SAFETY DATA SHEET
Zinc Oxide
According to Regulation (EU) No 453/2010

SECTION 1: IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

1.1. Product identifier

Product name: Zinc Oxide
CAS-No.: 1314-13-2
EC No.: 215-222-5

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

Identified uses:
- Laboratory chemicals. Lubricants and lubricant additives.
- Plating agents and metal surface treating agents.
- Process regulators, other than polymerisation or vulcanisation processes.
- Component in batteries. Corrosion inhibitors and anti-scaling agents.
- Process regulators, used in vulcanisation or polymerisation processes.
- Processing aid, not otherwise listed. Semiconductors.

Uses advised against:
- No specific uses advised against are identified.

1.3. Details of the supplier of the safety data sheet

Manufacturer:
Ekmekçiogulları Metal ve Kimya San. Tic. A.Ş.
Organize Sanayi Bölgesi
6. Cadde No:20 ÇORUM / TURKEY
Tel: +90 0 364 235 02 00
Fax: + 0 364 235 01 99
info@ekmekciogullari.com.tr

Contact Person:
Emel Coskun (Ms)

1.4. Emergency telephone number
- +90 364 254 97 60
- +90 542 743 22 14

SECTION 2: HAZARDS IDENTIFICATION

2.1. Classification of the substance or mixture

Classification (EC 1272/2008)
- Physical and Chemical Hazards: Not classified.
- Human health: Not classified.
- Environment:
  - Aquatic Acute 1 - H400;
  - Aquatic Chronic 1 - H410

Classification (67/548/EEC)
N;R50/53.

The Full Text for all R-Phrases and Hazard Statements are Displayed in Section 16.
SAFETY DATA SHEET
Zinc Oxide
According to Regulation (EU) No 453/2010

2.2. Label elements
EC No. 215-222-5
Label In Accordance With (EC) No. 1272/2008

Signal Word
Warning

Hazard Statements
H410 Very toxic to aquatic life with long lasting effects.

Precautionary Statements
P273 Avoid release to the environment.
P501 Dispose of contents/container in accordance with national regulations.

Supplementary Precautionary Statements
P391 Collect spillage

2.3. Other hazards
This substance are not PBT or vPvB substances.

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

3.1. Substance

<table>
<thead>
<tr>
<th>Substance</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZINC OXIDE</td>
<td>99.8%</td>
</tr>
</tbody>
</table>

CAS-No.: 1314-13-2   EC No.: 215-222-5   REACH registration number: 01-2119463881-32-XXXX

Classification (EC 1272/2008)     Classification (67/548/EEC)
Aquatic Acute 1 - H400             N;R50/53
Aquatic Chronic 1 - H410

The Full Text for all R-Phrases and Hazard Statements are Displayed in Section 16.

Composition Comments
The data shown are in accordance with the latest EC Directives.

SECTION 4: FIRST AID MEASURES

4.1. Description of first aid measures

General information
General first aid, rest, warmth and fresh air.
Do not give victim anything to drink if they are unconscious.
Get medical attention if any discomfort continues.
SAFETY DATA SHEET
Zinc Oxide
According to Regulation (EU) No 453/2010

Inhalation
Move into fresh air and keep at rest.
Get medical attention if any discomfort continues.

Ingestion
Rinse mouth thoroughly. Do not induce vomiting.
If vomiting occurs, the head should be kept low so that stomach vomit doesn't enter the lungs.
Get medical attention.

Skin contact
Remove contaminated clothing. Rinse the skin immediately with lots of water.

Eye contact
Make sure to remove any contact lenses from the eyes before rinsing.
 Promptly wash eyes with plenty of water while lifting the eyelids.
Get medical attention promptly if symptoms occur after washing.

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

Inhalation
Dusts may cause drowsiness and dizziness.

Ingestion
May cause discomfort if swallowed.

Skin contact
Prolonged skin contact may cause redness and irritation.

Eye contact
May cause temporary eye irritation.

4.3. Indication of any immediate medical attention and special treatment needed
No specific first aid measures noted.

SECTION 5: FIREFIGHTING MEASURES

5.1. Extinguishing media

Extinguishing media
Fire can be extinguished using: Water spray. Extinguish with alcohol-resistant foam, carbon dioxide or dry powder.

Unsuitable extinguishing media
No data available.

5.2. Special hazards arising from the substance or mixture

Hazardous combustion products
Carbon monoxide (CO). Carbon dioxide (CO2).

Unusual Fire & Explosion Hazards
No data available.

5.3. Advice for firefighters

Special Fire Fighting Procedures
Use pressurised air mask if product is involved in a fire.
Cool containers exposed to flames with water until well after the fire is out.

Protective equipment for fire-fighters
Self contained breathing apparatus and full protective clothing must be worn in case of fire.
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SECTION 6: ACCIDENTAL RELEASE MEASURES

6.1. Personal precautions, protective equipment and emergency procedures
Wear protective clothing as described in Section 8 of this safety data sheet.

6.2. Environmental precautions
Avoid discharge into drains, water courses or onto the ground.
Spillages or uncontrolled discharges into watercourses must be immediately alerted to the Environmental Agency or other appropriate regulatory body.

6.3. Methods and material for containment and cleaning up
Avoid generation and spreading of dust.
Collect powder using special dust vacuum cleaner with particle filter or carefully sweep into closed container.
Wash thoroughly after dealing with a spillage.

6.4. Reference to other sections
For personal protection, see section 8.
See section 11 for additional information on health hazards.
For waste disposal, see section 13.

SECTION 7: HANDLING AND STORAGE

7.1. Precautions for safe handling
Avoid handling which leads to dust formation. Avoid inhalation of dust and contact with skin and eyes.

7.2. Conditions for safe storage, including any incompatibilities
Store in tightly closed original container in a dry, cool and well-ventilated place. Keep in original container.

7.3. Specific end use(s)
The identified uses for this product are detailed in Section 1.2.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1. Control parameters
OELs for ZnO – group: “slightly soluble / insoluble Zn compounds”
(e.g.: ZnO - Zn(OH)2 - Zn3(PO4)2 - ZnCO3 - Zn metal – ZnS)

<table>
<thead>
<tr>
<th>Name</th>
<th>STD</th>
<th>TWA - 8 Hrs</th>
<th>STEL - 15 Min</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zinc Oxide (ZnO)</td>
<td>OEL</td>
<td>5 mg/m³ (fumes)</td>
<td>10 mg/m³ (dust)</td>
<td>HSE (1998)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 mg/m³ (fumes)</td>
<td>15 mg/m³ (dust; total)</td>
<td>OSHA (1989)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 mg/m³ (fumes)</td>
<td>5 mg/m³ (dust; respirable)</td>
<td>(legal limit values)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 mg/m³ (fumes)</td>
<td>6 mg/m³ (dust)</td>
<td>10 mg/m³</td>
</tr>
</tbody>
</table>

OEL = Occupational Exposure Limit.
SAFETY DATA SHEET
Zinc Oxide
According to Regulation (EU) No 453/2010

OELs for ZnCl2 – group: soluble zinc compounds
(e.g.: ZnCl2 - ZnSO4 - Zn(H3PO4)2 - ZnCl2/2NH4Cl - ZnCl2/3NH4Cl)

<table>
<thead>
<tr>
<th>Name</th>
<th>STD</th>
<th>TWA - 8 Hrs</th>
<th>STEL - 15 Min</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zinc Oxide (ZnCl2)</td>
<td>OEL</td>
<td>1 mg/m³</td>
<td>2 mg/m³</td>
<td>ACGIH (1991)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 mg/m³</td>
<td></td>
<td>SZW (1997)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 mg/m³</td>
<td>*2 mg/m³</td>
<td>HSE (1998)</td>
</tr>
</tbody>
</table>

OEL = Occupational Exposure Limit.
* This value is a 10 minutes-STEL

DNELs and PNECs

DNELs
- Oral
  DNELoral soluble Zn = 50 mg Zn/day (i.e., 0.83 mg Zn/kg bw/day);
  DNELoral insoluble Zn = 50 mg Zn/day (i.e., 0.83 mg Zn/kg bw/day);
- Dermal
  DNELdermal soluble Zn = 500 mg Zn/day (i.e., 8.3 mg Zn/kg bw/day);
  DNELdermal insoluble Zn = 5000 mg Zn/day (i.e., 83 mg Zn/kg bw/day);
- Inhalation - Worker
  DNELinhal soluble Zn (worker) = 1 mg Zn/m³;
  DNELinhal insoluble Zn (worker) = 5 mg Zn/m³;
- Inhalation - Consumer
  DNELinhal soluble Zn (consumer) = 1.3 mg Zn/m³;
  DNELinhal insoluble Zn (consumer) = 2.5 mg Zn/m³;

PNECs derived for the zinc ion

<table>
<thead>
<tr>
<th>Compartment (Environment)</th>
<th>PNEC value for Zn ion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshwater</td>
<td>20.6* µg/L</td>
</tr>
<tr>
<td>Saltwater</td>
<td>6.1* µg/L</td>
</tr>
<tr>
<td>STP</td>
<td>52 µg/L</td>
</tr>
<tr>
<td>Freshwater sediment</td>
<td>117.8* mg/kg sediment d.w.</td>
</tr>
<tr>
<td></td>
<td>A generic bioavailability factor of 0.5 is applied by default: PNEC_{bioav} = 235.6 mg/kg sediment d.w.</td>
</tr>
<tr>
<td>Saltwater sediment</td>
<td>56.5* mg/kg sediment d.w.</td>
</tr>
<tr>
<td></td>
<td>A generic bioavailability factor of 0.5 is applied by default: PNEC_{bioav} = 113 mg/kg sediment d.w.</td>
</tr>
<tr>
<td>Soil</td>
<td>35.6* mg/kg soil d.w.</td>
</tr>
<tr>
<td></td>
<td>A generic bioavailability/ageing factor of 3 is applied by default: PNEC_{bioav} = 106.8 mg/kg soil d.w.</td>
</tr>
<tr>
<td>Oral</td>
<td>No potential for bioaccumulation</td>
</tr>
</tbody>
</table>

*added value
SAFETY DATA SHEET
Zinc Oxide
According to Regulation (EU) No 453/2010

8.2. Exposure controls

Protective equipment

Process conditions
Provide eyewash station.

Engineering measures
Provide adequate ventilation, including appropriate local extraction, to ensure that the defined occupational exposure limit is not exceeded. All handling to take place in well-ventilated area.
- Process enclosures closed circuits or semi-enclosures where appropriate.
- Local exhaust ventilation on furnaces and other work areas with potential dust and fumes generation, dust capturing and removal techniques (high efficiency 90-95%).
- Containment of liquid volumes in sumps to collect/prevent accidental spillage.

Respiratory equipment
Wearing of gloves and protective clothing is compulsory (efficiency >=90%).
With normal handling, no respiratory personal protection (breathing apparatus) is necessary. If risk for exceedance of OEL/DNEL, use e.g.:
- Dust filter-half mask P1 (efficiency 75%)
- Dust filter-half mask P2 (efficiency 90%)
- Dust filter-half mask P3 (efficiency 95%)
- Dust filter-full mask P1 (efficiency 75%)
- Dust filter-full mask P2 (efficiency 90 %)
- Dust filter-full mask P3 (efficiency 97.5%)

Hand protection
Use protective gloves made of: Nitrile gloves are recommended.

Eye protection
Wear splash-proof eye goggles to prevent any possibility of eye contact.

Other Protection
Wear suitable protective clothing as protection against splashing or contamination.

Hygiene measures
Do not smoke in work area! Wash hands at the end of each work shift and before eating, smoking and using the toilet. Promptly remove any clothing that becomes contaminated. Use appropriate skin cream to prevent drying of skin. When using do not eat, drink or smoke.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

9.1. Information on basic physical and chemical properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>Powder, dust.</td>
</tr>
<tr>
<td>Colour</td>
<td>White.</td>
</tr>
<tr>
<td>Odour</td>
<td>Odourless.</td>
</tr>
<tr>
<td>Solubility</td>
<td>Slightly soluble in water.</td>
</tr>
<tr>
<td></td>
<td>The water solubility of Zn in ZnO is 2.9 mg/l.</td>
</tr>
<tr>
<td>Melting point</td>
<td>&gt;300°C</td>
</tr>
<tr>
<td>Relative density</td>
<td>5.68 g/cm³</td>
</tr>
</tbody>
</table>
SAFETY DATA SHEET

Zinc Oxide

According to Regulation (EU) No 453/2010

9.2. Other information
No information required.

SECTION 10: STABILITY AND REACTIVITY

10.1. Reactivity
No data available.

10.2. Chemical stability
No data available.

10.3. Possibility of hazardous reactions
No data available.

10.4. Conditions to avoid
No data available.

10.5. Incompatible materials
Materials To Avoid
Strong oxidising substances.

10.6. Hazardous decomposition products

SECTION 11: TOXICOLOGICAL INFORMATION

11.1. Information on toxicological effects

Acute Toxic Dose 1 - LD 50 >15,000 mg/kg (oral - rat) Reference: Löser (1972)
Acute Toxic Dose 1 - LD 50 >5,000 mg/kg (oral - rat) Reference: Löser (1977)
Acute Toxic Dose 2 - LD 50 >5,000 mg/kg (oral - rat) Reference: Löser (1977)
Acute Toxic Conc. - LC 50 >5.7 mg/L/4h (inhalation - rat) Reference: Klimisch and Freisberg (1982)

Skin Corrosion/Irritation:
Not irritating. (Löser, 1977; Lansdown, 1991)

Serious eye damage/irritation
Not irritant (Van Huygevoort, 1999e; Thijssen, 1978; Löser, 1977)
SAFETY DATA SHEET
Zinc Oxide
According to Regulation (EU) No 453/2010

Respiratory or skin sensitisation:
No sensitizing effects known (Van Huygevoort, 1999 g, h).

Germ cell mutagenicity:
No biologically relevant genotoxic activity (based on cross-reading between Zn compounds; no classification for mutagenicity required) (Chemical Safety report (CSR) zinc oxide. 2010).

Carcinogenicity:
No experimental or epidemiological evidence exists to justify classification of zinc compounds for carcinogenic activity (based on cross-reading between Zn compounds; no classification for carcinogenicity required) (Chemical Safety report (CSR) zinc oxide. 2010).

Reproductive Toxicity:
No experimental or epidemiological evidence exists to justify classification of zinc compounds for reproductive or developmental toxicity (based on cross-reading between Zn compounds; no classification for reproductive toxicity required) (Chemical Safety report (CSR) zinc oxide. 2010).

Specific target organ toxicity - single exposure:

Specific target organ toxicity - repeated exposure:
Target Organs: No experimental or epidemiological sufficient evidence for specific target organ toxicity (repeated exposure) (no classification for specific target organ toxicity (repeated exposure: STOT-RE) required) (Lam et al, 1985, 1988; Conner et al., 1988 [Cited in Chemical Safety report (CSR) zinc oxide. 2010]).

Aspiration hazard
Not available.

Inhalation
In high concentrations, vapours may irritate throat and respiratory system and cause coughing.

Ingestion
May cause discomfort if swallowed.

Skin contact
Prolonged and frequent contact may cause redness and irritation.

Eye contact
May irritate eyes.

SECTION 12: ECOLOGICAL INFORMATION

Ecotoxicity
Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

12.1. Toxicity

Acute Aquatic Toxicity
For zinc oxide (based on 62% solubilisation capacity on finest powders at most conservative loading of 1 mg/l at pH 8 (RA zinc oxide, ECB 2008) :

• for pH <7: 0.67 mg Zn/l (based on 48 hr Ceriodaphnia dubia test cfr. above)
• for pH >7-8.5: 0.21 mg Zn/l (based on 72 hr Selenastrum capricornutum test cfr. above)

M-factor: 1
SAFETY DATA SHEET
Zinc Oxide
According to Regulation (EU) No 453/2010

Chronic aquatic toxicity: freshwater
The chronic aquatic toxicity database on zinc contains high quality chronic NOEC/EC10 values on 23 species (8 taxonomic groups) obtained under a variety of conditions. These data, outlined in the CSR, were compiled in a species sensitivity distribution, from which the PNEC was derived (expressed as Zn++ion concentration). This PNEC is an added value, i.e. it is to be added to the zinc background in water, see section 8.1. of SDS.

Chronic aquatic toxicity: marine waters
The chronic aquatic toxicity database on zinc contains high quality chronic NOEC/EC10 values on 39 species (9 taxonomic groups) obtained under a variety of conditions. These data, outlined in the CSR, were compiled in a species sensitivity distribution, from which the PNEC was derived (expressed as Zn++ion concentration). This PNEC is an added value, to be added on the zinc background in water, see section 8.1. of SDS.

Sediment toxicity
The chronic toxicity of zinc to sediment organisms in the freshwater was assessed based on a database containing high quality chronic NOEC/EC10 values on 7 benthic species obtained under a variety of conditions. These data, outlined in the CSR, were compiled in a species sensitivity distribution, from which the PNEC was derived (expressed as total Zn contained in the sediment). This PNEC is an added value, to be added on the zinc background in the sediment, see table below. For the marine sediments, a PNEC was derived using the equilibrium partitioning approach, see section 8.1. of SDS.

Soil toxicity
The chronic toxicity of zinc to soil organisms was assessed based on a database containing high quality chronic NOEC/EC10 values on 18 plant species, 8 invertebrate species and 17 microbial processes, obtained under a variety of conditions. These data, outlined in the CSR, were compiled in a species sensitivity distribution, from which the PNEC was derived (expressed as total Zn contained in the soil). This PNEC is an added value, to be added on the zinc background in the soil, see section 8.1. of SDS.

Toxicity to micro-organisms in STP
The PNEC for STP was derived by applying an assessment factor to the lowest relevant toxicity value: 5.2mg Zn/l (Dutka et al., 1983)

12.2. Persistence and degradability
Zinc is an element, and as such the criterion “persistence” is not relevant for the metal and its inorganic compounds in a way as it is applied to organic substances. An analysis on the removal of zinc from the water column has been presented as a surrogate for persistence. The rapid removal of zinc from the water column is documented in the CSR. So, zinc and zinc compounds do not meet this criterion, neither.

12.3. Bioaccumulative potential
Zinc is a natural, essential element, which is needed for the optimal growth and development of all living organisms, including man. All living organisms have homeostasis mechanisms that actively regulate zinc uptake and absorption/excretion from the body; due to this regulation, zinc and zinc compounds do not bioaccumulate or biomagnify.

12.4. Mobility
For zinc (like for other metals) the transport and distribution over the different environmental compartments e.g. the water (dissolved fraction, fraction bound to suspended matter), soil (fraction bound or complexed to the soil particles, fraction in the soil pore water,...) is described and quantified by the metal partition coefficients between these different fractions. In the CSR, a solids-water partitioning coefficient of 158.5 l/kg (log value 2.2) was applied for zinc in soils (CSR zinc 2010).

12.5. Results of PBT and vPvB assessment
Zinc and zinc compounds are not PBT or vPvB.

12.6. Other adverse effects
No data available.

SECTION 13: DISPOSAL CONSIDERATIONS

13.1. Waste treatment methods
Dispose of waste and residues in accordance with local authority requirements.
Do not allow runoff to sewer, waterway or ground. This chemical is toxic to organisms in water.
Powder to be collected, sealed tightly in bags and disposed on approved landfills.
SAFETY DATA SHEET
Zinc Oxide
According to Regulation (EU) No 453/2010

SECTION 14: TRANSPORT INFORMATION

14.1. UN number

UN No. (ADR/RID/ADN) 3077
UN No. (IMDG) 3077
UN No. (ICAO) 3077

14.2. UN proper shipping name

Proper Shipping Name ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (ZINC OXIDE)

14.3. Transport hazard class(es)

ADR/RID/ADN Class 9
ADR/RID/ADN Class Class 9: Miscellaneous dangerous substances and articles.
ADR Label No. 9
IMDG Class 9
ICAO Class/Division 9

14.4. Packing group

ADR/RID/ADN Packing group III
IMDG Packing group III
ICAO Packing group III

14.5. Environmental hazards

Environmentally Hazardous Substance/Marine Pollutant

14.6. Special precautions for user

EMS F-A, S-F
Emergency Action Code 2Z
Hazard No. (ADR) 90
Tunnel Restriction Code (E)

14.7. Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code

No data available.
SAFETY DATA SHEET
Zinc Oxide
According to Regulation (EU) No 453/2010

SECTION 15: REGULATORY INFORMATION

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

Uk Regulatory References
The Control of Substances Hazardous to Health Regulations 2002 (S.I 2002 No. 2677) with amendments.
Control of Pollution Act 1974, Control of Pollution (Special Waste Regulations) Act 1980.

Statutory Instruments

Approved Code Of Practice
Classification and Labelling of Substances and Preparations Dangerous for Supply.

Guidance Notes
Workplace Exposure Limits EH40.
CHIP for everyone HSG(108).

EU Legislation

15.2. Chemical Safety Assessment
No chemical safety assessment has been carried out.

SECTION 16: OTHER INFORMATION

General Information
For further information please see the attached exposure scenarios.

Information Sources
This SDS is prepared based on the information received from the product owner.

Revision Comments
The SDS is generated in accordance with the REACH regulation. There is no change in content.

Issued By
Bülent Özdemir / CRAD Çevre Risk Analiz Denetim ve Eğitim Hizm. Ltd.Şti.
www.crad.com.tr Tel: +90 216 335 4600

Revision Date 23.09.2013
Issue Date 29.06.2011
Revision 1.0

Risk Phrases In Full
R50/53 Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Hazard Statements In Full
H400 Very toxic to aquatic life.
H410 Very toxic to aquatic life with long lasting effects.

Disclaimer
This information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process. Such information is, to the best of the company's knowledge and belief, accurate and reliable as of the date indicated. However, no warranty guarantee or representation is made to its accuracy, reliability or completeness. It is the user's responsibility to satisfy himself as to the suitability of such information for his own particular use.

11/42
Identification

Product name  Zinc Oxide (ZnO)  
REACH registration number  01-2119463881-32-XXXX  
Revision Date  11.11.2013  
Version Number  1.0  

1. Title of exposure scenario – (1)

Main title  Industrial use of ZnO in the formulation of preparations by mixing thoroughly, dry or in a solvent, the starting materials with potentially pressing, pelleting, sintering, possibly followed by packing.  
Main sector  SU3 Industrial uses  
Sector of use  SU8 Manufacture of bulk, large-scale chemicals (including petroleum products)  
SU9 Manufacture of fine chemicals  
SU10 Formulation [mixing] of preparations and/or re-packaging  

Environment

Environmental release category  ERC1 Manufacture of substances.  
ERC2 Formulation of preparations.  
ERC6a Industrial use resulting in manufacture of another substance (use of intermediates).  

Worker

Process category  PROC1 Use in closed process, no likelihood of exposure.  
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.  
PROC5 Mixing or blending in batch processes for formulation of preparations and articles (multistage and/or significant contact).  
PROC8a Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities.  
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).  
PROC13 Treatment of articles by dipping and pouring.  
PROC14 Production of preparations or articles by tableting, compression, extrusion, pelletisation.  
PROC15 Use as laboratory reagent.  
PROC22 Potentially closed processing operations with minerals/metals at elevated temperature.  
PROC26 Handling of solid inorganic substances at ambient temperature.  

Further explanations (if needed)

ZnSO4 is used in the manufacture of preparations by mixing thoroughly the starting materials, followed by direct use of packaging of the preparation. Many different industrial uses are characterised by this process. Therefore these industrial uses are all covered by this exposure scenario.

2. Conditions of use affecting exposure (Industrial - Environment ES-1)

In the described process, the zinc oxide is optionally:

- Removed from the packaging and stored in silos after delivery.
ANNEX I - EXPOSURE SCENARIO
Zinc Oxide

- Extracted from the silo and/or discharged from container, dosed and fed with the other reagents to the mixing tank. Mixing occurs batch-wise or continuously, according the process receipt. The mixing occurs in a closed or semi-closed tank/chamber.
- The preparation (dry or wet (solvent/paste) matrix) is further used as such or packed for further treatment/use.

**Product characteristics**
ZnO is used in minimum 80% purity

**Amounts used**
Daily and annual amount per site:
maximum 5000 T/y;

**Frequency and duration of use**
Continuous production is assumed as a worst case. It is possible that use is not continuous; this has to be considered when estimating exposure.

**Environment factors not influenced by risk management**
Flow rate of receiving surface water:
default for generic scenario: 18,000 m³/d, unless specified otherwise

**Other given operational conditions affecting environmental exposure**
- Processes are performed indoor in a confined area. Reactors can be located outdoors; use of catalyst/absorbent is in a closed system. Temperature steps are possible. All residues containing zinc are recycled.
- Even when no process waters (e.g. when dry process throughout), some non-process water can be generated containing zinc (e.g. from cleaning)

**Technical conditions and measures at process level (source) to prevent release**
- Process enclosures and closed circuits where relevant and possible.
- Dust capturing and removal techniques are applied on local exhaust ventilation on furnaces and other work areas with potential dust generation.
- Containment of liquid volumes in sumps to collect/prevent accidental spillage

**Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil**
- On-site waste water treatment techniques can be applied to prevent releases to water (if applicable) e.g.: chemical precipitation, sedimentation and filtration (efficiency 90-99.98%).
- Air emissions are controlled by use of bag-house filters and/or other air emission abatement devices e.g. fabric (or bag) filters (up to 99% efficiency), wet scrubbers (50-99% efficiency). This may create a general negative pressure in the building.

**Organizational measures to prevent/limit release from site**
- In general emissions are controlled and prevented by implementing an integrated management system e.g. ISO 9000, ISO 1400X series, or alike, and, when applicable, by being IPPC-compliant.
  - Such management system should include general industrial hygiene practice e.g.:
    - information and training of workers,
    - regular cleaning of equipment and floors,
    - procedures for process control and maintenance,...
  - Treatment and monitoring of releases to outside air, and exhaust gas streams (process & hygiene), according to national regulation,
  - SEVESO 2 compliance, if applicable.

**Conditions and measures related to municipal sewage treatment plant**
- In cases where applicable: default size, unless specified otherwise.

**Conditions and measures related to external treatment of waste for disposal**
Hazardous wastes from onsite risk management measures and solid or liquid wastes from production, use and cleaning processes should be disposed of separately to hazardous waste incineration plants or hazardous waste landfills as hazardous waste. Releases to the floor, water and soil are to be prevented. If the zinc content of the waste is elevated enough, internal or external recovery/recycling might be considered.

**Fraction of daily/annual use expected in waste:**
- zinc producers = 3.1 %
- zinc compound producers = 0.056 %
- downstream users = 0.30 %
ANNEX I - EXPOSURE SCENARIO
Zinc Oxide

Appropriate waste codes:
02 01 10*, 06 03 13*, 06 03 14, 06 03 15*, 06 04 04*, 06 04 05*, 06 05 02*, 08 01 11*, 10 05 01, 10 05 03*, 10 05 05*, 10 05 06*, 10 05 11, 10 05 99, 10 10 03, 10 10 05*, 11 02 03, 11 02 07*, 12 01 03*, 12 01 04, 12 01 12*, 15 01 4*, 15 01 10*, 15 02 02*, 16 01 04*, 16 01 06*, 16 01 18*, 16 06 02*, 16 08 02*, 16 08 03*, 16 11 02, 16 11 03*, 16 11 04, 16 11 06, 17 04 07*, 17 04 09*, 17 09 04*, 19 02 05*, 19 10 02*, 19 12 03*

Conditions and measures related to external recovery of waste
- All residues are recycled or handled and conveyed according to waste legislation.

3. Exposure estimation (Environment ES-1)

No exposure estimation presented for the environment.

2. Conditions of use affecting exposure (Workers - Health ES-1)

Further specification
ZnO is used in the manufacture of preparations by mixing thoroughly the starting materials, followed by direct use of packaging of the preparation. Many different industrial uses are characterised by this process. Therefore these industrial uses are all covered by this exposure scenario.

Product characteristic
- The concentration of ZnO in the mixtures can be up to >25% but is usually of the order of <= 5%, depending on the application.
- The preparation can be solid or liquid.
- When the preparation is in solid state, it can be in a) powdery, b) glassy or c) pelleted form. In the powder form, it can be characterised by high dustiness in a worst case situation.

Amounts used
Max 5000T/y = 14T/d = 5T/shift depending on the application.

Frequency and duration of use/exposure
8 hour shifts (default worst case) are assumed as starting point; it is emphasised that the real duration of exposure could be less. This has to be considered when estimating exposure.

Human factors not influenced by risk management
Uncovered body parts: (potentially) face.

Other given operational conditions affecting workers exposure
- High temperature steps can occur;
- All indoor processes in confined area.

Technical conditions and measures at process level (source) to prevent release
- Process enclosures and closed circuits where relevant and possible.
- Local exhaust ventilation on furnaces and other work areas with potential dust generation, dust capturing and removal techniques.
- Containment of liquid volumes in sumps to collect/prevent accidental spillage.

Technical conditions and measures to control dispersion from source towards the worker
- Local exhaust ventilation systems (generic LEV as worst case (84%); higher efficiency up to 90-95% is usual. Cyclones/filters (for minimizing dust emissions) : efficiency: 70-90% (cyclones), 50-80% (dust filters), 85-95% (double stage, cassette filters)
- Process enclosure, especially in the drying /calcination / packaging (potentially dusty) units.
- Dust control: dust and Zn in dust needs to be measured in the workplace air (static or individual) according to national regulations.
- Special care for the general establishment and maintenance of a clean working environment by e.g.:
  o Cleaning of process equipment and workshop.
- Storage of packaged Zn product in dedicated zones

Organisational measures to prevent /limit releases, dispersion and exposure
Such management system would include general industrial hygiene practice e.g.
### ANNEX I - EXPOSURE SCENARIO

**Zinc Oxide**

- Information and training of workers on prevention of exposure/accidents,
- Procedures for control of personal exposure (hygiene measures)
- Regular cleaning of equipment and floors, extended workers instruction-manuals
- Procedures for process control and maintenance,
- Personal protection measures (see below)

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

Wearing of gloves and protective clothing is compulsory (efficiency >=90%).

With normal handling, no respiratory personal protection (breathing apparatus) is necessary. If risk for exceedance of OEL/DNEL, use e.g.:

- dust filter-half mask P1 (efficiency 75%)
- dust filter-half mask P2 (efficiency 90%)
- dust filter-half mask P3 (efficiency 95%)
- dust filter-full mask P1 (efficiency 75%)
- dust filter-full mask P2 (efficiency 90%)
- dust filter-full mask P3 (efficiency 97.5%)

Eyes: safety glasses are optional.

### 3. Exposure estimation (Health ES-1)

No exposure estimation presented for the human health.

**Workers:** There is a need for limiting the risks; risk reduction measures which are already being applied shall be taken into account.

**Consumers:** There is at present no need for further information and/or testing and for risk reduction measures beyond those which are being applied already.

Additional information: See table 2 about overview of conclusions with respect to occupational risk characterisation.

<table>
<thead>
<tr>
<th>1. Title of exposure scenario - (2)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Main title</th>
<th>Industrial use of zinc oxide or ZnO-formulations in the manufacturing of other inorganic or organic zinc substances through different process routes, with potentially drying, calcining and packaging.</th>
</tr>
</thead>
</table>
| Product category | PC2 Adsorbents.  
PC7 Base metals and alloys.  
PC14 Metal surface treatment products, including galvanic and electroplating products.  
PC19 Intermediate.  
PC20 Products such as ph-regulators, flocculants, precipitants, neutralization agents  
PC21 Laboratory chemicals. |
| Article category | AC2 Machinery, mechanical appliance, electrical/elektronic articles.  
AC7 Metal articles  
AC12-2 Constructional articles and building material for outdoor use: wall construction material, road surface material, ceramic, metal, plastic and wood construction material, insulating material. |
| Main sector | SU3 Industrial uses |
| Sector of use | SU8 Manufacture of bulk, large-scale chemicals (including petroleum products)  
SU9 Manufacture of fine chemicals  
SU10 Formulation [mixing] of preparations and/or re-packaging  
SU14 Manufacture of basic metals, including alloys  
SU15 Manufacture of fabricated metal products, except machinery and equipment  
SU17 General manufacturing, e.g. machinery, equipment, vehicles, other transport equipment. |
| Environment category | ERC1 Manufacture of substances.  
ERC2 Formulation of preparations.  
ERC4 Industrial use of processing aids in processes and products, not becoming part of articles. |
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Zinc Oxide

ERG5 Industrial use resulting in inclusion into or onto a matrix.
ERG6a Industrial use resulting in manufacture of another substance (use of intermediates).
ERG6b Industrial use of reactive processing aids.
ERG8a Wide dispersive indoor use of processing aids in open systems.
ERG8d Wide dispersive outdoor use of processing aids in open systems.

Worker

Process category

PROC1 Use in closed process, no likelihood of exposure.
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.
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).
PROC13 Treatment of articles by dipping and pouring.
PROC15 Use as laboratory reagent.
PROC21 Low energy manipulation of substances bound in materials and/or articles
PROC22 Potentially closed processing operations with minerals/metals at elevated temperature.
PROC23 Open processing and transfer operations with minerals/metals at elevated temperature.
PROC26 Handling of solid inorganic substances at ambient temperature.

Further explanations (if needed)

ZnO is used as a starting material for the manufacturing of several other inorganic and organic zinc compounds. All the manufacturing processes are covered by the present scenario.

2. Conditions of use affecting exposure (Industrial - Environment ES-2)

Further specification
Description of activities/process(es) covered in the Exposure Scenario (optionally)

- Reception of the ZnO or ZnO-containing formulation, or ZnO-bearing raw material in the reaction tank, vessel or reactor.
- Sequential addition of reagents for purification steps and filtration on press filter, when needed (ventilation is adapted).
- Formulation is reacted or heat treated and dried.
- Concentration by water evaporation, under exhaust hood.
- Possible pouring on a cooling belt.
- Possible screening is optional.
- Discharge and packaging of produced zinc compounds. Workers have to place and adjust the bag or drum under the discharge pipe and to set the process in motion. Filled bags or drums are subsequently closed and carried to the storage area.
- Exposure to dust can occur during packing of the powder. Solutions are packed in intermediate bulk containers (ca. 1 m³ capacity); solids are packed in bags or drums.
- Maintenance activities.

Product characteristics
Zn-compounds are produced in their pure form e.g.: >99%, or in solution.

Amounts used
Up to 75 T/d of ZnO is transformed to equivalent Zn compound

Frequency and duration of use
Continuous production is assumed as a worst case. It is possible that use is not continuous; this has to be considered when estimating exposure.

Environment factors not influenced by risk management
Default for generic scenario: 18,000 m³/d, unless specified otherwise
ANNEX I - EXPOSURE SCENARIO
Zinc Oxide

Other given operational conditions affecting environmental exposure
- Wet processes (leaching, filtering, purification) followed by drying (possible grinding), or heat treatment and packaging;
- All indoor processes, in confined area.

Technical conditions and measures at process level (source) to prevent release
- Careful use of acids and corrosive solutions, if used.
- Sump containment is provided under the tanks and the filters i.o. to collect any accidental spillage
- When applicable, process waters need to be specifically treated before release
- Dosing and packaging operations occur under a special ventilation hood
- Process air is filtered before release outside the building

Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil
- On-site waste water treatment techniques are (if applicable) e.g.: chemical precipitation, sedimentation, filtration (efficiency 90-99.9%).
- Containment of liquid volumes in sumps to collect/prevent accidental spillage
- Air emissions are controlled by use of bag-house filters and/or other air emission abatement devices e.g. fabric (or bag) filters (up to 99% efficiency), wet scrubbers (50-99% efficiency). This may create a general negative pressure in the building. Air emissions are continuously monitored.

Organizational measures to prevent/limit release from site
- In general emissions are controlled and prevented by implementing an integrated management system e.g. ISO 9000, ISO 1400X series, or alike, and, when applicable, by being IPPC-compliant.
  - Such management system should include general industrial hygiene practice e.g.:
    - information and training of workers,
    - regular cleaning of equipment and floors,
    - procedures for process control and maintenance,...
- Treatment and monitoring of releases to outside air, and exhaust gas streams (process & hygiene), according to national regulation.
- SEVESO 2 compliance, if applicable.

Conditions and measures related to municipal sewage treatment plant
- In cases where applicable: default size, unless specified otherwise.

Conditions and measures related to external treatment of waste for disposal
Hazardous wastes from onsite risk management measures and solid or liquid wastes from production, use and cleaning processes should be disposed of separately to hazardous waste incineration plants or hazardous waste landfills as hazardous waste. Releases to the floor, water and soil are to be prevented. If the zinc content of the waste is elevated enough, internal or external recovery/recycling might be considered.

Fraction of daily/annual use expected in waste:
  - zinc producers = 3.1 %
  - zinc compound producers = 0.056 %
  - downstream users = 0.30 %

Appropriate waste codes:
02 01 10*, 06 03 13*, 06 03 14, 06 03 15*, 06 04 04*, 06 04 05*, 06 05 02*, 08 01 11*, 10 05 01, 10 05 03*, 10 05 05*, 10 05 06*, 10 05 11, 10 05 09, 10 10 03, 10 10 05*, 10 10 07*, 10 10 09*, 10 10 10, 10 10 11*, 11 01 09*, 11 02 02*, 11 02 03, 11 02 07*, 12 01 03*, 12 01 04, 12 01 12*, 15 01 4*, 15 01 10*, 15 02 02*, 16 01 04*, 16 01 06*, 16 01 18*, 16 06 02*, 16 08 02*, 16 08 03*, 16 11 02, 16 11 03*, 16 11 04, 16 11 06, 17 04 07*, 17 04 09*, 17 09 04*, 19 02 05*, 19 10 02*, 19 12 03*

Conditions and measures related to external recovery of waste
- All residues from the wet process are recycled.
- Users of Zn and Zn-compounds have to favour the recycling channels of the end-of-life products
- Users of Zn and Zn-compounds have to minimize Zn-containing waste, promote recycling routes and, for the remaining, dispose the waste streams according the Waste regulation.

3. Exposure estimation (Environment ES-2)

No exposure estimation presented for the environment.
Additional information: See table 1 about summary of results for the local exposure assessment.
2. Conditions of use affecting exposure (Workers - Health ES-2)

**Product characteristic**
- Zinc sulphate is transformed to equivalent pure zinc compound.
- The formed zinc compound can be produced as a powder with varying particle size (worst case scenario) or can be in solution.

**Amounts used**
Up to maximum 25T/shift

**Frequency and duration of use/exposure**
8 hrs shift (worst case)

**Human factors not influenced by risk management**
Uncovered body parts: (potentially) face.

**Other given operational conditions affecting workers exposure**
All processes are carried out indoor in confined areas.

**Technical conditions and measures at process level (source) to prevent release**
- Process enclosures or semi-enclosures where appropriate.
- Local exhaust ventilation work areas with potential dust and fumes generation, dust capturing and removal techniques.
- Containment of liquid volumes in sumps to collect/prevent accidental spillage

**Technical conditions and measures to control dispersion from source towards the worker**
- Local exhaust ventilation systems (high efficiency 90-95%)
- Cyclones/filters (for minimizing dust emissions): efficiency: 70-90% (cyclones), 50-80% (dust filters), 85-95% (double stage, cassette filters)
- Process enclosure, especially in the drying/calcination/ packaging (potentially dusty) units.
- Dust control: dust and Zn in dust needs to be measured in the workplace air (static or individual) according to national regulations.
- Special care for the general establishment and maintenance of a clean working environment by e.g.:
  - Cleaning of process equipment and workshop
- Storage of packaged Zn product in dedicated zones.

**Organisational measures to prevent/limit releases, dispersion and exposure**
In general integrated management systems are implemented at the workplace e.g. ISO 9000, ISO-ICS 13100, or alike, and are, when appropriate, IPPC-compliant.
Such management system would include general industrial hygiene practice e.g.:
- Information and training of workers on prevention of exposure/accidents,
- Procedures for control of personal exposure (hygiene measures)
- Regular cleaning of equipment and floors, extended workers instruction-manuals
- Procedures for process control and maintenance,...
- Personal protection measures (see below)

**Conditions and measures related to personal protection, hygiene and health evaluation**
Wearing of gloves and protective clothing is compulsory (efficiency >=90%).
With normal handling, no respiratory personal protection (breathing apparatus) is necessary. If risk for exceedance of OEL/DNEL, use e.g.:
- Dust filter-half mask P1 (efficiency 75%)
- Dust filter-half mask P2 (efficiency 90%)
- Dust filter-half mask P3 (efficiency 95%)
- Dust filter-full mask P1 (efficiency 75%)
- Dust filter-full mask P2 (efficiency 90%)
- Dust filter-full mask P3 (efficiency 97.5%)

Eyes: safety glasses are optional.
ANNEX I - EXPOSURE SCENARIO
Zinc Oxide

3. Exposure estimation (Health ES-2)

No exposure estimation presented for the human health.

Workers: There is a need for limiting the risks; risk reduction measures which are already being applied shall be taken into account.

Consumers: There is at present no need for further information and/or testing and for risk reduction measures beyond those which are being applied already.

Additional information: See table 2 about overview of conclusions with respect to occupational risk characterisation.

1. Title of exposure scenario (ES-3)

| Main title | Industrial and professional use of ZnO as active laboratory reagent in aqueous or organic media, for analysis or synthesis. |
| Product category | PC19 Intermediate.  
PC21 Laboratory chemicals.  
PC28 Perfumes, fragrances.  
PC39 Cosmetics, personal care. |
| Main sector | SU3 Industrial uses |
| Sector of use | SU10 Formulation [mixing] of preparations and/or re-packaging  
SU22 Professional use.  
SU24 Scientific research and development. |
| Environment | ERC1 Manufacture of substances.  
ERC2 Formulation of preparations.  
ERC4 Industrial use of processing aids in processes and products, not becoming part of articles.  
ERC6a Industrial use resulting in manufacture of another substance (use of intermediates).  
ERC6b Industrial use of reactive processing aids.  
ERC8a Wide dispersive indoor use of processing aids in open systems.  
ERC8b Wide dispersive indoor use of reactive substances in open systems.  
ERC8d Wide dispersive outdoor use of processing aids in open systems. |
| Worker Process category | PROC1 Use in closed process, no likelihood of exposure.  
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.  
PROC5 Mixing or blending in batch processes for formulation of preparations and articles (multistage and/or significant contact).  
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).  
PROC15 Use as laboratory reagent. |

2. Conditions of use affecting exposure (Industrial - Environment ES-3)

Further specification

The zinc oxides used for:

- Analysis: sample (solid or liquid) treatment or preparation: the substance is in the sample or in the reagents.
- or synthesis: manipulations are usually under ventilation (e.g. laminar flow, ventilation hood).
- The substance is used:
  - at the industrial scale, in industrial installations for air control and water treatment.
  - at the professional scale by laboratories.
Product characteristics
ZnO is used in minimum 80% purity; higher grades (>95%) are usual

Amounts used
Daily and annual amount per site:
maximum 5 T/y (industrial scale)
maximum 0.5 T/y (professional scale)

Frequency and duration of use
Use is usually intermittent but continuous use is assumed as a worst case. It is possible that use is not continuous; this has to be considered when estimating exposure.

Environment factors not influenced by risk management
If applicable: default for generic scenario: 18,000 m³/d, unless specified otherwise.

Other given operational conditions affecting environmental exposure
- All processes are performed indoor in a confined area, with dedicated laboratory equipment. All solid residues containing zinc are recovered for recycling.

Technical conditions and measures at process level (source) to prevent release
- Process enclosures and closed circuits where relevant.
- If relevant, dust capturing and removal techniques are applied on local exhaust ventilation (centralised treatment, scrubbers, filters, ...)
- Containment of liquid volumes to collect waste streams.

Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil
- At industrial scale, the waste waters will be treated in the on-site waste water treatment techniques that can be applied to prevent releases to water (if applicable) e.g.: chemical precipitation, sedimentation and filtration (efficiency 90-99.98%).
- At professional scale, the emissions are treated usually by STP. Professional services will be used for treating waste streams e.g. for the recovery of metallic solids (for recycling), and for the recovery of e.g. acid solutions containing the substance.
- Air emissions are controlled by use filters and/or other air emission abatement devices e.g. fabric (or bag) filters (up to 99% efficiency), wet scrubbers (50-99% efficiency). This may create a general negative pressure in the laboratory.

Organizational measures to prevent/limit release from site
- In general emissions are controlled and prevented by implementing an integrated management system e.g. ISO 9000, ISO 1400X series, or alike, and, when applicable, by being IPPC-compliant.
  Such management system should include general industrial hygiene practice e.g.:
  - Information and training of workers,
  - Regular cleaning of equipment and floors,
  - Procedures for process control and maintenance, ...
- Treatment and monitoring of releases to outside air, and exhaust gas streams (process & hygiene), according to national regulation.

Conditions and measures related to municipal sewage treatment plant
- In cases where applicable: default size, unless specified otherwise.

Conditions and measures related to external treatment of waste for disposal
- At industrial scale:
  Hazardous wastes from onsite risk management measures and solid or liquid wastes from production, use and cleaning processes should be disposed of separately to hazardous waste incineration plants or hazardous waste landfills as hazardous waste. Releases to the floor, water and soil are to be prevented. If the zinc content of the waste is elevated enough, internal or external recovery/recycling might be considered.

Fraction of daily/annual use expected in waste:
- zinc producers = 3.1 %
- zinc compound producers = 0.056 %
- downstream users = 0.30 %

Appropriate waste codes:
02 01 10*, 06 03 13*, 06 03 14*, 06 03 15*, 06 04 04*, 06 04 05*, 06 05 02*, 08 01 11*, 10 05 01, 10 05 03*, 10 05 05*, 10 05 06*, 10 05 11, 10 05 99, 10 10 03, 10 10 05*, 10 10 07*, 10 10 09*, 10 10 10, 10 10 11*, 11 01 09*, 11 02 02*, 11 02 03, 11 02 07*, 12 01 03*, 12
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01 04, 12 01 12*, 15 01 4*, 15 01 10*, 15 02 02*, 16 01 04*, 16 01 06*, 16 01 18*, 16 08 02*, 16 08 03*, 16 11 02, 16 11
03*, 16 11 04, 16 11 06, 17 04 07*, 17 04 09*, 17 09 04*, 19 02 05*, 19 10 02*, 19 12 03*

- At professional scale:
  Fraction of daily/annual use expected in waste: 42% of all articles, 58% of the zinc used is recycled. Appropriate waste codes:
  20 01 34, 20 01 40, 20 03 01, 20 03 07 Suitable Disposal: Waste from end-of-life articles can be disposed of as municipal
  waste, except when they are separately regulated, like electronic devices, batteries, vehicles, etc.
  Disposal of wastes is possible via incineration (operated according to Directive 2000/76/EC on the incineration of waste) or
  landfilling (operated according to Reference Document on the Best available Techniques for Waste Industries of August 2006

Conditions and measures related to external recovery of waste
- All residues are recycled or handled and conveyed according to waste legislation.

3. Exposure estimation (Environment ES-3)

No exposure estimation presented for the environment.
Additional information: See table 1 about summary of results for the local exposure assessment.

2. Conditions of use affecting exposure (Workers - Health ES-3)

Product characteristic
- ZnO is used in minimum 80% purity; higher grades (>95%) are usual.
- The sample can be solid or liquid.
- When the preparation is in solid state, it can be in a) powdery, b) glassy or c) pelletized form. In the powder form, it can be
  characterised by high dustiness in a worst case situation.

Amounts used
maximum 5 T/y (industrial scale)
maximum 0.5 T/y (professional scale)

Frequency and duration of use/exposure
Use is usually intermittent but continuous use is assumed as a worst case. It is possible that use is not continuous; this has to be
considered when estimating exposure.

Human factors not influenced by risk management
Uncovered body parts: (potentially) face.

Other given operational conditions affecting workers exposure
- High temperature steps can occur in protected zones (fume cupboards);
- All indoor processes in confined area, including hazardous substances cabinets.

Technical conditions and measures at process level (source) to prevent release
- Process enclosures and closed circuits where relevant and possible.
- Local exhaust ventilation on work areas with potential generation of dust or fumes, dust capturing and removal techniques
  (fume cupboards).
- Containment of liquid volumes and collection in special circuits

Technical conditions and measures to control dispersion from source towards the worker
- Local exhaust ventilation systems are provided where needed on the benches and in the fume cupboards.
- Process enclosures if relevant.
- Dust control: dust to be measured in the workplace air according to national regulations.
- Special care for the general establishment and maintenance of a clean working environment by e.g.:
  - Cleaning of process equipment and laboratory.
- Storage of Zn products in dedicated zones, e.g.: hazardous substances cabinets.

Organisational measures to prevent/limit releases, dispersion and exposure
In general integrated management systems are implemented at the workplace e.g. ISO 9000/9001, ISO-ICS 13100, or alike, and are,
when appropriate, IPPC-compliant.
Such management system would include general industrial hygiene practice e.g.:
- Information and training of workers on prevention of exposure/accidents,
- Procedures for control of personal exposure (hygiene measures)
- Regular cleaning of equipment and floors, extended workers instruction-manuals
- Procedures for process control and maintenance,...
- Personal protection measures (see below)

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

Wearing of gloves and protective clothing is compulsory (efficiency >=90%).
With normal handling, no respiratory personal protection (breathing apparatus) is necessary. If risk for exceedance of OEL/DNEL, use e.g.:

- dust filter-half mask P1 (efficiency 75%)
- dust filter-half mask P2 (efficiency 90%)
- dust filter-half mask P3 (efficiency 95%)
- dust filter-full mask P1 (efficiency 75%)
- dust filter-full mask P2 (efficiency 90 %)
- dust filter-full mask P3 (efficiency 97.5%)

Eyes: safety glasses are optional but usually taken as “normal laboratory practice”

### 3. Exposure estimation (Health ES-3)

No exposure estimation presented for the human health.
Workers: There is a need for limiting the risks; risk reduction measures which are already being applied shall be taken into account.
Consumers: There is at present no need for further information and/or testing and for risk reduction measures beyond those which are being applied already.

Additional information: See table 2 about overview of conclusions with respect to occupational risk characterisation.

### 1. Title of exposure scenario– (4)

<table>
<thead>
<tr>
<th>Main title</th>
<th>Industrial use of ZnO or ZnO-formulations as component for the manufacture of solid blends and matrices for further downstream use.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product category</td>
<td>PC1 Adhesives, sealants. PC5 Artists supply and hobby preparations. PC7 Base metals and alloys. PC8 Biocidal products. PC9a Coatings and paints, thinners, paint removers. PC9b Fillers, putties, plasters, modelling clay. PC9c Finger paints. PC11 Explosives. PC14 Metal surface treatment products, including galvanic and electroplating products. PC15 Non-metal-surface treatment products. PC17 Hydraulic fluids. PC18 Ink and toners. PC19 Intermediate. PC20 Products such as ph-regulators, flocculants, precipitants, neutralization agents. PC21 Laboratory chemicals. PC29 Pharmaceuticals. PC37 Water treatment chemicals.</td>
</tr>
<tr>
<td>Article category</td>
<td>AC2 Machinery, mechanical appliance, electrical/elektronic articles. AC3 Electrical batteries and accumulators. AC4 Stone, plaster, cement, glass and ceramic articles. AC7 Metal articles</td>
</tr>
<tr>
<td>Main sector</td>
<td>SU3 Industrial uses</td>
</tr>
</tbody>
</table>
## Annex I: Exposure Scenario

### Zinc Oxide

#### Sector of use

- SU1 Agriculture, forestry, fishery.
- SU4 Manufacture of food products
- SU5 Manufacture of textiles, leather, fur
- SU6 Manufacture of pulp, paper and paper products
- SU8 Manufacture of bulk, large-scale chemicals (including petroleum products)
- SU9 Manufacture of fine chemicals
- SU10 Formulation [mixing] of preparations and/or re-packaging
- SU11 Manufacture of rubber products
- SU12 Manufacture of plastics products, including compounding and conversion
- SU13 Manufacture of other non-metallic mineral products
- SU14 Manufacture of basic metals, including alloys
- SU16 Manufacture of computer, electronic and optical products, electrical equipment.
- SU20 Health services

#### Environment

<table>
<thead>
<tr>
<th>Environmental release category</th>
</tr>
</thead>
<tbody>
<tr>
<td>ERC1 Manufacture of substances.</td>
</tr>
<tr>
<td>ERC2 Formulation of preparations.</td>
</tr>
<tr>
<td>ERC3 Formulation in materials.</td>
</tr>
<tr>
<td>ERC4 Industrial use of processing aids in processes and products, not becoming part of articles.</td>
</tr>
<tr>
<td>ERC5 Industrial use resulting in inclusion into or onto a matrix.</td>
</tr>
<tr>
<td>ERC6a Industrial use resulting in manufacture of another substance (use of intermediates).</td>
</tr>
<tr>
<td>ERC6b Industrial use of reactive processing aids.</td>
</tr>
<tr>
<td>ERC7 Industrial use of substances in closed systems.</td>
</tr>
<tr>
<td>ERC8a Wide dispersive indoor use of processing aids in open systems.</td>
</tr>
<tr>
<td>ERC8b Wide dispersive indoor use of reactive substances in open systems.</td>
</tr>
<tr>
<td>ERC8d Wide dispersive outdoor use of processing aids in open systems.</td>
</tr>
<tr>
<td>ERC10a Wide dispersive outdoor use of long-life articles and materials with low release.</td>
</tr>
<tr>
<td>ERC10b Wide dispersive outdoor use of long-life articles and materials with high or intended release (including abrasive processing).</td>
</tr>
<tr>
<td>ERC11a Wide dispersive indoor use of long-life articles and materials with low release.</td>
</tr>
</tbody>
</table>

#### Worker

<table>
<thead>
<tr>
<th>Process category</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROC1 Use in closed process, no likelihood of exposure.</td>
</tr>
<tr>
<td>PROC2 Use in closed, continuous process with occasional controlled exposure.</td>
</tr>
<tr>
<td>PROC3 Use in closed batch process (synthesis or formulation).</td>
</tr>
<tr>
<td>PROC4 Use in batch and other process (synthesis) where opportunity for exposure arises.</td>
</tr>
<tr>
<td>PROC5 Mixing or blending in batch processes for formulation of preparations and articles (multistage and/or significant contact).</td>
</tr>
<tr>
<td>PROC6 Calendering operations.</td>
</tr>
<tr>
<td>PROC8b Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities.</td>
</tr>
<tr>
<td>PROC9 Transfer of substance or preparation into small containers (dedicated filling line, including weighing).</td>
</tr>
<tr>
<td>PROC13 Treatment of articles by dipping and pouring.</td>
</tr>
<tr>
<td>PROC14 Production of preparations or articles by tabletting, compression, extrusion, pelletisation.</td>
</tr>
<tr>
<td>PROC15 Use as laboratory reagent.</td>
</tr>
<tr>
<td>PROC22 Potentially closed processing operations with minerals/metals at elevated temperature.</td>
</tr>
<tr>
<td>PROC24 High (mechanical) energy work-up of substances bound in materials and/or articles.</td>
</tr>
<tr>
<td>PROC26 Handling of solid inorganic substances at ambient temperature.</td>
</tr>
</tbody>
</table>
ANNEX I - EXPOSURE SCENARIO
Zinc Oxide

Further explanations (if needed)
ZnO or ZnO-containing preparations are used in the manufacture of dry preparations by mixing thoroughly the starting materials, possibly followed by pressing or pelletizing, and finally packaging of the preparation.

2. Conditions of use affecting exposure (Industrial - Environment ES-4)

Further specification
In the described process, the ZnO (or Zn compound) containing preparation/mixture is optionally:
- Pressed at high temperature (>1000°C), grinded and re-pressed or fritted at high temperature.
- Molten at high temperature (>500°C) and further cast as glassy material.
- Pressed and pelletized at low temperature.
And subsequently packed, or used as such, in further treatment/use.

Product characteristics
ZnO (or Zn compound) in the preparation can be > 25%, usually <5%

Amounts used
maximum 5000 T/y;

Frequency and duration of use
Continuous production is assumed as a worst case. It is possible that use is not continuous; this has to be considered when estimating exposure.

Environment factors not influenced by risk management
default for generic scenario: 18,000 m³/d, unless specified otherwise

Other given operational conditions affecting environmental exposure
- All dry processes throughout, no process waters. Even when no process waters occur (with dry process throughout), some non-process water can be generated containing zinc (e.g. from cleaning)
- High temperature steps are possible.
- All processes are performed indoor in a confined area. All residues containing zinc are recycled.

Technical conditions and measures at process level (source) to prevent release
- Local exhaust ventilation on furnaces and other work areas with potential dust generation.
- Dust capturing and removal techniques are applied.
- Process enclosures where relevant and possible.

Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil
- No process waters, so possible emissions to water are limited and non-process related.
- On-site waste water treatment techniques can be applied to prevent releases to water (if applicable) e.g.: chemical precipitation, sedimentation and filtration (efficiency 90-99.98%).
- Air emissions are controlled by use of bag-house filters and/or other air emission abatement devices e.g. fabric or bag filters, wet scrubbers. This may create a general negative pressure in the building.

Organizational measures to prevent/limit release from site
- In general emissions are controlled and prevented by implementing an integrated management system e.g. ISO 9000, ISO 1400X series, or alike, and, when applicable, by being IPPC-compliant.
  Such management system should include general industrial hygiene practice e.g.:
  - information and training of workers,
  - regular cleaning of equipment and floors,
  - procedures for process control and maintenance,...
- Treatment and monitoring of releases to outside air, and exhaust gas streams (process & hygiene), according to national regulation.
- SEVESO 2 compliance, if applicable.

Conditions and measures related to municipal sewage treatment plant
- In cases where applicable: default size, unless specified otherwise.
ANNEX I - EXPOSURE SCENARIO

Zinc Oxide

Conditions and measures related to external treatment of waste for disposal
Hazardous wastes from onsite risk management measures and solid or liquid wastes from production, use and cleaning processes should be disposed of separately to hazardous waste incineration plants or hazardous waste landfills as hazardous waste. Releases to the floor, water and soil are to be prevented. If the zinc content of the waste is elevated enough, internal or external recovery/recycling might be considered.

Fraction of daily/annual use expected in waste:
- Zinc producers = 3.1%
- Zinc compound producers = 0.056%
- Downstream users = 0.30%

Appropriate waste codes:
02 01 10*, 06 03 13*, 06 03 14, 06 03 15*, 06 04 04*, 06 04 05*, 06 05 02*, 08 01 11*, 10 05 01, 10 05 03*, 10 05 05*, 10 05 06*, 10 05 11, 10 05 99, 10 10 03, 10 10 05*, 10 10 07*, 10 10 09*, 10 10 10, 10 10 11*, 11 01 09*, 11 02 02*, 11 02 03, 11 02 07*, 12 01 03*, 12 01 04, 12 01 12*, 15 01 4*, 15 01 10*, 15 02 02*, 16 01 04*, 16 01 06*, 16 01 18*, 16 06 02*, 16 08 02*, 16 08 03*, 16 11 02, 16 11 03*, 16 11 04, 16 11 06, 17 04 07*, 17 04 09*, 17 09 04*, 19 02 05*, 19 10 02*, 19 12 03*

Conditions and measures related to external recovery of waste
- All residues are recycled or handled and conveyed according to waste legislation.
- Users of Zn and Zn-compounds have to favour the recycling channels of the end-of-life products.
- Users of Zn and Zn-compounds have to minimize Zn-containing waste, promote recycling routes and, for the remaining, dispose the waste streams according the Waste regulation.

3. Exposure estimation (Environment ES-4)

No exposure estimation presented for the environment.
Additional information: See table 1 about summary of results for the local exposure assessment.

2. Conditions of use affecting exposure (Workers - Health ES-4)

Industrial formulation of dry preparations/mixtures by mixing thoroughly the zinc compounds with the other starting materials, with possible pressing, pelleting, sintering and packaging of the preparations/mixtures.

Product characteristic
- The concentration of ZnO in the mixtures can be up to >25% but is usually of the order of <= 5%, depending on the application.
- The preparation is in the solid state, usually with a low level of dustiness; however, powder forms can occur, the high dustiness is therefore applied as a worst case.

Amounts used
Max 5000T/y = 15T/d = 5T/shift depending of application.

Frequency and duration of use/exposure
8 hour shifts (default worst case) are assumed as starting point; it is emphasised that the real duration of exposure could be less. This has to be considered when estimating exposure.

Human factors not influenced by risk management
Uncovered body parts: (potentially) face.

Other given operational conditions affecting workers exposure
- Dry processes: dry operational conditions throughout the process; no process waters;
- High temperature steps can occur;
- Indoor processes in confined area.

Technical conditions and measures at process level (source) to prevent release
- Local exhaust ventilation on furnaces and other work areas with potential dust generation, dust capturing and removal techniques.
- Process enclosures where appropriate.
Technical conditions and measures to control dispersion from source towards the worker

- Local exhaust ventilation systems and process enclosures are generally applied.
- Cyclones/filters (for minimizing dust emissions): efficiency 70%-90% (cyclones); dust filters (50-80%).
- LEV in work area: efficiency 84% (generic LEV).

Organisational measures to prevent/limit releases, dispersion and exposure

In general integrated management systems are implemented at the workplace e.g. ISO 9000, ISO-ICS 13100, or alike, and are, when appropriate, IPPC-compliant.

Such management system would include general industrial hygiene practice e.g.:
- Information and training of workers on prevention of exposure/accidents,
- Procedures for control of personal exposure (hygiene measures)
- Regular cleaning of equipment and floors, extended workers instruction-manuals
- Procedures for process control and maintenance,...
- personal protection measures (see below)

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

Wearing of gloves and protective clothing is compulsory (efficiency >=90%). With normal handling, no respiratory personal protection (breathing apparatus) is necessary. If risk for exceedance of OEL/DNEL, use e.g.:

- dust filter-half mask P1 (efficiency 75%)
- dust filter-half mask P2 (efficiency 90%)
- dust filter-half mask P3 (efficiency 95%)
- dust filter-full mask P1 (efficiency 75%)
- dust filter-full mask P2 (efficiency 90%)
- dust filter-full mask P3 (efficiency 97.5%)

Eyes: safety glasses are optional.

3. Exposure estimation (Health ES-4)

No exposure estimation presented for the human health.

Workers: There is a need for limiting the risks; risk reduction measures which are already being applied shall be taken into account.

Consumers: There is at present no need for further information and/or testing and for risk reduction measures beyond those which are being applied already.

Additional information: See table 2 about overview of conclusions with respect to occupational risk characterisation.

1. Title of exposure scenario– (5)

Main title
Industrial use of ZnO or ZnO-formulations as component for the manufacture of dispersions, pastes or other viscous or polymerized matrices.

Product category
PC1 Adhesives, sealants.
PC2 Adsorbents.
PC4 Anti-freeze and de-icing products
PC7 Base metals and alloys.
PC8 Biocidal products.
PC9a Coatings and paints, thinners, paint removers.
PC9b Fillers, putties, plasters, modelling clay.
PC12 Lawn and garden preparations (-fertilizers).
PC14 Metal surface treatment products, including galvanic and electroplating products.
PC15 Non-metal-surface treatment products.
PC16 Heat transfer fluids.
PC17 Hydraulic fluids.
PC18 Ink and toners.
PC19 Intermediate.
ANNEX I - EXPOSURE SCENARIO
Zinc Oxide

PC20 Products such as pH-regulators, flocculants, precipitants, neutralization agents
PC21 Laboratory chemicals.
PC23 Leather tanning, dye, finishing, impregnation and care products.
PC24 Lubricants, greases and release products.
PC25 Metalworking fluids.
PC28 Perfumes, fragrances.
PC29 Pharmaceuticals.
PC31 Polishes and wax blends.
PC32 Polymer preparations and compounds.
PC33 Semiconductor.
PC34 Textile dyes, finishing and impregnating products, including bleaches and other processing aids.
PC35 Washing and cleaning products (including solvent-based products).
PC37 Water treatment chemicals.
PC39 Cosmetics, personal.
PC40 Extraction agents.

Article category
AC1 Vehicles.
AC2 Machinery, mechanical appliances, electrical/electronic articles.
AC3 Electrical batteries and accumulators.
AC7 Metal articles.
AC10 Rubber articles.
AC11 Wood articles.
AC13 Plastic articles.

Main sector
SU3 Industrial uses

Sector of use
SU1 Agriculture, forestry, fishery
SU4 Manufacture of food products.
SU5 Manufacture of textiles, leather, fur.
SU6b Manufacture of pulp, paper and paper products.
SU7 Printing and reproduction of recorded media.
SU8 Manufacture of bulk, large-scale chemicals (including petroleum products).
SU9 Manufacture of fine chemicals.
SU10 Formulation [mixing] of preparations and/or re-packaging.
SU11 Manufacture of rubber products.
SU12 Manufacture of plastics products, including compounding and conversion.
SU16 Manufacture of computer, electronic and optical products, electrical equipment.
SU18 Manufacture of furniture.
SU20 Health services.

Environment

Environmental release category
ERC1 Manufacture of substances.
ERC2 Formulation of preparations.
ERC3 Formulation in materials.
ERC4 Industrial use of processing aids in processes and products, not becoming part of articles.
ERC5 Industrial use resulting in inclusion into or onto a matrix.
ERC6a Industrial use resulting in manufacture of another substance (use of intermediates).
ERC6b Industrial use of reactive processing aids.
ERC6d Industrial use of process regulators for polymerisation processes in production of resins, rubbers, polymers.
ERC7 Industrial use of substances in closed systems.
ERC8a Wide dispersive indoor use of processing aids in open systems.
ERC8b Wide dispersive indoor use of reactive substances in open systems.
ERC8c Wide dispersive indoor use resulting in inclusion into or onto a matrix.
**ANNEX I - EXPOSURE SCENARIO**

**Zinc Oxide**

ERG8d Wide dispersive outdoor use of processing aids in open systems.
ERG8f Wide dispersive outdoor use resulting in inclusion into or onto a matrix.
ERG10a Wide dispersive outdoor use of long-life articles and materials with low release.
ERG10b Wide dispersive outdoor use of long-life articles and materials with high or intended release (including abrasive processing).
ERG11a Wide dispersive indoor use of long-life articles and materials with low release.

**Worker Process category**

PROC1 Use in closed process, no likelihood of exposure.
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.
PROC5 Mixing or blending in batch processes for formulation of preparations and articles (multistage and/or significant contact).
PROC6 Calendering operations.
PROC7 Spraying in industrial settings and applications
PROC8a Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities.
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).
PROC10 Roller application or brushing of adhesive and other coating.
PROC11 Use of blow agents in manufacture of foam.
PROC12 Treatment of articles by dipping and pouring.
PROC13 Production of preparations or articles by tabletting, compression, extrusion, pelletisation.
PROC19 Hand-mixing with intimate contact and only PPE available.
PROC20 Heat and pressure transfer fluids in dispersive use but closed systems.
PROC21 Low energy manipulation of substances bound in materials and/or articles.
PROC22 Potentially closed processing operations with minerals/metals at elevated temperature.
PROC24 High (mechanical) energy work-up of substances bound in materials and/or articles.
PROC26 Handling of solid inorganic substances at ambient temperature.

**Further explanations (if needed)**

ZnO or ZnO-containing preparations are used in the manufacture of liquid preparations by mixing thoroughly the starting materials, with a solvent in order to obtain a solution, dispersion or paste.

**2. Conditions of use affecting exposure (Industrial - Environment ES-5)**

**Further specification**

In the described process, the zinc oxide containing preparation/mixture is (optionally):
- Unpacked and stored in silos or used directly for small quantities.
- Extracted from the silo, dosed and fed with the other reagents and/or solvents to the mixing tank, batch-wise or continuously, according the process receipt.
- The resulting zinc salt containing mixture (solution, dispersion, paste) is directly further processed, or packed, for further treatment/use.
  - or
- Loaded into a reactor (from a hopper, drum or other container) used in a closed reactor, unloaded from a reactor (into a hopper, drum or other container); discharged catalyst/ absorbent is further processed.

**Product characteristics**

ZnO in preparation can be > 25%, usually <5%

**Amounts used**

Maximum 5000 T/y;
ANNEX I - EXPOSURE SCENARIO
Zinc Oxide

Frequency and duration of use
Continuous production is assumed as a worst case. It is possible that use is not continuous; this has to be considered when estimating exposure.

Environment factors not influenced by risk management
Default for generic scenario: 18,000 m³/d, unless specified otherwise.

Other given operational conditions affecting environmental exposure
- Even when no process waters occur, some non-process water can be generated containing zinc (e.g. from cleaning)
- Processes are performed indoor in a confined area. Reactors can be located outdoors; use of catalyst/absorbent is in a closed system.
- All residues containing zinc are recycled.

Technical conditions and measures at process level (source) to prevent release
- Local exhaust ventilation on furnaces and other work areas with potential dust generation.
- Dust capturing and removal techniques are applied.
- Process enclosures where relevant and possible.

Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil
- Some of the operations imply wet process-steps.
- Sump containment is provided under the tanks and the filters in order to collect any accidental spillage.
- On-site waste water treatment techniques can be applied to prevent releases to water (if applicable) e.g.: chemical precipitation, sedimentation and filtration (efficiency 90-99.98%).
- Air emissions are controlled by use of bag-house filters and/or other air emission abatement devices e.g. fabric or bag filters, wet scrubbers. This may create a general negative pressure in the building.

Organizational measures to prevent/limit release from site
- In general emissions are controlled and prevented by implementing an integrated management system e.g. ISO 9000, ISO 1400X series, or alike, and, when applicable, by being IPPC-compliant. Such management system should include general industrial hygiene practice e.g.:
  - information and training of workers,
  - regular cleaning of equipment and floors,
  - procedures for process control and maintenance,...
- Treatment and monitoring of releases to outside air, and exhaust gas streams (process & hygiene), according to national regulation.
- SEVESO 2 compliance, if applicable.

Conditions and measures related to municipal sewage treatment plant
- In cases where applicable: default size, unless specified otherwise.

Conditions and measures related to external treatment of waste for disposal
Hazardous wastes from onsite risk management measures and solid or liquid wastes from production, use and cleaning processes should be disposed of separately to hazardous waste incineration plants or hazardous waste landfills as hazardous waste. Releases to the floor, water and soil are to be prevented. If the zinc content of the waste is elevated enough, internal or external recovery/recycling might be considered.

Fraction of daily/annual use expected in waste:
- zinc producers = 3.1 %
- zinc compound producers = 0.056 %
- downstream users = 0.30 %

Appropriate waste codes:
02 01 10*, 06 03 13*, 06 03 14, 06 03 15*, 06 04 04*, 06 04 05*, 06 05 02*, 08 01 11*, 10 05 01, 10 05 03*, 10 05 05*, 10 05 06*, 10 05 11, 10 05 99, 10 10 03, 10 10 05*, 10 10 07*, 10 10 09*, 10 10 11*, 11 01 09*, 11 02 02*, 11 02 03, 11 02 07*, 12 01 03*, 12 01 04, 12 01 12*, 15 01 4*, 15 01 10*, 15 02 02*, 16 01 04*, 16 01 06*, 16 01 18*, 16 06 02*, 16 08 02*, 16 08 03*, 16 11 02, 16 11 03*, 16 11 04, 16 11 06, 17 04 07*, 17 04 09*, 17 09 04*, 19 02 05*, 19 10 02*, 19 12 03*

Conditions and measures related to external recovery of waste
- All residues are recycled or handled and conveyed according to waste legislation.
- Users of Zn and Zn-compounds have to favour the recycling channels of the end-of-life products.
ANNEX I - EXPOSURE SCENARIO

Zinc Oxide

- Users of Zn and Zn-compounds have to minimize Zn-containing waste, promote recycling routes and, for the remaining, dispose the waste streams according the Waste regulation.

### 3. Exposure estimation (Environment ES-5)

No exposure estimation presented for the environment.
Additional information: See table 1 about summary of results for the local exposure assessment.

### 2. Conditions of use affecting exposure (Workers - Health ES-5)

#### Product characteristic
- The concentration of ZnO in the mixtures can be up to >25% but is usually of the order of <= 5%, depending on the application.
- The preparation is in the liquid state, as a paste or dispersion or other viscous or polymerized matrix, with a low level of dustiness; however, powder and shaped solid forms can occur, medium dustiness is therefore applied as a worst case

**Amounts used**
Max 5000T/y = 20 T/d = 7 T/shift depending of application.

**Frequency and duration of use/exposure**
8 hour shifts (default worst case) are assumed as starting point; it is emphasised that the real duration of exposure could be less. This has to be considered when estimating exposure.

**Human factors not influenced by risk management**
Uncovered body parts: (potentially) face.

**Other given operational conditions affecting workers exposure**
- Wet processes.
- All indoor processes in confined area. Reactors can be located outdoors; use of catalyst/absorbent is in a closed system

**Technical conditions and measures at process level (source) to prevent release**
- Local exhaust ventilation on furnaces and other work areas with potential dust generation, dust capturing and removal techniques.
- Process enclosures where appropriate.

**Technical conditions and measures to control dispersion from source towards the worker**
- Local exhaust ventilation systems and process enclosures are generally applied
- Cyclones/filters (for minimizing dust emissions): efficiency 70%-90% (cyclones); dust filters (50- 80%)
- LEV in work area: efficiency 84% (generic LEV) is considered worst case; higher efficiencies are usual.

**Organisational measures to prevent /limit releases, dispersion and exposure**
In general integrated management systems are implemented at the workplace e.g. ISO 9000, ISO-ICS 13100, or alike, and are, when appropriate, IPPC-compliant.

Such management system would include general industrial hygiene practice e.g.:
- Information and training of workers on prevention of exposure/accidents,
- Procedures for control of personal exposure (hygiene measures)
- Regular cleaning of equipment and floors, extended workers instruction-manuals
- Procedures for process control and maintenance,...
- Personal protection measures (see below)

**Conditions and measures related to personal protection, hygiene and health evaluation**
Wearing of gloves and protective clothing is compulsory (efficiency >=90%).
With normal handling, no respiratory personal protection (breathing apparatus) is necessary. If risk for exceedance of OEL/DNEL, use e.g.:
- dust filter-half mask P1 (efficiency 75%)
- dust filter-half mask P2 (efficiency 90%)
- dust filter-half mask P3 (efficiency 95%)
- dust filter-full mask P1 (efficiency 75%)
Zinc Oxide

- dust filter-full mask P2 (efficiency 90 %)
- dust filter-full mask P3 (efficiency 97.5 %)

In particular, when PROC 7, 11, 19 are involved, respiratory protection is recommended.

Eyes: safety glasses are optional.

3. Exposure estimation (Health ES-5)

No exposure estimation presented for the human health.

Workers: There is a need for limiting the risks; risk reduction measures which are already being applied shall be taken into account.

Consumers: There is at present no need for further information and/or testing and for risk reduction measures beyond those which are being applied already.

Additional information: See table 2 about overview of conclusions with respect to occupational risk characterisation.

1. Title of exposure scenario– (6)

Main title
Industrial and professional use of solid substrates containing less than 25%w/w of ZnO.

Product category
PC1 Adhesives, sealants.
PC8 Biocidal products.
PC9a Coatings and paints, thinners, paint removers.
PC9b Fillers, putties, plasters, modelling clay.
PC9c Finger paints.
PC14 Metal surface treatment products, including galvanic and electroplating products.
PC15 Non-metal-surface treatment products.
PC18 Ink and toners.
PC19 Intermediate.
PC20 Products such as pH-regulators, flocculants, precipitants, neutralization agents
PC21 Laboratory chemicals.
PC23 Leather tanning, dye, finishing, impregnation and care products.
PC28 Perfumes, fragrances.
PC29 Pharmaceuticals.
PC33 Semiconductor.
PC34 Textile dyes, finishing and impregnating products, including bleaches and other processing aids.
PC35 Washing and cleaning products (including solvent-based products).
PC39 Cosmetics, person.

Article category
AC1 Vehicles
AC2 Machinery, mechanical appliances, electrical/electronic articles
AC4 Stone, plaster, cement, glass and ceramic articles.

Main sector
SU3 Industrial uses
SU22 Professional use.

Sector of use
SU5 Manufacture of textiles, leather, fur
SU6b Manufacture of pulp, paper and paper products
SU9 Manufacture of fine chemicals
SU10 Formulation [mixing] of preparations and/or re-packaging
SU13 Manufacture of other non-metallic mineral products
SU16 Manufacture of computer, electronic and optical products, electrical equipment
SU17 General manufacturing, e.g. machinery, equipment, vehicles, other transport equipment.
SU20 Health services
## ANNEX I - EXPOSURE SCENARIO
### Zinc Oxide

| Environment | ERC2 Formulation of preparations.  
|            | ERC4 Industrial use of processing aids in processes and products, not becoming part of articles.  
|            | ERC5 Industrial use resulting in inclusion into or onto a matrix.  
|            | ERC8a Wide dispersive indoor use of processing aids in open systems.  
|            | ERC8c Wide dispersive indoor use resulting in inclusion into or onto a matrix.  
|            | ERC8d Wide dispersive outdoor use of processing aids in open systems.  
|            | ERC8f Wide dispersive outdoor use resulting in inclusion into or onto a matrix.  
|            | ERC10a Wide dispersive outdoor use of long-life articles and materials with low release.  
|            | ERC10b Wide dispersive outdoor use of long-life articles and materials with high or intended release (including abrasive processing).  
|            | ERC11a Wide dispersive indoor use of long-life articles and materials with low release.  
|            | ERC12a Industrial processing of articles with abrasive techniques (low release).  
| Environmental release category | PROC1 Use in closed process, no likelihood of exposure.  
|                              | 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.  
|                              | PROC5 Mixing or blending in batch processes for formulation of preparations and articles (multistage and/or significant contact).  
|                              | PROC6 Calendering operations.  
|                              | PROC7 Spraying in industrial settings and applications.  
|                              | PROC8a Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities.  
|                              | 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).  
|                              | PROC10 Roller application or brushing of adhesive and other coating.  
|                              | PROC11 Spraying outside industrial settings and/or applications.  
|                              | PROC13 Treatment of articles by dipping and pouring.  
|                              | PROC14 Production of preparations or articles by tableting, compression, extrusion, pelletisation.  
|                              | PROC19 Hand-mixing with intimate contact and only PPE available.  
|                              | PROC21 Low energy manipulation of substances bound in materials and/or articles  
|                              | PROC22 Potentially closed processing operations with minerals/metals at elevated temperature. Industrial setting.  
|                              | PROC26 Handling of solid inorganic substances at ambient temperature.  

### 2. Conditions of use affecting exposure (Industrial - Environment ES-6)

**Further specification**
This scenario covers both the industrial scale processes and professional use. In the described process, the ZnO containing preparation/mixture is further processed, involving potentially the following steps:
- Reception/unpacking of material.
- Final application, embedding, or shaping to produce the end product or article.

**Product characteristics**
ZnO (or Zn compound) in the article is < 25%

**Amounts used**
- The quantities involved in this scenario are 10-50 times smaller than in blending (ES 4-ES 5); the concentration of the zinc substance is also lower (<25%).
- Typical quantities for both Industrial and professional are 50T/y (typical), maximum 500T/y (in industrial setting).
ANNEX I - EXPOSURE SCENARIO
Zinc Oxide

Frequency and duration of use
Continuous production is assumed as a worst case. It is possible that use is not continuous; this has to be considered when estimating exposure.

Environment factors not influenced by risk management
Default for generic scenario: 18,000 m³/d, unless specified otherwise

Other given operational conditions affecting environmental exposure
- Solid, so in principle all dry processes throughout, no process waters. Even when no process waters occur (with dry process throughout), some non-process water can be generated containing zinc (e.g. from cleaning).
- In industrial and professional setting, all processes are performed indoor in a confined area. All residues containing zinc are recycled.

Technical conditions and measures at process level (source) to prevent release
In industrial and professional setting the following applies:
- Local exhaust ventilation on furnaces and other work areas with potential dust generation.
- Dust capturing and removal techniques are applied.
- Process enclosures where relevant and possible.

Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil
In industrial and professional setting, the following applies:
- No process waters, so possible emissions to water are limited and non-process related.
- If zinc emissions to water, on-site waste water treatment techniques can be applied to prevent releases to water (if applicable) e.g.: chemical precipitation, sedimentation and filtration (efficiency 90-99.98%).
- By exposure modelling it is predicted that at use quantities of >100T/y, refinement of the exposure assessment to water and sediment needs to be made (exposure assessment based on real measured data and local parameters). Treatment of the emissions to water may be needed under such conditions (see "exposure estimation and risk characterisation").
- Air emissions are controlled by use of bag-house filters and/or other air emission abatement devices e.g. fabric or bag filters, wet scrubbers. This may create a general negative pressure in the building.

Organizational measures to prevent/limit release from site
- In general emissions are controlled and prevented by implementing an integrated management system. This would involve:
  - Information and training of workers.
  - Regular cleaning of equipment and floors.
  - Procedures for process control and maintenance,....
  - Treatment and monitoring of releases to outside air, and exhaust gas streams (process & hygiene), according to national regulation.
- SEVESO 2 compliance, if applicable.

Conditions and measures related to municipal sewage treatment plant
- In cases where applicable: default size, unless specified otherwise.

Conditions and measures related to external treatment of waste for disposal
- At industrial scale:
  Hazardous wastes from onsite risk management measures and solid or liquid wastes from production, use and cleaning processes should be disposed of separately to hazardous waste incineration plants or hazardous waste landfills as hazardous waste. Releases to the floor, water and soil are to be prevented. If the zinc content of the waste is elevated enough, internal or external recovery/recycling might be considered.

Fraction of daily/annual use expected in waste:
- Zinc producers = 3.1%
- Zinc compound producers = 0.056%
- Downstream users = 0.30%

Appropriate waste codes:
02 01 10*, 06 03 13*, 06 03 14, 06 03 15*, 06 04 04*, 06 04 05*, 06 04 06*, 08 01 11*, 10 05 01, 10 05 03*, 10 05 05*, 10 05 06*, 10 05 11, 10 05 09, 10 10 01, 10 10 03, 10 10 05*, 10 10 07*, 10 10 09*, 10 10 10, 10 10 11*, 11 01 09*, 11 02 02*, 11 02 03, 11 02 07*, 12 01 03*, 12 01 04, 12 01 12*, 15 01 4*, 15 01 10*, 15 01 02*, 16 01 04*, 16 01 18*, 16 06 02*, 16 08 02*, 16 08 03*, 16 11 02, 16 11 03*, 16 11 04, 16 11 06, 17 04 07*, 17 09 04*, 19 02 05*, 19 10 02*, 19 12 03*
ANNEX I - EXPOSURE SCENARIO
Zinc Oxide

- At professional scale:
  Fraction of daily/annual use expected in waste: 42% of all articles, 58% of the zinc used is recycled.

Appropriate waste codes:
20 01 34, 20 01 40, 20 03 01, 20 03 07

Suitable Disposal: Waste from end-of-life articles can be disposed of as municipal waste, except when they are separately regulated, like electronic devices, batteries, vehicles, etc.

Conditions and measures related to external recovery of waste
- All residues are recycled or handled and conveyed according to waste legislation.

3. Exposure estimation (Environment ES-6)

No exposure estimation presented for the environment.
Additional information: See table 1 about summary of results for the local exposure assessment.

2. Conditions of use affecting exposure (Workers - Health ES-6)

Product characteristic
The concentration of ZnO (or Zn compound) in the mixture is < 25%
- The mixture is in the solid state, with a low level of dustiness; however, powder forms can occur, the medium dustiness is therefore applied as a worst case.

Amounts used
- The quantities involved in this scenario are 10-50 times smaller than in blending (ES 4-ES 5); the concentration of the zinc substance is also lower (<25%).
- Typical quantities for both industrial and professional are 50 T/y (typical), or 0.15 T/day, 0.05 T/shift
- Maximum use quantity is 500 T/y (1.5 T/d, 0.5 T/shift) in industrial setting.

Frequency and duration of use/exposure
8 hour shifts (default worst case) are assumed as starting point; it is emphasised that the real duration of exposure could be less. This has to be considered when estimating exposure.

Human factors not influenced by risk management
Uncovered body parts: (potentially) face.

Other given operational conditions affecting workers exposure
- Industrial / Professional:
  - Dry processes: dry operational conditions throughout the process; no process waters;
  - Indoor processes in confined area.

Technical conditions and measures at process level (source) to prevent release
- Industrial / professional:
  - Local exhaust ventilation on work areas with potential dust generation, dust capturing and removal techniques.
  - Process enclosures where appropriate.

Technical conditions and measures to control dispersion from source towards the worker
- Industrial / Professional:
  - Local exhaust ventilation systems and process enclosures are generally applied
  - Cyclones/filters (for minimizing dust emissions): efficiency 70%-90% (cyclones); dust filters (50-80%).
  - LEV in work area: efficiency 84% (generic LEV).

Organisational measures to prevent /limit releases, dispersion and exposure
In general, management systems are implemented; They include general industrial hygiene practice e.g.:
- Information and training of workers on prevention of exposure/accidents,
- Procedures for control of personal exposure (hygiene measures).
- Regular cleaning of equipment and floors, extended workers instruction-manuals.
ANNEX I - EXPOSURE SCENARIO

Zinc Oxide

- Procedures for process control and maintenance,...
- Personal protection measures (see below).

Conditions and measures related to personal protection, hygiene and health evaluation
Wearing of gloves and protective clothing is compulsory (efficiency >90%). With normal handling, no respiratory personal protection (breathing apparatus) is necessary. If risk for exceedance of OEL/DNEL, use e.g.:

- dust filter-half mask P1 (efficiency 75%)
- dust filter-half mask P2 (efficiency 90%)
- dust filter-half mask P3 (efficiency 95%)
- dust filter-full mask P1 (efficiency 75%)
- dust filter-full mask P2 (efficiency 90 %)
- dust filter-full mask P3 (efficiency 97.5%)

Eyes: safety glasses are optional.

3. Exposure estimation (Health ES-6)

No exposure estimation presented for the human health.

Workers: There is a need for limiting the risks; risk reduction measures which are already being applied shall be taken into account. Consumers: There is at present no need for further information and/or testing and for risk reduction measures beyond those which are being applied already.

Additional information: See table 2 about overview of conclusions with respect to occupational risk characterisation.

1. Title of exposure scenario – (7)

Main title
Industrial and professional use of dispersions, pastes and polymerised substrates containing more than 25%w/w of ZnO.

Product category
PC1 Adhesives, sealants.
PC4 Anti-freeze and de-icing products.
PC9a Coatings and paints, thinners, paint removers.
PC9b Fillers, putties, plasters, modelling clay.
PC9c Finger paints.
PC14 Metal surface treatment products, including galvanic and electroplating products.
PC15 Non-metal-surface treatment products.
PC18 Ink and toners.
PC19 Intermediate.
PC20 Products such as ph-regulators, flocculants, precipitants, neutralization agents.
PC21 Laboratory chemicals.
PC24 Lubricants, greases and release products.
PC25 Metal working fluids.
PC28 Perfumes, fragrances.
PC29 Pharmaceuticals.
PC31 Polishes and wax blends.
PC32 Polymer preparations and compounds.
PC33 Semiconductor.
PC35 Washing and cleaning products (including solvent-based products).
PC39 Cosmetics, person.

Article category
AC1 Vehicles.
AC2 Machinery, mechanical appliances, electrical/electronic articles.
AC3 Electrical batteries and accumulators.
AC5 Fabrics, textiles and apparel.
AC7 Metal articles.
ANNEX I - EXPOSURE SCENARIO

Zinc Oxide

Main sector

SU3 Industrial uses.
SU22 Professional use.

Sector of use

SU1 Agriculture, forestry, fishery.
SU4 Manufacture of food products.
SU5 Manufacture of textiles, leather, fur.
SU6b Manufacture of pulp, paper and paper products.
SU9 Manufacture of fine chemicals.
SU10 Formulation [mixing] of preparations and/or re-packaging.
SU11 Manufacture of rubber products.
SU12 Manufacture of plastics products, including compounding and conversion.
SU13 Manufacture of other non-metallic mineral products.
SU15 Manufacture of fabricated metal products, except machinery and equipment.
SU17 General manufacturing, e.g. machinery, equipment, vehicles, other transport equipment.
SU18 Manufacture of furniture.
SU19 Building and construction work.
SU20 Health services.

Environment

ERC5 Industrial use resulting in inclusion into or onto a matrix.
ERC6d Industrial use of process regulators for polymerisation processes in production of resins, rubbers, polymers.
ERC8a Wide dispersive indoor use of processing aids in open systems.
ERC8c Wide dispersive indoor use resulting in inclusion into or onto a matrix.
ERC8d Wide dispersive outdoor use of processing aids in open systems.
ERC8e Wide dispersive outdoor use of reactive substances in open systems.
ERC8f Wide dispersive outdoor use resulting in inclusion into or onto a matrix.
ERC10a Wide dispersive outdoor use of long-life articles and materials with low release.
ERC10b Wide dispersive outdoor use of long-life articles and materials with high or intended release (including abrasive processing).
ERC11a Wide dispersive indoor use of long-life articles and materials with low release.
ERC12a Industrial processing of articles with abrasive techniques (low release).

Worker

PROC1 Use in closed process, no likelihood of exposure.
PROC4 Use in batch and other processes (synthesis) where opportunity for exposure arises.
PROC5 Mixing or blending in batch processes for formulation of preparations and articles (multistage and/or significant contact).
PROC7 Spraying in industrial settings and applications.
PROC8a Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities.
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).
PROC10 Roller application or brushing of adhesive and other coating.
PROC11 Spraying outside industrial settings and/or applications.
PROC13 Treatment of articles by dipping and pouring.
PROC14 Production of preparations or articles by tablettin, compression, extrusion, pelletisation.
PROC15 Use as laboratory reagent.
ANNEX I - EXPOSURE SCENARIO
Zinc Oxide

PROC17 Lubrication at high energy conditions and in partly open process.
PROC19 Hand-mixing with intimate contact and only PPE available.
PROC21 Low energy manipulation of substances bound in materials and/or articles
PROC24 High (mechanical) energy work-up of substances bound in materials and/or articles.

2. Conditions of use affecting exposure (Industrial - Environment ES-7)

Further specification
This scenario covers both the industrial scale processes and professional use. In the described process, the ZnO containing preparation/mixture is further processed, involving potentially the following steps:

- Reception/unpacking of material.
- Final application, embedding, or shaping to produce the end product or article.

Product characteristics
ZnO (or Zn compound) in the article is ≤40%

Amounts used
- The quantities involved in this scenario are 10-50 times smaller than in blending (ES 4-ES 5).
- Typical quantities for both Industrial and professional are 50T/y (typical), maximum 500T/y (in industrial setting).

Frequency and duration of use
Continuous production is assumed as a worst case. It is possible that use is not continuous; this has to be considered when estimating exposure.

Environment factors not influenced by risk management
Default for generic scenario: 18,000 m³/d, unless specified otherwise.

Other given operational conditions affecting environmental exposure
- Wet processes. All process and non-process waters should be recycled internally to a maximal extent.
- Even when no process waters occur, some non-process water can be generated containing zinc (e.g. from cleaning)
- In industrial and professional setting, all processes are performed in a confined area. All residues containing zinc are recycled.

Technical conditions and measures at process level (source) to prevent release
In industrial and professional setting the following applies:
- Process enclosures where relevant and possible
- Local exhaust ventilation on furnaces and other work areas with potential dust generation.
- Dust capturing and removal techniques are applied.
- Containment of liquid volumes in sumps to collect/prevent accidental spillage

Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil
In industrial and professional setting, the following applies:
- If zinc emissions to water, on-site waste water treatment techniques can be applied to prevent releases to water (if applicable) e.g.: chemical precipitation, sedimentation and filtration (efficiency 90-99.98%).
- By exposure modelling it is predicted that at use quantities of >100T/y, refinement of the exposure assessment to water and sediment needs to be made (exposure assessment based on real measured data and local parameters). Treatment of the emissions to water may be needed under such conditions (see "exposure estimation and risk characterisation").
- Air emissions are controlled by use of bag-house filters and/or other air emission abatement devices e.g. fabric or bag filters, wet scrubbers. This may create a general negative pressure in the building.

Organizational measures to prevent/limit release from site
In general emissions are controlled and prevented by implementing an integrated management system. This would involve:
- Information and training of workers,
- Regular cleaning of equipment and floors,
- Procedures for process control and maintenance,...
- Treatment and monitoring of releases to outside air, and exhaust gas streams (process & hygiene), according to national regulation.
- SEVESO 2 compliance, if applicable.
ANNEX I - EXPOSURE SCENARIO
Zinc Oxide

Conditions and measures related to municipal sewage treatment plant
- In cases where applicable: default size, unless specified otherwise.

Conditions and measures related to external treatment of waste for disposal
- At industrial scale:
  Hazardous wastes from onsite risk management measures and solid or liquid wastes from production, use and cleaning processes should be disposed of separately to hazardous waste incineration plants or hazardous waste landfills as hazardous waste. Releases to the floor, water and soil are to be prevented. If the zinc content of the waste is elevated enough, internal or external recovery/recycling might be considered.

Fraction of daily/annual use expected in waste:
- Zinc producers = 3.1%
- Zinc compound producers = 0.056%
- Downstream users = 0.30%

Appropriate waste codes:
- 02 01 10*, 06 03 14, 06 03 15*, 06 04 04*, 06 04 05*, 06 05 02*, 08 01 11*, 10 05 01, 10 05 03*, 10 05 05*, 10 05 06*, 10 05 11, 10 05 99, 10 10 03, 10 10 05*, 10 10 07*, 11 01 09*, 11 02 02*, 11 02 03, 11 02 07*, 12 01 03*, 12 01 04, 12 01 12*, 15 01 4*, 15 01 10*, 15 02 02*, 16 01 04*, 16 01 06*, 16 01 18*, 16 06 02*, 16 08 02*, 16 08 03*, 16 11 02, 16 11 03*, 16 11 04, 16 11 06, 17 04 07*, 17 04 09*, 17 09 04*, 19 02 05*, 19 10 02*, 19 12 03*

- At professional scale:
  Fraction of daily/annual use expected in waste: 42% of all articles, 58% of the zinc used is recycled.

Appropriate waste codes:
- 20 01 34, 20 01 40, 20 03 01, 20 03 07

Suitable Disposal: Waste from end-of-life articles can be disposed of as municipal waste, except when they are separately regulated, like electronic devices, batteries, vehicles, etc.

Conditions and measures related to external recovery of waste
- All residues are recycled or handled and conveyed according to waste legislation.

3. Exposure estimation (Environment ES-7)

No exposure estimation presented for the environment.
Additional information: See table 1 about summary of results for the local exposure assessment.

2. Conditions of use affecting exposure (Workers - Health ES-7)

Product characteristic
The concentration of ZnO (or Zn compound) in the mixture is ≤40%
- Particles can occur sporadically, the low level of dustiness is basically applied.
- Most of the processes imply the use of solutions or pastes; the “solution status” is therefore taken as the worst case.

Amounts used
- The quantities involved in this scenario are 10-50 times smaller than in blending (ES 4-ES 5).
- Typical quantities for both Industrial and professional are 50 T/y (typical), or 0.15 T/day, 0.05 T/shift
- Maximum use quantity is 500T/y (1.5T/d, 0.5T/shift) in industrial setting.

Frequency and duration of use/exposure
8 hour shifts (default worst case) are assumed as starting point; it is emphasised that the real duration of exposure could be less. This has to be considered when estimating exposure.

Human factors not influenced by risk management
Uncovered body parts: (potentially) face

Other given operational conditions affecting workers exposure
- Industrial / Professional:
  - Wet processes, all indoor in confined area.
Technical conditions and measures at process level (source) to prevent release
- Industrial /professional:
  - Local exhaust ventilation on work areas with potential dust generation, dust capturing and removal techniques
  - Process enclosures where appropriate

Technical conditions and measures to control dispersion from source towards the worker
- Industrial / Professional:
  - Local exhaust ventilation systems and process enclosures are generally applied
  - Cyclones/filters (for minimizing dust emissions): efficiency 70%-90% (cyclones); dust filters (50-80%).
  - LEV in work area: efficiency 84% (generic LEV).

Organisational measures to prevent /limit releases, dispersion and exposure
In general, management systems are implemented; They include general industrial hygiene practice e.g.:
- Information and training of workers on prevention of exposure/accidents,
- Procedures for control of personal exposure (hygiene measures)
- Regular cleaning of equipment and floors, extended workers instruction-manuals
- Procedures for process control and maintenance,...
- Personal protection measures (see below)

Conditions and measures related to personal protection, hygiene and health evaluation
Wearing of gloves and protective clothing is compulsory (efficiency >=90%).
With normal handling, no respiratory personal protection (breathing apparatus) is necessary. If risk for exceedance of OEL/DNEL, use e.g.:
  - dust filter-half mask P1 (efficiency 75%)
  - dust filter-half mask P2 (efficiency 90%)
  - dust filter-half mask P3 (efficiency 95%)
  - dust filter-full mask P1 (efficiency 75%)
  - dust filter-full mask P2 (efficiency 90 %)
  - dust filter-full mask P3 (efficiency 97.5%)

Eyes: safety glasses are optional

3. Exposure estimation (Health ES-7)

No exposure estimation presented for the human health.
Workers: There is a need for limiting the risks; risk reduction measures which are already being applied shall be taken into account.
Consumers: There is at present no need for further information and/or testing and for risk reduction measures beyond those which are being applied already.
Additional information: See table 2 about overview of conclusions with respect to occupational risk characterisation.
Table 1. Summary of results for the local exposure assessment from final RAR (Risk Assessment Report)

<table>
<thead>
<tr>
<th>Company</th>
<th>Conc. effluent STP (total) (µg/l)</th>
<th>C_{add} water episode (dissolved) (µg/l)</th>
<th>C_{add} sediment episode (mg/kg_{sw})</th>
<th>C_{add} agricultural soil (mg/kg_{wet})</th>
<th>C_{add} air (100m) (µg/m³)</th>
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<td><strong>Production companies:</strong></td>
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<td></td>
<td></td>
<td></td>
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<td>Tyre industry: processing</td>
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<td>Glass industry: processing (average use)</td>
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<td>469</td>
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<td>0.866-8.66</td>
<td>2.28-22.8</td>
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<td>Ferrites industry: site 1</td>
<td>8.67</td>
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<td>7.82</td>
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<td>Ferrites industry: site 2</td>
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<td>121</td>
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<td>Ferrites industry: site 4</td>
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<td>≤ 926</td>
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<td>9.74×10⁻¹</td>
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<td>0</td>
<td>0.12</td>
<td>0.316</td>
</tr>
</tbody>
</table>
# Annex I - Exposure Scenario

## Zinc Oxide

<table>
<thead>
<tr>
<th>Company</th>
<th>Conc. effluent STP (total) (µg/l)</th>
<th>C&lt;sub&gt;add&lt;/sub&gt; water episode (dissolved) (µg/l)</th>
<th>C&lt;sub&gt;add&lt;/sub&gt; sediment episode (mg/kg&lt;sub&gt;sediment&lt;/sub&gt;)</th>
<th>C&lt;sub&gt;add&lt;/sub&gt; agricultural soil (mg/kg&lt;sub&gt;soil&lt;/sub&gt;)</th>
<th>C&lt;sub&gt;add&lt;/sub&gt; air (100m) (µg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feedstuff additive: formulation (generic largest use)</td>
<td>0</td>
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<td>0.65</td>
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<td>Lubricants: formulation (average use)</td>
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<td>58.4</td>
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<td>Lubricants: formulation (largest use)</td>
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<td>102</td>
<td>2.444</td>
<td>355</td>
<td>4.76</td>
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<td>Lubricants: private use</td>
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<td>0.0238</td>
<td>0.569</td>
<td>0.0488</td>
<td>6.25 × 10&lt;sup&gt;3&lt;/sup&gt;</td>
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<tr>
<td>Paints: formulation</td>
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<td>Cosmetics pharmaceuticals: formulation (average use)</td>
<td>520</td>
<td>19.6</td>
<td>469</td>
<td>67.8</td>
<td>0.114</td>
</tr>
<tr>
<td>Cosmetics pharmaceuticals: formulation (largest use)</td>
<td>4.333</td>
<td>164</td>
<td>3.910</td>
<td>565</td>
<td>0.951</td>
</tr>
<tr>
<td>Cosmetics pharmaceuticals: private use</td>
<td>89</td>
<td>3.36</td>
<td>80.3</td>
<td>11.6</td>
<td>0</td>
</tr>
</tbody>
</table>

1) Some companies (numbers 9, 14, 15, 19, 21) proved to be not a zinc oxide producer and therefore no information is presented for these companies.

2) According to industry the Zn content of the purified water “usually contains less than 1 ppm Zn”.

## Table 2 Overview of conclusions with respect to occupational risk characterisation from final RAR (Risk Assessment Report)

<table>
<thead>
<tr>
<th>End point</th>
<th>MOS 1 Conclusion</th>
<th>MOS 2 Conclusion</th>
<th>MOS 3 Conclusion</th>
<th>MOS 4 Conclusion</th>
<th>MOS 5 Conclusion</th>
<th>MOS 6 Conclusion</th>
<th>MOS 7 Conclusion</th>
</tr>
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<tbody>
<tr>
<td>Acute toxicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>- Dermal</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>- Inhalation</td>
<td>&gt; 250</td>
<td>&gt; 250</td>
<td>&gt; 500</td>
<td>&gt; 313</td>
<td>&gt; 1,250</td>
<td>&gt; 625</td>
<td>&gt; 562</td>
</tr>
<tr>
<td>Irritation, acute exposure</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Dermal</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>- Inhalation</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>- Eyes</td>
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<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
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<tr>
<td>Sensitisation</td>
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<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
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<td>- Inhalation</td>
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<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>- Combined</td>
<td>0.8-1.3</td>
<td>1.1</td>
<td>2.5</td>
<td>1.1</td>
<td>1.1</td>
<td>1.1</td>
<td>1.1</td>
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<tr>
<td>Repeated dose toxicity, systemic effects</td>
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<td></td>
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</tr>
<tr>
<td>- Dermal</td>
<td>0.2-0.6</td>
<td>0.4</td>
<td>0.5</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
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</tr>
<tr>
<td>- Inhalation</td>
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<td>0.4</td>
<td>0.5</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
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<tr>
<td>- Combined</td>
<td>0.8-1.3</td>
<td>1.1</td>
<td>2.5</td>
<td>1.1</td>
<td>1.1</td>
<td>1.1</td>
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<tr>
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<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
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<td>Developmental effects</td>
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<td>- Dermal</td>
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<tr>
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<td>n.a.</td>
<td>n.a.</td>
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<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
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<tr>
<td>- Combined</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
</tbody>
</table>

a) Metal fume fever
b) Conclusion (i) applicable for “production” (i.e. all data, except recycling, combined), “recycling”, and “workplace 4”
Scenario 1: Production of zinc oxide
Scenario 2: Production of paint (and some other products) containing zinc oxide
Scenario 3: Use of zinc oxide in the rubber industry
Scenario 4: Use of paints containing zinc oxide
Scenario 5: Zinc die casting
Scenario 6: Brass casting
Scenario 7: Exposure to zinc oxide during welding
MOS: Margin of safety

4. Guidance to check compliance with the exposure scenario (Environment)

- Chemical Safety report (CSR) zinc sulphate. 2010.
- The European Chemical Industry Council  http://www.cefic.org/Search-Results/?q=zinc-oxide
- ESIS (European chemical Substances information System)  http://esis.jrc.ec.europa.eu/

4. Guidance to check compliance with the exposure scenario (Health)

- Chemical Safety report (CSR) zinc sulphate. 2010.
- The European Chemical Industry Council  http://www.cefic.org/Search-Results/?q=zinc-oxide
- ESIS (European chemical Substances information System)  http://esis.jrc.ec.europa.eu/