

National Infrastructure Guide *for* Propane as a Transportation Fuel



TULSA AREA
CLEAN CITIES

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Introduction & Overview of Propane

The propane industry in the United States has a well developed distribution network, moving propane safely from the source to customer sites. The U.S. Department of Transportation regulations and other codes and standards ensure the safe transport of propane on our highways, railroads, and waterways. If you live near or far from a natural gas main or power grid, you can readily utilize propane as a fuel.

PROPANE QUICK FACTS

| Propane Production, Usage & Efficiency | Storing & Transporting Propane | Today's Propane Distribution Network |
|--|--|--|
| <p>Propane occurs naturally and is captured during oil refining and natural gas processing.</p> <p>Approximately 97 percent of propane consumed in the U.S. is produced domestically and in Canada.</p> <p>Because of this, propane helps reduce our dependence on foreign petroleum, which in turn, increases our nation's energy security.</p> | <p>Propane can be stored in large tanks and underground facilities, or shipped by pipeline, rail, or truck to thousands of "secondary storage" facilities throughout the U.S.</p> <p>Propane is delivered from 13,500 retail propane storage facilities to nearly 60 million customers throughout the U.S.</p> | <p>90 barges and tankers 6,000 transports 12,500 bulk/storage distribution points 36,500 fuel delivery trucks (bobtails) 22,000 railroad tank cars 70,000 miles of pipeline 162,000 cylinder refillers such as hardware stores, gas stations, camp grounds</p> |

There are approximately 270,000 propane vehicles in the U.S. and more than 15 million propane vehicles worldwide. Propane used as an engine fuel is commonly referred to as "Autogas" or "Motor Fuel" to differentiate the use from other market segments such as agricultural, residential, and off-road applications.

Propane used as a transportation fuel has emerged as a great solution for many types of fleets looking to control their fuel costs and use a domestically produced fuel source. Many applications in both the public and private sector are a great fit for propane. Propane systems work well in applications from buses and delivery trucks, to fork lifts and commercial mowers, and many things in between. Some of the most common applications include: school and shuttle buses, delivery vehicles, landscaping, work trucks, utilities, emergency vehicles and for service, repair and maintenance vehicles.

HISTORY OF PROPANE

| 1910 | 1913 | 1970s | 2006 | TODAY |
|---|--|---|--|--|
| <p>PROPANE DISCOVERED DR. WALTER SNELLING</p> | <p>FIRST PROPANE VEHICLE IN THE U.S.A.</p> | <p>OIL CRISIS INCREASES THE POPULARITY OF PROPANE</p> <p>THE CLEAN AIR ACT IS PASSED AND THE EPA BEGINS REGULATING ALTERNATIVE FUEL CONVERSIONS</p> | <p>LIQUID PROPANE INJECTION SYSTEM INTRODUCED IN THE UNITED STATES</p> <p>CLEANFUEL USA UNVEILS: - GM 8.1 - GMC 4500-8500 - BLUE BIRD PROPANE VISION</p> | <p>MORE PROPANE PLATFORMS CONTINUE TO BECOME AVAILABLE, GIVING FLEETS BUYING OPTIONS:</p> <p>- ROUSH - CLEANTECH - CLEANFUEL USA - BLUE BIRD - COLLINS - IC - ALLIANCE AUTOGAS</p> |

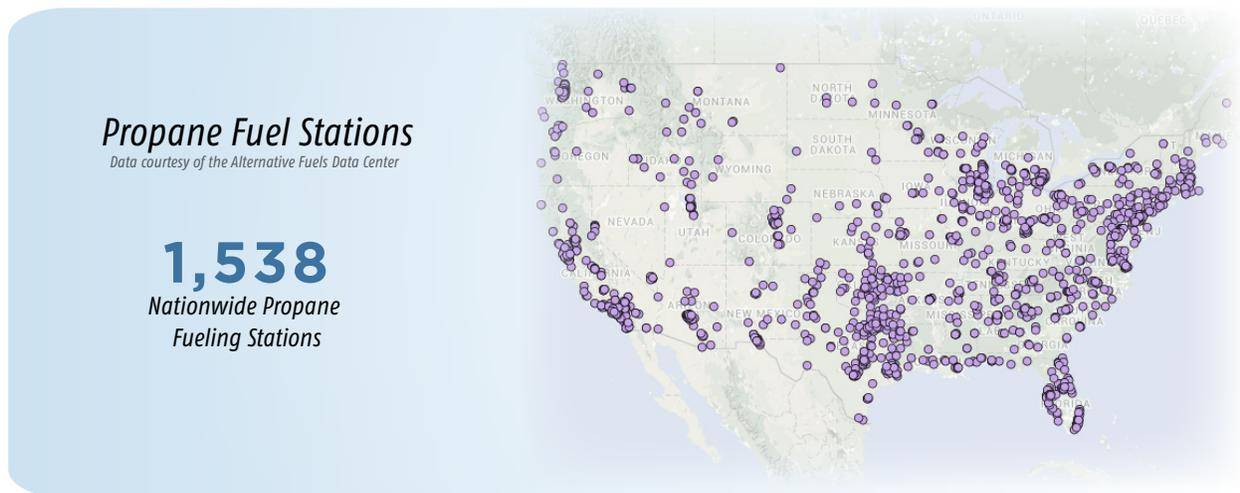
Fueling Infrastructure

The primary decision for those interested in propane fueling infrastructure is determining who will have access. In most states, codes for dispensers intended for public use are somewhat more stringent than those intended for private use.

These regulations are currently under review/revision nationally and in some states and may change in the near future.

Contact the local authority having jurisdiction (AHJ), propane marketer or the Propane Education & Research Council to determine requirements for individual States or regions. The AHJ varies across the country. In some states, it may be the Fire Marshal or Department of Agriculture, while other states may have an LP Gas Administration or Commission that regulates propane.

For assistance in determining the local AHJ, contact the National Propane Gas Association (NPGA) or the Propane Gas Association in your state.



The types of dispensers and types of ownership/leasing options exist for both public or private use sites and are typically one of the following:

- *Fleet/End-User Ownership*
- *Fleet/End-User Equipment Contract; Sole Use, Multiple User*
- *Managed Access Public Sites.*

Within these categories, the type of dispenser and size of the propane container is determined by assessing the needs of the fleet. There are entry-level packages with the propane tank and dispenser mounted on a common base or “skid” which are delivered to the site assembled. This is the easiest and least expensive option, offering great flexibility to a fleet just getting started with up to three propane powered vehicles. Additional configurations may include a stationary tank installation with crash protection and a dispenser assembly beside the container or several yards away on an island which may or may not have other fuels available. These may be simple configurations with only a pump and meter, or more advanced systems with a key or card lock system limiting access to designated personnel. Advanced systems can provide 24-hour access, and/or software compatible with various fleet management programs to streamline recordkeeping.

When choosing a company to design, install, and/or service the propane dispenser, a minimum of 3 years experience with propane installations and verifiable references is recommended.

Consult the local AHJ to determine if additional permits are required to install piping or service a propane installation.

Propane Dispenser Components



PROPANE INSTALLATION



HOSE BREAKAWAY PROTECTION



REMOTE TANK LEVEL MONITORING DEVICE

Propane is a leading alternative fuel in the U.S. because of its modest storage pressure, reasonable cost for vehicle conversions, fuel availability, as well as inexpensive and versatile dispensing station installations.

Propane dispensers typically operate at a pressure of <math><300</math> psig (pounds per square inch gauge). This relatively low pressure allows refueling with simple pumps that generate differential pressure between the dispenser storage container and the vehicle container. It is very important to select the properly sized pump for the intended fleet application. An undersized pump can create performance issues when filling.

In most ways, refueling a propane vehicle is similar to refueling a gasoline or diesel vehicle. There are, however, some distinct differences.

- Propane dispensing and vehicle fuel systems are sealed systems.
- Propane dispensers operate under higher pressures than other liquid fuels.
- Propane Tanks are only filled to 80% capacity to allow for fuel expansion.

An overfill protection device located in the fuel tank ensures that the fill will not exceed 80% of capacity. This safety feature will not be noticed by typical consumers, as fuel tanks are sized to allow for the needed range, and most new fuel gauges are calibrated to appear full at an 80% fill.



HIGH DIFFERENTIAL PUMP



LOW EMISSION TRANSFER NOZZLE



FLEET DEMONSTRATION - DISH NETWORK



FLEET DEMONSTRATION - FERRELLGAS



MANAGED ACCESS PUBLIC DISPENSER

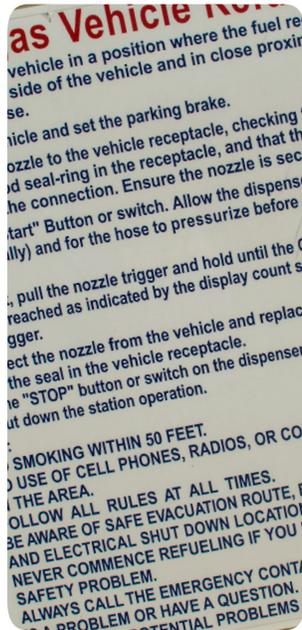


LOCKABLE CABINET ON PROPANE DISPENSER

Safety & Code Requirements

Propane dispensing stations must comply with various national and local codes and standards. The standards may vary across the U.S. and from state to state. There may be instances where a locality will also have specific requirements within city limits or jurisdictions. Lack of knowledge and subjectivity can have an impact on the approval process; therefore, it is wise to begin all new propane infrastructure projects by contacting the local Authority Having Jurisdiction (AHJ), such as your state's LP Gas Administration or Commission. Contact the National Propane Gas Association for assistance and contact information for the state association in your area.

National Propane Gas Association
www.npga.org



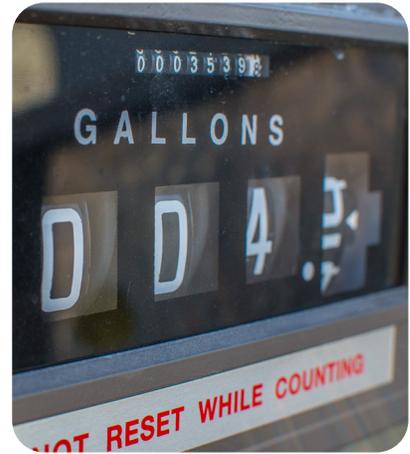
In addition to NFPA and state rules and regulations, the following codes and standards may also have requirements regarding installation of a propane dispenser:

- American National Standards Institute (ANSI) · American Society of Mechanical Engineers (ASME) · American Society for Nondestructive Testing (ASNT) · National Electrical Manufacturers Association (NEMA) · National Electric Code (NEC)
- Occupational Safety and Health Act (OSHA) · Uniform Building Code Commission, Local Jurisdiction · International Building Code (IBC) · International Fire Code (IFC)
- National Institute of Standards and Technology (NIST) · Society of Automotive Engineers (SAE) · Underwriters Laboratory (UL)



PHOTO COURTESY OF FERRELLAUTOGAS

Site Selection



Propane fueling dispensers are tremendously flexible and have relatively few site requirements. Because of this, you will likely see propane dispensers in locations which are inaccessible to other alternative fuels.

Minimum distance requirements from property lines, railroad tracks, power lines, and roadways are detailed in NFPA 58. Contacting an experienced local propane marketer is the first step in determining the best location for the propane dispenser. The only other requirement is access to standard electrical service. Specific cities and counties throughout the U.S. may also have specific zoning and ordinances which need to be considered, as well as their own setback requirements.

When soliciting for proposals for a propane dispenser, most states require specific equipment and performance standards to ensure quality and a fair comparison between bids. Most major distributors will have a detailed bid sheet that lists these items and can discuss the differences in equipment.

Warranty and service agreements should also be considered.



Economics

According to the United States Department of Energy's (DOE) analysis, *Costs Associated with Propane Vehicle Fueling Infrastructure*, purchasing new propane fueling equipment ranges from \$45,000 to \$300,000. There are ways to reduce the initial capital cost even further, which include lease agreements. Costs will vary widely from project to project based on the needs and size of the fleet, but these estimates are included to show the wide range of options available to fleet operators.

The chart below from the DOE's analysis of propane vehicle fueling infrastructure and highlights the wide variety of cost structures available for multiple applications and budgets.

PROPANE COSTS STRUCTURE GUIDE

| | STATION DESIGN | APPROX. DAILY USE | RANGE OF COSTS | EXAMPLE APPLICATIONS |
|-------------------------------|--|--|--|---|
| SMALL STATIONS (SKID-MOUNTED) | 1,000-GALLON STORAGE TANK 1 SINGLE-HOSE DISPENSER | 100-400 GALLON (IF TANK IS FILLED EVERY 2-WEEKS TO 2 TIMES, WEEKLY) | PURCHASING NEW EQUIPMENT: \$45,000 TO \$60,000 INITIAL COST FOR LEASING: \$3,000 TO \$10,000 | 3 SCHOOL BUSES x 16 GALLONS A DAILY 10 SHUTTLE VANS x 20 GALLONS A DAILY 100 SHUTTLE VANS x 20 GALLONS A DAILY |
| | 2,000 GALLON STORAGE W/ TWIN 1,000 GALLON TANKS 1 DUAL-HOSE DISPENSER | 200-800 GALLON (IF TANK IS FILLED EVERY 2-WEEKS TO 2 TIMES, WEEKLY) | PURCHASING NEW EQUIPMENT: \$60,000 TO \$70,000 INITIAL COST FOR LEASING: \$5,000 TO \$12,000 | 20 SCHOOL BUSES x 15 GALLONS A DAILY 30 SHUTTLE VANS x 18 GALLONS A DAILY 60 TAXIS x 7 GALLONS A DAILY |
| MEDIUM STATIONS | 12,000-GALLON STORAGE TANK 2 DUAL-HOSE DISPENSER | 450-1,800 GALLON (IF TANK IS FILLED WITH 1-3 TRANSPORT LOADS MONTHLY) | PURCHASING NEW EQUIPMENT: \$120,000 TO \$145,000 INITIAL COST FOR LEASING: \$15,000 TO \$50,000 | 35 SCHOOL BUSES x 14 GALLONS DAILY 65 POLICE CRUISERS x 7 GALLONS DAILY OR 100 SHUTTLE VANS x 20 GALLONS DAILY |
| | 18,000 GALLON STORAGE TANK 3 DUAL-HOSE DISPENSER | 900-2,400 GALLON (IF TANK IS FILLED WITH 2-4 TRANSPORT LOADS MONTHLY) | PURCHASING NEW EQUIPMENT: \$150,000 TO \$220,000 INITIAL COST FOR LEASING: \$15,000 TO \$50,000 | 60 SCHOOL BUSES x 16 GALLONS DAILY 70 SHUTTLE VANS x 20 GALLONS DAILY 100 SCHOOL BUSES x 10 GALLONS DAILY OR 150 TAXIS x 10 GALLONS DAILY |
| LARGE STATIONS | 30,000-GALLON STORAGE TANK 4 DUAL-HOSE DISPENSER | 900-3,000 GALLON (IF TANK IS FILLED WITH 2-5 TRANSPORT LOADS MONTHLY) | PURCHASING NEW EQUIPMENT: \$225,000 TO \$300,000 INITIAL COST FOR LEASING: \$15,000 TO \$50,000 | 70 SHUTTLE VANS x 20 GALLONS DAILY 100 DELIVERY VANS x 9 GALLONS DAILY OR 250 SCHOOL BUSES x 10 GALLONS DAILY |



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