CODE OF PRACTICE 42

IMPLEMENTATION OF EIGA CARBON DIOXIDE STANDARDS

REVISION 3: 2020

British Compressed Gases Association

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PREFACE

The British Compressed Gases Association (BCGA) was established in l971, formed out of the British Acetylene Association, which existed since l901. BCGA members include gas producers, suppliers of gas handling equipment and users operating in the compressed gas field.

The main objectives of the Association are to further technology, to promote safe practice and to prioritise environmental protection in the supply, use, storage, transportation and handling of industrial, food and medical gases, and we produce a host of publications to this end. BCGA also provides advice and makes representations on behalf of its Members to regulatory bodies, including the UK Government.

Policy is determined by a Council elected from Member Companies, with detailed technical studies being undertaken by a Technical Committee and its specialist Sub-Committees appointed for this purpose.

BCGA makes strenuous efforts to ensure the accuracy and current relevance of its publications, which are intended for use by technically competent persons. However this does not remove the need for technical and managerial judgement in practical situations. Nor do they confer any immunity or exemption from relevant legal requirements, including by-laws.

For the assistance of users, references are given, either in the text or Appendices, to publications such as British, European and International Standards and Codes of Practice, and current legislation that may be applicable but no representation or warranty can be given that these references are complete or current.

BCGA publications are reviewed, and revised if necessary, at five-yearly intervals, or sooner where the need is recognised. Readers are advised to check the Association's website to ensure that the copy in their possession is the current version.

This document has been prepared by BCGA Technical Sub-Committee 5. This document replaces BCGA Code of Practice 42, Revision 2: 2018. It was approved for publication at BCGA Technical Committee 162. This document was first published on 24/06/2020. For comments on this document contact the Association via the website www.bcga.co.uk.

CONTENTS

* Throughout this publication the numbers in [ ] brackets refer to references in Section 10. Documents referenced are the edition current at the time of publication, unless otherwise stated.

TERMINOLOGY AND DEFINITIONS

May	Indicates an option available to the user of this Code of Practice.
Shall	Indicates a mandatory requirement for compliance with this Code of Practice and may also indicate a mandatory requirement within UK law.
Should	Indicates a preferred requirement but is not mandatory for compliance with this Code of Practice.

CODE OF PRACTICE 42

IMPLEMENTATION OF EIGA CARBON DIOXIDE STANDARDS

1. INTRODUCTION

Liquefied carbon dioxide (CO_2) is routinely delivered to customers via a tanker. There is a potential risk for back-feed and contamination to the supplying tanker. The widespread use of a gas phase return connection when delivering carbon dioxide increases the probability of spreading that contamination to other customers. By ensuring that customer's tanks remain free from contaminants, the risk of contamination being spread throughout the supply chain can be controlled.

The European Industrial Gases Association (EIGA) has produced two related documents:

(i) EIGA 68 [2], *Prevention of carbon dioxide back-feed contamination*.

(ii) EIGA 70 [3], *Carbon dioxide source certification, quality standards and verification*.

When used together, within existing quality management systems, they are intended to provide a basis for quality assurance of the CO_2 supply chain. Member companies of the British Compressed Gases Association (BCGA) have accepted the recommendations of these EIGA standards.

BCGA Guidance Note 14 [5], *Production, storage, transport and supply of gases for use in food*, provides advice to producers and suppliers of food gases to ensure food safety and compliance with food safety Regulations.

NOTE: Any premises where gases are supplied for use with food or beverages as part of a food business will require registration of that premises with the local authorities.

This Code of Practice is intended to provide detailed guidance to ensure that the EIGA recommendations are implemented in a consistent manner and that suitable measures for verification are adopted and maintained across the UK industry.

1.1 Source verification

All sources of CO_2 will have a final product composition and impurity specification, which will be dependent upon the raw gas stream and the design and condition of the purification and liquefaction plant.

EIGA 70 [3] has been published to provide a minimum standard product specification for CO_2 intended for use in foods and beverages. This specification is consistent with the CO_2 specification of the International Society of Beverage Technologists (ISBT).

In addition to providing limiting values for a number of specified contaminants, EIGA 70 [3] provides recommendations on good practice for the evaluation of key characteristics of quality and purity of CO_2 for use in foods and beverages. The

document also provides recommendations for the qualification of plants used to produce CO_2 intended for use in foods and beverages.

Individual needs may, however, dictate the application of additional requirements negotiated between CO_2 suppliers and individual CO_2 users.

1.2 Prevention of back-feed contamination

Uniquely amongst industrial gases, bulk liquid CO_2 is normally supplied using a liquid fill-line together with a gaseous return connection to the road tanker. Any contamination in the customer tank can therefore be transferred, in part, to the supplying tanker. This provides the potential for any contamination to be spread to other customers and suppliers.

The techniques described in EIGA 68 [2] are designed to minimise the risk that customers' tanks become contaminated by the customers' processes, and to prevent any such contamination from subsequently spreading throughout the supply chain.

2. SCOPE

This BCGA Code of Practice seeks to provide guidance on interpretation and implementation of the recommendations detailed by EIGA and should be read in conjunction with the appropriate EIGA documents.

The Code of Practice also provides further details that are not covered by the EIGA documents.

The scope of this Code of Practice is confined to liquid CO_2 production plants and storage installations filled directly by delivery tanker.

3. RISK ASSESSMENT

3.1 Requirement

Suppliers of liquid CO_2 are required to perform an individual risk assessment on all customer installations to which they make deliveries. Satisfactory risk assessments, except for those covered by generic risk assessments (refer to Section 3.4), will require at least one visit to the site in order to verify and review process flow diagrams (PFD) and piping and instrumentation diagrams (P&ID).

Where product is supplied by third parties, i.e. Company A delivers CO_2 to or on behalf of Company B, the requirements of this Code shall be applied and verified by Company B. As a minimum Company B shall provide a statement to Company A confirming compliance by means of:

- the date when the assessment was completed;

- process category (for example, food freezing, drinks packaging, package gases);
- back-feed category; and
- where applicable, the preventive measures applied.

All installations shall be categorised to define the degree of risk. Suitable measures designed to prevent any back-contamination shall then be put into place and checks carried out on their effectiveness.

Table 1 lists the risk categories and minimum recommended preventive measures.

Risk Category	Process characteristics	Minimum preventive measures
0	Process takes place at atmospheric pressure.	None required.
1	Tank pressure is always greater than process pressure, even under process fault conditions.	Check valve with periodic testing of effectiveness.
2	Process pressure may rise above tank pressure under process fault conditions.	Automatic shut-off valve operated by pressure differential.
3	Process pressure is always greater than tank pressure.	Double block and bleed valves, operated automatically by pressure differential. Also consider single line filling.
4	Process flows return to tank.	Separate delivery and process tanks connected by a single transfer line fitted with double block and bleed back-flow protection.
X	Vapour withdrawal system.	Analysis of liquid samples at appropriate intervals.

Table 1: Risk analysis matrix

Alternative engineering solutions, which provide equivalent or better protection, may be used, refer to Section 3.3.

3.2 Vessel fault conditions

Risk assessments should consider process fault conditions. The possibility of a vessel fault leading to depressurisation is applicable to all categories.

In all cases of vessel depressurisation, the process and installation shall be reviewed by a competent person (refer to Section 5) to determine the risk of the vessel becoming contaminated.

Following depressurisation, the vessel shall only be brought back into service by means of a suitable and safe re-commissioning process, controlled and approved by a competent person, which will include due regard for contamination risks and the implementation of decontamination procedures when necessary.

NOTE: Whilst this code is concerned about contamination following a depressurisation, mechanical integrity concerns are paramount.

3.3 Alternative preventive measures

Alternative engineering solutions, which provide the equivalent of or better protection than that specified by EIGA, may be used provided that their effectiveness is proven and the evaluation process is formally documented.

As an example, where CO_2 is produced on site, isolation, quarantine, subsequent analysis to the EIGA commodity specification and batch release prior to delivery, or collection, of product would be acceptable for all categories, provided that the installation is subject to a recognised risk management process such as a Hazard Analysis Critical Control Point (HACCP) regime.

NOTE: For information on the HACCP technique, refer to "*HACCP A Practical Approach*" by Mortimore *et al* [4].

Alternative engineering solutions include:

- For all categories of installation: Single line filling, through an in-line check-valve in the liquid phase, provides an acceptable method of back-feed prevention. Where this method is used then a task risk assessment is required to ensure that single line filling can be completed safely, to include an assessment of environmental factors, for example, noise and gas dispersal.

- For Category 3: The use of an auto sensing pressure reversing obturator (ASPRO) to provide backflow prevention.

- For Category 3: Double critical check valves which are engineered for low temperature liquid CO_2 use, have proven acceptable reliability and are subject to a one year proof test interval, refer to Figure 1. Proof testing can be completed in the field where suitable block and bleed valves are provided, or check valves are replaced with new valves. Both activities are to be completed under a suitable work permit scheme.

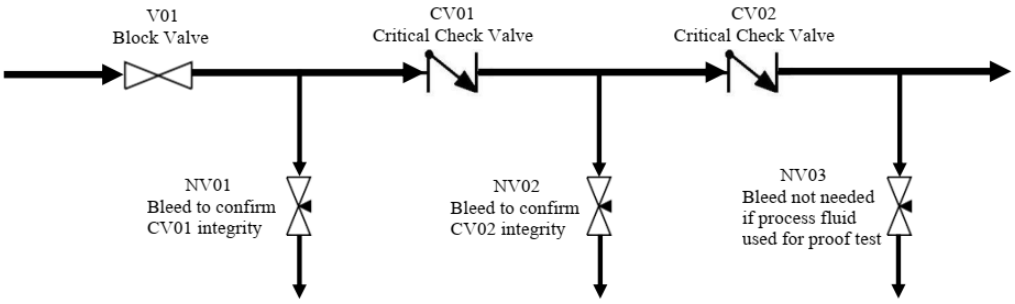

Figure 1: Example of a critical check valve assembly

3.4 Generic risk assessments

Generic risk assessments are not acceptable for tanks larger than 1,000 litres water capacity or any tank equipped with a gaseous return connection to the tanker.

NOTE: At sites where two or more tanks are used to provide system storage, i.e. on a common manifold, it is the combined system storage that is the critical value (>1000 litres water capacity).

Liquid container installations of up to and including 1,000 litres water capacity, which can be demonstrated as being designed, installed, filled and maintained in accordance with standard specifications, may be subject to generic assessment.

In order for a liquid container system to be suitable for generic assessment, it shall exhibit the following typical features:

- storage volume up to and including 1000 litres water capacity;
- a single-line filling mechanism;
- a back-feed protection device fitted to the delivery tanker.

3.5 Risk assessment questionnaire

A risk assessment questionnaire, of standard format and content, shall be completed for each installation. The document shall be completed by the assessor following the initial assessment visit and shall be retained as part of the record of the assessment and categorisation process. An example of a standard format is attached at Appendix 1. As a minimum, all of the details in EIGA 68 [2], Section 8, shall be marked. For ease of reference they are highlighted on the form in Appendix 1.

4. APPROVAL OF CATEGORY

Following the initial risk assessment, the provisional categorisation shall be the subject of a confirmation review by an in-house approval authority.

This authority can approve the proposed category assessment, recommend further investigation, re-categorise or require modifications to the installation.

5. COMPETENT PERSONS

The risk assessment and category rating process shall be carried out by suitably competent persons.

5.1 Assessor

The assessor shall be a suitably competent person, formally appointed by the company, with knowledge and understanding of the following topics:

- the properties of CO_2;
- customer applications and the potential risks of contamination;
- CO_2 storage and distribution systems;
- the relevant EIGA and BCGA requirements;
- pressure systems.

5.2 Approving authority

Assessments shall be overseen by an approving authority. The approving authority shall be a competent person appointed by the company to undertake the assessment review.

5.3 Competence records

Competence records should be maintained for all assessors and approving authorities. Competence records may include:

- the record of formal appointment by a duly authorised manager;
- relevant continuing professional development (CPD) activities;
- attendance at a training event;
- on-going record of numbers completed / length of experience;
- results of performance audits, supervisory activity, peer checking etc.

Records shall be current and kept up-to-date. Records should be retained for a minimum period of three years.

6. DOCUMENTATION

Companies shall maintain records on all installations into which they supply liquid CO_2.

The records shall include the following information:

- P&ID of the CO_2 system assessed for back-contamination risk;
- simple PFD of the customer's process when available;
- risk assessment and review;
- record of subsequent visits and effectiveness tests.

7. MONITORING AND TESTING

7.1 Contracts

Contracts for the supply of liquid CO_2 shall include a clause requiring the customer to notify the supplier of an intent to change the process or the configuration of the storage system. Receipt of such notification shall require the supplier to review the proposal and the risk classification of the installation.

7.2 Preventive checks

Each installation, not including those covered by generic risk assessment, or those protected by a single line filling through an in-line check valve, shall be reviewed in accordance with the frequencies detailed in Table 2 by a competent person to ensure that the risk assessment is valid, that the category is correct and the preventative measure is appropriate and effective.

Category	Recommended frequency
0	Maximum inspection / review frequency every 3 years.
1	In accordance with company policy on planned maintenance visits to tank. Maximum inspection / review frequency every 3 years.
2	In accordance with company policy on planned maintenance visits to tank. Maximum inspection / review frequency every 2 years.
3 & 4	Maximum inspection / review frequency every year.
X	Dependant on the rate of consumption of CO_2 gas from the gas phase of the storage tank. The assessment and review is the responsibility of the gas company customer contract owner (unless otherwise specified).

Table 2: Recommended frequency for inspection of preventive measures.

8. PRODUCT SOURCING

All suppliers of CO_2 shall ensure that their product conforms to the requirements of EIGA 70 [3].

NOTE: Increasingly CO_2 is being produced by methods such as anaerobic digestion. The use of CO_2 produced this way may be acceptable but requires careful evaluation prior to its use in foods and beverages.

All companies operating production sources which supply product into the UK market shall ensure that:

- their plants have been subject to HACCP review (refer to Section 3.3) and supply product which complies with EIGA 70 [3];
- all companies collecting product from them conform with this Code of Practice.

9. VERIFICATION

All companies involved with the supply of liquid CO_2 within the UK shall conform to EIGA requirements and shall have agreed to implement the guidelines of this document. The integrity of the entire supply system is dependent upon the continued co-operation of all companies involved.

All companies involved with the supply of liquid CO_2 within the UK shall ensure that they have formally documented procedures to prescribe the assessment of risk and the prevention of cross-contamination as required in EIGA 68 [2] and the guidance given in this Code of Practice. A recognised quality management system (QMS) shall be in place within each company, for example, the ISO 9000 [1], *Quality management systems*, series of standards. These procedures shall be included in the company's QMS.

Risk assessments will have been carried out in accordance with Section 3. Table 1 lists the risk categories. Table 2 details the recommended frequency for inspection / review of preventive measures.

These risk assessments and details of the activities carried out to ensure prevention of cross-contamination shall be included in the third party auditing process of the company's QMS.

9.1 Annual report to BCGA

Each member company (involved with the supply of CO_2 within the UK) shall produce an internal annual report based on the template detailed within Appendix 2.

This internal annual report shall be:

- for the time period June to June;
- provided (by the member company) to BCGA by the end of August.

The template in Appendix 2 should be used for the report. This will allow BCGA to assess the performance of the individual companies against a set of common criteria. The report shall state whether:

- all delivery sites reviewed during the audit are covered by the system;
- valid risk assessments are in place;
- competent people are appointed;
- alternative engineering solutions have been evaluated, where applicable;
- checks are in place;
- records are correct;
- CO_2 sourcing procedures are acceptable.

The individual reports provided are converted by BCGA into a single anonymous report. When completed the BCGA report is formally recorded and distributed to:

- all BCGA members who supply liquid CO_2;

- BCGA TSC5;
- BCGA Technical Committee.

The BCGA Report will be reviewed at the autumn meeting of TSC 5.

NOTE: TSC5 is the BCGA product quality committee (Technical Sub-Committee (TSC) 5).

10. REFERENCES

	Document Number	Title
1.	ISO 9000 Series	Quality management systems.
2.	EIGA 68	Prevention of CO_2 back-feed contamination.
3.	EIGA 70	Carbon dioxide source certification, quality standards and verification.
4.	ISBN: 9781461450276	'HACCP A Practical Approach' by Mortimore *et al*. Published by Springer-Verlag New York, Inc. 3rd Edition, 2012.
5.	BCGA Guidance Note 14	Production, storage, transport and supply of gases for use in food.

Further information can be obtained from:

European Industrial Gases Association (EIGA)	www.eiga.eu
International Organization for Standardization (ISO)	www.iso.org
British Compressed Gases Association (BCGA)	www.bcga.co.uk
International Society of Beverage Technologists (ISBT)	www.bevtech.org

BCGA STANDARD FOR CO_2 BACK-CONTAMINATION RISK ASSESSMENT

Risk Assessment - Template

NOTE: EIGA requirements are shown as highlighted.

Customer Name / Address	
Date of Assessment	

1. Storage tank details

Type		Size	
Manufacturer		Serial No.	
Last Inspection		Plant reference No.	
Max working pressure		Normal working pressure	
Relief valve set pressure		Date of last relief valve change	
Does the tank have an internal heater?		❑ Y/N	
Does the tank have a refrigeration unit?		❑ Y/N	
If so, what is the fridge type and capacity?			
Is the tank normally filled by 2 hose method?		❑ Y/N	
If not give details of fill method.			
Is CO_2 taken from tank as liquid & vaporised for use?		❑ Y/N	
Is CO_2 taken as gas from the top of the tank?		❑ Y/N	
If yes then detail the pressure build system			
If CO_2 is taken from both vapour and liquid phases of the tank - what proportion is taken as gas?		❑ Mainly liquid	
		❑ Mainly gas	

2. Vaporisers, pumps, ancillary CO_2 supply equipment

Vaporisers	
Type:	Number:
Comments:	
Pumps	
Type:	Number:
Comments:	

3. Fluid return lines

Does gas or liquid enter tank under normal conditions?	❑ Y/N
If so give details:	
Does gas or liquid enter the tank under fault / emergency conditions?	❑ Y/N
If so give details:	

4. Liquid supply pipework details

Normal supply pressure	
Maximum supply pressure	
Relief valve pressure	
Date of last relief valve change	

5. Gas supply pipework details

Normal supply pressure	
Maximum supply pressure	
Relief valve pressure	
Date of last relief valve change	

6. Application details

Normal CO_2 usage rate	
Maximum CO_2 usage rate	
What process will the CO_2 be used for? Give description.	
What product(s) will the CO_2 contact?	
At what pressure does the CO_2 contact the product(s) under normal conditions?	
What is the maximum pressure at which the CO_2 can contact the product(s) under fault conditions?	
What devices (if any) prevent backflow? (Give type / manufacturer and model number if possible)	

7. Existing preventive measures

What devices, if any, prevent backflow?	
If a check-valve is fitted is there:	
Provision to test for effectiveness?	❑ Y/N
Provision to maintain it?	❑ Y/N
Records of test / maintenance?	❑ Y/N
Date of last test	

8. Suppliers

Do other suppliers fill the tank?	❑ Y/N
If yes then who?	

Declaration

I hereby confirm that the risk assessment for the customer installation detailed above has been conducted in accordance with BCGA / EIGA guidelines for prevention of back-feed contamination.

Signed: _____ Date: _____

Name: _____

Provisional Risk Category: _____

Approval review

Risk assessment number _____ has been reviewed.

The confirmed risk category is _____

Signed: _____ Date: _____

Name: _____ Position: _____

BCGA ANNUAL REPORT - TEMPLATE

Company:

Point of contact:
Name / Email / Phone number

Compliance Yes / No	**Comments**
1. Has a 3rd party audit report been completed (within the timescales of Section 9.1)?	
	Include reference number and date of report.
2. All delivery sites reviewed during the audit are covered by the system.	
	List delivery sites.
3. Valid risk assessments are in place.	
4. Competent people are appointed.	
5. Alternative engineering solutions have been evaluated.	
6. Checks are in place.	
7. Records are correct.	
8. CO_2 sourcing procedures are acceptable.	

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