

EXPOSURE SCENARIO

Lead, dross, antimony rich

Date: 01.11.2019

Previous date:



1 Manufacture and use of lead intermediates

1.1 1 ES 1: Manufacture and use of lead intermediate

This exposure scenario includes the manufacture and use of lead intermediate.

Environment	
Manufacture and use at industrial site	ERC 1, 6a
Worker	
Use in closed, continuous process with occasional controlled exposure	PROC 2
Use in batch and other process (synthesis) where opportunity for exposure arises	PROC 4
Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities	PROC 8b
Low energy manipulation of substances in form of massive metal or bound in other materials and/or articles	PROC 21
Open processing and transfer operations with minerals/metals at elevated temperature	PROC 23
Handling of solid inorganic substances at ambient temperature	PROC 26

1.2 Conditions of use affecting exposure

1.2.1 Control of environmental exposure: Manufacture and use at industrial use

Several combinations of conditions of use are available for which safe use has been shown. One scenario should reflect the most realistic situation on site.

- 1) Maximum amount of total lead intermediates on site is 241,550 tonnes/year, combined with a minimum of 365 emission days per year. On site STP is present while no municipal STP is used. Water from on site STP is sent to freshwater, with minimum surface water flow rate of 240,000 m³/day. A discharge rate of STP is considered to be 2,000 m³/day (default value) (resulting in dilution of 120). Application of sludge on agricultural soil is not allowed.
- 2) Maximum amount of total lead intermediates on site is 61,130 tonnes/year, combined with a minimum of 220 emission days per year. On site STP is present while no municipal STP is used. Water from on site STP is sent to freshwater, with minimum surface water flow rate of 77,200 m³/day. A discharge rate of STP is considered to be 2,000 m³/day (default value) (resulting in dilution of 40). Application of sludge on agricultural soil is not allowed.
- 3) Maximum amount of total lead intermediates on site is 47,900 tonnes/year, combined with a minimum of 330 emission days per year. On site STP is present while no municipal STP is used. Water from on site STP is sent to marine water. A discharge rate of STP is considered to be 2,000 m³/day (default value) (dilution of 100). Application of sludge on agricultural soil is not allowed.
- 4) Maximum amount of total lead intermediates on site is 89,500 tonnes/year, combined with a minimum of 365 emission days per year. On site STP is present and water is subsequently sent to municipal STP. Water from municipal STP is sent to freshwater, with minimum surface water flow rate of 18,000 m³/day. A discharge rate of STP is considered to be 2,000 m³/day (default value) (resulting in dilution of 10). Application of sludge on agricultural soil is allowed.
- 5) Maximum amount of total lead intermediates on site is 56,355 tonnes/year, combined with a minimum of 200 emission days per year. On site STP is present and water is subsequently sent to municipal STP. Water from municipal STP is sent to freshwater, with minimum surface water flow rate of 18,000 m³/day. A discharge rate of STP is considered to be 2,000 m³/day (default value) (resulting in dilution of 10). Application of sludge on agricultural soil is allowed.

An on-site efficiency lies between 90 and 99.99 %. Neutralization of wastewater is needed before emission.

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The air abatement systems consist of bag filters and/or scrubbers, cyclones, lime injection, cassette filter units, etc. Collection and treatment of rainwater and re-use of effluent water/water circulation is present at site in 95% of the lead intermediate producing sites. On site treatment is present at all sites (unless all water is recycled) and the on site treatment efficiency lies between 90 and 99.99%.

1.2.2 Control of worker exposure: Raw material handling (WP1)

Title Workplace 1: 9.1.2 Raw material handling, PROC(s): 8b, 26		
Composition profile (overall content in all handled/processed materials)		
Element	upper limit concentration of the element in overall content	chemical species considered in risk assessment (worst-case considerations)
Ag	1%	soluble silver compounds
Al	5%	not considered (not hazardous for humans)
As	25%	arsenic trioxide
Au	0.1%	not considered (not hazardous for humans)
Ba	1%	soluble barium compounds
Bi	5%	not considered (not hazardous for humans)
Ca	25%	calcium oxide
Cd	1%	cadmium
Co	1%	cobalt
Cr	1%	not considered (not hazardous for humans)
Cu	100%	coppersulfate
Fe	100%	not considered (not hazardous for humans)
In	1%	not considered (not hazardous for humans)
K	1%	not considered (not hazardous for humans)
Mg	5%	not considered (not hazardous for humans)
Mn	25%	manganese dioxide
Mo	0.1%	molybdenum trioxide
Na	5%	not considered (not hazardous for humans)
Ni	5%	Nickel sulfate, nickel sulfide
Pb	100%	internal blood lead
S	25%	not considered (not hazardous for humans)
Sb	25%	diantimony trioxide
Se	1%	selenium
Si	25%	not considered (not hazardous for humans)
Sn	25%	not considered (not hazardous for humans)
Te	1%	tellurium
Ti	1%	not considered (not hazardous for humans)
Zn	25%	zincsulfate
Localised risk management measures (RMMs) at WP1 (reported measures represent minimum requirements)		
Process temperature	ambient temperature	
Level of enclosure	specific enclosure of the emission source is not required	
Localised controls	either a suppression technique such as wet suppression or capture sprays is required or an effective local exhaust ventilation system (minimum efficiency of 78 %)	
Further RMMs at specific activities at WP1		
Activity 1: Crane/other vehicle operations (in closed cabin)		
Level of separation	closed cabin	
Exposure duration	480 min/shift (restriction is not required)	
Personal protective equipment during activity 1		
Type of respiratory protective equipment	RPE is not required for operations in closed cabins.	
Type of dermal protection	Dermal protection is not required for operations in closed cabins.	
Type of eye protection	Eye protection for operations in closed cabins.	
Type of further PPE	General good occupational hygiene practices to be followed are described in the introduction to this ES.	

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Activity 2: Manual/semi-automated transfer operations (no separation of workers)	
Level of separation	separation of workers from the emission source is not required
Exposure duration	480 min/shift (restriction is not required)
Personal protective equipment during activity 2	
Type of respiratory protective equipment	APF = 10 (airstream helmet with P3 filter suggested for long-term exposure (higher APF not considered in risk assessment))
Type of dermal protection	Appropriate gloves have to be worn (acid-, heat-, mechanical-stress-resistant as relevant) to prevent from contact of the skin with any of the assessed substances (protection factor of 100 assumed) and must have a break-through time covering a full-shift.
Type of eye protection	Eye protection has to be worn unless contact of the eye with the assessed substances can be excluded (e.g. in a control room).
Type of further PPE	General good occupational hygiene practices to be followed are described in the introduction to this ES.
Activity 3: Cleaning, maintenance and removal of residuals	
Level of separation	separation of workers from the emission source is not required
Exposure duration	480 min/shift (restriction is not required)
Personal protective equipment during activity 3	
Type of respiratory protective equipment	APF = 10 (airstream helmet with P3 filter suggested for long-term exposure (higher APF not considered in risk assessment))
Type of dermal protection	Appropriate gloves have to be worn (acid-, heat-, mechanical-stress-resistant as relevant) to prevent from contact of the skin with any of the assessed substances (protection factor of 100 assumed) and must have a break-through time covering a full-shift.
Type of eye protection	Eye protection has to be worn unless contact of the eye with the assessed substances can be excluded (e.g. in a control room).
Type of further PPE	General good occupational hygiene practices to be followed are described in the introduction to this ES.
Activity 4: Control works, sampling	
Level of separation	separation of workers from the emission source is not required
Exposure duration	480 min/shift (restriction is not required)
Personal protective equipment during activity 4	
Type of respiratory protective equipment	APF = 10 (airstream helmet with P3 filter suggested for long-term exposure (higher APF not considered in risk assessment))
Type of dermal protection	Appropriate gloves have to be worn (acid-, heat-, mechanical-stress-resistant as relevant) to prevent from contact of the skin with any of the assessed substances (protection factor of 100 assumed) and must have a break-through time covering a full-shift.
Type of eye protection	Eye protection has to be worn unless contact of the eye with the assessed substances can be excluded (e.g. in a control room).
Type of further PPE	General good occupational hygiene practices to be followed are described in the introduction to this ES.

1.2.3 Control of worker exposure: Shredding and sorting (WP2)

Title Workplace 2: 9.1.3 Shredding and sorting, PROC(s): 2		
Composition profile (overall content in all handled/processed materials)		
Element	upper limit concentration of the element in overall content	chemical species considered in risk assessment (worst-case considerations)
Ag	0.1%	soluble silver compounds
Al	5%	not considered (not hazardous for humans)
As	1%	arsenic trioxide
Au	0.1%	not considered (not hazardous for humans)
Ba	0.1%	soluble barium compounds
Bi	0.1%	not considered (not hazardous for humans)
Ca	25%	calcium oxide
Cd	1%	cadmium
Co	0.1%	cobalt
Cr	5%	not considered (not hazardous for humans)
Cu	1%	Copper sulfate
Fe	100%	not considered (not hazardous for humans)
In	0.1%	not considered (not hazardous for humans)
K	0.1%	not considered (not hazardous for humans)
Mg	5%	not considered (not hazardous for humans)
Mn	1%	manganese dioxide
Mo	0.1%	molybdenum trioxide
Na	5%	not considered (not hazardous for humans)

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Ni	0.1%	nickelsulfate, nickel sulfide
Pb	100%	internal blood lead
S	25%	not considered (not hazardous for humans)
Sb	5%	diantimony trioxide
Se	0.1%	selenium
Si	25%	not considered (not hazardous for humans)
Sn	5%	not considered (not hazardous for humans)
Te	0.1%	tellurium
Ti	0.1%	not considered (not hazardous for humans)
Zn	1%	Zinc sulfate
Localised risk management measures (RMMs) at WP2 (reported measures represent minimum requirements)		
Process temperature	ambient temperature	
Level of enclosure/automation	fully automated process	
Localised controls	local exhaust ventilation with minimum efficiency of 78 %	
	a suppression technique such as wet suppression or capture sprays is required	
Further RMMs at specific activities at WP2		
Activity 1: Crane/other vehicle operations (in closed cabin)		
Level of separation	closed cabin	
Exposure duration	480 min/shift (restriction is not required)	
Personal protective equipment during activity 1		
Type of respiratory protective equipment	RPE is not required for operations in closed cabins.	
Type of dermal protection	Dermal protection is not required for operations in closed cabins.	
Type of eye protection	Eye protection for operations in closed cabins.	
Type of further PPE	General good occupational hygiene practices to be followed are described in the introduction to this ES.	
Activity 2: Manual/semi-automated transfer/shredding/sorting operations		
Level of separation	separation of workers from the emission source is not required	
Exposure duration	480 min/shift (restriction is not required)	
Personal protective equipment during activity 2		
Type of respiratory protective equipment	APF = 10 (airstream helmet with P3 filter suggested for long-term exposure (higher APF not considered in risk assessment))	
Type of dermal protection	Appropriate gloves have to be worn (acid-, heat-, mechanical-stress-resistant as relevant) to prevent from contact of the skin with any of the assessed substances (protection factor of 10 assumed) and must have a break-through time covering a full-shift.	
Type of eye protection	Eye protection has to be worn unless contact of the eye with the assessed substances can be excluded (e.g. in a control room).	
Type of further PPE	General good occupational hygiene practices to be followed are described in the introduction to this ES.	
Activity 3: Cleaning, maintenance and removal of residuals		
Level of separation	separation of workers from the emission source is not required	
Exposure duration	480 min/shift (restriction is not required)	
Personal protective equipment during activity 3		
Type of respiratory protective equipment	APF = 10 (airstream helmet with P3 filter suggested for long-term exposure (higher APF not considered in risk assessment))	
Type of dermal protection	Appropriate gloves have to be worn (acid-, heat-, mechanical-stress-resistant as relevant) to prevent from contact of the skin with any of the assessed substances (protection factor of 100 assumed) and must have a break-through time covering a full-shift.	
Type of eye protection	Eye protection has to be worn unless contact of the eye with the assessed substances can be excluded (e.g. in a control room).	
Type of further PPE	General good occupational hygiene practices to be followed are described in the introduction to this ES.	
Activity 4: Control works, sampling		
Level of separation	separation of workers from the emission source is not required	
Exposure duration	480 min/shift (restriction is not required)	
Personal protective equipment during activity 4		
Type of respiratory protective equipment	APF = 10 (airstream helmet with P3 filter suggested for long-term exposure (higher APF not considered in risk assessment))	
Type of dermal protection	Appropriate gloves have to be worn (acid-, heat-, mechanical-stress-resistant as relevant) to prevent from contact of the skin with any of the assessed substances (protection factor of 10 assumed) and must have a break-through time covering a full-shift.	
Type of eye protection	Eye protection has to be worn unless contact of the eye with the assessed substances can be excluded (e.g. in a control room).	
Type of further PPE	General good occupational hygiene practices to be followed are described in the introduction to this ES.	

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**1.2.4 Control of worker exposure: Desulfurisation (WP3)**

Title Workplace 3: 9.1.4 Desulfurisation, PROC(s): 4		
Composition profile (overall content in all handled/processed materials)		
Element	upper limit concentration of the element in overall content	chemical species considered in risk assessment (worst-case considerations)
Ag	1%	soluble silver compounds
Al	1%	not considered (not hazardous for humans)
As	1%	arsenic trioxide
Au	0.1%	not considered (not hazardous for humans)
Ba	0.1%	soluble barium compounds
Bi	1%	not considered (not hazardous for humans)
Ca	25%	calcium oxide
Cd	0.1%	cadmium
Co	0.1%	cobalt
Cr	0.1%	not considered (not hazardous for humans)
Cu	5%	Copper sulfate
Fe	25%	not considered (not hazardous for humans)
In	0.1%	not considered (not hazardous for humans)
K	0.1%	not considered (not hazardous for humans)
Mg	1%	not considered (not hazardous for humans)
Mn	0.1%	manganese dioxide
Mo	0.1%	molybdenum trioxide
Na	25%	not considered (not hazardous for humans)
Ni	0.1%	Nickel sulfate, nickel sulfide
Pb	100%	internal blood lead
S	25%	not considered (not hazardous for humans)
Sb	1%	diantimony trioxide
Se	0.1%	selenium
Si	5%	not considered (not hazardous for humans)
Sn	1%	not considered (not hazardous for humans)
Te	0.1%	tellurium
Ti	0.1%	not considered (not hazardous for humans)
Zn	25%	Zinc sulfate
Localised risk management measures (RMMs) at WP3 (reported measures represent minimum requirements)		
Process temperature	elevated temperature	
Level of enclosure	fully enclosed process	
Localised controls	local exhaust ventilation with minimum efficiency of 78 %	
Further RMMs at specific activities at WP3		
Activity 1: Supervision of closed or semi-closed process		
Level of separation	ventilated control room	
Exposure duration	480 min/shift (restriction is not required)	
Personal protective equipment during activity 1		
Type of respiratory protective equipment	RPE is not required for operations in ventilated control rooms	
Type of dermal protection	Dermal protection is not required for operations in ventilated control rooms.	
Type of eye protection	Eye protection for operations in ventilated control rooms.	
Type of further PPE	General good occupational hygiene practices to be followed are described in the introduction to this ES.	
Activity 2: Manual/semi-automated transfer operations		
Level of separation	separation of workers from the emission source is not required	
Exposure duration	480 min/shift (restriction is not required) (60-240 min)	
Personal protective equipment during activity 2		
Type of respiratory protective equipment	APF = 10 (airstream helmet with P3 filter suggested for long-term exposure (higher APF not considered in risk assessment))	
Type of dermal protection	Appropriate gloves have to be worn (acid-, heat-, mechanical-stress-resistant as relevant) to prevent from contact of the skin with any of the assessed substances (protection factor of 10 assumed) and must have a break-through time covering a full-shift.	
Type of eye protection	Eye protection has to be worn unless contact of the eye with the assessed substances can be excluded (e.g. in a control room).	
Type of further PPE	General good occupational hygiene practices to be followed are described in the introduction to this ES.	

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Activity 3: Cleaning, maintenance and removal of residuals	
Level of separation	separation of workers from the emission source is not required
Exposure duration	480 min/shift (restriction is not required)
Personal protective equipment during activity 3	
Type of respiratory protective equipment	APF = 10 (airstream helmet with P3 filter suggested for long-term exposure (higher APF not considered in risk assessment))
Type of dermal protection	Appropriate gloves have to be worn (acid-, heat-, mechanical-stress-resistant as relevant) to prevent from contact of the skin with any of the assessed substances (protection factor of 100 assumed) and must have a break-through time covering a full-shift.
Type of eye protection	Eye protection has to be worn unless contact of the eye with the assessed substances can be excluded (e.g. in a control room).
Type of further PPE	General good occupational hygiene practices to be followed are described in the introduction to this ES.
Activity 4: Control works, sampling	
Level of separation	separation of workers from the emission source is not required
Exposure duration	480 min/shift (restriction is not required)
Personal protective equipment during activity 4	
Type of respiratory protective equipment	APF = 10 (airstream helmet with P3 filter suggested for long-term exposure (higher APF not considered in risk assessment))
Type of dermal protection	Appropriate gloves have to be worn (acid-, heat-, mechanical-stress-resistant as relevant) to prevent from contact of the skin with any of the assessed substances (protection factor of 10 assumed) and must have a break-through time covering a full-shift.
Type of eye protection	Eye protection has to be worn unless contact of the eye with the assessed substances can be excluded (e.g. in a control room).
Type of further PPE	General good occupational hygiene practices to be followed are described in the introduction to this ES.

1.2.5 Control of worker exposure: Melting, smelting and drossing (WP4)

Title Workplace 4: 9.1.5 Melting, smelting and drossing, PROC(s): 22		
Composition profile (overall content in all handled/processed materials)		
Element	upper limit concentration of the element in overall content	chemical species considered in risk assessment (worst-case considerations)
Ag	5%	soluble silver compounds
Al	5%	not considered (not hazardous for humans)
As	25%	arsenic trioxide
Au	5%	not considered (not hazardous for humans)
Ba	1%	soluble barium compounds
Bi	5%	not considered (not hazardous for humans)
Ca	25%	calcium oxide
Cd	1%	cadmium
Co	1%	cobalt
Cr	5%	not considered (not hazardous for humans)
Cu	100%	copper(I) oxide
Fe	100%	not considered (not hazardous for humans)
In	1%	not considered (not hazardous for humans)
K	5%	not considered (not hazardous for humans)
Mg	5%	not considered (not hazardous for humans)
Mn	1%	manganese dioxide
Mo	1%	molybdenum trioxide
Na	5%	not considered (not hazardous for humans)
Ni	5%	nickel oxide
Pb	100%	internal blood lead
S	25%	not considered (not hazardous for humans)
Sb	25%	diantimony trioxide
Se	5%	selenium
Si	25%	not considered (not hazardous for humans)
Sn	25%	not considered (not hazardous for humans)
Te	5%	tellurium
Ti	1%	not considered (not hazardous for humans)
Zn	25%	not considered (not hazardous for humans)

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Localised risk management measures (RMMs) at WP4 (reported measures represent minimum requirements)	
Process temperature	elevated temperature (up to 1600°C)
Level of enclosure	closed furnace
Localised controls	integrated local exhaust ventilation with minimum efficiency of 84 %
Further RMMs at specific activities at WP4	
Activity 1: Supervision (in control room)	
Level of separation	separation of workers in ventilated control room
Exposure duration	480 min/shift (restriction is not required)
Personal protective equipment during activity 1	
Type of respiratory protective equipment	RPE is not required for operations in control rooms.
Type of dermal protection	Dermal protection is not required for operations in control rooms.
Type of eye protection	Eye protection for operations in control rooms.
Type of further PPE	General good occupational hygiene practices to be followed are described in the introduction to this ES.
Activity 2: Control walks/sampling	
Level of separation	separation of workers from the emission source is not required
Exposure duration	480 min/shift (restriction is not required)
Personal protective equipment during activity 2	
Type of respiratory protective equipment	APF = 10 (airstream helmet with P3 filter required for long-term exposure (higher APF not considered in risk assessment))
Type of dermal protection	Appropriate gloves have to be worn (acid-, heat-, mechanical-stress-resistant as relevant) to prevent from contact of the skin with any of the assessed substances (protection factor of 10 assumed) and must have a break-through time covering a full-shift.
Type of eye protection	Eye protection has to be worn unless contact of the eye with the assessed substances can be excluded (e.g. in a control room).
Type of further PPE	General good occupational hygiene practices to be followed are described in the introduction to this ES.
Activity 3: Crane/other vehicle operations (in closed cabin)	
Level of separation	closed cabin
Exposure duration	480 min/shift (restriction is not required)
Personal protective equipment during activity 3	
Type of respiratory protective equipment	RPE is not required for operations in closed cabins.
Type of dermal protection	Dermal protection is not required for operations in closed cabins.
Type of eye protection	Eye protection for operations in closed cabins.
Type of further PPE	General good occupational hygiene practices to be followed are described in the introduction to this ES.
Activity 4: Manual/semi-automated transfer operations (including charging of furnaces)	
Level of separation	separation of workers from the emission source is not required
Exposure duration	480 min/shift (restriction is not required)
Personal protective equipment during activity 4	
Type of respiratory protective equipment	APF = 10 (airstream helmet with P3 filter required for long-term exposure (higher APF not considered in risk assessment))
Type of dermal protection	Appropriate gloves have to be worn (acid-, heat-, mechanical-stress-resistant as relevant) to prevent from contact of the skin with any of the assessed substances (protection factor of 10 assumed) and must have a break-through time covering a full-shift.
Type of eye protection	Eye protection has to be worn unless contact of the eye with the assessed substances can be excluded (e.g. in a control room).
Type of further PPE	General good occupational hygiene practices to be followed are described in the introduction to this ES.
Activity 5: Cleaning, maintenance and removal of residuals	
Level of separation	separation of workers from the emission source is not required
Exposure duration	480 min/shift (restriction is not required)
Personal protective equipment during activity 5	
Type of respiratory protective equipment	APF = 10 (airstream helmet with P3 filter required for long-term exposure (higher APF not considered in risk assessment))
Type of dermal protection	Appropriate gloves have to be worn (acid-, heat-, mechanical-stress-resistant as relevant) to prevent from contact of the skin with any of the assessed substances (protection factor of 100 assumed) and must have a break-through time covering a full-shift.
Type of eye protection	Eye protection has to be worn unless contact of the eye with the assessed substances can be excluded (e.g. in a control room).
Type of further PPE	General good occupational hygiene practices to be followed are described in the introduction to this ES.

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1.2.6 Control of worker exposure: Refining and casting (WP5)

The following conditions of use are prescribed at this workplace:

Title Workplace 5: 9.1.6 Refining and casting, PROC(s): 23		
Composition profile (overall content in all handled/processed materials)		
Element	upper limit concentration of the element in overall content	chemical species considered in risk assessment (worst-case considerations)
Ag	5%	soluble silver compounds
Al	5%	not considered (not hazardous for humans)
As	1%	arsenic trioxide
Au	0.1%	not considered (not hazardous for humans)
Ba	1%	soluble barium compounds
Bi	5%	not considered (not hazardous for humans)
Ca	5%	calcium oxide
Cd	0.1%	cadmium
Co	0.1%	cobalt
Cr	1%	not considered (not hazardous for humans)
Cu	100%	copper(I) oxide
Fe	25%	not considered (not hazardous for humans)
In	0.1%	not considered (not hazardous for humans)
K	1%	not considered (not hazardous for humans)
Mg	5%	not considered (not hazardous for humans)
Mn	1%	manganese dioxide
Mo	0.1%	molybdenum trioxide
Na	0.1%	not considered (not hazardous for humans)
Ni	25%	nickel oxide
Pb	100%	internal blood lead
S	100%	not considered (not hazardous for humans)
Sb	25%	diantimony trioxide
Se	1%	selenium
Si	25%	not considered (not hazardous for humans)
Sn	25%	not considered (not hazardous for humans)
Te	1%	tellurium
Ti	0.1%	not considered (not hazardous for humans)
Zn	100%	not considered (not hazardous for humans)
Localised risk management measures (RMMs) at WP5 (reported measures represent minimum requirements)		
Process temperature	elevated temperature (up to 1250°C)	
Level of enclosure	partly enclosed process	
Localised controls	local exhaust ventilation with minimum efficiency of 78 %	
Further RMMs at specific activities at WP5		
Activity 1: Supervision (in control room)		
Level of separation	separation of workers in ventilated control room	
Exposure duration	480 min/shift (restriction is not required)	
Personal protective equipment during activity 1		
Type of respiratory protective equipment	RPE is not required for operations in control rooms.	
Type of dermal protection	Dermal protection is not required for operations in control rooms.	
Type of eye protection	Eye protection for operations in control rooms.	
Type of further PPE	General good occupational hygiene practices to be followed are described in the introduction to this ES.	
Activity 2: Control walks/sampling		
Level of separation	separation of workers from the emission source is not required	
Exposure duration	480 min/shift (restriction is not required)	
Personal protective equipment during activity 2		
Type of respiratory protective equipment	APF = 10 (airstream helmet with P3 filter required for long-term exposure (higher APF not considered in risk assessment))	
Type of dermal protection	Appropriate gloves have to be worn (acid-, heat-, mechanical-stress-resistant as relevant) to prevent from contact of the skin with any of the assessed substances (protection factor of 10 assumed) and must have a break-through time covering a full-shift.	
Type of eye protection	Eye protection has to be worn unless contact of the eye with the assessed substances can be excluded (e.g. in a control room).	
Type of further PPE	General good occupational hygiene practices to be followed are described in the introduction to this ES.	

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Activity 3: Crane/other vehicle operations (in closed cabin)	
Level of separation	closed cabin
Exposure duration	480 min/shift (restriction is not required)
Personal protective equipment during activity 3	
Type of respiratory protective equipment	RPE is not required for operations in closed cabins.
Type of dermal protection	Dermal protection is not required for operations in closed cabins.
Type of eye protection	Eye protection for operations in closed cabins.
Type of further PPE	General good occupational hygiene practices to be followed are described in the introduction to this ES.
Activity 4: Manual/semi-automated transfer operations (including casting)	
Level of separation	separation of workers from the emission source is not required
Exposure duration	480 min/shift (restriction is not required)
Personal protective equipment during activity 4	
Type of respiratory protective equipment	APF = 10 (airstream helmet with P3 filter required for long-term exposure (higher APF not considered in risk assessment))
Type of dermal protection	Appropriate gloves have to be worn (acid-, heat-, mechanical-stress-resistant as relevant) to prevent from contact of the skin with any of the assessed substances (protection factor of 10 assumed) and must have a break-through time covering a full-shift.
Type of eye protection	Eye protection has to be worn unless contact of the eye with the assessed substances can be excluded (e.g. in a control room).
Type of further PPE	General good occupational hygiene practices to be followed are described in the introduction to this ES.
Activity 5: Cleaning, maintenance and removal of residuals	
Level of separation	separation of workers from the emission source is not required
Exposure duration	480 min/shift (restriction is not required)
Personal protective equipment during activity 3	
Type of respiratory protective equipment	APF = 10 (airstream helmet with P3 filter required for long-term exposure (higher APF not considered in risk assessment))
Type of dermal protection	Appropriate gloves have to be worn (acid-, heat-, mechanical-stress-resistant as relevant) to prevent from contact of the skin with any of the assessed substances (protection factor of 100 assumed) and must have a break-through time covering a full-shift.
Type of eye protection	Eye protection has to be worn unless contact of the eye with the assessed substances can be excluded (e.g. in a control room).
Type of further PPE	General good occupational hygiene practices to be followed are described in the introduction to this ES.

1.2.7 Control of worker exposure: Storage, shipment and transport (WP6)

The following conditions of use are prescribed at this workplace:

Title Workplace 6: 9.1.7 Storage, shipment and transport, PROC(s): 21		
Composition profile (overall content in all handled/processed materials)		
Element	upper limit concentration of the element in overall content	chemical species considered in risk assessment (worst-case considerations)
Ag	1%	soluble silver compounds
Al	5%	not considered (not hazardous for humans)
As	5%	arsenic trioxide
Au	0.1%	not considered (not hazardous for humans)
Ba	1%	soluble barium compounds
Bi	1%	not considered (not hazardous for humans)
Ca	25%	calcium oxide
Cd	0.1%	cadmium
Co	0.1%	cobalt
Cr	0.1%	not considered (not hazardous for humans)
Cu	100%	copper(I) oxide
Fe	100%	not considered (not hazardous for humans)
In	0.1%	not considered (not hazardous for humans)
K	1%	not considered (not hazardous for humans)
Mg	1%	not considered (not hazardous for humans)
Mn	1%	manganese dioxide
Mo	0.1%	molybdenum trioxide
Na	5%	not considered (not hazardous for humans)
Ni	5%	nickel oxide
Pb	100%	internal blood lead
S	100%	not considered (not hazardous for humans)

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Sb	25%	diantimony trioxide
Se	1%	selenium
Si	25%	not considered (not hazardous for humans)
Sn	5%	not considered (not hazardous for humans)
Te	1%	tellurium
Ti	0.1%	not considered (not hazardous for humans)
Zn	1%	not considered (not hazardous for humans)
Localised risk management measures (RMMs) at WP6 (reported measures represent minimum requirements)		
Process temperature	ambient temperature	
Level of enclosure	specific enclosure of the emission source is not required	
Localised controls	local exhaust ventilation with minimum efficiency of 78%	
Further RMMs at specific activities at WP6		
Activity 1: Crane/other vehicle operations (in closed cabin) or other work (e.g. documentation) in dedicated closed rooms		
Level of separation	closed cabin/room	
Exposure duration	480 min/shift (restriction is not required)	
Personal protective equipment during activity 1		
Type of respiratory protective equipment	RPE is not required for operations in closed cabins/rooms.	
Type of dermal protection	Dermal protection is not required for operations in closed cabins/rooms.	
Type of eye protection	Eye protection for operations in closed cabins/rooms.	
Type of further PPE	General good occupational hygiene practices to be followed are described in the introduction to this ES.	
Activity 2: Manual/semi-automated transfer operations		
Level of separation	separation of workers from the emission source is not required	
Exposure duration	480 min/shift (restriction is not required)	
Personal protective equipment during activity 2		
Type of respiratory protective equipment	APF = 10 (airstream helmet with P3 filter suggested for long-term exposure (higher APF not considered in risk assessment))	
Type of dermal protection	Appropriate gloves have to be worn (acid-, heat-, mechanical-stress-resistant as relevant) to prevent from contact of the skin with any of the assessed substances (protection factor of 10 assumed) and must have a break-through time covering a full-shift.	
Type of eye protection	Eye protection has to be worn unless contact of the eye with the assessed substances can be excluded (e.g. in a control room).	
Type of further PPE	General good occupational hygiene practices to be followed are described in the introduction to this ES.	
Activity 3: Cleaning, maintenance and removal of residuals		
Level of separation	separation of workers from the emission source is not required	
Exposure duration	480 min/shift (restriction is not required)	
Personal protective equipment during activity 3		
Type of respiratory protective equipment	APF = 10 (airstream helmet with P3 filter suggested for long-term exposure (higher APF not considered in risk assessment))	
Type of dermal protection	Appropriate gloves have to be worn (acid-, heat-, mechanical-stress-resistant as relevant) to prevent from contact of the skin with any of the assessed substances (protection factor of 100 assumed) and must have a break-through time covering a full-shift.	
Type of eye protection	Eye protection has to be worn unless contact of the eye with the assessed substances can be excluded (e.g. in a control room).	
Type of further PPE	General good occupational hygiene practices to be followed are described in the introduction to this ES.	

1.3 Exposure estimation and reference to its source

1.3.1 Environmental release and exposure: Manufacture and use at industrial site

The environmental exposure and risk assessment is based on the different metal ions because it is the metal ion that is the toxic driver. The modelling tool EUSES was used to assess the environmental exposure.

Table 1: Exposure concentrations for the environment

Protection target	Metal	GES 1	GES 2	GES 3	GES 4	GES 5
		Exposure concentration (local PEC)				
Water (µg/l)	Copper	0.827	0.831	0.106	0.148	0.170
	Nickel	0.177	0.178	0.059	0.274	0.315

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	Zinc	1.697	1.707	1.084	0.224	0.257
	Cadmium	0.010	0.010	0.003	0.009	0.010
	Lead	0.210	0.211	0.013	0.079	0.091
	Arsenic	1.221	1.228	0.321	0.028	0.032
	Antimony	0.074	0.074	0.019	0.283	0.325
	Silver	0.002	0.002	0.002	0.002	0.002
	Selenium	0.118	0.119	0.031	NA	NA
	Cobalt	0.0001	0.0001	0.0000	0.0001	0.0001
	Molybdenum	0.004	0.004	0.001	0.006	0.007
	Chromium	0.000	0.000	0.000	0.000	0.000
	Manganese	0.012	0.012	0.003	0.055	0.098
Sediment* (mg/kg dw)	Copper	25.00	25.15	13.98	4.48	5.15
	Nickel	4.66	4.69	0.37	7.21	8.28
	Zinc	186.66	187.75	6.52	24.63	28.30
	Cadmium	1.35	1.36	0.35	1.12	1.29
	Lead	61.87	62.23	19.09	23.45	26.95
	Arsenic	12.21	12.28	3.21	0.28	0.32
	Antimony	0.33	0.33	0.09	1.27	1.45
	Silver	0.39	0.39	0.00	0.29	0.33
	Selenium	0.37	0.37	0.10	NA	NA
	Cobalt	0.004	0.004	0.002	0.004	0.005
	Molybdenum	0.01	0.01	0.00	0.02	0.02
	Chromium	0.01	0.01	0.00	0.00	0.00
	Manganese	0.0000	0.0000	0.0000	0.0002	0.0004
Predator (water) (mg/kgww)	Copper	Not needed				
	Nickel	0.54	0.54	NR	0.55	0.56
	Zinc	Not needed				
	Cadmium	Not needed				
	Lead	0.31	0.31	NR	0.21	0.22
	Arsenic	0.16	0.17	NR	0.00	0.00
	Antimony	Not needed				
	Silver	Not needed				
	Selenium	0.06	0.06	NR	NA	NA
	Cobalt	Not needed				
	Molybdenum	Not needed				
	Chromium	Not needed				
	Manganese	Not needed				
Top predator (marine water)	Copper	Not needed				
	Nickel	NR	NR	0.52	NR	NR
	Zinc	Not needed				
	Cadmium	Not needed				
	Lead	NR	NR	0.15	NR	NR
	Arsenic	NR	NR	0.01	NR	NR
	Antimony	Not needed				
	Silver	Not needed				
	Selenium	NR	NR	0.00	NR	NR
	Cobalt	Not needed				
	Molybdenum	Not needed				
	Chromium	Not needed				
	Manganese	Not needed				
Sewage treatment plant (mg/L)	Copper	NR	NR	NR	0.002	0.002
	Nickel	NR	NR	NR	0.004	0.004
	Zinc	NR	NR	NR	0.006	0.007
	Cadmium	NR	NR	NR	0.0003	0.0003
	Lead	NR	NR	NR	0.004	0.005
	Arsenic	NR	NR	NR	0.0003	0.0004
	Antimony	NR	NR	NR	0.003	0.003
	Silver	NR	NR	NR	0.0001	0.0001
	Selenium	NR	NR	NR	NA	NA
	Cobalt	NR	NR	NR	0.00002	0.00002
	Molybdenum	NR	NR	NR	0.0001	0.0001
	Chromium	NR	NR	NR	0.000001	0.000002
	Manganese	NR	NR	NR	0.0005	0.0010
Air (ng/m3)	Copper	94	24	19	35	22
	Nickel	20	11	11	13	11
	Zinc	5407	1366	1070	2000	1259
	Cadmium	15	4	3	6	4

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	Lead	9640	2435	1908	3565	2245
	Arsenic	12	3	2	4	3
	Antimony	36	11	9	15	10
	Silver	0.00009	0.00009	0.00009	0.00009	0.00009
	Selenium	0.8	0.2	0.2	NA	NA
	Cobalt	0.0016	0.00041	0.00032	0.00060	0.00038
	Molybdenum	NA	NA	NA	NA	NA
	Chromium	0.24	0.06	0.05	0.09	0.05
	Manganese	2.9	0.7	0.6	1.08175	0.68114
Agricultural soil (mg/kg dw)	Copper	0.04	0.01	0.01	1.18	1.34
	Nickel	0.005	0.001	0.001	0.12	0.14
	Zinc	2.33	0.59	0.46	2.11	1.98
	Cadmium	0.007	0.002	0.001	0.05	0.06
	Lead	4.23	1.07	0.84	2.63	2.21
	Arsenic	0.005	0.001	0.001	0.02	0.02
	Antimony	0.014	0.004	0.003	0.53	0.61
	Silver	0.00	0.00	0.00	0.01	0.01
	Selenium	0.0003	0.0001	0.0001	NA	NA
	Cobalt	0.0000007	0.0000002	0.0000001	0.0001	0.0001
	Molybdenum	NA	NA	NA	NA	NA
	Chromium	0.0001030	0.0000260	0.0000204	0.0003	0.0003
	Manganese	0.0013	0.0003	0.0003	0.0005	0.0003
	Predator (terrestrial) PEC oral terrestrial (mg/kg food)	Copper	Not needed			
Nickel		8.69	8.69	8.69	8.73	8.73
Zinc		Not needed				
Cadmium PEC soil (mg/kgdw)		0.01	0.01	0.01	0.01	0.01
Lead		7.30	6.57	6.51	6.93	6.83
Arsenic		0.006	0.001	0.001	0.02	0.02
Antimony		Not needed				
Silver		Not needed				
Selenium		0.0043	0.0011	0.0008	NA	NA
Cobalt		Not needed				
Molybdenum		Not needed				
Chromium		Not needed				
Manganese		Not needed				

NA: No data available

NR: Not relevant

Table 2: Quantitative risks for the environment

Protection target	Metal	GES 1	GES 2	GES 3	GES 4	GES 5
Water	Risk characterisation ratio (RCR)					
	Copper	0.219	0.219	0.136	0.132	0.135
	Nickel	0.588	0.588	0.229	0.615	0.627
	Zinc	0.082	0.083	0.178	0.011	0.012
	Cadmium	0.107	0.108	0.011	0.098	0.105
	Lead	0.088	0.088	0.005	0.032	0.038
	Arsenic	0.188	0.189	0.641	0.004	0.005
	Antimony	0.001	0.001	0.008	0.003	0.003
	Silver	0.204	0.204	0.005	0.190	0.196
	Selenium	0.044	0.045	0.016	NA	NA
	Cobalt	0.314	0.314	0.068	0.314	0.314
	Molybdenum	0.00002	0.00002	0.00033	0.00002	0.00002
	Chromium	0.00008	0.00008	0.00002	0.00002	0.00002
	Manganese	0.000	0.000	0.001	0.002	0.003
Sediment after AVScorrection	Copper	0.16	0.16	0.01	0.16	0.16
	Nickel	0.08	0.08	0.09	0.08	0.08
	Zinc	0.68	0.68	0.00	0.00	0.00
	Cadmium	0.16	0.16	0.44	0.16	0.16
	Lead	0.33	0.33	0.10	0.13	0.14
	Arsenic	0.19	0.19	0.71	0.00	0.00
	Antimony	0.08	0.08	0.31	0.17	0.18
	Silver	0.02	0.02	0.00	0.02	0.02

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	Selenium	0.04	0.04	0.02	NA	NA
	Cobalt	0.84	0.84	0.84	0.84	0.84
	Molybdenum	0.00003	0.00003	0.00032	0.00003	0.00003
	Chromium	0.00037	0.00037	0.00010	0.00009	0.00010
	Manganese	0.00001	0.00001	0.00003	0.00006	0.00011
Predator (freshwater) Predator (marine water)	Copper	Not needed				
	Nickel	0.044	0.044	NR	0.045	0.05
	Zinc	Not needed				
	Cadmium	Not needed				
	Lead	0.03	0.03	NR	0.02	0.02
	Arsenic	0.33	0.33	NR	0.008	0.01
	Antimony	Not needed				
	Silver	Not needed				
	Selenium	0.28	0.28	NR	0.000	0.00
	Cobalt	Not needed				
	Molybdenum	Not needed				
	Chromium	Not needed				
	Manganese	Not needed				
	Top predator (marine water)	Nickel	NR	NR	0.04	NR
Lead		NR	NR	0.01	NR	NR
Arsenic		NR	NR	0.02	NR	NR
Selenium		NR	NR	0.01	NR	NR
All other metals		Not needed				
Sewage treatment plant (applicable to GES 4 and 5)	Copper	NR	NR	NR	0.009	0.011
	Nickel	NR	NR	NR	0.012	0.013
	Zinc	NR	NR	NR	0.114	0.131
	Cadmium	NR	NR	NR	0.013	0.015
	Lead	NR	NR	NR	0.043	0.050
	Arsenic	NR	NR	NR	0.011	0.012
	Antimony	NR	NR	NR	0.001	0.001
	Silver	NR	NR	NR	0.002	0.003
	Selenium	NR	NR	NR	0.000000000	0.000000000
	Cobalt	NR	NR	NR	0.000004	0.000005
	Molybdenum	NR	NR	NR	0.000003	0.000003
	Chromium	NR	NR	NR	0.0000001	0.0000002
	Manganese	NR	NR	NR	0.000005	0.000010
Air	All metals	Not needed				
Agricultural soil	Copper	0.137	0.136	0.136	0.150	0.152
	Nickel	0.468	0.468	0.468	0.472	0.473
	Zinc	0.022	0.006	0.004	0.020	0.018
	Cadmium	0.169	0.163	0.163	0.220	0.227
	Lead	0.02	0.005	0.004	0.012	0.010
	Arsenic	0.018	0.004	0.003	0.064	0.071
	Antimony	0.017	0.016	0.016	0.031	0.033
	Silver	0.107	0.107	0.107	0.121	0.123
	Selenium	0.003	0.001	0.001	0.001	0.001
	Cobalt	0.886	0.886	0.886	0.886	0.886
	Molybdenum	0.063	0.063	0.063	0.063	0.063
	Chromium	0.00003	0.00001	0.00001	0.00009	0.00010
	Manganese	0.0004	0.0001	0.0001	0.0001	0.0001
	Predator (terrestrial)	Copper	Not needed			
Nickel		NR	NR	0.042	NR	NR
Zinc		Not needed				
Cadmium		Not needed				
Lead		NR	NR	0.01	NR	NR
Arsenic		NR	NR	0.02	NR	NR
Selenium		NR	NR	0.01	NR	NR
All other metals		Not needed				
All compartments	Te	This element has a similar emission potential (and consequently exposure) compared to arsenic. This elemental also has a similar hazard than arsenic. The resulting risk of these elements will therefore be equal than the risk of arsenic. And since safe use is demonstrated for arsenic, safe use is intrinsically demonstrated for this element.				
	Al, Fe, Sn, Bi, C	Not needed				
	Ca, Si, K, Na	These elements are naturally occurring and often essential for living organisms. The releases of				

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		these elements will not exceed potential toxic levels. Potential ecotoxicity effects will be more driven by its speciation (see S, O).
	S, O	In case of sulphates (or oxides), there is a potential environmental pH effect. However, since neutralisation of the wastewater is a standard practice risk management measure in wastewater management, safe use can be demonstrated.

* Sediment risk characterisation ratios are calculated based on bioavailable fraction (based on AVS).

1.3.2 Worker exposure: Raw material handling (WP1)

The exposure concentrations and risk characterisation ratios (RCR) for this workplace are reported in the following table. Please note that the protection factors as displayed in the table below either refer to assigned protection factors (APFs) that are defined according to e.g. BS EN 529:2005 or to protection factors that are considered relevant for the use of protective gloves.

Workplace 1: Raw material handling						
Type of DNEL	Element (chemical species) considered in assessment	EA source (EF)	RWC exposure (outside PPE)	DNEL, surrogate value or qualitative assessment	Protection factor	RCR
ISL	Ag (soluble silver compounds)	#1	0.5 µg/m³	10 µg/m³	RPE: 10	<0.01
	As (arsenic trioxide)	#3	2.5 µg/m³	4 µg/m³		0.06
	Ba (soluble barium compounds)	E43 (0.1)	0.6 µg/m³	500 µg/m³		<0.01
	Cd	#9	1.0 µg/m³	4 µg/m³		0.03
	Cu (copper sulfate)	#15	10.0 µg/m³	1000 µg/m³		<0.01
	Mn (manganese dioxide)	E3 (1.3)	3.2 µg/m³	200 µg/m³		<0.01
	Mo (molybdenum trioxide)	E3 (0.01)	<0.1 µg/m³	11170 µg/m³		<0.01
	Ni (nickel sulfate)	#23	2.8 µg/m³	50 µg/m³		0.01
	Pb	#25	25.9 µg/m³	100 µg/m³		0.03
	Se	#32	2.8 µg/m³	50 µg/m³		0.01
	Te	#38	2.8 µg/m³	100 µg/m³		<0.01
Zn (zinc sulfate)	#43	10.1 µg/m³	1000 µg/m³	<0.01		
ILL	As (arsenic trioxide)	#3	2.5 µg/m³	QA	RPE: 10	QA
	Ba (soluble barium compounds)	E43 (0.1)	0.6 µg/m³	500 µg/m³		<0.01
	Ca (calcium oxide)	E43 (1.3)	12.6 µg/m³	1000 µg/m³		<0.01
	Co	#13	0.3 µg/m³	40 µg/m³		<0.01
	Cu (copper sulfate)	#15	10.0 µg/m³	1000 µg/m³		<0.01
	Mo (molybdenum trioxide)	E3 (0.01)	<0.1 µg/m³	2220 µg/m³		<0.01
	Ni (nickel sulfate)	#23	2.8 µg/m³	50 µg/m³		0.01
	Sb (diantimony trioxide)	#29	2.8 µg/m³	500 µg/m³		<0.01
Se	#32	2.8 µg/m³	QA	QA		
Te	#38	2.8 µg/m³	100 µg/m³	<0.01		
ISA	Cu (copper sulfate)	#15	30.0 µg/m³	4000 µg/m³	gloves: 100	<0.01
	Mn (manganese dioxide)	E3 (1.3)	9.5 µg/m³	QA		QA
	Ni (nickel sulfate)	#23	8.3 µg/m³	16000 µg/m³		<0.01
	Te	#38	8.3 µg/m³	QA		QA
ILA	As (arsenic trioxide)	na	na	QA	gloves: 100	QA
	Ca (calcium oxide)	E43 (1.3)	37.8 µg/m³	4000 µg/m³		<0.01
	Cd	na	na	QA		QA
	Co	na	na	QA		QA
	Cu (copper sulfate)	#15	30.0 µg/m³	4000 µg/m³		<0.01
Ni (nickel sulfide)	#23	8.3 µg/m³	470 µg/m³	<0.01		
DLA	Ag (soluble silver compounds)	na	na	QA	gloves: 100	QA
	As (arsenic trioxide)	na	na	QA		QA
	Ca (calcium oxide)	na	na	QA		QA
	Cd	na	na	QA		QA
DSL	As (arsenic trioxide)	MEASE	848.4 µg/kg bw/d	85 µg/kg bw/d	gloves: 100	0.10
	Cd	MEASE	141.4 µg/kg bw/d	QA		QA
	Sb (diantimony trioxide)	MEASE	848.4 µg/kg bw/d	234700 µg/kg bw/d		<0.01
	Se	MEASE	141.4 µg/kg bw/d	7000 µg/kg bw/d		<0.01
	Te	MEASE	141.4 µg/kg bw/d	QA		QA
Zn (zinc sulfate)	MEASE	848.4 µg/kg bw/d	8300 µg/kg bw/d	<0.01		

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Workplace 1: Raw material handling						
Type of DNEL	Element (chemical species) considered in assessment	EA source (EF)	RWC exposure (outside PPE)	DNEL, surrogate value or qualitative assessment	Protection factor	RCR
DLL	As (arsenic trioxide)	na	na	QA		QA
	Cd	na	na	QA		QA
	Co	na	na	QA		QA
	Ni (nickel sulfate)	MEASE	10 µg/cm ² /d	0.44 µg/cm ² /d		0.23
	Se	na	na	QA		QA
	Te	na	na	QA		QA
DSA	Cd	MEASE	141.4 µg/kg bw/d	QA	QA	
	Se	MEASE	141.4 µg/kg bw/d	QA	QA	
	Te	MEASE	141.4 µg/kg bw/d	QA	QA	
Internal exposure (blood lead levels)	Pb	#50	23.01 µg/dL	40 µg/dL	RPE: 10 gloves: 100	0.58
CSL	As (arsenic trioxide)	ISL + DSL	na	na		0.16
	Pb (internal exposure)	#50	32.9 µg/dL	40 µg/dL		0.82
	Se	ISL + DSL	na	na		0.01
	Zn (zinc sulfate)	ISL + DSL	na	na		<0.01

Note: All exposure concentrations and threshold values are given as element;

Explanation of abbreviations: CSL = combined exposure assessment for systemic long-term effects, only relevant if systemic inhalation and dermal DNEL are available; DLA = dermal, local, acute; DLL = dermal, local, long-term; DNEL = derived no-effect level; DSA = dermal, systemic, acute; DSL = dermal, systemic, long-term; EA source = reference to data set in CSR Appendix 1; EF = total extrapolation factor; ILA = inhalation, local, acute; ILL = inhalation, local, long-term; ISA = inhalation, systemic, acute; ISL = inhalation, systemic, long-term; na = not applicable; QA = qualitative assessment; RCR = risk characterisation ratio; RWC = reasonable worst case

Sources for exposure assessment: #xxx = based on monitoring data; Exxx = based on extrapolation; xxx = number of assessment in GEA table

1.3.3 Worker exposure: Shredding and sorting (WP2)

The exposure concentrations and risk characterisation ratios (RCR) for this workplace are reported in the following table. Please note that the protection factors as displayed in the table below either refer to assigned protection factors (APFs) that are defined according to e.g. BS EN 529:2005 or to protection factors that are considered relevant for the use of protective gloves.

Workplace 2: Shredding and sorting						
Type of DNEL	Element (chemical species) considered in assessment	EA source (EF)	RWC exposure (outside PPE)	DNEL, surrogate value or qualitative assessment	Protection factor	RCR
ISL	Ag (soluble silver compounds)	E1 (0.3)	0.1 µg/m ³	10 µg/m ³	RPE: 10	<0.01
	As (arsenic trioxide)	E3 (0.1)	0.1 µg/m ³	4 µg/m ³		<0.01
	Ba (soluble barium compounds)	E43 (0.01)	0.2 µg/m ³	500 µg/m ³		<0.01
	Cd	E9 (1.5)	1.5 µg/m ³	4 µg/m ³		0.04
	Cu (copper sulfate)	E15 (0.01)	0.1 µg/m ³	1000 µg/m ³		<0.01
	Mn (manganese dioxide)	E3 (0.1)	0.2 µg/m ³	200 µg/m ³		<0.01
	Mo (molybdenum trioxide)	E3 (0.01)	<0.1 µg/m ³	11170 µg/m ³		<0.01
	Ni (nickel sulfate)	E23 (0.1)	0.1 µg/m ³	50 µg/m ³		<0.01
	Pb	E25 (1.5)	38.8 µg/m ³	100 µg/m ³		0.04
	Se	E32 (0.3)	0.8 µg/m ³	50 µg/m ³		<0.01
	Te	E38 (0.3)	0.8 µg/m ³	100 µg/m ³		<0.01
	Zn (zinc sulfate)	E43 (0.1)	0.7 µg/m ³	1000 µg/m ³		<0.01

EXPOSURE SCENARIO

Lead, dross, antimony rich

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Workplace 2: Shredding and sorting						
Type of DNEL	Element (chemical species) considered in assessment	EA source (EF)	RWC exposure (outside PPE)	DNEL, surrogate value or qualitative assessment	Protection factor	RCR
ILL	As (arsenic trioxide)	E3 (0.1)	0.1 µg/m³	QA	gloves: 10	QA
	Ba (soluble barium compounds)	E43 (0.01)	0.2 µg/m³	500 µg/m³		<0.01
	Ca (calcium oxide)	E43 (1.9)	18.9 µg/m³	1000 µg/m³		<0.01
	Co	E13 (0.3)	0.1 µg/m³	40 µg/m³		<0.01
	Cu (copper sulfate)	E15 (0.01)	0.1 µg/m³	1000 µg/m³		<0.01
	Mo (molybdenum trioxide)	E3 (0.01)	<0.1 µg/m³	2220 µg/m³		<0.01
	Ni (nickel sulfate)	E23 (0.1)	0.1 µg/m³	50 µg/m³		<0.01
	Sb (diantimony trioxide)	E29 (0.3)	0.7 µg/m³	500 µg/m³		<0.01
	Se	E32 (0.3)	0.8 µg/m³	QA		QA
ISA	Te	E38 (0.3)	0.8 µg/m³	QA	QA	
	Cu (copper sulfate)	E15 (0.01)	0.4 µg/m³	4000 µg/m³	<0.01	
	Mn (manganese dioxide)	E3 (0.1)	0.5 µg/m³	QA	QA	
	Ni (nickel sulfate)	E23 (0.1)	0.4 µg/m³	16000 µg/m³	<0.01	
ILA	Te	E38 (0.3)	2.3 µg/m³	QA	QA	
	As (arsenic trioxide)	na	na	QA	QA	
	Ca (calcium oxide)	E43 (1.9)	56.7 µg/m³	4000 µg/m³	<0.01	
	Cd	na	na	QA	QA	
	Co	na	na	QA	QA	
	Cu (copper sulfate)	E15 (0.01)	0.4 µg/m³	4000 µg/m³	<0.01	
DLA	Ni (nickel sulfide)	E23 (0.1)	0.4 µg/m³	470 µg/m³	<0.01	
	Ag (soluble silver compounds)	na	na	QA	QA	
	As (arsenic trioxide)	na	na	QA	QA	
	Ca (calcium oxide)	na	na	QA	QA	
DSL	Cd	na	na	QA	QA	
	As (arsenic trioxide)	MEASE	3.4 µg/kg bw/d	85 µg/kg bw/d	<0.01	
	Cd	MEASE	3.4 µg/kg bw/d	QA	QA	
	Sb (diantimony trioxide)	MEASE	6.8 µg/kg bw/d	234700 µg/kg bw/d	<0.01	
	Se	MEASE	3.4 µg/kg bw/d	7000 µg/kg bw/d	<0.01	
	Te	MEASE	3.4 µg/kg bw/d	QA	QA	
DLL	Zn (zinc sulfate)	MEASE	3.4 µg/kg bw/d	8300 µg/kg bw/d	<0.01	
	As (arsenic trioxide)	na	na	QA	QA	
	Cd	na	na	QA	QA	
	Co	na	na	QA	QA	
	Ni (nickel sulfate)	MEASE	0.5 µg/cm²/d	0.44 µg/cm²/d	0.11	
	Se	na	na	QA	QA	
DSA	Te	na	na	QA	QA	
	Cd	MEASE	3.4 µg/kg bw/d	QA	QA	
	Se	MEASE	3.4 µg/kg bw/d	QA	QA	
Internal exposure (blood lead levels)	Te	MEASE	3.4 µg/kg bw/d	QA	QA	
	Pb	#51	25.96 µg/dL	40 µg/dL	RPE: 10 gloves:10	0.65
CSL	As (arsenic trioxide)	ISL + DSL	na	na	RPE: 10 gloves:10	0.01
	Pb (internal exposure)	#51	33.0 µg/dL	40 µg/dL		0.83
	Se	ISL + DSL	na	na		<0.01
	Zn (zinc sulfate)	ISL + DSL	na	na		<0.01

Note: All exposure concentrations and threshold values are given as element;
 Explanation of abbreviations: CSL = combined exposure assessment for systemic long-term effects, only relevant if systemic inhalation and dermal DNEL are available; DLA = dermal, local, acute; DLL = dermal, local, long-term; DNEL = derived no-effect level; DSA = dermal, systemic, acute; DSL = dermal, systemic, long-term; EA source = reference to data set in CSR Appendix 1; EF = total extrapolation factor; ILA = inhalation, local, acute; ILL = inhalation, local, long-term; ISA = inhalation, systemic, acute; ISL = inhalation, systemic, long-term; na = not applicable; QA = qualitative assessment; RCR = risk characterisation ratio; RWC = reasonable worst case
 Sources for exposure assessment: #xxx = based on monitoring data; Exxx = based on extrapolation; xxx = number of assessment in GEA table

EXPOSURE SCENARIO

Lead, dross, antimony rich
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1.3.4 Worker exposure: Desulfurisation (WP3)

The exposure concentrations and risk characterisation ratios (RCR) for this workplace are reported in the following table. Please note that the protection factors as displayed in the table below either refer to assigned protection factors (APFs) that are defined according to e.g. BS EN 529:2005 or to protection factors that are considered relevant for the use of protective gloves.

Workplace 3: Desulfurisation						
Type of DNEL	Element (chemical species) considered in assessment	EA source (EF)	RWC exposure (outside PPE)	DNEL, surrogate value or qualitative assessment	Protection factor	RCR
ISL	Ag (soluble silver compounds)	E1 (1.5)	0.7 µg/m ³	10 µg/m ³	RPE: 10	0.01
	As (arsenic trioxide)	E3 (0.1)	0.1 µg/m ³	4 µg/m ³		<0.01
	Ba (soluble barium compounds)	E43 (0.01)	0.2 µg/m ³	500 µg/m ³		<0.01
	Cd	E9 (0.3)	0.3 µg/m ³	4 µg/m ³		0.01
	Cu (copper sulfate)	E15 (0.1)	0.6 µg/m ³	1000 µg/m ³		<0.01
	Mn (manganese dioxide)	E3 (0.01)	<0.1 µg/m ³	200 µg/m ³		<0.01
	Mo (molybdenum trioxide)	E3 (0.01)	<0.1 µg/m ³	11170 µg/m ³		<0.01
	Ni (nickel sulfate)	E23 (0.1)	0.1 µg/m ³	50 µg/m ³		<0.01
	Pb	E25 (1.5)	38.8 µg/m ³	100 µg/m ³		0.04
	Se	E32 (0.3)	0.8 µg/m ³	50 µg/m ³		<0.01
ILL	Te	E38 (0.3)	0.8 µg/m ³	100 µg/m ³	<0.01	
	Zn (zinc sulfate)	E43 (1.5)	15.1 µg/m ³	1000 µg/m ³	<0.01	
	As (arsenic trioxide)	E3 (0.1)	0.1 µg/m ³	QA	QA	
	Ba (soluble barium compounds)	E43 (0.01)	0.2 µg/m ³	500 µg/m ³	<0.01	
	Ca (calcium oxide)	E43 (1.9)	18.9 µg/m ³	1000 µg/m ³	<0.01	
	Co	E13 (0.3)	0.1 µg/m ³	40 µg/m ³	<0.01	
	Cu (copper sulfate)	E15 (0.1)	0.6 µg/m ³	1000 µg/m ³	<0.01	
	Mo (molybdenum trioxide)	E3 (0.01)	<0.1 µg/m ³	2220 µg/m ³	<0.01	
	Ni (nickel sulfate)	E23 (0.1)	0.1 µg/m ³	50 µg/m ³	<0.01	
	Sb (diantimony trioxide)	E29 (0.1)	0.2 µg/m ³	500 µg/m ³	<0.01	
ISA	Se	E32 (0.3)	0.8 µg/m ³	QA	QA	
	Te	E38 (0.3)	0.8 µg/m ³	QA	QA	
	Cu (copper sulfate)	E15 (0.1)	1.8 µg/m ³	4000 µg/m ³	<0.01	
	Mn (manganese dioxide)	E3 (0.01)	0.1 µg/m ³	QA	QA	
ILA	Ni (nickel sulfate)	E23 (0.1)	0.4 µg/m ³	16000 µg/m ³	<0.01	
	Te	E38 (0.3)	2.3 µg/m ³	QA	QA	
	As (arsenic trioxide)	na	na	QA	QA	
	Ca (calcium oxide)	E43 (1.9)	56.7 µg/m ³	4000 µg/m ³	<0.01	
	Cd	na	na	QA	QA	
	Co	na	na	QA	QA	
DLA	Cu (copper sulfate)	E15 (0.1)	1.8 µg/m ³	4000 µg/m ³	<0.01	
	Ni (nickel sulfide)	E23 (0.1)	0.4 µg/m ³	470 µg/m ³	<0.01	
	Ag (soluble silver compounds)	na	na	QA	QA	
	As (arsenic trioxide)	na	na	QA	QA	
DSL	Ca (calcium oxide)	na	na	QA	QA	
	Cd	na	na	QA	QA	
	As (arsenic trioxide)	MEASE	3.4 µg/kg bw/d	85 µg/kg bw/d	<0.01	
	Cd	MEASE	3.4 µg/kg bw/d	QA	QA	
	Sb (diantimony trioxide)	MEASE	3.4 µg/kg bw/d	234700 µg/kg bw/d	<0.01	
	Se	MEASE	3.4 µg/kg bw/d	7000 µg/kg bw/d	<0.01	
DLL	Te	MEASE	3.4 µg/kg bw/d	QA	QA	
	Zn (zinc sulfate)	MEASE	20.4 µg/kg bw/d	8300 µg/kg bw/d	<0.01	
	As (arsenic trioxide)	na	na	QA	QA	
	Cd	na	na	QA	QA	
	Co	na	na	QA	QA	
	Ni (nickel sulfate)	MEASE	0.5 µg/cm ² /d	0.44 µg/cm ² /d	0.11	
DSA	Se	na	na	QA	QA	
	Te	na	na	QA	QA	
	Cd	MEASE	3.4 µg/kg bw/d	QA	QA	
	Se	MEASE	3.4 µg/kg bw/d	QA	QA	
DSL	Te	MEASE	3.4 µg/kg bw/d	QA	QA	
	Cd	MEASE	3.4 µg/kg bw/d	QA	QA	

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Workplace 3: Desulfurisation						
Type of DNEL	Element (chemical species) considered in assessment	EA source (EF)	RWC exposure (outside PPE)	DNEL, surrogate value or qualitative assessment	Protection factor	RCR
Internal exposure (blood lead levels)	Pb	#52	16.06 µg/dL	40 µg/dL	RPE: 10 gloves: 10	0.40
CSL	As (arsenic trioxide)	ISL + DSL	na	na		0.01
	Pb (internal exposure)	#52	38.0 µg/dL	40 µg/dL		0.95
	Se	ISL + DSL	na	na		<0.01
	Zn (zinc sulfate)	ISL + DSL	na	na		<0.01

- Note: All exposure concentrations and threshold values are given as element;
- Explanation of abbreviations: CSL = combined exposure assessment for systemic long-term effects, only relevant if systemic inhalation and dermal DNEL are available; DLA = dermal, local, acute; DLL = dermal, local, long-term; DNEL = derived no-effect level; DSA = dermal, systemic, acute; DSL = dermal, systemic, long-term; EA source = reference to data set in CSR Appendix 1; EF = total extrapolation factor; ILA = inhalation, local, acute; ILL = inhalation, local, long-term; ISA = inhalation, systemic, acute; ISL = inhalation, systemic, long-term; na = not applicable; QA = qualitative assessment; RCR = risk characterisation ratio; RWC = reasonable worst case
- Sources for exposure assessment: #xxx = based on monitoring data; Exxx = based on extrapolation; xxx = number of assessment in GEA table

1.3.5 Worker exposure: Melting, smelting and drossing (WP4)

The exposure concentrations and risk characterisation ratios (RCR) for this workplace are reported in the following table. Please note that the protection factors as displayed in the table below either refer to assigned protection factors (APFs) that are defined according to e.g. BS EN 529:2005 or to protection factors that are considered relevant for the use of protective gloves.

Workplace 4: Melting, smelting and drossing						
Type of DNEL	Element (chemical species) considered in assessment	EA source (EF)	RWC exposure (outside PPE)	DNEL, surrogate value or qualitative assessment	Protection factor	RCR
ISL	Ag (soluble silver compounds)	#2	0.6 µg/m³	10 µg/m³	RPE: 10	0.01
	As (arsenic trioxide)	#4	4.3 µg/m³	4 µg/m³		0.11
	Ba (soluble barium compounds)	E49 (0.1)	1.3 µg/m³	500 µg/m³		<0.01
	Cd	#10	1.0 µg/m³	4 µg/m³		0.03
	Cu (copper(I) oxide)	#16	12.5 µg/m³	1000 µg/m³		<0.01
	Mn (manganese dioxide)	E4 (0.05)	0.2 µg/m³	200 µg/m³		<0.01
	Mo (molybdenum trioxide)	E4 (0.05)	0.2 µg/m³	11170 µg/m³		<0.01
	Ni (nickel oxide)	#24	2.8 µg/m³	50 µg/m³		0.01
	Pb	#44	418.7 µg/m³	100 µg/m³		0.42
	Se	#33	2.8 µg/m³	50 µg/m³		0.01
ILL	Te	#39	2.8 µg/m³	100 µg/m³	<0.01	
	As (arsenic trioxide)	#4	4.3 µg/m³	QA	QA	
	Ba (soluble barium compounds)	E49 (0.1)	1.3 µg/m³	500 µg/m³	<0.01	
	Ca (calcium oxide)	E49 (1.3)	29.4 µg/m³	1000 µg/m³	<0.01	
	Co	#14	0.3 µg/m³	40 µg/m³	<0.01	
	Cu (copper(I) oxide)	#16	12.5 µg/m³	1000 µg/m³	<0.01	
	Mo (molybdenum trioxide)	E4 (0.05)	0.2 µg/m³	2220 µg/m³	<0.01	
	Ni (nickel oxide)	#24	2.8 µg/m³	50 µg/m³	0.01	
	Sb (diantimony trioxide)	#30	2.9 µg/m³	500 µg/m³	<0.01	
	Se	#33	2.8 µg/m³	QA	QA	
ISA	Te	#39	2.8 µg/m³	QA	QA	
	Mn (manganese dioxide)	E4 (0.05)	0.6 µg/m³	QA	QA	
	Ni (nickel oxide)	#24	8.3 µg/m³	520000 µg/m³	<0.01	
	Te	#39	8.3 µg/m³	QA	QA	

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Workplace 4: Melting, smelting and drossing						
Type of DNEL	Element (chemical species) considered in assessment	EA source (EF)	RWC exposure (outside PPE)	DNEL, surrogate value or qualitative assessment	Protection factor	RCR
ILA	As (arsenic trioxide)	na	na	QA		QA
	Ca (calcium oxide)	E49 (1.3)	88.3 µg/m³	4000 µg/m³		<0.01
	Cd	na	na	QA		QA
	Co	na	na	QA		QA
	Ni (nickel oxide)	#24	8.3 µg/m³	3900 µg/m³		<0.01
DLA	Ag (soluble silver compounds)	na	na	QA	gloves: 10	QA
	As (arsenic trioxide)	na	na	QA		QA
	Ca (calcium oxide)	na	na	QA		QA
	Cd	na	na	QA		QA
DSL	As (arsenic trioxide)	MEASE	84.6 µg/kg bw/d	85 µg/kg bw/d		0.10
	Cd	MEASE	14.1 µg/kg bw/d	QA		QA
	Sb (diantimony trioxide)	MEASE	84.6 µg/kg bw/d	234700 µg/kg bw/d		<0.01
	Se	MEASE	28.2 µg/kg bw/d	7000 µg/kg bw/d		<0.01
	Te	MEASE	28.2 µg/kg bw/d	QA		QA
DLL	As (arsenic trioxide)	na	na	QA		QA
	Cd	na	na	QA		QA
	Co	na	na	QA		QA
	Ni (nickel oxide)	MEASE	1.0 µg/cm²/d	24 µg/cm²/d		<0.01
	Se	na	na	QA		QA
	Te	na	na	QA		QA
DSA	Cd	MEASE	14.1 µg/kg bw/d	QA		QA
	Se	MEASE	28.2 µg/kg bw/d	QA	QA	
	Te	MEASE	28.2 µg/kg bw/d	QA	QA	
Internal exposure (blood lead levels)	Pb	#53	25.6 µg/dL	40 µg/dL	RPE: 10 gloves: 10	0.64
CSL	As (arsenic trioxide)	ISL + DSL	na	na		0.21
	Pb (internal exposure)	#53	35.5 µg/dL	40 µg/dL		0.89
	Se	ISL + DSL	na	na		0.01

Note: All exposure concentrations and threshold values are given as element;
 Explanation of abbreviations: CSL = combined exposure assessment for systemic long-term effects, only relevant if systemic inhalation and dermal DNEL are available; DLA = dermal, local, acute; DLL = dermal, local, long-term; DNEL = derived no-effect level; DSA = dermal, systemic, acute; DSL = dermal, systemic, long-term; EA source = reference to data set in CSR Appendix 1; EF = total extrapolation factor; ILA = inhalation, local, acute; ILL = inhalation, local, long-term; ISA = inhalation, systemic, acute; ISL = inhalation, systemic, long-term; na = not applicable; QA = qualitative assessment; RCR = risk characterisation ratio; RWC = reasonable worst case
 Sources for exposure assessment: #xxx = based on monitoring data; Exxx = based on extrapolation; xxx = number of assessment in GEA table

1.3.6 Worker exposure: Refining and casting (WP5)

The exposure concentrations and risk characterisation ratios (RCR) for this workplace are reported in the following table. Please note that the protection factors as displayed in the table below either refer to assigned protection factors (APFs) that are defined according to e.g. BS EN 529:2005 or to protection factors that are considered relevant for the use of protective gloves.

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Workplace 5: Refining and casting						
Type of DNEL	Element (chemical species) considered in assessment	EA source (EF)	RWC exposure (outside PPE)	DNEL, surrogate value or qualitative assessment	Protection factor	RCR
ISL	Ag (soluble silver compounds)	E2 (4.0)	2.4 µg/m³	10 µg/m³	RPE: 10	0.02
	As (arsenic trioxide)	#5	23.5 µg/m³	4 µg/m³		0.59
	Ba (soluble barium compounds)	E46 (0.01)	4.9 µg/m³	500 µg/m³		<0.01
	Cd	#11	6.6 µg/m³	4 µg/m³		0.17
	Cu (copper(I) oxide)	#17	123.9 µg/m³	1000 µg/m³		0.01
	Mn (manganese dioxide)	E5 (1.3)	29.4 µg/m³	200 µg/m³		0.01
	Mo (molybdenum trioxide)	E5 (0.2)	5.3 µg/m³	11170 µg/m³		<0.01
	Ni (nickel oxide)	E24 (16.6)	46.1 µg/m³	50 µg/m³		0.09
	Pb	#27	239.0 µg/m³	100 µg/m³		0.24
	Se	#34	38.4 µg/m³	50 µg/m³		0.08
	Te	E39 (0.7)	2.0 µg/m³	100 µg/m³	<0.01	
ILL	As (arsenic trioxide)	#5	23.5 µg/m³	QA	RPE: 10	QA
	Ba (soluble barium compounds)	E46 (0.01)	4.9 µg/m³	500 µg/m³		<0.01
	Ca (calcium oxide)	E46 (0.1)	22.8 µg/m³	1000 µg/m³		<0.01
	Co	E14 (0.7)	0.2 µg/m³	40 µg/m³		<0.01
	Cu (copper(I) oxide)	#17	123.9 µg/m³	1000 µg/m³		0.01
	Mo (molybdenum trioxide)	E5 (0.2)	5.3 µg/m³	2220 µg/m³		<0.01
	Ni (nickel oxide)	E24 (16.6)	46.1 µg/m³	50 µg/m³		0.09
	Sb (diantimony trioxide)	#45	125.5 µg/m³	500 µg/m³		0.03
	Se	#34	38.4 µg/m³	QA	QA	
	Te	E39 (0.7)	2.0 µg/m³	QA	QA	
ISA	Mn (manganese dioxide)	E5 (1.3)	58.8 µg/m³	QA	RPE: 10	QA
	Ni (nickel oxide)	E24 (16.6)	138.3 µg/m³	520000 µg/m³		<0.01
	Te	E39 (0.7)	6.1 µg/m³	QA		QA
ILA	As (arsenic trioxide)	na	na	QA	RPE: 10	QA
	Ca (calcium oxide)	E46 (0.1)	45.5 µg/m³	4000 µg/m³		<0.01
	Cd	na	na	QA		QA
	Co	na	na	QA		QA
	Ni (nickel oxide)	E24 (16.6)	138.3 µg/m³	3900 µg/m³		<0.01
DLA	Ag (soluble silver compounds)	na	na	QA	gloves: 10	QA
	As (arsenic trioxide)	na	na	QA		QA
	Ca (calcium oxide)	na	na	QA		QA
	Cd	na	na	QA		QA
DSL	As (arsenic trioxide)	MEASE	14.1 µg/kg bw/d	85 µg/kg bw/d	gloves: 10	0.02
	Cd	MEASE	14.1 µg/kg bw/d	QA		QA
	Sb (diantimony trioxide)	MEASE	84.6 µg/kg bw/d	234700 µg/kg bw/d		<0.01
	Se	MEASE	14.1 µg/kg bw/d	7000 µg/kg bw/d		<0.01
	Te	MEASE	14.1 µg/kg bw/d	QA		QA
DLL	As (arsenic trioxide)	na	na	QA	gloves: 10	QA
	Cd	na	na	QA		QA
	Co	na	na	QA		QA
	Ni (nickel oxide)	MEASE	3.0 µg/cm²/d	24 µg/cm²/d		0.01
	Se	na	na	QA		QA
	Te	na	na	QA		QA
DSA	Cd	MEASE	14.1 µg/kg bw/d	QA	gloves: 10	QA
	Se	MEASE	14.1 µg/kg bw/d	QA		QA
	Te	MEASE	14.1 µg/kg bw/d	QA		QA
Internal exposure (blood lead levels)	Pb	#54	27.0 µg/dL	40 µg/dL	RPE: 10 gloves: 10	0.68
CSL	As (arsenic trioxide)	ISL + DSL	na	na	gloves: 10	0.60
	Pb (internal exposure)	#54	35.5 µg/dL	40 µg/dL		0.89
	Se	ISL + DSL	na	na		0.08

Note: All exposure concentrations and threshold values are given as element;
 Explanation of abbreviations: CSL = combined exposure assessment for systemic long-term effects, only relevant if systemic inhalation and dermal DNEL are available; DLA = dermal, local, acute; DLL = dermal, local, long-term; DNEL =

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derived no-effect level; DSA = dermal, systemic, acute; DSL = dermal, systemic, long-term; EA source = reference to data set in CSR Appendix 1 **Error! Reference source not found.**; EF = total extrapolation factor; ILA = inhalation, local, acute; ILL = inhalation, local, long-term; ISA = inhalation, systemic, acute; ISL = inhalation, systemic, long-term; na = not applicable; QA = qualitative assessment; RCR = risk characterisation ratio; RWC = reasonable worst case
 Sources for exposure assessment: #xxx = based on monitoring data; Exxx = based on extrapolation; xxx = number of assessment in GEA table

1.3.7 Worker exposure: Storage, shipment and transport (WP6)

The exposure concentrations and risk characterisation ratios (RCR) for this workplace are reported in the following table. Please note that the protection factors as displayed in the table below either refer to assigned protection factors (APFs) that are defined according to e.g. BS EN 529:2005 or to protection factors that are considered relevant for the use of protective gloves.

Workplace 6: Storage, shipment and transport						
Type of DNEL	Element (chemical species) considered in assessment	EA source (EF)	RWC exposure (outside PPE)	DNEL, surrogate value or qualitative assessment	Protection factor	RCR
ISL	Ag (soluble silver compounds)	E1 (1.5)	0.7 µg/m³	10 µg/m³	RPE: 10	0.01
	As (arsenic trioxide)	#47	7.7 µg/m³	4 µg/m³		0.19
	Ba (soluble barium compounds)	E43 (0.1)	0.8 µg/m³	500 µg/m³		<0.01
	Cd	#12	1.0 µg/m³	4 µg/m³		0.03
	Cu (copper(I) oxide)	#18	10.0 µg/m³	1000 µg/m³		<0.01
	Mn (manganese dioxide)	E47 (0.3)	2.1 µg/m³	200 µg/m³		<0.01
	Mo (molybdenum trioxide)	E47 (0.05)	0.4 µg/m³	11170 µg/m³		<0.01
	Ni (nickel oxide)	E23 (1.5)	4.2 µg/m³	50 µg/m³		0.01
	Pb	#48	77.7 µg/m³	100 µg/m³		0.08
	Se	E32 (1.5)	4.2 µg/m³	50 µg/m³		0.01
Te	E38 (1.5)	4.2 µg/m³	100 µg/m³	<0.01		
ILL	As (arsenic trioxide)	#47	7.7 µg/m³	QA	RPE: 10	QA
	Ba (soluble barium compounds)	E43 (0.1)	0.8 µg/m³	500 µg/m³		<0.01
	Ca (calcium oxide)	E43 (1.9)	18.9 µg/m³	1000 µg/m³		<0.01
	Co	E13 (0.3)	0.1 µg/m³	40 µg/m³		<0.01
	Cu (copper(I) oxide)	#18	10.0 µg/m³	1000 µg/m³		<0.01
	Mo (molybdenum trioxide)	E47 (0.05)	0.4 µg/m³	2220 µg/m³		<0.01
	Ni (nickel oxide)	E23 (1.5)	4.2 µg/m³	50 µg/m³		0.01
	Sb (diantimony trioxide)	E29 (1.5)	4.2 µg/m³	500 µg/m³		<0.01
Se	E32 (1.5)	4.2 µg/m³	QA	QA		
ISA	Te	E38 (1.5)	4.2 µg/m³	QA	QA	
	Mn (manganese dioxide)	E47 (0.3)	4.5 µg/m³	QA	QA	
	Ni (nickel oxide)	E23 (1.5)	12.5 µg/m³	520000 µg/m³	<0.01	
ILA	Te	E38 (1.5)	12.5 µg/m³	QA	QA	
	As (arsenic trioxide)	na	na	QA	QA	
	Ca (calcium oxide)	E43 (1.9)	56.7 µg/m³	4000 µg/m³	<0.01	
	Cd	na	na	QA	QA	
	Co	na	na	QA	QA	
DLA	Ni (nickel oxide)	E23 (1.5)	12.5 µg/m³	3900 µg/m³	<0.01	
	Ag (soluble silver compounds)	na	na	QA	QA	
	As (arsenic trioxide)	na	na	QA	QA	
	Ca (calcium oxide)	na	na	QA	QA	
	Cd	na	na	QA	QA	
DSL	As (arsenic trioxide)	MEASE	28.2 µg/kg bw/d	85 µg/kg bw/d	gloves: 10	0.03
	Cd	MEASE	14.1 µg/kg bw/d	QA		QA
	Sb (diantimony trioxide)	MEASE	84.6 µg/kg bw/d	234700 µg/kg bw/d		<0.01
	Se	MEASE	14.1 µg/kg bw/d	7000 µg/kg bw/d		<0.01
	Te	MEASE	14.1 µg/kg bw/d	QA		QA

EXPOSURE SCENARIO

Lead, dross, antimony rich

Date: 01.11.2019

Previous date:



Workplace 6: Storage, shipment and transport						
Type of DNEL	Element (chemical species) considered in assessment	EA source (EF)	RWC exposure (outside PPE)	DNEL, surrogate value or qualitative assessment	Protection factor	RCR
DLL	As (arsenic trioxide)	na	na	QA		QA
	Cd	na	na	QA		QA
	Co	na	na	QA		QA
	Ni (nickel oxide)	MEASE	1.0 µg/cm²/d	24 µg/cm²/d		<0.01
	Se	na	na	QA		QA
	Te	na	na	QA		QA
DSA	Cd	MEASE	14.1 µg/kg bw/d	QA	QA	
	Se	MEASE	14.1 µg/kg bw/d	QA	QA	
	Te	MEASE	14.1 µg/kg bw/d	QA	QA	
Internal exposure (blood lead levels)	Pb	#55	25.3 µg/dL	40 µg/dL	RPE: 10 gloves: 100	0.63
CSL	As (arsenic trioxide)	ISL + DSL	na	na		0.22
	Pb (internal exposure)	#55	38.7 µg/dL	40 µg/dL		0.97
	Se	ISL + DSL	na	na		0.01

Note: All exposure concentrations and threshold values are given as element;
 Explanation of abbreviations: CSL = combined exposure assessment for systemic long-term effects, only relevant if systemic inhalation and dermal DNEL are available; DLA = dermal, local, acute; DLL = dermal, local, long-term; DNEL = derived no-effect level; DSA = dermal, systemic, acute; DSL = dermal, systemic, long-term; EA source = reference to data set in CSR Appendix 1; EF = total extrapolation factor; ILA = inhalation, local, acute; ILL = inhalation, local, long-term; ISA = inhalation, systemic, acute; ISL = inhalation, systemic, long-term; na = not applicable; QA = qualitative assessment; RCR = risk characterisation ratio; RWC = reasonable worst case
 Sources for exposure assessment: #xxx = based on monitoring data; Exxx = based on extrapolation; xxx = number of assessment in GEA table