EC number	Manufacture	Identified uses			Life cycle stage		Linked to Identified Use	Sector of enduse (SU)	Chemical Product Category(PC)	Process category(PROC)	Article category(AC)	Environmentalrelease category (ERC)
		Formulation	End use	Consumer use	Service life (for articles)	Waste stage						
3			X		X	X	3 Lead battery production	16, 17	7	3, 4, 21, 22, 23, 25, 26, 28	1, 2, 3	5, 6a

Sectors of use (SU)

SU16 Manufacture of computer, electronic and optical products, electrical equipment C 26-27
SU17 General manufacturing, e.g. machinery, equipment, vehicles, other transport equipment C 28-30,33

Chemical Products Categories (PC)

PC7 Base metals and alloys

Process categories (PROC)

3, 4, 21, 22, 23, 25, 26, 28

Code	Name	Explanations and examples
PROC 3	Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition	Describes the general nature of processes taking place in sectors where the manufacture of substances or production of mixtures takes place (batch processes that involve limited manual interventions) or processes with closed process conditions as applied in chemical industry. The closed transfers inherent to the process including closed sampling are included. Open transfers to charge/discharge are not included.
PROC 4	Chemical production where opportunity for exposure arises	Describes the general nature of processes taking place in sectors where the manufacture of substances or production of mixtures takes place (processes where the nature of the design does not exclude exposure). The closed transfers inherent to the process including closed sampling are included. Open transfers to charge/discharge the system are not included

PROC 21	Low energy manipulation and handling of substances bound in/on materials or articles	Cover activities such as manual cutting, cold rolling or assembly/disassembly of material/article. It can also be used for handling/transfer of massive (metal) objects.
PROC 22	Manufacturing and processing of minerals and/or metals at substantially elevated temperature	Describes the general nature of processes taking place at smelters, furnaces, refineries, ovens, excluding casting, tapping and drossing operations. When the temperature has decreased , the handling of the cool material can be covered by PROC21 or PROC26.
PROC 23	Open processing and transfer operations at substantially elevated temperature	Describes certain processes taking place at smelters, furnaces and ovens: casting, tapping and drossing operations. Covers also hot dip galvanising raking of melted solids in paving and water granulation. When the temperature has decreased, the handling of the cold material can be covered by PROC21 or PROC26.
PROC 25	Other hot work operations with metals	Welding, soldering, gouging, brazing, flame cutting.
PROC 26	Handling of solid inorganic substances at ambient temperature	Transfer and handling of ores, concentrates, metals and other inorganic substances in solid (but not massive) potentially dusty form. Assignment of PROC8a, PROC8b or PROC9 not needed in this case. The handling of massive objects should be addressed with PROC21.
PROC 28	Manual maintenance (cleaning and repair) of machinery	Covers maintenance activities for uses where the maintenance is not already included in any of the other process categories. The category covers for example: • activities when closed systems are opened and potentially entered for cleaning • generally dedicated/separate cleaning tasks conducted on a shift or less frequent basis (e.g. between individual production batches) • removal of splashes around the machinery removal of filters or material from filters • cleaning of floors that are not directly around the machinery, but still need cleaning for instance because of dust deposition when handling a dusty product

Environmental Release categories (ERC)

LCS: Use at industrial sites	
ERC5	**ERC5**
ERC6a	**ERC6a**

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ERC5	Use at industrial site leading to inclusion into/onto article	The substance or its transformation products are included into or onto article Examples: • Use of binding agent and process regulators in paints and coatings or adhesives • Use of dyes in textile fabrics and leather products • Use of metals in coatings applied through plating and galvanizing processes • Use of plasticisers, pigments or flame retardants in article matrix or coatings on articles Covers also uses where the substance remains in the article after having previously been used as processing aid (e.g. heat stabilisers in plastic processing).
ERC6a	Use of intermediate	The substance is used in order to manufacture another substance Examples: • Use of chemical building blocks (feedstock) in the synthesis of agrochemicals, pharmaceuticals etc. • Use of cyclopentanone in the synthesis of cyclopentanol

Article Categories (AC)

Code	Name	Suitable TARIC chapters	Explanation and example
Categories of complex articles			
AC1	Vehicles	86-89	
AC1a	Vehicles covered by End of Life Vehicles (ELV) directive		e.g. personal vehicles, delivery vans
AC1b	Other vehicles		e.g. boat, train, metro, planes
AC2	Machinery, mechanical appliances, electrical/electronic articles	84/85	
AC2a	Machinery, mechanical appliances electrical/electronic articles covered by the Waste Electrical and Electronic Equipment (WEEE) directive		e.g. refrigerators, washing machines, vacuum cleaners, computers, telephones, drills, saws, smoke detectors, thermostats, radiators
AC2b	Other machinery, mechanical appliances, electrical / electronic articles		e.g. large-scale stationary industrial tools
AC3	Electrical batteries and accumulators	8506/07	

Lead Battery Production (IU3)

Exposure Scenario Format (3) addressing uses carried out by workers	
1. Title	
Free short title	Use of lead metal in lead battery production (Identified use 3)
Systematic title based on use descriptor	SU16 (Manufacture of computer, electronic and optical products, electrical equipment), SU 17 (General manufacturing); ERC 5 Use at industrial site leading to inclusion into/onto article, ERC 6a Use of intermediate; AC1 Vehicles, AC2 Machinery, mechanical appliances, electrical/electronic articles, AC 3 Electrical batteries
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 human health assessment of 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	Involved tasks	Involved PROCs
ES 3.1	plate manufacturing	Casting/production of grids, oxide production, mixing, pasting, and curing operations	PROC 3, 21, 22, 23
ES 3.2	plate treatment	jar/tank formation, plate washing, drying, cutting	PROC 4, 21
ES 3.3	assembly	stacking, assembly, welding and joining operations	PROC 21, 25, 26
ES 3.4	battery formation	acid filling, formation (wet batteries), finishing	PROC 4, 21
ES 3.5	internal logistics	storage of raw materials and finished goods, intra-facility transport, shipment	PROC 21
ES 3.6	others	cleaning and maintenance	PROC 28

Environment

ERC number	Name	Description	Level of containment	Dispersion of emission sources	Indoor / outdoor
ERC 5	Use at industrial site leading to inclusion into/onto article	The substance or its transformation products are included into or onto article	closed	industrial	indoor
ERC 6a	Use of intermediate	The substance is used in order to manufacture another substance	closed	industrial	indoor

2.1 Control of workers exposure

Product characteristic

Raw material is principally lead ingots, and sometime lead oxides. During the different process steps varying levels of dustiness occur. The article is an assembled and sealed battery.

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

Full shift exposure (8 hours) for all workplaces (not restricted).

Human factors not influenced by risk management

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

Other given operational conditions affecting workers exposure

Workplace	Involved PROCs	Room volume	Outdoor or indoor use	Process temperature	Process pressure
ES 3.1	PROC 3, 21, 22, 23	>1000 m³	indoors	not restricted	not restricted
ES 3.2	PROC 4, 21	>1000 m³	indoors		
ES 3.3	PROC 21, 25,26	>1000 m³	indoors		
ES 3.4	PROC 4, 21	>1000 m³	indoors		
ES 3.5	PROC 21	>1000 m³	indoors		
ES 3.6	PROC 28	>1000 m³	indoors		

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

Workplace	Involved PROCs	Level of containment	Level of segregation
ES 3.1	PROC 3, 21, 22, 23	closed system (lead oxide production)	enclosed space (curing chamber)
ES 3.2	PROC 4, 21	not required	not required
ES 3.3	PROC 21, 25, 26		
ES 3.4	PROC 4, 21		
ES 3.5	PROC 21		
ES 3.6	PROC 28		

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 3.1	PROC 3, 21, 22, 23	Any potentially required separation of workers from the emission source is indicated above under “Frequency and duration of exposure”. A reduction of exposure duration can be achieved, for example, by the installation of ventilated (positive pressure) control rooms or by removing the worker from workplaces involved with relevant exposure.	local exhaust ventilation	78 %	—
ES 3.2	PROC 4, 21		local exhaust ventilation	78 %	—
ES 3.3	PROC 21, 25, 26		local exhaust ventilation	78 %	—
ES 3.4	PROC 4, 21		local exhaust ventilation	78 %	—
ES 3.5	PROC 21		local exhaust ventilation	78 %	—
ES 3.6	PROC 28		local exhaust ventilation	78 %	—

Engineering and Ventilation Controls: basic aspects of equipment and facility design should be such that lead emissions that may contribute to occupational exposures are minimized. Such measures may include enclosure of process equipment such that sources of dust or aerosol emissions are minimized, 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. 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 minimize toxic substances prior to discharge or recirculation.

Organizational measures to prevent /limit releases, dispersion and exposure

Cleaning: Ensure general shop cleanliness is maintained by frequent washing/vacuuming. Clean every workplace at the end of every shift.
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; 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; 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 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; For workers in areas of significant exposure, provide sufficient working cloth 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 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 presentatives.

Conditions and measures related to personal protection, hygiene and health evaluation					
Workplace	Involved PROCs	Specification of respiratory protective equipment (RPE)	RPE efficiency (assigned protection factor, APF)	Specificationof gloves	Further personal protective equipment (PPE)
ES 3.1	PROC 3, 21, 22, 23	FFP1 mask for manual operations	APF = 4	protective gloves (heat and mechanical protection)	standard working clothes and shoes, additionally, standard “personal hygiene” measures have to be considered (see above)
ES 3.2	PROC 4, 21	FFP1 mask	APF = 4	protective gloves	
ES 3.3	PROC 21, 25, 26	FFP1 mask	APF = 4	protective gloves	
ES 3.4	PROC 4, 21	FFP1 mask	APF = 4	protective gloves	
ES 3.5	PROC 21	not required	—	not required	
ES 3.6	PROC 28	FFP1 mask	APF = 4	protective gloves	

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 (compare with “duration of exposure” above) should reflect the additional physiological stress for the worker due to the breathing resistance and mass of the RPE itself, due to the increased thermal stress by enclosing the head. In addition, it shall be considered that the worker’s capability of using tools and of communicating are reduced during the wearing of RPE.
For reasons as given above, the worker should therefore be (i) healthy (especially in view of medical problems that may affect the use of RPE), (ii) have suitable facial characteristics reducing leakages between face and mask (in view of scars and facial hair). The recommended devices above which rely on a tight face seal will not provide the required protection unless they fit the contours of the face properly and securely.
The employer and self-employed persons have legal responsibilities for the maintenance and issue of respiratory protective devices and the management of their correct use in the workplace. Therefore, they should define and document a suitable policy for a respiratory protective device programme including training of the workers.
An overview of the APFs of different RPE can be found in BS EN 529:2005.

2.2 Control of environmental exposure

Product characteristics

The produced material is a dry product with a Pb content between 60 and 100% depending on the application

Amounts used

This table and other tables in this exposure scenario report the ranges of key parameters for sites demonstrating adequate control. The values referred to as "selected for exposure scenario" are hypothetical values selected in order to comply with the requirement in the ECHA guidance to generate a generic exposure scenario.

Information type	Site tonnage (T substance)
Median (50th percentile)	20099
90th percentile	35627
Min	3272
Max	77400
Selected for Generic Exposure Scenario	10676

Frequency and duration of use

Information type	Emission days to water per site (d/y)	Emission days to air per site (d/y)
Median (50^{th} percentile)	312	304
90^{th} percentile	363	365
Min	215	215
Max	365	365
	312	304

Environment factors not influenced by risk management

This table report the range of the dilution capacity of the receiving surface water (calculated as the ratio between the flow rate of the river/lake/estuary/sea to the effluent discharge rate)

Information type	Dilution capacity
Median (50^{th} %)	10
90^{th} %	1000
Min	1
Max	1000
Selected for Generic Exposure Scenario to the freshwater environment	10
Selected for Generic Exposure Scenario to the marine environment	100

Other given operational conditions affecting environmental exposure

N/A

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

See chapter 2 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

The release factors to both the water and air compartments after on-site treatment are provided in the following table

Information type	Release factor to water (g/T)	Release factor to air (g/T)
Median (50th %)	0.85	1.97
90th %	2.10	22.32
Min	0.063	0.061
Max	19.64	344.75
Selected for Generic Exposure Scenario	0.20	344.75

Size of industrial sewage treatment plant (m^3/d)

Information type	Effluent flow (m^3/d)
Median (50th %)	218.6
Min	321.8
Max	13.8
Selected for Generic Exposure Scenario	536.0

Degradation efficacy

In case of on-site waste water emissions, the overall reported efficiency of the implemented risk management measures varies between 97 to 99.9%. In case of stack air emissions, the overall reported efficiency of the implemented risk management measures varies between 90 to 100%.

Sludge treatment

Sludge is recycled, incinerated or landfilled

Organizational measures to prevent / limit release from site

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

Conditions and measures related to municipal sewage treatment plant

The assumption by default for the off-site municipal sewage treatment plant is 2,000 m3/day
According to the VRAL (2008), the fraction of lead removed by the municipal STP is set at 84%
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 waste batteries, dross, scrap, plates, dust, swarf. These waste products are mainly recycled in the production process or treated by a licensed waste treatment operator (landfilled or incinerated)according to relevant waste regulation.

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 0499, 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*, 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 landfill operated 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.***
- ***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

Not applicable

3. 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 activitiesin 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).