

27. ES 27: Use at industrial sites; Industrial use of cobalt in the production of varistors and magnets (calcination/sintering processes)

27.1. Title section

Product category: Semiconductors (PC 33)

Sector of use: Manufacture of other non-metallic mineral products, e.g. plasters, cement (SU 13), Manufacture of fabricated metal products, except machinery and equipment (SU 15), Manufacture of computer, electronic and optical products, electrical equipment (SU 16)

Environment	
1: Industrial use of cobalt in the production of varistors and magnets (calcination/sintering processes) ES1 STP Discharge	ERC 5
2: Industrial use of cobalt in the production of varistors and magnets (calcination/sintering processes) ES2 Direct Discharge	ERC 5
3: Industrial use of cobalt in the production of varistors and magnets (calcination/sintering processes) ES3 Marine Discharge	ERC 5
Worker	
4: Raw material handling	PROC 26, PROC 21, PROC 8b
5: Preparation of raw material	PROC 5, PROC 4, PROC 2, PROC 3, PROC 1
6: Wet process	PROC 4, PROC 1
7: Preparation of pre-sintered materials	PROC 26, PROC 14, PROC 5, PROC 3, PROC 8b
8: Hot process/sintering	PROC 22, PROC 1
9: Formulation and filling	PROC 9, PROC 3, PROC 8b
10: Packaging of varistors	PROC 21
11: Packaging of magnets	PROC 21
12: Cleaning & Maintenance	PROC 28
Subsequent service life exposure scenario(s)	
ES 29: Service life (worker at industrial site); Various articles; Service life of cobalt-containing varistors and magnets in industrial settings	
ES 30: Service life (professional worker); Various articles; Service life of cobalt-containing varistors and magnets in professional settings	
ES 31: Service life (consumers); Machinery, mechanical appliances, electrical/electronic articles; cobalt being encapsulated in the internal part of the product	

27.2. Conditions of use affecting exposure

27.2.1. Control of environmental exposure: Industrial use of cobalt in the production of varistors and magnets (calcination/sintering processes) ES1 STP Discharge (ERC 5)

Amount used, frequency and duration of use (or from service life)
Daily amount per site $\leq 4.1E-3$ tonnes/day
Annual amount per site ≤ 1.5 tonnes/year
Emission days ≥ 365 days/year
Technical and organisational conditions and measures
Electrostatic precipitator or wet electrostatic precipitator or cyclones or fabric/bag filter or ceramic/metal mesh filter or wet scrubber
Chemical precipitation or sedimentation or filtration or electrolysis or reverse osmosis or ion exchange
Conditions and measures related to biological sewage treatment plant
Municipal sewage treatment plant is assumed.
Assumed domestic sewage treatment plant flow $\geq 2E3$ m ³ /day
Conditions and measures related to external treatment of waste (including article waste)
Dispose of waste product or used containers according to local regulations.
Other conditions affecting environmental exposure
Local freshwater dilution factor 100
No discharge to marine water assumed

27.2.2. Control of environmental exposure: Industrial use of cobalt in the production of varistors and magnets (calcination/sintering processes) ES2 Direct Discharge (ERC 5)

Amount used, frequency and duration of use (or from service life)
Daily amount per site $\leq 4.1E-3$ tonnes/day
Annual amount per site ≤ 1.5 tonnes/year
Emission days ≥ 365 days/year
Technical and organisational conditions and measures
Electrostatic precipitator or wet electrostatic precipitator or cyclones or fabric/bag filter or ceramic/metal mesh filter or wet scrubber
Chemical precipitation or sedimentation or filtration or electrolysis or reverse osmosis or ion exchange
Conditions and measures related to external treatment of waste (including article waste)
Dispose of waste product or used containers according to local regulations.
Other conditions affecting environmental exposure
Assumed effluent discharge flow from site $\geq 2E3$ m ³ /day
No discharge to marine water assumed
Local freshwater dilution factor 100

27.2.3. Control of environmental exposure: Industrial use of cobalt in the production of varistors and magnets (calcination/sintering processes) ES3 Marine Discharge (ERC 5)

Amount used, frequency and duration of use (or from service life)
Daily amount per site $\leq 4.1E-3$ tonnes/day
Annual amount per site ≤ 1.5 tonnes/year
Emission days ≥ 365 days/year
Technical and organisational conditions and measures

Electrostatic precipitator or wet electrostatic precipitator or cyclones or fabric/bag filter or ceramic/metal mesh filter or wet scrubber
Chemical precipitation or sedimentation or filtration or electrolysis or reverse osmosis or ion exchange
Conditions and measures related to external treatment of waste (including article waste)
Dispose of waste product or used containers according to local regulations.
Other conditions affecting environmental exposure
Assumed effluent discharge flow from site $\geq 2E3$ m ³ /day
No discharge to freshwater assumed
Local marine water dilution factor 100

27.2.4. Control of worker exposure: Raw material handling (PROC 26, PROC 21, PROC 8b)

Product (article) characteristics
Maximum emission potential covered in this ES: Medium.
Concentration of the substance in mixture is not restricted.
Physical form covered in this ES: Solid, powder / dust.
Physical form of product; Massive object
Physical form covered in this ES: Aqueous solution.
Amount used (or contained in articles), frequency and duration of use/exposure
Duration of exposure: Not restricted.
Technical and organisational conditions and measures
Process is carried out at ambient temperature.
Conditions and measures related to personal protection, hygiene and health evaluation
Wear suitable gloves tested to EN374.; For further specification, refer to section 8 of the SDS.
Use suitable eye protection.; For further specification, refer to section 8 of the SDS.
APF of RPE = 10 (90% respiratory protection).
Wear protective suit conforming to EN 13982 in cases where direct contact with the substance cannot be avoided.

27.2.5. Control of worker exposure: Preparation of raw material (PROC 5, PROC 4, PROC 2, PROC 3, PROC 1)

Product (article) characteristics
Maximum emission potential covered in this ES: Very low.
Concentration of the substance in mixture is not restricted.
Physical form covered in this ES: Aqueous solution.
Amount used (or contained in articles), frequency and duration of use/exposure
Duration of exposure: Not restricted.
Technical and organisational conditions and measures
Limit the process temperature to 95 °C.
Ensure enclosure of reaction vessel.
Use of an integrated local exhaust ventilation with an efficiency of at least 90% is required.
Conditions and measures related to personal protection, hygiene and health evaluation
Wear suitable gloves tested to EN374.; For further specification, refer to section 8 of the SDS.

Use suitable eye protection.; For further specification, refer to section 8 of the SDS.
Wear respiratory protection providing a minimum assigned protection factor of 10 (a minimum efficiency of 90%) unless inhalation exposure to the substance can be excluded. For further specification, refer to section 8 of the SDS.

27.2.6. Control of worker exposure: Wet process (PROC 4, PROC 1)

Product (article) characteristics
Maximum emission potential covered in this ES: Very low.
Concentration of the substance in mixture is not restricted.
Physical form covered in this ES: Aqueous solution.
Amount used (or contained in articles), frequency and duration of use/exposure
Duration of exposure: Not restricted.
Technical and organisational conditions and measures
Process is carried out at ambient temperature.
Ensure full containment of the process.
Level of automation should be semi-automated.
Use of an integrated local exhaust ventilation with an efficiency of at least 90% is required.
Conditions and measures related to personal protection, hygiene and health evaluation
Use suitable eye protection.; For further specification, refer to section 8 of the SDS.
Wear suitable gloves tested to EN374.; For further specification, refer to section 8 of the SDS.
APF of RPE = 10 (90% respiratory protection).

27.2.7. Control of worker exposure: Preparation of pre-sintered materials (PROC 26, PROC 14, PROC 5, PROC 3, PROC 8b)

Product (article) characteristics
Maximum emission potential covered in this ES: Medium.
Concentration of the substance in mixture is not restricted.
Physical form covered in this ES: Solid, powder / dust.
Amount used (or contained in articles), frequency and duration of use/exposure
Duration of exposure: Not restricted.
Technical and organisational conditions and measures
Process is carried out at ambient temperature.
Use of a local exhaust ventilation with an efficiency of at least 78% is required.
Conditions and measures related to personal protection, hygiene and health evaluation
Wear suitable gloves tested to EN374.; For further specification, refer to section 8 of the SDS.
Use suitable eye protection.; For further specification, refer to section 8 of the SDS.
APF of RPE = 10 (90% respiratory protection).
Wear protective suit conforming to EN 13982 in cases where direct contact with the substance cannot be avoided.

27.2.8. Control of worker exposure: Hot process/sintering (PROC 22, PROC 1)

Product (article) characteristics
Maximum emission potential covered in this ES: Medium (temperature based).

Concentration of the substance in mixture is not restricted.
Physical form covered in this ES: Molten.
Physical form covered in this ES: Solid, powder / dust.
Physical form covered in this ES: Massive object.
Amount used (or contained in articles), frequency and duration of use/exposure
Duration of exposure: Not restricted.
Technical and organisational conditions and measures
Limit the process temperature to 1.6E3 °C.
Control room during furnace operations is required.
Closed furnace or well-extracted open induction furnace.
Use of an integrated local exhaust ventilation with an efficiency of at least 90% is required.
Conditions and measures related to personal protection, hygiene and health evaluation
Use suitable eye protection.; For further specification, refer to section 8 of the SDS.
Wear suitable gloves tested to EN374.; For further specification, refer to section 8 of the SDS.
APF of RPE = 10 (90% respiratory protection).

27.2.9. Control of worker exposure: Formulation and filling (PROC 9, PROC 3, PROC 8b)

Product (article) characteristics
Maximum emission potential covered in this ES: Very low.
Concentration of the substance in mixture is not restricted.
Physical form covered in this ES: Aqueous solution.
Amount used (or contained in articles), frequency and duration of use/exposure
Duration of exposure: Not restricted.
Technical and organisational conditions and measures
Process is carried out at ambient temperature.
Conditions and measures related to personal protection, hygiene and health evaluation
Wear suitable gloves tested to EN374.; For further specification, refer to section 8 of the SDS.
Use suitable eye protection.; For further specification, refer to section 8 of the SDS.
Wear respiratory protection providing a minimum assigned protection factor of 10 (a minimum efficiency of 90%) unless inhalation exposure to the substance can be excluded. For further specification, refer to section 8 of the SDS.

27.2.10. Control of worker exposure: Packaging of varistors (PROC 21)

Product (article) characteristics
Maximum emission potential covered in this ES: Very low.
Limit the concentration of the substance in mixture to <= 5 %.
Physical form covered in this ES: Bound in article.
Amount used (or contained in articles), frequency and duration of use/exposure
Duration of exposure: Not restricted.
Conditions and measures related to personal protection, hygiene and health evaluation
Wear suitable gloves tested to EN374.; For further specification, refer to section 8 of the SDS.
Use suitable eye protection.; For further specification, refer to section 8 of the SDS.

Wear respiratory protection providing a minimum assigned protection factor of 10 (a minimum efficiency of 90%) unless inhalation exposure to the substance can be excluded. For further specification, refer to section 8 of the SDS.

27.2.11. Control of worker exposure: Packaging of magnets (PROC 21)

Product (article) characteristics
Maximum emission potential covered in this ES: Very low.
Physical form covered in this ES: Massive object.
Amount used (or contained in articles), frequency and duration of use/exposure
Duration of exposure: Not restricted.
Technical and organisational conditions and measures
Process is carried out at ambient temperature.
Conditions and measures related to personal protection, hygiene and health evaluation
Wear suitable gloves tested to EN374.; For further specification, refer to section 8 of the SDS.
Use suitable eye protection.; For further specification, refer to section 8 of the SDS.
Wear respiratory protection providing a minimum assigned protection factor of 10 (a minimum efficiency of 90%) unless inhalation exposure to the substance can be excluded. For further specification, refer to section 8 of the SDS.

27.2.12. Control of worker exposure: Cleaning & Maintenance (PROC 28)

Product (article) characteristics
Maximum emission potential covered in this ES: High.
Physical form covered in this ES: Solid, powder / dust.
Amount used (or contained in articles), frequency and duration of use/exposure
Duration of exposure: Not restricted.
Technical and organisational conditions and measures
Process is carried out at ambient temperature.
Process is carried out at ambient pressure.
Maintenance and repair work only at facilities which are not in operation. Minor cleaning tasks may be conducted under operation.
Conditions and measures related to personal protection, hygiene and health evaluation
Wear suitable gloves tested to EN374.; For further specification, refer to section 8 of the SDS.
Use suitable eye protection.; For further specification, refer to section 8 of the SDS.
APF of RPE = 40 (97.5% respiratory protection).
Wear protective suit conforming to EN 13982 in cases where direct contact with the substance cannot be avoided.

27.3. Exposure estimation and reference to its source

27.3.1. Environmental release and exposure: Industrial use of cobalt in the production of varistors and magnets (calcination/sintering processes) ES1 STP Discharge (ERC 5)

Release route	Release rate	Release estimation method
Water	0.012 kg/day	Estimated release factor

Release route	Release rate	Release estimation method
Air	8.2E-3 kg/day	Estimated release factor
Soil	0 kg/day	Estimated release factor

Protection target	Exposure estimate	RCR
Fresh water	1.23E-4 mg/L (EUSES 2.1.2)	0.199
Sediment (freshwater)	5.16 mg/kg dw (PEC sediment calculation method for metals)	0.096
Sewage Treatment Plant	3.69E-3 mg/L (EUSES 2.1.2)	< 0.01
Agricultural soil	0.343 mg/kg dw (EUSES 2.1.2)	0.031
Man via environment - Inhalation	2.28E-6 mg/m ³ (EUSES 2.1.2)	< 0.01

27.3.2. Environmental release and exposure: Industrial use of cobalt in the production of varistors and magnets (calcination/sintering processes) ES2 Direct Discharge (ERC 5)

Release route	Release rate	Release estimation method
Water	0.012 kg/day	Estimated release factor
Air	8.2E-3 kg/day	Estimated release factor
Soil	0 kg/day	Estimated release factor

Protection target	Exposure estimate	RCR
Fresh water	1.39E-4 mg/L (EUSES 2.1.2)	0.224
Sediment (freshwater)	5.76 mg/kg dw (PEC sediment calculation method for metals)	0.107
Agricultural soil	0.239 mg/kg dw (EUSES 2.1.2)	0.022
Man via environment - Inhalation	2.28E-6 mg/m ³ (EUSES 2.1.2)	< 0.01

27.3.3. Environmental release and exposure: Industrial use of cobalt in the production of varistors and magnets (calcination/sintering processes) ES3 Marine Discharge (ERC 5)

Release route	Release rate	Release estimation method
Water	0.012 kg/day	Estimated release factor
Air	8.2E-3 kg/day	Estimated release factor
Soil	0 kg/day	Estimated release factor

Protection target	Exposure estimate	RCR
Marine water	0.045 µg/L (Clocal calculation with Kp susp. matter marine)	0.019
Sediment (marine water)	17 mg/kg dw (PEC sediment calculation method for metals)	0.244
Agricultural soil	0.239 mg/kg dw (EUSES 2.1.2)	0.022
Man via environment - Inhalation	2.28E-6 mg/m ³ (EUSES 2.1.2)	< 0.01

27.3.4. Worker exposure: Raw material handling (PROC 26, PROC 21, PROC 8b)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, local, long term	15.3 µg/m ³ (Measured data)	0.383

27.3.5. Worker exposure: Preparation of raw material (PROC 5, PROC 4, PROC 2, PROC 3, PROC 1)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, local, long term	12 µg/m ³ (Measured data)	0.3

27.3.6. Worker exposure: Wet process (PROC 4, PROC 1)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, local, long term	2.9 µg/m ³ (Measured data)	0.072

27.3.7. Worker exposure: Preparation of pre-sintered materials (PROC 26, PROC 14, PROC 5, PROC 3, PROC 8b)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, local, long term	18.1 µg/m ³ (Measured data)	0.453

27.3.8. Worker exposure: Hot process/sintering (PROC 22, PROC 1)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, local, long term	18.1 µg/m ³ (Measured data)	0.453

27.3.9. Worker exposure: Formulation and filling (PROC 9, PROC 3, PROC 8b)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, local, long term	10 µg/m ³ (MEASE)	0.25

27.3.10. Worker exposure: Packaging of varistors (PROC 21)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, local, long term	10 µg/m ³ (MEASE)	0.25

27.3.11. Worker exposure: Packaging of magnets (PROC 21)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, local, long term	8.6 µg/m ³ (Measured data)	0.215

27.3.12. Worker exposure: Cleaning & Maintenance (PROC 28)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, local, long term	20.2 µg/m ³ (Measured data)	0.505

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

Guidance: Please refer to Section 0.3 of this “ES for Communication”.