SAFETY DATA SHEET: MANGANESE (II) SULFIDE

provided in accordance with Article 18(2) of Regulation (EC) No 1272/2008

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

1.1 Product Identifier:

Substance name: Manganese (II) sulfide
Other names: Manganese Sulphide, Manganese Sulfide,
Molecular Formula: MnS
EINECS number: 242-599-3
CAS number: 18820-29-6
REACH Registration number: [If applicable]
Unique formula identifier (UFI): Not applicable for this substance

1.2 Relevant identified uses of the Substance/Mixture and uses advised against:

Manufacture of powder metallurgy mix including packaging, compaction/sintering of powder metallurgy mixes - PC 7: Base metals and alloys
Machining of compacted sintered powder metallurgy mixes into final articles - PC 7: Base metals and alloys
Add or delete the above to suit your company's needs.

No known uses advised against.

1.3 Details of the supplier of the safety data sheet:(including address, phone numbers etc: Complete as required.

1.4 Emergency Telephone: Complete as required (For EU add 112); CIAV # of receiving country.

SECTION 2: HAZARDS IDENTITIFCATION

2.1 Classification of the substance or mixture:

Classification according to Regulation (EC) No. 1272/2008 [CLP] and the UN GHS: Classified as; Skin sensitization Cat 1; Skin irritation Cat2; Eye irritation cat 2.

2.2 Label elements:

Classification	Skin Sens. 1; Eye Irrit. 2; Skin irrit 2
Pictogram	
Signal word	Warning
Hazard statement	H315: Causes skin irritation. H317: May cause an allergic skin reaction. H319: Causes serious eye irritation.
Precautionary statement Prevention	P264, P261, P280,
Precautionary statement Response	P337+P313, P333+P313,
Precautionary Statement Disposal	P501
Additional Labelling requirements	EUH032: Contact with acids liberates very toxic gas (Hydrogen sulphide)

2.3 Other Hazards:

The substance is an inorganic mono-consistent substance. Based on available information, the substance does not meet the criteria for classification as persistent, bioaccumulative and toxic or very persistent and very bioaccumulative.

Endocrine disrupting properties have not been identified from existing acute or chronic data. Data lacking.

May form explosible dust-air mixture if dispersed.
It is advisable to avoid generating dust as all fine particles have the potential to explode. Contact with acids liberates very toxic gas (Hydrogen sulphide). Dust particles/fumes can irritate the eyes and could cause skin and or lung irritation.
Include other hazards if known.

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substance [Amend as appropriate]

Manganese sulfide is an inorganic mono-constituent substance. Its impurities are negligible and do not influence the classification.

Chemical name	EC No.	CAS number	Concentration % w/w	REACH Registration number

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Manganese (II) sulfide	242-599-3	18820-29-6	Complete as per your substance	xx-xxxxxx-xx
Other minor impurities - specify			Complete as per your substance	Not applicable for impurities

3.2 Mixtures: The substance is not a mixture.

SECTION 4: FIRST AID MEASURES

4.1 Description of first aid measures:

4.1.1 General Information

Avoid contact with eyes and skin as the substance can cause eye irritation and skin sensitization. In case of accident or unwellness, seek medical advice immediately.

4.1.2 Following Inhalation: Do not inhale. Wear an appropriate mask. The substance if inhaled could irritate the lungs. Include other relevant information based on your company's procedures.

4.1.3 Following Skin Contact: Wear appropriate protective equipment and avoid skin contact. Skin protection is a must. Include information based on your company's procedures.

4.1.4 Following Eye Contact: Eye protection is a must. Include information based on your company's procedures as well as the recommended specific goggle type.

4.1.5 Following Ingestion: Do not ingest. Employ good industrial hygiene. Include other relevant information based on your company's procedures.

4.1.6 Self protection of the first aider: Include other information based on your company's procedures.

4.2 Most important symptoms and effects, both acute and delayed: Dust particles will cause eye irritation/itchiness and lung irritation/coughing. Avoid skin contact as the substance is a skin sensitizer. These effects can be acute or delayed.

4.3 Indication of any immediate medical attention and special treatment needed: Include information based on your company's procedures.

SECTION 5 :FIRE-FIGHTING MEASURES :

5.1 Extinguishing media:

Avoid contact with acids. Include information on an appropriate extinguishing medium and any unsuitable extinguishing media based on your company's procedures.

5.2 Special hazards arising from substance or mixture:

The substance does not decompose naturally. However, upon combustion produces fumes of metallic oxides and oxides of carbon. Include any other relevant information.

5.3 Advice for fire-fighters:

Include information based on your company's procedures.

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SECTION 6: ACCIDENTAL RELEASE MEASURES:

6.1 Personal precautions, protective equipment and emergency procedures:

6.1.1 For non-emergency personnel:

a) Dusk mask googles and overalls are a must. See section 8 for more details.

b) Must have dust control and sufficient ventilation. Avoid all ignition sources as well as contact with acids.

c) In the event of any accidental release, evacuate the area and consult trained personnel's – Amend as per your company procedures.

6.1.2 For emergency responders: Remove persons to safety. Isolate hazard area and deny entry. Ventilate closed spaces before entering. Use personal protective equipment, specify which to use/which not to use. see section 8 – Amend as per your company procedures.

6.2 Environmental precautions:

Substance is not considered an environmental hazard based on available studies. However, it is advisable to keep away from drains/waterways as large quantities could clog drains. Include other information based on your company's procedures.

6.3 Methods and material for containment and cleaning up:

In the event of a spill, collect contaminated material and put in appropriate containers for disposal. Dispose of as special waste in compliance with local and national regulations.

6.3.1 For containment: Collect in closed and suitable containers for disposal. Include other information based on your company's procedures.

6.3.2 For cleaning up: Clean contaminated objects and areas thoroughly observing environmental regulations – Amend as per company procedures.

6.3.3 Other information: Include information based on your company's procedure such as clean-up techniques/materials never to be used.

6.4 Reference to other sections: Personal protective equipment: see section 8 & 13.

Section 7: HANDLING AND STORAGE:

7.1 Precautions for safe handling:

7.1.1 Recommendations:

a) Use only in well ventilated areas. Avoid generating dust as dust can easily enter the eyes. Wear personal protective clothing (see Section 8). Include other information based on your company's procedures.

b) Avoid handling with incompatible substances/mixtures (List incompatible substances if known)

c) Avoid dust generating operations or must be carried out in properly ventilated areas while wearing appropriate PPE.

d) Capture dust if possible and compress into pellets to minimize environmental exposure- Amend as per company procedures.

7.1.2 Advice on general occupational hygiene:

a) Do not eat, drink or smoke in work areas.

b) Wash hands before and after use and keep them dry.

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c) Remove contaminated clothing and personal protective equipment before entering eating areas - Include other information based on your company's procedures.

7.2 Conditions for safe storage, including any incompatibilities:

7.2.1 Specific storage requirements:

a) Risk management associated to physical and chemical properties

i) Explosive atmosphere: The substance is not explosive, however, store away from possible explosive materials and acids.

ii) Corrosive conditions: The substance does not corrode metal, hence no adverse corrosive effects are expected

iii) Flammability hazard: The substance is not flammable, however, keep away from flammable materials

iv) Incompatible substances or mixtures: Acids. **Include information based on company's procedures.**

v) Evaporative conditions: Avoid storage around organic evaporative materials/substances.

vi) Potential ignition sources: Keep away from ignition sources and acids.

b) How to control effects from environmental conditions: i) Weather conditions, (ii) ambient pressure, (iii) varying temperatures, (iv) sunlight, (v) humidity and (vi) vibration do not affect the integrity of the substance. However, store in cool dry areas. Amend as per your company's procedures.

c) How to maintain the integrity of the substance: The substance is very stable under normal conditions of use. It does not decompose or disintegrate. Stabilisers and antioxidants are not required.

d) Other advise

i) Ventilation requirements: Ensure adequate ventilation and store in a cool dry environment.

ii) Specific designs for storage: Keep/store only in original container/packaging. Include other information based on your company's procedures.

iii) Quantity limits under storage conditions: There is no limitation as the substance does not pose any physical and chemical hazards.

iv) Packaging compatibility: Store in original/similar packaging. Protect container/packaging against damage – Amend as per company's procedures.

7.3 Specific end uses(s):

Recommendations: Observe instructions for use and see exposure scenarios – Annex 1

SECTION 8: EXPOSURE CONTROLS/ PERSONAL PROTECTION:

8.1 Control Parameters:

8.1.1 Occupational exposure limits: The EU SCOEL OEL values for Manganese and its inorganic compounds are 0.2mg/m3 – inhalable and 0.05mg/m3 respirable.

8.1.1.1 National limits: Include other relevant country specific workplace limits.

8.1.1.2 Union limits: 0.2mg/m3 inhalable and 0.05mg/m3 respirable

8.1.1.3 Any other national exposure limit values: Include if available.

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8.1.1.4 Union Biological limit values: No union biological limit values exist for Inorganic manganese and its compounds.

8.1.1.5 Any other national biological limit values: Include if available.

8.1.2 Monitoring Procedures: Provide as per national laws/company procedures.

8.1.3 Formation of air contaminates: The substance does not produce air contaminants under normal conditions of use. OEL/BLV are therefore not provided Amend as per your company's use.

8.1.4 Derived No Effects Limits (DNELs)/Predicted No Effects Concentrations (PNECs):

Hazard Assessment conclusion for Workers: DNELS

Route	Type of effect	Hazard conclusion	Most sensitive endpoint
Inhalation	Systemic effects - Long-term	DNEL (Derived No Effect Level) 0.2mg/m³	neurotoxicity
Inhalation	Systemic effects - Acute	no-threshold effect and/or no dose-response information available	
Inhalation	Local effects - Long-term	no-threshold effect and/or no dose-response information available	
Inhalation	Local effects - Acute	no-threshold effect and/or no dose-response information available	
Dermal	Systemic effects - Long-term	DNEL (Derived No Effect Level) 0.00414mg/kg bw/day	neurotoxicity
Dermal	Systemic effects - Acute	no-threshold effect and/or no dose-response information available	
Dermal	Local effects - Long-term	no-threshold effect and/or no dose-response information available	
Dermal	Local effects - Acute	DNEL (Derived No Effect Level) 117.5µg/cm²	sensitisation (skin)
Eyes	Local effects	medium hazard (no threshold derived)	

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Hazard Assessment conclusion for the Environment: PNECs

Compartment	Hazard conclusion	Remarks/Justification
Freshwater	PNEC aqua (freshwater): 0.0108mg/L Intermittent releases: 0.049mg/L	Assessment factor: 50 Extrapolation method: assessment factor PNEC aqua (freshwater) Two chronic NOEC values in algae and Daphnia are available. The Daphnia NOEC of 0.54 mg/l is selected as the key value. **PNEC intermittent release hazard assessment conclusion:** PNEC aqua (intermittent releases) **PNEC intermittent release assessment factor:** 100.0 **PNEC intermittent release extrapolation method:** assessment factor **PNEC intermittent release justification:** Lowest L(E)C50 value from fish, Daphnia and algal studies. The key value is ErC50 = 4.9 mg/l from the algal growth study.
Marine water	PNEC aqua (marine water): 0.00108mg/L Intermittent releases:	Assessment factor: 500 Extrapolation method: assessment factor PNEC aqua (marine water) Two chronic NOEC values in algae and Daphnia are available. The Daphnia NOEC of 0.54 mg/l is selected as the key value. An additional assessment factor of 10 applies to the marine compartment.
Sediments (freshwater)	PNEC sediment (freshwater): 1.53mg/kg sediment dw	Assessment factor: 500 Extrapolation method: assessment factor PNEC sediment (freshwater) Equilibrium partitioning based on freshwater aquatic PNEC and Kd value of 650 ml/g. The tenfold safety factor is added to account for ingestion of compound bound to sediment.
Sediments (marine water)	PNEC sediment (marine water): 0.153mg/kg sediment dw	Assessment factor: 5000 Extrapolation method: assessment factor PNEC sediment (marine water) Equilibrium partitioning based on freshwater aquatic PNEC and Kd value of 650 ml/g. The tenfold safety factor is added to account for ingestion of compound bound to sediment.
Sewage treatment plant	PNEC STP: 100mg/L	Assessment factor: 10 Extrapolation method: assessment factor PNEC STP Activated sludge Respiration/inhibition test. NOEC = 1000mg/l

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Soil	PNEC soil: 6.2mg/kg soil dw	Assessment factor: 10 Extrapolation method: assessment factor PNEC soil Equilibrium partitioning based on aquatic PNEC and Kd value of 650. The tenfold safety factor is added to account for ingestion of compound bound to soil
Air	no hazard identified:	
Secondary poisoning	no potential for bioaccumulation:	According to the Guidance on information requirements and chemical safety assessment, Chapter R.11: PBT assessment, "the PBT and vPVB criteria of Annex XIII to the regulation do not apply to inorganic substances". Therefore, MnS is not considered to require any further assessment of PBT properties.

8.1.5 Control banding: A control banding approach is not used to decrease risk management measure during the use of this substance for the uses specified in section 1.2.

8.2 **Exposure controls:** See Exposure scenarios on, Annex 1

8.2.1 Appropriate engineering controls: Dust is trapped and recycled where possible. Wastewater is collected for treatment and recycled. Amend as per your company's procedures.

8.2.2 Individual protective measures: Overalls, goggles and masks are mandatory during use.

8.2.2.1 Other non-personal protection: Good industrial hygiene is a must. Keep and use in well ventilated areas. See section 5 for more information Amend as per your company's procedures.

8.2.2.2 CEN stand requirement for protective equipment: (Please state the quality/standard/thickness of the personal protective equipment used by your organisation)

a) Eye/face protection: Face protection is mandatory. complete as per your company procedures e.g type of goggles

b) Skin protection: Overalls, gloves and boots are mandatory as the substance is a skin irritant and a skin sensitizer (Please specify type of overall, gloves, boots including the thickness of material.

c) Respiratory protection: N95 Mask (Amend as per your company procedures)

d) Thermal hazards: Not applicable

8.2.3 Environmental exposure controls: The substance is not harmful to the environment. (Please include environmental controls employed by your company).

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SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES: [the information below is based on available literature and studies]

9.1 General information	
State	Solid
Colour	Dark green
Odour	Odourless
Melting point (Mpt) / Freezing point	>723 K (>450°C), Regulation (EC) No. 440/2008, Annex, A1
Boiling point or initial boiling point/boiling range	Melting pt >300°C, hence study not applicable
Flammability of solids	Not flammable, Regulation (EC) No. 440/2008, Method A10
Lower and upper explosion limit	Not applicable to solids
Flash Point	Not applicable to solids
Auto-ignition temperature	Not applicable to solids
Decomposition temperature	Not applicable to inorganic solids
pH	Include if known (where the substance is a solid, the pH of an aqueous solution at a given concentration shall be indicated)
Kinematic viscosity	Not applicable to solids
Solubility	Soluble: 6.16 x 10-3 g/L at 20±0.5°C., Regulation (EC) No. 440/2008, Annex A6
Partition Coefficient	Not applicable for inorganic substances
Vapour pressure	Study not conducted as Mpt >300°C
Density /Relative density	3.99 at 22.5. +/- 0.5°C, Regulation (EC) No. 440/2008, Annex, A3
Relative Vapour density	Not applicable to solids
Particle characteristics	Include PSD study results
9.2 Other information	None
9.2.1 Physical hazard classes	
Explosives properties	Non explosive
Flammable gases	Not applicable as the substance is a solid
Aerosols	Not applicable under normal conditions of use
Oxidizing gases	Not applicable as the substance is a solid
Gases under pressure	Not applicable as the substance is a solid
Flammability of liquids/Solids	Not flammable

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Self-reactive substances and mixtures	Not self-reactive
Pyrophoric liquids	Not applicable as the substance is a solid
Pyrophoric solids	Does not have pyrophoric properties
Self-heating substances and mixtures	Spontaneous ignition does not occur
Substances and mixtures which emit flammable gases in contact with water	Predicted not to emit flammable gases upon contact with water
Oxidising Liquids/solids	Non oxidising, Method A17
Organic peroxides	Not applicable to inorganic substances
Corrosive to metals	The substance is not corrosive to metals
Desensitised explosives	Not applicable
9.2.2 Other	Contact with acids liberates very toxic gas (Hydrogen sulphide)

SECTION 10: STABILITY AND REACTIVITY: [Amend information below to conform to your company information]

10.1 Reactivity: No specific test data related to reactivity available for this substance.

10.1.1 **Reactivity Hazard of substance:** Not applicable for inorganic substances

10.1.2 **Reactivity hazard of mixture:** Not applicable as the substance is not a mixture.

10.2 Chemical stability: The substance is chemically stable under recommended conditions of storage, use and temperature.

10.3 Possibility of Hazardous reaction: No hazardous reaction when handled and stored according to provisions.

10.4 Conditions to avoid: Include your company's information.

10.5 Incompatible Materials: Acids. Include your company's information.

10.6 Hazardous decomposition products: Does not decompose when used for intended uses. Include your company's information.

SECTION 11: TOXICOLOGICAL INFORMATION: [The information in this section is from experimental data and other available literature]

11.1 Information on toxicological effects:

a) Acute toxicity:

Acute oral toxicity: Not acutely toxic (LD50: >2000 mg/kg bw)

Acute dermal toxicity: Predicted not to be acutely toxic upon dermal exposure.

Acute inhalation toxicity: Not acutely harmful by inhalation (LC50 > 5.34 mg/L)

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b) Skin corrosion/irritation:

Not corrosive to the skin but irritating to the Skin (EPISKIN reconstituted human epidermis model)

c) Serious eye damage/irritation:

An eye irritant (SKINETHIC reconstituted human epithelium model)

d) Respiratory or skin sensitization:

A skin sensitizer (method B.42, Local lymph node assay). Predicted not to be a respiratory sensitizer.

e) Germ cell mutagenicity:

Negative in all test conducted using a MnCl2 – a very soluble salt considered as a worse-case evaluation:

- Ames test with S. typhimurium TA 98, TA 100, TA 1535, TA 1537, E coli WP2 uvrA (Met. act.: with and without) (OECD TG 471, EU method B13 and GLP); No toxicity was observed up a concentration of 5000 ug/plate.
- Mammalian cell gene mutation assay with mouse lymphoma L5178Y cells (met. act.: with and without) (OECD 476 and GLP); Negative for mouse lymphoma Cytoxicity: Yes, induced toxicity was not at the highest dose.
- In-vitro mammalian chromosome aberration test with human lymphocytes (Met. act.: with and without) (OECD guideline 473 and GLP). Negative for lymphocytes. Cytotoxicity: Yes

f) Carcinogenicity:

There are no specific studies on carcinogenicity for this substance. However, carcinogenicity report (NTP, 1993) on MnSO4 (more soluble/more bioavailable substance) and an expert review by Jenkinson, 2009 on genotoxicity as well as peer review article (Assem et al, 2011) concluded – no concerns, carcinogenicity in humans is not expected.

g) Reproductive toxicity:

There are no specific studies on reproductive parameters for this substance. However, studies exist on a more soluble/bioavailable manganese form - two generation reproductive toxicity study on the male/female rats using MnCl2 via inhalation (OECD guideline 416, GLP) concluded: No treatment related effects at 20 mg/m³ air in F0, F1 and F2 generations (Jardine L, 2013 and McGough & Jardine, 2017) - Not toxic to reproduction

A Prenatal-developmental toxicity study using MnCl2 via inhalation (OECD 414, GLP): concluded no fetal abnormalities at not specified at 15 mg/m³ (Dettwiler M, 2016)

h) Specific target organ toxicity (Single exposure):

Based on available data the classification criteria are not met.

i) Specific target organ toxicity (repeated exposure):

Published literature is unavailable in other to assess this endpoint. However, toxicity via inhalation has been reported from repeated exposure to other forms of manganese.

j) Aspiration hazard:

Data lacking

11.2 Information on other hazards

11.2.1 **Endocrine disrupting properties:** The substance is not considered an endocrine disruptor based on available literature – Data lacking.

SECTION 12: ECOLOGICAL INFORMATION:

12.1 Toxicity:

Acute (short-term) & Chronic (long-term) toxicity:

Based on available studies and using the CLP and GHS classification criteria, the substance does not meet the classification as an environmental hazard. PNEC's for fresh and marine water for this substance are much lower than the background concentration of manganese in European waters - (15.9 µg Mn/L in surface water; "Probabilistic Distribution of Manganese in European Surface Water, Sediment and Soil and Derivation of Predicted Environmental Concentrations (PEC) ", Parametrix, 2009 and supported by GEMAS data).

12.2 Persistence and degradation	No potential for persistence	According to the Guidance on information requirements and chemical safety assessment, Chapter R.11: PBT assessment, "the PBT and vPVB criteria of Annex XIII to the regulation do not apply to inorganic substances". Therefore, MnS is not considered to require any further assessment of PBT properties.
12.3 Bioaccumulative potential	No potential for bioaccumulation	According to the Guidance on information requirements and chemical safety assessment, Chapter R.11: PBT assessment, "the PBT and vPVB criteria of Annex XIII to the regulation do not apply to inorganic substances". Therefore, MnS is not considered to require any further assessment of PBT properties.
12.4 Mobility in soil	No potential to move into ground water	Data lacking

12.5 Results of PBT and vPvB assessment:

According to the Guidance on information requirements and chemical safety assessment, Chapter R.11: PBT assessment, "the PBT and vPVB criteria of Annex XIII to the regulation do not apply to inorganic substances". Therefore, MnS is not considered to require any further assessment of PBT properties.

12.6 Endocrine disrupting properties:

The substance is not considered an endocrine disruptor based on available literature – Data lacking.

12.7: Other adverse effects: None known

SECTION 13: DISPOSAL CONSIDERATIONS: Include your company's information

13.1 Waste treatment methods: Waste disposal in accordance with local and national laws covering waste and dangerous waste. Include additional company specific information

a) Waste treatment-relevant information: Include your company's /national law information.

b) Physical/chemical properties that affect waste treatment option: None known

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c) Sewage disposal-relevant information: Include your company's/national laws information.

d) Precautions for recommended waste treatment options: Include your company's information.

SECTION 14: TRANSPORT INFORMATION:

Transport may take place according to national regulations or land transport (ADR/RID), sea transport (IMDG) or Air transport (ICAO-TI/IATA-DGR).

14.1 UN Number: Include number or use not applicable if this is the case.

14.2 UN proper shipping name: Include name or use not applicable if this is the case.

14.3 Transport hazard class: Not hazardous

14.4 Packaging group: Include packaging group or use not applicable if this is the case.

14.5 Environmental hazard: Not hazardous to the environment

14.6 Special precautions for users: Always transport in closed containers, avoid generating dust. Avoid contact with acids [Amend as appropriate]

14.7 Maritime transport in bulk according to IMO instruments Complete as appropriate or used not applicable if this is the case.

SECTION 15: REGULATORY INFORMATION: [Delete as appropriate and include regulatory information specific to your country...]

15.1 Safety, health and environmental regulations/legislation for the substance:

UN GHS - UN Globally Harmonized System of Classification and Labeling of Chemicals (GHS): According to Chapter 1.5.2 of the UN Globally Harmonized System of Classification and Labeling of Chemicals (GHS) safety data sheets (SDS) are only required for substances and mixtures that meet the harmonized criteria for physical, health or environmental hazards. This substance meets these criteria; hence a safety data sheet is required.

EU CLP – Classification Labeling and Packaging Regulation: According to Article 59(2)(b) of (EC) No 1272/2008 (CLP), which amends REACH article 31(1), safety data sheets (SDS) are only required for substances and mixtures/special preparations that meet the harmonized criteria for physical, health or environmental hazards. MnS meets this criterion, hence a SDS according to 453/2010/EC is needed – this template is designed to meet this criteria.

EU REACH – Registration, Evaluation and Authorisation of Chemicals: REACH article 31(7) requires relevant exposure scenarios from the Chemical Safety Report (CSR) to be annexed to the SDS. These exposure scenarios are only required for hazard-classified substances or mixtures. This substance is hazard-classified according to CLP, therefore exposure scenarios are required. Ask your REACH/Chemical regulatory team.

15.2 Chemical Safety Report (CSR): A chemical safety assessment has been carried for this substance.

SECTION 16: OTHER INFORMATION:

a) **If using this template to develop your company's SDS** in the case of a revised safety data sheet, a clear indication of where changes have been made to the previous version of the safety data sheet is required in this section, unless such indication is given elsewhere in the safety data sheet, with an explanation of the changes, if appropriate. A supplier of a substance or mixture shall be able to provide an explanation of the changes upon request

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b) A key/legend to abbreviations and acronyms used in the SDS should be added in this section

c) Key Literature:

1. Anderson, K. A. (2009). Bioaccessibility of manganese from manganese Materials in Gastric and Lung (Alveolar) Biofluids, Oregon State University.

2. Assem, F. L., et al, (2011); The Mutagenicity and carcinogenicity of inorganic manganese compounds: A synthesis of the evidence, Journal of toxicology and environment, part B#

3. ARCHE (Assessing Risk of Chemicals): 2010. Development of Specific Emission Release Categories (SPERCs) for metals. Accessible online at: http://www.arche-consulting.be/metal-csa-toolbox/spercs-tool-for-metals/ [4.4.2012]

4. Atwal SS & Woolley SM (2009). MnS: Determination of Melting/Freezing Temperature and Flammability (Solids). Testing laboratory: Harlan Laboratories Limited Shardlow Business Park, Shardlow, Derbyshire, DE72 2GD, UK. Report no.: 2702-0014. Owner company: International Manganese Institute, 17 Rue Duphot, 75001 Paris, France. Report date: 2009-08-14.

5. Goodband TJ & Mullee DM (2010a). MnS: Acute toxicity to rainbow trout (Oncorhynchus mykiss). Testing laboratory: Harlan Laboratories Ltd., Shardlow Business Park, Shardlow, Derbyshire, DE72 2GD, UK. Report no.: 2702/0176. Owner company: International Manganese Institute, 17 Rue Duphot, 75001 Paris, France. Report date: 2010-05-20.

6. Goodband TJ & Mullee DM (2010b). MnS: Daphnid, Ceriodaphnia dubia survival and reproduction test. Testing laboratory: Harlan Laboratories Ltd Shardlow Business Park Shardlow Derbyshire DE72 2GD UK. Report no.: 2702/0148. Owner company: International Manganese Institute 17 Rue Duphot 75001 Paris France. Report date: 2010-05-21.

7. Griffiths DR (2010). MnS: Acute Inhalation Toxicity (Nose Only) Study In The Rat. Testing laboratory: Harlan Laboratories Ltd, Shardlow Business Park, Shardlow, Derbyshire, DE72 2GD, UK. Report no.: 2702/0094. Owner company: International Manganese Institute, 17 Rue Duphot, 75001 Paris, FRANCE. Report date: 2010-01-20.

8. O'Connor, B. and S. M. Woolley (2009). MnS (Hoganas): Determination of Water Solubility. H. L. Ltd., Harlan Laboratories Ltd.

9.

10. Parametrix and EURAS (2009): Probabilistic Distribution of Manganese in European Surface Water, Sediment, and Soil and Derivation of Predicted Environmental Concentrations (PEC) (598-5231001 (01/04), prepared for International Manganese Institute.

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INCLUDE ANNEX 1: **EXPOSURE SCENARIO FOR COMMUNICATION -ask reach@manganese.org**

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Revision date 06/2023 superseding date 01/2021
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