



Field Service Bulletin

CNG and LNG Leak Repair Tutorial

ENP-552
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1. Introduction

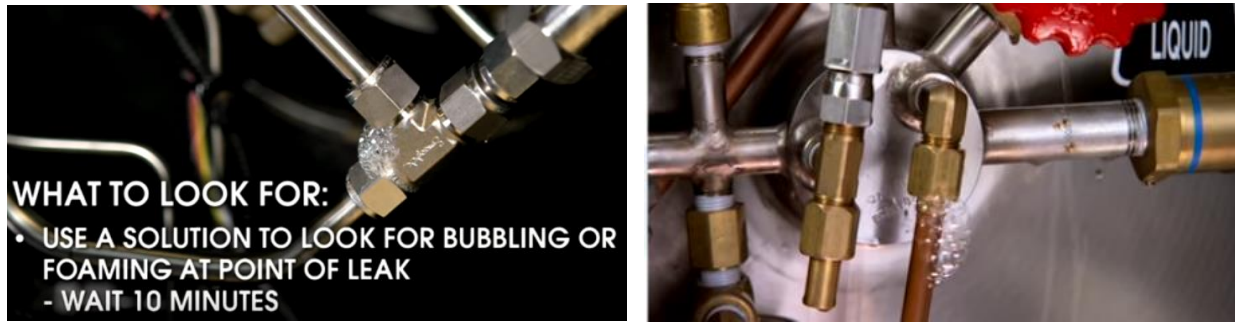


Figure 1 Leak detection for CNG (left) is the same as LNG (right).

Leak detection and repair is one of the basic skills all fleet maintenance, inspection and service personnel must have.

For monthly maintenance, the entire fuel system can be leak tested with leak detection solution, and/or a methane detector. All joints and connections should be tested.

Leaks usually occur at fitting connections. When checking for leaks always use certified methane detecting equipment and solutions designed for use with stainless steel and brass.

Videos on basic leak detection and repair for CNG and LNG are available on the Agility Fuel Solutions website.

Warning Messages Used in this Bulletin



Personal injury or death will occur if procedures are not followed.



Damage to equipment, fuel system or vehicle is possible if instructions are not followed.

2. Affected Units

This service tutorial can be applied to any and all natural gas fueled vehicles and fuel systems, in any configuration or from any manufacturer.

3. Corrective Action

Does not apply.

4. Tools and Materials

- Personal protective equipment (PPE), including eye and hearing protection as needed
- Standard hand tools
- Electronic methane detector (optional, see below)
- Leak detection solution
- O-ring lubricant, high pressure, silicone-based such as Parker Super-O-Lube
- Nickel anti-seize tape for LNG fittings
- O-ring kit, Agility Fuel Solutions part number **10500059**. Consists five (5) each of the most common O-rings in Agility CNG fuel systems.

5. Procedure

Safety Practices

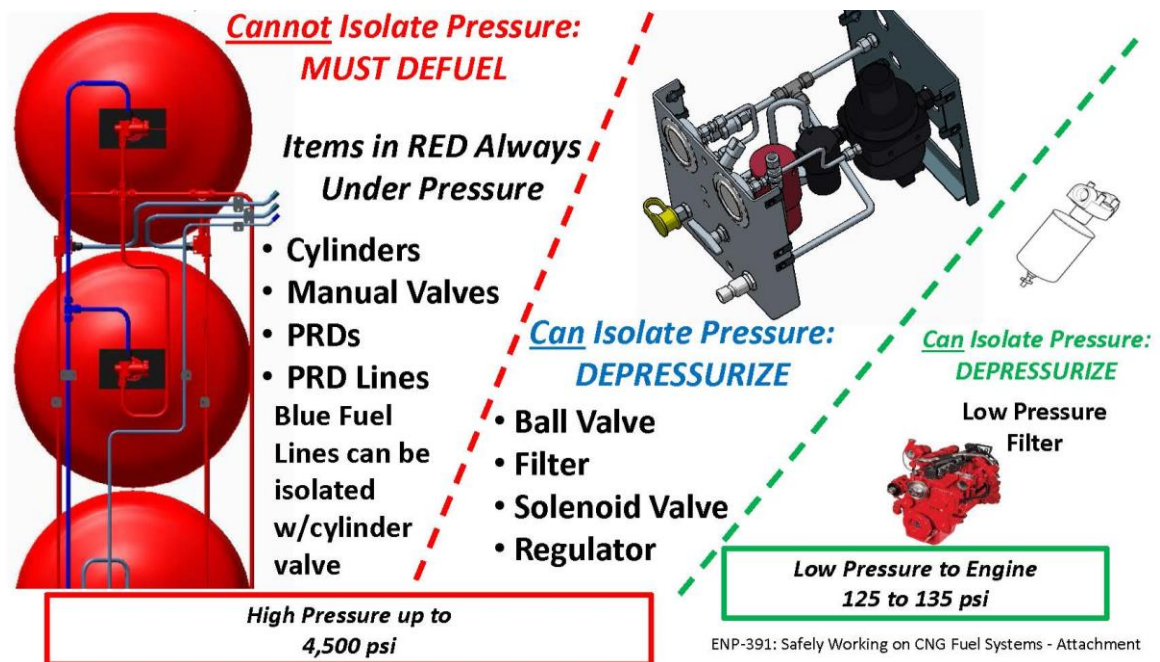
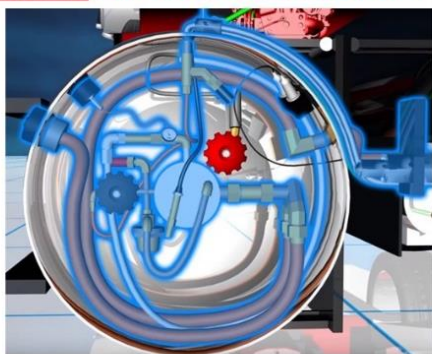


Figure 2 Beware of the pressure zones on CNG systems, and know when to depressurize and when to defuel.

Cannot Isolate Fuel: MUST DEFUEL



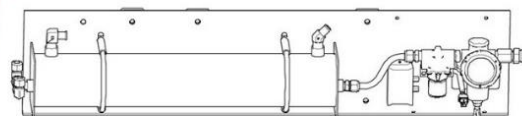
Items in **BLUE** Cannot be Isolated

- Tanks, Crossover Lines
- Liquid/Vent Valves
- On-Tank Gauges
- Economizer
- Pressure Relief Valves
- Knuckle and Knuckle Connections

Cryogenically Cold Liquid Fuel (-260°F/-162°C)



WARNING
Always Wear Appropriate PPE



**Can Isolate Fuel:
DEPRESSURIZE**

- Heat Exchanger
- Solenoid Valve
- Regulator
- Pressure Gauge

**Can Isolate Fuel:
DEPRESSURIZE**

Low Pressure
Filter



**Low Pressure Gas to Engine
125 to 135 psi**

ENP-462: Safely Working on LNG Fuel Systems - Attachment

Figure 3 Know and understand the LNG safety zones, too.

5.1 Locating Leaks

1. An electronic leak (methane) detector (“sniffer”) may be used to find the general leak area. However, most units are “broadband” and often give false warnings. **And, in order to pin-point the exact leak location, a liquid leak detector is necessary. A practical suggestion is to skip to Step 2.**
2. Apply a certified leak detecting solution and look for bubbling or foaming.
3. Allow at least 10 minutes so the smallest leaks can be detected.
4. Examine connections for ice, frost or signs of condensation around the tubing.
5. Visually check for damaged fittings or tubing.



DANGER



CAUTION

- A. Always depressurize (or defuel as needed) the system before starting repair work.
- B. **Never** tighten a fitting under pressure.
- C. You must be qualified to service any natural gas fuel system.
- D. Adjusting fittings requires accredited Swagelok® or Agility Fuel Solutions fitting assembly training.
- E. Never mix fittings from other companies. Agility systems use Swagelok fittings unless noted otherwise.



Figure 4 Various fittings and connections are used in a typical Agility fuel system. All connections should be leak-free. Top: CNG systems. Bottom: LNG systems.

5.2 General Procedures

Perform leak repairs in the order shown below and move on to the next repair only if the previous repair did not fix the leak.

1. If a leak is detected, depressurize the system, see Section 6.
2. Once the system is depressurized, tighten all leaking fittings. See below for notes on specific fitting types.
3. Repressurize the system.
4. When the system is pressurized, search for leaks again.
5. If leaks are found, depressurize the system and continue.
6. Remove fittings that are leaking and make sure the mating surfaces are clean.
7. Repressurize the system and test for leaks.
8. If the leak cannot be repaired, the component should be replaced.
9. If replacement is necessary, obtain replacement parts, install them and repeat the leak test.
10. Fix any leaks, re-pressurize the system and return the vehicle to service.

5.2.1 Compression Fittings

Swagelok compression fittings used on Agility systems feature a front and a rear ferrule and a compression nut. A wedge action seals the connection.



Figure 5 Left: Compression nut and ferrule set. Right: Compression tee fitting.

1. Swagelok recommends that fitting nuts should be tightened 1-1/4 turns beyond snug for tubing one inch and below.
2. Note: 1/16-, 1/8- and 3/16-in. tubing requires 3/4 turns beyond finger-tight.
3. If fitting threads are not clean or are damaged, the fitting must be replaced.
4. If tubing is not de-burred or if the tube is not cut square, the tube must be properly cut square and de-burred. This may require a new tube.
5. Snug is defined as the point at which the tube cannot be rotated freely in the pre-set swaging tool or fitting body. Swagelok fittings employ a two-ferrule design, the front ferrule provides the seal and the rear ferrule provides a firm grip on the tubing.

5.2.2 O-ring Boss (ORB) Fittings

ORB fittings seal with an O-ring and a sealing surface. The threads provide mechanical strength but does nothing to seal the fitting. Using the correct O-ring lubricant and applying the correct torque is important when using this fitting. See special note on O-rings in Section 6.



Figure 6 Left: 90-degree elbow with male ORB and compression fitting.

1. Check O-rings for damage. They must be properly lubed.
2. Check threads and O-ring mating surfaces for damage or debris. Any damage to the preformed packing (O-ring) will cause a leak.
3. Lubricate the O-ring with silicone-based lube, such as Parker Super-O-Lube.

4. Carefully install the O-ring into the fitting groove.
5. Screw the fitting into the mating component hand-tight until fully seated. Tighten fitting until snug.
6. Tighten lock nut to torque specification in Table 1.

5.2.3 National Pipe Thread Taper (NPT) Fittings

NPT fittings depend on the threads to seal the fitting. Since the thread is tapered, it creates a wedge between the fitting and the threaded port. A sealant is recommended, but it must not contaminate the system. PTFE tape and paste or liquid sealants are available. Agility recommends the use of methane-compatible nickel tape to seal NPT connections. Here are some precautions:

1. Skip the first one or two male threads to help prevent pieces of tape going into the plumbing system.
2. Wrap in a clockwise direction, no more than two turns of tape on the threads.
3. Tighten the fitting by hand, then wrench tighten.
4. Because thread and fitting quality may differ, there is no torque specification. Instead, use the following “turns from finger tight” recommendation, based on information from Parker Hannifin Corporation, Tube Fittings Division

Tapered Pipe Thread NPTF	Turns from Finger Tight
1/2-27	2 – 3
1/4-18	2 – 3
3/8-18	2 – 3
1/2-14	2 – 3
3/4-14	2 – 3

5.2.4 Hose Barbs

Usually found on silicon coolant hoses. In CNG systems, coolant lines are used to go from the engine block to the regulator water jacket. On LNG systems, coolant lines go from the engine to heat exchanger. There are two hose barb fittings, as shown below.

It is important to use the correct stainless steel hose clamps for these connections, as shown in Figure 8.



Figure 7 Left: 90-degree elbow with beaded hose barb and ORB male fitting. Right: 90-degree elbow with hose barb and NPT male pipe thread.



Figure 8 Stainless steel hose clamps for Agility systems must be compatible with silicone hoses. Although they may look like conventional worm gear “rubber hose” clamps, a closer look shows the smooth band that contacts the hose circumference.

5.2.5 JIC Fittings

The JIC fitting is usually found on low pressure fuel lines – lines coming from the fuel system regulator low pressure output to the engine. The seal is achieved by the internal wedge that is formed between the mating male and female fittings. Apply the recommended torque as shown in Table 1.



Figure 9 Size -8 Male JIC union, right: Male JIC to Swivel Male JIC fitting.

5.2.6 Hose End Fittings

Hoses are used when lines must accommodate flexing or movement, and are used in both CNG and LNG systems.



Figure 10 Left: Stainless steel high pressure CNG hose with tube stub end. Center: Cryogenic LNG hose with JIC swivel end. Right: Parker Parflex® hose with JIC fitting end.

6. Depressurize the System

1. Ensure the vehicle is turned off.
2. Locate and close all cylinder shutoff valves (turn handle fully clockwise).
3. Make sure the manual shut off-valve on the FMM panel is in the "ON/OPEN" position.
4. Start and run the engine until it stops.
5. Ensure the vehicle is off and the proper vehicle lock-out procedures are followed. (Remove the ignition key).
6. Check the gauges on the fill panel to ensure pressure is relieved (gauges read zero).
7. Slowly open the bleed valve inside the FMM.
8. Close the bleed valve to prevent fuel loss when work is completed and the system is re-fueled.

7. O-Rings

O-rings must be compatible with methane and temperatures encountered for either CNG or LNG. Agility recommends Viton or Buna O-rings. Standard rubber O-rings must never be used since they will fail prematurely and cause significant leaks.

A handy O-ring kit is available from the Agility Fuel Solutions parts department.



Figure 11 A handy O-ring kit is available. Part number 10500059.

The Agility Fuel Solutions O-ring kit, part number 10500059, consists five (5) each of the following:

- 10500021: O-Ring, 2-216, 1 1/8, -40 To 225F, NBR/Buna, N1470-70
- 10500025: O-ring, for face of LD36/LB36 Receptacle
- 10500047: O-ring, 2-208, -40F to 180F
- 10500056: O-ring, 3/8-16 SAE, 3-906, 0.47/0.63, -15F to 400F, Viton-90
- 10500057: O-ring, 1/2-13 SAE, 3-908, 0.64/0.82, -15F to 400F, Viton-90
- 10500058: O-ring, 1/4-20 SAE, 3-904, 0.35/0.49, -15F to 400F, Viton-90

8. Torque Specifications for Fittings

FITTINGS	MIN. TORQUE	DESIRED TORQUE	MAX. TORQUE ALLOWED
Type 3 Tank: Valve/PRD/End Plug into tank (1.125-12 thread)	110 ft-lbs	140 ft-lbs	160 ft-lbs
Valve/PRD/End Plug into Quantum Tank (1.125-12 thread)	110 ft-lbs	115 ft-lbs	120 ft-lbs
Valve/PRD/End Plug into Lincoln Tank (1.125-12 thread)	100 ft-lbs	110 ft-lbs	120 ft-lbs
Constant torque gear clamp 1-1/16 in. (#10)	--	50 in.-lbs	--
1/4-in. JIC*	11 ft-lbs	15 ft-lbs	18 ft-lbs
3/8-in. JIC*	18 ft-lbs	25 ft-lbs	31 ft-lbs
1/2-in. JIC*	36 ft-lbs	45 ft-lbs	59 ft-lbs
5/8-in. JIC*	57 ft-lbs	70 ft-lbs	85 ft-lbs
3/4-in. JIC*	79 ft-lbs	90 ft-lbs	118 ft-lbs

* Ref SAE J514 Table 2A

SAE Fittings in Manifold/Valve Ports O-Ring Boss (ORB)**			
3/8-24 SAE Straight	7 ft-lbs	7.5 ft-lbs	9 ft-lbs
7/16-20 SAE Straight	14.5 ft-lbs	15 ft-lbs	17 ft-lbs
1/2-20 SAE Straight	18 ft-lbs	18.5 ft-lbs	20 ft-lbs
9/16-18 SAE Straight	25 ft-lbs	26 ft-lbs	30 ft-lbs
3/4-16 SAE Straight	51 ft-lbs	52 ft-lbs	58 ft-lbs
7/8-14 SAE Straight	73 ft-lbs	74 ft-lbs	81 ft-lbs
1-1/16-12 SAE Straight	122 ft-lbs	125 ft-lbs	138 ft-lbs
1-3/16-12 SAE Straight	155 ft-lbs	158 ft-lbs	175 ft-lbs
1-5/16-12 SAE Straight	195 ft-lbs	199 ft-lbs	220 ft-lbs
1-5/8-12 SAE Straight	206 ft-lbs	210 ft-lbs	231 ft-lbs
1-7/8-12 SAE Straight	268 ft-lbs	273 ft-lbs	300 ft-lbs

** Ref SAE J1926-2 Table 4

9. Warranty Information

1. This procedure is covered under the standard warranty. Leak repair after the warranty period is considered part of routine maintenance for the lifetime of the vehicle.
2. Standard repair time (SRT) is 0.5 hours (30 minutes) per the Warranty Manual, ENP-065.

If you have any questions, contact Agility Fuel Solutions Customer Care: 949-267-7745, toll free: 855-500-2445 or support@agilityfs.com.

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