

Handling Propane Fuel

LESSON 8

UNIT: PROPANE

PROBLEM AREA: PROPANE USE IN AGRICULTURE



STUDENT LEARNING OBJECTIVES

Instruction in this lesson should result in students achieving the following objectives:

1. Explain the design, marking, filling, and inspection of propane bottles or cylinders.
2. Describe propane delivery, from production to the consumer.
3. List the regulatory agencies that monitor the propane gas industry.
4. Describe the disposal and exchange of bottles or cylinders.

NATIONAL SCIENCE STANDARDS ADDRESSED IN THIS LESSON

All students should develop an understanding of:

Physical Science: Content Standard B

- Structure and properties of matter

LIST OF RESOURCES

The following resources may be useful in teaching this lesson:

- propane101.com/propanecylinders.htm
- propane101.com/understandingpropanetanks.htm
- Energy.gov

LIST OF EQUIPMENT, TOOLS, SUPPLIES, AND FACILITIES

- Copies of sample test
- Visuals from accompanying masters
- Copies of student lab sheet

TERMS

The following terms are presented in this lesson (*shown in bold italics throughout the lesson*):

1. ASME
2. DOT
3. EPA
4. data plate
5. fill valve
6. float gauge
7. foot ring
8. liquid withdrawal valve
9. metal collar
10. OSHA
11. propane bleeder valve / fixed level gauge
12. regulator
13. safety relief valve
14. service valve
15. sleeve
16. vapor return valve

TELL STUDENTS...

"Today you will be learning more about gas bottle and cylinder design. In addition, you will be expected to trace the route of delivery from the production facility to the consumer. You will also be required to list regulatory agencies that monitor the propane gas industry and to describe the disposal and exchange of propane bottles or cylinders."

INTEREST APPROACH

Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible interest approach is included here.

1. Discuss how propane is used in the home. Ask if any of the students have ever seen or handled a propane tank. If so, what parts did they see on the tank? Did they know the role of each part?
2. Ask the students if they have heard about or witnessed any accidents caused by propane, natural gas, or other gases. Let students share their experiences.
3. Lead the class to explore why these accidents occurred and what could have been done to prevent them. Ask the students how they think propane should be handled.

Summary of Content and Teaching Strategies

OBJECTIVE 1

Explain the design, marking, filling, and inspection of propane bottles or cylinders.

ANTICIPATED PROBLEM

What are the components of propane bottles, cylinders, and tanks? What is the purpose of each part? What is the difference between a bottle, a cylinder, and a tank?

The design, marking, filling, and inspection of propane bottles, cylinders, and tanks are oriented around the single objective of safe storage, removal, refilling, and use of propane. Propane containers consist of redundant systems – coupled with markings – in more than one location that provide necessary information multiple times. For safety purposes, each bottle, cylinder, and tank is regularly submitted for an intensive inspection procedure.

- A. Bottles and cylinders are tanks designed for personal use and transport (e.g., for machine operation, grills, or blowtorches). All propane storage containers are generally considered “tanks,” but bottles and cylinders typically have fewer valves and gauges than tanks.
- B. Design:
 1. Propane Bottle and Cylinder Design
 - a. General design: Propane bottle and cylinders are simply metal tubes capped at both ends that can hold materials at high pressure. All containers must meet stringent safety guidelines.
 - b. A propane cylinder must have a **foot ring** and a **metal collar**. The foot ring ensures that the propane container remains upright, as it will not function properly or safely when it is on its side. The collar protects the valves located on the top of the cylinder and prevents them from being sheared off, which can create projectile hazards.
 2. Valve and gauge design
 - a. **Safety relief valve** – The safety relief valve is kept closed by a powerful spring. If the condition in the cylinder changes and pressure builds to a dangerous point, the relief valve is pushed open and the excess pressure can be heard hissing as it escapes. When the pressure returns to normal, the valve will close.
 - b. **Propane bleeder valve/fixed level gauge** – The propane bleeder valve, or fixed level gauge, is the only completely accurate measure of the propane level in a cylinder when it is being filled. It is connected to a narrow tube that extends exactly 20 percent of the way into the cylinder. As a result, when the cylinder is 80 percent full, it will release and let the filling technician know that the maximum capacity has been achieved. Some people believe they lose propane and money when it activates, but the total loss in a normal fill typically amounts to less than 10 cents.
 - c. **Vapor return valve** – The vapor return valve is used during the filling process. When a cylinder is being filled, a hose connects the vapor return valve to the delivery truck and siphons off excess vapor in the cylinder so it can be filled with more liquid.
 - d. **Liquid withdrawal valve** – The liquid withdrawal valve is used to completely empty a propane cylinder before it is transported or moved.
 - e. **Float gauge** – The float gauge consists of an air-filled capsule attached to a rod inside the cylinder. The float moves higher or lower according to the level of liquid in the cylinder and provides an approximate measure of the remaining liquid.
 - f. **Fill valve** – The fill valve is connected to a hose that is used by the propane technician during truck to tank delivery.
 - g. **Service valve** – The service valve provides the propane to the rest of the system and has a simple faucet-style hand wheel that controls the flow of propane from the cylinder into the attached hose.
 - h. **Regulator** – The regulator is often considered the heart of a propane gas system. It receives gas from the tank and controls the flow and distribution of the gas to the rest of the system. Most importantly, the regulator lowers the pressure of the gas so it can be used in residential applications.

C. Marking

1. Data plate:

- a. Data plate information – All propane cylinders are required to have a **data plate** that specifies important information. By law, a cylinder without a data plate or with a corroded or otherwise illegible data plate cannot be filled. While valves and connections can be replaced, a cylinder without a data plate or with an illegible data plate must be immediately decommissioned. A data plate must contain the following information:

- Service type (above or underground)
- Manufacturer’s name and address
- Water capacity in gallons or pounds
- Design pressure (working pressure) in psi
- “This container shall not contain a product that has a vapor pressure in excess of ___ psig at 100°F.”
- Outside surface area in square feet
- Year of manufacture
- Shell and head thickness
- Overall length (OL), outside diameter (OD), and head design (HD)
- Manufacturer’s serial number
- ASME code symbol

2. Sleeve:

- a. Sleeve information – The propane sleeve can cover a variety of information, but it is not a replacement for the data plate. The sleeve will typically carry information about storage, usage, safety, and other general advice to make residential propane use easier.

- b. Sleeve problems – Although cylinder sleeves instruct the owner to “remove the sleeve before use,” the advice is rarely followed. Propane cylinder sleeves are made of shrink-wrapped plastic. Any moisture between the sleeve and the cylinder is trapped and can condense when the propane cools during use. Moisture between the sleeve and the metal cylinder will invariably corrode the cylinder and damage its integrity, posing a serious safety hazard. Therefore, all sleeves should be removed immediately after cylinder purchase.

3. Painting – Many consumers think the larger residential tanks are ugly and are tempted to paint them in a creative fashion. This, unfortunately, can cause a loss of money and safety. Propane tanks are painted with a reflective coating so they do not absorb heat. People who paint their tanks – especially with dark colors – will lose propane through the relief valve as it expands under the heat and may suffer a breach in integrity.

- D. Many people choose to have their small propane cylinders filled by qualified individuals at propane refueling stations rather than exchanging them at available locations. Propane dealers frequently fill the 20-pound tanks used for gas grills. Cylinders are usually filled by bleeder valve, but they can be filled by weight.

E. Inspection:

1. Inspection overview – An inspection occurs whenever a cylinder is refilled by a technician at a residence or at a local filling station. Propane cylinders must be inspected regularly to make sure they are safe for continued use.
2. Inspection procedure – The filling technician will examine the cylinder for cracks or leaks, bulging, major denting or gouging, defective valves, leaking pressure relief valves, damage to the cylinder valves or foot rings, evidence of abuse, and requalification dates.

SUGGESTED TECHNIQUES TO HELP STUDENTS MASTER THIS OBJECTIVE

1. Use **VM-A** through **VM-K** to illustrate the parts of a propane cylinder.
2. If propane tanks are in use at school, point out the parts to students. Do not bring any cylinders larger than 1 pound into the classroom.
3. Use **LS-A** to show why decreased reflectivity caused by painting a propane tank can cause a loss of money and safety.

OBJECTIVE 2

Describe propane delivery, from production to the consumer.

ANTICIPATED PROBLEM

What supply chain does propane follow to reach the consumer?

After natural gas is removed from the ground, it is transported to a treatment plant where impurities are removed and the gases (e.g., propane) are separated.

- A. Once treated, the propane travels to a large underground storage facility.
- B. From the storage facility, the propane is distributed across the country through pipelines and by rail.
- C. When the propane reaches the pipeline terminal, or rail yard, it is loaded onto large bulk trucks or used to fill cylinders that are loaded onto trucks.
- D. The cylinders are loaded onto trucks and then sent to grocery stores, gas stations, and other exchange locations. The bulk trucks are sent homes, farms, and cylinder filling operations.

SUGGESTED TECHNIQUE TO HELP STUDENTS MASTER THIS OBJECTIVE

1. Use **VM-L** to help students trace the propane production and distribution system.

OBJECTIVE 3

List the regulatory agencies that monitor the propane gas industry.

ANTICIPATED PROBLEM

Which agencies regulate the usage and distribution of propane?

The propane industry is monitored by the following regulatory agencies.

- A. Environmental Protection Agency (EPA) – The **EPA** monitors the effects of propane and propane disposal on the environment.
- B. Department of Transportation (DOT) – The **DOT** monitors the transportation of propane, as well as the design and use of propane cylinders.
- C. Occupational Safety and Health Administration (OSHA) – **OHS**A monitors safety practices of propane workers and ensures that all of the safety devices approved by the American Society of Mechanical Engineers (ASME) are used properly.
- D. American Society of Mechanical Engineers (ASME) – **ASME** promotes the art, science, and practice of mechanical and multidisciplinary engineering and allied sciences around the globe.

SUGGESTED TECHNIQUES TO HELP STUDENTS MASTER THIS OBJECTIVE

1. Before covering this objective, write the acronyms on the board.
2. Give the students five minutes to write the complete name of each agency and its role.
3. Collect their writings to see where they are in terms of knowledge. Explain each agency and its role in the regulation of propane.

OBJECTIVE 4

Describe the disposal and exchange of bottles or cylinders.

ANTICIPATED PROBLEM

What are the correct methods for exchanging or disposing of bottles or cylinders?

Propane tanks and cylinders can be refilled many times. Rules for the disposal of containers vary from state to state.

- A. Exchange – An empty propane cylinder can be taken to almost any grocery store, convenience store, or gas station where, for a minimal fee, it can be exchanged with a filled tank. The empty cylinder is then refilled and purchased by another consumer.
- B. Disposal – A customer may keep a propane cylinder that is no longer fit for service, but the safest option is to leave it with the company that condemned it. Many scrap yards will not accept propane tanks of any size because of residual gas hazards.

SUGGESTED TECHNIQUE TO HELP STUDENTS MASTER THIS OBJECTIVE

1. The proper disposal of tanks is vitally important. Ask the students to explain how to dispose of an obsolete tank.

REVIEW/SUMMARY

Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used in determining which objectives need to be reviewed or taught from a different angle. The anticipated problems can be used as review questions.

APPLICATION

Use the included visual masters to apply the information presented in the lesson.

EVALUATION

Evaluation should focus on student achievement of the objectives for the lesson. Various techniques can be used, such as student performance on the application activities. A sample written test is provided..

ANSWERS TO SAMPLE TEST

Use the included lab sheets to apply the information presented in the lesson.

PART ONE: MATCHING

1. b
2. e
3. d
4. a
5. c

PART TWO: SHORT ANSWER

1. Sleeves can trap water and rust the tank.
2. An empty tank or one that is no longer used can be taken to a local exchange station for filling or disposal..

PART THREE: COMPLETION

1. Reflective/Light-Colored
2. Junkyards/Waste Facilities
3. Pipelines and Rail Cars
4. DOT
5. Weight

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PART ONE: MATCHING

INSTRUCTIONS: Match the term with the correct definition.

- a. regulator outlet
- b. propane bleeder valve / fixed level gauge
- c. data plate
- d. float gauge
- e. safety relief valve

- _____ 1. The only completely accurate measure of the propane level in a cylinder when it is being filled
- _____ 2. A device that lets out extra pressure in a propane tank
- _____ 3. A device that provides a rough estimate of the amount of propane left in a tank
- _____ 4. A device that provides the propane to the rest of the system
- _____ 5. A required item that specifies important information

PART TWO: SHORT ANSWER

INSTRUCTIONS: Provide a short written answer to the following questions.

1. Why should consumers remove the plastic sleeves from propane cylinders after they have read the information on them?

2. What should you do with propane tanks that are empty or no longer used?

PART THREE: COMPLETION

INSTRUCTIONS: Provide the word or words to complete the following statements.

1. Propane tanks are normally painted with a(n) _____ coating to keep heat from being absorbed by the tank.
2. Most _____ will not accept propane tanks for disposal because they cannot be sure that the tanks are empty.
3. Propane is transported through _____ from an underground storage facility to regional distribution centers.
4. The _____ monitors the transportation of propane.
5. Propane tanks can be filled by bleeder valve or _____

Safety Relief Valve



Propane Bleeder Valve



Vapor Return Valve



Liquid Withdrawal Valve



Float Gauge



Fill Valve



Service Valve



Regulator



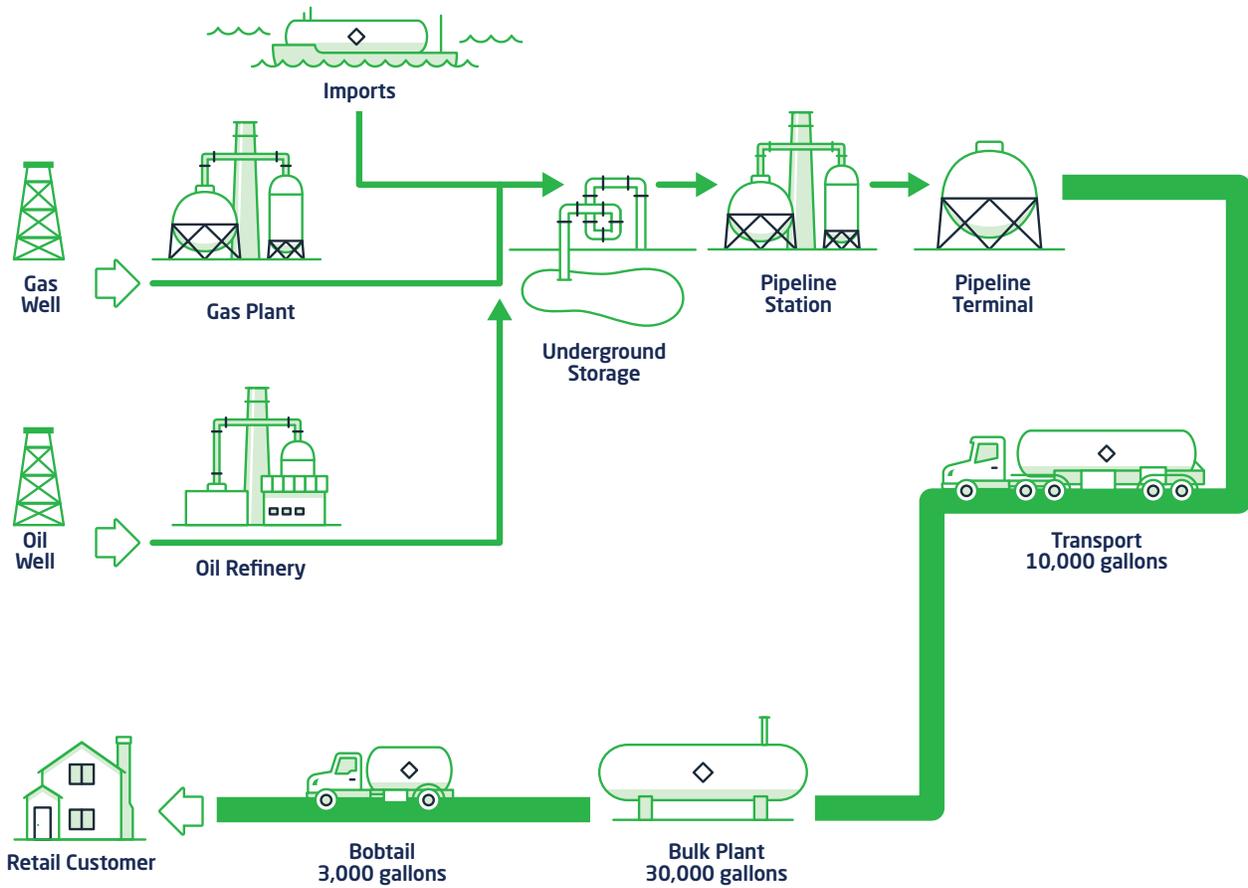
Data Plate



ASME Symbol



Propane Production and Distribution System



Increased Pressure Under Heat

PURPOSE

The purpose of this activity is to demonstrate why painting a propane tank is dangerous.

OBJECTIVE

Compare the effects of color and reflectivity on the absorption of energy and pressure buildup.

MATERIALS

- VM-M
- VM-N
- VM-O
- One water bottle painted matte black
- One water bottle painted glossy silver
- Two water balloons
- One heat lamp
- 100 mL water

PROCEDURE

1. Put 50 mL of water in each bottle.
2. Blow up each balloon to loosen it, and then deflate it.
3. Attach each balloon to the top of a water bottle, keeping each balloon deflated.
4. Place the bottles about 6 to 8 inches away from the heat lamp (or in direct sunlight on a sunny day). Compare your setup with the example in **VM-N**.
5. Observe the expansion of each balloon. Compare your results with the example in **VM-O**.

FOLLOW-UP QUESTIONS

1. Why was it important to put the same amount of water in each bottle?
2. Which bottle absorbed the most heat?
3. Why did one bottle become hotter than the other?
4. What was in the balloon of the hotter bottle?
5. Explain, based on your observations, why propane cylinders should not be painted.

Materials



Setup



Results

