SAFE BLOW-DOWN OF ACETYLENE CYLINDERS AND BUNDLES

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1 Introduction

There have been several acetylene cylinder blow-down fire incidents when cylinders have been vented in the yard. These incidents have the potential for operators to be seriously burnt or for an explosion to occur following an uncontrolled release of acetylene. This document has been prepared by the European Industrial Gases Association (EIGA) to give guidance on the safe blow-down of acetylene cylinders and bundles.

2 Scope and purpose

2.1 Scope

The scope covers individual cylinders and bundles containing different porous materials and different solvents.

This publication is intended for use by gas companies filling acetylene as well as cylinder test shops and cylinder scrapping facilities.

2.2 Purpose

This document provides guidance on safe blow-down practices.

3 Definitions

3.1 Publication terminology

3.1.1 Shall

Indicates that the procedure is mandatory. It is used wherever the criterion for conformance to specific recommendations allows no deviation.

3.1.2 Should

Indicates that a procedure is recommended.

3.1.3 May

Indicates that the procedure is optional.

3.1.4 Will

Is used only to indicate the future, not a degree of requirement.

3.1.5 Can

Indicates a possibility or ability.

3.2 Technical definitions

3.2.1 Acetylene Cylinder

Pressure vessel, manufactured and suitable for transport of acetylene, containing a porous material and solvent for dissolving acetylene (or solvent-free where applicable) with valve and other accessories fixed to the cylinder.

3.2.2 Acetylene cylinder bundle

Transportable unit consisting of two cylinders up to usually not more than 16 cylinders permanently manifolded together and contained within a rigid frame equipped with all necessary equipment for filling and use.

3.2.3 Acetylene gasholder

Device for storing the acetylene produced before cylinder filling (used in low-pressure acetylene plants).

3.2.4 Blow-down

Blowing down acetylene cylinders is the removal of acetylene from the cylinder to partially or completely reduce the pressure in the cylinder. "Blowing down" is also sometimes referred to as blowback, venting, emptying, or de-gassing.

3.2.5 Flame arrestor

Device that quenches a flame front.

3.2.6 Pressure

In this publication bar shall indicate gauge pressure unless otherwise noted i.e., (bar, abs) for absolute pressure and (bar, dif) for differential pressure.

4 Blowing down acetylene cylinders and bundles

Acetylene gas shall be released from acetylene cylinders and bundles in the following situations:

- when they are overfilled.
- to reduce the acetylene cylinder pressure to the required parameter prior to filling and replenishing with solvent (see also EIGA Doc 26, *Safe Filling of Acetylene Cylinders, Bundles and Battery Vehicles* [1][1])
- before maintenance, e.g. when the acetylene cylinder or bundle is defective or requires repair such as replacing leaking cylinder valves.
- before requalification.
- before scrapping.

In case of a leaking package, a risk assessment shall be completed before it’s being vented.

4.1 Blow-down manifold

Acetylene cylinders and bundles shall be blown down using a manifold specifically designed and approved for that purpose. The blow-down manifold comprises a rack to which cylinders and/or bundles are connected.

A risk assessment shall be completed before venting manifolds at cold temperatures to prevent forming acetylene hydrate or moisture freezing in the manifold.

Where possible, the recovered acetylene should be re-used to minimize the environmental impact of the gas emissions; for that purpose, the recovered acetylene should be directed to the low-pressure part of the system (e.g. to a gasholder or the compressor suction line header).

[1] References are shown by bracketed numbers and are listed in order of appearance in the reference section.

A blow-down manifold directed to atmospheric vent (through a high-level vent in a safe area) shall be used to blow-down acetylene cylinders or bundles when:

- acetylene cylinders or bundles whose contents are of unknown quality that can affect the process and quality of the final product if the acetylene is re-used.

- normalizing the pressure to atmospheric conditions in an acetylene cylinder or bundle before it is de-valved / dismantled where otherwise the system blow-down manifold restrictors or exit pressure would prevent complete pressure reduction.

- Cylinders and/or bundles containing different types of solvent shall not be blown down at the same time on the same manifold due to the potential risk of cross-contamination of solvents between cylinders.
  If there are different manifolds used for the blow-down of cylinders and/or bundles containing different types of solvent but directed to a common venting point or collecting vessel, the design shall consider back flow protection to avoid cross-contamination between manifolds.

4.2 Blow-down rate

Cylinders and bundles containing acetylene should not be blown down too quickly.

This is because:

- the solvent can be carried over with the acetylene if the blow down rate is too high, especially when the solvent is acetone.

- rapid blow-down cools the inside of the cylinder and reduces the cylinder pressure, this can result in a false pressure indication. There could still be considerable amounts of gas in the cylinder which is released when the cylinder warms up again.

The blow down rate shall be controlled e.g. by a pressure regulator or other flow restriction (e.g. orifice) to ensure the gas is completely withdrawn at an appropriate rate and to mitigate any potential adiabatic compression effects within the manifold. A typical vent rate is $1/8^{th}$ of the nominal acetylene cylinder capacity per hour (for example for an acetylene cylinder with a nominal capacity of 8kg of acetylene, the typical vent rate is 1 kg/h). [see ISO 11372, *Acetylene Cylinders* [2].

The blow-down period varies with cylinder size and amount of residual gas. For example, it may be shortened for smaller cylinders or for cylinders containing very little residual gas.

Blowing down back to the low-pressure part of the system only reduces the cylinder / bundle pressure to the operating pressure of the generator / gasholder. If the pressure needs to be reduced completely the cylinders should then be vented to atmosphere through the blow-down manifold.

After the pressure has decayed, it is recommended to leave all cylinders on the blow-down manifold with their valves open until they are warmed to ambient temperature. During this time, do not add or remove any cylinders from the manifold.

In case the manifold is equipped with a water trap, take precautions to avoid water to be sucked into the acetylene cylinders or bundles.

4.3 Temperature effects

If the temperature of the cylinder / bundle after blow-down is lower than the ambient temperature where the valve is to be removed, there is a possibility of the cylinder / bundle warming up with a consequent pressure build-up. This can result in a further discharge of acetylene when the cylinder valve is removed. Therefore, the cylinder / bundle should be normalized on the atmospheric blow-down manifold prior to removal of any cylinder valve. Special attention should be paid to the cylinders positioned in the inner part of the bundle once they will receive less heat influx compared to the outer cylinders.

4.4 Blocked or broken valves

If a cylinder / bundle is suspected to have a blocked or inoperable valve, the following checks could be performed:

- There is no pressure reading on the pressure gauge, but the cylinder / bundle weighs more than the tare weight.
- The cylinder / bundle weighs the same after being on the blow-down manifold as it did before the blow-down.
- No gas flow is observed during the whisper test (see ISO 25760, *Gas cylinders – Operational procedures for the safe removal of valves from gas cylinders*) [3]

Acetylene cylinders / bundles with blocked or broken valves shall be blown down:

- using an approved and risk-assessed method statement and procedure
- only by competent personnel experienced and trained in the procedure.

There are several methods that could be used to remove acetylene gas from cylinders with blocked or broken valves. The process used locally can vary depending upon the valve type, the specific damage, as well as the experience and skill level of local examination shop staff. Before any process is used locally, carry out a risk-assessment to ensure all risks are identified and safety precautions are applied. Supplementary information can be found in EIGA Doc 129, *Pressure Receptacles with Blocked or Inoperable Valves* [4].

4.5 Blow-down manifold design considerations

Points to consider during the manifold design:

- The manifold pipework shall be designed and manufactured to withstand acetylene decomposition pressures). Materials of components of the venting manifold shall be compatible with acetylene (For details see Doc 123, *Code of Practice - Acetylene* [5]).
- The system shall be designed to inherently restrict the flow-rate of acetylene venting from each of the cylinders / bundles into the manifold to minimize solvent carry-over.
- When venting to the gas holder or low pressure part of the process, the total flow shall be limited to avoid over-pressurisation or overfilling the downstream system.
- A flame arrestor shall be installed between the blow-down manifold and the downstream system to prevent a possible decomposition to spread to or from the blow-down manifold.
- An automated shutoff valve in the vent & return lines is recommended so that the flow can be stopped in an emergency, for example a plant evacuation.
- For atmospherically vented blow-down manifolds the design flow rate shall consider the sum of all individual flows and the potential dispersion at the vent outlet. This shall be used to define safe distances versus ignition sources or other risks (i.e. air intakes in buildings) and considered in the Explosion Protection Document (EPD).
- Appropriate lightning protection and earthing shall be provided.

5 References

Unless otherwise specified, the latest edition shall apply.

[1] EIGA Doc 26, *Safe Filling of Acetylene Cylinders, Bundles and Battery Vehicles*, www.eiga.eu

[2] ISO 11372, *Acetylene Cylinders*, www.iso.org

[3] ISO 25760 *Gas cylinders – Operational procedures for the safe removal of valves from gas cylinders,* www.iso.org

[4] EIGA Doc 129, *Pressure Receptacles with Blocked or Inoperable Valves,* www.eiga.eu.

[5] EIGA Doc 123, *Code of Practice – Acetylene*, www.eiga.eu