



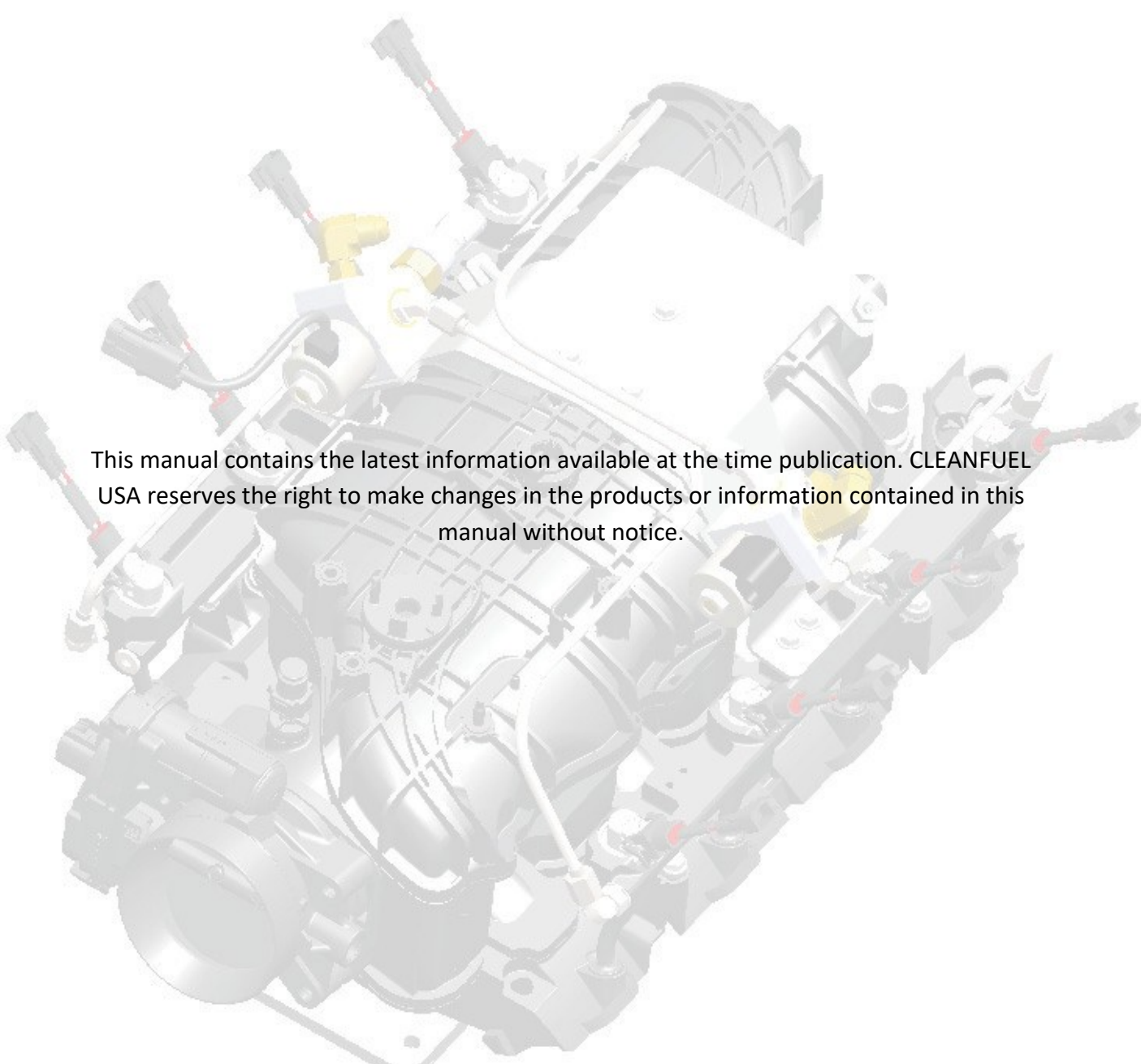
CLEANFUEL

USA

CLEANFUEL USA
GEN III DEDICATED LIQUID PROPANE INJECTION
SERVICE MANUAL FOR FREIGHTLINER
MT45/55 and P63 CHASSIS
WITH 6.0 LITER ENGINE



LIQUID PROPANE INJECTION



This manual contains the latest information available at the time publication. CLEANFUEL USA reserves the right to make changes in the products or information contained in this manual without notice.

CLEANFUEL USA GEN III DEDICATED LIQUID PROPANE INJECTION SERVICE MANUAL
FOR FREIGHTLINER MT45 / 55 and P63 CHASSIS WITH 6.0 LITER ENGINE

Copyright © 2016 by CLEANFUEL USA

All rights reserved. No part of this book may be reproduced or transmitted in any form or by any means electronic or mechanical, including photocopying, recording or any information storage and retrieval system without written permission
From CLEANFUEL USA.

To obtain a printed copy of the manual, contact CLEANFUEL USA at 877-234-1722 - Prices subject to change.

Written by: Brandon Thorn - CLEANFUEL USA

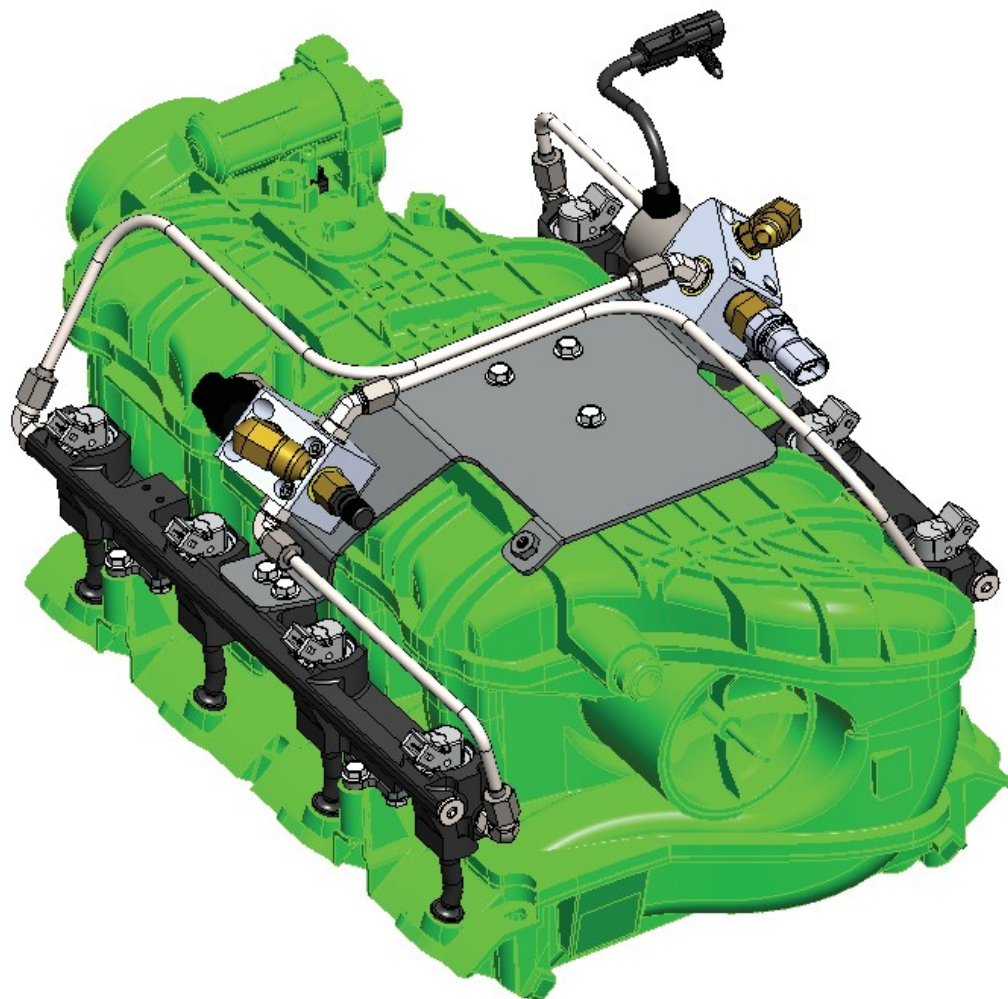
Printed by: Associated Print & Marketing with permission from CLEANFUEL USA

CleanFUEL USA Liquid Propane Injection System

Introduction

Liquid Propane Injection LPI® is a fully integrated, factory installed propane fuel system installed in the OEM factory. LPI® is also EPA/CARB certified and has demonstrated compliant tail pipe emissions, evaporative emissions and on-board diagnostics as required.

This manual is to provide general information on an LPI® equipped 6.0L Engine. Anyone who performs repairs to the LPI® system must be trained. Anyone who performs repairs must have knowledge of Liquefied Petroleum Gases and understand the safe handling and characteristics of propane. Some states may require a license to work on propane vehicles. Consult your state or local authorities or your state propane gas association. CleanFUEL USA is not responsible for your oversight to comply with federal, state or local laws regulating the installation or repair of propane gas systems.



The LPI® system is a sequential multi-port fuel injection system that injects propane in a liquid state to the engine. It works the same way as a modern sequential multi-port gasoline fuel injection system and can be diagnosed with the same diagnostic scanners used for gasoline vehicles.

In the event of any vehicle fuel system safety-related recalls, CFUSA will notify all customers who are registered and possess an affected vehicle.

For information contact:

CLEANFUEL USA INC.
29387 Lorie Lane
Wixom, Michigan 48393
Technical Call Center 877-234-1722
www.cleanfuelusa.com

FUEL SYSTEM WARNINGS

CAUTION: Do not smoke, carry lit tobacco, or use a open flame of any type when working on or near any fuel related component. Flammable air-fuel mixtures may be present and can be ignited causing property damage, personal injury or death.

CAUTION: Do not allow liquid propane to contact the skin. Escaping propane can cause severe freeze burns to the skin on contact. Wear protective gloves anytime you are loosening a fuel line or fitting where liquid propane could be trapped. Propane is stored as a liquid and the fuel system lines transfer fuel in a liquid state to the injectors.

CAUTION: Propane is non-poisonous, non-toxic, has the lowest flammability range of any other alternative fuel, and dissipates quickly when released to the atmosphere. Propane is heavier than air and can settle at the lowest point. When the air to propane ratio is between 2.15% and 9.60% the propane can ignite in the presence of an ignition source of 940° F (504° C) and higher. Keep away from all sparks, flames, heat, static electricity or other sources of ignition. Property damage, personal injury or death may occur if this warning is ignored.

CAUTION: Do not make repairs to the liquid propane injection fuel system if you are not trained to service the liquid propane injection fuel system. Contact the OEM dealer who sold you the vehicle or the installer of the system to locate a repair facility with trained technicians to repair your fuel system.

CAUTION: When making repairs to the liquid propane injection system disconnect the battery ground to ensure that the vehicle has no system electrical current. Property damage, personal injury or death may occur if this warning is ignored.

WARNINGS, CAUTIONS, and NOTES

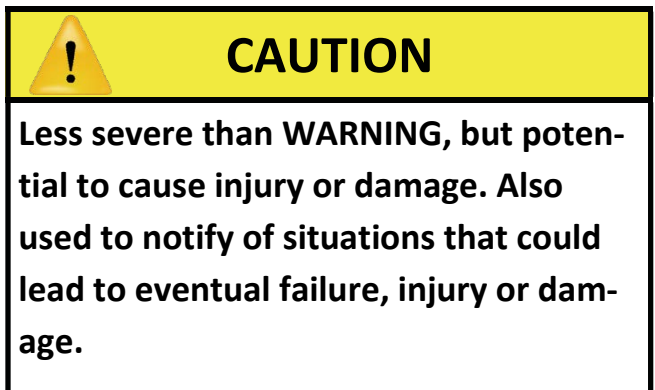
This manual contains several different warnings, cautions and notes that must be observed to prevent personal injury and or damage to the equipment, the fuel system or personal property.

A “**WARNING**” Label or statement is used when it has been determined that by performing a process or procedure defined in the manual improperly; it could result in serious bodily injury, death, property or vehicle damage.

Typical Warning Label



Typical Warning Label



This caution label may also appear in areas of this manual which apply to service and repair procedures which could render the fuel and emissions control system non-compliant. In addition, it may also be used to indicate a failure to observe which may influence the terms of the warranty.

An “**IMPORTANT**” statement generally denotes a situation which requires strict adherence to the assembly, tightening, or service procedure. Failure to observe this

procedure could result in an unsafe condition or improper performance of the vehicle or a component.

A **“NOTE”** statement applies to a specific item or procedure which is to be followed during the servicing of the vehicle or its components.

PROPER USE OF THIS SERVICE MANUAL, TOOLS AND EQUIPMENT

To reduce the potential for injury or damage to the vehicle during service repairs the technician should observe the following steps:

- The service procedures defined in this manual, when followed, have been found to be a safe and efficient process to repair the fuel system. In some cases, special tools may be required to perform the necessary procedures in order to safely remove and replace a failed component.
- The liquid propane injection system installed on the 6.0L engine has been listed with the California Air Resource Board (CARB) as a certified system and complies with all model year emissions regulations. When servicing the fuel and emission control system, you should follow all the recommended service and repair procedures to insure the fuel and emissions system are operational as designed and certified. Do not disable, defeat or tamper with any part of the fuel or emission systems which would leave the fuel and emissions control system in a non-compliant state.
- Tools identified in this manual can be obtained from CleanFUEL USA and/ or a CleanFUEL USA distributor.

IMPORTANT:

It is important to remember that there may be a combination of metric and SAE fasteners used in the installation of the liquid propane injection fuel system. Check to ensure proper fit when using a socket or wrench on any fastener to prevent damage to the component being removed/ installed or injury from “slipping off” the fastener.

IMPORTANT:

The liquid propane injection system utilizes fuel line hoses with swivel connections that attach to fixed mating connectors. You should always use a wrench of the proper size on both the swivel and the fixed fitting to prevent turning of the fixed fitting. Turning of the fixed fitting may cause a “twisting” or “kinking” of the hose or fuel line and may result in a restriction of the fuel line or a leak.



WARNING

ALWAYS LEAK CHECK ANY FUEL SYSTEM CONNECTION AFTER SERVICING! USE AN LIQUID LEAK DETECTION SOLUTION OR A ELECTRONIC LEAK DETECTOR OR BOTH. FAILURE TO LEAK CHECK COULD RESULT IN SERIOUS BODILY INJURY, DEATH OR SERIOUS PROPERTY DAMAGE



CAUTION

Do not use any other replacement o-rings other than those supplied by CleanFUEL USA. These o-rings have been made with special material that is compatible with the liquid propane as well as the fuel system components. The use of o-rings other than supplied by CleanFUEL USA can cause severe system damage and possible personal injury.



FASTENER CAUTION

Replacement components must be the correct part number for the application. Components requiring the use of the thread locking compound, lubricants, corrosion inhibitors, or sealants are identified in the service procedure. These coatings can affect the final torque, which may affect the operation of the component. Use the correct torque specification when installing components in order to avoid damage.

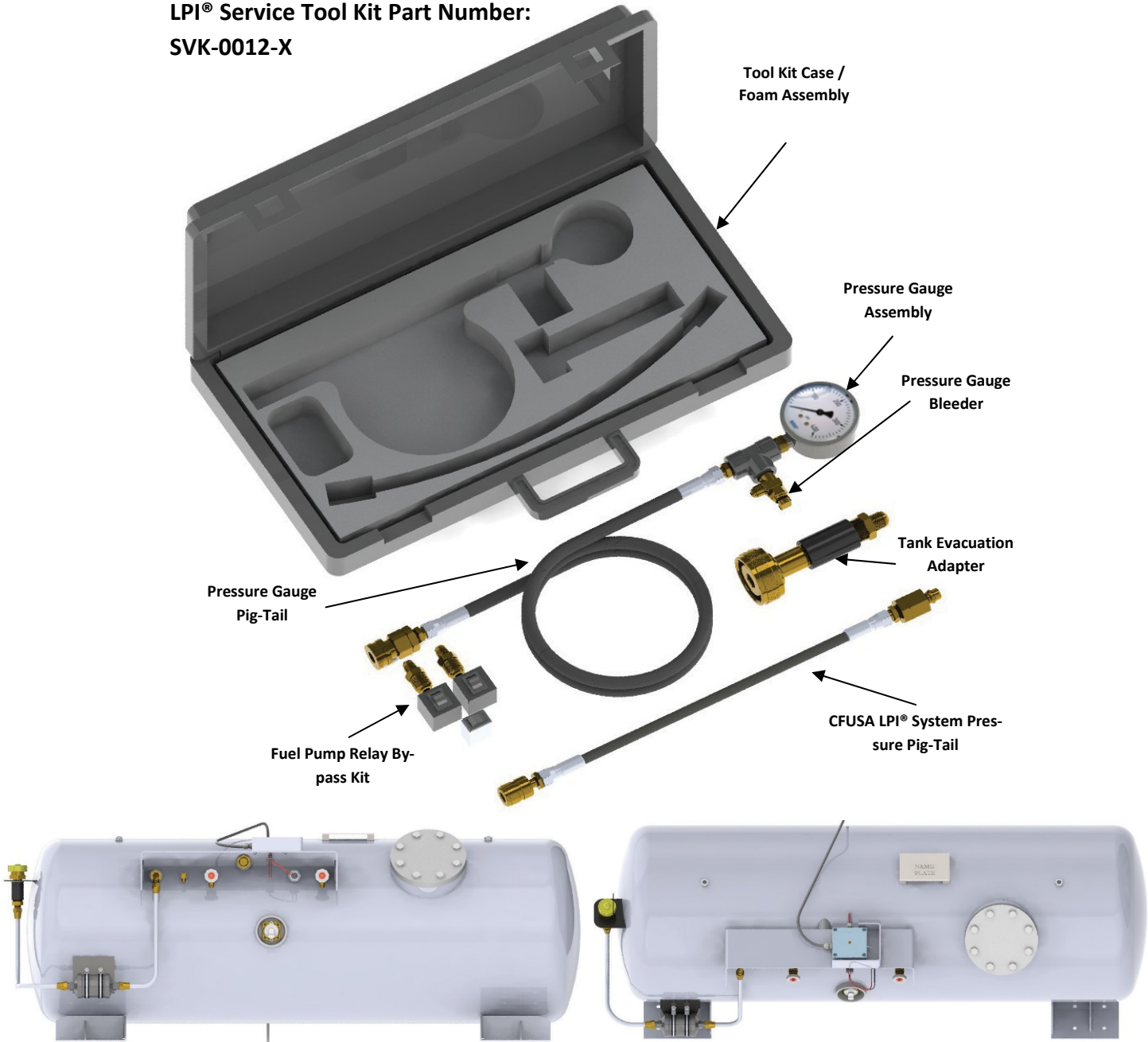
Liquid Propane Injection System

Service Tool Kit

Compatible with the 8.0L and 6.0L LPI® Fuel Systems.

This kit is required for properly repairing the **LPI®** fuel system

LPI® Service Tool Kit Part Number:
SVK-0012-X



CFUSA LPI® 6.0L DEDICATED LIQUID PROPANE INJECTION FUEL SYSTEM

General Information Section

60 Gallon LPG recovery tank equipped with internal transfer pump (Part Number: FTX-0083-X)

Table of Contents

Section :	Subsection:	Page Number:
General Information	Introduction	2
	Fuel System Warnings	3
	Service Tool Kit	5
	Table of Contents	6
	Facts About Propane	10
LPI® Maintenance	Maintenance of the Liquid propane LPI® System	14
	Fuel Fill Valve	14
	Annual Overfill Protection Device (OPD) Function Verification	14
	Propane Fuel System Leak Inspection	14
	Fuel Tank Maintenance	14
	Injectors and Fuel Rails	15
	Fill Filter / Inline Filter	15
	LPI® Fuel System Recommended Maintenance Schedule	16
Description and Operations	Liquid Propane Injection System Description and Operation	18
	MT45/55 Chassis - LPI® Fuel System Mechanization / Hydraulic Diagram	19
	P63 Chassis - LPI® Fuel System Mechanization / Hydraulic Diagram	20
	External Fuel Tank	21
	Internal Fuel Tank	22
	Filtration and Fuel Lines	23
	Fuel Rails and Fuel Distribution	23
	LPG Control Module	26
Diagnosis by Symptom	LPI® Fuel System Diagnosis by Symptom	28
	First Approach to Diagnosing the LPI® Fuel System	29
	Vehicle has No Power	29
	Vehicle will Not Start	30
	Engine Runs Poorly, Misfires, Backfires or Surges	31

Table of Contents Continued...

Section :	Subsection:	Page Number:
Diagnosis by Symptom (Continued...)	Vehicle has Poor Fuel Economy	31
	Cannot Fill the Propane Tank	31
	Dashboard Fuel Gauge Not Working	32
	Tank Making Noise, High Pitched Whistling Noise Or Grinding Sound	33
	LPI® Fuel Pump Diagnostics	34
	Fuel Sender Diagnostics	35
Repair and Replace	Engine Fuel System (Universal for Freightliner MT45/55 and P63 Chassis)	37
	Fuel Rail Assembly Replacement (Drivers Side)	38
	Fuel Rail Assembly Replacement (Passenger Side)	39
	LPI® Fuel Injector Replacement	40
	LPI® Fuel Injector Nozzle Replacement	41
	Supply Distribution Block Replacement	42
	Return Regulator Distribution Block Replacement	43
	LPG Stainless Steel Fuel Line Replacement	44
	Fuel Pressure and Temperature Sensor Replacement	45
	Fuel Pressure Test Port Replacement	46
	LPI® Internal Fuel Tank	48
	LPI® Fuel Pump Removal MT45/55 Chassis	49
	LPI® Fuel Pump Installation MT45/55 Chassis	51
	LPI® Fuel Pump Removal P63 Chassis	54
	LPI® Fuel Pump Installation P63 Chassis	56
	LPI® External Fuel Tank MT 45/55 Chassis	59
	Supply Valve Replacement	60
	Return Valve Replacement	61
	Service Evacuation Valve Replacement	62
	Pressure Relief Valve Replacement	63
	Overfill Protection Valve (Filler Valve) Replacement	64

Table of Contents Continued...

Section :	Subsection:	Page Number:
Repair and Replace (Continued...)	Fixed Liquid Level Gauge (80% Bleeder) Replacement	65
	Fuel Pump Wire Feed– Through Replacement	66
	Fuel Gauge Replacement	67
	Fuel Sender Replacement	68
	LPI® External Fuel Tank P63 Chassis	70
	Supply Valve Replacement	71
	Return Valve Replacement	72
	Service Evacuation Valve Replacement (Inside Baffle)	73
	Service Evacuation Valve Replacement (Behind Baffle)	74
	Pressure Relief Valve Replacement	75
	Overfill Protection Valve (Filler Valve) Replacement	76
	Fixed Liquid Level Gauge (80% Bleeder) Replacement	77
	Fuel Pump Feed– through Replacement	78
	Fuel Gauge Replacement	79
	Fuel Sender Replacement	80
	Check Valve Replacement (Supply Valve Side)	81
	Check Valve Replacement (Filler Valve Side)	82
	LPI® Fuel Filters	83
	Fill Filter Replacement MT 45/55 Chassis	84
	Supply Filter Replacement MT 45/55 Chassis	85
	Supply / Fill Filter Replacement P63 Chassis	86
	LPI® Fuel Lines (MT45/55 Chassis)	88
	FFWR Torque (Flats From Wrench Resistance)	89
	Filler Valve to Fill Filter	90
	Fill Filter to OPD Fill Valve (Tank Fill Valve)	91
	Supply Valve to Supply Filter	92
	Supply Filter to Supply Solenoid (Distribution Block)	93

Table of Contents Continued...

Section :	Subsection:	Page Number:
Repair and Replace (Continued...)	Return Regulator (Distribution Block) to Return Valve	94
LPI® Fuel Handling	LPI® Fuel Handling	96
	Introduction To the LPI® Service Tools	97
	LPI® Service Tool Kit	98
	LPI® Fuel System Pressure Test	99
	Evacuate / Drain Liquid Fuel from a LPI® Tank for Service	101
	LPG Fuel Line Draining	102
	Evacuate / Drain Liquid Fuel from the Liquid Service Valve on the LPI® Fuel Tank (Pressure Equalization Method)	103
	Evacuate / Drain Liquid fuel from the Liquid Supply Valve on the LPI® Fuel Tank (Fuel Pump Method)	105
	Evacuate / Drain Vapor Fuel from the Vapor Valve on the LPI® Fuel Tank	107
	Purging & Evacuating Propane Tanks	110
	Transferring Liquid fuel From the LPI® Evacuation Tank to a LPG Vehicle Fuel Tank	112

Facts About Propane

Approximate Properties of LP-Gases
(Commercial Propane)



Specific gravity of liquid (water = 1) at 60 degrees F...	0.504
Initial boiling point at 14.7 psia, (displayed in degrees F).....	- 44.0
Weight per gallon of liquid at 60 degrees F. (displayed in pounds).....	4.24
Cubic ft. of vapor per gallon at 60 degrees F.	36.38
Specific gravity of vapor (air = 1) at 60 degrees F... ..	1.50
Ignition temperature in air, degrees F.....	940 to 1120
Maximum flame temperature in air, degrees F.....	3,595

Limits of flammability in air

Percent of vapor in air/gas mixture:

Lower.....	2.15
Upper... ..	9.60

Air/Fuel ratio by volume... ..	15.6: 1
Air/Fuel ratio by weight... ..	24:1
Octane number as it relates to gasoline.....	98 to 102

Heating values:

BTU per cubic foot.....	2,488
BTU per pound.....	21,548
BTU per gallon.....	91,500

Approximate vapor pressure in psig at:

70 degrees F.....	109.3
100 degrees F.....	172.3
110 degrees F.....	197.3

Rate of expansion by volume; 1 part liquid expands 270 times to vapor.....	1:270
--	-------

CAUTION: When servicing a propane fuel tank be aware of your surroundings and caution everyone nearby of the possibility of flammable vapors. Work with a high awareness for safety and respect for other people and property. Make SAFETY a priority by practicing proper handling of propane at all times.

CAUTION: It is your responsibility to know the law. NFPA, National Fire Protection Association, has manuals for your reference in understanding safe handling of many products. We recommend that you obtain and read NFPA #58, Standard for the Storage and Handling of Liquefied Petroleum Gases.

Facts Continued

Propane is stored as a liquid therefore providing as much storage capacity as gasoline however the operating range for the same storage capacity is about 90% that of gasoline due to the energy content of a given volume of fuel. Propane has less energy content than gasoline but is more efficient due to its ability to vaporize almost completely. With a boiling point of -44 degrees Fahrenheit propane is stored as a liquid and requires only moderate pressure to keep it a liquid in the tank. The liquid propane injection system takes advantage of this characteristic by injecting the fuel as a liquid:

- The liquid fuel exiting the injector absorbs heat to vaporize therefore cools the incoming air charge. This makes the incoming air a higher density which increases the amount of air charge entering the combustion chamber which results in improved power.
- The liquid charge will also provide some cooling of internal engine components, intake valve and valve seat.
- The liquid also contains heavy ends such as oils or paraffins which separate at the point of vaporization providing some lubrication benefits.

Propane in general is widely used but people are not as familiar with it as they are with gasoline. We carry gasoline around in an open container, it can sit open without concern other than evaporation. We pour it from a can into a lawn mower and because it has been the most widely used engine fuel, we don't think about the dangers of it. Compared to gasoline propane is not as commonly used, therefore people are not as familiar nor comfortable with handling propane. Propane is in a sealed container and cannot be simply poured from a can into a fuel tank. By understanding the properties and safe handling of propane, you can have a safe and successful experience with it. This is why you will find warnings in this manual that caution you about the characteristics of propane and/or dangers that you could be faced with handling the product improperly. Propane is heavier than air in a vapor state; 1.5 times heavier than air. A good comparison that many people don't know is that gasoline is heavier than

air in a vapor state too; 4.5 times heavier. Actually propane is not much different than gasoline. Generally it is considered to be the fuel closest to gasoline in combustion characteristics than any other alternative fuel. Butane is yet closer due to its higher boiling point.

IMPORTANT: We recommend that you obtain and read NFPA #58, Standard for the Storage and Handling of Liquefied Petroleum Gases.

Propane is a colorless, odorless, non-toxic gas. An odorant called Ethyl Mercaptan is added at the producers terminal. All propane is odorized for the purpose of leak detection. Anytime the odor is detected an investigation for a leak must be performed.

Initially

- Eliminate all sources of ignition
- Verify all of the tank manual valves are closed
- If indoors, in a garage, all doors and windows should be opened
- Inspect the fuel system completely for leaks using approved leak detection solution or an electronic leak detection device
- Repair the source of the leak

CAUTION: Liquid propane vaporizes at a ratio of 1:270. This means it is 270 times more dense than vapor.

As previously mentioned, the boiling point of liquid propane is -44° F. Above this temperature it changes to a vapor. Below this temperature the fuel remains a liquid. In the propane tank the fuel is in a liquid state and the vapor pressure created by the boiling liquid sustains the fuel in a liquid state. As the temperature increases the pressure required to sustain the fuel in a liquid state increases. One other effect temperature has on the fuel is the space it occupies. As temperature & pressure increases, so does the liquid level inside of the tank. The liquid amount will remain the same however it expands and occupies more space. (refer to figure 1 in this section)

Facts Continued

This is why a propane tank is never filled more than 80% with liquid. There must be room for expansion of the liquid in case of increased temperature. For example, the tank is filled to 80% in the morning at the ambient temperature of 60 degrees. In the afternoon the temperature is at 80 degrees and the space requirement may increase by 3%. (Also refer to figure 1)

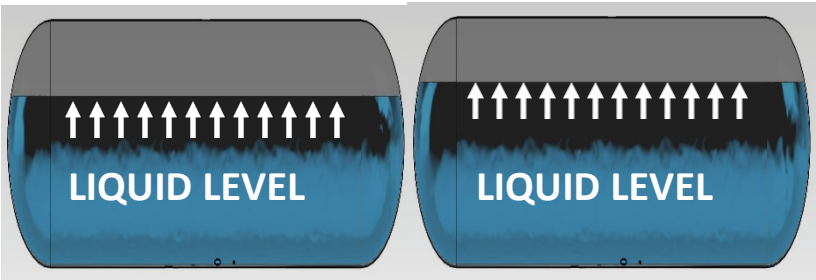


Figure 1

CAUTION: Never overfill a propane tank.

Propane Vapor Pressures	
Temperature Degrees F	Approximate Pressure (PSIG)
-40	1.3
-30	5.5
-20	10.7
-10	16.7
0	23.5
10	31.3
20	40.8
30	51.6
40	63.3
50	77.1
60	92.5
70	109.3
80	128.1
90	149.3
100	172.3
110	197.3

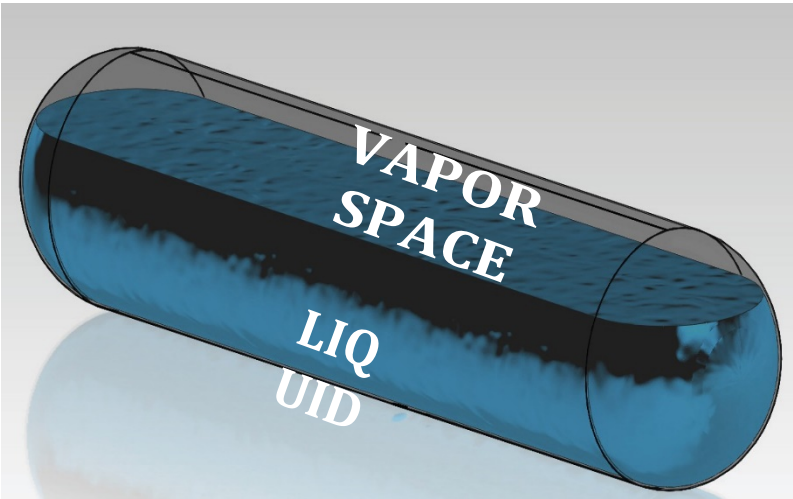


Figure 2

Propane Tank at 80% liquid level

NOTES:

Maintenance of the Liquid propane LPI® system

This section of the service manual supplement covers the components of the LPI® dedicated fuel system, which require regularly scheduled maintenance. For maintenance of the base engine, refer to the OEM engine service manual or for chassis refer to the OEM chassis manual.

Fuel Fill Valve

On the LPI® system prior to each fill; the fill valve coupling should be inspected for the following:

- Check coupling for damaged, cracked or stripped threads to prevent a “cross threaded” connection that may cause leaking or possible “blow-off” during fueling.
- Check the filler valve o-ring or gasket for any damage to prevent leakage during fueling. Replace if necessary. A new o-ring can be obtained from CleanFUEL USA or a CleanFUEL USA distributor. Part number: VAX-0503-S
- Check for debris in the fill valve and clean if necessary
- Check to insure there is no debris in the fill nozzle, clean if necessary.
- Check to ensure the fill cap is in place to prevent fuel contamination. Replacement filler valve caps can be obtained from CleanFUEL USA or a CleanFUEL USA distributor. Part number: VAX-0502-S

Annual Overfill protection device (OPD) function verification

The OPD (Overfill Protection Device) must be annually inspected to verify proper function. The date of the test must be marked on the decal located on the LPI® propane tank.

To test the function of the valve, park the vehicle on level ground. The tank fuel level should be less than 1/8 of a tank registering on the fuel gauge. The tank must then be filled using the 80% liquid level gauge (bleeder or outage valve) located on the tank. (This valve is not utilized for fueling, so it should be capped.) Remove the cap to

perform this procedure. Re-install when completed.

With the tank fuel level below 1/8 of a tank, fill it while monitoring the station pump meter and bleeder valve. The automatic stop fill valve (OPD) should close just before or after liquid appears in a steady stream from the bleeder valve. The metered volume of the tank should not exceed the published volume by more than 5%, with a temperature compensated meter. If the volume exceeds this amount, or the OPD does not stop the filling process within 2-3 gallons of the correct volume, then stop the filling process immediately. The tank OPD fill valve will need to be replaced. Refer to the External Tank Service section of this manual.



WARNING

Do not remove any valves or fittings from the tank unless the tank had been evacuated completely. The pressure inside a propane tank can push a valve or fitting out with enough force to cause death, injury or property damage.

Propane Fuel System Leak Inspection

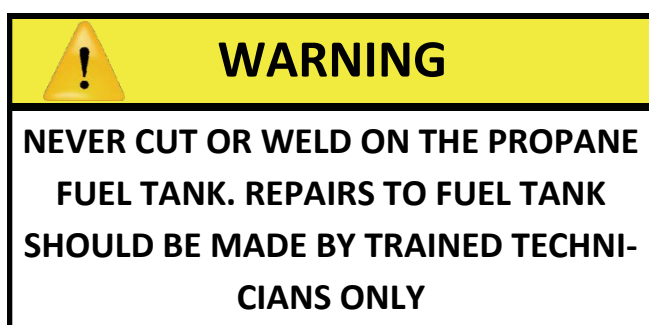
The propane fuel system should be inspected for leaks at least once per year, or anytime the system is serviced, or the distinctive odor of propane is detected. Use an approved liquid leak detection solution or an electronic leak detector. Inspection should be performed by a trained LPG service technician. If a leak is found repair or replace the component as required.

FUEL TANK MAINTENANCE

The LPI® fuel tank should be checked annually for the following:

- Check for any damage to the exterior of the tank.
- Inspect all fasteners and brackets to make sure the tank is securely fastened to the chassis.

- Check to ensure all service valves and or shut-off valves are functioning and the manual shut off valve fully closes the valve.
- Check to ensure the pressure relief valve vent is clear of any obstructions (some might include a dust cap ensure the cap is securely in place.) A new dust cap can be obtained from CleanFUEL USA or a CleanFUEL USA distributor. Part number: PRX-1000-S
- Check that all solenoid wiring and connectors are securely attached, connected and locked.



INJECTORS AND FUEL RAILS

The propane injectors and fuel rails require no adjustments. You should annually inspect the following items on the fuel rails and injectors.

- Check to ensure that all the injector electrical connectors are securely connected and locked.
- Check to make sure the fuel rail is securely attached to the engine.
- Check all injectors, rails and fittings for leaks using liquid leak detection solution or a electronic leak detector.

FILL FILTER / INLINE FILTER

Check the fill filter and inline filters annually for the following:

- Check that the brackets are securely attached to the chassis.
- Check all connections for leaks using a liquid leak detection solution or a electronicleak detector.

CFUSA LPI® 6.0L DEDICATED LIQUID PROPANE INJECTION FUEL SYSTEM

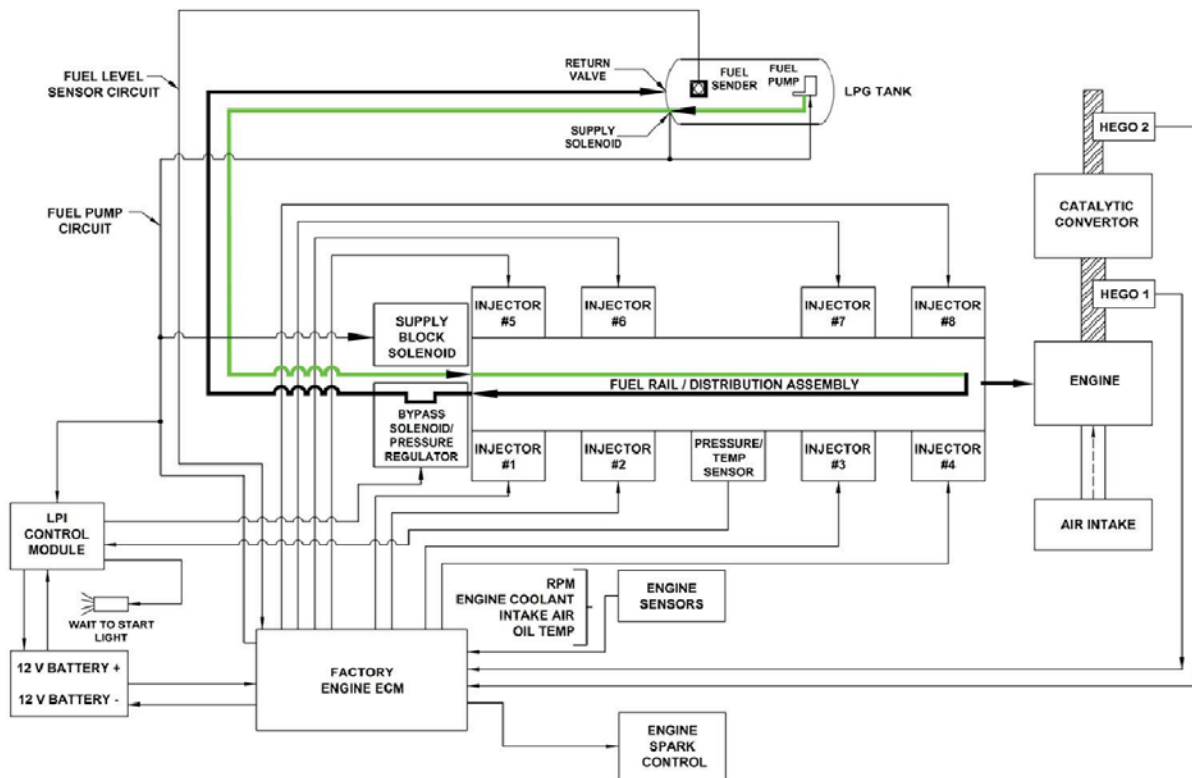
Maintenance Section

CFUSA LPI® FUEL SYSTEM RECOMMENDED MAINTENANCE SCHEDULE						
DESCRIPTION OF MAINTENANCE	FREQUENCY					
	Annually	Daily	5000 Miles	10,000 Miles	20,000 Miles	30,000 Miles
Fuel Tank Inspection						
Check for damage	X					X
Leak check all tank fittings and connections	X					X
Check all tank mounting hardware and data plate	X					X
OPD (Overfill Protection Device) Function Verification	X					
Fuel Lines						
Inspect lines for damage	X					X
Leak check all line fittings	X					X
Fuel Injector Rail and Injectors						
Leak check rail fittings and injectors	X					X
Injector electrical connectors	X					X
Fill Filter and Inline Filters						
Replace filters						X
<p>This maintenance schedule represents CleanFUEL USA recommended maintenance intervals to insure safe & reliable operation of the CleanFUEL USA LPI® (Liquid Propane Injection) system. Vehicles which operate in harsh environments may require operators to perform more comprehensive or frequent inspections. If you have any questions regarding the maintenance procedures and or questions regarding the system please contact your CleanFUEL USA service provider.</p>						

NOTES:

CFUSA LPI® 6.0L DEDICATED LIQUID PROPANE INJECTION FUEL SYSTEM

Description and Operations



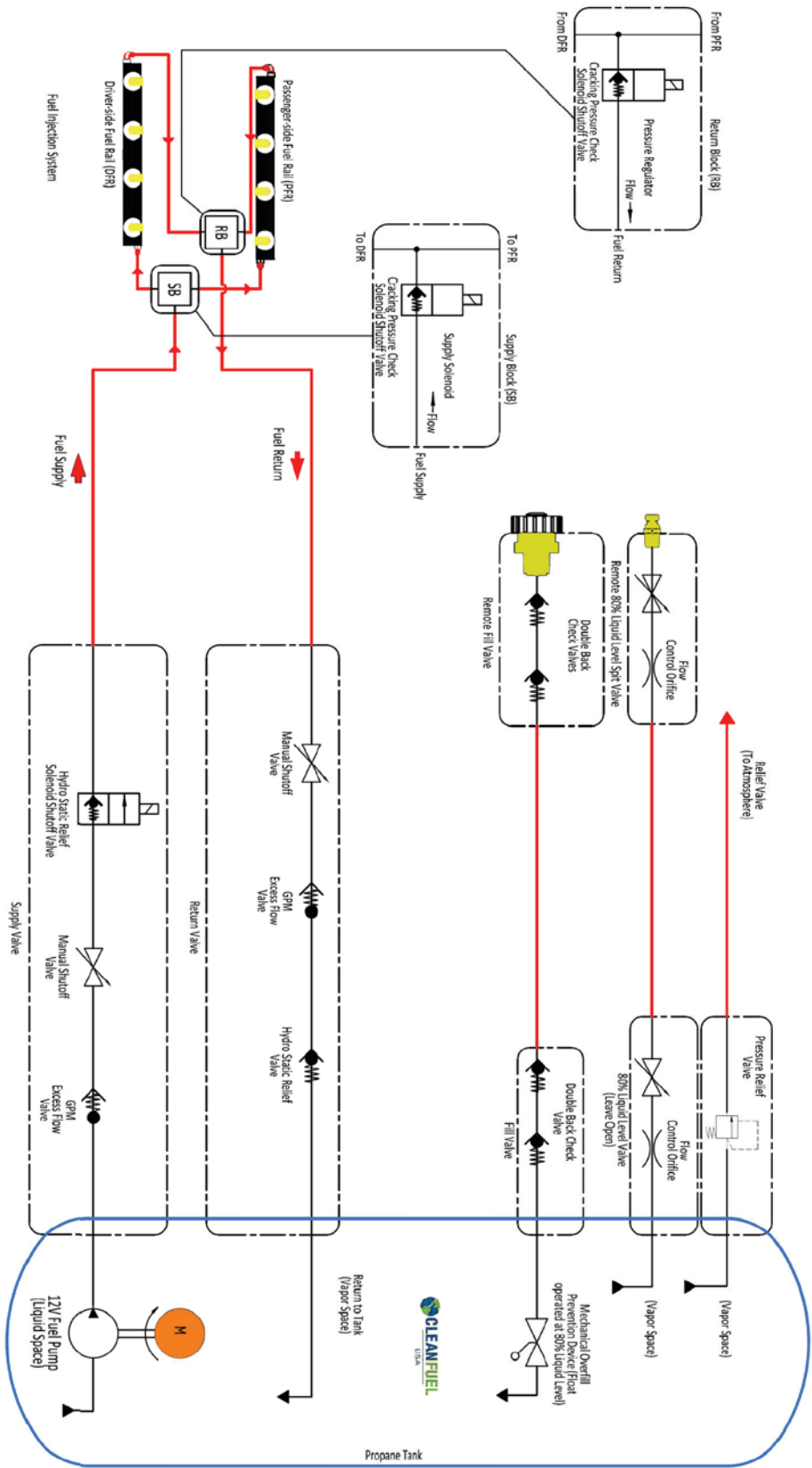
Liquid Propane Injection System Description and Operation

This LPI® fuel system is the most technologically advanced propane engine fuel system ever developed. LPI® works much like a typical gasoline fuel injection system. It works the same as a gasoline fuel injection system with the exception that it injects propane in a liquid state into the intake port. The gasoline system electronic engine management is the same and controls the LPI® system just as it would a gasoline injection system. Engine control diagnostics remain unchanged so the same scan tool and diagnostic approach is the same as a gasoline engine.

The LPI® system consists of three main components: the tank assembly, the fuel lines and the injectors. The tank is located on the vehicle frame rail and the lines are routed forward to the engine compartment injector rail assemblies. They are mounted in the same location as a set of gasoline injector rails would be installed. The fuel tank contains the most complicated components of the LPI® system. It includes an internal electric fuel pump, fuel supply and return valves, and a baffle that keeps the pump submerged in liquid propane. It also has a fuel level float assembly, pressure relief valve, overfill prevention device, and a liquid service valve. The LPI® fuel pump increases or boosts the tank pressure by 50–60 psi. The fuel

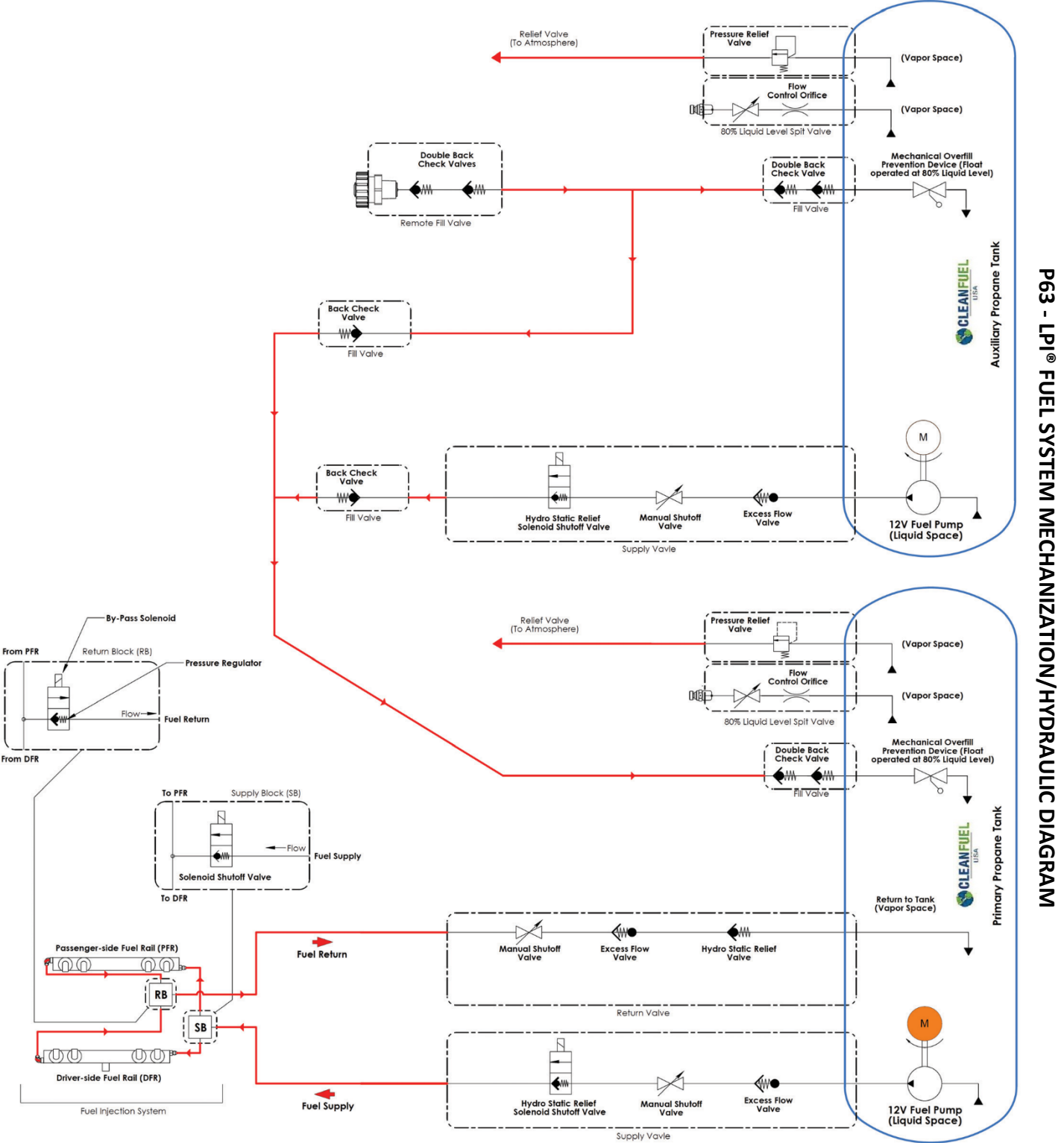
is supplied to the injectors then passes into the regulator/bypass then loops back to the return valve on the tank. The regulator maintains the fuel pump boost pressure between 50 to 60 psi. This allows liquid to be supplied to the injectors at all times. Regardless of the propane tank internal pressure, the pump boost pressure remains constant. This is how the fuel remains liquid throughout the supply section of the system. When the engine is turned off heat soak increases the pressure inside the rails causing the liquid to vaporize. To help with hot restarts, the system goes through a *Intelligent Purge* cycle for 4 to 11 seconds. By utilizing a pressure/temperature sensor located in the fuel rail, the LPG control module is able to intelligently calculate when liquid has been restored to the fuel rail. With liquid restored, this enables a perfect start every time. During this process the system activates a bypass solenoid valve which opens a larger return passage allowing the fuel rails to be purged rapidly with liquid propane. This time varies with the pressure and temperature of the LPI® fuel rails. This strategy is built into the system's LPG control module. During the purge cycle the "Wait to Start" indicator will be illuminated.

MT 45/55 - LPI® FUEL SYSTEM MECHANIZATION/HYDRAULIC DIAGRAM



CFUSA LPI® 6.0L DEDICATED LIQUID PROPANE INJECTION FUEL SYSTEM

Description and Operations



CFUSA LPI® 6.0L DEDICATED LIQUID PROPANE INJECTION FUEL SYSTEM

Description and Operations

LPI® FUEL SYSTEM OVERVIEW.

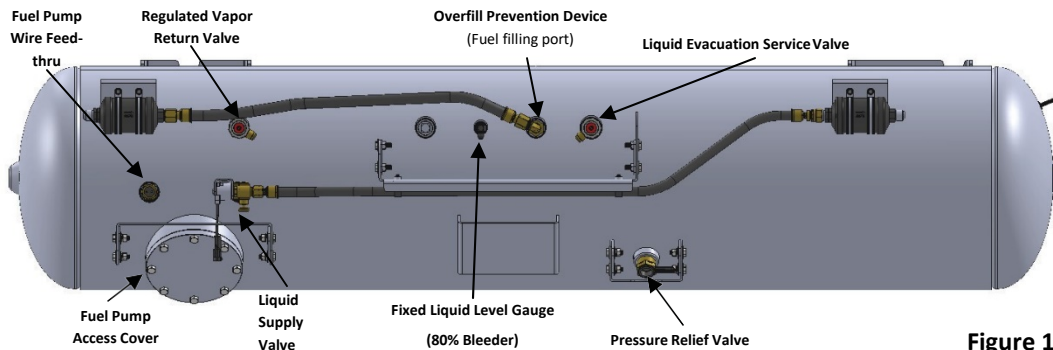


Figure 1

Pressure Relief Valve

If the pressure in the fuel tank exceeds 312.5 psi, the pressure relief valve (PRV) will vent propane vapor to the atmosphere. The pressure will not get this high unless the tank has been overfilled, or unless the tank is hotter than 60°C (140°F) or both. When the PRV vents the sudden pressure drop significantly cools the remaining liquid, the boiling liquid propane absorbs heat, pressure drops and the valve closes.

External Fuel Tank (Figures 1 & 2)

The fuel tanks meet American Society of Mechanical Engineers (ASME) design for a working pressure of 312.5 psi and a burst pressure of 1250 psi. A baffle is built into the tank to keep the fuel pump submerged in liquid propane.

Overfilling Prevention Device

The overfilling prevention device is a mechanical float-actuated valve that stops the tank from being filled more than 80% capacity. By code, tanks must not be filled more than 80% full. This is to allow room for the liquid propane to expand.

Fixed Liquid level Gauge (80% Bleeder)

The fixed liquid level gauge is a mechanical means of verifying when the propane tank reaches 80% capacity which is the maximum liquid capacity of any propane tank. This gauge is a bleeder opened by a small thumb wheel that can be used for visual monitoring during filling. When a white mist appears exiting this bleeder the tank is at 80% liquid capacity and the fill process should be stopped and the bleeder closed. Because the tank is equipped with an OPD it is not required to be used each time the tank is filled. However, many fill station attendants prefer to utilize it during the fill process. There are also fill stations where bleeding fuel to the atmosphere is prohibited. **CAUTION: If this bleeder is utilized propane exits the valve and when mixed with air, the area around the filling operation can become a flammable/combustible environment. Follow proper filling procedures when filling a propane tank.**

Liquid Supply Valve

The liquid supply valve delivers liquid pressurized by the fuel pump thru the fuel lines to the injector rails. The valve is excess flow protected and is integrated with an external 12 volt operated solenoid. It is activated when the ignition key is cycled to the on position. It is controlled by the OEM fuel pump control strategy. The electric solenoid serves as a 100% fuel lock-off for safety.

Vapor Return Valve

The liquid fuel is circulated from the fuel pump through the liquid supply valve, fuel lines, injector rails and back to the tank via the return valve. This return valve is a manual valve and the fuel returns to the vapor space of the tank. This valve is equipped with an internal hydrostatic line pressure relief device if the manual valve is closed.

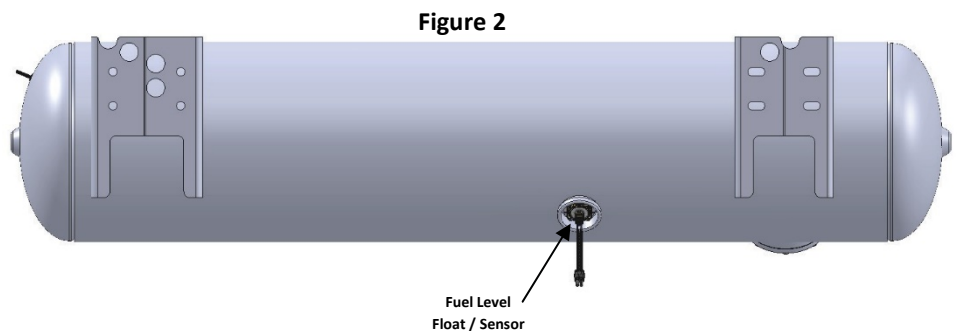


Figure 2

Fuel Pump Wire Pass-Thru

These two wires provide 12V and ground to the fuel pump through this hi-pressure sealed plug. The wires are sealed and molded into the pipe fitting without any added connections or terminals to increase resistance.

Fuel Level Float / Sensor

Externally mounted, an arm and float assembly extends into the tank. It raises or lowers with the liquid level of the fuel. A externally mounted sending unit reacts magnetically to the fuel level and provides a resistance value to the fuel level gauge on the dash. Resistance value is 250 ohms empty to 40 ohms full.

Liquid Evacuation Service Valve

This valve is used to evacuate the fuel from the tank before servicing any valve on the tank or the tank itself. The valve is capped with a brass cap which should always be reinstalled after any service procedure.

Fuel Pump Access Cover

This port is used to provide access to the fuel pump inside the tank. The fuel pump access cover utilizes an o-ring seal to seal to the flange. This o-ring should be replaced anytime it is removed.

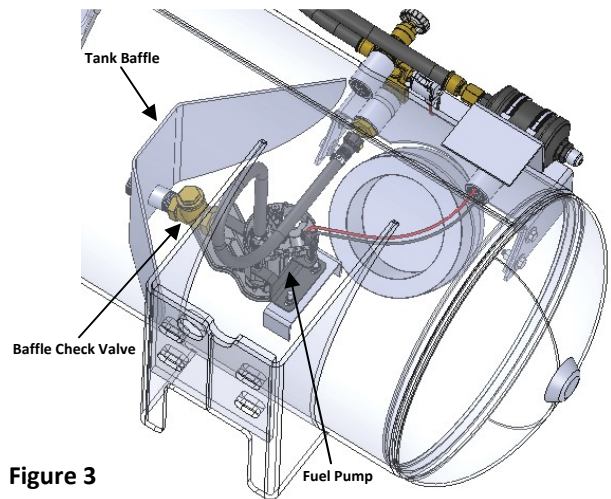


Figure 3

INTERNAL FUEL TANK

Fuel Pump

The LPI® system is equipped with a submerged fuel pump located in the bottom of the propane tank much like a submerged gasoline fuel pump. In order to keep the fuel a liquid through out the fuel lines and injectors the fuel pump will boost pressure to approximately 50 - 60 PSI over tank pressure.

Baffle Check Valve

A one way check valve is used to allow fuel to flow into the baffled area freely, thus submerging the fuel pump in liquid propane. The baffle check valve will not allow fuel to escape from inside the baffled area.



WARNING

Do not remove any valves or fittings from the tank unless the tank had been evacuated completely. The pressure inside a propane tank can push a valve or fitting out with enough force to cause death, injury or property damage.

FILTRATION AND FUEL LINES

Fill Filter / Supply Filters (Figures 5)

It is necessary as with any fuel to filter contaminants from entering the system. The liquid propane injection system incorporates a fill filter to catch contaminants from entering the tank during fueling. This alone will prevent most contamination from entering the fuel system however our filtration continues as with a gasoline system utilizing a “sock” type filter screen on the fuel pump and another inline fuel filter, located in the fuel supply line, to catch any contaminants before the fuel reaches the injectors. The fill filter and the inline fuel filter are replaceable and the recommended replacement interval is 30,000 miles. **Warning: When replacing filters the fuel line evacuation process must be followed.**

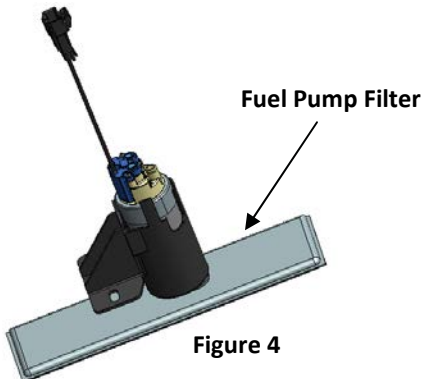


Figure 4

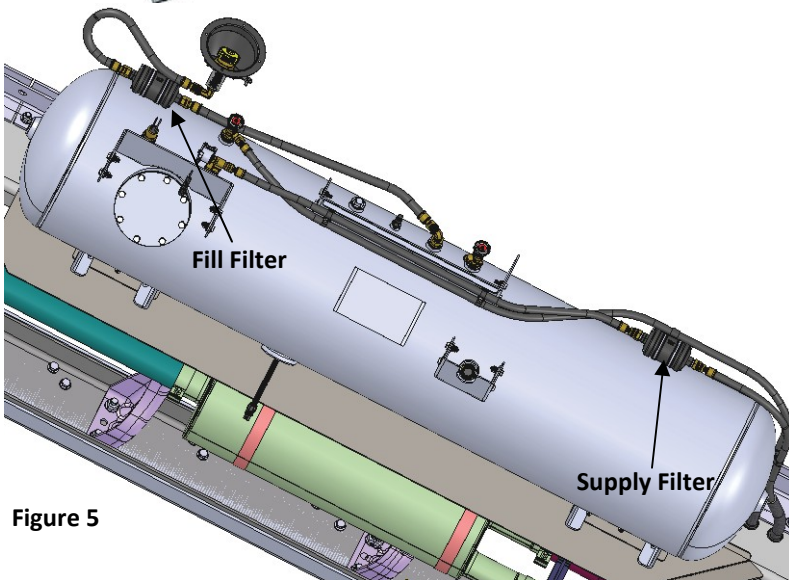


Figure 5

FUEL LINES (FIGURE 6)

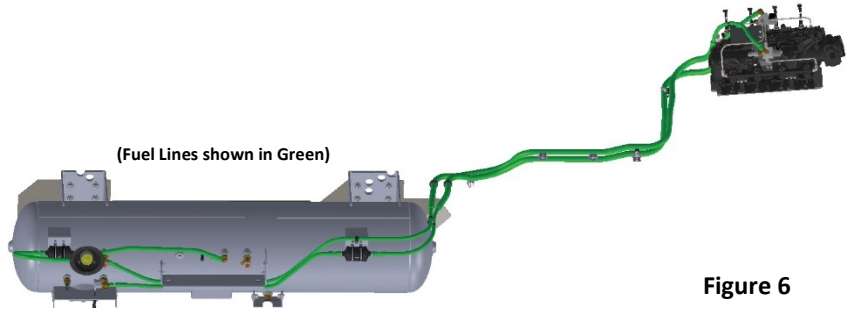


Figure 6

Fuel lines are Type III LPG approved hoses with minimum permeability in order to pass the evaporative shed test required by EPA/CARB. These hoses are very robust with rubber coated stainless steel braiding to protect against chaffing while built to a design working pressure of 350 PSI and burst pressure of 1,750 PSI. The lines are installed not to impinge on any sharp edges of the vehicle, engine or transmission components and are protectively routed the same as gasoline vehicles.

FUEL RAILS AND FUEL DISTRIBUTION (Figure 7)

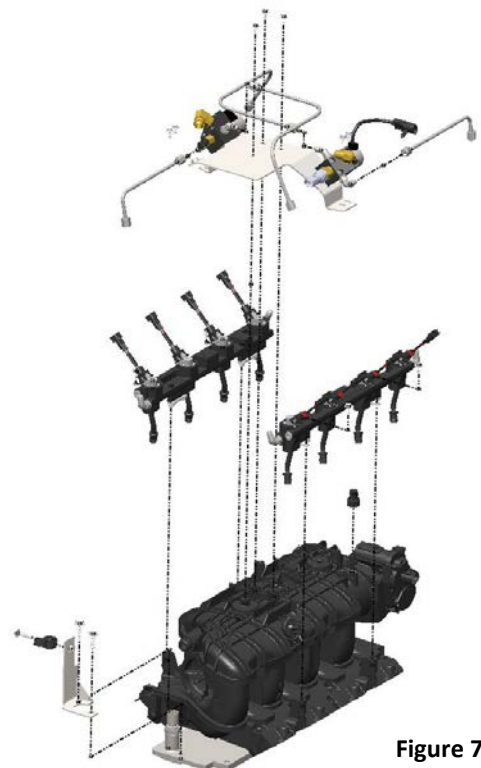


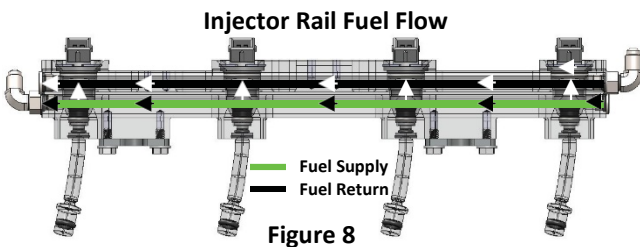
Figure 7

CFUSA LPI® 6.0L DEDICATED LIQUID PROPANE INJECTION FUEL SYSTEM

Description and Operations

LPI® Fuel Rails

The fuel rails are built of billet aluminum for minimum heat transfer and to accommodate the fuel distribution to each injector. The liquid fuel is delivered to each injector through a dedicated supply passage while a separate return passage allows fuel to flow back to the tank through the pressure regulator. While the engine is running the fuel flows through the rails and back to the tank generally in a liquid state. However, the absorption of heat from



the engine and some restriction in the return passage can

cause production of vapor bubbles which are returned to the tank and condense back to liquid depending on temperature and pressure. Once the engine has been turned

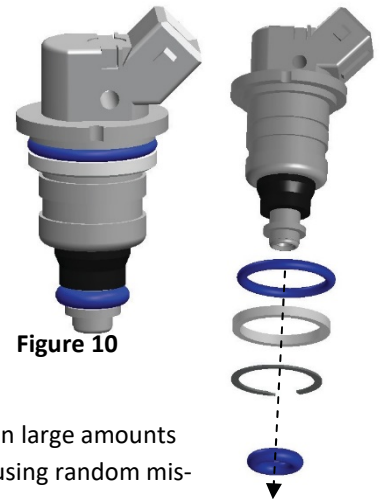
off the absorption of heat into the rails will vaporize the liquid fuel increasing the pressure in the rail which pushes the fuel mixture back to the tank until temperature and pressure is equal to the tank. This leaves a void of vapor, a "vapor lock", in the injector rails. Therefore the pump must prime the system for 4-11 seconds (depending on temperature) before the engine is started. The LPI® system uses a *Intelligent Purge* process that utilizes a "wait to start light" that illuminates during the duration for the pump priming. If the engine was turned off it can be re-started immediately without waiting for the "wait to start light" to turn off. It is recommended to follow the "wait to start light" procedure to start the engine

without the risk of a failed start. If started before the Wait to start time, a rough idle may be experienced until the injectors are full of liquid

LPI® Fuel Injector

(Figures 10 - 12)

The injectors are high quality Deka 2 automotive injectors manufactured by Continental. The injectors are very reliable unless subjected to fuel contamination, such as water.



When water is present in large amounts freezing could occur causing random misfires. Other contaminants such

as rust particles, sulfur or brine (salt) could restrict the injector orifice. **Figure 11**



The fuel injectors are a bottom feed design and the high impedance operating coils electrically match the resistance of most gasoline injector controllers at 12-14 Ω ohms. Flow calibrations are sized to meet the application. The spray pattern is commonly referred to as "pencil stream" and as liquid propane flows out of the injector orifice it immediately starts to vaporize.

Each injector is fitted with an electrical pigtail adaptor to accommodate the OEM electrical connectors.



WARNING

Do not remove an injector, injector rail fittings, or hoses unless the liquid supply/return valve have been closed and the fuel lines have been completely evacuated. The fuel pressure can push a valve or fitting out with enough force to cause death, injury or property damage.

LIQUID PROPANE INJECTION

CFUSA LPI® 6.0L DEDICATED LIQUID PROPANE INJECTION FUEL SYSTEM

Description and Operations

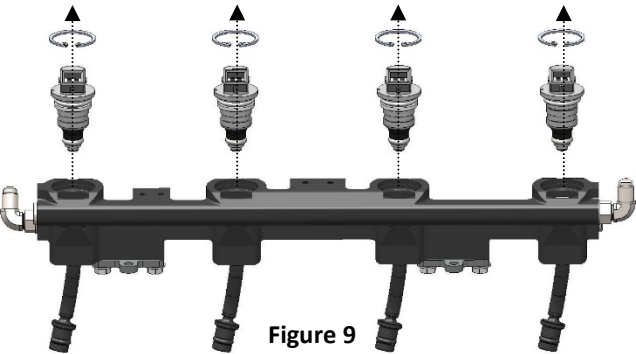


Figure 9

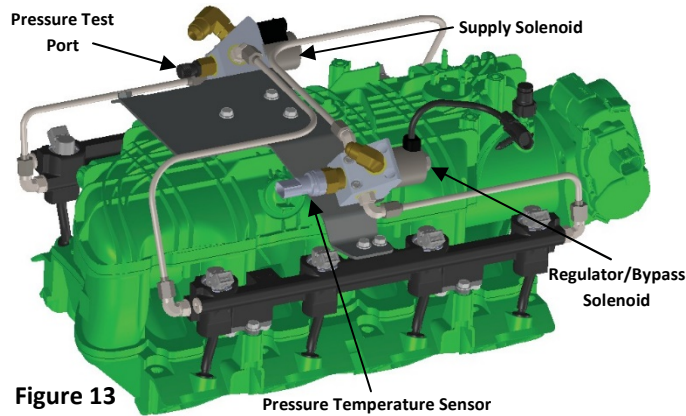


Figure 13

Pressure/Temperature Sensor (Figure 14)

The combination LPG pressure and temperature sensor is located on the back of the pressure regulator block. The LPG control module provides a reference voltage and ground to the sensor and receives the fuel pressure and temperature signals from the combination sensor. The values are used to calculate the amount of purge time required for start up.



Figure 14

Fuel Distribution Blocks (Figure 15)

The LPI® system fuel distribution / regulator blocks are located on top of the intake manifold. There is a supply block and regulated return block. The fuel passes into the supply block from the tank and is distributed equally to each rail, once the fuel exits the other side of both rails it is

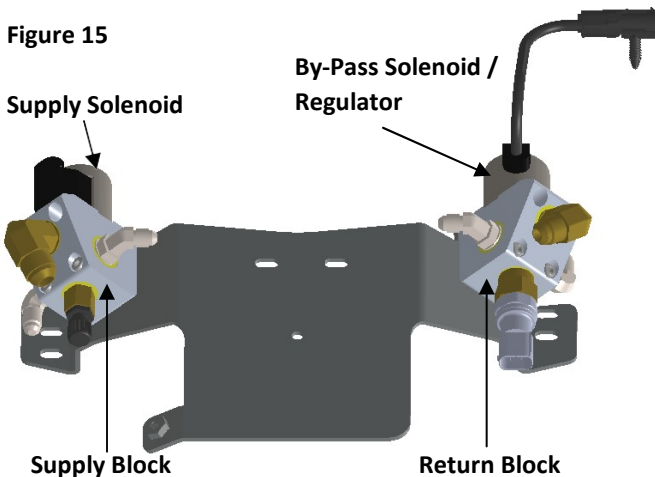


Figure 15

then returned through the return block where the fuel is regulated allowing the fuel rails to keep 50—60 PSI boost over tank pressure and the remaining fuel is then flows back to the tank.

Supply Solenoid

This normally closed valve opens when the Powertrain control module energizes the fuel pump relay. When energized, the supply solenoid allows fuel to pass through the fuel rails pushing against the fuel pressure regulator. Fuel flows directly into the return fuel line which is then

returned into the LPI® fuel tank.

By-pass Solenoid

This normally closed valve opens when the LPG control module energizes the LPG bypass relay. When energized, the fuel bypasses the fuel pressure regulator and flows directly into the return fuel line which is then returned into the LPI® fuel tank. This reduces the time required to purge all vapor from the system during start up.

Stainless Steel Fuel Line Routing

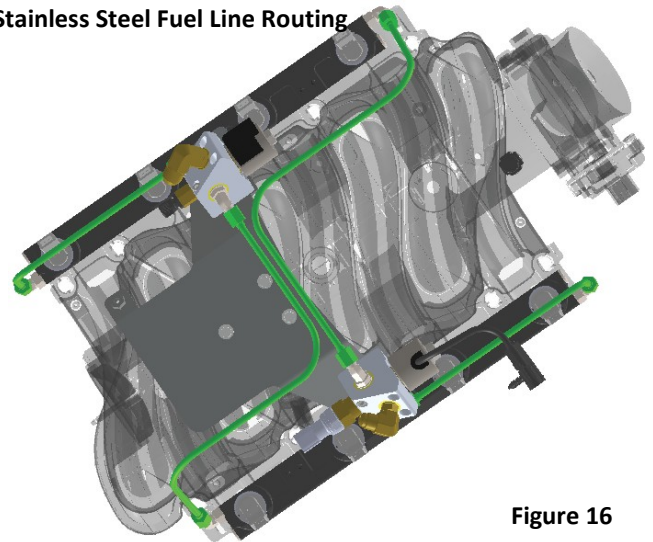


Figure 16

Stainless Steel Fuel Lines (Figure 16)

The fuel lines from the distribution block to the rails are made out of 1/4" OD 316 stainless steel. Each connection incorporates a double flare for added leak protection. The max rated working pressure is 4300 PSI which is well over the 350 Max PSI specification for running the LPI® System.

LPG Control Module (Figure 17)

Controls the *Intelligent purge* function which calculates the amount of time the wait to start indicator is illuminated and the amount of time the LPG bypass solenoid valve is energized. The LPG control module provides a 5V reference voltage and ground to the fuel Pressure/Temperature sensor. The return signals from the sensor are used to determine if the system needs to be primed and for how long. The

LPG control module monitors the signal and control circuits for proper operation. If a fault is detected the LPG control module will command the wait to start indicator to flash in 0.5 second increments for a total equal to the fault number. There will be a 3 second pause between

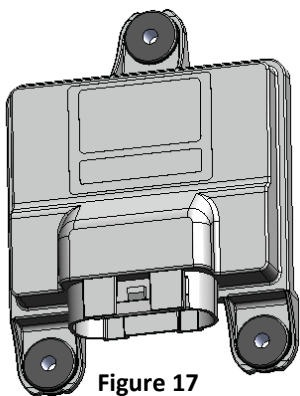


Figure 17

flashes or a 6 second pause if multiple faults are present.

NOTES:

LPI® Fuel System

Diagnosis by Symptom



LPI® Fuel System Diagnosis by Symptom

The LPI® system has the same diagnostic approach as a modern gasoline fuel Injection system, with the exception it utilizes liquid propane as the fuel. Because Liquid propane is a pressurized fuel, strict safety procedures must be followed and a clear understanding of the fuels properties and characteristics is mandatory before carrying out any service work on this advanced LPI® system.

First Approach to Diagnosing the LPI® Fuel System

1. Turn the ignition key on and verify the wait to start indicator functions correctly.
 - A. Illuminated for 3-11 seconds, when the light goes out start the engine.
2. Use a scan tool to verify any diagnostic trouble codes (DTC) and document. A DTC will point to the area of a problem however remember there are many things that can cause a DTC. Always refer to the original gasoline engine manufacturers diagnosis for a DTC.
3. If the problem is associated with engine performance, with the scanner connected.
 - 1) Connect fuel pressure gauge and verify fuel pressure is within specification
 - 2) Review the data display or operating data on the scan tool
 - A. Document the fuel trim data; short term/long term/ bank 1 & bank 2
 - 4) Review misfire data, if misfire is detected inspect spark plug wires and spark plug.

Note: It is highly recommended replacing the spark plugs with the original OEM recommended spark plugs.

Vehicle has No Power:

1. Verify there is sufficient fuel in the propane tank:
 - A. Check dash gauge then verify the dash gauge by checking the fuel level sending unit on tank. If the indicator arrow is visibly at empty put 5 to 10 gallons of fuel in the tank and verify power.
2. Verify that the manual valves on the tank are completely open; both supply and return manual valves must be open to their most outward stop, open counterclockwise until slightly snug.
3. If the inline fuel filter has not been changed within the recommended 30,000 mile/annual interval, change it. Refer to Changing Filters in this manual.
4. Connect TECH II and review trouble codes, does vehicle have any trouble codes? Refer to GM service procedures for trouble code identification, diagnosis & repair.
5. Review misfire counts with TECH II, if misfires are found inspect secondary ignition per the GM service procedure.
6. If any there are any trouble codes associated with "lean or rich" fuel control, review fuel trims.
7. If fuel trims are biased to one bank of the engine diagnose with GM service procedures. Perform cylinder power balance with TECH II; disable/enable one injector at a time to verify injector function. If any injector does not respond:
 - A. Inspect & repair electrical connection and re-try test.
 - B. Verify the injector electrical resistance is between 12-14 ohms. If open circuit injector is found replace injector. Follow **LPI® Fuel Injector Replacement** procedure under the **Repair and Replace** section.

LPI® Fuel System Diagnosis by Symptom CONTINUED...

7. If fuel trims are positive inspect for vacuum leaks. If vacuum leaks are found, repair leaks utilizing GM service procedures.
8. Perform LPI® fuel pump pressure test procedure under **LPI® Internal Tank Repair and Replace**.
 - A. It is recommended to always perform fuel pump pressure test procedure while reviewing trouble codes and data stream with a TECH II. If the fuel pump pressure is found to be below specified limits verify voltage and ground is correct or repair or replace fuel pump. See **LPI® Fuel Pump Removal and Installation** procedures under the **Repair and Replace** section.
9. Verify there are no restrictions of intake air or exhaust. Inspect air filter. Inspect exhaust back pressure per the GM service procedures.
10. Verify fuel pump control circuit and repair. Reference the GM fuel pump control circuit diagnosis procedures. If the fuel pump is running go to step 3.
3. Verify fuel pump pressure. Perform **Fuel System Pressure** test procedure, found on page 78. If the fuel pump boost pressure is not within the specification, continue to step 4.
4. If the inline fuel filter has not been changed at the recommended 30,000 mile/annual interval change it and recheck fuel pressure. If the fuel pump boost pressure is not within the specification, replace fuel pump. If this still does not fix the vehicle no start continue to step 5.
5. Check the injector control circuit as described in the GM service manual. Prove the injectors are getting a control signal from the PCM.
6. Check the secondary ignition as described in the GM service manual. Verify there is spark.
7. Verify by running an injector flow test with the TECH II that fuel is delivered to the intake port. It should be audible and the TECH II will only allow one cycle per injector.

Vehicle will Not Start:

1. Will engine crank? If no: check battery voltage and repair. If battery voltage is sufficient check starter circuit per GM service procedures. If yes go to step 2.
2. Engine cranks but will not start: Verify the fuel pump is running. Turn on ignition switch and fuel pump should run for 30 seconds; go to the tank and listen for the fuel pump. If ignition switch has been previously cycled the pump may not run until a full 30 seconds with key off. Leave ignition switch off for a full 30 seconds, turn ignition switch on and listen for the fuel pump. NOTE: *Starting procedure. The wait to start light will illuminate for seven (7) seconds when the key is switched to the on position, when the light goes out start the engine. If the ignition key is turned directly to the start position there is a 2 second starter engagement/crank delay if the key is held in the start position for 3 seconds the starter will engage. If the key is left in the on position for 2 seconds, before turning it to the start position, there is no crank delay.* If fuel pump is not running diagnose fuel

NOTE: Unless the fuel pump has no boost pressure the engine should start, however if the pressure is lower than the specification the engine may misfire and will get worse as the engine heats up due to heat absorption.

LPI® Fuel System Diagnosis by Symptom CONTINUED...**Engine Runs Poorly, Misfires, Backfires, or Surges:**

1. Connect a TECH II and check for trouble codes, check datastream for any inconsistencies including fuel trims. check misfire counts to verify which cylinders may have misfire.
2. Check the secondary ignition as described in the GM service manual. Look for carbon tracking and if found, replace spark plugs and at least the spark plug wire where carbon tracking was found. Use GM recommended spark plug wires and spark plugs.
3. If the inline fuel filter has not been changed at the recommended 30,000 mile/annual interval change it and verify fuel pressure is within specification.
4. Perform a cylinder balance test with the TECH II to verify each injector affects the engine equally.
5. Check for vacuum leaks or restrictions in the intake air duct work, air filter, and the exhaust. Follow GM diagnosis recommendations for exhaust back pressure test.

Vehicle has Poor Fuel Economy:

1. Connect the TECH II and review trouble codes.
2. Inspect the air filter and replace as needed
 - A. As the air filter gets dirty the engine gets less air. If fuel trims are documented before the air filter is changed the fuel trims should improve with a new filter and fuel trims would move to a more positive percentage number.
3. Oxygen sensors are critical to fuel economy and if sensor activity is biased to a lower voltage the sensor could be getting weak. A low voltage signal from an oxygen sensor will cause the PCM to add fuel and this could cause poor fuel economy.
4. Since fuel economy depends largely on the type of

service the vehicle is in; longer idle times, low speeds with stop and go, heavy accelerations/heavy loads, etc.; a clear understanding of how the customer is using the vehicle will help in determining causes of poor fuel economy. Differences between cruising the highway to city traffic can differ greatly.

5. Other sensors need to be evaluated carefully as well. Although a diagnostic trouble code may not be found, an inaccurate MAP sensor or MAF sensor could greatly reduce fuel economy. Refer to the GM service manual to understand how to verify accuracy of the electronic engine control and various sensors.

Cannot Fill the Propane Tank:

1. Verify the fuel tank is not full of fuel. If the fuel gauge sending unit is inoperative it could show an inaccurate empty condition and the tank could be full. With the vehicle on level ground remove the cap from the fixed liquid level gauge and open the valve to verify if liquid escapes. This valve is used annually to verify the OPD (Overfill Prevention Device) is working properly. See valve description under **System Description**.
2. Verify the propane fill station has sufficient pump differential pressure to overcome the pressure a propane autogas tank can experience from chassis heat/road heat. If the station pump will not provide 115-145 PSI differential pressure, chances are it is not designed for propane autogas vehicles. Recommend the customer to use a qualified propane vehicle fueling station.

**WARNING**

Liquid propane can cause serious burns if it comes in contact with your skin. Always wear gloves and eye protection when opening the fixed liquid level gauge (Bleeder) or anytime a line is serviced, filter is serviced or the fuel system depressurized for service. This type of burn is similar to frostbite and can be severe. The escaping fuel is flammable and could cause property damage, personal injury or death.

LPI® Fuel System Diagnosis by Symptom CONTINUED...

4. Remove and inspect the inline fill filter. Follow the procedures on page 64. The fill filter should be changed every 30,000 miles or every two years; whichever ever comes first.
5. In the event none of the above resolves the no fill evacuate the fuel and pressure from the tank and replace the mechanical float actuated stop fill valve (OPD). **See procedure for evacuating a propane tank in the LPI® Fuel Handling Section on page 75 and the procedure to replace the OPD valve on page 57.**
- D. Draining fuel from the tank or filling the tank to prove the float is working may be required. **Refer to the LPI® Fuel Handling section on page 75 for evacuating propane from the fuel tank.**
- E. If it is determined that the internal float assembly is not working, stuck or not floating; the tank must be evacuated to replace the float assembly. Refer to the **procedure for evacuating a propane tank in the LPI® Fuel Handling Section on page 75 and the Fuel Gauge Replacement section on page 60.**

Dashboard Fuel Gauge not working:

1. Connect the TECH II to verify a fuel gauge code is present or not. If there is a code for fuel gauge verify if it is a high voltage due to an open circuit or low voltage due to short to ground.
2. Verify the two wire connector is connected to the fuel gauge sending unit. Inspect the wiring going into each side of the connector.
3. Remove the fuel level gauge sending unit on the tank. Two small Phillips head screws. **DO NOT REMOVE THE 4 ALLEN HEAD BOLTS THAT MOUNTS THE GAUGE FLOAT ASSEMBLY TO THE TANK. See page 33 for Fuel Sender Diagnostics.** Follow the steps provided in the Fuel Sender Diagnostics before proceeding to step 4.

NOTE: It may or may not require removing the skid plate from the propane tank.

4. Verify the internal float is working
 - A. Set the sending unit indicator as described earlier to 1/2 tank.
 - B. Place the sending unit on the float gauge head/housing. The indicator needle should move to the level the float is inside the tank.
 - C. The float could be stuck or could be sitting on the bottom of the tank if it always shows empty (if the tank is not empty).

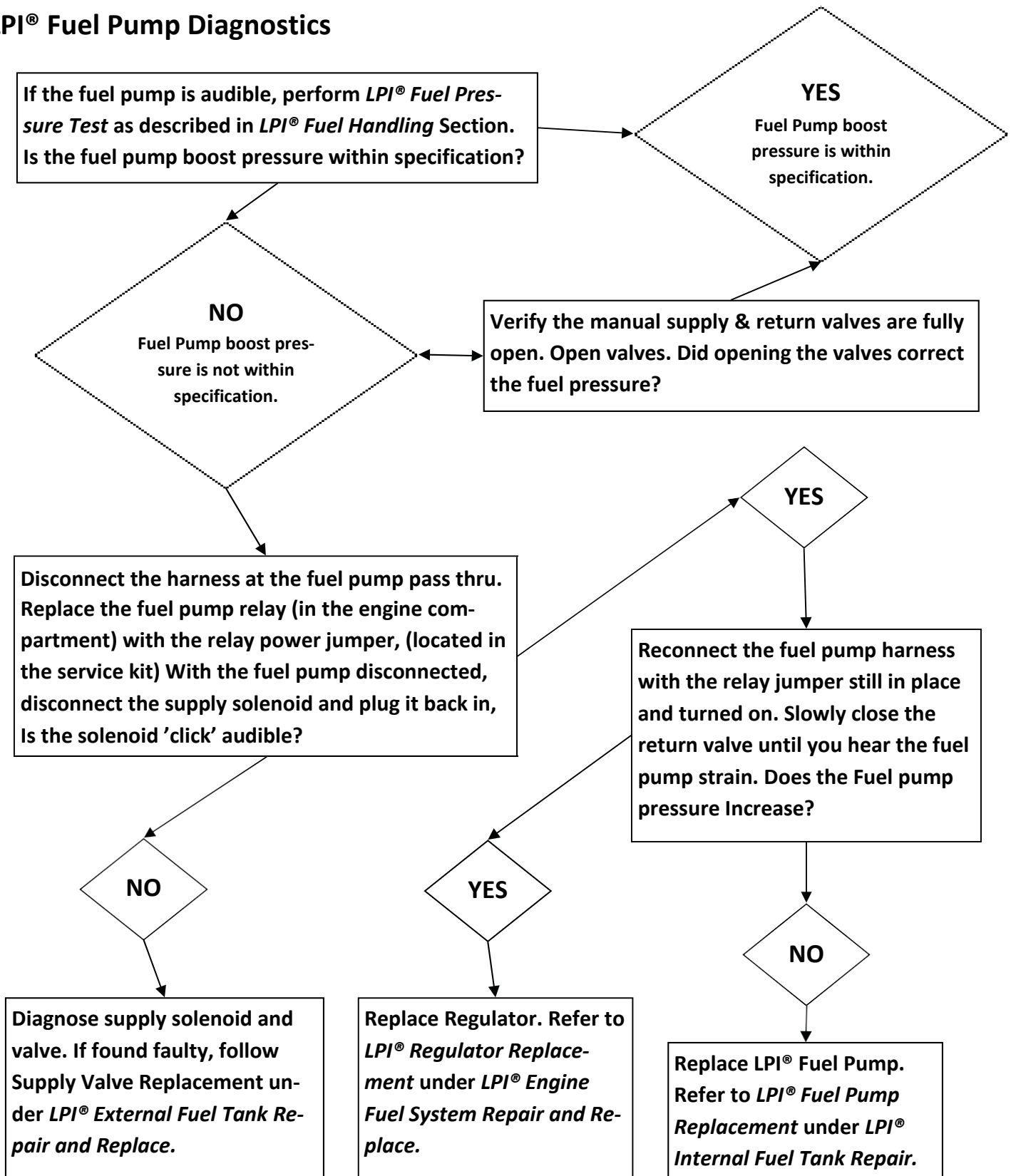
LPI® Fuel System Diagnosis by Symptom CONTINUED...**Tank making Noise, High Pitched Whistling Noise or Grinding Sound:**

Sometimes the flow of fuel back into the tank may make some noise. Besides the noise of the pump running, an audible noise of fuel equalizing after the engine has been turned off is normal. While the engine is running the noise of fuel flow above the sound of the pump running should not be excessive to the point of annoying. If the fuel level in the tank is very low, filling the tank with fuel may stop the noise in most cases. If the noise is annoying, continues regardless of fuel level the fuel regulator in the return passage may be malfunctioning, the pump is not boosting fuel pressure to specification, an excess flow or back check is rattling:

1. Perform a fuel pressure test to evaluate the pump performance. **Refer to page 78 for the *Fuel System Pressure Test Procedure*.**
2. If the pump is not within specification, verify voltage and ground are correct: 12 volts key on engine off or over 13 volts with engine running (charging voltage).
3. If the circuit is good and the pump is not within specification, replace fuel pump. **See *LPI® Fuel Pump Removal and Installation under the LPI® Internal Fuel Tank Repair and Replace Section on Page 45*.**
4. If the pump pressure is within specification close the manual return valve on the tank. Does this have any affect on the noise? Close the fuel supply manual valve a little to see if that affects the noise. If either reduces the noise the return valve components may need to be changed. The only components in the return circuit that could be rattling/whistling are the fuel pressure regulator or the back check.
5. If fuel pump is within specification contact the CFUSA technical call center for recommendations. Excessive noise is not normal however we know it is a possibility and we need more information.

Note: Remember to fully open both manual supply and return valves after testing.

LPI® Fuel Pump Diagnostics



Fuel Sender Diagnostics

Circuit/System Description

The fuel level sensor changes resistance in response to the fuel level. The engine control module (ECM) monitors the signal circuit of the fuel level sensor to determine the fuel level.

When the fuel tank is full, the sensor resistance is low and the ECM senses a low signal voltage. When the fuel tank is empty, the sensor resistance is high and the ECM senses a high signal voltage. The ECM uses the signal circuit of the fuel level sensor in order to calculate the percentage of remaining fuel in the tank. The ECM sends the fuel level percentage via the serial data circuit to the instrument cluster in order to control the fuel gauge

Circuit/System Verification

Ignition ON, verify the scan tool Fuel Tank Level Remaining parameter is between 4–98 percent.

Circuit/System Testing

Ignition OFF, disconnect the harness connector at the fuel level sensor.

Ignition ON, verify that the scan tool Fuel Tank Level Remaining parameter display is less than 4 percent.

If greater than the specified range, test the signal circuit terminal for a short to ground. If the circuit tests normal, a problem may exist in the ECM.

If all circuits test normal, test the fuel level sensor.

Component Testing

Follow the “Fuel Sender Replacement” procedure.

Utilizing a small screw driver on the back side of the fuel sender, (Figure 1) stick the screw driver to the magnets. Pivot the screw driver as shown. This will allow you to sweep the sender through all the OHM ranges.

Sweep the fuel level sensor slowly through its full range of motion while measuring resistance between the two sender terminals.

Test for a minimum resistance value of 37-43 Ω and a maximum value of 245-255 Ω without any spikes or dropouts.

- If minimum resistance is not 37-43 Ω , maximum resistance is not 245-255 Ω , or if there are any spikes or dropouts **Replace the fuel level sender.**

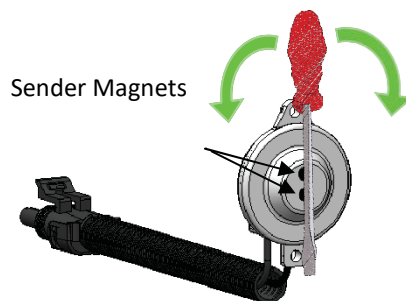


Figure 1

NOTES:

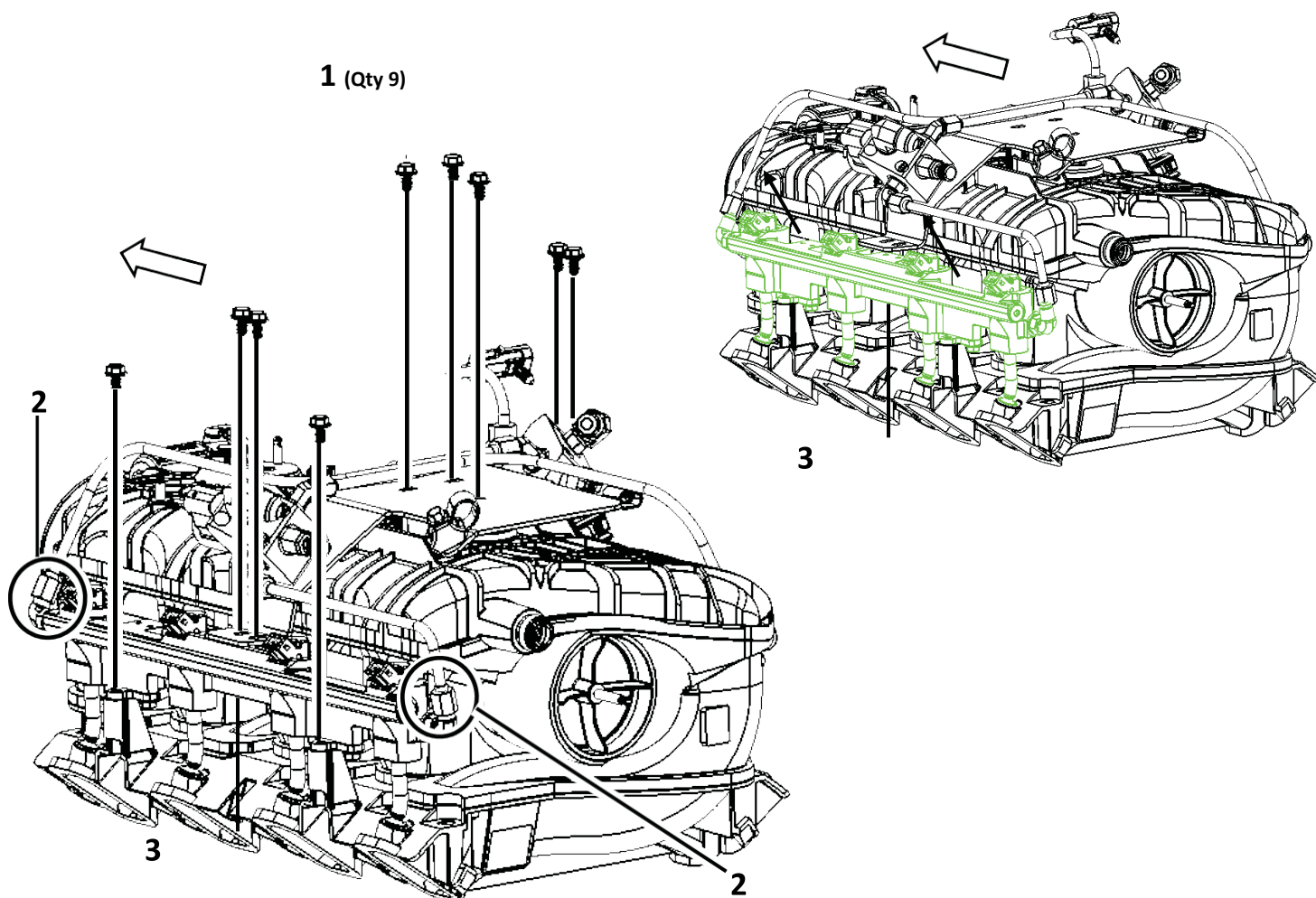
Engine Fuel System

Repair and Replace

Universal for Freightliner MT 45/55 and P63 Chassis



Fuel Rail Assembly Replacement (Drivers Side)



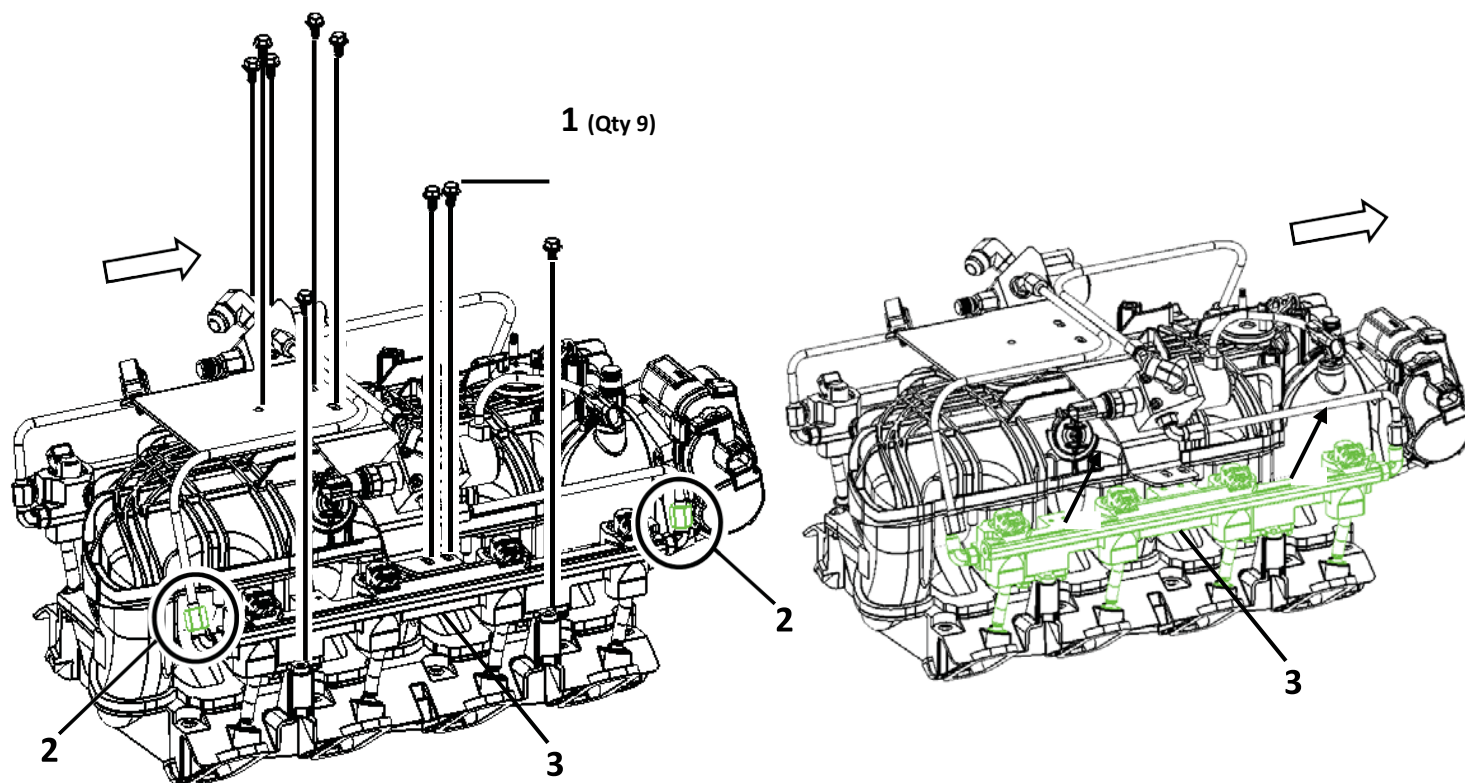
Preliminary Procedure

1. Drain the fuel lines. Refer to [LPG Fuel Line Draining](#).
2. Remove the engine cover.
3. Disconnect the electrical connectors.
4. Disconnect the stainless steel fuel lines.
5. Remove fuel rail.

COMPONENTS

- 1) LPI® Engine fuel system Bolts (Qty: 9)
Caution: Refer to [Fastener Caution](#) on page 4. **Torque:** 10.8 N·m (8 lb ft)
- 2) Stainless Steel Fuel lines
Caution: Refer to [Fastener Caution](#) on page 4. **Torque:** 16 N·m (12 lb ft)
- 3) Fuel Rail

Fuel Rail Assembly Replacement (Passenger Side)



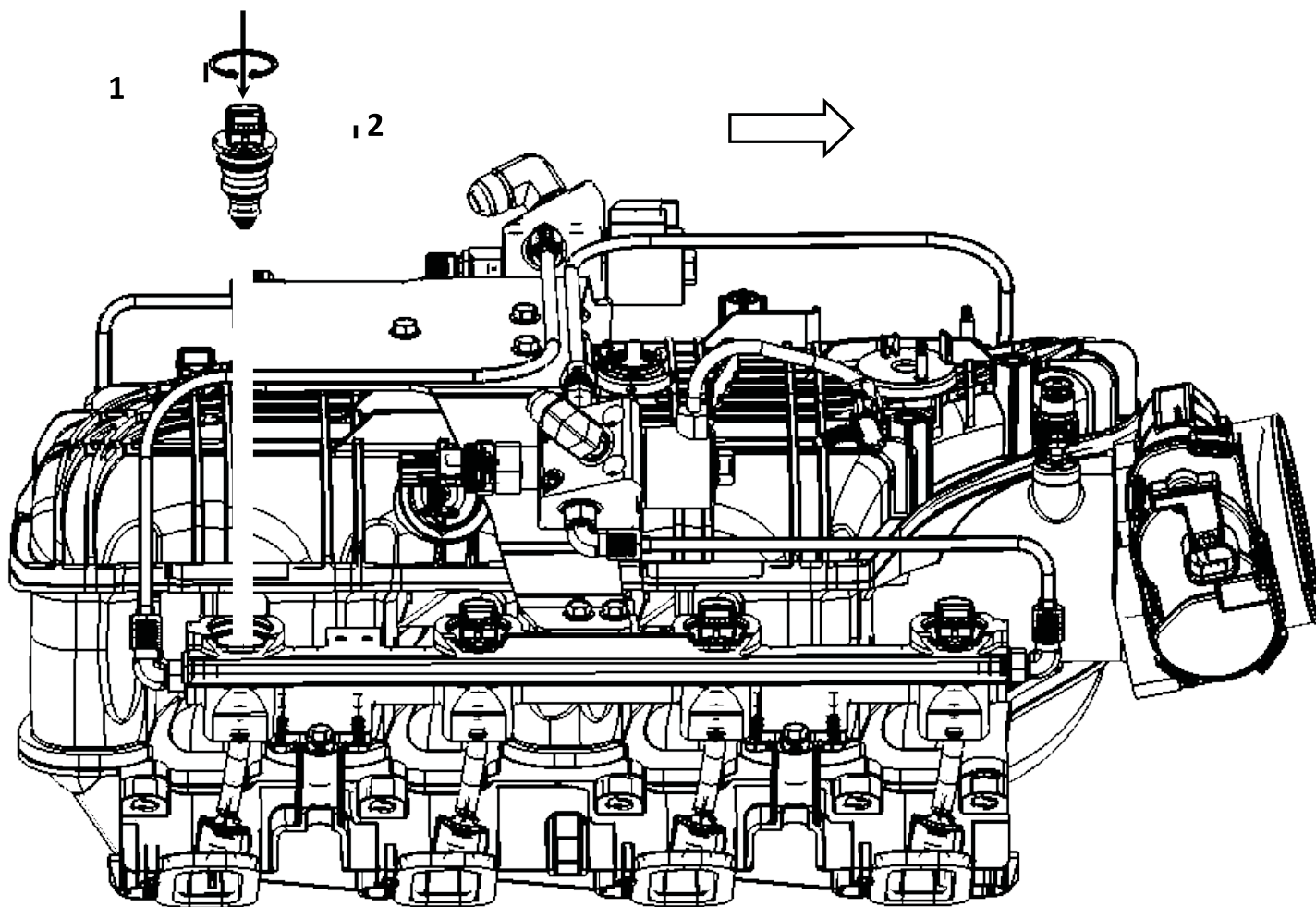
Preliminary Procedure

1. Drain the fuel lines. Refer to [LPG Fuel Line Draining](#).
2. Remove the engine cover.
3. Disconnect the electrical connectors.
4. Disconnect the stainless steel fuel lines.
5. Remove fuel rail.

COMPONENTS

- 1) LPI® Engine fuel system Bolts (Qty: 9)
Caution: Refer to [Fastener Caution](#) on page 4. **Torque:** 10.8 N·m (8 lb ft)
- 2) Stainless Steel Fuel lines
Caution: Refer to [Fastener Caution](#) on page 4. — (Lubricant or Anti-Seize Required) **Torque:** 16 N·m (12 lb ft)
- 3) Fuel Rail

LPI® Fuel Injector Replacement



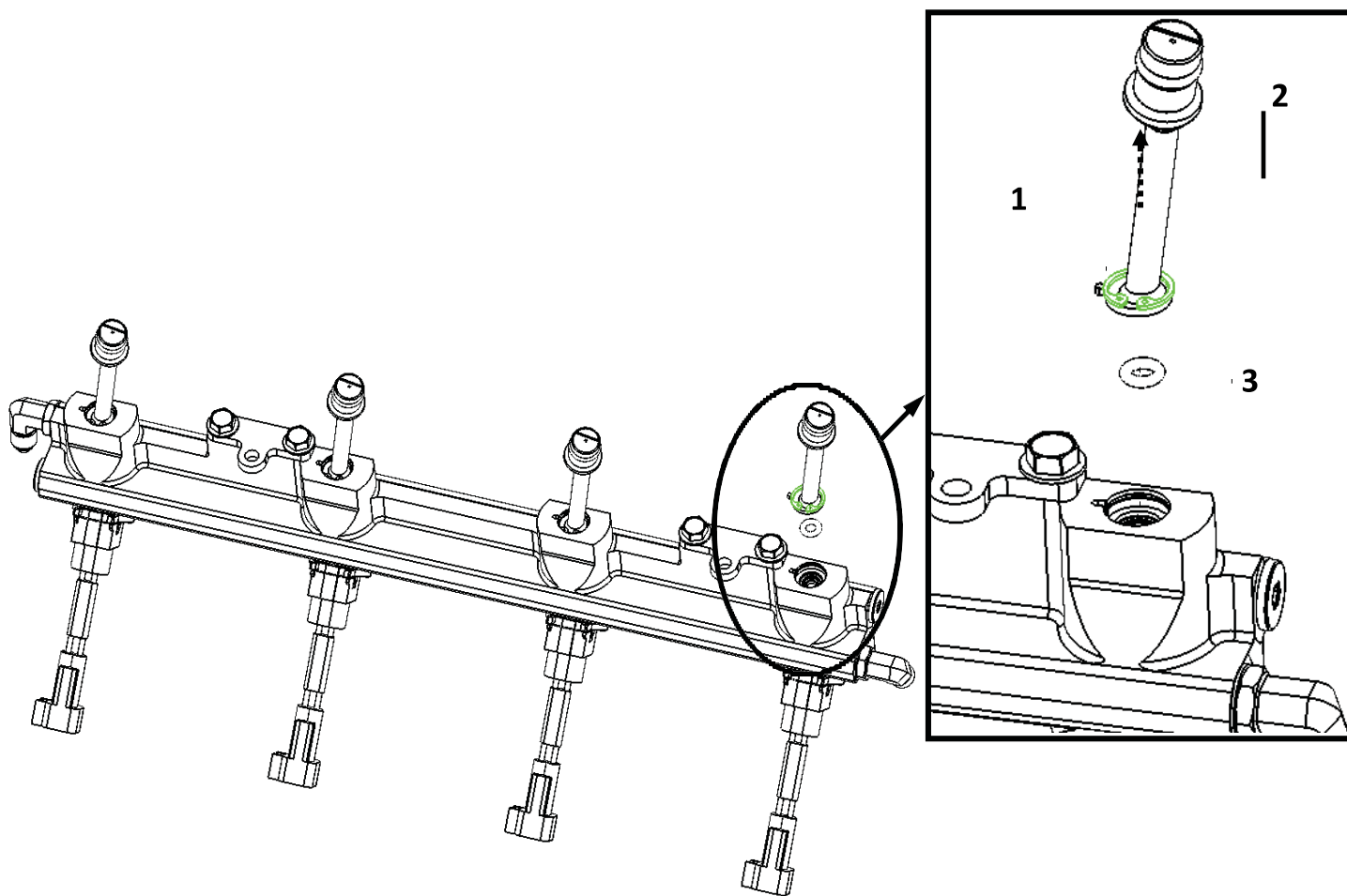
Preliminary Procedure

1. Drain the fuel lines. Refer to [LPG Fuel Line Draining](#).
2. Remove the engine cover.
3. Disconnect the electrical connector.

COMPONENTS

- 1) Fuel Injector Retaining Clip (Qty: 1)
Caution: Ensure clip is fully seated and fully engaged.
- 2) Fuel injector
Caution: Lubricate o-rings using clean 5w30 or similar weight motor oil.

LPI® Fuel Injector Nozzle Replacement



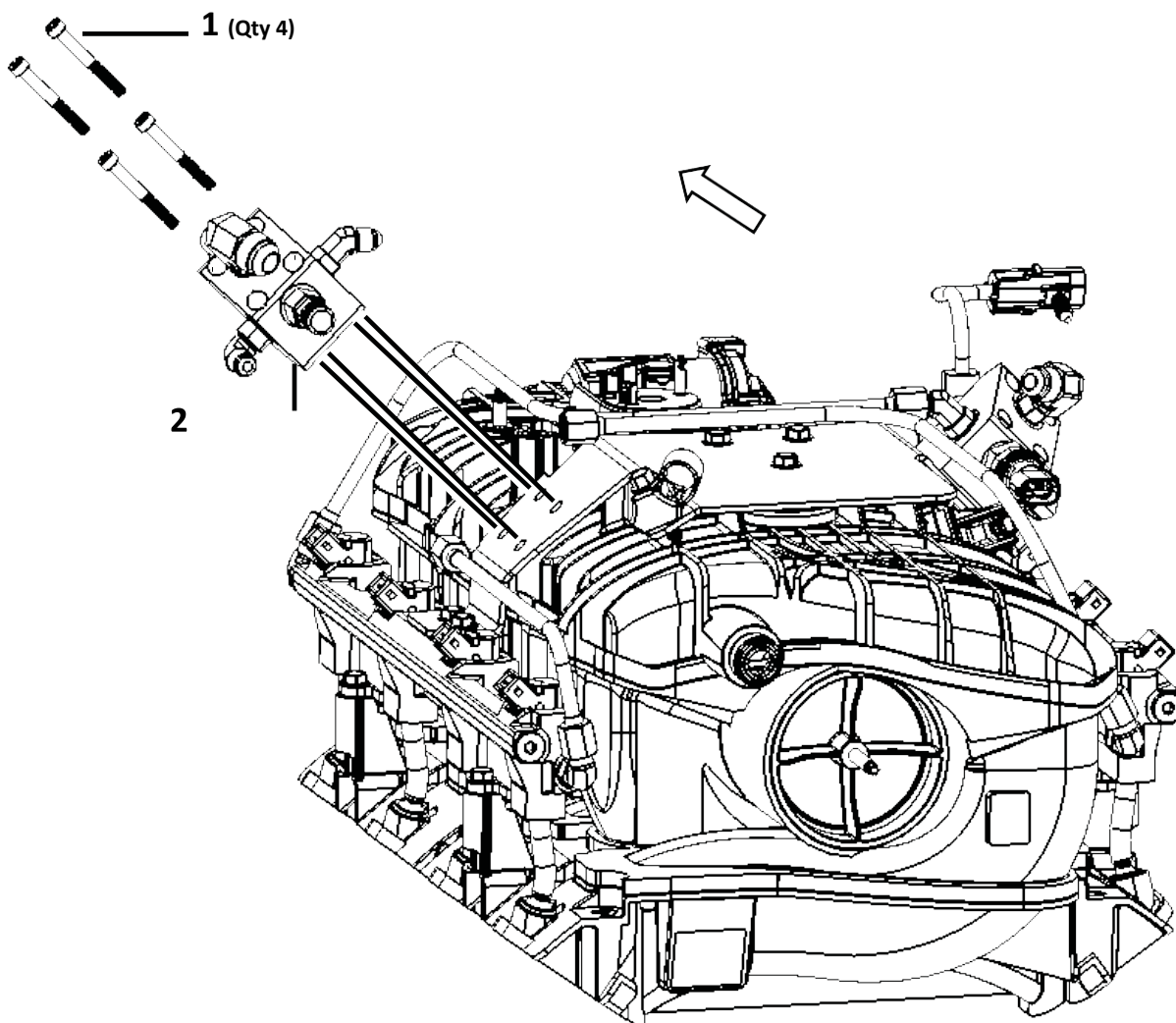
Preliminary Procedure

1. Drain the fuel lines. Refer to [LPG Fuel Line Draining](#).
2. Remove the engine cover.
3. Disconnect the electrical connectors
4. Remove Fuel Rail Assembly. [Refer to Fuel Rail Assembly Removal](#).

COMPONENTS

- 1) Fuel Injector Nozzle Retaining Clip (Qty: 1)
Caution: Ensure clip is fully seated and fully engaged.
- 2) Fuel Injector Nozzle (Qty: 1)
- 3) Fuel Injector Nozzle O-Ring (Qty: 1)
Caution: Lubricate o-rings using clean 5w30 or similar weight motor oil.

Supply Distribution Block Replacement



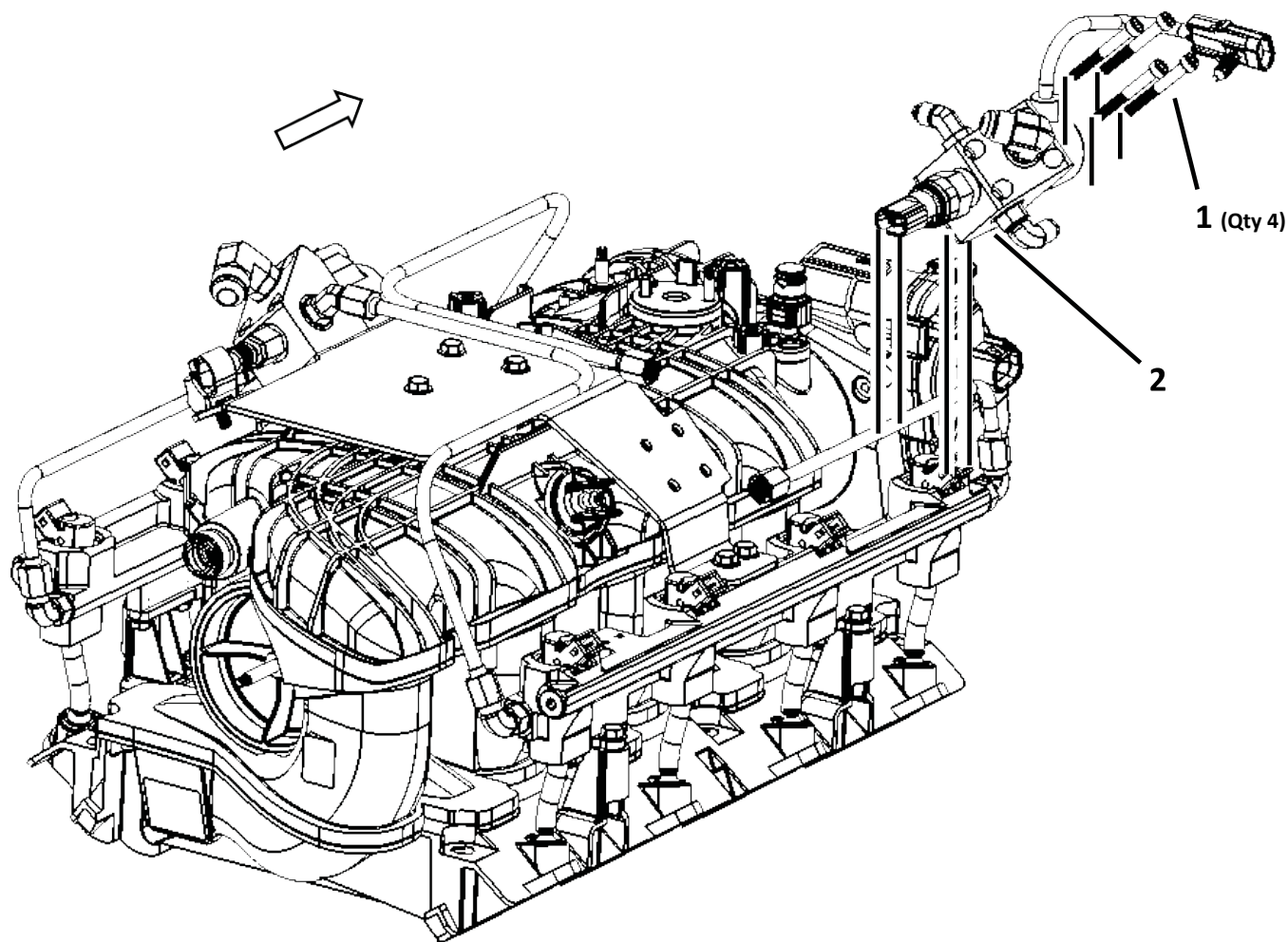
Preliminary Procedure

1. Drain the fuel lines. Refer to [LPG Fuel Line Draining](#).
2. Remove the engine cover.
3. Disconnect the electrical connectors.
4. Remove the fuel lines.

COMPONENTS

- 1) Supply Regulator Distribution Block bolts (Qty: 4)
Caution: Refer to [Fastener Caution](#) on page 4. **Torque:** 6.7 N·m (59 lb in)
- 2) Supply Distribution Block Assembly

Return Regulator Distribution Block Replacement



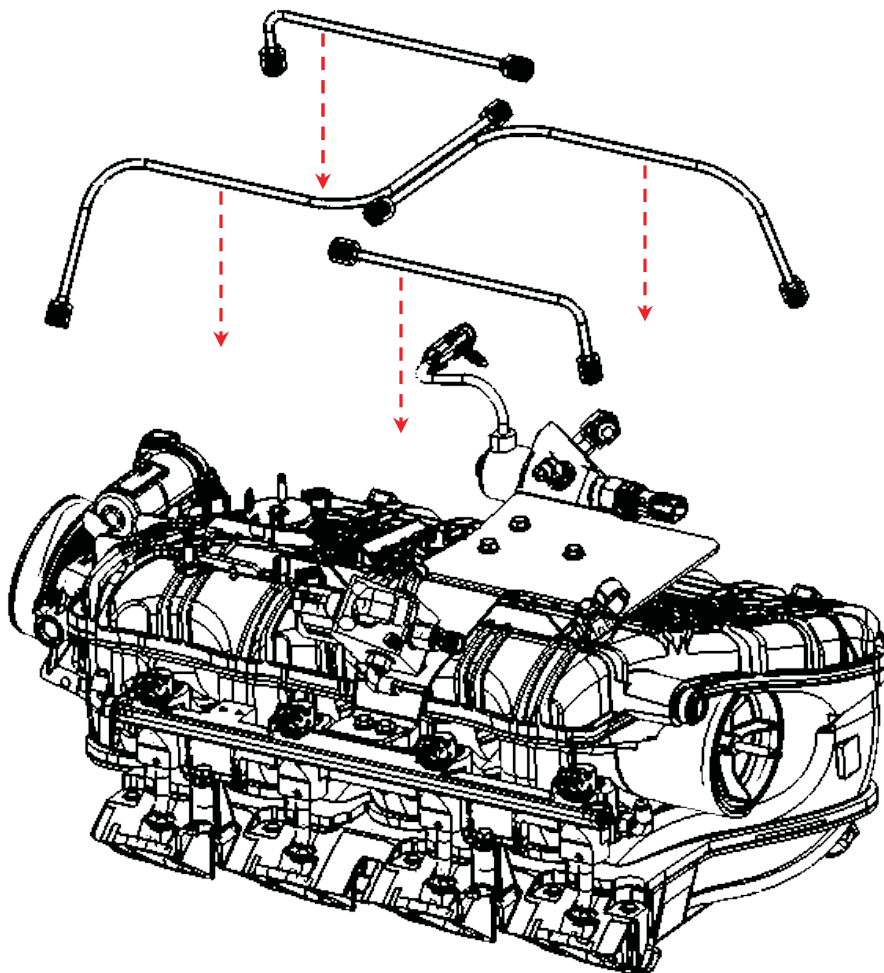
Preliminary Procedure

1. Drain the fuel lines. Refer to [LPG Fuel Line Draining](#).
2. Remove the engine cover.
3. Disconnect the electrical connectors.
4. Remove the fuel lines.

COMPONENTS

- 1) Return Regulator Distribution Block bolts (Qty: 4)
Caution: Refer to [Fastener Caution](#) on page 4. **Torque:** 6.7 N·m (59 lb in)
- 2) Return Regulator Distribution Block Assembly

LPG Stainless Steel Fuel Lines Replacement



Preliminary Procedure

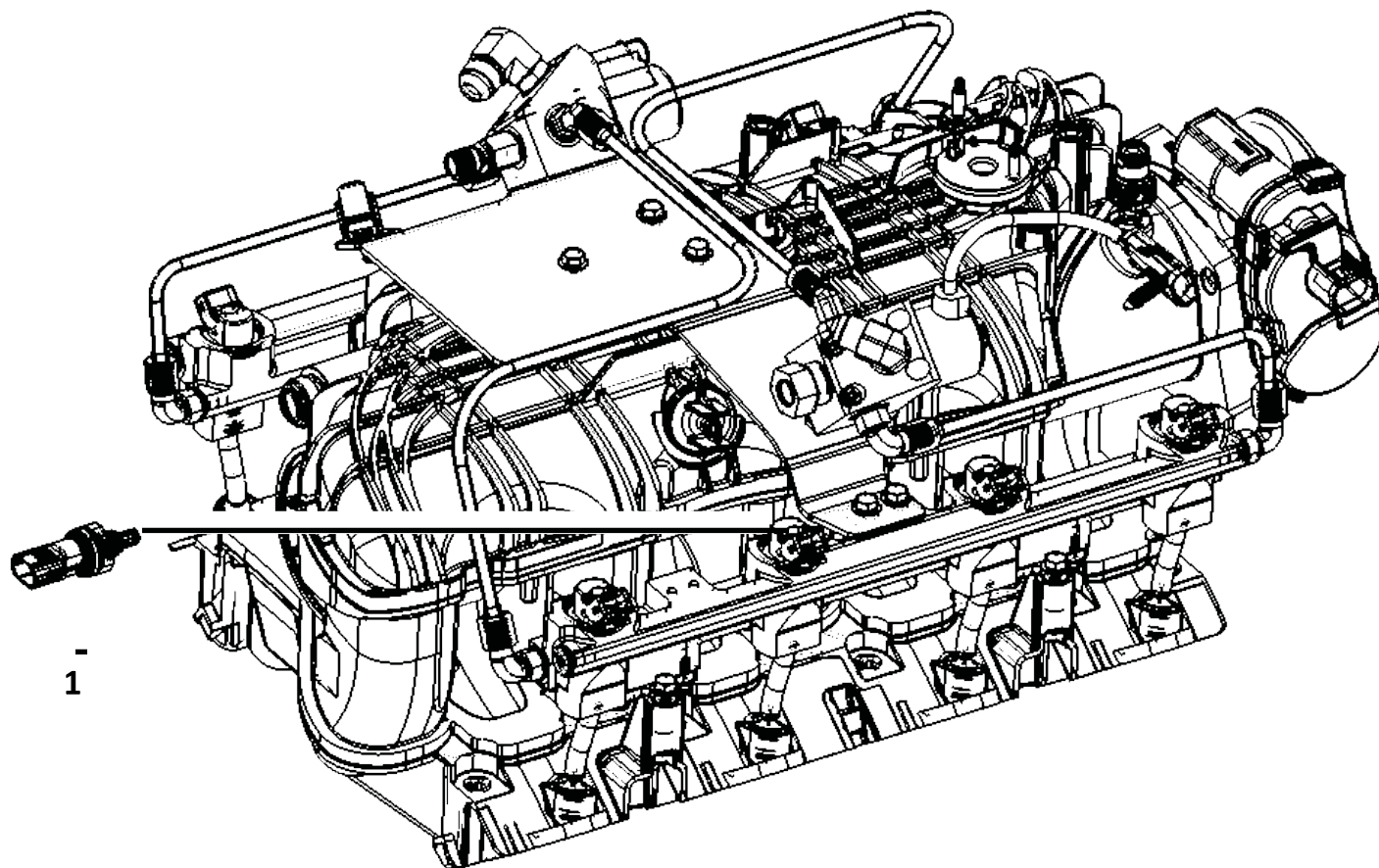
1. Drain the fuel lines. Refer to [LPG Fuel Line Draining](#).
2. Remove the engine cover.
3. Disconnect the electrical connector.

COMPONENTS

- 1) LPG Stainless Steel Fuel Lines (Qty 4)

Caution: Refer to [Fastener Caution](#) on page 4. **Torque:** 14.7 N·m (11 lb ft)

Fuel Pressure and Temperature Sensor Replacement



Preliminary Procedure

1. Drain the fuel lines. Refer to [LPG Fuel Line Draining](#).
2. Remove the engine cover.

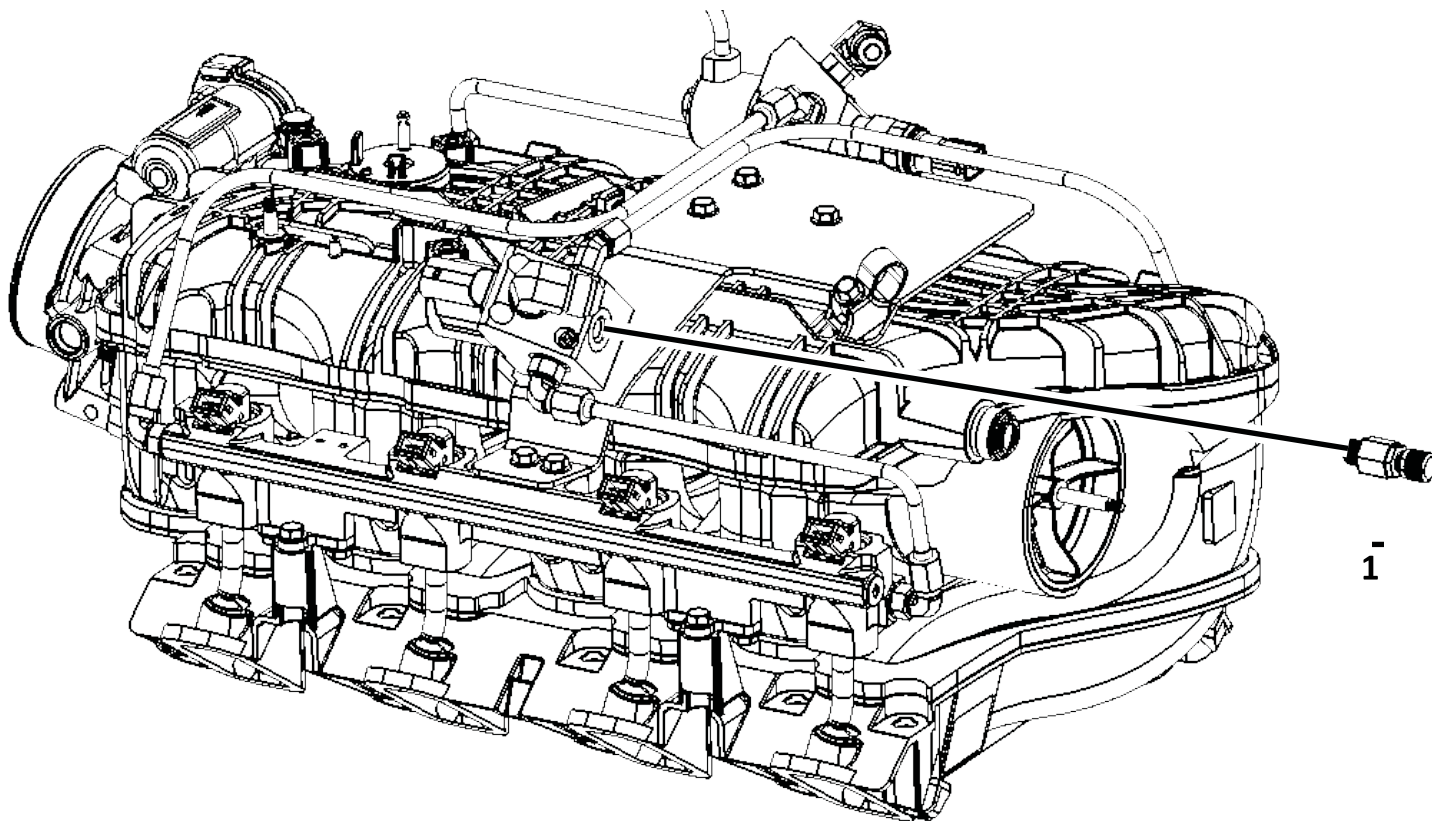
COMPONENTS

- 1) LPG Fuel Pressure and Temperature Sensor

Caution: Refer to **Fastener Caution** on page 4. **Torque:** 8.8 N·m (6.5 lb ft)

Caution: Lubricate o-rings using clean 5w30 or similar weight motor oil.

Fuel Pressure Test Port Replacement



Preliminary Procedure

1. Drain the fuel lines. Refer to [LPG Fuel Line Draining](#).
2. Remove the engine cover.

COMPONENTS

- 1) LPG Fuel Pressure Test Port and Adaptor

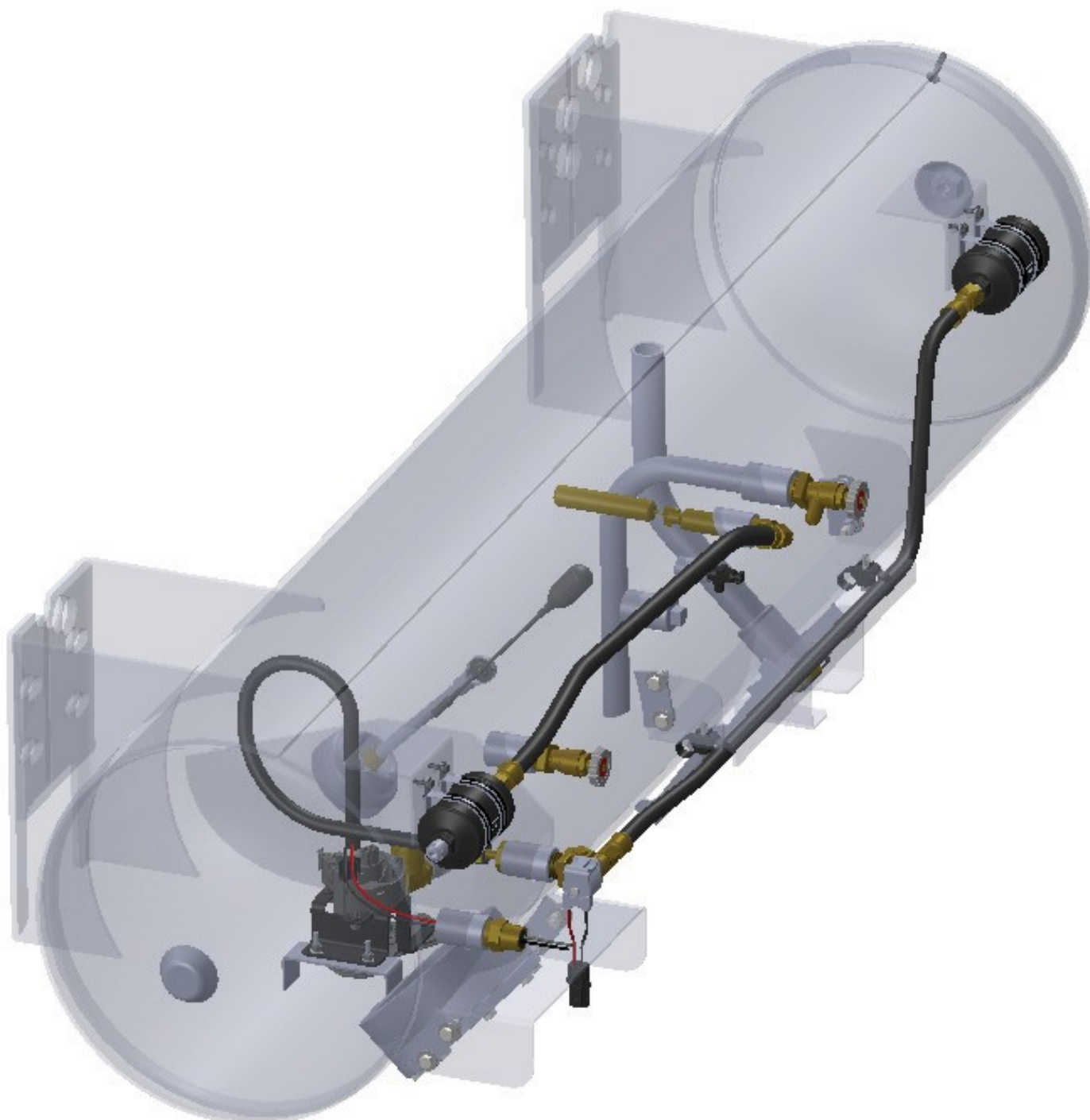
Caution: Refer to **Fastener Caution** on page 4. **Torque:** 10 N·m (7.4 lb ft)

Caution: Lubricate o-rings using clean 5w30 or similar weight motor oil.

NOTES:

LPI® Internal Fuel Tank

Repair and Replace



LPI® Fuel Pump Removal MT45/55 Chassis

Removal Procedure

1. Drain the fuel lines. Refer to [LPG Fuel Line Draining](#).
2. Drain the fuel tank. Refer to [LPG Tank Drain and Evacuation](#).

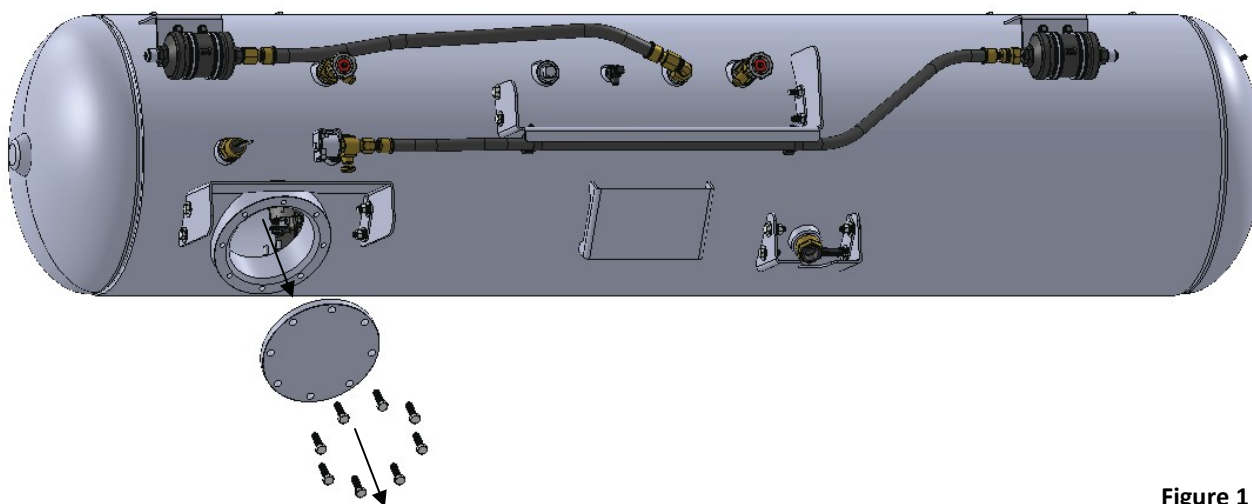


Figure 1

3. Remove LPI® access cover and bolts (QTY:8) (Figure 1) **Note: Be sure to remove and discard o-ring from access cover this will be replaced in the installation process.**

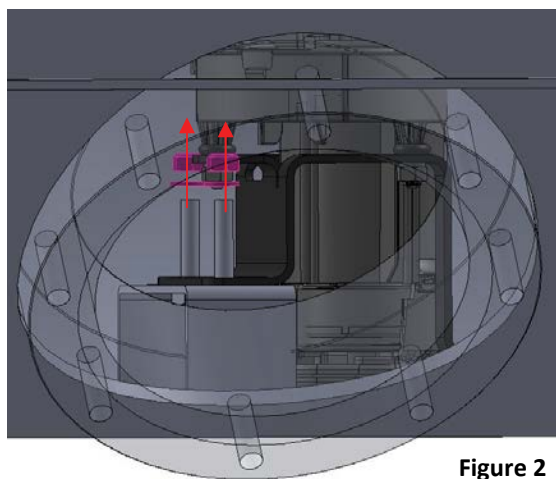


Figure 2

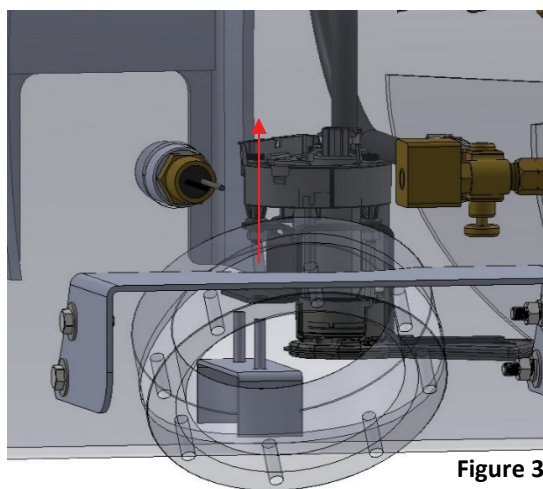


Figure 3

4. Remove fuel pump retaining nuts (Qty: 2) and washers (Qty: 2) (Figure 2)
5. Remove fuel pump by lifting straight up. (Figure 3)

LPI® Fuel Pump Removal MT45/55 Chassis—CONTINUED...

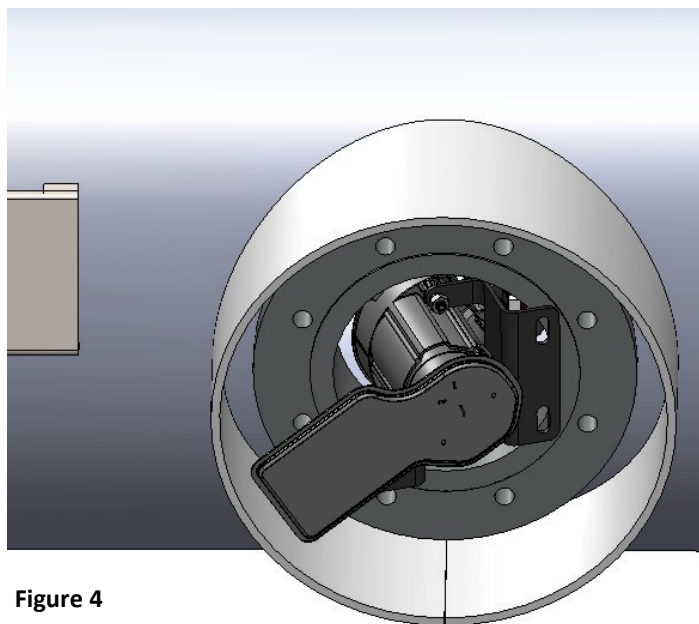


Figure 4

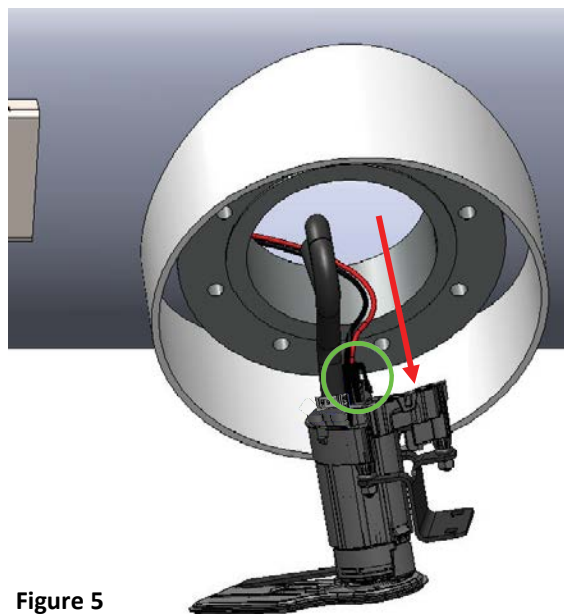


Figure 5

6. Remove fuel pump from LPI® Fuel Tank. **Note: Holding the bottom of the fuel pump, guide the filter sock through the opening first. Then pull the pump straight out. Caution: Do not use excess force removing the fuel pump.** (Figure 4 & 5)
Disconnect electrical connect from top of fuel pump. Spread tabs on connector and lift straight up. (Figure 5: Circled in Green)

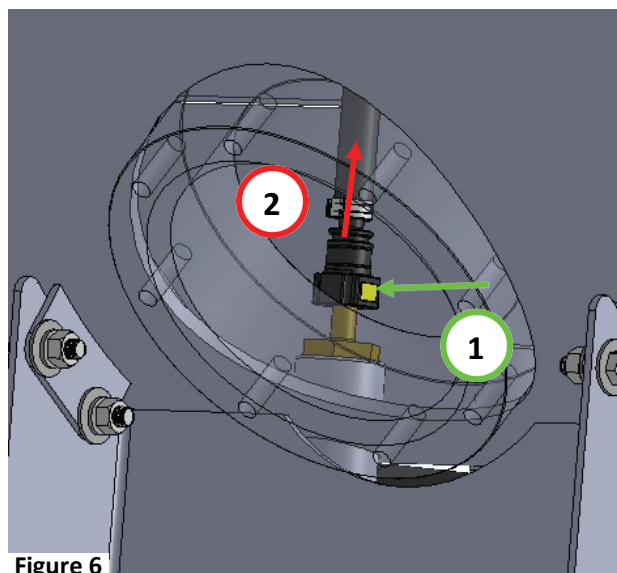


Figure 6

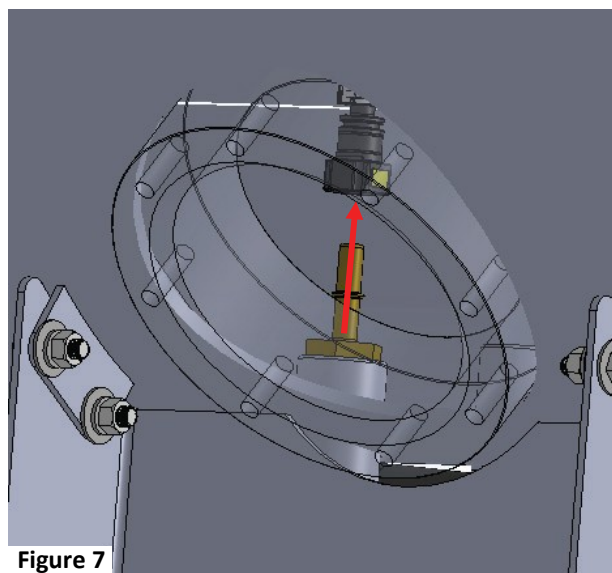
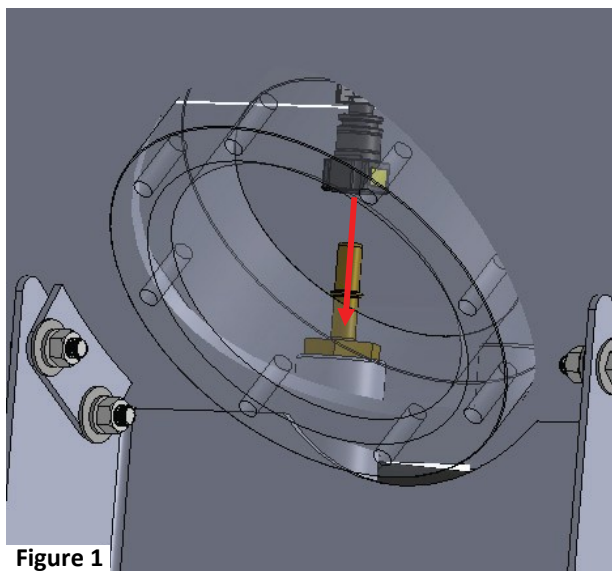


Figure 7

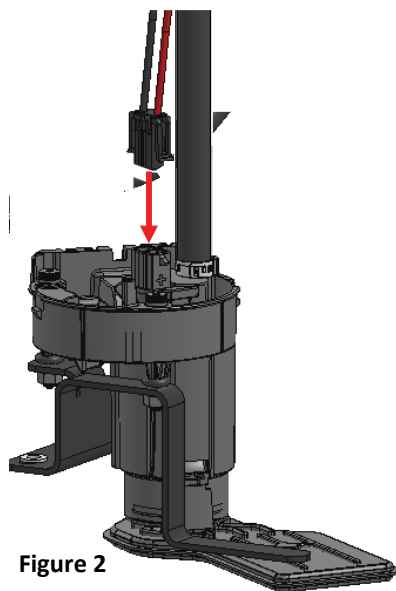
7. To remove the quick disconnect fitting from the fuel pump supply bushing. Press in the tab on the side of the quick disconnect **(1)** While pushing the tab in pull the assembly in the opposite direction from the quick connect bead fitting **(2)**. (Figure 6 & 7)

LPI® Fuel Pump Installation MT45/55 Chassis

Installation Procedure



1. Install new fuel pump hose quick connect onto the quick connect bead fitting inside the LPI® fuel tank. (Figure 1)



2. Connect the electrical connector to the new fuel pump. (Figure 2)

LPI® Fuel Pump Installation MT45/55 Chassis—CONTINUED...

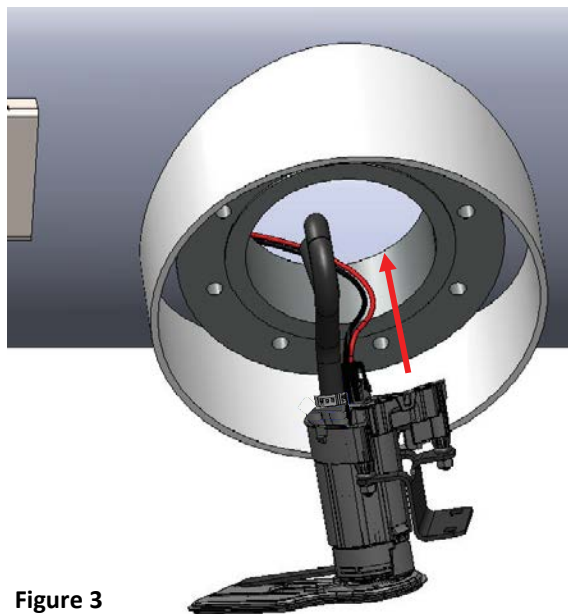


Figure 3

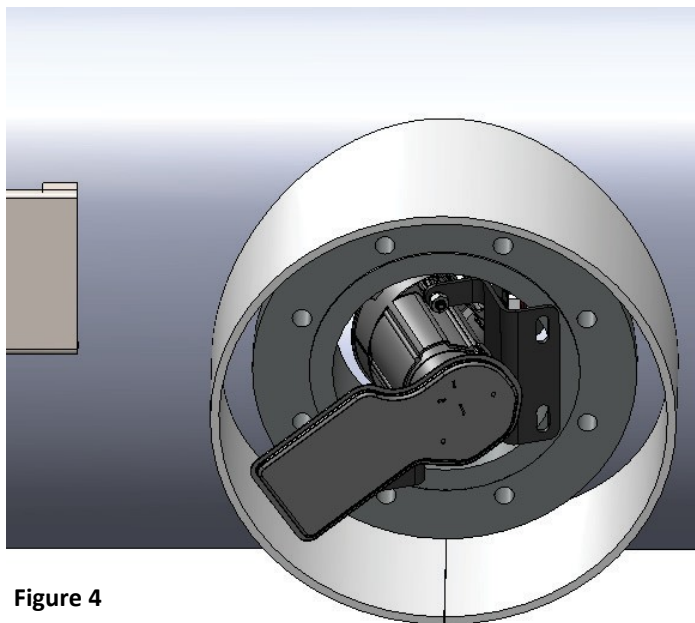


Figure 4

3. Install the fuel pump into the LPI® fuel tank. Start by inserting the fuel pump into the tank, once the flange hits the filter sock turn the fuel pump to the left slightly to allow the pump sock to be installed into the tank. (Figure 3 & 4)

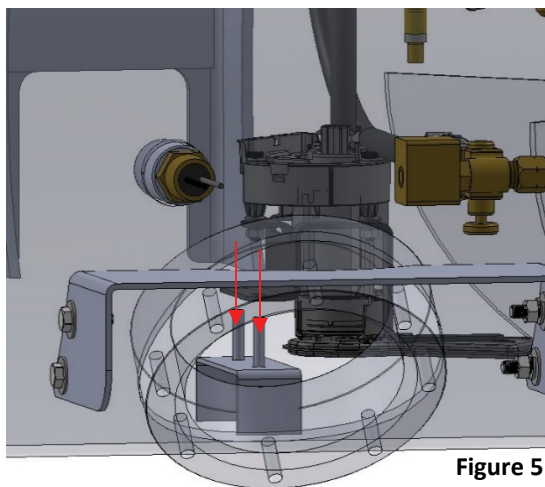


Figure 5

4. Install the fuel pump onto the fuel pump hold down bracket studs in the LPI® fuel tank. (Figure 5)

LPI® Fuel Pump Installation MT45/55 Chassis—CONTINUED...

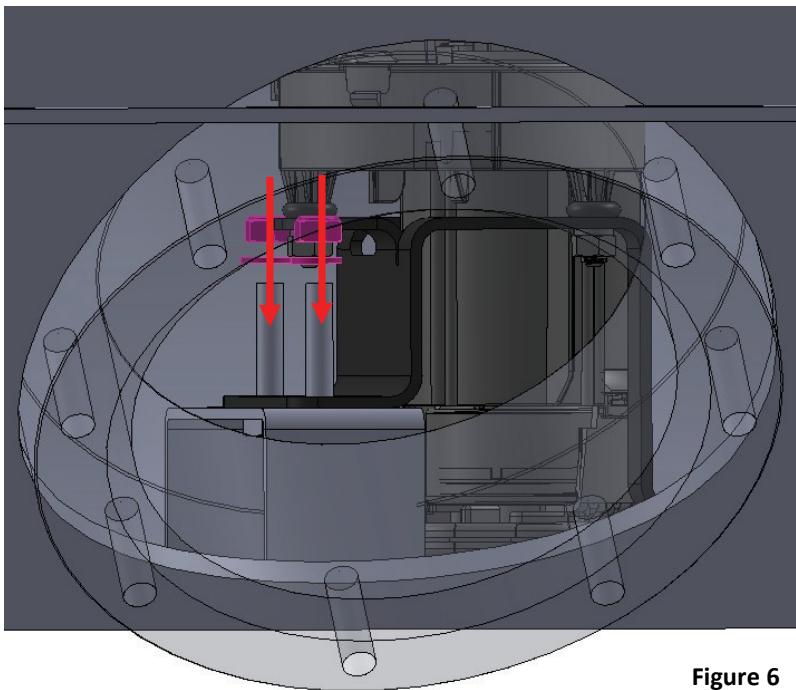


Figure 6

5. Install nuts (Qty 2) and washers (Qty 2) to fuel pump hold down bracket posts. (**Torque: FSNS - Fully seated not stripped**) (Figure 6)

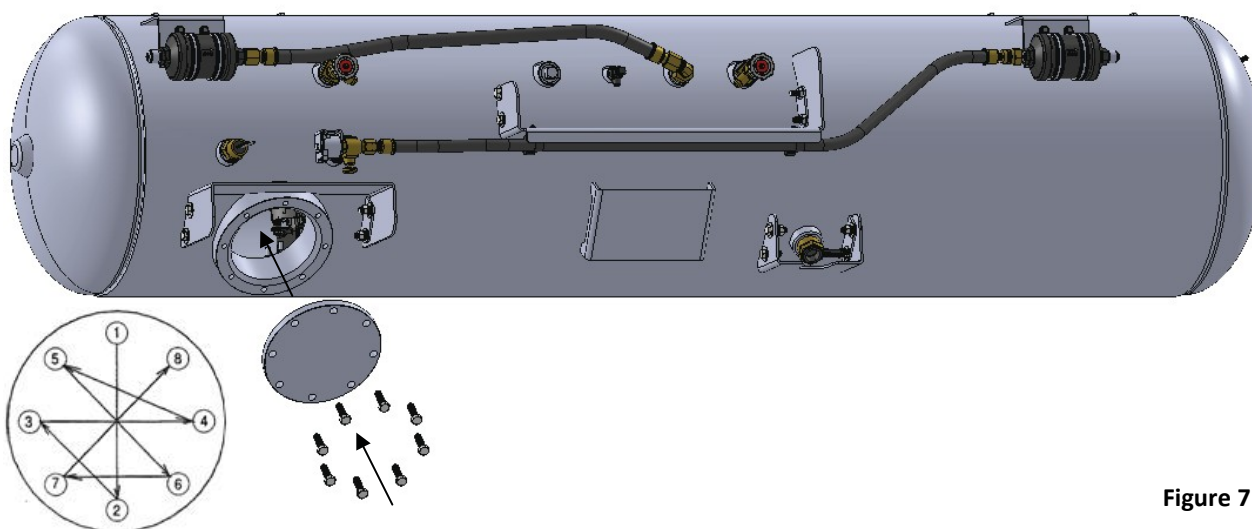


Figure 7

6. Inspect and clean access cover and tank flange for new o-ring installation. Install new access cover o-ring. Use motor oil to lubricate the o-ring in the access o-ring cover groove. Using Anti-Seize solution on the bolts, bolt the access cover onto the fuel tank. (**Torque: 33 ft-lb. - Utilize the torque sequence chart in the above figure**) (Figure 7) **TEST TI SEE IF THIS WORKS**

LPI® Fuel Pump Removal P63 Chassis

Removal Procedure

1. Drain the fuel lines. Refer to [LPG Fuel Line Draining](#).
2. Drain the fuel tank. Refer to [LPG Tank Drain and Evacuation](#).

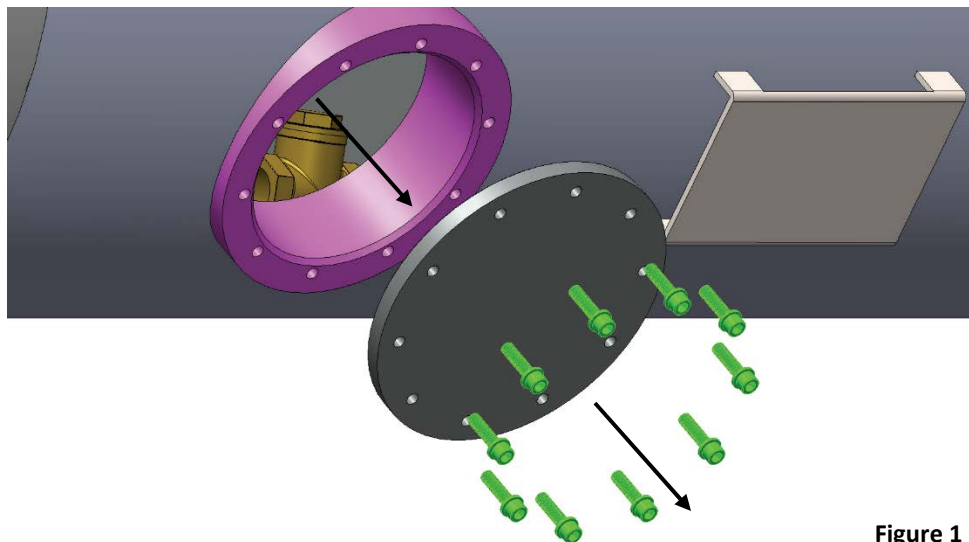


Figure 1

3. Remove LPI® access cover and bolts (QTY:10) (Figure 1) **Note: Be sure to remove and discard o-ring from access cover this will be replaced in the installation process.**

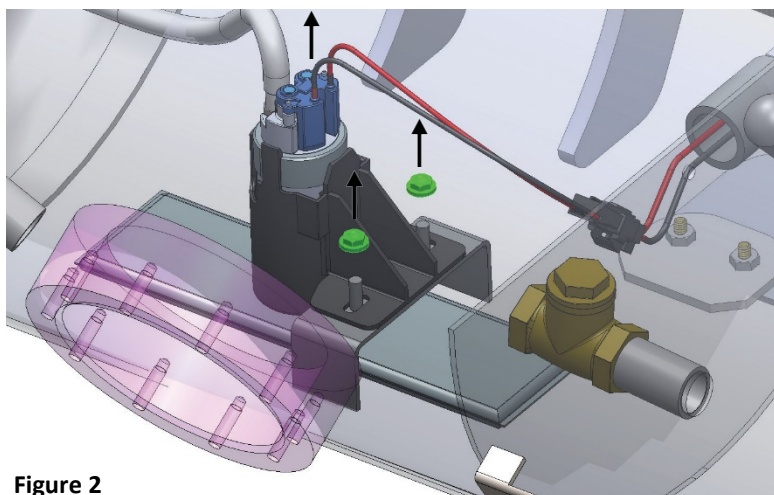


Figure 2

4. Remove fuel pump retaining nuts (Qty: 2) and washers (Qty: 2) (Figure 2)
5. Remove fuel pump by lifting straight up. (Figure 2)

LPI® Fuel Pump Removal P63 Chassis—CONTINUED...

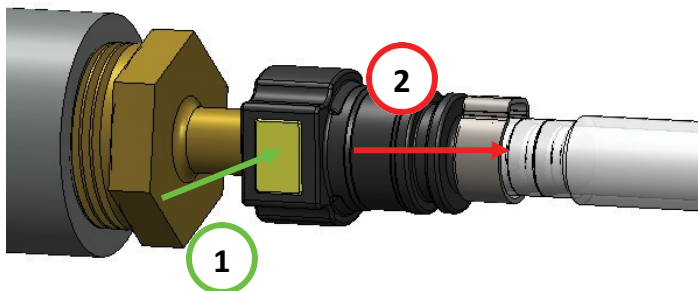


Figure 3

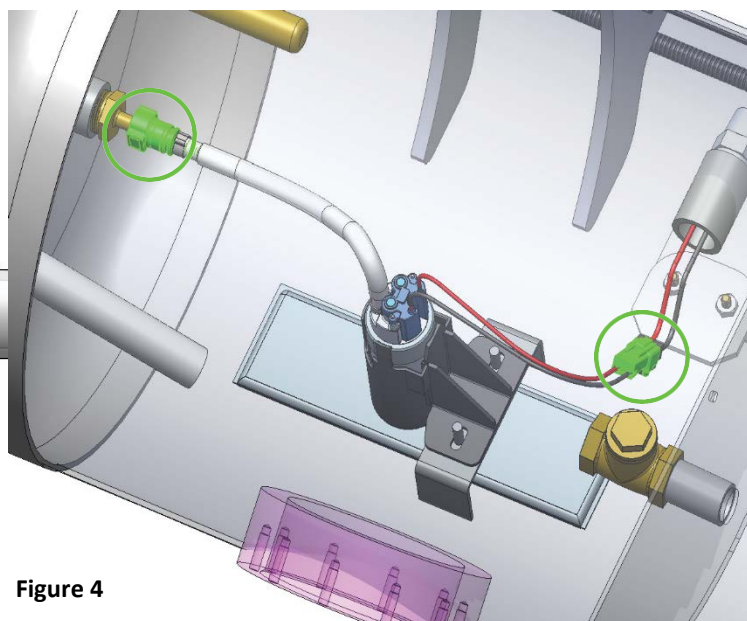


Figure 4

6. To remove the quick disconnect fitting from the quick connect bead fitting. Press in the tab on the side of the quick disconnect (1) While pushing the tab in pull the assembly in the opposite direction from the quick connect bead fitting (2). (Figure 6 & 7) Disconnect electrical connector. (Figure 4)

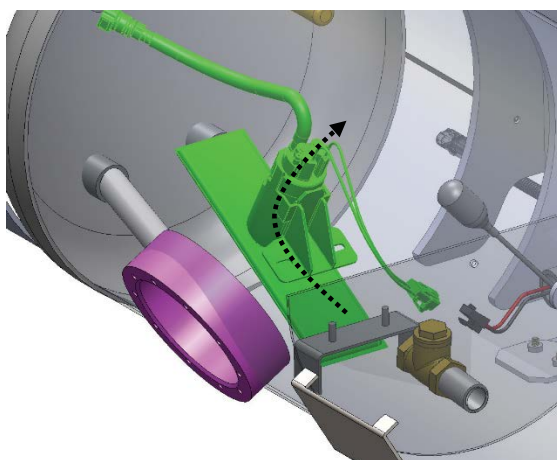


Figure 5

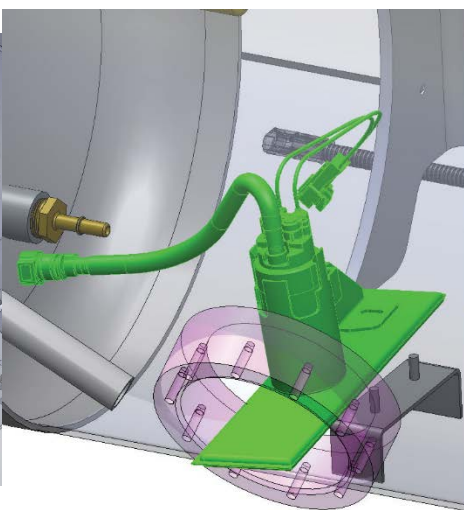


Figure 6

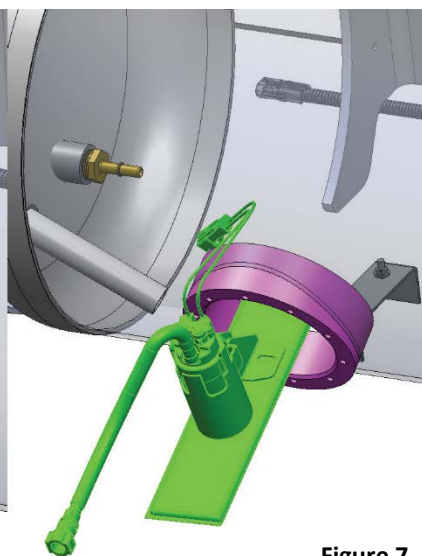


Figure 7

7. Remove fuel pump from LPI® Fuel Tank. **Note:** Holding the bottom of the fuel pump, guide the filter sock through the opening first. Then pull the pump straight out. **Caution:** Do not use excess force removing the fuel pump. (Figure 4-7)

LPI® Fuel Pump Installation P63 Chassis

Installation Procedure

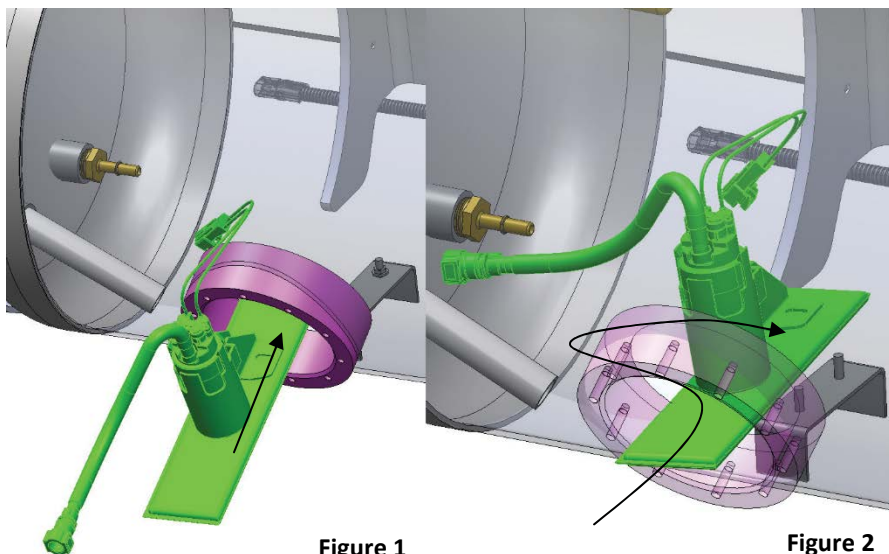


Figure 1

Figure 2

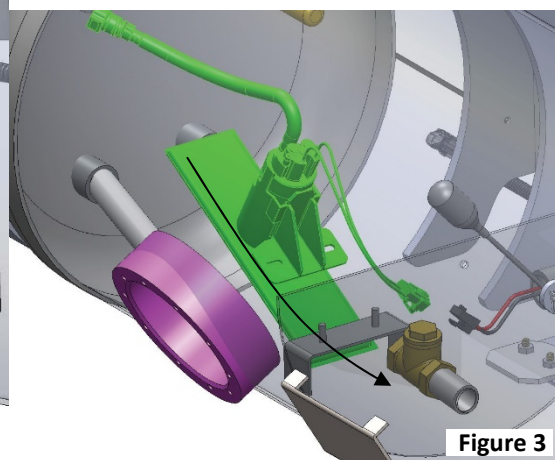


Figure 3

1. Install the fuel pump into the LPI® Fuel Tank. **Note: Holding the side of the fuel pump, guide the filter sock through the opening first. Caution: Do not use excess force installing the fuel pump.** Install the fuel pump filter under the hold down bracket and seat the fuel pump on the mounting studs. (Figure 1-3)

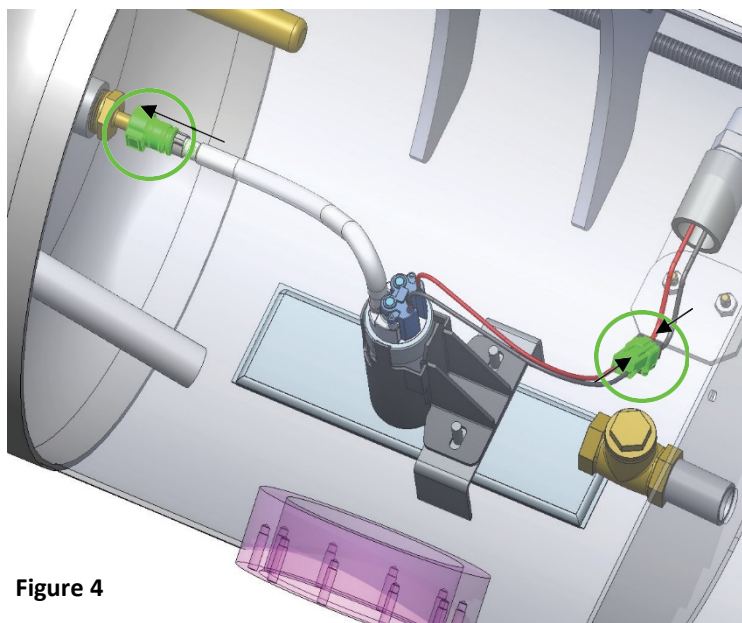


Figure 4

2. Connect the electrical connector to the new fuel pump. Connect the fuel pump quick connect fitting to the tank fitting. **Note: Ensure and audible click is heard also lightly pull on the hose to ensure the fitting is fully engaged.** (Figure4)

LPI® Fuel Pump Installation P63 Chassis—CONTINUED...

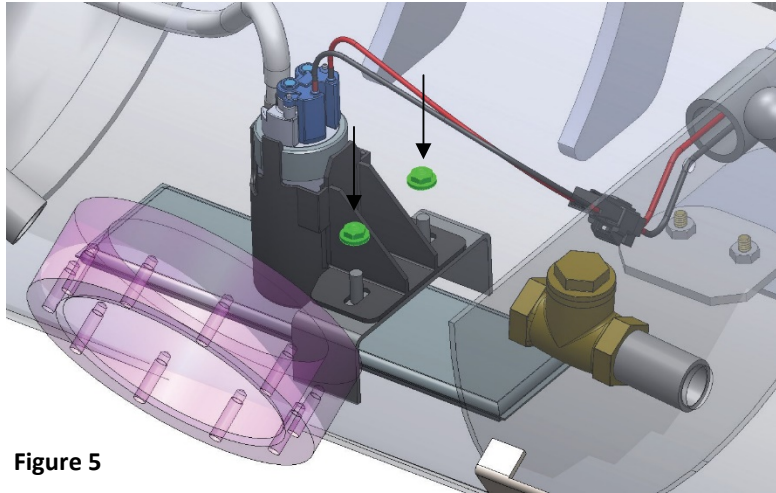


Figure 5

3. Install nuts (Qty 2) to fuel pump hold down bracket posts. (Torque: FSNS - Fully seated not stripped) (Figure 5)

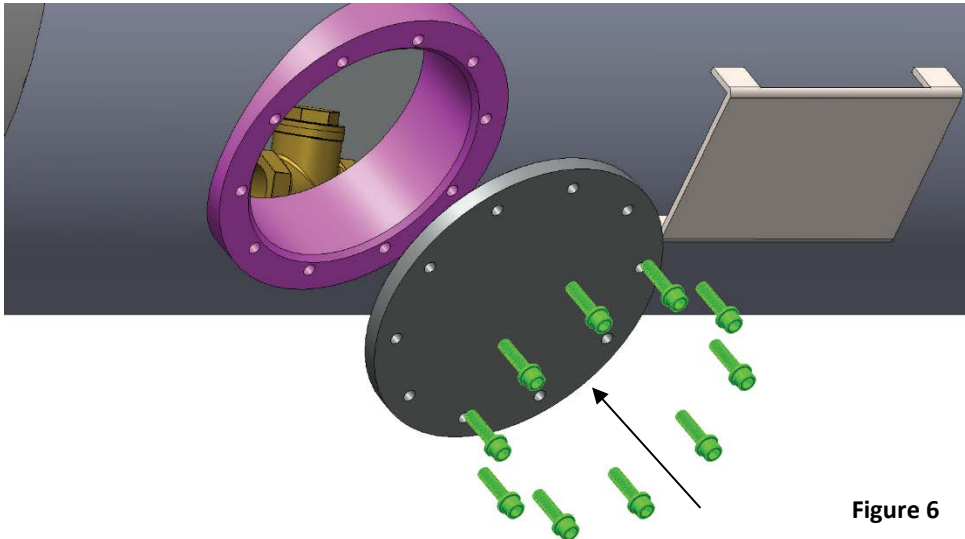


Figure 6

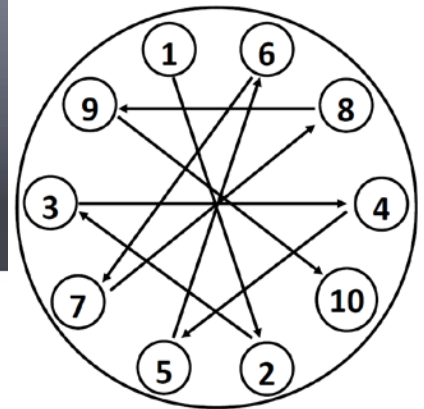


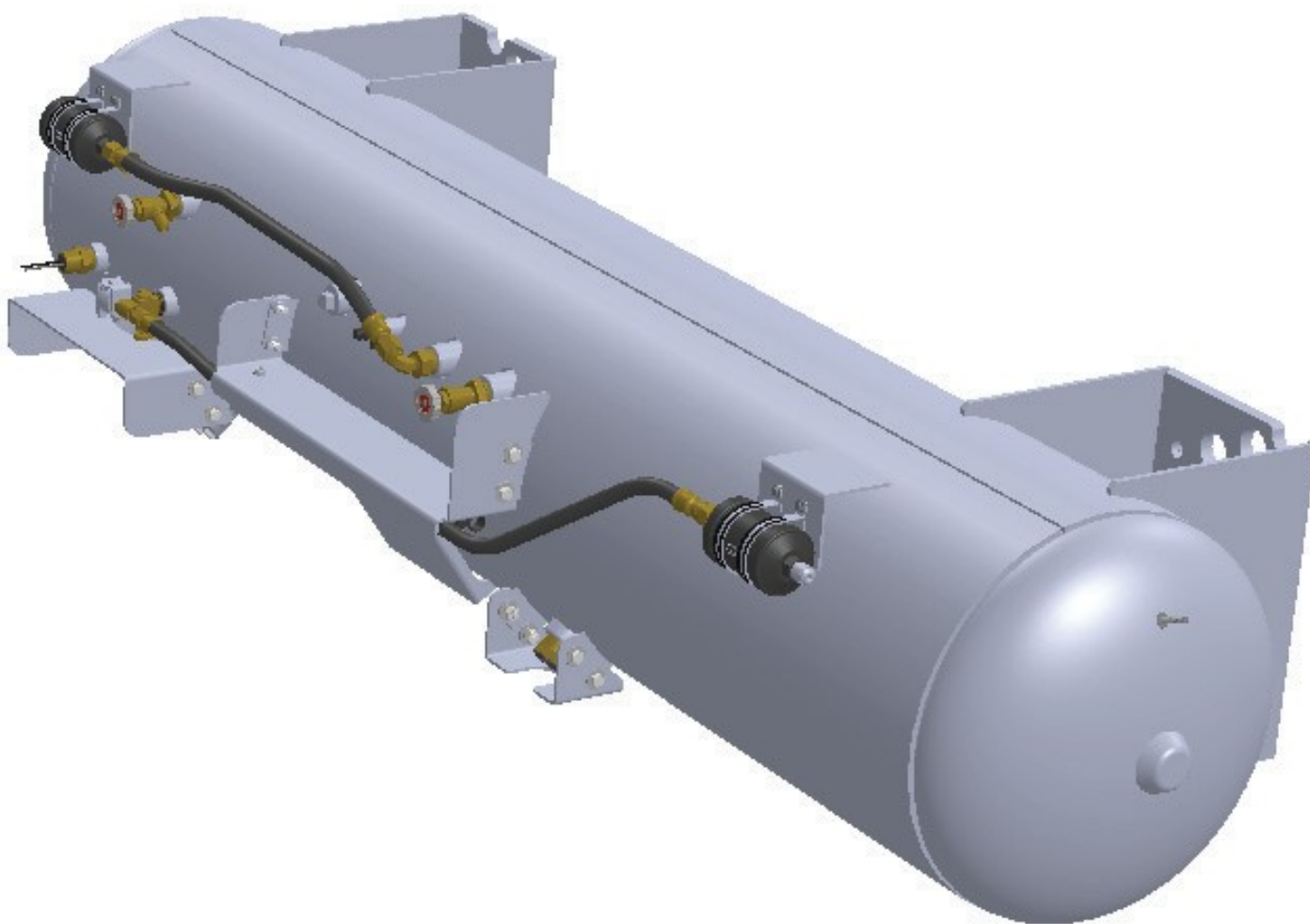
Figure 7

6. Inspect and clean access cover and tank flange for new o-ring installation. Install new access cover o-ring. Use motor oil to lubricate the o-ring in the access o-ring cover groove. Using Anti-Seize solution on the bolts, bolt the access cover onto the fuel tank. (Figure 6) (**Torque: 8 lb ft - Utilize the torque sequence chart in the above figure**) (Figure 7)

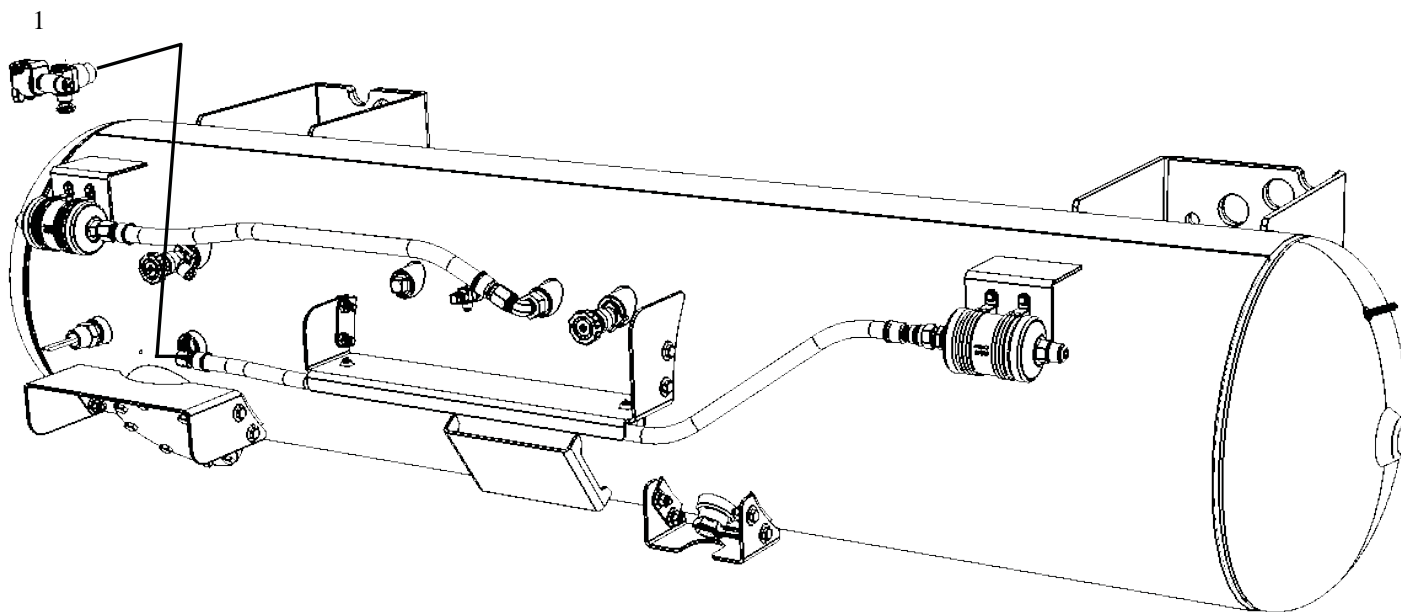
NOTES:

LPI® External Fuel Tank MT 45/55 Chassis

Repair and Replace



Supply Valve Replacement



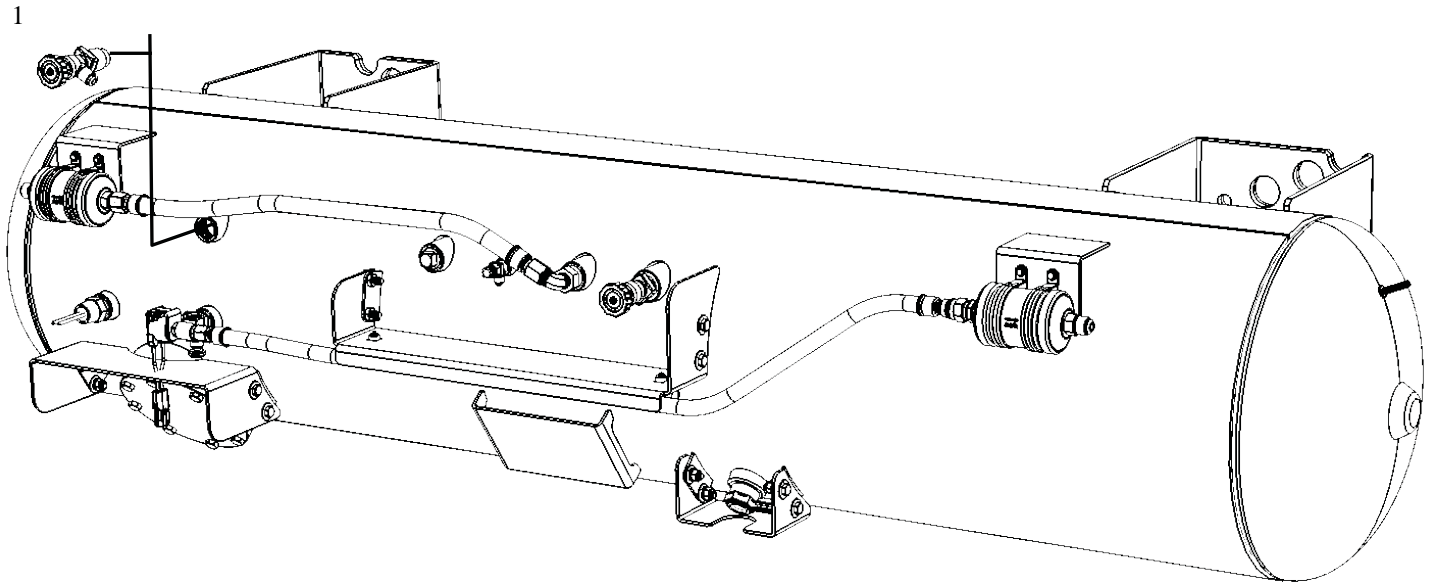
Preliminary Procedure

1. Drain the fuel lines. Refer to [LPG Fuel Line Draining](#).
2. Drain the fuel tank. Refer to [LPG Tank Drain and Evacuation](#).
3. Remove the fuel line.

COMPONENTS

- 1) Supply Valve Replacement.
Caution: Use Loctite 565 thread sealant on threads.
Caution: Refer to [Fastener Tightening Caution](#) on page 4.

Return Valve Replacement



Preliminary Procedure

1. Drain the fuel lines. Refer to [LPG Fuel Line Draining](#).
2. Drain the fuel tank. Refer to [LPG Tank Drain and Evacuation](#).
3. Remove the fuel line.

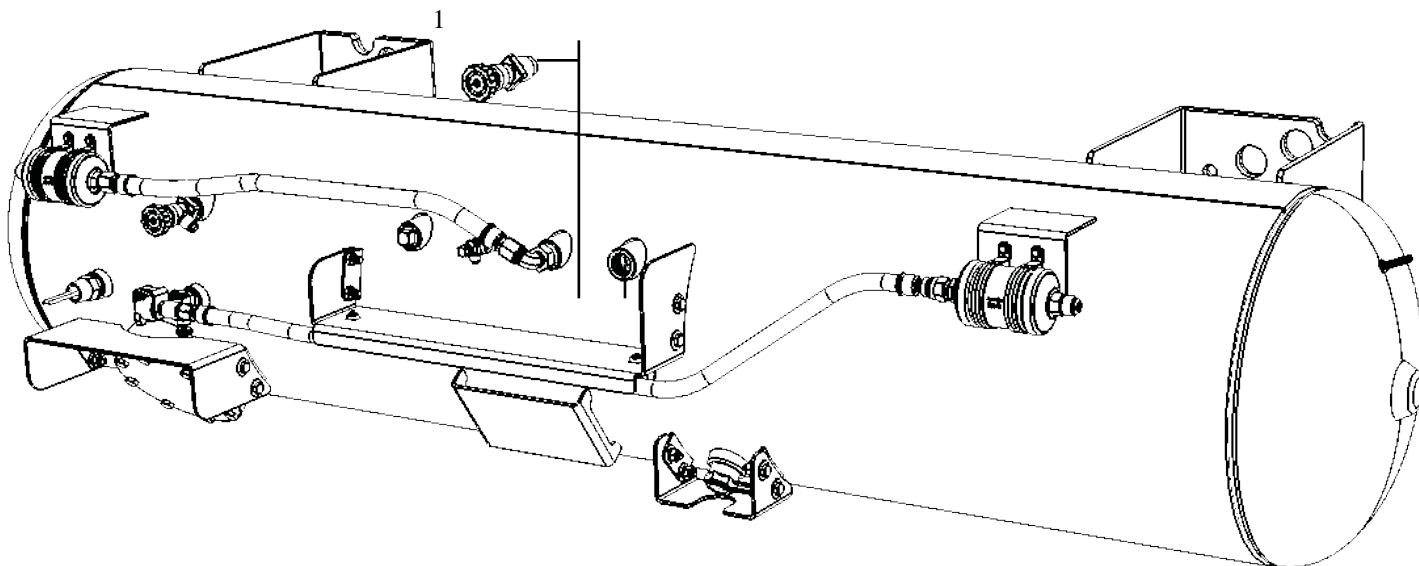
COMPONENTS

- 1) Return Valve Replacement.

Caution: Use Loctite 565 thread sealant on threads.

Caution: Refer to [Fastener Tightening Caution](#) on page 4.

Service Evacuation Valve Replacement



Preliminary Procedure

1. Drain the fuel lines. Refer to [LPG Fuel Line Draining](#).
2. Drain the fuel tank. Refer to [LPG Tank Drain and Evacuation](#).

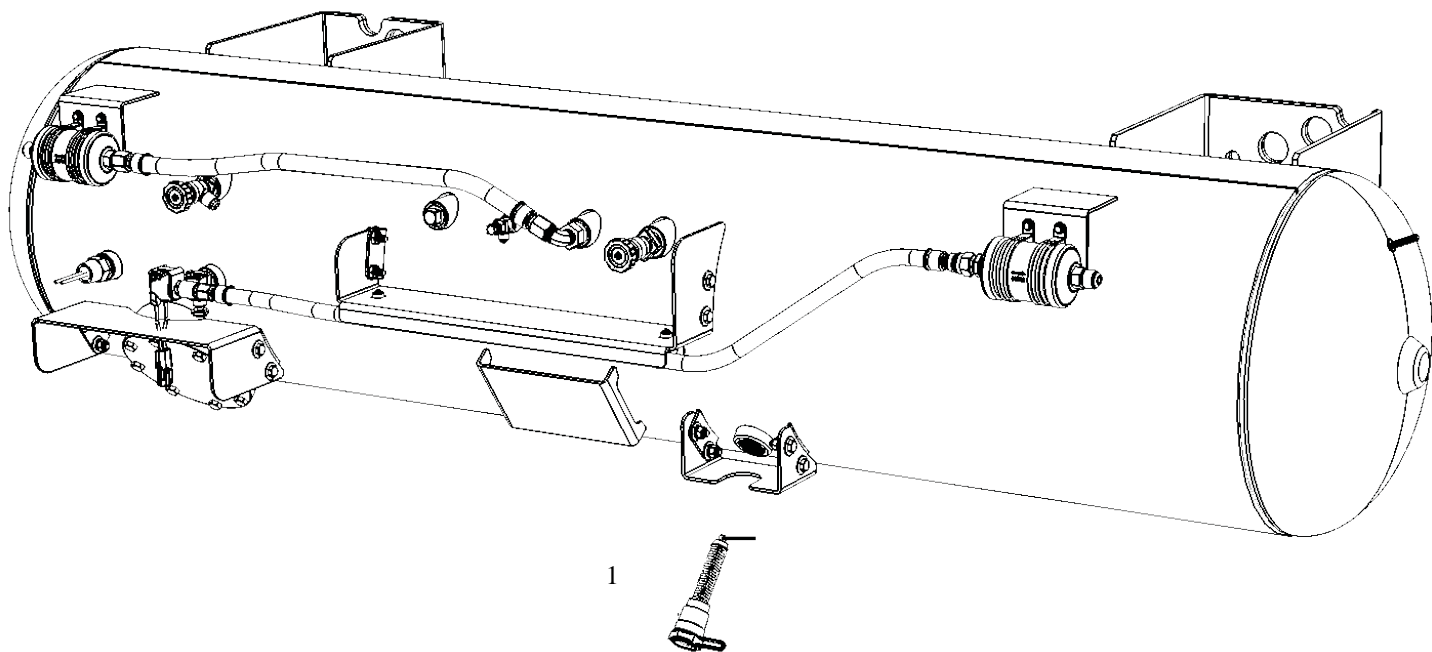
COMPONENTS

- 1) Service Evacuation Valve Replacement.

Caution: Use Loctite 565 thread sealant on threads.

Caution: Refer to [Fastener Tightening Caution](#) on page 4.

Pressure Relief Valve Replacement



Preliminary Procedure

1. Drain the fuel lines. Refer to [LPG Fuel Line Draining](#).
2. Drain the fuel tank. Refer to [LPG Tank Drain and Evacuation](#).

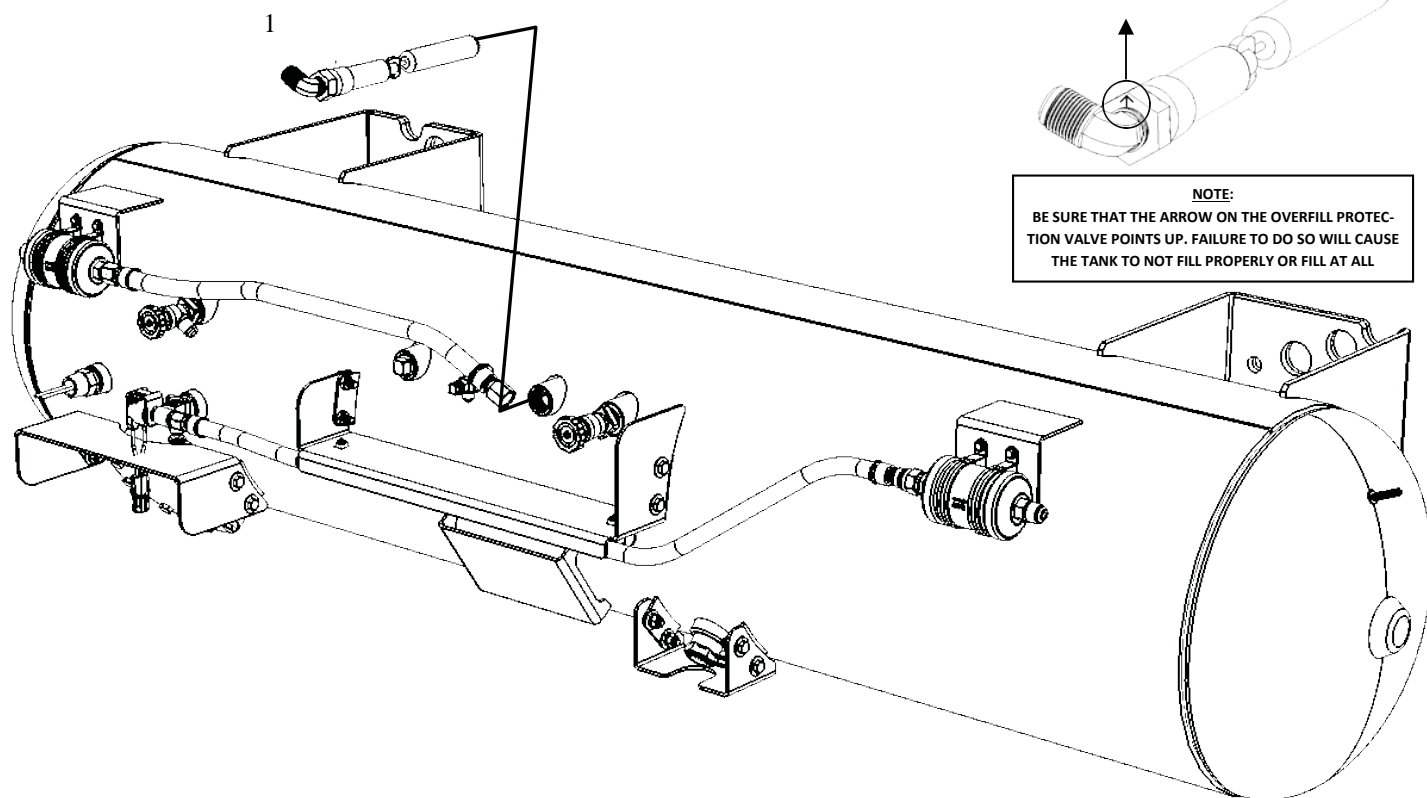
COMPONENTS

- 1) Pressure Relief Valve Replacement.

Caution: Use Loctite 565 thread sealant on threads.

Caution: Refer to [Fastener Tightening Caution](#) on page 4.

Overfill Protection Valve (Filler Valve) Replacement



Preliminary Procedure

1. Drain the fuel lines. Refer to [LPG Fuel Line Draining](#).
2. Drain the fuel tank. Refer to [LPG Tank Drain and Evacuation](#).
3. Remove the fuel line.

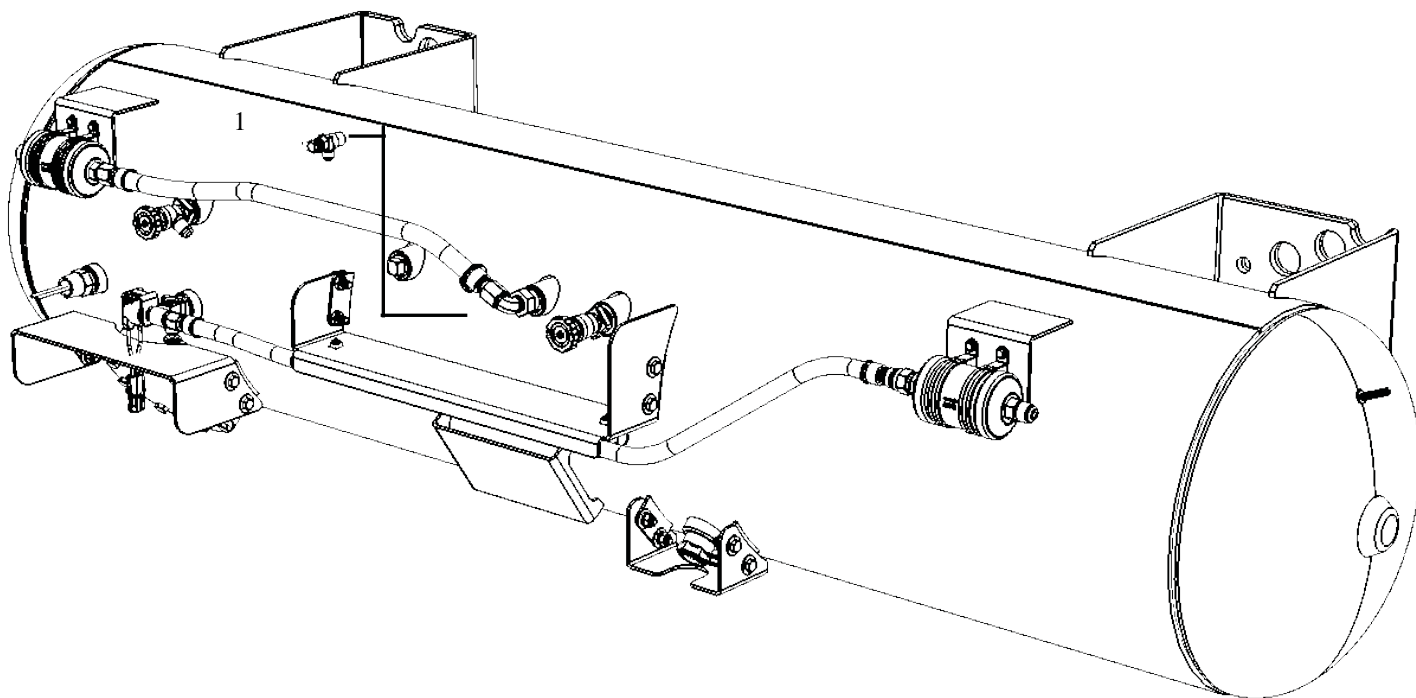
COMPONENTS

- 1) Overfill Protection Valve (Filler Valve) Replacement.

Caution: Use Loctite 565 thread sealant on threads.

Caution: Refer to [Fastener Tightening Caution](#) on page 4.

Fixed Liquid Level Gauge (80% Bleeder) Replacement



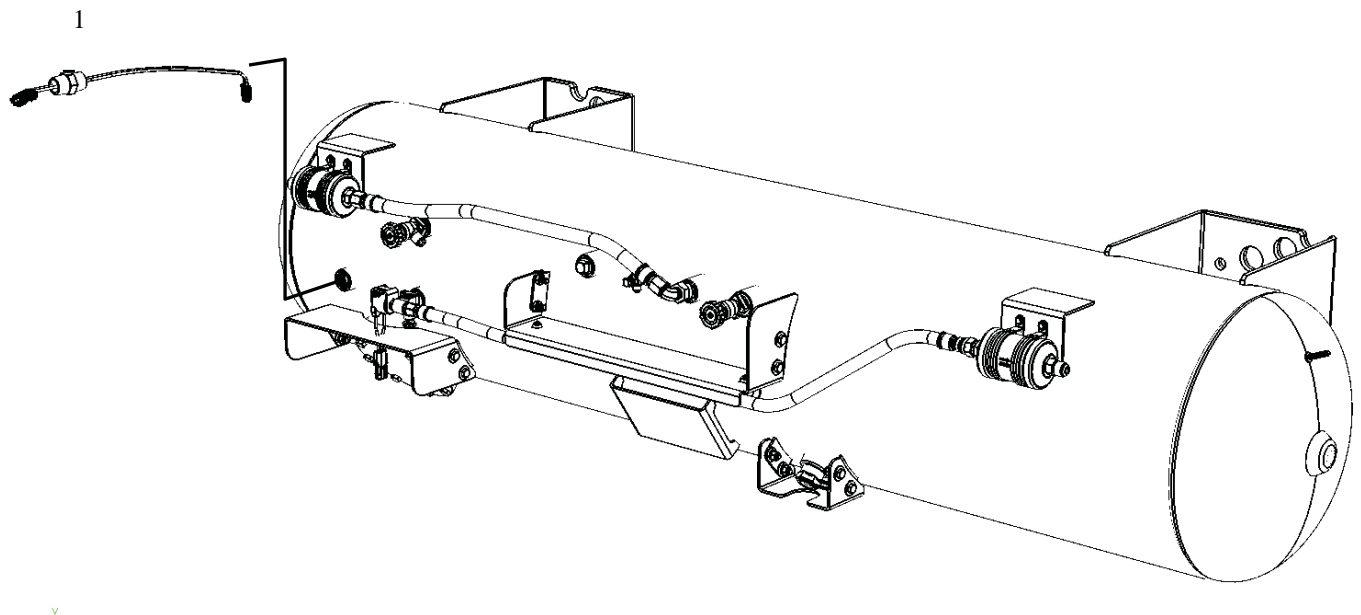
Preliminary Procedure

1. Drain the fuel lines. Refer to [LPG Fuel Line Draining](#).
2. Drain the fuel tank. Refer to [LPG Tank Drain and Evacuation](#).

COMPONENTS

- 1) Fixed Liquid Level Gauge (80% Bleeder) Replacement.
Caution: Use Loctite 565 thread sealant on threads.
Caution: Refer to [Fastener Tightening Caution](#) on page 4.

Fuel Pump Wire Feed-thru Replacement



Preliminary Procedure

1. Drain the fuel lines. Refer to [LPG Fuel Line Draining](#).
2. Drain the fuel tank. Refer to [LPG Tank Drain and Evacuation](#).

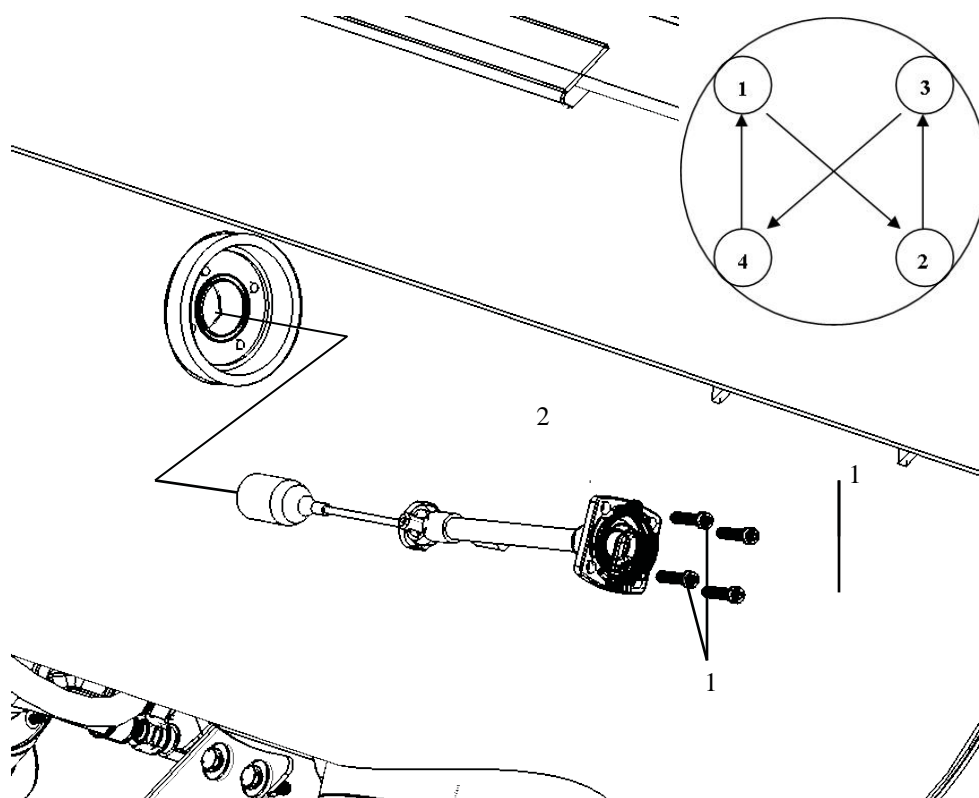
COMPONENTS

- 1) Fuel Pump Wire Feed-thru Replacement.

Caution: Use Loctite 565 thread sealant on threads.

Caution: Refer to [Fastener Tightening Caution](#) on page 4.

Fuel Gauge Replacement



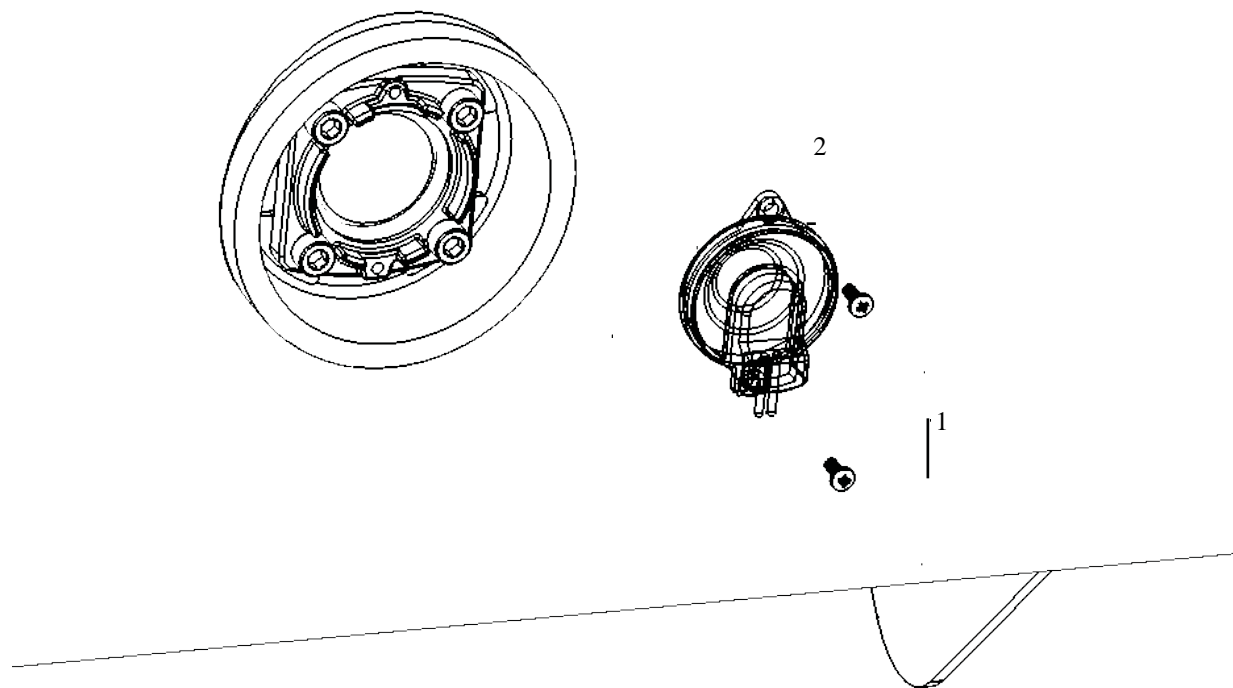
Preliminary Procedure

1. Drain the fuel lines. Refer to [LPG Fuel Line Draining](#).
2. Drain the fuel tank. Refer to [LPG Tank Drain and Evacuation](#).

COMPONENTS

- 1) Fuel Gauge Fasteners. (Qty: 4)
Caution: Refer to [Fastener Caution](#) on page 4. **Torque:** 9.5 N·m (7 lb ft)
(Torque twice utilize the torque sequence chart in the above figure)
- 2) Fuel Gauge. (Replace Gasket prior to reinstalling the gauge assembly)

Fuel Sender Replacement



Preliminary Procedure

1. Disconnect electrical connector.

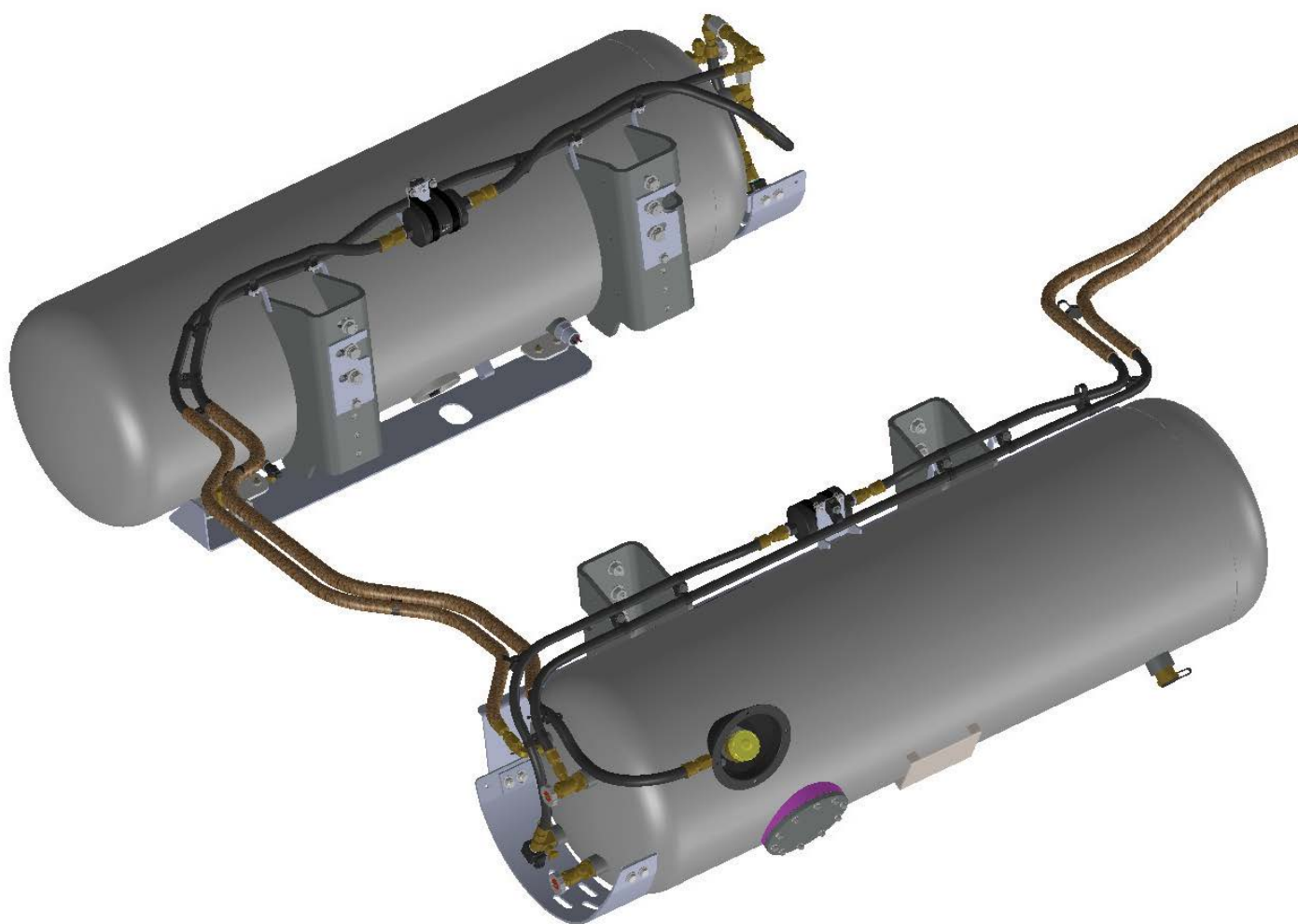
COMPONENTS

- 1) Fuel Sender Fasteners. (Qty: 2)
Caution: Refer to [Fastener Caution](#) on page 4. Torque: FSNS - Fully Seated Not Stripped.
- 2) Fuel Sender

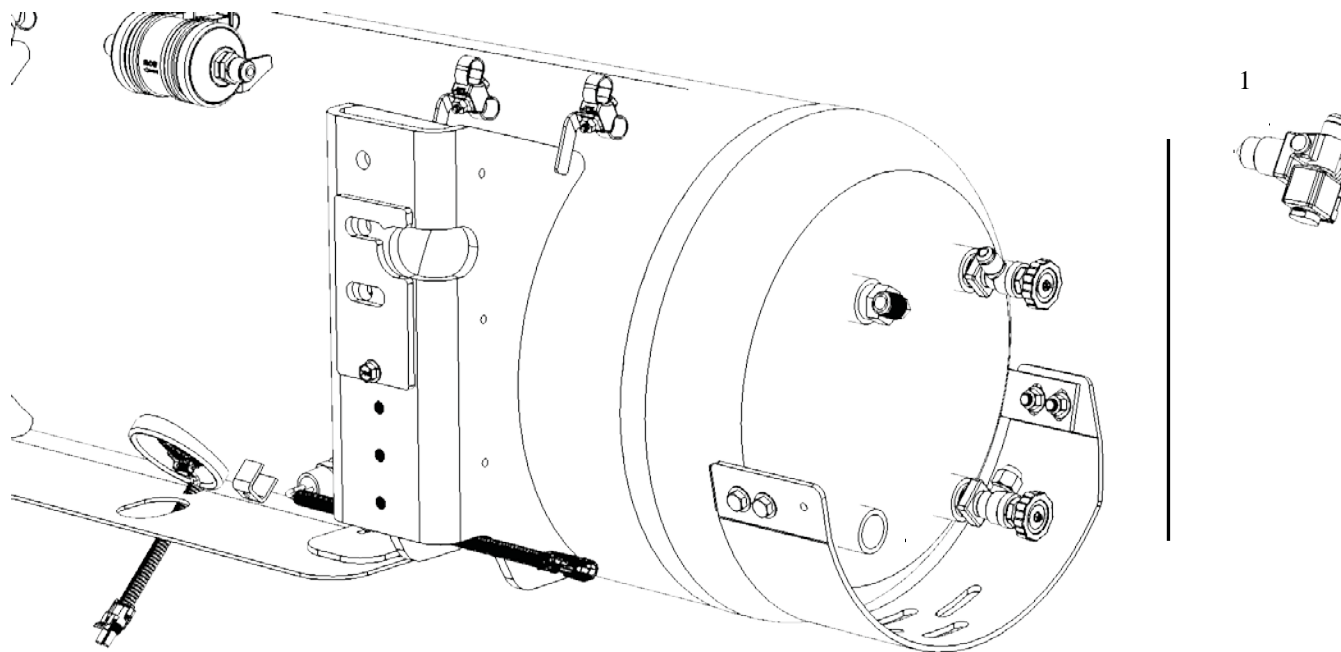
NOTES:

LPI® External Fuel Tank P63 Chassis

Repair and Replace



Supply Valve Replacement



Preliminary Procedure

1. Drain the fuel lines. Refer to [LPG Fuel Line Draining](#).
2. Drain the fuel tank. Refer to [LPG Tank Drain and Evacuation](#).
3. Remove the fuel line.

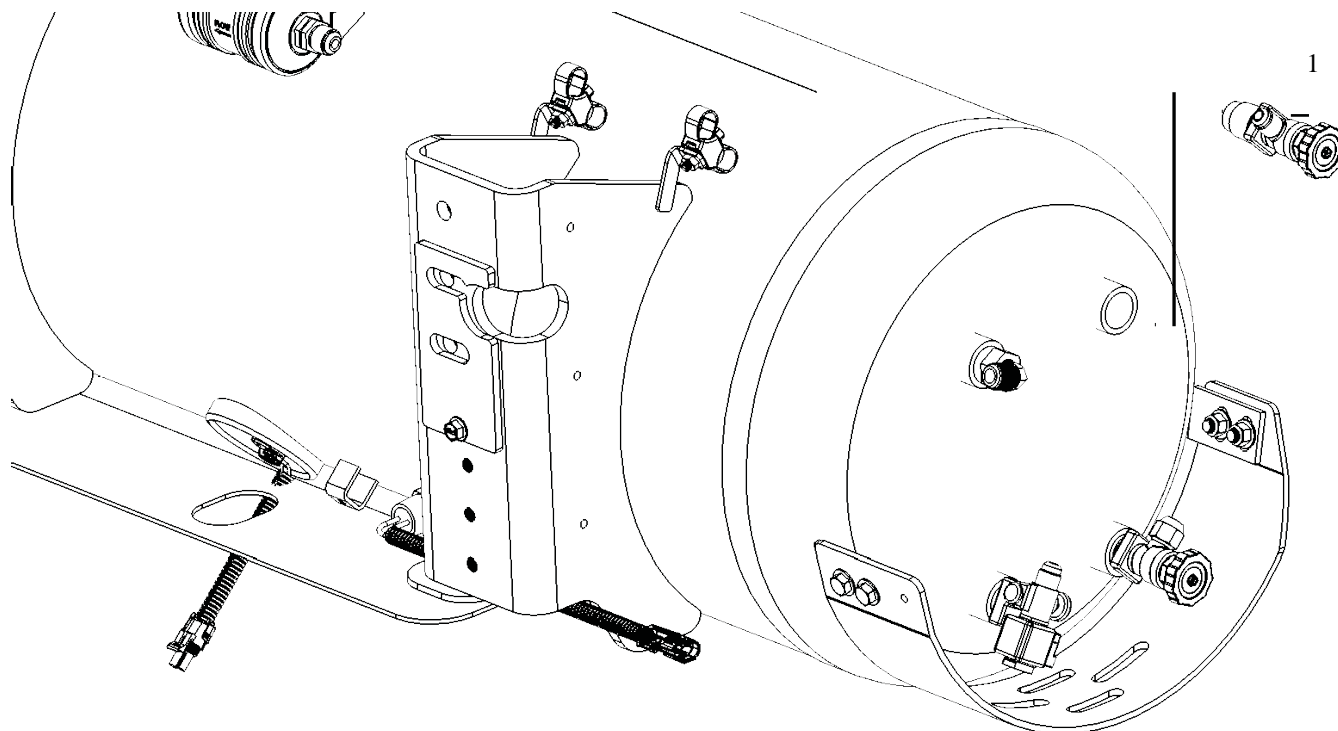
COMPONENTS

- 1) Supply Valve Replacement.

Caution: Use Loctite 565 thread sealant on threads.

Caution: Refer to [Fastener Tightening Caution](#) on page 4.

Return Valve Replacement



Preliminary Procedure

1. Drain the fuel lines. Refer to [LPG Fuel Line Draining](#).
2. Drain the fuel tank. Refer to [LPG Tank Drain and Evacuation](#).
3. Remove the fuel line.

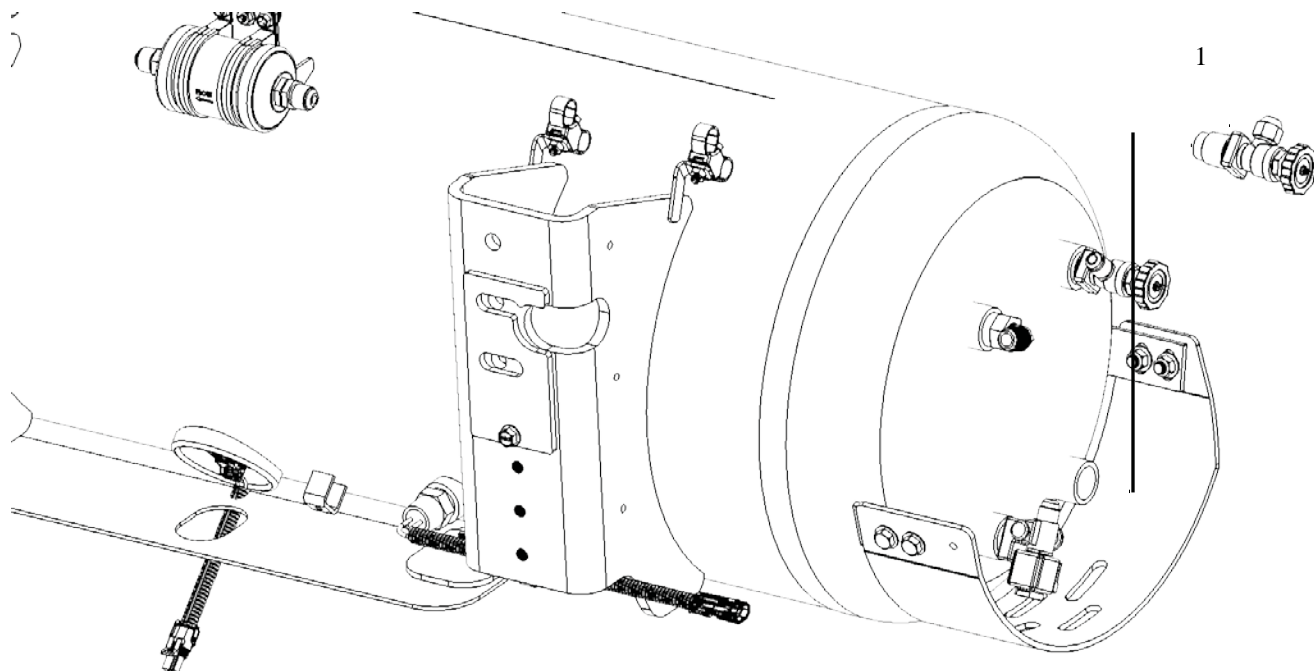
COMPONENTS

- 1) Return Valve Replacement.

Caution: Use Loctite 565 thread sealant on threads.

Caution: Refer to [Fastener Tightening Caution](#) on page 4.

Service Evacuation Valve Replacement (Inside Baffle)



Preliminary Procedure

1. Drain the fuel lines. Refer to [LPG Fuel Line Draining](#).
2. Drain the fuel tank. Refer to [LPG Tank Drain and Evacuation](#).

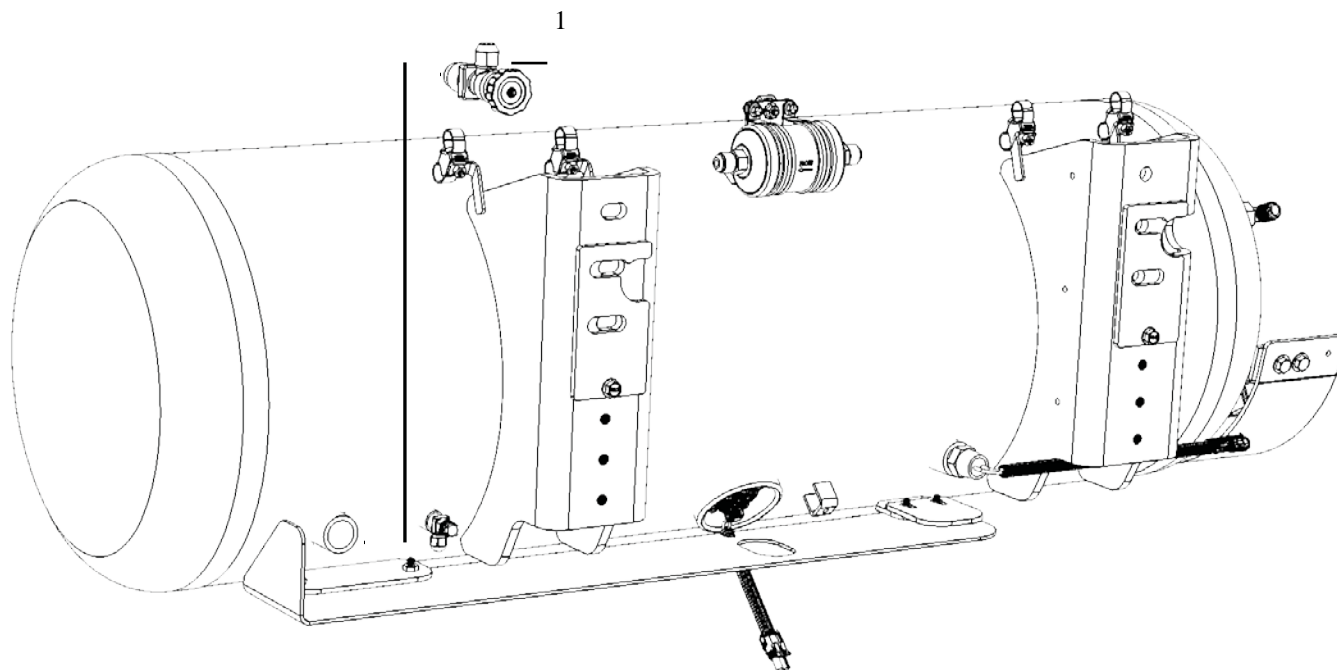
COMPONENTS

- 1) Service Evacuation Valve Replacement.

Caution: Use Loctite 565 thread sealant on threads.

Caution: Refer to [Fastener Tightening Caution](#) on page 4.

Service Evacuation Valve Replacement (Behind Baffle)



Preliminary Procedure

1. Drain the fuel lines. Refer to [LPG Fuel Line Draining](#).
2. Drain the fuel tank. Refer to [LPG Tank Drain and Evacuation](#).

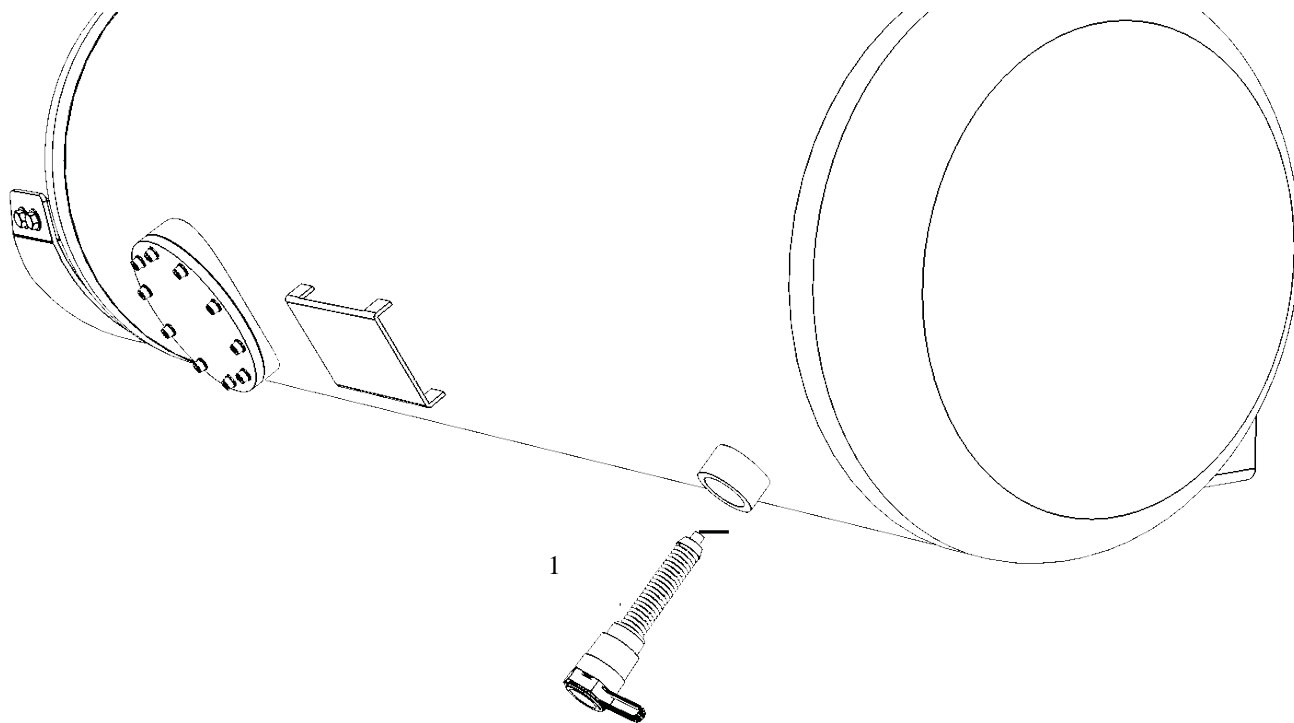
COMPONENTS

- 1) Service Evacuation Valve Replacement.

Caution: Use Loctite 565 thread sealant on threads.

Caution: Refer to [Fastener Tightening Caution](#) on page 4.

Pressure Relief Valve Replacement



Preliminary Procedure

1. Drain the fuel lines. Refer to [LPG Fuel Line Draining](#).
2. Drain the fuel tank. Refer to [LPG Tank Drain and Evacuation](#).

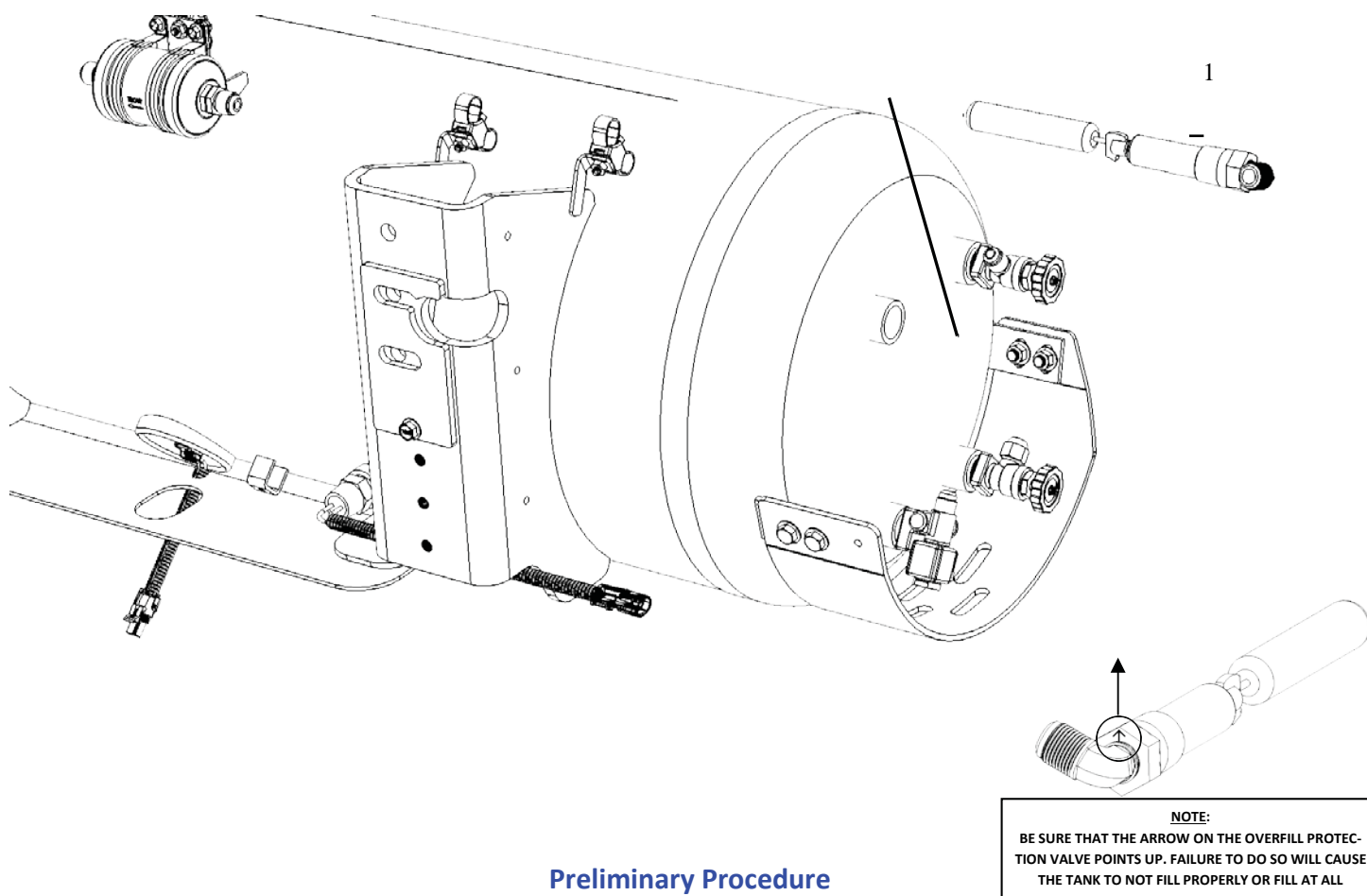
COMPONENTS

- 1) Pressure Relief Valve Replacement.

Caution: Use Loctite 565 thread sealant on threads.

Caution: Refer to [Fastener Tightening Caution](#) on page 4.

Overfill Protection Valve (Filler Valve) Replacement



Preliminary Procedure

1. Drain the fuel lines. Refer to [LPG Fuel Line Draining](#).
2. Drain the fuel tank. Refer to [LPG Tank Drain and Evacuation](#).
3. Remove the fuel line.

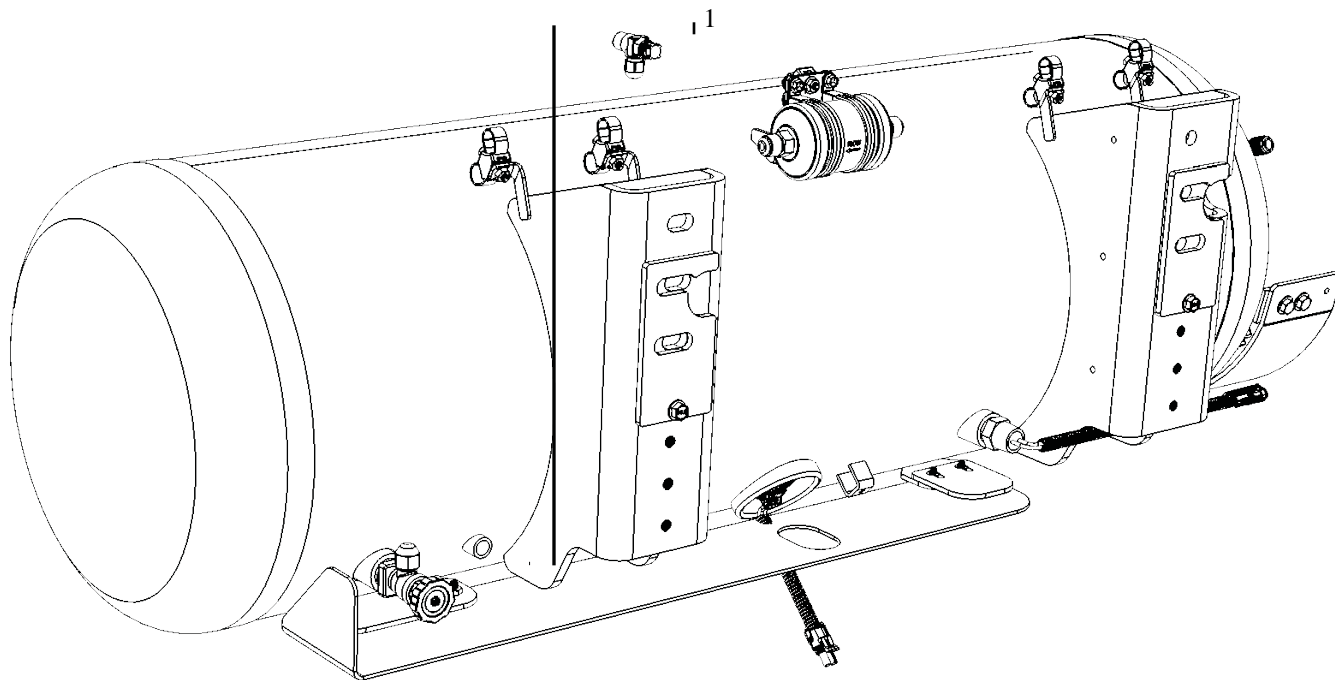
COMPONENTS

- 1) Overfill Protection Valve (Filler Valve) Replacement.

Caution: Use Loctite 565 thread sealant on threads.

Caution: Refer to [Fastener Tightening Caution](#) on page 4.

Fixed Liquid Level Gauge (80% Bleeder) Replacement



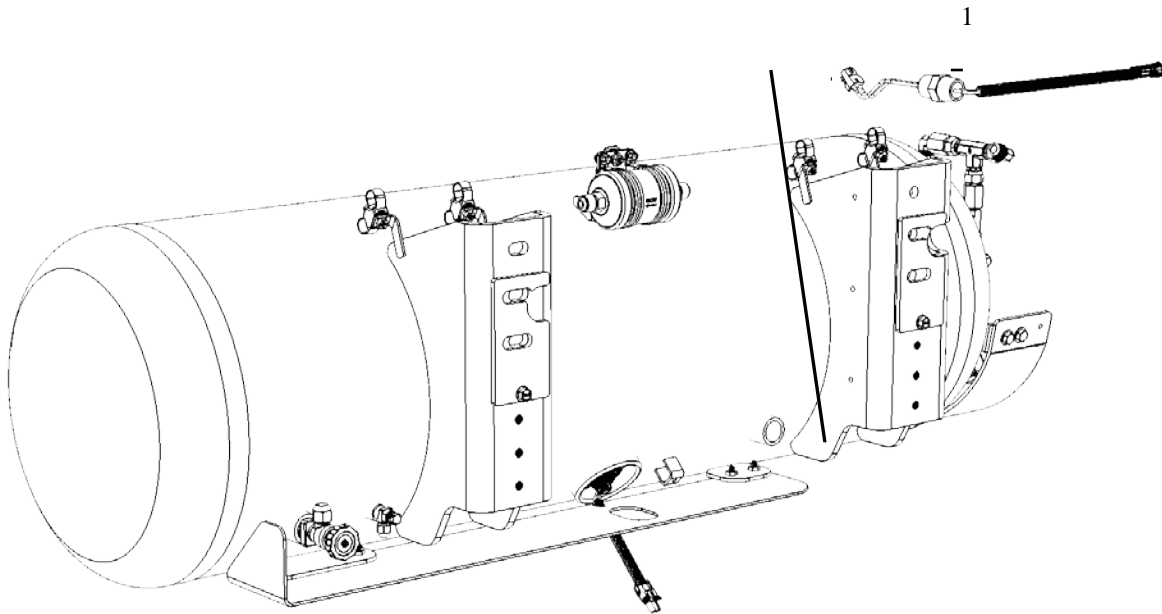
Preliminary Procedure

1. Drain the fuel lines. Refer to [LPG Fuel Line Draining](#).
2. Drain the fuel tank. Refer to [LPG Tank Drain and Evacuation](#).

COMPONENTS

- 1) Fixed Liquid Level Gauge (80% Bleeder) Replacement.
Caution: Use Loctite 565 thread sealant on threads.
Caution: Refer to [Fastener Tightening Caution](#) on page 4.

Fuel Pump Wire Feed-thru Replacement



Preliminary Procedure

1. Drain the fuel lines. Refer to [LPG Fuel Line Draining](#).
2. Drain the fuel tank. Refer to [LPG Tank Drain and Evacuation](#).

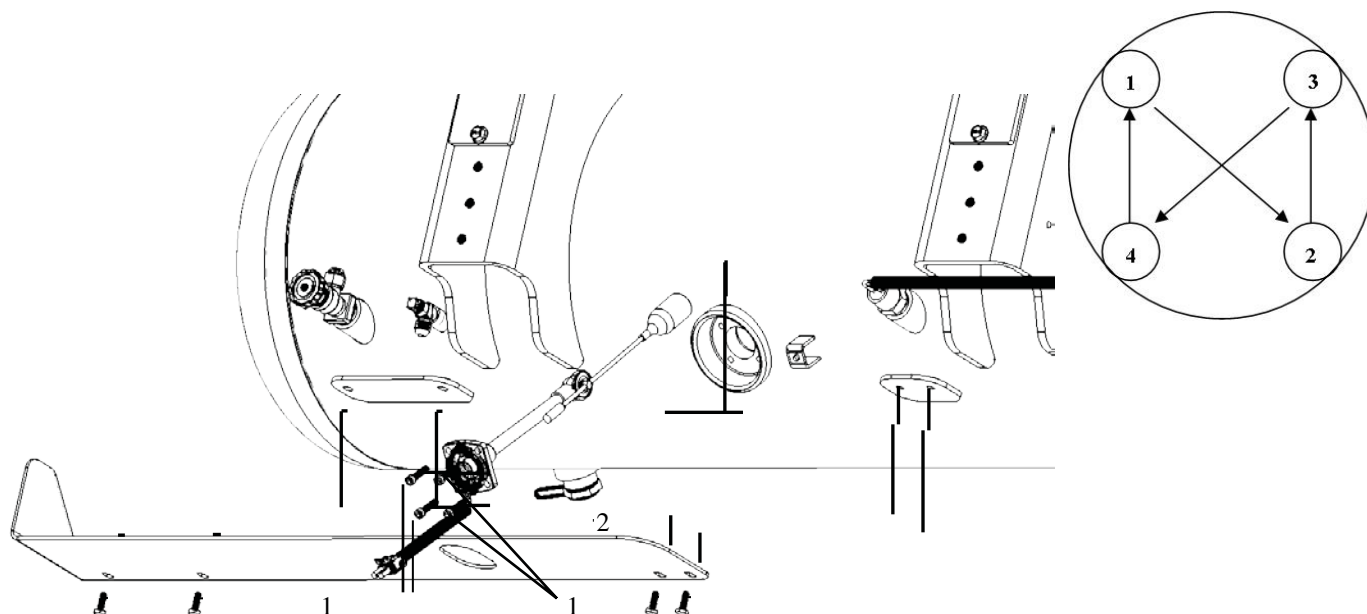
COMPONENTS

- 1) Fuel Pump Wire Feed-thru Replacement.

Caution: Use Loctite 565 thread sealant on threads.

Caution: Refer to [Fastener Tightening Caution](#) on page 4.

Fuel Gauge Replacement



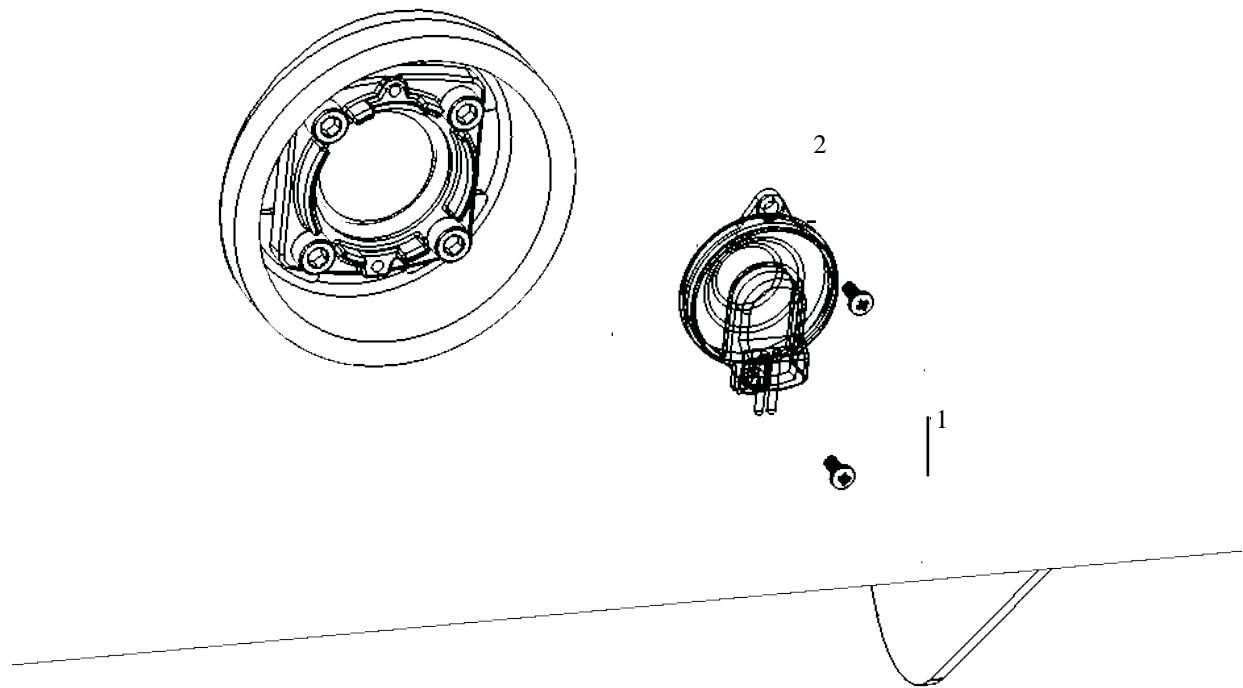
Preliminary Procedure

1. Drain the fuel lines. Refer to [LPG Fuel Line Draining](#).
2. Drain the fuel tank. Refer to [LPG Tank Drain and Evacuation](#).
3. Remove Tank Guard bolts and Guard.

COMPONENTS

- 1) Fuel Gauge Fasteners. (Qty: 4)
Caution: Refer to [Fastener Caution](#) on page 4. **Torque:** 9.5 N·m (7 lb ft)
(Torque twice utilize the torque sequence chart in the above figure)
- 2) Fuel Gauge. (Replace Gasket anytime gauge assembly is removed)

Fuel Sender Replacement



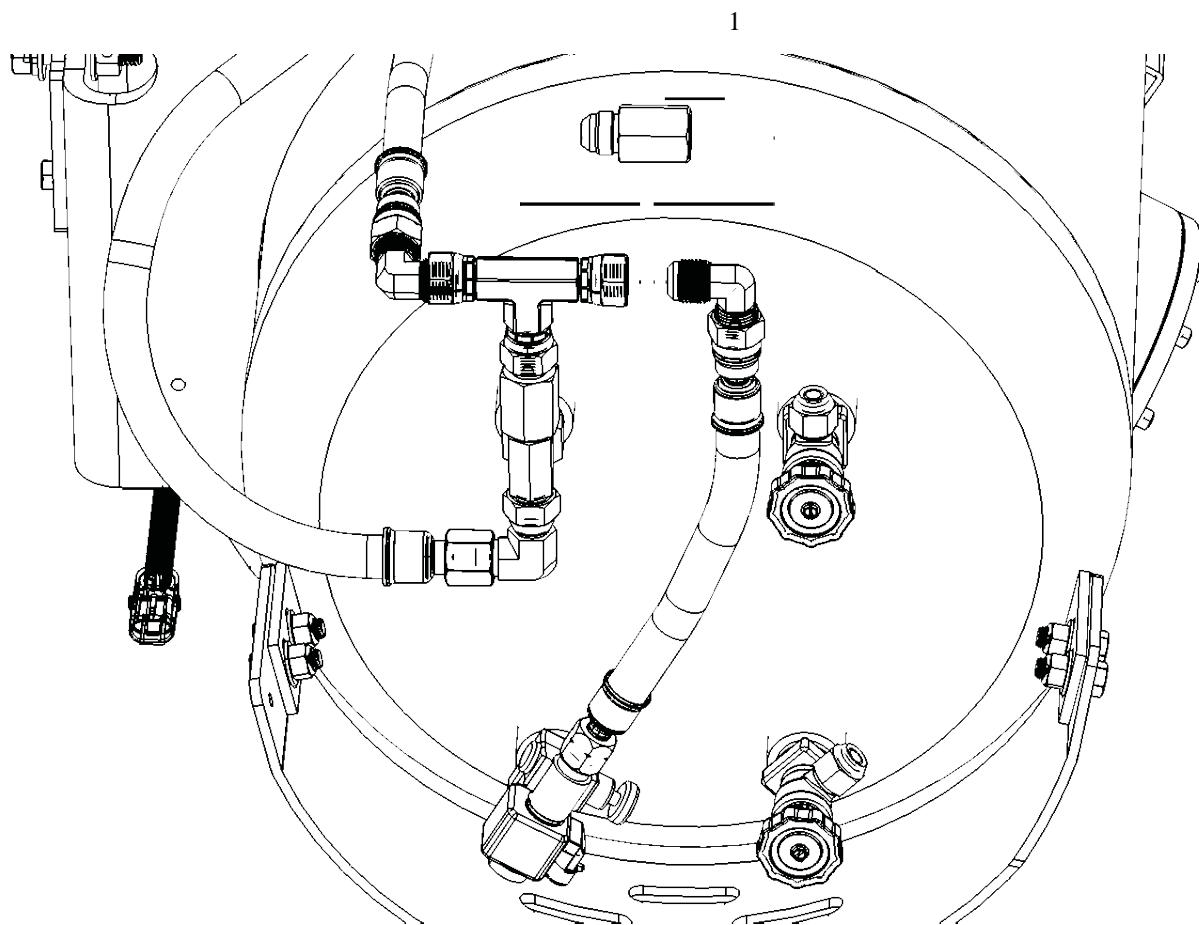
Preliminary Procedure

1. Disconnect electrical connector.

COMPONENTS

- 1) Fuel Sender Fasteners. (Qty: 2)
Caution: Refer to [Fastener Caution](#) on page 4. Torque: FSNS - Fully Seated Not Stripped.
- 2) Fuel Sender

Check Valve Replacement (Supply Valve Side)



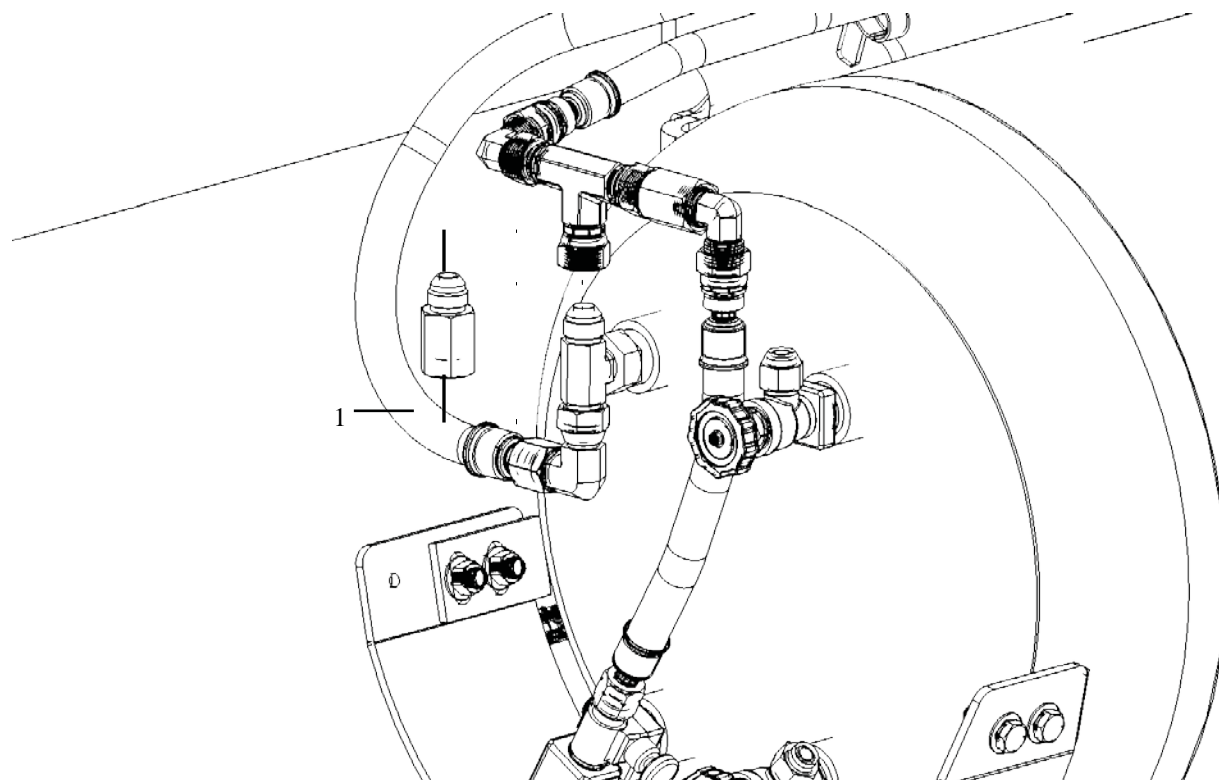
Preliminary Procedure

1. Drain the fuel lines. Refer to [LPG Fuel Line Draining](#).
2. Drain the fuel tank. Refer to [LPG Tank Drain and Evacuation](#).
3. Remove the fuel line.
4. Remove 90 degree fitting.

COMPONENTS

- 1) Check Valve.
Caution: Refer to [Fastener Tightening Caution](#) on page 4.

Check Valve Replacement (Fill Valve Side)



Preliminary Procedure

1. Drain the fuel lines. Refer to [LPG Fuel Line Draining](#).
2. Drain the fuel tank. Refer to [LPG Tank Drain and Evacuation](#).
3. Remove top hose T-Fitting.

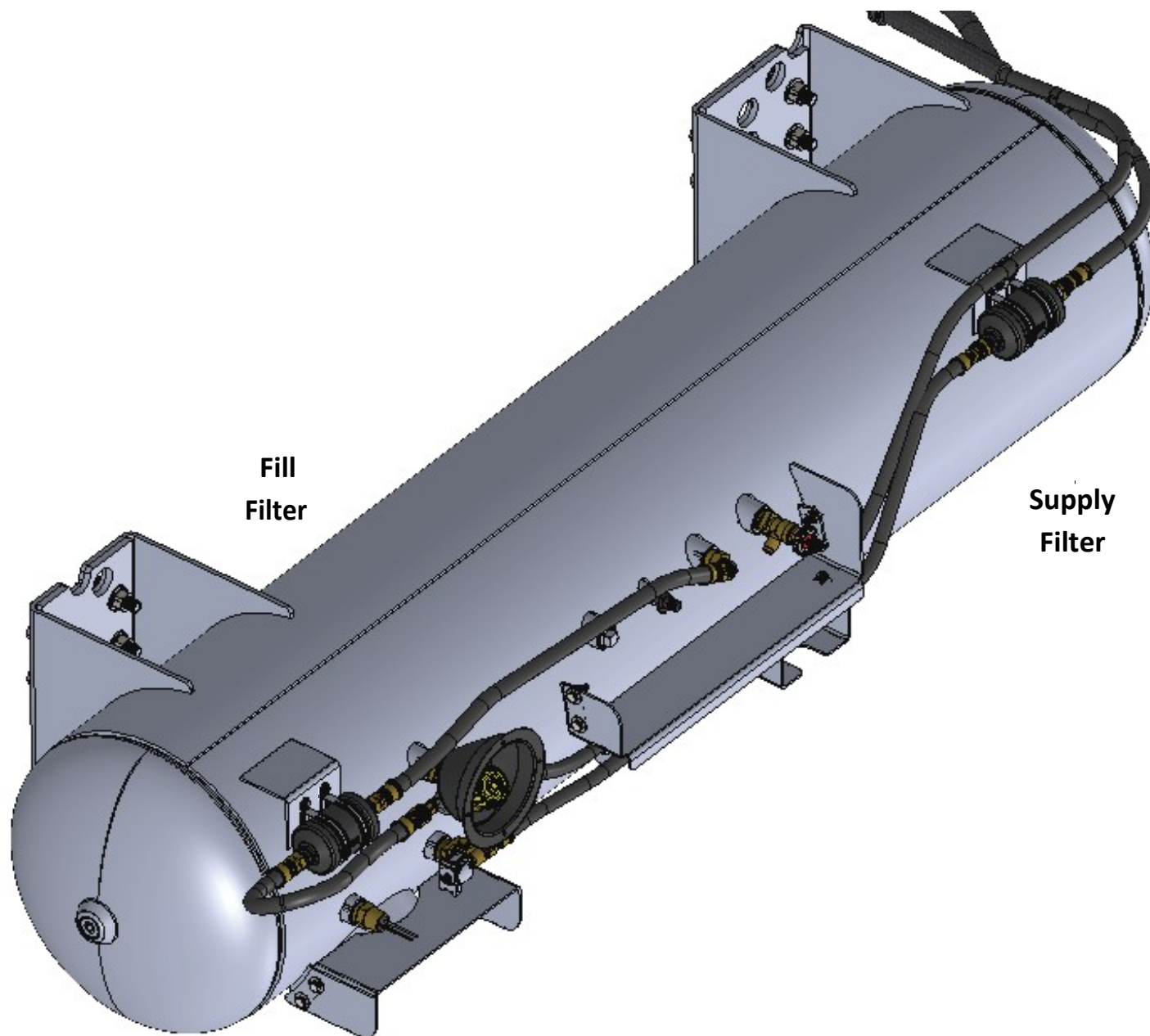
COMPONENTS

- 1) Check Valve.

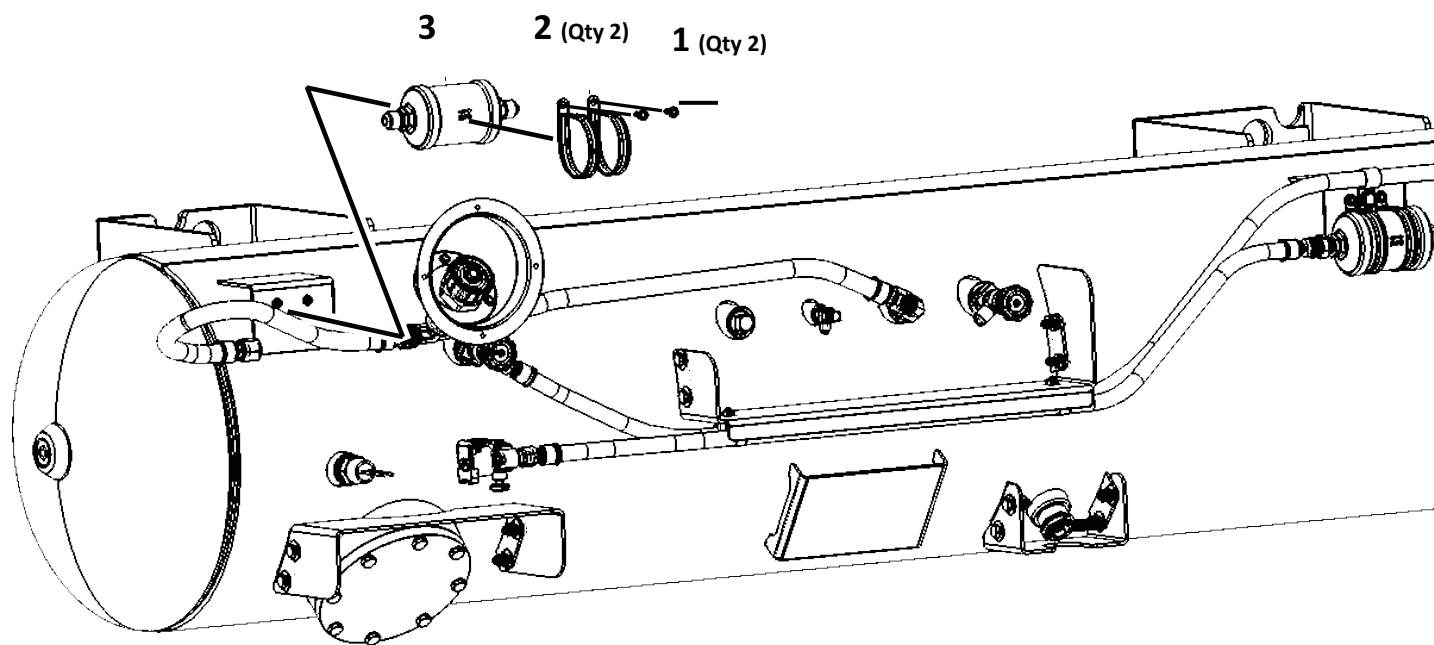
Caution: Refer to [Fastener Tightening Caution](#) on page 4.

LPI® Fuel Filters

Repair and Replace



Fill Filter Replacement MT45/55 Chassis



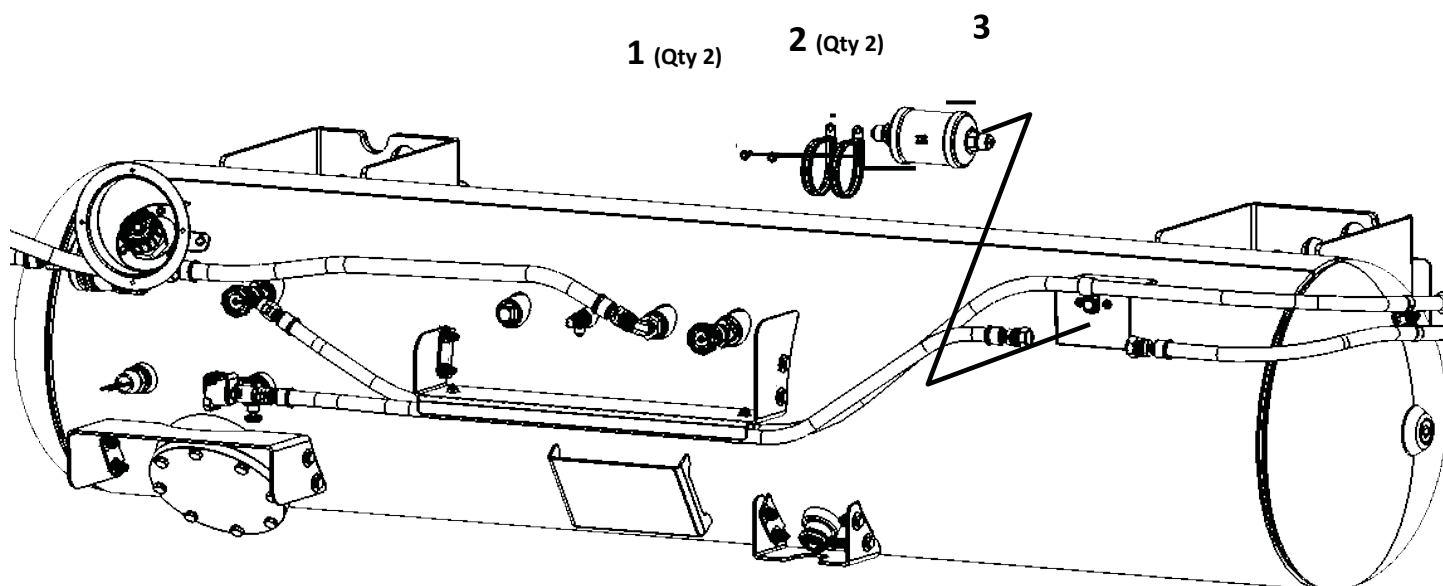
Preliminary Procedure

1. Drain the fuel lines. Refer to [LPG Fuel Line Draining](#).

COMPONENTS

- 1) Fuel Filter Clamp Bolt Fasteners. (Qty:2)
Caution: Refer to [Fastener Caution](#) on page 4. **Torque:** 7.8 N·m (69 lb in)
- 2) Filter Clamps (Qty: 2)
- 3) Fuel Filter

Supply Filter Replacement MT45/55 Chassis



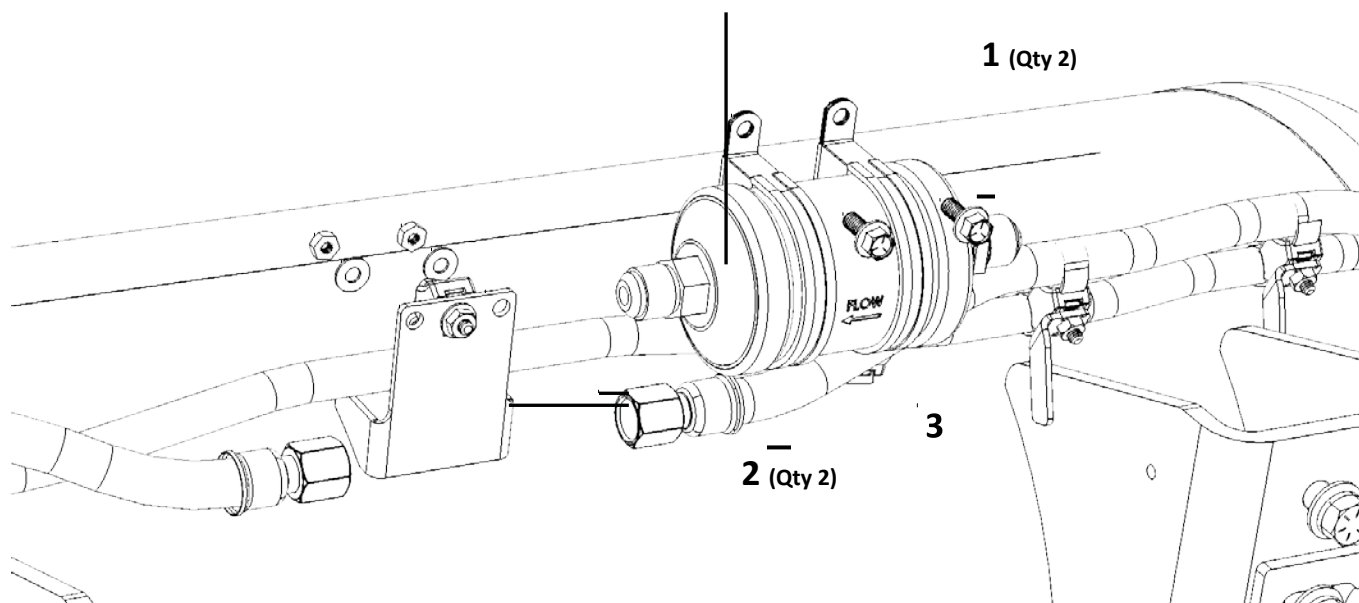
Preliminary Procedure

1. Drain the fuel lines. Refer to [LPG Fuel Line Draining](#).

COMPONENTS

- 1) Fuel Filter Clamp Bolt Fasteners. (Qty:2)
Caution: Refer to [Fastener Caution](#) on page 4. **Torque:** 7.8 N·m (69 lb in)
- 2) Filter Clamps (Qty: 2)
- 3) Fuel Filter

Supply / Fill Filter Replacement P63 Chassis



Preliminary Procedure

1. Drain the fuel lines. Refer to [LPG Fuel Line Draining](#).

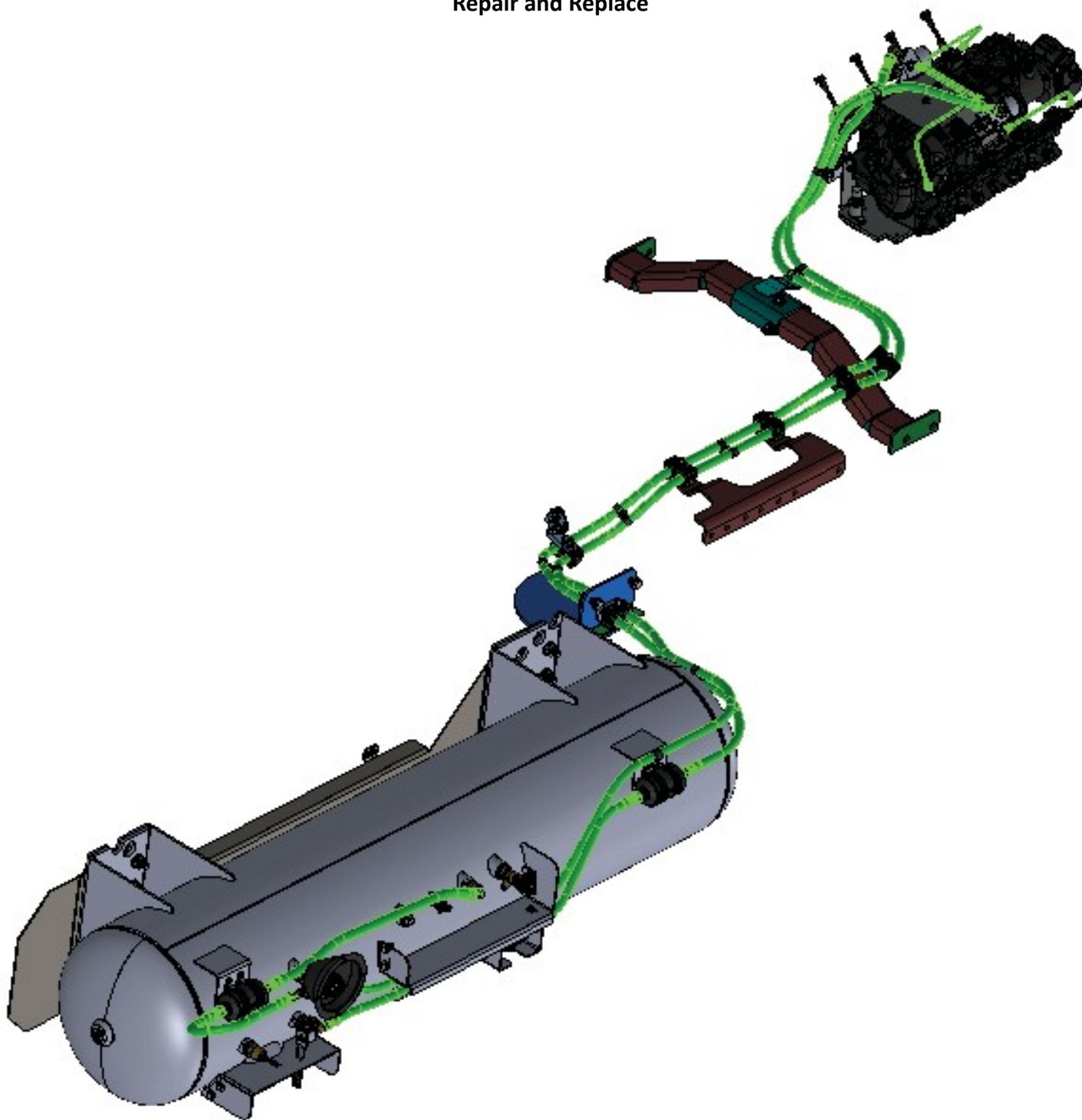
COMPONENTS

- 1) Fuel Filter Clamp Bolt Fasteners. (Qty:2)
Caution: Refer to [Fastener Caution](#) on page 4. **Torque:** 7.8 N·m (69 lb in)
- 2) Filter Clamps (Qty: 2)
- 3) Fuel Filter

NOTES:

LPI® Fuel Lines MT 45/55

Repair and Replace

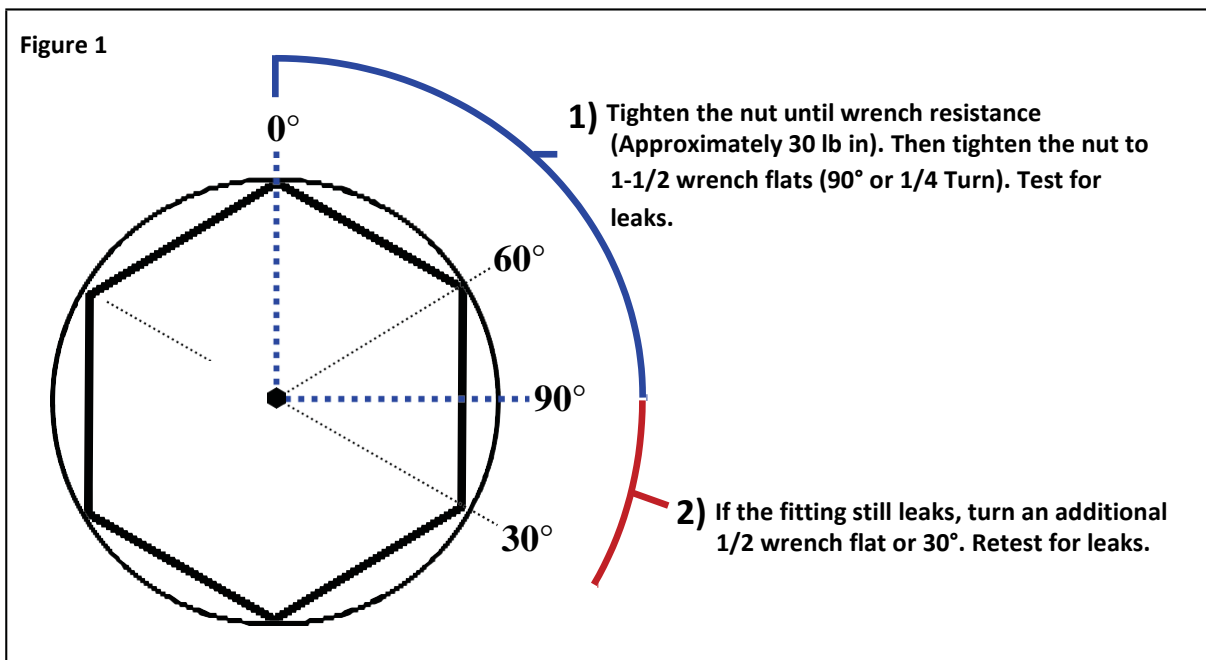


FFWR Torque (Flats from Wrench Resistance) - Fuel Line Replacement

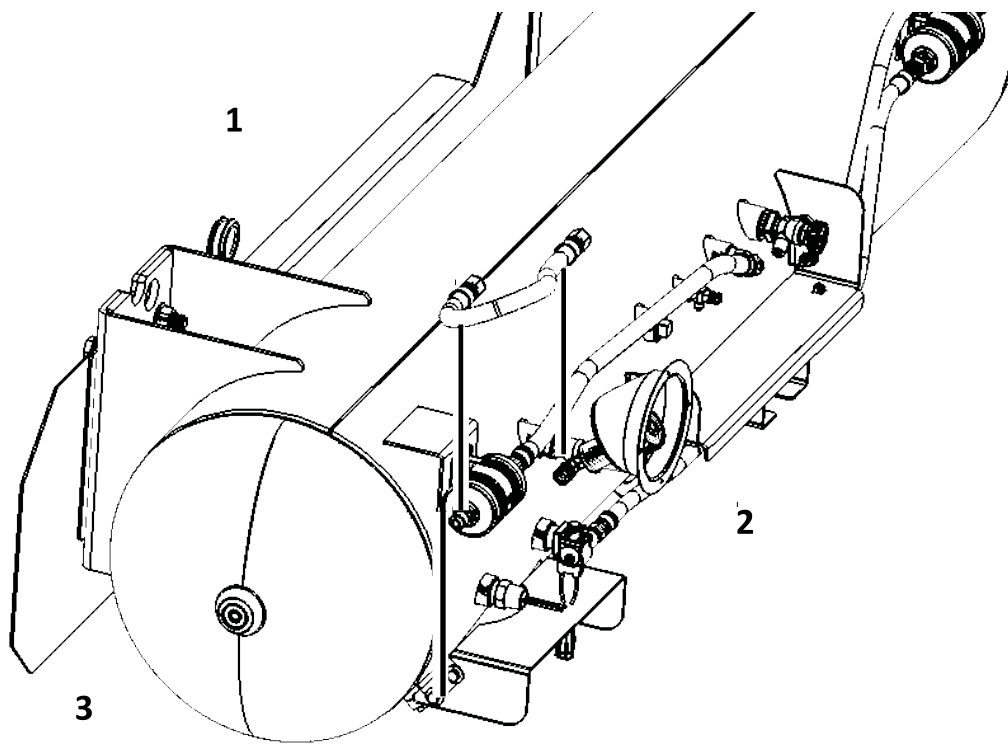
The **FFWR** method is the primary torque method and should be used whenever a fuel line is disassembled or removed. FFWR method circumvents the effects of differences in plating, lubrication, surface finishes, etc., that affect the torque value required to achieve proper joint.

Wherever possible, at the initial wrench resistance position, mark one of the flats of the nut and extend the mark on to the body hex with a permanent type ink marker. This will provide a visual reference when you tighten the nut the required number of flats (-6 and -8 hose fitting torque requirement is: 1-1/2 FFWR).

- 1) Tighten the nut lightly with a wrench (approximately 30 in.lb.), clamping the tube flare between the fitting nose and the sleeve. This is considered the Wrench Resistance (WR) position. Starting Wrench Resistance position, tighten the nut further by 1-1/2 flats. A flat is referred to as one side of the hexagonal tube nut and equates to 1/6 of a turn. **(Figure 1)** Leak check fitting assembly, if leaks are existent proceed to step 2.
- 2) Torque the nut an additional 1/2 flats. Retest for leaks **(Figure 1)**. If the fitting still leaks, follow the **LPG Fuel Line Draining** procedure, disassemble fitting and install copper seal bonnet. Retighten fitting assembly utilizing the FFWR specification and Retest for leaks.



Filler Valve to Fill Filter - Fuel Line Replacement



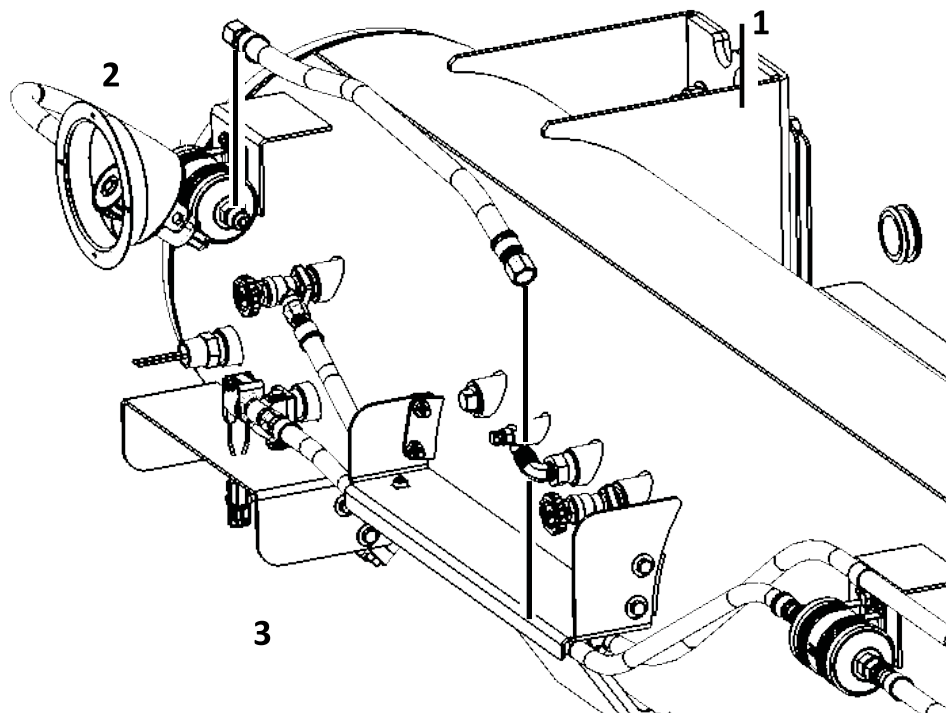
Preliminary Procedure

1. Drain the fuel lines. Refer to [LPG Fuel Line Draining](#).

COMPONENTS

- 1) Fuel Line - Fuel Fill Valve to Fill Filter
Caution: Refer to [Fastener Caution](#) on page 4. **Torque:** FFWR (Flats From Wrench Resistance) Refer to page 68
- 2) Fuel Fill Cup Assembly
- 3) Fuel Fill Filter

Fill Filter to OPD Fill Valve (Tank Fill Valve) - Fuel Line Replacement



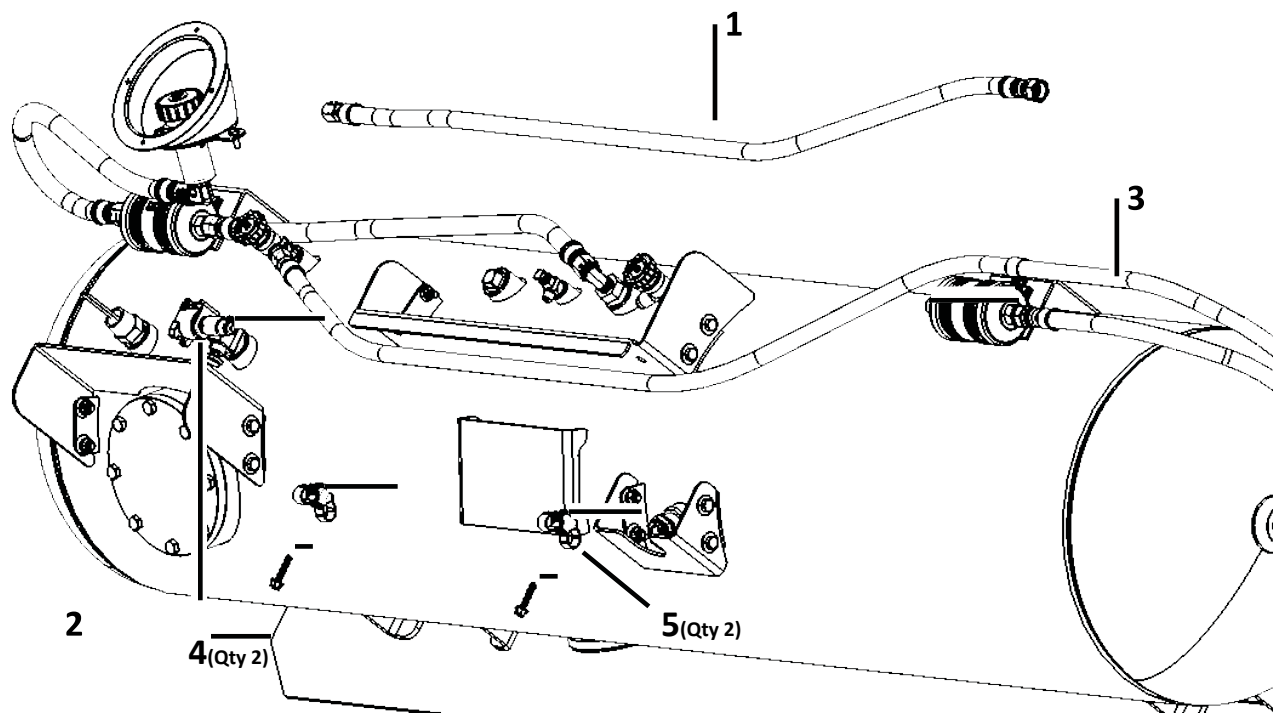
Preliminary Procedure

1. Drain the fuel lines. Refer to [LPG Fuel Line Draining](#).

COMPONENTS

- 1) Fuel Line - Fill Filter to OPD Fill Valve(Tank)
Caution: Refer to [Fastener Caution](#) on page 4. **Torque:** FFWR (Flats From Wrench Resistance) Refer to page 68
- 2) Fuel Fill Filter
- 3) OPD Fill Valve (Tank Fill Valve)

Supply Valve to Supply Filter - Fuel Line Replacement



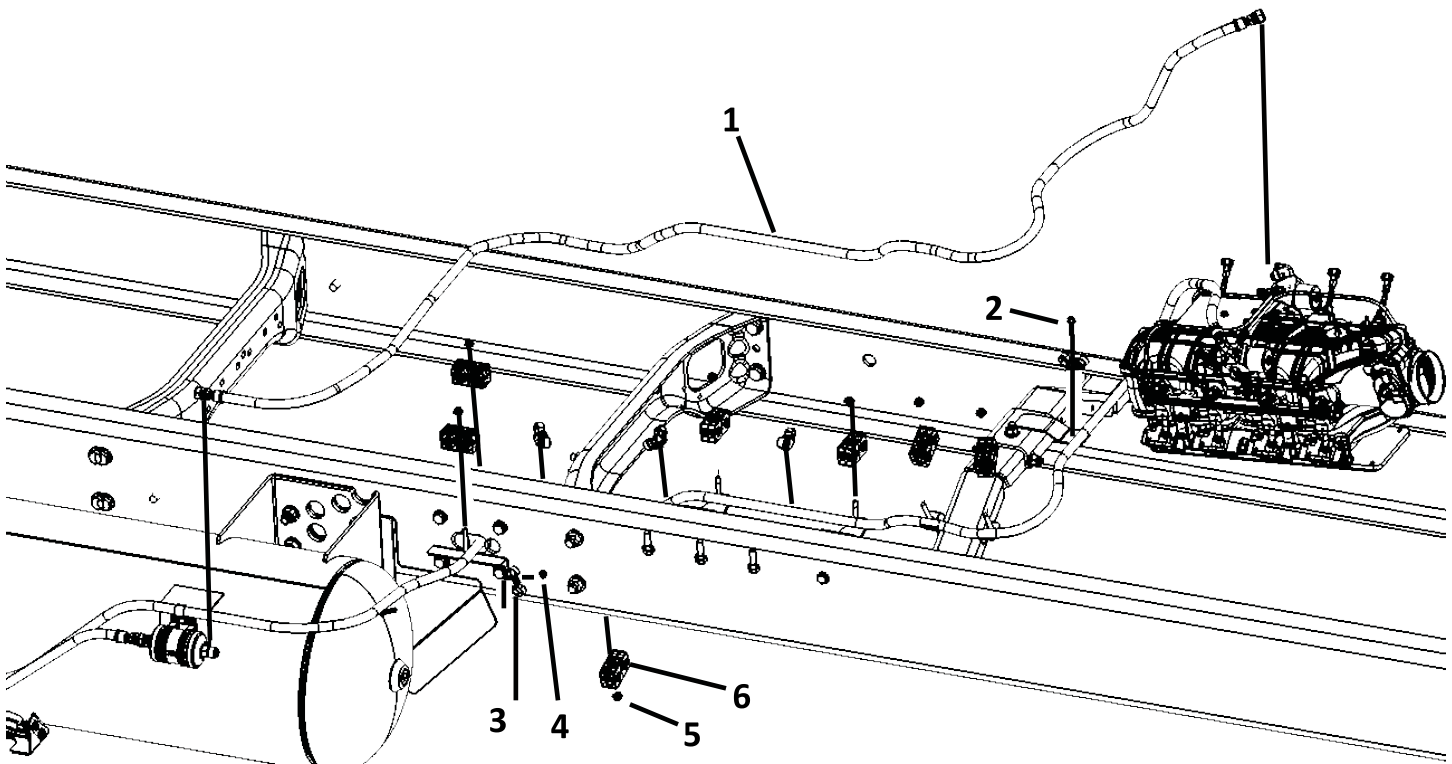
Preliminary Procedure

1. Drain the fuel lines. Refer to [LPG Fuel Line Draining](#).

COMPONENTS

- 1) Fuel Line - Supply Valve to Supply Filter
Caution: Refer to [Fastener Caution](#) on page 4. **Torque:** FFWR (Flats From Wrench Resistance) Refer to page 68
- 2) Supply Valve
- 3) Fuel Supply Filter
- 4) Fuel Line Retaining Clamp Bolts (QTY: 2)
Caution: Refer to [Fastener Caution](#) on page 4. **Torque:** 5.4 N·m (4 lb ft)
- 5) Fuel Line Retaining Clamps (QTY: 2)

Supply Filter to Supply Solenoid (Distribution Block) - Fuel Line Replacement



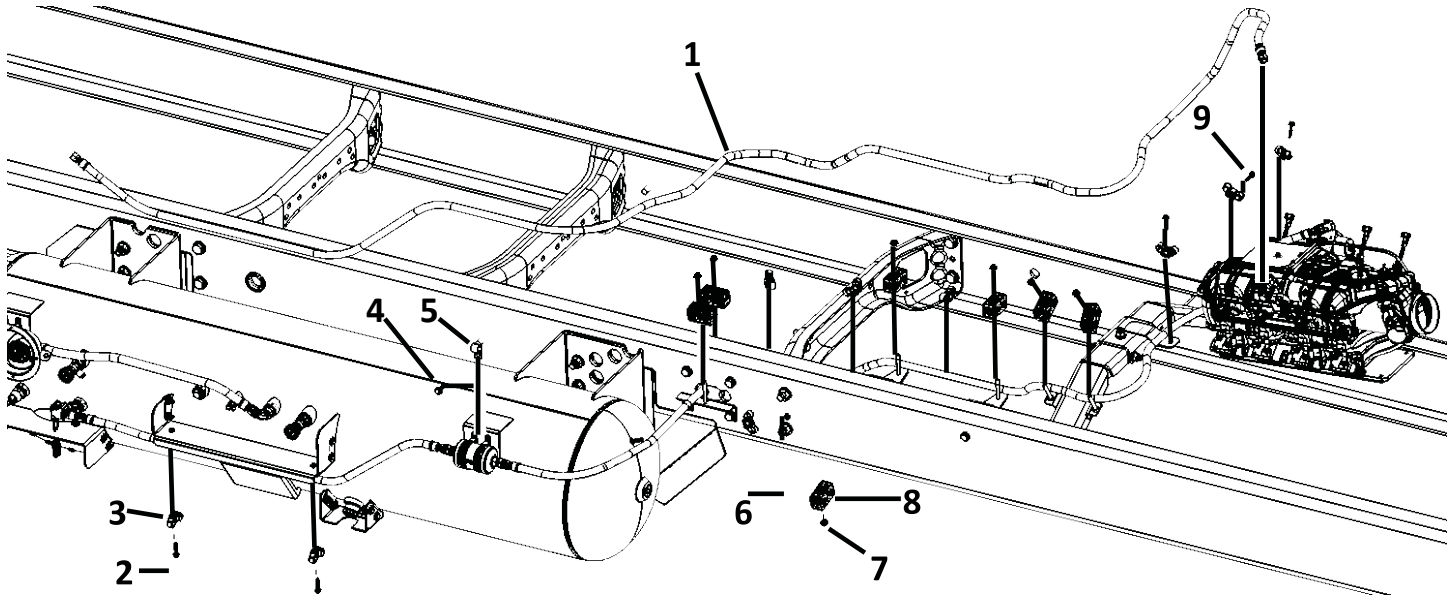
Preliminary Procedure

1. Drain the fuel lines. Refer to [LPG Fuel Line Draining](#).

COMPONENTS

- 1) Fuel Line - Supply Filter to Supply Solenoid (Distribution block)
Caution: Refer to [Fastener Caution](#) on page 4. **Torque:** FFWR (Flats From Wrench Resistance) Refer to page 68
- 2) Butterfly Zip-Tie Hose Clamp Bolt (QTY: 1)
Caution: Refer to [Fastener Caution](#) on page 4. **Torque:** 5.4 N·m (4 lb ft)
- 3) Butterfly Zip-Tie Hose Clamp (QTY: 5)
- 4) Butterfly Zip-Tie Hose Clamp nut (QTY: 1)
Caution: Refer to [Fastener Caution](#) on page 4. **Torque:** 5.4 N·m (4 lb ft)
- 5) Duel Line Hose Clamp Nut (QTY: 7)
Caution: Refer to [Fastener Caution](#) on page 4. **Torque:** 16.3 N·m (12 lb ft)
- 6) Duel Line Hose Clamp (QTY: 7)

Return Regulator (Distribution Block) to Return Valve - Fuel Line Replacement



Preliminary Procedure

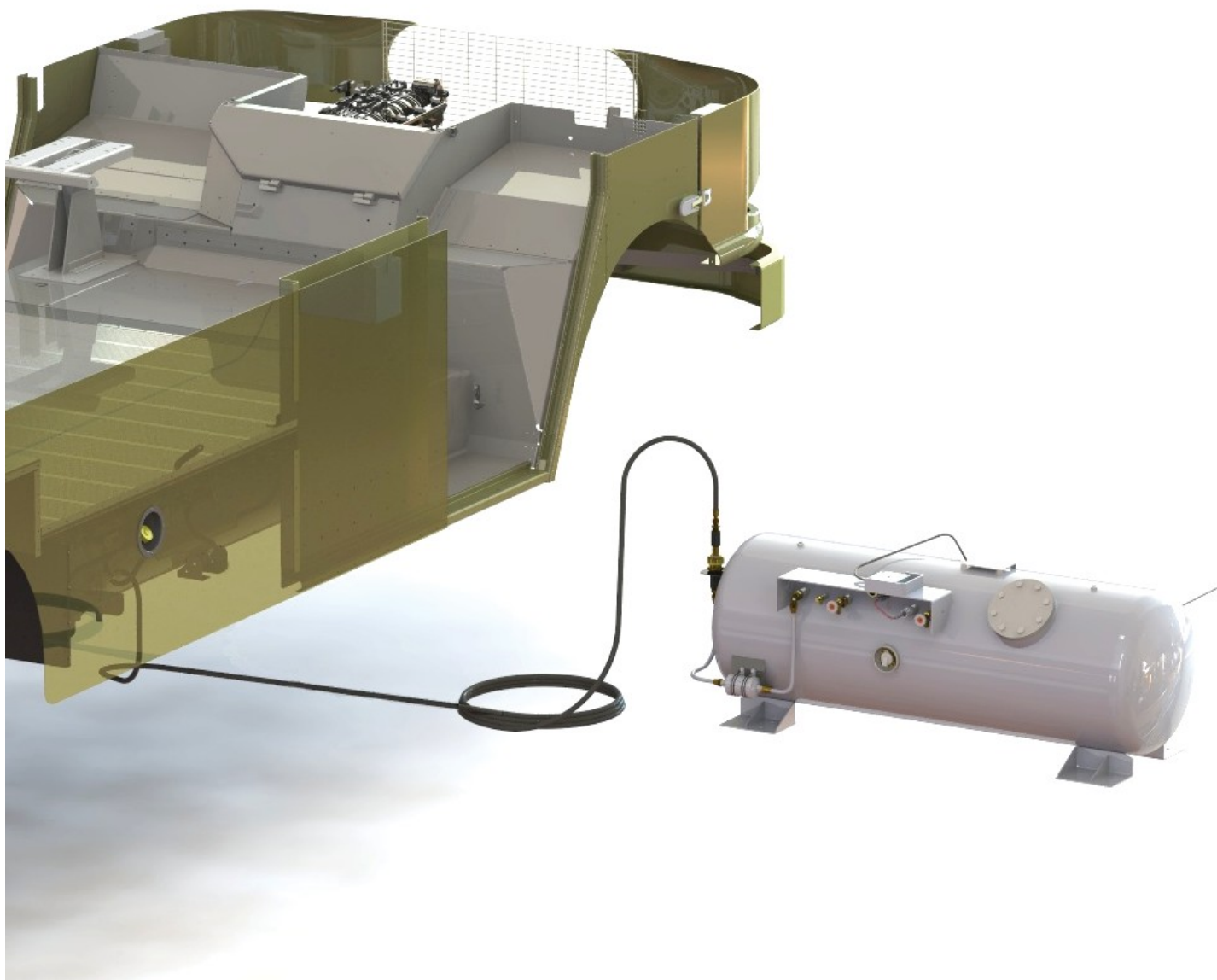
1. Drain the fuel lines. Refer to [LPG Fuel Line Draining](#).

COMPONENTS

- 1) Fuel Line - Bypass Solenoid (Distribution block) to Return Valve
Caution: Refer to [Fastener Caution](#) on page 4. **Torque:** FFWR (Flats From Wrench Resistance) Refer to page 68
- 2) Butterfly Zip-Tie Hose Clamp Bolt (1/4-20 Bolt) (QTY: 4)
Caution: Refer to [Fastener Caution](#) on page 4. **Torque:** 5.4 N·m (4 lb ft)
- 3) Butterfly Zip-Tie Hose Clamp (QTY: 9)
- 4) Single Hose Adel Clamp Bolt (M8 Bolt) (Qty: 1)
Caution: Refer to [Fastener Caution](#) on page 4. **Torque:** 24.4 N·m (18 lb ft)
- 5) Single Hose Adel Clamp (Qty: 1)
- 6) Butterfly Zip-Tie Hose Clamp Nut (1/4-20 Nut) (QTY: 1)
Caution: Refer to [Fastener Caution](#) on page 4. **Torque:** 5.4 N·m (4 lb ft)
- 7) Duel Line Hose Clamp Nut (QTY: 7)
Caution: Refer to [Fastener Caution](#) on page 4. **Torque:** 16.3 N·m (12 lb ft)
- 8) Duel Line Hose Clamp (QTY: 7)
- 9) Butterfly Zip-Tie Hose Clamp Bolt Engine Bracket (M6) (Qty: 1)
Caution: Refer to [Fastener Caution](#) on page 4. **Torque:** 11 N·m (8 lb ft)

NOTES:

LPI® Fuel Handling



Introduction to the LPI® Service Tools

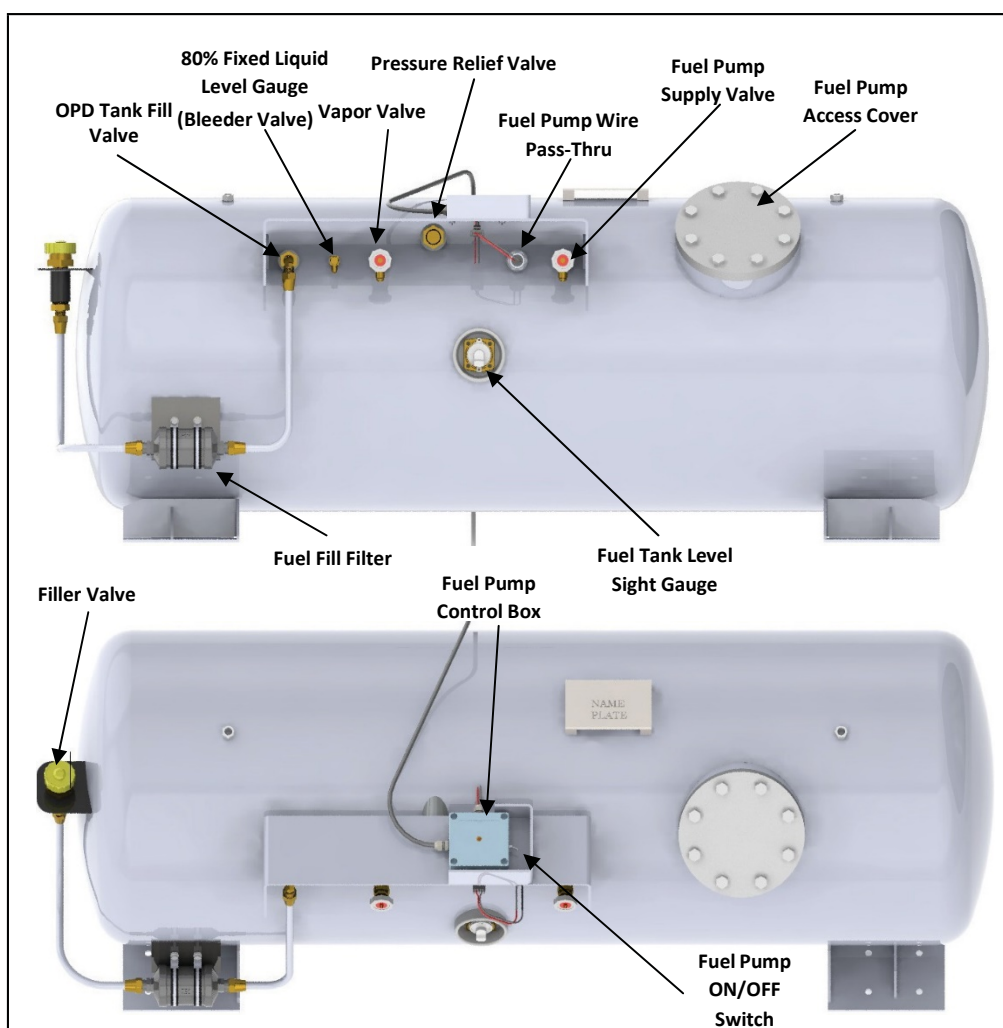
Liquid Fuel Evacuation Tank

The Liquid Fuel Evacuation Tank was designed to aid LPI® service technicians in the servicing of the CleanFUEL USA liquid propane fuel systems. This tank, if used correctly, will limit the amount of wasted liquid propane typically associated in the event of servicing propane powered vehicles.

The main benefit of this service tank is to not only receive fuel but transfer the fuel back to the vehicle tank that is being serviced. The Liquid Fuel Evacuation Tank utilizes an LPI® fuel pump to transfer the liquid propane fuel.

The Liquid Fuel Evacuation Tank utilizes many valves currently used on our LPI® vehicle tanks. However, the valves on the Liquid Fuel Evacuation Tank have greater flow capabilities which result in a faster transfer of fuel back to the vehicle. The fill valve is filter protected to limit the amount of debris entering the Liquid Fuel Evacuation Tank.

The electrical system powering the fuel pump inside the Liquid Fuel Evacuation Tank utilizes jumper style clamps that connect easily to any 12V automotive battery. The system is fuse protected with a 20 amp fuse located on the positive battery lead. The fuel pump control box is located on the tank guard. The control box contains the fuel pump ON/OFF switch, as well as a fuel pump ON warning light.



LPI® Service Tool Kit

The LPI® Service tool kit is an essential tool to help a technician effectively diagnose and aid in the servicing of the LPI® fuel system.

The LPI® Service Tool Kit comes with a complete pressure gauge assembly that will allow a technician to connect directly into the LPI® system pressure port enabling system fuel pressure reading and diagnosing the LPI® fuel pump.

The kit also includes various servicing features; the pressure gauge can double as a way of draining the fuel lines. Included are various fuel pump switched relay bypass adapters. The bypass adaptors will give the technician the ability of turning the fuel pump ON and OFF with out having to turn the key ON.

The kit also includes a 40' service evacuation hose used in the tank evacuation process. To aid in this process, a tank evacuation adaptor is provided. This allows the user to fill directly into the tank via the fill valve, saving the time of disconnecting any hoses.



CAUTION

Due to the safety back checks built into the gauge assembly (pressure gauge pig-tail, LPI system pressure pig-tail, and gauge assembly) It is imperative that the fuel gauge assembly is completely drained by using the bleeder valve before disconnecting the pig-tails. This procedure is required to be completed outdoors, away from any ignition sources. Liquid propane trapped in the hose could cause severe burns. Wear gloves while

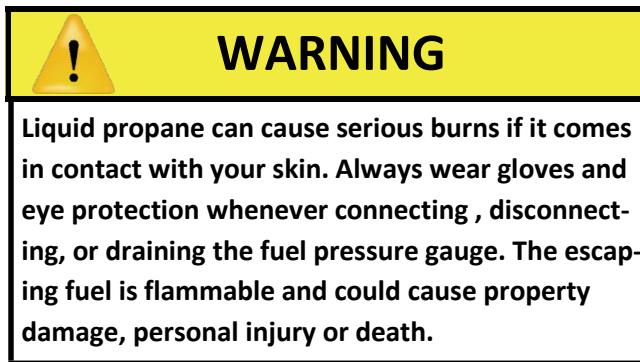
LPI® Fuel System Pressure Test

Test Procedure

The fuel pump is the heart of the system. Propane maintains pressure in the tank and could be delivered to the engine as a liquid just from the pressure in the tank however as the engine gets warmer the ability to maintain it in a liquid state at the injector would be impossible. Therefore a pump is utilized to boost the pressure and circulate the fuel back to the tank while the engine is running. There are 4 considerations when checking fuel pressure.

1. Tank Pressure: The internal pressure of the tank at any given ambient temperature or operating condition.
2. Priming Pressure: The amount of boost pressure during the 7 second prime will be less than full boost pressure because a solenoid opens to bypass the regulator which fills the injectors with liquid pushing all the vapor back to the tank.
3. Operating Pressure: The amount tank pressure with fuel pump boost pressure delivering engine while it is running.
4. Fuel Pump Boost Pressure: The amount of pressure the pump increases over tank pressure. Tank pressure subtracted from operating pressure is FP boostpressure.

To check fuel pressure connect the 0 to 400 PSI fuel gauge from the LPI® tool kit to the fuel pressure test port. The fuel pressure test port is a SCHRADER valve located on the drivers side fuel distribution block at the rear. The engine cover will need to be opened to gain access to the valve. Wear gloves when connecting/disconnecting the test gauge adaptor as liquid fuel can cause freeze burns.



1. Turn ignition key on, observe the wait to start light and start the engine when it goes out (7 seconds after key is turned on).
2. Document the **operating pressure** with engine running.
3. Turn engine off and ignition key to the off position.
4. Document the pressure (give it 30 seconds or so to equalize). This is considered **tank pressure**.
5. Turn on the ignition key and document the pressure while the wait to start light is on; this is **priming pressure**. We check this just to prove that the bypass solenoid is operating. If the solenoid was not closing, a low operating pressure would result and a mistaken diagnosis could lead to an unnecessary fuel pump replacement. If the solenoid did not open, a hard start could be the result.


LPI® Fuel Pressure Test CONTINUED...

6. Subtract tank pressure from the operating pressure. This is the **fuel pump boost pressure**.
7. A low fuel pump boost pressure would cause hard starting, reduced power during acceleration. If fuel pump boost pressure is less than 40 psi, the pump should be scheduled for replacement. Fuel pump boost pressure exceeding 60 psi would be caused by restriction or regulator is not opening. Unless boost pressure is extremely high (over 90 psi) engine operating characteristics should not be affected.
8. Tank pressures will be different depending on ambient temperature or how long the engine has been running. There is a certain amount of heat that returns to the tank with the circulating fuel, however, this heat is dissipating rapidly as it returns into the vapor space of the tank. Accurate internal tank pressure is important to determine fuel pump performance.

Specifications:			
LPI® Fuel Pump Performance Table			
	Example 1	(Tank Pressure being the Base Pressure Varies Depending Ambient Tempature)	Example 2
Operating Pressure (OP)	175		120
Tank Pressure (TP)	125		70
Priming pressure	160		105
Fuel Pump Boost Pressure (Subtract Tank pressure from operating pressure to obtain)	50		50

The fuel pressure test should be implemented as part of a scheduled maintenance. It is recommended to document fuel pump pressure at each scheduled maintenance and keep a record. This way it is likely to identify a weak pump prior to it failing. If the fuel pump fails the engine will not run.

It is also recommended not to run the pump dry of fuel. The most critical time is when the low fuel warning light has illuminated. In hilly terrain fuel can slosh away from the pump causing the pump to run dry. The tank has a baffle and check valve in the baffle to trap liquid around the pump. Since the propane tank design is cylindrical, it is not possible to have a low spot (a well) for the fuel pump as many gasoline tanks are designed. If the tank is low on fuel it is not recommended to leave the engine idling for long periods of time, as the fuel around the pump could be consumed and the engine would die. If this happened, rocking the vehicle would allow the fuel on the back side of the baffle to pass over into the fuel pump area so the vehicle could be started and driven to a fueling station. There is plenty of fuel around the fuel pump to not cause a problem in stalled traffic, however, if the low fuel indicator light is illuminated, it is recommended to refuel immediately, as there is a risk of stalling due to no fuel. Always turn the engine off if the vehicle is parked or sitting still. Save fuel and reduce emissions.



CAUTION

Always be sure to drain evacuation hose and gauge assembly after every use. Trapped liquid propane can cause damage to the service tool. If left for a long period of time.

Evacuate/Drain Liquid fuel from a LPI® Tank for Service

The safest ways to evacuate a propane tank:

- 1) Use up as much fuel as you can by driving the vehicle. (Get the fuel gauge to read around 1/16th of tank.) Then continue to procedure number 2, 3 or 4.
- 2) Transfer the liquid fuel to the Liquid Fuel Evacuation Tank, then continue to procedure number 4.
- 3) Transfer the liquid fuel to a empty propane tank, then continue to procedure number 4.
- 4) Burn the fuel through a certified propane flare stack.

Never release propane to the atmosphere where conditions would not permit:

- 1) The volume required to be released is excessive. (Greater than 1 gallon of liquid)
- 2) Where there are buildings, structures in close quarters.
- 3) When there is no wind to dilute the releasing fuel to a non-combustible limit of flammability.

It is never recommended to release to the atmosphere. In all cases when it is necessary to release fuel to the atmosphere all sources of ignition, clearances and wind condition must be considered. It is recommended if you cannot transfer the fuel to an empty tank that you burn the fuel through a certified propane flare stack.

Utilizing the fuel pump in the tank being serviced is the quickest way of evacuating the fuel out of the tank. However if the fuel pump is not operational it may be required to create a lower pressure in the tank being used to store the evacuated fuel. This can be achieved by opening the 80% fixed liquid level gauge (bleeder valve) on the liquid fuel evacuation tank, or empty propane tank being used in the evacuation process.



WARNING

Never service a tank inside a building. Always perform the evacuation process outside with 35' to 50' of clearance from any combustible materials, buildings or structures. Always remove any possible sources of ignition when performing the evacuation. If it is required to release fuel to the atmosphere, do so with the utmost safety and consideration to distance from the vehicle, a building or structure, wind direction & wind speed and adjacent properties. Use of a vent stack to dissipate the fuel and prevent the accumulation of a combustible mixture is a consideration. The person and company performing the work is liable for their action and must be properly trained, insured and licensed. The NFPA (National Fire Protection Association) document Number 58 states in chapter 1, "General Provisions 1-5 Qualification of Personnel: Persons who transfer liquid LP-Gas, who are employed to transport LP-Gas or whose primary duties fall within the scope of this code shall be trained in the proper handling procedures. Refresher training shall be provided at least every three years. The training shall be documented."

For more information contact your local, state or National Propane Gas Association and ask about certified employee training programs. For more information on NFPA or to order the LP-Gas Code handbook call NFPA at 1-800-344-3555 or visit the website at www.nfpa.org.



WARNING

Wear gloves while transferring or handling liquid propane. Liquid propane can cause severe burns upon skin contact much like frost bite.

LPG Fuel Line Draining

Draining Procedure

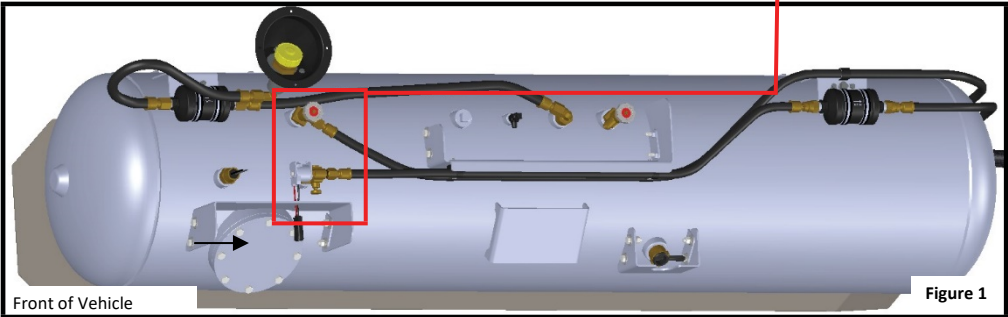
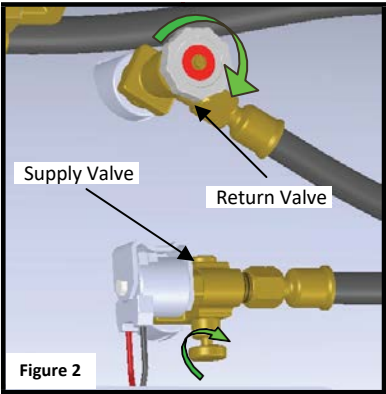
- 1) Locate and shut off the supply and return valves on the tank LPI® Tank. (Figures 1 and 2)
 - A. To shut off the supply valve, turn the valve handle clockwise until it reaches its stop.
NOTE: Damage may occur if the valve is over tightened.
 - B. To shut off the return valve, turn the valve handle clockwise until it reaches its stop.
NOTE: Damage may occur if the valve is over tightened.
- 2) Slowly crack open the supply and return lines that are connected to the supply and return valves. Crack the line until a white mist appears. When the white mist starts to disappear, crack the line open until there is absolutely no pressure.
Note: It is important to drain both the supply and return lines. This will ensure all pressure is removed from the fuel rails and lines.
- 3) Disconnect the supply and return lines from the valves until all service work is finished.
Note: Protect or cover openings from dirt, water, or insects.

Reconnecting the Fuel lines

- 1) Once the service work has been finished, reconnect the fuel lines to their designated supply or return valve.
- 2) Torque all line flare nuts: utilizing FFWR (Flats From Wrench Resistance) Torque. Refer to page 68
- 3) Be sure to open the supply and return valves after servicing.
NOTE: Damage may occur if the valve is over tightened.

Warning

Wear gloves and eye protection when opening a propane line that may contain liquid propane. This procedure is required to be performed outdoors unless the fuel line has been depressurized outside prior to pulling the vehicle into the garage. Liquid propane escaping from a fuel line can cause severe freeze burns much like frostbite. Do not release propane inside a garage or building. Eliminate all sources of ignition prior to depressurizing a fuel line. Ignition of propane vapors can cause property damage and or serious injury.



Evacuate/Drain liquid fuel from the Liquid Service Valve on the LPI® Fuel Tank (Pressure Equalization Method)

- 1) Locate the liquid evacuation service valve on the LPI® tank that needs to be evacuated/drained (This valve does not have any hoses connected to it and is covered with a cap for safety reasons.)
- 2) Making sure the service valve is shut all the way off. Turn valve clockwise until valve is fully seated. **Caution: Do not over tighten damage to the valve may occur. Figure 1**

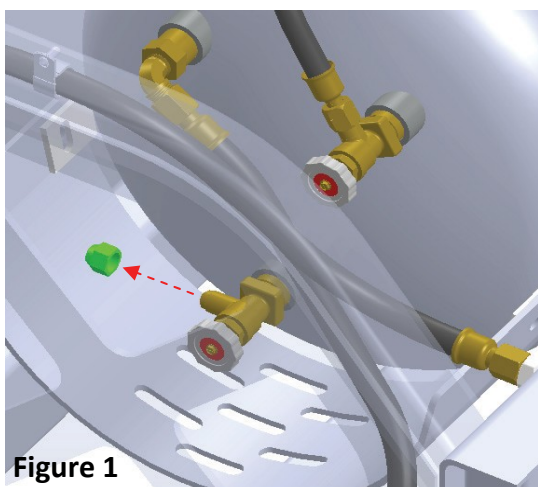


Figure 1

- 3) Connect service evacuation hose to the Liquid Evacuation Service Valve. **Torque: Fully Seated Not Stripped, Not Leaking. Figure 2**

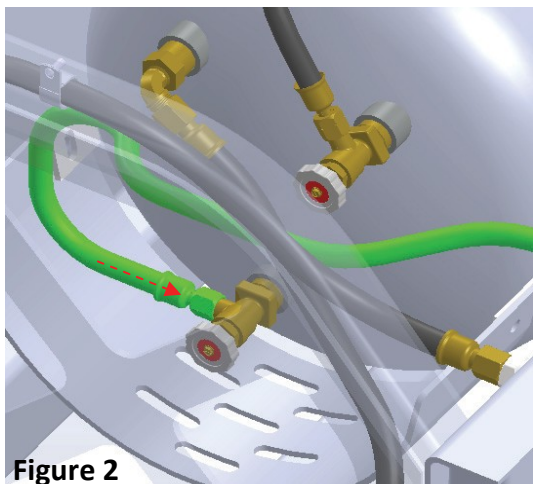


Figure 2

- 4) Connect service evacuation hose to the evacuation adapter. **Torque: Fully Seated Not Stripped, Not Leaking. Figure 3**

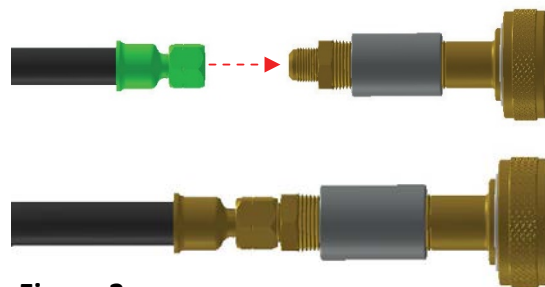


Figure 3

- 5) Remove the filler valve cap from the liquid fuel evacuation tank. **Figure 4**



Figure 4

- 6) Connect tank evacuation adapter to liquid fuel evacuation tank's filler valve. **Torque: Fully Seated Not Stripped, Not Leaking Figure 5.**

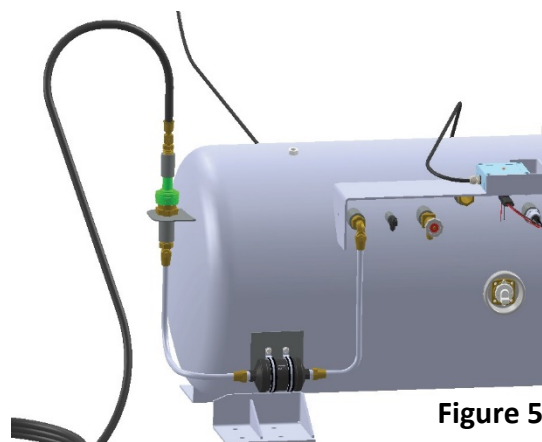
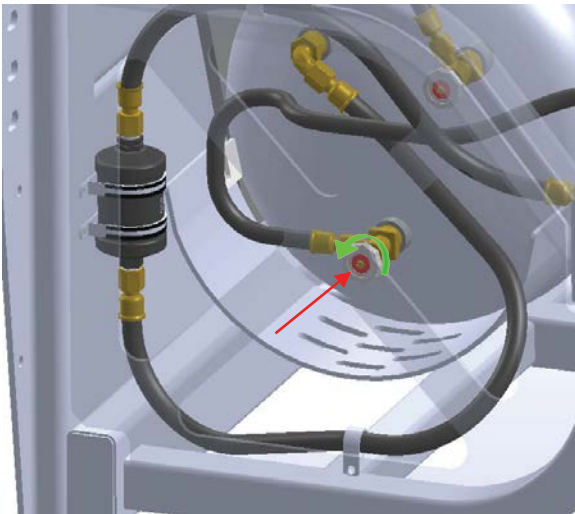


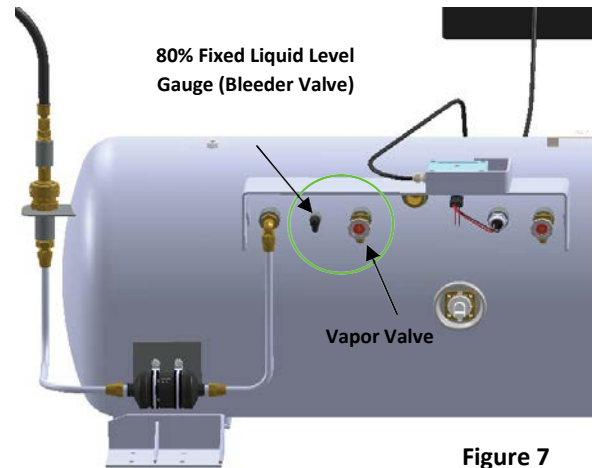
Figure 5

- 7) Slowly open the liquid evacuation service valve counter clockwise. An audible noise from the fill valve on the liquid fuel evacuation tank might be heard at this time. If the receiving tank is empty and has no vapor pressure the liquid service valve's excess flow protection may close, stopping or decreasing the flow. The liquid service valve on the LPI® vehicle tank is equipped with excess flow protection and will only allow the flow of approximately 2.4 gpm (gallons per minute). If the flow exceeds this, the excess flow will close and the valve will need to be closed and re-opened slowly to reset the excess flow and restart the fuel transfer process. **Figure 6**

**Figure 6**

- 8) Open the liquid fuel evacuation tank's vapor service valve or 80% fixed liquid level gauge bleeder. If the area where this work is being performed is not suitable to release propane vapor, it might be advisable to use a torch or flare stack to burn the releasing fuel preventing accumulation of the vapor which could possibly create a flammable mixture and be dangerous. **Figure 7**

Note: Always locate torch upwind of both propane tanks being utilized.

**Figure 7**

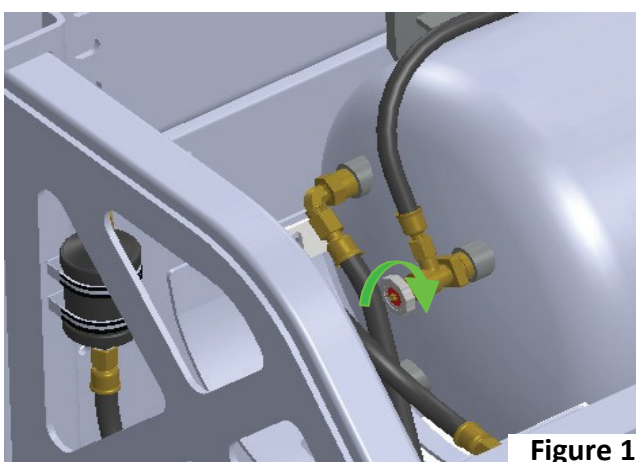
WARNING: Check for leaks on the evacuation tank, evacuation hoses and fittings before lighting the torch or flare stack.

CAUTION: Do not release any vapor pressure from the tank being evacuated. This would decrease the pressure differential between the two tanks and would slow the transfer process.

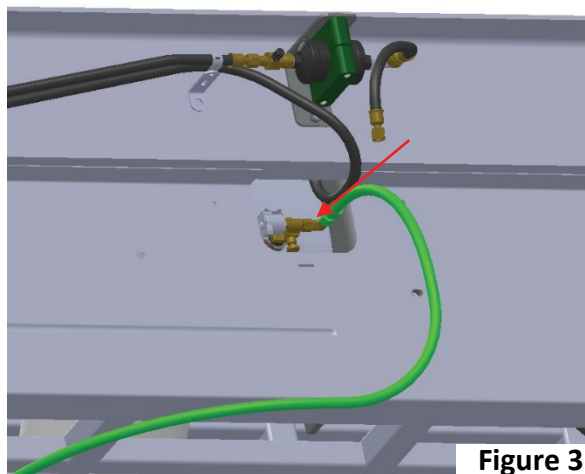
- 9) Open the liquid service valve for more flow. If the flow rate is exceeded the excess flow valve could close.
- 10) The person performing this procedure must be trained and familiar with the properties and characteristics of propane gas. This person must be in attendance of this procedure until it is complete. If the person must leave the evacuation process then all valves should be shut off and the process would require restarting upon return.
- 11) When the tank being evacuated is empty of liquid or the flow of liquid has stopped, turn off all valves and disconnect evacuation hose.
- 12) With the liquid drained from the tank, the remaining vapor in the tank must be removed and tank pressure reduced before safely servicing the tank.

Evacuate/Drain Liquid fuel from the Liquid Supply Valve on the LPI® Fuel Tank (Fuel Pump Method)

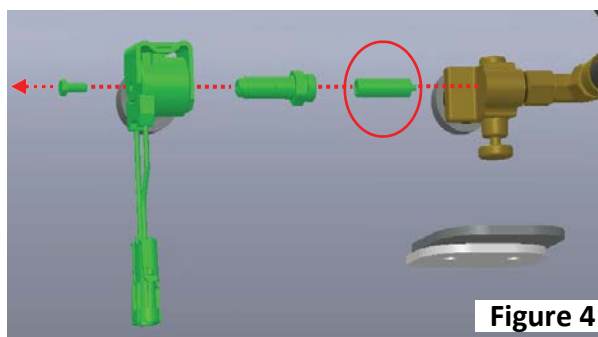
- 1) Locate the liquid supply and return valves on the LPI® Tank that needs to be evacuated/drained.
- 2) Shut off both valves by turning valve handle clockwise until the valve is fully seating. **Caution: Do not over tighten damage to the valve may occur. Figure 1 & 2**



- 3) Connect Service Evacuation Hose to the supply valve. **Torque: Fully Seated Not Stripped, Not Leaking. Figure 3**



- 4) Disconnect electrical connector on solenoid. Remove solenoid retaining bolt, slide off solenoid. Remove solenoid post and leaving out the plunger assembly. (circled on figure 4) install empty solenoid post back on supply valve. Use motor oil to lube O-ring. **Torque: Fully Seated Not Stripped, Not Leaking. Figures 4 & 5**



- 5) Connect service evacuation hose to the liquid evacuation adapter. **Torque: Fully Seated Not Stripped, Not Leaking. Figure 6**

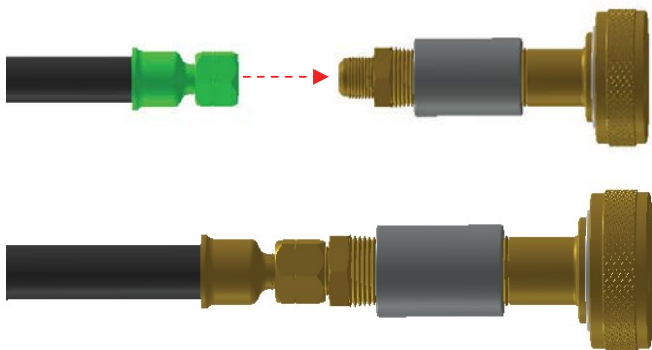


Figure 6

- 6) Remove the filler valve cap from the liquid fuel evacuation tank **Figure 7**.



Figure 7

- 7) Connect tank evacuation adapter to liquid fuel evacuation tank's filler valve. **Torque: Fully Seated Not Stripped, Not Leaking Figure 8**

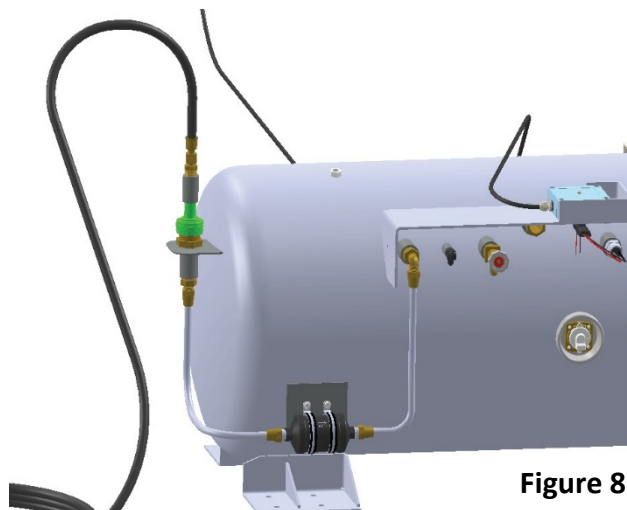


Figure 8

- 8) Slowly open the supply valve counter clockwise. An audible noise from the fill valve on the liquid fuel evacuation tank might be heard at this time. If the receiving tank is empty and has no vapor pressure the liquid service valve's excess flow protection may close, stopping or decreasing the flow. The supply valve on the LPI® vehicle tank is equipped with excess flow protection and will only allow the flow of approximately 2.4 G.P.M. (Gallons Per Minute). If the flow exceeds this the excess flow will close and the valve will need to be closed and reopened slowly to reset the excess flow and restart the fuel transfer process. **Figure 9**

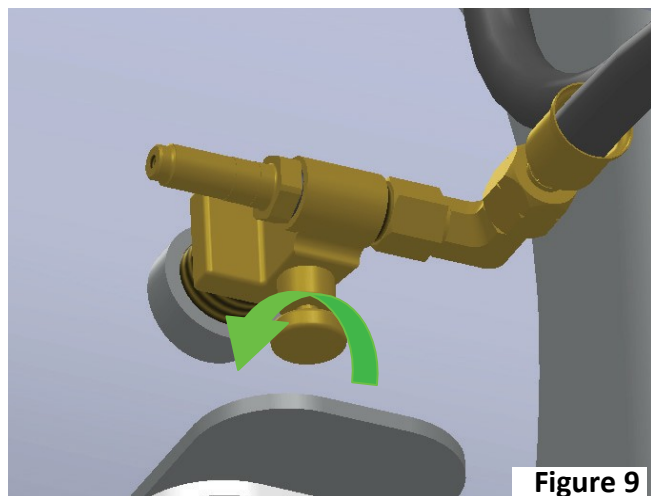


Figure 9

- 9) The internal pump can now be utilized to transfer the fuel from the vehicle being serviced to the liquid service evacuation tank. Utilizing one of the relay jumpers, locate the fuel pump relay in the under hood fuse panel. Unplug the fuel pump relay, replace with jumper and turn the switch to the "ON" position.
- NOTE: It is important to go back to the tank and check that the fuel pump can be audibly heard. If the fuel pump cannot be heard turn off jumper and check fuel pump wiring before proceeding.**

- 10) The person performing this procedure must be trained and familiar with the properties and characteristics of propane gas. This person must be in attendance of this procedure until it is complete and cannot leave the process unattended. If the person must leave the evacuation process then the fuel pump jumpers must be removed, all valves should be shut off and the process would require restarting upon return.

- 11) It is important to check the fuel level on the tank being serviced. If the fuel pump is not going to be replaced during the service event it is important to stop the pump once the fuel level drops below 1/8th. Any lower will risk a pump failure.

- 12) When the tank being evacuated is finished, pull fuel pump relay jumper and replace with OEM relay, turn off all valves and disconnect evacuation hose. Replace solenoid plunger and solenoid tower. **Torque: Fully Seated Not Stripped, Not Leaking.**

Evacuate/Drain Vapor Fuel from the Vapor Valve on the LPI® Fuel Tank -

Figure 1

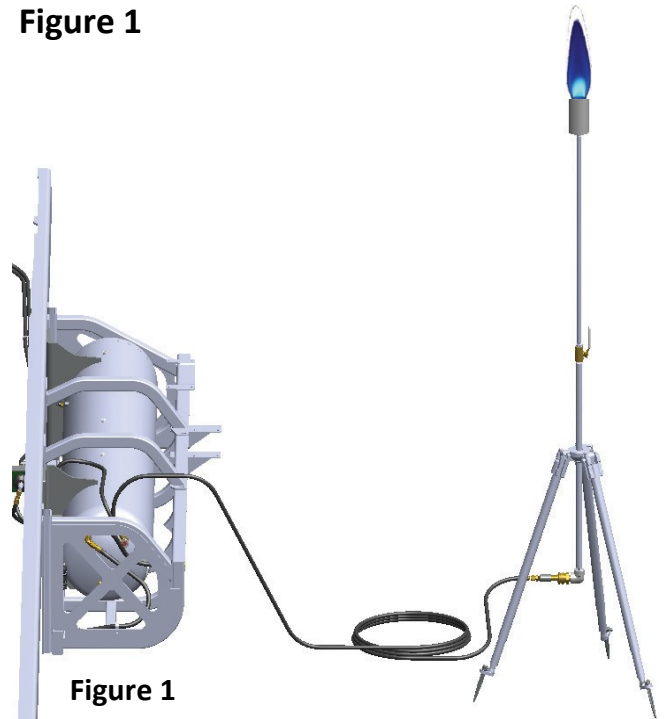


Figure 1

- 1) Locate the vapor return valve and liquid service valve on the LPI® tank that need to have the vapor evacuated/drained. Make sure both valves are turned off.
- 2) Disconnect the vapor return line from the vapor return valve on the LPI® tank. **Caution: This line is pressurized, Refer to LPI® Fuel line Draining prior to disconnecting.** Figure 2

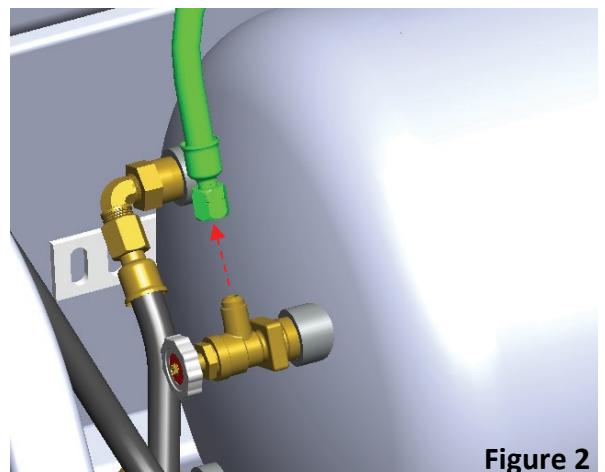


Figure 2

- 3) Connect service evacuation hose to vapor return valve. **Torque: Fully Seated Not Stripped, Not Leaking. Figure 3**

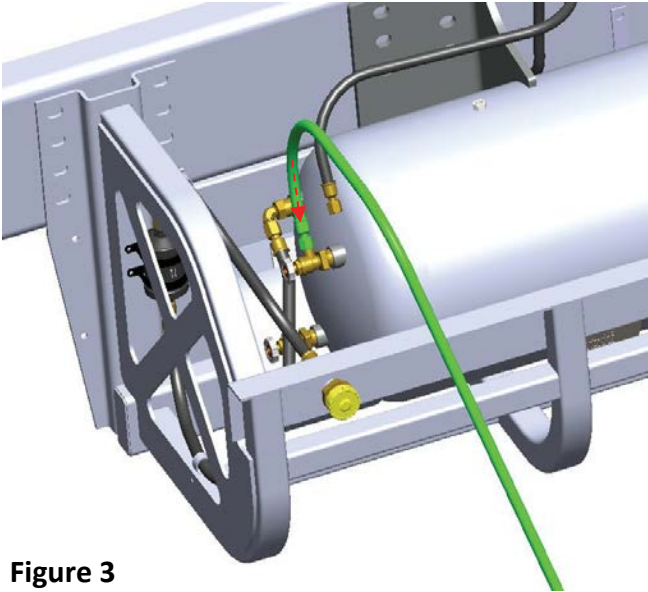


Figure 3

- 4) Connect service evacuation hose to the liquid evacuation adapter. **Torque: Fully Seated Not Stripped, Not Leaking. Figure 4**

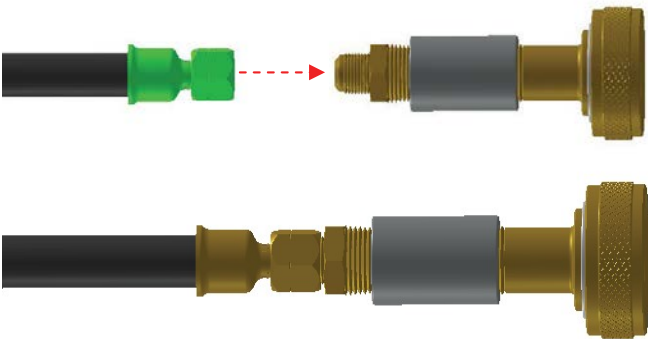


Figure 4

- 5) Connect tank evacuation adapter to the flare stacks filler style valve. **Torque: Fully Seated Not Stripped, Not Leaking Figure 5**

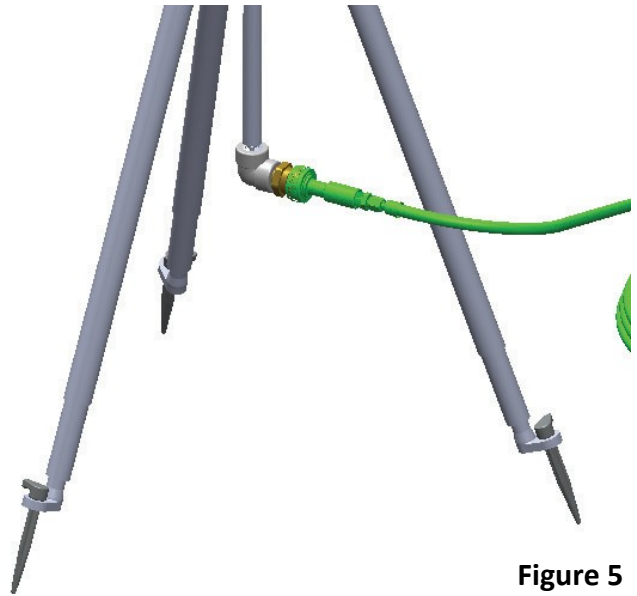


Figure 5



Warning

The vapor flare stack is to be used with VAPOR propane only. Utilizing this flare stack is ONLY to be used OUTSIDE, 25' from buildings vehicles, and other combustible materials. Keep flare stack as far away from the vehicle up wind from the tank being service. Failure to heed could result in death, injury or property damage.

- 6) Close ball valve to the OFF position on the flare stack. **Figure 6**

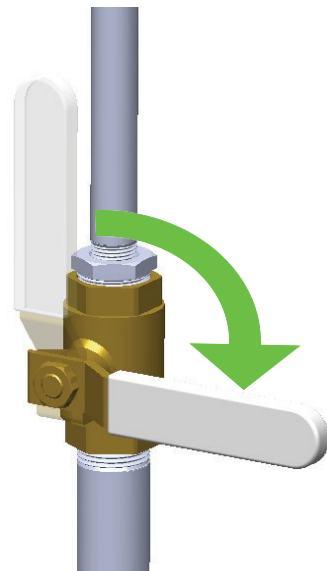
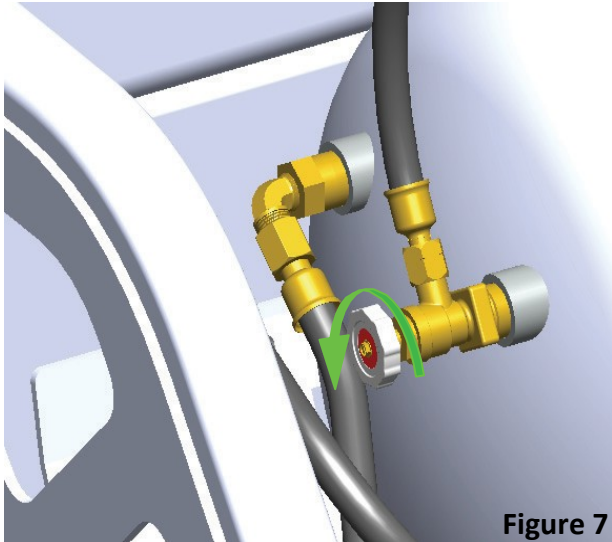


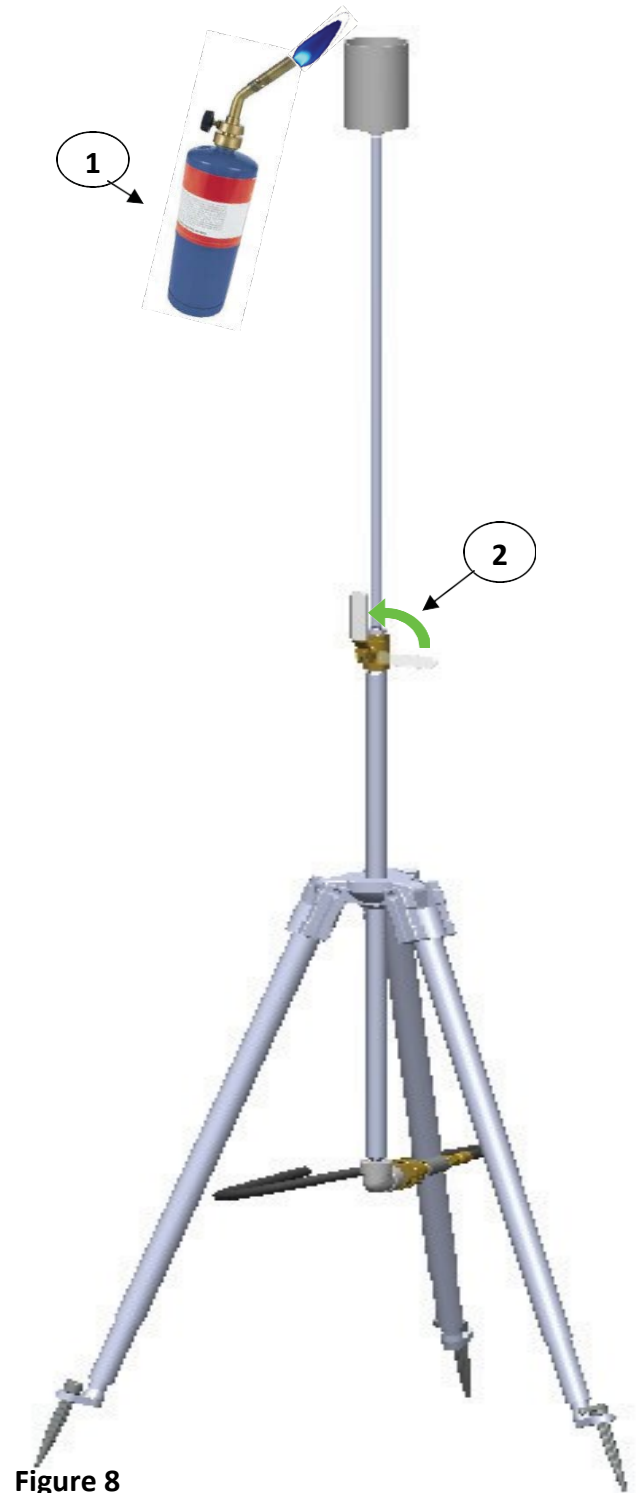
Figure 6

- 7) Slowly open vapor return valve on tank being evacuated until the stop is reached. Leak check all connections. **Figure 7**



- 8) Utilizing a lit propane “plumbing” style torch. Place the torch above the evacuation flare stack collar as shown in **Figure 8**, Slowly open the ball valve until the evacuation stack is lit. Then slowly open all the way making sure to be careful not to blow the flame out with the rushing fuel. If the flame blows out start over from **step 6** allowing a minute for the fuel to disperse before relighting.

CAUTION: NEVER LEAVE A FLARE STACK UNATTENDED. ALWAYS MONITOR THE EVACUATION PROCESS. IF IT IS REQUIRED THAT YOU ARE TO LEAVE THE AREA, TURN OFF ALL TANK VALVES BEFORE LEAVING. UPON RETURN, FOLLOW THE EVACUATION STEPS ON RELIGHTING THE FLARE STACK.



Purging & Evacuating Propane Tanks

Purging the propane tank

Purging the tank is different from the purge cycle in the LPI system. Purging the tank means removing the air (oxygen) or inert gas and moisture from inside the tank before putting the tank into service. This is a required procedure on all new tanks (tanks that have never been filled with propane) or tanks that have been evacuated and opened to the atmosphere for service or any other reason.

Why purge a propane tank

Most tanks are steel and are prone to rust. To prevent rust, purging will remove air (oxygen) and moisture which causes rust. Also by purging and removing the air (oxygen) from the tank there is no chance of air in the tank causing pressure fluctuations. This trapped air could also cause excess pressure in the tank and could cause a slow fill situation. *(NOTE: Most new tanks come purged with an inert gas and this same situation could also occur if the inert gas is not purged from the tank. In this case before the first fill release all the inert gas to "0 psi" and fill the tank; purging with propane is not required)*

The LPI system uses an electric fuel pump mounted inside the tank. Propane, in a vapor phase, must be mixed with air between 2.15% and 9.6% fuel to air mixture to be combustible or flammable. Always remove the OEM fuel pump relay and leave it removed until the tank is purged and re-filled. After servicing a tank if the atmosphere is not purged a combustible mixture could exist in the tank due to the removal/replacement of a valve or other component which may have allowed atmosphere into the tank. This combustible mixture is seldom found inside a tank and purging the tank prior to filling or re-filling the tank will eliminate the possibility of the air/fuel mixture becoming combustible.

How to purge a propane tank

Purge the tank in the open (outside), at least 35-50 feet from any building. Purging can be performed with the tank installed on the vehicle. For the LPI fuel system remove the OEM fuel pump relay before performing any purge process or fill process. At this point all replaced components should be installed and tightened to specification. The following procedures or method is approved by the United States "National Propane Gas Association" (NPGA). For more information you can go to their website at www.npga.org.

1. Remove the OEM fuel pump relay and/or disconnect the battery.
2. Open the 80% bleeder valve and/or the evacuation valve on the tank you want to purge. The caps on these valves will need to be removed prior to there opening. **Figure 1. Note: The tank should not have fuel at this time. It should be totally evacuated. Some pressure may build up if the tank was previously in-service and closed up for a period of time before purging. Release this pressure build up before starting the purging process.**

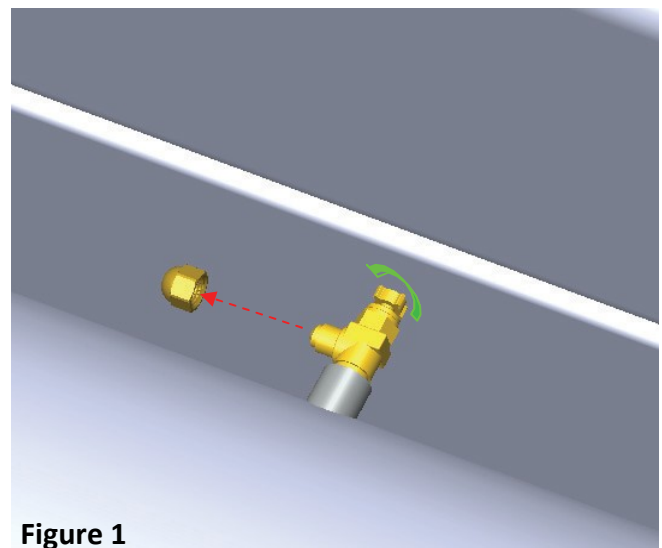


Figure 1

3. Remove filler valve cap from the same tank. **Figure 2**

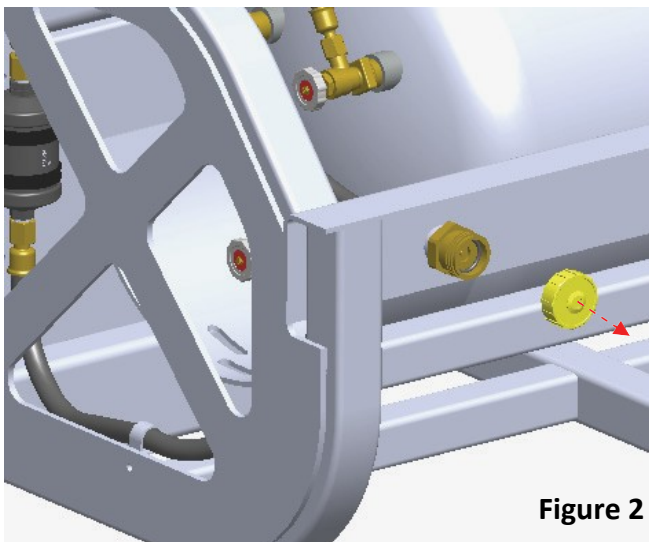
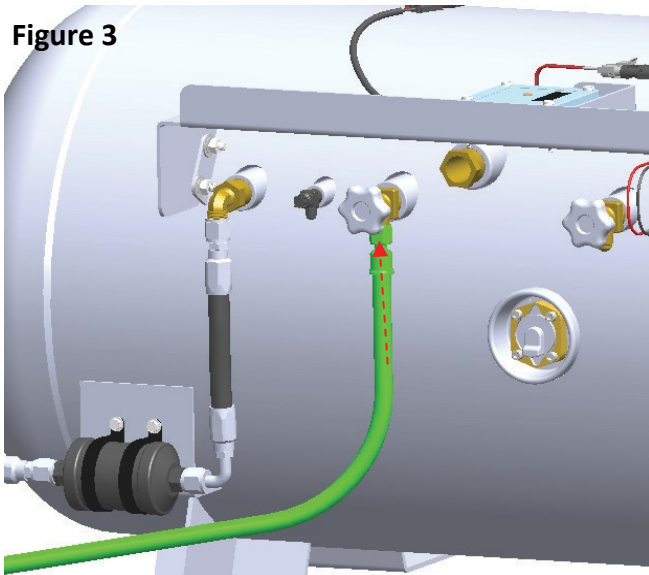


Figure 2

4. Connect service evacuation hose to the vapor service valve on the evacuation tank. **Torque: Fully Seated Not Stripped, Not Leaking. Figure 3**

Figure 3



5. Connect service evacuation hose to the liquid evacuation adapter. **Torque: Fully Seated Not Stripped, Not Leaking. Figure 4**

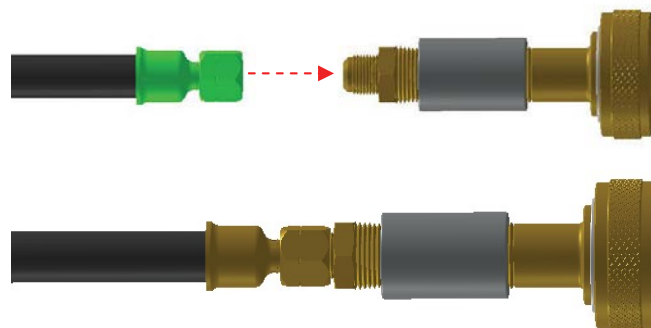


Figure 4

6. Connect liquid evacuation adapter to the fill connection on the tank that requires purging. **Figure 5**

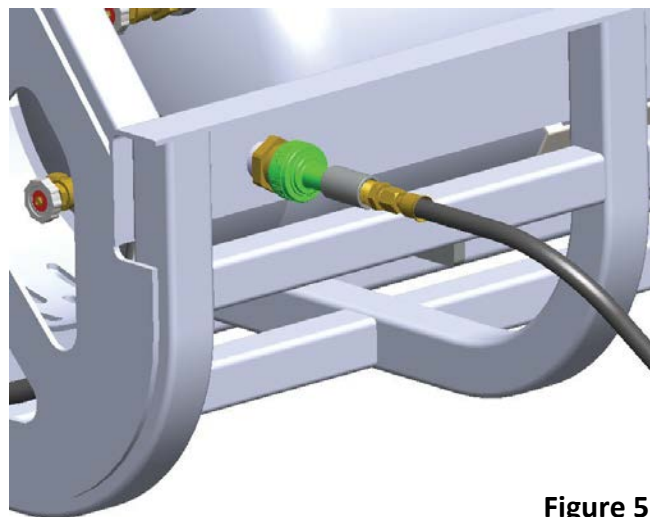
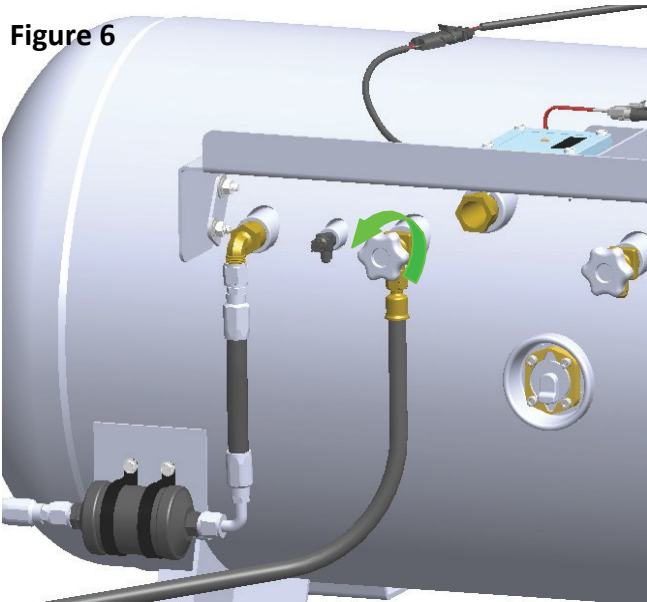


Figure 5

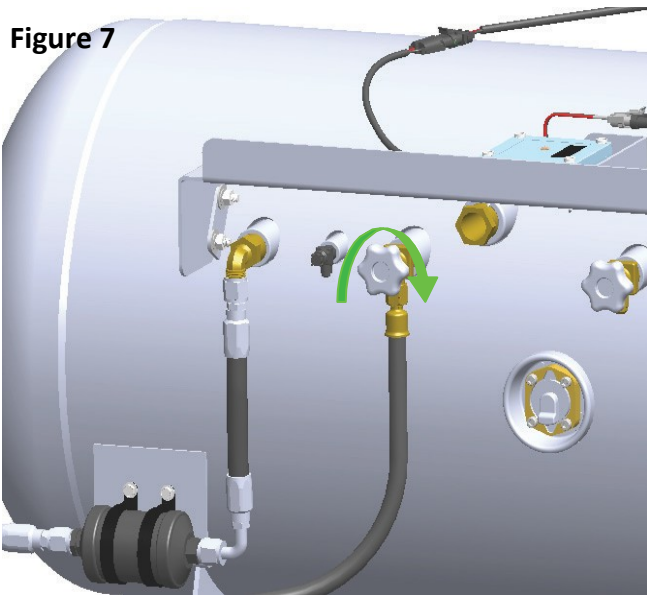
7. Slowly open the vapor service valve on the service evacuation tank (**Figure 6**) and allow vapor pressure to flow into the tank until the bleeder valve previously opened flows a constant pressure. Somewhere around 15 psi, the fuel system pressure gauge assembly can be utilized on the bleeder to get the vapor pressure reading of the tank being purged.

Figure 6



8. Once the tank being purged comes up to the pressure range, close the vapor service valve on the service evacuation tank. **Figure 7**

Figure 7



9. Release all the pressure in the tank being purged to atmosphere or to a flare stack if required by local or state laws. In order to ensure that at least 95% of the air is removed, the container must be pressurized and de-pressurized several times, repeat steps 7 thru 9, 3 or 5 times.

Note: If there is any indication of moisture or water in the tank and most of the liquid water was removed during service of the tank there remains some moisture. In this case it is a good idea to inject some methanol into the tank before filling the tank with fuel. On average one pint of methanol per 100 gallons of propane or 1 gallon of methanol per 1,000 gallons of propane will remove any moisture or water residue.

10. On the last purge with vapor, leave the tank being purged pressurized. This is a good time to check the tank and valves for leaks. Check for leaks with an approved leak detection fluid or electronic combustible gas detector.
11. If no leaks are found and the purge process is complete the tank is ready to be filled with liquid propane. The tank should be filled with a minimum of 10 gallons of fuel before the fuel pump relay is replaced and/or the battery is reconnected.

Transferring liquid fuel from the LPI® Evacuation Tank to a LPG vehicle Fuel Tank

- 1) Remove filler valve cap from the LPG tank that is going to receive the fuel transfer . **Figure 1**

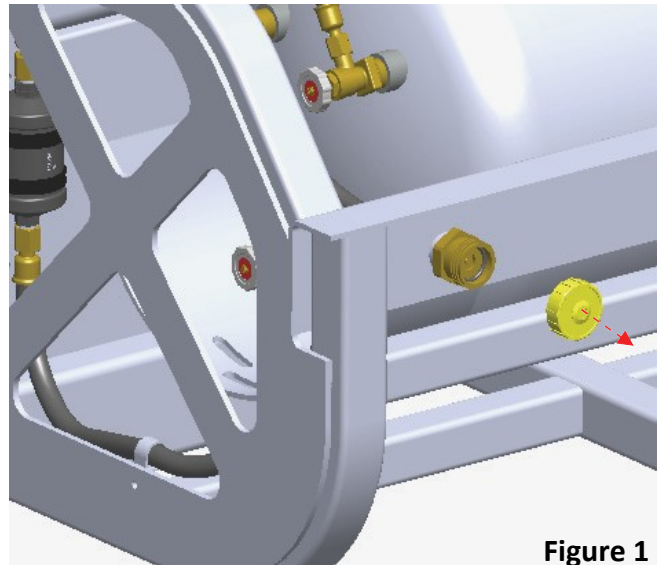


Figure 1

- 2) Connect service evacuation hose to the liquid evacuation adapter. **Torque: Fully Seated Not Stripped, Not Leaking. Figure 2**

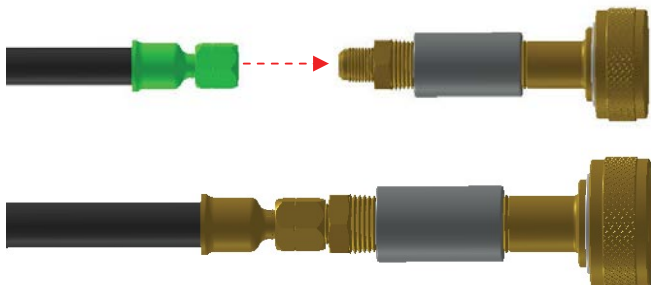


Figure 2

- 3) Connect liquid evacuation adapter to the fill connection on the tank that requires fuel. **Figure 3**

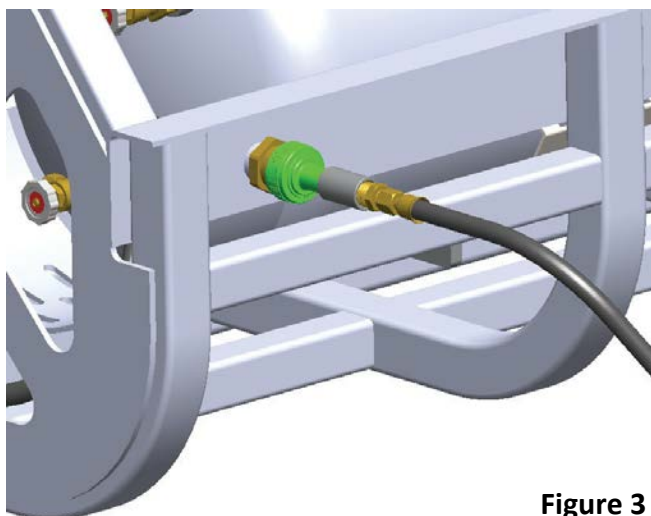


Figure 3

- 4) Connect service evacuation hose to the liquid service valve on the evacuation tank. **Torque: Fully Seated Not Stripped, Not Leaking. Figure 4**

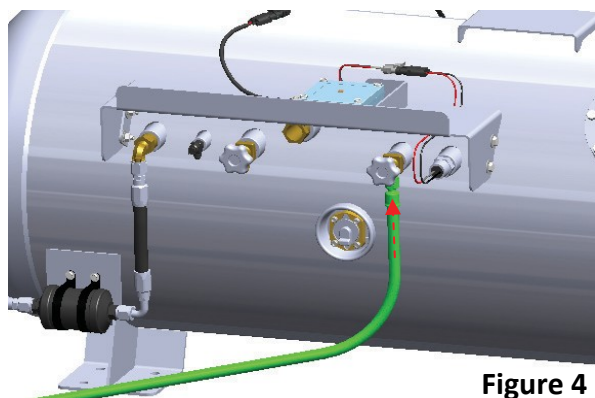


Figure 4

- 5) Slowly open the liquid service valve on the evacuation tank. **Figure 5**

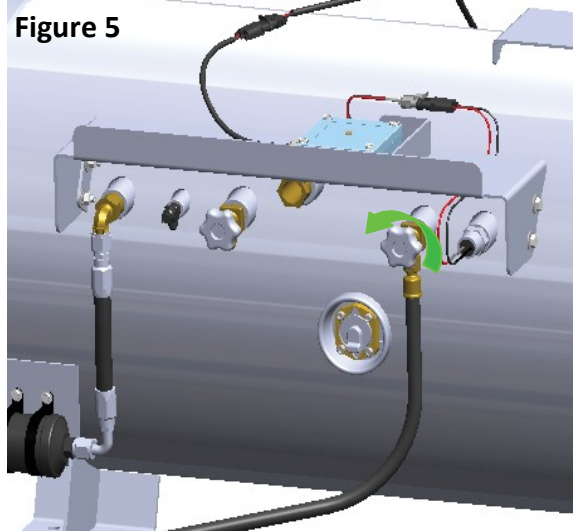


Figure 5

- 6) Verify that the evacuation tank controller is in the **OFF** position. **Figure 6**

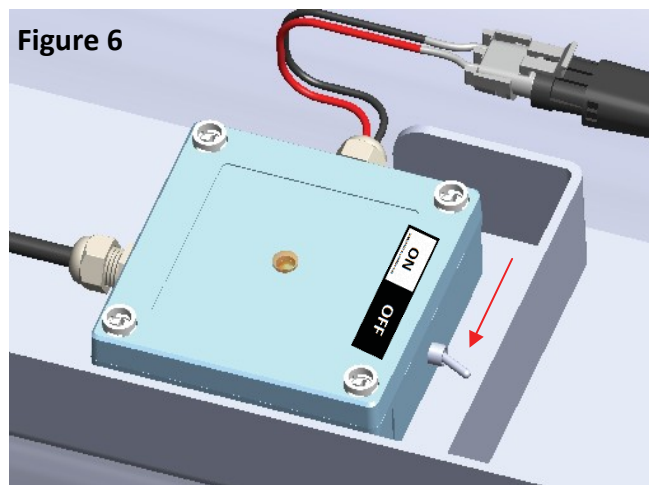


Figure 6

- 7) Connect the evacuation tank controller power leads to a 12 volt Automotive battery. **NOTE: The leads are color coded. Red = (+) Positive and Black = (-) Negative.) Figure 7**

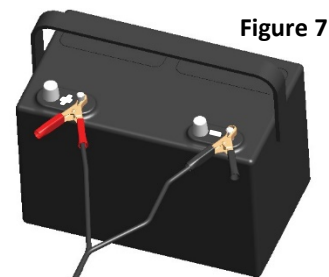
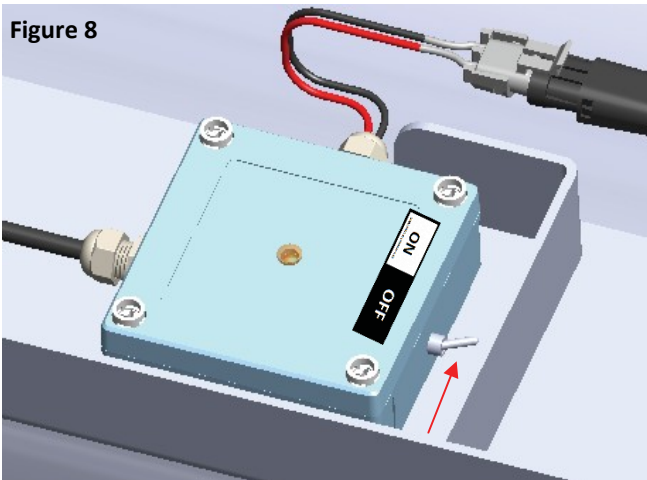


Figure 7

- 8) Turn the evacuation tank controller switch to the **ON** position to start the transfer process. **Figure 8**



- 9) When the transfer process is finished, turn the evacuation tank controller switch to the **OFF** position before closing the liquid valve. **NOTE: Failure to turn the pump off before closing the valve can result in premature fuel pump failure.** Disconnect the Evacuation Tank system in reverse order of these instructions. **Note: Always check the fuel level when using the service evacuation tank. Never run the fuel pump; Damage to the pump will result.**

NOTES:



CLEANFUEL USA INC.
29387 Lorie Lane
Wixom, Michigan 48393
877-234-1722
www.cleanfuelusa.com



Copyright © 2016 - CLEANFUELUSA