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RVIA STANDARDS AND EDUCATION DEPARTMENT

RV LP Gas Systems

Recreation Vehicle Industry Association
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Table of Contents

What You Will Learn in This Textbook

The following table lists the skills you will learn in this textbook. As you read the textbook, you can check ✔ the items you have read in the space provided.

Performance Objectives

✔	Objectives
	Identify types of containers and their components.
	Identify related terminology.
	Identify system components, their relationship and functions.
	Identify codes and standards applicable to DOT and ASME containers.
	Identify high and low pressure flex hoses.
	Explain the sources of LP gas.
	Differentiate between propane and butane gases.
	Identify the properties of propane gas.
	Identify the proper safety procedures for storage and handling LP gas.
	Identify vapor flow.
	Inspect/replace relief valves.
	Inspect/replace gauges (float mechanisms, sight gauges and dip tubes).
	Inspect, repair or replace stop fill float devices.
	Inspect, repair or replace automatic stop fill devices.
	Inspect, repair or replace service valves.
	Inspect/replace excess flow valves.
	Inspect/install mounting brackets.
	Identify reasons for purging.
	Purge air from a container.
	Verify propane odor (odorant fade).
	Transfer LP gas from one container to another.
	Leak test a container (pin hole and thread leaks).
	Inspect containers for dents, rust and general condition.
	Calculate container capacity.
	Fill containers.
	Apply appropriate labels.

Performance Objectives

✔	Objectives
	Prepare cylinders for transportation.
	Determine if a container is legal to be refilled.
	Identify container markings.
	The operation of regulators and their components (including automatic change over).
	Adjust regulator outlet pressure.
	Conduct a lock up test.
	Identify the reasons regulators fail.
	Remove and replace a regulator.
	Install and protect a regulator.
	Use appropriate test equipment.
	Types of system tests. -Time, pressure drop, leak test. -Regulator lock up test. -Operating pressure test.
	Leak test (using electronic leak tester, bubble solution, etc.).
	Appliance functional test.
	Troubleshoot tanks and components.
	Troubleshoot regulators.
	Determine serviceability of hoses (high and low pressure).
	Demonstrate the ability to inspect/replace LP gas piping system.
	Sizing, support and sealing of black iron pipe.
	Install and seal brass fittings.
	Identify and size copper tube types.
	Perform cutting and flaring of copper tubing.

SYMBOLS USED IN THIS TEXTBOOK

SYMBOL KEY
🗁 Valuable information
🕮 Workbook review

The following symbols are used in this textbook to help you find information quickly and easily.

Chapter 1

Introduction to RV LP Gas Systems

The LP gas system on a recreation vehicle is the system for storing and conveying the LP gas to the appliances. This system includes the LP gas containers, regulators, hoses, pipe, tubing, fittings and the appliances.

Caution

In many states personnel must be formally trained at an approved facility and licensed to perform some or all of the procedures which are contained in this textbook. Completion of this textbook is not authorization for the student to perform these functions.

CHECK THE REQUIREMENTS OF YOUR STATE.

IT IS YOUR RESPONSIBILITY TO MEET LOCAL REQUIREMENTS AND OBTAIN LICENSES AS REQUIRED.

1-1 THE BASIC RV LP GAS SYSTEM

All recreation vehicles that contain fuel burning appliances (ranges, ovens, refrigerators, water heaters, furnaces and in—older units—fuel-powered lights) use LP gas as the fuel. LP gas is a safe and proven fuel. LP gas is the only fuel currently used in RVs as the source of burning fuel for appliances. RVs do not use alcohol or gasoline as a fuel and seldom, if ever, use oil.

This material is intended to discuss how the LP gas is stored on the RV, how the LP gas is delivered to the appliances, and the materials and safety devices employed to ensure safe and efficient use of the LP gas. The basic design of most, if not all, LP gas systems in RVs is depicted in Figure 1-1.

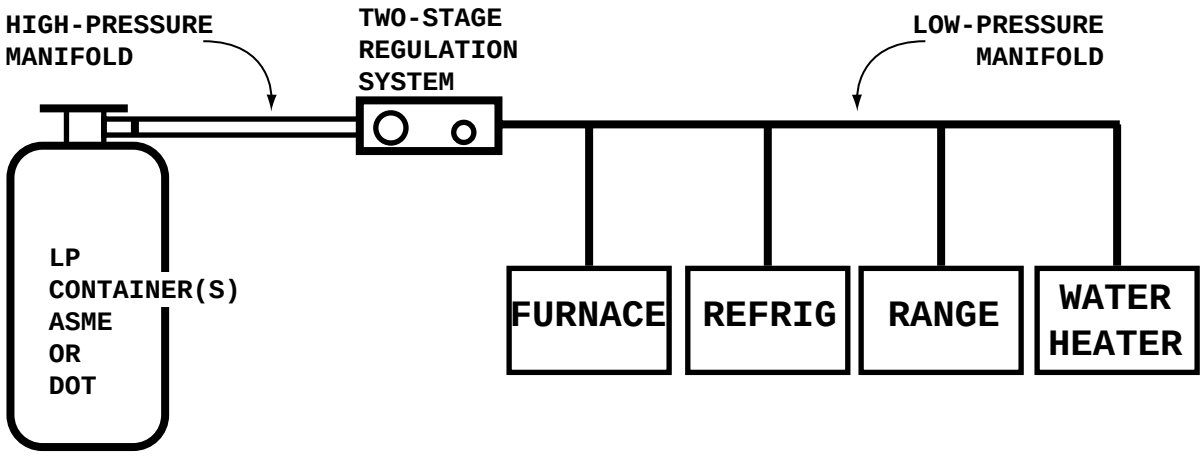


Figure 1-1 Basic LP Gas System

1-1.1 Components of the RV LP Gas System

As the preceding diagram shows, the LP gas system consists of the following:

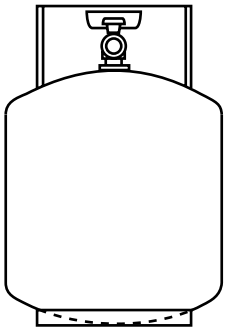
An LP gas container to store the LP gas, a two-stage regulator to reduce the pressure of the gas to the proper operating pressure for appliance use, and a piping system to deliver the gas from the container through the regulator and on to the appliances. Each of these components will be covered in detail by a complete chapter; however, a brief description of each is given here.

1-1.1.1 Containers

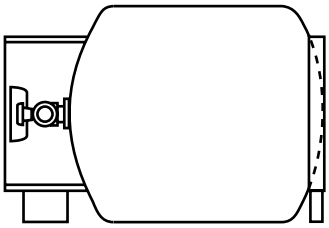
LP gas for use with recreation vehicles is stored in one of two types of containers. LP gas containers used in recreation vehicles are either DOT cylinders or ASME tanks. These are shown in the diagrams below. DOT cylinders are typically used on trailers and truck campers, while ASME tanks are used on motorhomes. All containers are filled to 80% of their total capacity to allow a vapor space at the top of the container and for liquid expansion. This vapor is the result of the liquefied petroleum boiling, which will create the vapor under pressure. Both types of containers provide safe and efficient storage but are constructed to different safety and design standards. Because of their designs, some containers are better suited for use on specific types of RVs.

1-1.1.1.1 DOT Cylinders

DOT cylinders, sometimes called “bottles,” are constructed to the requirements of the U.S. Department of Transportation, “Specifications for LP Gas Containers.” These containers are portable and come in a variety of sizes. The most common nominal sizes are 20, 30 and 40 pound. These size designations refer to the basic amount of LP gas these cylinders hold when filled to 80% of their full capacity. DOT cylinders are typically used on travel trailers, fifth wheel trailers, folding camping trailers, and truck campers. They can be vertical or horizontal cylinders and must be used in the position for which they were designed. Cylinders designed for vertical use can be mounted and filled only vertically. Cylinders designed for horizontal applications can be mounted and filled either horizontally or vertically, as shown in Figure 1-2.



Standard vertical
20 lb. DOT Cylinder

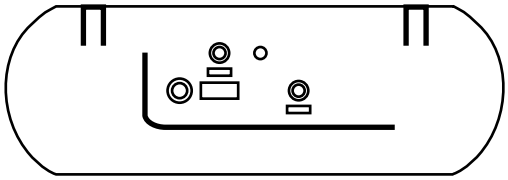


DOT 20 lb. cylinder
designed for horizontal use,
can also be used vertically

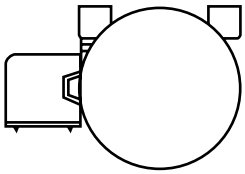
Figure 1-2 DOT Cylinders

1-1.1.1.2 ASME Tanks

ASME tanks are constructed to the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code. These tanks are permanently mounted to the recreation vehicles chassis or floor and come in a variety of sizes. ASME tanks, shown in Figure 1-3, are usually used on motorhomes:



ASME Horizontal Motorhome Tank



Side View

Figure 1-3 ASME Horizontal Motorhome Tank

1-1.2 Regulators

Regulators are components that reduce pressure. System regulators are located just downstream of the container(s) and reduce the high pressure coming from the container to a pressure that is usable by the appliances equivalent to an 11 inch water column (approx. 6-8 ounces). System regulators today are required to be two-stage configurations that work together to control the system pressure. In addition, there can be regulators at the appliance that also assist in controlling the pressure of LP gas as it enters the appliance.

1-1.3 Piping Systems

LP gas is delivered from the containers to the appliances by a variety of materials. These materials may include flexible hoses, iron piping and copper tubing. Each material has criteria for use, and all materials used must be compatible for use with LP gas. Specific materials must also be used to deliver the high-pressure LP gas from the container to the regulator.

1-1.4 Appliances

The purpose of LP gas is to operate the appliances, and while the individual appliances are discussed in detail in their own section, some information on appliances is provided below.

Because the burning of any fuel requires oxygen, and fuel burning also creates exhaust (or products of combustion) fuel-burning equipment intended for RV use must be specifically listed and approved for use in recreation vehicles. Listed RV appliances are referred to as "sealed combustion, direct vent" appliances, with the exception of the oven and stove. To determine if a particular appliance is acceptable for RV use, look at the appliance's nameplate. Some listing agency such as AGA or UL will have authorized its mark or logo on the appliance, and you will see the actual words "for use in recreation vehicles" right on this data plate or name plate. If you do not see these words, the appliance is not suitable for installation in an RV.

Using a "sealed combustion, direct vent" appliance ensures the user's safety, because the oxygen or air needed for combustion is drawn into the combustion chamber from the outside of the vehicle, and the exhaust, or products of combustion, are expelled to the outside. Otherwise, the users may be harmed or killed from oxygen depletion, asphyxiation, or carbon monoxide poisoning.

The only exceptions to using "sealed combustion, direct vent" appliances are ranges and refrigerators. Refrigerators are "sealed combustion, direct vent" appliances by their installation. Look at the refrigerator from outside the RV by removing the vent covers. The RV manufacturer has installed the refrigerator and sealed the edges with silicon or other sealant to ensure that air for combustion is not drawn from the living space of the RV and the exhaust cannot get into the living space. So, by its installation, the refrigerator is a "sealed combustion, direct vent" appliance.

Because the range is an attended appliance, it is not a "sealed combustion, direct vent" appliance and cannot be installed to ensure air/exhaust separation. This is why there is a large warning label on the range hood or in another location near the range to tell the user to open a window or vent and not to use the range for comfort heating.

1-2 PROPERTIES OF PROPANE

Propane gas is a petroleum product separated out of natural gas and crude oil in the refining process. It is a true gas and conforms to Charles and Boyle's Law in that its pressure is related to temperature when the volume is constant, and the volume varies directly with pressure when the temperature is constant. In addition, LP gas expands as pressure is reduced, so it expands in all directions, and any air movement from heat, motion, fans, wind, etc., will move LP gas around in a space. While LP gas is heavier than air and, in a perfectly still environment, will settle to the bottom of a space, it will not react like this in real-world conditions. Instead, once LP gas is mixed with air, the LP gas will not separate from the air. LP gas should be treated with the same caution as every other flammable gas.

Propane is nearly odorless and colorless as extracted. It looks and acts similar to water except for its boiling point. Water boils at +212°F at sea level, and propane boils at –44°F at sea level.

The boiling of either liquid produces a steam or vapor. The vapor produced by propane is a colorless, flammable gas. The higher the temperature above the boiling point, the greater the "steam" pressure. Propane gas is compressed 270 times to a liquid state for storage. Thus one gallon makes 36.4 cubic feet of gas vapor at sea level. Each cubic foot has 2500 BTU and uses about 25 parts of air to one part of gas to burn efficiently. Fortunately, propane gas limits of combustibility are rather narrow. The gas-to-air ratio must be between 2.5% and 9.6% to ignite. It takes approximately 1,000°F to ignite the mixture, and it can burn at up to 3,500°F when properly mixed with oxygen.

An odorant, usually ethyl mercaptan, is added to propane just after its manufacture as a warning agent. This sulfur compound gives the gas the rotten egg, skunk oil odor. One or more pounds of mercaptan is added to 10,000 gallons of LP gas; this makes the LP gas smell in concentrations of one-fifth of the lower limit of combustibility as required by NFPA 58, The LP Gas Code.

LP stands for "liquefied petroleum" and includes both propane and butane. Both propane and butane may be available in the marketplace and, if given a choice for use in a recreation vehicle, propane should be the choice. Propane has a much lower boiling point, which makes it the better choice for RVs, particularly in cold weather, since the LP gas must "boil" to create the vapor that is extracted from the container for use by the appliances. Commercial butane will not boil when the outside temperature is 15°F or lower (this shows the differences of "commercial" butane and "pure" butane). Therefore, the appliances will not work due to a lack of vapor pressure. Propane, on the other hand, boils at –44°F and will continue to provide the vapor for fuel.

Another important property of propane is the expansion of liquid as it is warmed. Propane gets about 1-1/2% larger for every 10°F it is warmed. Heat the gas 100°F, and the gauge will show 15% more fuel in the tank. Because of this property, all containers are filled with 80% liquid and 20% vapor.

Table 1-1 provides details on LP gas properties:

Table 1-1 Basic Fact About LP Gas[1]

Property	Commercial Propane	Commercial Butane
Pounds per gallon at 60°F (16°C)	4.20	4.81
Specific gravity of gas at 60°F (16°C)	1.50	2.01
Specific gravity of liquid at 60°F (16°C)	0.504	0.582
Cu. ft. gas per gallon liquid at 60°F (16°C)	36.38	31.26
Cu. ft. gas per pound at 60°F (16°C)	8.66	6.51
BTU per gallon	91,502	102,032
BTU per pound	21,548	21,221
Initial boiling point at 14.7 psi	–44°F (–12°C)	15°F (9°C)
Vapor pressure in psi at 70°F	127	17
Vapor pressure in psi at 100°F	196	37
Vapor pressure in psi at 130°F	287	69

1. Data from NFPA 58, Table B1-2-1, Appendix B (1995 edition) and *Rego Serviceman's Manual L-545*.

If there is a question as to whether propane or butane is in the container, connect a pressure gauge to the service valve and compare the pressure/temperature relationship to the chart. For example, if at 70°F ambient temperature the pressure reading is over 100 psi, you have propane in the container.

Table 1-2 provides details on LP gas capacities

Table 1-2 LP Gas Capacities (Propane)

Property	Lb. of Gas	BTU
1 - 2.5 gal. DOT cylinder	11	238,370
1 - 4.8 gal. DOT cylinder	20	433,400
1 - 7.2 gal. DOT cylinder	30	650,100
1 - 9.2 gal. DOT cylinder	40	866,800

Note

80% fill, 20% for vapor space

1-2.1 Conversions

Gallons to Liters (1 gallon = 3.785 liters)
F° to C° [(F° –32) ÷ 1.8]
11in. Water Column = 6-1/4 oz. per sq. in. pressure

The BTU demand of a gas appliance is found on the appliance data plate. This information can be used in evaluating how long your LP gas supply will last. For example; one gallon of LP gas contains approximately 91,500 BTU. If an appliance is rated at 30,000 BTU, then divide the 91,500 by 30,000 to show that the appliance operation time will be approximately 3 hours per gallon. The LP gas capacity of the container is stamped on the container's data plate. For example, a typical travel trailer with two 30-lb. LP gas containers would have approximately 1,290,000 BTU.

POUNDS: Multiply 60-lb. by 21,500 BTU per pound = 1,290,000 or
GALLONS: Multiply 14.2 gallons by 91,500 BTU per gallons = 1,299,300

A 30,000 BTU per hour appliance would be able to operate continuously for 43 hours. For example: 1,290,000 (available BTU) divided by 30,000 (BTU appliance demand) = 43 hours.

Note

Other than a gas refrigerator, most gas RV appliances do not operate continuously.

It is possible to "exceed the rate of vaporization," which is similar to the symptoms of running out of fuel when, in fact, there may be some propane in the container. This is because the fuel has been refrigerated from vaporization to the point where there is little or no container pressure. This can become more of a concern as ambient temperatures drop. This means that to camp in arctic climates, a full storage or auxiliary storage may be required to maintain sufficient container vapor pressure.

As a rule of thumb, when using an RV in cold climates, keep the storage above 50% full. The liquid gas must absorb heat from the atmosphere to boil and produce vapor to operate the appliances. The heat transfer occurs primarily through the shell wetted by the liquid. The lower the fuel supply, the less the wetted surface and the lower the vaporization rate.

Table 1-3 Vaporization Rates

19 gal. Water Capacity ASME LP Gas Tank BTU Available At					
% Full	+20°F	0°F	–5°F	–10°F	–15°F
60%	95,600	47,800	36,000	23,900	12,100
50%	86,000	43,000	32,250	21,500	11,750
40%	77,000	38,500	29,250	19,250	9,825
30%	68,000	34,000	25,500	17,000	8,500
20%	58,000	29,000	21,750	14,500	7,250
10%	43,200	21,600	16,200	10,800	5,400
20-lb. DOT Cylinder[1] BTU Available At					
% Full	+20°F	0°F	–5°F	–10°F	–15°F
60%	36,000	18,000	12,750	8,500	4,250
50%	32,400	16,200	12,150	8,100	4,050
40%	28,800	14,400	11,400	7,600	3,800
30%	25,200	12,600	10,450	7,300	3,150
20%	21,600	10,800	8,100	5,400	2,700
10%	16,200	8,100	6,075	4,050	2,025

1. For a 30-lb. cylinder, multiply × 1.40.

1-2.2 Basic LP Gas Safety

Safety is extremely important for anyone working with LP gas systems, and safety should be placed above all else in importance. LP gas is flammable, explosive under pressure, and can freeze skin. The following are some safety rules that should always be observed when working with RV LP Gas systems. Many of these will be discussed in further detail in other sections of this manual.

1-2.2.1 Basic Practices to Enhance Safety and Trouble-free Use

1. Never allow LP gas to come into direct contact with skin. When liquid propane is released, it absorbs surrounding heat to boil. Since it boils at –44°F, it absorbs heat, causing anything in contact to freeze. Always wear protective clothing such as gloves and eye protection when the potential for contact with propane liquid is present.

2. Never allow your LP gas container to be filled above the maximum safe level as indicated by the fixed maximum liquid level gauge (outage valve). The maximum safe level is 80%

full. This allows for expansion of LP gas when it is moved to warmer conditions. Propane gets about 1-1/2% larger for every 10°F it is warmed. Do not use the visible gauge for filling—it is only to indicate when to refill.

3. Do not use a wrench or pliers to close the service valve or fixed maximum liquid level gauge on your container. These valves are designed to be closed leak-tight by hand or screwdriver, as appropriate. If wrenches are necessary to stop a leak, the valve likely needs repair or replacement.

4. When tightening the POL nut (left-hand thread) at the service valve, draw it up snug with a proper wrench. This is a machined male brass fitting that seats securely against a female seat in the service valve - pipe dope is not necessary and not permitted on flare type connections. Check for leaks after connecting. To do this, apply the proper leak detector solution to the connection at the service valve. Be sure you have turned off all burners and pilot lights. Then open the service valve. Leaks, if present, will be detected by the appearance of bubbles. If bubbles appear, tighten the connector and repeat the leak test.

5. When you place the LP gas container into service, slowly open the service valve all the way. Listen to the regulator for a hiss or hum. This sound could be indicating a large leak. If you hear this hissing or humming, turn off the service valve and look to see that all appliances are off or that an open line does not exist. The source of the leak must be found and fixed. If you hear a "phfht." and there is no other noise, the system likely does not have a large leak. The "phfht" noise is simply the closing of the regulator's diaphragm. Be sure no small leaks are in the system by following item 6 below.

6. Check all container and gas line connections periodically to be sure they are tight. When testing for leaks, use leak detector solution or an electronic leak detector on each fitting throughout the system to determine if there are leaks. If bubbles appear at the fittings or the electronic leak detector sounds, using two wrenches to prevent twisting the tubing or stripping the fittings, tighten the leaking fitting joint to eliminate the leak. Sometimes, the simple tightening of the fitting will not correct a leak. If this is the case, the joint will need to be taken apart, old sealant removed (a steel brush works well), and new sealant applied. If you are working with a tubing joint, the fitting assembly will need to be taken apart and inspected. It is possible the flare is bad, requiring it to be cut off and reflared. DO NOT USE MATCHES OR A LIGHTER TO TEST FOR LEAKS. Perform a pressure drop test as per ANSI A119.2/NFPA 1192, paragraph 2-4.18.2, every time a gas fitting has been disconnected. Document the test. This means to write on the service order the type of test conducted, the date of the test, the pressure(s) used during the testing, the test results and the full signed name of the service technician. Using just initials in documenting tests is of little value, since more than one technician at a service facility can have the same initials or no one may remember who the initials stand for if the service technician leaves and test documentation becomes important several years later.

7. Make certain your container is properly fastened in place. Ensure that cylinder hold-down brackets and ASME tank mounting bolts are secure. According to the RV standards, the LP gas containers are to be installed so they will not become dislodged when a load equal to eight times the container's filled weight is applied to the container's center of gravity in any direction (ANSI A119.2/NFPA 1192, Paragraph 2-2.4).

8. On dual cylinder installations, turn the cylinder with the open part of the cylinder

guard(s) toward the trailer (travel trailer installation). This will protect the valves and regulator(s) against flying rocks and mud that may be thrown by the tow vehicle to the rear on gravel or dirt roads.

9. Transport cylinders with the valves closed and a plug or cap securely fitted into the service valve. Secure the container against falling or rolling. NFPA 58, Chapter 6, establishes the requirements for the transportation of LP gas containers. In general, the rule to follow whenever transporting LP gas cylinders is to secure them in the same horizontal or vertical position in which they are designed to be used.

10. Since uncontaminated LP gas is noncorrosive, you need not worry about the inside of your LP gas container rusting if it is purged correctly before being placed into service. However, the outside should be kept from rusting by a periodic coat of paint in a heat-reflective color (i.e., white or silver).

11. Do not store LP gas containers indoors or in enclosed areas. Do not expose LP gas containers to heat. Always store the containers with the service valves closed and plugged or capped.

12. Do not attempt to repair LP gas containers, valves or regulators unless you have been trained to do so.

13. Do not fill DOT cylinders beyond 12 years from date of manufacture unless properly recertified and so stamped per DOT regulation. Technician notes: For additional information on cylinder inspection and recertification see your LP gas supplier or write for the *Compressed Gas Association Bulletin C-6* ($22).

14. Observe valve information supplied by the appropriate manufacturer. Measure the dip tubes for proper length when changing DOT cylinder valves. Install the proper relief valves with proper pressure design and volume (375 psi for DOT cylinders, 312.5 psi design pressure (NFPA 58, 2-2.2.2) for ASME motorhome tanks).

15. An ASME overfilling prevention device must be installed properly for the valve to operate correctly. Since overfill devices are located inside the containers, only the device's nut or collar can be seen outside the tank. These nuts or collars have a position indicator to aid in proper installation. Some have a notch that needs to be located straight up, while others may have the word "top" to indicate the proper position. Overfilling prevention devices (OPD) for cylinders must be replaced with the appropriate valve. Check with the cylinder's manufacturer to ensure that the proper valve is used.

16. Practice safety at all times. If you have questions about the operation of an appliance or LP gas system, contact your supervisor.

CHAPTER 1 REVIEW

1. Propane gas is a petroleum product separated out of natural gas and crude oil in the refining process.

   True False

2. Commercial propane is odorless and colorless.

   True False

3. Propane and water boil at –44°F at sea level.

   True False

4. Ethyl Mercaptan is added to the LP Gas as a warning agent.

   True False

5. A gallon of propane weighs 10 pounds 2 ounces at 60°F.

   True False

6. Propane contracts as temperature is warmed.

   True False

7. The POL plug has a left-handed thread.

   True False

8. Determine the gallon capacity of a 65-lb. ASME tank at 60°F.

9. You have a 20-lb. DOT cylinder half full at –5°F. What is the BTU vaporization capacity per hour?

Chapter

2

LP Gas Containers

2-1 Components, Inspection and Maintenance

There are several components that are common to all LP gas containers. Familiarize yourself with these components before purging or filling LP gas containers to ensure safety and prevent accidental leaks.

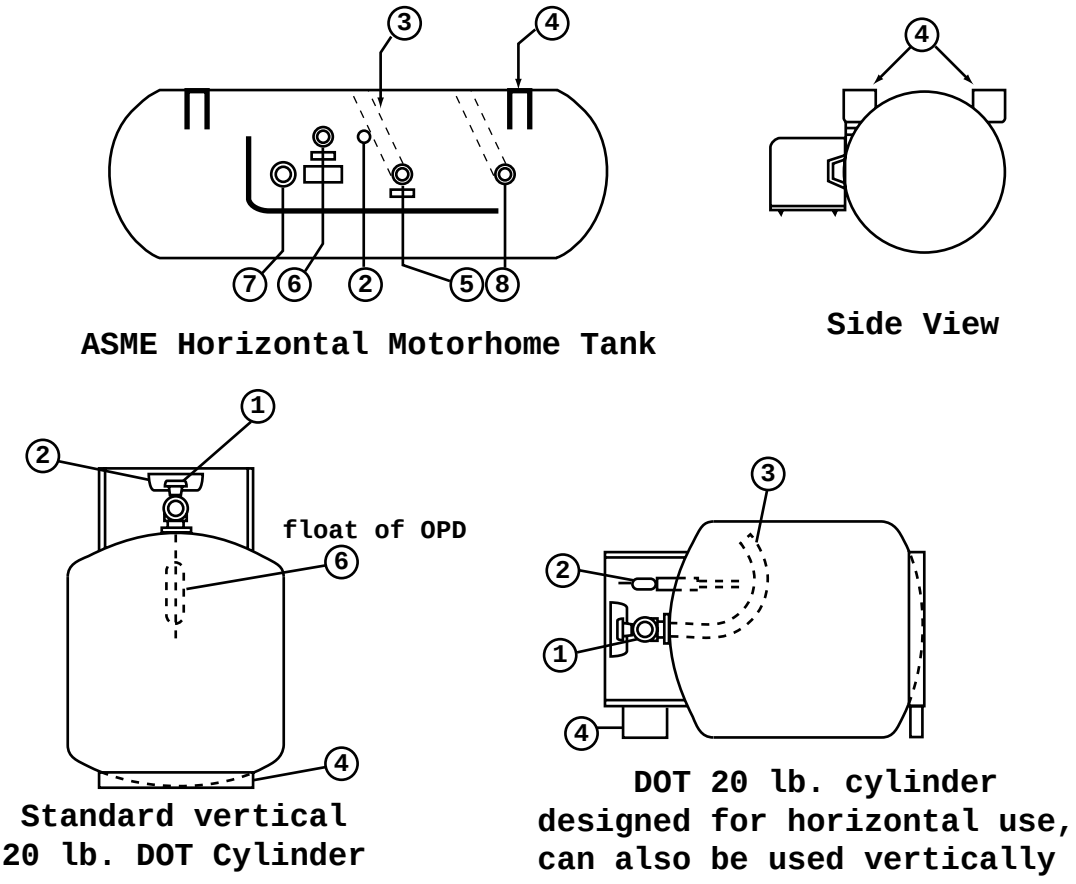


Figure 2-1 Common Components of LP Gas Containers

Note:

ASME tanks are referred to throughout as "tanks," DOT cylinders are referred to as "cylinders," and when both are discussed we use the word "containers."

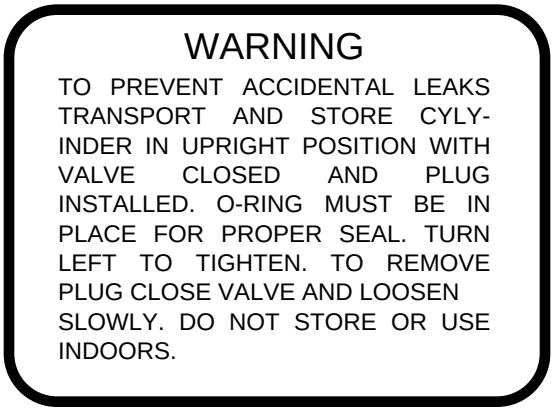


Figure 2-2 DOT Cylinder Warning Label

As shown in Figure 2-1, LP gas containers consist of the following parts:

1. Vapor withdrawal service valve with pressure relief valve (cylinders).
2. 20% fixed maximum liquid level gauge or outage valve (sometimes inaccurately called a 10% valve).
3. Vapor withdrawal tube or J-tube (used on containers where the service valve is not located on top of tank).
4. Bottom ring, stand legs, or mounting brackets.
5. Separate safety relief valve (tanks).
6. Overfilling prevention device valve.
7. Visible sight gauge. Available with remote sender.
8. Vapor withdrawal service valve with internal excess flow check valve.

2-2 LP GAS CONTAINER COMPONENTS AND INSTALLATION

All LP gas appliances for cooking, heating, lighting, water heating, and refrigeration are designed to operate on LP gas vapor only. Therefore, all LP gas tanks and cylinders designed for vapor service must be transported, installed, and used in the proper position. Do not transport, install, or use a vertical cylinder (see Figure 2-1) in a horizontal or upside-down position. Never use a horizontal cylinder or tank (see Figure 2-1) on its improper side. Liquid LP gas could enter the system designed for vapor only, creating a potentially hazardous condition.

Note

Some LP gas-powered generator sets may require a liquid supply for proper operation. Special containers or separate container openings may be supplied for this purpose. Liquid withdrawal outlets are so marked.

LP gas containers are permanently marked with the word “top” stamped on a tab welded to the tank or “arrows must point up” stamped in the guard or bracket of a cylinder to identify the proper position.

Always use a plug or cap when transporting or storing disconnected cylinders or tanks (full or empty). All LP gas tanks and cylinders must be securely attached in the proper position for the intended use. Use all brackets provided to ensure proper support and positioning.

Figure 2-3 displays an example of a POL plug. Figure 2-4 shows a type 1 CGA (Compressed Gas Association) No. 791 valve or dustcap.

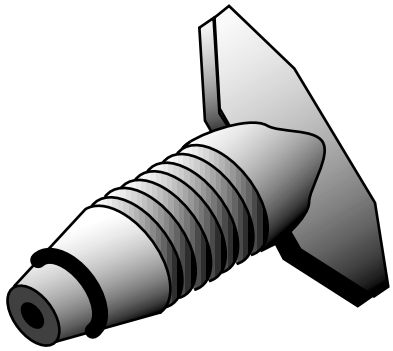


Figure 2-3 Plastic POL Plug

Caution:

Never use a POL plug in a type 1 CGA 791 valve.

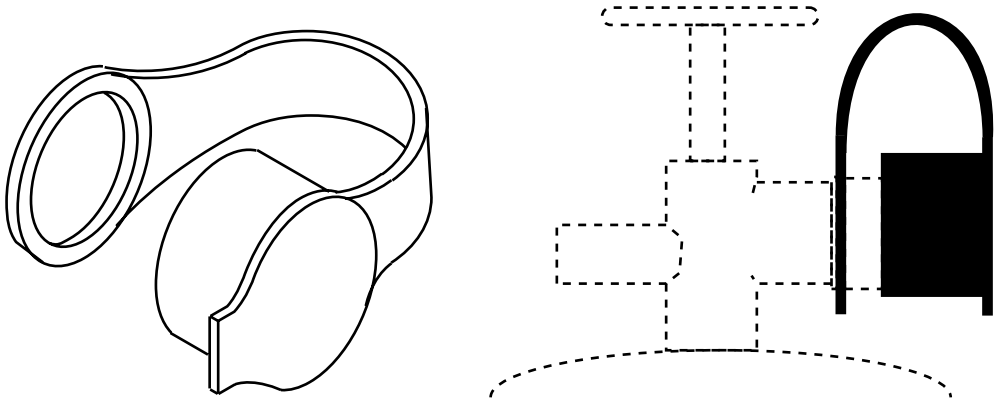


Figure 2-4 Type 1 CGA No.791 Valve Dustcap

There are 3 different cylinder valves available to the RV industry. There is a type 1 or CGA 791 valve, a type 2 or CGA 810 valve and the old style POL or CGA 510 valve. POL type valves, most commonly used in the RV industry, have a 5-prong handle, similar to a star, as shown in Figure 2-5. These are not provided any longer, but are still seen throughout the industry. POL-type valves will need to be upfitted to a type 1 or type 2 valve with overfilling protection by 2002, as required by NFPA 58.

Figure 2-5 Old Style Valve with POL (CGA 510)

The type 1 valve, or CGA 791 valve, shown in Figure 2-6, is sometimes called a QCC (Quick Coupling Connection) valve. This is a registered trademark (similar to POL meaning Prest-O-Lite). Connection to a type-1 valve requires a mating ACME nut, normally plastic, that includes the right-hand 1 5/16 ACME threads for tightening the fitting to the service valve of a cylinder. These threads are of a square type that have been used for years in LP gas connections where repeated hand tight connections are required. Examples include filler valves and vapor return valves.

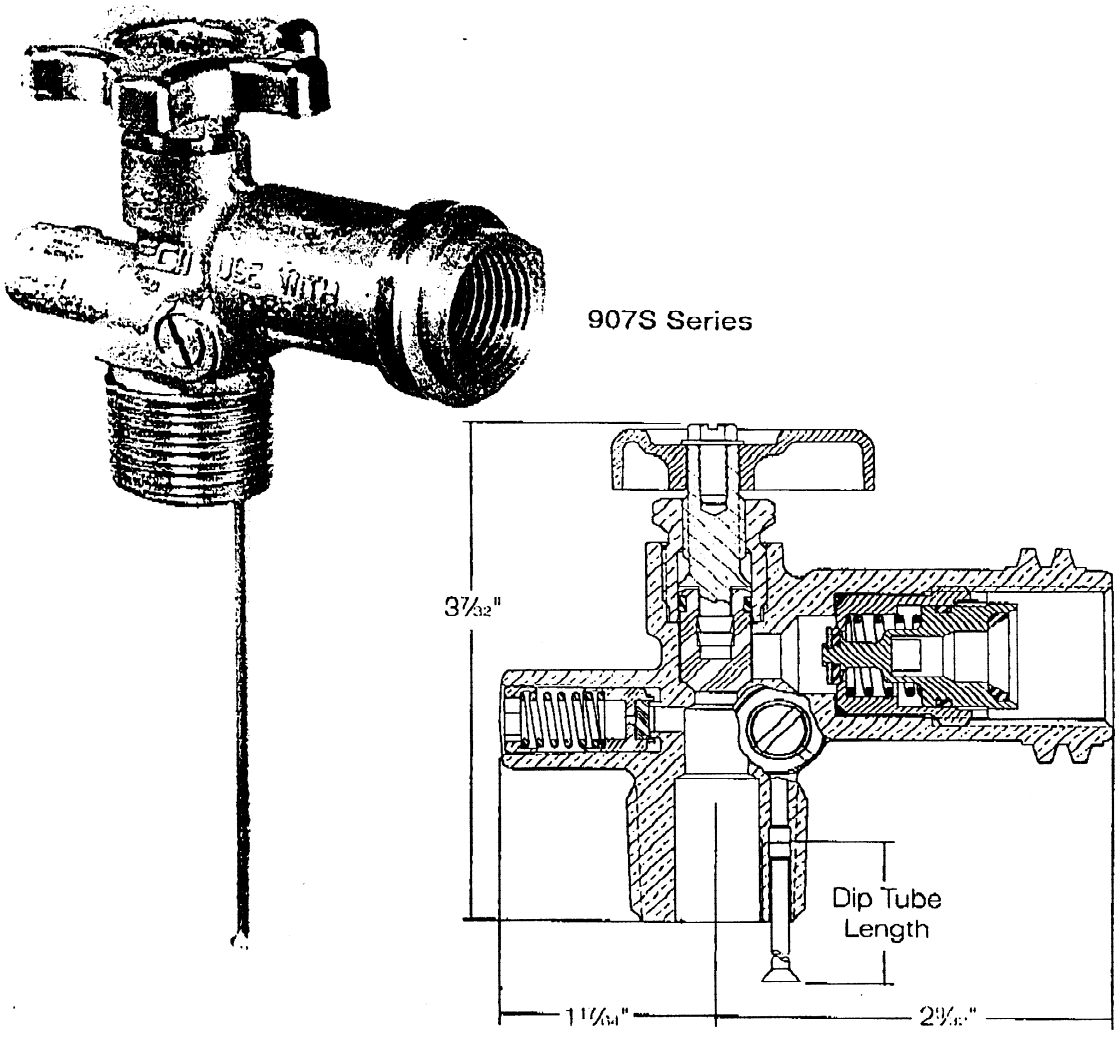


Figure 2-6 Type 1 Valve (CGA 791)

A type 2 or CGA 810 valve, as shown in Figure 2-7 uses a quick connect on the valve outlet. The quick connect type does not require tools or threads to complete the connection. The connection is accomplished by sliding the locking sleeve towards the cylinder's valve body, inserting the mating (vehicle side) component of the connection device into the outlet and releasing the locking sleeve.

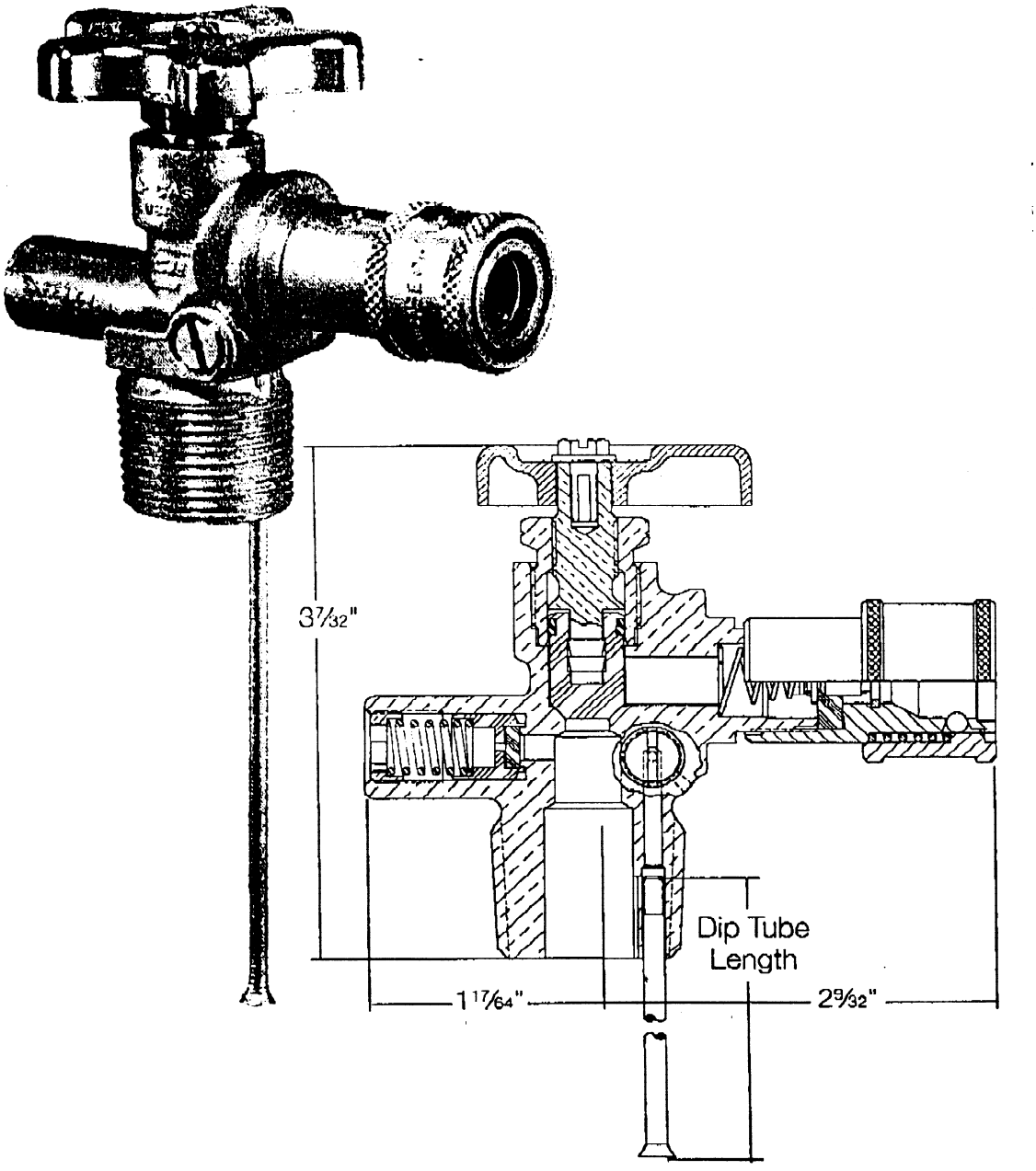


Figure 2-7 Type 2 Valve (CGA 810)

Both the type 1 and type 2 valves incorporate a back check device that will not allow LP gas to flow until a positive seal is achieved with the mating connection. The vehicle side of the connection has a thermal sensitive device that allows the back check to close, shutting off the flow of LP gas, if the connection is exposed to temperatures that exceed 240° F. Also included is a flow

limiting device which, if it senses excess LP gas flow, will activate to limit the flow of LP gas to a maximum of 10 standard cubic feet per hour (SCFH). Both type 1 and type 2 valves incorporate an overfilling prevention device (OPD) to prevent cylinders from being overfilled.

Type 1 valves are most commonly used with the RV industry. Type 2 valves are popular in the grill industry. Type 2 valves are not recommended for use in the RV industry.

2-3 LP GAS CONTAINER APPURTENANCES

All containers have appurtenances. The word "appurtenance" is a single term that includes all the fittings and valves on the container. Container appurtenances are items connected to the container openings needed to make the container a gas-tight entity. Appurtenances include the following terms: fill valve, shutoff valve, service valve, fixed maximum liquid level gauge, pressure-relief devices, backflow check valve, excess-flow valve and plugs. While these devices may be on each container, the types and placement on the containers may vary, depending on whether you are dealing with a DOT cylinder or an ASME tank.

2-3.1 Service Valves and Service Valve Assemblies

On DOT cylinders, the service valve is the primary valve on the container. It is sometimes called the "shutoff valve." The service valve is one assembly that is used for filling the cylinder with liquid, and vapor withdrawal to supply the system with LP gas vapor. The service valve is often called the "shutoff valve assembly," because the handle of the service valve is used to turn the cylinder on and off to let gas into and out of the container. On DOT cylinders, the service valve contains an integral relief valve and a fixed maximum liquid level gauge.

On ASME tanks, the service valve is the valve that is opened to allow LP vapor into the system. The handle of this valve is used to turn the gas supply off and on and again is sometimes called the "shutoff valve." The fill opening on the ASME tank is a separate opening from the service valve. The fill opening on the ASME tank is only used for filling the tank with liquid propane and usually has an overfilling prevention device (OPD) attached to it. Tanks built prior to 1983 may not have the OPD, as this device was not required by the RV Standard prior to that time.

2-3.2 Vapor Withdrawal Tubes

Vapor withdrawal tubes are sometimes referred to as "drop" tubes or "J-tubes." The drop tube, which "communicates" or is direct contact with the vapor space, is used to withdraw LP gas vapor to the service valve.

2-3.2.1 Testing Vapor Withdrawal Tubes

After the filling and reinstallation of an LP gas container on the RV, the procedure below should be followed before connecting the regulator:

2-3.2.1.1 Cylinders

1. When opening a valve on a DOT cylinder, be certain that liquid propane is not emitted. You can detect liquid propane as the white, fog-like substance that would be emitted from the service valve, if present. Vapor only, which is invisible, should be emitted from the valve. Opening the valve a small amount and checking the emission can perform this test. The emission of liquid can be evidence of an overfill.

2. On a horizontal DOT cylinder, lay the cylinder in its correct position, as indicated by the

arrow on the decal and the arrow on the guard pointing up when the cylinder is resting on its feet. When the service valve is opened slightly, a small amount or drop of liquid will be visible. This liquid may be trapped in the withdrawal tube that goes to the vapor space at the top of the cylinder. After a very small emission of liquid, gas vapor only should be emitted.

3. Turn off the service valve and wait for 30 to 60 seconds. Perform the procedure again to make sure there is no liquid in the tube. This tests the integrity of the tube to make sure there are no holes or cracks and that the tube is properly positioned in the cylinder.

2-3.2.1.2 Tanks

1. This same test described above must be done on ASME tanks used on motorhomes or camper vans. These tanks have an internal vapor withdrawal tube that runs to the upper center of the tank. Before re-attaching the regulator, open the service valve very slowly. You may see some liquid emitted from the valve. This liquid could have gotten into the withdrawal tube from splashing liquid during the filling process. After any liquid is evacuated, gas vapor only should be emitted.

2. If there is any question in your mind, perform the same test again to make certain that only vapor is exiting this tube.

Some RV service technicians have asked if the POL needs to be disconnected after each filling procedure, and the main valve opened to evacuate any liquid from the vapor withdrawal tube? The POL would then be reconnected and leak checked after the main valve is turned on. It has been determined that this step is not needed. The small amount of liquid in the vapor withdrawal tube following the filling process, if any, is safely eliminated by the RV's regulator system.

DOT cylinders use the same port (or opening) for filling and withdrawing gas, so many of the safety features are combined in the valve. The total device is often called the "shutoff valve assembly," as shown in Figure 2-8.

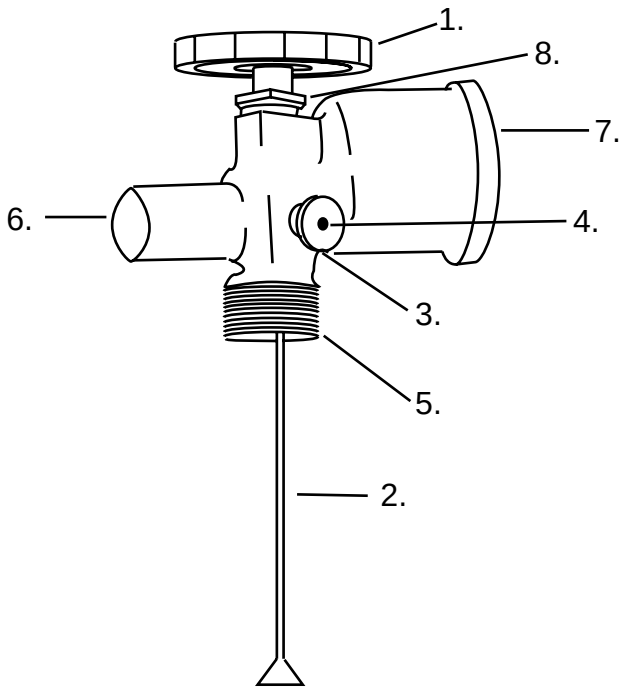


Figure 2-8 Old Style Shutoff Valve Assembly with POL connection and w/o OPD

The components, as identified in Figure 2-8, of the shutoff valve assembly are described below:

1. The shutoff valve is the main supply on/off valve for your whole LPG system. Open and close this valve by hand only.

2. The dip tube extends into the tank to the 80% full level. The length of the dip tube is marked on the guard of the cylinder (Example: DT 3.5 means the dip tube is 3-1/2 in. long) and on the data plate. The dip tube is formally called the fixed maximum liquid level gauge and also referred to as the vent stem, spitter, bleed, vent, or outage valve. The length of the dip tube, which is stamped on the cylinder's valve guard, can vary in length from cylinder to cylinder.

3. Outage port.

4. The fixed maximum liquid level gauge knob opens and closes the gauge. It should be opened during filling and closed at all other times. Fixed maximum liquid level gauge knobs on DOT cylinders, since 1980, use screwdriver slots for this purpose.

5. The shutoff valve. (Always inspect these threads when removing the assembly. If they become damaged, replace the entire unit as this flaw could lead to gas leaks.) These are 3/4 in. national pipe taper threads and should be coated with an approved gas thread compound when installing.

6. Relief valve opening or port. (Do not tamper.) Automatically opens to relieve excess pressure due to overfilling or fire.

7. Female POL fitting (left-hand thread) have been the standard LP gas outlet connection for vapor withdrawal on RV cylinders. The type 1 (CGA 791) valve is becoming the stan-

dard on RVs and will be required by the year 2002.

8. Bonnet and stem assembly.

Figure 2-9 shows a Type 1 Service Valve now required by ANSI A119.2/NFPA 1192-1999.

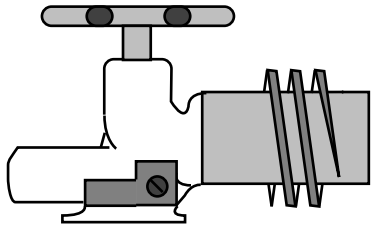


Figure 2-9 Type 1 Service Valve (CGA 791)

2-3.3 O-rings

O-rings are used as seals around the stems and working parts of the valves and fittings on propane containers. Their function is to seal as a result of pressure by making the rubber O-ring form a slight oval to fill the gap between the two metal parts being sealed. O-rings may not seal well when ~~new~~, old, cold or contaminated.

If you find a leak around the stem of the service valve on either type of container, in many instances it can be corrected by merely plugging the POL outlet with a plastic POL plug and opening and closing the service valve two or three times. The movement of the O-ring back and forth on the seating surface will wipe the surface clean of any impurities.

A service valve has to be able to prevent leakage around the valve stem in either the open or closed position. This is typically accomplished with an upper and lower seat and with an O-ring on the shaft of the valve stem. When a service valve is closed, it has a seat that closes off gas pressure from the container to prevent gas from leaking out of the system. When the valve is opened all the way, the valve stem presses against the upper seat to close off the gas pressure so it cannot get out of the system from around the valve stem. This sealing action at the “open” position is sometimes called “back-seating” and applies to most valves. Do not use any kind of tool or excessive force to back-seat a valve. To back-seat the valve, simply open it all the way. By doing this, you have protected the system from a gas leak. The O-ring only has to control the gas leak while in the process of opening or closing the valve. If the O-ring leak cannot be corrected by working the valve back and forth, it will be necessary to replace the valve, because repairing or replacing the o-rings is not permitted.

2-3.4 Liquid Level Gauges

The liquid level gauge is used to determine the level of liquid propane in an LP gas container. There may be two different types of liquid level gauges that can be used on LP gas containers. It is important to remember that the sight gauge is never to be used as a “measure” when filling a container, but the fixed maximum level gauge must be used when filling containers.

2-3.4.1 The Fixed Maximum Liquid Level Gauge

The fixed maximum liquid level gauge or outage gauge is used to determine the 80% level in an LP gas container. The fixed maximum liquid level gauge on a DOT cylinder is an integral part of the service valve. A dip tube is connected to the service valve and is located inside of the cylinder. The tube has a specific length determined by the size and shape of the cylinder and is designed to be located at the 80% total liquid capacity level of the cylinder. On an ASME tank, the liquid level outage valve is located on the body of the tank at the 80% liquid capacity level or is equipped with an internal tube to the 80% level.

The outage valve has an orifice the size of a 54 drill, restricting the amount of gas that can be released though the valve. The valve is designed to be opened approximately 1⁄3 to 1⁄2 turn during the fill process. The filler will observe the clear propane vapor when the container is below the 80% level (looks like air). When the container is filled above the 80% level, the fixed maximum liquid level gauge (remember! it is also called an outage valve) will emit a white mist. The outage valve will alternate between the clear vapor and the white mist when the liquid level in the container is filled to its maximum permitted fill level (80%). If a solid white mist is emitted from the valve, the container is overfilled. Bleed off any excess fuel through the outage valve until the emissions indicate a properly filled container.

Caution:

Bleed excess fuel in an open, safe manner, mindful of ignition sources and surrounding areas that may cause unsafe LP gas buildup.

The outage valve is to be used when filling a container, even though the container may have an overfilling prevention device (OPD).

Note

Persons filling LP gas containers are to be trained. Dispenser locations are to have controlled sources or ignition. Refer to NFPA 58 and other codes and regulations. Do not use tools to tighten outage valves that were designed to be operated by hand.

Figure 2-10 Type 1 Valve with OPD

2-3.4.2 Sight Gauges

On DOT cylinders, frequently the liquid level sight gauge is connected to the service valve. The sight gauge is optional, and only some cylinders are so equipped. Almost all ASME tanks are equipped with liquid level sight gauges to indicate the approximate quantity of fuel in the tank, as shown in Figure 2-11. The gauge itself is either bolted into the tank with four bolts or, more likely, screwed into the tank through a 1-1⁄4 in. opening so that the bolts cannot corrode and allow the gasket to leak. This device has a float inside the tank that floats at liquid level and operates a shaft through a set of gears that rotate a magnet inside the gauge. There can be either a dial chamber, which must be read by looking at the dial on the tank, or a dial chamber with a remote sender fastened onto the face of the gauge that sends an electrical signal to a monitor panel. This is a magnetic tracking dial chamber that follows the internal magnet of the gauge.

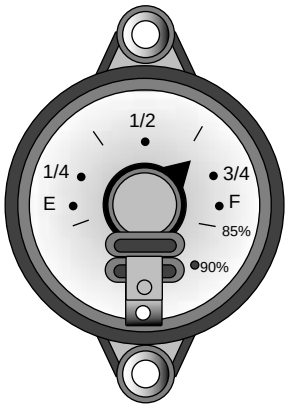


Figure 2-11 Sight Gauge

2-3.4.2.1 Remote Senders

The dial chamber or remote sender is fastened to the sight gauge itself. Some senders snap on to the gauge, and some use screws. On some chambers, one of the screws is a grounding stud. The other screw is connected to the wire that connects to the coach monitor panel. The receiver is more accurate if it is grounded to a good grounding terminal rather than depending on grounding through frame members of the RV. Over time, poor grounding can result, because a grounding nut screwed into a frame may rust or corrode and not allow proper grounding at the connection. The use of a star washer can help maintain a good ground connection. Also, dielectric compound can be used to help prevent corrosion from occurring at the connections exposed to moisture.

One end of the sender is pointed and one end is flat so that the unit can only be installed in one direction. The pointed end has an arrow that indicates the direction the float moves on gauge.

There are new senders with heat shrink wire connections to protect against corrosion. A magnet can be used to test the new style gauge without disconnecting the wire. This may require unsnapping the sender from the tank. Be sure to set the dial follower needle back to match the gauge sender magnet when installing this type of sender for the first time or when the sender has been removed (use a magnetic screwdriver or similar tool).

Caution should be used to avoid any possibility of a hot wire touching the sending device, as it could burn out the sender. The senders used in almost all recreation vehicles are rated 0 to 90 Ohms (Ω). There are a variety of these Ω resistance devices used by different vehicles. It is important to use the correct Ω resistance sender for your unit to be calibrated accurately. The back of the sender has the resistance inscribed in black letters.

2-3.4.2.2 Testing Receiver

On a 0 to 90 Ω sender, an open circuit will cause the receiver to read “full.” In fact, it will go beyond the full mark. This indicates that it has a great deal of resistance (no connection) and will read “full.” Use the following procedures to test your receiver or your wiring:

1. Disconnect the receiver, and it should read “full.”

2. Use a jumper or touch the wire from the receiver to ground. It should go to empty, since you would now have 0 Ω resistance (if your ground is good).

The same type of gauge/sender/receiver is used on some deluxe RVs. If these two wires are touched together, the gauge would go from full to empty, if the wiring and receiver are working properly. If this works and the gauge does not operate properly, then the trouble would be in the sender or the gauge.

2-3.4.2.3 Check Float Gauge for Sticking

1. Remove the sender from the gauge by removing the stud and Phillips screw, and connect the ground wire to the outside of the sender.

2. Reconnect the sender wire that runs from the receiver to the brass stud in the middle of the sender.

3. Operate the needle by use of a magnetic screwdriver. If this makes the receiver work properly, it is an indication that the internal gauge float is stuck or has somehow failed.

Figure 2-12 shows a Float Gauge:

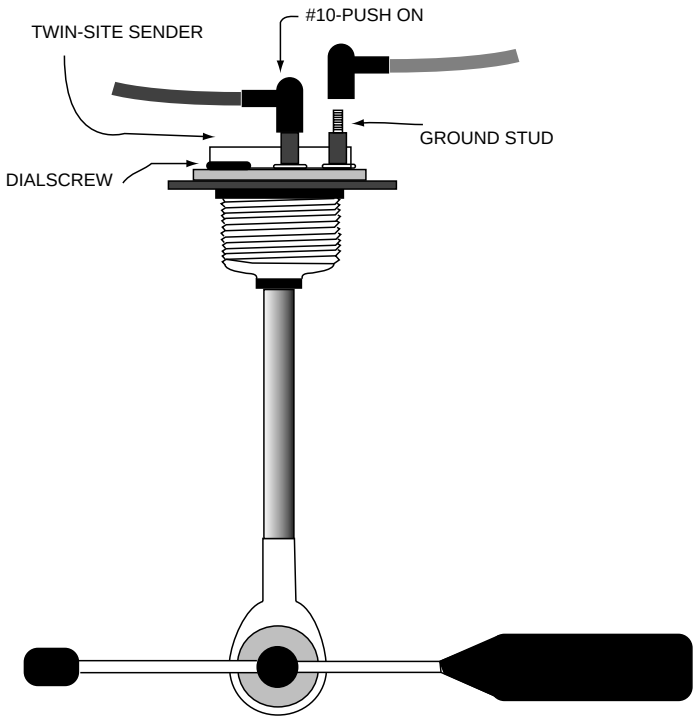


Figure 2-12 Float Gauge

Figure 2-13 shows a Rochester Sight Gauge:

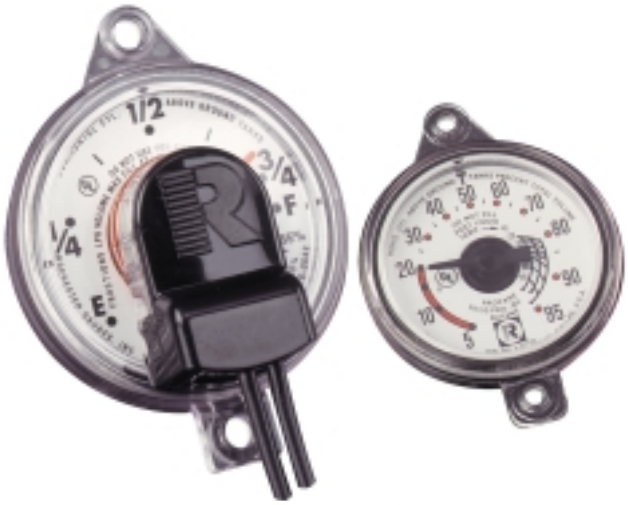


Figure 2-13 Rochester Sight Gauge

2-3.4.2.3.1 REMOVING THE GAUGE FROM AN ASME TANK

In the event you need to remove the gauge from an ASME motorhome tank, you must drop the tank (i.e., remove it from the vehicle). It will be necessary to remove the fuel and pressure from the tank to remove the valve. Information on evacuating the fuel is found in this text under "Emptying Containers." Remember that if you are transferring the fuel to another container, you must use a receiving container(s) that is large enough to contain the fuel. After the tank is evacuated, remove the gauge with the gauge in the vertical position. If you try to remove the gauge from the tank in its mounted position, the float will likely catch on some internal tubes and destroy the gauge assembly.

Caution

Be sure all pressure is exhausted from the tank, and leave the service valve open during the removal procedure. Ignition sources need to be eliminated for 25 feet.

2-3.4.2.3.2 REMOTE GAUGE—DOT

When using the remote gauge, as on 40-pound DOT cylinders, it is important to check the timing location of the float. The arrow on the sender must point away from the service valve. Since the float is installed in a coupling that is on a 7° angle, the center of the bottom of the float is in the quadrant of the cylinder underneath the service valve. The float needs to have room to move without touching the side of the cylinder. Thus, the arrow must point toward the side of the cylinder away from the service valve. If it points toward the service valve, the float will bump the cylinder side next to the service valve. You can sometimes correct this by tightening the gauge a one-half turn, if you have the proper socket and cylinder vice. Or you may contact your manufacturer's service department to return the cylinder and get one with the gauge installed correctly.

2-3.5 Overfilling Prevention Devices (OPDs)

The overfilling prevention device is a safety feature. This device uses an internal float that is connected to the fill valve of containers. During the filling process, once the level of liquefied petroleum gas reaches the 80% full level of the container, the overfilling prevention device activates and protects against additional LP liquid being introduced into the container.

Since 1984, overfilling prevention devices have been required in all permanently mounted ASME tanks on recreation vehicles, as well as propane fueled vehicles. Beginning in September of 1998, DOT cylinders were also required to use overfilling prevention devices.

2-3.5.1 OPDs for Cylinders

OPDs for cylinders can be vertical floats or horizontal floats. Figure 2-14 shows examples of these devices and Figure 2-15 shows how one would function.

Figure 2-14 Vertical & Horizontal OPDs for Cylinders

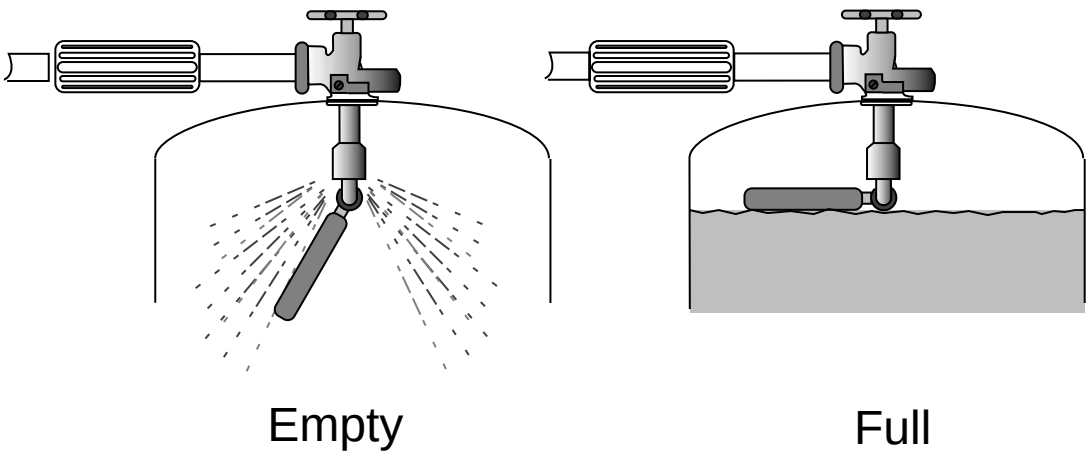


Figure 2-15 LP -Gas OPD Operation

2-3.5.2 Float-type OPDs For Tanks

First, we will discuss the float-type overfilling prevention device (OPD) used when the fill fitting is in the upper 45° quadrant of the tank. This is the most commonly used and the least troublesome, since almost all of its workings are automatic. This type of OPD requires very little knowledge on the part of the operator. An example of this type of OPD is shown in Figure 2-16.

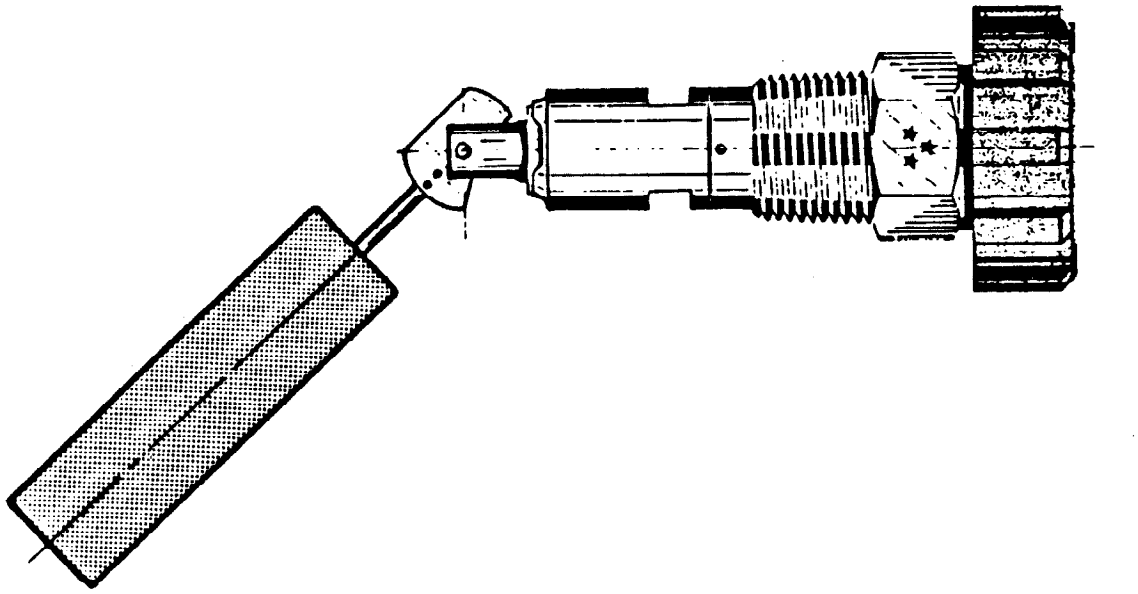


Figure 2-16 Float-Type OPD for LP-Gas Tanks

There is a piston assembly and valve that restricts the inlet fill capacity to keep the float from bouncing due to the rapid injection of propane. The fill rate is roughly 7 to 9 gallons per minute.

Some models of these valves did not have this feature or any other float devices currently on the market. These devices are occasionally difficult to use when filling a new or empty tank. This is because the fill rate is so rapid that the gas flying around inside the tank moves up the float. Since propane liquid weighs one-half as much as water, it acts like water on the moon, and it moves around in the tank quite freely. It can prematurely flip up the float. As mentioned previously, the current models being used in tanks, typically used on motorhomes, have a restricted fill rate, and this phenomenon is no longer a serious consideration.

Even when using an overfilling prevention device, it is still required that the fixed maximum liquid level gauge (outage valve) be opened and that it remains open during the entire transfer of liquid into the tank. In the event that the 80% overfilling prevention device does not work, the technician would be aware that the tank is filled when liquid appears at the outage valve opening.

One important consideration in checking any of the OPD float devices showing signs of not working properly is to make certain that the fill valve is installed so that the word “top” is pointing upward. It must be in this position for the device to function correctly. The word “top” is stamped into the metal of the fill valve in the correct position. On a motorhome, this will not always be easy to see. It will probably require a flashlight and a mirror to check. A small groove could also be cut into the face of the brass fill valve that points to the top to show correct valve positioning.

All fill valves must be kept free of foreign material while filling, and the dust cover must be replaced after every filling. Failure to observe this precaution may result in improper operation of the valve and require replacement.

Replacing any overfilling prevention device with something other than an overfilling prevention device is a violation of the national standards and must not be tolerated.

2-3.6 Auto Stops

Another type of overfilling prevention device was called the "Auto Stop". The Auto Stop is no longer in production, but is discussed herein to assist service technicians that may encounter them on older RVs. This device does not have to be positioned so that its float is in the upper quadrant of the tank. It operates in a completely different manner from a float system, and it can be installed in a tank not otherwise designed for an overfilling prevention device.

The Auto Stop utilizes the gas flow from the outage valve opening into the fill valve. Because the viscosity of gas vapor is different from that of gas liquid, the liquid does not escape through an outlet orifice as rapidly as vapor, and it will automatically cause a piston to close, shutting off the filling process.

There is only one moving part—the piston. It has three O-rings that perform seal functions between the different cavities in this valve. As previously mentioned, O-rings occasionally have to be seated. When an Auto Stop is used, it is important that the operator open and close the outage valves several times during the first filling to cause the piston to move back and forth and spread the lubricant along the walls of the valve to make the O-rings seal properly.

It is also important to know that, on this particular valve, when you open the outage, you must turn it open all the way. It does not screw out of the valve. It will open about two and one-half turns. It must be open all the way to allow the internally installed orifice to do the measuring to make the valve function properly. If the outage valve is only open part of the way, you are in effect changing the flow rate, and the valve may not open to allow you to fill the tank. It is also important to purge the air from the tank. Purging is discussed in Chapter 3. Air flows at a different rate than gas vapor, and this will frequently shut off the filling at about the 60% mark. The fact that liquid fills the lower 60% indicates that you have now compressed any of the unpurged air into the top of the tank. This will cause the air to flow through the orifices, causing the valve to shut off prematurely.

One of the advantages of the Auto Stop valve is that the valve can be serviced without emptying the fuel from the tank. The double back check device that is screwed into the tank keeps fuel from escaping out of the tank and into the area of the piston. If service personnel have been properly trained and understand the device, they can disassemble and work on the device by plugging off the line from the outage coupling and performing service functions. Personnel who have not been instructed in this procedure should not attempt to work on a tank containing gas.

2-3.7 Pressure Relief Valves

All LP gas containers have a pressure relief valve. This valve is designed to open at a specific high pressure to prevent the container from rupturing.

There are many types of pressure relief valves used in the LP gas industry. One characteristic common to all is they are not to be adjusted by service personnel. A pressure relief valve that malfunctions or is believed to be not working properly must be replaced. The following types of pressure relief valves are commonly used on RVs:

A. A pressure relief valve integral with the DOT cylinder service valves for cylinders of 40# capacity or smaller. The pressure setting of this relief valve is 375 psi, with an orifice size of 0.019. This pressure relief valve is commonly referred to as a "compact valve." The pressure relief valve on the service valve is the large opening on the back of the service valve, usually opposite from the fill side of the valve. The words "safety relief valve" are stamped on the shroud of this pressure relief valve. This type of service valve also incorporates the fixed maximum liquid level gauge (outage valve) on the body of the service valve.

B. The ASME tank uses two types of relief valves. They are:

   1. On older model tanks (pre-1993), some high-flow service valves with integral relief valves were used. The pressure relief valve was an integral part of the service valve and located outside the tank. This service valve is different from DOT cylinder valves in that the pressure relief setting is 312.5 psi. Further, there is no liquid level gauge opening on the service valve of the ASME tank. The pressure relief valve of the cylinder valve has a relief setting of 375 psi. Finally, ASME pressure relief valves are required to have a flow rating of at least 626 cubic feet per minute (CFM) and DOT pressure relief valves will not meet this requirement.

   2. Beginning in 1993, an internal pressure relief valve was required for use on all ASME tanks. This required the use of a separate opening into the tank as the pressure relief valve was no longer an integral part of the service valve. These internal relief valves are 3/4 or 1 inch pipe size and are protected from contamination by plastic dust caps. The current RV Standard requires that ASME tanks to specifically employ a separate internal type spring loaded relief valve (ANSI A119.2/NFPA 1192 paragraph 22.8.1). The RV Standard requires a 312.5-pound working pressure for ASME tanks.

2-3.8 Backflow Check Valve

The backflow check is a mechanical valve used in conjunction with the fill valve that permits the flow of vapor or liquid in only one direction. Backflow check valves are used primarily in filling ASME tanks. Backflow check valves are internal and were added to the ASME tank fill valve to prevent LP gas escaping from the tank into the atmosphere after the tank is filled. In the event the fill valve was sheared off a motorhome LP gas tank during a collision, the back checks prevent the gas from escaping into the atmosphere.

2-3.9 Excess Flow Valves

An excess flow valve is a device designed to close when the liquid or vapor passing through it exceeds the prescribed flow rate. An excess flow valve is required to be used in conjunction with all RV LP gas containers. The excess flow valve will not stop LP gas from flowing out of the container, but when activated, due to an opened or broken line as an example, it will limit the flow.

On ASME tanks, the excess flow valve is installed as an integral component of the service valve, sometimes called the "vapor withdrawal valve." On DOT cylinders, the excess flow valve is located in the POL, type 1 or type 2, fitting that attaches to the outlet of the service valve. This means the excess flow valve may be in the fitting of the regulator or in the fitting of the high pressure flexible hose connection, sometimes called the "pigtail."

The excess flow valve can be seen in a POL filling. Before connecting the POL fitting into the container and hooking it back up to the recreation vehicle's LP gas system, notice that inside the hole of the POL fitting is a square piece of material. This square piece of material is an excess flow check valve. POL fittings for use other than in recreation vehicle service typically do not have an excess flow check valve. The excess flow valve for the CGA 791 valve appears in the end of the fitting that connects to the cylinder valve but is not readily visible.

Figure 2-17 shows a POL fitting, including the front view displaying the square piece.

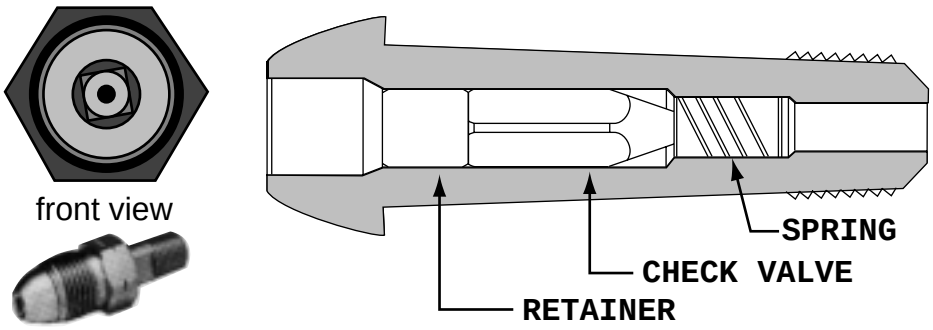


Figure 2-17 Excess Flow Male POL Fitting

Figure 2-18 shows an example of a Type 1 fitting.

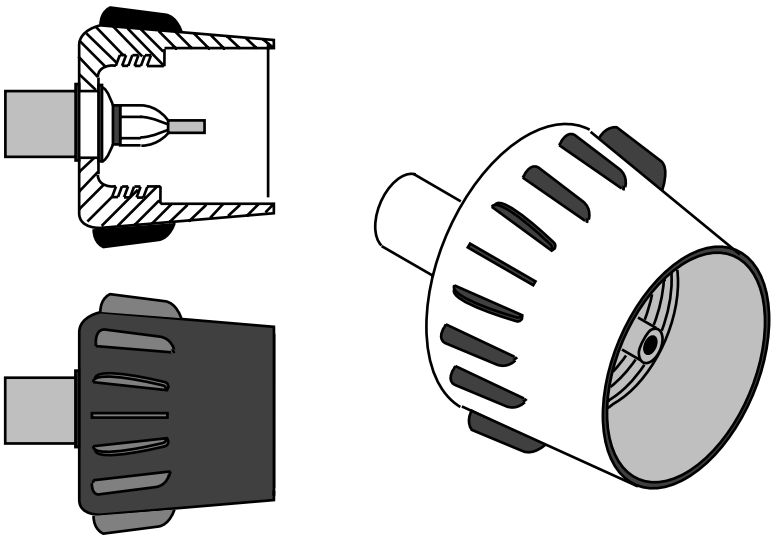


Figure 2-18 Type 1 Valve Fitting

Because RV units are subject to collision, and lines near the containers can break, the excess flow check valve acts as protection that will severely restrict the LP gas flow when an LP gas line ahead of the regulator(s) is broken. This could result from a collision involving a travel trailer or if a reg-

ulator is destroyed or broken off the container in a collision involving a motorhome. Should you need to replace any of these parts in the field, you are required to comply with national RV Standards and replace them with parts that contain an excess flow check valve.

Excess flow check valves have been a part of the ANSI A119.2 Standard for Recreation Vehicles since 1977. Every RV is required to have at least one excess flow valve at the container service valve. With DOT cylinders, the excess flow check valve is typically installed in the mating vehicle side fitting. This is because cylinders are removable and can be exchanged with another cylinder when they become empty. If the excess flow valve is installed as an integral component of the service valve, the required protection would be lost when the cylinders are exchanged. However, with ASME tanks that are permanently mounted, the excess flow check valve will be located in the inlet of the tank's service valve (ANSI A119.2/NFPA 1192, paragraph 2-2.7.7).

The excess flow check valve protects the LP gas system on the high-pressure side of the regulator, The excess flow check valve will not shut off low-pressure leaks.

2-4 EXAMINING THE CONTAINERS

Federal regulations and NFPA 58 require periodic requalification of all DOT LP gas cylinders. ASME tanks are not required to be requalified, but the guidelines provided herein should be considered to maximize safety.

2-4.1 Visually Inspecting Containers

DOT cylinders are required to be recertified, by visual inspection, at intervals of 12 years after manufacture and every five years thereafter. To recertify the cylinder, the person must be qualified and make records of the cylinder inspection. If a cylinder has been recertified by visual inspection, the date of requalification, followed by the letter "E," will be stamped on the cylinder valve guard. The materials herein are not intended as a guide for requalification of LP gas cylinders. Persons interested in requalification of cylinders should contact their LP gas supplier.

No cylinder should be filled if it is due for requalification. All LP gas containers (DOT or ASME) must be visually inspected prior to refilling. The visual inspection needs to start with the container's data plate and must also include the container surface, the valve guard and foot ring.

2-4.2 Review the Container Data Plate

Read the data plate on the container to obtain information on the container's capacity, working pressure and safe operating temperature.

2-4.3 DOT Cylinder Markings

DOT requires that certain information, such as the design manufacturing code, be permanently marked on the cylinder. Normally, this information is stamped on the outside of the valve guard or on the cylinder body itself. In some cases, the information is stamped on a metal plate, and the plate is attached to the cylinder.

The DOT marking is the "ID card" for the cylinder. This information can easily be used to distinguish between cylinders. In addition, the information can be used in selecting valves and determining when the cylinder needs reinspection. Whenever you are working with a DOT cylinder, be sure that all of the required information is clear and easy to read. Never place a cylinder into service or fill it with LP gas when any of the DOT information is missing or unreadable. Notify your supervisor immediately if you have questions.

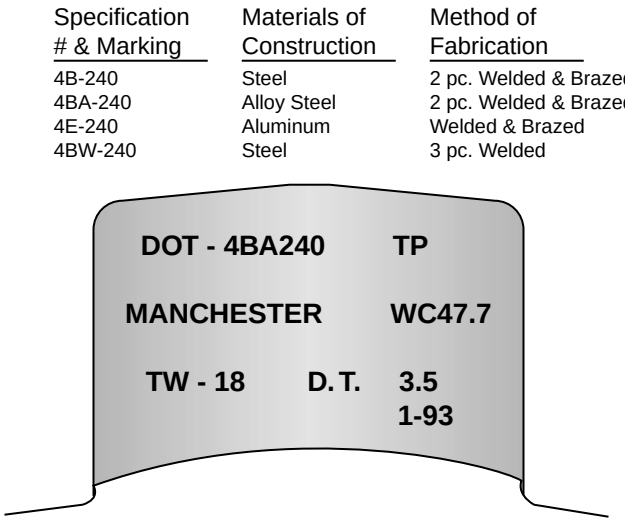
2-4.4 Design or Manufacturing Code

Cylinders for any type of service can be built under several design codes. DOT design code markings normally consist of two basic parts: the design code and the service pressure. Table 2-1 shows detailed design codes:

Table 2-1 Cylinder Design Codes

Specification Material of # and Marking Construction	Method of Fabrication	
4B-240	Steel	2 pc. Welded & Brazed
4BA-240	Alloy Steel	2 pc. Welded & Brazed
4E-240	Aluminum	Welded & Brazed
4~~8~~BW-240	Steel	3 pc. Welded & Brazed

Figure 2-19 shows an example of cylinder markings:



The picture shows the following markings.

DOT - 4BA240 **TP** - (Initials of Inspector)

welded alloy steel

service pressure

MANCHESTER (manufacturer)

WC 47.7 (water capacity in pounds)

TW -18 - (tare weight, weight of empty cylinder, in pounds)

D.T. 3.5 - (Dip Tube Length)

1-93 - (Date of Manufacture. Retest date is optional.)

Figure 2-19 Cylinder Markings

Figure 2-20 shows an example of tank markings.

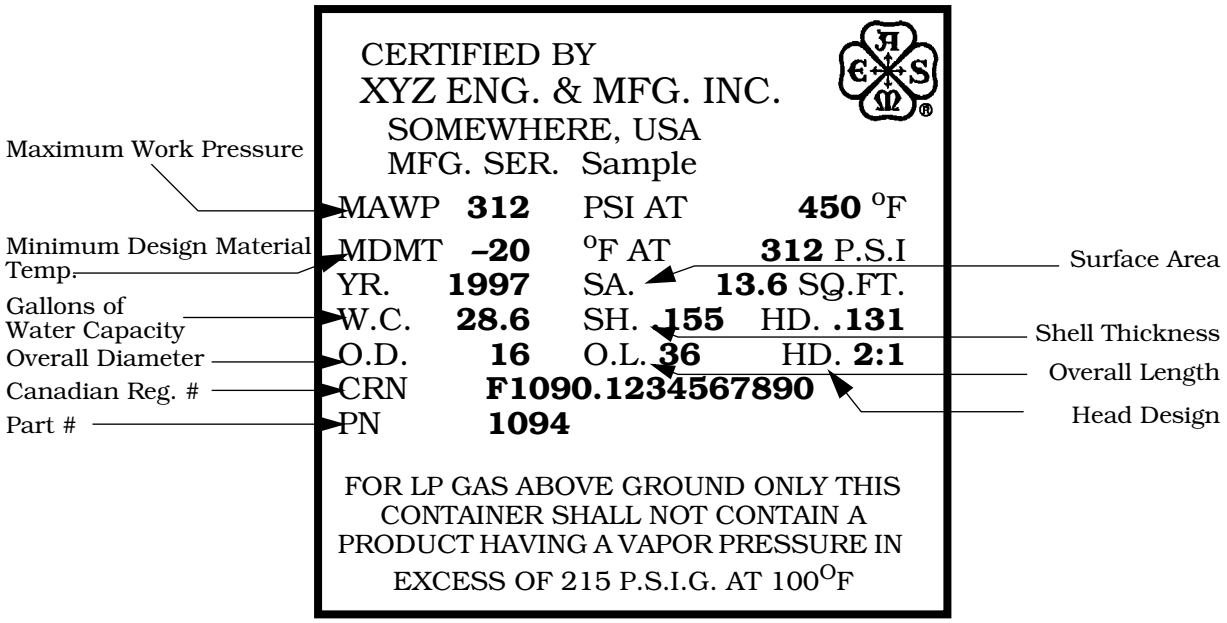


Figure 2-20 Tank Marking

2-5 CONTAINER INSPECTION

Tanks and cylinders must be inspected before each filling to determine the following:

- That their valve guards are in place and securely attached.
- That the container has not been subjected to physical damage, scraping, denting, gouging, excessive rusting, or fire.
- That fittings are working properly and do not leak.

2-5.1 Inspect/Install Mountings and Brackets

LP gas containers need to be secured to the recreation vehicle so they will not become dislodged when a load equal to 8 times the container's filled weight is applied to the filled container's center of gravity in any direction. (ANSI A119.2/NFPA 1192 paragraph 2-2.4)

ASME tanks are usually bolted to the RV's frame or floor. Be sure the brackets are securely bolted and all bolts intended to be used are tight and in place. If a bolt has been removed or has fallen out, tighten all bolts and replace missing bolts with bolts of equal size and strength. If washers and lock washers were used, be sure these items are also reinstalled. Bolt strength is often indicated by markings on the head of the bolt. These bolt head markings can be numbers or symbols. Figure 2-21 shows an LP gas mounting.

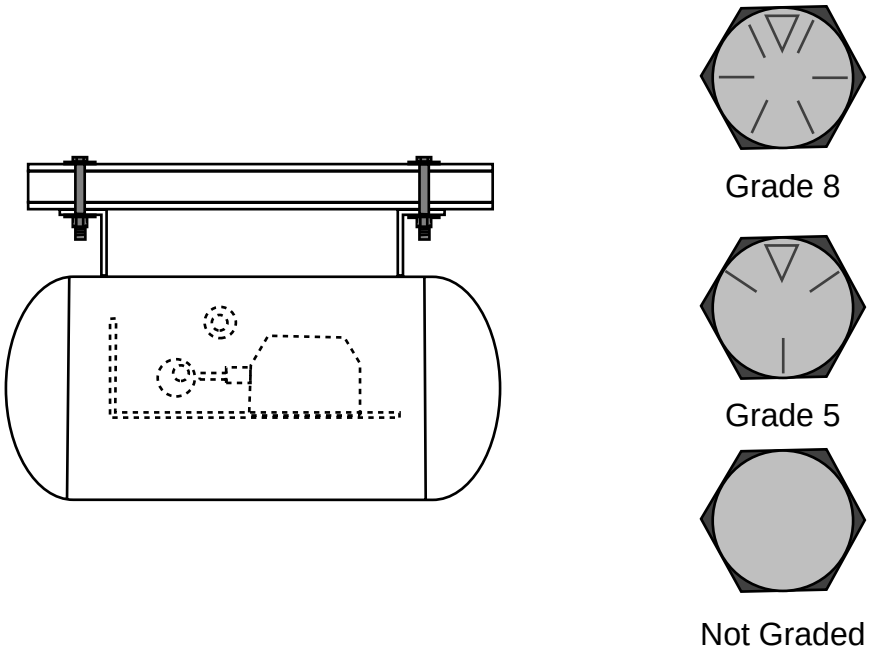


Figure 2-21 LP Container

DOT cylinders are usually located on the front of trailer A-frames or in compartments that are sealed off from the RV's interior. Cylinder securement methods vary, with the most common being adjustable straps around the middle of the cylinders and "T-bars" commonly used to secure double cylinders. Any method used must ensure that the cylinders will remain in place and in their proper and intended position. Be sure the securement method is intact and the hardware used is in good working order. On double cylinder assemblies, be sure the securement plate is adequately attached to the floor or frame. Figure 2-22 shows a double cylinder assembly:

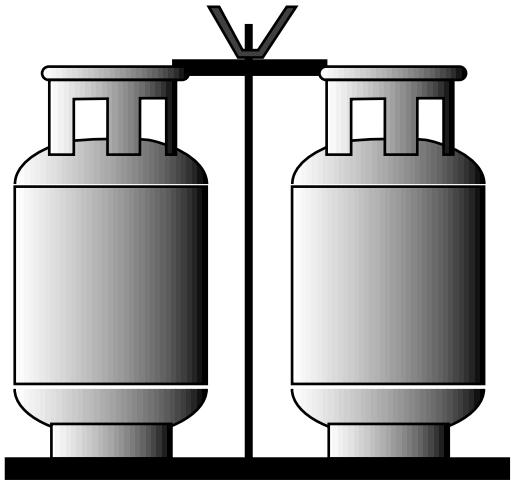


Figure 2-22 Double Cylinder Assembly

Figure 2-23 shows a cylinder assembly with an adjustable strap:

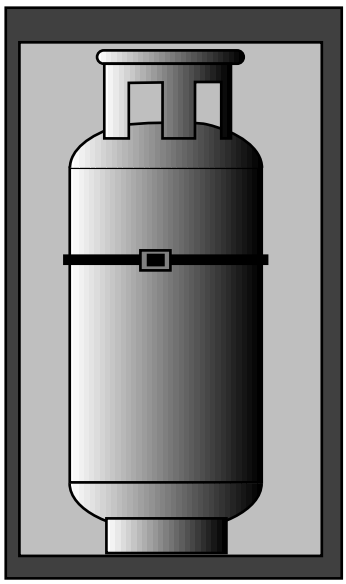


Figure 2-23 Cylinder Assembly with Adjustable Strap

2-6 PURGING CONTAINERS

All new containers and, in some cases, used containers, particularly those that have their service valves left open, may contain water, air or other contaminants. It is essential that these be removed before filling the container and putting it into service. The process of removing these contaminants is called "purging."

Purging an LP gas container is necessary to ensure that the LP gas supplied into the RV system will be at the correct pressure and that there is no unwanted air in the LP gas that could cause poor or unsafe appliance operation. Purging is necessary for brand new containers and other containers that have been contaminated with air. Used containers can become contaminated with air due to valve removal or empty containers that inadvertently had their valves left open.

Brand-new containers never before filled with LP gas contain dehydrated air inserted by the LP gas container manufacturer.

Dehydrated air is inserted for several purposes:

- To make certain that the container contains no moisture that could start an internal rusting process.
- To provide air instead of gas for pressure testing at recreation vehicle factories so they can test the LP gas system indoors.
- To use as a safety clue, should you open a container and find no air inside, be particularly attentive to leak testing that container. An empty container could indicate a defect in the container that allowed the air to escape.

Note

It is possible that a valve was opened during shipping or the air was used up in the testing process at the factory. Additionally, unpurged containers could cause several other related problems.

Air or moisture in a propane container is considered a contaminant. Air can contain water and oxygen. These are not designed to be in a propane container. Chemical reactions such as rust or high container pressure can have potentially harmful results. Moisture in certain conditions can have a plugging effect in regulator orifices (freeze up).

Oxygen in propane containers can lead to "odor fade." Air contains oxygen, and oxidation is a process that removes the odorant (usually ethyl mercaptan) that has been added to the propane.

Over a period of time, the air in an unpurged propane container could lead to rusting, which could reduce the odor level of the propane in that container. It is a good idea not to assume that everyone knows the smell of gas, natural or propane. Allow customers to observe the smell and document that they can identify the odor. A "sniff test" to verify the presence of the odorant is a good idea when filling propane containers.

Appliance burner problems. The false high pressure and the higher air-to-gas mixture from an unpurged cylinder will result in appliance burner tuning problems. Water heaters will roar, furnaces may bang or not even light, and if you adjust the air mix for the propane/air mixture found in the unpurged container, a too-rich burner condition will result once the straight propane fuels the appliance. This can cause a condition where excess carbon or carbon monoxide is produced. The additional service to retune the appliances is costly to the industry. The customers are inconvenienced, and the warranty claims are a problem for the dealer as well as for the appliance manufacturer. Tests indicate that the fuel is "off spec" for about half the first fill in a container that is not purged.

Air in a container can slow down or stop the fill process. LP gas dispenser pumps use a differential pressure to fill a container. If the container to be filled has a higher pressure than the dispenser storage container plus the pump's differential pressure, then the fill process can be slowed down or even stalled.

False Container Pressure. An abnormally high pressure can be observed in a propane container that was not purged. If you leave any air in the container and then fill it with liquid LP gas to its proper fill density of 80%, you will compress and trap any air inside the container between the top of the tank and the LP gas liquid. This trapped air can be pressurized 5 times the atmospheric pressure creating the situation called false container pressure. Figure 2-24 displays the creation of pressure in a cylinder:

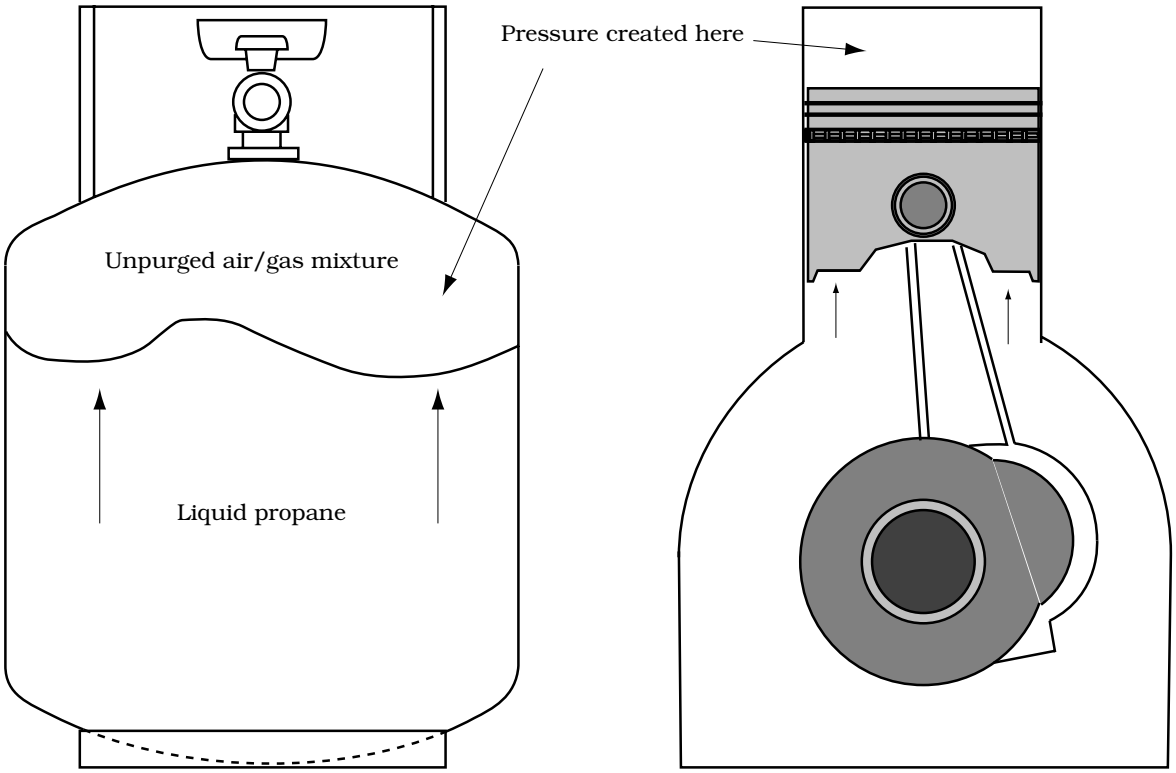


Figure 2-24 Creation of Pressure in a Cylinder

Propane vapor under sufficient pressure will condense to a liquid. The pressure will be relative to the temperature of the propane. Air, on the other hand, will be compressed by the piston (liquid propane) to the top of the cylinder. The more compression, the higher the pressure. Remember that you can compress air, but you can not effectively compress a liquid.

Caution

High pressure can be dangerous! Warm weather, heat, or fire could bring pressures in a propane cylinder to a higher level. The relief valve will function if the pressure of the compressed air is added to the pressure of the propane and the resulting pressure meets or exceeds the relief valve setting (375 psi = 165° F propane approx.). This could result in a release of gas at a much lower temperature than expected. This could be a hazardous condition with a potential fire and/or explosion.

2-6.1 Why Purge

1. Reduce moisture
2. Remove oxygen
   A. Odor fade
   B. Improper appliance operation

C. Slow filling

3. Eliminates false container pressure

2-6.2 Purging Procedures

Check to see if the container is filled with gas or air. If the container does not contain LP gas (as determined by smell, although the presence of a factory purge sticker is a clue), disconnect the regulator from the container's service valve, open it up, and let the compressed dehydrated air blow out. ASME tanks on motorhomes have an excess flow valve that may "slug" if the air volume escaping the tank exceeds the design of the valve. If that occurs, simply close the valve for about 2 seconds and slowly reopen the valve. New QCC (quick connect coupler) valves (shown in Figure 2-5) that have been in use in U.S.A. since 1994 require an adapter (full flow POL) to allow the air to escape through the service valve, although the liquid level gauge (bleed or outage) screw can be used to bleed the air though the 54 drill orifice in the outage valve.

Note

After the air is released or emptied, keep in mind that at sea level there is still 14.7 psi (atmospheric pressure) in the tank.

2-6.2.1 Safety Considerations for Purging with LP Gas

The purging procedure requires you to be more than 25 feet away from any source of ignition when releasing the air/gas mixture.

The use of a vent stack approximately 10 feet or taller will greatly improve fire safety. LP gas can be torched with a vent stack designed for the purpose and located according to code (25 feet from the dispenser). If a vent stack is not used, then it is recommended that the release of propane be restricted to the volume of a 54 drill-sized orifice.

Wear clothes and safety gear that are designed for dispenser operation. Examples include safety glasses, gloves, leather footwear, coveralls and hats.

2-6.2.2 Purge Procedures (NPGA Safety Bulletin #133)

1. Purge in a safe area.

2. Be sure that the container pressure has been released.

3. If free water is present or suspected to be in the container, contact your gas supplier for a determination of the cause and effect. Some cases may require mechanical or chemical drying or, in the case of internal rust, the container may need more attention or replacement.

4. Pressurize the container to approximately 15 psi with the LP gas vapor. Never purge with liquid. Purging with liquid will not quantify the effectiveness of the purge or the volume of the gas used. It will, however, cause the moisture in the tank to condense and/or freeze and not be expelled in the purge exhaust.

5. Vent the container to a safe atmosphere.

6. Repeat steps #4 and #5 for a total of five purgings[1].

7. Pressurize the container with propane vapor and perform leak tests on the container using leak detector solution and/or an electronic leak detector.

8. The container is now ready to be placed into service. Remove the factory purge sticker and install the appropriate DOT and/or OSHA decals.

2-6.2.3 Alternative Method to Vapor Purge Utilizing a Vacuum Pump

Twenty-six inches of mercury vacuum has been found to be an acceptable alternative to vapor purging. However, the investment in equipment and training can be higher. Caution should be exercised when applying the vacuum to containers that have or may have contained fuels.

2-7 LEAK TESTING CONTAINERS

Liquid leak detector solution or a mixture of liquid soap and water should be used. Do not use any liquid soap containing ammonia or chlorine because it will damage the brass fittings of the LP gas system. Never use a match to check for gas leaks. For cold-weather areas, there are name-brand leak-detecting solutions available through wholesale gas industry supply houses that are designed for leak-detection use in temperatures below freezing.

Examine the container carefully, particularly at the fitting threads, using leak-detection methods at the threads.

Examine all welded surfaces. On larger tanks and cylinders, there is a longitudinal weld that joins the shell together and two circumference welds that fasten the heads to the shell. On smaller cylinders, there may only be the circumference weld between the top and bottom halves.

On DOT cylinders, there are also welds at the foot ring and the guard, and a welded coupling where the service valve fitting is installed, as shown in Figure 2-25. On ASME tanks, there are welds that connect the brackets and at fittings that hold the valve guard in place. These should be checked for possible pinhole leaks.

1. Purging with 30 psi three times or 45 psi twice will result in an acceptable propane-to-air mixture that has been measured to be approximately 93.75% pure.

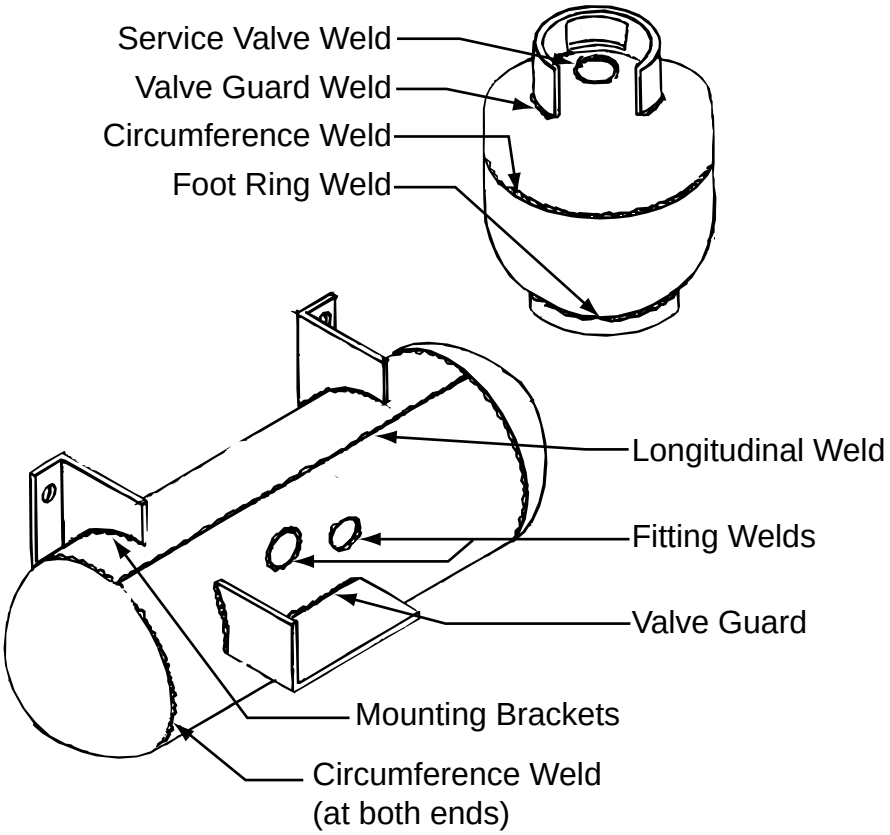


Figure 2-25 Welds on Containers

Caution

If this is the first time the container has been filled with LP gas, you must remember that LP gas can flow out of a leak where air will not escape in sufficient quantities to be detected.

Due to advanced detection techniques at the container manufacturer, fewer pinhole leaks will get into the marketplace. This is because of the container manufacturer's more thorough quality assurance checks. However, the service technician is the final quality control test.

Pinhole leaks are not normally hazardous but will leave an oily spot that can be detected after the container has been in use for a while. Pinhole leaks can cause a depletion of the gas supply, since the leak is constant. But in most instances, they will not sustain a flame. However, pinhole leaks can be detected by the odor, since the odorant is supposed to be detectable by smell in concentrations of one-fifth, the lower limit of flammability.

ASME tanks and DOT cylinders are warranted through the manufacturer. On an ASME tank, the date of manufacture is stamped on the nameplate. On a DOT cylinder, it is stamped on the valve guard. These dates of manufacture will be used as the date of warranty, unless the container manufacturer is provided with a bill of sale showing a later date.

An electronic leak detector may be substituted for the previous procedure. This device may find leaks faster and more easily than the use of soapy water or leak detector solution. Electronic leak detectors come in a variety of styles, but all have a sensing device (usually on a cable or flexible tube) that beeps when gas is detected. The device can be held in one hand while the probe is passed around the container or fittings with the other hand.

2-8 FILLING CONTAINERS

The following safety considerations apply to the process of filling LP gas containers:

Supervisors should check frequently on their personnel filling propane containers to determine if they are following the correct procedures. National codes and some state laws require that the filling personnel are properly trained and that documentation of their training is on file. Refillers are sometimes required to carry cards documenting their qualifications.

Before a DOT cylinder is filled for the first time, it should be identified as containing a flammable gas by affixing a red, diamond-shaped "Flammable Gas" decal, which contains the UN symbol 1075 for propane gas, as shown in Figure 2-26. This is United Nations symbol for international use that applies specifically to LP gas. The wing of the diamond reads "Liquefied Petroleum Gas" to identify the type of flammable gas. This is required to be affixed when the cylinder is first filled with LP gas.

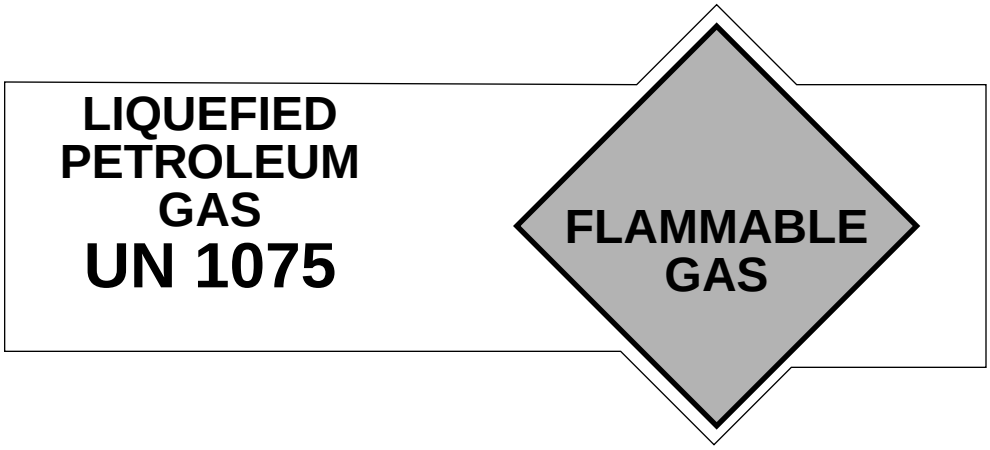


Figure 2-26 Flammable Gas Decal

No such marking is required on an ASME tank that is permanently mounted on a motorhome or van. On an ASME tank, decals of this type are voluntarily used either on the tank or on the compartment door used for access to the tank to identify the tanks for propane use.

2-8.1 Calculating DOT Cylinder Fill Weight

Fill cylinders (and tanks) to the 80% level only. If using a scale (the weight system), DOT cylinders typically used on recreation vehicles hold 20, 30, or 40 pounds of fuel in weight. They are sometimes called 5, 7, and 10-gallon cylinders. These are convenient references only and do not allude to the actual capacity of these cylinders. The propane capacity in pounds is 0.42 times the water capacity stamped on the collar. When filling cylinders by weight, refer to the T.W. stamped on the guard (example: T.W. 19). This is the tare weight, or the weight of the empty cylinder before LP gas is added. Add the 19-pound cylinder weight (T.W.) to the 20 LP gas capacity and fill the cylinder to 39 pounds.

Note

Cylinders are not filled by liquid meters.They are filled by weight or by the volumetric method using the fixed maximum liquid level gauge
The weight of filling connections and hoses need to be added to the tare weight for an accurate fill weight.

2-8.2 Filling Containers by Volume

If filling tanks by volume with a liquid meter, read the water capacity stamped on the ASME tank. Determine from that water capacity the volume of propane necessary to fill the container. The tank must be filled by utilizing the fixed maximum liquid level gauge.

The water capacity of a DOT cylinder is shown in pounds on the cylinder or on the cylinder's valve guard. Therefore, to determine the gallons of propane a DOT cylinder will hold, move the decimal one place to the left (based on NFPA 58 Table 4-4.2.1). The cylinders, however, must be filled by weight (0.42 times the W.C. in weight) or by utilizing the fixed maximum liquid level gauge.

2-8.2.1 Example 1

An empty 20# cylinder has a water capacity of approximately 48 pounds as specified on the valve guard of the cylinder. Multiply this water weight by 0.10 or simply move the decimal point one place to the left to determine how many gallons of propane it can hold. In this case, it will be 4.8 gallons of propane.

The LP gas capacity of an ASME tank is determined by taking 80% of the water capacity in gallons shown on the tank's data plate.

2-8.2.2 Example 2

An ASME tank is stamped 28.6 gallons of water capacity. To be properly filled to the 80% maximum fill level, multiply the number of gallons (28.6 W.C.) times 0.8. This would equal 22.9 gallons of LP gas.

2-8.3 Avoid Overfilling

To avoid overfilling the container, the person doing the filling should always use the fixed maximum liquid level gauge (outage valve). This means the outage valve must be opened during the filling process. Stop filling the container immediately when the white fog-like liquid is emitted from the outage valve opening. The outage valve should be opened in a well-ventilated area and kept open. This bleeding process ensures that any liquid in the container above the 80% level will be emitted from the container. You will know when this is accomplished because the white liquid stops. In most containers, the dip tube is fastened to the service valve. In some cases, the dip tube is located at a separate opening of the container. But in every case, the dip tube extends to the 80% level of the container, and the liquid level of LP gas must not extend above the end of this dip tube.

Reinstall the DOT cylinder on the trailer. If it is not to be reinstalled, or if you are refilling this cylinder and loading it in the customer's automobile to be transported to a travel trailer at another location, a plastic POL plug must be inserted into the service valve opening, unless it is a type 1 valve. This is a mandated safety procedure to guard against the accidental release of LP gas or dirt contamination. Cylinders with type 1 valves are encouraged to use a dust cap. The cylinder also needs to be secured for transport in an upright position. Read the manufacturer's caution label before transporting or storing cylinders. A caution label is shown in Figure 2-27.

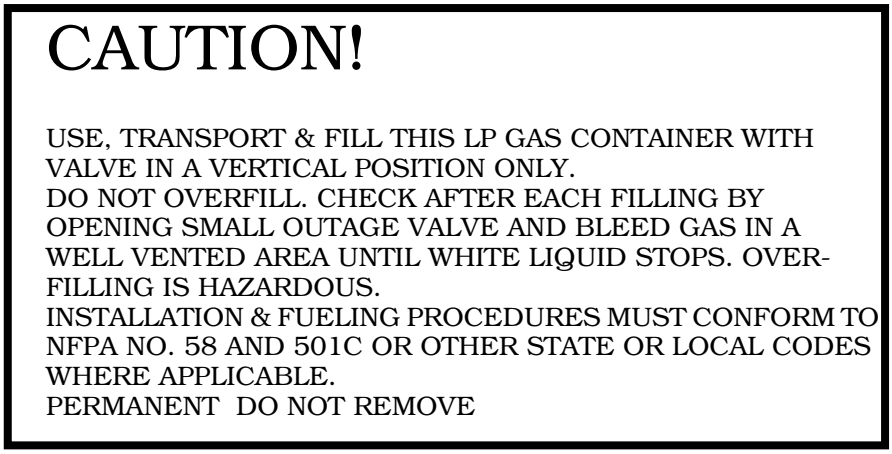


Figure 2-27 Caution Label

2-8.4 Emptying Containers

The propane must be removed from a tank or cylinder to perform valve repair/replacement or to return the container to the manufacturer for warranty repairs. It is required by law that the container is shipped empty of fuel and the valves plugged or capped.

2-9 Fuel Transfer Safety

In the interest of safety, all persons employed in handling LP gases shall be trained in proper handling and operating procedures, which the employer shall document (Ref. NFPA 58 1-5).

1. Wear protective clothes/gear:
    - Protective footwear.
    - Coveralls or full coverage garments with a consideration as to fire resistance. Cotton or cotton blends are less likely to melt in a flash fire.
    - Heavy gloves.
    - Vinyl gloves during liquid transfer.
    - Protective eye wear.

2. Prepare the transfer area.

    - 18 BC rated fire extinguisher or better. A water hose nearby and ready can be helpful if conditions permit.
    - Remove sources of ignition for 25 feet.
    - Use wind direction for safety advantage.

2-9.1 Torching off a Container

Torching is used to reduce container pressure to atmospheric pressure. Blowing unburned LP gas vapor in to the atmosphere in quantities larger than that of a 54 drill can be against fire safety and environmental codes. A torch up to 500,000 BTU is typically used to burn off the remaining LP gas vapor from the container. It is recommended that the torch be located at least 10 feet from the coach for fire safety. Figure 2-28 displays a sample torch.

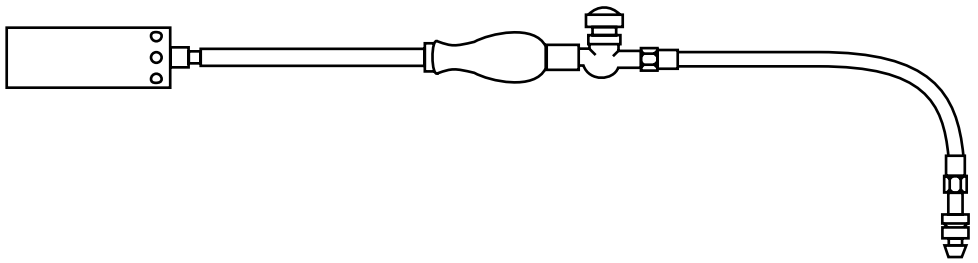


Figure 2-28 Torch

Caution

Qualified personnel need to be in attendance at all times during fuel transfer and torching. Use wind direction to your safety advantage.

2-9.2 Opening Container Valves

Use the following procedures to open container valves:

1. Make sure that all appliance valves are turned off.

2. Open a DOT cylinder or ASME tank service valve very slowly as you initially allow gas to enter the lines. The excess flow check valve at the first fitting of the system (i.e., in or at the service) may slug close if this valve is opened too quickly. “Slugging closed” will result in no gas being allowed into the system or a very low amount of pressure at the appliances.

    The seats of an excess flow check valve are metal to metal and are not designed to have a total seal. Therefore, some pressure can get through the check valve and into the system. Frequently, a regulator is returned to its manufacturer with the complaint that it read only 3 to 4 inches water column under a light appliance load. This is almost a sure sign that the excess flow check valve is slugged, and the only gas coming into the regulator was equivalent to 3 to 4 inches water column. This was likely not a malfunction of the regulator. It was the proper functioning of the excess flow check valve when the valve was

turned on too quickly. Instruct customers to open their service valves slowly.

A regulator consists of a number of moving mechanical parts that open and close a valve by use of a spring-loaded diaphragm. The quick opening of the service valve tends to exceed the closing speed of this diaphragm. The diaphragm operates a seat assembly, and excessive pressure, created by opening the service valve too quickly, can be admitted downstream of the regulator and onto the appliances before the seat is completely closed.

3. Listen to the regulator.

   A good safety precaution is to listen to the regulator after the service valve or valves have been opened. Any valves inside the vehicle on an appliance that are turned on, or any disconnected lines, can be detected by listening to the regulator. You would be able to hear the hissing sound of gas passing through the orifices of the container's regulator. This safety check should be observed every time the LP gas' service valve is turned on. If you hear gas flowing through the regulator, the service valve should be turned off and checks should be made to determine if any appliance valves have been left on. If no valves are found on, immediately investigate to see if there are open lines or obvious openings at the fittings. If nothing is obvious, find the source of the leak by using leak detector solution or an electronic leak detector. Always make sure there is no source of ignition near when searching for a leak. Under no circumstances should a listening test be construed to be a final leak test of the vehicle.

4. Keep electricity cut off to the recreation vehicle. Also keep appliance pilot lights off while searching for any LP gas leak in an RV.

2-9.3 Leak Test Using Automatic Regulators

If an automatic regulator on a multi-cylinder assembly is used, it can be used to do an "informal" leak test. The indicator is nothing more than a pressure gauge. Turn on the supply at the cylinder and then turn it off (with all the gas valves in the RV closed off). Wait 3-4 minutes, and the red signal indicating the cylinder is empty should not appear. If it does appear, the system has lost the gas pressure, indicating that there is a leak inside. If this test is redone, the severity of the leak can be determined by how rapidly the red signal appears.

If this leak testing method is not familiar, set up a known size leak such as turning on the range top burner pilot or oven dial to the pilot "on" position. If there is concern that there is a leak in the system, don't light the pilot light. Observe the red indicator. In a system with only the top burner pilot or the oven pilot leaking, the high-pressure gases in the pigtails and automatic changeover portion will provide fuel to this leak for about 3-4 minutes or less. With a known leak such as a pilot light, make certain the amount of time it takes for the red flag to indicate on the automatic regulator is observed. This will help the technician understand the system as a leak test device. This test is not a substitute for the documented leak test required when checking a new coach or after a gas line has been opened or otherwise disconnected.

CHAPTER 2 REVIEW

1. Whenever you transport or store disconnected LP gas containers you should always use a _____.

2. Which of the following is NOT a LP gas container "appurtenance"?

   A. Fill Valve

   B. High Pressure Pigtail

   C. Liquid Level Gauge

   D. Service Valve

3. Which of the following valves is the primary valve on a DOT Cylinder?

   A. Excess-flow Valve

   B. Fixed Maximum Liquid Level Gauge

   C. Service Valve

   D. Gate Valve

4. A _____ is used to withdraw LP gas vapor to the service valve in an ASME tank or a horizontal cylinder.

5. A properly sized and installed dip tube will extend into a LP gas container to the _____ level.

6. The length of a dip tube can be found:

   A. In the service manual

   B. On the cylinder guard

   C. On the shipping invoice

   D. On the cylinder data plate

7. Use of an overfilling prevention device relieves the necessity to open the outage valve during the filling process.

   True False

8. Pressure relief valves are adjusted by the technician as part of the leak test.

True False

9. The pressure setting for a pressure relief valve for a DOT cylinder, 40# capacity or smaller, is _____ psi.

   A. 3.75

   B. 37.5

   C. 375

   D. 3750

10. The proper setting for a pressure relief valve on a ASME tank is _____ psi.

    A. 312.5

    B. 31.25

    C. 3.125

    D. none of the above

11. The _____ acts as protection that will severely restrict the LP gas flow when an LP gas line ahead of a regulator(s) is broken or opened.

12. DOT cylinders are required to be recertified at intervals of _____ years after its manufacture and every _____ years thereafter.

13. Purging is only necessary when placing a new LP gas container into service.

    True False

14. Correct purging procedures requires a minimum of _____ feet clearance from any source of ignition.

15. Proper purging procedures are contained in:

    A. The owner's manual

    B. ANSI A119.2

    C. NFPA Bulletin 110-A

    D. NPGA Safety Bulletin #133

16. Pinhole leaks can usually be detected by the _____ that forms after the container has been in use for awhile.

17. List the two methods which can be used to determine the amount of LP gas to be added to a container when filling.

    A.

    B.

Chapter

3

Regulators

3-1 Purpose, Function and Design

Regulators have often been called the "heart" of the RV LP gas system. If the "heart" of the system is functioning improperly or not at all, the appliances will not work properly either. The regulator is responsible for reducing the container's variable high pressure that is created by the "boiling" of LP gas liquid to a low pressure usable by the individual appliances.

To ensure that the LP gas system has the correct working pressure, several regulators are required. The primary system regulator, located at the container(s), is required to be a two-stage regulator. This two-stage regulator can be an individual device that incorporates both regulators, or two separate components.

The first-stage regulator reduces container pressure to about 10 psi. The second-stage regulator reduces the 10 psi to a little over 6 ounces of pressure (10 to 14 inches water column). The addition of the two-stage regulator enabled more consistent pressure control and eliminated system problems previously seen with single-stage regulators. When dealing with older RVs, if single-stage regulators are seen, the owners should be encouraged to upgrade to a two-stage system.

A regulator works by using atmospheric pressure and a spring. These two influences control the diaphragm inside the regulator. The diaphragm moves up and down, working the lever. The lever has seats that open and close as the lever and diaphragm move. These movements are based on the atmospheric pressure and the tension on the spring, controlling the flow of LP gas. The seat is used to block the flow of LP gas intermittently, allowing the proper amount of LP gas to achieve the correct pressure. Figures 3-1 and 3-2 show the flow of LP gas through a single stage and two stage regulator.

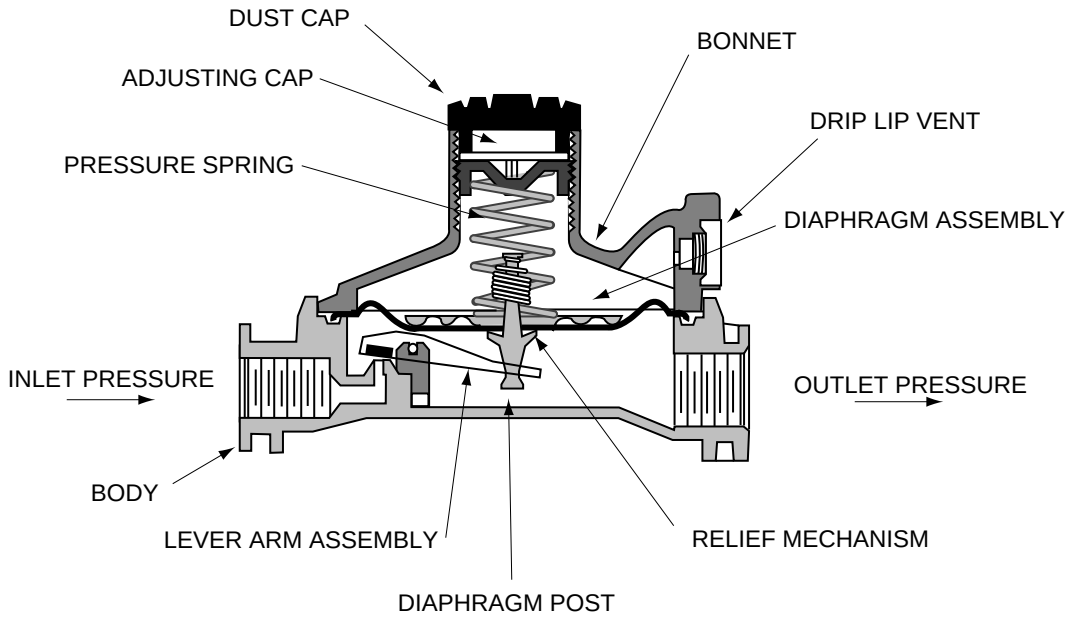


Figure 3-1LP Flow Through Single Stage Regulator

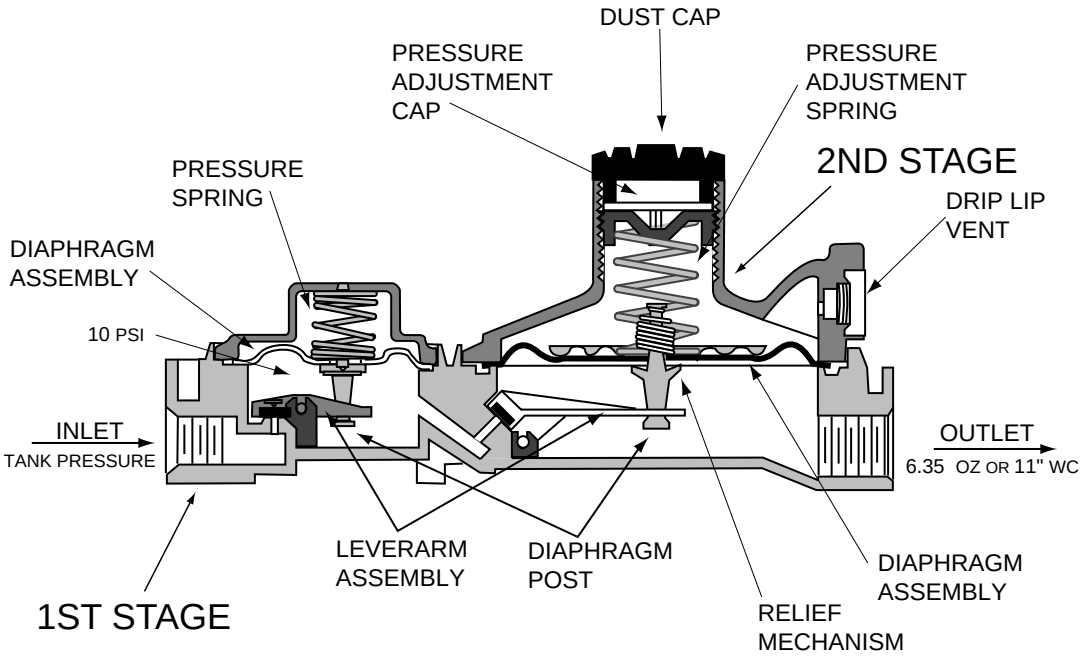


Figure 3-2 LP Flow Through Two Stage Regulator

In addition to the two-stage regulator at the containers, furnaces, water heater, and cooktop/ ovens have their own regulator. If a malfunction in the main system regulation system allowed liquid propane into the system where it would turn to vapor inside the piping, the individual appliance regulator could prevent high pressure from reaching the burner(s) by reducing the high pressure to the working pressure of the appliance (about 10 in water column).

3-2 AUTOMATIC CHANGEOVER REGULATOR

An automatic changeover regulator is a two stage regulator designed for use with two LP gas cylinders. It is connected to the regulator with two pigtails in the same manner as with a tee. A tee is a connection in the input side of the regulator that permits two pigtails to be connected to the regulator at the same time. When using an automatic changeover regulator, both cylinder valves should be in the open position. An automatic changeover regulator typically has a changeover knob with an indicator, such as an arrow, to show which cylinder is in use. In addition, there is another indicator to show there is fuel in the system and is being used. One common brand uses an indicator that shows white. As long as there is fuel in the service cylinder, the color indicator will show white. When the service cylinder is empty, the regulator will automatically change to the reserve cylinder, and the color indicator will change to red. At this point, the valve on the service cylinder should be turned off and the changeover knob should be changed so the arrow points at the reserve cylinder, thereby making it the service cylinder. The red indicator will change back to white as soon as the arrow knob is turned. The empty cylinder can now be disconnected for refilling. Once the empty tank is back in place, it becomes the reserve cylinder.

3-3 LP GAS PRESSURE FACTS

- The system functions at a working pressure of 11 inches water column (W.C.).
- The lock up pressure setting for a regulator is 14 in. W.C.
- The first-stage regulator reduces container pressure to approximately 10 psi.
- The second-stage regulator reduces the pressure of 10 psi to 11 in. W.C. or 6.3 oz. per square inch.
- Appliance regulators are set for about 10 to 10.5 in. W.C.

Figure 3-3 describes the details of pressure equivalents and displays an example of a U-tube manometer:

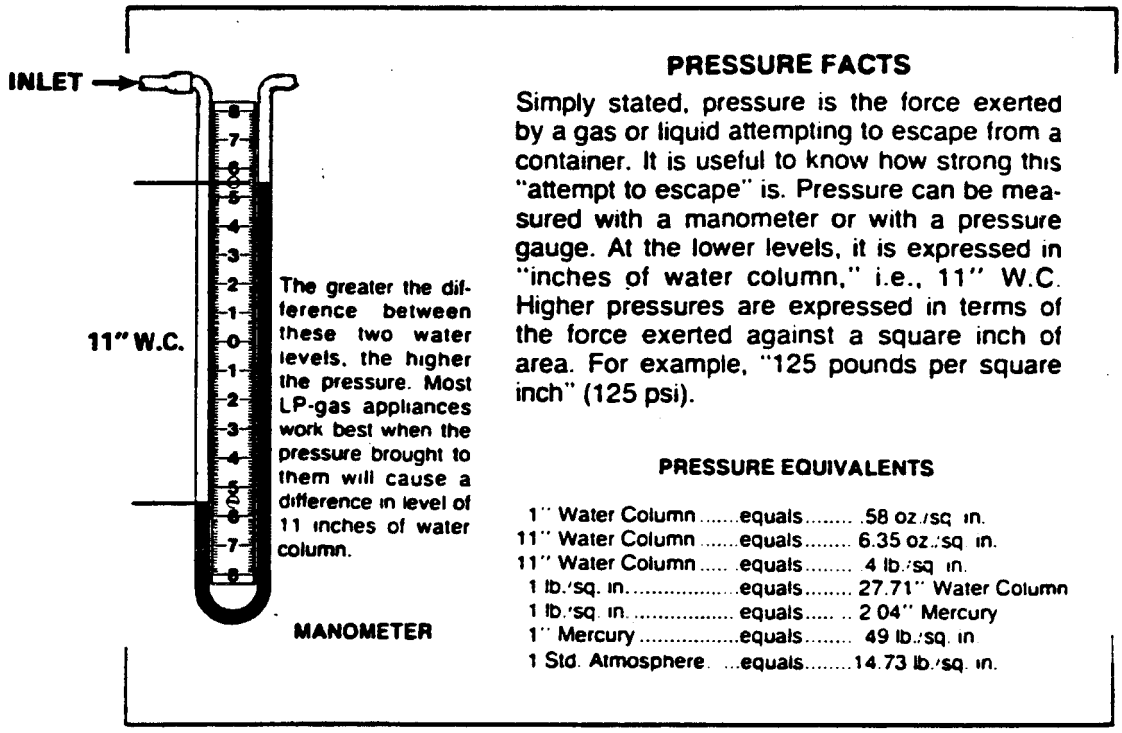


Figure 3-3 Manometer and Pressure Equivalents

3-3.1 Manometers

A manometer is a device used to measure pressure. Manometers can be either a dial gauge or a loop or U-tube-type, as shown in Figure 3-4. Pressure is a force exerted by a gas or liquid attempting to escape from a container.

A dial gauge shows the pressure of the system using a needle that points to number indicators. The higher the number, the higher the pressure. Dial gauge manometers should be calibrated often.

The U-tube-type manometer uses a clear tube filled with water. A linear scale marked off in inches is located between the two legs of the loop or "U." The amount of pressure is determined by adding the numbers together that correspond to the level of water in each leg. By using manometers, the LP gas system can be checked for leaks and proper operating settings of the regulator.

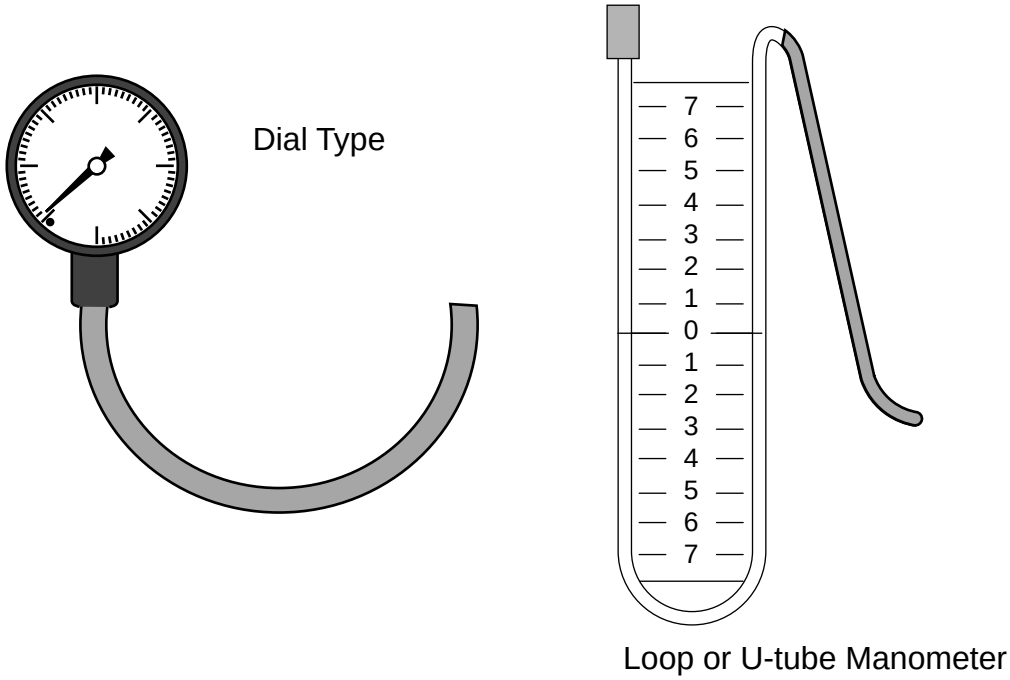


Figure 3-4 Manometer Examples

3-4 INSPECTING REGULATORS

When checking the LP gas system, be sure to inspect the regulator. Look to be sure it is secured to the vehicle or container, and make sure the regulator is not encrusted with dirt, mud or ice. Regulators are rugged and trustworthy instruments, but insects or dirt that have plugged the vent opening can cause pressure problems. If debris obstructs the working mechanism of the regulator, high-pressure LP gas may pass directly into your appliances. Both possibilities create substantial safety problems.

Another source of vent clog is ice that can form quickly in a freezing rain. Tests conducted by both Fisher Controls Company and Underwriter's Laboratories showed that vent openings that point to the ground and have a drip-lip construction are unlikely to freeze completely closed. In support of this, the RV Standards require that the regulator's vent must be pointing directly to the ground or within 45° of this vertical plane when installed. This positioning helps drain away any moisture that may accumulate on the diaphragm inside the regulator. Excessive moisture build-up could prevent the regulator from working or permit high-pressure gas downstream of the regulator, especially in cold weather. Always ensure that the regulator's vent points downward within 45° of the vertical plane. This requires that you use the model regulator designed for the proper purpose. A regulator for a motorhome's ASME tank has a vent that discharges out of the side of the regulator so that the regulator, when laying on its side, vents downward within 45° and will drain any condensation that might get into the area of the diaphragm. A regulator to be mounted on the front wall of the RV, or on the container assembly, will have the vent pointing the same side as the regulator's outlet opening. Therefore, when the regulator is mounted on the front of the unit, the vent is pointing downward and will also drain condensation. Figure 3-5 shows two-stage regulators:

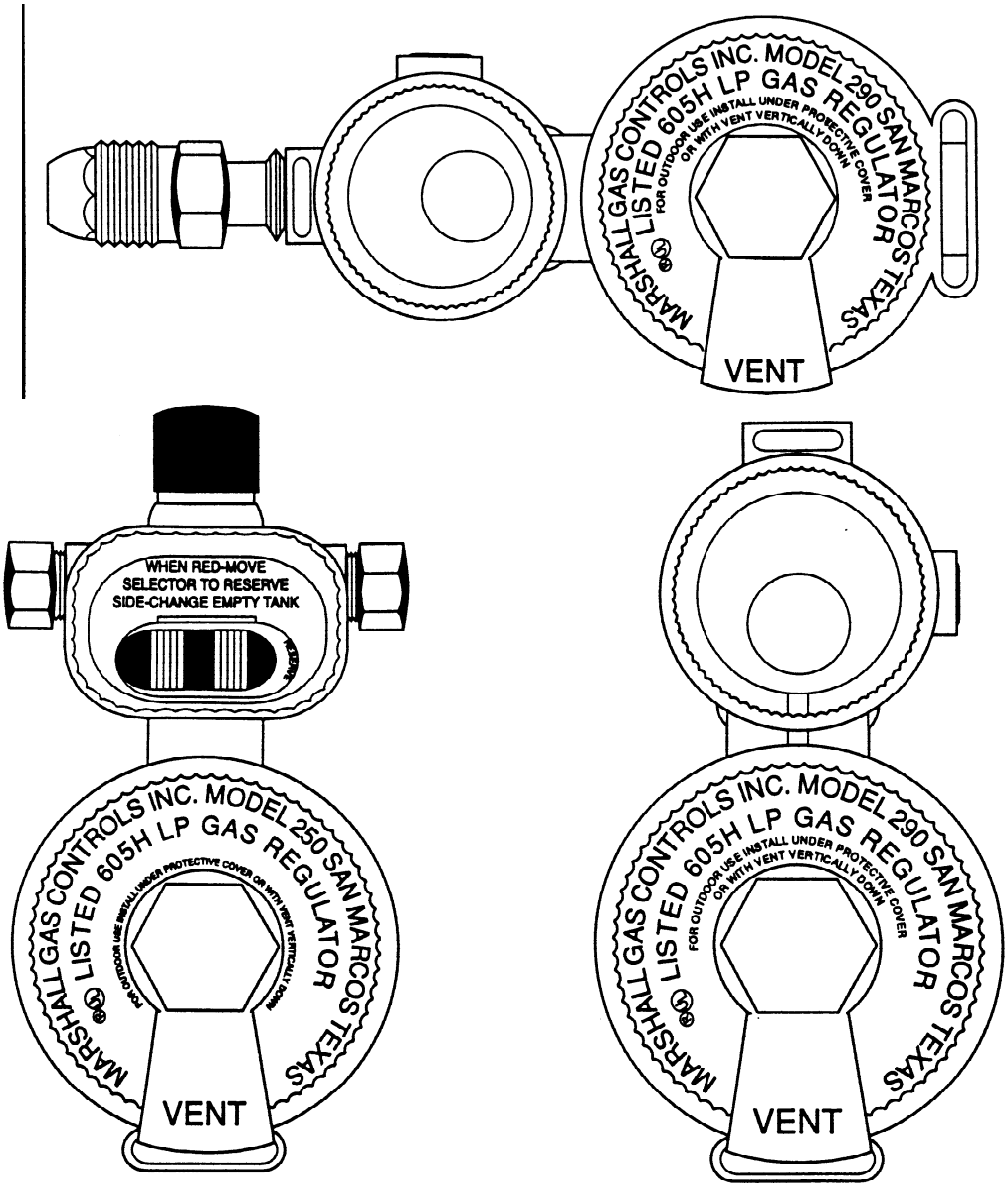


Figure 3-5 Two-stage Regulators

Most regulators have a fine-meshed vent covering that helps prevent blocked vents. However, regulator vent screens can be quickly clogged with road splash or insects, such as mud daubers(wasps). Ensure that nothing is blocking the regulator vent.

DOT cylinders, not in compartments or under housings, should be turned so the relief valve faces away from the RV, the service valve faces the unit, and the regulator is mounted between the cylinder(s) and the RV to protect it from damage from flying rocks and debris. The cylinder guard acts as protection for the service valve in the event of flying objects or collision. This positioning also adds additional protection to the regulator cover that is attached directly to the regulator. Remember that this cover keeps contamination from blocking or plugging the regulator's vent.

Frequent inspection and, if necessary, cleaning is highly recommended, even where the regulator is installed in a compartment or under a cover. Beware of carelessly installed covers or hoods. If installed upside down, they may actually fill with water that can ultimately freeze the vent closed.

3-5 STORAGE AND ASSEMBLY OF REGULATORS

Regulators should be stored in a clean area with the inlet and outlet plugged to prevent dirt, debris, insects, etc., from entering the regulator's openings.

When installing the POL to the regulator, care should be taken to ensure that no pipe compound, Teflon® tape or foreign material gets into the regulator. To prevent this problem, be sure pipe joint compound or Teflon® tape is only installed on the male threads. Never apply pipe joint compound or Teflon® tape to female threads.

Some pigtails have ends that are inverted flares. As with all flare joints, no pipe joint compounds of any type should be used. Other pigtails are NPT (tapered pipe threads) and should be installed using thread compounds approved for use with LP gas. Figures 3-6 and 3-7 show cut-away diagrams of regulators.

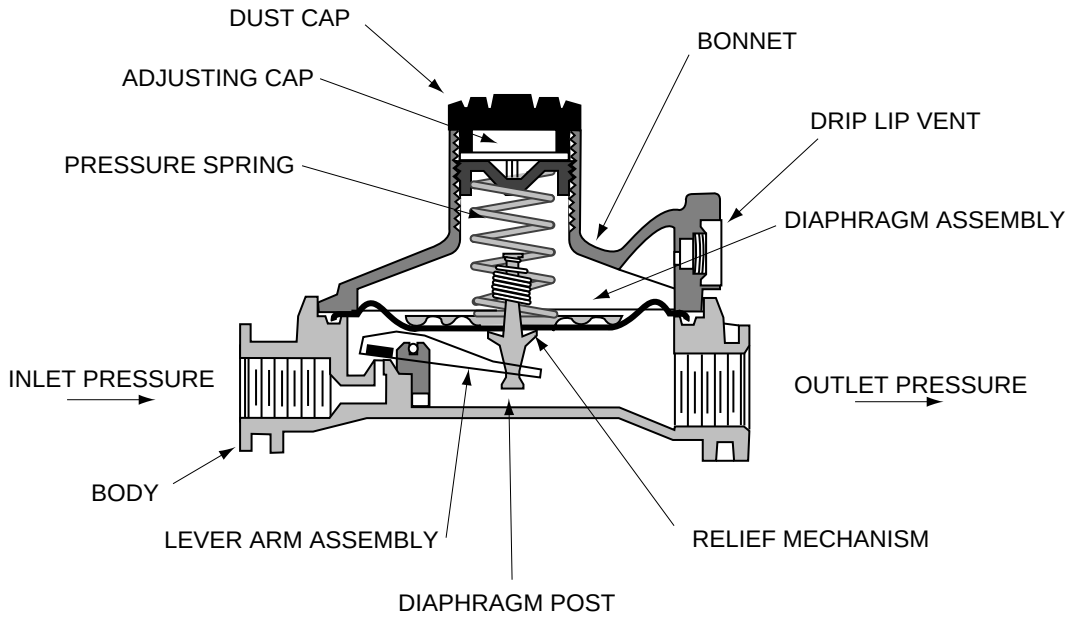


Figure 3-6 Cut-away Single Stage Regulator

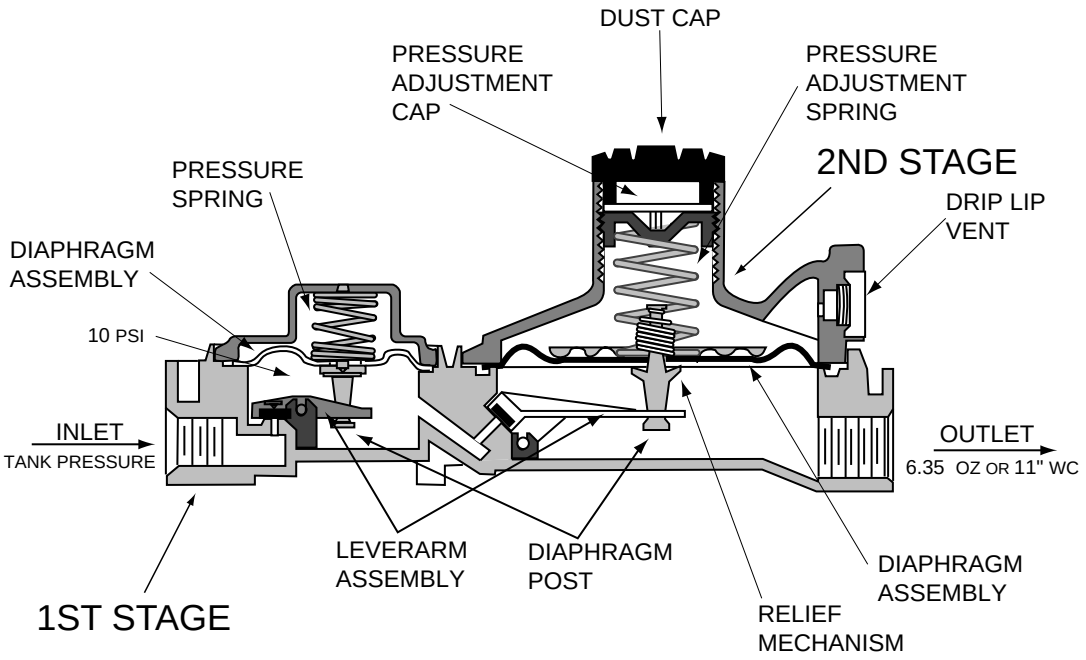


Figure 3-7 Cut-away Two Stage Regulator

3-5.1 Adjusting Regulators

To adjust the system regulator, an operating pressure test and a lock-up pressure check of your system regulator, located at the containers, must be conducted.

The operating test is used to determine what pressure the system regulator is delivering to the system when at least 50% of the appliance load is functioning. The lock-up pressure test verifies the pressure at which the regulator locks up, when no LP gas is flowing through the system. The operating test should show a working pressure of 10-1⁄2 to 11 inches water column when properly conducted, and the lock-up pressure should never exceed 14 inches water column.

3-5.1.1 Operating Pressure Test

To conduct these tests effectively and efficiently, follow these guidelines:

1. Obtain or build this testing device:

   Equipment Needed:

   A. Brass T 3⁄8 × 3⁄8 flare × 1⁄4 pipe thread

   B. A low-pressure flex hose connector (short length - 10 in.)

   C. Inch pipe cap drilled at #42 (3⁄32 drill) or 75,000 BTU orifice

   D. Short piece of 3⁄8 copper tubing flared on one end

   E. Bonnet nut

   F. Manometer and connection hose

G. Gas cock

This apparatus is shown in Figure 3-8.

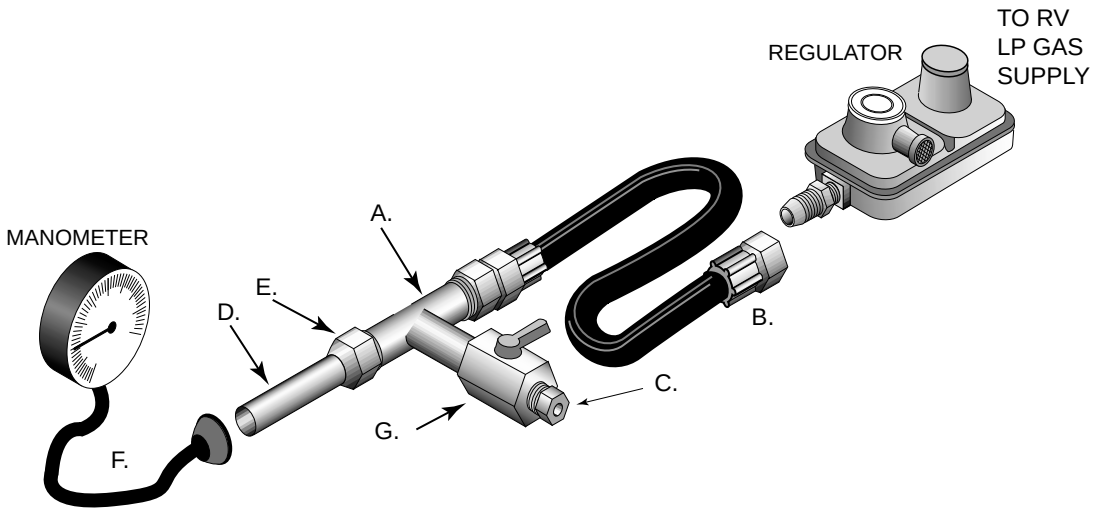


Figure 3-8 Test Apparatus

2. With the LP gas system off, disconnect the low-pressure hose or piping from the regulator outlet and connect the above referenced T to the regulator's output by using the short low-pressure flex hose.

3. Use the small piece of 3⁄8 in. tubing flared on one end and attach it with the bonnet nut to an open leg of the T. This creates an opening for connecting the manometer for measuring the pressure. With this type of test setup, you are now working at the propane container area with the regulator and the manometer connected beside you, so that you are looking at all these devices at the same time.

4. Attach the gas cock to the remaining leg of the T, which is the 1⁄4-inch pipe thread opening. On the outlet side of the gas cock, attach the cap with the #42 drill hole or an orifice that is rated at 75,000 BTU. You are now ready to test!

5. With the manometer connected, turn on the gas at the container. Slowly open the gas cock. Opening the gas cock represents the flow of about one-half or more of the BTU flow rate of the inside appliances. The operating pressure is now shown on the manometer. This operating pressure should be approximately 11 inches, nominal[1]. If you find that the pressure is significantly off the 11 inches W.C. reading, readjust the regulator by removing the dust cover. Use a screwdriver and turn the adjusting screw until the system's operating pressure is at 11 inches W.C. If adjustment of the regulator is required, remember that screwing in the adjusting screw (clockwise) increases the pressure; screwing out the adjusting screw (counterclockwise) decreases the pressure.

Most RV regulator manufacturers set and test their regulators at an operating pressure of 11 inches W.C.

1. Nominal means ± .5 in. or 10.5 to 11.5 in. W.C.

3-5.1.2 Lock-up Test

Immediately after conducting the operating pressure test outlined above, simply close the gas cock. This represents turning off all the appliance burners so that no gas flows through the system. The pressure now shown on the manometer is the lock-up pressure. Lock-up pressure is the amount of pressure required to press against the regulator diaphragm, overcome the spring, and completely seat the lever seat assembly in the regulator so that no gas flows through the regulator. This pressure should not be more than 14 inches W.C. (or 1⁄2 pound of pressure) as specified in the RV Standard under paragraph 2-2.9.2. Never allow a system to operate above the maximum allowable pressure of 14 inches W.C.

If adjustment of the regulator is required, remember that screwing in the adjusting screw in (clockwise) increases the pressure; screwing the adjusting screw out (counterclockwise) decreases the pressure . The lock-up pressure should be checked again. If the regulator will not lock up at a pressure of 14 inches or less, the regulator should be rejected and a new one placed on the system. Always check the lock-up pressure after the regulator has been adjusted.

3-5.2 Leak Testing Regulators

If the regulator passes your visual test and is secure and clean, make sure there are no leaks around the body of the regulator by applying a generous amount of leak detection solution or use an electronic leak detector. After applying a leak detection solution, you should not see bubbling around the edges or fittings. If leaks do appear, tighten the fittings. If there are leaks around the crimped edges, the regulator will need to be replaced. Remove the regulator, tag it and identify in writing the problems detected. If it is within warranty, return it to its manufacturer. If not, throw it away so it won't inadvertently be used again.

The regulator should be checked for leaks around the edges where the diaphragm is sealed, at vents, and at any other connection or openings. Check these locations during the lock-up test only. If the regulator's operating pressure and lock-up pressure are within tolerance (i.e., 11 inches W.C. operating and 14 inches W.C. lock-up), remove the test equipment and reconnect the flex hose onto the recreation vehicle manifold system.

3-5.3 Other Regulator Troubleshooting Tips

While testing regulator pressures, if you observe pressures that fluctuate, i.e. the needle on a mechanical manometer (or the water in a water manometer is constantly moving up and down), this suggests several potential problems that may involve the following:

- The regulator is handling liquid. The container is overfilled, an internal withdrawal tube is not working properly, or a vertical cylinder is incorrectly used in the horizontal position.

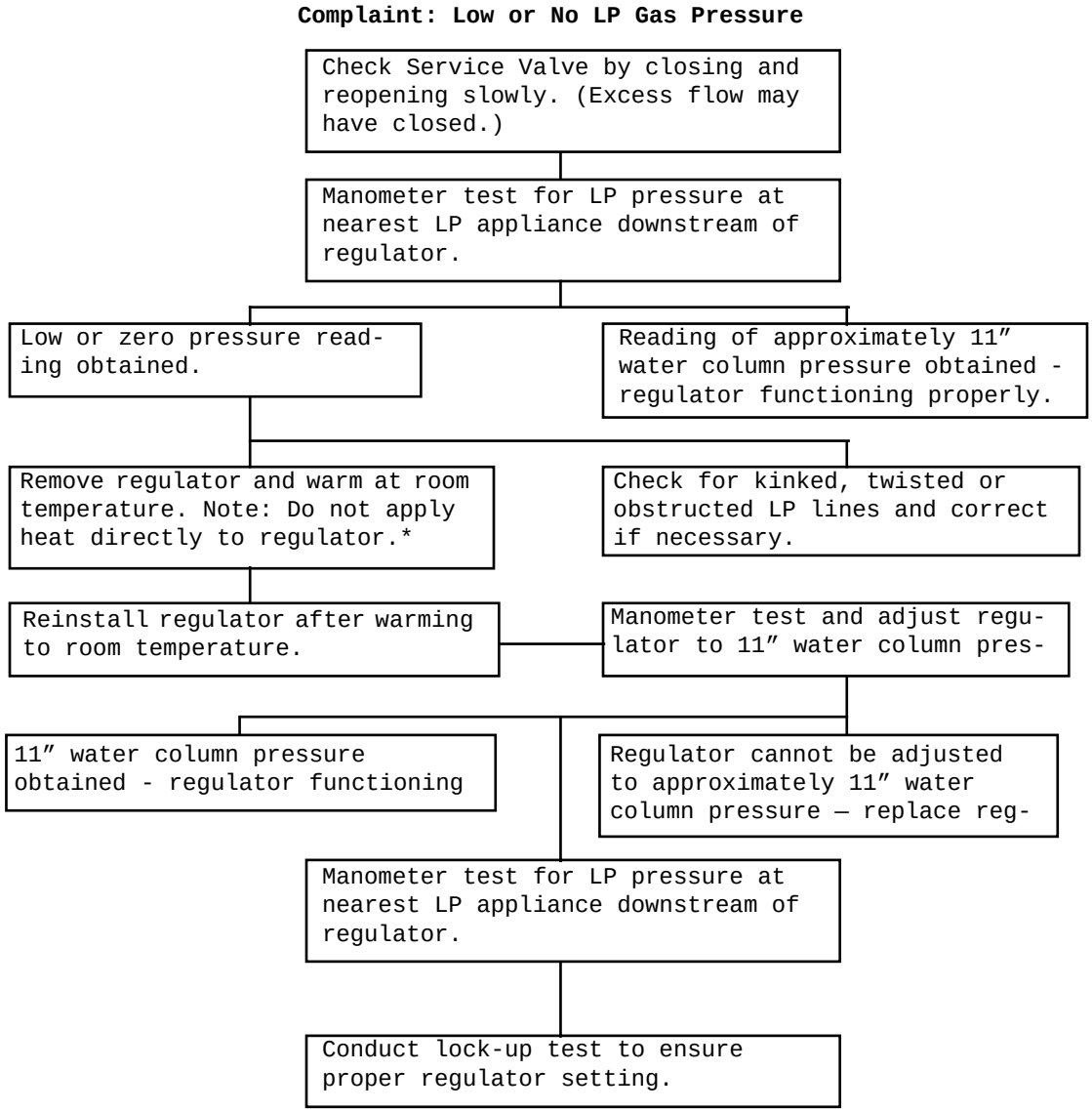
- There is friction in the pivoting parts of the regulator due to corrosion if water has been allowed to enter the regulator or if it has in some way been contaminated.

- If you observe any of these conditions, check for the reason of the condition and correct the fault. If it can not be corrected, replace the regulator. Tag the faulty regulator describing clearly in writing the condition found so that, when it is returned to the regulator manufacturer, they can verify your findings.

- Temperature change in a piping system can cause a lock-up reading to change. The pres-

sure will rise if the temperature rises and decreases as the piping cools.

Figure 3-9 shows you how to troubleshoot low or no gas pressure:



*** In freezing weather pour warm water on the first stage inlet to test for ice in regulator.**

Figure 3-9 Troubleshooting Low or No Gas Pressure

3-5.3.1 Results of Regulator Overpressure

Regulator overpressure may result in any of the following conditions. If any of these conditions are found, be sure to replace the regulator and tag it with a written description as to what you found:

- Leaking around the crimped area diaphragm of the first stage.
- Leaking at a very small vent hole near the spring tower in the first stage.

- Both of the above.

3-5.3.2 Excessive Pressure From the Second Regulator

Should the regulator's first-stage no longer reduce the container pressure to approximately 10 pounds, the second-stage regulator would be receiving container pressure, which will increase the system's outlet pressure. Instead of seeing an operating pressure of 11 or 11-1⁄2 inches water column with a lock-up pressure of 14 inches water column, we may see an operating pressure (particularly on a warm day) above 12 inches and a lock-up pressure above 14 inches water column.

These higher pressures would indicate the necessity to troubleshoot the regulator, and could lead to replacement. Either high-pressure liquid may have damaged the regulator, or there could have been foreign material under the seats of the regulator, preventing a tight seal. Refer to the symptoms of container overfill addressed below.

3-5.3.3 Lock-up Pressure Continues to Creep

After conducting a lockup pressure test, the regulator locks up and, over a period of three or four minutes, the pressure on the gauge gradually increases. Foreign material may have entered the inlet of the regulator and be under the regulator's seat, preventing the seat from functioning to tightly close off the flow of LP gas. This is not acceptable. This is particularly true in relation to appliances with electronic ignition since they have no burning pilot lights to use up small amounts of gas that might get through the regulator seat arrangement. This condition is not typically correctable, and the regulator needs to be replaced.

It is important to observe lock-up for a few minutes to make certain that the seat is closing tightly. If it is seating properly, the lockup pressure will hold steady.

3-5.3.4 Symptoms of Overfill

While testing regulators, if you see a regulator that leaks around the crimped area of the first-stage regulator, it indicates that the regulator has been subjected to extremely high pressure, likely attributed to container overfill sometime in its previous history. In these situations, the system has likely been fed liquid, and there is a very good chance the first-stage regulator will operate improperly.

Caution

If a regulator has symptoms that indicate it has been subject to overfill, it is important to immediately test the container to make certain that the overfill is not currently occurring. Never ignore a potentially overfilled container!

1. Test to make certain the container is not overfilled by opening the outage valve (fixed maximum liquid level gauge) and seeing if there is a stream of vapor instead of liquid. If there is liquid, the container is filled above the 80% level. If there is vapor, the level of LP gas is below the 80% level, and you can discount the potential for an overfilled container. By careful examination of the relief valve for oils or odor caused by weeping, you may find some clues that there was regulator failure that was the result of an overfill of the propane system. Use caution and wear eye protection when examining these devices.

2. When a vertical cylinder is standing upright, there should be no liquid drawn into the

regulator. On an ASME tank or horizontal cylinder, liquid may splash into the vapor withdrawal tube and, thus, you could experience an initial draw of a small amount of liquid into the regulator. If you get a continuing draw of liquid, this is a strong indication that the container has been overfilled or the vapor withdrawal tube has a defect. If a continuing supply of liquid propane is present in the regulator, it will frost the exterior of the regulator. The liquid propane vaporizing into a gas inside the regulator causes this, and may also cause rupturing of the regulator's diaphragm, allowing gas to escape through the vent hole of the first-stage regulator. If the recreation vehicle is inside a building, you need to get it outside. As ambient temperature rises, the LP gas will expand, and the pressure relief valve may release gas into your shop.

3. Look for any signs of oily material or an abnormal amount of dirt that might be stuck to the exterior of the regulator. A small amount of gas leaking from these areas can be detected by a leak test. Occasionally, green blowflies will be a clue about a small leak before using leak detector solution because they like to gather around this smell.

4. All ASME tank pressure relief valves should have plastic dust covers. If the dust cover is missing, observe the pressure relief valve for oxidation patterns (discolored brass). Shiny brass could mean that the cover came off recently, indicating that the pressure relief valve may have recently discharged.

5. Wipe the pressure relief valve area with your fingers. You may pick up residual odorant from around the pressure relief valve area and be able to smell this on your hands. This would indicate that there had been previous discharge at the pressure relief valve.

6. If a pressure relief valve is leaking, empty the container by flaring off the gas with a torch, remove the valve and replace it. (See fuel transfer and torching in Chapter 2.) Do not tamper with pressure relief valves, and do not attempt repairs. Replacement is mandatory. Be sure the pressure relief valve used for replacement has the correct pressure setting of 312.5 psi. Using a valve with a lower pressure setting can result in premature relief and possible unsafe situations.

3-6 REGULATOR COVERS

According to ANSI A119.2/NFPA 1192, regulators are required to be under protective covers where installed above the vehicles' floor line, as with trailers, or "compartmentalized" where installed below the floor line, as with motorhomes. Figure 3-10 shows a snap on regulator cover and ASME below-floor regulator cover:

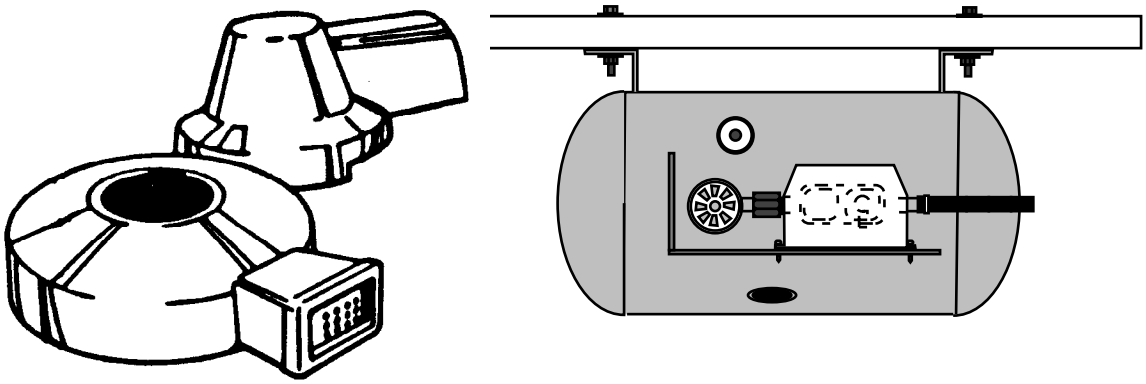


Figure 3-10 Snap On Regulator Cover and ASME Below-floor Regulator Cover

3-6.1 Regulators Above the Floor

If the regulator is not within a compartment, check the regulator to be sure that it has the plastic regulator cover installed. The plastic cover protects the regulator by covering the regulator vent, preventing it from being contaminated by wheel spray, freezing rain, mud, or any other materials that might plug the vent opening.

3-6.2 Regulators Below the Floor

If the regulator is located below the floor line, it must be in a compartment. This is again to help protect the regulator and to provide sufficient space for it to function. The compartment is to mean a six-sided enclosure. None of the sides may be the LP gas regulator itself. The sides may be fabricated of wood, metal, plastic or equal, and be part of the RV side walls or floor, the container or its valve guard, or any combination of the above. According to the RV Standards, the size of the compartment has to allow for sufficient room for tool operation for connection to and replacement of the regulator(s). In addition, the compartment must have at least a 1 square inch vent opening located within 1 inch of the compartment floor. The most common "compartment" is a five-sided plastic box attached to the valve guard (sixth side).

3-7 CONNECTORS AND HOSES

3-7.1 High-Pressure Connectors or Pigtails

High-pressure LP gas connectors or pigtails are the high-pressure gas line between the LP gas cylinder(s) and the regulator. Today, most of these gas lines or pigtails are flexible hose assemblies. Prior to 1977, RV pigtails were made of copper. Copper could be kinked or broken in RV use in vehicle accidents or from repeated cylinder change-out. A kink in a broken copper pigtail might provide enough flow restriction to prevent the excess flow valve in the POL from being activated. In 1977, the ANSI A119.2/NFPA 501C Standard for Recreation Vehicles was changed to require that only flexible lines be used. These high-pressure LP gas connectors are listed as a total assembly to the UL 569, Standard for Pigtails and Flexible Hose Connectors for LP gas. An assembly means the hose and fittings are supplied as a total unit. Because these are listed assemblies, the hose and both ends must be assembled by an authorized hose assembly manufacturer. If a fitting on the assembly is damaged or otherwise needs replacement, you need to replace the entire assembly. High-pressure LP gas connectors are listed for use at pressures up to 350 psi.

The bullet nose, left-hand threaded, brass fitting on the container end of the high-pressure hose assembly (pigtail) is called a POL (Prest-O-Lite). "PUT ON LEFT" is a common memory aid. There are different styles of POLs. Code requires that recreation vehicles have the excess flow POL.

The fitting at the other end of the pigtail can be male pipe thread, 1/4 inch inverted flare fitting or, in the case of a transfer hose, POL on both ends. Pipe thread uses an approved pipe sealant, and the inverted flare or POL would not use a sealant.

3-7.2 Low-Pressure Connectors

Low-pressure LP gas connectors are also listed assemblies manufactured to comply with UL 569 with a maximum length of 60 inches. These connectors are used downstream of the regulator and are most commonly found between the regulator's outlet and the LP gas manifold of the RV's LP gas system. These low-pressure connectors are also used to connect moveable appliances found in folding camping trailers where the kitchen units fold down for travel or where the ranges can be moved outside for use. These hose assemblies are listed with a working pressure of 1 psi.

In applications where the regulator is permanently installed, as is the case with some travel trailers where the regulator is mounted on the front exterior wall, a flexible hose connector would not be required. A properly sized copper line can be used, since the regulator is not moved when removing or filling the cylinder(s).

Twisting or kinking a hose assembly can cause a restriction in the fuel supply. A twist in a high-pressure hose would usually be less restrictive than a twist or kink in a low-pressure hose, because even though the high-pressure hose has a smaller diameter the higher gas pressure will typically supply more gas flow. Install the connections that do not have a swivel first. The POL has a swivel, but be aware that a twist could appear even with a swivel.

CHAPTER 3 REVIEW

Circle the *best* response:

1. You observe fluctuating pressure on your manometer while conducting a regulator pressure test. Which of the following would not be the cause? (There may be more than one choice)

   A. Vent is plugged so that the diaphragm cannot breathe.

   B. The regulator is handling liquid due to overfilling.

   C. Diaphragm is punctured.

   D. Parts are corroded.

2. Which symptom or symptoms of regulator overpressure and previous overpressure will be externally obvious when inspecting the first stage of the regulator?

   A. Leaking at a very small vent hole near the spring tower.

   B. Leaking around the crimped area.

   C. Neither A or B.

   D. Both A and B.

3. A customer complains that all of the appliances work but not at normal efficiency. Based on the symptoms, you determine that the problem is probably low pressure. The first thing you should do is:

   A. Remove the regulator.

   B. Check for kinks in the LP gas line.

   C. Check operation of the service valve.

   D. Check need for recertifying LP gas container.

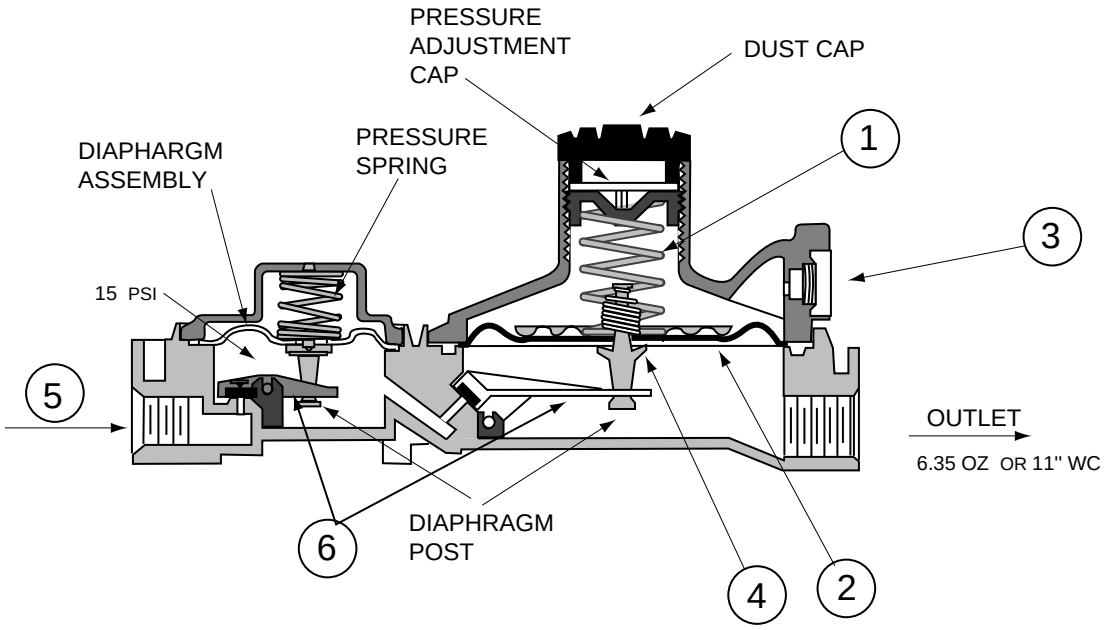
4. List two symptoms of overfill.

   A.

   B.

5. Explain the use of a regulator cover.

6. LP GAS REGULATOR COMPONENT IDENTIFICATION



Insert the proper name of the component numbered on the diagram.

1. 4.

2. 5.

3. 6.

Chapter

4

LP Gas Piping Systems

4-1 Materials, Sealants and Testing

The piping of the LP gas system of an RV is designed to safely transfer the LP gas from the container to the appliances. The piping system can be made of many different materials. Any material used has to be new and free of defects. Damage to fittings and piping requires removal of the damaged section or replacement with new parts. Any material used has to have a melting point of not less than 1450°F (except for listed flexible hose assemblies) and can include the following materials:

- Piping: steel, wrought iron (black iron pipe), threaded copper or brass. Galvanized pipe is also allowed.
- Fittings: steel, wrought iron (black iron pipe), brass (stress-relieved or forged).
- Tubing: copper (annealed type K or L). Where used for natural gas, the tubing must be internally tinned, seamless brass or steel, and also must be externally corrosion-protected.
- Hose: listed flexible, nonmetallic tubing or hose for use with LP gas.

For practical purposes, most RVs have LP gas piping systems consisting of a main manifold made of iron pipe, with risers of copper tubing branching off the main manifold to each appliance. Some RVs have LP gas piping systems consisting of only copper tubing. The typical RV LP gas system is shown in Figure 4-1.

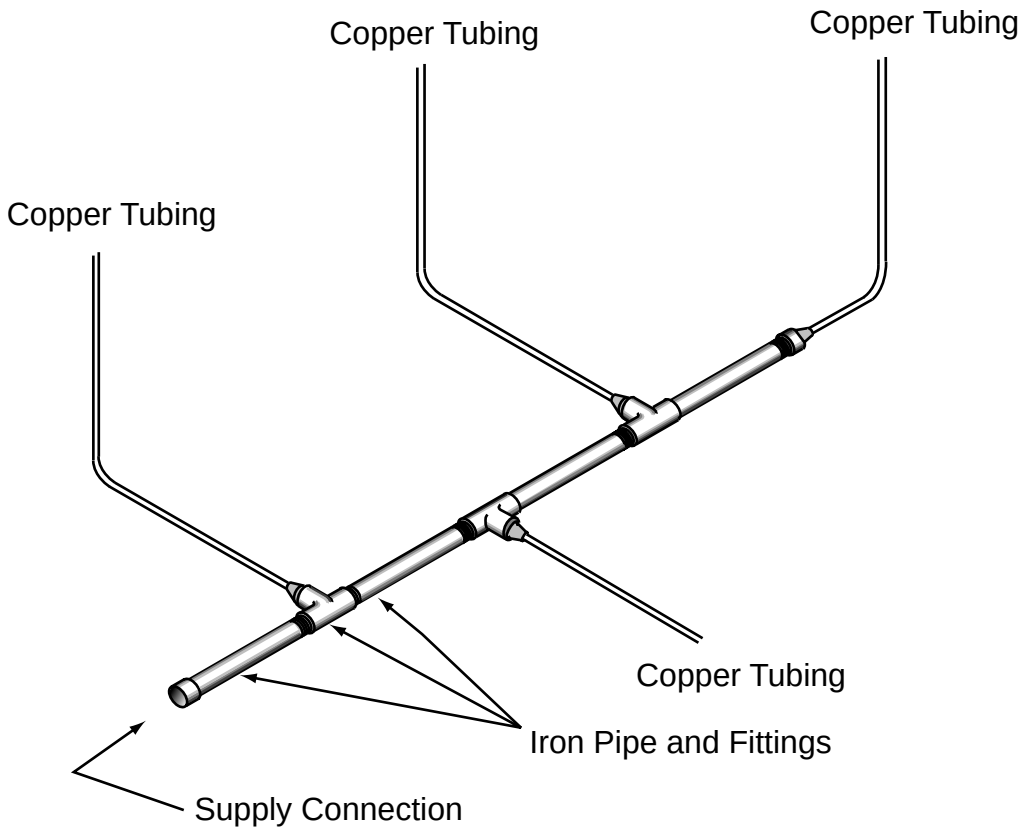


Figure 4-1 LP Manifold and Risers

4-1.1 Iron Pipe Manifolds

When repairing or replacing iron pipe manifolds, joints in the manifold consist of threaded pipe connections. Pipe threads are tapered and are intended to be connected with pipe joint compound. Pipe joint compound used should be marked on the label as being acceptable for use with LP gas. Teflon type tape is also acceptable for use with LP gas when coupling pipe and fittings. When using pipe joint compound or tape, be sure to apply the pipe joint compound only to male threads and not past the first thread on the male fitting . This will allow the pipe joint compound to assist in sealing the joint without letting pipe joint compound or tape inside the piping system. If pipe joint compound or tape got inside the piping system, it could migrate through the system, possibly going to a valve or regulator, causing damage. Also be aware that it is possible to have iron pipe that is over threaded (too many threads). This eliminates the taper in the threaded section, resulting in a loose fit with the female fitting. The number of threads should be between 9 and 13 on a properly threaded pipe. Keep this in mind when threading pipe for manifold systems.

Iron pipe manifold systems must be secured to prevent vibration, rattling, and any other movement that could loosen joints in the system. The RV Standard requires the iron pipe manifold to be secured to the vehicle every 4 ft. along the run, and to be rigidly anchored to the vehicle within 6 in. of the supply connection or any copper tubing connections to the iron manifold that are at the end of pipe runs. The iron manifold must be rigidly anchored to the vehicle within 12 in. of any copper tubing connections to the iron manifold that are within runs of the manifold, as shown in Figure 4-2.

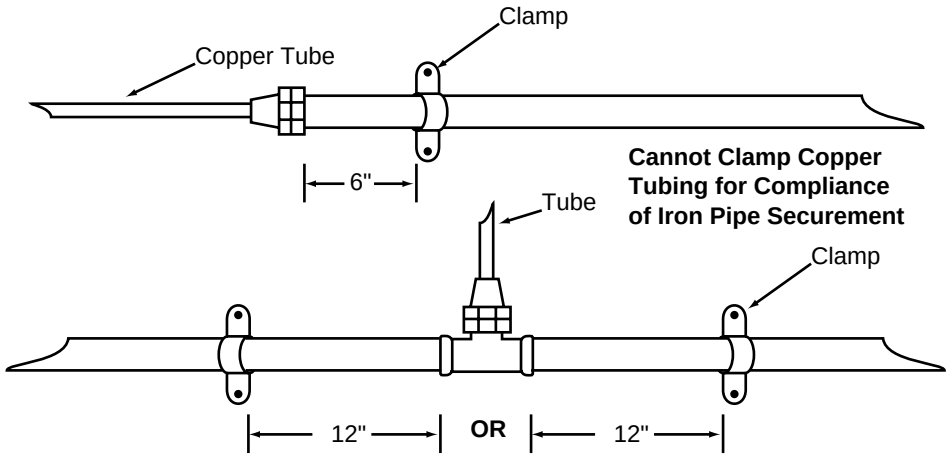


Figure 4-2 Iron Pipe Manifold

4-1.2 Copper Tubing

Copper tubing joints in RVs use flared fittings where the tubing is flared out with a 45° flaring tool. Be sure flaring tools used are not 37° fittings or tools when working on RVs. Tools for flaring can be hand held, as shown in Figure 4-3, or can sometimes be bench-mounted. The flare fitting is designed to accept a flared tube and make a metal-to-metal connection without pipe joint compound. In fact, pipe joint compound on a flared fitting is prohibited!

Flare connections can be made up by any service technician using the following procedure and a hand-held flaring tool.

1. The tubing must first be cut square. This is best accomplished using a special tubing cutting tool. Cutting tubing with a saw blade will substantially reduce the chances of obtaining a good seating surface during the flaring process and will result in excessive burrs. Cut the tubing with a tubing cutter of the appropriate size. Some tubing cutters are large, for more leverage, and some are small for tight locations. Both will cut tubing sizes used in RVs. Place the tubing inside the cutter and rollers of the cutter and turn the knob until it contacts the tubing. Start rotating the cutter around the tubing and turn the knob to apply more pressure with each revolution. Do not apply too much pressure as it will distort the tubing. Just tighten the cutter about 1⁄8 to 1⁄4 turn of the knob with each revolution around the tubing. The amount of pressure applied should be enough to feel resistance on the knob but do not force it. The cut will be smooth and the tubing will retain its round form. After cutting through, the tubing will have a rounded outer edge and a raw lip or ridge on the inside diameter.

2. Check the outside of the tubing to be sure it is smooth and free of loose scales. If it is not, file or sand it smooth.

3. The tubing must then be reamed on the inside to prevent burrs or other imperfections during the flaring process. The larger style tubing cutters will usually have a reaming blade mounted on the handle of the tool. To ream the tubing, insert the reaming-blade inside the tubing and rotate it around until the lip or ridge is gone. This is extremely important because if the lip or ridge is not removed, a good flare cannot be achieved. The lip or ridge will “roll over” inside the flare during the flaring process, preventing a good surface of contact between the flare nut and fittings. If the tubing cutter does not have a

reaming device, a scraper or a small, fine file can be used. File or scrape the inside of the tubing until the lip or ridge is gone. When removing the lip or ridge, it is a good practice to hold the tube opening toward the ground so the shavings fall to the ground instead of staying inside the tubing.

4. Put the flare nut on the tubing before beginning the flare. If you forget, you may have to cut the tubing and reflare it after the nut is put on correctly.

5. Using the hand-held flaring tool, clamp the tubing in the vise portion of the tool by inserting the tubing into the jaws and clamping the handles together. This will lock the tubing in the tool. Be sure the end of the tubing is flush with the outboard end of the vise portion. Then tighten the flaring cone clockwise into the open end of the tubing by screwing it down in a clockwise direction. Tighten the flare cone down on the tubing until it can no longer be turned. Then back off the flaring cone and release the tubing from the vise. Re-clamp the tubing in the hand vise and leave about 1⁄8 to 3⁄16 inch of tubing protruding from the top of the vise. (This 1⁄8 to 3⁄16 inch is approximate for 3⁄8 O.D. tubing and would be slightly more for 1⁄2 inch O.D. tubing). Tighten down the flaring cone again, this will complete the flare. This 2 step method will assist in making a good flare without cracking the edge of the tubing or creating burrs and excessive length in the flare.

6. The flare has to be perfectly formed in order to produce a tight connection. If you attempt to make the flare all at once, you can "bell" the flare. Once you get the hang of using the flaring tool, flaring tubing in one operation can become routine. Until then, use the two step method described previously.

7. Once the flare is complete, inspect it carefully for any deformity or defect that could cause or lead to a leak. Figure 4-4 shows examples of correct and incorrect flares. The flare should be conical in appearance without burrs or cracks. Look closely to see if hairline cracks are present, usually extending from the outside edge of the flare towards the inside of the pipe. If any of these defects are present, cut the flare off the end of the pipe and begin again. Also, if the tubing was protruding from the end of the vise portion of the tool too far, an overlap or doubling back can occur. Be sure the finished flare has no visible faults, as it is this surface that will be fitted between the male flare receiver and the bonnet nut that forms and keeps the seal. Keeping the flaring cone tip slightly lubricated helps ensure a smooth seating surface.

Never use sealants such as pipe dope or thread tape (Teflon™ tape) on flare fittings. The copper forms a tight seal against the "nose" of a flare fitting upon tightening. The use of sealants can prevent a proper seal.

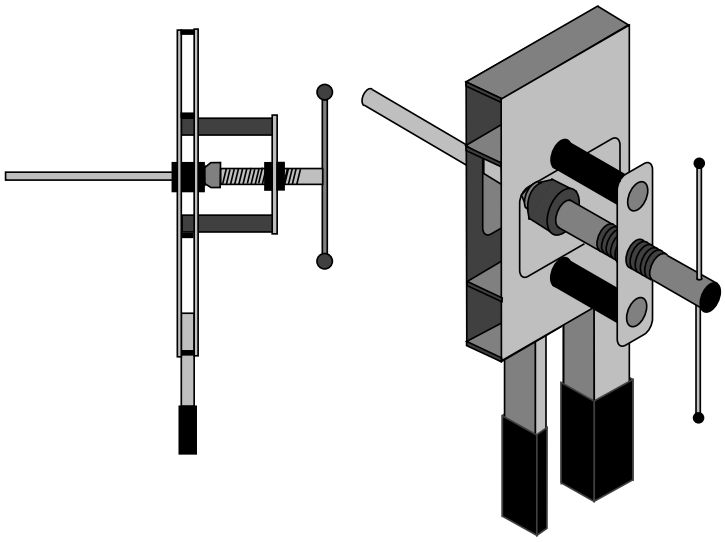


Figure 4-3 Hand Flaring Tool

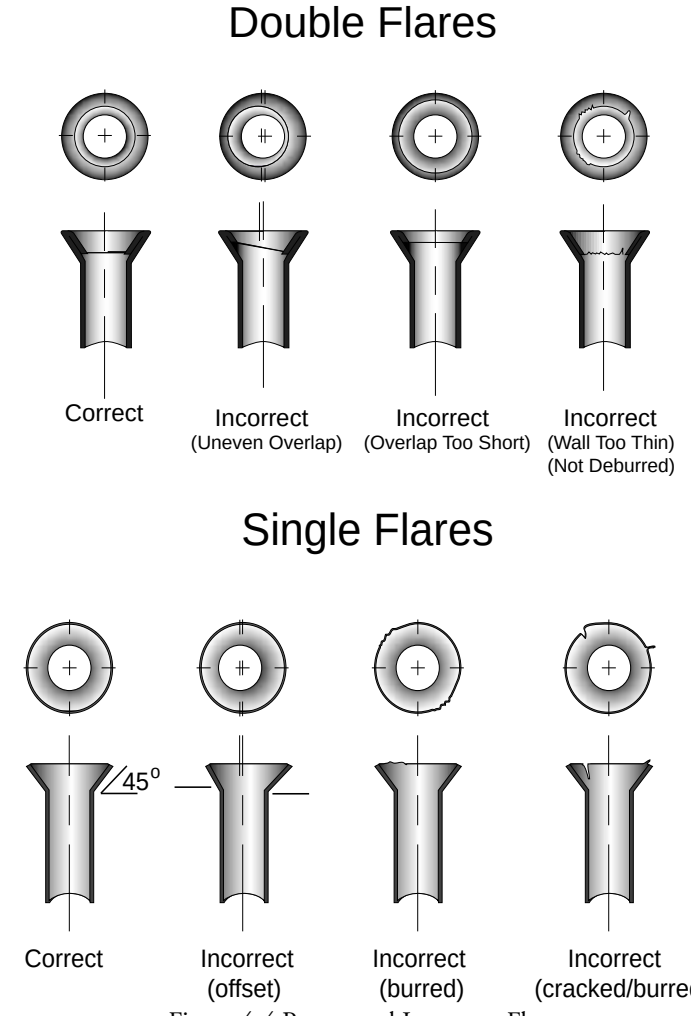


Figure 4-4 Proper and Improper Flares

Copper tubing must be installed and routed in a way to prevent any potential of physical damage when encountering vibration over its service life of the vehicle. This means it should never be routed against a surface that could cause damage such as metal edges. Be sure to use grommets or other protection where tubing passes through structure, cut holes, etc. Tubing must also be supported every 4 feet to prevent excessive vibration.

4-1.3 Flare Nuts

Brass flare nuts are used for connecting copper tubing. Flare nuts are required by ANSI A119.2/ NFPA 1192 to be either forged or stress relieved. Forged flare nuts have much more rounded edges, a bumpy exterior and are thicker than milled fittings.

Flare nuts that are milled from bar stock need to be annealed (heated then cooled) to reduce the stress that is created by milling. Without annealing the nuts, the potential for cracking or splitting is substantially increased under normal use. The manufacturer must identify stress-relieved nuts as being stress relieved. Unless they are individually identified by the manufacturer (stamped), visual identification is difficult.

When flare nuts are loosened or tightened, two wrenches should be used to keep the tubing from twisting and possibly kinking. Using two wrenches in this manner is sometimes referred to as using "backup wrenches." In fact, this practice should be employed when working with any piping fittings. Backup wrenches enable the service technician to correctly tighten a fitting joint without damaging the system. Care should be taken that fitting joints are not over-tightened.

4-1.4 Leak Testing the Piping System

Anytime the LP gas system is opened by loosening a fitting, removing an appliance, replacing a line, or a leak is suspected, the system must be tested for leaks by pressurizing the system. Pressurizing the system allows leaks to be identified and located. Leak testing with air pressure is typically performed by using a dial gauge or U-tube manometer and seeing if the pressure drops according to the test device. This test is referred to as a pressure drop test. However, leak testing can also be done in accordance with the ANSI A119.2 RV Standard using leak detector solution or an electronic leak tester on a system that has been pressurized. These tests are further explained in the following paragraphs.

From a liability standpoint, the best test for use by the RV service technician is the pressure drop test. However, any test that is properly conducted and adequately documented will help in the event of a lawsuit. The pressure drop test will test the entire system and ensure the system is leak free, not only the line loosened or replaced. While the bubble test is outlined in the ANSI A119.2 RV Standard, it is used in conjunction with a pressure test of the entire piping system before the appliances are connected. Testing a single fitting with soapy water as the only leak test on the RV will work, but it can create liability issues; particularly if a leak is present in another location within the piping system and not found.

The electronic tester and the leak detector solution are great ways to locate leaks, once a leak in the system is identified. Even when the system has not been opened, the system should be tested for leaks at least once before each season. Testing for leaks is easy and requires very few tools.

4-1.4.1 Pressure Drop Test

To leak test the LP gas system, perform a pressure drop test with a dial or loop manometer shown in Figure 4-5. This pressure drop test is outlined by the RV Standard. Every leak test should be documented with the date, test results, and name of individual conducting the test on the service order or PDI form. The procedure is discussed below.

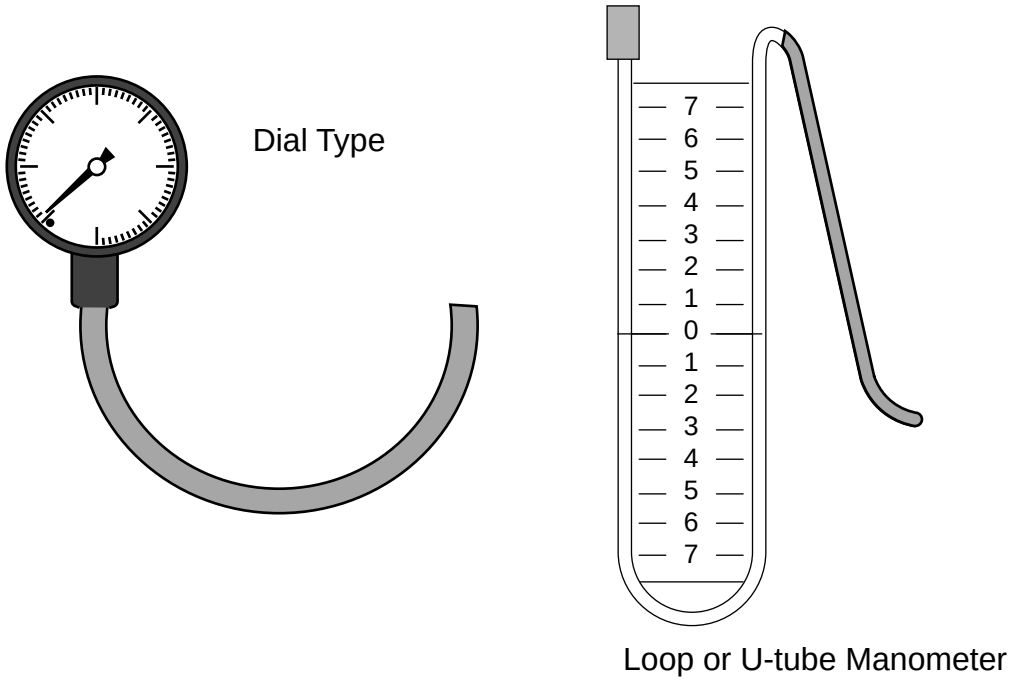


Figure 4-5 Type Manometers

1. After shutting off the gas valves on the range and other appliances, and all open pilot lights are also shut off, turn on the gas at the propane container by opening the service valve slowly, pressurizing the system, and listening to the regulator for sounds of escaping gas that could indicate an open gas line. Gas passing through the regulator when the service valve is first turned on usually makes a sound like “PFFFFT” until the regulator locks up. Once the regulator locks up, no sound should be heard.

2. Turn the service valve back off again at the propane container.

3. Attach a test gauge to a range spud. This is usually accomplished by removing a range burner, and using a gauge with a connection tube that pushes on to the spud fitting where the burner was removed. The gauge must be calibrated in minimum increments of 1/2 oz. or 1" of water column. Proper test equipment is essential to performing an accurate test. Test equipment gauges must be in good condition (e.g. returning to 0, cover in place and straight needles).

4. Pressurize the entire system to 10-14 in. water column (6-8 oz./sq. in.) and be sure it has equalized throughout the system. Shut off the source of pressure to the system.

5. While carefully monitoring the gauge at the range, open a range burner and reduce the pressure in the system to 9" water column(+ or - 0.5"). This prevents the appliance regulator from becoming a factor in the test.

6. Monitor the test for a minimum test period of 3 minutes, no pressure drop should be detected. If a pressure drop is noted, locate and repair the leak and retest until a successful test is obtained.

7. Document the test pressure on your work order. If testing at 7-3⁄4 inches W.C., document this pressure and the duration of the test on the work order. The RV Standard requires this test to be conducted for a minimum of 3 minutes (ANSI A119.2/NFPA 1192 paragraph 2-4.18.2). Using the manometer test, there should be no observable pressure drop during the 3-minute test. If a leak is observed, one method of discovering its location is with an electronic leak detector. If you don't have an electronic leak detector, use a liquid leak detector solution and apply the solution to every fitting in the system to find the leak.

Figure 4-6 shows a dial gage manometer connected at the range burner.

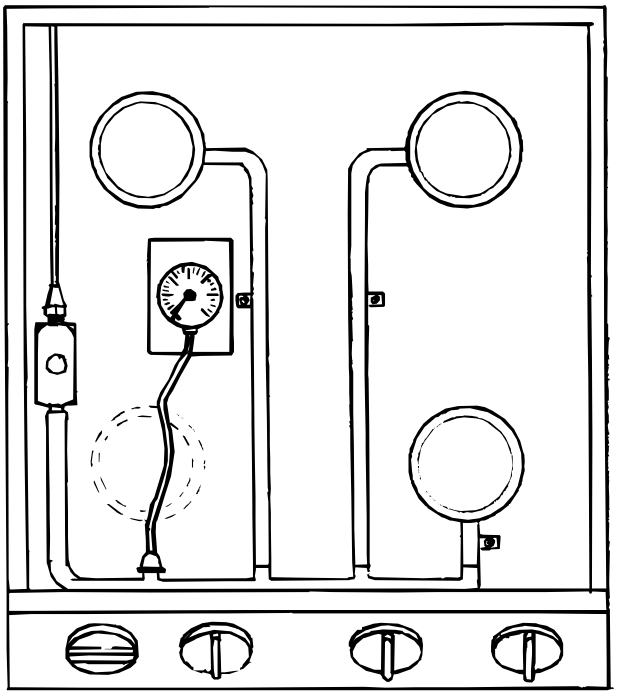


Figure 4-6 Manometer at Range Burner with Rangetop Off

4-1.5 Locating Piping Systems Leaks

4-1.5.1 Bubble Leak Test

After it has been determined a leak is present by using the pressure drop test outlined previously, a bubble leak test can be used to locate the leak. A bubble leak test can be performed with the system in its normal working condition, the appliances turned off, and the container service valve turned on. Simply use leak detector solution and apply it to each and every fitting. If a soap and water solution is used, the soap used must not contain any chlorine or ammonia, as these can

cause corrosion. Check the soap's ingredients before using it. Special leak detector solution is recommended and it is readily available. If a leak is present, the leak detector solution will bubble around the leaking fitting. Using two wrenches to prevent twisting the tubing or stripping the fittings, tighten the leaking joint to make the bubbles stop. Sometimes, simple tightening of the fittings will not correct a leak. If this is the case, the joint will need to be taken apart, old sealant removed (a steel brush works well), and new sealant applied. If working with tubing joints, the fitting assembly will need to be taken apart and inspected. It is possible the flare is bad, requiring it to be cut off and reflared. Also, be sure to examine the flare nut carefully. Older flare nuts can become brittle and could have cracked. Newer fittings are annealed (heat treated) to resist cracking, but always inspect the flare nuts when searching for a leak. Never use a match to find leaks in the LP gas system.

4-1.5.2 Electronic Leak Test

Leaks can also be located using an electronic leak detector. Use the electronic leak detector (shown in Figure 4-7) manufacturer's instructions to properly conduct testing. Some leak detector solution may cause an electronic leak detector to activate, indicating there is a leak. If using a leak detector solution, be careful about results you may obtain when using the electronic tester.

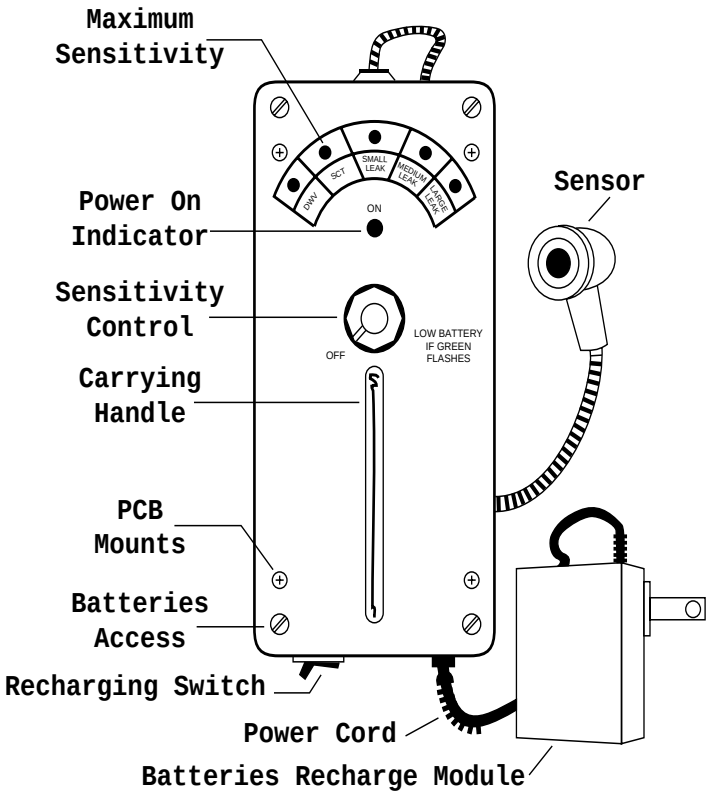


Figure 4-7 Electronic Gas Detector

4-1.6 Correcting Leaks in LP Gas Systems

Any leaks in the LP gas system must be repaired. The method used will depend on the material where the leak is present. Leaks in threaded connections of the iron manifold will often require the threaded connection to be disassembled, the old sealant cleaned off, and new sealant applied to the male threads and reconnected. Pinhole leaks at elbows or "Ts" of the iron manifold are

sometimes not at the threaded connection and can only be repaired by replacing the fitting. Leaks at flared fittings can often be corrected by simply tightening the flare (bonnet) nut. If this fails to correct the leak, remove the flare nut and reflare the copper tubing. Leaks resulting from cracked flare nuts can be repaired only by replacing the flare nut. Remember to retest the system after any leak is repaired to ensure that the fix has been successful .

4-1.6.1 Documentation of tests

Whenever you conduct a test of the LP gas system, it is important to document your work. This helps you show the work you did and it can also protect you in potential lawsuits. The following form gives you a single document for each RV that you test. All tests are outlined for your use.

4-1.6.2 L.P. System Check Information Checklist

Year, make, license, serial number of coach

_____

Manometer installed: (example: before regulator on range)

_____

_____

Pressure when tank turned on:

_____ " W.C.

Running pressure with 50% load on.

_____ " W.C. with _____

_____on. (appliances)

Adjusted pressure to:

_____ " W.C.

Lock-up pressure stops at:

_____ " W.C. after _____ minutes

Leak Check: Starting pressure: _____ " W.C.

Drop pressure to: _____ " W.C.

Pressure: _____ " W.C. after _____ minutes

Removal of manometer leak check: (how performed?) _____

_____

Service Tech Signature _____ Date _____

CHAPTER 4 REVIEW

1. Which of the following materials is not approved for use as LP gas piping?

   A. Steel

   B. Copper

   C. Brass

   D. Plastic

   E. Wrought or black iron

2. List the two approved materials for joining pipe connections.

   A.

   B.

3. Flare fittings are designed to be used without any sealant material.

   True False

4. LP gas systems should be checked for leaks once each year.

   True False

5. List the two methods of locating leaks in RVs.

   A.

   B.

6. ANSI A119.2 requires that a pressure drop test be conducted for a minimum of _____ minutes.

7. During the pressure drop test cited above, the pressure must be maintained at a nominal _____ or less W.C. for the minimum time frame.

8. The number of threads in a threaded pipe does not affect performance.

   True False

9. Copper tubing should be supported every _____ to prevent physical damage from vibration.

10. The two types of flare nuts approved for use in RVs are:

    A.

    B.

Chapter

5

RV LP Gas System Codes and Standards

5-1 Codes and Standards

Codes and Standards for Recreation Vehicles are contained in the document ANSI A119.2 Standard on Recreational Vehicles. This document contains chapters on Fuel Systems, Fire and Life Safety and Plumbing and references the National Electrical Code Section 551 for electrical requirements. All the requirements relating to LP gas systems are contained in the Fuel Systems chapter. The technician is encouraged to have access to these documents and to become familiar with standards applicable to the work he performs. Many of these standards have been mentioned in this document, where applicable. The following table summarizes applicable standards and is organized according to the task the technician is performing.

Table 5-1 A119.2 and NFPA 58 Requirements Applicable to RV Service Technician Document

Service Technician's Task	Code Reference	Summary of Requirement
Inspect, Adjust, Replace LP Regulator	2-2.7.6	Vent openings for regulators must be positioned within 45° of vertical downward.
	2-2.7.6	Regulator(s) must be equipped with a durable cover to protect the regulator vent opening from the elements.
	2-4.6	Single- or double-flare tubing joints of 45° are required by this standard.
	2-4.6	Paragraph 2-4.6 also restricts the use of sealants on flare joints.
	2-4.7	Thread lubricants, such as vaseline, may be used but only on the male threads.
	2-4.6	Compression type fittings must be listed as vibration resistant to be acceptable for use.

Table 5-1 A119.2 and NFPA 58 Requirements Applicable to RV Service Technician Document

Service Technician's Task	Code Reference	Summary of Requirement
Inspect, Repair, Replace LP Gas Piping System	2-4.2	Any defective gas tubing or piping must be replaced not repaired. Gas pipe shall be steel or wrought iron pipe complying with ANSI B36.10M. Also, copper tubing shall be type K or L and conform to ASTM B88.
	2-4.8	Where tubing passes through walls, floors, partition, etc., it shall be protected by snugly fitting weather resistant grommets.
	2-4.9	Pipe or tubing joints are restricted from being located in any wall, floor, partition or concealed construction.
	2-4.9	LP tubing located in storage areas below floor level must be protected.
	551-56(e)	Gas supply systems to be electrically bonded to the chassis by approved (listed) means.

Table 5-1 A119.2 and NFPA 58 Requirements Applicable to RV Service Technician Document

Service Technician's Task	Code Reference	Summary of Requirement
Testing LP Gas System Before Appliances are Connected	2-4.18.1	Requirements for this test, performed on the piping system without the appliances attached, are as follows: • The test shall be performed using a gauge with 1/10 psi increments or smaller (oz. are acceptable). • The entire gas system shall be tested up to but not including appliances. • Temperature of the air and piping shall be approximately the same at the beginning of the test and remain the same throughout the test period. • The system shall be pressurized to a minimum 3 lbs or 48 oz. • After pressurizing the system, the source of pressure shall be removed from the system. • During a 10-minute period, a drop in pressure shall not occur. • If leaks are detected, defective material shall be replaced not repaired. • If a bubble-type leak detector (Seek a Leak) is used, after a 10-minute equalization period, the detector shall not indicate any air flow for a period of 1 minute. • If a bubble-type detector (Seek a Leak) is used, a gauge must be used to assure a minimum test setting of 3 psi. • Test equipment shall not be damaged or defective.

Table 5-1 A119.2 and NFPA 58 Requirements Applicable to RV Service Technician Document

Service Technician's Task	Code Reference	Summary of Requirement
Testing the LP gas system with appliances connected	2-4.18.2	Requirements for this test are as follows: • All appliances shall be installed and connected to gas system prior to performing this test. • Temperature of the air and piping shall be approximately the same at the beginning of the test and remain the same throughout the test period. • The entire piping system shall be pressurized at 10 - 14 inches of water column (or 6 - 8 oz.). • The source of pressure shall be disconnected or turned off. • The appliance shut-off valves shall be closed. • Test the appliance connections with soapy water or bubble solution. Products that contain ammonia or chlorine shall not be used. • An alternate test allows a dial gauge or U-tube manometer to be used to perform the test. The gauge or manometer used must be capable of measuring in inches of water column or 1/2 oz. increments. • This requirement does not allow any drop in pressure during the 3-minute test period. • If a regulator is used downstream of the test pressure source, the system must be bled off to release any high pressure that may be trapped between the pressure source and regulator. This may be accomplished by opening a range burner until the manometer drops. • If the system requires bleeding off, a minimum test setting of 10 inches of W.C. must be maintained.

Table 5-1 A119.2 and NFPA 58 Requirements Applicable to RV Service Technician Document

Service Technician's Task	Code Reference	Summary of Requirement
		• Systems that monitor the test pressure by connecting the gauge to a range spud need to have the test pressure reduced to 8 inches of water column.

5-1.1 References

The following documents or portions thereof are referenced within this standard and shall be considered part of this document. The edition indicated for each reference is the current edition as of the date of the publication of this document.

ANSI Publications. American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036.

ANSI A119.2/NFPA 1192, Standard on Recreational Vehicles, 1999 edition.

NFPA Publications. National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

NFPA 58, LP Gas Code, 1998 edition.

Government Publications. U.S. Government Printing Office, Washington, DC 20234.

U.S. Department of Transportation, Specifications for LP Gas Containers.

ASME Publications. American Society of Mechanical Engineers, 345 East 47th Street, New York, NY 10017.

ASME, Boiler and Pressure Vessel Code, Section VIII, Division I, Rules for Construction of Unfired Pressure Vessels.

ANSWER KEYS

Chapter 1

1. True

2. False

   Ethyl mercaptan is added to commercial propane.

3. False

   Propane does, water boils at 212°F.

4. True

5. False

   Propane weighs 4.2 lbs. per gallon at 60°F.

6. False

   Propane expands as temperature is warmed, 1-1/2% for every 10°F.

7. True

8. 15.5 gallons. Propane weighs 4.20 lb. per gallon at 60°F (Table 1-1). Divide 65 (lb. capacity of ASME tank) by 4.20 (propane weight per gallon) = 15.476 rounded to 15.5.

9. 12,150 BTU. Using Table 1-3, a DOT cylinder at 50% full and at –5°F, the BTU vaporization capacity per hour is 12,150 BTU.

Chapter 2

1. POL plug or cap

2. B

3. C

4. Vapor withdrawal tube

5. 80% Full

6. B and D

7. False

8. False

9. C

10. A

11. Excess Flow Valve
12. 12, 5
13. False
14. 25
15. D
16. oily spot
17. By weight

    By container volume

Chapter 3

Technician Evaluation Regulators

1. A and C
2. D
3. C
4. Any two of the following:
    - When the outage valve is opened, there is a stream of liquid.
    - If you get a continuing draw of liquid into the regulator.
    - Any signs of oily material or an abnormal amount of dirt that might be stuck to old or oily material.
    - You may pick up residual odorant from around the relief valve area and be able to smell this on your hands.
5. The cover protects the regulator vent from being contaminated or plugged up.
6. 1. Adjustment spring
    2. Diaphragm Assembly
    3. Drip Lip Vent
    4. Relief mechanism
    5. Inlet
    6. Lever arm assemblies

Chapter 4

1. D

2. A. Pipe joint compound marked for LP gas use.

   B. Teflon tape

3. True

4. False

   The system should be tested at least once before each camping season and anytime the system is opened by loosening a fitting, removing an appliance, replacing a line, or leak is suspected.

5. A. Bubble leak test

   B. Electronic leak test

6. 3

7. 8 inches

8. False

9. 4 feet

10. A. Forged

    B. Stress-relieved

GLOSSARY OF LP GAS TERMS

AGA

American Gas Association—An agency involved in testing and listing gas fired appliances, controls and accessories. The "Blue Star," A.G.A. label states that the design of a labeled appliance "complies with national safety standards."

ANSI

American National Standards Institute—An organization that establishes criteria for the development of voluntary consensus standards concerning products and equipment.

ANSI A119.2/NFPA 1192

The Standard on Recreation Vehicles—This document contains the LP gas system requirements for recreation vehicles, along with other requirements.

ASME

American Society of Mechanical Engineers.

ASME Code

The Boiler and Pressure Vessel Code (Section VIII. "Rules of the Construction of Unfired Pressure Vessels") of the American Society of Mechanical Engineers. Only Division I of Section VIII of the ASME Code is applicable in this standard except UG-125 through UG-136 shall not apply. (NFPA 58)

ASME Tank

A container constructed in accordance with the ASME Code (NFPA 58).

Authority Having Jurisdiction

The organization, office, or individual responsible for approving equipment, an installation or a procedure (NFPA 58).

BTU

British Thermal Unit—A unit of energy. One BTU will raise the temperature of one pound of fresh water 1 degree F.

Butane

A hydrocarbon fuel gas heavier than methane or propane and a constituent of liquefied petroleum (LP) gas.

Container

Any vessel, including cylinders, tanks, portable tanks, and cargo tanks used for the transporting or storing of LP gases (NFPA 58).

Container Appurtenances

Items connected to container openings needed to make a container a gas tight entity. These include, but are not limited to, pressure relief devices (shutoff, backflow check, excess flow check valves) liquid level gauges, and plugs (NFPA 58).

Container Assembly

An assembly consisting essentially of the container and fittings for all container openings. These include shutoff valves, excess flow valves, liquid gauging devices, pressure relief devices, and protective housings (NFPA 58).

Cylinder

A portable container constructed to DOT cylinder specifications or, in some cases, constructed in accordance with the ASME Code of a similar size and for similar service. The maximum size permitted under DOT specifications is 1,000 lbs. (454-kg.) water capacity (NFPA 58).

Dip Tube

The vent stem of a DOT shutoff valve assembly that extends into the cylinder to the 80% full level. Excess liquid is vented through the ~~relief~~ bleed port. The length of the stem is marked on the guard of the container.

DOT

U.S. Department of Transportation.

Emergency Shutoff Valve

A shutoff valve incorporating thermal and manual means of closing and providing for remote means of closing (NFPA 58).

Ethyl Mercaptan

A sulfur compound (odorant) added to propane gas as a warning agent (NFPA 58, Paragraph 1-1.4).

Excess Flow Valve

(Also called Excess-Flow Check Valve)—A device designed to close when the liquid or vapor passing through it exceeds a prescribed flow rate as determined by pressure drop (NFPA 58).

Fahrenheit

The common scale of temperature measurement in the English system of units. It is based on the freezing point of water being 32°F and the boiling point of water being 212°F at standard pressure conditions.

False Container Pressure

The result of an improperly purged container, where air in the container is pushed to the top of the container and compressed, yielding an excessive pressure reading.

Fixed Liquid Level Gauge

A type of liquid level gauge using a relatively small positive shutoff valve and designed to indicate when the liquid level in a container being filled reaches the point at which this gauge or its connecting tube makes contact with the liquid in the container (NFPA 58).

Fixed Maximum Liquid Level Gauge (Outage Valve)

A fixed liquid level gauge, which indicates the liquid level at which the container is filled to its maximum permitted filling limit (NFPA 58).

Flexible Connector

A short, not exceeding 36 in. (1 m.) overall length, component of a piping system fabricated of flexible material (such as hose) and equipped with suitable connections on both ends. LP gas resistant rubber and fabric (or metal), or a combination of them, or all metal may be used. Flexible connectors are used where there is the need for, or the possibility of, greater relative movement between the points connected than is acceptable for rigid pipe (NFPA 58).

Float Gauge

A gauge constructed with a float inside the container resting on the liquid surface, which transmits its position through suitable leverage to a pointer and dial outside the container indicating the liquid level. Normally, the motion is transmitted magnetically through a nonmagnetic plate so that no LP gas is released to the atmosphere (NFPA 58).

Gallon

US Standard 1 US gal.

0.833 Imperial gal. = 231 cu. in.

3.785 liters (NFPA 58).

Gas

Liquefied petroleum gas in either the liquid or vapor state. The more specific terms “liquid LP gas” or “vapor LP gas” are normally used for clarity (NFPA 58).

High Pressure Connector

A connector designed to carry full container pressure.

High Pressure Hose

Also called pigtail, one end contains a POL fitting and the other end varies, depending upon application. This hose must be rated at 350-psi minimum.

Hydrocarbon

A compound found in LP gas, carbon monoxide, alcohol, cleaning solutions, hair sprays and other organic compounds. All of these compounds may activate an electronic leak detector.

Labeled

Equipment or materials to which has been attached a label, symbol or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation that maintains periodic inspection of production of labeled equipment or materials and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner (NFPA 58) (ex. CGA, AGA).

Liquefied Petroleum Gas (LP gas or LPG)

Any material having a vapor pressure not exceeding that allowed for commercial propane composed predominantly of the following hydrocarbons, either by themselves or as mixtures: propane, propylene, butane (normal butane or isobutane), and butylenes (NFPA 58).

Listed

Equipment or materials included in a list published by an organization acceptable to the authority having jurisdiction and concerned with evaluation of product and services that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states either that the equipment, material or service meets identified standards or has been tested and found suitable for use ~~in~~ for a specified purpose (NFPA 58) (ex. UL).

Lock-up

When the regulator seat is closed and there is no flow of LP gas. Lock-up should not exceed 14”water column for RV vapor systems.

Low-Pressure Hose

A connector hose that carries maximum of 1 psi and is to be used in connection with any gas source that usually carries low-pressure gas to appliances.

LP Gas System

An assembly consisting of one or more containers with a means for conveying LP gas from the container(s) to dispensing or consuming devices (either continuously or intermittently) and that incorporates components intended to achieve control of quantity, flow, pressure, or state (either liquid or vapor) (NFPA 58).

Manometer

An instrument used to measure air and gas pressure or vacuum. Its unit of measurement may be inches of water column (W.C.).

Methane

A hydrocarbon gas that is flammable, odorless and colorless with a chemical formula of CH 4 and is the principal component of natural gases.

Natural Gas

Mixture of approximately 94% methane, plus 6% other gases. Formed naturally below the earth's surface, it is tasteless, odorless, and colorless.

NFPA

National Fire Protection Association

NFPA 58

The LP Gas Code

Odorant Fade

Problem caused when the odorant that is added to propane (ethyl mercaptan) is not detectable as a warning agent. The proper purging of air from a new container or one that has been mistakenly left open will help prevent oxygen or rust in the container that may combine with the odorant and reduce the detectability. "Sniff test" your fuel when filling.

OPD

Overfilling Prevention Devices. (Previously known as stop fill devices). Devices which prevent filling of LP gas containers beyond the maximum 80% fill level.

Piping, Piping Systems

Pipe, tubing, hose and flexible rubber, or metallic hose connectors made up with valves and fittings into complete systems for conveying LP gas in either the liquid or vapor state at various pressures from one point to another (NFPA 58).

POL

(Prest-O-Lite) A fitting or cylinder service valve thread design produced by the Prest-O-Lite company used for connections at the cylinder valve. (Also known as CGA Type 510 connection or spud & nut).

POL Plug

A plug inserted into a DOT cylinder's service valve during transport or when the cylinder is not connected for service.

Portable Container

A container designed to be moved readily, as distinguished from containers designed for stationary installations. Portable containers, designed for transportation, filled to their maximum filling limit include "cylinder," "cargo tanks," and "portable tanks"; all three of which are separately defined. Containers designed to be readily moved from one location to another, but substantially empty of product, are "portable storage containers" and are separately defined (NFPA 58).

Pressure Relief Device

A device designed to open to prevent a rise of internal fluid pressure in excess of a specified value due to emergency or abnormal conditions (NFPA 58).

Propane

A liquefied petroleum gas (C3H8) a gaseous hydrocarbon of the methane series found in petroleum.

PSI, PSIG, and PSIA

Pounds per square inch, pounds per square inch gauge, and pounds per square inch absolute, respectively (NFPA 58).

Purging

A process of displacing the dehydrated air installed by the container's manufacturer from a container using propane vapor prior to its first filling.

Regulator, Automatic Changeover

An integral two-stage regulator that combines two high-pressure regulators and a second-stage regulator into a single unit. It incorporates two inlet connections and a service-reserve pressure indicator and is designed for use with dual or multiple cylinder installations. The system automatically changes the LP gas vapor withdrawal from the designated service cylinder(s) when depleted to the designated reserve cylinder(s) without interruption of service. The service reserve indicator gives a visual indication of the cylinder(s) that are supplying the system (NFPA 58).

Regulator, First Stage

A pressure regulator for LP gas vapor service designed to reduce pressure from the container to 10.0 psi (69 kPa) or less (NFPA 58).

Regulator, High Pressure

A pressure regulator for LP gas liquid or vapor service designed to reduce pressure from the container to a lower pressure in excess of 1.0 psi (6.9 kPa) (NFPA 58).

Regulator, Integral Two-Stage

A pressure regulator that combines a high-pressure regulator and a second-stage regulator into a single unit (NFPA 58).

Regulator, Second Stage

A pressure regulator for LP gas vapor service designed to reduce first-stage regulator outlet pressure to 14 in. W.C. (4.0 kPa) or less (NFPA 58).

Regulator, Single Stage

A pressure regulator for LP gas vapor service designed to reduce pressure from the container to 1.0 psi (6.9 kPa) or less (NFPA 58).

Remote Senders

An electrical device located in the float gauge assembly which transmits an electrical signal to an internal read out on the monitor panel located inside the RV that indicates the level of LP gas in the container(s).

Sight Gauge

A visual magnetic gauge responding to an internal float which indicates the approximate quantity of fuel in an LP gas container.

Slugging

A term used to describe the automatic closing of an excess flow check valve. The closing or "slugging" occurs when the liquid or vapor flow rate exceeds the excess flow valve's designed capacity.

Stop Fill Device

An overfilling prevention device that will prevent filling a container above the 80% maximum filling level.

Type 1 Valve

This is a CGA 791 valve that has 1 5/16-inch ACME threads on the exterior of the valve. The interior of the valve outlet retains the old POL left hand thread so that the cylinder can be filled with existing equipment. Connection to the valve is accomplished by attaching the mating vehicle side right hand threaded 1 5/16-inch ACME nut with a force applied by hands only; no tools are used for this connection.

Type 2 Valve

This is a CGA 810 valve that has an outlet of the quick connect type, requiring no tools or threads to complete the connection.

Two-Stage Regulator System

An LP gas vapor delivery system that combines a first-stage regulator and a second-stage regulator(s), or an integral two-stage regulator (NFPA 58).

Vapor Withdrawal Tube

An internal withdrawal tube, inside ASME tanks and all horizontal cylinders, that communicates with the vapor space at or near the highest point in the container when it is in the service position. The tube draws vapor from the tank to the regulator. In the RV industry, you may hear people refer to it as the riser or drop tube. It can be straight or "J" shaped.

Water Capacity

The amount of water in either pounds or gallons at 60°F (15.6°C) required to fill a container full of water (NFPA 58).

Water Column

Abbreviated as W.C. it is a unit measure used for expressing pressure. (27.7" W.C. = 1 P.S.I.)

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