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## 9.3. Exposure scenario 3: Use at industrial site - Use as an intermediate

**Market sector:** Manufacture of other substances

PC 19: Intermediate

**Sector of use:**

SU 9, Manufacture of fine chemicals

Environment contributing scenario(s):	
Use as an intermediate	ERC 6a
Worker contributing scenario(s):	
Raw material handling	PROC 26
Closed batch process	PROC 3
Open or semi-closed reaction process	PROC 4
Wet cleaning	PROC 8a
Vacuum cleaning	PROC 26

### Explanation on the approach taken for the ES

It is noted that this exposure scenario focusses on exposure to the substance to be registered. Please refer to information on safe use for the handling of the individual manufactured substances for process steps commencing the chemical transformation step.

### 9.3.1. Environmental contributing scenario 1: Use as an intermediate

#### 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 Pd to wastewater and air arising from the use of palladium di(4-oxopent-2-en-2-oate) as an intermediate at an industrial site. Wastewater is treated by an on-site wastewater treatment plant (WWTP) prior to discharge to the receiving water body in a number of ways:

- To freshwater via a municipal sewage treatment plant (STP) [ES 3.1];
- Direct discharge to freshwater [ES 3.2]; or

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- Direct discharge to marine water [ES 3.3].

Airborne emissions are treated by in-stack mitigation systems prior to discharge (all ES). Exposure assessment for the environment is based on representative exposure characteristics from the Pd manufacturing and processing sector for wastewater emissions and adjusted SpERC values for stack emissions to air (supported by a limited amount of emission data).

A sector-wide monitoring dataset is available, based on emissions of total palladium, resulting from production and use of a variety of palladium compounds collected during 2012 - 2016 from sites across Europe. In this assessment the release factor (RF) for wastewater is set at 0.00562% (equivalent to 56.2 g/T); the 50<sup>th</sup> percentile measured wastewater release factor from 12 sites. The use of adjusted release factors for air is supported by the available data on measured Pd emissions in air at sites producing Pd compounds. In this assessment the release factor (RF) to air is set at 10% of the SpERC RF for 'manufacture of metal compounds'<sup>13</sup> to air of 0.03% (adjusted from 0.3% and equivalent to 30 g/T) is much higher than the mean measured RF of 21.8 g/T based on quantifiable measurements from three sites manufacturing Pd compounds; additionally, monitoring was performed at two further sites though these results were less than the limit of detection.

#### **9.3.1.3. Risk Management Measures (RMMs)**

All sites from the palladium manufacturing and processing sector that provided data on emissions to water reported that wastewater treatment was primarily based on chemical precipitation followed by sedimentation and/or filtration. Two sites reported an additional step involving ion exchange. The reported efficiency for treatment of wastewater containing palladium compounds varied from 98 to 99.99%, with the majority of sites reporting  $\geq 99.9\%$  removal efficiency. Similarly, all sites reporting on RMMs for stack emissions to air (n=8) stated the use of wet scrubbers, with the reported efficiency in the range 99.9-100%.

#### **9.3.1.4. Exposure Scenario**

The use of palladium di(4-oxopent-2-en-2-oate) as an industrial intermediate is considered to have the same operating conditions and emission characteristics as manufacture on the basis that many companies in this sector manufacture palladium di(4-oxopent-2-en-2-oate) for use as an intermediate and using facilities using this compounds as intermediate would be undertaking similar processes.

A summary of the emission characteristics used to quantify the environmental aspects of the generic exposure scenario (GES) for use of palladium di(4-oxopent-2-en-2-oate) as an intermediate is detailed below:

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<sup>13</sup> <http://www.arche-consulting.be/content/documents/Eurometaux-1.2.v2.1.pdf>

<b>1. Title</b>	
<b>ES3: Use of palladium di(4-oxopent-2-en-2-oate) as an intermediate</b>	
<b>Life cycle</b>	Use as an intermediate at industrial site
<b>Systematic title based on use descriptor</b>	ERC: ERC 6A Use as an intermediate – industrial
<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 as an industrial intermediate
<b>Systematic title based on use descriptor (environment)</b>	ERC 6A Use as an intermediate – industrial
<b>Processes, tasks, activities covered (environment)</b>	Use as an industrial intermediate: delivery and processing of palladium di(4-oxopent-2-en-2-oate), cleaning & maintenance.
<b>Environmental Assessment Method</b>	Estimates based on monitoring data of emissions, local and regional concentrations are used for calculation of PECs
<b>Product characteristics</b>	
Palladium di(4-oxopent-2-en-2-oate) as a solid.	
Environmental assessment is based on the estimated emission of palladium di(4-oxopent-2-en-2-oate) in wastewater discharge and in stack emissions to air.	
<b>Amounts used</b>	
<b>Annual production/use at a site</b>	ES 3.1 and ES 3.2: 80.2 tonnes Palladium di(4-oxopent-2-en-2-oate) (28.0 tonnes Pd metal equivalent); 90P from sector data ES 3.3: 1.43 tonnes Palladium di(4-oxopent-2-en-2-oate) (0.50 tonnes Pd metal equivalent); calculated M <sub>safe</sub>
<b>Frequency and duration of use</b>	
<b>Pattern of release to the environment</b>	280 days per year per site (50P from sector data)
<b>Environment factors not influenced by risk management</b>	
<b>Receiving surface water flow rate</b>	ES 1.1: STP: 3,000 m <sup>3</sup> /d (minimum STP size from sector data)  Receiving water: 93,000 m <sup>3</sup> /d (based on 50P dilution factor from sector data) ES 1.2: Receiving water: 119,880 m <sup>3</sup> /d (maximum allowable dilution factor of 1000; assumption made on knowledge of sector data.) ES1.3 Marine water: 100x dilution
<b>Dilution capacity, freshwater</b>	ES 1.1: Discharge to freshwater via STP:

	DF in STP = 25; DF in receiving water = 32 (sector data) ES 1.2: Direct discharge to freshwater: DF = 1,000 (maximum allowable)
<b>Dilution capacity, marine</b>	ES 1.3 Direct discharge to marine water: DF = 100 (default)
<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 releases to soil</b>	
<p><b>Waste water:</b> All ES: On-site wastewater treatment by chemical precipitation, sedimentation and/or filtration. Efficiency 99.9 % (sector data) Release factor after on-site treatment: 56.2 g/T (50P from sector data)</p> <p>ES 3.1. Off-site municipal sewage treatment plant (STP) Efficiency 73.4 % (based on European STP monitoring programme)<sup>14</sup></p> <p>ES 3.3: Direct discharge to marine water: 10 g/T (arbitrary)</p> <p><b>Air:</b> All ES: Treatment of air emissions by wet scrubbers and filters (e.g. fabric, bag, HEPA). Release factor after on-site treatment: 30 g/T (10% of SpERC RF for 'Manufacture of metal compounds'<sup>15</sup>)</p>	
<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>	ES 3.1: Yes ES 3.2: No ES 3.3: No

<sup>14</sup> Stutt E, Wilson I, Merrington G & Rothenbacher K (2016) Determining the Removal of Platinum Group Metals in Industrial Effluent during Sewage Treatment. In: Abstracts Book of the SETAC Europe 26th Annual Meeting – 22-26 May 2016, Nantes, France, Society of Environmental Toxicology and Chemistry

<sup>15</sup> ARCHE (2013) Manufacture of metal compounds. spERC code Eurometaux 1.2.v2.1. Available online at <http://www.arche-consulting.be/metal-csa-toolbox/SPERCs-tool-for-metals/>

<b>Discharge rate of the Municipal STP</b>	ES 3.1: 3 000 m <sup>3</sup> /d (minimum from sector data)						
<b>Fate of the sludge from Municipal STP</b>	The sludge is incinerated (with ash going to landfill)						
<b>Conditions and measures related to external treatment of waste for disposal</b>							
Palladium di(4-oxopent-2-en-2-oate)- and other Pd-containing waste is filled into containers and transported to licensed recycling facilities for recovery or disposed of at appropriate landfill facilities.							
<b>Conditions and measures related to external recovery of waste</b>							
Palladium di(4-oxopent-2-en-2-oate)- and other Pd -containing waste suitable for recycling may be recycled either internally or at licensed recycling facility.							
The sludge from the on-site treatment plant is processed for metal reclamation (recycling).							
<b>3. Exposure and risk estimation</b>							
<b>Environment [based on total Pd emissions]</b>							
ERC 6A							
<b>ES 3 Use of palladium di(4-oxopent-2-en-2-oate) as an industrial intermediate*</b>							
Compartment	Unit	PNEC	PEC <sub>regional</sub>	C <sub>local</sub>	PEC	RCR	Methods for calculation of environmental concentrations
Discharge to STP (ES 3.1)	mg Pd/L	1.46 mg/L	1.75 x10 <sup>-7</sup> mg/L	4.98 x 10 <sup>-4</sup> mg/L	4.98 x 10 <sup>-4</sup> mg/L	3.4 x 10 <sup>-4</sup>	Reasonable worst case exposure modelling based on 90P sector tonnage & 50P release factor
Freshwater via STP (ES 3.1)	mg Pd/L	2.66 x10 <sup>-5</sup> mg/L	1.75 x10 <sup>-7</sup> mg/L	1.50 x10 <sup>-5</sup> mg/L	1.52 x10 <sup>-5</sup> mg/L	0.57	
Freshwater following direct discharge (ES 3.2)	mg Pd/L	2.66 x10 <sup>-5</sup> mg/L	1.75 x10 <sup>-7</sup> mg/L	1.81 x 10 <sup>-6</sup> mg/L	1.98 x 10 <sup>-6</sup> mg/L	0.07	
Freshwater sediment via STP (ES 3.1)	mg Pd/kg g w.w.	0.060 mg/kg	3.33 x10 <sup>-4</sup> mg/kg	0.008 mg/kg	0.009 mg/kg	0.14	
Freshwater sediment via direct discharge (ES 3.2)	mg Pd/kg g w.w.	0.060 mg/kg	3.33 x10 <sup>-4</sup> mg/kg	0.001 mg/kg	0.001 mg/kg	0.02	

Marine water via direct discharge (ES 3.3)	mg Pd/L	2.66 x10 <sup>-6</sup> mg/L	1.70 x 10 <sup>-8</sup> mg/kg	1.20 x 10 <sup>-6</sup> mg/kg	1.21 x 10 <sup>-6</sup> mg/kg	0.46	Maximum safe tonnage calculation (M <sub>safe</sub> ) based on default dilution for marine environment
Marine sediment via direct discharge (ES 3.3)	mg Pd/k g w.w.	0.006 mg/kg	3.31 x10 <sup>-5</sup> mg/kg	4.30 x 10 <sup>-3</sup> mg/kg	4.33 x 10 <sup>-3</sup> mg/kg	0.72	
Terrestrial (ES 3.1 and 3.2)	mg Pd/k g w.w.	1.04 x 10 <sup>-2</sup> mg/kg	1.64 x10 <sup>-3</sup> mg/kg	1.80 x10 <sup>-6</sup> mg/kg	1.64 x10 <sup>-3</sup> mg/kg	0.16	Modelled increase in soil concentrations due to deposition from atmospheric emissions (i.e. assuming no application of sewage sludge to land)
Terrestrial (ES 3.3)	mg Pd/k g w.w.	1.04 x 10 <sup>-2</sup> mg/kg	1.64 x10 <sup>-3</sup> mg/kg	3.21 x10 <sup>-8</sup> mg/kg	1.64 x10 <sup>-3</sup> mg/kg	0.16	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 Pd equivalent due to the Pd 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.

### 9.3.2. Worker contributing scenario 1: Raw material handling (PROC 26)

### 9.3.2.1. Conditions of use

	Method
<b>Product (article) characteristics</b>	
• Physical form of substance: Solid	External Tool (MEASE)
• Maximum emission potential of the substance: High (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.)	External Tool (MEASE)
• Content in preparation: Not restricted [Effectiveness Inhal: 0%; Dermal: 0%]	External Tool (MEASE)
<b>Amount used (or contained in articles), frequency and duration of use/exposure</b>	
• Maximum duration of exposure: > 240 min (not restricted) [Effectiveness Inhal: 0%; Dermal: 0%]	External Tool (MEASE)
<b>Technical and organisational conditions and measures</b>	
• Pattern of use: Non-dispersive use	External Tool (MEASE)
• Pattern of exposure control: Direct handling	External Tool (MEASE)
• Contact level: Intermittent	External Tool (MEASE)
• Generic local exhaust ventilation: Lower confidence limit (industrial use) (Standard efficiency) [Effectiveness Inhal: 78%]	External Tool (MEASE)
<b>Conditions and measures related to personal protection, hygiene and health evaluation</b>	
• 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.)	
• Respiratory protective equipment (RPE) as precautionary measure: RPE protecting from local effects via inhalation (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.)	
• 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.)	

### 9.3.2.2. Exposure and risks for workers

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

**Table 9. Exposure concentrations and risks for workers**

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	2.2E3 µg/m <sup>3</sup> (External Tool (MEASE))	RCR = 0.086
Inhalation, local, long-term		Qualitative (see below)
Inhalation, local, acute		Qualitative (see below)
Dermal, systemic, long-term	141.4 µg/kg bw/day (External Tool (MEASE))	RCR < 0.01
Dermal, local, long-term		Qualitative (see below)
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.09

#### Remarks on exposure data

##### **External Tool (MEASE)**

- Dermal, systemic, long-term:  
For calculation of systemic exposure, the exposure estimate for total dermal loading as obtained in MEASE (reported in mg/day) is divided by a body weight of 70 kg for workers.

#### Conclusion on risk characterisation

Further information on the risk characterisation for local effects via inhalation, for local dermal effects and local effects to the eyes is given in Section 9.0.2.3.

Under the prescribed conditions of use, exposure is well below the DNELs and no local effects are expected. Therefore, risks are adequately controlled.

### 9.3.3. Worker contributing scenario 2: Closed batch process (PROC 3)

#### 9.3.3.1. Conditions of use

	Method
Product (article) characteristics	

	Method
• Physical form of substance: Solid	External Tool (MEASE)
• Maximum emission potential of the substance: High (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.)	External Tool (MEASE)
• Content in preparation: Not restricted [Effectiveness Inhal: 0%; Dermal: 0%]	External Tool (MEASE)
<b>Amount used (or contained in articles), frequency and duration of use/exposure</b>	
• Maximum duration of exposure: > 240 min (not restricted) [Effectiveness Inhal: 0%; Dermal: 0%]	External Tool (MEASE)
<b>Technical and organisational conditions and measures</b>	
• Pattern of use: Non-dispersive use	External Tool (MEASE)
• Pattern of exposure control: Non-direct handling	External Tool (MEASE)
• Contact level: Intermittent	External Tool (MEASE)
• Level of containment: Closed process	External Tool (MEASE)
<b>Conditions and measures related to personal protection, hygiene and health evaluation</b>	
• 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.)	
• Respiratory protective equipment (RPE) as precautionary measure: RPE protecting from local effects via inhalation (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.)	
• 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.)	

### 9.3.3.2. Exposure and risks for workers

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

**Table 10. Exposure concentrations and risks for workers**

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	<b>1E3 µg/m<sup>3</sup></b> (External Tool (MEASE))	RCR = 0.039
Inhalation, local, long-term		Qualitative (see below)
Inhalation, local, acute		Qualitative (see below)
Dermal, systemic, long-term	<b>1.71 µg/kg bw/day</b> (External Tool (MEASE))	RCR < 0.01
Dermal, local, long-term		Qualitative (see below)
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.039

**Remarks on exposure data**

**External Tool (MEASE)**

- Dermal, systemic, long-term:  
For calculation of systemic exposure, the exposure estimate for total dermal loading as obtained in MEASE (reported in mg/day) is divided by a body weight of 70 kg for workers.

**Conclusion on risk characterisation**

Further information on the risk characterisation for local effects via inhalation, for local dermal effects and local effects to the eyes is given in Section 9.0.2.3.

Under the prescribed conditions of use, exposure is well below the DNELs and no local effects are expected. Therefore, risks are adequately controlled.

**9.3.4. Worker contributing scenario 3: Open or semi-closed reaction process (PROC 4)**

**9.3.4.1. Conditions of use**

	Method
<b>Product (article) characteristics</b>	
• Physical form of substance: Solid	External Tool (MEASE)
• Maximum emission potential of the substance: High (Only the highest	External Tool (MEASE)

	Method
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.)	
• Content in preparation: Not restricted [Effectiveness Inhal: 0%; Dermal: 0%]	External Tool (MEASE)
<b>Amount used (or contained in articles), frequency and duration of use/exposure</b>	
• Maximum duration of exposure: > 240 min (not restricted) [Effectiveness Inhal: 0%; Dermal: 0%]	External Tool (MEASE)
<b>Technical and organisational conditions and measures</b>	
• Pattern of use: Non-dispersive use	External Tool (MEASE)
• Pattern of exposure control: Non-direct handling	External Tool (MEASE)
• Contact level: Intermittent	External Tool (MEASE)
<b>Conditions and measures related to personal protection, hygiene and health evaluation</b>	
• 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.)	
• Respiratory protective equipment (RPE) as precautionary measure: RPE protecting from local effects via inhalation (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.)	
• 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.)	

#### 9.3.4.2. Exposure and risks for workers

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

**Table 11. Exposure concentrations and risks for workers**

Route of exposure and type of effects	Exposure concentration	Risk characterisation

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	5.5E3 µg/m <sup>3</sup> (External Tool (MEASE))	RCR = 0.216
Inhalation, local, long-term		Qualitative (see below)
Inhalation, local, acute		Qualitative (see below)
Dermal, systemic, long-term	3.43 µg/kg bw/day (External Tool (MEASE))	RCR < 0.01
Dermal, local, long-term		Qualitative (see below)
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.216

#### Remarks on exposure data

##### External Tool (MEASE)

- Dermal, systemic, long-term:  
For calculation of systemic exposure, the exposure estimate for total dermal loading as obtained in MEASE (reported in mg/day) is divided by a body weight of 70 kg for workers.

#### Conclusion on risk characterisation

Further information on the risk characterisation for local effects via inhalation, for local dermal effects and local effects to the eyes is given in Section 9.0.2.3.

Under the prescribed conditions of use, exposure is well below the DNELs and no local effects are expected. Therefore, risks are adequately controlled.

### 9.3.5. Worker contributing scenario 4: Wet cleaning (PROC 8a)

#### 9.3.5.1. Conditions of use

	Method
<b>Product (article) characteristics</b>	
• Physical form of substance: Solution, suspension	External Tool (MEASE)
• Maximum emission potential of the substance: Very low (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	External Tool (MEASE)

	Method
this assessment.)	
• Content in preparation: Not restricted [Effectiveness Inhal: 0%; Dermal: 0%]	External Tool (MEASE)
<b>Amount used (or contained in articles), frequency and duration of use/exposure</b>	
• Maximum duration of exposure: > 240 min (not restricted) [Effectiveness Inhal: 0%; Dermal: 0%]	External Tool (MEASE)
<b>Technical and organisational conditions and measures</b>	
• Pattern of use: Non-dispersive use	External Tool (MEASE)
• Pattern of exposure control: Direct handling	External Tool (MEASE)
• Contact level: Extensive	External Tool (MEASE)
<b>Conditions and measures related to personal protection, hygiene and health evaluation</b>	
• Gloves: Protective gloves according to EN 374 have to be worn. Gloves have to be changed according to manufacturer's information or when damaged, whatever is the earlier. [Effectiveness Dermal: 90%]	External Tool (MEASE)
• 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.)	
• Respiratory protective equipment (RPE) as precautionary measure: RPE protecting from local effects via inhalation (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.)	

### 9.3.5.2. Exposure and risks for workers

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

**Table 12. Exposure concentrations and risks for workers**

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	50 µg/m <sup>3</sup> (External Tool (MEASE))	RCR < 0.01
Inhalation, local, long-term		Qualitative (see below)
Inhalation, local, acute		Qualitative (see below)

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Dermal, systemic, long-term	34.29 µg/kg bw/day (External Tool (MEASE))	RCR < 0.01
Dermal, local, long-term		Qualitative (see below)
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR < 0.01

#### Remarks on exposure data

##### External Tool (MEASE)

- Dermal, systemic, long-term:  
For calculation of systemic exposure, the exposure estimate for total dermal loading as obtained in MEASE (reported in mg/day) is divided by a body weight of 70 kg for workers.

#### Conclusion on risk characterisation

Further information on the risk characterisation for local effects via inhalation, for local dermal effects and local effects to the eyes is given in Section 9.0.2.3.

Under the prescribed conditions of use, exposure is well below the DNELs and no local effects are expected. Therefore, risks are adequately controlled.

### 9.3.6. Worker contributing scenario 5: Vacuum cleaning (PROC 26)

#### 9.3.6.1. Conditions of use

	Method
<b>Product (article) characteristics</b>	
• Physical form of substance: Solid, powder / dust	External Tool (MEASE)
• Maximum emission potential of the substance: High (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.)	External Tool (MEASE)
• Content in preparation: Not restricted [Effectiveness Inhal: 0%; Dermal: 0%]	External Tool (MEASE)
<b>Amount used (or contained in articles), frequency and duration of use/exposure</b>	

	Method
<ul style="list-style-type: none"> <li>Maximum duration of exposure: &gt; 240 min (not restricted) [Effectiveness Inhal: 0%; Dermal: 0%]</li> </ul>	External Tool (MEASE)
<b>Technical and organisational conditions and measures</b>	
<ul style="list-style-type: none"> <li>Integrated local exhaust ventilation: Lower confidence limit (industrial use) (Standard efficiency) [Effectiveness Inhal: 84%] <i>Surrogate exposure determinant used to reflect the efficiency of a vacuum cleaner.</i></li> </ul>	External Tool (MEASE)
<ul style="list-style-type: none"> <li>Pattern of use: Non-dispersive use</li> </ul>	External Tool (MEASE)
<ul style="list-style-type: none"> <li>Pattern of exposure control: Non-direct handling</li> </ul>	External Tool (MEASE)
<ul style="list-style-type: none"> <li>Contact level: Extensive</li> </ul>	External Tool (MEASE)
<ul style="list-style-type: none"> <li>Additional operational conditions for cleaning: No direct manual removal of dust.</li> </ul>	External Tool (MEASE)
<b>Conditions and measures related to personal protection, hygiene and health evaluation</b>	
<ul style="list-style-type: none"> <li>Respiratory protective equipment (RPE): RPE with minimum APF = 20 (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.) [Effectiveness Inhal: 95%]</li> </ul>	External Tool (MEASE)
<ul style="list-style-type: none"> <li>Gloves: Protective gloves according to EN 374 have to be worn. Gloves have to be changed according to manufacturer's information or when damaged, whatever is the earlier. [Effectiveness Dermal: 90%]</li> </ul>	External Tool (MEASE)
<ul style="list-style-type: none"> <li>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.)</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 13. Exposure concentrations and risks for workers**

Route of exposure and type of effects	Exposure concentration	Risk characterisation

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	80 µg/m <sup>3</sup> (External Tool (MEASE))	RCR < 0.01
Inhalation, local, long-term		Qualitative (see below)
Inhalation, local, acute		Qualitative (see below)
Dermal, systemic, long-term	1.41 µg/kg bw/day (External Tool (MEASE))	RCR < 0.01
Dermal, local, long-term		Qualitative (see below)
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR < 0.01

#### Remarks on exposure data

##### **External Tool (MEASE)**

- Dermal, systemic, long-term:  
For calculation of systemic exposure, the exposure estimate for total dermal loading as obtained in MEASE (reported in mg/day) is divided by a body weight of 70 kg for workers.

#### Conclusion on risk characterisation

Further information on the risk characterisation for local effects via inhalation, for local dermal effects and local effects to the eyes is given in Section 9.0.2.3.

Under the prescribed conditions of use, exposure is well below the DNELs and no local effects are expected. Therefore, risks are adequately controlled.