



SAFETY TRAINING LEAFLET 04 NITROUS OXIDE

Doc 23.04/18

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Prepared by Safety Advisory Council

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Note: this Safety Training Leaflet is taken from Leaflet 3: NITROUS OXIDE in Doc 23/08 Safety Training of Employees. The leaflet has been put into a new format and 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 Nitrous oxide

2.1 Properties of nitrous oxide

- Nitrous oxide is referred to by its chemical formula N_2O . It is, at room temperature and atmospheric pressure, a colourless gas with a barely perceptible sweet odour and taste. In cylinders nitrous oxide is liquefied with a pressure of approximately 50 bar at 20°C.
- Nitrous oxide is heavier than air. Therefore, it can accumulate in areas below ground level such as pits and trenches where it may be slow to disperse.
- Nitrous oxide is not toxic. When the gas is inhaled, it is inebriating (that is why it is also called "laughing gas") and narcotic.
- Inhalation of high concentrations may cause fatal asphyxiation as it displaces oxygen in air.

2.2 Oxidising properties of nitrous oxide

- Nitrous oxide is not flammable but has to be treated as an oxidising agent (like oxygen - see Safety Training Leaflet 03 *Oxygen*). Its oxidising power is much higher than air and almost 50 % of pure oxygen.
- Make sure that all items such as tools, cleaning rags and clothes which may come into contact with nitrous oxide are free of oil and grease. Clean them with approved solvents and remove all traces of solvents before exposing them to nitrous oxide. See also Safety Training Leaflet 22 *Solvents*.
- In areas where nitrous oxide enrichment can occur, do not smoke and do not use naked flames.
- Do not use nitrous oxide for applications for which it is not intended. Especially do not use nitrous oxide as a substitute for pressurised air (e.g. for operating pneumatic tools).
- Nitrous oxide is non-corrosive. It can be used with any oxygen compatible material.

2.3 Decomposition

- When nitrous oxide is heated to above 650°C, it decomposes into nitrogen and oxygen. This decomposition in closed vessel could cause a sudden pressure increase, and a violent rupture of the vessel (tank, cylinder, etc.).

2.4 Greenhouse gas

- Nitrous oxide is a “greenhouse gas” but has no other harmful effect to the environment. The contribution of nitrous oxide produced by the gas industry to the global warming potential is negligible.
- Therefore, nitrous oxide can be released under certain conditions to the atmosphere.

2.5 Nitrous oxide manufacturing (production) specific hazards and prevention measures

- Nitrous oxide is manufactured by thermal decomposition of ammonium nitrate.
- Ammonium nitrate is an explosive compound that must be handled with care and stored with adequate fire protection. The contamination of ammonium nitrate with combustible substances can lead to ignition and/or the formation of toxic carbon monoxide during the manufacture of nitrous oxide.
- Ammonium nitrate during the process is heated up to 250°C. Protection against contact with hot reactor surfaces is necessary.
- Nitrous oxide during the process is purified with corrosive substances (caustic soda and sulphuric acid). When handling these substances relevant safety practices must be observed.

2.6 Nitrous oxide cylinder filling specific hazards and prevention measures

- Contamination of nitrous oxide cylinders with moisture is hazardous as it causes corrosion, which in turn can cause cylinders to burst.
- Nitrous oxide is filled in liquid form under pressure in the cylinders. It is hazardous to overfill cylinders with liquefied gases, as they can consequently burst. Each cylinder must bear a readable tare weight indication, which has to be considered at the filling process.
- (Filling weight = tare weight + weight of the filled gas).
- Cylinders must be emptied safely prior to tare weight check. In the event of a difference between tare weight and actual weight, the cylinder must be de-valved and inspected internally.
- The quantity of nitrous oxide in a cylinder can only be measured by weight and not by pressure.
- Weighing scale used to fill nitrous oxide cylinders should be certified by a third party and must be frequently checked using test weights.
- You must know how to stop the cylinder-filling process in case of an emergency.
- Nitrous oxide cylinders should be fitted with valves with built-in bursting discs. Make sure you know how to identify those valves and what to do in case a bursting disc blows out. (Go away and wait until the cylinder is empty).
- When not connected to the filling rack, cylinders must be capped and secured against falling.
- Don't mix nitrous oxide with flammable gases, because a violent explosion might occur.

- Before devalving, vent slowly, and weigh the cylinder to make sure that no liquid is left.

2.7 Nitrous oxide storage specific hazards and prevention measures

- Liquid nitrous oxide storage tanks are registered pressure vessels, you must know what the indications engraved in the identification plate mean. Tank pressure monitoring and control is critical, operating instructions must be known and respected, uncontrolled deviations must be reported immediately.
- Pressure relief devices protect storage tanks against overpressure hazards, you must know their set points.
- It is hazardous to overfill liquid nitrous oxide storage tanks. Level of liquid nitrous oxide in a storage tank is monitored.
- Flexible hoses should be coupled to safety lines secured at both ends (trailer or truck at one end and storage tank at the other end).
- A liquid nitrous oxide release in the atmosphere generates a thick cloud made of condensed moisture. Do not expose yourself to the cloud and try to get out of the cloud to breathe.
- Keep the entire nitrous oxide equipment free from oil and grease.
- Electrical heating inside the storage tanks is allowed only to heat the liquid phase. If the gas phase is heated, a violent decomposition of nitrous oxide may occur.

Appendix 1 – Nitrous Oxide – Test Questions

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

1. The two most important safety characteristics of Nitrous Oxide is that it is:
A. Flammable
B. Cryogenic
C. Oxidising Agent
D. Asphyxiating
2. Which two of the following hazards can be caused when using Nitrous Oxide?
A. Corrosive
B. Burns
C. Fire
D. Oxygen deficiency
3. Nitrous Oxide is heavier than air.
A. True
B. False
4. Nitrous Oxide is in cylinders a liquefied gas with a pressure of approximately 50 bar at 20°C
A. True
B. False
5. Tick the true sentences from the following
A. The filling of N₂O cylinders is controlled by weight
B. Keep the entire N₂O equipment free from oil and grease
C. The filling of N₂O is controlled by a pressure gauge
D. N₂O could be filled in any compressed gas cylinder
6. Tick the materials that may react violently with Nitrous Oxide.
A. Greases
B. Concrete
C. Copper
D. Oils
E. Organic waste
F. Dirty Teflon
7. Don't mix Nitrous Oxide with flammable gases, because a violent explosion might occur.
A. True
B. False
8. If the bursting disc of a Nitrous Oxide cylinder blows out:
A. You have to stop the leak immediately
B. You have to go away and wait until the cylinder is empty

Appendix 2 – Nitrous Oxide – Test Answers

1. C and D
2. C and D
3. A
4. A
5. A and B
6. A, D, E, and F
7. A
8. B