Diagnostic Service Manual

Freightliner Custom Chassis Corporation (FCCC) MT

CNG Fuel Systems

FCCC Model	Wheelbase
MT-45	168-in
MT-55	178-in
MT-55	208-in



DSM.0008 Ver. 1.0
February 24, 2022

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This manual is designed as a support document for trained technicians in the maintenance and diagnostic procedures of the compressed gas fuel system provided by Hexagon Agility®.

No attempt shall be made to fill, install, maintain, or repair this system until this manual and all referenced supporting documentation have been read and fully understood.

Original Equipment Manufacturer (OEM) replacement parts may be obtained by contacting Freightliner Customer Chassis Corporation (FCCC).

Fuel system warranty or non-warranty product support may be obtained by calling or emailing Hexagon Agility® Customer Care and Technical Services (CCTS).

Please provide **your name, phone number, email address, and complete vehicle information: VIN, year, make, model, mileage, unit number vehicle owner,** and **current vehicle location.** A service advisor will contact you to arrange vehicle repair or ship a part.

⚠WARNING

All replacement parts must adhere to the accepted standards and ratings as specified by Hexagon Agility®. Use of any part that is not approved by Hexagon Agility® is not recommended and may compromise the integrity and safety of the system.

NOTICE

Do not remove components from original packaging until necessary. Any components that are to be reinstalled must be thoroughly cleaned, inspected, and stored in a satisfactory manner until reinstallation.

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FCCC MT CNG

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AGA	American Gas Association
ANSI	American National Standards Institute
ASM	assembly
Bar	metric unit of pressure
CGA	Compressed Gas Association
CNG	compressed natural gas
CSA	Canadian Standards Association
DMM	digital multimeter
DS	driver side
ECM	electronic control module
ECU	electronic control unit
FMI	failure mode identifier
FMM	fuel management module

HP	high-pressure
IPC	instrument panel cluster
LP	low-pressure
MIL	malfunction indicator light
NFPA	National Fire Protection Association
NGV	natural gas vehicle
NSC	National Standards of Canada
OEM	original equipment manufacturer
PRD	pressure relief device
PS	passenger side
psi	pounds per square inch
SPN	suspect parameter number

Hexagon Agility® provides safety guidelines to ensure the safety of personnel servicing and / or operating compressed natural gas (CNG) equipment. All personnel involved must adhere to the standards provided, specialized training, along with federal, state, and municipal laws and regulations.

CNG presents unique characteristics that are distinctive from gasoline and diesel fuel. CNG when stored at ambient temperature and 3600 psi **(250 Bar)** is in a gaseous state.

CNG vehicles are equipped with temperature activated pressure relief devices (PRDs) to evacuate stored fuel safely in the event of a thermal event. PRDs trigger when cylinder(s) surroundings or internal enclosure temperatures exceed 220°F (110°C) and use vent lines with dedicated exits to evacuate the pressurized gas. The vent tube design allows for controlled evacuation/flaring under certain environmental conditions.

Hexagon Agility® minimizes these potential hazards through state-of-the art design and testing practices. Always observe the procedures and recommendations of this manual.

Warning and Signal Words Used in this Manual

Symbol	Definition
DANGER	**DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.**
WARNING	**WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.**
CAUTION	**CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.**
NOTICE	***NOTICE* is used to address practices not related to physical injury, such as best practices or tips to help an operation or procedure go smoothly and prevent equipment damage.**
SAFETY INSTRUCTIONS	**SAFETY INSTRUCTIONS indicate specific safety-related instructions or procedures.**
C	**CRITICAL CHARACTERISTIC − Product feature directly affects:** ▪ **Safety of vehicle users, people nearby and maintenance personnel, or** ▪ **Regulatory compliance.**
M	**MANUFACTURING CHARACTERISTIC −** ▪ **A product feature solely used to improve manufacturability or maintain process control.** ▪ **A process parameter or Step that has a significant effect on achieving a Critical Characteristic or Significant Characteristic or maintaining material identification/ traceability.**

Qualified Personnel

Due to the presence of high-pressure and flammable fuel, CNG fuels systems are a form of hazardous energy storage.

CNG systems must be maintained and inspected exclusively by trained personnel with qualifications in accordance with the applicable codes.

⚠WARNING **Individuals involved in any aspect of CNG fuel system maintenance, emergency response, servicing or testing must be properly trained. Individuals who are not trained are not permitted to service, maintain, test, or inspect a system.**

Safety Equipment

SAFETY INSTRUCTIONS **Observe all recommendations below when operating or servicing a CNG fuel system.**

1. CNG safety signage should be visible at all applicable locations as stipulated by federal, state, and municipal law.
2. Natural gas rated fire extinguishers should be accessible and visible throughout all servicing and fueling areas. Verify fire extinguishers are charged, up to date, and rated correctly.
3. In case of emergency, self-contained breathing apparatus should be on site in an easily accessible area.
4. Areas designated for CNG fueling systems must have adequate lighting that complies with NFPA code.
5. Protective eyewear and footwear should be worn by all personnel near a CNG system.
6. When locating the source of a leak only use certified leak detecting solutions such as Swagelok Snoop® or Formula 365 (p/n 10301242) or a combustible gas detector. Any other product or solutions are unacceptable.
7. Only use tools that are in good working order with proper calibration.
8. Wear appropriate attire and PPE while servicing or maintaining any CNG system.

General Safety Precautions

WARNING **Observe all recommendations below when operating or servicing a CNG fuel system. Strict compliance with proper safety and handling practices is essential when operating a CNG fuel system.**

1. Verify parking brake is engaged, wheels are chocked, and ignition switch is in OFF position.
2. Follow all maintenance procedures in the order in which they are written, do not skip steps unless with explicit permission from Hexagon Agility®.
3. Never use an open flame as a source of illumination in proximity to a CNG system. Natural gas is both volatile and explosive.
4. Any process or procedure that generates sparks, flames, or heated particles is ***never*** applicable in designated CNG area.
5. If a CNG system does require a process or procedure that generates sparks, flames, or significant heat, refer to ENP-442 for all Hot Work guidelines.
6. CNG fuel delivery systems are to be serviced in designated areas that comply will all federal, state, and municipal laws and regulations.
7. When performing service or repairs to any portion of the fuel system, install proper lockout/tagout (LOTO) device and observe all LOTO practices.
8. CNG servicing and fueling areas must be well ventilated as stipulated by federal, state, and municipal law.
9. Perform all maintenance and service procedures in a dust free environment.
10. Never attempt to open system components that are under pressure.
11. Never attempt to depressurize or vent a system by loosening a fitting.
12. A portable fire extinguisher rated for natural gas must be installed on the vehicle in an easily accessible location.
13. Do not start engine if a CNG leak is detected.
14. Verify all systems are grounded before transferring CNG fuel from one vehicle to another. Transferring CNG may cause a buildup of static electricity which could discharge and ignite the fuel.
15. Fuel system working pressure is up to 4500 psi **(310.2 Bar)**. Hot weather fill pressures commonly reach 4100 psi **(282.6 Bar)**.
16. Never smoke or produce an open flame near or around a CNG vehicle or a CNG dispensing/filling station.
17. Always ground vehicle prior to fueling or defueling.
18. If the vehicle will be out of service for an extended time, turn the 1/4-turn manual shut off valve to the OFF/CLOSED" position. To consume residual CNG forward of the 1/4-turn manual shutoff valve run the engine until it stalls.

Vehicle Fire Procedure

In the event of a CNG fire it is imperative that the vehicle operator acts quickly and efficiently by observing the following steps:

1. Turn off engine and set parking brake.
2. Get passengers out of vehicle as quickly as possible.
3. Evacuate the area.
4. Call 9-1-1.
5. Notify attending emergency personnel the vehicle is a CNG vehicle.
6. IF *possible and only with the proper training:* Extinguish fire using an appropriately rated fire extinguisher.

First Responder Guide

WARNING **For comprehensive emergency response procedures, refer to Hexagon Agility® publication ENP-084, "First Responder Guide: CNG and LNG Vehicle Fuel Systems."**

Vehicles equipped with compressed natural gas must have blue reflective decals on the rear of the vehicle identifying the fuel as CNG.

Blue diamond CNG decal cannot be installed on rear bumper per U.S. DOT mandate. Side CNG decals must be installed adjacent to vehicle DOT number.



CNG blue diamond decal, Hexagon Agility® p/n 10602105

Codes and Compliances

For complete and detailed information concerning CNG codes and regulations please refer to the following:

USA: NFPA 52

Canada: CAN/CGA B109

North America: ANSI/AGA NGV 3.1 / CGA 12.3 and NGV 12.3-M95

Return to Service Inspection

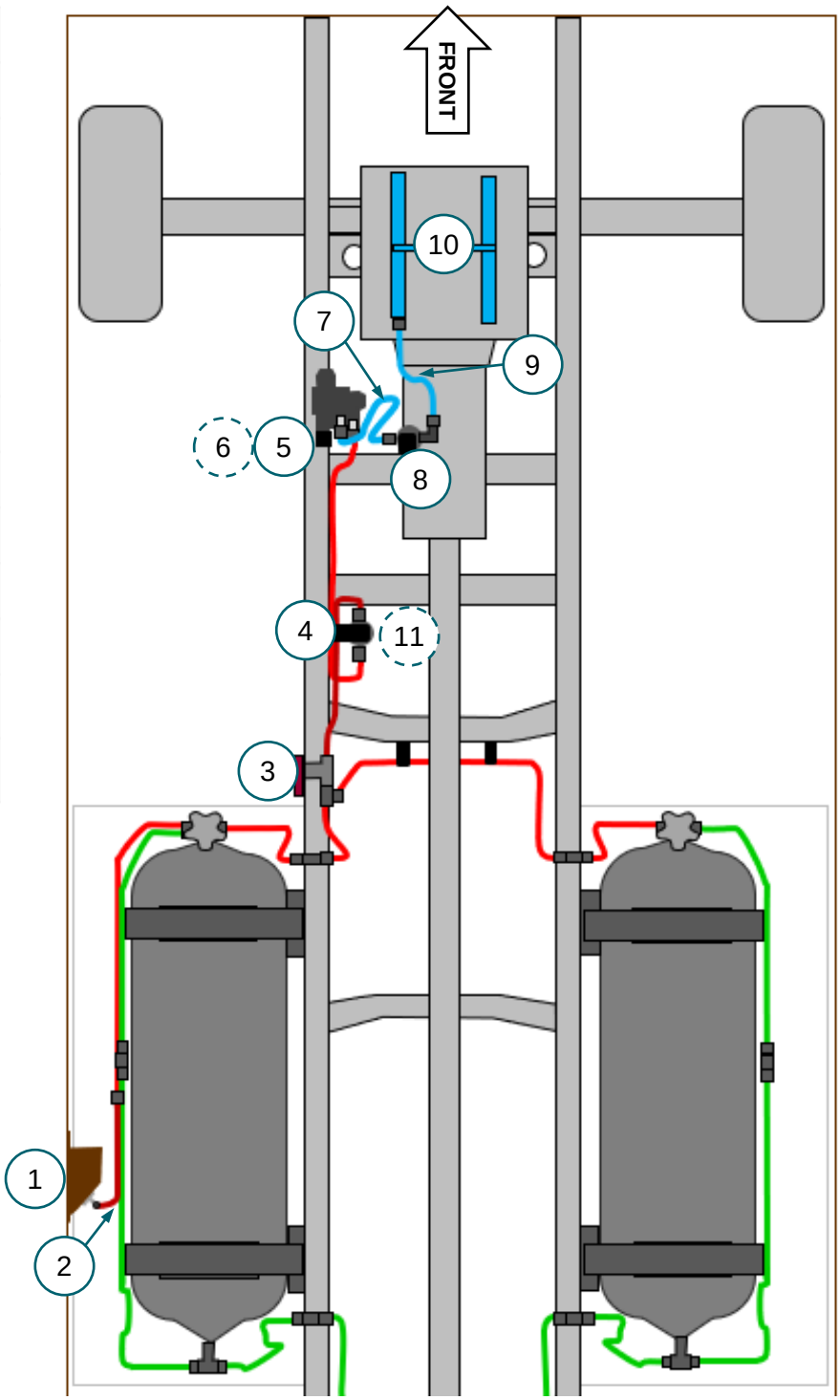
WARNING **If vehicle has been subjected to a fire or collision, the fuel storage system must be inspected by a qualified inspector before it can be returned to service.**

Fuel Delivery System Schematic

Item	Description
1	fuel fill panel
2	HP flexible fuel hose
3	1/4-turn manual shutoff valve
4	high-pressure (HP) fuel filter
5	pressure regulator
6*	supply solenoid valve (SSV)
7	low-pressure (LP) fuel tube
8	LP fuel filter
9	LP flexible fuel hose
10	fuel rails and fuel injectors
11†	bleed valve
—	LP fuel tubes
—	HP fuel tubes

**part of pressure regulator assembly*

†located on HP fuel filter



Fuel Storage and PRD Vent System Schematics

Fuel Storage System

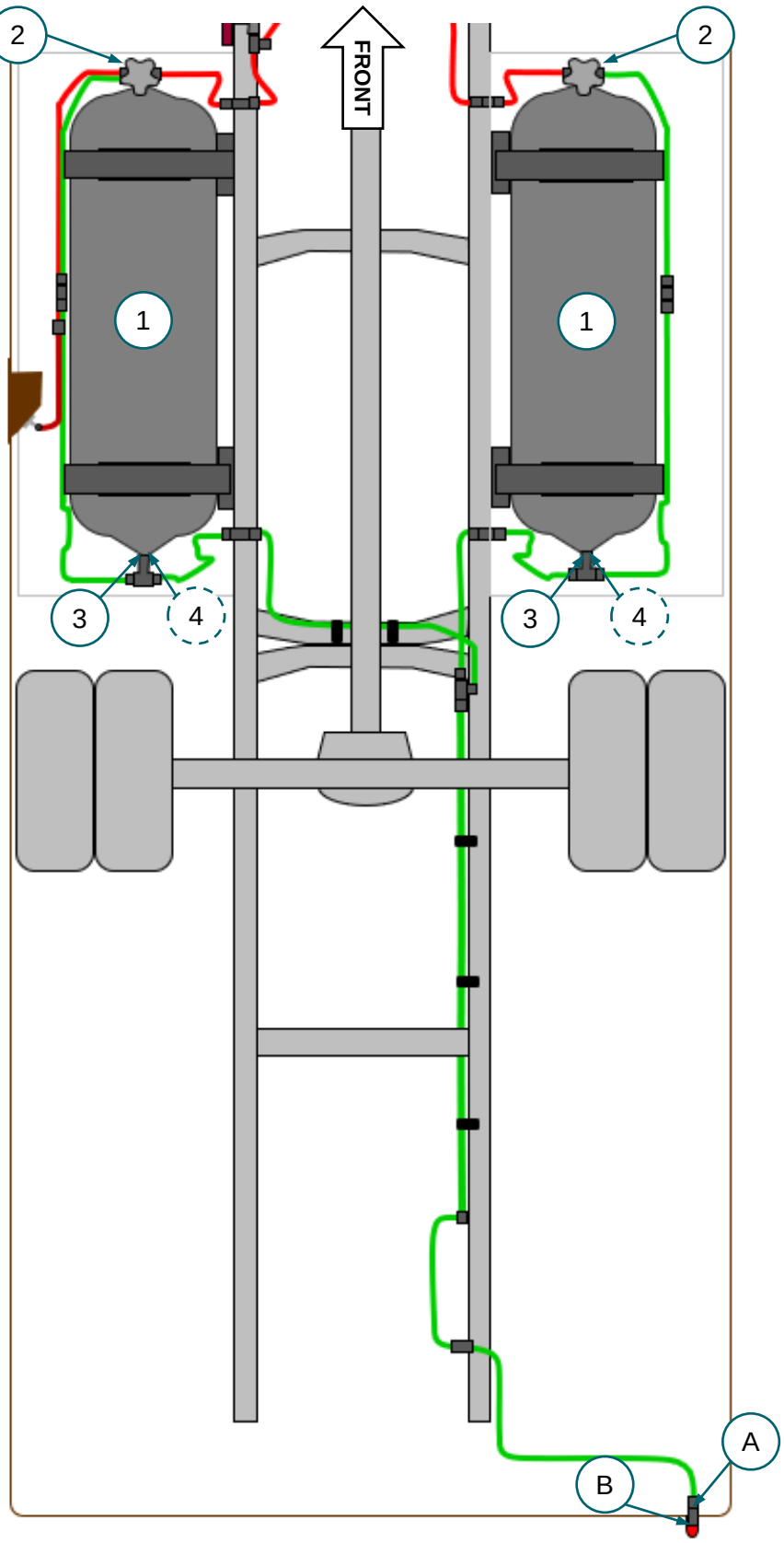
Item	Description
1	cylinders
2	cylinder manual valves
3	PRDs
4*	PRD adapters

**if equipped*

PRD Vent System

Item	Description
A	PRD vent outlet (45° elbow)
B*	PRD vent cap
——	PRD vent tubes

**part of PRD vent outlet assembly*



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The following section covers a variety of potential fuel system faults and their respective solutions. The conditions addressed in this section are unique to CNG storage systems; however, conditions concerning other onboard systems may influence or directly cause problems with the CNG storage system.

For any faults not addressed in this manual or for warranty information please contact Hexagon Agility® Customer Care and Technical Services:

833-4-HEX-CARE, toll-free in the U.S. and Canada

CONDITION: After disconnecting the fuel fill nozzle, CNG flows out of the fill receptacle.

Issue	Solution
Fuel fill receptacle O-ring frozen due to gas expansion	• Close cylinder manual valve(s). • Wait for receptacle to warm to ambient temperature to check if leak persists. • Use a slow fill rate to avoid icing.
Damaged fuel fill receptacle O-ring	• Close cylinder manual valve(s). • Replace O-ring.
Debris in fuel fill receptacle	• Close cylinder manual valve(s). • Inspect exterior of fuel fill receptacle for blockage or damage. • If no debris is found, fuel fill receptacle must be removed for internal inspection.
Damaged fuel fill receptacle – external evidence	• Close cylinder manual valve(s). • Depressurize fuel system. • Replace fuel fill receptacle. *NOTE:* inspect fill panel check valve when performing this repair.
Damaged fuel fill receptacle – internal check valve failure	

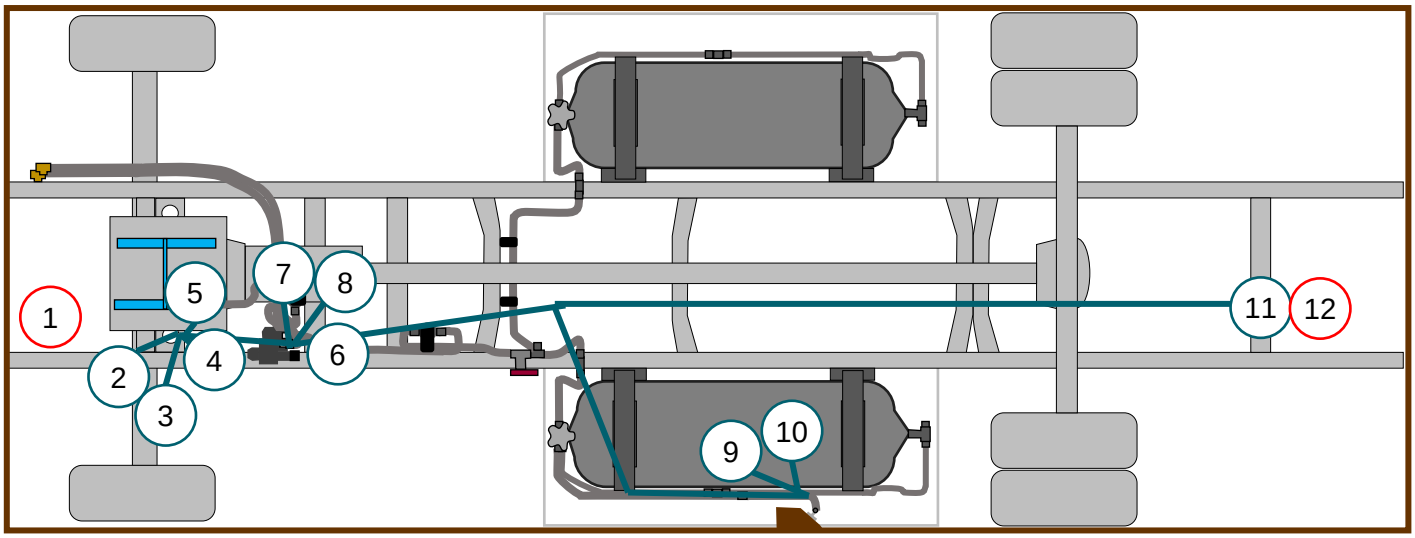
CONDITION: With the 1/4-turn manual shutoff valve in the closed position and the vehicle continues to run for an extended period, suspect 1/4-turn manual valve fault.

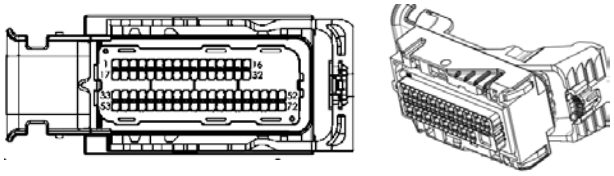
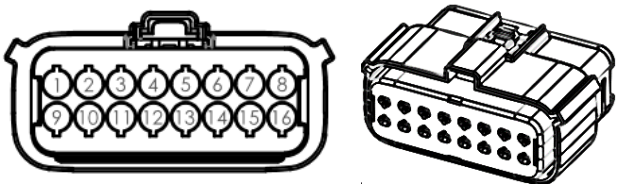
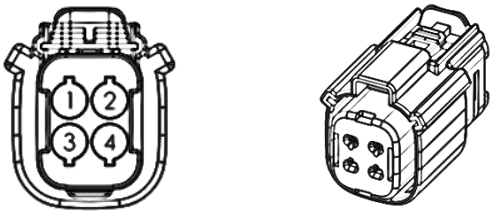
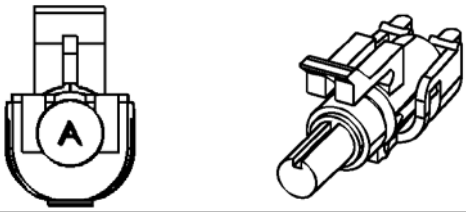
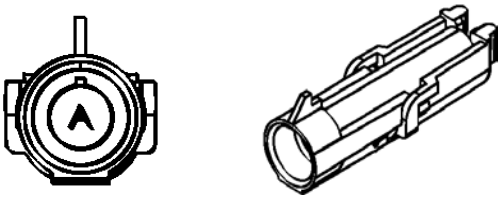
Issue	Solution
Valve seat wear / debris in valve does not allow valve to fully close	• Close cylinder manual valve(s). • Depressurize fuel system. • Replace 1/4-turn manual shutoff valve.

ISSUE: Poor engine performance (rough idle, lacks power, hesitation, stalls)

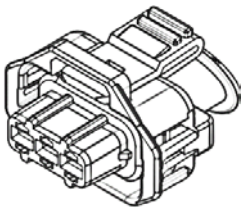
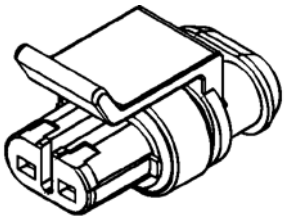
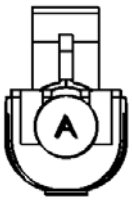
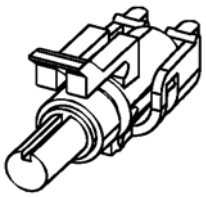
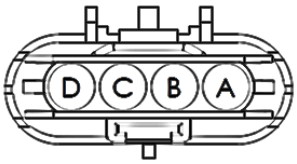
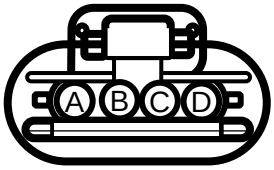
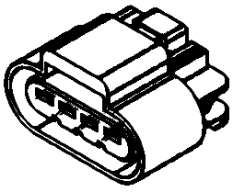
Issue	Remedy
Low pressure side of fuel system is less than 125 psi **(8.62 Bar)** • LP fuel hose restriction • LP fuel filter clogged • HP fuel filter clogged • HP / LP fuel tubes kinked/bent • pressure regulator fault • fuel injector(s) fault	• Refer to Engine Misfire Diagnostic procedure section(s) below.
• Ignition system fault • Induction system restriction • Exhaust system restriction • Mechanical engine failures • Engine sensor fault	• Refer to OEM procedure.

Connector Location View



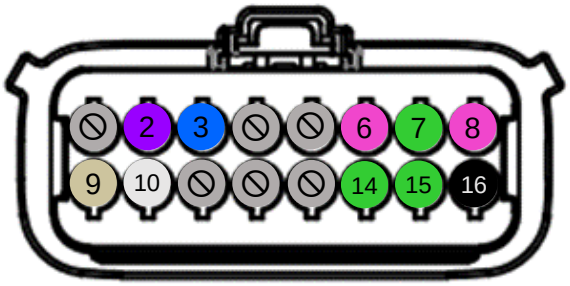
1 **J3 OEM ECU** connector located at (DS) radiator core support. *Refer to OEM manual for pin-out.*	
2 **C1 Electronic Control Module** (ECM) connector located inside at driver footwell.	
3 **C2 Electronic Control Module** (ECM) connector located inside at driver footwell.	
4 **IO31 Start Confirm** connector located behind instrument cluster.	
5 **IO30 Crank Request** connector located behind instrument cluster.	

Connector Location View

6 **G21 Supply Solenoid Ground** located on frame between pressure regulator and 1/4-turn manual shutoff valve.	
7 **P31 Pressure Transducer** connector located on pressure regulator.	 
8 **Y41 Supply Solenoid** connector located on pressure regulator.	 
9 **G20 Fill Panel Ground** located on bottom of fill panel.	
10 **D81 DAP (Drive Away Protection)** located on bottom of fill panel.	 
11 **F78 Fuel System Harness Interface** located near last crossmember of chassis.	 
12 **F79 Connector** OEM Fuel Send and Return Harness	 

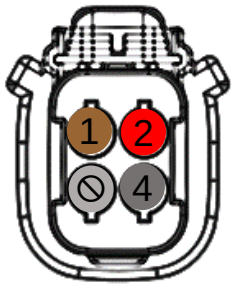
ECM C1 connector pin-out

Cavity	Circuit	Color	Description
1	-	-	NA
2	313	PUR	Start Relay Confirm
3	314	BLU	Start Relay Request
4	-	-	NA
5	-	-	NA
6	204	PNK	Supply Solenoid (B+)
7	312	GRN	Drive Away Protection
8	204	PNK	ECM Power
9	408	TAN	Fuel Gauge Low Reference
10	315	WHT	Fuel Gauge Signal
11	-	-	NA
12	-	-	NA
13	-	-	NA
14	312	GRN	Drive Away Protection
15	312	GRN	Drive Away Protection
16	104	BLK	ECM Ground



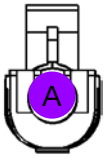
ECM C2 connector pin-out

Cavity	Circuit	Color	Description
1	409	BRN	Low Reference
2	604	RED	5V Reference
3	-	-	NA
4	316	GRY	Pressure Signal



IO31 Start Confirm pin-out

Cavity	Circuit	Color	Description
A	313	PUR	Start Relay Confirm



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IO30 Crank Request

Cavity	Circuit	Color	Description
A	409	BLUE	Low Reference



G21 Supply Solenoid Ground

Cavity	Circuit	Color	Description
A	105	BLK	Supply Solenoid Ground



G20 Fill Panel Ground

Cavity	Circuit	Color	Description
A	104	BLK	ECM Ground



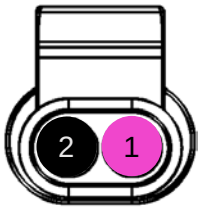
P31 connector pin-out

Cavity	Circuit	Color	Description
1	409	BRN	Low Reference
2	316	GRY	Pressure Signal
3	604	RED	5V Reference



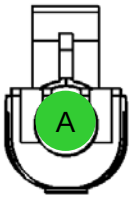
Y41 Supply Solenoid

Cavity	Circuit	Color	Description
1	204	PNK	Supply Solenoid B+
2	105	BLK	Supply Solenoid Ground



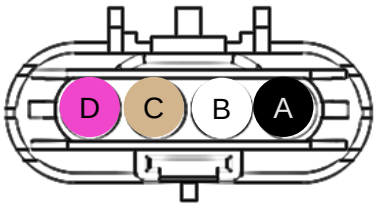
D81 DAP Drive Away Protection

Cavity	Circuit	Color	Description
A	312	GRN	Drive Away Protection



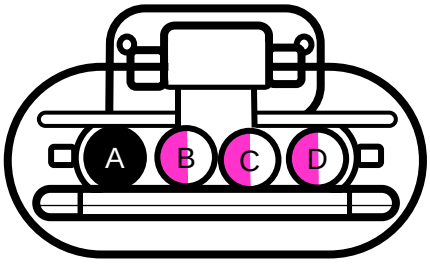
F78 Fuel System Harness Interface

Cavity	Circuit	Color	Description
A	104	BLK	Supply Solenoid Ground
B	315	WHT	Fuel Gauge Signal
C	406	TAN	Fuel Gauge Low Reference
D	204	PNK	ECU Power



F79 Connector OEM Fuel Send and Return Harness

Cavity	Circuit	Color	Description
A	104	BLK	Supply Solenoid Ground
B	315	PK/WT	Fuel Gauge Signal
C	406	PK/WT	Fuel Gauge Low Reference
D	204	PK/WT	ECU Power



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Fuel Gauge Non-operation



Symptom Description

Fuel gauge non-operation occurs when the gauge displays empty while pressure greater than 600 psi **(41.3 Bar)** is indicated on the HP fuel gauge.

NOTICE

To confirm this condition, ignition ON. The instrument panel cluster (IPC) will perform self-check mode. If the fuel gauge needle sweeps to full and returns to empty, the fuel gauge non-operation condition exists.

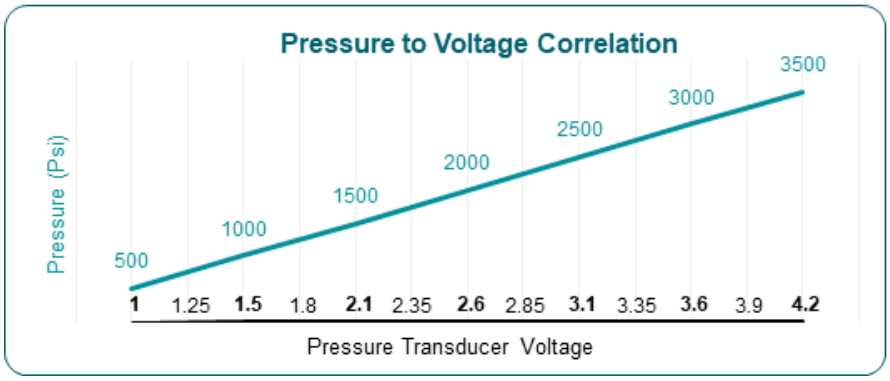
Possible causes include the following:

1. Power or ground insufficient at pressure transducer
2. Power or ground insufficient on connector for ECM
3. Calibration or bad OEM ECU

The following diagnostic steps are designed to systematically identify the root cause(s) of non-operation fuel gauge condition and point to corresponding repair procedures.

Circuit / Sensor Description

The Electronic Control Module (ECM) monitors CNG fuel system pressure using a pressure transducer in the pressure regulator. The transducer monitors cylinder pressure using a 5V signal communicated to the ECM. The ECM uses calibration logic to transmit resistance values via the F78-F79 connector interface. The OEM ECU transmits fuel level through the CAN network to the IPC.



Fault Codes

SPN: 96 **FMI: 2,3,4,7**	FMI 2: Fuel Level Sensor “A” Circuit Intermittent
	FMI 3: Fuel Level Sensor “A” Circuit High
	FMI 4: Fuel Level Sensor “A” Circuit Low
	FMI 7: Fuel Level Sensor “A” Circuit Range / Performance

The following fault code(s) may set when vehicle ignition is left in the ON position while the driver does not engage the starter within approximately 30 seconds.

SPN	FMI	Type	MIL	Possible Faults
96	02	B	Yes	• Vehicle was left with Ignition On, Engine off for a prolonged period. • Malfunctioning ECM. • Intermittent poor electrical connection. • Damaged pressure transducer.
96	03	B	Yes	• Vehicle was left with Ignition On, Engine Off for a prolonged period. • Malfunctioning ECM. • Reference circuit shorted to power. • Open in signal circuit. • Damaged pressure transducer.
96	04	B	Yes	• Vehicle was left with Ignition On, Engine Off for a prolonged period. • Malfunction in the ECM. • Short to ground in the signal circuit. • Short to ground in the low reference circuit. • Loose electrical connector or terminal. • Loose electrical connector or terminal.
96	07	B	Yes	• Vehicle was left with Ignition On, Engine Off for a prolonged period. • Malfunction in the ECM. • Intermittent or poor connection. • Damaged pressure transducer.

Tools and Supplies

Item	Purpose
safety glasses	eye protection
shop rags	clean fuel system components before and after repair
flashlight	illuminate components
mirror	observe backside of fittings while performing leak check
digital multi-meter (DMM)	resistance and voltage measurements
PSI PowerLink or other OBD-II diagnostic tool	read fault codes and ECM values

General Safety Precautions

⚠WARNING **ALWAYS use personal protective equipment (PPE) when working around pressurized fuel systems.**

⚠WARNING **Verify parking brake is engaged, wheels are chocked, and ignition switch is in OFF position.**

⚠WARNING **Install proper lockout/tagout (LOTO) device and observe all LOTO practices.**

NOTICE The following procedure covers the Hexagon Agility® interface with the vehicle fuel gauge circuit. *Refer to OEM service manual for additional instructions*.

Preliminary Diagnostics

Complete an Initial Vehicle Check *(refer to **DSM.0009**).*

1. Record system fuel pressure on fill panel HP gauge.

   NOTICE If pressure is below 500 psi **(34.5 Bar)**, add fuel.

2. Connect PSI PowerLink or other OBD-II diagnostic tool to vehicle and navigate to OEM ECU fault code and data parameter lists.
3. Record all active and history fault codes and parameters prior to clearing out all fault codes.
4. Observe and record the fuel level data from HP gauge, IPC gauge, and OBD-II tool.

HP Gauge vs. OEM Fuel Gauge vs. OBD-II Readings*		
Pressure (psi) ± 5%	**OEM Gauge Level**	**OBD-II Tool %**
3100	Full	100
2460	3/4	75
1850	1/2	50
1150	1/4	25
600	Empty	0

** NOTE, chart is intended for normal operation conditions. Readings may vary.*

   a. **If within range** proceed to **Step 5** below.

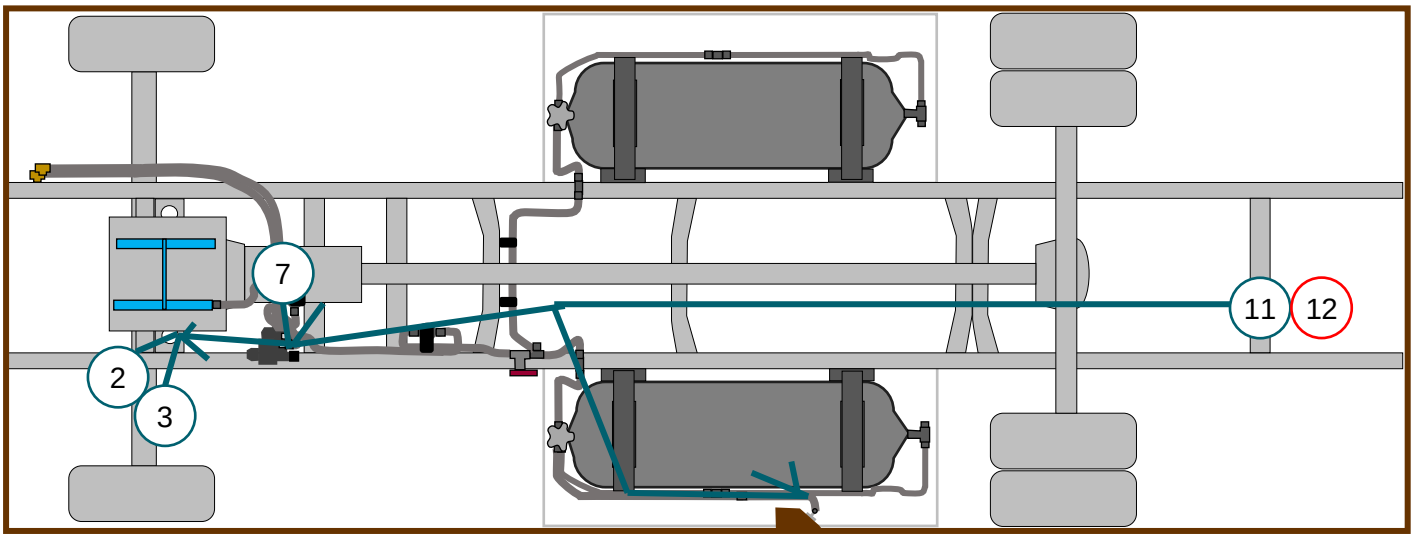
   b. **If not within range** proceed to **Circuit/System Testing**.

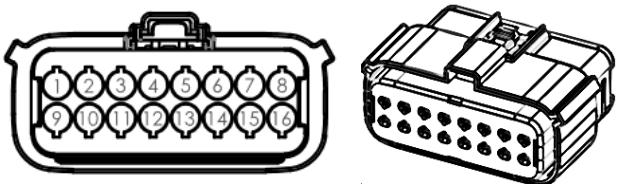
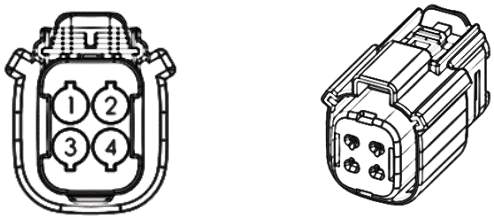
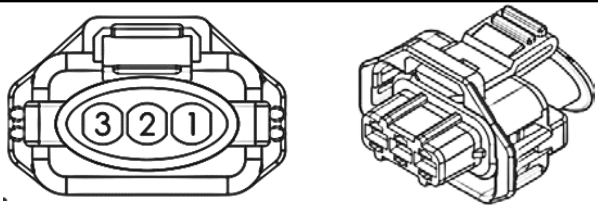
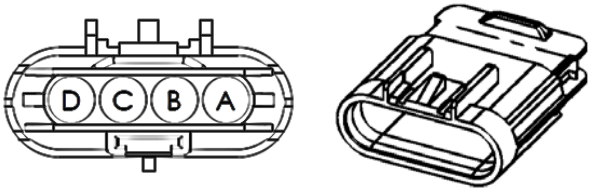
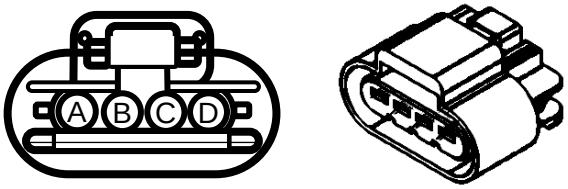
5. Clear fault codes.
6. Operate the vehicle in the same conditions for enabling the fault code or within the same conditions that triggered the fault code based on the recorded data.
7. Verify the fault code does not set.
   - If any fault code sets proceed to **Circuit/System Testing**.
8. While observing the fuel level data, perform wiggle test on the harness connectors to test for poor or intermittent connections. Review **Circuit Schematic and Connector End Views** to locate test points.

   a. **If any fault code sets** proceed to **Circuit/System Testing**.

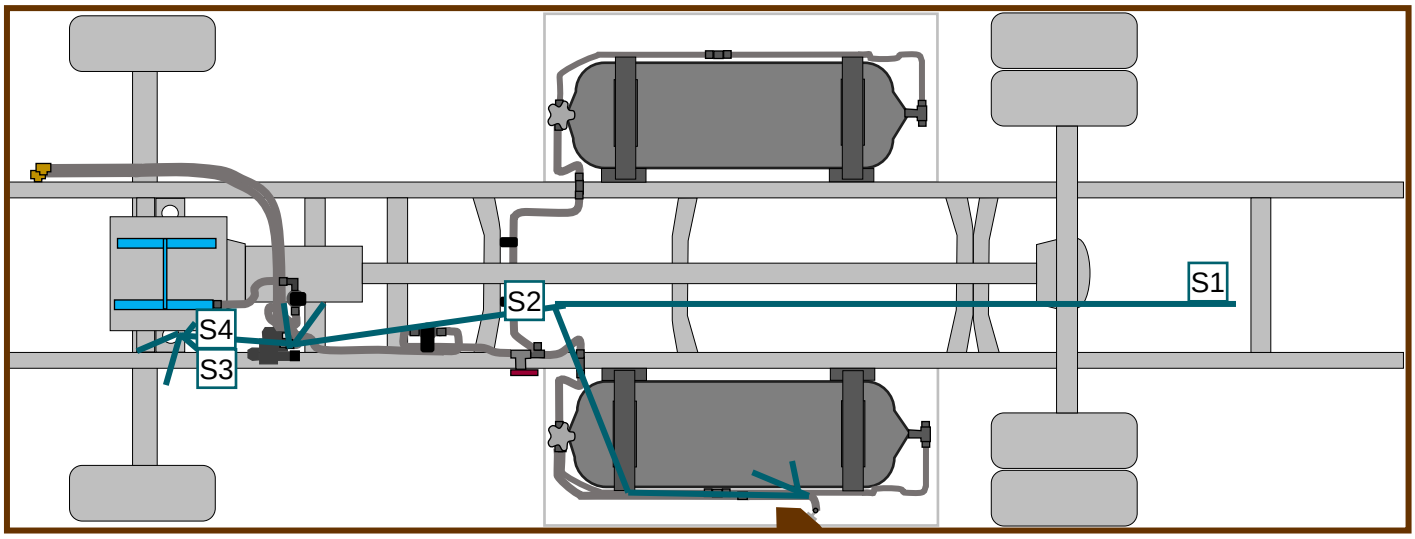
   b. **If no fault code sets**, system is functioning to design intent.

Connector Location View



2 **C1 Electronic Control Module** (ECM) connector located inside at driver footwell.	
3 **C2 Electronic Control Module** (ECM) connector located inside at driver footwell.	
7 **P31 Pressure Transducer** connector located on pressure regulator.	
11 **F78 connector** located near last crossmember of chassis.	
12 **F79 connector** OEM fuel send and return harness.	

Harness Splice Location View

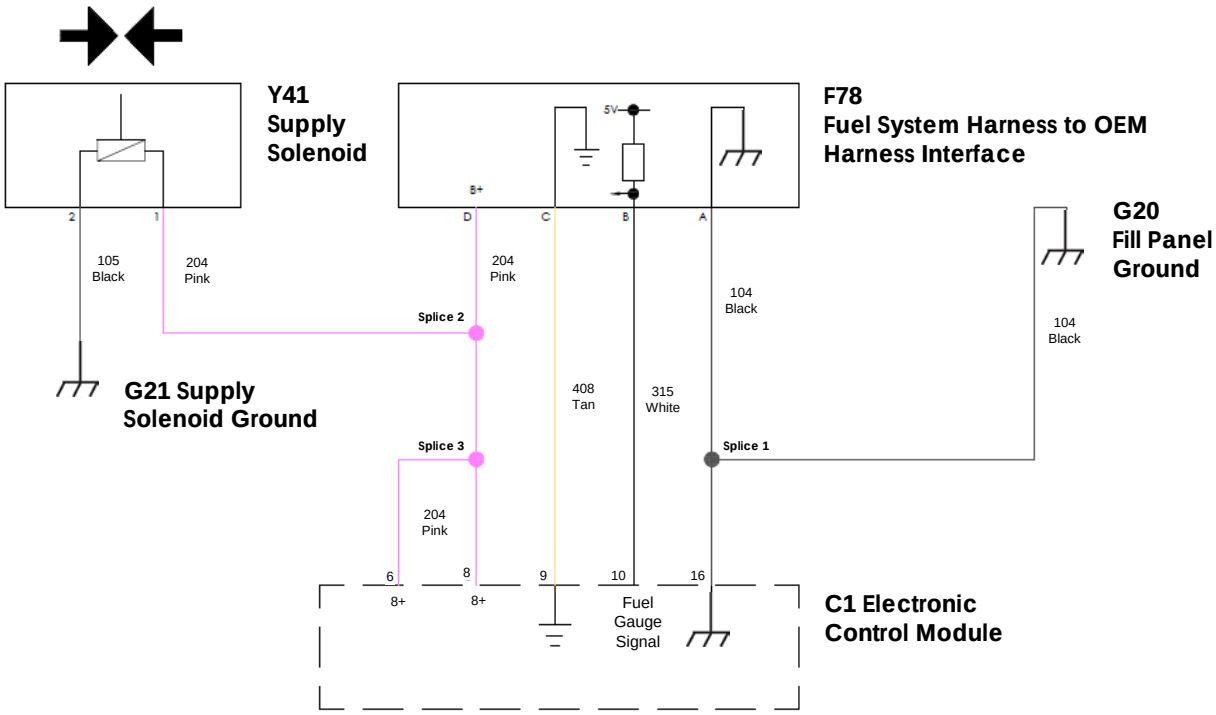


S1	**Splice 1**, located near **F78** Fuel System Harness Interface.
S2	**Splice 2**, located near 1/4-turn manual shutoff valve.
S3	**Splice 3**, located inside harness near grommet on firewall within engine compartment.
S4	**Splice 4**, located inside harness near grommet on firewall within engine compartment.

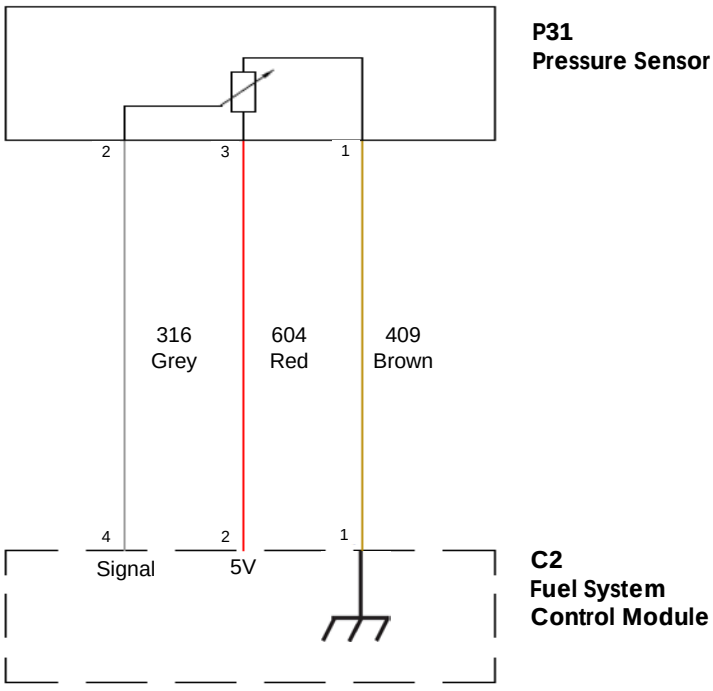
NOTICE

Never probe an electrical connection with anything other than an appropriately sized shaped test. Doing so may result in damage to components.

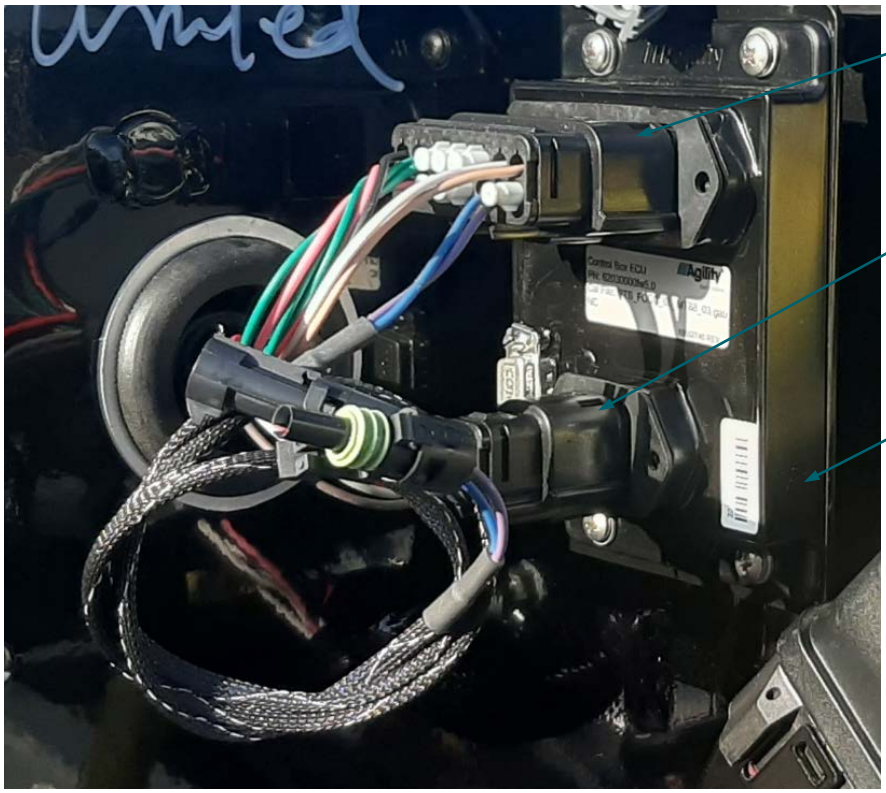
Fuel Gauge Electrical Schematic

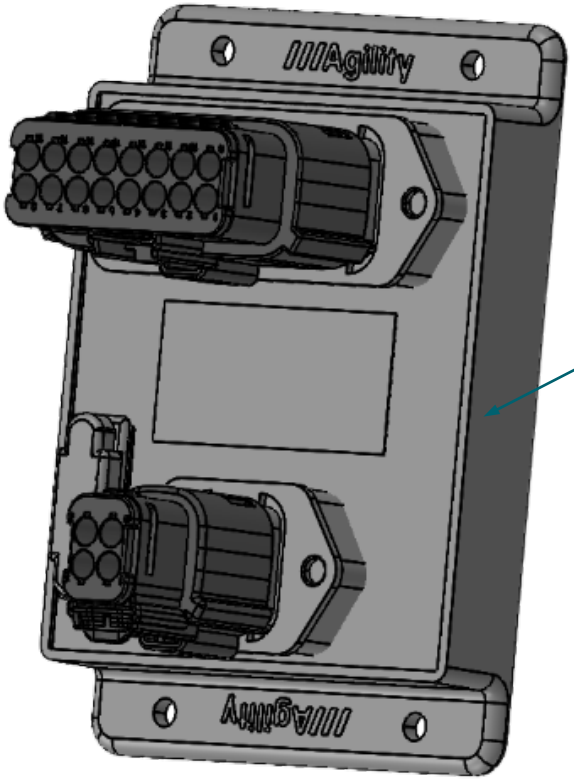


Fuel Pressure Sensor Schematic



Hexagon Agility® ECM (driver footwell)



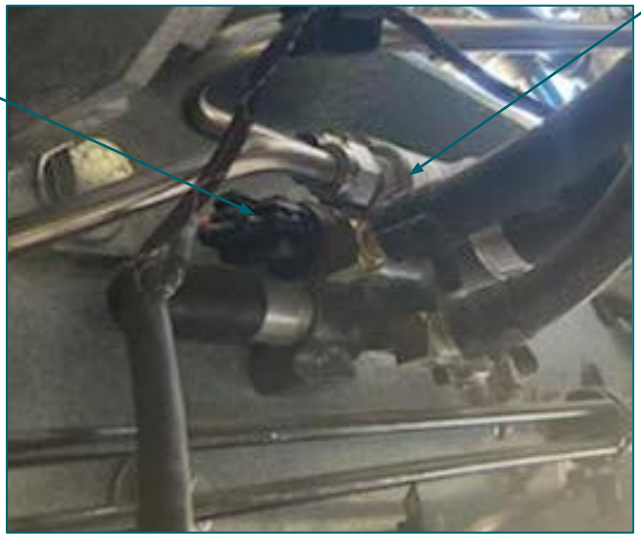


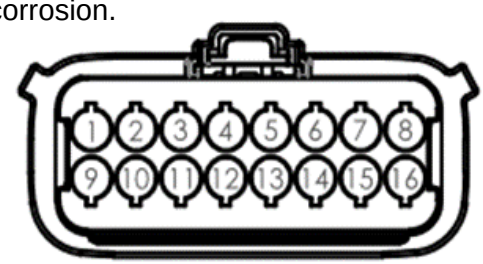
Pressure regulator (driver side frame rail)



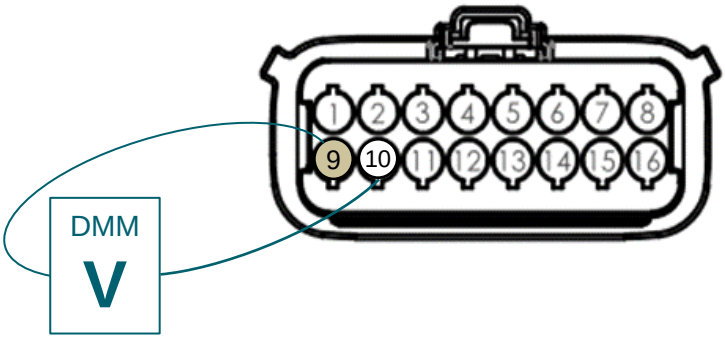
P31 connector

pressure regulator



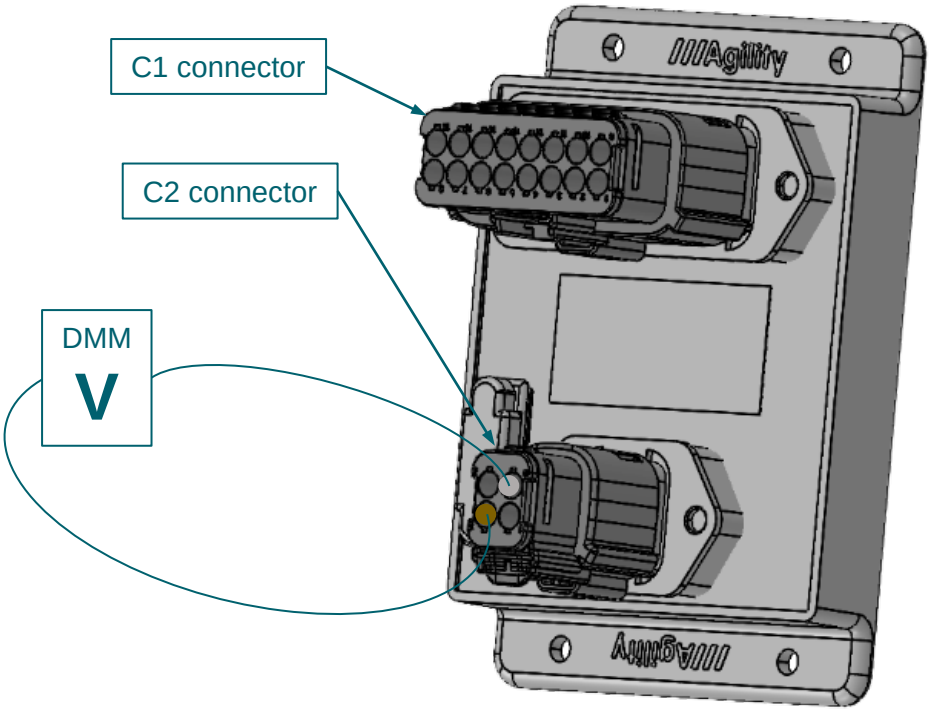
Step 1	➢ Does the vehicle start and run?	
	Yes: ↳ **Proceed to Step 2.**	**No:** ↳ **Proceed to Step 13.**
Step 2	➢ Ignition **OFF.** ➢ Disconnect ECM connector **C1**. ➢ Inspect for damage or corrosion. 	
	Damage or corrosion found: ↳ **Repair damage.** *Refer to harness and wire repair procedure DSM.0036.* ↳ **Perform System Verification Procedure.**	**No damage or corrosion found:** ↳ **Proceed to Step 3.**

NOTICE **Never probe an electrical connection with anything other than an appropriately sized shaped test lead. Doing so may result in damage to components.**

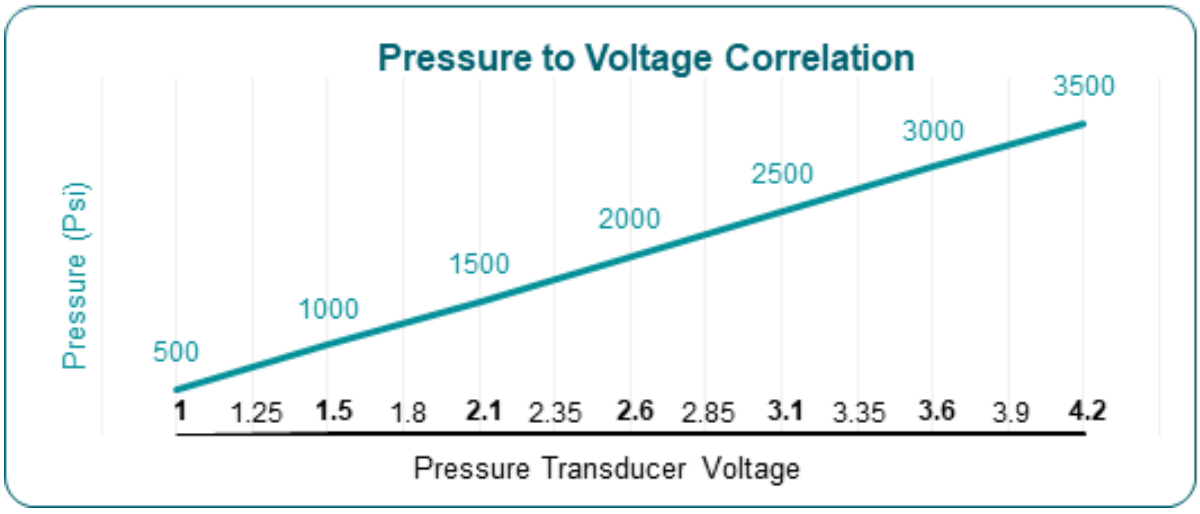
Step 3	➢ ECM connector **C1** still disconnected. ➢ Ignition **ON**. ➢ Using a DMM, measure the voltage between ECM connector **C1 Terminal 9** (Tan) and **Terminal 10** (White). 		
	If equal to 4.8-5.2V: ↳ **Proceed to Step 4.**	**If less than 4.8V:** ↳ **Proceed to Step 5.**	**If greater than 5.2V:** ↳ **Proceed to Step 19.**

Step 4

- Ignition **OFF**.
- Reconnect ECM connector **C1**.
- Using a DMM, back probe ECM connector **C2 Cavity 1** (Brown) and **C2 Cavity 4** (Gray).
- Ignition **ON, <u>within 30 seconds</u>**, measure and record voltage.



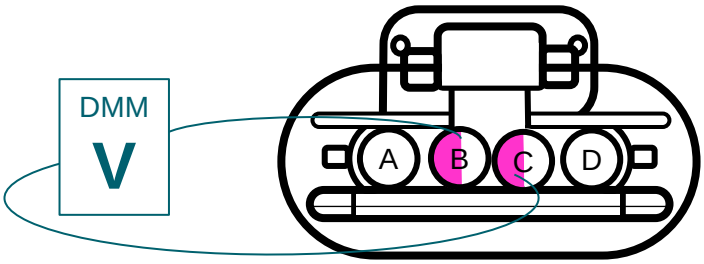
- Record HP gauge reading at fill panel.
- Compare HP gauge reading and pressure transducer voltage using the table below.



Voltage is within range:	**Voltage is not within range:**
↳ **Proceed to Step 18.**	↳ **Proceed to Step 9.**

Step 5

- Ignition **OFF**.
- Disconnect connector **F78-F79 Fuel System Harness Interface**.
- Ignition **ON**, **within 30 seconds**, measure the voltage between **OEM Harness Interface F79** connector **Terminal B** (Pink/White) and **Terminal C** (Pink/White) .

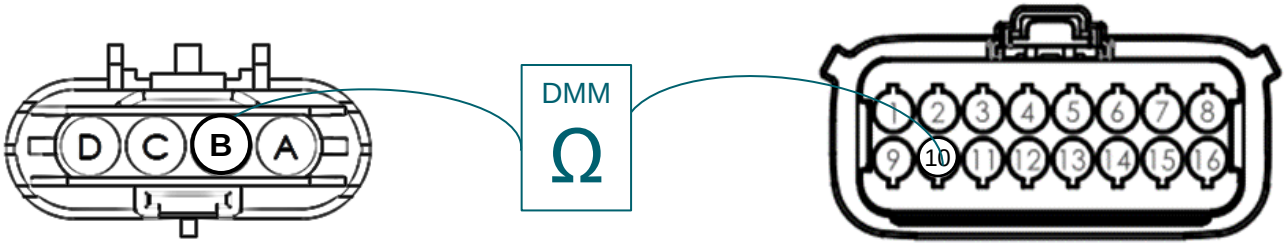


Voltage is between 4.8-5.2V :
↳ **Proceed to Step 6.**

Voltage is not between 4.8-5.2V :
↳ **Refer to OEM chassis diagnostics for further instructions.**

Step 6

- Ignition **OFF**.
- **F78 connector** still disconnected.
- Disconnect ECM connector **C1**.
- Measure resistance from connector **F78 Terminal B** (White) to connector **C1 Terminal 10** (White).

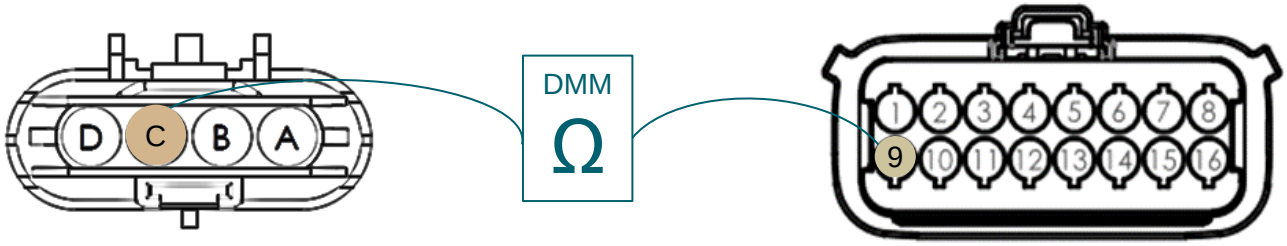


Resistance is less than 10 ohms:
↳ **Proceed to Step 7.**

Resistance is greater than 10 ohms:
↳ **Repair high resistance in circuit 315 between F78 and C1 connectors.** *Refer to DSM.0036.*
↳ **Perform System Verification Procedure.**

Step 7

- Ignition OFF.
- **F78** connector still disconnected.
- ECM connector C1 still disconnected.
- Measure resistance between connector F78 Terminal C (Tan) and connector C1 Terminal 9 (Tan).

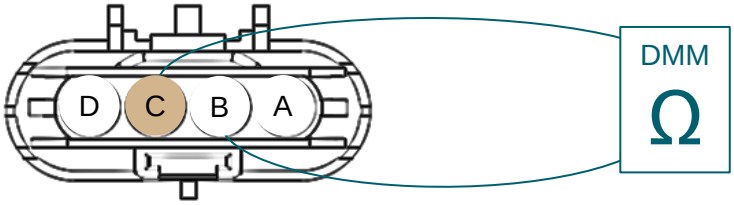


Resistance is less than 10 ohms:
↳ **Proceed to Step 8.**

Resistance is greater than 10 ohms:
↳ **Repair high resistance in circuit 408 between F78 and C1 connectors.** *Refer to DSM.0036.*
↳ **Perform System Verification Procedure.**

Step 8

- With connector **C1 and F78** still disconnected**.**
- Measure the resistance between **F78 Terminal B** (White) and **Terminal C** (Tan)**.**

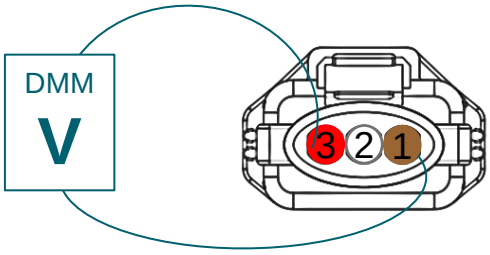


Resistance is less than 10 ohms:
↳ **Repair the short between circuit 315 and 408.** *Refer to DSM.0036.*
↳ **Perform System Verification Procedure.**

Resistance is more than 10 ohms:
↳ **Suspect intermittent electrical fault condition.**
↳ **Perform System Verification Procedure.**

Step 9
Continued from Step 4.

- Ignition **OFF**.
- Disconnect **P31 Pressure Transducer** connector.
- Ignition **ON**, **<u>within 30 seconds</u>**, measure voltage between **P31 Terminal 1** (Brown) and **Terminal 3** (Red).

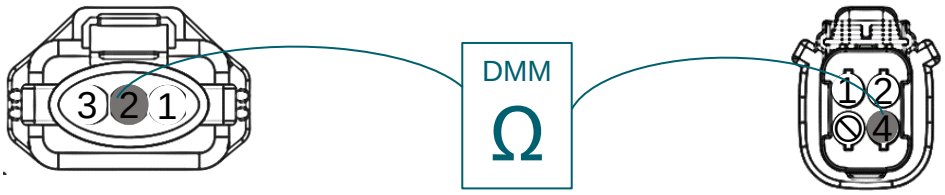


Voltage is between 4.8-5.2V:
↳ **Proceed to Step 10.**

Voltage is not between 4.8-5.2V:
↳ **Proceed to Step 11.**

Step 10

- Ignition **OFF**.
- **ECM** connector **C2** still disconnected.
- Measure resistance between connector **P31 Terminal 2** (Gray) and connector **C2 Terminal 4** (Gray).

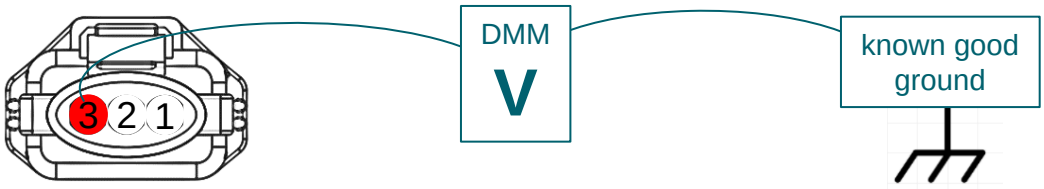


Resistance is less than 10 ohms:
↳ **Replace regulator.**
↳ **Perform System Verification Procedure.**

Resistance is not less than 10 ohms:
↳ **Repair open or high resistance on circuit 316**. *Refer to DSM.0036.*
↳ **Perform System Verification Procedure.**

Step 11
Continued from Step 9.

- Connector **P31** still disconnected.
- Ignition **ON**, **<u>within 30 seconds</u>**, measure for battery voltage between connector **P31 Terminal 3** (Red) and **known good ground**.



Voltage is between 4.8-5.2:
↳ **Repair high resistance in circuit 409 between P31 and C2.** *Refer to DSM.0036.*
↳ **Perform System Verification Procedure.**

Voltage is not between 4.8-5.2:
↳ **Proceed to Step 12.**

Step 12

- Ignition **OFF**.
- **ECM** connector **C2** still disconnected.
- Measure resistance between connector **P31 Terminal 3** (Red) and connector **C2 Terminal 2** (Red).

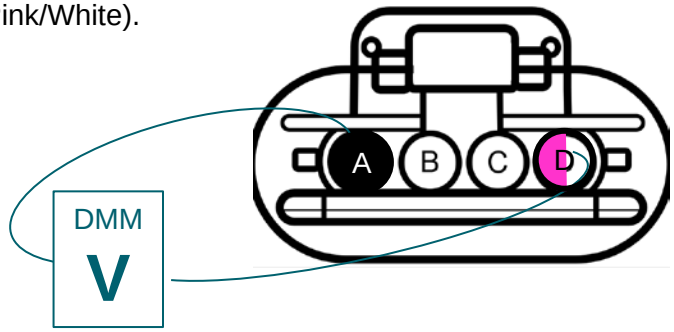


Resistance is less than 10 ohms:
↳ **Possible 5V reference circuit.**
↳ **Replace ECM.**
↳ **Perform System Verification Procedure.**

Resistance is more than 10 ohms:
↳ **Repair high resistance in circuit 604 between P31 and C2.** *Refer to DSM.0036.*
↳ **Perform System Verification Procedure.**

Step 13
Continued from Step 1.

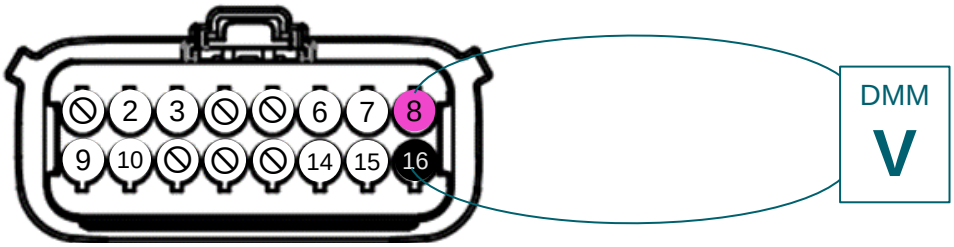
- Ignition **OFF**, disconnect **F78-F79 connector interface**.
- Ignition ON, **within 30 seconds**, measure voltage connector **OEM F79** between **Terminal A** (Black) and **Terminal D** (Pink/White).



Voltage equal to battery voltage:	Voltage not equal to battery voltage:
↳ **Proceed to Step 14.**	↳ Possible chassis harness fuel pump control circuit. Follow FCCC diagnostic manual. ↳ **Perform System Verification Procedure**.

Step 14

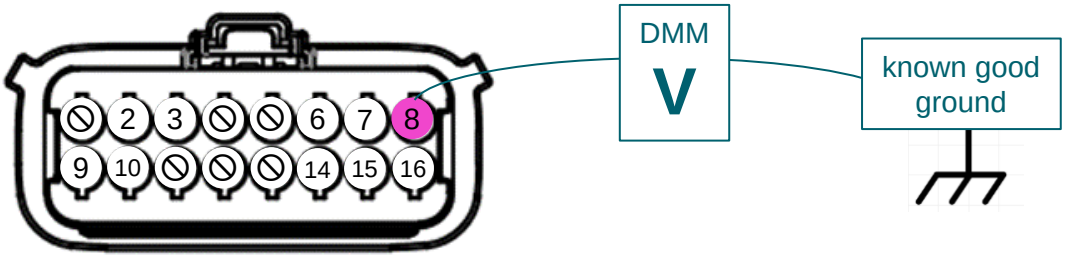
- Ignition **OFF**, reconnect connector **F78-F79.**
- **ECM** connector **C1** still disconnected.
- Ignition **ON**, **within 30 seconds**, measure voltage between connector **C1 Terminal 8** (Pink) and connector **C1 Terminal 16** (Black).



Voltage equal to battery voltage:	Voltage not equal to battery voltage:
↳ **Proceed to Step 16.**	↳ **Proceed to Step 15.**

Step 15

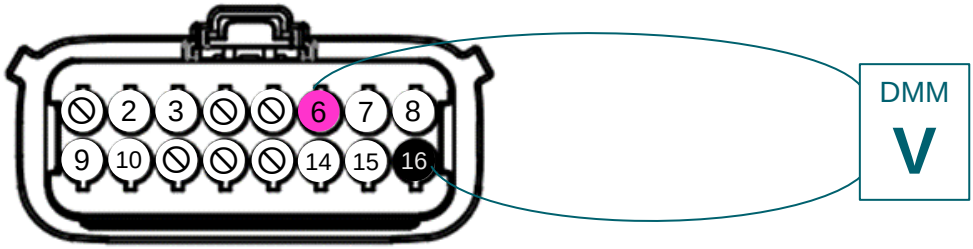
- **ECM** connector **C1** still disconnected.
- Ignition **ON, within 30 seconds,** measure voltage between connector **C1 Terminal 8** (Pink) and a **known good ground.**



Voltage equal to battery voltage:	Voltage not equal to battery voltage:
↳ **Repair high resistance in circuit 104 between C1 and Splice 1.** *Refer to DSM.0036.* ↳ **Perform System Verification Procedure.**	↳ **Proceed to Step 16.**

Step 16

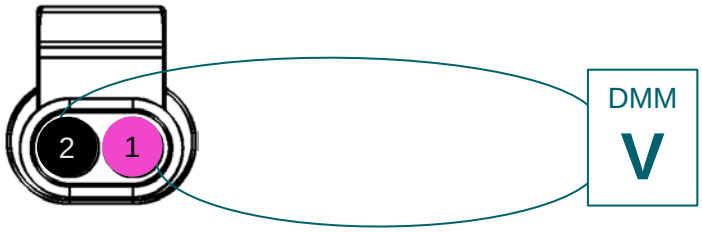
- With connector **ECM** connector **C1** still disconnected.
- Ignition **ON, within 30 seconds**, measure voltage between **C1 Terminal 6** (Pink) and **Terminal 16** (Black).



Voltage equal to battery voltage:	Voltage not equal to battery voltage:
↳ **Repair high resistance in circuit 204 between C1 Terminal 8 and Splice 3.** *Refer to DSM.0036.* ↳ **Perform System Verification Procedure.**	↳ **Proceed to Step 17.**

Step 17

- Ignition **OFF**, disconnect **Y41** connector.
- Ignition **ON**, **within 30 seconds**, measure voltage between connector **Y41 Terminal 1** (Pink) and **Terminal 2** (Black).

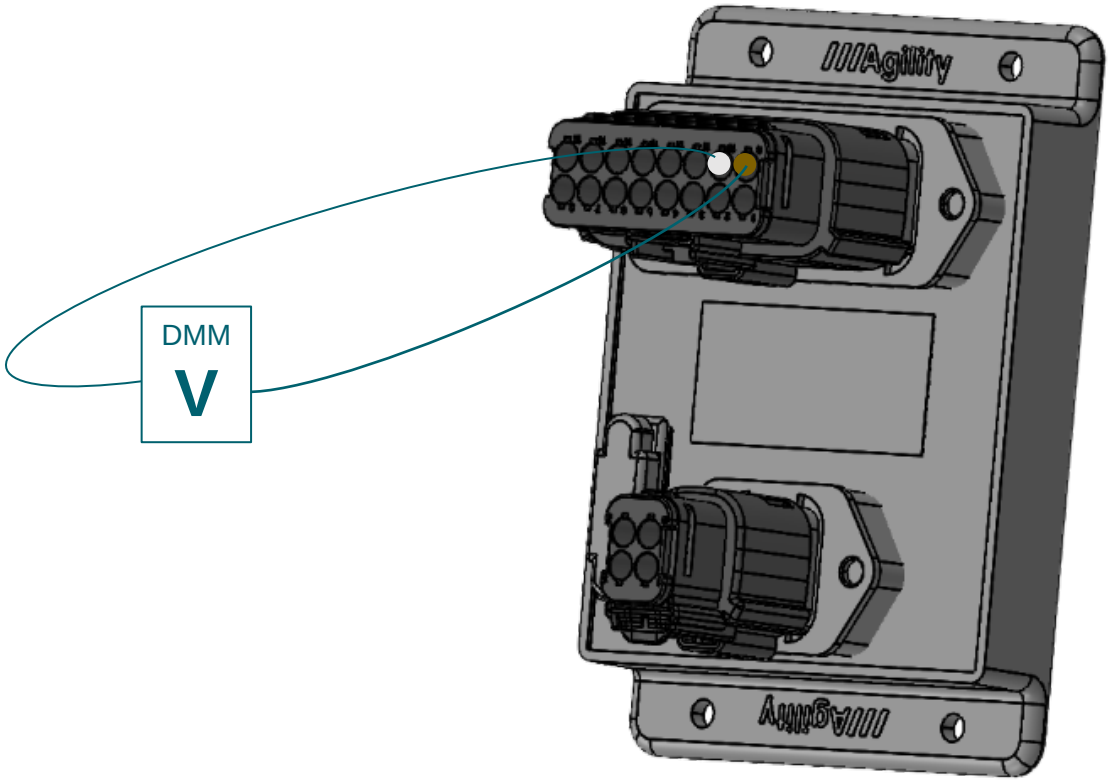


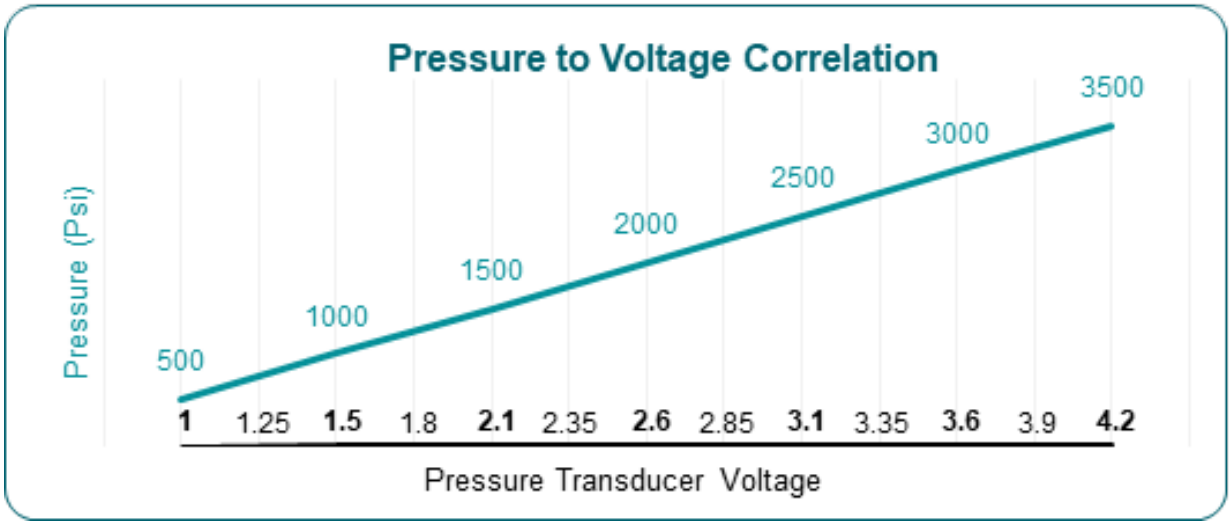
Voltage is equal to battery voltage:	Voltage is not equal to battery voltage:
↳ **Repair the open on the circuit 204 between Splice 2 and 3.** *Refer to DSM.0036.* ↳ **Perform System Verification Procedure.**	↳ **Repair the open on circuit 204 between F78 and Splice 2.** *Refer to DSM.0036.* ↳ **Perform System Verification Procedure.**

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Step 18
Continued from Step 4.

- Ignition **OFF**
- Ensure **ECM** connector **C1** is connected.
- Back probe **C1 Cavity 9** (Tan) and **C1 Cavity 10** (White).
- Ignition **ON**, **<u>within 30 seconds</u>**, measure voltage.

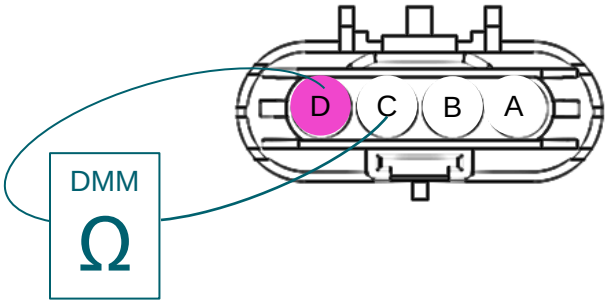




Voltage value is within the specified range:	Voltage value is not within the specified range:
↳ **Follow FCCC diagnostic procedure.**	↳ **Replace ECM.** ↳ **Perform System Verification Procedure.**

Step 19
Continued from Step 3.

- Ignition **OFF**, with connector **C1** still disconnected.
- Disconnect connector **F78**.
- Measure resistance between connector **F78 Terminal B** (White) and connector **F78 Terminal D** (Pink).



Resistance is less than 10 ohms:
↳ **Repair short to power between circuit 315 and 204. Refer to DSM.0036.**
↳ **Perform System Verification Procedure.**

Resistance is greater than 10 ohms:
↳ *Suspected short to power on fuel level circuit of chassis harness between F79 and OEM ECU connector or a failed ECU.*
↳ **Follow FCCC diagnostic procedure.**
↳ **Perform System Verification Procedure.**

Crank, No-Start



Introduction

A “Crank, No Start” condition exists when ignition power is present to turn the engine via the starter and the engine cranks, but the engine will not fire. Possible causes include the following:

- closed fuel system valve
- restricted fuel system hose or component
- clogged fuel filter
- faulty component or circuit
- ECM software or calibration not up to date

The following diagnostic steps are designed to systematically identify the root cause(s) of the Crank, No Start condition and point to corresponding repair procedures.

Tools and Supplies

Item	Purpose
safety glasses	eye protection
shop rags	clean fuel system components before and after repair
flashlight	illuminate components
LP fuel pressure gauge 0-200 psi **(0-13.8 Bar)**	standard fuel test gauge 0-200 psi **(0-13.8 Bar)**
mirror	observe backside of fittings while performing leak check
spark tester	used to detect ignition or spark failure
noid light	used to diagnose fuel injector issue
digital multimeter (DMM)	resistance and voltage measurements
PSI PowerLink or other OBD-II diagnostic tool	read fault codes and ECM values

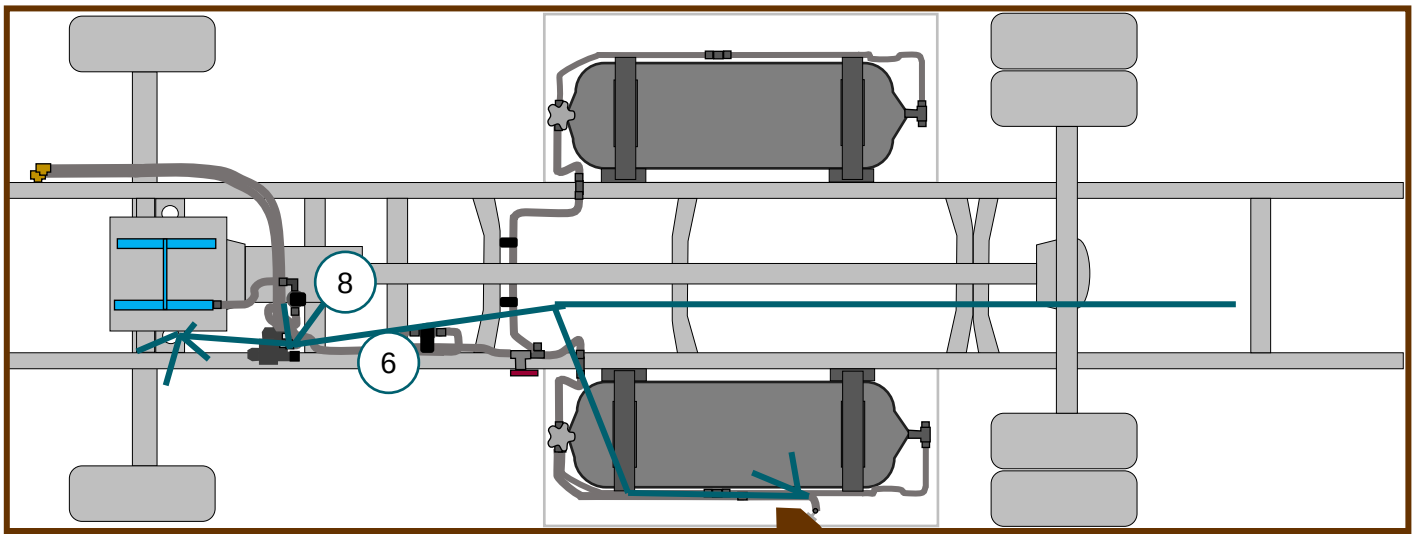
General Safety Precautions

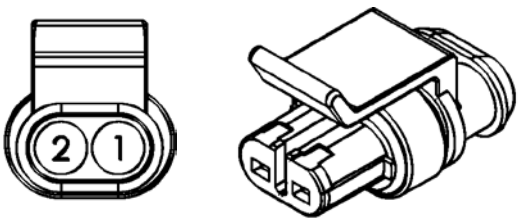
⚠WARNING **ALWAYS use personal protective equipment (PPE) when working around pressurized fuel systems.**

⚠WARNING **Verify parking brake is engaged, wheels are chocked, and ignition switch is in OFF position.**

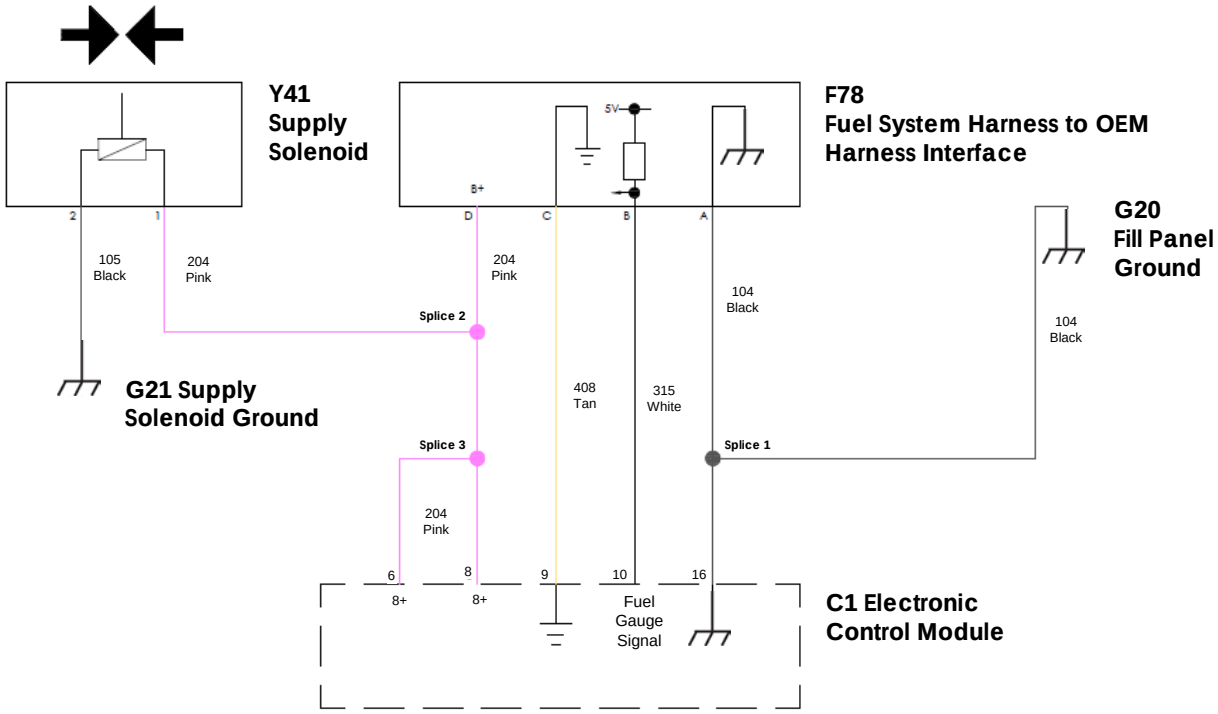
⚠WARNING **Install proper lockout/tagout (LOTO) device and observe all LOTO practices.**

Connector Location View



6 **G21 Supply Solenoid Valve Ground** located on frame between pressure regulator and 1/4-turn manual shutoff valve.	
8 **Y41 Supply Solenoid Valve** connector Located on pressure regulator.	

Electrical Schematic

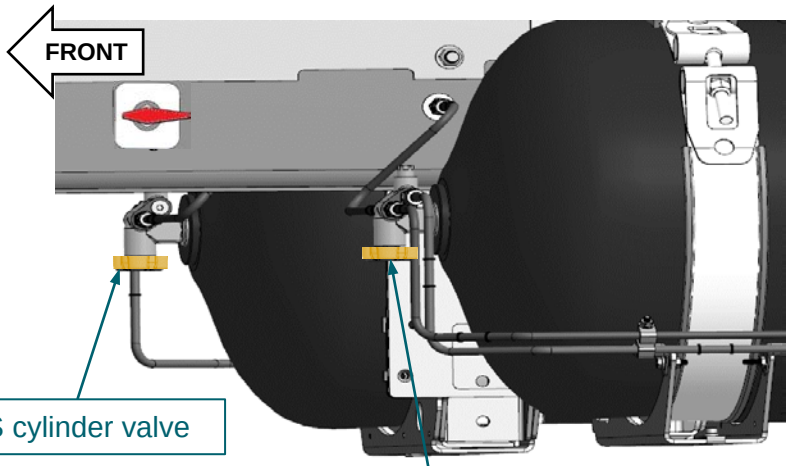


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Step 1

➢ Verify driver side (DS) and passenger side (PS) cylinder valves are in open position.





cylinder shield valve access hole

PS cylinder valve

DS cylinder valve

Both valves are closed:
↳ **Open both valves, proceed to Step 2.**

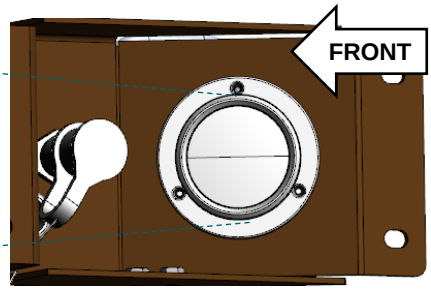
Both valves are open:
↳ **Proceed to Step 2.**

Step 2

➢ Check fuel fill panel HP gauge.

➢ If less than 600 psi **(41.3 Bar)**, vehicle may crank but not start.





HP fuel gauge

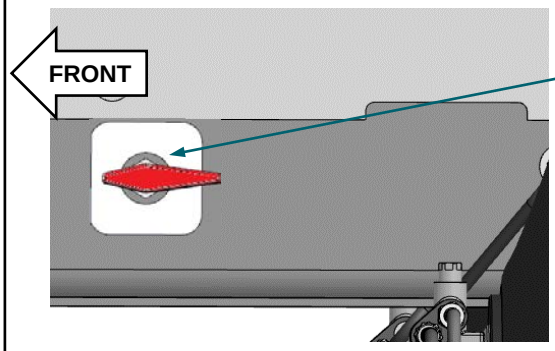
fuel fill panel

Less than 600 psi (41.3 Bar):
↳ **Fuel to 600+ psi; retry crank.**

More than 600 psi (41.4 Bar):
↳ **Proceed to Step 3.**

Step 3

➢ Verify 1/4-turn manual shutoff valve is in open position.



1/4-turn manual shutoff valve

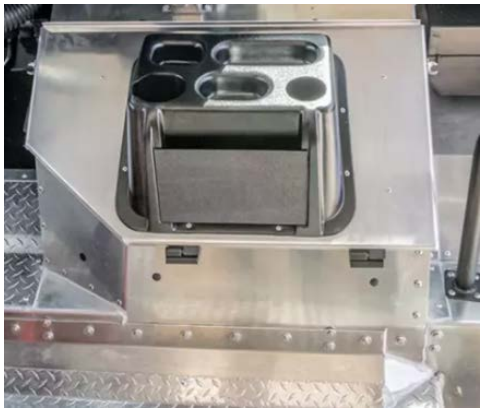


Valve is closed:
↳ **Open valve; retry crank.**
↳ **Engine won't start, proceed to Step 4.**

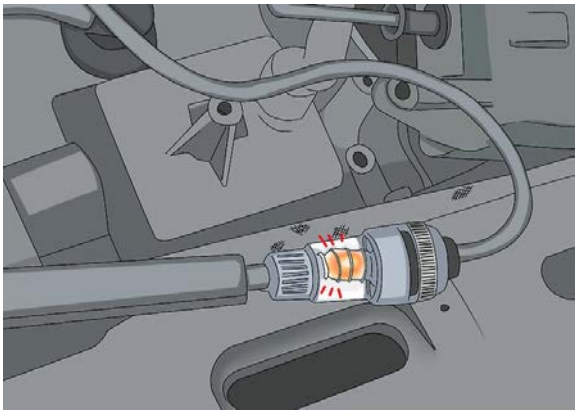
Valve is open:
↳ **Proceed to Step 4.**

Step 4

- Remove engine access cover. *Refer to OEM manual.*
- Check both cylinder banks for engine spark using a spark tester. *Refer to OEM manual.*



engine access cover

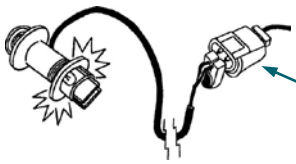


spark tester

Spark is not present: ↳ **Refer to OEM manual.**	**Spark is present:** ↳ **Proceed to Step 5.**

Step 5

- Remove harness connector from a rear fuel injector of each cylinder bank.
- Use noid light to check for power at each fuel injector selected.



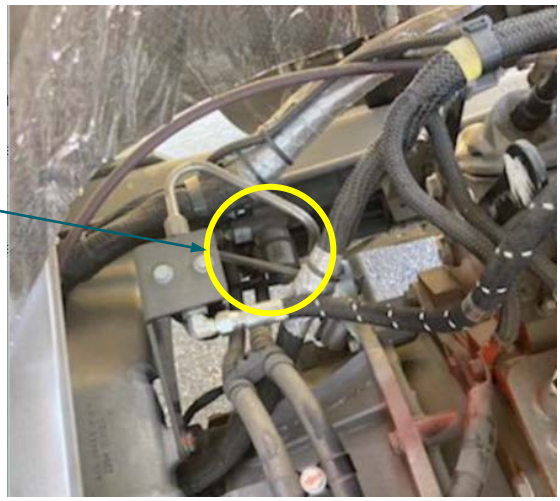
fuel injector connector

Noid light does not flash: ↳ **Refer to OEM manual.**	**Noid light flashes:** ↳ **Proceed to Step 6.**

Step 6

- Pressure regulator/supply solenoid valve is located beneath driver seat.
- With an assistant positioned at the regulator, engage the ignition while listening for solenoid “click”.

pressure regulator/ supply solenoid valve

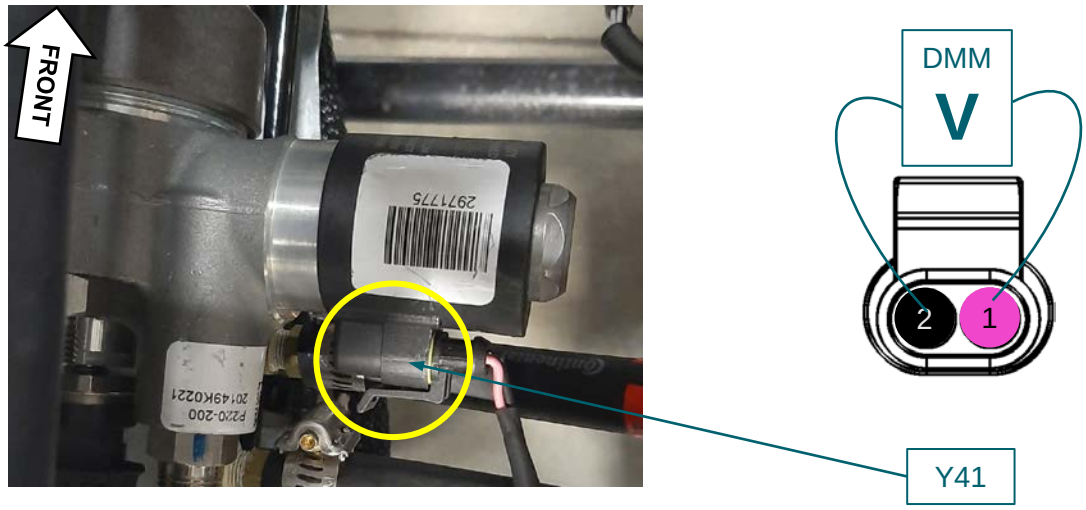


Click is present: ↳ **Proceed to Step 9.**	**Click is not present:** ↳ **Proceed to Step 7.**

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Step 7

- Disconnect **Y41 supply solenoid valve** connector.
- Using a DMM, check for battery voltage across the **Y41** connector **Terminals 1** (Pink) and **2** (Black).



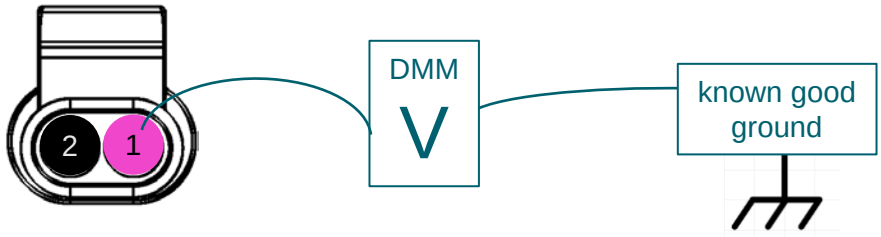
Battery voltage present;
↳ **Replace pressure regulator.**

⚠WARNING **Always follow OEM fuel system depressurization and repair instructions.**

Battery voltage not present:
↳ **Proceed to Step 8.**

Step 8

- Check for battery voltage from **Y41** connector **Terminal 1** (Pink) to **known good ground.**



Battery voltage to ground present:
↳ **Repair open or high resistance in circuit 105 between Y41 and G21.** *Refer to DSM.0036.*
↳ **Perform System Verification Procedure.**

Battery voltage not present:
↳ **Repair open or high resistance in circuit 204 between Y41 and Splice S3/S4. Refer to DSM.0036.**
↳ **Perform System Verification Procedure.**

Step 9
Continued from Step 6

⚠WARNING **Depressurize fuel system; refer to Depressurization section of this manual.**

⚠WARNING **Observe organizational LOTO practices; install lockout/tagout (LOTO) devices.**

Depressurization complete:
↳ **Proceed to Step 10.**

Step 10

➢ Remove LP fuel hose from fuel rail fitting using line disconnect tool.

⚠CAUTION **ALWAYS verify fuel system has been depressurized!**



line disconnect tool

LP hose



LP fuel line disconnected:
↳ **Proceed to Step 11.**

Step 11

➢ Install a commercially available fuel pressure test port adaptor and gauge rated for at least 150 psi **(10.3 Bar)** from fuel rail to LP fuel hose.

⚠WARNING **Verify connections are secure by pulling fuel line connection firmly.**

NOTICE **Verify gauge is at least 150 psi (10.3 Bar) and CNG compatible.**

fuel line adaptor tool



Test tool installed:
↳ **Proceed to Step 12.**

Step 12

- With all lines and connections secured, pressurize system as per procedure at the end of Depressurization section.
- Record LP fuel gauge pressure.

Pressure is 120 psi (8.3 Bar):	Pressure is less than 120 psi (8.3 Bar):
↳ **Retry crank. If no start,** ↳ **Reprogram / replace ECM.**	↳ **Proceed to Step 13.**

Step 13

WARNING **Depressurize fuel system; refer to Depressurization section of this manual.**

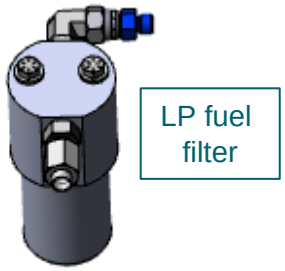
WARNING **Observe organizational LOTO practices; install lockout/tagout (LOTO) devices.**

Depressurization complete:
↳ **Proceed to Step 14.**

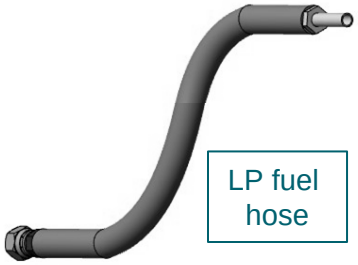
Step 14

CAUTION **ALWAYS verify fuel system has been depressurized!**

- Remove LP fuel hose from LP fuel filter.
- Remove LP fuel hose from **fuel line adaptor tool** using the line disconnect tool.
- With the LP fuel hose removed, use compressed air to verify LP fuel hose flow is unobstructed.



Fitting configurations may vary





Compressed air flows:	Compressed air does not flow:
↳ **Proceed to Step 15.**	↳ **Replace LP fuel hose.** ↳ **Complete leak check procedure.** ↳ **Perform System Verification Procedure.**

Step 15

- Inspect HP and LP filters for blockage.
- Refer to Filter Element Replacement section for disassembly and assembly instructions.

LP fuel filter



Fitting configurations may vary

HP fuel filter



Debris found:

↳ **Replace element, clean filter bowl and reassemble per filter element replacement instructions. Proceed to Step 16.**

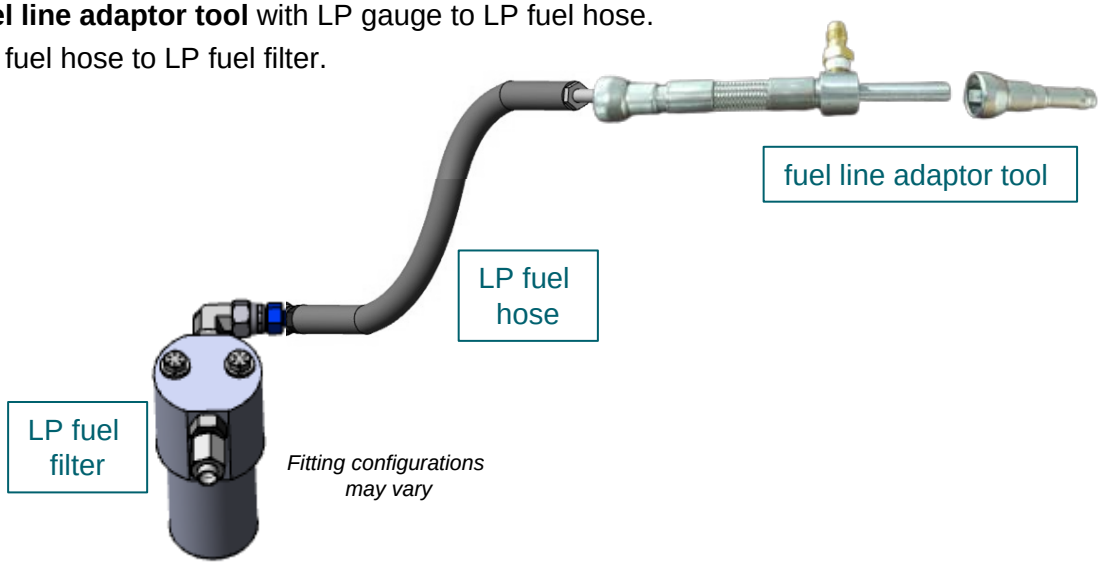
Debris not found:

↳ **Replace element, clean filter bowl and reassemble per filter element replacement instructions. Proceed to Step 16.**

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Step 16

- Reattach **fuel line adaptor tool** with LP gauge to LP fuel hose.
- Reattach LP fuel hose to LP fuel filter.



- Pressurize fuel system per **Step 12**.
- Ignition **ON**.
- Check **fuel line adapter tool** LP gauge for 120 psi **(8.27 Bar)**.

Pressure is 120 psi (8.27 Bar).	**Pressure is less than 120 psi (8.27 Bar)**.
↳ **Retry crank. If vehicle starts, proceed to Step 17.** ↳ **If vehicle does not start, close 1/4-turn manual shutoff valve.** ↳ **Reprogram / replace ECM.** ↳ **Perform System Verification Procedure.**	↳ **Close 1/4-turn manual shutoff valve.** ↳ **Replace regulator.** ↳ **Perform System Verification Procedure.**

Step 17

⚠WARNING **Depressurize fuel system; refer to Depressurization section of this manual.**

⚠WARNING **Observe organizational LOTO practices; install lockout/tagout (LOTO) devices.**

Depressurization complete:
↳ **Proceed to Step 18.**

Step 18

- Remove **fuel line adaptor tool** from fuel rail and LP fuel hose.
- Reinstall LP fuel hose on fuel rail quick disconnect fitting.
- Complete **Leak Check Procedure** DSM.0037 at all fittings and connections involved in this procedure.
- **Perform System Verification Procedure**.

No-Crank, No-Start



Introduction

A “No Crank, No Start” condition exists when the engine will not start and there is no response when the ignition is turned to the cranking position. Possible causes for this condition are;

- DAP system failure
- electrical failure
- component failure

The following diagnostic steps are designed to systematically identify the root cause(s) of lack of power and direct to corresponding repair procedures.

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Tools and Supplies

Item	Purpose
safety glasses	eye protection
shop rags	clean fuel system components before and after repair
flashlight	illuminate components
mirror	observe backside of fittings while performing leak check
Digital Multimeter (DMM)	resistance and voltage measurements
PSI PowerLink or other OBD-II diagnostic tool	read fault codes and ECM values

Personal / Vehicle Precautions

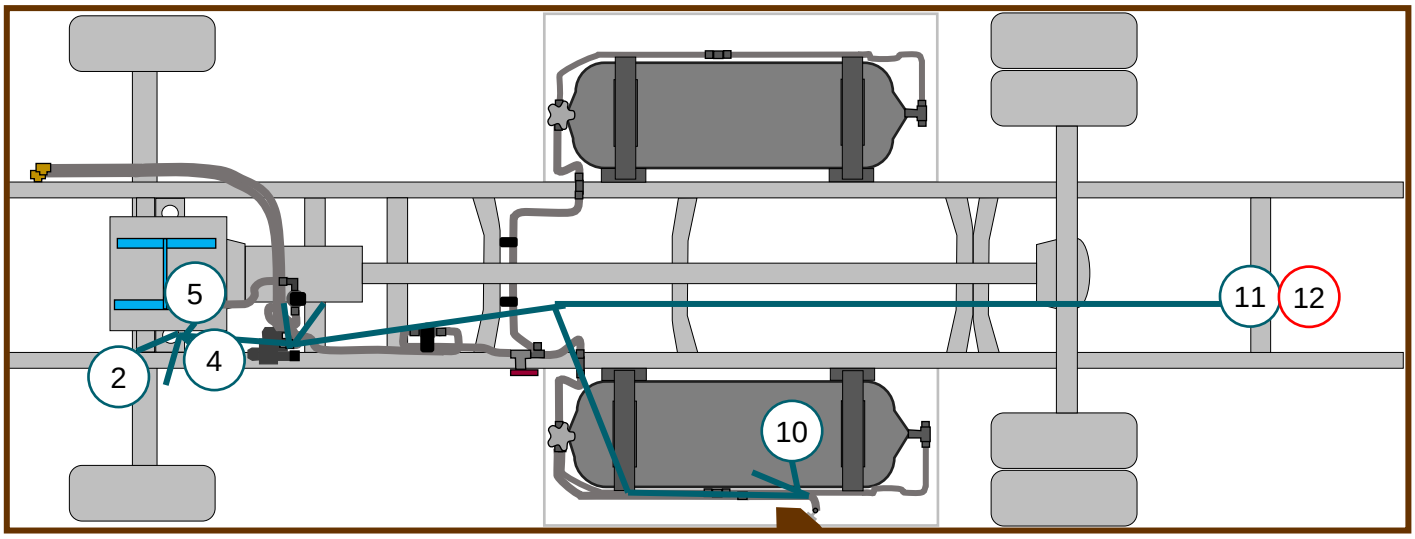
⚠WARNING **Wear approved personal protective equipment (PPE) including safety glasses.**

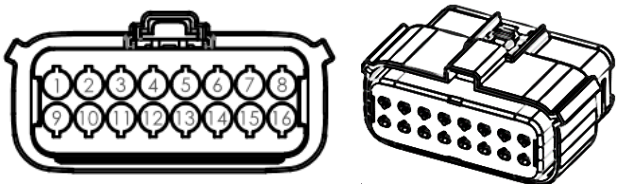
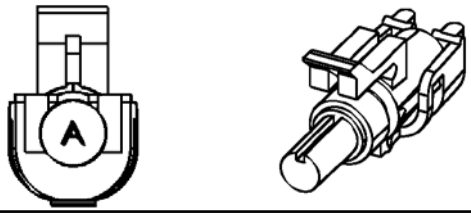
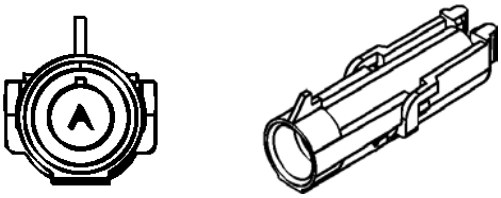
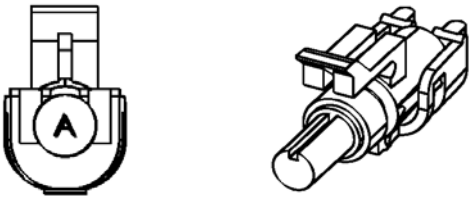
⚠WARNING **Verify service facility is well ventilated.**

⚠WARNING **Verify parking brake is engaged, wheels are chocked, and ignition switch is in OFF position.**

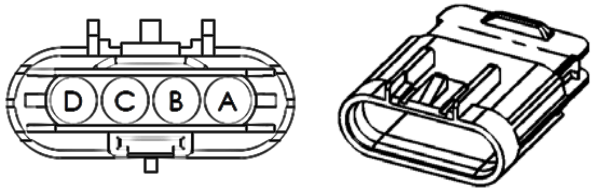
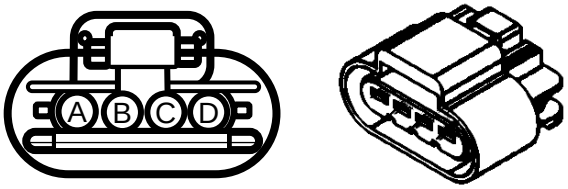
⚠WARNING **Install proper lockout/tagout (LOTO) device and observe all LOTO practices.**

Connector Location View

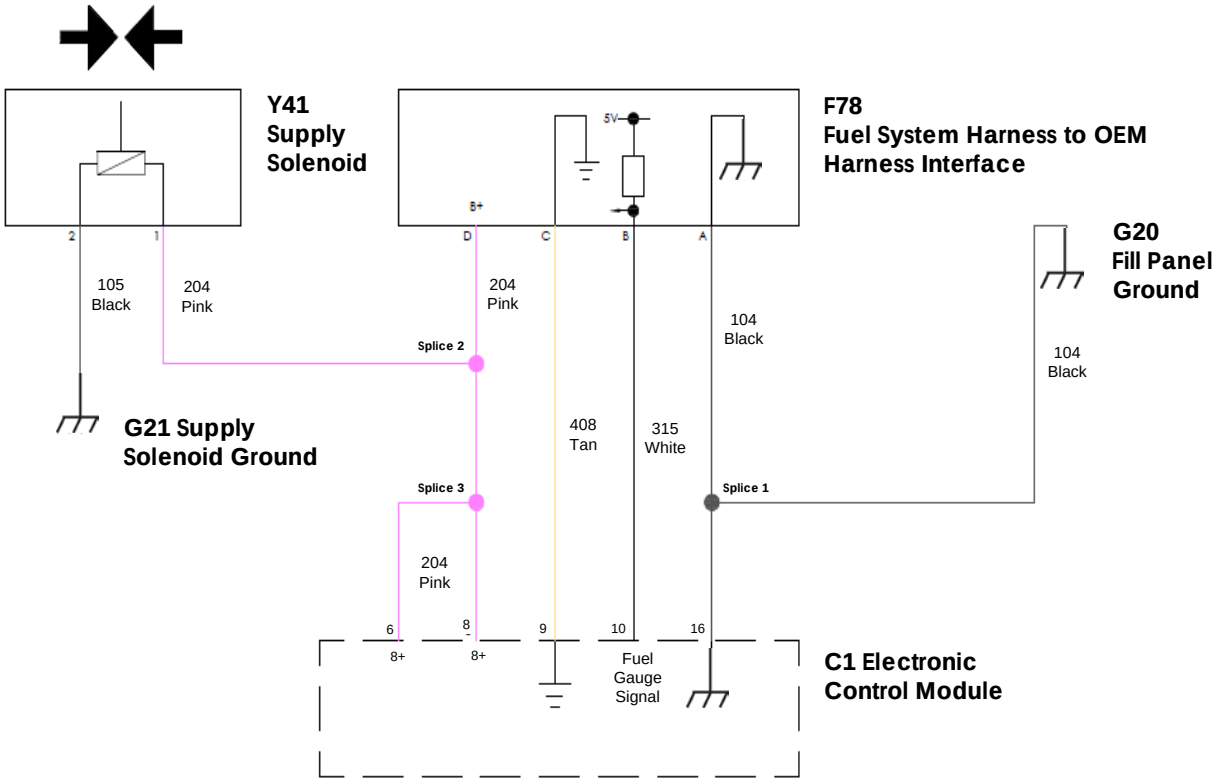


2 **C1 Electronic Control Module** (ECM) connector located inside at driver footwell.	
4 **IO31 Start Confirm** connector located inside driver footwell.	
5 **IO30 Crank Request** connector located inside of driver footwell.	
10 **D81 DAP (Drive Away Protection)** located on bottom of fill panel.	

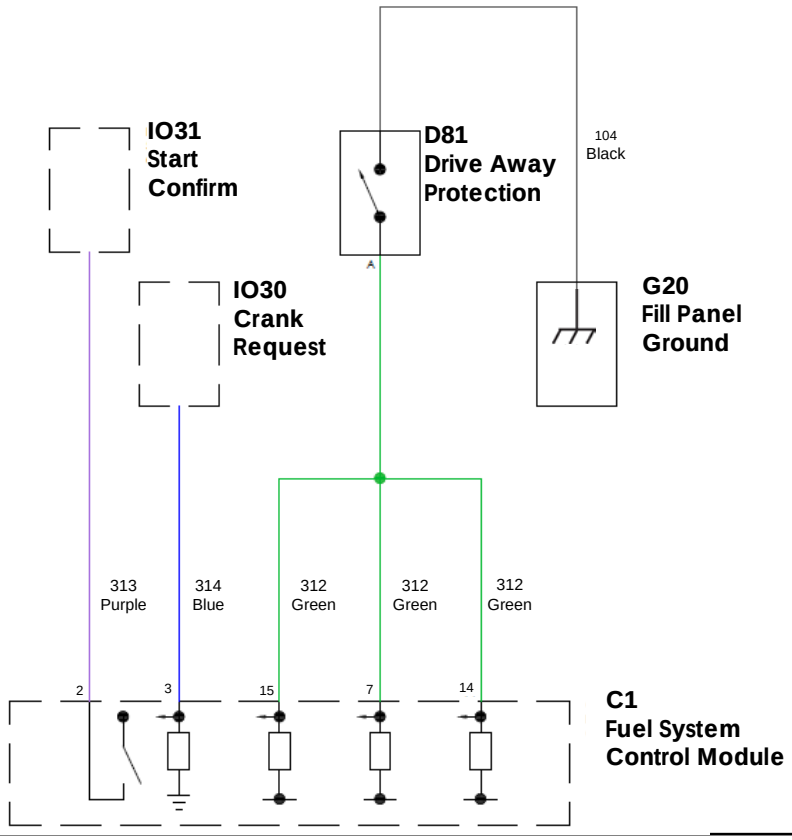
Connector Location View

11 **F78 Fuel System Harness Interface** located near last crossmember of chassis.	
12 **F79 Connector** OEM Fuel Send and Return Harness	

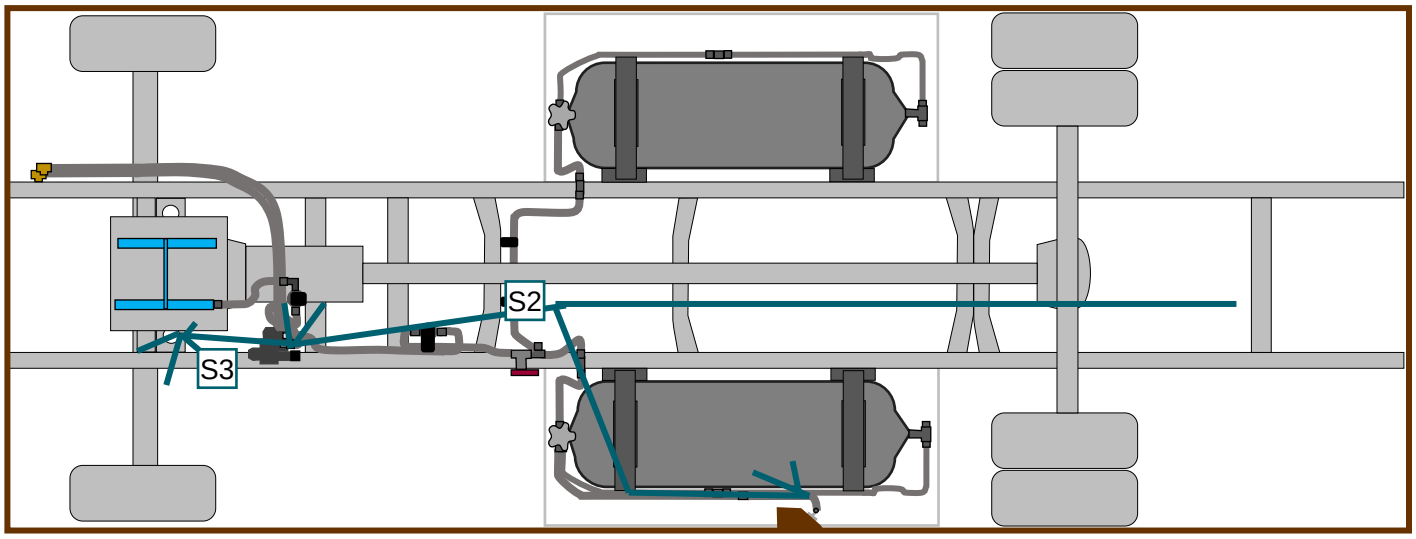
Electrical Schematic



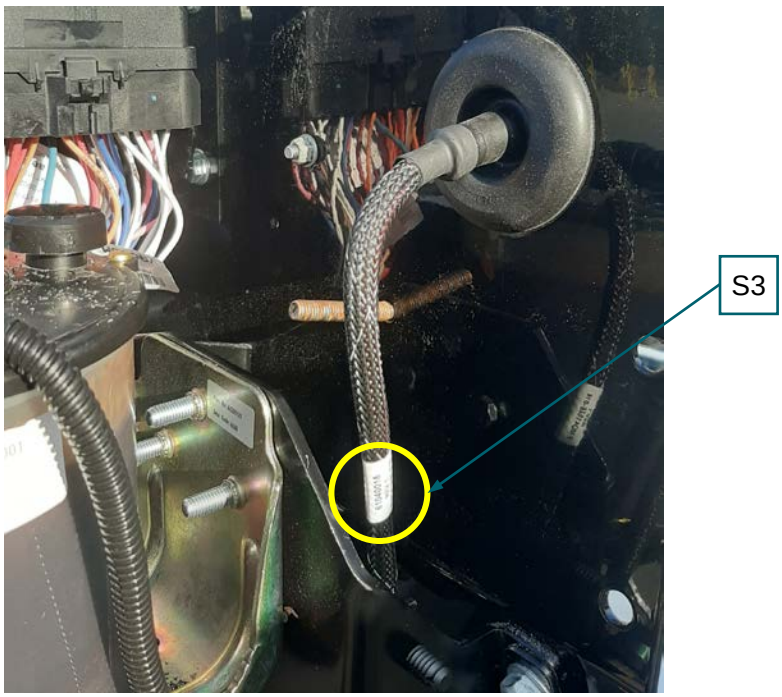
DAP Schematic



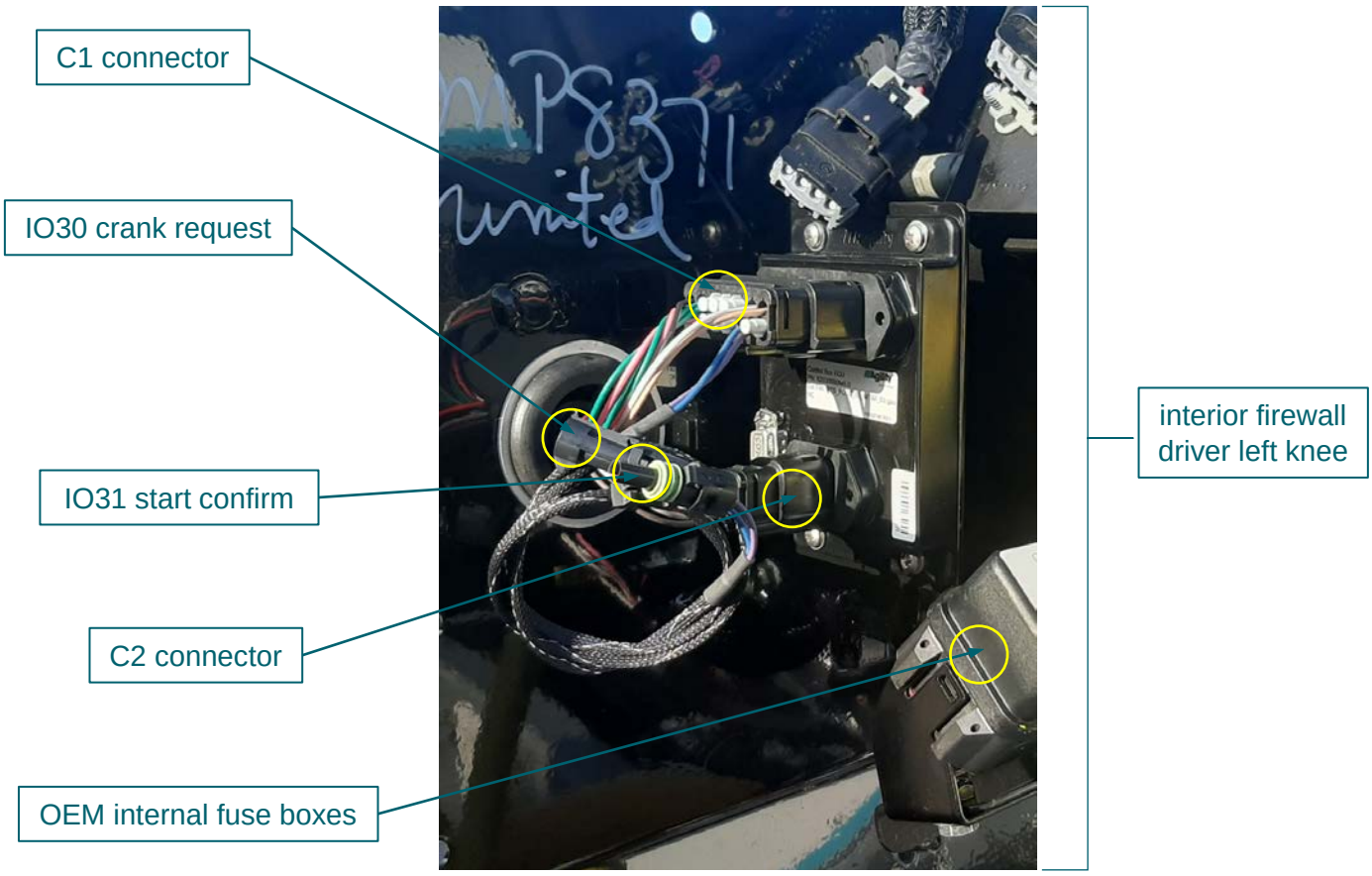
Harness Splice Location View



S2	**Splice 2**, located inside harness along frame rail near 1/4-turn manual shutoff valve.
S3	**Splice 3**, located inside harness near grommet on firewall within engine compartment.
S4	**Splice 4**, located inside harness near grommet on firewall within engine compartment.



Chassis Harness and ECM Connection Locations



Step 1

➢ Is the fuel cap installed completely? Drive away protection **(DAP)** will prevent the engine from starting if cap is not firmly in place.





Cap is not installed:
↳ **Install and retry crank.**

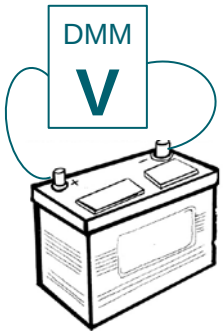
Cap is installed but will not crank:
↳ **Proceed to Step 2.**

Step 2

➢ Check for minimum battery voltage using a **DMM.**

battery located inside PS steps



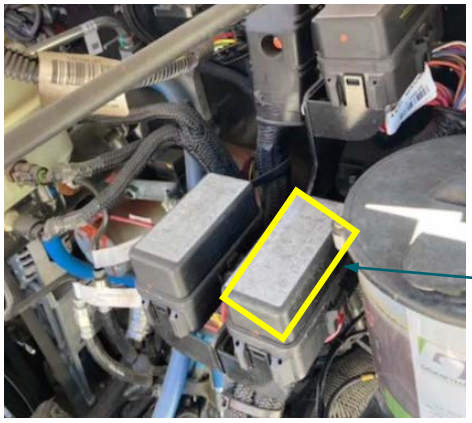


Battery voltage 12.2V or less:
↳ **Charge and test battery per OEM procedure; replace if need.**
↳ **Test Charging System per OEM procedure.**
↳ **Retry crank.**
↳ **If no crank, proceed to Step 3.**

Battery voltage greater than is 12.2V:
↳ **Proceed to Step 3.**

Step 3

➢ On DS, near the engine compartment firewall, locate fuse block as shown and remove cover.
➢ Test OEM 15-amp fuse.
➢ Test fuel pump relay per OEM instruction**s.**



fuse
fuel pump relay
fuse block

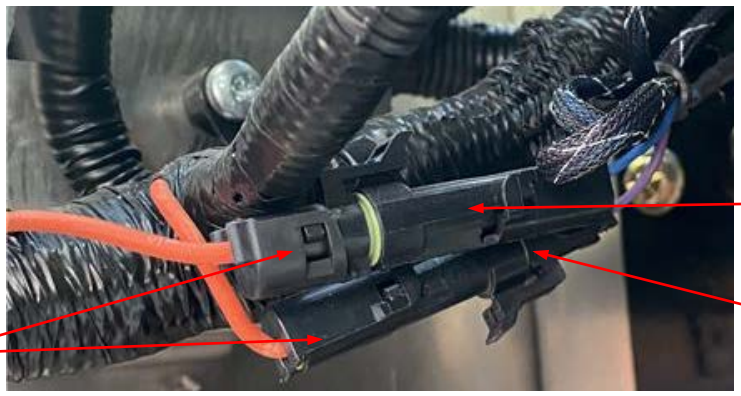


Fuse and/or relay are blown:
↳ **Replace affected component, retry crank.**

Fuse and relay are good:
↳ **Proceed to Step 4.**

Step 4

- Locate **IO31** start confirm connector (Purple) and **IO30** crank request connector (Blue) in DS footwell.
- Disconnect **IO31** connector from the OEM start relay connector (Orange).
- Disconnect **IO30** connector from the OEM start relay connector (Orange).
- Connect OEM start relay connectors (Orange) together.
- Crank vehicle.

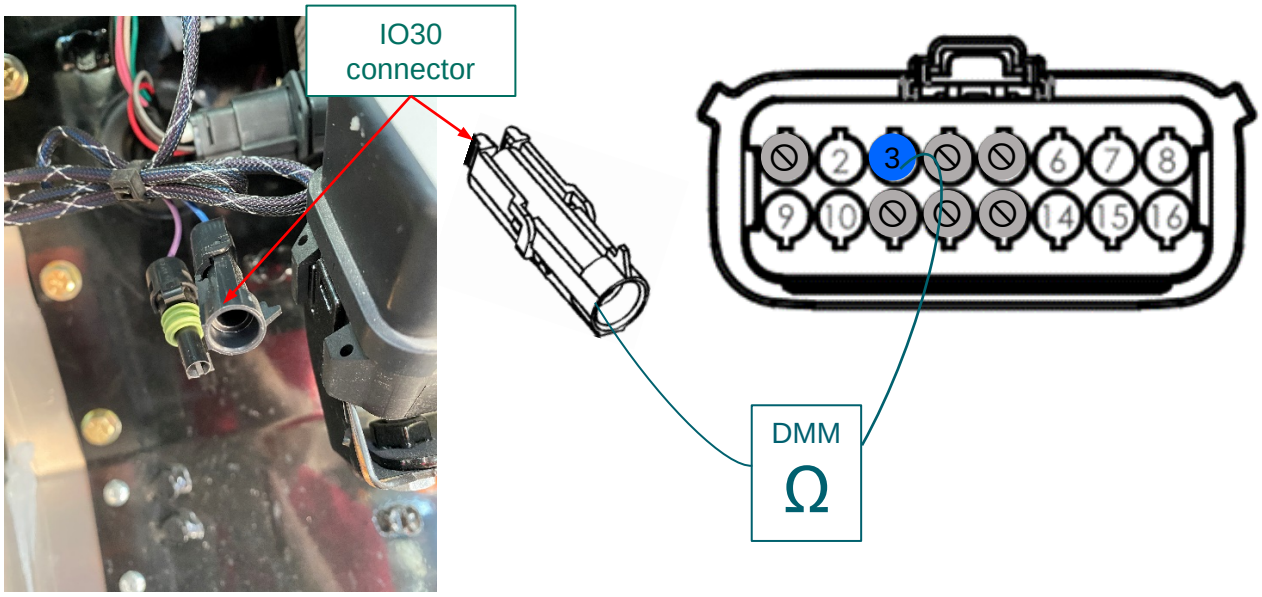


Engine does not crank:
↳ **Follow FCCC diagnostic procedure.**

Engine cranks:
↳ **Proceed to Step 5.**

Step 5

- With **IO30** (Blue) connector still disconnected.
- Check continuity **IO30** (Blue) with **ECM** connector **C1 Terminal 3** (Blue).

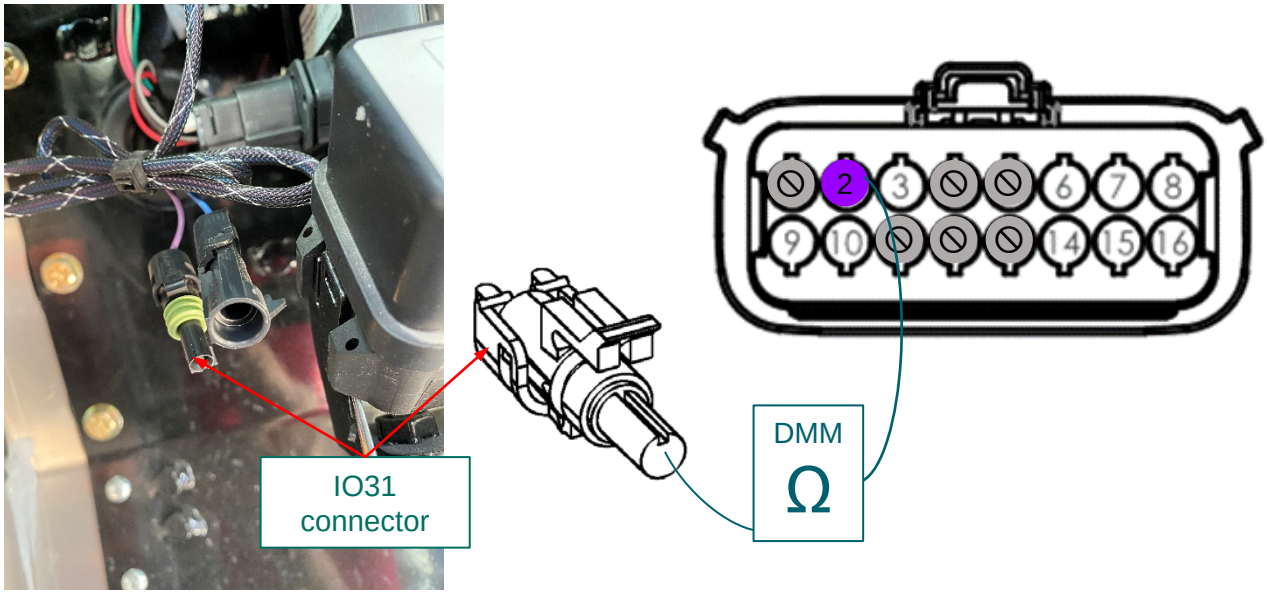


Continuity is not present:
↳ **Repair high resistance in circuit 314 between C1 and IO30 Connectors.** *Refer to DSM.0036.*
↳ **Perform System Verification Procedure.**

Continuity is present:
↳ **Continue to Step 6.**

Step 6

- With **ECM** connector **C1** still disconnected.
- Check continuity between connector **IO31** (Purple) and **ECM** connector **C1 Terminal 2** (Purple).

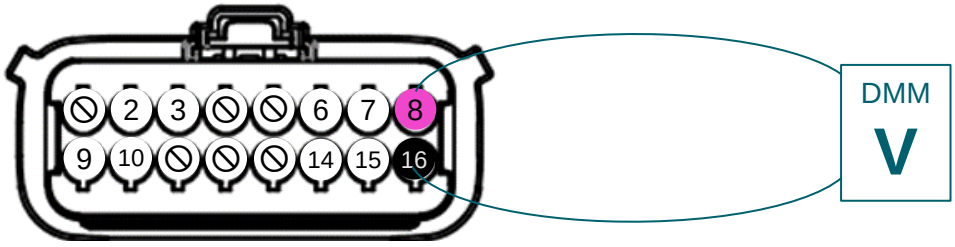


Continuity is not present:
↳ **Repair high resistance in circuit 313 between C1 and IO31 Connectors.** *Refer to DSM.0036.*
↳ **Perform System Verification Procedure.**

Continuity is present:
↳ **Reconnect IO30 and IO31 connectors to OEM connectors (Orange).**
↳ **Continue to Step 7.**

Step 7

- Ignition **OFF.**
- Ignition **ON**, **within 30 seconds**, measure voltage between connector **C1 Terminal 8** (Pink) and connector **C1 Terminal 16** (Black).

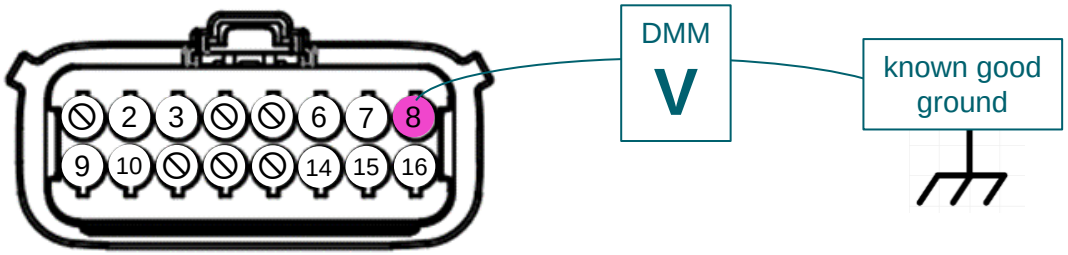


Voltage equal to battery voltage:
↳ **Proceed to Step 8.**

Voltage not equal to battery voltage:
↳ **Proceed to Step 8.**

Step 8

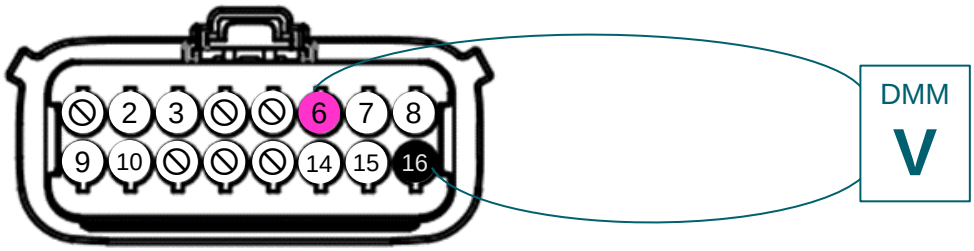
- Ignition **OFF**.
- Ignition **ON, <u>within 30 seconds</u>,** measure voltage between connector **C1 Terminal 8** (Pink) and a **known good ground.**



Voltage equal to battery voltage: ↳ **Repair high resistance in circuit 104 between C1 and Splice 1.** *Refer to DSM.0036.* ↳ **Perform System Verification Procedure.**	**Voltage not equal to battery voltage:** ↳ **Proceed to Step 9.**

Step 9

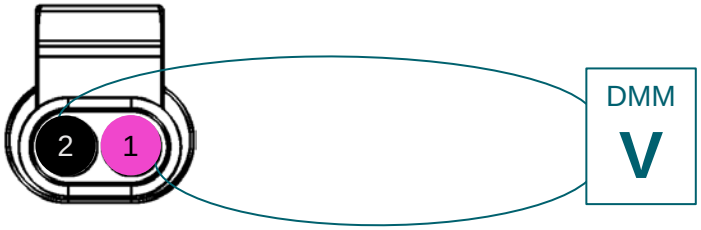
- Ignition **OFF**.
- Ignition **ON, <u>within 30 seconds</u>**, measure voltage between **C1 Terminal 6** (Pink) and **Terminal 16** (Black).



Voltage equal to battery voltage: ↳ **Proceed to Step 12.**	**Voltage not equal to battery voltage:** ↳ **Proceed to Step 10.**

Step 10

- Ignition **OFF**, disconnect **Y41** connector.
- Ignition **ON**, **within 30 seconds**, measure voltage between connector **Y41 Terminal 1** (Pink) and **Terminal 2** (Black).

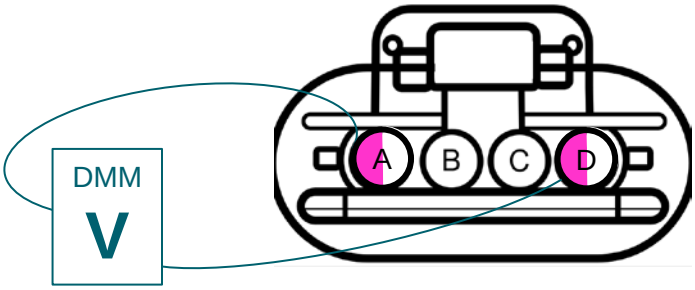


Voltage is equal to battery voltage:
↳ **Repair the open on the circuit 204 between Splice 2 and 3.** *Refer to DSM.0036.*
↳ **Perform System Verification Procedure.**

Voltage is not equal to battery voltage:
↳ **Proceed to Step 11.**

Step 11

- Ignition **OFF**, disconnect **F78-F79 connector interface**.
- Ignition ON, **within 30 seconds**, measure voltage connector **OEM F79** between **Terminal A** (Pink/White) and **Terminal D** (Pink/White).

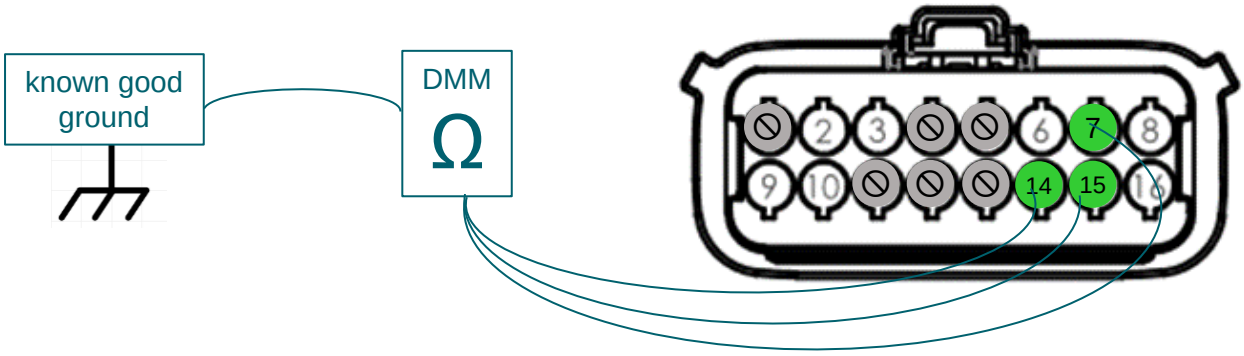


Battery voltage not present:
↳ **Follow FCCC diagnostic procedure.**
↳ **Perform System Verification Procedure.**

Battery voltage present:
↳ **Repair the open on circuit 204 between F78 and Splice 2.** *Refer to DSM.0036.*
↳ **Perform System Verification Procedure.**

Step 12
Continued from Step 9

- With **ECM** connector **C1 still disconnected**
- Check continuity between **known good ground** and **Terminals 7, 14 and 15.**



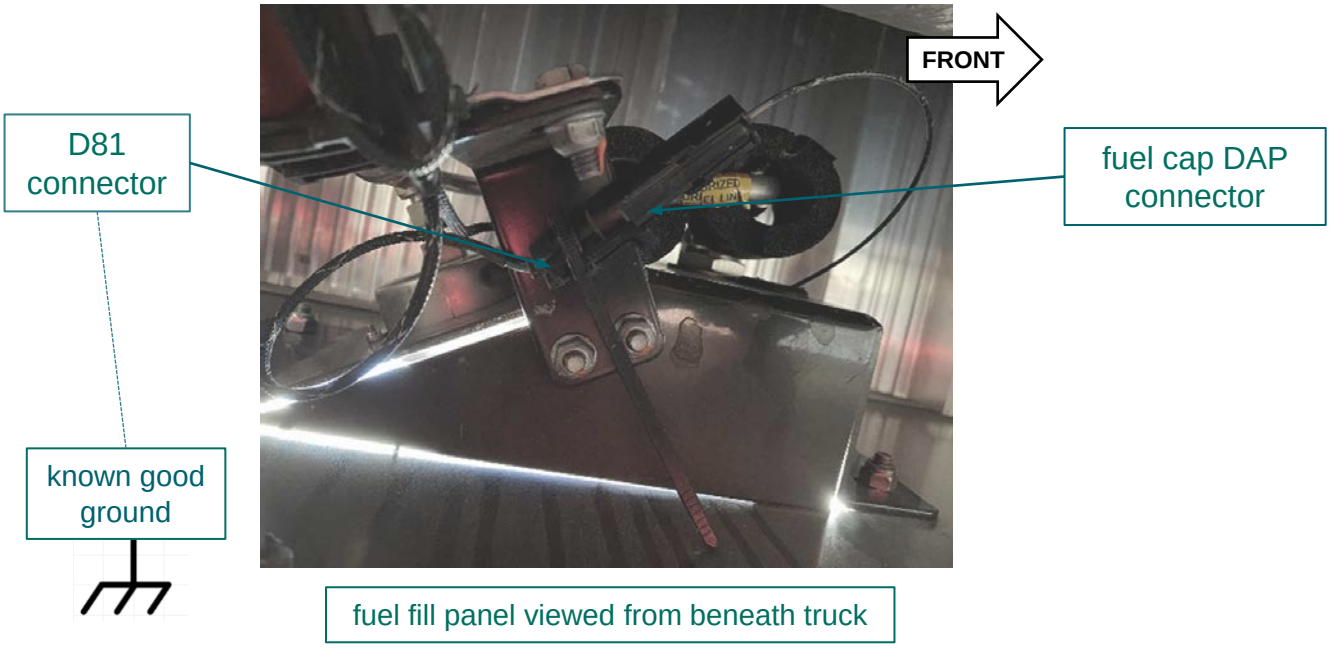
Continuity present on all:
↳ **Reconnect all connections.**
↳ **Perform System Verification Procedure.**

Continuity not present on one or more:
↳ **Proceed to Step 13.**

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Step 13

- Disconnect **fuel cap DAP** connector from **D81 chassis harness connector** on the back of the fuel fill panel.
- Using jumper wire ground **D81 chassis harness connector** to **known good ground**.
- Attempt to start vehicle.

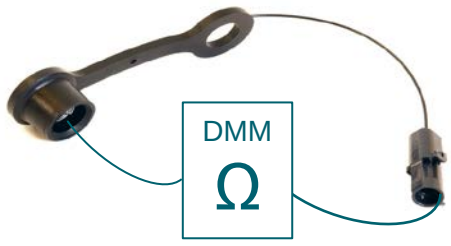


fuel fill panel viewed from beneath truck

Vehicle does not start:	Vehicle starts:
↳ **Repair open circuit 312 between C1 and terminals 14, 15 and 7 including Splice 4 through D81.** *Refer to DSM.0036.* ↳ **Perform System Verification Procedure.**	↳ **Proceed to Step 14.**

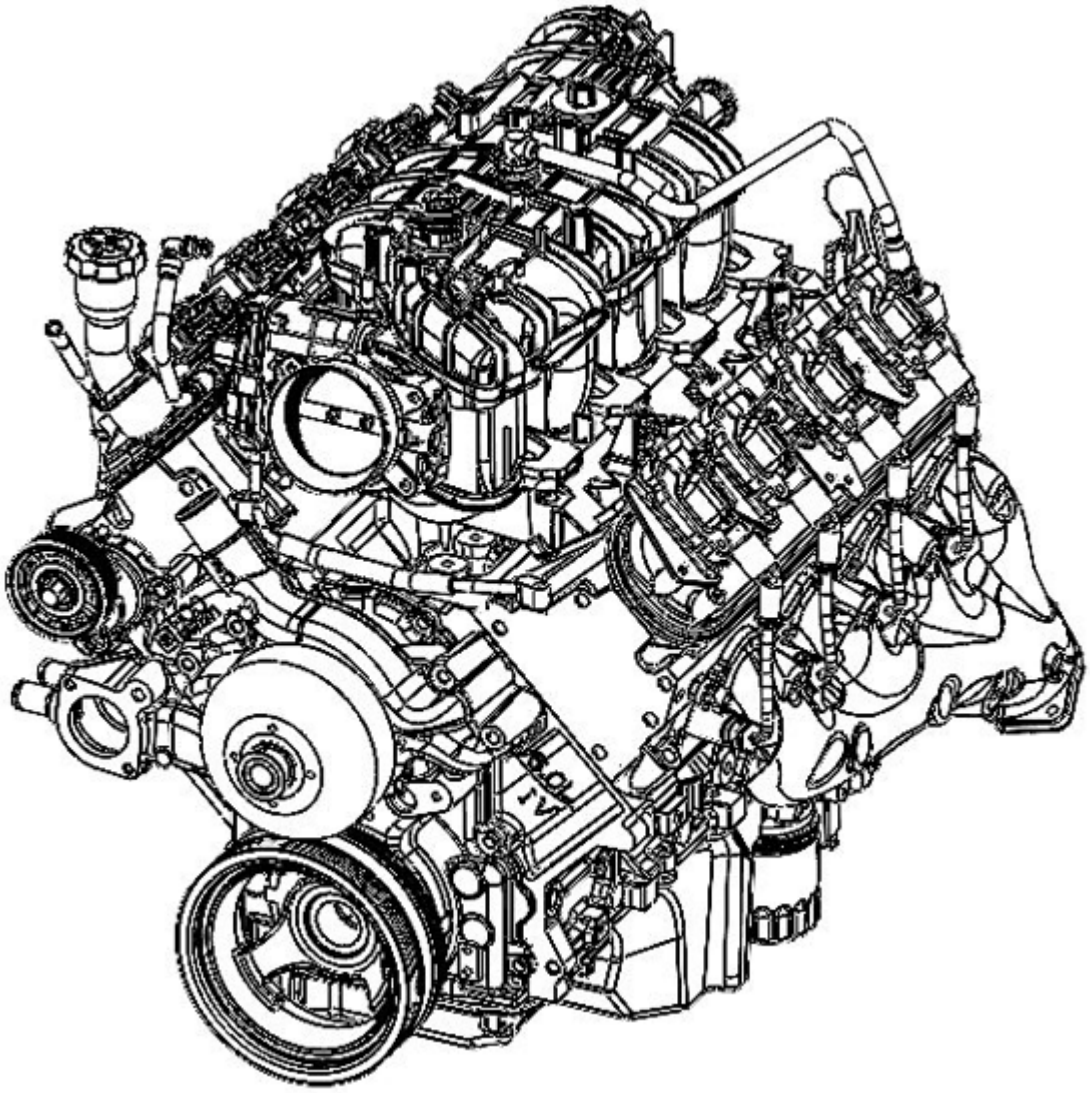
Step 14

- As outlined in **Step 4**, disconnect **DAP** connector from chassis harness **(D81).**
- Using a **DMM**, test for continuity through cap and connector circuit.



More than 5 ohms resistance:	Less than 5 ohms resistance:
↳ **Replace DAP fill cap assembly.** ↳ **Perform System Verification Procedure.**	↳ **Reconnect all connectors.** ↳ **Perform System Verification Process.**

Engine Misfire Diagnostics



Symptom Description

A vehicle that runs rough or has a rough idle condition is exhibited when the vehicle will start and run but has an abnormal vibration. This condition may be accompanied by a diagnostic trouble code (DTC). When diagnosing a rough idle condition with DTC faults, always follow the diagnostic procedures for any active fault codes before diagnosing the rough idle.

This symptom-based diagnostic section is designed to assist in diagnosing a general engine misfire. The following issues are possible causes of a random and/or multiple cylinder misfire.

1. Injector(s) fault.
2. Ignition system fault.
3. Restricted induction or exhaust system.
4. Restricted CNG system component.
5. Mechanical engine failure(s).
6. Engine sensor fault.
7. Abnormal fuel pressure.

Circuit / System Verification

1. Perform the preliminary vehicle inspection in procedure DSM.0009.
2. Connect the diagnostic scan tool and record all fault code information.
3. Clear all fault code information.
4. If any fault code other than a SPN: 132 FMI: 31 is present, diagnose and repair all prevailing fault codes first.

Fault Codes

SPN: 1322 **FMI: 31**	FMI 2: Fuel Injector Malfunction

The following fault code(s) may set when vehicle ignition is left in the ON position while the driver does not engage the starter within approximately 30 seconds.

SPN	FMI	Type	MIL	Possible Faults
1322	31	B	Yes	• Fuel injector malfunction

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Tools and Supplies

Item	Purpose
safety glasses	eye protection
shop rags	clean fuel system components before and after repair
flashlight	illuminate components
mirror	observe backside of fittings while performing leak check
digital multimeter (DMM)	resistance and voltage measurements
PSI PowerLink or other OBD-II diagnostic tool	read fault codes and ECM values
noid light	used to diagnose fuel injector issue

General Safety Precautions

⚠WARNING **ALWAYS use personal protective equipment (PPE) when working around pressurized fuel systems.**

⚠WARNING **Verify parking brake is engaged, wheels are chocked, and ignition switch is in OFF position.**

⚠WARNING **Install proper lockout/tagout (LOTO) device and observe all LOTO practices.**

Step 1	➢ Start and idle vehicle.	
	The vehicle exhibits a misfire condition: ↳ **Proceed to Step 2.**	**The vehicle does not exhibit a misfire condition:** ↳ **Operate the vehicle under the conditions when the fault code set.** ↳ **If the fault code does not set, return the vehicle to service.**

NOTICE **Never probe an electrical connection with anything other than an appropriately sized shaped test lead. Doing so may result in damage to components.**

Step 2	➢ Inspect the ignition system and fuel injectors.	
	Loose or damaged connectors found: ↳ **Repair damage.** *Refer to harness and wire repair procedure DSM.0036.* ↳ **Perform System Verification Procedure.**	**Loose or damaged connectors not found:** ↳ **Proceed to Step 3.**
Step 3	➢ Inspect induction system for; • plugged air filter • collapsed air filter • damaged induction tubing • loose or missing vacuum port • loose or missing vacuum cap	
	Above listed damage found: ↳ **Repair or replace component(s).** ↳ **Perform System Verification Procedure.**	**No damage found:** ↳ **Proceed to Step 4.**
Step 4	➢ Perform PSI Cylinder Power Balance Test. ➢ Refer to OEM procedure.	
	Cylinder(s) failed: ↳ **Proceed to Step 5.**	**Cylinders(s) passed:** ↳ **Proceed to Step 6.**
Step 5	➢ Install a fuel injector Noid test light on suspect cylinder(s). ➢ Start, and idle the engine. ➢ Does the light pulse comparable to the other injectors not exhibiting this condition?	
	Damaged parts located: ↳ **Replace the injector(s) as needed and retest.** ↳ **Perform System Verification Procedure**.	**No damaged parts:** ↳ **Repair the open or high resistance in the injector driver circuit.**

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Step 6

➢ Inspect ignition system by checking for:
- damaged or worn coil packs
- damaged or worn spark plug wires
- bad spark plugs

Damaged parts located:
↳ **Repair damaged part.**
↳ **Perform System Verification Procedure**.

No damaged parts:
↳ **Proceed to Step 7.**

Step 7

⚠WARNING **Depressurize fuel system; refer to Depressurization section of this manual.**

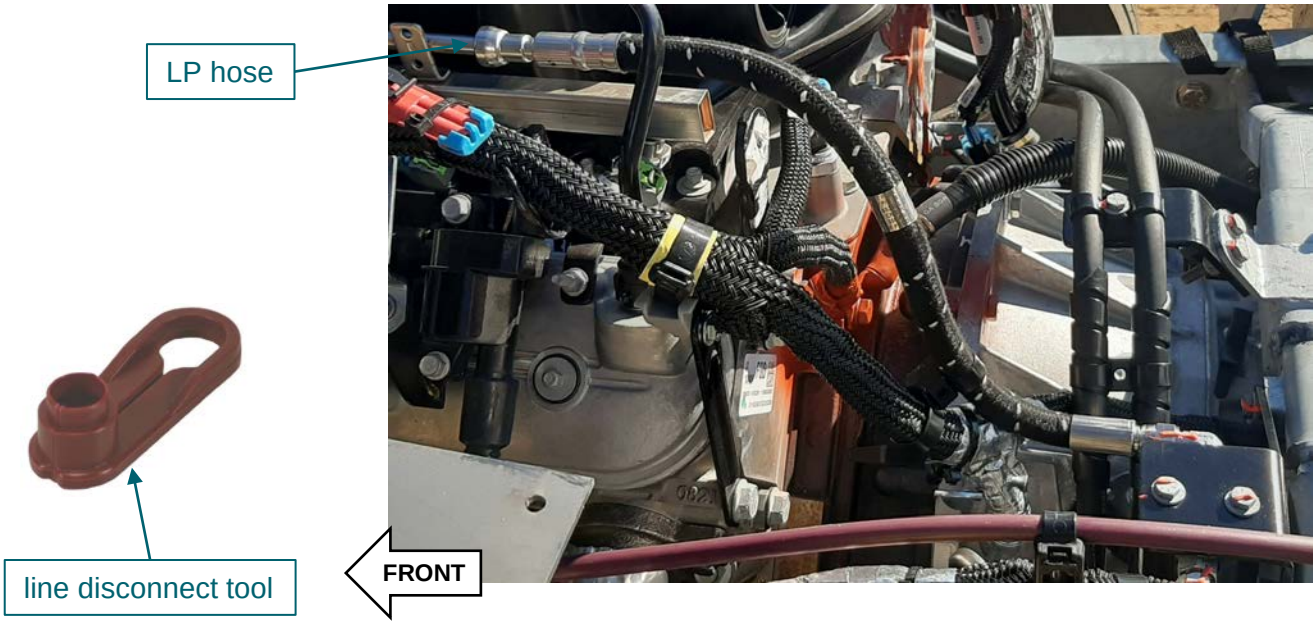
⚠WARNING **Observe organizational LOTO practices; install lockout/tagout (LOTO) devices.**

Depressurization complete:
↳ **Proceed to Step 8.**

Step 8

⚠CAUTION **ALWAYS verify fuel system has been depressurized!**

➢ Remove LP fuel hose from fuel rail fitting using line disconnect tool.



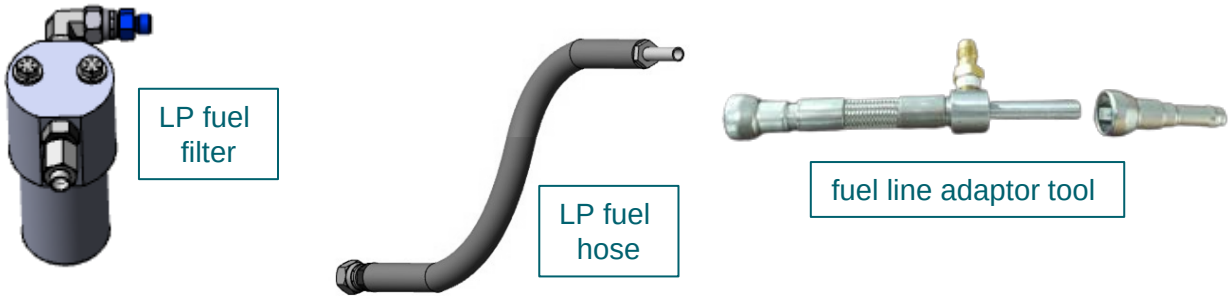
LP fuel line disconnected:
↳ **Proceed to Step 9.**

Step 9	➢ Install a commercially available fuel pressure test port adaptor and gauge rated for at least 150 psi **(10.3 Bar)** from fuel rail to LP fuel hose. **⚠WARNING** **Verify connections are secure by pulling fuel line connection firmly.** **NOTICE** **Verify gauge is at least 150 psi (10.3 Bar) and CNG compatible.** fuel line adaptor tool 
	Test tool installed: ↳ **Proceed to Step 10.**
Step 10	➢ With all lines and connections secured, pressurize system as per procedure at the end of Depressurization section.
	Pressure is less than 120 psi (8.27 Bar): ↳ **Proceed to Step 11.**
Step 11	➢ Attempt to start and idle the engine and monitor fuel pressure.
	Fuel pressure is between 120-130 psi (8.27-8.96 Bar): ↳ **Possible engine mechanical failure or ECM calibration concern.** **NOTE: ECM calibration typically will result in a no start condition prior to a misfire condition.** **Fuel pressure is not between 120-130 psi (8.27-8.96 Bar):** ↳ **Proceed to Step 12.**
Step 12	**⚠WARNING** **Depressurize fuel system; refer to Depressurization section of this manual.** **⚠WARNING** **Observe organizational LOTO practices; install lockout/tagout (LOTO) devices.**
	Depressurization complete: ↳ **Proceed to Step 13.**

Step 13

- Remove LP fuel hose from LP fuel filter.
- Remove LP fuel hose from **fuel line adaptor tool** using the line disconnect tool.
- With the LP fuel hose removed, use compressed air to verify LP fuel hose flow is unobstructed.

⚠CAUTION **ALWAYS verify fuel system has been depressurized!**

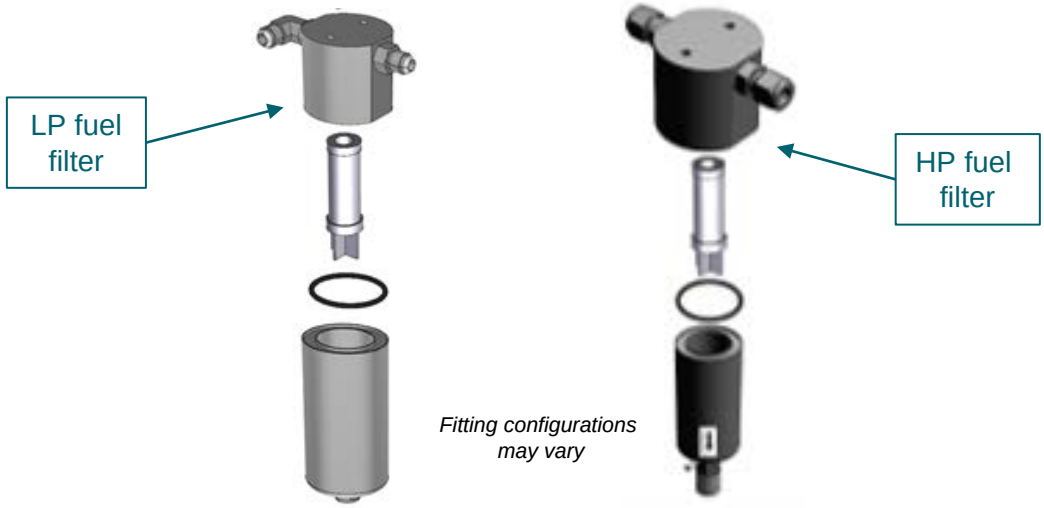


Compressed air flows:
↳ **Proceed to Step 14.**

Compressed air does not flow:
↳ **Replace LP fuel hose.**
↳ **Complete leak check procedure DSM.0037.**
↳ **Perform System Verification Procedure.**

Step 14

- Refer to Filter Element Replacement section for disassembly and assembly instructions.
- Inspect LP and HP filters for blockage.

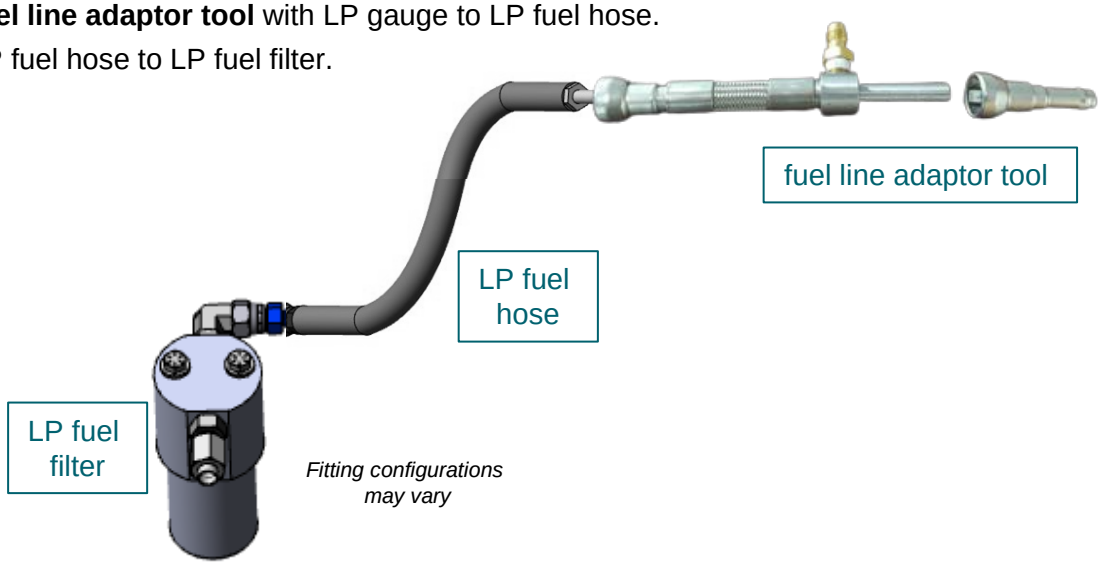


Debris found:
↳ **Replace element, clean filter bowl and reassemble per filter element replacement instructions.**
↳ **Proceed to Step 15.**

Debris not found:
↳ **Replace element, clean filter bowl and reassemble per filter element replacement instructions.**
↳ **Proceed to Step 15.**

Step 16

- Reattach **fuel line adaptor tool** with LP gauge to LP fuel hose.
- Reattach LP fuel hose to LP fuel filter.



Proceed to Step 17.

Step 17

- With all lines and connections secured, pressurize system as per procedure at the end of Depressurization section.

↳ **Proceed to Step 18.**

Step 19

- Ignition **ON**.
- Check for 120 psi **(8.3 Bar)** at LP pressure test tool gauge.

Pressure is 120 psi (8.3 Bar) :	**Pressure is less than 120 psi (8.3 Bar):**
↳ **Engine condition not present**. ↳ **Proceed to Step 20.**	↳ **Replace regulator.** ↳ **Perform System Verification Procedure.**

Step 20

- Start and idle the engine.

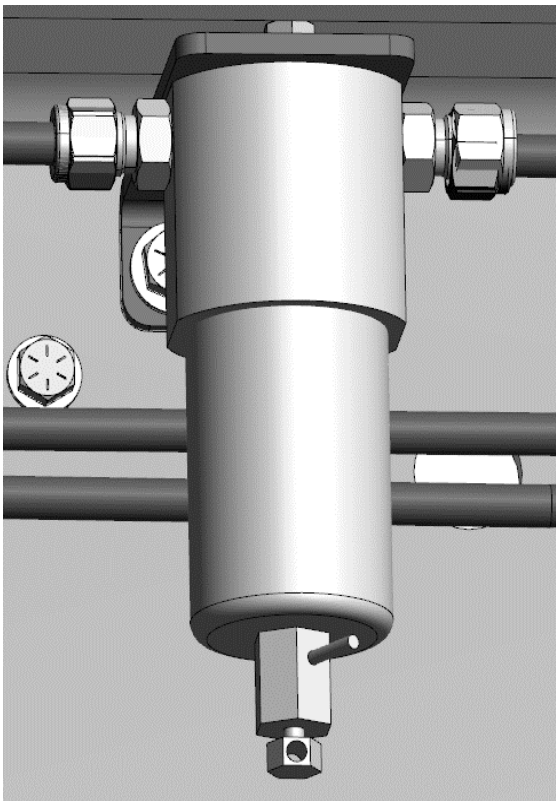
Condition still present?	**Condition not present.**
↳ **Possible ECM failure or calibration. Reprogram / replace ECM.** ↳ **Perform System Verification Procedure.**	↳ **Proceed to Step 21.**

Step 21

- Complete depressurization procedure per **Step 11**.
- Remove **fuel line adaptor tool** from fuel rail and LP fuel hose.
- Reinstall LP fuel hose on fuel rail quick disconnect fitting.
- Complete **Leak Check Procedure** DSM.0037 at all fittings and connections involved in this procedure.
- Perform **System Verification Procedure**.

Step 20	➢ Start and idle the engine.	
	Condition still present? ↳ **Possible ECM failure or calibration. Reprogram / replace ECM.** ↳ **Perform System Verification Procedure.**	**Condition not present.** ↳ **Proceed to Step 21.**
Step 21	➢ Complete depressurization procedure per **Step 11**. ➢ Remove **fuel line adaptor tool** from fuel rail and LP fuel hose. ➢ Reinstall LP fuel hose on fuel rail quick disconnect fitting. ➢ Complete **Leak Check Procedure** DSM.0037 at all fittings and connections involved in this procedure. ➢ Perform **System Verification Procedure**.	

Depressurization



Introduction

Depressurization is required whenever **fuel delivery system** plumbing and components are repaired or replaced.

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WARNING **Depressurization is required for fuel delivery system component repairs.**

Depressurization AND defueling are required when repairing or replacing fuel storage system components and associated cylinder straps, isolators, and bracket assemblies.

WARNING **Depressurization must be performed in well-ventilated area.**

Tools and Supplies

Item	Purpose
safety glasses	eye protection
shop rags	clean fuel system components before and after repair
flashlight	illuminate components
mirror	observe backside of fittings while performing leak check
7/16-in wrench	open and close bleed valve pressure relief nut
torque wrench	torque bleed valve
11/16-in socket	use with torque wrench

General Safety Precautions

WARNING **Verify parking brake is engaged, wheels are chocked, and ignition switch is in OFF position.**

WARNING **ALWAYS use personal protective equipment (PPE) when working around pressurized fuel systems.**

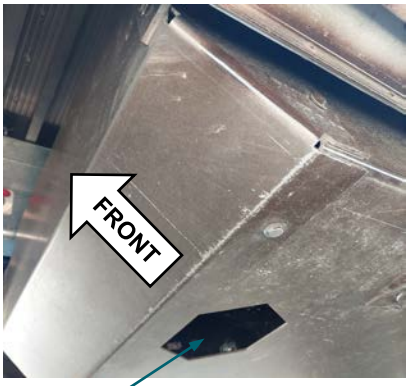
WARNING **Install proper lockout/tagout (LOTO) device and observe all LOTO practices.**

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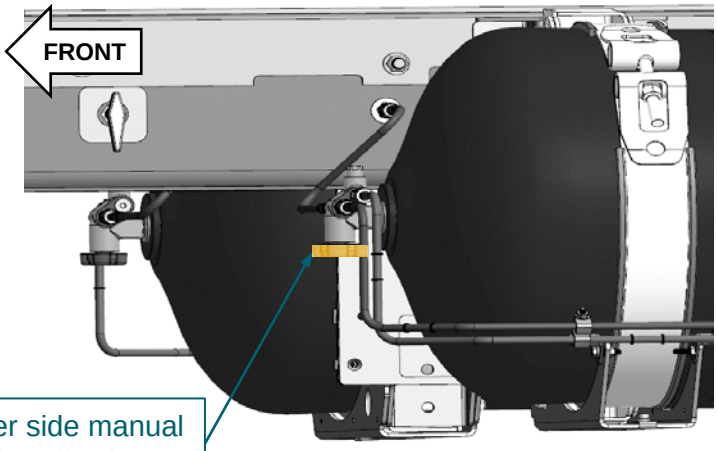
⚠WARNING **Before servicing fuel system plumbing and components, fuel pressure must be released using the following depressurization procedure.**

Step 1

➢ Close driver side cylinder manual shutoff valve.



cylinder shield valve access hole

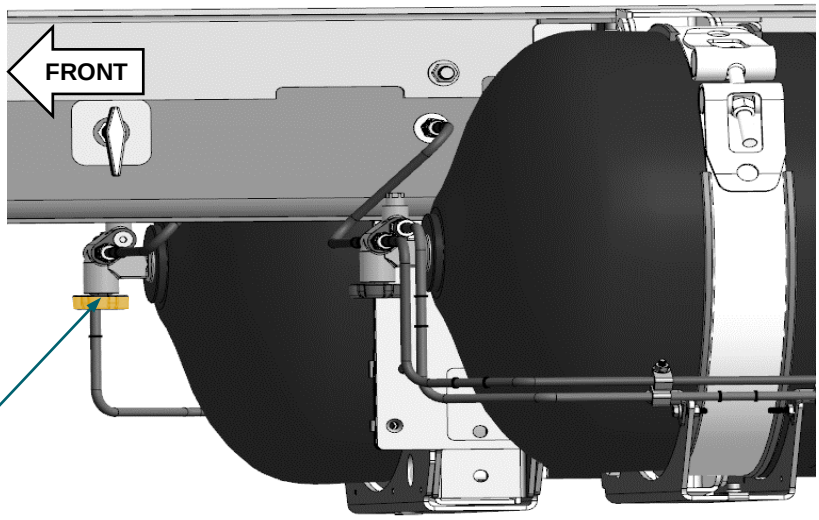


driver side manual shutoff valve

Step 2

➢ Close passenger side manual shutoff valve.

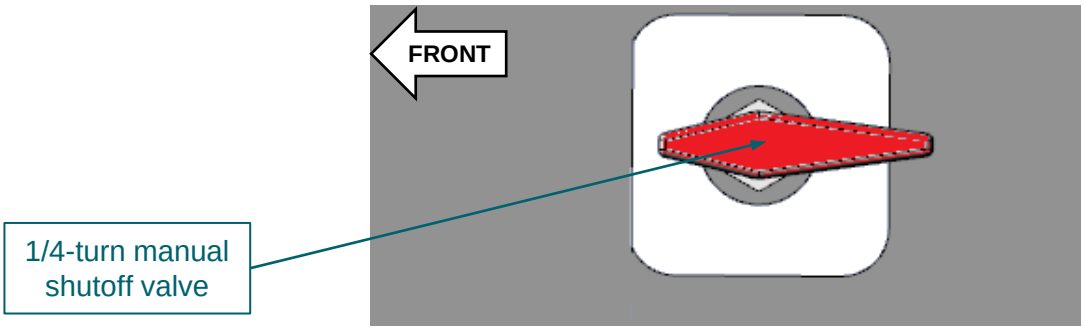
NOTE: *PS cylinder shield access hole similar to DS.*



passenger side manual shutoff valve

Step 3

- Verify 1/4-turn manual shutoff valve is open.



Step 4

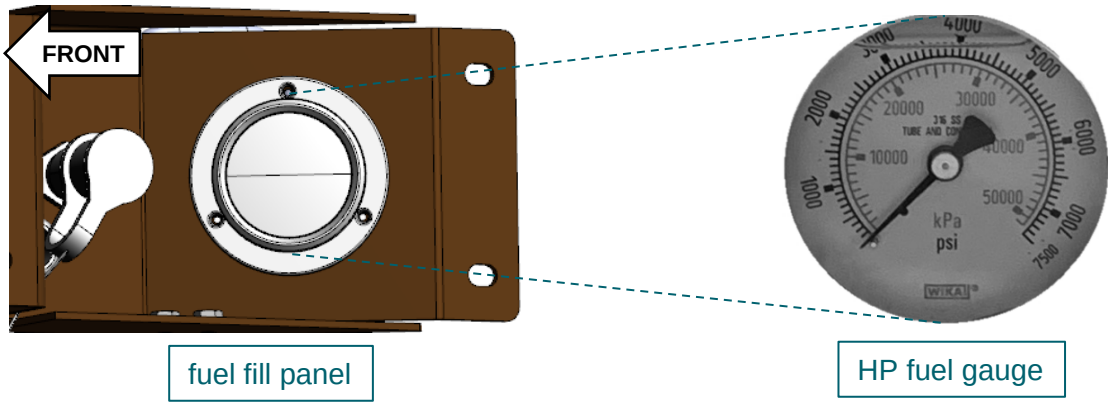
- Start vehicle and allow engine to run until it stalls.
- Attempt to start (crank for approx. 5 seconds) until HP fuel gauge shows approximately zero or crank 10 times to purge remaining fuel from fuel injectors.



Step 5

- Verify HP fuel gauge on fuel fill panel reads zero pressure.

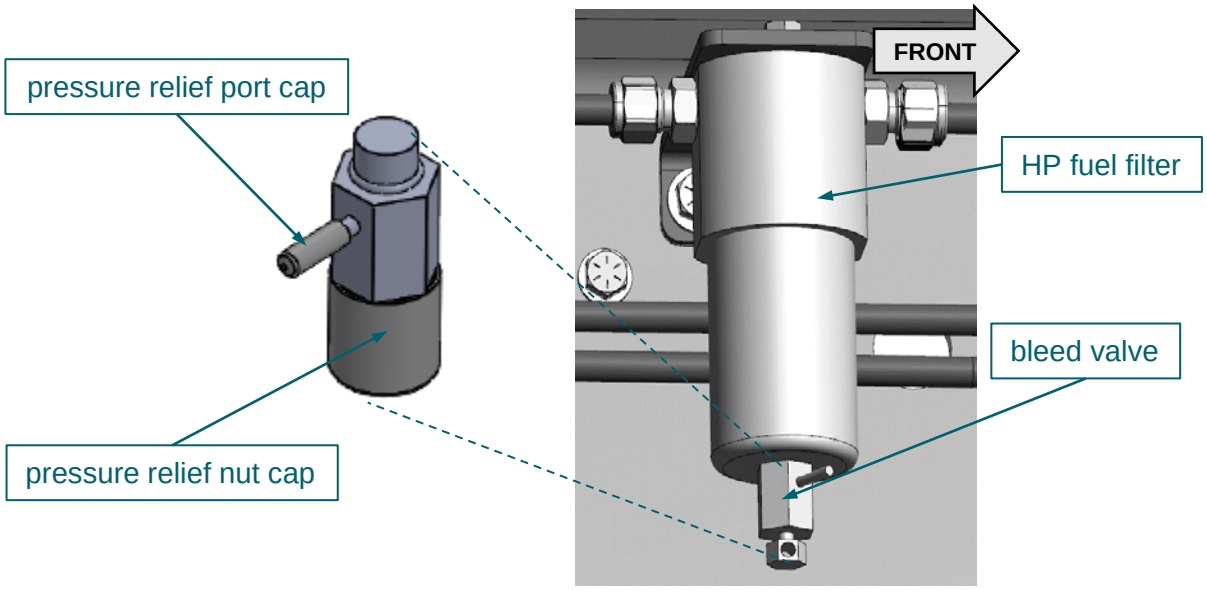
⚠WARNING **Confirm HP gauge reads zero before proceeding.**



Step 6

➢ Remove pressure relief port cap and pressure relief nut cap from bleed valve located on HP fuel filter.

NOTICE **Store pressure relief port cap and pressure relief nut cap for reinstallation later.**

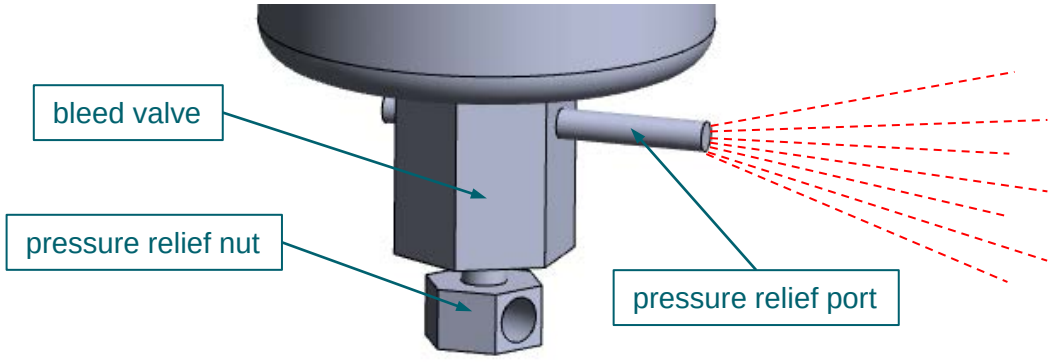


Step 7

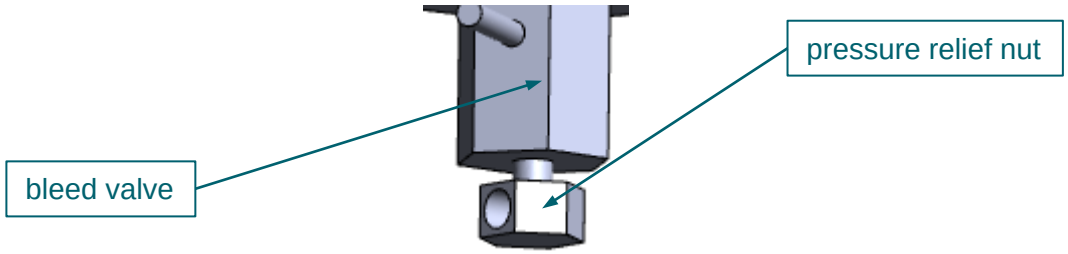
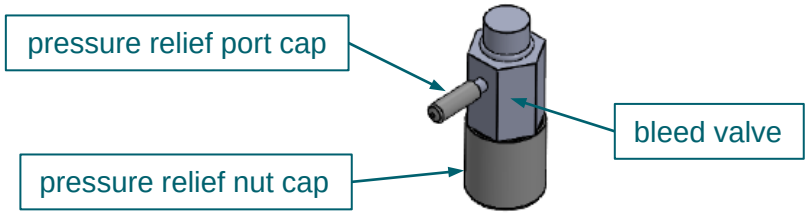
➢ Use a 7/16-in wrench to open pressure relief nut on bleed valve located on the HP fuel filter.

⚠WARNING **High-pressure fuel will exit from pressure relief port. Use appropriate PPE and maintain safe distance.**

⚠WARNING **Verify pressure has been released. This occurs when the sound of gas escaping has stopped.**



NOTICE **Complete service and repairs as needed.**

Step 8	➢ Use a 7/16-in wrench to close pressure relief nut on bleed valve. **To increase service life, ensure proper valve performance, and prevent leakage, apply only enough torque to bleed pressure relief nut as is required to achieve positive shutoff per Swagelok® instructions.** 
Step 9	➢ Install pressure relief port cap and pressure relief nut cap on bleed valve. **NOTICE** **Pressure relief port cap and pressure relief nut cap must be installed to prevent foreign object debris (FOD) intrusion. If pressure relief port cap and pressure relief nut cap are not present, reference service parts catalog for replacement.** 

⚠WARNING **Leak check procedure DSM.0037 must be performed before vehicle may be cleared for operation.**

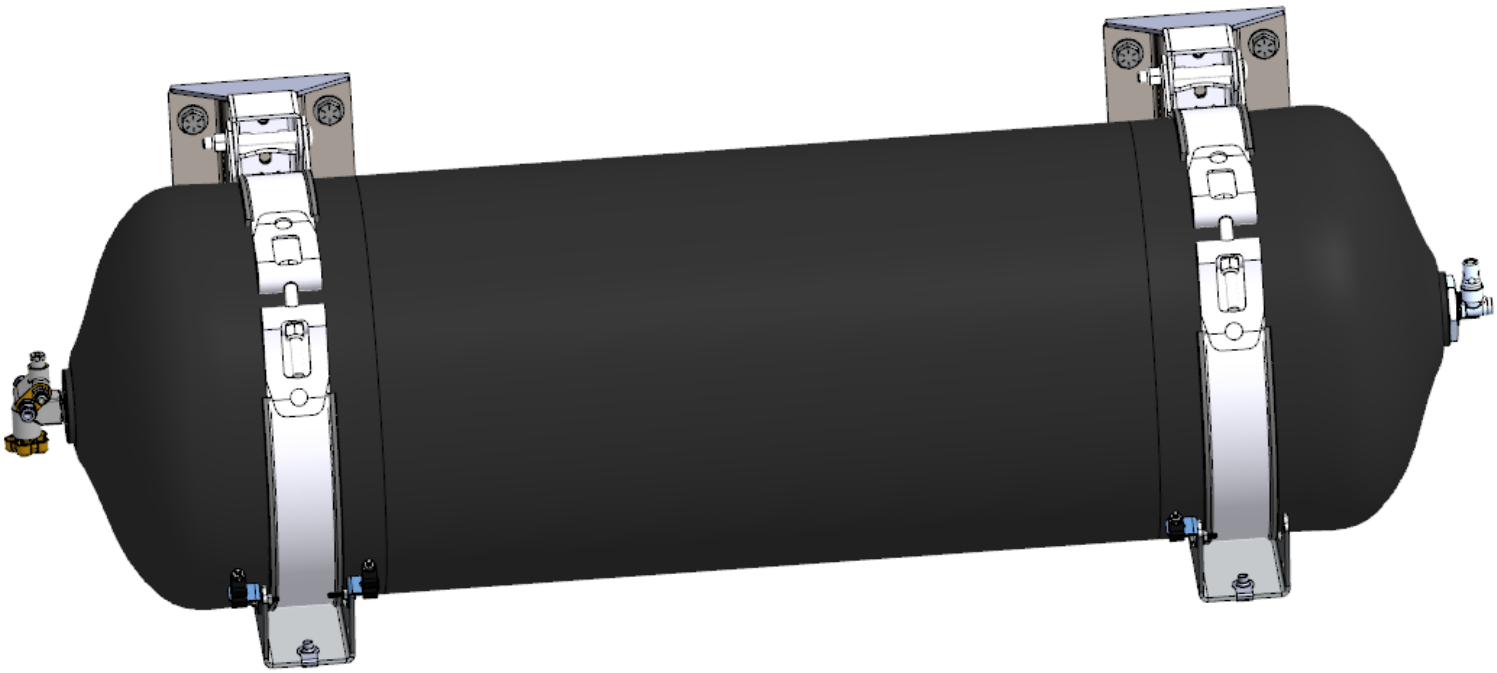
Fuel System Pressurization

After completing all repairs, always perform the following Steps to repressurize the system:

1. Ensure pressure relief nut is closed
2. Ensure pressure relied nut cap is installed.
3. Open driver side and passenger side cylinder valves.
4. Always perform leak check procedures.
5. Before operating vehicle, **Perform System Verification Procedures**.

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Defueling



Introduction

Defueling is required to repair or replace **fuel storage system** plumbing and components.

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⚠WARNING **Depressurization is required for fuel delivery system component repairs.**

Depressurization AND defueling are required when repairing or replacing fuel storage system components and associated cylinder straps, isolators, and bracket assemblies.

Tools and Supplies

Item	Purpose
safety glasses	eye protection
shop rags	clean fuel system components before and after repair
flashlight	illuminate components
mirror	observe backside of fittings while performing leak check
7/16-in wrench	bleed valve
11/16-in wrenches (QTY: 2)	remove and replace bleed valve and defuel adapter
torque wrench	torque bleed valve
11/16-in socket	torque bleed valve
CNG defueling kit, p/n 69500019	CNG defueling
defuel hose, 35-ft, p/n 20100021	CNG defueling

Personal / Vehicle Precautions

⚠WARNING **Wear approved personal protective equipment (PPE) including safety glasses.**

⚠WARNING **Verify service facility is well ventilated.**

⚠WARNING **Verify parking brake is engaged, wheels are chocked, and ignition switch is in OFF position.**

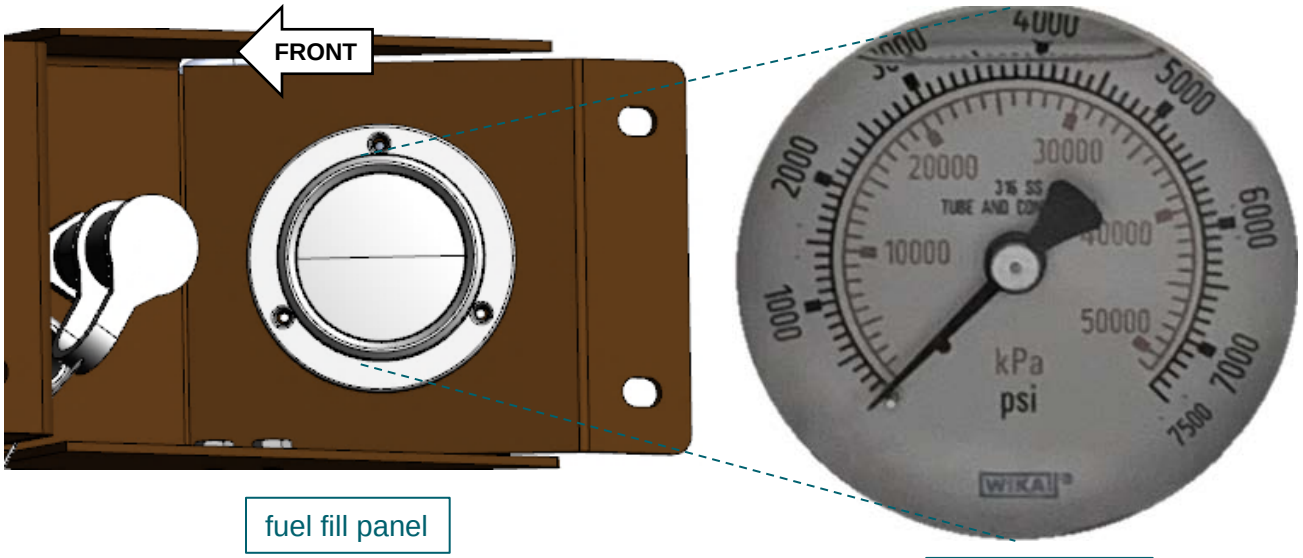
⚠WARNING **Install proper lockout/tagout (LOTO) device and observe all LOTO practices.**

⚠WARNING **Fuel system must be fully depressurized before defueling is attempted.**

Step 1

➢ ***If HP fuel gauge does not read approximately zero***, perform Fuel System Depressurization procedure.

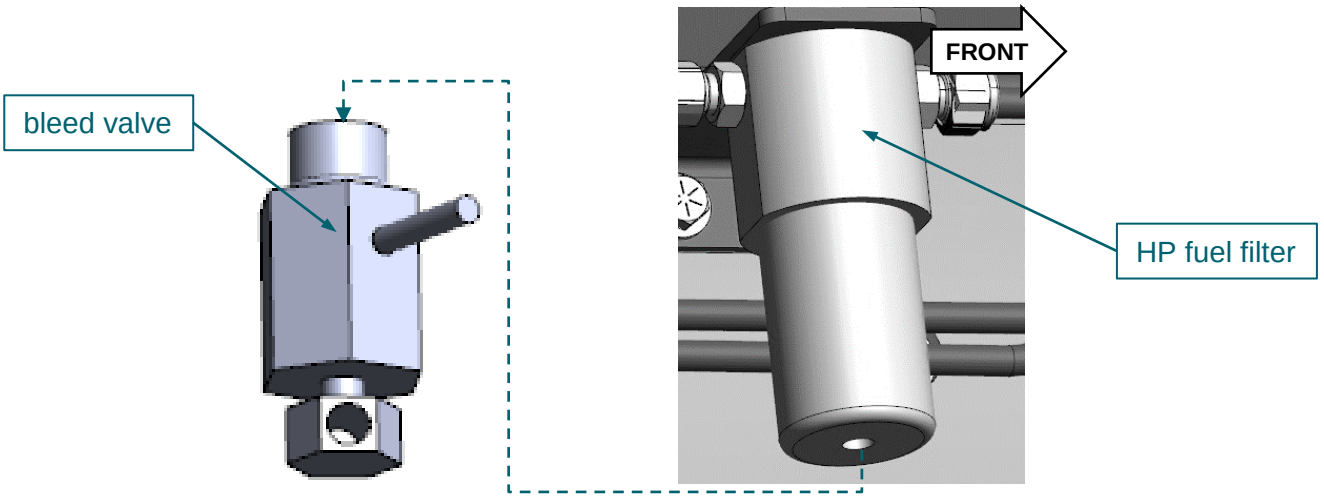
⚠WARNING **Verify HP fuel gauge on fuel fill panel reads approximately zero.**



Step 2

➢ Use a 11/16-in wrench to remove bleed valve from HP fuel filter.

NOTICE **Store bleed valve in a clean plastic bag for reinstallation later.**

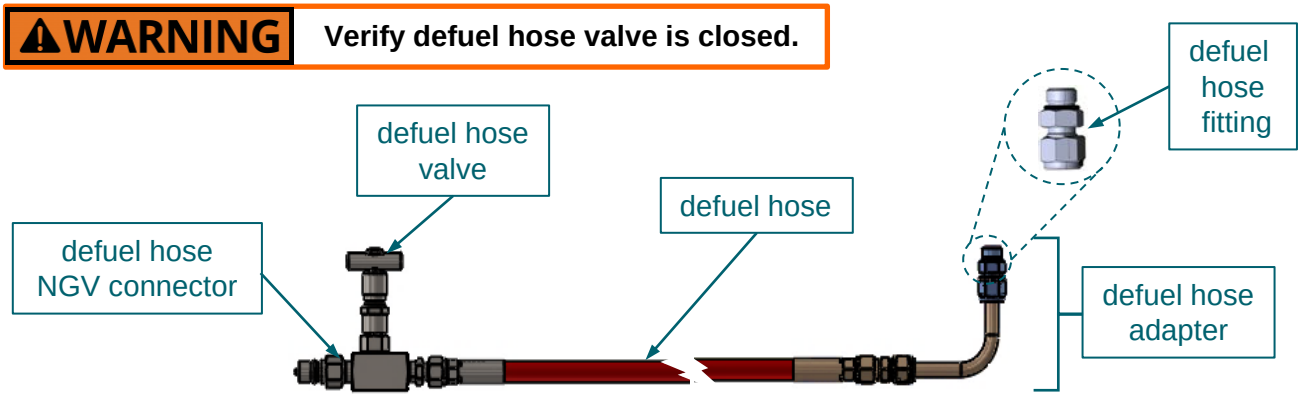


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Step 3

- Select defuel hose adapter CNG defueling kit, p/n 69500019.
- Remove defuel hose fitting from defuel hose adapter using a pair of 11/16-in wrenches.

⚠WARNING **Verify defuel hose valve is closed.**



NOTE: *Defuel hose shown shortened for clarity.*

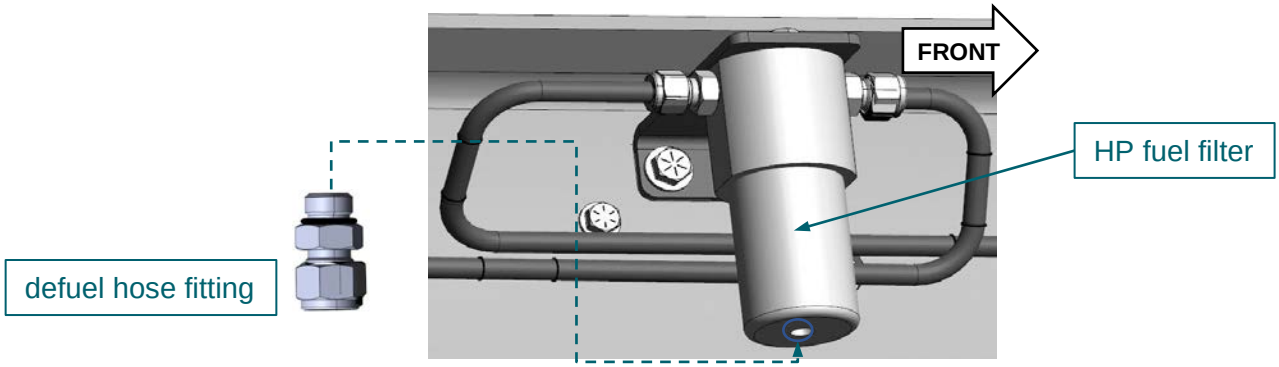
NOTICE **Inspect defuel hose fitting and NGV connector O-rings *(not visible)* for damage; replace if necessary.**

Step 4

C **Apply a light coat of Parker Super O-Lube® to fitting O-ring before installing. Verify O-ring and sealing surfaces are clean and free of debris.**

- Attach defuel hose fitting to HP fuel filter where bleed valve was removed using an 11/16-in wrench.

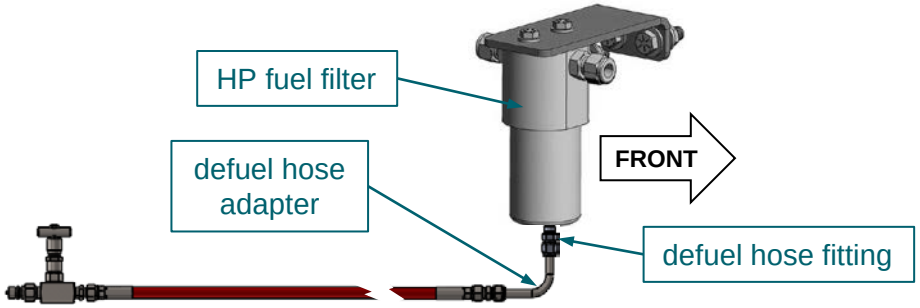
C **Torque fitting to 25 ft-lbs (33.9 Nm).**



Step 5

C **Tighten fittings according to Appendix A: WI.0199 Removal and Retightening of Tube Fittings.**

- Attach defuel hose adapter to fitting using a pair of 11/16-in wrenches.

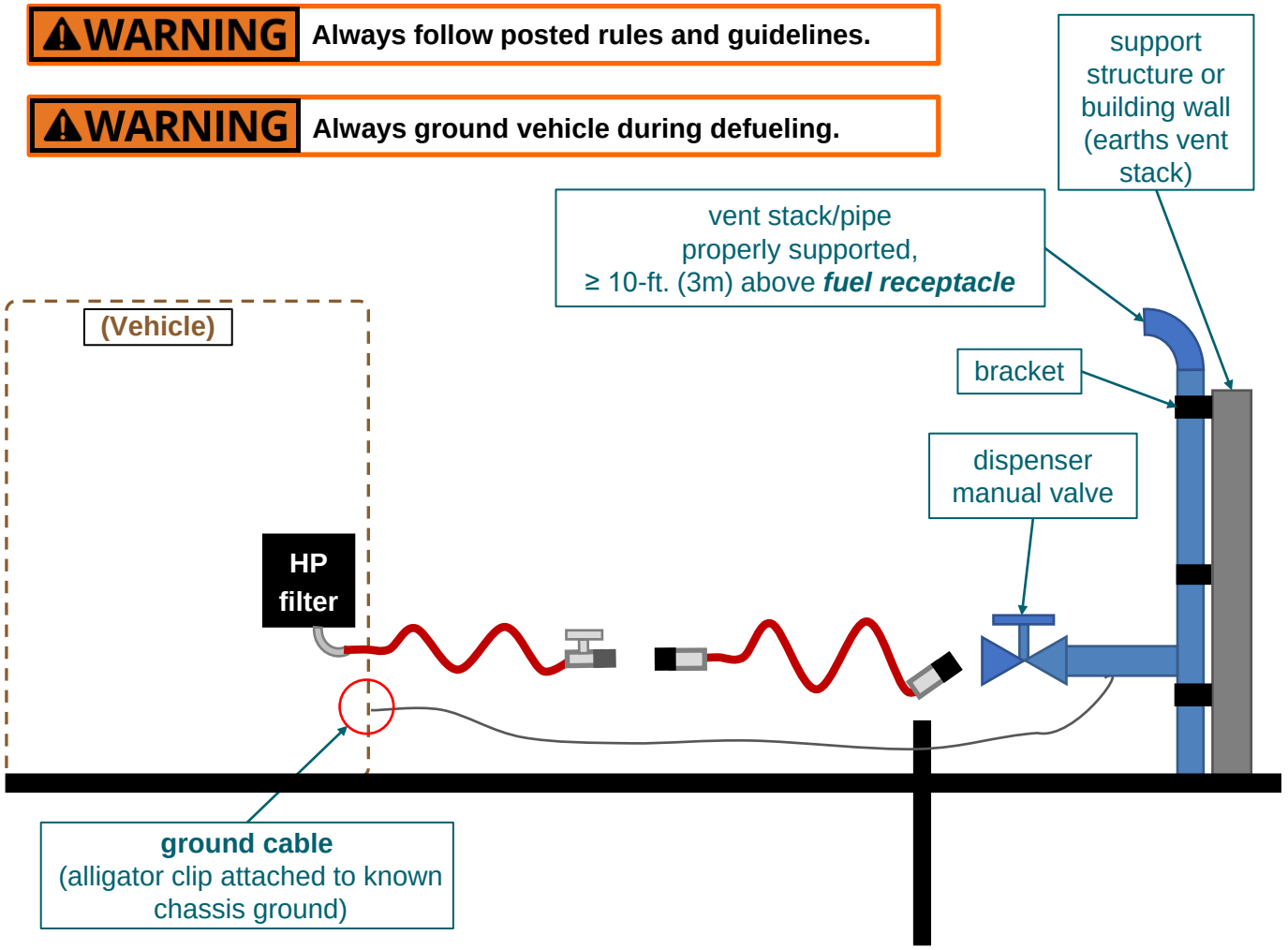


Step 6

- Attach ground cable clips to the vehicle ground and fuel dispenser or vent stack.
- Attach NGV connector end of defuel hose adapter to defuel hose.

⚠WARNING **Always follow posted rules and guidelines.**

⚠WARNING **Always ground vehicle during defueling.**

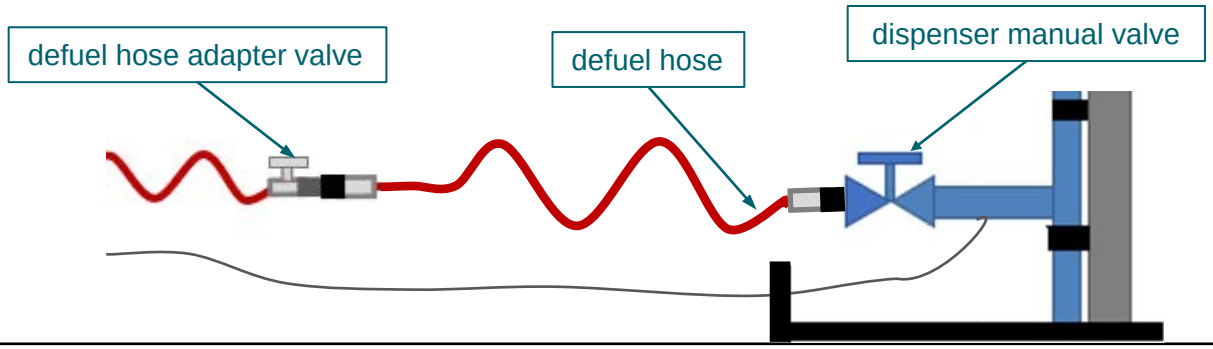


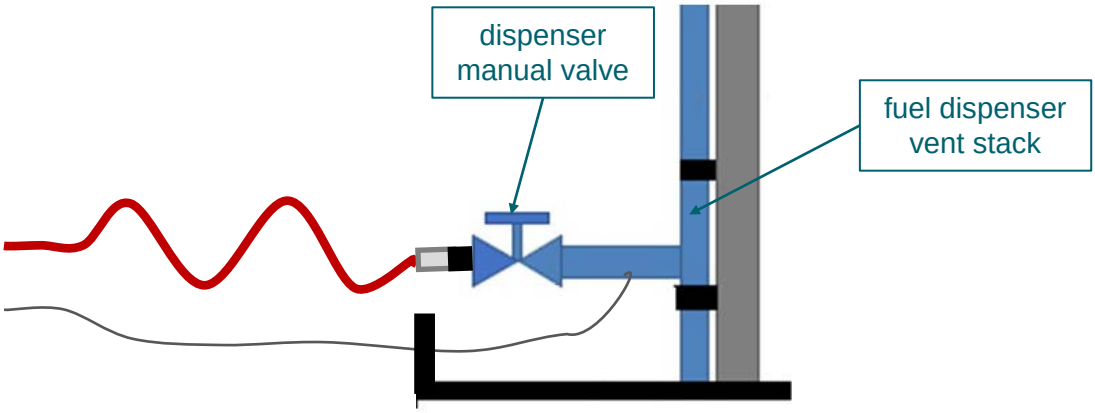
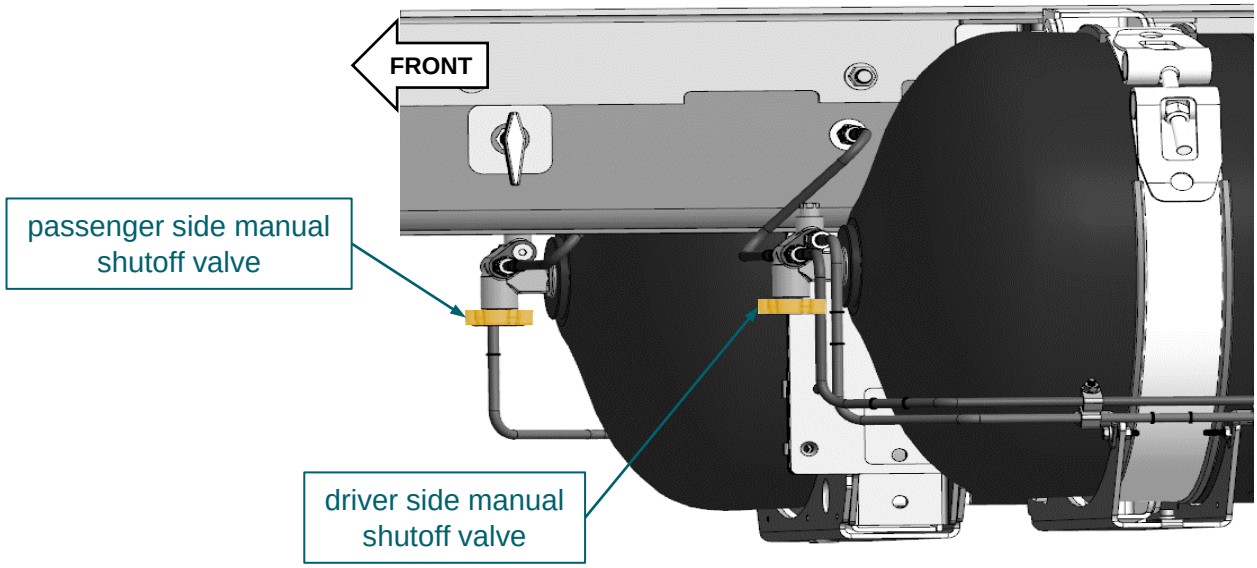
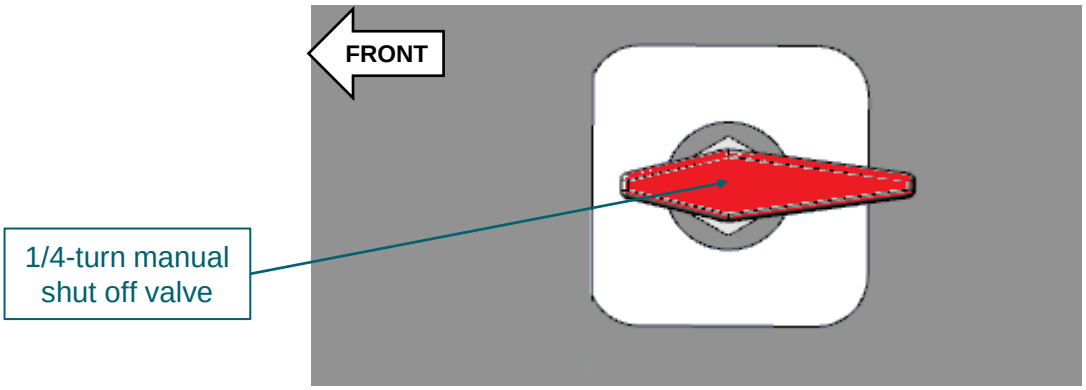
NOTICE **If fuel facility ground cable is not present, use ground cable, p/n 69500021, from defueling service kit, CNG, p/n 69500019.**

Step 7

⚠WARNING **Verify defuel hose adapter valve is closed.**

- Attach defuel hose to fuel dispenser defuel receptacle or vent stack receptacle.

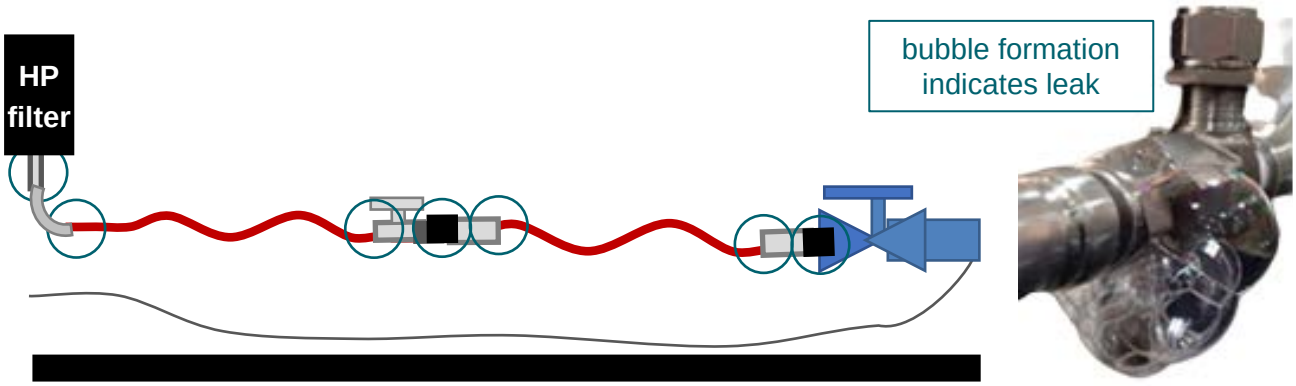


Step 8	➢ Open manual valve on fuel dispenser or vent stack. 
Step 9	➢ Open driver side and passenger side cylinder manual shutoff valve. *NOTE: Cylinder shields not shown.* 
Step 10	➢ Verify 1/4-turn manual shut off valve is open. 

⚠WARNING **Verify defuel hose connections and any other disturbed fittings are not leaking. Follow leak check procedure DSM.0037 before moving forward with defuel procedure.**

Step 10

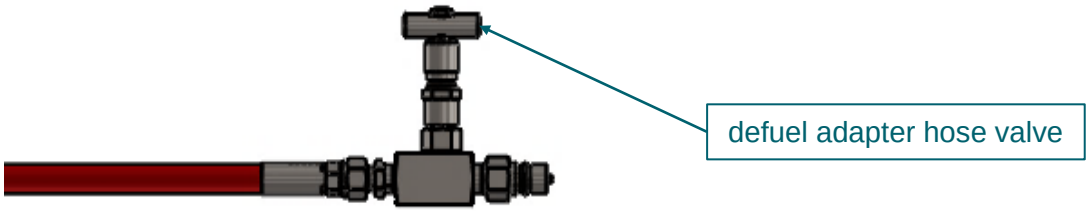
- Perform leak check on all defuel fitting connections per DSM.0037 indicated below.
- If leaks are found, perform depressurization procedure and repair leak.



Step 11

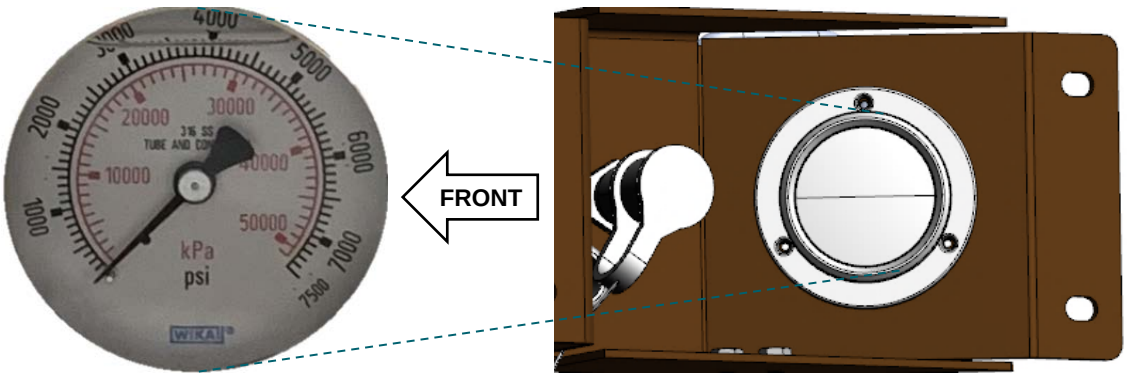
- Slowly open valve on defuel adapter hose.

NOTICE **If defueling rate is too rapid, the excess flow valve will close and prevent defueling. Wait approximately five minutes for excess flow valve to reset and adjust valve for a lesser flow before resuming defuel procedure.**



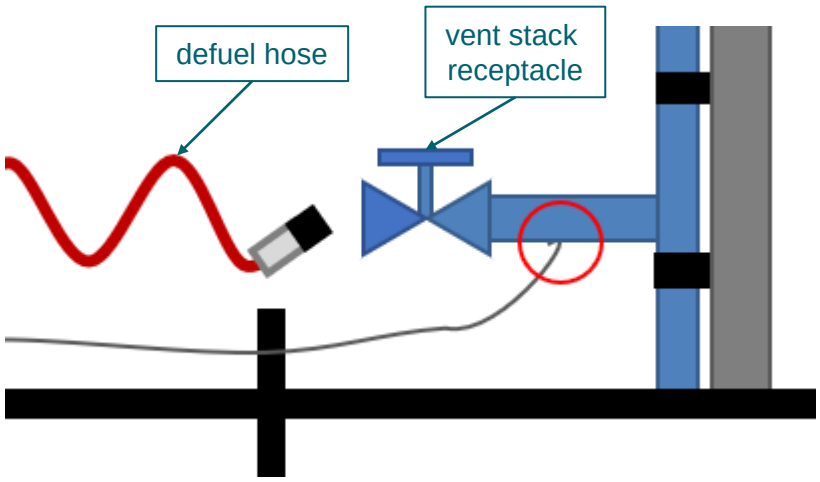
Step 12

- Monitor system fuel level on fuel fill panel HP fuel gauge until it reads zero.



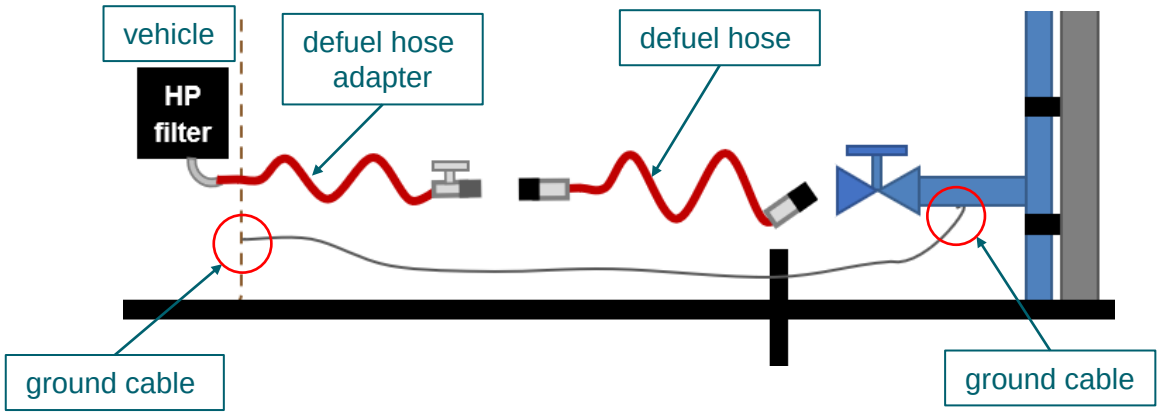
Step 13

- Disconnect defuel hose from fuel dispenser or vent stack receptacle.



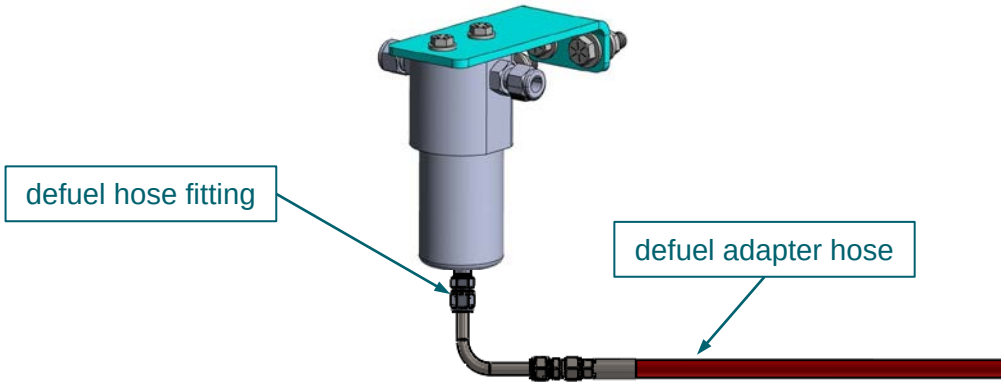
Step 14

- Remove defuel hose from defuel hose adapter.
- Detach ground cable clips from vehicle ground and fuel dispenser or vent stack.



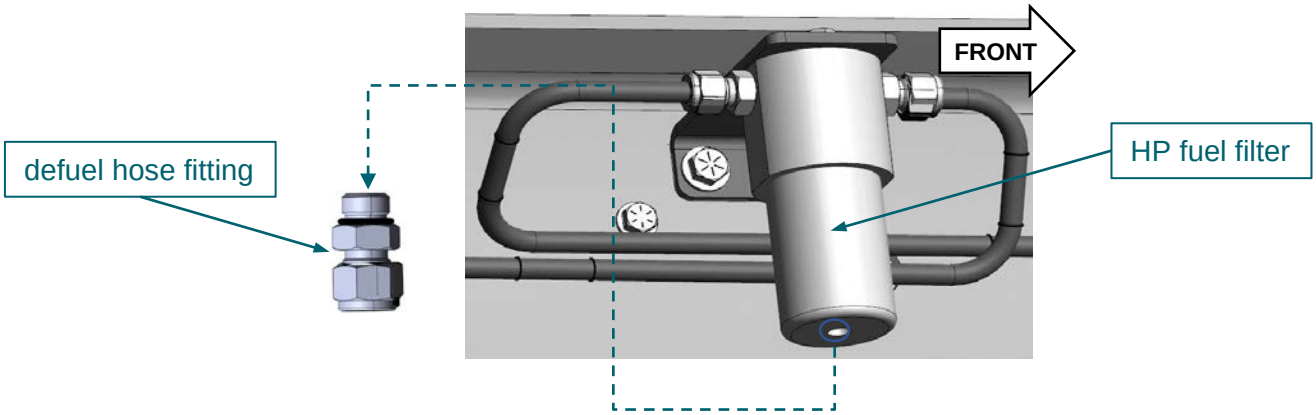
Step 15

- Remove defuel hose adapter from defuel hose fitting using a pair of 11/16-in wrenches.



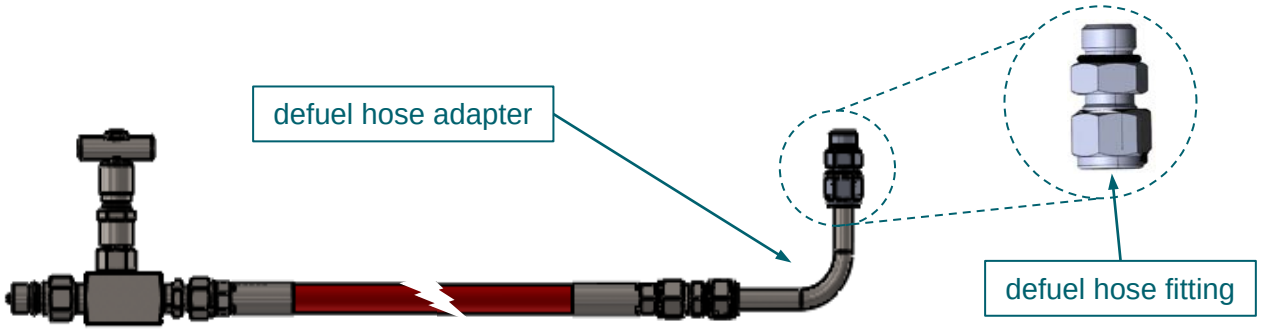
Step 16

➢ Use an 11/16-in wrench to remove fitting from HP fuel filter.



Step 17

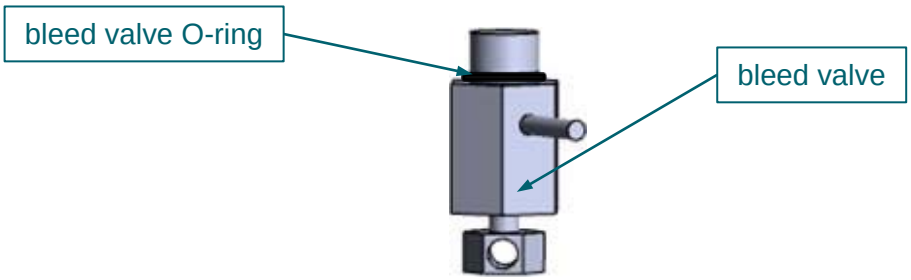
➢ Reconnect defuel hose fitting to defuel hose adapter; tighten finger tight only.



Step 18

➢ Collect bleed valve and inspect for damage or wear. Replace O-ring if necessary.

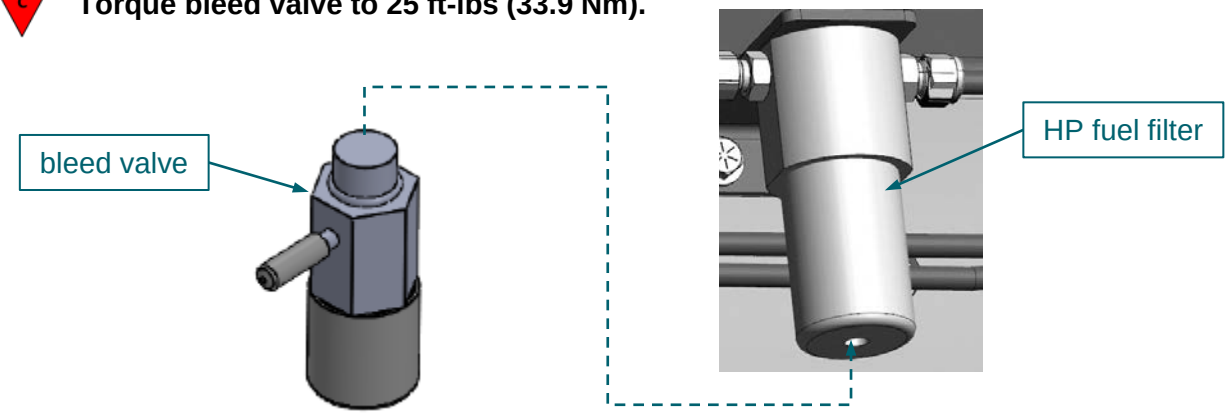
C **Apply a light coat of Parker Super O-lube® to (a) O-ring.**



Step 19

➢ Use an 11/16-in wrench to reinstall bleed valve in HP fuel filter port.

C **Torque bleed valve to 25 ft-lbs (33.9 Nm).**

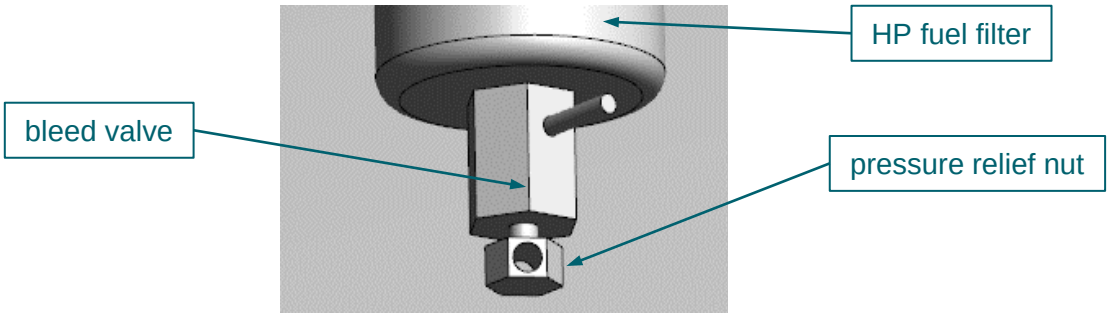


NOTICE **Complete repair work as needed.**

Step 20

➢ Close pressure relief nut on bleed valve using a 7/16-in wrench.

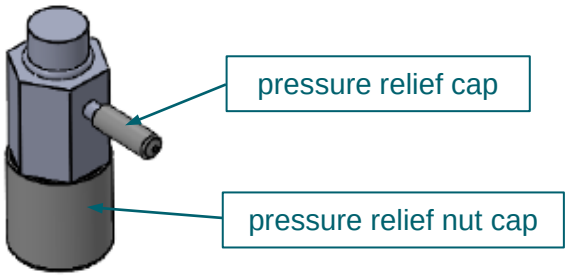
M **To increase service life, ensure proper valve performance, and prevent leakage, apply only enough torque to pressure relief nut as is required to achieve positive shutoff per Swagelok® instructions.**



Step 22

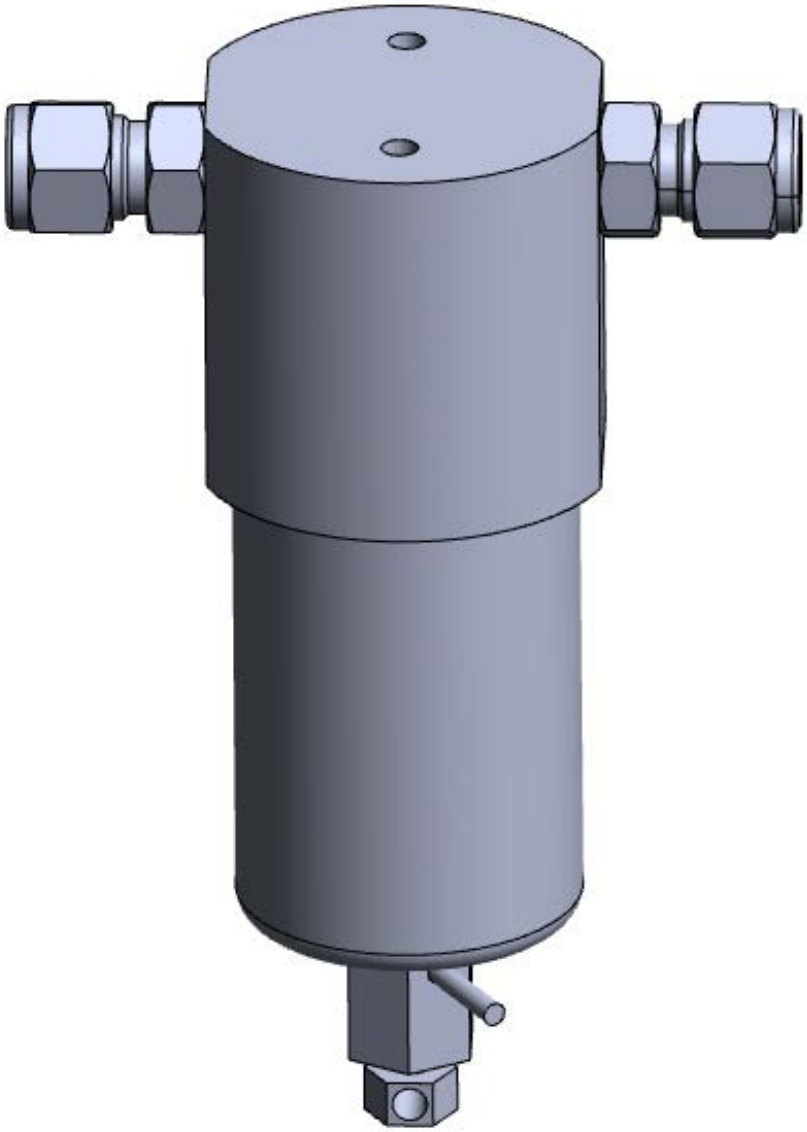
➢ Install pressure relief cap and pressure relief nut cap on bleed valve.

NOTICE **Caps must be installed to prevent foreign object debris (FOD) intrusion. If caps and are not present, reference service parts catalog for replacement.**



⚠WARNING **Leak check procedure DSM.0037 must be performed before vehicle may be cleared for operation.**

Filter Element Replacement



Filter Element Replacement

FCCC MT CNG

Introduction

Hexagon Agility® has established the following maintenance intervals to ensure safe and reliable engine fuel system operation. For questions regarding engine and fuel system service and maintenance please refer to the Hexagon Agility® website for the latest contact information.

REQUIRED FUEL SYSTEM SERVICE	INTERVAL*		
	years	mi	km
Drain HP and LP fuel filters and change filter elements	n/a	5000	8000

Tools and Supplies

Item	Purpose
safety glasses	eye protection
shop rags	clean fuel system components before and after repair
flashlight	illuminate components
mirror	observe backside of fittings while performing leak check
combination and socket wrenches	remove and install fuel system fittings, fasteners, and components
torque wrench	accurately tighten fuel system fittings, fasteners, and components
crow foot wrenches	use with torque wrench
Swagelok® Snoop® or equivalent leak detection fluid Formula 365, p/n 10802096	perform leak test
filter element service kit, p/n 69000481	filter element, O-ring
55 mm crowfoot wrench	used with torque wrench to tighten/loosen filter bowl
Parker Super O-Lube or equivalent	used for O-ring

Personal / Vehicle Precautions

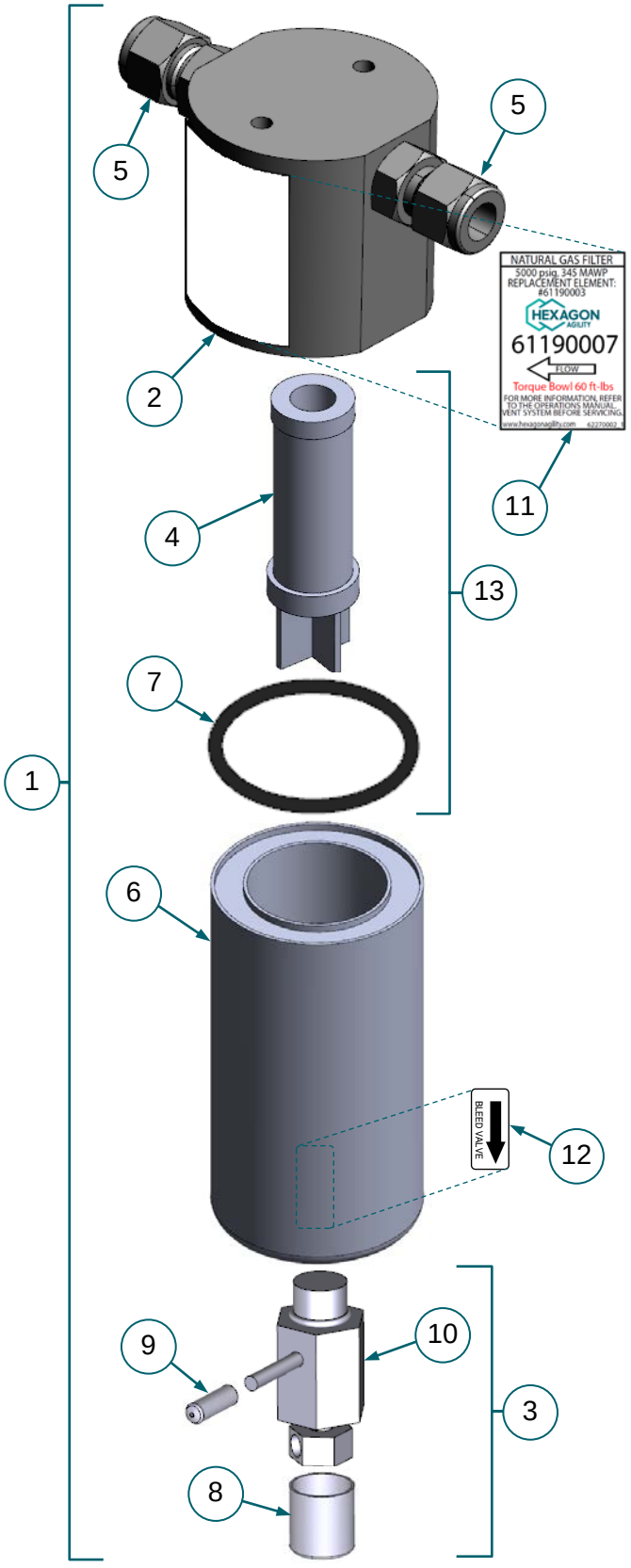
⚠WARNING **Wear approved personal protective equipment (PPE) including safety glasses.**

⚠WARNING **Verify service facility is well ventilated.**

⚠WARNING **Verify parking brake is engaged, wheels are chocked, and ignition switch is in OFF position.**

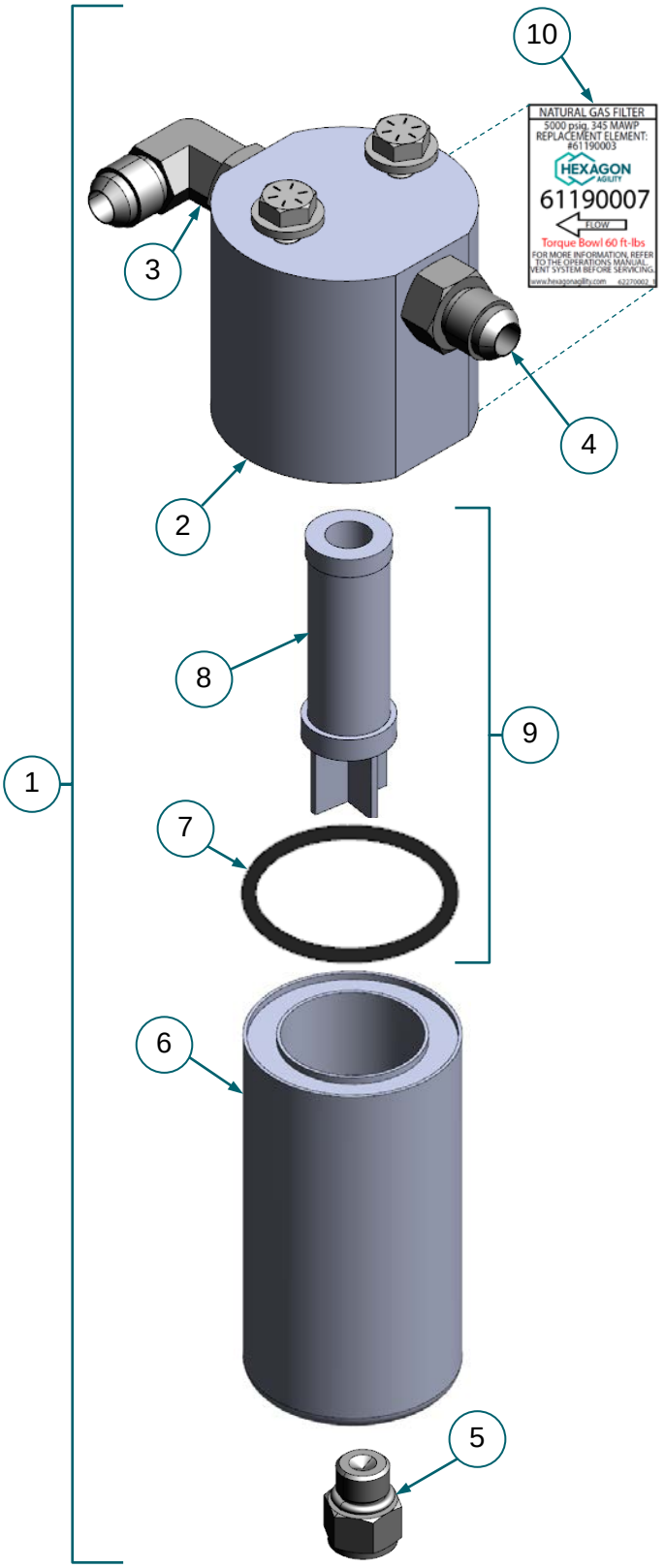
High-pressure fuel filter components		
Item	Part Description	QTY
1	ASM, HP fuel filter, CNG – *includes (2), (3), QTY: 2 (5), (6), (8), (9), (11), (12),(13), and mounting hardware (not shown)*	1
2	Filter head, CNG (POA 1)	1
3	ASM, bleed valve	1
4	Filter element, CNG (POA 13)	1
5	Fitting, tube, connector	2
6	Filter bowl, CNG	1
7	O-ring, filter bowl (POA 13)	1
8	Cap, pressure relief nut	1
9	Cap, pressure relief port	1
10	Bleed valve (POA 3)	1
11	Decal, fuel filter, CNG	1
12	Decal, bleed valve	1
13	Kit, service, filter element – *includes (4), (7) and O-ring lube*	1

POA = Part of Assembly



Low-pressure fuel filter components		
Item	Part Description	QTY
1	ASM, LP fuel filter, CNG – *includes (2), (3), (4), (5), (6), (9), (10), and mounting hardware*	1
2	Filter head, CNG (POA 1)	1
3	Fitting, 90-degree elbow	1
4*	Fitting, tube, connector	1
5	LP filter bowl drain plug	1
6	Filter bowl, CNG	1
7	O-ring, filter bowl (POA 9)	1
8	Filter element, CNG (POA 9)	1
9	Kit, service, filter element – *includes (7), (8) and O-ring lube*	1
10	Decal, fuel filter, CNG	1

POA = Part of Assembly
** Fitting configurations may vary*



Step 1

⚠WARNING **Depressurize fuel system; refer to Depressurization section of this manual.**

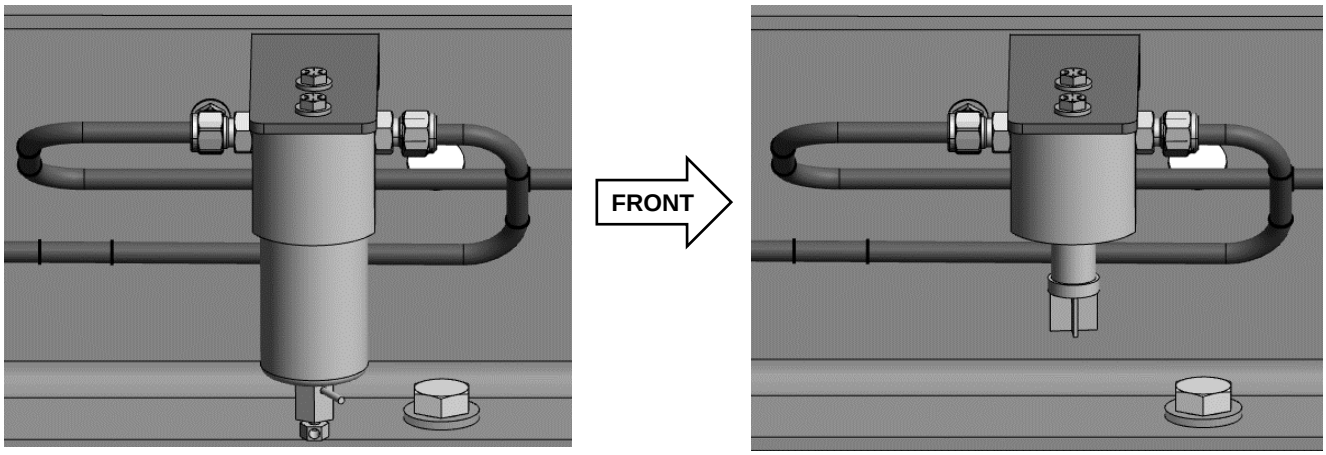
⚠WARNING **Observe organizational LOTO practices; install lockout/tagout (LOTO) devices.**

Depressurization complete:
↳ **Proceed to Step 2.**

Step 2

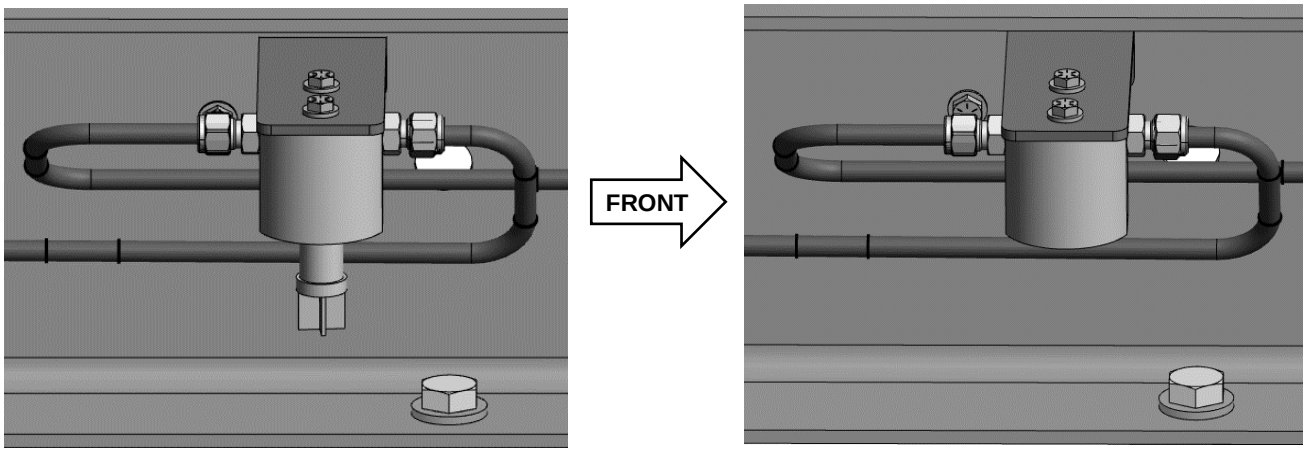
⚠CAUTION **ALWAYS verify fuel system has been depressurized!**

➢ Remove bowl from filter assembly using a 55 mm crow foot wrench.



Step 3

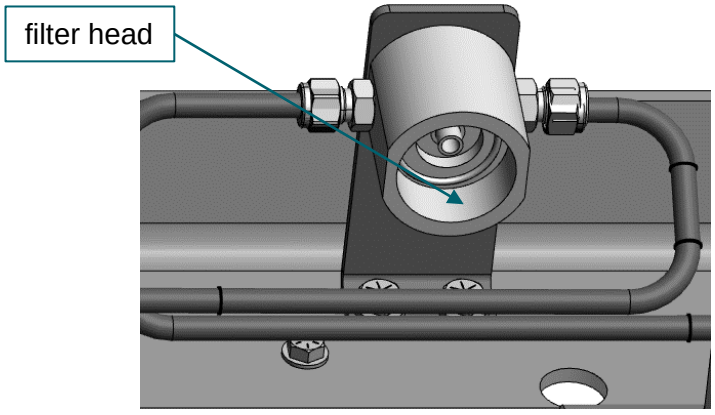
➢ Remove filter element from filter assembly.

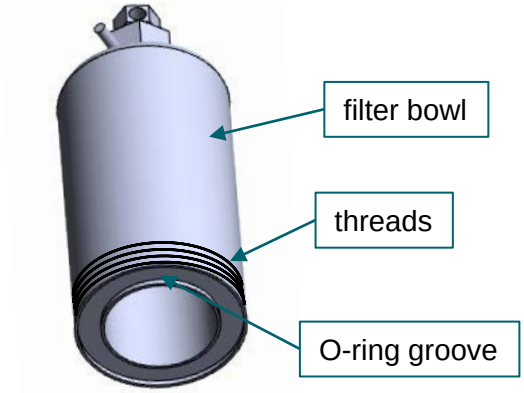


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Step 5

- Clean filter assembly of any dirt and residue using a clean, dry, shop towel.

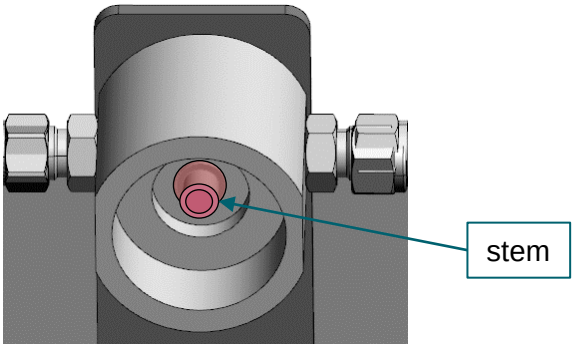




Step 6

- Inspect filter assembly including stem, O-ring sealing surfaces, and threads for damage or wear.

NOTICE **Clean and inspect filter head threads for debris, cross-threading, burrs, etc. *If stem, filter head threads, or filter bowl threads are damaged,* obtain replacement HP filter assembly from Hexagon Agility® CCTS.**



Step 7

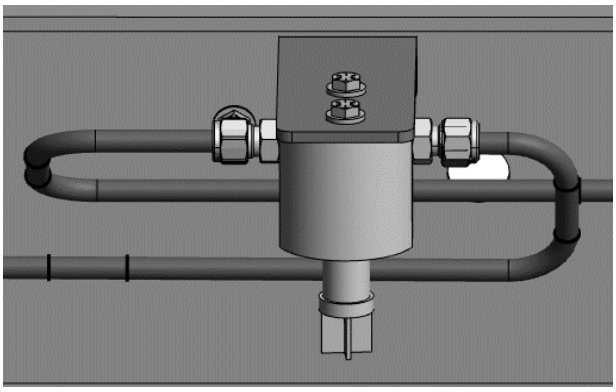
- Prepare filter element service kit, p/n 6900048, for installation.
- Lube O-ring with lubricant *(not shown).*



NOTICE **Inspect plastic stem in filter head. If damaged, replace.**

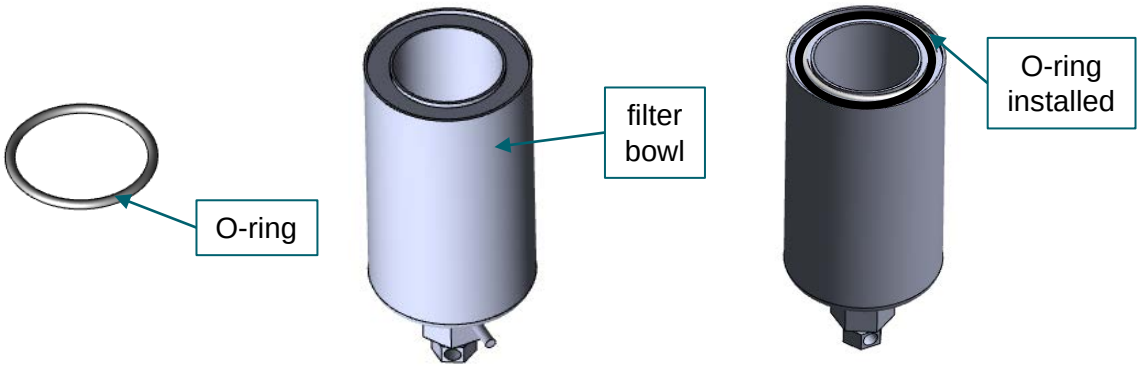
Step 9

➢ Install new filter element in filter head.



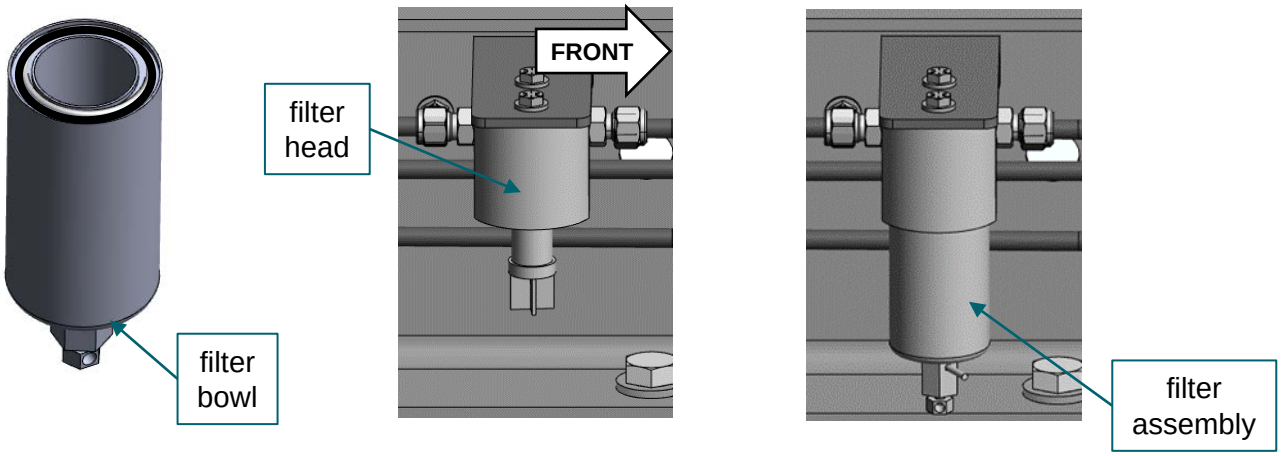
Step 10

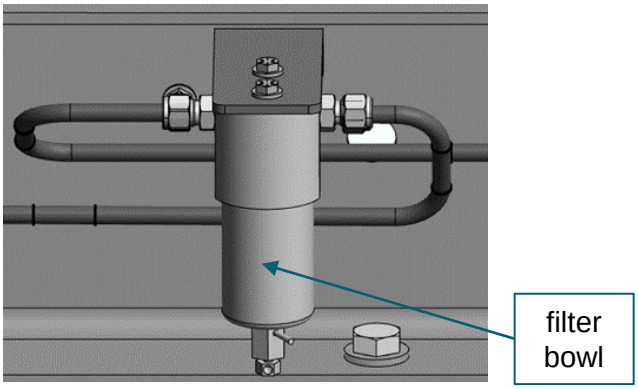
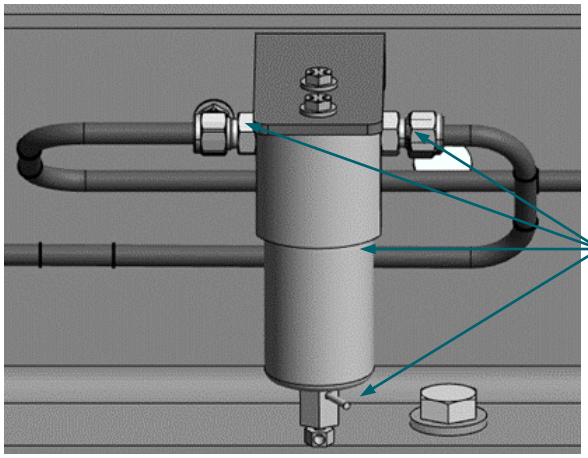
➢ Install lubed O-ring into the filter bowl groove.



Step 11

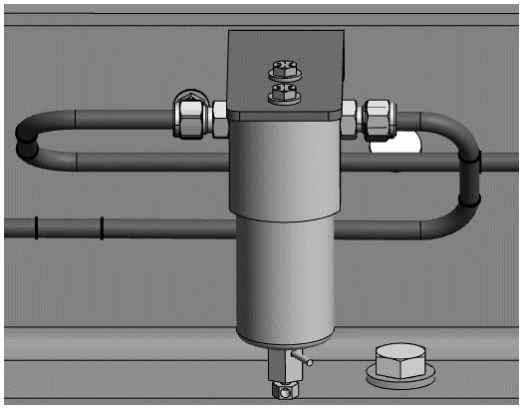
➢ Finger tighten bowl into filter head.



Step 12	C Torque filter bowl to 65 ft-lbs (88.1 Nm) using 55 mm crow-foot wrench. 
Step 13	➢ Apply leak check solution to all fittings on the filter assembly to check for leaks.  
Step 14	➢ With all lines and connections secured, pressurize system as per procedure at the end of Depressurization section. ↳ **Proceed to Step 15.**

Step 15

- Inspect filter assembly for leaks.
- Bubbles from solution will indicate leak(s).





Leaks found:	No leaks found:
↳ **Proceed to Step 16.**	↳ **Procedure complete.**

Step 16

WARNING **Depressurize fuel system; refer to Depressurization section of this manual.**

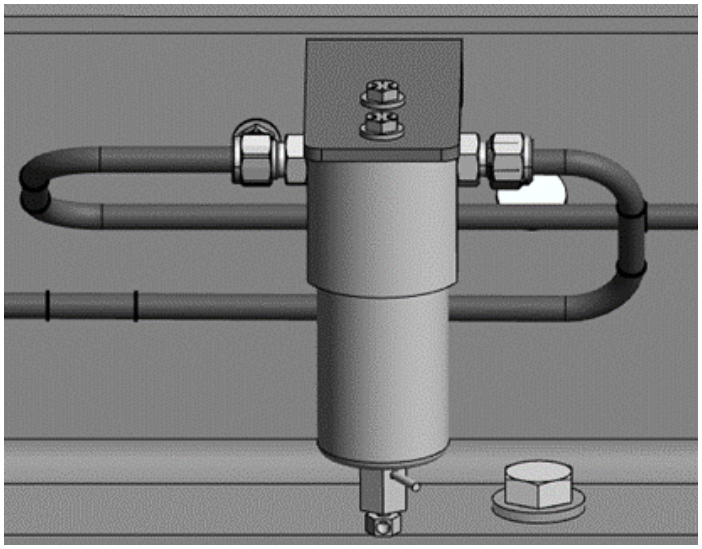
WARNING **Observe organizational LOTO practices; install lockout/tagout (LOTO) devices.**

Depressurization complete:
↳ **Proceed to Step 17.**

Step 17

CAUTION **ALWAYS verify fuel system has been depressurized!**

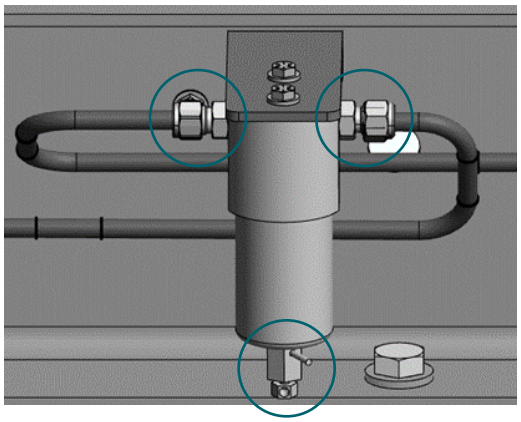
- Repair, replace or tighten all fittings which indicated leaks.



Step 18

➢ Apply leak check solution to all fittings (circled) on the filter assembly to check for leaks.





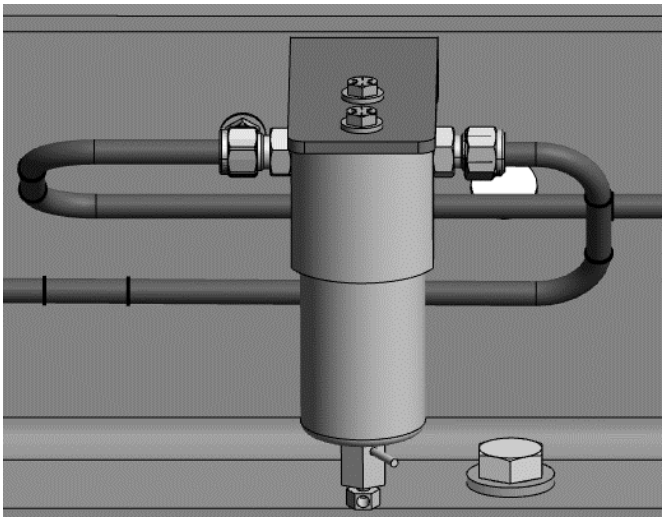
Step 19

➢ With all lines and connections secured, pressurize system as per procedure at the end of Depressurization section.

↳ **Proceed to Step 20.**

Step 20

➢ Inspect filter assembly for leaks.



Leaks found:

↳ **Complete depressurization procedure.**

↳ **Replace filter assembly or components as needed.**

No leaks found:

↳ **Procedure complete.**

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After completing all repairs, always perform the following Steps to confirm the issue is fixed:

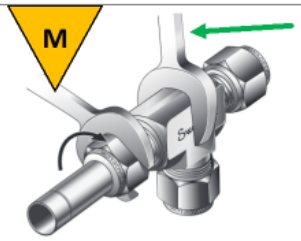
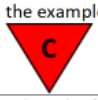
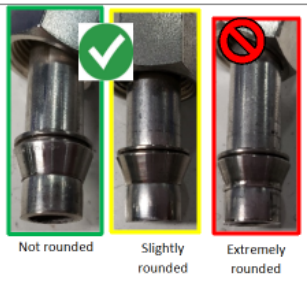
1. Reconnect all connectors and verify connections are secure.
2. Reattach any enclosure covers and verify fuel cap is installed.
3. *If applicable:* clear fault codes using Cummins® INSITE™ tool.
4. Run vehicle until it reaches normal operating temperature. *Refer to OEM instructions.*
5. If fault is cleared, return vehicle to duty.
6. If fault is not cleared, Contact Hexagon Agility® Technical Support for further diagnostic assistance.

Removal and Retightening of Tube Fittings

Agility® fuel solutions

Removal and Retightening of Tube Fittings
Scope: Swagelok fittings

Standard Work Instruction

1	Remove any torque seal using a non-marking scraper (such as a fingernail).		2	Remove any torque seal and the blue paint pen marks from fitting and nut using a mild solvent (such as Isopropyl alcohol) on a cloth. Do NOT remove the DMT mark! **BE CAREFUL WHEN HANDLING SOLVENTS.**	
WH	New toque seal is needed when the fitting is retightened.		WHY	New blue marks are needed when the fitting is retightened.	
3	Put a "backing wrench" on the body of the adjacent fitting. Note: some products require holding a different component - this is noted in the product-specific work instructions.		4	Loosen nut and completely remove tube from fitting.	
WHY	The backing wrench prevents the fitting from rotating. This ensures that no other fittings are accidentally loosened.		WHY		
5	Inspect the front ferrule to verify that the tube can be reused. The front ferrule must not be rounded as the example highlighted in red. 		6	To reinstall, follow the tightening sequence in WI.0198. Note that there will likely be a gap between the DMT mark and the top of the nut when hand-tight.	
WHY	When the front ferrule cannot spin freely, the back ferrule is pressed against it too much. This is caused by over-tightening.		WHY	Retightening causes the back ferrule to press further against the front ferrule, which shifts the nut position.	

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Removal and Retightening of Tube Fittings

Removal and Retightening of Tube Fittings
Scope: Swagelok fittings

Standard Work Instruction

Equipment List:

Description	Manufacturer	Manufacturer's Part Number
70% Isopropyl alcohol wipes	Any	---
Open-ended wrenches	Any	---
Vise	Any	---

Job Breakdown:

Important Steps	Key Points	Reasons Why
1. Remove torque seal	1. Completely removed	Must be replaced.
2. Remove paint marks	1. Completely removed	Need new visual aid to start tightening.
	2. Be safe	Solvents must be handled carefully.
	3. Don't remove DMT line	Provides reference for tightening.
3. Loosen nut	1. Use backing wrench	Holds everything in place to prevent leaks.
4. Check ferrule	1. Spins freely	A tight-fitting ferrule could leak.
5. Re-install nut	1. Per work instruction	Provides correct process

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Hexagon Agility® Customer Care and Technical Services

Fuel system warranty or non-warranty product support may be obtained by calling or emailing Hexagon Agility® Customer Care and Technical Services (CCTS).

Please provide **your name, phone number, email address, and complete vehicle information: VIN, year, make, model, mileage, unit number vehicle owner,** and **current vehicle location.** A service advisor will contact you to arrange vehicle repair or ship a part.

+1 877 500 2445	Support	Parts Orders
(toll-free, U.S. and Canada)	support@hexagonagility.com	parts@hexagonagility.com

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