



SAFETY TRAINING LEAFLET 12 CRYOGENIC LIQUIDS, SPILLS AND VAPOUR CLOUDS

Doc 23.12/18

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



SAFETY TRAINING LEAFLET 12 CRYOGENIC LIQUIDS, SPILLS AND VAPOUR CLOUDS

Prepared by Safety Advisory Group

Disclaimer

All technical publications of EIGA or under EIGA's name, including Codes of practice, Safety procedures and any other technical information contained in such publications were obtained from sources believed to be reliable and are based on technical information and experience currently available from members of EIGA and others at the date of their issuance.

While EIGA recommends reference to or use of its publications by its members, such reference to or use of EIGA's publications by its members or third parties are purely voluntary and not binding.

Therefore, EIGA or its members make no guarantee of the results and assume no liability or responsibility in connection with the reference to or use of information or suggestions contained in EIGA's publications.

EIGA has no control whatsoever as regards, performance or non performance, misinterpretation, proper or improper use of any information or suggestions contained in EIGA's publications by any person or entity (including EIGA members) and EIGA expressly disclaims any liability in connection thereto.

EIGA's publications are subject to periodic review and users are cautioned to obtain the latest edition.



Table of Contents

1	Introduction	1
1.1	Safety leaflets	1
1.2	Comprehension tests.....	1
2	Cryogenic liquids, spills and vapour clouds	1
	Appendix 1 – Cryogenic Liquids, Spills and Vapour Clouds – Test Questions	4
	Appendix 2 – Cryogenic Liquids, Spills and Vapour Clouds – Test Answers.....	5

Note: this Safety Training Leaflet is taken from Leaflet 11: CRYOGENIC LIQUIDS, SPILLS AND VAPOUR CLOUDS in Doc 23/08 Safety Training of Employees. The leaflet has been put into a new format, but the content has not been revised.

1 Introduction

1.1 Safety leaflets

Safety training leaflets summarise the basic operational safety knowledge which needs to be known by employees working in the gas industry.

Refer to EIGA Doc 23 *Safety Training of Employees* for the various combinations of leaflets which define the scope of safety training for a variety of specific jobs.

Each leaflet addresses a specific topic as identified in the title.

1.2 Comprehension tests

There is a comprehension test for each leaflet, included in **Appendix 1**.

Each test comprises several questions. To pass the test it is suggested that the employee should score 75% at the first attempt. Incorrect answers should be discussed to confirm understanding.

Appendix 2 includes the list of correct answers.

2 Cryogenic liquids, spills and vapour clouds

1. In our industry the main cryogenic liquids are oxygen, nitrogen and argon kept at such low temperatures that they are in liquid form.
2. Liquids can be held in a variety of containers - such as dewars for small quantities or insulated tanks and road tankers for larger quantities. Each type of container has its own filling procedures.
 - 2.1. Use only containers designed and identified for the specific cryogenic liquid you are handling.
 - 2.2. Always follow the correct transfer procedure, including transfer equipment, correct coupling, and hoses.
3. Boiling and splashing always occur when filling a warm container. Wear protective equipment such as goggles or face shield, gloves.
 - 3.1. Stand clear of boiling and splashing liquid and its issuing gas.
4. High concentrations of oxygen are a fire hazard. Excessive amounts of nitrogen and argon in the air reduce the concentration of oxygen and can cause asphyxiation.
 - 4.1. Never release cryogenic liquids in confined areas.
 - 4.2. Always handle cryogenic liquids in well-ventilated areas to prevent hazardous concentrations of gases.
5. Cryogenic liquids are so cold that they can freeze skin and other human tissues immediately, thus inflicting serious injuries. Breathing the very cold gases which arise from vaporising cryogenic liquids can cause serious damage to the lungs.
 - 5.1. Never allow any unprotected part of your body to touch uninsulated pipes or vessels containing cryogenic liquids. Wear protective clothing (goggles, gloves and safety shoes).
6. When a cryogenic liquid is released into the atmosphere, its extremely low temperature condenses the atmospheric water vapour, and this forms a dense fog. A cryogenic liquid spill is often identified by the presence of a low-lying cloud of fog creeping over the ground.

These clouds can be dangerous as you do not know their temperature or composition. Visibility inside the cloud is very low and you could fall, perhaps into a stream of cryogenic liquid.

If the cloud is of nitrogen or argon, then it is likely that the cloud does not contain sufficient oxygen to support life. In this case you could collapse immediately, and death could follow.

- 6.1. DO NOT ENTER A VAPOUR CLOUD; but see (8.2.) below.
 - 6.2. When you see a cryogenic spill, or a large vapour cloud notify your supervisor immediately.
 - 6.3. If possible shut off the source of liquid, by use of a remotely controlled valve if one is fitted. Do not expose yourself to a hazard, such as high oxygen, combustible or asphyxiating atmospheres or cryogenic liquid.
- 7 If the spillage was near to a vehicle the cold liquid could freeze the tyres to the ground and make them so hard and brittle that the tyres could explode.
- 7.1. If liquid has reached the tyres do not attempt to move the vehicle. Also, do not start engine in case of oxygen spill.
- 8 Low or high oxygen contents will generally exist inside and in the immediately vicinity of the vapour clouds. However, wind and weather conditions could spread hazardous conditions beyond the vapour cloud. Watch the windsock frequently.
- 8.1. Keep clear of the vapours and be prepared to move if the wind changes. Portable oxygen analysers can be used to evaluate oxygen enrichment or deficiency hazards.
 - 8.2. If it is essential to enter a cloud caused by nitrogen or argon, then wear a self-contained breathing apparatus provided you are trained and qualified to do so. A standby man, also wearing a breathing apparatus must monitor personnel in action.
- 9 If the release gas is oxygen, then your clothes could become saturated with it and could then catch fire very easily. Also, a fire can occur at any time in an oxygen cloud, in the event that it contacts highly combustible material.
- 9.1. If you suspect that you have been contaminated with oxygen, do not go near any source of ignition for at least 15 minutes. Ventilate your clothing; change if possible. **DO NOT SMOKE OR APPROACH SMOKERS!**
- 10 If the cloud has been caused by oxygen, a running or starting internal combustion engine could explode. If the cloud has been caused by nitrogen or argon the vehicle could stall, thus trapping the occupants in the cloud.
- 10.1. If roads, railway lines, rivers or canals bordering the site are threatened by the liquid or the vapour cloud, then your supervisor may instruct you to notify the authorities to stop or divert traffic. No traffic must be allowed to enter the cloud. (An emergency call list should be available).
 - 10.2. Shut off petrol or diesel engines on any equipment that could be remaining in the area.
- 11 Carbon steel becomes brittle when in contact with cryogenic liquids, so steel plates can crack, and structural steel beams can fail and piping can burst.
- 11.1. If necessary and on the advice of your supervisor, divert the liquid away from vulnerable plant equipment towards a safe area by using stainless steel or aluminium sheet or clean sand dikes. Do not allow liquid oxygen to enter drains or sewers.
 - 11.2. Water sprayed from a fire hose will help to vaporise the liquid and protect vulnerable steelwork by coating it with ice. However, judgement must be made on the weather

and wind conditions. It may not be desirable to speed up vaporisation as the resulting larger vapour clouds could endanger staff and third parties.

- 11.3. If so advised by your supervisor, shut down any air conditioning or ventilating systems that may draw vapours or gases from the spill into buildings.
- 11.4. Call the emergency services in the event of a large LOX spill. Have them stand by until the spillage is dispersed. Do not allow vehicles to enter the vapour cloud.
- 11.5. Keep all visitors to the site advised as to the hazards of the spill and arrange for their evacuation from the area unless they are company staff who are qualified to assist with the emergency.
- 11.6. If liquid oxygen reaches a black top (tarmac) area do not allow any movement of machines or people until it has fully thawed and there are no frozen areas.
- 11.7. When the cloud has cleared, and the emergency is over, do not enter any area below ground level, for example a pit or gulley, without checking the atmosphere to ensure that it does not contain either a deficiency or an excess of oxygen.

Appendix 1 – Cryogenic Liquids, Spills and Vapour Clouds – Test Questions

Tick the correct answer (s) or write in the blank spaces as requested.

1. Tick three equipment items that should be part of your Personal Protective Equipment when transferring cryogenic liquid to an open container:

A. Face shield	B. Cryogenic gloves
C. Fire resistant clothes	D. Long sleeve garment

2. Tick three characteristics that cryogenic gloves must have:

A. Long arm	B. Waterproofing
C. Easy to remove	D. Short arm

3. The cloud produced by a release of cryogenic liquid into the atmosphere can be dangerous because...:

A. It could cause oxygen enrichment	B. It could cause oxygen deficiency
C. Visibility inside the cloud is very low and you could fall into a stream of cryogenic liquid	

4. Name three cryogenic products distributed by our companies:

5. Tick the correct statements:

A. Use only containers designed and identified for the specific cryogenic liquid you are handling
B. The clouds from cryogenic spillage are water vapour with no risk
C. The gases generated in a cloud are so cold that the lungs could be seriously damaged
D. The risk of high or low oxygen content in these clouds is present only in confined spaces

6. If the release gas is oxygen, then your clothes could get saturated with and could catch fire very easily. You should not go near any source of ignition for not less than...

A. 30 minutes	B. 60 minutes
C. 15 minutes	D. 20 minutes

7. If the spillage was near a vehicle and the liquid has reached the tyres. It has to be moved away immediately

A. True	B. False
---------	----------

8. Carbon steel becomes brittle when in contact with cryogenic liquids, so steel plates can crack, structural steel beams can fail and piping can burst

A. True	B. False
---------	----------

Appendix 2 – Cryogenic Liquids, Spills and Vapour Clouds – Test Answers

1. A, B and D
2. A, B and C
3. A, B and C
4. LOX; LAR; LIN
5. A and C
6. C
7. B
8. A