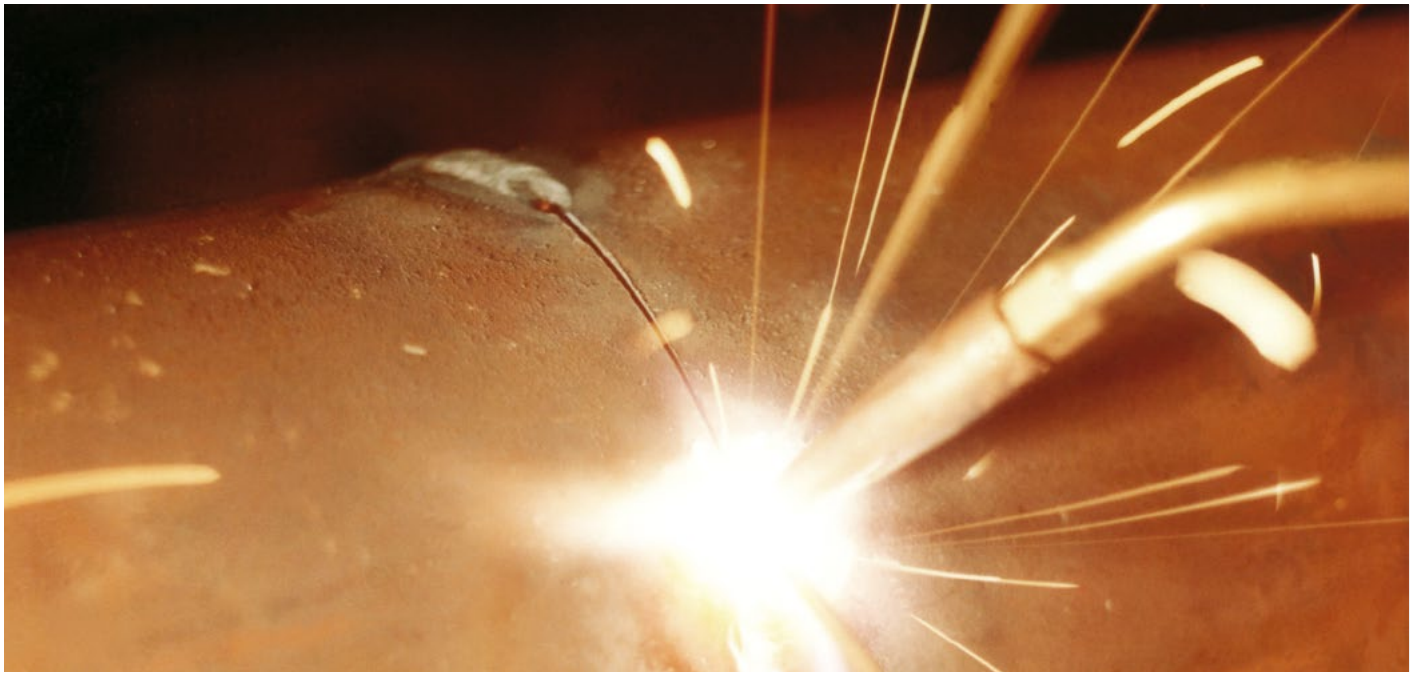
BOC
A Linde company

Facts About Acetylene

The Facts

First used in 1906 for welding and cutting metals, acetylene has earned an enviable reputation for being the strongest, safest and simplest to use of all the fuel gases. Here we examine why.



At a glance

- A colourless gas with a garlic like odour.
- Stored in maroon coloured cylinder.
- Cylinder valves have left hand connections.
- Ignition temperature: 325 °C.
- Flammability limits: 2.5–82.0 volume % The lower limit is the one that is reached first.
- Specific gravity: 0.9 (air = I so acetylene is lighter than air).
- Fuel to oxygen ratio 1:1.1.
- Do not use with copper, silver or mercury.

What's special about acetylene?

Oxygen and acetylene together (oxy-acetylene) produces a flame temperature of 3150 °C, making it the hottest of all the fuel gases and the only fuel gas that can weld steel.

In cutting, acetylene gives the fastest pre-heating and piercing times of any of the other fuel gas combinations.

It also gives the lowest level of hardening to the surface of the cut and because lower heat levels are passed into the material being cut, distortion is minimised.

Acetylene uses less oxygen than other gases like propane and propylene, and requires fewer cylinders, giving less handling and downtime.

Acetylene gas is slightly lighter than air. Because of this, unused gas won't gather in low areas and cause a potential hazard. It is the only fuel gas recommend for use in underground working conditions. However, in any confined space, extraction should be used to remove any potentially dangerous products, including acetylene.

What's acetylene used for?

The fabrication industry uses acetylene for many major applications.

- It is the only fuel gas that can be used for welding.
- It is also ideal for brazing, cutting, flame gouging, spot heating, hardening, texturing, cleaning, and thermal spraying many materials.
- The glass and materials processing industries also often use acetylene when carbon coating, because it provides a lubricated surface between two materials.
- Acetylene is mixed with oxygen or air to produce a graphitic and amorphous carbon coating that loosely adheres to the surface.

What Do Acetylene Cylinders Consist of?

Acetylene cylinders differ from other compressed cylinders in that they contain a porous filler material (or mass), and a solvent in which the acetylene is dissolved.

If acetylene were to be stored as a compressed gas in cylinders (in the same way as other gases) it would be very unstable and could decompose explosively. For this reason, it is dissolved in a solvent, which allows greater quantities of the gas to be stored at a lower pressure in a safe manner.

Decomposition is a chemical reaction whereby acetylene breaks down into its constituent elements, carbon and hydrogen. This reaction gives out a great deal of heat, which can cause the gas to effectively ignite without the presence of air or oxygen.

Decomposition can be initiated by a flash back from welding or cutting equipment, or by exposure to intense heat. It requires heat in excess of 400 °C which is normally only achieved by the direct impingement of flames on a cylinder.

There is also a theoretical possibility of decomposition initiated from a severe shock to the cylinder, such as dropping the cylinder from a height of several storeys off a building. This could result in damage to the cylinder shell and an internal cavity being created in the monolithic mass. This would then leave the cylinder prone to decomposition from any subsequent shocks.

Acetylene cylinders contain a number of features to minimise the potential for decomposition.

Acetylene is stored in maroon-coloured cylinders with left-hand connections. The robust steel cylinder shell contains the internal gas pressure and protects the porous mass against damage.

All acetylene cylinders contain a porous honeycomb material called a monolithic mass. They also contain a solvent (acetone) which is absorbed by the porous mass. The acetylene dissolves in the acetone and holds the acetylene in a stable condition. The function of the porous mass is to evenly distribute the acetone throughout the cylinder and prevent the presence of large internal voids, thereby reducing the likelihood of decomposition and controlling decomposition should it occur.

The porous mass contains thousands of small pores, which act as a stabiliser by dividing the acetylene into small units. If decomposition were to occur, the acetylene in some of the units would decompose slowly but the walls of the cells would absorb heat to the stage where decomposition can no longer continue. If a flame were to develop, the small pores would act as arrestors.

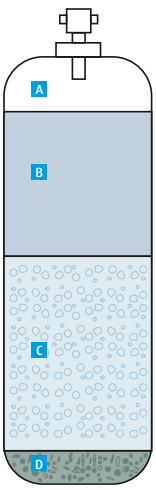
Experiments have shown that should decomposition occur and the cylinder left to cool down naturally, then the porous mass does extinguish the flame and the cylinder no longer represents a hazard.

This storage method also allows the cylinder to hold more acetylene at a lower pressure. The cylinder features a copper-alloy valve for controlling the gas flow.

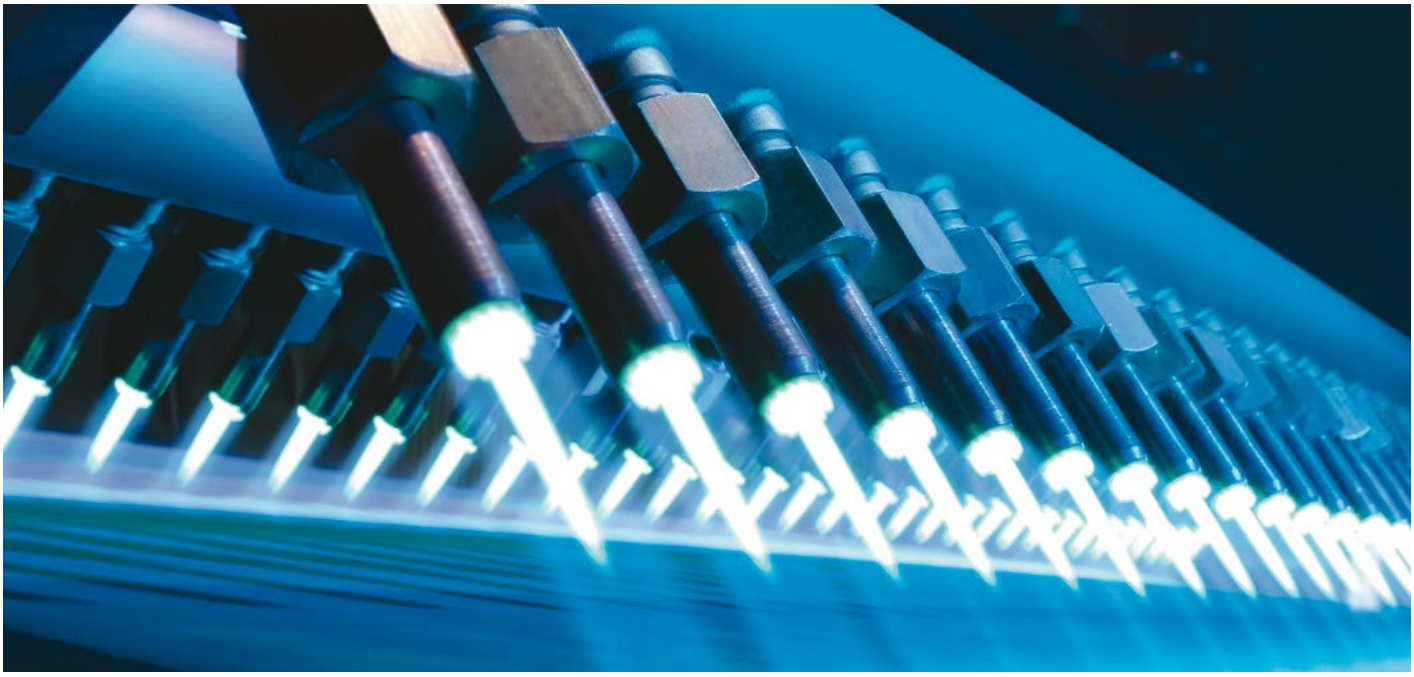
The cylinder's bursting discs release any potentially dangerous pressure safely. So if the cylinder pressure builds, this outlet minimises the risk of the cylinder rupturing or exploding.

Cylinder volume

A Space for expansion 15%, B Dissolved acetylene 33%, C Acetone 42%, D Porous mass 10%



Each of the items shown in the cylinder volume diagram are spread evenly throughout the cylinder



How should I use acetylene?

General advice
Only use acetylene in well-ventilated areas. Acetylene is lighter than air, which means it can rise into roof spaces and empty areas.

Detecting acetylene gas is easy because it has a distinctive garlic like smell, even in concentrations below 2%.

Always use an acetylene cylinder in an upright position.

If the cylinder has been transported horizontally, place it in an upright position for 12 hours prior to use, or for at least as long as the cylinder has been laid flat. This will allow the acetone to re-settle within the cylinder.

Only use regulators designed and labelled for use with acetylene.

Never interchange the regulator with those for other fuel gases or use left to right hand adapters. This is because cylinder pressure and properties are different for each gas.

Only use hoses that comply with European standard ENSS9 (formally BS 51 20) – the hose will be coloured red for acetylene.

Never try to repair damaged hoses, replace them with new ones.

Ensure a hose check valve is fitted. This will prevent oxygen and acetylene mixing in the hoses. Hoses from BOC Trad equip centres come fitted with check valves.

During use hoses must be fully extended. A fire in a coiled hose would be very intense.

When the cylinder is in use keep it away from sources of heat and prevent any hot metal dripping onto it.

Ensure the flame from the torch is never directed onto the cylinder.

Never use a leaking cylinder or connect it to leaking equipment.

Never roll the cylinder across the ground always use a cylinder trolley. Cylinders may be churned for short distances only.

Never drop or damage an acetylene cylinder.

Calculating the Acetylene You Need

Before using, work out how much acetylene you need. It is always safer to be conservative about how much gas can be withdrawn from a cylinder as opposed to optimistic.

If you require significant amounts of acetylene, you should consider using MCPs (manifolded cylinder pallets) or installing a pipeline.

The amount of acetylene that can be taken from a cylinder is limited by the rate at which the solvent will give up the gas and the temperature at which the acetylene cylinder is being stored.

The table on the right shows acetylene withdrawal against storage temperature for cylinders between 6 and 8m3 capacity (m3/hr). These figures demonstrate that if you use the acetylene occasionally, not continuously, you can withdraw around 50% more at any time. That's because the monolithic mass and acetone can only release a certain amount of acetylene.

Remember – the table on the right only refers to full, large-size cylinders. As the cylinder empties, the maximum withdrawal rates will fall despite how much you're using the product.

Should this limit be exceeded then acetone will be withdrawn along with the acetylene. This is characterised by the flame taking on a yellow or green tinge.

As the stored temperature falls then it is more difficult for the acetone to give up the acetylene and the withdrawal rate reduces even further. It is recommended that acetylene should be stored away from the elements as much as possible. In very low temperatures some form of indirect heating can be provided to ensure cylinder withdrawal is maximised.

Please contact our freephone number 0800 111 333 for more information regarding this.

Acetylene withdrawal against storage temperature for cylinders between 6 and 8m3 capacity (m3/hr)

Temperature	Continuous	Intermittent
15 °C	0.7	1.1
0 °C	0.4	0.6
-10 °C	0.3	0.5

Preparation for use

It is important that the correct procedure for lighting up is followed in order to prevent a flashback or backfire.

Lighting up procedure

- Ensure the cylinders are located so that, where possible, they are within view of the operator and are restrained to avoid them being knocked over.
- If the cylinders are on a trolley, ensure the fuel gas regulator outlet is pointing away from the oxygen cylinder.
- Check all equipment including regulators, safety devices, hoses and torches, for damage and insure the equipment is in a good condition
- Assemble the equipment in accordance with manufacturers instructions.
- Ensure the pressure adjusting screws on both regulators are fully wound out.
- Pressurise the system by slowly opening each cylinder valve in turn. Never open a valve completely, one and a half turns is sufficient.
- When using a cylinder key to open the valve, leave the key fitted to the valve while the cylinder is in use.
- Leak test assembled equipment (using leak detector fluid). Check for leaks on all connections from the regulators to the torch. If a leak is present turn the cylinder off, vent the equipment of gas, then tighten or refit the piece of equipment. Never use tape or a sealing compound to stop leaks.
- Set gas pressures to manufacturer's recommended values.
- Open valves on the torch and purge oxygen and acetylene hoses in turn. This should be conducted in a well ventilated area and away from any source of ignition.

It is essential that the purging of the system takes place following each period of non-use.

- Adjust gas pressures as necessary, while the gas is flowing.
- Shut off valves on torch.
- Open the acetylene valve and light the torch using a spark lighter. The torch should be pointing upwards for acetylene. Adjust in accordance to manufacturer's instructions. The acetylene should be burning without generating carbon particles in the air. If these are being generated, open the acetylene torch valve further.
- Slowly open the oxygen valve and introduce oxygen until a neutral flame is seen.

Safe shut down

- Extinguish the flame by closing the acetylene torch valve.
- Close the oxygen at the torch valve.
- Close both cylinder valves.
- Open the torch valves, in turn, to vent hoses.
- Once regulator outlet gauges read zero, turn the pressure adjustment screws anticlockwise to prevent damage to the regulator diaphragm.
- Close the valves on the torch.
- Visually check equipment for any damage.
- Return cylinders to the storage area.

What Are the Recommended Safety Procedures?

Avoiding "flashbacks"

A flashback occurs when acetylene and oxygen mixes and burns in the hose, either because the recommended procedures haven't been observed, the nozzle is blocked, the equipment is leaking, or through backfeeding (when a higher pressure gas feeds back up a lower pressure stream). The flame travels back to the gas source and can lead to a fire or explosion in either or both the oxygen and acetylene cylinders.

- Always ensure your acetylene and oxygen cylinders are fitted with flashback arrestors downstream of pressure regulators. This ensures compliance with BCGA (British Compressed Gas Assoc iation) code of practice 7.
- The flashback arrestor must be designed to comply with BS EN 730.
- Flashback arrestors should be replaced every five years , or at the manufacturer's recommended interval .
- Acetylene manifolds must also be fitted with a flashback arrestor.

Dealing with a"flashback"

If a flashback occurs, take the following actions:

- Close both torch valves – oxygen first.
- Close the oxygen and acetylene cylinder valves.
- Check the acetylene cylinder all over with the back of your bare hand for a rise in temperature. If the temperature of the cylinder shell rises, treat the cylinder as if it has been involved in a fire (see section ,In the event of a fire on your premises'). Call the fire brigade immediately. Do not move the cylinder or open the valve.
- If the temperature of the acetylene cylinder shell does not rise, open the torch valves to release any pressure in the system and then unwind the pressure adjustment screw on each regulator.
- Ascertain the cause of the incident and examine all equipment for damage. Also check for any signs of soot.
- Replace any damaged equipment.
- Ensure the hose check valve is reset or replaced as necessary, prior to attempting to re-light the equipment.

Avoiding backfires

A backfire occurs when the flame from the torch regresses into the body or neck of the blowpipe and rapidly self extinguishes. A backfire will become sustained when the flame remains alight. This can be identified by a "popping" or "squealing" sound. Again this can be caused though not using the correct pressures, lighting up procedures or damaged and blocked equipment.

Dealing with a backfire

If a backfire occurs take the following actions:

- Close both torch valves – oxygen first.
- Check the regulator pressure settings are correct and that the cylinders are not empty.
- If the nozzle or torch has overheated, immerse it in cold water.
- Check that the nozzle is tight and undamaged.
- Purge each hose in turn and ensure the correct gas flows have been established.
- Perform the start procedure as recommended by the equipment supplier
- If the backfire recurs immediately the torch or nozzle may be faulty.
- If the cylinder starts to heat, do not move the cylinder or open the valve. Call the fire brigade immediately .See section "In the event of fire on your premises".

Leaking cylinders

If the cylinder has a leak that is not ignited and the cylinder is not getting hot, try:

- Closing the valve.
- Never try to tighten the cylinder valve in the body or tamper with safety devices.

Should this not work, take the following actions immediately:

- Extinguish all ignition sources.
- Evacuate uninvolved personnel from the area.
- Take the cylinder outside to a well ventilated area
- Call the BOC Customer Service Centre on 0800 111 333.
- Ensure the work area is thoroughly ventilated before returning.
- If the cylinder is hot, please see, In the event of fire on your premises'. Do not move the cylinder or open the valve.

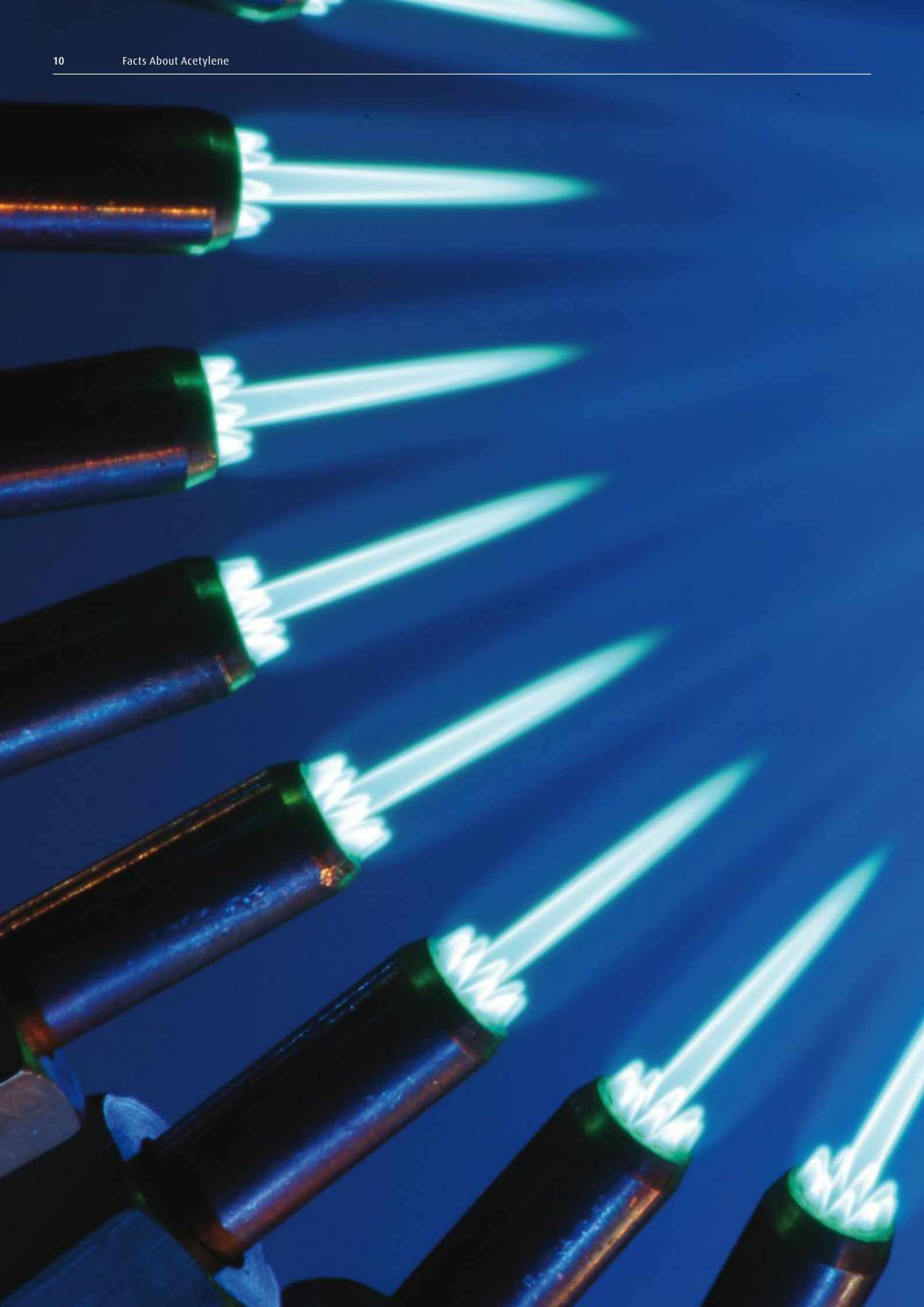
Ignited leaks

Fires from small leaks from the cylinder regulator and its connections may usually be safely extinguished if action is taken quickly. If the cylinder is standing alone and the fire is small and isn't affecting other flammable materials or cylinders:

- Extinguish all ignition sources.
- If it is believed that closing the valve can stop the leak, extinguish the flame with a dry powder extinguisher or a wet rag and close the valve. Wear leather gauntlets and keep hands clear of any fusible plugs.
- Check to see if the leakage has stopped. Check the cylinder with the back of your bare hand for hot areas.
- If the cylinder shows signs of heating call the fire brigade immediately. Do not move the cylinder or open the valve. See section, In the event of fire on your premises'.
- Evacuate personnel to a safe location.
- Call the BOC Customer Service Centre on 0800 111 333.
- If the flame is impinging on flammable materials or other cylinders, follow the actions below.

In the event of fire on your premises

- Evacuate the area (minimum 200 metres) and call the fire brigade.
- Make available the type, number and location of your cylinders. If they don't have this information, they can't enter your premises to deal with the situation.
- Do not approach or move the cylinders.
- Wait for the fire brigade to attend
- Ensure nobody tampers or interferes with the cylinder during this period.
- Call the BOC Customer Service Centre on 0800 111 333 as soon as possible. BOC will arrange for recovery of the cylinder.



How can I minimise exposure to incidents?

There are many things a good company can do to minimise exposure to the risk of gas cylinder incidents:

- Do not store full or empty cylinders inside a building.
- Only take the minimum number of cylinders into a building which are required for actual use.
- Be sure the contents and location of cylinders on your site are known and can be explained to the fire brigade in the event of a fire.
- Follow the guidelines, in this factsheet, for the safe storage and use of acetylene cylinders (also see BCGA code of practice CP6 and guidance note GN2).
- Ensure all welding and cutting equipment is maintained in good order, leak tested and fitted with the correct non return valves and flashback arrestors (see code of practice CP7).
- Keep cylinders away from sources of heat and flammable materials.
- Ensure all staff are fully trained and assessed as competent in the use of the gas cylinders and related equipment.

How should I store acetylene cylinders?

- The storage area should be outside in a well-ventilated area.
- The store should be located 5 metres from other buildings, or separated by a double brick wall to give fire resistance of at least 30 mins. It should also be away from boundary fences. (see BCGA code of practice CP6 for separation distances).
- Store cylinders in a structure that prevents any damage from physical impact, protects cylinders from extreme weather conditions and is away from potential heat and ignition sources .
- The structure should be constructed from non-combustible materials
- Ensure ease of access in and around the structure, considering access for deliveries and emergency services.
- Ensure the store is secure and restrict access to authorised personnel only.
- Ensure the store features good warning signs, including the type of gas stored, no smoking, and labelled areas for full and empty cylinders.
- Always store cylinders in an upright secured position on a well-drained and level surface. Never stack acetylene horizontally.
- Store all full and empty cylinders with the cylinder valves closed, except MCPs, where the individual valves should be left open and the outlet valve closed.
- Separate full from empty cylinders.
- Segregate all full and empty acetylene cylinders from oxidising gases (such as oxygen).
- Periodically check stored cylinders for general condition and leaks.

For more information on storing acetylene, please see:

- BCGA guidance note GN2
- BCGA code of practice CP6
- BOC Safe under Pressure booklet
- BOC Safety training workshops

How safe is acetylene?

Acetylene is the most flexible oxy-fuel gas and is used across multiple welding and metal cutting applications. Put simply, there is no replacement for it and when handled, stored and transported correctly, Acetylene is perfectly safe and has been invaluable to industry for over one hundred and sixty years.

BOC Conducts rigorous tests to ensure all acetylene cylinders pass strict international safety standards (ISO 3807). Below are a few test examples:

- Drop test: to simulate heavy use, cylinders are overfilled and dropped from a height of 0.5 metres one hundred times .
- Elevated temperature test: to simulate cylinders being kept in hot conditions, a cylinder is placed in a water bath and heated to 65 °C, checking the cylinder doesn't burst.
- Backfire test: to simulate a flashback, cylinders are subject to an internal detonation to ignite a fire. To pass the test, the fire must extinguish itself, and the cylinder must not leak, explode or show any sign of distress.

These test results are then submitted to the Health and Safety Executive to obtain formal approval for the operationof the cylinders.

Also, all BOC acetylene cylinder shells are designed to withstand a minimum test pressure of 5 I bar (750 psi). However, many cylinder shells are designed to withstand pressures of over 60 bar (870psi). In comparison, propane cylinders only have a test pressure of 25–30 bar.

For more safety information, please request a copy of the BOC Acetylene Material Safety Data Sheet by calling the Customer Service Centre free on 0800 111 333.

BOC is a Linde company, the Leading Global Gases and Engineering Business with a Mission to Make the World More Productive

We are the UK and Ireland's largest provider of industrial, medical, and special gases as well as related equipment, engineering services, and solutions to support them.

We produce, package, and distribute thousands of different types of gases to our customers every day. Our unrivalled range includes atmospheric gases, high purity gases and mixtures, refrigerants, and chemicals, for applications as diverse as cooling magnets in hospital MRI scanners to fuelling zero emissions vehicles and much more.

BOC offers tailored supply solutions for every size of customer; our cylinder customers enjoy a nationwide delivery and collection network; bulk customers the reassurance of 24/7 delivery; and for our high-demand customers we offer onsite production or dedicated pipeline supply.

And all of this is backed up by industry leading customer service, expert technical support and best-in-class levels of safety and environmental performance – the basis on which we have earned our reputation as a reliable and trusted partner.

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