CHEMICAL SAFETY REPORT

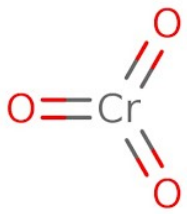
PUBLIC

Legal name of applicant:	C&E Plating Limited
Submitted by:	C&E Plating Limited
Date:	1st November 2023
Substance:	Chromium trioxide, EC/List no.215-607-8, CAS no.1333-82-0
Use title:	Functional chrome-plating with decorative character
Use number:	1

CONTENTS

1 SUBSTANCE INFORMATION

Substance: Chromium trioxide (EC no. 215-607-8, CAS no. 1333-82-0)



Use title: Functional chrome plating with decorative character

2 COMPANY INFORMATION

C&E Plating limited undertake the plating of components used in the manufacture of jewellery and automotive products. The company is located in the Jewellery quarter in Birmingham inside two converted houses. The chromium plating process is carried out in a single dedicated room which is adjacent to the rear yard. The company is located at 8&9 Key Hill Drive, Birmingham, B18 5NY.

Claim 1

3 PRODUCTS

The Chromium plating is used primarily on automotive badges used to designate the make and model of vehicles. The company specialise in small batches of small components with many pieces being single pieces. The production of automotive badges represents the majority of the company's work with chromium trioxide.

4 EXPOSURE SCENARIOS

The exposure scenarios in which the material is used are given in Table 4.1

Table 4.1. Overview of exposure scenarios and worker contributing scenarios

Identifier	Market Sector	Title of exposure scenario	Usage (Kg)	
			Weekly	Annual
ES 1: F-1	Use at industrial site	Functional chrome plating with decorative character	Claim 1	Claim 1

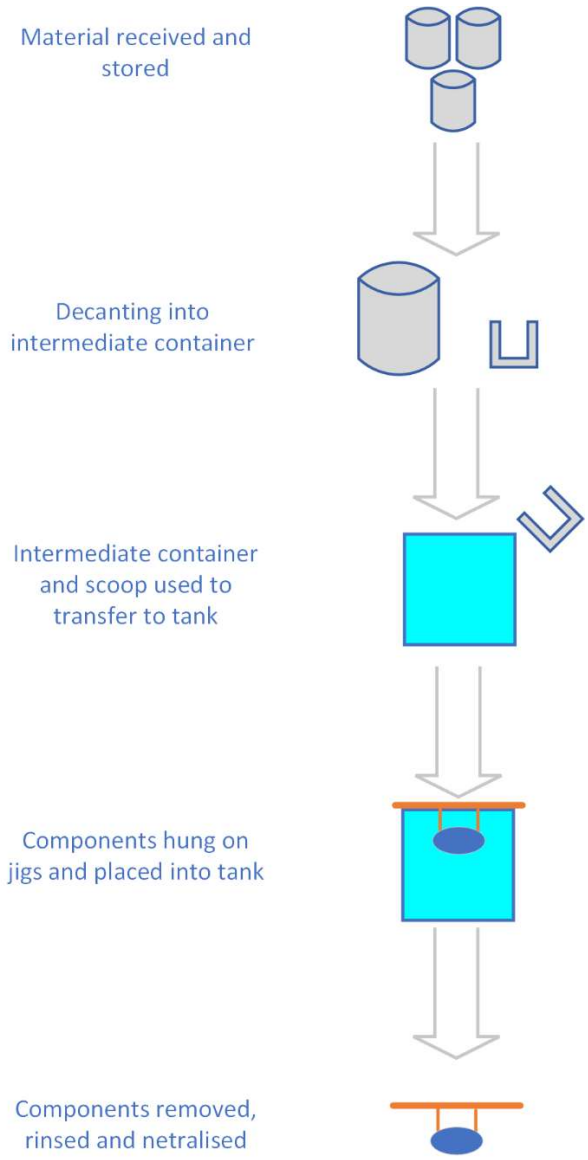
Contributing scenario	ERC / PROC	Name of the contributing scenario
ECS1	ERC 6b	Functional chrome plating with decorative character
WCS 1	PROC 1	Delivery and storage of raw material
WCS 2	PROC 8b	Decanting and transfer to materials to plating tanks
WCS3	PROC 9	Sampling of chromium solution
WCS4	PROC 3	Operation of plating process
WCS5	PROC 4	Jigging and unloading of components

WCS6	PROC 28	Maintenance activities

4.1.1 Description of activities

A schematic diagram of the activities undertaken is given in Figure 4.1.1. The activities undertaken involve the receipt of hexavalent chromium supplied in metal drums. This material is stored before being transported to the area where it is used. The material is transferred directly to two tanks by weighing it out in a jug and pouring it into the tank.

Figure 4.1.1 Schematic diagram of activities



A schematic flow diagram of the plating process is given in Figure 4.1.2. Claim 1 [redacted] The components to be plated are hung on metal jigs which are then suspended in the appropriate plating tank where an electrical current is applied. The components are left in the tank for the appropriate period of time. After this, the jigs are removed and the remaining material on them neutralized and cleaned by passing them through a series of rinse tanks. Photographs of the facility are given in figures 4.1.3 to 4.1.5..

Figure 4.1.2 Claim 1

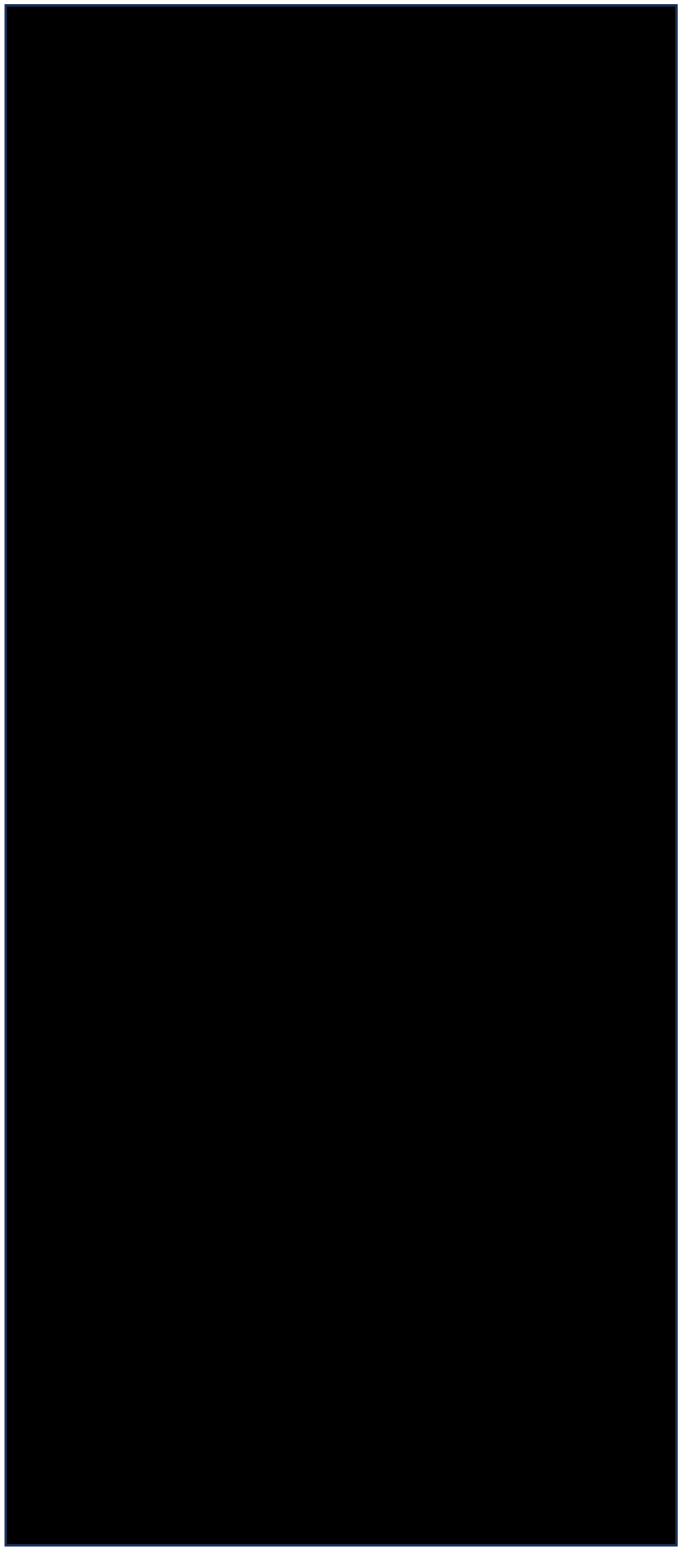


Figure 4.1.3 Claim 1

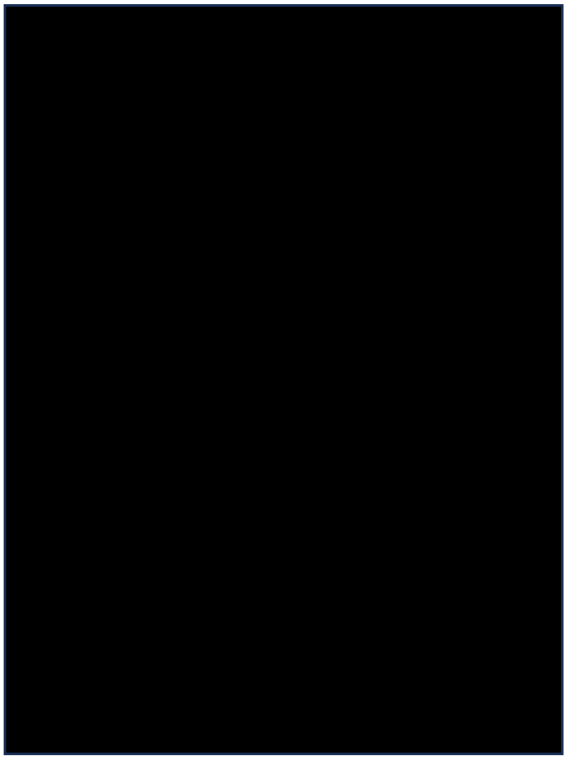


Figure 4.1.4 Claim 1

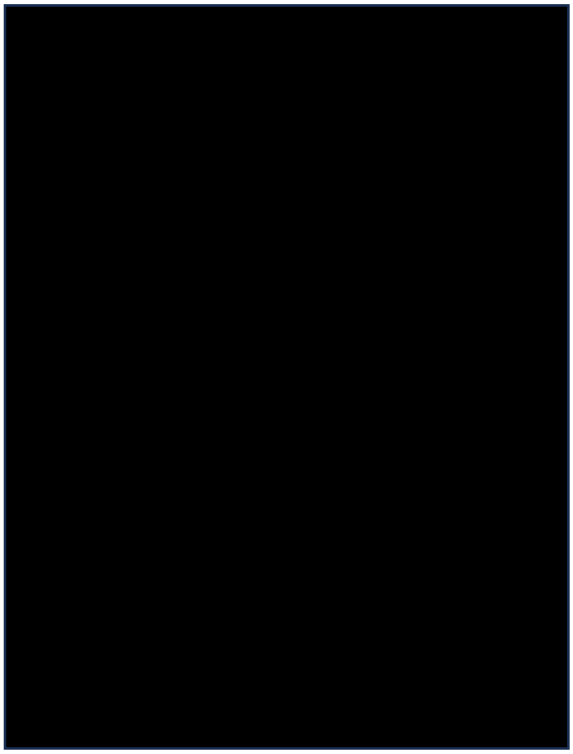
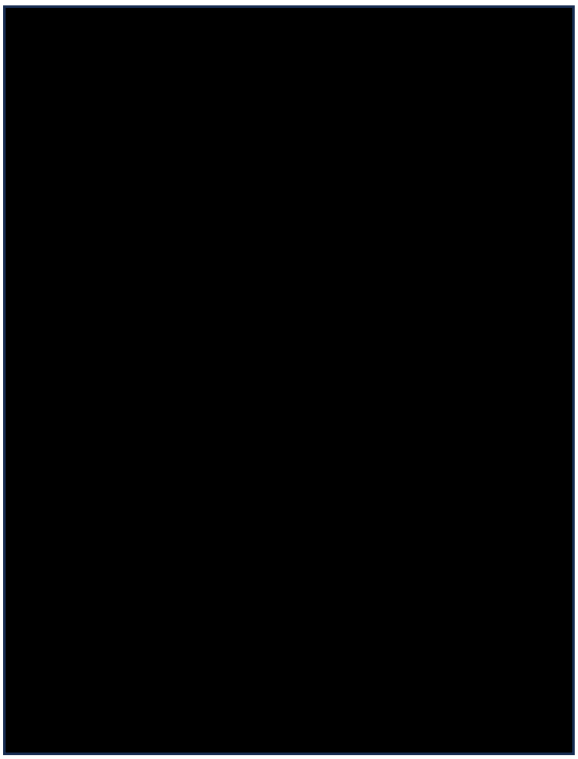


Figure 4.1.5 Claim 1



5 SUMMARY OF RISK MANAGEMENT MEASURES

The company operate an integrated system of risk management measures designed to limit exposures to chromium. The risk management measures have been selected through a system of risk assessments and review. Samples of the risk assessments and associated safety management documentation are given in the confidential appendix.

The following is a summary of the Risk Management Measures which are used to control exposure to chromium trioxide.

Containment - The chromium trioxide is stored and used in dedicated facilities which are not used for any other purpose.

Segregation – Administrative controls are used to segregate the storage and use of chromium trioxide.

Low dust materials - The material supplied to the site is in granular form which releases limited dust during handling and transfer.

Process controls – A surfactant is added to the tank solutions to reduce the risk of misting. The concentration of the surfactant is monitored on a regular basis.

General Ventilation – The facility is serviced with good general ventilation and is largely open to outside at one end when the plant is in operation.

Administrative controls – The facility is only operated by two employees. The plating staff have been put through extensive practical training.

The company are in the process of documenting the working procedures.

Personal Protective Equipment – Personal Protective Equipment is worn in the form of:

- **Apron -** Acid resistant
- **Gauntlets** – Acid resistant
- **Gloves –** Disposable nitrile gloves for all handling activities.
- **Face-shield –** Acid resistant
- **Wellington boots –** Acid resistant

6 EXPOSURE MONITORING

6.1.1 Exposure monitoring

Historical data is available on personal exposures to chromium VI as well as levels encountered above the tanks. These data show that exposures were well controlled (<0.001 $mg.m^{-3}$ which represents <10% of the Workplace Exposure Limit). One recent set of exposure monitoring has been carried out (July 2023). A summary of the results is given in Table 6.1.1. This showed exposures to be controlled to well below the Workplace Exposure Limit for the Bright Chrome tank but indicated issues, with misting occurring on the Black Chrome tank. It is understood that the misting issues have been resolved.

Table 6.1 Personal exposures to Hexavalent Chromium

Sample Ref	Activity	Hexavalent Chromium Exposure (8hr TWA)	
		$mg.m^{-3}$	% WEL
25M635 25M666	Plating activities	0.002	21

6.1.2 Biological monitoring

One recent set of biological monitoring was carried out in July 2023 with analysis of samples being carried out by the Health and Safety Laboratory. This showed levels of chromium in workers to be at levels of unexposed workers and well below the guidance value. These results are summarized in Figure 6.2.1.

Figure 6.2.1 Claim 1

7 EXPOSURE SCENARIOS

The following sections set out the various exposure scenarios.

7.1.1 ECS1 Functional chrome plating with decorative character ERC6b

Waste

All the solid waste containing traces of Chromium Trioxide is sent for disposal as hazardous waste via a licensed waste contractor.

Water

Waste water generated by the process is sent through the company's water treatment plant. This neutralises any chromium trioxide present.

Environmental emissions

No stack emissions data is available for the site as there is no local exhaust ventilation and no formal requirement to undertake emissions monitoring.

Air monitoring in the workplace for personal exposures has been found to be low. It is anticipated that the significant dilution of any releases in the workplace will occur i.e. environmental releases will be significantly lower than personal exposures.

Table 7.1.1. summarises the quantification of release to the environment. As quantifiable data is not available the releases to the environment, these have been assed qualitatively and are given in table 7.1.2

Table 7.1.1. Quantification of releases to the general environment.

Release Route	Release Factor	Release Kg or T/year
Water	Measured data	Release factor 0 Local release rate 0 Kg/day Justification: On site waste water treatment reduces CRVI so that releases are negligible.
Air	Measured data	Measured concentrations above tank <0.001 $mg.m^{-3}$. Local release rate < 1mg/day There is only general ventilation in the area so no airflows can be measured but it is unlikely that the process will release more than 1 mg/day.
Soil	Measured data	Release factor 0 Local release rate 0 Kg/day All waste water is treated and all waste materials are collected as hazardous waste by an external contractor.

Table 7.1.2. Exposure concentrations and risks for workers (ERC6b)

Route of exposure and type of effects	Exposure	Risk quantification Cancer Risk
Humans via the environment - Inhalation	Negligible	Qualitative
Humans via the environment – Food	Negligible	Qualitative

7.1.2 WCS1 Delivery and storage of raw material PROC1

Material is delivered to site in sealed drums. The drums are inspected upon arrival and damaged and contaminated kegs are not accepted. Kegs are manually transferred using a trolley to the material storage room.

Task duration: 30 minutes

Task frequency: Once per month

Number of workers: Typically one or two workers are engaged in this activity.

Risk Management measures: The following risk management measures are used during this task:

- Sealed kegs containing inner liners
- Low dust material
- General ventilation
- Personal protective equipment including overalls and gloves.

Exposure assessment

Inhalation exposure and dermal exposure have been assessed qualitatively. As the material is received in sealed containers exposures by inhalation and skin contact are considered to be negligible.

Exposure and risks for workers

The exposure concentrations have been assessed qualitatively. These are summarised in table 7.2.1.

Table 7.2.1. Exposure concentrations and risks for workers (WCS1)

Route of exposure and type of effects	Exposure	Risk quantification Cancer Risk
Inhalation, systemic, long-term	None	Qualitative

7.1.3 WCS2 Decanting and transfer to materials to plating tanks PROC8b

Task description

The chromium plating tanks are topped up by manually pouring an amount of chromium material into them. The process is carried out with the tanks switched off. The material is transferred from a drum into a jug using a hand scoop. The material is weighed out so that the appropriate amount is added. Once weighed out the tanks are left to allow time for the material to dissolve.

Task duration

15 minutes is used as worst-case estimate.

Task frequency

Between once per week and once per month depending upon the level of production.

Number of workers

One worker currently carries out this activity, Claim 1

Risk Management measures

The following risk management measures are used during this task:

- Low dust material
- Use of mist suppressant
- General ventilation
- Careful handling of material
- Personal protective equipment including overalls and gloves.

Exposure assessment

Exposure assessment has been conducted on the basis of worst case scenarios where solid material is used. The company are in the process of using up stock on the bright chrome tank, following this liquid rather than power additions will be made. The most recent Personal monitoring results show exposures to be 0.002 $mg.m^{-3}$. Though this was higher than has been previously experienced where all exposures were <0.001 $mg.m^{-3}$.

In the absence of multiple sets of recent exposure data Inhalation Exposure was modelled using ART 1.5 tool. The conditions of use and input values are summarised in table 7.3.1.

Table 7.3.1. Inhalation Exposure modelling for WCS2 Decanting and transfer to materials to plating tanks PROC8b

Parameters used in ART tool	Method
Product Type: Powders, granules or pelletised material	ART 1.5

Parameters used in ART tool	Method
Dustiness: Granules, flakes or pellets	ART 1.5
Moisture Content: Dry product (< 5 % moisture content)	ART 1.5
Powder Weight Fraction: Pure Material (100%)	ART 1.5
Primary Emission located in the breathing zone: Yes	ART 1.5
Activity class: Transfer of powders, granules or pelletised material, falling powders	ART 1.5
Activity: Transferring 0.1 to 1 kg/minute	ART 1.5
Type of transfer: Careful transfer	ART 1.5
Drop Height <0.5m	ART 1.5
Handling that reduces contact between product and adjacent air	ART 1.5
Primary Localised Controls: None	ART 1.5
Process fully enclosed and enclosure regularly monitored: No	ART 1.5
Demonstrable and effective housekeeping: Yes	ART 1.5
Work area: Indoor	ART 1.5
Room size: $30m^3$	ART 1.5
Ventilation rate: Mechanical ventilation giving at least 10 ACH	ART 1.5
Secondary emissions source: No	ART 1.5
Exposure duration: 15 min	ART 1.5
Percentile: 90^{th}	ART 1.5

Exposure and risks for workers

The exposure concentrations estimated with the model are reported in Table 7.3.2. Cancer risks have been included in order to compare values with combined exposure. In calculating the level of risk it has been assumed that the activity is carried out once every two weeks with a concentration of 1 ug/m^3 equating to an excess risk of 0.004 (RAC opinion).

Table 7.3.2. Exposure concentrations and risks for workers (WCS2)

Route of exposure and type of effects	Exposure concentration	Risk quantification Cancer Risk
Inhalation, personal monitoring	0.0002 $mg.m^{-3}$	Cancer risk = 0.002 $mg.m^{-3}$ x 0.1 x 4 Cancer risk = $8.0x10^{-4}$
Inhalation, ART tool	0.00028 $mg.m^{-3}$	Cancer risk = 0.0028 $mg.m^{-3}$ x 0.1 x 4 Cancer risk = $1.1x10^{-3}$

7.1.4 WCS3 Sampling of chromium solution PROC9

Task description

Samples are taken from the chromium tanks in order to analyse them and decide on appropriate additions. The activity is typically undertaken by the chemical supply company. It involves immersing a sample jug into the liquid of the tank and collecting approximately 100mls of liquid. A portion of this (approximately 10mls) is then decanted into a sample vial. The sample vial is then sealed. The remaining solution is then poured back into the solution. The sampling jug is then rinsed and dried. Sampling is carried out when the tanks are switched off.

Task duration

10 minutes is used as worst-case estimate.

Task frequency

Once every two weeks.

Number of workers

The task is normally carried out by a contractor from the chemical supply company.

Risk Management measures

The following risk management measures are used during this task:

- Use of mist suppressant
- General ventilation
- Careful handling of material
- Personal protective equipment including overalls, gloves.

Exposure assessment

In the absence of any task specific exposure monitoring data, exposures were modelled using ART 1.5 tool. The conditions of use and input values for each are summarised in table 7.4.1.

Table 7.4.1. Inhalation Exposure modelling for WCS3 Sampling of chromium solution PROC9

Parameters used in ART tool	Method
Product Type: Liquids	ART 1.5
Process temperature: Room temperature	ART 1.5
Vapour pressure: 0.1 Pa	ART 1.5
Liquid Weight Fraction: Small (1 to 5%)	ART 1.5
Viscosity: Low	ART 1.5
Activity class: Activities with open liquid surface	ART 1.5
Activity: Activities with undisturbed surfaces	ART 1.5
Situation: Open surface 0.1 to 0.3 m^2	ART 1.5
Localised controls: None	ART 1.5
Process fully enclosed and enclosure regularly monitored: No	ART 1.5
Demonstrable and effective housekeeping: yes	ART 1.5
Work area: Indoor	ART 1.5

Parameters used in ART tool	Method
Room size: 30m^3	ART 1.5
Ventilation rate: Mechanical ventilation giving at least 10 ACH	ART 1.5
Secondary emissions source: No	ART 1.5
Segregation: None	ART 1.5
Exposure duration: 10 min	ART 1.5
Percentile: 90th	ART 1.5

Exposure and risks for workers

The exposure concentrations estimated are reported in Table 7.4.2. Cancer risks have been included in order to compare values with combined exposure. In calculating the level of risk, it has been assumed that the activity is carried out once every two weeks, with a concentration of 1 ug/m^3 equating to an excess risk of 0.004 (RAC opinion).

Table 7.4.2. Exposure concentrations and risks for workers (WCS3)

Route of exposure and type of effects	Modelled Exposure concentration	Risk quantification Cancer Risk
Inhalation, systemic, long-term	0.000032 mg.m^{-3}	Cancer risk = 0.000032 mg.m^{-3} x 0.1 x 4 Cancer risk = 1.3*10^{-5}

7.1.5 WCS4 Operation of plating process PROC3

Task description

Components are jigged and placed within the plating tanks. The tanks are then turned on and left for the appropriate period of time. Once plated the jigged components are removed and passed through a series of neutralising and rinsing tanks to remove excess chrome solution and to stop any further reactions.

Task duration

Plating takes place on a batch process with employees engaged in other activities. Employees will spend a maximum of 1 hour in the chrome plating area in any one day.

Task frequency

Multiple times in one day

Number of workers

Claim 1

Risk Management measures

The following risk management measures are used during this task:

- Use of mist suppressant
- General ventilation
- Careful handling of material
- Personal protective equipment including overalls, and gloves

Exposure assessment

The most recent Personal monitoring results show exposures to be 0.002 $mg.m^{-3}$. Though this was higher than has been previously experienced where all exposures were <0.001 $mg.m^{-3}$.

In the absence of multiple sets of recent exposure data, Inhalation Exposure was modelled using ART 1.5 tool. The conditions of use and input values are summarised in table 7.5.1.

Table 7.5.1. Inhalation Exposure modelling for WCS4 Operation of plating process PROC3

Parameters used in ART tool	Method
Product Type: Liquids	ART 1.5
Process temperature: Room temperature	ART 1.5
Vapour pressure: 0.1 Pa	ART 1.5
Liquid Weight Fraction: Small (1 to 5%)	ART 1.5
Viscosity: Low	ART 1.5
Activity class: Activities with open liquid surface	ART 1.5
Activity: Activities with undisturbed surfaces	ART 1.5
Situation: Open surface 0.1 to 0.3 m^2	ART 1.5
Localised controls: None	ART 1.5
Process fully enclosed and enclosure regularly monitored: No	ART 1.5
Demonstrable and effective housekeeping: Yes	ART 1.5
Work area: Indoor	ART 1.5
Room size: $30m^3$	ART 1.5
Ventilation rate: Mechanical ventilation giving at least 10 ACH	ART 1.5
Secondary emissions source: No	ART 1.5
Segregation: None	ART 1.5
Exposure duration: 10 min	ART 1.5
Percentile: 90^{th}	ART 1.5

Exposure and risks for workers

The exposure concentrations estimated with the model are reported in Table 7.5.2. Cancer risks have been included in order to compare values with combined exposure. In calculating the level of risk, it has been assumed that the activity is carried out once every two weeks, with a concentration of 1 ug/m^3 equating to an excess risk of 0.004 (RAC opinion).

Table 7.5.2. Exposure concentrations and risks for workers (WCS4)

Route of exposure and type of effects	Exposure concentration	Risk quantification Cancer Risk
Inhalation, personal monitoring	0.0002 $mg.m^{-3}$	Cancer risk = 0.0002 $mg.m^{-3}$ x 4 Cancer risk = $8.0x10^{-4}$

Inhalation, ART tool	0.00028 $mg.m^{-3}$	Cancer risk = 0.000019 $mg.m^{-3}$ x 4 Cancer risk = $7.6x10^{-5}$

7.1.6 WCS5 Jigging and unloading of components PROC4

Task description

Operators use wire and hooks to place components on jigs for plating. Once plated the components are neutralised and rinsed, then allowed to dry before they are manually removed. The components are inspected and then wrapped for despatch.

Task duration

60 minutes is used as worst-case estimate.

Task frequency

Daily

Number of workers

Claim 1

Risk Management measures

The following risk management measures are used during this task:

- General ventilation
- Personal protective equipment including overalls and gloves.

Exposure assessment

In the absence of specific task based exposure data, personal exposure was modelled using ART 1.5 tool. The conditions of use and input values are summarised in table 7.6.1.

Table 7.6.1. Inhalation Exposure modelling for WCS5 Jigging and unloading of components PROC4

Parameters used in ART tool	Method
Product Type: Liquids	ART 1.5
Process temperature: Room temperature	ART 1.5
Vapour pressure: 0.1 Pa	ART 1.5
Liquid Weight Fraction: Minute (0.01 to 0.1%)	ART 1.5
Viscosity: Low	ART 1.5
Activity class: Handling of contaminated objects	ART 1.5
Activity: Treated/contaminated objects (surface 0.1 - 0.3 m²)	ART 1.5
Contamination: <10% of surface area	ART 1.5
Localised controls: None	ART 1.5
Process fully enclosed and enclosure regularly monitored: No	ART 1.5
Demonstrable and effective housekeeping: Yes	ART 1.5
Work area: Indoor	ART 1.5

Parameters used in ART tool	Method
Room size: 30m^3	ART 1.5
Ventilation rate: Mechanical ventilation giving at least 10 ACH	ART 1.5
Secondary emissions source: No	ART 1.5
Segregation: None	ART 1.5
Exposure duration: 60 min	ART 1.5
Percentile: 90th	ART 1.5

Exposure and risks for workers

The exposure concentrations estimated with the models are reported in Table 7.6.2.

Table 7.6.2. Exposure concentrations and risks for workers (WCS5)

Route of exposure and type of effects	Modelled Exposure concentration	Risk quantification Cancer Risk
Inhalation, ART tool	3.8 x 10^{-7} mg.m^{-3}	Cancer risk = 3.8x10^{-7} mg.m^{-3} x 4 Cancer risk = 1.5x10^{-6}

7.1.7 WCS6 Maintenance activities PROC 28

Task description

The process requires minimal maintenance activities to be carried out. The full draining and inspection of the tank probably represents the worst case scenario in terms of exposure during maintenance. However, this is only undertaken very rarely. Normal maintenance involves removing and replacing electrodes.

Task duration

30 minutes is used as worst-case estimate.

Task frequency

Once per month

Number of workers

One worker currently carries out this activity, Claim 1

Risk Management measures

The following risk management measures are used during this task:

- General ventilation
- Personal protective equipment including overalls, and gloves.

Exposure assessment

In the absence of specific task based exposure data, personal exposure was modelled using ART 1.5 tool. The conditions of use and input values are summarised in table 7.7.1.

Table 7.7.1. Inhalation Exposure for WCS6 Maintenance activities PROC 28

Parameters used in ART tool	Method
Product Type: Liquids	ART 1.5
Process temperature: Room temperature	ART 1.5
Vapour pressure: 0.1 Pa	ART 1.5
Liquid Weight Fraction: Small (1 to 5%)	ART 1.5
Viscosity: Low	ART 1.5
Activity class: Handling of contaminated objects	ART 1.5
Activity: Treated/contaminated objects (surface 0.1 - 0.3 m^2)	ART 1.5
Contamination: >90% of surface area	ART 1.5
Localised controls: None	ART 1.5
Process fully enclosed and enclosure regularly monitored: No	ART 1.5
Demonstrable and effective housekeeping: Yes	ART 1.5
Work area: Indoor	ART 1.5
Room size: $30m^3$	ART 1.5
Ventilation rate: Mechanical ventilation giving at least 10 ACH	ART 1.5
Secondary emissions source: No	ART 1.5
Segregation: None	ART 1.5
Exposure duration: 60 min	ART 1.5
Percentile: 90^{th}	ART 1.5

Exposure and risks for workers

The exposure concentrations estimated with the model are reported in Table 7.7.2. Cancer risks have been included in order to compare values with combined exposure. In calculating the level of risk it has been assumed that the activity is carried out once every two weeks with a concentration of 1 ug/m^3 equating to an excess risk of 0.004 (RAC opinion).

Table 7.7.2. Exposure concentrations and risks for workers (WCS6)

Route of exposure and type of effects	Modelled Exposure concentration	Risk quantification Cancer Risk
Inhalation, ART tool	0.0001 $mg.m^{-3}$	Cancer risk = 0.0001 $mg.m^{-3}$ x 0.05 x 4 Cancer risk = $2.0*10^{-5}$

8 RISK CHARACTERIZATION RELATED TO COMBINED EXPOSURES

8.1.1 Human Health related to worker exposure

Role	Number of workers	WCS covered in role	Excess risk
Main plating operator	Claim 1	PROC 1	Negligible
		PROC 8b	$8.0x10^{-4}$
		PROC 3	$7.6x10^{-5}$
		PROC 4	$1.5x10^{-6}$
		PROC 28	$2.0x10^{-5}$
		Total Risk	$8.9x10^{-4}$
Secondary plating operator	Claim 1	PROC 4	$1.5x10^{-6}$
Chemical contractor	1	PROC 9	$1.3*10^{-5}$

8.1.2 Environment

Table 8.2.1. summarises the total releases to the environment.

Table 8.2.1 Summary of releases to the environment

Release Route	Total release per year
Water	0 Kg/year
Air	<1 g per year
Soil	Not relevant

Exposure to humans via the environment is considered to be solely by release to air with all material being in an inhalable format. i.e. the oral route is not considered. Based on a release of <1mg/day from the site a local environmental concentration is estimated as $<1.0x10^{-9}$ $mg.m^{-3}$.

RAC opinion on lung cancer to the general population is $2.9x10^{-2}$ per 1 $ug.m^{-3}$. This equates to an excess risk of $2.9x10^{-8}$.

RAC opinion on lung cancer to the workers is $4.0x10^{-3}$ per 1 $ug.m^{-3}$. This equates to an excess risk of $4.0x10^{-9}$.

9 EXPOSURE ASSESSMENT (AND RELATED RISK CHARACTERISATION)

The exposure scenarios in which the material is used are given in Table 9.1

Table 9.1. Overview of exposure scenarios and worker contributing scenarios

Identifier	Market Sector	Title of exposure scenario	Usage (Kg)	
			Weekly	Annual
ES 1: F-1	Use at industrial site	Functional chrome plating with decorative character	Claim 1	Claim 1

Contributing scenario	ERC / PROC	Name of the contributing scenario
ECS1	ERC 6b	Functional chrome plating with decorative character
WCS 1	PROC 1	Delivery and storage of raw material
WCS 2	PROC 8b	Decanting and transfer to materials to plating tanks
WCS3	PROC 9	Sampling of chromium solution
WCS4	PROC 3	Operation of plating process
WCS5	PROC 4	Jigging and unloading of components
WCS6	PROC 28	Maintenance activities

The following sections set out the various exposure scenarios.

9.1.1 ECS1 Functional chrome plating with decorative character ERC6b

Waste

All the solid waste containing traces of Chromium Trioxide is sent for disposal as hazardous waste via a licensed waste contractor.

Water

Waste water generated by the process is sent through the company's water treatment plant. This neutralises any chromium trioxide present.

Environmental emissions

No stack emissions data is available for the site as there is no local exhaust ventilation and no formal requirement to undertake emissions monitoring.

Air monitoring in the workplace for personal exposures has been found to be low. It is anticipated that the significant dilution of any releases in the workplace will occur i.e. environmental releases will be significantly lower than personal exposures.

Table 9.1.1. summarises the quantification of release to the environment. As quantifiable data is not available the releases to the environment, these have been assed qualitatively and are given in table 9.1.2

Table 9.1.1. Quantification of releases to the general environment.

Release Route	Release Factor	Release Kg or T/year
Water	Measured data	Release factor 0 Local release rate 0 Kg/day Justification: On site waste water treatment reduces CRVI so that releases are negligible.
Air	Measured data	Measured concentrations above tank <0.001 $mg.m^{-3}$. Local release rate < 1mg/day There is only general ventilation in the area so no airflows can be measured but it is unlikely that the process will release more than 1 mg/day.
Soil	Measured data	Release factor 0 Local release rate 0 Kg/day All waste water is treated and all waste materials are collected as hazardous waste by an external contractor.

Table 9.1.2. Exposure concentrations and risks for workers (ERC6b)

Route of exposure and type of effects	Exposure	Risk quantification Cancer Risk
Humans via the environment - Inhalation	Negligible	Qualitative
Humans via the environment – Food	Negligible	Qualitative

9.1.2 WCS1 Delivery and storage of raw material PROC1

Material is delivered to site in sealed drums. The drums are inspected upon arrival and damaged and contaminated kegs are not accepted. Kegs are manually transferred using a trolley to the material storage room.

Task duration: 30 minutes

Task frequency: Once per month

Number of workers: Typically one or two workers are engaged in this activity.

Risk Management measures: The following risk management measures are used during this task:

- Sealed kegs containing inner liners
- Low dust material
- General ventilation
- Personal protective equipment including overalls and gloves.

Exposure assessment

Inhalation exposure and dermal exposure have been assessed qualitatively. As the material is received in sealed containers exposures by inhalation and skin contact are considered to be negligible.

Exposure and risks for workers

The exposure concentrations have been assessed qualitatively. These are summarised in table 9.2.1.

Table 9.2.1. Exposure concentrations and risks for workers (WCS1)

Route of exposure and type of effects	Exposure	Risk quantification Cancer Risk
Inhalation, systemic, long-term	None	Qualitative

9.1.3 WCS2 Decanting and transfer to materials to plating tanks PROC8b

Task description

The chromium plating tanks are topped up by manually pouring an amount of chromium material into them. The process is carried out with the tanks switched off. The material is transferred from a drum into a jug using a hand scoop. The material is weighed out so that the appropriate amount is added. Once weighed out the tanks are left to allow time for the material to dissolve.

Task duration

15 minutes is used as worst-case estimate.

Task frequency

Between once per week and once per month depending upon the level of production.

Number of workers

One worker currently carries out this activity, Claim 1

Risk Management measures

The following risk management measures are used during this task:

- Low dust material
- Use of mist suppressant
- General ventilation
- Careful handling of material
- Personal protective equipment including overalls and gloves.

Exposure assessment

Exposure assessment has been conducted on the basis of worst case scenarios where solid material is used. The company are in the process of using up stock on the bright chrome tank, following this liquid rather than power additions will be made. The most recent Personal monitoring results show exposures to be 0.002 $mg.m^{-3}$. Though this was higher than has been previously experienced where all exposures were <0.001 $mg.m^{-3}$.

In the absence of multiple sets of recent exposure data Inhalation Exposure was modelled using ART 1.5 tool. The conditions of use and input values are summarised in table 9.3.1.

Table 9.3.1. Inhalation Exposure modelling for WCS2 Decanting and transfer to materials to plating tanks PROC8b

Parameters used in ART tool	Method
Product Type: Powders, granules or pelletised material	ART 1.5

Parameters used in ART tool	Method
Dustiness: Granules, flakes or pellets	ART 1.5
Moisture Content: Dry product (< 5 % moisture content)	ART 1.5
Powder Weight Fraction: Pure Material (100%)	ART 1.5
Primary Emission located in the breathing zone: Yes	ART 1.5
Activity class: Transfer of powders, granules or pelletised material, falling powders	ART 1.5
Activity: Transferring 0.1 to 1 kg/minute	ART 1.5
Type of transfer: Careful transfer	ART 1.5
Drop Height <0.5m	ART 1.5
Handling that reduces contact between product and adjacent air	ART 1.5
Primary Localised Controls: None	ART 1.5
Process fully enclosed and enclosure regularly monitored: No	ART 1.5
Demonstrable and effective housekeeping: Yes	ART 1.5
Work area: Indoor	ART 1.5
Room size: $30m^3$	ART 1.5
Ventilation rate: Mechanical ventilation giving at least 10 ACH	ART 1.5
Secondary emissions source: No	ART 1.5
Exposure duration: 15 min	ART 1.5
Percentile: 90^{th}	ART 1.5

Exposure and risks for workers

The exposure concentrations estimated with the model are reported in Table 9.3.2. Cancer risks have been included in order to compare values with combined exposure. In calculating the level of risk it has been assumed that the activity is carried out once every two weeks with a concentration of 1 ug/m^3 equating to an excess risk of 0.004 (RAC opinion).

Table 9.3.2. Exposure concentrations and risks for workers (WCS2)

Route of exposure and type of effects	Exposure concentration	Risk quantification Cancer Risk
Inhalation, personal monitoring	0.0002 $mg.m^{-3}$	Cancer risk = 0.002 $mg.m^{-3}$ x 0.1 x 4 Cancer risk = $8.0x10^{-4}$
Inhalation, ART tool	0.00028 $mg.m^{-3}$	Cancer risk = 0.0028 $mg.m^{-3}$ x 0.1 x 4 Cancer risk = $1.1x10^{-3}$

9.1.4 WCS3 Sampling of chromium solution PROC9

Task description

Samples are taken from the chromium tanks in order to analyse them and decide on appropriate additions. The activity is typically undertaken by the chemical supply company. It involves immersing a sample jug into the liquid of the tank and collecting approximately 100mls of liquid. A portion of this (approximately 10mls) is then decanted into a sample vial. The sample vial is then sealed. The remaining solution is then poured back into the solution. The sampling jug is then rinsed and dried. Sampling is carried out when the tanks are switched off.

Task duration

10 minutes is used as worst-case estimate.

Task frequency

Once every two weeks.

Number of workers

The task is normally carried out by a contractor from the chemical supply company.

Risk Management measures

The following risk management measures are used during this task:

- Use of mist suppressant
- General ventilation
- Careful handling of material
- Personal protective equipment including overalls, gloves.

Exposure assessment

In the absence of any task specific exposure monitoring data, exposures were modelled using ART 1.5 tool. The conditions of use and input values for each are summarised in table 9.4.1.

Table 9.4.1. Inhalation Exposure modelling for WCS3 Sampling of chromium solution PROC9

Parameters used in ART tool	Method
Product Type: Liquids	ART 1.5
Process temperature: Room temperature	ART 1.5
Vapour pressure: 0.1 Pa	ART 1.5
Liquid Weight Fraction: Small (1 to 5%)	ART 1.5
Viscosity: Low	ART 1.5
Activity class: Activities with open liquid surface	ART 1.5
Activity: Activities with undisturbed surfaces	ART 1.5
Situation: Open surface 0.1 to 0.3 m^2	ART 1.5
Localised controls: None	ART 1.5
Process fully enclosed and enclosure regularly monitored: No	ART 1.5
Demonstrable and effective housekeeping: yes	ART 1.5
Work area: Indoor	ART 1.5

Parameters used in ART tool	Method
Room size: 30m^3	ART 1.5
Ventilation rate: Mechanical ventilation giving at least 10 ACH	ART 1.5
Secondary emissions source: No	ART 1.5
Segregation: None	ART 1.5
Exposure duration: 10 min	ART 1.5
Percentile: 90th	ART 1.5

Exposure and risks for workers

The exposure concentrations estimated are reported in Table 9.4.2. Cancer risks have been included in order to compare values with combined exposure. In calculating the level of risk, it has been assumed that the activity is carried out once every two weeks, with a concentration of 1 ug/m^3 equating to an excess risk of 0.004 (RAC opinion).

Table 9.4.2. Exposure concentrations and risks for workers (WCS3)

Route of exposure and type of effects	Modelled Exposure concentration	Risk quantification Cancer Risk
Inhalation, systemic, long-term	0.000032 mg.m^{-3}	Cancer risk = 0.000032 mg.m^{-3} x 0.1 x 4 Cancer risk = 1.3*10^{-5}

9.1.5 WCS4 Operation of plating process PROC3

Task description

Components are jigged and placed within the plating tanks. The tanks are then turned on and left for the appropriate period of time. Once plated the jigged components are removed and passed through a series of neutralising and rinsing tanks to remove excess chrome solution and to stop any further reactions.

Task duration

Plating takes place on a batch process with employees engaged in other activities. Employees will spend a maximum of 1 hour in the chrome plating area in any one day.

Task frequency

Multiple times in one day

Number of workers

Claim 1

Risk Management measures

The following risk management measures are used during this task:

- Use of mist suppressant
- General ventilation
- Careful handling of material
- Personal protective equipment including overalls, and gloves

Exposure assessment

The most recent Personal monitoring results show exposures to be 0.002 $mg.m^{-3}$. Though this was higher than has been previously experienced where all exposures were <0.001 $mg.m^{-3}$.

In the absence of multiple sets of recent exposure data, Inhalation Exposure was modelled using ART 1.5 tool. The conditions of use and input values are summarised in table 9.5.1.

Table 9.5.1. Inhalation Exposure modelling for WCS4 Operation of plating process PROC3

Parameters used in ART tool	Method
Product Type: Liquids	ART 1.5
Process temperature: Room temperature	ART 1.5
Vapour pressure: 0.1 Pa	ART 1.5
Liquid Weight Fraction: Small (1 to 5%)	ART 1.5
Viscosity: Low	ART 1.5
Activity class: Activities with open liquid surface	ART 1.5
Activity: Activities with undisturbed surfaces	ART 1.5
Situation: Open surface 0.1 to 0.3 m^2	ART 1.5
Localised controls: None	ART 1.5
Process fully enclosed and enclosure regularly monitored: No	ART 1.5
Demonstrable and effective housekeeping: Yes	ART 1.5
Work area: Indoor	ART 1.5
Room size: $30m^3$	ART 1.5
Ventilation rate: Mechanical ventilation giving at least 10 ACH	ART 1.5
Secondary emissions source: No	ART 1.5
Segregation: None	ART 1.5
Exposure duration: 10 min	ART 1.5
Percentile: 90^{th}	ART 1.5

Exposure and risks for workers

The exposure concentrations estimated with the model are reported in Table 9.5.2. Cancer risks have been included in order to compare values with combined exposure. In calculating the level of risk, it has been assumed that the activity is carried out once every two weeks, with a concentration of 1 ug/m^3 equating to an excess risk of 0.004 (RAC opinion).

Table 9.5.2. Exposure concentrations and risks for workers (WCS4)

Route of exposure and type of effects	Exposure concentration	Risk quantification Cancer Risk
Inhalation, personal monitoring	0.0002 $mg.m^{-3}$	Cancer risk = 0.0002 $mg.m^{-3}$ x 4 Cancer risk = $8.0x10^{-4}$

Inhalation, ART tool	0.00028 $mg.m^{-3}$	Cancer risk = 0.000019 $mg.m^{-3}$ x 4 Cancer risk = $7.6x10^{-5}$

9.1.6 WCS5 Jigging and unloading of components PROC4

Task description

Operators use wire and hooks to place components on jigs for plating. Once plated the components are neutralised and rinsed, then allowed to dry before they are manually removed. The components are inspected and then wrapped for despatch.

Task duration

60 minutes is used as worst-case estimate.

Task frequency

Daily

Number of workers

Claim 1

Risk Management measures

The following risk management measures are used during this task:

- General ventilation
- Personal protective equipment including overalls and gloves.

Exposure assessment

In the absence of specific task based exposure data, personal exposure was modelled using ART 1.5 tool. The conditions of use and input values are summarised in table 9.6.1.

Table 9.6.1. Inhalation Exposure modelling for WCS5 Jigging and unloading of components PROC4

Parameters used in ART tool	Method
Product Type: Liquids	ART 1.5
Process temperature: Room temperature	ART 1.5
Vapour pressure: 0.1 Pa	ART 1.5
Liquid Weight Fraction: Minute (0.01 to 0.1%)	ART 1.5
Viscosity: Low	ART 1.5
Activity class: Handling of contaminated objects	ART 1.5
Activity: Treated/contaminated objects (surface 0.1 - 0.3 m²)	ART 1.5
Contamination: <10% of surface area	ART 1.5
Localised controls: None	ART 1.5
Process fully enclosed and enclosure regularly monitored: No	ART 1.5
Demonstrable and effective housekeeping: Yes	ART 1.5

Parameters used in ART tool	Method
Work area: Indoor	ART 1.5
Room size: 30m^3	ART 1.5
Ventilation rate: Mechanical ventilation giving at least 10 ACH	ART 1.5
Secondary emissions source: No	ART 1.5
Segregation: None	ART 1.5
Exposure duration: 60 min	ART 1.5
Percentile: 90th	ART 1.5

Exposure and risks for workers

The exposure concentrations estimated with the models are reported in Table 9.6.2.

Table 9.6.2. Exposure concentrations and risks for workers (WCS5)

Route of exposure and type of effects	Modelled Exposure concentration	Risk quantification Cancer Risk
Inhalation, ART tool	3.8 x 10^{-7} mg.m^{-3}	Cancer risk = 3.8x10^{-7} mg.m^{-3} x 4 Cancer risk = 1.5x10^{-6}

9.1.7 WCS6 Maintenance activities PROC 28

Task description

The process requires minimal maintenance activities to be carried out. The full draining and inspection of the tank probably represents the worst case scenario in terms of exposure during maintenance. However, this is only undertaken very rarely. Normal maintenance involves removing and replacing electrodes.

Task duration

30 minutes is used as worst-case estimate.

Task frequency

Once per month

Number of workers

One worker currently carries out this activity, Claim 1

Risk Management measures

The following risk management measures are used during this task:

- General ventilation
- Personal protective equipment including overalls, and gloves.

Exposure assessment

In the absence of specific task based exposure data, personal exposure was modelled using ART 1.5 tool. The conditions of use and input values are summarised in table 9.7.1.

Table 9.7.1. Inhalation Exposure for WCS6 Maintenance activities PROC 28

Parameters used in ART tool	Method
Product Type: Liquids	ART 1.5
Process temperature: Room temperature	ART 1.5
Vapour pressure: 0.1 Pa	ART 1.5
Liquid Weight Fraction: Small (1 to 5%)	ART 1.5
Viscosity: Low	ART 1.5
Activity class: Handling of contaminated objects	ART 1.5
Activity: Treated/contaminated objects (surface 0.1 - 0.3 m²)	ART 1.5
Contamination: >90% of surface area	ART 1.5
Localised controls: None	ART 1.5
Process fully enclosed and enclosure regularly monitored: No	ART 1.5
Demonstrable and effective housekeeping: Yes	ART 1.5
Work area: Indoor	ART 1.5
Room size: $30m^3$	ART 1.5
Ventilation rate: Mechanical ventilation giving at least 10 ACH	ART 1.5
Secondary emissions source: No	ART 1.5
Segregation: None	ART 1.5
Exposure duration: 60 min	ART 1.5
Percentile: 90^{th}	ART 1.5

Exposure and risks for workers

The exposure concentrations estimated with the model are reported in Table 9.7.2. Cancer risks have been included in order to compare values with combined exposure. In calculating the level of risk it has been assumed that the activity is carried out once every two weeks with a concentration of 1 ug/m^3 equating to an excess risk of 0.004 (RAC opinion).

Table 9.7.2. Exposure concentrations and risks for workers (WCS6)

Route of exposure and type of effects	Modelled Exposure concentration	Risk quantification Cancer Risk
Inhalation, ART tool	0.0001 $mg.m^{-3}$	Cancer risk = 0.0001 $mg.m^{-3}$ x 0.05 x 4 Cancer risk = $2.0*10^{-5}$

10 RISK CHARACTERIZATION RELATED TO COMBINED EXPOSURES

10.1.1 Human Health related to worker exposure

Role	Number of workers	WCS covered in role	Excess risk
Main plating operator	Claim 1	PROC 1	Negligible
		PROC 8b	$8.0x10^{-4}$
		PROC 3	$7.6x10^{-5}$
		PROC 4	$1.5x10^{-6}$
		PROC 28	$2.0x10^{-5}$
		Total Risk	$8.9x10^{-4}$
Secondary plating operator	Claim 1	PROC 4	$1.5x10^{-6}$
Chemical contractor	1	PROC 9	$1.3*10^{-5}$

10.1.2 Environment

Table 10.2.1. summarises the total releases to the environment.

Table 10.2.1 Summary of releases to the environment

Release Route	Total release per year
Water	0 Kg/year
Air	<1 g per year
Soil	Not relevant

Exposure to humans via the environment is considered to be solely by released to air with all material being in an inhalable format. i.e. the oral route is not considered. Based on a release of <1mg/day from the site a local environmental concentration is estimated as $<1.0x10^{-9}$ $mg.m^{-3}$.

RAC opinion on lung cancer to the general population is $2.9x10^{-2}$ per 1 $ug.m^{-3}$. This equates to an excess risk of $2.9x10^{-8}$.

RAC opinion on lung cancer to the workers is $4.0x10^{-3}$ per 1 $ug.m^{-3}$. This equates to an excess risk of $4.0x10^{-9}$.

Justification for confidentiality claims

Claim 1 – Claim 1