Cyclopropane

IDENTIFICATION

Cyclopropane
Trimethylene

ZVG No: 31000
CAS No: 75-19-4
EC No: 200-847-8
INDEX No: 601-016-00-6

CHARACTERISATION

SUBSTANCE GROUP CODE

140210 Hydrocarbons, cyclic, saturated
162000 Organic gases

STATE OF AGGREGATION

The substance is gaseous.

PROPERTIES

colourless
petroleum ether-like odour

CHEMICAL CHARACTERISATION

Extremely flammable gas. Forms explosive mixtures with air.
Only slightly soluble in water.
Gas is heavier than air.

FORMULA

C3H6

Molar mass: 42,08 g/mol
Conversion factor (gaseous phase) at 1013 mbar and 20 °C:
1 ml/m³ = 1,75 mg/m³

PHYSICAL AND CHEMICAL PROPERTIES

TRIPLE POINT

Temperature: -127,7 °C

MELTING POINT

Melting point: -127,62 °C

BOILING POINT

Boiling Point: -32,9 °C

CRITICAL DATA

Crit. temperature: 125,2 °C
Crit. pressure: 55,79 bar
Crit. density: 0,259 g/cm³

DENSITY

VAPOUR DENSITY
under standard conditions (0 °C, 1013 mbar)
Value: 1,9185 kg/m³

DENSITY OF LIQUID PHASE AT BOILING POINT
Value: 0,6802 kg/l

RELATIVE VAPOUR DENSITY
Ratio of the density to dry air at the same temperature and pressure
Value: 1,48

VAPOUR DENSITY
Value: 1,789 kg/m³

Temperature: 15 °C
at 1 bar

VAPOUR PRESSURE

Vapour pressure: 6,315 bar
Temperature: 20 °C

Vapour pressure: 8,3 bar
Temperature: 30 °C

Vapour pressure: 13,427 bar
Temperature: 50 °C

IGNITION TEMPERATURE

Ignition temperature: 495 °C
Temperature class: T1
Minimum ignition energy: 0,17 mJ
Max. exper. safe gap (MESG): 0,91 mm
Explosion group: IIA-B

EXPLOSION LIMITS

Lower explosion limit:
2,4 vol. %
40 g/m³
Upper explosion limit:
10,4 vol. %
185 g/m³

SOLUBILITY IN WATER

Concentration: 502 mg/l

PARTITION COEFFICIENT (octanol/water)

log Kow: 1,72
Recommended value of LOG KOW Databank.

HAZARDOUS REACTIONS

Hazardous chemical reactions:
The substance can react dangerously with:
chlorine
oxidizing agents
nitric oxides

hydrogen bromide
hydrogen chloride

OCCUPATIONAL HEALTH AND FIRST AID

ROUTES OF EXPOSURE

Main Routes of exposure:
The main route of exposure for chlorotrifluoromethane (CTFM) is via the respiratory tract.[07866]

Respiratory tract:
Inhaled blood is rapidly resorbed via the lungs.[07866]
Due to the low blood/gas distribution coefficient (0.55), the balance-blood concentration was rapidly achieved even after exposure to high CTFM concentrations.[07712]
However, for the same reason the CTFM dose resorbed from the air stream is expected to be proportionately relatively low.[99999]

Skin:
Data on possible dermal resorption of CTFM in the form of gas or frozen liquid are lacking.[99983]
If resorption of this kind takes place, it is assumed to be of minor significance.[99999]

Gastrointestinal tract:
Oral intake of CTFM is improbable, even after exposure to the cryogenic (rapidly vaporising) liquid.[99999]

TOXIC EFFECTS

Main toxic effects:
Acute effects: Disorders of the central nervous system (narcotic agent);[07866]
Chronic effects: No information available.[99983]

Acute toxicity:
Handling of the liquefied CTFM must be considered to involve local frostbite due to direct contact with the skin or the mucosae.[00022]
Even concentrated CTFM gas causes only slight irritations of the respiratory tract.[07866]
Possible irritations of the eyes were indicated, but these effects are also expected to be minor.[05001, 99983]
CTFM triggered systemic effects, namely pronounced depression, on the CNS only in the high concentration range.[07866]
The following symptoms, depending on the inhaled concentration, might occur: Vertigo, irregular breathing, muscle weakness, narcosis-like conditions (stupor) up to a deep loss of consciousness.[99983]
A ten-minute inhalation of 10,000 ppm CTFM allegedly cause drowsiness.[05001]
Mixtures of 15%-30% CTFM with oxygen were applied as an inhalational anaesthetic (sufficient tolerance width).[07786]
In this concentration range CTFM provides moderate pain relief and muscle relaxation,

and the anaesthetic effect is rapidly reversible after termination of the exposure.[07712]
The narcotic stadium involves the risk of cardiac arrhythmia (ventricular fibrillation, since CTFM sensitises the heart against adrenaline) or due to a (sometimes observed) drop in the blood pressure during the wake-up phase.[99983]
The development of correspondingly high concentrations at workplaces might occur after accidental events when large amounts of liquefied CTFM vaporise or compressed gas suddenly relaxes.
However, in these cases loss of consciousness might also be due to acute oxygen deficiency; the displacement of oxygen involves an immediate suffocation risk.[00022]

Chronic toxicity:
Data on the chronic effects of CTFM or results of long-term animal experiments are not available.[99983]
The usual handling conditions for CTFM at workplaces are not expected to involve any risk of health impairment.[07866]

Reproductive toxicity, Mutagenicity, Carcinogenicity:
Reproductive toxicity: Sufficient information is not available.[07866]
Mutagenicity: Sufficient data are not available (microbiological trials tested negative).
Carcinogenic potential: Sufficient information is not available.[07784]

Biotransformation and Excretion:
A large portion of resorbed CTFM is exhaled in unchanged condition; approx. 0.5% of the resorbed dose is transformed into CO2 and water.[07712]
Appropriate information on further metabolisation paths is not available.[99983]

Annotation:
This occupational health information was compiled on 01.07.1996.
It will be updated if necessary.
This information was translated from German into English by Übersetzungsbüro Branco.

FIRST AID

Eyes:
After eye contact with gaseous CTFM:
Rinse the affected eye with widely spread lids for 10 minutes under running water whilst protecting the unimpaired eye.
[05001]
Cryogenic liquid CTFM triggers superficial frostbite in the eyes. Provide sterile covering; always:
Arrange medical treatment.
[00022]

Skin:
Contact of the skin with the gas does not require any treatment.[99983]
After exposure to liquid CTFMs, proceed as indicated under item ‘Eyes’.[05001]

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

Lay the casualty down in a quiet place and protect him against hypothermia.
In the case of breathing difficulties have the casualty inhale oxygen.
If the casualty is unconscious but breathing lay him in a stable manner on his side.
If the casualty has stopped breathing give mouth to nose resuscitation. If this is not possible use mouth to mouth resuscitation. Keep his respiratory tract clear.
Arrange medical treatment.
[05001]

Swallowing:
Ingestion of gaseous/liquid CFTMs is not relevant in practice.[99983]

Information for physicians:
Depending on the concentration, CTFM triggers narcotic effects; rapid release entails atmospheric oxygen displacement -> suffocation.
Liquid CTFM triggers congelations.[99983, 00022]
Symptoms of acute CTFM toxicities:
Contact of the eyes with the vapours entails mild to minor irritations of the conjunctiva; liquid splashes induce local frostbite by rapid vaporisation.
Frostbite due to rapid vaporisation can also apply to wetted skin.[99983, 05001]
Inhaled CTFM triggers only minimal irritations to the respiratory tract and the lungs, but depending on the dose it might entail slight -> intensive depressions of the CNS; an extensive range of narcotic conditions is characteristic in this complex:
Depending on the dose CTFM resorption is followed by headache, nausea, vertigo, muscle weakness, stupor, respiratory disorders -> (slow, except for massive intake) loss of reflexes, loss of consciousness-> collapse -> respiratory and cardiovascular paralysis.[07866, 07718]
The resorptive effects also include the release of endogenous catecholamines; this must by all means be taken into consideration with regard to the therapy (see below).
Ingestion is practically impossible.[07798, 99999]
First medical assistance:
Eyes affected by splashes or vaporous CTFM are rinsed with Isogutt/physiological NaCl solution/water and covered with sterile material; all cases require the examination of the casualty by an ophthalmologist.[07638]
Dampened skin (and possibly clothes sticking to it) must be treated with warm water. The rapidly thawed superficial so-called ‘moment frostbite’ usually subsides rapidly.[99992]
A dermatocorticoid can then be applied.
The dominating resorptive effect, the slight -> pronounced -> narcosis that finally results in respiratory paralysis, requires the performance of the appropriate measures of cardiopulmonary cerebral resuscitation/vital therapy.[99983, 07879]
Do not apply any adrenaline-type sympathomimetic drugs or similar preparations; risk of interactions/ventricular fibrillation.[00022]
All these pharmaceuticals are incompatible with CTFM.[07798]
Pneumonia prophylaxis, in contrast, should be performed.[07638]
Asphyxia/anoxia due to air displacement (see above) must be treated with the supply of high oxygen amounts to all numb/unconscious casualties.
Control of the CNS functions, the blood, liver, kidney and lung parameters must be performed in hospital.[99999]

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

Annotation:
This first aid information was compiled on 01.07.1996.
It will be updated if necessary.
This information was translated from German into English by Übersetzungsbüro Branco.

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.

Equipment:
Use only closed apparatus.
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.
Empty apparatus after cooling down.
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.
For seals:
Polytetrafluoro ethylene PTFE (Teflon)
Polychloro trifluoro ethylene PCTFE
Acrylonitrile butadiene rubber NBR
Fluoro rubber FKM

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.
Refilling or transfer in storage rooms is prohibited.
Prevent cylinders from falling over.

Suck back of water into the container must be prevented. Do not allow backfeed into the container.
Purge air from equipment before introducing the gas.
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.

Cleaning and maintenance:
Regular inspection of leak test required!
Only conduct maintenance and other work on or in the vessel or closed spaces after obtaining written permission.

TECHNICAL MEASURES - STORAGE

Storage:
Containers have to be labelled clearly and permanently.
Make sure cylinders are tight.
Store in a cool place.
Keep container in a well-ventilated place.
Keep upright, protect against falling over.
Protect from exposure to sunlight.
Maybe provide water sprinkling.
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 stora-ge 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 sub-stances 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 ha-zardous chemical reactions are possible.

TECHNICAL MEASURES - FIRE AND EXPLOSION PROTECTION

Technical, constructive measures:
Substance is combustible.
Fire fighting equipment must be available.
Take precautionary measures against static discharges.
Earth all parts which can be electrically charged.
Suitable measures must be applied to seal off waste-water systems, cable and pipe access ways, etc. (e.g.: immersing and sand beds).
Protect parts of the system from any warming; if necessary, provide cooling with sprayed water.

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.
Displacement with air is only permissible under strict observance of special protective measures.
Work done with fire or open flame should only be carried out with written permission if the risk of fire or explosion cannot be completely eliminated.
Do not use any tools that cause sparks.
It must be avoided that gases or vapours can escape into other rooms where sources of ignition are present.
Creeping gases from afar may cause ignition.

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.

Observe the restrictions on juvenile employment as defined in the "Jugendarbeitsschutzgesetz".
Only employees are permitted to enter the work areas. Signposting to this effect must be displayed.

PERSONAL PROTECTION

Body protection:
Wear flameproof, antistatic protective clothing.
Use protective boots while handling gas cylinders.

Respiratory protection:
In an emergency (e.g.: unintentional release of the substance) respiratory protection must be worn. Consider the maximum period for wear.
Wear self-contained breathing apparatus.
Do not use filter respirator.

Eye protection:
Sufficient eye protection should be worn.
When handling compressed gas, at least glasses with side protection should be worn.
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.

Occupational hygiene:
Avoid skin contact with the liquid phase: risk of frostbite.
Avoid inhalation of gas.
Change clothing that has been in contact with or taken up any of the gas and air the clothing far from any sources of ignition.

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.
Wear respiratory protection (see chapter Personal Protection).
Attempt to stop the gas from escaping. Otherwise place leaky bottles under a suctioning device or put them outdoors.
Gas is moving on the ground.

Use non-sparking tools.
Afterwards ventilate area.

Endangerment of watert:
The effects on water sources have not yet been categorised. Yet escape into ground, lakes, or streams should be avoided under all circumstances. Inform responsible authorities in case of escape.

FIRE FIGHTING MEASURES

Classes of fires:
C gaseous, also compressed substances

Suitable extinguishing media:
Dry extinguishing powder
Carbon dioxide extinguisher with gas nozzle
Fight large fire with water spray.

Instructions:
In the case of fire advise fire fighters on the presence of gas cylinders.
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.
Shut off sources of ignition.
Only put out fire if the gas flow can be interrupted.
Risk of explosion from gas accumulation and backfire.
Fire fighting just towards the flames.
Use only explosion proved equipment.

Special protective equipment:
Wear self-contained breathing apparatus.

REGULATIONS

EUROPEAN GHS CLASSIFICATION ACCORDING TO REGULATION (EC) 1272/2008

Classification:
Flammable gases, Category 1; H220
Gases under pressure

Signal Word: "Danger"

Hazard Statement - H-phrases:
H220: Extremely flammable gas.

Note U
When put in the market gases have to be classified as 'Gases under pressure', in one of the groups compressed gas, liquefied gas, refrigerated liquefied gas or dissolved gas. The group depends on the physical state in which the gas is packaged and therefore has to be assigned case by case.

Reference: 07500

COLOUR CODING OF GAS CYLINDERS

Shoulder colour: Red
(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

Warning label:

Caution - gas cylinder

Caution - explosive atmosphere

Precept label:

Use safety goggles

Wear safety shoes

TECHNICAL INSTRUCTIONS ON AIR QUALITY CONTROL (TA LUFT)

Chapter 5.2.5 Organic Substances.
The following values, specified as overall carbon, are in all not allowed to be exceeded in exhaust gas:

Mass flow: 0,50 kg/hr

or

Mass conc.: 50 mg/m³

At old units with an annual mass flow till 1,5 Mg/a, specified as total carbon, the emissions in exhaust gas are not allowed to exceed 1,5 kg/h.

TRANSPORT REGULATIONS

UN Number: 1027
Shipping name: Cyclopropane
Hazard Identification Number: 23
Class: 2.1 (Flammable Gases)
Packing Group: -
Danger Label: 2.1

Tunnel restrictions:
Transports in tanks: passage forbidden through tunnels of category B, C, D and E.
Other transports: passage forbidden through tunnels of category D and E.

SEVESO III - Directive

Annex I Part 1 Section: P2

Flammable gases, Category 1 or 2

Qualifying Quantity Column 2:	10 t
Qualifying Quantity Column 3:	50 t

RESTRICTIONS OF USE / BANS OF USE

Directives on Safety in School (BGR/GUV-SR 2003)
Activity ban for pupils till grade 9 (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 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

LINKS

Publications of EIGA (European Industrial Gases Association) Documents Download
Publications of the IGV (Industriegaseverband e.V.) (in german only)

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Data acquisition and maintenance manual of the GESTIS substance database (not publicly)

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Datenbank CHEMSAFE, Version 2.10 (2014), DECHEMA-PTB-BAM

Reference: 01410
Sicherheitsdatenblatt (Material Safety Data Sheet), Linde

Reference: 02070
LOG KOW Databank, compiled by Dr. James Sangster, Sangster Research Laboratories, Montreal, Canada, distributed by Technical Database Services (TDS), New York

Reference: 05001
Kühn-Birett-Merkblätter bis 88. Ergänzungslieferung

Reference: 05200
Kühn-Birett "Merkblätter Gefährliche Arbeitsstoffe" Loseblattsammlung mit Ergänzungslieferungen, ecomed Sicherheit, Landsberg

Reference: 05300
TRGS 510 "Lagerung von Gefahrstoffen in ortsbeweglichen Behältern" Ausgabe Januar 2013, geändert und ergänzt November 2014

Reference: 06002
L. Roth, U. Weller "Gefährliche Chemische Reaktionen" Loseblattsammlung mit Ergänzungslieferungen ("Dangerous chemical reactions" loose-leaf collection with supplement deliveries), ecomed-Verlag

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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)

Reference: 07635
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M. Daunderer "Toxikologische Enzyklopädie - Klinische Toxikologie - Giftinformation, Giftnachweis, Vergiftungstherapie" Loseblatt-Ausgabe, ecomed-Verlagsgesellschaft mbH, Landsberg

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