

1. Title		Version 5, 2015
GES 33 Machining of nickel alloys and nickel-coated metal objects		
Life cycle	DU of Ni Metal	
Free short title	Machining of nickel alloys and nickel-coated metal objects	
Systematic title based on use descriptor	SU: Not relevant PC: Not relevant ERC: ERC 12a: Industrial processing of articles with abrasive techniques (low release) ERC 12b: Industrial processing of articles with abrasive techniques (high release) PROC: PROC 21: low energy manipulation of substances bound in materials and / or articles PROC 24: High (mechanical) energy work-up of substances bound in materials and/or articles PROC 0: Cleaning and maintenance	
Processes, tasks, activities covered (environment)		
Processes, tasks, activities covered (workers)	Contributing exposure scenario ES 33.1 PROC 21: Raw materials handling Contributing exposure scenario ES 33.2 PROC 24: Machining operations Contributing exposure scenario ES 33.3 PROC 0: Cleaning and maintenance	
2. Operational conditions and risk management measures		
2.1 Control of environmental exposure		
Environmental related free short title	Machining of nickel alloys	
Systematic title based on use descriptor (environment)	ERC 12a: Industrial processing of articles with abrasive techniques (low release) ERC 12b: Industrial processing of articles with abrasive techniques (high release)	
Processes, tasks, activities covered (environment)	Handling of Ni alloys Machining of the Ni alloys (including cutting and dry honing) Cleaning and maintenance	
Environmental Assessment Method	Estimates based on monitoring local and regional concentrations for the steel sector are used for calculation of PEC	
Product characteristics		
Ni is in solid form. 50-70% in concentration.		
Amounts used		
Maximum daily use at a site	38.4 tonnes (median days and 50 th percentile tonnage)	
Maximum annual use at a site	ES 1, 2 & 3: 14,000 tonnes (50 th percentile from the Ni RAR, 2008/2009)	
Frequency and duration of use		
Pattern of release to the environment	365 days per year per site (median)	
Environment factors not influenced by risk management		
Receiving surface water flow rate	ES 1: Discharge to STP: 48,000 m3/d (Effluent STP: 2000 m3/d) ES 2 : Direct discharge: 198,000 m3/d (Effluent Site: 2000 m3/d)	
Dilution capacity, freshwater	ES 1: Discharge to STP: 25 ES 2: Direct discharge: 100	
Dilution capacity, marine	ES3: Marine discharge: 100 (default)	
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:		

On-site wastewater treatment by chemical precipitation, sedimentation, filtration, electrolysis, coagulation, oiling removal, reverse osmosis or ion exchange. Off-site wastewater treatment in municipal STP for ES1 (Efficiency 40 %).
 ES 1 Discharge to STP: Release factor after on-site treatment based on 75th % from the Ni RAR, 2008/2009: 7.25 g Ni/T
 ES 2 Direct discharge: Release factor after on-site treatment based on 75th % from the Ni RAR, 2008/2009: 7.25 g Ni/T
 ES 3 Marine discharge: Release factor after on-site treatment based on 75th % from the Ni RAR, 2008/2009: 7.25 g Ni/T

Air:

Treatment of air emission by use of fabric or bag filters, wet scrubbers, ceramic filters, dry or semi-dry scrubbers, electrostatic precipitation.

ES 1, 2 & 3: Release factor after on-site treatment based on 75th percentile from the Ni RAR, 2008/2009: 31.55 g Ni/T

Organizational measures to prevent/limit release from site

None

Conditions and measures related to municipal sewage treatment plant

Municipal Sewage Treatment Plant (STP)	Yes for ES 1 Discharge to STP
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Discharge rate of the Municipal STP	2000 m ³ /d (default)
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Incineration of the sludge of the Municipal STP	The sludge is applied to agricultural soil
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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.

Q_{max}, local(shredding)=26kg Ni/day

(Note: This Q_{max}, 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 ES 33.1

Raw material handling

Workers related free short title	Machining of nickel alloys and nickel-coated metal objects
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Use descriptor covered	PROC 21: low energy manipulation of substances bound in materials and/or articles.
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Processes, tasks, activities covered	Raw material handling operations involve manual handling of nickel alloys and
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	nickel-coated objects such as feeding into machinery and removal of objects after machining operations. The objects vary in size and shape depending on the facility.
Assessment Method	Exposure estimated using a Tier 1 model
Product characteristic	
Ni is in solid form. 50-70% in concentration.	
Amounts used	
Not relevant	
Frequency and duration of use/exposure	
8 hour shifts. The length of actual physical contact with raw materials depends upon the scale of machining and size of the object. Contact with raw materials may be transitory (~1 min several times throughout the shift).	
Human factors not influenced by risk management	
Respiration volume under conditions of use	Light to medium level work, 10 m ³ /d
Room size and ventilation rate	Not relevant
Area of skin contact with the substance under conditions of use	1980 cm ²
Body weight	70 kg
Other given operational conditions affecting workers exposure	
The extent and duration of contact with raw materials depends upon the method and scale of the machining process, ranging from very small parts lifted by hand for short periods of time throughout the shift to large parts lifted with equipment resulting in little contact. Use of coolant on machined parts also reduces potential risk by reducing dustiness. Maintain clean workplace to prevent accumulation of powders and dusts on surfaces.	
Technical conditions and measures at process level (source) to prevent release	
<u>Dermal</u> : Automation of processes should be used when appropriate to reduce dermal contact.	
Technical conditions and measures to control dispersion from source towards the worker	
LEV is required	
Organisational measures to prevent /limit releases, dispersion and exposure	
None	
Conditions and measures related to personal protection, hygiene and health evaluation	
<u>Dermal</u> : Gloves voluntary where direct contact with Ni coated surface could occur.	
2.3 Control of workers exposure for contributing exposure scenario ES 33.2	
Machining operations.	
Workers related free short title	Machining of nickel alloys and nickel-coated metal objects
Use descriptor covered	PROC 26: Handling of solid inorganic substances at ambient temperature.
Processes, tasks, activities covered	Cutting and dry honing operations including machining using a machine tool (lathe, milling machine, CNC, etc), and grinding/polishing operations
Assessment Method	Estimation of inhalation exposure based on measured data. Estimation of dermal exposure based on Tier 1 model.
Product characteristic	
Ni is in solid form. 50-70% in concentration.	
Amounts used	
Not relevant	
Frequency and duration of use/exposure	
8 hour shifts. The duration of contact and number of contact events is dependent upon the specific machining process and level of automation. Workers are not exposed throughout the shift period.	
Human factors not influenced by risk management	
Respiration volume under conditions of use	Not relevant
Room size and ventilation rate	Not relevant
Area of skin contact with the substance under conditions of use	1980 cm ²
Body weight	Not relevant
Other given operational conditions affecting workers exposure	
Machining operations involve application of various tools (including automated, semi-automated, and manual) on a solid object to obtain a desired geometry and dimensions. The operations include cutting, drilling and honing. Machining operations that involve cutting or sawing may generate metal dust which may pose inhalation exposure risk. Minimal or no exposure is expected when the process is fully-automated. During the fully-automated operations, the machine holds the parts. In addition, operators	

avoid the contact with objects during the machining operation due to physical hazard. Maintain clean workplace to prevent accumulation of powders and dusts on surfaces							
Technical conditions and measures at process level (source) to prevent release							
Dermal: Automation of processes should be used where appropriate to reduce potential dermal contact.							
Inhalation: Enclosure of machining process should be used where appropriate to reduce inhalation exposure to Ni metal.							
Technical conditions and measures to control dispersion from source towards the worker							
LEV is required for process steps involving operations that generate metal dust.							
Organisational measures to prevent /limit releases, dispersion and exposure							
None							
Conditions and measures related to personal protection, hygiene and health evaluation							
Inhalation: Use of RPE (FFP3, APF 20) is required when process is not fully enclosed or automated or when operator is required to enter the enclosure during operation.							
Dermal: Gloves are voluntary where direct contact with Ni metal may occur.							
2.4 Control of workers exposure for contributing exposure scenario ES 33.3							
Cleaning and maintenance							
Workers related free short title	Machining of nickel alloys and nickel-coated metal objects						
Use descriptor covered	PROC 0: Cleaning and maintenance						
Processes, tasks, activities covered	Cleaning and maintenance						
Assessment Method	Estimation of dermal exposure based on Tier 1 model.						
Product characteristic							
Ni is present in solid and granular form. 50-70% in concentration.							
Amounts used							
Not relevant							
Frequency and duration of use/exposure							
8 hour shifts. Actual duration of exposure may be lower depending on duties to be carried out.							
Human factors not influenced by risk management							
Respiration volume under conditions of use	Light to medium level work, 10 m ³ /						
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							
Cleaning and maintenance work of plant and premises can include scheduled regular and intermittent/occasional tasks of long and short duration which may lead to exposure to Ni metal dust.							
Maintain clean workplace to prevent accumulation of powders and dusts on surfaces.							
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							
Use vacuum, pressure washing with water, or other similar methods to remove Ni powder and dust during cleaning.							
Organisational measures to prevent /limit releases, dispersion and exposure							
None							
Conditions and measures related to personal protection, hygiene and health evaluation							
Inhalation: Use of RPE (FFP3, APF 20) is required.							
Dermal: Gloves suitable for handling powders and other suitable protective clothing are required where direct contact with Nickel containing particles could occur							
3. Exposure and risk estimation							
Environment							
ERC 12a, 12b Machining of nickel alloys							
Compartment	Unit	PNEC	PEC _{Regional}	C _{local}	PEC	RCR	Methods for calculation of environmental concentrations

ES 1: Freshwater STP discharge							Measured values, Tier 3-RWC (Ni RAR 2008/2009)
Freshwater	µg Ni/L	7.1	2.9	2.39	5.29	0.75	
STP	mg Ni/L	0.33	-	-	0.083	0.25	
Sediment	mg Ni/kg	136	33.5	62.9	96.4	0.71	
Terrestrial	mg Ni/kg	29.9	16.2	2.75	18.95	0.63	
ES 2: Freshwater direct discharge							
Freshwater	µg Ni/L	7.1	2.9	1.00	3.90	0.55	
Sediment	mg Ni/kg	136	33.5	26.2	59.7	0.44	
Terrestrial	mg Ni/kg	29.9	16.2	0.15	16.35	0.55	
ES 3: Marine direct discharge							
Marine water	µg Ni/L	8.6	0.3	1.00	1.30	0.15	
Sediment	mg Ni/kg	136	16.1	26.2	42.3	0.31	
Terrestrial	mg Ni/kg	29.9	16.2	0.15	16.35	0.55	

Workers

ES 33.1

PROC 21: Raw materials handling

	Unit	DNEL	Exposure concentration	RCR	Methods for calculation of exposure
Dermal					
Acute systemic	mg Ni /kg/day	-	NR	-	
Acute local	mg Ni/cm ² /day	-	NR	-	
Long-term systemic	mg Ni /kg/day	-	NR	-	
Long-term local	mg Ni/cm ² /day	0.035	0.005	0.14	Exposure estimated using MEASE for PROC 21 (massive solid, Ni present in >25% concentration, Industrial use, greater than 4 hours of operation, non-dispersive use, direct handling, intermittent exposure, no gloves).
Inhalation					
Acute local	mg Ni/m ³	4.0	0.033	0.008	3 x the long-term exposure estimate.
Long-term systemic and local	mg Ni/m ³	0.05	0.011	0.22 (excluding RPE)	Exposure estimated using MEASE for PROC 21 (massive solid, Ni present in >25% concentration, Industrial use, greater than 4 hours of operation, non-dispersive use, direct handling, intermittent exposure, LEV)

ES 33.2

PROC 26: Machining operations

	Unit	DNEL	Exposure concentration	RCR	Methods for calculation of exposure
Dermal					
Acute systemic	mg Ni /kg/day	-	NR	-	
Acute local	mg Ni/cm ² /day	-	NR	-	

Long-term systemic	mg Ni /kg/day	-	NR	-	
Long-term local	mg Ni/cm ² /day	0.035	0.005	0.14	Exposure estimated using MEASE for PROC 24 (low dustiness solid, Ni present in >25% concentration, Industrial use, greater than 4 hours of operation, non-dispersive use, non-direct handling, intermittent exposure, no gloves).
Inhalation					
Acute local	mg Ni/m ³	4.0	0.59	0.148	Maximum of 5 measurements from short-term personal monitoring taken during machining operations.
Long-term systemic and local	mg Ni/m ³	0.05	0.03	0.6	Maximum of 5 measurements from long-term personal monitoring taken during machining operations.
ES 33.3					
PROC 0: Cleaning and maintenance					
	Unit	DNEL	Exposure concentration	RCR	Methods for calculation of exposure
Dermal					
Acute systemic	mg Ni /kg/day	-	NR	-	
Acute local	mg Ni/cm ² /day	-	NR	-	
Long-term systemic	mg Ni /kg/day	-	NR	-	
Long-term local	mg Ni/cm ² /day	0.035	0.0005	0.014	Exposure estimated using MEASE for PROC 10 (low dustiness solid, Ni present in >25% concentration, Industrial use, greater than 4 hours of operation, non-dispersive use, non-direct handling, intermittent exposure, and properly designed gloves).
Inhalation					
Acute local	mg Ni/m ³	4.0	0.33	0.0825	3 x the long-term exposure estimate.
Long-term systemic and local	mg Ni/m ³	0.05	0.11	2.2 excluding RPE By use of RPE (APF 20): 0.11	Exposure estimated using MEASE for PROC 10 (low dustiness solid, Ni present in >25% concentration, Industrial use, greater than 4 hours of operation, non-dispersive use, non-direct handling, intermittent exposure, LEV).
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/m³.

Respirable fraction exposure levels should be kept below 0.01 mg Ni/m³.

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 machining of nickel alloys and nickel-coated metal objects

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/m³ as annual average in PM₁₀ 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/m³. The value of 15.5 is derived from the difference between the DNEL of 20 ng Ni/m³ and the EU regional background concentration ($C_{regional}$) of 4.5 ng Ni/m³ (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