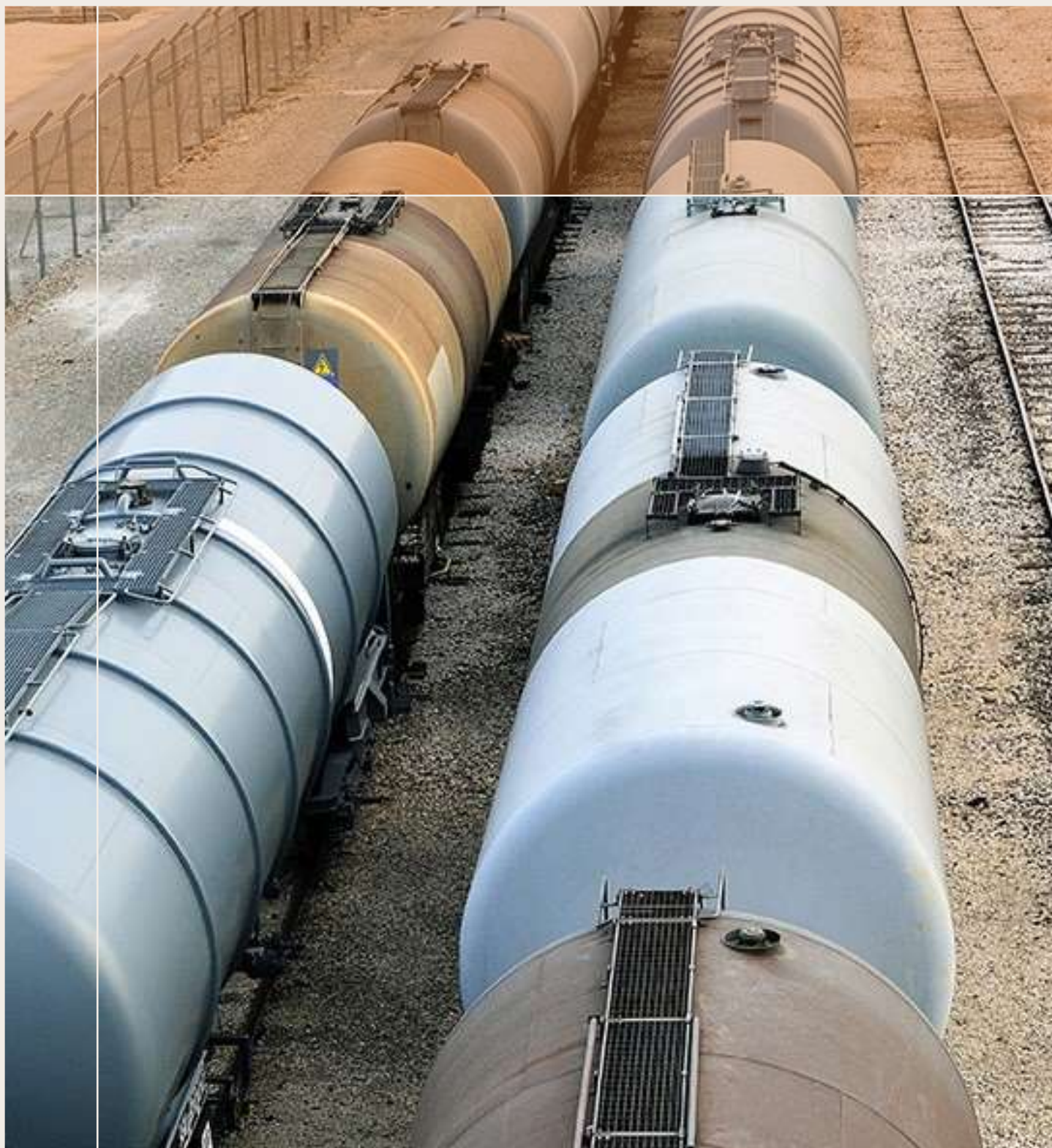


Guidelines for the distribution of **Acrylonitrile**

Revision 5, March 2014
Acrylonitrile Cefic Sector Group





Notice

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Member Companies of the Cefic Acrylonitrile Sector Group	



1 Introduction

1.1

Although Acrylonitrile is a hazardous material in terms of flammability, polymerization activity and toxicity, it can be distributed and handled safely provided that appropriate precautions are observed.

1.2

The transport of Acrylonitrile in bulk is subject to National regulations within Europe. In addition, the international movement of Acrylonitrile by road, rail, sea or inland waterways is subject to agreements which lay down specific and mandatory requirements.

1.3

These Guidelines have been prepared by Cefic (European Chemical Industry Council) Acrylonitrile Sector Group to establish appropriately high standards of safety for the transport of Acrylonitrile.

1.4

These Guidelines take into account the transport of Acrylonitrile in bulk in road tankers, Rail Tank Cars, sea-going tankers, river barges and tank containers. They cover all aspects of the transport. Reference to existing regulatory controls is only made where this is considered necessary for the purpose of clarification.

1.5

The Cefic Acrylonitrile Sector Group recommends that these Guidelines are adopted by all parties who are involved in the distribution of Acrylonitrile.

1.6

In order to facilitate effective supervision in storage and transport, all involved parties had to make sure that transport equipment meets the design and construction requirements of national and international regulations. In addition it is recommended that transport equipment is designed and constructed in accordance to the guidelines in this document.

1.7

These guidelines will be periodically reviewed by the Sector Group members.

1.8

The transport companies must be assessed in accordance to Cefic SQAS (Safety Quality Assessment System) with good result.

A review meeting of producer and Transport Company is recommended after every new assessment.

1.9

The weight to be attached to particular guidelines is indicated by the following usages:

- a) "Should" implies a recommendation based upon the judgement of experienced people but recognises that some discretion is appropriate.
- b) "Must" is a definite requirement, but is normally limited to procedures essential to adequate design or sound operation.



2 Product classification and properties

2.1 General Description

Acrylonitrile (acrylic acid nitrile, 2-PROPENENITRILE, cyanoethylene, vinylcyanide, AN, ACN, $\text{CH}_2 = \text{CH} - \text{CN}$) is commercially produced by ammoxidation of propylene in the presence of ammonia. The commercial product is liquid, colourless, clear, flammable and poisonous and has an irritant effect on the skin.

CAS Number: 107-13-1.

Index Number: 608-003-00-4.

EEC Number: 203-466-5 (EINECS Number).

2.2 Physical Properties

APPEARANCE AND ODOUR	COLOURLESS LIQUID WITH A PUNGENT ODOUR
Boiling point	77.3 °C (171.1°F)
Burning velocity (in air)	0.47 m/s
Critical temperature	246 °C (474.8°F)
Density (at 20°C)	806 kg/m ³
Melting point	- 83.5 °C (-118.3°F)
Molecular weight	53.1
Refractive index	$n_D^{25} = 1.3888$
Solubility (20°C)	7.35 wt % ACN in water 3.1 wt % water in ACN

	METRIC UNITS	SI UNITS
Critical pressure	34.9 bar	3490 kPa
Heat of vaporization	147 kcal/kg	615 kJ/kg
Specific heat	0.5 kcal /kg, °C	2.09 kJ/kg, °C
Surface tension (at 24 °C)	0.0065 kcal/m ²	0.0273 J/m ²
Vapour pressure (20 °C)	0.12 bar	12 kPa
Viscosity (20 °C)	0.4 cP	0.4 mPa.s

Reference: Handbook of CHEMISTRY and Physics, VOLUME 88 (2007-2008)

Acrylonitrile is miscible with many organic solvents such as alcohols, ethers, acetone, benzene, carbon tetrachloride, ethylacetate, ethylene cyanhydrin, toluene, petroleumether and kerosenes. Azeotropes are formed between Acrylonitrile and many of these solvents.

2.3 Chemical Properties

Explosion Limits in air, at 25 °C (vol %)	lower limit: 3 upper limit: 17
Flash point	
• Tag open cup	-5 °C (23 °F)
• Tag closed up	-1 °C (30.2 °F)
Ignition group	G 1
Ignition temperature	481 °C (898 °F)

	METRIC UNITS	SI UNITS
Heat of combustion (25 °C)	- 7928 kcal/kg	- 33173 kJ/kg
Heat of polymerization	- 337 kcal/kg	- 1412 kJ/kg

Reference: *Handbook of CHEMISTRY and Physics, VOLUME 88 (2007-2008)*

Acrylonitrile is a versatile chemical intermediate. The presence of both olefinic and nitrile groups permits a large variety of reactions. The nitrile group can undergo hydrolysis, hydrogenation, esterification and reduction. Reactions of the double bond include polymerisation, copolymerisation, cyanoethylation, cyclisation and halogenation. Mixtures of Acrylonitrile with air are flammable. In its liquid state, Acrylonitrile has a tendency to polymerise, which can however be prevented by the addition of phenolic (e.g. methyl ether of hydroquinone or amine-based stabilizers and small quantities of water. By adding concentrated caustic alkali or concentrated sulphuric acid, polymerisation can be accelerated to such an extent that it may assume an explosive nature. Acrylonitrile has no corrosive effect on metals. So stainless steel, carbon steel and aluminium/magnesium are used as materials for storage tanks. (For product quality reasons, avoid contact with copper or copper alloys).

2.4 Uses

Acrylonitrile is used as:

- A raw material for the production of synthetic fibres, plastics and synthetic rubber. One of the reasons for the versatility of Acrylonitrile is that it can form copolymers with other unsaturated compounds, such as styrene and butadiene, for example.
- A raw material for acrylic acid, acrylic esters, acrylic amide, carbon fibre.
- In the synthesis of compounds used for the production of adhesives, anti-oxidants, binders for dyestuffs and emulsifiers.

Exposure Scenarios

There are five exposure scenarios for uses of Acrylonitrile plus one for manufacture. These cover production of acrylic and mod-acrylic textile fibres; Production of ABS and SAN plastics; Monomer for production of nitrile rubbers; other intermediate uses; laboratory reagent. Full details can be obtained from the Acrylonitrile suppliers. The following use codes are covered;

SECTORS OF USE	DESCRIPTION
SU 0	Other
SU 5	Manufacture of textiles and furs
SU 8	Manufacture of bulk
SU 9	Manufacture of fine chemicals
SU 10	Repackaging
SU 11	Manufacture of rubber products
SU 12	Manufacture of plastic products; including compounding and conversion
SU 22:	Professional uses
PRODUCT CODE	
PC 19	Intermediate
PC 32	Polymer preparations and compounds
PROCESS CODES	
PROC 1	Used in closed process, no likelihood of exposure
PROC 2	Used in closed continuous process with occasional controlled exposure
PROC 3	Use in closed batch process (synthesis or formulation)
PROC 4	Use in batch and other process (synthesis) where opportunity for exposure arises
PROC 8b	Transfer of substance or preparation/charging/discharging from/to vessel/large containers at dedicated facilities
PROC 9	Transfer of substances or preparation into small containers (dedicated filling line, including weighing)
PROC 15	Laboratory uses
ENVIRONMENTAL RELEASE CODES	
ERC 6a	Industrial use resulting in the manufacture of another substance (intermediates)
ERC 6c	Industrial use of monomers for manufacture of thermoplastics
ERC 6d	Industrial use of process regulators for polymerisation processes in production of resins, rubbers, polymers.

2.5 Classification and Labelling

2.5.1 Classification according to EU Dangerous Substances Directive (DSD)

Highly Flammable (F)	R11
Toxic (T)	R23/24/25
Carc. Cat. 2	R45
Irritant (Xi)	R37/38, R41, R43
Dangerous for the Environment (N)	R51/53

2.5.2 Labelling according to EU directive 67/548/EEC

F, T, Xi, N

R 45- 11-23/24/25-37/38-41-43-51/53

S 9-16-53-45-61

+ S 27 (*)

(*) S 27* is not an EU requirement but is recommended.

2.5.3 Classification and Labelling according to Regulation (EC)1272/2008 (CLP)

CLASSIFICATION	
EU CLP GHS CLASSIFICATION	
Official CLP Classification: (EC 1272/2008)	Flammable Liquid Category 2 Carcinogenicity Category 1B Reproductive Toxicity Category 2 Acute Toxicity (Oral) Category 3 Acute Toxicity (Dermal) Category 3 Acute Toxicity (Inhalation) Category 3 Eye Corrosion/Irritation Category 1 Skin Corrosion/Irritation Category 2 Specific Target Organ Toxicity Single Exposure Category 3 (H335) Skin Sensitization Category 1 Aquatic Toxicity Chronic Category 2
	H225 Highly flammable liquid and vapour. H301 Toxic if swallowed. H311 Toxic in contact with skin H315 Causes skin irritation. H317 May cause allergic skin reaction. H318 Causes serious eye damage H331 Toxic if inhaled. H335 May cause respiratory irritation. H350 May cause cancer. H361D Suspected of damaging the unborn child. H411 Toxic to aquatic life with long lasting effects.
Labelling	Signal word: Danger
Hazard pictograms	

2.6 Transport Classifications

The transport classifications for Acrylonitrile are described as follows:

RID - ADR - ADN	
CLASS	3
CODE	336
UN NUMBER	1093
LABELS	3 + 6.1

TITRE 2.2	
CLASS	3 subsidiary risk 6.1
UN NUMBER	1093
PACKING GROUP	I
LABEL	3 + 6.1 (toxic)
OFFICIAL NAME	Acrylonitrile stabilized

WARNING BOARD	
<u>336</u> Kemler Code	UK HAZCHEM CODE: 3WE Hazard Diamonds – Flammable + toxic + environmental hazard
<u>1093</u> UN No.	

THE CLASSIFICATIONS FOR HEALTH PROTECTION ARE	
EmS	3-02

IATA	
CLASS	3
UN NUMBER	1093
PACKING GROUP	I
LABEL	3 + 6.1 (toxic)



3 Specific chemical hazards

3.1 Polymerisation hazards

Under some conditions, Acrylonitrile may undergo polymerisation. The polymerisation reaction is highly exothermic; the heat released can lead to additional polymerisation accelerating to the point where it becomes out of control. Monomer can vaporise at elevated temperatures and can cause sufficient pressure to rupture storage vessels.

Hazardous conditions can result from any of the following, even when the Acrylonitrile is properly inhibited:

- Contact with free radical catalysts such as peroxides and hydroperoxides.
- Mixing with basic/alkaline material such as sodium hydroxide, potassium hydroxide and ammonia.
- Mixing with Lewis acid catalysts such as boron trifluoride, titanium tetrachloride and sodium borohydride.
- Contact with strong mineral or organic acids.
- Exposure to high energy radiation such as UV light, X-rays and gamma rays.

The storage of inhibited Acrylonitrile does not normally give a polymerisation hazard.

3.2 Inhibition

The material is stabilised/inhibited against spontaneous polymerisation prior to dispatch with:

- Water: 0.25 – 0.5% by weight.
- MEHQ: 30-50ppm (Monomethylether of Hydroquinone).
- Oxygen: trace amount.



4 Health concerns

Acrylonitrile is toxic if inhaled or swallowed or in contact with the skin. Skin contact causes blistering; the eyes and mucous membranes are particularly at risk. Symptoms of acute exposure are headache, nausea, dizziness and vomiting. After substantial exposure, the symptoms are unconsciousness, spasms and cessation of breathing. These symptoms can be delayed several hours after exposure. Acrylonitrile must be regarded as if it is potentially carcinogenic to man. If any contact with Acrylonitrile has taken place or is suspected, immediate consultation of medical service is strongly recommended.

The effects of Acrylonitrile on humans, animals and environment have been extensively studied and documented:

Toxicity by inhalation (LC50)

YEAR	SOURCE	SPECIES	AN VAPOR LC50	
			DURATION	VALUE
2005	SECCO / SNF Group	Rat	4-hours	946 ppm
1990	Vernon et al	Rat	1-hour	> 1008 ppm
1981	Appel et al	Rat / Various	1-hour 4-hours	1578 ppm 557 ppm
1942	Dudley and Neal	Rat	1-hour 4-hours	1810 ppm 473 ppm

Dermal Toxicity (LD50) Rabbit 280MG/KG

YEAR	SOURCE	SPECIES	AN LD50	
			DURATION	VALUE
2005	SNF (RTI unpublished, 2005)	Rat	4-hours	200 mg/kg (LD10)
1995	BUA	Rabbit	Various	148-693 mg/kg
1969	Vernon et al	Rabbit	24-hours	< 200 mg/kg

Oral Toxicity (LD50)

YEAR	SOURCE	SPECIES	AN LD50
1995	GDCh/BUA	Various	25 to 186 mg/kg
1969 (1990)	Vernon et al	Rat	81 mg/kg
1983	WHO	Mouse	25-48 mg/kg

General assessments on effects of Acrylonitrile on humans, animals and environment:

- European Union Risk Assessment Report. (2004) Acrylonitrile, CAS No. 107-13-1. Vol 32. European Chemicals Bureau, European Commission Joint Research Centre.
- IARC Monographs 19 (1979) and 71 (1999) Class 2B.
- Environmental Health Criteria 28: Acrylonitrile, WHO (1983).
- Environmental Hazard Assessment: Acrylonitrile, Nielsen et al. (1993).
- BUA-Stoffbericht 142; Acrylonitrile, GdCh (1994).
- The Sapphire Group, Inc. (unpublished, 2004) Toxicological Review of Acrylonitrile (CAS No. 107-13-1). Prepared for The Acrylonitrile Group, Inc.
- REACH Generic Chemical Safety Report for Acrylonitrile, AN REACH Consortium (2010).

REACH DNELs for Industrial exposure scenarios

SYSTEM	DERMAL		INHALATION	
EFFECT	LOCAL	SYSTEMIC	LOCAL	SYSTEMIC
Acute	Dermal Irritant/sensitizer	Local Inhalation exposure regarded as protective	10 mg/m ³ (4.5 ppm)	Local Inhalation exposure regarded as protective
Long-term	Dermal Irritant/sensitizer	1.4 mg/kg bwd/d*	1.8 mg/m ³ (0.8 ppm)	2.7 mg/m ³ (1.0 ppm)

(*) Dermal irritant/sensitizer; value provided only for assessment of PPE

NOTE: Acrylonitrile is classified as an IARC 2B Carcinogen (possible human carcinogen/ EU GHS 1B, May Cause Cancer. At the time of publication the 8 h TWA OEL for Acrylonitrile in most Member States and Switzerland was 2 ppm, but 1 ppm in the Czech Republic and 3 ppm in Slovakia and Slovenia, based on potential cancer risk.

The systemic long-term REACH DNEL is based on potential irritation risk and is regarded as protective of any potential cancer risk.

4.1 Ingestion

Ingesting Acrylonitrile is potentially fatal and will cause severe irritation of the mouth, throat and digestive tract. Gastro-intestinal burns are also likely. This may have the effects of causing respiratory complications, nausea or vomiting. Onset of typical signs of intoxication may be rapid and fatal.

4.2 Inhalation

Breathing Acrylonitrile at a concentration of 22 mg/m³ and higher for 20 to 45 minutes causes headaches, nausea and disorientation. Specific levels of Acrylonitrile causing death are not reported, but animal experiments suggest that, as far as inhalation is concerned, exposure to Acrylonitrile at 500 to 2000 mg/m³ for to 3 hours could be fatal. Simultaneous exposure to some organic solvents may enhance the toxicity of Acrylonitrile.

4.3 Effects on skin and eyes

Liquid Acrylonitrile is absorbed into the body via the skin, and the same non-specific symptoms of systemic poisoning occur as with inhalation of Acrylonitrile vapour. Moreover, exposure of the skin to liquid Acrylonitrile can cause skin irritation, redness and blistering. Local injury can occur a few hours after contact with the liquid.

Liquid Acrylonitrile has a burning effect on the eyes. Development of allergic dermatitis is possible after skin contact.

4.4 Long term effects

In the course of several long-term tests in which Acrylonitrile was administered to rats both orally and via inhalation, a carcinogenic effect was detected. There is a significant epidemiological database on humans exposed to Acrylonitrile at work. These data do not suggest a consistent correlation between Acrylonitrile and cancer in humans at occupationally relevant exposures. Presently, however, Acrylonitrile should be regarded as potentially carcinogenic to man.

No clear evidence for a relationship of Acrylonitrile exposure and the incidence or the mortality of specific tumours can be derived from these epidemiological studies. On the basis of the available results of experimental and epidemiological studies, it cannot be evaluated whether or not the carcinogenic effects in the rat are relevant for man because the mechanism of carcinogenesis is unknown. It is therefore recommended to keep exposure to Acrylonitrile as low as possible both at the workplace and in the environment, and that skin contact with the liquid has to be avoided.

Reference: Cole, P. Mandel JS and JJ Collins 2008, Acrylonitrile and cancer: A review of the EPIDEMIOLOGY, Regul. Toxicol. PHARMACOL. (2008), DOI:10.1016/J.YRTPH.2008.09.004

4.5 Medical Treatment

The first priorities are decontamination and obtaining rapid medical attention. On site Emergency medical attention will require subsequent assessment by a doctor or in a hospital Emergency Unit. Those treating victims of Acrylonitrile poisoning should make sure that they are equipped with the necessary personal protective equipment and that those exposed are properly decontaminated. Where Acrylonitrile poisoning is evident, pay attention to the vital functions (breathing and blood circulation) and the effects on the skin, eyes, liver and central nervous system. Acrylonitrile can be absorbed via inhalation or contamination of the skin.

All exposed patients should be evaluated by a medical doctor before being released.

Where symptoms progress or the person is unconscious, establishment of intra venous access as soon as possible for IV Antidote treatments is essential. Current antidote regimes should be checked with National Poison Centres:

Typically the following are proposed:

- Germany / Austria: 4-DMAP and sodium thiosulphate.
- France: Hydroxycobalamine plus sodium thiosulphate.
- Italy: Hydroxycobalamine and sodium thiosulphate.
- Spain: Hydroxycobalamine plus sodium thiosulphate.
- NL: Hydroxycobalimine and sodium thiosulphate.
- U.K.: Sodium nitrite followed by sodium thiosulphate/dicobalt edetate (severe confirmed cases).
- U.S.A.: Amylnitrite plus sodium nitrite and sodium thiosulphate.

Please refer to your national poison centres for the most up-to-date information.

Hydroxycobalimine and sodium thiosulphate are recommended, but please contact national poison centre for the latest treatment.

(*) Please note that the recommended antidotes differ from country to country, and are under constant review. Cyanide antidotes are theoretically useful but clinically unproven in Acrylonitrile poisoning. Please refer to your national authorities for current recommendations.



5 Personal protective equipment

5.1 First Aid Box

Locations where Acrylonitrile is handled should be equipped with suitable first-aid units, containing, in addition to the normal first aid requisites, a written procedure on how to handle exposures to Acrylonitrile. Detailed information could also be found in the Safety Data Sheet.

5.2 Breathing protection

For work purposes, air masks must be equipped with clear view face piece, speaking diaphragm and air demand regulator. The air will be supplied from a portable air cylinder, or air supply hose from air tanks or long duration cylinders. The use of a positive pressure mask gives greater protection and is preferred.

Escape masks must only be used for emergency purposes due to potential saturation of the filter and should only be used once.

5.3 Eye Protection

Eye protection must be worn at any time.

5.4 Hand protection

Preventive: disposable gloves made of high quality butyl rubber or neoprene.
Repressive: (Pressurised) see Body protection section (5.6).

5.5 Foot protection

Butyl rubber knee-length boots (Wellingtons). Leather footwear are not recommended in cases of operations with increased risk such as loading and unloading in case of skin contact with heavier-than air Acrylonitrile vapours.

5.6 Body protection

Preventive: PVC or neoprene (for usage one time only) overall with a close-fitting hood and an elastic fitting around wrists and ankles.

Repressive: Pressurised butyl rubber gas-tight suit with an independent air supply.

5.7 Safety showers

Quick-opening safety showers conveniently located in exposure area. Consideration must be given to providing an activation switch which alarms in the central control room. For better visibility the safety shower should be painted or clearly marked in a fluorescent colour.

5.8 Walkie-talkie (ex-proof type)

To call for help and provide communications in an emergency.

5.9 Materials required for first aid and medical treatment

- Oxygen.
- Recommended antidotes as listed above (Chapter 5).

The medical treatment must be provided by a physician and these antidotes must only be given to patients obviously symptomatic and poisoned by Acrylonitrile.

Oxygen may be administered by trained personnel.



6 Environmental considerations

6.1 Environmental Hazards

- Acrylonitrile, while not readily biodegradable based on available information, appears to degrade rapidly in wastewater treatment plants following acclimation of the biomass and also degrades in surface water. Up to 99% biodegradation has been reported in simulation tests.
- It has an acute harmful effect on fish: 11-100 mg/l.
- It does not bioconcentrate.
- The water hazard classification in Germany is WGK3.

6.2. Fire and Explosion Hazards

Acrylonitrile is a flammable liquid and its vapour can form explosive mixtures with air under ambient conditions. Flammable organics handling precautions must be followed when handling Acrylonitrile.

6.3. Destruction of Acrylonitrile

6.3.1 Larger quantities

Re-processing or burning in a suitable incinerator.

6.3.2 Smaller quantities (in the kilograms range)

It is recommended to dispose smaller quantities as chemical waste and dispose it properly in drums which can be sent for incineration. Smaller quantities may be cleaned-up by suitable absorbent materials as a means to facilitate mop-up and incineration.

It is advised to consult with your supplier who can provide expert advice on disposal options.

6.4 Breakdown of Acrylonitrile in the soil

Whenever Acrylonitrile is spilt onto the soil, a dangerous situation will occur initially through the risk of explosion and toxic effects of the vapour. After pumping away and/or evaporation, the soil is left contaminated. The extent to which Acrylonitrile can find its way into groundwater and/or surface water depends on:

- The amount of Acrylonitrile in the soil.
- The geohydrological conditions.

Acrylonitrile is easily soluble in groundwater. In the event of a leakage, there is a risk of washing away and groundwater contamination.

Microbiological life occurs primarily in the top layer (approximately 40 cm) of the soil. The amount of microbiological activity is largely dependent upon the organic matter (humus) content, the amount of clay material, the soil structure (air) and climatological factors such as temperature and so on.

Acrylonitrile is highly reactive through the nitrile group and the dual bond. The substance polymerizes easily, especially under the effect of light and in the presence of strong acids and bases. A partial hydrolysis (reaction of the nitrile group) gives acrylamide ($\text{CH}_2=\text{CHCONH}_2$). Acrylamide is easily biodegradable. A complete hydrolysis gives acrylic acid ($\text{CH}_2=\text{CHCOOH}$), this substance being less toxic and also easily biodegradable.

The toxic concentration of Acrylonitrile for micro-organisms in the soil is about 4 to 5 %. In the event of an Acrylonitrile leakage completely killing off micro-biological soil life, under favourable experimental conditions an almost complete recovery of microbiological activity was possible in a relatively short time (3 WEEKS).

The contaminated soil has to be disposed of safely, for instance through incineration.

The local authorities responsible for water and the environment must be informed.



7 Transport

7.1 Design and construction of Rail Tank Cars (RTC's)

Rail Tank Cars for the carriage of Acrylonitrile must meet the design and construction requirements of:

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

In addition, it is recommended that Rail Tank Cars are designed and constructed in accordance with appendix 1.

7.2 Design and construction of road tankers

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

- a) National Regulations, when used for national transport.
- 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, it is recommended that road tankers are designed and constructed in accordance with appendix 2.

7.3 Design and construction of tank containers

Tank containers may be used for the carriage of Acrylonitrile 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, it is recommended that tank containers are designed and constructed in accordance with appendix 2.

7.4 Design and construction of tank ships and barges

Tank ships and barges used for the carriage of Acrylonitrile by sea must meet the design and construction requirements of:

- a) International Regulations such as the codes for the construction and equipment of ships carrying liquefied gases and dangerous chemicals in bulk as produced by the International Maritime Organisation (IMO)
- b) National and International Regulations for the design and construction of barges such as the regulations concerning the Transport of Dangerous Substances in Barges on the River Rhine (ADNR)

In addition to the above requirements, it is recommended that the ships and barges are designed and constructed in accordance with appendix 3.

7.5 Loading operations

7.5.1

The operations of filling any road tanker, tank container, Rail Tank Cars or ship tank with Acrylonitrile is a potential hazard.

It is therefore important that loading facilities and transport equipment are correctly designed and constructed, properly used and maintained.

It is recommended to have the loading facilities inspected by the supplier every 2 to 5 years to ensure sharing of experience and best practice.

7.5.2

Be also aware that static electricity can build up during loading. Approved and regularly tested earth connection must be installed and connected before the loading connection is made.

The installation of an Earth Proofing Device is strongly recommended. It is best practice to use an interlock system.

7.5.3

Loading facilities must be designed and located having due regard to the potential hazards associated with Acrylonitrile. The design and construction of storage, handling and transport equipment is described in Section 3 and appendices 1 to 4 of these Guidelines.

Transport equipment is subject to periodic inspection and testing requirement as specified in national and international regulations.

7.5.4

Written operating instructions for loading Acrylonitrile must be available at all loading points. Personnel involved must be fully trained in their implementation. Instructions must show the specific hazards of Acrylonitrile and outline specific procedures in emergency situations.

7.5.5

All necessary protective clothing and emergency equipment must be available for loading operations.

During connecting or disconnecting of the transport equipment a respiratory protection must be worn. The use of a chemical suite, butyl rubber gloves and wellingtons during that operations is recommended as well.

7.5.6

A visual inspection of the transport equipment must be carried out by the loading terminal personnel before, during and after loading. This inspection does not replace or diminish the responsibility of the owner of the road tanker, tank container, ship or to ensure that the equipment is properly tested, maintained and fit for purpose. It is meant to ensure that the transport of Acrylonitrile is conducted as safely as possible.

The inspection list detailed in appendix 5 is recommended for use by the loader to check the condition of Acrylonitrile transport equipment.

7.5.7

In addition to the routine inspection of all transport equipment prior to each loading operation, a responsible person from the loading company must carry out a check on each road tanker, tank container or Rail Tank Cars prior to initial introduction into service, or reintroduction to service after maintenance or repair. These checks are also shown in detail in appendix 5.

7.5.8

The Routine Inspection List assumes that Acrylonitrile is to be conveyed by international transport. In circumstances where Acrylonitrile is to be conveyed nationally (more usually), in accordance with international regulations, the inspection list must be modified as appropriate.

7.5.9

It is necessary that all loading facilities are properly equipped for safe unloading operations.

7.6 Unloading operations**7.6.1**

Unloading any road tanker, tank container, Rail Tank Cars or ship tank containing Acrylonitrile is a potential hazard.

It is important that unloading facilities are correctly designed, constructed, used and maintained.

The supplier must inspect the unloading facilities before the first delivery and reinspect every 3- 5 years.

7.6.2

Be also aware that static electricity can build up during unloading. Approved and regularly tested earth connection must be installed and connected before the unloading connection is made. The installation of an Earth Proofing Device is strongly recommended. It is best practice to use an interlock system.

7.6.3

Unloading facilities must be designed and located having due regard to the potential hazards associated with Acrylonitrile. The design and construction of storage, handling and transport equipment is described in Section 3 and appendices 1 to 4 of these Guidelines.

Transport equipment is subject to periodic inspection and testing requirement as specified in national and international regulations.

The instructions must recognize the specific hazards of Acrylonitrile, and ensure the correct operation of unloading equipment in both normal and emergency situations.

7.6.4

Written operating instructions for loading Acrylonitrile must be available at all loading points. Personnel involved must be fully trained in their implementation. Instructions must show the specific hazards of Acrylonitrile and outline specific procedures in emergency situations.

During connecting or disconnecting of the transport equipment a respiratory protection must be worn. The use of a chemical suite, butyl rubber gloves and wellingtons during that operations is recommended as well.

7.6.5

An inspection of the transport equipment is recommended and must be carried out at the unloading terminal at the customer's site.

This inspection does not replace or diminish the responsibility of the Acrylonitrile supplier and the owner of the road tanker, tank container, Rail Tank Cars or ship to ensure that the equipment and transport documentation are in correct conditions and issued properly.

We recommend following an Inspection Unloading List, (see appendix 6) and this must be applied for all unloading operations involving Acrylonitrile.

7.6.6

Unloading of Acrylonitrile at a customer's premises is the customer's responsibility. If requested, the consignor or Acrylonitrile supplier may provide the customer with technical advice and safety service which in principle may include a safety visit. In such a case appendix 7 may be used as check list. It is recommended that customer must evaluate whether their premises, especially reception and storage facilities, correspond with the requirements of the scheme included in appendix 7.

7.7 Acrylonitrile transport by road

7.7.1 General requirements for Acrylonitrile Transport by Road

Acrylonitrile road transport is under "ADR" or national regulations which are obligatory and must be met in all countries.

In certain countries specific transport permission issued by the authorities is required. As Acrylonitrile is classified as a high hazard chemical, all involved parties in the transport must apply to ADR 1.10 and must have a security plan. All involved personell must be trained accordingly.

7.7.2

The haulier is responsible for the safe transport of Acrylonitrile by road from the loading point to the discharge point.

The following points are important and need to be included in standards related to land transport and must be complied with.

The Haulage Company should be assessed to SQAS (Safety and Quality Assessment System under the auspices of Cefic) with good results. Regular review meetings on the SQAS assessment should be done by the supplier. Review meetings should minimum take place after every new assessment.

7.7.3 Routing

Acrylonitrile must only be transported on defined routes. The route to be followed must be selected carefully and must be known to both the haulier and the consignor or supplier. In countries where specific transport permission is required, the route is part of the permission.

As far as possible, the route must:

- a) Utilize motorways
- b) Be planned to avoid major centres of population or areas of high population density.
- c) Avoid use of tunnels or passenger ferries.

7.7.4 Safe Parking

Drivers of Acrylonitrile road tankers en route must ensure that the vehicle, when not being driven, is either supervised at all times or is parked in a safe parking location.

Use an authorized parking area for dangerous chemicals products when available.

If the above is not available, the parking area must be in an isolated position in the open, in an area which is preferably lit at night.

7.7.5 Severe Weather Conditions

When severe weather conditions are experienced during transport, for example icy roads, snow or poor visibility caused by fog, the delivery must be stopped at the next suitable parking place. The delivery must not resume until weather conditions improve. Local rules may apply. (The present requirement for minimum visibility is 200 meters in The Netherlands.)

7.7.6 Delays or Accidents

All delays during transport caused by severe weather conditions, breakdowns or other reasons must be reported to the consignor immediately.

Transport accidents must also be reported to the consignor immediately.

7.7.7 Emergency Procedure

If emergency action needs to be taken by drivers when leaks, spills or fire occur during transport, then the instructions given in the "Instructions in writing" must be followed. See appendix 11.

Note that the European Acrylonitrile producers cooperate to assist in emergency situations.

7.8 Acrylonitrile transport by rail

7.8.1

Acrylonitrile railway transport is under "RID" regulations or national regulations which are obligatory and must be met in all countries. As Acrylonitrile is classified as a high hazard chemical, all involved parties in the transport must apply to RID 1.10 and must have a security plan. All involved personell must be trained accordingly.

7.8.2

The appropriate railway authorities are responsible for the safe transport of Acrylonitrile by rail from the dispatch siding to the 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 or the railway company owning the rail network.

7.8.3

The appropriate railway authorities will normally intervene in the event of a transport emergency involving Acrylonitrile Rail Tank Cars. Railway authorities must be made aware of the information contained in these guidelines as an aid for railway hazardous cargo intervention teams.

7.8.4

“Piggyback” transport is not allowed.

7.8.5 Emergency Procedure

In the event of derailment, leak, or other problem involving rail tank cars of Acrylonitrile the railway personnel must inform the consignor immediately. In addition under the ICE scheme, the National Emergency Centre for the country in which the accident has occurred must be contacted.

7.9 Acrylonitrile transport by water

7.9.1

Transport of Acrylonitrile by sea is generally made by cargo chemical ships. Acrylonitrile sea transport is under “IMDG and / or IMO regulations”, which are standard and adopted by all major countries that transport dangerous goods by sea.

7.9.2

Because of the nature of the activity, a number of different parties may be involved in the operation of sea transportation from consignor to customer.

These may include the:

- Shipping Company
- Port or harbour authorities
- Surveyors
- Hauliers (road or rail)
- Chemical terminal storage company

All these parties are involved in both loading and unloading the product.

7.9.3

Prior to the commencement of each new delivery plan, a safety audit of critical aspects of the transport operation should be carried out by the consignor as recommended.

This audit may include, as appropriate:

- a) The shipping company (type and technical information about the chemical cargo tanker).
- b) Loading/Unloading and storage facilities at the chemical terminals at the port.
- c) Emergency handling procedures within hazardous cargo yards at the chemical terminals.
- d) Responsibility for emergency response arrangements between consignor and customer.

7.9.4

If transshipment of the product is part of the logistics chain it must take place under following the local, national and international regulations and company specific requirements. (e.g. Ship to Ship Transfer Guide which is a collaboration between OCIMF, SIGTTO and CDI).

Company specific requirements which needs to follow in addition to the above mentioned are given by the consignor or producer.

7.10 Personal safety equipment

7.10.1

In all situations where exposure to Acrylonitrile liquid and/or vapour is possible, adequate personal protection must be worn and be available. The number of each item needed depends on the number of people, the area, and the number of floors in the Acrylonitrile handling area. This protective equipment must be readily accessible in all handling areas. More detailed information is indicated in Chapter 6.

7.10.2 Safety equipment kit

Road tankers and vehicles conveying tank containers must be equipped with safety equipment which, as a minimum, must include:

- Safety goggles
- Butyl rubber gloves
- Suitable respiratory protective device (in the case of canister respirators, canisters must be used only once, and then discarded)
- Fire extinguishers
- Two reflecting cones/triangles or orange flash lights
- Fluorescent garment
- Torch
- Wheel blocks (one per vehicle) of a size suited to the weight of the vehicle and to the diameter of the wheels

The requirements for the safety kit are regulated by the ADR.

7.11 Product training for road tanker and tank container drivers

7.11.1

The ADR agreement requires that all drivers of road tankers or tank containers 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. Drivers of vehicles carrying Acrylonitrile in drums should also have undertaken similar training.

7.11.2

However, the hazards associated with Acrylonitrile are such that drivers must be specifically trained by the producer and/or an designee who is approved by producer / cosignor, to understand the particular nature of the dangers which may arise during transportation of this product and the action to be taken in an emergency situation.

7.11.3

All consignors of Acrylonitrile must undertake the responsibility for ensuring that specific product training for Acrylonitrile is provided to drivers.

Upon successful completion of training, drivers must be provided with a certificate, valid for two years, indicating the nature, duration and location of the course.

7.11.4

A driver who has been trained to ADR standards and who has been provided with specific training by another member of the Cefic AN Sector Group, to the standard required by appendix 10, may be regarded as suitably trained to carry Acrylonitrile.

7.12 Safety auditing of road hauliers

7.12.1

Acrylonitrile producers use the services of professional 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. Contractual arrangements with hauliers must explicitly provide that the transport is only sub-contracted with the approval of the consignor.

7.12.2

A checklist for routine inspection of tankers/containers at loading terminals is given in appendix 5.

7.12.3

These reviews do not replace or diminish the haulier's responsibility to ensure that the equipment meets the appropriate safety standards and is properly maintained.



8 Storage

The storage and handling of Acrylonitrile is subject to legislative controls in many countries. The design and construction of storage for Acrylonitrile must therefore comply with these controls.

The general guidelines contained in appendix 4 exemplifies the best general practice which is followed within the Acrylonitrile manufacturing industry and must be used provided it does not conflict with any specific legal obligations.

8.1 Safety auditing of bulk storage terminals

If bulk storage of Acrylonitrile is done by third party companies, the product owner is advised to check that the terminal owner has been audited on a regular basis, e.g. by CDI-T (Chemical Distribution Institute Terminals).

A review meeting Producer / Tankfarm Operator is required after each new CDI-T assessment.

These recommendations also apply to temporary used Storage Facilities.

8.2 General considerations

The following important points need to be included in standards related to storage operations with Acrylonitrile:

- Operations shall be planned to avoid loss of containment during both normal operations and maintenance work. Adequate equipment and instructions shall be provided for specific operations to ensure that this is achieved.

Gas detections in the tank bund are recommended:

- Acrylonitrile must be stored in tanks with due regard to other materials stored in the vicinity (Precautions must be taken against mixing with alkaline or acidic materials).
See attachments 1 and 2 to appendix 3.
- Particular attention must be paid to equipment cleaning and repair.
- To avoid dangerous polymerisation, the Acrylonitrile storage tanks must be monitored for:
 - Liquid temperatures
 - Inhibitor content
 - Colour

For other considerations concerning Acrylonitrile storage tanks installations, see appendix 7.

8.3 Storage and Handling of Acrylonitrile

- Acrylonitrile must be properly stored and handled to avoid polymerisation and discolouration which are the primary indicators of poor storage.
- Acrylonitrile in static storage must be analyzed regularly for quality, colour, appearance, inhibitor content and water content.
Sampling more frequently than weekly may be required if abnormal storage conditions develop.

Store Acrylonitrile only in clean, dedicated storage tanks.

8.3.1 Polymer Formation

- For polymerization hazards of Acrylonitrile see Chapter 3.
- Polymer formation during the storage of Acrylonitrile can occur as a result of:
 - Low inhibitor concentrations, including water.
 - Presence of contaminants which can act as polymerisation initiators.
 - High ambient temperature which may also contribute to polymer formation.
 - When monomer vaporises and then condenses in cooler parts of the storage container or vessel, the condensed monomer is essentially uninhibited and is at greater risk of polymer formation than the main volume of Acrylonitrile.

In order to minimise polymer formation, the following countermeasures must be taken:

- Store Acrylonitrile only in clean, dedicated containers or vessels
- Avoid storage times of more than 6 months.
- Recirculate Acrylonitrile through lines and pumps to prevent stagnation.
- During storage, test the pH, the inhibitor and water content and restore to the normal levels if required.
- A minimal content of oxygen is required to guarantee the effectiveness of the stabiliser MEHQ.
Storage under stripping conditions resulting in removal of the oxygen content has to be avoided.
- If stored without proper stabilisation, spontaneous polymerisation could start, detectable by turbidity, cloudiness and rising APHA (Hazen) numbers.

8.3.2 Colour Formation

- Acrylonitrile in storage can develop colour which can be carried into polymer end product. Colour formation is usually the first sign that storage problems are developing.
- Colour formation in storage can be minimized by the following steps:
 - Do not use copper or copper alloys in any part of the storage and handling system
 - Control the temperature of tank contents.
 - Avoid storage times of more than 6 months.
 - Recirculate Acrylonitrile through lines and pumps to prevent stagnation.
 - If colour is formed, it can be reduced by reprocessing.

8.4 Preparation of Tanks and Equipment for Cleaning and Repairs

8.4.1 Maintenance Practices in Preparation of Tanks and Equipment

- When cleaning or repairing pumps, piping, vessels, etc. used for Acrylonitrile service, all standard safety practices applicable to toxic, volatile flammable hydrocarbons must be followed.
- Tank and equipment cleaning must be under the direction of thoroughly trained personnel who are fully familiar with all of the hazards and the safeguards necessary for the safe performance of their work.
- When isolating pipelines, for whatever reason, line blinds or other safe means of disconnection must be used.
- Tanks, pumps, lines and valves must always be drained and thoroughly flushed with water or steam. Liquid or vapour discharges must be released in such a way as to avoid personnel exposure.
- The vaporised Acrylonitrile in the steam effluent must not be of sufficient concentration to contaminate the work area in excess of safe limits.
- If pipe sections are to be removed and flanges opened, the lower bolts on the side away from the craftsman must be loosened first and care must be taken to avoid personal contact with the liquid draining or dripping from the equipment. The system must be emptied as far as possible and depressurised before the line opening procedure is started.
- Lock electrical switches and take all necessary precautions to prevent accidental starting of any electrically operated moving part in or near the equipment.
- Working in accordance with LOTOTO (lock out, tag out, try out) procedure is recommended.

8.4.2 Entering the tank

- No one must enter a tank or confined space until proper testing has been done and a work/entrance permit issued.
- Vessels must be free of sludge or other visible deposits before personnel entry, normally by washing.
- Equipment must be isolated from surrounding pipes and equipment (e.g. by line blinds) before entering.
- After the decontamination is complete, continue to provide adequate ventilation to ensure that the vapour concentration in the equipment remains below 10 % of the Lower Explosion Limit of Acrylonitrile in air.
- The tank must not be entered if the Acrylonitrile concentration is higher than the national exposure limit.
- Check the Acrylonitrile concentration regularly in the vapour space. Ensure that the samples are representative of the concentration at the points where the work is to be carried out. If complete decontamination is not possible and Acrylonitrile concentrations are measurable, respiratory protection is needed for entry.

NOTE : Acrylonitrile vapours may be released from deposits and surface deposits which are disturbed by the work activity or inspection. In this case, a positive pressure breathing apparatus is mandatory.

Regular checks on oxygen and Acrylonitrile concentrations should be conducted during the work.

- If personnel are to enter, provide ventilation to ensure an adequate supply of fresh air within the vessel (20 - 21 % oxygen).
- One man on the outside of the tank must keep the men in the tank under observation to raise the alarm and initiate rescue procedure if any of the men in the tank are overcome. Under no circumstances must the stand-by man enter the tank.
- In all cases, if repair work is interrupted, the tank atmosphere must be checked again and a new work permit issued before resumption of work.
- Under no circumstance must a rescuer enter a tank to remove a victim of overexposure without proper respiratory protection, a safety harness and an attached life line.
Another attendant must be immediately available to assist in the rescue, if needed.

8.4.3 Exterior Repair Work

- Exterior tank repairs, including cutting, riveting, welding, and mechanical brushing before painting, must be permitted only after thorough cleaning and testing of the tank to make sure it is free of vapour and after a work permit has been issued by an authorized person. Repeated tests with a continuously oxygen monitoring device must be made to fully protect the workmen.
- Filling a clean empty tank with water or inert gas is a method which may be used for outside welding or hot works.
- Solid (polymer) deposits on the walls of the tank or vessel can release Acrylonitrile or organic flammable vapours during the hot work and result in a high content of flammable materials inside the tank with the risk of a serious explosion.

8.5 Sampling and Analytical Techniques

The quality of Acrylonitrile in storage can be determined by analysis of representative samples for some key parameters: appearance, solution pH, colour, water and inhibitor content, etc. The following must be noted:

- All necessary safety precautions must be observed in handling Acrylonitrile to avoid personal exposure. Closed sampling systems are recommended.
- Clean, dry, unbreakable Acrylonitrile-resistant bottles must be used for sample collection, e.g. polyethylene, polypropylene, aluminium or plastic coated amber-coloured glass. Exposure to sunlight must be avoided.
- Care must be taken to prevent the build up of static electricity.

Additionally for larger samples (liters):

- Keep the velocity low, eg less than 1m/s
- Use dip pipes, free from rough edges
- Make an earth connection

Installation of an earth proving unit is recommended.



9 Emergency response

9.1 Alarm system and emergency plan

When Acrylonitrile is stored in a certain quantity (check local legislation) a suitable alarm system is necessary such that in case of any serious leakage and/or fire of Acrylonitrile all persons involved may be warned. In consultation with the local authorities, an emergency plan must be developed; setting out appropriate actions in the case of leakage and / or fire. Also consideration should be given to the surrounding population.

A part of the emergency plan considers the evacuation of (parts of) the plant, the neighbouring plants and people in further surroundings to minimize exposure in case of an Acrylonitrile vapour cloud.

9.2 Assistance scheme in respect of transport incidents

In case of an emergency please contact one of the member companies listed in appendix 12.

9.3 Measures in the event of release of Acrylonitrile

For personal means of protection see section 5.

In the event of Acrylonitrile being discharged, it is important to restrict the evaporating area as much as possible. Evaporation and hence the formation of a toxic and explosive gas cloud can be prevented by a foam blanket. The released liquid must then be moved to sealable tanks or drums. Any remaining quantities of Acrylonitrile must be removed with a suitable absorbent and transported in closed drums to a suitable processing installation.

Any leaking drum must be turned around so that the leak is at the top, thus preventing any liquid from being released. Where the leak cannot be sealed on the spot, the leaking drum must be put into an oversized drum (salvage drum).

In order to ensure that the case of small leaks dangers can be kept to a minimum during transport of Acrylonitrile, a suitable collecting drum (possibly flexible - plastic) must be available.

9.4 Fire-fighting

See appendix 4 paragraph 8 for fire prevention considerations.

For personal protection see Section 5. For fire-fighting operations, it may be necessary to combine the protection mentioned with heat-proof clothing. When Acrylonitrile catches fire or explodes, water vapour, carbon dioxide, nitrogen oxides and nitrogen are formed, and, if combustion is incomplete carbon monoxide and hydrocyanic acid in addition. In the event of heating and contact with basic substances, hydrocyanic gas can also be formed.

Acrylonitrile vapour represents a higher hazard than the combustion products. It is therefore advisable, if the fire cannot be quickly brought under control and the subsequently heated Acrylonitrile leaking out cannot be covered with foam, to let this liquid burn.

In case of a fire in the vicinity of an Acrylonitrile storage, the fire-fighting procedure needs to be carried out in such a way that the fire cannot spread. Use a water screen to protect the Acrylonitrile containing equipment and cool the equipment containing Acrylonitrile with water.

Small Acrylonitrile fires can be extinguished with CO₂ or extinguishing powder. For extinguishing Acrylonitrile fires, special knowledge of fire-fighting means and methods is necessary, which can be obtained from the manufacturers.

10 List of acronyms / abbreviations

ADR	Accord européen relatif au transport des marchandises dangereuses par route
ADNR	Accord européen relatif au transport des marchandises dangereuses par voie de navigation intérieure
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ATEX	Appareils destinés à être utilisés en ATmosphères EXplosibles
BCH	Sub-Committee on Bulk Chemical
BTX	Benzene, Toluene, Xylene
CAF	Compressed asbestos fibre
CAS	Chemical Abstract System
CDI	Chemical Distribution Institute
Cefic	Conseil Européen de l'Industrie Chimique
CEN	Comité Européen de Normalisation
DEG	Di ethylene glycol
(4-) DMAP	4-Dimethylaminophenol
EBIS	European Barge Inspection Scheme
EU	European Union
EINECS	European Inventory of Existing Commercial Chemical Substances
EmS	Emergency procedures of ships carrying dangerous goods
IARC	International Agency for Research on Cancer
IATA	International Air Transport Association
IBC	Intermediate bulk container
IMDG	International Maritime Dangerous Goods
IMO	International Maritime Organization
ISO	International Standards Organization
LC50	Lethal concentration (50%)
LD50	Lethal dose (50%)
MEG	Mono ethylene glycol
MeHQ	Monomethyl ether Hydroquinone

MEK	Methyl ethyl ketone
MEL	Maximum exposition limit
MFAG	Medical First Aid Guide for use in Accidents involving dangerous goods
MTBE	Methyl ter butyl ether
NBR	Nitrile-(butadiene)-rubber
OSHA	Occupational Safety and Health Administration (USA)
PTFE	Poly tetra fluorethylene
PVC	Poly vinyl chloride
RID	Règlement International concernant le transport de marchandises dangereuses par chemin de fer
RTC	Rail Tank Car
RTECS	Registry of Toxic Effects of Chemical Substances
SBR	Styrene-butadiene-rubber
TEG	Tri ethylene glycol
TRK	Technische Richtkonzentration
UN	United Nations
VLE	Valeurs limites d'exposition
VME	Valeurs limites de moyennes d'exposition

Appendix 1 Design and construction of rail tank cars (RTC's)

(Design must follow current RID or national regulations). The following are guidelines drawn from RID regulations with specific comments for Acrylonitrile application.

1 Construction

1.1

Tanks may be constructed in either stainless steel or carbon steel.
Carbon steel tanks must be rendered free from loose rust.

1.2

Tank fittings and attachments in contact with Acrylonitrile must also be of the above materials, and not contain copper or alloys of copper.

2 Tank construction

Tanks must be constructed in accordance to RID or TSI regulations.

3 Equipment

3.1 Manholes

For inspection purposes the tank must be fitted with at least one manhole of not less than 500 mm diameter, which shall be located away from any main seam in the tank shell. Man lids must be of the flat bolted type.

3.2 Pressure/vacuum Relief

3.2.1

RID regulation does not allow any pressure and / or vacuum release valves.

3.3 Filling/Discharge and Vapour Return Fittings

3.3.1

All openings in the tank shell must be above the surface level of the liquid. No pipes or pipe connections must pass through the walls of the shell below the surface level of the liquid.

3.3.2

The filling/discharge and vapour return connections must be on top of the tank. The liquid and vapour outlets must be equipped with a dry disconnect coupling in accordance to NATO STANAG 3756 and an approved pressure cap or another closing device.

Selectivity coded couplings for Acrylonitrile do exist and are highly recommended.

For further information contact your supplier

The recommended dimensions of the top connections are:

Liquid phase (dip tube):	DN 80
Vapour return:	DN 50

These connections must be marked with colour codes:

Red for liquid
Blue for vapour

In addition, the names 'dip tube' and 'vapour return' (or 'pressure connection') must be marked in German/French or English.

3.3.3

The filling/discharge pipe must reach as close as practicable to the bottom of the carrying tank. It should be supported so as to prevent any vibrations caused by the movement of the vehicle.

3.3.4

The vapour return connection must be used for vapour return during tank filling operations. It is also used to empty the tank by pressure using an inert gas. The railcar must be depressurised and securely closed before being returned.

3.3.5

Filling/discharge and vapour return connections must be provided with means to prevent unauthorised access. A tamper proof cap covering all top connections must be fitted.

3.4

The permanent fitting of thermometers and pressure gauges is not recommended.

4 Walkways

4.1

At least one walkway of 'safety grating' construction must be provided on top of the tank to give access to the equipment and fittings. Walkway must be reached by an open rung access ladder. The platform must fully cover the work place around the connections.

5 Chassis

5.1

Tank shells welded over the full length to external under frames must be excluded from the transport of Acrylonitrile.

5.2

At least one earthing connection must be provided on each side of the RTC.

5.3

In accordance with the RID regulations RTCs must be equipped with shock absorbing buffers ("crash buffers").

6 Hazard Warning Labels

Hazard warning labels must be provided in accordance with RID regulations.

7 Initial Inspection, Testing and Certification

7.1

The tank and fittings must be inspected, tested and certified by an inspection authority approved by the Company, in accordance with the national regulations.

7.2

Inspection and testing must comply with the design code and must include a check on the design characteristics and workmanship, an internal and external examination and a hydraulic pressure test at a gauge pressure of not less than 4 bar.

7.3

The main seams of the tank shell must be subjected to 10 % radiography.

8 Marking

Tanks must be fitted with a corrosion resistant metal plate permanently attached to the tank. The plate must be marked in accordance with national regulations and with the additional information below if not already required:

- a) The date of manufacture of the tank
- b) The working or net capacity of the tank
- c) The water or gross capacity of the tank
- d) The design temperature range
- e) The design and test pressures
- f) Approved by:

Appendix 2 Design and construction of road tankers and tank containers

1 Materials of Construction

1.1

Tanks must be constructed of stainless steel.

1.2

Tank fittings and attachments in contact with Acrylonitrile must be of the above material, and must not contain copper or alloys of copper.

2 Tank Construction

2.1

The maximum width of the tank and its fittings must be such that it does not project beyond the overall width of the vehicle.

2.2

The tank must be circular cross-section and the thickness of the tank shell must be designed for a pressure of not less than 10 bar g.

The tank must be able to withstand a hydraulic pressure of not less than 4 bar g.

For unprotected tanks, the tank shell thickness shall in no case be less than the minimum thickness shown below for stainless steel for example:

Stainless steel Type 304

MINIMUM SHELL THICKNESS	
TANKS 1.8 M DIAM AND BELOW	TANKS ABOVE 1.8 M DIAM
4 mm	4.75 mm

For protected tanks, where purpose-built tank protection is provided, consideration may be given to reducing the minimum shell thickness stated above.

2.3

The tank, its supports and fastenings to the vehicle must be capable of withstanding the effects of inertia of the contents due to the vehicle motion.

2.4

Where baffle plates are fitted to reduce liquid surge, adequate venting and draining facilities must be provided in the baffles. Baffle openings must not be less than 500 mm diameter to permit access through the baffles. These openings must be staggered in location along the tank. Baffle plates must be of the same material as and no less thick as the tank shell.

2.5

The manufacture and workmanship of the tank shell shall be to ASME Code Section VIII Division 1 or BS5500, or to an equivalent pressure vessel code which is approved by the Company.

2.6

All load bearing attachments must have backing plates (double plates) of a material and thickness similar to the tank shell. Corners of backing plates must be well rounded. Where backing plates cross main weld seams, they must be stopped 25 mm each side of the weld.

3 Equipment

3.1 Manholes

3.1.1

The tank must be fitted with at least one manhole of not less than 500 mm diameter. This must be of as low a profile as possible and located away from any weld seam in the tank shell.

3.1.2

Man lids must be in stainless steel or compatible with the tank material and of the flat bolted type.

3.1.3

The man lid must be fitted with an asbestos free gaskets.

3.2 Pressure Relief

3.2.1

Where the installation of pressure relief valves is permitted by the European country in which the road tanker is to be used, the tank must be fitted with one or more pressure relief valves of the spring loaded type. Pressure relief valves must be preceded by a bursting disc and the space between valve and disc fitted with a pressure gauge for checking the integrity of the disc. The bursting disc must have direct access to the vapour space of the tank. The materials of these devices must be similar to that of the tank shell.

3.2.2

The discharge from pressure relief valves must be so arranged that any escaping vapour cannot impinge directly on the tank shell.

3.2.3

The size of the pressure relief valve(s) must be determined in accordance with API 520, the appropriate DIN method or an equivalent which is approved by the Company.

They must be designed and constructed so that in the case of total fire engulfment, the pressure inside the tank does not exceed the hydraulic test pressure of 4 bar g.

Relief valves must be designed in accordance to ADR/RID/IMDG regulations

3.3 Filling / Discharge and Vapour Return Connections

3.3.1

All openings in the tank shell must be above the surface level of the liquid. No pipes or pipe connections must pass through the walls of the shell below the surface level of the liquid.

3.3.2

Dry disconnect couplings in accordance to NATO STANAG 3756 must be used in combination with a valve as first closure.

It is highly recommended to use selectivity coded couplings for safety reasons..

For current information on the recommended type of 'DRY DISCONNECT COUPLING', contact your supplier.

3.3.3

The filling/discharge pipe must be 80 mm diameter and reach as close as practicable to the bottom of the tank.

3.3.4

It is strongly recommended to empty the transport equipment by pump. Use of a self-priming pump is strongly recommended. If a slight overpressure is needed an inert gas must be used.

Tank containers or Road tankers must be depressurised and all openings must be properly closed before being returned.

4 Walkways (not for tank containers)

4.1

At least one walkway of 'safety grating' construction must be provided on top of the tank to give access to the equipment and fittings. The walkway must be fitted with a collapsible handrail (or other equivalent means of protection on the loading/unloading station). In case road tanker access is available from ground level, the walkway must be reached by an open rung access ladder. The platform must fully cover the workplace around the connections.

4.2

Walkway supports must be attached to the tank shell through the backing plates of the same thickness and material as the shell.

5 Vehicle Rear-End Protection (for road tankers)

Rear end protection must be provided as required by ADR regulations. The rear bumper bar and under-run protection must extend at least 300 mm beyond the end of the tank.

6 Earthing Connections

Earthing connections must 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 loading or unloading of a vehicle. Connections must be provided at each end of the tank and also adjacent to the discharge point.

7 Fire Extinguisher

A suitable fire extinguisher must be provided, mounted on the chassis.

8 Hazard Warning Label Holders

Appropriate hazard warning label holders must be provided.

9 Side Guards

Side guards must be provided where they are stipulated in ADR regulations.

10 Initial Inspection, Testing and Certification

The tank and fittings must be inspected, tested and certified by an inspection authority approved by the Company in accordance with ADR regulations.

11 Tank Containers

Tank containers for Acrylonitrile must be full framed design meeting IMO Type 1 or ADR / RID requirements for transport by road and rail.

Appendix 3 Design and construction of tank ships and barges

1 Materials of Construction

Tanks of ships and barges must be constructed in accordance to IMO and ADN regulations. Cargo tank coatings are limited to Stainless Steel, Zinc and Marine Line.

Marine Line coating, however, can not be approved if there are cracks or abnormalities in the lining.

2 Tank Construction

2.1

Among the guidelines laid down in the above regulations and codes are the following requirements:

- a) Vessels containing tanks must be double skinned
- b) There must be spacing between hull and the inner tank wall
- c) Tanks must have individual manifolds and pumps to avoid cross contamination of product
- d) Tanks must have a separate venting facility
- e) Tanks must be capable of being internally circulated
- f) Tanks must be capable of being ventilated.

2.2

AND regulations require C-type (double-hulled) barges for transport of Acrylonitrile on inland waterways.

2.3

A nitrogen purging facility on the vessel is recommended.

3 Cargo Separation for Safety Purposes

3.1

Cargo which reacts in the hazardous manner with Acrylonitrile must be separated by means of a void space, pump room; empty tank or a mutually compatible cargo. (See attachment 1)

3.2

Tanks containing Acrylonitrile must have separate pumping and piping systems which must not pass through other cargo tanks containing such incompatible cargoes and have separate vent system.

3.3

Cargo piping must not pass through any accommodation or machinery space, other than pump room.

3.4

Acrylonitrile is a heat sensitive product and must remain segregated from other products carried at temperatures in excess of 30 °C.

3.5

Heating coils in tanks carrying Acrylonitrile must be blanked off.

3.6

Edible products must never be loaded with bulkhead to bulkhead contact with Acrylonitrile and piping systems must be entirely separate.

3.7

The procedure for determining the compatibility of Acrylonitrile with other products is outlined in attachment 1. It is based on information extracted from Title 46 of the United States Code of Federal Regulations.

3.8

In addition to item 3.7, consideration must be given to the previous cargo compatibility guide given in attachment 2.

4 Inspection of ships and barges

Inspection of ships and barges to assess fitness for Acrylonitrile must be done by a knowledgeable person and/or by a marine surveyor. The following schemes are recommended:

- EBIS (European Barge Inspection Scheme) for barges.
- CDI-M (Chemical Distribution Institute Marine).

Before chartering any ship or barge for loading Acrylonitrile, the ship/barge must be vetted to ensure that it has been inspected and meets an acceptable safety standard.

Attachment 1 to Appendix 3

Prior cargos

In general, dedicated tanks are preferable to carry loads of Acrylonitrile. However, loading can be done assuming proper precautions are met, including:

- Only acceptable previous cargo was in the storage vessel;
- No unacceptable previous cargo was in the storage vessel (Exceptions maybe allowed after following an science based and approved cleaning and testing process accepted by the manufacturer);
- The vessel, lines, etc. have been properly cleaned and dried.

Manufacturers have lists of acceptable and unacceptable previous cargo as well as information about science based cleaning and testing methodes. Please contact your supplier for detailed information.

As a general principle Acrylonitrile must not be loaded when the prior cargo was :

- Bromine
- Ammonia
- Amines
- Copper and copper alloys
- Strong acids
- Strong bases
- Peroxides or other free radical initiators.

Exceptions from the above are possible. Manufacturers may have approved science based cleaning and testing methods to assure that Acrylonitrile is allowed to be loaded behind the mentioned groups of chemicals.

Appendix 4 Design and construction of storage tanks

NOTE: local regulations must also be followed

1 Location of storage tanks

1.1

The arrangement and grouping of storage tanks must take into account access for:

- a) Normal operation
- b) Emergency evacuation
- c) Fire fighting

1.2

The design of the tank farm must take account of the likely consequences of any accidental spillage or fire. Products which react chemically with Acrylonitrile must be kept in totally segregated storage.

1.3

Storage tanks should be located at ground level and in the open air so that must a leak occur, it is more likely to be detected and any vapour emissions will be dispersed by natural ventilation.

Acrylonitrile Storage tanks below ground surface are not recommended because vapours are heavier than air.

1.4

Storage tanks must be located in a well ventilated position away from potential sources of ignition or so as to minimise the effect of radiation from any fire which could possibly occur in any adjacent area.

1.5

All tanks must be surrounded by a bund wall capable of containing 110 % of the capacity of the largest tank within the bund. The walls and floor of the bund should be impervious to liquid and designed to withstand a full hydrostatic head. Bund walls should not be higher than 1.5 metres to ensure adequate natural ventilation of the bunded areas, ready access for fire fighting, and good means of escape in any emergency situation.

1.6

Intermediate lower bund walls are recommended to divide tanks into groups to contain any accidental leakage and to minimise the surface area of any spillage.

1.7

The floor of the bund must be sloped to prevent minor spillages remaining below any tank. Provision must be made for the removal or drainage of surface water from the area within the bund. Preferably, surface water must be pumped out of bunds. If bund drains are used, they must be provided with valves outside the bund walls, with procedures in force to ensure these valves remain closed, and preferably locked, except when drainings are being removed. Acrylonitrile contaminated drainings must be pumped to suitable effluent treatment or recovery system.

1.8

No combustible material, or full or empty drums must be stored in the bund or against the bund wall.

1.9

Under normal conditions storage tank must not vent to the atmosphere..

2 Tank Construction

Acrylonitrile must be handled in closed system.

2.1

The storage tank must be of adequate strength and capacity for the proposed duty. It must be sited on an impervious base and surrounded by a bund of adequate size and strength. The tank and its supports must be designed and constructed in accordance with an appropriate nationally recognised standard of good engineering practice.

2.2

Storage tanks must be the smallest compatible with shipping and receiving requirements. Storage times in excess of six months must be avoided to minimise degradation of Acrylonitrile quality.

2.3

Stainless steel, carbon steel or aluminium alloys (with magnesium) are recommended.

No copper or material containing alloys of copper must contact liquid Acrylonitrile, since copper can discolour the Acrylonitrile and has been known to cause problems with polymerisation in some applications.

2.4

Carbon steel tanks must be cleaned, either by chemical or physical means, before initial use to remove rust. If the tank is cleaned by chemical means, further cleaning with water according to a written procedure is mandatory in order to prevent a potential incident resulting from a chemical reaction. Be aware of potential Acrylonitrile release from rust particles and /or the tank surface, after cleaning.

2.5

The use of a multi-compartmented tank are not allowed because of the risk of product contamination or heating from adjacent compartments.

2.6

Acrylonitrile storage tanks do not require insulation or refrigeration. White paint must be considered for outside storage tank exterior surface, to minimise temperature rise.

2.7

Agitation of storage tanks on production units is recommended both for uniformity of sampling and for the addition of inhibitors. Agitation is best achieved by recirculating pumps.

2.8

A manhole of minimum 500 mm must be provided on all tanks to allow for internal inspection and cleaning.

2.9

Design of new storage tanks must be based on full draining concept, sloped to outlet with no trapped areas.

2.10

An earthing point must be fitted on the tank and connected to a good earth.

2.11

Acrylonitrile must be stored under a nitrogen blanket in order to avoid explosive vapour mixtures. Nitrogen blanketing substantially reduces the potential for flammability of vapors above the surface of liquid Acrylonitrile. The oxygen level should be purged to below 8 percent. Although the MEHQ and water inhibitor system will remain effective well below 8 percent oxygen in the vapor space.

2.12

Acrylonitrile must be handled in closed system.

2.13

A pressure/vacuum vent valve must be provided at the top of the tank. The vent must terminate in a safe place away from sources of ignition and from occupied areas, passageways or sheltered space where vapour could accumulate. Free circulation of air around this vent is essential to disperse vapours.

3 Level and temperature measurement

3.1

Storage tanks must be provided with a suitable means of determining both the liquid level and temperature in the tank, without the necessity of opening a gauge hatch which would involve personnel exposure to Acrylonitrile.

3.2

A high level switch must be installed to prevent overfilling. This must be independent from the level indicator and must, as a minimum, activate a valve in the feed line in order to stop the product flow in case the high level setting is reached (normally 95 vol%).

4 Pipework

4.1

An example of the general layout of a loading facility is shown on attached diagram (Attachment 1 to appendix 4). Pipelines must normally be of the same material as the tank.

4.2

A tank discharge line must be provided which must be a minimum of 50 mm nominal bore. The line may be taken from the bottom or side of the tank and must be fitted with an isolating valve as close to the tank wall as possible. In all cases discharge must be by pump.

The pump and controls must be sited outside the bund.

4.3

A facility must be provided for draining the tank. This must be fitted from the lowest point on the tank and fitted with a suitable isolation valve and blanked off when not in use.

4.4

Wherever possible, continuously welded pipe work must be used. However, where pipe work may have to be disconnected for maintenance or inspection, flange joints must be fitted. Flanges must conform to recognize national Standards and Codes. Spiral wound gaskets with graphite filling are recommended. Screwed fittings must not be used except for stainless steel instrumentation.

4.5

On long pipelines, thermal relief valves should be fitted, the relief valve must vent to a safe location, e.g. the storage tank.

4.6

Pipe work must be routed to ensure that joints are not located over doorways, windows or close to possible sources of ignition and to minimise the possibility of accidental damage.

4.7

Fixed, dedicated loading/unloading arms of stainless steel are preferred to hoses. If hoses are used for loading or unloading operations, they must be Acrylonitrile - resistant lined armoured austenitic stainless steel flex hose or equivalent. Hoses must be inspected for wear or damage frequently and replaced as necessary. It is recommended that a hose testing programme is in place. Hoses must be tested at least every year. The test must comprise a hydraulic pressure test at 1.5 x the working pressure, an electrical continuity test and a visual inspection. Hoses must be properly marked.

5 Pumps

5.1

Pumps must be located outside tank bunds, on an impervious base, in an open space, and not in walled or confined spaces.

5.2

Centrifugal pumps are normally used for Acrylonitrile. Double mechanical seals or hermetic closed pumps (magnetic drive) may be used although the latter is preferred. The first one must be equipped with a water flush facility or nitrogen barrier fluid for environmental considerations.

5.3

Pumps must be constructed of either cast steel or stainless steel. Plastic pumps must not be used.

5.4

Pumps may be driven pneumatically, hydraulically or electrically.
Where electric motors are used to drive the pump, they must be explosion proof.

5.5

If pumps are remotely controlled, then a stop button must be provided at the pump and at the delivery point.

5.6

The capacity of pumps must be such that the linear velocity of the liquid being pumped does not exceed 7 m per second in the pipelines.

5.7

It must be noted that if centrifugal pumps are used, flow under gravity may occur when the pump is stopped.

5.8

Pumps used for unloading must be stopped automatically in the following cases:

- low flow (at end of unloading)
- high temperature of pump (when pump is running dry)
- high level in tank

In order to avoid accidental application of a vacuum (e.g. when vapour return line is blocked or nitrogen feed interrupted), a pressure switch in the suction of the pump, is recommended to stop the pump when the pressure in the line drops below atmospheric pressure.

6 Valves

6.1

Valves must be fitted directly on all bottom outlets of a tank unless these branches are blanked off.

6.2

Isolating valves may be ball or gate valves with PTFE seats. However local/national regulations might forbid PTFE in valves because of its low melting point. Angle or globe valves are also acceptable on Acrylonitrile service.

6.3

Diaphragm valves must not be used with Acrylonitrile.

6.4

Valve bonnets gaskets may be soft iron, spiral wound or equivalent.

7 Electrical Considerations

7.1

The selection, installation and maintenance of electrical equipment for use in hazardous areas are based on the area classification system which is accepted internationally.

7.2

The table attached (Attachment 2 to appendix 4) illustrates a typical hazardous area classification for storage tanks containing liquids with a flash point of less than 32 degrees C. It is therefore appropriate for operations involving Acrylonitrile.

7.3

Wherever possible the installation of electrical equipment must be confined to 'safe areas'. Where this is not possible, electrical equipment must be specified as safe for the appropriate zone.

7.4

Pumps, tanks, electric motors and all parts of the system must be effectively earthed to prevent the accumulation of static electrical charges.

7.5

Working areas, i.e., tanks stairs, platforms, loading and unloading points must be adequately illuminated for emergency response and security reasons.

8. Fire Prevention Considerations

8.1

Provision must be made to apply 'alcohol' type foam to storage tanks, in the event of a tank fire. Foams may be applied onto the liquid surface via an external foam 'riser' or via internal foam distributors.

Alkaline foams must not be used.

Water is not an effective fire extinguishing agent for Acrylonitrile although it may be used as a cooling agent on adjacent equipment.

8.2

External water coolant sprinkler systems should be installed where ambient temperatures can be high.

8.3

Tanks must be provided with safety relief systems which on high pressure relieve the tank vapour contents to a safe location. A vent scrubbing and flare relief system is both appropriate methods of disposal. Flame arrestors must be installed in the case of a flare system with regular inspection to check for possible polymer build-up.

Fig. 1a Tank for Acrylonitrile with road loading station

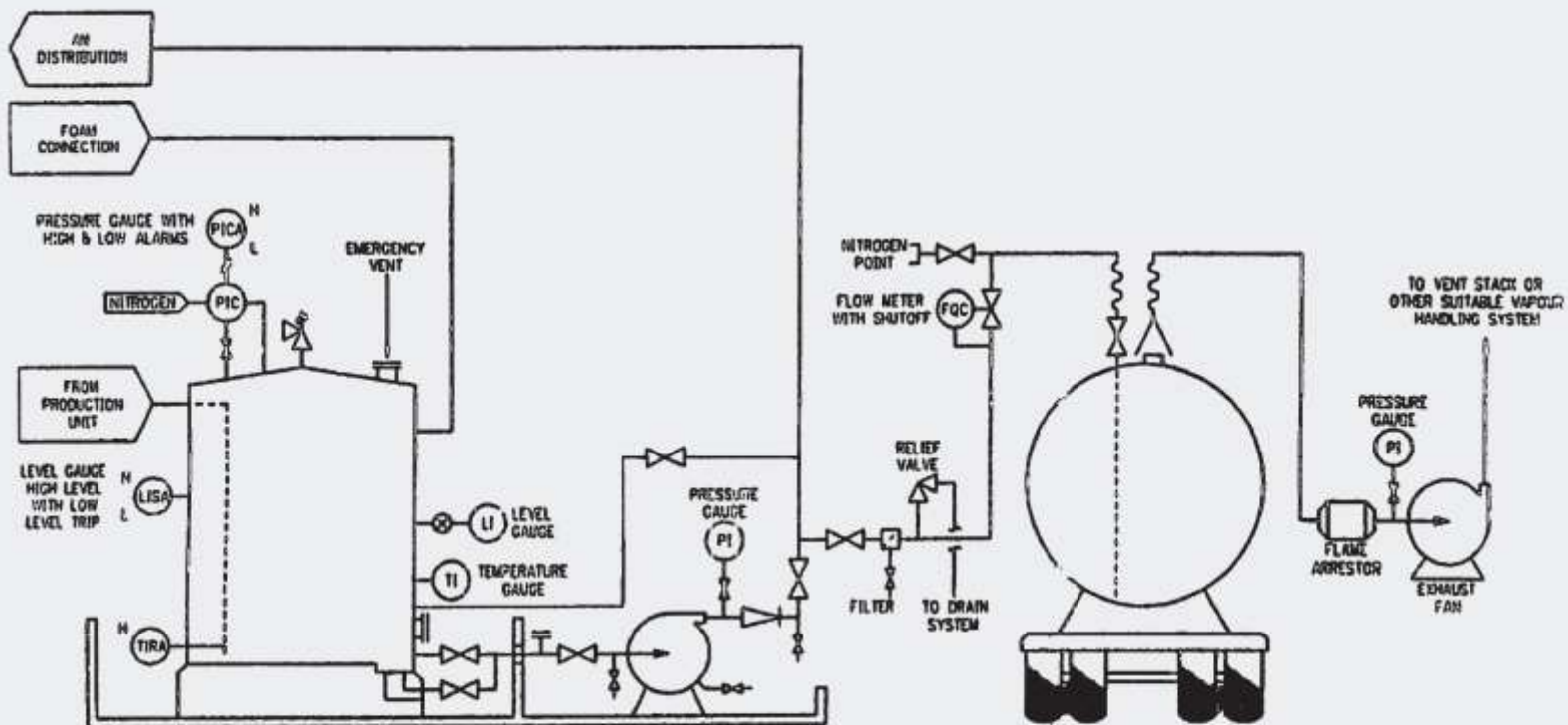
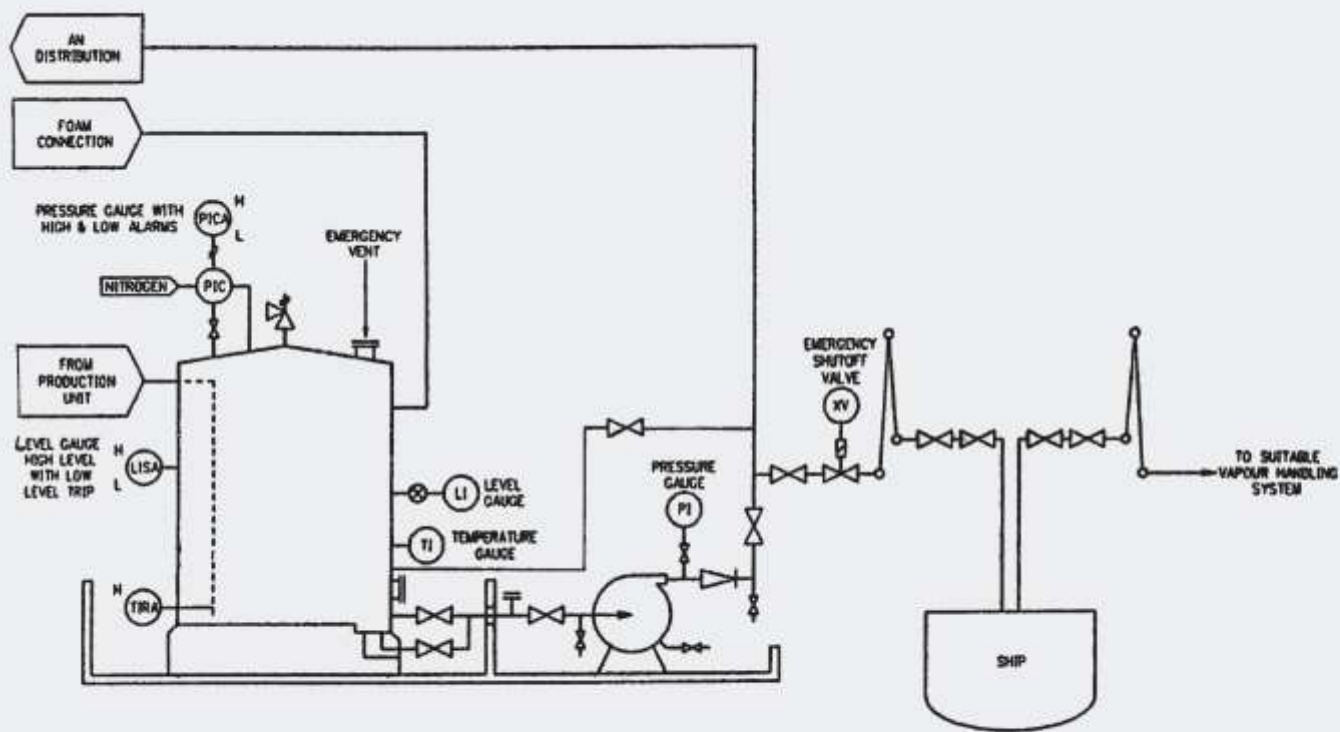


Fig. 1b Tank for Acrylonitrile with ship loading facility



ANY ALARM SITUATION TRIGGERS SYSTEM SHUTDOWN AND PURGE
SHIP'S TANK PRESSURE CONTROLLED AT 5 mBAR ATMOSPHERE

Attachment 2 to Appendix 4

Hazardous area classification for storage tanks containing liquids with a flash point of less than 32°C

For details please see ATEX regulations.

Appendix 5 Inspection loading list 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 safety deficiencies on the truck? (e.g. lights, tyres, windscreen, etc.).
2.	Is there a valid ADR-Certificate for Acrylonitrile for the tanker?
3.	Has the driver a valid ADR licence for the transport of dangerous substances and a valid ACN specific training certificate?
4.	Are all dangerous goods labels fitted with correct identification numbers (336/1093) attached and are the instructions in writing in the language the driver can read and understand on board?
5.	For combined ADR/IMO transport; are the IMO dangerous goods labels fitted?
6.	Does the driver have all the necessary items of protective clothing and safety equipment?
7.	Do you know the tare weight?
8.	Are all the valves closed upon arrival?
9.	Can all valves be operated?
10.	Is the tanker properly earthed?

B) WHILST LOADING

Monitor for leaks and spillages!

C) AFTER LOADING

1.	Is the maximum gross weight exceeded? (Check by weighbridge)
2.	Is the maximum level of filling exceeded? (Check by weighbridge) Maximum defined by ADR/RID as $\frac{95}{1 + X (50 \text{ tf})}$ Where X = cubic coefficient of expansion tf = filling temperature (°C)
3.	Are all valves closed with all bolts in place?
4.	Has the filling requirement of less than 20% or more than 80 % been reached for road tankers and tank containers without baffle plates?

2 Routine inspection of rail tank cars at loading terminals

Example of checklist which can be used for inspecting rail tank cars.
The checklist must be translated into the national language of the company.

1. IDENTIFICATION			
1.1	Number wagon:		
1.2	Wagon empty/loaded:		
1.3	RTC permitted for transport of AN ?:	YES	NO
1.4	Next hydraulical test:		
1.5	Last revision chassis:		
1.6	Test/revision not overdue?:	YES	NO

2. GENERAL CONDITION		YES	NO
2.1	Visual damage (board, chassis, appendages.....)		
2.2	Wagon marked with non conformity note Railways <ul style="list-style-type: none"> If yes: Which model of note Which defect/damage 		
2.3	Wagon and connections free from leakages/product remains		
2.4	General condition of wagon OK		

3. LABELLING/MARKING		YES	NO
3.1	Markings inscription board/chassis and barrel properly Readable		
3.2	Prescribed (RID)danger labels fitted (L/R)		
3.3	Prescribed (RID)danger board (danger code/product identification code 336/1093) fitted (L/R)		
3.4	Product name, 'Acrylonitrile' 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 atmospheric air etc...)(L/R)		

4.1	Visual damage/Defect of unloading/loading system on top	
4.2	All top valves closed/	
4.3	Dry Disconnect Coupling in good condition	
4.4	Top connections marked (colour code or name)	
4.5	Pressure cap in place and in good condition	

5. TA K EXTERIOR		YES	NO
5.1	No product remainders on top of tank (no odour)		
5.2	Walkway on top in proper condition and safely accessible		
5.3	Ladder in proper condition		

6. CHASSIS		YES	NO
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. LOAD WEIGHTS		YES	NO
7.1	Is the maximum gross weight not exceeded? (Check by weighbridge) - check against max loading categories		
7.2	Is the maximum degree of filling not exceeded? (Check by weighbridge) Maximum degree of defined by RID as $\frac{95}{1 + X (50 \text{ tf})}$ where X = cubic coefficient of expansion tf = filling temperature (°C)		

8. REMARKS
.....
.....
.....

Appendix 6 Inspection unloading list of transport equipment

The same Guidelines as in Appendix 5 must be used in the preparation of such a procedure, and in this section we made the consideration that we are discharging the Acrylonitrile at Customer's premises.

In addition to the points indicated in Appendix 5, the following points are to be noted:

1

The conditions of discharge at customer's premises are the customer's responsibility

2

Immediately upon arrival the driver must report to the Customer's Representative, who will be responsible for

- a) Positive identification of the product
- b) Identifying the discharge point
- c) Confirming that the installation can receive the load
- d) Connections to and operation of customer installation will be made by his own personnel under his responsibility

3

Depending on local legislation and / or Site requirements the driver should remain near the vehicle for emergency reasons. Driver should not stay in the vehicle during loading and unloading.

NOTE: If the transport equipment is connected, the emergency plan shall include the contents of this equipment.

4

The following point must be highlighted in the instructions

If any problems develop during discharging, the operation must be stopped and the tanker isolated preferably by shutting the external discharge valve(s).

5

Unloading checklist

An unloading checklist is highly recommended to prevent operator's errors.

Appendix 7 Safety scheme for reception and storage facilities at Acrylonitrile customer premises

1 Purpose

The purpose of this scheme is to ensure that a sufficient level of equipment is available and appropriate operating procedures are in place at customers premises to permit the safe unloading and storage of Acrylonitrile. The checklist must be used as for a self-audit by the customer. It can also be used as a guideline as part of the service of the supplying company (see chapter 4.2.6).

2 Scope

2.1

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

2.2

The principal objective is to ensure that the transfer of Acrylonitrile 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 scheme must also be used to:

- a) Assess and record any changes in policy, attitudes or equipment since the previous check.
- b) Obtain customer's comments on the transport operation and equipment being used.

3 Conduct of the scheme

3.1

The shown checklist in app 8 should be seen as an aid that all relevant items are considered.

3.2

The guidance notes (see appendix 9 attached) provide an explanation of the check-list, and recommended minimum standards in certain cases.

Appendix 8 Acrylonitrile unloading/storage checklist

CUSTOMER _____ DATE _____

ADDRESS _____

PERSONS INTERVIEWED _____

VISITED BY _____

1. THE UNLOADING AREA

1.1.	Ease of access
1.2.	Housekeeping
1.3.	Separation of other activities
1.4.	Ability to mobilise road tanker/rail wagons in case of emergency
1.5.	Facilities to isolate area and restrict access
1.6.	Water sprays
1.7.	Electrical classification
1.8.	Minimum safety distances must be 15 m. between the off-loading point and storage, ignition sources etc.
1.9.	Hoses/Loading arms
1.10.	Earthing point
1.11.	Protection against pipe damage
1.12.	Other vehicles and trucks movements
1.13.	Spillage control systems
1.14.	Hazard labelling of unloading points

2. THE UNLOADING PERSONNEL AND EQUIPMENT

2.1	The presence of customer's operator
2.2	Operator's experience, training and seniority
2.3	Deputy availability
2.4	Hose testing and renewal policy
2.5	Fixed loading arm testing and maintenance
2.6	Availability of suitable safety equipment
2.7	Communication system

3. THE UNLOADING OPERATIONS

3.1	Written procedures
3.2	Hose purging and leak testing
3.3	Sampling procedure
3.4	Atmospheric / personal Acrylonitrile monitoring
3.5	Method of unloading (N2 pressure, pump - pump preferred)
3.6	Safeguards for pump
3.7	Emergency response
3.8	Emergency stop

4. NITROGEN SUPPLY

4.1	Source of nitrogen
4.2	Check of nitrogen purity

5. THE STORAGE TANK

5.1	SITING <ul style="list-style-type: none"> • Bunded • Shared • If shared, with what? • Separation distances • Emergency disposal facilities
5.2	CONSTRUCTION <ul style="list-style-type: none"> • Construction materials • Insulated • Uninsulated • Refrigerated • Water Sprays • Earthed • Agitation • Blanketing • Fire protection • Internal coating tanks • Maximum pressure rating • Maximum allowed working pressure • Date and type of last test, inspection • Dip inlet pipe

5.3	RELIEF VALVES <ul style="list-style-type: none"> • Separate • Combined with interlock • Size • Venting to: (Stack, Scrubber, Other) • Flame arrestors • Nitrogen purge vents
5.4	INSTRUMENTATION <ul style="list-style-type: none"> • Nitrogen blanketing pressure • Control points: <ul style="list-style-type: none"> - Temperature - Pressure - Level • Are control and alarms independent?
5.5	MONITORING OF STORAGE <ul style="list-style-type: none"> • Temperature • Pressure • Level
5.6	PIPING
5.7	PUMPS
5.8	VALVES
5.9	GASKETS
5.10	HOSES

6. STORAGE TANK TO PROCESS

Precautions to prevent process streams contaminating storage vessels

7. PROCEDURES

There must be written procedure available for the following:

- Unloading Acrylonitrile
- Testing, inspection and maintenance of equipment
- Emergency procedures including the rapid use, transfer, dilution or venting of Acrylonitrile in the storage tank.

8. CUSTOMER'S COMMENTS

.....

.....

.....

Appendix 9 Guidance notes for Acrylonitrile unloading/storage checklist

1. THE UNLOADING AREA

- | | |
|-----|---|
| 1.1 | There must be sufficient space for easy access of vehicles. |
| 1.2 | Unless it is connected to the unloading facilities, it must be possible for the vehicle to be removed from the unloading area in the case of an emergency. |
| 1.3 | Barriers, warning notices are required. Special consideration may need to be given to prevent shunting close to the unloading area. |
| 1.4 | There must be a manual water spray system. Ideally this must be a permanent installation over/around the unloading area. Strategically placed fire hoses/monitors are acceptable. |
| | The water system must be available for knocking down vapour. |
| | Besides water sprays, a foam-based system is also recommendable. |
| 1.5 | The unloading area must have the appropriate electrical classification. |
| 1.6 | Unloading arms of stainless steel should be preferred to hoses. |
| 1.7 | The earthing point continuity must be checked on a regular basis. The use of an Earth Proofing device with indicator is strongly recommended. |

2. THE UNLOADING PERSONNEL AND EQUIPMENT

- | | |
|-----|---|
| 2.1 | The customer's operator must be present during off-loading and maintain control of the Acrylonitrile unloading area. |
| 2.2 | There must be at least two trained deputies to provide cover for illness and holidays. |
| 2.3 | The tank test pressure must not be less than 1.5 times the maximum working pressure. Regular testing of the tank is recommended. |
| 2.4 | Consider general protective suits for Acrylonitrile. Goggles must be worn. A safety shower and eye fountain must be sited adjacent to the unloading area. |

3. NITROGEN SUPPLY

- | |
|--|
| A high standard of nitrogen purity must be maintained. |
| All nitrogen lines must be fitted with back flow protection. |

4. THE STORAGE TANK

- | |
|---|
| The sizing of Acrylonitrile storage tanks must be the smallest compatible with shipping and receiving requirements. |
| Storage times in excess of 6 months must be avoided to minimize degradation of Acrylonitrile quality. |

4.1.	<p>CONSTRUCTION</p> <p><i>Construction MATERIALS</i></p> <ul style="list-style-type: none"> Carbon steel, stainless steel, and aluminium are suitable for handling Acrylonitrile. Neither copper nor material containing copper as an alloy element must contact liquid. Copper can discolour the Acrylonitrile and has been known to cause polymerisation in some applications. <p><i>Insulation and Refrigeration</i></p> <ul style="list-style-type: none"> Acrylonitrile storage tanks do not require insulation or refrigeration. White paint must be considered for outside storage tank exterior surfaces, to minimise temperature rise. <p><i>Agitation</i></p> <ul style="list-style-type: none"> Agitation of Acrylonitrile is recommended both for uniformity of sampling and for addition of inhibitors. Agitation is best achieved by a recirculation pump. <p><i>Blanketing</i></p> <ul style="list-style-type: none"> Storage tanks must be blanketed with inert gas for explosion protection. <p><i>Fire Protection</i></p> <ul style="list-style-type: none"> The provision of fire protection systems, eg. foam, must be considered where appropriate, even water spray systems to isolate from other fires near the tank. <p><i>Earthing</i></p> <ul style="list-style-type: none"> The installation of an earth proofing device with indicator is strongly recommended. <p><i>Internal Coating</i></p> <ul style="list-style-type: none"> Internal coatings are not required for Acrylonitrile storage tanks. If internal coating is used, it must not be alkaline. However, there are only a limited number of suitable coatings for handling Acrylonitrile, and strict consideration must be given before use.
4.2	<p>RELIEF VALVES</p> <ul style="list-style-type: none"> Adequate provision must be made for vapour displacement caused by tank breathing, pumping operation, etc, for fire exposure relief and for explosion relief. Purge the relief valves inlet and discharge with N2 to avoid deposition of polymer.
4.3	<p>INSTRUMENTATION AND MONITORING</p> <ul style="list-style-type: none"> Level indicators and level alarms are advised to prevent tanks overfilling. Consideration must be given to extra high level interlocks to shut off the tank feed. Pressure and temperature indications are also advised and must be monitored regularly.
4.4	<p>PIPING</p> <ul style="list-style-type: none"> Carbon steel, stainless steel or aluminium may be used. Avoid copper and copper alloys. All low points must be provided with drains. Blanks must be fitted to open ends. On long pipelines, thermal relief valves must be fitted, the relief valve must vent to a safe location, e.g. the storage tank.
4.5	<p>PUMPS</p> <ul style="list-style-type: none"> Centrifugal pumps are preferred for Acrylonitrile service. For environmental considerations double mechanical seals with water flush or nitrogen barrier fluid or magnetic drive pumps are preferred.
4.6	<p>VALVES</p> <ul style="list-style-type: none"> Gate, globe, angle or butterfly valves may be used in Acrylonitrile service. Bonnet gaskets may be soft iron or spiral-wound. For ball valves, Teflon seats are acceptable (except when forbidden by local/national regulations).
4.7	<p>GASKETS</p> <ul style="list-style-type: none"> Gaskets of the spiral-wound graphite filled type are recommended.
4.8	<p>HOSES</p> <ul style="list-style-type: none"> The use of hoses should be avoided, but if needed for loading or unloading operations, they must be Acrylonitrile-resistant line armoured austenitic stainless steel flex hose or equivalent. Hoses must be inspected and pressure test for wear or damage frequently and replaced as necessary (inspect at least every 12 months).

Appendix 10 General instructions for Acrylonitrile road tanker drivers

Table of contents

1. Introduction
2. Definitions
3. Product information
4. Personal safety equipment
5. Loading and unloading
6. Transportation
7. Emergency procedure

1 Introduction

- Acrylonitrile is a flammable and toxic product but can be handled, transported and stored in a safe way, provided that appropriate precautions are observed.
- The Acrylonitrile tanker driver has an important job to do; being in charge of the technical care of the 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 Acrylonitrile during transport and the action to be taken in the event of an emergency.
- The objective in preparing a uniform set of instructions for all drivers is to ensure that Acrylonitrile is handled and transported as safely as possible.
- Before drivers are permitted to convey Acrylonitrile, they must:
 - a) Already be in possession of valid ADR driver certificate, dangerous goods class 3 or equivalent document if transport is within national territory only.
 - b) Have received specific, additional training on Acrylonitrile hazards, guided by an Acrylonitrile producing Company, affiliated to Cefic.
Retraining every 2 years is recommended.
Drivers who have received this Acrylonitrile familiarisation must receive a written training certificate which will be mutually acceptable to all Acrylonitrile producing companies affiliated to Cefic.

In principle, drivers without an Acrylonitrile Training Certificate must no longer be accepted for the transport of Acrylonitrile.

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 pressures	The pressure, above the liquid, caused by vapour in equilibrium with that liquid.
Flash point	The lowest temperature at which vapour above the liquid can be ignited in combination with oxygen from the air.
Lower explosion limit	The minimum concentration of a substance in air, at which ignition is possible. At lower concentrations the mixture is too «weak».
Upper explosion limit	The maximum concentration of a substance in air, at which ignition can take place. At higher concentrations the mixture is too «rich».
Decomposition	A reaction at which a substance breaks down into several other parts; 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.
A D R	European Agreement concerning the International Carriage of Dangerous Goods by Road.
R I D	Regulations concerning the International Carriage of Dangerous Goods by Rail.
I M O	International Maritime Organisation (Organisation for International transport by sea, including international ferries).

3 Product information

A summary of key properties, health hazards, personnel safety precautions and emergency actions is defined on the attached Instructions in Writing (Appendix 11). Further information specific to road tankers is defined below and more detail can be found in the main text of the Acrylonitrile Guidelines.

4 Personal Safety Equipment

The minimum protective equipment required is mentioned in the Instructions in Writing. See appendix 11.

5 Loading and unloading

Specific written operating instructions must be available at the filling and off-loading points which will vary depending on local operating conditions.

Personnel involved must be fully trained in the implementation of the procedures.

6 Transportation

Acrylonitrile must only be transported on defined routes which must be in accordance to the ADR regulations:

Utilise motorways, avoid major centres of population and avoid use of tunnels or passenger ferries.

Tanker drivers must ensure that their vehicle, when parked, is in a safe location - preferably a supervised authorised parking area for dangerous chemical products, certainly in an isolated open position - preferably lit at night.

Retraining every two years is recommended.

7 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 Acrylonitrile is very small.

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

Follow the instructions indicated in the Instructions in Writing (Appendix 11). They are available in various languages at the following web site: http://www.unece.org/trans/danger/publi/adr/adr_linguistic_e.htm

7.1 Additional information

- When abnormalities occur, do everything possible to drive the vehicle to an open area or space away from buildings and populated areas. Park and leave the vehicle taking with you:
 - The Instructions in writing
 - The transport documents
 - The personal safety equipment
 - The Acrylonitrile driver instructions
- Alert everybody in the surroundings and keep people away
- Contact immediately the local Police and the Fire Brigade
- Ensure that the consignor is notified as soon as possible and provide detailed information about the incident.

7.2 Vapour/Liquid leakages and/or fire

- Park and leave the vehicle immediately
- Alert everybody in the surroundings and keep people as far away from the vehicle as possible
- Immediately contact the local Police and The Fire Brigade
- Ensure that the consigner is notified as soon as possible.

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

- Contact the local Police
- Ensure that the consignor is notified as soon as possible
- If the vehicle cannot be moved, the emergency orange flash lights, cones or triangles must be placed to protect the front and rear of the vehicle. Check possible leaks and general condition of the tank and truck.

Appendix 11 Instructions in writing

Drivers must have the latest version of the Instructions in writing with him in accordance to the ADR regulations:
http://www.unece.org/trans/danger/publi/adr/adr_linguistic_e.html

Appendix 12 Member companies of the Cefic Acrylonitrile Sector Group

MEMBER COMPANIES	ADDRESS	24H ER NUMBER
DSM	Kerenshofweg 200, 6167AE Geleen, the Netherlands	+31 46 4765900
INEOS	Alte Straße 201, 55769 Köln, Germany	+49 22135552223
	Middlesbrough TS2 1TX Seal Sands, UK	+44 164 254 6464
Mitsubishi International GmbH	Kennedydamm 19, DE-40476, Düsseldorf (Germany)	
Asahi Kasei Chemicals	1-105 Kanda Jinbocho, Chiyoda-ku, Tokyo 101-8101, Japan	



Cefic aisbl - European Chemical Industry Council

Avenue E. van Nieuwenhuyselaan 4

1160 Brussels - Belgium

T +32 2 676 72 11

F +32 2 676 73 00

www.cefic.org