1. Title GES 40 Use of nickel metal in surface treatment for the production of abrasive tools	Version 1, 2015
Life cycle	End use – DU of Ni metal in abrasive tool production
Free short title	Use of nickel metal in the abrasive tool production – nickel electroplating and electroless plating
Systematic title based on use descriptor	SU: SU 3: Industrial use SU 15: Manufacture of fabricated metal products SU 17: General manufacturing, e.g. machinery, equipment, vehicles, other transport equipment PC: PC 14: Metal surface treatment products, including galvanic and electroplating products ERC: ERC5:Industrial use resulting in inclusion into or onto a matrix **PROC**: PROC 3: Use in closed batch process (synthesis or formulation) PROC 4: Use in batch and other process where opportunity for exposure arises PROC 5: Mixing or blending in batch processes for formulation of preparations and articles (multistage and/or significant contact) PROC 8a: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities PROC 8b:Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities PROC 13: Treatment of articles by dipping and pouring PROC 15: Use as a laboratory reagent PROC 0: Cleaning and maintenance
Processes, tasks, activities covered (environment)	Use of nickel metal in the abrasive tool production – nickel electroplating and electroless plating
Processes, tasks, activities covered (workers)	Contributing exposure scenario CES 40.1 PROC 3, PROC 4, PROc 5, PROC 8a, PROC 8b , PROC 13, PROC 15 : Use of nickel metal in abrasive tool production (nickel plating) - Raw materials handling - Addition of Ni anode to tank solution - Addition of abrasives to tank solution - Dipping items with surfaces to be cleaned, prepared and coated into solutions - Tank rinsing and manual hosing down treated of coated items - Removal of coated items from jigs or barrels - Removal and treatment of spent solution and dirty rinse water from tanks - Testing solution composition - Polishing the plate on coated workpieces - Testing the quality and thickness of the plate - Packaging of finished items Contributing exposure scenario CES 40.2: PROC 0: - Cleaning and maintenance of plant and premises and of anodes
2. Operational conditions and risk management measures	
2.1 Control of environmental exposure	
Environmental related free short title	Use of nickel metal in the abrasive tool production – nickel electroplating and electroless plating
Systematic title based on use descriptor (environment)	ERC5: Industrial use resulting in inclusion into or onto a matrix
Processes, tasks, activities covered (environment)	Metal surface treatment – nickel electroplating, electroless (chemical) nickel plating
Environmental Assessment Method	Estimates based on monitoring local and regional concentrations are used for

	calculation of PEC
Product characteristics	
Ni metal: Pellets, rounds, other shaped pieces or preformed electrodes	
Amounts used	
Maximum daily use at a site	ES 1: 0.001 tonnes/day ES 2: 0.015 tonnes/day
Maximum annual use at a site	ES 1: 0.2 tonnes Ni; Direct discharge ES 2: 3 tonnes Ni; No discharge to water
Frequency and duration of use	
Pattern of release to the environment	Water: 200 days per year per site Air: 200 days per year per site
Environment factors not influenced by risk management	
Receiving surface water flow rate	ES 1: direct discharge: 18000 m3/d (Effluent Site: 2000 m3/d) ES 2: no discharge to water
Dilution capacity, freshwater	ES 1: 10 (default) ES 2: no discharge to water
Dilution capacity, marine	-
Other given operational conditions affecting environmental exposure	
None	
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	
Waste water: Direct water emissions should be reduced by implementing one or more of the following RMMs: Chemical precipitation, sedimentation, filtration, electrolysis, reverse osmosis or ion exchange. Reported RRM efficiency is between 98.6 and 99.9 % (typical 99.1%) ES1 freshwater direct discharge: 5000 g/T (spERC metalic coating v2.1, 2013) ES2 no discharge to water: 0 g/T **Air:** Direct air emissions should be reduced by implementing one or more of the following RMMs: Electrostatic precipitators, wet electrostatic precipitators, cyclones, fabric or bag filters, ceramic and metal mesh filters, or wet scrubbers. Reported RMMs efficiency is between 95 and > 99% ES1 & 2 Release factor after on-site treatment: 2000 g/T (spERC metalic coating v2.1, 2013)	
Organizational measures to prevent/limit release from site	
None	
Conditions and measures related to municipal sewage treatment plant	
Municipal Sewage Treatment Plant (STP)	No
Discharge rate of the Municipal STP	-
Incineration of the sludge of the Municipal STP	-
Conditions and measures related to external treatment of waste for disposal	
Hazardous 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 or hazardous waste landfills as hazardous waste. Releases to the floor, water and soil are to be prevented. If the nickel content of the waste is elevated enough, internal or external recovery/recycling might be considered. **Fraction of daily/annual use** expected in waste: - Nickel producers = 0.05 % - DU: stainless steel and alloy steels = 0.6 % - DU: nickel alloys, copper alloys, foundry, batteries, catalysts, chemicals, dyes and others = 0.5 % - DU: Plating = 3%	

Appropriate waste codes:

01 03 07*, 02 01 10*, 06 03 13*, 06 03 15*, 06 04 05*, 06 05 02*, 10 08 04, 10 08 08*, 10 08 09, 10 08 15*, 10 08 16, 10 10 03, 10 10 05*, 10 10 07*, 10 10 09*, 10 10 10, 10 10 11*, 11 02 07*, 12 01 03*, 12 01 04, 15 01 04*, 15 01 10*, 16 01 04*, 16 01 06*, 16 01 08*, 16 06 02*, 16 06 05, 16 08 02*, 16 08 03*, 17 04 07*, 17 04 09*, 19 09 04*, 19 10 02*, 19 12 03*

Suitable disposal: Keep separate and dispose of to either

- Hazardous waste incineration operated according to Council Directive 2008/98/EC on waste, Directive 2000/76/EC on the incineration of waste and the Reference Document on the Best Available Techniques for Waste Incineration of August 2006.
- Hazardous landfill operated under Directive 1999/31/EC.

Conditions and measures related to external recovery of waste	
Shredders pre-treating metal wastes should have a maximum release factors to air of 0.0015 after RMM and no releases to water and soil. Qmax, local(shredding)=26kg Ni/day (Note: This Qmax, local for shredders is based on the existing information at the moment of the update. It will be reviewed when new information is available from the BREF for shredding)	
2.2 Control of workers exposure for contributing exposure scenario CES 40.1	
Nickel plating of abrasive tools	
Workers related free short title	Use of nickel metal in the brasive tool production – nickel electroplating and electroless plating
Use descriptor covered	PROC 3: Use in closed batch process (synthesis or formulation)} opportunity for exposure arises PROC 4: Use in batch and other process where opportunity for exposure arises PROC 5: Mixing or blending in batch processes for formulation of preparations and articles (multistage and/or significant contact) PROC 8a: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities PROC 8b:Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities PROC 13: Treatment of articles by dipping and pouring PROC 15: Use as a laboratory reagent
Processes, tasks, activities covered	- Raw materials handling - Addition of Ni anode to tank solution - Dipping items with surfaces to be cleaned, prepared and coated into solutions - Tank rinsing and manual hosing down treated of coated items - Removal of coated items from jigs or barrels - Removal and treatment of spent solution and dirty rinse water from tanks - Testing solution composition - Packaging finished product
Assessment Method	Estimation of dermal exposure using a Tier 1 model (MEASE) Estimation of inhalation exposure based on measured data (CES 40.1) and the MEASE (CES 40.2)
Product characteristic	
Ni metal: Pellets, rounds, other shaped pieces or preformed 'pole' electrodes	
Amounts used	
Not relevant	
Frequency and duration of use/exposure	
Ni metal would normally be added to the tank on an 'as needed basis' and it may be months between additions.	
Human factors not influenced by risk management	
Respiration volume under conditions of use	Light to medium level work is routinely undertaken ~10 m^3/d

Room size and ventilation rate	Not relevant
Area of skin contact with the substance under conditions of use	240, 480 & 960 cm^2 depending on task
Body weight	70 kg
Other given operational conditions affecting workers exposure	
Nickel as raw material is handled dry at ambient temperature and humidity Oral: Good workplace hygiene practice	
Technical conditions and measures at process level (source) to prevent release	
Anodes should be bagged where possible to prevent the release of Ni particles, dust or chips into the tank solution which are then contacted by workers. Anode stubs, removed from the tank solution during anode replacement, should not be left lying around the shop floor and RPE should be used if dust is released during the cutting of stubs for recycling in anode baskets. Oral: Good workplace hygiene practice.	
Technical conditions and measures to control dispersion from source towards the worker	
LEV is required for handling Ni anodes when they are friable and dusty and give rise to airborne dust when handled.	
Organisational measures to prevent /limit releases, dispersion and exposure	
Regular training in good work hygiene practices and proper use of PPE.	
Conditions and measures related to personal protection, hygiene and health evaluation	
Inhalation: Air-assisted filtering visor, masks or hood with P2 filter element (Assigned Protection Factor ~10 based on use of powered respirator meeting EN12492 requirement) or equivalent suitable respirator) is required for addition tasks during routine pH adjustment where exposure to nickel-containing mist or dust is possible. Air-assisted filtering visor, masks or hood with P3 filter element (Assigned Protection Factor ~20 based on use of powered respirator meeting EN12492 requirement or FFP3 (EN149) or equivalent suitable respirator) is required for emergencies and non-routine tasks where exposure to nickel-containing mist or dust is possible. Dermal: Use of suitable chemical gloves (EN 374, protection level 6, PVC or equivalent) goggles and special safety clothing is required to control dermal exposure Protective equipment should be chosen based on activities being undertaken, potential for exposure to airborne nickel and other relevant workplace hazards and may include protective suit with hood (conforming to EN13982-1 Type 5), safety shoes (e.g. according to EN 20346).	
2.3 Control of workers exposure for contributing exposure scenario CES 40.2	
Cleaning and maintenance	
Workers related free short title	Use of nickel metal in the abrasive tool production – nickel electroplating and electroless plating
Use descriptor covered	PROC 0: Cleaning and maintenance
Processes, tasks, activities covered	Cleaning and maintenance of plant, anodes and premises
Assessment Method	Estimation of dermal and inhalation exposure using a Tier 1 model (MEASE)
Product characteristic	
Nickel-containing dusts from electrolytic solutions made from Ni metal as pellets, rounds, other shaped pieces or preformed (pole) electrodes	
Amounts used	
Not relevant	
Frequency and duration of use/exposure	
Duration of exposure during cleaning and maintenance is considered to average 1 hour per day for surface finishing including tank emptying, refilling tank solutions and replenishing tank solutions. Frequency of replacement of anodes in the bath depends on process and through-put rate of plated items down the line and is an anode is likely to last for months.	
Human factors not influenced by risk management	
Respiration volume under conditions of use	Light to medium level work is routinely undertaken ~10 m^3/d
Room size and ventilation rate	Not relevant
Area of skin contact with the substance under conditions of use	960 cm^2
Body weight	70 kg
Other given operational conditions affecting workers exposure	
Oral: Good workplace hygiene practice	
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 (on the few occasions where it is appropriate) and general exhaust ventilation.
Vacuuming or suitable wet removal methods for cleaning settled dust etc. from plant and premises. Avoid inappropriate cleaning methods such as dry brushing

Organisational measures to prevent /limit releases, dispersion and exposure

Regular training in good work hygiene practices and proper use of PPE.

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

Inhalation to mists and particulates and skin exposure to mists, liquids splashes and particulates shall be controlled by RPE and gloves when undertaking maintenance and cleaning work.
Inhalation: Use of air-assisted filtering visor, masks or hood with P3 filter element for plant or premises heavily contaminated with nickel-containing dust or spills {APF 20 or 40 based on use of powered respirator meeting EN12492 or EN12941 requirement or FFP3 (EN136) or equivalent suitable respirator}. RPE with a lower APF of 10 {air-assisted filtering visor, masks or hood with P2 filter element including powered respirators meeting the EN12492 TM1 or EN 12941 TH1 requirement or the FFP2 (EN149) or equivalent suitable respirator} may be used for cleaning and maintenance work where the plant or premises is less heavily contaminated with nickel-containing dust or spills. It is important to note that the disposable mask FFP1 (with APF = 4) is not recommended for use with Ni-containing dust.
Dermal: Use of suitable chemical gloves (EN 374, protection level 6, PVC or equivalent) goggles and special safety clothing is required to control dermal exposure Protective equipment should be chosen based on activities being undertaken, potential for exposure to airborne nickel and other relevant workplace hazards and may include protective suit with hood (conforming to EN13982-1 Type 5), safety shoes (*e.g.* according to EN 20346).

3. Exposure and risk estimation

Environment

ERC 5
Metal surface treatment– nickel electroplating, electroless (chemical) nickel plating

Compartment	Unit	PNEC	$PEC_{Regional}$	C_{local}	PEC	RCR	Methods for calculation of environmental concentrations
ES 1: Freshwater direct discharge							Measured values, Tier 3-RWC
Freshwater	µg Ni/L	7.1	2.9	0.18	3.08	0.43	
Sediment	mg Ni/kg	136	33.5	4.7	38.2	0.28	
Terrestrial	mg Ni/kg	29.9	16.2	< 0.01	16.2	0.54	
ES 2: No discharge to water							
Terrestrial	mg Ni/kg	29.9	16.2	< 0.01	16.2	0.54	

Workers

CES 40.1
PROC 3, 4, 5, 8a, 8b, 13, 1: Ni plating of abrasive tools

	Unit	DNEL	Exposure concentration	RCR	Methods for calculation of exposure
Dermal	mgNi/kg/day				
Acute systemic					
Acute local	$mgNi/cm^2/day$	-	NR		
Long-term systemic	mgNi/kg/day	-	NR		
Long-term local	$mgNi/cm^2/day$	0.035	0.0011	0.0031	Read-across from (modeled 90th percentile exposure estimate) GES 10: Use of nickel metal in metal surface treatment: nickel electroplating, nickel electroforming, electroless nickel plating, 2015

Inhalation					
Acute local	mgNi/m^3	4.0	0.060	0.015	3 x estimated (read-across) long-term exposure
Long-term systemic and local	mgNi/m^3	0.05	0.02	0.4	Based on read-across from Ni metal surface finishing (GES 10: Use of nickel metal in surface treatment: nickel electroplating, nickel electroforming, electroless nickel plating, CES 10.1 Surface finishing, 2015
CES 40.2 PROC 0: Cleaning and maintenance					
	Unit	DNEL	Exposure concentration	RCR	Methods for calculation of exposure
Dermal					
Acute systemic	mgNi/kg/day	-	NR		
Acute local	mgNi/cm^2/day	-	NR		
Long-term systemic	mgNi/kg/day	-	NR		
Long-term local	mgNi/cm^2/day	0.035	0.00001	0.0003	90th percentile exposure estimate using MEASE for PROC 10 {Ni content >25% massive metal, industrial, incidental exposure, NDU, NDH, duration 15-60 minutes, GV, gloves}
Inhalation					
Acute local	mgNi/m^3	4.0	1.71	0.43	3 x long term exposure
Long-term systemic and local	mgNi/m^3	0.05	0.57 0.029	11.4 (excluding RPE) 0.57 By use of RPE (APF = 20)	<u>For exposure to Ni dust</u> 90th percentile exposure estimate using MEASE for PROC 10 {Ni content >25% of solid medium dustiness powder, industrial, incidental exposure, NDU, NDH, duration 15-60 minutes, GV, RPE, gloves} and <u>For exposure to massive Ni</u> Read-across from (modeled 90th percentile exposure estimate) GES 4: Nickel sulphate in metal surface treatment: nickel electroplating, nickel electroforming, electroless nickel plating for $NiSO_4$ (2015 update)

NR: Not Relevant

Acute local inhalation
DNEL based on respirable size aerosols. Equivalent inhalable fraction levels expected to be at least 3-fold higher

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

Environment

Scaling tool: Metals EUSES IT tool (free download: http://www.arche-consulting.be/Metal-CSA-toolbox/du-scaling-tool)

Scaling of the release to air and water environment includes:
Refining of the release factor to air and waste water and/or and the efficiency of the air filter and wastewater treatment facility.

Scaling of the PNEC for aquatic environment by using a tiered approach for correction for bioavailability and background concentration (C_{local} approach).

Scaling of the PNEC for soil compartment by using a tiered approach for correction for bioavailability and background concentration (C_{local} approach).

Workers

Scaling considering duration and frequency of use
Collect process monitoring data with an inhalable sampler. The simultaneous use of a respirable sampler is encouraged. Use aerosol particle size information, when available, to confirm the appropriate use of the inhalable DNEL of 0.05 mg Ni/m^3.
Respirable fraction exposure levels should be kept below 0.01 mg Ni/m^3.

For further information and guidance on exposure scenarios, available tools, and scaling options, please visit the Nickel Consortia exposure scenario library at the following link: http://www.nickelconsortia.eu/exposure-scenario-library.html

Man via Environment exposure and risk characterisation assessments for the use of nickel metal in surface treatment for the production of abrasive tools

Inhalation is the critical exposure pathway for humans via the environment. The PEC for air at site neighbouring residential areas should be lower than the chronic inhalation DNEL for the general public of 20 ng Ni/m^3 as annual average in PM_{10} in order to demonstrate adequate control of risk (RCR < 1) for Man via the Environment (MvE).

Hereto a Generic safe use Exposure Scenario for MvE was developed based on the EUSES model. The MvE GES is defined as the product of tonnage (T) and emission factor to air (EF) being lower than 18000 g Ni/year. The value of 18000 g Ni/year is derived by using EUSES model to back-calculate the product of T and EF that results in a local air concentration (C_{local}) of 15.5 ng Ni/m^3. The value of 15.5 is derived from the difference between the DNEL of 20 ng Ni/m^3 and the EU regional background concentration ($C_{regional}$) of 4.5 ng Ni/m^3 (P90 annual concentration for 2012).

Generic safe use ES for all sectors according to Tier 1 (EUSES model)

Sector	Tonnage (Ni T /year)	Emission factor (g Ni/T)	Tonnage × emission factor (g /year)	C_{local} (ng/m^3)	$C_{regional}$ (ng/m^3)	PEC_{local} (ng/m^3)	RCR = PEC/DNEL (DNEL= 20 ng/m^3)
All	T	EF	T × EF < 18000	<15.5	4.5*	<20	<1

**: EU average of country P90 annual Ni concentrations (2012)*

If a site is not compliant with these conditions, meaning that the product of tonnage and emission factor is above 18000 g Ni/year, a tiered approach including site-specific modelling can be applied to demonstrate safe use