

Hydrogen cyanide



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

IDENTIFICATION

Hydrogen cyanide

Formonitrile
Prussic acid

ZVG No: 12450
CAS No: 74-90-8
EC No: 200-821-6
INDEX No: 006-006-00-X

CHARACTERISATION

SUBSTANCE GROUP CODE

128200 Cyanides

STATE OF AGGREGATION

The substance is liquid.
Boiling point is in the range of room temperature.

PROPERTIES

colourless
bitter almond-like odour

CHEMICAL CHARACTERISATION

Extremely flammable liquid.
Vapours form explosive mixtures with air.
To avoid hazardous reactions the substance has to be pure and a sufficient amount of a suitable stabilizer has to be added.
Mixable with water.
Highly volatile.
Although the substance is liquid at room temperature, it is subject to the regulations for pressure gas.
Acute or chronic health hazards result from the substance.
The substance is hazardous to the aquatic environment.

[Substance information in Wikipedia](#)

FORMULA

HCN

CHN

$\text{H}-\text{C}\equiv\text{N}$

Molar mass: 27,03 g/mol

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

1 ml/m³ = 1,12 mg/m³

PHYSICAL AND CHEMICAL PROPERTIES

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

TRIPLE POINT

Temperature: -13,3 °C

Pressure: 0,187 bar

Reference: 00260

MELTING POINT

Melting point: -13 °C

Reference: 00440

BOILING POINT

Boiling Point: 26 °C

Reference: 00440

CRITICAL DATA

Crit. temperature: 183,7 °C

Crit. pressure: 53,9 bar

Crit. density: 0,195 g/cm³

Reference: 00260

DENSITY

DENSITY

Value: 0,69 g/cm³

Temperature: 20 °C

Reference: 00440

DENSITY OF LIQUID PHASE AT BOILING POINT

Value: 0,667 kg/l

Reference: [00260](#)

RELATIVE VAPOUR DENSITY

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

Value: 0,93

Reference: [00440](#)

VAPOUR PRESSURE

Vapour pressure: 817 hPa

Temperature: 20 °C

Reference: [00446](#)

Vapour pressure: 1190 hPa

Temperature: 30 °C

Reference: [00446](#)

Vapour pressure: 2,5 bar

Temperature: 50 °C

Reference: [00106](#)

Vapour pressure: 1690 hPa

Temperature: 40 °C

Reference: [00446](#)

FLASH POINT

Flash point: < -20 °C

Closed cup

Reference: [00440](#)

IGNITION TEMPERATURE

Ignition temperature: 535 °C

Temperature class: T1

Reference: [00440](#)

EXPLOSION DATA

Lower explosion limit:

5,4 vol.%

60 g/m³

Upper explosion limit:

46,6 vol.%

520 g/m³

Max. exper. safe 0,8 mm
gap (MESG):

Explosion IIB
group:

Maximum explosion pressure:

10,2 bar

Reference: [00440](#)

SOLUBILITY IN WATER

mixable with water

PARTITION COEFFICIENT (octanol/water)

log Kow: -0,2

Recommended value of LOG KOW Databank.

Reference: 02070

HAZARDOUS REACTIONS**Hazardous chemical reactions**

This substance is very reactive and polymerizes spontaneously, unless a stabilizing agent is added. The exothermic polymerization reaction can speed up to explosion, when the temperature exceeds 180 degree C.

Various impurities as well as heat or pressure may act as polymerization initiators.

In the following it is not discriminated between the kinds of the hazardous reactions, because all the listed substances cause strong exothermic reactions and therefore comprise the danger of explosion:

The substance can react dangerously with:

amines
ammonia
chlorine
fluorine
oxidizing agents
oxygen
acids
acetaldehyde
alkalies
ammonium chloride
chlorates (heat)
metal oxides
sodium cyanide
nitrites (heat)
polymerisation initiators
hydrochloric acid
heat
water (2-5%), alkalis (heat)

TOXICOLOGY / ECOTOXICOLOGY**ECOTOXICOLOGICAL DATA****LC50 Fish (96 hours)**

Minimum: 0,028 mg/l
Maximum: 0,157 mg/l
Median: 0,0925 mg/l
Study number: 12

Reference for median:

Kovacs, T.G. 1979. The Effect of Temperature on Cyanide Toxicity to Rainbow Trout (*Salmo gairdneri*) Part I: Acute Toxicity Part II: Sub-lethal Toxicity. ^{2E} Concordia University, Montreal, Quebec, Canada :69 p. (Author Communication Used); Broderius, S.J., ^{2E} Jr., and ^{2E} 1977. Relative Toxicity of Free Cyanide and Dissolved Sulfide Forms to the Fathead Minnow (*Pimephales promelas*). J.Fish.Res.Board Can. 34(12):2323-2332 (Personal Communication Used)

Reference: 02072

OCCUPATIONAL HEALTH AND FIRST AID

Routes of exposure | Toxic effects | First Aid |
Occupational health check

ROUTES OF EXPOSURE**Main routes of exposure**

Under occupational conditions, the main intake pathways for hydrogen cyanide (HCN) proceed via the respiratory tract and through the skin.[07619]

Respiratory tract

The retention of HCN for volunteers exposed to 3.6 - 17.8 ppm for 1 - 3 minutes was 39 - 77 % for mouth respiration and 13 - 19 % for nasal respiration.[07619]

Retention was not dependent on the concentration.

The duration of the exposure was probably too short to reach a steady-state concentration in the blood because monkeys exposed to 100 - 150 ppm required 10 min for this.

On the whole, it was stated that HCN is very rapidly and effectively absorbed via the bronchial mucous membranes and alveoles.[80500]

Skin

The magnitude and the rapidity of absorption of cyanide from aqueous solutions or of HCN from the air depend on the humidity of the skin, concentration and pH value of the solution, size of the area contacted and the duration of contact.[80500]

In in-vitro studies on human skin with aqueous solutions, a permeability constant of 3.5×10^{-4} cm/h was determined for the cyanide ion and 1×10^{-2} cm/h for HCN. The non-dissociated HCN is therefore 30 times more rapidly absorbed than the cyanide ion.

The uptake of gaseous HCN via the skin caused serious systemic damage only in high concentrations (for dogs from 5785 ppm upwards for 180 minutes).[07619]

Gastrointestinal tract

HCN is absorbed rapidly and probably completely from aqueous solutions taken in orally.[80500]

TOXIC EFFECTS**Main toxic effects**

Acute:

Slight irritation to the eyes due to high concentrations of vapors and solutions, irritation to the skin probably minor or absent, disturbances to the nervous system, heart/circulatory system and metabolism, respiratory paralysis[07619]

Chronic:

Loss of well-being,[07748]

unspecific effects to the CNS[07619]

Acute toxicity

Although there are decades of experience with gaseous HCN or "prussic acid" dissolved in water, the reports available contain no clear statements on the potential of HCN to irritate mucous membranes and skin or on any possible resulting warning effect.[99983]

The direct irritative effect to the eyes seems to be only slight: 2 - 5 minutes in an atmosphere containing 1 vol.% HCN (10000 ppm) for volunteers with respiratory protection caused only reddening of the eyes.[99997]

A fumigator who was exposed to HCN vapors during an accident showed edema in the cornea after 1 - 2 hours (this must have caused impairment to sight). Because the reaction is practically neutral, contact with pure grade aqueous solutions of HCN will initiate systemic rather than irritative effects.[07979]

HCN (no detailed data) applied into the conjunctival sac of rabbits caused systemic effects after a short time and was fatal after 3 - 12 minutes, depending on the dose. From this unusual toxicity test, an LD50 value of 1 mg/kg bw was derived. Contact of the eyes with HCN solutions must therefore be considered as extremely toxic, probably because of the rapid absorption via the conjunctival blood vessels.[00451]

The potential to irritate the skin seems also to be minor.

In the experiment on volunteers mentioned above, uncovered skin areas became red. After leaving the atmosphere containing HCN, however, it appeared to be red-white marbled. Only significantly higher concentrations (about 53000 ppm) caused severe tingling to the exposed, uncovered arm of a volunteer after 22 minutes.

Volunteers (see above) exposed to an atmosphere containing 1 % HCN who used respiratory protection already suffered from symptoms, which substantiate a high dermal toxicity after a few minutes: hot flush on the whole body (in particular on the back of the head and the nape of the neck), rush of blood to the head, beating of the heart and quickening of the pulse. The following delayed effects were reported: headache, shivering fit, nausea, vomiting, weakness, abnormal sleepiness. HCN concentrations of > 1 vol.% were considered life threatening even if respiratory protection is used and the exposure is short (much less than 5 minutes). High temperature and perspiration favor the penetration of HCN through the skin.[99997]

No data on the potential to sensitize is available.[99983]

The odor threshold value (characteristic odor of bitter almond) was reported to be 0.2 - 5.1 ppm. Generally, it is considered as lying below the endangering threshold.

However, many people are unable to perceive the odor of HCN even at high concentrations.[07619]

According to an older report, which nevertheless seems still to be valid, slow inhalative poisoning usually proceeds in 4 steps:

- initial phase: irritation to the mucous membranes, burning on the tongue, metallic-scratchy taste in the mouth and throat
- asthmatic phase: slowing down (then speeding up) of respiration, severe difficulty in breathing but still hardly changed heart action
- convulsive phase: anxiety, headache, vertigo, difficulty in breathing, clouded awareness, tonic-clonic and tetanic cramps
- asphyctic phase: dilated pupils, respiratory arrest, rapid onset of death.[99997]

Following high concentrations, massive disturbances to the heart/circulatory system can occur in addition: initial tachycardia, then bradycardia, arrhythmia, hypotension, collapse of the peripheral vessels.[07985]

The following concentrations are considered to be lethal: 270 ppm: immediately; 181 ppm: 10 min; 135 ppm: 30 min; 108 - 135 ppm: 0.5 - 1 h; ca. 50 ppm is considered to be tolerable for a short time. Following severe poisoning cases which were survived, there are examples of serious neurological damage.[07619]

Oral poisoning for humans has only been reported with salts of HCN.

However, experiments on rats showed that soluble cyanides are equitoxic (LD50 for rats: 3 - 4 mg - CN/kg bw).[07985]

Chronic toxicity

Skin contact with solutions of HCN can lead to dermatitis and skin eruptions.[07619]

Occupationally related chronic exposure occurs rather seldom. The following symptoms are considered typical: headache, vertigo, confusion, muscular weakness, disturbances to sight, speech impediment, gastrointestinal complaints.

These symptoms were found in an older study on persons who were occupationally exposed to HCN at about 10 ppm (4.2 - 12 ppm) for long time periods.[07985]

Some authors assume that the chronic poisoning with HCN really should be attributed to chronic endogenous poisoning with thiocyanate.

However, the possibility of direct subacute and chronic damage through cyanide was noted for cases in which the generally very effective detoxication mechanism via thiocyanate is disturbed.[07637]

Adaptation to HCN does not seem to develop, rather increasing hypersensitivity.[07606]

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.

An influence on the functions of the male and female reproductive organs as well as a potential to damage the developing embryo or fetus were established at parental-toxic concentrations.

Mutagenicity:

The few in-vitro tests on various Salmonella strains which were carried out with HCN itself were negative (aside from TA 100 without activation).

In most of the further tests with cyanides, the results were also negative.[07619]

Carcinogenicity:

Insufficient data is available.[99983]

Biotransformation and excretion

HCN absorbed is reversibly bound, in particular to methemoglobin (0.5 - 1 % of the hemoglobin) and plasma proteins and is distributed into all organs (in particular into the liver, lung, spleen and brain).

Only an extremely minor proportion of unchanged cyanide is eliminated via the airways and kidneys (note that these statements are different). In the quantitatively most important step of the biotransformation, thiocyanate (rhodanide) is formed. This reaction is catalyzed by the generally very active enzyme rhodanese which is sufficiently available. The reaction is only limited by the availability of "sulfane-sulfur" which is capable of reacting. However, this can be substituted and/or replenished by exogenous thiosulfate.

The main point of attack of cyanide in the mammalian organism is the cytochrome oxidase complex by which the utilization of oxygen in the cells is (reversibly) hindered.

Many other enzyme systems are also inhibited, e.g. catalase, peroxidase and superoxide dismutase which are used for the detoxication of reactive oxygen species.

The inhibition of the oxidative phosphorylation is most distinctly noticeable in the brain. As a result, the ADP/ATP quotient is changed and this finally causes glycogenolysis.

This leads to the anaerobic formation of ATP with the consequence of rapid onset of lacticidosis.

The classic antidote therapy makes use of the high affinity of cyanide to Fe³⁺. A proportion of the Fe²⁺-hemoglobin is therefore oxidized to Fe³⁺-Hb and this intercepts the noxa.

Cyanide is slowly released from the complex formed and bound by additional application of thiosulfate. Then it is eliminated via the kidneys as thiocyanate (see above).[08057]

Annotation

This occupational health information was compiled on 03.11.2006.

It will be updated if necessary.

FIRST AID**Eyes**

For irritation or reddening of the eyes following contact with vapors, e.g. if respiratory protection without eye protection was used:

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

Arrange medical treatment.

Contact of the eyes with splashes of liquid or aqueous hydrogen cyanide (HCN) is life threatening because of extremely rapid absorption!

Call a physician to the site of the accident in every case.

[07985, 00451, 99999]

Skin

Following contact with aqueous solutions containing HCN or with high concentrations of vapor (e.g. following emergency use of an escape mask without protective clothing):

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

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

Remove contaminated clothing while protecting yourself.

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

Arrange for medical treatment.

Respiratory tract

During rescue from an atmosphere containing HCN, breathing equipment which functions fully independently of the outside air must generally be worn!

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.

Put the casualty in a half-sitting position.

If the casualty is unconscious but breathing lay him in a stable manner on his side.

Do not carry out mouth-to-mouth resuscitation.

Immediately call a physician to the site of the accident.

Use a (non-rebreathing) mask for artificial ventilation with oxygen.

[07978, 07985, 00330]

Swallowing

Ingestion of "prussic acid" as a solution or in the liquified form in workplaces is hardly conceivable and in the community it is hardly likely.

If ingestion nevertheless has taken place:

Rinse the mouth and spit the fluids out.

Do not make the casualty vomit.

Arrange medical treatment.

Do not carry out mouth-to-mouth resuscitation but apply oxygen via a (non-rebreathing) mask.

During spontaneous vomiting definitely hold the head of the casualty low (danger of aspiration!).

[07985, 99999]

Information for physicians

Inhalative intake was the main pathway for the poisoning cases reported.

- Symptoms of acute poisoning:[99983]

Eyes: slight irritation (reddening and possible corneal edema) following contact with vapor and certainly also with aqueous solutions; extremely pronounced systemic effects, dependent on concentration and duration of contact

Skin: initially minor irritation through vapors/aerosols, then reddening and/or red/white marbled pattern; only due to high concentrations and prolonged duration of contact:

severe tingling; concentration-dependent systemic effects: dermal exposure to vapors > 1 vol.% (10000 ppm) possibly resulting from a contact duration of 5 min or more may be lethal (despite efficient respiratory protection)

Inhalation: irritation to the mucous membranes burning of the tongue, metallic-scratchy taste in the mouth and throat; gradual up to sudden onset of systemic effects, dependent on the concentration

Ingestion: following intake of aqueous HCN solutions slight up to moderate irritation to mucous membranes, rapid onset of absorptive-toxic effects[99997]

Absorption: dyspnoea, craving for fresh air, anxiety, clouded awareness, headache, vertigo, tonic-clonic and tetanic cramps, coma; at high concentrations in addition initially tachycardia, then bradycardia, arrhythmia, hypotension, collapse of the peripheral vessels, respiratory arrest, cardiac arrest.[99983]

If the cause of serious poisoning is not known, the combination of tachypnoea, light red venous blood, metabolic acidosis, central-nervous symptoms (and a possibly perceptible odor of bitter almonds) is considered to be a typical symptom complex of poisoning with HCN/cyanides. So start the appropriate measures.

- Medical advice:

Treatment of the absorptive-toxic effects by taking steps to maintain the vital functions is the main issue in every case.[07978]

"Topical effects", if registered on the eyes and skin should then be treated symptomatically (possibly with the help of an ophthalmologist).[99999]

The intensity of the therapy should correspond to the seriousness of the poisoning:

degree 0: anxiety, agitation, vertigo, light-headedness, (possible slight dyspnoea) -> oxygen, rest, sedation, observation

degree 1: change in awareness, psychomotor slowing down -> oxygen, 100 ml sodium thiosulfate solution 10 %, i.v.

degree 2: coma and/or metabolic acidosis -> intubation, oxygen (FiO₂ 1.0), partial blind buffering (prior to hospitalization as necessary) with 1 molar sodium hydrogencarbonate solution, possibly also DMAP/thiosulfate (see degree 3)

degree 3: unconsciousness, metabolic acidosis and/or cramps, arrhythmia, shock -> intubation, oxygen (FiO₂ 1.0), compensation of acidosis, anticonvulsive agents, formation of methemoglobin through 3.25 mg 4-dimethylamino phenol (4-DMAP)/kg bw i.v. and subsequent application of thiosulfate (100 ml, 10 %, i.v.) via the same cannula

degree 4: cardiac arrest -> cardiopulmonary resuscitation, otherwise as for degree 3.[07978]

Following oral intake of aqueous HCN solutions, vomiting should not be induced (see "Swallowing"). [07985]

Gastrolavage should only be carried out after stabilization of the vital functions, despite the very rapid absorption.[07978]

The actual priorities must be set by the emergency physician on site.[99999]

Recommendations

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

The assessments of the applicability and risk of the mouth-to-mouth resuscitation for persons poisoned with HCN/cyanides are inconsistent. Because it is disputed that an allegedly extremely small amount of cyanide is exhaled unchanged, [99983] this measure should probably be avoided (at least for hydrogen cyanide which becomes bioavailable extremely rapidly).[07985]

In every factory in which HCN or soluble cyanides are handled, equipment for artificial ventilation should therefore be on stand by.[99999]

The MetHb-former (iso)amyl nitrite as an antidote (inhalation over 10 sec at 1 minute intervals, with post administration of sodium thiosulfate) is mostly not used, firstly because it is not very effective and also because of the hypotonic side effect which it causes. It is mentioned in the new literature only as a last resort when no other antidotes are available.[08013]

Following combined exposure to HCN and CO (combustion gas from fires) the preclinical use of methemoglobin forming substances is considered as contra-indicated. Such exposure can be identified by the deposit of soot particles in the upper airways.[99997]

Annotation

This first aid information was compiled on 03.11.2006.
It will be updated if necessary.

OCCUPATIONAL HEALTH CHECK

Prophylaxis offer: Occupational medical prevention has to be offered to workers conducting fumigation activities.

Deadlines: Occupational medical prevention has to be offered to employees prior to taking up work. Deadlines for the proposal of regularly recurrent occupational medical prevention are to gather from the Occupational Health Rule (Arbeitsmedizinische Regel) "[AMR Nummer 2.1](#)".

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.

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

Provide equipment for the generation of water curtains for the case of a hydrogen cyanide leak. This is not permissible if the generated hydrocyanic acid can drain away uncontrollably. If an immediate annihilation of the collected hydrocyanic acid is not possible it should be covered with heavy foam.

The floor should not have a floor drain.

Washing facility at the workplace required.

Eye bath required. These locations must be signposted clearly.

When handling excessive amounts of the substance an emergency shower is required.

Equipment

Use only closed apparatus.

If dangerous pressure can arise from contact with heat, suitable safety measures and equipment should be provided.

Through appropriate technical equipment prevent the following:

- back flow of hydrogen cyanide into pipes conducting other substances,
- intrusion of substances that react with hydrogen cyanide into pipes or tanks.

If release of the substance cannot be prevented, then it should be suctioned off at the point of exit.

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

Exhaust air containing a high concentration of hydrogen cyanide can be incinerated, e.g. at contact with noble metal or together with gas fuel or oil.

Exhaust air containing a small concentration of hydrogen cyanide can be purified by washing with alkali hydroxide solution.

Label containers and pipelines clearly.

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

Suitable materials:

For cylinders and valves:

All usual materials.

In the presence of cyanides, danger of stress corrosion cracking in steel containers.

For seals:

Polytetrafluoro ethylene PTFE (Teflon)

Polychloro trifluoro ethylene PCTFE

Polyvinylidene fluoride PVDF

Fluoro rubber FKM

Ethylene/Propylene-Diene-Terpolymers EPDM

Advice on safer handling

When handling hydrogen cyanide it has to be stabilised. Amongst others the following acids can be used as stabilisers: sulfuric acid, phosphoric acid, acetic acid, oxalic acid and sulfur dioxide.

Do not store cylinders at the working area.

Do not force open valve.

Only cylinders or cylinder bundles are to be used.

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

Before filling ensure, that containers are free from stress corrosion.

Impurities or humidity detected in gas cylinder has to be removed.

The gas has to be dry when filled. That means, the dew-point has to be $< -10^{\circ}\text{C}$ dry containers are to be filled.

Within one year from the date of filling, the content of a bottle has to be used or annihilated safely.

Don't empty steel containers completely! Before filling, the interior of fully depleted containers, has to be treated in a suitable way.

Prevent cylinders from falling over.

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

Hydrogen cyanide may be filled only when the water content does not exceed 3 % and when it's free from alkalies or other compounds facilitating polymerization.

Fumigation with hydrogen cyanide for pest control, quality assurance and sterilisation is regulated by the "[TRGS 512](#) Begasungen"

Cleaning and maintenance

Pipes conducting hydrogen cyanide may only be opened after they have been depressurised and flushed free of hydrogen cyanide. If alkali has to be used for the removal of polymerisation products the equipment has to be flushed with diluted acid and then hot water until the alkali is completely removed.

To avoid polymerisation, tanks and pipes for hydrogen cyanide should be treated with a 0,25 % acid solution for 2-3 hours before refilling.

Use protective equipment while cleaning if necessary.

Only conduct maintenance and other work on or in the vessel or closed spaces after obtaining written permission.

Regular inspection of leak test required!

TECHNICAL MEASURES - STORAGE

Storage

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

Containers have to be labelled clearly and permanently.

Hydrogen cyanide must be sufficiently stabilised, the water content must not exceed 3%; it must be free from alkalies and other substances which might promote polymerisation.

From the date of filling the content of a cylinder has to be used within one year or be returned to the provider or be destroyed by a specialist.

Store in a cool place.

Keep container in a well-ventilated place.

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.

Protect from exposure to sunlight.

Store containers upright and protect against falling over.

Automatic devices for detecting and reporting hydrogen cyanide should be installed in storage areas.

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.

Fire fighting equipment must be available.

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.

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.

It must be avoided that gases or vapours can escape into other rooms where sources of ignition are present.

ORGANISATIONAL MEASURES

Instruction on the hazards and the protective measures using instruction manual ([TRGS 555](#)) are required with signature if just more than one minor hazard was detected.

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.

In plants where hydrogen cyanide is handled or where hydrogen cyanide may form, respiratory protection devices should always carried to enable any escape from the danger zone.

Respiratory protection: Gas filter B, colour code grey.

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

Sufficient eye protection must be worn.

Wear glasses with side protection.

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.

For protection against spray or splash (brief contact), protective gloves of the following materials are suitable:

Butyl rubber - Butyl

Nitrile rubber/Nitrile latex - NBR

Occupational hygiene

Foods, beverages and other articles of consumption must not be consumed at the work areas.

Suitable areas are to be designated for these purposes.

Avoid contact with skin. In case of contact wash skin.

Avoid inhalation of gas.

Avoid inhalation of vapour or mist.

Avoid contact with clothing. Contaminated clothes must be exchanged and cleaned carefully.

Before a break it might be necessary to change clothes.

Provide washrooms with showers and if possible rooms with separate storage for street clothing and work clothing.

The skin must be washed with soap and water before breaks and at the end of work. Apply fatty skin-care products after washing.

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.

The hazardous area may only be entered once suitable protective measures are implemented. Only then can the hazardous situation be removed (see chapter Personal Protection).

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

Only if all of the ensuing hydrogen cyanide solution can be collected safely: use water spray.

Use non-sparking tools.

Endangerment of water:

Severe hazard to waters. Avoid penetration into water, drainage, sewer, or the ground. Inform the responsible authorities about penetration of even small quantities.

FIRE FIGHTING MEASURES

Classes of fires

C gaseous, also compressed substances

Suitable extinguishing media

Dry extinguishing powder

Foam

Unsuitable extinguishing media

Extinguishing powder based on bicarbonate

Instructions

Cool surrounding containers with water spray.

If possible, take container out of dangerous zone.

Heating causes a rise in pressure, risk of bursting and explosion.

Explosive polymerisation at higher temperatures.

Shut off sources of ignition.

Only put out fire if the gas flow can be interrupted.

Risk of explosion from gas accumulation and backfire.

Possibly allow to burn out in controlled manner.

Use only explosion proved equipment.

Shut off the area wide-ranging.

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)

Hydrogen cyanide vapours

Carbon monoxide and carbon dioxide

nitrogen

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](#) | [Seveso III](#) | [Restriction of use](#) | [Technical rules](#) | [Regulations of accident insurers](#) | [Occupational health check](#)

EUROPEAN GHS CLASSIFICATION AND LABELLING

Classification

Flammable liquids, Category 1; H224
Acute toxicity, Category 1, oral; H300
Acute toxicity, Category 1, dermal; H310
Acute toxicity, Category 1, inhalation; H330
Specific Target Organ Toxicity (repeated exposure), Category 1; H372
Hazardous to the aquatic environment, Acute Category 1; H400
Hazardous to the aquatic environment, Chronic Category 1; H410



Signal Word "Danger"

Hazard Statement - H-phrases

H224: Extremely flammable liquid and vapour.
H300+H310+H330: Fatal if swallowed, in contact with skin or if inhaled.
H372: Causes damage to organs through prolonged or repeated exposure.
----- Affected organs: thyroid
----- Route of exposure: Oral
H410: Very toxic to aquatic life with long lasting effects.

Precautionary Statement - P-phrases

P210: Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.
P260: Do not breathe dust/fume/gas/mist/vapours/spray.
P262: Do not get in eyes, on skin, or on clothing.
P273: Avoid release to the environment.
P280: Wear protective gloves/protective clothing/eye protection/face protection.
P303+P361+P353: IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water or shower.
P304+P340: IF INHALED: Remove person to fresh air and keep comfortable for breathing.
P310: Immediately call a POISON CENTER or doctor.
P501: Dispose of contents / container in accordance with local / regional / national / international regulations.

Registration entry of the manufacturer on the ECHA website

Reference: [07520](#)

State: 2020

Checked: 2021

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.

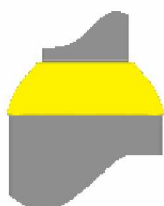
Reference: [99999](#)

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)



Also permissible:
Cylinder shoulder colour: Yellow and red
(toxic and/or corrosive, flammable gases)

WORKPLACE LABELLING ACCORDING TO GERMAN ASR A1.3

Prohibition label



No open flame; fire, open ignition sources and smoking prohibited



No admittance for unauthorized persons



No eating and drinking

Warning label



Caution - inflammable material



Caution - toxic material

Precept label



Use safety goggles



Wear safety
gloves

GERMAN WATER HAZARD CLASS

Substance No: 309

WGK 3 - severe hazard to waters

Scope: liquid hydrocyanic acid

Classification according to the announcement of the list of substances hazardous to water in the Federal Register of 10.08.2017, last update 17.08.2021

TECHNICAL INSTRUCTIONS ON AIR QUALITY CONTROL (TA LUFT)

Chapter 5.2.4 Gaseous inorganic substances

Class II

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

Mass flow: 15 g/hr

or

Mass conc.: 3 mg/m³

TRANSPORT REGULATIONS

UN Number: 1051

Shipping name: Hydrogen cyanide, stabilized, with less than 3% water

Hazard Identification Number: 663 (RID)

Class: 6.1 (Toxic Substances)

Packing Group: I (high danger)

Danger Label: 6.1/3



Special labelling: Symbol (fish and tree)



Classification code: TF1

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](#)

UN Number: 1614

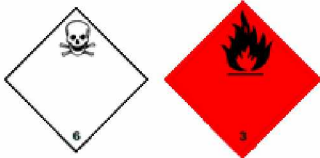
Shipping name: Hydrogen cyanide, stabilized containing less than 3% water and absorbed in a porous inert material

Hazard Identification Number: 663 (RID)

Class: 6.1 (Toxic Substances)

Packing Group: I (high danger)

Danger Label: 6.1/3



Special labelling: Symbol (fish and tree)



Classification code: TF1

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

0,9 ml/m³

1 mg/m³

Peak limitation: Excursion factor 5

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

Category II - Substances with systemic effects

Risk of percutaneous absorption

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

Source: EU

EC OCCUPATIONAL EXPOSURE LIMIT VALUES

Directive 2017/164/EU

Recommended indicative occupational exposure limit value for the European Union

A national occupational exposure limit value has to be set.

8 hours limit value: 1 mg/m³ (0,9 ppm)

Short term limit value: 5 mg/m³ (4,5 ppm)

(as cyanide)

Risk of percutaneous absorption

RECOMMENDATIONS OF MAK-COMMISSION

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

1,9 ml/m³
2,1 mg/m³

Peak limitation: Excursion factor 2
Duration 15 min, mean; 4 times per shift; interval 1 hour
Category II - Substances with systemic effects

Risk of percutaneous absorption

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)

Annex I Part 1 Section: H1
Acute toxic Category 1, all exposure routes
Qualifying quantity for the application of
Lower-tier requirements: 5 t
Upper-tier requirements: 20 t

DIRECTIVE 2012/18/EU (Seveso III)

Annex I Part 1 Section: P5a
Flammable liquids, Category 1
Qualifying quantity for the application of
Lower-tier requirements: 10 t
Upper-tier requirements: 50 t

DIRECTIVE 2012/18/EU (Seveso III)

Annex I Part 1 Section: E1
Hazardous to the aquatic environment, Category Acute 1 or Chronic 1
Qualifying quantity for the application of
Lower-tier requirements: 100 t
Upper-tier requirements: 200 t

RESTRICTIONS OF USE / BANS OF USE

REACH Regulation (EC) No 1907/2006 Annex XVII

Annex XVII, Point 3

1. The putting into circulation and the utilisation of the substance is not allowed in decorative objects, games and joke articles.
 2. Substances labelled with H304 which can be utilised as fuels in decorative lamps and are put in circulation in amounts of 15 l or less must not contain a dye and/or a perfume.
- Further information on prohibitions can be taken from the regulation.

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)

Ordinance on Prohibitions of Use of Plant Protection Products

Attachment 2 for §§ 1, 4 and 5 Paragraph 2

The substance may be utilised for the fumigation with hydrocyanic acid only in the following areas:

1. amongst others in mills, stockrooms and containers for transportation against storage pests
2. plants in vegetative rest
3. in greenhouses

The application in nature protection areas and national parks is forbidden.

Emblems, plants or culture media which is covered with or contains a plant protection product that contains the substance must not be imported.

Further information on restrictions and exceptions can be taken from the Ordinance on Prohibitions of Use of Plant Protection Products.

Consumer Goods Ordinance

Attachment 1 to § 3, Point 5

The substance must not be utilised for the production or treatment of joke articles.

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 Januar 2010, zuletzt geändert und ergänzt Oktober 2016

[TRGS 401](#)

Gefährdung durch Hautkontakt, Ermittlung - Beurteilung - Maßnahmen; Ausgabe Juni 2008; zuletzt berichtigt März 2011

[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

[TRGS 720](#)

Gefährliche explosionsfähige Gemische - Allgemeines; Ausgabe Juli 2020, zuletzt berichtigt März 2021

[TRGS 721](#)

Gefährliche explosionsfähige Gemische - Beurteilung der Explosionsgefährdung; Ausgabe Oktober 2020, zuletzt berichtigt Dezember 2020

[TRGS 722](#)

Vermeidung oder Einschränkung gefährlicher explosionsfähiger Atmosphäre; Ausgabe Februar 2021

[TRGS 723](#)

Gefährliche explosionsfähige Gemische - Vermeidung der Entzündung gefährlicher explosionsfähiger Gemische; Ausgabe Juli 2019, zuletzt geändert Oktober 2020

[TRGS 724](#)

Gefährliche explosionsfähige Gemische - Maßnahmen des konstruktiven Explosionsschutzes, welche die Auswirkung einer Explosion auf ein unbedenkliches Maß beschränken; Ausgabe Juli 2019

[TRGS 512](#)

Begasungen; Ausgabe Januar 2007; zuletzt geändert und ergänzt: September 2012

REGULATIONS OF GERMAN ACCIDENT INSURERS

DGUV Regel 112-190

Benutzung von Atemschutzgeräten, Ausgabe Dezember 2011

<http://publikationen.dguv.de/dguv/pdf/10002/r-190.pdf>

(in German only)

LINKS

[International Limit Values](#)

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

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

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

[DGUV Information 213-098: List of substances - lesson in schools \(in German only\)](#)

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IFA: Erfassungs- und Pflegehandbuch der GESTIS-Stoffdatenbank (nicht öffentlich)

Data acquisition and maintenance manual of the GESTIS substance database (non-public)

Quelle: 00106

Sorbe "Sicherheitstechnische Kenndaten chemischer Stoffe" ("Safety-related characteristics of chemical substances"), sicherheitsNet.de, Landsberg, 07/2011

Quelle: 00260

1x1 der Gase. Physikalische Daten für Wissenschaft und Praxis. Herausgeber: AIR LIQUIDE Deutschland GmbH, Düsseldorf, 1. Auflage 2005

Quelle: 00330

^{2E} "Neue Datenblätter für gefährliche Arbeitsstoffe nach Gefahrstoffverordnung" Loseblattsammlung mit Ergänzungslieferungen, WEKA-Verlag, Augsburg

Quelle: 00440

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Quelle: 00446

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Quelle: 00451

HSDB-Datenbankrecherche 2004

Quelle: 01271

GHS-Sicherheitsdatenblatt, BASF

GHS Material Safety Data Sheet, BASF

Quelle: 02070

LOG KOW Databank, compiled by ^{2E} Sangster Research Laboratories, Montreal, Canada, distributed by Technical Database Services (TDS), New York

Quelle: 02072

Ecotoxicological Data, compiled by the US Environmental Protection Agency (EPA), selected and distributed by Technical Database Services (TDS), New York, 2009

Quelle: 05200

Kühn-Birett "Merkblätter Gefährliche Arbeitsstoffe" Loseblattsammlung mit Ergänzungslieferungen, ecomed Sicherheit, Landsberg

Quelle: 05240

[TRGS 407](#) "Tätigkeiten mit Gasen - Gefährdungsbeurteilung" Ausgabe Februar 2016

Quelle: 05300

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

Quelle: 05350

[TRGS 900](#) "Arbeitsplatzgrenzwerte" Ausgabe Januar 2006, zuletzt geändert und ergänzt Juni 2021

Quelle: 06002

2E

"Gefährliche Chemische Reaktionen" Loseblattsammlung mit Ergänzungslieferungen

"Dangerous chemical reactions" loose-leaf collection with supplement deliveries

ecomed-Verlag

Quelle: 07500

Verordnung (EG) Nr. 1272/2008 des Europäischen Parlaments und des Rates vom 16. Dezember 2008 über die Einstufung, Kennzeichnung und Verpackung von Stoffen und Gemischen, zur Änderung und Aufhebung der Richtlinien 67/548/EWG und 1999/45/EG und zur Änderung der Verordnung (EG) Nr.1907/2006 (EG-GHS-Verordnung)

Quelle: 07520

Europäische Chemikalienagentur ECHA: Informationen über registrierte Substanzen

European Chemicals Agency ECHA: Information on registered substances

Quelle: 07580

Bekanntmachung der Liste der wassergefährdenden Stoffe im Bundesanzeiger vom 10.08.2017, zuletzt geändert 17.08.2021

Quelle: 07606

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Quelle: 07635

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Quelle: 07637

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American Conference of Governmental Industrial Hygienists "Documentation of the threshold limit values and biological exposure indices Loseblattsammlung mit Ergänzungslieferungen

Quelle: 07902

BAM: Datenbank [Gefahrgut-Schnellinfo](#)

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Quelle: 07979

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Springfield, Illinois; 1993

Quelle: 07985

IPCS: CICADs - Concise International Chemical Assessment Documents. WHO, Genf, Serie ab 1998

Quelle: 08013

Ludewig "Akute Vergiftungen" 9. Auflage, Wissenschaftliche Verlagsgesellschaft, Stuttgart 1999

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Verlagsgesellschaft mbH, Stuttgart 2004

Quelle: 08112

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Liste arbeitsmedizinisch-toxikologischer Standardwerke (2)

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Quelle: 99997

Projektgebundene arbeitsmedizinisch-toxikologische Literatur (1)

Project related bibliographical references regarding occupational health and toxicology (1)

Quelle: 99999

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](#) |
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