



SAFETY BULLETIN 01/05

ASIA INDUSTRIAL GASES ASSOCIATION

3 HarbourFront Place, #09-04 HarbourFront Tower 2, Singapore 099254

www.asiaiga.org

Safe use of acetylene

This document is for people who use acetylene for welding, cutting and similar processes. It provides advice and information on the fire and explosion hazards of acetylene

This document is based on a UK Health and Safety Executive Document - INDG 327. Acknowledgment is duly made here.

It is meant to give advice and guidance only – Risk assessment should be applied when using the gas in unusual circumstances. The gas or equipment supplier should be consulted in these cases.

Acetylene Cylinder Explosion

Below is a description of an acetylene cylinder explosion.

An operator was lighting an oxy/acetylene cutting torch. There was a flashback to the acetylene cylinder, which started to vibrate.

Three minutes later the cylinder exploded.

The cylinder split into two parts. The largest part shot through a window and traveled over 20 metres before embedding itself in an embankment at the factory boundary.

The workshop was badly damaged. The windows were blown out and the roof collapsed. The explosion also lifted the roof of the main factory building, which had to be replaced. The cost of the damage was over \$US 2 million

Fortunately, no one was injured, because the operator realized that the cylinder was in a dangerous condition. He raised the alarm and the factory was immediately evacuated.

What went wrong

Acetylene is an extremely flammable gas. It is different from other flammable gases because it can also become unstable. Under certain conditions, it can decompose explosively into its constituent elements, carbon and hydrogen.

The operator did not fully appreciate the hazards of acetylene. He did not follow the recommended procedures or take adequate precautions.

In particular:

- The correct lighting up procedure was not followed.
- The gas hoses were not purged.
- The acetylene gas was not at the correct pressure.
- The gas cylinders were not protected with flashback arresters.

Note: A flashback can occur when.....

There is a flammable mixture of fuel gas and oxygen in the hoses when the torch is lit. If it is not stopped, the flame will ignite the mixture and will travel backwards from the torch, along the hoses, through the regulator and into the cylinder.

A flashback can also trigger decomposition of the acetylene in the fuel hose, in the regulator and in the cylinder itself. Decomposition within an acetylene cylinder can lead to the cylinder exploding.

Hazards of Acetylene Cylinders

There are a number of incidents each year where a flashback into an acetylene cylinder triggers decomposition, leaving the cylinder in a dangerous, unstable condition. An explosion of the cylinder only three minutes after a flashback in the above incident is extremely rare. In most cases, if the decomposition is identified at an early stage, there is time for the building to be evacuated, the emergency services to be called and for emergency action to be taken.

To make an unstable cylinder safe, the emergency services or local firefighting team may have to apply cooling water for many hours. It could be several days before the cylinder can be moved, because moving the cylinder could restart or accelerate the decomposition.

These incidents put at risk anyone in the vicinity of the cylinder and anyone who tries to make the cylinder safe, such as the emergency services. Moving Acetylene cylinders that are decomposing and therefore hot is extremely dangerous as they can explode. This has happened and resulted in fatalities.

Acetylene cylinders can be used safely

Acetylene cylinders have a different design from most other gas cylinders. It consists of a steel casing or shell containing a porous mass. The porous mass is a cellular structure which completely fills the cylinder. The acetylene gas in the cylinder is dissolved in acetone or a similar solvent which is absorbed by the porous mass.

Decomposition of the acetylene is usually triggered by heat.

For example, if the cylinder is:

- Involved in a fire
- Scorched by flames from a blowtorch
- Involved in a flashback

The porous mass is designed to slow down or stifle any decomposition of the gas. From the start of decomposition to the cylinder exploding it would normally take several hours. This will usually (but not always) provide time for emergency action.

Decomposition can be triggered more easily and can proceed more rapidly if:

- The porous mass has been damaged by repeated flashbacks or by mechanical damage including denting the cylinder shell by mishandling or subjecting the cylinders to impact.
- The cylinder valve is leaking gas (an open or leaking valve increases the rate of decomposition within the cylinder).
- The acetylene in the hoses is above the pressure recommended by the gas or equipment supplier. For most welding and cutting processes the acetylene pressure should not exceed 0.62 bar (9 p.s.i.)

What can be done to prevent flashback

Training

DO NOT use or let your employees use oxy/acetylene equipment unless training has been conducted. This training will make the operation safer and more cost effective in the use of gas.

Use the correct lighting-up procedures

- Before lighting the blowpipe, purge the hoses by opening the gas supply to each hose for a few seconds. This will flush out any flammable mixtures of gases in the hose. Purge one hose at a time and close the blowpipe valve after purging. Do this in a well-ventilated area.
- Use a spark igniter to light the gas. An igniter only provides a spark when and where it is wanted. The spark required to light the gas is low energy and is unlikely to cause a fire elsewhere.
- Use the correct gas pressures and nozzle sizes for the job.

Handle acetylene cylinders with care

- DO NOT drop them from height or subject them to impact; any dents in the cylinder can damage the porous mass inside.
- DO NOT roll them across the floor – DO NOT use them as rollers to move steel plate
- Keep cylinders in an upright position when being used. Ideally transport the cylinders vertically but it is more important to transport securely and they should not be transported without restraint and protected from impact. If a cylinder has been transported horizontally then store in upright position for at least two hours before using.

Fit and maintain flashback arresters

- Fit flashback arresters onto the pressure regulators on both the acetylene cylinder and the oxygen cylinder.
- For long lengths of hose typically in excess of 5 metres fit arresters on both the blowpipe and the regulator. DO NOT join hoses – contact your supplier for long hoses and advice.
- Take advice from your gas or equipment supplier regarding maintenance or replacement of these safety devices

Fit and maintain non-return valves (sometimes called check valves)

- Fit non-return valves (often called check valves) on the torch, to prevent back feeding of gas into the hoses.
- Inspect regularly and replace damaged non-return valves. Take advice from your gas or equipment supplier regarding maintenance or replacement
- Note: non-return valves will not stop a flashback once it has occurred.

Keep nozzles in good condition

- Poorly maintained nozzles cause turbulent gas flow, which increases the risk of flashback.
- Inspect nozzles regularly. Make sure they are not blocked by dirt or spatter. Replace damaged nozzles.
- DO NOT hold the nozzle too close to the work piece. The nozzle can overheat and cause a flashback.

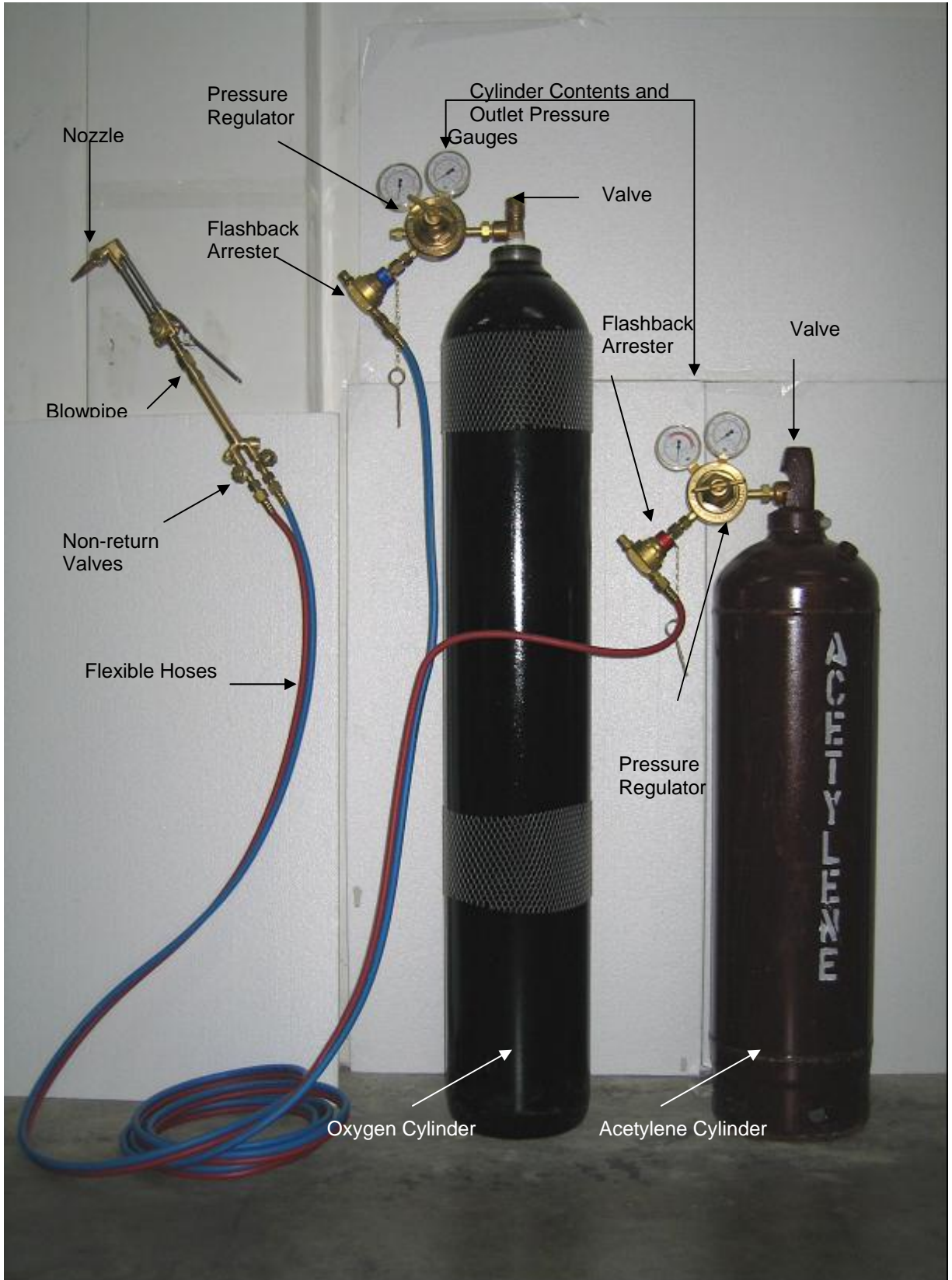
If a flashback does occur

- Immediately close the cylinder valves, both acetylene and oxygen, if it is safe to do so. The flame should go out when the fuel gas (acetylene) is shut off. If the flame cannot be put out at once, evacuate the area and call the emergency services and the gas supplier.
- Check any acetylene cylinder which has been involved in a flashback or which may have been affected by fire or flames. If it becomes warm or starts to vibrate, evacuate the building immediately and call the emergency fire services. Also call the gas supplier.
- DO NOT attempt to move an unstable cylinder. Direct water spray at the cylinder body, if it is safe to do so. This must be done from a safe location. Seek advice from the gas supplier
- DO NOT re use a cylinder that has been involved in a flashback – contact the gas supplier
- Before using the equipment again have it checked by a trained authorized person or contact the equipment supplier for advice

Typical equipment used in oxy/acetylene gas welding and cutting

See below a typical oxy/ acetylene welding and cutting set. The **cylinder colours** vary in some countries so if in doubt the label on the cylinder should be checked to verify correct gas and safety features.

**Note for illustration purposes these cylinders are not restrained.
Normally all gas cylinders should be secured to prevent fall**



Disclaimer

All technical publications of AIGA or under AIGA's name, including Codes of practice, Safety procedures and any other technical information contained in such publications were obtained from sources believed to be reliable and are based on technical information and experience currently available from of AIGA and others at the date of their issuance.

Where AIGA recommends reference to or use of its publications by its members, such reference to or sue of AIGA's publications by its members or third parties are purely voluntary and not binding.

Therefore, AIGA or its members make no guarantee of the results and assume no liability or responsibility in connection with the reference to or use of information or suggestions contained in AIGA 's publications.

AIGA has no control whatsoever as regards, performance or non-performance, misinterpretation, proper or improper use of any information or suggestions contain in AIGA's publications by any person or entity (including AIGA members) and AIGA expressly disclaims any liability in connection thereto.

AIGA's publications are subject to periodic review and users are cautioned to obtain the latest edition.

© AIGA 2005 - AIGA grants permission to reproduce this publication provided the Association is acknowledged as the source