LOGISTICS UK

Working safely with alternatively fuelled vehicles

Briefing note

As the take-up of alternatively fuelled heavy goods vehicles becomes more prevalent, the likelihood of drivers and workshop staff encountering these vehicles is increasing and it is the employer's responsibility to ensure that their staff are kept safe. Logistics UK has produced this guidance document to both raise awareness of the risks associated with running and working on these vehicles, and to offer advice on some steps that can be taken to ensure that risks are identified, and effective mitigations put in place.

Types of alternatively fuelled vehicles

Liquified Natural Gas (LNG)

- Mainly methane, though may contain some ethane, propane and butane.
- LNG is created by cooling natural gas to -161°C, thereby creating a liquid.
- This liquid is colourless, odourless and non-toxic, but it is an extremely cold (cryogenic) fluid.
- At ambient pressure and temperature, one litre of LNG will expand to 600 litres of natural gas.
- Although LNG vapours are not toxic, LNG is classified as a simple asphyxiant and as such can reduce the oxygen content of an atmosphere, especially within confined spaces.

Most LNG powered vehicles work in much the same way as petrol vehicles, using a spark ignition for combustion, but some use diesel (or HVO) to ignite the gas. The fuel (natural gas) is super-cooled and stored as a liquid (cryogenically), which means that LNG can be a more expensive option than CNG (see below), but it can be better for longer ranges as the liquid density of LNG is greater than CNG, so more fuel can be stored.

Compressed Natural Gas (CNG)

- As with LNG, CNG is mainly methane though may contain some ethane, propane and butane.
- CNG is compressed natural gas at high pressures in the region of 200-300 bar.
- As with LNG, CNG vapours are not toxic, however, they can reduce the oxygen content of an atmosphere, especially in confined spaces.

CNG works in a similar fashion to LNG, but to work effectively, the fuel system transfers the high-pressure gas in the fuel tank through a pressure regulator to reduce it to a level compatible with the engine fuel injection system.

Electrically powered vehicles

- High voltage components and cabling – up to 650 volts DC.
- Battery packs require cooling.
- Electric arc can create temperatures to thousands of degrees Celsius.
- Electrical injuries are caused by electrical current passing through the body.

Electric vehicles use electricity to power an electric motor(s) replacing the conventional engine drive line.

Electric vehicles currently have a typical voltage of around 650 volts (though these can range between 60–1500 volts) direct current (DC).

Any accidental contact with live components at voltages above 110 volts DC can be fatal, so inspecting and working on these vehicles, compared to conventionally fuelled vehicles, can be more risky if adequate provisions are not taken. Particular consideration may need to be given to persons who have medical pacemakers fitted as these devices may be affected by high voltage systems.

Most electric powered vehicles are battery electric vehicles (BEV), but some can be hybrids.

Electric Hybrid vehicles

The electric systems in hybrids are essentially the same as in BEVs, but electric hybrids tend to work in three ways:

1 As a conventional internal combustion engine (ICE) operating as normal, with electric assistance.

2 With an option to transfer between the ICE and battery electric.

3 With the vehicle operating as a battery electric vehicle, but where the ICE is used to charge the batteries – unlike a BEV's which needs to be mains charged.

Hydrogen combustion – hydrogen (H_2)

- An odourless, tasteless, colourless and highly combustible gas.
- It is lighter than air, so rises and disperses.
- Although nontoxic, it is a simple asphyxiant and can displace oxygen, particularly in confined spaces.
- Hydrogen burns as a very pale flame with no smoke, as such it can be hard to detect fires.
- Hydrogen can be stored as either a compressed gas or as a cryogenic liquid at ambient pressures and temperatures; one litre of liquid hydrogen would expand to 848 litres of hydrogen gas.
- When stored as a compressed gas in pressurised cylinders or tanks, it will be stored at pressures in the region of 350–700 bar.

With hydrogen combustion, the fuel is stored in tanks, like CNG, and also works in the same way.

Hydrogen fuel cell (also known as fuel cell electric vehicles – FCEV)

These vehicles are effectively running two systems: one is the conversion of hydrogen into electric energy (through the use of fuel cells), and the other as that of a BEV.

Like other electric vehicles, FCEVs use electricity to power an electric motor. However, these vehicles provide their electricity from fuel cells powered by hydrogen rather than drawing electricity from only a battery, but they do also have batteries to provide for peak demand and store energy. To help reduce the amount of fuel used, FCEVs can use their batteries for storing recaptured energy from kinetic energy recovery systems (KERS), such as braking. Unlike BEVs whose range is governed by the amount of energy stored in the batteries, FCEVs' range is determined by the amount of hydrogen contained in its fuel tanks (therefore, size of fuel tank).

Risks of different propulsion systems

Liquified Natural Gas (LNG)

- Flammability.
- Skin burns from extremely cold surfaces – cryogenics.
- Potential for asphyxiation.

Compressed Natural Gas (CNG)

- Flammability.
- Explosion from high pressure containers.
- Potential for asphyxiation.

Electrically powered vehicles

- Electric arcing can result in fire (or explosion).
- Skin burns.
- Damage to internal organs.
- Cardiac arrhythmias and respiratory arrest – leading to loss of life.
- Potential for electrical systems to affect medical devices such as pacemakers.
- Possibility of injury from vehicle movement – electrically driven vehicles are silent in operation.

Electric hybrid vehicles

- As per electric powered vehicles.

Hydrogen combustion

- Flammability – and hard to detect fires.
- Skin burns from extremely cold surfaces – cryogenics.
- Explosion from high pressure containers.
- Potential for asphyxiation.

Hydrogen fuel cell

- As per electrically powered vehicles and hydrogen combustion.

Managing workshop staff

Skills and knowledge

The main consideration here is to identify how staff are trained and how competent they are to work on these types of vehicles.

Operators should consider:

- Are they just inspecting vehicles without any form of touching components?
- Is it just an awareness that is needed or formal training?
- Is/will their continuous professional development (CPD) programme be aligned to future planned vehicle purchases and/or maintenance contracts?

Working on gas and hydrogen

Before any drilling, cutting or welding is carried out, it is imperative that the exact location of any fuel tanks, pipes or components are determined and the necessary precautions taken to prevent them from being damaged.

Only qualified or competent persons should undertake work on gas or hydrogen systems, using safe and approved tools and equipment, with work being undertaken in a safe environment.

Before undertaking any work on the gas tanks, pipes or components, all relevant PPE should be worn.

Even the undertaking of inspections of these vehicles can bring with it risks. Workshop staff need to be made aware of these so that they can take the necessary precautions.

Working on electric and hybrid

Only qualified or competent people should work on electric vehicles. However, even the undertaking of inspections of these vehicles can bring with it risks and workshop staff need to be made aware of these so that they can take the necessary precautions.

Before undertaking any investigation, work or repairs it is advised that all high voltage cables are identified (these are usually coloured orange – but caution should be taken to identify any that may have been accidentally painted over) and these are visually

assessed for any signs of damage. Unless the vehicle is required to be energised, it is recommended that the high voltage battery is isolated, or disconnected, doing so in accordance with the manufacturer's instructions.

Before any drilling, cutting or welding is carried out it is imperative that the exact location of any high voltage cables are determined and the necessary precautions are taken to prevent them from being damaged.

If work needs to be conducted on the vehicle's battery pack or other high voltage electrical components, these may still retain high voltage or contain large amounts of energy. Therefore, the high voltage electrical systems should be fully isolated and any stored energy in the system discharged – refer to manufacturer's instructions.

Before undertaking any work on the high voltage system, all relevant PPE should be worn, and necessary tools and test equipment used.

If it is not possible to isolate the high voltage electrical systems and to discharge the stored energy, then before commencing any work, necessary control measures should be identified and implemented – refer to the manufacturer's instructions.

Tools and facilities

Are your (or your maintenance providers') workshops safe for these vehicles?

Consider the specifications of the facility:

- Gas detectors.
- Ventilation – if forced ventilation, then intrinsically safe if fuel flammable.
- Warning signs.
- Barriers.
- Insulated tools for electric or hybrid vehicles.
- Intrinsically safe tools for gas vehicles.
- Intrinsically safe equipment – where necessary.
- PPE.

Managing drivers

Do your drivers understand the nuances of alternatively fuelled vehicles?

Consider their competence and training needs:

- Gas/hydrogen awareness and refuelling training.
- Electric awareness and recharging training.
- Driving electric vehicle through floods.
- Action following an accident:
  - Live electrics.
  - Escape of gas/hydrogen.
- Different driving skills and driver instrument understanding.
- Quiet running – potential for incidents from road users not hearing the vehicles.
- Restrictions of vehicle use, tunnels, terminals, etc.

Managing the situation

Employers have a responsibility to keep staff and working facilities safe. Logistics UK suggests the following measures should be considered (this is not a definitive list):

1 Know what future fleet replacement programmes look like and what vehicles the transport operation will be responsible for.

2 Understand the risks these vehicles pose, compared to the existing fleet.

3 Establish what risk assessment the business has undertaken related to the operation of those vehicles.

4 Where necessary, undertake a specific risk assessment for the operational responsibilities involved.

5 Ensure risk assessments are undertaken as early as possible – mitigations may be expensive or take time to implement.

6 Implement actions and monitor to ensure they have been adopted – "what gets measured, gets done".

7 Take action early – "failing to prepare is preparing to fail".

Remember – ignorance is not bliss and a corporate manslaughter charge can lead to prison sentences.

Reference documents:

HSE – Electricity at Work: Safe Working Practice

The IMI – Electric vehicle qualifications

Information source and acknowledgments

https://www.hse.gov.uk/mvr/topics/electric-hybrid.htm

https://tide.theimi.org.uk/learn/qualifications/electric-vehicle-qualifications

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