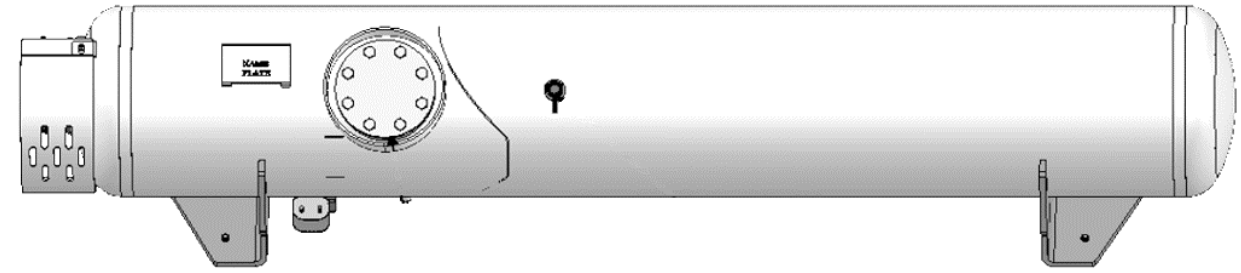
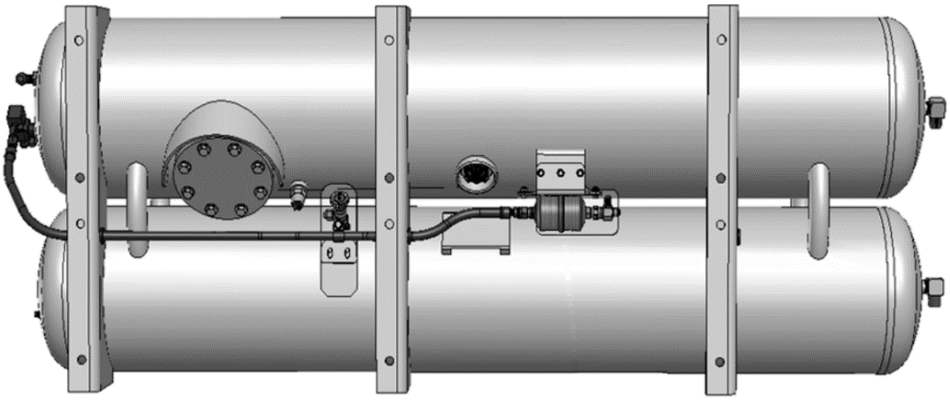
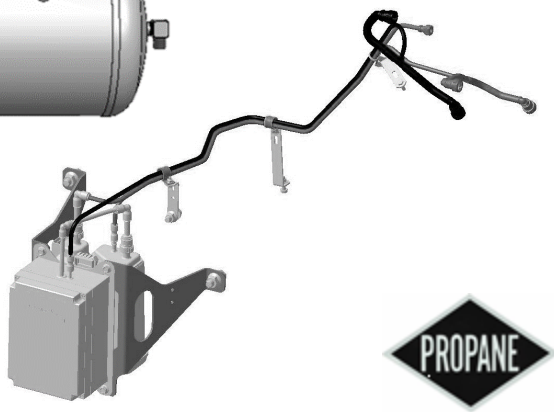
HEXAGON AGILITY

488LPI Propane Autogas Fuel Storage and EVAP System Service Manual







PROPANE

DSM.0054 Ver. 1.0
May 27, 2022

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Preface

This manual is designed as a support document for trained technicians in the maintenance, inspection, and service of the 488LPI™ propane autogas fuel storage and evaporative (EVAP) emissions systems provided by Hexagon Agility®.

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

Original Equipment Manufacturer (OEM) parts not serviced by Hexagon Agility® may be obtained by contacting Freightliner Custom Chassis Corporation or Thomas Built Buses.

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 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.

Table of Contents

- Preface
- Acronyms
- Safety
  - Warning and Signal Words Used in this Manual
  - Qualified Personnel
- Maintenance, Inspection, and Repair Procedures
  - Fuel Storage System
    - Fuel Filter Replacement
    - Fuel Line Drain Procedure
    - Fuel Pump Replacement
    - Fuel System Leak Detection Procedure
    - Fuel Tank Drain Procedure
    - Fuel Tank Pass Through Wiring Replacement
  - Evaporative (EVAP) Emissions System
    - EVAP Emissions System Overview & Schematic
    - EVAP Line and Tube Replacement
    - EVAP Pump Replacement
    - EVAP System Inspection

Acronyms

AHJ	authority having jurisdiction
EVAP	evaporative emissions
LPG	liquid propane gas
LPI	Liquid Propane Injection
NFPA	National Fire Protection Association

Safety

Hexagon Agility® provides safety guidelines to ensure the safety of personnel servicing and / or operating liquid propane gas[1] (LPG) equipment. All personnel involved must adhere to industry standards including NFPA 58, specialized training, and all federal, state, and municipal laws and regulations.

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

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

Warning and Signal Words Used in this Manual

WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

***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.**

Critical Characteristic

Product feature directly affects:

- **Safety of vehicle users, people nearby and maintenance personnel, or**
- **Regulatory compliance.**

Qualified Personnel

LPG 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 LPG 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.

[1] LPG used for automotive applications is often referred to as “propane autogas.”

Fuel Filter Replacement

DESCRIPTION AND OPERATION

Two Fuel Filters—a “Fill Filter” mounted in the Fuel Fill Line and an “Inline Filter” positioned in the Fuel Tank to Engine Lines —remove moisture and other impurities from the 488LPI™ Fuel Storage System.

Fuel Filters are retained using two mounting methods depending on application:

A. Freightliner Custom Chassis Corporation S2G
   - **Fill Filter** secured using a block clamp bolted to a bracket affixed to the inner rear of the Fuel Tank protective “cage” structure on the passenger side frame rail. *Figure 1*
   - **Inline Filter** secured using P-clamps bolted to a bracket affixed to the inner front of the Fuel Tank cage. *Figure 1*

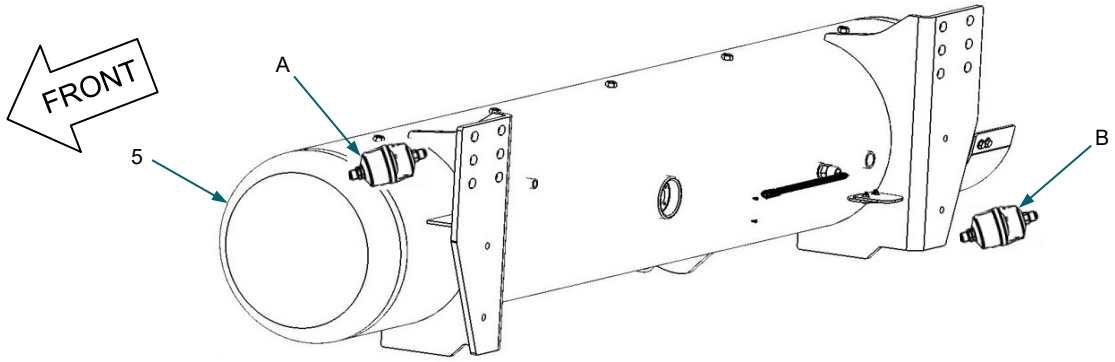


Figure 1:
(5) S2G Propane Fuel Tank, (A) Inline Filter (B) Fill Filter.
NOTE: Passenger side frame rail, mounting plates, and clamps not shown.

B. Thomas Built Buses C2 Propane
   - **Fill Filter** secured using a block clamp bolted to a plate affixed to chassis frame crossmember at rear of Fuel Tank. *Figure 2*
   - **Inline Filter** secured using P-clamps bolted to a plate at bottom middle of Fuel Tank. *Figure 2*

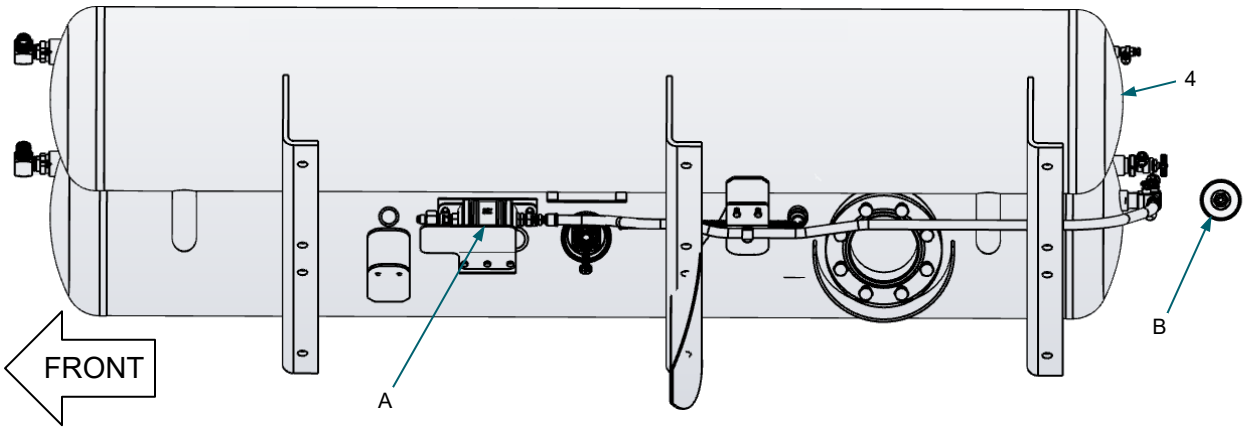


Figure 2:
(4) C2 Propane Fuel Tank, (A) Inline Filter (B) Fill Filter.
NOTE: Chassis frame crossmember, mounting plate and clamps not shown.

⚠WARNING

Fuel Line pressure can exceed 250 psi (17 bar). Exercise caution when performing fuel system service.

REMOVAL PROCEDURE

1. Secure vehicle outdoors in a safe location.
2. **⚠WARNING**

   Bleed Fuel Lines per NFPA 58 and any organizational or AHJ regulations.
3. Remove Fuel Lines from Fuel Filter (1) inlet port (2) and outlet port (3). *Figure 3*
4. Remove Fuel Filter (1) from mount:
   - **a. C2 Propane Inline Filter**
     - Remove three fasteners (10) securing Fuel Filter Mounting Plate (9) to Fuel Tank assembly to access P-clamps. *Figure 4*
     - Loosen P-clamps (6) to remove Fuel Filter (1). *Figure 5*
   - **b. C2 Propane Fill Filter**
     - Remove two fasteners *(not shown)* securing Block Clamp to OEM plate *(not shown)* at chassis crossmember. *Figure 6*
     - Remove (1) Fuel Filter from (7) Block Clamp and (8) Isolator. *Figure 6*

     NOTICE

     Inspect Isolator for wear. Set intact Isolator aside for reuse or obtain replacement for damaged or missing Isolator from Hexagon Agility.

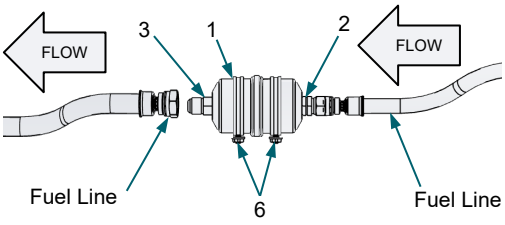


Figure 3:
Fuel Filter (1), inlet port (2), outlet port (3).
NOTE: P-clamps (6)shown.

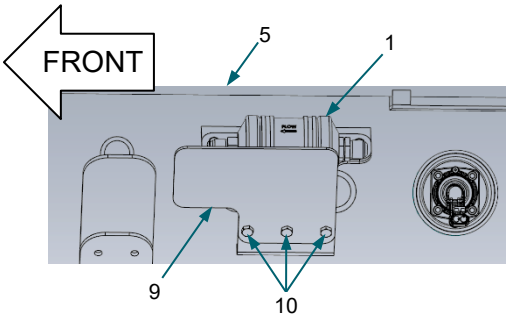


Figure 4:
C2 Propane Fuel Tank (5), Inline Fuel Filter (1), Fuel Filter Mounting Plate (9), fasteners (10)

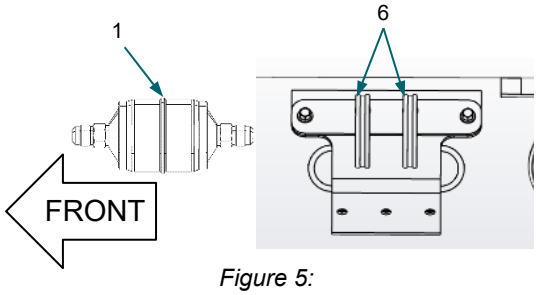


Figure 5:
C2 Propane Inline Filter (1), P-clamps (6)

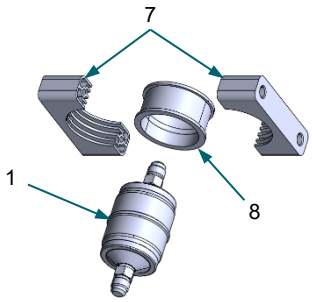


Figure 6:
C2 Propane Fill Filter (1), Block Clamp (6), Isolator (8)

c. S2G Inline Filter

- Loosen P-clamps (6) to remove Fuel Filter (1). *Figure 7*

d. S2G Fill Filter

- Remove two fasteners securing Block Clamp to plate *(not shown). Figure 8*
- Remove (1) Fuel Filter from (7) Block Clamp and (8) Isolator. *Figure 8*

NOTICE

Inspect Isolator for wear. Set intact Isolator aside for reuse or obtain replacement for damaged or missing Isolator from Hexagon Agility.

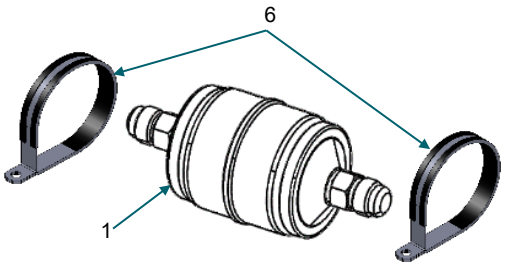


Figure 7:
Fuel Filter (1), (6) P-clamps

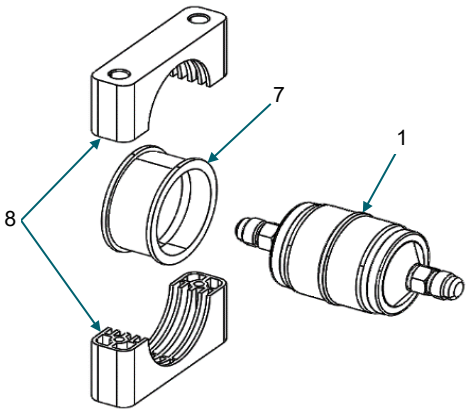


Figure 8:
Fuel Filter, (8) Block Clamp, (7) Isolator

INSTALLATION PROCEDURE

1. Install Fuel Filter in mount as follows:
   a. (6) P-clamps *Figure 7*
   b. (7) Block Clamp, (8) Isolator *Figure 8*

   NOTICE

   Verify Inline Fuel Filter is installed in the proper direction as indicated by flow arrow on the label.
2. **C2 Propane Inline Filter ONLY**: Install Fuel Filter Mounting Plate on Fuel Tank.

   Torque bolts to 7 ft-lbs (9.5 Nm).
3. Install Fuel Lines on Fuel Filter (1) inlet and outlet ports (2) and (3). *Figure 3*
4. **WARNING**

   Check for fuel leaks. *Refer to Fuel System Leak Detection Procedure.*
5. Verify proper operation.

Fuel Line Drain Procedure

DESCRIPTION AND OPERATION

Chassis mounted 488LPI™ Fuel Lines supply liquid propane to the engine and return fuel back to the Fuel Tank. When performing fuel system repairs and maintenance, it is sometimes necessary to drain propane from the Fuel Lines.

⚠WARNING

Fuel Line pressure can exceed 250 psi (17 bar). Exercised caution when performing fuel system service.

REMOVAL PROCEDURE

1. Secure vehicle outdoors in a safe location.
2. **⚠WARNING**

   Bleed Fuel Lines per NFPA 58 and any organizational or AHJ regulations.
3. Remove Fuel Drain Valve Cap (2) from Fuel Drain Valve (1). *Figure 1*
4. Connect Fuel Transfer Hose *(not shown)* to Fuel Drain Valve (1). *Figure 1*
5. Connect other end of Fuel Transfer Hose *(not shown)* to Fill Receptacle of Fuel Recovery Tank. *Figure 2*
6. **⚠WARNING**

   Perform Static Fuel Discharge per NFPA 58 and any organizational AHJ regulations.
7. Repeat Step 6 until no fuel pressure remains in both lines.

   ⚠WARNING

   Both Fuel Supply and Fuel Return Lines must be drained to ensure all pressure is removed from Fuel Rails.
8. Disconnect Fuel Supply Line from Fuel Supply Manual Shutoff Valve (6) and Fuel Return Line from Fuel Return Manual Shutoff Valve (7). *Figures 3 & 4*

   NOTICE

   Cover Fuel Line openings to prevent moisture or FOD intrusion.

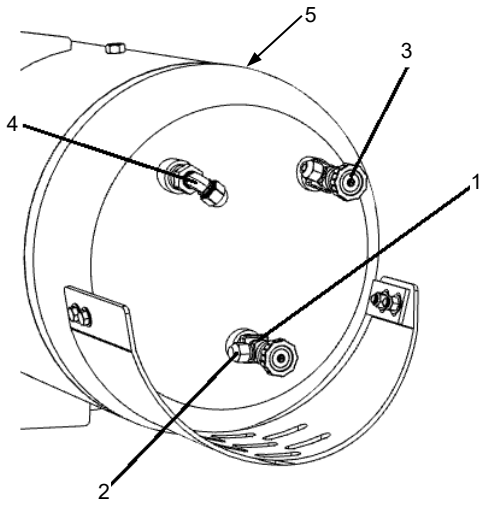


Figure 1:
Fuel Tank (5), Fuel Drain Valve (1), Fuel Drain Valve Cap (2), Fuel Return Manual Shutoff Valve (3), Fill Valve Adaptor 90-degree elbow (4)

INSTALLATION PROCEDURE

1. Install Fuel Supply Line on Fuel Supply Manual Shutoff Valve (6) and Fuel Return Line on Fuel Return Manual Shutoff Valve (7). *Refer to Fuel Line Replacement. Figures 3 & 4*
2. Slowly open Fuel Supply and Return Manual Shutoff Valves (6) & (7) by turning knobs counterclockwise. *Figures 3 & 4*
3. **⚠WARNING**
   Check for fuel leaks. *Refer to Fuel System Leak Detection Procedure.*
4. Verify proper operation.

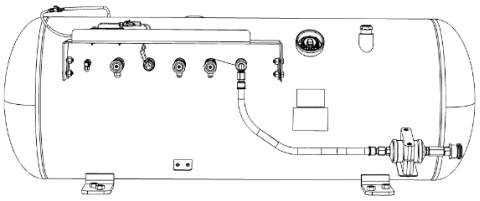


Figure 2:
Fuel Recovery Tank

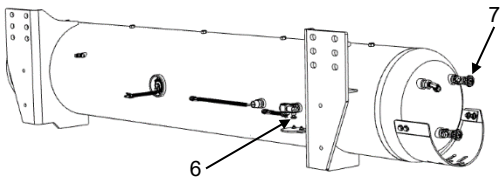


Figure 3:
Tank Side Fuel Supply Manual Shutoff Valve (6) and Tank End Fuel Return Manual Shutoff Valve (7) locations

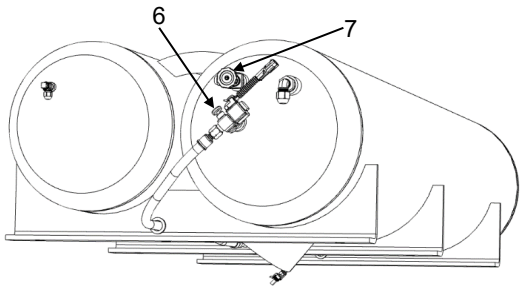


Figure 4:
Tank End Fuel Supply Manual Shutoff Valve (7) and Fuel Return Manual Shutoff Valve (6) locations

Fuel Pump Replacement

DESCRIPTION AND OPERATION

The 488LPI™ Fuel Pump is specially designed for use on propane fuel systems. The Fuel Pump is controlled by a relay which is controlled by the Electronic Control Module (ECM) using a ground side driver. The ECM ground the Fuel Pump Relay which in turn supplies power to the Fuel Pump and the Fuel Supply Solenoid. The Fuel Pump is powered on during the fuel purge cycle and anytime the engine is running.

The Fuel Pump provides boost pressure to the fuel system above tank pressure which varies depending on temperature. Tank pressure is directly proportional to tank temperature, meaning that when temperature goes up the tank pressure goes up. Normal boost pressure should be at least 55 psi (3.8 bar) more than tank pressure. Boost pressure is necessary to ensure liquid propane does not vaporize until it is injected by the Fuel Injectors. Fuel boost pressure readings less than 55 psi (3.8 bar) above tank pressure must be diagnosed and repaired, as low boost pressure may lead to poor engine performance and the setting of ECM fault codes. If the Fuel Pump is deemed defective it should be replaced.

⚠WARNING

Fuel Line pressure can exceed 250 psi (17 bar); exercise caution when performing fuel system service.

REMOVAL PROCEDURE

1. Secure vehicle outdoors in a safe location.
2. Bleed Fuel Lines per NFPA 58 and any organizational or AHJ regulations.
3. Drain Fuel Tank. *Refer to Fuel Tank Drain Procedure.*
4. Remove Fuel Tank (8) Access Cover (1) Retaining Bolts (2). *Figure 1*
5. Remove Fuel Tank Access Cover (1). *Figure 1*
6. Remove Fuel Tank Access Cover (1) O-ring (3). *Figure 1*
7. Disconnect Fuel Pump Supply Line Quick Connect Adaptor (7). *Figure 2*
8. Disconnect Fuel Pump Electrical Connector (6). *Figure 2*
9. Remove Fuel Pump Retaining Nuts (5). *Figure 2*
10. Remove Fuel Pump Assembly from Tank (8) through Access Opening (4). *Figures 1 & 2*

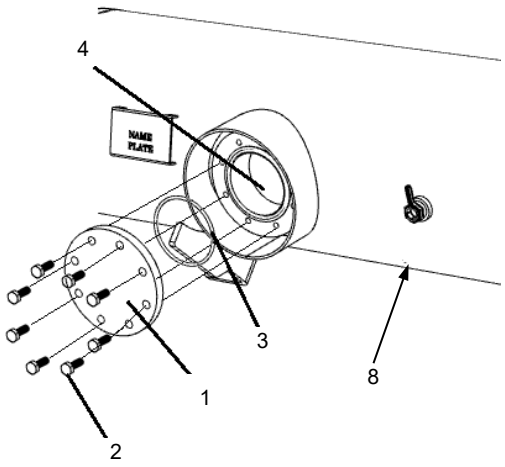


Figure 1:
Fuel Tank (8), Access Cover (1), Access Cover Retaining Bolts (2), Access Cover O-ring (3), Access Opening (4)

INSTALLATION PROCEDURE

1. Install new Fuel Pump (10) into Fuel Tank (8) through Access Opening (4). *Figures 1 & 2*
2. Connect Fuel Pump Electrical Connector (6). *Figure 2*
3. Install two (2) Fuel Pump Retaining Nuts (5). *Refer to Fuel System Torque and Tightening Specifications.*
4. Connect Fuel Pump Fuel Supply Line to Quick Connect Adaptor (7).

   Gently pull on Fuel Line to ensure Quick Connector is seated.
5. Install new Fuel Tank Access Cover O-ring (3). *Figure 1*
6. Install Fuel Tank Access Cover (1). *Figure 1*
7. Install Fuel Tank Access Cover Retaining Bolts (2).

   Tighten Bolts using a star pattern. *Refer to Fuel System Torque and Tightening Specifications. Figure 1*
8. Fill Fuel Tank with propane removed during Fuel Tank Drain Procedure.
9. Install Fuel Supply and Fuel Return Lines. *Refer to Fuel Line Replacement.*
10. **⚠WARNING**

    Check for leaks with an approved LPG leak detection solution. *Refer to Fuel System Leak Check Procedure.*
11. Verify proper operation.

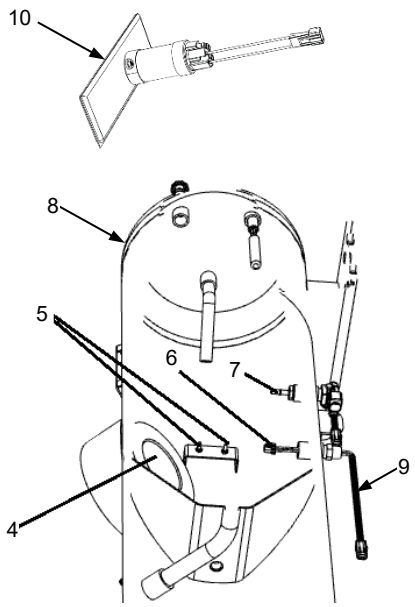


Figure 2:
Cutaway of Fuel Tank (8) showing Access Opening (4), Fuel Pump Retaining Bolts (5), Fuel Pump Electrical Connector (6), Fuel Supply Line Quick Connect Adaptor (7); Fuel Supply Line (9)

Fuel System Leak Detection Procedure

DESCRIPTION AND OPERATION

Safe and effective 488LPI™ Engine and Fuel System operation, maintenance and repairs require the system be free of propane leaks. Use the following procedure to check the Fuel System for leaks.

⚠WARNING

Fuel Line pressure can exceed 250 psi (17 bar). Caution must be exercised.

PROCEDURE

1. Secure vehicle outdoors in a safe location.
2. *If removed:* Connect and tighten Fuel Supply and Fuel Return Lines at Fuel Distribution Blocks. *Refer to Fuel and Supply Return Line Replacement* and *Fuel System Torque & Tightening Specifications.*
3. *If removed:* Connect and tighten Fuel Supply and Fuel Return Lines at Fuel Supply (1) and Fuel Return (2) Manual Shutoff Valves. *Refer to Fuel and Supply Return Line Replacement* and *Fuel System Torque & Tightening Specifications. Figures 1 & 2*
4. Slowly turn Fuel Supply Manual Shutoff Valve (1) and Fuel Return (2) Manual Shutoff Valve knobs counterclockwise to open. *Figures 1 & 2*

   NOTICE

   Knobs must be opened slowly or Excess Flow Protection Valve will trigger and stop fuel flow.
5. Disconnect Fuel Supply Solenoid (3) Electrical Connector. *Figures 1 & 2*
   - Energize Fuel Supply Solenoid (3) with twelve (12) volts using a Power Probe® or similar tool. *Figures 1 & 2.* **NOTE**: *An audible "click" should be heard indicating the solenoid has opened.*
   - If an audible click is not heard, check 12 V power supply for a good connection.
   - Re-energize the Fuel Supply Manual Shutoff Valve Solenoid and listen again for an audible click.

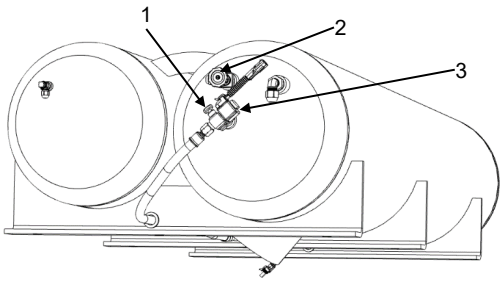


Figure 1:
Tank End Fuel Supply Manual Shutoff Valve (1),
Fuel Return Manual Shutoff Valve (2),
Fuel Supply Solenoid (3)

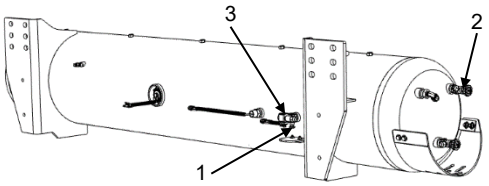


Figure 2:
Tank Side Fuel Supply Manual Shutoff Valve (1)
and Fuel Supply Solenoid (3) with
Tank End Fuel Return Manual Shutoff Valve (2)

- Once energized, the Fuel Supply Manual Shutoff Valve Solenoid allows fuel to flow and pressurizes the fuel system.

6. When fuel system is pressurized, spray each Line Fitting with an approved LPG leak detection solution and look for any bubbling around the connections.
   - Retighten any loose fittings. *Follow Fuel System Torque & Tightening Specifications.*
   - Spray leak source again with leak detection solution

   ⚠WARNING

   Depressurize fuel system before replacing damaged fittings, lines, seals, or components.
7. Connect Fuel Supply Solenoid (3) Electrical Connector. *Figures 1 & 2*

Fuel Tank Drain Procedure

DESCRIPTION AND OPERATION

The 488LPI™ Fuel Tank stores liquid propane and houses the Fuel Pump which supplies fuel to the engine and returns fuel back to the Tank for storage. When performing fuel system repairs and maintenance, it is sometimes necessary to drain propane from the Fuel Tank.

⚠WARNING

Fuel Line pressure can exceed 250 psi (17 bar).

REMOVAL PROCEDURE

1. Secure vehicle outdoors in a safe location.
2. Bleed Fuel Lines per NFPA 58 and any organizational or AHJ regulations.
3. Remove Fuel Drain Valve Cap (2) from Fuel Drain Valve (1). *Figure 1*
4. Connect Fuel Transfer Hose *(not shown)* to Fuel Drain Valve (1). *Figure 1*
5. Connect other end of Transfer Hose to Fill Receptacle *(not shown)* of LPI® Fuel Recovery Tank. *Figure 4*
6. Perform Static Fuel Discharge per NFPA 58 and any organizational or AHJ regulations.

   ⚠WARNING

   Verify that you and any equipment used are properly grounded.
7. Repeat Step 6 until no fuel pressure remains in both hoses.

   ⚠WARNING

   Both Fuel Supply and Fuel Return Lines must be drained to ensure all pressure is removed from Fuel Rails.
8. Disconnect Fuel Supply Hose from Fuel Supply Manual Shutoff Valve (6) and Fuel Return Hose from Fuel Return Manual Shutoff Valve (7). *Figures 2 & 3*

   NOTICE

   Cover Fuel Hose openings to moisture or FOD intrusion.

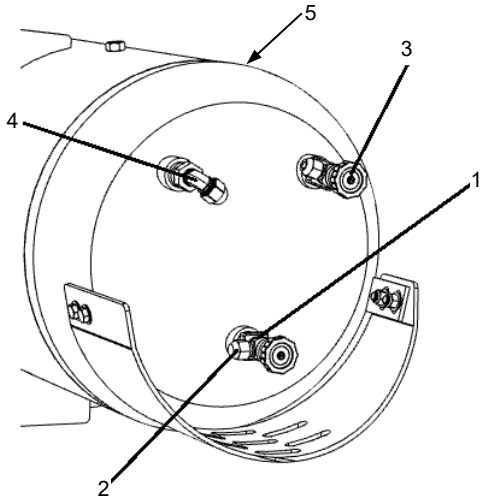


Figure 1:
Fuel Tank (5), Fuel Drain Valve (1),
Fuel Drain Valve Cap (2),
Fuel Return Manual Shutoff Valve (3),
Fuel Fill Hose 90° Elbow Nipple (4)

INSTALLATION PROCEDURE

1. Install Fuel Supply Line on Fuel Supply Manual Shutoff Valve (6) and Fuel Return Line on Fuel Return Manual Shutoff Valve (7). *Refer to Fuel Hose Replacement. Figures 2 & 3*
2. Slowly open Fuel Supply and Return Manual Shutoff Valves (6) and (7) by turning knobs counterclockwise. *Figures 2 & 3*
3. **⚠WARNING**

   Check for fuel leaks. *Refer to Fuel System Leak Detection Procedure.*
4. Verify proper operation.

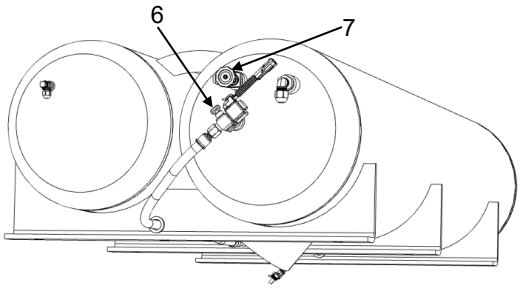


Figure 2:
Tank End Fuel Supply Manual Shutoff Valve (7) and Fuel Return Manual Shutoff Valve (6) locations

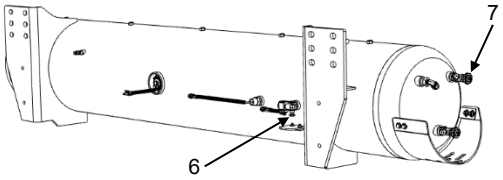


Figure 3:
Tank Side Fuel Supply Manual Shutoff Valve (6) and Tank End Fuel Return Manual Shutoff Valve (7) locations

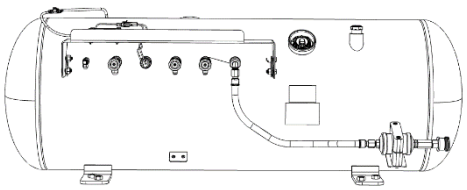


Figure 4:
LPI® Fuel Recovery Tank, Special Tool 69000235

Fuel Tank Pass-Through Wiring Harness Replacement

DESCRIPTION AND OPERATION

A Fuel Tank Pass-Through Wiring Harness provides the 488LPI™ Fuel Pump with battery power and ground to operate. Fuel Tank Pass-Through Wiring is designed to withstand tank pressure while maintaining proper seal.

⚠WARNING

If the Fuel Tank Pass-Through Wiring Harness is damaged or otherwise defective it must be replaced.

⚠WARNING

Fuel Line pressure can exceed 250 psi (17 bar). Exercise caution when performing fuel system service.

REMOVAL PROCEDURE

1. Secure vehicle outdoors in a safe location.
2. Bleed Fuel Lines per NFPA 58 and any organizational or AHJ regulations.
3. Drain Fuel Tank (8). *Refer to Fuel Tank Drain Procedure. Figure 1*
4. Remove Fuel Tank (8) Access Cover (1) Retaining Bolts. *Figure 1*
5. Remove Fuel Tank Access Cover (1). *Figure 1*
6. Remove Fuel Tank Access Cover (1) O-ring (3). *Figure 1*
7. Disconnect Fuel Pump Electrical Connector (6). *Figure 2*
8. Remove Fuel Tank Pass-Through Wiring (9) from Tank (8) through Access Opening (4). *Figures 1 & 2*

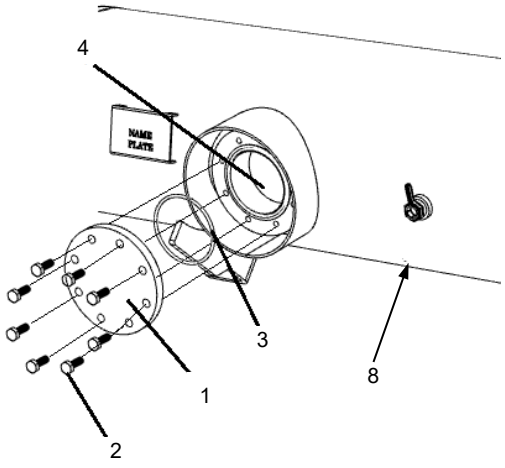


Figure 1:
Fuel Tank (8), Access Cover (1), Access Cover Retaining Bolts (2), Access Cover O-ring (3), Access Opening (4)

INSTALLATION PROCEDURE

1. Install new Fuel Tank Pass-Through Wiring Harness (9) into Fuel Tank (8). *Figure 2*
2. Connect Fuel Pump Electrical Connector (6). *Figure 2*
3. Install new Fuel Tank Access Cover O-ring (3). *Figure 1*
4. Install Fuel Tank Access Cover (1). *Figure 1*
5. Install Fuel Tank Access Cover Retaining Bolts (2).

   C **Tighten Bolts using a star pattern.** *Refer to Fuel System Torque and Tightening Specifications. Figure 1*
6. Connect Fuel Tank Pass-Through Wiring Harness Connector to Chassis Harness
7. Fill Fuel Tank with propane removed during Fuel Tank Drain Procedure.
8. Install Fuel Supply and Fuel Return Lines. *Refer to Fuel Line Replacement.*
9. **⚠WARNING**

   Check for leaks with an approved LPG leak detection solution. *Refer to Fuel System Leak Check Procedure.*
10. Verify proper operation.

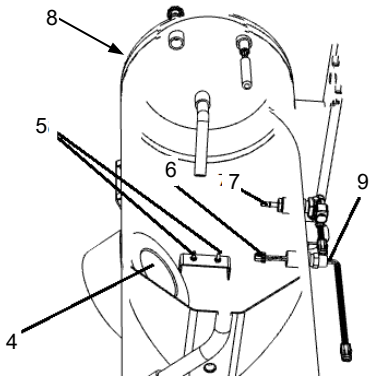


Figure 2:
Cutaway of Fuel Tank (8) showing Access Opening (4), Fuel Pump Retaining Bolts (5), Fuel Pump Electrical Connector (6), Fuel Supply Line Quick Connect Adaptor (7); Fuel Tank Pass-Through Wiring Harness (9)

Evaporative (EVAP) Emissions System Overview & Schematic

DESCRIPTION AND OPERATION

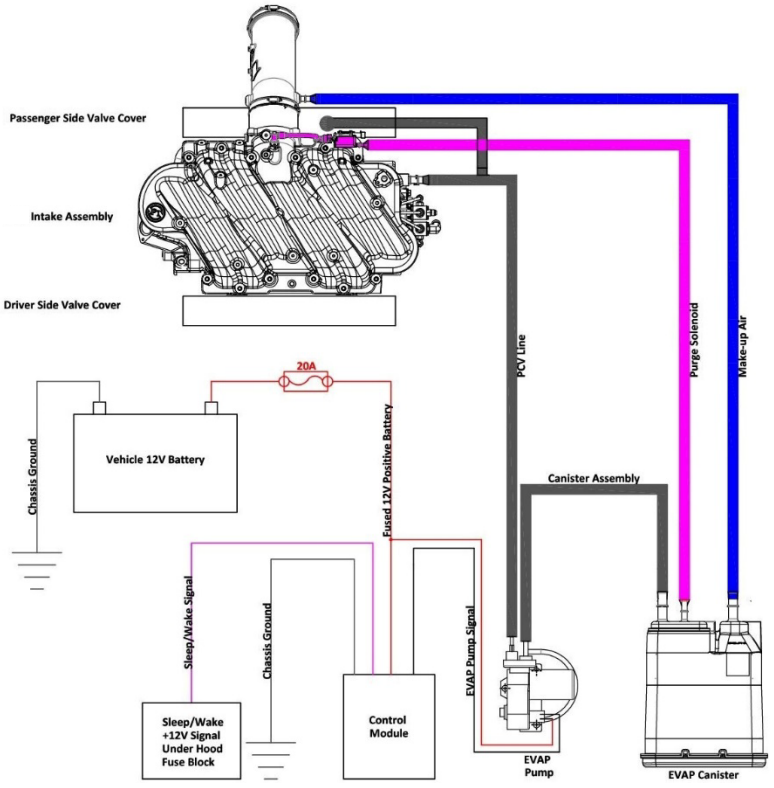
The 488LPI™ engine evaporative (EVAP) emissions system is essential for optimum performance with minimal emissions. The EVAP system relies upon three line types to circulate various gases: EVAP Purge Lines convey traces of propane in gaseous form, PCV Lines recirculate engine blow-by products, and a Make-Up Air Line supplies air necessary for positive crankcase ventilation. A leak from a broken line or improperly connected fitting can trigger the engine control module (ECM) to generate a range of diagnostic trouble codes (DTCs).

EVAP system lines run from the passenger side Valve Cover and rear of the Upper Intake Manifold to the chassis mounted EVAP Module Box and EVAP Canister on the passenger side frame rail.

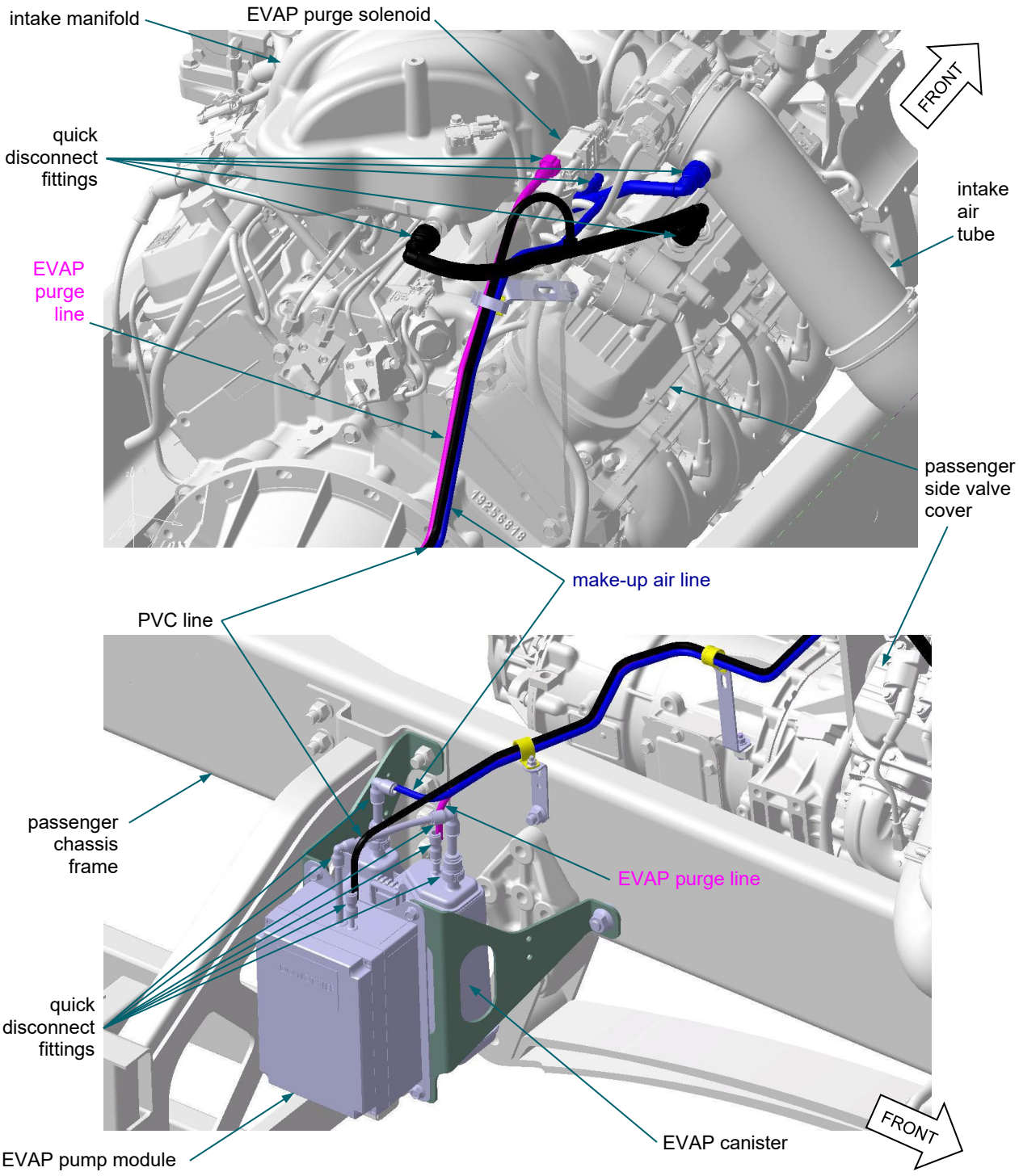
EVAP system lines are as follows:

1. EVAP Purge Line, engine intake mounted
2. EVAP Purge Line, engine to EVAP canister
3. PCV Line, engine to EVAP pump
4. PCV Line, EVAP pump to EVAP canister
5. Make-Up Air Line, engine to EVAP canister

EVAP System Schematic



EVAP System Component Locations



EVAP System Line & Tube Replacement

DESCRIPTION AND OPERATION

EVAP system lines run from the passenger side valve cover and rear of the intake manifold to the chassis mounted EVAP module box and EVAP canister on the passenger side frame rail.

EVAP system lines and corresponding repair procedures are as follows:

A. EVAP purge line, intake mounted
B. EVAP purge line, engine to EVAP canister
C. PCV line, engine to EVAP pump module
D. PCV line, EVAP pump module to EVAP canister
E. Make-up air line, engine to EVAP canister
F. PCV lines, EVAP pump module box top to EVAP pump

QUICK CONNECT REMOVAL PROCEDURE

1. Secure vehicle on an approved hoist.
2. Raise vehicle.

NOTICE

Depending upon the line being serviced, it may be necessary to open the hood for engine bay access and/or remove the EVAP module box cover.

3. *To safely release quick connect fittings for all line types:* Firmly but gently squeeze quick connect fitting (1) tab (2) and twist fitting counterclockwise. Pull fitting straight off nipple (3). *Figure 1*

NOTICE

Gently decouple and remove lines and fittings to avoid cracking the tubing or weakening the connections.

NOTICE

Use wire as needed to temporarily support long lines.

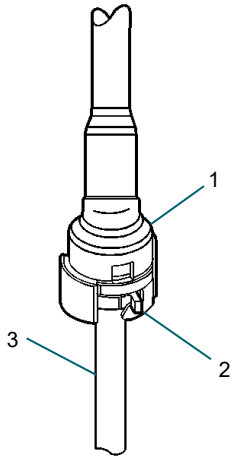


Figure 1: Quick connect fitting (1), release tab (2), nipple (3).

REMOVAL PROCEDURES

A. EVAP purge line, intake mounted

1. Remove intake mounted EVAP purge line (5) from EVAP purge solenoid (4) and from purge line fitting (6) on intake manifold (7). *Figure 2*

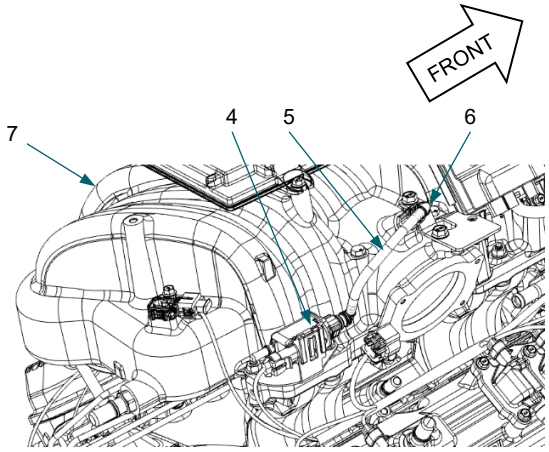


Figure 2: EVAP purge solenoid (4), intake mounted EVAP purge line (5), EVAP purge line fitting (6), intake manifold (7).
NOTE: Intake air tube not shown for clarity.

B. EVAP purge line, EVAP purge solenoid to EVAP canister

1. Remove engine to EVAP canister EVAP purge line *(not visible*) from EVAP purge solenoid (4) fitting (8) on intake manifold (7). *Figure 3*
2. Remove engine to EVAP purge solenoid to EVAP canister line (14) from quick connect fitting (1) on EVAP module (12). *Figure 4*
3. Loosen P-clamps (20) to release EVAP purge line (14). *Figure 4 Refer to OEM procedure.*

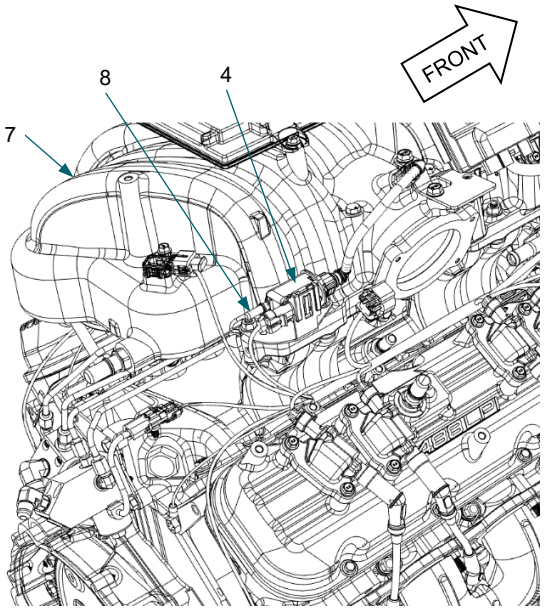


Figure 3: EVAP purge solenoid (4), fitting (8), intake manifold (7).
NOTE: Intake air tube not shown for clarity.

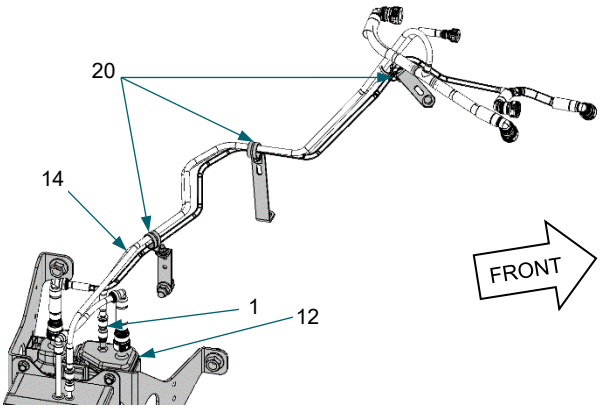


Figure 4: EVAP purge solenoid to EVAP cannister line (14), P-clamps (20), quick connect fitting (1), EVAP cannister (13).

C. PCV line, engine to EVAP pump module

1. Remove engine to EVAP module PCV line *(not shown)* from PCV valve (10) on passenger side valve cover and PCV line fitting (9) on rear of intake manifold (7). *Figure 2*
2. Remove engine to EVAP pump module box PCV line (16) from quick connect fitting (1) on EVAP pump module (12). *Figure 4*
3. Loosen P-clamps (20) to release line engine to EVAP Pump module PCV line (16). *Figure 6 Refer to OEM procedure*.

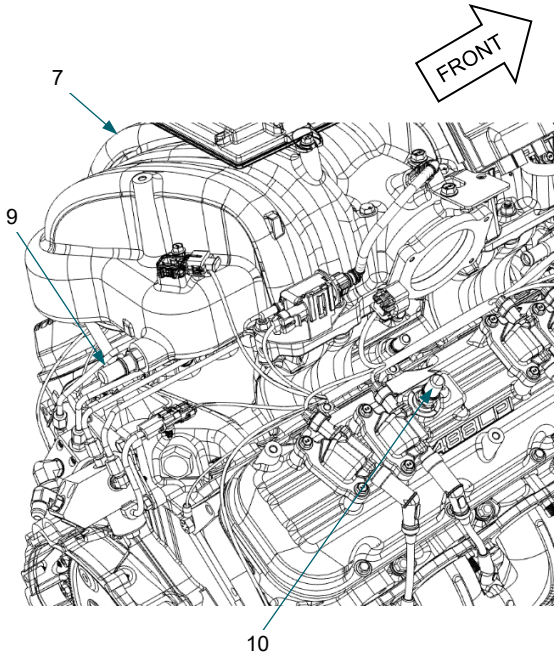


Figure 5: PCV line fitting (9), PCV valve (10), intake manifold (7).
NOTE: Intake air tube not shown for clarity.

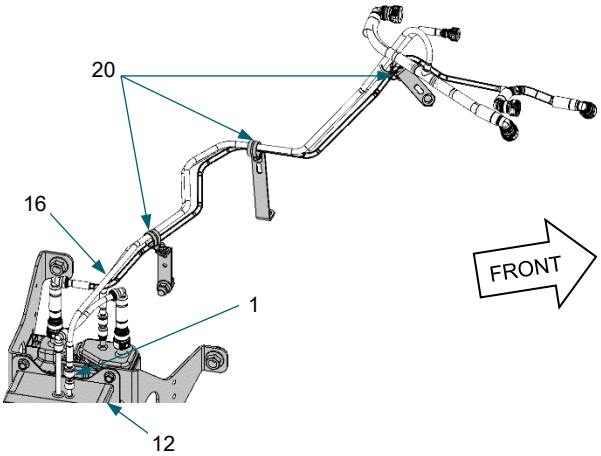


Figure 6: engine to EVAP pump module PCV line (16), EVAP pump module (12); quick disconnect fitting (1), P-clamps (20).

D. Make-up air line, engine to EVAP canister

1. Remove make-up air line *(not shown)* from make-up air line fitting (11) on intake air tube (17). *Figure 7*
2. Remove make-up air line (15) from quick connect fitting (1) on EVAP pump module (12) . *Figure 8*
3. Loosen P-clamps (20) to release make-up air line (15). *Figure 8 Refer to OEM procedure*.

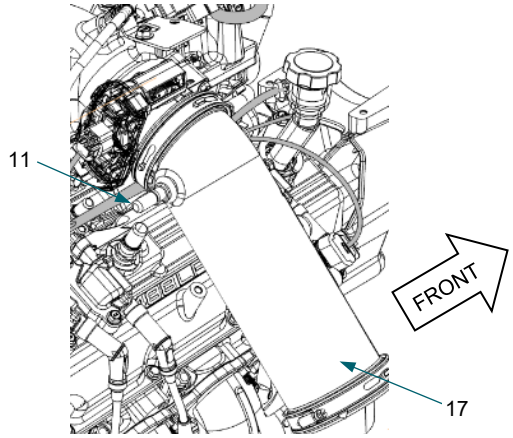


Figure 7: Make-up air line fitting (11), intake air tube (17).

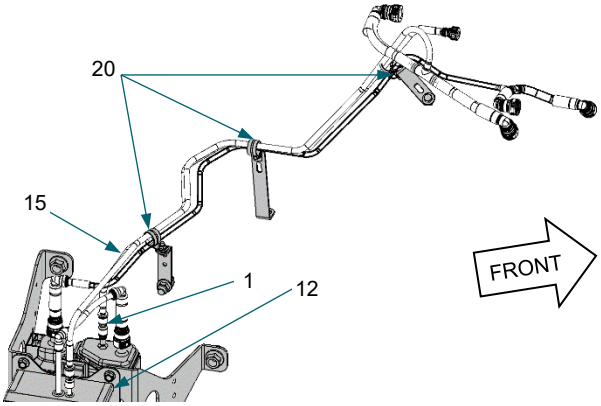


Figure 8: Make-up air line (15), quick connect fitting (1), EVAP pump module (12), P-clamps (20).

E. PCV line, EVAP module box to EVAP canister

1. Remove PCV line, EVAP module box to EVAP canister (18) from quick connects (1) at EVAP module (12) and EVAP canister (13). *Figure 9*

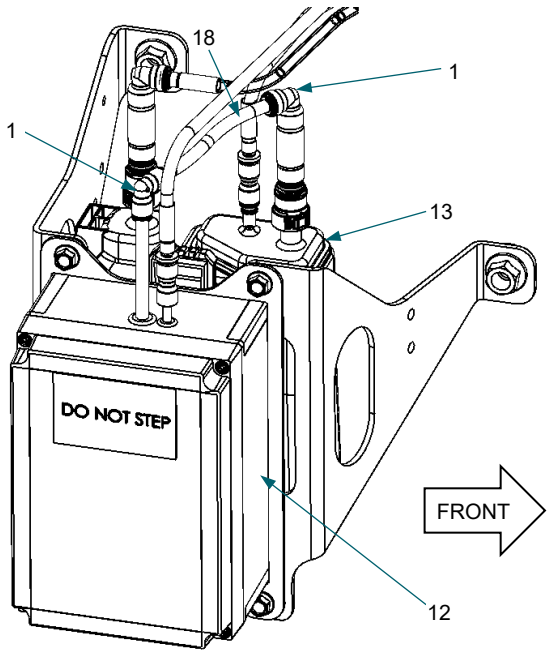


Figure 9: EVAP pump module (12), PCV line, engine to EVAP pump module (16), EVAP canister (13).

F. PCV lines, EVAP pump module box top to EVAP pump

1. Remove QTY: 4 fasteners securing EVAP pump module () cover (19). *Figure 10*
2. Remove PCV lines (22) from EVAP pump (22) at quick disconnects (1). *Figure 11*

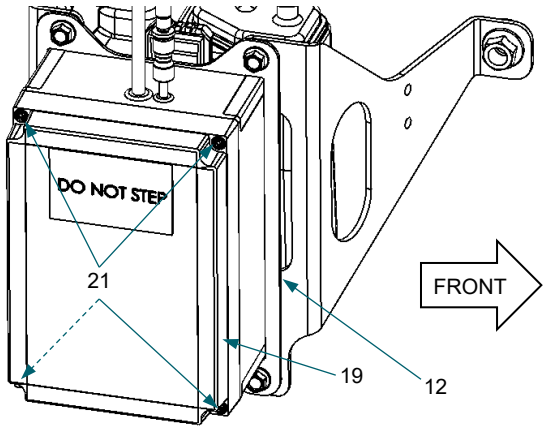


Figure 10. EVAP pump module box (12), cover (19), fasteners (21).

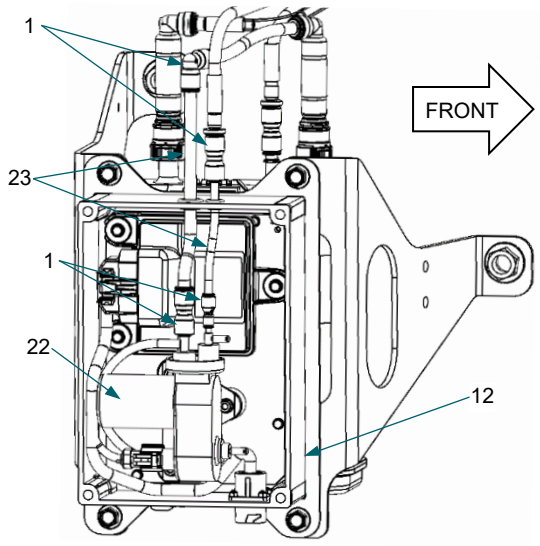


Figure 11: EVAP module box (12), quick connect fittings (1), EVAP pump (22).

INSTALLATION PROCEDURE

1. Verify PCV line *(not shown)* connections at PCV valve (10) and rear intake manifold fitting (9) are securely fastened. *Figure 1*

   NOTICE

   Gently position and secure lines and fittings to avoid cracking the tubing or weakening the connections.

2. Verify EVAP purge solenoid quick connect fitting (16) and manifold fitting (14) are securely fastened. *Figure 2*
3. Verify EVAP purge line quick connect fitting (15) at EVAP purge solenoid (7) is securely fastened. *Figure 1*
4. Verify make-up air line (16) quick connect fitting at intake air tube (17) is securely fastened. *Figure 2*

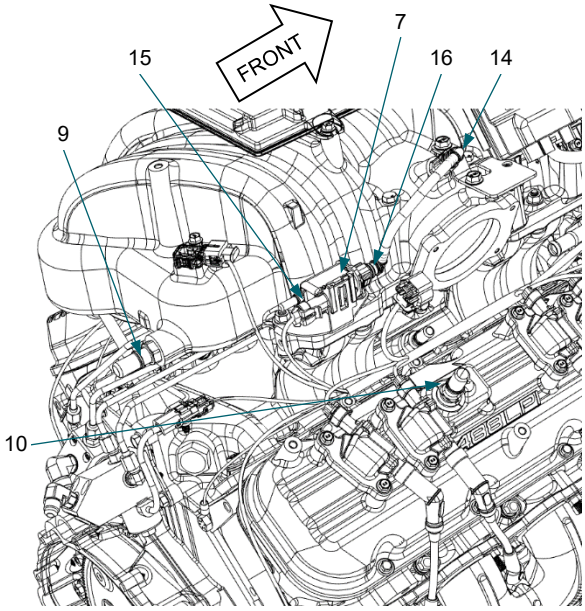


Figure 1: EVAP purge solenoid (7), purge solenoid to EVAP purge line location (15), purge solenoid fitting to intake location (16), purge line fitting (14) location on intake manifold. PCV intake fitting (11), PCV valve (10). NOTE: Intake air tube not shown for clarity.

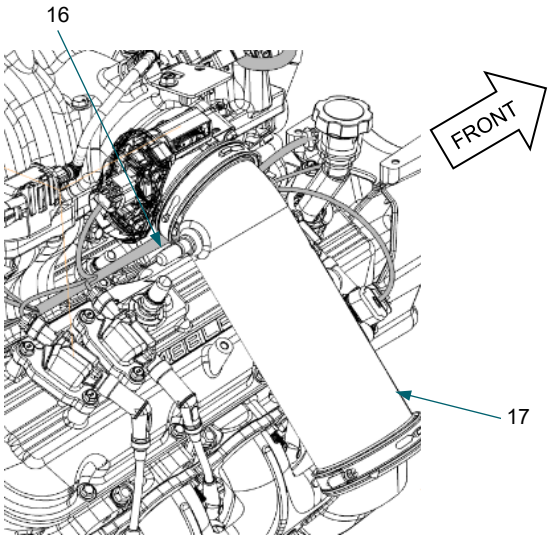


Figure 3: Make-up air line fitting (6) location on intake air tube (17).

5. Verify PVC line (16) quick connect fittings (1) at top of EVAP pump module (12) and

top of EVAP canister (13) are secure. *Figure 3*

6. Verify EVAP purge line (14) quick connect fittings (1) at EVAP canister (3) a securely fastened. *Figure 3*
7. Verify make-up air line (15) quick connect fitting (1) at EVAP canister (3) is securely fastened. *Figure 3*
8. Verify PCV line quick connect fittings (19) to EVAP pump (2) are securely fastened. *Figure 4*
9. *If removed:* Install cover (19) on EVAP module box (8). *Figure 3.*
10. Verify proper operation.

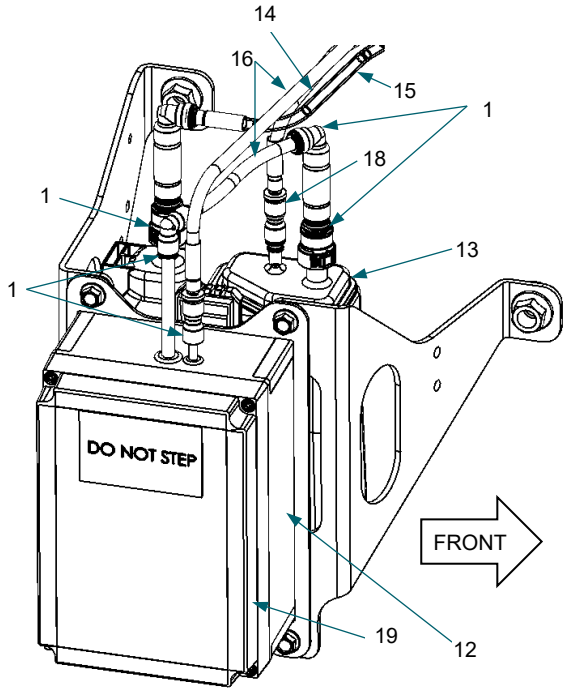


Figure 3: EVAP pump module (12), cover (19), PCV lines (5), quick connector fittings (1), make-up air line (6), EVAP canister (3).

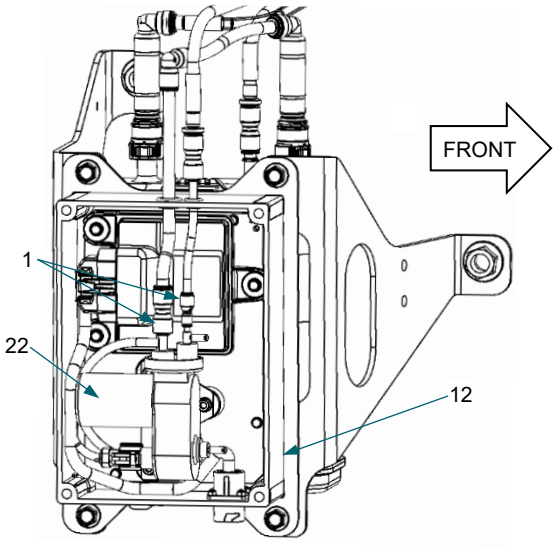


Figure 4: EVAP pump module box (12, PCV line quick connect fittings (1), EVAP pump (22).

EVAP Pump Replacement

DESCRIPTION AND OPERATION

The EVAP pump circulates propane vapors from the engine intake manifold via the PCV system and the EVAP purge solenoid to the EVAP canister. The EVAP pump is controlled by the EVAP module which is controlled by the electronic control module (ECM) using a ground side driver. The EVAP pump powers on during the fuel purge cycle and anytime the engine is running. The EVAP pump is located inside the EVAP module box on the passenger side frame rail.

REMOVAL PROCEDURE

1. Secure vehicle on an approved hoist.
2. Remove negative battery cable or, *if equipped:* use battery disconnect switch on battery box to shutoff vehicle power.
3. Raise vehicle.
4. Unplug chassis harness electrical harness *(not shown; refer to OEM procedure)* from EVAP plug electrical connector (1) on bottom of EVAP box (4). *Figure 1*
5. Remove four bolts (2) securing EVAP module front cover (3). *Figure 1*
6. Remove EVAP pump module box front cover (3). *Figure 1*

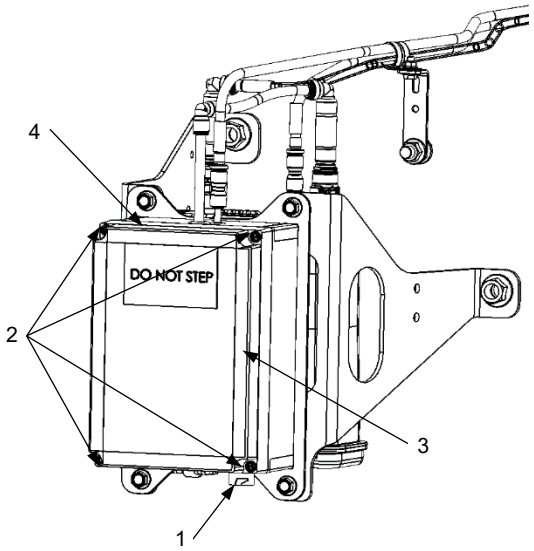


Figure 1: EVAP pump module box (4), cover (3), cover bolts (2), electrical connector (1).

7. Disconnect PVC out line quick connect adaptor (5). *Figure 2*
8. Disconnect PCV in purge line quick connect adaptor (6). *Figure 2*
9. Remove EVAP module harness connector (7) from EVAP pump (8). *Figure 2*
10. Remove EVAP pump retaining bolts (9). *Figure 2*
11. Remove EVAP pump (8) from EVAP module box (4). *Figures 2 & 3*

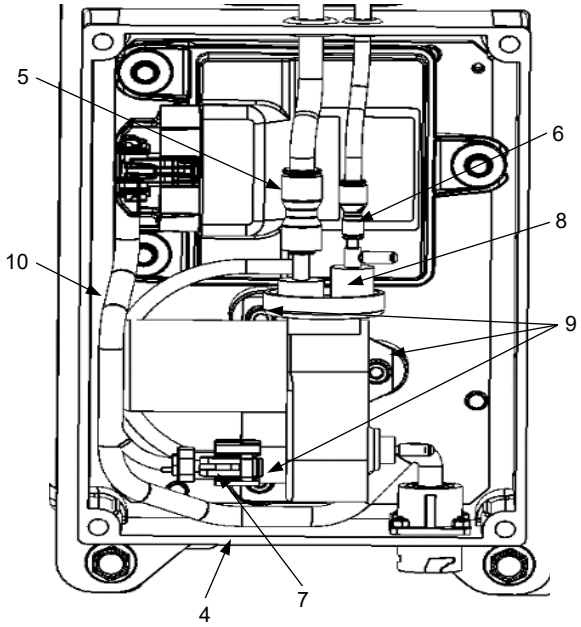


Figure 2: EVAP module box (4), PCV out line quick connect adapter (5), PCV in line quick connect adapter (6), EVAP module harness (10), EVAP pump harness connector (7), EVAP pump (8), EVAP pump bolts (5).

INSTALLATION PROCEDURE

1. Install new EVAP pump (8) into EVAP module box (4). *Figure 3*
2. Install EVAP pump retaining bolts (9). *Refer to Fuel System Torque and Tightening Specifications. Figure 1*
3. Apply dielectric grease to EVAP module harness connector (7) and connect to EVAP pump (8). *Figure 2*
4. Connect EVAP pump (8) to PCV in line quick connect adaptor (5). *Figure 4*
5. Connect EVAP pump (8) to PCV out purge line quick connect adaptor (6). *Figure 4*

   C **Pull gently but firmly upward on PCV and EVAP purge lines to ensure connectors are seated.**
6. Install EVAP module front cover (3). *Figure 1*
7. Install EVAP module front cover retaining bolts (2). *Refer to Fuel System Torque and Tightening Specifications. Figure 1*
8. Apply dielectric grease chassis electrical harness connector *(not shown)* and plug into EVAP module harness connector (1). *Figure 1*

   NOTICE

   Clean and inspect harness plug and connector for corrosion before plugging in; replace harness as necessary.
9. Reinstall negative battery cable or, *if equipped:* use battery disconnect switch on battery box to restore vehicle power.
10. Verify proper operation.

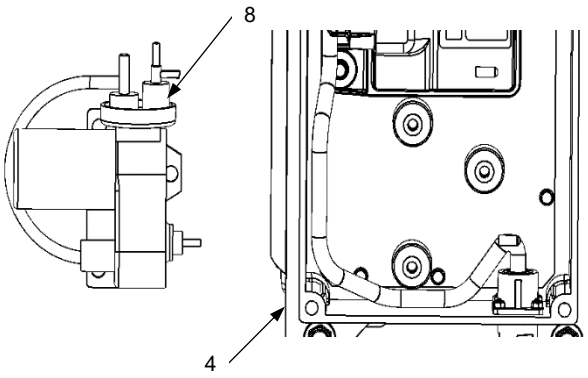


Figure 3: EVAP module box (4), EVAP pump (8).

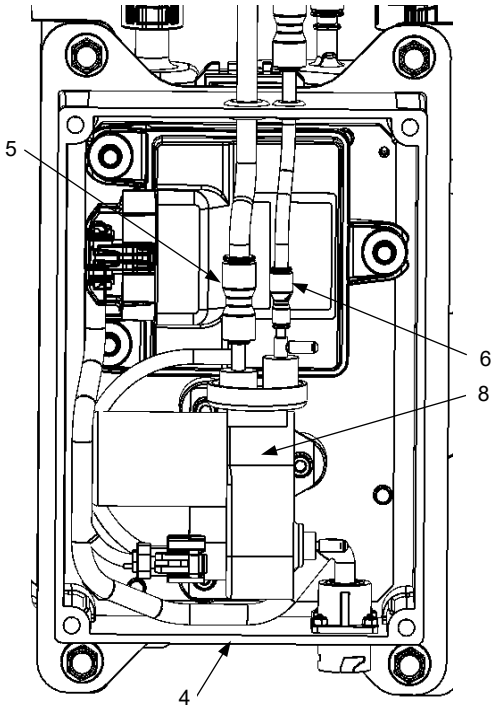


Figure 4: EVAP module box (4), PCV out line quick connect adapter (5), PCV in line quick connect adapter (6), EVAP pump (8).

EVAP System Inspection

DESCRIPTION AND OPERATION

A properly functioning EVAP system is essential for optimum 488LPI™ engine performance with minimal emissions. Refer to *488LPI™ Operators Manual* for EVAP system inspection intervals.

The EVAP system runs from the passenger side Valve Cover and rear of the Upper Intake Manifold back to chassis mounted portions of the EVAP system comprising the following components:

1. EVAP Module*
2. EVAP Pump*
3. EVAP Canister
4. EVAP Purge Line
5. PCV Lines
6. Make-up Air Line
7. EVAP Purge Solenoid

**Located inside EVAP Module Box.*

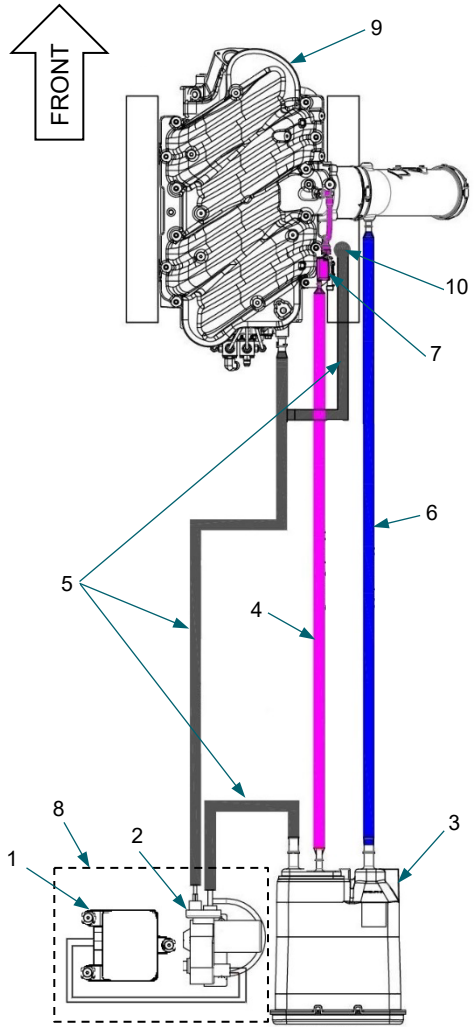


Figure 1:
EVAP system components:
Intake Manifold (9), EVAP Module Box (8),
EVAP Module (1), EVAP Pump (2),
EVAP Canister (3), EVAP Purge Line (4),
PCV Lines (5), Make-up Air Line (6),
EVAP Purge Solenoid (7), PCV Valve (10)

INSPECTION PROCEDURE

1. Secure vehicle on an approved hoist.
2. Remove negative (–) battery cable or, *if equipped:* use battery disconnect switch on battery box to shut off vehicle power.
3. Open hood.
4. Raise vehicle.
5. Verify PCV Line (5) connections at PCV Valve (10) and rear Upper Intake Manifold fitting (11) are securely fastened. *Figure 1*
6. Verify EVAP Purge Solenoid Quick Connect Fitting (16) and Upper Intake Manifold fitting (14) are securely fastened. *Figure 2*
7. EVAP Purge Line quick connect fitting (15) at EVAP Purge Solenoid (7) is securely fastened. *Figure 2*
8. Verify Make-Up Air Line (6) quick connect fitting at Air Intake Tube (12) is securely fastened. *Figure 3*
9. Verify PCV Line quick connect fittings (19) at top of EVAP Module Box (1) and top of EVAP Canister (3) are secure. *Figure 4*
10. Verify EVAP Purge Line (4) quick connect fitting (18) at EVAP Canister (3) is securely fastened. *Figure 4*
11. Verify Make-Up Air Line (6) quick connect fitting (17) at EVAP Canister (3) is securely fastened. *Figure 4*
12. Remove cover (13) from EVAP Module Box (8) to gain access to PCV Line connections at EVAP Pump. *Figure 4. Refer to EVAP Pump Replacement procedure.*
13. Verify PCV Line quick connect fittings (19) to EVAP Pump (2) are securely fastened. *Figure 5*
14. Install cover (13) on EVAP Module Box (8). *Refer to EVAP Pump Replacement procedure. Figure 4.*

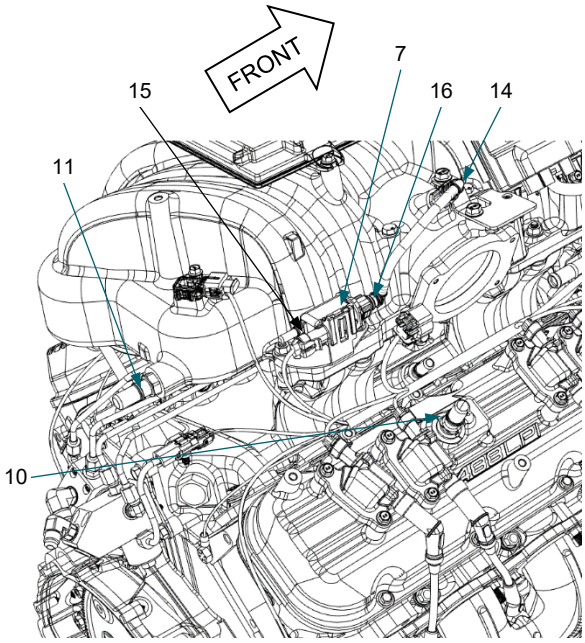


Figure 2:
EVAP Purge Solenoid (7), purge solenoid to EVAP purge line location (15), purge solenoid fitting to intake location (16), purge line fitting (14) location on Upper Intake Manifold.
PCV Intake Fitting (11), PCV Valve (10).
NOTE: Air Intake Tube not shown for clarity.

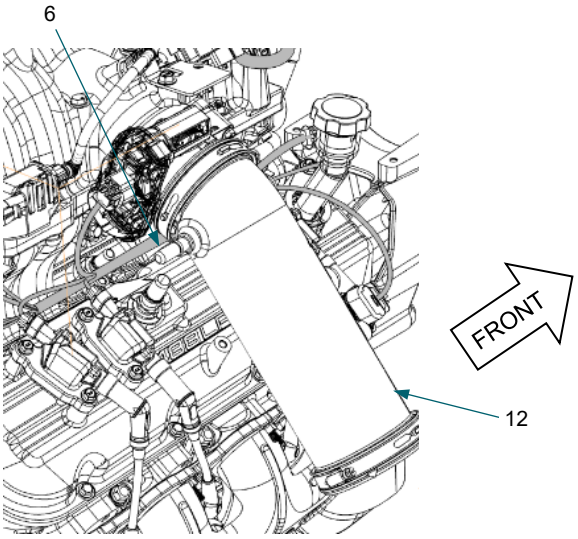


Figure 3:
Make-up Air Line fitting (6) location on Air Intake Tube (12).

15. Reinstall negative battery cable (–) or*, if equipped:* use battery disconnect switch on battery box to restore vehicle power.
16. Verify proper operation.

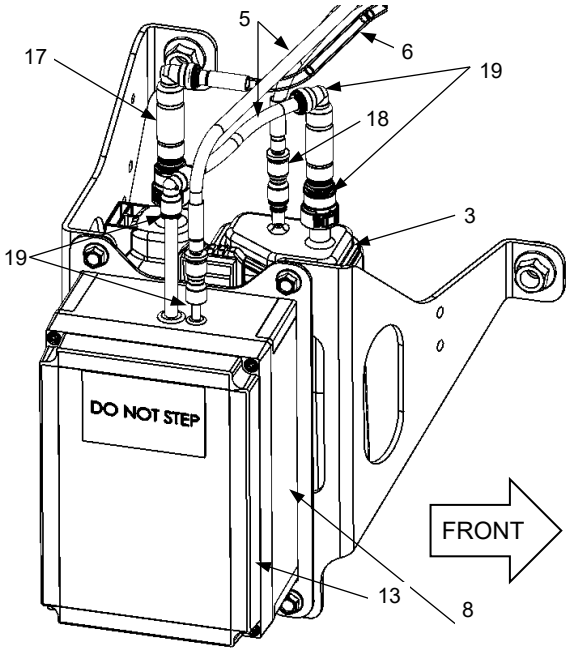


Figure 4:
EVAP Module box (8), cover (13), PCV Lines (5), PCV Line quick connector fittings (19), EVAP Purge Line fitting (18), EVAP Canister (3), Make-Up Air Line (6)

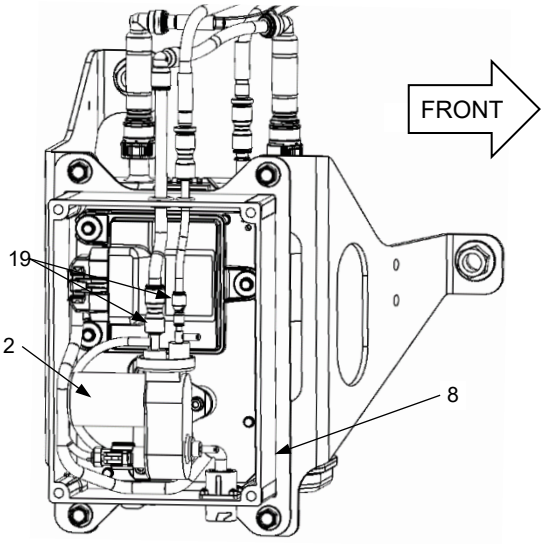


Figure 5:
EVAP Module box (8), PCV line quick connect fittings (19), EVAP Pump (2).