


Chlorine



IDENTIFICATION

Chlorine
E 925

ZVG No: 7170
CAS No: 7782-50-5
EC No: 231-959-5
INDEX No: 017-001-00-7  017-001-00-7

CHARACTERISATION

SUBSTANCE GROUP CODE

133000 Halogens
139100 Inorganic gases

STATE OF AGGREGATION

The substance is gaseous.

PROPERTIES

chartreuse
pungent odour

CHEMICAL CHARACTERISATION

Oxidizing gas.

The substance itself does not burn, but in contact with combustible substances it increases the risk of fire and can fuel any existing fire substantially.

Sparingly soluble in water.

Gas is heavier than air.

Chlorine is one of the most reactive elements, it acts strongly oxidizing and already at room temperature reacts vigorously with many elements, organic and inorganic compounds under large evolution of heat.

Acute or chronic health hazards result from the substance.

The substance is hazardous to the aquatic environment.

(see: chapter REGULATIONS).

PHYSICAL AND CHEMICAL PROPERTIES

TRIPLE POINT

Temperature: -101,0 °C

Pressure: 0,014 bar

MELTING POINT

Melting point: -100,98 °C

BOILING POINT

Boiling Point: -34,1 °C

CRITICAL DATA

Crit. temperature: 144,0 °C

Crit. pressure: 77,0 bar

Crit. density: 0,573 g/cm³

DENSITY

VAPOUR DENSITY

under standard conditions (0 °C, 1013 mbar)

Value: 3,2149 kg/m³

DENSITY OF LIQUID PHASE AT BOILING POINT

Value: 1,5625 kg/l

RELATIVE VAPOUR DENSITY

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

Value: 2,48

VAPOUR DENSITY

Value: 3,000 kg/m³

Temperature: 15 °C

at 1 bar

VAPOUR PRESSURE

Vapour pressure: 6,776 bar

Temperature: 20 °C

Vapour pressure: 8,8 bar

Temperature: 30 °C

Vapour pressure: 14,3 bar

Temperature: 50 °C

SOLUBILITY IN WATER

Concentration: 14,6 g/l

Temperature: 0 °C

Concentration: 7,3 g/l

Temperature: 20 °C

Concentration: 5,7 g/l

Temperature: 30 °C

HAZARDOUS REACTIONS

Hazardous chemical reactions:

Risk of explosion in contact with:

amines

ammonia

acetaldehyde; acetylene (UV light); acetylene (Hitze);

alkylphosphine (impact); amidosulphuric acid;

ammonium chloride; antimony hydride; aziridine;

benzine; benzene (vapour/ light); boron hydrides; bromine pentafluoride (heat);

butadiene; butane; tert-butyl alcohol; 1-chloro-2-propyne/ iron; hydrogen chloride gas/

air; cyanuric acid; diborane; dibutyl phthalate (heat); diethyl ether; oxygen difluoride;

dimethyl formamide; dimethyl sulphoxide; disilyl ether; ethane/coal; ethylene/ air;

ethylphosphine; greases; fluorine (sparks); glycerin/chlorine liquid; rubber/chlorine

liquid; hexachlorodisilane/Wärme; hydrazine; hydrazine sulphate; hydrocarbons;

linseed oil/chlorine liquid; methane/ catalyst; phenylmagnesium bromide; phosphorus

(white); polypropylene /chlorine liquid; propane (heat); propene (heat); pyridine,

chlorinated/ iron; oxygen; carbon disulphide/ iron; nitrogen trichloride; nitrogen triiodide;

styrene/ iron(III) chloride; aminosulphonic acid/ water; tetraselenium tetranitride;

vanadium powder; wax; hydrogen

The substance can react dangerously with:

alkali metals
alcohols
aluminium
combustible substances
reducing agents
organic substances
water
metal powders; arsenic hydride; beryllium powder; boron; caesium acetylide; caesium oxide (heat); calcium; calcium nitride; calcium hydride; hydrogen cyanide; dichlorodimethyl ether; dimethyl ether; dioxan vapour (heat); metal carbides; ethylene oxide; glycerin (occlusion); hydroxylamine; iodine (chlorine liquid); metal hydrides; caoutchouc; coal/ activated carbon; lithium silicide; mercaptans; metals/heat; metals/humidity; methyl vinyl ether; sodium hydroxide; oil; phosphines; phosphides; phosphorus (red); phosphorus trioxide; phosphorus hydride; mercury oxide; hydrogen sulphide; silanes; silver oxide; sulphides; oil of turpentine; tungsten oxide (heat); zinc diethyl; tin fluoride;

OCCUPATIONAL HEALTH AND FIRST AID

ROUTES OF EXPOSURE

Main Routes of exposure:

The main exposure pathway for chlorine is via the respiratory tract. [2050]

Respiratory tract:

Based on its moderate solubility in water, inhaled chlorine is retained to a high degree on the mucous membranes in the upper respiratory tract and in the tracheobronchial area but at high concentrations it reaches the alveoles as well.

In aqueous media, chlorine reacts in an equilibrium reaction to form hydrochloric acid and hypochlorous acid/hypochlorit ions.

This reaction also takes place on the moist mucous membranes in the respiratory tract. Under physiological conditions (pH 6 - 8) mainly hypochlorous acid and hypochlorite ions will be present.

All of the mentioned chlorine species readily react with tissue components, so that the transfer of chlorine into the blood is assessed to be negligible, at least in comparison with the direct reaction on the tissue. [2050]

Specific kinetic studies are not available. [99983]

Skin:

For exposure to chlorine gas it is assumed that no uptake of systemically relevant doses via the skin will take place. [2050]

With regard to the uptake of chlorine from a saturated aqueous solution, it was estimated by means of two physicochemical models that a transfer of approx. 30 - 300 mg/2000 cm²/hour could be possible. [7619]

On the whole, the uptake through the skin is not considered a relevant exposure pathway for chlorine. [2050]

Gastrointestinal tract:

The oral intake of chlorine is hardly significant during occupational handling. It is only conceivable by swallowing small amounts which are dissolved in the saliva. [99999] Swallowed chlorine in the stomach will mainly exist in the form of hypochlorous acid. According to the findings of a study in which rats received ³⁶Cl-labeled hypochlorous acid orally, a proportion of the chlorine can very rapidly be transferred into the blood. The absorbed proportion consisted at least of 36% (measured on the amount excreted in the urine). [2050]

TOXIC EFFECTS

Main toxic effects:

Acute:

Irritation to the eyes and airways, danger of serious lung damage; [7619] in higher concentrations, corrosive effects to contacted tissues [2050]

Chronic:

Irritation to the airways [2050]

Acute toxicity:

Chlorine is an irritant gas which causes severe irritation or chemical burns on contacted tissues. Under exposure conditions which are typical for workplaces, effects on the eyes and respiratory tract, predominantly in the bronchi, are of the greatest concern. Findings on the effects of low concentrations are available from studies on volunteers: 0.06 - 0.2 ppm: odor threshold; in single cases; subjective feeling on the eyes and nose; 0.4 - 0.5 ppm: no statistically significant changes of parameters of the lung function; from 1 ppm upwards: influence on the lung function; 1 - 2 ppm: irritation to the eyes and airways. [7619]

Individual differences in the sensitivity for irritative effects are to be taken into account. For persons exposed occupationally adaptation was observed from which a higher irritation threshold resulted. On the other hand, disposed persons (e.g. asthmatics) can show a hyperreactivity to chlorine. [419, 2050]

On the whole, 0.5 ppm (1.5 mg/m³) was reported to be a NOAEL for irritation to the respiratory tract. Irritation to the eyes appears at a concentration level of 0.2 - 4 ppm. Higher concentrations increasingly lead to irritation to the eyes and airways and there is a danger of lung damage.

A report of an accident describes typical symptoms due to an intoxication with chlorine gas after inhalation of 66 ppm for approx. one hour (88 persons were concerned): difficulties in breathing, cough, irritation to the eyes and throat, headache, dizziness, breast pain, gastrointestinal complaints. Pulmonary function tests and bronchoscopy showed damage to the lungs (inflammatory changes, tracheobronchial congestion, chronic bronchitis, hemorrhagic areas in the bronchial mucosa). Effects were detectable for up to 25 days following exposure.

In serious cases, fever, exhaustion, nausea, vomiting, cramps, cyanosis, muscular pain and hypothermia can occur as further symptoms. [2050]

Convalescence usually proceeds rapidly. In isolated cases, hyperreactivity of the airways can persist (see "Chronic toxicity"). [419]

Following lethal poisoning with chlorine gas, death mostly results from pulmonary edema which manifests after a latency period. At very high concentrations, death from asphyxia due to bronchoconstriction, bronchospasm and/or laryngospasm, shock,

respiratory arrest or cardiovascular complications can occur even after only a short period. [2050, 7619]

In tests on rodents, 30 min-LC50 values were found to be at 300 - 400 ppm (900 - 1200 mg/m³).

According to a critical data evaluation of an AEGL (acute exposure guideline limit) value, a 4 h-LC50 value of 650 mg/m³ was extrapolated for humans. [2050] On the other hand, 500 ppm (approx. 1500 mg/m³) is reported to be fatal following inhalation for only 5 - 10 minutes. [160]

Because of the severe eye and airway irritation during exposure to chlorine gas, damage to the skin is mostly of secondary concern. [99983]

However, following contact with liquefied chlorine, frostbite and serious chemical burns on all contacted tissues are to be feared.

Aqueous solutions produce irritation to the mucous membranes and skin, dependent on the chlorine content (from approx. 5% upwards irritating and from 10% upwards corrosive).

There is no indication of a potential to sensitize the skin.

The oral toxicity of aqueous solutions of chlorine or hypochlorite is mainly determined from the locally damaging potential and therefore from the concentration of chlorine.

5% solutions are mainly expected to cause superficial damage to the mucous membranes in the mouth and esophagus. However, following extensive intake, also irreversible or even fatal damage in the gastrointestinal tract is possible. Irrespective of this, there is a danger that in case of aspiration even little amounts would produce life threatening lung damage. [2050]

In the case of swallowing of higher concentrated solutions, life threatening chemical burns, in particular in the area of esophagus and stomach, which are largely independent of the dose, are to be feared. Based on experience with poisoning concerning sodium hypochlorite solution, symptoms of CNS disturbances or cardiovascular responses can become noticeable. These effects are possibly less likely systemically conditioned than a secondary effect of the local damage. [2050, 419]

Chronic toxicity:

From workplace studies on persons exposed to chlorine, information is available indicating that irritation to the airways with impairment of the lung function are the critical effects following repeated exposure as well. Based on mixed exposures which were always registered in the examined workplaces, conclusions regarding dose-effect relationships are only possible to a limited extent. However, there were no indications that at concentrations up to 0.5 ppm chlorine irritative effects or changes of functional parameters of the lungs were noticeable.

Under experimental conditions, in 2 studies on volunteers exposed twice through to repeatedly to concentrations of > 0.5 ppm chlorine, no effects were found. [7619, 2050]

From animal experimental studies on rats and mice (6-week study and 2-year study) as well as on rhesus monkeys (one-year study) it was concluded that the effects of chlorine do not seem to be aggravated by prolonged duration of exposure. The only slight effects on the nasal epithelium which were reported to have sometimes already been found at 0.1 or 0.4 ppm are considered non-relevant for humans because of methodological shortcomings in these studies and of the limited suitability of rodents as an animal model for the effects of chlorine. [7619]

No confirmation is available for a sensitizing effect of chlorine on the airways. [2050] In single cases, hyperreactivity of the airways has been reported (Reactive Airways Dysfunction Syndrome; RADS) as a consequence of a high (possibly only single) exposure to chlorine gas. [419] This reaction seems to be pseudoallergically related, not immunologically and seems to require an individual predisposition. [2050] With regard to the non-occupational uptake of chlorine via the drinking water, animal experiments which were carried out with sodium hypochlorite solution should be taken into consideration. In these studies, no distinct systemic effects were found and no target organs of a systemic action were identified. The NOAEL derived from a lifetime study on rats was found to be approx. 14 mg/kg bw x d with regard to the chlorine content. [435, 2050]

Reproductive toxicity, Mutagenicity, Carcinogenicity:

For classifying the reproductive toxicity and mutagenic and carcinogenic potential see list in Annex VI of the CLP regulation or TRGS 905 or 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.

[7619]

In view of the oral intake of chlorine via the drinking water, studies with the administration of sodium hypochlorite solution to rodents (dosage up to 5 mg/kg bw x d) did not prove any developmental toxic or fertility disturbing effects.

For the inhalative exposure to chlorine gas it is expected, because of the corrosive action in the respiratory tract, that the possibility of reaching the concentrations of hypochlorite or chloride which can cause reproductive toxic effects can be excluded.

[2050]

Mutagenicity:

In a study with chlorine gas up to the cytotoxic concentration, no mutagenicity was found. [7619]

Results from tests with chlorine and sodium hypochlorite solution were not unequivocal but there is no suspicion that it could be mutagenic. [2050]

Carcinogenicity:

In long-term studies on rats and mice which inhaled chlorine gas, the incidence of neoplasia was not increased, so that no carcinogenic potential was indicated.

In view of the chlorination of drinking water, no causal relationship between the intake of chlorine and increased incidence of tumors could be demonstrated in animal experiments and epidemiological studies. Based on these findings, no risk of a carcinogenic action is seen for occupational exposure. [2050]

Biotransformation and Excretion:

Based on the hydrolysis of chlorine in the organism under physiological conditions (pH 6 - 8), predominantly hypochlorous acid will be present.

In a study with radioactively ³⁶Cl-labeled hypochlorous acid on rats, distribution of the radioactivity into the blood and various organs (predominantly bone marrow, testes, skin, kidney, lungs) was found. In the blood > 80% of the ³⁶Cl radioactivity was present in the form of chloride. Only 50% of the radioactivity was rapidly excreted, mainly with the urine (36%) but also with the feces (15%).

It is assumed that in the stomach an additional a reaction to chlorinated organic compounds as well as direct reactions with tissue components may take place. [2050]

Annotation:

This occupational health information was compiled on 17.01.2012.
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.

Following contact with the subcooled/ liquefied gas:

Carefully rinse the eyes only shortly under running water (cold or lukewarm but not hot).

Do not part lids, leave contact lenses in their place initially.

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

[2001, 419, 454, 99996]

Skin:

Following contact with aqueous solution:

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.

[2001]

Following contact with liquefied chlorine or expanded (extremely cold) gas:

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

First thaw off clothing frozen to the body by rinsing with a lot of cold or lukewarm water and only after that, peel it off carefully. Also rinse skin areas with cold/lukewarm water.

Do not rub affected areas and do not use dry heat but cover with a sterile dressing.

Immediately call a physician to the site of the accident.

Watch for simultaneous danger of inhalative exposure (measurements see below!) [419]

Respiratory tract:

Whilst protecting yourself remove the casualty from the hazardous area and take him to the fresh air.

Even if there are no complaints, the casualty should be carried or driven (horizontale position; for dyspnea half-upright position). Absolutely avoid any form of bodily exertion.

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

As soon as possible repeatedly have the casualty deeply breath a glucocorticoid inhalation spray in.

In the case of breathing difficulties have the casualty inhale oxygen.

Immediately call for an emergency physician.

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

For respiratory arrest, carry out artificial respiration, if possible using a breathing apparatus (e.g. with a bag valve mask). Be very sure to avoid any inhalation of the exhaled air!

In the case of cardiac arrest (lack of heart beat or pulse) immediately apply heart lung resuscitation. The protection of the vital functions (heartbeat and respiration without

assistance) takes priority over every other activity.
Poisoning symptoms can appear after a period of delay.
[80120, 419, 8088]

Swallowing:

If chlorine solution have been swallowed:

Rinse the mouth and spit the fluids out.

If the casualty is conscious have him drink copious amounts of liquids (water).

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

Do not make the casualty vomit.

During spontaneous vomiting hold the head of the casualty low with the body in a prone position in order to avoid aspiration.

Call a physician to the site of the accident. [454, 8088]

Information for physicians:

Dependent on the state of matter and concentration, chlorine mainly acts irritating through to corrosively but the main problem is the danger of lung damage. [2050]

- Symptoms of acute poisoning:

Eyes/Skin: due to gas/aqueous solutions: lacrimation, burning sensation, pain, depending on the concentration superficial epithelial damage through to chemical burns; [2050]

due to liquefied/expanded extremely cold gas: frostbite and chemical burns, danger of blindness [419]

Inhalation: pungent, irritating in the nose and throat, headache, retrosternal pain, tachypnea, difficulty in breathing, stridor, possible asthmoid complaints; following increasing exposure, increasing danger of damage of the airways/lungs: tracheobronchitis, pulmonary edema and/or pneumonia (after latency) or (at still higher concentrations) very rapid laryngospasm, glottic edema, bronchospasm, possibly reflex respiratory/cardiac arrest [2050, 419]

Ingestion (solutions containing chlorine): burning sensation, pain in the mouth, throat, esophagus, stomach; nausea, vomiting (danger of aspiration) and of corrosive damage of contacted mucous membranes (ulceration, perforation, strictures in the esophagus/stomach); following aspiration, danger of most serious lung damage; [2050, 419] as a consequence of massive corrosion even acute cardiovascular responses (collapse, shock) [8088]

Absorption: less as a consequence of absorption than because of massive tissue damage: disturbance of the CNS (lethargy, unconsciousness up to coma), cardiovascular reactions, possible disturbances of the kidney function. [2050]

- Medical advice:

Following contact with the eyes, first aid measures (rinsing alleviation of pain) must be followed by ophthalmologic treatment as soon as possible. [454, 419]

Rinse contaminated skin with a lot of water. Irritated areas can be treated with a dermatic containing a corticoid. Following contact with undercooled, liquefied gas, treat analogous to frostbite. Simultaneously watch for inhalative risk. [99999]

Following inhalation, administration of glucocorticoids (inhalatively and/or intravenously) is indicated. In an early phase, inhalation of aerosolized solutions of 0.5 - 2% sodium

hydrogen carbonate solution can be attempted (see "Recommendations"). [80120, 8088]

All further prophylactic measures for pulmonary edema, but administration of oxygen as necessary intermittently because of possible unfavorable side effects.

Codeine for tussive irritation, for bronchospasm, additional administration of bronchodilators.

Intubation and artificial ventilation can become necessary. Support cardiovascular functions.

Hospitalize in every case for further diagnostics and treatment. [8088, 419]

Following swallowing of solutions containing chlorine, measures can only be decided considering the situation and the clinical picture. If signs of perforation are definitely absent, gastrolavage in intubation and if possible under supervision should be considered. [8088, 2050] Administration of glucocorticoids can become necessary in order to prevent glottic edema or damage from aspiration (see measures after inhalation). [160]

For every suspected case of poisoning, hospitalize the casualty. Prophylaxis for pulmonary edema, monitoring of the cardiovascular, CNS and respiratory functions, diagnostics and treatment of corrosive damage and observation of the acid-base balance and hemogram (in particular leucocyte count) as well as of the kidney functions. [419, 454, 8088]

Recommendations:

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

[99999]

In the literature, the possible use of a sodium hydrogen carbonate aerosol for inhalation is indicated. An American report describes that 86 patients who suffered from distinct effects in their airways (cough inspiratory stridor, difficulty in breathing) after inhalation of chlorine gas, were treated with 5% sodium hydrogen carbonate inhalate. Resulting from this, none of the patients developed pulmonary edema and for no patient did the clinical picture deteriorate.

The following procedure was used: a mixture of 3 ml 8.4% sodium hydrogen carbonate solution and 2 ml isotonic saline solution was nebulized with air or oxygen and inhaled as an aerosol, sometimes even repeatedly. [160, 99996]

Annotation:

This first aid information was compiled on 17.01.2012.

It will be updated if necessary.

SAFE HANDLING

TECHNICAL MEASURES - HANDLING

Workplace:

Provision of very good ventilation in the working area.

The gas is heavier than air. Adequate ventilation of the floor area must be ensured as well.

Devices for detecting and reporting the presence of hazardous gases should be present.

Protect ducts and sewers against penetration by the gas.

Eye bath required. These locations must be signposted clearly.

Install water curtain generating devices for the case of an accidental chlorine release.

Equipment:

Use only closed apparatus.

Parts of the production plant in contact to the gas, which are contaminated with organic impurities like fats or oils, have to be cleaned before filling.

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

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

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.

Prevent backflow of chlorine as well as intrusion of other substances into the apparatus.

Label containers and pipelines clearly.

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

Suitable materials:

For cylinders and valves:

Steel

Stainless steel

Brass

For seals:

Polytetrafluoro ethylene PTFE (Teflon)

Polychloro trifluoro ethylene PCTFE

Polyvinylidene fluoride

Fluoro rubber FKM

Unsuitable materials:

Aluminium

Aluminium alloys

Risk of vigorous reaction with aluminium(-alloys).

Risk of corrosion or hydrogen embrittlement under moist conditions; for safety requirements see hydrogen chloride.

Advice on safer handling:

Do not store cylinders at the working area.

Do not force open valve.

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

Valves have to be gas-tight closable and equipped with undetachable lock nuts, joined to the valve. Lock nuts have to be fitted with undamaged gaskets, suitable for the use with fluorine.

Tight valves can be loosened with warm air. The air temperature must not exceed 40 degree C.

If the pressure cylinder is leaky or there are any ambiguities contact the gas cylinder

filling plant.

Prevent cylinders from falling over.

Suck back of water into the container must be prevented. Do not allow backfeed into the container.

Prior to filling, ensure that the cylinders are free from contaminants and humidity.

The gas has to be dry when filled. That means, the dew-point has to be < -10 °C.

Use leak-proof equipment with exhaust for refilling or transfer.

Refilling or transfer in storage rooms is prohibited.

Usually transport occurs in containers with high pressure. Use suitable equipment for the transport.

Tightly screw on the protective caps and blind nuts when transporting. Secure cylinders against falling over, do not throw.

For liquid chlorine:

Prevent seepage into flooring (use of a steel tub).

Cleaning and maintenance:

Regular inspection of leak test required!

Suctioning and separating devices have to be checked and maintained regularly.

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

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

All work on or at pipes that conduct chlorine has to be done under the supervision of specially instructed personnel.

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.

Store in a cool place.

Store in a dry 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.

Protect from overheating/heating up.

Protect from moisture.

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

For transporting, storing, preparing, emptying, and maintaining pressurized gas bottles, the detailed rules in TRG 280 must be absolutely adhered to. For pressurised gas packaging, observe the applicable TRG 300.

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.

Consider the regulations of TRG 280 at collocated storage of different compressed gases.

The substance should not be stored with substances with which hazardous chemical reactions are possible.

TECHNICAL MEASURES - FIRE AND EXPLOSION PROTECTION

Technical, constructive measures:

Substance is non-combustible. Select fire and explosion prevention measures according to the other used substances.

However, chlorine reacts with iron at temperatures above 170 degree C. This may lead to a "chlorine-iron-fire".

Protect parts of the system from any warming; if necessary, provide cooling with sprayed water.

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

Precaution on handling:

Welding only under supervision.

Only work on vessels and lines after these have been completely emptied.

Work that requires fire (e.g. welding or soldering) and is in the vicinity of chlorine-containing pipes or vessels may only be carried out if suitable measures have been taken to prevent them from being heated.

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 the employment of expectant and nursing mothers as defined in the "Mutterschutzverordnung".

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

PERSONAL PROTECTION

Body protection:

Depending on the risk, wear gas-tight protective clothing.

Protective suits have to be checked for embrittlement after each use.

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.

Take along escape filters.

Respiratory protection: Gas filter B, colour code grey.

Do not use small filters (filter class 1).

Perhaps also necessary for improved protection:

Respiratory protection: Combination filter B - P2 or B - P3, recommended B - P3, colour code grey-white.

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 chemical safety goggles.

If there is a risk of gases escaping, eye safety is best protected by wearing a full mask.

When handling liquid gas, chemical safety goggles must be used as well as a protective shield.

Hand protection:

Wear leather gloves to prevent frostbite injuries from rapidly expanding gas when handling pressurised gas bottles.

Skin protection cremes do not protect sufficiently against the substance. When there is

a risk of direct contact with the substance, chemical-resistant gloves are required.

Occupational hygiene:

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

Avoid contact with eyes. In case of contact rinse the affected eye(s).

Avoid inhalation of gas.

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

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

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.

Wear respiratory protection, eye protection, hand protection and body protection (see chapter Personal Protection).

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

Contain escaping gases/vapours with water.

Afterwards ventilate area.

Use plenty of water to clean the area surrounding the leak and equipment that has been in contact with the gas.

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

Instructions:

Substance is incombustible. Select fire fighting measures according to the surrounding conditions.

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

Cool surrounding containers with water spray.

Do not get water into containers, otherwise violent reaction occurs.

If possible, take container out of dangerous zone.

Rise in pressure and risk of bursting when heating.

Do not attack escaping, liquid chlorine with water, simply contain gases and mist with water spray.

Special protective equipment:

Wear self-contained breathing apparatus and special tightly sealed suit.

FURTHER INFORMATION

When chlorine gas is used for chlorination of water, additional measures must be considered (according to VBG 65).

REGULATIONS

Classification:

Oxidising gases, Category 1; H270

Gases under pressure, liquefied gas; H280

Acute toxicity, Category 2, inhalation; H330

Skin irritation, Category 2; H315

Eye irritation, Category 2; H319

Specific Target Organ Toxicity (single exposure), Category 3; H335

Hazardous to the aquatic environment, Acute Category 1; H400



Signal Word: "Danger"

Hazard Statement - H-phrases:

H270: May cause or intensify fire; oxidiser.

H280: Contains gas under pressure; may explode if heated.

H330: Fatal if inhaled.

H315: Causes skin irritation.

H319: Causes serious eye irritation.

H335: May cause respiratory irritation.

H400: Very toxic to aquatic life.

Supplemental Hazard Statement - EUH-phrases:

EUH071: Corrosive to the respiratory tract.

Precautionary Statement - P-phrases:

P260: Do not breathe gas/vapours.

P220: Store away from combustible materials.

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

P244: Keep reduction valves free from grease and oil.

P273: Avoid release to the environment.

P304+P340: IF INHALED: Remove person to fresh air and keep comfortable for breathing.

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

P332+P313: If skin irritation occurs: Get medical advice/attention.

P370+P376: In case of fire: Stop leak if safe to do so.
P302+P352: IF ON SKIN: Wash with plenty of soap and water.
P315: Get immediate medical advice/attention.
P405: Store locked up.
P403: Store in a well-ventilated place.

Manufacturer's specification by Air Liquide

Reference: [01401](#)

The substance is listed in appendix VI, table 3.1 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.

M-factor: M=100

Reference: [07501](#) [07505](#)

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 open flame; fire, open ignition sources and smoking prohibited



No admittance for unauthorized persons



No eating and drinking

Warning label:



Caution - toxic material



Caution - oxidizing material



Caution - gas cylinder

Precept label:



Use safety goggles



Wear safety shoes



Wear safety gloves

GERMAN WATER HAZARD CLASS

Substance No: 223

WGK 2 - hazard to waters

Classification according to the Administrative Regulation of Substances Hazardous to Water (VwVwS)

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: 1017

Shipping name: Chlorine

Hazard Identification Number: 265

Class: 2.3 (Toxic gases)

Packing Group: -

Danger Label: 2.3/5.1/8



Special labelling: Symbol (fish and tree)



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.

TRGS 900 - GERMAN OCCUPATIONAL EXPOSURE LIMIT VALUES

0,5 ml/m³

1,5 mg/m³

Peak limitation: Excursion factor 1

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

Scope:
Chlorine

EC OCCUPATIONAL EXPOSURE LIMIT VALUES

Commission Directive 2006/15/EC
Recommended indicative occupational exposure limit value for the European Community
A national occupational exposure limit value has to be set.
Short term limit value: 1,5 mg/m³ (0,5 ppm)

RECOMMENDATIONS OF MAK-COMMISSION

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

0,5 ml/m³
1,5 mg/m³

Peak limitation: Excursion factor 1

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 a risk of damage to the developing embryo or foetus when MAK and BAT values are adhered to.

SEVESO III - Directive

Annex I Part 2 Number: 10

Chlorine

Qualifying Quantity 10 t

Column 2:

Qualifying Quantity 25 t

Column 3:

RESTRICTIONS OF USE / BANS OF USE

Directives on Safety in School (BGR/GUV-SR 2003)

Activity ban for pupils till grade 4 (form) inclusive.

Substance list to GUV-SR 2004 (as of 11.2010)

Special substitute check required (substances with CMR, T+, E, and C with R35).

Substance list to GUV-SR 2004 (as of 11.2010)

FURTHER REGULATIONS

[TRGS 200](#)

Einstufung und Kennzeichnung von Stoffen, Zubereitungen und Erzeugnissen;
Ausgabe Oktober 2011

[TRGS 201](#)

Einstufung und Kennzeichnung bei Tätigkeiten mit Gefahrstoffen; Ausgabe Oktober
2011

[TRGS 400](#)

Gefährdungsbeurteilung für Tätigkeiten mit Gefahrstoffen; Ausgabe Dezember 2010;
geändert und ergänzt September 2012

[TRGS 555](#)

Betriebsanweisung und Information der Beschäftigten; Ausgabe Januar 2013

[TRGS 600](#)

Substitution; Ausgabe August 2008

[TRGS 402](#)

Ermitteln und Beurteilen der Gefährdungen bei Tätigkeiten mit Gefahrstoffen:
Inhalative Exposition; Ausgabe Januar 2010, zuletzt geändert und ergänzt April 2014

[TRGS 401](#)

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

TRGS 407

Tätigkeiten mit Gasen - Gefährdungsbeurteilung; Ausgabe Juni 2013, berichtigt
Dezember 2013

TRGS 725/TRBS 3145

Ortsbewegliche Druckgasbehälter - Füllen, Bereithalten, innerbetriebliche Beförderung,
Entleeren; Ausgabe Juni 2013

TRGS 726/TRBS 3146

Ortsfeste Druckanlagen für Gase; Ausgabe April 2014

[TRGS 510](#)

Lagerung von Gefahrstoffen in ortsbeweglichen Behältern; Ausgabe Januar 2013,
geändert und ergänzt November 2014

[TRGS 500](#)

Schutzmaßnahmen; Ausgabe Januar 2008, ergänzt Mai 2008

[TRGS 800](#)

Brandschutzmaßnahmen; Ausgabe Dezember 2010

DGUV Vorschrift 50 (BGV D5): Chlorung von Wasser