Manufacture and industrial use of cobalt containing alloys, steels and tools		
Systematic title based on use descriptor	SU3 (Industrial use), SU14, SU15 PC7, PC14, PC38 AC1, AC2, AC7 (appropriate PROCs are given in Section 2 below)	
2. Operational conditions and risk management measures		
Workplace	**Involved task**	**Involved PROCs**
Handling of massive materials	Unpacking, weighing, preparation of charge for furnaces	8b, 21
Melting and casting	Melting, casting, dross removal, degassing	22, 23
Finishing of massive objects	Packaging, peeling, hot rolling, forging, pickling, gouging, flame cutting, extrusion, dry honing, sectioning, cutting, crushing	13, 14, 21, 24, 25
Mechanical treatment of hard coated metals and/or alloys – low kinetic energy	Machining, dressing, polishing, stripping, boring, assembly, disassembly	21
Mechanical treatment of hard coated metals and/or alloys – high kinetic energy	Sectioning, grinding, cutting, abrasive cutting	24
Handling of powders	Packaging, furnace loading, sieving, mixing	5, 26
Powder production	Atomisation, handling in a closed system	1 (27a, 27b)
Further processing	Cold and hot isostatic pressing in a closed system	1 (24)
Thermal spraying – fully automated	Flame spraying – melt fusion, plasma spraying / high-velocity flame spraying	1 (25)
Thermal spraying – NOT fully automated	Flame spraying – melt fusion, plasma spraying / high-velocity flame spraying	25
Use of tools in industrial settings	Cutting or drilling	24
Cleaning & maintenance	Manual cleaning, repair and maintenance operations, removal of residuals from e.g. filters/overspill or as waste	8a, 26
2.1 Control of workers exposure		
Product characteristics		
Workplace	**Use in preparation and content in preparation**	**Physical form of the product**
Handling of massive materials	No restriction	Massive cobalt and massive scrap (e.g. ingots, cathodes, rounds)
melting and casting		Massive (e.g. ingots, cathodes) / Molten
Finishing of massive objects	No restriction (up to 90 %)	Massive
Mechanical treatment of hard coated metals and/or alloys – low kinetic energy	No restriction	Massive
Mechanical treatment of hard coated metals and/or alloys – high kinetic energy		Massive
Handling of powders		Scrap steel and alloy powders and solids
Powder production		Molten
Further processing		Cobalt in alloy
Thermal spraying – fully automated		Powder
Thermal spraying – NOT fully automated		Powder
Use of tools in industrial settings		Massive
Cleaning & maintenance	Not applicable	Powder, Dust
Amounts used		
No restriction.		

Frequency and duration of use/exposure
No restriction.
Human factors not influenced by risk management
The shift breathing volume 10 m³/8 h (full shift).
Other given operational conditions affecting workers exposure
Room volume not applicable, process temperature or pressure ambient or no restriction respectively for all workplace except: melting and casting, and powder production – process temperature 1500°C, further processing – process temperature 1200°C and high pressure, thermal spraying – fully automated/NOT fully automated – flame temperature up to approx. 3,100°C, sintering at 1,000°C to 1,200°C; plasma can reach temperatures up to 30,000°C and high pressure applied during plasma and high – velocity flame spraying. cleaning & maintenance - room volume no restriction, process temperature or pressure ambient (system not in operation). Indoor use.
Technical conditions and measures at process level (source) to prevent release
Melting and casting closed furnace, powder production and further processing closed system. Thermal spraying – fully automated full containment and enclosed space. Other workplace level of containment/segregation not required.
Technical conditions and measures to control dispersion from source towards the worker
Localised controls (LC) not required for all workplace except: melting and casting, handling of powders and thermal spraying – NOT fully automated (local exhaust ventilation, efficiency up to 78%), use of tools in industrial settings (local exhaust ventilation, efficiency up to 84%). Level of separation if required see frequency and duration of exposure section. Installation of ventilated (positive pressure) control rooms can also reduce exposure. Additional Information: cleaning & maintenance: maintenance and repair work only at facilities which are not in operation. Minor cleaning tasks may be conducted under operation.
Organisational measures to prevent/limit releases, dispersion and exposure
Additional information See Section: 7, 8, 11 (SDS).
Conditions and measures related to personal protection, hygiene and health evaluation

Workplace	Specification of respiratory protective equipment (RPE)	RPE efficiency (assigned protection factor, APF)	Specification of gloves and further personal protective equipment (PPE)
Handling of massive materials	No measures required	Not applicable	Since cobalt has sensitising properties, the use of suitable chemical resistant gloves (EN 374) providing protection for the duration of activity (e.g. nitrile rubber (0.4 mm), chloroprene rubber (0.5 mm), butyl rubber (0.7 mm) is a prerequisite for all process steps in which direct contact to cobalt substances is possible. In cases where direct contact with cobalt cannot be avoided, a protective suit conforming to EN13982 should be worn. As a general requirement for the conducted processes: standard working clothes (long-sleeve overall) and safety shoes.
Melting and casting			
Finishing of massive objects			
Mechanical treatment of hard coated metals and/or alloys – low kinetic energy			
Mechanical treatment of hard coated metals and/or alloys – high kinetic energy	Mask type: FFP2	APF=10	
Handling of powders	Powered filtering device incorporating a hood or a helmet, TH3	APF=40	
Powder production	No measures required	Not applicable	
Further processing			
Thermal spraying – fully automated			
Thermal spraying – NOT fully automated	Mask type: FFP3	APF=20	
Use of tools in industrial settings	No measures required	Not applicable	
Cleaning & maintenance	Mask type: FFP2 (low – medium dusty materials)	APF=10	
	Mask type: powered filtering device incorporating a hood or a helmet, TH3 (high dusty materials)	APF=40	

2.2 Control of environmental exposure

Amounts used
750 tonnes Co/annum/site
Frequency and duration of use/exposure
Continuous use/release. More than 250 days/year to the air compartment and 336 days/year to the water compartment.

Environment factors not influenced by risk management

The dilution capacity of the receiving surface water (calculated as the ratio between the flow rate of the river/lake/estuary/sea to the effluent discharge rate):

- Dilution factor for the freshwater environment (Fresh water – STP ES): 100
- Dilution factor for the freshwater environment (Fresh water – direct discharge ES): 150
- Dilution factor for the marine environment: 150

Other given operational conditions affecting environmental exposure

Not applicable.

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

Water: One or more of the following measures (as set out in the BAT Reference Document on Non-Ferrous Metal Processes), to be taken for emissions to water:

- Chemical precipitation: used primarily to remove the metal ions
- Sedimentation
- Filtration: used as final clarification step
- Electrolysis: for low metal concentration
- Reverse Osmosis (OR): extensively used for the removal of dissolved metals
- Ion exchange: final cleaning step in the removal of heavy metal from process wastewater

Air: One or more of the following measures (as set out in the BAT Reference Document on Non-Ferrous Metal Processes) to be taken for emissions to air:

- Electrostatic precipitators using wide electrode spacing: 5 – 15 mg/Nm³
- Wet electrostatic precipitators: < 5 mg/Nm³
- Cyclones, but as primary collector: < 50 mg/Nm³
- Fabric or bag filters: high efficiency in controlling fine particulate (melting): < 5mg/Nm³ (membrane filtration achieves < 1 mg/Nm³)
- Ceramic and metal mesh filters. PM10 particles are removed: 0.1 mg/Nm³
- Wet scrubbers: < 4 mg/Nm³

Soil: No measures to reduce emissions to soil

The release factors to both the water and air compartments after on-site treatment are:

- Estimated fraction released to water (g Co/tonne Co): 24.9
- Estimated fraction released to air (g Co/tonne Co): 422.1

Organisational measures to prevent/limit release from site

Please see section 8 SDS for more details.

Conditions and measures related to municipal sewage treatment plant

Two different exposure scenarios (ES) for the freshwater environment were considered. As default exposure scenario, an offsite municipal STP is included and sludge is applied to agricultural soil. As a second exposure scenario, no off-site municipal STP (direct discharge) is included and no sludge is applied to agricultural soil. For the marine environment, the ES considers no off-site municipal STP (direct discharge) treatment and no sludge application to agricultural soil. The assumption by default for the off site municipal sewage treatment plant is 2,000 m³/day. The fraction of Co removed by the municipal STP is set at 40 %.

Conditions and measures related to external treatment of waste for disposal

Suitable disposal: Wastes from onsite risk management measures and solid or liquid wastes from production, use and cleaning processes should be disposed of separately to hazardous waste incineration plants (Council Directive 2008/98/EC, Directive 2000/76/EC and BAT Reference Document 2006) or hazardous waste landfills as hazardous waste (Directive 1999/31/EC). Releases to the floor, water and soil are to be prevented. If the cobalt content of the waste is elevated enough, internal or external recovery/recycling might be considered. **Fraction of daily/annual use** expected in waste: 0.001 or 0.1%
Appropriate waste codes: 01 03 07*; 11 02 07*; 06 05 02*; 15 01 10*; 10 08 04; 10 10 11*; 12 01 03; 12 01 04; 06 03 13*; 06 03 15*; 10 10 03; 10 10 05*; 10 10 07*; 16 06 05; 16 08 02* 16 08 03

3. Exposure estimation and reference to its source

Occupational exposure

The risk characterisation ratio (RCR) is the quotient of the exposure estimate and the respective Derived No Effect Level (DNEL) and has to be below 1 to demonstrate a safe use. For inhalation exposure, the RCR is based on a DNEL for cobalt of 40 µg/m³.

Workplace	Method used for inhalation exposure assessment	Inhalation exposure estimate (RCR)	Method used for dermal exposure assessment	Dermal exposure estimate (RCR)
Handling of massive materials	analogous data	9 µg/m³ (0.225)	Since cobalt has sensitising properties, dermal exposure has to be minimised as far as technically feasible. A DNEL for dermal effects has not been derived. Thus, dermal exposure is not assessed in this exposure scenario.	
Melting and casting	measured data	2 µg/m³ (0.053)		
Finishing of massive objects	analogous data	24 µg/m³ (0.59)		
Mechanical treatment of hard coated metals and/or alloys – low kinetic energy	measured data	10 µg/m³ (0.25)		
Mechanical treatment of hard coated metals and/or alloys – high kinetic energy		29 µg/m³ (0.725)		
Handling of powders		27 µg/m³ (0.68)		
Powder production	MEASE	10 µg/m³ (0.25)		
Further processing		10 µg/m³ (0.25)		
Thermal spraying – fully automated		10 µg/m³ (0.25)		
Thermal spraying – NOT fully automated	published data	20 µg/m³ (0.49)		
Use of tools in industrial settings	analogous data	20 µg/m³ (0.5)		
Cleaning & maintenance	analogous data	21 µg/m³ (0.53) (low – medium dusty materials)		
		24 µg/m³ (0.61) (high dusty materials)		

Environmental emissions

The risk characterisation ratio (RCR) is the quotient of the local Predicted Environmental Concentration (PEC) and the respective PNEC (Predicted No Effect Concentration) and has to be below 1 to demonstrate a safe use.

Compartment	Predicted Environmental Concentration	Predicted No Effect Concentration	Risk characterisation ratio
Fresh water – STP	0.21 µg/l	0.51 µg/l	0.40
Fresh water – direct discharge	0.22 µg/l	0.51 µg/l	0.43
Sea water	0.10 µg/l	2.36 µg/l	0.04
Freshwater sediment – STP	8.31 mg/kg	9.5 mg/kg dw	0.87
Freshwater sediment – direct discharge	8.76 mg/kg	9.5 mg/kg dw	0.92
Marine water sediment	7.56 mg/kg	9.5 mg/kg dw	0.80
Terrestrial – sludge application	0.64 mg/kg	10.9 mg/kg dw	0.59
Terrestrial – no sludge application	0.12 mg/kg	10.9 mg/kg dw	0.011
Sewage treatment plant	0.017 mg/l	0.37 mg/l	0.05

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

Occupational and Environmental exposure

The DU works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the downstream user can demonstrate on his own that his operational conditions and implemented risk management measures are adequate. For human health, this has to be done by showing that they limit the inhalation exposure to a level below the DNEL (given that the processes and activities in question are covered by the PROCs listed above) as given below. If measured data are not available, the DU may make use of an appropriate scaling tool such as MEASE (www.ebrc.de/mease.html) to estimate the associated exposure. For the environment, this has to be done by showing that they limit the PEC below the PNEC for the respective environmental compartment. If measured data are not available, the DU may make use of an appropriate scaling tool such as the DU-Scaling tool (http://www.arche-consulting.be/Metal-CSA-toolbox/duscaling-tool) to estimate PEC values.