

Storage & Handling of Liquefied Petroleum Gases (LPGs)



Safety Snippet - LPG Storage & Handling

Liquefied Petroleum Gas, commonly referred to as LPG, is a flammable fuel that helps run households and industries worldwide. However, alongside its versatility, LPG is also a highly hazardous flammable material that carries huge amounts of explosive potential. The most severe LPG disaster in history (San Juanico, Mexico - 1984 LPG Storage and Distribution Center Disaster) resulted in 13 separate Boiling Liquid Expanding Vapor Explosions (BLEVE) with 500-600 fatalities and 5,000-7,000 injuries. As a result, several regulatory and industry best practice standards were created for the proper storage and handling of LPGs.

LPG Regulatory and RAGAGEP Standards

For any facility in which LPGs are stored, **OSHA standard 1910.110 - Storage and Handling of Liquefied Petroleum Gases** details OSHA requirements pertaining to every aspect of storing, transferring, and transporting LPGs. Particular concerns of the standard are prevention of excess pressure in storage containers, safety devices, regulators, and electrical installations, along with other potential sources of ignition. It should be noted that this standard is not applicable for the following:

- Marine and pipeline terminals, natural gas processing plants, refineries, or tank farms other than those at industrial sites
- LPG refrigerated storage systems
- LPG when used with oxygen
- LPG when used in Utility Gas Plants
- Low-pressure (not in excess of one-half pound per square inch or 14 inches water column) LPG piping systems, and the installation and operation of residential and commercial appliances

Another significant standard that serves as Recognized and Generally Accepted Good Engineering Practice (RAGAGEP), is **NFPA 58: Liquefied Petroleum Gas Code**, which is the industry benchmark for safe LPG storage, handling, transportation, and use.

For LPG storage installations in refinery applications, **API Standard 2510: Design and Construction of Liquefied Petroleum Gas Installations (LPG)** is a particularly useful guide.

In This Issue

Various regulations and Good Engineering Practices are identified and explained for LPG Storage & Handling facilities.

Safety Snippets are published monthly and can be located on the Nebula Safety & Environmental LinkedIn page or website.

<https://www.NebulaSafety.com>

LPG Storage Best Practice Items

Below are a few industry best practice items to keep in mind to design a safe, well-instrumented LPG storage system (refer to API Standard 2510 for further details):

- LPG Overfill Protection Systems

- o Hazard: Where there is a potential to release liquid LPG through an LPG vessel's pressure relief valve, atmospheric discharge is not acceptable as LPGs can pool at grade and present a fire/explosion hazard. Releasing liquid LPG through an LPG vessel's pressure relief valve to a flare system can also be hazardous due to auto-refrigeration of piping and low temperature brittle fracture.
- o Inherently Safe Solution: To prevent discharge of liquid LPG from pressure relief valves routed to atmosphere or flare, the inherently safe solution is to limit the maximum supply pressure to the LPG storage vessel to less than the pressure relief valve set pressure (e.g., ensure the upstream pump's maximum blocked-in discharge pressure is below MAWP of LPG storage vessel).
- o Overfill Protection Solution: Where inherently safer design is not possible, an alternative is to initiate automatic shutdown of filling systems prior to overfill with safety instrumented systems (SIS).
 - Install independent level and pressure transmitters on LPG vessel that isolates the fill line upon high-high level, high-high pressure or manual ESD activation
 - Install thermowell and temperature indicator on each LPG vessel
 - Install pressure gauge on each vessel's vapor space
 - Install hydrocarbon detectors

- LPG Shutoff Valves

- o LPG shutoff valves should be installed to minimize the consequences of a major LPG release
- o Recommended Shutoff Valve Installation:
 - Install shutoff valves (gate, globe, butterfly valves, etc.) on all vessel connections as applicable
 - Position shutoff valves as close to the vessel as practical (preferably on shell nozzle), while still ensuring shutoff valves are accessible for operation and maintenance
 - Design shutoff valves to provide a visual indication of valve position for those located below the vessel's maximum liquid level
 - Ensure shutoff valves are able to maintain an adequate seal under fire conditions
 - For LPG vessels above 10,000 gallons:
 - Ensure all shutoff valves located below the maximum liquid level close automatically or are remotely operable during the first 15 minutes of fire exposure
 - Consider using fusible links or other types of valves that close automatically under fire exposure

- LPG Vessel Dewatering

- o Hazard: During dewatering, there is a possibility for the water draw valve to be opened too far resulting in LPG flash vaporizing and auto-refrigerating, thereby preventing closure of the throttle valve and a release of LPG material.
- o Operational/Design Solution: Install spring loaded deadman valves for water draw valves on LPG vessels. Install a dewatering pot isolated from the main vessel during the draining operation to minimize the quantity of LPG accidentally released. Operations should be trained on water draw procedure.

Reach out to the Nebula Safety & Environmental Team at NebulaSafety.com for additional information.

Additionally, Nebula Safety can conduct a gap analysis for your facility to identify applicable deficiencies and opportunities for improvement.

References:

<https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.110>
https://minerva.jrc.ec.europa.eu/en/shorturl/technical_working_group_2_seveso_inspections/woodlpg_lng_accidents_by_maureenpdf
<http://ufdcimages.uflib.ufl.edu/IR/00/00/29/21/00001/OA03300.pdf>