



## POSITION PAPER 3

### THE CASE FOR THE MANDATORY FITTING OF RESIDUAL PRESSURE VALVES TO GAS CYLINDERS CONTAINING CARBON DIOXIDE

#### Background

Carbon dioxide (CO<sub>2</sub>) and mixtures containing CO<sub>2</sub>, are supplied in gas cylinders which are sealed closed by a cylinder valve.

Modern cylinder valves can incorporate a residual pressure device, this prevents ingress of contaminants by maintaining a positive differential pressure between the pressure within the cylinder and the valve outlet. Such cylinder valves are known as Residual Pressure Valves (RPVs). Their purpose is to maintain the quality of the gas inside the cylinder, which helps to prevent internal corrosion taking place. Such valves, and their component parts, should be compatible with CO<sub>2</sub> and be designed, manufactured and cleaned for CO<sub>2</sub> service accordingly.

Currently, where steel cylinders are approved for a 15 year periodic inspection and test, the use of a RPV is mandatory within the *Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations* <sup>[2]</sup>. Such RPV's are designed and type tested to the requirements of BS EN ISO 15996 <sup>[4]</sup>, *Gas cylinders. Residual pressure valves. Specification and type testing of cylinder valves incorporating residual pressure devices*.

When an RPV has been fitted to a gas cylinder by the cylinder owner it forms part of the construction requirements of the cylinder and valve assembly and will be included in the overall quality control plan under their duties within the *Provision and Use of Work Equipment Regulations* (PUWER) <sup>[1]</sup>.

Whilst RPVs are used in many gas duties within the industrial gases industry, one specific area where the fitting of RPV's has proven especially beneficial is in the supply of food (beverage) gas cylinders as they help to ensure product purity for food use. Food gases normally include an element of CO<sub>2</sub>. If contaminated with moisture, the resulting mixture with CO<sub>2</sub> will likely cause internal corrosion of the cylinder, which can result in catastrophic rupture under pressure.

The European Industrial Gases Association (EIGA) provide guidance on the use of RPV's, refer to EIGA 64 <sup>[9]</sup>, *Use of residual pressure valves*.

Sadly there are in UK a number of companies in the food (beverage) gas market which compromise the safety of gas cylinder packages.

Such rogue or illicit fillers are more interested in just filling a cylinder, caring little for the quality of the gas or the internal condition of the cylinder. They have been known to remove or interfere with RPVs to enable cylinders to be filled quickly. End users too are sometimes tempted to remove or interfere with RPVs in order to get the last bit of gas out of cylinders. The removal of, or interference with, a RPV is a breach of PUWER <sup>[1]</sup>.

The ‘sins’ of rogue and illicit suppliers include the following, which all breach relevant laws, as outlined in BCGA Leaflet 10<sup>[8]</sup>, *Profit through quality. Good gas, good business*:

- misappropriation and theft of other parties’ cylinders, often involving the damaging removal of legitimate stamp markings so as to render them difficult to identify or trace back to their rightful owners;
- failure to periodically inspect and test gas cylinders in accordance with the required legislation;
- use of cylinders which are past their periodic inspection and test dates;
- use of internally corroded, damaged, dented or gouged cylinders;
- removal or interference with RPV’s so as to render the safety feature ineffective;
- filling food (beverage) gas cylinders with poor quality gas;
- failure to properly affix food traceability (and other stampings) labelling;
- failure to register filling sites as food premises with local authorities.

For some years, and with help from the *Health & Safety Executive (HSE)*, the *Department for Transport (DfT)*, the *British Beer and Pub Association (BBPA)*, and the *Brewing Food and Beverage Industry Suppliers Association (BFBI)*, BCGA has been campaigning to clean up rogue or illicit traders in food (beverage) gas cylinder filling and supply, with mixed success.

Reputable gas suppliers do not engage in such practices, in particular, BCGA member suppliers are required to adhere to BCGA codes of practice which require compliance to the law and go further in terms of best safety practice.

RPV’s are fitted by reputable suppliers as safety devices. Their function is to retain a residual positive pressure in the gas cylinder, whilst most prevent backflow of aqueous fluid (beer, cleaning fluids etc.) by inclusion of a non-return device. This maintains the quality of the gas inside the cylinder and keeps the inside of the cylinder dry and free from back-contamination.

If food (beverage) gas cylinders containing CO<sub>2</sub> or gas mixtures containing >5 % CO<sub>2</sub> are not fitted with RPV’s, moisture or other corrosion agents may gain access. The gas residues dissolve in the moisture to form corrosive carbonic acid, this will result in rapid internal corrosion. Steel cylinders are, of course, most at risk.

If cylinders are not protected from this internal corrosion the result can be catastrophic failure (explosion) of the cylinders. This hidden hazard has been the cause of huge damage to premises, serious injury and clearly presents a risk of fatalities. Such incidents are reportable under the *Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR)*<sup>[3]</sup>.

BCGA is therefore calling for the use and maintenance of RPV’s on all gas cylinders which are manufactured from steel, are classified as transportable pressure equipment, are greater than one litre water capacity and contain CO<sub>2</sub> or gas mixtures containing >5 % CO<sub>2</sub> to be made mandatory, with suitably severe penalties where people flout the law.

We suggest that this is possible within the UK *Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations* <sup>[2]</sup>, which imposes the law governing gas cylinder safety standards.

Some examples of what can happen when legal requirements and / or best practice cylinder guidance are not followed are displayed at Annex 1.

## References

1. SI 1998 No. 2306, The Provision and Use of Work Equipment Regulations 1998 (PUWER).
2. SI 2009 No. 1348, The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009 (as amended).
3. SI 2013 No. 1471, The Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR).
4. BS EN ISO 15996, Gas cylinders. Residual pressure valves. Specification and type testing of cylinder valves incorporating residual pressure devices
5. HSE Safety Alert – 07/05/2010 - Stress corrosion cracking of beverage mixed gas cylinders. <http://www.hse.gov.uk/safetybulletins/mixedgascylinders.htm>
6. BCGA Code of Practice 32, The safe filling of food gas cylinders for beverage dispense.
7. BCGA Guidance Note 6, Avoidance and detection of internal corrosion in gas cylinders.
8. BCGA Leaflet 10, Profit through quality. Good gas, good business
9. EIGA 64, *Use of residual pressure valves*.

## For further information

UK Legislation

[www.legislation.gov.uk](http://www.legislation.gov.uk)

Health and Safety Executive (HSE)

[www.hse.gov.uk](http://www.hse.gov.uk)

Department for Transport (DfT)

[www.dft.gov.uk](http://www.dft.gov.uk)

British Standards Institute (BSI)

[www.bsigroup.co.uk](http://www.bsigroup.co.uk)

European Industrial Gases Association (EIGA)

[www.eiga.eu](http://www.eiga.eu)

British Compressed Gases Association (BCGA)

[www.bcgaco.uk](http://www.bcgaco.uk)

British Beer and Pub Association (BBPA)

[www.beerandpub.com](http://www.beerandpub.com)

Brewing Food and Beverage Industry Suppliers Association (BFBi)

[www.bfbi.org.uk](http://www.bfbi.org.uk)

## EXAMPLES OF POOR PRACTICE RESULTING IN AN INCIDENT

### Guardian Gas

In March 2010 a worker filling gas cylinders had his leg severed below the knee when a faulty cylinder he was filling exploded at Guardian Gas Ltd. The cylinder was being filled with a carbon dioxide / nitrogen mixture. The cylinder separated into four distinct parts. Investigations suggested that the cylinder failed by stress corrosion cracking starting inside the cylinder and that there were clear indications of internal corrosion of the cylinder walls.

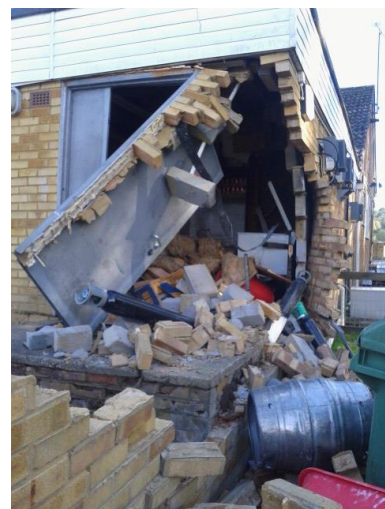
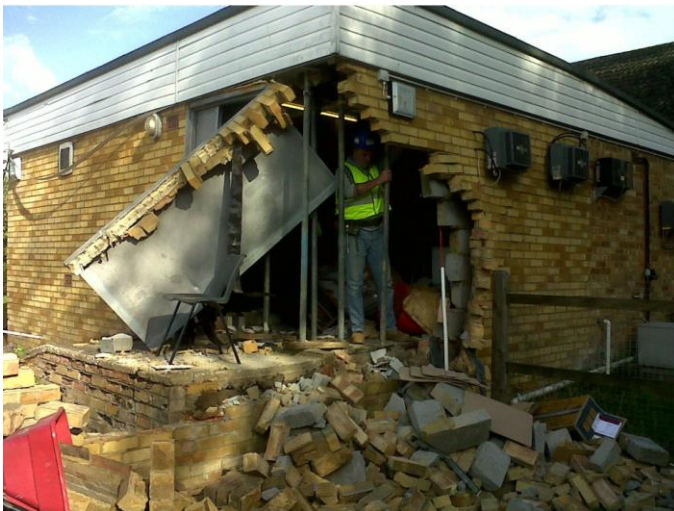
Note the subsequent HSE Safety Alert recommendation for the use of RPV's or a reduced periodicity between inspection and testing.

<http://www.hse.gov.uk/safetybulletins/mixedgascylinders.htm>

### Marlow RFC

A gas cylinder used to dispense beer exploded in a storage room at Marlow Rugby Football Club in the morning of 12 October 2012. The cylinder was filled with a carbon dioxide 30 % / nitrogen 70 % mixture. The HSE investigated and discovered that the cylinder was badly corroded and that the RPV was missing (presumed removed). The failure mechanism was identified as stress corrosion cracking due to aqueous contamination. The cylinder explosion partly demolished the building.

[www.bucksfreepress.co.uk/news/9996559.freak-explosion-rocks-rugby-club/](http://www.bucksfreepress.co.uk/news/9996559.freak-explosion-rocks-rugby-club/)



### **Lancashire Chinese restaurant**

In May 2016 an explosion occurred in a Chinese restaurant, leaving a hole in the wall and blowing out all the windows. Restaurant closed for the evening so no injuries. Caused extensive damage internally. The cylinder made its own exit via the wall, leaving debris over the adjacent road. The cylinder was a carbon dioxide / nitrogen mixture.

<http://www.lep.co.uk/news/chinese-restaurant-rocked-by-explosion-1-7898265>



### **J&R Gases**

In October 2015 a company employee was filling a food (beverage) gas cylinder when an adjacent cylinder exploded. He was badly injured by flying shrapnel and airlifted to hospital, where his leg had to be amputated below the knee. Some other workers were also injured in the explosion. Failure of the cylinder was most likely due to fluid in the cylinder, resulting in corrosion.

<https://www.healthandsafetyatwork.com/news-and-prosecution/j-r-gases-fined-after-cylinder-explosion>