SAFETY DATA SHEET

Chromium Trioxide

This Safety Data Sheet contains information concerning the potential risks to those involved in handling, transporting and working with the material, as well as describing potential risks to the consumer and the environment. This information must be made available to those who may come into contact with the material or are responsible for the use of the material. This Safety Data Sheet is prepared in accordance with formatting described in the Regulation (EU) No 453/2010, and described in CLP Regulation (EC) No 1272/2008.

Section 1. Identification of the substance/mixture and of the company/undertaking

1.1 Product identifier

Chemical Name: Chromium Trioxide
CAS Number: 1333-82-0
REACH Registration No.: 01-211-9458868-17-0010

1.2 Relevant identified uses of the substances or mixture and of the company/undertaking

Intermediate, Formulation of preparations, Surface treatments, Use of catalysts containing chromium trioxide, small scale laboratory use of chromium trioxide.

1.3 Details of the supplier of the safety data sheet

Manufacturer

Company name:	JSC “Aktyubinsk Chromium Chemicals Plant”
Address:	030015, Aktobe, Kazakhstan
Phone number:	+7 7132 536501
Fax number:	+7 7132 536508
E-mail of the person responsible for the SDS:	ves@azhs.kz
EU Only Representative	Bondex Trading Ltd

1.4 Emergency telephone number

In case of emergency:

Emergency telephone number:	+7 7132 536517
Hours of operation:	24×7

Section 2. Hazards Identification

2.1 Classification of the substance

Classification under CHIP:	O, C, T+, N, Carc Cat 1, Muta Cat 2, Repr Cat. 3, R9, R24/25, R26, R35, R42/43, R45, R46, R48/23, R50/53, R62
Classification under CLP:	Ox. Sol. 1. May cause fire or explosion; strong oxidiser. Carc. 1A. May cause cancer. Muta. 1B. May cause genetic defects. Repr. 2. Suspected of damaging fertility. Acute Tox. 2. Fatal in contact with skin. Acute Tox. 2. Fatal if inhaled. Acute Tox. 3. Toxic if swallowed. STOT RE 1. Causes damage to organs through prolonged or repeated exposure. Skin Corr. 1A. Causes severe skin burns and eye damage. Resp. Sens. 1. May cause allergy or asthma symptoms or breathing difficulties if inhaled. Skin Sens. 1. May cause an allergic skin reaction. Aquatic Chronic 1. Very toxic to aquatic life with long lasting effects.

Physicochemical hazards: A strong oxidiser. Store away from all incompatible materials.

Human health: May cause organ damage following prolonged exposure. Symptoms experienced may include anaemia, dermal irritation/corrosion and local corrosion/irritation of the respiratory tract. Possible carcinogenic potential, with increased risk of tumours observed in the respiratory system such as the lungs, chronic irritation, and corrosion of the respiratory tract. May cause genetic effects and suspected of fertility damage, with a decrease in the number of implantations observed. Acutely toxic if ingested with respiratory and skin sensitisation potential. Symptoms of respiratory irritation include local irritation/corrosion of the respiratory tract being the primary cause of immediate death. Occupational exposure may also cause asthma. Causes liver damage and renal failure. Causes damage to gastrointestinal tract if ingested. May cause cardiovascular collapse if swallowed and may result in haematological toxicity.

Environment: Considered very toxic to aquatic life.

Please see Section 16 for full text of each classification.

2.2 Label elements

Regulation (EC) No 1272/2008:

Hazard Statements

H271 May cause fire or explosion, strong oxidiser.
H350 May cause cancer.
H340 May cause genetic defects
H361 Suspected of damaging fertility.
H330 Fatal if inhaled.
H310 Fatal in contact with skin.
H301 Toxic if swallowed.
H372 Causes damage to organs through prolonged or repeated exposure.
H314 Causes severe skin burns and eye damage
H334 May cause allergy or asthma symptoms or breathing difficulties if inhaled.

H317 May cause an allergic skin reaction
H410 Very toxic to aquatic life with long lasting effects.

Precautionary statements:

P201	Obtain special instructions before use.
P210	Keep away from heat/sparks/open flames/hot surfaces. — No smoking.
P221	Take any precaution to avoid mixing with combustibles…
P280	Wear protective gloves/protective clothing/eye protection/face protection.
P284	Wear respiratory protection.
P301+P330+P331	IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.
P303+P361+P353	IF ON SKIN (or hair): Remove immediately all contaminated clothing. Rinse skin with water/shower.
P304+P340	IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
P305+P351+P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P310:	Immediately call a POISON CENTER or doctor/physician.

Directive 67/548/EEC:


Oxidising


Very Toxic


Dangerous for the environment

Risk phrases

R45 May cause cancer.
R46 May cause heritable genetic damage.
R9 Explosive when mixed with combustible material.
R24/25 Toxic in contact with skin and if swallowed.
R26 Very toxic by inhalation.
R35 Causes severe burns.
R42/43 May cause sensitisation by inhalation and skin contact.
R48/23 Toxic: Danger of serious damage to health by prolonged exposure through inhalation.
R62 Possible risk of impaired fertility.
R50/53 Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Safety Phrases

S53 Avoid exposure - obtain special instructions before use.
S45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).
S60 This material and its container must be disposed of as hazardous waste.
S61 Avoid release to the environment. Refer to special instructions / safety data sheets.

2.3 Other hazards

PBT:	Not considered to be a PBT

Section 3. Composition

Name	CAS Number	EINECS Number	% Composition	Classification according to CHIP	Classification according to CLP
Chromium Trioxide	1333-82-0	215-607-8	100 %	O, C, T+, R9, R24/25, R26, R35, R42/43, R45, R46, R48/23, R50/53, R62	H271 H301 H310 H314 H317 H330 H334 H340 H350 H361 H372 H410

See section 16 for full description of the text of each classification.

Section 4. First Aid Measures

4.1 Description of first aid measures

Inhalation
Remove subject to fresh air. If breathing is difficult, administer oxygen. If breathing has stopped, give artificial respiration. Seek medical attention immediately. Continue to monitor for respiratory distress for 72 hours.

Skin contact
Immediately flush affected area(s) with copious amounts of water for at least 15 minutes. Remove contaminated clothing and shoes. Seek medical attention immediately. Thoroughly clean or discard contaminated clothing and shoes.

Accidental eye contact
Hold affected eye(s) open and irrigate with water for at least 15 minutes. Remove contact lenses if present. Seek medical attention immediately.

Ingestion
Do not induce vomiting. Seek medical attention immediately. Never give anything by mouth to an unconscious person. Give large quantities of water. If vomiting occurs, keep airways clear and give more water.

4.2 Most important symptoms and effects, both acute and delayed

No information available.

4.3 Indication of any immediate attention and special treatment needed

If ingested, seek medical attention immediately and give large quantities of water. If product comes in contact with either the skin or the eyes immediately flush with water for at least 15 minutes.

Section 5. Firefighting Measures

5.1 Extinguishing media

Use media appropriate for surrounding fire.

5.2 Special hazards arising from the substance or mixture

Combustion can be violent. The substance reacts strongly with materials which are readily oxidised. Reaction may be rapid enough to cause ignition.

5.3 Advice for fire-fighters

Firefighters should wear self-contained breathing apparatus in positive pressure mode and chemical protective clothing.

Section 6. Accidental Release Measures

6.1 Personal precautions, protective equipment and emergency procedures

Clean-up personnel should wear appropriate protective equipment including respiratory protection.

6.2 Environmental precautions

Accidental spills should be dealt with immediately to prevent the formation of inhalable dusts or aerosols and release to the aquatic environment.

6.3 Method for cleaning up

Spilled solid material should be placed in a separate clean, dry closed container. Spilled liquid material should be treated with adsorbent material (sand, soil, vermiculite) and placed in a clean dry container. Spillage should be disposed of through an approved contractor or by reduction to trivalent chromium with an excess of strong reducing agent such as sodium thionate or sodium bisulphite. The addition of alkaline (calcium oxide, calcium hydroxide) causes precipitation of insoluble chromium hydroxide from liquid waste.

6.4 Reference to other sections

Refer to section 8 of SDS for personal protection details.

Section 7. Handling and Storage

7.1 Precautions for safe handling

Protect containers from physical damage and contamination. Do not eat, drink or smoke in areas where the substance is being used or stored. Wash thoroughly after handling. Wear appropriate personal protective equipment. Avoid contact with skin, eyes, and clothing. Wear respiratory protection where there is risk of exposure to the substance. Remove any contaminated clothing and wash before reuse. Do not reuse empty containers.

7.2 Condition for safe storage, including any incompatibilities

Store in a cool, dry place away from ignition sources, combustible, organic or other readily oxidisable materials. Keep containers closed when not in use.

7.3 Specific end use(s)

No further details

Section 8. Exposure Controls/Personal Protection

8.1 Control parameters

Chromium Trioxide 100%

Workers:
Inhalation DMEL: 0.01 mg/m^3 Cr(VI), equivalent to 0.02 mg/m^3 chromium trioxide
General population:
Oral DNEL: 0.00035 mg/kg bw/d chromium (III), equivalent to 0.0007 mg/kg bw/day CrO_3
Inhalation DMEL: 3.5 ng/m^3 chromium (VI), equivalent to 6.6 ng/m^3 chromium trioxide.

There is no agreed occupational exposure limit at EU level.

Workplace exposure limits

France: VLE (15 minutes): 0.1 mg/m^3 and VME (8 hour): 0.05 mg/m^3
Finland: Chromium (VI) compounds (TWA): 0.05 mg/m^3
Germany: Production of soluble chromium (VI) compounds: TRK (TWA): 0.1 mg/m^3 chromium (VI) and other chromium (VI) compounds: TRK (TWA): 0.05 mg/m^3
The Netherlands: Soluble chromium (VI) compounds (TWA): 0.025 mg/m^3 and STEL: 0.05 mg/m^3
Sweden: Chromates and chromic acid (TWA): 0.02 mg/m^3 and STEL: 0.06 mg/m^3
UK – MEL (8 hour reference period): 0.5 mg m^{-3} (0.24 ppm) Cr (III) compounds (as Cr) and 0.05 mg m^{-3} Cr (VI)

PNEC (freshwater): 3.4 µg/L for chromium (VI) equivalent to 6.5 µg/L CrO_3 and 4.7 µg/L for chromium (III) equivalent to 9.0 µg/L CrO_3
PNEC (fresh water sediment): 31 mg/kg for chromium (III), equivalent to 60 mg/kg CrO_3
PNEC (soil): 3.3 mg/kg for chromium (III)) equivalent to 6.3 mg/kg CrO_3
PNEC (sewage treatment plant): 0.21 mg/L chromium (VI) equivalent to 0.40 mg/L CrO_3 and 10 mg/L for chromium (III)) equivalent to 20 mg/L CrO_3

8.2 Exposure controls

Ventilation as necessary to control chromic acid levels to acceptable levels. Local exhaust ventilation with full or partial enclosure should be used for processes likely to generate dust, fumes or mist.

Respiratory protection

Approved filter type dust respirator if open system is employed.

Hand protection

Suitable chemical resistant, impervious gloves.

Eye protection

Face shield, safety glasses or close fitting chemical safety goggles are recommended when dust or mist is present.

Skin protection

Impervious coveralls, gloves, and footwear or other full-body protective clothing should be worn when the possibility of exposure exists.

Section 9. Physical and Chemical Properties

9.1 Information on basic physical and chemical properties

Appearance:	Dark red solid
Odour:	n.a
Odour threshold:	n.a.
pH:	n.a.
Melting point/freezing point °C:	196
Initial boiling point and boiling range °C:	n.a
Flash point:	n.a
Evaporation rate:	n.a
Flammability	Not flammable
Vapour pressure:	n.a.
Vapour density	n.a.
Relative density:	Approximately 2.7 g/cm^3
Solubility:	Approximately 1,667g/L.
Partition Coefficient: n-octanol/water:	n.a.
Auto-ignition temperature:	Does not spontaneously ignite.
Decomposition temperature:	The substance decomposes at 250°C to produce Cr_2O_3 and O_2
Viscosity:	n.a.
Explosive properties:	Not explosive.
Oxidising properties:	Oxidising

9.2 Other information

No further details

Section 10. Stability and Reactivity

10.1 Reactivity

Stable under normal conditions and use. Hazardous polymerisation will not occur.

10.2 Chemical stability

Stable under normal conditions and use.

10.3 Possibility of hazardous reactions

Hazardous reactions are not expected.

10.4 Conditions to avoid

Incompatibles.

10.5 Incompatible materials

Readily oxidises combustible, organic or other readily oxidisable materials (wood, paper, sulfur, aluminum, plastics, etc.). Corrosive to metals.

10.6 Hazardous decomposition products

Thermal decomposition begins at 196 degrees C and may produce fumes of chromic oxide and oxygen.

Section 11. Toxicological Information

11.1 Information on toxicological effects

Acute Toxicity: Toxic in contact with skin and if swallowed. Very toxic by inhalation. Causes severe burns. Danger of serious damage to health by prolonged exposure through inhalation.

LD_{50} (acute oral toxicity study in Fischer 344 rats) = 52 (42 – 62) mg/kg bw/d
LD_{50} (acute inhalation toxicity study in Fischer 344 rats) = 263 (224 – 309) mg/m^3 in males and 167 (116 – 238 mg/m^3 in females.
LD_{50} (acute dermal toxicity study in New Zealand White rabbits) = 57 mg/kg bw.

Irritation: Respiratory sensitiser.
Corrosivity: Corrosive to skin and eyes.
Sensitisation: May cause sensitisation by inhalation and skin contact.
Repeated dose toxicity: Danger of serious damage to health by prolonged exposure through inhalation.
Carcinogenicity: Classified as a Category 1 carcinogen according to IARC.
Mutagenicity: May cause heritable genetic damage. A bacterial reverse mutation assay conducted on Chromium Trioxide indicates that Chromium Trioxide is directly mutagenic *in vitro*. An *in vitro* cytogenicity study indicated that Chromium Trioxide is directly clastogenic. An *in vitro* mammalian cell mutagenicity study indicates that Chromium Trioxide is directly mutagenic. The results of an *in vivo* study indicate that Chromium Trioxide can produce significant mutagenic activity *in vivo*.
Toxicity for reproduction: Possible risk of impaired fertility, with adverse effects on the fertility of male and female mice observed. Foetotoxicity, including post-implantation losses, were observed in mice.

Route of exposure: Inhalation, Ingestion and Dermal.

Symptoms related to the physical, chemical and toxicological characteristics:
Eye and Skin Corrosion. Inhalation may result in the onset of asthma and respiratory tract irritation. May be carcinogenic and cause heritable genetic damage. Impaired fertility with a loss in the number of implantations may occur. Following prolonged inhalation exposure, cardiovascular, skin, kidney damage, damage to the liver, gastrointestinal tract, respiratory system, eyes and lung damage may occur.

Section 12. Ecological Information

12.1 Toxicity

Very toxic to aquatic organisms. Long-term adverse effects may result in the aquatic environment.

96-hour LC_{50} was determined to be 13 (*Oncorhynchus mykiss*)
96-hour EC_{50} was determined to be 0.13 – 4.6 mg/L (*Scenedesmus subspicatus*)

12.2 Persistence and degradability

Not relevant for a simple organic substance.

12.3 Bioaccumulative potential

Chromium Trioxide is taken up by fish but is not expected to bioaccumulate, with bioconcentration factor of less than 1L/kg.

12.4 Mobility in soil

Under neutral to alkaline conditions, high mobility in soil is expected with leaching into the lower anaerobic where reduction to Chromium (III) may occur. In the presence of organic matter, Chromium Trioxide is rapidly reduced to Chromium (III). In soils with low organic matter, reduction is likely to be slower.

12.5 Results of PBT and vPvB assessment

This substance is not identified as a PBT substance

12.6 Other adverse effects

No further details

Section 13. Disposal Considerations

13.1 Waste treatment methods

Disposal operations - The substance should be reclaimed or recycled where possible, or reduce to trivalent chromium and disposed of *via* an approved waste contractor or in line with local regulations and discharge limits. Do not release into sewers or waterways. Do not incinerate or dispose of to landfill.

Disposal of packaging – No information available.

Please follow all local, regional, national and international laws.

Section 14. Transport Information

14.1 UN number

1463

14.2 UN proper shipping name

Chromium Trioxide, Anhydrous

14.3 Transport hazard class(es)

5.1 (6.1, 8)

14.4 Packing group

II

14.5 Environmental hazards

Environmentally Hazardous Substance

14.6 Special precautions for user

No information available

14.7 Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code

Not applicable to packaged goods

Section 15. Regulatory Information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

No further information

15.2 Chemical safety assessment

A chemical safety assessment has been conducted.

Section 16. Other Information

Other information

This safety data sheet is prepared in accordance with Regulation (EC) No 453/2010.
* indicates text in the SDS which has changed since the last revision.

Risk phrases used in Section 3

R45 May cause cancer.
R46 May cause heritable genetic damage.
R9 Explosive when mixed with combustible material.
R24/25 Toxic in contact with skin and if swallowed.
R26 Very toxic by inhalation.
R35 Causes severe burns.
R42/43 May cause sensitisation by inhalation and skin contact.
R48/23 Toxic: Danger of serious damage to health by prolonged exposure through inhalation.
R62 Possible risk of impaired fertility.
R50/53 Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
H271 May cause fire or explosion, strong oxidiser.
H350 May cause cancer.
H340 May cause genetic defects
H361 Suspected of damaging fertility.
H330 Fatal if inhaled.
H310 Fatal in contact with skin.
H301 Toxic if swallowed.
H372 Causes damage to organs through prolonged or repeated exposure.
H314 Causes severe skin burns and eye damage
H334 May cause allergy or asthma symptoms or breathing difficulties if inhaled.
H317 May cause an allergic skin reaction
H410 Very toxic to aquatic life with long lasting effects.

Note: The regulatory information given above only indicates the principal regulations specifically applicable to the product described in the safety data sheet. The user's attention is drawn to the possible existence of additional provisions which complete these regulations. Refer to all applicable national, international and local regulations or provisions.

Downstream user exposure scenario for Chromium Trioxide

1	Exposure Scenario 1

Intermediate in the Manufacture of other Chromium Substances

Processes Covered:

Environmental Releases

ERC6a: Industrial use resulting in manufacture of another substance (use of intermediates)

Worker Processes

PROC01: Use in closed process, no likelihood of exposure.
PROC02: Use in closed, continuous process with occasional controlled exposure.
PROC03: Use in closed batch process (synthesis or formulation).
PROC08b: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities
PROC09: Transfer of substance or preparation into small containers (dedicated filling line, including weighing).

Product Category

PC19: Intermediate

Contributing Environmental Scenario: Environmental exposure arising due to Intermediate use of Chromium Trioxide in the Manufacture of other Chromium Substances.

Contributing Worker Scenario: Worker exposure arising due to transfer from storage drums/barrels to reactor vessel, day to day operation of the closed system reactor and cleaning and maintenance of the reactor.

2.1	Contributing scenario 1 controlling environmental exposure for ES 1

Environmental exposure arising due to Intermediate use of Chromium Trioxide in the Manufacture of other Chromium Substances.

Section 2.1 describes the environmental releases that may occur during the intermediate use of Chromium Trioxide in the manufacture of other Chromium Substances. These releases may occur due to emission to wastewater or through emission to the atmosphere. If emission to wastewater occurs on-site treatment in an industrial waste water treatment plant will be required in order to lower downstream emissions to the environment. Removal efficiencies in the industrial WWTP operates at 99.99% efficiency. The WWTP also reduces the majority of Cr(VI) present to Cr(III) and alkaline substances added to precipitate chromium hydroxide which is insoluble in water, allowing for its removal to landfill, incineration or recycling. Emissions to the municipal STP should be avoided.

Emissions to air should be removed by scrubbing. As a minimum it is expected that off gas removal efficiency of 99% would be required. Emissions to local air (after scrubbing) should have a concentration of no more than $0.0027mg/M^3$.

Product characteristics

The produced substance is a non-flammable, non-dusty solid. The substance has a high melting point (196°C) and is of low volatility.

Amounts used
Production sites may use up to 400 tonnes per annum, with approximately 1,000 tonnes used per year in the European Union. According to the guidance for this tonnage band, the default REACH number of emission days per year are 20 days, however, with continuous emissions, it may be up to 365 emission days per year.
Frequency and duration of use
Frequency of exposure is estimated to be 220 days per year, with an 8 hour working day.
Environmental factors influenced by risk management
Flow rate of receiving water at least 18,000 m^3 per day. Dilution of STP emissions at least 10 fold.
Other operational conditions affecting environmental exposure
Production takes place in a highly specialized indoor facility with emissions to air being scrubbed before release. Reactions are performed under closed conditions, with transfer pipelines are either fully or partially closed systems.
Technical conditions and measures at process level (source) to prevent release
Transfer operations are carried out indoors in dedicated facilities, under a hood to reduce potential emissions. Total losses to water are measured.
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil
Waste water should be emitted to either the on-site WWTP or to the municipal STP for smaller facilities with less than 10kg per day loss to wastewater. If an onsite WWTP is available emission to surface water after treatment should be less than 0.0002 % per day Cr (III). Emissions to air after scrubbing should be less than 0.5 kg per day. Sludge from the on-site WWTP should not be spread to soil. Substances present in waste water is chemically treated on site to reduce Chromium Trioxide to Cr(III), which is insoluble in water. This solid waste will be sent as waste for landfill, incineration or recycling.
Organizational measures to prevent/limit releases from site
Workers are fully trained in order to prevent accidental release and exposures are monitored to ensure airborne concentrations are within acceptable levels.
Conditions and measures related to municipal STP
If emissions to the municipal STP are to be made they should be limited to 10 kg per day. Removal efficiencies in the standard STP are estimated to be 99%. The emission volume of the STP should be at least the default of 2,000 m^3 per day.
Conditions and measures related to external treatment of waste for disposal
Residues from scrubbers may be sent to external waste treatment, on-site effluent treatment or recycled back into the manufacturing process. Sludge is recycled, incinerated or sent to landfill. Cr(III) residues are sent as solid waste to landfill, incineration or recycling.
Conditions and measures related to external recovery of waste
There is no envisaged external recovery of waste. Waste sludge is reduced and then incinerated.

2.2	**Contributing scenario 2 controlling worker exposure for transferring of substance from barrel to reactor vessel**

Worker exposure arising due to Intermediate use of Chromium Trioxide in the Manufacture of other Chromium Substances.
Section 2.2 describes the potential exposure to workers during the intermediate use of chromium trioxide. The potential exposure arises from the transfer of the substance from its storage source (barrel/drum) to the reactor vessel in order for the reaction to take place. Workers involved in this transfer of the substance will be exposed in the manual handling of the substance from barrel/drum to reactor vessel. Appropriate PPE and onsite control parameters are in place to limit the risk of exposure to workers involved in this task.
Product characteristics
The produced substance is a non-flammable, non-dusty solid. The substance has a high melting point (196°C) and is of low volatility.
Amounts used
Production sites may use up to 400 tonnes per annum, with approximately 1,000 tonnes used per year in the European Union.
Frequency and duration of use exposure

Workers perform standard shifts of 8 hours per day and have standard working years of 220 days per year. Transfer of chromium trioxide is generally a short duration task, with limited potential for exposure.
Human factors not influence by risk management
Respiration volume under conditions of use: 10 m^3/d Area of skin contact with the substance under conditions of use: 0 cm^2 due to the use of protective equipment during the transfer of the compound from the barrel to the reactor vessel.
Other given operational conditions affecting worker exposure
The transfer of chromium trioxide to the reactor vessel is carried out with local exhaust ventilation in place. Personal protective equipment is also used to minimize the potential for dermal exposure during the transfer process.
Technical conditions and measures at process level (source) to prevent release
The transfer of the substance from the barrel/drum to the reactor vessel takes place in a fully closed system, with LEV in place.
Technical conditions to control dispersion from source towards worker
LEV should be in place during transfer.
Organizational measures to prevent/limit release
Workers are fully trained in safe use and the use of appropriate PPE in order to prevent accidental release. Frequent monitoring for health effects is conducted by medical surveillance programs.
Conditions and measures related to personal protection, hygiene and health.
Protective gloves with an efficiency of greater than 90%, faceshield and overalls are worn, in addition to RPE if the system is not fully closed. LEV operates at the site of transfer of the substance to ensure there is minimal exposure.

2.3	**Contributing scenario 3 controlling worker exposure due to day to day operation of closed system reactor**

Worker exposure arising due to day to day operation of closed system reactor
Section 2.3 describes the potential exposure to workers involved in the day to day operational processes associated with the use of chromium trioxide as an intermediate occur in a closed reactor system. In order to ensure efficient operation, workers will undertake tasks to allow proper day to day operation of the closed system reactor. As the system is completely closed, there is low risk of exposure to workers, however, appropriate PPE is worn and LEV in place to minimise the potential for exposure.
Product characteristics
The produced substance is a non-flammable, non-dusty solid. The substance has a high melting point (196°C) and is of low volatility
Amounts used
Production sites may use up to 400 tonnes per annum, with approximately 1,000 tonnes used per year in the European Union. According to the guidance for this tonnage band, the default REACH number of emission days per year are 20 days, however, with continuous emissions, it may be up to 365 emission days per year.
Frequency and duration of use exposure
Workers perform standard shifts of 8 hours per day and have standard working years of 220 days per year. All activities involved in the day to day operation of the reactor vessel are not expected to be of a long duration.
Human factors not influence by risk management
Respiration volume under conditions of use: 10 m^3/d Area of skin contact with the substance under conditions of use: 0 cm^2 due to the use of protective equipment during the transfer of the compound from the barrel to the reactor vessel.
Other given operational conditions affecting worker exposure
All reactions occur under closed conditions, with limited opportunity for worker exposure. Protective gloves with an efficiency of 90%, faceshield and overalls are worn in the event of accidental contact during day to day operations associated with the reactor vessel.
Technical conditions and measures at process level (source) to prevent release
As previously mentioned, all operations occur in a closed system, with limited potential for exposure and with LEV in place. Workers involved in the day to day operation of the reactor vessel wear appropriate PPE (and RPE if LEV is not in place) to minimise dermal and inhalation contact should the opportunity for exposure arise.

Technical conditions to control dispersion from source towards worker
All processes occur in a closed system. During the day to day operation of the closed reactor vessel, workers wear appropriate PPE, including gloves faceshield and overalls to prevent accidental contact. All operations are conducted under controlled conditions, with local exhaust ventilation in place to minimise the potential for inhalation exposure.
Organizational measures to prevent/limit release
Workers are fully trained in the safe use of the substance and the use of appropriate PPE. All workers are actively monitored for health effects by medical surveillance programs to ensure exposure levels do not exceed acceptable levels.
Conditions and measures related to personal protection, hygiene and health.
Protective gloves with an efficiency of greater than 90%, faceshield and overalls are worn, in addition to RPE if LEV is not in place. LEV operates at the site of transfer of the substance to ensure there is minimal exposure.

2.4	**Contributing scenario 4 controlling worker exposure for cleaning and maintenance of reactor**

Worker exposure arising due to cleaning and maintenance of the reactor.
Section 2.4 describes the potential exposure to workers during the cleaning and maintenance of the reactor vessel used in the intermediate use of chromium trioxide. Workers will be involved in activities to ensure the reactor vessel is properly maintained to allow efficient functioning. Such activities include cleaning of the reactor and system repair. When these activities are taking place, LEV will be in place and appropriate PPE will be worn by workers to minimise the possible risk of exposure.
Product characteristics
The produced substance is a non-flammable, non-dusty solid. The substance has a high melting point (196°C) and is of low volatility.
Amounts used
Production sites may use up to 400 tonnes per annum, with approximately 1,000 tonnes used per year in the European Union.
Frequency and duration of use exposure
Workers perform standard shifts of 8 hours per day and have standard working years of 220 days per year. Cleaning and maintenance operations of the reactor only rarely occur.
Human factors not influence by risk management
Respiration volume under conditions of use: 10 m^3/d Area of skin contact with the substance under conditions of use: 0 cm^2 due to the use of protective equipment during the transfer of the compound from the barrel to the reactor vessel.
Other given operational conditions affecting worker exposure
All maintenance activities occur under closed conditions, with limited potential for worker exposure. Protective gloves with an efficiency of 90%, faceshield and overalls are worn in the event of accidental contact during cleaning and maintenance operations necessary for ensuring the reactor vessel can function efficiently.
Technical conditions and measures at process level (source) to prevent release
As previously mentioned, there is limited potential for exposure in all maintenance activities and with LEV in place. Workers involved in cleaning and maintaining the reactor vessel wear appropriate PPE (and RPE if LEV is not in place) to minimise dermal and inhalation contact should the opportunity for exposure arise.
Technical conditions to control dispersion from source towards worker
All processes occur in a closed system. During cleaning and maintenance activities, workers wear appropriate PPE, including gloves, faceshield and overalls to prevent accidental contact. All operations are conducted under controlled conditions, with local exhaust ventilation in place to minimise the potential for inhalation exposure.
Organizational measures to prevent/limit release
Workers are fully trained in the safe use of the substance and the use of appropriate PPE. All workers are actively monitored for health effects by medical surveillance programs to ensure exposure levels do not exceed acceptable levels.
Conditions and measures related to personal protection, hygiene and health.
Protective gloves with an efficiency of greater than 90%, faceshield and overalls are worn, in addition to RPE if LEV is not in place. LEV operates at the site of transfer of the substance to ensure there is minimal exposure.

3	Exposure estimation and reference to its source

Information for contributing scenario 1:

The following PEC values were calculated using EUSES 2.1

PEC	Values
PEC in sewage	0.004 mg/L (Cr(III)) 0 mg/L (Cr(III))
PEC in aquatic compartment: Freshwater Marine Water	0.0004 mg/L (Cr(III)) 0 mg/L (Cr(VI)) 0.00004 mg/L (Cr(III)) 0 mg/L (Cr(VI))
PEC in sediments: Freshwater sediments Marine water sediments	3.88 x 10^{4} mg/kg d.w. (Cr(III)) 3.8 x 10^{5} mg/kg d.w. (Cr(III))
PEC in soil and groundwater: Agricultural soil Grassland Groundwater	1.39 x 10^{-4} mg/kg ww (Cr(III)) 1.39 x 10^{-4} mg/kg ww (Cr(III)) 8.03 x 10^{-4} mg/L (Cr(III))
PEC in air: annual average	8.03 x 10^{-4} mg/L (Cr(III))

The following RCR values were obtained:

Compartment	RCR Values
Freshwater	0.044
Marine Water	0.044
Freshwater sediments	6.47 x 10^{-6}
Marine sediment	6.47 x 10^{-6}
Agricultural soil	1.58 x 10^{-5}
Grassland	1.58 x 10^{-5}
STP (EUSES model) STP (measured data)	0.0002 0.0025 – 0.003

Information for contributing scenario 2:

The following values were obtained using MEASE

PROC 8b: Dermal Exposure – 0.0004 mg/kg bw/d CrO_3
Inhalational Exposure - 0.004 mg/m^3 CrO_3
RCR Inhalation exposure - 0.02
PROC 9: Dermal Exposure - 0.00037 mg/kg bw/d CrO_3
Inhalational Exposure - 0.004 mg/m^3 CrO_3
RCR Inhalation exposure - 0.02

Information for contributing scenario 3:

The following values were obtained using MEASE

PROC 1: Dermal Exposure – 0.00018 mg/kg bw/d CrO_3
Inhalational Exposure - 0.01 mg/m^3 CrO_3
RCR Inhalation exposure - 0.5

Information for contributing scenario 4:

The following values were obtained using MEASE

PROC 2: Dermal Exposure – 0.0004 mg/kg bw/d CrO_3
Inhalational Exposure - 0.01 mg/m^3 CrO_3
RCR Inhalation exposure - 0.5

PROC 3: Dermal Exposure – 0.00018 mg/kg bw/d CrO_3
Inhalational Exposure - 0.004 mg/m^3 CrO_3
RCR Inhalation exposure - 0.02

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

Environmental releases:

In order to work within the boundaries of the ES the following conditions should be met:

- Emission to air after scrubbing less than 0.0027 mg/M^3
- If an on-site WWTP is used the WWTP sludge should not be spread to soil
- If an onsite WWTP is used emission from the plant to surface water should be no more than 0.0002 % per day
- Residues from scrubbers may be sent to external waste treatment, on-site effluent treatment or recycled back into the manufacturing process.
- Cr(III) residues are sent as solid waste to landfill, incineration or recycling.

Worker exposure:

In order to work within the boundaries of the ES the following conditions should be met:

- Transfer operations are conducted in closed facilities.
- The transfer of chromium trioxide to the reactor vessel is carried out with local exhaust ventilation in place.
- LEV should be in place in transfer areas and in the system housing the reactor vessel during activities such as cleaning, general maintenance of the reactor and in the day to day activities to ensure its efficient functioning.
- Workers should wear protective gloves, faceshield and overalls at all times while in the transfer area, during day to day operations and during the cleaning and maintenance operations.
- Where the potential for dermal exposure exists, gloves with a minimum efficiency of 90% should be worn.
- Health monitoring should be conducted regularly to ascertain the potential levels of exposure.
- All worker exposures were below the DNEL, indicating safe use. The inhalation DNEL was determined to be 0.02mg/m^3.

1	Exposure Scenario 2

Formulations of Preparations used e.g., in metal finishing or as a catalyst

Processes Covered:

Environmental Releases

ERC2: Formulations of preparations.

Worker Processes

PROC01: Use in closed process, no likelihood of exposure.
PROC03: Use in closed batch process (synthesis or formulation).
PROC05: Mixing or blending in batch processes for formulation of preparations* and articles (multistage and/or significant contact)
PROC08b: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities
PROC09: Transfer of substance or preparation into small containers (dedicated filling line, including weighing).
PROC14: Production of preparations* or articles by tabletting, compression, extrusion, pelletisation.

Product Category

PC14: Metal surface treatment products, including galvanic and electroplating products.
PC15: Non-metal-surface treatment products.
PC20: Products such as pH-regulators, flocculants, precipitants, neutralization agents.

Contributing Environmental Scenario: Environmental exposure arising due to formulations in preparations.

Contributing Worker Scenario: Worker exposure arising due to transfer of substances or preparations from storage container to formulation machinery, mixing and blending of compound, production of solid preparations and articles and day to day operations and maintenance of the reactor vessel.

2.1	Contributing scenario 1 controlling environmental exposure for ES 2

Environmental exposure arising due to Formulations of Preparations.

Section 2.1 describes the environmental releases that may occur during the use of Chromium Trioxide for the formulation of preparations in metal finishing processes or as a catalyst. These releases may occur due to emission to wastewater or through emission to the atmosphere. If emission to wastewater occurs on-site treatment in an industrial waste water treatment plant will be required in order to lower downstream emissions to the environment. Removal efficiencies in the industrial WWTP operates at 99% efficiency. The WWTP also reduces the majority of Cr(VI) present to Cr(III) and alkaline substances added to precipitate chromium hydroxide which is insoluble in water, allowing for its removal to landfill, incineration or recycling. Emissions to the municipal STP should be avoided.

Emissions to air should be removed by scrubbing. As a minimum it is expected that off gas removal efficiency of 90% would be required. Emissions to local air (after scrubbing) should be no more that 0.00062 kg per day.

Product characteristics

The substance prior to production of the preparation is a non-dusty solid. Following preparation of the formulation, the substance is liquid. The substance has a high melting point (196°C) and is of low volatility.

Amounts used

The largest concentration handled at 3 sites is 2000-3000 tonnes per annum, with an approximate total of 9,100

tonnes used per year. According to the guidance for this tonnage band, the default REACH number of emission days per year are 100 emission events per year; however, this may increase to 365 emission days per year with continuous processes. The concentration of substance per preparation is usually in the range of 50-450g/L.
Frequency and duration of use
Frequency of exposure is estimated to be 220 days per year, with an 8 hour working day.
Environmental factors influenced by risk management
Flow rate of receiving water at least 18,000 m^3 per day. Dilution of STP emissions at least 10 fold.
Other operational conditions affecting environmental exposure
Charging, mixing and packaging of the formulation takes place in a highly controlled way to minimise exposure. Any emissions to air are scrubbed are scrubbed before release. Wastewater from cleaning of the equipment are recycled back into the process and incorporated into subsequent batches. Reactions are performed under closed conditions.
Technical conditions and measures at process level (source) to prevent release
The formulation of preparations is conducted in a highly enclosed system, under a hood to reduce potential emissions.
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil
Waste water should be emitted to the on-site WWTP. If an onsite WWTP is available emission to surface water after treatment should be less than 1 kg per year Cr (III) and 0 kg per year Cr (VI). Wastewater may be either recycled for re-use in subsequent batches formulated or reduced to Cr (III) and disposed of to a landfill site. Emissions to air after scrubbing should be less than 0.025 % per day. Sludge from the on-site WWTP should not be spread to soil. Substances present in waste water is chemically treated on site to reduce Chromium Trioxide to Cr(III), which is insoluble in water. This solid waste will be sent as waste for landfill, incineration or recycling. Any residues from scrubbers should be treated on site or recycled.
Organizational measures to prevent/limit releases from site
Workers are fully trained in order to prevent accidental release and exposures are monitored to ensure airborne concentrations are within acceptable levels.
Conditions and measures related to municipal STP
Removal efficiencies in the standard STP are estimated to be 99%. The emission volume of the STP should be at least the default of 2,000 m^3 per day.
Conditions and measures related to external treatment of waste for disposal
Residues from scrubbers may be sent to external waste treatment, on-site effluent treatment or recycled back into the manufacturing process. Sludge is recycled, incinerated or sent to landfill. Cr(III) residues are sent as solid waste to landfill, incineration or recycling.
Conditions and measures related to external recovery of waste
There is no envisaged external recovery of waste.

2.2	**Contributing scenario 2 controlling worker exposure for transfer of substances or preparations from storage container to formulation machinery.**

Worker exposure arising due to transfer of substances or preparations from storage container to formulation machinery.
Section 2.2 describes the potential exposure to workers during the formulation of preparations using Chromium Trioxide. The most likely time of potential exposure to workers arises during the transfer of substances or preparations from storage container to formulation machinery. Appropriate PPE and onsite control parameters are in place to limit the risk of exposure to workers involved in this task.
Product characteristics
The substance prior to production of the preparation is a non-dusty solid. Following preparation of the formulation, the substance is liquid. The substance has a high melting point (196°C) and is of low volatility.
Amounts used
The largest concentration handled at 3 sites is 2000-3000 tonnes per annum, with an approximate total of 9,100 tonnes used per year. The concentration of substance per preparation is usually in the range of 50-450g/L.
Frequency and duration of use exposure
Workers perform standard shifts of 8 hours per day and have standard working years of 220 days per year. The transfer of Chromium trioxide into the formulation machinery is generally a short duration task, with limited potential for exposure.

Human factors not influence by risk management
Respiration volume under conditions of use: 10 m^3/d/8h-day Area of skin contact with the substance under conditions of use: 0 cm^2 due to the use of protective equipment during the transfer of the compound from the barrel to the reactor vessel.
Other given operational conditions affecting worker exposure
The transfer of chromium trioxide into the formulation machinery is carried out with local exhaust ventilation in place. Personal protective equipment is also used to minimize the potential for dermal exposure during the transfer process.
Technical conditions and measures at process level (source) to prevent release
The transfer of chromium trioxide into the formulation machinery takes place in the presence of LEV. Once in the formulation machinery, the preparation is fully contained.
Technical conditions to control dispersion from source towards worker
LEV should be in place during the transfer process.
Organizational measures to prevent/limit release
Workers are fully trained in safe use and the use of appropriate PPE in order to prevent accidental release. Frequent monitoring for health effects is conducted by medical surveillance programs.
Conditions and measures related to personal protection, hygiene and health.
Protective gloves with an efficiency of greater than 90%, washable/disposable overalls, safety boots/wellingtons and faceshield are worn, in addition to RPE if the system is not fully closed. LEV operates at the site of transfer of the substance to ensure there is minimal exposure.

2.3	**Contributing scenario 3 controlling worker exposure for mixing and blending of Chromium Trioxide into liquid formulations.**

Worker exposure arising due to mixing and blending of Chromium Trioxide into liquid formulations.
Section 2.3 describes the potential exposure to workers involved in the mixing and blending of Chromium Trioxide into liquid formulations in the formulation machinery. In this task, worker exposure is minimized as it occurs in a highly controlled, closed system. As the system is completely closed, there is low risk of exposure to workers, however, appropriate PPE is worn and LEV is in place to minimise the potential for exposure.
Product characteristics
The substance prior to production of the preparation is a non-dusty solid. Following preparation of the formulation, the substance is liquid. The substance has a high melting point (196°C) and is of low volatility.
Amounts used
The largest concentration handled at 3 sites is 2000-3000 tonnes per annum, with an approximate total of 9,100 tonnes used per year. The concentration of substance per preparation is usually in the range of 50-450g/L.
Frequency and duration of use exposure
Workers perform standard shifts of 8 hours per day and have standard working years of 220 days per year. Worker contact with chromium trioxide is expected to be very low during the mixing and blending process due to the use of engineering controls and PPE so only short exposure duration is expected.
Human factors not influence by risk management
Respiration volume under conditions of use: 10 m^3/d/8h-day Area of skin contact with the substance under conditions of use: 0 cm^2 due to the use of protective equipment during the transfer of the compound from the barrel to the reactor vessel.
Other given operational conditions affecting worker exposure
The mixing and blending of chromium trioxide into liquid formulations in the formulation machinery is conducted in a highly controlled, closed system. Local exhaust ventilation is in place (effectiveness of 80%) to minimise inhalation exposure. Personal protective equipment is also used to minimize the potential for dermal exposure during mixing and blending.
Technical conditions and measures at process level (source) to prevent release
The mixing and blending of chromium trioxide into liquid formulations in the formulation machinery takes place in the presence of LEV. Once in the formulation machinery, the preparation is fully contained and no exposure to workers is expected.
Technical conditions to control dispersion from source towards worker
LEV should be in place during the mixing and blending process.
Organizational measures to prevent/limit release

Workers are fully trained in safe use and the use of appropriate PPE in order to prevent accidental release. Frequent monitoring for health effects is conducted by medical surveillance programs.
Conditions and measures related to personal protection, hygiene and health.
Protective gloves with an efficiency of greater than 90%, washable/disposable overalls, safety boots/wellingtons and faceshield are worn, in addition to RPE if the system is not fully closed. LEV operates during the mixing and blending process.

2.4	**Contributing scenario 4 controlling worker exposure for production of solid preparations or articles.**

Worker exposure arising due to production of solid preparations or articles.
Section 2.4 describes the potential exposure to workers during the production of solid preparations or articles. The final preparation exists as a ready-to-use liquid, eliminating the risk of dust formation in the application. This reduces the potential of exposure to workers.
Product characteristics
The substance prior to production of the preparation is a non-dusty solid. Following preparation of the formulation, the substance is liquid. The substance has a high melting point (196°C) and is of low volatility.
Amounts used
The largest concentration handled at 3 sites is 2000-3000 tonnes per annum, with an approximate total of 9,100 tonnes used per year. The concentration of substance per preparation is usually in the range of 50-450g/L.
Frequency and duration of use exposure
Workers perform standard shifts of 8 hours per day and have standard working years of 220 days per year. Worker contact with chromium trioxide is expected to be very low during the production of solid preparations or articles due to the physical state of the formulation, indicating that the potential for exposure will be very limited.
Human factors not influence by risk management
Respiration volume under conditions of use: 10 m^3/d/8h-day Area of skin contact with the substance under conditions of use: 0 cm^2 due to the use of protective equipment during the transfer of the compound from the barrel to the reactor vessel.
Other given operational conditions affecting worker exposure
Protective gloves with an efficiency of 90%, washable/disposable overalls, safety boots/wellingtons and faceshield are worn, in addition to RPE if the system is not fully closed, in the event of accidental contact during the preparation of formulations. Local exhaust ventilation is also in place (effectiveness of 80%) to minimise inhalation exposure.
Technical conditions and measures at process level (source) to prevent release
As previously mentioned, precautionary measures are taken to minimise exposure during the production of solid preparations or articles. LEV, with an effectiveness of 80%, is in place. Workers involved in the preparation of formulations or articles wear appropriate PPE (and RPE if LEV is not in place) to minimise dermal and inhalation contact should the opportunity for exposure arise.
Technical conditions to control dispersion from source towards worker
During the production of solid preparations or articles, workers wear appropriate PPE, including gloves, washable/disposable overalls, safety boots/wellingtons and faceshield to prevent accidental contact. All operations are conducted under controlled conditions, with local exhaust ventilation in place to minimise the potential for inhalation exposure.
Organizational measures to prevent/limit release
Workers are fully trained in the safe use of the substance and the use of appropriate PPE. All workers are actively monitored for health effects by medical surveillance programs to ensure exposure levels do not exceed acceptable levels.
Conditions and measures related to personal protection, hygiene and health.
Protective gloves with an efficiency of greater than 90%, washable/disposable overalls, safety boots/wellingtons and faceshield are worn, in addition to RPE if the system is not fully closed. LEV operates during day to day maintenance operations.

2.5	**Contributing scenario 5 controlling worker exposure for day to day operations and maintenance of the formulation machinery**

Worker exposure arising due to day to day operations and maintenance of the reactor vessel.

Section 2.4 describes the potential exposure to workers during the day to day operations and maintenance of the formulation machinery used in the intermediate use of chromium trioxide. Workers will be involved in activities to ensure the formulation machinery is properly maintained to allow efficient functioning. Such activities include cleaning and sampling of the formulation machinery and system repair. When these activities are taking place, LEV will be in place and appropriate PPE will be worn by workers to minimise the possible risk of exposure.

Product characteristics

The substance prior to production of the preparation is a non-dusty solid. Following preparation of the formulation, the substance is liquid. The substance has a high melting point (196°C) and is of low volatility.

Amounts used

The largest concentration handled at 3 sites is 2000-3000 tonnes per annum, with an approximate total of 9,100 tonnes used per year. The concentration of substance per preparation is usually in the range of 50-450g/L.

Frequency and duration of use exposure

Workers perform standard shifts of 8 hours per day and have standard working years of 220 days per year. Worker contact with chromium trioxide is expected to be very low during the day to day operations and maintenance of the formulation machinery due to the use of engineering controls and PPE so only short exposure duration is expected.

Human factors not influence by risk management

Respiration volume under conditions of use: 10 m^3/d/8h-day
Area of skin contact with the substance under conditions of use: 0 cm^2 due to the use of protective equipment during the transfer of the compound from the barrel to the reactor vessel.

Other given operational conditions affecting worker exposure

Protective gloves with an efficiency of 90%, washable/disposable overalls, safety boots/wellingtons and faceshield are worn, in addition to RPE if the system is not fully closed, in the event of accidental contact during cleaning and maintenance operations necessary for ensuring the formulation machinery can function efficiently. Local exhaust ventilation is also in place (effectiveness of 80%) to minimise inhalation exposure.

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

As previously mentioned, precautionary measures are taken to minimise exposure during day to day maintenance operations. LEV, with an effectiveness of 80%, is in place. Workers involved in cleaning and maintaining the formulation machinery wear appropriate PPE (and RPE if LEV is not in place) to minimise dermal and inhalation contact should the opportunity for exposure arise.

Technical conditions to control dispersion from source towards worker

During cleaning and maintenance of the closed formulation machinery, workers wear appropriate PPE, including gloves, washable/disposable overalls, safety boots/wellingtons and faceshield to prevent accidental contact. All operations are conducted under controlled conditions, with local exhaust ventilation in place to minimise the potential for inhalation exposure.

Organizational measures to prevent/limit release

Workers are fully trained in the safe use of the substance and the use of appropriate PPE. All workers are actively monitored for health effects by medical surveillance programs to ensure exposure levels do not exceed acceptable levels.

Conditions and measures related to personal protection, hygiene and health.

Protective gloves with an efficiency of greater than 90%, washable/disposable overalls, safety boots/wellingtons and faceshield are worn, in addition to RPE if the system is not fully closed. LEV is also in place during preparation of formulations.

3	**Exposure estimation and reference to its source**

Information for contributing scenario 1:

The following PEC values were calculated using EUSES 2.1

PEC	Values
PEC in sewage	0.001 mg/L (Cr(III))
PEC in aquatic compartment: Freshwater Marine Water	1.02×10^{-4} mg/L (Cr(III)) 1.02×10^{-5} mg/L (Cr(III))
PEC in sediments: Freshwater sediments Marine water sediments	0.000133 mg/kg d.w. (Cr(III)) 1.32×10^{-5} mg/kg d.w. (Cr(III))
PEC in soil and groundwater: Agricultural soil Grassland Groundwater	1.53×10^{-4} mg/kg ww (Cr(III)) 1.53×10^{-4} mg/kg ww (Cr(III)) 8.82×10^{-4} mg/L (Cr(III))
PEC in air: annual average during emission annual deposition	1.73×10^{-4} mg/L (Cr(III)) 6.32×10^{-4} mg/L (Cr(III)) 3.13×10^{-4} mg/L (Cr(III))

The following RCR values were obtained:

Compartment	RCR Values
Freshwater	0.011
Marine Water	0.011
Freshwater sediments	2.22×10^{-6}
Marine Water sediment	2.2×10^{-6}
Agricultural soil	0.0000179
Grassland	0.0000179
STP (EUSES model)	<1 (Cr(VI)) 0.00005 (Cr(III))

Information for contributing scenario 2:

The following values were obtained using MEASE

PROC 8b: Dermal Exposure – 0.00037 mg/kg bw/d CrO_3
Inhalational Exposure - 0.018 mg/m^3 CrO_3 (Solid)
- 0.002 mg/m^3 CrO_3 (Liquid)
RCR Inhalation Exposure - 0.9 (Solid)
- 0.1 (Liquid)
PROC 9: Dermal Exposure - 0.00037 mg/kg bw/d CrO_3
Inhalational Exposure - 0.018 mg/m^3 CrO_3 (Solid)
- 0.002 mg/m^3 CrO_3 (Liquid)
RCR Inhalation Exposure - 0.1 (Solid)
- 0.1 (Liquid)

Information for contributing scenario 3:

The following values were obtained using MEASE

PROC 5: Dermal Exposure – 0.00037 mg/kg bw/d CrO_3 (Liquid)
- 0.00037 mg/cm^2/d
Inhalational Exposure - 0.009 mg/m^3 CrO_3 (Liquid)
- 0.005 mg/m^3 CrO_3 (Solid)
RCR Inhalation Exposure - 0.25 (Solid)
- 0.45 (Liquid)

Information for contributing scenario 4:

The following values were obtained using MEASE

PROC 14: Dermal Exposure – 0.00037 mg/kg d CrO_3
Inhalational Exposure - 0.002 mg/m^3 CrO_3
RCR Inhalation Exposure - 0.1

Information for contributing scenario 5:

The following values were obtained using MEASE

PROC 1: Dermal Exposure – 0.00018 mg/kg bw/d CrO_3
Inhalational Exposure - 0.001 mg/m^3 CrO_3
RCR Inhalation Exposure - 0.05
PROC 3: Dermal Exposure – 0.00018 mg/kg bw/d CrO_3
Inhalational Exposure - 0.002 mg/m^3 CrO_3
RCR Inhalation Exposure - 0.1

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

Environmental releases:

In order to work within the boundaries of the ES the following conditions should be met:

- Emission to air after scrubbing less than 0.025% per day
- If an on-site WWTP is used the WWTP sludge should not be spread to soil
- If an onsite WWTP is used emission from the plant to surface water should be no more than 1/kg per year for Cr (III).
- Residues from scrubbers may be sent to external waste treatment, on-site effluent treatment or recycled back into the manufacturing process.
- Cr(III) residues are sent as solid waste to landfill, incineration or recycling.

Worker exposure:

In order to work within the boundaries of the ES the following conditions should be met:

- Weighing and loading, mixing and blending and preparation of formulations are conducted in closed facilities.
- The weighing and loading of chromium trioxide to the reactor vessel is carried out with local exhaust ventilation in place.
- LEV should be in place in weighing and loading areas and in the system housing the reactor vessel during activities such as cleaning, general maintenance of the reactor, mixing and blending activities and preparation of the formulation.
- Workers should wear protective gloves, faceshield, safety boots/wellingtons and washable/disposable overalls at all times while in the weighing and loading areas and in the system housing the reactor vessel during activities such as cleaning, general maintenance of the reactor, mixing and blending activities and preparation of the formulation.
- Where the potential for dermal exposure exists, gloves with a minimum efficiency of 90% and disposable/washable overalls should be worn.
- Health monitoring should be conducted regularly to ascertain the potential levels of exposure.
- All worker exposures were below the DNEL, indicating safe use. The inhalation DNEL was determined to be 0.02mg/m^3.

1	Exposure Scenario 3

Surface treatment, including e.g., functional and decorative electroplating, passivation, anodising, plastic plating

Processes Covered:

Environmental Releases

ERC5: Industrial use resulting in inclusion into or onto a matrix.

Worker Processes

PROC02: Use in closed continuous process with occasional controlled exposure.
PROC08b:Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities
PROC09: Transfer of substance or preparation into small containers (dedicated filling line, including weighing).
PROC10: Roller application or brushing.
PROC13: Treatment of articles by dipping or pouring.

Product Category

PC14: Metal surface treatment products, including galvanic and electroplating products.
PC15: Non-metal-surface treatment products.

Contributing Environmental Scenario: Environmental exposure arising due to surface treatment.

Contributing Worker Scenario: Worker exposure arising due to transfer of compound into reactor vessel, day to day maintenance operations of the reactor vessel, application of the substance to the item and immersion operations.

2.1	Contributing scenario 1 controlling environmental exposure for ES 2

Environmental exposure arising due to surface treatment

Section 2.1 describes the environmental releases that may occur during the use of Chromium Trioxide in the surface treatment of metals. These releases may occur due to emission to wastewater or through emission to the atmosphere. If emission to wastewater occurs on-site treatment in an industrial waste water treatment plant will be required in order to lower downstream emissions to the environment. Removal efficiencies in the industrial WWTP operates at 99.99% efficiency. Emissions to the municipal STP should be avoided.

Emissions to air should be removed by scrubbing. As a minimum it is expected that off gas removal efficiency of 99% would be required. Emissions to local air (after scrubbing) should be no more that 2.78×10^{-5} mg/m^3.

Product characteristics

The substance is a liquid, with a high melting point (196°C) and low volatility.

Amounts used

The different surface treatments require different concentrations of chromium trioxide to be used, with approximately 350 – 450g/L for decorative chrome plating, 30 -100 g/L for anodising and 220 – 280g/L for passivation/chromating. An approximate total of 9,000 tonnes is estimated to be used per year, with a maximum annual amount per site of 500 tonnes per annum. According to the guidance for this tonnage band, the default REACH number of emission days per year are 20 emission events per year; however, this may increase to 365 emission days per year with continuous processes.

Frequency and duration of use

Frequency of exposure is estimated to be 220 days per year, with an 8 hour working day.
Environmental factors influenced by risk management
Flow rate of receiving water at least 18,000 m^3 per day. Dilution of STP emissions at least 10 fold.
Other operational conditions affecting environmental exposure
Process tanks, equipped with a fume extraction hood and fume suppressants to control foaming and reduce the amount of aerosol are used. Extracted vapours are treated with a mist eliminator and the wash liquor treated with other chromium effluents or recycled to the plating tanks for evaporative losses. Effluents are treated a separate WWTP with reduction of CR(VI) to Cr(III), followed by flocculation and precipitation. Any emissions to air are scrubbed before release.
Technical conditions and measures at process level (source) to prevent release
The formulation of preparations is conducted in an enclosed system, under a hood to reduce potential emissions.
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil
Waste water should be emitted to the on-site WWTP. If an onsite WWTP is available emission to surface water after treatment should be less than 0.0064% per year Cr (III) and 0 % per year Cr (VI). Wastewater is treated by reduction to Cr (III) and disposal in a landfill site or recycled. Emissions to air after scrubbing should be less than 0.5 % per day. Sludge from the on-site WWTP should not be spread to soil. Substances present in waste water is chemically treated on site to reduce Chromium Trioxide to Cr(III), which is insoluble in water. This solid waste will be sent as waste for landfill, incineration or recycling. Any residues from scrubbers should be treated on site or recycled.
Organizational measures to prevent/limit releases from site
Workers are fully trained in order to prevent accidental release and exposures are monitored to ensure airborne concentrations are within acceptable levels.
Conditions and measures related to municipal STP
Removal efficiencies in the standard STP are estimated to be 99.99%. The emission volume of the STP should be at least the default of 2,000 m^3 per day.
Conditions and measures related to external treatment of waste for disposal
Residues from scrubbers may be sent to external waste treatment, on-site effluent treatment or recycled back into the manufacturing process. Sludge is recycled, incinerated or sent to landfill. Cr(III) residues are sent as solid waste to landfill, incineration or recycling.
Conditions and measures related to external recovery of waste
There is no envisaged external recovery of waste.

2.2	**Contributing scenario 2 controlling worker exposure for transfer of compound from storage source to plating equipment.**

Worker exposure arising due to transfer of compound from storage source to plating equipment
Section 2.2 describes the potential exposure to workers during the transfer of chromium trioxide from storage source to the plating equipment. Appropriate PPE and onsite control parameters are in place to limit the risk of exposure to workers involved in this task.
Product characteristics
The substance is a liquid, with a high melting point (196°C) and low volatility.
Amounts used
The different surface treatments require different concentrations of chromium trioxide to be used, with approximately 350 – 450g/L for decorative chrome plating, 30 -100 g/L for anodising and 220 – 280g/L for passivation/chromating. An approximate total of 9,000 tonnes is estimated to be used per year, with a maximum annual amount per site of 500 tonnes per annum.
Frequency and duration of use exposure
Frequency of exposure is estimated to be 220 days per year, with an 8 hour working day.
Human factors not influence by risk management
Respiration volume under conditions of use: 10 m^3/d/8h-day Area of skin contact with the substance under conditions of use: 0 cm^2 due to the use of protective equipment during the transfer of the compound from the barrel to the reactor vessel.
Other given operational conditions affecting worker exposure
Personal protective equipment is used to minimize the potential for dermal exposure during the transfer process. If open solutions of chromium trioxide are used, RPE must be worn. LEV and mist suppressants are also in

place to reduce inhalation exposure.
Technical conditions and measures at process level (source) to prevent release
The transfer of chromium trioxide onto the plating equipment takes place in the presence of LEV. The preparation is fully contained within a vessel.
Technical conditions to control dispersion from source towards worker
LEV and mist suppressants should be in place.
Organizational measures to prevent/limit release
Workers are fully trained in safe use and the use of appropriate PPE in order to prevent accidental release. Frequent monitoring for health effects is conducted by medical surveillance programs.
Conditions and measures related to personal protection, hygiene and health.
Protective gloves with an efficiency of greater than 90%, washable/disposable overalls, safety boots/wellingtons and faceshield are worn, in addition to RPE if in the vicinity of the plating tank. LEV (80% efficiency) and mist suppressants operate at the site of transfer of the substance to ensure there is minimal exposure.

2.3	**Contributing scenario 3 controlling worker exposure for application of chromium trioxide**

Worker exposure arising due to the application of chromium trioxide.
Section 2.3 describes the potential exposure to workers involved in the application of chromium trioxide to the surface of the metal by roller or brushing. In this task, the process can be automated, semi-automated, barrel or manual, with the potential for worker exposure greatest during manual application. To minimise the potential of worker exposure, PPE, RPE, LEV and mist suppressants are used to reduce the potential for dermal and inhalation exposure.
Product characteristics
The substance is a liquid, with a high melting point (196°C) and low volatility
Amounts used
The different surface treatments require different concentrations of chromium trioxide to be used, with approximately 350 – 450g/L for decorative chrome plating, 30 -100 g/L for anodising and220 – 280g/L for passivation/chromating. An approximate total of 9,000 tonnes is estimated to be used per year, with a maximum annual amount per site of 500 tonnes per annum.
Frequency and duration of use exposure
Frequency of exposure is estimated to be 220 days per year, with an 8 hour working day.
Human factors not influence by risk management
Respiration volume under conditions of use: 10 m^3/d/8h-day Area of skin contact with the substance under conditions of use: 0 cm^2 due to the use of protective equipment during the transfer of the compound from the barrel to the reactor vessel.
Other given operational conditions affecting worker exposure
The application of chromium trioxide to metals by brush or roller application is conducted either by automatic, semi-automatic, barrel or manual process. Local exhaust ventilation (effectiveness of 80%) and mist suppressants are in place to minimise inhalation exposure. This is particularly important for reducing exposure when applied in the semi-automatic or manual process. In the automated and barrel application process, the system is more enclosed. Personal protective equipment is also used to minimize the potential for dermal exposure during mixing and blending.
Technical conditions and measures at process level (source) to prevent release
The application of chromium trioxide takes place in the presence of LEV and mist suppressants. If applied by barrel or automated plating, there is some degree of system closure.
Technical conditions to control dispersion from source towards worker
LEV and mist suppressants should be in place during application by brush or roller.
Organizational measures to prevent/limit release
Workers are fully trained in safe use and the use of appropriate PPE in order to prevent accidental release. Frequent monitoring for health effects is conducted by medical surveillance programs.
Conditions and measures related to personal protection, hygiene and health.
Protective gloves with an efficiency of greater than 90%, washable/disposable overalls, safety boots/wellingtons and faceshield are worn, in addition to RPE if the system is not fully closed. LEV and mist suppressants operate during the mixing and blending process.

2.4	**Contributing scenario 4 controlling worker exposure for day to day operations and maintenance of the plating tanks**

Worker exposure arising due to day to day operations and maintenance of the reactor vessel.

Section 2.4 describes the potential exposure to workers during the cleaning and maintenance of the plating tanks used in the surface treatment of metals with chromium trioxide. Workers will be involved in activities to ensure the plating tanks are properly maintained to allow efficient functioning. Such activities include cleaning of the reactor and system repair. When these activities are taking place, LEV will be in place and appropriate PPE will be worn by workers to minimise the possible risk of exposure.

Product characteristics

The substance is a liquid, with a high melting point (196°C) and low volatility

Amounts used

The different surface treatments require different concentrations of chromium trioxide to be used, with approximately 350 – 450g/L for decorative chrome plating, 30 -100 g/L for anodising and220 – 280g/L for passivation/chromating. An approximate total of 9,000 tonnes is estimated to be used per year, with a maximum annual amount per site of 500 tonnes per annum.

Frequency and duration of use exposure

Workers perform standard shifts of 8 hours per day and have standard working years of 220 days per year. Worker contact with chromium trioxide is expected to be very low during the day to day operations and maintenance of the plating tanks due to the use of engineering controls and PPE so only short exposure duration is expected.

Human factors not influence by risk management

Respiration volume under conditions of use: 10 m^3/d/8h-day
Area of skin contact with the substance under conditions of use: 0 cm^2 due to the use of protective equipment during the transfer of the compound from the barrel to the reactor vessel.

Other given operational conditions affecting worker exposure

Protective gloves with an efficiency of 90%, washable/disposable overalls, safety boots/wellingtons and faceshield are worn, in addition to RPE if the system is not fully closed, in the event of accidental contact during cleaning and maintenance operations necessary for ensuring the plating equipment can function efficiently. Local exhaust ventilation is also in place (effectiveness of 80%) and mist suppressants also minimise inhalation exposure.

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

As previously mentioned, precautionary measures are taken to minimise exposure during day to day maintenance operations. LEV, with an effectiveness of 80%, and mist suppressants are in place. Workers involved in cleaning and maintaining the plating tank wear appropriate PPE (and RPE if LEV is not in place) to minimise dermal and inhalation contact should the opportunity for exposure arise.

Technical conditions to control dispersion from source towards worker

During cleaning and maintenance of the plating equipment, workers wear appropriate PPE, including gloves, washable/disposable overalls, safety boots/wellingtons and faceshield to prevent accidental contact. All operations are conducted under controlled conditions, with local exhaust ventilation and mist suppressants in place to minimise the potential for inhalation exposure.

Organizational measures to prevent/limit release

Workers are fully trained in the safe use of the substance and the use of appropriate PPE. All workers are actively monitored for health effects by medical surveillance programs to ensure exposure levels do not exceed acceptable levels.

Conditions and measures related to personal protection, hygiene and health.

Protective gloves with an efficiency of greater than 90%, washable/disposable overalls, safety boots/wellingtons and faceshield are worn, in addition to RPE if the system is not fully closed. LEV and mist suppressants operate during day to day maintenance operations.

2.5	**Contributing scenario 5 controlling worker exposure for immersion operations**

Worker exposure arising due to immersion operations

Section 2.4 describes the potential exposure to workers during immersion of the metal into chromium trioxide.
Product characteristics
The substance is a liquid, with a high melting point (196°C) and low volatility
Amounts used
The different surface treatments require different concentrations of chromium trioxide to be used, with approximately 350 – 450g/L for decorative chrome plating, 30 -100 g/L for anodising and220 – 280g/L for passivation/chromating. An approximate total of 9,000 tonnes is estimated to be used per year, with a maximum annual amount per site of 500 tonnes per annum.
Frequency and duration of use exposure
Workers perform standard shifts of 8 hours per day and have standard working years of 220 days per year.
Human factors not influence by risk management
Respiration volume under conditions of use: 10 m^3/d/8h-day Area of skin contact with the substance under conditions of use: 0 cm^2 due to the use of protective equipment during the transfer of the compound from the barrel to the reactor vessel.
Other given operational conditions affecting worker exposure
Protective gloves with an efficiency of 90%, washable/disposable overalls, safety boots/wellingtons and faceshield are worn, in addition to RPE if there is no system closure (in the case of semi-automated and manual plating process), in the event of accidental contact during the preparation of formulations. Local exhaust ventilation is also in place (effectiveness of 80%), as well as mist suppressants, to minimise inhalation exposure.
Technical conditions and measures at process level (source) to prevent release
As previously mentioned, precautionary measures are taken to minimise exposure during the immersion of metals into chromium trioxide. LEV, with an effectiveness of 80%, is in place, as well as mist suppressants. Workers involved in the immersion operations wear appropriate PPE (and RPE if LEV is not in place) to minimise dermal and inhalation contact should the opportunity for exposure arise.
Technical conditions to control dispersion from source towards worker
During the immersion operation, workers wear appropriate PPE, including gloves, washable/disposable overalls, safety boots/wellingtons and faceshield to prevent accidental contact. All operations are conducted under controlled conditions, with local exhaust ventilation and mist suppressants in place to minimise the potential for inhalation exposure.
Organizational measures to prevent/limit release
Workers are fully trained in the safe use of the substance and the use of appropriate PPE. All workers are actively monitored for health effects by medical surveillance programs to ensure exposure levels do not exceed acceptable levels.
Conditions and measures related to personal protection, hygiene and health.
Protective gloves with an efficiency of greater than 90%, washable/disposable overalls, safety boots/wellingtons and faceshield are worn, in addition to RPE if the system is not fully closed. LEV and mist suppressants are also in place during preparation of formulations.

3	**Exposure estimation and reference to its source**

Information for contributing scenario 1:

The following PEC values were calculated using EUSES 2.1

PEC	**Values**
PEC in sewage	0.048 mg/L (Cr(III))
PEC in aquatic compartment: Freshwater Marine Water	0.0048 mg/L (Cr(III)) 0.00048 mg/L (Cr(III))
PEC in sediments: Freshwater sediments Marine water sediments	0.004 mg/kg d.w. (Cr(III)) 4.14×10^{-4} mg/kg d.w. (Cr(III))
PEC in soil and groundwater: Agricultural soil Grassland Groundwater	4.07×10^{-5} mg/kg ww (Cr(III)) 4.07×10^{-5} mg/kg ww (Cr(III)) 2.35×10^{-4} mg/L (Cr(III))
PEC in air: annual average	1.52×10^{-6} mg/L (Cr(VI))

The following RCR values were obtained:

Compartment	RCR Values
Freshwater	0.533
Marine Water	0.553
Freshwater sediments	0.000068
Marine Water sediment	0.000068
Agricultural soil	1.58×10^{-7}
Grassland	1.58×10^{-7}
STP (EUSES model)	0.0024

Information for contributing scenario 2:

The following values were obtained using MEASE

PROC 8b: Dermal Exposure – 0.000037 mg/kg d CrO_3
Inhalational Exposure - 0.002 mg/m^3 CrO_3
RCR Inhalation Exposure - 0.1
PROC 9: Dermal Exposure - 0.000037 mg/kg d CrO_3
Inhalational Exposure - 0.002 mg/m^3 CrO_3
RCR Inhalation Exposure - 0.1

Information for contributing scenario 3:

The following values were obtained using MEASE

PROC 10: Dermal Exposure – 0.000037 mg/kg d CrO_3
Inhalational Exposure - 0.009 mg/m^3 CrO_3
RCR Inhalation Exposure - 0.045

Information for contributing scenario 4:

The following values were obtained using MEASE

PROC 2: Dermal Exposure – 0.000369 mg/kg d CrO_3
Inhalational Exposure - 0.01 mg/m^3 CrO_3
RCR Inhalation Exposure - 0.5

Information for contributing scenario 5:

The following values were obtained using MEASE

PROC 13: Dermal Exposure – 0.000037 mg/kg d CrO_3
Inhalational Exposure - 0.002 mg/m^3 CrO_3
RCR Inhalation Exposure - 0.1

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

Environmental releases:

In order to work within the boundaries of the ES the following conditions should be met:

- Emission to air after scrubbing less than 0.5%.
- If an onsite WWTP is used emission from the plant to surface water after treatment should be no more than 0.0064% per year Cr (III) and 0% Cr (VI).
- Residues from scrubbers may be sent to external waste treatment, on-site effluent treatment or recycled

back into the manufacturing process.
- Cr(III) residues are sent as solid waste to landfill, incineration or recycling.

Worker exposure:

In order to work within the boundaries of the ES the following conditions should be met:

- Transfer, application of chromium trioxide and immersion operations can be conducted in automated, semi-automated, manual or barrel processes. Automated and barrel processes have a degree of system closure while semi-automated and manual processes have a lower level of system closure.
- LEV, with a minimum efficiency of 80%, and mist suppressants should be in place in transfer areas and during the semi-automated and barrel processes during application and immersion applications.
- Workers should wear protective gloves, faceshield, safety boots/wellingtons and washable/disposable overalls at all times while transfer areas and in the system housing the reactor vessel during activities such as cleaning, general maintenance of the reactor, application of chromium trioxide and immersion operations
- Where the potential for dermal exposure exists, gloves with a minimum efficiency of 90% and disposable/washable overalls should be worn.
- Health monitoring should be conducted regularly to ascertain the potential levels of exposure.
- All worker exposures were below the DNEL, indicating safe use. The inhalation DNEL was determined to be 0.02mg/m^3.

1	**Exposure Scenario 4**

Use of catalysts containing chromium trioxide.

Processes Covered:

Environmental Releases

ERC6b: Industrial use of reactive processing aids.

Worker Processes

PROC01: Use in closed process, no likelihood of exposure
PROC02: Use in closed continuous process with occasional controlled exposure.
PROC03: Use in closed batch process (synthesis or formulation)
PROC04: Use in batch and other process (synthesis) where opportunity for exposure arises.
PROC08b:Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities
PROC09: Transfer of substance or preparation into small containers (dedicated filling line, including weighing).

Product Category

PC20: Products such as pH-regulators, flocculants, precipitants, neutralization agents.

Contributing Environmental Scenario: Environmental exposure arising due to use of catalysts containing chromium trioxide.

Contributing Worker Scenario: Worker exposure arising due to loading and transfer of catalyst into reactor vessel, day to day maintenance operation of the reactor vessel and cleaning and maintenance of the reactor.

2.1	**Contributing scenario 1 controlling environmental exposure for ES 2**

Environmental exposure arising due to surface treatment

Section 2.1 describes the environmental releases that may occur during the use of catalysts containing Chromium Trioxide. These releases may occur due to emission to wastewater or through emission to the atmosphere. If emission to wastewater occurs on-site, treatment in an industrial waste water treatment plant will be required in order to lower downstream emissions to the environment. Removal efficiencies in the industrial WWTP operates at 99.99% efficiency. The majority of Cr (VI) is incorporated into the catalyst. Any remaining Cr (VI) is treated in the WWTP by reduction of Cr (VI) to Cr (III) and precipitated as chromium hydroxide which is insoluble in water, allowing for its removal to landfill, incineration or recycling. Emissions to the municipal STP should be avoided.

Emissions to air should be removed by scrubbing. As a minimum it is expected that off gas removal efficiency of 99% would be required. Emissions to local air (after scrubbing) should be no more that 1.39×10^{-6} mg/m^3.

Product characteristics

The substance is a solid of low dust, with a high melting point (196°C) and low volatility.

Amounts used

An approximate total of 100 tonnes is estimated to be used per year. According to the guidance for this tonnage band, the default REACH number of emission days per year are 20 emission events per year; however, this may increase to 365 emission days per year with continuous processes.

Frequency and duration of use
Frequency of exposure is estimated to be 220 days per year, with an 8 hour working day.
Environmental factors influenced by risk management
Flow rate of receiving water at least 18,000 m^3 per day. Dilution of STP emissions at least 10 fold.
Other operational conditions affecting environmental exposure
Catalyst use of Chromium Trioxide is a highly automated process which takes place in an enclosed environment. Potential emissions to air are scrubbed before release. Reactions are performed under closed conditions.
Technical conditions and measures at process level (source) to prevent release
Catalyst use of Chromium Trioxide is conducted in an enclosed system, with local exhaust ventilation in place to minimise emissions.
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil
Waste water should be emitted to the on-site WWTP. If an onsite WWTP is available emission to surface water after treatment should be less than 0.000005% per year Cr (III) and 0 % per year Cr (VI). Wastewater is treated by reduction to Cr (III), which is then precipitated as chromium hydroxide, and disposed of in a landfill site, incinerated or recycled. Emissions to air after scrubbing should be less than 0.001% per day. Sludge from the on-site WWTP should not be spread to soil. Substances present in waste water is chemically treated on site to reduce Chromium Trioxide to Cr(III), which is insoluble in water. This solid waste will be sent as waste for landfill, incineration or recycling. Any residues from scrubbers should be treated on site or recycled.
Organizational measures to prevent/limit releases from site
Workers are fully trained in order to prevent accidental release and exposures are monitored to ensure airborne concentrations are within acceptable levels.
Conditions and measures related to municipal STP
Removal efficiencies in the standard STP are estimated to be 99.99%. The emission volume of the STP should be at least the default of 2,000 m^3 per day.
Conditions and measures related to external treatment of waste for disposal
Residues from scrubbers may be sent to external waste treatment, on-site effluent treatment or recycled back into the manufacturing process. Sludge is recycled, incinerated or sent to landfill. Cr(III) residues are sent as solid waste to landfill, incineration or recycling.
Conditions and measures related to external recovery of waste
There is no envisaged external recovery of waste. Waste sludge is reduced and then incinerated.

2.2	**Contributing scenario 2 controlling worker exposure for transfer and loading of catalyst.**

Worker exposure arising due to loading and transfer of catalyst from storage source to reactor vessel.
Section 2.2 describes the potential exposure to workers during the use of catalysts containing chromium trioxide. The potential exposure arises from the transfer of the substance from its storage source (barrel/drum) to the reactor vessel in order for the reaction to take place. Workers involved in this transfer of the substance will be exposed in the manual handling of the substance from barrel/drum to reactor vessel. Appropriate PPE and onsite control parameters are in place to limit the risk of exposure to workers involved in this task.
Product characteristics
The substance is a solid of low dust, with a high melting point (196°C) and low volatility.
Amounts used
An approximate total of 100 tonnes is estimated to be used per year.
Frequency and duration of use exposure
Frequency of exposure is estimated to be 220 days per year, with an 8 hour working day.
Human factors not influence by risk management
Respiration volume under conditions of use: 10 m^3/d/8h-day Area of skin contact with the substance under conditions of use: 0 cm^2 automated system in an enclosed environment, therefore no dermal contact.
Other given operational conditions affecting worker exposure
The transfer of catalysts containing chromium trioxide to the reactor vessel is carried out with local exhaust ventilation in place. Personal protective equipment is also used to minimize the potential for dermal exposure during the transfer process.

Technical conditions and measures at process level (source) to prevent release
The transfer of the catalysts from its source to the reactor vessel is an automated process which takes place in a fully closed system, with LEV in place.
Technical conditions to control dispersion from source towards worker
LEV and should be in place during the transfer process.
Organizational measures to prevent/limit release
Workers are fully trained in safe use and the use of appropriate PPE in order to prevent accidental release. Frequent monitoring for health effects is conducted by medical surveillance programs.
Conditions and measures related to personal protection, hygiene and health.
Protective gloves with an efficiency of greater than 90%, washable/disposable overalls, safety boots/wellingtons and faceshield are worn, in addition to RPE if the system is open. LEV operates at the site of transfer of the substance to ensure there is minimal exposure.

2.3	**Contributing scenario 3 controlling worker exposure due day to day operation of closed system reactor**

Worker exposure arising due to day to day operation of closed system reactor.
Section 2.3 describes the potential exposure to workers involved in the day to day operational processes associated with the use of catalysts containing chromium trioxide in a closed system. In order to ensure efficient operation, workers will undertake tasks to allow proper day to day operation of the closed system reactor. As the system is completely closed, there is low risk of exposure to workers, however, appropriate PPE is worn and LEV in place to minimise the potential for exposure.
Product characteristics
The substance is a solid of low dust, with a high melting point (196°C) and low volatility.
Amounts used
An approximate total of 100 tonnes is estimated to be used per year.
Frequency and duration of use exposure
Frequency of exposure is estimated to be 220 days per year, with an 8 hour working day. All activities involved in the day to day operation of the reactor vessel are not expected to be of a long duration.
Human factors not influence by risk management
Respiration volume under conditions of use: 10 m^3/d/8h-day Area of skin contact with the substance under conditions of use: 0 cm^2 automated system in an enclosed environment, therefore no dermal contact.
Other given operational conditions affecting worker exposure
All reactions occur under closed conditions, with limited opportunity for worker exposure. Protective gloves with an efficiency of 90%, faceshield, safety boots/wellingtons and washable/disposable overalls are worn in the event of accidental contact during day to day operations associated with the reactor vessel.
Technical conditions and measures at process level (source) to prevent release
As previously mentioned, all operations occur in a closed system, with limited potential for exposure and with LEV in place. Workers involved in the day to day operation of the reactor vessel wear appropriate PPE (and RPE if LEV is not in place and it is an open system) to minimise dermal and inhalation contact should the opportunity for exposure arise.
Technical conditions to control dispersion from source towards worker
All processes occur in a closed system. During the day to day operation of the closed reactor vessel, workers wear appropriate PPE, including gloves faceshield, safety boots/wellingtons and washable/disposable overalls to prevent accidental contact. All operations are conducted under controlled conditions, with local exhaust ventilation in place to minimise the potential for inhalation exposure.
Organizational measures to prevent/limit release
Workers are fully trained in the safe use of the substance and the use of appropriate PPE. All workers are actively monitored for health effects by medical surveillance programs to ensure exposure levels do not exceed acceptable levels.
Conditions and measures related to personal protection, hygiene and health.
Protective gloves with an efficiency of greater than 90%, faceshield, safety boots/wellingtons and washable/disposable overalls are worn, in addition to RPE if LEV is not in place. LEV operates in the system to ensure there is minimal exposure.

2.4	Contributing scenario 4 controlling worker exposure for cleaning and maintenance of reactor

Worker exposure arising due to cleaning and maintenance of the reactor.

Section 2.4 describes the potential exposure to workers during the cleaning and maintenance of the reactor vessel used in processes with catalysts containing chromium trioxide. Workers will be involved in activities to ensure the reactor vessel is properly maintained to allow efficient functioning. Such activities include cleaning and sampling of the reactor and system repair. When these activities are taking place, LEV will be in place and appropriate PPE will be worn by workers to minimise the possible risk of exposure.

Product characteristics

The substance is a solid of low dust, with a high melting point (196°C) and low volatility.

Amounts used

An approximate total of 100 tonnes is estimated to be used per year.

Frequency and duration of use exposure

Workers perform standard shifts of 8 hours per day and have standard working years of 220 days per year. Cleaning and maintenance operations of the reactor only rarely occur.

Human factors not influence by risk management

Respiration volume under conditions of use: 10 m^3/d/8h-day
Area of skin contact with the substance under conditions of use: 0 cm^2 automated system in an enclosed environment, therefore no dermal contact.

Other given operational conditions affecting worker exposure

Protective gloves with an efficiency of 90%, washable/disposable overalls, safety boots/wellingtons and faceshield are worn, in addition to RPE if the system is not fully closed, in the event of accidental contact during cleaning and maintenance operations necessary for ensuring the reactor vessel can function efficiently. Local exhaust ventilation is also in place to minimise inhalation exposures.

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

As previously mentioned, there is limited potential for exposure in all maintenance activities and with LEV in place. Workers involved in cleaning and maintaining the reactor vessel wear appropriate PPE (and RPE if LEV is not in place) to minimise dermal and inhalation contact should the opportunity for exposure arise.

Technical conditions to control dispersion from source towards worker

All processes occur in an automated, closed system. During cleaning and maintenance activities, workers wear appropriate PPE, including gloves, washable/disposable overalls, safety boots/wellingtons and faceshield to prevent accidental contact. All operations are conducted under controlled conditions, with local exhaust ventilation in place to minimise the potential for inhalation exposure.

Organizational measures to prevent/limit release

Workers are fully trained in the safe use of the substance and the use of appropriate PPE. All workers are actively monitored for health effects by medical surveillance programs to ensure exposure levels do not exceed acceptable levels.

Conditions and measures related to personal protection, hygiene and health.

Protective gloves with an efficiency of greater than 90%, washable/disposable overalls, safety boots/wellingtons and faceshield are worn, in addition to RPE if the system is not fully closed. LEV operates during day to day maintenance operations.

3	Exposure estimation and reference to its source

Information for contributing scenario 1:

The following PEC values were calculated using EUSES 2.1

PEC	Values
PEC in sewage	2.5×10^{-4} mg/L (Cr(III))
PEC in aquatic compartment: Freshwater Marine Water	2.67×10^{-5}mg/L (Cr(III)) 2.66×10^{-6} mg/L (Cr(III))
PEC in sediments: Freshwater sediments Marine water sediments	
PEC in soil and groundwater: Agricultural soil Grassland Groundwater	5.9×10^{-4} mg/kg ww (Cr(III)) 5.9×10^{-4} mg/kg ww (Cr(III)) 2.29×10^{-4} mg/L (Cr(III))
PEC in air: annual average	7.64×10^{-8} mg/L (Cr(VI))

The following RCR values were obtained:

Compartment	RCR Values
Freshwater	2.25×10^{-7}
Marine Water	0.0028
Freshwater sediments	1.15×10^{-6}
Marine Water sediment	1.15×10^{-6}
Agricultural soil	7.9×10^{-9}
Grassland	7.9×10^{-9}
STP	<1 (Cr(VI)) 1.25×10^{-5} (Cr(III))

Information for contributing scenario 2:

The following values were obtained using MEASE

PROC 8b: Dermal Exposure – 0.00037 mg/kg/d CrO_3
Inhalational Exposure - 0.002 mg/m^3 CrO_3
RCR Inhalation Exposure - 0.1
PROC 9: Dermal Exposure - 0.00037 mg/kg/d CrO_3
Inhalational Exposure - 0.002 mg/m^3 CrO_3
RCR Inhalation Exposure - 0.1

Information for contributing scenario 3:

The following values were obtained using MEASE

PROC 3: Dermal Exposure – 0.00018 mg/kg/d
Inhalational Exposure - 0.002 mg/m^3 CrO_3
RCR Inhalation Exposure - 0.1
PROC 4: Dermal Exposure – 0.00037 mg/kg/d
Inhalational Exposure - 0.008 mg/m^3 CrO_3
RCR Inhalation Exposure - 0.4

Information for contributing scenario 4:

The following values were obtained using MEASE

PROC 1: Dermal Exposure – 0.00018 mg/kg bw/d CrO_3
Inhalational Exposure - 0.01 mg/m^3 CrO_3
RCR Inhalation Exposure - 0.5
PROC 2: Dermal Exposure – 0.00037 mg/kg bw/d CrO_3
Inhalational Exposure - 0.01 mg/m^3 CrO_3
RCR Inhalation Exposure - 0.5

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

Environmental releases:

In order to work within the boundaries of the ES the following conditions should be met:

- Emission to air after scrubbing less than 0.001% per day
- If an on-site WWTP is used the WWTP sludge should not be spread to soil
- If an onsite WWTP is used emission from the plant to surface water should be no more than 0.000005% per year
- Residues from scrubbers may be sent to external waste treatment, on-site effluent treatment or recycled back into the manufacturing process.
- Cr(III) residues are sent as solid waste to landfill, incineration or recycling.

Worker exposure:

In order to work within the boundaries of the ES the following conditions should be met:

- Transfer operations are conducted in closed facilities, with local exhaust ventilation in place.
- LEV should be in place in transfer areas and in the system housing the reactor vessel during activities such as cleaning, general maintenance of the reactor and in the day to day activities to ensure its efficient functioning.
- Workers should wear protective gloves, faceshield, safety boots/wellingtons and washable/disposable overalls at all times while in the while in the transfer area, during day to day operations and during the cleaning and maintenance operations.
- Where the potential for dermal exposure exists, gloves with a minimum efficiency of 90% and disposable/washable overalls should be worn.
- Health monitoring should be conducted regularly to ascertain the potential levels of exposure.
- All worker exposures were below the DNEL, indicating safe use. The inhalation DNEL was determined to be 0.02mg/m^3.

1	Exposure Scenario 5

Small scale laboratory use of chromium trioxide.

Processes Covered:

Environmental Releases

ERC8b: Wide dispersive indoor use of reactive substances in open systems.

Worker Processes

PROC15: Use as laboratory reagent

Product Category

PC21: Laboratory chemicals.

Contributing Environmental Scenario: Environmental exposure arising due to small scale laboratory use of chromium trioxide.

Contributing Worker Scenario: Worker exposure arising due to manual handling of chromium trioxide in oxidative reactions.

2.1	Contributing scenario 1 controlling environmental exposure for ES 2

Environmental exposure arising due to small scale laboratory use of chromium trioxide.

Section 2.1 describes the environmental releases that may occur during the small scale laboratory use of Chromium Trioxide as an oxidising agent. These releases may occur due to emission to wastewater or through emission to the atmosphere. If emission to wastewater occurs on-site, treatment in an industrial waste water treatment plant will be required in order to lower downstream emissions to the environment. Removal efficiencies in the industrial WWTP operates at 99% efficiency. Cr (VI) is treated in the WWTP by reduction of Cr (VI) to Cr (III) and precipitated as chromium hydroxide which is insoluble in water, allowing for its removal to landfill, incineration or recycling. Alternatively, in a laboratory setting in educational institutions, chromium aqueous waste is collected and disposed of via special waste. Emissions to the municipal STP should be avoided.

Emissions to air should be removed by scrubbing. As a minimum it is expected that off gas removal efficiency of 99% would be required. Emissions to local air (after scrubbing) should be no more that 1.39×10^{-8} mg/m^3.

Product characteristics

The substance is a solid of low dust or a liquid, with a high melting point (196°C) and low volatility.

Amounts used

An approximate total of 1 ton is estimated to be used per year, with less than 1 kg used per site. According to the guidance for this tonnage band, the default REACH number of emission days to the STP per year is 365; however, 20 emission events per year was used for calculation.

Frequency and duration of use

Frequency of exposure is estimated to be 220 days per year, with an 8 hour working day.

Environmental factors influenced by risk management

Flow rate of receiving water at least 18,000 m^3 per day. Dilution of STP emissions at least 10 fold.

Other operational conditions affecting environmental exposure

The small scale laboratory use of Chromium Trioxide is normally conducted in a closed system, under nitrogen. Potential emissions to air are scrubbed before release. Reactions are performed under closed conditions.

Technical conditions and measures at process level (source) to prevent release
Catalyst use of Chromium Trioxide is conducted in an enclosed system, with local exhaust ventilation in place to minimise emissions.
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil
Waste water should be emitted to the on-site WWTP. If an onsite WWTP is available emission to surface water after treatment should be less than 0.0002% per year Cr (III) and 0 % per year Cr (VI). In analytical laboratories, wastewater is treated by reduction to Cr (III), which is then precipitated as a salt. In educational institutes, the chromium aqueous waste is collected and disposed of *via* special waste. Emissions to air after scrubbing should be less than 0.001% per day. Sludge from the on-site WWTP should not be spread to soil. Any residues from scrubbers should be treated on site or recycled.
Organizational measures to prevent/limit releases from site
Workers are fully trained in order to prevent accidental release and exposures are monitored to ensure airborne concentrations are within acceptable levels.
Conditions and measures related to municipal STP
Removal efficiencies in the standard STP are estimated to be 99 %. The emission volume of the STP should be at least the default of 2,000 m^3 per day.
Conditions and measures related to external treatment of waste for disposal
Residues from scrubbers may be sent to external waste treatment, on-site effluent treatment or recycled back into the manufacturing process. Chromium aqueous waste from educational institutes is collected and disposed of *via* special waste.
Conditions and measures related to external recovery of waste
There is no envisaged external recovery of waste. Waste sludge is reduced and then incinerated.

2.2	**Contributing scenario 2 controlling worker exposure for manual handling of chromium trioxide in oxidative reactions.**

Worker exposure arising due to manual handling of chromium trioxide in oxidative reactions.
Section 2.2 describes the potential exposure to workers during the small scale laboratory use of chromium trioxide. The potential exposure arises from the manual handling of chromium trioxide in laboratory based oxidative reactions. Appropriate PPE and onsite control parameters are in place to limit the risk of exposure to workers involved in this task.
Product characteristics
The substance is a solid of low dust or a liquid, with a high melting point (196°C) and low volatility.
Amounts used
An approximate total of 1 ton is estimated to be used per year in Europe, with less than 1 kg used per site.
Frequency and duration of use exposure
Frequency of exposure is estimated to be 220 days per year, with an 8 hour working day.
Human factors not influence by risk management
Respiration volume under conditions of use: 10 m^3/d/8h-day Area of skin contact with the substance under conditions of use: 0 cm^2 use of protective clothing during the process means that any dermal contact will be avoided.
Other given operational conditions affecting worker exposure
The small scale laboratory use of chromium trioxide is carried out in a closed system, under nitrogen, with local exhaust ventilation in place. Personal protective equipment is also used to minimize the potential for dermal exposure during the manual handling of chromium trioxide.
Technical conditions and measures at process level (source) to prevent release
The small scale laboratory use of chromium trioxide is carried out in a closed system, under nitrogen, with local exhaust ventilation in place.
Technical conditions to control dispersion from source towards worker
LEV and should be in place during manual handling.
Organizational measures to prevent/limit release
Workers are fully trained in safe use and the use of appropriate PPE in order to prevent accidental release. Frequent monitoring for health effects is conducted by medical surveillance programs.
Conditions and measures related to personal protection, hygiene and health.

Protective gloves with an efficiency of greater than 90%, washable/disposable overalls and goggles are worn. LEV operates during the manual handling and oxidative reactions to minimise inhalation exposure.

3 Exposure estimation and reference to its source

Information for contributing scenario 1:

The following PEC values were calculated using EUSES 2.1

PEC	Values
PEC in sewage	
PEC in aquatic compartment: Freshwater Marine Water	1.65×10^{-6} mg/L (Cr(III)) 1.6×10^{-7} mg/L (Cr(III))
PEC in sediments: Freshwater sediments Marine water sediments	4.782×10^{-5} mg/kg d.w. (Cr (III)) 4.707×10^{-6} mg/kg d.w. (Cr (III))
PEC in soil and groundwater: Agricultural soil Grassland Groundwater	3.97×10^{-5} mg/kg ww (Cr(III)) 3.97×10^{-5} mg/kg ww (Cr(III)) 2.28×10^{-4} mg/L (Cr(III))
PEC in air: annual average	7.62×10^{-10} mg/L (Cr(VI))

The following RCR values were obtained:

Compartment	RCR Values
Freshwater	1.11×10^{-5}
Marine Water	1.11×10^{-5}
Freshwater sediments	7.97×10^{-7}
Marine Water sediment	7.8×10^{-7}
Agricultural soil	7.9×10^{-11}
Grassland	7.9×10^{-11}
STP	<1 (Cr(VI)) 5×10^{-8} (Cr(III))

Information for contributing scenario 2:

The following values were obtained using MEASE

PROC 15: Dermal Exposure – 0.00018 mg/kg/d CrO_3
Inhalational Exposure - 0.005 mg/m^3 CrO_3
RCR Inhalation Exposure - 0.25

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

Environmental releases:

In order to work within the boundaries of the ES the following conditions should be met:

- Emission to air after scrubbing less than 0.001% per day
- If an on-site WWTP is used the WWTP sludge should not be spread to soil
- If an onsite WWTP is used emission from the plant to surface water should be no more than 0.000002 per year
- Residues from scrubbers may be sent to external waste treatment, on-site effluent treatment or recycled back into the manufacturing process.
- Wastewater from educational institutes, chromium aqueous waste is collected and disposed *via* special waste.
- In analytical laboratories, Cr (VI) is reduced to Cr (III) followed by precipitation to salt.

Worker exposure:

In order to work within the boundaries of the ES the following conditions should be met:

- LEV should be in place during manual handling procedures
- Protective gloves with an efficiency of greater than 90%, washable/disposable overalls and goggles should be worn during manual handling procedures.
- Where the potential for dermal exposure exists, gloves with a minimum efficiency of 90% and disposable/washable overalls should be worn.
- Health monitoring should be conducted regularly to ascertain the potential levels of exposure.
- All worker exposures were below the DNEL, indicating safe use. The inhalation DNEL was determined to be 0.02mg/m^3.