CONSEIL EUROPEEN DE
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CEFIC

EUROPEAN CHEMICAL
INDUSTRY COUNCIL

CEFIC GUIDELINES

FOR THE DISTRIBUTION

OF METHYLAMINES

Published by the Methylamines and Derivatives Sector Group

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Avenue E Van Nieuwenhuyse, 4 Bte 2 – B – 1160 Brussels **Tel +32.26767211 Fax +32.26767301**

MEMBERS COMPANIES OF THE METHYLAMINES & DERIVATIVES SECTOR GROUP

AIR PRODUCTS

AKZO NOBEL

BASF

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NOTICE

The information, specification, procedures, methods and recommendations in these guidelines are presented in good faith, are believed to be accurate and reliable, but may well be incomplete and/or not applicable to all conditions or situations that may exist or occur. No representation, guarantee or warranty is made as to the accuracy, reliability or completeness of the said information, specifications, procedures, methods and recommendations or that the application or use of any of the same will avoid hazards, accidents, losses, damages or injury of any kind to persons or property or that the same will not infringe patents of others or give desired results. Readers are cautioned to satisfy themselves as to the suitability of said information, specifications, procedures, methods and recommendations for the purposes intended prior to use.

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1. INTRODUCTION

The CEFIC (European Chemical Industry Council) Responsible Care Program requires that Chemical Companies demonstrate their commitment to continuously improve all aspects of performance which relate to the protection of Health, Safety and the Environment. An overview of the key elements of CEFIC's distribution Responsible Care program is contained in Appendix 1.

These guidelines have been prepared by a technical committee under the direction of the CEFIC Methylamine and Derivatives Sector Group in the application of Responsible Care to the distribution of methylamines. They are consistent with the CEFIC recommendations on safe management practices in distribution and establish appropriately high standards of safety for the distribution of methylamines. The key elements of the CEFIC management practices are contained in Appendix 2.

The distribution of methylamines is subject to regulation within Europe. International movement is subject to international agreements which make recommendations for the classification, packaging. labelling and transportation of hazardous substances. National and international regulations differ in some respects. These guidelines relate to the practical aspects of methylamines distribution. Reference to regulatory controls is only made where this is considered necessary for the purpose of clarification. It must be emphasised that this document only provides guidance and does not purport to be an authoritative interpretation or exposition of national or international law on any matters referred to in it.

The CEFIC Methylamine and Derivatives Sector Group recommend that these guidelines are adopted by all parties who are involved in the distribution of methylamines.

The Sector Group will review these guidelines on a regular basis.

2. PRODUCT INFORMATION

INTRODUCTION

Information relating to properties, safety, health and environmental issues is published in individual product specific safety data sheets. These are continuously updated to include new hazard information, changes in product classification, toxicology and legislation. The following general sections should be used in conjunction with the most recent safety data sheet for the product.

NOMENCLATURE

Throughout these guidelines "methylamines" is used as a collective name for the group of products monomethylamine, dimethylamine, trimethylamine and the solutions. The individual product name is used when statements refer to a single product. The abbreviations MMA, DMA and TMA are used in tables.

2.1. IDENTIFICATION

NAMES:	Monomethylamine Methanamine MMA	Dimethylamine Methanamine, N-methyl- DMA	Trimethylamine Methanamine, N,N-dimethyl- TMA
EINECS NUMBER:	200-820-0	204-697-4	200-875-0
EU ANNEX 1 INDEX NUMBER: GASES	612-001-00-9	612-001-00-9	612-001-00-9
SOLUTIONS	612-001-01-6	612-001-01-6	612-001-01-6
CAS NUMBER:	74-89-5	124-40-3	75-50-3

2.2. **PHYSICAL PROPERTIES**

GASES	MMA	DMA	TMA
Formula	CH_3NH_2	$(CH_3)_2NH$	$(CH_3)_3N$
Molar mass g/mol	31.06	45.08	59.11
Melting Point (101.3 kPa) °C	-93	-92	-117
Boiling Point (101.3 kPa) °C	- 6.3	6.9	2.9
Flash Point (closed cup) °C	-56	-55	-65
Critical Temperature °C	156.9	164.5	160.1
Critical Pressure MPa	7.46	5.31	4.07
Autoignition temperature in air at 101.3 kPa °C	430	402	190
Explosive limits in air (STP): - lower % vol/vol	5.0	2.8	2.0
- upper	20.7	14.4	11.6
Heat of combustion liquid (25 °C 101.3 kPa) kJ/mol	-1061	-1745	-2423
Heat of fusion "	6.13	5.95	6.55
Heat of solution of gas in water at 25 °C "	44.5	52.2	51.7
Heat of formation of the ideal gas 25 °C "	-23.0	-18.5	-23.9
Heat of formation of liquid 25 °C "	-47.3	-44.0	-45.8
Density g/cm3 at 20°C	0.668	0.661	0.639
Relative vapour density (air=1)	1.07	1.55	2.03
Vapour pressure (kPa at 20°C)	290	179	187
Minimum ignition energy mJ		<0.3	
Odour threshold ppm	0.02	0.02	0.0002
Partition coefficient log P noctanol/water	-0.7	-0.38	-0.27
Viscosity (liquid phase) 20 °C mPas	0.185	0.196	0.185
Maximum solubility in water at 20°C wt%	63	78	63

SOLUTIONS	MMA40	DMA 40 / 60	TMA40
Boiling Point (101.3 kPa) °C	49.4	51.0 36.0	30.8
Melting Point (101.3 kPa) °C	-38	-36 -60	1.7
Flash Point (closed cup) °C	-10	-18 -32	-20
Solution pH (0.1 N)	11.2	11.5	11.2
Flashpoint of 1% aqueous solution °C 45		40 30	
Density g/cm3 at 20°C	0.904	0.895 0.827	0.880
Vapour pressure kPa 20°C	32	26 57	61
Viscosity 20 °C mPas	1.5	1.7 2.0	4.0

2.3. **HAZARDS**

METHYLAMINE GASES: Extremely flammable. Harmful by inhalation. Irritating to respiratory system and skin. Risk of serious damage to eyes.

METHYLAMINE SOLUTIONS: Highly to extremely flammable. Harmful by inhalation and if swallowed. Causes burns.

WARNING PROPERTIES

Methylamines have an intense fishy odour which is detectable at very low concentrations. The odour provides an early warning of exposure to trace concentrations. Higher concentrations are increasingly unpleasant causing irritation of the eyes and respiratory tract.

FLAMMABILITY

Methylamines and their solutions in water are flammable. The flashpoints of the liquefied gases are as low as -50°C and the commercially available solutions are flammable at temperatures below ambient. Methylamine vapour is heavier than air and may spread at ground level with the risk of ignition at some distance from the source. Vapour from the liquefied methylamine gases is cold and has a correspondingly higher vapour density.

CHEMICAL REACTIVITY

Methylamines are alkaline substances and in concentrated form will react violently and exothermically with strong acids. The gases evolve heat on solution in water and the accidental addition of water to a liquefied methylamine gas will cause a large increase in the rate of gas evolution. Mixtures of methylamines and air are highly flammable and will explode if ignited in a confined space.

Dimethylamine is a secondary amine and in common with other members of this group of chemical compounds nitrosamines may be formed in the presence of nitrosating agents under acidic conditions.
Mercury is reported to produce explosive compounds on long term contact with ammonia. For this reason, mercury should not be used with methylamines and should be excluded from measurement instruments.

2.4. **TOXICOLOGY AND OCCUPATIONAL HEALTH**

INHALATION

Methylamines are harmful by inhalation and irritating to the respiratory system. Atmospheric concentrations in excess of the occupational exposure limit may lead to irritation of the eyes and respiratory system. Exposure to high concentrations may produce lung damage. Fluid build up on the lung (pulmonary oedema) may occur up to 48 hours after exposure and could prove fatal.
The product odour and properties provide warning of inhalation exposure. The methylamines have odour thresholds which are an order of magnitude less than the occupational exposure limits adopted by the EU member states. Higher concentrations are unpleasant and cause irritation of the eyes and respiratory tract. These effects provide a warning of exposure at tolerable concentrations and allow an individual to take evasive action. Note, however, that olfactory fatigue may reduce the sensitivity to odour on prolonged exposure.

ORAL

Methylamine solutions are harmful if swallowed and will cause immediate and severe irritation of the gastrointestinal tract.

SKIN CONTACT

Concentrated aqueous solutions of methylamines are alkaline (pH 11) and will cause skin burns. The gases are extremely soluble in water and at high concentrations will dissolve in the moisture of the skin to produce the same effects as the solutions. In addition, contact with the liquefied gases as liquid or spray may cause frostbite.

EYE CONTACT

Methylamines are corrosive to the eye. Vapour concentrations may cause eye irritation and transient impairment of vision. This may result in the perception of a "blue haze" or "halo" around points of light.

CARCINOGENICITY

Short term tests and a consideration of the molecular structure indicate that it is unlikely that methylamines are a carcinogenic hazard to man.

MUTAGENICITY

There is no evidence of mutagenic potential.

REPRODUCTIVE SYSTEM

There is no evidence of reproductive system toxicity.

2.5. **ENVIRONMENTAL**

Amines occur naturally in the environment at trace levels as products of metabolic and degradation processes. They have low potential for bioaccumulation and are substantially biodegradable.

Amines are water soluble and volatile and are readily dispersed in air, surface waters and soil after loss to the environment. Discharge to surface waters results in partial removal by volatilisation, depending on the initial concentration, with the remaining product decomposed by biodegradation. The half life in a flowing river has been estimated at 1 to 2 days. The predicted biodegradation products include lower molecular weight amines, formates, formaldehyde, carbon dioxide, ammonia, and methane depending on aerobic or anaerobic conditions. Amines released to surface soils are lost by evaporation, biodegradation and leaching into groundwaters. Discharges to atmosphere are predicted to be most rapidly removed by reaction with hydroxyl radicals. Half life estimates range from 2 to 20 hours. Solution in rain droplets is also a significant removal process for atmospheric emissions.

ENVIRONMENTAL CLASSIFICATION

All three methylamines have the same classification

Wassergefährdungsklasse (WGK): 2, Water endangering.
TA Luft: Class I, number 3.1.7

. (WGK 0 = in general not water endangering, 1 = slightly, 3 = strongly)

2.6. **INTERNATIONAL TRANSPORT REGULATIONS**

GASES	MMA	DMA	TMA
Proper Shipping Name	Methylamine, Anhydrous	Dimethylamine, Anhydrous	Trimethylamine, Anhydrous
UN Number/ADR SIN	1061	1032	1083
ICAO/IATA Class	2.1	2.1	2.1
IMDG Class	2.1	2.1	2.1
ADR/RID Class	2	2	2
Item No.	2F	2F	2F

SOLUTIONS			
Proper Shipping Name	Methylamine Aqueous Sol (%)	Dimethylamine Aqueous Solution (%)	Trimethylamine Aqueous Solution (%)
UN Number/ADR SIN	1235	1160	1297
UN Packing Group	II	II	I
ICAO/IATA Class Primary	3	3	3
Subsidiary 1	8	8	8
IMDG Class Primary 1	3.2	.2(40%)3.1(60%)	3.1
Subsidiary	Corrosive	Corrosive	Corrosive
ADR/RID Class	3	3	3
Item Number	22 (b)	22 (b)	22 (a)

In view of the frequent changes the current transport classification should be confirmed from the most recent copy of the product safety data sheet.

2.7. **EC LABELLING RISK/SAFETY ADVICE**

METHYLAMINE GASES

Classification and labelling according to Annex 1 of Council Directive 67/548/EEC and amendments

F+ Extremely flammable
Xn Harmful

Risk Phrases	R12	Extremely flammable.
	R20	Harmful by inhalation.
	R37/38	Irritating to respiratory system and skin.
	R41	Risk of serious damage to eyes.
Safety Phrases	S16	Keep away from sources of ignition - No smoking.
	S26	In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
	S39	Wear eye/face protection.

METHYLAMINE SOLUTIONS

Classification and labelling according to Annex 1 of Council Directive 67/548/EEC and amendments.

F+ Extremely flammable
C Corrosive

Monomethylamine and dimethylamine solutions have boiling points which are greater than the Annex 1 extremely flammable substance boiling point limit of 35° C. They are consequently labelled as highly flammable F and use the risk phrase R11 Highly flammable. The flammability statements for the solutions are:

	MMA40	DMA40/60	TMA40/45/50
Highly flammable	F, R11	F, R11	
Extremely flammable			F+, R12

Risk Phrases:	R12	Extremely flammable.
	R11	Highly flammable.
	R20/22	Harmful by inhalation and if swallowed.
	R34	Causes burns.
Safety Phrases:	S3	Keep in a cool place.
	S16	Keep away from sources of ignition - No smoking.
	S26	In case of contact with eyes, rinse immediately with plenty of water and seek medical advice
	S29	Do not empty into drains.
	S36/37/39	Wear suitable protective clothing, gloves and eyes/ face protection.
	S45	In case of accident or if you feel unwell, seek medical advice immediately (show label where possible).

In view of the frequent changes the current labelling requirements should be confirmed from the most recent copy of the product safety data sheet.

3 TRANSPORT AND STORAGE OPERATIONS

3.1. LOADING OPERATIONS

3.1.1. The operation of any road tanker, tank container, rail tank wagon or barge/vessel with a dangerous substance is a potential hazard.
It is therefore important that loading facilities and transport equipment are correctly designed and constructed, and properly used and maintained.

3.1.2. Transport equipment is designed to meet the requirements of the ADR, RID and IMO Regulations and is subject to periodic inspection and testing as laid down in these Regulations. Normally, official inspection and testing is carried out by the competent authorities in the country of registration.

3.1.3. Written operating instructions should be available for all filling points covering the loading of methylamines into bulk road tankers, tank containers, rail tank wagons, or vessels, and the personnel involved should be fully trained in their implementation. The instructions should recognise the specific hazards of the methylamines and the need for total containment to prevent odour problems.

3.1.4. All necessary protective clothing and emergency equipment should be available at the loading point. Personnel should be trained in the correct use of this clothing and equipment.

3.1.5. An inspection of the transport equipment should be carried out by the loading terminal staff before, during and after loading. This inspection does not replace the responsibility of the owner of the tank container to ensure that the equipment is properly tested, maintained and fit for purpose. The inspection list in Appendix 3 is recommended for use by the supplier of the tank container. Vessels have specific checklists according to the IMO regulations.

3.1.6. The inspection list assumes international conveyance. National regulations may differ from the requirements laid down in international transport agreements. The inspection list should be modified as appropriate.

3.1.7. In addition to the routine loading inspection of all transport equipment, it is recommended that tank containers are leak tested under air or nitrogen pressure prior to initial introduction into service, or reintroduction to service after maintenance or repair. A soap solution test should be incorporated and the soap test continued for a period of time to allow foam to form at minor leaks. Soap solution will not produce foam at a methylamines gas leak.

3.2. **TRANSPORT OF METHYLAMINES BY ROAD**

3.2.1. HAULAGE CONTRACTORS

The haulier is responsible for the safe transport of methylamines by road from the loading point to the discharge point. Road hauliers must meet all the relevant national and international regulations relating to the transportation of hazardous materials, and should operate to standards equivalent to ISO 9000 and participate in an SQAS scheme.

3.2.2. ROUTING

Methylamines should only be transported on defined routes which should be selected to utilise major roads and as far as possible avoid areas of high population density. Road transport of methylamine gases is not permitted in Germany if the journey could be made by rail or inland waterway. Special limiting conditions apply if road transport is to be used for all or part of a journey.

3.2.3. SAFE PARKING

Vehicles carrying methylamines should be either supervised or parked in a safe place. Safe parking requires that the location is removed from populated areas and has minimal traffic activity. Parking should preferably be in an approved lorry park for vehicles carrying hazardous substances or within a secure factory boundary or a transport depot. No potential source of ignition should be in the vicinity and the vehicle should be capable of being easily removed in an emergency.

For short term stops the vehicle should be supervised or parked, as far as is practicable, so that the driver has sight of the vehicle and is able to return to it immediately if necessary.

Drivers must inform their traffic office of their overnight parking location.

3.2.4. SEVERE WEATHER CONDITIONS

When severe weather conditions are experienced during transport, for example icy roads, snow or poor visibility, the delivery should be stopped at the next suitable parking place. The delivery should not recommence until weather conditions improve.

3.2.5. DELAYS OR ACCIDENTS

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

3.2.6. EMERGENCY PROCEDURE

Drivers shall be given precise instructions in case of leaks, spills or fire. Recommended instructions are given in the Transport Emergency Card.

3.2.7. FERRY SELECTION.

The consignor will ensure that he knows which ferry operators are being used by the road haulier.

3.2.8. CUSTOMER COLLECTION

Customer collection should be avoided. However, if such collections take place , the checklist indicated in Appendix 3 should be used. The collection documents should include a statement that the transportation tank is suitable and has been maintained to the standard required for the transportation of methylamines.

3.2.9. MULTIMODAL TRANSPORT

Tank containers are often transported in a multimodal system. This is generally organised by the haulier. Management systems shall be in place to ensure quality and safety operations by the road haulier collecting the tank-container from the rail/road/marine transfer point at the customer side.

3.2.10. SUBCONTRACTING

A subcontractor must fulfil the same requirements as the principal haulier including compliance with these guidelines.

3.3. TRANSPORT OF METHYLAMINES BY RAIL

3.3.1. The appropriate railway companies or rail authorities are responsible for the safe transport of methylamines by rail from despatch location to final

3.3.2. reception facilities. The selection of route, intermediate stopping locations and cessation of traffic due to severe weather conditions are matters to be decided by the railway companies and authorities.

3.3.2. The railway company will contact the authorities and the consignor in the event of a transport emergency involving methylamine rail tank wagons. Railway companies should be made aware of the information contained in these guidelines.

3.3.3. In some cases, rail tank wagons are transported over the public road from the final rail station to the customer by a 'piggyback' arrangement. Particular attention should be given to load safety during this operation.

3.3.4. In case of multimodal transport, terminals should comply with acceptable safety standards in particular to fire fighting capabilities and site security.

3.3.5. In the event of derailment, leak or other problems involving rail tank cars loaded with methylamines railway companies or authorities should inform the consignor immediately.

The emergency response telephone number is displayed on the wagon.

3.3.6. The consignor will ensure that they are informed which rail-ferry operators are being used by the national railways.

3.4. TRANSPORT OF METHYLAMINES BY SEA

3.4.1. Transport by sea may be either:

a. by roll on/roll off ferries
b. lift on/lift off shipment in tank containers.
c. methylamine solutions in bulk by seagoing vessels.
d. methylamine gases are not currently transported in ship bulk tanks.

3.4.2. Prior to the commencement of each traffic flow, the transport company should make sure that all parties involved have adequate safety standards.

Particular areas of interest are:

a. the shipping company,
b. loading/unloading facilities at container terminals,
c. emergency handling within hazardous cargo yards at container terminals,
d. emergency handling on board,
e. division of emergency response arrangements between consignor and customer.

The safety performance should preferably be checked by means of an SQAS.

3.4.3 Transport by sea and waterways in bulk requires a vessel which is certified for the carriage of each product.

3.5. UNLOADING OPERATIONS

3.5.1. The unloading of a tank container is a potentially hazardous operation. Unloading facilities must be specifically designed and constructed for methylamine use, and attention paid to their proper operation and maintenance.

3.5.3. Operating instructions should be produced for each unloading installation. These should be based on a comprehensive safety study of the process hazard and operability. Staff should be fully trained in the operation for both normal and emergency situations.

3.5.4. Protective clothing and emergency equipment should be available for unloading operations. Staff should be trained in the correct use of this clothing and equipment.

3.5.5. The safe discharge of methylamines at a customer's premises is the customer's responsibility. The supplier is responsible for the provision of a suitable delivery tank and its safe operation. The supplier may provide technical advice and visit the installation to determine that delivery staff are not put at risk and to establish that the unloading facilities are adequate. This advice is not intended to replace the customers safety practices and the customer remains responsible for the installation and the safety of employees and visitors to the site.

In cases where a site visit is made, the scheme included in Appendix 5 may be used as a checklist. The customer, however, should evaluate the reception and storage facilities against the requirements of Appendix 5.

4. DESIGN AND CONSTRUCTION OF TRANSPORT AND STORAGE EQUIPMENT

4.1. CURRENT OPERATING PRACTICES

Methylamines are supplied in road tanks, rail tanks, and ISO tanks which can be delivered either by road or rail. Anhydrous methylamines are delivered as liquefied gases under pressure in pressure vessels. Methylamine solutions are liquids at ambient temperatures and can be delivered in general purpose tanks or in pressure vessels. Smaller quantities of product can also be supplied in cylinders or heavy duty drums.

4.2. DESIGN AND CONSTRUCTION OF RAILCARS

Railcars for the carriage of methylamines must meet the design and construction requirements of: the national regulations or local rail administration regulations, when used for national transport or, regulations such as the International Regulations concerning the Carriage of Dangerous Goods by Rail (RID), when used for international transport.

Tanks may be constructed of carbon steel or stainless steel. All valves should be of leak tight design. Bellows seal valves are recommended for methylamines railcar duty. Liquid and gas outlets may be differentiated by fitting with DN 80 and DN 50 flanges respectively. Flanges for gas tanks should comply with the EU regulation for carriage of liquefied gases.

4.3. DESIGN AND CONSTRUCTION OF ROAD TANKERS

Tanktrucks used for the transportation of methylamines by road must meet the design and construction requirements of national regulations, if limited to national boundaries, or international regulations, such as the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR), when used for international transport.

Tanks may be constructed of carbon steel or stainless steel. Tanks used for a range of products are best made from stainless steel to facilitate cleaning. All valves should be of leak tight design. Liquid and vapour phase connections on gas tanks may be differentiated by fitting DN 80 and DN 50 flanges respectively. For bottom discharge tanks the vapour return line should be extended down the tank side so that all connections can be made from ground level.

4.4. DESIGN AND CONSTRUCTION OF TANK CONTAINERS

Tank containers (ISO tanks) may be used for the carriage of methylamines by road, rail, and 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. DN50 flanges are stipulated for gas tanks.

The same principles of construction apply as are used for tanktrucks. Flange adapters, or any equipment fixed to the tanks which protrude beyond the tank frame must be removed before shipping.

4.5. DESIGN AND CONSTRUCTION OF VESSELS

Vessels used for the carriage of methylamines by sea must meet the design and construction requirements of international regulations such as the international code for the construction and equipment of ships carrying dangerous chemicals in bulk as produced by the International Maritime Organisation (IMO).

4.6. DESIGN AND CONSTRUCTION OF STORAGE TANKS

The storage and handling of methylamines are subject to legislative controls in many countries. The design and construction of storage tanks must comply with these controls.

The guidelines contained in Appendix 6 define the best practice as used by the methylamine producers. These guidelines should be complied with, provided that they do not conflict with specific local legislation.

4.7. DESIGN AND CONSTRUCTION OF LOADING AND UNLOADING FACILITIES

Loading and unloading facilities should be designed and located to meet chemical industry engineering standards having due regard to the hazards associated with the handling of methylamines and the need for total containment to prevent odour nuisance. Attention should be given to the protection of personnel from product hazards and their safety if required to access the top of tank containers and when connecting and disconnecting transfer hoses.

5. EMERGENCY PROCEDURES

5.1. EMERGENCY PLANNING

5.1.1. TRANSPORT

Each methylamine producer has a regularly tested emergency procedure for responding to transport emergencies. Telephone calls to a company emergency number are routed 24 hours per day to competent staff who have access to all relevant product information. This emergency response is also supported by national centres which maintain 24 hour cover and hold a register of contacts and chemical data. The industry resources are co-ordinated within the Responsible Care initiative of CEFIC in the ICE-Emergency Response programme. This aims to minimise the consequences of transport accidents involving chemicals by providing assistance in each European country and co-ordinating emergency response particularly across national boundaries. The chemical industry makes its expertise available to the authorities who are in charge of chemical emergencies.

The ICE-Emergency Response scheme, described in Appendix 1, incorporates pre-existing national emergency response schemes, for example; TUIS Germany and Chemsafe in the UK, and now covers the majority of European countries.

5.1.2 STORAGE

The Seveso II Directive (Council Directive 96/82/EC Dec 1996) requires major accident planning for storage installations holding more than set quantities of methylamines. The regulations require a major accident prevention policy or, if larger quantities of product are involved, a more extensive safety report which includes the involvement of the local population in its planning. The application of both will be monitored by competent authority inspections. Annual on site inspections are stipulated for sites which require a safety report unless the competent authority defines a different inspection interval. The timing of the introduction of the regulations is dependent on national legislation but is due to be effective from 1999.

SEVESO II DIRECTIVE

Emergency Planning:	**Major accident policy**	**Safety report**
DANGEROUS SUBSTANCE	QUALIFYING	QUANTITY (TONNE)
Liquefied extremely flammable gases (MMA, DMA and TMA)	50	200
Highly flammable liquids (MMA 40%, DMA 40% & 60%)	5000	50,000
Extremely flammable liquids (TMA 40%, 45% & 50%)	10	50

5.2. MEASURES IN THE EVENT OF A RELEASE OF METHYLAMINES

5.2.1. - Shut off all potential ignition sources and leaks, if without risk
- No open flames
- Keep upwind
- Isolate area and deny entry
- Do not get into eyes
- Avoid contact with skin
- Avoid breathing vapour

5.2.2. - Dilute liquid spills with large amounts of water
- Use water spray to reduce the extent of vapour
- Dike larger spills and recover
- Prevent entry into sewers and natural waters
- If substance has entered a water course or sewer, inform and advise the authorities

5.2.3. Methylamine spillage's can be controlled by water spray, containment, dilution with water, or foam blanketing. The method used depends on the size of the spillage and the location. Minor leaks and spillage can be removed with water spray. If a release is of major proportions anhydrous methylamine gases will produce a vapour cloud and possibly a chilled liquefied gas pool. Methylamine solutions will form a liquid pool and a smaller vapour cloud. Both situations can be contained by blanketing the liquid pool with alcohol resistant fire fighting foam and using water spray to "knock down" vapour. Note that the addition of water to a chilled liquefied gas pool will produce a large increase the rate of evolution of amine vapour.

5.3. **FIRE FIGHTING**

5.3.1. Consider allowing a leaking gas flame to continue to burn if safe to do so.

5.3.2. Cool containers exposed to heat / fire with water, to prevent over pressure / bursting.

5.3.3. Small fires: use dry chemical, carbon dioxide or water spray.

5.3.4. Large fires: use water spray, fog or alcohol resistant fire fighting foam.

5.3.5. Massive fires:
- do not direct water jets into liquefied gas
- use unmanned hose holders or monitor nozzle
- consider letting the fire burn out
- dike liquid run-off
- prevent entry into sewers and natural waters

6. PERSONAL PROTECTION, FIRST AID AND MEDICAL TREATMENT

6.1. **PERSONAL PROTECTION**

6.1.1. Wear light protective clothing, chemical gloves, anti static boots and eye protection.

6.1.2. Eye protection: use enclosed chemical goggles

6.1.3. Wear respiratory protective equipment if exposure to atmospheric concentrations above the occupational exposure limit is possible.

6.1.4. Clothing for spill and fire:
- wear full protective clothing and approved positive pressure breathing apparatus
- remove contaminated clothing immediately, preferably under a safety shower / fire hose spray, and wash before re-use
- destroy contaminated shoes and leather items

6.2. **FIRST AID AND MEDICAL TREATMENT**

INHALATION

Remove patient to fresh air, keep warm and at rest. If there is difficulty breathing give artificial respiration. Obtain immediate medical attention.

SKIN CONTACT

Flush skin with plenty of water. Immediately remove contaminated clothing. Obtain medical attention. The methylamine gases can chill the skin and clothing causing frostbite. In this case take care detaching clothing from the skin, thaw with cold water.

EYE CONTACT

Apply immediate and continuous irrigation with running water for at least 15 minutes. The eye lids should be held open away from the eye ball. Obtain immediate medical attention.

INGESTION

Do not induce vomiting. Give water to drink (1/2 litre). Obtain immediate medical attention.

FURTHER MEDICAL TREATMENT

Symptomatic treatment and supportive therapy as indicated. Following severe exposure the patient should be kept under medical review for at least 48 hours as delayed pulmonary oedema may develop.

APPENDIX 1

CEFIC AND RESPONSIBLE CARE

1. RESPONSIBLE CARE - A PUBLIC COMMITMENT

"Chemical companies shall demonstrate their commitment to continuously improve all aspects of performance which relate to protection of health, safety and the environment."

2. PREVENTION OF ACCIDENTS

Within Responsible Care, prevention is a prerequisite to Emergency Response. The CEFIC-ICE (International Chemical Environment) prevention programme provides a valuable tool in reducing the number of incidents during the distribution of chemicals, from the time they leave the factory gate until their arrival at the customer's premises.

The objective is to minimise the possibility for incidents to happen. Since most distribution activities are subcontracted and since compliance with regulations is a necessary but not a sufficient condition to prevent accidents, there is a need for uniform safety & quality criteria against which distribution companies are regularly assessed. Unlike ISO 9002, which concentrates on quality, at a level set by the individual distribution company, SQAS - Safety & Quality Assessment Systems - provide objective performance indicators, which allow the monitoring of continuous improvements.

Based on detailed questionnaires, distribution contractors can be assessed by a qualified third party. Questions relate to management, equipment and operations, split by: statutory requirements, additional chemical industry requirements and desirable items. Scoring results can be presented in different ways but it is up to each individual chemical company to evaluate the results according to its own standards.

The distribution contractors will include:

* Marine transport: Vessels and ferries
* Road transport: Road carriers
* Storage operations: Terminals and warehouses

3. EMERGENCY RESPONSE

Although the chemical industry has a fine record in preventing chemical transport incidents, it is committed to continuous improvement. The ICE Emergency Response scheme, a co-operative programme co-ordinated by CEFIC, will provide emergency response across national boundaries. It aims to build upon the best existing prevention practices, preserve proven emergency response schemes and extend the best emergency schemes to countries where none exist.

The chemical industry makes its expertise available to authorities - who are normally in charge of the emergency - at three levels of assistance.

Level 1: Remote information and general advice by telephone or fax.
Level 2: Presence of an expert who will provide advice at the scene of an incident.
Level 3: Actual help with equipment and personnel at the scene of an incident.

For detailed information on this subject consult: "the CEFIC Distribution Emergency Response Guidelines for use by the Chemical Industry", issued in 1993.

APPENDIX 2

CEFIC RECOMMENDATIONS ON SAFE MANAGEMENT PRACTICES IN DISTRIBUTION.

These recommendations (issued in 1993) conform to the principles of Responsible Care and include the following topics.

1. Safety, health and environmental policies
2. Auditing
3. Risk reduction
4. Specification of packages, tanks and other equipment
5. Incidents evaluation
6. Codes and regulations
7. Control operations
8. Training
9. Selection and monitoring of Contractors
10. Data and information
11. Emergency Response
12. Information to the public

Although these guidelines for the distribution of methylamines are product specific, it is essential that policies, systems and procedures as described in the CEFIC recommendations on safe management practices in distribution are in place and well maintained.

APPENDIX 3

INSPECTION OF TRANSPORT EQUIPMENT

Hauliers are responsible for providing a tank which is fit for the purpose of transporting the material and complies with the transport regulations with regard to the design parameters for the class of material. Tanks must be subject to an appropriate preventative maintenance programme

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 visible vehicle faults. (e.g. lights and tyres in good condition)?

2. Is there a valid ADR-certificate for the individual product or product solution?

3. For tank containers, is the tank container plate valid?

4. Has the driver a valid ADR licence for the transport of dangerous substances?

5. Does the driver have all the necessary items of protective clothing and safety equipment?

6. Is the Tremcard in all required languages on board?

7. Are dangerous goods labels fitted with the product identification numbers as listed in section 2.7 or the national identification plate in accordance with national regulations

8. For combined ADR/IMO transport are the IMO dangerous goods labels fitted?

9. Is the tank or vehicle tare weight available and does the check weight confirm that the tank is empty?

10. Is the load weight within the maximum degree of filling?

11. Can all valves be operated correctly?

12. Are all the valves and man-lids closed?

b. After loading

1. Are all valves closed and blank plates fitted with all bolts in place?

2. Is the container leak proof and odourless? Wash off any spillage's and re-check.

3. Is the vehicle gross weight within the permitted maximum limit?

4. Are any required seals or locks in place?

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

The rail tank wagon owner is responsible for providing a tank which is fit for the purpose of transporting methylamines and complies with the transport regulations with regard to the design parameters for the class of material. Tanks must be subject to an appropriate preventative maintenance programme.

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

a. Before loading

1. Is the RTC suitable for methylamines transport, e.g. in respect of maximum working pressure of tank. Is the inspection date stamped on the tank valid?

2. Are all dangerous goods labels fitted with the product identification numbers as listed in section 2.7 attached, or the national identification plate in accordance with national regulations?

3. For combined RID/IMO transport: are the IMO dangerous goods labels fitted?

4. Is the tank or vehicle tare weight available and does the check weight confirm that the tank is empty?

4. Are all the valves and flanges on both sides of the RTC properly closed and blanked?

6. Can the loading valves be operated?

7. In case of hydraulically or mechanically operated internal valves :
Is the emergency bolt unused and in the stored position on the RTC chassis? (The emergency bolt may only be used to open the bottom valves in the case of an emergency. It is strictly forbidden to load with the internal valve opened by the emergency bolt.)

b. <u>After loading</u>

1. Are all valves closed and blank plates fitted with all bolts in place on both sides of the rail tank car?

2. Is the container leak proof and odourless? Wash off any spillage's and re-check.

3. The maximum gross weight and filling ratio should not be exceeded.

5. Are any required seals or locks in place

3. <u>Unloading</u>

The above guidelines should be used to prepare a checklist for the inspection delivery vehicles before and during unloading.

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

1. Written operating procedures should be available for product sampling, unloading product to storage, the inspection and maintenance of equipment including hoses, dealing with spillage, emergency procedures, instructions to drivers, and site arrangements.

Have the external emergency services been involved in the emergency planning?
Are internal/external medical and first aid services available?

2. Have staff been trained in the application of the procedures?

3. Delivered products should be positively identified, as a minimum, by cross checking the tank labelling, delivery documentation, and the prearranged delivery schedule.

4. The discharge point should be identified, and traced to the correct storage tank, only by the receiving company staff. The delivery point should be clearly labelled with the product name.

5. The confirmation of storage space for the delivered product should be an integral part of the off-loading procedure.

6. The receiving company staff must be present during the off-loading operation and have access to remote shut off controls in the event of an emergency.

4. Maintenance of transport equipment

During operations, unscheduled maintenance of the transport equipment may be necessary if quick closing valves or bottom valves on containers cease to function correctly. Similar difficulties may be experienced with excess flow valves on road tank cars and containers.

Customers should be requested to immediately report to the consignor any difficulties which are experienced with the operation of valves. The provision of an information tag on the returning transport equipment identifying the difficulty can be of assistance

Consignors of RTCs should maintain close liaison with local rail companies or authorities on all matters concerning the maintenance of equipment.

APPENDIX 4

GUIDE FOR THE MARINE CHARTERING AND HANDLING OF METHYLAMINES.

SHIPS COMPLYING WITH BULK CHEMICAL CODES

Inspection of all marine vessels for compliance with these guidelines shall be made by a responsible person prior to each loading to confirm a satisfactory condition of the vessels cargo system.

Ships that have not previously been in service will be inspected by a marine surveyor, under the CDI scheme (see note) or a company initiated scheme, to verify compliance with these guidelines and all applicable regulations prior to charter acceptance.

1. CERTIFICATION - Methylamines will only be loaded/carried on vessels meeting all currently applicable requirements and regulations of all applicable conventions, IMO Bulk Gas Codes, IMO Bulk Chemical Codes , SOLAS and standards such as those set by the US Coast Guard.

   An applicable US Coast Guard letter of compliance or the IMO Certificate for the carriage must be current prior to the loading and for the duration of the voyage.

2. PRIOR CARGOES - Documentation of the previous three cargoes should be provided prior to the ships arrival at the loading berth for conformation of the absence of incompatible materials.

   All tanks and associated piping must be thoroughly cleaned to effectively remove all traces of previous cargoes.

   Water may be used for cleaning provided the final rinse for tanks that are washed is fresh water.

3. CARGO SYSTEM INSPECTION - The cargo systems must be presented free of scale, sludge, solids, or other foreign matter

   The vessel should arrive with tanks cleaned, dry and purged with air. The cargo tanks will be entered for inspection to ensure freedom from contamination, including significant deposits, or accumulations of rust.

   A vessel in continuous methylamine service will be re-inspected following the completion of any significant repairs or alterations or a minimum of once per year, whichever is shorter.

Cargo tanks, piping and supports systems drawings must be provided for inspection and verification of the following:

A. Cargo tanks and piping systems (no visual defects) must be constructed of carbon steel or stainless steel, and must be free of loose rust, scale and previous cargo residues. Inorganic zinc coatings are not suitable for methylamines.

B. Cargo tanks must be fitted with temperature, pressure, and level detection devices. These should be equipped with alarms to warn of, high level**,** and high or low pressure conditions. Documentation for the settings and testing must be provided.

C. A mechanical refrigeration system should be provided unless the cargo system is designed to withstand the vapour pressure of the cargo at 45 °C . Cargo systems must be able to maintain carriage temperature below the boiling point temperature at the cargo tank design pressure limits. Uninsulated cargo tanks may be fitted with cooling systems. Above deck cargo tanks must be insulated and may be fitted with cooling systems.

Refrigeration equipment and/or insulation may be omitted when climatic conditions, length of voyage and other factors warrant. These exceptions will be made on a case by case basis and specific written approval is required.

D. Low points in cargo tanks, cargo piping and vent piping must be inspected and found to be free of wash water, previous cargoes, and other foreign materials.

E. The relief pressure must not be greater than the design pressure of the cargo tank.

F. Cargo tank insulation, if installed, must be a closed cell non-absorbent insulation such as urethane, foam glass, ceramic foam or a block perlite type insulation system.

G. Cargo pumps must be deep-well pumps of the centrifugal type and constructed of steel or stainless steel. Approved types of hydraulically operated submerged pumps are acceptable.

4. PREPARATION FOR LOADING - A line of communication between ship and shore (agreed in writing in a loading agreement *)* must be established prior to commencement of purge and loading operations, and must be continuously maintained during the purge and loading operations.

5. LOADING - Cargo loading is to commence at a reduced rate until sufficient level is reached in the cargo tanks to obtain samples for analytical verification of product quality and until the inlet nozzle is completely submerged. The integrity of all systems is to be verified during this initial loading. The loading rate may be increased following these verifications.

6. CARRIAGE - Cool stowage and stowage away from heated cargoes should be selected.

7. CARGO SEGREGATION

Methylamines should be segregated from other cargoes with which they react in a hazardous manner. These include hydrochloric, nitric, acetic, sulphuric and other acids.

8. TANK CLEANING

Methylamines are extremely soluble in water. This property is useful for the control of vapour, which can be absorbed with a water spray, and for washing away spills and for tank cleaning. The introduction of water into a tank containing methylamine vapour may result in a vacuum and a consequent collapse of the tank. The owner or master of the ship should be warned that care is needed when water washing tanks after use for amines.

Note:

Chemical Distribution Institute (CDI).

The CDI is a non-profit making organisation created through CEFIC. Its two principal objectives, for both its marine and terminal schemes, are to maintain an inspection system which provides data on chemical and chemical gas carriers and bulk liquid storage terminals and to administer the training and accreditation of third-party inspectors. The inspection of ships covers all operational and management systems and performance monitoring and review are a feature of the service.

Further information can be obtained from

The Chemical Distribution Institute
St Martins House Business Centre
Ockham Road South
East Horsley
Surrey KT24 6RX Telephone +44 1483 281268

APPENDIX 5

A SAFETY SCHEME FOR THE RECEPTION AND STORAGE OF METHYLAMINES

1. **PURPOSE**

The checklist can be used for internal auditing. It will be used in supplier audits of off-loading facilities.

2. **SCOPE**

2.1. The scheme applies to the reception, off-loading and storage of anhydrous methylamine gases and methylamine solutions.

2.2. The principal objective is to ensure that the transfer of methylamines from the delivering vehicle to the storage tank is carried out safely. Other aspects of storage and operation are included as they contribute to the overall safety of the system.

2.3. Audits should also take account of any changes in policy or equipment since the previous audit and look for continuous improvement towards total containment.

METHYLAMINES UNLOADING AND STORAGE CHECKLIST

1. THE UNLOADING AREA

1.1 Ease of access
1.2 Housekeeping
1.3 Separation from other activities
1.4 Ability to mobilise and remove road tanker/RTC in case of emergency
1.5 Facilities to isolate area and restrict access
1.6 Fire water spray / foam systems
1.7 Electrical classification
1.8 Minimum safety distances according to national regulations between the off-loading point and:
- Storage
- Ignition source
- Boundary fence/or other facilities

1.9 Off-loading point / adjacent points labelled / tank labelled
1.10 Hoses/loading arms
1.11 Earthing Point
1.12 Pipe damage protection
1.13 Other vehicles/fork lift truck movements
1.14 Communication systems.
1.15 Shutdown systems/ remote isolation

2. UNLOADING

2.1 Personnel and equipment
2.2 The presence of customer's operator
2.3 Operator's competence.
2.4 Deputy availability
2.5 Hose testing and renewal policy
2.6 Fixed loading arm testing and maintenance
2.7 Availability of safety equipment

OPERATIONS

2.8 Written procedures
2.9 Hose purging and leak testing
2.10 Sampling procedure
2.11 Atmospheric/personal methylamines exposure monitoring
2.12 Method of unloading:
- Nitrogen Pressure
- Pump

2.13 Use of the "rail hook".
2.14 Safeguards for pump
2.15 Emergency response

3. STORAGE TANK

3.1 LOCATION
Bunded area
Shared
If shared, with what? - Strong acids, for example, are not compatible.
Separation distances
Emergency disposal facilities

3.2 CONSTRUCTION
Construction materials
Fire insulated
Fire water / foam availability
Earthed
Maximum pressure rating
Maximum allowed working pressure
Date and type of last test/inspection
Dip inlet pipe
Nitrogen blanketing
Vapour return system

3.3 RELIEF AND CHECK VALVES
Separate relief valves
Combined with interlock
Size
Venting to stack, scrubber, other system.
Flame traps
Precautions to prevent back flow from plant streams to storage vessels

3.4 INSTRUMENTATION

Nitrogen padding pressure

Control points:

- Temperature
- Pressure
- Level

Alarm settings:

- Temperature
- Pressure
- Level

Are control indicators and alarms independent?

3.5 MONITORING OF STORAGE

Temperature

Pressure

Level

Capacity of tanks

4. **PROCEDURES**

There should be written procedures available for the following:

- Unloading methylamines
- Testing, inspection and maintenance of equipment
- Emergency.
- Driver instructions
- Site procedures

6. **COMMENTS**

7. GUIDANCE NOTES FOR METHYLAMINES UNLOADING AND STORAGE CHECKLIST

The numbering refers to the items in the check list.

1. THE UNLOADING AREA

1.1 There should be sufficient space for easy vehicular access. "Drive through" road access is preferred

1.4 Unless it is connected to the unloading facilities, it should be possible for the vehicle to be removed from the unloading area in the case of an emergency. The emergency procedures and equipment should include the tank vehicle and its contents.

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

1.6 There should be a fire fighting system. Preferably this should be a permanent installation for the unloading area. Strategically placed fire hoses/monitors ready for use are acceptable.

1.7 The area electrical zone classification should be defined and electrical installations specified accordingly.

1.9 All unloading points must be clearly labelled. If other substances are unloaded in the area, procedures or engineering controls should be in place to avoid unloading of methylamines into the wrong tanks.

1.10 Hoses used for the connection of delivery vehicles to the discharge point should be flexible stainless steel or jointed arm lines. Chemical duty hoses lined with amine resistant material, FEP rubber, polyamide or similar, can also be used.

1.11 The earthing point should be tested on a regular basis. Electrical continuity is required throughout the system to prevent static discharge. Potential sources of static charge, such as splash filling, should be eliminated.

2. UNLOADING

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

2.5 The test pressure of the hoses should not be less than 1.5 times the maximum design working pressure. The frequency of testing is recommended as at least every 12 months.

Hoses should be visually examined for external damage each time they are used.

2.6 The discharge line connections should be pressurised with nitrogen and leak tested before commencing the discharge.

2.7 Air breathing sets with eye coverage and protective PVC suits should be available for emergency use.

A safety shower and eye fountain should be sited adjacent to the unloading area.

2.12 If unloading is by pump, a dedicated vapour return system (balance line) to the delivery tank can be used.

2.13 Rail tanks used for anhydrous methylamines and some other tanks have systems for emergency closure of the tank valves. These can be simple mechanical devices which close the valves on accidental movement of the tank. Consideration should be given to making the operation fail safe by incorporating, for example, a pneumatic activator to close the valves on loss of the air supply due to fire or remote operation.

3. THE STORAGE TANK

3.2 The need for storage tank fire protection is dependent on the position relative to other fire risks. Steel tank support legs should be protected with fire proof lagging or provided with other supplementary fire protection..

3.3 If fire protection of storage tanks is not provided relief valves must be sized accordingly to cope with fire engulfment.

3.4 Level alarms should be linked to cut off the discharge pump at the upper alarm limit. Procedures must be present which prevent tanks from being overfilled.

APPENDIX 6

GENERAL GUIDELINES FOR DESIGN AND CONSTRUCTION OF METHYLAMINE STORAGE TANKS

1. LOCATION OF STORAGE TANKS

1.1. The arrangement and lay out of storage tanks should take into account:
   a) normal operation
   b) emergency operation
   c) fire fighting activities
   d) odour containment

1.2. The design of the tank-farm should consider the containment of fire fighting run-off water and the quantities of water required to dilute small spillage's of methylamines to the point at which the solution is not flammable and or odourless.

1.3. Storage tanks shall be located away from sources of ignition, and positioned so as to minimise the effect of radiation from fire in an adjacent area.

1.4. Tanks shall be sited on an impervious base and methylamines solution tanks should be surrounded by a bund wall capable of containing 110 % of the tank capacity, or 50% to 100% of the total tank capacity for multiple tanks in a single bund depending on national regulations. The walls and floor of the bund should be impervious to liquid and designed to withstand a full hydrostatic head. Bund walls should be designed to ensure adequate natural ventilation of the bunded areas, ready access for fire fighting, and good means of escape in any emergency situation.

1.5. Intermediate lower bund walls are recommended to divide tanks into groups to contain spillage and reduce the spread of liquid. If tanks share a common diked area, products within the area should be chemically compatible. Products which react with methylamines, e.g. strong acids, should be separated from methylamines storage.

1.6. The floor of the bund shall be sloped to prevent minor spillage's remaining below any tank. Provisions should be made for the removal or drainage of surface water from the area within the bund. Preferably, surface water should be pumped out of the bund. If bund drains are used, they shall be provided with valves outside the bund wall, with procedures in force to ensure these valves remain closed, except when surface water is being removed.

1.7. No combustible materials or equipment shall be stored in the bund or against the bund wall.

2. TANK CONSTRUCTION

2.1. The tank and its supports shall be designed and constructed in accordance with an appropriate nationally recognised standard of good engineering practice.

2.2. Copper, zinc and other non-ferrous metals and alloys are corroded by methylamines and should be excluded from storage systems. Care should be taken to ensure they are not included in minor items such as pressure gauge components.

2.3. Storage tanks should be compatible with shipping and/or receiving requirements.

2.4. Vapour control systems should aim for total containment. Vents should discharge into a closed system protected by an acid scrubber or other odour removal process. Exit gases to atmosphere have regulatory methylamines trace concentration limits. Final emission concentrations need to be carefully assessed against the odour threshold. Nuisance odour emission will produce public complaint.

2.5. Carbon steel storage tanks are generally the most economical. Vertical storage tanks are often used for large volume storage. Horizontal tanks are also satisfactory for bulk storage, but these are generally used for small installations.

2.6. Tank filling should be from the top with a dip-pipe (and siphon break) extending to the bottom of the tank to prevent splash filling.

2.7. Insulation is normally not required but can be applied for fire protection if this is required from the fire risk assessment.

2.8. An accessible manhole of minimum 500 mm diameter shall be provided on all tanks to allow for internal inspection and cleaning.

2.9. Design of new storage tanks shall be based on full draining concept, sloped to the outlet with no trapped areas.
Eliminate "dead spots" in liquid and vapour lines.

2.11. Tanks are fitted with a pressure relief valve to protect the tank against over-pressure in the worst case of fire engulfment. A bursting disc can be fitted under this valve to improve odour containment.

2.12. Each tank and off-loading system shall have a continuous earth. Resistance to earth to be checked at least annually.

3. STORAGE TANK ENGINEERING CONTROLS

3.1. Storage tanks shall be provided with a suitable means of determining the liquid level and pressure.

3.2. Audible high level alarms, which automatically shut down the unloading process in the event of overfill, are strongly recommended.

3.3. A nitrogen padding system can be installed to reduce the flammability risk

4. PIPELINES

4.1. Electrical continuity is required for all pipelines to protect against electrical static.

4.2. The tank discharge line should include a remotely operated emergency shut off valve.

4.3. Continuous welded pipelines should be used were possible to reduce the number of potential leakage points at joints.

4.4. Stainless steel spiral wound gaskets should be used for permanent flanged joints. Short term flanged joint gasket material can be asbestos free graphite laminate, modified PTFE or similar.

4.5. Pipelines should be routed to ensure that flanges are not located over walkways and are protected from accidental damage.

4.6. Flexible hoses can be of stainless steel or methylamine resistant chemical hose. Hoses shall be inspected and pressure tested on a regular basis. Records of inspection data and results shall be retained.

4.7. All tanks and unloading point pipeline connections must be clearly identified.

4.8. A closed sample system with samples taken into a cylinder is required to prevent emissions and odour whilst sampling.

4.9. Valves should be fitted as close as feasible to the tank. Bellows seal valves are preferred. Unused outlets should be blanked off.

5. PUMPS

5.1. Pumps should be located outside of the tank bund in the open, fixed to an impervious base and with a sill, drained to a safe place, to contain spills.

5.2. Seal-less magnetic drive or canned pumps are recommended. The pump should be

5.3. located so as to give a net positive head on the suction side to prevent vapour locking.

5.3. Pumps should be constructed of ductile steel, or stainless steel.

5.4. If pumps are remotely controlled then stop buttons shall be provided at the pump and at the remote control centre.

6. ELECTRICAL

6.1. The selection, installation and maintenance of electrical equipment for use in hazardous areas should be according national regulations.

6.2. Pumps, tanks, electrical motors, pipelines, and all parts of the system must be effectively earthed to prevent the accumulation of static electrical charges. A compliance program shall be in place.

6.3. Working areas, i.e. tank stairs, platforms, loading/unloading facilities should be adequately illuminated for emergency response and security.

7. FIRE FIGHTING

7.1. A contingency plan shall be in place and tested in practice at least once per year.

7.2. It is recommended to install sprinkler water at tanks and pumps.

7.3. Alcohol resistant foam is an effective fire fighting medium. A blanket of foam will also contain amine vapour and reduce the odour from an amine spillage while recovery or disposal is considered.

7.4 Caution: The addition of water to a chilled liquid pool of anhydrous methylamines will cause a large increase in the rate of gas evolution.

8. SYSTEMS FOR GAS DETECTION

8.1. Flammable gas detectors located in the storage and off-loading area are a useful addition to the detection of hazardous vapours.

APPENDIX 7

GLOSSARY OF ABBREVIATIONS

ADR	Accord européen relatif au transport des marchandises dangereuses par route. European agreement concerning the international carriage of dangerous goods by road.
CAS	Chemical Abstract System
CDI	Chemical Distribution Institute
CEFIC	Conseil Européen de L'Industrie Chimique European Chemical Industry Council
DIN	German Industry Standard (Deutsche Industrie Norm)
DMA	Dimethylamine
DN	Diameter
EU	European Union
EINECS	European Inventory of Existing Commercial Chemical Substances.
IATA	International Air Transport Association
ICAO	International Civil Aviation Organisation
ICE	International Chemical Environment (CEFIC)
IMDG	International Maritime Dangerous Goods
IMO	International Maritime Organisation
ISO	International Standard Organisation.
MMA	Monomethylamine
PTFE	Polytetrafluorethylene

RID	Règlement International concernant le transport de marchandises dangereuses par chemin de fer. Regulations concerning the international carriage of dangerous goods by rail.
RTC	Rail Tank Car
SQAS	Safety and Quality Assessment Systems (CEFIC)
TMA	Trimethylamine
Tremcard	Transport Emergency Card (ADR)
UN	United Nations