

1. Title		Version 6, 2015
GES 7 Production of nickel-containing pigments		
Life cycle	Industrial use – DU of NiO	
Free short title	Production of nickel-containing inorganic pigments from NiO	
Systematic title based on use descriptor	<p>SU: SU 3 Industrial use SU 9 Manufacture of fine chemicals</p> <p>PC: PC 19 Intermediates</p> <p>ERC: ERC 6a: Industrial use resulting in manufacture of another substance (use of intermediates) SPERC for the production and formulation stage of metal compounds</p> <p>PROC: PROC 2 Use in closed, continuous process with occasional controlled exposure (e.g. sampling) PROC 8b Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities PROC 9 Transfer of substance or preparation into small containers (dedicated filling line, including weighing) PROC 22: Potentially closed processing operations with minerals/metals at elevated temperature PROC 24 High mechanical energy workup of substances bound in materials or articles PROC 26 Handling of solid inorganic substances at ambient temperature</p>	
Processes, tasks, activities covered (environment)	Production of inorganic pigments: Dosing and mixing; Drying (if wet mixing); Calcination (charge); Calcination (discharge); Milling (dry or wet); Washing (optional); Drying (if washed); Mixing and/or packaging; Laboratory; Cleaning and maintenance	
Processes, tasks, activities covered (workers)	Contributing exposure scenario ES 7.1 PROC 8b: Raw materials handling Contributing exposure scenario ES 7.2 PROC 2, PROC 26: Mixing raw materials Contributing exposure scenario ES 7.3 PROC 22: Drying and Calcining product Contributing exposure scenario ES 7.4 PROC 24: Dry milling Contributing exposure scenario ES 7.5 PROC 24: Wet milling, Washing and Drying Contributing exposure scenario ES 7.6 PROC 9: Blending and packaging Contributing exposure scenario ES 7.7 PROC 0: Cleaning and maintenance	
2. Operational conditions and risk management measures		
2.1 Control of environmental exposure		
Environmental related free short title	Production of nickel-containing inorganic pigments from NiO	
Systematic title based on use descriptor (environment)	ERC 6a: Industrial use resulting in manufacture of another substance (use of intermediates) SPERC data for metals and metal compounds for the production and formulation stage of metal compounds such as pigments.	
Processes, tasks, activities covered (environment)	Production of inorganic pigments: Dosing and mixing; Drying (if wet mixing); Calcination (charge); Calcination (discharge); Milling (dry or wet); Washing (optional); Drying (if washed); Mixing and/or packaging; Laboratory; Cleaning and maintenance	
Environmental Assessment Method	Estimates based on monitoring local and regional concentrations are used	

	for calculation of PEC. SPERCS data for metal and metal compounds are used in order to estimate releases to wastewater for a generic ES with discharge to municipal STP.
Product characteristics	
The tonnage is based on Ni originating from the use of NiO as well as other Ni compounds used at same sites.	
Amounts used	
Maximum daily use at a site	0.45 tonnes (median 50 th % emission days, max tonnage)
Maximum annual use at a site	ES1, 2 & 3: 156 tonnes Ni (max)
Frequency and duration of use	
Pattern of release to the environment	346 days per year per site (median 50 th %)
Environment factors not influenced by risk management	
Receiving surface water flow rate	ES 1 Discharge to STP: 18,000 m ³ /d (Effluent STP: 2000 m ³ /d) ES 2 Direct discharge: 29,700 m ³ /d (Effluent Site: 300 m ³ /d)
Dilution capacity, freshwater	ES 1 Discharge to STP: 10 ES 2 Direct discharge: 100
Dilution capacity, marine	ES 3 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: ES 1 Discharge to STP: On-site wastewater treatment by chemical precipitation and filtration. (Efficiency: 90%) and Off-site wastewater treatment plant, municipal STP for ES 1 (Efficiency 40%) ES 1 Freshwater discharge to STP: Release factor after on-site treatment: 140 g/T ES 2 Freshwater direct discharge: Release factor after on-site treatment: 140 g/T ES 3 Marine direct discharge: Release factor after on-site treatment: 140 g/T Air: Treatment of air emissions by fabric or bag filters. ES 1, 2 & 3: Release factor to air after on-site treatment: 45 g/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
Discharge rate of the Municipal STP	2000 m ³ /d (default)
Incineration of the sludge of the Municipal STP	The sludge is applied to agricultural soil
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 %	

<ul style="list-style-type: none"> - 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% <p>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*</p> <p>Suitable disposal: Keep separate and dispose of to either</p> <ul style="list-style-type: none"> - 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 ES 7.1	
Raw materials handling	
Workers related free short title	Production of nickel-containing inorganic pigments from NiO
Use descriptor covered	PROC 8b Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities PROC 26 Handling of solid inorganic substances at ambient temperature
Processes, tasks, activities covered	Raw materials handling – reception and preparation of NiO
Assessment Method	Estimation of inhalation exposure based on measured data. Estimation of dermal exposure based on Tier 1 model.
Product characteristic	
NiO is supplied as finely divided powder which is prepared as a solution / slurry for pigment processing	
Amounts used	
Frequency and duration of use/exposure	
The raw materials handling process lasts for between an hour over every 8 hour shift and up to the full 8 hour shift.	
Human factors not influenced by risk management	
Respiration volume under conditions of use	Respiration volume under conditions of use
Room size and ventilation rate	Room size and ventilation rate
Area of skin contact with the substance under conditions of use	Area of skin contact with the substance under conditions of use
Body weight	Body weight
Other given operational conditions affecting workers exposure	
Manual opening of NiO bags and manual tipping or automatic discharge of NiO powders and other ingredients, including water, into the reactor Oral: Good workplace hygiene practice.	
Technical conditions and measures at process level (source) to prevent release	
<u>Inhalation</u> : The manual opening of bags and tipping of the NiO powder from the bags into the reactor is likely to give rise to	

<p>significant exposures to inhalable NiO.</p> <p>The automated closed conveying of NiO feedstock into reactors and wetting of this powder is unlikely to give rise to significant exposures to inhalable NiO.</p> <p>The process needs to be ventilated where not fully enclosed in order to control inhalation exposure to NiO dust. <u>Dermal</u>: The manual opening of bags and tipping of the NiO powder from the bags into the reactor is likely to give rise to significant dermal exposures to NiO dust.</p> <p>Containment and automation of the processes should be used where possible to eliminate dermal contact.</p>	
Technical conditions and measures to control dispersion from source towards the worker	
LEV is required for processes that are not fully enclosed and are likely to give rise to NiO dust, such as opening of bags, charging of reactors or preparing suspensions of solid NiO.	
Organisational measures to prevent /limit releases, dispersion and exposure	
Training to reinforce good workplace hygiene practice and hygiene issues.	
Conditions and measures related to personal protection, hygiene and health evaluation	
<p>Inhalation: Powered respirators with mask or hood (EN12941:1998, TM2 or 12492:1998, TH2) or disposable FFP3 respirator (EN 149:2001) is required at process steps that are not fully enclosed and are likely to give rise to Ni dust or fumes. It is important to note that the disposable mask FFP1 (with APF = 4) is not recommended for use with Ni-containing dust.</p> <p>Dermal: Suitable gloves (EN 374, protection level 6, PVC or equivalent), goggles and special safety clothing are required. Other protective equipment should be chosen based on activities being undertaken, potential for exposure to airborne NiSO₄ and other relevant workplace hazards may include protective suit with hood (conforming to EN13982-1 Type 5), safety shoes (e.g. according to EN 20346).</p>	
2.3 Control of workers exposure for contributing exposure scenario ES 7.2	
Mixing raw materials	
Workers related free short title	Production of nickel-containing inorganic pigments from NiO
Use descriptor covered	<p>PROC 2: Use in closed, continuous process with occasional controlled exposure (e.g. sampling)</p> <p>PROC 5 Mixing or blending in batch processes for formulation of preparations* and articles (multistage and/or significant contact)</p> <p>PROC 8b Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities</p> <p>PROC 26: Handling of solid inorganic substances at ambient temperature</p>
Processes, tasks, activities covered	Wet or dry automatic mixing of raw materials
Assessment Method	<p>Estimation of inhalation exposure based on read across measured data.</p> <p>Estimation of dermal exposure based on Tier 1 model.</p>
Product characteristic	
NiO in a solution/slurry and/or wet powder mixture (other pigment ingredients as dry powder mixture)	
Amounts used	
Frequency and duration of use/exposure	
The raw materials mixing process lasts for between an hour over every 8 hour shift and up to the full 8 hour shift.	
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	480 cm ²
Body weight	Not relevant
Other given operational conditions affecting workers exposure	
Dry or wet mixing together (stirring solutions or suspensions) of all raw materials in a closed reactor	

Oral: Good workplace hygiene practice.	
Technical conditions and measures at process level (source) to prevent release	
<p><u>Inhalation</u>: The automated closed conveying of product mix from the wet process is unlikely to give rise to significant exposures to inhalable NiO. Automated open conveying of product mix from the dry process may give rise to significant exposures to inhalable NiO.</p> <p>The process needs to be ventilated where not fully enclosed in order to control inhalation exposure to NiO dust</p> <p><u>Dermal</u>: Containment of the processes should be used where possible to eliminate dermal contact</p>	
Technical conditions and measures to control dispersion from source towards the worker	
LEV is required for processes that are not automated or enclosed and are likely to give rise to NiO dust, such as open conveying of dry product mix.	
Organisational measures to prevent /limit releases, dispersion and exposure	
Training to reinforce good workplace hygiene practice and hygiene issues.	
Conditions and measures related to personal protection, hygiene and health evaluation	
<p><u>Inhalation</u>: Powered respirators with mask or hood (EN12941:1998, TM2 or 12492:1998, TH2) or disposable FFP3 respirator (EN 149:2001) is required at process steps that are not fully enclosed and are likely to give rise to Ni dust or fumes. It is important to note that the disposable mask FFP1 (with APF = 4) is not recommended for use with Ni-containing dust.</p> <p><u>Dermal</u>: Suitable gloves (EN 374, protection level 6, PVC or equivalent), goggles and special safety clothing are required. Other protective equipment should be chosen based on activities being undertaken, potential for exposure to airborne NiSO₄ and other relevant workplace hazards may include protective suit with hood (conforming to EN13982-1 Type 5), safety shoes (e.g. according to EN 20346).</p>	
2.4 Control of workers exposure for contributing exposure scenario ES 7.3	
Drying and calcining of product	
Workers related free short title	Production of nickel-containing inorganic pigments from NiO
Use descriptor covered	<p>PROC 2 Use in closed, continuous process with occasional controlled exposure (e.g. sampling)</p> <p>PROC 4 Use in batch and other process (synthesis) where opportunity for exposure arises</p> <p>PROC 9 Transfer of substance or preparation into small containers (dedicated filling line, including weighing)</p> <p>PROC 22: Potentially closed processing operations with minerals/metals at elevated temperature</p>
Processes, tasks, activities covered	Drying and calcining of wet product mix or calcining of dry product mix
Assessment Method	<p>Estimation of inhalation exposure based on read across measured data.</p> <p>Estimation of dermal exposure based on Tier 1 model.</p>
Product characteristic	
NiO-containing wet precursor (granules or slurry) and dry Ni-containing product mixture	
Amounts used	
Frequency and duration of use/exposure	
Drying and calcining of product is continuous between 4 and 24 hours per day.	
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	Up to 1980 cm ²
Body weight	Not relevant
Other given operational conditions affecting workers exposure	

Continuous and automated drying and calcining operation can be performed in tunnel ovens or rotary kilns. During operation of the 'discontinuous' drying and calcining processes, the mixture of raw materials is (manually or automatically) loaded into crucibles and conveyed through the oven on wagons. Then the calcined product is unloaded (manually or automatically) from the crucible and transferred to milling.

Oral: Good workplace hygiene practice.

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

Inhalation: The calcining of product mix where ovens are not fully enclosed and where there are manual interventions is likely to give rise to significant exposures to inhalable Ni-containing dust. Automated open conveying of product from the calciner may give rise to significant exposures to inhalable Ni-containing dust.

The process needs to be ventilated where not fully enclosed in order to control inhalation exposure to Ni-containing dust.

Dermal: Automation and containment of the processes should be used where possible to eliminate dermal contact

Technical conditions and measures to control dispersion from source towards the worker

LEV is required for processes not fully enclosed and likely to give rise to Ni-containing dust, such as calcining the product in crucibles in a tunnel oven

Organisational measures to prevent /limit releases, dispersion and exposure

Training to reinforce good workplace hygiene practice and hygiene issues.

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

Inhalation: Powered respirators with mask or hood (EN12941:1998, TM2 or 12492:1998, TH2) or disposable FFP3 respirator (EN 149:2001) is required at process steps that are not fully enclosed and are likely to give rise to Ni dust or fumes. It is important to note that the disposable mask FFP1 (with APF = 4) is not recommended for use with Ni-containing dust.

Dermal: Suitable gloves (EN 374, protection level 6, PVC or equivalent), goggles and special safety clothing are required. Other protective equipment should be chosen based on activities being undertaken, potential for exposure to airborne NiSO₄ and other relevant workplace hazards may include protective suit with hood (conforming to EN13982-1 Type 5), safety shoes (e.g. according to EN 20346).

2.5 Control of workers exposure for contributing exposure scenario ES 7.4

Dry milling

Workers related free short title	Production of nickel-containing inorganic pigments from NiO
Use descriptor covered	PROC 22: Potentially closed processing operations with minerals/metals at elevated temperature PROC 24 High mechanical energy workup of substances bound in materials or articles (PROC 2 Used in closed, continuous process with occasional controlled exposure)
Processes, tasks, activities covered	Milling of calcined product to a powder
Assessment Method	Estimation of inhalation exposure based on read across measured data. Estimation of dermal exposure based on Tier 1 model.
Product characteristic	
Solid Ni-containing calcined product	
Amounts used	
Frequency and duration of use/exposure	
Dry milling of product is continuous over every 8 hour shift	
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	480, 1980 cm ²
Body weight	Not relevant
Other given operational conditions affecting workers exposure	
The dry calcined product is milled in an enclosed ball mill and conveyed to packaging.	

Oral: Good workplace hygiene practice.	
Technical conditions and measures at process level (source) to prevent release	
<p><u>Inhalation</u>: Not fully enclosed powder transfer operations and continuously operating mills are likely to give rise to significant exposures to inhalable Ni-containing dust. The process needs to be ventilated where not fully enclosed in order to control inhalation exposure to Ni-containing dust and, where possible, mills segregated from other production processes.</p> <p><u>Dermal</u>: Automation of processes should be used where possible to eliminate dermal contact.</p>	
Technical conditions and measures to control dispersion from source towards the worker	
LEV is required for processes not fully enclosed and that are likely to give rise to Ni-containing dust	
Organisational measures to prevent /limit releases, dispersion and exposure	
Training to reinforce good workplace hygiene practice and hygiene issues.	
Conditions and measures related to personal protection, hygiene and health evaluation	
<p><u>Inhalation</u>: Powered respirators with mask or hood (EN12941:1998, TM2 or 12492:1998, TH2) or disposable FFP3 respirator (EN 149:2001) is required at process steps that are not fully enclosed and are likely to give rise to Ni dust or fumes. It is important to note that the disposable mask FFP1 (with APF = 4) is not recommended for use with Ni-containing dust.</p> <p><u>Dermal</u>: Suitable gloves (EN 374, protection level 6, PVC or equivalent), goggles and special safety clothing are required. Other protective equipment should be chosen based on activities being undertaken, potential for exposure to airborne Ni-containing dust and other relevant workplace hazards may include protective suit with hood (conforming to EN13982-1 Type 5), safety shoes (e.g. according to EN 20346).</p>	
2.6 Control of workers exposure for contributing exposure scenario ES 7.5	
Wet milling, Washing and Drying	
Workers related free short title	Production of nickel-containing inorganic pigments from NiO
Use descriptor covered	PROC 22: Potentially closed processing operations with minerals/metals at elevated temperature PROC 24 High mechanical energy workup of substances bound in materials or articles (PROC 2 Used in closed, continuous process with occasional controlled exposure)
Processes, tasks, activities covered	Calcined NiO products containing salts are ground wet, washed to eliminate excess of soluble salts and dried
Assessment Method	Estimation of inhalation exposure based on read across measured data. Estimation of dermal exposure based on Tier 1 model.
Product characteristic	
Solid Ni-containing calcined product	
Amounts used	
Frequency and duration of use/exposure	
Wet milling, washing and drying of product is continuous over every 8 hour shift	
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	
The dry calcined product is milled wet then washed and dried (atomisers, jet drier) where the plant is largely enclosed. Oral: Good workplace hygiene practice.	
Technical conditions and measures at process level (source) to prevent release	
<u>Inhalation</u> : Not fully enclosed operations for powder drying and transfer are likely to give rise to significant exposures to	

inhalable Ni –containing dust. The process needs to be ventilated where not fully enclosed in order to control inhalation exposure to Ni-containing dust.	
<u>Dermal</u> : Automation of processes should be used where possible to eliminate dermal contact.	
Technical conditions and measures to control dispersion from source towards the worker	
LEV is required for processes not fully enclosed and likely to give rise to Ni-containing dust	
Organisational measures to prevent /limit releases, dispersion and exposure	
Training to reinforce good workplace hygiene practice and hygiene issues.	
Conditions and measures related to personal protection, hygiene and health evaluation	
Inhalation: Powered respirators with mask or hood (EN12941:1998, TM2 or 12492:1998, TH2) or disposable FFP3 respirator (EN 149:2001) is required at process steps that are not fully enclosed and are likely to give rise to Ni dust or fumes. It is important to note that the disposable mask FFP1 (with APF = 4) is not recommended for use with Ni-containing dust.	
Dermal: Suitable gloves (EN 374, protection level 6, PVC or equivalent), goggles and special safety clothing are required. Other protective equipment should be chosen based on activities being undertaken, potential for exposure to airborne NiSO ₄ and other relevant workplace hazards may include protective suit with hood (conforming to EN13982-1 Type 5), safety shoes (e.g. according to EN 20346).	
2.7 Control of workers exposure for contributing exposure scenario ES 7.6	
Blending and packaging	
Workers related free short title	Production of nickel-containing inorganic pigments from NiO
Use descriptor covered	PROC 2 Use in closed, continuous process with occasional controlled exposure (e.g. sampling) PROC 9 Transfer of substance or preparation into small containers (dedicated filling line, including weighing)
Processes, tasks, activities covered	The calcined powder product is blended with additives and packed (bags or big bags)
Assessment Method	Estimation of inhalation exposure based on read across measured data. Estimation of dermal exposure based on read across from similar process for Ni metal.
Product characteristic	
Ni-containing powder pigment	
Amounts used	
Frequency and duration of use/exposure	
Packaging of pigment is continuous over every 8 hour shift	
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	Not relevant
Body weight	Not relevant
Other given operational conditions affecting workers exposure	
Oral: Good workplace hygiene practice	
Technical conditions and measures at process level (source) to prevent release	
<u>Inhalation</u> : Automated drum and big bag filling with some manual interventions (such as loading of empty /unloading of full drums, closing of lids and manually adding or removing pellets/powder to achieve the correct mass) during the filling of drums with Ni-containing pigment) are likely to give rise to significant exposures to Ni-containing powder and dust. The process needs to be ventilated where not fully enclosed in order to control inhalation exposure to Ni-containing dust.	
<u>Dermal</u> : Automation of processes should be used where possible to eliminate dermal contact.	
Technical conditions and measures to control dispersion from source towards the worker	

LEV is required for processes not fully enclosed and that are likely to give rise to Ni-containing dust	
Organisational measures to prevent /limit releases, dispersion and exposure	
Training to reinforce good workplace hygiene practice and hygiene issues.	
Conditions and measures related to personal protection, hygiene and health evaluation	
Inhalation: Powered respirators with mask or hood (EN12941:1998, TM2 or 12492:1998, TH2) or disposable FFP3 respirator (EN 149:2001) is required at process steps that are not fully enclosed and are likely to give rise to Ni dust or fumes. It is important to note that the disposable mask FFP1 (with APF = 4) is not recommended for use with Ni-containing dust. Dermal: Suitable gloves (EN 374, protection level 6, PVC or equivalent), goggles and special safety clothing are required. Other protective equipment should be chosen based on activities being undertaken, potential for exposure to airborne NiSO ₄ and other relevant workplace hazards may include protective suit with hood (conforming to EN13982-1 Type 5), safety shoes (e.g. according to EN 20346).	
2.8 Control of workers exposure for contributing exposure scenario ES 7.7	
Cleaning and maintenance	
Workers related free short title	Production of nickel-containing inorganic pigments from NiO
Use descriptor covered	PROC 0: Cleaning and maintenance
Processes, tasks, activities covered	Cleaning and maintenance operations are regularly performed on-site. This involves cleaning and maintenance of equipment and installations used for handling of raw materials and final product
Assessment Method	Estimation of inhalation exposure and dermal exposure based on Tier 1 model.
Product characteristic	
Variable, includes Ni-containing powders and more coarse residues	
Amounts used	
Frequency and duration of use/exposure	
The cleaning and maintenance activities last for between up to an hour over every 8 hour shift and up to the full 8 hour 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	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 (where appropriate) and general exhaust ventilation. Vacuuming or suitable wet removal methods for cleaning settled dust f etc. from plant and premises. Avoid inappropriate cleaning methods such as dry brushing.	
Organisational measures to prevent /limit releases, dispersion and exposure	
Training to reinforce good workplace hygiene practice and hygiene issues.	
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. <u>Inhalation:</u> 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 based on use of powered respirator meeting EN12492 requirement or FFP3	

(EN149) 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.

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 NiO, Ni-containing dusts 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

ERC2, SPERC: Production and formulation of metal compounds
Production of nickel-containing inorganic pigments from NiO

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
Freshwater	µg Ni/L	7.1	2.9	1.36	4.26	0.60	
STP	mg Ni/L	0.33	-	-	0.019	0.06	
Sediment	mg Ni/kg	136	33.5	35.7	69.2	0.51	
Terrestrial	mg Ni/kg	29.9	16.2	0.59	16.79	0.56	
ES 2: Freshwater direct discharge							
Freshwater	µg Ni/L	7.1	2.9	1.51	4.41	0.62	
Sediment	mg Ni/kg	136	33.5	39.7	73.2	0.54	
Terrestrial	mg Ni/kg	29.9	16.2	<0.01	16.20	0.54	
ES 3: Marine direct discharge							
Marine water	µg Ni/L	8.6	0.3	1.51	1.81	0.21	
Sediment	mg Ni/kg	136	16.1	39.7	55.8	0.41	
Terrestrial	mg Ni/kg	29.9	16.2	<0.01	16.20	0.54	

Workers

ES 7.1

PROC 8b, PROC 26: Raw Materials Handling

	Unit	DNEL NiO	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	0.012	0.00005	0.004	90 th percentile exposure estimate modelled using MEASE for PROC 8b & 26 {Ni content >25%, industrial, NDU, NDH, incidental exposure, LEV, ESWOB, duration >240 minutes, gloves}
Inhalation					
Acute local	mg Ni/m ³	3.9	0.018	0.005	Estimated as 3x the long-term value.
Long-term systemic and local	mg Ni/m ³	0.05	0.65 0.033	13 (excl. RPE) 0.66 By use of RPE	90 th percentile exposure estimate modelled using MEASE for PROC 8b & 26 {Ni content >25%, industrial, NDU, NDH,,

				(APF =20)	LEV, ESWOB, duration >240 minutes, gloves}
ES 7.2					
PROC 2, PROC 5, PROC 8b, PROC 26: Mixing raw materials					
	Unit	DNEL NiO	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	0.012	0.00005	0.004	90 th percentile exposure estimate modelled using MEASE for PROC 2, 5, 8b, 26 {Ni content >25%, industrial, NDU, NDH, LEV, ESWOB, duration >240 minutes, gloves}
Inhalation					
Acute local	mg Ni/m ³	3.9	0.009	0.002	Estimated as 3x the long-term value.
Long-term systemic and local	mg Ni/m ³	0.05	0.003	0.06	75 th percentile value from 8 personal exposure measurements
ES 7.3					
PROC 2, PROC 4, PROC 9, PROC 22: Drying and calcining product					
	Unit	DNEL NiO	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	0.012	0.00005	0.004	90 th percentile exposure estimate modelled using MEASE for PROC 2, 4, 9, 22 {Ni content >25%, industrial, NDU, NDH, intermittent EV, ESWOB, duration >240 minutes, gloves}
Inhalation					
Acute local	mg Ni/m ³	3.9	0.06	0.015	3 x long term exposure measurement for charging
Long-term systemic and local	mg Ni/m ³	0.05	0.02	0.4	Undefined 'average' based on 8 personal exposure measurements for charging (highest of 8 composite measured values)
ES 7.4					

(PROC 2) PROC 22, PROC 24: Dry Milling					
	Unit	DNEL NiO	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	0.012	0.00003	0.003	90 th percentile from MEASE modelling (PROC 2, 22, & 24{Ni content 5-25%, industrial, NDU, NDH, incidental exposure, LEV, ESWOB, duration >240 minutes, gloves})
Inhalation					
Acute local	mg Ni/m ³	3.9	0.12	0.03	Estimated as 3x the long-term value. A factor of 3 was considered sufficient to account for the limited dataset.
Long-term systemic and local	mg Ni/m ³	0.05	0.04	0.8	Based on a single personal exposure measurement, reported for milling and verified by MEASE modelling
ES 7.5					
PROC 22, PROC 24: Wet milling, washing and drying					
	Unit	DNEL NiO	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	0.012	0.00003	0.003	90 th percentile from MEASE modelling (PROC 22, & 24{Ni content 5-25%, solid low dustiness, industrial, NDU, NDH, incidental exposure, LEV, ESWOB, duration >240 minutes, gloves})
Inhalation					
Acute local	mg Ni/m ³	3.9	0.012	3.1 x 10 ⁻³	Estimated as 3x the long-term value. A factor of 3 was considered sufficient to account for the limited dataset.
Long-term systemic and local	mg Ni/m ³	0.05	0.004	0.08	Based on a single personal exposure measurement for drying final product

ES 7.6 PROC 2, PROC 9: Mixing and/or packaging					
	Unit	DNEL NiO	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	0.012	0.00029	0.024	Read across 75 th percentile for personal exposure measurement (hands & arms) for insoluble nickel) reported for an analogous operation for packaging of NiSO ₄ ·6H ₂ O and Ni Hydroxycarbonate
Inhalation					
Acute local	mg Ni/m ³	3.9	0.3	0.08	10 x long term exposure measurement based on handling powders during packaging. A factor of 10 was considered sufficient to account for the limited dataset.
Long-term systemic and local	mg Ni/m ³	0.05	0.03	0.6	Based on a single personal exposure measurement for mixing and/or packaging
ES 7.7 PROC 0: Cleaning and Maintenance					
	Unit	DNEL NiO	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	0.012	0.00003	0.003	90 th percentile exposure estimate modelled using MEASE for PROC 10 {Ni content >25%, industrial, NDU, NDH, incidental exposure, duration 60 - 240 minutes, gloves}
Inhalation					
Acute local	mg Ni/m ³	3.9	1.026	0.26	3 x modelled exposure value
Long-term systemic	mg Ni/m ³	0.05	0.34	6.8 (excl.	90 th percentile from

and local			0.0342	RP)E 0.68 By use of RPE (APF =10)	MEASE modelling
			0.0171	0.34 By use of RPE (APF = 20)	
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

<p>Environment</p> <p>Scaling tool: Metals EUSES IT tool (free download: http://www.arche-consulting.be/Metal-CSA-toolbox/du-scaling-tool)</p> <p>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.</p> <p>Scaling of the PNEC for aquatic environment by using a tiered approach for correction for bioavailability and background concentration (C_{local} approach).</p> <p>Scaling of the PNEC for soil compartment by using a tiered approach for correction for bioavailability and background concentration (C_{local} approach).</p> <p>Workers</p> <p>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.</p> <p>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</p>

Man via Environment exposure and risk characterisation assessments for the production of nickel-containing pigments

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