



# UPGRADING YOUR GARAGE FOR LIGHTER THAN AIR FUELS

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Maintenance  
facility upgrades  
are an important  
piece to the  
conversion puzzle

## UPGRADING YOUR GARAGE FOR

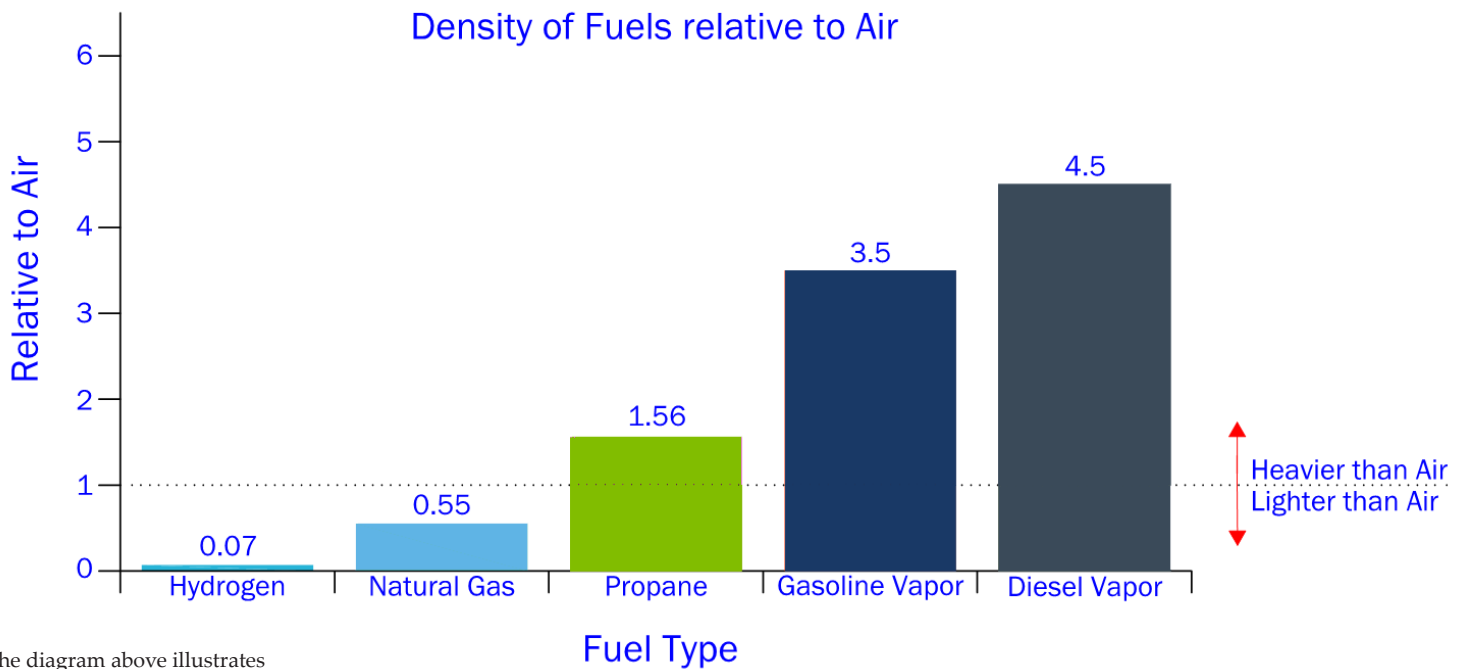
# lighter than air FUELS



**T**he latest and greatest alternative fuel options allow companies to convert their fleets to a fuel that suits their needs, while providing financial and environmental benefits. There is growing interest from fleet owners in compressed natural gas (CNG), propane, electric and even hydrogen. While mainly focused on the fueling station and vehicles, one critical component fleet owners tend to overlook is where their new alternative fuel vehicles will be maintained.

While some companies outsource their maintenance, it is very common to perform maintenance right at the fleet's facility. Most existing maintenance facilities were designed and constructed to perform maintenance on diesel vehicles only. With many different types of alternative fuels now available, it is important to check if the existing maintenance area can accommodate work on vehicles of different fuels.

Gasoline and propane fumes are heavier than air, so if they leak out during vehicle maintenance, they collect on the floor of garages. CNG and Hydrogen, which are both lighter than air fuels, will rise to the highest points of the room if leaked during maintenance. In both scenarios, measures must be in place to eliminate danger of explosion or fume inhalation if and when leakage occurs. For the purpose of this article, we will focus on maintenance facilities that accommodate vehicles with lighter than air fuels.



The diagram above illustrates how densities vary depending on the fuel type.

### Major vs. Minor Maintenance

When trying to figure out how much it will cost to upgrade a maintenance facility to accommodate CNG or hydrogen vehicles, there are many factors to consider. The first thing to ask yourself is what type of maintenance do you perform? It is important to classify your garage as either a major or minor maintenance facility. These terms are defined clearly in NFPA 70 National Electrical Code (NEC), dictating what measures you must take to be compliant and safe. Essentially, minor maintenance consists of brake changes, tire rotation and small tasks that do not affect the fuel system or pose any threat to the fuel system.



When you begin to add bodywork, grinding, welding or anything associated with the fuel system, then you crossed into major maintenance. Even if grinding is happening on another part of the vehicle, there is the potential of slipping and compromising the fuel system. A typical CNG system has pressure upwards of 4,000 pounds per

square inch (psi) and a hydrogen system is closer to 10,000 psi. With this kind of pressure, it is crucial that the fuel systems are respected. A slip while grinding may not normally seem like a big deal, but if one of these pipes at this pressure were compromised, it could cause serious risk to anyone nearby, such as severe bodily harm or even death.

Once the maintenance type is determined, the appropriate direction can be taken to meet the code requirements. The code can get a little confusing at times. To ensure you properly meet all requirements, including an engineer or someone familiar with the codes in the conversion process is crucial. It is much cheaper to do it right the first time, rather than ripping out components and replacing them if the inspector finds the code requirements were not met. The Authority Having Jurisdiction (AHJ), who is typically the local building inspector, has the ultimate say if the systems are acceptable or not. It is a good idea to keep these individuals in the loop early on in design and let them



Duct, pictured above, is fabricated with small take-offs, dampers and bird screen to exhaust evenly from each trapped ceiling pocket cavity.



be part of the progress. This will help to avoid surprises or misunderstandings near the end of the project when it is too late.

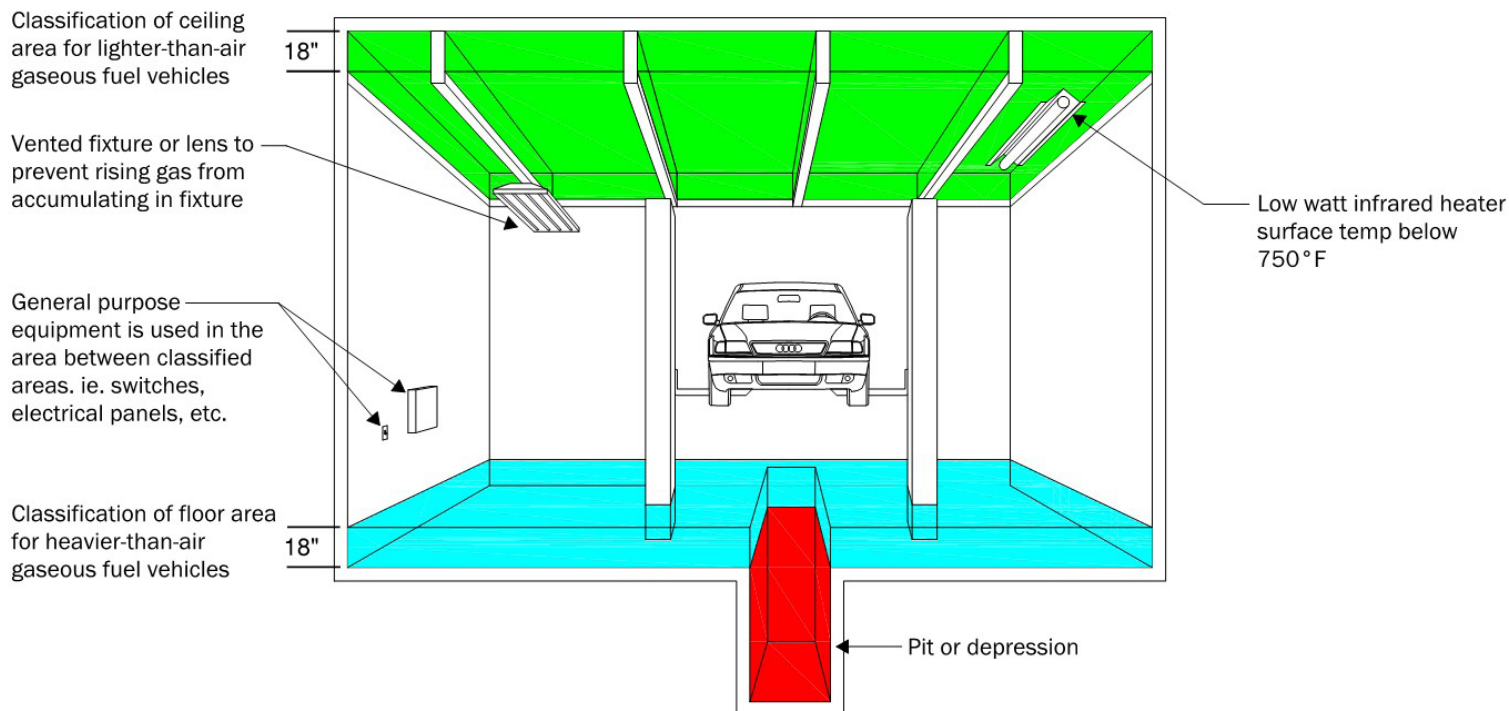
### **What are the code requirements for a major maintenance facility?**

For lighter than air fuels in a major maintenance facility, the top 18" of the space is classified as Class 1 Division 2 for electrical installations under the National Electrical Code (NEC) or NFPA 70. This means any electrical equipment installed in the top 18" of this space needs to be in compliance with a Class 1 Division 2 installation, or relocated out of the area to a lower point in the room. There is one other option allowed by the NEC. If ventilation is provided at a rate of 1 cubic foot per minute (cfm) per square foot of ceiling area, the space is then considered unclassified and the standard electrical installations are permitted.

If you choose to forgo the minimum ventilation rate and "classify" the top 18"

of the space, NFPA 52 calls for installation of a gas detection system for the space. A gas detection system is required to be interlocked with emergency exhaust fans that will purge the space upon detection of gas (methane or hydrogen in this case). Ventilation equipment in the space must be shut down and make-up air is required for the exhaust fans. Typically make-up air is provided by opening overhead doors or louvers in the wall. Additionally, if there are multiple pockets in the facility that are 18" or greater, each pocket is required to be exhausted.

It is also important to inspect existing light fixtures in major maintenance facilities. Fixtures must be vented or have lenses to prevent rising gas from collecting within them. The existing heating system must be evaluated as well. NFPA 30A does not permit surface temperatures above 750°F or open flames within the space. Overhead infrared heaters that keep personnel comfortable in the colder months are common in maintenance facilities.



The diagram above illustrates classified areas for both lighter and heavier than air fuels.

Typically these heaters need to be removed or replaced to meet code requirements, as they increase the surface temperature above the permissible threshold.

It is important to note that when dealing with lighter than air fuels, the three codes that apply are NFPA 52, NFPA 30A and NFPA 70. Sometimes the codes contradict each other, and you must take local, state and national compliance standards into consideration. This can get confusing really quick, which is why you should have an engineer involved in your project who can decode all of the standards and regulations.

## What are the code requirements for a minor maintenance facility?

There are far less requirements for facilities that perform only minor maintenance. You just need to make sure your facility meets the minimum code requirement for ventilation in a standard repair garage. Typically found as a mechanical exhaust rate in the mechanical code, this rate varies per state so it is important to be familiar with the codes in your area. In the case of hydrogen, if you are not working directly on the fuel system or welding, and do not have an open flame within 18" of the fuel system—you are permitted to perform major maintenance tasks if the volume of hydrogen in the tank is less than 200 standard cubic feet.

After reviewing major and minor maintenance requirements for lighter than air fuels, it is easy to see how the code gets complicated pretty quickly depending on the path you choose and the components within the space.

Light fixtures need to be vented or have a lens to prevent rising gas from collecting within them. This is an example of an acceptable vented light fixture.



A make-up air unit was installed on the roof of a major maintenance garage that services CNG vehicles.



A gas detection system commonly monitors for methane, carbon monoxide and nitrogen dioxide in a CNG maintenance garage. A remote gas detector is shown above.

## How do I know what approach to take?

For most owners, this decision usually comes down to money. It is important to determine the most economical solution. There is no one size fits all solution. Every garage has differences that will guide you down one path or another.

Typically the upfront cost is less if you opt for an air handling unit with a high airflow rate, allowing declassification of the space. This requires no rework of existing electrical devices, no gas detection system and no emergency exhaust fans. However, when you look more closely, bringing in a higher airflow rate means you need to temper and heat it. Nearly the entire United States, with few exceptions, have enough cold days that warrant closing the overhead doors and heating the space to keep employees comfortable. The cost to heat a larger volume of air quickly adds up. In most states, it is found that two or three years of energy costs actually exceed the cost to purchase a gas detection system and address electrical concerns. Those items are a one time, capital cost, where energy costs are ongoing and continue to rise.

## I determined my approach, now what?

Once you assessed the existing garage, reviewed all of the required codes, and determined the path you will take, the next step is to select the equipment. At a minimum you will likely need exhaust fans, make-up air units and gas detection systems. It is very important to select equipment specific to the types of alternative fuel vehicles you will be servicing. For lighter than air fuels, the exhaust fans need to be aluminum with an explosion proof motor outside of the airstream. Rooftop mounted make-up air units should be indirect fired so there is no open flame just in case any rising gas makes its way up into the unit when it is not running.

Gas detection equipment mounted within the top 18" of your facility should be rated for a Class 1 Division 2 environment. Selecting the right equipment for the application will help ensure you get the most use out of your equipment, as well as avoid any health risks. Additionally, to keep this equipment running efficiently and effectively, it is important to perform the manufacturers' recommended maintenance. If an owner does not have the capacity or skill set to do this, often times you can contract these services with the installer.

### **Converting is worth it.**

Your head is probably spinning by now and chances are you may be nervous to proceed with a conversion. The truth is, if you work with the right people, this process will be very smooth, efficient and easy. It is mandatory to meet code, but the savings you will realize from switching to an alternative fuel provides a favorable return on investment. Do not let a repair garage upgrade deter you from converting to alternative fuel vehicles. At the very least, it is worth performing a study to see what type of payback and savings your fleet can obtain.■



An emergency exhaust fan was installed on the roof of a major maintenance garage. It is interlocked with a methane detection system to purge the space if a methane leak is detected.



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