Substance Information Sheet

Copper massive (particle size above 1mm)

Substance Information Sheet in dependence on REACH Regulation (EC 1907/2006), and CLP Regulation (EC 1272/2008).

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

1.1 Product identifier

Name of Substance: **Copper massive (particle size above 1mm)**
Trade name: **Oxygen free copper OFE-OK®, OF-OK®, DCuB1®, DCuB2®**
Deoxidized copper Cu-DHP, Cu-DLP, Cu-XLP/PHC, Cu-HCP, Cu-ETP

Chemical formula	Cu
EC number:	231-159-6
CAS number (EC inventory):	7440-50-8
Registration number:	01-2119480154-42-0140
Index number:	Not assigned

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

Copper in massive form does not meet the criteria for classification in accordance to the regulation EC 1272/2008. No safety measurements are therefore needed for copper in massive form.

During specific industrial uses (e.g. melting), safety measures may however be needed due to the potential occurrence of hazardous copper-bearing materials (dusts, mists, fumes) and soluble copper compounds in and around the industrial settings. This Substance Information Sheet (SIS) has therefore focussed on the safety data and safety measures of relevance to the industrial uses of copper massives.

1.2.1 Relevant identified uses

The downstream uses can be summarised as:

Manufacture
M-1: Production of copper massive (cathode)

Formulation
F-3: Production of copper alloy shapes, and ingots or melts

Uses at industrial sites
IW-1: Use of copper and copper alloy shapes for the production of shapes, ingots and /or copper containing articles.
IW-2 Use of copper/ copper containing alloys as intermediate for production of other copper containing substances.
IW-3: Use of copper /copper containing alloys for the fabrication of copper containing articles by mechanical processes (such as rolling, extrusion).
IW-4: Use of copper/ copper containing alloys for the fabrication of wire rod
IW-9: Coating and electroplating

Uses by professional workers
PW-3: Professional use of copper solder

Consumer uses
C-3: Use of copper solder

Article service life
SL-1: Professional installation and maintenance or use of copper containing articles
SL-2: Consumer use of articles with expected dermal exposure - indoors

SL-3: Consumer use of articles with no expected dermal exposure - indoors
SL-4: Consumer use of articles with expected environmental exposure - outdoors
SL-5: Professional use of copper containing semi-finished articles in the production finished articles or of “components” for other articles

1.2.2 Uses advised against

There are no uses advised against.

1.3 Details of the supplier of the Substance Information Sheet

Aurubis Finland Oy
Kuparitie
28101 Pori
P.O. Box 60
28101 Pori
www.aurubis.com
Tel: + 358 2 6266111

e-mail address of competent person responsible for the SDS:
info-pori@aurubis,com

1.4 Emergency telephone number

Myrkytystietokeskus,Stenbäckinkatu 11, 00290 Helsinki
Tel. +358 9 4711

SECTION 2: Hazards Identification

2.1 Classification of the substance or mixture

Classification according to Regulation (EC) No. 1272/2008 (CLP/GHS)
Not classified

2.2 Label elements

Classification Labelling and Packaging Regulation EC 1272/2008
None

2.3 Other hazards

The substance does not meet the criteria for a PBT or vPvB substance.
Copper is not expected to contribute to ozone depletion, ozone formation, global warming or acidification.

SECTION 3: Composition/information on ingredients *

3.1 Substances

Name of Substance: Copper massive: metallic copper material in massive form with specific surface area (SSA) below 0.67 mm^2/mg (equivalent to copper spheres of 1 mm diameter). Degree of purity: >= 99.9 % (w/w)

CAS: 7440-50-8
EINECS: 231-159-6
Concentration: ≥ 99.9%

Classification impurities: none

3.2 Mixtures

Not applicable

SECTION 4: First Aid Measures

4.1 Description of first aid measures

Copper in massive form is not hazardous.

During some uses, the following hazardous derivatives may occur/be formed: respirable copper-bearing particles and soluble copper compounds. This section also considers potential hazards of copper-bearing materials and copper compounds (referred to as “copper”), relevant to the production and use of copper massive materials.

General information: Get medical attention if any discomfort develops.
Show this Substance Information Sheet to the doctor in attendance.

Following inhalation: In case of exposure to fumes, fine particulates, powders, flakes: move to fresh air, lay patient down, get medical attention if discomfort persists.

Following ingestion: In case of significant oral intake (several mg Cu), rinse mouth and give 200-300 ml water to drink.
Do not induce vomiting.
Get medical attention if any discomfort continues.

Following skin contact: Use general hygiene measures for contact with the material: wash with soap and warm water.

In case of contact with molten product, cool rapidly with water and seek immediate medical attention. Do not attempt to remove molten product from skin because skin will tear easily. Cuts or abrasions should be treated promptly with thorough cleansing of the affected area.

Following eye contact: Use general measures if eye irritations occur. Do not rub eyes. Remove any contact lenses. Flush eyes thoroughly with water, taking care to rinse under eyelids. If discomfort continues, consult a physician.

4.2 Most important symptoms and effects, both acute and delayed

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

4.3 Indication of any immediate medical attention and special treatments needed

Treat symptomatically

SECTION 5: Firefighting Measures

5.1 Extinguishing media

Suitable extinguishing media: Massive Copper itself is non-flammable. Use firefighting measures appropriate to surrounding materials.
Extinguishing media which may be used where molten copper is present: sand, sodium chloride

Unsuitable extinguishing media: Extinguishing media which must not be used where molten copper is present: water or halogenated extinguishing media.

5.2 Special hazards arising from the substance or mixture

Respirable dust.

5.3 Advice for fire fighters

General protection is needed: wear a self-contained breathing apparatus and a fully protective suit and gloves. Dispose of fire debris and contaminated fire fighting media in accordance with official regulations.

SECTION 6: Accidental Release Measures

Copper in massive form is not hazardous.
During some uses, hazardous “copper” may be formed and therefore accidental releases of respirable copper-bearing particles and soluble copper compounds are considered.

6.1 Personal precautions, protective equipment and emergency procedures

6.1.1 For non-emergency personel

Avoid formation of dust.
Ensure adequate ventilation.
Avoid inhalation of dust and fumes.

Wear suitable protective equipment.

6.1.2 For emergency responders
Avoid formation of dust.
Ensure adequate ventilation.
Avoid inhalation of dust and fumes.
Wear suitable protective equipment.
Keep unprotected persons away.

6.2 Environmental precautions

- Liquids containing powder should be absorbed in vermiculite, dry sand, or earth before putting into a suitable container for recycling or disposal as hazardous waste.
- Collect dust, particulates, powders, flakes using a vacuum cleaner with a HEPA filter. Place in a suitable container for recycling or disposal as hazardous waste.
- Although the substance is not classified as dangerous to the environment, in the event of an accidental release the product should be prevented from reaching the sewage system or any water course, and from penetrating the ground/soil. Dispose of spilled material in accordance with the relevant local regulations. See Section 13 for disposal considerations.

6.3 Methods and materials for containment and clearing up
Avoid dust formation.
Sweep all spilled material or use an appropriate industrial vacuum cleaner.
Collect spilled material in suitable containers or closed plastic bags for recovery or disposal.
Dispose spilled material or contaminated material as waste. See section 13 for disposal considerations.

6.4 References to other sections
For more information on exposure controls/personal protection or disposal considerations, check Sections 8 to 13 of this Substance Information Sheet.

SECTION 7: Handling and Storage

7.1 Precautions for safe handling
7.1.1 Protective measures
Copper is not classified in massive forms and no protective measures are needed for safe handling

7.1.2 Advice on general occupational hygiene
Avoid contact with molten material. Do not use water on molten metal.
Melting, burning, sawing, brazing, grinding or machining operations may generate fumes and dusts.
Avoid generation and spreading of dust. Avoid inhalation of dust and small particles and contact with eyes.
Provide adequate ventilation.
Observe good industrial hygiene practices.

7.2 Conditions for safe storage, including any incompatibilities
Avoid direct contact with strong acids.

7.3 Specific end uses(s)
Check the identified uses in section 1.2 of this safety data sheet.
For more information see the relevant Exposure Scenario, Annex I and check section 2.1: Control of workers exposure.

SECTION 8. Exposure Controls/Personal Protection

An overview of the assigned protection factors (APFs) of different RPE (according to BS EN 529:2005) can be found in the glossary of MEASE (www.ebrc.de/mease.html).

8.1 Control parameters

Country	Occupational exposure limit	Maximum exposure time	Document number–Date	Basis	Link to the legislation
UK	0.2 mg Cu (fume)/m³ 1 mg Cu (dust and mist)/m³	8h TWA (dust and mist)/m³	2007	Copper	Health and Safety Executive- http://www.hse.gov.uk/coshh/table1.pdf

Belgium	0.2 mg Cu (fume)/m³ 1 mg Cu (dust and mist)/m³	8h TWA	2007	Copper	Service public fédéral Emploi, Travail et Concertation sociale- http://www.emploi.belgique.be/WorkArea/showcontent.aspx?id=23914
France	0.2 mg Cu (fume)/m³ 1 mg Cu (dust)/m³	8h TWA	2008	Copper	INSTITUT NATIONAL DE RECHERCHE ET DE SÉCURITÉ- http://en.inrs.fr/inrs-pub/inrs01.nsf/IntranetObject-accesParReference/ED%20984/$File/ED984.pdf

8.1.2 PNECs and DNELs

Exposure pattern	Route	Descriptor	DNEL / PNEC
Systemic effects - Long-term	Inhalation	Internal dose DNEL (Derived No Effect Level) Using absorption factors of 25% for oral, 100% for inhalation (respirable) and 0.03% for dermal exposure routes	0.041mg Cu/kg B wt/d
Local effects - Long-term	Inhalation	No hazard identified	
Local effects - Acute	Inhalation	No hazard identified	
Systemic effects - Long-term:	Dermal	DNEL (Derived No Effect Level): dermal adsorption factor (0.03%)	137 mg Cu/kg B wt/d
Systemic effects - Acute:	Dermal	DNEL (Derived No Effect Level): dermal adsorption factor (0.03%)	273 mg Cu/kg B wt/d
Local effects - Long-term	Dermal	No hazard identified	
Local effects - Acute	Dermal	No hazard identified	
Local effects	Eyes	No hazard identified	
Environmental	Freshwater	PNEC (Predicted No Effect Concentration) Includes a default bio-availability correction	7.8 µg dissolved Cu/L (1)
Environmental	Marine water	PNEC (Predicted No Effect Concentration) Includes a default bio-availability correction	5.2 µg dissolved Cu/L (1)
Environmental	Sediment freshwater	PNEC (Predicted No Effect Concentration) Includes a default bio-availability correction	87 mg Cu/kg dry wt (1)
Environmental	Sediment estuarine	PNEC (Predicted No Effect Concentration)	288 mg Cu/kg dry wt (1)
Environmental	Sediment marine	PNEC (Predicted No Effect Concentration)	676 mg Cu/kg dry wt (1)
Environmental	Soil	PNEC (Predicted No Effect Concentration) Includes a default bio-availability correction	65.5 mg Cu/kg dry wt (1)
Environmental	STP	PNEC (Predicted No Effect Concentration)	230 µg dissolved Cu/L

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

8.2 Exposure controls

See Annex I for a detailed description of the required exposure control measures. Any control measures and associated efficiency values are based on actual measured data at the workplace or on the MEASE tool for occupational exposure assessment (http://www.ebrc.de/industrial-chemicals-reach/projects-and-references/mease.php)

For appropriate air monitoring," total" and "respirable" copper levels should be assessed. A tool that allows to calculate the systemic internal human health exposure levels, using the Multi-Path Model of Particle Deposition (MPPD) , is available from ECI.

The environmental assessment uses the Metal EUSES calculator for Downstream Uses which can be freely downloaded from http://www.arche-consulting.be/Metal-CSA-toolbox/du-scaling-tool. For environmental monitoring, the physico-chemical characteristics of the local receiving environment should preferably be monitored (see section 12 and http://www.copperalliance.eu/industry/regulatory-framework/initiatives-and-regulations/reach/classification-and-labelling/copper)

Appropriate engineering controls

Prevent formation of dust where possible. Ensure appropriate ventilation/exhaustion at machinery and places where dust can be generated.
Any deposit of dust which cannot be avoided should be regularly removed preferably using appropriate industrial vacuum cleaners or central vacuum systems.
Waste air should be released into the atmosphere only after it has passed through suitable dust separators.
Waste water generated during the production process or cleaning operations should be collected and should preferably be treated in an on-site waste water treatment plant which ensures efficient removal of copper

Personal protection measures

Eye/face protection:
As a precautionary measure, the wearing of suitable safety glasses is advised.

Skin protection:
Copper is not classified as hazardous to skin (see section 11 for more details).

Respiratory protection:
Melting, grinding or machining operations as well as packaging may generate fumes and dusts.
Avoid generation and spreading of dust - Use local ventilation to keep levels below established threshold values. A suitable particle filter mask is recommended where needed (see annex 1).

Thermal hazards
Not applicable. Copper does not have any self-heating or auto-flammable properties.

Environmental exposure controls
Avoid "solubilisation" and release of "copper-ions" to the environment.

SECTION 9: Physical and Chemical Properties

9.1 Information on basic physical and chemical properties

Property	Value
Appearance / Physical state at 20°C and 101.3 kPa	Solid, copper colour. The particle size >1mm
Odour	Odourless
Odour threshold	Not applicable
pH-value at 20°C	Not applicable to an inorganic solid.
Melting / freezing point	1059-1069°C
Initial boiling point and boiling range	Not applicable to a solid that melts >300°C
Flash point	Not applicable to an inorganic solid
Flammability	Product is not inflammable.
Upper/lower flammability or explosive limits	Not applicable
Vapour pressure	Not applicable to a solid that melts at >300°C

Vapour density	Not applicable to an inorganic solid.
Relative Desity	8.78
Density	8.78g/cm^3 at 20°C
Water solubility	Insoluble – copper needs to be transformed into a copper compound to become soluble.
Partition coefficient n-octanol/water (log value)	Not applicable to inorganic substances.
Auto-ignition temperature	Not applicable
Decomposition temperature	Decomposition and/or melting starts at 1059°C
Viscosity	Not applicable to an inorganic solid
Explosive properties	Product is not explosive.
Oxidising properties	Does not meet the criteria as an oxidizer

9.2 Other information
Not applicable.

SECTION 10: Stability and Reactivity

10.1 Reactivity
Not applicable. See section 9.

10.2 Chemical stability
Under normal conditions of use and storage, the product is stable.

10.3 Possibility of hazardous reactions
Reaction with H- equivalents releases soluble copper compounds.

10.4 Conditions to avoid
Avoid dust formation and contact with acids.

10.5 Incompatible materials
Strong acids

10.6 Hazardous decomposition products
The element Cu° does not decompose but may be transformed into other metal forms (e.g. Cu^{2+}) –see section 10.3 .

SECTION 11: Toxicological Information

11.1 Information on toxicological effects

The toxicological information was obtained from the Risk Assessment Report on copper and copper compounds, assessed by the EC Technical Committee for New and Existing Substances (TCNES) and the EC Scientific Committee on Health and Environmental Risks (SCHER) (see: http://echa.europa.eu/web/guest/copper-voluntary-risk-assessment-reports), and supplemented with recent information gathered for the REACH registration and beyond. The additional information confirms the hazard profile derived for copper massive as well as the DNELs derived.

Toxicity endpoints	Description of effects
Acute toxicity	Oral: The following acute oral data were obtained • Acute oral effects - LD50 - observed for coated copper flakes are between 300 and 500 mg/kg. Method: OECD Guideline 423 and EU Method B.1 tris. Species: Rat (Sprague-Dawley) male/female. • These data are used for the classification of coated copper flakes and for read-across to the classification of copper massive. Considering the lower solubility and bioaccessibility of copper massive, the data are read-across to copper massive. The assessment justifies that copper massive forms do not require classification for acute lethal effects after oral exposure. Inhalation: The following acute inhalation data were obtained. • The acute inhalation LC50 in the rat, performed with coated copper flakes, was: LC50 (4 h) > 5.11 mg/L . Method OECD 436. (males and females combined). Species rat (Sprague-Dawley) male/female

	Considering the lower solubility and bioaccessibility and the higher particle size of copper massive, compared to coated copper flakes, the data are read-across to copper massive. The assessment justifies that copper massive forms-do not require classification for acute lethal effects after inhalation exposure. Dermal The following acute inhalation data were obtained • Acute lethal effects - LD50, observed for coated copper flakes, for CuO and for Cu sulphate are > 2,000 mg/kg. Method OECD 402. Species rat (Sprague-Dawley) male/female Considering the lower solubility and bioaccessibility and the higher particle size of copper massive, compared to coated copper flakes and copper compounds, the data are read-across to copper massive. The assessment justifies that copper massive forms do not require classification for acute lethal effects after inhalation exposure. **The classification criteria, for copper in massive form, according to Regulations (EC) No 1272/2008 and 67/548/EEC on acute toxicity, are therefore not met.**
Skin corrosion/irritation;	• Animal data on coated copper flakes and CuO, showed no irritation. Erythema and Edema score 0 (mean) (Time point: 24, 48 and 72 h). Method: OECD Guideline 404 and EU Method B.4. Species: rabbit (New Zealand White). With regard to skin irritation, available animal data for copper (II) oxide and coated copper flakes do not require these substances to be classified as irritant. Considering the lower solubility and bioaccessibility of copper massive compared to copper oxides and copper flakes, the data are read-across do not require classification for skin irritation. **The classification criteria, for copper in massive form, according to Regulations (EC) No 1272/2008 and 67/548/EEC on skin corrosion / irritation are therefore not met**
Serious eye damage/irritation;	• Animal data on coated copper flakes and CuO, showed slightly irritating. (Time point: 24, 48 and 72 h). Method OECD Guideline 405 and EU Method B.5. Species rabbit (New Zealand White) With regard to eye irritation, available animal data for coated copper flakes require to be classified as irritant cat 2, while copper (II) oxide does not merit classification as eye irritant. Considering the lower solubility and bioaccessibility of copper massive compared to copper oxides and copper flakes, and the differences in shapes, no classification is proposed for copper massive. **The classification criteria, for copper in massive form and copper powder, according to Regulations (EC) No 1272/2008 and 67/548/EEC on eye irritation are therefore not met.**
Respiratory or Skin Sensitisation	Skin Sensitisation • Animal data on coated copper flakes and CuO, showed not sensitising, dose 50% - 10% w/w resp. Time point: 24, 48 h). Method: OECD Guideline 406. Species: guinea pig (Dunkin-Hartley) male. The available animal data do not meet the criteria requiring these substances to be classified for skin sensitisation. Considering the lower solubility and bioaccessibility of copper massive compared to copper oxides and copper flakes, the data are read across to copper massive do not require classification for skin sensitisation. Respiratory Sensitisation In the absence of relevant human or animal data, there is no basis for classification of copper massive for respiratory sensitisation. **The classification criteria, for copper in massive form and copper powder, according to Regulations (EC) No 1272/2008 and 67/548/EEC on sensitization are therefore not met.**
Germ cell mutagenicity; Genotoxicity	• 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 µg/plate). Method OECD Guideline 471. Species Salmonella typhimurium Strains. • Soluble copper compound. Similar negative findings have also been reported for copper chloride. Results from two *in vivo* mammalian cell (rat and mouse) tests show that copper sulphate is genotoxic only at high, cytotoxic concentrations (up to 250 mg/l). Methods: OECD. Guideline 486 (rat) and EU Method B.12 (mouse) Consideration of the weight of evidence from in vitro and in vivo tests, leads to the conclusion that copper and copper compounds are not genotoxic. **The classification criteria for copper in massive form, according to Regulations (EC) No 1272/2008 and**

	67/548/EEC on germ cell mutagen are therefore not met.
Carcinogenicity	Oral 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. Species: rats and mouse. 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. Inhalation and dermal There are no high quality inhalation nor dermal data available. However, there is sufficient data available to indicate that copper and copper compounds do not meet the criteria requiring classification for carcinogenicity. **The classification criteria for copper in massive form, according to Regulations (EC) No 1272/2008 and 67/548/EEC on carcinogenicity are therefore not met**
Reproductive toxicity	**Effects on fertility** • A high quality study indicates that the no-observed-adverse-effect level (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. Method OECD Guideline 416 and EPA OPPTS 870.3800. **The classification criteria for copper in massive form, according to Regulations (EC) No 1272/2008 and 67/548/EEC on reproductive toxicity are therefore not met.**
Summary of evaluation of the CMR properties;	**The classification criteria for copper in massive form for endpoints carcinogenic, mutagenic, or toxic for reproduction, according to Regulations (EC) No 1272/2008 and 67/548/EEC are not met**
STOT-single exposure	Acute toxicity, oral: The classification criteria according to regulation (EC) 1272/2008 as specific target organ toxicant (STOT) – single exposure, oral are not met since, in addition, to the effects which were responsible for the death of the animals, no reversible or irreversible adverse organ-specific health effects were observed immediately or delayed after exposure at the guidance value, oral for a Category 1 classification of 300 mg/kg bw and at the guidance value, oral for a Category 2 classification of 2,000 mg/kg bw. No classification is required. Acute toxicity, inhalation: The classification criteria according to regulation (EC) 1272/2008 as specific target organ toxicant (STOT) – single exposure, inhalation (dust/mist/fume). are not met since, in addition, to the effects which were responsible for the death of the animals, no reversible or irreversible adverse organ-specifc health effects were observed immediately or delayed after exposure at the guidance value, inhalation (dust/mist/fume) for a Category 1 classification (C ≤ 1 mg/L/4h) and at the guidance value, inhalation for a Category 2 (5.0 ≥ C > 1.0 mg/L/4h). No classification is required. Acute toxicity, dermal: The classification criteria according to regulation (EC) 1272/2008 as specific target organ toxicant (STOT) – single exposure, dermal are not met since no reversible or irreversible adverse health effects were observed immediately or delayed after exposure and no effects were observed at the guidance value, dermal for a Category 1 classification (C ≤ 1,000 mg/kg bw) and at the guidance value, dermal for a Category 2 classification (2,000 mg/kg bw ≥ C > 1,000 mg/kg bw). No classification is required. **The classification criteria, for copper in massive form and copper powder (>10µm), according to Regulations (EC) No 1272/2008 and 67/548/EEC on STOT-SE are not met.**
STOT-repeated exposure;	Oral 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 $CuSO_4$/kgBW/day and above ($NOAEL_{oral}$ rat = 16 mg Cu /kg body weight/day). 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 0.041 mg Cu/kg body weight/day. Species rat (F344/N) male/female. Method: equivalent or similar to EU Method B.26 Inhalation: In the 4-weeks repeated dose of Cu_2O by inhalation to rats (Kirkpatrick 2010), no serious adverse effects were observed at the maximum tested concentration (2 mg/m3). Some transient effects, related to the immunological response of eliminating copper particles were observed at all doses. From the study it was concluded that, no STOT-RE classification is warranted. Method OECD Guideline 412 **The classification criteria, for copper in massive form, according to Regulations (EC) No 1272/2008 on**

	Specific Target Organ Toxicity are therefore not met.
Aspiration hazard	Inhalation: Copper massive and its marketed downstream use products have a d50 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))1 can be used to quantify the particle dependent absorption. There is no aspiration hazard for massive copper.

[2] MPPD from : Asharian and Freijer, 1999

SECTION 12: Ecological Information

12.1 Toxicity

The ecotoxicological information was obtained from the Risk Assessment report on copper and copper compounds, assessed by the EC Technical Committee for New and Existing Substances (TCNES) and the EC Scientific Committee on Health and Environmental Risks (SCHER) (see: http://echa.europa.eu/web/guest/copper-voluntary-risk-assessment-reports), and supplemented with recent information gathered for the REACH registration and beyond. The additional information confirms the hazard profile derived for copper massive and refined the PNECs derived for the some compartments (soil and marine waters).

Environmental bioavailability

In accordance to the CLP guidance (2012), the environmental bio-availability of a copper massive form in freshwater environments is 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 following transformation-dissolution data were identified as the most reliable data for classification of copper massive (specific surface area 0.67 mm2/mg) for environmental hazards

- At pH 6 after 7 days: 1.5 µg Cu/mm2 * 0.67 mm2/mg * 1 mg/L = 1.0 µg dissolved Cu/L released
- At pH 6 after 28 days: 5.0 µg Cu/mm2 * 0.67 mm2/mg * 1 mg/L = 3.4 µg dissolved Cu/L released

These data assume a mass loading of 1 mg/L and a worst case (finest) copper massive particle of 0.67 mm2/mg.

Acute and chronic aquatic toxicity test results and environmental classification:

Given the data-richness of the copper dataset, it is not possible to include all relevant and reliable acute/chronic toxicity data for copper in this SDS: The acute ecotoxicity database contains 785 high quality data points; the chronic ecotoxicity database contains 190 high quality data points. A concise summary is given below; data represent standard test guidelines and test species, and are expressed as dissolved copper concentrations.

Acute data for the aquatic environment

Given the large amount of acute toxicity data that have been published for copper, only high quality data obtained for the standard OECD test species and endpoints were retained for further assessment:

- Fish: *Oncorhynchus mykiss*, *Brachydanio rerio*, *Cyprinus carpio*, *Pimephales promelas*, *Lepomis macrochirus*: 96h-LC_{50} values
- Crustacaea: *Daphnia magna*, *Ceriodaphnia dubia*: 48h-$L(I)C_{50}$ values
- Algae and higher plants: *Pseudokirchneriella subcapitata*, *Chlamydomonas reinhardtii*, *Chlorella vulgaris*, *Lemna minor*: (72/96/168h-EC_{50}).

In total, 451 high quality acute data points were retained, and reliable $L(E)C_{50}$ values ranged between 3 and 9,150 µg $Cu_{dissolved}$/L.

Chronic data for the aquatic environment

Fish:
High quality chronic NOEC/$(L(E)C_{10}$ values are available for 10 freshwater species: *Ictalurus punctatus*, *Oncorhynchus kisutch*, *Oncorhynchus mykiss*, *Salvelinus fontinalis*, *Pimephales promelas*, *Pimephales notatus*, *Perca fluviatilis*, *Noemacheilus barbatulus*, *Catostomus commersoni* and *Esox lucius*, with individual values ranging from 2.2 µg Cu/L to 188 µg Cu/L. Species-specific (geometric mean) NOEC/EC_{10} values range from 11.6 µg Cu/L (*Oncorhynchus mykiss*, growth) to 56.2 µg Cu/L (*Pimephales notatus*, growth).
Individual NOEC/$L(E)C_{10}$ values for two marine fish range between 55 and 123 µg Cu/L. Species-specific NOECs are 55 µg Cu/L (*Atherinops affinis*) and 57.8 µg Cu/L (*Cyprinodon variegatus*).

Invertebrates:
High quality chronic NOEC/(L(E)C_{10} values are available for 13 freshwater species: *Brachionus calyciflorus*, *Clistoronia magnifica*, *Chironomus riparius*, *Paratanytarsus parthenogeneticus*, *Juga plicifera*, *Campeloma decisum*, *Villosa iris*, *Dreissenia polymorpha*, *Ceriodaphnia dubia*, *Daphnia magna*, *Daphnia pulex*, *Hyalella azteca* and *Gammarus pulex*.
Individual NOEC/(L(E)C_{10} values range between 4 µg Cu/L and 188 µg Cu/L. Species-specific (geometric mean) NOEC/EC_{10} values range from 6.0 µg/L Cu (*Juga plicifera*, mortality) to 50.3 µg/L Cu (*Hyalella azteca*, mortality)
Species-specific NOEC/EC_{10}s for 18 marine invertebrates range from 5.9 µg Cu/L (*Mytilus galloprovincialis*) to 145 µg Cu/L (*Penaeus monodon*).

Algae & aquatic plants:
High quality chronic NOEC/(L(E)C10 values are available for three freshwater species: *Chlamydomonas reinhardtii*, *Chlorella vulgaris* and *Pseudokirchneriella subcapitata*. Species-specific (geometric mean) NOEC/EC_{10} values range from 43.0 µg/L Cu (*Pseudokirchneriella subcapitata*, growth) to 138 µg/L Cu (*Chlorella vulgaris*, growth)
Species-specific NOEC/EC_{10}s for four marine algal species range from 2.9 µg Cu/L (*Phaeodactylum tricornutum*) to 11 µg Cu/L (*Fucus vesiculosus*).

Terrestrial long-term toxicity data

Plants:
67 NOEC/EC_{10} values, representing nine species of monocotyle and dicotyle plants (*Polygonum convolvulus* (*Polyonaceae*), *Lycopersicon esculentum* (*Solanaceae*), *Hordeum vulgare*, *Avena sativa* and *Pao annua* (*Poaceae*), *Senecio vulgaris*, *Andryala integrifolia* and *Hypochoeris radicata* (*Asteraceae*), and *Lolium perenne* (*Gramineae*).

Invertebrates:
108 NOEC/EC_{10} values, representing ten species of hard and soft bodied organisms with different exposure routes and feeding strategies: *Eisenia andrei*, *Eisenia fetida* and *Lumbricus rubellus* (*Lumbricidae*), *Cognettia sphagnetorum* (*Enchytraedae*), *Isotoma viridis*, *Folsomia candida* and *Folsomia fimetaria* (I*sotomidae*), *Hypoaspis aculeifer* (*Laelapidae*), *Platynothrus peltifer* (*Camisiidae*), *Plectus acuminatus* (*Plectidae*).

Microbial processes:
77 NOEC/EC_{10} values for nine different endpoints that represent the C- and N-cycle, and measurement of microbial biomass (i.e. maize induced respiration, substrate induced respiration, litter decomposition, glutamic acid decomposition, N-mineralisation, denitrification, nitrification, ammonification, biomass C, biomass N).

Sewage Treatment Plant data

High quality effects endpoints on micro-organisms are available for heterotrophic respiration inhibition, nitrification inhibition and effects on ciliated protozoa from sewage treatment plants. NOEC values generated in tests with mixed bacterial populations (activated sludge) range between 0.23-0.45 mg $Cu_{dissolved}$/L, and between 0.26 – >0.92 mg $Cu_{dissolved}$/L for heterotrophs and nitrifiers, respectively. The short term tests with *T. pyriformis* resulted in NOEC and EC_{50}(growth) values between 3.6 - 3.8 mg $Cu_{nominal}$/L and 8.0-10.2 mg $Cu_{nominal}$/L, respectively.
Across endpoints/studies 0.23 mg $Cu_{dissolved}$/L is considered as the most reliable NOEC.

Classification of Copper massive.

For classification purposes, the data were split according to pH as described in the CLP guidance. The lowest species-specific acute L(E)C_{50} and chronic NOEC/EC_{10} values at each pH were selected as final ERV. Data summaries were carried out in accordance with the CLP guidance. Geometric mean values were calculated if more than 4 data-points were available for the same species across all pH bands and endpoints. The derived acute and chronic ERVs for dissolved copper are provided In the Table below.

Acute and chronic reference values for soluble copper ions

pH	Acute ERV (µg Cu/l)	Chronic ERV (µg Cu/l)
pH 6	12.1	11.4
pH 7	14.0	6.3
pH 8	40.0	12.6

Acute environmental hazard classification for copper massive
At pH 6, the copper release after 7 days transformation-dissolution at a mass loading of 1 mg/L (1.0 µg Cu/L) is below the acute ERV at pH 6 (12.1 µg Cu/L). The copper release at pH 6 is, as worst-case assumption, also compared to the acute ERVs at pH 7 (14.0 µg/L) and at

pH 8 (40.0 µg/L). The copper release is in both cases lower than the corresponding ERV.

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.

Chronic environmental hazard classification for copper massive
At pH 6, the copper release after 28 days transformation-dissolution at a mass loading of 1 mg/L (3.4 µg Cu/L) is below the chronic ERV at pH 6 (11.4 µg Cu/L). The copper release at pH 6 can, as worst-case assumption, also be compared to the chronic ERVs at pH 7 (6.3 µg/L) and at pH 8 (12.6 µg/L). The copper release is in both cases lower than the ERV.

The assessment demonstrates that, according to Regulations (EC) No 1272/2008 and 67/548/EEC, copper massive does not need to be classified for chronic aquatic toxicity.

PNEC derivation for Copper

Aquatic environment

Test media characteristics (e.g., pH, dissolved organic carbon (DOC), hardness) have an influence on the bioavailability and ecotoxicity of copper. Species-specific NOECs were therefore calculated after normalizing the NOECs towards a series of realistic environmental conditions that can be found in Europe. Such normalization was done by using chronic copper bioavailability models (Biotic Ligand Models). These species-specific BLM-normalized NOECs were used for the derivation of log-normal Species Sensitivity Distributions (SSD) and HC5 values (the median fifth percentile of the SSD), using statistical extrapolation methods and to derive a PNEC.
PNE-values for the various typical EU scenarios range between 7.8 to 22.1 µg Cudissolved/L. The value of 7.8 µg Cudissolved/L is protective for 90% of the EU surface waters, and is taken forward as 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.

Species-specific NOECs for the marine environment are calculated after DOC-normalisation to 2 mg/L (typical for coastal areas). The normalised values are used for the derivation of species sensitivity distributions (SSD) and HC5 values, using statistical extrapolation methods, resulting in an HC5 value of 5.2 µg Cu/L. This HC5 represents 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.

Terrestrial environment

The PNECsoil is based on chronic NOEC/EC10 values from 28 different species and processes. Data were normalised to different soil types by implementing a leaching-ageing factor (taking into account the observed differences between lab-spiked soils and field-contaminated soils) and using relevant regression (bio) availability models. Species Sensitivity Distributions were constructed using the normalised NOEC/EC10 data, and HC5 values from log-normal distributions ranged between 65.5 and 150 mg Cu/kg dry weight. The value of 65.5 mg 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.

Sewage treatment plant

The bacterial studies using mixed population tests (e. g. activated sludge) are representative for microbial degradation in STP. The lowest NOEC of 0.23 mg Cudissolved/L is the PNEC relevant to Sewage treatment plants.

Sediment compartment

A value of 87 mg Cu/kg dry weight is the default chronic freshwater sediment PNEC, to be used to assess local risks. This value is based on the ecotoxicological data on sediment organisms, and this information is included both the Risk Assessment for Copper and Copper compounds, and in the REACH registration dossiers for copper and copper compounds. The assessment can be refined if the organic carbon concentration and the Acid Volatile Sulphide concentrations of the local sediment is available.

For more information on how the environmental classification was derived and how to assess bio-availability, contact your supplier.

12.2 Persistence and degradability

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

The EU 2012 CLP guidance does not provide detailed information on how to assess the fate of the copper ion. Therefore, following the GHS and CLP principles, the fate of the copper ion under "environmentally relevant" conditions was modelled, using the Ticket Unit World Model (http://blog.unitworldmodel.net). Following a single exposure dose, copper ion removal rates from the water-column through partitioning and settling and subsequent binding to sediment sulphides was assessed for various environmental conditions. To examine the potential for remobilization of copper from sediments, a series of 1-year simulations were performed, using the TICKET-UWM. Rapid removal from the water column was also assessed using data from one mesocosm and three field studies (Rader et al., 2013). 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 was defined as 70% removal within 28 days. Literature data also 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” and is considered as “rapidly degradable”.

12.3 Bioaccumulative potential

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.”

12.4 Mobility in soil

Copper-ions bind strongly to the soil matrix. The binding depends on the soil properties. A median water-soil partitioning coefficient (Kp) of 2120 L/kg has been derived for soils.

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, such as copper and its inorganic compounds.
Copper is not PBT or vPvB.

12.6 Other adverse effects

Copper is not expected to contribute to ozone depletion, ozone formation, global warming or acidification.

SECTION 13: Disposal Considerations

13.1 Waste treatment methods

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility.

SECTION 14: Transport Information

Copper massive do not need to be classified for transportation.

RID/ADR:	not restricted	ADNR/ADN:	not restricted
IATA/ICAO:	not restricted	IMO/IMDG:	not restricted

14.1. UN number

Not applicable.

14.2. UN proper shipping name

Not applicable.

14.3. Transport hazard class(es)

Not applicable.

14.4. Packing group

Not applicable.

14.5. Environmental hazards

Not applicable.

14.6. Special precautions for user

Not applicable.

14.7. Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

Not applicable.

SECTION 15: Regulatory Information

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

15.1.1 Worldwide Chemical Inventories

EC inventory (EU): 231-159-6
TSCA (USA): listed
DSL(Canada): listed
AICS (Australia): listed
NZIoC (New Zealand): listed
ENCS (Japan): listed
ECL(Korea): listed
PICCS (Philippines): listed
IECSC(China): listed

Country-specific regulations must be observed.

Copper is not a SEVESO substance, not an ozone depleting substance and not a persistent organic pollutant.

15.2 Chemical Safety Assessment
A Chemical Safety Assessment has been carried out for the substance.

SECTION 16: Other Information

Data are based on our latest knowledge but do not constitute a guarantee for any specific product features and do not establish a legally valid contractual relationship.

Abbreviation and acronyms:

TCNES: EC Technical Committee for New and Existing Substances (TCNES)
SCHER: EC Scientific Committee on Health and Environmental Risks
REACH: EC Regulation on Registration, Evaluation and Authorisation of Chemicals (Regulation (EC) No 1907/2006 as amended)
LD50: Lethal dose to 50% of the test organisms
LC50: Lethal concentration to 50% of the test organisms
LC10: Lethal concentration to 10% of the test organisms
EC10: Effective concentration to 10% of the test organisms

NOEC: No Observed Effect Concentration = highest concentration tested without effects
DNEL: Derived No-Effect Level
SSD: Species Sensitivity Distribution= distribution of the species-specific NOEC or (L(E)C10 values for all species tested.
SSA: Specific Surface Area
HC-5: The concentration without effect for 95% of the species = statistically derived environmental threshold value.
PNEC: Predicted No-effects Concentration
DOC: Dissolved Organic Carbon
OC: Organic Carbon
CEC: Cationic Exchange Capacity
AVS: Acid Volatile Sulphide.

Revision information:
This is the first version of this Substance Information Sheet.

Disclaimer:
The information contained within this Safety Data Sheet is the property of the members of the Copper REACH Consortium. Only legal entities with legitimate access may use this data.
This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. Furthermore, this substance information sheet (including its Annex) is made up based on the legal requirements as set by EC 1907/2006 (REACH) based on information as available.

Exposure scenarios

M-1: Production of copper massive

It includes:
Contributing ES 1 controlling environmental exposure for massive copper production (hereunder)
Contributing ES 1 controlling worker exposure: Raw material and scrap handling of massive metal (hereunder)
Contributing ES 2 controlling worker exposure: Smelting and fire refining (hereunder)
Contributing ES 3 controlling worker exposure: Electrolytic Refining (hereunder)
Contributing ES 20 controlling worker exposure: Raw material and scrap handling of fines, milling to fines
Contributing ES 30 controlling worker exposure: Hydro-metallurgical copper production (hereunder)

Contributing ES 1 controlling environmental exposure for massive copper production
ERC 1
Product characteristic
Solid, concentration ranges >0% - <100%
Amounts used
In the VRAR, safe use could be demonstrated using site-specific assessments for tonnages up to 366,000 Tonnes/year (Reference period 2002-2006)
Frequency and duration of use
230-365 days/year.
Environment factors not influenced by risk management
Site-specific flow rate of receiving surface water, site-specific bio-availability corrections and region - specific copper background values were used, where possible
Technical conditions and measures at process level (source) to prevent release
The releases to water and air have been reduced with RRM, resulting in a 90th P water emission factor of 3.9 and 90th P air emission factor of 13.1
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil
Release to air: 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**: On-site wastewater treatment and if needed, additional municipal wastewater treatment	
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	
A copper removal rate of 80% has been considered if relevant. Justification for this value can be found in the VRAR of Copper (2008). The 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	**Risk characterisation ratio’s observed for the producing sites**
Aquatic pelagic (freshwater)	$\leq$ 0.6
Aquatic pelagic (marine)	$\leq$ 0.4
Sediment (freshwater)	$\leq$ 0.5
Sediment (marine)	$\leq$ 0.2
Agricultural soil	$\leq$ 0.5
Sewage Treatement plant	$\leq$ 0.1
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.
4. 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. For environment, the Metal EUSES calculator for DUs can be freely downloaded from http://www.arche-consulting.be/Metal-CSA-toolbox/du-scaling-tool. Following parameters can be scaled: amounts used at local site, number of release days per year, discharge to marine or freshwater, discharge rate effluent, flow rate of the river, suspended solids concentration in local water, presence/absence of off-site municipal STP (and removal efficiency), release fraction to air and water. Following ECHA Guidance, the scaled RCR should be smaller or equal than the RCRs mentioned above.	

Contributing exposure scenario (1) controlling worker exposure	
Number of contributing ES	1
Title of contributing ES	Raw material and scrap handling of massive metal
Sector of Use (SU) – Main	3
Process category (PROC) used for exposure assessment	26
Process categories (PROC) used for descriptor purposes	26
Processes and activities covered	
Handling of anodes, blister, cathodes, ingots, shapes and certain metallic scraps including: - Unloading from ships (where shipped break-bulk), containers, trucks and railcars - Loading onto transport. - Transfer to storage areas. - Storage (most likely in the open air, but could be under cover), usually in stacks or on pallets. - Baling (compression of loose materials into compact lumps), drying and other preparation of scrap. - Moving by forklifts, loaders, bins and skips to furnace loading areas. - Blending in open outdoor systems - Discharge into furnaces (may involve some manual handling)	
Product characteristic	
Used in (special) preparation	Not relevant
Content in (special) preparation	Not relevant
Physical State	Massive
Frequency and duration of use/exposure	
Duration	8h/d
Frequency	260d/yr
Human factors not influenced by risk management	
Respiration volume under conditions of use	10 m3/day
Body weight	70 kg
Other given operational conditions affecting workers exposure	
Indoors/outdoors	Outdoors/Indoors
Process temperature	Outdoors/room temperature
Process pressure	Atmospheric pressure
Technical conditions and measures at process level (source) to prevent release	
Level of containment	open system
Technical conditions and measures to control dispersion from source towards the worker	
Presence of Local Exhaust Ventilation (LEV)?	no
Minimum efficiency of LEV	Not relevant
Conditions and measures related to personal protection, hygiene and health evaluation	
Specification of Respiratory Protection Equipment (RPE)	no
Specification of gloves	no
Specification of full body dermal protection	no
Specification of eye protection	no

Exposure Assessment			
Long term exposure			
	Unit	Exposure concentratio n	Justification
External dermal exposure	mg/d	85	Following the approach from the Cu VRAR (2008), the analogous substance" approach was taken, by extrapolating from data collected in the zinc industry. The production of Zn metal involves among other processes such as raw material handling, smelting, refining and casting, which are very similar to those involved in the production of

			Cu.
External inhalation exposure	mg/m³	0.6	Based on measured data from the Cu VRAR. Handling of massive involves negligible exposure to workers
Internal dermal + inhalation systemic (occupational)	mg/kg/d	0.024	Calculated from external exposure based on the methodology outlined in section 9.3.1.4 and the VRAR of Copper (2008).
Risk Characterisation Ratio (combined dermal and inhalation systemic)	-	0.58	The internal DNELs and RCRs are derived from internal NOAELs and absorbed doses. The method for derivation of RCR values for occupational and combined exposure is outlined in section 9.3.1.4 and the VRAR of Copper (2008).
Risk Characterisation Ratio (local inhalation)	-	0.6	
Guidance to DU to evaluate whether he works inside the boundaries set by the ES			
Occupational scaling: The occupational calculator for DUs can be freely downloaded from the http://www.eurocopper.org/copper/reach.html. In the simple and easy-to-use DU-interface, measured inhalation and/or dermal values can be entered. An internal Cu concentration is then calculated and risk conclusion is given.			

Contributing exposure scenario (2) controlling worker exposure		
Number of contributing ES		2
Title of contributing ES		Smelting and fire refining
Sector of Use (SU) – Main		3
Process category (PROC) used for exposure assessment		22
Process categories (PROC) used for descriptor purposes		22, 23, 8b
Processes and activities covered		
Production of copper massive by pyrometallurgical processing of primary materials (copper concentrates) and secondary materials (copper containing scraps). Production process consist of smelting of concentrate/scraps to matte/black copper (or directly to blister), further conversion to blister and fire refining to anode copper. Processes applied include : - Charging of furnace/converter - solid feed or molten feed - Oxidation/reduction processes under heat - Removal/tapping of molten materials from furnace/converter– matte, black copper, slag, blister - Transfer of molten material by ladles or launders -matte, black copper, slag, blister - Casting of anodes		
Product characteristic		
Used in (special) preparation		No
Content in (special) preparation		Not relevant
Physical State		Molten state during process, final product is solid copper in massive form. Exposure to fumes/aerosols, splashes, dust has to be considered.
Dustiness	**Respirable (%)**	12%
	Tracho-bronchial (%)	33%
	Extra-thoracic (%)	55%
	Justification	Particle size distribution of airborne copper at the smelter, converter based on measured data
Frequency and duration of use/exposure		
Duration		8h/d
Frequency		260d/yr
Human factors not influenced by risk management		
Respiration volume under conditions of use		10 m³/day
Body weight		70 kg
Other given operational conditions affecting workers exposure		
Indoors/outdoors		Indoors
Process temperature		900-1340°C
Process pressure		Furnaces are operated under negative pressure
- Processes are source of direct and diffuse dust and fume emissions. - Charging and transfer of molten materials related to batch type of operation (conversion and refining stages) are potential source of diffuse emissions.		

- Pyrometallurgical processes use significant quantities of cooling water. Closed cooling systems are applied.	
Technical conditions and measures at process level (source) to prevent release	
Level of containment	Smelting furnaces are effectively sealed or hooded to minimize exposure and release, more prone during tapping cycles. - For primary, concentrate burner or lances are used and for secondary, enclosed furnace charging system are used. - Enclosed lauders/conveyors for material transfer to prevent release of fume losses - To capture or prevent emissions occurring during charging and pouring, converters are either enclosed or provided with primary and in some cases secondary capture hoods. - Addition of materials through the hood or tuyeres - Automatic controls prevent blowing during the periods that the converter is “rolled out” or “rolled in” - Hoods to capture fumes arising during tapping and casting operations - Supervision of automated process
Level of separation	Workers in separate control room with clean air supply, workers in cabin during tapping/casting operations
Level of automatisation	Most processes are controlled and operated automatically, tapping and casting may involve manual operations.
Technical conditions and measures to control dispersion from source towards the worker	
Presence of Local Exhaust Ventilation (LEV)?	yes
Minimum efficiency of LEV	90%
Organisational measures to prevent /limit releases, dispersion and exposure	
Health and Safety Management System (OSHAS, ..) Regular inspection/maintenance of furnaces and ducts to ensure air tightness and prevent fugitive releases. Housekeeping and hygiene procedures: - Work area, equipment and floors regularly cleaned - Prohibition of eating, drinking and smoking in contaminated areas - Changing of contaminated clothes - Provision of adequate facilities for washing, changing and storage of clothing Competence and Training: - Activity should only be executed by specialists or authorized personnel. - Regular training and instruction of workers - Procedures for process control to minimize release/exposure Monitoring: - Establish monitoring system for exposure at the work place - personal air samplers or fixed measurements - Establish appropriate health surveillance program First aid instructions: - In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. - In case of accident by inhalation: remove casualty to fresh air and keep at rest. - After contact with skin (molten metal), take off immediately all contaminated clothing and seek medical advice	
Conditions and measures related to personal protection, hygiene and health evaluation	
Specification of Respiratory Protection Equipment (RPE)	no
Specification of gloves	no
Specification of full body dermal protection	no
Specification of eye protection	no

Exposure Assessment			
Long term exposure			
	Unit	**Exposure concentration**	**Justification**
External dermal exposure	mg/d	85	Following the approach from the Cu VRAR (2008), the analogous substance" approach was taken, by extrapolating from data collected in the zinc industry. The production of Zn metal involves among other processes such as raw material handling, smelting, refining and casting, which are very similar to those involved in the production of Cu.
External inhalation exposure	mg/m^3	0.34	Based on measured data from the Cu intermediated dossier

Internal dermal + inhalation systemic (occupational)	mg/kg/d	0.018	Calculated from external exposure based on the methodology outlined in section 9.3.1.4 and the VRAR of Copper (2008).
Risk Characterisation Ratio (combined dermal and inhalation systemic)	-	0.43	The internal DNELs and RCRs are derived from internal NOAELs and absorbed doses. The method for derivation of RCR values for occupational and combined exposure is outlined in section 9.3.1.4 and the VRAR of Copper (2008).
Risk Characterisation Ratio (inhalation local)	-	0.34	
Guidance to DU to evaluate whether he works inside the boundaries set by the ES			
Occupational scaling: The occupational calculator for DUs can be freely downloaded from the http://www.eurocopper.org/copper/reach.html. In the simple and easy-to-use DU-interface, measured inhalation and/or dermal values can be entered. An internal Cu concentration is then calculated and risk conclusion is given.			

Contributing exposure scenario (3) controlling worker exposure		
Number of contributing ES		3
Title of contributing ES		Electrolytic Refining
Sector of Use (SU) – Main		3
Process category (PROC) used for exposure assessment		4
Process category (PROC) used for descriptor purposes		3, 4, 8b
Processes and activities covered		
production of copper cathodes by electrolysis. This includes: Preparation of starter sheets. Loading of anode and blanks or starter sheets in tank, Plating of copper onto the cathode, Removal of cathode, Removal of spent anode, Removal of anode slimes.		
Product characteristic		
Used in (special) preparation		Yes/No
Content in (special) preparation		>0 - <100%
Physical State		Massive
Dustiness	Respirable (%)	12%
	Tracho-bronchial (%)	33%
	Extra-thoracic (%)	55%
	Justification	Read-across from particle size distribution of airborne copper at the smelter, converter based on measured data
Frequency and duration of use/exposure		
Duration		8h/d
Frequency		260d/yr
Human factors not influenced by risk management		
Respiration volume under conditions of use		10 m^3/day
Body weight		70 kg
Other given operational conditions affecting workers exposure		
Indoors/outdoors		Indoors
Process pressure		Atmospheric pressure
Technical conditions and measures at process level (source) to prevent release		
Level of containment		closed system
Level of automatisation		automated
Technical conditions and measures to control dispersion from source towards the worker		
Presence of Local Exhaust Ventilation (LEV)?		no
Minimum efficiency of LEV		Not revelant
Conditions and measures related to personal protection, hygiene and health evaluation		
Specification of Respiratory Protection Equipment (RPE)		no
RPE effectiveness		Not revelant
Specification of gloves		no
Specification of full body dermal protection		no
Specification of eye protection		no

Exposure Assessment			
Long term exposure			
	Unit	Exposure concentration	Justification
External dermal exposure	mg/d	85	Following the approach from the Cu VRAR (2008), the analogous substance" approach was taken, by extrapolating from data collected in the zinc industry. The production of Zn metal involves among other processes such as raw material handling, smelting, refining and casting, which are very similar to those involved in the production of Cu.
External inhalation exposure	mg/m^3	0.05	Based on measured data from the Cu intermediates dossier (2014)

Internal dermal + inhalation systemic (occupational)	mg/kg/d	0.006	Calculated from external exposure based on the methodology outlined in section 9.3.1.4 and the VRAR of Copper (2008).
Risk Characterisation Ratio (combined dermal and inhalation systemic)	-	0.14	The internal DNELs and RCRs are derived from internal NOAELs and absorbed doses. The method for derivation of RCR values for occupational and combined exposure is outlined in section 9.3.1.4 and the VRAR of Copper (2008).
Risk Characterisation Ratio (inhalation local)	-	0.05	
Guidance to DU to evaluate whether he works inside the boundaries set by the ES			
Occupational scaling: The occupational calculator for DUs can be freely downloaded from the http://www.eurocopper.org/copper/reach.html. In the simple and easy-to-use DU-interface, measured inhalation and/or dermal values can be entered. An internal Cu concentration is then calculated and risk conclusion is given.			

Contributing exposure scenario (20) controlling worker exposure		
Number of contributing ES		20
Title of contributing ES		Raw material and scrap handling of fines, milling to fines
Sector of Use (SU) – Main		3
Process category (PROC) used for exposure assessment		26
Process categories (PROC) used for descriptor purposes		26
Processes and activities covered		
"Handling of ores and concentrates, anodes, blister, cathodes, ingots, shapes and certain metallic scraps including: - Unloading from ships (where shipped break-bulk), containers, trucks and railcars - Loading onto transport. - Transfer to storage areas. - Storage (most likely in the open air, but could be under cover), usually in stacks or on pallets. - Baling (compression of loose materials into compact lumps), drying and other preparation of scrap. - Moving by forklifts, loaders, bins and skips to furnace loading areas. - Blending in open outdoor systems - Discharge into furnaces (may involve some manual handling)" - Milling of particulates		
Product characteristic		
Used in (special) preparation		Not relevant
Content in (special) preparation		Not relevant
Physical State		Powder
Dustiness	**Respirable (%)**	12%
	Tracho-bronchial (%)	33%
	Extra-thoracic (%)	55%
	Justification	Read across from particle size distribution of airborne copper at furnace operations in powder production as a worst-case approach
Frequency and duration of use/exposure		
Duration		8h/d
Frequency		260d/yr
Human factors not influenced by risk management		
Respiration volume under conditions of use		10 m^3/day
Body weight		70 kg
Other given operational conditions affecting workers exposure		
Indoors/outdoors		Outdoors/Indoors
Process temperature		Outdoors/room temperature
Process pressure		Atmospheric pressure
Technical conditions and measures at process level (source) to prevent release		
Level of containment		closed system
Technical conditions and measures to control dispersion from source towards the worker		
Presence of Local Exhaust Ventilation (LEV)?		yes if opportunity for exposure arises unless occupational monitoring demonstrate safe use without LEV
Minimum efficiency of LEV		95%
Organisational measures to prevent /limit releases, dispersion and exposure		

Conditions and measures related to personal protection, hygiene and health evaluation			
Specification of Respiratory Protection Equipment (RPE)			yes RPE (P3) if inhalable/ respirable dust indoor unless occupational monitoring demonstrate safe use without RPE
RPE effectiveness			95%
Specification of gloves			no
Specification of full body dermal protection			no
Specification of eye protection			no
Exposure Assessment			
Long term exposure			
	Unit	**Exposure concentration**	**Justification**
External dermal exposure	mg/d	85	Following the approach from the Cu VRAR (2008), the analogous substance" approach was taken, by extrapolating from data collected in the zinc industry. The production of Zn metal involves among other processes such as raw material handling, smelting, refining and casting, which are very similar to those involved in the production of Cu.
External inhalation exposure	mg/m^3	0.13	Based on measured data from the Cu VRAR (2008)
Internal dermal + inhalation systemic (occupational)	mg/kg/d	0.007	Calculated from external exposure based on the methodology outlined in section 9.3.1.4 and the VRAR of Copper (2008).
Risk Characterisation Ratio (combined dermal and inhalation systemic)	-	0.18	The internal DNELs and RCRs are derived from internal NOAELs and absorbed doses. The method for derivation of RCR values for occupational and combined exposure is outlined in section 9.3.1.4 and the VRAR of Copper (2008).
Risk Characterisation Ratio (inhalation local)	-	0.007	
Guidance to DU to evaluate whether he works inside the boundaries set by the ES			
Occupational scaling: The occupational calculator for DUs can be freely downloaded from the http://www.eurocopper.org/copper/reach.html. In the simple and easy-to-use DU-interface, measured inhalation and/or dermal values can be entered. An internal Cu concentration is then calculated and risk conclusion is given.			

Contributing exposure scenario (30) controlling worker exposure		
Number of contributing ES		30
Title of contributing ES		Hydro-metallurgical copper production
Sector of Use (SU) – Main		3
Process category (PROC) used for exposure assessment		4
Process categories (PROC) used for descriptor purposes		3, 4
Processes and activities covered		
- Atmospheric leaching of crushed concentrates in leach reactors, thickening and washing of the leach residue - StepwisesSolvent extraction, washing and stripping - Electrowinning (electrolytic refinement)		
Product characteristic		
Used in (special) preparation		No
Content in (special) preparation		>0 - <100%
Physical State		From fines (concentrates) to massive metal
Dustiness	Respirable (%)	12%
	Tracho-bronchial (%)	33%
	Extra-thoracic (%)	55%
	Justification	Read-across from particle size distribution of airborne copper at the smelter, converter based on measured data
Frequency and duration of use/exposure		
Duration		8h/d
Frequency		260d/yr
Human factors not influenced by risk management		
Respiration volume under conditions of use		10 m^3/day
Body weight		70 kg
Other given operational conditions affecting workers exposure		
Indoors/outdoors		Indoors and outdoors
Process temperature		90°C
Process pressure		Atmospheric pressure
Technical conditions and measures at process level (source) to prevent release		
Level of containment		Closed leaching reactors, automated solvent reaction
Level of automatisation		usually automated
Technical conditions and measures to control dispersion from source towards the worker		
Presence of Local Exhaust Ventilation (LEV)?		Yes. Removable hoods are installed over the electrowinning tanks and the captured gas gas ducted to a ascribbing system
Minimum efficiency of LEV		90%
Conditions and measures related to personal protection, hygiene and health evaluation		
Specification of Respiratory Protection Equipment (RPE)		no
RPE effectiveness		Not relevant
Specification of gloves		yes
Specification of full body dermal protection		no
Specification of eye protection		yes

Exposure Assessment			
Long term exposure			
	Unit	**Exposure concentration**	**Justification**
External dermal exposure	mg/d	85	Following the approach from the Cu VRAR (2008), the analogous substance" approach was taken, by extrapolating from data collected in the zinc industry. The production of Zn metal involves among other processes such as raw material handling, smelting, refining and

			casting, which are very similar to those involved in the production of Cu.
External inhalation exposure	mg/m³	0.05	Read across from measured data from the Copper intermediates
Internal dermal + inhalation systemic (occupational)	mg/kg/d	0.006	Calculated from external exposure based on the methodology outlined in section 9.3.1.4 and the VRAR of Copper (2008).
Risk Characterisation Ratio (combined dermal and inhalation systemic)	-	0.14	The internal DNELs and RCRs are derived from internal NOAELs and absorbed doses. The method for derivation of RCR values for occupational and combined exposure is outlined in section 9.3.1.4 and the VRAR of Copper (2008).
Risk Characterisation Ratio (inhalation local)	-	0.05	
Guidance to DU to evaluate whether he works inside the boundaries set by the ES			
Occupational scaling: The occupational calculator for DUs can be freely downloaded from the http://www.eurocopper.org/copper/reach.html. In the simple and easy-to-use DU-interface, measured inhalation and/or dermal values can be entered. An internal Cu concentration is then calculated and risk conclusion is given.			

F-3: Production of copper alloy shapes, and ingots or melts

It includes:
Contributing ES3 on environmental downstream use scenario of copper (please refer to section F-1)
Contributing ES1 controlling worker exposure: Raw material and scrap handling of massive metal (please refer to section M-1)
Contributing ES7 on worker exposure: particulate, powder handling, mixing blending and weighing, metal (please refer to section M-2)
Contributing ES20 on worker exposure: raw material handling of scrap and fines, milling to fines, (please refer to section M-1)
Contributing ES23 on worker exposure: melting and casting (hereunder).

Contributing exposure scenario (23) controlling worker exposure		
Number of contributing ES		23
Title of contributing ES		Melting and casting
Sector of Use (SU) – Main		3
Process category (PROC) used for exposure assessment		23
Process categories (PROC) used for descriptor purposes		21, 22, 23
Processes and activities covered		
- Alloy production - Melting: melting of copper in a hot melting furnace (temperature ranges between 1000°C and 1100°C); operation is supervised and operated highly automatically. Routine operation for workers: furnace loading, furnace operation and supervision, process control, inspection. - Molten metal is transferred to casts. This can be automated or performed manually (tapping); i.e. breaching the sand or ceramic material holding the molten metal, this flows out through a permanent channel by a worker using a long pole. - Casting can be subdivided, according to the end use of the product, into casting of billets or slabs, casting for sand and die casting and casting for wirerod,… These processes are essentially similar and distinguished mainly by the final manipulation of the product. Casting (e.g. extrusion, drawing, rolling) to form semis and/or items destined for a specific application (e.g. tubes, sheets). Casting is usually continuous or semi-continuous depending on the plant and the application. Billets and wire rod are formed from continuous casting by cutting the cooled copper with a saw. Slabs are casted in a discontinuous manner; ingots may be cast discretely in moulds.		
Product characteristic		
Used in (special) preparation		Yes/No
Content in (special) preparation		>0 - <100%
Physical State		Molten state during process, final product is solid copper in massive form. Exposure to fumes/aerosols, splashes, dust has to be considered.
Dustiness	**Respirable (%)**	12%
	Tracho-bronchial (%)	33%
	Extra-thoracic (%)	55%
	Justification	Read-across from particle size distribution of airborne copper at the smelter, converter based on measured data
Frequency and duration of use/exposure		
Duration		8h/d
Frequency		260d/yr
Human factors not influenced by risk management		
Respiration volume under conditions of use		10 m^3/day
Body weight		70 kg
Other given operational conditions affecting workers exposure		
Indoors/outdoors		Indoors
Process temperature		900-1340°C
Process pressure		Atmospheric pressure
Technical conditions and measures at process level (source) to prevent release		
Level of automatisation		usually automated
Technical conditions and measures to control dispersion from source towards the worker		
Presence of Local Exhaust Ventilation (LEV)?		yes
Minimum efficiency of LEV		90%
Conditions and measures related to personal protection, hygiene and health evaluation		

Specification of Respiratory Protection Equipment (RPE)	Respiratory protection (Full face mask type P1) required for operations outside control room unless occupational monitoring demonstrate safe use without RPE
RPE effectiveness	75%
Specification of gloves	no
Specification of full body dermal protection	no
Specification of eye protection	no

Exposure Assessment

Long term exposure

	Unit	**Exposure concentration**	**Justification**
External dermal exposure	mg/d	85	Following the approach from the Cu VRAR (2008), the analogous substance" approach was taken, by extrapolating from data collected in the zinc industry. The production of Zn metal involves among other processes such as raw material handling, smelting, refining and casting, which are very similar to those involved in the production of Cu.
External inhalation exposure	mg/m^3	0.64	Based on measured data from the Cu VRAR (2008)
Internal dermal + inhalation systemic (occupational)	mg/kg/d	0.024	Calculated from external exposure based on the methodology outlined in section 9.3.1.4 and the VRAR of Copper (2008).
Risk Characterisation Ratio (combined dermal and inhalation systemic)	-	0.59	The internal DNELs and RCRs are derived from internal NOAELs and absorbed doses. The method for derivation of RCR values for occupational and combined exposure is outlined in section 9.3.1.4 and the VRAR of Copper (2008).
Risk Characterisation Ratio (inhalation local)	-	0.64	

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

Occupational scaling: The occupational calculator for DUs can be freely downloaded from the http://www.eurocopper.org/copper/reach.html. In the simple and easy-to-use DU-interface, measured inhalation and/or dermal values can be entered. An internal Cu concentration is then calculated and risk conclusion is given.

IW-1: Use of copper and copper alloy shapes for the production of shapes, ingots and / or copper containing articles

It includes:
Contributing ES3 on environmental downstream use scenario of copper (please refer to section F-1)
Contributing ES1 controlling worker exposure: Raw material and scrap handling of massive metal (please refer to section M-1)
Contributing ES5 on worker exposure: low energy mechanical processing of cold metal (hereunder).
Contributing ES20 on worker exposure: raw material handling of scrap and fines, milling to fines, (please refer to section M-1)
Contributing ES23 on worker exposure: melting and casting, (please refer to section F-3)
Contributing ES26 on worker exposure: surface treatment (hereunder).

Contributing exposure scenario (5) controlling worker exposure		
Number of contributing ES		5
Title of contributing ES		Low energy mechanical processing of cold metal
Sector of Use (SU) – Main		3,21,22
Process category (PROC) used for exposure assessment		21
Process categories (PROC) used for descriptor purposes		21
Processes and activities covered		
Semi-finished products are further processed through a variety of mechanical processes to a variety of copper and copper alloy industrial and consumer products as wires, cables, sheets, profiles and strips: - Machining: all processes in which a workpiece is modified by removing unwanted material in the form of turnings with the aim to obtain the desired shape. This includes: turning, drilling, countersinking, reaming, planning, shaping, broaching, sawing, filing, rasping and grinding - Cold forming - Mechanical polishing (mechanical abrasion) Swaging. Introduction of the workpiece into rolling mills, drawing blocks, Pilger mills and dies. Passage of the metal through the rolls, mills or dies. Straightening, reeling, coiling, levelling, cutting to length, deburring, chamfering, pointing. Coiling, shearing, cutting to length. Removal of the desired product from the machine(s) Loading and feeding the strip or rod into the press or lathe. Pressing or machining the desired shape. Cutting the product from the workpiece. Removal of the desired product, excess metal and offcuts from the press.		
Product characteristic		
Used in (special) preparation		Yes
Content in (special) preparation		>0 - <100%
Physical State		Massive
Dustiness	**Respirable (%)**	12%
	Tracho-bronchial (%)	33%
	Extra-thoracic (%)	55%
	Justification	Read-across from particle size distribution of airborne copper at the smelter, converter based on measured data
Frequency and duration of use/exposure		
Duration		8h/d
Frequency		260d/yr
Human factors not influenced by risk management		
Respiration volume under conditions of use		10 m^3/day
Body weight		70 kg
Other given operational conditions affecting workers exposure		
Indoors/outdoors		Indoors
Process temperature		Room temparture - 100°C
Technical conditions and measures to control dispersion from source towards the worker		
Presence of Local Exhaust Ventilation (LEV)?		yes
Minimum efficiency of LEV		70% if automated, 90% if manual
Conditions and measures related to personal protection, hygiene and health evaluation		
Specification of Respiratory Protection Equipment (RPE)		no

RPE effectiveness			Not revelant
Specification of gloves			no
Specification of full body dermal protection			no
Specification of eye protection			no
Exposure Assessment			
Long term exposure			
	Unit	**Exposure concentration**	**Justification**
External dermal exposure	mg/d	85	Following the approach from the Cu VRAR (2008), the analogous substance" approach was taken, by extrapolating from data collected in the zinc industry. The production of Zn metal involves among other processes such as raw material handling, smelting, refining and casting, which are very similar to those involved in the production of Cu.
External inhalation exposure	mg/m^3	0.33	Based on measured data from the Cu VRAR (2008)
Internal dermal + inhalation systemic (occupational)	mg/kg/d	0.017	Calculated from external exposure based on the methodology outlined in section 9.3.1.4 and the VRAR of Copper (2008).
Risk Characterisation Ratio (combined dermal and inhalation systemic)	-	0.426	The internal DNELs and RCRs are derived from internal NOAELs and absorbed doses. The method for derivation of RCR values for occupational and combined exposure is outlined in section 9.3.1.4 and the VRAR of Copper (2008).
Risk Characterisation Ratio (inhalation local)	-	0.33	
Guidance to DU to evaluate whether he works inside the boundaries set by the ES			
Occupational scaling: The occupational calculator for DUs can be freely downloaded from the http://www.eurocopper.org/copper/reach.html. In the simple and easy-to-use DU-interface, measured inhalation and/or dermal values can be entered. An internal Cu concentration is then calculated and risk conclusion is given.			

Contributing exposure scenario (26) controlling worker exposure			
Number of contributing ES			26
Title of contributing ES			Surface treatment
Sector of Use (SU) – Main			3
Process category (PROC) used for exposure assessment			21
Process categories (PROC) used for descriptor purposes			13, 21, 24
Processes and activities covered			
the application of mechanical or chemical processes to metal shapes and articles to improve or alter surface quality and appearance including: - Mechanical milling to remove oxide layers - Pickling - Chemical treatment or blasting of internal tube surfaces. - Cleaning and stain removal. - Polishing. - Pre-patination.			
Product characteristic			
Used in (special) preparation			Yes
Content in (special) preparation			>0 - <100%
Physical State			Massive
Dustiness	Respirable (%)		12%
	Tracho-bronchial (%)		33%
	Extra-thoracic (%)		55%
	Justification		Read-across from particle size distribution of airborne copper at the smelter, converter based on measured data
Frequency and duration of use/exposure			
Duration			8h/d
Frequency			260d/yr
Human factors not influenced by risk management			
Respiration volume under conditions of use			10 m^3/day
Body weight			70 kg
Other given operational conditions affecting workers exposure			
Indoors/outdoors			Indoors
Technical conditions and measures to control dispersion from source towards the worker			
Presence of Local Exhaust Ventilation (LEV)?			Yes
Minimum efficiency of LEV			90%
Conditions and measures related to personal protection, hygiene and health evaluation			
Specification of Respiratory Protection Equipment (RPE)			no
RPE effectiveness			Not relevant
Specification of gloves			no
Specification of full body dermal protection			no
Specification of eye protection			no

Exposure Assessment			
Long term exposure			
	Unit	**Exposure concentration**	**Justification**
External dermal exposure	mg/d	85	Following the approach from the Cu VRAR (2008), the analogous substance" approach was taken, by extrapolating from data collected in the zinc industry. The production of Zn metal involves among other processes such as raw material handling, smelting, refining and casting, which are very similar to those involved in the production of Cu.
External inhalation exposure	mg/m^3	0.33	Based on "analogous process" approach by extrapolating from

			measured data from the Cu VRAR (2008)
Internal dermal + inhalation systemic (occupational)	mg/kg/d	0.017	Calculated from external exposure based on the methodology outlined in section 9.3.1.4 and the VRAR of Copper (2008).
Risk Characterisation Ratio (combined dermal and inhalation systemic)	-	0.43	The internal DNELs and RCRs are derived from internal NOAELs and absorbed doses. The method for derivation of RCR values for occupational and combined exposure is outlined in section 9.3.1.4 and the VRAR of Copper (2008).
Risk Characterisation Ratio (inhalation local)	-	0.33	
Guidance to DU to evaluate whether he works inside the boundaries set by the ES			
Occupational scaling: The occupational calculator for DUs can be freely downloaded from the http://www.eurocopper.org/copper/reach.html. In the simple and easy-to-use DU-interface, measured inhalation and/or dermal values can be entered. An internal Cu concentration is then calculated and risk conclusion is given.			

IW-2: Use of copper / copper containing alloys as intermediate for production of other copper containing substances

It includes:
Contributing ES3 on environmental downstream use scenario of copper (please refer to section F-1)
Contributing ES1 controlling worker exposure: Raw material and scrap handling of massive metal (please refer to section M-1)
Contributing ES5 on worker exposure: low energy mechanical processing of cold metal (please refer to section IW-1).
Contributing ES20 on worker exposure: raw material handling of scrap and fines, milling to fines, (please refer to section M-1)
Contributing ES23 on worker exposure: melting and casting (please refer to section F-3)
Contributing ES26 on worker exposure: surface treatment (please refer to section IW-1)

IW-3: Use of copper / copper containing alloys for the fabrication of copper containing articles by mechanical processes (such as rolling, extrusion)

It includes:
Contributing ES3 on environmental downstream use scenario of copper (please refer to section F-1)
Contributing ES1 controlling worker exposure: Raw material and scrap handling of massive metal (please refer to section M-1)
Contributing ES5 on worker exposure: low energy mechanical processing of cold metal (please refer to section IW-1).
Contributing ES9 on worker exposure: High energy workup of metal (hereunder).
Contributing ES12 on worker exposure: welding (hereunder).
Contributing ES14 on worker exposure: hot processes (hereunder).
Contributing ES16 on worker exposure: Etching (hereunder)
Contributing ES26 on worker exposure: surface treatment (please refer to section IW-1)

Contributing exposure scenario (9) controlling worker exposure	
Number of contributing ES	9
Title of contributing ES	High energy workup of metal
Sector of Use (SU) – Main	3
Process category (PROC) used for exposure assessment	24
Process categories (PROC) used for descriptor purposes	24
Processes and activities covered	
Changing the microstructure of metals by batch or continuous heating in a controlled atmosphere to improve physical properties I) Fabrication of semis: For further processing the casted slabs or billets are up heated and then transformed either by milling or extrusion. As the following production steps carried out under cold forming conditions the processed semis must be treated by an annealing process in order to reduce the hardness evolved due to the cold forming process. In some cases the produced semis must be treated by stress relieving in order to adjust final conditions. For annealing before cold rolling usually bell type furnaces are used with electric heating or indirectly fired by natural gas or fuel oil. Tower type furnaces are applied for intermediate annealing of pre-rolled coils; they are heated by natural gas and are operated with protection gas. Strand annealing furnaces are in use for final and also for intermediate annealing; this method is a so-called touchless annealing process; surface oxidation is avoided by applying protection gas. II) Fabrication of end user products Several end user products are produced by up heating small pieces of metals and then transformed into goods by die-forging	

Product characteristic			
Used in (special) preparation			Yes
Content in (special) preparation			>0 - <100%
Physical State			Massive
Dustiness	**Respirable (%)**		12%
	Tracho-bronchial (%)		33%
	Extra-thoracic (%)		55%
	Justification		Read-across from particle size distribution of airborne copper at the smelter, converter based on measured data
Frequency and duration of use/exposure			
Duration			8h/d
Frequency			260d/yr
Human factors not influenced by risk management			
Respiration volume under conditions of use			10 m^3/day
Body weight			70 kg
Other given operational conditions affecting workers exposure			
Indoors/outdoors			Indoors
Process temperature			600-800°C
Technical conditions and measures to control dispersion from source towards the worker			
Presence of Local Exhaust Ventilation (LEV)?			yes
Minimum efficiency of LEV			70% if aut, 90% if manual
Conditions and measures related to personal protection, hygiene and health evaluation			
Specification of Respiratory Protection Equipment (RPE)			no
Specification of gloves			no
Specification of full body dermal protection			no
Specification of eye protection			no
Exposure Assessment			
Long term exposure			
	Unit	**Exposure concentration**	**Justification**
External dermal exposure	mg/d	85	Following the approach from the Cu VRAR (2008), the analogous substance" approach was taken, by extrapolating from data collected in the zinc industry. The production of Zn metal involves among other processes such as raw material handling, smelting, refining and casting, which are very similar to those involved in the production of Cu.
External inhalation exposure	mg/m^3	0.2	Based on measured data from the Cu VRAR (2008)
Internal dermal + inhalation systemic (occupational)	mg/kg/d	0.013	Calculated from external exposure based on the methodology outlined in section 9.3.1.4 and the VRAR of Copper (2008).
Risk Characterisation Ratio (combined dermal and inhalation systemic)	-	0.316	The internal DNELs and RCRs are derived from internal NOAELs and absorbed doses. The method for derivation of RCR values for occupational and combined exposure is outlined in section 9.3.1.4 and the VRAR of Copper (2008).
Risk Characterisation Ratio (inhalation local)	-	0.2	
Guidance to DU to evaluate whether he works inside the boundaries set by the ES			
Occupational scaling: The occupational calculator for DUs can be freely downloaded from the http://www.eurocopper.org/copper/reach.html. In the simple and easy-to-use DU-interface, measured inhalation and/or dermal values can be entered. An internal Cu concentration is then calculated and risk conclusion is given.			

Contributing exposure scenario (12) controlling worker exposure		
Number of contributing ES		12
Title of contributing ES		Welding
Sector of Use (SU) – Main		3,21,22
Process category (PROC) used for exposure assessment		25
Processes and activities covered		
Heating of the workpieces and bringing them together to fuse and bond before cooling: including - joining of two pieces of metal by heating the contact points; - joining two pieces of metal by use of heated filler materials It can be made possible or facilitated through the use of auxiliary welding materials such as inert gases, welding powders or pastes. There are more than 80 different types of welding and associated processes. Some of the most common types include: arc welding, which includes "stick", or shielded metal arc welding (SMAW), the gas-shielded methods of metal inert gas (MIG) and tungsten inert gas (TIG), plasma arc welding (PAW), and submerged arc welding (SAW). Other welding processes may use oxy-acetylene gas, electrical current, lasers, electron beams, friction, ultrasonic sound, chemical reactions, heat from fuel gas, and robots.		
Product characteristic		
Used in (special) preparation		Yes
Content in (special) preparation		>0 - <100%
Physical State		Massive, potential exposure to fumes
Dustiness	**Respirable (%)**	12%
	Tracho-bronchial (%)	33%
	Extra-thoracic (%)	55%
	Justification	Read-across from particle size distribution of airborne copper at the smelter, converter based on measured data
Frequency and duration of use/exposure		
Duration		8h/d
Frequency		260d/yr
Human factors not influenced by risk management		
Respiration volume under conditions of use		10 m^3/day
Body weight		70 kg
Other given operational conditions affecting workers exposure		
Indoors/outdoors		Indoors/outdoors
Technical conditions and measures at process level (source) to prevent release		
Level of containment	- Unconfined space for GTAW, SAW, Autogeneous, PAW, ESW/EGW, Resistance, Stud welding, Solid state, Gases brazing, MMAW, FCAW, GMAW, Powder Plasma Arc, Arc Gouging and Cutting, Thermal Spray. - Closed system or confined space for laser welding, laser cutting and electron beam Described processes/abbreviations are according to ISO 4063.	
Technical conditions and measures to control dispersion from source towards the worker		
Presence of Local Exhaust Ventilation (LEV)?	- Low general exhaust ventilation for GTAW, SAW, Autogeneous, PAW, ESW/EGW, Resistance, Stud welding, Solid state, Gases brazing - Low general exhaust ventilation and low LEV for MMAW, FCAW - High LEV for GMAW, powder plasma arc - High LEV and reduced (negative) pressured area for Arc Gouging and Cutting, Thermal spraying - Medium general exhaust ventilation for laser welding, laser cutting and electron beam - High LEV and externel air supply for all other welding processes in closed system or confined space Described processes/abbreviations are according to ISO 4063.	
Minimum efficiency of LEV	General exhaust ventilation medium is double compared to low. General ventilation low. When no LEV, the ventilation requirement is 5-fold.	
Conditions and measures related to personal protection, hygiene and health evaluation		
Specification of Respiratory Protection Equipment (RPE)		No
RPE effectiveness		Not relevant
Specification of gloves		Yes
Specification of full body dermal protection		no
Specification of eye protection		no

Exposure Assessment			
Long term exposure			
	Unit	**Exposure concentration**	**Justification**
External dermal exposure	mg/d	Negligible	Based on protection due to gloves
External inhalation exposure	mg/m³	0.2	Based on MEASE predictions (Version 1.01) (assuming PROC 25, professional use, FF P3, 95%)
Internal dermal + inhalation systemic (occupational)	mg/kg/d	0.01	Calculated from external exposure based on the methodology outlined in section 9.3.1.4 and the VRAR of Copper (2008).
Risk Characterisation Ratio (combined dermal and inhalation systemic)	-	0.26	The internal DNELs and RCRs are derived from internal NOAELs and absorbed doses. The method for derivation of RCR values for occupational and combined exposure is outlined in section 9.3.1.4 and the VRAR of Copper (2008).
Risk Characterisation Ratio (inhalation local)	-	0.01	
Guidance to DU to evaluate whether he works inside the boundaries set by the ES			
Occupational scaling: The occupational calculator for DUs can be freely downloaded from the http://www.eurocopper.org/copper/reach.html. In the simple and easy-to-use DU-interface, measured inhalation and/or dermal values can be entered. An internal Cu concentration is then calculated and risk conclusion is given.			

Contributing exposure scenario (14) controlling worker exposure		
Number of contributing ES		14
Title of contributing ES		Hot processes
Sector of Use (SU) – Main		3
Process category (PROC) used for exposure assessment		24
Process categories (PROC) used for descriptor purposes		24
Processes and activities covered		
Manufacture of semi-finished products from heated shapes • Billets or slabs of metal are heated and extruded or rolled to produce resp. rods, profiles and tube forms, and strip. Hot worked products are cold worked by drawing or rolling with or without intermediate or final annealing, pickling and cleaning. Some initial semi-manufactured forms may be produced by near net shape casting, or by heating and forming under pressure (Conform). Ultra thin foils are produced by electro-deposition rather than rolling. - Hot forming - Rolling: pre-heating, hot rolling and miling, intermediate annealing, cold rolling, pickling, washing and drying, re-rolling and strand annealing, finishing, cutting to length and/or width - Extrusion and drawing: - The whole process, started by the extrusion press or the hot piercing mill, is a sequence of (mostly) reducing steps changing shape and size. During these processing steps the tools of the equipment for size and shape changing are cooled and protected by adequate media, using emulsion for the breakdown rolling and lubricants for the drawing units.		
Product characteristic		
Used in (special) preparation		Yes
Content in (special) preparation		>0 - <100%
Physical State		Massive
Dustiness	**Respirable (%)**	12%
	Tracho-bronchial (%)	33%
	Extra-thoracic (%)	55%
	Justification	Read-across from particle size distribution of airborne copper at the smelter, converter based on measured data
Frequency and duration of use/exposure		
Duration		8h/d
Frequency		260d/yr
Human factors not influenced by risk management		
Respiration volume under conditions of use		10 m^3/day
Body weight		70 kg
Other given operational conditions affecting workers exposure		
Indoors/outdoors		Indoors
Process temperature		650-1000°C
Technical conditions and measures to control dispersion from source towards the worker		
Presence of Local Exhaust Ventilation (LEV)?		yes
Minimum efficiency of LEV		70% if automated, 90% if manual
Conditions and measures related to personal protection, hygiene and health evaluation		
Specification of Respiratory Protection Equipment (RPE)		no
Specification of gloves		no
Specification of full body dermal protection		no
Specification of eye protection		no

Exposure Assessment			
Long term exposure			
	Unit	**Exposure concentration**	**Justification**
External dermal exposure	mg/d	85	Following the approach from the Cu VRAR (2008), the analogous substance" approach was taken, by extrapolating from data collected in the zinc industry. The production of Zn metal involves

			among other processes such as raw material handling, smelting, refining and casting, which are very similar to those involved in the production of Cu.
External inhalation exposure	mg/m^3	0.2	Based on measured data from the Cu VRAR (2008)
Internal dermal + inhalation systemic (occupational)	mg/kg/d	0.013	Calculated from external exposure based on the methodology outlined in section 9.3.1.4 and the VRAR of Copper (2008).
Risk Characterisation Ratio (combined dermal and inhalation systemic)	-	0.316	The internal DNELs and RCRs are derived from internal NOAELs and absorbed doses. The method for derivation of RCR values for occupational and combined exposure is outlined in section 9.3.1.4 and the VRAR of Copper (2008).
Risk Characterisation Ratio (inhalation local)	-	0.2	
Guidance to DU to evaluate whether he works inside the boundaries set by the ES			
Occupational scaling: The occupational calculator for DUs can be freely downloaded from the http://www.eurocopper.org/copper/reach.html. In the simple and easy-to-use DU-interface, measured inhalation and/or dermal values can be entered. An internal Cu concentration is then calculated and risk conclusion is given.			

Contributing exposure scenario (16) controlling worker exposure			
Number of contributing ES			16
Title of contributing ES			Etching
Sector of Use (SU) – Main			3, 22
Process category (PROC) used for exposure assessment			13
Process category (PROC) used for descriptor purposes			13
Processes and activities covered			
Use of acid to cut into unprotected parts of a copper plate to create a design or outline; used for print-making and industrial production of interconnects and printed circuit boards etc. This includes: - Preparing the surface of the target. - Blanking the parts not to be etched. - Exposure of the target to acid. - Using the etched outline as product or for printing. - Coating the component with copper followed by selective Chemical-Mechanical removal of the copper to leave the desired copper pattern.			
Product characteristic			
Used in (special) preparation			Yes
Content in (special) preparation			>0 - <100%
Physical State			Massive, potential exposure to fumes
D=tiness	Respirable (%)		12%
	Tracho-bronchial (%)		33%
	Extra-thoracic (%)		55%
	Justification		Read-across from particle size distribution of airborne copper at the smelter, converter based on measured data
Frequency and duration of use/exposure			
Duration			8h/d
Frequency			260d/yr
Human factors not influenced by risk management			
Respiration volume under conditions of use			10 m^3/day
Body weight			70 kg
Other given operational conditions affecting workers exposure			
Indoors/outdoors			Indoors
Process temperature			Room temperature
Process pressure			Atmospheric pressure
Technical conditions and measures at process level (source) to prevent release			
Level of containment			largely closed for industrial use, open for professional use
Level of automatisation			largely automated for industrial use
Technical conditions and measures to control dispersion from source towards the worker			
Presence of Local Exhaust Ventilation (LEV)?			yes
Minimum efficiency of LEV			70% if aut., 90% if manual
Conditions and measures related to personal protection, hygiene and health evaluation			
Specification of Respiratory Protection Equipment (RPE)			Yes (P2) if no LEV present unless occupational monitoring demonstrate safe use without RPE
RPE effectiveness			90%
Specification of gloves			no
Specification of full body dermal protection			no
Specification of eye protection			no
Exposure Assessment			
Long term exposure			
	Unit	Exposure concentration	Justification

External dermal exposure	mg/d	240	Based on MEASE predictions
External inhalation exposure	mg/m^3	0.01	Based on MEASE predictions (Version 1.01)
Internal dermal + inhalation systemic (occupational)	mg/kg/d	0.008	Calculated from external exposure based on the methodology outlined in section 9.3.1.4 and the VRAR of Copper (2008).
Risk Characterisation Ratio (combined dermal and inhalation systemic)	-	0.19	The internal DNELs and RCRs are derived from internal NOAELs and absorbed doses. The method for derivation of RCR values for occupational and combined exposure is outlined in section 9.3.1.4 and the VRAR of Copper (2008).
Risk Characterisation Ratio (inhalation local)	-	0.01	
Guidance to DU to evaluate whether he works inside the boundaries set by the ES			
Occupational scaling: The occupational calculator for DUs can be freely downloaded from the http://www.eurocopper.org/copper/reach.html. In the simple and easy-to-use DU-interface, measured inhalation and/or dermal values can be entered. An internal Cu concentration is then calculated and risk conclusion is given.			

IW-4: Use of copper / copper containing alloys for the fabrication of wire rod

It includes:
Contributing ES3 on environmental downstream use scenario of copper (please refer to section F-1)
Contributing ES1 controlling worker exposure: Raw material and scrap handling of massive metal (please refer to section M-1)
Contributing ES5 on worker exposure: low energy mechanical processing of cold metal (please refer to section IW-1).
Contributing ES13 on worker exposure: Continuous wire rod production (hereunder)
Contributing ES23 on worker exposure: melting and casting (please refer to section F-3)
Contributing ES26 on worker exposure: surface treatment (please refer to section IW-1)

Contributing exposure scenario (13) controlling worker exposure		
Number of contributing ES		13
Title of contributing ES		Wire rod production
Sector of Use (SU) – Main		3
Process category (PROC) used for exposure assessment		13
Process categories (PROC) used for descriptor purposes		13
Processes and activities covered		
Production of wire rod by immersion of seed rod in molten metal. This includes: - Charging of bath with raw material. - Copper cathodes are melted and cast in a continuous process into a rotating mould into a bar - The bar is rolled in line into a circular rod from, cooled, pickled, coiled and cut to required batch sizes.		
Product characteristic		
Used in (special) preparation		Yes
Content in (special) preparation		>0 - <100%
Physical State		Massive
Dustiness	**Respirable (%)**	12%
	Tracho-bronchial (%)	33%
	Extra-thoracic (%)	55%
	Justification	Read-across from particle size distribution of airborne copper at the smelter, converter based on measured data
Frequency and duration of use/exposure		
Duration		8h/d
Frequency		260d/yr
Human factors not influenced by risk management		
Respiration volume under conditions of use		10 m3/day
Body weight		70 kg
Other given operational conditions affecting workers exposure		
Indoors/outdoors		Indoors
Process pressure		Atmospheric pressure
Technical conditions and measures to control dispersion from source towards the worker		

<table>
<tr><td colspan="3">Presence of Local Exhaust Ventilation (LEV)?</td><td>yes</td></tr>
<tr><td colspan="3">Minimum efficiency of LEV</td><td>90%</td></tr>
<tr><td colspan="4">Conditions and measures related to personal protection, hygiene and health evaluation</td></tr>
<tr><td colspan="3">Specification of Respiratory Protection Equipment (RPE)</td><td>no</td></tr>
<tr><td colspan="3">RPE effectiveness</td><td>no</td></tr>
<tr><td colspan="3">Specification of gloves</td><td>no</td></tr>
<tr><td colspan="3">Specification of full body dermal protection</td><td>no</td></tr>
<tr><td colspan="3">Specification of eye protection</td><td>no</td></tr>
<tr><td colspan="4">Exposure Assessment</td></tr>
<tr><td colspan="4">Long term exposure</td></tr>
<tr><td></td><td>Unit</td><td>Exposure concentration</td><td>Justification</td></tr>
<tr><td>External dermal exposure</td><td>mg/d</td><td>240</td><td>Based on MEASE predictions</td></tr>
<tr><td>External inhalation exposure</td><td>mg/m^3</td><td>0.1</td><td>Based on MEASE predictions (Version 1.01)</td></tr>
<tr><td>Internal dermal + inhalation systemic (occupational)</td><td>mg/kg/d</td><td>0.013</td><td>Calculated from external exposure based on the methodology outlined in section 9.3.1.4 and the VRAR of Copper (2008).</td></tr>
<tr><td>Risk Characterisation Ratio (combined dermal and inhalation systemic)</td><td>-</td><td>0.31</td><td>The internal DNELs and RCRs are derived from internal NOAELs and absorbed doses. The method for derivation of RCR values for occupational and combined exposure is outlined in section 9.3.1.4 and the VRAR of Copper (2008).</td></tr>
<tr><td>Risk Characterisation Ratio (inhalation local)</td><td>-</td><td>0.1</td><td></td></tr>
<tr><td colspan="4">Guidance to DU to evaluate whether he works inside the boundaries set by the ES</td></tr>
<tr><td colspan="4">Occupational scaling: The occupational calculator for DUs can be freely downloaded from the http://www.eurocopper.org/copper/reach.html. In the simple and easy-to-use DU-interface, measured inhalation and/or dermal values can be entered. An internal Cu concentration is then calculated and risk conclusion is given.</td></tr>
</table>

IW-9: Coating and electroplating

It includes:
Contributing ES3 on environmental downstream use scenario of copper (please refer to section F-1)
Contributing ES11 on worker exposure: coating and electroplating (hereunder).
Contributing ES25 on worker exposure: electrodeposition (hereunder).

Contributing exposure scenario (11) controlling worker exposure			
Number of contributing ES			11
Title of contributing ES			Coating & Electroplating
Sector of Use (SU) – Main			3
Process category (PROC) used for exposure assessment			13
Process categories (PROC) used for descriptor purposes			13
Processes and activities covered			
plating of copper onto product or material using a copper plating anode			
Product characteristic			
Used in (special) preparation			Yes
Content in (special) preparation			>0 - <100%
Physical State			Massive
Dustiness	Respirable (%)		12%
	Tracho-bronchial (%)		33%
	Extra-thoracic (%)		55%
	Justification		Read-across from particle size distribution of airborne copper at the smelter, converter based on measured data
Frequency and duration of use/exposure			
Duration			8h/d
Frequency			260d/yr
Human factors not influenced by risk management			
Respiration volume under conditions of use			10 m^3/day
Body weight			70 kg
Other given operational conditions affecting workers exposure			
Indoors/outdoors			Indoors
Process temperature			Room temperature
Process pressure			Atmospheric pressure
Technical conditions and measures to control dispersion from source towards the worker			
Presence of Local Exhaust Ventilation (LEV)?			yes
Minimum efficiency of LEV			90%
Conditions and measures related to personal protection, hygiene and health evaluation			
Specification of Respiratory Protection Equipment (RPE)			no
RPE effectiveness			Not relevant
Specification of gloves			no
Specification of full body dermal protection			no
Specification of eye protection			no
Exposure Assessment			
Long term exposure			
	Unit	Exposure concentration	Justification
External dermal exposure	mg/d	240	Based on MEASE predictions
External inhalation exposure	mg/m^3	0.1	Based on MEASE predictions (Version 1.01)

Internal dermal + inhalation systemic (occupational)	mg/kg/d	0.013	Calculated from external exposure based on the methodology outlined in section 9.3.1.4 and the VRAR of Copper (2008).
Risk Characterisation Ratio (combined dermal and inhalation systemic)	-	0.31	The internal DNELs and RCRs are derived from internal NOAELs and absorbed doses. The method for derivation of RCR values for occupational and combined exposure is outlined in section 9.3.1.4 and the VRAR of Copper (2008).
Risk Characterisation Ratio (inhalation local)	-	0.1	
Guidance to DU to evaluate whether he works inside the boundaries set by the ES			
Occupational scaling: The occupational calculator for DUs can be freely downloaded from the http://www.eurocopper.org/copper/reach.html. In the simple and easy-to-use DU-interface, measured inhalation and/or dermal values can be entered. An internal Cu concentration is then calculated and risk conclusion is given.			

Contributing exposure scenario (25) controlling worker exposure		
Number of contributing ES		25
Title of contributing ES		Electrodeposition
Sector of Use (SU) – Main		3
Process category (PROC) used for exposure assessment		4
Process categories (PROC) used for descriptor purposes		27b
Processes and activities covered		
Dissolution of copper in acid. Plating of copper from the liquor on a resolving titanium drum. Continuous removal of the plated copper layer as a foil strip. Shearing of the coil to length.		
Product characteristic		
Used in (special) preparation		Yes
Content in (special) preparation		>0 - <100%
Physical State		Massive
Dustiness	**Respirable (%)**	12%
	Tracho-bronchial (%)	33%
	Extra-thoracic (%)	55%
	Justification	Read-across from particle size distribution of airborne copper at the smelter, converter based on measured data
Frequency and duration of use/exposure		
Duration		8h/d
Frequency		260d/yr
Human factors not influenced by risk management		
Respiration volume under conditions of use		10 m^3/day
Body weight		70 kg
Other given operational conditions affecting workers exposure		
Indoors/outdoors		Indoors
Process temperature		Room temperature
Process pressure		Atmospheric pressure
Technical conditions and measures at process level (source) to prevent release		
Level of containment		closed system
Technical conditions and measures to control dispersion from source towards the worker		
Presence of Local Exhaust Ventilation (LEV)?		no
Minimum efficiency of LEV		Not revelant
Conditions and measures related to personal protection, hygiene and health evaluation		
Specification of Respiratory Protection Equipment (RPE)		no
RPE effectiveness		Not revelant
Specification of gloves		yes
Specification of full body dermal protection		no
Specification of eye protection		no
Exposure Assessment		

Long term exposure			
	Unit	Exposure concentration	Justification
External dermal exposure	mg/d	Negligible	Based on protection due to gloves
External inhalation exposure	mg/m^3	0.05	Based on MEASE predictions (Version 1.01)
Internal dermal + inhalation systemic (occupational)	mg/kg/d	0.006	Calculated from external exposure based on the methodology outlined in section 9.3.1.4 and the VRAR of Copper (2008).
Risk Characterisation Ratio (combined dermal and inhalation systemic)	-	0.14	The internal DNELs and RCRs are derived from internal NOAELs and absorbed doses. The method for derivation of RCR values for occupational and combined exposure is outlined in section 9.3.1.4 and the VRAR of Copper (2008).
Risk Characterisation Ratio (inhalation local)	-	0.006	
Guidance to DU to evaluate whether he works inside the boundaries set by the ES			
Occupational scaling: The occupational calculator for DUs can be freely downloaded from the http://www.eurocopper.org/copper/reach.html. In the simple and easy-to-use DU-interface, measured inhalation and/or dermal values can be entered. An internal Cu concentration is then calculated and risk conclusion is given.			

PW-3: Professional use of copper solder

It includes:
Contributing ES 4 for controlling environmental wide dispersive use scenario
Contributing ES 12 for worker on welding (please refer to section IW-3)

Contributing ES4 controlling local wide dispersive use of copper

Use descriptors

ERC 8a, 8b, 8c, 8d, 8e, 8f, 9a, 9b, 10a, 10b, 11a, 11b

Additional information

This generic exposure scenario has been created based on measured copper concentrations in effluents from municipal STPs

Conditions of Use

Product characteristics

Copper is used in a variety of formulations or articles used by professional users, consumers and during service life

Amounts used

Total amounts used are not relevant since the assessment is done based on effluent concentrations from STPs

Frequency and duration of use

Releases occur for 365 day/year, it’s a wide dispersive use and STPs are also operating 365 day/year.

Environment factors not influenced by risk management

Information type	Dilution factor	Remarks
Selected for Exposure Scenario	10	Freshwater default

Other given operational conditions affecting environmental exposure

Indoor or outdoor use of products containing copper is possible; copper can be used in formulations that go down the drain but also in articles with non-intended releases.

Conditions and measures related to municipal sewage treatment plant

All releases are going directly into a municipal sewer. The releases are treated in an STP with removal efficiency for copper of 80 %. The STP is dimensioned according to the defaults in EUSES. I.e. 10,000 inhabitants equivalents and 2,000 m^3/day water treated per day.

Copper concentrations in effluents of municipal STPs have been collected from the Cu VRAR

Country	**RWC-ambient $PEC_{STP\text{-}effluent}$**	
	Cu_{total} (µg/L)	**$Cu_{dissolved}$ (µg/L)**
Belgium	11.1	-
The Netherlands	15.1	-
United Kingdom	54.0	8.1

Additionally more recent data from Flanders (Belgium region) has been optained from the VMM. The data has been analysed and treated the same way as in the Cu VRAR and summarized below.

Flanders data for different year	**Cu_{total} (µg/L)**
2011	18.3
2012	18.8
2013	16.0

For countries for which no $Cu_{dissolved}$ data is available the total value will be taken forward to risk characterization taking into account partitioning in the river. A second risk characterization with $Cu_{dissolved}$ will be performed without partitioning in the river.

The RWC 90th percentile for total Cu concentrations taken forward is 18.8 µg Cu/L (Flanders 2012) and reflect the situation of a realistic worst case region, Flanders (Belgium), in terms of population density, and density of agricultural and industrial activities. Note that the PNECs are expressed in Cu dissolved, using PECtotal values for the STP represents a worst case.

The RWC 90th percentile for dissolved Cu concentrations taken forward is 8.1 µg Cu/L (UK 2000).

Exposure estimation and reference to its source

	Compartment	Operational conditions	Value	Unit	PNEC	RCR
ES A	PEC stp	90th P of total copper conc. in effluents of STPs in the Flemish region: 18.8 µg Cu/L	18.8	µg/L	230	0.08
	PEC freshwater		4.2	µg/L	7.8	0.54
	PEC sediment		39.1	mg/kg dw	87	0.45
	PEC soil		28.0	mg/kg dw	65	0.43
ES B	PEC stp	90th P of dissolved copper conc. in effluents of STPs in the UK: 8.1 µg Cu/L	8.1	µg/L	230	0.04
	PEC freshwater		3.7	µg/L	7.8	0.48
	PEC sediment		24.5	mg/kg dw	87	0.28
	PEC soil		25.9	mg/kg dw	65	0.40

C-3: Use of copper solder

It includes:
Contributing ES 4 for controlling environmental wide dispersive use scenario (please refer to section PW-3
Contributing ES 12 for worker on welding (please refer to section IW-3)

SL-1: Professional installation and maintenance or use of copper containing articles

It includes:
Contributing ES 4 for controlling environmental wide dispersive use scenario (please refer to section PW-3)
Contributing ES 18 Consumer exposure to copper metal, copper powder or copper containing products

Contributing exposure scenario (18) controlling consumer exposure	
Number of contributing ES	18
Title of contributing ES	Consumer exposure to copper metal, copper powder or copper containing products
Sector of Use (SU) – Main	21.22
Product Categories (PC)	3, 5,7,8,9,14,18,21,24,25,26,31,32,35,39
Processes and activities covered	
This scenario includes a variety of downstream uses: - Spraying, dipping, pouring, curing, film formation (heat, UV) of coatings and inks - End use of cosmetics - End use of cleaning and body care - Plastics - Aerosol, spray can - Biocidal use - Lubricants, additives in combination with inks and coatings - End use of friction linings - End use of sintered parts/bearing - End use of diamond tools	
Product characteristic	
A distinction is made between copper powder containing consumer products and massive copper products: • Copper powder concentrations in consumer products is usually low (<1%). Copper content in paint (to give a metallic look) can be as high as 25%. The physical state is usually liquid/slurry. • Massive and sintered copper products are solid (low dustiness) and can contain higher copper concentrations such as for jewellery cutlery and coins.	
Exposure Assessment	
Consumer exposure scenario for combined occupational and consumer assessment The consumer exposure scenarios are not directly relevant to these workers. It is also assumed that copper industry workers are unlikely to take copper in dietary supplements. Therefore, for the purpose of combining occupational and consumer exposures for this group, a separate consumer scenario is considered following the Cu VRAR. As typical consumer scenario for workers, it will be assumed workers are exposed via the dermal route to 0.14 mg Cu/day to coins and to 4.3E-6 mg Cu/day via haircare products (Cu VRAR, 2008). As RWC consumer scenario for workers it will be assumed workers are exposed via the dermal route to 0.28 mg Cu/day to coins, to 1.4E-5 mg Cu/day via haircare products and via the inhalation route to 0.001 mg Cu/person/day by smoking cigarettes (Cu VRAR, 2008). Consumer exposure scenario The exposure estimation for the consumer exposure only can be found below.	
Routes of exposure	
The most relevant routes of exposures are summarized below. Selection of the worst-case exposure route is based on consumer exposure estimations from Cu VRAR (2008), summarized in **Fehler! Verweisquelle konnte nicht gefunden werden.**.	

	Inhalation	**Dermal**	**Oral**
Massive or sintered copper products	Not relevant	Dermal contact to handling of coins, copper jewellery	Not relevant

Copper powder containing preparations	Inhalation exposure through unintentional use cigarette smoking	Dermal contact to face cream, haircare products, paint	Oral exposure through food supplements
Worst-case exposure considered in generic consumer exposure scenario	Inhalation exposure through unintentional use cigarette smoking	Dermal exposure through paint	Oral exposure through food supplements
External exposure (mg/person/day)	Typical: none Reasonable worst-case: 0.0005	Typical: none Reasonable worst-case: 4.03	Typical: nonen Reasonable worst-case: 2
Long term exposure			

	Unit	**Exposure concentration**	**Justification**
Internal dermal + inhalation systemic (occupational)	mg/kg BW/d	1.9E-2	Reasonable worst-case internal exposure estimate from Cu VRAR (2008)
Risk Characterisation Ratio (combined dermal and inhalation)	-	0.46	Based on NOAEL for repeated dose effects of 4.075 mg/kg/day and an assessment factor of 100 (Cu VRAR, 2008)

SL-2: Consumer use of articles with expected dermal exposure – indoors

It includes:
Contributing ES 4 for controlling environmental wide dispersive use scenario (please refer to section PW-3)
Contributing ES 18 Consumer exposure to copper metal, copper powder or copper containing products (please refer to section SL-1)

SL-3: Consumer use of articles with no expected dermal exposure – indoors

It includes:
Contributing ES 4 for controlling environmental wide dispersive use scenario (please refer to section PW-3)
Contributing ES 18 Consumer exposure to copper metal, copper powder or copper containing products (please refer to section SL-1).

SL-4: Consumer use of articles with expected dermal exposure – outdoors

It includes:
Contributing ES 4 for controlling environmental wide dispersive use scenario (please refer to section PW-3)
Contributing ES 18 Consumer exposure to copper metal, copper powder or copper containing products (please refer to section SL-2)

SL-5: Professional use of copper containing semi-finished articles in the production finished articles or of "components" for other articles

It includes:
Contributing ES 4 for controlling environmental wide dispersive use scenario (please refer to section PW-3)
Contributing ES 18 Consumer exposure to copper metal, copper powder or copper containing products (please refer to section SL-1)