



USE OF RESIDUAL PRESSURE VALVES

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USE OF RESIDUAL PRESSURE VALVES

As part of a programme of harmonization of industry standards, the Asia Industrial Gases Association (AIGA) has published, AIGA Doc 63, *Use of residual pressure valves*, jointly produced by members of the International Harmonization Council and originally published by the European Industrial Gases Association (EIGA) as EIGA Doc 64, *Use of residual pressure valves*.

This publication is intended as an international harmonized publication for the worldwide use and application by all members of Asia Industrial Gases Association (AIGA), Compressed Gas Association (CGA), European Industrial Gases Association, EIGA, and Japan Industrial and Medical Gases Association (JIMGA). Each association's technical content is identical, except for regional regulatory requirements and minor changes in formatting and spelling.

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Amendments to 63/14

Section	Change
	Rewrite following adoption as a harmonised publication

1 Introduction

Cylinder valves that retain a residual positive pressure in a gas cylinder and some types of devices that prevent backflow of fluid by means of a non-return device, commonly referred to as residual pressure valves (RPV), have been available for many years. Important benefits of RPVs include preventing moisture ingress and contamination, which reduce the potential for internal cylinder corrosion. Additional benefits include productivity improvements in the cylinder fill operation, avoiding internal cylinder contamination that could create hazardous situations, and reducing cylinder maintenance.

In the past, industry relied on users not to allow backflow into cylinders. Fillers typically relied on prefill inspection procedures to identify potentially contaminated cylinders returned from customers. Despite these measures, incidents caused by backflow of contaminants into cylinders have occurred, which highlight the potential benefit from usage of RPVs.

The use of RPVs generally requires a special fill connector for filling, evacuation, or both. The dimensions of the fill connector need to match certain critical dimensions of the valve outlet.

2 Scope and purpose

2.1 Scope

This publication is intended for use by the compressed gas industry and provides guidelines for the use of RPVs. This publication does not describe any design qualification tests of RPVs.

2.2 Purpose

The purpose of this publication is to give guidance on the selection, operation, maintenance, and installation of these valves, so common practices are established across the gas industry and these valves are beneficial to both the end user and filler of gas cylinders.

3 Definitions

For the purpose of this publication, the following definitions apply.

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 Residual pressure valve types

There are two types of RPVs; Type 1 and Type 2. Use of either Type 1 or Type 2 is dependent upon operational and gas quality requirements. Both types contain a residual pressure device to retain a positive pressure in the cylinder.

NOTE Some cylinder valves with integrated pressure regulators (VIPRs) can have similar positive pressure and non-return functionality as RPVs.

3.2.1.1 Type 1

RPV that retains a positive pressure in the cylinder greater than the pressure downstream of the valve outlet and also incorporates a non-return feature to prevent backflow into the cylinder from a higher pressure on the valve outlet.

NOTE Cylinders with Type 1 RPVs cannot be filled or evacuated unless the RPV is deactivated or a special fill connector is used to overcome the non-return feature.

3.2.1.2 Type 2

RPV that retains a positive pressure in the cylinder greater than atmospheric pressure but will not prevent backflow into the cylinder if the pressure on the valve outlet is high enough to overcome the RPV mechanism and the residual pressure in the cylinder.

NOTE Cylinders with Type 2 RPVs can be filled with a conventional fill connector but cannot be evacuated unless the RPV is deactivated or a special fill connector is used.

4 Benefits of residual pressure valves

RPVs provide several benefits over conventional valves. Where there is a possibility of backflow, the Type 1 with a non-return feature is more useful to ensure gas quality and cylinder internal condition are not compromised. These benefits include:

- Maintaining positive pressure—A RPV will maintain positive pressure and prevent atmospheric contamination if the valve is left open;
- Improved filling productivity—Depending on the gas purity required, the venting and evacuation stages during the fill process may be eliminated allowing for the top-fill of cylinders;

NOTE Some regulations require venting and evacuation for certain products prior to filling regardless of the type of valve installed.

- Extended service life of the cylinder—The lifetime expectancy of a cylinder is extended by reducing the exposure of the cylinder internal surfaces to the atmosphere (moisture ingress), which can lead to corrosion;
- Prevention of contaminants entering the cylinder—Type 1 RPVs can prevent the ingress of contaminants for example sea water, toxics, and flammable materials such as solvents, oils, gases, etc., which can lead to consequences on refilling or subsequent customer use. Type 1 RPVs are more useful in preventing backflow contamination;
- Potential for reduced risk of cylinder failure—Moisture ingress into the cylinder can cause corrosion and stress corrosion cracking (SCC), which can lead to cylinder failure through leakage or burst. The likelihood of moisture ingress can be significantly reduced through the use of RPVs; and
- Potential for extended requalification period—As of 2015, the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR) has a provision for a steel cylinder

requalification period of 15 years for certain gases provided the cylinder has been equipped with a RPV Type 1 throughout the retest interval [1].¹

NOTE At the time of publication, this only applies to the signatories of the ADR [1].

5 Applications

RPVs should be considered for the following:

- Applications where there is the possibility of internal corrosion due to the ingress of a fluid. For example, sea water and moisture. This would benefit carbon steel cylinders used in marine service;
- Applications where the cylinder is used in a service where the possibility of backflow contamination from the end users process can create hazardous conditions for the end user or fill plant operator. Examples include beverage dispensing, industrial nitrogen used in agricultural applications to pressurize toxic chemicals, nitrogen used in oil and gas industries for inerting and blanketing applications.
- Applications where gas purity is important such as high purity argon, helium, and medical or food gas products; and
- Gases and gas mixtures such as those containing carbon monoxide in steel cylinders that are susceptible to SCC.

NOTE RPVs are not adequate as the only safeguard to prevent SCC (see AIGA 065, *Avoidance of Failure of Carbon Monoxide and of Carbon Monoxide/Carbon Dioxide Mixtures Cylinders* [2]).

6 Use of residual pressure valves—Filling facilities

6.1 Prefill inspection recommendations and requirements

As part of the prefill procedure, a check shall be made on the condition of the RPV based on the valve manufacturer's recommendations. This check may be performed in a number of different ways depending upon the type of the RPV.

6.1.1 Visual inspection

The valve shall be visually inspected to ensure that the RPV mechanism does not appear damaged or compromised. The visual inspection shall check that the RPV does not appear to have been removed or damaged by an end user or contaminated with dirt, debris, oils, or other contaminants. A cylinder with a compromised valve shall be removed from service.

6.1.2 Functional test

The functionality of the RPV of every valve shall be checked prior to each filling:

- Open the cylinder valve or bundle of cylinders main valve to check for residual pressure;
- If gas is emitted, the cylinder or bundle of cylinders may be filled;
- If no gas is emitted, the functioning of the residual pressure device shall be checked;
- If the check shows that the residual pressure device has retained pressure, the cylinder or bundle of cylinders may be filled;
- If the check shows that the residual pressure device has not retained pressure, the internal condition of the cylinder or bundle of cylinders shall be checked for contamination;

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

- If no contamination is detected, the cylinder or bundle of cylinders may be filled following repair or replacement of the residual pressure device; and
- If contamination is detected, a corrective action shall be carried out, for example set aside for further examination.

The functional test does not apply to new cylinders or cylinders that are returning to service from maintenance, where the valve was removed from the cylinder so there is no pressure in the cylinder.

NOTE For VIPRs, this check of condition may involve establishing that residual pressure has been retained before the start of filling and that the pressure regulator is functional at the end of filling.

6.2 Fill connectors

The design dimensions of RPVs and fill connectors vary between manufacturers. Even minor dimensional differences of fill connectors or RPVs can result in the incompatibility of a connection.

Fill connectors used to fill cylinders equipped with RPVs shall be mechanically compatible with the RPV (for example, pin condition including length) and chemically compatible with the gas in accordance with ISO 15996, *Gas cylinders—Residual pressure valves—General requirements and type testing*,] ISO 11114-1, *Gas cylinders—Compatibility of cylinder and valve materials with gas contents—Part 1: Metallic materials* and ISO 11114-2, *Gas cylinders—Compatibility of cylinder and valve materials with gas contents—Part 2: Non-metallic materials* [3, 4, 5].

The fill connector supplied or recommended by the valve manufacturer should be used unless the RPV and fill connector have been manufactured to standardized dimensions in accordance with national or international standards (for example, CGA V-1, *Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections* [6]).

Standardized RPV fill connectors and valves should be marked after the connection number, for example: 540R and 320R. In these examples, the “R” indicates the valve meets the standardized connection in CGA V-1 [6] and any fill connector marked similarly (for example: 540R, 320R) can be used with the valve.

WARNING: Use of an improper RPV fill connector could damage the RPV and/or fill connector or fail to fully actuate the residual pressure device within the RPV. An improper fill connector in oxygen (or other oxidizer) service can lead to ignition that can result in property damage, personal injury, or death.

6.2.1 Types of fill connectors

There are two basic types of RPV fill connectors: fixed pin and retractable pin. The fixed pin fill connector has a fixed actuation pin attached to the end of the filling nipple. The retractable pin design has a spring-loaded actuation pin incorporated in the filling nipple and for some designs the pin can be completely retracted for filling standard valves (see Figures 1 and 2). When using retractable pin type fill connectors, care shall be taken in selection and use to prevent inadvertent disengaging of the retracted pin.

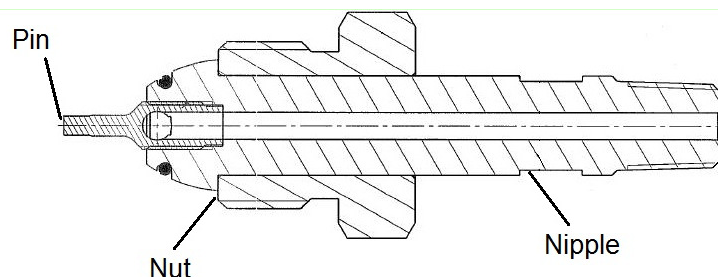


Figure 1—Example of a fixed pin adapter

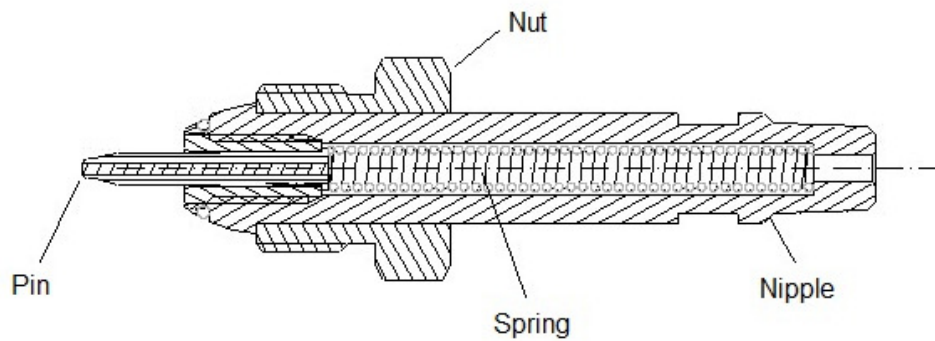


Figure 2—Example of a retractable pin design

6.2.2 Materials of construction for pins

As the pin of the RPV fill connector is in the flow path of the gas, material selection and cleanliness is very important because mechanical loading and flow velocities around the pin are higher than through standard fill connectors. Therefore, materials compatible with oxygen and other oxidizing gas services shall be selected for these conditions.

6.2.3 Precautions to be taken when handling fill connectors

When connecting the fill connector to the cylinder valve outlet, ensure the fill connector pin is not damaged during insertion and that the pin does not score the outlet thread and/or sealing surface.

When fill connectors are not in use, ensure there is protection from impact damage to prevent bending of the pin. In addition, ensure the fill connector is protected from contamination such as dirt, debris, and oils.

6.2.4 Condition, maintenance, and inspection of fill connectors

Prior to using a RPV fill connector, it should be inspected for significant wear of all components especially for the condition of the actuation pin. Any fill connectors with a bent or broken actuation pin shall be repaired or replaced before next use.

If polymeric or elastomeric seals are used on the fill connector, these seals shall be inspected before each use and replaced when visibly worn, frayed, cracked, or otherwise damaged.

6.2.5 Filling mixed loads

Care shall be taken when mixed populations of cylinders with both RPV and conventional valves have to be filled together on the same manifold. This can result in the transfer of potentially impure gas from those cylinders fitted with conventional valves to those that are protected in use by a RPV. One measure that can be taken to avoid such cross contamination is to vent cylinders without RPVs before connecting to the manifold.

6.3 Installing residual pressure valves into cylinders

RPVs shall be installed in accordance with established operating procedures (for example, ISO 13341, *Gas cylinders—Fitting of valves to gas cylinders* [7]). In order not to compromise the functionality and to obtain the benefits of a RPV, an internal visual inspection of the cylinder shall be performed to ensure that the cylinder is in good condition and free of all contaminants such as debris and visible moisture.

6.4 Devalving cylinders equipped with residual pressure valves

For all devalving operations, care needs to be taken to ensure that the cylinder contains no pressure. The devalving guidelines in CGA P-38, *Guidelines for Devalving Cylinders*; EIGA Safety Information 18, *Devalving Gas Cylinders*; or ISO 25760, *Gas cylinders—Operational procedures for the safe removal of valves from gas cylinders* shall be followed [8, 9, 10].

A particular concern when removing valves with RPVs from cylinders is that the operator believes that the cylinder is empty after venting because no gas is being emitted from the open valve. After venting, it is necessary to attach a fill connector to allow the residual pressure to be released from the cylinder.

Before devalving, the operator shall confirm that the cylinder is empty of all pressure. A small amount of inert gas or air shall be introduced into the cylinder through the valve outlet and fill connector to verify whether or not the gas flows unhindered into the cylinder.

7 References

Unless otherwise specified, the latest edition shall apply.

[1] *International Carriage of Dangerous Goods by Road (ADR)*, United Nations Economic Commission for Europe www.unece.org

[2] AIGA 065, *Avoidance of Failure of Carbon Monoxide and of Carbon Monoxide/Carbon Dioxide Mixtures Cylinders*, www.asiaiga.org

NOTE This publication is part of an international harmonization program for industry standards. The technical content of each regional document is identical, except for regional regulatory requirements. See the referenced document preface for a list of harmonized regional references.

[3] ISO 15996, *Gas cylinders—Residual pressure valves—General requirements and type testing*, www.iso.org

[4] ISO 11114-1, *Gas cylinders—Compatibility of cylinder and valve materials with gas contents—Part 1: Metallic materials*, www.iso.org

[5] ISO 11114-2, *Gas cylinders—Compatibility of cylinder and valve materials with gas contents—Part 2: Non-metallic materials*, www.iso.org

[6] CGA V-1, *Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections* www.cganet.com

[7] ISO 13341, *Gas cylinders—Fitting of valves to gas cylinders*, www.iso.org

[8] CGA P-38, *Guidelines for Devalving Cylinders*, Compressed Gas Association, Inc., 14501 George Carter Way, Suite 103, Chantilly, VA 20151. www.cganet.com

[9] EIGA Safety Information 18, *Devalving Gas Cylinders*, www.eiga.eu

[10] ISO 25760, *Gas cylinders—Operational procedures for the safe removal of valves from gas cylinders*, www.eiga.eu