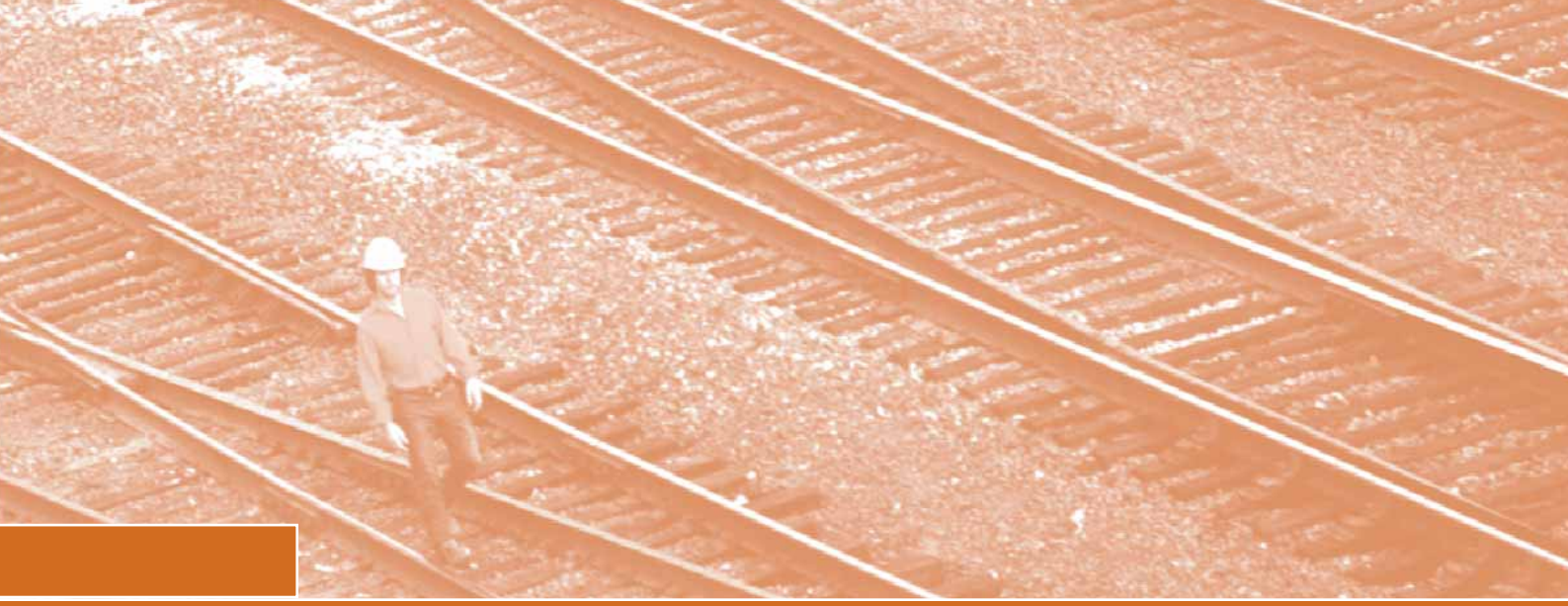


Guidelines for the distribution of

Ethylene Oxide / Third Revision

2004

Ethylene Oxide and Derivatives
Sector Group

cefic

Summary

CONTENTS

APPENDICES

1 Introduction

1.1 Although ethylene oxide is a hazardous material in terms of flammability, reactivity and toxicity, it can be distributed and handled safely provided that appropriate precautions are observed.

1.2 The transport of ethylene oxide in bulk is subject to strict regulations within most countries in Europe. In addition, the international movement of ethylene oxide by road, rail or sea is subject to international agreements which lay down specific requirements concerning transport which must be observed by all parties involved.

1.3 These Guidelines have been prepared by the Cefic (European Chemical Industry Council) Ethylene Oxide and Derivatives Sector Group to establish appropriately high standards of Safety for the transport of ethylene oxide.

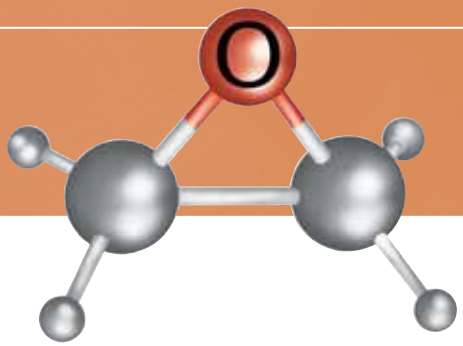
1.4 These Guidelines take into account the transport of ethylene oxide in bulk in road tankers, rail tank cars and tank containers. They cover all aspects of the transport activity from loading to delivery point. Reference to existing regulatory controls is only made where this is considered necessary for the purpose of clarification.

1.5 The Cefic Ethylene Oxide and Derivatives Sector Group recommends that these Guidelines are adopted by all parties who are involved in the distribution of ethylene oxide, and will arrange a regular review of these guidelines.

1.6 In order to facilitate effective supervision of safety in transport to destination, it is recommended that ethylene oxide producers should arrange transport themselves.

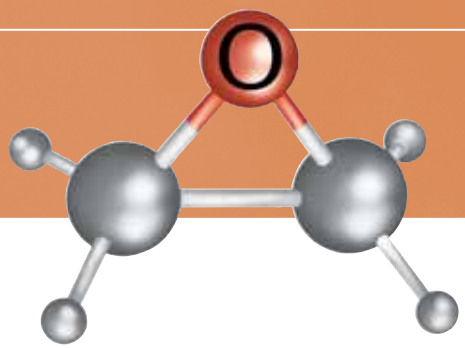
1.7 The Guidelines do not deal with the bulk movement of ethylene oxide in gas carrier ships, nor with the movement of ethylene oxide in any type of cylinders or MEGC's.

2 Properties and hazards of ethylene oxide



2.1 Properties

Boiling point at atmospheric pressure	10.5°C (range 10.4° - 10.7°C)
Melting point	- 111.3°C
Flash point (closed cup)	< -18°C
Density (liquid) at 0°C	890 kg/m3
Vapour density (air = 1)	1.52
Heat of evaporation	578 kJ/kg at atmospheric pressure and 10.5 °C
Specific heat - liquid	1.97 kJ/kg °C at 11°C 2.00 kJ/kg °C at 20°C
Specific heat - gas	1.06 kJ/kg.°C at 25°C.
Heat of polymerisation	2093 kJ/kg
Heat of decomposition of gas	83,700 kJ/kg mole
Heat of combustion	27649 kJ/kg.
Electrical conductivity of pure liquid	4 10^{-6} S/m
Minimum ignition energy at 1 bar and 25°C in air	0.06 mJ
Melting point of hydrate	11°C (maximum at 30 % EO)
Auto ignition temperature	429 °C
Auto decomposition temperature:	560 °C
Smell of pure EO	Not apparent until concentration reaches approx. 500--700 ppm Adaptation may take place.



2.2 Flammability

Ethylene oxide is highly flammable and has a flash point below -18°C. It is flammable in air at all concentrations above 2.6 % (by volume). There is no upper flammable limit as normally conceived in that exothermic decomposition replaces combustion at the higher ranges up to 100 % ethylene oxide vapour.

Due to its low boiling point and flammability, ethylene oxide is, in some respects, similar to LPG. However, an essential difference is that ethylene oxide is fully miscible with water. Another important difference is that ethylene oxide has an unusually low minimum ignition energy for mixtures in air. The lowest value at about 10.4 % ethylene oxide by volume is 0.06mJ and this figure is similar to the ignition energy of about 0.02mJ required by hydrogen/air mixtures.

Any leaks of ethylene oxide, for example from flanges, must therefore be avoided because of the high risk of ignition.

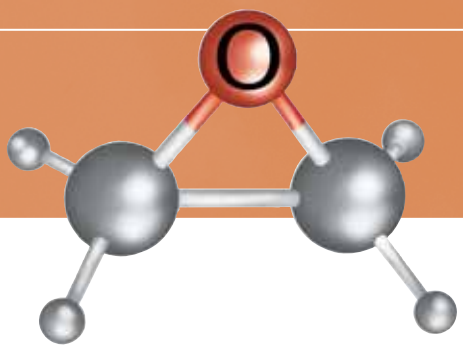
The auto-ignition temperature (AIT) of ethylene oxide in air at atmospheric pressure is 429°C. However, any contaminants present, such as rust can significantly reduce the AIT.

Solutions of ethylene oxide in water may give rise to flammable vapour. Even a 1 % solution of ethylene oxide in water has a closed cup flashpoint of 22°C. As much water as possible should always be used for dilution. If insufficiently diluted solutions enter sewers there may still be a flammability risk.

If ethylene oxide comes into contact with certain insulation materials it can self heat. Temperatures up to 700°C have been recorded. Insulation fires can raise vessel wall temperatures above the auto decomposition temperature and cause explosive decompositions (see section 2.4).

2.3 Chemical reactivity

Ethylene oxide is a highly reactive chemical which reacts exothermically, especially in the presence of a catalyst, with impurities/compounds such as water, alcohols, ammonia, amines, acids/bases and rust. These reactions can be self-accelerating and strongly exothermic, even with only traces of the compound present.



2.4 Decomposition

Pure ethylene oxide vapour decomposes explosively if ignited even in the absence of air. Ethylene oxide decomposition is initiated if the chemical is heated to about 560°C, the auto-decomposition temperature (ADT).

Decomposition is catalysed by metal acetyl ides as well as the metals copper, silver, mercury, and their alloys. Increasing pressure lowers the ADT. The presence of rust may also initiate decomposition at a lower temperature due to the formation of a hot spot caused by polymerisation.

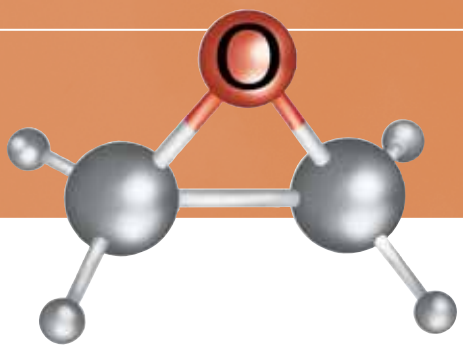
2.5 Polymerisation

Ethylene oxide is stable at room temperature in the absence of catalysts/contaminants. Purely thermal initiation of polymerisation begins at around 100°C.

Polymerisation of ethylene oxide is highly exothermic and, if the temperature is not controlled by removal of heat at a sufficient rate, the polymerisation is self-accelerating. This can lead to vaporisation of unreacted ethylene oxide and also possibly to explosive decomposition of the vapour. This polymerisation can be promoted by impurities or contamination which act as catalysts, for example by acids, bases, metal oxides and anhydrous chlorides of iron, aluminium and tin. Therefore it is most important to maintain clean equipment when handling ethylene oxide, and to ensure inadvertent mixing with other chemicals does not occur.

Rust is also a moderate initiator of the polymerisation reaction of ethylene oxide. It must be thoroughly removed from any equipment containing ethylene oxide.

At ambient temperature, the polymerisation of ethylene oxide in the presence of rust is slow. The polymer is a thermally stable viscous liquid which is soluble in the monomer. If exposed to water at temperatures higher than 50°C the polymer will react to produce polyethylene glycol which is sticky and difficult to remove from equipment.



2.6 Health hazards

Since ethylene oxide boils at 10.5°C it vaporises rapidly at ambient temperatures and atmospheric pressure.

2.6.1 Short term effects

a. Vapour

Exposure to ethylene oxide vapour will produce severe irritation of the skin, eyes and nose and may cause severe pulmonary oedema.

Headaches, nausea, vomiting and shortness of breath are caused by high concentrations (typically above 1000ppm). Central nervous depression may also result from exposure to high levels of vapour.

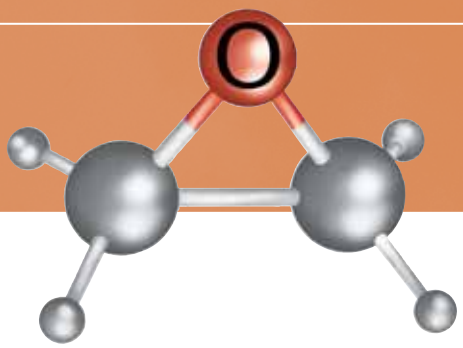
Many people cannot detect any smell from pure ethylene oxide at atmospheric concentrations below 500--700ppm. The smell threshold is well above the hygiene level. The sense of smell is subject to fatigue so that this should not be used as a reliable indicator of the level of ethylene oxide present.

b. Liquid and solutions

Liquid ethylene oxide when spilled on the exposed skin may produce reddening or, more seriously, frostbite. Solutions in water in the range 40 - 80% ethylene oxide give a more rapid burning than pure ethylene oxide itself. Even dilute solutions may be severely irritant to the skin and may, in rare cases, produce an allergic contact dermatitis. The burning effects may be delayed.

The eyes are particularly susceptible to serious and permanent damage from splashes of ethylene oxide, even by dilute solutions.

Industrial experience of single accidental large exposures to ethylene oxide liquid indicate that with adequate first aid treatment, recovery will be complete.



2.6 Health hazards

2.6.2 Long term effects

Ethylene oxide is recognised as a direct acting mutagen and has the potential to cause mutations in the cells of exposed human tissue. The chronic inhalation toxicity of ethylene oxide has been evaluated in long term studies on rats from which it has been concluded that ethylene oxide is associated with increases in natural-occurring tumours. These results indicate that there is a clear association between ethylene oxide exposure and the incidence of cancer. IARC (Category 1)/EU have classified ethylene oxide as carcinogenic to humans.

Animal studies have not shown teratogenic effects but adverse reproductive effects have been observed at high levels of exposure.

National regulations concerning the personal exposure limits for ethylene oxide in air vary between different European countries. At the present time, values vary between 1 and 10 ppm.

Concentrations of ethylene oxide in the working atmosphere should be as low as reasonably practicable below the regulated hygiene level.

The working atmosphere should be monitored regularly to ensure compliance with the exposure limit.

2.7 Environmental hazards

Ethylene oxide is toxic to micro organisms and fish. The LC50 value for fishes is 84 mg/L (exposure time 96 hours). However, in free-flowing waters the ethylene oxide concentration decreases continually due to a combination of evaporation, hydrolysis and biodegradation.

For example, within 4 hours at 25°C in moving water, the concentration drops by approximately 95%. The ethylene glycol produced as a result of ethylene oxide hydrolysis is considerably less toxic to aquatic organisms and is readily biodegradable.

3 Safety and quality assessment of road hauliers

3.1 The ethylene oxide producers utilise the services of specialised road hauliers in order to distribute their product. In such cases, it is of vital importance that the chemical company is assured that the hauliers that are employed are competent, and operates to appropriate safety standards.

3.2 It is recommended that all consignors involved in the transport of ethylene oxide should undertake safety assessments of the bulk road haulage operations of each of their hauliers. This will enable each consignor to satisfy itself as to the suitability of hauliers employed, and ensure that appropriate safety standards are maintained.

3.3 A haulier safety and quality assessment system (SQAS) has been produced by Cefic. It is recommended that this system is used as a minimum standard for assessing hauliers engaged in the transport of ethylene oxide.

3.4 Assessment does not replace or diminish the responsibility of the haulier to ensure that all aspects of his operations meet the appropriate legal and safety requirements and standards.

4 Design and construction of transport equipment

4.1 Design and construction of rail tank cars (RTCs)

Rail tank cars for the carriage of ethylene oxide must meet the design and construction requirements of:

a. National Regulations or Local Railway Administration Regulations, when used for national transport, and
b. International Regulations, such as the International Regulations concerning the Carriage of Dangerous Goods by Rail (RID), when used for international transport.

In addition, rail tank cars must be designed and constructed in accordance with the guidelines contained in Appendix 1 or to an equivalent standard.

4.2 Design and construction of road tankers

Road tankers used for the carriage of ethylene oxide by road must meet the design and construction requirements of:

a. National Regulations, when used for national transport, and
b. International Regulations, such as the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR), when used for international transport.

In addition to the above requirements, road tankers must be designed and constructed in accordance with the guidelines contained in Appendix 2 or to an equivalent standard.

4.3 Design and construction of tank containers

Tank containers may be used for the carriage of ethylene oxide by road, rail or sea. They must meet the design and construction requirements of the appropriate National or International Regulations depending upon the specific transport modes which are to be utilised.

In addition to the above requirements, tank containers must be designed and constructed in accordance with the guidelines contained in Appendix 2 or to an equivalent standard.

5 Product training for road tanker and tank container drivers

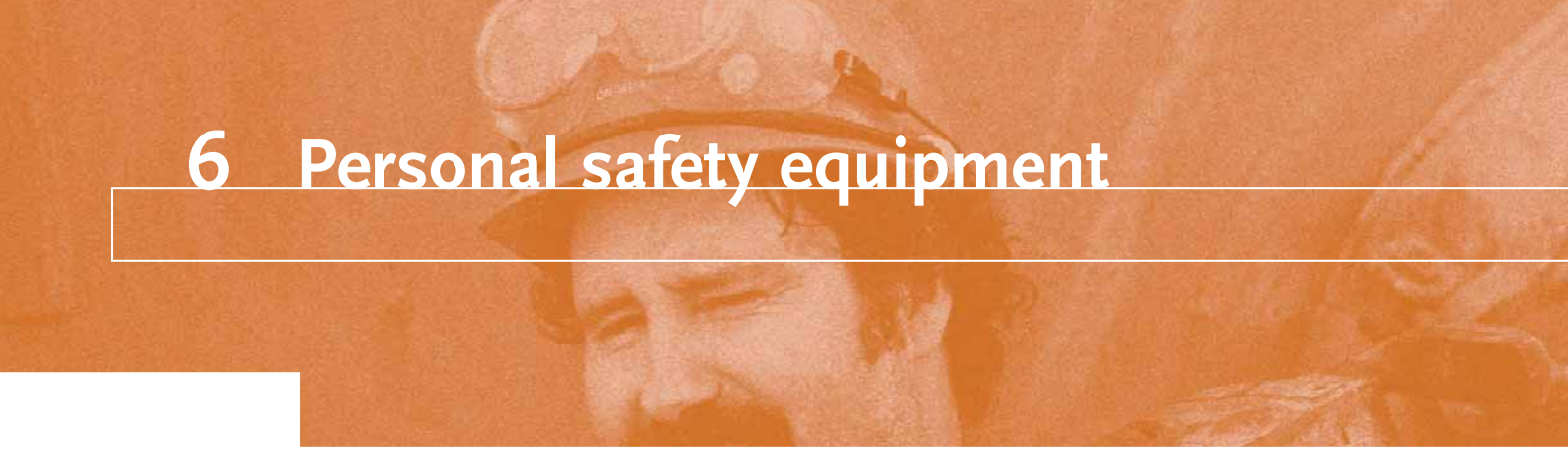
5.1 The ADR agreement requires that all drivers of road tankers or transport units carrying tank containers with a total capacity of more than 3000 litres must have successfully participated in a training course on the particular requirements that have to be met during the carriage of dangerous goods. A similar training requirement for drivers is included in most national transport regulations.

5.2 However, the hazards associated with ethylene oxide are such that drivers should be specifically trained to understand the particular nature of the dangers which may arise during transportation of this product and the actions to be taken in an emergency situation. The content of the specific training which needs to be given is shown in Appendix 3.

5.3 Before a driver is allowed to convey ethylene oxide, he / she:

a. Must have received product training to the standard required by the ADR agreement; and
b. must have successfully participated in a specific training course for ethylene oxide.

5.4 All consignors of ethylene oxide should undertake the responsibility for ensuring that specific product training for ethylene oxide is provided to drivers. Upon successful completion of training and validation, drivers should be provided with a certificate, valid for two years. Drivers should be issued with a copy of the training material in their native language for their retention.
Companies that receive ethylene oxide should be encouraged to ask to see the drivers ethylene oxide training certificate.



6 Personal safety equipment

6.1 In all situations where exposure to ethylene oxide liquid and/or vapour is possible, adequate personal protection should be worn. As a minimum, the following should be used:

a. Safety goggles
b. Gloves suitable for ethylene oxide
c. Suitable respiratory protective device.

Protective suits and boots may also need to be considered depending upon the circumstances.

6.2 It should be noted that many materials in common use are permeable to or are attacked by ethylene oxide.

Butyl rubber has been found to give the best degree of protection. Neoprene or natural rubber may also be considered for protective clothing, but may not remain vapour-tight after prolonged use.
Leather is permeated by liquid ethylene oxide and PVC and nitrile rubber offer only very limited resistance. Consequently, these materials should not be used for protection against ethylene oxide liquid or vapour. Leather, PVC or nitrile rubber footwear should be avoided. Delayed skin burns may result if ethylene oxide is allowed to permeate through these materials.
Prior to the acquisition of the personal protective equipment (PPE), formal confirmation needs to be obtained from the PPE-manufacturer that the PPE is resistant for EO-use (including breakthrough / degradation time). Following contact with EO-liquid/vapours all used gloves must be discarded.

6.3 If any leather wear does come into contact with ethylene oxide, it should be discarded immediately because decontamination of leatherwear is not possible.

6.4 Eyewash facilities and safety showers (frost-protected as necessary) should be provided in all areas where ethylene oxide is handled.

7 Loading operations

7.1 The operation of filling any road tanker, tank container or rail tank car (RTC) with a dangerous substance is a potential hazard. It is therefore important that loading facilities and transport equipment are correctly designed and constructed, and properly used and maintained.

7.2 The design and construction of transport equipment is described in Section 4 of these Guidelines. Equipment, which meets the requirements of the ADR, RID and / or IMO Regulations, is subject to periodic inspection and testing requirements as laid down in these Regulations. The competent authorities carry out official inspection and testing.

7.3 Written operating instructions should be available covering all activities for loading of ethylene oxide into road tankers, tank containers and rail tank cars. Personnel involved should be fully trained in their implementation (involvement of fire brigades in the training is recommended). The instructions should recognise the specific hazards of ethylene oxide, and ensure the correct operation of loading equipment in both normal and emergency situations.

7.4 All necessary protective clothing and emergency equipment should be available for loading operations (see Chapter 6). Personnel should be trained in the correct use of this clothing and equipment.

7.5 It is not the intention of this section of the Guidelines to attempt to set detailed operating instructions for loading ethylene oxide vehicles, since these of necessity will depend upon local operating conditions. However, as part of the operating instructions, the loading terminal staff should carry out an inspection of the transport equipment before, during and after loading. This inspection does not replace or diminish the responsibility of the owner of the road tanker, tank container or rail tank car to ensure that the equipment is properly tested, maintained and fit for purpose. It is meant to ensure that the transport of ethylene oxide is conducted as safely as possible. An inspection list such as the one described in Appendix 4 is recommended for use by the loader to check the condition of the ethylene oxide transport equipment, and this should be applied for all loading operations.

7.6 In addition to the routine inspection of all transport equipment prior to each loading operation, a responsible person from the loading company should carry out a check on each road tanker, tank container or rail tank car prior to initial introduction into service, or reintroduction to service after maintenance or repair. An example of these checks is shown in Appendix 4.

8 Transport of ethylene oxide by road

8.1 The haulier is responsible for the safe transport of ethylene oxide by road from the loading point to the discharge point. Special consideration should be given to the following:

8.1.1 Routing

The transport of ethylene oxide has to follow the ADR-regulations. According to this the route must be selected carefully. As far as possible, the route should:
a. Utilise motorways,
b. Avoid inhabited areas

8.1.2 Safe parking

Drivers must ensure that the vehicle is either supervised or is parked in a secure place.

No potential source of heat or fire must exist in the vicinity, and the vehicle must be capable of being easily removed in an emergency.

Drivers must inform the haulier of their overnight parking location. The overnight parking locations must be selected in accordance with regulations (for example ADR).

8.1.3 Severe weather conditions

When severe weather conditions are experienced during transport, for example icy roads, snow or poor visibility, the delivery should be stopped at the next suitable parking place

8.1.4 Delays or accidents

All delays during transport, whether due to severe weather conditions, breakdown or other reasons must be reported to the consignor as soon as possible. Transport accidents must also be reported to the consignor as soon as possible.

8.1.5 Pressure and temperature checks

For road transport the pressure and/or temperature of the tank contents should be checked regularly and recorded on a checklist or in a logbook

8.1.6 Emergency procedure

Drivers should be given precise instructions as to the acceptable pressure and temperature rise during the journey (see Chapter 8.1.5), and the emergency action to be taken in the event that readings in excess of acceptable levels are observed.

Recommended instructions are given in Appendix 3, Section 9.

9 Transport of ethylene oxide by rail

9.1 The railway operating companies are responsible for the safe transport of ethylene oxide by rail from despatch siding to final reception siding. The selection of route, intermediate stopping locations and cessation of traffic due to severe weather conditions are matters to be decided by the railway authorities.

9.2 The railway authorities or railway operating companies will normally intervene in the event of a transport emergency involving ethylene oxide rail tank cars. Railway authorities should be made aware of the information contained in these Guidelines as an aid for railway hazardous cargo intervention teams.

9.3 Rail tank cars shall not be transported over the public road from the final rail siding to the customer by a 'piggyback' arrangement. Multimode transport by tank container may provide a viable alternative.

10 Transport of ethylene oxide by sea

10.1 Transport of ethylene oxide by sea may be either:

a. by roll on/roll off freight ferries, or

b. lift on/lift off shipment in tank containers.

Basic requirements for ferry movements are given in the IMDG Code. Local agreements applicable in some sea areas may modify the requirements of the Code in certain circumstances, eg the Baltic Memorandum of Understanding.

Any movement of ethylene oxide must comply with the relevant regulations. In addition, freight only ferries will be used whenever possible. These services may carry road haulage drivers as well as their cargo. If there is no exclusive freight ferry available, then an alternative ferry service may be used, provided that it has been audited, and shown to offer the same degree of safety.

10.2 Because of the nature of the activity, a number of different parties may be involved in the operation of transporting ethylene oxide from consignor to customer. These may include the shipping company, port or harbour authorities and hauliers.

10.3 Prior to the commencement of each traffic flow, the consignor should carry out a safety assessment of each aspect of the transport operation. This assessment should include, as appropriate:

a. the shipping company,

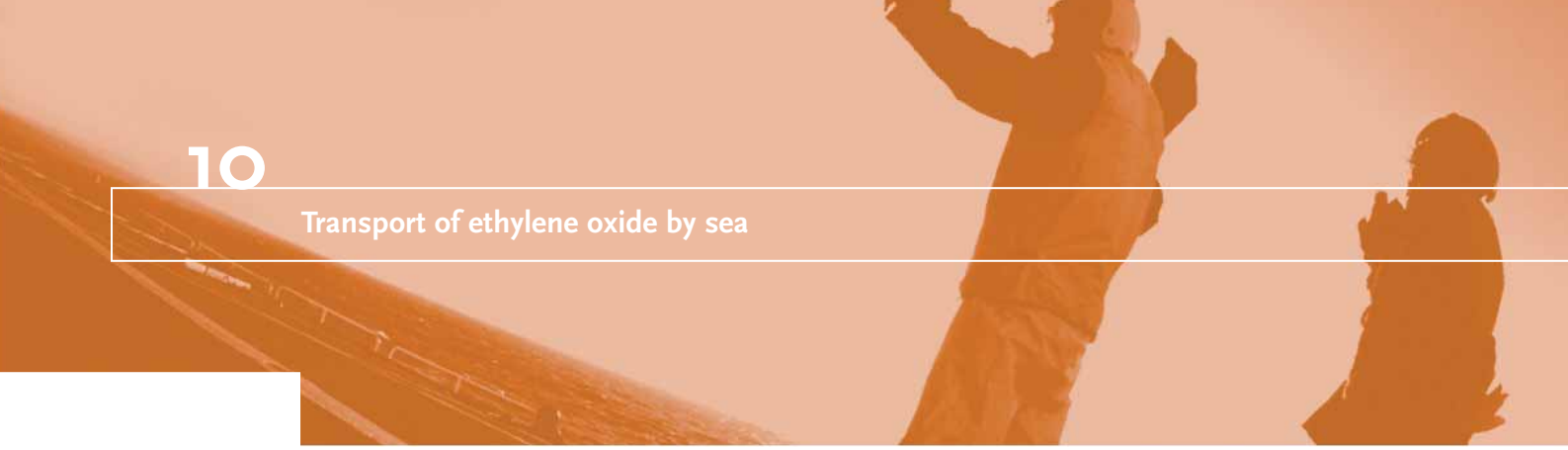
b. loading/unloading facilities at container terminals,

c. emergency handling within hazardous cargo yards at container terminals,

d. emergency handling on board,

e. responsibility for emergency response should be agreed between consignor and customer.

A recommended check list for assessing ferry operators and associated terminal facilities is shown in Appendix 6.



10 Transport of ethylene oxide by sea

10.4 The consignor may decide to issue specific instructions for the control of the operation to all parties involved and the actions to be taken in the event of an emergency.

10.5 Road tanker or tank container movements involving short sea crossings should be driver accompanied.

11 Unloading operations

11.1 The operation of unloading any road tanker, tank container or rail tank car of ethylene oxide is a potential hazard. It is therefore important that unloading facilities are correctly designed and constructed with respect to the potential hazards and properly used and maintained.

11.2 The equipment should be subject to regular checks according to maintenance standards.

11.3 Written operating instructions should be available for unloading ethylene oxide from road tankers, tank containers and rail tank cars. Personnel involved should be fully trained in their implementation (involvement of fire brigades in the training is recommended). The instructions should recognise the specific hazards of ethylene oxide, and ensure the correct operation of unloading equipment in both normal and emergency situations.

11.4 All necessary protective clothing and emergency equipment should be available for unloading operations (see Chapter 6). Personnel should be trained in the correct use of this clothing and equipment.

11.5 The conditions for discharge of ethylene oxide at a customer's premises are the customer's responsibility. If a customer requires, the consignor may provide him with technical advisory and safety service, which in principle may include safety visits. If a safety visit is made, the scheme included in Appendix 5 may be used. Normally the customer himself should evaluate whether his premises, especially his reception and storage facilities, correspond with the requirements of the scheme included in Appendix 5.

11.6 Appropriate systems should be in place to ensure the identification of the supplied product.

12 A mutual aid scheme for providing assistance at transport emergencies

12.1 All chemical companies involved in the transport of ethylene oxide in Europe should have a system for receiving transport emergency messages and for providing expert advice to minimise any hazard arising from an incident on road, rail or water.

12.2 However, because Europe occupies a very large geographical area, the ability of an individual chemical company to provide expert advice quickly at the scene of an incident may be severely restricted if a considerable distance has to be travelled to reach the scene.

12.3 With the objective of ensuring that expert assistance is available as promptly as possible at the scene of any ethylene oxide transport emergency, all producers participate in a mutual aid scheme for emergency response.

12.4 The principles of the scheme are as follows:

a. If the Emergency Authorities in any country call for assistance from a Company under the provisions of a national scheme, then the provisions of that scheme will be paramount.
b. The Company which has supplied the ethylene oxide (the Supplying Company) must accept the general obligation to respond to the emergency.
c. A second Company (the Assisting Company) may be requested by the Supplying Company to respond, so as to provide:
   - a quicker response, if the Assisting Company is closer to the scene of the incident,
   - equipment
   - reinforcements.
d. The Supplying Company remains responsible when an Assisting Company has been requested to participate.
e. The Assisting Company acts on behalf of the Supplying Company until the latter's representatives reach the scene.
f. All Companies participating in these arrangements make available such services and assistance as would be provided for their own ethylene oxide.

12.5 Regular technical communication has been established between participating Companies in order to:

a. maintain a Mutual Aid procedure based on the principles described in Section 12.4 above,
b. ensure that the training and equipment at participating centres is adequate,
c. agree common methods of approach in the resolution of transport emergency situations.

Appendix 1

Design and construction of rail tank cars (RTCs)

1. Scope

1.1. Tanks for the carriage of ethylene oxide shall meet the International Regulations concerning the carriage of Dangerous Goods by rail (RID) for this specific product.
The requirements that follow, give supplementary information and do not replace RID requirements, they will apply for all new built rail tank cars and form a guidance for evaluation of rented rail tank cars. Existing rail cars may not be fully in compliance with the following constructions recommendations.

2. Materials of construction

2.1. For new rail tank cars the tank shall be constructed of stainless steel meeting at least the following specification: AISI/SAE 304LN or the according equivalent for the approved Pressure Vessel Code. All materials shall be furnished with a minimum 3.1B certificate according to EN 10204.

2.2. Tank fittings and attachments in contact with ethylene oxide shall also be of the above-mentioned materials, and may not contain copper or alloys of copper and/or magnesium.

3. Tank construction

3.1. Tanks are to be designed according to an approved Pressure Vessel Code (for example ASME BPVC, AD-Merkblätter).

3.2. The Inner side of the tank must be pickled and passivated.
Grinding is only allowed at the bottom part of the tank to allow for complete emptying of the rail tank car.

3.3. Requirements for all pressure retaining welds are:

- Shall be 100 % radiographed.
- All Welding Procedure Specifications (WPS) and Procedure Qualification Records (PQR) must be made available for approval.
- All WPS and PQR must confirm with the approved Pressure Vessel Code.

Appendix 1

Design and construction of rail tank cars (RTCs)

3.4. No baffle plates are to be fitted

3.5. Reinforcement (backing) plates are required when the load bearing attachments (T-bar, anchor plates..) are not made of a stainless steel (see also "Material of construction").

3.6. The design of the rail tank car must guarantee a complete unloading of the rail tank car (e.g. by means of a slope towards the bottom centre.) Criterion: less than 5 litres of remaining product.

3.7. Nozzles on the shell should, as much as possible, be located away from the shell main weld seams.

3.8. For inspection purposes, the tank shall be fitted with one manhole not less than 500 mm diameter; the manhole shall be fully bolted and may have a hinged design (right hand side).

3.9. All gaskets (between flanges as well as the manhole) must be round spiral wound stainless steel type 304, filled with pure graphite (99,9 %).
Depending on the flange design inner- and/or outer guide rings are required (e.g. gaskets for tongue and groove flanges don't have guide rings).

3.10. Valves packing must be resistant to ethylene oxide and all valves must be of a fire-safe design.

3.11. Tanks must be designed so that there are no pockets that can trap liquid during discharge.

3.12. The two screw threaded inlet points at each end of the tank, top centre (to permit the initial pressure test of the tank), shall be seal welded.

3.13. The only openings allowed in the tank are :

- One manhole;
- Two foot valves;
- Two threaded inlet points;

3.14. The welds at the outer side of the shell shall be pickled and passivated.

3.15. In order to protect welds for stress corrosion cracking, all stainless steel surfaces can be coated.

Appendix 1

Design and construction of rail tank cars (RTCs)

4. Equipment

4.1. Pressure relief devices.
No pressure relief devices shall be fitted.

4.2. Filling/Discharge and Vapour Return fittings:

4.2.1. The tank must be fitted with an NB 80 mm filling/discharge pipe with an 80 mm shut off valve. The vapour return connections shall be a NB 50 mm pipe, fitted with a NB 50 mm shut off valve. Valves shall be of an approved make & type, e.g. bellow valve.

4.2.2. In addition, a quick closing internal safety device shall be fitted in the tank shell for the liquid filling/discharge connection. The device shall be capable of being operated remotely. The device shall also close automatically in the event of a hose rupture or the inadvertent movement of the rail tank car. The valve actuator shall consist of a hydraulic system.

4.2.3. Both the filling/discharge and vapour return connections must be able to be closed by means of a blind flange. Materials of connections must be similar to that of the tank shell.

4.2.4. Both the filling/discharge and vapour return connections are equipped with the dry disconnect coupling (NATO standard) and a dust cap or pressure retaining cap. Materials of connections must be similar to that of the tank shell. It is recommended to maintain the shut off valve in addition to the dry disconnect coupling (figure 1).

Figure 1: disconnect coupling, 80 mm for liquid line (left side), 50 mm for the vapour line

Appendix 1

Design and construction of rail tank cars (RTCs)

4.2.5. Connections should be adequately protected against possible impact that may occur during transport. This protection could be provided by means of a strong steel guard or by utilising the chassis of the vehicle. Both the liquid and vapour connections shall be clearly marked by their name (liquid/vapour).

To ensure that the foot valves/internal safety devices remain closed should either of the connection pipes be damaged, the design should be such that if the pipes are subjected to excessive strain, the tank shell remains undamaged.
Connection pipes, flanges and valves shall be suitable for the same test pressure as the tank shell.
These connections should be provided with means to prevent unauthorised access.

4.3. Internal Vapour Return Pipe

4.3.1. The tank pipe shall be fitted with a NB 50 mm internal vapour return pipe which shall extend from the foot valve/internal safety device to the vapour space. The pipe shall be designed to restrict liquid entry and shall be supported so as to withstand any vibration during movement of the rail tank car.

5. Earthing connection

5.1. Earthing connections shall be provided to prevent dangerous differences in electrical potential arising between the carrying tank, the body of the vehicle, the piping and the ground during the filling or discharging of the vehicle.
Connections should be provided at each end of the tank and also adjacent to the discharge connections (figure 2).

Figure 2: earthing connection of a Railway Tank Car

Appendix 1

Design and construction of rail tank cars (RTCs)

6. Insulation

6.1. Rail tank cars are to be insulated.

6.2. The insulating material shall:
a. Demonstrate minimum reactivity when in contact with ethylene oxide.
b. Be suitable for operating at the lowest ambient temperatures likely to be met in service.

6.3. The whole tank (with exception of the flanges and valves) has to be insulated.

6.4 All insulated flanges (e.g. manhole and bottom valve) shall have leak collectors preventing leaks to get into the main tank insulation. The insulation between the flange and the leak collector shall consist of foam glass.

6.5 The insulating thickness shall be minimum 100 mm.

6.6 The insulating material is to be covered by a stainless steel protection of minimum 0,8 mm thickness (weather barrier).

7. Instrumentation

Rail regulations normally permit the use of thermometers and pressure gauges and therefore these may be fitted to RTCs. However, if these devices are fitted, there is a need to ensure through regular examination and testing that they remain in proper working order. Instruments fitted to RTCs can produce misleading readings as a result of the effects of vibration during transit or the accumulation of small amounts of polymer.

If thermometers and pressure gauges are fitted, they should also be positioned in such a way that they are protected from external damage.

Appendix 2

Design and construction of road tankers and tank containers

1. Scope

1.1. Tanks for the carriage of ethylene oxide shall meet the International Regulations concerning the carriage of Dangerous Goods by road (ADR) for this specific product.
The requirements that follow, give supplementary information and do not replace ADR requirements, they will apply for all new built road tankers/tank containers.

2. Materials of construction

2.1. For new road tankers/tank containers the tank shall be constructed of stainless steel meeting at least the following specification: AISI/SAE 304LN or the according equivalent for the approved Pressure Vessel Code. All materials shall be furnished with a minimum 3.1B certificate according to EN 10204.

2.2. Tank fittings and attachments in contact with ethylene oxide shall also be of the above-mentioned materials, and may not contain copper or alloys of copper and/or magnesium.

3. Tank construction

3.1. Tanks are to be designed according to an approved Pressure Vessel Code (for example ASME BPVC, AD-Merkblätter).

3.2. The Inner side of the tank must be pickled and passivated.
Grinding is only allowed at the bottom part of the tank to allow for complete emptying of the road tankers/tank containers.

3.3 Requirements for all pressure retaining welds are:

- Shall be 100 % radiographed.
- All Welding Procedure Specifications (WPS) and Procedure Qualification Records (PQR) must be made available for approval.
- All WPS and PQR must confirm with the approved Pressure Vessel Code.

Appendix 2

Design and construction of road tankers and tank containers

3.4. Baffle plates are to be fitted

3.5. Reinforcement (backing) plates are required when the load bearing attachments (T-bar, anchor plates,.....) are not made of a stainless steel (see also "Material of construction").

3.6. The design of the road tankers / tank containers must guarantee a complete unloading of the road tankers/tank containers. Criterion: less than 5 litres remaining product.

3.7. Nozzles on the shell should, as much as possible, be located away from the shell main weld seams.

3.8. For inspection purposes, the tank shall be fitted with one manhole not less than 500 mm diameter; the manhole shall be fully bolted and may have a hinged design (right hand side).

3.9. All gaskets (between flanges as well as the manhole) must be round spiral wound stainless steel type 304, filled with pure graphite (99,9 %).
Depending on the flange design inner- and/or outer guide rings are required.
(e.g. gaskets for tongue and groove flanges don't have guide rings)

3.10. Valves packing must be resistant to ethylene oxide and all valves must be of a fire-safe design.

3.11. Tanks must be designed so that there are no pockets that can trap liquid during discharge.

3.12. The two screw threaded inlet points at each and of the tank, top centre (to permit the initial pressure test of the tank), shall be seal welded.

3.13. The only openings allowed in the tank are :

- One manhole;
- Two foot valves;
- Two threaded inlet points;

3.14. The welds at the outer side of the shell shall be pickled and passivated.

3.15. In order to protect welds for stress corrosion cracking, all stainless steel surfaces can be coated

Appendix 2

Design and construction of road tankers and tank containers

4. Equipment

4.1. Pressure relief devices

Any pressure relief design must conform to ADR and IMO regulations. If pressure relief valves are fitted, they shall be preceded by a bursting disc, which must be suitable for use under safety valves. The space between valve and disc could be fitted with a pressure gauge for checking the integrity of the disc.

Bursting discs shall have direct access to the vapour space of the tank. Pressure relief valves shall be of the spring loaded type. The discharge from pressure relief valves shall be so arranged that any escaping vapour cannot impinge directly on the tank shell.

Bursting discs and pressure relief valves shall be constructed of stainless steel.

4.2. Filling/Discharge and Vapour Return fittings:

Figure 3: Typical set-up of fitting and discharge connections

Appendix 2

Design and construction of road tankers and tank containers

4.2.1. The tank must be fitted with a NB 80 mm filling/discharge pipe with a 80 mm shut off valve. The vapour return connections shall be a NB 50 mm pipe, fitted with a NB 50 mm shut off valve. Valves shall be of an approved make and type.

4.2.2 In addition, a quick closing internal safety device shall be fitted in the tank shell for the liquid filling/discharge connection. The device shall be capable of being operated remotely. The device shall also close automatically in the event of a hose rupture and it is recommended that it closes automatically in case of inadvertent movement of the road tankers/tank containers. The valve actuator shall consist of a hydraulic system.

4.2.3 Both the filling/discharge and vapour return connections must be able to be closed by means of a blind flange. Materials of connections must be similar to that of the tank shell.

4.2.4 Both the filling/discharge and vapour return connections are equipped with the dry disconnect coupling (NATO standard) and a dust cap or pressure retaining cap. Materials of connections must be similar to that of the tank shell.

4.2.5. Connections should be adequately protected against possible impact that may occur during transport. This protection could be provided by means of a strong steel guard or by utilising the chassis of the vehicle. For tank containers, all connections should be contained within the ISO framework. Both the liquid and vapour connections shall be clearly marked by their name (liquid/vapour).
To ensure that the foot valves/internal safety devices remain closed should either of the connection pipes be damaged, the design should be such that if the pipes are subjected to excessive strain, the tank shell remains undamaged.
Connection pipes, flanges and valves shall be suitable for the same test pressure as the tank shell.
These connections should be provided with means to prevent unauthorised access.

4.3. Internal Vapour Return Pipe

4.3.1. The tank pipe shall be fitted with a NB 50 mm internal vapour return pipe which shall extend from the foot valve/internal safety device to the vapour space. The pipe shall be designed to restrict liquid entry and shall be supported so as to withstand any vibration during movement of the road tankers/tank containers.

Appendix 2

Design and construction of road tankers and tank containers

5. Earthing connection

5.1. Earthing connections shall be provided to prevent dangerous differences in electrical potential arising between the carrying tank, the body of the vehicle, the piping and the ground during the filling or discharging of the vehicle. Connections should be provided at each end of the tank and also adjacent to the discharge connections.

6. Insulation

6.1. Road tankers/tank containers are to be insulated.

6.2. The insulating material shall:
a. Demonstrate minimum no reactivity when in contact with ethylene oxide.
b. Be suitable for operating at the lowest ambient temperatures likely to be met in service.

6.3. The whole tank (with exception of the flanges and valves) has to be insulated.

6.4. All insulated flanges (e.g. manhole and bottom valve) shall have leak collectors preventing leaks to get into the main tank insulation. The insulation between the flange and the leak collector shall consist of foam glass.

6.5. The insulating thickness shall be minimum 100 mm.
6.6. The insulating material is to be covered by a stainless steel protection of minimum 0,8 mm thickness (weather barrier).

7. Instrumentation

Temperature and pressure measuring devices must be fitted. Surface temperature measurement of the tank bottom is recommended for new equipment. The pressure measuring device shall be installed in the vapour phase. Both devices shall be suitably protected.

Appendix 3

General instructions for ethylene oxide drivers

Contents

Appendix 3

General instructions for ethylene oxide drivers

1. Introduction

Ethylene oxide (EO) is flammable, chemically reactive and toxic, having harmful properties as to health and to the environment. Nevertheless, it can be handled, transported and stored in a safe way, provided that appropriate precautions are observed.

The ethylene oxide driver has an important job to do. He is accompanying the shipment and is, during the entire transport, in charge of the technical care of his vehicle and the product. It is essential that the driver is totally familiar with the nature of the potential hazards which may be presented by ethylene oxide during transport, and the action to be taken in the event of an emergency.

These general instructions for ethylene oxide drivers have been prepared by the EO Distribution Working Group of Cefic (Conseil Européen de l'Industrie Chimique = European Chemical Industry Council). They have been accepted by all European EO producers within Cefic as a uniform set of instructions for issue to all ethylene oxide drivers, and as the basis for specific product training for drivers.

The objective in preparing a uniform set of instructions for all drivers is to ensure that ethylene oxide is handled and transported as safely as possible.

It should be noted that individual ethylene oxide producers may stipulate additional requirements where they see fit for safe transport.

Before drivers are permitted to convey ethylene oxide they must:

a. already be in possession of a valid ADR drivers certificate, dangerous goods, class 2 for international transport, or an equivalent document,
b. have attended a specific, additional training course for ethylene oxide familiarisation organised by an ethylene oxide producing company affiliated to Cefic.

Drivers who have successfully completed an ethylene oxide training and associated test will receive an Ethylene Oxide training certificate giving the drivers name.

The Training Certificate will be mutually acceptable to all ethylene oxide producing companies affiliated to Cefic.

Drivers without an Ethylene Oxide Training Certificate will not be accepted for the transport of ethylene oxide.

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General instructions for ethylene oxide drivers

2. Definitions

Boiling point :	The specific temperature at which a liquid converts into the gas/vapour phase. This temperature depends on the pressure above the liquid.
Vapour pressure :	The pressure, above the liquid, caused by vapour in equilibrium with that liquid.
Flash point :	Lowest temperature at which vapour above the liquid can be ignited in combination with oxygen from the air.
Lower explosion :	The minimum concentration of a substance in air, at limit which ignition is possible. At lower concentrations the mixture is too “lean”.
Upper explosion :	The maximum concentration of a substance in air, at limit which ignition can take place. At higher concentrations the mixture is too “rich”.
Decomposition :	A reaction in which a substance breaks down into several other parts (components). Very often considerable heat is produced at the same time.
Polymerisation :	A chemical reaction in which individual molecules of the same substance combine together to produce a much larger molecule (polymer). Considerable heat is often produced at the same time.
Exothermic :	A reaction with formation of heat e.g. polymerisation with generation of heat is an exothermic reaction.
ADR :	European Agreement Concerning the International Carriage of Dangerous Goods by Road.
RID :	Regulations concerning the International Carriage of Dangerous Goods by Rail.
IMO :	International Maritime Organisation. (Organisation for international transport by sea, including international ferries).

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General instructions for ethylene oxide drivers

3. Product information

3.1 Transport classification

ADR/RID : Description : Ethylene Oxide with nitrogen up to a total pressure of 1 MPa (10 bar) at 50°C
Class : Class 2, TF
Hazard identification number : 263
Substance identification number : 1040
UK carriage of dangerous goods by road regulations :
Description : as above
UN Number : 1040
Class : 2.3
Subsidiary hazard : 2.1
Emergency action code : 2 PE

3.2 Alternative product names

Ethylene oxide
Ethene oxide
1,2 - epoxyethane
(Normal abbreviation : EO)

3.3 Chemical formula

C_2H_4O or 

Molecular weight : 44.05

3.4 Flammability

Ethylene Oxide has a flash point of -18°C. This means that at -18°C and higher there is a flammable vapour present above the ethylene oxide liquid. It is flammable in air at all concentrations above 2.6 % (by volume). There is no upper flammable limit as normally conceived in that exothermic decomposition replaces combustion at the higher ranges up to 100 % ethylene oxide vapour.

Mixtures of flammable vapour in air usually have an upper explosion limit (UEL). At the upper explosion limit, the gas mixture is normally too "rich" for ignition, as there is insufficient oxygen available in the air. However, ethylene oxide has no upper explosion limit. So, at concentrations of ethylene oxide in air above 2.6 %, the vapours of ethylene oxide are always flammable or explosive.

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Due to its low boiling point (10.5°C) and flammability, ethylene oxide is in some respects similar to LPG. However, an important difference is that ethylene oxide is fully miscible with water. Another important difference is that ethylene oxide requires very little energy for ignition.

Ethylene oxide diluted with water can still give rise to a flammable vapour. Even a 1 % solution of ethylene oxide in water has a flashpoint of 22°C. Therefore all spills need to be diluted at least 100-fold.

As much water as possible should always be used to dilute any ethylene oxide leakage. If insufficiently diluted solutions enter drains or sewers there may still be a flammable risk.

Ethylene oxide auto-ignites in air if the temperature reaches 429°C.

3.5 Chemical reactivity

Ethylene oxide is a highly reactive chemical which can react especially in the presence of a catalyst, with compounds such as water, alcohols, ammonia, amines, and organic acids. These reactions can be self-accelerating and generate considerable quantities of heat. Therefore it is most important to ensure inadvertent mixing with other chemicals, including water does not occur.

It is the reactivity of ethylene oxide which makes it so important as the feedstock for the preparation of other useful chemicals. The most important derivative is ethylene glycol, which is used in antifreeze and for the manufacture of polyester fibres. Other ethylene oxide derivatives are used as surfactants and solvents.

Ethylene oxide itself is used as a disinfectant, sterilising agent in controlled circumstances

3.6 Decomposition

When exposed to temperatures above 560°C the vapours of EO above the liquid decompose spontaneously and can cause an explosion. No oxygen is required.

Decomposition and explosion can be prevented by diluting the vapours with a suitable inert gas, typically nitrogen.

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General instructions for ethylene oxide drivers

The nitrogen must be very pure, as follows:

- purity 99.99% minimum
- oxygen 20 ppm maximum
- water 5 ppm maximum

3.7 Polymerisation

Liquid ethylene oxide is very susceptible to polymerisation which can be initiated by acids, bases or catalysts such as metal oxides and anhydrous chlorides of iron, aluminium and tin. Therefore it is most important to maintain clean equipment when handling ethylene oxide, and to ensure inadvertant mixing with other chemicals does not occur eg: during cleaning activities...

The polymerisation reaction can generate considerable heat and, if the temperature cannot be controlled, it will accelerate leading to vaporisation of unreacted ethylene oxide and possibly to explosive decomposition of the vapour.

Slow polymerisation can occur, producing solid polymer, which is thermally stable. Examples of slow polymerisation can sometimes be found inside loading, unloading lines and filters.

4. Health hazards

EO is recognised as a direct acting mutagen and has the potential to cause mutations in cells of exposed human tissue.

Animal experiments indicate that EO should be regarded as probably carcinogenic to humans.

The regulations concerning the personal exposure limits for EO in air vary between different European countries. At the present time, values typically vary between 1 and 10 ppm.

4.1 Inhalation of the vapour

Inhalation of EO vapour irritates the respiratory organs and causes accumulation of fluid in the lungs. The symptoms may develop some hours later and are exacerbated by physical exertion.

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General instructions for ethylene oxide drivers

The injured person must rest and therefore admission into a hospital is essential. When exposed to higher vapour concentrations, nausea and vomiting can be observed as first symptoms.

First aid: fresh air, rest and call a doctor at once!

4.2 Skin contact with liquid ethylene oxide

Liquid EO when spilled on the exposed skin may produce reddening. However, longer contact could result in damage of the skin.

Figure 4: Blister and skin burns caused by an Ethylene Oxide Water mixture

Solutions of EO in water, depending on the EO concentration and exposure time can cause severe chemical damage. Concentrations of about 50% appear to be most dangerous. However, the skin may become irritated by EO concentrations as low as 1% in water or by EO vapour (figure 3).

Intensive skin contact may result in a chronic allergic eczema.

First aid: Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Call a doctor.

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General instructions for ethylene oxide drivers

4.3 Eyes

EO vapour irritates the mucous membrane of the eyes.
Liquid EO and solutions of EO in water can cause severe burns and may cause permanent corneal damage.

First aid: Irrigate eyes for 10-15 minutes and call a doctor at once!

IF IN CONTACT WITH EO, MEDICAL ATTENTION MUST ALWAYS BE SOUGHT AT ONCE.

5. Personal safety equipment

If exposure to liquid and/or inhalation of vapour is possible, adequate personal protection must be worn. As a minimum, the following should be used:

- safety goggles
- resistant gloves (e.g. butyl rubber)
  Natural rubber, PVC or nitrile rubber may NOT provide adequate resistance.
- suitable respiratory protective device.

The personal means of protection should be clean and maintained in a good condition. The EO driver must know how to use them properly.

6. Loading / unloading

Loading and unloading facilities should be situated at a safe distance from storage tanks. For reasons of polymerisation, contamination must be avoided. Therefore, only dedicated road tankers, tank containers and rail tank cars must be used for ethylene oxide and they must be held under nitrogen pressure at all times.

Externally, each road vehicle should be inspected visually before filling to ensure that it is in a good mechanical condition. The vapour space must always be sampled and tested for oxygen content (maximum 0.3%). The leakproofness of loading/unloading valves must be checked. Before connection, the tank has to be earthed and hose connections purged with nitrogen. Filling of the tank must not exceed 0.78 kg/litre of capacity.

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General instructions for ethylene oxide drivers

After loading, the tank is to be pressurised with nitrogen. Annex 1 indicates the equilibrium maximum and minimum total pressure to :

- ensure that the gas phase remains inerted even if heated to 50° C
- ensure that the pressure does not rise to above 10 bars on heating to 50° C.

When filling transport tanks, an appropriate allowance should be made to the pressures indicated to allow for equilibration between the gas and liquid phases after the tank is sealed. This allowance will vary depending upon loading conditions, but may be of the order of 0.5- 1.0 bar. Even after unloading, ethylene oxide tanks should be maintained at a minimum gauge pressure of 3 bars by using nitrogen.

Drivers must report back to the principal/consignor if they find that unloading conditions do not meet the necessary safety requirements.

Tanks which have been stored for a long time may have valves choked by polymer. If this occurs the valve should be closed and expert advice sought. Tanks should be used regularly or cleaned if stood unused for long periods.

Loading and unloading facilities at terminals should have a remote controlled shut-off valve between the storage tanks and the loading/unloading vehicles.

Loading/unloading procedure: key points

When loading or unloading, the following points must be observed.

- Earthing : During loading or unloading, the vehicle must be earthed. The earthing cable should be fitted and a satisfactory earth established before loading or unloading connections are made. Similarly, at the end of the transfer operation, the loading or unloading connections must be disconnected before the earthing cable is unfastened.
- Tank vehicle : Make sure that before loading the oxygen content is always measured. This MUST be lower than 0.3% vol.
- Breathing : During connecting/disconnecting, breathing protection should be worn.
- Connections : After connection, the flexible hoses must be pressurised with nitrogen and the connections checked for leaks before transfer is allowed to commence by means of a soap test or equivalent measurement.

Before disconnection, the flexible hoses must be purged with nitrogen.

Appendix 3

General instructions for ethylene oxide drivers

7. Transportation

7.1 Placarding/labelling

Loaded and also empty uncleaned EO vehicles must be provided with hazard labels in order to comply with the appropriate transport regulations. For example, for ADR transport, the following should be provided:

- danger label 2.3. (toxic gas)
- danger label 2.1. (flammable gas)

Figure 5: Dangerous goods label and hazard identification number

Furthermore the hazard identification number (263) and the substance identification number (1040) must be marked on the vehicle (figure 5).

7.2 Provision of instructions in writing

Drivers engaged in the transport of loaded and also empty unclean EO vehicles must be in possession of transport emergency cards in the appropriate languages depending upon the routing and on the final destination of the vehicle. Copies of the official Cefic Tremcard for ethylene oxide as well as the Emergency Response Intervention Card (ERIC) are included in Annexes 2 and 3.

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General instructions for ethylene oxide drivers

7.3 Routing

The transport of ethylene oxide has to follow the ADR-regulations. According to this the route must be selected carefully. As far as possible,the route should utilise motorways and avoid inhabited areas.
The preferred route should be known by all involved parties.

7.4 Safe parking

Drivers must ensure that the vehicle is either supervised or is parked in a secure place. No potential source of heat or fire must exist in the vicinity, and the vehicle must be capable of being easily removed in an emergency.

Drivers must inform the haulier of their overnight parking location. The overnight parking locations must be selected in accordance with regulations (for example ADR).

7.5 Severe weather

When severe weather conditions are experienced during transport, for example icy roads, snow or poor visibility, the delivery should be stopped at the next suitable parking place.

7.6 Delays

All delays during transport, whether due to severe weather conditions, breakdown or other reasons must be reported to the consignor as soon as possible. Transport accidents must also be reported to the consignor as soon as possible.

7.7 Pressure and temperature checks during longer journeys
For road transport, the pressure and/or temperature of the tank contents should be checked regularly and recorded on a checklist or in a logbook.

7.8 General remarks

Although vehicles and tanks are maintained in good condition and accompanied by a skilled experienced driver, once on route the driver can be confronted with unforeseen situations or problems which he cannot handle on his own.
If there are technical or safety problems concerning the product during the journey or at customers premises, drivers should immediately contact their principals by phone.

Appendix 3

General instructions for ethylene oxide drivers

8. Emergency procedure

If the appropriate transport regulations are complied with, and the requirements set out in this document are adhered to, the risk of a transport emergency involving ethylene oxide is very small.

Nevertheless, it is essential that drivers should be aware of the appropriate action to be taken should an emergency occur.

8.1 Increase of temperature or pressure in the tank

During the journey, the temperature of the ethylene oxide should not increase more than 3°C in 24 hours. Normally the pressure in the tank should not increase, and under normal circumstances will only do so if the temperature increases.

If a more rapid rate of temperature increase is observed or a temperature of 25°C is reached, or a significant increase in pressure is observed, apply the following emergency procedure:

1. Do everything possible to drive the vehicle to an open space away from buildings and populated areas. Park and leave the vehicle, taking with you:
   any temperature/pressure records,
   the transport emergency card,
   the transport documents.
2. Alert everybody in the surroundings and keep people away.
3. Contact immediately the local Police and the Fire Brigade.
4. Ensure that the consignor is notified as soon as possible and provide detailed information - when the increase started, how long has the temperature/ pressure been increasing, what is the present temperature/pressure.
5. Assist the local authorities and hand over the transport emergency card.
6. Check whether the temperature and/or pressure is still increasing. Should the temperature reach 40°C, or if the pressure approaches the maximum allowed working pressure of the tank, or the rate of temperature rise accelerates quickly, e.g. 2° - 3°C per 5 - 10 minutes, then immediate evacuation of the surrounding area is required.

   Urgently request the local Police to evacuate the surrounding area immediately and move people as far as possible away from the tank.

Appendix 3

General instructions for ethylene oxide drivers

8.2 Vapour/liquid leakages and/or fire

1. Abandon the vehicle immediately.
2. Alert everybody in the surroundings and keep people as far away from the vehicle as possible.
3. Contact immediately the local Police and the Fire Brigade.
4. Ensure that the consignor is notified as soon as possible.

8.3 In the case of accident involving injury or immobilisation of the vehicle, but no leakage or fire

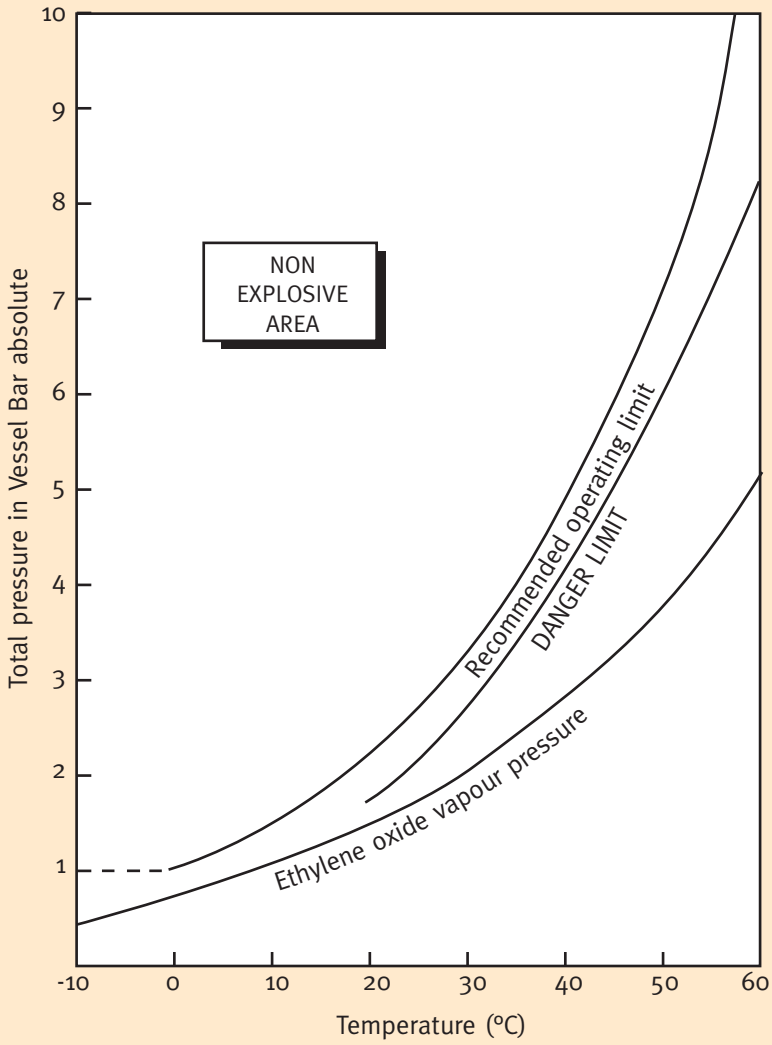
1. Contact immediately the local Police.
2. Ensure that the consignor is notified as soon as possible.
3. If the vehicle cannot be moved, the emergency orange flashing lights should be positioned to protect the front and rear of the vehicle. Checks of the temperature and pressure of the tank should continue to be made and recorded.

Appendix 3

General instructions for ethylene oxide drivers

Annex 1

Total pressure of transport containers



Source: J.H. Burgoyne, K E Bett and R Lee, I Chem E, Symposium Series No 25, (1963) The Explosive Decomposition of Ethylene Oxide Vapour Under Pressure Part 2 **[Back to Table of Contents]**

Appendix 3

General instructions for ethylene oxide drivers

Annex 2

Transport emergency card (Version 2004)

TRANSPORT EMERGENCY CARD (Road)

Class	2
HI No	263
UN	1040

LOAD

Ethylene oxide with nitrogen

Name of substance(s):

- Colourless liquefied gas - Perceptible odour.

NATURE OF DANGER

- Toxic.
- The gas poisons: by inhalation, by absorption through skin. Symptoms may develop after several hours.
- Flammable.
- May form explosive mixture with air, particularly in empty uncleaned receptacles.
- In low concentration the gas may have narcotic effect and may cause giddiness.
- Spilled liquid has very low temperature and evaporates creating serious explosion hazard.
- Contact with liquid gas causes cold burns: to skin, to eyes.
- The gas is heavier than air and spreads along ground. Production of mist on contact with moist air.
- Heating will cause pressure rise, severe risk of bursting and subsequent explosion.
- May react vigorously with acids and alkalis creating explosion hazard.
- The gas causes strong irritant effect: on eyes, on skin, on air passages.

PERSONAL PROTECTION

- Respiratory protective device enabling driver to escape e.g. escape hood or mask with combined gas particle cartridge.
- Goggles or face shield.
- Light protective clothing.
- Protective gloves.
- Protective footwear.
- Eyewash bottle with clean water.

INTERVENTION EQUIPMENT

- Not applicable.

GENERAL ACTIONS BY THE DRIVER

- Stop the engine.
- No naked lights. No smoking.
- Mark roads with self-standing warning signs and warn other road users or passers-by.
- Keep public away from danger area. Keep upwind.
- Notify police and fire brigade as soon as possible.

ADDITIONAL AND/OR SPECIAL ACTIONS BY THE DRIVER

- Put on your respiratory protective device and keep out of the danger area.

FIRE (information for the driver in case of fire)

- Do not attempt to deal with any fire involving the load.

FIRST AID

- If substance has got into the eyes, immediately wash out with plenty of water. Continue treatment until medical assistance is provided.
- Remove contaminated clothing immediately and wash affected skin with plenty of water.
- Seek medical treatment when anyone has symptoms apparently due to inhalation or contact with skin or eyes.
- Persons who have inhaled the gas or have been in contact with the substance may not show immediate symptoms. They must lie down and keep quite still and should be taken to a doctor with this card. Patient must be kept under medical supervision for at least 24 hours.
- In case of burns immediately cool affected skin as long as possible with cold water.
- Apply artificial respiration only if patient is not breathing or under medical supervision.

SUPPLEMENTARY INFORMATION FOR EMERGENCY SERVICES

- Use waterspray to "knock down" vapour.
- If vapour cloud drifts towards populated area, warn inhabitants and keep them indoors. On the advice of an expert consider evacuation.
- Sewers must be covered and basements and workpits evacuated.
- Consult an expert immediately.
- In case of fire warn everybody: explosion hazard.
- Do not extinguish a leaking gas flame. Extinguish secondary fire.
- Keep container(s) cool by spraying with water if exposed to fire: If possible fight fire from protected position.

Additional information

EMERGENCY TELEPHONE: .....

Source: Example of Cefic Tremcard

Appendix 3

General instructions for ethylene oxide drivers

Annex 3
ERIC card (Version 2004)

Substance : ETHYLENE OXIDE WITH NITROGEN
UN Number : 1040
HIN : 263
ADR Label : 2.3+2.1
ADR Class : 2
Classification Code : 2TF
Packing Group :
ERIC : 2-12

Emergency Response Information
Flammable toxic liquefied gas.

1. Characteristics.

- Hazardous to skin, eyes and air passages.
- Forms explosive mixture with air.
- Toxic by inhalation or skin absorption.
- The gas is absorbed or readily dispersed by water fog/spray.

2. Hazards.

- Gives off toxic or irritant gases or fumes when burning.
- Heating of container(s) will cause pressure rise with risk of bursting and immediate release of expanding toxic vapour cloud which may ignite, leading to explosion (VCE) and creation of a pressure wave.
- Contact with liquid will cause frostbite and severe damage to eyes.
- The gas may be invisible and may enter sewers, basements or confined spaces.

3. Personal protection.

- Gas tight suit.
- Protect personnel from radiated heat with water fog curtain or other heat protective measures.
- Insulating undergarments and thick textile or leather gloves.
- Consider wearing standard fire fighting clothing underneath the suit.

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General instructions for ethylene oxide drivers

4. Intervention Actions.

4.1 General.

- No smoking, eliminate ignition sources.
- PUBLIC SAFETY HAZARD - Warn people nearby to stay indoors with doors and windows closed. Stop any ventilation. Consider evacuation of people in immediate danger.
- Keep upwind. Put on protective equipment before entering danger area.
- Minimise number of personnel in risk area.
- Warn people to leave and not to re-enter basements, sewers or other confined spaces.

4.2 Spillage

- Stop leaks if possible.
- Check explosive limits.
- Use low sparking hand tools and intrinsically safe equipment.
- Knock down or disperse gas cloud with water spray.
- If substance has entered a water course or sewer, inform the responsible authority.
- Ventilate sewers and basements where there is no risk to personnel or public.
- In the absence of specialist advice, drench spillage with water spray to assist evaporation and absorb gas but avoid unnecessary run off which will cause pollution.

4.3 Fire (involving the substance)

- Keep container(s) cool with water.
- Cut off gas supply if safe to do so.
- Do NOT extinguish leaking gas flame unless ABSOLUTELY necessary.
- Work from protected position to reduce risk to personnel. Use unmanned monitors or lances.
- Extinguish with water fog (spray) or dry powder.
- Do not use water jet to extinguish.
- Use water spray to knock down fire fumes if possible.
- Avoid unnecessary run-off of extinguishing media which may cause pollution.

Appendix 3

General instructions for ethylene oxide drivers

5. First Aid.

- If substance has got into eyes, wash out with water for at least 15 minutes and seek immediate medical attention.
- Remove contaminated clothing immediately and drench affected skin with plenty of water.
- Persons who have been in contact with the substance or have inhaled fumes should get immediate medical attention. Pass on all available product information.
- In case of burns, immediately cool affected skin for as long as possible with cold water. Do not remove clothing adhering to skin.
- Mouth to mouth resuscitation should be avoided. Use alternative methods, preferably with oxygen or compressed air driven apparatus.
- Thaw frosted parts carefully with cold water.

6. Essential Precautions For Product Recovery.

- Do not use standard recovery equipment. Seek specialist advice immediately.

7. Precautions After Intervention.

7.1 Undressing.

- Drench contaminated suit and breathing apparatus with water before removing facemask and suit.
- Use chemical protection suit and self contained breathing apparatus while undressing contaminated co-workers or handling contaminated equipment.

7.2 Equipment Clean Up.

- Seek specialist advice before leaving incident.

Appendix 4

Inspection of transport equipment

1. Routine inspection of road tankers and tank containers at loading terminals

If any of the following conditions are not met, the loading operation must be stopped and the situation rectified before loading is allowed to continue.

a. Before loading

1. Are there any visual objections on the truck against safe driving? (e.g. lights and tyres in good condition)
2. Is there a valid ADR-certificate for ethylene oxide?
3. Has the driver a valid ADR licence for the transport of dangerous substances and a valid EO specific training certificate?
4. For tank containers, is the tank container plate valid?
5. Are all 'dangerous goods' labels fitted, are the identification numbers 263/1040 attached. For road transport: is the Tremcard in all required languages on board?
6. Does the driver possess all the items of protective clothing and safety equipment? (as specified by the Tremcard)
7. Determine the maximum payload based on :
   - tare weight
   - country of destination
   - transport mode
   - maximum filling degree
8. Are all the valves closed upon arrival?
9. Is the tank placed at the correct loading position?
10. Are the wheels of the tank (or the rail tank car) blocked by wheel blocks or other tools?
11. Do all valves function correctly?
12. Is the oxygen concentration below 0.3 %? The tank must then be brought under a nitrogen and ethylene oxide atmosphere as per Annex 1 of Appendix 3.

b. Whilst loading

1. Is the maximum degree of filling not exceeded?

c. After loading

1. Is the vessel pressurised with nitrogen to a pressure suitable for transport?
2. Is the maximum gross weight not exceeded? (check by weighbridge)
3. Is a leakage test performed (bottom valve and end valve)?
4. Are all valves closed and blinded, with all bolts in place or are all dry disconnect couplings / metal caps in place?
5. Are all seals or locks in place?

Appendix 4

Inspection of transport equipment

2. Routine inspection of rail tank cars (RTCs) at loading terminals

If any of the following conditions are not met, the loading operation must be stopped and the situation rectified before loading is allowed to continue.

a. Before loading

1. Is the rail track secured to prevent collision?
2. Is the Rail Tank Car dedicated for ethylene oxide transport?
3. Is the inspection date not exceeded?
4. Are all 'dangerous goods' labels fitted and are the identification numbers 263/1040 attached?
6. Is the tare weight in your possession?
7. Are all the valves properly closed upon arrival?
8. Is the emergency bolt, which opens the bottom valves mechanically, in a safe position on the RTC chassis?
   (This emergency bolt may only be used to open the bottom valves in the case of an emergency. It is strictly forbidden to start loading with an emergency valve blocked by the emergency bolt.)
9. Is the RTC placed at the right loading position?
10. Are the wheels of the RTC blocked by wheel blocks or other tools?
11. Do all valves function correctly?
12. Is the oxygen concentration below 0.3%?
    The tank must then be brought under a nitrogen and ethylene oxide atmosphere as per Annex 1 of Appendix 3.

b. Whilst loading

1. Is the maximum degree of filling not exceeded?

c. After loading

1. Is the RTC pressurised with nitrogen to a pressure suitable for transport?
2. Is the maximum gross weight not exceeded ?
3. Is a leakage test performed (bottom valve and end valve)?
4. Are all valves closed and blinded, with all bolts in place or are all dry disconnect couplings / metal caps in place?
5. Are all seals or locks in place?

Appendix 4

Inspection of transport equipment

3. Initial inspection of road tankers, tank containers and rail tank cars (RTCs)

Before road tankers, tank containers or RTCs are first introduced to ethylene oxide service, or reintroduced to service following maintenance or repair, a responsible person from the loading company should seek confirmation of the following items:

a. is the transport equipment identical in all respects with the general arrangement engineering drawing?
b. have the correct packings and gaskets been fitted? (for example, spiral wound, stainless steel type 304, graphite-filled or tanged graphite)
c. has the tank been properly cleaned? (grit blasting and vacuum cleaning for carbon steel tanks, with no rust remaining; degreasing for stainless steel tanks).
d. do all valves function correctly? (Hydraulic bottom valve indicator, figure 5) It is recommended that for the first loading of a new or repaired vehicle a special "take into service procedure" will be conducted. This should include pressure tightness tests with i.e. nitrogen before loading and also EO leak tests after the start of loading.

Figure 6: Hydraulic bottom valve indicator

Appendix 4

Inspection of transport equipment

4. Maintenance of transport equipment

During operations, unscheduled maintenance of the transport equipment may be necessary if quick closing valves or bottom valves on road tankers/tank containers or RTCs cease to function correctly. Similar difficulties may be experienced with excess flow valves on tank containers and road tank cars. Valves may become blocked with small amounts of polymer.
Customers should be instructed to immediately report to the consignor any difficulties which are experienced with the operation of valves. The provision of an information tag on the returning transport equipment identifying the difficulty can be of assistance.
Consignors of RTCs should maintain close liaison with local railway authorities on all matters concerning the running gear of RTCs.

Appendix 5

Example of a checklist for Rail Tank Cars

The following conditions have to be carefully checked (proposed Checklist) and if one or more of these are not met, the loading operation has to be stopped and the situation rectified before loading continues.

Example of Checklist rail tank cars

rail tank cars liquids - inspection prior to departure

1. Identification

1.1 Wagon number:
1.2 Wagon empty/loaded:
1.3 Which substance loaded/unloaded:
1.5 Hazard Identification Number/UN-number:
1.6 Substance permitted for transport: YES NO
1.6 Next periodic inspection:
1.7 Last overhaul underframe:
1.8 Inspection dates valid: YES NO

2. General Condition YES NO N/A

2.1 Visual damage (insulation,panel,underframe,equipment.....)
2.2 Wagon marked with non conformity note Railways
If yes:Which model of note .....
Which defect/damage .....
2.3 Wagon and connections free from leakages/substance residues.
2.4 General condition of wagon OK

3. Labelling/marking YES NO N/A

3.1 Markings inscription panel/underframe and tank properly readable.
3.2 Prescribed (RID) danger labels fitted (L/R)
3.3 Prescribed (RID) orange marking(Hazard Identification Number/UN-number) fitted (L/R).
3.4 Substance name marked on wagon (L/R)
3.5 Labelling/marking removed if cleaned (L/R)
3.6 Specific markings (emergency telephone numbers,presence of nitrogen, under atmospherical air etc...) (L/R)
3.7 Operation instructions bottom valve present.

Appendix 5

Example of a checklist for Rail Tank Cars

4. Bottom unloading/loading system YES NO N/A

4.1 Visual damage/defect unloading/loading system
4.2 Bottom valve indicators in closed position
4.3 Outlet valve (liquid and vapour return) in closed condition
4.4 Outlet connections fitted with tightened dust caps or tightened pressure caps
4.5 Dust caps or pressure caps fitted with a chain
4.6 Operation system outlet valves secured with securing pins
4.7 Operation system bottom valves secured with securing pins
4.8 Securing pins fitted with chains
4.9 Hydraulical system free of any leaks
4.10 Valves sealed
4.11 Earthing point present

5. Tank exterior YES NO N/A

5.1 No substance residues on tank
5.2 Insulation in proper condition

6. Underframe YES NO N/A

6.1 Crossing bridge in proper condition
6.2 Steps in proper condition
6.3 Braking shoes in proper condition
6.4 Braking hoses/couplings in proper condition
6.5 Hand brake in proper condition

7. Leak testing YES NO N/A

7.1 Leak test performed and:
7.1.1 Bottom valve leak tight
7.1.2 Outlet valve leak tight

8. Remarks:...

Inspected by:... Date:...
[:also to be inspected prior to loading

Appendix 6

A safety visit scheme for the reception and storage facilities at ethylene oxide customers

1. Introduction

1.1 The purpose of this scheme is to ensure that a sufficient level of equipment is available and appropriate operating procedures are in place at customer's premises to permit the safe unloading and storage of ethylene oxide.

2. Scope

2.1 This visit scheme shall apply to the reception of EO by road or rail at all customers.

2.2 The principal objective is to ensure that the transfer of EO from the delivering vehicle to the storage tank can be carried out safely. However, because the storage system and procedures may affect the safety of the unloading operation, these also need to be considered.

2.3 The visit should also be used to:
Assess and record any changes in policy, attitudes or equipment since the previous visit.
Obtain customer's comments on the transport operation and equipment being used.

3. Conduct of the visit

3.1 It is recommended that the checklist shown in Annex 1 is used during the visit as an aid to ensure that all relevant items are considered.

3.2 The guidance notes (Annex 2) provide an explanation of the checklist, and recommended minimum standards in certain cases.

Appendix 6

A safety visit scheme for the reception and storage facilities at ethylene oxide customers

Annex 1

Ethylene oxide unloading / storage checklist

CUSTOMER:
DATE:
ADDRESS:

PERSONS INTERVIEWED:

VISITED BY:

1. The unloading area

1.1 Ease of access; are crash barriers or buffer installed?
1.2 Housekeeping
1.3 Separation from other activities
1.4 Ability to mobilise road tanker/RTC in case of emergency
1.5 Facilities to isolate area and restrict access
1.6 Water sprays / Fire fighting systems
1.7 Electrical classification, defined explosive proof area?
1.8 Minimum safety distances should be 15 metres between the offloading point and storage.
- Ignition source
- Boundary fence/or other facilities
1.9 Adjacent offloading points
1.10 Hoses/loading arms
1.11 Earthing Point
1.12 Pipe damage protection
1.13 (Other vehicles and trucks movements) Could the unloading area be isolated from traffic during unloading operation? Could the railway track be blocked?
1.14 Adequate lighting
1.15 Is a drive away protection installed what type? (Only for road transport)
1.16 Is the unloading area equipped with a drain system to deal with a spillage of EO and or polluted water during emergency response actions?
1.17 Is the unloading area equipped with an explosive atmosphere detection and alarm?

Appendix 6

A safety visit scheme for the reception and storage facilities at ethylene oxide customers

2. The unloading operation

2.1 Personnel and equipment
2.1.1 The presence of customer's operator
2.1.2 Operator's experience, training and seniority
2.1.3 Deputy availability
2.1.4 Hose testing and renewal policy
2.1.5 Fixed loading arm testing and maintenance
2.1.6 Availability of suitable safety equipment
2.1.7 Communication system
2.2 Operations
2.2.1 Written procedures (See Section 6 below).
2.2.2 Hose purging and leak testing
2.2.3 Sampling procedure
2.2.4 Atmospheric/personal EO monitoring
2.2.5 Method of unloading
2.2.6 Use of rail hook
2.2.7 Safeguards for pump
2.2.8 Emergency response
2.2.9 Emergency shut down
3.1 Source of nitrogen

3. Nitrogen supply

3.2 Protection of nitrogen purity
4.1 SITING

4. The storage tank

Bunded
Shared
If shared, with what?
Separation distances
Emergency disposal facilities, drain system
Is the tank farm equipped with an explosive atmosphere detection and alarm?

4.2 CONSTRUCTION
Material of construction:
Insulated
Uninsulated
Refrigerated

Appendix 6

A safety visit scheme for the reception and storage facilities at ethylene oxide customers

Water sprays / Fire fighting systems
Earthed
Design pressure
Maximum allowed working pressure
Date and type of last test/inspection
Dip inlet pipe

4.3 RELIEF VALVES
Separate
Combined with interlock
Size:
Venting to
- Stack
- Scrubber
- Other

Flame arrestors
Nitrogen purged vents

4.4 INSTRUMENTATION
Nitrogen padding pressure
Temperature control
Pressure control
Level indicator
Alarm settings:
- Temperature
- Pressure
- Level

Are controls / indicators and alarms independent?

4.5 MONITORING OF STORAGE
Temperature
Pressure
Level

5. Storage tank to process

Precaution to prevent plant streams contaminating storage vessels.

Appendix 6

A safety visit scheme for the reception and storage facilities at ethylene oxide customers

6. Procedures

There should be written procedures available for the following:

- Identification of the product prior to unloading
- Unloading EO
- Testing, inspection and maintenance of equipment
- Emergency procedures including the rapid use, dilution or venting of the EO in the storage tank

7. Customer's comments

Appendix 6

A safety visit scheme for the reception and storage facilities at ethylene oxide customers

Annex 2
Guidance notes for ethylene oxide unloading / storage checklist

1. The unloading area

1.1 There should be sufficient space for easy vehicular access.

1.2 Unless it is connected to the unloading facilities, it should be possible for the vehicle to be removed from the unloading area in the case of an emergency. If it is connected to the unloading facilities, then the emergency arrangements should take account of the contents of the vehicle.

1.3 Barriers, warning notices (e.g. no access; no smoking) are required. Special consideration may need to be given to prevent shunting close to the unloading area.

1.4 There should be a manual water spray system. Ideally this should be a permanent installation over/around the unloading area. Strategically placed fire hoses/monitors are acceptable. The water system should be capable of knocking down vapour. The volume of water should be enough to dilute leakages one hundred fold before discharge to the sewer.

1.5 It is permissible for some materials (e.g. Propylene Oxide) to be off-loaded in the vicinity of EO. All unloading points must be clearly labelled. Any dry disconnect couplings used for EO should have the EO Selectivity Code

1.6 Hoses or unloading arms should preferably be of stainless steel. They should be dedicated to EO, have suitable gaskets (spiral wound graphite or equivalent) and stored in such a way so as to prevent contamination.

1.7 The earthing point should have been checked on a regular basis.

Appendix 6

A safety visit scheme for the reception and storage facilities at ethylene oxide customers

2. The unloading

2.1. The customer's operator must be present during off-loading.

2.2 The relevant parts of the Cefic General Instructions for EO Drivers should represent the minimum requirements for training. The operator should be tested on this.

2.3 There should be at least sufficient trained deputies to provide cover for illness and holidays.

2.4 The test pressure of the loading arm should not be less than 1.5 times the maximum working pressure (according to standard regulations for pipes the test pressure is 1.3 times the maximum working pressure). The frequency of testing is recommended as at least every 12 months.

2.5 Air breathing sets with eye coverage. Protective suits, boots and gloves of suitable material (butyl rubber has been found to give the best degree of protection. Neoprene or natural rubber may also be considered for protective clothing, but may not remain vapour-tight, particularly after continued use. PVC offers only very limited resistance).
A safety shower and eye fountain should be sited adjacent to the unloading area.

2.6 During storage and unloading, a nitrogen pressure should be maintained within the non-explosive area as indicated in the graph of Appendix 3, Annex 1.

2.7 Hoses must be purged with nitrogen and leak tested before commencing the discharge.

2.8 If unloading is by pump, a vapour return system can be used provided the gas phase is within specifications.

2.9 If a pump is used, the pump system must be designed to control any abnormal temperature rise in the pump. For example, there should be a temperature trip and alarm and a low flow trip and alarm to prevent heating or running dry (a re-cycle loop is not essential for an off-loading pump). A water sprinkler (manual or automatic coupled to a gas detector) should be provided for pumps.
A method for identifying seal leakages should be in operation.
Sealed pump design requires specific attention.

Appendix 6

A safety visit scheme for the reception and storage facilities at ethylene oxide customers

3. Nitrogen

Nitrogen is a potential source of contamination and the purity of the nitrogen must be maintained.

3.1 The nitrogen should preferably be supplied by a separate and independent dedicated supply system.
The EO nitrogen supply system must not be shared with supplies to amines, acids or other catalysts for EO polymerisation.
Ideally the supplies for storage and the plant should be taken from two completely independent sources. If this is not possible or the system is shared the integrity of the nitrogen supply system must be protected.
All nitrogen lines must be fitted with back flow protection. Nitrogen should be taken from a high-pressure supply, which is protected by:

- Double block and bleed systems activated by a low positive pressure difference across the valves.
- Knock out drums fitted with level gauges and a high level alarm, or independent low pressure alarm with shut off valve.

4. The storage tank

Some of this section falls outside the unloading safety checking procedure. However, the information is useful both from safety and quality viewpoints. It also provides information on the customer's competence and attitudes to safety.

4.2 Insulated refrigerated storage is preferred but uninsulated tanks with a water drench are acceptable particularly in colder climates.

4.3 Relief valves should be large enough to cope with fire engulfment.
Polymer formation is possible in flame traps. If these are used, regular inspection should be included in the maintenance schedules.

4.4 Level alarms are advised but if they are absent, procedures must be present which prevent tanks overfilling.

4.5 The temperature and pressure of the storage tank should be monitored and alarmed regularly.

5. Storage tank to process

Back flow and contamination prevention is essential. Similar equipment to that used for maintaining the nitrogen integrity should be used (see Section 3 above).

Appendix 7

Assessment of ferry operators and associated terminal facilities.

Contents

1. Introduction

This checklist has been developed to assist ferry auditing and does not cover structural design details of the vessels.

It should be used as a simple aid to ensure that all basic elements and procedures are in place to secure a safe passage and that all persons involved are aware of the nature and risk of the product being transported.
Whilst in most cases the haulier/railway company will suggest the use of a particular ferry route, the consignor involved should always determine whether the particular ferry/operator/mode of transport is suitable.
No rating system has been incorporated in the checklist.

The checklist assumes that the ferry operator has a licence to operate, is in possession of the necessary documents to operate a ferry under national and international legislation, and that the vessel has the required certificate of seaworthiness.

The checklist is designed for RO/RO ferries which are in general use.

In due course it is anticipated that a Cefic assessment scheme will be developed as part of the ICE initiative which will include ferry structural design.

Appendix 7

Assessment of ferry operators and associated terminal facilities.

2. Management systems

- Does the ferry management have a safety, health and environmental policy?
- Is it prominently displayed on the ship and understood?
- Is there a drug - and alcohol policy?
- If the ferry is subchartered are the safety standards in force at least of the same standard as on the company owned vessels?
- Are there recruitment and staffing policies/procedures?
- Does the ferry line comply to the SOLAS requirements?
- Is management aware of the nature and hazards of the product (Safety Data Sheets), and actions to be taken in the event of an emergency?
- Does the ferry comply with the requirements regarding numbers of passengers carried?
- Is the ferry company ISO certified?
- Is there sufficient competence in marine engineering issues to assure the integrity of the ferry?

3. Terminal facilities/ systems

- Is the terminal/ferry interface managed effectively?
- Is the terminal located in a populated area?
- Is there a good road/rail infrastructure?
- Do the rail/road access routes pass through local city centres?
- Is sufficient supervised space available for safe parking of tankcars, tank containers and railtank cars with hazardous goods?
- Is there sufficient space and appropriate facilities to deal with emergencies? (e.g. firefighting, or in case of leakage transferring to other tankcars)
- Can hazardous goods road tankers, tank containers and rail tankcars easily evacuate the parking area in case of fire?
- Is a permit necessary from the terminal operator to enter the port area with hazardous goods?
- Is the access to the terminal area controlled by a security system?
- Is there sufficient fire fighting capability available either on the terminal or nearby to respond effectively?
- Is hazardous goods parking segregated from the parking for passenger, cars, coaches, etc?
- Are personnel trained in handling/exposure to chemicals, and actions to be taken in the event of emergency?
- Are appropriate emergency exercises carried out on a regular basis?

Appendix 7

Assessment of ferry operators and associated terminal facilities.

4. Ferry management /equipment

- Is the general appearance of the ferry externally sound and well cared for? Is the external plating heavily corroded and/or buckled?
- Are the hazardous goods vehicles correctly stowed with sufficient supporting chains to prevent movement?
- Does the place of stowage comply with the regulations? (Weather deck , sufficient ventilation, etc)
- Does the exposed weather deck have a sufficient high bulwark (at least 3 to 4 m high)?
- Are hazardous goods road tankers, tank containers and rail tank cars protected from adverse weather conditions (for instance not stowed right at the bow area where damage may be caused by large waves)?
- Is the principle of "last in - first out" applied for very hazardous goods allowing minimum exposure to damage during loading/unloading traffic movements and rapid exit in the event of emergency?
- Are smoking regulations in areas with hazardous cargoes enforced?
- Are systems in place to ensure that bow and/or stern doors are closed and sealed prior to departure?
- Is the condition of above seals and securing devices regularly checked?
- Are mandatory procedures strictly adhered to or do the masters have freedom of interpretation?

5. Ferry emergency systems

- Are the emergency procedures for passengers prominently displayed on the ship?
- Are the evacuation signs clear and visible also in case of power failure?
- Has the fire system (pumps, emergency pumps and emergency generators been tested frequently (logbook)?
- Is the fire fighting party on board conversant with the nature and precautions for the product in case of fire (chemical fire fighting course, Safety Data Sheets, Hazard identification number, UN number and Hazardous labelling)?
- Do ships crew carry out frequent fire/emergency drills (check logbook)?
- Does the emergency equipment include gas measurement, chemical suits and has the ships fire fighting personnel regularly trained in use of those items? (check status of equipment and experience in operation)
- Ask the crew to open some deck fire hydrants. Do they open easily?
- Does the captain have all the required information directly available regarding the nature and safety precautions relevant to the product?

Appendix 7

Assessment of ferry operators and associated terminal facilities.

- Is there an emergency system in place(24 hours) which can advise the captain and provide level - 1 response?
- Does the main office have duty personnel with access to a hazardous goods database available 24 hours?
- Are duty personnel trained and conversant with hazardous goods and do they have immediate access to hazard information? (Ask for a demonstration.)
- Are there equipment/procedures in place to establish radio/telephone contact to and from the ship when it is at sea?

Appendix 8

Sector Group Member companies

Company	Country
AKZO NOBEL	NETHERLANDS
BASF	GERMANY
BP CHEMICALS	UNITED KINGDOM
CLARIANT	SWITZERLAND
DOW EUROPE	SWITZERLAND
INEOS OXIDE	UNITED KINGDOM
IQA	SPAIN
PKN	POLAND
SASOL GERMANY	GERMANY
SHELL CHEMICALS	NETHERLANDS

Notice

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