Safety advice.

Dissolved acetylene.

Properties

Acetylene is a compound of carbon and hydrogen with the chemical formula C₂H₂. Acetylene is the only common dissolved gas. It is chemically very unstable and, even at atmospheric pressure, acetylene gas can explode. In order to safely store acetylene, cylinders are filled with a porous mass. In this mass there is a solution of acetylene in acetone or DMF (dimethylformamide) under pressure, typically 15 bar. Acetylene in solution is stable.

Physical properties

At atmospheric temperatures and pressures, acetylene is a colourless gas which is slightly lighter than air. Pure acetylene is odourless, but acetylene of ordinary commercial purity has a distinctive, garlic-like smell¹.

¹This may not be the case for petrochemical acetylene.

Chemical properties

Acetylene burns in air with an intensely hot, luminous and smoky flame. It can be liquefied and solidified and both phases are highly unstable. Mixtures of acetylene with air or oxygen in certain proportions can explode if ignited. Acetylene under pressure without the presence of air or oxygen can decompose with explosive force. Dissolved acetylene in a cylinder is safe.

Example of acetylene cylinder where acetylene is dissolved in acetone. On the left side you see a cylinder with the porous mass and on the right side the percentage of the different components.

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Hazard

Flammability
Acetylene is a flammable gas and may react explosively even in the absence of air. The flammability range in air goes from 2.3 vol% to 88 vol%, but even at concentrations above 88 vol% (up to 100 vol%) acetylene can still explosively decompose. The ignition temperatures of acetylene, mixtures of acetylene and air, and mixtures of acetylene with oxygen will vary according to composition, pressure, water vapor content and initial temperature. As a typical example, mixtures containing 30% acetylene by volume with air at atmospheric pressure can auto-ignite at about 305 °C.

Hot acetylene cylinders
Acetylene cylinders exposed to fire or flames may present an explosion hazard.

Gas under pressure
An acetylene cylinder containing a dissolved gas under pressure may rupture (or burst) if heated.

Decomposition
When acetylene is heated to about 300 °C, the acetylene molecule decomposes into its components: carbon and hydrogen. Energy is liberated in the form of heat, and the pressure rises sharply. At atmospheric pressure the molecules are too far apart for this reaction to start, but if the gas is compressed (for example, in a welding hose where the working pressure is set too high – above 1.5 bar gauge) the molecular decomposition spreads with explosive speed. Compression of gases results in a temperature rise that could be sufficient to initiate acetylene decomposition in pipework and hoses. The presence of impurities in acetylene piping/hoses will increase the risk of decomposition occurring under compression conditions.

Polymerisation
Acetylene is capable of reacting with other acetylene molecules to form larger hydrocarbon molecules, for example benzene. This process is known as polymerisation and heat is required to initiate the reaction. Once the process is started, heat is liberated and the reaction becomes self-sustaining above atmospheric pressure; this can lead to the explosive decomposition of acetylene. Polymerisation readily commences at 400 °C at atmospheric pressure and can occur at lower temperatures in the presence of catalysts such as pipe scale, rust, silica gel, diatomite and charcoal.

Liquid and solid acetylene
Never make liquid or solid acetylene, as both forms are highly unstable.

Acetylides
When acetylene comes into contact with copper, brass with a copper content >65%, silver, mercury or salts of these metals, acetylides can form. These acetylides are highly sensitive to shock or friction, resulting in a potential explosion risk.

Asphyxiation
Acetylene has a narcotic effect and in high concentrations may cause asphyxiation.

Example of safety device which combines check valve and flame arrestor in one unit

Example of check valves mounted on torch
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Precautions

PPE
Wear eye protection when using gases. Wear goggles with suitable filter lenses when use is cutting/welding. Wear flame resistant/retardant clothing. Wear working gloves and safety shoes while handling containers. Take precautionary measures against static discharges. Gas detectors should be used when quantities of acetylene may be released.

Materials
Acetylene can form dangerous compounds with copper, brass, silver and mercury. Do not use alloys containing more than 65% copper.

Acetylene system
The acetylene system must be leak-proof from the source e.g. cylinder to the point of use.

Ignition sources
Avoid any potential ignition sources, including: matches or cigarette lighters, mobile phones, two-way radios, pagers, petrol driven engines, sparks from static electricity (even the static from wearing nylon or man-made fibres may ignite acetylene), non-flameproof electrical equipment, friction, any item containing batteries, aluminium ladders or equipment impacting against rusted metallic materials. Flammable zones classification should be considered and only equipment suitable for potentially explosive atmospheres should be used with acetylene.

Confined spaces
A risk assessment must be carried out before entering or working in a confined space and a permit to work must be obtained to ensure safe working conditions. When open flames are used, for example in cutting or welding, flames consume the oxygen in the air and oxygen deficiency may occur. Acetylene flames may produce toxic/corrosive fumes. Ensure proper ventilation is in place and/or use adequate breathing protection.

Safety devices
Check valves and flashback arrestors must be mounted on both acetylene and oxygen connections. Check valves are mounted on torches on both fuel gas and oxygen connections. Check valves effectively prevent the reverse flow of gas. Flashback arrestors effectively prevent a flashback from propagating back to the gas supply system or cylinders. Check valve and flashback arrestor can be combined in one device. To prevent decomposition in the hose line or torch, the acetylene pressure downstream of the pressure regulator must not exceed 1.5 bar.

General recommendations
• Do not drag cylinders
• For capped cylinders, ensure the cap is fitted when they are being stored or transported
• External damage to cylinders and valves (e.g. by welding or striking electric arcs or impact by sharp objects) must be avoided
• Do not use cylinders as rollers or work supports
• Secure acetylene cylinders during use, storage and transport to prevent movement
• Perform valve leak test before transport and use
• Acetylene cylinders should not be left in non-dedicated vehicles
• Any stamping or means of identification on the cylinder must not be altered
• Never heat cylinders, e.g. by direct flame, electrical devices or hot water, to raise the pressure or the flow rate
• Avoid hot work such as flames or grinding close to an acetylene cylinder. Use a safety distance of 1 m for a single cylinder and 3–5 m for multiple cylinders or bundles
• Cylinders must be connected to low pressure equipment only using proper pressure regulators
• Cylinder valves are unsuitable for pressure and flow regulation
• Close acetylene cylinder valve when not in use, including during work breaks
• Keep cylinder valve outlets and other equipment free from contaminants, particularly oil and water
• Do not repair or modify cylinders and valves. Any damage should be made known to the supplier
• Acetylene cylinders should only be used in the vertical position
• Acetylene should never be transferred from one container to another.

Permission to enter a confined space
shall be given only after the issue of an entry permit.

Proper clothes and personal protection equipment, e.g. gloves and safety shoes, must be worn.

Cylinder valves must be protected against damage by screwing on cylinder caps.
Emergency

Acetylene is an extremely flammable gas. Eliminate ignition sources and do not extinguish a leaking gas fire unless the leak can be stopped. Exposure to a fire may cause cylinders to rupture/explode.

Spill or leak
1. If safe to do so, isolate container
2. Evacuate area, eliminate ignition sources and ensure adequate ventilation
3. Stop leak, if possible (e.g. close the cylinder valve wearing proper hand protection)
4. Prevent entry into confined areas
5. Consider the risk of potentially explosive atmospheres.

First aid
Inhalation: Remove victim to uncontaminated area and fresh air. Keep victim warm and rested. Call a doctor. Apply artificial respiration if breathing has stopped.

Fire
1. Suitable extinguishing media: water, dry powder or foam
2. Unsuitable extinguishing media: carbon dioxide
3. Do not extinguish a leaking gas fire unless leak can be stopped (e.g. closing the cylinder valve wearing proper hand protection)
4. Exposure to fire may cause containers to rupture or explode
5. Use water spray or fog to control fire fumes
6. Move container away (if safe to do so) or cool with water from a protected position
7. Prevent water used in emergency cases from entering sewers and drainage systems
8. If the container is leaking, do not spray water directly onto the container
9. Water the surrounding area to contain fire
10. Advise Fire Service of the location and quantities of acetylene
11. Damaged/impacted cylinders should be handled only by specialists (return to supplier)
12. Acetylene cylinders exposed to heat in a fire or subjected to thermal decomposition should not be approached or moved until they have been cooled and checked to ensure further decomposition is not occurring. This may be done by using a “wetting test” or using thermal imaging equipment.

Refer to the relevant Safety Data Sheet for further information/contact your local Linde supplier for specific questions.

More information is available from the EIGA Code of Practice: Acetylene IGC Doc 123, available on the EIGA website www.eiga.eu

Road vehicles are only suitable for transporting gas receptacles if they can be suitably ventilated.

Road vehicles are only suitable for transporting gas receptacles if the receptacles can be reliably secured to prevent them rolling away or falling.

Cylinder exposed to fire must be cooled from a protected position.

The safety data sheet informs users about chemical and physical properties of a material and its generic use, provides advice on the safe handling, storage, transport, use and disposal of the material, provides information about the health effects, exposure control, environmental effects and emergency procedures.