



## **INVESTIGATION GUIDELINE**

**Revised 2004**

### **LIQUIFIED PETROLEUM (LP) GAS FUEL TRAIN**

#### **I. INTRODUCTION**

##### **A. Background Information**

Liquefied petroleum gas can be propane or butane, or a mixture of the two; in the United States it is primarily propane. These fuel gases are obtained from natural gas, or as a byproduct from the refining of oil. LP is transported by pipeline, railcars, or truck and stored in tanks. It is usually in areas in which natural gas is not available, as a reserve gas supply in some cities, and as the fuel for some engines.

LP-gas is stored under pressure in liquid form in tanks. As the fuel is drawn from the tank it vaporizes and is burned in the same way as other fuel gases. The specific gravity of gas is its weight compared to the same volume of air. The specific gravity of natural gas is 0.4 - 0.8 (compared to 1.0 for air). Thus, natural gas will rise when released into the air. The specific gravity of propane is 1.5 and of butane is 2.0. Thus, gasoline, propane, and butane will fall when released into the air and may accumulate in low spots creating a hazard if an ignition source is introduced.

The collection of LP gas in low areas may be one explanation for an increased risk of fire but the mechanics of storing LP gas and delivering it to the appliance may also play a role in added risk. Particularly, problems may arise if the fuel tank is overfilled and liquid flows to the burners. The pressure regulator, being outdoors needs some protection from water, ice, and snow. LP gas contaminated by water or chemicals while difficult to recognize, can affect the safety of the operating controls.

Information from investigations is needed to determine the probable cause of incidents involving LP-gas, which aspects of the LP system may be failing, and if failures occur, why they happen.



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### **B. Product Descriptions**

#### **1. Definitions and General Description**

This project encompasses LP-gas and all devices in contact with or regulating the gas from the dispenser at the filling location to the control valve on the appliance and all functions associated with these devices. It is limited to residential LP containers larger than one pound. Since failures in the LP system often manifest themselves at the appliance, assignments will be made of failures in appliances fueled by LP-gas as well as problems with the LP storage tank and delivery system. In the former case, the investigation should follow the guidelines for the particular appliance as well as that for the LP gas fuel train. The possibility that a problem at the appliance may be the result of a problem at the tank/cylinder or pressure regulator should be considered when conducting the investigation.

#### **Descriptions/Functions of Parts of LP System:**

**Pressure Regulator.** A device to reduce a high inlet pressure (as in a tank or cylinder) to a preset, lower pressure and maintain this pressure despite changes in inlet pressure, appliance demand and weather conditions. (See Figure 2 for details of operation.)

**Regulator Vent.** A hole or port in the pressure regulator which allows the regulator to "breathe and maintain atmospheric pressure on the regulator diaphragm." As the regulator operates, air is drawn into or pushed out of the vent. To protect the vent from becoming blocked by dirt, a screen is often installed in front of the opening. Most regulators use a "drip lip" vent to protect against water and snow by routing water away from the vent. (See Figure 2b.)

**Regulator Relief Valve.** A component designated to relieve the excess pressure that might build up downstream of the regulator. When the relief valve opens, gas is allowed to pass out of the regulator through the vent. (See Figure 3a.)

**Service (Cylinder) Valve.** Controls the flow of gas out of a tank or cylinder. (See Figure 3b.)

**Flow Limiting Device.** A component of the system that limits or interrupts the flow of LP in the event of a large leak. It could be an orifice or separate valve in the line that restricts the flow of gas.

**Pressure Relief Valve.** A device installed in LP containers to prevent over-pressurization. It may be a separate relief valve on the tank or may be incorporated into the service valve. If it is part of the service valve, the relief opening is generally opposite the LP withdrawal line.

**Fixed Liquid Level Gauge.** Used when filling a cylinder to indicate that the level of liquid propane is at the maximum design level (tank is full). This may be built into the cylinder valve. (See 3b.)



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**Overfill Prevention Device (OPD).** An OPD is required in all 20-pound cylinders. It works much like the float valve in a toilet; when the propane reaches a preset level, it closes to prevent the cylinder from being overfilled.

### **Specific Items of Interest**

If the LP cylinder is filled away from its "use" location you may want to visit the location where it was filled to observe filling practices. For tanks filled at the customers' homes, it is important to learn whether the tanks are filled in a pre-arranged cycle or whether the filling takes place on request.

### **Headquarters Contact**

Donald Switzer

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## **II. INSTRUCTIONS FOR COLLECTING SPECIFIC INFORMATION**

### **A. Synopsis**

Describe the problem in the LP-gas delivery train, and its consequence to the gas appliance and to anyone affected.

**For data retrieval from the computer, please make sure the following key words are used in the free text summary as appropriate: LP-gas, gas leak, fire, flexible connector, pressure regulator, propane fuel, drip leg, contamination, control valve, fuel tank, and (specific appliance).**

### **B. Description of Incident Environment**

- Provide a general description of the building involved including age, and use.
- Indicate the location of the LP-fuel tank/cylinder and the pathway the gas takes to fuel the appliance up to the control valve.
- Describe the climate conditions at the time of the incident or any weather that affected the incident, i.e., icing of pressure regulator and whether installed with proper protection. Determine whether any past or present flooding blocked regulator vent or affected valves.
- Specify whether combustible materials had a role in the incident, and how?
- If the incident involves a gas grill, determine where the flames originated.



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- If the incident involves a grill, describe any sound the consumer heard prior to the fire or explosion. Was there a hissing, or a popping sound? What did the flames look like and how large were they? Big gentle flames indicate a low pressure leak, whereas hard flames like a propane torch indicate a pressure leak.

### **C. Description of Interaction between Injured Person(s) and Product**

- State the nature of the hazard (fire, CO, explosion, leak, potential, none).
- For incidents involving gas leaks, was an odor detected.
- Give the date of the incident and the location of the problem.
- Describe the events leading to the incident including any pre-existing problems.
- If incident involved relighting - indicate who relit the pilot, the person's familiarity with lighting instruction, and whether instructions are displayed on the appliance. Report how often the appliance has been re-lighted in the past year, and in the past month. If relighting has been frequent, try to determine the reason, i.e., gas turned on in vacation home only during occupancy, unexplained pilot outage, etc.
- Indicate the extent and value of any damage.
- Provide information on the number of persons exposed to the hazard and the number of victims. For each victim indicate the age, sex, severity of injury, and any competence-reducing factors.
- Indicate perception of the hazard and familiarity with LP system, and with the appliance.
- Detail any human reaction that had a bearing on the incident or the outcome.

### **Description of Product**

#### **LP System Components:**

##### ***LP Tank/Cylinder***

- Describe the tank or cylinder as to capacity, age, general condition, effects of weathering, and evidence of corrosion or leaking.
- Record all markings on the cylinder.



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- Note the number and type of appliances that use the LP fuel.
- Indicate whether tank/cylinder was overfilled and if so, what resulted.
- Detail filling practice including location of refilling, frequency, steps taken to prevent overfilling (weight measurement, automatic fill limiting devices), who does the filling and the training of that person, who relights the appliances.
- Note type of service. Is refilling done on routine basis or does consumer call for service?
- Identify gas supplier and the out-of-gas procedure. Note how often customer ran out of fuel in past two years.
- For two-cylinder service, indicate whether switch over is automatic, or requires action by the customer.
- In cases where cylinders are taken to a refilling center, describe the operation of this facility and the care exercised in preventing overfilling, and contamination of the gas.
- Describe the pressure regulator as to manufacturer, installation configuration, orientation of the vent opening, protection from weather, presence of a drip lip (see Figure 2b), and evidence of leakage or clogging. Photograph the regulator and record all markings.
- Note whether connection between cylinder valve and regulator are tight and free of leaks.
- For tank pressure relief valves, indicate the venting location, and whether improper sizing, or corrosion, or leakage is a problem.
- Describe any flow-limiting device. (See Descriptions/Function.)

### ***Connections between LP Tank and Appliance***

- For appliance connector valves specify the construction, material, turn direction, and any failure of grease seals or leakage.
- For flexible connectors note material of tubing and coating and any evidence of ruptures or corrosion. Record data on metal band around the connector. If there



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was a leak in the flexible connector follow Guidelines for Flexible Connectors. Be careful not to move or disturb the connector.

- For flexible connectors, determine the thread, type, size, and direction. Indicate the presence of drip legs (sediment traps) and the use of pipe joint compounds.
- For rigid piping, state material (i.e. copper, galvanized, black pipe) and whether there is a drip leg/sediment trap in the piping to the appliance.

### **Appliance:**

- Identify appliance involved by brand name, age, and any characteristics relative to the incident. Use Guidelines for individual appliance, as appropriate. Copy all information on tags or labels.
- Indicate what servicing was needed during the prior year.

### ***Control Valve/Pilot***

- If current incident involves re-lighting an appliance, ask the victim to indicate the exact steps taken to re-light and how many attempts were made to re-light before success or problem resulted.
- Specify any difficulties with the control knob; include ease or difficulty turning knob whether knob sticks, whether any tools were used to turn the knob.

### **E. Other**

No guideline can cover all factors you may encounter. Please include any additional information you believe appropriate.

### **III. Photographs / Diagrams of Incident Scene**

- Photograph the fuel tank, the pressure regulator, the relief valve, and any area of special interest.

### **Obtaining samples and documents related to the investigation**

- Engineering would be interested in failed pressure regulators, flexible connectors, and relief valves. Contact Donald Switzer about sample collection.



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- Obtain any official or other reports from engineers, fire service, and insurance companies.
- Note opinions of cause of incident from any outside investigators.