ACETYLENE INSTALLATIONS AT CUSTOMER PREMISES

Doc 212/18

EUROPEAN INDUSTRIAL GASES ASSOCIATION AISBL

AVENUE DES ARTS 3-5 • B – 1210 BRUSSELS
Tel: +32 2 217 70 98 • Fax: +32 2 219 85 14
E-mail: info@eiga.eu • Internet: www.eiga.eu

Doc 212/18

ACETYLENE INSTALLATIONS AT CUSTOMER PREMISES

Prepared by WG-12 Acetylene

Disclaimer

EUROPEAN INDUSTRIAL GASES ASSOCIATION AISBL
Avenue des Arts 3-5 B 1210 Brussels Tel +32 2 217 70 98 Fax +32 2 219 85 14
E-mail: info@eiga.eu Internet: www.eiga.eu

Table of Contents

Tables

Figures

1 Introduction

Acetylene is a substance with unique properties; it is extremely flammable and can decompose explosively.

These unique properties shall be taken into account when designing and operating an acetylene installation.

This publication has been prepared by the European Industrial Gases Association (EIGA) to provide guidance for the design and the safe operations of acetylene customers' installations.

Acknowledgement is given to the British Compressed Gases Association for using information from their publications BCGA Code of Practice 5 *The design and construction of manifolds using acetylene gas from 1.5 to 25 bar* and BCGA Code of Practice 6 *The safe distribution of acetylene in the pressure range 0 – 1.5 bar* [1,2] [1].

2 Scope and purpose

2.1 Scope

This publication details the best available current practices for the design of acetylene fixed and mobile supply systems, which generally include:

- high pressure manifold;
- low pressure distribution system; and
- point of use.

The publication also includes recommendations for the maintenance and operations of the equipment that are part of these installations.

The publication does not apply to acetylene plants and it is not intended to replace manufacturers and company instructions, but should be used in conjunction with such instructions.

Installations that use trailers or bundles of cylinders as the acetylene source and then compress this into cylinders are excluded from this publication.

2.2 Purpose

To give recommendations for the safe operation of acetylene supply systems on customers' premises.

3 Definitions

3.1 Publications 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

Indicate that the procedure is optional.

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

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 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.

3.2.2 Acetylene system

Any equipment instrument, device from the cylinder valve or bundle outlet connection to the use point.

3.2.3 Automatic quick acting shutoff device

Self-acting device which closes quickly, for example when triggered by acetylene decomposition.

3.2.4 Deflagration

Explosion propagating at subsonic velocity.

3.2.5 Detonation

Explosion propagating at supersonic velocity.

3.2.6 Distributed system

Acetylene system with fixed or permanent piping.

3.2.7 Explosion

Abrupt oxidation or decomposition reaction producing an increase in temperature, pressure, or in both simultaneously.

3.2.8 Flame arrestor

Device that quenches a flame front.

3.2.9 Flashback arrestor

Device that stops a flame front and the flow of gas. This device can be activated either by a pressure shock wave or by a temperature sensing device.

This is also known as decomposition blocker, see EN ISO 14114 *Gas welding equipment -- Acetylene manifold systems for welding, cutting and allied processes -- General requirements* [3].

3.2.10 Localized system

Acetylene system without fixed or permanent piping, normally being just a flexible hose, for example a torch.

3.2.11 Manifold system

System of two or more cylinders connected on the high-pressure side for collective withdrawal.

3.2.12 Pressure range:

Acetylene systems in customer installations are divided into one of the following pressure ranges:

- Low pressure: Pressure not exceeding 1.5 bar (0.15 MPa)
- *High Pressure:* Pressure greater than 1.5 bar (0.15 MPa) but not exceeding 25 bar (2.5 MPa)

This publication uses bar as the unit of pressure, and if not stated otherwise, the pressure is stated as bar gauge.

3.2.13 Working range

Refer to EIGA Doc 123, *Code of Practice – Acetylene* [4].

4 Design of acetylene installations

4.1 Materials

All materials used shall be resistant to the action of the acetylene, its impurities and other substances, for example, acetone or dimethylformamide (DMF) carried over during use of acetylene, under the operating conditions. Where relevant, atmospheric corrosion shall be taken into account.

Equipment, including pipework, valves and fittings, shall withstand not only the stresses at maximum operating pressure but also the thermal and mechanical stresses resulting from acetylene explosion or decomposition.

4.1.1 Recommended materials

Seamless carbon steel or stainless steel is the recommended material for acetylene pipework.

For valves and fittings other materials such as brass are acceptable, based on Table 1.

For welded pipework, the materials chosen shall have suitable characteristics and the strength of the weld shall be not less than that of the material to be welded.

In some countries, regulatory requirements specify the welded materials to be certified.

4.1.2 Materials not allowed

Certain metals, such as copper, silver and mercury, can form very sensitive compounds with acetylene, which can easily explode. Other metals, such as aluminium, magnesium or zinc can suffer severe corrosion under the influence of the impurities that occur in acetylene.

The following restrictions shall be observed:

Table 1 Material restrictions

Material	Conditions for Use
Copper	Not allowed
Silver	Not allowed
Mercury	Not allowed
Copper alloys containing more than 70% of copper	Not allowed
Copper alloys containing up to 70% of copper	Generally permitted. Consideration (not to use) should be given to the use of copper alloy when large surfaces are in contact with acetylene (e.g. filters)
Grey cast iron Malleable cast iron Spheroidal graphite cast iron forged iron	Only for fittings, valve housing and similar components. Refer to EN 1561, *Founding. Grey cast irons* and EN 1562 *Founding. Malleable cast irons* [5,6]
Silver alloys	Suitable for brazing if silver content is lower than 43% and copper content is lower than 21% and the gap between the two parts does not exceed 0,3 mm.
Aluminium, zinc, magnesium, and their alloys	Not recommended for components, which come in contact with wet acetylene contaminated with lime or ammonia (un-purified generator gas).
Zinc	Suitable as external anti-corrosion protective coating.

4.1.3 Sealing and plastic materials

Compatible plastic materials are listed in EN ISO 14114 *Gas welding equipment -- Acetylene manifold systems for welding, cutting and allied processes -- General requirements* and EN ISO 11114-2 *Gas cylinders. Compatibility of cylinder and valve materials with gas contents. Non-metallic materials* [3, 7].

4.2 Design considerations

All pipework shall be supported and, where relevant, protected from mechanical impact and vibration.

Acetylene pipelines shall not be used for earthing and/or as an electrical conductor.

Electrical wiring shall meet current electrical installation standards with a minimum distance of 50 mm from electrical conduits.

Acetylene systems shall be bonded to ensure equipotential and earthed against build-up of static electricity. The maximum resistance to earth shall be 10 ohms.

If possible, the installation of electrical equipment in acetylene storage areas should be avoided; if needed, electrical equipment shall meet the local electrical code of practice (Gas Group IIC, Temperature Classification T2 and Zoning Classification as determined).

Vent lines shall be protected from blockage, for example, by ice and shall discharge outdoors to a safe area, where accumulation of gas will not occur.

It is good practice for the gas source and high pressure piping to be located outdoors separated by a firewall from the indoor usage points.

NOTE Local regulations can require specific requirements for a fire wall, guidance can be found in NFPA 221, *Standard for High Challenge Fire Walls, Fire Walls, and Fire Barrier Walls* [8].

Warning notices shall be displayed in accordance with current legislation, for example ATEX Directive *on the harmonisation of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres* [9]. It is a good practice to have a fire-resistant sign “Acetylene-Flammable Gas”.

4.3 Limitations on gas draw-off rate

Typical values for acetone and DMF solvent cylinders are approximately:

- Intermittent use: 1/7 of the cylinder contents per hour;
- In case of sensitivity to solvent carry-over: 1/10 of the cylinder contents per hour; and
- Continuous use: 1/15 of the cylinder contents per hour.

At lower temperatures and pressure draw-off rates will decrease.

5 High pressure manifolds

5.1 General

High pressure acetylene manifold systems shall be fitted with the following system components:

5.1.1 High-pressure non-return valves

High-pressure non-return valve shall be installed immediately downstream of the acetylene source (cylinder or bundle) to prevent backflow.

This may be part of the acetylene source of supply, for example, the bundle can include this non-return valve. If the customer installation relies upon the non-return valve being part of the source of supply it is important for the receiver of the bundles to check that there is a non-return valve installed on the bundle.

5.1.2 High pressure flashback arrestor

High pressure flashback arrestors are recommended for bundle source systems to avoid propagation of decomposition between bundles.

This may be part of the acetylene source of supply, for example, the bundle can include this flashback arrestor. If the customer installation relies upon the flashback arrestor being part of the source of supply it is important for the receiver of the bundles to check that there is a flashback arrestor installed on the bundle.

5.1.3 High-pressure hose assemblies

High-pressure hose assemblies are installed between the cylinder/bundle and the high-pressure pipework. The length of the hoses should be kept to a minimum, usually no greater than 1.5 m, and typically with an internal diameter between 6 to 8 mm.

5.1.4 High-pressure valves

When the supply line of acetylene is provided with one or more branches, each of them shall be provided with a high-pressure stop valve that isolates the branch.

5.1.5 Venting and purging of high pressure manifolds

Purging the equipment and the piping with acetylene to remove air from the changeover manifold shall

be performed.

Purging is not required if non-return valves and isolation valves are provided and positioned at the coupling to reduce the amount of entrapped air.

5.1.6 Quick-acting shut off devices

A manual quick-acting shut-off valve or an automatic quick-acting shut-off device shall be installed to prevent continue withdrawal of acetylene if an accident occurs. The use of an automatic device is mandatory when the acetylene source are bundles.

For single cylinder systems, a safety device with multiple functions according to EN 730-1 *Gas welding equipment. Safety devices. Incorporating a flame (flashback) arrestor* [10] is recommended.

5.1.7 Pressure gauges

Pressure gauge shall be installed on the upstream side of the pressure regulator. It may be an integral part of the regulator or a separate device.

5.1.8 Main pressure regulator

A cylinder or manifold regulator shall be installed to reduce the source pressure to the distribution pipeline pressure.

5.1.9 Pressure protection device

A pressure relief device or a pressure-sensitive cut-off valve shall be installed to protect the low-pressure distribution system. When pressure sensitive cut-off device is used, the upstream piping of the device shall be rated for high pressure system.

5.2 Equipment

5.2.1 Manifolds

The length of manifolds, pipes and the overall manifold configuration shall be kept to a minimum and the design of the pipework minimize the ingress of air into the system. The preference is for a fully welded construction.

All pipe internal diameters shall be kept to the practical minimum necessary to sustain required flow rates, and shall not exceed 25 mm nominal size for pressures above 1,5 bar.

Pipelines in the high-pressure section shall be designed to withstand detonation; this can be carried out by one of the following methods:

- Piping withstanding detonation and reflection occurring at any point; or
- Piping withstanding undisturbed detonation with reinforcement at reflection points.

Piping withstanding detonation and reflection occurring at any point

To calculate the necessary wall thickness, the following formula should be used:

$$t = \frac{P * d}{(20 * S) - P}$$

Where: S: Allowable stress for the pipe/material [N/mm2]

P: Design pressure [barg]

d: Internal diameter of the pipe [mm]

t: Minimum wall thickness [mm]

The design pressure P and the allowable stress S are calculated as follows:

P = 35*(Pw+1)-1

S = Sy/1.1

Where: Pw: Maximum operating pressure [barg]

Sy: Stress at yield point (lower) of the material [N/mm2]

5.2.1.1 Piping withstanding undisturbed detonation with reinforcement at reflection points

The piping wall thickness is calculated with the same formula above, but the “design pressure” P is calculated as follows:

P = 20*(Pw+1)-1

Piping with wall thickness calculated in this way should be used only for straight parts of the line. Reinforcements of the wall thickness shall be employed at points of pressure wave reflection, for example, piping ends, sharp bends, valves, tee junctions. The reinforcements shall double the wall thickness of straight parts, as a minimum, and cover a pipe length at least equal to three times the internal diameter of the pipe.

Manifolds shall be checked against test pressure accordingly to Section 8.

5.2.2 Valves

Valves shall withstand a test pressure at 1,1 times the design pressure of the piping.

Design shall take into account the risk of ignition due to friction; for this reason, the use of filters to prevent dirt in the valve seat should be considered.

The valve design shall ensure electrical continuity between its component parts.

5.2.3 Gauges

Gauges shall conform to one of the following:

- Withstand acetylene decomposition without catastrophic failure;
- Be protected against over-pressurization by a gauge protector;
- Be equipped with a blow off back relief device and a maximum inlet orifice of 0.5 mm diameter; or
- A pressure gauge flash arrestor with cut-off mechanism.

5.2.4 Regulators

Regulators shall withstand acetylene decomposition without unintended failure.

Design shall take into account the risk of ignition due to friction: when an integral filter is not part of the regulator, separate filters on the line shall be installed, see EN ISO 7291 *Gas welding equipment. Pressure regulators for manifold systems used in welding, cutting and allied processes up to 30 MPa (300 bar)* [11].

5.2.5 High pressure hoses

The use of flexible high-pressure hoses is permitted only when rigid pipes are not suitable or practical.

The following shall be observed:

- Hoses shall be compatible to acetylene and solvents, both acetone and DMF;
- The length and diameter of the hoses shall be kept to the minimum practicable (typically less than 1 m) to avoid decomposition or mishandling of long hoses. For further information, refer to EIGA Doc 42, *Flexible connections in high pressure gas systems* [12];
- Hoses shall have a minimum bursting pressure of 1000 bar and resist acetylene decomposition at initial pressure of 25 bar;
- Hose fittings should be designed to avoid changes in diameter; when this is not the case, a gradual taper should be made;
- The polymer in contact with acetylene shall have conductive properties to avoid static electricity buildup.

Assemblies shall conform to EN ISO 14113, *Gas welding equipment. Rubber and plastics hose and hose assemblies for use with industrial gases up to 450 bar (45 MPa)*, [13].

6 Low pressure distribution system

6.1 Design considerations

Distribution pipework may be designed to one of the following criteria:

- To ensure that detonation will not occur at any time in the piping. Table 2 shall be used in design practice.[2]
- If the bore size or the pressure is not adequate to support the required flow rate, different sizes can be used following the advice from a specialist in acetylene systems design. In this case, additional safety provisions (e.g. flashback arrestors) in the distribution system could be required.

Underground piping should only be considered if there is no alternative.

Table 2 Pipework size maximum operating pressure

Bore size	Maximum operating pressure
23 mm	1.5 bar
25 mm	1.3 bar
35 mm	1.0 bar
42 mm	0.8 bar
54 mm	0.5 bar
72 mm	0.35 bar

Pipes shall be welded wherever practicable. At the user point, threaded connections are commonly used.

[2] Source: Sargent Diagram, Working Range I

6.2 General

The configuration of the low-pressure acetylene distribution system depends on the type of installation and is influenced by:

- Single versus multiple use points;
- Localized versus distributed piping; and
- If the final use point is a flame.

Each use point requires a check valve.

Multiple use points shall require the installation of flashback arrestors at each use point.

Localized use requires the use of flashback arrestor downstream the regulator; distributed use will require additional flashback arrestor at each use point. Or downstream of regulator.

If the final use point is a flame, an extra flame arrestor close to mixer/blender is required.

In the table below are summarized the recommended equipment to be provided downstream the pressure regulator.

6.3 Type of Installations

6.3.1 Single cylinder/bundle installation

As a minimum, starting from the acetylene source (immediately downstream the pressure regulator):

A. Flashback arrestor with automatic quick acting shutoff device.
B.1 Low pressure non-return valve on each blowpipe inlet.
B.2 Flashback arrestor with automatic quick acting shutoff device and non-return valve.

In the case of using a torch, the non-return valve, (B1) shall be replaced by a flashback arrestor.

The use of additional flashback arrestors will increase safety, but reduce the flow capacity of the system. Care should be taken to ensure flow capacity is adequate for the correct and safe use of the downstream equipment in accordance with the supplier's operating instructions.

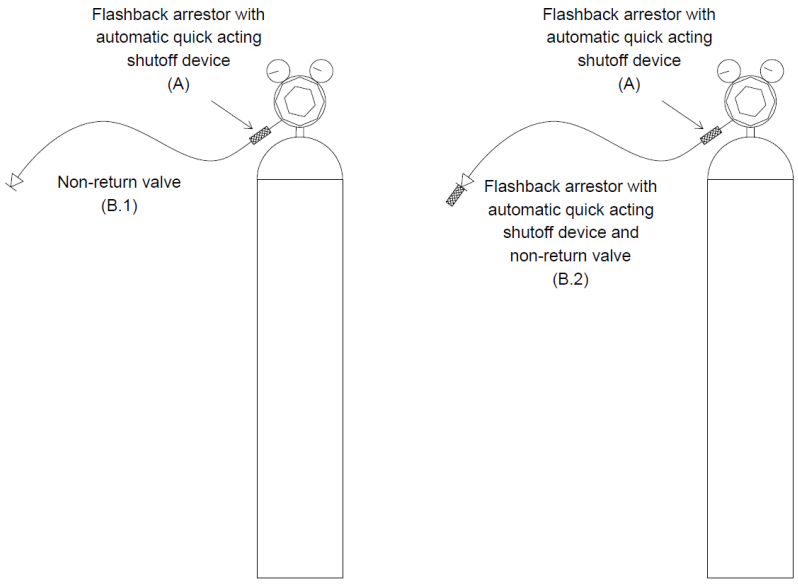

Figure 1 Single cylinder/bundle installation

6.3.2 Fixed installation – Single source

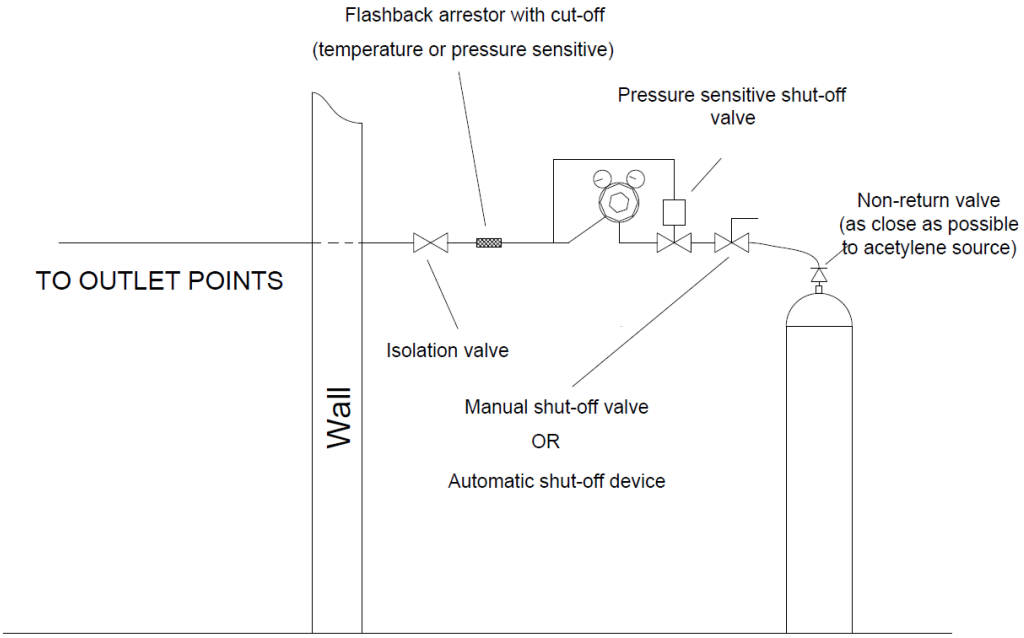

Figure 2 Fixed installation - single source

The following equipment shall be installed in association with the source of supply pressure regulator:

- A pressure sensitive device monitoring the pressure downstream of the PCV that isolates the flow upstream of the PCV. An alternative is a pressure relief device downstream of the PCV but this has to consider the discharge of the acetylene, avoiding potential for a gas cloud explosion to a safe location
- Flashback arrestor with pressure or temperature sensitive cut-off fitted within 1 metre downstream of the pressure regulator
- Low pressure isolating valve
- Outlet points equipped as Section 7
- Optional: purge line upstream the PCV
- Optional: before the flashback arrestor, a filter may be installed

6.3.3 Fixed installation – Multiple sources (in-use and stand-by)

The required equipment is the same as above except the purge lines (one for each branch, to allow for depressurizing and purge of the section).

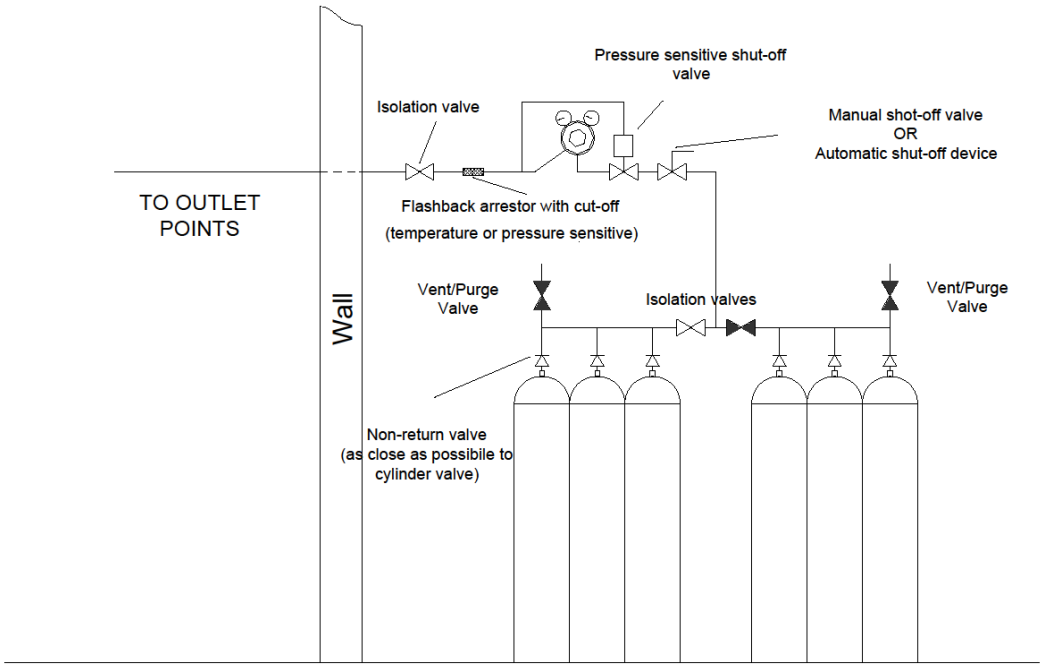

Figure 3 Fixed installation - multiple source

6.3.4 Acetylene trailers

The same configuration applies as in figure 3, but the trailer shall have a pneumatic actuated valve for emergency shut off.

NOTE Acetylene trailers are considered as static installations.

7 Outlet points

Outlet points shall include:

- Manual isolating valve;
- Non-return valve;
- Flashback arrestor with pressure or temperature sensitive cut-off; and
- An outlet pressure regulator (from 1.5 bar down to mbars) is generally required for standard applications.

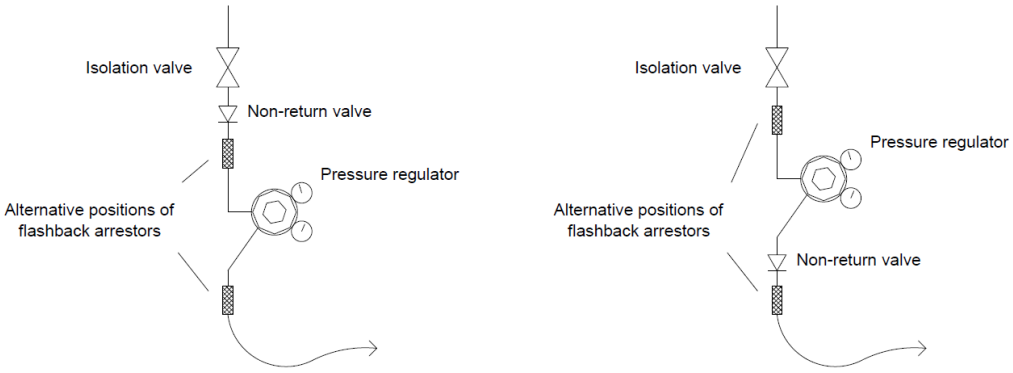

Figure 4: Different outlet point configurations

If acetylene is connected to devices using other fuel or oxidant gases, all the lines (including other fuel gases and oxidants) shall be equipped with non-return valve and flashback arrestor as near to the point of mixing as practicable.

8 Testing of the installation

The installations shall be checked on commissioning to ensure that all connections and fittings are secure and leak free.

Pressure gauges and safety devices may have to be removed before testing; parts which have been tested prior to installation may be excluded from strength pressure test.

The following tests apply:

8.1 High pressure manifold

8.1.1 Strength test:

The high-pressure manifold shall be hydraulically (preferably) or pneumatically tested to a minimum pressure of 315 bar. After hydraulic testing, the system shall be thoroughly dried out.

8.1.2 Leak test:

The high-pressure manifold shall be pressurised in stages from a minimum pressure of 1 bar to the maximum working pressure (minimum: 18 bar – maximum: 25 bar)) and all joints tested with suitable leak testing medium. Any leaks shall be rectified before the test is continued.

8.1.3 Function tests:

The following equipment shall be checked:

- Valves for closure, tightness and gland leakage
- Automatic change over devices for correct operation
- Regulators for correct operation and outlet pressures

8.2 Low pressure distribution systems

8.2.1 Strength test:

The strength test shall be led at pressure 1,5 times the operating pressure, with a minimum value of 3,75 bar.

NOTE Pressure relief devices and pressure gauges may be removed before testing.

8.2.2 Leak test:

The low-pressure distribution system shall be tested at the maximum allowable working pressure.

8.2.3 Function tests:

The following equipment shall be checked:

- Valves for closure, tightness and gland leakage;
- Automatic change-over devices for correct operation;
- Cut-off devices for correct operation and set pressure; and
- Regulators for correct operation and outlet pressures.

Records of the tests shall be retained and kept available for inspections.

9 Storage of acetylene cylinders and bundles

Storage of acetylene cylinders and bundles is regulated by national and local legislation.

Where feasible, storage area should preferably be in a well-ventilated area that is secure, lockable and at safe distance from other hazards.

Sometimes, it is required to have the cylinders that are in use or in stand-by in a dedicated acetylene building; such a building requires ATEX risk assessment [9].

For more information, see EIGA Safety Leaflet 04 *The safe transport, use and storage of acetylene cylinders* [14].

10 Identification

New acetylene installations shall be marked according to EN ISO 14114 [3].

11 Operation

Suitable instruction cards shall be available on the workplace to indicate how to operate the installation and a system flowsheet/scheme.

Safety signs and warning notices appropriate to the installation shall be clearly displayed as well as emergency contact information.

The manufacturer shall provide the user with an instructions manual.

All operators shall receive adequate instructions and training before operating the installation.

The following shall be observed:

- In case of prolonged inactivity of the acetylene installation, all the equipment shall be purged out of service with inert gas (preferably not carbon dioxide) until residual acetylene is kept to a minimum.

- When acetylene installation will be put into service again, it shall be purged using an inert gas to ensure no oxygen will be contained in piping and equipment prior to the introduction of the acetylene.

12 Maintenance

Periodic maintenance and checks are required to ensure the installation remains in a safe condition. It is responsibility of the user to ensure that maintenance and checks are carried out.

The maintenance schedule for an acetylene installation shall be in accordance with local legislation.

As well as inspection by the user, there shall be periodic inspections by a person who is competent[3] to perform inspections on acetylene systems.

These controls may not be exhaustive and some additional checks be required as per manufacturer's recommendations (included in the instructions manual); the frequency of these checks should be defined on the manufacturer/installer's recommendations.

12.1 Inspection by the user

The periodic inspection by the user should take into account the following:

- Equipment is in good order, is being correctly used and all the required equipment is fitted;
- Manifold, framework, and chains are in good condition;
- Pigtails and flexible hoses are not corroded or damaged;
- Valves shut-off and open correctly;
- Regulators are suitable for the gas and pressures and are not damaged;
- System is operating normally; and
- Housekeeping rules are observed, for example, rooms are not being used as a store room.

12.2 Inspection by competent person

The inspection should consider the followings:

- All changes (including removals and additions of components) and extensions of the installation conform to this publication;
- Changes of the nearby equipment/rooms/processes do not affect operations and safety of the acetylene installation;
- Pipelines are identified adequately;
- Filters, if installed, are in good condition and not blocked;
- Visual inspection downstream of the flashback arrestors; the presence of soot indicates a decomposition occurred in the piping. This requires that the flashback arrestor needs to be replaced;
- Functional check of the check-valves;
- Valves (including those for emergency) are accessible and easy to operate. Valves at service point outlets and vent valves shall be checked for tightness;
- The setting and operation of regulators is satisfactory;
- The operation of safety devices is correct;
- Safety signs and warning notices are present and legible;
- The external finish of pipelines and their protection against corrosion is acceptable; and
- Pipelines hoses and associated equipment are not damaged and acceptable for further use.

[3] Competent person can have different interpretations in different countries, accordingly to local legislation.

12.3 Keeping of records

The following records should be kept by the user:

- Details of any repairs or modifications carried out;
- Any designer's/manufacturer's/supplier's documents;
- Strength and leak certificates;
- All other reports containing information relevant to the assessment of matters of safety; and
- Details of any out of service periods and storage conditions.

13 Emergency procedures

Guidance can be found in EIGA Safety Info 02 *Handling of gas cylinders during and after exposure to heat or fire* [15].

13.1 Nearby fire

If safe to do so, extinguish the flame as quickly as possible.

Warning: Keep away, do not approach or attempt to move the cylinder or open the valve.

Sound the alarm and evacuate the area.

Contact the fire and rescue services and the gas supplier.

13.2 Fire due to hose/piping leak

If present when the fire or heat events starts and it is safe to do so, close any open cylinder valves.

If it is not safe to close the cylinder valves, then:

• Evacuate the area.

• Raise the alarm, call the emergency services and the gas supplier.

14 References

Unless otherwise specified the latest edition shall apply.

[1] BCGA Code of Practice 5 *The design and construction of manifolds using acetylene gas from 1.5 to 25 bar* *www.bcga.co.uk*

[2] BCGA Code of Practice 6 *The safe distribution of acetylene in the pressure range 0 – 1.5 bar* www.bcga.co.uk

[3] EN ISO 14114 *Gas welding equipment -- Acetylene manifold systems for welding, cutting and allied processes -- General requirements* www.cen.eu

[4] EIGA Doc 123 *Acetylene Code of Practice* www.eiga.eu

[5] EN 1561, *Founding. Grey cast irons* www.cen.eu

[6] EN 1562 *Founding. Malleable cast irons* www.cen.eu

[7] EN ISO 11114-2 *Gas cylinders. Compatibility of cylinder and valve materials with gas contents. Non-metallic materials*, www.cen.eu

[8] NFPA 221, *Standard for High Challenge Fire Walls, Fire Walls, and Fire Barrier Walls* www.nfpa.org

[9] DIRECTIVE 2014/34/EU *of The European Parliament and of The Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres* www.europa.eu

[10] EN 730-1 *Gas welding equipment. Safety devices. Incorporating a flame (flashback) arrestor,* www.cen.eu

[11] EN ISO 7291 *Gas welding equipment. Pressure regulators for manifold systems used in welding, cutting and allied processes up to 30 MPa (300 bar,)* www.cen.eu

[12] EIGA Doc 42, *Flexible connections in high pressure gas systems,* www.eiga.eu

[13] EN ISO 14113, *Gas welding equipment. Rubber and plastics hose and hose assemblies for use with industrial gases up to 450 bar (45 MPa),* www.cen.eu

[14] EIGA Safety Leaflet 04, *The safe transport, use and storage of acetylene cylinders,* www.eiga.eu

[15] EIGA Safety Info 02 *Handling of gas cylinders during and after exposure to heat or fire*, www.eiga.eu