SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

Trade name : Carbon monoxide, CARBON MONOXID (N18, N25, N37, N47)
SDS no. : 019
Chemical description : Carbon monoxide
CAS-No. : 630-08-0
EC-No. : 211-128-3
EC Index-No. : 006-001-00-2
Registration-No. : 01-2119480165-39
Chemical formula : CO

1.2. Relevant identified uses of the substance or mixture and uses advised against

Relevant identified uses : Industrial and professional. Perform risk assessment prior to use. See the list of identified uses and exposure scenarios in the annex of the safety data sheet. Contact supplier for more information on uses.
Uses advised against : Consumer use.

1.3. Details of the supplier of the safety data sheet

Company identification

Supplier
AIR LIQUIDE Deutschland GmbH
Luise-Rainer-Straße 5
40235 Düsseldorf - GERMANY
T +49 (0)211 6699-0 - F +49 (0)211 6699-222
info@airliquide.de

E-Mail address (competent person) : info.SDB@airliquide.de

1.4. Emergency telephone number

Emergency telephone number : +49 (0)2151 398668
Availability ( 24 / 7 )

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

Classification according to Regulation (EC) No. 1272/2008 [CLP]

<table>
<thead>
<tr>
<th>Physical hazards</th>
<th>Health hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flammable gases, Category 1</td>
<td>Acute toxicity (inhalation:gas) Category 3</td>
</tr>
<tr>
<td>Gases under pressure : Compressed gas</td>
<td>Reproductive toxicity, Category 1A</td>
</tr>
<tr>
<td></td>
<td>Specific target organ toxicity — Repeated exposure, Category 1</td>
</tr>
</tbody>
</table>

2.2. Label elements

Labelling according to Regulation (EC) No. 1272/2008 [CLP]

Hazard pictograms (CLP) :

- GHS02
- GHS04
- GHS06
- GHS08

Signal word (CLP) : Danger
Hazard statements (CLP) :
H220 - Extremely flammable gas..
H280 - Contains gas under pressure; may explode if heated..
H331 - Toxic if inhaled..
H360D - May damage the unborn child.
H372 - Causes damage to organs through prolonged or repeated exposure.

Precautionary statements (CLP)

- Prevention:
P202 - Do not handle until all safety precautions have been read and understood.
P260 - Do not breathe gas, vapours.
P210 - Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.

- Response:
P308+P313 - IF exposed or concerned: Get medical advice.
P377 - Leaking gas fire: Do not extinguish, unless leak can be stopped safely.
P381 - In case of leakage, eliminate all ignition sources.
P304+P340+P315 - IF INHALED: Remove person to fresh air and keep comfortable for breathing. Get immediate medical advice / attention.

- Storage:
P403 - Store in a well-ventilated place.
P405 - Store locked up.

Supplemental information:
Restricted to professional users.

2.3. Other hazards:
None.

SECTION 3: Composition/information on ingredients

<table>
<thead>
<tr>
<th>Name</th>
<th>Product identifier</th>
<th>Composition [V-%]:</th>
<th>Classification according to Regulation (EC) No. 1272/2008 [CLP]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon monoxide</td>
<td>630-08-0, 211-128-3, 006-001-00-2, 01-2119480165-39</td>
<td>100</td>
<td>Flam. Gas 1, H220, Press. Gas (Comp.), H280, Acute Tox. 3 (Inhalation:gas), H331, Repr. 1A, H360D, STOT RE 1, H372</td>
</tr>
</tbody>
</table>

Contains no other components or impurities which will influence the classification of the product.

3.2. Mixtures:
Not applicable.

SECTION 4: First aid measures

4.1. Description of first aid measures

- Inhalation:
Remove victim to uncontaminated area wearing self contained breathing apparatus. Keep victim warm and rested. Call a doctor. Apply artificial respiration if breathing stopped. Provide oxygen.

- Skin contact:
Adverse effects not expected from this product.

- Eye contact:
Adverse effects not expected from this product.

- Ingestion:
Ingestion is not considered a potential route of exposure.

4.2. Most important symptoms and effects, both acute and delayed

Symptoms may include dizziness, headache, nausea and loss of co-ordination. Delayed adverse effects possible. Refer to section 11.

4.3. Indication of any immediate medical attention and special treatment needed

Obtain medical assistance.

SECTION 5: Firefighting measures

5.1. Extinguishing media
- Suitable extinguishing media: Water spray or fog. Dry powder.
- Unsuitable extinguishing media: Carbon dioxide. Do not use water jet to extinguish.

**5.2. Special hazards arising from the substance or mixture**

Specific hazards: Exposure to fire may cause containers to rupture/explode.
Hazardous combustion products: None that are more hazardous than the product itself.

**5.3. Advice for firefighters**

Specific methods: Use fire control measures appropriate for the surrounding fire. Exposure to fire and heat radiation may cause gas receptacles to rupture. Cool endangered receptacles with water spray jet from a protected position. Prevent water used in emergency cases from entering sewers and drainage systems. If possible, stop flow of product. Use water spray or fog to knock down fire fumes if possible. Do not extinguish a leaking gas flame unless absolutely necessary. Spontaneous/explosive re-ignition may occur. Extinguish any other fire. Move containers away from the fire area if this can be done without risk.


**SECTION 6: Accidental release measures**

6.1. Personal precautions, protective equipment and emergency procedures

- Try to stop release.
- Evacuate area.
- Monitor concentration of released product.
- Consider the risk of potentially explosive atmospheres.
- Wear self-contained breathing apparatus when entering area unless atmosphere is proved to be safe.
- Eliminate ignition sources.
- Ensure adequate air ventilation.
- Act in accordance with local emergency plan.
- Stay upwind.

6.2. Environmental precautions

- Try to stop release.

6.3. Methods and material for containment and cleaning up

- Ventilate area.

6.4. Reference to other sections

- See also sections 8 and 13.

**SECTION 7: Handling and storage**

7.1. Precautions for safe handling

Safe use of the product: The product must be handled in accordance with good industrial hygiene and safety procedures. Only experienced and properly instructed persons should handle gases under pressure. Consider pressure relief device(s) in gas installations. Ensure the complete gas system was (or is regularly) checked for leaks before use. Do not smoke while handling product. Avoid exposure, obtain special instructions before use.
Use only properly specified equipment which is suitable for this product, its supply pressure and temperature. Contact your gas supplier if in doubt.

Installation of a cross purge assembly between the cylinder and the regulator is recommended.

Avoid suck back of water, acid and alkalis.

Assess the risk of potentially explosive atmospheres and the need for explosion-proof equipment.

Purge air from system before introducing gas.

Take precautionary measures against static discharge.

Keep away from ignition sources (including static discharges).

Consider the use of only non-sparking tools.

Do not breathe gas.

Avoid release of product into atmosphere.

Ensure equipment is adequately earthed.

Safe handling of the gas receptacle:

Refer to supplier's container handling instructions.

Do not allow backfeed into the container.

Protect cylinders from physical damage; do not drag, roll, slide or drop.

When moving cylinders, even for short distances, use a cart (trolley, hand truck, etc.) designed to transport cylinders.

Leave valve protection caps in place until the container has been secured against either a wall or bench or placed in a container stand and is ready for use.

If user experiences any difficulty operating cylinder valve discontinue use and contact supplier.

Never attempt to repair or modify container valves or safety relief devices.

Damaged valves should be reported immediately to the supplier.

Keep container valve outlets clean and free from contaminants particularly oil and water.

Replace valve outlet caps or plugs and container caps where supplied as soon as container is disconnected from equipment.

Close container valve after each use and when empty, even if still connected to equipment.

Never attempt to transfer gases from one cylinder/container to another.

Never use direct flame or electrical heating devices to raise the pressure of a container.

Do not remove or deface labels provided by the supplier for the identification of the cylinder contents.

Suck back of water into the container must be prevented.

Open valve slowly to avoid pressure shock.

7.2. Conditions for safe storage, including any incompatibilities:

Observe all regulations and local requirements regarding storage of containers.

Containers should not be stored in conditions likely to encourage corrosion.

Container valve guards or caps should be in place.

Containers should be stored in the vertical position and properly secured to prevent them from falling over.

Stored containers should be periodically checked for general condition and leakage.

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

Store containers in location free from fire risk and away from sources of heat and ignition.

Keep away from combustible materials.

Segregate from oxidant gases and other oxidants in store.

All electrical equipment in the storage areas should be compatible with the risk of a potentially explosive atmosphere.

7.3. Specific end use(s):

None.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

<table>
<thead>
<tr>
<th>Carbon monoxide (630-08-0)</th>
<th>OEL: Occupational Exposure Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EU</td>
<td>TWA IOELV (EU) 8 h [mg/m³]</td>
</tr>
<tr>
<td></td>
<td>TWA IOELV (EU) 8 h [ppm]</td>
</tr>
</tbody>
</table>
Carbon monoxide (630-08-0)

DNEL: Derived no effect level (Workers)

- Acute - local effects, inhalation: 100 ppm
- Acute - systemic effects, inhalation: 100 ppm
- Long-term - local effects, inhalation: 20 ppm
- Long-term - systemic effects, inhalation: 20 ppm

PNEC (Predicted No-Effect Concentration): No data available.

8.2. Exposure controls

8.2.1. Appropriate engineering controls

- Product to be handled in a closed system and under strictly controlled conditions.
- Provide adequate general and local exhaust ventilation.
- Preferably use permanent leak-tight installations (e.g. welded pipes).
- Systems under pressure should be regularly checked for leakages.
- Ensure exposure is below occupational exposure limits (where available).
- Gas detectors should be used when toxic gases may be released.
- Consider the use of a work permit system e.g. for maintenance activities.

8.2.2. Individual protection measures, e.g. personal protective equipment

- A risk assessment should be conducted and documented in each work area to assess the risks related to the use of the product and to select the PPE that matches the relevant risk. The following recommendations should be considered:
  - PPE compliant to the recommended EN/ISO standards should be selected.

  - Eye/face protection
    - Wear safety glasses with side shields.
    - Standard EN 166 - Personal eye-protection - specifications.

  - Skin protection
    - Hand protection
      - Wear working gloves when handling gas containers.
      - Standard EN 388 - Protective gloves against mechanical risk.
    - Other
      - Consider the use of flame resistant anti-static safety clothing.
      - Standard EN ISO 1149-5 - Protective clothing: Electrostatic properties.
      - Wear safety shoes while handling containers.
      - Standard EN ISO 20345 - Personal protective equipment - Safety footwear.

  - Respiratory protection
    - Never use any kind of filtering respiratory protection equipment when working with this substance due to it having poor or no warning properties.
    - Keep self contained breathing apparatus readily available for emergency use.
    - Self contained breathing apparatus is recommended, where unknown exposure may be expected, e.g. during maintenance activities on installation systems.
    - Standard EN 137 - Self-contained open-circuit compressed air breathing apparatus with full face mask.

  - Thermal hazards
    - None in addition to the above sections.

8.2.3. Environmental exposure controls

- Refer to local regulations for restriction of emissions to the atmosphere. See section 13 for specific methods for waste gas treatment.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Appearance

- Physical state at 20°C / 101.3kPa: Gas.
**Carbon monoxide**

- **Colour**: Colourless.
- **Odour**: Odourless.
- **Odour threshold**: Odour threshold is subjective and inadequate to warn of overexposure.
- **Melting point**: -205 °C
- **Boiling point**: -192 °C
- **Flash point**: Not applicable for gases and gas mixtures.
- **Flammability range**: 10.9 - 76 vol %
- **Relative vapour density at 20 °C**: Not applicable.
- **Evaporation rate (ether=1)**: Not applicable for gases and gas mixtures.
- **Vapour pressure [20°C]**: Not applicable.
- **Vapour pressure [50°C]**: Not applicable.
- **Relative density, gas (air=1)**: 1
- **Relative density, liquid (water=1)**: 0.79
- **Solubility in water**: 30 mg/l
- **pH value**: Not applicable for gases and gas mixtures.
- **Partition coefficient n-octanol/water [log Kow]**: 1.78
- **Decomposition point [°C]**: Not applicable.
- **Auto-ignition temperature**: 605 °C
- **Viscosity [20°C]**: No reliable data available.
- **Explosive Properties**: Not applicable.
- **Oxidising Properties**: Not applicable.

### 9.2. Other information

- **Molar mass**: 28 g/mol
- **Critical temperature [°C]**: -140 °C
- **Other data**: No additional information available

## SECTION 10: Stability and reactivity

### 10.1. Reactivity

- No reactivity hazard other than the effects described in sub-sections below.

### 10.2. Chemical stability

- Stable under normal conditions.

### 10.3. Possibility of hazardous reactions

- Can form explosive mixture with air.
  - May react violently with oxidants.

### 10.4. Conditions to avoid

- Keep away from heat/sparks/open flames/hot surfaces. – No smoking.
  - Avoid moisture in installation systems.

### 10.5. Incompatible materials

- Air, Oxidisers.
  - For additional information on compatibility refer to ISO 11114.
  - See also 'EIGA Doc.95: Avoidance of Failure of CO and of CO/CO2 Mixtures Cylinders’ at www.eiga.eu.

### 10.6. Hazardous decomposition products

- Under normal conditions of storage and use, hazardous decomposition products should not be produced.
SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute toxicity: Toxic if inhaled.

<table>
<thead>
<tr>
<th>LC50 inhalation rat (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3760 ppm/1h</td>
</tr>
<tr>
<td>1300 ppm/4h</td>
</tr>
</tbody>
</table>

Skin corrosion/irritation: No known effects from this product.

Serious eye damage/irritation: No known effects from this product.

Respiratory or skin sensitisation: No known effects from this product.

Germ cell mutagenicity: No known effects from this product.

Carcinogenicity: No known effects from this product.

Reproductive toxicity:
- Toxic for reproduction: Fertility: No known effects from this product.
- Toxic for reproduction: unborn child: May damage the unborn child.

STOT-single exposure: Suppresses the oxygen uptake by red blood cells.

Target organ(s): Blood.

STOT-repeated exposure: Causes damage to organs through prolonged or repeated exposure.

Target organ(s): heart.

Aspiration hazard: Not applicable for gases and gas mixtures.

SECTION 12: Ecological information

12.1. Toxicity

Assessment: No ecological damage caused by this product.

EC50 48h - Daphnia magna [mg/l]: Study scientifically unjustified.
EC50 72h - Algae [mg/l]: Study scientifically unjustified.
LC50 96 h - Fish [mg/l]: Study scientifically unjustified.

12.2. Persistence and degradability

Assessment: Will not undergo hydrolysis.

Not readily biodegradable.

12.3. Bioaccumulative potential

Assessment: Not expected to bioaccumulate due to the low log Kow (log Kow < 4).
Refer to section 9.

12.4. Mobility in soil

Assessment: Because of its high volatility, the product is unlikely to cause ground or water pollution.
Partition into soil is unlikely.

12.5. Results of PBT and vPvB assessment

Assessment: Not classified as PBT or vPvB.

12.6. Other adverse effects

Other adverse effects: No known effects from this product.

Effect on the ozone layer: None.

Effect on global warming: Contains greenhouse gas(es).
SECTION 13: Disposal considerations

13.1. Waste treatment methods

Contact supplier if guidance is required.
Do not discharge into areas where there is a risk of forming an explosive mixture with air.
Waste gas should be flared through a suitable burner with flash back arrestor.
Must not be discharged to atmosphere.
Ensure that the emission levels from local regulations or operating permits are not exceeded.
Refer to the EIGA code of practice Doc.30 "Disposal of Gases", downloadable at http://www.eiga.org for more guidance on suitable disposal methods.
Return unused product in original cylinder to supplier.

List of hazardous waste codes (from Commission Decision 2001/118/EC)
: 16 05 04 *: Gases in pressure containers (including halons) containing dangerous substances.

13.2. Additional information

: External treatment and disposal of waste should comply with applicable local and/or national regulations.

SECTION 14: Transport information

14.1. UN number

UN-No. : 1016

14.2. UN proper shipping name

Transport by road/rail (ADR/RID) : CARBON MONOXIDE, COMPRESSED
Transport by air (ICAO-TI / IATA-DGR) : Carbon monoxide, compressed
Transport by sea (IMDG) : CARBON MONOXIDE, COMPRESSED

14.3. Transport hazard class(es)

Labelling :

- 2.3 : Toxic gases.
- 2.1 : Flammable gases.

Transport by road/rail (ADR/RID)
Class : 2.
Classification code : 1TF.
Hazard identification number : 263.
Tunnel Restriction : B/D - Tank carriage : Passage forbidden through tunnels of category B, C, D and E. Other carriage : Passage forbidden through tunnels of category D and E.

Transport by sea (IMDG)
Class / Div. (Sub. risk(s)) : 2.3 (2.1)
Emergency Schedule (EmS) - Fire : F-D.
Emergency Schedule (EmS) - Spillage : S-U.

14.4. Packing group

Transport by road/rail (ADR/RID) : Not established.
Transport by air (ICAO-TI / IATA-DGR) : Not established.
Transport by sea (IMDG) : Not established.

14.5. Environmental hazards

Transport by road/rail (ADR/RID) : None.
Transport by air (ICAO-TI / IATA-DGR) : None.
14.6. Special precautions for user

Packing Instruction(s)

Transport by road/rail (ADR/RID) : P200.
Transport by air (ICAO-TI / IATA-DGR)
  Passenger and Cargo Aircraft : Forbidden.
  Cargo Aircraft only : Forbidden.
Transport by sea (IMDG) : P200.

Special transport precautions : Avoid transport on vehicles where the load space is not separated from the driver's compartment.
Ensure vehicle driver is aware of the potential hazards of the load and knows what to do in the event of an accident or an emergency.
Before transporting product containers:
- Ensure there is adequate ventilation.
- Ensure that containers are firmly secured.
- Ensure cylinder valve is closed and not leaking.
- Ensure valve outlet cap nut or plug (where provided) is correctly fitted.
- Ensure valve protection device (where provided) is correctly fitted.

14.7. Transport in bulk according to Annex II of Marpol and the IBC Code

: Not applicable.

SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

EU-Regulations
Restrictions on use : Restricted to professional users (Annex XVII REACH).
Seveso Directive : 2012/18/EU (Seveso III) : Covered.

National regulations
National legislation : Ensure all national/local regulations are observed.

Germany
Water hazard class (WGK) : Water hazard class (WGK) 1, low hazard to waters (Classification according to VwVwS, Annex 1 or 2; ID No. 257)


15.2. Chemical safety assessment

A CSA has been carried out.

SECTION 16: Other information


Abbreviations and acronyms : ATE - Acute Toxicity Estimate
CLP - Classification Labelling Packaging Regulation; Regulation (EC) No 1272/2008
EINECS - European Inventory of Existing Commercial Chemical Substances
CAS# - Chemical Abstract Service number
Training advice:

Ensure operators understand the flammability hazard.

Users of breathing apparatus must be trained.

Ensure operators understand the toxicity hazard.

Further information:

This Safety Data Sheet has been established in accordance with the applicable European Union legislation.

Full text of H- and EUH-statements:

<table>
<thead>
<tr>
<th>Acute Tox. 3 (Inhalation:gas)</th>
<th>Acute toxicity (inhalation:gas) Category 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flam. Gas 1</td>
<td>Flammable gases, Category 1</td>
</tr>
<tr>
<td>Press. Gas (Comp.)</td>
<td>Gases under pressure: Compressed gas</td>
</tr>
<tr>
<td>Reppr. 1A</td>
<td>Reproductive toxicity, Category 1A</td>
</tr>
<tr>
<td>STOT RE 1</td>
<td>Specific target organ toxicity – Repeated exposure, Category 1</td>
</tr>
</tbody>
</table>

- H220: Extremely flammable gas.
- H280: Contains gas under pressure; may explode if heated.
- H331: Toxic if inhaled.
- H360D: May damage the unborn child.
- H372: Causes damage to organs through prolonged or repeated exposure.

DISCLAIMER OF LIABILITY:

Before using this product in any new process or experiment, a thorough material compatibility and safety study should be carried out.

Details given in this document are believed to be correct at the time of going to press.

Whilst proper care has been taken in the preparation of this document, no liability for injury or damage resulting from its use can be accepted.
Annex to the safety data sheet

This Annex documents the Exposure Scenarios (ESs) related to the identified uses of the registered substance. The ESs detail protective measures for workers and the environment in addition to those described in sections 7, 8, 11, 12 and 13 of the SDS that are required to ensure that the potential exposure to workers and the environment remains within acceptable levels for each of the identified uses.

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<td>Metal treatment</td>
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<td>Electronic component manufacture</td>
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<td>Manufacture of pharmaceutical products</td>
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<td>Intermediate (transported, on-site isolated)</td>
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<td>Transfilling in pressure receptacles</td>
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<td>Feedstock in chemical processes</td>
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<td>Industrial uses, closed contained conditions</td>
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<tr>
<td>Controlling agent in catalytic reaction</td>
<td>019-1</td>
<td>Industrial uses, closed contained conditions</td>
<td>12</td>
</tr>
<tr>
<td>Monomer in polymer production</td>
<td>019-1</td>
<td>Industrial uses, closed contained conditions</td>
<td>12</td>
</tr>
<tr>
<td>Calibration of analysis equipment</td>
<td>019-1</td>
<td>Industrial uses, closed contained conditions</td>
<td>12</td>
</tr>
</tbody>
</table>
# SAFETY DATA SHEET

## Carbon monoxide

### 1. 019-1: Industrial uses, closed contained conditions

#### 1.1. Title section

**Industrial uses, closed contained conditions**

| Processes, tasks, activities covered | Industrial uses, including product transfers and associated laboratory activities within different closed or contained systems |
| Environment | Use descriptors |
| CS1 | ERC2, ERC6a, ERC6b, ERC8d |
| Worker | Use descriptors |
| CS2 | PROC1 |
| CS3 | PROC2, PROC3, PROC4 |
| CS4 | PROC8b, PROC9 |
| Assessment method | ECETOC TRA 2.0 |

#### 1.2. Conditions of use affecting exposure

**1.2.1. Control of environmental exposure: ERC2, ERC6a, ERC6b, ERC8d**

- **ERC2**
  - Formulation of preparations
- **ERC6a**
  - Industrial use resulting in manufacture of another substance (use of intermediates)
- **ERC6b**
  - Industrial use of reactive processing aids
- **ERC8d**
  - Wide dispersive outdoor use of processing aids in open systems

**Product (article) characteristics**

- **Physical form of product**
  - See section 9 of the SDS, No additional information
- **Concentration of substance in product**
  - <= 100 %

**Amount used, frequency and duration of use (or from service life)**

- The actual tonnage handled per site is not considered to influence the immissions as such for this scenario as there is practically no release
- Covers frequency up to: 5 days/week
- Emission Days (days/year) 220

**Technical and organisational conditions and measures**

- Wastewater emission controls are not applicable as there is no direct release to wastewater
- Soil emission controls are not applicable as there is no direct release to soil
- Ensure operatives are trained to minimise releases

**Conditions and measures related to sewage treatment plant**

- Not applicable as there is no release to wastewater

**Conditions and measures related to treatment of waste (including article waste)**

- External treatment and disposal of waste should comply with applicable local and/or national regulations
- See section 13 of the SDS

**Other conditions affecting environmental exposure**

- No additional information

**1.2.2. Control of worker exposure: PROC1**

- **PROC1**
  - Use in closed process, no likelihood of exposure

**Product (article) characteristics**

- **Physical form of product**
  - See section 9 of the SDS, No additional information
- **Concentration of substance in product**
  - <= 100 %

**Amount used (or contained in articles), frequency and duration of use/exposure**

- The actual tonnage handled per shift is not considered to influence the exposure as such for this scenario. Instead, the combination of the scale of operation
(industrial vs. professional) and level of containment/automation (as reflected in the PROCs and technical conditions) is the main determinant of the process-intrinsic emission potential.

Exposure duration <= 8 h/day
Covers frequency up to: 5 days/week

Technical and organisational conditions and measures
Handle product within a closed system
Ensure operatives are trained to minimise exposure
Ensure supervision is in place to check that the RMMs are in place and are being used correctly and that the OCs are being followed

Conditions and measures related to personal protection, hygiene and health evaluation
Self contained breathing apparatus is recommended, where unknown exposure may be expected, e.g. during maintenance activities on installation systems.
See section 8 of the SDS.

Other conditions affecting workers exposure
Indoor or outdoor use

1.2.3. Control of worker exposure: PROC2, PROC3, PROC4

PROC2 Use in closed, continuous process with occasional controlled exposure
PROC3 Use in closed batch process (synthesis or formulation)
PROC4 Use in batch and other process (synthesis) where opportunity for exposure arises

Product (article) characteristics
Physical form of product See section 9 of the SDS, No additional information
Concentration of substance in product <= 100 %

Amount used (or contained in articles), frequency and duration of use/exposure
The actual tonnage handled per shift is not considered to influence the exposure as such for this scenario. Instead, the combination of the scale of operation (industrial vs. professional) and level of containment/automation (as reflected in the PROCs and technical conditions) is the main determinant of the process-intrinsic emission potential.
Exposure duration <= 8 h/day
Covers frequency up to: 5 days/week

Technical and organisational conditions and measures
Handle product within a closed system
Ensure operatives are trained to minimise exposure
Ensure supervision is in place to check that the RMMs are in place and are being used correctly and that the OCs are being followed

Conditions and measures related to personal protection, hygiene and health evaluation
Self contained breathing apparatus is recommended, where unknown exposure may be expected, e.g. during maintenance activities on installation systems.
See section 8 of the SDS.

Other conditions affecting workers exposure
Indoor or outdoor use

1.2.4. Control of worker exposure: PROC8b, PROC9

PROC8b Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities
PROC9 Transfer of substance or preparation into small containers (dedicated filling line, including weighing)

Product (article) characteristics
Physical form of product See section 9 of the SDS, No additional information
Concentration of substance in product <= 100 %

Amount used (or contained in articles), frequency and duration of use/exposure
The actual tonnage handled per shift is not considered to influence the exposure as such for this scenario. Instead, the combination of the scale of operation
(industrial vs. professional) and level of containment/automation (as reflected in the PROCs and technical conditions) is the main determinant of the process-intrinsic emission potential.

Exposure duration <= 8 h/day
Covers frequency up to: 5 days/week

**Technical and organisational conditions and measures**

Handle product within a closed system
Ensure operatives are trained to minimise exposure
Ensure supervision is in place to check that the RMMs are in place and are being used correctly and that the OCs are being followed

**Conditions and measures related to personal protection, hygiene and health evaluation**

Self contained breathing apparatus is recommended, where unknown exposure may be expected, e.g. during maintenance activities on installation systems.

**Other conditions affecting workers exposure**

Indoor or outdoor use

### 1.3. Exposure estimation and reference to its source

#### 1.3.1. Environmental release and exposure: ERC2, ERC6a, ERC6b, ERC8d

The exposure of aquatic, terrestrial, sediment and sewage treatment microorganisms is considered to be negligible because the substance partitions primarily to air when released to the environment. The resulting environmental exposure is not expected to add significantly to already present background levels of the gas in the environment.

#### 1.3.2. Worker exposure: PROC1

<table>
<thead>
<tr>
<th>Route of exposure and type of effects</th>
<th>Exposure estimate</th>
<th>Assessment conditions</th>
<th>RCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inhalation - Long-term - systemic effects</td>
<td>0.011 mg/m³</td>
<td>Indoor use, With LEV</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>Inhalation - Acute - systemic effects</td>
<td>0.023 mg/m³</td>
<td>Indoor use, With LEV</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

#### 1.3.3. Worker exposure: PROC2, PROC3, PROC4

<table>
<thead>
<tr>
<th>Route of exposure and type of effects</th>
<th>Exposure estimate</th>
<th>Assessment conditions</th>
<th>RCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inhalation - Long-term - systemic effects</td>
<td>11.7 mg/m³</td>
<td>Indoor use, With LEV</td>
<td>0.585</td>
</tr>
<tr>
<td>Inhalation - Acute - systemic effects</td>
<td>23.4 mg/m³</td>
<td>Indoor use, Without LEV</td>
<td>0.234</td>
</tr>
</tbody>
</table>

#### 1.3.4. Worker exposure: PROC8b, PROC9

<table>
<thead>
<tr>
<th>Route of exposure and type of effects</th>
<th>Exposure estimate</th>
<th>Assessment conditions</th>
<th>RCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inhalation - Long-term - systemic effects</td>
<td>23.3 mg/m³</td>
<td>Indoor use, With LEV</td>
<td>1.165</td>
</tr>
<tr>
<td>Inhalation - Acute - systemic effects</td>
<td>46.7 mg/m³</td>
<td>Indoor use, Without LEV</td>
<td>0.467</td>
</tr>
</tbody>
</table>

#### 1.4. Guidance to Downstream User to evaluate whether he works inside the boundaries set by the ES

##### 1.4.1. Environment

Guidance - Environment: Check that RMMs and OCs are as described above or of equivalent efficiency

##### 1.4.2. Health

Guidance - Health: Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures. For scaling see: http://www.ecetoc.org/tra