

Propane



IDENTIFICATION

Propane
R 290
n-Propane

ZVG No: 10020
CAS No: 74-98-6
EC No: 200-827-9
INDEX No: 601-003-00-5

CHARACTERISATION

SUBSTANCE GROUP CODE

140110 Hydrocarbons, aliphatic, saturated
162000 Organic gases

STATE OF AGGREGATION

The substance is gaseous.

PROPERTIES

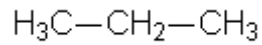
colourless
odourless

CHEMICAL CHARACTERISATION

Extremely flammable gas. Forms explosive mixtures with air.
Practically insoluble in water.
Gas is heavier than air.

FORMULA

C₃H₈



Molar mass: 44,10 g/mol

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

1 ml/m³ = 1,83 mg/m³

PHYSICAL AND CHEMICAL PROPERTIES

TRIPLE POINT

Temperature: -187,7 °C

Pressure: 0,196 nanobar

MELTING POINT

Melting point: -187,7 °C

BOILING POINT

Boiling Point: -42,1 °C

CRITICAL DATA

Crit. temperature: 96,8 °C

Crit. pressure: 42,6 bar

Crit. density: 0,226 g/cm³

DENSITY

VAPOUR DENSITY

under standard conditions (0 °C, 1013 mbar)

Value: 2,0098 kg/m³

DENSITY OF LIQUID PHASE AT BOILING POINT

Value: 0,5812 kg/l

RELATIVE VAPOUR DENSITY

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

Value: 1,55

VAPOUR DENSITY

Value: 1,874 kg/m³

Temperature: 15 °C
at 1 bar

VAPOUR PRESSURE

Vapour pressure: 8,327 bar
Temperature: 20 °C

Vapour pressure: 10,8 bar
Temperature: 30 °C

Vapour pressure: 17,081 bar
Temperature: 50 °C

FLASH POINT

Flash point: -104 °C
Closed cup

IGNITION TEMPERATURE

Ignition temperature: 470 °C
Temperature class: T1
Minimum ignition energy: 0,24 mJ
Max. exper. safe gap (MESG): 0,92 mm
Explosion group: IIA

EXPLOSION LIMITS

Lower explosion limit:
1,7 mol% (Ideal gas: mol% = vol.%)
Upper explosion limit:
10,8 mol% (Ideal gas: mol% = vol.%)
Maximum explosion pressure:
9,4 bar

SOLUBILITY IN WATER

Concentration: 75 mg/l
Temperature: 20 °C

PARTITION COEFFICIENT (octanol/water)

log Kow: 2,36
Recommended value of LOG KOW Databank.

HAZARDOUS REACTIONS

Decomposition temperature: 780 ... 800 °C

Decomposition products:

Ethene; propene; methane; hydrogen;

Hazardous chemical reactions:

Risk of explosion in contact with:

chlorine dioxide

The substance can react dangerously with:

barium peroxide

FURTHER INFORMATION

global warming potential : 3

ozone depletion potential : 0

OCCUPATIONAL HEALTH AND FIRST AID

ROUTES OF EXPOSURE

Main Routes of exposure:

The only toxicologically relevant intake pathway for propane (P.) proceeds via the respiratory tract.[07619]

Respiratory tract:

Kinetic studies on mice provided detectable concentrations of metabolites and also showed absorptive-toxic effects, so effective absorption could be assumed.[07877]

However, because of the high vapor pressure, the amount really retained is probably low.[99999]

Skin:

The amount absorbable through the skin is considered to be small.[07619]

This is plausible because the gas is poorly soluble in water (62.4 mg/l at 20 degrees C) and even liquid homologues of[99999] P., eg pentane, 2-methylpentane or hexane only showed penetration rates of a few $\mu\text{g}/\text{cm}^2 \times \text{h}$ under occlusive conditions.[99997]

Gastrointestinal tract:

As a result of the physico-chemical properties, unintentional oral intake of toxicologically relevant concentrations is not possible under conditions encountered in practice.[99999]

TOXIC EFFECTS

Main toxic effects:

Acute:

Frostbite following skin contact with the gas which has been let down;

central-nervous disturbances;[07619]

in extreme situations suffocation due to oxygen deficiency

Chronic:

Dessication of the mucous membranes, cough, gastrointestinal disturbances and functional changes to the heart through high concentrations[07877]

Acute toxicity:

Gaseous P. in concentrations up to 10 vol.% does not cause any noticeable irritation to the skin or mucous membranes of the eyes and upper respiratory tract.[00451]

Direct contact of gas let down from compressed gas cylinders with the eyes and skin leads to reddening, edema and deep necrosis as a consequence of "chemical frostbites".

There is no information on the potential to sensitize the skin, not even at high gas concentrations.[07877]

Dermal toxicity is also hardly to be expected, not even if persons using effective respiratory protection are placed in a room containing a concentrated mixture of P. vapor in air.[99999]

The odor threshold for P. is between 5000 and 20000 ppm. Slight irritation only appears at much higher concentrations.[00451]

From several studies on humans it appears that 1000 ppm does not initiate any systemic effects either. In further inhalation studies it was found that short-term exposure to even 10000 ppm (1 vol.%) did not cause any or only a slightly dazed feeling. Only at concentrations from 10 vol.% upwards the following symptoms can be produced, also dependent on the concentration: accelerated respiration, difficulties in breathing, disturbances to coordination, decreased alertness, emotional instability, rapid fatigue, nausea, vomiting, weakness, unconsciousness, cramps and deep coma.[07748]

One case of death due to asphyxia has been reported and this was following massive exposure to P.[00451]

Dogs exposed to 100000 ppm (10 vol.%) for 5 minutes developed sensitization of the heart muscle to epinephrine.

The EC50 for this effect was reported to be 18 vol.%.

Rhesus monkeys exposed to 100000 ppm (duration not given) only showed respiratory depression but no further poisoning symptoms.[07619]

Chronic toxicity:

In an experiment, 125 volunteers used a deodorant containing 65 - 70 weight % propane/isobutane twice per day for 12 weeks. No irritation to the skin was observed.[00451]

Employees in a filling plant for liquid gas (butane, propane) who were repeatedly exposed to a maximum of 8000 ppm P./butane showed the following symptoms: dry cough, dryness in the throat, gastrointestinal complaints, functional changes of the heart (sinus tachycardia, multiple extrasystoles and other changes noticeable from the ECG).[07877]

21 monkeys inhalatively exposed for 90 days to 750 ppm of a deodorant containing more than 50 % propane as a propellant did not show any exposure-related symptoms.[07619]

Reproductive toxicity, Mutagenicity, Carcinogenicity:

Reproductive toxicity:

Insufficient data is available.[07619]

Serious fetotoxic action of the homologous butane which led to cot death following high exposure of 2 pregnant women was considered not to follow a noxa-related mechanism but to be a definitive consequence of hypoxia caused by exposure.

Mutagenicity:

Concentrations of P. in air up to 50 % did not show any mutagenic potential to microorganisms but the highest concentration was cytotoxic.

Carcinogenicity:

No data is available.[07877]

Biotransformation and Excretion:

50000 ppm P. inhalatively taken in was partially metabolized to form isopropanol and acetone (no quantitative data available). Both of the metabolites were detected in the blood, liver, brain and kidneys after exposure for 1 hour.[07619]

Because microsomal oxidation takes place on the (omega-1)-carbon, n-propanol is not formed. This was also confirmed experimentally.[00451]

Annotation:

This occupational health information was compiled on 11.11.2005.

It will be updated if necessary.

FIRST AID

Eyes:

If frostbite results from direct contact with propane gas released from pressure gas cylinders, contact lenses should initially remain in place. Immediately mildly rinse the eye concerned with water of normal temperature. Do not spread the lids.

Do not apply heat.[99999]

Arrange medical treatment.

Skin:

For frostbite resulting from contact with undercooled liquid propane, cut open contaminated clothing and remove it carefully. Leave clothing caked to the skin in place initially. Rinse frostbitten areas with luke-warm water. Never use hot water. Do not move frostbitten extremities (do not massage). Cover with sterile material, protect against further loss of warmth.

While these activities are proceeding, absolutely call a physician (danger of infection to the wounds, undercooling).[99999]

Respiratory tract:

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

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

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

Arrange medical treatment.

If there is a danger of unconsciousness, put/transport the casualty in a stable side position.[05097]

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. 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.

Swallowing:

Not relevant.[99999]

Information for physicians:

- Symptoms of acute poisoning:

Eyes/skin: Frostbite due to direct contact with the undercooled liquid.

Inhalation (extremely high concentrations): vertigo, nausea, stupor, muscular weakness, cramps, narcosis, irregular respiration, unconsciousness, death through oxygen deficiency.[07748]

- Medical advice:

For extensive frostbite with a fall in the body temperature, immediately warm the patient in a water bath of 40 - 42 degrees C.[99997]

There is no consistent opinion on the optimal therapy for local frostbite without decrease of the core temperature (gradual warming or dipping into maximum 40 degrees C warm water with alleviation of pain as necessary).[99983]

Threatening suffocation requires application of fresh air or better air enriched with oxygen.[05097]

In serious cases artificial ventilation, shock therapy. Resuscitation in hospital as necessary. Careful observation of the circulatory system is necessary. Do not apply epinephrine and derivatives because the heart is sensitized to their arrhythmogenic effect.[99999]

Recommendations:

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

Examination of the functions of the liver and kidneys and a neurologic postobservation is indicated in every case in order to recognize possible late sequels.[99999]

Annotation:

This first aid information was compiled on 12.09.2005.

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.

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

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.

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.

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

Keep upright, protect against falling over.

Protect from exposure to sunlight.

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 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, explosion-protected electrical operating systems, pumps, controls, and valves, 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.

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

Suitable measures must be applied to seal off waste-water systems, cable and pipe access ways, etc. (e.g.: immersing and sand beds).

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.

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 water:

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.

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 ignition sources. 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](#)

State: 2012

Checked: 2015

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



Wear safety gloves

GERMAN WATER HAZARD CLASS

Substance No: 560

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: 1978

Shipping name: Propane

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

1800 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

1800 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 200 t

Column 3:

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 Oktober 2016

[TRGS 407](#)

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

[TRGS 745/TRBS 3145](#)

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

[TRGS 746/TRBS 3146](#)

Ortsfeste Druckanlagen für Gase; Ausgabe September 2016

[TRGS 510](#)

Lagerung von Gefahrstoffen in ortsbeweglichen Behältern; Ausgabe Januar 2013, zuletzt berichtigt November 2015

[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 \(Industriegaseverband e.V.\) \(in german only\)](#)

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Reference: 01400
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Reference: 01401
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Reference: 05350
[TRGS 900](#) "Arbeitsplatzgrenzwerte" Ausgabe Januar 2006, zuletzt geändert und ergänzt November 2016
Reference: 06002
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DFG: Toxikologisch-arbeitsmedizinische Begründungen von MAK-Werten; Verlag Chemie
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American Conference of Governmental Industrial Hygienists "Documentation of the threshold limit values and biological exposure indices" Loseblattsammlung mit Ergänzungslieferungen
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Reference: 07902
ADR 2015 - Europäisches Übereinkommen über die internationale Beförderung gefährlicher Güter auf der Straße (ADR)
Reference: 08104
DFG Deutsche Forschungsgemeinschaft: MAK- und BAT-Werte-Liste 2016, Senatskommission zur Prüfung gesundheitsschädlicher Arbeitsstoffe, Mitteilung 52; VCH
Reference: 99983
Literaturlisten - Standardwerke, erweitert (Bibliographical reference - standard works, extended)
Reference: 99994
Projektgebundene Literaturliste Nr. 4
(Project related bibliographical reference No 4)
Reference: 99997
Projektgebundene Literaturliste Nr. 1
(Project related bibliographical reference No 1)
Reference: 99999
Angabe des Bearbeiters (Indication of the editor)

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