

Ammonia, anhydrous



[Identification](#) | [Characterisation](#) | [Formula](#) | [Physical and chemical properties](#) | [Toxicology / Ecotoxicology](#) | [Occupational health and first aid](#) | [Safe handling](#) | [Regulations](#) | [Links](#) | [Literature register](#)

IDENTIFICATION

Ammonia, anhydrous

Anhydrous ammonia

ZVG No: 1100
CAS No: 7664-41-7
EC No: 231-635-3
INDEX No: 007-001-00-5

CHARACTERISATION

SUBSTANCE GROUP CODE

128100 Nitrogen-hydrogen-compounds, inorganic
139100 Inorganic gases

STATE OF AGGREGATION

The substance is gaseous.

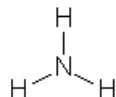
PROPERTIES

gas liquefied under pressure
colourless
pungent suffocating odour

CHEMICAL CHARACTERISATION

Flammable gas.
Ammonia gas burns only at high concentrations, high temperature and a strong energy source. Without heat input the flame extinguishes immediately.
Freely soluble in water.
Aqueous solution reacts alkaline.
Gas is lighter than air.
Acute or chronic health hazards result from the substance.
The substance is hazardous to the aquatic environment.
(see: chapter REGULATIONS).

FORMULA

 NH_3 H_3N 

Molar mass: 17,03 g/mol

Conversion factor (gaseous phase) at 1013 mbar and 20 °C:

1 ml/m³ = 0,708 mg/m³

PHYSICAL AND CHEMICAL PROPERTIES

[Triple point](#) | [Melting point](#) | [Boiling point](#) | [Critical data](#) | [Density](#) | [Vapour pressure](#) | [Ignition temperature](#) | [Explosion data](#) | [Solubility](#) | [Hazardous reactions](#) | [Further Information](#)

TRIPLE POINT

Temperature: -77,9 °C

Pressure: 0,061 bar

Reference: [00260](#)

MELTING POINT

Melting point: -77,7 °C

Reference: [01401](#) [01411](#)

BOILING POINT

Boiling Point: -33,4 °C

Reference: [00440](#)

CRITICAL DATA

Crit. temperature: 132,4 °C

Crit. pressure: 112,8 bar

Crit. density: 0,235 g/cm³

Reference: [00440](#)

DENSITY

VAPOUR DENSITY

under standard conditions (0 °C, 1013 mbar)

Value: 0,7714 kg/m³

Reference: [00440](#)

DENSITY OF LIQUID PHASE AT BOILING POINT

Value: 0,6819 kg/l

Reference: [00260](#)

RELATIVE VAPOUR DENSITY

Ratio of the density to dry air at the same temperature and pressure

Value: 0,60

Reference: [00440](#)

VAPOUR DENSITY

Value: 0,7198 kg/m³

Temperature: 15 °C

at 1 bar

Reference: [00260](#)

VAPOUR PRESSURE

Vapour pressure: 8,5737 bar

Temperature: 20 °C

Reference: [00260](#) [01411](#)

Vapour pressure: 11,7 bar

Temperature: 30 °C

Reference: [00107](#)

Vapour pressure: 20,3 bar

Temperature: 50 °C

Reference: [00107](#)

Vapour pressure: 33,1 bar

Temperature: 70 °C

Reference: [00107](#)

IGNITION TEMPERATURE

Ignition temperature: 630 °C

Temperature class: T1

Reference: [00440](#)

EXPLOSION DATA

Lower explosion limit:

14 mol% (Ideal gas: mol% = vol.%)

108 g/m³

Upper explosion limit:

32,5 mol% (Ideal gas: mol% = vol.%)

240 g/m³

Max. exper. safe gap (MESG): 3,18 mm

Explosion group: IIA

Maximum explosion pressure:

6,9 bar

Reference: [00440](#)

SOLUBILITY IN WATER

Concentration: 531 g/l

Temperature: 20 °C

Reference: [01411](#)

HAZARDOUS REACTIONS

Hazardous chemical reactions

Risk of explosion in contact with:

oxidizing agents

mercury

hydrogen peroxide

chlorites; stibane (heat); calcium; halogenes except bromine; chlorine azide; chlorodinitrobenzene;

chloroformamidiniumnitrate; chloronitrobenzene (heat); dichloroethane (liquid ammonia);

dichlorine oxide; difluorine trioxide; gold; gold chloride; hydrocarbons/air; air/fire; magnesium

perchlorate/gas; sodium hypochlorite (dry); picric acid; mercury hypoiodide; oxygen/catalyst; sulfur;

silver; silver chloride; silver nitrate; silver oxide; nitrogen trichloride; sulfinyl chloride; tellurium

halogenides

Mixtures with oxidizing gases are explosive.

The substance can react dangerously with:

bromine

acids

nitric oxides

acetaldehyde; acrolein; barium; boron; boron halogenides; bromine pentafluoride; hydrogen

bromide; chlorine compounds; chromium trioxide; dimethyl sulfate; dinitrogen oxide; ethene oxide;

hydrogen fluoride; carbon oxides; methane/heat; methyl mercaptan; pentaborane; phosgene;

phosphorus oxide; phosphine; platinum catalysts; sulfur dioxide; hydrogen sulfide; silane;

tetramethylammoniumamide

FURTHER INFORMATION

global warming potential: 0

ozone depletion potential: 0

Reference: [06501](#) [07450](#)

TOXICOLOGY / ECOTOXICOLOGY

ECOTOXICOLOGICAL DATA

LC50 Fish (96 hours)

Minimum: 0,3 mg/l

Maximum: 338 mg/l

Median: 27,1 mg/l

Study number: 29

Reference for median:

Poucher, S. 1986. Memo to D.J.Hansen, U.S. EPA. Results of Acute Toxicity Tests Conducted with Ammonia at ERL, Narragansett. Memo to D.J.Hansen, U.S.EPA, Narragansett, RI :18 p.

LC50 Crustaceans (48 hours)

Minimum: 2,08 mg/l

Maximum: 903 mg/l

Median: 22,8 mg/l

Study number: 25

Reference for median:

Lin, H.P., G. Charmantier, and J.P. Trilles 1991. Ammonia Toxicity to Different Developmental Stages of *Penaeus japonicus* (Crustacea, Decapoda) and Its Effects on Osmoregulation. C.R.Acad.Sci.Ser.III 312(3):99-105

Reference: 02072

OCCUPATIONAL HEALTH AND FIRST AID

[Routes of exposure](#) | [Toxic effects](#) | [First Aid](#)

ROUTES OF EXPOSURE

Main routes of exposure

The main intake pathway for ammonia (A.) is via the respiratory tract.[07619]

Respiratory tract

On account of its high solubility in water A. is absorbed mainly in the upper respiratory tract. In the first few minutes almost the entire inhaled amount of A. is retained by the mucous membranes (mainly the nasal mucous membranes).[07619]

Thereafter the retained portion sinks rapidly until a status of equilibrium is reached. Among volunteers who were exposed to 500 ppm of A., the retained proportion after 30 minutes amounted to only 4 - 30% (mean value 23%).[00083]

The respiratory minute volume, which is affected by A. dependent on concentration and length of exposure, has a significant effect on the amount of A. absorbed.[07619]

Skin

Although kinetic data are not available, absorbability via the skin is assumed on account of the known deep-reaching tissue-damaging potential of A. As far as the absorption of toxic doses is concerned, this intake pathway is not accorded any significance.[07619]

Gastrointestinal tract

Oral intake of solutions in water is considered possible in principle, but not for A. in water-free, liquid form.[99999]

In principle, however, systemically relevant doses may be absorbed via the digestive tract.[07619]

TOXIC EFFECTS

Main toxic effects

Acute:

Severely irritative/corrosive effects to the eyes, respiratory tract and skin, danger of severe damage to the eyes and respiratory tract

Chronic:

Chronic respiratory irritation/respiratory complaints[07619]

Acute toxicity

The clinical poisoning picture of A. is characterized mainly by its extremely severe local effects, in particular effects on the eyes and upper respiratory tract. Severe tissue damage results from its highly effective penetrative ability.[07619]

Even low concentrations of A. in gas form irritate the upper mucous membranes of the eye (lacrimation, burning sensation, sharp pain, conjunctivitis). Concentrated gas or splashes of liquid A. cause severe eye damage (loss of the corneal epithelia, damage to the iris, cataract, glaucoma), which may occur after a latency period of up to ten days. There is a risk of blinding or permanent degenerative damage to the eyes.[99983]

Splashes of liquid A. cause severe corrosive damage to the skin (the cooling effect increases this damage).[07656]

After exposure of the skin to gaseous A. in concentrations of 1 Vol% slight irritation was observed; exposure to 3 Vol% for a few minutes caused severe pain with corrosion and blistering.

Inhalative exposure causes irritation in the respiratory tract, initially in particular to the upper airways. Minor exposure results in dryness of the nose and eyes, irritation to the nose and throat, and subjective sense of unpleasant smell. Initial exposure of as little as 20 - 30 ppm A. can cause slight irritation. After accustomization (which may occur within a matter of hours or over a longer term of 1 - 2 weeks) higher exposure at least up to 100 ppm can be tolerated. A level of 300 ppm is probably intolerable even after an acclimatization period. Symptoms registered at high levels of exposure are: cough, breathing difficulties, increased breathing rate, nausea, vomiting, disturbed sense of smell, later also inflammation of the respiratory passages (laryngitis, tracheobronchitis). [07619]

In isolated cases, delayed-onset asthmatic symptoms with persistent bronchial hyperreactivity (respiratory airways dysfunction syndrome: RADS) have been observed.[99996]

Inhalation of very high concentrations of approx. 1700 ppm and upwards may be lethal as a result of damage to the respiratory tract (possibly without a latency period: glottic edema, laryngospasm, pulmonary edema, broncho-pneumonia) and reflexive respiratory and heart failure.[07619]

If severe poisoning is survived, protracted chronic respiratory complaints often present themselves. Lung function (for example vital capacity) may be limited for many years.[07748]

Severe poisoning is, however, rare on account of the pronounced olfactory warning.[07978]

Chronic toxicity

According to experience from occupational exposure, the critical effects of A. are irritation to mucous membranes, in particular the respiratory passages, also following long-term exposure.[07619]

There are also various reports of increases in respiratory symptoms (increased bronchial reactivity/hyperreactivity, cough, labored breathing, shortness of breath, inflammation) and restricted lung function among those exposed to A. whilst employed in animal breeding centers. However, only a few studies are available in which the relationship has been systematically examined or in which the influence of mixed exposure has been excluded.

In a study on workers in two urea production facilities, those exposed to A. from an average of 25 ppm (3 - 182 ppm) showed a significantly high incidence of respiratory symptoms (cough, phlegm production, wheezing, shortness of breath) as well as bronchial asthma. Persons subject to very high levels of exposure also coughed up blood. The relative risk of the 4 first-mentioned symptoms (above) as well as asthma and chronic bronchitis rose in relation to the cumulative exposure level above 70 ppm-years. In the second factory where exposure lay in the range of 0.03 - 10 ppm, respiratory symptoms were not significantly raised. There are reports of non-specific bronchial hyperreactivity with cough, reduced maximum expiratory flow rate, rhinitis and lacrimation in individual cases of exposure after relatively low exposure to A. (e.g. 8 - 15 ppm) over a period of several months. Very high exposure (30 - 400 ppm A.) over many years is reported to have led to interstitial fibrosis.[99996]

In establishing thresholds for workplaces, the following studies in particular were taken into account. 25 volunteers (apprentices) exposed to 12 - 17 ppm showed an increased error rate while solving complex problems, which at 17 ppm was equivalent to the disruption effect of 90 db(A) noise disturbance. Workers from a sodium carbonate producing factory who were exposed to mean ammonia concentrations of 9.2 +/- 1.4 ppm (maximum approx. 25 ppm) for 12.2 +/- 8.9 years showed no significant deviation from the control group regarding the lung function parameters tested (FVC, FEV1, FEF50, FEF75) and sense of smell.

There are no indications of a significant skin sensitizing potential of A. The two older existing reports of urticaria in two workers exposed to A. were not substantiated in similar newer studies.[07619]

Reproductive toxicity, mutagenicity, carcinogenicity

For classifying the reproductive toxicity and mutagenic and carcinogenic potential see list in Annex VI of the CLP regulation / TRGS 905 / List of MAK values (see section REGULATIONS).

Reproductive toxicity:

There is no reason to fear a risk of damage to the developing embryo or foetus when MAK and BAT values are observed.

This assessment is based primarily on the estimation that at the relevant concentration level the potential uptake of exogenous ammonia is considerably lower than the amount of A. which is formed endogenously in the intestinal tract.

In addition the detoxification capacity of the liver is assessed as sufficient.

Mutagenicity:

There are no reliable in-vitro or in-vivo test results available. Results from cytogenetic experiments on small groups of occupationally-exposed persons do not permit conclusions to be drawn on account of mixed exposure.[07619]

Carcinogenicity:

Insufficient data is available.[99983]

In an experiment on rats which inhaled the vapors of a 12% solution of A., neoplastic changes to the nasal tissues were observed, however only in conjunction with toxic cell damage and chronic inflammation. Epidemiological studies do not permit conclusions to be drawn for A. (alone) on account of mixed exposure.[99996]

Biotransformation and excretion

Inhaled A. is apparently exhaled unchanged to a large extent. There are no detailed studies available on the kinetics of the retained portion within the body. Based on the knowledge available for endogenous A., it is assumed that A. is distributed rapidly to all parts of the body via the blood circulation. A. from exogenous sources can be involved in physiological metabolism as is the case for endogenous A. An excess is quickly excreted (primarily with the urine) or metabolized in the liver to form glutamine and urea. Detoxification is also possible in other tissues.

Biomonitoring for persons occupationally exposed to A. is considered to be of little value on account of the high level of endogenous A. produced and the adaptive metabolism of A. It is estimated that inhalative exposure to 25 ppm A. would increase the level of endogenous A. in the body by approx. 10%, calculated from the level achieved without ingestion of food.[99996]

Annotation

This occupational health information was compiled on 06.05.2008.

It will be updated if necessary.

FIRST AID

Eyes

As soon as possible:

Rinse the affected eye with widely spread lids for 10 minutes under running water whilst protecting the unimpaired eye.

Then, immediately transport the casualty to an eye doctor / to hospital.

[07979, 00330, 00022]

Skin

Whilst protecting yourself, relocate the casualty away from the source of danger.

Remove contaminated clothing while protecting yourself.

If clothing has become frozen to the body following contact with liquid ammonia, leave such clothing in place for the time being.

Rinse the affected skin areas for at least 10 to 20 minutes under running water.

Arrange for medical treatment.

In most cases priority will need to be given to the concurrent massive inhalation damage (for measures to be taken, see below).

[00330, 99999]

Respiratory tract

Whilst protecting yourself remove the casualty from the hazardous area and take him to the fresh air. Lay the casualty down in a quiet place and protect him against hypothermia. As soon as possible repeatedly have the casualty deeply breathe a glucocorticoid inhalation spray in. In the case of breathing difficulties have the casualty inhale oxygen. Allow the patient to take a semi-seated position in cases of shortness of breath. If the casualty is unconscious but breathing lay him in a stable manner on his side. For respiratory arrest, carry out artificial ventilation if possible with a breathing apparatus; in every case the first aider must pay attention to protect himself. In case of cardiac arrest (no response and no normal breathing), immediately perform chest compressions and ventilation. If available, use Automated External Defibrillator (AED). The protection of the vital functions (respiration and circulation) takes priority over all other measures. In the meantime call an emergency physician to the site of the accident in all cases. [00022]

Swallowing

Oral intake of water-free liquid A. is highly unlikely, even in small quantities. If such a case should occur:

Rinse the mouth and spit the fluids out.

Lay the casualty down in a quiet place and protect him against hypothermia.

If possible and if the patient remains conscious, have him/ her slowly sip a glass of water. Conduct further measures as for inhalation (see above).

Information for physicians

- Symptoms of acute poisoning:

Eyes: burning/stabbing pains, lacrimation, conjunctivitis; at high concentrations blepharospasm (self-protective mechanism), mainly delayed onset of edema/opacity of the cornea, loss of the epithelium, iritis, cataract, glaucoma, irreversible damage to the eyes caused primarily by splashes of liquid ammonia[07979]

Skin: irritation through to corrosion; following contact with liquid ammonia, damage due to freezing is also possible[00160]

Inhalation: irritation to the nose and throat, cough, breathing difficulties, hyperpnea, nausea, vomiting,[07619] later inflammation of the respiratory passages, possibly asthmatic symptoms; [99996] following massive exposure, rapid onset of glottic edema, laryngo/bronchospasm, reflexive respiratory/cardiac arrest; pulmonary edema, pneumonia (also as sequela).

- Medical advice:[07619]

If A. comes into contact with the eyes, thorough specialist care is required after initial first aid (rinsing, treatment of pain) is completed.[00022]

Skin damage should be treated according to symptoms after thorough rinsing of the affected area. [99999]

In most cases treatment of the effects of inhalation will be of primary importance. Following massive inhalation the administration of glucocorticoids (inhalative, i.v.) and oxygen are indicated. Codeine may be administered to treat irritative cough.

Artificial ventilation is indicated in cases of respiratory failure or laryngo/bronchospasm - additionally, administer bronchodilators in cases of bronchospasm. If there is a risk of pulmonary edema, use limited-pressure ventilation where possible. In all cases immobilize the patient and monitor the cardiopulmonary system carefully. Infuse plasma expanders where signs of shock are present. Transport the casualty to hospital as soon as possible (even when symptoms are slight or absent).[07978]

Similar measures as for inhalation will be required in the highly unlikely event of the oral intake of liquid gas, on account of its immediate evaporation, in particular prophylaxis for glottic edema is likely to be necessary. Further decisions relating to treatment should be taken on an according to the prevailing situation in each case.[00160]

After hospitalization, primary monitoring and treatment should include continuation of glottic/pulmonary edema prophylaxis, followed by pneumonia prophylaxis, monitoring of the O₂-/CO₂-partial pressure in the blood, cardiopulmonary parameters, blood clotting status and electrolyte levels.

Long-term observation is necessary with regard to pulmonary sequelae and/or pulmonary function disturbances.[07978]

Recommendations

Provide the physician information about the substance/product and treatment already administered.

Annotation

This first aid information was compiled on 06.05.2008.
It will be updated if necessary.

SAFE HANDLING

[Handling](#) | [Storage](#) | [Fire and explosion protection](#) | [Organisational measures](#) | [Personal protection](#) | [Disposal considerations](#) | [Accidental release measures](#) | [Fire fighting measures](#)

TECHNICAL MEASURES - HANDLING

Workplace

Provision of very good ventilation in the working area.

Install a ceiling exhaust.

Provide devices for detecting and reporting gas hazards (gas detectors with alarm triggering).

Ensure gas concentrations in the ambient air are sufficiently below the occupational exposure limit.

Eye bath required. These locations must be signposted clearly.

Equipment

Handle gas in a closed system.

Provide safety valves in gas installations.

Installation of a cross purge assembly between the cylinder and the regulator is recommended.

Purge system with dry inert gas (e.g. helium or nitrogen) before gas is introduced and when system is placed out of service.

Check the entire gas system for leaks before use and regularly thereafter!

Avoid gas leakage to the atmosphere.

Excess pressure must be vented through an appropriate scrubber system.

Use small cylinders and place them away from working area or in an exhausting hood.

Consider emission limit values, a purification of waste gases if necessary.

Label containers and pipelines clearly.

There should be a shutoff for the lines at a safe distance.

Suitable materials:

All common materials are suitable for cylinders and valves, with the exception of:

Copper

Copper alloys

(e.g. brass)

(Risk of stress corrosion in humid air)

Suitable for seals or as nonmetallic materials are:

Polytetrafluoro ethylene PTFE (Teflon)

Polychloro trifluoro ethylene PCTFE

Polyamide PA

Polypropylene PP

Polyoxomethylene POM

Polyether ether ketone PEEK

Polypropylene sulfide PPS

Polyvinyl chloride

Butyl rubber IIR

Polychloroprene rubber CR

Ethylene/Propylene-Diene-Terpolymers EPDM

Fluorocarbon lubricant FC

Molybdenum disulfide lubricant (MoS₂)

Advice on safer handling

Avoid exposure - obtain special instructions before use.

Do not store cylinders at the working area.

Protect gas cylinders from mechanical damage; do not pull, roll, push or drop.

Always use a gas cylinder trolley or other suitable equipment to transport gas cylinders.

Transport in elevators together with persons is prohibited.

Tightly screw on the protective caps and blind nuts when transporting.

Do not lift the gas cylinder by the valve protection cap or the valve protection ring.

When changing bottles, always inspect the leak-proof closure of the filled and empty bottles.

Prevent cylinders from falling over.

Do not remove the valve protection cap until the bottle has been placed against a wall or laboratory bench or on a bottle stand and is ready for use.

Open valves slowly to avoid pressure surges, do not force open.

Close valves after each use and after draining.

Replace the caps or nuts and valve protection cap as soon as the container is separated from the system.

Do not allow backfeed of gas into the container.

Avoid backflow of water or other liquids into the gas container.

Purge air from equipment before introducing the gas.

Never transfer gas from one container to another!

Never use flames or electric heaters to increase pressure in the container!

Cleaning and maintenance

Regular inspection of leak test required!

Check hoses at least every half-year.

Keep valve connections of the container clean and free of impurities, especially free of oil and water.

Never attempt to repair valves or safety pressure relief devices on the tank. Damage to these devices must be reported immediately to the supplier.

Consider work permit procedures e.g. for maintenance work.

Only work with vessels and lines after they have been thoroughly rinsed.

TECHNICAL MEASURES - STORAGE

Storage

Keep in locked storage or only make accessible to specialists or their authorised assistants.

Keep container tightly closed.

Store container below 50 °C in a well-ventilated place.

Store containers upright and protect against falling over.

A valve protection cage should be provided or the valve protection cap should be fitted.

Check stored cylinders regularly for leaks and correct storage conditions.

Segregate from oxidant gases and other oxidants.

Keep away from combustible materials.

The containers should be stored in a place without fire hazard and away from heat and ignition sources.

Protect from exposure to sunlight.

Do not store the containers under conditions that accelerate corrosion.

All electrical equipment in the storage areas should be compatible with the risk of a potentially explosive atmosphere.

Do not store in escape routes, work rooms, or in direct proximity to them.

Any gases that escape from storage rooms for toxic gases must be capable of being safely drawn off or collected and then disposed of. The facilities must be capable of being operated from a safe location.

Filling and decanting in storage rooms is prohibited.

Conditions of collocated storage

Storage class 2 A (Gases)

Only substances of the same storage class should be stored together.

Collocated storage with the following substances is prohibited:

- Pharmaceuticals, foods, and animal feeds including additives.
- Infectious, radioactive und explosive materials.
- Flammable liquids of storage class 3.
- Other explosive substances of storage class 4.1A.
- Flammable solid substances or desensitized substances of storage class 4.1B.
- Pyrophoric substances.
- Substances liberating flammable gases in contact with water.
- Strongly oxidizing substances of storage class 5.1A.
- Oxidizing substances of storage class 5.1B.
- Organic peroxides and self reactive substances.
- Combustible and non combustible acutely toxic substances of storage classes 6.1A and 6.1B.
- Combustible toxic or chronically acting substances of storage class 6.1C.
- Noncombustible toxic or chronically acting substances of storage class 6.1D.
- Combustible liquids of storage class 10.

Under certain conditions the collocated storage with the following substances is permitted (For more details see [TRGS 510](#)):

- Aerosols (spray bottles).
- Ammonium nitrate and preparations containing ammonium nitrate.
- Combustible corrosive substances of storage class 8A.
- Combustible solids of storage class 11.

Observe special regulations for the combined storage of different gases according to [TRGS 510](#).

TECHNICAL MEASURES - FIRE AND EXPLOSION PROTECTION

Technical, constructive measures

Substance is combustible.

Only high temperature or a strong source of energy lead to ignition.

Fire fighting equipment must be available.

Inspect the electrical fittings regularly against the higher risk of corrosion.

The possibility of the formation of a hazardous explosive atmosphere must be evaluated in the risk assessment. Depending on the result of the risk assessment, measures in accordance with [TRGS 722](#) (prevention of formation), [TRGS 723](#) (prevention of ignition) and [TRGS 724](#) (constructive explosion protection) may be required.

Take precautionary measures against static discharges.

Earth all parts which can be electrically charged.

Protect from any warming; if necessary provide cooling by water sprinkling.

Precaution on handling

The gas-air mixture is explosive.

Area with explosion risk.

Keep at a distance from sources of ignition (e.g. electrical devices, open flames, heat sources, sparks).

Observe the smoking prohibition!

Absolutely no welding in the working area.

Only work with vessels and lines after these have been thoroughly rinsed and inerting.

Before introducing gas, purge equipment with inert gas to remove air.

Displace contents with inert gas before cleaning and repair.

Work done with fire or open flame should only be carried out with written permission if the risk of fire or explosion cannot be completely eliminated.

Do not use any tools that cause sparks.

ORGANISATIONAL MEASURES

Compressed gases may only be handled by experienced and appropriately instructed persons.

Instruction on hazards and protective measures based on the operating instructions ([TRGS 555](#)) with signature required.

Instruction must be provided before employment and then at a minimum of once per annum thereafter.

An escape and rescue plan must be prepared when the location, scale, and use of the work-site so demand.

It must be assured that the workplace limit values are being maintained. If the limit values are exceeded, additional protection measures are necessary.

The measurements must be recorded and kept on file.

The number of employees who work with the hazardous substance must be kept to a minimum.

Observe the restrictions on juvenile employment as defined in the "Jugendarbeitsschutzgesetz".

Observe the restrictions on activities of pregnant women according to the the „Mutterschutzgesetz“ (German Maternity Protection Act)

Only employees are permitted to enter the work areas. Signposting to this effect must be displayed.

PERSONAL PROTECTION

Body protection

Keep suitable chemically resistant protective clothing readily available for emergency use.

Wear flameproof, antistatic protective clothing.

Use protective boots while handling gas cylinders.

Respiratory protection

In an emergency (e.g.: unintentional release of the substance, exceeding the occupational exposure limit value) respiratory protection must be worn. Consider the maximum period for wear.

Respiratory protection: Gas filter K, colour code green.

Use insulating device for concentrations above the usage limits for filter devices, for oxygen concentrations below 17% volume, or in circumstances which are unclear.

Eye protection

Wear safety goggles with side protection.

Wear basket goggles and face protection when transferring or connecting and disconnecting.

Hand protection

Work gloves must be worn when handling compressed gas cylinders.

If there is a risk of substance contact, chemical-resistant protective gloves are required.

Currently there is no information available regarding suitable glove materials for ammonia gas.

Ask the manufacturer for suitable materials.

The Data on ammonia solution can be used for orientation.

The following data is for a solution of 32% ammonia:

The following materials are suitable for protective gloves (Permeation time \geq 8 hours):

Butyl rubber - Butyl (0,5 mm)

Protective gloves of the following materials should not be worn longer than 2 hours continually (Permeation time \geq 2 hours):

Fluoro carbon rubber - FKM (0,4 mm)

Protective gloves of the following materials should not be worn longer than 1 hour continually (Permeation time \geq 1 hour):

Polychloroprene - CR (0,5 mm)

Following materials are unsuitable for protective gloves because of degradation, severe swelling or low permeation time:

Natural rubber/Natural latex - NR

Nitrile rubber/Nitrile latex - NBR

Polyvinyl chloride - PVC

The times listed are suggested by measurements taken at 22 °C and constant contact. Temperatures raised by warmed substances, body heat, etc. and a weakening of the effective layer thickness caused by expansion can lead to a significantly shorter breakthrough time. In case of doubt contact the gloves' manufacturer. A 1.5-times increase / decrease in the layer thickness doubles / halves the breakthrough time. This data only applies to the pure substance. Transferred to mixtures of substances, these figures should only be taken as an aid to orientation.

Occupational hygiene

Do not smoke when handling the gas or pressure vessels.

Do not inhale gas, danger to life.

Change and air out clothing that has been in contact with or taken up any of the gas.

DISPOSAL CONSIDERATIONS

Hazardous waste according to Waste Catalogue Ordinance (AVV).

Compressed gas cylinders can normally be returned to the supplier. Pressurised cans are non-returnable and must be disposed of.

Do not empty pressure vessels to the point of pressure compensation. Mark empty vessels to avoid confusion with full ones.

ACCIDENTAL RELEASE MEASURES

Shut off all sources of ignition.

Provide adequate ventilation.

Evacuate area. Warn affected surroundings.

To eliminate the hazardous condition, the hazardous area may only be entered with a suitable chemical protection suit and self-contained breathing apparatus.

Attempt to stop the gas from escaping. Otherwise place leaky bottles under a suctioning device or put them outdoors.

Monitor the concentration of the released gas.

Consider the risk of potentially explosive atmospheres.

Knock down escaping gas with water mist or fine spray jet.

If liquefied gas leaks from defective pressure vessels, evacuate area until all the leaked liquid has evaporated (soil is free of frost).

Rinse equipment in contact with the gas or the area around the leak with plenty of water.

If gas is released outside, stay on the side facing the wind.

Endangerment of water:

Distinct hazard to waters. Prevent penetration into water, drainage, sewer, or the ground. Inform the responsible authorities about penetration of larger quantities.

FIRE FIGHTING MEASURES

Classes of fires

C gaseous, also compressed substances

Suitable extinguishing media

Water (spray - not splash)

Dry extinguishing powder

Foam

Unsuitable extinguishing media

Carbon dioxide

Instructions

In the case of fire advise fire fighters on the presence of gas cylinders.

Cool endangered pressure vessels with water spray from a protected position.

If possible, take container out of dangerous zone.
Heating causes a rise in pressure, risk of bursting and explosion.
Shut off sources of ignition.
Only put out fire if the gas flow can be interrupted.
Risk of explosion from gas accumulation and backfire.
Contain escaping gases with water spray.
Be watchful for frostbite in case of contact with fluid.
Do not allow runoff to get into the sewage system.

Special protective equipment

In the case of a fire hazardous substances can be released.
Nitrous gases (nitric oxides)
Wear self-contained breathing apparatus and special tightly sealed suit.

REGULATIONS

[GHS Classification/ Labelling](#) | [Colour coding of gas cylinders](#) | [Workplace labelling](#) | [Water hazard class](#) | [Air quality control](#) | [Transport Regulations](#) | [Threshold limit values](#) | [EC-Threshold limit values](#) | [MAK recommendations](#) | [SevesoIII](#) | [Restriction of use](#) | [Technical rules](#) | [Regulations of accident insurers](#)

EUROPEAN GHS CLASSIFICATION AND LABELLING

Classification

Flammable gases, Category 2; H221
Gases under pressure, liquefied gas; H280
Acute toxicity, Category 3, inhalation; H331
Skin corrosion, Category 1B; H314
Serious eye damage, Category 1; H318
Hazardous to the aquatic environment, Acute Category 1; H400
Hazardous to the aquatic environment, Chronic Category 2; H411



Signal Word "Danger"

Hazard Statement - H-phrases

H221: Flammable gas.
H280: Contains gas under pressure; may explode if heated.
H331: Toxic if inhaled.
H314: Causes severe skin burns and eye damage.
H410: Very toxic to aquatic life with long lasting effects.

Supplemental Hazard Statement - EUH-phrases

EUH071: Corrosive to the respiratory tract.

Precautionary Statement - P-phrases

P210: Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.

P260: Do not breathe gas/vapours.

P273: Avoid release to the environment.

P280: Wear protective gloves/protective clothing/eye protection/face protection.

P303+P361+P353+P315: IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water or shower. Get immediate medical advice/attention.

P304+P340+P315: IF INHALED: Remove person to fresh air and keep comfortable for breathing. Get immediate medical advice/attention.

P305+P351+P338+P315: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Get immediate medical advice/attention.

P377: Leaking gas fire: Do not extinguish, unless leak can be stopped safely.

P381: In case of leakage, eliminate all ignition sources.

P405: Store locked up.

P403: Store in a well-ventilated place.

Other hazards:

Contact with the evaporating liquid can cause frostbite on skin.

Manufacturer's specification by Linde

Reference: [01411](#)

State: 2020

Checked: 2020

The substance is listed in appendix VI, table 3 of CLP regulation.

The given classification can deviate from the listed classification, since this classification is to be complemented concerning missing or divergent danger classes and categories for the respective substance.

Reference: [99999](#)

GHS-CLASSIFICATION OF MIXTURES

The classification of mixtures containing this substance results from Annex 1 of Regulation (EC) 1272/2008.

Reference: [07500](#)

COLOUR CODING OF GAS CYLINDERS



Cylinder shoulder colour:
Yellow
(toxic and/or corrosive gases)

WORKPLACE LABELLING ACCORDING TO GERMAN [ASR A1.3](#)

Prohibition label



No Smoking



No admittance for unauthorized persons

Warning label



Caution - toxic material



Caution - corrosive material



Caution - gas cylinder

Precept label



Use safety goggles



Wear safety shoes



Wear safety gloves

GERMAN WATER HAZARD CLASS

Substance No: 211

WGK 2 - distinct hazard to waters

Classification according to the announcement of the list of substances hazardous to water in the Federal Register of 10.08.2017, last update 24.11.2023

TECHNICAL INSTRUCTIONS ON AIR QUALITY CONTROL ([TA LUFT](#))

Chapter 5.2.4 Gaseous inorganic substances

Class III

Following values are not allowed to be exceeded in the exhaust gas

Mass flow: 0,15 kg/hr

or

Mass conc.: 30 mg/m³

TRANSPORT REGULATIONS

UN Number: 1005

Shipping name: Ammonia,
anhydrous

Hazard Identification Number: 268

Class: 2.3 (Toxic gases)

Packing Group: -

Danger Label: 2.3/8



Special labelling: Symbol (fish and tree)



Classification code: 2TC

Tunnel restrictions:

Transports in tanks: passage forbidden through tunnels of category C, D und E.

Other transports: passage forbidden through tunnels of category D and E.

Reference: [07902](#)

TRGS 900 - GERMAN OCCUPATIONAL EXPOSURE LIMIT VALUES

20 ml/m³

14 mg/m³

Peak limitation: Excursion factor 2

Duration 15 min, mean; 4 times per shift; interval 1 hour

Category I - Substances for which local irritant effects determine the exposure limit value, also respiratory allergens

There is no reason to fear a risk of damage to the developing embryo or foetus when AGW and BGW are adhered to.

Source: DFG, EU

EC OCCUPATIONAL EXPOSURE LIMIT VALUES

Directive 2000/39/EC

Recommended indicative occupational exposure limit value for the European Union

A national occupational exposure limit value has to be set.

8 hours limit value: 14 mg/m³ (20 ppm)

Short term limit value: 36 mg/m³

RECOMMENDATIONS OF MAK-COMMISSION

This data is recommended by scientific experience and is not established law.

20 ml/m³

14 mg/m³

Peak limitation: Excursion factor 2

Duration 15 min, mean; 4 times per shift; interval 1 hour

Category I - Substances for which local irritant effects determine the exposure limit value, also respiratory allergens

Pregnancy: Group C

There is no reason to fear damage to the embryo or foetus when MAK and BAT values are observed.

DIRECTIVE 2012/18/EU (Seveso III)

The substance is subject to the hazard categories of the Hazardous Incident Ordinance:

- H2 Acute toxic, Category 2 (all exposure routes) or Category 3 (inhalation exposure route) or Category 3 (oral route if neither acute inhalation toxicity classification nor acute dermal toxicity classification can be derived)
- P2 Flammable gases, Category 1 or 2
- E1 Hazardous to the aquatic environment, Category Acute 1 or Chronic 1

The substance is mentioned by name in Annex 1:

35: Ammonia, anhydrous

Quantity thresholds for determination of operation scopes:

Annex I Part 2 Number: 35

Anhydrous Ammonia

The quantity thresholds specified in Annex 1, Part 2 are to be used:

Qualifying quantity for the application of

Lower-tier requirements: 50 t

Upper-tier requirements: 200 t

RESTRICTIONS OF USE / BANS OF USE

REACH Regulation (EC) No 1907/2006 Annex XVII

Annex XVII, Point 40

Shall not be used, as substance or as mixtures in aerosol dispensers where these aerosol dispensers are intended for supply to the general public for entertainment and decorative purposes such as the following:

- metallic glitter intended mainly for decoration,
- artificial snow and frost,
- “whoopee” cushions,
- silly string aerosols,
- imitation excrement,
- horns for parties,
- decorative flakes and foams,
- artificial cobwebs,
- stink bombs.

Further information on prohibitions and exceptions can be taken from the regulation.

Annex XVII, Point 75

Mixtures containing certain hazardous substances shall no longer be placed on the market for tattooing purposes. Mixtures containing such substances in specified concentrations shall no longer be used for tattooing purposes after 04.01.2022. Substances falling within one or more of the following points:

- carcinogenic or reproductive toxic substances according to Part 3 of Annex VI to CLP Regulation (excluding the classification due to effects only following exposure by inhalation),
- skin-sensitising, skin-corrosive, skin-irritant, serious eye-damaging or eye-irritant substances according to Annex VI Part 3 of the CLP Regulation,
- substances listed with specified conditions in Annex II or IV to Regulation (EC) No 1223/2009 [Cosmetics Regulation], and
- substances listed in Appendix 13 to Annex XVII (point 75) of the REACH Regulation.

In general, mixtures placed on the market for use for tattooing purposes must be labelled "Mixture for use in tattoos or permanent make-up." from 04.01.2022 on and may not be used for tattooing purposes without this labelling. Further safety information shall be provided on the packaging or in the instructions for use. Before using a mixture for tattooing purposes, the person using the mixture shall provide this information to the person undergoing the procedure.

Further information on the restrictions, concentration limits and exemptions can be taken from the Regulation.

Annex XVII to Regulation (EC) No 1907/2006, [consolidated version](#) (BAUA) (only in German)

TECHNICAL RULES FOR HAZARDOUS SUBSTANCES

[TRGS 201](#)

Einstufung und Kennzeichnung bei Tätigkeiten mit Gefahrstoffen; Ausgabe Februar 2017, zuletzt geändert und ergänzt April 2018

[TRGS 400](#)

Gefährdungsbeurteilung für Tätigkeiten mit Gefahrstoffen; Ausgabe Juli 2017

[TRGS 555](#)

Betriebsanweisung und Information der Beschäftigten; Ausgabe Februar 2017

[TRGS 600](#)

Substitution; Ausgabe Juli 2020

[TRGS 402](#)

Ermitteln und Beurteilen der Gefährdungen bei Tätigkeiten mit Gefahrstoffen: Inhalative Exposition; Ausgabe September 2023

[TRGS 401](#)

Gefährdung durch Hautkontakt, Ermittlung - Beurteilung - Maßnahmen; Ausgabe Oktober 2022

[TRGS 407](#)

Tätigkeiten mit Gasen - Gefährdungsbeurteilung; Ausgabe Februar 2016, geändert und ergänzt Oktober 2016

[TRGS 745](#)/TRBS 3145

Ortsbewegliche Druckgasbehälter - Füllen, Bereithalten, innerbetriebliche Beförderung, Entleeren; Ausgabe Februar 2016

[TRGS 746](#)/TRBS 3146

Ortsfeste Druckanlagen für Gase; Ausgabe September 2016

[TRGS 510](#)

Lagerung von Gefahrstoffen in ortsbeweglichen Behältern; Ausgabe Dezember 2020

[TRGS 500](#)

Schutzmaßnahmen; Ausgabe September 2019

[TRGS 800](#)

Brandschutzmaßnahmen; Ausgabe Dezember 2010

REGULATIONS OF GERMAN ACCIDENT INSURERS

[DGUV Regel 112-190](#)

Benutzung von Atemschutzgeräten, Ausgabe November 2021
(in German only)

LINKS

[International Limit Values](#)

[OECD Screening Information DataSet \(SIDS\)](#)

[The MAK Collection for Occupational Health and Safety](#)

[Principles for the Safe Handling and Distribution of Highly Toxic Gases and Mixtures \(IGC Doc 130/11/E\)](#)

[Safe Transfer of Toxic Liquefied Gases \(IGC Doc 188/14/E\)](#)

[Publications of the IGTV \(Industriegaseverband e.V.\) \(in German only\)](#)

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[TRGS 510](#) "Lagerung von Gefahrstoffen in ortsbeweglichen Behältern" Ausgabe Dezember 2020

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Angabe des Bearbeiters

Indication of the editor

[Identification](#) | [Characterisation](#) | [Formula](#) | [Physical and chemical properties](#) | [Toxicology / Ecotoxicology](#) | [Occupational health and first aid](#) | [Safe handling](#) | [Regulations](#) | [Links](#) | [Literature register](#)

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