SAFETY DATA SHEET
GILDAURA 5NR ELECTROLYTE SALT

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

Product name GILDAURA 5NR ELECTROLYTE SALT

Product number 039048

1.2. Relevant identified uses of the substance or mixture and uses advised against

Identified uses Plating agents and metal surface treating agents.

1.3. Details of the supplier of the safety data sheet

Supplier

PMD CHEMICALS LIMITED
401 Broad Lane
Coventry
CV5 7AX
Tel: 024 7692 0168
stevel@pmdchemicals.co.uk

1.4. Emergency telephone number

Emergency telephone 024 7692 0168 (Mon-Fri 8.30-16.30)

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

Classification (SI 2019 No. 720)

Physical hazards Not Classified

Health hazards Acute Tox. 3 - H301 Acute Tox. 4 - H332 Skin Corr. 1B - H314 Eye Dam. 1 - H318 Skin Sens. 1 - H317 Carc. 1B - H350 Repr. 1B - H360FD

Environmental hazards Aquatic Chronic 2 - H411

2.2. Label elements

Hazard pictograms

Signal word Danger

Hazard statements

H301 Toxic if swallowed.
H332 Harmful if inhaled.
H314 Causes severe skin burns and eye damage.
H317 May cause an allergic skin reaction.
H350 May cause cancer.
H360FD May damage fertility. May damage the unborn child.
H411 Toxic to aquatic life with long lasting effects.

GILDAURA 5NR ELECTROLYTE SALT

Precautionary statements	P202 Do not handle until all safety precautions have been read and understood. P260 Do not breathe vapour/ spray. P280 Wear protective gloves/ protective clothing/ eye protection/ face protection. P301+P310 IF SWALLOWED: Immediately call a POISON CENTER/ doctor. P303+P361+P353 IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water or shower. P308+P313 IF exposed or concerned: Get medical advice/ attention.
Supplemental label information	EUH032 Contact with acids liberates very toxic gas. RCH002b For professional users only.
Contains	POTASSIUM CYANATE, BORIC ACID, E.D.T.A disodium salt. dihydrate, ORGANIC COPPER SALT, GOLD POTASSIUM CYANIDE, ORGANIC CADMIUM SALT
Supplementary precautionary statements	P264 Wash contaminated skin thoroughly after handling. P273 Avoid release to the environment. P301+P330+P331 IF SWALLOWED: Rinse mouth. Do NOT induce vomiting. P304+P340 IF INHALED: Remove person to fresh air and keep 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. P363 Wash contaminated clothing before reuse.

2.3. Other hazards

SECTION 3: Composition/information on ingredients

3.2. Mixtures

POTASSIUM CYANATE **15-20%**

CAS number: 590-28-3 EC number: 209-676-3

Classification
Acute Tox. 4 - H302
Eye Irrit. 2 - H319

SODIUM CARBONATE **5-15%**

CAS number: 497-19-8 EC number: 207-838-8

Classification
Eye Irrit. 2 - H319

BORIC ACID **5-15%**

CAS number: 10043-35-3 EC number: 233-139-2

Classification
Repr. 1B - H360FD

E.D.T.A disodium salt. dihydrate **5-15%**

CAS number: 6381-92-6 EC number: 205-358-3

Classification
Acute Tox. 4 - H332
STOT RE 2 - H373

GILDAURA 5NR ELECTROLYTE SALT

ORGANIC COPPER SALT	**5-15%**
CAS number: 14552-35-3	EC number: 238-597-7

Classification
Skin Corr. 1B - H314

GOLD POTASSIUM CYANIDE	**1-5%**
CAS number: 13967-50-5	EC number: 237-748-4
M factor (Acute) = 1	M factor (Chronic) = 1

Classification
Met. Corr. 1 - H290
Acute Tox. 2 - H300
Acute Tox. 2 - H330
Skin Irrit. 2 - H315
Eye Dam. 1 - H318
Skin Sens. 1 - H317
Aquatic Acute 1 - H400
Aquatic Chronic 1 - H410

ORGANIC CADMIUM SALT	**<1%**
CAS number: —	
M factor (Chronic) = 10	

Classification
Acute Tox. 2 - H330
Muta. 2 - H341
Carc. 1B - H350
Repr. 2 - H361
STOT RE 1 - H372
Aquatic Chronic 1 - H410

The full text for all hazard statements is displayed in Section 16.

SECTION 4: First aid measures

4.1. Description of first aid measures

General information CAUTION! First aid personnel must be aware of own risk during rescue! Remove affected person from source of contamination. Get medical attention.

Inhalation Get medical attention. Move affected person to fresh air and keep warm and at rest in a position comfortable for breathing. When breathing is difficult, properly trained personnel may assist affected person by administering oxygen.

Ingestion Get medical attention immediately. Do not induce vomiting. Never give anything by mouth to an unconscious person. Remove affected person from source of contamination. Give plenty of water to drink. Move affected person to fresh air and keep warm and at rest in a position comfortable for breathing.

Skin contact Remove affected person from source of contamination. Remove contaminated clothing. Wash skin thoroughly with soap and water. Get medical attention promptly if symptoms occur after washing.

GILDAURA 5NR ELECTROLYTE SALT

Eye contact Remove affected person from source of contamination. Remove any contact lenses and open eyelids wide apart. Continue to rinse for at least 15 minutes. Get medical attention immediately. Continue to rinse.

4.2. Most important symptoms and effects, both acute and delayed

4.3. Indication of any immediate medical attention and special treatment needed

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media Use fire-extinguishing media suitable for the surrounding fire.

5.2. Special hazards arising from the substance or mixture

Specific hazards Thermal decomposition or combustion products may include the following substances: Toxic gases or vapours.

Hazardous combustion products Hydrogen cyanide (HCN).

5.3. Advice for firefighters

Special protective equipment for firefighters Wear positive-pressure self-contained breathing apparatus (SCBA) and appropriate protective clothing.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

Personal precautions Wear protective clothing as described in Section 8 of this safety data sheet.

6.2. Environmental precautions

Environmental precautions Do not discharge into drains or watercourses or onto the ground.

6.3. Methods and material for containment and cleaning up

Methods for cleaning up Do not touch or walk into spilled material. Wear suitable protective equipment, including gloves, goggles/face shield, respirator, boots, clothing or apron, as appropriate. Collect and place in suitable waste disposal containers and seal securely. Label the containers containing waste and contaminated materials and remove from the area as soon as possible. Flush contaminated area with plenty of water. Inform authorities if large amounts are involved.

6.4. Reference to other sections

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Usage precautions Avoid spilling. Avoid contact with skin and eyes. Provide adequate ventilation. Avoid inhalation of vapours. Use approved respirator if air contamination is above an acceptable level.

7.2. Conditions for safe storage, including any incompatibilities

Storage precautions Store in tightly-closed, original container in a dry, cool and well-ventilated place. Store in closed original container at temperatures between 5°C and 30°C.

Storage class Toxic storage.

7.3. Specific end use(s)

SECTION 8: Exposure controls/Personal protection

8.1. Control parameters

Occupational exposure limits

ORGANIC COPPER SALT

GILDAURA 5NR ELECTROLYTE SALT

Long-term exposure limit (8-hour TWA): WEL 0.1(Cu) mg/m³

GOLD POTASSIUM CYANIDE

Long-term exposure limit (8-hour TWA): WEL 5 mg/m3(Sk)
as -CN

ORGANIC CADMIUM SALT

Long-term exposure limit (8-hour TWA): WEL 0.025(Cd) mg/m³
WEL = Workplace Exposure Limit.

POTASSIUM CYANATE (CAS: 590-28-3)

DNEL	Workers - Inhalation; Long term systemic effects: 25 mg/m³ Workers - Inhalation; Short term systemic effects: 81.8 mg/m³ Workers - Dermal; Long term systemic effects: 28.57 mg/kg/day Workers - Dermal; Short term systemic effects: 100 mg/kg/day
PNEC	- Fresh water; 0.018 mg/l - marine water; 0.0018 mg/l - Intermittent release; 0.18 mg/l - STP; 100 mg/l - Sediment (Freshwater); 0.0914 mg/kg - Sediment (Marinewater); 0.00914 mg/kg - Soil; 0.0078 mg/kg

BORIC ACID (CAS: 10043-35-3)

DNEL	Industry - Inhalation; Long term systemic effects: 8.3 mg/m³ Industry - Dermal; Long term systemic effects: 3924800 mg/kg/day Consumer - Oral; Short term systemic effects: 0.98 mg/kg/day Consumer - Dermal; Long term local effects: 196 mg/kg/day Consumer - Dermal; Long term systemic effects: 0.98 mg/kg/day Consumer - Inhalation; Long term systemic effects: 4.15 mg/m³ Consumer - Oral; Long term systemic effects: 0.98 mg/kg/day
PNEC	- Fresh water; 1.35 mg/l - marine water; 1.35 mg/l - water; Intermittent release 9.1 mg/l - Sediment; 1.8 mg/kg - STP; 1.75 mg/l

SODIUM CARBONATE (CAS: 497-19-8)

DNEL	Workers - Inhalation; Long term local effects: 10 mg/m³

E.D.T.A disodium salt. dihydrate (CAS: 6381-92-6)

Ingredient comments	No exposure limits known for ingredient(s).
DNEL	Workers - Inhalation; Long term local effects: 1.5 mg/m³ Workers - Inhalation; Short term local effects: 3 mg/m³
PNEC	- Fresh water; 2.2 mg/l - marine water; 0.22 mg/l - Intermittent release; 1.2 mg/l

GOLD POTASSIUM CYANIDE (CAS: 13967-50-5)

GILDAURA 5NR ELECTROLYTE SALT

DNEL	Workers - Inhalation; Long term systemic effects: 0.071 mg/m³ Workers - Dermal; Long term systemic effects: 0.1 mg/kg/day
PNEC	Fresh water; 0.2 µg/l Intermittent release; 0.2 µg/l marine water; 0.02 µg/l STP; 6 mg/l Sediment (Freshwater); 0.33 mg/kg Sediment (Marinewater); 0.033 mg/kg Soil; 0.067 mg/kg

ORGANIC CADMIUM SALT

DNEL	Workers - Inhalation; Long term systemic effects: 0.004 mg/m³
PNEC	- Fresh water; 0.19 µg/l - marine water; 1.14 µg/l - STP; 20 µg/l - Sediment (Freshwater); 1.8 mg/kg - Sediment (Marinewater); 0.64 mg/kg - Soil; 0.9 mg/kg

8.2. Exposure controls

Protective equipment

Appropriate engineering controls	Provide adequate general and local exhaust ventilation.
Eye/face protection	Eyewear complying with an approved standard should be worn if a risk assessment indicates eye contact is possible. The following protection should be worn: Dust-resistant, chemical splash goggles.
Hand protection	Use protective gloves.
Other skin and body protection	Wear appropriate clothing to prevent any possibility of skin contact.
Hygiene measures	Use engineering controls to reduce air contamination to permissible exposure level. Do not smoke in work area. Wash at the end of each work shift and before eating, smoking and using the toilet. Promptly remove any clothing that becomes contaminated. Wash promptly with soap and water if skin becomes contaminated. Use appropriate skin cream to prevent drying of skin. When using do not eat, drink or smoke.
Respiratory protection	Wear a suitable dust mask.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Appearance	Dusty powder.
Colour	Various colours.
pH	pH (diluted solution): 6-9 @ 5%
Melting point	Not available.
Initial boiling point and range	Not determined.

GILDAURA 5NR ELECTROLYTE SALT

Flash point	Not applicable.
Evaporation rate	Not known.
Evaporation factor	Not available.
Flammability (solid, gas)	Not applicable.
Upper/lower flammability or explosive limits	Not available.
Vapour pressure	Not known.
Vapour density	Not available.
Solubility(ies)	Soluble in water.
Partition coefficient	Not applicable.
Auto-ignition temperature	Not applicable.
Decomposition Temperature	Not available.
Viscosity	Not available.
Explosive properties	Not applicable.
Oxidising properties	Does not meet the criteria for classification as oxidising.

9.2. Other information

SECTION 10: Stability and reactivity

10.1. Reactivity

10.2. Chemical stability

Stability Stable at normal ambient temperatures.

10.3. Possibility of hazardous reactions

Possibility of hazardous reactions Contact with acids liberates toxic gas.

10.4. Conditions to avoid

10.5. Incompatible materials

Materials to avoid Acids.

10.6. Hazardous decomposition products

Hazardous decomposition products Toxic gases/vapours/fumes of: Hydrogen cyanide (HCN).

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute toxicity - oral

ATE oral (mg/kg) 196.06

Acute toxicity - inhalation

ATE inhalation (gases ppm)	3,844.51
ATE inhalation (vapours mg/l)	17.78
ATE inhalation (dusts/mists mg/l)	1.75

GILDAURA 5NR ELECTROLYTE SALT

Skin corrosion/irritation

Skin corrosion/irritation Causes burns.

Serious eye damage/irritation

Serious eye damage/irritation Causes serious eye damage.

Respiratory sensitisation

Respiratory sensitisation Based on available data the classification criteria are not met.

Skin sensitisation

Skin sensitisation Based on available data the classification criteria are not met.

Carcinogenicity

Carcinogenicity May cause cancer.

Reproductive toxicity

Reproductive toxicity - fertility May damage fertility.

Reproductive toxicity - development Contains a substance/a group of substances which may damage the unborn child.

Specific target organ toxicity - single exposure

STOT - single exposure Based on available data the classification criteria are not met.

Specific target organ toxicity - repeated exposure

STOT - repeated exposure Based on available data the classification criteria are not met.

Inhalation Harmful by inhalation.

Ingestion Harmful if swallowed.

Skin contact Harmful in contact with skin.

Eye contact Severe irritation, burning and tearing.

Acute and chronic health hazards Known or suspected mutagen. Contains a substance/a group of substances which may cause cancer.

Route of exposure Inhalation Skin absorption Ingestion. Skin and/or eye contact

Toxicological information on ingredients.

SODIUM CARBONATE

Skin contact Irritating to skin.

Eye contact Irritating to eyes.

BORIC ACID

Skin corrosion/irritation

Skin corrosion/irritation Based on available data the classification criteria are not met.

Serious eye damage/irritation

Serious eye damage/irritation Based on available data the classification criteria are not met.

Respiratory sensitisation

GILDAURA 5NR ELECTROLYTE SALT

Respiratory sensitisation	Based on available data the classification criteria are not met.

Skin sensitisation

Skin sensitisation	Based on available data the classification criteria are not met.

Germ cell mutagenicity

Genotoxicity - in vitro	Based on available data the classification criteria are not met.
Genotoxicity - in vivo	Based on available data the classification criteria are not met.

Carcinogenicity

Carcinogenicity	Based on available data the classification criteria are not met.

Reproductive toxicity

Reproductive toxicity - fertility	May damage fertility.
Reproductive toxicity - development	May damage fertility or the unborn child.

Specific target organ toxicity - single exposure

STOT - single exposure	Based on available data the classification criteria are not met.

Specific target organ toxicity - repeated exposure

STOT - repeated exposure	Based on available data the classification criteria are not met.

Aspiration hazard

Aspiration hazard	Not relevant.

Ingestion	Harmful if swallowed.
Skin contact	Harmful: danger of serious damage to health by prolonged exposure in contact with skin.
Acute and chronic health hazards	Known or suspected mutagen.
Target organs	No specific target organs known.

E.D.T.A disodium salt. dihydrate

Inhalation	Harmful by inhalation.
Ingestion	May cause discomfort if swallowed.
Skin contact	Powder may irritate skin.
Eye contact	Particles in the eyes may cause irritation and smarting.
Acute and chronic health hazards	The product irritates mucous membranes and may cause abdominal discomfort if swallowed.

GOLD POTASSIUM CYANIDE

Skin corrosion/irritation

Skin corrosion/irritation	Causes skin irritation.

GILDAURA 5NR ELECTROLYTE SALT

Serious eye damage/irritation

Serious eye damage/irritation	Causes serious eye damage.

Respiratory sensitisation

Respiratory sensitisation	Based on available data the classification criteria are not met.

Skin sensitisation

Skin sensitisation	May cause an allergic skin reaction.

Germ cell mutagenicity

Genotoxicity - in vitro	Based on available data the classification criteria are not met.

Carcinogenicity

Carcinogenicity	Based on available data the classification criteria are not met.

Reproductive toxicity

Reproductive toxicity - fertility	Based on available data the classification criteria are not met.
Reproductive toxicity - development	Based on available data the classification criteria are not met.

Specific target organ toxicity - single exposure

STOT - single exposure	Based on available data the classification criteria are not met.

Specific target organ toxicity - repeated exposure

STOT - repeated exposure	Based on available data the classification criteria are not met.

Aspiration hazard

Aspiration hazard	Based on available data the classification criteria are not met.

Inhalation	Toxic by inhalation. Unconsciousness, possibly death.
Ingestion	Toxic if swallowed. Unconsciousness, possibly death.
Skin contact	Toxic through skin absorption (percutaneous).
Eye contact	Severe irritation, burning and tearing.
Acute and chronic health hazards	Gas or vapour is toxic or extremely irritating, even on brief exposure. Gas or vapour displaces oxygen available for breathing (asphyxiant). This chemical can be hazardous when inhaled and/or touched. Toxic through skin absorption (percutaneous). Repeated exposure may cause chronic eye irritation. Exposure may cause: Unconsciousness. Death.
Route of exposure	Inhalation Skin absorption Ingestion. Skin and/or eye contact
Medical symptoms	Cyanosis (blue tissue condition - nails, lips and/or skin).

ORGANIC CADMIUM SALT

Acute toxicity - inhalation

ATE inhalation (dusts/mists mg/l)	0.05

SECTION 12: Ecological information

GILDAURA 5NR ELECTROLYTE SALT

Ecotoxicity The product contains substances which are toxic to aquatic organisms and which may cause long-term adverse effects in the aquatic environment.

Ecological information on ingredients.

E.D.T.A disodium salt. dihydrate

Ecotoxicity The product components are not classified as environmentally hazardous. However, large or frequent spills may have hazardous effects on the environment.

GOLD POTASSIUM CYANIDE

Ecotoxicity Dangerous for the environment if discharged into watercourses.

12.1. Toxicity

Ecological information on ingredients.

SODIUM CARBONATE

Acute aquatic toxicity

Acute toxicity - fish EC_{50}, 96 hour: 300 mg/l, Lepomis macrochirus (Bluegill)

BORIC ACID

Acute aquatic toxicity

Acute toxicity - fish LC_{50}, 96 hours: 456 mg/l, Fish

Acute toxicity - aquatic invertebrates EC_{50}, 48 hours: 760 mg/l, Daphnia magna

E.D.T.A disodium salt. dihydrate

Acute aquatic toxicity

Acute toxicity - fish LC_{50}, 96 hours: >100 mg/l, Fish

Acute toxicity - aquatic invertebrates EC_{50}, 48 hours: >100 mg/l, Daphnia magna

Acute toxicity - aquatic plants IC_{50}, 72 hours: >100 mg/l, Algae

GOLD POTASSIUM CYANIDE

Toxicity Very toxic to aquatic organisms.

Acute aquatic toxicity

$LE(C)_{50}$ 0.1 < L(E)C50 ≤ 1

M factor (Acute) 1

Chronic aquatic toxicity

NOEC 0.01 < NOEC ≤ 0.1

Degradability Non-rapidly degradable

M factor (Chronic) 1

12.2. Persistence and degradability

Ecological information on ingredients.

GILDAURA 5NR ELECTROLYTE SALT

SODIUM CARBONATE

Persistence and degradability The product contains only inorganic substances which are not biodegradable.

E.D.T.A disodium salt. dihydrate

Persistence and degradability The product is not readily biodegradable.

12.3. Bioaccumulative potential

Partition coefficient Not applicable.

Ecological information on ingredients.

BORIC ACID

Bioaccumulative potential The product is not bioaccumulating.

Partition coefficient Not available.

E.D.T.A disodium salt. dihydrate

Bioaccumulative potential The product does not contain any substances expected to be bioaccumulating.

Partition coefficient Not applicable.

GOLD POTASSIUM CYANIDE

Partition coefficient Not available.

12.4. Mobility in soil

Ecological information on ingredients.

BORIC ACID

Mobility Mobile.

E.D.T.A disodium salt. dihydrate

Mobility The product is soluble in water.

12.5. Results of PBT and vPvB assessment

Ecological information on ingredients.

E.D.T.A disodium salt. dihydrate

Results of PBT and vPvB assessment This substance is not classified as PBT or vPvB according to current UK criteria.

12.6. Other adverse effects

Ecological information on ingredients.

E.D.T.A disodium salt. dihydrate

Other adverse effects Not determined.

SECTION 13: Disposal considerations

13.1. Waste treatment methods

GILDAURA 5NR ELECTROLYTE SALT

Disposal methods Dispose of waste to licensed waste disposal site in accordance with the requirements of the local Waste Disposal Authority.

SECTION 14: Transport information

14.1. UN number

UN No. (ADR/RID) 3077

UN No. (IMDG) 3077

UN No. (ICAO) 3077

14.2. UN proper shipping name

Proper shipping name (ADR/RID) ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (Gold potassium cyanide)

Proper shipping name (IMDG) ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (Gold potassium cyanide)

Proper shipping name (ICAO) ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (Gold potassium cyanide)

Proper shipping name (ADN) ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (Gold potassium cyanide)

14.3. Transport hazard class(es)

ADR/RID class 9

ADR/RID label 9

IMDG class 9

ICAO class/division 9

Transport labels

14.4. Packing group

ADR/RID packing group III

IMDG packing group III

ICAO packing group III

14.5. Environmental hazards

Environmentally hazardous substance/marine pollutant

14.6. Special precautions for user

EmS F-A, S-F

Emergency Action Code 2Z

Hazard Identification Number (ADR/RID) 90

Tunnel restriction code (E)

14.7. Transport in bulk according to Annex II of MARPOL and the IBC Code

GILDAURA 5NR ELECTROLYTE SALT

SECTION 15: Regulatory information

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

National regulations Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC, including amendments.

Guidance Workplace Exposure Limits EH40.

15.2. Chemical safety assessment

SECTION 16: Other information

Key literature references and sources for data Dangerous Properties of Industrial Chemicals, N.Sax, Croner's: Dangerous Substances. Croner's: Emergency Spillage Guide. Croner's: Substances Hazardous to Health. Material Safety Data Sheet, Misc. manufacturers.

Revision date 09/12/2022

Revision 3

Supersedes date 11/11/2015

Hazard statements in full

H290 May be corrosive to metals.
H300 Fatal if swallowed.
H301 Toxic if swallowed.
H302 Harmful if swallowed.
H314 Causes severe skin burns and eye damage.
H315 Causes skin irritation.
H317 May cause an allergic skin reaction.
H318 Causes serious eye damage.
H319 Causes serious eye irritation.
H330 Fatal if inhaled.
H332 Harmful if inhaled.
H341 Suspected of causing genetic defects.
H350 May cause cancer.
H360FD May damage fertility. May damage the unborn child.
H361 Suspected of damaging fertility or the unborn child.
H372 Causes damage to organs through prolonged or repeated exposure.
H373 May cause damage to organs through prolonged or repeated exposure.
H400 Very toxic to aquatic life.
H410 Very toxic to aquatic life with long lasting effects.
H411 Toxic to aquatic life with long lasting effects.

This information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process. Such information is, to the best of the company's knowledge and belief, accurate and reliable as of the date indicated. However, no warranty, guarantee or representation is made to its accuracy, reliability or completeness. It is the user's responsibility to satisfy himself as to the suitability of such information for his own particular use.

Annex I: Exposure Scenarios

Sector	Identified Use	Sector of Use Category (SU)	Chemical Product Category (PC)	Process Category (PROC)	Article Category (AC)	Environmental Release Category (ERC)	Exposure Scenario Number	
							Environment	Human Health
Metallurgy	Formulation into alloys	3, 14	7, 19	8b, 22, 23, 24	7	1, 2	E2	ES2, ES7, ES8, ES18, ES21, ES32
	Manufacture of flux mixtures and pastes	3, 10, 13	38	3, 4, 5, 8b, 9, 14	-	2	E4	ES2, ES7, ES8, ES16, ES18, ES21, ES22, ES32
	Industrial use of fluxes for (Precious) Metal smelting	3, 14	7, 19	22	7	6b	E2	ES2, ES7, ES8, ES18, ES21, ES32
	Industrial use of flux pastes for coating, brazing and welding rods	3, 10	38	14	7	5	E11	ES24
	Industrial/Professional use of brazing, soldering and welding rods	3, 14, 15, 17, 19	38	13, 25, 26	-	4	E9	ES40
	Use of borates in metal treatment (plating, passivation, galvanising, etc.)	3, 15, 17	14	3, 4, 5, 8a, 8b	-	4	E9	ES12, ES17, ES29

NOTE to the downstream users:

In the case where there are exposure scenarios during the daily work which are not listed in the joint table of the appendix and described in the following detailed exposure scenarios, please visit the following webpage, containing all the existing exposure scenarios and consult your safety administrator about the missing exposure scenario. Please forward your findings to your supplier, so that the eSDS can be updated and completed accordingly.

Link to the webpage containing the full list of exposure scenarios

http://www.ima-reach-hub.eu/index.php?option=com_docman&task=cat_view&gid=75&Itemid=26

E2: Generic industrial use of borates resulting in the manufacture of another substance

Use descriptors

ERC 1, 6a, 6b

Additional information

This generic exposure scenario has been created based on ERC 1, 6a and 6b. This scenario is valid for but not limited to following uses:

- *Manufacture of new chemicals using borates as starting materials (e.g. PVA solutions in printing industry)*
- *Manufacture of new chemicals using borates as catalysts (e.g. Use of borate as catalyst in polymer production)*
- *Formulation of borates into alloys*
- *Industrial use as flux for metal smelting and slag modifier*
- *Intermediate use in the production of non oxide ceramic powders*

Exposure scenario 1 is calculated with a default dilution

Exposure scenario 2 is calculated with a dilution factor of 100

Controlling environmental exposure

Product characteristics

Borates including boric acid, boric oxide, disodium octaborate and sodium tetraborates are used in granular form, powder form or can be dissolved in a liquid.

Amounts used

Tonnage calculations have been based on boron such that no RCR exceeds 0.97, using back-calculations with the relevant PNECs when necessary.

The equivalent tonnage of product handled on site should be calculated from the conversion factors detailed in the product table. For those operations that handle a combination of borate compounds, the boron equivalent of the combined tonnage cannot exceed the Site Tonnage (T Boron) value.

Information type	Site tonnage (T Boron/year)
Selected for Exposure Scenario 1	*190*
Selected for Exposure Scenario 2	*1 150*

Substance	Formula	Conversion factor for equivalent dose of B (multiply by)
Boric acid	*H3BO3*	*0.1748*
Boric oxide	*B2O3*	*0.3110*
Disodium tetraborate anhydrous	*Na2B4O7*	*0.2149*
Disodium tetraborate pentahydrate	*Na2B4O7.5H2O*	*0.1484*
Disodium tetraborate decahydrate	*Na2B4O7.10H2O*	*0.1134*
Disodium octaborate tetrahydrate	*Na2B8O13.4H2O*	*0.2096*
Sodium metaborate anhydrous	*NaBO2*	*0.1643*
Sodium metaborate dihydrate	*NaBO2.2H2O*	*0.1062*
Sodium metaborate tetrahydrate	*NaBO2.4H2O*	*0.0784*
Sodium pentaborate anhydrous	*NaB5O8*	*0.2636*
Sodium pentaborate pentahydrate	*NaB5O8.5H2O*	*0.1832*

Frequency and duration of use

Use occurs 300 days per year per site (estimated based on questionnaires)

Environment factors not influenced by risk management

Information type	Dilution factor	Remarks
Selected for Exposure Scenario 1	*10*	*Freshwater default*
Selected for Exposure Scenario 2	*100*	*Marine default or specific river*

Other given operational conditions affecting environmental exposure

Delivery and raw material handling mostly happen in open air. Weighing takes place inside the building. Most of the subsequent steps take place inside a building in (semi) enclosed systems.

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

None

Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil

The release factor to water is taken from the REACH guidance and based on the ERCs because only very few sites reported a reliable release factor or data to calculate one. ERC 1 is more worst case then ERC 6a and 6b so a release of 6% to water has been selected.

The release factor to air is not taken from the REACH guidance because the 5% release from ERC 1 and ERC 6a is unrealistic for compounds that are not volatile. Therefore the worst case release factor to air is taken from the glass exposure scenario instead. This release factor takes into account a heating step in case this would happen. At low temperatures borates are not volatile.

Information type	Release factor to water (g/T)	Release factor to air (g/T)
Selected for Exposure Scenario 1 and 2	*60 000*	*36 562*

Organisational measures to prevent/limit release from site

Spillages of powder or granulated borates should be swept or vacuumed up immediately and placed in containers for disposal in order to prevent unintentional release to the environment.

Conditions and measures related to municipal sewage treatment plant

Not relevant, boron is not removed from water in municipal STP. Generic scenarios are considered without the use of a municipal STP. If sites discharge to a municipal STP the concentration of boron should not exceed 10 mg/L in the municipal STP.

Conditions and measures related to external treatment of waste for disposal

Where appropriate material should be recovered and recycled through the process. Waste containing borates should be handled as an hazardous waste and removed by licensed operator to an off site location where it can be incinerated or disposed to a hazardous landfill.

Conditions and measures related to external recovery of waste

No external recovery of waste, spilt product is sometimes internally recovered and reused in the process.

Exposure estimation and reference to its source

	Compartment	Operational conditions	Value	Unit	$PNEC_{add}$	RCR
ES 1	*PEC freshwater*	*190 T/y, 100 d/y, D=10, RFwater = 60 000*	*1 956*	*µg/L*	*2 900*	*0.675*
	PEC soil	*190 T/y, 100 d/y, RFair = 36 562*	*0.86*	*mg/kg dw*	*5.7*	*0.150*
ES 2	*PEC freshwater/ marine*	*1 150 T/y, 100 d/y, D=100, RFwater = 60 000*	*1 206*	*µg/L*	*2 900*	*0.416*
	PEC soil	*1 150 T/y, 100 d/y, RFair = 36 562*	*5.15*	*mg/kg dw*	*5.7*	*0.904*

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

The DU works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the DU can demonstrate on his own that his implemented risk management measures are adequate. Detailed guidance for evaluation of ES can be acquired via your supplier or from the ECHA website (guidance R16). For environmental exposure, a DU-scaling tool (free download: http://www.archeconsulting.be/Metal-CSA-toolbox/du-scaling-tool) is available

E4: Generic formulation of borates into mixtures

Use descriptors

ERC 2

Additional information

This generic exposure scenario has been created based on ERC2. This scenario is valid for but not limited to following uses:

- *Formulation in refractory mixtures*
- *Manufacture of flux mixtures and pastes*
- *Formulation into industrial fluids*
- *Industrial use of industrial fluids in mixing*
- *Formulation in fertilizers*
- *Formulation in construction materials*
- *Formulation into photographic solutions*
- *Formulation into analytical reagents*
- *Formulation into cement*

Exposure scenario 1 has been calculated with emissions to air and water and the default dilution factor
Exposure scenario 2 has been calculated with emissions to air and water and a dilution factor of 100
Exposure scenario 3 has been calculated with emissions to air but no emissions to water

Controlling environmental exposure

Product characteristics

Borates including boric acid, boric oxide, disodium octaborate and sodium tetraborates are used in granular form, powder form or can be dissolved in a liquid.

Amounts used

Tonnage calculations have been based on boron such that no RCR exceeds 0.97, using back-calculations with the relevant PNECs when necessary.
The equivalent tonnage of product handled on site should be calculated from the conversion factors detailed in the product table. For those operations that handle a combination of borate compounds, the boron equivalent of the combined tonnage cannot exceed the Site Tonnage (T Boron) value.

Information type	Site tonnage (T Boron/year)
Selected for Exposure Scenario	*950*
Selected for Exposure Scenario	*9 500*
Selected for Exposure Scenario	*15 000*

Substance	Formula	Conversion factor for equivalent dose of B (multiply by)
Boric acid	H_3BO_3	*0.1748*
Boric oxide	B_2O_3	*0.3110*
Disodium tetraborate anhydrous	$Na_2B_4O_7$	*0.2149*
Disodium tetraborate pentahydrate	$Na_2B_4O_7.5H_2O$	*0.1484*
Disodium tetraborate decahydrate	*Na2B4O7.10H2O*	*0.1134*
Disodium octaborate tetrahydrate	*Na2B8O13.4H2O*	*0.2096*
Sodium metaborate anhydrous	*NaBO2*	*0.1643*
Sodium metaborate dihydrate	*NaBO2.2H2O*	*0.1062*
Sodium metaborate tetrahydrate	*NaBO2.4H2O*	*0.0784*
Sodium pentaborate anhydrous	*NaB5O8*	*0.2636*
Sodium pentaborate pentahydrate	*NaB5O8.5H2O*	*0.1832*

Frequency and duration of use

Formulation occurs 200 days per year per site (Median value calculated from data from questionnaires)

Environment factors not influenced by risk management

Information type	Dilution factor	Remarks
Selected for Exposure Scenario	*10*	*Freshwater default*
Selected for Exposure Scenario 2	*100*	*Marine default or specific river*
Selected for Exposure Scenario 3	*NR*	

Other given operational conditions affecting environmental exposure

Delivery and raw material handling mostly happen in open air. Weighing takes place inside the building. Most of the subsequent steps take place inside a building in (semi) enclosed systems.

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

None

Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil

For the remaining sectors where no spERCs or measured data was available the worst case spERC from the formulation of detergents was taken and an extra safety factor of 2 has been applied to them. The spERCs for detergents cover liquids and solids so they can be used for liquid and solid mixtures.
Emissions to water can only be reduced by very specific treatment technologies including ion exchange resins, reverse osmosis etc . Removal efficiency is dependent upon a number of factors and will vary from 40 to 90%. Much of the technology is currently not appropriate to high volume or mixed waste streams. Boron is not removed in considerable amounts in conventional WWTP (assumed removal efficiency is 0%).
Emissions to air can be removed by one or more of the following measures :
- Electrostatic precipitators
- Cyclones, but as primary collector
- Fabric or bag filters: high efficiency in controlling fine particulate (melting): achieve emission values Membrane filtration techniques can achieve
- Ceramic and metal mesh filters. PM10 particles are removed
- Wet scrubbers

Information type	Release factor to water (g/T)	Release factor to air (g/T)
Selected for Exposure Scenario 1 and 2	*8000*	*400*
Selected for Exposure Scenario 3	*0*	*400*

Organisational measures to prevent/limit release from site

Spillages of powder or granulated borates should be swept or vacuumed up immediately and placed in containers for disposal in order to prevent unintentional release to the environment.

Conditions and measures related to municipal sewage treatment plant

Not relevant, boron is not removed from water in municipal STP. If sites discharge to a municipal STP the concentration of boron should not exceed 10 mg/L in the municipal STP.

Conditions and measures related to external treatment of waste for disposal

Where appropriate material should be recovered and recycled through the process. Waste containing borates should be handled as an hazardous waste and removed by licensed operator to an off site location where it can be incinerated or disposed to a hazardous landfill.

Conditions and measures related to external recovery of waste

No external recovery of waste, spilt product is sometimes internally recovered and reused in the process.

Exposure estimation and reference to its source

	Compartment	Operational conditions	Value	Unit	$PNEC_{add}$	RCR
ES1	*PEC freshwater*	*950 T/y, 200 d/y, D=10, RFwater = 8 000*	*1 956*	*µg/L*	*2 900*	*0.675*
	PEC soil	*950 T/y, 200 d/y, RFair = 400*	*0.05*	*mg/kg dw*	*5.7*	*0.009*
ES2	*PEC freshwater/ marine*	*9 500 T/y, 200 d/y, D=100, RFwater = 8 000*	*1 956*	*µg/L*	*2 900*	*0.675*
	PEC soil	*9 500 T/y, 200 d/y, RFair = 400*	*0.47*	*mg/kg dw*	*5.7*	*0.082*
ES3	*PEC freshwater*	*15 000 T/y, 200 d/y, RFwater = 0*	*NR*	*µg/L*	*2 900*	*NR*
	PEC soil	*15 000 T/y, 200 d/y, RFair = 400*	*0.74*	*mg/kg dw*	*5.7*	*0.130*

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

The DU works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the DU can demonstrate on his own that his implemented risk management measures are adequate. Detailed guidance for evaluation of ES can be acquired via your supplier or from the ECHA website (guidance R16). For environmental exposure, a DU-scaling tool (free download: http://www.archeconsulting.be/Metal-CSA-toolbox/du-scaling-tool) is available

E9: Generic industrial use of borates as processing aids in processes and products

Use descriptors

ERC: 4

Additional information

This generic exposure scenario has been created based on ERC 4. ERC 4 is valid for but not limited to following uses:
- *Industrial/professional use of welding, brazing or soldering rods*
- *Use of borates in metal treatment (plating, passivation, galvanising,cleaning, etc.)*
- *Industrial use of industrial fluids*
- *Industrial use of photographic solutions*
- *Industrial use of abrasives*

Exposure scenario 1 has been calculated with emissions to air and water and the default dilution factor
Exposure scenario 2 has been calculated with emissions to air and water and a dilution factor of 100
Exposure scenario 3 has been calculated with emissions to air and water and a dilution factor of 1000
Exposure scenario 4 has been calculated by considering site specific dilution factors

Controlling environmental exposure

Product characteristics

Borates including boric acid, boric oxide, disodium octaborate and sodium tetraborates are used in granular form, powder form or can be dissolved in a liquid.

Amounts used

Tonnage calculations have been based on boron such that no RCR exceeds 0.97, using back-calculations with the relevant PNECs when necessary.
The equivalent tonnage of product handled on site should be calculated from the conversion factors detailed in the product table. For those operations that handle a combination of borate compounds, the boron equivalent of the combined tonnage cannot exceed the Site Tonnage (T Boron) value.

Information type	Site tonnage (T Boron/year)
Selected for Exposure Scenario 1	*14*
Selected for Exposure Scenario 2	*140*
Selected for Exposure Scenario 3	*1 150*
Selected for Exposure Scenario 4	*50*

Substance	Formula	Conversion factor for equivalent dose of B (multiply by)
Boric acid	H_3BO_3	*0.1748*
Boric oxide	B_2O_3	*0.3110*
Disodium tetraborate anhydrous	$Na_2B_4O_7$	*0.2149*
Disodium tetraborate pentahydrate	$Na_2B_4O_7.5H_2O$	*0.1484*
Disodium tetraborate decahydrate	$Na_2B_4O_7.10H_2O$	*0.1134*
Disodium octaborate tetrahydrate	$Na_2B_8O_{13}.4H_2O$	*0.2096*
Sodium metaborate anhydrous	$NaBO_2$	*0.1643*
Sodium metaborate dihydrate	$NaBO_2.2H_2O$	*0.1062*
Sodium metaborate tetrahydrate	$NaBO_2.4H_2O$	*0.0784*
Sodium pentaborate anhydrous	NaB_5O_8	*0.2636*
Sodium pentaborate pentahydrate	$NaB_5O_8.5H_2O$	*0.1832*

Frequency and duration of use

Production occurs 365 days per year per site (median 50th % from questionnaires)

Environment factors not influenced by risk management

Information type	Dilution factor	Remarks
Selected for Exposure Scenario 1	*10*	*Freshwater default*
Selected for Exposure Scenario 2	*100*	*Marine default or specific river*
Selected for Exposure Scenario 3	*1 000*	*Maximum dilution factor*
Selected for Exposure Scenario 4	*36*	*Site specific dilution factor*

Other given operational conditions affecting environmental exposure

Delivery and raw material handling mostly happen in open air. Weighing takes place inside the building. Most of the subsequent steps take place inside a building in (semi) enclosed systems.

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

None

Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil

The release factor to water is taken from the REACH guidance and based on the ERCs because only very few sites reported a reliable release factor or data to calculate one. The 100% release is not unrealistic in the case of borates being dissolved in baths.
The release factor to air is not taken from the REACH guidance because the 100% release is unrealistic for compounds that are not volatile.
Therefor the worst case release factor to air is taken from the glass exposure scenario instead. This release factor takes into account a heating step in case this would happen.

Information type	Release factor to water (g/T)	Release factor to air (g/T)
Selected for Exposure Scenario 1, 2, 3 and 4	*1 000 000*	*36 562*

Organisational measures to prevent/limit release from site

Spillages of powder or granulated borates should be swept or vacuumed up immediately and placed in containers for disposal in order to prevent unintentional release to the environment.

Conditions and measures related to municipal sewage treatment plant

Not relevant, boron is not removed from water in municipal STP. Generic scenarios are considered without the use of a municipal STP. If sites discharge to a municipal STP the concentration of boron should not exceed 10 mg/L in the municipal STP.

Conditions and measures related to external treatment of waste for disposal

Where appropriate material should be recovered and recycled through the process. Waste containing borates should be handled as an hazardous waste and removed by licensed operator to an off site location where it can be incinerated or disposed to a hazardous landfill.

Conditions and measures related to external recovery of waste

No external recovery of waste, spilt product is sometimes internally recovered and reused in the process.

Exposure estimation and reference to its source

	Compartment	Operational conditions	Value	Unit	$PNEC_{add}$	RCR
ES1	*PEC freshwater*	*14 T/y, 365 d/y, D=10, RFwater = 1000000*	*1 974*	*µg/L*	*2 900*	*0.681*
	PEC soil	*14 T/y, 365 d/y, RFair = 36 562*	*0.07*	*mg/kg dw*	*5.7*	*0.012*
ES2	*PEC freshwater/ marine*	*140 T/y, 365 d/y, D=100, RFwater = 1000000*	*1 974*	*µg/L*	*2 900*	*0.681*
	PEC soil	*140 T/y, 365 d/y, RFair = 36 562*	*0.63*	*mg/kg dw*	*5.7*	*0.111*
ES3	*PEC freshwater*	*1 150 T/y, 365 d/y, RFwater = 1 000 000*	*1 632*	*µg/L*	*2 900*	*0.563*
	PEC soil	*1 150 T/y, 365 d/y, RFair = 36 562*	*5.15*	*mg/kg dw*	*5.7*	*0.904*
ES4	*PEC freshwater*	*50 T/y, 365 d/y,D= 36, RFwater = 1000000*	*1 974*	*µg/L*	*2 900*	*0.681*
	PEC soil	*50 T/y, 365 d/y, RFair = 36 562*	*0.23*	*mg/kg dw*	*5.7*	*0.040*

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

The DU works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the DU can demonstrate on his own that his implemented risk management measures are adequate. Detailed guidance for evaluation of ES can be acquired via your supplier or from the ECHA website (guidance R16). For environmental exposure, a DU-scaling tool (free download: http://www.archeconsulting.be/Metal-CSA-toolbox/du-scaling-tool) is available

E11:Generic industrial use of borates resulting in inclusion into or onto a matrix

Use descriptors

ERC 5

Additional information

This generic exposure scenario has been created based on ERC 5. ERC 5 is valid for but not limited to following uses:

- *Industrial use of refractory mixtures*
- *Industrial use of flux pastes for coating brazing and welding rods*
- *Industrial use of industrial fluids*
- *Use of borates in construction materials*
- *Swimming pool tablet production*
- *Industrial use of cement*
- *Production of non oxide ceramic powders*

Exposure scenario 1 has been calculated with emissions to air and water and the default dilution factor
Exposure scenario 2 has been calculated with emissions to air and water and a dilution factor of 100
Exposure scenario 3 has been calculated with emissions to air and water and a dilution factor of 1000
Exposure scenario 4 has been calculated with emissions to air but no emissions to water

Controlling environmental exposure

Product characteristics

Borates including boric acid, boric oxide, disodium octaborate and sodium tetraborates are used in granular form, powder form or can be dissolved in a liquid.

Amounts used

Tonnage calculations have been based on boron such that no RCR exceeds 0.97, using back-calculations with the relevant PNECs when necessary.
The equivalent tonnage of product handled on site should be calculated from the conversion factors detailed in the product table. For those operations that handle a combination of borate compounds, the boron equivalent of the combined tonnage cannot exceed the Site Tonnage (T Boron) value.

Substance	Formula	Conversion factor for equivalent dose of B (multiply by)
Boric acid	H_3BO_3	*0.1748*
Boric oxide	B_2O_3	*0.3110*
Disodium tetraborate anhydrous	$Na_2B_4O_7$	*0.2149*
Disodium tetraborate pentahydrate	$Na_2B_4O_7.5H_2O$	*0.1484*
Disodium tetraborate decahydrate	$Na_2B_4O_7.10H_2O$	*0.1134*
Disodium octaborate tetrahydrate	$Na_2B_8O_{13}.4H_2O$	*0.2096*
Sodium metaborate anhydrous	$NaBO_2$	*0.1643*
Sodium metaborate dihydrate	$NaBO_2.2H_2O$	*0.1062*
Sodium metaborate tetrahydrate	$NaBO_2.4H_2O$	*0.0784*
Sodium pentaborate anhydrous	NaB_5O_8	*0.2636*
Sodium pentaborate pentahydrate	$NaB_5O_8.5H_2O$	*0.1832*

Frequency and duration of use

Use occurs 100 days per year per site (estimated based on questionnaires)

Environment factors not influenced by risk management

Information type	Dilution factor	Remarks
Selected for Exposure Scenario 1	*10*	*Freshwater default*
Selected for Exposure Scenario 2	*100*	*Marine default or specific river*
Selected for Exposure Scenario 3	*1 000*	*Maximum dilution factor*
Selected for Exposure Scenario 4	*NR*	

Other given operational conditions affecting environmental exposure

Indoor and outdoor use possible.

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

None

Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil

The release factor to water is taken from the REACH guidance and based on the ERCs because only very few sites reported a reliable release factor or data to calculate one.

Some sites reported that they do not discharge wastewater to the environment. They either don't use water in the process, recycle the water in a closed system or send their wastewater to an offsite location for special treatments. Therefore an exposure scenario (4) without wastewater will also be calculated.
The release factor to air is not taken from the REACH guidance because the 50% release is unrealistic for compounds that are not volatile.
Therefor the worst case release factor to air is taken from the glass exposure scenario instead. This release factor takes into account a heating step in case this would happen.

Information type	Release factor to water (g/T)	Release factor to air (g/T)
Selected for Exposure Scenario 1, 2 and 3	*500 000*	*36 562*
Selected for Exposure Scenario 4	*0*	*36 562*

Organisational measures to prevent/limit release from site

Spillages of powder or granulated borates should be swept or vacuumed up immediately and placed in containers for disposal in order to prevent unintentional release to the environment.

Conditions and measures related to municipal sewage treatment plant

Not relevant, boron is not removed from water in municipal STP. Generic scenarios are considered without the use of a municipal STP. If sites discharge to a municipal STP the concentration of boron should not exceed 10 mg/L in the municipal STP.

Conditions and measures related to external treatment of waste for disposal

Where appropriate material should be recovered and recycled through the process. Waste containing borates should be handled as an hazardous waste and removed by licensed operator to an off site location where it can be incinerated or disposed to a hazardous landfill.

Conditions and measures related to external recovery of waste

No external recovery of waste, spilt product is sometimes internally recovered and reused in the process.

Exposure estimation and reference to its source

	Compartment	Operational conditions	Value	Unit	$PNEC_{add}$	RCR
ES1	*PEC freshwater*	*7.5 T/y, 100 d/y, D=10, RFwater = 500 000*	*1 931*	*µg/L*	*2 900*	*0.681*
	PEC soil	*7.5 T/y, 100 d/y, RFair = 36 562*	*0.04*	*mg/kg dw*	*5.7*	*0.007*
ES2	*PEC freshwater/ marine*	*75 T/y, 100 d/y, D=100, RFwater = 500 000*	*1 931*	*µg/L*	*2 900*	*0.681*
	PEC soil	*75 T/y, 100 d/y, RFair = 36 562*	*0.34*	*mg/kg dw*	*5.7*	*0.060*
ES3	*PEC freshwater*	*750 T/y, 100 d/y, D=1000, RFwater = 500000*	*1 931*	*µg/L*	*2 900*	*0.681*
	PEC soil	*750 T/y, 100 d/y, RFair = 36 562*	*3.36*	*mg/kg dw*	*5.7*	*0.590*
ES4	*PEC freshwater*	*1 150 T/y, 100 d/y, RFwater = 0*	*NR*	*µg/L*	*2 900*	*NR*
	PEC soil	*1 150 T/y, 100 d/y, RFair = 36 562*	*5.15*	*mg/kg dw*	*5.7*	*0.904*

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

The DU works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the DU can demonstrate on his own that his implemented risk management measures are adequate. Detailed guidance for evaluation of ES can be acquired via your supplier or from the ECHA website (guidance R16). For environmental exposure, a DU-scaling tool (free download: http://www.archeconsulting.be/Metal-CSA-toolbox/du-scaling-tool) is available.

ES2: Closed and largely closed production at high temperatures
Use descriptors
PROC1. Use in closed process, no likelihood of exposure. *PROC2. Use in closed, continuous process with occasional controlled exposure.* *PROC3. Use in closed batch process (synthesis or formulation).* *PROC22. Use in closed batch process at elevated temperature* *PROC23. Use in open batch process at elevated temperature*
Controlling worker exposure for closed and largely closed production at high temperatures
Product characteristics
Borates are granular powders. They are used in these processes to make solid articles such as glass and metals as well as frits and ceramic powders.
Amounts used
The amount of borate used at any one time will depend on the size of the plant and the substance or preparation being manufactured but is likely to be several tonnes per day.
Frequency and duration of use
The frequency and duration of use will depend on the substance or preparation being produced. For most closed manufacturing processes the activity is 24 hours, 365 days per year, if a furnace has to be kept in operation.
Human factors not influenced by risk management
None
Other given operational conditions affecting workers' exposure
The tasks are carried out indoors. The process temperatures are mainly very high, as these processes include glass making, ceramics, steel and alloy making.
Technical conditions and measures at process level (source) to prevent release
The transfer of substances and the production processes are closed and automatically controlled from control cabins, which is where operatives spend most of their time.
Technical conditions and measures to control dispersion from source towards the worker
Where there are breaches in the closed systems such as pouring and removal of slag in metal production, LEV is used to control fumes.
Organisational measures to prevent/limit releases, dispersion and exposure
Training of operatives and regular testing and maintenance of plant and equipment.
Conditions and measures related to personal protection, hygiene and health evaluation
Operatives wear overalls or heavy heat resistant clothing. Eye protection should be worn where good hygiene practice requires it or substance classification demands it. Where engineering controls (automation /enclosure/LEV) do not provide sufficient protection against inhalation exposure to boron, P2/P3 respirators must be worn. In some cases, battery-powered, air-fed helmets are worn. These respirators, if worn correctly, with a good face-fit, will provide sufficient protection. Where tight-fitting RPE is used, the worker should be face-fit tested to ensure that a good face sealcan be obtained. Tight-fitting RPE relies on a good face seal and will not provide the required protection unless they fit the contours of the face properly and securely. The employer and the self-employed have legal responsibilities for the maintenance and issue of respiratory protective equipment and the management of their correct use in the workplace. A suitable policy for a respiratory protective equipment programme including training of the workers should be in place.
Exposure estimation and reference to its source
There are 45 datapoints for general production activities including routine cleaning. They range from 0.0 mgB/m^3 to 0.21 mgB/m^3. The 90th percentile for these data is 0.08 mgB/m^3. These data do not take into account the use of RPE. The 90th percentile value is well below the inhalation DNEL of 1.45mgB/m^3. *There are no specific data for inhalation exposure to borates during slag removal. Inhalation exposure was estimated using MEASE for this activity. The parameters used were solid – low dustiness, 1-5% boron, PROC2, duration <15 minutes, exterior LEV and use of RPE (APF 40). Inhalation exposure, taking into account the use of rpe (APF40) was estimated to be <0.001mgB/m^3. If a faceshield is worn, which offers little if any respiratory protection, the inhalation exposure is estimated to be 0.01mgB/m^3, 8-hr TWA.* *Dermal exposure is unlikely to occur except when routine cleaning is taking place. MEASE has been used to estimate potential exposure during this activity. The parameters used were high dustiness solid, >25% boron, PROC2, duration of exposure 15-60 minutes, closed system without breaches, direct handling, incidental contact and enclosed process. The estimated dermal exposure is 0.048mgB/day . This exposure estimate also assumes that all the dust is borate. This value is well below the dermal DNEL of 4800mgB/day.*
Guidance to DU to evaluate whether he works inside the boundaries set by the ES

If the parameters used in the MEASE model outlined above do not reflect conditions at the DU facility, the DU can use MEASE and input the parameters that do reflect conditions at the DU facility to check whether the DU works inside the boundaries set by the ES.

ES7: Discharging bags (25-50kg) into mixing vessels
Use descriptors
PROC4 Use in batch and other process (synthesis) where opportunity for exposure arises.
PROC5 Mixing or blending in batch processes for formulation of preparations and articles (multistage and/or significant contact).
Controlling worker exposure for discharging bags (25-50kg) into mixing vessels
Product characteristics
Borates are granular powders.
Amounts used
The amount of borate used at any one time will depend on the size of the plant and the substance or preparation being manufactured.
Frequency and duration of use
made every day, or several times a day, while for others it is a weekly, monthly or even yearly process. The duration of the activity can last from a few minutes up to about an hour, depending on the size of the batch being produced. The bags of borate are brought from the warehouse to the plant by forklift truck. The operative lifts the bag to the charging point on the vessel either manually or using a winch, and cuts the bag, pouring the borate into the vessel. This procedure is repeated until the required number of bags of borate has been added to the mixture. The task may be repeated more than once in a shift. In some cases, part bags may be weighed before addition to ensure the correct amount of borate is added. *At some sites, where the borate is delivered in 25kg bags, the bags of borate are fed directly into the furnace without being opened.* *At some sites, the addition of the borate from the bag is semi-automated and the empty bag is automatically disposed of into a plastic tube for disposal.* *The frequency and duration of use will depend on the substance or preparation being produced. For some, batches are*
Human factors not influenced by risk management
None
Other given operational conditions affecting workers' exposure
The tasks are carried out indoors. The process temperatures are varied, depending on the sector of use, but the release of the borate from the bags is carried out at ambient temperature.
Technical conditions and measures at process level (source) to prevent release
None required. *At some sites semi-automation of the bag emptying process removes the source of exposure from the worker.*
Technical conditions and measures to control dispersion from source towards the worker
Local exhaust ventilation (LEV) at the bag discharge point is used to control the dispersion of airborne dust towards the worker. The hood should enclose the charging point as far as possible and the LEV should pull airborne dust away from the operative. *The empty bag should be placed directly to waste.*
Organisational measures to prevent/limit releases, dispersion and exposure
Training of operatives and regular testing and maintenance of plant and equipment.
Conditions and measures related to personal protection, hygiene and health evaluation
Operatives wear overalls and gloves. Eye protection should be worn where good hygiene practice requires it or substance classification demands it. Where LEV does not reduce inhalation exposure to boron below the inhalation DNEL, P2/P3 respirators must be worn. These, if worn correctly, with a good face-fit will provide sufficient reduction in exposure. Where RPE is used, the worker should be face-fit tested to ensure that a good face seal can be obtained. RPE relies on a tight face seal and will not provide the required protection unless they fit the contours of the face properly and securely. The employer and self-employed persons have legal responsibilities for the maintenance and issue of respiratory protective equipment and the management of their correct use in the workplace. A suitable policy for a respiratory protective equipment programme including training of the workers should be in place.
Exposure estimation and reference to its source
There are 41 datapoints for the discharge of 25 kg bags into mixing vessels or similar. They range from none detected to 1.45mg B/m^3, 8-hr TWA. Any short-term exposure values have been time-weighted to 8 hours to allow comparison against the inhalation DNEL. The 90th percentile for this dataset is 0.78mgB/m^3. This value is below the inhalation DNEL of 1.45mg/m^3. *Dermal exposure is unlikely to occur except when routine cleaning is taking place. MEASE has been used to estimate potential exposure during this activity. The parameters used were high dustiness solid, >25% boron, PROC4, duration of exposure 15-60 minutes, non-dispersive use, direct handling, incidental contact and no gloves . The estimated*

dermal exposure is 0.48mgB/day. This exposure estimate also assumes that all the dust is borate. This value is well below the dermal DNEL of 4800mgB/day.
Guidance to DU to evaluate whether he works inside the boundaries set by the ES
If the parameters used in the MEASE model outlined above do not reflect conditions at the DU facility, the DU can use MEASE and input the parameters that do reflect conditions at the DU facility to check whether the DU works inside the boundaries set by the ES

ES8: Discharging big bags (750 – 1500kg) into mixing vessels
Use descriptors
PROC4. Use in batch and other process (synthesis or formulation)
PROC5. Mixing or blending in batch processes for formulation of preparations and articles (multistage and/or significant contact)
PROC8b. Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities.
Controlling worker exposure for discharging big bags (750 – 1500kg) into mixing vessels
Product characteristics
Borates are granular powders.
Amounts used
The amount of borate used at any one time will depend on the size of the plant and the substance or preparation being manufactured, but may be several tonnes.
Frequency and duration of use
The frequency and duration of use will depend on the substance or preparation being produced. For some, batches are made every day, or several times a day, while for others it is a weekly, monthly process. The duration of the activity can last from a few minutes up to about an hour, depending on the size of the batch being produced. The bags of borate are brought from the warehouse to the plant by forklift truck. The operative lifts the big bag to the charging point on the vessel using a winch or forklift truck, and cuts the base of the big bag, releasing the borate into the vessel. This procedure is repeated until the required number of big bags of borate has been added to the mixture. The task may be repeated more than once in a shift. In some cases, part bags may be weighed before addition to ensure the correct amount of borate is added.
Human factors not influenced by risk management
None
Other given operational conditions affecting workers' exposure
The tasks are carried out indoors. The process temperatures are varied, depending on the sector of use, but the release of the borate is carried out at ambient temperature.
Technical conditions and measures at process level (source) to prevent release
Single-use bags can be opened by the use of sharp prongs at the discharge hopper. When the big bag is placed at the discharge hopper and lowered, the prongs cut into the base of the bag releasing the borate into the hopper. This removes the operator from the immediate vicinity and contributes to a reduction in exposure.
Technical conditions and measures to control dispersion from source towards the worker
Local exhaust ventilation (LEV) at the bag discharge point is used to control the dispersion of airborne dust towards the worker.
Organisational measures to prevent/limit releases, dispersion and exposure
Training of operatives and regular testing and maintenance of plant and equipment.
Conditions and measures related to personal protection, hygiene and health evaluation
Operatives wear overalls and gloves. Eye protection should be worn where good hygiene practice requires it or substance classification demands it. Where engineering controls (automation /enclosure/LEV) do not provide sufficient protection against inhalation exposure to boron, P2/P3 respirators must be worn. These, if worn correctly, with a good face-fit, will provide sufficient reduction in exposure. Where RPE is used, the worker should be face-fit tested to ensure that a good face seal can be obtained. RPE relies on a tight face seal and will not provide the required protection unless they fit the contours of the face properly and securely. The employer and the self-employed have legal responsibilities for the maintenance and issue of respiratory protective equipment and the management of their correct use in the workplace. A suitable policy for a respiratory protective equipment programme including training of the workers should be in place.
Exposure estimation and reference to its source
There are 31 personal exposure datapoints for the discharge of big bags. They range from 0.005 mgB/m^3 to 6.9 mgB/m^3. For most downstream users the discharging of bags into receiving vessels is the main source of exposure to borates for those operatives, and is a short-term activity. Some short-term data was supplied converted to 8-hr TWAs. Any short-term exposure values provided have been time-weighted to 8 hours to allow comparison against the inhalation DNEL. This is a very wide data range and largely reflects the effectiveness of the LEV at different plants. These data do not take into account the use of RPE. The 90th percentile for these data is 2.0mgB/m^3, which is above the inhalation DNEL of 1.45mgB/m^3. If effective engineering controls/LEV are not in place, RPE (P2/P3) must be used to reduce worker exposure below the inhalation DNEL until effective engineering controls are put in place. *There are no dermal exposure data available, so MEASE has been used to estimate dermal exposure. The parameters used were high dustiness solid, >25% boron, PROC 4, 15-60 minutes duration, non-dispersive use, extensive contact,*

exterior LEV and no gloves. Dermal exposure is estimated to be 4.8mgB/day. This value is well below the dermal DNEL of 4800mgB/day.
Guidance to DU to evaluate whether he works inside the boundaries set by the ES
If the parameters used in the MEASE model outlined above do not reflect conditions at the DU facility, the DU can use MEASE and input the parameters that do reflect conditions at the DU facility to check whether the DU works inside the boundaries set by the ES.

ES12: Use of cleaning solutions in industrial or professional settings
Use descriptors
PROC2. Use in closed, continuous process with occasional controlled exposure
PROC4. Use in batch and other process (synthesis) where opportunity for exposure arises
PROC7. Industrial spraying
PROC10. Roller application and brushing
PROC11. Non-industrial spraying.
PROC19. Hand-mixing with intimate contact and only PPE available.
Controlling worker exposure for use of cleaning solutions in industrial or professional settings
Product characteristics
The detergents are liquids and generally contain 1-2% borate, therefore less than 0.5% boron. Occasionally, metal cleaners can contain maximum boron contents of 8 up to 12 %. They may be used for surface cleaning manually or for cleaning using sprays. Spray cleaning may be on an industrial scale cleaning large objects, or may be on a professional scale where workers are using manual sprays to clean work surfaces.
Amounts used
The amounts used will vary depending on what is being cleaned. A large aeroplane for example would need hundreds of litres of fluid, while a smaller object may only require a litre.
Frequency and duration of use
For industrial and professional cleaners, the use of cleaning agents will be daily. The length of time within a shift that the cleaning fluid is being used or handled will vary, but could be for most of an 8-hour shift.
Human factors not influenced by risk management
None
Other given operational conditions affecting worker exposure
Cleaning generally takes place in well-ventilated areas. Processes do not take place at temperatures higher than 60°C.
Technical conditions and measures at process level (source) to prevent release
None
Technical conditions and measures to control dispersion from source towards the worker
Dispensers may be used to prevent skin contact or splashing of neat product.
Organisational measures to prevent/limit releases, dispersion and exposure
Training of operatives.
Conditions and measures related to personal protection, hygiene and health evaluation
None
Exposure estimation and reference to its source
The exposure estimation is a worst case assumption assuming a maximum boron content of 5 - 25 %. *If the detergent is being used with a mop/brush and bucket there will be no aerosol generated and therefore no inhalation exposure. However, sprays may be used. For example low pressure sprays may be used for cleaning the exterior of aeroplanes.* *There are no exposure data available for these activities, so ART has been used to estimate inhalation exposure. Considering most critical processes, PROC 7 and PROC 10 are assessed.* *PROC 7* *The parameters used were powder dissolved in a liquid, 5% boron, industrial use, 480 minutes, moderate application ratewith high compressed air and medium viscosity. Estimated inhalation exposure during spraying was 1.2 mgB/m^3, 8-hr TWA.* *PROC 10* *The parameters used were powder dissolved in a liquid, 12% boron, industrial use, 480 minutes, moderate application rate and medium viscosity.* *Estimated inhalation exposure roller application was 0.11 mgB/m^3, 8-hr TWA.* *These estimates for inhalation exposure are below the inhalation DNEL of 1.45 mgB/m^3, 8-hr TWA.* *There are no dermal exposure data available, so MEASE was used to estimate dermal exposure. Considering most critical processes, PROC 7 and PROC 10 are assessed.* *PROC 7* *The parameters used were liquid, 5-25% boron, industrial use, >240 minutes, wide dispersive use, intermittent contact and no gloves. Estimated dermal exposure during spraying of large objects was 0.14 mgB/day.* *PROC 10* *The parameters used were liquid, 5-25% boron, industrial use, >240 minutes, wide dispersive use, intermittent contact and no gloves. Estimated dermal exposure during roller application was 14.4 mgB/day.* *These values are well below the dermal (external) DNEL of 4800 mgB/day.*

Guidance to DU to evaluate whether he works inside the boundaries set by the ES
If the parameters outlined above do not reflect conditions at the DU facility, the DU can use MEASE and input the parameters that do reflect conditions at the DU facility to check whether the DU works inside the boundaries set by the ES

ES16: Closed production at ambient temperatures
Use descriptors
PROC1. Use in closed process, no likelihood of exposure.
PROC2. Use in closed, continuous process with occasional controlled exposure.
PROC3. Use in closed batch process (synthesis or formulation).
Controlling worker exposure for closed production at ambient temperatures
Product characteristics
Borates are granular powders. They are used in these processes to make mixtures such as pastes and coatings
Amounts used
The amount of borate used at any one time will depend on the size of the plant and the substance or preparation being manufactured, but could be up to a tonne per shift.
Frequency and duration of use
There are daily maintenance activities, planned maintenance and reactive maintenance on the plants.
Human factors not influenced by risk management
None
Other given operational conditions affecting worker exposure
The tasks are carried out indoors.
Technical conditions and measures at process level (source) to prevent release
Most of the transfer of substances and the production processes are closed including the opening and addition of borates from 25kg bags.
Technical conditions and measures to control dispersion from source towards the worker
Where processes are partially open, LEV is used to control exposure to airborne contaminants.
Organisational measures to prevent/limit releases, dispersion and exposure
Training of operatives and regular testing and maintenance of plant and equipment.
Conditions and measures related to personal protection, hygiene and health evaluation
Operatives wear overalls, safety shoes, safety glasses and when necessary to control exposure below the DNEL, P2/P3 respirators must also be worn.
Exposure estimation and reference to its source
There are 45 datapoints for general production activities including routine cleaning. They range from 0.0 mgB/m^3 to 0.21 mgB/m^3. The 90th percentile for these data is 0.08 mgB/m^3. These data do not take into account the use of RPE. The 90th percentile value is well below the inhalation DNEL of 1.45mgB/m^3. *Dermal exposure is unlikely to occur except when routine cleaning is taking place. MEASE has been used to estimate potential exposure during this activity. The parameters used were high dustiness solid, >25% boron, PROC2, duration of exposure 15-60 minutes, closed system without breaches, direct handling, incidental contact, enclosed process and no gloves worn. The estimated dermal exposure is 0.048 mgB/day. This exposure estimate also assumes that all the dust is borate. This value is well below the dermal DNEL of 4800mgB/day.*
Guidance to DU to evaluate whether he works inside the boundaries set by the ES
If the parameters used in the MEASE model outlined above do not reflect conditions at the DU facility, the DU can use MEASE and input the parameters that do reflect conditions at the DU facility to check whether the DU works inside the boundaries set by the ES.

ES17: Make up of treatment bath for galvanising, plating and other surface treatments
Use descriptors
PROC8b. Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities
Controlling worker exposure for makeup of treatment bath for galvanising, plating and other surface treatments
Product characteristics
The borate/boric acid is a powder and is supplied in 25kg bags.
Amounts used
The amount of borate used in plating baths will vary depending on the size of the bath, but is in the region of 25-200kg.
Frequency and duration of use
The borate in the treatments baths may be topped up once or twice a week with 25-50kg of borate, or baths may only be made up once or twice a year with 200kg, with the addition of the borate taking approximately 30 minutes.
Human factors not influenced by risk management
None
Other given operational conditions affecting workers' exposure
The tasks are carried out indoors.
Technical conditions and measures at process level (source) to prevent release
None
Technical conditions and measures to control dispersion from source towards the worker
Canopy hoods over the baths capture and remove steam.
Organisational measures to prevent/limit releases, dispersion and exposure
Training of operatives and regular testing and maintenance of plant and equipment.
Conditions and measures related to personal protection, hygiene and health evaluation
Operatives wear chemical resistant overalls and chemical-resistant gloves. Eye protection should be worn where good hygiene practice requires it or substance classification demands it. When adding borate to the bath they may wear P1/P2 respirators. Where RPE is used, the worker should be face-fit tested to ensure that a good face seal can be obtained. The RPE above rely on a tight face seal and will not provide the required protection unless they fit the contours of the face properly and securely. The employer and self-employed persons have legal responsibilities for the maintenance and issue of respiratory protective equipment and the management of their correct use in the workplace. Therefore, they should define and document a suitable policy for a respiratory protective equipment programme including training of the workers.
Exposure estimation and reference to its source
There are no specific data for the addition of borates in treatment baths. However there are data available for emptying 25kg bags. There are 41 datapoints for the discharge of 25 kg bags into mixing vessels or similar. They range from none detected to 1.45mg B/m^3, 8-hr TWA. Any short-term exposure values have been time-weighted to 8 hours to allow comparison against the DNEL. The 90th percentile for this dataset is 0.78mgB/m^3. This value is below the inhalation DNEL of 1.45mg/m^3. *The dermal exposure was estimated using MEASE. The parameters used were high dustiness solid, 5-25% boron, PROC 8b, industrial use, 15-60 minutes, non-dispersive use, direct handling, intermittent exposure and no gloves. The estimated exposure for this activity was 0.29mgB/day. This is well below the dermal dose DNEL of 4800mg/day.*
Guidance to DU to evaluate whether he works inside the boundaries set by the ES
If the parameters outlined above do not reflect conditions at the DU facility, the DU can use MEASE and input the parameters that do reflect conditions at the DU facility to check whether the DU works inside the boundaries set by the ES.

ES18: Transfer of substance or preparation from/to large vessels/containers at dedicated facilities
Use descriptors
PROC8b. Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities
Controlling worker exposure for transfer of substance or preparation from/ to large vessels/ containers at dedicated facilities
Product characteristics
Borates are granular powders.
Amounts used
The amount of borate delivered at any one time will depend on the size of the plant and the substance or preparation being manufactured. Each road tanker normally contains about 25-40 tonnes.
Frequency and duration of use
The frequency and duration of use will depend on the substance or preparation being produced. For some, deliveries are made every day, or several times a day, while for others it is a weekly or monthly process. The duration of the off-loading activity lasts for one to two hours per road tanker. *Some sites take borates in pallets of 25kg bags, which may occur as infrequently as once or twice per year, while for others it is a weekly process.*
Human factors not influenced by risk management
None
Other given operational conditions affecting workers' exposure
The tasks are carried out outdoors so deliveries are made at ambient temperature.
Technical conditions and measures at process level (source) to prevent release
The transfer of borate is made pneumatically. A flexible hose is connected from the road tanker to the plant pipework. The borate is then pumped to the plant silos using either the motor on the road tanker or using onsite pumps. The system is therefore closed and there is little opportunity for worker exposure. The connection and disconnection of the flexible pipework takes one or two minutes, and this is the only opportunity for potential exposure to the borate. *Borates arriving by pallet are taken from the truck into the warehouse using a forklift truck.*
Technical conditions and measures to control dispersion from source towards the worker
The receiving silos are fitted with filters to prevent the dispersion of borate with the displaced air from the top of the silos.
Organisational measures to prevent/limit releases, dispersion and exposure
Training of operatives and regular testing and maintenance of plant and equipment.
Conditions and measures related to personal protection, hygiene and health evaluation
Operatives wear overalls and gloves. Eye protection should be worn where good hygiene practice requires it or substance classification demands it.
Exposure estimation and reference to its source
There is only one data point available for this activity exclusively. This value is 0.016 mgB/m^3. *The ART exposure model was used to estimate exposure during this activity. The parameters used were fine dry dust, vacuum transfer of powders, transferring 100-1000kg/minute, open process, fully enclosed process, outdoors, LEV. The estimated 90th percentile exposure to dust was 0.13mg/m^3. The boron equivalent would be in the range 0.01 – 0.03mgB/m^3 depending on the boron-containing material being off-loaded. This range accords well with the one real datapoint obtained. This value is well below the inhalation DNEL of 1.45mgB/m^3* *MEASE was used to estimate dermal exposure during this activity. The parameters used were >25% boron, PROC2, duration <15minutes, closed system without breaches, non-direct handling, incidental contact and no gloves. The estimated exposure is 0.024mgB/day. This value is well below the dermal DNEL of 4800mgB/day.* *There is no inhalation or dermal exposure risk to workers off-loading pallets of borates as the bags are sealed onto the pallets with polythene shrink wrap.*
Guidance to DU to evaluate whether he works inside the boundaries set by the ES
If the parameters used in the MEASE model outlined above do not reflect conditions at the DU facility, the DU can use MEASE and input the parameters that do reflect conditions at the DU facility to check whether the DU works inside the boundaries set by the ES.

ES21: General maintenance activities
Use descriptors
PROC8a. Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities.
PROC8b. Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities.
Controlling worker exposure for general maintenance activities
Product characteristics
Borates are granular powders. They are used in numerous processes and industries.
Amounts used
The amount of borate used at any one time will depend on the size of the plant and the substance or preparation being manufactured.
Frequency and duration of use
There are daily maintenance activities, planned maintenance and reactive maintenance on the plants.
Human factors not influenced by risk management
None
Other given operational conditions affecting worker exposure
Most tasks are carried out indoors, although there may also be outdoor activities.
Technical conditions and measures at process level (source) to prevent release
Most of the transfer of substances and the production processes are closed and automatically controlled from control cabins on the plant. Maintenance activities take place on and around the plant.
Technical conditions and measures to control dispersion from source towards the worker
Where processes are partially open, LEV is used to control exposure to fumes.
Organisational measures to prevent/limit releases, dispersion and exposure
Training of operatives and regular testing and maintenance of plant and equipment.
Conditions and measures related to personal protection, hygiene and health evaluation
Operatives wear overalls, safety shoes and when necessary to control exposure below the DNEL, P2/P3 respirators must also be worn. Eye protection should be worn where good hygiene practice requires it or substance classification demands it.
Exposure estimation and reference to its source
There are 13 datapoints for maintenance activities in closed manufacturing plants. When maintenance activities are taking place on a particular piece of plant, the plant may be opened to allow access to work, so that the normal engineering controls will not be working. The exposure data ranges from 0 to 2.66 mgB/m^3. This is a wide range and reflects the variety of work carried out by maintenance workers. The 90th percentile for these data is 1.33 mgB/m^3, which is below the inhalation DNEL of 1.45mgB/m^3. These estimates do not take into account the effect of RPE. Where engineering controls are not effective, RPE (P2/P3) must be worn to ensure inhalation exposure remains below the DNEL.Dermal exposure may occur during maintenance activities. MEASE has been used to estimate this exposure. The parameters used were high dustiness solid, 1-25% boron, PROC 8a, industrial use, 60-240 minutes, non-dispersive use, direct handling, incidental contact and no gloves worn. The estimated exposure to dust is 1.728mgB/day. This is well below the dermal (external) DNEL of 4800 mgB/day.
Guidance to DU to evaluate whether he works inside the boundaries set by the ES
If the parameters used in the MEASE model outlined above do not reflect conditions at the DU facility, the DU can use MEASE and input the parameters that do reflect conditions at the DU facility to check whether the DU works inside the boundaries set by the ES.

ES22: Transfer of substances into small containers
Use descriptors
PROC9. Transfer of substance or preparation into small containers (dedicated filling line, including weighing)
Controlling worker exposure for transfer of substances into small containers
Product characteristics
The products may be powder, liquid or paste.
Amounts used
The amount of borate in the finished substance/preparation will depend on what has been made. The range may vary from 1 to 40%, so boron content may vary from 0.11 to 8.6% and the substance may be in solid, liquid or paste form. The amount of product packaged may be tens of tonnes per day.
Frequency and duration of use
The frequency and duration of use will depend on the substance or preparation being produced. For some, batches are made every day, or several times a day, while for others it is a weekly or monthly process. Packaging activities can last from 1 hour to 8 hours.
Human factors not influenced by risk management
None
Other given operational conditions affecting worker exposure
Some packaging processes are largely automatic. For example, packaging of liquids may be automatic apart from loading the closed containers onto a pallet. Some packaging of powder or granular products into 25kg sacks may be completely automatic, or the operative may have to place the bag on the filling chute and then manually close the bag and place on a pallet.
Technical conditions and measures at process level (source) to prevent release
Not required. *Where the packaging process is completely automatic, there is a reduction in exposure to the worker as the worker is removed from the process.*
Technical conditions and measures to control dispersion from source towards the worker
Where powders are being bagged the minimum engineering control required is effective LEV in place to control inhalation exposure. *At liquid filling stations there is no requirement for LEV as there is minimal risk for exposure by inhalation unless aerosols are generated.* *Where pastes are packaged there is no likelihood of inhalation exposure so LEV is not required.*
Organisational measures to prevent/limit releases, dispersion and exposure
Training of operatives and regular testing and maintenance of plant and equipment.
Conditions and measures related to personal protection, hygiene and health evaluation
Operatives wear overalls, safety shoes and when necessary P2/P3 respirators. Eye protection should be worn where good hygiene practice requires it or substance classification demands it.
Exposure estimation and reference to its source
There are few real data for packaging boron-containing substances. There are some data for packaging borate powders in 25kg bags from the manufacturers and these can be used and adapted to take into account that the substances or preparations will contain between 1 and 40% borate. The range of personal exposure measurements is 0.02 to 1.4mg B/m^3. The range for the preparations would therefore be between 0.001 and 0.56 mg B/m^3. The 90th percentile for this range is between 0.001 and 0.4mg B/m^3 depending on the percentage borate in the preparation. This range for the 90th percentile is well below the inhalation DNEL of 1.45mg B/m^3. These figures have assumed that the packaging operations will take place for 8 hours per day. In many cases packaging may only take place for 1 or 2 hours per day, in which case exposure to boron would be lower still. These figures take into account risk management measures such as LEV, but do not take into account the effect of wearing RPE. *The ART exposure model for inhalation predicts a 90th percentile of 0.06mg/m^3 borate for filling liquids. The parameters used were falling liquids, transfer flow 10-100l/minute, open process splash loading, effective housekeeping, indoors, any size workroom, LEV and good natural ventilation. The equivalent 90th percentile for exposure to boron would be 0.01mgB/m^3. This estimate assumes exposure over an 8-hr working day. This value is well below the inhalation DNEL of 1.45mgB/m^3.* *There are no dermal exposure data available, so MEASE has been used to estimate dermal exposure during non-automated packaging of powders. The parameters used were high dustiness solid, 5-25% boron, PROC9, duration >240 minutes, non-dispersive use, direct handling, intermittent contact, integrated LEV and no use of gloves. Dermal exposure is estimated to be 1.44mgB/day. This range is well below the dermal DNEL of 4800mgB/day.* *MEASE was also used to estimate dermal exposure during the packaging of liquids. The parameters used were aqueous liquid, 5-25% boron, PROC9, duration >240 minutes, non-dispersive use, non-direct handling, incidental contact,*

integrated LEV and no gloves. Dermal exposure is estimated to be 0.144mgB/day, which is below the dermal DNEL of 4800mgB/day.
Guidance to DU to evaluate whether he works inside the boundaries set by the ES
If the parameters used in the MEASE model outlined above do not reflect conditions at the DU facility, the DU can use MEASE and input the parameters that do reflect conditions at the DU facility to check whether the DU works inside the boundaries set by the ES.

ES24 Industrial use of flux pastes to coat welding/brazing rods
Use descriptors
PROC9. Transfer of substance or preparation into small containers (dedicated filling line, including weighing)
PROC14. Production of preparations or articles by tabletting, compression, extrusion, pelletisation.
Controlling worker exposure for coating of welding/brazing rods with flux paste
Product characteristics
The flux paste used to coat the rods contains 10% borate, which is equivalent to 1.48% boron.
Amounts used
The amount of flux paste used to coat rods is hundreds of tonnes per year.
Frequency and duration of use
The coating of welding/brazing rods may take place on a daily basis in some plants, while at other plants it may be carried out weekly or even monthly.
Human factors not influenced by risk management
None
Other given operational conditions affecting workers' exposure
The coating of rods takes place indoors in ambient conditions.
Technical conditions and measures at process level (source) to prevent release
The extrusion and coating process is carried out in an enclosed system under pressure.
Technical conditions and measures to control dispersion from source towards the worker
None
Organisational measures to prevent/limit releases, dispersion and exposure
Training of operatives.
Conditions and measures related to personal protection, hygiene and health evaluation
Operatives wear work clothes. Operatives wear RPE (P3) to prevent inhalation exposure to dust, and suitable gloves when handling paste and packing coated rods. Eye protection should be worn where good hygiene practice requires it or substance classification demands it.
Exposure estimation and reference to its source
There are no exposure data available. *Inhalation exposure will not occur during loading of the paste into the extrusion press. Some exposure may occur during the packing of the dried, coated rods.* *ART was used to estimate inhalation exposure during the packing of coated rods into bags. The parameters used were coarse, dry, residual dust on solid objects, normal handling, effective housekeeping with no localised controls, in any size workroom with no restriction on general ventilation characteristics. The model gives an estimate of 90th percentile inhalable borate (as B) of 0.043mgB/m^3, 8-hr TWA. This is well below the inhalation DNEL of 1.45mgB/m^3, 8-hr TWA. Dermal exposure was estimated using MEASE. The parameters used were massive object, 1-5% boron, PROC 9, industrial use, >240 minutes, nondispersive use, direct handling, extensive contact and no gloves. Dermal exposure was estimated to be 4.8 mgB/day. This value is below the dermal (external) DNEL of 4800 mgB/day.*
Guidance to DU to evaluate whether he works inside the boundaries set by the ES
If the parameters outlined above do not reflect conditions at the DU facility, the DU can use MEASE and input the parameters that do reflect conditions at the DU facility to check whether the DU works inside the boundaries set by the ES.

ES29: Galvanising, plating and other surface treatment of metal articles (including cleaning processes)
Use descriptors
PROC13. Treatment of articles by dipping and pouring.
Controlling worker exposure for galvanising, plating and other surface treatment of metal articles (including cleaning processes)
Product characteristics
The amount of borate in plating solutions is between 3.5 and 5% borate/boric acid. This is equivalent to less than 1% boron.
Amounts used
The amount of borate in plating baths will vary depending on the size of the bath but is in the region of 25-200kg, giving a concentration of approximately 1% boron in the plating solution.
Frequency and duration of use
The treatment baths can be used up to 24 hours per day. In some cases the articles are automatically dipped, but in other cases, the components are taken out of the bath in a basket and turned manually. It is estimated that over a shift this task may take up to 1 hour.
Human factors not influenced by risk management
None
Other given operational conditions affecting workers' exposure
The tasks are carried out indoors. *The baths are operated at about 60°C*
Technical conditions and measures at process level (source) to prevent release
None
Technical conditions and measures to control dispersion from source towards the worker
Canopy hoods over the baths capture and remove steam.
Organisational measures to prevent/limit releases, dispersion and exposure
Training of operatives and regular testing and maintenance of plant and equipment.
Conditions and measures related to personal protection, hygiene and health evaluation
Operatives wear chemical resistant overalls and chemical-resistant gloves. Eye protection should be worn where good hygiene practice requires it or substance classification demands it.
Exposure estimation and reference to its source
There are no specific data for the use of borates in treatment baths. Inhalation exposure is unlikely as there is no aerosol generated during this activity. *The dermal exposure was estimated using MEASE. The estimation took into account the potential for exposure when manually turning components.* *The parameters used were liquid, less than 1% boron, PROC 4, industrial use, 15-60 minutes, non-dispersive use, direct handling, intermittent exposure and no gloves. The estimated exposure for this activity was 0.048mgB/day. This is well below the dermal dose DNEL of 4800mg/day.*
Guidance to DU to evaluate whether he works inside the boundaries set by the ES
If the parameters outlined above do not reflect conditions at the DU facility, the DU can use MEASE and input the parameters that do reflect conditions at the DU facility to check whether the DU works inside the boundaries set by the ES

ES32: Working in a laboratory
Use descriptors
PROC15. Use as laboratory reagent.
Controlling worker exposure for working in a laboratory
Product characteristics
Borates are granular powders.
Amounts used
Samples of about 1kg are taken at borate processing and refining plants and also for quality control purposes at sites receiving borates, but only a few grams are used in quality control tests. Small amounts of borates may be used as analytical reagents in a wide variety of laboratories.
Frequency and duration of use/exposure
Technicians in quality control laboratories may spend a few minutes weighing borate samples each day, which is the only source of exposure, as the samples are normally collected by the plant operatives. The frequency of use of borates in other laboratories will be variable, but is unlikely to be daily.
Human factors not influenced by risk management
None
Other given operational conditions affecting workers' exposure
Very small quantities are used, and tests are often carried out in fume cupboards.
Technical conditions and measures at process level (source) to prevent release
None
Technical conditions and measures to control dispersion from source towards worker
Some tests are carried out in fume cupboards.
Organisational measures to prevent/limit releases, dispersion and exposure
Training of operatives and regular testing and maintenance of plant and equipment.
Conditions and measures related to personal protection, hygiene and health evaluation
Operatives wear laboratory coats, safety shoes and gloves. Eye protection should be worn where good hygiene practice requires it or substance classification demands it.
Exposure estimation and reference to its source
There are 18 datapoints for laboratory technicians. The range of results was 0 to 0.2mgB/m3, 8-hr TWA The 90th percentile for this dataset was 0.16 mgB/m^3, which is well below the inhalation DNEL of 1.45 mgB/m^3.As there are no real data for dermal exposure during this activity, MEASE has been used to estimate dermal exposure. The parameters used for estimating dermal exposure during laboratory work were; a high dustiness solid, with 5-25% boron, PROC 15, duration 15-60 minutes, nondispersive use, non-direct handling, incidental contact, integrated LEV and no gloves. The estimated dermal exposure is 0.014mgB/day. This value is well below the dermal DNEL of 4800mgB/day.
Guidance to DU to evaluate whether he works inside the boundaries set by the ES
If the parameters used in the MEASE model outlined above do not reflect conditions at the DU facility, the DU can use MEASE and input the parameters that do reflect conditions at the DU facility to check whether the DU works inside the boundaries set by the ES.

ES40: Industrial/professional use of fluxes in welding/brazing
Use descriptors
PROC25. Other hot work operations with metals.
Controlling worker exposure for use of fluxes in welding/brazing
Product characteristics
The flux paste used when welding or brazing contains 10% borate, which is equivalent to 1.48% boron.
Amounts used
The amount of flux paste used will depend on the frequency of use of welding/brazing rods requiring the use of the flux. Anmually it is likely to amount to several kgs per welder.
Frequency and duration of use
In an industrial setting, welding is likely to take place on a daily, shift-length basis. *In a professional setting, welding is likely to be a less frequent, shorter duration activity.*
Human factors not influenced by risk management
None
Other given operational conditions affecting workers' exposure
Welding is likely to take place indoors in ambient conditions.
Technical conditions and measures at process level (source) to prevent release
None
Technical conditions and measures to control dispersion from source towards the worker
Local exhaust ventilation is used to control welding fume.
Organisational measures to prevent/limit releases, dispersion and exposure
Training of operatives and maintenance of equipment.
Conditions and measures related to personal protection, hygiene and health evaluation
Operatives wear work clothes. Operatives wear RPE (P3) to prevent inhalation exposure to welding fume, and suitable gloves.
Exposure estimation and reference to its source
There are no specific exposure data available. *ART cannot be used to estimate exposure during hot processes. MEASE has been used to estimate inhalation and dermal exposure. The parameters used were massive object, 1-5% boron, Industrial use, >240 minutes, wide-dispersive use, non-direct handling, intermittent contact, exterior LEV, no respirator and no gloves. The estimated inhalation exposure is 0.1 mgB/m^3, 8-hr TWA. This is well below the inhalation DNEL of 1.45mgB/m^3, 8-hr TWA.* *Dermal exposure was estimated to be 0. 198mgB/day, assuming no gloves worn. This value is below the dermal (external) DNEL of 4800 mgB/day.* *The estimated exposures reflect industrial use where welding or brazing activities will take place on a daily, shift-length basis. Exposures for professional use would be much lower, as welding is less likely to be a daily activity and would be carried out for shorter periods of time.*
Guidance to DU to evaluate whether he works inside the boundaries set by the ES
If the parameters outlined above do not reflect conditions at the DU facility, the DU can use MEASE and input the parameters that do reflect conditions at the DU facility to check whether the DU works inside the boundaries set by the ES