

## 9.3. Exposure scenario 3: Use at industrial sites - Use in electroplating or metal surface treatment

**Market sector:** Electroplating and surface treatment

**Product category used:** PC 14: Metal surface treatment products, including galvanic and electroplating products; PC 15: Non-metal-surface treatment products

**Sector of use:** SU 16: Manufacture of computer, electronic and optical products, electrical equipment

Environment contributing scenario(s):		
CS 1	Use in electroplating or metal surface treatment	ERC 5
Worker contributing scenario(s):		
CS 2	Handling of solutions	PROC 8b
CS 3	Small scale handling of solutions	PROC 9
CS 4	Handling of medium dusty materials	PROC 26
CS 5	Wet chemical process in fully contained system	PROC 1
CS 6	Closed continuous wet chemical process	PROC 2
CS 7	Wet chemical batch process in closed system	PROC 3
CS 8	Open or semi-closed wet chemical process	PROC 4
CS 9	Mixing or blending in batch process	PROC 5
CS 10	Spraying	PROC 7
CS 11	Laboratory analyses	PROC 15
CS 12	Plating	PROC 13
CS 13	Roller application or brushing	PROC 10
CS 14	Wet cleaning	PROC 28
CS 15	Vacuum cleaning	PROC 28

### Explanation on the approach taken for the ES

During this use, the substance is chemically transformed into silver. Any subsequent handling steps after transformation of the substance are not in the scope of this ES.

### 9.3.1. Env CS 1: Use in electroplating or metal surface treatment (ERC 5)

#### 9.3.1.1. Conditions of use

The conditions of use are as described in the generic exposure scenario (GES) below.

#### 9.3.1.2. Releases

The GES and associated risk assessment are concerned with releases of silver to waste-water and air during the use of  $KAg(CN)_2$  in electroplating or metal surface treatment in an industrial scenario. This waste-water is assumed to be treated at a municipal STP before discharge to freshwater. Exposure assessment for the aquatic environment is based on calculation of the maximum safe tonnage (Msafe) of  $KAg(CN)_2$  that can be used for electroplating; modelling of environmental exposure is based on release factors detailed in the SpERC for 'Industrial use of metals and metal compounds in metallic coating'<sup>1</sup>. Msafe is calculated using release factors (RFs) adjusted to 10% of the values recommend in the SpERC for base metals based on the monetary value of silver (see Section 9.0.2).

<sup>1</sup> ARCHE (2013) Industrial use of metals and metal compounds in metallic coating. SpERC code Eurometaux 5.1 v2.1. Available online at <http://www.arche-consulting.be/metal-csa-toolbox/SPERCs-tool-for-metals/>

## Potassium dicyanoargentate

<b>1. Title</b>	
<b>ES3: Use at industrial site - Use in electroplating or metal surface treatment</b>	
<b>Life cycle</b>	Use of potassium dicyanoargentate in electroplating or metal surface treatment
<b>Systematic title based on use descriptor</b>	<b>ERC:</b> ERC 5
<b>2. Operational conditions and risk management measures</b>	
<b>2.1 Control of environmental exposure</b>	
<b>Environmental related free short title</b>	Use at industrial site in electroplating or metal surface treatment
<b>Systematic title based on use descriptor (environment)</b>	ERC 5 (Industrial use resulting in inclusion into or onto a matrix)
<b>Processes, tasks, activities covered (environment)</b>	Industrial use of potassium dicyanoargentate for electroplating or metal surface treatment: As defined by SpERC for 'Industrial use of metals and metal compounds in metallic coating' <sup>8</sup>
<b>Environmental Assessment Method</b>	Estimates based on SpERC for 'Industrial use of metals and metal compounds in metallic coating' <sup>8</sup> are used for calculation of maximum tonnage that can be used safely without risk to the environment
<b>Product characteristics</b>	
Potassium dicyanoargentate as solid or aqueous solution.	
Environmental assessment is based on the measured release factors detailed in the SpERC for 'Industrial use of metals and metal compounds in metallic coating' and default characteristics for environmental compartments detailed in the ECHA technical guidance and EUSES model.	
<b>Amounts used</b>	
<b>Maximum annual safe use at a site (Msafe)</b>	8.30 tonnes KAg(CN) <sub>2</sub> (4.5 tonnes Ag metal equivalent)
<b>Frequency and duration of use</b>	
<b>Pattern of release to the environment</b>	220 days per year per site (SpERC for Industrial use of metals and metal compounds in metallic coating' <sup>8</sup> )
<b>Environment factors not influenced by risk management</b>	
<b>Receiving surface water flow rate</b>	STP: 2,000 m <sup>3</sup> /d (default) Receiving water: 18,000 m <sup>3</sup> /d (default)
<b>Dilution capacity, freshwater</b>	Env ES: Discharge to freshwater via STP: DF = 10 (default)
<b>Dilution capacity, marine</b>	NR
<b>Other given operational conditions affecting environmental exposure</b>	
None	
<b>Technical conditions and measures at process level (source) to prevent release</b>	
Appropriate process control systems shall be implemented.	
<b>Technical onsite conditions and measures to reduce or limit discharges, air emissions and</b>	

## Potassium dicyanoargentate

<b>releases to soil</b>	
<b>Waste water:</b>	
ES Discharge to freshwater via STP:	
On-site wastewater treatment by chemical precipitation, sedimentation, electrolysis, reverse osmosis, ion exchange and/or filtration.	
Efficiency >99% (typical values reported in SpERC for 'Industrial use of metals and metal compounds in metallic coating')	
And	
off-site wastewater treatment plant, municipal STP	
Efficiency 80% (based on assessment of available monitoring data and literature)	
Release factor after on-site treatment: 500 g/T (SpERC RF adjusted to 10% based on monetary value of Ag as detailed in section 9.02)	
<b>Air:</b>	
ES:	
Treatment of air emissions by cyclones, filters (e.g. fabric, bag, HEPA or ceramic), electrostatic precipitators and/or wet scrubbers.	
Efficiency 95 to >99% (typical values reported in SpERC for 'Industrial use of metals and metal compounds in metallic coating')	
Release factor after on-site treatment: 200 g/T (SpERC RF adjusted to 10% based on monetary value of Ag as detailed in section 9.02)	
<b>Organizational measures to prevent/limit release from site</b>	
Regular operator training.	
<b>Conditions and measures related to municipal sewage treatment plant (if applicable)</b>	
<b>Municipal Sewage Treatment Plant (STP)</b>	Yes
<b>Discharge rate of the Municipal STP</b>	2 000 m <sup>3</sup> /d (default)
<b>Fate of the sludge from Municipal STP</b>	Hazardous waste produced during the manufacture and downstream use is sent to a recycler only marginal amounts are sent to a landfill or an incinerator. Waste containing silver is recycled for almost a 100%
<b>Conditions and measures related to external treatment of waste for disposal</b>	
KAg(CN) <sub>2</sub> <sup>-</sup> and other Ag-containing waste is filled into containers and transported to licensed recycling facilities for recovery or disposed of at landfill.	
<b>Conditions and measures related to external recovery of waste</b>	
The focus of the silver industry is on the minimisation of waste by optimising the process and by utilizing residues and wastes as far as possible. The residues arising from different stages of the production process are therefore used as raw materials for other processes and an extensive network of metallurgical operators has been established for many years to increase the recovery of metals and eliminate the quantities of waste for disposal.	
<b>3. Exposure and risk estimation</b>	
<b>Environment [based on total Ag emissions]</b>	
ERC 5	
<b>ES</b> Use at industrial site - Use in electroplating or metal surface*	

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Compartment	Unit	PNEC	PEC <sub>regional</sub>	C <sub>local</sub>	PEC	RCR	Methods for calculation of environmental concentrations
ES Discharge to STP	mg Ag/L	0.025 mg/L	6.06 x10 <sup>-6</sup> mg/L	1.01 x10 <sup>-3</sup> mg/L	1.01 x10 <sup>-3</sup> mg/L	0.040	SpERC RFs applied to Msafe tonnage and dilution factor at municipal sewage works
ES Freshwater via STP	mg Ag/L	4.0 x10 <sup>-5</sup> mg/L	6.06 x10 <sup>-6</sup> mg/L	2.62 x10 <sup>-5</sup> mg/L	3.23 x10 <sup>-5</sup> mg/L	0.81	SpERC RFs applied to Msafe tonnage and Ag-specific values for STP removal efficiency and dilution in ultimate receiving water body
Freshwater sediment via STP	mg /kgw. w.	96.4 mg/kg	2.13 mg/kg	1.34 mg/kg	3.47 mg/kg	0.36	SpERC RFs applied to Msafe tonnage and Ag-specific values for STP removal efficiency and dilution in ultimate receiving water body
Terrestrial	mg/kg w.w.	1.24 mg/kg	0.086 mg/kg	1.80 x10 <sup>-6</sup> mg/kg	8.60 x10 <sup>-2</sup> mg/kg	0.069	Modelled increase in soil concentrations due to deposition from atmospheric emissions (i.e. assuming no application of sewage sludge to land)
* All concentrations reported as Ag equivalent due to the silver metal PNEC used for assessment.							

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

##### Environment

Scaling tool: Metals EUSES IT tool (free download:  
<http://www.arche-consulting.be/Metal-CSA-toolbox/du-scaling-tool>)

Scaling of the release to air and water environment includes:

- Refining of the release factor to air and waste water and/or and the efficiency of the air filter and wastewater treatment facility.
- Adjustment of the flow rate for the receiving water body and subsequent dilution factor.

#### 9.3.1.3. Exposure and risks for man via the environment

Assessment of risks for man via the environment is based on inhalation exposure to airborne particulates containing silver released to the atmosphere during the use of KAg(CN)<sub>2</sub> in electroplating or metal surface treatment.

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Annual emission to air (kg Ag)	Emission days per year	Concentration in local air (mg Ag/m <sup>3</sup> )	Annual average concentration in air (mg Ag/m <sup>3</sup> )	DNEL (mg Ag/m <sup>3</sup> )	RCR
0.9	300	$8.3 \times 10^{-7}$	$6.9 \times 10^{-7}$	0.04	$2.09 \times 10^{-5}$

### 9.3.2. Worker CS 2: Handling of solutions (PROC 8b)

Task(s) covered with this contributing scenario: Transfer processes, such as replenishment.

#### 9.3.2.1. Conditions of use

Product (Article) characteristics
<ul style="list-style-type: none"> <li>• Physical form of substance: Solution</li> <li>• Maximum emission potential of the substance: Very low <i>Only the highest emission potential (EP) is reported. Lower EPs (e.g. if materials of lower dustiness are being handled in parallel) are thus automatically covered in this assessment.</i></li> <li>• Content in preparation: Not restricted [Effectiveness Inhalation: 0%, Dermal: 0%]</li> </ul>
Amount used (or contained in articles), frequency and duration of use/exposure
<ul style="list-style-type: none"> <li>• Maximum duration of exposure: &gt; 240 min (not restricted) [Effectiveness Inhalation: 0%, Dermal: 0%]</li> </ul>
Conditions and measures related to personal protection, hygiene and health evaluation
<ul style="list-style-type: none"> <li>• Respiratory protective equipment (RPE) as precautionary measure: RPE protecting from local effects via inhalation <i>Due to potential adverse effects of the substance to the respiratory tract, RPE (minimum assigned protection factor of 10) is prescribed on a precautionary basis for all workplaces unless inhalation exposure to the substance can be excluded.</i></li> <li>• Eye protection: Eye protection to be worn to protect from adverse effects to the eyes <i>Due to the adverse effects of the substance to the eyes, direct contact of the eyes with the substance is to be avoided including hand to eye transfer after touching contaminated surfaces. Suitable eye protection equipment (e.g. goggles or visors) must be worn.</i></li> <li>• Gloves as precautionary measure: Gloves protecting from local effects to the skin (high hazard) <i>Due to the potential adverse effects of the substance to skin, protective gloves according to EN 374 have to be worn at all workplaces. Additionally, face protection is required to be worn as appropriate.</i></li> </ul>

#### 9.3.2.2. Exposure and risks for workers

The exposure concentrations and risk characterisation ratios (RCR) are reported in the following table.

**Table 9.19. Exposure concentrations and risks for workers**

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, systemic, long term	10 µg/m <sup>3</sup> (MEASE: 1.02.01)	RCR = 0.128
Combined routes, systemic, long-term		RCR = 0.128

#### Remarks on exposure data from external estimation tools:

MEASE 1.02.01

#### Risk characterisation

Further information on the risk characterisation for local effects or acute systemic effects via inhalation, for local dermal effects and local effects to the eyes is given in Section 9.0.4.2.

Under the prescribed conditions of use, exposure is below the DNEL and local effects are not expected. Therefore, risks are adequately controlled.

### 9.3.3. Worker CS 3: Small scale handling of solutions (PROC 9)

Task(s) covered with this contributing scenario: Transfer processes, such as replenishment (including manual replenishment).

#### 9.3.3.1. Conditions of use

Product (Article) characteristics
<ul style="list-style-type: none"> <li>Physical form of substance: Solution</li> <li>Maximum emission potential of the substance: Very low <i>Only the highest emission potential (EP) is reported. Lower EPs (e.g. if materials of lower dustiness are being handled in parallel) are thus automatically covered in this assessment.</i></li> <li>Content in preparation: Not restricted [Effectiveness Inhalation: 0%, Dermal: 0%]</li> </ul>
Amount used (or contained in articles), frequency and duration of use/exposure
<ul style="list-style-type: none"> <li>Maximum duration of exposure: &gt; 240 min (not restricted) [Effectiveness Inhalation: 0%, Dermal: 0%]</li> </ul>
Conditions and measures related to personal protection, hygiene and health evaluation
<ul style="list-style-type: none"> <li>Respiratory protective equipment (RPE) as precautionary measure: RPE protecting from local effects via inhalation <i>Due to potential adverse effects of the substance to the respiratory tract, RPE (minimum assigned protection factor of 10) is prescribed on a precautionary basis for all workplaces unless inhalation exposure to the substance can be excluded.</i></li> <li>Eye protection: Eye protection to be worn to protect from adverse effects to the eyes <i>Due to the adverse effects of the substance to the eyes, direct contact of the eyes with the substance is to be avoided including hand to eye transfer after touching contaminated surfaces. Suitable eye protection equipment (e.g. goggles or visors) must be worn.</i></li> <li>Gloves as precautionary measure: Gloves protecting from local effects to the skin (high hazard) <i>Due to the potential adverse effects of the substance to skin, protective gloves according to EN 374 have to be worn at all workplaces. Additionally, face protection is required to be worn as appropriate.</i></li> </ul>

#### 9.3.3.2. Exposure and risks for workers

The exposure concentrations and risk characterisation ratios (RCR) are reported in the following table.

**Table 9.20. Exposure concentrations and risks for workers**

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, systemic, long term	10 µg/m <sup>3</sup> (MEASE: 1.02.01)	RCR = 0.128
Combined routes, systemic, long-term		RCR = 0.128

#### Remarks on exposure data from external estimation tools:

MEASE 1.02.01

#### Risk characterisation

Further information on the risk characterisation for local effects or acute systemic effects via inhalation, for local dermal effects and local effects to the eyes is given in Section 9.0.4.2.

Under the prescribed conditions of use, exposure is below the DNEL and local effects are not expected. Therefore, risks are adequately controlled.

### 9.3.4. Worker CS 4: Handling of medium dusty materials (PROC 26)

Task(s) covered with this contributing scenario: Transfer processes, such as replenishment (including manual replenishment).

#### 9.3.4.1. Conditions of use

Product (Article) characteristics
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<ul style="list-style-type: none"> <li>• Physical form of substance: Solid</li> <li>• Maximum emission potential of the substance: Medium</li> </ul> <p><i>Only the highest emission potential (EP) is reported. Lower EPs (e.g. if materials of lower dustiness are being handled in parallel) are thus automatically covered in this assessment.</i></p> <ul style="list-style-type: none"> <li>• Content in preparation: Not restricted [Effectiveness Inhalation: 0%, Dermal: 0%]</li> </ul>
Amount used (or contained in articles), frequency and duration of use/exposure
<ul style="list-style-type: none"> <li>• Maximum duration of exposure: &gt; 240 min (not restricted) [Effectiveness Inhalation: 0%, Dermal: 0%]</li> </ul>
Technical and organisational conditions and measures
<ul style="list-style-type: none"> <li>• Exterior local exhaust ventilation: Lower confidence limit (industrial use) [Effectiveness Inhalation: 75%]</li> </ul>
Conditions and measures related to personal protection, hygiene and health evaluation
<ul style="list-style-type: none"> <li>• Respiratory protective equipment (RPE): RPE with minimum APF = 20 [Effectiveness Inhalation: 95%]</li> </ul> <p><i>APF = assigned protection factor according to EN 529. At minimum any combination of particle filter class P3 with mask according to EN 140, EN 1827 or filtering half mask (FF P3) according to EN 149 or combination of P2 filter with face piece according to EN 12941 or EN 12942 or any RPE providing higher APFs according to EN 529 is required.</i></p> <ul style="list-style-type: none"> <li>• Eye protection: Eye protection to be worn to protect from adverse effects to the eyes</li> </ul> <p><i>Due to the adverse effects of the substance to the eyes, direct contact of the eyes with the substance is to be avoided including hand to eye transfer after touching contaminated surfaces. Suitable eye protection equipment (e.g. goggles or visors) must be worn.</i></p> <ul style="list-style-type: none"> <li>• Gloves as precautionary measure: Gloves protecting from local effects to the skin (high hazard)</li> </ul> <p><i>Due to the potential adverse effects of the substance to skin, protective gloves according to EN 374 have to be worn at all workplaces. Additionally, face protection is required to be worn as appropriate.</i></p>

### 9.3.4.2. Exposure and risks for workers

The exposure concentrations and risk characterisation ratios (RCR) are reported in the following table.

**Table 9.21. Exposure concentrations and risks for workers**

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, systemic, long term	50 µg/m <sup>3</sup> (MEASE: 1.02.01)	RCR = 0.641
Combined routes, systemic, long-term		RCR = 0.641

#### Remarks on exposure data from external estimation tools:

MEASE 1.02.01

#### Risk characterisation

Further information on the risk characterisation for local effects or acute systemic effects via inhalation, for local dermal effects and local effects to the eyes is given in Section 9.0.4.2.

Under the prescribed conditions of use, exposure is below the DNEL and local effects are not expected. Therefore, risks are adequately controlled.

### 9.3.5. Worker CS 5: Wet chemical process in fully contained system (PROC 1)

#### 9.3.5.1. Conditions of use

Product (Article) characteristics
<ul style="list-style-type: none"> <li>• Physical form of substance: Solution</li> <li>• Maximum emission potential of the substance: Very low</li> </ul> <p><i>Only the highest emission potential (EP) is reported. Lower EPs (e.g. if materials of lower dustiness are being handled in parallel) are thus automatically covered in this assessment.</i></p>

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• Content in preparation: Not restricted [Effectiveness Inhalation: 0%, Dermal: 0%]
Amount used (or contained in articles), frequency and duration of use/exposure
• Maximum duration of exposure: > 240 min (not restricted) [Effectiveness Inhalation: 0%, Dermal: 0%]
Technical and organisational conditions and measures
• Level of containment: Closed process
Conditions and measures related to personal protection, hygiene and health evaluation
<ul style="list-style-type: none"> <li>• Respiratory protective equipment (RPE) as precautionary measure: RPE protecting from local effects via inhalation <i>Due to potential adverse effects of the substance to the respiratory tract, RPE (minimum assigned protection factor of 10) is prescribed on a precautionary basis for all workplaces unless inhalation exposure to the substance can be excluded.</i></li> <li>• Eye protection: Eye protection to be worn to protect from adverse effects to the eyes <i>Due to the adverse effects of the substance to the eyes, direct contact of the eyes with the substance is to be avoided including hand to eye transfer after touching contaminated surfaces. Suitable eye protection equipment (e.g. goggles or visors) must be worn.</i></li> <li>• Gloves as precautionary measure: Gloves protecting from local effects to the skin (high hazard) <i>Due to the potential adverse effects of the substance to skin, protective gloves according to EN 374 have to be worn at all workplaces. Additionally, face protection is required to be worn as appropriate.</i></li> </ul>

### 9.3.5.2. Exposure and risks for workers

The exposure concentrations and risk characterisation ratios (RCR) are reported in the following table.

**Table 9.22. Exposure concentrations and risks for workers**

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, systemic, long term	1 µg/m <sup>3</sup> (MEASE: 1.02.01)	RCR = 0.013
Combined routes, systemic, long-term		RCR = 0.013

#### Remarks on exposure data from external estimation tools:

MEASE 1.02.01

#### Risk characterisation

Further information on the risk characterisation for local effects or acute systemic effects via inhalation, for local dermal effects and local effects to the eyes is given in Section 9.0.4.2.

Under the prescribed conditions of use, exposure is below the DNEL and local effects are not expected. Therefore, risks are adequately controlled.

## 9.3.6. Worker CS 6: Closed continuous wet chemical process (PROC 2)

### 9.3.6.1. Conditions of use

Product (Article) characteristics
<ul style="list-style-type: none"> <li>• Physical form of substance: Solution</li> <li>• Maximum emission potential of the substance: Very low <i>Only the highest emission potential (EP) is reported. Lower EPs (e.g. if materials of lower dustiness are being handled in parallel) are thus automatically covered in this assessment.</i></li> <li>• Content in preparation: Not restricted [Effectiveness Inhalation: 0%, Dermal: 0%]</li> </ul>
Amount used (or contained in articles), frequency and duration of use/exposure
• Maximum duration of exposure: > 240 min (not restricted) [Effectiveness Inhalation: 0%, Dermal: 0%]
Technical and organisational conditions and measures

• Level of containment: Closed process
Conditions and measures related to personal protection, hygiene and health evaluation
<ul style="list-style-type: none"> <li>• Respiratory protective equipment (RPE) as precautionary measure: RPE protecting from local effects via inhalation <i>Due to potential adverse effects of the substance to the respiratory tract, RPE (minimum assigned protection factor of 10) is prescribed on a precautionary basis for all workplaces unless inhalation exposure to the substance can be excluded.</i></li> <li>• Eye protection: Eye protection to be worn to protect from adverse effects to the eyes <i>Due to the adverse effects of the substance to the eyes, direct contact of the eyes with the substance is to be avoided including hand to eye transfer after touching contaminated surfaces. Suitable eye protection equipment (e.g. goggles or visors) must be worn.</i></li> <li>• Gloves as precautionary measure: Gloves protecting from local effects to the skin (high hazard) <i>Due to the potential adverse effects of the substance to skin, protective gloves according to EN 374 have to be worn at all workplaces. Additionally, face protection is required to be worn as appropriate.</i></li> </ul>

### 9.3.6.2. Exposure and risks for workers

The exposure concentrations and risk characterisation ratios (RCR) are reported in the following table.

**Table 9.23. Exposure concentrations and risks for workers**

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, systemic, long term	1 µg/m <sup>3</sup> (MEASE: 1.02.01)	RCR = 0.013
Combined routes, systemic, long-term		RCR = 0.013

#### Remarks on exposure data from external estimation tools:

MEASE 1.02.01

#### Risk characterisation

Further information on the risk characterisation for local effects or acute systemic effects via inhalation, for local dermal effects and local effects to the eyes is given in Section 9.0.4.2.

Under the prescribed conditions of use, exposure is below the DNEL and local effects are not expected. Therefore, risks are adequately controlled.

## 9.3.7. Worker CS 7: Wet chemical batch process in closed system (PROC 3)

### 9.3.7.1. Conditions of use

Product (Article) characteristics
<ul style="list-style-type: none"> <li>• Physical form of substance: Solution</li> <li>• Maximum emission potential of the substance: Very low <i>Only the highest emission potential (EP) is reported. Lower EPs (e.g. if materials of lower dustiness are being handled in parallel) are thus automatically covered in this assessment.</i></li> <li>• Content in preparation: Not restricted [Effectiveness Inhalation: 0%, Dermal: 0%]</li> </ul>
Amount used (or contained in articles), frequency and duration of use/exposure
• Maximum duration of exposure: > 240 min (not restricted) [Effectiveness Inhalation: 0%, Dermal: 0%]
Technical and organisational conditions and measures
• Level of containment: Closed process
Conditions and measures related to personal protection, hygiene and health evaluation
<ul style="list-style-type: none"> <li>• Respiratory protective equipment (RPE) as precautionary measure: RPE protecting from local effects via inhalation <i>Due to potential adverse effects of the substance to the respiratory tract, RPE (minimum assigned</i></li> </ul>

protection factor of 10) is prescribed on a precautionary basis for all workplaces unless inhalation exposure to the substance can be excluded.

- Eye protection: Eye protection to be worn to protect from adverse effects to the eyes  
*Due to the adverse effects of the substance to the eyes, direct contact of the eyes with the substance is to be avoided including hand to eye transfer after touching contaminated surfaces. Suitable eye protection equipment (e.g. goggles or visors) must be worn.*
- Gloves as precautionary measure: Gloves protecting from local effects to the skin (high hazard)  
*Due to the potential adverse effects of the substance to skin, protective gloves according to EN 374 have to be worn at all workplaces. Additionally, face protection is required to be worn as appropriate.*

### 9.3.7.2. Exposure and risks for workers

The exposure concentrations and risk characterisation ratios (RCR) are reported in the following table.

**Table 9.241. Exposure concentrations and risks for workers**

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, systemic, long term	10 µg/m <sup>3</sup> (MEASE: 1.02.01)	RCR = 0.128
Combined routes, systemic, long-term		RCR = 0.128

#### Remarks on exposure data from external estimation tools:

MEASE 1.02.01

#### Risk characterisation

Further information on the risk characterisation for local effects or acute systemic effects via inhalation, for local dermal effects and local effects to the eyes is given in Section 9.0.4.2.

Under the prescribed conditions of use, exposure is below the DNEL and local effects are not expected. Therefore, risks are adequately controlled.

## 9.3.8. Worker CS 8: Open or semi-closed wet chemical process (PROC 4)

### 9.3.8.1. Conditions of use

Product (Article) characteristics
<ul style="list-style-type: none"> <li>• Physical form of substance: Solution</li> <li>• Maximum emission potential of the substance: Very low <i>Only the highest emission potential (EP) is reported. Lower EPs (e.g. if materials of lower dustiness are being handled in parallel) are thus automatically covered in this assessment.</i></li> <li>• Content in preparation: Not restricted [Effectiveness Inhalation: 0%, Dermal: 0%]</li> </ul>
Amount used (or contained in articles), frequency and duration of use/exposure
<ul style="list-style-type: none"> <li>• Maximum duration of exposure: &gt; 240 min (not restricted) [Effectiveness Inhalation: 0%, Dermal: 0%]</li> </ul>
Conditions and measures related to personal protection, hygiene and health evaluation
<ul style="list-style-type: none"> <li>• Respiratory protective equipment (RPE) as precautionary measure: RPE protecting from local effects via inhalation <i>Due to potential adverse effects of the substance to the respiratory tract, RPE (minimum assigned protection factor of 10) is prescribed on a precautionary basis for all workplaces unless inhalation exposure to the substance can be excluded.</i></li> <li>• Eye protection: Eye protection to be worn to protect from adverse effects to the eyes <i>Due to the adverse effects of the substance to the eyes, direct contact of the eyes with the substance is to be avoided including hand to eye transfer after touching contaminated surfaces. Suitable eye protection equipment (e.g. goggles or visors) must be worn.</i></li> <li>• Gloves as precautionary measure: Gloves protecting from local effects to the skin (high hazard) <i>Due to the potential adverse effects of the substance to skin, protective gloves according to EN 374 have to be worn at all workplaces. Additionally, face protection is required to be worn as appropriate.</i></li> </ul>

### 9.3.8.2. Exposure and risks for workers

The exposure concentrations and risk characterisation ratios (RCR) are reported in the following table.

**Table 9.25. Exposure concentrations and risks for workers**

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, systemic, long term	50 µg/m <sup>3</sup> (MEASE: 1.02.01)	RCR = 0.641
Combined routes, systemic, long-term		RCR = 0.641

#### **Remarks on exposure data from external estimation tools:**

MEASE 1.02.01

#### **Risk characterisation**

Further information on the risk characterisation for local effects or acute systemic effects via inhalation, for local dermal effects and local effects to the eyes is given in Section 9.0.4.2.

Under the prescribed conditions of use, exposure is below the DNEL and local effects are not expected. Therefore, risks are adequately controlled.

### 9.3.9. Worker CS 9: Mixing or blending in batch process (PROC 5)

#### 9.3.9.1. Conditions of use

Product (Article) characteristics
<ul style="list-style-type: none"> <li>Physical form of substance: Solution</li> <li>Maximum emission potential of the substance: Very low</li> </ul> <p><i>Only the highest emission potential (EP) is reported. Lower EPs (e.g. if materials of lower dustiness are being handled in parallel) are thus automatically covered in this assessment.</i></p> <ul style="list-style-type: none"> <li>Content in preparation: Not restricted [Effectiveness Inhalation: 0%, Dermal: 0%]</li> </ul>
Amount used (or contained in articles), frequency and duration of use/exposure
<ul style="list-style-type: none"> <li>Maximum duration of exposure: &gt; 240 min (not restricted) [Effectiveness Inhalation: 0%, Dermal: 0%]</li> </ul>
Conditions and measures related to personal protection, hygiene and health evaluation
<ul style="list-style-type: none"> <li>Respiratory protective equipment (RPE) as precautionary measure: RPE protecting from local effects via inhalation</li> </ul> <p><i>Due to potential adverse effects of the substance to the respiratory tract, RPE (minimum assigned protection factor of 10) is prescribed on a precautionary basis for all workplaces unless inhalation exposure to the substance can be excluded.</i></p> <ul style="list-style-type: none"> <li>Eye protection: Eye protection to be worn to protect from adverse effects to the eyes</li> </ul> <p><i>Due to the adverse effects of the substance to the eyes, direct contact of the eyes with the substance is to be avoided including hand to eye transfer after touching contaminated surfaces. Suitable eye protection equipment (e.g. goggles or visors) must be worn.</i></p> <ul style="list-style-type: none"> <li>Gloves as precautionary measure: Gloves protecting from local effects to the skin (high hazard)</li> </ul> <p><i>Due to the potential adverse effects of the substance to skin, protective gloves according to EN 374 have to be worn at all workplaces. Additionally, face protection is required to be worn as appropriate.</i></p>

#### 9.3.9.2. Exposure and risks for workers

The exposure concentrations and risk characterisation ratios (RCR) are reported in the following table.

**Table 9.26. Exposure concentrations and risks for workers**

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, systemic, long term	50 µg/m <sup>3</sup> (MEASE: 1.02.01)	RCR = 0.641
Combined routes, systemic, long-term		RCR = 0.641

**Remarks on exposure data from external estimation tools:**

MEASE 1.02.01

**Risk characterisation**

Further information on the risk characterisation for local effects or acute systemic effects via inhalation, for local dermal effects and local effects to the eyes is given in Section 9.0.4.2. Under the prescribed conditions of use, exposure is below the DNEL and local effects are not expected. Therefore, risks are adequately controlled.

**9.3.10. Worker CS 10: Spraying (PROC 7)**

**9.3.10.1. Conditions of use**

Product (Article) characteristics
<ul style="list-style-type: none"> <li>Physical form of substance: Solution</li> <li>Maximum emission potential of the substance: Medium (spraying process) <i>The emission potential (EP) is assessed according to the glossary of MEASE.</i></li> <li>Content in preparation: 1 - 5 % [Effectiveness Inhalation: 80%, Dermal: 80%]</li> </ul>
Amount used (or contained in articles), frequency and duration of use/exposure
<ul style="list-style-type: none"> <li>Maximum duration of exposure: &gt; 240 min (not restricted) [Effectiveness Inhalation: 0%, Dermal: 0%]</li> </ul>
Technical and organisational conditions and measures
<ul style="list-style-type: none"> <li>Generic local exhaust ventilation: Lower confidence limit (industrial use) [Effectiveness Inhalation: 78%]</li> </ul>
Conditions and measures related to personal protection, hygiene and health evaluation
<ul style="list-style-type: none"> <li>Respiratory protective equipment (RPE): RPE with minimum APF = 20 [Effectiveness Inhalation: 95%]</li> <li>Gloves as precautionary measure: Gloves protecting from local effects to the skin (high hazard) <i>Due to the potential adverse effects of the substance to skin, protective gloves according to EN 374 have to be worn at all workplaces. Additionally, face protection is required to be worn as appropriate.</i></li> <li>Eye protection: Eye protection to be worn to protect from adverse effects to the eyes <i>Due to the adverse effects of the substance to the eyes, direct contact of the eyes with the substance is to be avoided including hand to eye transfer after touching contaminated surfaces. Suitable eye protection equipment (e.g. goggles or visors) must be worn.</i></li> </ul>

**9.3.10.2. Exposure and risks for workers**

The exposure concentrations and risk characterisation ratios (RCR) are reported in the following table.

**Table 9.27. Exposure concentrations and risks for workers**

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, systemic, long term	44 µg/m <sup>3</sup> (MEASE: 1.02.01)	RCR = 0.564
Combined routes, systemic, long-term		RCR = 0.564

**Remarks on exposure data from external estimation tools:**

MEASE 1.02.01

**Risk characterisation**

Further information on the risk characterisation for local effects or acute systemic effects via inhalation, for local dermal effects and local effects to the eyes is given in Section 9.0.4.2. Under the prescribed conditions of use, exposure is below the DNELs and local effects are not expected. Therefore, risks are adequately controlled.

### 9.3.11. Worker CS 11: Laboratory analyses (PROC 15)

#### 9.3.11.1. Conditions of use

Product (Article) characteristics
<ul style="list-style-type: none"> <li>Physical form of substance: Solution</li> <li>Maximum emission potential of the substance: Very low <i>Only the highest emission potential (EP) is reported. Lower EPs (e.g. if materials of lower dustiness are being handled in parallel) are thus automatically covered in this assessment.</i></li> <li>Content in preparation: Not restricted [Effectiveness Inhalation: 0%, Dermal: 0%]</li> </ul>
Amount used (or contained in articles), frequency and duration of use/exposure
<ul style="list-style-type: none"> <li>Maximum duration of exposure: &gt; 240 min (not restricted) [Effectiveness Inhalation: 0%, Dermal: 0%]</li> </ul>
Conditions and measures related to personal protection, hygiene and health evaluation
<ul style="list-style-type: none"> <li>Respiratory protective equipment (RPE) as precautionary measure: RPE protecting from local effects via inhalation <i>Due to potential adverse effects of the substance to the respiratory tract, RPE (minimum assigned protection factor of 10) is prescribed on a precautionary basis for all workplaces unless inhalation exposure to the substance can be excluded.</i></li> <li>Eye protection: Eye protection to be worn to protect from adverse effects to the eyes <i>Due to the adverse effects of the substance to the eyes, direct contact of the eyes with the substance is to be avoided including hand to eye transfer after touching contaminated surfaces. Suitable eye protection equipment (e.g. goggles or visors) must be worn.</i></li> <li>Gloves as precautionary measure: Gloves protecting from local effects to the skin (high hazard) <i>Due to the potential adverse effects of the substance to skin, protective gloves according to EN 374 have to be worn at all workplaces. Additionally, face protection is required to be worn as appropriate.</i></li> </ul>

#### 9.3.11.2. Exposure and risks for workers

The exposure concentrations and risk characterisation ratios (RCR) are reported in the following table.

**Table 9.28. Exposure concentrations and risks for workers**

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, systemic, long term	10 µg/m <sup>3</sup> (MEASE: 1.02.01)	RCR = 0.128
Combined routes, systemic, long-term		RCR = 0.128

#### Remarks on exposure data from external estimation tools:

MEASE 1.02.01

#### Risk characterisation

Further information on the risk characterisation for local effects or acute systemic effects via inhalation, for local dermal effects and local effects to the eyes is given in Section 9.0.4.2.

Under the prescribed conditions of use, exposure is below the DNEL and local effects are not expected. Therefore, risks are adequately controlled.

### 9.3.12. Worker CS 12: Plating (PROC 13)

#### 9.3.12.1. Conditions of use

Product (Article) characteristics
<ul style="list-style-type: none"> <li>Physical form of substance: Solution</li> <li>Maximum emission potential of the substance: Very low <i>Only the highest emission potential (EP) is reported. Lower EPs (e.g. if materials of lower dustiness are being handled in parallel) are thus automatically covered in this assessment.</i></li> <li>Content in preparation: Not restricted [Effectiveness Inhalation: 0%, Dermal: 0%]</li> </ul>

## Potassium dicyanoargentate

Amount used (or contained in articles), frequency and duration of use/exposure
<ul style="list-style-type: none"> <li>Maximum duration of exposure: &gt; 240 min (not restricted) [Effectiveness Inhalation: 0%, Dermal: 0%]</li> </ul>
Conditions and measures related to personal protection, hygiene and health evaluation
<ul style="list-style-type: none"> <li>Respiratory protective equipment (RPE) as precautionary measure: RPE protecting from local effects via inhalation <i>Due to potential adverse effects of the substance to the respiratory tract, RPE (minimum assigned protection factor of 10) is prescribed on a precautionary basis for all workplaces unless inhalation exposure to the substance can be excluded.</i></li> <li>Eye protection: Eye protection to be worn to protect from adverse effects to the eyes <i>Due to the adverse effects of the substance to the eyes, direct contact of the eyes with the substance is to be avoided including hand to eye transfer after touching contaminated surfaces. Suitable eye protection equipment (e.g. goggles or visors) must be worn.</i></li> <li>Gloves as precautionary measure: Gloves protecting from local effects to the skin (high hazard) <i>Due to the potential adverse effects of the substance to skin, protective gloves according to EN 374 have to be worn at all workplaces. Additionally, face protection is required to be worn as appropriate.</i></li> </ul>

### 9.3.12.2. Exposure and risks for workers

The exposure concentrations and risk characterisation ratios (RCR) are reported in the following table.

**Table 9.29. Exposure concentrations and risks for workers**

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, systemic, long term	10 µg/m <sup>3</sup> (MEASE: 1.02.01)	RCR = 0.128
Combined routes, systemic, long-term		RCR = 0.128

#### **Remarks on exposure data from external estimation tools:**

MEASE 1.02.01

#### **Risk characterisation**

Further information on the risk characterisation for local effects or acute systemic effects via inhalation, for local dermal effects and local effects to the eyes is given in Section 9.0.4.2.

Under the prescribed conditions of use, exposure is below the DNEL and local effects are not expected. Therefore, risks are adequately controlled.

### 9.3.13. Worker CS 13: Roller application or brushing (PROC 10)

#### 9.3.13.1. Conditions of use

Product (Article) characteristics
<ul style="list-style-type: none"> <li>Physical form of substance: Solution</li> <li>Maximum emission potential of the substance: Very low <i>Only the highest emission potential (EP) is reported. Lower EPs (e.g. if materials of lower dustiness are being handled in parallel) are thus automatically covered in this assessment.</i></li> <li>Content in preparation: Not restricted [Effectiveness Inhalation: 0%, Dermal: 0%]</li> </ul>
Amount used (or contained in articles), frequency and duration of use/exposure
<ul style="list-style-type: none"> <li>Maximum duration of exposure: &gt; 240 min (not restricted) [Effectiveness Inhalation: 0%, Dermal: 0%]</li> </ul>
Conditions and measures related to personal protection, hygiene and health evaluation
<ul style="list-style-type: none"> <li>Respiratory protective equipment (RPE) as precautionary measure: RPE protecting from local effects via inhalation <i>Due to potential adverse effects of the substance to the respiratory tract, RPE (minimum assigned protection factor of 10) is prescribed on a precautionary basis for all workplaces unless inhalation exposure to the substance can be excluded.</i></li> </ul>

- Eye protection: Eye protection to be worn to protect from adverse effects to the eyes  
*Due to the adverse effects of the substance to the eyes, direct contact of the eyes with the substance is to be avoided including hand to eye transfer after touching contaminated surfaces. Suitable eye protection equipment (e.g. goggles or visors) must be worn.*
- Gloves as precautionary measure: Gloves protecting from local effects to the skin (high hazard)  
*Due to the potential adverse effects of the substance to skin, protective gloves according to EN 374 have to be worn at all workplaces. Additionally, face protection is required to be worn as appropriate.*

### 9.3.13.2. Exposure and risks for workers

The exposure concentrations and risk characterisation ratios (RCR) are reported in the following table.

**Table 9.30. Exposure concentrations and risks for workers**

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, systemic, long term	50 µg/m <sup>3</sup> (MEASE: 1.02.01)	RCR = 0.641
Combined routes, systemic, long-term		RCR = 0.641

#### Remarks on exposure data from external estimation tools:

MEASE 1.02.01

#### Risk characterisation

Further information on the risk characterisation for local effects or acute systemic effects via inhalation, for local dermal effects and local effects to the eyes is given in Section 9.0.4.2.

Under the prescribed conditions of use, exposure is below the DNEL and local effects are not expected. Therefore, risks are adequately controlled.

## 9.3.14. Worker CS 14: Wet cleaning (PROC 28)

### 9.3.14.1. Conditions of use

Product (Article) characteristics
<ul style="list-style-type: none"> <li>• Physical form of substance: Solution, suspension</li> <li>• Maximum emission potential of the substance: Very low <i>Only the highest emission potential (EP) is reported. Lower EPs (e.g. if materials of lower dustiness are being handled in parallel) are thus automatically covered in this assessment.</i></li> <li>• Content in preparation: Not restricted [Effectiveness Inhalation: 0%, Dermal: 0%]</li> </ul>
Amount used (or contained in articles), frequency and duration of use/exposure
<ul style="list-style-type: none"> <li>• Maximum duration of exposure: &gt; 240 min (not restricted) [Effectiveness Inhalation: 0%, Dermal: 0%]</li> </ul>
Conditions and measures related to personal protection, hygiene and health evaluation
<ul style="list-style-type: none"> <li>• Respiratory protective equipment (RPE) as precautionary measure: RPE protecting from local effects via inhalation <i>Due to potential adverse effects of the substance to the respiratory tract, RPE (minimum assigned protection factor of 10) is prescribed on a precautionary basis for all workplaces unless inhalation exposure to the substance can be excluded.</i></li> <li>• Eye protection: Eye protection to be worn to protect from adverse effects to the eyes <i>Due to the adverse effects of the substance to the eyes, direct contact of the eyes with the substance is to be avoided including hand to eye transfer after touching contaminated surfaces. Suitable eye protection equipment (e.g. goggles or visors) must be worn.</i></li> <li>• Gloves as precautionary measure: Gloves protecting from local effects to the skin (high hazard) <i>Due to the potential adverse effects of the substance to skin, protective gloves according to EN 374 have to be worn at all workplaces. Additionally, face protection is required to be worn as appropriate.</i></li> </ul>

### 9.3.14.2. Exposure and risks for workers

The exposure concentrations and risk characterisation ratios (RCR) are reported in the following table.

Table 9.31. Exposure concentrations and risks for workers

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, systemic, long term	50 µg/m <sup>3</sup> (MEASE: 1.02.01)	RCR = 0.641
Combined routes, systemic, long-term		RCR = 0.641

**Remarks on exposure data from external estimation tools:**

MEASE 1.02.01

Explanations: According to ECHA Guidance R. 12 (Version 3.0, December 2015) PROC 28 should be used for cleaning and maintenance. In MEASE, Version 1.02.01, no PROC 28 is available and PROC 8a was used as surrogate in MEASE for the exposure calculation. PROC 8a is used for cleaning and maintenance, when solutions of the substance are handled.

**Risk characterisation**

Further information on the risk characterisation for local effects or acute systemic effects via inhalation, for local dermal effects and local effects to the eyes is given in Section 9.0.4.2.

Under the prescribed conditions of use, exposure is below the DNEL and local effects are not expected. Therefore, risks are adequately controlled.

### 9.3.15. Worker CS 15: Vacuum cleaning (PROC 28)

#### 9.3.15.1. Conditions of use

Product (Article) characteristics
<ul style="list-style-type: none"> <li>Physical form of substance: Solid, powder / dust</li> <li>Maximum emission potential of the substance: High</li> </ul> <p><i>Only the highest emission potential (EP) is reported. Lower EPs (e.g. if materials of lower dustiness are being handled in parallel) are thus automatically covered in this assessment.</i></p> <ul style="list-style-type: none"> <li>Content in preparation: Not restricted [Effectiveness Inhalation: 0%, Dermal: 0%]</li> </ul>
Amount used (or contained in articles), frequency and duration of use/exposure
<ul style="list-style-type: none"> <li>Maximum duration of exposure: &gt; 240 min (not restricted) [Effectiveness Inhalation: 0%, Dermal: 0%]</li> </ul>
Technical and organisational conditions and measures
<ul style="list-style-type: none"> <li>Integrated local exhaust ventilation: Lower confidence limit (industrial use) [Effectiveness Inhalation: 84%]</li> </ul> <p><i>Surrogate exposure determinant used to reflect the efficiency of a vacuum cleaner.</i></p>
Conditions and measures related to personal protection, hygiene and health evaluation
<ul style="list-style-type: none"> <li>Respiratory protective equipment (RPE): RPE with minimum APF = 40 [Effectiveness Inhalation: 97.5%]</li> </ul> <p><i>APF = assigned protection factor according to EN 529. At minimum combination of particle filter class P3 with face piece according to EN 136, EN 12941 or EN 12942 or any RPE providing higher APFs according to EN 529 is required.</i></p> <ul style="list-style-type: none"> <li>Eye protection: Eye protection to be worn to protect from adverse effects to the eyes</li> </ul> <p><i>Due to the adverse effects of the substance to the eyes, direct contact of the eyes with the substance is to be avoided including hand to eye transfer after touching contaminated surfaces. Suitable eye protection equipment (e.g. goggles or visors) must be worn.</i></p> <ul style="list-style-type: none"> <li>Gloves as precautionary measure: Gloves protecting from local effects to the skin (high hazard)</li> </ul> <p><i>Due to the potential adverse effects of the substance to skin, protective gloves according to EN 374 have to be worn at all workplaces. Additionally, face protection is required to be worn as appropriate.</i></p>

#### 9.3.15.2. Exposure and risks for workers

The exposure concentrations and risk characterisation ratios (RCR) are reported in the following table.

Table 9.32. Exposure concentrations and risks for workers

## Potassium dicyanoargentate

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, systemic, long term	40 µg/m <sup>3</sup> (MEASE: 1.02.01)	RCR = 0.513
Combined routes, systemic, long-term		RCR = 0.513

### **Remarks on exposure data from external estimation tools:**

MEASE 1.02.01

Explanations: According to ECHA Guidance R. 12 (Version 3.0, December 2015) PROC 28 should be used for cleaning and maintenance. In MEASE, Version 1.02.01, no PROC 28 is available and PROC 26 was used as surrogate in MEASE for the exposure calculation. PROC 26 is used for cleaning and maintenance, when powder/dust of the substance is handled.

### **Risk characterisation**

Further information on the risk characterisation for local effects or acute systemic effects via inhalation, for local dermal effects and local effects to the eyes is given in Section 9.0.4.2.

Under the prescribed conditions of use, exposure is below the DNEL and local effects are not expected. Therefore, risks are adequately controlled.