INTRODUCTION
Propane or liquid propane gas (LPG) is a colorless odorless flammable gas used in cooking, heating and power generation. The odor of propane is from an added odorant. Commercially available "propane" fuel, or LPG, is not pure. Typically in the United States and Canada, it is primarily propane (at least 90%), with the rest mostly ethane, propylene, butane, and odorants including ethyl mercaptan. It has a relative gas density of 1.5 (Air is 1). Propane gas is denser then air and when release will have a tendency to sink. In an enclosed area a buildup of propane can lead to a fire or explosion.

If propane leaks into the ambient air the lower explosive limit (LEL) can be reached. As the figure below illustrates if the ambient air has 2.15 % propane then a flash fire or explosion can occur. This explosive range extends up to 9.6%. Above 9.6 percent too much oxygen has been displaced for the gas to ignite. However if propane is present above 9.6 % the act of airing out a room or area can bring more oxygen into the area decreasing the propane concentration into the flammable range leading to a fire or explosion. Propane is stored and transported in steel tanks or cylinders. The compressed gas that is released from the storage vessel is very cold, so cold that it can lead to frostbite on exposed skin.

The physical properties of propane include a low flash point (-155oF); Boiling point (-44oF) and Freezing point (-305oF).

Small Propane Cylinder Safety
Propane cylinders come in a variety of sizes, from 10 to 100 pound. Below is an illustrations of the most common small size cylinders; i.e. cylinders that can easily be transported. Disposable propane cylinders are covered in a separate guidance document.
Cylinder Valves

Prior to 1994, propane cylinder valves had a left hand thread (counter-clockwise). Since 1994, propane cylinders have been designed with a right hand thread (clockwise) or a quick disconnect device. Effective April 1, 2002 Washington State adopted a requirement that all propane cylinders with a capacity of less than 40 pounds must have an Overfill Protection Device (OPD). An OPD is a safety feature that helps prevent small propane cylinders from being overfilled. An overfilled cylinder doesn't have enough space left if the liquid expands when exposed to warmer temperatures. This can cause an increase in cylinder pressure and create potentially hazardous conditions. All propane cylinders without an OPD are prohibited from being refilled by anyone. The OPD serves as a safety shut-off device and prevents overfilling of propane cylinders to avert propane release, fire and possible injury. Propane cylinders equipped with an OPD have the letters “OPD” stamped on the valve hand wheel and on the side of the valve. Most propane cylinders with a triangular valve wheel have an OPD. Propane cylinders with a round or star-shaped valve wheel usually do not have an OPD.
What valve did the OPD replace on small cylinders (less than 40 pound size)

- POL Valves
- ACME Valves

STORAGE OF SMALL PROPANE CYLINDERS
- **NEVER** store or place a propane cylinder indoors or in an enclosed area such as a basement, garage, shed, or tent.
- **NEVER** store or place a propane cylinder in an area of excessive heat (120 degrees or higher) or near a stove, fireplace, or other heat source. The heat builds up pressure inside the cylinder, which may cause the pressure relief valve to release propane. Flash fires or explosions can result from exposing cylinder to heat.
- **NEVER** store or place a spare cylinder under or near a barbecue grill.
- **DO NOT** smoke or have any ignition sources such as flames or spark producing electrical tools in the area while handling or transporting cylinders.

TRANSPORTATION OF SMALL PROPANE CYLINDERS
- **ALWAYS** transport and store a cylinder in a secure and upright position in order that the safety release valve will function properly and so it will not fall, shift, or roll.
- **ALWAYS** close the cylinder valve and, if required, seal with a plug, even if the cylinder is empty.
- **NEVER** keep a filled cylinder inside a hot vehicle or transport it inside a closed trunk.
- **ALWAYS** place the cylinder in a well-ventilated part of the vehicle.
- **ALWAYS** proceed directly to your destination and immediately remove the cylinder from your vehicle.

CYLINDER USE
- Check hose connections for leaks by brushing a 50% liquid dish soap and 50% water solution onto all hose connections and valves. Bubbles indicate a leak. If you encounter a leak, shut off the propane at the tank, if it’s safe to do so, tighten hose connections and check again for leaks using the dish soap and water solution. Never use matches or lighters to check for leaks.
- Inspect the propane cylinder for cuts, gouges, dents and rusting and replace if necessary.
- Propane Cylinders must be “in date”. A tank’s manufacture date is stamped into the collar of the tank. It is in this format: 05-12. A tank is in compliance for twelve years from the original manufacture date. So a tank manufactured in 05-12, is good until 05-24. If a tank is out of date, you have a couple of options: you can have it re-qualified (definitely worth it for any size tank besides BBQ tanks) or if it is a BBQ sized tank (5 gal/20 lb.) you can exchange it. Re-qualifying a tank certifies it for another five years. When this is done the date stamp with have an “E” at the end of it: 05-12E. A tank can only be re-qualified three times. After that, it must be recycled.
NEVER use a damaged cylinder or one that has been in a fire.

Remember, empty propane cylinders are equally as dangerous as full cylinders and the same safety precautions must be followed. NEVER attempt to disassemble or cut open a propane cylinder, which could result in an explosion and flash fire.

Propane cylinders are painted a light or reflective color to reduce heat absorption from the sun, which increases the internal pressure within tank. Never paint a propane cylinder a dark color.

DO NOT UNDER ANY CIRCUMSTANCES TRY TO MODIFY OR REPAIR VALVES, REGULATORS, OR OTHER CYLINDER OR APPLIANCE PARTS.

Propane cylinders incorporate special components such as valves, connectors, and other parts to keep them safe for use with grills and other propane appliances. Damage to any component can cause a gas leak. DON’T RISK IT!

INDUSTRIAL PROPANE BOTTLES/ FORKLIFT CYLINDERS OPERATION

Propane powered forklifts primarily use 33 pound cylinders as their fuel source and are equipped for liquid service. Larger forklifts can use the 40 pound cylinders as their fuel source. Because the cylinders are designed for liquid service, they have to be placed properly on the lift truck to operate correctly. Improper cylinder installation can result in loss of power and eventually complete loss of engine functionality. Although industrial propane cylinders are within the 4-40 pound class, they do not require OPD valves in order to be refilled. When a 33 pound forklift cylinder is properly mounted on a lift truck, it will generally provide around 8 hours of continuous operation. Forklift propane tanks are designed to be mounted on their side. An illustration of a forklift propane tank is presented below.
RECOMMENDED PRACTICES:

- Do not leave LPG-powered trucks near heat sources, stairways, exits, or other egress areas.
- When parking LPG-powered trucks for a long period of time, turn the service valve off.
- Only trained and authorized personnel should replace LPG containers.
- Propane tanks should not extend past the rear overhead guard supports.
- Follow proper procedures for storing and handling liquid petroleum gas. [29 CFR 1910.110]

SAFE FUELING

Those employees responsible for filling propane tanks must undergo safety training for safe fueling. This training can be through an outside vendor or through EH&S. Documentation of training must be kept on file.

Responsible employees must:

- Wear proper personal protection equipment.
- Understand the regulations, routine inspections, and operation of the dispensing equipment.
- Inspecting containers to ensure that they are safe for filling; no defects, within date, OPD present.
- Fill containers to their proper levels and preventing containers from being overfilled.
- Do not refuel LPG-powered trucks in confined areas where LPG vapors could collect if a leak occurs.
- Shut down and secure the dispenser in the event of an emergency.
- Keep ignition sources at least 25 feet away from any placarded vehicle carrying hazardous materials and propane tanks during fueling.

PROPANE DELIVERY

A metered bobtail propane delivery truck must be attended by a qualified person at all times while being loaded and unloaded. If a bobtail is unattended, it must be shut down and disconnected.

During loading and unloading, the qualified attendant must:

- Remain within 150 feet of the cargo tank.
- Remain within 25 feet of the delivery hose.
- Have an unobstructed view of the cargo tank and delivery hose, except when necessary to use controls or monitor the receiving container.
- If an unobstructed view is not possible, observe both the cargo tank and the receiving container at least once every five minutes when the internal self-closing stop valve is open.

In the event of an emergency during loading or unloading, all bobtails must be equipped with a means of immediately shutting down the transfer of propane. This includes an off-truck remote to control the self-closing stop valve, and shutoff motor and auxiliary power equipment. This remote must function reliably at a minimum of 150 feet.

Follow these steps to determine the total fill weight of a cylinder:

- Look for the water capacity (WC) and tare weight (TW) mark stamped on each cylinder or its protective collar.
- Water capacity is the amount of water, in pounds, that the cylinder will hold when the container is filled to its maximum capacity.
- Tare weight is the weight of the empty container, including the cylinder valves.
- Determine the propane capacity from a conversion table. If you don’t have access to a conversion table, you can determine the propane capacity by using this formula:
WC(lb) x .42 = propane capacity (lb)

For example, if a particular cylinder has a water capacity of 80 lb; it can safely hold 33.5 lb of propane.
The calculation is: 80 lb X .42 = 33.5 lb of propane.

- Add the cylinder’s tare weight, maximum propane capacity, and the
- weight of the filling hose or nozzle. The sum of these three weights
- determines the scale’s set point.
- Set the scale to this weight and begin filling the cylinder. As soon as
  the filling weight reaches the scale’s set point, immediately stop the
  filling process.

**Follow these steps when filling cylinders by volume:**

- Open the appropriate liquid outlet and by-pass return valves on the
  cargo or storage tank as necessary.
- Open the vent valve on the fixed maximum liquid level gauge to check the level of propane in the
  cylinder.
- Connect the hose to the filling connection such as the filler valve or service valve as appropriate.
- Start the pump and slowly open the valve on the end of the hose.
- Open the service valve on the cylinder if filling through this connection.
- When a white mist appears from the fixed maximum liquid level gauge, immediately close the
  hose end valve.
- Close the cylinder service valve (if using this connection to fill), disconnect the hose, and store it
  properly.
- Check the cylinder for leaks and apply any DOT or hazard warning labels as necessary.

**Grilling Safety Tips**

Propane tanks make grilling easy and convenient. In most cases, grilling is a pleasant way to spend a
summer evening or weekend outdoors with family and friends. There have been few problems with
propane tanks in these situations, but the potential for problems exists, as it does with any source of
energy. To reduce the possibility of these problems, follow these steps:

1. Keep spare propane tanks away from the heat of the grill.
2. Use and store propane tanks outdoors only and in an upright position so the valve is at the
   uppermost part of the tank.
3. Never carry tanks into a house or other type of building.
4. If the tank becomes corroded or loses its collar ring (the carrying handle) or its foot ring (the
   support ring on the bottom), replace the tank immediately.
5. Clean the grill regularly to prevent flare-ups and fires.

With these simple precautions, you can continue to count on your propane grill to provide a safe and
convenient way to grill.

**Large Propane Tanks**

There are several sizes of large Propane tanks on the EWU campus. These are used for the emergency
electrical backup/standby generators. These tanks vary in size from 250 gallons to 1,000 gallons. A
transfer switch automatically monitors utility power and transfers the electrical load to the generator if
power is lost usually within 10 seconds. These generators kick on automatically. When main power is
restored the generators shut down.
Propane Tank Distance Requirements
Distance rules are applicable to propane tanks and their connections in relation to what surrounds them, whether it's a house or another propane tank. Care and consideration of surrounding buildings, driveways, awnings, house or building openings, property lines and more need to be taken into account when placing a propane tank in a legal and safe location. The guid below should be confirmed with the local building and fire department.

Container Distance Requirements
The distance requirements for propane tank locations are dependent upon the container size. Generally, the majority of tanks fall under a ten foot rule with regard to buildings and houses. The standards and rules differ when locations such as playgrounds, parking lots, railroad tracks or other flammable materials are taken into consideration.

**Tanks under 125 gallons water capacity:**
must be at least 10 feet from a window air conditioner must be placed a minimum of 5 feet from a crawl space opening

**Tanks 125-500 gallons water capacity:**
must be placed a minimum of 10 feet from a building must be at least 10 feet from a line of adjoining property

**Tanks up to 2000 gallons water capacity:**
must be placed a minimum of 25 feet from the building no part of an underground tank of this size shall be less than 10 feet from a building or line of adjoining property.
Tanks that are enclosed behind a fence or wall should be clearly marked as to what is behind the enclosure for firefighting response.

No Smoking signs should also be placed.
The point of transfer is defined as "the location where connections and disconnections are made or where LP-Gas is vented to the atmosphere in the course of transfer operations". The transfer of propane during the filling process results in residual liquid release between the tank fill valve and the hose end connection upon completion of transfer. When the hose is unhooked from the tank, liquid is released into the atmosphere. For this reason, the point of transfer is subject to distance requirements.

Relief Valve Distances
Safety relief valves are subject to distance rules for the simple fact that if the relief valve opens allowing propane to vent, the vicinity above and around the relief valve needs to be clear of obstructions and ignition sources. A safety relief valve on an ASME propane tank, if fully activated, will vent propane vertically up and for this reason, propane tanks have to be installed out from under an awning or part of a building overhang.

Unsafe Propane Tank Distance Example
The picture of the propane tank below illustrates the dangers of unsafe distances regarding relief valve proximity. The arrow labeled 1 is the propane safety relief valve. Arrow number 2 is a hot water heater. Arrow number 3 is the bed of an RV slide-out. If the relief valve were to fully open, the propane stream would be directly underneath the bed of this RV slide-out. If the relief valve opened and propane came in contact with the hot water heater flame (arrow #3), a dangerous situation would present itself immediately. For these reasons, and many others, propane tanks, points of transfer and safety relief valves are subject to distance requirements for the safety of propane consumers.

SCREENING
Screening an above ground tank is permitted providing that the screen:
- is located on one side of the tank only
- does not impede natural ventilation around the tank(s)
- is either boulders or non-flammable ranch type fencing
- does not obstruct the delivery driver’s line of vision when filling the tank
- is located at least 3ft away from tanks of less than 2000lb capacity.
PROPAANE TANK SECURITY
No one should smoke, use electrical equipment or park vehicles near the tank. ‘No smoking’ and other signs should be clearly displayed and maintained. Ignition sources, eg bonfires and barbecues, should not be allowed near the tank. Temporary use of grass-cutting equipment within the vicinity of the tank is permitted.

The tank should be protected from unauthorized access to reduce the chance of intentional or accidental interference. For larger tanks a security fence is required to keep it secure. This fence should allow natural air flow (eg made from wire mesh) and should be kept in good condition. Any gates should be kept locked unless access to the tank is required. Tank valve covers should be kept locked whether or not the tank is fenced.

IMPACT PROTECTION
If possible, the tank (and its associated piping) should not be located in areas where there is motor traffic. However, where this is not possible, then protection from a motor vehicle hitting the tank is required such as crash barriers or bollards. A security fence and/or road markings (eg ‘no-parking’ notices, double yellow lines) are unlikely to provide this protection.

VENTILATION AND CONDITIONS AROUND THE TANK
In case of leaks there should be plenty of room around the tanks to ensure good air flow so that pockets of heavier-than-air LPG vapors cannot build up around them.

It is also very important to keep the area around the tank free of rubbish, particularly if it is combustible or could reduce the levels of ventilation. For similar reasons keep weeds and grass cut down around the tank. If you choose to use a weed killer then you should not use something that is chlorate-based (as this can make the dead plants easier to ignite). Vegetation must be kept at least 10 feet from the tank.

FIRE PROTECTION
In storage locations the aggregate quantity of propane stored is in excess of 720 lb (327 kg), shall be provided with at least one approved portable fire extinguisher having a minimum capacity of 18 lb (9.2 kg) dry chemical with a B:C rating. The required fire extinguisher shall be located no more than 50 ft (15 m) from the storage location.

This document is for guidance only. Check with the local building and fire department to confirm tank placement, security, screen wall and fire protection needs.

REFERENCES
Propane Education and Research Council
NFPA 58
OSHA
NFPA 10