

Chemical Safety Guidance Series

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Acetylene Gas: User Guidance

Occupational Health and Safety Service

HSD177C (rev 3)



UNIVERSITY OF
CAMBRIDGE

Guidance for Using and Storing Acetylene Gas

Acetylene is potentially extremely hazardous and before considering its use you should ask

DO I REALLY NEED TO USE IT ?

HAVE I CONSIDERED SAFER ALTERNATIVES ?

Background

Acetylene (C_2H_2) is a colourless, 'non-toxic' but asphyxiant, slightly lighter than air gas with a distinct garlic like odour as a result of an impurity, however do not rely on the smell as a control measure. It is the simplest member of a group of unsaturated hydrocarbons called alkynes and is used as a chemical building block in organic synthesis and as a hydrocarbon fuel gas for heating, cutting and welding (burning at over $3300^{\circ}C$ in oxygen).

Hazards and Safe Handling Procedures

Acetylene is an extremely flammable gas with a low Flash Point ($-18^{\circ}C$), an auto-ignition temperature of $305^{\circ}C$ and wide explosive limits of 2.5 to 81 % in air - greater than any other commonly used flammable gas.

WARNING: Acetylene is inherently unstable because it can explosively decompose if exposed to excess temperature / fire, pressure or mechanical shock.

Acetylene decomposition is a chemical reaction whereby the acetylene breaks down to its constituent elements of carbon and hydrogen, generating a great deal of heat and pressure. Acetylene decomposition can be initiated by exposure to heat, as in a fire situation, pressures in excess of 15psi or severe shock, such as dropping a cylinder or by a 'flashback' into the cylinder via a hose or pipe. The temperature of a cylinder containing acetylene undergoing decomposition will rise exponentially as the decomposition releases large amounts of energy and the cylinder may also vibrate.

Once decomposition starts it is self-heating and thereby self-generating, if unchecked the reaction will result in the cylinder exploding. However if the cylinder is cooled sufficiently before it explodes it is often possible to prevent it exploding. Cooling is generally achieved by applying very large quantities of water directly onto the cylinder from fire hoses over a long period of time, up to 24hours, using many thousands of litres of water.

Therefore if you are using acetylene you should consider the consequences of a fire or other inadvertent initiation of decomposition. Ask yourself the question "where would all the water go?" If the answer is down through several floors of offices and research laboratories it would be prudent to **relocate the work before you start** to a better area, possibly the ground floor, on an outside wall, but not adjacent to a fire exit or public footpath in case it does explode.

WARNING: A hot acetylene cylinder is MUCH more sensitive to shock and must NEVER be moved until it has thoroughly cooled inside (thermal imaging may be required). Attempting to move hot acetylene cylinders has resulted in fatalities in the UK.

If acetylene in a storage cylinder explosively decomposes it will create a large fire ball and send fragments of the metal cylinder flying for hundreds of meters. Additionally, if this reaction, or an ignition of acetylene occurs within a supply hose/pipe or torch base it can propagate back into the storage cylinder by 'flashback' causing it to explode violently. Therefore a 'flashback' arrester **MUST** always be fitted to acetylene storage cylinders to prevent such an occurrence.

Acetylene is stored in a liquid state, usually as a solution in acetone contained in a steel cylinder with a porous filling to stabilise it and make it safe to transport and use, if handled correctly, however:

Acetylene cylinders should never be stored or used horizontally, i.e. on their side. However should an acetylene cylinder have been on its side it **MUST** be returned to the upright position for at least as many minutes as the cylinder was on its side, up to 24 hours; to allow the acetylene/acetone solution to drain down to its base.



Acetylene must only be used in with an appropriate acetylene specific pressure regulator, which should not exceed a maximum setting of 15 psi and acetylene must never be used at pressures in excess of 15 psi.

Note: Flammable gas regulators and valves have an opposite thread to other gas regulators and valves. In addition oxygen cylinders, which are often used in conjunction with acetylene, will have an oxygen specific regulator, generally blue in colour in oxy-acetylene kits. Oxyacetylene kits will also have colour coded hoses (red for acetylene and blue for oxygen) and these must always be in good condition, inspected regularly and replaced if faulty or every 5 years and NEVER EVER interchanged.

Regulators MUST be replaced if faulty or every 5 years at maximum.

Acetylene can react with a number of metals including copper and silver to form explosive acetylides, therefore copper pipe and silver solder must never be used with acetylene gas.

Acetylene only requires a very low ignition energy, indeed it is possible to ignite an Acetylene enriched atmosphere with the static discharge from a human finger. The static charge developed by walking across a carpet floor on a dry day can be 1700 times greater than that needed to ignite acetylene. When mixed with pure oxygen, the ignition energy of acetylene is almost 100 times lower than it is in air.

Because acetylene is only slightly lighter than air it only dissipates slowly if released, therefore give careful consideration as to the level of ventilation in any area where it is stored or used.

Risk Assessment

The Dangerous Substances and Explosive Atmospheres Regulations, requires users to carry out a written risk assessment of the work activities with dangerous substances and eliminate, substitute or reduce the risks as far as reasonably practical.

The Control of Substances Hazardous to Health Regulations, requires users to carry out a written risk assessment of any hazardous substance used at work including gases such as acetylene.

The Regulatory Reform (Fire Safety) Order, requires building users to carry out a written Fire Risk Assessment and where cylinders are used or stored on the premises this should take account of the possible impact that a fire involving a cylinder might have on the surrounding community. When an acetylene cylinder is thought to be involved in a fire or thought to be situated close enough to be affected by the fire, the Fire and Rescue Service will create a '24 hour hazard zone' around it and will advise people in the zone to evacuate the area. The hazard zone will have an initial radius of 150 - 200 metres. Depending upon circumstances the Fire and Rescue Service may also cool the cylinder with copious amounts of water for up to 24 hours.

Further Advice from the University Fire Safety Unit

All compressed gas cylinders when subjected to heat present a hazard to those in the vicinity but with the exception of Acetylene the hazard diminishes significantly as the other cylinders are removed from the heat. Generally, Acetylene has a good safety record but there have been several incidents over the last few years some of which have resulted in the death of Firefighters.

Fire Safety Managers in premises that have identified the use of Acetylene should discuss with existing users whether the continued use is necessary or whether Acetylene can be removed from site and be replaced with a less hazardous alternative.

IF YOU REALLY DO NEED TO KEEP ACETYLENE

YOU SHOULD:

- Notify the University Fire Safety Unit:
The Fire Safety Unit keep a register of Departments that use Acetylene.
- Carry out a Fire Risk Assessment as required by the Regulatory Reform (Fire Safety) Order 2005, your findings and control measures must be recorded.
- You should always know the location of Acetylene cylinders within your buildings and this information should be available for the emergency services in your DREAM file.
- When not in use acetylene cylinders should be stored outside the main building in a secure ventilated store.
- Always store and use the Acetylene cylinders in accordance with guidance published by the Health and Safety Executive as described in their leaflets:
 - INDG 327 Take Care with Acetylene.
 - INDG 297 Safety in Gas Welding, Cutting and Similar Processes.
- There are also some useful leaflets published by the British Compressed Gases Association:
 - GN 2 Guidance for the storage of transportable gas cylinders in the workplace.
 - GN 7 Safe use of individual portable or mobile gas supply equipment.
 - GP 7 The safe use of oxy-fuel gas equipment.

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