

Computers and Control Systems: Pinpoint Tests

Test HA: Natural Gas Fuel Control

PINPOINT TEST HA: NATURAL GAS FUEL CONTROL

Natural Gas Fuel Control

HA

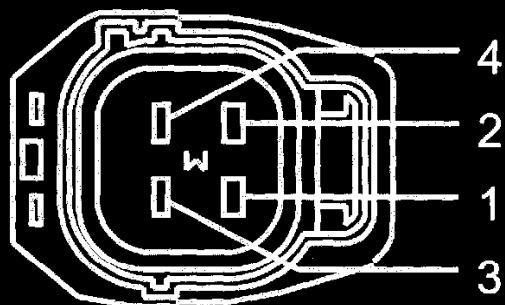
Note

This Pinpoint Test is intended to diagnose the following:

- HO2S/HTR (Heater) (9F472).
- HO2S Connections.
- Vacuum Systems.
- Fuel Injectors.
- Harness Circuits: HO2S GND, HO2S, INJ-1-8, VPWR and SIG RTN.
- Powertrain control module (PCM) (12A650).
- Natural Gas Module (NG) (9F954).

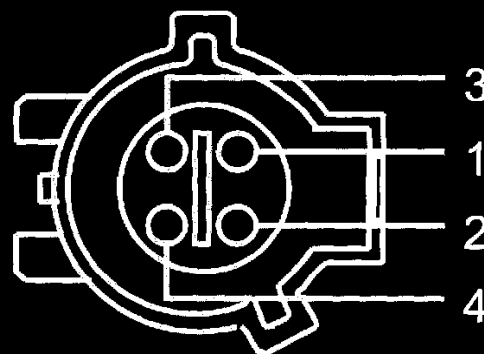
Heated Exhaust Oxygen Sensor (HO2S) Sensor Connector

A



A0077521

B



A0077561

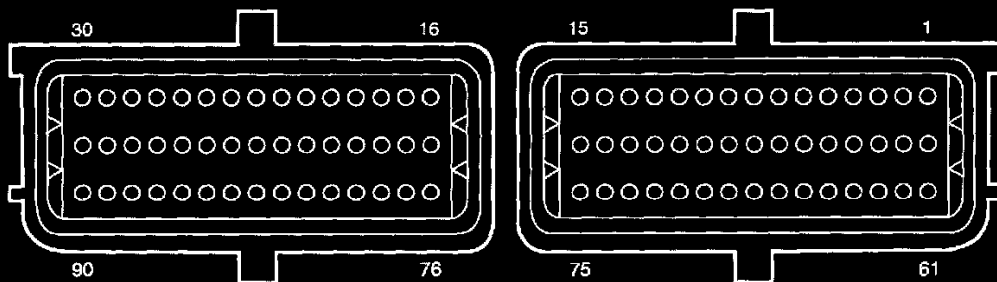
Natural Gas Fuel Control

HA

Vehicle	Connector	Circuit	Pin
Focus 2.3L	A	HO2S Signal	4
		HO2S Heater	2
		SIGRTN	3
		VPWR	1
All other vehicles	B	HO2S Signal	3
		HO2S Heater	1
		SIGRTN	4
		VPWR	2

Natural Gas (NG) Module Connector

A



A0080046

B



A16075-A

Connector

Natural Gas Fuel Control**HA**

Vehicle	Connector	Circuit	Pin
E-Series	A	INJ8	68
		INJ7	67
		INJ6	66
		INJ5	65
		INJ4	64
		INJ3	63
		INJ2	62
		INJ1	61
		INJ8 Out	53
		INJ7 Out	52
		INJ6 Out	51
		INJ5 Out	50
		INJ4 Out	49
		INJ3 Out	48
		INJ2 Out	47
		INJ1 Out	46
		CASE GND	75
		VPWR	60
		PWRGND	89
		SRtn	89
SRef	74		
All other vehicles	B	INJ8	44
		INJ7	43
		INJ6	25
		INJ5	24
		INJ4	23
		INJ3	5
		INJ2	4
		INJ1	3
		INJ8 Out	54
		INJ7 Out	53
		INJ6 Out	42
		INJ5 Out	33
		INJ4 Out	35
		INJ3 Out	39
		INJ2 Out	59
		INJ1 Out	58
		CASE GND	25
		VPWR	37
		PWRGND	40
		SRtn	46
SRef	26		

Powertrain Control Module (PCM) Connector

For PCM connector views or reference values, REFER to Reference Values

Connector

Natural Gas Fuel Control

HA

Connector	Circuit	Pin
104 Pin	HTR22	96
	HTR12	95
	HTR21	94
	HTR11	93
	HO2S22	61
	HO2S12	35
	HO2S21	87
	HO2S11	60
	PWRGND	103
	SIGRTN	91
	INJ8	98
	INJ7	72
	INJ6	99
	INJ5	73
	INJ4	100
	INJ3	74
	INJ2	101
INJ1	75	
VPWR	71	

	Test Steps	Results	Action to Take
HA1	DTCS P0135, P0141, P0155 AND P0161: HO2S HTR CIRCUIT FAULT <ul style="list-style-type: none"> • DTC/HO2S Reference List. <ul style="list-style-type: none"> — DTC P0135 = HO2S HTR-11. — DTC P0141 = HO2S HTR-12. — DTC P0155 = HO2S HTR-21. — DTC P0161 = HO2S HTR-22. <p>Note: On some applications, a vehicle hoist is required to access the HO2S harness.</p> <ul style="list-style-type: none"> • Visually inspect the HO2S harness for exposed wiring, water contamination, corrosion and proper assembly. • Were any of the above conditions or concerns found during inspection? 	Yes → No →	Repair any concerns found. GO to HA2 .
HA2	PERFORM KOEO SELF-TEST <ul style="list-style-type: none"> • Key ON Engine RUN. • Engine at 2000 RPM for 1 minute. • Key ON Engine OFF. • Run PCM KOEO Self-Test. • Are DTCs P0135, P0141, P0155 or P0161 present? 	Yes → No →	KEY OFF. GO to HA3 . KEY OFF. Unable to duplicate or identify fault at this time. GO to Z1 .

Connector And Test HA1-HA2

Natural Gas Fuel Control

HA

Test Steps		Results	Action to Take						
HA3	CHECK VPWR VOLTAGE TO HO2S HARNESS CONNECTOR Note: If DTCs P0135 and P0155 or P0141 and P0161 are displayed, both heater circuits will require testing. DTCs displayed separately are tested individually. <ul style="list-style-type: none"> • HO2S Sensor connector disconnected. • Key ON Engine OFF. • Measure the Voltage between: <table border="1"> <tr> <td>(+)HO2S Sensor Connector, Harness Side</td> <td>(-)HO2S Sensor Connector, Harness Side</td> </tr> <tr> <td>VPWR</td> <td>SIGRTN</td> </tr> </table> <ul style="list-style-type: none"> • Is the Voltage above 10.5 V? 	(+)HO2S Sensor Connector, Harness Side	(-)HO2S Sensor Connector, Harness Side	VPWR	SIGRTN	Yes → No →	KEY OFF. GO to HA5 . KEY OFF. GO to HA4 .		
(+)HO2S Sensor Connector, Harness Side	(-)HO2S Sensor Connector, Harness Side								
VPWR	SIGRTN								
HA4	CHECK VPWR CIRCUIT FOR OPEN IN HARNESS <ul style="list-style-type: none"> • PCM connector disconnected. • Measure the Resistance between: <table border="1"> <tr> <td>(+)PCM Connector, Harness Side</td> <td>(-)HO2S Sensor Connector, Harness Side</td> </tr> <tr> <td>VPWR - Pin 71</td> <td>VPWR</td> </tr> </table> <ul style="list-style-type: none"> • Is the Resistance below 5 Ohm? 	(+)PCM Connector, Harness Side	(-)HO2S Sensor Connector, Harness Side	VPWR - Pin 71	VPWR	Yes → No →	GO to HA5 . REPAIR open circuit. CHECK fuse.		
(+)PCM Connector, Harness Side	(-)HO2S Sensor Connector, Harness Side								
VPWR - Pin 71	VPWR								
HA5	CHECK HO2S HEATER RESISTANCE <ul style="list-style-type: none"> • HO2S Sensor connector disconnected. • Measure the Resistance between: <table border="1"> <tr> <td>(+)HO2S Sensor Connector, Component Side</td> <td>(-)HO2S Sensor Connector, Component Side</td> </tr> <tr> <td>HO2S Heater</td> <td>VPWR</td> </tr> </table> <ul style="list-style-type: none"> • Is the Resistance between 3 Ohm - 30 Ohm? 	(+)HO2S Sensor Connector, Component Side	(-)HO2S Sensor Connector, Component Side	HO2S Heater	VPWR	Yes → No →	GO to HA6 . INSTALL a new HO2S sensor.		
(+)HO2S Sensor Connector, Component Side	(-)HO2S Sensor Connector, Component Side								
HO2S Heater	VPWR								
HA6	CHECK HO2S CASE FOR SHORT TO VPWR AND SIGRTN <ul style="list-style-type: none"> • Measure the Resistance between: <table border="1"> <tr> <td>(+)HO2S Sensor Connector, Component Side</td> <td>(-)HO2S Sensor Connector, Component Side</td> </tr> <tr> <td>SIGRTN</td> <td>HO2S Case</td> </tr> <tr> <td>VPWR</td> <td>HO2S Case</td> </tr> </table> <ul style="list-style-type: none"> • Are the resistances above 10 KOhm? 	(+)HO2S Sensor Connector, Component Side	(-)HO2S Sensor Connector, Component Side	SIGRTN	HO2S Case	VPWR	HO2S Case	Yes → No →	GO to HA7 . INSTALL a new HO2S sensor.
(+)HO2S Sensor Connector, Component Side	(-)HO2S Sensor Connector, Component Side								
SIGRTN	HO2S Case								
VPWR	HO2S Case								

Test HA3-HA6

Natural Gas Fuel Control

HA

Test Steps		Results	Action to Take												
HA7	CHECK HO2S HEATER CIRCUIT FOR SHORTS TO VPWR AND GROUND <ul style="list-style-type: none"> PCM connector disconnected. Measure the Resistance between: <table border="1"> <tr> <td>(+)HO2S Sensor Connector, Harness Side</td> <td>(-)HO2S Sensor Connector, Harness Side</td> </tr> <tr> <td>HO2S Heater</td> <td>HO2S Signal</td> </tr> <tr> <td>HO2S Heater</td> <td>VPWR</td> </tr> <tr> <td>HO2S Heater</td> <td>SIGRTN</td> </tr> </table> <ul style="list-style-type: none"> Measure the Resistance between: <table border="1"> <tr> <td>(+)HO2S Sensor Connector, Harness Side</td> <td>(-)Vehicle battery</td> </tr> <tr> <td>HO2S Heater</td> <td>Negative post</td> </tr> </table> <ul style="list-style-type: none"> Is the Resistance above 10 KOhm? 	(+)HO2S Sensor Connector, Harness Side	(-)HO2S Sensor Connector, Harness Side	HO2S Heater	HO2S Signal	HO2S Heater	VPWR	HO2S Heater	SIGRTN	(+)HO2S Sensor Connector, Harness Side	(-)Vehicle battery	HO2S Heater	Negative post	Yes No	→ GO to HA8 . → REPAIR short circuit.
(+)HO2S Sensor Connector, Harness Side	(-)HO2S Sensor Connector, Harness Side														
HO2S Heater	HO2S Signal														
HO2S Heater	VPWR														
HO2S Heater	SIGRTN														
(+)HO2S Sensor Connector, Harness Side	(-)Vehicle battery														
HO2S Heater	Negative post														
HA8	CHECK HO2S HTR GROUND FOR OPEN IN IN HARNESS <ul style="list-style-type: none"> Measure the Resistance between: <table border="1"> <tr> <td>(+)PCM Connector, Harness Side</td> <td>(-)HO2S Sensor Connector, Component Side</td> </tr> <tr> <td>HO2S Heater</td> <td>HO2S Heater</td> </tr> </table> <ul style="list-style-type: none"> Is the Resistance below 5 Ohm? 	(+)PCM Connector, Harness Side	(-)HO2S Sensor Connector, Component Side	HO2S Heater	HO2S Heater	Yes No	→ INSTALL a new PCM. (refer to Diagnostic Methods, Flash Electrically Erasable Programmable Read Only Memory (EEPROM)). → REPAIR open circuit.								
(+)PCM Connector, Harness Side	(-)HO2S Sensor Connector, Component Side														
HO2S Heater	HO2S Heater														
HA9	DTCS P1130, P1131, P1132, P1150, P1151, P1152, P2195, P2196, P2197 AND P2198: UPSTREAM HO2S (S) NOT SWITCHING <ul style="list-style-type: none"> DTC/HO2S Reference List. <ul style="list-style-type: none"> HO2S-11 = DTCs P1131, P1132, P1130, P2195 and P2196. HO2S-21 = DTCs P1151, P1152, P1150, P2197 and P2198. CHECK intake air system for leaks, obstructions and damage. Verify the integrity of the PCV system. CHECK for disconnected spark plug wires. Check for vacuum leaks. Are any of the above concerns present? 	Yes No	→ Repair as necessary. → GO to DC25 .												

Test HA7-HA9

Natural Gas Fuel Control

HA

Test Steps		Results	Action to Take
HA10	DTCS P0171, P0172, P0174 AND P0175: FUEL SYSTEM AT THE CORRECTED FUEL TRIM		
	<ul style="list-style-type: none"> • Fuel System DTC Reference list: <ul style="list-style-type: none"> — Bank 1 = DTCs P0171 (lean) and P0172 (rich). — Bank 2 = DTCs P0174 (lean) and P0175 (rich). • CHECK intake air system for leaks, obstructions and damage. • Check the air cleaner for blockage. • Verify customer did not run out of fuel. • Verify clean sufficient fuel. • Verify the integrity of the PCV system. • CHECK for disconnected spark plug wires. • Check for vacuum leaks. • Are any of the above concerns present? 	Yes → No →	REPAIR as necessary. GO to DC25 .
HA11	RETRIEVE CONTINUOUS MEMORY DTCS		
	<ul style="list-style-type: none"> • Retrieve Continuous Memory DTCS • Are DTCS P1130, P1150, P0171, P0174, P0172 or P0175 present? 	Yes → No →	KEY OFF. GO to HA12 . GO to Z1 .
HA12	PERFORM KOER SELF-TEST		
	<ul style="list-style-type: none"> • Run KOER Self-Test. • Are DTCS P1131, P1132, P1151, P1152, P2195, P2196, P2197 or P2198 present? 	Yes → No →	KEY OFF. GO to HA13 . GO to Z1 .
HA13	CHECK FUEL PRESSURE		
	<p>Note: THE FUEL SYSTEM IS PRESSURIZED WHEN THE ENGINE IS NOT RUNNING. TO PREVENT INJURY OR FIRE, USE CAUTION WHEN WORKING ON THE FUEL SYSTEM. BECOME FAMILIAR WITH THE WARNING, CAUTION AND NOTE IN PINPOINT TEST HB BEFORE SERVICING.</p> <ul style="list-style-type: none"> • Key ON Engine OFF. • Access the PCM-FRP PID using a scan tool. • Record fuel pressure. <p>Increase engine speed to 2500 rpm and maintain for one minute. Record pressure reading.</p> <ul style="list-style-type: none"> • Is the Pressure between 552 KPa (80.1 psi) - 827 KPa (119.9 psi)? 	Yes → No →	KEY OFF. GO to HA14 . GO to HB1 .

Test HA10-HA13

Natural Gas Fuel Control

HA

Test Steps		Results →	Action to Take				
HA14	CHECK FUEL SYSTEM FOR PRESSURE STABILITY						
	<ul style="list-style-type: none"> • Cycle key ON and OFF twice. • Key ON Engine OFF. • Access the PCM-FRP PID using a scan tool. • Monitor fuel pressure for two minutes. • INSPECT fuel system for external leaks. • Does the fuel pressure remain within 69 kPa (10 psi) of the highest reading after two minutes? 	Yes → No →	For No Start symptom GO to HA15 . For For DTCs P1130, P1150, P0171, P0172, P0174 and P0175: GO to HA15 . For All other symptoms GO to HA32 . GO to HB1 .				
HA15	CHECK FUEL SYSTEM FOR PRESSURE STABILITY WITH KEY ON						
	<ul style="list-style-type: none"> • Key ON Engine OFF. • Access FRP PID and monitor the fuel pressure. • Does the fuel pressure remain within 69 kPa (10 psi) of the highest reading after 10 seconds? 	Yes → No →	For No Start symptom GO to HA16 . For DTCs P1130, P1150, P0171 and P0174: GO to HA25 . REPAIR pressure concern. GO to HA26 .				
HA16	CHECK FUEL INJECTORS ABILITY TO DELIVER FUEL						
	<ul style="list-style-type: none"> • Access the PCM-FRP PID using a scan tool. • Access FRP PID and monitor the fuel pressure. • Cycle key ON and OFF twice. • IFS connector disconnected. • Crank the engine for ten seconds and monitor the fuel pressure reading. • Was there a pressure drop greater than 34 kPa (10 psi)? 	Yes → No →	Concern is elsewhere. RETURN to Symptom Charts for further direction. GO to HA17 .				
HA17	CHECK VREF VOLTAGE AT NATURAL GAS (NG) VEHICLE MODULE						
	<ul style="list-style-type: none"> • IFS connector connected. • INSTALL NG Module Breakout Box. • Key ON Engine OFF. • Measure the Voltage between: <table border="1" style="margin-left: 20px;"> <tr> <td>(+)NG Module</td> <td>(-)NG Module</td> </tr> <tr> <td>SRef</td> <td>SRtn</td> </tr> </table> <ul style="list-style-type: none"> • Is the Voltage between 4 V - 6 V? 	(+)NG Module	(-)NG Module	SRef	SRtn	Yes → No →	KEY OFF. For No Start symptom GO to HA18 . For All other symptoms GO to HA27 . KEY OFF. GO to HA20 .
(+)NG Module	(-)NG Module						
SRef	SRtn						

Test HA14-HA17

Natural Gas Fuel Control

HA

Test Steps		Results	Action to Take				
HA18	CHECK FOR OPEN IN POWER GROUND <ul style="list-style-type: none"> NG Module connector disconnected. Measure the Resistance between: <table border="1"> <tr> <td>(+)NG Module Connector, Harness Side</td> <td>(-)Vehicle battery</td> </tr> <tr> <td>PWRGND</td> <td>Negative post</td> </tr> </table> <ul style="list-style-type: none"> Is the Resistance below 5 Ohm? 	(+)NG Module Connector, Harness Side	(-)Vehicle battery	PWRGND	Negative post	Yes → No →	GO to HA19 . REPAIR open circuit.
(+)NG Module Connector, Harness Side	(-)Vehicle battery						
PWRGND	Negative post						
HA19	CHECK FOR OPEN IN POWER GROUND CIRCUIT IN NG MODULE <ul style="list-style-type: none"> NG Module connector disconnected. Measure the Resistance between: <table border="1"> <tr> <td>(+)NG Module Connector, Harness Side</td> <td>(-)NG Module Connector, Harness Side</td> </tr> <tr> <td>PWRGND</td> <td>SRtn</td> </tr> </table> <ul style="list-style-type: none"> Is the Resistance below 5 Ohm? 	(+)NG Module Connector, Harness Side	(-)NG Module Connector, Harness Side	PWRGND	SRtn	Yes → No →	For No Start symptom GO to HA27 . For All other symptoms GO to A9 . INSTALL a new NG module.
(+)NG Module Connector, Harness Side	(-)NG Module Connector, Harness Side						
PWRGND	SRtn						
HA20	CHECK VREF VOLTAGE <ul style="list-style-type: none"> Is the VREF reading greater than 6.0 volts? 	Yes → No →	GO to HA25 . GO to HA21 .				
HA21	CHECK BATTERY VOLTAGE <ul style="list-style-type: none"> Measure the battery voltage across terminals. Is the voltage reading greater than 10.5 volts? 	Yes → No →	GO to HA22 . REFER to Charging System.				
HA22	CHECK VPWR AT THE NG MODULE <ul style="list-style-type: none"> Key ON Engine OFF. Measure the Voltage between: <table border="1"> <tr> <td>(+)NG Module Connector, Harness Side</td> <td>(-)NG Module Connector, Harness Side</td> </tr> <tr> <td>VPWR</td> <td>PWRGND</td> </tr> </table> <ul style="list-style-type: none"> Is the Voltage above 10.5 V? 	(+)NG Module Connector, Harness Side	(-)NG Module Connector, Harness Side	VPWR	PWRGND	Yes → No →	GO to HA24 . GO to HA23 .
(+)NG Module Connector, Harness Side	(-)NG Module Connector, Harness Side						
VPWR	PWRGND						
HA23	CHECK VOLTAGE BETWEEN VPWR AT THE NG MODULE AND BATTERY GROUND <ul style="list-style-type: none"> Measure the Voltage between: <table border="1"> <tr> <td>(+)NG Module Connector, Harness Side</td> <td>(-)Vehicle battery</td> </tr> <tr> <td>VPWR</td> <td>Negative post</td> </tr> </table> <ul style="list-style-type: none"> Is the Voltage above 10.5 V? 	(+)NG Module Connector, Harness Side	(-)Vehicle battery	VPWR	Negative post	Yes → No →	REPAIR open circuit. (Ground) REPAIR open circuit. (Power)
(+)NG Module Connector, Harness Side	(-)Vehicle battery						
VPWR	Negative post						

Test HA18-HA23

Natural Gas Fuel Control

HA

Test Steps		Results	Action to Take								
HA24	CHECK VREF VOLTAGE TO THE FUEL TANK PRESSURE SENSOR										
<ul style="list-style-type: none"> FTP Sensor connector disconnected. (On the Crown Vic., the fuel tank pressure sensor is located under the vent box cover of the upper tank assembly.) Key ON Engine OFF. Measure the Voltage between: <table border="1"> <tr> <td>(+)FTP Sensor Connector, Harness Side</td> <td>(-)FTP Sensor Connector, Harness Side</td> </tr> <tr> <td>VREF</td> <td>SIGRTN</td> </tr> </table> <ul style="list-style-type: none"> Is the Voltage between 4 V - 6 V? 		(+)FTP Sensor Connector, Harness Side	(-)FTP Sensor Connector, Harness Side	VREF	SIGRTN	Yes → No →	KEY OFF. INSTALL a new FTP sensor. KEY OFF. GO to HA26 .				
(+)FTP Sensor Connector, Harness Side	(-)FTP Sensor Connector, Harness Side										
VREF	SIGRTN										
HA25	CHECK VREF CIRCUIT FOR SHORT TO POWER IN HARNESS										
<ul style="list-style-type: none"> FTP Sensor connector disconnected. NG Module connector disconnected. Key ON Engine OFF. Measure the Voltage between: <table border="1"> <tr> <td>(+)NG Module Connector, Harness Side</td> <td>(-)NG Module Connector, Harness Side</td> </tr> <tr> <td>SRef</td> <td>PWRGND</td> </tr> </table> <ul style="list-style-type: none"> Is the Voltage below 1 V? 		(+)NG Module Connector, Harness Side	(-)NG Module Connector, Harness Side	SRef	PWRGND	Yes → No →	INSTALL a new NG module. REPAIR short circuit to PWR.				
(+)NG Module Connector, Harness Side	(-)NG Module Connector, Harness Side										
SRef	PWRGND										
HA26	CHECK VREF CIRCUIT FOR SHORT TO PWR GND										
<ul style="list-style-type: none"> NG Module connector disconnected. Measure the Resistance between: <table border="1"> <tr> <td>(+)NG Module Connector, Harness Side</td> <td>(-)NG Module Connector, Harness Side</td> </tr> <tr> <td>SRef</td> <td>SRtn</td> </tr> <tr> <td>SRef</td> <td>PWRGND</td> </tr> <tr> <td>SRef</td> <td>CASE GND</td> </tr> </table> <ul style="list-style-type: none"> Are the resistances above 10 KOhm? 		(+)NG Module Connector, Harness Side	(-)NG Module Connector, Harness Side	SRef	SRtn	SRef	PWRGND	SRef	CASE GND	Yes → No →	INSTALL a new NG module. REPAIR short circuit to GND.
(+)NG Module Connector, Harness Side	(-)NG Module Connector, Harness Side										
SRef	SRtn										
SRef	PWRGND										
SRef	CASE GND										

Test HA24-HA26

Natural Gas Fuel Control

HA

Test Steps		Results	Action to Take																			
HA27	CHECK FUEL INJECTOR(S) AND HARNESS RESISTANCE FROM THE NATURAL GAS (NG) MODULE TO THE FUEL INJECTOR(S)																					
	<ul style="list-style-type: none"> NG Module connector disconnected. Measure the Resistance between: <table border="1"> <thead> <tr> <th>(+)NG Module Connector, Harness Side</th> <th>(-)NG Module Connector, Harness Side</th> </tr> </thead> <tbody> <tr><td>VPWR</td><td>INJ1 Out</td></tr> <tr><td>VPWR</td><td>INJ2 Out</td></tr> <tr><td>VPWR</td><td>INJ3 Out</td></tr> <tr><td>VPWR</td><td>INJ4 Out</td></tr> <tr><td>VPWR</td><td>INJ5 Out</td></tr> <tr><td>VPWR</td><td>INJ6 Out</td></tr> <tr><td>VPWR</td><td>INJ7 Out</td></tr> <tr><td>VPWR</td><td>INJ8 Out</td></tr> </tbody> </table> <ul style="list-style-type: none"> Are the resistances between 3 Ohm - 7 Ohm? 	(+)NG Module Connector, Harness Side	(-)NG Module Connector, Harness Side	VPWR	INJ1 Out	VPWR	INJ2 Out	VPWR	INJ3 Out	VPWR	INJ4 Out	VPWR	INJ5 Out	VPWR	INJ6 Out	VPWR	INJ7 Out	VPWR	INJ8 Out	Yes → No →	GO to HA30 . GO to HA28 .	
(+)NG Module Connector, Harness Side	(-)NG Module Connector, Harness Side																					
VPWR	INJ1 Out																					
VPWR	INJ2 Out																					
VPWR	INJ3 Out																					
VPWR	INJ4 Out																					
VPWR	INJ5 Out																					
VPWR	INJ6 Out																					
VPWR	INJ7 Out																					
VPWR	INJ8 Out																					
HA28	CHECK FUEL INJECTOR(S) HARNESS RESISTANCE BETWEEN NG MODULE AND FUEL INJECTOR																					
	<ul style="list-style-type: none"> INJ connector disconnected. Measure the Resistance of injector circuits between the NG module harness connector pins and the fuel injector(s) harness connector. Measure the Resistance between: <table border="1"> <thead> <tr> <th>(+)NG Module Connector, Harness Side</th> <th>(-)INJ Connector, Harness Side</th> </tr> </thead> <tbody> <tr><td>INJ1 Out</td><td>INJ</td></tr> <tr><td>INJ2 Out</td><td>INJ</td></tr> <tr><td>INJ3 Out</td><td>INJ</td></tr> <tr><td>INJ4 Out</td><td>INJ</td></tr> <tr><td>INJ5 Out</td><td>INJ</td></tr> <tr><td>INJ6 Out</td><td>INJ</td></tr> <tr><td>INJ7 Out</td><td>INJ</td></tr> <tr><td>INJ8 Out</td><td>INJ</td></tr> <tr><td>VPWR</td><td>VPWR</td></tr> </tbody> </table> <ul style="list-style-type: none"> Are the resistances below 5 Ohm? 	(+)NG Module Connector, Harness Side	(-)INJ Connector, Harness Side	INJ1 Out	INJ	INJ2 Out	INJ	INJ3 Out	INJ	INJ4 Out	INJ	INJ5 Out	INJ	INJ6 Out	INJ	INJ7 Out	INJ	INJ8 Out	INJ	VPWR	VPWR	Yes → No →
(+)NG Module Connector, Harness Side	(-)INJ Connector, Harness Side																					
INJ1 Out	INJ																					
INJ2 Out	INJ																					
INJ3 Out	INJ																					
INJ4 Out	INJ																					
INJ5 Out	INJ																					
INJ6 Out	INJ																					
INJ7 Out	INJ																					
INJ8 Out	INJ																					
VPWR	VPWR																					

Test HA27-HA28

Natural Gas Fuel Control

HA

Test Steps		Results	Action to Take																																		
HA29	CHECK FUEL INJECTOR HARNESS CIRCUIT FOR SHORTS TO POWER AND GROUND BETWEEN THE NG MODULE AND INJECTORS																																				
	<ul style="list-style-type: none"> Measure the Resistance between: 	Yes	→ For other than P0172 and P0175, REPLACE only the damaged fuel injector(s), otherwise: GO to HA31 .																																		
	<table border="1"> <thead> <tr> <th>(+)NG Module Connector, Harness Side</th> <th>(-)NG Module Connector, Harness Side</th> </tr> </thead> <tbody> <tr><td>INJ1 Out</td><td>VPWR</td></tr> <tr><td>INJ2 Out</td><td>VPWR</td></tr> <tr><td>INJ3 Out</td><td>VPWR</td></tr> <tr><td>INJ4 Out</td><td>VPWR</td></tr> <tr><td>INJ5 Out</td><td>VPWR</td></tr> <tr><td>INJ6 Out</td><td>VPWR</td></tr> <tr><td>INJ7 Out</td><td>VPWR</td></tr> <tr><td>INJ8 Out</td><td>VPWR</td></tr> <tr><td>INJ1 Out</td><td>PWRGND</td></tr> <tr><td>INJ2 Out</td><td>PWRGND</td></tr> <tr><td>INJ3 Out</td><td>PWRGND</td></tr> <tr><td>INJ4 Out</td><td>PWRGND</td></tr> <tr><td>INJ5 Out</td><td>PWRGND</td></tr> <tr><td>INJ6 Out</td><td>PWRGND</td></tr> <tr><td>INJ7 Out</td><td>PWRGND</td></tr> <tr><td>INJ8 Out</td><td>PWRGND</td></tr> </tbody> </table>	(+)NG Module Connector, Harness Side	(-)NG Module Connector, Harness Side	INJ1 Out	VPWR	INJ2 Out	VPWR	INJ3 Out	VPWR	INJ4 Out	VPWR	INJ5 Out	VPWR	INJ6 Out	VPWR	INJ7 Out	VPWR	INJ8 Out	VPWR	INJ1 Out	PWRGND	INJ2 Out	PWRGND	INJ3 Out	PWRGND	INJ4 Out	PWRGND	INJ5 Out	PWRGND	INJ6 Out	PWRGND	INJ7 Out	PWRGND	INJ8 Out	PWRGND	No	→ REPAIR short circuit.
	(+)NG Module Connector, Harness Side	(-)NG Module Connector, Harness Side																																			
	INJ1 Out	VPWR																																			
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INJ7 Out	PWRGND																																				
INJ8 Out	PWRGND																																				
<ul style="list-style-type: none"> Are the resistances above 10 KOhm? 																																					
HA30	CHECK FUEL INJECTOR DRIVER SIGNAL																																				
<ul style="list-style-type: none"> NG Module connector connected. This test step requires a standard 12 volt test lamp. <p>Note: A properly operating system will show a dim glow at idle on the test lamp.</p> <ul style="list-style-type: none"> Connect non-powered test lamp between: 	Yes	→ For Runs Rough condition, RETURN to Symptom Charts. For No Start symptom GO to A5 . For All other symptoms GO to HA34 .																																			
<table border="1"> <thead> <tr> <th>(+)Fuel Injector Connector, Harness Side</th> <th>(-)Fuel Injector Connector, Harness Side</th> </tr> </thead> <tbody> <tr><td>INJ</td><td>VPWR</td></tr> </tbody> </table>	(+)Fuel Injector Connector, Harness Side	(-)Fuel Injector Connector, Harness Side	INJ	VPWR	No	→ No light/ bright continuous light, GO to HA31 .																															
(+)Fuel Injector Connector, Harness Side	(-)Fuel Injector Connector, Harness Side																																				
INJ	VPWR																																				
<ul style="list-style-type: none"> Crank or start the engine. Does the test lamp have a dim glow while cranking or running the engine? 																																					

Natural Gas Fuel Control

HA

Test Steps		Results	Action to Take
HA33	CHECK FUEL INJECTOR DRIVER SIGNAL FROM PCM		
	<ul style="list-style-type: none"> This test requires a standard 12 volt test lamp. PCM connector disconnected. NG Module connector disconnected. <p>Note: A properly operating system will show a dim glow or flicker at idle on the test lamp.</p> <ul style="list-style-type: none"> Connect a test lamp between the VPWR circuit and each PCM Fuel Injector Signal circuit at the NG module harness connector. Does the test lamp have a dim glow or flicker while cranking or starting the engine? 	<p>Yes →</p> <p>No →</p>	<p>For no starts: REPLACE NG module. For runs rough: Return to Symptom Chart. For DTCs: GO to HA34.</p> <p>INSTALL a new PCM. REFER to Diagnostic Methods, Flash Electrically Erasable Programmable Read Only Memory (EEPROM)</p>
HA34	FLOW TEST FUEL INJECTORS		
	<ul style="list-style-type: none"> Use Rotunda Natural Gas (NG) Injector Tester found in the special NG Tool Kit (113-00114) or equivalent to flow test NG fuel injectors. Follow the Rotunda Natural Gas (NG) Injector Tester test steps indicated below, or follow the specific instructions included with the injector tester you are using. Observe WARNING, CAUTION and NOTE. Key OFF. Key ON Engine OFF. Access the PCM-FPM PID using a scan tool. Note initial FRP sensor pressure using the scan tool. Electronic fuel injector tester installed to suspect fuel injector. Select pulse width of 200 m sec. Activate the fuel injector tester. Note the final FRP sensor pressure using scan tool. Subtract final pressure from initial pressure to find pressure drop. REPEAT above test procedure for all remaining fuel injectors. Is the leakage and flow within specifications? 	<p>Yes →</p> <p>No →</p>	<p>For P0171, P0172, P0174, P0175: GO to Z1.</p> <p>For P1130 and P1150: GO to HA37.</p> <p>For All other symptoms GO to HA36.</p> <p>INSTALL a new Fuel Injector.</p>
HA35	CYLINDER COMPRESSION CHECK		
	<ul style="list-style-type: none"> REFER to testing procedures for Standard Models (Non Bi-Fuel). Are cylinder compression readings within specification? 	<p>Yes →</p> <p>No →</p>	<p>For DTCs P1132, P1152, P2196 and P2198: GO to HA41.</p> <p>For All other symptoms GO to HA36.</p> <p>REPAIR as necessary.</p>

Test HA33-HA35

<h1>Natural Gas Fuel Control</h1>	<h1>HA</h1>
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	Test Steps	Results	Action to Take						
HA36	CHECK HO2S INTEGRITY <ul style="list-style-type: none"> • CHECK HO2S harness for chafing, or damage and service as required. • Visually inspect the HO2S and connector for indication of submersion in water, oil and coolant. REPAIR as necessary. • Run engine at 2000 rpm for two minutes. • Perform KOER Self-Test. • Key OFF. • Are DTCs P1131, P1151, P2195 and/or P2197 present? 	Yes → No →	GO to HA37 . Unable to duplicate or identify fault. GO to Z1 .						
HA37	CHECK HO2S'S ABILITY TO GENERATE A VOLTAGE GREATER THAN 0.5 VOLT <ul style="list-style-type: none"> • Any vacuum or air leaks can cause DTCs P1131, P1151,P1130,P1150,P2195 and P2197. • HO2S Sensor connector disconnected. • Connect digital multimeter to the HO2S Signal circuit and HO2S SIG RTN circuit or HO2S GND circuit at the HO2S sensor connector. • Run engine at 2000 rpm for two minutes. • Rerun KOER Self-Test and monitor HO2S voltage. • Does voltage reading indicate greater than 0.5 volt during or at the end of Self-Test? 	Yes → No →	GO to HA38 . INSTALL a new HO2S sensor.						
HA38	CHECK HO2S SIGNAL AND HO2S GROUND CIRCUITS FOR OPEN IN HARNESS <ul style="list-style-type: none"> • PCM connector disconnected. • HO2S Sensor connector disconnected. • Measure the Resistance between: <table border="1" style="width: 100%; border-collapse: collapse; margin: 5px 0;"> <tr> <td style="width: 50%; text-align: center;">(+)PCM Connector, Harness Side</td> <td style="width: 50%; text-align: center;">(-)HO2S Sensor Connector, Harness Side</td> </tr> <tr> <td style="text-align: center;">HO2S Signal</td> <td style="text-align: center;">HO2S Signal</td> </tr> <tr> <td style="text-align: center;">SIGRTN - Pin 91</td> <td style="text-align: center;">SIGRTN</td> </tr> </table> <ul style="list-style-type: none"> • Are the resistances below 5 Ohm? 	(+)PCM Connector, Harness Side	(-)HO2S Sensor Connector, Harness Side	HO2S Signal	HO2S Signal	SIGRTN - Pin 91	SIGRTN	Yes → No →	GO to HA39 . REPAIR open circuit.
(+)PCM Connector, Harness Side	(-)HO2S Sensor Connector, Harness Side								
HO2S Signal	HO2S Signal								
SIGRTN - Pin 91	SIGRTN								
HA39	CHECK HO2S CIRCUIT FOR SHORT TO GROUND IN HARNESS <ul style="list-style-type: none"> • Measure the Resistance between: <table border="1" style="width: 100%; border-collapse: collapse; margin: 5px 0;"> <tr> <td style="width: 50%; text-align: center;">(+)PCM Connector, Harness Side</td> <td style="width: 50%; text-align: center;">(-)Vehicle battery</td> </tr> <tr> <td style="text-align: center;">HO2S Signal</td> <td style="text-align: center;">Negative post</td> </tr> </table> <ul style="list-style-type: none"> • Is the Resistance above 10 KOhm? 	(+)PCM Connector, Harness Side	(-)Vehicle battery	HO2S Signal	Negative post	Yes → No →	GO to HA40 . REPAIR short circuit.		
(+)PCM Connector, Harness Side	(-)Vehicle battery								
HO2S Signal	Negative post								

Test HA36-HA39

Natural Gas Fuel Control

HA

Test Steps		Results	Action to Take						
HA40	CHECK HO2S CIRCUIT FOR SHORT TO GROUND <ul style="list-style-type: none"> Measure the Resistance between: <table border="1"> <tr> <td>(+)HO2S Sensor Connector, Harness Side</td> <td>(-)PCM Connector, Harness Side</td> </tr> <tr> <td>HO2S Signal</td> <td>PWRGND - Pin 103</td> </tr> <tr> <td>HO2S Signal</td> <td>SIGRTN - Pin 91</td> </tr> </table> <ul style="list-style-type: none"> Are the resistances above 10 KOhm? 	(+)HO2S Sensor Connector, Harness Side	(-)PCM Connector, Harness Side	HO2S Signal	PWRGND - Pin 103	HO2S Signal	SIGRTN - Pin 91	Yes No	→ For other than P1130 and P1150 INSTALL a new PCM, otherwise: GO to HA41 . → REPAIR short circuit.
(+)HO2S Sensor Connector, Harness Side	(-)PCM Connector, Harness Side								
HO2S Signal	PWRGND - Pin 103								
HO2S Signal	SIGRTN - Pin 91								
HA41	CHECK FOR DTCS P1132, P1152, P2196 AND P2198 WITH P1130 AND P1150 <ul style="list-style-type: none"> Perform KOER Self-Test. Are DTCS P1132, P1152, P2196 or P2198 present? 	Yes No	→ GO to HA42 . → Unable to duplicate or identify fault at this time. GO to Z1 .						
HA42	CHECK HO2S SIGNAL FOR SHORT TO VPWR AND VREF <ul style="list-style-type: none"> DTCS P1130, P1132, P2196=HO2S-11. DTCS P1150, P1152, P2198=HO2S-21. Key ON Engine OFF. Access the HO2S PID for the DTC generated. Is the voltage greater than 1.0 volt and less than 4.0 volts? 	Yes No	→ GO to HA43 . → GO to HA45 .						
HA43	CHECK HO2S CIRCUIT FOR SHORT TO VPWR <ul style="list-style-type: none"> HO2S Sensor connector disconnected. PCM connector disconnected. Measure the Resistance between: <table border="1"> <tr> <td>(+)HO2S Sensor Connector, Harness Side</td> <td>(-)HO2S Sensor Connector, Harness Side</td> </tr> <tr> <td>HO2S Signal</td> <td>VPWR</td> </tr> </table> <ul style="list-style-type: none"> Is the Resistance above 10 KOhm? 	(+)HO2S Sensor Connector, Harness Side	(-)HO2S Sensor Connector, Harness Side	HO2S Signal	VPWR	Yes No	→ GO to HA44 . → REPAIR short circuit to PWR.		
(+)HO2S Sensor Connector, Harness Side	(-)HO2S Sensor Connector, Harness Side								
HO2S Signal	VPWR								
HA44	CHECK HO2S SIGNAL FOR SHORT TO HO2S HTR CIRCUIT IN THE SENSOR <ul style="list-style-type: none"> HO2S Sensor connector disconnected. Key ON Engine OFF. Access the PCM-HO2S Signal PID using a scan tool. Is the HO2S voltage less than 0.2 volt? 	Yes No	→ INSTALL a new HO2S sensor. → INSTALL a new PCM. REFER to Diagnostic Methods, Flash Electrically Erasable Programmable Read Only Memory (EEPROM)						

Natural Gas Fuel Control

HA

Test Steps		Results	Action to Take				
HA45	ATTEMPT TO GENERATE DTCS P1131, P1151, P2195 AND P2197 <ul style="list-style-type: none"> HO2S Sensor connector disconnected. Add jumper wire between the points described below: <table border="1"> <tr> <td>Point A HO2S Sensor Connector, Harness Side</td> <td>Point B Vehicle battery</td> </tr> <tr> <td>HO2S Signal</td> <td>Negative post</td> </tr> </table> <ul style="list-style-type: none"> Activate KOER Self-Test. Is DTC P1131, P1151, P2195 OR P2197 present? 	Point A HO2S Sensor Connector, Harness Side	Point B Vehicle battery	HO2S Signal	Negative post	Yes → No →	GO to HA46 . Disconnect PCM and inspect connector for damage. If OK REPLACE PCM (refer to Diagnostic Methods, Flash Electrically Erasable Programmable Read Only Memory (EEPROM)).
Point A HO2S Sensor Connector, Harness Side	Point B Vehicle battery						
HO2S Signal	Negative post						
HA46	HO2S SENSOR VOLTAGE CHECK <ul style="list-style-type: none"> HO2S Sensor connector disconnected. Connect digital Multimeter to HO2S SIG circuit and HO2S SIG RTN circuit at the HO2S sensor connector. Disconnect Vacuum hose from vacuum tree. Start engine and run at 2000 rpm. Does the voltage reading indicate less than 0.4 volt within 30 seconds? 	Yes → No →	GO to HA47 . INSTALL a new HO2S sensor.				
HA47	MONITOR HO2S PID FOR PROPER SWITCHING <ul style="list-style-type: none"> Key ON Engine RUN. Engine at operating temperature. Access the PCM-HO2S Signal PID using a scan tool. Perform a wiggle-Test on the harness connected to the HO2S sensor. Did the HO2S voltage stay high (greater than 0.45 volt) or low (less than 0.45 volt)? 	Yes → No →	Isolate cause of lack of HO2S switching and repair. GO to HA48 .				
HA48	TEST DRIVE WHILE MONITORING HO2S PID FOR PROPER SWITCHING <p>Note: This test step requires an observer to monitor PID for proper operation.</p> <ul style="list-style-type: none"> Access the PCM-HO2S Signal PID using a scan tool. While observer views HO2S PID, test drive vehicle under different road conditions in an attempt to simulate the original fault. Does HO2S appear to switch properly? 	Yes → No →	Unable to duplicate or identify fault at this time. INSTALL a new HO2S sensor.				

Test HA45-HA48

Natural Gas Fuel Control

HA

Test Steps		Results	Action to Take				
HA49	DTC P1127 KOER						
<ul style="list-style-type: none"> Possible causes: <ul style="list-style-type: none"> Engine not operating long enough prior to performing KOER self-test. Exhaust system too cool. Key ON Engine RUN. Access the PCM-HTR11 and PCM-HTR21 PIDs using a scan tool. Access HTR11, 21 PIDS. Do all PIDS indicate on? 		Yes → No →	With engine still running, complete a KOER Self-Test to verify P1127 is no longer present. Operate engine until all PIDS indicate ON. Complete a KOER Self-Test.				
HA50	DTC P1128 KOER						
<ul style="list-style-type: none"> P1128 refers to the upstream HO2S. Possible causes: <ul style="list-style-type: none"> Crossed HO2S harness connectors. Crossed wiring at PCM 104-pin harness connector. Key OFF. Visually inspect HO2S connector(s) for any crossed or stretched wire or wire harnesses not mounted properly. Are there any indications of crossed connectors or wires? 		Yes → No →	Repair as necessary. GO to HA51 .				
HA51	VERIFY PROPER HO2S SIGNAL PIN LOCATION						
<ul style="list-style-type: none"> PCM connector disconnected. Disconnect both of the suspect HO2S sensors at the HO2S harness connector. P1128 = HO2S 11/21 Upstream. <ul style="list-style-type: none"> HO2S-11 = Test Pin 60. HO2S-21 = Test Pin 87. Measure the Resistance between: <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; text-align: center;">(+)HO2S Sensor Connector, Harness Side</td> <td style="width: 50%; text-align: center;">(-)PCM Connector, Harness Side</td> </tr> <tr> <td style="text-align: center;">HO2S Signal</td> <td style="text-align: center;">HO2S Signal</td> </tr> </table> <ul style="list-style-type: none"> Is the Resistance below 5 Ohm? 		(+)HO2S Sensor Connector, Harness Side	(-)PCM Connector, Harness Side	HO2S Signal	HO2S Signal	Yes → No →	HO2S SIG circuit is OK. Unable to duplicate or identify fault at this time. Connect HO2S connector to proper HO2S or RELOCATE HO2S signal pins in the PCM harness connector or HO2S harness connector.
(+)HO2S Sensor Connector, Harness Side	(-)PCM Connector, Harness Side						
HO2S Signal	HO2S Signal						
HA52	KOER DTCS P0040, P0041, P1129 AND P2278: CROSSED SENSOR WIRES						
<ul style="list-style-type: none"> Key OFF. Note: Sensor wiring swapped bank to bank. Warning: Use caution near hot components. Confirm wiring is connected to opposite bank. Are there any crossed connections or wires? 		Yes → No →	Swap connectors on HO2S sensors CLEAR the DTCs and REPEAT Self-Test. KEY OFF. Unable to duplicate or identify fault at this time. GO to Z1.				