SAFETY DATA SHEET

Based upon Regulation (EC) No 1907/2006, as amended by Regulation (EU) No 2020/878

zinc Z1 SHG

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

1.1. Product identifier

Product name	:	zinc Z1 SHG
Synonyms	:	KATHODE EN ONGELEGEERD ZINK; SSHG; Z1; zinc; ZINC BATTERY GRADE,; ZINC CATHODES; ZINC ELECTROLIQUE; zinc, solid, in massive state; ZINK, SHG (Special High Grade)
Registration number REACH	:	01-2119467174-37-0000 (Nyrstar Belgium NV/SA) 01-2119467174-37-0035 (Nyrstar Budel BV) 01-2119467174-37-0045 (Nyrstar France SAS)
Product type REACH	:	Substance/mono-constituent
CAS number	:	7440-66-6
EC number	:	231-175-3
Molecular mass	:	65.37 g/mol
Formula	:	Zn

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

1.2.1 Relevant identified uses

IU01: Zinc metal production RLE (GESZn 0)
IU03: Storage of ingots-slabs in warehouses (GESZn 1)
IU04: Production of chemicals (pyro) (GESZn 3)
IU07: Melting, alloying and casting (GESZn 1)
IU08: Cathodic protection - sacrifical anodes (GESZn 1)
IU09: Downstream use of zinc-based sacrifical anodes (GESZn 8)
IU10: Extraction of PM (Parkes process) (GESZn 5)
IU11: Zinc casting / granules, pellets, prills, … (GESZn 1, GESZn 6)
IU12: Zinc sheet casting and rolling (GESZn 1, GESZn 6)
IU13: Wire and rods manufacturing (GESZn 1, GESZn 6)
IU14: Downstream use of Zn based wire for metal spraying (GESZn 8)
IU15: Component for soldering/brazing/welding products (GESZn 1, GESZn 6)
IU16: Downstream use of Zinc based brazing/soldering products (GESZn 8)
IU17: Strips and coins manufacturing (GESZn 1, GESZn 6)
IU18: Batteries ballots, cans manufacturing (GESZn 1, GESZn 6)
IU19: Zinc (pure or alloyed) powder manufacturing (GESZn 2)
IU20: Passivated zinc powder manufacturing (pure or alloyed) (GESZn 2)
IU30: Brass manufacturing (GESZn 1)
IU31: Use of brass casts for transformation into semi-products (GESZn 6)
IU32: Use of brass containing products (GESZn 8)
IU33: Die-casting alloys manufacturing (GESZn 1)
IU34: Use of die-casting ingots (GESZn 6)
IU35: Manufacturing of Zinc containing Al-alloys (GESZn 1)
IU36: Use of zinc containing Al alloys (GESZn 6)
IU37: General hot dip galvanizing (GESZn 5)
IU38: Continuous hot dip galvanizing (GESZn 5)
IU39: Electrogalvanizing (GESZn 5)
IU40: Electroplating (GESZn 5)
IU41: Production of "targets by (EB) PVD or other sputtering techniques (GESZn 5)
IU42: Use of galvanized goods Generic consumer/environment
For more detailed information regarding the Identified Uses and the associated Exposure Scenarios: see attached annex

1.2.2 Uses advised against

No uses advised against

1.3. Details of the supplier of the safety data sheet

Supplier of the safety data sheet

Nyrstar Belgium N.V. on behalf of Nyrstar Sales & Marketing A.G.
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infoSDS@nyrstar.com

Manufacturer of the product

Nyrstar Sales & Marketing SA
1 Rue de Jargonnant
CH-1207 Geneva
infoSDS@nyrstar.com

1.4. Emergency telephone number

24h/24h (Telephone advice: English, French, German, Dutch) :
+32 14 58 45 45 (BIG)

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

Not classified as dangerous according to the criteria of Regulation (EC) No 1272/2008

2.2. Label elements

Not classified as dangerous according to the criteria of Regulation (EC) No 1272/2008

2.3. Other hazards

The melting down of moist metal leads to explosion risk
Heated product causes burns

SECTION 3: Composition/information on ingredients

3.1. Substances

Name REACH Registration No	CAS No EC No	Conc. (C)	Classification according to CLP	Note	Remark	M-factors and ATE
zinc 01-2119467174-37	7440-66-6 231-175-3	>99.995		(2)(10)	Mono-constituent	
lead massive: [particle diameter ≥1mm] 01-2119513221-59	7439-92-1 231-100-4	<30 ppm	Repr. 1A; H360FD Lact. ; H362 STOT RE 1; H372	(1)(2)(4)(10)	Impurity	

(1) For H- and EUH-statements in full: see section 16
(2) Substance with a Community workplace exposure limit
(4) Enumerated in candidate list of substances of very high concern (SVHC) for authorisation (Article 59 of Regulation (EC) No. 1907/2006)
(10) Subject to restrictions of Annex XVII of Regulation (EC) No. 1907/2006

3.2. Mixtures

Not applicable

SECTION 4: First aid measures

4.1. Description of first aid measures

General:
Check the vital functions. Unconscious: maintain adequate airway and respiration. Respiratory arrest: artificial respiration or oxygen. Cardiac arrest: perform resuscitation. Victim conscious with laboured breathing: half-seated. Victim in shock: on his back with legs slightly raised. Vomiting: prevent asphyxia/aspiration pneumonia. Prevent cooling by covering the victim (no warming up). Keep watching the victim. Give psychological aid. Keep the victim calm, avoid physical strain. Depending on the victim's condition: doctor/hospital.

After inhalation:
After inhalation of fume: Remove the victim into fresh air. Respiratory problems: consult a doctor/medical service.

After skin contact:
In case of burns: Wash immediately with lots of water (15 minutes)/shower. Remove clothing while washing. Do not tear off solidified product from the skin. Do not remove clothing if it sticks to the skin. Cover wounds with sterile bandage. Consult a doctor/medical service. If burned surface > 10%: take victim to hospital.

After eye contact:
After contact with fume: Rinse immediately with plenty of water for 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Take victim to an ophthalmologist.

After ingestion:
Not applicable.

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

4.2.1 Acute symptoms

After inhalation:
AFTER INHALATION OF DUST: Irritation of the nasal mucous membranes. Dry/sore throat. Coughing. AFTER INHALATION OF FUME: Feeling of weakness. Metal fume fever. Vomiting. Nausea.

After skin contact:
IF MELTING: Burns.

After eye contact:
IF MELTING: Burns.

After ingestion:
No data available.

4.2.2 Delayed symptoms
No data available.

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

Not applicable.

SECTION 5: Firefighting measures

5.1. Extinguishing media

5.1.1 Suitable extinguishing media:
Adapt extinguishing media to the environment for surrounding fires.

5.1.2 Unsuitable extinguishing media:
Not applicable.

5.2. Special hazards arising from the substance or mixture

On burning formation of metal oxides (zinc oxide). In molten state: violent to explosive reaction with water (moisture).

5.3. Advice for firefighters

5.3.1 Instructions:
Dilute toxic gases with water spray. In case of metal bath fire: add metal blocks. When cooling/extinguishing: no water in the substance.

5.3.2 Special protective equipment for fire-fighters:
Gloves (EN 374). Protective clothing (EN 14605 or EN 13034). Heat/fire exposure: self-contained breathing apparatus (EN 136 + EN 137).

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

No naked flames.

6.1.1 Protective equipment for non-emergency personnel
See section 8.2

6.1.2 Protective equipment for emergency responders
Gloves (EN 374). Protective clothing (EN 14605 or EN 13034).

Suitable protective clothing
See section 8.2

6.2. Environmental precautions

No data available

6.3. Methods and material for containment and cleaning up

If melted: allow liquid to solidify before taking it up. Pick-up the material. Wash clothing and equipment after handling.

6.4. Reference to other sections

See section 13.

SECTION 7: Handling and storage

The information in this section is a general description. If applicable and available, exposure scenarios are attached in annex. Always use the relevant exposure scenarios that correspond to your identified use.

7.1. Precautions for safe handling

Avoid raising dust. Keep away from naked flames/heat. Observe strict hygiene. On (re)melting down: dry and preheat installation before use. Add only dry material to the metal bath.

7.2. Conditions for safe storage, including any incompatibilities

7.2.1 Safe storage requirements:
Storage temperature: Temperature above dew point. Store in a dry area. Keep at temperature above dew point. Meet the legal requirements.

7.2.2 Keep away from:
Heat sources, (strong) acids.

7.2.3 Suitable packaging material:
No data available

7.2.4 Non suitable packaging material:
No data available

7.3. Specific end use(s)

If applicable and available, exposure scenarios are attached in annex. See information supplied by the manufacturer.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

8.1.1 Occupational exposure

a) Occupational exposure limit values

If limit values are applicable and available these will be listed below.

Belgium

Zinc (oxyde de) (fraction alvéolaire)	Time-weighted average exposure limit 8 h	2 mg/m³
	Short time value	10 mg/m³

France

Zinc (oxyde de, fumées)	Time-weighted average exposure limit 8 h (VL: Valeur non réglementaire indicative)	5 mg/m³
Zinc (oxyde de, poussières)	Time-weighted average exposure limit 8 h (VL: Valeur non réglementaire indicative)	10 mg/m³

USA (TLV-ACGIH)

Zinc oxide	Time-weighted average exposure limit 8 h (TLV - Adopted Value)	2 mg/m³ (R)
	Short time value (TLV - Adopted Value)	10 mg/m³ (R)

(R): Respirable fraction

b) National biological limit values

If limit values are applicable and available these will be listed below.

8.1.2 Sampling methods

Product name	Test	Number
Zinc & Cpds (as Zn)	NIOSH	7030
Zinc (Elements on wipes)	NIOSH	9102
Zinc (Elements)	NIOSH	7300
Zinc (Elements, aqua regia ashing)	NIOSH	7301
Zinc (Elements, hot block/HCl/HNO3 digestion)	NIOSH	7303
Zinc (Zn)	NIOSH	8005
Zinc (Zn)	NIOSH	8310
Zinc Oxide	NIOSH	7030
Zinc Oxide	NIOSH	7502
Zinc Oxide	OSHA	ID 121
Zinc Oxide	OSHA	ID 143
Zinc	NIOSH	7030
Zinc	OSHA	1006
Zinc	OSHA	ID 105
Zinc	OSHA	ID 121
Zinc	OSHA	ID 125G

8.1.3 Applicable limit values when using the substance or mixture as intended

If limit values are applicable and available these will be listed below.

8.1.4 Threshold values

DNEL/DMEL - Workers

zinc Z1 SHG

Effect level (DNEL/DMEL)	Type	Value	Remark
DNEL	Long-term systemic effects dermal	83 mg/kg bw/day	
	Long-term systemic effects inhalation	5 mg/m³	

DNEL/DMEL - General population

zinc Z1 SHG

Effect level (DNEL/DMEL)	Type	Value	Remark
DNEL	Long-term systemic effects oral	0.83 mg/kg bw/day	
	Long-term systemic effects dermal	83 mg/kg bw/day	
	Long-term systemic effects inhalation	2.5 mg/m³	

PNEC

zinc Z1 SHG

Compartments	Value	Remark
Fresh water	20.6 µg/l	
Marine water	6.1 µg/l	
STP	100 µg/l	
Fresh water sediment	117.8 mg/kg sediment dw	
Marine water sediment	56.5 mg/kg sediment dw	
Soil	35.6 mg/kg soil dw	

8.1.5 Control banding

If applicable and available it will be listed below.

8.2. Exposure controls

The information in this section is a general description. If applicable and available, exposure scenarios are attached in annex. Always use the relevant exposure scenarios that correspond to your identified use.

8.2.1 Appropriate engineering controls

Avoid raising dust. Keep away from naked flames/heat.

8.2.2 Individual protection measures, such as personal protective equipment

Observe strict hygiene. Do not eat, drink or smoke during work.

a) Respiratory protection:

Dust production: dust mask with filter type P2.

b) Hand protection:

Gloves, On heating: heat insulating gloves (EN 407).

Materials	Remark
leather	Good resistance

c) Eye protection:

On (re)melting down: face shield.

d) Skin protection:

Protective clothing (EN 14605 or EN 13034). On (re)melting down: heatproof clothing (EN 11612). Protective clothing against molten metal splash (EN 9185). Protective clothing for workers exposed to heat (EN 11612). Safety shoes type S3.

8.2.3 Environmental exposure controls:

See sections 6.2, 6.3 and 13

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical form	Solid
	Metal
	Physical state depending on the production process
Odour	Odourless
Odour threshold	Not applicable
Colour	Commercial substance: grey-white
Particle size	Not applicable
Explosion limits	Not applicable
Flammability	Not classified as flammable
Log Kow	Not applicable
Dynamic viscosity	Not applicable
Kinematic viscosity	Not applicable
Melting point	416 °C ; 1013 hPa
Boiling point	907 °C ; Not required: exemption according to REACH
Relative vapour density	Not applicable
Vapour pressure	Data not required
Solubility	Water ; insoluble
Relative density	7.1 ; 20 °C
Absolute density	7140 kg/m³
Decomposition temperature	Not applicable
Auto-ignition temperature	Not applicable
Flash point	Not applicable
pH	Not applicable

9.2. Other information

Evaporation rate	Ether

SECTION 10: Stability and reactivity

10.1. Reactivity

Not applicable.

10.2. Chemical stability

Stable under normal conditions.

10.3. Possibility of hazardous reactions

In molten state: violent to explosive reaction with water (moisture). Oxidizes slowly in moist air.

10.4. Conditions to avoid

Precautionary measures

Avoid raising dust. Keep away from naked flames/heat.

10.5. Incompatible materials

(strong) acids.

10.6. Hazardous decomposition products

Reacts with (some) acids: release of highly flammable gases/vapours (hydrogen). On burning formation of metal oxides (zinc oxide).

SECTION 11: Toxicological information

11.1. Information on hazard classes as defined in Regulation (EC) No 1272/2008

11.1.1 Test results

- Toxicokinetics: summary

Zinc compounds release, depending on their solubility, zinc cations which determine the biological activity of the respective zinc compounds. Sufficient data is available on the soluble zinc compounds zinc chloride and zinc sulphate and on the slightly soluble zinc compounds ZnO and ZnCO3.

Zinc is an essential trace element which is regulated and maintained in the various tissues mainly by the gastrointestinal absorption and secretion during high and low dietary zinc intake and because of the limited exchange of zinc between tissues, a constant supply of zinc is required to sustain the physiological requirements. The zinc absorption process in the intestines includes both passive diffusion and a carrier-mediated process. The absorption can be influenced by several factors such as ligands in the diet and the zinc status. Persons with adequate nutritional levels absorb 20-30% and animals absorb 40-50%. Persons that are zinc deficient absorb more, while persons with excessive zinc intake absorb less.

For the soluble zinc compounds, the available information suggests an oral absorption value of 20%. This value can be considered as the lower bound range at adequate nutritional levels. The oral absorption of the slightly soluble zinc oxide has been shown to be 60% of that of the soluble zinc compounds. This corresponds to approximately 12-18%. No oral absorption information is available for the remaining slightly soluble and insoluble zinc compounds (i.e., ZnO, Zn(OH)2, Zn3(PO4)2, ZnCO3, Zn, ZnS). However, considering that these substances have lower water solubility than ZnO, it can be conservatively assumed that the oral absorption of these compounds is ≤ 12%.

Animal data suggests that there is pulmonary absorption following inhalation exposure. Half-life values of 14 and 6.3 hours were reported for dissolution of zinc oxide. The absorption of inhaled zinc depends on the particle size and the deposition of these particles therefore data was provided on the particle size distribution of zinc aerosol from three different industry sectors. The particle size distribution data was evaluated by using a multiple path particle deposition (MPPDep) model. This model revealed that for zinc aerosols the largest part of the deposition is in the head region and much less in the tracheobronchial and pulmonary region. Although most of the material deposited in the head and tracheobronchial region is rapidly translocated to the gastrointestinal tract, a part will also be absorbed locally.

Based on data for local absorption of radionuclides in the different airway regions, it can be assumed that the local absorption of the soluble zinc compounds will be approximately 20% of the material deposited in the head region, 50% of the material deposited in the tracheobronchial region and 100% of the material deposited in the pulmonary region. For the slightly soluble and insoluble zinc compounds a negligible absorption can be assumed for materials deposited in the head and the tracheobronchial region. 100% of the deposited slightly or insoluble zinc compounds are assumed to be absorbed in the pulmonary tract. The deposited material will be cleared via the lung clearance mechanisms into the gastrointestinal tract where it will follow oral absorption kinetics. Therefore the inhalation absorption for the soluble zinc compounds is a maximum of 40% and for the slightly soluble and insoluble zinc compounds inhalation absorption is at a maximum of 20%. These values can be assumed as a reasonable worst case, because they are considered to cover existing differences between the different zinc industry sectors with respect to the type of exercise activities (and thus breathing rate) and particle size distribution.

The available information from in vivo as well as the in vitro studies suggests the dermal absorption of zinc compounds through intact skin to be less than 2%. In vitro studies that estimated dermal absorption values only on the basis of the zinc levels in the receptor medium without taking into account the zinc present in the stratum corneum appear to underestimate absorption values derived from in vivo studies. Such zinc trapped in the skin layers may become systemically available at a later stage. Quantitative data to evaluate the relevance of this skin depot are however lacking. Given the efficient homeostatic mechanisms of mammals to maintain the total body zinc and the physiologically required levels of zinc in the various tissues to be constant, the anticipated slow release of zinc from the skin is not expected to disturb the homeostatic zinc balance of the body. Considering the available information on dermal absorption, the default for dermal absorption of all zinc compounds (solutions or suspensions) is 2%. Based on the physical appearance, for dust exposure to zinc and zinc compounds a 10-fold lower default value of 0.2% is a reasonable assumption.

Zinc appears to be distributed to all tissues and tissue fluids and it is a cofactor in over 200 enzyme systems. The excretion of zinc is primarily via faeces, but also via urine, saliva, hair loss, sweat and mothers-milk.

Acute toxicity

zinc Z1 SHG

Route of exposure	Parameter	Method	Value	Exposure time	Species	Value determination	Remark
Oral	LD50	Equivalent to OECD 401	> 2000 mg/kg bw		Rat	Experimental value	
Dermal	LD50	Equivalent to OECD 402	> 2000 mg/kg bw	24 weeks (daily, 5 days / week)	Rat	Read-across	
Inhalation	LC50	Equivalent to OECD 403	> 5.41 mg/l	4 weeks (daily, 5 days / week)	Rat	Experimental value	
Inhalation (ZnO, metal oxides)	LC50	Equivalent to OECD 403	> 5.7 mg/l	4 weeks (daily, 5 days / week)	Rat	Experimental value	

Conclusion

Toxicity is only applicable when components are released
Low acute toxicity by the dermal route
Low acute toxicity by the oral route
Low acute toxicity by the inhalation route

Corrosion/irritation

zinc Z1 SHG

Route of exposure	Result	Method	Exposure time	Time point	Species	Value determination	Remark
Eye	Moderately irritating	Equivalent to OECD 405			Rabbit	Experimental value	

Eye	Not irritating	Equivalent to OECD 405			Rabbit	Experimental value	
Dermal	Not irritating	Equivalent to OECD 404			Rabbit	Weight of evidence	
Dermal (ZnO, metal oxides)	Not irritating	Equivalent to OECD 404			Guinea pig	Read-across	
Dermal	Not irritating	Human observation			Human	Read-across	
Dermal (ZnO, metal oxides)	Not irritating	Human observation			Human	Literature study	
Inhalation (ZnO, metal oxides)	Not irritating					Literature study	

Conclusion

Not classified as irritating to the skin
Not classified as irritating to the eyes

Respiratory or skin sensitisation

zinc Z1 SHG

Route of exposure	Result	Method	Exposure time	Observation time point	Species	Value determination	Remark
Dermal	Negative	Equivalent to OECD 429			Mouse	Read-across	
Dermal (ZnO, metal oxides)	Negative	Guinea pig maximisation test			Guinea pig	Experimental value	
Dermal (ZnO, metal oxides)	Negative	Human observation			Human		
Inhalation	Negative					Inconclusive, insufficient data	

Conclusion

Not classified as sensitizing for inhalation
Not classified as sensitizing for skin

Specific target organ toxicity

zinc Z1 SHG

Route of exposure	Parameter	Method	Value	Organ	Effect	Exposure time	Species	Value determination
Oral	NOAEL	Equivalent to OECD 408	13.3 mg/kg bw/day	Blood	No effect	90 weeks (daily, 5 days / week)	Rat (male / female)	Read-across
Oral	NOAEL	Human observation study	50 mg/kg bw/day		No effect		Human (male / female)	Weight of evidence
Inhalation (ZnO, metal oxides)	NOAEL	Equivalent to OECD 409	2.7 mg/m³	Lungs	No effect	5 day(s)	Guinea pig	Experimental value
Inhalation (ZnO, metal oxides)		Human observation		General	No effect		Human	Literature study

Conclusion

Low sub-chronic toxicity by the dermal route
Low sub-chronic toxicity by the oral route
Low sub-chronic toxicity by inhalation route

Mutagenicity (in vitro)

zinc Z1 SHG

Result	Method	Test substrate	Effect	Value determination	Remark
Negative	OECD 471	Bacteria (S.typhimurium)		Read-across	

The chronic toxicity of the component(s) relates only to the substance in finely divided state and/or in molten state

Mutagenicity (in vivo)

zinc Z1 SHG

Result	Method	Exposure time	Test substrate	Organ	Value determination
Negative	Equivalent to OECD 474		Rat		Read-across

The chronic toxicity of the component(s) relates only to the substance in finely divided state and/or in molten state

Conclusion

Not classified for mutagenic or genotoxic toxicity

Carcinogenicity

zinc Z1 SHG

Route of exposure	Parameter	Method	Value	Exposure time	Species	Effect	Organ	Value determination
Oral		Other		51 weeks (daily, 5 days / week)	Rat	No neoplastic effects	General	Literature study
Oral		Human observation study		204 weeks (daily, 5 days / week)	Human	No neoplastic effects	General	Literature study

The chronic toxicity of the component(s) relates only to the substance in finely divided state and/or in molten state

Conclusion

Not classified for carcinogenicity

Reproductive toxicity

zinc Z1 SHG

	Parameter	Method	Value	Exposure time	Species	Effect	Organ	Value determination
Developmental toxicity		Human observation			Human (female)	No effect		Experimental value
	NOAEL	Equivalent to OECD 416	200 mg/kg bw/day	1 days (gestation, daily) - 18 days (gestation, daily)	Rat (female)	No effect		Weight of evidence
Effects on fertility		Human observation			Human (female)	No adverse systemic effects		Experimental value
	NOAEL	Equivalent to OECD 406	200 mg/kg bw/day		Rat (male / female)	No effect		Weight of evidence

The chronic toxicity of the component(s) relates only to the substance in finely divided state and/or in molten state

Conclusion

Not classified for reprotoxic or developmental toxicity

Toxicity other effects

zinc Z1 SHG

No (test)data available

Chronic effects from short and long-term exposure

zinc Z1 SHG

No effects known.

11.2. Information on other hazards

No evidence of endocrine disrupting properties

SECTION 12: Ecological information

12.1. Toxicity

zinc Z1 SHG

	Parameter	Method	Value	Duration	Species	Test design	Fresh/salt water	Value determination
Acute toxicity fishes	LC50	ASTM	0.169 mg/l	96 h	Oncorhynchus mykiss	Static system	Fresh water	Read-across
	LC50	Other	0.330 mg/l - 0.780 mg/l	96 h	Pimephales promelas	Static system		Read-across
Acute toxicity crustacea	EC50	US EPA	0.413 mg/l	48 h	Ceriodaphnia dubia	Static system	Fresh water	Experimental value
	EC50	Equivalent to OECD 202	0.530 mg/l	48 h	Daphnia magna	Static system	Fresh water	Read-across
	EC50	Other	0.095 mg/l - 0.530 mg/l	48 h	Ceriodaphnia dubia	Static system	Fresh water	Read-across
	NOEC	Other	201 mg/kg sediment dw	35 day(s)	Gammarus pulex	Semi-static system	Fresh water	Read-across
Toxicity algae and other aquatic plants	IC50	OECD 201	0.136 mg/l	72 h	Pseudokirchneriella subcapitata	Static system	Fresh water	Experimental value
	EC10	Other	0.0077 mg/l	7 day(s)	Ceramium tenuicore	Static system	Salt water	Experimental value
	EC10	Other	0.6708 mg/l	10 day(s)	Algae	Flow-through system	Salt water	Read-across
Acute toxicity other aquatic organisms	NOEC	ASTM	1135 mg/kg sediment dw	28 day(s)	Tubifex tubifex	Flow-through system	Fresh water	Read-across

Acute toxicity other aquatic organisms	NOEC	Other	0.400 mg/l	10 week(s)	Dreissena polymorpha	Static system	Fresh water	Read-across
Long-term toxicity fish	NOEC	Other	0.440 mg/l	72 day(s)	Oncorhynchus mykiss	Flow-through system	Fresh water	Read-across
	NOEC	Other	0.530 mg/l	36 month(s)	Salvelinus fontinalis	Flow-through system	Fresh water	Read-across
	NOEC	Other	0.025 mg/l	27 day(s)	Clupea harengus	Semi-static system	Salt water	Read-across
Long-term toxicity aquatic crustacea	NOEC	Other	0.037 mg/l	3 week(s)	Daphnia magna	Semi-static system	Fresh water	Read-across
	NOEC	US EPA	0.0056 mg/l	24 day(s)	Invertebrata	Semi-static system	Salt water	Read-across
Toxicity aquatic micro-organisms	EC50	Equivalent to OECD 209	5.2 mg/l	3 h		Static system	Fresh water	Read-across

	Parameter	Method	Value	Duration	Species	Value determination
Toxicity soil macro-organisms	NOEC	Other	1634 mg/kg soil dw	42 day(s)	Lumbricus terrestris	Read-across
	EC10	OECD 220	35.7 mg/kg soil dw	42 day(s)	Enchytraeus albidus	Read-across
Toxicity soil micro-organisms	NOEC	Other	17 mg/kg soil dw	12 week(s)	Soil micro-organisms	Read-across
	EC10	Other	2623 mg/kg soil dw	6 week(s)	Soil micro-organisms	Read-across
Toxicity terrestrial plants	EC10	OECD 208	5855 mg/kg soil dw	21 day(s)	Triticum aestivum	Read-across
	NOEC	OECD 208	32 mg/kg soil dw	25 day(s)	Triticum pratense	Read-across
Toxicity birds	NOEC	Other	> 150 mg/kg bw	28 day(s)	Anas plathyrhynchos	Experimental value

Conclusion

Very toxic to aquatic plants

Not classified as dangerous for the environment according to the criteria of Regulation (EC) No 1272/2008

12.2. Persistence and degradability

Water

Biodegradability: not applicable

12.3. Bioaccumulative potential

zinc Z1 SHG

BCF fishes

Parameter	Method	Value	Duration	Species	Value determination
		Not applicable			

BCF other aquatic organisms

Parameter	Method	Value	Duration	Species	Value determination
		Not applicable			

Log Kow

Method	Remark	Value	Temperature	Value determination
	Not applicable			

Conclusion

Bioaccumulation: not applicable

12.4. Mobility in soil

No (test)data on mobility of the substance available

12.5. Results of PBT and vPvB assessment

The criteria of PBT and vPvB as listed in Annex XIII of Regulation (EC) No 1907/2006 do not apply to inorganic substances.

12.6. Endocrine disrupting properties

No evidence of endocrine disrupting properties

12.7. Other adverse effects

zinc Z1 SHG

Greenhouse gases

Not included in the list of fluorinated greenhouse gases (Regulation (EU) No 517/2014)

Ozone-depleting potential (ODP)

Not classified as dangerous for the ozone layer (Regulation (EC) No 1005/2009)

SECTION 13: Disposal considerations

The information in this section is a general description. If applicable and available, exposure scenarios are attached in annex. Always use the relevant exposure scenarios that correspond to your identified use.

13.1. Waste treatment methods

13.1.1 Provisions relating to waste

European Union

Can be considered as non hazardous waste according to Directive 2008/98/EC, as amended by Regulation (EU) No 1357/2014 and Regulation (EU) No 2017/997.

Waste material code (Directive 2008/98/EC, Decision 2000/0532/EC).

17 04 04 (metals (including their alloys): Zinc). Depending on branch of industry and production process, also other waste codes may be applicable.

13.1.2 Disposal methods

Recycle/reuse. Remove waste in accordance with local and/or national regulations.

13.1.3 Packaging/Container

No data available

SECTION 14: Transport information

Road (ADR), Rail (RID), Inland waterways (ADN), Sea (IMDG/IMSBC), Air (ICAO-TI/IATA-DGR)

14.1. UN number

Transport	Not subject

14.2. UN proper shipping name

14.3. Transport hazard class(es)

Hazard identification number	
Class	
Classification code	

14.4. Packing group

Packing group	
Labels	

14.5. Environmental hazards

Environmentally hazardous substance mark	no

14.6. Special precautions for user

Special provisions	
Limited quantities	

14.7. Maritime transport in bulk according to IMO instruments

Annex II of MARPOL 73/78	Not applicable

SECTION 15: Regulatory information

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

European legislation:

VOC content Directive 2010/75/EU

VOC content	Remark
	Not applicable (inorganic)

Prior informed consent (PIC)

Contains component(s) listed in Annex I of Regulation (EU) No 649/2012: Part 1 - List of chemicals subject to export notification procedure

REACH Candidate list

Contains component(s) included in candidate list of substances of very high concern (SVHC) for authorisation (Article 59 of Regulation (EC) No 1907/2006)

REACH Annex XVII - Restriction

Subject to restrictions of Annex XVII of Regulation (EC) No. 1907/2006: restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and articles.

	Designation of the substance, of the group of substances or of the mixture	Conditions of restriction
· zinc	Substances falling within one or more of the following points: (a) substances classified as any of the following in Part 3 of Annex VI to Regulation (EC) No 1272/2008: — carcinogen category 1A, 1B or 2, or germ cell mutagen category 1A, 1B or 2, but excluding any such substances classified due to effects only following exposure by inhalation — reproductive toxicant category 1A, 1B or 2 but excluding any such substances classified due to effects only following exposure by inhalation — skin sensitiser category 1, 1A or 1B	Mixtures for tattooing purposes are subject to the restrictions of Regulation (EU) 2020/2081

	— skin corrosive category 1, 1A, 1B or 1C or skin irritant category 2 — serious eye damage category 1 or eye irritant category 2 (b) substances listed in Annex II to Regulation (EC) No 1223/2009 of the European Parliament and of the Council (c) substances listed in Annex IV to Regulation (EC) No 1223/2009 for which a condition is specified in at least one of the columns g, h and i of the table in that Annex (d) substances listed in Appendix 13 to this Annex. The ancillary requirements in paragraphs 7 and 8 of column 2 of this entry apply to all mixtures for use for tattooing purposes, whether or not they contain a substance falling within points (a) to (d) of this column of this entry.	

The identified uses are not covered by restrictions of Annex XVII of Regulation (EC) No 1907/2006

National legislation Belgium

No data available

National legislation The Netherlands

Waterbezwaarlijkheid	B (5); Algemene Beoordelingsmethodiek (ABM)

National legislation France

No data available

National legislation Germany

WGK	nwg; Verordnung über Anlagen zum Umgang mit wassergefährdenden Stoffen (AwSV) - 18. April 2017

National legislation Austria

No data available

National legislation United Kingdom

No data available

Other relevant data

No data available

15.2. Chemical safety assessment

A chemical safety assessment has been performed.

SECTION 16: Other information

Full text of any H- and EUH-statements referred to under section 3:

H360FD May damage fertility. May damage the unborn child.
H362 May cause harm to breast-fed children.
H372 Causes damage to organs (blood, central nervous system, kidneys) through prolonged or repeated exposure.

(*)	INTERNAL CLASSIFICATION BY BIG
ADI	Acceptable daily intake
AOEL	Acceptable operator exposure level
ATE	Acute Toxicity Estimate
CLP (EU-GHS)	Classification, labelling and packaging (Globally Harmonised System in Europe)
DMEL	Derived Minimal Effect Level
DNEL	Derived No Effect Level
EC50	Effect Concentration 50 %
ErC50	EC50 in terms of reduction of growth rate
LC50	Lethal Concentration 50 %
LD50	Lethal Dose 50 %
NOAEL	No Observed Adverse Effect Level
NOEC	No Observed Effect Concentration
OECD	Organisation for Economic Co-operation and Development
PBT	Persistent, Bioaccumulative & Toxic
PNEC	Predicted No Effect Concentration
STP	Sludge Treatment Process
vPvB	very Persistent & very Bioaccumulative

The information in this safety data sheet is based on data and samples provided to BIG. The sheet was written to the best of our ability and according to the state of knowledge at that time. The safety data sheet only constitutes a guideline for the safe handling, use, consumption, storage, transport and disposal of the substances/preparations/mixtures mentioned under point 1. New safety data sheets are written from time to time. Only the most recent versions may be used. Unless indicated otherwise word for word on the safety data sheet, the information does not apply to substances/preparations/mixtures in purer form, mixed with other substances or in processes. The safety data sheet offers no quality specification for the substances/preparations/mixtures in question. Compliance with the instructions in this safety data sheet does not release the user from the obligation to take all measures dictated by common sense, regulations and recommendations or which are

necessary and/or useful based on the real applicable circumstances. BIG does not guarantee the accuracy or exhaustiveness of the information provided and cannot be held liable for any changes by third parties. This safety data sheet is only to be used within the European Union, Switzerland, Iceland, Norway and Liechtenstein. Any use outside of this area is at your own risk. Use of this safety data sheet is subject to the licence and liability limiting conditions as stated in your BIG licence agreement or when this is failing the general conditions of BIG. All intellectual property rights to this sheet are the property of BIG and its distribution and reproduction are limited. Consult the mentioned agreement/conditions for details.

Introduction to (short) Generic Exposure Scenarios (GES)

For assessment of exposures at local scale, several generic exposure scenarios (GES) were developed in the chemical safety report (CSR) for each zinc substance. This was necessary because of the significant number of uses that was identified for each of the substances. The multitude of identified uses was assigned to the respective GES based on similarity of process, and, consequently, similarity in exposure and risk management measures. So, GES are relevant for the different identified uses that they group at the same time.

Approaches for local exposure assessment

- Assessment of workers exposure is related to the place /process the worker is involved in. The GES group different processes; exposure assessment is done using the worst case approach by considering full shift exposure at the workplace with highest potential for exposure. Risk management measures are specified accordingly.
- Environmental emissions (notably to water) are usually integrating the totality of emissions from a given site, and cannot be distinguished for each process. Therefore assessments in the GES are done for the site as a whole.

Shortened GES for annexing to the e-SDS

For reasons of clarity, shortened versions of the GES as documented in the CSR have been listed below. These shortened versions focus on a) operational conditions and b) risk management measures. Repetition of information contained in the SDS has been avoided by cross-referencing.

How to identify the GES related to a given use?

In table below, the generic exposure scenarios (GES) developed for Zn metal are presented.

Table: Generic exposure scenarios (GES) for zinc metal (ref : CSR zinc metal, version Nov 2010)

Number	Sector	Uses	Code
0	Zinc metal production	Manufacture Substance	GES_{Zn} 0
1	Formulation step: melting, alloying and casting in massive pieces	Formulation general	GES_{Zn} 1
2	Formulation step: melting, alloying manufacture of powders		GES_{Zn} 2
3	First tier applications	Manufacturing of other zinc compounds	GES_{Zn} 3
5		Use of molten zinc	GES_{Zn} 5
6		Transformation of massive zinc	GES_{Zn} 6
8	Second tier applications	DU of massive pieces of zinc	GES_{Zn} 8

To facilitate the identification of the GES related to a given downstream use, the table below lists the different uses that were identified for Zn metal. In this table, the downstream user can look up its use(s) and find the corresponding GES for attachment to his e-SDS.

Table: Identified uses for Zn metal and corresponding Generic Exposure Scenario (GES) (ref: CSR zinc metal, version Nov 2010)

IU number	**Identified Use (IU) name**	**GES code**
1	Zinc metal production RLE	GESZn 0
3	Storage of ingots-slabs in warehouses	GESZn 1
4	Production of chemicals (pyro)	GESZn 3
7	Melting, alloying and casting	GESZn 1
8	Cathodic protection - sacrifical anodes	GESZn 1
9	Downstream use of zinc-based sacrifical anodes	GESZn 8
10	Extraction of PM (Parkes process)	GESZn 5
11	Zinc casting / granules, pellets, prills, …	GESZn 1, GESZn 6
12	Zinc sheet casting and rolling	GESZn 1, GESZn 6
13	Wire and rods manufacturing	GESZn 1, GESZn 6
14	Downstream use of Zn based wire for metal spraying	GESZn 8
15	Component for soldering/brazing/welding products	GESZn 1, GESZn 6
16	Downstream use of Zinc based brazing/soldering products	GESZn 8
17	Strips and coins manufacturing	GESZn 1, GESZn 6
18	Batteries ballots, cans manufacturing	GESZn 1, GESZn 6
19	Zinc (pure or alloyed) powder manufacturing	GESZn 2
20	Passivated zinc powder manufacturing (pure or alloyed)	GESZn 2
30	Brass manufacturing	GESZn 1
31	Use of brass casts for transformation into semi-products	GESZn 6
32	Use of brass containing products	GESZn 8
33	Die-casting alloys manufacturing	GESZn 1
34	Use of die-casting ingots	GESZn 6
35	Manufacturing of Zinc containing Al-alloys	GESZn 1
36	Use of zinc containing Al alloys	GESZn 6
37	General hot dip galvanizing	GESZn 5
38	Continuous hot dip galvanizing	GESZn 5
39	Electrogalvanizing	GESZn 5
40	Electroplating	GESZn 5
41	Production of "targets by (EB) PVD or other sputtering techniques	GESZn 5, Generic consumer/environment*
42	Use of galvanized goods	Generic consumer/environment

* corresponds to “GES 10” in IUCLID

GES Zn - 0: industrial use of zinc-bearing materials, primary and secondary, to produce pure zinc metal in several process steps –hydrometallurgical and pyrometallurgical , with occasional controlled exposure.

- SU: 3,8,14,0 (Nace C24.4.3., E38.3)
- PROC: 2, 8b, 9, 22, 26
- PC : 7
- AC : NA
- ERC : 1

Description of activities/process(es) covered in the Exposure Scenario:

Hydrometallurgical process: electro-winning ("RLE" or roasting-leaching-electrolysis) process

- Roasting of the sulphidic zinc-bearing material to form ZnO-calcine
- Dissolving the calcine and other zinc-bearing materials into sulphuric acid solution, generating a zinc sulphate solution
- The Zinc sulphate solution is circulating continuously between the electrolytic-cells, the atmospheric coolers outside the building and the leaching steps
- The temperature is kept around ~37°C and current is applied between the series of Pb-anodes and Al-cathodes
- Zinc deposits at the cathode and O2 is evolved at the anode
- A foaming agent is added in order to have a blanket of foam at the solution surface in the cells i.o.t. prevent aerosols emissions
- The Zinc deposit is removed mechanically from the cathodes every ~24-36h, is washed and melted in automated furnaces
- The anodes need also to be cleaned from occasional deposits (PbO2/MnO2/…) every 2-3 weeks and replaced by new anodes every ~18 months
- The cells need to be cleaned up regularly from accumulating cellmud
- Maintenance activities

Pyrometallurgical process: Imperial Smelting Furnace (ISF) and distillation process

- Primary zinc-bearing sulphidic material and secondary zinc sources are continuously roasted and agglomerated on closed belts.
- The agglomerated calcine is fed to the furnace; zinc is fumed off (>1000°C) and recovered in condensers
- The condensed liquid zinc phase is fed to distillation columns
- The purified zinc is cast in appropriate formats

Maintenance activities

Contributing scenario (1) controlling environmental exposure.

Product characteristics: see sections 3 (composition) and 9 (phys-chem properties) of SDS

Zinc is produced in its pure form (typically : >99.99 %)

Amounts used Up to 600000 T/y

Frequency and duration of use: continuous production

Environment factors not influenced by risk management: Flow rate of receiving surface water default: 18,000 m^3/d, unless specified otherwise

Other given operational conditions affecting environmental exposure

- Air on the working place is filtered before release outside the building
- All indoor processes, in confined area.

Technical conditions and measures at process level (source) to prevent release: see section 8.2.3 of SDS and appendix exposure controls

Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil: see section 8.2.3 of SDS and appendix exposure controls
Organizational measures to prevent/limit release from site: see section 8.2.3 of SDS and appendix exposure controls
Conditions and measures related to municipal sewage treatment plant In cases where applicable, default size of the municipal STP (2000 m^3/d), unless specified otherwise.
Conditions and measures related to external treatment of waste for disposal By-products formed during the process are either recycled, internally or externally, or handled further as waste , according the waste legislation
Conditions and measures related to external recovery of waste • If any, all hazardous wastes are treated by certified contractors according to EU and national 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 legislation.
Contributing scenario (2) controlling worker exposure
Product characteristic: see sections 3 (composition) and 9 (phys-chem properties) of SDS • Pure Zn is cast as massive metal ingots of different size • Zn-finished product is stored in dedicated zones
Amounts used Up to 500 T/shift
Frequency and duration of use/exposure 8hrs shift (worst case); continuous exposure is assumed as default. Occasional use of personal protection equipment (see below).
Human factors not influenced by risk management: Uncovered body parts (potentially) face exposed as a result of the nature of the activity
Other given operational conditions affecting workers exposure: Indoor processes in confined areas.
Technical conditions and measures at process level (source) to prevent release: see section 8.2.1 of SDS and appendix exposure controls
Technical conditions and measures to control dispersion from source towards the worker: see section 8.2.1.of SDS and appendix exposure controls
Organisational measures to prevent /limit releases, dispersion and exposure: see section 8.2.1 of SDS and appendix exposure controls
Conditions and measures related to personal protection, hygiene and health evaluation: see section 8.2.2 of SDS and appendix exposure controls

Exposure estimation and reference to its source: not relevant, refer to CSR.
Risks for workers and to the environment have to be assessed considering the PNECs and DNELs mentioned under SDS sections 8.1.4.

Guidance to DU to evaluate whether he works inside the boundaries set by the (G)ES.
Occupational exposure/environmental emissions
The DU works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the downstream user can demonstrate on his own that his operational conditions and implemented risk management measures are adequate. Detailed guidance for evaluation of ES can be acquired via your supplier or from the ECHA website (guidance R14, R16). Environmental and human exposure can be measured or modelled (more information on tools available in SDS section 8.1.4.).

In addition, bioavailability corrections can be integrated in the exposure assessment, if the environmental parameters that are needed for the calculations are documented (see SDS section 8.1.4.)

GES Zn-1: industrial use of zinc cathodes or slabs, primary or secondary, that are melted, possibly alloyed, and cast/transformed in required massive formats and possibly stored: slabs, ingots, anodes, sheet, bar, wire, pellets, die-cast parts.
SU: 3,10, 14, 15, 0 (Nace C24.4.3./C25.6.1./C25.9.3./E38.3) PROC: 2, 3, 4, 5, 6, 8b, 9, 13, 15, 21, 22, 23, 24, 26 PC : 7, 38 AC : 1, 2, 3, 7 ERC : 1, 2, 5, 6a, 10a, 11a, 12b
Description of activities/process(es) covered in the Exposure Scenario • Delivering and stockpiling of the slabs or ingots of zinc and other alloying metals (e.g. Al, Sn, Mg, Ti, Fe, Co, Si, Cu, Ni, Bi …). • The ingots are fed into the melting/alloying furnace. • The alloying metals are molten and mixed/dissolved in the liquid phase at ~500°C up to 900°C • the melt is transferred to the casting ladle or machines, cast into ingots or directly into a (continuous) casting machine to form it as e.g. sheet, rods, bars, wires, sections and tubes • Maintenance activities
Contributing scenario (1) controlling environmental exposure
Product characteristics: see sections 3 (composition) and 9 (phys-chem properties) of SDS Physical state: massive solid
Amounts used Up to 1500 T zinc/day
Frequency and duration of use: Continuous use
Environment factors not influenced by risk management: Flow rate of receiving surface water default: 18,000 m^3/d, unless specified otherwise
Other given operational conditions affecting environmental exposure
• Dry manipulations in the whole building: only cooling water is present, whether in closed circuit or re-used in another process. • Air on the working place is filtered before release outside the building • All indoor processes, in confined area.
Technical conditions and measures at process level (source) to prevent release: see section 8.2.3. of SDS and appendix exposure controls
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil: see section 8.2.3. of SDS and appendix exposure controls
Organizational measures to prevent/limit release from site: see section 8.2.3. of SDS and appendix exposure controls
Conditions and measures related to municipal sewage treatment plant: In cases where applicable: default size of the municipal STP (2000 m^3/d), unless specified otherwise
Conditions and measures related to external treatment of waste for disposal • If any, all hazardous wastes are treated by certified contractors according to EU and national 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 legislation.
Conditions and measures related to external recovery of waste

By-products formed during the process are either recycled, internally or externally, or handled further as waste , according the waste legislation
Contributing scenario (2) controlling worker exposure
Product characteristic: see sections 3 (composition) and 9 (phys-chem properties) of SDS Physical status : massive solid
Amounts used Up to 500 T/shift
Frequency and duration of use/exposure 8hrs shift (worst case), continuous exposure is assumed as default
Human factors not influenced by risk management: Uncovered body parts (potentially) face can be exposed as a result of the nature of the activity
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 on furnaces and other 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 See section 8.2.1.of sds and appendix exposure controls
Organisational measures to prevent /limit releases, dispersion and exposure: see section 8.2.1. of sds and appendix exposure controls
Conditions and measures related to personal protection, hygiene and health evaluation: see section 8.2.2. of sds and appendix exposure controls

Exposure estimation and reference to its source: not relevant, refer to CSR.
Risks for workers and to the environment have to be assessed considering the PNECs and DNELs mentioned under SDS sections 8.1.4.

Guidance to DU to evaluate whether he works inside the boundaries set by the (G)ES.
Occupational exposure/environmental emissions
The DU works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the downstream user can demonstrate on his own that his operational conditions and implemented risk management measures are adequate. Detailed guidance for evaluation of ES can be acquired via your supplier or from the ECHA website (guidance R14, R16). Environmental and human exposure can be measured or modelled (more information on tools available in SDS section 8.1.4.).

In addition, bioavailability corrections can be integrated in the exposure assessment, if the environmental parameters that are needed for the calculations are documented (see SDS section 8.1.4.)

GES Zn-2: industrial use of zinc, pure or alloyed, in the production of zinc powder and dust by different sputtering techniques including coating and superficial passivation steps.
• SU: 9, 14 (Nace C20.1.3.) • PROC: 3, 9, 22, 27a, 27b • PC : 7, 14 • AC : - • ERC : 1, 2
Description of activities/process(es) covered in the Exposure Scenario • Delivering and stockpiling of the Zinc slabs or ingots. • The Zinc ingots are fed into the melting/alloying furnace. • Zinc and, optionally, alloying elements, are molten and mixed at 450-500°C • By gravity, injection or suction, the liquid metal is fed into the sputtering chamber • Further cooling, classification, blending and packaging of produced zinc dust and powder. 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. • Maintenance activities
Contributing scenario (1) controlling environmental exposure
Product characteristics: see sections 3 (composition) and 9 (phys-chem properties) of SDS Zinc is produced in its pure form (typically : >99 %) or alloyed.
Amounts used Up to 30000 T/y
Frequency and duration of use Continuous production is assumed as a worst case
Environment factors not influenced by risk management Flow rate of receiving surface water default: 18,000 m^3/d, unless specified otherwise
Other given operational conditions affecting environmental exposure • Air on the working place is filtered before release outside the building • All indoor processes, in confined area.
Technical conditions and measures at process level (source) to prevent release: see section 8.2.3. of SDS and appendix exposure controls
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil: see section 8.2.3. of SDS and appendix exposure controls
Organizational measures to prevent/limit release from site: see section 8.2.3 of SDS and appendix exposure controls
Conditions and measures related to municipal sewage treatment plant: In cases where applicable: use default size of the municipal STP (2000 m^3/d) unless specified otherwise.
Conditions and measures related to external treatment of waste for disposal
• If any, all hazardous wastes are treated by certified contractors according to EU and national legislation. • Users of Zn powders have to favour the recycling channels of the end-of-life products • Users of Zn powders have to minimize Zn-containing waste, promote recycling routes and, for the remaining, dispose the waste streams according the Waste legislation.
Conditions and measures related to external recovery of waste

By-products formed during the process are either recycled, internally or externally, or handled further as waste , according the waste legislation
Contributing scenario (2) controlling worker exposure
Product characteristic: see sections 3 (composition) and 9 (phys-chem properties) of SDS Zn-powders and dusts are packed in appropriate packaging (e.g. drums) and stored in enclosed buildings => High dustiness is assumed as worst case (particle size from <500µm (powders) down to 10µm (fine dusts)
Amounts used Up to 30 T/shift
Frequency and duration of use/exposure 8hrs shift (worst case), continuous exposure is assumed as default.
Human factors not influenced by risk management Uncovered body parts: (potentially) face exposed as a result of the nature of the activity
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: see section 8.2.1 of SDS and appendix exposure controls
Technical conditions and measures to control dispersion from source towards the worker: See section 8.2.1. of SDS and appendix exposure controls
Organisational measures to prevent /limit releases, dispersion and exposure: see section 8.2.1 of SDS and appendix exposure controls
Conditions and measures related to personal protection, hygiene and health evaluation: see section 8.2.2 of SDS and appendix exposure controls

Exposure estimation and reference to its source: not relevant, refer to CSR.
Risks for workers and to the environment have to be assessed considering the PNECs and DNELs mentioned under SDS sections 8.1.4.

Guidance to DU to evaluate whether he works inside the boundaries set by the (G)ES.
Occupational exposure/environmental emissions
The DU works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the downstream user can demonstrate on his own that his operational conditions and implemented risk management measures are adequate. Detailed guidance for evaluation of ES can be acquired via your supplier or from the ECHA website (guidance R14, R16). Environmental and human exposure can be measured or modelled (more information on tools available in SDS section 8.1.4.).

In addition, bioavailability corrections can be integrated in the exposure assessment, if the environmental parameters that are needed for the calculations are documented (see SDS section 8.1.4.)

GES Zn-3: industrial use of zinc ingots or zinc powder in the manufacturing of other inorganic or organic zinc substances through different process routes, hydro-, pyro-, electrolytic processes
• SU: 8, 9, 10, 0 (Nace C23.9.9.) • PROC: 2, 8b, 9, 22, 26 • PC : 7, 19, 20, 21 • AC : na • ERC : 1
Description of activities/process(es) covered in the Exposure Scenario 1. In case of wet processes: a. Reception of the Zn metal, transfer to the reaction tank b. Sequential addition of reagents for purification steps and filtration on press filter, when needed (ventilation is adapted). c. Concentration by solvent evaporation, under exhaust hood. d. Possible pouring on a cooling belt or feeding to a crystaliser. 2. In case of dry process a. Reception of zinc metal, transfer to the furnace b. Fuming of the zinc vapour, oxidation in an air stream, cooling and collecting of the dust 3. Discharge and packaging of produced zinc compounds. Filled bags or drums are subsequently closed and carried to the storage area. 4. 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. 5. Maintenance activities
Contributing scenario (1) controlling environmental exposure
Product characteristics: see sections 3 (composition) and 9 (phys-chem properties) of SDS Zn-compounds are produced in their pure form e.g; > 99%, or in solution.
Amounts used Up to 75 T/d of Zn 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 Flow rate of receiving surface water default used: 18,000 m^3/d, unless specified otherwise
Other given operational conditions affecting environmental exposure • Dry process (fuming, oxidation) or wet processes (leaching, filtering, purification) followed by drying (possible grinding), and packaging; • All indoor processes, in confined area.
Technical conditions and measures at process level (source) to prevent release: see section 8.2.3 of SDS and appendix exposure controls • High temperature around furnaces • Dosing and packaging operations occur under a special ventilation hood
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil: see section 8.2.3. of SDS and appendix exposure controls
Organizational measures to prevent/limit release from site: see section 8.2.3. of SDS and appendix exposure control**s**
Conditions and measures related to municipal sewage treatment plant In cases where applicable: default size of the municipal STP (2000 m^3/d) will be used unless specified

otherwise.
Conditions and measures related to external treatment of waste for disposal • If any, all hazardous wastes are treated by certified contractors according to EU and national 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.
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 to the Waste regulation.
Contributing scenario (2) controlling worker exposure
Product characteristic: see sections 3 (composition) and 9 (phys-chem properties) of SDS • Zinc 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 8hrs shift (worst case)
Human factors not influenced by risk management Uncovered body parts: (potentially) face can be exposed as a result of the nature of the activity
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: see section 8.2.1 of SDS and appendix exposure controls
Technical conditions and measures to control dispersion from source towards the worker: see section 8.2.1. of SDS and appendix exposure controls
Organisational measures to prevent /limit releases, dispersion and exposure: see section 8.2.1. of SDS and appendix exposure controls
Conditions and measures related to personal protection, hygiene and health evaluation: see section 8.2.2 of SDS and appendix exposure controls

Exposure estimation and reference to its source: not relevant, refer to CSR.
Risks for workers and to the environment have to be assessed considering the PNECs and DNELs mentioned under SDS sections 8.1.4.

Guidance to DU to evaluate whether he works inside the boundaries set by the (G)ES.
Occupational exposure/environmental emissions
The DU works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the downstream user can demonstrate on his own that his operational conditions and implemented risk management measures are adequate. Detailed guidance for evaluation of ES can be acquired via your supplier or from the ECHA website (guidance R14, R16). Environmental and human exposure can be measured or modelled (more information on tools available in SDS section 8.1.4.).

In addition, bioavailability corrections can be integrated in the exposure assessment, if the environmental parameters that are needed for the calculations are documented (see SDS section 8.1.4.)

Zinc GES-5: Industrial use of Zinc, alloyed or not, for metal surface treatment (e.g. corrosion protection of steel by hot dip galvanising) or for pyrometallurgical extraction processes.
SU: 3, 5, 0 (NACE C25.6.1.) PROC : 13, 22, 23 PC : 7,14 AC : 1,2,3,7 ERC : 2,5
The hot-dip galvanising process includes the following steps: 1) In batch (general) galvanising: • the steel article is immersed into a bath of molten zinc (kettle") for a given time (typically 3-20 minutes). Prior to immersion, the steel article has been prepared by: i) mounting on a transportation line, ii) pre-treatment by degreasing, pickling, fluxing and optionally drying) • after removal from the kettle, the excess zinc drains back into the kettle. In semi-automated processes for tubes and pipes, excess zinc can be removed with compressed air or steam. 2) In continuous galvanising: • The steel articles (e.g.: sheet -strip/coil,…) are continuously unwound and fed to a fully or partially automated process. Wire galvanising follows a similar process. • The coils are automatically welded end-to-end to give a truly continuous process. • The sheet strip undergoes surface cleaning (chemical and/or thermal treatment) and heat treatment in special designed and closed furnace zones, before the zinc coating and finishing. • The galvanising bath consists of one or more tanks, usually made of a ceramic material or steel, which contain molten zinc (or zinc alloy). The steel passes through the bath and its surface is coated with zinc/iron-zinc alloys. Because of the speed of the strip (up to 180 m/min) and the short exposure time, the coating is very thin. • When the steel leaves the bath, gas (air or nitrogen) "knives" wipe off the excess zinc. An automatic gauge that measures the thickness of the coating, using e.g. X-ray measurement technology controls the system. • The steel is gradually cooled by air coolers after leaving the bath, possibly quenched in a water tank, dried, "finished" (to give the desired surface properties and appearance), edge-trimmed if necessary, cut to the required length and re-wound. • "Galvannealing" is a special after-treatment in which galvanised steel strip is heated again to allow the formation of a zinc-iron alloy (8-12% iron) on the surface, giving a particularly smooth appearance. Coils of finished galvanised steel are large and very valuable products that have to meet very stringent quality requirements. They are always stored under cover, usually in areas with temperature and humidity control. They are also always protected against corrosion by a passivating rinse layer, an oil film, plastic wrap or interleaved paper or a combination of some of these. In addition, they are always transported on covered truck beds. Therefore, there is no possibility of zinc-containing run-off from these products while at the plant or during transport (EU RA zinc metal, 2006).
Contributing scenario (1) controlling environmental exposure
Product characteristics: see sections 3 (composition) and 9 (phys-chem properties) of SDS

- Pure zinc metal or zinc alloy is used in the molten state.
- During immersion, the surface of the steel sheet reacts with the zinc to form a coating consisting of several zinc-iron alloy layers that are normally covered with an outer layer of zinc.
- The thickness of the zinc coating can vary generally between 250µm (batch galvanising) to <10-35 µm (continuous hot dip galvanizing; for a tube of conduction, the thickness of the zinc coating can be up to 60µm)
- During the Parkes-process (lead refining step)the formed triple alloy contains up to 35% w/w zinc

Amounts used

- Depending on the steel volume treated, a galvanising line will treat up to 3500 T Zn/y (general galvanising) and up to 12000 t/y of Zn in continuous galvanising (EU RA). On the biggest continuous galvanising sites, up to 3 lines can be operational in parallel.
- Parkes process: up to 5000T/y.

Frequency and duration of use Continuous operations

Environment factors not influenced by risk management:

Flow rate of receiving surface water default value 18,000 m^3/d used unless specified otherwise

Other given operational conditions affecting environmental exposure

- The galvanising process includes a high level of automation.
- All processes are performed indoor in a confined area. All residues containing zinc are recycled.
- The same technology is applied throughout the EU.

Technical conditions and measures at process level (source) to prevent release

- Process enclosures and closed circuits where relevant and possible (e.g.: when coolers are used, the cooling-water circulates in closed circuitry
- 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%). It is specified that by the implementation of BREF, the emission abatement efficiency is usually higher, resulting in a maximum release of 200-300kg of zinc /year by 1 continuous galvanising line.
- 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.
- Special procedures are used for cleaning and maintenance

Organizational measures to prevent/limit release from site: see section 8.2.3. of SDS and appendix exposure controls

Conditions and measures related to municipal sewage treatment plant:

In cases where applicable: default size of the municipal STP (2000 m^3/d) will be used unless specified otherwise.

Conditions and measures related to external treatment of waste for disposal

- If any, all hazardous wastes are treated by certified contractors according to EU and national 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 legislation.

Conditions and measures related to external recovery of waste

- All residues are recycled or handled and conveyed according to waste legislation.
- The excess zinc in the process is recovered and is either returned to the zinc kettle or sent for zinc recovery in the secondary industry. Zinc-enriched dross, ash and kettle skimmings are also either re-utilised in the plant or by the secondary zinc industry

Contributing scenario (2) controlling worker exposure

Product characteristic: see sections 3 (composition) and 9 (phys-chem properties) of SDS

Pure Zinc metal or zinc alloy is used.

Amounts used A general (batch) galvanising line will treat up to 3500 T/y of zinc, a continuous galvanising plant will treat up to 12000 t/y of Zn (EU RA). This would result in a maximum use of about 12T/d, 40T/d, respectively. These amounts have however no relation to worker exposure.

Frequency and duration of use/exposure

- Continuous hot dip galvanising: continuous, largely automated process.
- Batch hot dip galvanising: immersion of a batch of steel articles in molten zinc typically occurs 3 to 4 times per hour during an 8-hour shift.

Human factors not influenced by risk management:

Uncovered body parts (potentially) face can be exposed as a result of the nature of the activity

Other given operational conditions affecting workers exposure

- The molten zinc (alloy) in the galvanising kettle is at 445-460 °C (batch-GHDG), and 440-520°C (continuous-CHDG), resp.. Some GHDG process variants operate at up to 560°C. At this temperature (just above the melting point) the formation of zinc oxide fumes is minimal.
- Thin layers of a mix of solidifying zinc-iron intermetallic phases and ZnO are formed at the surface of the molten zinc bath and are removed manually or mechanically by “skimming”
- Some alloying elements may be used e.g. Pb, Ni, Al, Sb, Mg …which may trigger some specific risk management measures for workers

Technical conditions and measures at process level (source) to prevent release

- In general, process enclosures and closed circuits where relevant and possible, and in line with IPPC-BREF
- If applicable, local exhaust ventilation on furnaces and other work areas with potential dust generation, dust capturing and removal techniques.
    - Batch galvanising: IPPC BREF requires that the galvanising kettle is fully enclosed for the purpose of capturing emissions to air. These enclosures also restrict exposure of workers to zinc and zinc compounds during immersion of the steel articles.
    - Continuous galvanising: feeding of massive zinc blocks is automated, only traces of dust are generated at (masked) kettle and generally no LEV or process enclosure is needed.

Technical conditions and measures to control dispersion from source towards the worker: see section 8.2.1 of SDS and appendix exposure controls

Local exhaust ventilation systems and process enclosures are generally applied in GHDG, so inhalation is also prevented by process enclosures e.g. shields between the ventilation hood and the kettle

Organisational measures to prevent /limit releases, dispersion and exposure: see section 8.2.1 of SDS and appendix exposure controls

Conditions and measures related to personal protection, hygiene and health evaluation: see section 8.2.2 of SDS and appendix exposure controls

Exposure estimation and reference to its source: not relevant, refer to CSR.
Risks for workers and to the environment have to be assessed considering the PNECs and DNELs mentioned under SDS sections 8.1.4.

Guidance to DU to evaluate whether he works inside the boundaries set by the (G)ES.
Occupational exposure/environmental emissions
The DU works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the downstream user can demonstrate on his own that his operational conditions and implemented risk management measures are adequate. Detailed guidance for evaluation of ES can be acquired via your supplier or from the ECHA website (guidance R14, R16). Environmental and human exposure can be measured or modelled (more information on tools available in SDS section 8.1.4.).

In addition, bioavailability corrections can be integrated in the exposure assessment, if the environmental parameters that are needed for the calculations are documented (see SDS section 8.1.4.)

GES Zn-6: industrial use of zinc massive pieces (i.e. slabs, bars, sheets...), pure or alloyed, cast and optionally further rolled and/or punched to form semi-finished articles.
• SU: 3, 14, 15, 16, 0 (Nace C24.5.3&4./C25.9.3./C27.2.) • PROC: 2, 3, 4, 5, 6, 8b, 14, 15, 21, 22, 23, 24, 26 • PC : 7, 14, 15, 20, 21, 38 • AC : 1, 2, 3, 7 • ERC : 2, 3, 5, 6b
Description of processes covered in the exposure scenario, e.g. casting for rolling, granules/pellets casting, die casting, brass casting... • High purity zinc (alloy) ingot is melted, optionally alloyed, and poured onto the casting machine or fed to the injection nozzles. • After casting, the strip, the granules the die-cast, the brass bar are rapidly cooled down; the remainder of the operations concerns automated operations of the final articles that are in the massive metal form. • All castings are performed in specially dedicated machines: continuous strip-casting (i.e. Hazelett …), continuous brass-rod casting, batch hot-chamber die-casting machine. • The fresh scrap is usually returned to the melting furnace for direct recycling • The articles are stored before shipping to the final transformer • Maintenance activities
Contributing scenario (1) controlling environmental exposure
Product characteristics: see sections 3 (composition) and 9 (phys-chem properties) of SDS Zinc alloys for sheet rolling are typically made with Cu, Ti. Zinc alloys for die-casting are typically made of aluminium and magnesium, optionally copper. Brass is made of copper and ~30% zinc. These alloying elements may trigger some specific risk management measures for workers
Amounts used Up to 500 T zinc/day
Frequency and duration of use Continuous use
Environment factors not influenced by risk management: Flow rate of receiving surface water default value 18,000 m^3/d used unless specified otherwise
Other given operational conditions affecting environmental exposure • The molten zinc in the kettle is at 450-615 °C (higher for Cu- or Al-rich alloys). • Dry manipulations in the whole building: only cooling water is present, whether in closed circuit or re-used in another process. • Air on the working place is filtered before release outside the building • All indoor processes, in confined area.
Technical conditions and measures at process level (source) to prevent release: see section 8.2.3. of SDS and appendix exposure controls
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil: see section 8.2.3. of SDS and appendix exposure controls
Organizational measures to prevent/limit release from site: see section 8.2.3. of SDS and appendix exposure controls
Conditions and measures related to municipal sewage treatment plant: In cases where applicable: default size of the municipal STP (2000 m^3/d) will be used unless specified otherwise.
Conditions and measures related to external treatment of waste for disposal

If any, all hazardous wastes are treated by certified contractors according to EU and national 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 legislation
Conditions and measures related to external recovery of waste By-products formed during the process are either recycled, internally or externally, or handled further as waste , according the waste legislation
Contributing scenario (2) controlling worker exposure
Product characteristic: see sections 3 (composition) and 9 (phys-chem properties) of SDS • Besides brass, where zinc is in a proportion of ~30% w/w, the composition of major zinc alloys is generally Zn: > 80 %. • Variable amounts of Cu, Al, Ni, Bi, Mn, Ti, In, Sb, Mg … may be added to some alloy products to improve specific properties of the material • The final forms are massive metal
Amounts used Up to 170 T/shift
Frequency and duration of use/exposure 8hrs shift (worst case), continuous exposure is assumed as default.
Human factors not influenced by risk management: Uncovered body parts (potentially) face can be exposed as a result of the nature of the activity
Other given operational conditions affecting workers exposure • The molten zinc in the kettle is basically at 450-615 °C, higher for Cu- and Al-rich alloys. • All processes are carried out indoor in confined areas.
Technical conditions and measures at process level (source) to prevent release: see section 8.2.1 of SDS and appendix exposure controls
Technical conditions and measures to control dispersion from source towards the worker: see section 8.2.1. of SDS and appendix exposure controls
Organisational measures to prevent /limit releases, dispersion and exposure: see section 8.2.1 of SDS and appendix exposure controls
Conditions and measures related to personal protection, hygiene and health evaluation: see section 8.2.2 of SDS and appendix exposure controls

Exposure estimation and reference to its source: not relevant, refer to CSR.
Risks for workers and to the environment have to be assessed considering the PNECs and DNELs mentioned under SDS sections 8.1.4.

Guidance to DU to evaluate whether he works inside the boundaries set by the (G)ES.
Occupational exposure/environmental emissions
The DU works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the downstream user can demonstrate on his own that his operational conditions and implemented risk management measures are adequate. Detailed guidance for evaluation of ES can be acquired via your supplier or from the ECHA website (guidance R14, R16). Environmental and human exposure can be measured or modelled (more information on tools available in SDS section 8.1.4.).

In addition, bioavailability corrections can be integrated in the exposure assessment, if the environmental parameters that are needed for the calculations are documented (see SDS section 8.1.4.)

GES Zn - 8: Industrial and professional downstream use of massive pieces made of -or coated with- zinc, alloyed or not.

SU: 3, 14, 15, 16, 17, 19, 21, 22, 0(NACEC25.9.3.)

PROC: 4, 7, 11, 13, 15, 21, 23, 25, 26

PC: 7, 9a, 14,38

AC: 1, 2, 3, 7

ERC: 5, 10a, 11a

This scenario covers both the industrial scale processes and professional use. In the described process, the Zn metal 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

Contributing scenario (1) controlling environmental exposure

Product characteristics: see sections 3 (composition) and 9 (phys-chem properties) of SDS

Zn metal in the article is < 25% when located in the coating, >25% when located in the mass of the article.

Amounts used

Typical quantities for Industrial use are 50T/y (typical), maximum 500T/y (in industrial setting). For professional use, quantities are much lower.

Frequency and duration of use: Continuous production is assumed as a worst case

Environment factors not influenced by risk management:

Flow rate of receiving surface water default value 18,000 m^3/d used 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, processes are performed usually indoor in a confined area. Professional use can be outdoors.
- All residues containing zinc are recycled.

Technical conditions and measures at process level (source) to prevent release

- In industrial and professional setting indoor, 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.
- In outdoor professional use, no LEV is assumed

Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil

- In industrial and professional setting indoor, 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 > 200T/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.

- 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: see section 8.2.3 of SDS and appendix exposure controls

Conditions and measures related to municipal sewage treatment plant: In cases where applicable: default size of the municipal STP (2000 m^3/d) will be used unless specified otherwise.

Conditions and measures related to external treatment of waste for disposal

- If any, all hazardous wastes are treated by certified contractors according to EU and national 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 to the Waste legislation.

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

Contributing scenario (2) controlling worker exposure

Product characteristic: see sections 3 (composition) and 9 (phys-chem properties) of SDS

Zn metal in the article is < 25% when located in the coating, >25% when located in the mass of the article.

- The zinc containing mixture is in the solid state, usually with a low level of dustiness;
- However, for some processes, e.g. welding (PC 38), fine powder forms can occur; for these processes, high dustiness is considered

Amounts used

Typical quantities for Industrial setting are 50 T/y (typical), or 0.15 T/day, 0.05 T/shift. In industrial setting, maximum use quantity is 500T/y (1.5T/d, 0.5T/shift). In professional use, quantities are much lower.

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 can be exposed as a result of the nature of the activity

Other given operational conditions affecting workers exposure

- Industrial / Professional:
  - Dry processes: dry operational conditions throughout the process; no process waters;
  - Mostly indoor processes (industrial and professional) in confined area; professional use can also occur outdoors.

Technical conditions and measures at process level (source) to prevent release

• Industrial /professional indoor
  ○ Local exhaust ventilation on work areas with potential dust generation, dust capturing and removal techniques
  ○ Process enclosures where appropriate
• Professional outdoor: no LEV assumed, only local ventilation of area

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)
• Professional outdoor: no LEV assumed, but ventilation and RPE for some PROC/PC recommended

Organisational measures to prevent /limit releases, dispersion and exposure: see section 8.2.1 of SDS and appendix exposure controls
Conditions and measures related to personal protection, hygiene and health evaluation: see section 8.2.2 of SDS and appendix exposure controls

Exposure estimation and reference to its source: not relevant, refer to CSR.
Risks for workers and to the environment have to be assessed considering the PNECs and DNELs mentioned under SDS sections 8.1.4.

Guidance to DU to evaluate whether he works inside the boundaries set by the (G)ES.
Occupational exposure/environmental emissions
The DU works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the downstream user can demonstrate on his own that his operational conditions and implemented risk management measures are adequate. Detailed guidance for evaluation of ES can be acquired via your supplier or from the ECHA website (guidance R14, R16). Environmental and human exposure can be measured or modelled (more information on tools available in SDS section 8.1.4.).

In addition, bioavailability corrections can be integrated in the exposure assessment, if the environmental parameters that are needed for the calculations are documented (see SDS section 8.1.4.)

Appendix Exposure controls

1. Appropriate engineering controls

Technical conditions and measures at process level (source) to prevent release

- Process enclosures or semi-enclosures where appropriate.
- 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 system (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 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 finished 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 personnel 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)

2. Personal protection

- 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 P2 (efficiency 90%)
    - Dust filter-half mask P3 (efficiency 95%)
    - Dust filter-full mask P2 (efficiency 90 %)
    - Dust filter-full mask P3 (efficiency 97.5%)
- On (re)melting down: face shield
- Information-training of the workers and their staff and line managers focused on careful hygiene behaviour.

3. Environmental exposure control

Technical conditions and measures at process level (source) to prevent release

- Process enclosures and closed circuits where relevant
- Careful use of sulphuric acid and corrosive solutions, if used
- When applicable, sump containment is provided under the tanks and the filters i.o. to collect any accidental spillage and process waters need to be specifically treated before release
- Dusty operations occur under a specific local 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 90-99.98%).
- 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