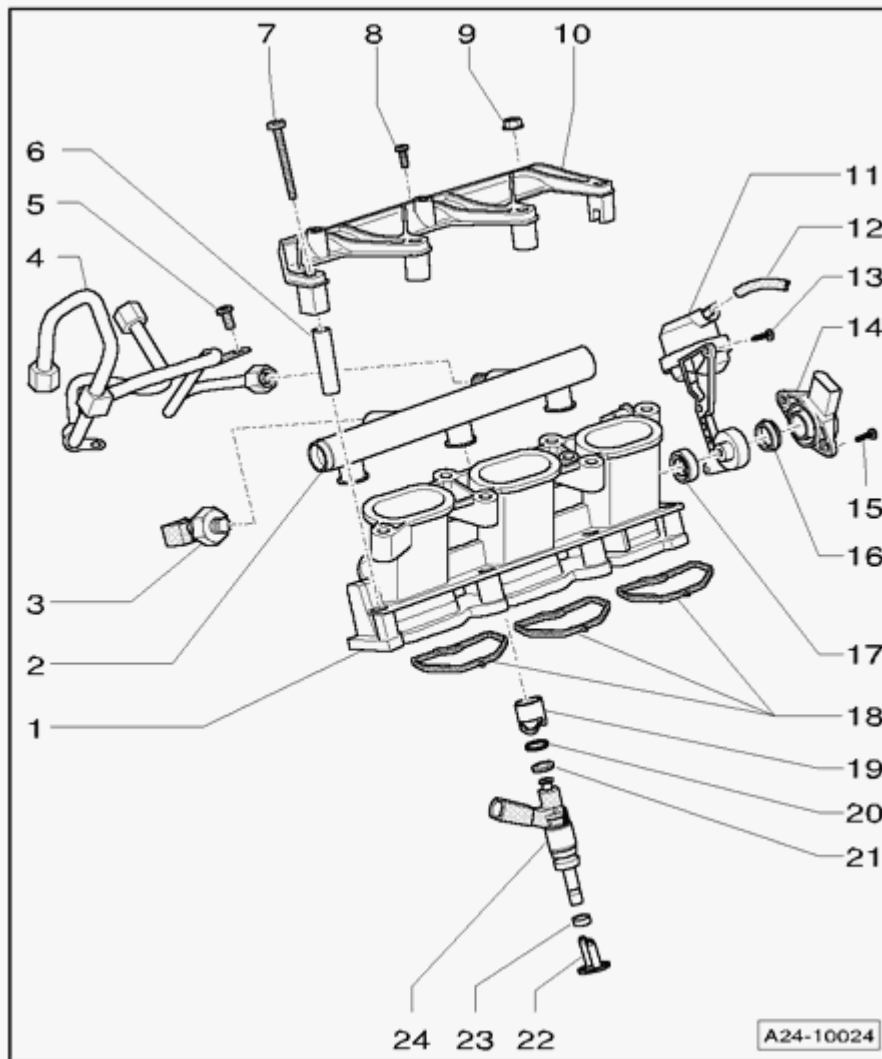


Fig. 46: Intake Manifold Lower-Part, Component Overview
Courtesy of VOLKSWAGEN UNITED STATES, INC.

1 - Intake manifold lower part

- Removing and installing --> **Intake manifold lower-part with fuel rail, removing and installing**
- After installation, adapt both intake manifold runner position sensors in operating mode "Guided Fault-Finding" in "Adapting intake manifold runner position sensor"

2 - Fuel rail

3 - Fuel Pressure Sensor G247

4 - High-pressure lines

CAUTION: • Before opening high pressure components of the fuel injection

system, pressure must be relieved to residual pressure --> Procedure that must be performed before opening the high-pressure fuel injection system. Pay close attention!

- Then wrap a clean rag around the connection and relieve residual pressure by carefully loosening the connection.

- Do not change bend shape
- Tighten high-pressure lines *To fasten high-pressure line (14 mm) on fuel rail, use under Intake manifold lower-part with fuel rail, removing and installing*

5 - 10 Nm

6 - Sleeve

7 - 10 Nm

8 - 2.5 Nm

9 - 10 Nm

10 - Retaining bracket for fuel rail

11 - Vacuum actuator for intake manifold runner control

12 - Vacuum hose

- To Intake Manifold Runner Control (IMRC) Valve N316

13 - 2.5 Nm

14 - Intake Manifold Runner Position Sensor

- Left Intake Manifold Runner Position Sensor 2 G512 , right Intake Manifold Runner Position Sensor G336

15 - 2.5 Nm

16 - Seal

- Replace if damaged
- Lift out with screwdriver to replace
- Press in by hand

17 - Seal

- Replace if damaged
- Lift out with screwdriver to replace
- Press in by hand

18 - Seals

- Replace

19 - Support ring

- Make sure it is seated properly
- The fuel rail wields force via support ring to hold fuel injector tightly in cylinder head.

20 - O-ring

- Replace
- Moisten with clean engine oil

21 - Spacer ring

- Replace if damaged

22 - Radial adjustment

- Replace if damaged
- Clip with support ring - **19** -

23 - Combustion chamber seal

- Replacing --> **Fuel injectors, removing and installing.**

24 - Fuel injector

Removing and installing --> **Fuel injectors, removing and installing**

Intake manifold lower-part with fuel rail, removing and installing

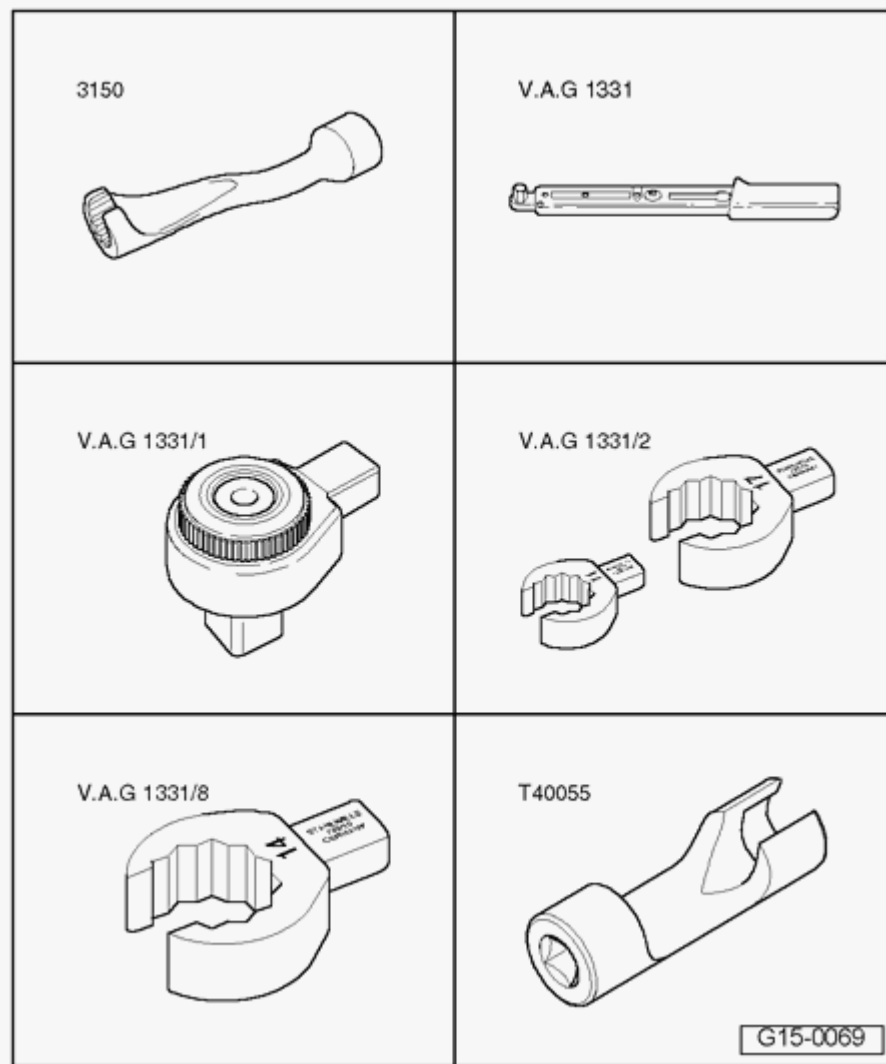


Fig. 47: Identifying Special Tools - Intake Manifold Lower-Part With Fuel Rail, Removing And Installing
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

- Socket 14 mm 3150
- Torque wrench V.A.G 1331
- Ratchet V.A.G 1331/1
- Open end wrench socket 17 mm V.A.G 1331/2
- SW 14 socket, open ring V.A.G 1331/8
- Socket T40055

Special tools, testers and auxiliary items required

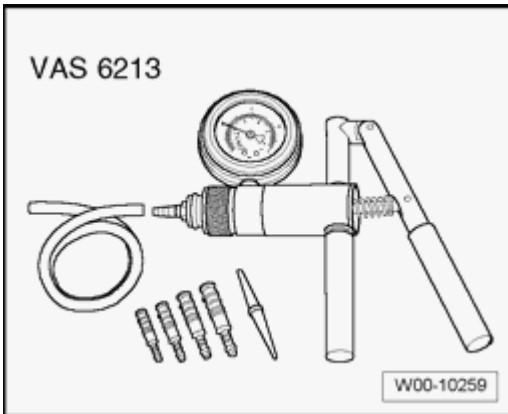


Fig. 48: Identifying Hand Vacuum Pump VAS 6213
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Hand vacuum pump VAS 6213

Removing

NOTE:

- The following removal and installation procedure is for the left intake manifold lower-part. The procedure for the other side is identical.

CAUTION:

- Fuel system is under high pressure! Before opening high pressure components of the fuel injection system, pressure must be relieved to residual pressure --> Procedure that must be performed before opening the high-pressure fuel injection system. Pay close attention!
- Then wrap a clean rag around the connection and relieve residual pressure by carefully loosening the connection.

- Remove upper part of intake manifold --> Intake manifold upper-part, removing and installing.

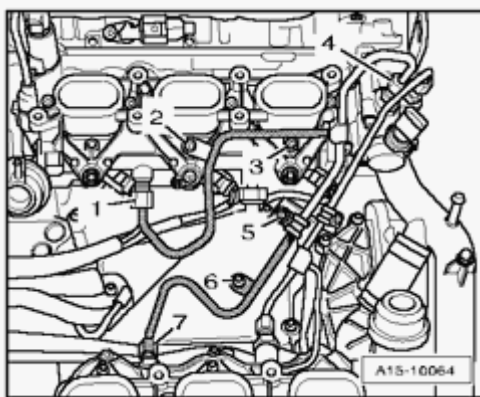


Fig. 49: Removing High-Pressure Line, Thereby Removing Bolts And Union Nuts
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove high-pressure line, thereby removing bolts and union nuts - **1 through 7** -.

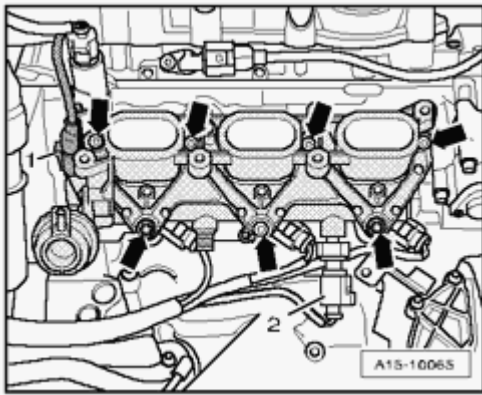


Fig. 50: Removing/Installing Intake Manifold Bolts And Nuts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect electrical harness connectors:
 1. Intake Manifold Runner Position Sensor 2 G512
 2. Fuel Pressure Sensor G247
- Remove bolts and nuts - **arrows** - and remove intake manifold lower-part with fuel rail.

NOTE:

- **Plug intake ports of the cylinder head with clean rags.**

Installing

Installation is in reverse order of removal, note the following:

NOTE:

- **Replace gaskets and O-rings.**
- **Lightly moisten fuel injector O-rings with clean engine oil.**

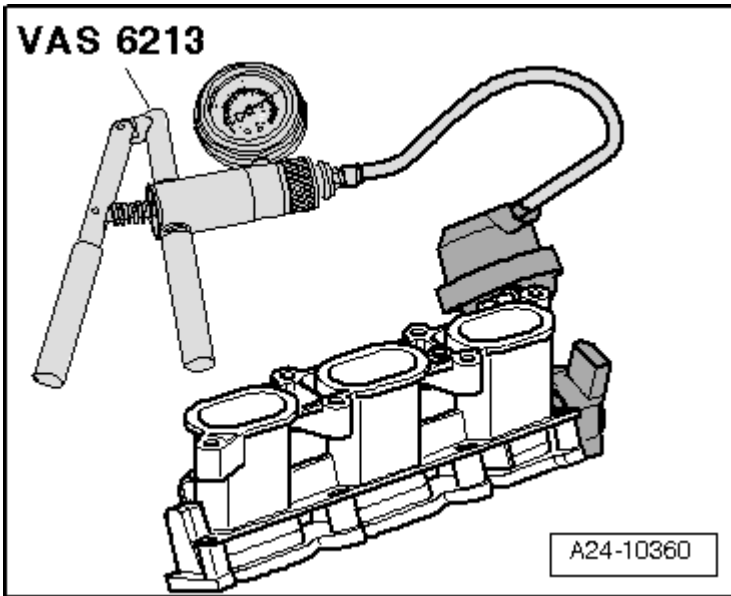


Fig. 51: Connecting Hand Vacuum Pump VAS 6213 To Intake Manifold Runner Control Vacuum Actuator

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect Hand Vacuum Pump VAS 6213 to intake manifold runner control vacuum actuator, as shown in illustration.
- Generate vacuum using hand vacuum pump.
- The intake flaps are opened.

NOTE:

- If the intake flaps are not opened, they could have seized when installing the lower part of the intake manifold in the cylinder head.

- Install lower part of intake manifold and press fuel rail evenly onto fuel injectors.

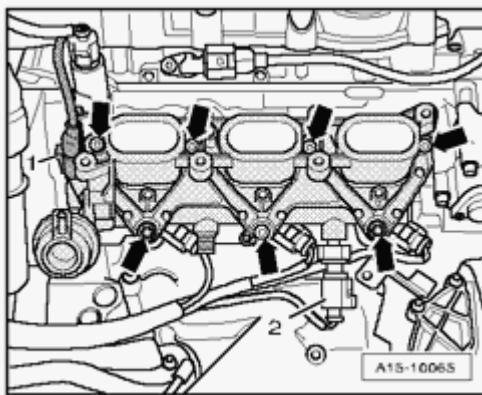


Fig. 52: Removing/Installing Intake Manifold Bolts And Nuts

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Fasten bolts - **arrows** - for intake manifold lower-part in a diagonal sequence and in stages.
- Remove hand vacuum pump from intake manifold runner control vacuum actuator.
- Connect electrical harness connectors - **1** - and - **2** -.

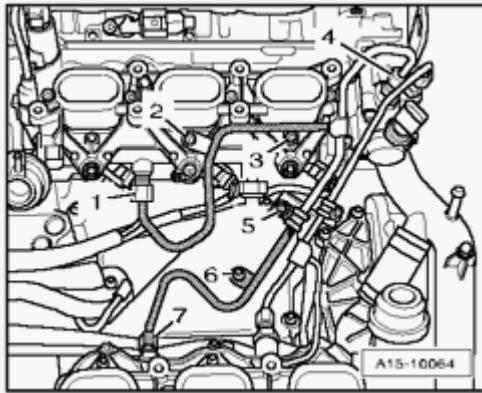


Fig. 53: Removing High-Pressure Line, Thereby Removing Bolts And Union Nuts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Hand-tighten union nuts - **1** - , - **4** - and - **7** - of high-pressure lines, and then for lines - **2** - , - **3** - , - **5** - and - **6** -.
- Make sure high-pressure lines are seated free of stress.

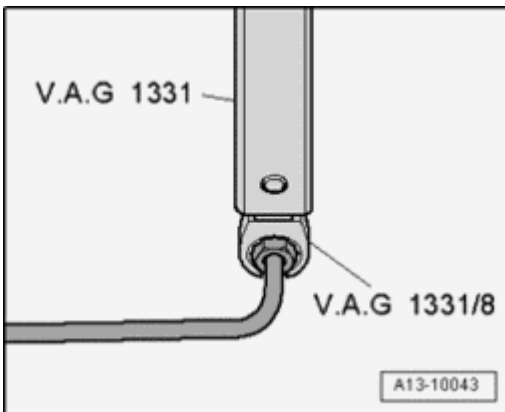


Fig. 54: Fastening High-Pressure Line At Fuel Rail Using Torque Wrench V.A.G 1331 With Open End Wrench Socket V.A.G 1331/8
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- To fasten high-pressure line (14 mm) on fuel rail, use Torque Wrench V.A.G 1331 with Socket Insert AF 14 V.A.G 1331/8.

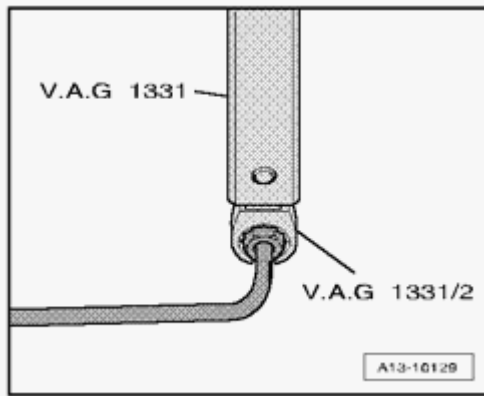


Fig. 55: Fastening High-Pressure Line At Fuel Rail Using Torque Wrench V.A.G 1331 With Open End Wrench Socket V.A.G 1331/2

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- To fasten high-pressure line (17 mm) to fuel rail, use Torque Wrench V.A.G 1331 with Socket Insert AF 17 V.A.G 1331/2.

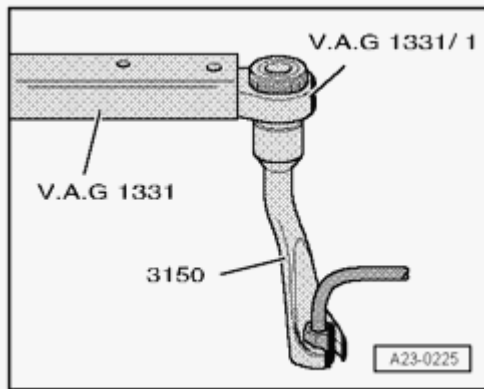


Fig. 56: Fastening High-Pressure Line (14 mm) At High Pressure Pump Use Torque Wrench V.A.G 1331 With Ratchet V.A.G 1331/1 And Socket 14 mm 3150

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- To fasten high-pressure line (14 mm) at high pressure pump use torque wrench V.A.G 1331 with ratchet V.A.G 1331/1 and socket 14 mm 3150.

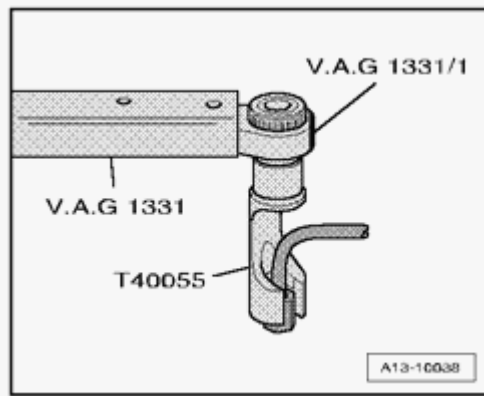


Fig. 57: Fastening High-Pressure Line At High Pressure Pump Using Torque Wrench V.A.G 1331 With Ratchet V.A.G 1331/1 And Socket 17 mm T40055

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- To fasten high-pressure line (17 mm) to high pressure pump, use Torque Wrench V.A.G 1331 with Reversible Ratchet V.A.G 1331/1 and Socket T40055.

Torque specifications

Component		Nm
Intake manifold lower-part to cylinder head		9
High pressure lines to	High pressure pump	25
	Fuel rail	25

Fuel injectors, removing and installing

Special tools, testers and auxiliary items required



Fig. 58: Identifying Tool Set T10133

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Tool set T10133

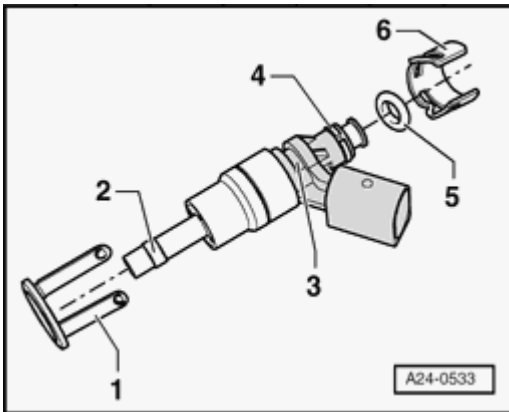


Fig. 59: High-Pressure Fuel Injector - Component Overview
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

High-pressure fuel injector - component overview

1. Radial adjustment - Replace if damaged
2. Combustion chamber seal (Teflon seal) - replace, the seal must not be greased or be handled with any other lubricant during installation
3. Groove on fuel injector
4. Spacer ring - Replace if damaged
5. O-ring - replace, lightly coat with clean engine oil during installation
6. Support ring - fuel rail welds force via support ring to hold fuel injector tightly in cylinder head

Removing

CAUTION:

- Fuel system is under high pressure! Before opening high pressure components of the fuel injection system, pressure must be relieved to residual pressure --> Procedure that must be performed before opening the high-pressure fuel injection system. Pay close attention!
 - Then wrap a clean rag around the connection and relieve residual pressure by carefully loosening the connection.
- Remove upper part of intake manifold --> Intake manifold upper-part, removing and installing.
 - Remove corresponding intake manifold lower-part --> Intake manifold lower-part with fuel rail, removing and installing.

If fuel injectors cannot be pulled out of cylinder head by hand, proceed as follows:

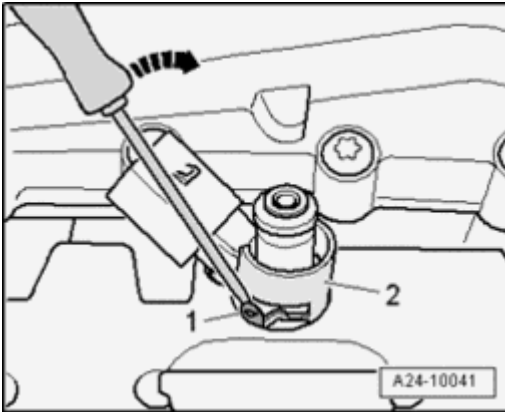


Fig. 60: Using Screwdriver To Bend Retaining Tabs Of Radial Adjustment Aside And Pull Support Ring From Fuel Injector

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Using a screwdriver, bend retaining tabs - **1** - of radial adjustment aside - **arrow** - and pull support ring - **2** - from fuel injector.

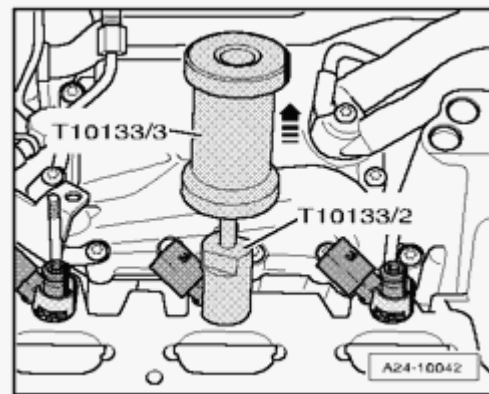


Fig. 61: Guiding Puller T10133/2 Into Groove On Fuel Injector And Carefully Drive Fuel Injector Out

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Attach slide wrench T10133/3 with adapter T10133/2.
- Guide puller T10133/2 into groove on fuel injector and carefully drive fuel injector out.

NOTE:

- When setting the puller in place, the radial adjustment can be destroyed, because the retaining tabs break.

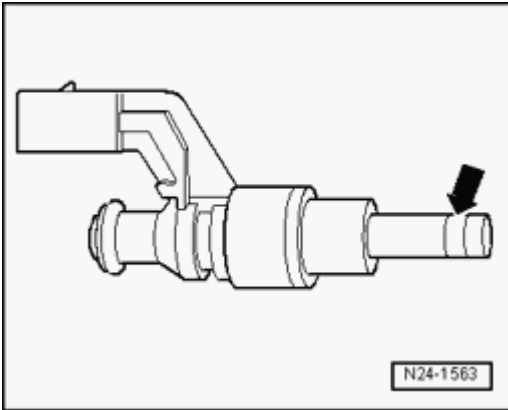


Fig. 62: Cleaning Fuel Injector In Area Of Sealing Ring
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Carefully remove old combustion chamber seal - **arrow** - , thereby cutting seal open with a knife or spreading seal open with a small screwdriver and pulling it forward and off.
- Make sure that the groove of the fuel injector does not become damaged. If groove is damage, the fuel injector must be replaced.

Installing

NOTE:

- Replace combustion chamber seal and O-ring.
- Replace spacer ring if damaged.
- Lightly moisten fuel injector O-rings with clean engine oil.
- Re-insert injector lines at same cylinder.

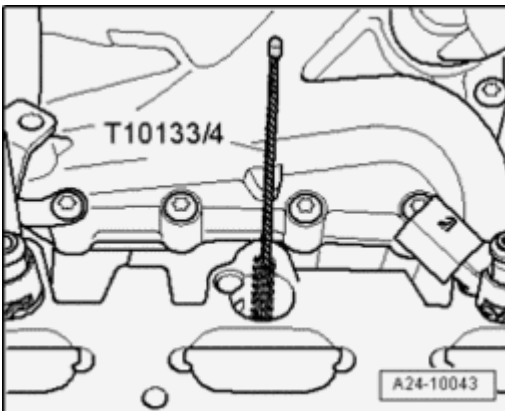


Fig. 63: Cleaning Bore In Cylinder Head With Nylon Cylinder Brush T10133/4
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Clean bore in cylinder head with nylon cylinder brush T10133/4.

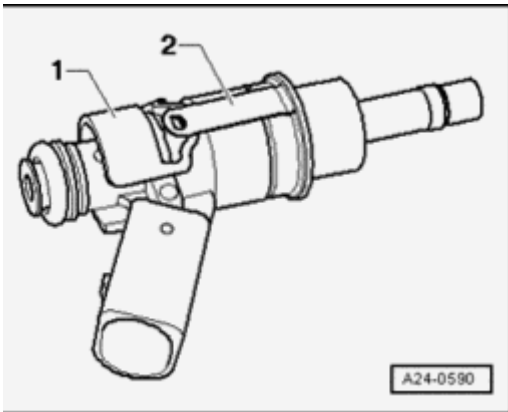


Fig. 64: Installing Fuel Injector Again With Support Ring And Clipping In Radial Compensation On Support Ring

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Clip radial adjustment - 1 - to support ring - 2 -.
- When re-installing a fuel injector, use a clean cloth to clean combustion residue from groove for combustion chamber seal and shaft of fuel injector.

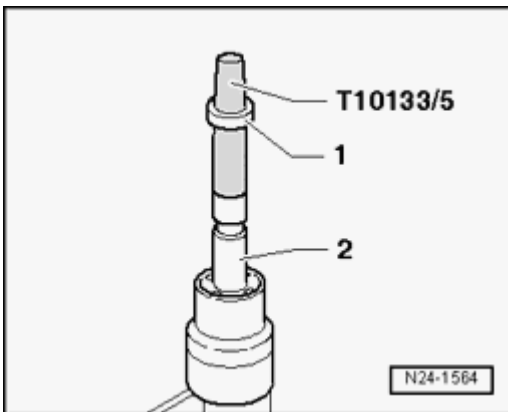


Fig. 65: Placing Assembly Cone T10133/5 With New Teflon Seal Onto Fuel Injector

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Place assembly cone T10133/5 with new combustion chamber seal - 1 - on fuel injector - 2 -.

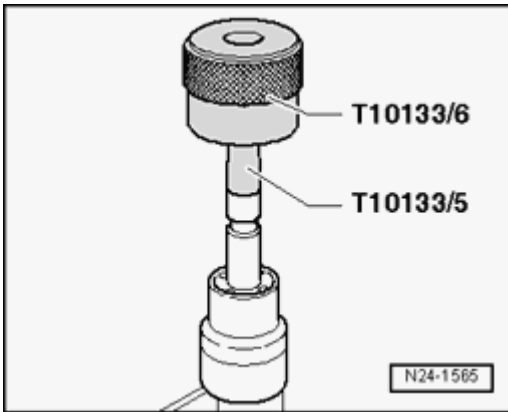


Fig. 66: Sliding Combustion Chamber Seal As Far Possible Onto Assembly Cone T10133/5 Using Assembly Sleeve T10133/6

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Slide combustion chamber seal as far possible onto assembly cone T10133/5 using assembly sleeve T10133/6.
- Turn assembly sleeve T10133/6 around and slide combustion chamber seal into groove.

NOTE:

- When pushing the combustion chamber seal onto fuel injector, the seal spreads open. Therefore after pushing it on, it must be tightened again in 2 steps, as follows.

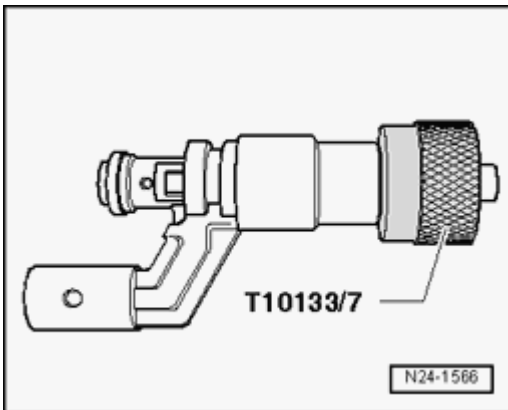


Fig. 67: Pressing Calibrating Sleeve T10133/7 On To Fuel Injector Until It Stops

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Press sizing sleeve T10133/7 with a slight turning motion (approx. 180°) onto fuel injector until it stops.
- Pull sizing sleeve T10133/7 off again, turning it in opposite direction.

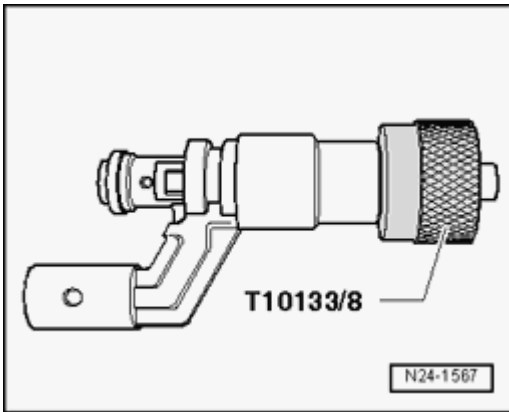


Fig. 68: Pressing Calibrating Sleeve T10133/8 On To Fuel Injector Until It Stops
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Press sizing sleeve T10133/8 with a slight turning motion (approx. 180°) onto fuel injector until it stops.
- Pull sizing sleeve T10133/8 off again, turning it in opposite direction.
- Moisten new O-ring 3 with clean engine oil before installing.

NOTE:

- The combustion chamber seal must not be oiled.

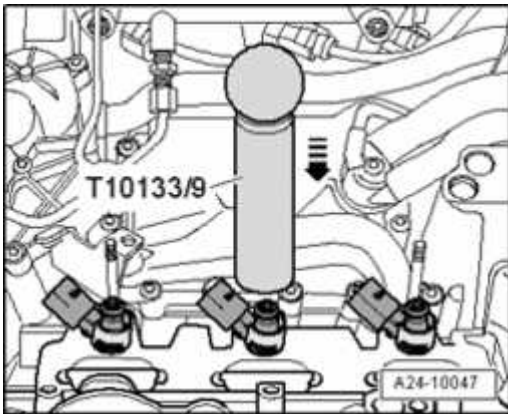


Fig. 69: Sliding Fuel Injector Into Bore Cylinder Head As Far As Stop Using Assembly Drift T10133/9
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Slide fuel injector into bore cylinder head as far as stop using assembly drift T10133/9.

NOTE:

- The fuel injector must not be difficult to install. If necessary, wait as the combustion chamber seal continues to pull itself together.
- Make sure fuel injectors are correctly positioned in cylinder head.
- The electrical connection of fuel injector must engage in intended recess of cylinder head.

Further installation is in reverse order of removal, note the following:

- Install intake manifold lower-part --> **Intake manifold lower-part with fuel rail, removing and installing.**
- Install intake manifold upper-part --> **Intake manifold upper-part, removing and installing.**

Fuel pressure and residual pressure before high pressure pump, checking

Special tools, testers and auxiliary items required

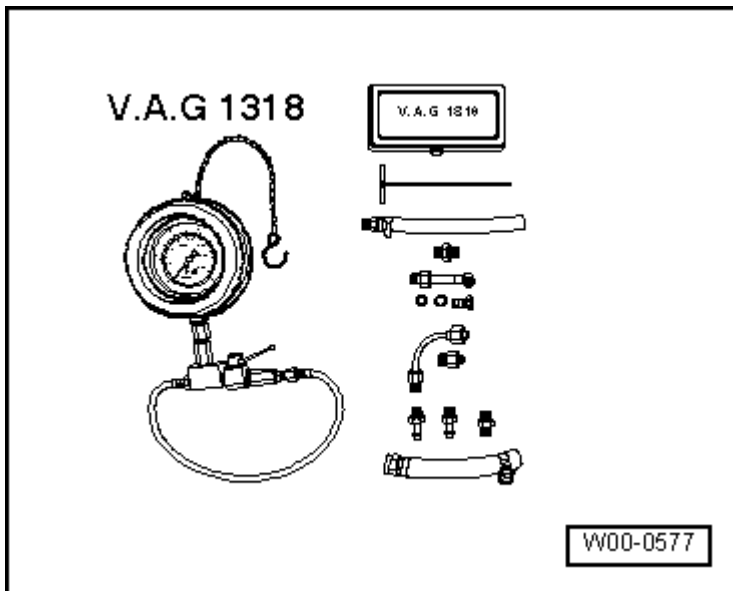


Fig. 70: Identifying Pressure Gauge V.A.G 1318
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pressure gauge K-Jetronic V.A.G 1318
- Pressure gauge adapter V.A.G 1318/10-12

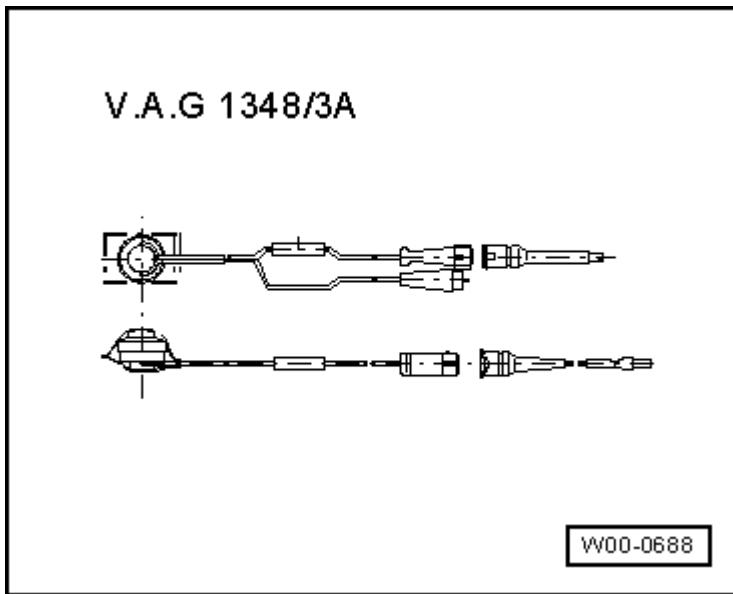


Fig. 71: Identifying Remote Control Connection V.A.G 1348/3A
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remote Control V.A.G 1348/3A with adapter cable V.A.G 1348/3-3
- Measuring container, fuel-resistant

Test conditions

- Battery voltage at least 12.5 V.
- Fuel filter OK.
- Fuel tank at least $\frac{1}{4}$ filled.
- Fuel Pump (FP) Control Module J538 OK; checking --> **20 - FUEL SUPPLY SYSTEM** .
- Ignition switched off.

Checking fuel pressure

Sedan with front wheel drive:

- Remove carpeting in luggage compartment.
- Fold forward right backrest of rear seat, if necessary.

Wagon with front wheel drive:

- Remove left 1/3 backrest -->
 - **72 - SEAT - FRAMES**
 - **72 - SEAT - FRAMES** for BODY INTERIOR - CABRIOLET

- Remove left side trim in luggage compartment and dirt tray -->
 - **70 - INTERIOR TRIM**
 - **70 - INTERIOR TRIM** for BODY INTERIOR - CABRIOLET

All with front wheel drive:

- Fold forward right backrest of rear seat, if necessary.
- Remove luggage compartment floor trim.

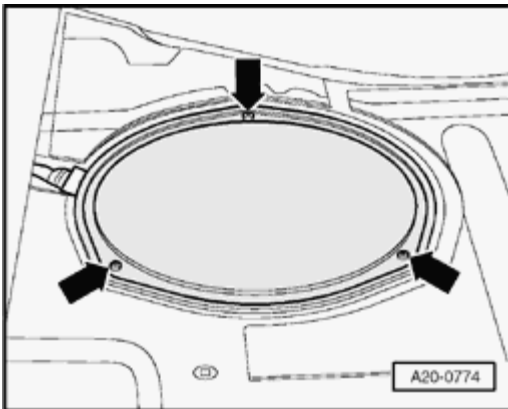


Fig. 72: Unbolting Cover

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove cover for locking flange - **arrows** -.

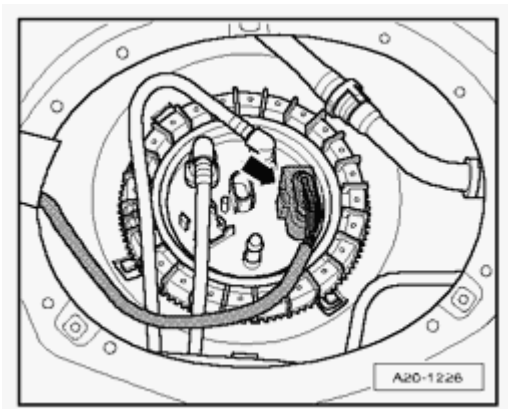


Fig. 73: Disconnecting Electrical Harness Connector At Locking Flange

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Carefully release and disconnect electrical harness connector - **arrow** - at locking flange.

Vehicles with all wheel drive:

- Remove rear seat bench -->
 - 72 - SEAT - FRAMES
 - 72 - SEAT - FRAMES for BODY INTERIOR - CABRIOLET

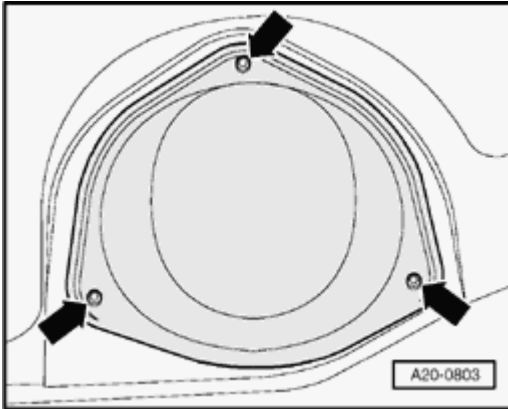


Fig. 74: Removing Cover Bolts For Locking Flange
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove cover for right locking flange - **arrows** -.

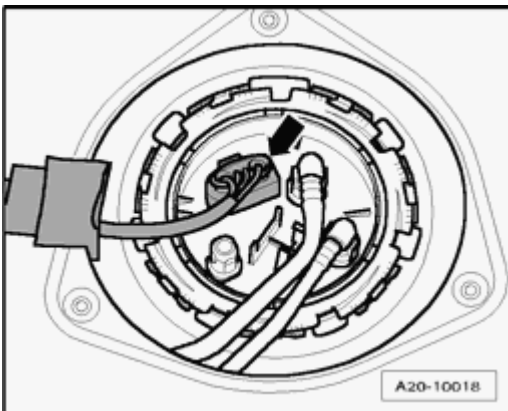


Fig. 75: Disconnecting Electrical Harness Connector At Right Locking Flange
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Carefully release and disconnect electrical harness connector - **arrow** - at locking flange.

All:

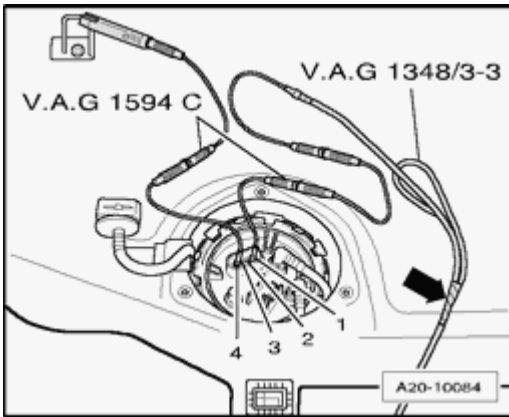


Fig. 76: Connecting Other End Of Hand Held Remote Starter (Jumper) To Vehicle Battery (+)
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect Remote Control V.A.G 1348/3A with adapter cable V.A.G 1348/3-3 with an adapter cable from Connector Test Set V.A.G 1594C at terminal - 1 -.
- Cover 2nd connector terminal of adapter cable V.A.G 1348/3-3 with insulating tape to prevent short circuit - **arrow** -.
- Route Remote Control V.A.G 1348/3A switch forward in engine compartment.
- Connect contact - 4 - to vehicle Ground (GND) using a self-made adapter cable.
- Connect alligator clip to battery "+".

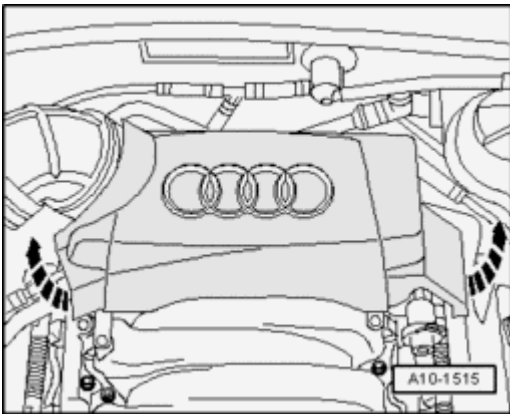


Fig. 77: Removing Rear Engine Cover
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pull rear engine cover off - **arrows** -.

CAUTION:

- Fuel system is under high pressure! Before opening high pressure components of the fuel injection system, pressure must be relieved to residual pressure --> Procedure that must be performed before opening the high-pressure fuel injection system. Pay close attention!
- Then wrap a clean rag around the connection and relieve residual

pressure by carefully loosening the connection.

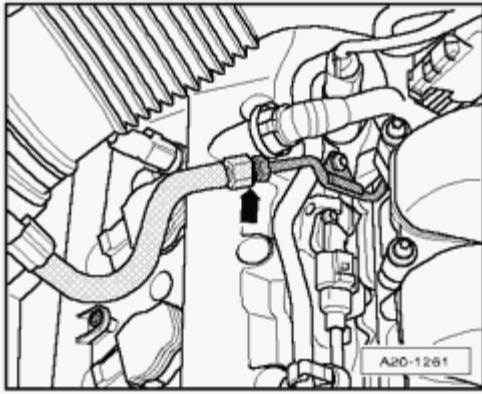


Fig. 78: Disconnecting Fuel Line

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect fuel line - **arrow** -.

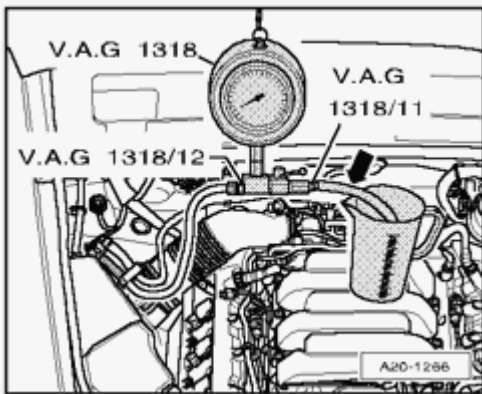


Fig. 79: Connecting Pressure Gauge V.A.G 1318 To Fuel Line Using Adapter V.A.G 1318/11 And V.A.G 1318/12

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Connect Fuel Inj. Pressure Gauge-CIS V.A.G 1318 with Adapter V.A.G 1318/11 and V.A.G 1318/12 in fuel line.
- Connect assisting hose - **arrow** - to pressure gauge and hold it in a measuring container.
- Open shut-off valve of pressure gauge. The lever points in direction of flow.
- Bleed fuel system, by briefly pressing remote control.

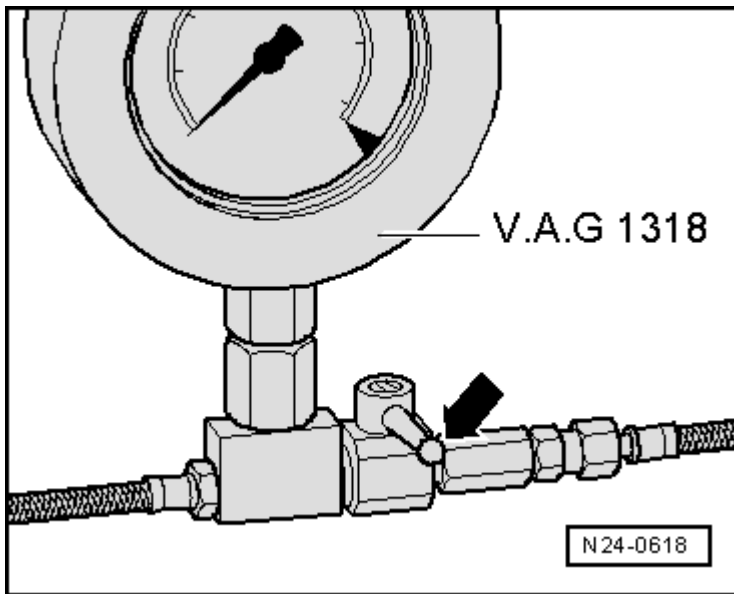


Fig. 80: Locating V.A.G 1318 Shut-Off Tap
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Close shut-off valve of pressure gauge. Lever stands perpendicular to direction of flow - **arrow** -.
- Hold switch of remote control until no more pressure increase is observed on fuel pressure gauge.
- Specified value: approx. 6 bar positive pressure

If specification is not obtained:

- Check delivery quantity of Fuel Pump (FP) --> **20 - FUEL SUPPLY SYSTEM** .

Checking residual pressure

- Check for leaks and for residual pressure by observing pressure loss on pressure gauge.
- After 10 minutes there must be a residual pressure of at least 3.75 bar.

The holding pressure drops below 3.75 bar:

- Check connection between fuel pressure gauge and fuel line for leaks.
- Check pressure gauge for leaks.
- Check fuel lines and their connections for leaks.
- Replace fuel filter with integrated fuel pressure regulator --> **20 - FUEL SUPPLY SYSTEM** .
- Replace fuel pump --> **20 - FUEL SUPPLY SYSTEM** .

Assembly is in reverse order of removal, note the following:

NOTE:

- Before disconnecting pressure gauge, release pressure by opening shut-off valve. Hold a container in front of connection for this.

Torque specifications

Component	Nm
Fuel line to fuel rail	28

High pressure pump, removing and installing

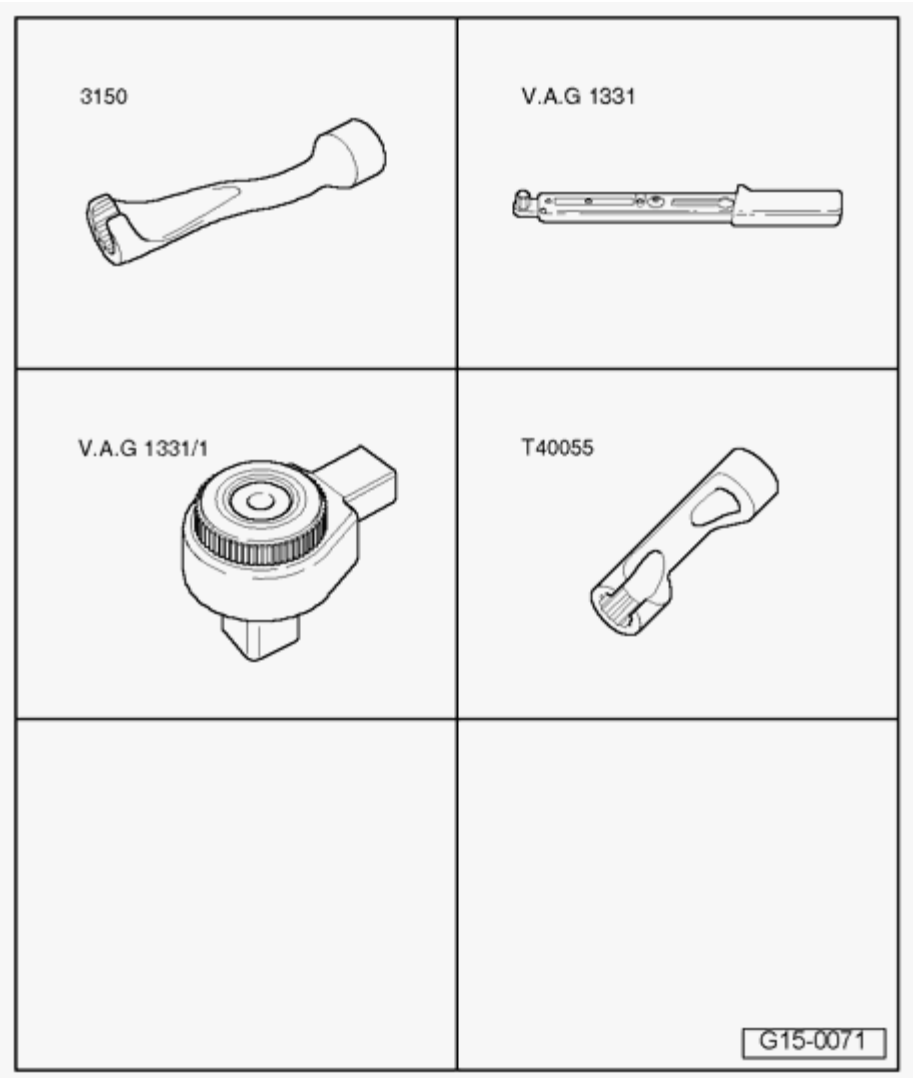


Fig. 81: Identifying Special Tools - High Pressure Pump, Removing And Installing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Special tools, testers and auxiliary items required

• Socket 14 mm 3150	
12:28:42 AM	Page 59

- Torque wrench V.A.G 1331
- Ratchet V.A.G 1331/1
- Socket T40055

Removing

CAUTION:

- Fuel system is under high pressure! Before opening high pressure components of the fuel injection system, pressure must be relieved to residual pressure --> Procedure that must be performed before opening the high-pressure fuel injection system. Pay close attention!
 - Then wrap a clean rag around the connection and relieve residual pressure by carefully loosening the connection.
- Drain coolant --> 19 - ENGINE - COOLING SYSTEM .
 - Remove front coolant pipe --> 19 - ENGINE - COOLING SYSTEM .
 - Remove upper part of intake manifold --> Intake manifold upper-part, removing and installing.

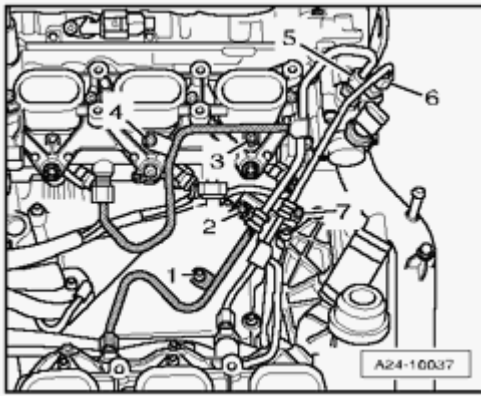


Fig. 82: Removing Bolts & Union Nuts

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **1 through 4** - and - **7** -.
- Loosen union nuts - **5** - and - **6** -.

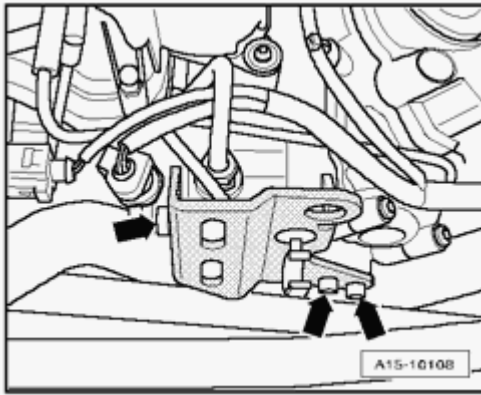


Fig. 83: Removing Large Lifting Eye

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- If equipped, remove large lifting eye - **arrows** -.

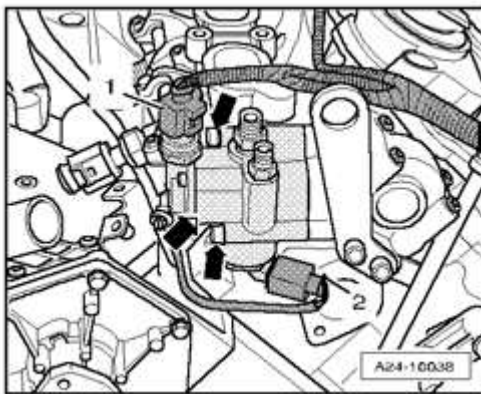


Fig. 84: Disconnecting Electrical Connector

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect electrical connector - **2** -.

NOTE:

- **Ignore - 1 -.**

- Remove bolts - **arrows** -.
- Carefully lift high pressure lines.

NOTE:

- **Do not change bend shape.**

- Remove high pressure pump with actuator.

Installing

Installation is in reverse order of removal, note the following:

NOTE:

- **Replace O-ring.**

- To set high pressure pump in place, lift high pressure lines only slightly.

NOTE:

- **High pressure line connections must not show any signs of damage.**
- **Do not change bend shape of high pressure lines.**

- Place high pressure pump with actuator into cylinder head and fasten.
- Hand-tighten union nuts for high-pressure lines.
- Make sure high-pressure lines are seated free of stress.

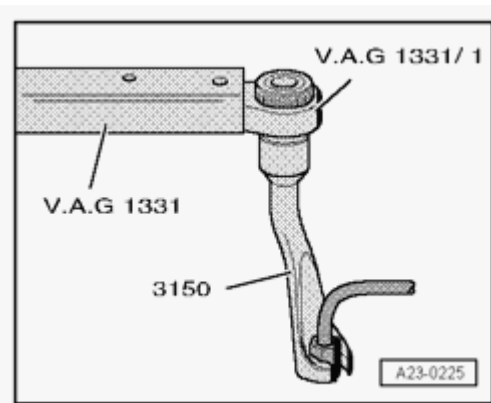


Fig. 85: Fastening High-Pressure Line (14 mm) At High Pressure Pump Use Torque Wrench V.A.G 1331 With Ratchet V.A.G 1331/1 And Socket 14 mm 3150

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- To fasten high-pressure line (14 mm) at high pressure pump use torque wrench V.A.G 1331 with ratchet V.A.G 1331/1 and socket 14 mm 3150.

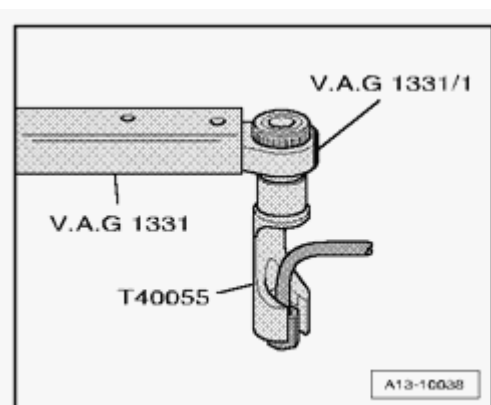


Fig. 86: Fastening High-Pressure Line At High Pressure Pump Using Torque Wrench V.A.G 1331 With Ratchet V.A.G 1331/1 And Socket 17 Mm T40055

Courtesy of VOLKSWAGEN UNITED STATES, INC.

2005 Audi A4 Quattro

ENGINE PERFORMANCE 3.2 V6 4V Fuel Injection Ignition, Engine Code(s): BKH

- To fasten high-pressure line (17 mm) to high pressure pump, use Torque Wrench V.A.G 1331 with Reversible Ratchet V.A.G 1331/1 and Socket T40055.
- Install intake manifold upper-part --> **Intake manifold upper-part, removing and installing.**
- Install front coolant pipe --> **19 - ENGINE - COOLING SYSTEM** .
- Fill with coolant --> **19 - ENGINE - COOLING SYSTEM** .

Torque specifications

Component	Nm
High pressure pump to cylinder head	10
High pressure lines to high pressure pump	25

Fuel system, bleeding

To prevent damage to catalytic converter the fuel system must be bled after repair work on fuel lines or on fuel filter.

Work procedure

- Start engine and let engine run a few minutes at average RPM and then turn off again.

NOTE:

- **At the beginning, engine may run roughly due to air in fuel supply system.**

- Check fuel supply system for leaks.
- Check DTC memory and, if necessary, erase.
- Then perform a road test with at least one acceleration at Wide Open Throttle (WOT), then fuel supply system must be checked again for leaks.
- Check DTC memory and, if necessary, erase it. After DTC memory is erased, a readiness code must be generated for engine control module using operating mode "Guided Fault-Finding".

Wiring and components, checking with Test box V.A.G 1598/42

Special tools, testers and auxiliary items required

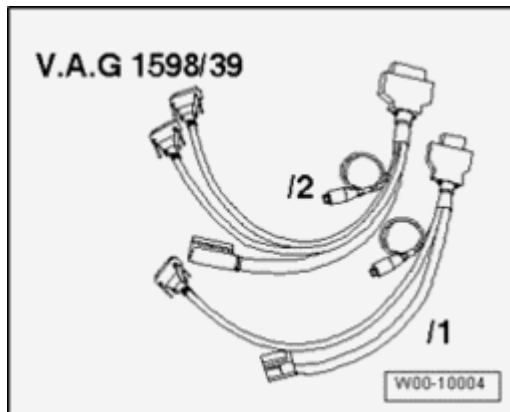


Fig. 87: V.A.G 1598/39-1/2 Adapter Cables

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Adapter cable V.A.G 1598/39

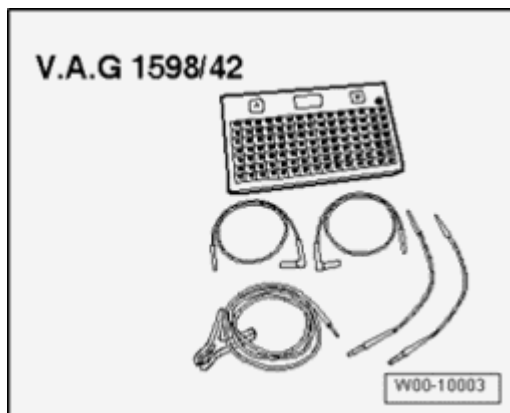


Fig. 88: V.A.G 1598/42 Test Box

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Test box V.A.G 1598/42

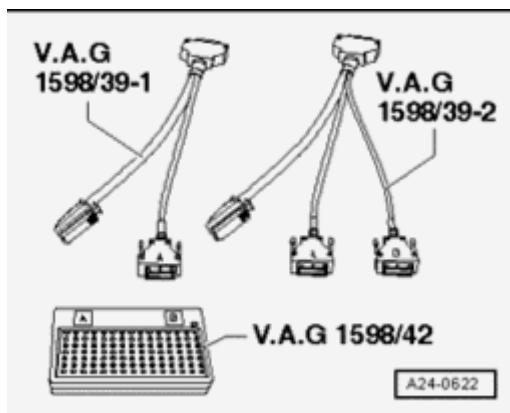


Fig. 89: Connecting Test Box V.A.G 1598/42 To Wiring Harness With Adapter Cable V.A.G 1598/39-1 Or Adapter Cable V.A.G 1598/39-2

Courtesy of VOLKSWAGEN UNITED STATES, INC.

NOTE:

- The test box V.A.G 1598/42 is designed with 105 terminals. It can be connected to the engine control module (ECM) via 2 different adapter cables.
- The engine control module (ECM) is connected to the vehicle electrical harness via a 60-pin connector and a 94-pin connector.
- For testing at the 60-pin connector, the adapter cable V.A.G 1598/39-1 is connected to the test box with connector "A". Components of the 60-pin harness connection --> Electrical Wiring Diagrams, Troubleshooting and Component Locations.
- For testing at the 94-pin connector, the adapter cable V.A.G 1598/39-2 is connected to the test box with connectors "A" and "B". Components of the 94-pin harness connection --> Electrical Wiring Diagrams, Troubleshooting and Component Locations.
- The test box V.A.G 1598/42 is designed so that it can be connected simultaneously to the engine control module harness and the engine control module itself. This is advantageous because electronic engine control remains fully functional (e.g. measurement of signals with engine running) when the test box is attached.
- The procedure will indicate whether the engine control module is to remain connected to the test box or not.
- To connect measuring instruments (e.g. Voltage Tester V.A.G 1527B , Multimeter V.A.G 1526C etc.) always use Connector Test Set V.A.G 1594C.

The engine control module (ECM) must be removed to disconnect the ECM harness connectors --> Engine Control Module (ECM), removing and installing.

CAUTION: To avoid damaging electronic components, set measuring range before connecting test leads and observe all test requirements.

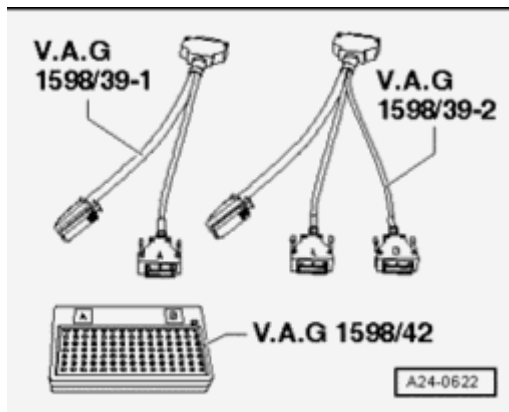


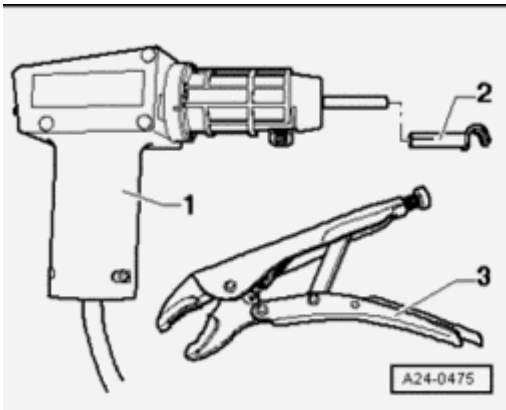
Fig. 90: Connecting Test Box V.A.G 1598/42 To Wiring Harness With Adapter Cable V.A.G 1598/39-1

Or Adapter Cable V.A.G 1598/39-2**Courtesy of VOLKSWAGEN UNITED STATES, INC.**

- Connect Test Box V.A.G 1598/42 to wiring harness with adapter lead V.A.G 1598/39-1 or adapter lead V.A.G 1598/39-2. Clamp test box Ground (GND) clip to battery negative terminal. The procedure will indicate whether engine control module is to be connected to test box or not.
- Perform test as described in corresponding repair procedure.
- After completing test, install engine control module (ECM) --> **Engine Control Module (ECM), removing and installing.**

After installing Engine Control Module (ECM), the following work steps must be performed:

- Check DTC memory and, if necessary, erase it. After DTC memory is erased, a readiness code must be generated for engine control module using operating mode "Guided Fault-Finding".

Engine Control Module (ECM), removing and installing**Special tools, testers and auxiliary items required****Fig. 91: Heat Gun, Adapter Nozzle And Pliers****Courtesy of VOLKSWAGEN UNITED STATES, INC.**

- Heat Gun 220 V/50 Hz VAS 1978/14 - **1** - with nozzle attachment - **2** - from Wiring Harness Repair kit VAS 1978A
- Locking pliers - **3** - (commercially available)

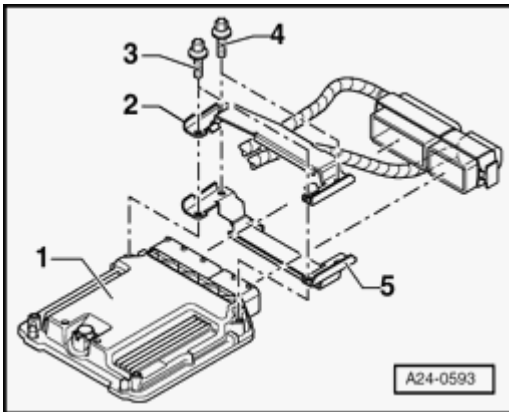


Fig. 92: Removing Protective Housing From Engine Control Module (ECM) J623
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

NOTE:

- The Engine Control Module (ECM) - 1 - is bolted to a protective housing - 5 -. To make removal of shear bolts - 4 - for retaining tabs - 2 - more difficult, the threads are coated with locking compound.
- To disconnect the connectors from the engine control module (ECM) (e.g. to connect the test box or to replace the ECM), the protective housing must be removed.

Removing

- If engine control module (ECM) was replaced, select diagnostic object "Replacing engine control module (ECM)" in "Guided Fault-Finding".
- Turn ignition and remove ignition key.

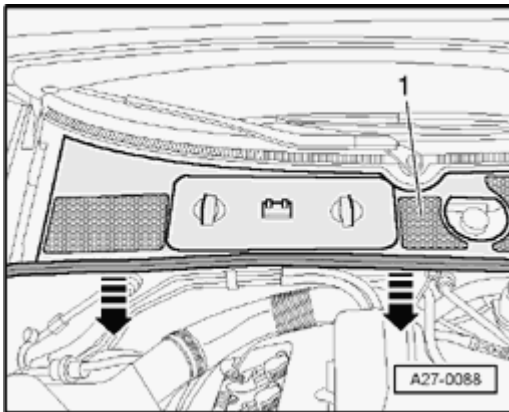


Fig. 93: Identifying Plenum Chamber Cover & Removing Rubber Seal
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove rubber seal of plenum chamber cover in direction of - **arrow** -.
- Remove plenum chamber cover - 1 - toward front.

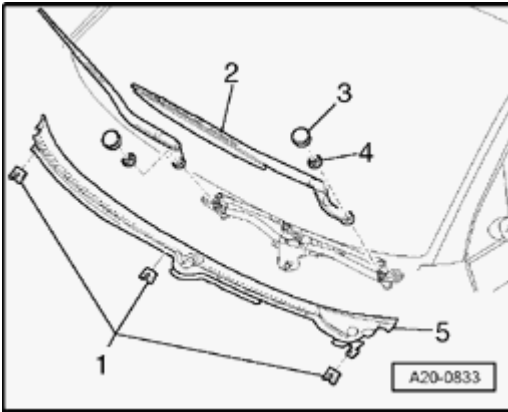


Fig. 94: Removing Securing Clips And Cowl

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Pry off both covers - 3 - using a screwdriver.
- Loosen hex-nuts - 4 - by several turns.
- Loosen wiper arms - 2 - from wiper axle by tilting slightly.
- Remove nuts completely and remove wiper arms.

NOTE:

- If wiper arm cannot be removed in this way, use a standard puller.

- Disconnect securing clips - 1 - and remove cowl grille - 5 -.

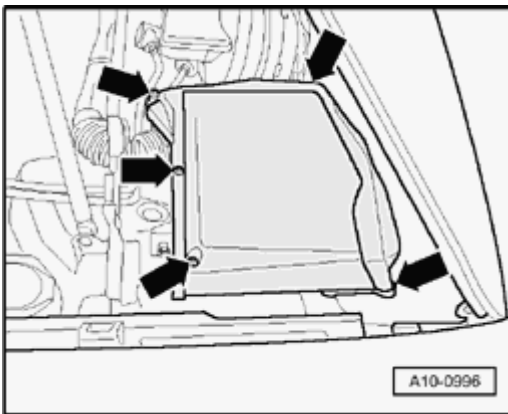


Fig. 95: Removing Screws And Cover From E-Box In Plenum Chamber

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove cover for E-Box in plenum chamber - **arrows** -.

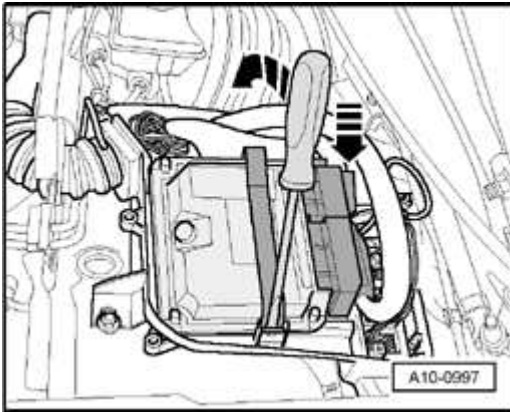


Fig. 96: Using Screwdriver To Remove Retainer Bar And Engine Control Module (ECM) J623
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Using a screwdriver, carefully pry off mounting bracket - **arrows** - and remove Engine Control Module (ECM) from E-Box.

NOTE:

- Engine Control Module (ECM) remains connected at wiring harness.

CAUTION: To avoid damage (burning) of wire connections and harness connectors, insulation and control modules, the following work steps must be adhered to exactly! Observe operating instructions for heat gun.

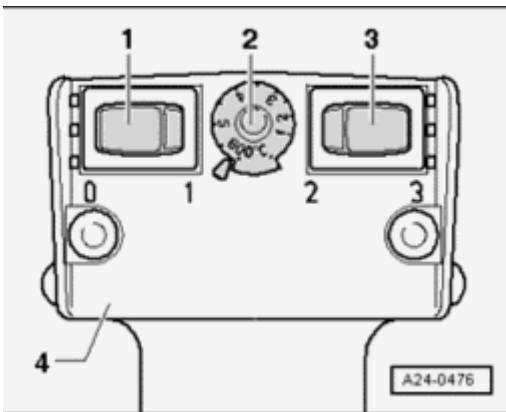


Fig. 97: Performing Adjustments On Hot Air Gun
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Set adjustment on heat gun as shown in illustration, with temperature potentiometer - **2** - set to maximum heat and two-stage air flow switch - **3** - set to level "3".

NOTE:

- Next, the threads of the protective housing in which the shear bolts are threaded is heated using the heat gun. This step decreases the locking effect of the locking compound on the shear bolt thread, thus allowing the shear bolts to be removed more easily.

CAUTION: By heating the shear bolts, parts of the protective housing will become extremely hot. Do not burn yourself on this! Ensure only the shear bolts are heated and not any of the surrounding parts. Possibly cover these parts.

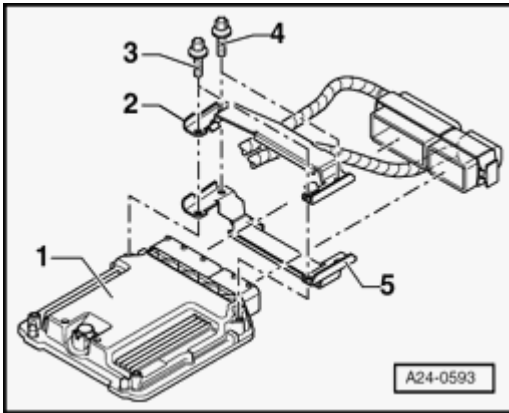


Fig. 98: Removing Protective Housing From Engine Control Module (ECM) J623
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Perform the following steps in order on both shear bolts - 4 -.

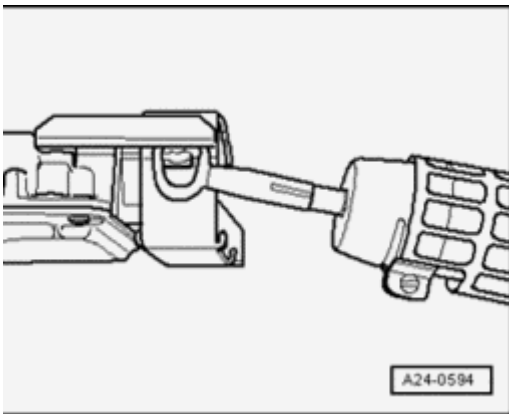


Fig. 99: Using Heat Gun To Direct Heat Gun Nozzle At Shear Bolt Of Retaining Tab
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Direct heat gun nozzle at protective housing shear bolts.
- Switch heat gun on and heat bolt for approx. 20 to 25 seconds.

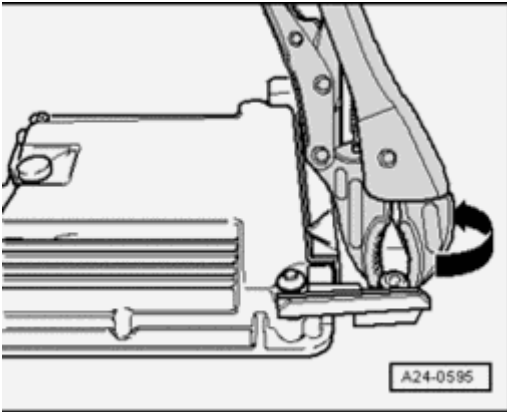


Fig. 100: Using Locking Pliers To Remove Shear Bolt
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove shear bolts with locking pliers - **arrow** -.

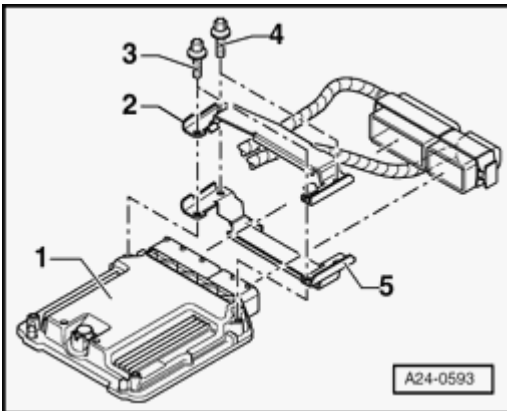


Fig. 101: Removing Protective Housing From Engine Control Module (ECM) J623
Courtesy of VOLKSWAGEN UNITED STATES, INC.

NOTE:

- The threads of both shear bolts - 3 - that are installed in the ECM are not coated with a locking compound. The threads in the ECM housing must not be heated and do not require to be heated (unintentional heating of the ECM).

- Remove both shear bolts - 3 -.
- Separate retaining tab - 2 - of control module connector.
- Release and disconnect connectors from engine control module (ECM).

NOTE:

- Adaptation values are erased when connectors are disconnected from Engine Control Module (ECM), DTC memory content remains intact.

Installing

Installation is in reverse order of removal, note the following:

- The ECM must be equipped with protective housing again.
- Clean locking compound residue from shear bolt threaded holes. Cleaning can be performed with a thread cutter (tap).
- Use new shear bolts.

After installing a new Engine Control Module (ECM), the following work steps must be performed:

- Activate engine control module (ECM) in "Guided Fault-Finding" under "Replacing engine control module (ECM)".

Oxygen sensor before catalytic converter, bank 1 (right side), removing and installing

Special tools, testers and auxiliary items required

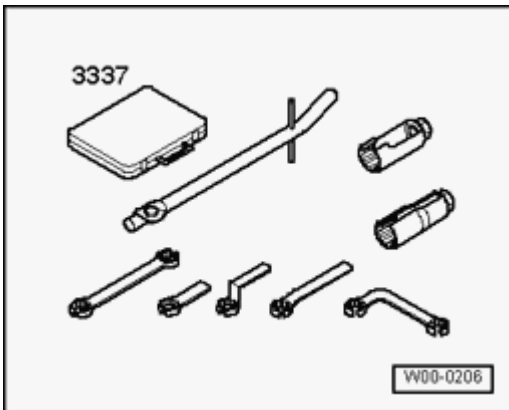


Fig. 102: Identifying Ring Spanner 7-Piece Set 3337
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Ring spanner 7-piece set for oxygen sensor 3337

Removing

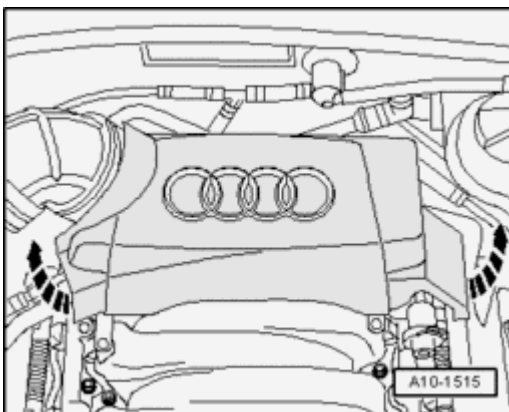


Fig. 103: Removing Rear Engine Cover

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove rear engine cover - **arrows** -.

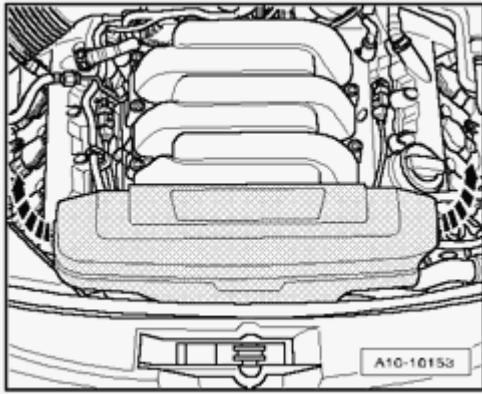


Fig. 104: Identifying Front Engine Cover

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove front engine cover - **arrows** -.

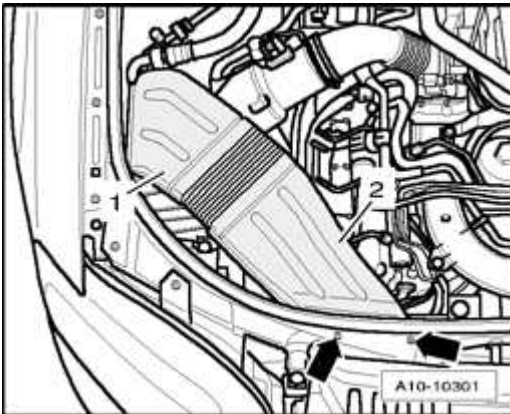


Fig. 105: Identifying Bolts & Air Duct

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **arrows** -.
- Remove air duct - **1** - and - **2** -.

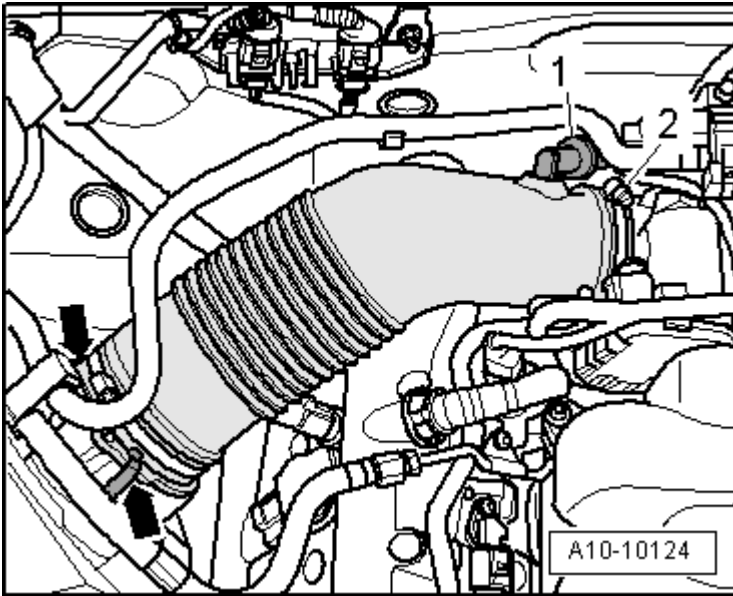


Fig. 106: Disconnecting Check Valve From Connection At Air Duct Hose
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect check valve - **1** - from air duct hose.
- Remove air duct hose, thereby loosening hose clamp - **2** - and opening clips - **arrows** -.

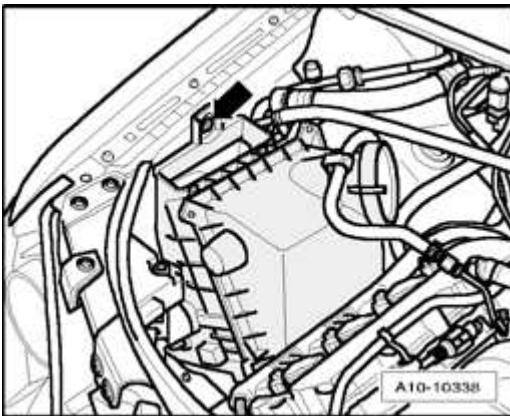


Fig. 107: Removing Upper Part Of Air Filter Housing
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove pin from spreader clips - **arrow** -.
- Remove air filter housing.

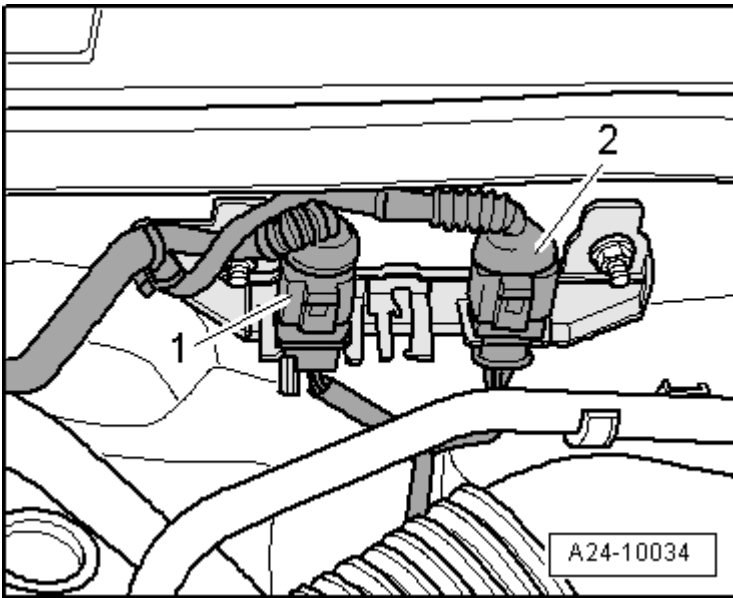


Fig. 108: Disconnecting Electrical Harness Connector For Heated Oxygen Sensor (HO2S) G39
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect electrical harness connector - 1 - for Heated Oxygen Sensor (HO2S) G39 and free up wire.

NOTE:

- Ignore - 2 -.

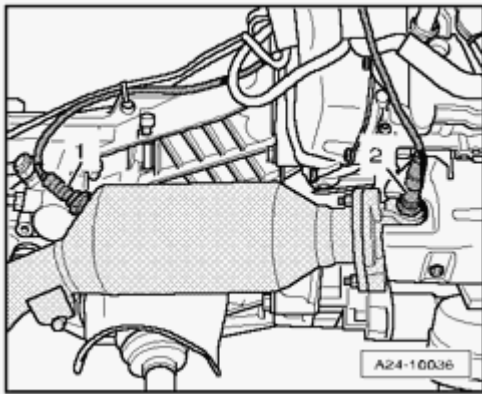


Fig. 109: Removing Oxygen Sensor Using Ring Spanner Set 3337
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove oxygen sensor - 2 - using ring spanner set 3337.

NOTE:

- To improve clarity, the engine is removed.

Installing

Installation is in reverse order of removal, note the following:

NOTE:

- New oxygen sensors are coated with assembly paste; the paste must not get into slots of oxygen sensor body.
- When reinstalling the previously used oxygen sensor, coat thread with hot bolt paste . Paste must not get on to slits of sensor body.
- Electrical wire of oxygen sensor must always be secured in the same position when installing so that contact with the exhaust pipe is avoided.

Torque specifications

Component	Nm
Oxygen sensor in front exhaust pipe	55

Oxygen sensor before catalytic converter, bank 2 (left side), removing and installing

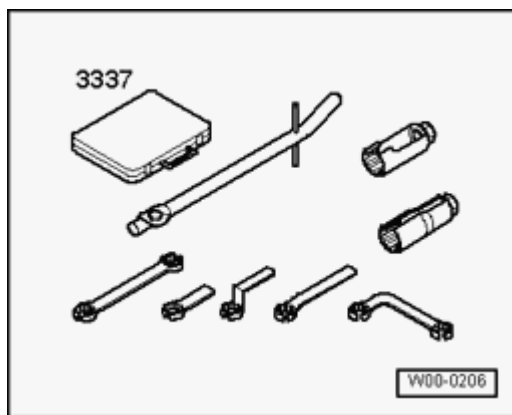
Special tools, testers and auxiliary items required

Fig. 110: Identifying Ring Spanner 7-Piece Set 3337
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Ring spanner 7-piece set for oxygen sensor 3337

Removing**NOTE:**

- All cable ties opened or cut during engine removal must be reinstalled at the same locations during installation.

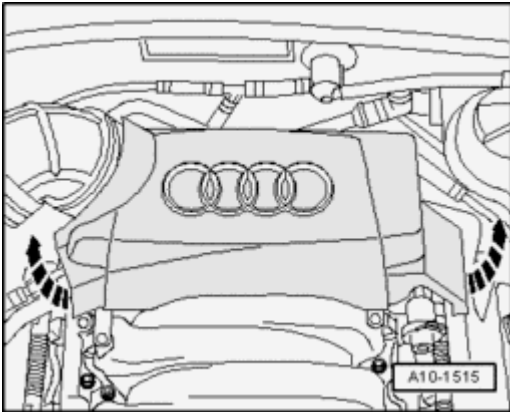


Fig. 111: Removing Rear Engine Cover

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove rear engine cover - **arrows** -.

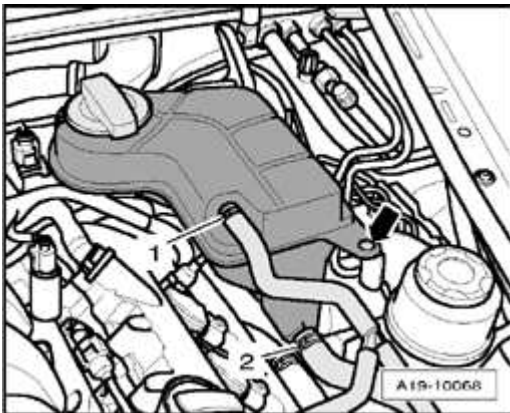


Fig. 112: Removing Coolant Hoses At Coolant Expansion Tank

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove coolant expansion tank - **arrow** -.
- Disconnect electrical connection from Engine Coolant Level (ECL) Warning Switch F66 at bottom of coolant reservoir and set aside coolant reservoir with coolant hoses - **1** - and - **2** - connected.

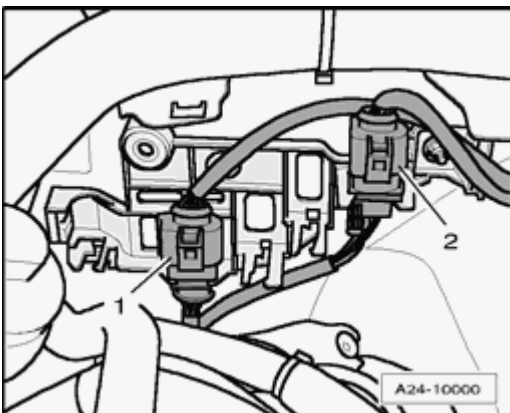


Fig. 113: Disconnecting Electrical Harness Connector For Heated Oxygen Sensor (HO2S) 2 G108
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect electrical harness connector - 2 - for Heated Oxygen Sensor (HO2S) 2 G108 and free up wire.

NOTE:

- Ignore - 1 -.

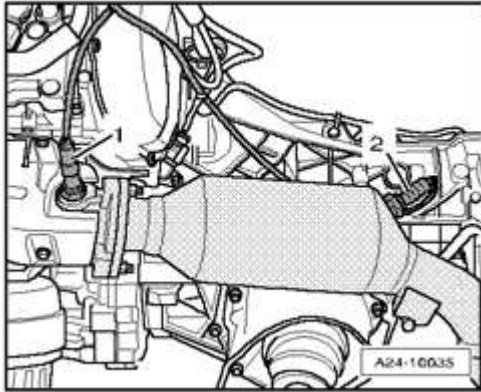


Fig. 114: Removing Oxygen Sensor Using Ring Spanner Set 3337
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove oxygen sensor - 1 - using ring spanner set 3337.

NOTE:

- To improve clarity, the engine is removed.

Installing

Installation is in reverse order of removal, note the following:

NOTE:

- New oxygen sensors are coated with assembly paste; the paste must not get into slots of oxygen sensor body.
- When reinstalling the previously used oxygen sensor, coat thread with hot bolt paste . Paste must not get on to slits of sensor body.
- During installation, all cable ties must be re-installed at the same location.
- Wires of oxygen sensors must always be secured in the same position when installing so that contact with the exhaust pipe is avoided.

Torque specifications

Component	Nm
Oxygen sensor in front exhaust pipe	55

Oxygen sensor behind catalytic converter, bank 1 (right side), removing and installing

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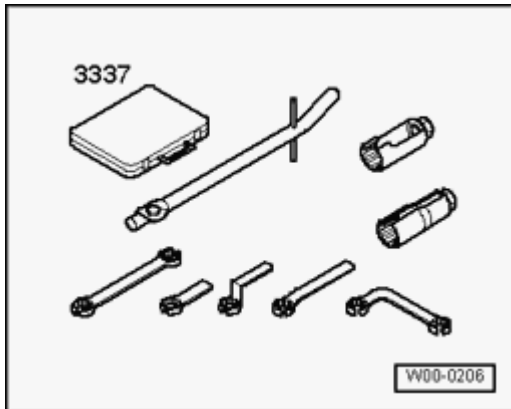
Special tools, testers and auxiliary items required

Fig. 115: Identifying Ring Spanner 7-Piece Set 3337
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Ring spanner 7-piece set for oxygen sensor 3337

Removing**NOTE:**

- All cable ties which are opened or cut open when removing, must be replaced in the same position when installing.

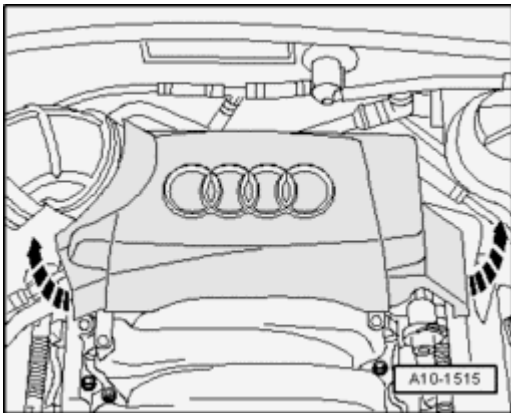


Fig. 116: Removing Rear Engine Cover
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove rear engine cover - **arrows** -.

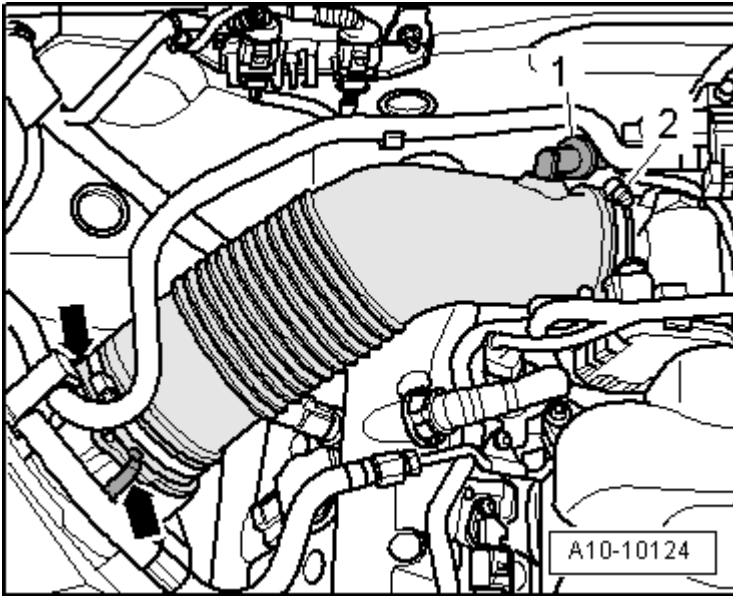


Fig. 117: Disconnecting Check Valve From Connection At Air Duct Hose
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect check valve - 1 - from connection at air duct hose.
- Remove air duct hose, thereby loosening hose clamp - 2 - and opening clips - arrows -.

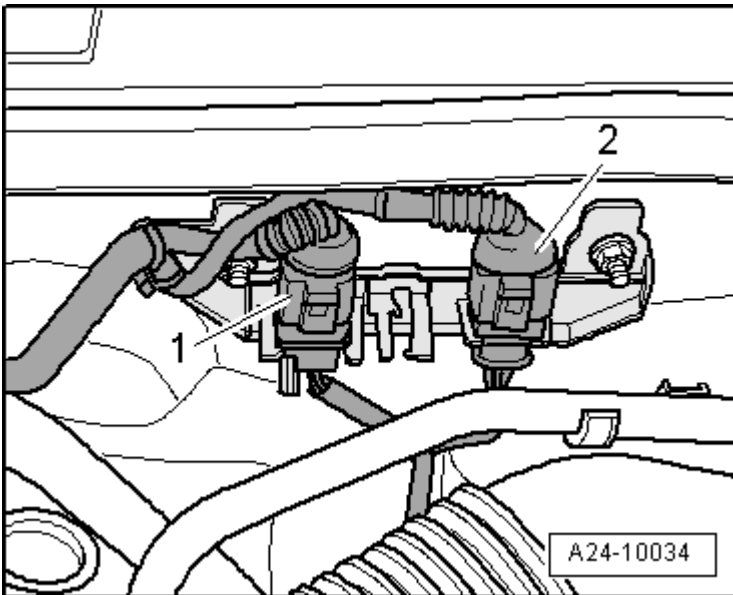


Fig. 118: Disconnecting Electrical Harness Connector For Heated Oxygen Sensor (HO2S) G39
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect electrical harness connector - 2 - for Oxygen Sensor (O2S) Behind Three Way Catalytic Converter (TWC) G130 and free up the wiring.

NOTE:

- Ignore - 1 -.

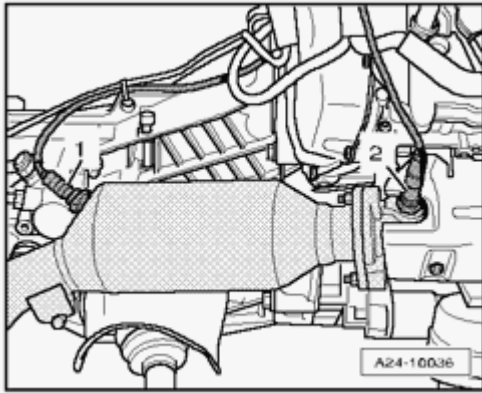


Fig. 119: Removing Oxygen Sensor Using Ring Spanner Set 3337
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove oxygen sensor - 1 - using ring spanner set 3337.

NOTE: • To improve clarity, the engine is removed.

Installing

Installation is in reverse order of removal, note the following:

- NOTE:**
- Replace O-ring.
 - New oxygen sensors are coated with assembly paste; the paste must not get into slots of oxygen sensor body.
 - When reinstalling the previously used oxygen sensor, coat thread with hot bolt paste . Paste must not get on to slits of sensor body.
 - During installation, all cable ties must be re-installed at the same location.
 - Electrical wire of oxygen sensor must always be secured in the same position when installing so that contact with the exhaust pipe is avoided.

Torque specifications

Component	Nm
Oxygen sensor in front exhaust pipe	55

Oxygen sensor behind catalytic converter, bank 2 (left side), removing and installing

Special tools, testers and auxiliary items required

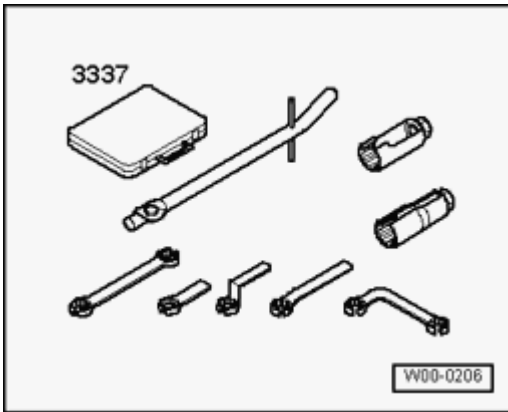


Fig. 120: Identifying Ring Spanner 7-Piece Set 3337
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Ring spanner 7-piece set for oxygen sensor 3337

Removing

NOTE:

- All cable ties which are opened or cut open when removing, must be replaced in the same position when installing.

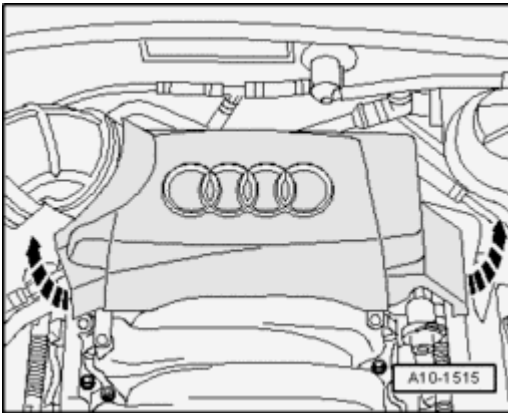


Fig. 121: Removing Rear Engine Cover
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove rear engine cover - **arrows** -.

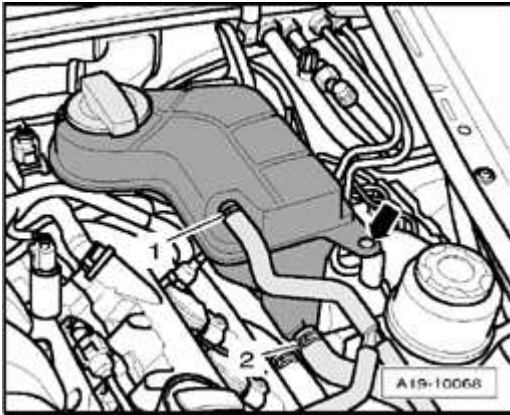


Fig. 122: Removing Coolant Hoses At Coolant Expansion Tank
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove coolant expansion tank - **arrow** -.
- Disconnect electrical connection from Engine Coolant Level (ECL) Warning Switch F66 at bottom of coolant reservoir and set aside coolant reservoir with coolant hoses - **1** - and - **2** - connected.

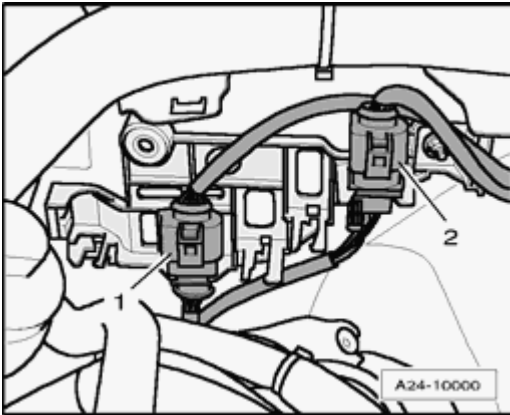


Fig. 123: Disconnecting Electrical Harness Connector For Heated Oxygen Sensor (HO2S) 2 G108
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect electrical harness connector - **1** - for Oxygen Sensor (O2S) 2 Behind Three Way Catalytic Converter (TWC) G131 and free up wiring.

NOTE:

- Ignore - **2** -.

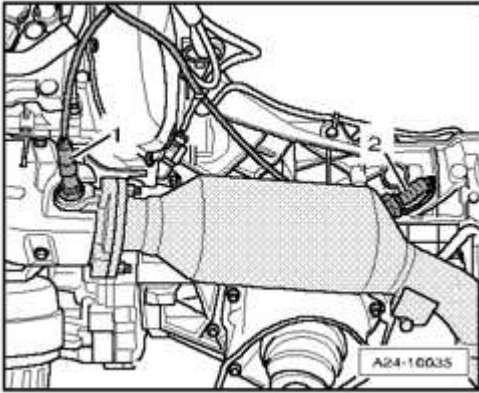


Fig. 124: Removing Oxygen Sensor Using Ring Spanner Set 3337
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove oxygen sensor - 2 - using ring spanner set 3337.

NOTE:

- To improve clarity, the engine is removed.

Installing

Installation is in reverse order of removal, note the following:

NOTE:

- Replace O-ring.
- New oxygen sensors are coated with assembly paste; the paste must not get into slots of oxygen sensor body.
- When reinstalling the previously used oxygen sensor, coat thread with hot bolt paste . Paste must not get on to slits of sensor body.
- During installation, all cable ties must be re-installed at the same location.
- Electrical wire of oxygen sensor must always be secured in the same position when installing so that contact with the exhaust pipe is avoided.

Torque specifications

Component	Nm
Oxygen sensor in front exhaust pipe	55

28 - IGNITION SYSTEM

GENERAL INFORMATION AND SAFETY MEASURES

Ignition system, general information

- For trouble-free operation of the electrical components a voltage of at least 12.5 V is necessary.
- It is possible that the control module will recognize a malfunction and store a DTC during some tests. Therefore after completing all checks and repairs the DTC memory must be checked and if necessary erased.
- If the engine only starts briefly and then turns off again after troubleshooting, repair or checking of the components, it may be that the immobilizer is blocking the Engine Control Module (ECM). DTC memory must then be checked and if necessary, control module must be adapted.

Safety precautions

If special testing equipment is required during road test, note the following:

- CAUTION:**
- Test and measuring equipment must always be secured to the rear seat and be operated from there by a second person.
 - If test and measuring instruments are operated from the front passengers seat and the vehicle is involved in an accident, there is a possibility that the person sitting in this seat may receive serious injuries when the airbag is triggered.
 - Do not touch or disconnect wires of ignition system when engine is running or turning at starting RPM.
 - Always switch ignition off before disconnecting or reconnecting wires for the injection and ignition system, including high voltage wiring and test leads.

CAUTION: To reduce the risk of damage to the fuel injection and ignition system, always observe the following:

- If the engine is to be cranked at starting RPM without starting (e.g. during compression test), disconnect electrical connectors on ignition coils and on fuel injectors. After performing work, check and erase DTC memory.
- Clean engine only with the ignition switched off.
- The battery must only be disconnected and connected with the ignition switched off, since the Engine Control Module (ECM) can otherwise be damaged.
- Observe safety precautions when disconnecting the battery -->
 - 27 BATTERY, STARTER, GENERATOR, CRUISE CONTROL

- **27 BATTERY, STARTER, GENERATOR, CRUISE CONTROL for ELECTRICAL EQUIPMENT, CABRIOLET**

IGNITION, SERVICING

Technical data

Engine code		BKH (3.2 l/4V/188 kW engine)
Engine idle speed		650 to 750 RPM (not adjustable)
Ignition timing		Not adjustable, regulated by control module
Ignition system		Single coil ignition system with 6 ignition coils (power output stages integrated) that are inserted directly on spark plugs.
Spark plugs		Designations Data sheets for exhaust emission test Torque specification
Ignition sequence		1-5-3-6-2-4

Ignition coils, removing and installing

Special tools, testers and auxiliary items required

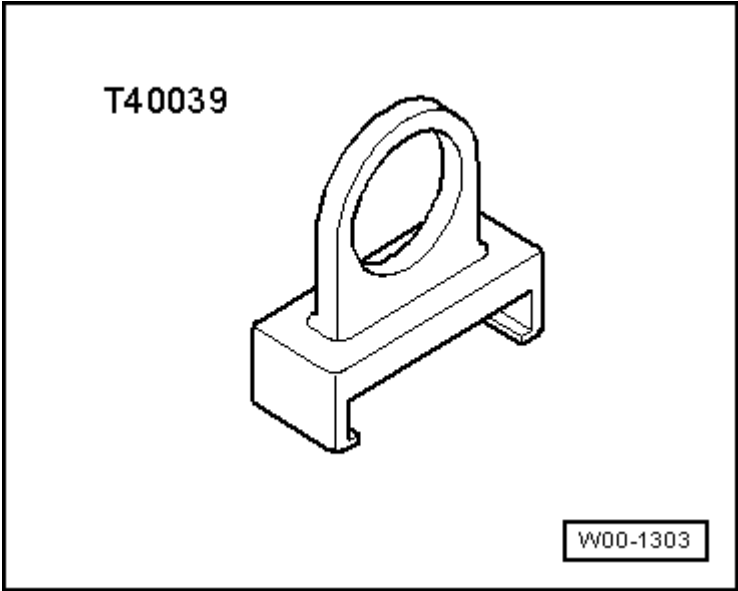


Fig. 125: Identifying Ignition Coil Puller T40039
 Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Puller T40039

Removing

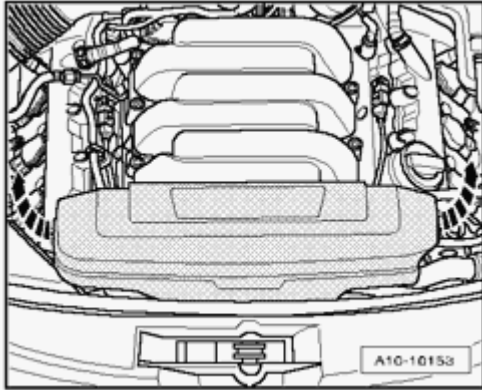


Fig. 126: Identifying Front Engine Cover

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove front engine cover - **arrows** -.

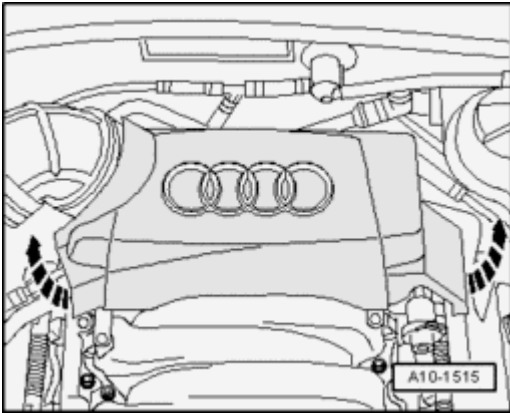


Fig. 127: Removing Rear Engine Cover

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove rear engine cover - **arrows** -.

Cylinder bank 1 (right):

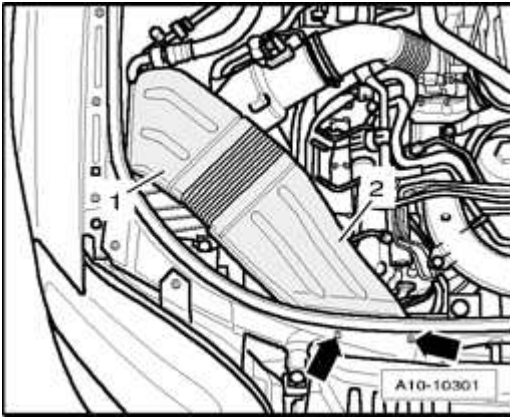


Fig. 128: Identifying Bolts & Air Duct

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolts - **arrows** -.
- Remove air duct - **1** - and - **2** -.

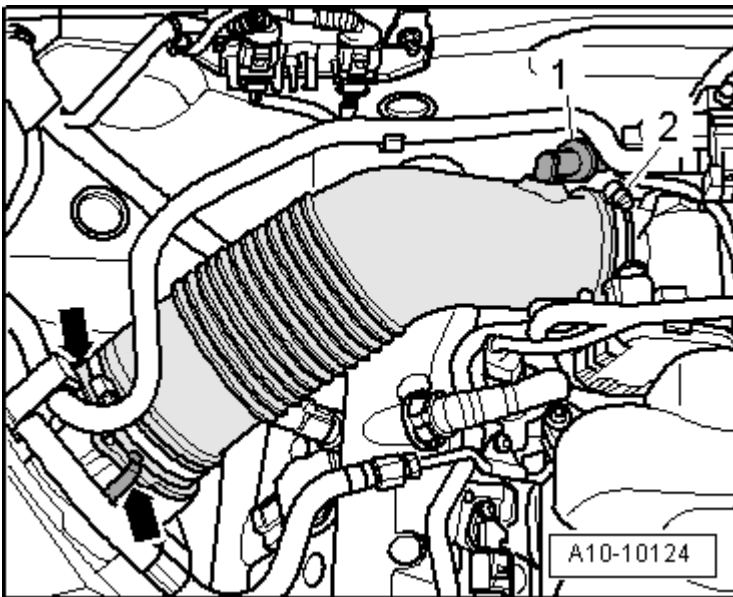


Fig. 129: Disconnecting Check Valve From Connection At Air Duct Hose

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect check valve - **1** - from air duct hose.
- Remove air duct hose, thereby loosening hose clamp - **2** - and opening clips - **arrows** -.

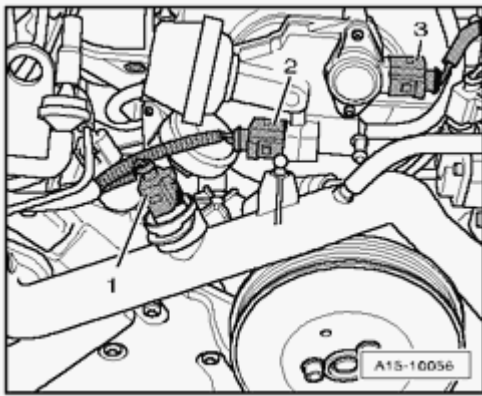


Fig. 130: Disconnecting Electrical Connectors At Engine Coolant Temperature (ECT) Sensor G62 And Intake Manifold Flap Change-Over Valve N239

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect electrical connectors at Engine Coolant Temperature (ECT) Sensor G62 - **1** - and Intake Manifold Flap Change-over Valve N239 - **2** -.

NOTE:

- Ignore - **3** -.

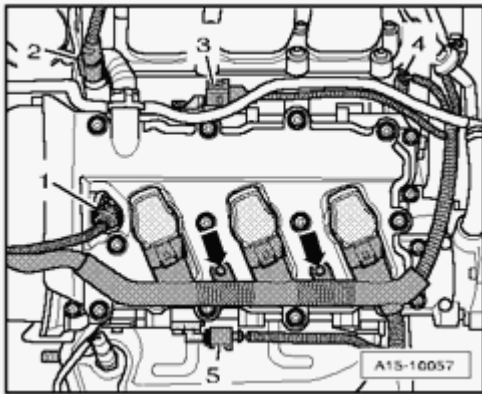


Fig. 131: Disconnecting Electrical Harness Connectors

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect electrical harness connectors.

1. Camshaft Adjustment Valve 1 (exhaust) N318
2. Camshaft Adjustment Valve 1 N205
3. Camshaft Position (CMP) sensor G40
4. Intake Manifold Runner Position Sensor G336
5. Camshaft position (CMP) sensor 3 G300

- Remove bolts - **arrows** - and disconnect electrical connections at ignition coils.

- Set electrical wiring harness aside.

Cylinder bank 2 (left):



Fig. 132: Removing Coolant Hoses At Coolant Expansion Tank
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove coolant expansion tank - **arrow** -.
- Disconnect electrical connection from Engine Coolant Level (ECL) Warning Switch F66 at bottom of coolant reservoir and set aside coolant reservoir with coolant hoses - **1** - and - **2** - connected.

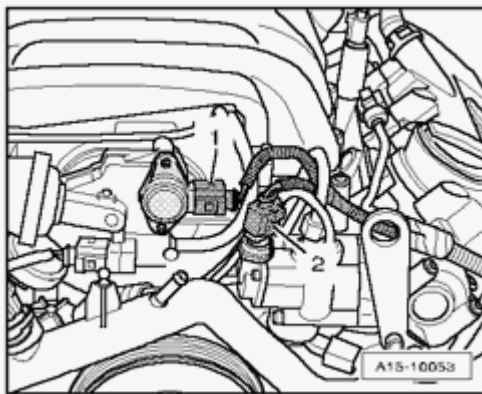


Fig. 133: Disconnecting Electrical Connectors On Intake Manifold Tuning (IMT) Valve Position Sensor G513
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect electrical connectors on Intake Manifold Tuning (IMT) Valve Position Sensor G513 - **1** -.

NOTE:

- Ignore - **2** -.

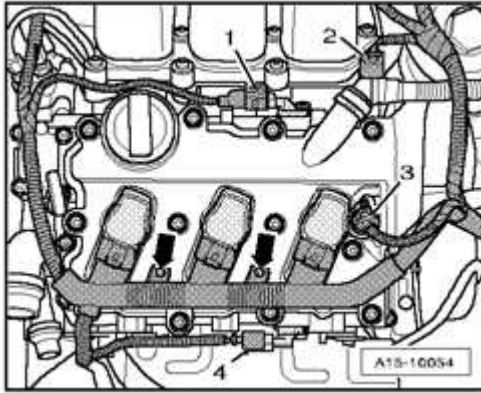


Fig. 134: Disconnecting Electrical Harness Connectors

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Disconnect electrical harness connectors.
- 1. Camshaft position (CMP) sensor 2 G163
- 2. Camshaft Adjustment Valve 2 N208
- 3. Camshaft Adjustment Valve 2 (exhaust) N319
- 4. Camshaft position (CMP) sensor 4 G301
- Remove bolts - **arrows** - and disconnect electrical connections at ignition coils.
- Set electrical wiring harness aside.

Continued for both sides:

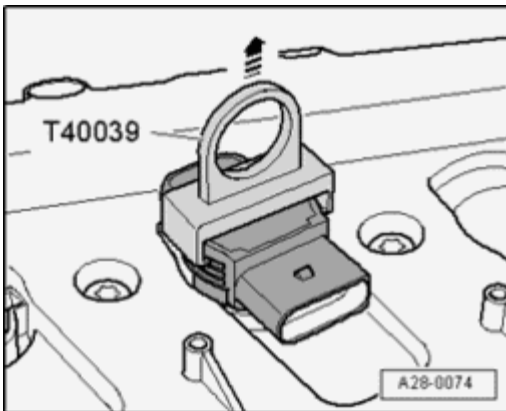


Fig. 135: Removing Ignition Coils Using Ignition Coil Puller T40039

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove ignition coils using ignition coil puller T40039.

Installing

Installation is in reverse order of removal.

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