n-Butane

IDENTIFICATION

n-Butane
Butan
R 600

ZVG No: 10030
CAS No: 106-97-8
EC No: 203-448-7
INDEX No: 601-004-00-0

CHARACTERISATION

SUBSTANCE GROUP CODE

140110 Hydrocarbons, aliphatic, saturated
162000 Organic gases

STATE OF AGGREGATION

The substance is gaseous.

PROPERTIES

colourless
nearly odourless

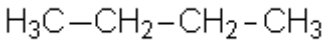
CHEMICAL CHARACTERISATION

Extremely flammable gas. Forms explosive mixtures with air.
Practically insoluble in water.
Gas is heavier than air.
Evaporation of very cold liquid or expansion of the gas causes formation of cold mist

spreading on the ground.

FORMULA

C4H10



Molar mass: 58,12 g/mol
Conversion factor (gaseous phase) at 1013 mbar and 20 °C:
1 ml/m³ = 2,42 mg/m³

TOXICOLOGY / ECOTOXICOLOGY

TOXICOLOGICAL DATA

LC50 inhalation rat
Value: 658 mg/l/4 h
Farmakologiya i Toksikologiya Vol. 30, Pg. 102, 1967.

Reference: 02071

PHYSICAL AND CHEMICAL PROPERTIES

TRIPLE POINT

Temperature: -138,3 °C
Pressure: 0,007 hPa

MELTING POINT

Melting point: -138,29 °C

BOILING POINT

Boiling Point: -0,5 °C

CRITICAL DATA

Crit. temperature: 152,0 °C
Crit. pressure: 37,96 bar
Crit. density: 0,228 g/cm³

DENSITY

VAPOUR DENSITY
under standard conditions (0 °C, 1013 mbar)
Value: 2,7091 kg/m³

DENSITY OF LIQUID PHASE AT BOILING POINT
Value: 0,6011 kg/l

RELATIVE VAPOUR DENSITY
Ratio of the density to dry air at the same temperature and pressure
Value: 2,08

VAPOUR DENSITY
Value: 2,514 kg/m³
Temperature: 15 °C
at 1 bar

VAPOUR PRESSURE

Vapour pressure: 2,081 bar
Temperature: 20 °C

Vapour pressure: 2,8 bar
Temperature: 30 °C

Vapour pressure: 4,9 bar
Temperature: 50 °C

FLASH POINT

Flash point: -60 °C

IGNITION TEMPERATURE

Ignition temperature: 365 °C
Temperature class: T1
Minimum ignition energy: 0,25 mJ
Max. exper. safe gap (MESG): 0,98 mm
Explosion group: IIA

Temperature class: T2
Explosion group: IIA

EXPLOSION LIMITS

Lower explosion limit:
1,4 vol. %

33 g/m³
Upper explosion limit:
9,4 vol. %
231 g/m³
Maximum explosion pressure:
9,4 bar

SOLUBILITY IN WATER

Concentration:	61 mg/l
Temperature:	20 °C
Concentration:	0,0298 ml/g H2O

PARTITION COEFFICIENT (octanol/water)

log Kow: 2,89
Recommended value of LOG KOW Databank.

HAZARDOUS REACTIONS

Hazardous chemical reactions:
Risk of explosion in contact with:
oxidizing agents
nickelcarbonyl / oxygen
flames, sparks

FURTHER INFORMATION

global warming potential : 3
ozone depletion potential : 0

OCCUPATIONAL HEALTH AND FIRST AID

ROUTES OF EXPOSURE

Main Routes of exposure:
The main intake pathway for n-butane (B.) is via the respiratory tract. [7619]

Respiratory tract:
Experimental information on the kinetics of uptake of B. by humans is not available. [99983]
In a study on volunteers exposed to 100 ppm isobutane for 20 minutes, 14% was absorbed. [99997]
In an inhalative kinetic study in which rats were exposed to 100 ppm of B. and isobutane, the rate of absorption was found to be 2 – 3 times higher for B. than for isobutene, [7619] so the amount of B. retained in the human organism would be

expected to be much higher than 14%. [99999]

Skin:
Kinetic data on the penetration through the skin is not available. [99983]
As a result of its physical-chemical properties, the residence time of the liquefied gas on the skin would be very short, so the absorption through the skin is expected to be negligible. [7619]

Gastrointestinal tract:
Unintentional oral intake under normal conditions is hardly possible because of the very low boiling point of the liquefied gas. [419]
Absorption of B. via the gastrointestinal tract should be possible but not toxicologically relevant. [451]

TOXIC EFFECTS

Main toxic effects:
Acute:
Frost bite following skin contact with the sub-cooled liquid, [7619]
disturbances to the central nervous system and to the heart function at very high gas concentrations, suffocating effect due to displacement of oxygen [99996]
Chronic:
Insufficient information available [99983]

Acute toxicity:
Even at high concentrations, gaseous B. is not irritating to the eyes and the skin.
By contrast, the liquid or expanded gas released from pressurized containers can cause frostbite on the eyes and skin. [7619]
A long history of occupation exposure has not provided any evidence of a sensitizing action. [7877]
No test information is available on the dermal toxicity. [99983]. Systemic effects are not expected following contact with the skin alone as the absorption through the skin is assumed to be low and also because of its low toxicity [419].
Occupational experience has shown that B. is not irritating to the respiratory tract.
The smell of the gas should become noticeable at concentrations from 1250 to 5050 ppm [451, 7877] but higher odor threshold concentrations (50000 ppm) have also been referred. [7619]
At very high concentrations, disturbances in the CNS become noticeable (euphorizing, hallucinotic and narcotic effects). [99996] These effects are consequences of the direct action to the CNS. [7619] At higher concentrations still, they are superimposed and strengthened by an anoxic effect (due to displacement of oxygen from the air breathed in). [419] At very high concentrations, disturbances to the heart function also occur (arrythmogenic effect). [7619, 99996]
The picture of symptoms is known from the abuse of B. as an intoxicant (almost always by teenagers): euphoria, blurred vision, weak speech, general weakness, headache, nausea, state of intoxication with hallucinations, tinnitus, ataxia. At very high concentrations there can be disturbances to the heart function (tachycardia) and CNS depression (drowsiness through to loss of consciousness/coma), possibly also cramps.
Following exposure resulting from accidents in the workplace (e.g. leakage from tanks),

the main symptoms expected are headache, drowsiness and coma.
The only severe and often fatal poisonings reported to date resulted from its abuse. The cause of death was mostly failure of the heart-circulatory system due to heart rhythm disturbances (ventricular fibrillation) and/or suffocation resulting from respiratory paralysis and an acute lack of oxygen. In one case, reanimation was initially successful but death later resulted from acute kidney failure (following massive rhabdomyolysis). The result of the autopsy was mostly unspecific (lung and brain edema and congestion in the organs). [99996] When severe poisoning was survived, in individual cases there was consequential damage in the central nervous system (e.g. hemiparesis of the right side and memory gaps). [7619]
Lasting damage could be the result of direct impact to the CNS or caused by temporary anoxia during the intoxication. [99996]
Little information is available on the dose-effect relationship.
Volunteers subjected to 10000 ppm B. for 10 minutes suffered from dizziness but no further effects. The threshold for the onset of narcotic effects to humans is estimated to be 17000 ppm B. [419, 7619] The concentration causing death is thought to not be much higher than that causing narcotic effects. [451]
Reduction of the oxygen content in the air to 18% is reached at a concentration of 140000 ppm B. [419]
In tests on rodents a 4h-LC50 was determined for rats to be 273,000 ppm and a 2 h-LC50 for mice 282,000 ppm. Dogs suffered sensitivity of the heart muscles to adrenaline at concentrations above 150,000 ppm. [7619]

Chronic toxicity:
Workers (n = 22) occupationally exposed at an LPG filling station (butane, propane) and who apparently were subjected to high exposure (2 measurements with a maximum of 8000 ppm but no further information) suffered from the following complaints: dryness in the throat, dry coughing, considerable excitation, sometimes dizziness. The ECG revealed disturbances to the heart function (tachycardia, multiple extrasystoles, incomplete right bundle branch block). [7619]
However, from this information it is not possible to say if these effects were caused by acute actions resulting from exposure to peaks in concentration. [99999]
As a result of the increasing abuse of B., there have been isolated cases for which lasting psychotic disturbances have been reported. These casualties (minors) who abused B. over long periods of time (from months to years), suffered from visual and acoustical hallucinations, bodily perception disorders and delusions, after contact with B. had ceased. These were attributed to massive inhalation of B. [99996]
Long-term animal experiments are only available for butane-pentane mixtures and from these the toxicity of B. can be seen to be low. Rats subjected to concentrations of 1000 and 4500 ppm of a 1:1 mixture of B. and n-pentane in a 90-day study showed a temporary hunched body position, intermittent tremor and lethargy during the exposure but no damage to organs was found. (NOAEC for damage to organs: 2250 ppm B.). [7619]

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:
The available information was considered to be insufficient for evaluation and hence for classification.
In isolated cases damage to the brain was found in newly born children whose mothers suffered from butane gas poisoning during their pregnancies. This damage was not attributed to any reproductive toxic effects by butane but rather by intrauterine anoxia. [7619]
Animal experimental data is not available. [99983]
Mutagenicity:
No mutagenic effect was seen in microbiological tests (including tests in accordance with OECD Guideline 479), not even at very high B. concentrations (up to 500,000 ppm) [7619]
In any case a potential hazard is seen when B. contains >/= 0.1% 1,3-butadiene (see ZVG number 531353). [7510]
Carcinogenicity:
Tests on the carcinogenicity are not available. [99983]
In any case a potential hazard is seen when B. contains >/= 0.1% 1,3-butadiene (see ZVG number 531353). [7510]

Biotransformation and Excretion:
In studies on rodents, inhaled B. was seen to be distributed throughout the organism and the highest concentrations were found in the fatty tissue, brain, spleen, liver and kidneys (in the order from highest to lowest).
For mice which inhaled very high concentrations of B. for an hour (660,000 ppm together with adequate amounts of oxygen), unchanged B. and the metabolites 2-butanol and methylethylketone were found in the blood [7619].
Both metabolites could be exhaled. The excretion of 2-butanol via the urine (as glucuron acid conjugate) could also be a significant elimination path. Based on kinetic studies with ethane and pentane, the elimination of B. is estimated to be very rapid (half-life of 8 minutes). [451]

Annotation:
This occupational health information was compiled on 13.04.2010.
It will be actualised if necessary.

FIRST AID

Eyes:
Following contact with the liquefied or expanded gas, rinse eyes only briefly with flowing (lukewarm) water. Do not spread the eyelids, leave contact lenses in place. No warmth. Sterile covering.
Arrange medical treatment.
[419]

Skin:
Whilst protecting yourself, relocate the casualty away from the source of danger.
Remove contaminated clothing while protecting yourself.
Following contact with liquefied n-butane / expanded gas, initially thaw clothing which has frozen onto the body with a lot of cold or lukewarm water and then remove it

carefully.
Rinse any skin areas suspected of being frozen caused by contact with sub-cooled n-butane with cold/lukewarm water. Do not rub affected skin areas or subject them to dry warmth, instead cover them with a sterile covering.
Lay the casualty down in a quiet place to rest and protect him against hypothermia.
Arrange for medical treatment.
[419]

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.
Arrange medical treatment.
Following massive inhalation, the following can be necessary:
If the casualty is unconscious but breathing lay him in a stable manner on his side.
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.
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.
[419]

Swallowing:
Swallowing of the sub-cooled liquid is hardly conceivable. [419]
If this has nevertheless occurred, have the casualty slowly drink 1 – 2 glasses of water.
For further treatment, see under “Respiratory tract”.
Call a physician to the site of the accident. [99999]

Information for physicians:
Gaseous n-butane does not cause irritation but following expansion from gas bottles it could cause frostbite. Systemic effects are expected at very high concentrations.
- Symptoms of acute poisoning:
Eyes: frostbite caused by the liquefied or expanded gas
Skin: frostbite caused by the liquefied or expanded gas (numbness, tingling feeling in the skin, itching, burning, stiffness of the affected areas)
Inhalation: at very high concentrations (from approx. 10000 ppm) systemic effects (see below), at concentrations above 140,000 ppm hypoxic effects due to reduction of the amount of oxygen in the air breathed in; [419]
following direct inhalation of aerosols from pressure vessels, possible reflex cardiac arrest caused by the effect of cold on the vagus nerve [99996]
Ingestion: following intake of the sub-cooled liquid probable frost damage in the mouth or acute heart-circulatory system reactions (see above); [99999] danger of aspiration [451]
Absorption: following massive inhalation, dizziness, state of excitement/euphoria, blurred vision, weak speech, general weakness, headache, nausea, vomiting, state of intoxication with hallucinations, ataxia, disturbances to the heart functions (tachycardia, arrhythmia, ventricular fibrillation), dazed state up to loss of consciousness/cramps,

symptoms of strong hypoxia/anoxia; danger of cardiac and respiratory arrest, if the poisoning is survived, complications caused by rhabdomyolysis/acute kidney failure or resulting from having suffered hypoxia, possibly lasting damage to the CNS and heart. [99996]

- Medical advice:
Following eye contact with the liquefied/expanded gas, rinsing of the eyes and consultation of an ophthalmologist is indicated.
Local frostbite on the skin or undercooling resulting from impact over a large area can be treated in the usual way.
Following massive inhalation, liberally apply fresh air and as soon as possible have the casualty inhale oxygen. Place the patient in a quiet place. Carry out further treatment symptomatically. [419]
Following extremely high exposure, cardiac-pulmonary and cerebral resuscitation measures could rapidly become necessary. In this situation exercise care in the use of adrenaline/ephedrine and derivatives (at very high concentrations the heart is sensitized to the effect of catecholamines). Use of an anti-arrhythmic medicament is recommended. [99996]
Even if there are no poisoning symptoms, following massive exposure, hospitalization is recommended to carry out further diagnosis of the heart, circulatory and lung function, the acid-base balance and the kidney function. [419, 99996]

Recommendations:
Provide the physician information about the substance/product and treatment already administered.
[99999]
Butane can contain small quantities of 1,3-butadiene (see ZVG number 531353). [7510]
The impact on the casualty can be estimated by determining the amount of mercapturic acid derivates of the 1,3-butadiene metabolites and by the determination of hemoglobin adducts. The determination of 1,3-butadiene-DNA adducts seems to be suitable for effect monitoring. [7620]

Annotation:
This first aid information was compiled on 13.04.2010.
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.

Equipment:
Use only closed apparatus.
If dangerous pressure can arise from contact with heat, suitable safety measures and equipment should be provided.
Do not open apparatus or ovens while they are still hot.
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.
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
Polyvinylidene fluoride
Polyamide PA
Polypropylene PP
Acrylonitrile butadiene rubber NBR
Polychloroprene rubber CR
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.
Use leak-proof equipment with exhaust for refilling or transfer.
Purge air from equipment before introducing the gas.
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.
Only work with vessels and lines after they have been thoroughly rinsed.

TECHNICAL MEASURES - STORAGE

Storage:
Containers have to be labelled clearly and permanently.
Container labelling per red paint, sticker with product notation.

Commercially available liquified in pressure containers.
Keep container tightly closed.
Store in a cool place.
Keep container in a well-ventilated place.
Keep upright, protect against falling over.
Outdoors provide for a shelter, eventually water spraying system for cylinders and containers.
Prevent non-admissible pressure.
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.

Measures required by the "Explosionsschutz-Richtlinie":
- Preventing the formation of an explosive atmosphere (limiting and monitoring the concentration, making inert, sealing, ventilation, warning systems, etc.)
- Preventing the ignition of an explosive atmosphere (separation into zones, removal of sources of ignition, explosion-proof electrical installation, grounding, etc.)
- Architectural measures to limit the effects of an explosion (explosive-force-proof construction, release of explosive pressure, explosion suppression, etc.)
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.
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.
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, exceeding the occupational exposure limit value) respiratory protection must be worn. Consider the maximum period for wear.
This is a low-boiling-point substance of group 2 of the BGR 190.
Respiratory protection: Gas filter AX, colour code brown.
Max. concentration for use:
1000 ml/m³ for max. 60 min.
5000 ml/m³ for max. 20 min.
Filters may only be used in their original condition. Repeated use is permissible for the appropriate maximum period within a single shift (max. 8 hours). Do not use AX filters against mixtures of low-boiling-point substances and other organic compounds.
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 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:
No hazards to sources of water are to be feared if released into water, drainage, sewer, or the ground.

FIRE FIGHTING MEASURES

Classes of fires:
C gaseous, also compressed substances

Suitable extinguishing media:
Water (spray - not splash)
Dry extinguishing powder
Carbon dioxide extinguisher with gas nozzle

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.
Be watchful for frostbite in case of contact with fluid.
Use only explosion proved equipment.
Explosion danger by penetration into sewerage.

Special protective equipment:
Wear self-contained breathing apparatus.

REGULATIONS

Classification:
Flammable gases, Category 1; H220
Gases under pressure, liquefied gas; H280

Signal Word: "Danger"

Hazard Statement - H-phrases:
H220: Extremely flammable gas.
H280: Contains gas under pressure; may explode if heated.

Precautionary Statement - P-phrases:
P210: Keep away from heat, hot surfaces, sparks, open flames and other sources of ignition. No smoking.
P377: Leaking gas fire: Do not extinguish, unless leak can be stopped safely.
P381: Eliminate all ignition sources if safe to do so.
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

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

GERMAN WATER HAZARD CLASS

Substance No: 561

non-hazardous to waters

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

TECHNICAL INSTRUCTIONS ON AIR QUALITY CONTROL (TA LUFT)

Chapter 5.2.5 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: 1011
Shipping name: Butane
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.

TRGS 900 - GERMAN OCCUPATIONAL EXPOSURE LIMIT VALUES

1000 ml/m³
2400 mg/m³

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

Source: DFG

RECOMMENDATIONS OF MAK-COMMISSION

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

1000 ml/m³
2400 mg/m³

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

Pregnancy: Group D
A classification according to groups A-C is not possible, because either there is no data available or the available data is insufficient for a final evaluation.

SEVESO III - Directive

Annex I Part 2 Number: 18
Liquefied flammable gases, Category 1 or 2
Qualifying Quantity 50 t
Column 2:

Qualifying Quantity Column 3:	200 t

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 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 79 (BGV D34): Verwendung von Flüssiggas

LINKS

International Limit Values
The MAK Collection for Occupational Health and Safety
Publications of EIGA (European Industrial Gases Association) Documents Download
Publications of the IGV (Industriegaseverband e.V.) (in german only)

REFERENCES

Reference: 00001
IFA: Erfassungs- und Pflegehandbuch der GESTIS-Stoffdatenbank (nicht öffentlich)
Data acquisition and maintenance manual of the GESTIS substance database (not publicly)

Reference: 00106
Sorbe "Sicherheitstechnische Kenndaten chemischer Stoffe" ("Safety-related characteristics of chemical substances"), sicherheitsNet.de, Landsberg, 07/2011

Reference: 00240
E. Brandes, W. Möller "Sicherheitstechnische Kenngrößen" Band 1 "Brennbare Flüssigkeiten und Gase" ("Safety-related characteristics" Vol. 1 "Combustible liquids and gases"), Wirtschaftsverlag NW, Verlag für neue Wissenschaft GmbH, Bremerhaven, 2003

Reference: 00260
1x1 der Gase. Physikalische Daten für Wissenschaft und Praxis. Herausgeber: AIR LIQUIDE Deutschland GmbH, Düsseldorf, 1. Auflage 2005

Reference: 00336
Schriftreihe der Bundesanstalt für Arbeitsschutz Gefährliche Arbeitsstoffe - (GA 32) GAS-ATLAS, 2. Auflage, Dortmund 1992

Reference: 00419
CHEMINFO-Datenbankrecherche (CHEMpendium) ab 2001

Reference: 00440
Datenbank CHEMSAFE, Version 2.10 (2014), DECHEMA-PTB-BAM

Reference: 00451
HSDB-Datenbankrecherche 2004

Reference: 01401
GHS-Sicherheitsdatenblatt (GHS Material Safety Data Sheet), Air Liquide

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

Reference: 02071
Toxicological Data, compiled by the National Institute of Health (NIH), USA, selected and distributed by Technical Database Services (TDS), New York, 2009

Reference: 05154
Kühn-Birett-Merkblätter: 154. Ergänzungslieferung; 10/2002

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

Reference: 05350
TRGS 900 "Arbeitsplatzgrenzwerte" Ausgabe Januar 2006, zuletzt geändert und ergänzt November 2015

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

Reference: 06501
DIN EN 378-1 "Kälteanlagen und Wärmepumpen" Ausgabe Juni 2008 mit Berichtigung Januar 2010

Reference: 07510
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, geändert durch Verordnung (EG) Nr. 790/2009 der Kommission vom 10. August 2009 (EG-GHS-Verordnung) (ehemals Richtlinie 67/548/EWG mit Anpassungsrichtlinien in der jeweils gültigen Fassung).

Reference: 07584
Allgemeine Verwaltungsvorschrift zur Änderung der Verwaltungsvorschrift wassergefährdende Stoffe - VwVwS vom 27. Juli 2005; Bundesanzeiger Jahrgang 57, Nr. 142a, vom 30. Juli 2005

Reference: 07619
DFG: Toxikologisch-arbeitsmedizinische Begründungen von MAK-Werten; Verlag Chemie

Reference: 07620
DFG: Arbeitsmedizinisch-toxikologische Begründungen von BAT-Werten; Verlag Chemie

Reference: 07635
AUERDATA 98 und BGR/GUV-R 190 "Einsatz von Atemschutzgeräten" Ausgabe 11/2009

Reference: 07796
L. Roth "Wassergefährdende Stoffe" Loseblattsammlung mit Ergänzungslieferungen, ecomed-Verlag

Reference: 07877
BUA Stoffbericht 144: Flüssiggas (Propan, Butan, Isobutan und Gemische) - Stand 06/94

Reference: 07902
ADR 2015 - Europäisches Übereinkommen über die internationale Beförderung gefährlicher Güter auf der Straße (ADR)

Reference: 08102
DFG Deutsche Forschungsgemeinschaft: MAK- und BAT-Werte-Liste 2015, Senatskommission zur Prüfung gesundheitsschädlicher Arbeitsstoffe, Mitteilung 51; VCH

Reference: 99983
Literaturlisten - Standardwerke, erweitert (Bibliographical reference - standard works, extended)

Reference: 99996
Projektgebundene Literaturliste Nr. 2 (Project related bibliographical reference No 2)

Reference: 99997
Projektgebundene Literaturliste Nr. 1
(Project related bibliographical reference No 1)

Reference: 99999
Angabe des Bearbeiters (Indication of the editor)