Annex: Exposure Scenarios

ES 1 Primary lead production

1. Title		
Identified Use	Use of concentrates and other lead bearing materials in primary lead production	
Systemic title based on use descriptor	PC7, ERC1	
2. Operational conditions and risk management measures		
Involved PROCs	Involved Tasks	
PROC 26	Raw material handling: ore/concentrate delivery, loading/unloading, and furnace feed mixing	
PROC 22, 8b	Sintering: feeding/unloading, sinter plant operation	
PROC 22, 1, 2	Smelting: furnace operation (blast, rotary, and reverbatory furnaces)	
PROC 23	Refining and casting: decopperisation, softening (As, Sb, Sn removal), silver separation, zinc distillation, casting of lead ingots/slabs or lead alloy ingots	
PROC 21	Internal logistics: storage and shipment of finished goods, intra-facility transport	
PROC 28	Others: repair, cleaning, and maintenance, quality control, and engineering	
2.1 Control of workers exposure		
Product characteristic	Raw material is principally lead concentrates, although some scrap metallic lead, used lead-acid batteries, production residues, ashes, sludge and filter dust may be used. These materials will have varying levels of dustiness. The product is massive lead metal, usually as ingots or bars with low dust.	
Amounts used	Not restricted	
Frequency and duration of use/exposure	Full shift (8 hours) exposure for all workplaces other than sintering (part shifts, < 8 hours)	
Human factors not influenced by risk management	See Section 8 of the SDS, above (hygiene measures affecting lead blood levels)	
Other given operational conditions affecting workers exposure	Outdoor handling of bulk ores and raw materials Indoor handling, room volume >1000 m^3	
Technical conditions and measures at process level (source) to prevent release	Full containment of furnace operations, reaction vessels and other handling operations. Manual handling of ores and finished metal.	
Technical conditions and measures to control dispersion from source towards the worker	Controls give 78% minimum worker exposure reduction. Risk Management Measures include enclosure of process equipment, negative draft exhaust systems and/or local exhaust ventilation. Pass waste air through cleaning equipment.	
Organisational measures to prevent /limit releases, dispersion and exposure	See Section 8 of the core SDS, above.	
Conditions and measures related to personal protection, hygiene and health evaluation	Minimum Respiratory Protective Equipment (RPE) is FFP 2 mask, except in cases where adequate ventilation/emission control in place (see also section 8).	
2.2 Control of environmental exposure		
Amounts used	26,000 tonnes/annum/site	
Frequency and duration of use	Continuous use/release, up to 326 days/year	
Environment factors not influenced by risk management	Dilution factor (Freshwater): 10 Dilution factor (Marine): 100	
Other given operational conditions affecting environmental exposure	Not applicable	
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	See Section 8 of the SDS, above.	
	Estimated fraction released to water (g/tonne):	0.26
	Estimated fraction released to air (g/tonne):	25.41
Organisational measures to prevent/limit release from site	See Section 8 of the SDS, above.	

Conditions and measures related to external treatment of waste for disposal	Different Pb-bearing wastes resulting from the processes described above are generated in the form of dross, flue dust, slag. These waste products are mainly recycled in the production process or landfilled.			
3 Exposure estimation				
Health Exposure Estimations (based on measures outlined in section 2.1)		Blood Lead Levels	Derived No-Effect Level	Risk Characterisation Ratio
	Blood lead concentrations for workers (90th Percentile):	28.3 µg/dL	40.0 µg/dL	0.71
Environmental Exposure Estimations (based on measures outlined in section 2.2)		Predicted Exposure Concentrations (Maximum)	Predicted No Effect Concentrations	Risk Characterisation Ratio
	Freshwater:	0.91 µg/l	2.4 µg/l	0.38
	Marine:	0.051 µg/l	3.3 µg/l	0.02
	Freshwater sediment:	164.15 mg/kg dw	186 mg/kg dw	0.88
	Marine water sediment:	60.72 mg/kg dw	168 mg/kg dw	0.36
	Terrestrial:	28.52 mg/kg dw	212.0 mg/kg dw	0.13
	Sewage treatment plant:	0.012 mg/l	0.1 mg/l	0.12
4 Guidance to DU to evaluate whether they work inside the boundaries set by the ES				
The DU works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the downstream user can demonstrate on his own that his implemented risk management measures are adequate. Detailed guidance for evaluation of ES can be acquired via your supplier or from the ECHA website (guidance R14, R16). For environmental exposure, a DU-Scaling tool (free download: http://www.arche-consulting.be/Metal-CSA-toolbox/du-scaling-tool) is available. For human health, exposure (as measured blood lead levels) must be below the DNEL: DNEL for male workers: 40 µg/dL DNEL for female workers of reproductive capacity: 10 µg/dL				

ES 2: Secondary lead production

1. Title	
Identified Use	Use of lead-batteries and scrap in secondary lead production
Systemic title based on use descriptor	ERC 1; PC 7
2. Operational conditions and risk management measures	
Involved PROCs	Involved Tasks
PROC 8b, 26	Raw material handling: storage, transport and handling of batteries and other lead scrap
PROC 2	Shredding and sorting: for batteries, separation of sulphuric acid, shredding (breaking), grid-separation, elution of PbO-paste, also sorting of other lead scrap
PROC 4	Desulphurisation: sulphur removal from PbO-paste
PROC 22	Melting and smelting: melting of grids, smelting and reduction of paste
PROC23	Refining and casting: refining of lead, casting of ingots
PROC21	Storage, shipment and transport: storage and shipment of finished goods, intra-facility transport
PROC28	Repair, cleaning and maintenance
2.1 Control of workers exposure	
Product characteristic	Raw material is principally lead scrap, used lead batteries, drosses and battery oxides. These materials will have varying levels of dustiness. The product is massive lead metal, usually as ingots.
Amounts used	Not restricted

Frequency and duration of use/exposure	Full shift exposure (8 hours) for all workplaces (not restricted).			
Human factors not influenced by risk management	See Section 8 of the SDS, above (hygiene measures affecting lead blood levels)			
Other given operational conditions affecting workers exposure	Indoor handling, room volume >1000 m^3			
Technical conditions and measures at process level (source) to prevent release	Enclosed system for melting of grids, smelting and reduction of paste.			
Technical conditions and measures to control dispersion from source towards the worker	Controls give 78% minimum worker exposure reduction. Risk Management Measures include enclosure of process equipment, dilution ventilation and/or local exhaust ventilation. Pass waste air through cleaning equipment. Separation of workers via control room for melting of grids, smelting and reduction of paste. Protective gloves to be worn.			
Organisational measures to prevent /limit releases, dispersion and exposure	See Section 8 of the core SDS, above.			
Conditions and measures related to personal protection, hygiene and health evaluation	Minimum Respiratory Protective Equipment (RPE) is FFP 2 mask, except in cases where adequate ventilation/emission control in place (see also section 8).			
2.2 Control of environmental exposure				
Amounts used	13,000 tonnes/annum/site			
Frequency and duration of use	Continuous use/release, up to 345 days/year			
Environment factors not influenced by risk management	Dilution factor (Freshwater): 10 Dilution factor (Marine): 100			
Other given operational conditions affecting environmental exposure	Not applicable			
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	See Section 8 of the SDS, above.			
	Estimated fraction released to water (g/tonne):	0.018		
	Estimated fraction released to air (g/tonne):	154.65		
Organisational measures to prevent/limit release from site	See Section 8 of the SDS, above.			
Conditions and measures related to external treatment of waste for disposal	Pb-bearing wastes resulting from the processes described above are generated in the form of solids (e.g. slags, matte). These should be treated by a licensed waste treatment operator (landfilled or incinerated) according to relevant waste regulation.			
3 Exposure estimation				
Health Exposure Estimations (based on measures outlined in section 2.1)		Blood Lead Levels	Derived No-Effect Level	Risk Characterisation Ratio
	Blood lead concentrations for workers (90^{th} Percentile):	24.2 µg/dL	40.0 µg/dL	0.61
Environmental Exposure Estimations (based on measures outlined in section 2.2)		Predicted Exposure Concentrations (Maximum)	Predicted No Effect Concentrations	Risk Characterisation Ratio
	Freshwater:	0.84 µg/l	2.4 µg/l	0.35
	Marine:	0.051 µg/l	3.3 µg/l	0.02
	Freshwater sediment:	166.07 mg/kg dw	186 mg/kg dw	0.89
	Marine water sediment:	60.95 mg/kg dw	168 mg/kg dw	0.36
	Terrestrial:	29.30 mg/kg dw	212.0 mg/kg dw	0.14
	Sewage treatment plant:	12 µg/l	100 µg/l	0.12
4 Guidance to DU to evaluate whether they work inside the boundaries set by the ES				
The DU works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the downstream user can demonstrate on his own that his implemented risk management measures are adequate. Detailed guidance for evaluation of ES can be acquired via your supplier or from the ECHA website (guidance R14, R16). For environmental exposure, a DU-Scaling tool (free download: http://www.arche-consulting.be/Metal-CSA-toolbox/du-scaling-tool) is available. For human health, exposure (as measured blood lead levels) must be below the DNEL:				

DNEL for male workers:	40 µg/dL
DNEL for female workers of reproductive capacity:	10 µg/dL

ES 3: Lead Battery Production

1. Title		
Identified Use	Use of lead in lead battery production, also incorporating the manufacture and use of lead monoxide, pentalead tetraoxide sulphate and tetralead trioxide sulphate	
Systemic title based on use descriptor	SU16, SU17; ERC 5, ERC 6a; AC 1, AC 2, AC 3	
2. Operational conditions and risk management measures		
Involved PROCs	Involved Tasks	
PROC 3, 21, 22, 23	Plate manufacturing: Casting/production of grids, oxide production, mixing, pasting, and curing operations	
PROC 4, 21	Plate treatment: Jar/tank formation, plate washing, drying, cutting	
PROC 21, 25, 26	Assembly: Stacking, assembly, welding and joining operations	
PROC 4, 21	Battery formation: Acid filling, formation (wet batteries), finishing	
PROC 21	Internal logistics: Storage of raw materials and finished goods, intra-facility transport, shipment	
PROC 28	Cleaning and maintenance	
2.1 Control of workers exposure		
Product characteristic	Raw material is principally lead ingots, and sometime lead oxides. Lead sulphates are formed during the paste production process. During the different process steps varying levels of dustiness occur. The article is an assembled and sealed battery.	
Amounts used	Not restricted	
Frequency and duration of use/exposure	Full shift exposure (8 hours) for all workplaces (not restricted).	
Human factors not influenced by risk management	See Section 8 of the SDS, above (hygiene measures affecting lead blood levels)	
Other given operational conditions affecting workers exposure	Indoor handling, room volume >1000 m^3	
Technical conditions and measures at process level (source) to prevent release	Closed system required for oxide production and enclosed spaces for curing operations.	
Technical conditions and measures to control dispersion from source towards the worker	Controls give 78% minimum worker exposure reduction. Risk Management Measures include enclosure of process equipment, dilution ventilation and/or local exhaust ventilation. Pass waste air through cleaning equipment. Separation of workers via control room for melting of grids, smelting and reduction of paste.	
Organisational measures to prevent /limit releases, dispersion and exposure	See Section 8 of the core SDS, above.	
Conditions and measures related to personal protection, hygiene and health evaluation	Minimum Respiratory Protective Equipment (RPE) is FFP 2 mask, except in cases where adequate ventilation/emission control in place (see also section 8).	
2.2 Control of environmental exposure		
Amounts used	10,676 tonnes/annum/site (of lead)	
Frequency and duration of use	Continuous use/release, up to 315 days/year	
Environment factors not influenced by risk management	Dilution factor (Freshwater): 10 Dilution factor (Marine): 100	
Other given operational conditions affecting environmental exposure	Not applicable	
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	See Section 8 of the SDS, above.	
	Estimated fraction released to water (g/tonne):	0.18
	Estimated fraction released to air (g/tonne):	344.75
Organisational measures to prevent/limit release from site	See Section 8 of the SDS, above.	

Conditions and measures related to external treatment of waste for disposal	Different Pb-bearing wastes resulting from the processes described above are generated in the form of waste batteries, dross, scrap, plates, dust, swarf. These waste products are mainly recycled in the production process or incinerated			
3 Exposure estimation				
Health Exposure Estimations (based on measures outlined in section 2.1)		Blood Lead Levels	Derived No-Effect Level	Risk Characterisation Ratio
	Blood lead concentrations for workers (90th Percentile):	23.0 µg/dL	40.0 µg/dL	0.53
Environmental Exposure Estimations (based on measures outlined in section 2.2)		Predicted Exposure Concentrations (Maximum)	Predicted No Effect Concentrations	Risk Characterisation Ratio
	Freshwater:	0.84 µg/l	2.4 µg/l	0.35
	Marine:	0.051 µg/l	3.3 µg/l	0.02
	Freshwater sediment:	167.80 mg/kg dw	186 mg/kg dw	0.90
	Marine water sediment:	61.15 mg/kg dw	168 mg/kg dw	0.36
	Terrestrial:	29.50 mg/kg dw	212.0 mg/kg dw	0.14
	Sewage treatment plant:	13 µg/l	100 µg/l	0.13
4 Guidance to DU to evaluate whether they work inside the boundaries set by the ES				
The DU works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the downstream user can demonstrate on his own that his implemented risk management measures are adequate. Detailed guidance for evaluation of ES can be acquired via your supplier or from the ECHA website (guidance R14, R16). For environmental exposure, a DU-Scaling tool (free download: http://www.arche-consulting.be/Metal-CSA-toolbox/du-scaling-tool) is available. For human health, exposure (as measured blood lead levels) must be below the DNEL: DNEL for male workers: 40 µg/dL DNEL for female workers of reproductive capacity: 10 µg/dL				

ES 4: Lead sheet production

1. Title	
Identified Use	Use of secondary lead materials in lead sheet production
Systemic title based on use descriptor	SU 14, SU 15, ERC 5 ; PC 7
2. Operational conditions and risk management measures	
Involved PROCs	Involved Tasks
PROC 26, 4, 23	Raw material handling: scrap delivery, loading/unloading, and furnace feed mixing
PROC 22, 23	Melting, drossing and refining
PROC 24	Milling operations
PROC 21	Sawing and slitting operations
PROC 21	Internal logistics: storage and shipment of finished goods, intra-facility transport
PROC 28	Others: repair, cleaning, and maintenance, quality control, and engineering
2.1 Control of workers exposure	
Product characteristic	Raw materials are principally metallic scrap. Fine lead particles are generated during the process steps. Finished product is solid, dry (>90% lead purity).
Amounts used	Not restricted.

Frequency and duration of use/exposure	Full shift (8 hours) exposure for all workplaces other than raw material handling and melting, drossing and refining (3 hours).			
Human factors not influenced by risk management	See Section 8 of the SDS, above (hygiene measures affecting lead blood levels).			
Other given operational conditions affecting workers exposure	Indoor handling, room volume >1000 m^3. Process temperature for raw material handling <500°C. Process temperature for melting, drossing and refining <510°C.			
Technical conditions and measures at process level (source) to prevent release	Enclosed space (furnace) for melting, drossing and refining.			
Technical conditions and measures to control dispersion from source towards the worker	Controls give 78% minimum worker exposure reduction for all processes other than milling operations (17%). Risk Management Measures include enclosure of process equipment, dilution ventilation and/or local exhaust ventilation. Pass waste air through cleaning equipment.			
Organisational measures to prevent /limit releases, dispersion and exposure	See Section 8 of the core SDS, above.			
Conditions and measures related to personal protection, hygiene and health evaluation	Minimum Respiratory Protective Equipment (RPE) is FFP 2 mask, except in cases where adequate ventilation/emission control in place (see also section 8). Protective gloves are required.			
2.2 Control of environmental exposure				
Amounts used	14,700 tonnes/annum/site			
Frequency and duration of use	Continuous use/release, up to 296 days/year			
Environment factors not influenced by risk management	Dilution factor (Freshwater): 10 Dilution factor (Marine): 100			
Other given operational conditions affecting environmental exposure	Not applicable			
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	See Section 8 of the SDS, above.			
	Estimated fraction released to water (g/tonne):	0.008		
	Estimated fraction released to air (g/tonne):	43.44		
Organisational measures to prevent/limit release from site	See Section 8 of the SDS, above.			
Conditions and measures related to external treatment of waste for disposal	Different Pb-bearing wastes resulting from the processes described above are generated in the form of solids (dross, slag). The waste products should be treated by a licensed waste treatment operated according to relevant waste regulation.			
3 Exposure estimation				
Health Exposure Estimations (based on measures outlined in section 2.1)		Predicted Blood Lead Levels (Maximum)	Derived No-Effect Level	Risk Characterisation Ratio
	Blood lead concentrations for workers (90th Percentile):	24.0 µg/dL	40.0 µg/dL	0.60
Environmental Exposure Estimations (based on measures outlined in section 2.2)		Predicted Exposure Concentrations (Maximum)	Predicted No Effect Concentrations	Risk Characterisation Ratio
	Freshwater:	0.84 µg/l	2.4 µg/l	0.35
	Marine:	0.051 µg/l	3.3 µg/l	0.02
	Freshwater sediment:	144.1 mg/kg dw	186 mg/kg dw	0.77
	Marine water sediment:	61.2 mg/kg dw	168 mg/kg dw	0.36
	Terrestrial:	28.51 mg/kg dw	212.0 mg/kg dw	0.13
	Sewage treatment plant:	13 µg/l	100 µg/l	0.13
4 Guidance to DU to evaluate whether they work inside the boundaries set by the ES				
The DU works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the downstream user can demonstrate on his own that his implemented risk management measures are adequate. Detailed guidance for evaluation of ES can be acquired via your supplier or from the ECHA website (guidance R14, R16). For environmental exposure, a DU-Scaling tool (free download: http://www.arche-consulting.be/Metal-CSA-toolbox/du-scaling-tool) is available. For human health, exposure (as measured blood lead levels) must be below the DNEL: DNEL for male workers: 40 µg/dL				

DNEL for female workers of reproductive capacity:	10 µg/dL

ES 5: Use of Lead in the Production of Hot-Dip Galvanized Steel (including wire galvanizing)

1. Title		
Identified Use	Use of lead in the production of Hot-Dip Galvanized Steel (including wire galvanizing)	
Systemic title based on use descriptor	SU15; ERC 5, PC 14; AC 7	
2. Operational conditions and risk management measures		
Involved PROCs	Involved Tasks	
PROC 23	Raw material handling	
PROC 23, 13	Hot dip galvanizing: periodic alloying additions of lead to the molten zinc bath (batch galvanizing).	
PROC 23	Wire Galvanizing: lead wire passed through a bath of molten zinc	
PROC 28	Cleaning and maintenance, quality control	
2.1 Control of workers exposure		
Product characteristic	Massive steel coated with a metallic lead layer.	
Amounts used	Not restricted	
Frequency and duration of use/exposure	Full shift exposure (8 hours) for all workplaces.	
Human factors not influenced by risk management	See Section 8 of the SDS, above (hygiene measures affecting lead blood levels)	
Other given operational conditions affecting workers exposure	Indoor handling, room volume >1000 m^3. Process temperature 445-460°C for molten zinc bath.	
Technical conditions and measures at process level (source) to prevent release	Enclosed system for Hot dip galvanizing and Wire Galvanizing.	
Technical conditions and measures to control dispersion from source towards the worker	Controls give 78% minimum worker exposure reduction. Risk Management Measures include enclosure of process equipment, dilution ventilation and/or local exhaust ventilation. Pass waste air through cleaning equipment.	
Organisational measures to prevent /limit releases, dispersion and exposure	See Section 8 of the core SDS, above.	
Conditions and measures related to personal protection, hygiene and health evaluation	Minimum Respiratory Protective Equipment (RPE) is FFP 2 mask, except in cases where adequate ventilation/emission control in place (see also section 8). Thermal gloves required for Hot Dip Galvanizing and Wire Galvanizing.	
2.2 Control of environmental exposure		
Amounts used	500-1000 tonnes/annum/site	
Frequency and duration of use	Continuous use/release, up to 42 days/year	
Environment factors not influenced by risk management	No emissions to water.	
Other given operational conditions affecting environmental exposure	Not applicable	
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	See Section 8 of the SDS, above.	
	Estimated fraction released to water (g/tonne):	No Emissions
	Estimated fraction released to air (g/tonne):	4,000
Organisational measures to prevent/limit release from site	See Section 8 of the SDS, above.	
Conditions and measures related to external treatment of waste for disposal	The Pb content of wastes leaving the process is insignificant.	

3 Exposure estimation				
Health Exposure Estimations (based on measures outlined in section 2.1)		Blood Lead Levels	Derived No-Effect Level	Risk Characterisation Ratio
	Blood lead concentrations for workers :	<12.0 µg/dL	40.0 µg/dL	<0.3
Environmental Exposure Estimations (based on measures outlined in section 2.2)		Predicted Exposure Concentrations (Maximum)	Predicted No Effect Concentrations	Risk Characterisation Ratio
	Freshwater:	No Emissions	2.4 µg/l	N/A
	Marine:	No Emissions	3.3 µg/l	N/A
	Freshwater sediment:	No Emissions	186 mg/kg dw	N/A
	Marine water sediment:	No Emissions	168 mg/kg dw	N/A
	Terrestrial:	29.6 mg/kg dw	212.0 mg/kg dw	0.14
	Sewage treatment plant:	No Emissions	0.1 mg/l	N/A

4 Guidance to DU to evaluate whether they work inside the boundaries set by the ES

The DU works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the downstream user can demonstrate on his own that his implemented risk management measures are adequate. Detailed guidance for evaluation of ES can be acquired via your supplier or from the ECHA website (guidance R14, R16). For environmental exposure, a DU-Scaling tool (free download: http://www.arche-consulting.be/Metal-CSA-toolbox/du-scaling-tool) is available. For human health, exposure (as measured blood lead levels) must be below the DNEL:

DNEL for male workers: 40 µg/dL
DNEL for female workers of reproductive capacity: 10 µg/dL

ES 6: Use of Lead metal in production of a range of lead articles (e.g. cast, rolled and extruded production, ammunition and lead shot)

1. Title	
Identified Use	Use of lead metal in the production of cast, rolled and extruded products, e.g. weights, foil, string, rope, bars, shot, sheathing and cables.
Systemic title based on use descriptor	SU 15, SU 17; PC 7, PC 38; AC 7, AC1, AC 2, AC 3; ERC5

2. Operational conditions and risk management measures	
Involved PROCs	Involved Tasks
PROC 26	Raw material handling
PROC22, 23	Melting
PROC 23	Refining and Casting
PROC 14	Extrusion
PROC 24	Milling/Rolling
PROC 21	Sawing/Slitting
PROC 25	Soldering/Manufacture of Solder
PROC 21, 22, 23, 24, 25, 4, 5	Production of lead shot
PROC 21	Ammunition Manufacture (i.e. assembly of ammunition)
PROC 23	Addition of coating metal to bath
PROC 23	Hot dip coating
PROC 21	Storage and Shipment

2.1 Control of workers exposure	
Product characteristic	Raw material is lead ingots, bars, or other forms of massive lead (1-99% purity). Raw materials can also include lead powder and paste. Finished lead articles are in solid form.
Amounts used	Not restricted

Frequency and duration of use/exposure	4 – 8 hour shifts for all workplaces.			
Human factors not influenced by risk management	See Section 8 of the SDS, above (hygiene measures affecting lead blood levels).			
Other given operational conditions affecting workers exposure	Indoor handling, room volume >20m^3 for raw material handling, >60m^3 for melting and >1000m^3 for all other workplaces.			
Technical conditions and measures at process level (source) to prevent release	Enclosed systems required for melting, refining and casting and possibly soldering/production of lead shot. Open systems/no direct handling required for remaining workplaces.			
Technical conditions and measures to control dispersion from source towards the worker	Controls give 78% minimum worker exposure reduction. Risk Management Measures include enclosure of process equipment, dilution ventilation and/or local exhaust ventilation. Pass waste air through cleaning equipment. LEV typically required for all processes other than storage and shipment.			
Organisational measures to prevent /limit releases, dispersion and exposure	See Section 8 of the core SDS, above.			
Conditions and measures related to personal protection, hygiene and health evaluation	Minimum Respiratory Protective Equipment (RPE) is FFP 2 mask, except in cases where adequate ventilation/emission control in place (see also section 8). Leather or thermal-protective gloves required for all processes other than milling/rolling, sawing/slitting and storage and shipment.			
2.2 Control of environmental exposure				
Amounts used	Not restricted.			
Frequency and duration of use	Continuous use/release, up to 300 days/year.			
Environment factors not influenced by risk management	Flow rate of receiving surface water is 37 m$^{3/}$s.			
Other given operational conditions affecting environmental exposure	Not applicable.			
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	See Section 8 of the SDS, above.			
	Estimated emissions released to water:	20 kg/annum/site		
	Estimated emissions released to air:	100 kg/annum/site		
Organisational measures to prevent/limit release from site	See Section 8 of the SDS, above.			
Conditions and measures related to external treatment of waste for disposal	Pb-bearing wastes resulting from the processes described above are generated in the form of solids (e.g. dross, slags). These should be treated by a licensed waste treatment operator (landfilled or incinerated) according to relevant waste regulation.			
3 Exposure estimation				
Health Exposure Estimations (based on measures outlined in section 2.1)		Blood Lead Levels	Derived No-Effect Level	Risk Characterisation Ratio
	Blood lead concentrations for workers :	33.7 µg/dL	40.0 µg/dL	0.84
Environmental Exposure Estimations (based on measures outlined in section 2.2)		Predicted Exposure Concentrations (Maximum)	Predicted No Effect Concentrations	Risk Characterisation Ratio
	Freshwater:	0.622 µg/l	2.4 µg/l	0.26
	Marine:	0.049 µg/l	3.3 µg/l	0.015
	Freshwater sediment:	103.5 mg/kg dw	186 mg/kg dw	0.53
	Marine water sediment:	57.1mg/kg dw	168 mg/kg dw	0.34
	Terrestrial:	28.3 mg/kg dw	212.0 mg/kg dw	0.13
	Sewage treatment plant:	The site is assumed not to be connected with an off-site STP		
4 Guidance to DU to evaluate whether they work inside the boundaries set by the ES				
The DU works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the downstream user can demonstrate on his own that his implemented risk management measures are adequate. Detailed guidance for evaluation of ES can be acquired via your supplier or from the ECHA website (guidance R14, R16). For environmental exposure, a DU-Scaling tool (free download: http://www.arche-consulting.be/Metal-CSA-toolbox/du-scaling-tool) is available. For human health, exposure (as measured blood lead levels) must be below the DNEL: DNEL for male workers: 40 µg/dL				

DNEL for female workers of reproductive capacity:	10 µg/dL

ES 7: Use of lead metal in the production of leaded steels – Industrial

1. Title		
Identified Use	Use of lead metal in the production of leaded steels	
Systemic title based on use descriptor	SU 14; PC 7; AC 7; ERC 3	
2. Operational conditions and risk management measures		
Involved PROCs	Involved Tasks	
PROC 26	Raw material handling	
PROC 22, 23	Secondary Steel making. Carried out using a ladle arc furnace. Lead is added by the addition of lead pellets or adding lead shot by deep injection into the ladle.	
PROC 23	Casting via continuous casting route or ingot casting	
PROC 21, 24, 25	Rolling / Cutting / Finishing	
PROC 21	Internal logistics	
PROC 28, 25	Others	
2.1 Control of workers exposure		
Product characteristic	Raw material is principally graphitised lead shot. The lead can be added in conjunction with other additives or separately. The lead shot is granular with a diameter of 2mm and below. The product is massive metal, usually as blooms, billets, ingots or bars. The concentration of lead in the finished steel product is typically in the range 0.2-0.35%.	
Amounts used	Not restricted	
Frequency and duration of use/exposure	Full shift exposure (8 hours) for all workplaces (not restricted).	
Human factors not influenced by risk management	See Section 8 of the SDS, above (hygiene measures affecting lead blood levels)	
Other given operational conditions affecting workers exposure	Indoor handling, room volume >1000 m^3. Outdoor storage of finished products.	
Technical conditions and measures at process level (source) to prevent release	All workplaces other than Raw Material Handling require enclosed systems with extraction.	
Technical conditions and measures to control dispersion from source towards the worker	Controls give 78% minimum worker exposure reduction. Risk Management Measures include enclosure of process equipment, dilution ventilation and/or local exhaust ventilation. Pass waste air through cleaning equipment. Leather gloves are required for all processes.	
Organisational measures to prevent /limit releases, dispersion and exposure	See Section 8 of the core SDS, above.	
Conditions and measures related to personal protection, hygiene and health evaluation	Minimum Respiratory Protective Equipment (RPE) is FFP 2 mask, except in cases where adequate ventilation/emission control in place (see also section 8).	
2.2 Control of environmental exposure		
Amounts used	Approx.430.7 tonnes/annum/site	
Frequency and duration of use	Continuous use/release, up to 156 days/year (3 days/week)	
Environment factors not influenced by risk management	Flow rate of receiving surface water 13.0 m^3/s	
Other given operational conditions affecting environmental exposure	Not applicable	
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	See Section 8 of the SDS, above.	
	Estimated fraction released to water (g/tonne):	255.4
	Estimated fraction released to air (g/tonne):	1,686.8
Organisational measures to prevent/limit release from site	See Section 8 of the SDS, above.	

Conditions and measures related to external treatment of waste for disposal	Different Pb-bearing wastes resulting from the processes described above are generated in the form of extraction dust, slag. These waste products are mainly recycled in the production process or through off site processes.			
3 Exposure estimation				
Health Exposure Estimations (based on measures outlined in section 2.1)		Predicted Blood Lead Levels (Maximum)	Derived No-Effect Level	Risk Characterisation Ratio
	Blood lead concentrations for male workers (maximum):	15.3 µg/dL	40.0 µg/dL	0.38
Environmental Exposure Estimations (based on measures outlined in section 2.2)		Predicted Exposure Concentrations (Maximum)	Predicted No Effect Concentrations	Risk Characterisation Ratio
	Freshwater:	0.84µg/l	2.4 µg/l	0.35
	Marine:	No Emissions	3.3 µg/l	N/A
	Freshwater sediment:	166.2 mg/kg dw	186 mg/kg dw	0.89
	Marine water sediment:	No Emissions	168 mg/kg dw	N/A
	Terrestrial:	28.9 mg/kg dw	212.0 mg/kg dw	0.14
	Sewage treatment plant:	The site is assumed not to be connected with an off-site STP.		
4 Guidance to DU to evaluate whether they work inside the boundaries set by the ES				
The DU works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the downstream user can demonstrate on his own that his implemented risk management measures are adequate. Detailed guidance for evaluation of ES can be acquired via your supplier or from the ECHA website (guidance R14, R16). For environmental exposure, a DU-Scaling tool (free download: http://www.arche-consulting.be/Metal-CSA-toolbox/du-scaling-tool) is available. For human health, exposure (as measured blood lead levels) must be below the DNEL: DNEL for male workers: 40 µg/dL DNEL for female workers of reproductive capacity: 10 µg/dL				

ES 8: Lead Powder Production

1. Title	
Identified Use	Use of lead metal in the production of powders (Solder)
Systemic title based on use descriptor	SU 15, SU 17; PC 0, PC 7; ERC 2
2. Operational conditions and risk management measures	
Involved PROCs	Involved Tasks
PROC 26	Raw material handling
PROC 22, 25	Manufacture of Solder (molten lead alloy)
PROC 27a, 27b	Powder Production: Blowing of molten lead alloy with different gases
PROC 27a, 27b, 26	Powder Production: Ultrasonic atomisation (Solder falling onto an ultrasonic horn) and Centrifugal atomisation (Solder falling onto a spinning disc)
PROC 21	Storage and Shipment
2.1 Control of workers exposure	
Product characteristic	Raw material is lead or lead alloy ingots, bars, or other forms of massive lead with a lead content usually in the range 36-99%.
Amounts used	Not restricted

Frequency and duration of use/exposure	Full shift exposure (8 hours) for all workplaces.			
Human factors not influenced by risk management	See Section 8 of the SDS, above (hygiene measures affecting lead blood levels)			
Other given operational conditions affecting workers exposure	Indoor handling, room volume >150 m^3 Outdoor handing for raw material processes.			
Technical conditions and measures at process level (source) to prevent release	Enclosed systems are required for all workplaces other than Raw Material Handling and Storage and Shipment.			
Technical conditions and measures to control dispersion from source towards the worker	Controls give 78% minimum worker exposure reduction. Risk Management Measures include enclosure of process equipment, negative draft exhaust systems and/or local exhaust ventilation. Pass waste air through cleaning equipment.			
Organisational measures to prevent /limit releases, dispersion and exposure	See Section 8 of the core SDS, above.			
Conditions and measures related to personal protection, hygiene and health evaluation	Minimum Respiratory Protective Equipment (RPE) is FFP 2 mask, except in cases where adequate ventilation/emission control in place (see also section 8). Leather gloves are required for all workplaces other than Raw Handling and Storage and Shipment.			
2.2 Control of environmental exposure				
Amounts used	Not restricted			
Frequency and duration of use	Continuous use/release, up to 300 days/year			
Environment factors not influenced by risk management	No emissions to the environment.			
Other given operational conditions affecting environmental exposure	Not applicable			
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	See Section 8 of the SDS, above.			
	Estimated fraction released to water (g/tonne):	No emissions		
	Estimated fraction released to air (g/tonne):			
Organisational measures to prevent/limit release from site	See Section 8 of the SDS, above.			
Conditions and measures related to external treatment of waste for disposal	Pb-bearing wastes resulting from the processes described above are generated in the form of solids (e.g. dross, slags). These should be treated by a licensed waste treatment operator (landfilled or incinerated) according to relevant waste regulation.			
3 Exposure estimation				
Health Exposure Estimations (based on measures outlined in section 2.1)		Predicted Blood Lead Levels (Maximum)	Derived No-Effect Level	Risk Characterisation Ratio
	Blood lead concentrations for male workers (maximum):	16.0 µg/dL	40.0 µg/dL	0.4
Environmental Exposure Estimations (based on measures outlined in section 2.2)		Predicted Exposure Concentrations (Maximum)	Predicted No Effect Concentrations	Risk Characterisation Ratio
	Freshwater:	No Emissions	2.4 µg/l	N/A
	Marine:	No Emissions	3.3 µg/l	N/A
	Freshwater sediment:	No Emissions	186 mg/kg dw	N/A
	Marine water sediment:	No Emissions	168 mg/kg dw	N/A
	Terrestrial:	28.3 mg/kg dw	212.0 mg/kg dw	0.13
	Sewage treatment plant:	No Emissions	100 µg/l	N/A
4 Guidance to DU to evaluate whether they work inside the boundaries set by the ES				
The DU works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the downstream user can demonstrate on his own that his implemented risk management measures are adequate. Detailed guidance for evaluation of ES can be acquired via your supplier or from the ECHA website (guidance R14, R16). For environmental exposure, a DU-Scaling tool (free download: http://www.arche-consulting.be/Metal-CSA-toolbox/du-scaling-tool) is available. For human health, exposure (as measured blood lead levels) must be below the DNEL:				

DNEL for male workers:	40 µg/dL
DNEL for female workers of reproductive capacity:	10 µg/dL

ES 9: Use of lead metal in lead oxide production

1. Title		
Identified Use	Use of lead metal in lead oxide production	
Systemic title based on use descriptor	SU 8; ERC 6a; PC 19	
2. Operational conditions and risk management measures		
Involved PROCs	Involved Tasks	
PROC 21, 22, 24, 26	Lead oxide production: production of crude oxide, further oxidation/calcination, grinding/milling, packaging	
PROC 21	Internal logistics: storage (raw materials, finished goods) and shipment of finished goods	
PROC 28	Repair, cleaning, and maintenance, quality control, engineering	
2.1 Control of workers exposure		
Product characteristic	Ingots of highly refined metallic lead (99.9 %) are used as raw material. The oxidation products are powders. Varying levels of dustiness will occur during the process steps.	
Amounts used	Not restricted	
Frequency and duration of use/exposure	Full shift (8 hours) exposure for all workplaces (not restricted).	
Human factors not influenced by risk management	See Section 8 of the SDS, above (hygiene measures affecting lead blood levels)	
Other given operational conditions affecting workers exposure	Indoor handling, room volume >1000 m^3. Process temperature <620°C during production of crude oxide.	
Technical conditions and measures at process level (source) to prevent release	Full containment for the Lead oxide production workplace.	
Technical conditions and measures to control dispersion from source towards the worker	Controls give 78% minimum worker exposure reduction. Risk Management Measures include enclosure of process equipment, negative draft exhaust systems and/or local exhaust ventilation. Pass waste air through cleaning equipment.	
Organisational measures to prevent /limit releases, dispersion and exposure	See Section 8 of the core SDS, above.	
Conditions and measures related to personal protection, hygiene and health evaluation	Minimum Respiratory Protective Equipment (RPE) is FFP 2 mask, except in cases where adequate ventilation/emission control in place (see also section 8).	
2.2 Control of environmental exposure		
Amounts used	14,000 tonnes/annum/site	
Frequency and duration of use	Continuous use/release, up to 365 days/year	
Environment factors not influenced by risk management	Dilution factor (Freshwater): 10 Dilution factor (Marine): 100	
Other given operational conditions affecting environmental exposure	Not applicable	
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	See Section 8 of the SDS, above.	
	Estimated fraction released to water (g/tonne):	0.015
	Estimated fraction released to air (g/tonne):	6.45
Organisational measures to prevent/limit release from site	See Section 8 of the SDS, above.	
Conditions and measures related to external treatment of waste for disposal	Pb-bearing wastes resulting from the processes described above are generated in the form of oxides. These waste products are recycled in the production process	

3 Exposure estimation				
Health Exposure Estimations (based on measures outlined in section 2.1)		Predicted Blood Lead Levels (Maximum)	Derived No-Effect Level	Risk Characterisation Ratio
	Blood lead levels (90th Percentile):	22.2 µg/dL	40.0 µg/dL	0.56
Environmental Exposure Estimations (based on measures outlined in section 2.2)		Predicted Exposure Concentrations (Maximum)	Predicted No Effect Concentrations	
	Freshwater:	0.88 µg/l	2.4 µg/l	0.37
	Marine:	0.052 µg/l	3.3 µg/l	0.016
	Freshwater sediment:	160.92 mg/kg dw	186 mg/kg dw	0.87
	Marine water sediment:	62.31 mg/kg dw	168 mg/kg dw	0.37
	Terrestrial:	28.33 mg/kg dw	212.0 mg/kg dw	0.13
	Sewage treatment plant:	14 µg/l	100 µg/l	0.14

4 Guidance to DU to evaluate whether they work inside the boundaries set by the ES

The DU works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the downstream user can demonstrate on his own that his implemented risk management measures are adequate. Detailed guidance for evaluation of ES can be acquired via your supplier or from the ECHA website (guidance R14, R16). For environmental exposure, a DU-Scaling tool (free download: http://www.arche-consulting.be/Metal-CSA-toolbox/du-scaling-tool) is available. For human health, exposure (as measured blood lead levels) must be below the DNEL:

DNEL for male workers: 40 µg/dL
DNEL for female workers of reproductive capacity: 10 µg/dL

ES 10: Use of molten lead as heat transfer fluid in closed process

1. Title	
Identified Use	Use of molten lead as heat transfer fluid in closed process
Systemic title based on use descriptor	SU 14, SU15 ; ERC 7 ; PC 16
2. Operational conditions and risk management measures	
Involved PROCs	Involved Tasks
PROC 2	Lead is used in liquid/molten form in an enclosure (main crucible belt) 24 hours per day, 365 days per year. The molten lead bath is covered by a thick layer of mineral granulates (vermiculite), so its contact between ambient air and molten lead is avoided
PROC 8b, PROC 23, PROC 24, PROC 26	Removal of the vermiculite insulation and the lead oxide solid layer. Drainage of the liquid/molten lead in open air and transfer to ancillary containers. Skimming of the ancillary crucible (lead after remelting). Filling of the crucible belt with liquid/molten lead in open air
2.1 Control of workers exposure	
Product characteristic	Molten lead is used as a heat transfer fluid in closed process.
Amounts used	Amount in tank: approx. 45 tonnes
Frequency and duration of use/exposure	8 hour shift 350 days a year. Maintenance: maximum once a year
Human factors not influenced by risk management	See Section 8 of the SDS, above (hygiene measures affecting lead blood levels)
Other given operational conditions affecting workers exposure	No limitations assessed
Technical conditions and measures at process level (source) to prevent release	None needed.
Technical conditions and measures to control dispersion from source towards the worker	Ensure good ventilation where possible.

Organisational measures to prevent /limit releases, dispersion and exposure	See Section 8 of the core SDS, above.
Conditions and measures related to personal protection, hygiene and health evaluation	For operations covered by this scenario, gloves should ideally be worn.
2.2 Control of environmental exposure	
Overview	No environmental emissions.
Conditions and measures related to recovery of articles at the end of service life	Not applicable
3 Exposure estimation	

Health Exposure estimations (based on measures outlined in section 2.1)		Blood Lead Levels	Derived No Effect Level	Risk Characterisation Ratio
	Blood lead concentrations for workers :	4.3 µg/dL	40µg/dL	<0.15
Environmental Exposure estimations (based on measures outlined in section 2.2)	Not applicable			

4 Guidance to DU to evaluate whether they work inside the boundaries set by the ES
The DU works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the downstream user can demonstrate on his own that his implemented risk management measures are adequate. Detailed guidance for evaluation of ES can be acquired via your supplier or from the ECHA website (guidance R14, R16). For environmental exposure, a DU-Scaling tool (free download: http://www.arche-consulting.be/Metal-CSA-toolbox/du-scaling-tool) is available. For human health, exposure (as measured blood lead levels) must be below the DNEL: DNEL for male workers: 40 µg/dL DNEL for female workers of reproductive capacity: 10 µg/dL

ES 11: Professional Use of Lead Solder

1. Title	
Identified Use	Professional Use of Lead Solder
Systemic title based on use descriptor	PC 7, PC 38; SU 15, SU 16, SU 17, SU 19, SU 0; AC 3, AC 7; ERC 0, ERC 8c.
2. Operational conditions and risk management measures	
Involved PROCs	Involved Tasks
PROC 0, PROC 4, PROC 5, PROC 15, PROC 25	Use of low temperature melting solders for electrical appliance assemblage or repair and pipe joining or assembly of stained glass articles.
2.1 Control of workers exposure	
Product characteristic	Ingots, wire or powder of metallic alloy containing lead (typically range of 37-75%).
Amounts used	Based on maximum professional use of 20 kg per shift.
Frequency and duration of use/exposure	Use of lead solders is assumed to occur 0.5 - 3 hours per day, five days per week
Human factors not influenced by risk management	See Section 8 of the SDS, above (hygiene measures affecting lead blood levels)
Other given operational conditions affecting workers exposure	No limitations assessed
Technical conditions and measures at process level (source) to prevent release	None needed.
Technical conditions and measures to control dispersion from source towards the worker	Ensure good ventilation where possible.

Organisational measures to prevent /limit releases, dispersion and exposure	See Section 8 of the core SDS, above.
Conditions and measures related to personal protection, hygiene and health evaluation	For operations covered by this scenario, gloves should ideally be worn.
2.2 Control of environmental exposure	
Overview	No environmental emissions during professional use.
Conditions and measures related to recovery of articles at the end of service life	Soldered articles are expected to be recovered and recycled (by a licensed recovery operator in accordance with relevant legislation), owing to the intrinsic values of the substrates and the solders.
3 Exposure estimation	

Health Exposure estimations (based on measures outlined in section 2.1)		Predicted Blood Lead Levels (Maximum)	Derived No Effect Level	Risk Characterisation Ratio
	Solder, electrical, stained glass, plumbing	1.55 µg/dL	40 µg/dL	0.04
	Solder, industrial (bars)	5.2 µg/dL	40 µg/dL	0.13

Environmental Expo estimations (based measures outlined i 2.2)		Predicted Exposure Concentrations (regional)	Predicted No Effect Concentrations	Risk Characterisation Ratio
Freshwater:	0.61 µg/l	2.4 µg/l	0.25	
Marine:	0.046 µg/l	3.3 µg/l	0.014	
Freshwater sediment:	100.1 mg/kg dw	186 mg/kg dw	0.54	
Marine water sediment:	53.2 mg/kg dw	168 mg/kg dw	0.32	
Terrestrial:	28.3 mg/kg dw	212.0 mg/kg dw	0.13	

4 Guidance to DU to evaluate whether they work inside the boundaries set by the ES

The DU works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the downstream user can demonstrate on his own that his implemented risk management measures are adequate. Detailed guidance for evaluation of ES can be acquired via your supplier or from the ECHA website (guidance R14, R16). For environmental exposure, a DU-Scaling tool (free download: http://www.arche-consulting.be/Metal-CSA-toolbox/du-scaling-tool) is available. For human health, exposure (as measured blood lead levels) must be below the DNEL:

DNEL for male workers: 40 µg/dL
DNEL for female workers of reproductive capacity: 10 µg/dL

ES 12 Use of lead as a laboratory agent and in chemical analysis

Exposure Scenario Format (10) addressing uses carried out by workers	
1. Title:	
Free short title	Use of lead oxides and lead metal as an analytical reagent in the analysis of precious elements (Identified Use 26)
Systematic title based on use descriptor for article service life	Use of lead metal or lead oxides (normally lead monoxide) in the fire assay procedure for the analysis of silver, gold and platinum group element purity in materials such as ore samples or metal alloys entails use of “fire assay” techniques. Lead, in the form of added metal or metal formed during the assay acts a “collecting agent” in high temperature reactions that separate precious metals from mineral matrices or other metals. This is a laboratory scale process, typically conducted under highly controlled conditions within the confines of high air flow fume hoods.
Description of the use	Use of lead metal or lead oxides (normally lead monoxide) in the fire assay procedure for the analysis of silver, gold and platinum group element purity in materials such as ore samples or metal alloys entails use of “fire assay” techniques. Lead, in the form of added metal or metal formed during the assay acts a “collecting agent” in high temperature reactions that separate precious metals from mineral matrices or other metals. This is a laboratory scale process, typically conducted under highly controlled conditions within the confines of high air flow fume hoods. The fire assay is a two-step laboratory scale process typically conducted under highly controlled conditions and within the confines of high velocity air flow fume hoods. Items to be analysed are first added to a high temperature fusion mixture containing lead or lead monoxide, the material to be tested and fluxes such as sodium carbonate, borax, and silica to ultimately yield a borosilicate slag overlaying molten lead containing precious metals. The molten lead in the two-phase melt is then poured into a mold to cool and a precious metal-containing “lead button” formed.

Exposure Scenario Format (10) addressing uses carried out by workers	
	In a subsequent cupellation step, lead button is subjected to extreme heat (approx. 1000 °C) which results in the melting and simultaneous oxidation of the lead – leaving behind a precious metal "button" which can then be analysed by a variety of different methods. The lead monoxide generated and vaporized at high temperatures is captured by ventilation controls for recycling and reuse; in some cases, some lead monoxide may be retained in the vessel, which is either recovered and reused or is discarded as hazardous waste.
Processes, tasks activities covered	PROC 15; PC21; ERC 6b; SU14 (Manufacture of basic metals, including alloys)
Assessment Method	Biomonitoring data (blood lead values) were used in the human health assessment of exposure as they integrate all pathways of potential exposures to lead. It is noted that the number of workers in this specific activity is small, and that the workers are likely to be involved in other processes involving lead, potentially inside and outside the laboratory setting.
2. Operational conditions and risk management measures	
All materials described in section 1 are designated as TRA 13 chemical reagents. User contact would generally be restricted to skin contact for professional users that undertake handling or maintenance activity of materials within the context of small scale laboratory laboratories (PROC 15). The amount of dermal lead transfer, and the surface area of affected skin, will vary as a function of the frequency of contact and the quantities of lead/lead oxide used or generated during the assay. The nature of the fire assay is such that gloves, respirators and eye goggles are worn during conduct of the assay. The conditions and general procedures used for the fire assay are not unlike those of lead smelting and refining and would be expected to generate high concentrations of lead-containing aerosols. However, the fire assay is a laboratory scale process conducted under controlled conditions that approach that of a closed system. Lead/lead oxide are further used and generated in kg quantities or less. Thus, although there are process similarities with the conditions used for lead smelting and refining, the scale of lead use and waste generation are such that strict analogies to lead smelting exposure environments are inappropriate. The elevated temperature conditions of the cupellation step in the fire assay (approx. 1000 ^{o}C volatize lead and be expected to result in significant lead-containing aerosols. However, inhalation exposures are essentially eliminated by the wearing of respirators and routine conduct of the assay within the confines of high velocity ventilation fume hoods. Inhalation exposure to lead under the conditions described would be minimal and would not be expected to result in measurable changes in blood lead. Opportunities for lead exposure are presented in the preparatory steps of the assay as raw materials for the fire assay are measured and mixed. However, conduct of these activities within a fume hood eliminates most exposure pathways. Dermal contact with lead metal at the start of, or at intermediate steps of, the fire assay is seen as posing the predominate risk of lead exposure. Opportunities for dermal exposure are usually limited, however, by risk management measures such as the wearing of gloves during the conduct of the assay These risk management measures are employed, at least in part, for thermal protection and to minimize exposures to other noxious substances generated during the conduct of the assay but also serve to mitigate exposures to lead. Risks of lead exposure would primarily be expected under conditions of improper handling of assay materials without use of gloves.	
2.1 Control of exposure	
Product characteristic	
Dermal contact is possible with lead metal at different steps of the fire assay. Risks of inhalation exposure are not presented due to the closed nature of the reaction system for the fire assay and precautionary use of respirators.	
Amounts used	
Lead used in the fire assay would be >99% pure and uses in kg quantities or less.	
Frequency and duration of use/exposure	
The use is assumed to occur several times a day, up to 5 days per week, 52 weeks per year. The duration of each single exposure event is less than one hour.	
Human factors not influenced by risk management	
Adult contact with lead during the fire assay would be limited to the hands.	
Other given operational conditions affecting workers exposure	
Fire assays conducted on a smaller scale would result in lead buttons significantly less than 1 kg in weight – smaller scale processes would yield lower levels of dermal exposure and small increases in blood lead than those predicted above.	
Technical conditions and measures at process level (source) to prevent release	
Assays are conducted within fume hoods that prevent exposure to lead-containing aerosols.	
Technical conditions and measures to control dispersion from source towards the worker	
Exhaust and general ventilation.	
Organisational measures to prevent /limit releases, dispersion and exposure	
Closed reaction system; small-scale operation in laboratory setting	
Conditions and measures related to personal protection, hygiene and health evaluation	
The nature of the fire assay is such that gloves, respirators and eye goggles are worn during conduct of the assay. Cleaning: Ensure general laboratory cleanliness is maintained by frequent washing/vacuuming. Clean every workplace at the end of every shift.	

Exposure Scenario Format (10) addressing uses carried out by workers
Personal protective equipment: Assess the need to wear respiratory protective equipment in production areas. Consider use effective masks accompanied by a compliance policy (ensure proper shaving; ensure workers do not remove RPE in production areas in order to communicate). Where masks are used, employ formal mask cleaning and filter changing strategies. Personal hygiene: Ensure workers follow simple hygiene rules (e.g. do not bite nails and keep them cut short, avoid touching or scratching face with dirty hands or gloves); ensure workers do not wipe away sweat with hands or arms, e.g. by providing disposable perspiration towels; ensure workers use disposable tissues rather than a handkerchief; prohibit drinking, eating and smoking in production areas; prevent access to eating and non-production areas in working clothes; ensure workers as a minimum wash hands, arms, faces and mouths (but preferably shower) and change into personal clothing (or clean coveralls provided by the company) before entering eating areas; ensure workers handle dirty working clothes with care; consider making showering obligatory at the end of a shift, and provide towels and soap; allow no personal belongings to be taken into production areas, and allow no items that have been used in production areas to be taken home. Blood lead monitoring: Set in place a monitoring regime which covers all site activities (for women and for men); use certified laboratories to measure blood lead levels or have own laboratory certified; consider benchmarking with other companies/sectors; encourage workers to undertake regular blood lead monitoring, including a blood test prior to starting in the role. The blood lead levels of workers should be monitored on a regular basis, often in reference to an "action level" that is typically 5 µg/dL below the exposure limit deemed to be safe. If the action level is exceeded, appropriate measures are to be taken, (e.g. ban overtime, provide counselling on proper work practice and hygiene, instigate an individual blood lead management plan, increase blood lead sampling frequency) in an effort to prevent further increases in blood lead. If the safe threshold (40 µg/dL for men; 10 µg/dL for women of reproductive capacity) is exceeded, continue ban on overtime, ensure strict hygiene procedures are followed, undertake detailed inspections to ensure correct use of personal protective equipment, undertake detailed inspections to ensure recommended workplace procedures are followed, move employee to workplace where exposure is expected to be lower or remove from lead environment altogether, further increase blood lead sampling frequency, and continue frequent sampling until results are below the first action level. Creating a culture of safety: Define and communicate a clear policy for controlling occupational exposure to lead; ensure managers set the example in terms of personal protection and hygiene; where possible, involve occupational physicians in making workers take control of their own blood lead levels; consider making low blood lead levels a condition of employment, with disciplinary action taken where protective equipment and hygiene procedures are not followed; involve managers when workers' blood lead levels exceed action levels; consider publicising company blood lead performance to workers via notices and briefings to ensure the topic remains a key priority; provide detailed training for new personnel on the risks of lead exposure and the procedures for protection; provide instruction on specific lead exposure risks for workers undertaking new tasks; provide regular refresher courses for all employees on the risks of lead exposure and the procedures for protection; involve worker representatives.
2.2 Control of environmental exposure
Product characteristics
Releases to the environment are not expected due to the small scale of the process and ventilation controls.
Amounts used
Lead used in the fire assay would be >99% pure and uses in kg quantities or less
Frequency and duration of use
Variable, up to 5 days per week, 52 weeks per year.
Environment factors not influenced by risk management
Not relevant
Other given operational conditions affecting environmental exposure
The assay is conducted indoors in a laboratory setting.
Technical conditions and measures at process level (source) to prevent release
Closed reaction system
Conditions and measures related to municipal sewage treatment plant
n/a
Organisational measures to prevent/limit release from site
Emission control measures should be complimented by an integrated management system e.g. ISO 9000, ISO 14001, or the like.
Conditions and measures related to treatment of waste
Lead residues and oxides produced during the fire assay are expected to be fully recovered and recycled. *Appropriate waste codes:* *20 01 34, 20 01 40, 20 03 01, 20 03 07* *Suitable Disposal:* *Waste from end-of-life articles can be disposed of as municipal waste, except when they are separately regulated, like electronic devices, batteries, vehicles, etc.* *Disposal of wastes is possible via incineration (operated according to Directive 2000/76/EC on the incineration of waste) or landfilling (operated according to Reference Document on the Best Available Techniques for Waste Industries of August 2006 and Council Directive 1999/31/EC and Council Decision 19 December 2002).*

Exposure Scenario Format (10) addressing uses carried out by workers

Conditions and measures related to recovery of waste

Recycling of the lead waste materials is expected, particularly since facilities using the fire assay are likely to be associated with industrial facilities engaged in the production and/or recycling of metals.

3. Exposure estimation and reference to its source

Occupational exposure

The 90th percentile of the measured blood lead data for the years 2013-2016 is presented below, together with the risk characterisation ratio (RCR) which is based on the derived no-effect level (DNEL) of 40 µg/dL.

90th percentile (RCR): 17.4 (0.44)
Number of employees: 29
Number of blood lead points: 88

Note that the workforce in this use is small; workers involved in fire assay are assumed to be involved in other processes involving lead, potentially inside and outside the laboratory, as part of their job.

Environmental emissions

An environmental reasonable worst-case scenario has been applied. This is due to the fact, based upon the regional (diffuse) emissions inventory and the regional monitoring data contained within the CSR for this substance, no risk has been determined for any environmental compartment (see below) on a regional or continental scale. This takes into account cumulative emissions from all identified uses of this substance. Given this generic conclusion, no specific environmental emissions data on the uses covered by this ES are included.

Compartment	Unit	PNEC	PEC regional	RCR
Fresh water	µg/ L	2.4	0.61	0.25
Marine water	µg/ L	3.3	0.046	0.01
Fresh water sediment (without bioavailability correction)	mg/kg dw	186	100.1	0.54
Marine water sediment	mg/kg dw	168	53.2	0.32
Terrestrial	mg/kg dw	212	28.3	0.13

The preceding summary has been in part extracted from expert judgement evaluations contained within the Voluntary Risk Assessment Report for Lead at: http://echa.europa.eu/chem_data/transit_measures/vrar_en.asp

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

The user must comply with the hygiene measures set out in Section 2.1.

Additional good practice advice beyond the REACH CSA

Note: The measures reported in this section have not been taken into account in the exposure estimates related to the exposure scenario above. They are not subject to obligation laid down in Article 37 (4) of REACH

Adherence to basic proper hygiene (frequent washing of hands) and wearing of gloves would effectively reduce and essentially eliminate the lead exposures described above. Prohibitions on eating or smoking prior to the washing of hands could further be advised. Precautionary use of respirators is practiced and guards against inhalation exposures that might be associated with incomplete capture of lead-containing aerosols by ventilation controls.

ES 13 Use of lead metal in the production of leaded copper alloys

Exposure Scenario Format (27) addressing uses carried out by workers	
1. Title	
Free short title	Use of lead metal in the production of leaded copper alloys (Identified Use 27)
Systematic title based on use descriptor	SU 14 (Manufacture of basic metals, including alloys); ERC 3 Formulation into solid matrix; PC 7 (Base metals and alloys) AC 7 (metal articles)
Processes, tasks, and/or activities covered	Processes, tasks and/or activities covered are further described in Section 2 below.
Assessment Method	Biomonitoring data (blood lead values) were used for the assessment of human health exposure as they integrate all pathways of potential exposures to lead. Information on the operational conditions (OC), risk management measures (RMM) and release estimations were used to estimate the environmental exposure using the EUSES 2.0 model.

2. Operational conditions and risk management measures

Human Health

Workplace	Description	Short process description	Involved PROCs
ES 27.1	raw material handling	Handling of solid inorganic substances at ambient temperature (massive metals without dust forming potential)	PROC 26
ES 27.2	Melting of scrap or ingots from leaded copper alloys and pure metals (copper, zinc, lead, other metals). Lead is added as massive lead ingots into the molten material.	Melting of massive metals and transferring the molten material to a casting machine: Potentially closed processing operations with minerals/metals at elevated temperature Industrial setting Open processing and transfer operations with minerals/metals at elevated temperature	PROC 22, 23
ES 27.3	Casting of shapes or ingots via continuous or batch casting route or ingot casting	Potentially closed processing operations with minerals/metals at elevated temperature Industrial setting	PROC 23
ES 27.4	Production of articles from leaded copper alloy shapes or castings by mechanical processes: Hot and Cold Rolling / Extrusion, Drawing / Annealing / Cutting / Finishing	High (mechanical) energy work-up of substances bound in materials and/or articles / Other hot work operations with metals (scarfing, burning) / Low energy manipulation of substances bound in materials and/or articles	PROC 24, 25, 21
ES 27.5	internal logistics	storage and shipment of finished goods, intra-facility transport	PROC21
ES 27.6	manual maintenance	repair, cleaning, and maintenance, quality control, and engineering/ Other hot work operations with metals (scarfing, burning)	PROC 28, 25

Environment

ERC number	Name	Description	Level of containment	Dispersion of emission sources	Indoor / outdoor
ERC 3	Formulation into solid matrix	Applies to uses in formulating industries; substance is mixed (blended) in order to be physically or chemically bound into or onto a solid matrix	Closed (semi)	industrial	indoor

2.1 Control of workers exposure

Product characteristic

Raw material is scrap from lead containing copper alloys or ingots from lead containing copper alloys according to ES 27.3. The chemical composition of the molten material is adjust using massive lead pieces. The lead can be added in conjunction with other metals depending on the desired chemical composition. The product is massive metal, usually as flat or round shapes, billets, ingots or bars. The typical content of lead in copper alloys is up to 4 %.

Amounts used

Amounts used per shift are not considered to influence the exposure as such for this scenario. Instead, the combination of the scale of operation (industrial vs. professional) and level of containment/automation (as reflected in the PROC) is the main determinant of the process intrinsic emission potential.

Frequency and duration of use/exposure

Exposure of workers to lead only occurs during the melting and casting operations or manual maintenance operations. Full shift (8 hours) exposure for melting and casting operatives. Exposure due to manual maintenance is sporadic and part shift.

Human factors not influenced by risk management

Refer to occupational hygiene measures as described below which influences the variation in blood leads.

Other given operational conditions affecting workers exposure

Workplace	Involved PROCs	Room volume	Outdoors or indoors?	Process temperature	Process pressure
ES 27.1	PROC 21	>1000 m³	indoors	not restricted	not restricted
ES 27.2	PROC 22, 23	>1000 m³	indoors		
ES 27.3	PROC 23	>1000 m³	indoors		
ES 27.4	PROC 24, 25, 21	>1000 m³	indoors		
ES 27.5	PROC 21	>1000 m³	Indoors / outdoors (storage)		
ES 27.6	PROC 28, 25	>1000 m³	indoors		

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

Workplace	Involved PROCs	Level of containment	Level of segregation
ES 27.1	PROC 21	not required	not required
ES 27.2	PROC 22, 23	Enclosed system with extraction	
ES 27.3	PROC 23		
ES 27.4	PROC 24, 25, 21		
ES 27.5	PROC 21		
ES 27.6	PROC 28, 25		

Technical conditions and measures to control dispersion from source towards the worker					
Workplace	Involved PROCs	Level of separation	Localised controls (LC)	Efficiency of LC (according to MEASE)	Further information
ES 27.1	PROC 21	closed cabin with positive pressure	local exhaust ventilation (LEV generally not used in raw material handling)	78%	For manual operations the use of adequate PPE (see below) is required.
ES 27.2	PROC 22, 23	control room for the majority of the shift, however operators will be present on plant next to the furnace	local exhaust ventilation (industrial scale extraction very large systems)	78%	For incidental control walks and minor maintenance works the use of Procedural controls and adequate PPE (see below) is required.
ES 27.3	PROC 23	Minimal separation due to presence on casting floor, some time spent in control cabin	local exhaust ventilation (industrial scale extraction very large systems)	78%	As well as the use of extraction systems the use of procedural controls and adequate PPE may be required (see below)
ES 27.4	PROC 24, 25, 21	Minimal only rolling will be in cabins / Cutting and finishing will be close to source	local exhaust ventilation	78%	As well as the use of extraction systems the use of procedural controls and adequate PPE may be required (see below)
ES 27.5	PROC 21	not required	no	not applicable	-
ES 27.6	PROC 28, 25	not required	no	not applicable	PPE will be required for welding and burning operations (see below)
Engineering and Ventilation Controls: basic aspects of equipment and facility design should be such that lead emissions that may contribute to occupational exposures are minimised. Such measures may include enclosure of process equipment so that sources of dust or fume emissions are minimised, negative draft exhaust systems to reduce emissions from enclosures and/or local exhaust ventilation installed at unavoidable sources of process emissions. The design characteristics of any local exhaust ventilation (e.g. exhaust hoods) will be specific to the emission source being controlled. As well as the capture hood the design of ducting should be taken into consideration so that fallout does not occur due to flawed duct design. Air flow and velocity should also be considered and taken account of as lead is denser than other metals / dust so an increased flow and velocity will be required to carry the particles to the air cleaner. Area ventilation should also be balanced such that air flow within a work area moves from areas of low to high exposure potential. Air captured by ventilation controls may require treatment to minimise toxic substances prior to discharge or recirculation via the air cleaning device such as bag filter, precipitator etc.					

Organisational measures to prevent /limit releases, dispersion and exposure

Cleaning: Ensure general shop cleanliness is maintained by frequent washing/vacuuming. Clean spillages in the workplace at the end of every shift.
Personal protective equipment: Assess the need to wear respiratory protective equipment in production areas as a last resort only if adequate control cannot be achieved via the use of extraction and procedural controls. Consider the use of effective masks for example EN149: FFP3S accompanied by a compliance policy (ensure proper shaving; ensure workers do not remove RPE in production areas in order to communicate).
Where masks are used, employ formal mask cleaning and filter changing strategies; For workers in areas of significant exposure, provide sufficient working clothes to enable daily change into clean clothes. In such cases all work clothing should be cleaned by the employer on a daily basis and is not permitted to leave the work site.
Personal hygiene: Ensure workers follow simple hygiene rules (e.g. do not bite nails and keep them cut short, avoid touching or scratching face with dirty hands or gloves); Ensure workers do not wipe away sweat with hands or arms, e.g. by providing disposable perspiration towels; Ensure workers use disposable tissues rather than a handkerchief; Prohibit drinking, eating and smoking in production areas; Prevent access to eating and non-production areas in working clothes; Ensure workers as a minimum wash hands, arms, faces and mouths (but preferably shower) and change into personal clothing (or clean coveralls provided by the company) before entering eating areas; For high exposure workplaces, at the end of a shift, workers may need to pass through a room containing washbasins for the cleaning of hands, followed by a 'dirty' room for the removal of working clothes, then through showers into a 'clean' room for changing into personal clothing; Ensure workers handle dirty working clothes with care; Consider making showering obligatory at the end of a shift, and provide towels and soap; Recommend that no personal belongings to be taken into production areas, and suggest that no items that have been used in production areas to be taken home.
Blood lead monitoring: Set in place a monitoring regime which covers all site activities (for women and for men); Use certified laboratories to measure blood lead levels or have own laboratory certified; Consider benchmarking with other companies/sectors; Define a policy for submitting workers to blood lead monitoring, including increased frequency for workers undertaking high-risk jobs and workers with elevated blood lead levels; Ensure all workers have a blood test prior to working on site. The blood lead levels of workers will be monitored on a regular basis, often in reference to an "action level" that is typically 5 µg/dL below the exposure limit deemed to be safe. If the action level is exceeded, appropriate measures are to be taken, (e.g. ban overtime, provide counselling on proper work practice and hygiene, instigate an individual blood lead management plan, increase blood lead sampling frequency) in an effort to prevent further increases in blood lead. If the safe threshold (40 µg/dL for men; 10 µg/dL for women of reproductive capacity) is exceeded, continue ban on overtime, ensure strict hygiene procedures are followed, undertake detailed inspections to ensure correct use of personal protective equipment, undertake detailed inspections to ensure recommended workplace procedures are followed, move employee to workplace where exposure is expected to be lower or remove from lead environment altogether, further increase blood lead sampling frequency, and continue frequent sampling until results are below the first action level.
Creating a culture of safety: Define and communicate a clear policy for controlling occupational exposure to lead; Ensure managers set the example in terms of personal protection and hygiene; Where possible involve occupational physicians in making workers take control of their own blood lead levels; Consider making low blood lead levels a condition of employment, with disciplinary action taken where protective equipment and hygiene procedures are not followed; Involve managers when workers' blood lead levels exceed action levels; Consider publicising company blood lead performance (anonymously) to workers via notices and briefings to ensure the topic remains a key priority; Provide detailed training for new personnel on the risks of lead exposure and the procedures for protection; Provide instruction on specific lead exposure risks for workers undertaking new tasks; Provide regular refresher courses for all employees on the risks of lead exposure and the procedures for protection; Involve worker representatives.

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

Workplace	Involved PROCs	Specification of RPE	RPE efficiency (assigned protection factor, APF)	Specification of gloves	Further PPE
ES 27.1	PROC26	half mask, FFP3 for manual operations	APF=20	leather gloves for manual operations	Standard working clothes and shoes, additionally, standard "personal hygiene" measures have to be considered (see above).
ES 27.2	PROC22, 23	half mask, FFP3, for control walks and maintenance works	APF=20	leather gloves for control walks and maintenance works	
ES 27.3	PROC 23	half mask, FFP3		leather gloves	
ES 27.4	PROC 21, 24,25	half mask, FFP3	APF=20		
ES 27.5	PROC21	half mask, FFP3	APF=20		
ES 27.6	PROC28, 25	half mask, FFP3	APF=20		

Recommended minimum RPE except in cases where adequate ventilation/emission control in place (see also section 4 on how to assess if used ventilation/emission controls are already adequate).
Any RPE as defined above shall only be worn if the following principles are implemented in parallel: The duration of work (reflected in "duration of exposure" above) should reflect the additional physiological stress for the worker due to the breathing resistance and mass of the RPE itself, due to the increased thermal stress by enclosing the head. In addition, it shall be considered that the worker's capability of using tools and of communicating are reduced during the wearing of RPE.
For reasons as given above, the worker should therefore be (i) healthy (especially in view of medical problems that may affect the use of RPE), (ii) have suitable facial characteristics reducing leakages between face and mask (in view of scars and facial hair). The recommended devices above which rely on a tight face seal will not provide the required protection unless they fit the contours of the face properly and securely. Face fit testing is recommended to form part of the RPE compliance policy

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

2.2 Control of environmental exposure

Product characteristics

Raw material is scrap from lead containing copper alloys or ingots from lead containing copper alloys according to ES 27.3. The chemical composition of the molten material is adjust using massive lead pieces. The lead can be added in conjunction with other metals depending on the desired chemical composition. The product is massive metal, usually as flat or round shapes, billets, ingots or bars. The typical content of lead in copper alloys is up to 4 %.

Amounts used

3100 Tonnes Pb/year

Frequency and duration of use

300 Days per year

Environment factors not influenced by risk management

Flow rate of receiving surface water
18000 m3/d (default value)

Other given operational conditions affecting environmental exposure

N/A

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

See chapter 2 of CSR

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

One or more of the following measures (as set out in in the BAT Reference Document on Non-Ferrous Metal Processes) are taken to reduce emissions to water:

- Chemical precipitation: used primarily to remove the metal ions
- Sedimentation
- Filtration: used as final clarification step
- Electrolysis: for low metal concentration
- Reverse osmosis: extensively used for the removal of dissolved metals
- Ion exchange: final cleaning step in the removal of heavy metal from process wastewater

One or more of the following measures (as set out in in the BAT Reference Document on Non-Ferrous Metal Processes) are taken to reduce emissions to air:

- Electrostatic precipitators using wide electrode spacing: Wet electrostatic precipitators:
- Cyclones, but as primary collector
- Fabric or bag filters: high efficiency in controlling fine particulate (melting): achieve emission values Membrane filtration techniques can achieve
- Ceramic and metal mesh filters. PM10 particles are removed
- Wet scrubbers

- specify the size of industrial sewage treatment plant (m3/d)
The assumption is default 2,000 m3/day
- specify degradation efficacy
In case of on-site waste water emissions, the overall reported efficiency of the implemented risk management measures varies between 95 to 98%. In case of stack air emissions, the overall reported efficiency of the implemented risk management measures varies between 95 to 99.95%.
- specify sludge treatment
Sludge is recycled, incinerated or landfilled

Organisational measures to prevent/limit release from site

Emission control measures should be complimented by an integrated management system e.g. ISO 9000, ISO 14001, or alike

Conditions and measures related to municipal sewage treatment plant

- Size of municipal sewage system/treatment plant (m3/d)
The assumption by default for the off-site municipal sewage treatment plant is 2,000 m3/day
- specify degradation efficacy;
According to the VRAL (2008), the fraction of lead removed by the municipal STP is set at 84%
- sludge treatment technique (disposal or recovery);
For the generic exposure scenario, it is assumed that the waste water is not connected to a municipal sewage treatment plant

Conditions and measures related to external treatment of waste for disposal

Different Pb-bearing wastes resulting from the processes described above are generated in the form of extraction dust, slags/drosses. These waste products are mainly recycled in the production process or through off-site processes

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

Fraction of daily/annual use expected in waste:

- *primary producers = 0.22 %*
- *secondary producers = 0.73 %*
- *compound producers = 0.02 %*
- *battery manufacturers = 1.25E-8 %*
- *lead sheet manufacturers = 0.19 %*

Appropriate waste codes:

02 01 10, 06 03 15*, 06 04 05*, 06 05 02*, 10 04 01*, 10 04 02*, 10 04 04*, 10 04 05*, 10 04 06*, 10 04 07*, 10 04 99, 10 05 99, 10 10 10, 10 10 11*, 12 01 03*, 15 01 04*, 15 01 10*, 15 02 02*, 16 01 04*, 16 01 06*, 16 01 19, 16 06 01*, 16 06 02*, 16 08 02*, 16 08 03*, 16 11 03*, 17 04 03, 17 04 07*, 17 04 09*, 17 09 04*, 19 01 11*, 19 02 05*, 19 08 11*, 19 08 13*, 19 08 14, 19 10 02*, 19 12 03*, 19 12 11**

Suitable disposal: Keep separate and dispose of to either

- *Hazardous waste incineration operated according to Council Directive 2008/98/EC on waste, Directive 2000/76/EC on the incineration of waste and the Reference Document on the Best Available Techniques for Waste Incineration of August 2006.*
- *Hazardous landfill operated under Directive 1999/31/EC.*

A detailed assessment has been performed and is reported in the Waste report (ARCHE, 2013)

Conditions and measures related to external recovery of waste

Lead dust from the bag filter plants are collected by external contractors and removed and regenerated off site.

3. Exposure estimation and reference to its source

Occupational exposure

In the following column “Blood lead levels”, the 90th percentile of the measured blood lead data is provided from fabricators of semis from leaded copper alloys for the years 2015-2017. The risk characterisation ratio (RCR) is based on the DNEL of 40 µg/dL.

Workplace	Involved PROCs	Method used for exposure assessment	Blood lead level at 90th percentile* (RCRs)	Counts**	Inhalation exposure estimate	Dermal exposure estimate
Job rotation	PROC 21, 22, 23, 24, 25, 28	measured blood lead data	25.0 µg/dL (0.63)	860	not relevant because blood lead integrates all relevant paths of exposure	

*Worker blood lead data were reported only in bands. Therefore, a worst-case assumption was made, i.e. that all workers reported in a given band had the highest blood lead value of that band.
** “Counts” refers to the total number of annual datapoints used to calculate the 90th percentile for the three-year period; a given worker may have more than one annual datapoint, i.e. if they were employed for more than one year they would be represented twice or three times in the statistical analysis.

Environmental emissions

These tables report the Local concentrations (Clocal), the regional concentrations (PECregional), the Predicted Exposure Concentrations (PEC), the Predicted No Effect Concentrations (PNEC) and Risk Characterisation Ratios (RCR) in the different environmental compartments.

Compartment	Unit	PNEC	PEC regional	C local	PEC	RCR
Fresh water	µg/L	2.4	0.61	0.0434	0.653	0.272
Marine water	µg/L	3.3	0.046	0.00434	0.0503	0.015
Fresh water sediment (without bioavailability correction)	mg/kg dw	186	83.3	12.81	96.11	0.517
Marine water sediment	mg/kg dw	168	53.2	1.28	54.48	0.324
Terrestrial	mg/kg dw	212	28.3	0.00643	28.3	0.134
Fresh water foodchain	mg/kg ww	10.9	/	/	0.962	0.088
Marine water foodchain	mg/kg ww	10.9	/	/	0.073	0.0067
Terrestrial foodchain	mg/kg ww	10.9	/	/	1.272	0.117

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

The DU works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the downstream user can demonstrate on his own that his implemented risk management measures are adequate (given that the processes, operational conditions and activities in question are covered by the PROCs listed above). This has to be done by showing that they limit the exposure (reflected in measured blood lead levels) to a level below the respective DNEL as given below:

DNEL for male workers: 40 µg/dL

DNEL for female workers of reproductive capacity: 10 µg/dL

For the environment, please note that if a DU does not comply with the conditions stipulated in the safe use ES, it is recommended to apply the Metals EUSES IT tool in order to perform a site-specific assessment (free download: http://www.arche-consulting.be/Metal-CSA-toolbox/du-scaling-tool).