



PREVENTION OF CARBON DIOXIDE BACKFEED CONTAMINATION

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Prepared WG-8 Food Gases and Carbon Dioxide

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Amendments from 68/08

Section	Change
	Editorial to align with EIGA Style Manual
3.1	Addition of definitions section
4.1	Additional examples added
4.3	Appendix C moved to new section
8	New paragraph added
10	Reference section added
Appendix C	Moved to 4.3

Note: Technical changes from the previous edition are underlined

1 Introduction

All deliveries of liquefied carbon dioxide potentially represent a risk for backfeed and contamination of 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.

This publication gives guidance on how to minimise the probability of contamination arising in customer's carbon dioxide storage tanks. By ensuring that customer's tanks remain free from contaminants, the hazard of contamination being spread throughout the supply chain are also controlled.

2 Scope and Purpose

2.1 Scope

This publication is concerned with preventing contamination that enters the carbon dioxide storage tank at the user's premises and subsequently contaminates the delivery tanker and depot storage tank.

2.2 Purpose

To provide recommendations that will protect against backfeeding of contaminants from the customer's process into the customer's storage tanks and consequently spreading to other customers via the delivery tanker.

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

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

3.1.5 Can

Indicates a possibility or ability.

4 Examples of contamination

The following are examples of how contamination can arise in users' storage tanks that can also lead to contamination of the delivery tanker.

4.1 Contamination occurring at user's premises

Contamination can occur at the users' premises in the following circumstances:

- Recovered carbon dioxide from breweries or other processes where carbon dioxide is recovered;
- Build-up of contaminants due to distillation of liquid carbon dioxide in tank when a substantial proportion of product is withdrawn from the top of the tank as gas or following accidental depressurization;
- Oil contamination from customer's transfer pumps. These pumps are installed where the customer wants to avoid the noise of the tanker engine which powers the tanker mounted transfer pump;
- Flow into the storage tank of material from the degradation of the delivery hose lining. This usually occurs with rubber lined hoses, either by the lining breaking down or by liquid carbon dioxide dissolving plasticisers;
- Use of hoses whose connections are contaminated with oil, grit, mud or water. The correct application of procedures avoids this contamination;
- The backfeeding of any chemical contaminant into the storage tank from the customer's and /or carbon dioxide recycling processes/loops;
- The flow of contaminated carbon dioxide into the storage tank from filling returned cylinders without blowing down the returned gas when the overpressure protection relief device exhausts into the storage tank;
- Contamination due to the backflow of cleaning fluids from beverage processes;
- Contamination with residual water or foreign particles during inappropriate operations of user and/or truck trailer retesting; and
- Contamination through inappropriate food contact materials (design or maintenance operations).

4.2 Backflow into the delivery tanker in fault conditions

Backflow into the delivery vehicle can occur into the delivery tanker in the following fault conditions:

- Backflow of contaminated liquid stored in 80 bar tanks. Despite single hose filling, contamination can return due to the pressure gradient if pumping systems or procedures fail; or
- Backflow of contaminated gas due to use of a gas balance line to increase the speed of delivery where the driver's instruction requires the use a liquid hose only.

4.3 Distillation in storage containers

The methods of storage and use employed by gas users can affect the composition of carbon dioxide supplied to the point of use or in the liquid phase of the gas user's container.

When carbon dioxide is drawn from the vapour phase of a container there will be a single plate distillation effect. This will affect the concentration of impurities in the liquid phase dependent upon the relative volatility of the impurity concerned.

Where the volatility of the impurity is such that its concentration is increased in the liquid phase through distillation, the concentration of the impurity in the withdrawn gas phase will also rise and could eventually exceed the levels specified in the production and/ or delivery specification.

It is recommended that when vapour phase withdrawal from a container is used liquid carbon dioxide is withdrawn at intervals determined by appropriate testing, to restrict the impurities to within acceptable levels.

5 Method of protecting against contamination

The approach taken is that customers are required to advise their suppliers of the nature of their process of using carbon dioxide. Customers are also asked to notify suppliers of any subsequent changes to the process or installation. A model questionnaire is given in Section 9. Based on the information supplied, the gas supplier shall evaluate the probability of contamination and recommend that engineering modifications are made to the user's installation and, where required, to the method by which the tanker delivers into the tank.

No distinction is made between the different substances which can cause contamination because even air could be considered by some users as a contaminant. The emphasis of this guidance is therefore placed on maintaining the purity of the carbon dioxide at the level of the agreed delivery specification.

Guidance on determining the probability of contamination for various user processes is given in Section 5. Section 6 gives recommendations on the preventive measures which are necessary for each category of probability.

Where more than one carbon dioxide supplier fills a storage tank, the suppliers shall liaise to ensure that each is following the guidelines in this publication.

6 Risk definitions, categories and examples

The categories run from 0 to 4, with 4 representing the highest probability of carbon dioxide contamination. A further category X is also defined for one specific type of storage tank configuration.

6.1 Category 0

Category 0 includes processes in which the contact between the carbon dioxide and the product takes place at atmospheric pressure.

Examples of category 0 include:

- Food freezing and chilling;
- Processes using snow horns;
- In-transit refrigeration;
- Rubber deflashing;
- Meat tumbling;
- Food packaging with pure carbon dioxide; and
- Inerting.

6.2 Category 1

Category 1 includes processes in which there is a continuous connection between the storage tank and the process, but a high forward pressure differential is maintained at all times, except during maintenance.

Examples of Category 1 include:

- Carbonation;
- pH control;
- inerting;

- heat treatment;
- foundries, for example sand hardening; and
- medical carbon dioxide baths.

6.3 Category 2

Category 2 are processes in which, under fault conditions, the pressure can become higher than the storage tank pressure.

Examples of category 2 include:

- processes using gas mixers e.g. modified atmosphere packaging of food;
- blow moulding; and
- aerosol propellant.

6.4 Category 3

Category 3 includes processes at a pressure which is higher than the storage tank pressure.

Examples of Category 3 include:

- cylinder filling (carbon dioxide and carbon dioxide mixtures);
- cylinder filling on top of returned gas;
- inerting under pressure;
- polystyrene extruders;
- blow mould cooling (air forming);
- nuclear reactor coolant systems; and
- foam and plastic expansion.

6.5 Category 4

Category 4 is where the storage tank is part of the customer's process. The installation is designed to allow gas or liquid from the process to flow back into the tank.

Examples of Category 4 include:

- breweries with carbon dioxide recovery systems;
- tobacco expansion;
- recirculating carbon dioxide lines;
- extraction processes; and
- atomization processes.