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TECHNICAL INFORMATION SHEET 32

REVISION 1: 2014

ACETYLENE OR PROPANE (FOR WELDING, CUTTING AND ALLIED PROCESSES)

Background

Fuel gases are generally hydrocarbon based and are chosen for their ability to burn in air or oxygen. Two of the most popular fuel gases are acetylene and propane.

However, these gases have many different properties, and care should be taken to choose the correct gas for your particular application. Your choice of fuel gas is fundamental to the quality, safety, efficiency and cost-effectiveness of your fabrication processes. Detailed guidance on the use of fuel gases and associated equipment is available in BCGA CP 7, *The safe use of oxy-fuel gas equipment (individual portable or mobile cylinder supply).*

In the years between 2003 and the end of 2012, the UK Fire and Rescue Service operated a significantly excessive and very disruptive protocol for dealing with fires involving acetylene cylinders. This original protocol caused much misinformation to abound about the behaviour of acetylene in response to fire – and in turn influenced the Health and Safety Executive and many ancillary bodies, such as insurers, to recommend that oxy-acetylene should be replaced by oxy-propane where possible.

Following detailed research, this has since been re-assessed through the 'BAM Research' project (refer to the BCGA Website – 'Cylinders in Fire' webpage). The Fire and Rescue Service protocol for acetylene fires was officially changed with effect from 30th November 2012.

The reality now is that an acetylene fire need be no more disruptive than any other fire involving gas cylinders and that in many scenarios, oxy-acetylene is the safer option to choose.

Welding, cutting and allied processes in confined spaces

Where oxygen and fuel gases are used in confined spaces, for example in tunnels, shafts, dry docks, ships compartments etc. appropriate ventilation shall be provided to prevent the accumulation of the gases and the potential of creating a flammable and / or asphyxiant atmosphere. When choosing your fuel gas particular consideration should be given to the densities of the respective gases. Heavy fuel gases, such as propane, will tend to sink and will therefore collect in any low-lying areas. Lighter gases, such as acetylene, will more naturally rise and will be easier to disperse. The use of acetylene is therefore recommended as the fuel gas of choice, especially in underground, tunnel or similar locations.

NOTE: Ventilation systems will need to be designed specifically for use with flammable gases.

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Safety

There are a number of common safety considerations that should be taken into account.

Care should be taken when working in enclosed areas as flames will consume atmospheric oxygen and could render the working area oxygen deficient.

Care should be taken not to introduce additional oxygen, via leaks or failure to turn off valves, as oxygen enriched atmospheres will cause any material in the vicinity to burn vigorously.

Components, such as regulators, are designed for use with each specific gas. The pressures are different and the gases can react with certain materials e.g. acetylene reacts with copper to form acetylides, these can form an impact explosive! Only a regulator designed for acetylene is to be used with acetylene. Refer to BCGA Safety Alert 01, *The hazards of using incorrect regulators on acetylene gas cylinders*.

In the event of a fire occurring, with the exception of very small gauge or hose fires, oxy-fuel users should not attempt to fight fires involving gas cylinders themselves, but rather should immediately evacuate the area and call the Fire and Rescue Service. However, reading and taking account of the following may help users prevent cylinders becoming involved in fires in the first place:

- BCGA Leaflet 6, *Cylinders in fire*.
- Fire & Rescue Service, Hazardous materials, operational guidance for the Fire & Rescue Service. This updated guidance was published in November 2012.
- The BCGA website, '[Cylinders in fire](#)' page.

To help prevent a fire occurring flashback arrestors and non-return valves shall always be fitted.

Table 1 details the common properties of acetylene and propane that are useful for those engaged in welding, cutting and other allied processes.

References:

1) BCGA CP 7, *The safe use of oxy-fuel gas equipment (individual portable or mobile cylinder supply).*
2) BCGA Leaflet 6, *Cylinders in fire*.
3) BCGA Safety Alert 01, *The hazards of using incorrect regulators on acetylene gas cylinders*.

Table 1: Common properties of acetylene and propane

Properties	Acetylene	Propane	Comments
Use for welding	Yes	No	Propane cannot be used for gas welding. Propane has enough heat to melt steel, however the flame is far to oxidising to produce sound quality welds in carbon steel.
Use for cutting	Yes	Yes	
Use for brazing	Yes	Yes	
Cylinder gas content	8 kg 9.05 m^3	47 kg 25.38 m^3	Typical maximum values.
Cylinder water volume (litre)	50	104	Typical maximum values.
Flame temperature with oxygen (°C)	3160	2828	Acetylene has the highest heat transfer rates. Acetylene heat transfer can only be approached by LPG gases by using larger nozzle sizes, excessive oxygen or by operating at near nozzle flame lift-off conditions.
Heat intensity ($MJ/m^2/s$)	61.0	34.0	Determines how effectively heat can be transferred into a work piece. An acetylene flame has nearly twice the flame intensity of propane enabling rapid heating of materials.
Calorific values (kJ/m^3)	54772	95758	The total amount of heat released by a unit weight or unit volume of a fuel gas mixture during complete combustion.
Heat distribution (kJ/m^3) 1) Primary flame 2) Secondary flame	 18890 35882	 10433 85325	The energy split between the primary flame (inner cone) and secondary flame (outer cone). It can be seen from the figures that acetylene has a much higher energy release in the primary cone that makes it ideal for cutting, welding and preheating operations.
Nozzle size			When using propane the operator will need to use a larger size nozzle.
Flammability limits in air (%)	2.5 to 81	2.2 to 9.5	
Maximum fill pressure (bar)	18	10	At standard temperature 15 ºC.
Cylinder burst pressure (bar)	105	67	
Critical temperature (°C)	36	97	Many gases can be transformed to liquids with out cooling them to their boiling point. This is done by increasing the pressure, whereby the boiling point rises. However, for each gas there is a critical temperature above which the gas cannot be transformed to a liquid no matter how high a pressure it is subjected to. The pressure that just brings about condensation at the critical temperature is called the critical pressure.
Mixing ratio with oxygen	1 : 1	1 : 4	Propane will consume more oxygen, therefore more oxygen cylinders required on site with increased manual handling.
Stability			The acetylene flame tends to be more stable and sits on the nozzle better.
			Acetylene flame temperature more concentrated therefore the flame is more controllable then propane.
			Acetylene flame is easier than the propane flame to set correctly.

Moisture content contained in combustion gases (%)	3	32	The combustion of propane and oxygen produces a fairly high level of moisture in the burnt gas compositions following combustion compared to that produced with acetylene. Depending on the application this may or may not be an issue. For example: preheating prior to welding.
Density	0.9	1.55	Acetylene is lighter than air, therefore will tend to disperse through the atmosphere. Care must be taken when working near enclosed roof spaces. Propane is heavier than air and will tend to sink and will therefore collect in any gullies, drains or low-lying voids.
Hazard in a fire	De-composition	Boiling Liquid Expanding Vapour Explosion	In a continuous fire both types of cylinder will explode due to the increase in temperature (and associated pressure).