

Material Safety Data Sheet

In Accordance with MOEL Public notice No 2020-130 MSDS Number: AA06900-000000311 Issue date: 6/28/1996 Revision date: 11/22/2021 Version: 6.0

1. Chemical product and company identification

1.1. Product identifier

Product form : Mixture

Trade name : K-316LT

Product code : KISWEL_MIX_94

1.2. Recommended uses and restrictions

Use Categories

35 - Welding and soldering products, flux products

1.2.1. Recommended use

Welding and soldering products, flux products.

1.2.2. Restrictions on use

1.3. Supplier information

- Supplier

Company : KISWEL

Address : (51544) South Korea 704, Gongdan-ro, Seongsan-gu, Changwon-si, Gyeongnam, Korea

Tel. : 055)269-7200 Fax : 055)266-4487

2. Hazards identification

2.1. Classification of the substance or mixture

Respiratory sensitisation, Category 1	H334
Skin sensitisation, Category 1	H317
Carcinogenicity, Category 2	H351
Specific target organ toxicity - Repeated exposure, Category 1	H372
Specific target organ toxicity - Repeated exposure, Category 2	H373

2.2. Label elements

2.2.1. Hazard pictograms (GHS KR)





2.2.2. Signal word (GHS KR)

Danger.

2.2.3. Hazard statements (GHS KR)

H317 - May cause an allergic skin reaction.

H334 - May cause allergic reactions, asthma or shortness of breath and etc if inhaled.

H351 - Suspected of causing cancer.

H372 - Causes damage to organs through prolonged or repeated exposure.

H373 - May cause damage to organs through prolonged or repeated exposure.

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2.2.4. Precautionary statements (GHS KR)

Precaution:

- P201 Obtain special instructions before use.
- P202 Do not handle until all safety precautions have been read and understood.
- P260 Do not breathe dust/fume/gas/mist/vapours/spray.
- P261 Avoid breathing dust/fume/gas/mist/vapours/spray.
- P264 Wash hands, forearms and face thoroughly after handling.
- P270 Do not eat, drink or smoke when using this product.
- P272 Contaminated work clothing should not be allowed out of the workplace.
- P280 Wear protective gloves/protective clothing/eye protection/face protection/hearing protection.
- P284 Wear respiratory protection.

Treatment:

P302+P352 - IF ON SKIN: Wash with plenty of water/....

P304+P340 - IF INHALED: Remove person to fresh air and keep comfortable for breathing.

P308+P313 - IF exposed or concerned: Get medical advice/attention.

P314 - Get medical advice/attention if you feel unwell.

P321 - Take ... treatment.

P333+P313 - If skin irritation or rash occurs: Get medical advice/attention.

P342+P311 - If experiencing respiratory symptoms: Call a POISON CENTER/doctor/....

P362+P364 - Take off contaminated clothing and wash it before reuse.

Storage:

P405 - Store locked up.

Disposal:

P501 - Dispose of contents/container according to waste related regulations.

2.3. Hazards - Other hazards which do not result in classification - Hazard Risk

Not applicable

3. Composition/information on ingredients

Product form : Mixture

Substance name	Other Names	Product identifier number	Concentration (%)
Iron	Iron, elemental / Direct reduced Iron / Iron, reduced / Elemental iron / IRON POWDER / iron	CAS-No.: 7439-89-6 KECI-No.: KE-21059	55 – 65
Chromium	Chromium metal / Chromium, elemental / Chromium, metal / Chromium, metallic / Chrome, metal / Chrome	CAS-No.: 7440-47-3 KECI-No.: KE-05970	17 – 20
Nickel	Nickel metal / Nickel, elemental / Nickel, metallic / Nickel, metal / C.I. 77775	CAS-No.: 7440-02-0 KECI-No.: KE-25818	8 – 10
Titanium Dioxide	C.I. 77891 / C.I. Pigment White 6 / Titanium oxide (TiO2) / CI 77891 / Titanium(IV) oxide / C.I. Pigment White 7 / Pigment White 6 / Titanium dioxide nanoparticles / TITANIUM DIOXIDE / Titanium oxide / Titanium dioxide(2)	CAS-No.: 13463-67-7 KECI-No.: KE-33900	5 – 7
Molybdenum	Molybdenum metal / Molybdenum, elemental / Molybdenum, metal / Molybdenum, metallic / molybdenum	CAS-No.: 7439-98-7 KECI-No.: KE-25427	1 – 3

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Substance name	Other Names	Product identifier number	Concentration (%)
Manganese	Manganese, elemental / Manganese metal / manganese	CAS-No.: 7439-96-5 KECI-No.: KE-22999	1 – 2

4. First-aid measures

4.1. First-aid measures after eye contact

Rinse eyes with water as a precaution.

4.2. First-aid measures after skin contact

Wash skin with plenty of water.

4.3. First-aid measures after inhalation

Remove person to fresh air and keep comfortable for breathing.

4.4. First-aid measures after ingestion

Call a poison center or a doctor if you feel unwell.

4.5. Other medical advice or treatment

Treat symptomatically.

5. Fire-fighting measures

5.1. Suitable (and unsuitable) extinguishing media

Suitable extinguishing media : Water spray. Dry powder. Foam.

Unsuitable extinguishing media : No data available

5.2. Special hazards arising from the substance or mixture

No data available

5.3. Special protective equipment and precautions for fire-fighters

Protection during firefighting : Do not attempt to take action without suitable protective equipment. Self-contained

breathing apparatus. Complete protective clothing.

6. Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

Ventilate spillage area.

Do not breathe dust/fume/gas/mist/vapours/spray.

Do not attempt to take action without suitable protective equipment.

For further information refer to section 8: "Exposure controls/personal protection".

Dispose of materials or solid residues at an authorized site.

6.2. Environmental precautions and protective procedures

Avoid release to the environment.

6.3. Methods and material for containment and cleaning up

Mechanically recover the product.

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7. Handling and storage

7.1. Precautions for safe handling

Precautions for safe handling : Ensure good ventilation of the work station.

Wear personal protective equipment.

Do not breathe dust/fume/gas/mist/vapours/spray.

Hygiene measures : Do not eat, drink or smoke when using this product.

Always wash hands after handling the product.

7.2. Conditions for safe storage

Storage conditions : Store in a well-ventilated place.

Keep cool.

8. Exposure controls/personal protection

8.1. Occupational Exposure Limits

K-316LT		
No data available		
Titanium Dioxide (13463-67-7)		
Korea - Occupational Exposure Limits		
Local name	이산화티타늄 # Titanium dioxide	
ISHA OEL TWA	10 mg/m³	
Remark (KR)	발암성 2 # Carcinogenicity 2	
Regulatory reference	고용노동부고시 제2020-48호 # MOEL Public Notice. No. 2020-48	
China - Occupational Exposure Limits		
OEL PC-TWA	8 mg/m³ (total dust)	
Chemical category	Possibly carcinogenic to humans dust	
Catalogue of Occupational Hazard Factors	Category 1 - Dusts	
Indonesia - Occupational Exposure Limits		
NAB (OEL TWA)	10 mg/m³	
Chemical category	A4 - not classifiable as a human carcinogen	
Singapore - Occupational Exposure Limits		
PEL (OEL TWA)	10 mg/m³	
Taiwan - Occupational Exposure Limits		
OEL TWA	10 mg/m³	
OEL STEL	15 mg/m³	
Vietnam - Occupational Exposure Limits		
OEL TWA	6 mg/m³ (inhalable dust) 5 mg/m³ (respirable dust)	
OEL STEL	10 mg/m³ (inhalable dust)	
Australia - Occupational Exposure Limits		
OES TWA [1]	10 mg/m³ (containing no asbestos and <1% crystalline silica-inhalable dust)	

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Titanium Dioxide (13463-67-7)		
USA - ACGIH - Occupational Exposure Limits		
ACGIH OEL TWA	10 mg/m³	
ACGIH chemical category	Not Classifiable as a Human Carcinogen	
USA - IDLH - Occupational Exposure Limits		
IDLH	5000 mg/m³	
USA - NIOSH - Occupational Exposure Limits		
NIOSH REL TWA	2.4 mg/m³ (CIB 63-fine) 0.3 mg/m³ (CIB 63-ultrafine, including engineered nanoscale)	
USA - OSHA - Occupational Exposure Limits		
OSHA PEL TWA [1]	15 mg/m³ (total dust)	
Iron (7439-89-6)		
Korea - Occupational Exposure Limits		
Local name	철염(가용성) # Iron salts (Soluble, as Fe)	
ISHA OEL TWA	1 mg/m³	
Regulatory reference	고용노동부고시 제2020-48호 # MOEL Public Notice. No. 2020-48	
China - Occupational Exposure Limits		
Catalogue of Occupational Hazard Factors	Category 1 - Dusts	
Indonesia - Occupational Exposure Limits		
NAB (OEL TWA)	1 mg/m³	
Manganese (7439-96-5)		
Korea - Occupational Exposure Limits		
Local name	망간 및 무기 화합물 # Manganese&Inorganic compounds, as Mn	
ISHA OEL TWA	1 mg/m³ 1 mg/m³ (音) # (Fume)	
ISHA OEL STEL	3 mg/m³ (音) # (Fume)	
ISHA PEL TWA	1 mg/m³	
Regulatory reference	고용노동부고시 제2020-48호 # MOEL Public Notice. No. 2020-48	
China - Occupational Exposure Limits	1	
OEL PC-TWA	0.15 mg/m ³	
OEL PC-TWA (Highly Toxic Goods)	0.15 mg/m³ (dust and fume)	
OEL PC-STEL (Highly Toxic Goods)	0.45 mg/m³ (dust and fume)	
Catalogue of Occupational Hazard Factors	Category 3 - Chemicals	
India - Occupational Exposure Limits		
PEL (OEL TWA)	1 mg/m³ (fume)	
PEL (OEL STEL)	0.03 mg/m³ (fume)	
PEL (OEL C)	5 mg/m³ (dust)	
Indonesia - Occupational Exposure Limits		
NAB (OEL TWA)	0.1 mg/m³ (inhalable particulate) 0.02 mg/m³ (respirable particulate)	

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Chemical category A4 - not classifiable as a human carcinogen Singapore - Occupational Exposure Limits PEL (OEL TWA) 1 mg/m² (dust and fume) OEL STEL 3 mg/m² (fume) Singapore - BTLV BTLV 50 µg/l Parameter: Manganese - Madium: urine Taiwan - Occupational Exposure Limits OEL TWA 1 mg/m² (category C3 special chemical-fume) OEL STEL 2 mg/m² (category C3 special chemical-fume) OEL STEL 2 mg/m² (category C3 special chemical) Vietnam - Occupational Exposure Limits OEL TWA 0.3 mg/m² OEL STEL 0.6 mg/m² Australia - Occupational Exposure Limits OES TWA [1] 1 mg/m² (dust and fume) OES STEL 3 mg/m² (fume) SS mg/m² (fume) ACGIH Occupational Exposure Limits ACGIH OEL TWA 0.2 mg/m² (fume) USA - ACGIH - Occupational Exposure Limits OES TWA [1] 1 mg/m² (fume) ACGIH chemical category Not Classifiable as a Human Carcinogen USA - IDLH - Occupational Exposure Limits IDLH 500 mg/m² USA - NIOSH - Occupational Exposure Limits NIOSH REL TWA 1 mg/m² (fume) NIOSH REL TWA 1 mg/m² (fume) NIOSH REL TYA 1 mg/m² (melal) SHA OEL TWA 1 mg/m² (melal)	Manganese (7439-96-5)		
PEL (OEL TWA) 1 mg/m² (dust and fume) OEL STEL 3 mg/m² (fume) Singapore - STLV Singapore - STLV STLV 50 μg/l Parameter: Manganese - Medium: urine Talwan - Occupational Exposure Limits OEL TWA 1 mg/m² (category C3 special chemical-fume) OEL STEL 2 mg/m² (category C3 special chemical-fume) OEL STEL 2 mg/m² (category C3 special chemical-fume) OEL STEL 0.6 mg/m² Australia - Occupational Exposure Limits OEL TWA 0.3 mg/m² OEL STEL 0.6 mg/m² Australia - Occupational Exposure Limits OES STEL 3 mg/m² (dust and fume) OES STEL 3 mg/m² (fume) USA - ACGIH - Occupational Exposure Limits ACGIH - Occupational Exposure Limits OES MWA 0.1 mg/m² (inhalable particulate matter) O.1 mg/m² (inhalable particulate matter) ACGIH - Occupational Exposure Limits USA - IDLH - Occupational Exposure Limits Singapore - STEL 3 mg/m² (fume) USA - NIOSH - Occupational Exposure Limits USA - STEL 3 mg/m² (fume) NIOSH REL TWA 1 mg/m² (fume) NIOSH REL STEL 3 m	Chemical category	A4 - not classifiable as a human carcinogen	
OEL STEL 3 mg/m² (fume) Singaporo - BTLV BTLV 50 μg/h Parameter: Manganese - Medium: urine Taiwan - Occupational Exposure Limits OEL TWA 1 mg/m² (category C3 special chemical-fume) OEL STEL 2 mg/m² (category C3 special chemical-fume) OEL C 5 mg/m² (category C3 special chemical-fume) OEL TWA 0.3 mg/m² OEL TWA 0.3 mg/m² OEL STEL 0.6 mg/m² Australia - Occupational Exposure Limits OES TWA [1] 1 mg/m² (dust and fume) OES STEL 3 mg/m² (tume) USA - ACGIH - Occupational Exposure Limits ACGIH OEL TWA 0.1 mg/m² (funbalable particulate matter) OE TWA 1 1 mg/m² (mhalable particulate matter) OE TWA 1 mg/m² (mhalable particulate matter) OE TWA 1 mg/m² (mhalable particulate matter) OE TWA - INDEH - Occupational Exposure Limits NIOSH REL TWA 1 mg/m² (fume) USA - NIOSH - Occupational Exposure Limits NIOSH REL TWA 1 mg/m² (fume) NIOSH REL TWA 1 mg/m² (fume) NIOSH REL STEL 3 mg/m² USA - OSHA - Occupational Exposure Limits OSHA PEL C 5 mg/m² (fume) NIOSH REL STEL 3 mg/m² USA - Occupational Exposure Limits OSHA PEL C 5 mg/m² (fume) NIOSH REL STEL 3 mg/m² USA - Occupational Exposure Limits OSHA PEL C 5 mg/m² (fume) NIOSH REL STEL 3 mg/m² USA - Occupational Exposure Limits OSHA PEL C 5 mg/m² (fume) NIOSH REL STEL 3 mg/m² USA - Occupational Exposure Limits OSHA PEL C 5 mg/m² (fume) NIOSH REL STEL 3 mg/m² (fume) NIOSH REL STEL	Singapore - Occupational Exposure Limits		
Singapore - BTLV BTLV 50 μg/l Parameter: Manganese - Medium: urine Talwan - Occupational Exposure Limits OEL TWA 1 mg/m² (category C3 special chemical-fume) OEL STEL 2 mg/m² (category C3 special chemical-fume) OEL C 5 mg/m² (category C3 special chemical-fume) OEL C 5 mg/m² (category C3 special chemical) Vietnam - Occupational Exposure Limits OEL TWA 0.3 mg/m² OEL STEL 0.6 mg/m² Australia - Occupational Exposure Limits OES TWA [1] 1 mg/m² (dust and fume) OES STEL 3 mg/m² (fume) USA - ACGIH - Occupational Exposure Limits ACGIH - Occupational Exposure Limits ACGIH - Occupational Exposure Limits DLH 0.02 mg/m² (respirable particulate matter) O.1 mg/m² (inhalable particulate matter) USA - IDLH - Occupational Exposure Limits DLH S00 mg/m² USA - IDLH - Occupational Exposure Limits NIOSH REL TWA 1 mg/m² (fume) NIOSH REL TWA 1 mg/m² (fume) NIOSH REL STEL 3 mg/m² (fume) NIOSH REL TWA 1 mg/m² (fume) NIOSH REL C 5 mg/m² (fume) NIOSH REL C 5 mg/m² (fume) NICKel (7440-02-0) Korea - Occupational Exposure Limits USHA OEL TWA 1 mg/m² (metal) USHA OEL TWA 0.2 mg/m² Remark (KR) 2 # Carcinogenicity 2 mg/m² (Fuma) Remark (KR) 2 # Carcinogenicity 2 mg/m² (Fuma) Chemical category Possibly carcinogenic to humans	PEL (OEL TWA)	1 mg/m³ (dust and fume)	
BTLV 50 μg/l Parameter: Manganese - Medium: urine Taiwan - Occupational Exposure Limits OEL TWA 1 mg/m² (category C3 special chemical-fume) OEL STEL 2 mg/m² (category C3 special chemical-fume) OEL STEL 2 mg/m² (category C3 special chemical-fume) OEL TWA 0.3 mg/m² OEL STEL 0.6 mg/m² Australia - Occupational Exposure Limits OES TWA [1] 1 mg/m² (dust and fume) OES STEL 3 mg/m² (tune) USA - ACGIH - Occupational Exposure Limits ACGIH OEL TWA 0.02 mg/m² (respirable particulate matter) 0.1 mg/m² (inhalable particulate matter) 0.2 mg/m² (respirable particulate matter) USA - IDLH - Occupational Exposure Limits IDLH 500 mg/m² USA - NIOSH - Occupational Exposure Limits NIOSH REL TWA 1 mg/m² (fume) NIOSH REL TWA 1 mg/m² (fume) NIOSH REL STEL 3 mg/m² (fume) NIOSH A - Occupational Exposure Limits OSHA - OCCUPATIONAL Exposure Limits OSHA - OCCUPATIONAL Exposure Limits USA - OCCUPATIONAL Exposure Limits OSHA - OCCUPATIONAL Exposure Limits USA - OCCUPATIONAL Exposure Limits OSHA PEL C 5 mg/m² (fume) Nickel (7440-02-0) Korea - Occupational Exposure Limits USA - OCCUPATIONAL 1 mg/m² (metal) USHA PEL TWA 0.2 mg/m² Regulatory reference 3 mg/m² 2 g Carcinogenicity 2 Regulatory reference 3 mg/m² 4 MOEL Public Notice. No. 2020-48 China - Occupational Exposure Limits OEL PC-TWA 1 mg/m² Chemical category Possibly carcinogenic to humans	OEL STEL	3 mg/m³ (fume)	
Talwan - Occupational Exposure Limits OEL TWA 1 mg/m² (category C3 special chemical-fume) OEL STEL 2 mg/m² (category C3 special chemical-fume) OEL C 5 mg/m² (category C3 special chemical) Violanam - Occupational Exposure Limits OEL TWA 0.3 mg/m² OEL STEL 0.6 mg/m² Australia - Occupational Exposure Limits OES TWA [1] 1 mg/m² (dust and fume) OES STEL 3 mg/m² (fume) USA - ACGIH - Occupational Exposure Limits ACGIH - Occupational Exposure Limits ACGIH - Occupational Exposure Limits OES TWA [1] 5.0 mg/m² (respirable particulate matter) ACGIH - Occupational Exposure Limits IDLH 5.0 mg/m² (mhalable particulate matter) USA - NIOSH - Occupational Exposure Limits IDLH 5.0 mg/m² (fume) USA - NIOSH - Occupational Exposure Limits IDLH 5.0 mg/m² (fume) NIOSH REL TWA 1 mg/m² (fume) NIOSH REL STEL 3 mg/m² USA - Oscupational Exposure Limits OSHA PEL C 5 mg/m² (fume) Nickel (7440-02-0) Korsa - Occupational Exposure Limits Local name 14 mg/m² (metal) SHA PEL TWA 0.2 mg/m² Repark (KR) 1 mg/m² (Metal) SHA PEL TWA 0.2 mg/m² Regulatory reference 2 mg/m² & Garcinogenicity 2 Regulatory reference 2 mg/m² & MOEL Public Notice. No. 2020-48 China - Occupational Exposure Limits OEL PC-TWA 1 mg/m² Chemical category Possibly carcinogenic to humans	Singapore - BTLV		
DEL TWA 1 mg/m² (category C3 special chemical-fume) OEL STEL 2 mg/m² (category C3 special chemical-fume) OEL C 5 mg/m² (category C3 special chemical) Vietnam - Occupational Exposure Limits OEL TWA 0.3 mg/m² OEL STEL 0.6 mg/m² Australia - Occupational Exposure Limits OES TWA [1] 1 mg/m² (dust and fume) OES STEL 3 mg/m² (fume) USA - AGGIH - Occupational Exposure Limits ACGIH OEL TWA 0.2 mg/m² (fune) USA - AGGIH - Occupational Exposure Limits ACGIH chemical category Not Classifiable as a Human Carcinogen USA - IDLH - Occupational Exposure Limits IDLH 500 mg/m² USA - NOSH - Occupational Exposure Limits IDLH 500 mg/m² USA - NOSH - Occupational Exposure Limits IDLH 500 mg/m² USA - NOSH - Occupational Exposure Limits IDLH 500 mg/m² USA - Occupational Exposure Limits NIOSH REL STEL 3 mg/m² (fume) NIOSH REL STEL 3 mg/m² USA - Occupational Exposure Limits USA - Occupational Exposure Limits OSHA PEL C 5 mg/m² (fume) Nickel (7440-02-0) Korea - Occupational Exposure Limits Local name 나 1 mg/m² (metal) ISHA OEL TWA 1 mg/m² (metal) ISHA DEL TWA 0.2 mg/m² Remark (KR) 1 mg/m² (metal) CSHA PEL TWA 0.2 mg/m² Regulatory reference 1 mg/m² 4 mg/m² Chemical category Possibly carcinogenic to humans	BTLV	50 μg/l Parameter: Manganese - Medium: urine	
DEL STEL 2 mg/m³ (category C3 special chemical-fume) OEL C 5 mg/m² (category C3 special chemical) Vietnam - Occupational Exposure Limits OEL TWA 0.3 mg/m³ OEL STEL 0.6 mg/m³ Australia - Occupational Exposure Limits OES TWA[1] 1 mg/m³ (dust and fume) OES STEL 3 mg/m³ (respirable particulate matter) USA - ACGIH - Occupational Exposure Limits ACGIH OEL TWA 0.02 mg/m³ (respirable particulate matter) O.1 mg/m³ (inhalable particulate matter) ACGIH chemical category Not Classifiable as a Human Carcinogen USA - IDLH - Occupational Exposure Limits IDLH 500 mg/m³ USA - NIOSH - Occupational Exposure Limits NIOSH REL TWA 1 mg/m² (fume) NIOSH REL STEL 3 mg/m³ USA - OSHA - Occupational Exposure Limits OSHA PEL C 5 mg/m³ (fume) NICkel (7440-02-0) Korea - Occupational Exposure Limits Local name	Taiwan - Occupational Exposure Limits		
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Vietnam - Occupational Exposure Limits OEL TWA 0.3 mg/m³ OEL STEL 0.6 mg/m³ Australia - Occupational Exposure Limits OES TWA [1] 1 mg/m³ (dust and fume) OES STEL 3 mg/m³ (fume) USA - ACGIH - Occupational Exposure Limits ACGIH OEL TWA 0.2 mg/m³ (inhalable particulate matter) ACGIH chemical category Not Classifiable as a Human Carcinogen USA - IDLH - Occupational Exposure Limits IDLH 500 mg/m³ USA - NIOSH - Occupational Exposure Limits NIOSH REL TWA 1 mg/m³ (fume) NIOSH REL TWA 1 mg/m³ (fume) NIOSH REL STEL 3 mg/m³ USA - Occupational Exposure Limits NIOSH PEL C 5 mg/m³ (fume) NICKel (7440-02-0) Korea - Occupational Exposure Limits Local name 나를 (급令) # Nickel (Metal) ISHA OEL TWA 1 mg/m³ (metal) ISHA DEL TWA 0.2 mg/m³ Remark (KR) 발안성 2 # Carcinogenicity 2 Regulatory reference 元金上等年工利 利2020-48 年 MOEL Public Notice, No. 2020-48 China - Occupational Exposure Limits OEL PC-TWA 1 mg/m³ Chemical category Possibly carcinogenic to humans	OEL STEL	2 mg/m³ (category C3 special chemical-fume)	
OEL TWA 0.3 mg/m³ OEL STEL 0.6 mg/m³ Australia - Occupational Exposure Limits OES TWA [1] 1 mg/m³ (dust and fume) OES STEL 3 mg/m³ (fume) USA - ACGIH - Occupational Exposure Limits ACGIH OEL TWA 0.02 mg/m³ (instable particulate matter) 0.1 mg/m³ (inhalable particulate matter) 0.1 mg/m³ (inhalable particulate matter) Not Classifiable as a Human Carcinogen USA - IDLH - Occupational Exposure Limits IDLH 500 mg/m³ USA - NIOSH - Occupational Exposure Limits NIOSH REL TWA 1 mg/m³ (fume) NIOSH REL STEL 3 mg/m³ USA - OshA - Occupational Exposure Limits OSHA PEL C 5 mg/m² (fume) Nickel (7440-02-0) Korea - Occupational Exposure Limits Local name 나를 (금속) # Nickel (Metal) ISHA OEL TWA 1 mg/m³ (metal) ISHA PEL TWA 0.2 mg/m³ Remark (KR) 만약 2 # Carcinogenicity 2 Regulatory reference 교육노동부교시 제2020-48호 # MOEL Public Notice. No. 2020-48 China - Occupational Exposure Limits OEL PC-TWA 1 mg/m³ Chemical category Possibly carcinogenic to humans	OEL C	5 mg/m³ (category C3 special chemical)	
OEL STEL 0.6 mg/m³ Australia - Occupational Exposure Limits OES TWA [1] 1 mg/m³ (dust and fume) OES STEL 3 mg/m³ (fume) USA - ACGIH - Occupational Exposure Limits ACGIH OEL TWA 0.02 mg/m³ (respirable particulate matter) 0.1 mg/m² (inhalable particulate matter) 0.2 mg/m² USA - IDLH - Occupational Exposure Limits NIOSH REL TWA 1 mg/m² (fume) NIOSH REL STEL 3 mg/m² USA - OSHA - Occupational Exposure Limits OSHA - Occupational Exposure Limits OSHA PEL C 5 mg/m² (fume) NICKel (7440-02-0) Korea - Occupational Exposure Limits Local name 나 핵 (급속) # Nickel (Metal) ISHA OEL TWA 1 mg/m² (metal) ISHA PEL TWA 0.2 mg/m² Remark (KR)	Vietnam - Occupational Exposure Limits		
Des TWA [1] 1 mg/m² (dust and fume) OES TWA [1] 1 mg/m² (dust and fume) OES STEL 3 mg/m² (fume) USA - ACGIH - Occupational Exposure Limits ACGIH OEL TWA 0.2 mg/m² (respirable particulate matter) 0.1 mg/m² (inhalable particulate matter) ACGIH chemical category Not Classifiable as a Human Carcinogen USA - IDLH - Occupational Exposure Limits IDLH 500 mg/m² USA - NIOSH - Occupational Exposure Limits NIOSH REL TWA 1 mg/m² (fume) NIOSH REL TWA 3 mg/m² USA - OSHA - Occupational Exposure Limits OSHA PEL C 5 mg/m² (fume) Nickel (7440-02-0) Korea - Occupational Exposure Limits Local name 1 mg/m² (metal) ISHA OEL TWA 1 mg/m² (metal) ISHA DEL TWA 0.2 mg/m² Remark (KR)	OEL TWA	0.3 mg/m³	
DES TWA [1] 1 mg/m³ (dust and fume) DES STEL 3 mg/m³ (fume) USA - ACGIH - Occupational Exposure Limits ACGIH OEL TWA 0.02 mg/m³ (respirable particulate matter) 0.1 mg/m³ (inhalable particulate matter) ACGIH chemical category Not Classifiable as a Human Carcinogen USA - IDLH - Occupational Exposure Limits IDLH 500 mg/m³ USA - NIOSH - Occupational Exposure Limits NIOSH REL TWA 1 mg/m³ (fume) NIOSH REL STEL 3 mg/m³ USA - OSHA - Occupational Exposure Limits OSHA PEL C 5 mg/m³ (fume) Nickel (7440-02-0) Korea - Occupational Exposure Limits Local name Limits Local name Limits Local name Limits USHA DEL TWA 1 mg/m³ (metal) ISHA DEL TWA 0.2 mg/m³ Remark (KR) 世纪 2 # Carcinogenicity 2 Regulatory reference 교용노동부교시 제2020-48호 # MOEL Public Notice. No. 2020-48 China - Occupational Exposure Limits OEL PC-TWA 1 mg/m³ Chemical category Possibly carcinogenic to humans	OEL STEL	0.6 mg/m³	
OES STEL 3 mg/m³ (fume) USA - ACGIH - Occupational Exposure Limits ACGIH OEL TWA 0.02 mg/m³ (respirable particulate matter) 0.1 mg/m³ (inhalable particulate matter) ACGIH chemical category Not Classifiable as a Human Carcinogen USA - IDLH - Occupational Exposure Limits IDLH 500 mg/m³ USA - NIOSH - Occupational Exposure Limits NIOSH REL TWA 1 mg/m³ (fume) NIOSH REL STEL 3 mg/m³ USA - OSHA - Occupational Exposure Limits OSHA PEL C 5 mg/m³ (fume) Nickel (7440-02-0) Korea - Occupational Exposure Limits Local name 나펠 (급속) # Nickel (Metal) ISHA OEL TWA 1 mg/m³ (metal) ISHA PEL TWA 0.2 mg/m³ Remark (KR) 빨암성 2 # Carcinogenicity 2 Regulatory reference 교육노동부교시 제2020-48호 # MOEL Public Notice. No. 2020-48 China - Occupational Exposure Limits OEL PC-TWA 1 mg/m³ Chemical category Possibly carcinogenic to humans	Australia - Occupational Exposure Limits		
USA - ACGIH - Occupational Exposure Limits ACGIH OEL TWA 0.02 mg/m³ (respirable particulate matter) 0.1 mg/m³ (inhalable particulate matter) ACGIH chemical category Not Classifiable as a Human Carcinogen USA - IDLH - Occupational Exposure Limits IDLH 500 mg/m³ USA - NIOSH - Occupational Exposure Limits NIOSH REL TWA 1 mg/m³ (fume) NIOSH REL STEL 3 mg/m³ USA - OSHA - Occupational Exposure Limits OSHA PEL C 5 mg/m³ (fume) Nickel (7440-02-0) Korea - Occupational Exposure Limits Local name	OES TWA [1]	1 mg/m³ (dust and fume)	
ACGIH OEL TWA 0.02 mg/m³ (respirable particulate matter) 0.1 mg/m³ (inhalable particulate matter) 0.2 mg/m³ (inhalable	OES STEL	3 mg/m³ (fume)	
O.1 mg/m³ (inhalable particulate matter) ACGIH chemical category Not Classifiable as a Human Carcinogen USA - IDLH - Occupational Exposure Limits IDLH 500 mg/m³ USA - NIOSH - Occupational Exposure Limits NIOSH REL TWA 1 mg/m³ (fume) NIOSH REL STEL 3 mg/m³ USA - OSHA - Occupational Exposure Limits OSHA PEL C 5 mg/m³ (fume) Nickel (7440-02-0) Korea - Occupational Exposure Limits Local name 나젤 (급속) # Nickel (Metal) ISHA OEL TWA 1 mg/m³ (metal) ISHA PEL TWA 0.2 mg/m³ Remark (KR) 발암성 2 # Carcinogenicity 2 Regulatory reference 고용노동부고시 제2020-48호 # MOEL Public Notice. No. 2020-48 China - Occupational Exposure Limits OEL PC-TWA 1 mg/m³ Chemical category Possibly carcinogenic to humans	USA - ACGIH - Occupational Exposure Limits		
USA - IDLH - Occupational Exposure Limits IDLH 500 mg/m³ USA - NIOSH - Occupational Exposure Limits NIOSH REL TWA 1 mg/m³ (fume) NIOSH REL STEL 3 mg/m³ USA - OSHA - Occupational Exposure Limits OSHA PEL C 5 mg/m³ (fume) Nickel (7440-02-0) Korea - Occupational Exposure Limits Local name 나젤 (금속) # Nickel (Metal) ISHA OEL TWA 1 mg/m³ (metal) ISHA PEL TWA 0.2 mg/m³ Remark (KR) 발악성 2 # Carcinogenicity 2 Regulatory reference 고용노동부고시 제2020-48호 # MOEL Public Notice. No. 2020-48 China - Occupational Exposure Limits OEL PC-TWA 1 mg/m³ Chemical category Possibly carcinogenic to humans	ACGIH OEL TWA		
IDLH 500 mg/m³ USA - NIOSH - Occupational Exposure Limits NIOSH REL TWA 1 mg/m³ (fume) NIOSH REL STEL 3 mg/m³ USA - OSHA - Occupational Exposure Limits OSHA PEL C 5 mg/m³ (fume) Nickel (7440-02-0) Korea - Occupational Exposure Limits Local name 니젤 (금속) # Nickel (Metal) ISHA OEL TWA 1 mg/m³ (metal) ISHA PEL TWA 0.2 mg/m³ Remark (KR) 발암성 2 # Carcinogenicity 2 Regulatory reference 교용노동부고시 제2020-48호 # MOEL Public Notice. No. 2020-48 China - Occupational Exposure Limits OEL PC-TWA 1 mg/m³ Chemical category Possibly carcinogenic to humans	ACGIH chemical category	Not Classifiable as a Human Carcinogen	
USA - NIOSH - Occupational Exposure Limits NIOSH REL TWA 1 mg/m³ (fume) NIOSH REL STEL 3 mg/m³ USA - OSHA - Occupational Exposure Limits OSHA PEL C 5 mg/m³ (fume) Nickel (7440-02-0) Korea - Occupational Exposure Limits Local name 나캠 (급속) # Nickel (Metal) ISHA OEL TWA 1 mg/m³ (metal) ISHA PEL TWA 0.2 mg/m³ Remark (KR) 발암성 2 # Carcinogenicity 2 Regulatory reference 교육노동부고시 제2020-48호 # MOEL Public Notice. No. 2020-48 China - Occupational Exposure Limits OEL PC-TWA 1 mg/m³ Chemical category Possibly carcinogenic to humans	USA - IDLH - Occupational Exposure Limits		
NIOSH REL TWA 1 mg/m³ (fume) NIOSH REL STEL 3 mg/m³ USA - OSHA - Occupational Exposure Limits OSHA PEL C 5 mg/m³ (fume) Nickel (7440-02-0) Korea - Occupational Exposure Limits Local name 니켈 (급속) # Nickel (Metal) ISHA OEL TWA 1 mg/m³ (metal) ISHA PEL TWA 0.2 mg/m³ Remark (KR) 발암성 2 # Carcinogenicity 2 Regulatory reference 고용노동부교시 제2020-48호 # MOEL Public Notice. No. 2020-48 China - Occupational Exposure Limits OEL PC-TWA 1 mg/m³ Chemical category Possibly carcinogenic to humans	IDLH	500 mg/m³	
NIOSH REL STEL 3 mg/m³ USA - OSHA - Occupational Exposure Limits OSHA PEL C 5 mg/m³ (fume) Nickel (7440-02-0) Korea - Occupational Exposure Limits Local name	USA - NIOSH - Occupational Exposure Limits		
USA - OSHA - Occupational Exposure Limits OSHA PEL C 5 mg/m³ (fume) Nickel (7440-02-0) Korea - Occupational Exposure Limits Local name 니젤 (급속) # Nickel (Metal) ISHA OEL TWA 1 mg/m³ (metal) ISHA PEL TWA 0.2 mg/m³ Remark (KR) 발암성 2 # Carcinogenicity 2 Regulatory reference 고용노동부고시 제2020-48호 # MOEL Public Notice. No. 2020-48 China - Occupational Exposure Limits OEL PC-TWA 1 mg/m³ Chemical category Possibly carcinogenic to humans	NIOSH REL TWA	1 mg/m³ (fume)	
SHA PEL C 5 mg/m³ (fume) Nickel (7440-02-0) Korea - Occupational Exposure Limits Local name 니켈 (금속) # Nickel (Metal) ISHA OEL TWA 1 mg/m³ (metal) ISHA PEL TWA 0.2 mg/m³ Remark (KR) 발암성 2 # Carcinogenicity 2 Regulatory reference 고용노동부코시 제2020-48호 # MOEL Public Notice. No. 2020-48 China - Occupational Exposure Limits OEL PC-TWA 1 mg/m³ Chemical category Possibly carcinogenic to humans	NIOSH REL STEL	3 mg/m³	
Nickel (7440-02-0) Korea - Occupational Exposure Limits Local name 니켈 (급속) # Nickel (Metal) ISHA OEL TWA	USA - OSHA - Occupational Exposure Limits		
Korea - Occupational Exposure Limits Local name 니켈 (급속) # Nickel (Metal) ISHA OEL TWA 1 mg/m³ (metal) ISHA PEL TWA 0.2 mg/m³ Remark (KR) 발암성 2 # Carcinogenicity 2 Regulatory reference 고용노동부고시 제2020-48호 # MOEL Public Notice. No. 2020-48 China - Occupational Exposure Limits OEL PC-TWA 1 mg/m³ Chemical category Possibly carcinogenic to humans	OSHA PEL C	5 mg/m³ (fume)	
Local name 니켈 (금속) # Nickel (Metal) ISHA OEL TWA 1 mg/m³ (metal) ISHA PEL TWA 0.2 mg/m³ Remark (KR) 발암성 2 # Carcinogenicity 2 Regulatory reference 고용노동부고시 제2020-48호 # MOEL Public Notice. No. 2020-48 China - Occupational Exposure Limits OEL PC-TWA 1 mg/m³ Chemical category Possibly carcinogenic to humans	Nickel (7440-02-0)		
ISHA OEL TWA 1 mg/m³ (metal) ISHA PEL TWA 0.2 mg/m³ Remark (KR) 발암성 2 # Carcinogenicity 2 Regulatory reference 고용노동부고시 제2020-48호 # MOEL Public Notice. No. 2020-48 China - Occupational Exposure Limits OEL PC-TWA 1 mg/m³ Chemical category Possibly carcinogenic to humans	Korea - Occupational Exposure Limits		
ISHA PEL TWA 0.2 mg/m³ Remark (KR) 발암성 2 # Carcinogenicity 2 Regulatory reference 고용노동부고시 제2020-48호 # MOEL Public Notice. No. 2020-48 China - Occupational Exposure Limits OEL PC-TWA 1 mg/m³ Chemical category Possibly carcinogenic to humans	Local name	니켈 (금속) # Nickel (Metal)	
Remark (KR) 발암성 2 # Carcinogenicity 2 Regulatory reference 고용노동부고시 제2020-48호 # MOEL Public Notice. No. 2020-48 China - Occupational Exposure Limits OEL PC-TWA 1 mg/m³ Chemical category Possibly carcinogenic to humans	ISHA OEL TWA	1 mg/m³ (metal)	
Regulatory reference 고용노동부고시 제2020-48호 # MOEL Public Notice. No. 2020-48 China - Occupational Exposure Limits OEL PC-TWA 1 mg/m³ Chemical category Possibly carcinogenic to humans	ISHA PEL TWA	0.2 mg/m³	
China - Occupational Exposure Limits OEL PC-TWA 1 mg/m³ Chemical category Possibly carcinogenic to humans	Remark (KR)	발암성 2 # Carcinogenicity 2	
OEL PC-TWA 1 mg/m³ Chemical category Possibly carcinogenic to humans	Regulatory reference	고용노동부고시 제2020-48호 # MOEL Public Notice. No. 2020-48	
Chemical category Possibly carcinogenic to humans	China - Occupational Exposure Limits		
	OEL PC-TWA	1 mg/m³	
	Chemical category	Possibly carcinogenic to humans	
OEL PC-TWA (Highly Toxic Goods) 1 mg/m³	OEL PC-TWA (Highly Toxic Goods)	1 mg/m³	
OEL PC-STEL (Highly Toxic Goods) 2.5 mg/m³	OEL PC-STEL (Highly Toxic Goods)	2.5 mg/m ³	

Material Safety Data Sheet

In Accordance with MOEL Public notice No 2020-130

Catalogue of Occupational Hazard Factors Catagory 3 - Chemicalis Indonesia - Occupational Exposure Limits 1.5 mg/m* (inhalable particulate) Chemical category A5 - not suspected as human carcinogen Singapore - Occupational Exposure Limits PEL (OEL TWA) 1 mg/m* Cell TWA 1 mg/m* OEL STEL 2 mg/m* OEL TWA 1 mg/m* OEL TWA 0.5 mg/m* OEL TWA 1.5 mg/m* (inhalable particulate matter) Australia - Occupational Exposure Limits VER - ACGIH - Occupational Exposure Limits Signif Parameter: Nickel - Medium: urine - Samping time: post-shift at end of workweek background) USA - IDLH - Occupational Exposure Limits USA - NICKEL TWA 0 on figm/m* USA - NICKEL TWA	Nickel (7440-02-0)		
NAB (OEL TWA) 1.5 mg/m* (inhalable particulate) Chemical calegory A5 - not suspected as human carcinogen Singapore - Occupational Exposure Limits I mg/m* PEL (OEL TWA) 1 mg/m* OEL TWA 1 mg/m* OEL STEL 2 mg/m* Thaliand - Occupational Exposure Limits I mg/m* OEL TWA 0.05 mg/m* OEL STEL 0.25 mg/m* Australia - Occupational Exposure Limits Versus Mg/m* OES TWA[1] 1 mg/m* ACGIH OCCUpational Exposure Limits Versus Mg/m* ACGIH - DEL TWA 1.5 mg/m* (inhalable particulate matter) ACGIH - Biological Exposure Limits Versus Mg/m* USA - ACGIH - Decupational Exposure Limits Versus Mg/m* USA - IDLH - Occupational Exposure Limits Versus Mg/m* USA - NOSH - Occupational Exposure Limits Versus Mg/m* USA - OSHA - Occupational Exposure Limits Versus Mg/m* <td>Catalogue of Occupational Hazard Factors</td> <td>Category 3 - Chemicals</td>	Catalogue of Occupational Hazard Factors	Category 3 - Chemicals	
Chemical calegory A5 - not suspected as human carcinogen FEL (OEL TWA) I mg/m' OEL STEL 1 mg/m' OEL STEL 2 mg/m' Thailard - Occupational Exposure Limits OEL TWA I mg/m' OEL TWA O 0.05 mg/m' OEL STEL 0.05 mg/m' OEL TWA I mg/m' OEL STEL 0.05 mg/m' OEL STEL 0.05 mg/m' OEL STEL 0.5 mg/m' Australia - Occupational Exposure Limits OEL TWA I mg/m' OEL STEL 0.5 mg/m' Australia - Occupational Exposure Limits OES TWA [1] I mg/m' AUSTRALIA - Occupational Exposure Limits OES TWA [1] I mg/m' ACGIH CHEL TWA I supported as a Human Carcinogen USA - ACGIH - Biological Exposure Indices EEI Spigl Parameter Nickel - Medium: urine - Sampling time; post-shift at end of workweek (background) USA - IDLH - Occupational Exposure Limits USA - IDLH - Occupational Exposure Limits USA - NOSH - Occupational Exposure Limits USA - OSHA - Occupational Exposure Limits OEL TWA 0.015 mg/m' USA - OSHA - Occupational Exposure Limits OEL TWA 0.05 mg/m' Chromium (740-47-3) Korea - Occupational Exposure Limits OEL PC-TWA 0.05 mg/m' Chemical category Sensilizer, Carcinogenic to humans OEL PC-TWA (Highly Toxic Goods) 0.05 mg/m' Challogue of Occupational Hazard Factors 0.05 mg/m' Catalogue of Occupational Exposure Limits	Indonesia - Occupational Exposure Limits		
Singapore - Occupational Exposure Limits	NAB (OEL TWA)	1.5 mg/m³ (inhalable particulate)	
PEL (OEL TWA) 1 mg/m² Talwan - Occupational Exposure Limits OEL TWA 1 mg/m² OEL STEL 2 mg/m² Talland - Occupational Exposure Limits OEL TWA 1 mg/m² OEL TWA 0 1 mg/m² Vietnam - Occupational Exposure Limits OEL TWA 0.05 mg/m² OEL STEL 0.25 mg/m² OEL STEL 0.25 mg/m² Australia - Occupational Exposure Limits OES TWA 1 mg/m² OEL STEL 0.25 mg/m² Australia - Occupational Exposure Limits OES TWA (1) 1 mg/m² AUSA - ACGIH - Occupational Exposure Limits ACGIH - Occupational Exposure Limits ACGIH - Occupational Exposure Limits BEI 5 mg/m² (inhalable particulate mater) ACGIH - Chemical category Not Suspected as a Human Carcinogen USA - ACGIH - Biological Exposure Indices BEI 5 mg/m² (inhalable particulate mater) USA - ACGIH - Decupational Exposure Limits USA - OCCUPATIONAL Exposure Limits IDLH 10 mg/m² USA - NIOSH - Occupational Exposure Limits SHA OEL TWA 0.55 mg/m² Chromium (7440-47-3) Korea - Occupational Exposure Limits PARA OEL TWA 0.05 mg/m² OEL FC-TWA 0.05 mg/m² OEL PC-TWA (Highly Toxic Goods) 0.15 mg/m² OEL PC-TWA (Highly Toxic Goods) 0.05 mg/m² Catalogue of Occupational Hazard Factors 0.26 etegory 3 - Chemicals Linits Indicessia - Occupational Exposure Limits	Chemical category	A5 - not suspected as human carcinogen	
Talwan - Occupational Exposure Limits OEL TWA 1 mg/m² OEL STEL 2 mg/m² Thailand - Occupational Exposure Limits OEL TWA 1 mg/m² Victnam - Occupational Exposure Limits 0.05 mg/m² OEL TWA 0.05 mg/m² OEL STEL 0.25 mg/m² Australia - Occupational Exposure Limits 0.25 mg/m² OES TWA [1] 1 mg/m² USA - ACGIH - Occupational Exposure Limits 1.5 mg/m² (inhalable particulate matter) ACGIH Chemical category Not Suspected as a Human Carcinogen USA - ACGIH - Biological Exposure Indices 5 ligil Parameter. Nickel - Medium: urine - Sampling time: post-shift at end of workweek (background) USA - IDLH - Occupational Exposure Limits 10 mg/m² USA - NIOSH - Occupational Exposure Limits 10 mg/m² USA - OSHA - Occupational Exposure Limits 1 mg/m² USA - OSHA - Occupational Exposure Limits 1 mg/m² Chromium (7440-47-3) 1 mg/m² Korea - Occupational Exposure Limits 1 mg/m² Chromium (7440-47-3) 0.5 mg/m² Cherical category 0.05 mg/m² Cherica	Singapore - Occupational Exposure Limits		
OEL TWA 1 mg/m² OEL STEL 2 mg/m² Thailand - Occupational Exposure Limits 1 mg/m² OEL TWA 1 mg/m² Vietnam - Occupational Exposure Limits 0.05 mg/m² OEL TWA 0.25 mg/m² Australia - Occupational Exposure Limits 0.25 mg/m² Australia - Occupational Exposure Limits 0.85 mg/m² (mhalable particulate matter) ACGIH - Occupational Exposure Limits 0.15 mg/m² (mhalable particulate matter) ACGIH OBL TWA 1.5 mg/m² (mhalable particulate matter) ACGIH - Biological Exposure Indices 5 log/l Parameter: Nickel - Medium: urine - Sampling time: post-shift at end of workweek (background) USA - ACGIH - Doccupational Exposure Limits 10 mg/m² USA - NDSH - Occupational Exposure Limits 10 mg/m² USA - OSHA - Occupational Exposure Limits 0.015 mg/m² USA - OSHA - Occupational Exposure Limits 1 mg/m² OSH REL TWA [1] 1 mg/m² Chromitum (7440-47-3) Noral Group (mg/m²) Korea - Occupational Exposure Limits 0.5 mg/m² (metal) China - Occupational Exposure Limits 0.5 mg/m² Chemical category Sensitizer, Carcinogenic to humans<	PEL (OEL TWA)	1 mg/m³	
OEL STEL 2 mg/m² Thailand - Occupational Exposure Limits 1 mg/m² Vietnam - Occupational Exposure Limits 0.05 mg/m² OEL TWA 0.05 mg/m² OEL TWA 0.25 mg/m² Australia - Occupational Exposure Limits - 0.25 mg/m² Australia - Occupational Exposure Limits - 1.5 mg/m² (inhalable particulate matter) OES TWA [1] 1 mg/m² USA - ACGIH - Occupational Exposure Limits Not Suspected as a Human Carcinogen USA - ACGIH - Biological Exposure Indices 5 pg/n Parameter: Nickel - Medium: urine - Sampling time: post-shift at end of workweek (background) USA - IDLH - Occupational Exposure Limits 10 mg/m² USA - NIOSH - Occupational Exposure Limits 10 mg/m² USA - OSHA - Occupational Exposure Limits O.15 mg/m² USA - OSHA PEL TWA [1] 1 mg/m² Chromium (7440-47-3) Korea - Occupational Exposure Limits USA OCCUPATIONAL Exposure Limits O.5 mg/m² (metal) Chenical category Sensitizer, Carcinogenic to humans OEL PC-TWA (righty Toxic Goods) 0.15 mg/m² OEL MAC (Highty Toxic Goods) 0.15 mg/m² OEL MAC (Highty Toxic Goods) 0.05	Taiwan - Occupational Exposure Limits		
Thailand - Occupational Exposure Limits	OEL TWA	1 mg/m³	
OEL TWA 1 mg/m² Vietnam - Occupational Exposure Limits 0.05 mg/m² OEL STEL 0.25 mg/m² Australia - Occupational Exposure Limits 0.25 mg/m² OES TWA [1] 1 mg/m² USA - ACGIH - Occupational Exposure Limits ACGIH OEL TWA 1.5 mg/m² (inhalable particulate matter) ACGIH OEL TWA 1.5 mg/m² (inhalable particulate matter) ACGIH chemical category Not Suspected as a Human Carcinogen USA - ACGIH - Biological Exposure Indices BEI 5 μg/l Parameter: Nickel - Medium: urine - Sampling time: post-shift at end of workweek (background) USA - IDLH - Occupational Exposure Limits IDLH 10 mg/m² USA - NIOSH - Occupational Exposure Limits NIOSH REL TWA 0.015 mg/m² USA - OSHA - Occupational Exposure Limits VISA - OSHA - Occupational Exposure Limits USA - OCcupational Exposure Limits VISA - OSHA - Occupational Exposure Limits USA - OCcupational Exposure Limits VISA - OSHA - OCcupational Exposure Limits USA - OCcupational Exposure Limits OS mg/m² (metal) Chromium (7440-47-3) OS mg/m² (metal) Chromium (7440-47-3) OS mg/m² (metal) Chiba - Occupational Exposure Limits OS mg/m	OEL STEL	2 mg/m³	
Victoriam - Occupational Exposure Limits OEL TWA 0.05 mg/m² OEL STEL 0.25 mg/m² Australia - Occupational Exposure Limits OES TWA [1] 1 mg/m² USA - ACGIH - Occupational Exposure Limits ACGIH OEL TWA ACGIH OEL TWA 1.5 mg/m² (inhalable particulate matter) ACGIH - Biological Exposure Indices Sig/l Parameter: Nickel - Medium: urine - Sampling time: post-shift at end of workweek (background) USA - ACGIH - Biological Exposure Limits 10 mg/m³ USA - IDLH - Occupational Exposure Limits 10 mg/m³ USA - NIOSH - Occupational Exposure Limits NIOSH REL TWA USA - Occupational Exposure Limits 1 mg/m³ USA - Occupational Exposure Limits 1 mg/m³ Chromium (7440-47-3) X mg/m² (metal) Korea - Occupational Exposure Limits S mg/m² (metal) China - Occupational Exposure Limits O.5 mg/m² OEL PC-TWA 0.05 mg/m² Cheling In Tyo	Thailand - Occupational Exposure Limits		
OEL TWA 0.5 mg/m² 0.5 mg/m	OEL TWA	1 mg/m³	
OEL STEL 0.25 mg/m² Australia - Occupational Exposure Limits 1 mg/m² USA - ACGIH - Occupational Exposure Limits 1.5 mg/m² (inhalable particulate matter) ACGIH OEL TWA 1.5 mg/m² (inhalable particulate matter) ACGIH - Biological Exposure Indices 5 µg/l Parameter: Nickel - Medium: urine - Sampling time: post-shift at end of workweek (background) USA - ACGIH - Occupational Exposure Limits 10 mg/m² IDLH - Occupational Exposure Limits 0.015 mg/m² NIOSH - Occupational Exposure Limits 0.015 mg/m² USA - SHA - Occupational Exposure Limits 1 mg/m² Chromium (7440-47-3) Korea - Occupational Exposure Limits SHA OEL TWA 0.5 mg/m² (metal) China - Occupational Exposure Limits O.5 mg/m² China - Occupational Exposure Limits O.5 mg/m² Chemical category Sensitizer, Carcinogenic to humans OEL PC-TWA 0.5 mg/m² Chemical category Sensitizer, Carcinogenic to humans OEL PC-TWA (Highly Toxic Goods) 0.15 mg/m² OEL MAC (Highly Toxic Goods) 0.5 mg/m² Catalogue of Occupational Hazard Factors Category 3 - Chemicals Indonesia - Occupa	Vietnam - Occupational Exposure Limits		
Australia - Occupational Exposure Limits OES TWA [1] 1 mg/m³ USA - ACGIH - Occupational Exposure Limits ACGIH OEL TWA 1.5 mg/m³ (inhalable particulate matter) ACGIH chemical category Not Suspected as a Human Carcinogen USA - ACGIH - Biological Exposure Indices BEI 5 μg/l Parameter: Nickel - Medium: urine - Sampling time: post-shift at end of workweek (background) USA - IDLH - Occupational Exposure Limits IDLH 10 mg/m³ USA - NIOSH - Occupational Exposure Limits NIOSH REL TWA 0.015 mg/m³ USA - OSHA - Occupational Exposure Limits OSHA PEL TWA [1] 1 mg/m³ Chromium (7440-47-3) Korea - Occupational Exposure Limits ISHA OEL TWA 0.5 mg/m³ (metal) China - Occupational Exposure Limits OEL PC-TWA 0.5 mg/m³ Chemical category Sensitizer, Carcinogenic to humans OEL PC-TWA (Highly Toxic Goods) 0.15 mg/m³ OEL MAC (Highly Toxic Goods) 0.05 mg/m³ Catalogue of Occupational Hazard Factors Category 3 - Chemicals Indonesia - Occupational Exposure Limits	OEL TWA	0.05 mg/m³	
OES TWA [1] 1 mg/m³ USA - ACGIH - Occupational Exposure Limits ACGIH OEL TWA 1.5 mg/m³ (inhalable particulate matter) ACGIH chemical category Not Suspected as a Human Carcinogen USA - ACGIH - Biological Exposure Indices BEI 5 µg/l Parameter: Nickel - Medium: urine - Sampling time: post-shift at end of workweek (background) USA - IDLH - Occupational Exposure Limits IDLH 10 mg/m³ USA - NIOSH - Occupational Exposure Limits NIOSH REL TWA 0.015 mg/m³ USA - OSHA - Occupational Exposure Limits OSHA PEL TWA [1] 1 mg/m³ Chromium (7440-47-3) Korea - Occupational Exposure Limits ISHA OEL TWA 0.5 mg/m³ (metal) China - Occupational Exposure Limits OEL PC-TWA 0.5 mg/m³ Chemical category Sensitizer, Carcinogenic to humans OEL PC-TWA (Highly Toxic Goods) 0.15 mg/m³ OEL MAC (Highly Toxic Goods) 0.05 mg/m³ Catalogue of Occupational Hazard Factors Category 3 - Chemicals Indonesia - Occupational Exposure Limits	OEL STEL	0.25 mg/m³	
USA - ACGIH - Occupational Exposure Limits ACGIH CEL TWA ACGIH chemical category Not Suspected as a Human Carcinogen USA - ACGIH - Biological Exposure Indices BEI 5 µg/l Parameter: Nickel - Medium: urine - Sampling time: post-shift at end of workweek (background) USA - IDLH - Occupational Exposure Limits IDLH 10 mg/m² USA - NIOSH - Occupational Exposure Limits NIOSH REL TWA 0.015 mg/m² USA - OSHA - Occupational Exposure Limits OSHA PEL TWA [1] 1 mg/m³ Chromium (7440-47-3) Korea - Occupational Exposure Limits ISHA OEL TWA 0.5 mg/m² (metal) China - Occupational Exposure Limits OEL PC-TWA 0.05 mg/m³ Chemical category Sensitizer, Carcinogenic to humans OEL PC-TWA (Highly Toxic Goods) 0.05 mg/m³ Catalogue of Occupational Hazard Factors Category 3 - Chemicals Indonesia - Occupational Exposure Limits	Australia - Occupational Exposure Limits		
ACGIH OEL TWA 1.5 mg/m² (inhalable particulate matter) ACGIH chemical category Not Suspected as a Human Carcinogen USA - ACGIH - Biological Exposure Indices BEI 5 mg/ll Parameter: Nickel - Medium: urine - Sampling time: post-shift at end of workweek (background) USA - IDLH - Occupational Exposure Limits IDLH 10 mg/m² USA - NIOSH - Occupational Exposure Limits NIOSH REL TWA 0.015 mg/m² USA - Occupational Exposure Limits OSHA PEL TWA 11 1 mg/m² Chromium (7440-47-3) Korea - Occupational Exposure Limits ISHA OEL TWA 0.5 mg/m² (metal) China - Occupational Exposure Limits OEL PC-TWA 0.05 mg/m² Chemical category Sensitizer, Carcinogenic to humans OEL PC-TWA (Highly Toxic Goods) 0.15 mg/m³ OEL MAC (Highly Toxic Goods) 0.05 mg/m³ Catalogue of Occupational Hazard Factors Category 3 - Chemicals Indonesia - Occupational Exposure Limits	OES TWA [1]	1 mg/m³	
ACGIH chemical category Not Suspected as a Human Carcinogen USA - ACGIH - Biological Exposure Indices BEI Spg/I Parameter: Nickel - Medium: urine - Sampling time: post-shift at end of workweek (background) USA - IDLH - Occupational Exposure Limits IDLH 10 mg/m³ USA - NIOSH - Occupational Exposure Limits NIOSH REL TWA 0.015 mg/m³ USA - OSHA - Occupational Exposure Limits OSHA PEL TWA [1] 1 mg/m³ Chromium (7440-47-3) Korea - Occupational Exposure Limits ISHA OEL TWA 0.5 mg/m³ (metal) China - Occupational Exposure Limits OEL PC-TWA 0.05 mg/m³ Chemical category Sensitizer, Carcinogenic to humans OEL PC-TWA (Highly Toxic Goods) 0.15 mg/m³ OEL MAC (Highly Toxic Goods) 0.05 mg/m³ Catalogue of Occupational Hazard Factors Category 3 - Chemicals Indonesia - Occupational Exposure Limits	USA - ACGIH - Occupational Exposure Limits		
USA - ACGIH - Biological Exposure Indices BEI 5 μg/l Parameter: Nickel - Medium: urine - Sampling time: post-shift at end of workweek (background) USA - IDLH - Occupational Exposure Limits IDLH 10 mg/m³ USA - NIOSH - Occupational Exposure Limits NIOSH REL TWA 0.015 mg/m³ USA - OSHA - Occupational Exposure Limits OSHA PEL TWA [1] 1 mg/m³ Chromium (7440-47-3) Korea - Occupational Exposure Limits ISHA OEL TWA 0.5 mg/m³ (metal) China - Occupational Exposure Limits OEL PC-TWA 0.05 mg/m³ Chemical category Sensitizer, Carcinogenic to humans OEL PC-TWA (Highly Toxic Goods) 0.15 mg/m³ OEL MC (Highly Toxic Goods) 0.05 mg/m³ Catalogue of Occupational Hazard Factors Category 3 - Chemicals Indonesia - Occupational Exposure Limits	ACGIH OEL TWA	1.5 mg/m³ (inhalable particulate matter)	
BEI 5 µg/l Parameter: Nickel - Medium: urine - Sampling time: post-shift at end of workweek (background) USA - IDLH - Occupational Exposure Limits IDLH 10 mg/m³ USA - NIOSH - Occupational Exposure Limits NIOSH REL TWA 0.015 mg/m³ USA - OSHA - Occupational Exposure Limits OSHA PEL TWA [1] 1 mg/m³ Chromium (7440-47-3) Korea - Occupational Exposure Limits ISHA OEL TWA 0.5 mg/m³ (metal) China - Occupational Exposure Limits OEL PC-TWA 0.05 mg/m³ Chemical category Sensitizer, Carcinogenic to humans OEL PC-TWA (Highly Toxic Goods) 0.15 mg/m³ OEL MAC (Highly Toxic Goods) 0.05 mg/m³ Catalogue of Occupational Hazard Factors Category 3 - Chemicals Indonesia - Occupational Exposure Limits	ACGIH chemical category	Not Suspected as a Human Carcinogen	
Chackground	USA - ACGIH - Biological Exposure Indices		
IDLH 10 mg/m³ USA - NIOSH - Occupational Exposure Limits NIOSH REL TWA 0.015 mg/m³ USA - OSHA - Occupational Exposure Limits OSHA PEL TWA [1] 1 mg/m³ Chromium (7440-47-3) Korea - Occupational Exposure Limits ISHA OEL TWA 0.5 mg/m³ (metal) China - Occupational Exposure Limits OEL PC-TWA 0.05 mg/m³ Chemical category Sensitizer, Carcinogenic to humans OEL PC-TWA (Highly Toxic Goods) 0.15 mg/m³ OEL MAC (Highly Toxic Goods) 0.05 mg/m³ Catalogue of Occupational Hazard Factors Category 3 - Chemicals Indonesia - Occupational Exposure Limits	BEI		
USA - NIOSH - Occupational Exposure Limits NIOSH REL TWA USA - OSHA - Occupational Exposure Limits OSHA PEL TWA [1] Chromium (7440-47-3) Korea - Occupational Exposure Limits ISHA OEL TWA O.5 mg/m³ (metal) China - Occupational Exposure Limits OEL PC-TWA O.5 mg/m³ (metal) Chemical category Sensitizer, Carcinogenic to humans OEL PC-TWA (Highly Toxic Goods) O.15 mg/m³ OEL MAC (Highly Toxic Goods) O.55 mg/m³ Catalogue of Occupational Hazard Factors Category 3 - Chemicals Indonesia - Occupational Exposure Limits	USA - IDLH - Occupational Exposure Limits		
NIOSH REL TWA 0.015 mg/m³ USA - OSHA - Occupational Exposure Limits OSHA PEL TWA [1] 1 mg/m³ Chromium (7440-47-3) Korea - Occupational Exposure Limits ISHA OEL TWA 0.5 mg/m³ (metal) China - Occupational Exposure Limits OEL PC-TWA 0.05 mg/m³ Chemical category Sensitizer, Carcinogenic to humans OEL PC-TWA (Highly Toxic Goods) 0.15 mg/m³ OEL MAC (Highly Toxic Goods) 0.05 mg/m³ Catalogue of Occupational Hazard Factors Category 3 - Chemicals Indonesia - Occupational Exposure Limits	IDLH	10 mg/m³	
USA - OSHA - Occupational Exposure Limits OSHA PEL TWA [1] 1 mg/m³ Chromium (7440-47-3) Korea - Occupational Exposure Limits ISHA OEL TWA 0.5 mg/m³ (metal) China - Occupational Exposure Limits OEL PC-TWA 0.05 mg/m³ Chemical category Sensitizer, Carcinogenic to humans OEL PC-TWA (Highly Toxic Goods) 0.15 mg/m³ OEL MAC (Highly Toxic Goods) 0.05 mg/m³ Catalogue of Occupational Hazard Factors Category 3 - Chemicals Indonesia - Occupational Exposure Limits	USA - NIOSH - Occupational Exposure Limits		
Chromium (7440-47-3) Korea - Occupational Exposure Limits ISHA OEL TWA 0.5 mg/m³ (metal) China - Occupational Exposure Limits OEL PC-TWA 0.05 mg/m³ Chemical category Sensitizer, Carcinogenic to humans OEL PC-TWA (Highly Toxic Goods) 0.15 mg/m³ OEL MAC (Highly Toxic Goods) 0.05 mg/m³ Catalogue of Occupational Hazard Factors Category 3 - Chemicals Indonesia - Occupational Exposure Limits	NIOSH REL TWA	0.015 mg/m³	
Chromium (7440-47-3) Korea - Occupational Exposure Limits ISHA OEL TWA 0.5 mg/m³ (metal) China - Occupational Exposure Limits OEL PC-TWA 0.05 mg/m³ Chemical category Sensitizer, Carcinogenic to humans OEL PC-TWA (Highly Toxic Goods) 0.15 mg/m³ OEL MAC (Highly Toxic Goods) 0.05 mg/m³ Catalogue of Occupational Hazard Factors Category 3 - Chemicals Indonesia - Occupational Exposure Limits	USA - OSHA - Occupational Exposure Limits		
Korea - Occupational Exposure Limits ISHA OEL TWA 0.5 mg/m³ (metal) China - Occupational Exposure Limits OEL PC-TWA 0.05 mg/m³ Chemical category Sensitizer, Carcinogenic to humans OEL PC-TWA (Highly Toxic Goods) 0.15 mg/m³ OEL MAC (Highly Toxic Goods) 0.05 mg/m³ Catalogue of Occupational Hazard Factors Category 3 - Chemicals Indonesia - Occupational Exposure Limits	OSHA PEL TWA [1]	1 mg/m³	
ISHA OEL TWA China - Occupational Exposure Limits OEL PC-TWA 0.05 mg/m³ Chemical category Sensitizer, Carcinogenic to humans OEL PC-TWA (Highly Toxic Goods) 0.15 mg/m³ OEL MAC (Highly Toxic Goods) 0.05 mg/m³ Catalogue of Occupational Hazard Factors Category 3 - Chemicals Indonesia - Occupational Exposure Limits	Chromium (7440-47-3)		
China - Occupational Exposure Limits OEL PC-TWA 0.05 mg/m³ Chemical category Sensitizer, Carcinogenic to humans OEL PC-TWA (Highly Toxic Goods) 0.15 mg/m³ OEL MAC (Highly Toxic Goods) 0.05 mg/m³ Catalogue of Occupational Hazard Factors Category 3 - Chemicals Indonesia - Occupational Exposure Limits	Korea - Occupational Exposure Limits		
OEL PC-TWA 0.05 mg/m³ Chemical category Sensitizer, Carcinogenic to humans OEL PC-TWA (Highly Toxic Goods) 0.15 mg/m³ OEL MAC (Highly Toxic Goods) 0.05 mg/m³ Catalogue of Occupational Hazard Factors Category 3 - Chemicals Indonesia - Occupational Exposure Limits	ISHA OEL TWA	0.5 mg/m³ (metal)	
Chemical category Sensitizer, Carcinogenic to humans OEL PC-TWA (Highly Toxic Goods) OEL MAC (Highly Toxic Goods) OEL MAC (Highly Toxic Goods) Catalogue of Occupational Hazard Factors Indonesia - Occupational Exposure Limits	China - Occupational Exposure Limits		
OEL PC-TWA (Highly Toxic Goods) OEL MAC (Highly Toxic Goods) Oatalogue of Occupational Hazard Factors Category 3 - Chemicals Indonesia - Occupational Exposure Limits	OEL PC-TWA	0.05 mg/m³	
OEL MAC (Highly Toxic Goods) Catalogue of Occupational Hazard Factors Category 3 - Chemicals Indonesia - Occupational Exposure Limits	Chemical category	Sensitizer, Carcinogenic to humans	
Catalogue of Occupational Hazard Factors Category 3 - Chemicals Indonesia - Occupational Exposure Limits	OEL PC-TWA (Highly Toxic Goods)	0.15 mg/m³	
Indonesia - Occupational Exposure Limits	OEL MAC (Highly Toxic Goods)	0.05 mg/m³	
	Catalogue of Occupational Hazard Factors	Category 3 - Chemicals	
NAB (OEL TWA) 0.5 mg/m³	Indonesia - Occupational Exposure Limits		
	NAB (OEL TWA)	0.5 mg/m³	

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Chromium (7440-47-3)		
Chemical category	A4 - not classifiable as a human carcinogen	
Singapore - Occupational Exposure Limits		
PEL (OEL TWA)	0.5 mg/m ³	
Taiwan - Occupational Exposure Limits		
OEL TWA	1 mg/m³	
OEL STEL	2 mg/m³	
Australia - Occupational Exposure Limits		
OES TWA [1]	0.5 mg/m³	
USA - ACGIH - Occupational Exposure Limits		
ACGIH OEL TWA	0.5 mg/m³ (inhalable particulate matter)	
USA - ACGIH - Biological Exposure Indices		
BEI	$0.7~\mu g/l$ Parameter: Total chromium - Medium: urine - Sampling time: end of shift at end of workweek (population based)	
USA - IDLH - Occupational Exposure Limits		
IDLH	250 mg/m³	
USA - NIOSH - Occupational Exposure Limits		
NIOSH REL TWA	0.5 mg/m³	
USA - OSHA - Occupational Exposure Limits		
OSHA PEL TWA [1]	1 mg/m³	
Molybdenum (7439-98-7)		
Korea - Occupational Exposure Limits		
Local name	몰리브덴 (불용성화합물) # Molybdenum (Insoluble compounds)	
ISHA OEL TWA	10 mg/m³ 흡입성 # (Inhalable fraction)	
	5 mg/m³ 호흡성 # (Respirable fraction)	
Regulatory reference	고용노동부고시 제2020-48호 # MOEL Public Notice. No. 2020-48	
Indonesia - Occupational Exposure Limits	Indonesia - Occupational Exposure Limits	
NAB (OEL TWA)	5 mg/m³ (respirable particulate)	
Chemical category	A3 - confirmed animal carcinogen	
Australia - Occupational Exposure Limits		
OES TWA [1]	10 mg/m³	
USA - ACGIH - Occupational Exposure Limits		
ACGIH OEL TWA	10 mg/m³ (inhalable particulate matter) 3 mg/m³ (respirable particulate matter)	
USA - IDLH - Occupational Exposure Limits		
IDLH	5000 mg/m³	
	·	

8.2. Appropriate engineering controls

Appropriate engineering controls : Ensure good ventilation of the work station. Environmental exposure controls : Avoid release to the environment.

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8.3. Personal protection

Respiratory protection:

In case of insufficient ventilation, wear suitable respiratory equipment

Eye protection:

Safety glasses

Hand protection:

Protective gloves

Skin and body protection:

Wear suitable protective clothing

Personal protective equipment symbol(s):







9. Physical and chemical properties

a) Appearance : No data available

Physical state : Solid

b) Odour : No data available c) Odour threshold : No data available

d) pH : No data available

e) Melting / freezing point : No data available / Not applicable

f) Initial boiling point and boiling range : No data available g) Flash point : Not applicable h) Evaporation rate : No data available i) Flammability (solid, gas) : Non flammable. i) Upper / lower flammability or explosive limits : Not applicable

j) Upper / lower flammability or explosive limits : Not applicable : No data available : No data available

Partition coefficient n-octanol/water : No data available 0) Auto-ignition temperature : Not applicable p) Decomposition temperature : No data available q) Viscosity, kinematic : Not applicable r) Viscosity, dynamic : No data available Molecular mass : No data available

10. Stability and reactivity

10.1. Chemical stability and Possibility of hazardous reactions

The product is non-reactive under normal conditions of use, storage and transport. Stable under normal conditions.

No dangerous reactions known under normal conditions of use.

10.2. Conditions to avoid

None under recommended storage and handling conditions (see section 7).

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10.3. Incompatible materials

No data available

10.4. Hazardous decomposition products

Under normal conditions of storage and use, hazardous decomposition products should not be produced.

11. Toxicological information

11.1. Information on exposure routes

Oral : Not classified

Skin and eyes contact : May cause an allergic skin reaction.

Inhalation : May cause allergic reactions, asthma or shortness of breath and etc if inhaled.

11.2. Health hazards

Acute toxicity (oral):

Not classified

Acute toxicity (dermal):

Not classified

Acute toxicity (inhalation):

Not classified

Titanium Dioxide (13463-67-7)	
LD50 oral rat	> 5000 mg/kg bodyweight Animal: rat, Animal sex: female, Guideline: OECD Guideline 425 (Acute Oral Toxicity: Up-and-Down Procedure), Guideline: EPA OPPTS 870.1100 (Acute Oral Toxicity)
LC50 Inhalation - Rat	> 6.82 mg/l (Other, 4 h, Rat, Male, Experimental value, Inhalation (dust), 14 day(s))
LC50 Inhalation - Rat (Dust/Mist)	> 3.43 mg/l Source: ECHA

Iron (7439-89-6)	
LD50 oral rat	98600 mg/kg bodyweight Animal: rat, Animal sex: male, Guideline: OECD Guideline 401 (Acute Oral Toxicity)
LC50 Inhalation - Rat	> 250 mg/m³ air (6 h, Rat, Male, Experimental value, Inhalation (dust))

Manganese (7439-96-5)	
LD50 oral rat	> 2000 mg/kg bodyweight Animal: rat, Animal sex: female, Guideline: OECD Guideline 420 (Acute Oral Toxicity - Fixed Dose Method), Guideline: EU Method B.1 bis (Acute Oral Toxicity - Fixed Dose Procedure)
LC50 Inhalation - Rat	> 5.14 mg/l air Animal: rat, Guideline: OECD Guideline 403 (Acute Inhalation Toxicity), Guideline: EU Method B.2 (Acute Toxicity (Inhalation))
LC50 Inhalation - Rat (Dust/Mist)	> 5.14 mg/l Source: ECHA

Nickel (7440-02-0)	
LD50 oral rat	> 9000 mg/kg bodyweight Animal: rat, Guideline: OECD Guideline 401 (Acute Oral Toxicity)
LC50 Inhalation - Rat	> 10.2 mg/l (Exposure time: 1 h)

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Chromium (7440-47-3)	
LD50 oral rat	> 5000 mg/kg bodyweight (Equivalent or similar to OECD 420, Rat, Male / female, Readacross, Oral, 14 day(s))
LC50 Inhalation - Rat	> 5.41 mg/l air Animal: rat, Guideline: OECD Guideline 403 (Acute Inhalation Toxicity)
LC50 Inhalation - Rat (Dust/Mist)	> 5.41 mg/l Source: ECHA

Molybdenum (7439-98-7)	
LD50 oral rat	> 2000 mg/kg Source: ECHA
LD50 dermal rat	> 2000 mg/kg bodyweight Animal: rat, Guideline: OECD Guideline 402 (Acute Dermal Toxicity)
LD50 dermal rabbit	> 2000 mg/kg Source: ECHA
LC50 Inhalation - Rat	> 5.84 mg/l/4h
LC50 Inhalation - Rat (Dust/Mist)	> 3.92 mg/l Source: ECHA

Skin corrosion/irritation:

Not classified

Serious eye damage/irritation:

Not classified

Respiratory sensitization:

May cause allergic reactions, asthma or shortness of breath and etc if inhaled.

Skin sensitization:

May cause an allergic skin reaction.

Carcinogenicity:

Suspected of causing cancer.

Titanium Dioxide (13463-67-7)	
IARC group	2B - Possibly carcinogenic to humans

Nickel (7440-02-0)	
IARC group	2B - Possibly carcinogenic to humans

Chromium (7440-47-3)	
IARC group	3 - Not classifiable

Mutagenicity:

Not classified

Reproductive toxicity:

Not classified

STOT-single exposure:

Not classified

STOT-repeated exposure:

Causes damage to organs through prolonged or repeated exposure. May cause damage to organs through prolonged or repeated exposure.

Nickel (7440-02-0)	
LOAEC (inhalation, rat,dust/mist/fume, 90 days)	0.004 mg/l air Animal: rat, Guideline: OECD Guideline 412 (Subacute Inhalation Toxicity: 28-Day Study)
STOT-repeated exposure	Causes damage to organs through prolonged or repeated exposure.

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Chromium (7440-47-3)	
LOAEC (inhalation, rat,dust/mist/fume, 90 days)	≥ 0.0044 mg/l air Animal: rat, Guideline: OECD Guideline 413 (Subchronic Inhalation Toxicity: 90-Day Study)
STOT-repeated exposure	Causes damage to organs through prolonged or repeated exposure.

Molybdenum (7439-98-7)	
NOAEC (inhalation, rat, dust/mist/fume, 90 days)	> 0.1 mg/l air Animal: rat, Guideline: OECD Guideline 413 (Subchronic Inhalation Toxicity: 90-Day Study)
STOT-repeated exposure	May cause damage to organs through prolonged or repeated exposure.

Aspiration hazard:

Not classified

K-316LT	
Viscosity, kinematic	Not applicable

Titanium Dioxide (13463-67-7)	
Viscosity, kinematic (calculated value) (40 °C)	Not applicable (solid)
Density	3.9 – 4.1 g/cm³
Viscosity, kinematic	Not applicable (solid)
Viscosity, dynamic	Not applicable (solid)

Iron (7439-89-6)	
Density	7.87 g/cm³ Type: 'density' Temp.: 20 °C

Manganese (7439-96-5)	
Density	7200 kg/m³

Nickel (7440-02-0)	
Viscosity, kinematic (calculated value) (40 °C)	Not applicable (solid)
Density	8.9 g/cm³ (at 25 °C)
Viscosity, kinematic	Not applicable (solid)
Viscosity, dynamic	Not applicable (solid)

Chromium (7440-47-3)	
Density	7.19 g/cm³ (at 20 °C)

Molybdenum (7439-98-7)	
Density	10.2 g/cm³ (at 20 °C)

12. Ecological information

12.1. Ecotoxicity

Ecology - general

: The product is not considered harmful to aquatic organisms nor to cause long-term adverse effects in the environment.

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Hazardous to the aquatic environment, short-term

(acute)

Hazardous to the aquatic environment, long-term

(chronic)

: Not classified

: Not classified

Titanium Dioxide (13463-67-7)	
LC50 - Fish [1]	155 mg/l Test organisms (species): other:Japanese Medaka
EC50 - Crustacea [1]	19.3 mg/l Test organisms (species): Daphnia magna
EC50 - Crustacea [2]	27.8 mg/l Test organisms (species): Daphnia magna
EC50 - Other aquatic organisms [1]	> 100 mg/l Test organisms (species):
EC50 72h - Algae [1]	> 100 mg/l Test organisms (species): Pseudokirchneriella subcapitata (previous names: Raphidocelis subcapitata, Selenastrum capricornutum)
ErC50 algae	61 mg/l (EPA 600/9-78-018, 72 h, Pseudokirchneriella subcapitata, Static system, Fresh water, Experimental value, Nominal concentration)
LOEC (chronic)	5 mg/l Test organisms (species): Daphnia magna Duration: '21 d'
NOEC (chronic)	≥ 2.92 mg/l Test organisms (species): Daphnia magna Duration: '21 d'

Iron (7439-89-6)	
LC50 - Fish [1]	8.65 mg/l Source: ECHA
LC50 - Other aquatic organisms [1]	106.3 mg/l Source: ECHA
EC50 - Crustacea [1]	> 100 mg/l Test organisms (species): Daphnia magna
EC50 - Crustacea [2]	> 10000 mg/l Test organisms (species): Daphnia magna
EC50 72h - Algae [1]	18 mg/l Source: ECHA

Manganese (7439-96-5)	
LC50 - Fish [1]	> 3.6 mg/l Test organisms (species): Oncorhynchus mykiss (previous name: Salmo gairdneri)
EC50 - Crustacea [1]	> 1.6 mg/l Test organisms (species): Daphnia magna
EC50 72h - Algae [1]	4.5 mg/l Test organisms (species): Desmodesmus subspicatus (previous name: Scenedesmus subspicatus)
EC50 72h - Algae [2]	2.8 mg/l Test organisms (species): Desmodesmus subspicatus (previous name: Scenedesmus subspicatus)
NOEC (chronic)	1.7 mg/l Test organisms (species): Ceriodaphnia dubia Duration: '8 d'
BCF - Fish [1]	81 (Pisces)
BCF - Other aquatic organisms [1]	300000 (Mollusca)
BCF - Other aquatic organisms [2]	125000 (Crustacea)

Nickel (7440-02-0)	
LC50 - Fish [1]	> 100 mg/l (Exposure time: 96 h - Species: Brachydanio rerio)
LC50 - Fish [2]	1.3 mg/l (Exposure time: 96 h - Species: Cyprinus carpio [semi-static])
EC50 - Crustacea [1]	> 100 mg/l (Exposure time: 48 h - Species: Daphnia magna)
EC50 - Crustacea [2]	1 mg/l (Exposure time: 48 h - Species: Daphnia magna [Static])
EC50 96h - Algae [1]	0.174 – 0.311 mg/l (Species: Pseudokirchneriella subcapitata [static])
EC50 72h - Algae [1]	0.18 mg/l (Species: Pseudokirchneriella subcapitata)

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Nickel (7440-02-0)	
BCF - Other aquatic organisms [1]	8 – 45 (≤ 4 week(s), Cambarus sp., Flow-through system, Fresh water, Experimental value, Fresh weight)

Chromium (7440-47-3)	
LC50 - Fish [1]	13.9 – 210 mg/l Source: GESTIS
EC50 - Crustacea [1]	17.7 – 18.9 mg/l Source: ECHA
EC50 72h - Algae [1]	0.1 – 17.8 mg/l Source: GESTIS
BCF - Fish [1]	0.0048 (Pisces, Literature study, Dry weight)
Partition coefficient n-octanol/water (Log Pow)	0.23 Source: SRC

Molybdenum (7439-98-7)	
LC50 - Fish [1]	609.1 mg/l Source: EHCA
EC50 72h - Algae [1]	289.2 mg/l Source: ECHA
BCF - Fish [1]	260 – 500 (Tilapia rendalli)
Partition coefficient n-octanol/water (Log Pow)	0.23 Source: SRC Access on Jan 2006

12.2. Persistence and degradability

Titanium Dioxide (13463-67-7)	
Persistence and degradability	Biodegradability: not applicable.
Chemical oxygen demand (COD)	Not applicable (inorganic)
ThOD	Not applicable (inorganic)

Iron (7439-89-6)	
Persistence and degradability	Biodegradability in soil: not applicable. Biodegradability: not applicable.
Chemical oxygen demand (COD)	Not applicable
ThOD	Not applicable
BOD (% of ThOD)	Not applicable

Manganese (7439-96-5)	
Persistence and degradability	Biodegradability: not applicable.
Chemical oxygen demand (COD)	Not applicable
ThOD	Not applicable
BOD (% of ThOD)	Not applicable

Nickel (7440-02-0)	
Persistence and degradability	Biodegradability in soil: not applicable. Biodegradability: not applicable.
Chemical oxygen demand (COD)	Not applicable (inorganic)
ThOD	Not applicable (inorganic)

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Chromium (7440-47-3)	
Persistence and degradability	Biodegradability: not applicable.
Chemical oxygen demand (COD)	Not applicable (inorganic)
ThOD	Not applicable (inorganic)

Molybdenum (7439-98-7)	
Persistence and degradability	Biodegradability: not applicable.
Chemical oxygen demand (COD)	Not applicable
ThOD	Not applicable
BOD (% of ThOD)	Not applicable

12.3. Bioaccumulative potential

Titanium Dioxide (13463-67-7)	
Bioaccumulative potential	Not bioaccumulative.

Iron (7439-89-6)	
Bioaccumulative potential	No bioaccumulation data available.

Manganese (7439-96-5)	
BCF - Fish [1]	81 (Pisces)
BCF - Other aquatic organisms [1]	300000 (Mollusca)
BCF - Other aquatic organisms [2]	125000 (Crustacea)
Bioaccumulative potential	No bioaccumulation data available.

Nickel (7440-02-0)	
BCF - Other aquatic organisms [1]	$8-45~(\le 4~\text{week(s)},~\text{Cambarus sp.},~\text{Flow-through system},~\text{Fresh water},~\text{Experimental value},~\text{Fresh weight)}$
Bioaccumulative potential	Low potential for bioaccumulation (BCF < 500).

Chromium (7440-47-3)	
BCF - Fish [1]	0.0048 (Pisces, Literature study, Dry weight)
Partition coefficient n-octanol/water (Log Pow)	0.23 Source: SRC
Bioaccumulative potential	Not bioaccumulative.

Molybdenum (7439-98-7)	
BCF - Fish [1]	260 – 500 (Tilapia rendalli)
Partition coefficient n-octanol/water (Log Pow)	0.23 Source: SRC Access on Jan 2006
Bioaccumulative potential	No bioaccumulation data available.

12.4. Mobility in soil

Titanium Dioxide (13463-67-7)	
Surface tension	No data available in the literature

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Titanium Dioxide (13463-67-7)	
Ecology - soil	Low potential for mobility in soil.

Iron (7439-89-6)	
Surface tension	Not applicable (solid)
Ecology - soil	Adsorbs into the soil.

Manganese (7439-96-5)	
Ecology - soil	No (test)data on mobility of the substance available.

Nickel (7440-02-0)	
Surface tension	Not applicable (solid)
Ecology - soil	No (test)data on mobility of the substance available.

Chromium (7440-47-3)		
Surface tension No data available (test not performed)		
Partition coefficient n-octanol/water (Log Pow)	0.23 Source: SRC	
Ecology - soil	No (test)data on mobility of the substance available.	

Molybdenum (7439-98-7)	
Partition coefficient n-octanol/water (Log Pow) 0.23 Source: SRC Access on Jan 2006	
Ecology - soil	Adsorbs into the soil.

12.5. Other adverse effects

Ozone : Not classified
Other adverse effects : No data available

13. Disposal considerations

13.1. Disposal method

Dispose of contents/container in accordance with licensed collector's sorting instructions.

13.2. Disposal precaution

No data available

14. Transport information

UN RTDG	ADR	IMDG	IATA
14.1. UN number			
Not applicable	Not applicable	Not applicable	Not applicable
14.2. UN proper shipping name			
Not applicable	Not applicable	Not applicable	Not applicable
14.3. Transport hazard class(es)			
Not applicable	Not applicable	Not applicable	Not applicable

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UN RTDG	ADR	IMDG	IATA
14.4. Packing group			
Not applicable	Not applicable	Not applicable	Not applicable
14.5. Marine pollutant			
Not applicable	Not applicable	Not applicable	Not applicable
No supplementary information available			

14.6. Special precautions for user

No data available

15. Regulatory information

15.1. Occupational Safety and Health Act

Hazardous Substances Prohibited for Manufacturing Hazardous Substances Requiring Permission Threshold Limit Values Chemicals	Not applicable Not applicable Applicable	13463-67-7: Titanium dioxide 7439-89-6: Iron salts (Soluble, as Fe) 7439-96-5: Manganese&Inorganic compounds, as Mn 7440-02-0: Nickel 7440-47-3: Chromium 7439-98-7: Molybdenum
Hazardous Substances Below Permissible Level	Applicable	7439-96-5: Manganese and its inorganic compounds 7440-02-0: Nickel and its insoluble inorganic compounds
Hazardous Substances Subject to Working Environment Measurement	Applicable	13463-67-7: Titanium dioxide 7439-96-5: Manganese and its inorganic compounds 7440-02-0: Nickel and its inorganic compounds 7440-47-3: Chromium and its inorganic compounds
Hazardous Substances Subject to Workers Requiring Health Examination	Applicable	7439-96-5: Manganese and its inorganic compounds 7440-02-0: Nickel and its inorganic compounds 7440-47-3: Chromium and its compounds
Hazardous Substances Subject to Control	Applicable	13463-67-7: Titanium dioxide 7439-89-6: Iron and its compounds 7439-96-5: Manganese and its inorganic compounds 7440-02-0: Nickel and its inorganic compounds 7440-47-3: Chromium and its compounds(except Chromium(VI) compounds)

15.2. Chemicals Control Act

No data available

15.3. ACT ON REGISTRATION, EVALUATION, ETC. OF CHEMICALS (K-REACH)

No data available

15.4. Safety Control of Dangerous Substances Act

Safety Control of Dangerous Substances Act Applicable

(Class 2 Combustible solid - category 4 Iron Powder (Designated quantity:

500kg); Class 2 Combustible solid - category 5 Metal powder (Designated

quantity: 500kg))

Applicable 7439-89-6: Iron powder

(Class 2 Combustible solid - category 4 Iron Powder (Designated quantity:

500kg))

7439-96-5: Manganese powder

(Class 2 Combustible solid - category 5 Metal powder (Designated quantity:

500kg))

7440-47-3: Chromium powder

(Class 2 Combustible solid - category 5 Metal powder (Designated quantity:

500kg))

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7439-98-7: Molybdenum powder

(Class 2 Combustible solid - category 5 Metal powder (Designated quantity: 500kg))

15.5. Wastes Control Act

No data available

15.6. Other Domestic and International Regulatory Information

Domestic

Persistent Organic Pollutants(POPs) Control Act Ozone Depleting Substances(ODS) Not applicable Not applicable

International

EU Regulatory Information

EU Candidate list (SVHC)
EU authorization list (REACH Annex XIV)
EU restriction list (REACH Annex XVII)

Contains no REACH Annex XIV substances

Not applicable

US Regulatory Information

CERCLA Section 103 (40CFR302.4) EPCRA Section 302 (40CFR355.30)

EPCRA Section 302 (40CFR355.30) Not applicable EPCRA Section 304 (40CFR355.40) Not applicable

EPCRA Section 313 (40CFR372.65)

Contains listed substances

Contains listed substances

Contains no substance on the REACH candidate list

International agreements

No data available

16. Other information

16.1. Data sources:

16.2. Issue date:

REGULATION (EC) No 1272/2008 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006, Classification according to Classification, Labelling and Packaging of Substances and Mixtures (SEA) Regulation published in the Official Journal numbered 28848 on December 11, 2013, Supplier's safety documents, This MSDS is prepared based on Article 41 of the Occupational Safety and Health Act and Notice No.2016-19 of the Ministry of Employment and Labor (based on the availability of material safety and health data), taking into account the status of regulations related to Korea, ECHA (European Chemicals Agency), No data available, This safety data sheet was compiled with data and information from the following sources: RTECS, ECOSAR, HSDB, SIDS SIAP, ChemWATCH, CESAR, Chemical DB, This MSDS is prepared based on KOSHA, NITE, ESIS, NLM, SIDS, IPCS, NCIS, etc.

6/28/1996

16.3. Revision number and date:16.4. Other information:

6.0, 22/11/2021 No data available

This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It should not therefore be construed as guaranteeing any specific property of the product.

11/22/2021 (Revision date) KR - en 18/18