Version Application:				Technical Service Bulletin Number:
☒	CARB 04	☐	EPA 10	TSB-001
☒	EPA 07 Upfit	☐	ADR 80/03	**Released Date:**
☐	ADR 80/02			22-4-2010

Westport™ GX & LNG System Technical Service Bulletin

This Technical Service Bulletin has been prepared in conjunction with customer bulletin W1-SL-002 to provide instructions for the mandatory fuel shut-off valve upgrade for certain Westport vehicles. Westport has determined that a defect related to motor vehicle safety exists in certain Westport ISX G vehicles equipped with Liquefied Natural Gas pumps.

A vent hole associated with the pump pressure relief valve may have been covered by a welding process, during the manufacture of the pump. This can render the pressure relief valve ineffective, resulting in the possible build up of gas in the pump if the manual shut-off valve is closed. This could result in a sudden leak of high pressure gas within the tank shroud and a slower leak of tank pressure, which could result in personal injury and/or vehicle or property damage.

1. **Identification of the affected vehicles**
   Vehicles requiring this upgrade have their VIN numbers listed in the table below:

#	Pump S/N	Vehicle VIN	ESN	Model Year
1	F9624.049	1XKDD49X47R207207	79225579	2007
2	F9624.053	1XKDD49X09R250705	79317720	2009
3	F9624.054	1XKDD49X79J252157	79321600	2009
4	F9624.055	1XKDD49X19R250700	79316782	2009
5	F9624.056	1XKDD49X17R197090	79224978	2007
6	F9624.058	1XKDD49X57R197044	79223875	2007
7	F9624.063	1XKDD49X99R250699	79316191	2009
8	F9624.064	1XKDD49X69R250692	79316189	2009
9	F9624.071	1XKDD49X49J252150	79320736	2009
10	F9624.079	1XKDD49X87R197085	79227791	2007
11	F9624.080	1XKDD49X89J252152	79320734	2009

2. Prevention of failure condition

To prevent this condition from occurring, ensure that manual shutoff valve is **open at all times**, Figure 1. Communicate this information to all persons involved with the vehicle.

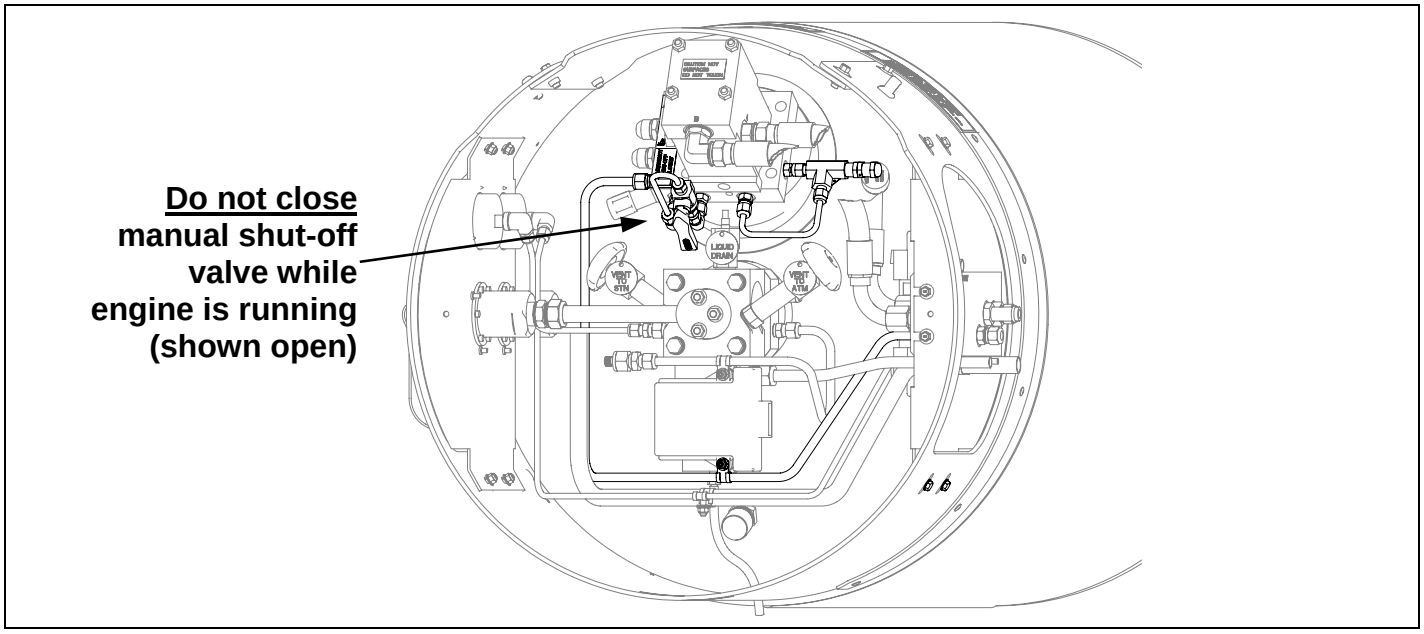


Figure 1: Components to be removed from tank

3. Procedure

Westport service work instruction *INS-10012351 Installing the Automatic Tank Shutoff Valve Retrofit Kit*, details the steps needed to complete the upgrade to the LNG tank. When referring to the work instruction, utilize the LHS (Left Hand Side) instructions only.

This Westport service work instruction, and others referenced within this work instruction can be accessed via the Westport Service website (http://service.westport.com).

Installing the Automatic Tank Shutoff Valve Retrofit Kit

Special Tools and Materials Required:

- Westport Work Instruction *INS-10011728 Draining the High Pressure Gas System*
- Westport Work Instruction *INS-10011871 Draining the LNG Tank*
- Westport Work Instruction *INS-10011729 General Guidelines for Fittings Installation*
- Westport Work Instruction *INS-10011857 Detailed Gas System Leak Inspection*
- Swagelok *General Guidelines for Tube Bending*
- Swagelok *General Guidelines for Tube Fitting*
- Automatic tank shutoff valve retrofit kit:
  - LHS: 10012347 (Left Hand Side)
  - RHS: 10012348 (Right Hand Side)
- Tube cutter, tube bender and tube deburring tool (Swagelok or equivalent)
- Appropriate personal protective equipment (PPE)

Stage 1: In Preparation

1. Park vehicle in a well ventilated outside area, turn vehicle off.
2. Drain the high pressure gas system in accordance with Westport Work Instruction *INS-10011728 Draining the High Pressure Gas System*
3. Drain LNG tank or tanks in accordance with Westport Work Instruction *INS-10011871 Draining the LNG Tank*

WARNING
Failure to properly drain the LNG tank(s) may lead to natural gas leakage and/or severe cryogenic burns. Wear appropriate safety equipment at all times.

Stage 2: Removing LNG Pump HP Plumbing Components

NOTE
Refer to Figure 1 for steps 4-7

4. Remove the HP discharge tube including associated pump manifold fitting.
5. Remove the manual shut-off valve and associated tube and fittings.
6. Remove the pump pressure relief valve and associated tubing and fittings.
7. Remove the “Emergency Shut-off Closed” label from pump manifold.

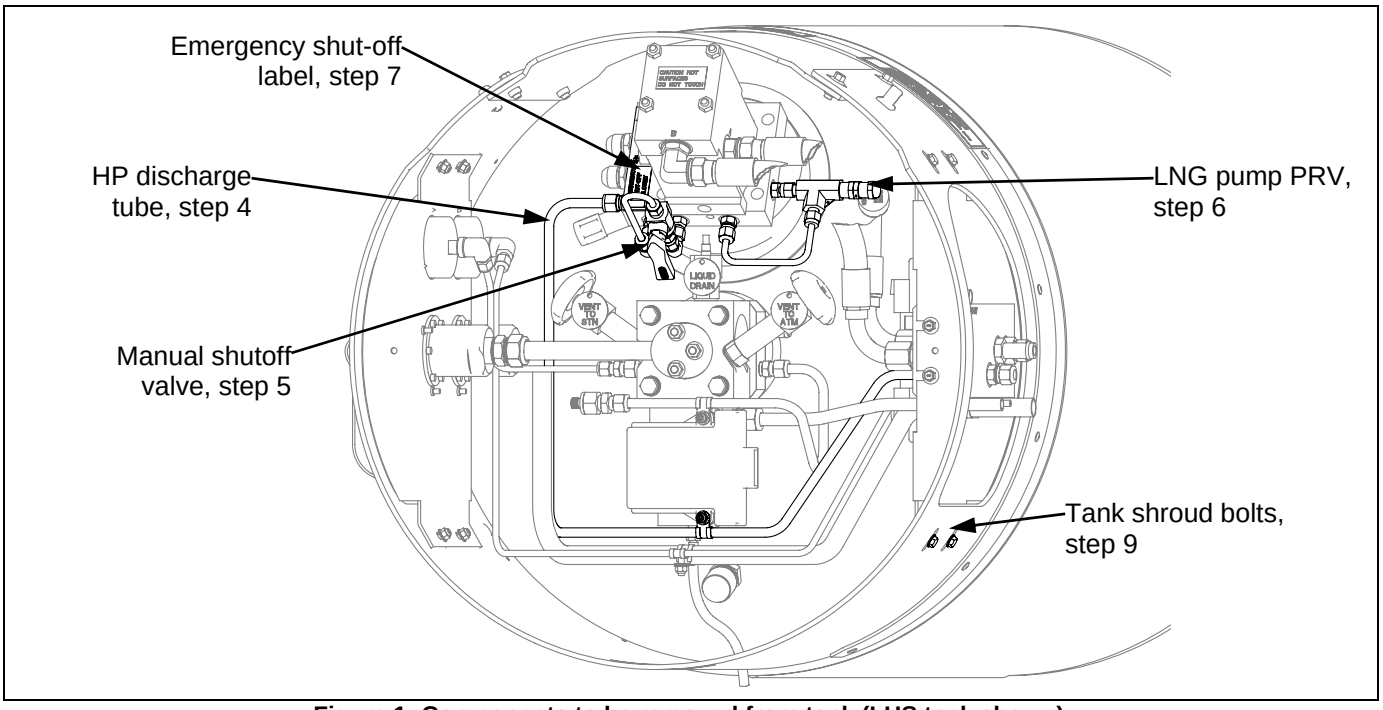


Figure 1: Components to be removed from tank (LHS tank shown)

8. LHS tank only: Remove the temperature sensor from hydraulic manifold block and set aside (Figure 2).
9. Remove the two (2) tank shroud fasteners indicated in Figures 1 & 2.

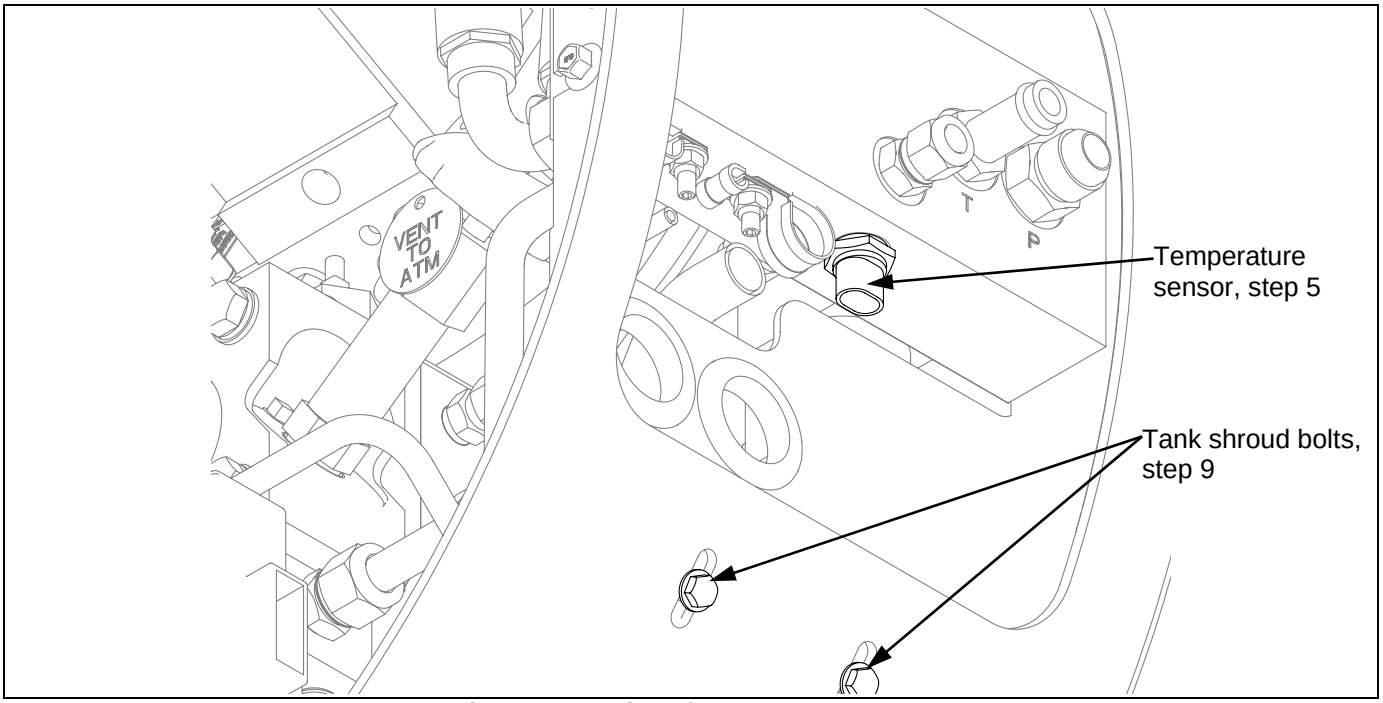


Figure 2: Location of temperature sensor

Stage 3: Installing retrofit components on the LNG pump

10. Before installing the provided port plugs (1x -06 plug and 3x -04 plugs): replace nitrile o-rings (black) with provided disogrin (white) o-rings and lubricate o-rings with clean 15W-40 oil. Ensure o-rings are in acceptable condition before installing (i.e. not twisted, nicked, torn or otherwise damaged).
11. Install the provided -06 plug with disogrin o-ring in the discharge tube port (Figure 3). Torque to **37 N·m (28 ft·lbs)**.
12. Install the three (3) provided -04 plugs with disogrin o-rings in the shutoff valve handle and PRV discharge tube fitting locations (Figure 3). Torque to **26 N·m (19 ft·lbs)**.

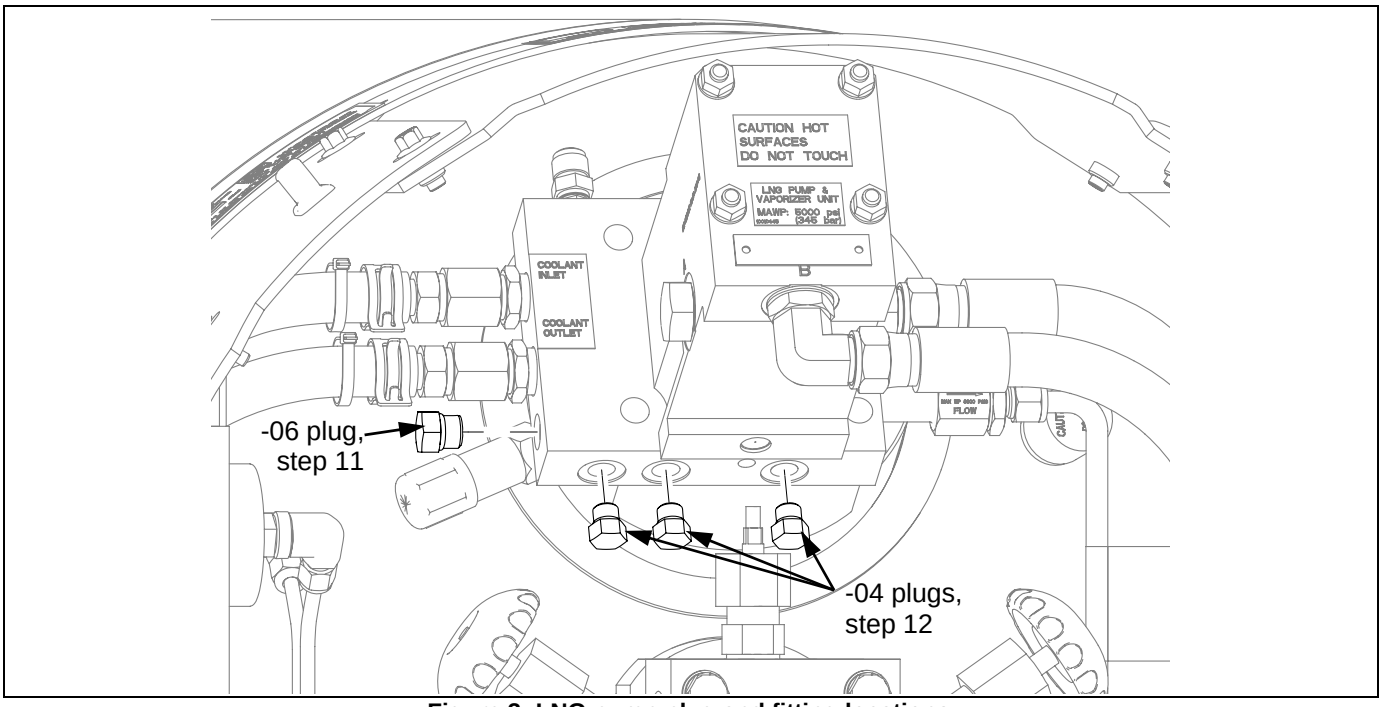


Figure 3: LNG pump plug and fitting locations

Stage 4: Installing the regulator assembly and gas discharge tube (LHS tank)

NOTE

In order to gain access for installation of regulator retrofit, it may be necessary to remove hydraulic, coolant, electrical harnesses etc. Take care to minimize spillage when disconnecting any of these lines and to keep the fittings as clean as possible.

13. Remove the M14 hex head plug with disogrin o-ring from regulator assembly and set aside (Figure 4).
14. Install temperature sensor with disogrin o-ring from hydraulic manifold into the port (Figure 5). Torque to **45 N·m (33 ft·lbs)**.
15. Loosely install the regulator discharge tube onto the regulator outlet (Figure 6).

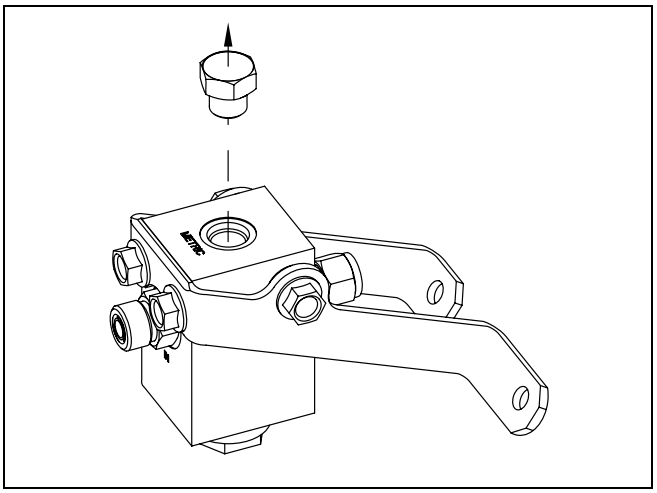


Figure 4: Removal of plug from regulator assembly. Refer to Step 13.

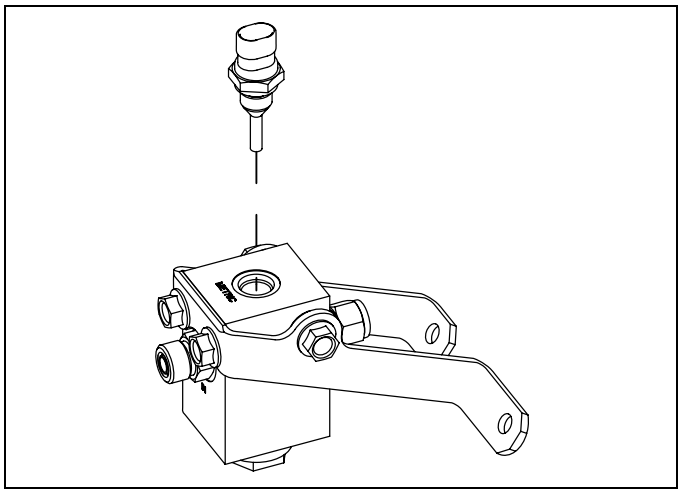


Figure 5: Installation of temperature sensor to regulator Assembly. Refer to Step 14

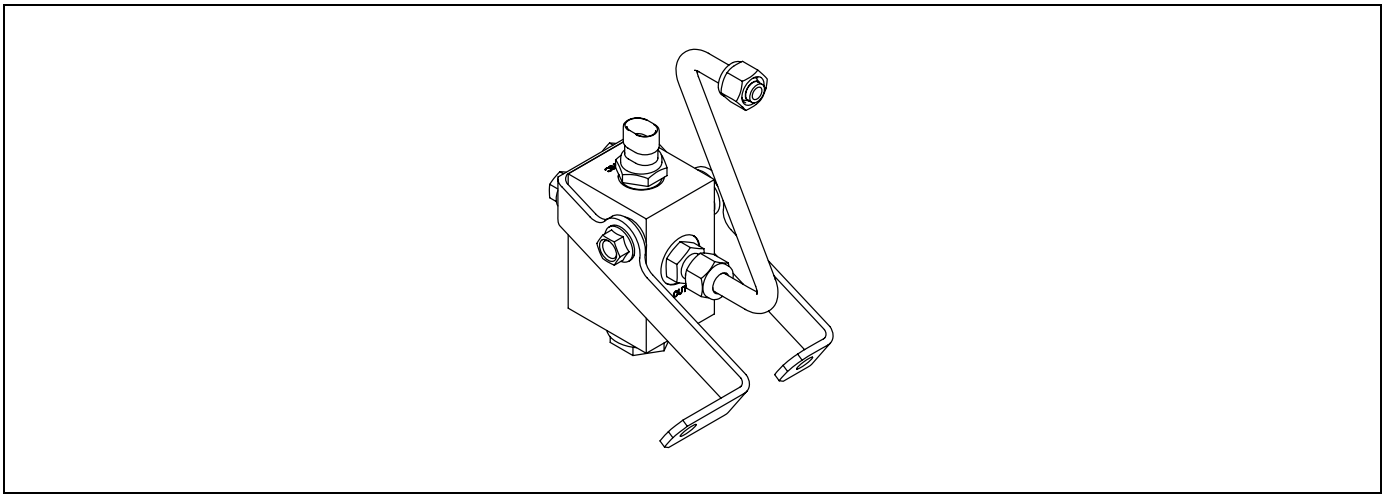


Figure 6: Regulator with discharge tube attached. Refer to step 16

16. Fasten the regulator assembly loosely to the tank shroud using the provided mounting bolts, washers and nylok nuts (Figure 7).
17. Replace the check valve o-ring (black with yellow dot) with a provided disogrin (white) o-ring prior to installation. Then, loosely install discharge check valve and tube assembly between the LNG pump and the regulator assembly (Figure 7). Torque the check valve into the pump discharge port at **23 N·m (17 ft·lbs)**.
18. Tighten the LNG pump discharge tube to the regulator inlet o-ring face seal fitting **1/8th of a turn past finger tight** to ensure metal to metal contact (Figure 7).
19. Once the fit and alignment of the tubes, regulator assembly and check valve are acceptable tighten all tube fittings to **¼ of a turn past finger tight** (Figure 7).
20. Torque regulator mounting bolts to **9 N·m (17 ft·lbs)** (Figure 7).
21. Install the M14 hex head plug with disogrin o-ring from Step 12 into the temperature sensor port on the bottom of the hydraulic manifold.
22. For dual tank systems (road side, curb side/remote), proceed to Stage 5. For single tank systems (roadside), proceed to Stage 6.

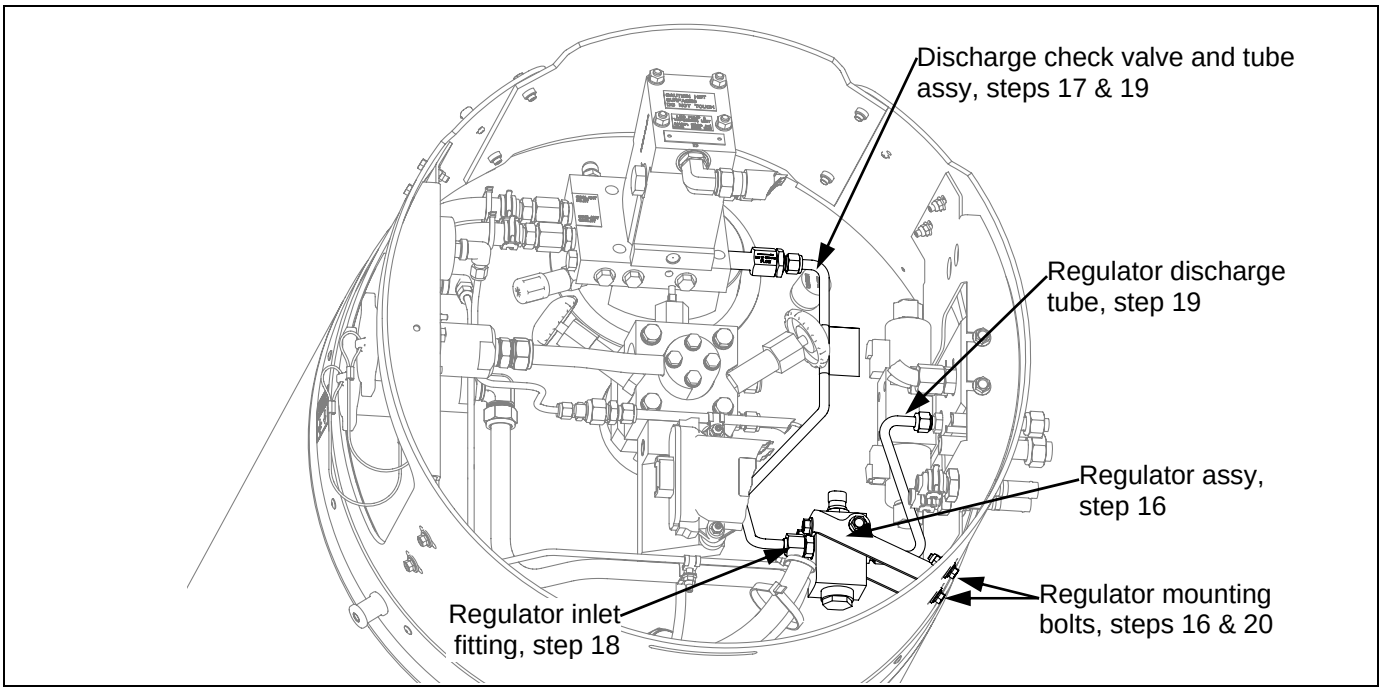


Figure 7: Installation location of regulator components and tube assemblies (LHS tank)

Stage 5: Installing the regulator assembly and gas discharge tube (RHS tanks only)

NOTE
It is not necessary to relocate the temperature sensor from the hydraulic manifold to the regulator on RHS tanks.

23. Fasten the regulator assembly loosely to the tank shroud using the provided mounting bolts, washers and nylok nuts (see Figure 8).
24. Loosely install the pump discharge check valve and tube assembly between the LNG pump and regulator assembly. Torque the check valve into the pump discharge port at **23 N·m (17 ft·lbs)**.
25. Loosely install the discharge tube between the regulator and the hydraulic manifold.
26. Tighten the LNG pump discharge tube to the regulator inlet o-ring face seal fitting **1/8th of a turn past finger tight** to ensure metal to metal contact.
27. Once the fit and alignment of the tubes, regulator assembly and check valve are acceptable, tighten all tube fittings to **¼ turn past finger tight**.
28. Torque regulator mounting bolts to **9 N·m (17 ft·lbs)**

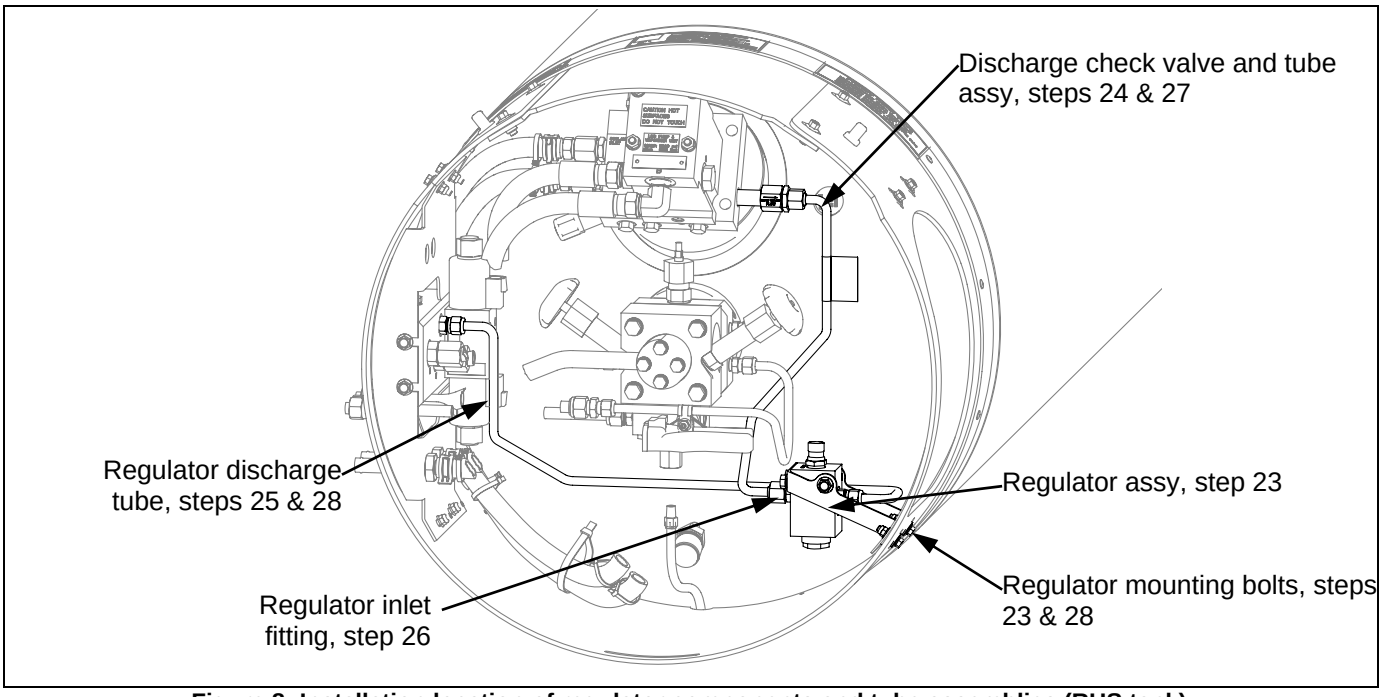


Figure 8: Installation location of regulator components and tube assemblies (RHS tank)

Stage 6: Removing check valve from accumulator

29. Remove the check valve found near the accumulator. An example of this valve is shown in Figure 9 although other configurations are possible.
30. Install provided length of tubing between nearest fittings/hose to replace the check valve. Install tubing in accordance with Swagelok *General Guidelines for Tube Bending,* Swagelok *General Guidelines for Tube Fitting* and Westport Work Instruction *INS-10011729 General Guidelines for Fittings Installation.*

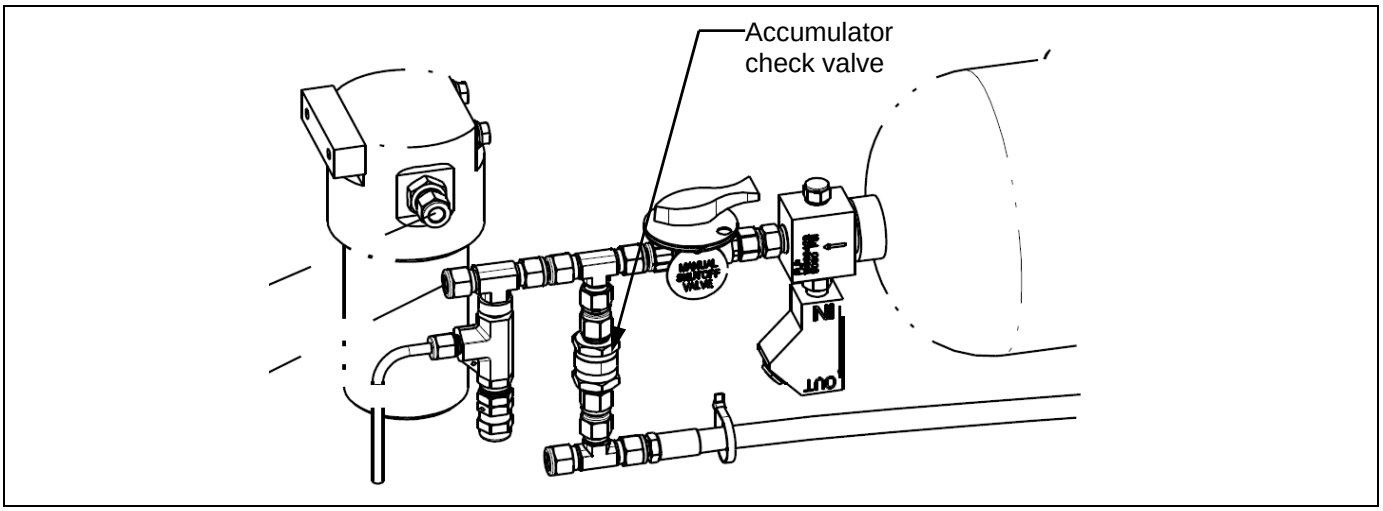


Figure 9: Accumulator check valve configuration (ADR80/02 build shown with check valve still installed).

Stage 7: Completion

31. Remove tank shroud labels from tanks and replace with provided labels.
32. Leak check LNG tank and high pressure gas system in accordance with Westport Work Instruction INS-10011857 Detailed Gas System Leak Inspection

Draining the High Pressure Gas System

Applicable Models:

MY 2006, MY 2007, AHD, AHDII

Revision History:

REV	ECO	Date (D/M/Y)	Description
00	23292	08/02/2008	Initial Release

Notes:

Safety Warnings:

- **THE HIGH PRESSURE GAS SYSTEM ON THE HPDI TRUCK CAN CONTAIN UP TO 4000PSI, EVEN WHEN THE VEHICLE HAS BEEN PARKED. ONLY QUALIFIED TECHNICIANS FAMILIAR WITH HIGH PRESSURE CNG/LNG GAS SYSTEMS SHOULD CONDUCT THIS PROCEDURE. IF IN DOUBT, DO NOT PROCEED.**
- **ALWAYS ASSUME ALL HIGH PRESSURE GAS SYSTEM COMPONENTS, INCLUDING ACCUMULATOR, FILTER CANISTER AND LINES ARE PRESSURIZED.**
- **USE HEARING AND EYE PROTECTION AT ALL TIMES.**

Draining the High Pressure Gas System

Purpose:

This procedure is to be used whenever the High Pressure Gas System is to be serviced. This may include, but shall not be limited to:

- Changing a high pressure gas line
- Changing the CNG filter
- Changing / repairing the Fuel Conditioning Module (FCM)
- Changing LNG pumps
- Changing LNG tanks
- Changing the accumulator and pressure relief device

Special Tools & Materials Required

- Westport Grounding Cable 10010815 (or equivalent)

Stage 1: In preparation

1. Ensure that the vehicle is outdoors, in a well ventilated area. Turn vehicle off.

2. Ground the CNG vent stacks running up the back of the vehicle's cab with the Westport grounding cable (10010815) or equivalent. Ground to your facility's designated grounding point.

WARNING
Static electricity is created when high velocity CNG is vented through the vent stacks. Improper / lack of grounding can result in electro-discharge sparks which can ignite CNG vapour.

Stage 2: Draining the Accumulator

3. If you are not servicing the accumulator, the accumulator manifold, the accumulator shut-off valve or the pressure relief device (PRD) attached to it, the accumulator does not need to be drained of CNG. Skip to stage 3.

SAFETY WARNING
The accumulator must first be drained if it, the shut-off valve or the PRD is being serviced. Failure to do so may result in serious high pressure blast injury. If in doubt, follow the below steps to fully drain the accumulator pressure.

4. Turn the LNG pump(s) shut off valve(s) to the CLOSED position, see figure 1.

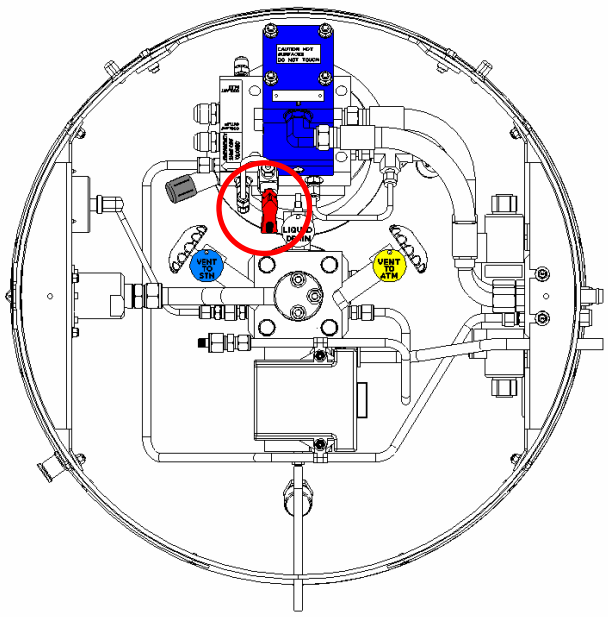


Figure 1. Location of LNG Pump Shut Off Valves. Diagram shows the ON (flowing) position.

5. Ensure that the accumulator service shut off valve is in the OPEN position, see Figure 2.

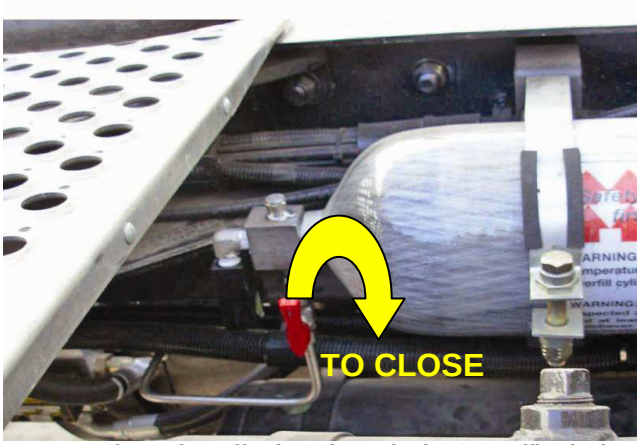


Figure 2. Accumulator shut-off valve, shown in the OPEN (flowing) position.

6. Open the FCM gas vent valve (see Figure 3) to allow gas pressure in lines and accumulator to evacuate. A persisting venting sound should be audible through the vent stack at the rear of the cab as the accumulator drains. Loosen the thumbscrew more gradually until all gas pressure is fully relieved.

NOTE

The technician should know the approximate CNG pressure / level within the accumulator prior to working on the truck. If gas venting stops within 5 seconds, there might be a blockage in the gas lines, and residual pressure may be trapped. Contact Westport Service Personnel if the cause of blockage cannot be identified.

7. When the venting subsides, shut-off the vent valve and shut off the accumulator service shut-off valve.

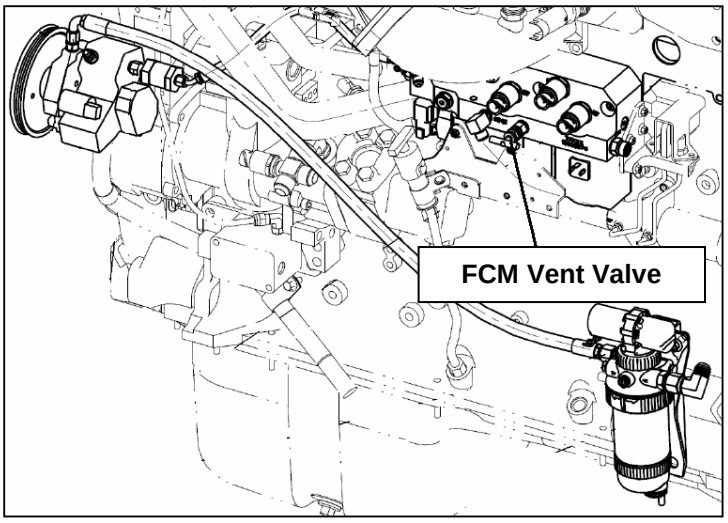


Figure 3. FCM Gas Vent Valve

Stage 3: Draining the high pressure gas lines while retaining accumulator pressure

8. Turn the accumulator service shut-off valve to the CLOSED position. Turn the shut-off valve on the LNG pump(s) to the CLOSED position.

SAFETY WARNING

To prevent the accumulator shut-off valve from accidentally opening and discharging accumulator pressure, the shut-off valve must be locked out.

In the absence of appropriate valve lockout hardware, loosen the setscrew on the stem of the red valve handle and remove handle.

9. Open the gas vent valve on the FCM to allow gas pressure in lines to evacuate, see Figure 3. The venting should not persist for more than 5 seconds. If the venting persists, the accumulator shut-off valve or the LNG pump delivery check valve may be faulty. Identify the fault, and repair as necessary.

SAFETY WARNING

The accumulator service shut-off valve is in direct communication with the accumulator CNG pressure. If the valve is suspected to be leaking, allow the valve to leak until the accumulator pressure is safely relieved before any disassembly.

10. When venting subsides, close the FCM gas vent valve.

NOTE

Remember to re-open the accumulator shut-off valve and LNG pump shut-off valves slowly to charge the system after all repair work is complete. Check for audible leaks

Draining the LNG Tank

Purpose:

This procedure is to be used whenever the LNG Tank or High Pressure Gas System is to be serviced. This may include, but shall not be limited to:

- Changing a LNG tank
- Changing a LNG pump
- Repairing / replacing LNG tank fill receptacles (receptacle, fill tube, etc.)
- Recharging the LNG tank vacuum insulation.

Special Tools & Materials Required

- Westport LNG Tank service kit (P/N 10010902)
- Westport grounding cable kit (P/N 10010815)

Stage 1: In preparation

1. Before beginning work, ensure that the vehicle:

    - is properly parked in an outdoor shop area with park brake on, engine off,
    - is not on sloped ground that can cause any depleting LNG to flow uncontrollably downhill,
    - is not directly over any sewage or storm drains that depleting LNG may flow into (natural gas trapped in storm drains may form an explosive combustion mixture with air), and
    - is cordoned off with cones or equivalent warning signs to prevent other workers from inadvertently approaching the vehicle while it is draining.

2. If your service location is equipped with a LNG station with a **liquid** return line, move the vehicle to the LNG station. Otherwise, skip to stage 4, *Draining the LNG*.

3. If you have the option of transferring the LNG to another Westport LNG truck in your fleet, skip to stage 3. Otherwise, skip to stage 4, *Draining the LNG.*

4. Ground the tank at the tank grounding lug using grounding cable 10010815 (ground to designated grounding point, fence post, building external pipes etc.), see Figure 1.

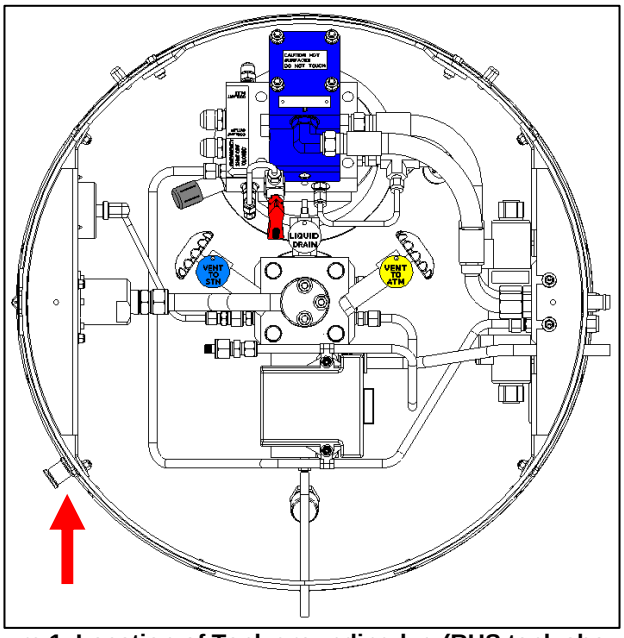


Figure 1. Location of Tank grounding lug (RHS tank shown).

Stage 2: Returning LNG to the station

5. Connect the *Tank Adaptor* (Green) of the LNG Drain Kit to the LNG tank liquid drain port, see Figure 2.
6. Connect the *Station Quick Disconnect Adaptor* (Blue) to the *Tank Adaptor*, see Figure 3.

Figure 1. Attachment of the Tank Adaptor

Figure 2. Attachment of the Station Quick Disconnect Adaptor

7. Connect the station's return line to the quick disconnect adaptor.
8. Open the liquid drain valve. Observe that the return line chills and frosts as LNG is being returned to station.
9. Observe the tank pressure gauge for pressure decrease as LNG is being transferred. When pressure stabilizes, LNG return is complete.

10. Turn the liquid drain valve stem on the tank hub manifold to OFF.
11. Remove the station line with caution. If the connection is frozen or appears to leak LNG upon disconnecting, douse the connection with warm water to defrost before proceeding.

WARNING
LNG return-to-station flow stops when tank pressure equalizes with station pressure. There can still be significant amount of LNG left in the tank.

12. Proceed with stage 4, *Draining the LNG*.

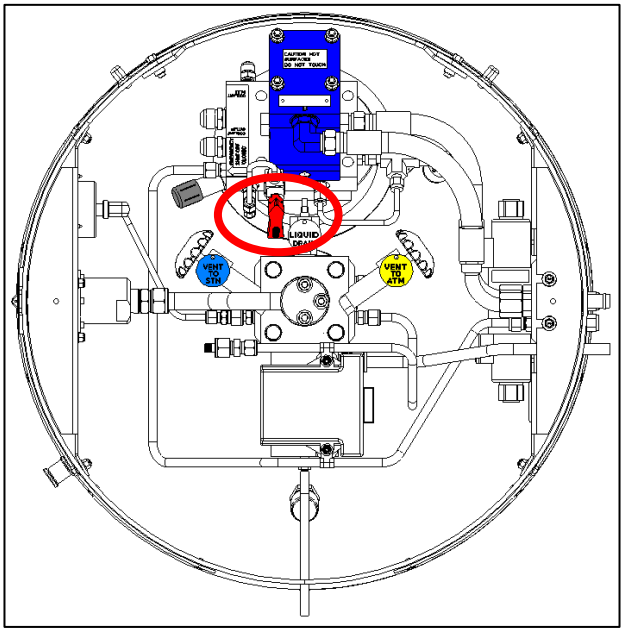


Figure 4. Location of Tank Liquid Drain valve.

Stage 3: Transferring LNG to another vehicle

13. Ensure that the receiving tank is emptier (as shown by driver display) and has lower pressure than the donor tank. If the receiver tank is full, select another tank or proceed directly to stage 4, *Draining the LNG*.
14. Connect the *Tank Adaptor* (Green) to the LNG tank liquid drain port, see Figure 2.
15. Connect the *Tank Adaptor with PRV* (White) to the receiving LNG tank liquid drain port in the same manner as step 14. Open the adaptor's bleed valve.
16. Connect the flexible transfer hose (Black) between the two tank adaptors, see Figure 5.

Figure 5. Attachment of the Flexible Transfer Hose, with the hose routed to the receiving tank on the same vehicle, right hand side.

17. To pre-cool the flexible transfer hose, slowly open the donor tank's Liquid Drain Valve and observe frost, indicating that the transfer hose is being chilled as LNG passes through. Gas will vent rapidly through the bleed valve. When the hose is sufficiently cooled, LNG will begin to leak from the bleed valve on the receiver tank end of the hose. Close the bleed valve tightly at this time.

WARNING
Venting LNG splatters easily, and may cause cryogenic burns. Use cryogenic protection gloves and eye protection at all times.

18. Open both tanks' liquid drain valves fully and allow LNG to transfer, see Figure 6.

19. When LNG transfer is complete (LNG tank pressures are stabilized), close both tanks' Liquid Drain Valves.

20. Without delay, carefully open the bleed valve to vent any trapped LNG. Leave valve open.

21. When frosting dissipates, torque Liquid Drain Valve to **11 Nm (98 in-lbs)** and remove the flexible hose and tank adaptors in reverse order

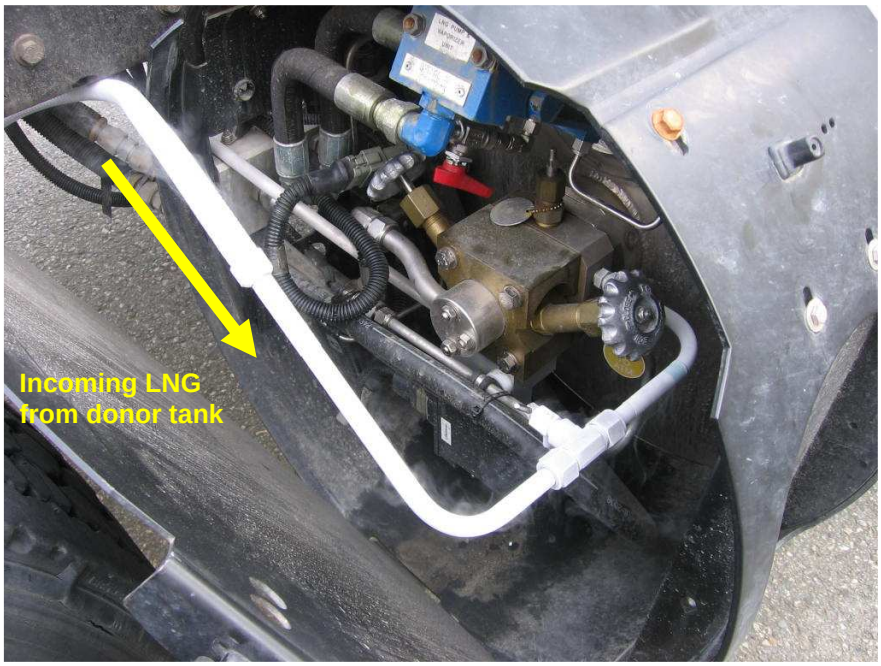


Figure 6. LNG transfer in process, note heavy frosting.

Stage 4: Draining LNG to the atmosphere

NOTE
Excessive LNG venting harms the atmosphere. Wherever possible, always transfer excessive LNG to another vehicle or return it to the LNG station. Vent to the atmosphere as a last resort.

22. Attach the *Tank Adaptor with the PRV (GREEN)* to the tank's Liquid Drain port, see Figure 2.

23. Attach the *Vent Valve Adaptor (RED)* to the tank adaptor, and the *Vent Stack (WHITE)* to the vent valve adaptor, See Figure 8. Ensure that the bend at the tip of the vent stack points down towards the ground. Close the vent valve fully.

    If the ambient conditions are excessively wet, discharging LNG liquid and vapour may tend to pool excessively on the ground, or being to run / flow on wet pavement. In this case, an alternate vent stack configuration may be used to discharge LNG upward (See Figure 9).

WARNING
Venting LNG splatters easily, and may cause cryogenic burns. Protective helmet should be worn during all upward LNG draining operations. Use cryogenic protection gloves and eye protection at all times.

Do not loiter around a draining LNG tank. LNG / natural gas displaces oxygen and may cause asphyxiation.

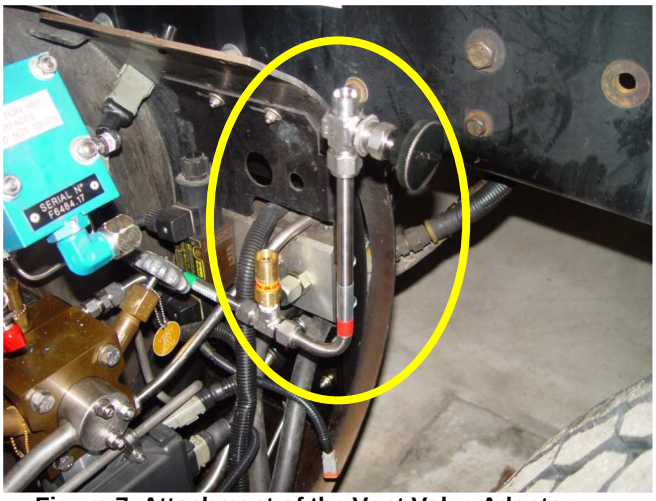


Figure 7. Attachment of the Vent Valve Adaptor

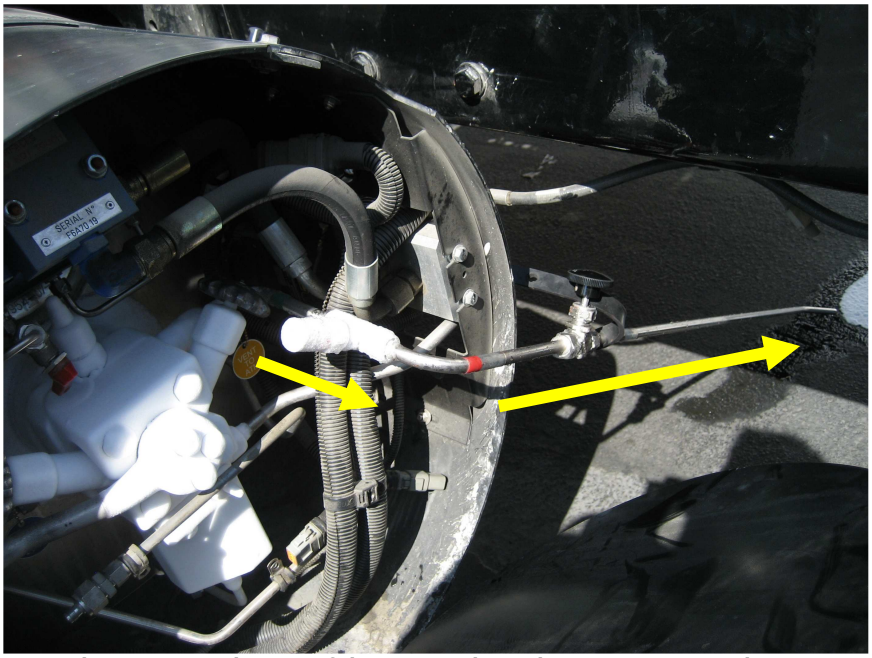


Figure 8. Attachment of the Vent Valve Adaptor & Vent Stack

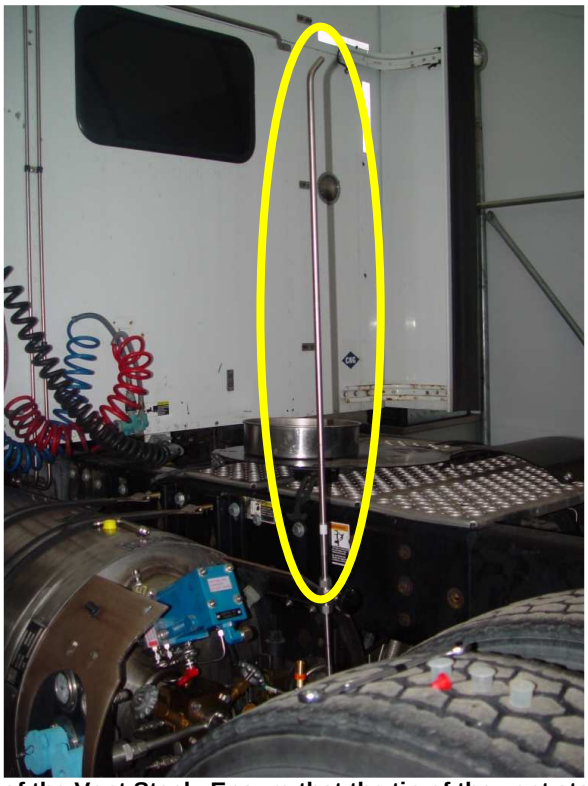


Figure 9. Alternate configuration of the Vent Stack. Ensure that the tip of the vent stack is pointed away from yourself and any other personnel.

24. Fully open the tank's Liquid Drain Valve, and observe that the drain line chills as LNG flows.

25. Modulate the vent valve *carefully* to achieve a healthy discharge rate. The LNG discharge should be acorn shaped at the vent stack exit, with no droplets or splatter.

WARNING

Venting LNG splatters easily, and may cause cryogenic burns. Protective helmet should be worn during all upward LNG draining operations. Use cryogenic protection gloves and eye protection at all times.

Do not loiter around a draining LNG tank. LNG / natural gas displaces oxygen and may cause asphyxiation.

26. When LNG is depleted, fully close the tank Liquid Drain Valve but allow the vent valve to remain open so as not to trap any LNG.

27. When frosting dissipates, torque Liquid Drain Valve to **11 Nm (98 in-lbs)** and remove the flexible hose and tank adaptors in reverse order

General Guidelines for Fittings Installation

This document is provided as a guide in the absence of Module Layout Drawing specifications for the component in question. In the event of a discrepancy between specifications in this document and specifications in the applicable layout drawing, the latter shall be deemed official.

NPT (tapered thread) Fittings

- Use anaerobic sealant only, such as *Loctite 567 Thread Sealan (P/N 1001853),* or equivalent.

CAUTION
Generic 'teflon' tapes and sealant types are not compatible with high pressure gas applications and do not meet a Westport fuel system's cleanliness specifications.

- Apply sealant leaving the first 2 threads free of sealant to prevent system contamination.
- Tighten all NPT fittings to **1-3 turns past finger tight**. Do not over-tighten.
- **Never back-off fitting** to achieve the correct orientation. Further tighten up to 1 turn.
- Total number of threads engaged should be between **3-1/2 to 6** threads. Any more or less indicates the fitting or port has compromised threads or is out of spec. Investigate before continuing, as this or will cause the fitting to loosen due to fluid pulses or vibration.

JIC (Flare) Fittings

- **FFWR (Flats From Wrench Resistance)** shall be used if a torque wrench is not available, or if the location of the fitting does not permit the use of a torque wrench. See Table 1.

JIC size	Thread	Torque * (Nm)	Torque* (ft-lbs)	FFWR**
-4	7/16 - 20	15-17	11-13	2
-6	9/16 - 18	27-30	20-22	2
-8	3/4 - 16	59-65	43-48	2
-10	7/8 - 14	68-79	55-60	1-1/2
-12	1-1/16 -12	107-119	79-88	1-1/2

* For non-lubricated, carbon steel fittings only
** FFWR: Flats From Wrench Resistance

Table 1. Installation torque values for JIC (Flare) fittings.

Re-use of O-rings

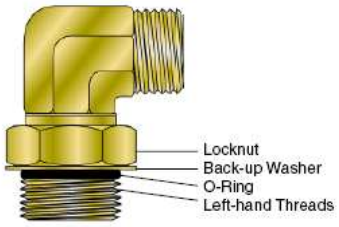
In general, O-rings on Westport O-ring style fittings are reusable, given proper care. Prior to installation or reinstallation, ensure that the o-ring is properly seated, without tears, deformation, signs of aging or excessive compression set. If in doubt, replace O-ring with Westport supplied replacements. Always lubricate the O-ring with the system's fluid, or, in the case of a gas fitting, lubricate o-ring with 15W40 engine oil.

Always leak check a gas fitting with leak detector after installation. Some gas leaks may not be audible.

SAE J1926 (ORB) O-ring Non-adjustable Fittings

- Lubricate all o-rings and threads with the system fluid before installation
- Ensure that the O-ring is fully seated, and free of damage. Tighten fitting to specified torque values in Table 2.
- For threading into soft metals (aluminum or brass), decrease torque values by **35%**

SAE J1926 (ORB) O-ring Adjustable Fittings



- Lubricate all o-rings and threads with the system fluid before installation.
- To install, back off locknut and back-up washer fully. Thread fitting in until O-ring contacts port surface. Back off to achieve proper orientation (point direction). Tighten lock nut to specified torque vales in Table 2.
- For threading into soft metals (aluminum or brass), decrease torque values by **35%**

CAUTION
Use Westport supplied replacement parts only.
SAE J1926 (ORB) fittings when supplied by Westport for natural gas are fitted with *Disogrin* (white in colour), gas compatible O-rings. Any other o-ring types are not compatible.

SAE J1926 (ORB) O-ring Non-Adjustable & Adjustable Fittings		Opposing end style: Face Seal		Opposing end style: JIC-Flare / hose fittings	
SAE Size	Thread	Torque (Nm)	Torque (ft-lbs)	Torque (Nm)	Torque (ft-lbs)
-4	7/16 - 20	35-39 (20*-22*)	26-28 (15*-17*)	29-32 (20*-22*)	22-24 (15*-17*)
-6	9/16 - 18	46-51	35-39	40-44	29-32
-8	3/4 -16	80-88	60-66	70-77	52-57
-10	7/8 - 14	135-149	100-110	115-126	85-93
-12	1-1/16 - 12	185-204	135-149	185-204	135-149
-16	1-5/16 - 12	270-297	200-220	270-297	200-220
-20	1-5/8 - 12	340-374	250-275	340-374	250-275

***adjustable fittings**

Table 2. Installation torque values for SAE J1926 (ORB) fittings, adjustable and non-adjustable.

SAE J1453 (ORFS) O-ring Face Seal Fittings

- Lubricate all o-rings and threads with the system fluid before installation. (For gas fittings, use 15W40 engine oil)
- Tighten specified torque vales in Table 3.

- **FFWR (Flats From Wrench Resistance)** shall be used if a torque wrench is not available, or if the location of the fitting does not permit the use of a torque wrench.

CAUTION
Use Westport supplied replacement parts only.
SAE J1453 (ORFS) fittings when supplied by Westport for natural gas are fitted with *Disogrin* (white in colour), gas compatible O-rings. Any other o-ring types are not compatible.

Face Seal Fittings		Torque		Flats From Wrench Resistance (FFWR)	
SAE Size	Thread	Torque (Nm)	Torque (ft-lbs)	Tube Nuts	Swivel / Hose
-4	9/16 - 18	25-28	18-20	1/4 - 1/2	1/2 - 3/4
-6	1 1/16 - 16	40-44	30-33	1/4 - 1/2	1/2 - 3/4
-8	1 3/16 - 16	55-61	40-44	1/4 - 1/2	1/2 - 3/4
-10	1 - 14	80-88	60-66	1/4 - 1/2	1/2 - 3/4
-12	1 3/16 - 12	115-127	85-94	1/4 - 1/2	1/3 - 1/2
-16	1 7/16 - 12	150-165	110-121	1/4 - 1/2	1/3 - 1/2
-20	1 11/16 - 12	205-225	150-165	1/4 - 1/2	1/3 - 1/2

Table 3. Installation torque values for SAE J1453 (ORFS) fittings.

Swagelok High Pressure Nut & Ferrule Compression Fittings

Initial installation:

See illustrations next page.

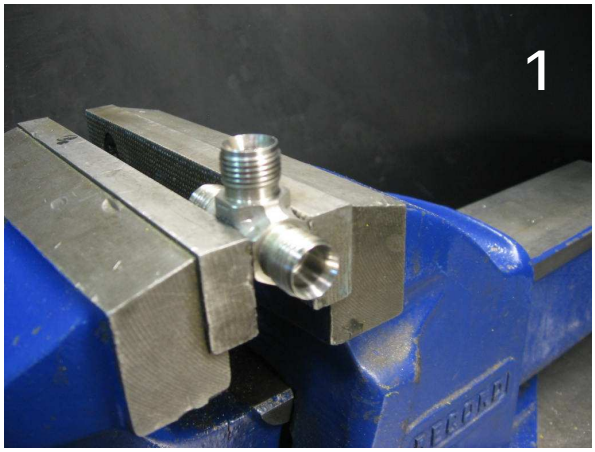
1. Securely clamp the fitting body into a vice.
2. Insert the nut and a complete front, rear ferrule set onto the tube.
3. Ensure that the tube end is free of burrs from previous tube cuts, and insert the tube end into the fitting, ensuring that the tube is fully seated into the fitting body.
4. Thread the nut until finger tight, and scribe / mark the nut at the 12 o'clock (top) position.
5. Further tighten the nut 1 ¼ turn until the mark is at the 3'clock position.
6. Initial installation is complete.

NOTE
Initial installations of nut and ferrules are permanent. Make all necessary bends and test fit your tube sections for fitment before the above procedure.

Subsequent re-installations:

1. A Swagelok compression fitting may be removed and reinstalled multiple times. If your new tube section is prefitted with a nut & ferrule set, or if it is a re-installation, insert the pre-fitted tube into the fitting until the front ferrule is fully seated. Tighten nut to fitting **finger tight + ¼ turn only.**

NOTE
Tightening beyond the above specification does not stop leaks. Check for damage to the ferrule and fitting seat interface if leaks are found. Replace as necessary.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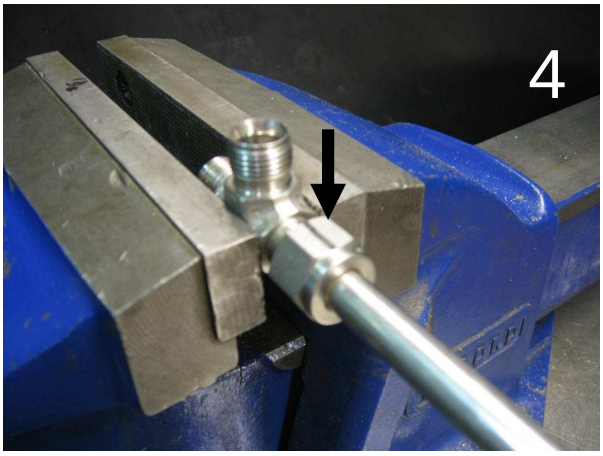
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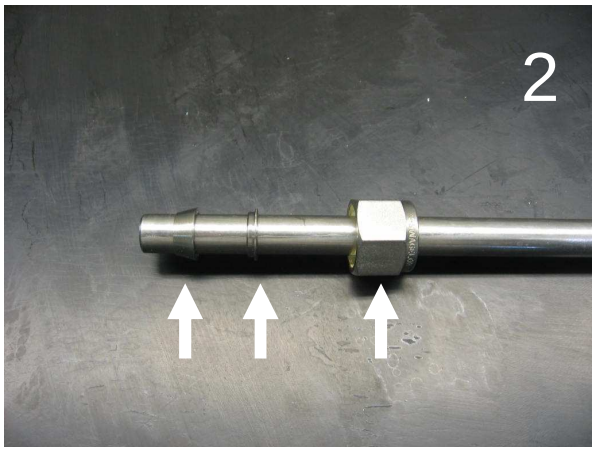
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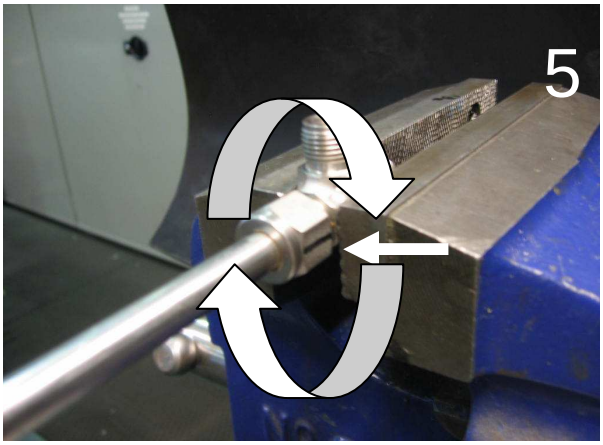
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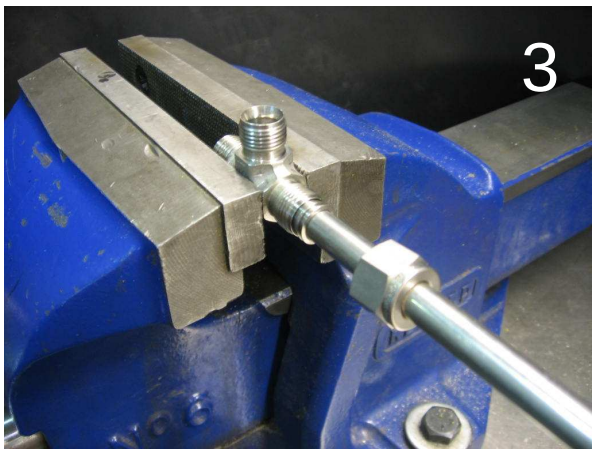
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6

Detailed Gas System Leak Inspection

Special Tools & Materials Required

- ‘SNOOP’ gas leak detection fluid

In Preparation

1. Place vehicle in a well ventilated shop area. Turn vehicle off.
2. Ensure that the Accumulator shut-off valve and the LNG Pump Shut-off valves are in the OPEN position. See Figure 1 and 2.

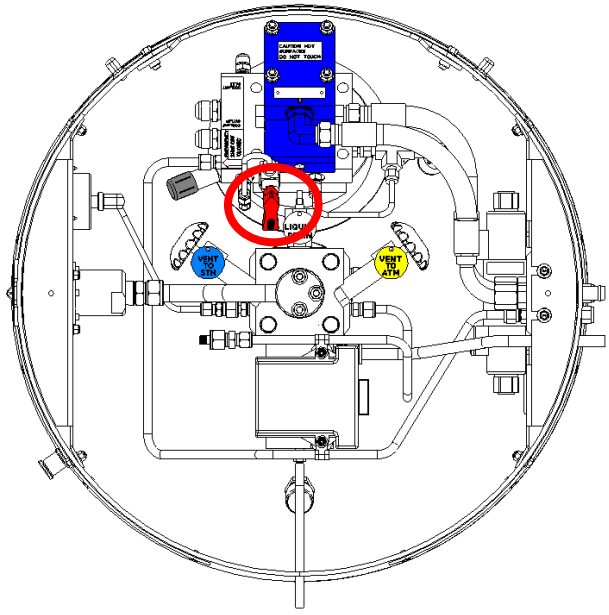

Figure 1. Location of LNG pump shut-off valve, shown in the OPEN (flowing) position.

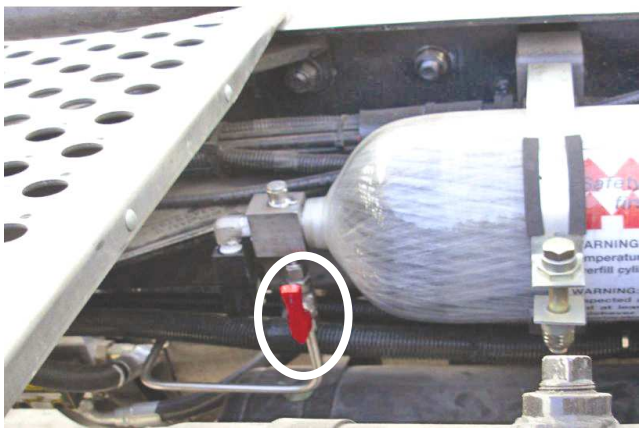

Figure 2. Location of Accumulator shut-off valve, shown in the OPEN (flowing) position.

Pressurized Leak Test

3. Start the vehicle and monitor the Westport driver display. When the “Please Wait” sign dismisses, wait a further 1 minute and shut the vehicle down. Gas system pressure should be fully built.
4. Listen for audible gas leaks along the chassis and in the engine bay.
5. Spray SNOOP gas leak detection fluid liberally on the following components of the gas system, and observe for frothing or bubbling indicating a gas leak.
    - High pressure delivery line from the LNG pump (within tank shroud)
    - LNG pump pressure relief valve (5500 PSI)
    - LNG Tank high pressure gas discharge connection (in hydraulic manifold)
    - All stainless steel gas lines & fittings along the frame rails
    - Accumulator pressure relief device and accumulator body
    - Gas filter housing, inlet and outlet connections
    - System pressure relief valve (5400 PSI)
    - FCM manual vent valve
    - FCM main body
    - Any other location where gas leak is suspected
6. If leak is detected, *Drain the High Pressure Gas System* following Westport Work Instruction INS-10011728 before attempting any repairs (including tightening of fittings).

DANGER

Always depressurize the system before any repair action (Westport Work Instruction INS-10011728). High pressure gas bursts can cause serious harm or injury to eye sight, hearing and skin.