ROUSH CLEANTECH

Blue Bird Vision

Compressed Natural Gas (CNG)

Service Manual

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FOREWARD

This manual is intended to provide technicians with the procedures required to maintain and service the unique components for the ROUSH CleanTech low-pressure CNG system. Service procedures for other vehicle components may be referenced to, which can be found in one of the Blue Bird Service Manuals. For base engine or transmission information, refer to the 2017 Ford F-650 (H561) workshop manual. For access to the Ford manual, please subscribe to www.motorcraft.com.

INTRODUCTION

CNG System Overview

The introduction of the CNG powered Blue Bird Vision marks a new expansion in alternative fuel powered school buses. The bus is powered by a Ford Triton 6.8L V10 engine equipped with a Compressed Natural Gas (CNG) fuel system. The CNG system stores compressed natural gas in the fuel tanks. A regulator assembly regulates high pressure from the tanks to a lower pressure fuel rail. The injectors meter and inject natural gas vapor into each of the original ten (10) inlet ports on the Triton engine. The ROUSH CleanTech CNG system is fully integrated using Ford's One Touch Integrated Start (OTIS) system. When the ignition key is turned to Start and released to the On position, if the Blue Bird Multiplex start logic is satisfied, the Ford PCM will start the engine.

ROUSH CleanTech Technical Assistance

Technical issues involving starting, operating or re-fueling a propane-powered bus should be reported to your local qualified service provider. In the event further technical assistance is needed, you should first contact your authorized Blue Bird Dealer regarding any technical issues with your Blue Bird product. If additional technical assistance is needed and the above mentioned technical assistance is unavailable, you can call ROUSH CleanTech Customer Service at 800-59-ROUSH (597-6874) with any questions regarding ROUSH CleanTech CNG Fuel System.

⚠ WARNING

CleanTech nor Blue Bird approve of any additions to or modifications of this fuel system. This fuel system is designed and installed to meet federal standards and engine manufacturer's guidelines. The maintenance provider or modifier assumes all responsibility for the vehicle engine and fuel system if the fuel system is changed or modified. Some states require a special license to perform maintenance or work on CNG powered vehicles. Check with local authorities or your state natural gas association for details. All service, maintenance and repairs performed on CNG systems must be done by an authorized CNG service technician.

SAFETY INFORMATION

The National Fire Protection Association (NFPA) publishes a code book of rules that apply to the storage, handling, transportation, and use of compressed natural gas (CNG). The book is known as NFPA 52. It is revised as necessary and published every other year. This code is adopted as law in most political subdivision in the United States. Check with your local authorities for regulations applicable to CNG.

Alert Messages

The following alert messages appear from time to time in appropriate places in this manual. Ensure that all personnel in the immediate area are aware of these reminders.

These messages consist of reminders of Dangers and Warnings. Other reminders may appear under the heading, Notes.

⚠ DANGER

Although natural gas is nontoxic, nonpoisonous, and dissipates quickly when released into the atmosphere, extreme caution must be taken when working on the fuel system due to the high pressures required to store the fuel and its flammability. Natural gas vapor is lighter than air and rises to high points. When the ratio of natural gas to air is between 5.3% and 15%, it will burn in the presence of an ignition source at 1076°F (580°C) or hotter. Keep away from heat, sparks, flames, static electricity or other sources of ignition. Failure to heed this danger may result in severe personal injury or death.

The fuel supply lines remain pressurized after engine shutdown. Keep away from heat, sparks, flames, static electricity or other sources of ignition. Do NOT enter storage areas or confined space unless they are adequately ventilated. Failure to heed this danger may result in severe personal injury or death.

Do NOT carry lighted smoking materials or smoke while working on fuel system components. Failure to heed this danger could result in severe personal injury or death.

Disconnect the battery ground at the battery to ensure that the vehicle electrical system has no current. Failure to heed this danger could result in severe personal injury or death.

⚠ WARNING

The CNG fuel system is under pressure. The fuel tanks and high pressure lines are up to approximately 3600 psi and the low-pressure lines and fuel rails are regulated down to approximately 101 psig. Extreme caution should be taken when working around or depressurizing these lines. Slowly loosen fittings and use protective eye wear. Failure to heed this warning may result in severe personal injury.

Technicians working with, or around, fuel systems should be properly trained to utilize extreme care and caution at all times. Failure to exercise extreme caution and care may lead to serious accidents which can result in property damage, personal injury and/or death.

Purging and Venting (Tanks and Lines)

Venting of CNG to the atmosphere is covered by NFPA 52. Refer to NFPA 52, Local Codes and Proper Training for specific information relating to safe venting of CNG.

Description and Operation

The Ford 6.8L engine is controlled by the same Powertrain Control Module (PCM) as used on Ford medium-duty trucks; however, the fuel control calibration has been optimized for CNG. A Gateway Module controls the fuel system components, upon command from the PCM.

CNG is stored under pressure in three fuel tanks. Fuel from the tanks is manifolded together into a single high pressure feed line to the regular assembly.

The high-pressure fuel line connects to a 3-way valve located on the regulator assembly and has three working positions: on, off, and vent. The “on” position will allow fuel to the regulator for normal operation. The “off” position shuts off the high-pressure side from the low-pressure side. The “vent” position is used to depressurize the system for service.

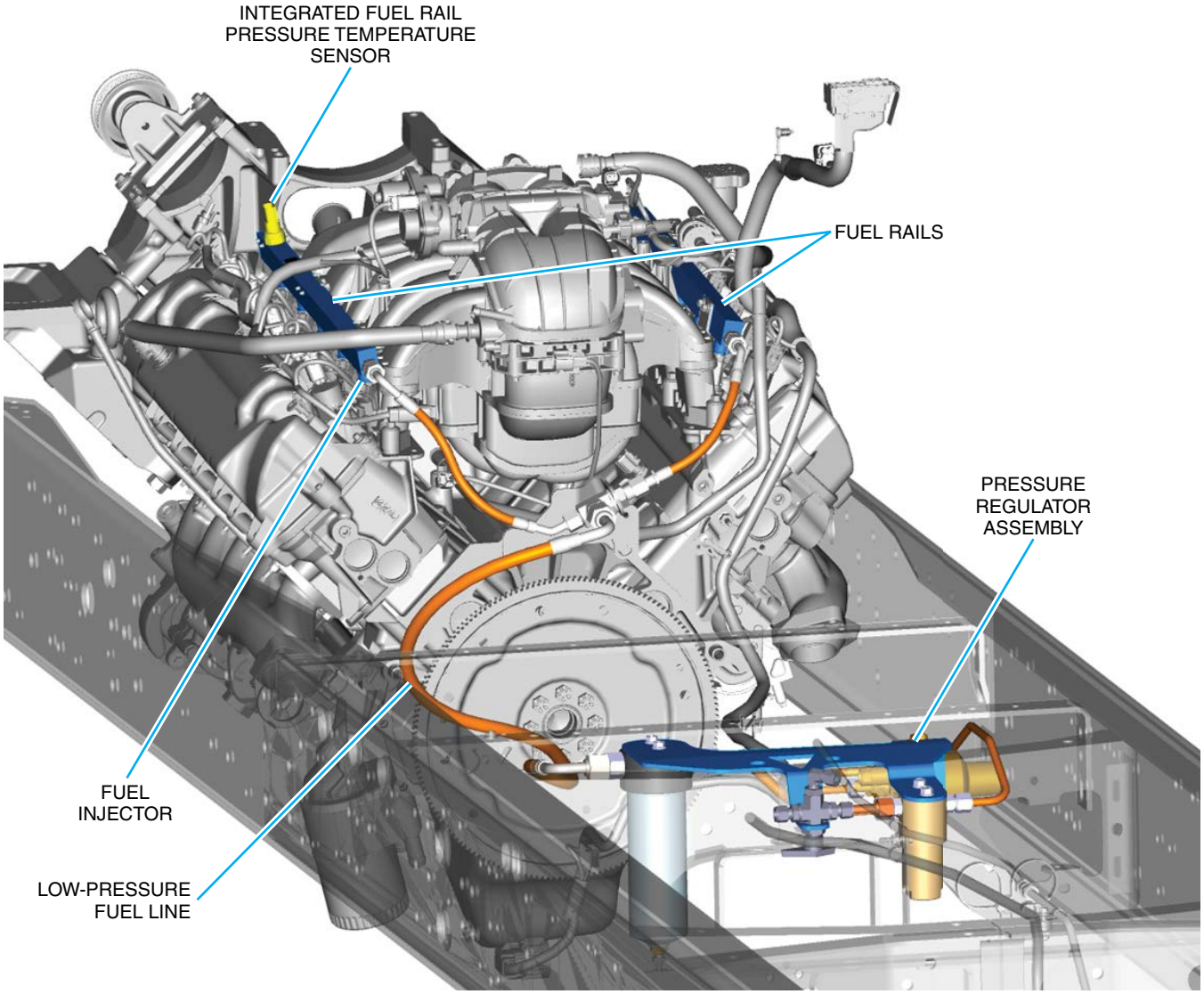
The regulator assembly contains a low pressure and high pressure filter, as well as a fuel level pressure sender, regulator, and 3-way valve for depressurizing the system.

The filters remove contaminates from the fuel before it reaches the fuel rails and injectors. They each have a serviceable element that should be replaced at each engine oil change - 6 month or 5,000 miles (whichever comes first). The low-pressure filter has a drain that should be drained every 2,000 miles.

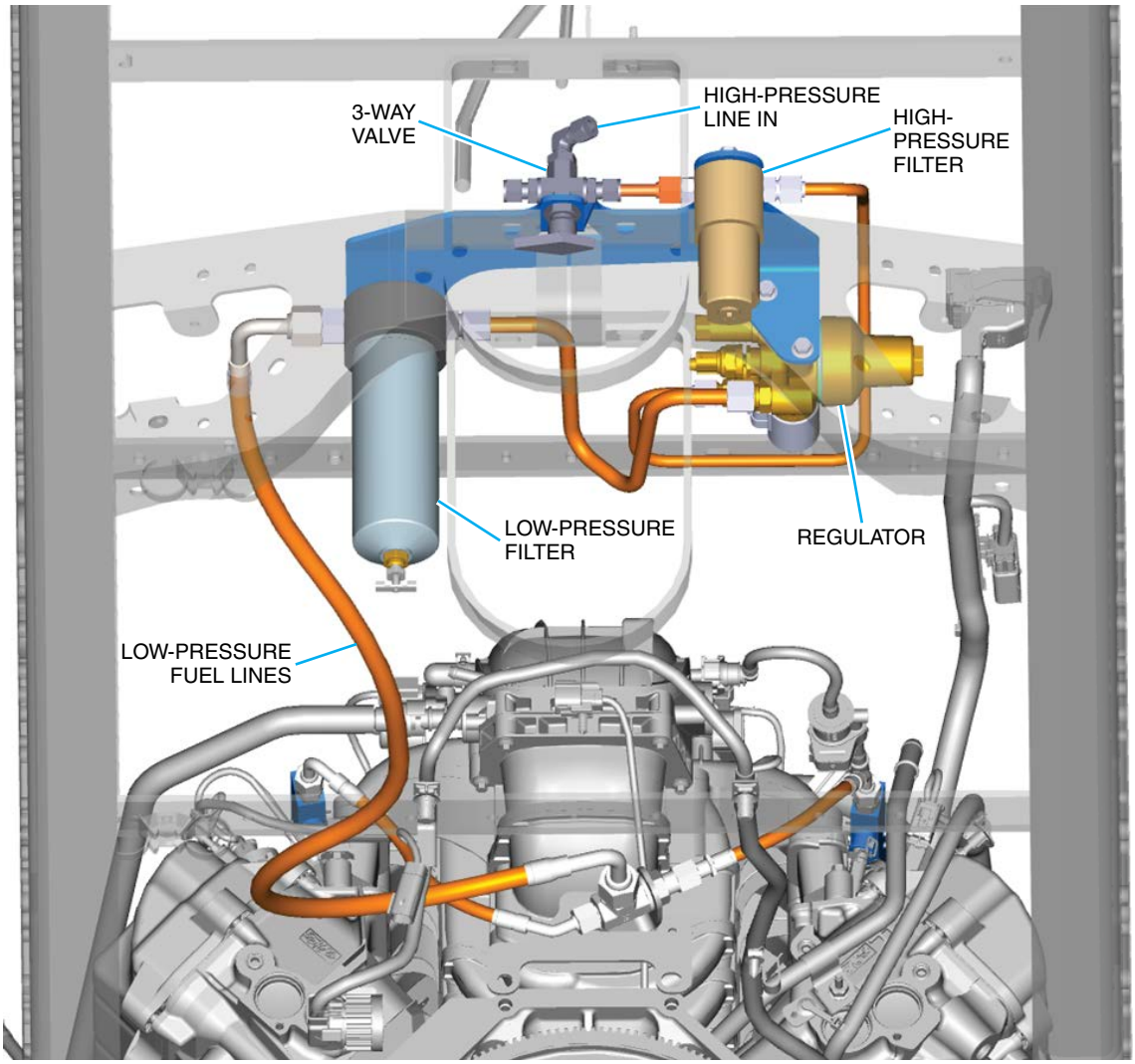
The regulator reduces fuel pressure from the tank (up to 3600 psi) to an injection pressure of approximately 101 psig. Coolant lines flow warm engine coolant through the regulator to prevent it from freezing due the cooling affect from the change in pressure. The regulator contains a pressure sensor that reads the high side and determines the fuel level sent to the cluster.

Lower pressure fuel leaves the regulator assembly through the low-pressure line and to the fuel rails. The fuel rails contain 10 port injectors that inject fuel into the intake manifold. The fuel rails also contain an integrated fuel pressure temperature sensor (IPTS) that monitors the pressure in the rails.

Pressure Regulator and Rails



Fuel Pressure Regulator



View from under the vehicle

Depressurizing Lines and Rails

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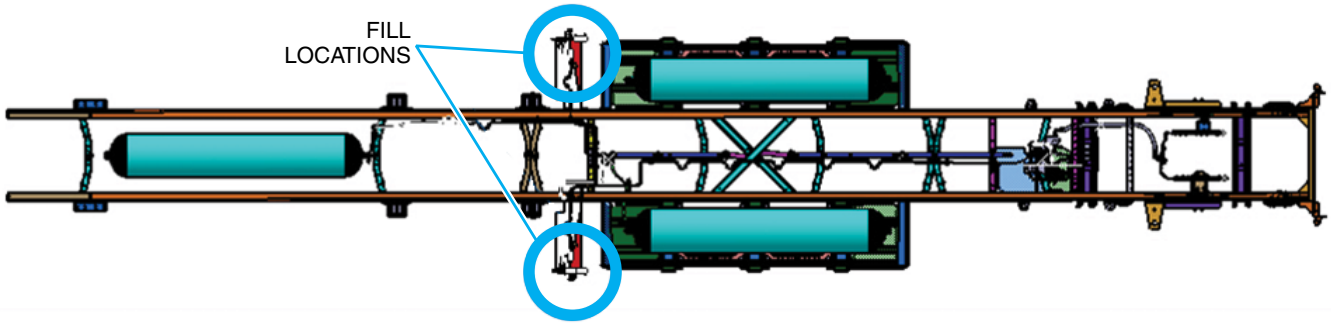
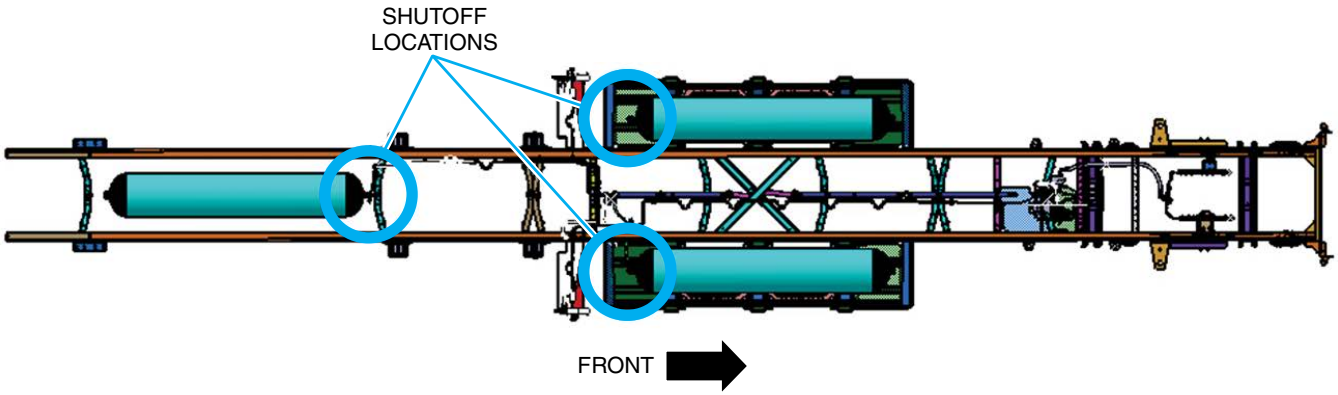
Depressurization should only be performed by a trained and certified CNG technician. Before disconnecting any of the fuel system components, they must be depressurized. Never place a tool on a fuel line or fuel rail that has not been depressurized. This procedure should be performed regardless of how long the vehicle has been off. The person performing the repair should always be the one to depressurize the system, and verify the procedure before continuing with a repair.

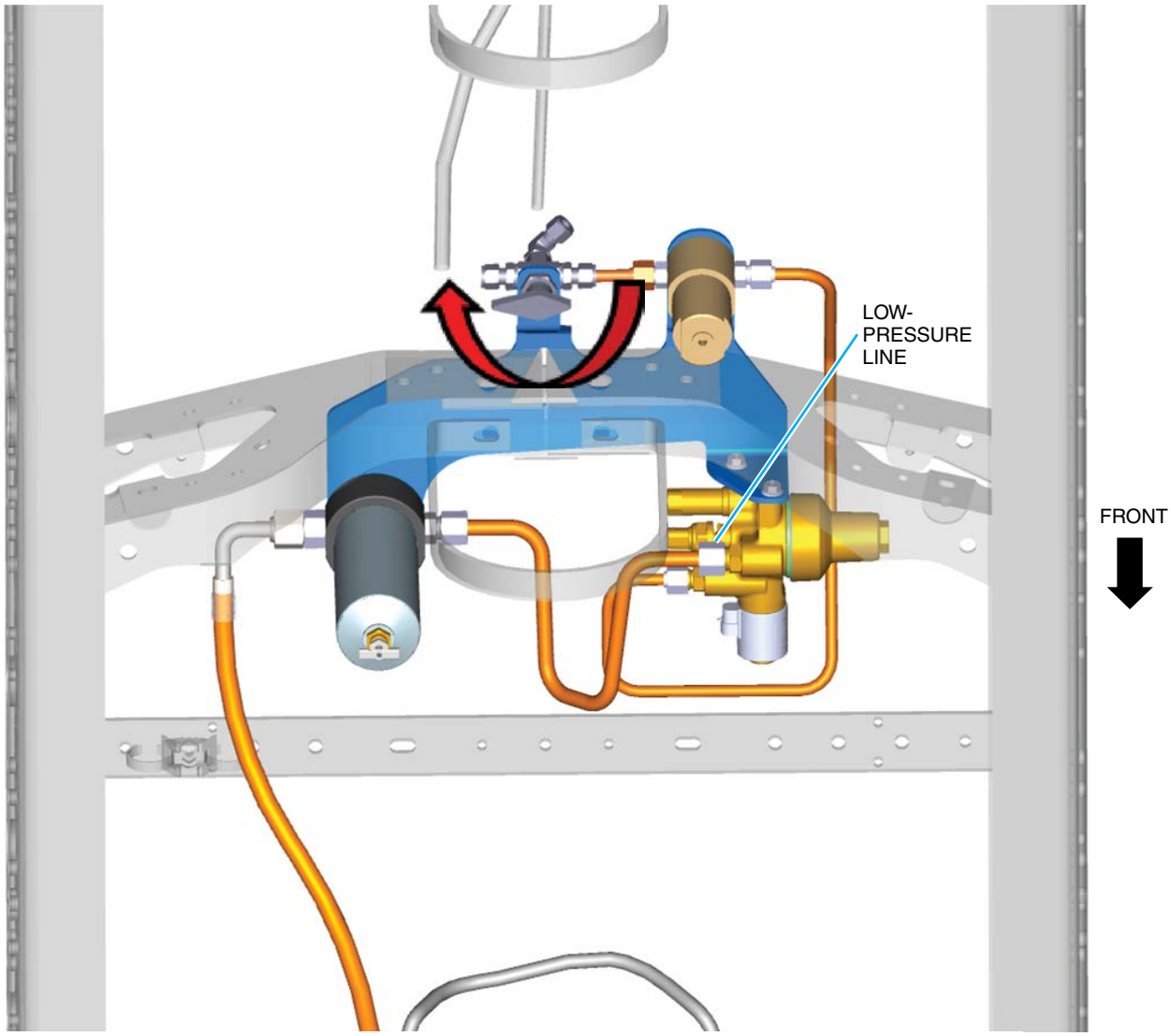
1. Park the bus in an outdoor, well-ventilated area that is at least 35 feet from any sources of ignition.
2. Monitor the gauges at each fill location on the bus. Depending on the side regularly used for filling, the pressures may be different. Ensure at least one of the gauges is reading positive pressure before continuing.



3. Close the shutoff valve on each of the three (3) fuel tanks.



4. Start the bus and let it run until the engine stalls. This may take several minutes.
5. Perform the start procedure a second time. This time it should crank no-start.
6. Locate the 3-way valve on the regulator assembly and slowly turn it vent. Refer to “3-way valve operation” procedure. There should be a small pressure release through the vent stack.



View from under the vehicle

7. Look at the gauges at each vehicle fill location. Ensure they are both reading 0 psi.
8. Using an OBDII scan tool, ensure fuel rail pressure <15 psi, and fuel level is 0%.
9. Disconnect the negative battery cable.
10. Ensure you are grounded to the vehicle, to reduce the risk of static electricity, then slowly loosen the fitting on the low-pressure side of the regulator.

NOTE: There still may still be some pressure in the system. Take caution and slowly loosen any fittings.

11. Slowly loosen any fittings when working on the fuel system to perform repair.

Re-Pressurizing Fuel System

1. Ensure all fuel line connections are tightened down using the recommended torque procedure for that component.
2. Turn the 3-way valve to the on position.
3. Open the shut-off valves on each of the three (3) fuel tanks.
4. Leak check all lines, fittings, and components that were serviced using a bubbling leak detection solution or electronic hydrocarbon gas detector. Ensure the fuel system is bubble tight, or that no gas is detected by an electronic detector.

NOTE: Only use a non-corrosive bubbling leak detection solution, such as Snoop or A/C leak detector. When using an electronic leak detector, follow the manufacturer's recommended instructions.

5. Connect the negative battery terminal.
6. Start the bus then immediately turn it off.
7. Leak check all lines, fittings, and components that were serviced again.

Filter Maintenance

The CNG fuel system on the Vision bus is equipped with two (2) fuel filters. The high-pressure filter filters fuel before the regulator. The low-pressure filter filters fuel after the regulator and has a petcock for draining oil separated from the fuel.

Draining the Low-Pressure Filter

The low-pressure filter should be drained every 2,000 miles. To drain the low-pressure filter:

1. Perform the *Depressurizing Fuel Lines and Rails* procedure.

NOTE: The fuel system must be depressurized before draining the filter.

2. Slowly open the petcock on the bottom of the filter by turning clockwise and let it drain.
3. Once liquid is no longer dripping, close the petcock by turning counter-clockwise.
4. Torque to 1.8-2.3 Nm.
5. Perform *Re-pressurizing Fuel System* procedure.
6. Leak check the low-pressure filter petcock.

Filter Element Replacement

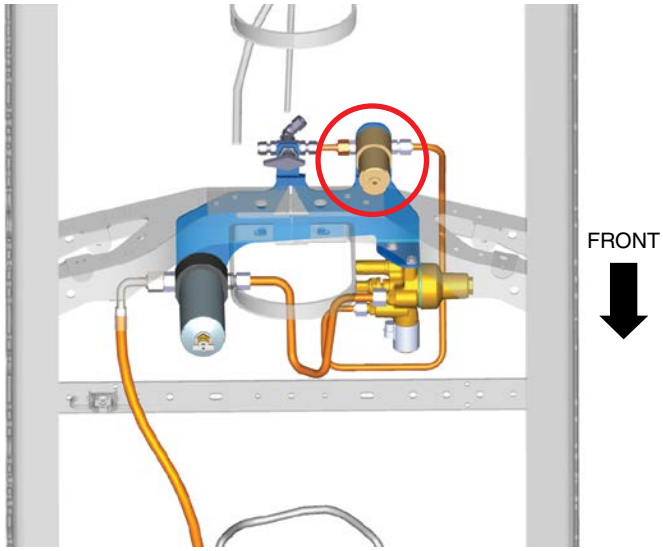
Both the low- and high-pressure filter elements should be replaced at each oil change (6 months/ 5,000 miles) or as needed. The filter element is inside the filter housing.

Replacing the High-Pressure Filter

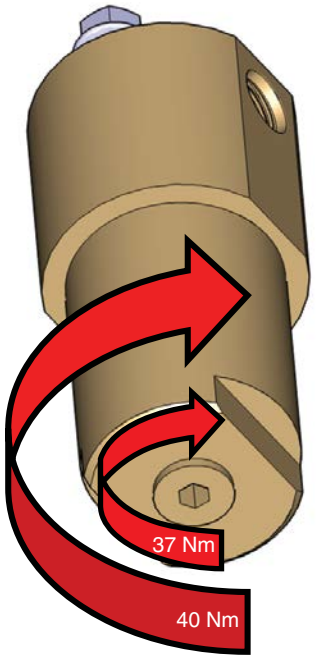
1. Perform the *Depressurizing Fuel Lines and Rails* procedure.
2. Remove the drain plug with a 1/4" hex key wrench and drain until liquid is removed.
3. Change the drain plug O-ring and lubricate with lubricant included in the kit.
4. Using the bottom flats, unscrew the bowl.
5. Remove the filter element from the filter housing and discard.

NOTE: Follow proper health and safety precautions when handling filter element.

6. Install new filter element by inserting it on the center post of the filter housing.
7. Replace the O-ring in the bowl channel. Lubricate the O-ring with the included lubricant before inserting it in the channel.
8. Install the bowl on the filter housing. Torque to 40 Nm.
9. Install drain plug with new O-ring. Torque to 37 Nm.
10. Perform *Re-Pressurizing Fuel System* procedure and test for leaks.



View from under the vehicle

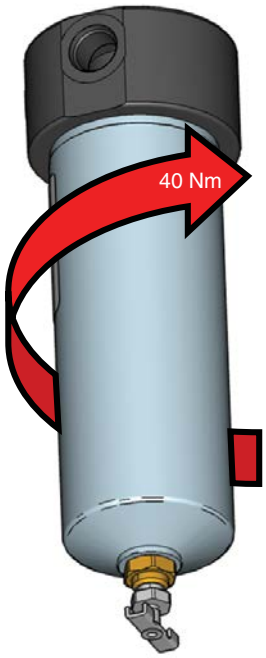


Replacing the Low-Pressure Filter Element

1. Perform the *Depressurizing Fuel Lines and Rails* procedure.
2. Perform the *Draining the Low-Pressure Filter* procedure.
3. Unscrew the bowl from the low-pressure filter housing. A strap or oil filter wrench can be used to aid in removal.
4. Unscrew the plastic filter element nut from the post. Remove the filter element and discard.

NOTE: Follow proper health and safety precautions when handling filter element.

5. Install new filter element on the housing post and replace the filter element nut.
6. Replace the bowl O-ring and lubricate with the lubricant included in the filter kit.
7. Install the bowl on the filter housing. Torque to 40 Nm.



8. Perform *Re-Pressurizing Fuel System* procedure and test for leaks.

Compression Fitting Assembly and Remake Procedure

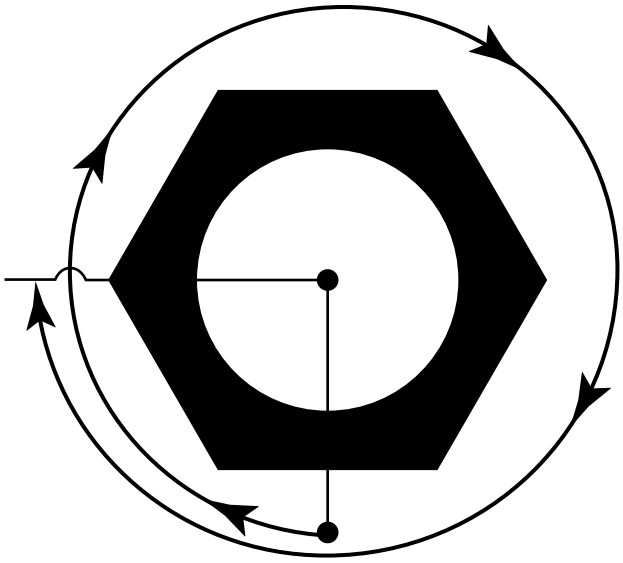
The CNG fuel system contains both O-ring sealing line connections and compression fitting line connections. O-ring connections utilize a tightening torque specification, whereas compression fitting connections require a rotation torque procedure and are different for initial assembly of new components and remaking a connection. After making any connections, the union should be leak checked.

New Component Assembly

When a compression fitting is being connected for the first time, follow this procedure.

1. Finger-tighten the nut.
2. Counter brace the fitting body with a second wrench to prevent turning it.
3. Turn the nut 1-1/4 turns.

NOTE: Not over-tightening the fitting will allow for re-making the connection in the future.



FINGER TIGHTEN + 1-1/4 TURNS

Remaking Compression Fitting Connections

When disassembling and reassembling compressions fittings, follow this procedure.

NOTE: Before taking the fitting apart, use a paint pen to draw a line across both sides of the fitting, marking the fitting orientation.

1. To reinstall, hand-tighten the nut.
2. Rotate the fitting to line up with the initial installation mark.

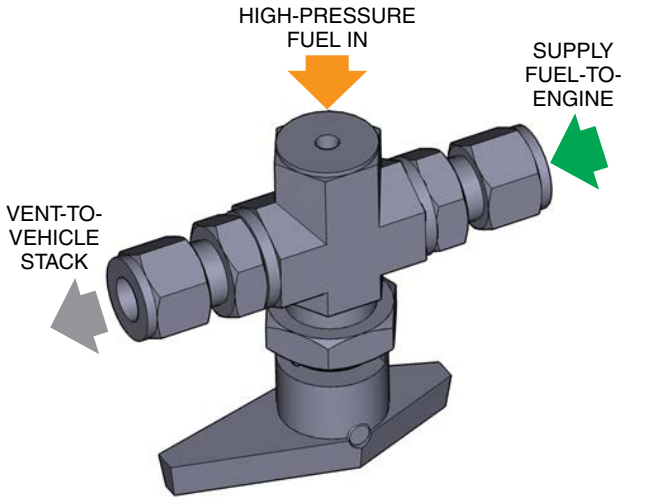
NOTE: Effort to reach this mark will be greater than making the connection the first time.

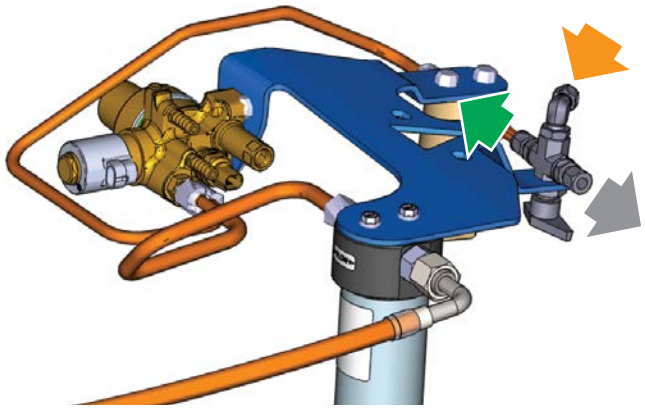
3. After several remakes, it will be necessary to advance the nut slightly past the original position by 10°-20° (less than 1/3 or a hex flat).

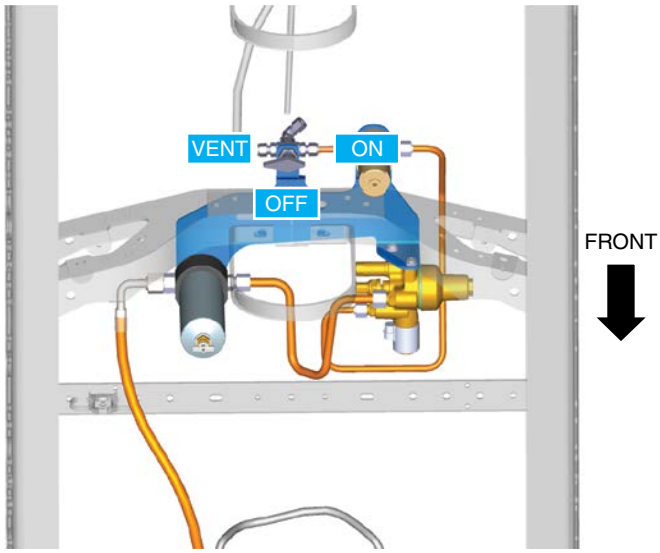
3-WAY VALVE

Operation

The 3-way valve controls the flow of fuel from the high-pressure line to the high-pressure filter and regulator. The 3-way valve has three (3) positions: on, off, and vent. During normal operation, the valve should be in the “on” position. Turning the valve to the “off” position will shut off fuel to the low-pressure side. The “vent” position will vent the fuel lines through the vent system and out of the vehicle vent stack.







Removal

1. Perform *Depressurizing Fuel Lines and Rails* procedure.
2. Remove the hex set screw from the 3-way valve handle, and remove the handle.

3. Mark the fitting orientation with a paint pen, then slowly loosen the three (3) lines connecting to the 3-way valve.
4. Remove the nut securing the 3-way valve to the bracket.
5. Unthread the fitting connecting the short fuel line to the high-pressure filter so that the 3-way valve body can be rotated.
6. Rotate the 3-way valve body, disconnecting it from the lines.

Replacement

1. Loosen screws mounting high-pressure filter to the bracket.
2. Align the 3-way valve so that the arrow of the handle points inward towards the regulator assembly when turned.
3. Insert the 3-way valve into the bracket and hand tighten the nut securing it to the bracket.
4. Hand-tighten the three (3) lines connecting to the 3-way valve.
5. Torque the fitting connecting the short fuel line to the high-pressure filter to 40 Nm.
6. Tighten the three (3) compression fittings connecting to the 3-way valve using the *Compression Fitting Assembly and Remake* procedure.
7. Torque the nut holding the 3-way valve to the bracket to 34 Nm.
8. Align the handle on the 3-way valve and install the set screw. Torque set screw to 3.4 Nm.
9. Perform *Re-Pressurizing Fuel System* procedure and test for leaks per the procedure.

HIGH-PRESSURE FILTER ASSEMBLY

Removal

1. Perform *Depressurizing Fuel Lines and Rails* procedure.
2. Slowly loosen then remove the line connection on both sides of the filter assembly.
3. Remove the two (2) screws securing the high-pressure filter to the bracket.

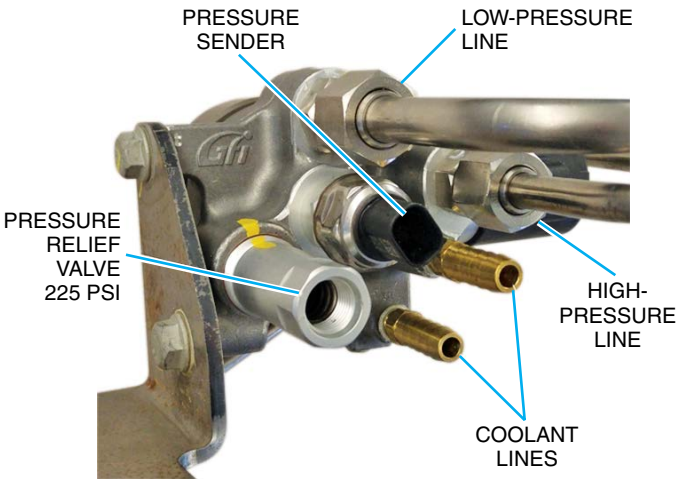
Replacement

1. Align the high-pressure filter assembly on the bracket so that the flow direction arrow points away from the 3-way valve.
2. Hand-tighten the two (2) screws securing the filter to the bracket.
3. Hand-tighten the two (2) lines on either side of the high-pressure fuel filter.
4. Counter brace the line fitting and torque each fitting to 40 Nm.
5. Torque the mounting screws 10 Nm.
6. Perform *Re-Pressurizing Fuel System* procedure and test for leaks per the procedure.

FUEL PRESSURE REGULATOR

Overview

The fuel pressure regulator assembly consists of a high-pressure inlet, fuel supply solenoid, pressure regulator, fuel level pressure sender, low-pressure outlet, pressure relief device, and coolant barbs.



Removal

1. Perform *Depressurizing Fuel Lines and Rails* procedure.
2. Remove coolant lines.

NOTE: Follow proper health and safety precautions working with coolant.

3. Remove the line from the pressure relief valve.
4. Unplug pressure sender connector.
5. Slowly loosen low- and high-pressure fuel lines, then disconnect them.
6. Remove the two (2) screws mounting the pressure regulator to the bracket.

Replacement

1. Align pressure regulator with the holes on the bracket.
2. Hand-tighten the screws, securing the regulator to the bracket.
3. Hand-tighten the two (2) fuel line fittings.
4. Torque the fitting connecting the low-pressure line to the regulator to 55 Nm.
5. Torque the fitting connecting the high-pressure line to the regulator to 40 Nm.
6. Install coolant lines and spring clamps.
7. Plug in pressure sender connection.
8. Install line to pressure relief device.
9. Torque mounting screws to 20 Nm.
10. Refill and evacuate air from the cooling system as necessary per the Blue Bird workshop manual procedure.
11. Perform *Re-Pressurizing Fuel System* procedure and test for leaks per the procedure.

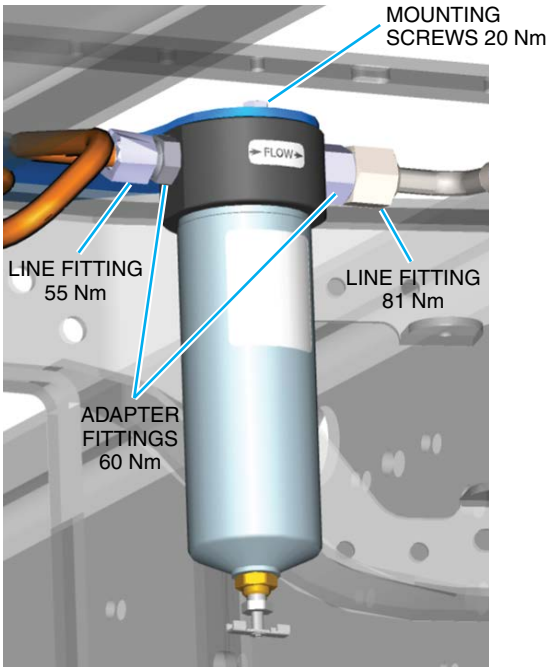
LOW PRESSURE FILTER ASSEMBLY

Removal

1. Perform *Depressurizing Fuel Lines and Rails* procedure.
2. Slowly loosen then remove the line connection on both sides of the filter assembly.
3. Remove the two (2) screws securing the high-pressure filter to the bracket.
4. Remove the low-pressure filter assembly.

Replacement

1. Align the low-pressure filter assembly on the bracket so that the flow direction arrow points away from the pressure regulator.
2. Hand-tighten the two (2) screws securing the filter to the bracket.
3. Hand-tighten the two (2) lines on either side of the high-pressure fuel filter.
4. Counter brace the adapter fitting and torque each fitting to 55 Nm.
5. Torque the mounting screws 20 Nm.
6. Perform *Re-Pressurizing Fuel System* procedure and test for leaks.



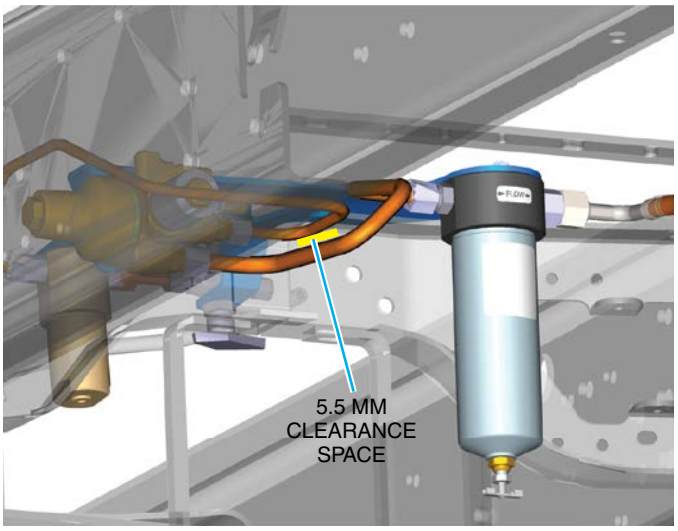
REGULATOR ASSEMBLY FUEL LINES

Removal

1. Perform *Depressurizing Fuel Lines and Rails* procedure.
2. Slowly loosen the fitting on the outlet of the high-pressure filter, then unthread the line fitting.
3. Unthread the high-pressure inlet line fitting on the inlet of the pressure regulator.
4. Remove the high-pressure line.
5. Slowly loosen the line fitting on the inlet of the low-pressure filter, then unthread the line fitting.
6. Unthread the low-pressure line fitting on the outlet of the pressure regulator.
7. Remove the low-pressure line.

Replacement

1. Loosen the mounting bolts for the low- and high-pressure filter to allow for some movement.
2. Align and hand-tighten the fittings on the low-pressure line.
3. Align and hand tighten the fitting on the high-pressure line.
4. Clock lines so there is at least 5.5 mm of space between the two (2) lines at any point.



5. Ensure the space between lines is retained.
6. Torque fittings on the low-pressure line to 55 Nm. Counter brace the adapter when tightening.
7. Torque fittings on the high-pressure line to 40 Nm. Counter brace the adapter when tightening.
8. Torque the low- and high-pressure filter mounting screws.
9. Perform *Re-Pressurizing Fuel System* procedure and test for leaks by using a leak detection solution.

FORWARD FUEL SUPPLY LINE

Removal

1. Perform *Depressurizing Fuel Lines and Rails* procedure.
2. Unthread the forward fuel supply line fittings from the low-pressure filter.
3. Unthread the forward fuel supply line from the Y-connector.
4. Remove the forward fuel supply line.

Replacement

1. Position forward supply line and hand-tighten the fitting to the low-pressure filter and Y-connector.
2. Torque both fittings to 40 Nm.
3. Perform *Re-Pressurizing Fuel System* procedure and test for leaks by using a leak detection solution.

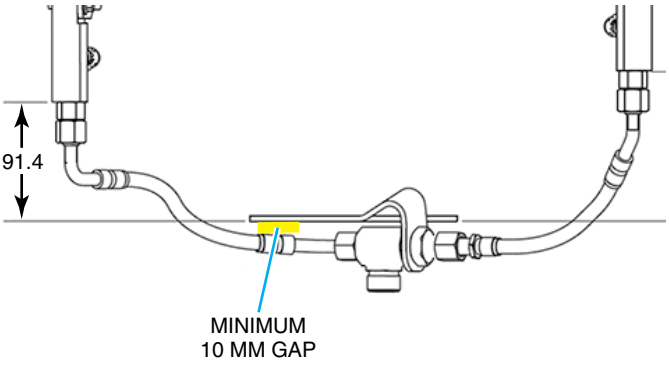
FUEL RAIL SUPPLY LINES

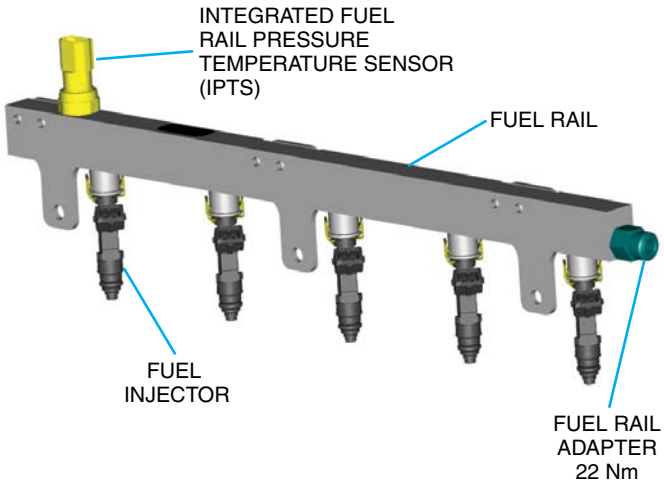
Removal

1. Perform *Depressurizing Fuel Lines and Rails* procedure.
2. Unthread the fuel rail supply line fittings from the Y-connector.
3. Counter brace the adapter fitting and unthread the fuel rail supply line from the fuel rail adapter.
4. Remove the fuel rail supply lines.

Replacement

1. Position fuel rail supply line and hand-tighten the fitting to the Y-connector and fuel rail.
2. Ensure there is at least 10 mm of space between the left fuel rail supply line and the bracket for the Y-connector.

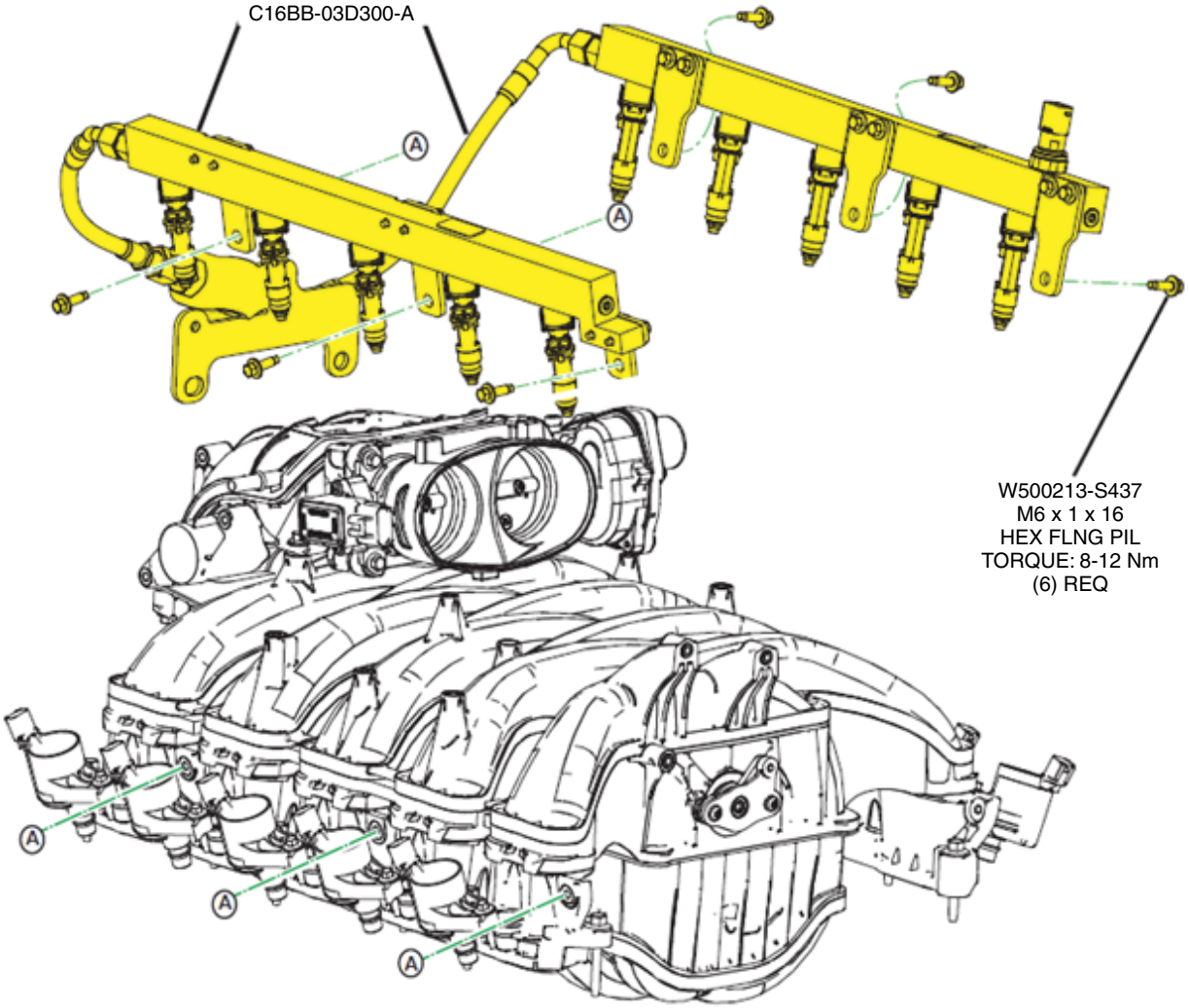




Removal

1. Perform *Depressurizing Fuel Lines and Rails* procedure.

2. Counter brace the fuel rail adapter fitting and unthread the fuel rail supply line fitting on the back of each fuel rail.
3. Remove the six (6) fuel rail mounting screws.



4. Lift up on the rails to remove them from the intake manifold.

Replacement

1. Inspect the fuel injector O-rings. Replace if necessary.
2. Lubricate the O-rings at the bottom of the injectors with clean engine oil.
3. Insert the fuel rails into the intake manifold. Push down firmly to fully seat the O-rings.
4. Install the six (6) fuel rail mounting screws. Torque to 8-12 Nm.
5. Hand-tighten the fuel rail supply lines to the fuel rail adapters.
6. Counter brace the adapter and torque the fuel rail supply fitting to 40 Nm.

FUEL INJECTORS

Removal

1. Perform *Depressurizing Fuel Lines and Rails* procedure.
2. Remove the fuel rail per the *Fuel Rail Removal* procedure.

3. Carefully remove the injector retention clip securing the fuel injector to the fuel rail.
4. Remove the fuel injector.

Replacement

1. Inspect the fuel injector O-rings. Replace if necessary.
2. Lubricate the injector O-rings with clean engine oil.
3. Insert the fuel injector into the fuel rail. Clock injector as seen in fuel rail diagram.
4. Install the injector retention clip.
5. Install the fuel rail assembly per the *Fuel Rail Replacement* procedure.
6. Perform *Re-Pressurizing Fuel System* procedure and test for leaks by using a leak detection solution.

FUEL RAIL PRESSURE/ TEMPERATURE SENSOR (IPTS)

Removal

1. Perform *Depressurizing Fuel Lines and Rails* procedure.
2. Unplug the electrical connector from the IPTS.
3. Unthread the IPTS from the fuel rail.

Replacement

1. Install the IPTS into the fuel rail and torque to 7 Nm.
2. Connect the electrical connector to the IPTS.
3. Perform *Re-Pressurizing Fuel System* procedure and test for leaks.

GATEWAY MODULE

Removal

1. Disconnect the negative ground cables from the vehicle batteries. Ensure battery is disconnected before proceeding.
2. Disconnect the main harness connector at the Gateway Module.
3. Remove the four (4) mounting bolts and retain.
4. Remove the Gateway Module.

Replacement

1. Install the Gateway Module to the isolators using the four (4) bolts and torque to 11.5 Nm.
2. Connect the main harness connector to the Gateway Module.
3. Push until the connector is fully seated, then close lever until the tab locks it in place.
4. Connect the vehicle batteries.

ROUSH CLEANTECH SYSTEM USE AND MAINTENANCE

Use, maintenance, service, and repair of the ROUSH CleanTech System must be in accordance with regulations put forth by the NFPA in their pamphlets #52, by the American Society of Mechanical Engineers (ASME), the Department of Transportation (DOT), the American National Standards Institute (ANSI) and all applicable federal, state, provincial and local authorities. Among those responsible for compliance are the maintenance provider, refueler and end-user personnel.

Service Recommendations

It is strongly recommended that all service needs for the engine and fuel system of the ROUSH CleanTech System installed on your vehicle be referred to a qualified CNG service technician. Working with compressed natural gas that fuels an internal combustion engine requires special training. Technical issues involving starting, operating or re-fueling a CNG powered bus should be reported to your local qualified service provider. In the event further technical assistance is needed, you should first contact your authorized Blue Bird Dealer regarding any technical issues with your Blue Bird product. Customer support on the ROUSH CleanTech fuel system can be reached by contacting 800-59-ROUSH (597-6874).

DIAGNOSTICS

Diagnostic Trouble Codes

Diagnostic Trouble Code Chart

Below are a list of trouble codes unique to the ROUSH CleanTech CNG fuel system, or where the logic or component function involved in the trouble code have been changed from the description of the DTC in the Ford Workshop Manual. For non-CNG Vision specific codes, refer to the Ford Powertrain Control/Emissions Diagnosis Service Manual at www.motorcraft.com (F-650) for diagnostic information.

ROUSH CleanTech Diagnostic Trouble Codes

These diagnostic trouble codes (DTCs) are added or modified from the base Ford calibration strategy for the 6.8L V10.

P0148 — Fuel Delivery Error

Description	At least one bank is lean at WOT.
Possible Causes	• Low fuel level • Severely restricted low-pressure filter • Severely restricted high-pressure filter • Faulty fuel pressure regulator • Kinked or crushed fuel line • 3-way valve in the wrong position • Tank valves closed
Symptom	Vehicle hesitation or stall condition.
Diagnostic Aid	—
Action	Refer to *Engine Stumble, Stall, Roush Idle* procedures.

P0181 — Fuel Temperature Sensor "A" Circuit Range/Performance

Description	This DTC sets when fuel temperature sensor is outside of calibrated difference when compared to the inputs from IAT and CHT sensors.
Possible Causes	• CAN bus fault between the Gateway Module and the PCM • Wiring fault between IPTS and Gateway Module • Short to voltage in harness • Incorrect harness connection • Damaged IPTS • IPTS failure • Gateway Module failure
Symptom	Potential for vehicle hesitation or rough run.
Diagnostic Aid	The Gateway Module reads the IPTS and passes the voltage reading over the CAN bus to the PCM. The PCM monitors the voltage as if the sensor were plugged into the vehicle.
Action	Refer to the *Fuel Rail Pressure Temperature Sensor Test* procedure.

P0182 — Fuel Temperature Sensor "A" Circuit Low

Description	This fault sets when the PCM detects the FRT circuit is open or shorted to ground.
Possible Causes	• CAN bus fault between the Gateway Module and PCM • Wiring fault between IPTS and Gateway Module • Short to ground in harness • VREF open or short • Low ambient temperature operation • Incorrect harness connection • Damaged IPTS (or FTS) • IPTS failure • Gateway Module failure
Symptom	Potential for vehicle hesitation or rough run.
Diagnostic Aid	Verify the fuel rail temperature PID value to determine open or short.
Action	Refer to the *Fuel Rail Pressure Temperature Sensor Test* procedure.

P0183 — Fuel Temperature Sensor "A" Circuit High

Description	This fault sets when the PCM detects the FRT circuit is open or shorted to ground.
Possible Causes	• CAN bus fault between the Gateway Module and PCM • Wiring fault between IPTS and Gateway Module • Short in harness • Incorrect harness connection • Damaged IPTS (or FTS) • IPTS failure • Gateway Module failure
Symptom	Potential for vehicle hesitation or rough run.
Diagnostic Aid	Verify the fuel rail temperature PID value to determine open or short.
Action	Refer to the *Fuel Rail Pressure Temperature Sensor Test* procedure.

P0192 — Fuel Rail Pressure Sensor Circuit Low (Bank 1)

Description	This DTC sets when the PCM detects the FRP circuit is shorted to ground or open.
Possible Causes	• CAN bus fault between the Gateway Module and PCM • Wiring fault between IPTS and Gateway Module • Short in harness • Low ambient temperature operation • Incorrect harness connection • Damaged IPTS (or FTS) • IPTS failure • Gateway Module failure
Symptom	Vehicle hesitation or rough run.
Diagnostic Aid	Verify the fuel rail temperature PID value to determine open or short.
Action	Refer to the *Fuel Rail Pressure Temperature Sensor Test* procedure.

P0193 — Fuel Rail Pressure Sensor Circuit High (Bank 1)

Description	This DTC sets when the PCM detects the FRP circuit is shorted to ground or open.
Possible Causes	• CAN bus fault between the Gateway Module and PCM • Wiring fault between IPTS and Gateway Module • Short in harness • VREF open or short • Low ambient temperature operation • Incorrect harness connection • Damaged IPTS (or FTS) • IPTS failure • Gateway Module failure
Symptom	Vehicle hesitation or rough run.
Diagnostic Aid	Verify the fuel rail temperature PID value to determine open or short.
Action	Refer to the *Fuel Rail Pressure Temperature Sensor Test* procedure.

P025A — Fuel Pump Module "A" Control Circuit/Open

Description	This DTC sets when the PCM detects the FPC circuit is open or shorted to voltage. When the PCM commands the fuel pump (FP) ON, the PCM can detect a short to voltage on the FPC circuit. When the PCM commands the FP OFF, the PCM can detect an open circuit or a short to ground on the FPC circuit.
Possible Causes	Shorted or open wiring to the electronic fuel pump relay (EFPR)
Symptom	• Crank no-start • Stumble stall
Diagnostic Aid	The CNG fuel system has no fuel pump, rather an EFPR is used to power the supply solenoid in the fuel pressure regulator.
Action	Refer to the Blue Bird Wiring diagram to test wire continuity (vantage.blue-bird.com).

P025B — Fuel Pump Module "A" Control Circuit Range/Performance

Description	The fuel pump control module monitors the duty cycle and frequency of the signal it receives from the PCM. The fuel pump control module determines if the signal from the PCM on the FPC circuit is a valid duty cycle and frequency. If the duty cycle or frequency is invalid, the fuel pump control module sends a 20% duty cycle signal on the FPM circuit to report the concern to the PCM. This DTC sets when the fuel pump control module is still reporting that it is receiving an invalid duty cycle or frequency from the PCM after a calibrated amount of time.
Possible Causes	Refer to the Ford Powertrain Control/Emissions Diagnosis Service Manual at www.motorcraft.com (F-650) for possible causes.
Symptom	• Crank no-start • Stumble stall • Rough idle • Low power
Diagnostic Aid	The CNG fuel system has no fuel pump, rather an EFPR is used to power the supply solenoid in the fuel pressure regulator.
Action	Test electronic fuel pump relay (EFPR) and related wiring.

P0462 — Fuel Level Sensor "A" Circuit Low

Description	This DTC sets when the fuel pressure signal is electrically less than the minimum allowable value.
Possible Causes	• Fuel pressure sender wiring shorted to ground • Low VREF power to fuel level sender • Open VREF • Damaged fuel pressure sender • Faulty Gateway Module
Symptom	Fuel gauge will show empty regardless of fuel level.
Diagnostic Aid	The Gateway Module reads fuel level sender input and broadcasts it to the PCM and IC.
Action	Refer to the *Fuel Level Sender Test* procedure.

P0463 — Fuel Level Sensor "A" Circuit High

Description	This DTC sets when the fuel pressure signal is electrically less than the minimum allowable value.
Possible Causes	• Fuel pressure sender wiring shorted to ground • Damaged fuel pressure sender • Faulty Gateway Module
Symptom	Fuel gauge will show empty regardless of fuel level.
Diagnostic Aid	The Gateway Module reads fuel level sender input and broadcasts it to the PCM and IC.
Action	Refer to the *Fuel Level Sender Test* procedure.

P25B0 — Fuel Level Sensor "A" Stuck

Description	If the vehicle is driven a considerable distance and the fuel level sender value doesn't change, the fault is set.
Possible Causes	• Damaged fuel level sender • Wiring fault between fuel level sender and Gateway Module • Faulty Gateway Module
Symptom	Fuel level does not change correctly with fuel use and refueling.
Diagnostic Aid	The Gateway Module reads fuel level sender input and broadcasts it to the PCM and IC.
Action	Refer to the *Fuel Level Sender Test* procedure.

U0108 — Lost Communication with Alternative Fuel Control Module

Description	Lost communication with the Gateway Module. The PCM monitors CAN bus communication for missing messages from the Gateway Module. If the messages are continuously missing, a fault is set.
Possible Causes	• Wiring issue between the Gateway Module and the PCM • No power to the Gateway Module • Missing ground to the Gateway Module • Blown fuse for the Gateway Module
Symptom	• Crank, no start • Stumble, stall • Rough idle
Diagnostic Aid	—
Action	Refer to *Gateway Module Test* procedure.

U0109 — Loss of Communication on Fuel Pump Control Module "A"

Description	The Gateway Module repeats the signal from the second EFPR to the PCM over the CAN bus. The PCM monitors this communication. If there is a lack of communication for a long enough period of time, a fault is set.
Possible Causes	• Wire fault between the EFPR and Gateway Module • Wire fault between Gateway Module and PCM • No power to the EFPR • Gateway Module fault • CAN bus fault • Blown fuse • Refer to the Ford Powertrain Control/Emissions Diagnosis Service Manual for a list of other causes.
Symptom	—
Diagnostic Aid	The CNG fuel system has no fuel pump, rather an EFPR is used to power the supply solenoid in the fuel pressure regulator.
Action	Test electronic fuel pump relay (EFPR) and related wiring.

DIAGNOSTIC TESTS AND PROCEDURES

Parameter ID (PID) List

This is a list of PIDs that monitor unique ROUSH CleanTech CNG fuel system components.

Parameter	Ford PID	Description
Fuel Rail Pressure	FRP	Fuel rail pressure relative to manifold vacuum.
Fuel Rail Temperature	FRT	Fuel rail temperature
Fuel Level	FL (per)	Fuel level percentage
Fuel Pump Mode	FP #	On/off status of the electronic fuel pump module. On the CNG bus this controls the supply solenoid in the fuel pressure regulator.
Fuel Pump Percentage	FP (per)	Duty cycle sent to the electronic fuel pump module that controls the supply solenoid in the fuel pressure regulator.

Engine Does Not Crank

Step	Procedure	Action
1	**Is battery voltage above 10 volts?**	**Yes** — Go to Step 2. **No** — Determine cause of low battery voltage.
2	**Refer to *Blue Bird Multiplex Diagnostics* to determine if start signal is going to the PCM.** Is the problem corrected?	**Yes** — Diagnostic is complete. **No** — Go to Step 3.
3	**Refer to the Ford Powertrain Control/Emissions Diagnosis Service Manual at www.motorcraft.com (F-650) starting system diagnostic.** Is the problem corrected?	**Yes** — Diagnostic is complete. **No** — Call ROUSH CleanTech Customer Service at 800-597-6874.

Engine Cranks, No Start

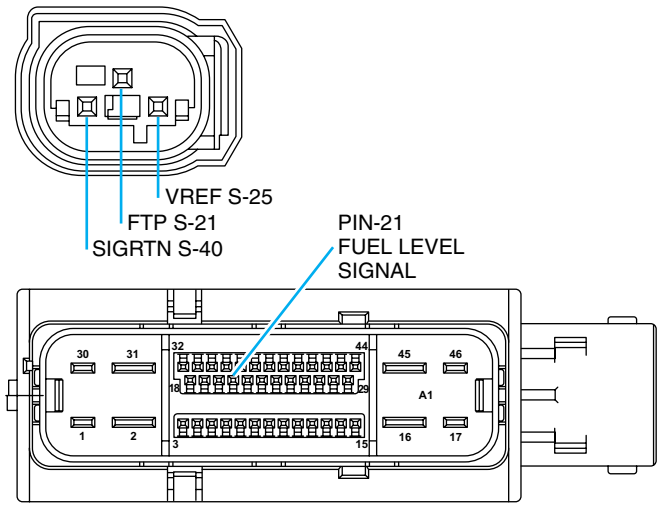
Step	Procedure	Action
1	**Verify the following:** a. Is there fuel in the tank of at least 1/8 tank or more (add fuel if necessary)? b. Are the three (3) tank shut-off valves fully open? c. Are the emergency shut-offs at the refueling locations fully open? d. Is the 3-way valve in the on position? e. Does the battery voltage stay above 11 volts during crank? f. Check fuse for the fuel supply solenoid.	**Yes** — Go to Step 2. **No** — Correct fault and retry.
2	**Check for diagnostic trouble codes (DTC).** Are any codes present?	**Yes** — Go to Step 3. **No** — Go to Step 4.
3	**Is the DTC identified on the ROUSH CNG DTC list?**	**Yes** — Refer to Roush DTC diagnostics. If issue is not resolved, go to Step 4. **No** — Refer to the Ford Workshop Manual F-650 Diagnostic Trouble Codes.
4	**Check fuel pressure.** a. Measure and record fuel rail and fuel tank pressure, key on, engine off (KOEO). b. Is fuel pressure within specification? 7.0 +/- 0.5 barg (101.5 +/- 7.25 psig).	**Yes** — Refer to the Ford Workshop Manual F-650 for engine cranks, no start. **No** — If pressure is too high, replace the pressure regulator. If pressure is too low, go to step 5.
5	**Is fuel pressure above 10 psi?**	**Yes** — Go to Step 6. **No** — Perform supply solenoid electrical test.
6	**Remove low- and high-pressure filter bowl per the procedures in this manual.** Do the filter elements have signs of contamination?	**Yes** — Replace filter element(s). **No** — Replace pressure regulator. Contact 800-59-ROUSH if problem persists.

Engine Stumble, Stall, Rough Idle

Step	Procedure	Action
1	**Verify the following:** a. Does the fuel gauge indicate at least 1/8th tank of fuel (refuel if necessary)? b. Are the three (3) tank shut-off valves fully open? c. Are the emergency shut-offs at the refueling locations fully open? d. Does the battery voltage stay above 11 volts during crank? e. Check for air restrictions and un-metered air leaks (air filter, vacuum leaks).	**Yes** — Go to Step 2. **No** — Correct the fault and retry.
2	**Check for diagnostic trouble codes (DTCs).** Are any codes present?	**Yes** — Go to Step 3. **No** — Go to Step 4.
3	**Is the DTC identified on the ROUSH CNG DTC list?**	**Yes** — Refer to Roush DTC diagnostics. If issue is not resolved, go to step 4 **No** — Refer to the Ford Workshop Manual F-650 Diagnostic Trouble Codes.
4	**Check fuel pressure.** a. Measure and record fuel rail pressure using an OBDII scan tool. b. Is fuel pressure within specification? 7.0 +/- 0.5 barg (101.5 +/- 7.25 psig).	**Yes** — Go to Step 7. **No** — Go to Step 5.
5	**Perform *Fuel Rail Pressure Temperature Sensor Test*.** Does the test pass?	**Yes** — Go to Step 6. **No** — Replace sensor or wiring concern per procedure.
6	**Remove low- and high-pressure filter bowl per the procedures in this manual.** Do the filter elements have signs of contamination?	**Yes** — Replace filter element(s). **No** — Replace pressure regulator. Contact 800-59-ROUSH if problem persists.
7	**Perform the *Fuel Injector Electrical Test* on all ten injectors.** Are injectors and wiring functioning properly?	**Yes** — Go to Step 8. **No** — Replace injector(s) or wiring per diagnostic.
8	**Refer to the Ford Workshop Manual F-650 for Engine Stumble, Stall Rough Idle.** Is the issue resolved?	**Yes** — Diagnostic complete. **No** — Contact Roush support at 800-59-ROUSH.

Fuel Level Sender Test

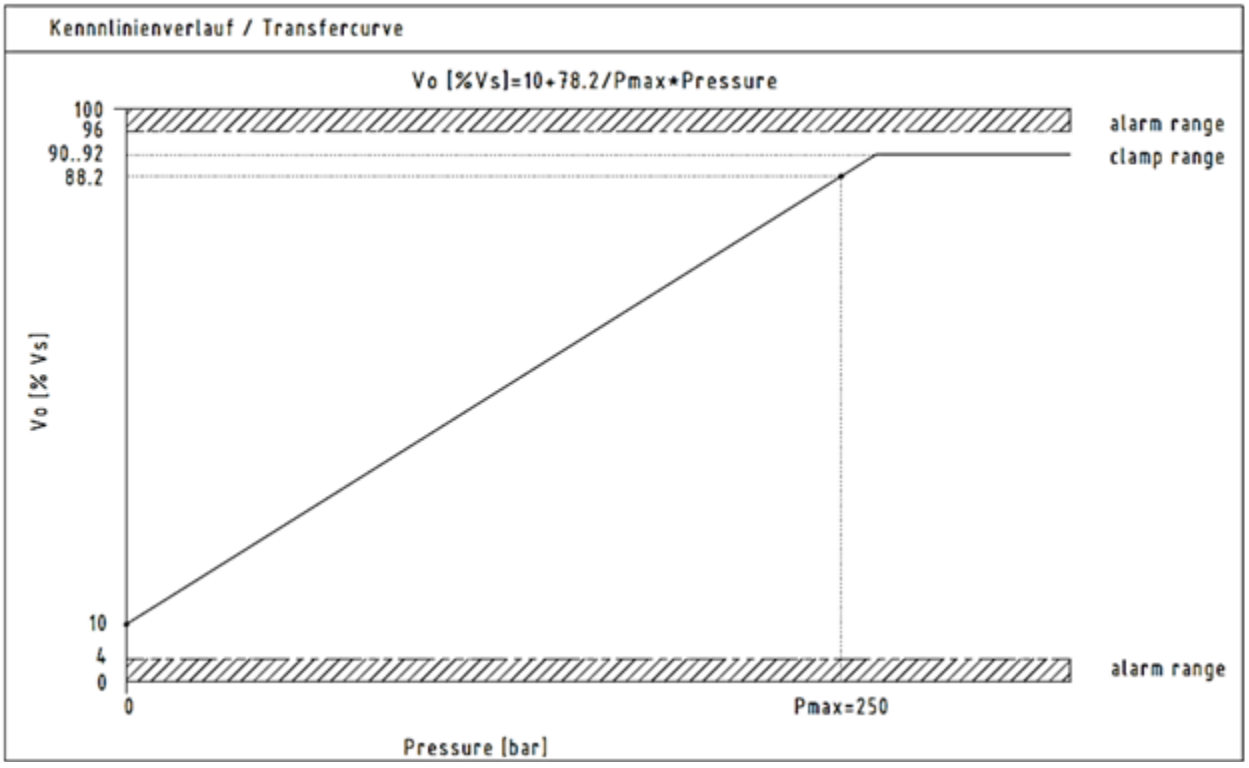
The fuel level sender detects the pressure at the high-side of the regulator and sends a voltage signal to the Gateway Module indicating fuel level.



Step	Procedure	Action
1	**Disconnect the connector for the fuel level pressure sender. Using a Digital Volt/Ohm Meter (DVOM), measure voltage from the power wire of the fuel level sender to the ground wire of the fuel level sender with KOEO.** Is 5v power present? **NOTE** If voltage is present but less than 5v, test other circuits and sensors on the 5v reference network to determine the cause of the voltage drop. Refer to the Blue Bird wiring diagram (vantage.blue-bird.com).	**Yes** — Go to Step 3. **No** — Go to Step 2.
2	**With the positive probe still on the power wire, move the ground probe to a good chassis ground.** Is 5v power present?	**Yes** — Repair ground wire. **No** — Repair the power wire.
3	**Check continuity between the signal wire (FTP S-21) at the fuel level sender and pin-21 at the Gateway Module connector.** Is there continuity?	**Yes** — Go to Step 4. **No** — Repair wiring concern.
4	**Plug in the sending unit connector and check voltage between the signal wire and ground.** Is voltage between 0.5v and 4.55v?	**Yes** — Go to Step 5. **No** — Replace the fuel level sender sensor.

Step	Procedure	Action
5	**Check voltage at pin-21 of the Gateway Module.** Does it read the same at the signal wire at the sensor?	**Yes** — Find voltage drop on signal wire and repair. **No** — Go to Step 6.
6	**Drive vehicle for at least 10 miles or refuel vehicle. Recheck voltage at the signal wire.** Has voltage changed?	**Yes** — Replace the fuel level sender sensor. **No** — Contact Roush CleanTech support 800-59-ROUSH.

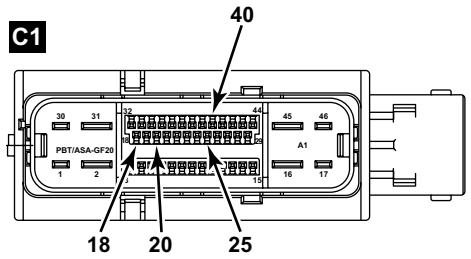
Fuel Pressure Sender Specifications

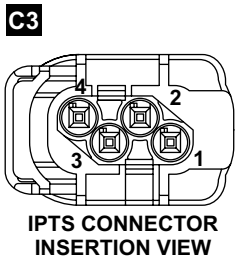


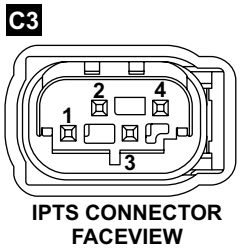
Fuel Injector Test

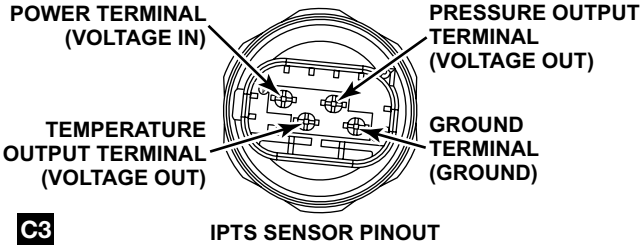
Step	Procedure	Action
1	**Disconnect the electrical connector from the fuel injector. Using a noid light or appropriate tool, check for signal to the injector with KOER.** Is there consistent signal to the injector?	**Yes** — Go to Step 3. **No** — Go to Step 2.
2	**Perform the same signal test as step 1 on the injector driver wire at the PCM connector. Refer to the Blue Bird wiring diagram (vantage.blue-bird.com).** Is there consistent signal to the wire?	**Yes** — Repair wiring concern. **No** — Replace the PCM.
3	**Swap the injector with another injector on the vehicle.** Does the concern follow the injector?	**Yes** — Replace the injector. **No** — Injector is not cause of fault.

Integrated Fuel Rail Pressure Temperature Sensor Test









Step	Procedure	Action
1	**Unplug connector 3 (underhood harness) to integrated fuel rail pressure temperature sensor (IPTS).**	Go to Step 2.
2	**Check resistance of the IPTS.** a. Vehicle at ambient room temperature (20-30°C, 68-86°F). b. Using a digital volt ohm meter (DVOM), measure resistance across the IPTS terminal pin-1 and pin-3. c. Is the resistance value between 8K-12K ohms?	**Yes** — Go to Step 3. **No** — Replace the IPTS.
3	**Check circuit continuity between the IPTS and the Gateway Module.** a. Using a DVOM, check continuity in the underhood harness between: • Pin-1, connector C3 and pin-40, connector C1 • Pin-2, connector C3 and pin-20, connector C1 • Pin-3, connector C3 and pin-18, connector C1 • Pin-4, connector C3 and pin-25, connector C1 b. Is there good continuity in the circuits?	**Yes** — Contact ROUSH Support at 800-59-ROUSH. **No** — Repair circuit wiring.

IPTS Temperature/Resistance Chart

Temp, °C	A R, Nom.	A R, Min.	A R, Max.
–40	316181	301183	331179
–30	169149	162304	175994
–20	94143	90938	97349
–10	54308	52781	55836
0	32014	31290	32738
10	19691	19346	20036
20	12474	12315	12633
25	10000	8900	10100
30	8080	7977	8182
40	5372	5282	5462
50	3661	3585	3737
60	2536	2474	2598
70	1794	1744	1844
80	1290	1250	1330
90	941.8	909.8	974.0
100	697.2	671.3	723.1
110	524.9	504.0	545.9
120	399.6	382.6	416.6
130	308.4	294.6	322.3
135	271.3	258.6	283.9

Fuel Rail Pressure Test

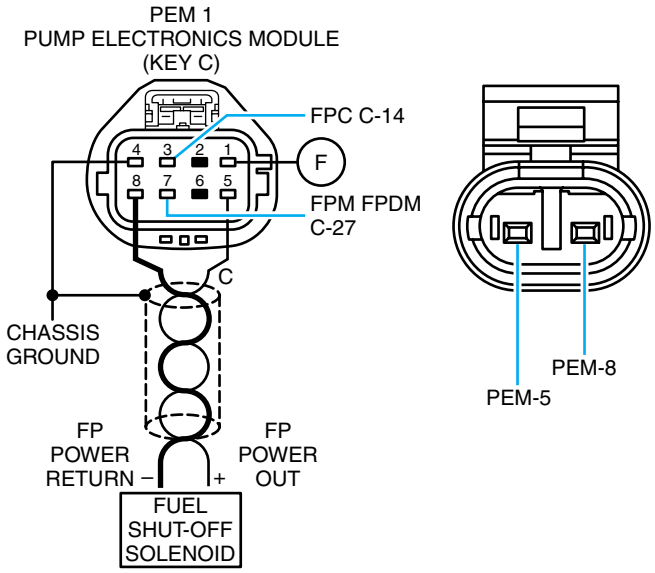
Step	Procedure	Action
1	**Unplug connector 3 (underhood harness) to integrated fuel rail pressure temperature sensor (IPTS).**	Go to Step 2.
2	**Using a DVOM, measure voltage from the power wire to the ground wire of the IPTS with KOEO.** Is 5v power present? **NOTE** If voltage is present but less than 5v, test other circuits and sensors on the 5v reference network to determine the cause of the voltage drop. Refer to the Blue Bird wiring diagram (vantage.blue-bird.com).	**Yes** — Go to Step 4. **No** — Go to Step 3.

Step	Procedure	Action
3	**With the positive probe still on the power wire, move the ground probe to a good chassis ground.** Is 5v power present?	**Yes** — Repair ground wire. **No** — Repair the power wire.
4	**Plug in connector 3. Using a universal probe, read voltage from the signal wire (pin-2).** Is voltage between 0.5v and 1.5 volts?	**Yes** — Go to Step 5. **No** — Replace the fuel level sender sensor.
5	**Check circuit continuity between the IPTS and the Gateway Module.** a. Using a DVOM, check continuity in the underhood harness between: • Pin-1, connector C3 and pin-40, connector C1 • Pin-2, connector C3 and pin-20, connector C1 • Pin-3, connector C3 and pin-18, connector C1 • Pin-4, connector C3 and pin-25, connector C1 b. Is there good continuity in the circuits?	**Yes** — Contact ROUSH Support 800-59-ROUSH. **No** — Repair circuit wiring.

Fuel Rail Pressure Sensor Values

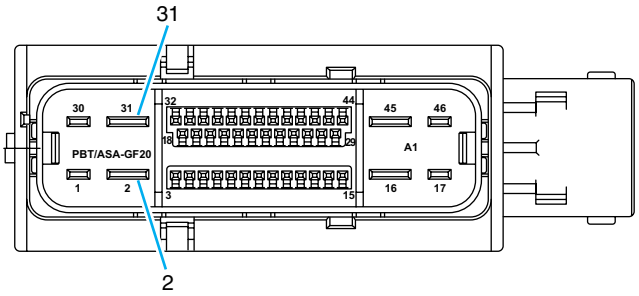
Vout	PSIA	Vout	PSIA
0.5	0.0	2	191.2
0.6	12.7	2.1	204.0
0.7	25.5	2.2	216.7
0.8	38.2	2.3	229.5
0.9	51.0	2.4	242.2
1	63.7	2.5	255.0
1.1	76.5	2.6	267.7
1.2	89.2	2.7	280.5
1.3	102.0	2.8	293.2
1.4	114.7	2.9	306.0
1.5	127.5	3	318.7
1.6	140.2	3.1	331.5
1.7	153.0	3.2	344.2
1.8	165.7	3.3	357.0
1.9	178.5	3.4	369.7

Supply Solenoid Test



Step	Procedure	Action
1	**Measure fuel rail pressure using an OBDII scan tool.** Is fuel rail pressure within specification with KOER (after a start attempt if vehicle will not start) 7.0 +/- 0.5 barg (101.5 +/- 7.25 psig)?	**Yes** — Supply solenoid is functioning properly. **No** — Go to Step 2.
2	**Using a universal probe and a digital volt ohm meter (DVOM), measure voltage to the supply solenoid with KOER.** Is voltage at least 12v?	**Yes** — Go to Step 3. **No** — Test operation of the electronic fuel pump relay (EFPR). Repair fuse, wiring, or EFPR.
3	**Test for ground at the ground wire on the supply solenoid connector.** Is there a good ground at the connector?	**Yes** — Repair ground wire. **No** — Repair the power wire.
4	**Measure amp draw on the power wire going to the supply solenoid. Amp draw with KOER should between 0.78-0.88 amps at 68°F (amperage may change slightly with temperature).** Is amp draw within specification?	**Yes** — Call Roush support at 800-59-ROUSH. **No** — Replace pressure regulator.

Gateway Module Test



Step	Procedure	Action
1	**Disconnect the Gateway Module connector. Refer to the *Blue Bird Service Manual* for circuit information.**	Go to Step 2.
2	**Check for battery voltage (B+) to the Gateway Module.** a. Using a multimeter, check for B+ voltage at cavity 2 of the SRM connector. Use the body as a reference ground. b. Is there voltage (B+)?	**Yes** — Go to Step 5. **No** — Go to Step 3.
3	**Check for continuity in the circuits.** a. Check circuit continuity between cavity 2 of the Gateway Module connector and the Blue Bird fuse box. Refer to the *Blue Bird Service Manual* for fuse box and circuit information. b. Is there good continuity in the circuit?	**Yes** — Go to Step 4. **No** — Repair circuit wiring.
4	**Check Gateway Module fuse at fuse box.** a. Check condition of Gateway Module power fuse in the Blue Bird fuse box. Refer to the *Blue Bird Service Manual* for fuse box and circuit information. b. Is fuse blown?	**Yes** — Replace fuse. **No** — Go to Step 5.
5	**Check the Gateway Module ground circuit for continuity.** a. Using a multimeter, check ground at cavity 31 of the Gateway Module connector. Use the body as a reference ground. b. Is there good continuity?	**Yes** — Go to Step 6. **No** — Repair circuit wiring.
6	**Check CAN wiring for Gateway Module circuit continuity. Refer to the *Blue Bird Service Manual* for circuit information.** a. Check Gateway Module circuits for continuity. b. Is there good continuity in the circuits?	**Yes** — Call ROUSH Technical Support at 800-59-ROUSH. **No** — Repair circuit wiring.