Safety Data Sheet

Solder (lead-free)

Safety Data Sheet according to the REACH Regulation (EC) 1907/2006, and the CLP Regulation (EC)1272/2008.
Revisions from the previous major version are indicated by a vertical line at the left margin.

SECTION 1: Identification of the Substance/Mixture and of the Company/Undertaking

1.1 Product identifier

Solder sticks, bars, ingots, pellets and solid wire of alloys:

96SC[(2)(3)], 99C[(2)], Fenix 100[(2)], Fenix 100T, HQ 005[(2)], HQ 300[(3)], HQ 305[(2)(3)], HQ 350[(3)], HQ 350P[(3)], HQ 387[(2)(3)], HQ 400[(3)], HQ 405[(2)(3)], SAC 0307[(2)(3)], SAC 300[(3)], SAC 305[(2)(3)], SAC 387[(2)(3)], SAC 405[(2)(3)], Starli LF2[(2)], Starli LF3[(2)], Starli Sb3[(1)], Sn70Zn30[(4)], Sn75Zn25[(4)], Sn95Ag5[(3)],Sn95Sb5[(1)], Sn95,5Ag4Cu0,5+Pb[(2)(3)], Sn96,5Ag3,5[(3)], Sn96,5Ag3Cu0,5[(2)(3)], Sn97Ag3[(3)], Sn99Cu1[(2)], Sn99,3Cu0,7[(2)], Sn99,5Cu0,4[(2)], SnAg3[(3)], SnAg3,5[(3)], SnAg3Cu0,5[(2)(3)], SnCu0,5[(2)], SnCu3[(2)], S-Sn97Cu3[(2)], S-Sn98Cu1Ag[(2)(3)], S-Sn99Cu1[(2)], S-Sn95Sb5[(1)].

[(1)] contains antimony
[(2)] contains copper.
[(3)] contains silver
[(4)] contains zinc

This data sheet does not apply to powders or other finely divided forms of the product.

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

Soldering and surface coating for electronic, electrical and engineering applications at temperatures up to 500°C.
Manufacture of solder powder.

Exposure Scenario details are given in section 16.

1.3 Details of the supplier of the safety data sheet

Fenix Metals Sp. z o.o.
Ul. Zakladowa 50
39-400 Tarnobrzeg
Poland

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Fax: +48 15822 9671 (Poland), +44 (0)20 8916 2257 (UK)
Email: info@fenixmetals.com

1.4 Emergency telephone number

Poland: +48 15822 9636, (office hours only), UK: +44 (0)20 8916 2256 (office hours only)

SECTION 2: Hazards Identification

2.1 Classification of the substance or mixture

The components of the product are not classified as hazardous under the Dangerous Substances Directive 67/548/EEC or the Classification Labelling and Packaging Regulation (EC) 1272/2008.

The product is not classified as dangerous under the Dangerous Preparations Directive 1999/45/EC or the Classification Labelling and Packaging Regulation (EC) 1272/2008.

2.2 Label elements

Dangerous Preparations Directive 1999/45/EC - none required.

Classification Labelling and Packaging Regulation (EC) 1272/2008 - none required.

2.3 Other hazards

Burns from contact with molten product; inhalation of fine powder, dust or fumes.

SECTION 3: Composition/Information on Ingredients

3.2 Mixtures

Declarable components: none

Other components:

Substance:	Weight (%)	EC No:	CAS No:	Registration No:
Tin	>60	231-141-8	7440-31-5	01-2119486474-28-0024 Some of this substance is exempted from the registration requirements in accordance with Article 2.7(d), as it is a recovered substance.
Antimony (products marked [(1)])	1-8	231-146-5	7439-92-1	05-2114310155-65
Copper (products marked [(2)])	0.1-5	231-159-6	7440-50-8	No registration number is given for this substance, because it is exempted from the registration requirements in accordance with Article 2.7(d), as it is a recovered substance.
Silver (products marked [(3)])	1-8	231-131-3	7440-22-4	05-2114130135-65
Zinc (products marked [(4)])	20-40	231-175-3	7440-66-6	

SECTION 4: First Aid Measures

4.1 Description of first aid measures

Inhalation Inhalation of metals in massive form is not expected. However, if use or processes produce dust or fume, and inhalation of these is suspected, remove exposed person to fresh air, give rest, and get medical attention. If flux fumes are inhaled, consult the safety data sheet for the flux concerned.

Ingestion Rinse out mouth and give plenty of water to drink. Get medical attention.

Eye contact Check for contact lenses and remove if present. Wash the eyes thoroughly with water. Get medical advice if irritation or other symptoms occur.

Skin contact Remove contaminated clothing. Wash affected area with soap and water. Get medical attention if irritation occurs. In case of contact with molten metal, cool skin rapidly with cold water.

4.2 Most important symptoms and effects, both acute and delayed

For antimony, acute or delayed effects are not anticipated.

For high oral intakes of soluble copper compounds, the first symptoms are gastro-intestinal. Vomiting may occur. The most critical organ for delayed effects from “copper” excess is the liver. Nose-lung irritation may be a symptom occurring after inhalation of copper containing fumes/dusts/mists.

Symptoms of acute silver poisoning:
Direct contact may cause mild local irritation of the skin or eyes. Inhalation of fumes or dusts of silver may be irritating to mucous membranes and upper respiratory tract. Exposure to high concentrations of smoke or dust may cause lung damage and pulmonary oedema. ingestion of silver compounds can cause irritation of the gastrointestinal tract.

Symptoms of chronic silver poisoning:
Prolonged exposure to the smoke or dust causes a metallic taste in the mouth, loss of appetite, headache and general infirmity. It can also cause a bluish or grayish discoloration of the skin, eyes and mucous membranes (Argyria). It may take several years before it develops. The stains are permanent.

4.3 Indication of any immediate medical attention and special treatment needed

Not applicable.

SECTION 5: Firefighting Measures

5.1 Extinguishing media

Use extinguishing measures that are appropriate to local circumstances and the surrounding environment. Suitable extinguishing agents: CO2, dry powder, sand or water spray. Do not use full water jets or foam.

5.2 Special hazards arising from the substance or mixture

This product is not flammable but may combust at high temperatures. No explosive properties have been identified for the components of this product.

5.3 Advice for fire fighters
Remove containers or product away from fire or cool with water.

SECTION 6: Accidental Release Measures

The product as supplied in solid form is not hazardous if spilled or released, although normal hygiene measures should be taken if the product is manually handled. This section relates to accidental release of materials, such as dross, dust or fume, arising from use of the product, as a result of fire or from other causes.

6.1 Personal precautions, protective equipment and emergency procedures
Keep unauthorised personnel from the spillage area. Wear personal protection (see Section 8).

6.2 Environmental precautions
Do not discharge into drains, surface waters or groundwater. In case of entry into waterways, soil or drains, inform the responsible authorities.

6.3 Methods and materials for containment and clearing up
Pieces can be picked up. Collect spilled material by vacuum cleaning or by sweeping in damped condition and keep in closed containers. Avoid raising dust. Label containers and send for recovery or disposal (see section 13).

6.4 Reference to Other Sections
See section 8: Exposure Controls/Personal Protection.
See section 13: Disposal Considerations.

SECTION 7: Handling and Storage

7.1 Precautions for safe handling
Wear protective clothing (see Section 8). If use or processes produce dust or fume, wear respiratory protection. Product is dense, so take care when carrying heavy loads. Do not let molten metal contact water. Ensure that product and any tools are dry before contact with molten metal. Wash hands after handling the product. See section 16 for relevant Exposure Scenarios.

7.2 Conditions for safe storage, including any incompatibilities
Do not store with acids or alkalis. Do not allow contamination with other chemicals.

7.3 Specific end uses(s)
See section 16 for specific Exposure Scenarios.

SECTION 8. Exposure Controls/Personal Protection

8.1 Control parameters
Occupational exposure standards:

UK	EH40	Tin (inorganic compounds)	2mg/m^3 8hr TWA, 4mg/m^3 15min STEL
		Antimony (metal & compounds)	0.5mg/m^3 8hr TWA
		Silver (metallic)	0.1mg/m^3 8hr TWA
		Copper (dust)	1mg/m^3 8hr TWA, 2mg/m^3 15min STEL
		(fume)	0.2mg/m^3 8hr TWA
France	ED 984	Etain	pas catalogué
		Antimoine	0.5mg/m^3 VME
		Argent (métallique)	0.1mg/m^3 VME
		Cuivre (poussière)	1mg/m^3 VME, 2mg/m^3 VLCT (ou VLE)
		(fumé)	0.2mg/m^3 VME

Germany TRGS900 Zinn(IV) Verbindungen, anorganische (einetembare Fraktion)
2mg/m^3 Grenzwert
Zinn(II) Verbindungen, anorganische (einetembare Fraktion)
8mg/m^3 Grenzwert
Antimon (einetembare Fraktion)
0.5mg/m^3 Grenzwert
Spitzenbegrenzung, Überschreitungsfaktor 4
Antimonverbindungen (ausgenommen Antimonwasserstoff und Diantimontrioxid) (einetembare Fraktion)
0.5mg/m^3 Grenzwert
Diantimontrioxid (einetembare Fraktion)
0.1mg/m^3 Grenzwert
Silber 0.1mg/m^3 Grenzwert
Spitzenbegrenzung, Überschreitungsfaktor 8
Kupfer und seine Verbindungen (einetembare Fraktion)
1mg/m^3 Grenzwert
Spitzenbegrenzung, Überschreitungsfaktor 4
Kupfer-Rauch (alveolengängige Fraktion)
0.1mg/m^3 Grenzwert
Spitzenbegrenzung, Überschreitungsfaktor 4
Zinkhaltige Rauch (einetembare Fraktion)
1mg/m^3 Grenzwert
Spitzenbegrenzung, Überschreitungsfaktor 2

In countries other than the UK, France and Germany, different exposure limits may apply.

PNECs and DNELs - antimony:

Exposure pattern	Route	Descriptor	DNEL/PNEC
Long-term - systemic effects	Dermal	DNEL	281 mg/kg bw/day
Long-term - local effects	Inhalation	DNEL	0.5 mg/m^3
	Freshwater	PNEC	0.113 mg Sb/L
	Marine	PNEC	0.0113 mg Sb/L
	Sediment - freshwater	PNEC	7.8 mg Sb/kg wwt
	Sediment - marine	PNEC	1.56 mg Sb/kg wwt
	Soil	PNEC	37 mg Sb/kg dwt
	STP	PNEC	2.55 mg Sb/L

PNECs and DNELs - copper

Exposure pattern	Route	Descriptors	DNEL/PNEC
Human long-term systemic effects	Oral, dermal and inhalation	Internal dose DNEL using absorption factors of 25% for oral, 100% for inhalation (respirable) and 0.03% for dermal exposure routes	0.041mg Cu/kg B wt/day
Human short-term systemic effects	Oral, dermal and inhalation	Internal dose DNEL using absorption factors of 25% for oral, 100% for inhalation (respirable) and 0.03% for dermal exposure routes	0.082mg Cu/kg B wt/day
Human short-term effects - drinking water	Oral	NOAEL for drinking water	4mg/L
Environmental	Fresh water	PNEC. Includes a default bio-availability correction	7.8 µg dissolved Cu/L[(1)]
Environmental	Marine water	PNEC. Includes a default bio-availability correction	5.2 µg dissolved Cu/L[(1)]
Environmental	Sediment - fresh water	PNEC. Includes a default bio-availability correction	87 mg Cu/kg dry wt[(1)]
Environmental	Sediment - estuarine	PNEC	288 mg Cu/kg dry wt[(1)]

Environmental	Sediment - marine	PNEC	676 mg Cu/kg dry wt(1)
Environmental	Soil	PNEC. Includes a default bio-availability correction	65.5 mg Cu/kg dry wt(1)
Environmental	STP	PNEC	230 g dissolved Cu/L

(1) Default PNEC values are given. These can be refined if information on local environment is available (see section 12.1)

PNEC and DNELs - silver

DNELs (derived from the levels causing changes in the body - by inhalation, exposure to prolonged and severe):

Employees:

soluble silver compounds	0.01mg Ag/m^{3*}
Poorly soluble / insoluble silver compounds	0.1mg Ag/m^{3**}

General Public:

soluble silver compounds	0.004mg Ag/m^{3*}
Poorly soluble / insoluble silver compounds	0.04mg Ag/m^{3**}

DNELs (derived from the levels causing changes in the body - after ingestion, exposure to long-term):

Employees:

soluble silver compounds	0.02mg Ag/kg body weight/day*
Poorly soluble / insoluble silver compounds	0.12mg Ag/kg body weight/day**

General Public:

soluble silver compounds	0.002mg Ag/kg body weight/day*
Poorly soluble / insoluble silver compounds	0.12mg Ag/kg body weight/day**

* value only for calculations
** value appropriate for the metallic silver

PNEC freshwater: 0.04µg Ag/L (Soluble Ag)
PNEC marine: 0.86µg Ag/L (Soluble Ag)
PNEC sediment freshwater: 438mg Ag/kg dw
PNEC sediment marine: 438mg Ag/kg dw
PNEC soil: 0.794mg Ag/kg ww
PNEC STP: 0.025mg Ag/L (Soluble Ag

PNECs and DNELs - zinc

DN(M)ELS for employees
Inhalation exposure
DNEL = 2.5 mg/m3 (inhalation exposure to water-soluble salts of zinc)
DNEL = 5 mg/m3 (inhalation exposure to poorly soluble or insoluble zinc salts).

Oral Exposure
DNEL = 50 mg Zn / day (ie, 0.63 mg Zn / kg body weight) (exposure to oral water-soluble salts of zinc)
DNEL. = 50 mg Zn / day (ie 0.83 mg Zn / kg body weight) (exposure to oral slightly soluble or insoluble zinc salts)

Dermal exposure
DNEL = 500 mg Zn / day (ie 8.3 mg Zn / kg body weight) (Dermal exposure to water-soluble salts of zinc)
DNEL = 5000 mg Zn / day (ie, 83 mg Zn / kg body weight) (Dermal exposure to poorly soluble or insoluble zinc salts)

DN (M) ELS for the general population
DNEL = 1.3 mg/m3 (inhalation exposure to water-soluble salts of zinc)
DNEL = 2.5 mg/m3 (inhalation exposure to poorly soluble or insoluble zinc salts)

PNEC for aquatic organisms

	Value	Assessment factor
PNEC in fresh water	20.6µg dissolved Zn/L	1
PNEC in sea water	6.1µg dissolved Zn/L	3

PNEC for organisms inhabiting the sediment

	Value	Assessment factor
PNEC for freshwater sediment	117.8mg/kg dry weight	1
PNEC for marine sediment	56.5mg/kg dry weight	1

PNEC for organisms inhabiting the soil

	Value	Assessment factor
PNEC for soil	35.6mg/kg dry weight	1

PNEC for organisms of biological waste water treatment plant

	Value	Assessment factor
PNEC for biological organisms from sewage treatment plants	52mg/L	100

8.2 Exposure controls
The need for personal protective equipment should be based on a workplace risk assessment for the particular use.

8.2.1 Organisational measures
No special measures required. However, if use or processes produce dust or fume, then local exhaust ventilation may be required.

8.2.2 Personal Protection Equipment
PPE should be to European (EN) standards.

Respiratory protection
Wear suitable respiratory protective equipment if exposure to dust or fume is likely.

Hand protection
Protective gloves. Material of gloves: neoprene or leather. Insulating gloves should be worn when handling molten or hot metal. Consult manufacturers concerning breakthrough times.

Eye protection
A face shield, safety goggles or safety glasses should be worn when handling molten metal.

Skin and body Protection
Wear protective work clothing. For processing involving hot or molten metal, use heat-resistant safety clothing.

Hygiene measures
Wash hands after handling product.

SECTION 9: Physical and Chemical Properties

9.1 Information on basic physical and chemical properties

Appearance:	Grey or silvery metallic solid
Odour:	None
Odour threshold:	Not applicable
pH:	Not applicable
Melting point:	217°C to 310°C, depending on grade.
Boiling point:	>600°C
Flashpoint:	Not applicable
Evaporation rate:	Not applicable
Flammability:	Not flammable
Upper/lower flammability limits:	Not applicable
Vapour pressure:	Not applicable
Vapour density:	Not applicable
Relative density:	7.2g/mL to 7.5g/mL, depending on grade.
Solubility in water:	Tin - insoluble (<0.1 g/L) Antimony - 18.2 mg/L at T° 20°C (ISO 6341 medium – loading 2 g Sb/L-pH 4.6) Copper - insoluble, needs to be transformed into a copper compound to become soluble Silver - 0.03 mg / L
Solubility in other solvents:	Not applicable
Partition coefficient (log Kow):	Not applicable
Autoignition temperature:	Not below 400°C
Decomposition temperature:	Not applicable
Viscosity:	Not applicable

Explosive properties: Not explosive

Oxidising properties: Not oxidising

9.2 Other information

Prolonged storage at low temperatures may cause a change in the allotrope of tin, which affects the physical properties of the substance.

SECTION 10: Stability and Reactivity

10.1 Reactivity

Stable under recommended storage and handling conditions.

10.2 Chemical stability

Stable under recommended storage and handling conditions.

10.3 Possibility of hazardous reactions

No hazardous reactions are expected under normal conditions of use.

Combustion or hot processes can result in the formation of dross or ashes containing antimony trioxide. Inhalation of these should be avoided.

10.4 Conditions to avoid

Avoid dust formation. See section 7.2 Conditions for safe storage.

10.5 Incompatible materials

Acids, alkalis, strong oxidizing agents, chlorine. Tin reacts strongly with cupric nitrate and with fused ammonium nitrate below 200°C. Reactions with acids or bases can liberate hydrogen, which is extremely flammable.

10.6 Hazardous decomposition products

No decomposition if used as directed.

SECTION 11: Toxicological Information

11.1 Information on toxicological effects

For copper, most of the available hazard data are related to exposure of soluble copper compounds (e.g. copper sulphate) and fine copper flakes, coated with zinc stearates (particle size around 5µm). For the hazard profile of copper in massive forms, information on solubility, bioaccessibility and bioavailability is combined with the hazard profile of soluble copper compounds in a read-across approach to assess its potential hazards.

Absorption

Antimony

Oral = 1% (ECB, 2008)
Dermal = 0.26% (negligible) (ECB, 2008)
inhalation = 6.82 % (ECB, 2008)

Copper

Copper is an essential element and therefore the concentration of copper in the body is strictly and efficiently regulated by homeostatic mechanisms. The major control mechanism is gastrointestinal absorption and biliary excretion into faeces. Liver has an important role in the maintenance of the copper homeostasis. The failure to maintain homeostasis may lead to adverse effects resulting either from deficiency or excess.

INHALATION: Copper massive and its marketed downstream use products have a d_{50} particle size >10 µm and therefore do not meet the criteria for acute inhalation classification. In specific cases (e.g. during production), dusts, mists and fumes may be produced. The absorption of the respirable fraction (fumes) is considered to be complete (100%). Absorption of the "inhalable" fraction depends on the particle size and the Multiple Path Model of Particle Deposition (MPPD)) can be used to quantify the particle dependent absorption.

ORAL: The solubility of copper massive forms in gastric fluid is low. In-vitro bio-accessibility of soluble copper compounds, copper powders and copper massive forms (various sizes) in gastric fluid (in accordance with ASTM D5517-07), demonstrated that, for massive forms, the release of copper ions in gastric fluids was only <0.1% of its total potential release (Rodriguez et al., 2010).

Following administration of soluble copper compounds, a dose dependent adsorption of copper ions has been drawn from true pooled fitted data (exposure-specific absorption). The essential nutritive value of copper-ions drives this homeostasis with a copper absorption ranging between 20% (high copper intake - near toxicity) and 80% (low copper intake - near deficiency) for soluble copper compounds. Considering the most reliable

human data currently available (Turnlund et al,1989; 1998; 2005 and Harvey et al, 2003; 2005), for a given soluble copper dose in the Gastro Intestinal Tract, oral absorption of copper in humans can be calculated based on the mean result for two functions:

Equation 1 - oral absorption% = -15.0 ln(x) + 63.2
Equation 2 - oral absorption% =72.9 $e^{-0.1167x}$
x= copper intake (mg/day)

DERMAL: A dermal absorption of 0.3% for soluble and insoluble copper substances in solution or suspension is observed from in- vitro percutaneous tests on human skin (Roper 2003; Cage 2003). For the dry exposure scenarios applicable to copper powders, the dermal absorption value of 0.03% applies.

Acute toxicity

Tin

Acute toxicity oral LC_{50}: >2000mg/kg (rat) – OECD 423.
Acute toxicity inhalation LC_{50}: >5mg/L (rat) – OECD 403.
Acute toxicity dermal LC_{50}: >2000mg/kg (rat) – OECD 402.

Antimony

Based on read-across from ATO, antimony has a low acute toxicity:
Oral LD_{50} rat > 20,000 mg/kg bw (Fleming, 1938; Gross et al, 1955; Myers et al, 1978)
Dermal LD_{50} rabbit > 8,300 mg/kg bw (Gross et al, 1955)
Inhalation LC_{50} rat > 5,200 mg/l (Leuschner, 2006)

Based on read-across from ATO, antimony does not require classification as STOT, single exposure, oral and inhalation since no reversible or irreversible adverse health effects were observed immediately or delayed after exposure and no effects were observed at the guidance value.

Copper

ORAL: At high levels, solubilised copper-ions may induce gastro-Intestinal effects. Acute oral effects, assessed from animal studies using CuO (Sanders, 2002a), copper sulphate (Lheritier, 1994) and coated copper flakes (Sanders, 2001a) are available. Comparison of the toxicity profiles demonstrates the importance of solubility/bio-accessibility for read-across of toxicity data among copper-bearing substances. The available animal data combined with in-vitro bio-accessibility data permitted the assessment of the acute toxicity of copper in powder and massive form.

The assessment concluded that, according to the Regulations (EC) No 1272/2008 and 67/548/EEC, copper sulphate and coated copper flakes meet the criteria as acute harmful by oral intake (LD_{50} rats>300 mg/kg body weight). The assessment further concluded that, according to Regulations (EC) No 1272/2008 and 67/548/EEC, copper (massive and powder forms) and CuO do not meet the criteria for classification after oral intake (LD_{50}>2000 mg/kg body weight).

Acute gastrointestinal effects associated with copper sulphate additions to drinking water were investigated in humans (Araya et al, 2001 and 2003) and a NOAEL of 4mg Cu/L was derived. At higher doses (6 to 8 mg Cu as $CuSO_4$/L, administered as a bolus on an empty stomach) nausea was the most frequently reported symptom (10% at 6 mg/L and 18% at 8 mg/L) and generally occurred within 15 minutes of administration. Other gastrointestinal symptoms (vomiting, diarrhoea and abdominal pain) were reported less frequently and abdominal pain showed no relationship to concentration.

Acute toxicity inhalation: copper massive has a particle size >10 µm and down-stream uses do not lead to particles with d_{50} <10µm. Therefore, according to Regulations (EC) No 1272 and 67/548/EEC, these do not meet the criteria for classification as harmful by inhalation.

INHALATION: Available acute inhalation toxicity data on coated copper flakes (Wesson, 2001) and copper oxychloride (Wesson, 2003) demonstrate that these soluble materials need to be classified as “harmful by inhalation” (LD_{50} rats 1-5 g/m3 air). The inhalation toxicity was characterized by local damage at the site of predominant deposition of particles (effect on respiratory tract and in lungs).

Copper massive has a particle size >10 µm and down-stream uses do not lead to particles with d_{50} <10µm. Therefore, according to Regulations (EC)

No 1272 and 67/548/EEC, these do not meet the criteria for classification as harmful by inhalation.

DERMAL: Consideration of available acute dermal toxicity data on copper (coated copper flakes (Sanders, 2001b)) and copper compounds (copper sulphate (Lheritier, 1993) and copper oxide (Sanders, 2002b)) (LD_{50}>2000 mg/kg body weight) against EU classification criteria, according to Regulations (EC) No 1272/2008 and 67/548/EEC, leads to the conclusion that copper nor any of the tested copper compounds require classification for acute lethal effects after dermal exposure.

The classification criteria, for very fine and soluble "copper" bearing substances, according to the regulations (EC) No 1272/2008 and 67/548/EEC on acute toxicity, lead to a classification as "harmful if swallowed and if inhaled".

The classification criteria, for copper in massive form and copper powder, according to Regulations (EC) No 1272/2008 and 67/548/EEC on acute toxicity, are therefore not met.

Silver

Toxic concentrations and doses:

LD_{50} (rat):> 2 000 mg / kg body weight (silver);
LD_{50} (rat, oral): 3702 mg / kg body weight (Ag_2O);
LC_{50} (rat, inhalation): no data;
LD_{50} (rat skin): no data.

Zinc

Ingestion:
Harmful. May cause gastrointestinal tract irritation with nausea, vomiting, diarrhea, loss of appetite, abdominal pain, fever and chills. May affect central and autonomic nervous system, with ataxia, drowsiness impaired motor coordination, dizziness, irritation, aching muscles. Can cause changes in the blood.

Inhalation:
Exposure to zinc dust or fumes may cause respiratory irritation. Exposure to inhalation of zinc fumes may cause the so-called foundry fever with a sweet taste in the mouth, fever chills, headache, weakness, excessive sweating, strong thirst, leg pain, and chest, breathing problems and vomiting.

Skin corrosion/irritation

Tin

Not irritating (rabbit) – OECD 404.

Antimony

Based on read-across from ATO, antimony is not a corrosive agent.

Copper

Animal data (coated copper flakes (Sanders, 2001c) and CuO (Sanders, 2002c)) have demonstrated that, according to Regulation (EC) No 1272 and Directive 67/548/EEC, "copper" is not a skin irritant.

Silver

Direct contact may cause mild local skin irritation.

Zinc

The substance is not classified as hazardous in this class.

May cause skin irritation. After prolonged exposure, may cause dermatitis.

Serious eye damage/irritation

Tin

Not irritating (rabbit) – OECD 405.

Copper

Animal studies with coated copper flakes (Sanders 2001d) and CuO (Sanders, 2002d) induced slight reversible eye irritation effects. Following the criteria, according to the Regulations (EC) No 1272 and 67/548/EEC, the coated copper flakes and CuO are not considered as an eye irritant.

Silver

Direct contact may cause mild local eye irritation.

Zinc

May cause irritation on exposure to fumes and dust.

Sensitisation

There is no evidence that tin, antimony or zinc cause respiratory or skin sensitisation.

Copper

Animal data (coated copper flakes (Sanders 2001e) and CuO (Sanders 2002e)) have demonstrated that, according to Regulations (EC) No 1272/2008 and 67/548/EEC, “copper” is not a skin sensitizer.

Silver

There have been a few cases of allergic skin inflammation on contact with powdered silver, silver solutions or dental amalgams.

Repeated dose toxicity

Tin

No information available.

Antimony

$NOAEC_{inhalation}$ = 0.51 mg/m³ (Newton et al, 1994)
$NOAEL_{oral}$ = 1686 mg/kg/day (Hext et al, 1999)
The NOAEC was determined in a study with a high background incidence of lung inflammation in controls, therefore there is considerable uncertainty regarding the reliability of this numerical value. The NOAEC is based on impaired lung clearance that was observed at 4.50 mg/m³.

Based on read-across from ATO, antimony does not require classification as STOT, repeated exposure, oral since no reversible or irreversible adverse health effects were observed immediately or delayed after exposure and the NOAEL is above the guidance value.

Based on read-across from ATO, antimony does not require classification as STOT, repeated exposure, inhalation since there is an absence of consistent identifiable toxic effects other than the non-specific PSP overload, which is an adaptive response not triggering a STOT classification.

Carcinogenicity

Tin

Not carcoinogenic. Both the Ames test and in vitro chromosome aberration test (CHO cells) are negative.

Antimony

Antimony metal does not require classification according to Regulation (EC) 1272/2008. However, as a consequence of the read across from ATO to antimony metal, antimony metal powder requires the same inhalation carcinogenicity classification. NOAEC: 0.51 mg/m³ / Target organ: respiratory: lung

Copper

All available studies on the carcinogenicity of copper are public domain studies but study qualities are limited due to shorter exposure periods (<2 years) and small group sizes (Carlton et al., 1973; Burki and Okita, 1969 and Harrison et al., 1954). However, using these studies in a weight of evidence approach, it was concluded that copper compounds do not raise concerns with respect to carcinogenic activity.

Zinc

The substance is not classified as hazardous in this class.

Mutagenicity

Tin

Ames test: Not mutagenic – OECD 471.
In vitro mammalian cytogenicity: Not mutagenic – OECD 473.
In vitro gene mutation in mammalian cells: Not mutagenic – OECD 476.

Antimony

Based on read-across from ATO, antimony is not expected to cause systemic mutagenicity in vivo after oral administration. Negative in vivo results on chromosome aberrations and micronuclei were obtained in two different species via oral application – mouse (Elliot et al., 1998) and rat (Whitwell, 2006), (Kirkland et al., 2007). An in vivo UDS assay in rats was also negative (Elliot et al., 1998). The classification criteria according to Regulation (EC) 1272/2008 as germ cell mutagen are also not met.

Copper

Public domain data indicate that copper sulphate is negative in vitro in bacterial cell reverse mutation assays, and in several other bacterial cell assays up to and including cytotoxic doses (1000-~3000 g/plate). Similar negative findings have also been reported for copper chloride. Results from in vitro mammalian cell tests show that copper sulphate is genotoxic only at high, cytotoxic concentrations (up to 250 mg/L).

Two in vivo genotoxicity studies performed on a soluble copper compound (copper sulphate), in accordance to respectively OECD 486 and EU B.12 were negative (Ward, 1994 and Riley, 1994).

The classification criteria for copper in massive form and copper powder, according to Regulation (EC) No 1272/2008 and Directive 67/548/EEC on germ cell mutagen are therefore not met.

Zinc

The substance is not classified as hazardous in this class.

Toxicity for reproduction

Tin

For tin, both the Ames test and in vitro chromosome aberration test (CHO cells) are negative.

Antimony

For antimony, based on the available long-term toxicity studies in rodents (Omura et al, 2002) and the relevant information on the toxicokinetic behaviour in rats, it is concluded that diantimony trioxide and, based on read-across from ATO, also antimony does not present a reproductive toxicity hazard, because of the lack of absorption and systemic distribution, and a correspondingly negligible exposure of reproductive organs in male and female mammalian species to diantimony trioxide. For these reasons, no classification for reproductive toxicity is required.
The reference Schroeder R.E. (2003) was identified as key study for developmental toxicity and will be used for classification and labelling. This study suggests that the NOAEC for developmental toxicity is > 6.3 mg antimony trioxide/m^3. Thus, classification as developmental toxicant according to Regulation (EC) 1272/2008 is similarly not required for antimony metal.

Copper

A high quality study (Mylchreest, 2005) indicates that the NOAEL for reproductive toxicity of a soluble copper compound (copper sulphate pent hydrate) in rats is > 1500 mg/kg food or >24 mg Cu/kg bw/d, the highest dose tested. At the highest dose, slight non-reproductive toxicity effects (transient effect on spleen weight) were observed.

The classification criteria for copper in massive form and copper powder, according to Regulation (EC) No 1272/2008 and Directive 67/548/EEC on reproductive toxicity are therefore not met.

Zinc

The substance is not classified as hazardous in this class.

STOT-single exposure

Tin

No effects.

Copper

The effects following acute toxicity (oral and inhalation – see above) have been used for the classification as harmful. The local oral and inhalation effects resulted in mortality.

The classification criteria, for copper in massive form and copper powder, according to Regulations (EC) No 1272/2008 and 67/548/EEC on STOT-SE are not met.

Silver

Inhalation of silver smoke and dust may irritate mucous membranes and upper respiratory tract. Exposure to high concentration of smoke/dust may damage the lungs and cause pneumothorax.

Ingesting silver compounds may irritate the stomach.

STOT-repeated exposure

Tin

Repeated dose toxicity (oral gavage) NOEL >1000 mg/kg/day (rat). 28 day subacute study – OECD 407.

Copper

NOAELoral rat = 16mg Cu /kg body weight/day (Hebert C.D., 1993). Following repeated administration of $CuSO_4$ in the feed for 13 weeks produced effects in the forestomach, liver and kidney. Inflammation of the liver occurred in male and female animals at 260 mg CuSO4/kgBW/day and above. The incidence and severity of the effects were dose-dependent. This study was used in the subsequent calculation of an oral and systemic DNEL (including a Safety factor of 100 and an oral absorption of 25%) of 0.041mg Cu/kg body weight/day.

The classification criteria, for copper in massive form and copper powder, according to Regulations (EC) No 1272/2008 on Specific Target Organ Toxicity are therefore not met.

Silver

Prolonged exposure to silver smoke/dust may cause blue or grey discolouration on eyes, nose, lips, throat and skin. This occurs over time and it may take several years before such discolouration occurs. It is irreversible.

Aspiration hazard

The product is a solid and aspiration hazards are not expected to occur.

SECTION 12: Ecological Information

For copper, most of the available hazard data are related to exposure of soluble copper compounds (e.g. copper sulphate). For the hazard profile of copper massive forms (assessed from a sphere of 1mm diameter), information on solubility and bioavailability are combined with the hazard profile of soluble copper compounds in a read-across approach to assess its potential hazards.

12.1 Toxicity

12.1.1 Tin

Short term toxicity to fish 96 h LC_{50}: >12.4µg/L (NOEC 12.4µg/L) *Pimephales promelas* (total tin from aged solutions of tin) – OECD 203.

Long term toxicity to aquatic invertebrates 7 days: LC_{50} (mortality) >3200µg/L, EC_{50} (reproduction) 1303µg/L (total tin from aged tin solutions) – *Daphnia magna* – EPA 1002.0.

Toxicity to algae EC_{50} (72 h): >19.2µg/L (total tin from aged tin solutions) - *Pseudokirchnerella subcapitata* – OECD 201.

12.1.2 Antimony

Antimony metal and antimony containing compounds will dissolve and generate antimony ions (Vangheluwe et al., 2001). The environmental section will therefore discuss the fate of antimony in general.

Acute aquatic toxicity test results:		
Marine fish [Pagrus major]	96 h LC_{50}	6.9 mg Sb/L (Takayanagi, 2001)
Freshwater fish [Pimephales promelas]	96 h LC_{50}	14.4 mg Sb/L (Brooke et al, 1986)
Invertebrates [Chlorohydra viridissima]	96 h LC_{50}	1.77 mg Sb/L (TAI, 1990)
Algae [Pseudokirchneriella subcapitata]	72 h ErC_{50} (growth rate)	> 36.6 mg Sb/L (Heijerick et al, 2004)

Chronic aquatic toxicity test results:		
Fish [Pimephales promelas]	28 d NOEC/LOEC (growth; length)	1.13/2.31 mg Sb/L (Kimball, 1978)
Invertebrates [Daphnia magna]	21 d NOEC/LOEC (reproduction)	1.74/3.13 mg Sb/L (Heijerick et al, 2003)
Algae [Pseudokirchneriella subcapitata]	72 h NOEC/LOEC (growth rate)	2.11/4.00 mg Sb/L (Heijerick et al, 2004)
Chronic sediment toxicity test results:		
Midge [Chironomus riparius]	14-d NOEC (growth)	78 mg Sb/kg ww (Heijerick et al, 2005)
Chronic terrestrial toxicity test results (values were determined in a soil spiked with Sb_2O_3 and aged for 31 weeks before testing):		
Soil invertebrates	NOEC	999 mg Sb/kg dw (Moser, 2007)
Plants	NOEC	999 mg Sb/kg dw (Smolders et al., 2007)
Soil microorganisms	NOEC	2930 mg Sb/kg dw (Smolders et al., 2007)
Toxicity tests for microorganisms (for STP):		
Aquatic microorganisms	NOEC	2.55 mg Sb/L (EPAS, 2005)
Inhibition of nitrification	NOEC	27 mg Sb/L (EPAS, 2005)

12.1.3 Copper

Environmental bioavailability: In accordance to the CLP guidance (2009), the environmental bio-availability of a copper massive form (1 mm sphere) in freshwater environments was assessed from transformation/dissolution tests (OECD 29). The data demonstrate higher release at lower pH. The data also demonstrate a linear relationship between the releases and the exposed surface area. The non-abrasive release of dissolved copper ions to the aqueous transformation/dissolution medium (7 days, 100 mg/L loading, pH6), was 6.7µg Cu/L corresponding to a surface–specific release of 0.15µg Cu/mm2 (Rodriguez et al., 2007).

Acute aquatic toxicity test results and environmental classification: The acute toxicity of soluble copper ions was assessed from studies on soluble copper compounds. From a literature search 451 high quality L(E)C_{50} values were retained. For the algae 66 individual data points were selected for 3 standard species (Pseudokirchnerella subcapitata, Chamydomonas reinhardtii and Chlorella vulgaris). For the invertebrates 123 individual data points were selected for 2 standard species(Ceriodaphnia dubia and Daphnia magna) and for the fish 262 individual data points were selected for 5 standard species (Oncorhynchus mykiss, Pimephales promelas, Lepomis macrochirus, Brachydanio rerio and Cyprinus carpio). The data were treated and summarized in accordance with the CLP guidance (2009) to derive the pH dependent acute reference value. The lowest species-specific geometric mean L(E)C_{50} reference was obtained for an invertebrate (Ceriodaphnia dubia) at pH 5.5-6.5 with an acute L(E)C_{50} of 25.0µg Cu/L (Van Sprang et al., 2010).

To assess the environmental classification of copper in massive form, the copper release from the 7 days transformation/dissolution data of copper in massive forms (6.7µg Cu/L at 100mg/L, pH6) was combined with the acute reference value for the copper ions (25µg Cu/L) (Van Sprang et al., 2010).

The assessment demonstrates that, according to Regulations (EC) No 1272/2008 and 67/548/EEC, copper massive forms do not need to be classified for acute environmental hazards.

In accordance with the EU CLP guidelines (2009), chronic classification applies if the substance is persistent or bio-accumulative. For “copper” it has been be demonstrated that the bio-available copper-ions are rapidly removed from the water column (Rader, 2010) – see also section 12.2. Copper is an essential nutrient, copper concentrations are very strongly regulated and copper is not bio-magnified across the food-web – see also section 12.3. The “bio-accumulation” criteria therefore do not apply the “copper”.

Based on the assessment (see section 12.2 and 12.3), according to Regulations (EC) No 1272/2008 and 67/548/EEC, Copper massive does not meet the classification for chronic aquatic toxicity.

Chronic freshwater toxicity test results and PNEC derivation: The chronic toxicity of soluble copper ions was assessed from studies on soluble copper compounds. 139 individual NOEC/EC_{10} values resulting in 27 different species-specific soluble Cu-ions NOEC values, covering different trophic levels (fish, invertebrates and algae) were used for the PNEC derivation. The large intra-species variability in the reported single species NOECs was related to the influence of test media characteristics (e.g., pH, dissolved organic carbon (DOC), hardness) on the bioavailability and thus toxicity of copper. Species-specific NOECs were therefore calculated after normalizing the NOECs towards a series of realistic environmental conditions in Europe (typical EU scenarios, with well-defined pH, hardness and DOC). Such normalization was done by using chronic copper bioavailability models (Biotic

Ligand Models), developed and validated for three taxonomic groups (fish, invertebrates and algae) and additional demonstration of the applicability of the models to a range of other species. The species-specific BLM-normalized NOECs were used for the derivation of log-normal Species Sensitivity Distributions (SSD) and HC_5 values (the median fifth percentile of the SSD), using statistical extrapolation methods to derive a PNEC. The data allow the derivation of PNECs for the typical EU scenario ranging between 7.8 and 22.1µg dissolved Cu/L. Additional BLM scenario calculations for a wide range of surface waters across Europe further demonstrated that the HC_5 of 7.8 µg dissolved Cu/L, is protective for 90% of the EU surface waters and can thus be considered as a reasonable worst case for Europe in a generic context.

Copper threshold values were also derived for three high quality mesocosm studies, representing lentic and lotic systems. The mesocosm studies included the assessment of direct and indirect effects to large variety of taxonomic group and integrate potential effects from uptake from water as well as from food. The results confirm the BLM normalized single species threshold values.

Conclusion: a value of 7.8µg dissolved Cu/L is the default chronic freshwater PNEC, to be used to assess local risks. The assessment can be refined if information on local water chemistry (dissolved organic carbon, pH, calcium, magnesium, sodium and alkalinity) is available.

Chronic marine waters toxicity test results and PNEC derivation: The chronic toxicity of soluble copper ions was assessed from studies on soluble copper compounds. 51 high-quality chronic $NOEC/EC_{10}$ values, resulting in 24 different species-specific soluble Cu-ions NOEC values covering different trophic levels (fish, invertebrates, algae), were retained for the PNEC derivation. NOEC values were related to the Dissolved Organic Carbon (DOC) concentrations of the marine test media. Species-specific NOECs were therefore calculated after DOC normalizing of the NOECs. These species-specific NOECs were used for the derivation of species sensitivity distributions (SSD) and HC_5 values, using statistical extrapolation methods. The organic carbon normalisation was carried out at a DOC level typical for coastal areas (2mg/L) and resulted in an HC_5 value of 5.2µg Cu/L.

A Copper threshold value was also recently derived from a high quality marine mesocosm study (Foekema et al., 2010). The mesocosm studies included the assessment of direct and indirect effects to large variety of taxonomic group and integrate potential effects from uptake from water as well as from food. The results confirm the DOC normalized single species threshold values.

Conclusion: a value of 5.2µg dissolved Cu/L is the default chronic marine water PNEC, to be used to assess local risks. The assessment can be refined if the dissolved organic carbon concentration of the local environment is available.

Chronic freshwater sediment toxicity test results and PNEC derivation: The sediment PNEC included using a weight of evidence approach considering different sources and tiered approaches of information: (1) sediment ecotoxicity data from spiking sediments with soluble copper compound, (2) pelagic ecotoxicity data in combination with water-sediment partitioning coefficients (Kd values) derived through different approaches and (3) mesocosm/field ecotoxicity.

High-quality chronic benthic NOECs for six benthic species, representing 62 NOEC values were retained for the PNEC derivation. NOEC values were related to sediment characteristics (e.g., Organic Carbon (OC) and Acid Volatile Sulphides (AVS)), influencing the bioavailability and thus toxicity of copper to benthic organisms. The derivation of the freshwater HC_5 sediment for copper was therefore based on the OC-normalized dataset, containing only low-AVS sediments.

An HC-5 of 1741mg Cu/kg OC, corresponding to 87 mg Cu/kg dry weight for a sediment with 5 % O.C. (TGD default value) is used.

Conclusion: a value of 87 mg Cu/kg dry weight is the default chronic freshwater sediment PNEC, to be used to assess local risks. The assessment can be refined if the organic carbon concentration and the Acid Volatile Sulphide concentrations of the local sediment is available.

Chronic terrestrial toxicity test results and PNEC derivation: Chronic terrestrial toxicity is derived from spiking of soils with soluble copper compounds. A high-quality dataset of 252 individual chronic $NOEC/EC_{10}$ values from 28 different species and processes representing different trophic levels (i.e., decomposers, primary producers, primary consumers) has been retained for the PNEC derivation. The observed intra-species differences in toxicity data were related to differences in bioavailability: the latter related to differences in soil properties and to differences in ageing and application mode and rate.

The soil property best explaining the variability in toxicity for most of the endpoints was the eCEC (effective Cation Exchange Capacity). To account for the observed difference between lab-spiked soils and field-contaminated soils, a conservative leaching-ageing factor of 2 was agreed based on test data from the mechanistic research on ageing and ionic strength (leaching) effects. For the normalisation of the ecotoxicity data, first the leaching-ageing factor was applied on all added $NOEC/EC_{10}$ values. These adjusted values, after addition of the respective Cu background concentrations, were subsequently normalised to a wide range of EU soils using the relevant regression (bio)availability models, generating soil-type specific HC_5 values and a derivation of the PNEC. Species Sensitivity Distributions were constructed using the normalised $NOEC/EC_{10}$ data. HC_5 values from log-normal distributions ranging between 65.5 and 150mg Cu/kg dry weight were obtained (Oorts et al., 2010).

A total of eight single species studies were available in which the toxicity of Cu to micro-organisms, invertebrates and plants in field-contaminated aged soils was investigated for a wide range of European soil types (peaty, sandy, clay). A total of five multi-species studies were available, three of which studied the effects of copper in freshly spiked soils and two in field contaminated aged soils. Invertebrates, plants and micro-organisms were

studied. Single-species and multi-species field studies indicate that effects did not occur at an exposure level at the HC_5 value. See Copper Risk assessment Report

Conclusion: a value of 65.5mg Cu/kg dry weight is the default chronic soil PNEC, to be used to assess local risks. The assessment can be refined if the pH and Cation Exchange Capacity of the local soil is available.

12.1.4 Silver

Based on available data, the classification criteria regarding toxicity of silver to the environment are not met. Data on acute and chronic toxicity of silver ions in the aquatic environment are available for a wide range of freshwater and saltwater species. In most studies, the toxicity of silver ions as the test material was used very well soluble in water, silver nitrate.

Fish:
Acute toxicity:
LC_{50} (96h), Pimephales promelas: 1.2g Ag/L
LC_{50} (96h), Oncorhynchus mykiss: 1.48mg Ag/L
LC_{50} (96h), Salmo gairdneri: 6.5g Ag/L (soft water)
LC_{50} (96h), Salmo gairdneri: 13mg Ag/L (hard water)

Chronic toxicity:
EC_{10} (217d), Salmo trutta: 0.19mg Ag/L
EC_{10} (217d), Salmo trutta: 1.23mg Ag/ L
EC_{10} (196d), Oncorhynchus mykiss: 0.17mg Ag/L
NOEC (32d), Pimephales promelas: 0.351mg Ag/L (stunting)
EC_{10} (32d), Pimephales promelas: 0.39mg Ag/L (stunting)
EC_{10} (32d), Pimephales promelas: 0.44mg Ag/L (mortality)

Crustaceans:
Acute toxicity:
LC_{50} (48 h), Daphnia magna: 0.22mg Ag/L
LC_{50} (48 h), Ceriodaphnia dubia: 0.76mg Ag/L
Chronic Toxicity
EC_{10} (7d), Ceriodaphnia dubia: 2.48mg Ag/L (for reproduction)
EC_{10} (21d), Daphnia magna: 2.14mg Ag/L (stunting)
NOEC (7d), Ceriodaphnia reticulata: 1mg Ag/L (for reproduction)

Algae:
Acute toxicity:
EC_{10} (24h), Chlamydomonas reinhardtii: 0.54mg Ag/L (growth inhibition)
EC_{10} (24h), Pseudokirchneriella subcapitata: 0.41mg Ag/L (growth inhibition)

Chronic Toxicity
NOEC (14 d), Champi parvula: 1.2gAg/L
Predicted concentrations of silver do not cause changes in the environment:
PNEC (surface water): 0.04mg/ L
PNEC (sea water): 0.86mg/L
PNEC (sediment surface): 1.2mg/kg of sludge (dry weight)
PNEC (marine sediments): 1.2mg/kg of sludge (dry weight)

12.1.5 Zinc

Acute toxicity to aquatic environment

The effect on freshwater organisms depends on pH:

For water with low pH: 0.413 mg Zn/L (based on the lowest value for Ceriodaphnia dubia);
For water and a neutral / high pH: 0.136 mg Zn/L (based on the lowest value for Selenastrum capricornutum).
See also Section 8.

Chronic toxicity to aquatic environment

The effect on freshwater organisms depends on pH:

For water at pH 8.0: 19 mg Zn/L (based on data for Pseudokircherniella subcapitata)
For water at pH 6.0, 82 mg Zn/L (based on data for Daphnia magna).

Persistence and degradability

12.2.1 Tin

Not applicable.

12.2.2 Antimony
Antimony cannot be degraded, but may be transformed between different phases, chemical species, and oxidation states. Antimony is therefore considered to be persistent (P) and very persistent (vP) like any other metal.

12.2.3 Copper
“Copper” cannot be degraded, but may be transformed between different phases, chemical species, and oxidation states.

In accordance with the EU 2009 CLP guidance, the fate of the copper ion under “environmentally relevant” conditions was modelled, using the Ticket Unit World Model. Rapid removal from the water column was also assessed using data from one mesocosm and three field studies (Rader et al., 2010). The assessment demonstrated the rapid removal of copper-ions, delivered as soluble copper compounds, from the water column under “normal environmental conditions”. Rapid removal of a substance from the water column is defined as 70% removal within 28 days. Literature data demonstrates the strong binding of copper-ions to sediment materials and especially the anaerobic CuS complexes are very stable (Simpson et al., 1998; Sundelin and Erickson, 2001). The remobilisation of Cu-ions to the water column is therefore not expected. The assessment therefore demonstrates that “copper” does not meet the criterion as “persistent”.

12.2.4 Silver
Silver is a persistent substance.

12.2.5 Zinc
Not applicable.

Bioaccumulative potential

12.3.1 Tin

The potential for bioaccumulation of tin is low.

12.3.2 Antimony
Bioaccumulation of antimony by both aquatic and terrestrial organisms is low. A BCF of 40 has been determined for aquatic organisms and a BSAF of 1 for earthworms. Therefore, antimony is not considered bioaccumulative (B) or very bioaccumulative (vB) based on the definitive criteria.

12.3.3 Copper
The Guidance states the following on Bioaccumulation: “Metals that are essential nutrients are actively regulated: removal and sequestration processes that minimise toxicity are complemented by an ability to up-regulate concentrations for essentiality. As a result, the “bioaccumulative” criterion is not applicable to these metals.”.

12.3.4 Silver
According to the Chemical Safety Report for silver, there are several studies on various organisms. To develop a safety assessment for silver account was taken of the study carried out on carps (Cyprinus carpio), in which fish were exposed to 0.2mg Ag/L for 30 days. The bioconcentration factor (BCF) or coefficient of concentration in the body in relation to its concentration in the ambient aquatic environment for carp was 70. The value of BCF in fish ≥ 500 indicates a capacity for bioconcentration.

12.3.5 Zinc
Because of the homeostatic mechanisms of absorption and excretion, it is estimated that zinc does not bioaccumulate.

12.4 Mobility in soil

12.4.1 Tin

Log Kd: 2.1 - 4.3L/kg.

12.4.2 Antimony
For antimony, a log Kp of 2.07 has been determined for soil.

12.4.3 Copper

Copper ions bind strongly to the soil matrix. The binding depends on the soil properties. A median water-soil partitioning coefficient (Kp) of 2120L/kg has been derived for soils (more details see Copper Risk Assessment Report, 2008 and Copper Chemical Safety Report, 2010).

12.4.4 Silver

Silver ions react in the soil with CO_3^{2-}, S^{2-}, SO_3^{2-} and Cl^- to form extremely sparingly soluble compounds, which therefore remain in the upper layer of soil..

12.4.5 Zinc

No data available.

12.5 Results of PBT and vPvB assessment
The PBT and vPvB criteria of Annex XIII to the Regulation do not apply to inorganic substances.

12.6 Other adverse effects
Silver is one of the most toxic metals for bacteria.

SECTION 13: Disposal Considerations

13.1 Waste treatment methods
Whatever cannot be saved for recovery or recycling should be disposed of according to national legislation complying with the European Waste Directive 2008/98/EC. Do not allow waste to reach drains, ground water, soil or sewage system. Do not send to landfill.

SECTION 14: Transport information

14.1 UN Number: Not classified as dangerous goods.

14.2 UN Proper shipping name: Not classified as dangerous goods.

14.3 Transport hazard class(es): Not classified as dangerous goods.

14.4 Packing group: Not classified as dangerous goods.

14.5 Environmental hazards: Not classified as dangerous goods.

14.6 Special precautions for user: None.

14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code:
Not transported in bulk.

SECTION 15: Regulatory Information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture
The components of this product are not subject to authorisation or restriction.

15.2 Chemical Safety Assessment
Chemical safety assessments have been carried out for the components of this product.

SECTION 16: Other Information

Revision information
Changes from the previous major revision are indicated by a vertical line at the left margin.

Exposure Scenarios
The following Exposure Scenarios are provided in the annex to this safety data sheet:

Exposure Scenario Sn No. 2:	Industrial use of tin in manufacture of solders and other tin-containing alloys with similar melting temperatures, including their use in other articles and manufacturing processes
Exposure Scenario Sn No. 3:	Industrial use of tin solders (including the manufacture of electronic and electrical articles)
Exposure Scenario Sn No. 7:	Industrial use of tin in tin coatings - electrolytic plating
Exposure Scenario Sn No. 8:	Industrial use of tin and tin alloys in tin coatings - hot dip and thermal spraying
Exposure Scenario Sn No. 9:	Industrial use of tin in primary and secondary recovery
Exposure Scenario Sn No. 11:	Consumer exposure to tin metal or tin-containing products
Exposure Scenario Sn No. 12:	Professional exposure to tin metal or tin-containing products

Exposure Scenario Sb No. 5: Use of antimony metal in preparations (including solder)
Exposure Scenario Ag No. 2: Use of silver metal in re-melting and alloying.
Exposure Scenario Ag No. 4: Use of silver metal in electronics, contact materials and electroplating.
Exposure Scenario Ag No. 7: Professional uses of silver metal, silver alloys or silver containing articles.
Exposure Scenario Cu No. 02: Generic scenario for controlling environmental exposure

List of Abbreviations

APF	Assigned Protection Factor
ATO	Antimony Trioxide
AVS	Acid volatile sulphides
BCF	Bioconcentration factor
BLM	Biotic ligand model
BSAF	Biota-Sediment Accumulation Factor
bw	Body weight
B wt	Body weight
CAS No.	Chemical Abstract Service registry number
CLP	Classification Labelling and Packaging Regulation EC 1272/2008
d_{50}	Median diameter
DMEL	Derived Minimal Effect Level
DNEL	Derived No-Effect Level
DOC	Dissolved Organic Carbon
DU	Downstream User
dwt	Dry weight
EC No.	European Community number
EC_{10}	Concentration giving 10% of maximal response
EC_{50}	Concentration giving half maximal response
ECB	European Chemicals Bureau
EUSES	European Union System for the Evaluation of Substance
HC_5	5th percentile of the SSD (Species Sensitivity Distribution)
IBC Code	International Code for the Construction and Equipment of Ships carrying Dangerous

	Chemicals in Bulk
Kd	Sorption coefficient
Kp	Sorption coefficient
LC_{50}	Lethal concentration to 50% of the test organisms
LD_{50}	Lethal dose to 50% of the test organisms
LOEC	Lowest observed effect concentratio
MARPOL 73/78	International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978
MEASE	Model for Estimation and Assessment of Substance Exposure
NOAEC	No Observed Adverse Effect Concentration
NOAEL	No Observed Adverse Effect Level
NOEC	No Observed Effect Concentration
NOEL	No Observed Effect Level
PBT	Persistent, bioaccumulative and toxic
PNEC	Predicted No-Effect Level
PPE	Personal Protection Equipment
PSP	Postsynaptic Potential
RCR	Risk Characterisation Ratio
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals Regulation EC 1907/2006
RPE	Respiratory Protective Equipment
SDS	Safety Data Sheet
STEL	Short Term Exposure Limit
STOT	Specific Target Organ Toxicity
STP	Sewage Treatment Plant
TDL_0	Lowest dose with toxic effect
TGD	Technical Guidance Document
TWA	Time Weighted Average
VLCT	Valeur Limite Courte Terme
VLE	Valeur Limite d'Exposition
VME	Valeur Moyenne d'Exposition
vPvB	Very Persistent Very Bio-accumulative
wwt	Wet weight

Method of evaluation

This product has not been tested. Data for the components of this product are conclusive and insufficient for classification. Based on available data, the classification criteria are not met

Classification according to CLP Regulation

Classification Labelling and Packaging Regulation EC 1272/2008 - Not classified as hazardous.

Legal Statement

ES Sn No. 2: Industrial use of tin in the manufacture of tin solders and other tin based alloys with similar melting temperatures, including their use in other articles and manufacturing processes.

1. Title	
Free short title	*Industrial use of tin in the manufacture of solders and other tin containing alloys with similar melting temperatures, including their use in other articles and manufacturing processes*
Systematic title based on use descriptor	*Industrial use of tin in the manufacture if base metals and alloys for the manufacture of solder (PROC 1, 5, 8a, 8b, 9, 14, 19, 21, 22, 23,26, 27a) for use in vehicles, machinery, mechanical appliances, electrical/electronic articles, electrical batteries and accumulators* *ERC 2 (formulation of preparations), 3 (formulation in materials), 10a (wide dispersive outdoor use of long-life articles and materials with low release) and 12a (industrial processing of articles with abrasive techniques (high release))*
Processes, tasks activities covered	• *Handling and transport of massive metal* • *Handling or use of molten metal bath* • *Alloy production* • *Manual casting* • *Machine casting of ingot, bar or billets. Continuous casting of billet, rod or strip* • *Rolling* • *Extrusion* • *Wire drawing and spooling* • *Other cold working processes e.g. stamping forging, swaging* • *Annealing or other heat treating processes* • *Drilling, boring, milling and turning* • *Atomising/Other powder forming processes* • *Sieving* • *Weighing and packing of powder* • *Open powder containers and adding powder to paste mixing vessel* • *Mixing paste* • *Filling paste containers with product* • *Centrifugal and manual casting of metal into rubber moulds* • *Manual casting – investment casting* • *Rolling or roll bonding* • *Grinding, polishing or buffing* • *Pressing and sintering of powder*
2. Operational conditions and risk management measures	
The industrial use of tin in manufacture of solders and other tin containing alloys with similar melting temperatures, including their use in other articles and manufacturing processes involves a number of tasks as detailed above. These tasks are both open and closed processes and are performed at a number of temperatures (from ambient to 600 ºC) with different levels of exposure (from 15 mins to >4 hours over a 8 hour shift).	
2.1 Control of workers exposure	
Product characteristic	
For the following uses/PROC codes, the substance is available as a solid with low dustiness: • *PROC 1, 5, 14 and 21* *For the following uses/PROC codes, the substance is available as a solid with medium dustiness:* • *PROC 8a, 22, 23, 26 and 27* *For the following uses/PROC codes, the substance is available as a liquid:* • *PROC 19*	

Frequency and duration of use/exposure

All process occur for the following duration:

- *Handling and transport of massive metal: 15 mins - 4 hours*
- *Handling or use of molten metal bath: 1-4 hours*
- *Alloy production: 1-4 hours*
- *Manual casting: >4 hours*
- *Machine casting of ingot, bar or billets. Continuous casting of billet, rod or strip: 1 – 4 hours*
- *Cold rolling: >4 hours*
- *Extrusion: > 4 hours*
- *Wire drawing and spooling: >4 hours*
- *Other cold working processes (e.g. stamping or forging): >4 hours*
- *Annealing or other heat treating processes: <1 hour*
- *Drilling, boring, milling and turning: >4 hours*
- *Atomising/Other powder forming processes: >4 hours*
- *Sieving: > 4 hours*
- *Weighing and packing of powder: >4 hours*
- *Open powder containers and adding powder to paste mixing vessel: 15 mins - 1 hour*
- *Mixing paste: 1 – 4 hours*
- *Filling paste containers with product: >4 hours*
- *Centrifugal and manual casting of metal into rubber moulds: >4 hours*
- *Manual casting – investment casting: >4 hours*
- *Stamping: > 4 hours*
- *Rolling or roll bonding: > 4 hours*
- *Grinding or polishing or buffing: 1-4 hours*

Human factors not influenced by risk management

Not applicable.

Other given operational conditions affecting workers exposure

All processes occur indoor at the following temperatures:

- *Handling and transport of massive metal: Ambient*
- *Handling or use of molten metal bath: <400 ºC*
- *Alloy production: up to 600 ºC*
- *Manual casting: <350 - >550 ºC*
- *Machine casting of ingot, bar or billets. Continuous casting of billet, rod or strip: <350 - >550 ºC*
- *Cold rolling: <150 ºC*
- *Extrusion: <150 ºC*
- *Wire drawing and spooling: <60 ºC*
- *Other cold working processes (e.g. stamping or forging): Ambient*
- *Annealing or other heat treating processes: <150 ºC*
- *Drilling, boring, milling and turning: Ambient*
- *Atomising/Other powder forming processes: <350 ºC*
- *Sieving: Ambient*
- *Weighing and packing of powder: Ambient*
- *Pressing and sintering of powder: >400 ºC*
- *Open powder containers and adding powder to paste mixing vessel: Ambient*
- *Mixing paste: <50 ºC*
- *Filling paste containers with product: Ambient*
- *Centrifugal and manual casting of metal into rubber moulds: <300ºC*
- *Manual casting – investment casting: <400 ºC*
- *Rolling or roll bonding: <150 ºC*

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

Not applicable

Technical conditions and measures to control dispersion from source towards the worker

Local Exhaust Ventilation is required for the following tasks:

- *Handling or use of molten metal bath*
- *Alloy production*
- *Manual casting (larger scale facilities)*
- *Machine casting of ingot, bar or billets. Continuous casting of billet, rod or strip (larger scale facilities)*
- *Extrusion*
- *Atomising/Other powder forming processes*
- *Sieving*
- *Weighing and packing of powder*
- *Open powder containers and adding powder to paste mixing vessel*
- *Centrifugal and manual casting of metal into rubber moulds*
- *Manual casting – investment casting*

Organisational measures to prevent /limit releases, dispersion and exposure

Not applicable

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

- *Handling or use of molten metal bath – workers must wear suitable protective gloves. Eye protection (goggles) must be worn in all areas where there is a risk from molten metal. Respiratory protective equipment must be used when handling dross*
- *Alloy production – workers must wear suitable protective gloves and eye protection (goggles). Suitable respiratory protective equipment must be used when working on dusty processes*
- *Manual casting – workers must wear gloves and eye protection (goggles)*
- *Machine casting of ingot, bar or billets. Continuous casting of billet, rod or strip – workers must wear suitable protective gloves and eye protection (goggles)*
- *Cold rolling – workers must wear suitable protective gloves*
- *Extrusion - workers must wear suitable protective gloves. Eye protection (goggles) must be worn if risk of hotshortness or working with molten alloy charging of the container*
- *Annealing or other heat treatment processes - workers must wear suitable protective gloves*
- *Drilling, boring, milling and tuning – workers must wear eye protection (goggles)*
- *Atomising/Other powder forming processes – workers must wear suitable protective gloves and respiratory protective equipment. Eye protection must be used when working with molten metal*
- *Sieving – workers must wear suitable protective gloves and respiratory protective equipment*
- *Weighing and packing of powder- workers must wear suitable protective gloves and respiratory protective equipment*
- *Pressing and sintering of powder – workers must wear suitable protective gloves and eye protection (goggles). Suitable respiratory protective equipment must be worn if workers are exposed to powder during the loading process*
- *Open powder containers and adding powder to paste mixing vessel – workers must wear suitable protective gloves and respiratory protective equipment*
- *Mixing paste – workers must wear suitable protective gloves*
- *Filling paste containers with product – workers must wear suitable protective gloves*
- *Centrifugal and manual casting of metal into rubber moulds – workers must wear suitable protective gloves and eye protection (goggles)*
- *Manual casting (investment casting) - workers must wear suitable protective gloves and eye protection (goggles)*

2.2 Control of environmental exposure

Amounts used

Modelled EU tonnage 20000tpa. Modelled site tonnage 600 tpa

Frequency and duration of use

Continuous, 225 days/year

Environment factors not influenced by risk management
Default data for receiving water and for the municipal sewage treatment plant are18 000 m3/d and 2000 m3/d, respectively (resulting dilution factor 10). For marine assessments an additional tenfold dilution is assumed.
Other given operational conditions affecting environmental exposure
Open and closed systems, wet and dry processes
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil
SPERC fact sheet – Formulation of massive metal or metal powder in alloys, version 1.1 *Modelled release factors to air 0.007% (after RMM), water 0.003%(after on-site RMM)), soil 0%.*
Conditions and measures related to municipal sewage treatment plant
EUSES default STP with primary settler with effluent discharge rate 2000000l/d, serving 10000 inhabitants. Zero degradation assumed. 90.3% to sludge, 9.7% to water calculated in EUSES based on partition coefficients. Sludge assumed to be spread to agricultural land.
Conditions and measures related to external treatment of waste for disposal
External treatment and disposal of waste should comply with applicable local and/or national regulations.
Conditions and measures related to external recovery of waste
External recovery and recycling of waste should comply with applicable local and/or national regulations.
3. Exposure estimation and reference to its source
All exposure estimates for human health show risk characterisation ratios below the value of 1 and so all uses covered by this Exposure Scenario are considered to be safe for human health. *A quantitative risk assessment is not required for the environment as there is no basis for setting a PNEC. In addition, this substance is not classified as hazardous to the environment. A qualitative assessment has been applied. A review of these RMMs indicates that if the user complies with the following generic statements, risks to the environment can be considered to be adequately controlled: Avoid release to the environment.*
4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES
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.
Additional good practice advice beyond the REACH CSA
Use specific measures expected to reduce the predicted exposure beyond the level estimated based on the exposure scenario.

ES Sn No. 3: Industrial use of tin solders

1. Title	
Free short title	*Industrial use of tin solders (including the manufacture of electronic and electrical articles)*
Systematic title based on use descriptor	*Industrial use of tin solder for the manufacture of computer, electronic and optical products, electrical equipment, general manufacturing and building and construction work (PROC 8a, 8b, 9, 22, 23, 25, 26)* *ERC 5 (industrial use resulting in inclusion into or onto a matrix)*
Processes, tasks activities covered	• *Handling of solder alloys* • *Handling and transport of metal pastes* • *Re-melting of tin alloy* • *Hand soldering with soldering iron* • *Machine soldering with soldering iron* • *Hand soldering and tinning with gas torch* • *Machine soldering with gas torch* • *Wave soldering* • *Reflow soldering* • *Printing of paste (for reflow soldering)* • *Oven or furnace soldering up to 425 ºC* • *Induction soldering* • *Resistance soldering* • *Laser soldering*

2. Operational conditions and risk management measures

The industrial use of tin in the industrial use of tin solders involves a number of tasks as detailed above. These tasks are both open and closed processes and are performed at a number of temperatures (from ambient to 400 ºC) with different levels of exposure (from <1 hour to up to 8 hours).

2.1 Control of workers exposure

Product characteristic

For all PROC codes covered by this Exposure Scenario the substance is available as a solid with medium dustiness.

Frequency and duration of use/exposure

All process occur for the following duration:

- *Handling of solder alloys: <1 hour*
- *Handling and transport of metal pastes:<1 hour*
- *Re-melting of tin alloy:<1 hour*
- *Hand soldering with soldering iron: 1-4 hours*
- *Machine soldering with soldering iron: 1-4 hours*
- *Hand soldering with gas torch: <1 hour*
- *Machine soldering with gas torch: <1 hour*
- *Wave soldering: <1 hour*
- *Reflow soldering: <1 hour*
- *Printing of paste (for reflow soldering): up to 8 hours*
- *Oven or furnace soldering: 1-4 hours*
- *Induction soldering: < 1hour*
- *Resistance soldering: < 1 hour*
- *Laser soldering: < 1 hour*

Human factors not influenced by risk management

Not applicable.

Other given operational conditions affecting workers exposure

All processes occur indoor at the following temperatures:

- *Handling of solder alloys: ambient*
- *Handling and transport of metal pastes: ambient*
- *Re-melting of tin alloy: <400 ºC*
- *Hand soldering with soldering iron: ≤400 ºC*
- *Machine soldering with soldering iron: ≤400 ºC*
- *Hand soldering with gas torch: ≤400 ºC*
- *Machine soldering with gas torch: ≤400 ºC*
- *Wave soldering: ≤300 ºC*
- *Reflow soldering: ≤250 ºC*
- *Printing of paste (for reflow soldering): ambient*
- *Oven or furnace soldering >425 ºC*
- *Induction soldering: ≤400 ºC*
- *Resistance soldering: ≤400 ºC*
- *Laser soldering: ≤400 ºC*

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

Not applicable

Technical conditions and measures to control dispersion from source towards the worker

Local Exhaust Ventilation is required for the following tasks:

- *Re-melting of tin alloy: Required for larger scale operations only.*
- *Hand soldering with soldering iron*
- *Machine soldering with soldering iron*
- *Hand soldering with gas torch: LEV is not required however this activity should be performed with adequate ventilation.*
- *Machine soldering with gas torch*
- *Wave soldering*
- *Reflow soldering*
- *Oven or furnace soldering*
- *Induction soldering*
- *Resistance soldering*
- *Laser soldering*

Organisational measures to prevent /limit releases, dispersion and exposure

Not applicable

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

- *Handling of solder alloys – workers must wear suitable protective gloves*
- *Handling and transport of metal pastes –workers must wear suitable protective gloves if handling paste*
- *Re-melting of tin alloy – workers must wear suitable protective gloves and eye protection(goggles). Suitable respiratory protective equipment must be worn when removing dross*
- *Hand soldering with soldering iron – workers must wear suitable eye protection (goggles)*
- *Machine soldering with soldering iron – workers must wear suitable protective eye protection (goggles) if in close proximity to machine soldering.*
- *Hand soldering with gas torch – workers must wear suitable protective gloves and eye protection(goggles)*
- *Machine soldering with gas torch – workers must wear suitable protective gloves and eye protection (goggles*
- *Wave soldering – workers must wear suitable protective gloves and eye protection (goggles). Suitable respiratory protective equipment may be worn when removing dross*
- *Reflow soldering – workers must wear suitable protective gloves*
- *Printing of paste (for reflow soldering) – workers must wear suitable protective gloves and eye protection (goggles)*
- *Oven or furnace soldering – workers must wear suitable protective gloves and eye protection (goggles)*

- *Induction soldering – workers must wear suitable protective gloves and eye protection (goggles)*
- *Resistance soldering - workers must wear suitable protective gloves and eye protection (goggles)*
- *Laser soldering - workers must wear suitable protective gloves and eye protection (goggles)*

2.2 Control of environmental exposure

Amounts used

Modelled EU tonnage 17500tpa. Modelled site tonnage 600 tpa

Frequency and duration of use

Continuous, 215 days/year

Environment factors not influenced by risk management

Default data for receiving water and for the municipal sewage treatment plant are18 000 m3/d and 2000 m3/d, respectively (resulting dilution factor 10). For marine assessments an additional tenfold dilution is assumed.

Other given operational conditions affecting environmental exposure

Not applicable

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

SPERC fact sheet – Use of metals and metal compounds in metallic coatings, version 1.1
Modelled release factors to air 0.4% (after RMM), water 0.6%(after on-site RMM)), soil 0%.

Conditions and measures related to municipal sewage treatment plant

EUSES default STP with primary settler with effluent discharge rate 2000000l/d, serving 10000 inhabitants. Zero degradation assumed. 90.3% to sludge, 9.7% to water calculated in EUSES based on partition coefficients. Sludge assumed to be spread to agricultural land.

Conditions and measures related to external treatment of waste for disposal

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

Conditions and measures related to external recovery of waste

External recovery and recycling of waste should comply with applicable local and/or national regulations.

3. Exposure estimation and reference to its source

All exposure estimates for human health show risk characterisation ratios below the value of 1 and so all uses covered by this Exposure Scenario are considered to be safe for human health.

A quantitative risk assessment is not required for the environment as there is no basis for setting a PNEC. In addition, this substance is not classified as hazardous to the environment. A qualitative assessment has been applied. A review of these RMMs indicates that if the user complies with the following generic statements, risks to the environment can be considered to be adequately controlled: Avoid release to the environment.

4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES

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.

Additional good practice advice beyond the REACH CSA

Use specific measures expected to reduce the predicted exposure beyond the level estimated based on the exposure scenario.

ES Sn No. 7: Industrial use of tin in tin coatings - electrolytic plating

1. Title	
Free short title	*Industrial use of tin in tin coatings - electrolytic plating*
Systematic title based on use descriptor	*Industrial use of tin in tin plating using electrolytic plating for the manufacture of tin plate for food cans, beverage cans, aerosols, closures, general line containers, battery blanks, electronic shielding, Automative fillers, copper pipes, food processing equipment; manufacture of tin nickel for: electronics, domestic building and leisure, precision and general engineering, chemical process and food industries, medical and dentistry uses, energy uses; manufacture of tin zinc for automative roofing; manufacture of tin copper for red and yellow bronze/white bronze speculum; manufacture of copper-tin-zinc for decorative and electronics (PROC 3, 8a, 8b, 9, 13,14, 21, 22, 23, 26)for use in vehicles, machinery, mechanical appliances, electrical/electronic articles and metal articles* *ERC 2 (formulation of preparations), 3 (formulation in materials) and 5 (industrial use resulting in inclusion into or onto a matrix)*
Processes, tasks activities covered	• *Electrolytic tinning/plating*
2. Operational conditions and risk management measures	
The industrial use of tin in tin coatings (electrolytic plating) involves the task detailed above. This task is both an open and closed process and is performed at>100 850 ºC)and at > 4 hours exposure	
2.1 Control of workers exposure	
Product characteristic	
For the majority of the uses/PROC codes covered by this Exposure Scenario the substance is available as a solid with low dustiness. *For the following uses/PROC codes, the substance is available as a liquid:* • *manufacture of Copper-Tin-Zinc - Decorative & Electronics – PROC 3*	
Frequency and duration of use/exposure	
All process occur for the following duration: • *Electrolytic tinning/plating: >4 hours*	
Human factors not influenced by risk management	
Not applicable.	
Other given operational conditions affecting workers exposure	
All processes occur indoor at the following temperatures: • *Electrolytic tinning/plating: <100 ºC*	
Technical conditions and measures at process level (source) to prevent release	
Not applicable	
Technical conditions and measures to control dispersion from source towards the worker	
Local Exhaust Ventilation is not required for this task	
Organisational measures to prevent /limit releases, dispersion and exposure	
Not applicable	
Conditions and measures related to personal protection, hygiene and health evaluation	
• *Electrolytic tinning/plating – gloves and eye protection (goggles) must be worn*	

2.2 Control of environmental exposure
Amounts used
Modelled EU tonnage 20000tpa. Modelled site tonnage 4500 tpa
Frequency and duration of use
Continuous, 215 days/year
Environment factors not influenced by risk management
Default data for receiving water and for the municipal sewage treatment plant are18 000 m3/d and 2000 m3/d, respectively (resulting dilution factor 10). For marine assessments an additional tenfold dilution is assumed.
Other given operational conditions affecting environmental exposure
Not applicable
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil
SPERC fact sheet – Use of metals and metal compounds in metallic coatings, version 1.1 *Modelled release factors to air 0.4% (after RMM), water 0.6%(after on-site RMM)), soil 0%.*
Conditions and measures related to municipal sewage treatment plant
EUSES default STP with primary settler with effluent discharge rate 2000000l/d, serving 10000 inhabitants. Zero degradation assumed. 90.3% to sludge, 9.7% to water calculated in EUSES based on partition coefficients. Sludge assumed to be spread to agricultural land.
Conditions and measures related to external treatment of waste for disposal
External treatment and disposal of waste should comply with applicable local and/or national regulations.
Conditions and measures related to external recovery of waste
External recovery and recycling of waste should comply with applicable local and/or national regulations.
3. Exposure estimation and reference to its source
All exposure estimates for human health show risk characterisation ratios below the value of 1 and so all uses covered by this Exposure Scenario are considered to be safe for human health. *A quantitative risk assessment is not required for the environment as there is no basis for setting a PNEC. In addition, this substance is not classified as hazardous to the environment. A qualitative assessment has been applied. A review of these RMMs indicates that if the user complies with the following generic statements, risks to the environment can be considered to be adequately controlled: Avoid release to the environment.*
4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES
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.
Additional good practice advice beyond the REACH CSA
Use specific measures expected to reduce the predicted exposure beyond the level estimated based on the exposure scenario.

ES Sn No. 8: Industrial use of tin and tin alloys in tin coatings - hot dip and thermal spraying

1. Title	
Free short title	*Industrial use of tin and tin alloys in tin coatings – hot dip and thermal spraying*
Systematic title based on use descriptor	*Industrial use of tin in tin coatings using hot dip and thermal spraying for zinc galvanising (PROC 3, 8a, 8b, 9, 13, 22, 23, 26) and the manufacture and use of alloy for thermal spray (PROC 7, 14, 19, 21, 22, 23, 26, 27a for use in vehicles, machinery, mechanical appliances, electrical/electronic articles and metal articles)* *ERC 2 (formulation of preparations), 3 (formulation in materials) and 5 (industrial use resulting in inclusion into or onto a matrix)*
Processes, tasks activities covered	• *Handling and transport of massive metal* • *Handling or use of molten metal bath >400 ºC* • *Alloy production* • *Manual casting of alloys* • *Machine casting of alloys* • *Hot dipping and immersion soldering* • *Solder coating processes for fine wires* • *Handling of alloy* • *Spraying*
2. Operational conditions and risk management measures	
The industrial use of tin in tin coatings (hot dip and thermal spraying) involves a number of tasks as detailed above. These tasks are both open and closed processes and are performed at a number of temperatures up to 475 ºC with different levels of exposure (from 1-4 hours to up to 4 hours).	
2.1 Control of workers exposure	
Product characteristic	
For the majority of the uses/PROC codes covered by this Exposure Scenario the substance is available as a solid with low dustiness. *For the following uses/PROC codes, the substance is available as a solid with medium dustiness:* • *Manufacture and Use of Alloy for thermal spray – PROC 19, 22, 23, 26, 27a.* *For the following uses/PROC codes, the substance is available as a liquid:* • *Zinc Galvanising – PROC 3, 8a, 8b, 9, 13.* • *Manufacture and Use of Alloy for thermal spray – PROC 7.*	
Frequency and duration of use/exposure	
All process occur for the following duration: • *Handling and transport of massive metal: 1-4 hours* • *Handling or use of molten metal bath >400 ºC: up to 4 hours* • *Alloy production: 1-4 hours* • *Machine casting of alloys: 1-4 hours* • *Mould casting of alloys: 1-4 hours* • *Hot dipping and immersion soldering: >4 hours* • *Solder coating processes for fine wires: 1-4 hours* • *Handling of alloy:1-4 hours* • *Spraying: 1-4 hours*	
Human factors not influenced by risk management	
Not applicable.	

Other given operational conditions affecting workers exposure

All processes occur indoor at the following temperatures:

- *Handling and transport of massive metal: Ambient*
- *Handling or use of molten metal bath >400 ºC: up to 550 ºC*
- *Alloy production: up to 500 ºC*
- *Machine casting of alloys: up to 500 ºC*
- *Mould casting of alloys: up to 500ºC*
- *Hot dipping and immersion soldering: up to 475 ºC*
- *Solder coating processes for fine wires: up to 450 ºC*
- *Handling of alloy: Ambient*
- *Spraying: up to 400 ºC*

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

Not applicable

Technical conditions and measures to control dispersion from source towards the worker

Local Exhaust Ventilation is required for the following tasks:

- *Handling or use of molten metal bath >400 ºC*
- *Alloy production*
- *Permanent mould casting*
- *Hot dipping (Galvanising)*
- *Immersion tinning or solder coating, includes tern coating*
- *Solder coating processes for fine wires*
- *Spraying*

Organisational measures to prevent /limit releases, dispersion and exposure

Not applicable

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

- *Handling and transport of massive metal – workers must wear suitable protective gloves and eye protection (goggles)*
- *Handling or use of molten metal bath >400 ºC – workers must wear suitable protective gloves, eye protection (goggles) and respiratory protective equipment*
- *Alloy production – workers must wear suitable protective gloves, eye protection (goggles) and respiratory protective equipment*
- *Manual casting of alloys - workers must wear suitable protective gloves and eye protection (goggles)*
- *Machine casting of alloys - workers must wear suitable protective gloves and eye protection (goggles)*
- *Hot dipping and immersion soldering – workers must wear suitable protective gloves and eye protection (goggles)*
- *Solder coating processes for fine wires – workers must wear suitable protective gloves*
- *Spraying - workers must wear suitable protective gloves and eye protection (goggles). Suitable respiratory protective equipment must be worn if LEV is insufficient*

2.2 Control of environmental exposure

Amounts used

Modelled EU tonnage 50 tpa. Modelled site tonnage 5 tpa

Frequency and duration of use

Continuous, 215 days/year

Environment factors not influenced by risk management

Default data for receiving water and for the municipal sewage treatment plant are18 000 m3/d and 2000 m3/d, respectively (resulting dilution factor 10). For marine assessments an additional tenfold dilution is assumed.

Other given operational conditions affecting environmental exposure
Not applicable
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil
SPERC fact sheet – Use of metals and metal compounds in metallic coatings, version 1.1 *Modelled release factors to air 0.4% (after RMM), water 0.6%(after on-site RMM)), soil 0%.*
Conditions and measures related to municipal sewage treatment plant
EUSES default STP with primary settler with effluent discharge rate 2000000l/d, serving 10000 inhabitants. Zero degradation assumed. 90.3% to sludge, 9.7% to water calculated in EUSES based on partition coefficients. Sludge assumed to be spread to agricultural land.
Conditions and measures related to external treatment of waste for disposal
External treatment and disposal of waste should comply with applicable local and/or national regulations.
Conditions and measures related to external recovery of waste
External recovery and recycling of waste should comply with applicable local and/or national regulations.
3. Exposure estimation and reference to its source
All exposure estimates for human health show risk characterisation ratios below the value of 1 and so all uses covered by this Exposure Scenario are considered to be safe for human health. *A quantitative risk assessment is not required for the environment as there is no basis for setting a PNEC. In addition, this substance is not classified as hazardous to the environment. A qualitative assessment has been applied. A review of these RMMs indicates that if the user complies with the following generic statements, risks to the environment can be considered to be adequately controlled: Avoid release to the environment.*
4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES
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.
Additional good practice advice beyond the REACH CSA
Use specific measures expected to reduce the predicted exposure beyond the level estimated based on the exposure scenario.

ES Sn No. 9: Industrial use of tin in primary and secondary recovery

1. Title	
Free short title	*Industrial use of tin in primary and secondary recovery*
Systematic title based on use descriptor	*Industrial manufacture of basic metals, including alloys through primary end-of-life recovery (PROC 1, 2, 3, 4, 8b, 9, 22, 23, 26).* *ERC 1 (manufacture of substances)*
Processes, tasks activities covered	• *Scrap metal handling* • *Scrap metal processing i.e. shredding, separation, etc.* • *Handling of other scrap material* • *Secondary smelting* • *Pyrochemical refining* • *Liquidation refining* • *Vacuum distillation* • *Electrolytic refining*

2. Operational conditions and risk management measures

The industrial use of tin in primary and secondary recovery involves a number of tasks as detailed above. These tasks are both open and closed processes and are performed at a number of temperatures (from <70 to <1200 ºC) with exposure at >4 hours.

2.1 Control of workers exposure

Product characteristic

For the majority of the uses/PROC codes covered by this Exposure Scenario the substance is available as a solid with medium dustiness except for PROC 1 and 2 where the substance is available as a liquid.

Frequency and duration of use/exposure

All process occur for the following duration:

- *Scrap metal handling: >4 hours*
- *Scrap metal processing i.e. shredding, separation, etc: >4 hours*
- *Handling of other scrap material: >4 hours*
- *Secondary smelting: >4 hours*
- *Pyrochemical refining: >4 hours*
- *Liquidation refining: >4 hours*
- *Vacuum distillation: >4 hours*
- *Electrolytic refining: >4 hours*

Human factors not influenced by risk management

Not applicable.

Other given operational conditions affecting workers exposure

All processes occur indoor at the following temperatures:

- *Scrap metal handling: Ambient*
- *Scrap metal processing i.e. shredding, separation, etc: up to 150 ºC*
- *Handling of other scrap material: Ambient*
- *Secondary smelting: up to 1200 ºC*
- *Pyrochemical refining: up to 660 ºC*
- *Liquidation refining: up to 300 ºC*
- *Vacuum distillation: up to 1400 ºC*
- *Electrolytic refining: up to 70 ºC*

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

Not applicable

Technical conditions and measures to control dispersion from source towards the worker

Local Exhaust Ventilation is required for the following tasks:

- *Secondary smelting*
- *Pyrochemical refining*
- *Liquidation refining*
- *Vacuum distillation*

Organisational measures to prevent /limit releases, dispersion and exposure

Not applicable

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

- *Scrap metal handling – gloves and eye protection (goggles) must be worn. Respiratory protective equipment must be worn when handling dusty material or in a dusty environment*
- *Scrap metal processing i.e. shredding, separation, etc – gloves and eye protection (goggles) must be worn. Respiratory protective equipment must be worn when handling dusty material or in a dusty environment*
- *Handling of other scrap material – gloves, eye protection (goggles) and respiratory protective equipment must be worn*
- *Secondary smelting – gloves, eye protection (goggles) and respiratory protective equipment must be worn*
- *Pyrochemical refining – gloves and eye protection (goggles) must be worn. Respiratory protective equipment must be worn when removing drosses or working close to molten alloy*
- *Liquidation refining – gloves and eye protection (goggles) must be worn. Respiratory protective equipment must be worn when removing drosses or working close to molten alloy*
- *Vacuum distillation – gloves and eye protection (goggles) must be worn. Respiratory protective equipment must be worn when working with hot, open furnace*
- *Electrolytic refining – gloves and eye protection (goggles) must be worn*

2.2 Control of environmental exposure

Amounts used

Modelled EU tonnage 15000 tpa. Modelled site tonnage 12000 tpa

Frequency and duration of use

Continuous, 220 days/year

Environment factors not influenced by risk management

Default data for receiving water and for the municipal sewage treatment plant are18 000 m3/d and 2000 m3/d, respectively (resulting dilution factor 10). For marine assessments an additional tenfold dilution is assumed.

Other given operational conditions affecting environmental exposure

Open and closed systems, wet and dry processes

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

SPERC fact sheet – Manufacture and recycling of massive metal and metal powder, version 1.2
Modelled release factors to air 0.03% (after RMM), water 0.01%(after on-site RMM)), soil 0%.

Conditions and measures related to municipal sewage treatment plant

EUSES default STP with primary settler with effluent discharge rate 2000000l/d, serving 10000 inhabitants. Zero degradation assumed. 90.3% to sludge, 9.7% to water calculated in EUSES based on partition coefficients. Sludge assumed to be spread to agricultural land.

Conditions and measures related to external treatment of waste for disposal

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

Conditions and measures related to external recovery of waste

External recovery and recycling of waste should comply with applicable local and/or national regulations.

3. Exposure estimation and reference to its source
All exposure estimates for human health show risk characterisation ratios below the value of 1 and so all uses covered by this Exposure Scenario are considered to be safe for human health. *A quantitative risk assessment is not required for the environment as there is no basis for setting a PNEC. In addition, this substance is not classified as hazardous to the environment. A qualitative assessment has been applied. A review of these RMMs indicates that if the user complies with the following generic statements, risks to the environment can be considered to be adequately controlled: Avoid release to the environment.*
4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES
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.
Additional good practice advice beyond the REACH CSA
Use specific measures expected to reduce the predicted exposure beyond the level estimated based on the exposure scenario.

ES Sn No. 11: Consumer exposure to tin metal or tin containing products

1. Title	
Free short title	*Consumer exposure to tin metal or tin containing products*
Systematic title based on use descriptor	*Consumer use of base metals, alloys and metal surface treatment products in vehicles, machinery, mechanical appliances, electrical/electronic articles, electrical batteries and accumulators and metal articles* *ERC 8c (wide dispersive indoor use resulting in inclusion into or onto a matrix), 8f (wide dispersive outdoor use resulting in inclusion into or onto a matrix), 10a (wide dispersive outdoor use of long-life articles and materials with low release) and 11a (wide dispersive indoor use of long-life articles and materials with low release)*
2. Operational conditions and risk management measures	
The consumer use of tin or tin containing products occurs via consumer interaction with tin-containing articles	
2.1 Control of consumers exposure	
Product characteristic	
Consumers will be exposed to tin via 'massive solid' articles in articles such as vehicles, machinery, mechanical appliances, electrical/electronic articles, electrical batteries and accumulators	
Amounts used	
No information availabl	
Frequency and duration of use/exposure	
No information available	
Human factors not influenced by risk management	
No information available	
Other given operational conditions affecting consumers exposure	
Not applicable	
Conditions and measures related to information and behavioural advice to consumers	
Not applicable	
Conditions and measures related to personal protection and hygiene	
Not applicable	
2.2 Control of environmental exposure	
Amounts used*	
*Based on a EU tonnage of 15000 tpa and equation given in R.16 (EU tonnage/10/2000*4) the modelled tonnage is 3 tpa/typical STP. This therefore covers the combined risk from all uses (professional and consumer) of tin containing products and articles.*	
Frequency and duration of use	
Continuous, 365 days/year	
Environment factors not influenced by risk management	
Default data for receiving water and for the municipal sewage treatment plant are18 000 m3/d and 2000 m3/d, respectively (resulting dilution factor 10). For marine assessments an additional tenfold dilution is assumed.	
Other given operational conditions affecting environmental exposure	
ERC – highest emission from relevant ERC *Modelled release factors to air 15%, water 3.2%, soil 3.2%.*	

Conditions and measures related to municipal sewage treatment plant
EUSES default STP with primary settler with effluent discharge rate 2000000l/d, serving 10000 inhabitants. Zero degradation assumed. 90.3% to sludge, 9.7% to water calculated in EUSES based on partition coefficients. Sludge assumed to be spread to agricultural land.
Conditions and measures related to external treatment of waste for disposal
External treatment and disposal of waste should comply with applicable local and/or national regulations.
Conditions and measures related to external recovery of waste
External recovery and recycling of waste should comply with applicable local and/or national regulations.
3. Exposure estimation and reference to its source
Consumer exposure to tin is likely to occur via the use of articles *A quantitative risk assessment is not required for the environment as there is no basis for setting a PNEC. In addition, this substance is not classified as hazardous to the environment. A qualitative assessment has been applied. A review of these RMMs indicates that if the user complies with the following generic statements, risks to the environment can be considered to be adequately controlled: Avoid release to the environment.*
4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES
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.

ES Sn No. 12: Professional exposure to tin metal or tin containing products

1. Title	
Free short title	*Professional exposure to tin metal or tin containing products*
Systematic title based on use descriptor	*Professional use to tin or tin containing products as base metals, alloys and metal surface treatment products in vehicles, machinery, mechanical appliances, electrical/electronic articles, electrical batteries and accumulators and metal articles (PROC 4, 9, 14, 21, 22, 23, 25, 26)* *ERC 8c (wide dispersive indoor use resulting in inclusion into or onto a matrix), 8f (wide dispersive outdoor use resulting in inclusion into or onto a matrix), 10a (wide dispersive outdoor use of long-life articles and materials with low release) and 11a (wide dispersive indoor use of long-life articles and materials with low release)*
Processes, tasks activities covered	*No information available*
2. Operational conditions and risk management measures	
The professional use of tin or tin containing products includes both open and closed processes	
2.1 Control of workers exposure	
Product characteristic	
For the uses/PROC codes covered by this Exposure Scenario the substance is available as a solid with low dustiness	
Frequency and duration of use/exposure	
No information available	
Human factors not influenced by risk management	
Not applicable.	
Other given operational conditions affecting workers exposure	
No information available	
Technical conditions and measures at process level (source) to prevent release	
Not applicable	
Technical conditions and measures to control dispersion from source towards the worker	
No information available	
Organisational measures to prevent /limit releases, dispersion and exposure	
Not applicable	
Conditions and measures related to personal protection, hygiene and health evaluation	
No information available	
2.2 Control of environmental exposure	
Amounts used	
*Based on a EU tonnage of 15000 tpa and equation given in R.16 (EU tonnage/10/2000*4) the modelled tonnage is 3 tpa/typical STP. This therefore covers the combined risk from all uses (professional and consumer) of tin containing products and articles.*	
Frequency and duration of use	
Continuous, 365 days/year	
Environment factors not influenced by risk management	
Default data for receiving water and for the municipal sewage treatment plant are18 000 m3/d and 2000 m3/d, respectively (resulting dilution factor 10). For marine assessments an additional tenfold dilution is assumed.	

Other given operational conditions affecting environmental exposure
Not applicable
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil
ERC – highest emission from relevant ERC *Modelled release factors to air 15%, water 3.2%, soil 3.2%.*
Conditions and measures related to municipal sewage treatment plant
EUSES default STP with primary settler with effluent discharge rate 2000000l/d, serving 10000 inhabitants. Zero degradation assumed. 90.3% to sludge, 9.7% to water calculated in EUSES based on partition coefficients. Sludge assumed to be spread to agricultural land.
Conditions and measures related to external treatment of waste for disposal
External treatment and disposal of waste should comply with applicable local and/or national regulations.
Conditions and measures related to external recovery of waste
External recovery and recycling of waste should comply with applicable local and/or national regulations.
3. Exposure estimation and reference to its source
All exposure estimates for human health show risk characterisation ratios below the value of 1 and so all uses covered by this Exposure Scenario are considered to be safe for human health. *A quantitative risk assessment is not required for the environment as there is no basis for setting a PNEC. In addition, this substance is not classified as hazardous to the environment. A qualitative assessment has been applied. A review of these RMMs indicates that if the user complies with the following generic statements, risks to the environment can be considered to be adequately controlled: Avoid release to the environment.*
4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES
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.
Additional good practice advice beyond the REACH CSA
Use specific measures expected to reduce the predicted exposure beyond the level estimated based on the exposure scenario.

Exposure Scenario Sb No. 5: Use of antimony metal in preparations (including solder)

1. Title

Systematic title based on use descriptor	SU22 (Professional uses) PC11, PC38 AC2, AC7 (appropriate PROCs and ERCs are given in section 2 below)
Processes, tasks and/or activities covered	Processes, tasks and/or activities covered are described in Section 2 below.
Assessment Method	For occupational assessment either measured data or MEASE was used. Environmental assessment uses EUSES.

2. Operational conditions and risk management measures

Task	Involved tasks	Involved PROCs	Involved ERC
Handling of preparations at ambient temperature	Handling of solder	21	10a, 10b, 11a, 11b, 12a, 12b
Use of preparations at elevated temperatures	Soldering	25	

2.1 Control of workers exposure

Product characteristic

Task	Used in preparation	Content in preparation	Physical form	Emission potential
Handling of preparations at ambient temperature	not restricted		massive object	very low
Use of preparations at elevated temperatures	Yes	<5%	molten	Low (temperature based)

Amounts used

Not restricted.

Frequency and duration of use/exposure

Duration of exposure is not restricted for any task.

Human factors not influenced by risk management

The shift breathing volume during all process steps reflected in the PROCs is assumed to be 10 m^3/shift (8 hours).

Other given operational conditions affecting workers exposure

Process temperature for task “Use of preparation at elevated temperatures” is up to 500°C. Operational conditions are not restricted or not relevant for other tasks.

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

No containment for any task is required.

Technical conditions and measures to control dispersion from source towards the worker

Dilution ventilation is required for all tasks.

Organisational measures to prevent /limit releases, dispersion and exposure

Check section 7.1.2, section 8.2.2.2 and section 11 in the core SDS for further information

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

No respiratory protective equipment is required for any task. Check section 8 in the core SDS for further information.

2.2 Control of environmental exposure

Amounts used

Based on a EU tonnage of 30000 tonnes Sb/year and equation given in R.16 (EU tonnage/10/2000*4) the modelled tonnage is 6 tonnes Sb/year/typical STP. This therefore covers the combined risk from all uses (professional and consumer) of Sb metal containing products and articles.

Frequency and duration of use

Continuous use/release, 365 days/year

Environment factors not influenced by risk management
Default data for receiving water and for the municipal sewage treatment plant are18 000 m3/d and 2000 m3/d, respectively (resulting dilution factor 10). For marine assessments a default additional tenfold dilution is assumed.
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil
For local assessment of diffuse inputs of Sb metal all emissions are assumed to go to a local sewage treatment works. Over 95% of use of Sb containing products and articles has a release to water ≤3.2% based on the ERC. This has therefore been selected as the release fraction. Modelled release factors to water 3.2% before STP (ERC).
Conditions and measures related to municipal sewage treatment plant
EUSES default STP with primary settler with effluent discharge rate 2000000l/d, serving 10000 inhabitants. Zero degradation assumed. 79.1% to sludge, 20.9% to water calculated in EUSES based on partition coefficients. Sludge assumed to be spread to agricultural land.
Conditions and measures related to external treatment of waste for disposal
Check section 13 in the core SDS for further information.

3. Exposure estimation and reference to its source

Occupational exposure
The risk characterisation ratio (RCR) is the quotient of the refined exposure estimate and the respective DNEL (derived no-effect level) and has to be below 1 to demonstrate a safe use. For inhalation exposure, the RCR is based on the DNEL for antimony metal of 0.5 mg/m3.

Task	Method used for inhalation exposure assessment	Inhalation exposure estimate (RCR)	Method used for dermal exposure assessment	Dermal exposure estimate (RCR)
Handling of preparations at ambient temperature	MEASE	0.050 mg/m3 (0.10)	Dermal exposure has to be minimised to an extent as technically feasible when working under certain conditions as described in above exposure scenario section 2 and in section 8 and section 11 of the core SDS.	
Use of preparations at elevated temperatures	MEASE	0.20 mg/m³ (0.40)		

Environmental emissions
Local PEC

Air mg.m-3 (RCR)	Fresh water mg/l (RCR)	Marine water mg/l (RCR)	Sediment freshwater mg/kg wwt (RCR)	Sediment marine water mg/kg wwt (RCR)	Soil mg/kg wwt (RCR)	STP mg/l (RCR)
2.6E-06 (NA)	5.87E-03 (0.052)	7.15E-04 (0.063)	5.71 (0.73)	0.70 (0.45)	9.03 (0.28)	5.5E-02 (0.022)

4. Guidance to DU to evaluate whether he works inside the boundaries set by the 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). If measured data are not available, scaling tool for human health part is: MEASE (free download via: www.ebrc.de/mease.html. For environmental exposure: DU-Scaling tool (free download via: http://www.arche-consulting.be/Metal-CSA-toolbox/du-scaling-tool).

ES Ag No. 2: Use of silver metal in re-melting and alloying

Exposure Scenario Format (1) addressing uses carried out by workers

1. Title

Free short title	Use of silver metal in re-melting and alloying as alloying agent (incl. brazes and solders), massive silver objects (including investment bars, jewellery, tableware, decoration), biomedical, dentistry or therapy applications
Systematic title based on use descriptor	SU3 (Industrial uses), SU14, SU15 PC7, PC38 AC2, AC7 (appropriate PROCs and ERCs are given in Section 2 below)
Processes, tasks and/or activities covered	Processes, tasks and/or activities covered are described in Section 2 below.
Assessment Method	The assessment of occupational exposure in this scenario is based on the following assessment methods: (i) measured data, (ii) analogous data and/or (iii) modelled data. For each reported occupational exposure estimate it is reported which method was used in Section 3 of this exposure scenario. A detailed description of the methodology can be found in Section 9.0.1 of the exposure scenarios addendum of the chemical safety report.

2. Operational conditions and risk management measures

Workplace	Involved tasks	Involved PROCs	Environment	ERC
Raw material handling	weighing, mixing, sieving, production of suspension	3, 4, 8b, 21		
Production and handling of powders	weighing, mixing, milling, sieving	5, 26, 27b		
Melting and casting	melting, casting, refining	22, 23		
Mechanical treatment	sawing, milling, grinding, rolling, etching, polishing, brushing, cutting, coiling	10, 14, 21, 24		
Annealing	annealing (including any heat treatment above the recrystallisation temperature)	1 (22 is considered as conducted in closed system)		
Final handling	assembly, surface treatment, polishing, stamping	14, 21		
Packaging of massive objects	packaging	21		
Brazing and soldering	brazing and soldering	25		
Welding (not part of this exposure scenario) Please refer to the exposure scenario "Welding in industrial and/or professional settings".		25		

2.1 Control of workers exposure

Product characteristic

According to the MEASE approach, the substance-intrinsic emission potential is one of the main exposure determinants. This is reflected by an assignment of a so-called fugacity class in the MEASE tool. For operations conducted with solid substances at ambient temperature the fugacity is based on the dustiness of that substance. Whereas in hot metal operations, fugacity is temperature based, taking into account the process temperature and the melting point of the substance. As a third group, high abrasive tasks are based on the level of abrasion instead of the substance intrinsic emission potential. The spraying of aqueous solutions is assumed to be involved with a medium emission.

Workplace	Use in preparation	Content in preparation	Physical form	Emission potential
Raw material handling	not restricted		granules, scrap, massive silver	very low – low
Production and handling of powders			powder	high
Melting and casting			molten	high
Mechanical treatment			massive	medium
Annealing			massive	very low

Final handling		massive	very low
Packaging of massive objects		massive	very low
Brazing and soldering		molten	low

Amounts used

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

Frequency and duration of use/exposure

Workplace	Duration of exposure
Raw material handling	480 minutes (not restricted)
Production and handling of powders	480 minutes (not restricted)
Melting and casting	480 minutes (not restricted)
Mechanical treatment	480 minutes (not restricted)
Annealing	480 minutes (not restricted)
Final handling	480 minutes (not restricted)
Packaging of massive objects	480 minutes (not restricted)
Brazing and soldering	480 minutes (not restricted)

Human factors not influenced by risk management

The shift breathing volume during all process steps is assumed to be 10 m3/shift (8 hours).

Other given operational conditions affecting workers exposure

Workplace	Room volume	Outdoor or indoor use	Process temperature	Process pressure
Raw material handling	>1,000 m3	indoors	ambient	not restricted
Production and handling of powders	>1,000 m3	indoors	ambient	not restricted
Melting and casting	>1,000 m3	indoors	up to 1300°C	not restricted
Mechanical treatment	>1,000 m3	indoors	ambient	not restricted
Annealing	>1,000 m3	indoors	ambient	not restricted
Final handling	>1,000 m3	indoors	ambient	not restricted
Packaging of massive objects	>1,000 m3	indoors	ambient	not restricted
Brazing and soldering	>1,000 m3	indoors	< 950°C	not restricted

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

Workplace	Level of containment	Level of segregation
Raw material handling	not required	enclosed space
Production and handling of powders	not required	enclosed space
Melting and casting	closed furnace	enclosed space
Mechanical treatment	not required	not required
Annealing	closed system	enclosed space
Packaging of massive objects	not required	not required
Brazing and soldering	not required	not required

Technical conditions and measures to control dispersion from source towards the worker

Workplace	Level of separation	Localised controls (LC)	Efficiency of LC (according to MEASE)*	Further information
Raw material handling	not required	local exhaust ventilation	78 %	-
Production and handling of powders	not required	local exhaust ventilation	78 %	-

Melting and casting	not required	local exhaust ventilation	78 %	-
Mechanical treatment	not required	local exhaust ventilation	78 %	-
Annealing	not required	not required	na	-
Final handling	not required	not required	na	-
Packaging of massive objects	not required	not required	na	-
Brazing and soldering	not required	local exhaust ventilation	78 %	-

*It has to be assured that localised controls like local exhaust ventilation systems are inspected and maintained at appropriate frequencies to guarantee the functionality and efficiency.

Organisational measures to prevent /limit releases, dispersion and exposure

Avoid inhalation or ingestion. General occupational hygiene measures are required to ensure a safe handling of the substance. These measures involve good personal and housekeeping practices (i.e. regular cleaning with suitable cleaning devices), no eating and smoking in the workplace, unless otherwise stated below the wearing of standard working clothes and shoes. Shower and change clothes at end of work shift. Do not wear contaminated clothing at home. Do not blow dust off with compressed air.

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

Workplace	Specification of respiratory protective equipment (RPE)	RPE efficiency (assigned protection factor, APF)	Specification of gloves	Further personal protective equipment (PPE)
Raw material handling	not required	na	Gloves are optional for process steps at ambient temperature, thermal protective gloves should be used for hot processes	
Production and handling of powders	FFP3 mask	APF=20		standard working clothes (overall) and safety shoes
Melting and casting	not required	na		
Mechanical treatment	FFP2 mask	APF=10		
Annealing	not required	na		
Final handling	not required	na		
Packaging of massive objects	not required	na		
Brazing and soldering	not required (please note that the release of fine particles cannot be excluded during brazing and soldering, if exposures of workers to brazing and/or soldering fumes are likely to occur appropriate RPE should be selected)	na		

Any RPE as defined above shall only be worn if the following principles are implemented in parallel: The duration of work (compare with "duration of exposure" above) should reflect the additional physiological stress for the worker due to the breathing resistance and mass of the RPE itself, due to the increased thermal stress by enclosing the head. In addition, it shall be considered that the worker's capability of using tools and of communicating are reduced during the wearing of RPE.

For reasons as given above, the worker should therefore be (i) healthy (especially in view of medical problems that may affect the use of RPE), (ii) have suitable facial characteristics reducing leakages between face and mask (in view of scars and facial hair). The recommended devices above which rely on a tight face seal will not provide the required protection unless they fit the contours of the face properly and securely.

The employer and self-employed persons have legal responsibilities for the maintenance and issue of respiratory protective devices and the management of their correct use in the workplace. Therefore, they should define and document a suitable policy for a respiratory protective device programme including training of the workers.

An overview of the APFs of different RPE (according to BS EN 529:2005) can be found in the glossary of MEASE.

2.2 Control of environmental exposure

Product characteristics

Product related conditions, e.g. the concentration of the substance in a preparation; package design affecting exposure

Amounts used
Daily and annual amount per site (for point sources); annual amount for wide disperse use
Frequency and duration of use
Intermittent (< 12 time per year) or continuous use/release
Environment factors not influenced by risk management
Flow rate of receiving surface water
Other given operational conditions affecting environmental exposure
Other operational conditions, e.g. indoor or outdoor use of products; process conditions related to temperature and pressure
Technical conditions and measures at process level (source) to prevent release
Process design aiming to prevent releases and hence exposure of the environment; this also includes conditions ensuring rigorous containment; specify effectiveness of containment (e.g. residual losses)
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil
Technical measures, e.g. on-site waste water and waste treatment techniques, scrubbers, filters and other technical measures aiming at reducing releases to air, sewage system, surface water or soil; this includes strictly controlled conditions to minimise emissions; specify efficacy of measures; specify the size of industrial sewage treatment plant (m3/d), degradation efficacy and sludge treatment (if applicable).
Organizational measures to prevent/limit release from site
Specific organisational measures or measures needed to support the functioning of particular technical measures. Those measures need to be reported in particular for demonstrating strictly controlled conditions.
Conditions and measures related to municipal sewage treatment plant
Size of municipal sewage system/treatment plant (m3/d); specify degradation efficacy; sludge treatment technique (disposal or recovery); measures to limit air emissions from sewage treatment (if applicable)
Conditions and measures related to external treatment of waste for disposal
Type of suitable treatment for waste generated by workers uses, e.g. hazardous waste incineration, chemical-physical treatment for emulsions, chemical oxidation of aqueous waste: specify efficacy of treatment
Conditions and measures related to external recovery of waste
Specify type of suitable recovery operations for waste generated by workers uses, e.g. re-destillation of solvents, refinery process for lubricant waste, recovery of slags, heat recovery outside waste incinerators; specify efficacy of measure;

3. Exposure estimation and reference to its source

Occupational exposure

The risk characterisation ratio (RCR) is the quotient of the refined exposure estimate and the respective derived no-effect level (DNEL). For inhalation exposure, the RCR is based on the DNEL for metallic silver of 0.1 mg/m3.

Workplace	Method used for inhalation exposure assessment (refer to introduction)	Inhalation exposure estimate (RCR)	Method used for dermal exposure assessment	Dermal exposure estimate (RCR)
Raw material handling	analogous data	0.047 mg/m3 (0.472)	Due to the negligible dermal absorption of metallic silver, the dermal route is not a relevant exposure path for metallic silver and a DNEL for dermal effects has not been derived. Thus, dermal exposure is not assessed in this exposure scenario.	
Production and handling of powders	analogous data	0.06 mg/m3 (0.6)		
Melting and casting	analogous data	0.016 mg/m3 (0.16)		
Mechanical treatment	MEASE	0.066 mg/m3 (0.66)		
Annealing	MEASE	0.001 mg/m3 (0.01)		
Final handling	MEASE	0.050 mg/m3 (0.50)		
Packaging of massive objects	MEASE	0.050 mg/m3 (0.50)		
Brazing and soldering	analogous data	0.016 mg/m3 (0.16)		

4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES

Occupational exposure

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. This has to be done by showing that they limit the inhalation and dermal exposure to a level below the respective DNEL (given that the processes and activities in question are covered by the PROCs listed above) as given below. If measured data are not available, the DU may make use of an appropriate scaling tool such as MEASE (www.ebrc.de/mease.html) to estimate the associated exposure. The glossary of MEASE can be considered for the classification of the dustiness of a specific material.

$DNEL_{inhalation}$: 0.1 mg/m³

Environmental emissions

ES Ag No. 4: Use of silver metal in electronics, contact materials and electroplating

Exposure Scenario Format (1) addressing uses carried out by workers

1. Title

Free short title	Use of silver metal in contact and fuse materials (incl. absorber rods), as electroplating agent, as coating and in electronics (incl. sintering/calcination processes and production of photovoltaic cells).
Systematic title based on use descriptor	SU3 (Industrial uses), SU9, SU14, SU16 PC14 AC2 (appropriate PROCs and ERCs are given in Section 2 below).
Processes, tasks and/or activities covered	Processes, tasks and/or activities covered are described in Section 2 below.
Assessment Method	The assessment of occupational exposure in this scenario is based on the following assessment methods: (i) measured data, (ii) analogous data and/or (iii) modelled data. For each reported occupational exposure estimate it is reported which method was used in Section 3 of this exposure scenario. A detailed description of the methodology can be found in Section 9.0.1 of the exposure scenarios addendum of the chemical safety report.

2. Operational conditions and risk management measures

Workplace	Involved tasks	Involved PROCs	Environment	ERC
Raw material handling	weighing, mixing, blending, sieving, filling	3, 4, 5, 8a, 8b, 9, 26		
Processes in closed systems	sputtering, screen printing (solar cells)	1, 2		
Mechanical treatment	pressing, rolling, cutting	14, 21, 24		
Hot processes	sintering, melting, casting, heat treatment, extrusion, soldering	22, 23, 25		
Wet process	electrolytic dissolution of silver, drying, electroplating	2, 3, 4, 27b		
Finishing	milling, cutting, shaping, sawing, grinding, brushing, polishing, assembly	14, 21, 24		
Production and handling of powders	powder production, atomisation, packaging	26, 27a, 27b		
Packaging of massive objects	packaging	21		
Welding (not part of this exposure scenario) Please refer to the exposure scenario "Welding in industrial and/or professional settings".		25		

2.1 Control of workers exposure

Product characteristic

According to the MEASE approach, the substance-intrinsic emission potential is one of the main exposure determinants. This is reflected by an assignment of a so-called fugacity class in the MEASE tool. For operations conducted with solid substances at ambient temperature the fugacity is based on the dustiness of that substance. Whereas in hot metal operations, fugacity is temperature based, taking into account the process temperature and the melting point of the substance. As a third group, high abrasive tasks are based on the level of abrasion instead of the substance intrinsic emission potential. The spraying of aqueous solutions is assumed to be involved with a medium emission.

Workplace	Use in preparation	Content in preparation	Physical form	Emission potential
Raw material handling	not restricted		various (powder, silver alloy, silver crystals, massive silver, granules)	high
Processes in closed systems	not restricted		various	high
Mechanical treatment	not restricted		massive, powder	low - high

Hot processes	not restricted	molten	high
Wet process	not restricted	wetted powder, solution	low – very low
Finishing	not restricted	massive	medium
Production and handling of powders	not restricted	powder	high
Packaging of massive objects	not restricted	massive	very low

Amounts used

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

Frequency and duration of use/exposure

Workplace	Duration of exposure
Raw material handling	480 minutes (not restricted)
Processes in closed systems	480 minutes (not restricted)
Mechanical treatment	480 minutes (not restricted)
Hot processes	480 minutes (not restricted)
Wet process	480 minutes (not restricted)
Finishing	480 minutes (not restricted)
Production and handling of powders	480 minutes (not restricted)
Packaging of massive objects	480 minutes (not restricted)

Human factors not influenced by risk management

The shift breathing volume during all process steps is assumed to be 10 m3/shift (8 hours).

Other given operational conditions affecting workers exposure

Workplace	Room volume	Outdoor or indoor use	Process temperature	Process pressure
Raw material handling	>1,000 m3	indoors	ambient	not restricted
Processes in closed systems	>1,000 m3	indoors	not restricted	not restricted
Mechanical treatment	>1,000 m3	indoors	not restricted	not restricted
Hot processes	>1,000 m3	indoors	up to 1300°C	not restricted
Wet process	>1,000 m3	indoors	not restricted	not restricted
Finishing	>1,000 m3	indoors	not restricted	not restricted
Production and handling of powders	>1,000 m3	indoors	ambient	not restricted
Packaging of massive objects	>1,000 m3	indoors	ambient	not restricted

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

Workplace	Level of containment	Level of segregation
Raw material handling	not required	enclosed space
Processes in closed systems	closed, continuous process	enclosed space
Mechanical treatment	closed press	enclosed space
Hot processes	closed furnace	enclosed space
Wet process	closed reactor	not required
Finishing	not required	not required
Production and handling of powders	not required	enclosed space
Packaging of massive objects	not required	not required

Technical conditions and measures to control dispersion from source towards the worker				
Workplace	Level of separation	Localised controls (LC)	Efficiency of LC (according to MEASE)*	Further information
Raw material handling	not required	local exhaust ventilation	78 %	-
Processes in closed systems	not required	local exhaust ventilation	78 %	-
Mechanical treatment	not required	not required	na	-
Hot processes	not required	local exhaust ventilation	78 %	-
Wet process	not required	local exhaust ventilation	78 %	-
Finishing	not required	local exhaust ventilation	78 %	-
Production and handling of powders	not required	local exhaust ventilation	78 %	-
Packaging of massive objects	not required	not required	na	-
*It has to be assured that localised controls like local exhaust ventilation systems are inspected and maintained at appropriate frequencies to guarantee the functionality and efficiency.				

Organisational measures to prevent /limit releases, dispersion and exposure
Avoid inhalation or ingestion. General occupational hygiene measures are required to ensure a safe handling of the substance. These measures involve good personal and housekeeping practices (i.e. regular cleaning with suitable cleaning devices), no eating and smoking in the workplace, unless otherwise stated below the wearing of standard working clothes and shoes. Shower and change clothes at end of work shift. Do not wear contaminated clothing at home. Do not blow dust off with compressed air.

Conditions and measures related to personal protection, hygiene and health evaluation				
Workplace	Specification of respiratory protective equipment (RPE)	RPE efficiency (assigned protection factor, APF)	Specification of gloves	Further personal protective equipment (PPE)
Raw material handling	FFP3 mask	APF=20	Gloves are optional for process steps at ambient temperature, thermal protective gloves should be used for hot processes.	standard working clothes (overall) and safety shoes.
Processes in closed systems	FFP2 mask during manual operations	APF=10		
Mechanical treatment	FFP3 mask	APF=20		
Hot processes	not required (please note that the release of fine particles cannot be excluded during soldering, if exposure of workers to soldering fumes is likely to occur appropriate RPE should be selected)	na		
Wet process	not required	na		
Finishing	FFP2 mask	APF=10		
Production and handling of powders	FFP3 mask	APF=20		
Packaging of massive objects	not required	na		

Any RPE as defined above shall only be worn if the following principles are implemented in parallel: The duration of work (compare with "duration of exposure" above) should reflect the additional physiological stress for the worker due to the breathing resistance and mass of the RPE itself, due to the increased thermal stress by enclosing the head. In addition, it shall be considered that the worker's capability of using tools and of communicating are reduced during the wearing of RPE.

For reasons as given above, the worker should therefore be (i) healthy (especially in view of medical problems that may affect the use of RPE), (ii) have suitable facial characteristics reducing leakages between face and mask (in view of scars and facial hair). The recommended devices above which rely on a tight face seal will not provide the required protection unless they fit the contours of the face properly and securely.

The employer and self-employed persons have legal responsibilities for the maintenance and issue of respiratory protective devices and the

management of their correct use in the workplace. Therefore, they should define and document a suitable policy for a respiratory protective device programme including training of the workers.

An overview of the APFs of different RPE (according to BS EN 529:2005) can be found in the glossary of MEASE.

2.2 Control of environmental exposure

Product characteristics

Product related conditions, e.g. the concentration of the substance in a preparation; package design affecting exposure.

Amounts used

Daily and annual amount per site (for point sources); annual amount for wide disperse use.

Frequency and duration of use

Intermittent (< 12 time per year) or continuous use/release.

Environment factors not influenced by risk management

Flow rate of receiving surface water.

Other given operational conditions affecting environmental exposure

Other operational conditions, e.g. indoor or outdoor use of products; process conditions related to temperature and pressure.

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

Process design aiming to prevent releases and hence exposure of the environment; this also includes conditions ensuring rigorous containment; specify effectiveness of containment (e.g. residual losses).

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

Technical measures, e.g. on-site waste water and waste treatment techniques, scrubbers, filters and other technical measures aiming at reducing releases to air, sewage system, surface water or soil; this includes strictly controlled conditions to minimise emissions; specify efficacy of measures; specify the size of industrial sewage treatment plant (m3/d), degradation efficacy and sludge treatment (if applicable).

Organizational measures to prevent/limit release from site

Specific organisational measures or measures needed to support the functioning of particular technical measures. Those measures need to be reported in particular for demonstrating strictly controlled conditions.

Conditions and measures related to municipal sewage treatment plant

Size of municipal sewage system/treatment plant (m3/d); specify degradation efficacy; sludge treatment technique (disposal or recovery); measures to limit air emissions from sewage treatment (if applicable).

Conditions and measures related to external treatment of waste for disposal

Type of suitable treatment for waste generated by workers uses, e.g. hazardous waste incineration, chemical-physical treatment for emulsions, chemical oxidation of aqueous waste: specify efficacy of treatment.

Conditions and measures related to external recovery of waste

Specify type of suitable recovery operations for waste generated by workers uses, e.g. re-destillation of solvents, refinery process for lubricant waste, recovery of slags, heat recovery outside waste incinerators; specify efficacy of measure.

3. Exposure estimation and reference to its source

Occupational exposure

The risk characterisation ratio (RCR) is the quotient of the refined exposure estimate and the respective derived no-effect level (DNEL). For inhalation exposure, the RCR is based on the DNEL for metallic silver of 0.1 mg/m3.

Workplace	Method used for inhalation exposure assessment (refer to introduction)	Inhalation exposure estimate (RCR)	Method used for dermal exposure assessment	Dermal exposure estimate (RCR)
Raw material handling	analogous data	0.06 mg/m3 (0.6)	Due to the negligible dermal absorption of metallic silver, the dermal route is not a relevant exposure path for metallic silver and a DNEL for dermal effects has not been derived. Thus, dermal exposure is not assessed in this exposure scenario.	
Processes in closed systems	MEASE	0.022 mg/m3 (0.22)		
Mechanical treatment	analogous data	0.056 mg/m³ (0.56)		
Hot processes	analogous data	0.016 mg/m3 (0.16)		
Wet process	analogous data	0.0883 mg/m3 (0.883)		
Finishing	MEASE	0.066 mg/m3 (0.66)		
Production and handling of powders	analogous data	0.06 mg/m3 (0.6)		
Packaging of massive objects	MEASE	0.05 mg/m3 (0.5)		

Environmental emissions

4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES

Occupational exposure

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. This has to be done by showing that they limit the inhalation and dermal exposure to a level below the respective DNEL (given that the processes and activities in question are covered by the PROCs listed above) as given below. If measured data are not available, the DU may make use of an appropriate scaling tool such as MEASE (www.ebrc.de/mease.html) to estimate the associated exposure. The glossary of MEASE can be considered for the classification of the dustiness of a specific material.

$DNEL_{inhalation}$: 0.1 mg/m³

Environmental emissions

ES Ag No. 7: Professional uses of silver metal, silver alloys or silver containing articles

Modified Exposure Scenario Format (3) addressing service life resulting from downstream use (article/preparation handled by worker)

1. Title

Free short title	Use of massive (silver) objects (e.g. investment bars, decoration, tableware), silver alloys and silver plated/containing articles (e.g. photovoltaic cells)
Systematic title based on use descriptor	SU22 (Professional uses) PC38 AC2, AC3, AC7 (appropriate PROCs and ERCs are given in Section 2 below)
Processes, tasks and/or activities covered	Processes, tasks and/or activities covered are described in Section 2 below.
Assessment Method	The assessment of occupational exposure in this scenario is based on the following assessment methods: (i) measured data, (ii) analogous data and/or (iii) modelled data. For each reported occupational exposure estimate it is reported which method was used in Section 3 of this exposure scenario. A detailed description of the methodology can be found in Section 9.0.1 of the exposure scenarios addendum of the chemical safety report.

2. Operational conditions and risk management measures

Task	Involved tasks	Involved PROCs	Environment	ERCs
Handling of objects/articles at ambient temperature	handling	21		
Soldering/brazing	soldering, brazing	25		

2.1 Control of workers exposure

Product (article) characteristic

According to the MEASE approach, the substance-intrinsic emission potential is one of the main exposure determinants. This is reflected by an assignment of a so-called fugacity class in the MEASE tool. For operations conducted with solid substances at ambient temperature the fugacity is based on the dustiness of that substance. Whereas in hot metal operations, fugacity is temperature based, taking into account the process temperature and the melting point of the substance. As a third group, high abrasive tasks are based on the level of abrasion instead of the substance intrinsic emission potential. The spraying of aqueous solutions is assumed to be involved with a medium emission.

Task	Content in article/preparation	Release potential	Emission potential
Handling of objects/articles at ambient temperature	not restricted	very low	very low
Soldering/brazing	not restricted	low	low

Amounts (contained in articles) present at workplace

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

Frequency and duration of use/exposure

Task	Duration of exposure
Handling of objects/articles at ambient temperature	480 minutes (not restricted)
Soldering/brazing	480 minutes (not restricted)

Human factors not influenced by risk management

The shift breathing volume during all process steps is assumed to be 10 m3/shift (8 hours).

Other given operational conditions affecting workers exposure

Task	Room volume	Outdoor or indoor use	Process temperature	Process pressure
Handling of objects/articles at ambient temperature	not restricted	not restricted	Not considered relevant for occupational exposure assessment of the conducted processes.	
Soldering/brazing	not restricted	not restricted	< 950°C	Not considered relevant for occupational exposure assessment of the conducted processes.

Technical conditions and measures at process level (source) to prevent release		
Task	Level of containment	Level of segregation
Handling of objects/articles at ambient temperature	not required	not required
Soldering/brazing	not required	not required

Technical conditions and measures to control dispersion from source towards the worker				
Task	Level of separation	Type of ventilation	Efficiency of ventilation (according to MEASE)	Further information
Handling of objects/articles at ambient temperature	not required	not required	na	-
Soldering/brazing	not required	not required	na	-

Organisational measures to prevent /limit releases, dispersion and exposure

Avoid inhalation or ingestion. General occupational hygiene measures are required to ensure a safe handling of the substance. These measures involve good personal and housekeeping practices (i.e. regular cleaning with suitable cleaning devices), no eating and smoking in the workplace, unless otherwise stated below the wearing of standard working clothes and shoes. Shower and change clothes at end of work shift. Do not wear contaminated clothing at home. Do not blow dust off with compressed air.

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

Task	Specification of respiratory protective equipment (RPE)	RPE efficiency (assigned protection factor, APF)	Specification of gloves	Further personal protective equipment (PPE)
Handling of objects/articles at ambient temperature	not required	na	not required	-
Soldering/brazing	Where brazing is carried out in a confined space then a suitable fume filter face mask should be used providing there is no question of depletion of oxygen in the atmosphere. Under these circumstances a helmet fed with fresh air or self contained breathing apparatus is to be preferred (Heathcote, 1981).	APF>20		-

Any RPE as defined above shall only be worn if the following principles are implemented in parallel: The duration of work (compare with "duration of exposure" above) should reflect the additional physiological stress for the worker due to the breathing resistance and mass of the RPE itself, due to the increased thermal stress by enclosing the head. In addition, it shall be considered that the worker's capability of using tools and of communicating are reduced during the wearing of RPE.

For reasons as given above, the worker should therefore be (i) healthy (especially in view of medical problems that may affect the use of RPE), (ii) have suitable facial characteristics reducing leakages between face and mask (in view of scars and facial hair). The recommended devices above which rely on a tight face seal will not provide the required protection unless they fit the contours of the face properly and securely.

The employer and self-employed persons have legal responsibilities for the maintenance and issue of respiratory protective devices and the management of their correct use in the workplace. Therefore, they should define and document a suitable policy for a respiratory protective device programme including training of the workers.

An overview of the APFs of different RPE (according to BS EN 529:2005) can be found in the glossary of MEASE.

2.2 Control of environmental exposure

Product characteristics

Product related conditions, e.g. the concentration of the substance in a preparation; package design affecting exposure

Amounts used

Daily and annual amount per site (for point sources); annual amount for wide disperse use

Frequency and duration of use

Intermittent (< 12 time per year) or continuous use/release

Environment factors not influenced by risk management

Flow rate of receiving surface water

Other given operational conditions affecting environmental exposure
Other operational conditions, e.g. indoor or outdoor use of products; process conditions related to temperature and pressure
Technical conditions and measures at process level (source) to prevent release
Process design aiming to prevent releases and hence exposure of the environment; this also includes conditions ensuring rigorous containment; specify effectiveness of containment (e.g. residual losses)
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil
Technical measures, e.g. on-site waste water and waste treatment techniques, scrubbers, filters and other technical measures aiming at reducing releases to air, sewage system, surface water or soil; this includes strictly controlled conditions to minimise emissions; specify efficacy of measures; specify the size of industrial sewage treatment plant (m3/d), degradation efficacy and sludge treatment (if applicable).
Organizational measures to prevent/limit release from site
Specific organisational measures or measures needed to support the functioning of particular technical measures. Those measures need to be reported in particular for demonstrating strictly controlled conditions.
Conditions and measures related to municipal sewage treatment plant
Size of municipal sewage system/treatment plant (m3/d); specify degradation efficacy; sludge treatment technique (disposal or recovery); measures to limit air emissions from sewage treatment (if applicable)
Conditions and measures related to external treatment of waste for disposal
Type of suitable treatment for waste generated by workers uses, e.g. hazardous waste incineration, chemical-physical treatment for emulsions, chemical oxidation of aqueous waste: specify efficacy of treatment
Conditions and measures related to external recovery of waste
Specify type of suitable recovery operations for waste generated by workers uses, e.g. re-destillation of solvents, refinery process for lubricant waste, recovery of slags, heat recovery outside waste incinerators; specify efficacy of measure;

3. Exposure estimation and reference to its source

Occupational exposure

The risk characterisation ratio (RCR) is the quotient of the refined exposure estimate and the respective derived no-effect level (DNEL). For inhalation exposure, the RCR is based on the DNEL for metallic silver of 0.1 mg/m3.

Task	Method used for inhalation exposure assessment (refer to introduction)	Inhalation exposure estimate (RCR)	Method used for dermal exposure assessment	Dermal exposure estimate (RCR)
Handling of objects/articles at ambient temperature	qualitative assessment (non abrasive handling of massive silver objects is assumed to result in negligible exposure)	(<<1)	Due to the negligible dermal absorption of metallic silver, the dermal route is not a relevant exposure path for metallic silver and a DNEL for dermal effects has not been derived. Thus, dermal exposure is not assessed in this exposure scenario.	
Soldering/brazing	MEASE	< 0.05 mg/m3 (< 0.5)		

Environmental emissions

4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES

Occupational exposure

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. This has to be done by showing that they limit the inhalation and dermal exposure to a level below the respective DNEL (given that the processes and activities in question are covered by the PROCs listed above) as given below. If measured data are not available, the DU may make use of an appropriate scaling tool such as MEASE (www.ebrc.de/mease.html) to estimate the associated exposure. The glossary of MEASE can be considered for the classification of the dustiness of a specific material.

$DNEL_{inhalation}$: 0.1 mg/m³

Environmental emissions

ES Cu No. 02: Generic scenario for controlling environmental exposure

Contributing exposure scenario (02) generic scenario for controlling environmental exposure

ERC 1, 2, 3, 4, 5, 6a, 6b, 6c, 6d, 7, 12a, 12b

Product characteristic

Solid, liquid (powder solutions), concentration ranges >0% - <100%

Amounts used

31,000 Tonnes/year (generic value). Higher tonnages can be covered through scaling (see section on DU compliance checking). In the VRAR, safe use could be demonstrated using site-specific assessments for tonnages up to 366,000 Tonnes/year (reference year 2002-2006) using site-specific emission factors, site-specific dilution factors, additional municipal sewage treatments and site-specific bio-availability corrections where relevant.

Frequency and duration of use

365 days/year. Sites with smaller number of emission days can be covered through scaling.

Environment factors not influenced by risk management

Flow rate of receiving surface water is set at the worst-case level 18,000 m3/day (EUSES default). For the generic scenario, this results in a dilution factor of 10. For the marine scenarios, a default dilution factor of 100 was used. In the VRAR, dilution factors up to 1,000 are demonstrated.

Sites with deviating flow can be covered through scaling

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

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

Release to air: The median sector-specific release factor for producers of 4.52 g/tonnes for air was selected as a reasonable worst case for the whole industry (all sectors considered). The factor includes fume/dust collection and abatement system where relevant (such as hot processes). Options are electrostatic precipitators, fabric or bag filters, ceramic filters, wet scrubbers, dry- or semi-dry scrubbers. High dust removal/filtration efficiency between 95% and 99.9% is required for stack emissions. For raw material storage and handling: spraying with water is needed for small particles.

Release to water: The median sector-specific release factor for producers of 0.89 g/tonnes for water was selected as a reasonable worst case for the whole industry (all sectors considered). It is assumed that there is on-site wastewater treatment and that the waste-water is not connected to municipal sewage treatment plant.

Organizational measures to prevent/limit release from site

- Regular inspection/maintenance of workplace to prevent fugitive releases.
- Housekeeping and hygiene procedures: work area, equipment and floors regularly cleaned, water spraying to suppressant dust formation
- Competence and training: activities should only be executed by specialists or authorized personnel, regular training and instruction of workers, procedures for process control to minimise release/exposure
- In case of dust formation, regular monitoring

Conditions and measures related to municipal sewage treatment plant

In the scaling tool, the EUSES default settings were used but can be adapted to site-specific information.

The presence of a municipal sewage treatment plant was not assumed but can be included if relevant. A copper removal rate of 80% can be considered for municipal sewage treatment plant if relevant. Justification for this value can be found in the VRAR of Copper (2008).

The default scenario of use of municipal sludge on agricultural soil was used.

Conditions and measures related to external treatment of solid waste for disposal

Solid wastes generated from industrial sites are disposed as “hazardous wastes”.

Conditions and measures related to external recovery of solid waste

Copper is a valuable material and therefore, the generation of waste is minimized The use of copper scrap is key element of the industrial copper production/use process.

Exposure Assessment - Environment

Compartment	Unit	PEC regional	PEC local (incl. PECreg)	RCR	Justification
Environmental release factor to aquatic (after on-site STP)	g/g	NR	0,89E-6	NR	This is value is the maximum 50th percentile observed in one sector with more than two company data points. The few sites with higher release factor to wastewater can be covered through scaling.

Environmental release factor to air (direct + STP)	g/g	NR	4.52E-6	NR	This is value is the maximum 50th percentile observed in one sector. The few sites with higher release factor to wastewater can be covered through scaling.
Exposure concentration in sewage treatment plant (STP) effluent	mg/L	0	0.0075	0.03	Calculation based on EUSES in case municipal STP is present.
Exposure concentration in aquatic pelagic (freshwater)	mg/L	0.0029	0.0055	0.7	Calculation based on EUSES
Exposure concentration in aquatic pelagic (marine)	mg/L	0.0011	0.0032	0.2	Calculation based on EUSES
Exposure concentration in sediment (freshwater)	mg/kg dw	67	145.21	0.9	Calculation based on EUSES. For the RCR full binding of the regional Cu-PEC to Acid Volatile Sulphides (AVS) and thus, no-availability of the regional Cu-PEC is considered. Justification provided in the copper VRAR
Exposure concentration in sediment (marine)	mg/kg dw	16.1	28.9	0.05	Calculation based on EUSES
Exposure concentration in agricultural soil	mg/kg dw	24.4	24.4	0.4	Calculation based on EUSES
Oral exposure concentration predator Oral exposure concentration top predator Exposure concentration in earthworm	Copper is an essential trace element, well regulated in all living organisms. Difference in copper uptake rates are related to essential needs, varying with the species, size, life stage, seasons... Copper homeostasic mechanisms are applicable across species with specific processes being active depending on the species, life stages.... Simple estimations on secondary poisoning are therefore not adequate. There is overwhelming evidence to show the absence of copper biomagnification across the tropic chain in the aquatic and terrestrial food chains. Differences in sensitivity among species are not related to the level in the trophic chain but to the capability of internal homeostasis and detoxification. Field evidence has further provided evidence on the mechanisms of action of copper in the aquatic and terrestrial environment and the absence of a need for concern for secondary poisoning.				
Note that the regional risk characterisation also demonstrates safe use (see Cu VRAR and follows automatically from local risk characterisation).					

Guidance to DU to evaluate whether he works inside the boundaries set by the ES

If a DU has OC/RMMs outside the OC/RMM specifications in the ES, then the DU can evaluate whether he works inside the boundaries set by the ES through scaling.

Environment

The Metal EUSES calculator for DUs can be freely downloaded from the http://www.eurocopper.org/copper/reach.html or http://www.arche-consulting.be/Metal-CSA-toolbox/du-scaling-tool.

In the registrant-interface, the generic default OCs and RMMs can be entered. Some of them are very relevant for metals, such as the possibility to provide measured regional concentrations and solid-water partition coefficients.

In the simple and easy-to-use DU-interface, key OC and RMM can be changed according to the site-specific OC and RMMs of the DU. This includes general parameters as release factors, dilution, presence/absence of municipal sewage treatment plant, etc... It also allows the DU to enter bioavailability-corrected PNECs (Predicted No Effect Concentrations).

In the background, the full EUSES model is run to calculate exposure and risks. The resulting risk characterisation ratios allow the DU to assess safe use. In this way, the DU scaling tool enables the DU to check compliance with the ES if his OCs or RMMs differ from those in the ES.

Additional good practice advice (for environment) beyond the REACH CSA

Note: The measures reported in this section have not been taken into account in the exposure estimates related to the exposure scenario above. They are not subject to obligation laid down in Article 37 (4) of REACH, Thus, the downstream user is not obliged to i) carry out an own CSA and ii) to notify the use to the Agency, if he does not implement these measures.

- Environmental Management System (ISO 14001, EMAS)
- Reduce the fugitive emissions where possible
- Release to water: Direct cooling water and effluents are treated to remove dissolved Cu. Options: chemical precipitation, sedimentation, filtration or electrolysis. Copper removal efficiency of the on-site treatment varies between 90% and 99.9%. Alternatively, waste-waters can be connected to municipal sewage treatment plants.

Exposure assessment - indirect exposure of humans via the environment

External exposure through	Unit	Value	Justification
Inhalation – Local	mg/person /day	0.093	Reasonable worst-case values taken from Cu VRAR (2008) basis: TGD default 24 hr inhalation volume (20m3)

	mg/person /day	0.057	Typical values taken from Cu VRAR (2008) basis: TGD default 24 hr inhalation volume (20m3) Value used in combined exposure and taken forward to risk characterisation.
Dietary intake – Local	mg/person /day	2.35	Reasonable worst-case values taken from Cu VRAR (2008) regional dietary intake included
	mg/person /day	1.44	Typical values taken from Cu VRAR (2008) regional dietary intake included Value used in combined exposure and taken forward to risk characterisation.