

Safety Data Sheet

Regulation : In accordance with Regulation (EU) 2015/830 (REACH), Annex II, and OSHA 29 CFR 1910.1200

Section I – IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

Important Note: As a solid, manufactured article, exposure to hazardous ingredients is not expected with normal use. This battery is an article pursuant to 29 CFR 1910.1200 and, as such, is not subject to the OSHA Hazard Communication Standard requirement. The information contained in this Safety Data Sheet contains valuable information critical to the safe handling and proper use of the product. This SDS should be retained and available for employees and other users of this product.

1.1 Product identifier

Model name INR18650-20R

Substance name : Lithium-ion batteries

Synonyms :

Lithium-ion Cell, Lithium-ion Pack, Lithium-ion Battery, Li-Ion Cell, Li-Ion Pack, Li-Ion Battery

1.2 Relevant identified uses of the substance or mixture and uses advised against

Relevant identified uses : Lithium-ion batteries

Uses advised against : Use for recommended use only

Further Information : Not available

1.3 Details of the supplier of the safety data sheet

Supplier : SAMSUNG SDI Co., Ltd.

Street address/P.O. Box : 150-20, Gongse-ro, Giheung-gu, Yongin-si, Gyeonggi-do, Korea

Country ID/Postcode/Place :

Telephone number : 1-800-424-9300: US and Canada / 1-703-527-3887: International

Responsible Department: Quality team

e-mail address of competent person responsible for the SDS : Not available

National contact : 1-800-424-9300: US and Canada / 1-703-527-3887: International

1.4 Emergency Telephone

: 1-800-424-9300: US and Canada / 1-703-527-3887: International

Opening hours : Not available

Other comments : Not available

1.5 Further Information

Battery-System: Lithium-ion (Li-ion)

Nominal Voltage: 3.6 V

Rated Capacity: 2.0 Ah

Wh rating: 7.2 Wh

Anode (negative electrode): based on intercalation graphite

Cathode (positive electrode): based on lithiated metal oxide (Cobalt, Nickel or Manganese)



Remark:

The information and recommendations set forth are made in good faith and believed to be accurate as of the date of preparation. SAMSUNG SDI Co., Ltd. makes no warranty, expressed or implied, with respect to this information and disclaims all liabilities from reliance on it.

Section II – HAZARDS IDENTIFICATION

※ This is a product that fulfills a certain function in solid state with specific shape without discharging any chemical substance in its use and has no obligation to write (M)SDS. Since this document contains the precautions for safe handling related to its materials or chemical substances consisting of this product, please note that these overall information is irrelevant to this product.

2.1 Classification of the substance or mixture

2.1.1 Classification according to Regulation (EC) No. 1272/2008 [CLP] and OSHA 29 CFR 1910.12

00 : Not classified

2.1.2 Additional information:

Classification of the substance or mixture.

Preparation Hazards and Classification: The product is a Lithium ion cell or battery and is therefore classified as an article and is not hazardous when used according to the recommendations of the manufacturer. The hazard is associated with the contents of the cell or battery. Under recommended use conditions, the electrode materials and liquid electrolyte are non-reactive provided that the cell or battery integrity remains and the seals remain intact. The potential for exposure should not exist unless the cell or battery leaks, is exposed to high temperatures or is mechanically, electrically or physically abused/damaged. If the cell or battery is compromised and starts to leak, based upon the battery ingredients, the contents are classified as Hazardous.

Hazardous Materials Information Label (HMIS)

Health: Not available
Flammability: Not available
Physical Hazard: Not available

NFPA Hazard Ratings

Health: Not available
Flammability: Not available
Reactivity: Not available
Unique Hazard:

2.2 Label elements

Hazard pictograms : Not applicable

Signal word : Not applicable

Hazard statement : Not applicable

Precautionary statements: Not applicable

Supplemental Hazard information (EU) : Not applicable



2.3 Other hazards :

Appearance, Color and Odor: Solid object with no odor.

Primary Routes(s) of Exposure: These chemicals are contained in a sealed enclosure. Risk of exposure occurs only if the cell or pack is mechanically, thermally, electrically or physically abused to the point of compromising the enclosure.

If this occurs, exposure to the electrolyte solution contained within can occur by inhalation, ingestion, eye contact and skin contact.

Potential Health Effect(s):

Acute (short term): see Section 8 for exposure controls.

In the event that this cell or pack has been ruptured, the electrolyte solution contained within the cell would be corrosive and can cause burns to skin and eyes.

Inhalation: Inhalation of materials from a sealed cell is not an expected route of exposure. Vapors or mists from a ruptured cell may cause respiratory irritation.

Ingestion: Swallowing of materials from a sealed cell is not an expected route of exposure.

Swallowing the contents of an open cell can cause serious chemical burns to mouth, esophagus, and gastrointestinal tract.

Skin: Contact between the cell and skin will not cause any harm. Skin contact with the contents of an open cell can cause severe irritation or burns to the skin.

Eye: Contact between the cell and the eye will not cause any harm. Eye contact with the contents of an open cell can cause severe irritation or burns to the eye.

CHRONIC (long term): see Section 11 for additional toxicological data.

Interactions with other chemicals: Immersion in high conductivity liquids may cause corrosion and breaching of the cell or battery enclosure. The electrolyte solution inside of the cells may react with alkaline (basic) materials and present a flammability hazard.

Potential Environmental Effects: Not Available.

Section III – COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Mixture

CAS No.	EC No.	REACH Registration No.	%[weight]	Name	Common Name (Synonyms)	Classification according to Regulation(EC) No 1278/2008(CLP)
7782-42-5	231-955-3	-	15~25	Graphite	Not available	Not classified
12031-65-1	Not available	-	15~25	Lithium nickelate	Not available	Skin Sens. 1, H317 STOT RE 1, H372 Carc. 1A, H350i
7439-89-6	231-096-4	-	10~20	Iron	Not available	Not classified
12057-17-9	Not available	-	5~15	Lithium manganese	Not available	Pyr. Sol. 1, H250 Water-react. 2, H261



				oxide		
12190-79-3	235-362-0	-	1~10	cobalt lithium dioxide	Not available	Flam. Liq. 3, H226 Acute Tox. 4, H332
7440-50-8	231-159-6	-	1~10	Copper	Not available	Not classified
616-38-6	210-478-4	-	1~10	dimethyl carbonate	Not available	Flam. Liq. 2, H225
7429-90-5	231-072-3	-	1~10	Aluminium	Not available	Pyr. Sol. 1, H250 Water-react. 2, H261
9002-88-4	Not available	-	1~10	Polyethylene	Not available	Not classified
96-49-1	202-510-0	-	1~10	1,3-Dioxolan-2-one	Not available	Not classified
21324-40-3	244-334-7	-	1~10	lithium hexafluorophosphate(1-)	Not available	Not classified
141-78-6	205-500-4	-	0.1~1	ethyl acetate	Not available	Flam. Liq. 2, H225 Eye Irrit. 2, H319 STOT SE 3, H336
1333-86-4	215-609-9	-	0.1~1	Carbon black	Not available	Not classified
7440-02-0	231-111-4	-	0.1~1	Nickel	Not available	Skin Sens. 1, H317 Carc. 2, H351 STOT RE 1, H372 Aquatic Chronic 3, H412
554-13-2	209-062-5	-	0.1~1	lithium carbonate	Not available	Not classified

Further Information

Because of the cell structure the dangerous ingredients will not be available if used properly.
 During charge process a lithium graphite intercalation phase is formed.

Section IV – FIRST-AID MEASURES

4.1 Description of first aid measures

Following eye contact :

- Rinse eyes with plenty of water for at least 15 minutes and seek medical attention.

Following skin contact :

- Remove contaminated clothing and wash before reuse.
- Immediately rinse contact area with plenty of clean water.
- Provide first aid to contacted area to prevent infection.
- Get medical attention.

Following inhalation :

- In case of inhalation of organic electrolyte mist, move from exposure to fresh air.



- If necessary give oxygen. Get medical attention.

Following ingestion :

- In case of ingestion of electrolyte don't induce vomiting.
- If patient is conscious and alert give 2~4 cupfuls of milk or water.
- Never give anything by mouth to an unconscious person.
- Get medical attention immediately.

Further Information :

- The following first aid measures are required only in case of exposure to interior battery components after damage of the external battery casing.
- Undamaged, closed cells do not represent a danger to the health.

4.2 Most important symptoms and effects, both acute and delayed

Acute effects : Not available

Delayed effects : Not available

4.3 Indication of immediate medical attention and special treatment needed

- Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves.

Section V – FIRE-FIGHTING MEASURES

5.1 Extinguishing media

- When the scale of the fire is small, use a HFC (hydrofluorocarbon) clean-agent fire extinguisher or alcohol resistant foam fire extinguishers. (In case of battery overheating, wear protective gear and immerse heated battery in water)
- In case of large fire, use large amount of water to extinguish.

5.2 Special hazards arising from the substance or mixture

- Flammable gas leaks before ignition and then the product ignites.

5.3 Advice for firefighters

- The ignited battery has a high temperature, so there is a risk of additional ignition even if the fire is extinguished at early stage. Sprinkle a large amount of water until the battery temperature drops to normal temperature.
- If the battery is ignited in multi-stacked condition, multi-stack should be disassembled and then extinguished so that heat is not transferred between batteries
- In the event of a battery fire, cool it by spraying water directly on the battery.
- When handling a overheated battery, wear heat-resistant protective equipment.

Section VI – ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures



For non-emergency personnel

Protective equipment : Use personal protective equipment, see Section 8

Emergency procedures :

- In case of cell damage, possible release of dangerous substances and a flammable gas mixture.
- Eliminate all ignition sources.
- Please note that materials and conditions to avoid.
- Battery may emit electrolyte if charging or discharging rates exceed manufacturer's recommendations or if pack has been breached.
- Move battery to well ventilated area to prevent gas accumulation.

For emergency responders

- Eliminate all ignition sources.
- Please note that materials and conditions to avoid.
- Move battery to well ventilated area to prevent gas accumulation.

6.2 Environmental precautions :

- Avoid release to the environment.
- Prevent entry into waterways, sewers, basements or confined areas.

6.3 Methods and material for containment and cleaning up

For containment : Not available

For cleaning up :

- Cover with Dry earth, DRY sand or other non-combustible material and put on the plastic sheet to minimize spreading or contact with rain.
- Move battery to well ventilated area to prevent gas accumulation.
- Dispose in accordance with applicable local, state and federal regulations.

Other information: Not available

6.4 Reference to other sections

- See also sections 8 and 13 of the Safety Data Sheet.

Section VII – HANDLING AND STORAGE

7.1 Precautions for safe handling

- In case of cell damage, possible release of dangerous substances and a flammable gas mixture.
- The battery stores electrical energy and is capable of rapid energy discharge.
- Battery cell contents are under pressure.
- Handle battery carefully to avoid puncturing case or electrically shorting terminals.

7.2 Conditions for safe storage, including any incompatibilities

Technical measures and storage conditions : Not available

Packaging materials : Not available

Requirements for storage rooms and vessels :

- Storage at room temperature (approx. 20 °C) at approx. 40% of the nominal capacity



- Keep in closed original container.

7.3 Specific end use(s)

Recommendations : Not available

Industrial sector specific solutions : Not available

Section VIII – EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1 Control parameters

Occupational Exposure limits

Name	ACGIH regulation	Biological exposure index	OSHA regulation	NIOSH regulation	EU regulation
Graphite	TWA = 2mg/m ³	Not available	Not applicable	Not applicable	Not applicable
Lithium nickelate	Not applicable	Not available	TWA = 1 mg/m ³ (Nickel, metal and insoluble compounds (as Ni), Nickel, soluble compounds (as Ni), CAS.no7440-02-0)	TWA = Ca 0.015 mg/m ³ (Nickel, metal and insoluble compounds (as Ni), Nickel, soluble compounds (as Ni), CAS.no7440-02-0)	Not applicable
Iron	Not applicable	Not available	Not applicable	Not applicable	Not applicable
Lithium manganese oxide	TWA = 10 mg/m ³ (Magnesium oxide CAS.no 1309-48-4)	Not available	TWA = 15 mg/m ³ (Magnesium oxide fume - Total Particulate CAS.no 1309-48-4)	TWA = 10 mg/m ³ (Magnesium oxide fume - Total Particulate CAS.no 1309-48-4)	Not applicable
cobalt lithium dioxide	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Cobalt, Co	TWA = 0.02 mg/m ³	Not available	TWA = 0.1 mg/m ³	TWA 0.05 mg/m ³	Not applicable
Copper	TWA = 0.2 mg/m ³	Not available	Not applicable	Not applicable	Not



	(fume)				applicable
dimethyl carbonate	Not applicable	Not available	Not applicable	Not applicable	Not applicable
Aluminium	TWA = 1 mg/m ³ (respirable particulate matter)	Not available	TWA = 15 mg/m ³ (Aluminum Metal (as Al) Total dust) TWA = 5 mg/m ³ (Aluminum Metal (as Al) Respirable fraction)	TWA = 1 mg/m ³ (Aluminum Metal (as Al), Respirable fraction)	Not applicable
Polyethylene	Not applicable	Not available	Not applicable	Not applicable	Not applicable
1,3-Dioxolan-2-one	Not applicable	Not available	Not applicable	Not applicable	Not applicable
lithium hexafluorophosphate(1-)	Not applicable	Not available	Not applicable	Not applicable	Not applicable
ethyl acetate	TWA = 400 ppm	Not available	TWA = 400 ppm TWA = 1400 mg/m ³	TWA = 400 ppm	TWA = 734 mg/m ³ , TWA= 200 ppm, STEL = 1468 mg/m ³ , STEL = 400 ppm
Carbon black	TWA = 3mg/m ³ (inhalable particulate matter)	Not available	TWA = 3.5 mg/m ³	TWA = 3.5 mg/m ³ Ca TWA = 0.1 mg PAHs/m ³ [Carbon black in presence of polycyclic aromatic hydrocarbons (PAHs)]	Not applicable
Nickel	TWA = 1.5 mg/m ³ (inhalable particulate matter)	Not available	TWA = 1 mg/m ³ (metal and insoluble compounds (as Ni)) TWA = 1 mg/m ³ (soluble compounds (as	Ca TWA = 0.015 mg/m ³ (metal and insoluble compounds (as Ni)) Ca TWA = 0.015 mg/m ³	Not applicable



			Ni))	(soluble compounds (as Ni))	
lithium carbonate	Not applicable	Not available	Not applicable	Not applicable	Not applicable

8.2 Exposure controls

8.2.1 Appropriate engineering controls :

Substance/mixture related measures to prevent exposure during identified uses:

- Avoid charging batteries in areas where hydrogen gas accumulate.
- Use local exhaust ventilation to maintain concentrations of hydrogen below the Lower Explosive collect and transport flammable gases in ventilation systems.
- Insure proper ventilation is present and electrolyte mist and vapours.

Structural measures to prevent exposure:

- Avoid charging batteries in areas where hydrogen gas accumulate.
- Use local exhaust ventilation to maintain concentrations of hydrogen below the Lower Explosive collect and transport flammable gases in ventilation systems.
- Insure proper ventilation is present and electrolyte mist and vapours.

Organisational measures to prevent exposure: Not available

Technical measures to prevent exposure:

- Insure proper ventilation is present and electrolyte mist and vapours.

8.2.2 Individual protection measures, such as personal protective equipment :

Eye and face protection

- Wear ANSI approved safety glasses with side shield during normal use.
- Wear NIOSH approved face shield with safety glasses and H.V protection during intentional disassembly.

Skin protection

Hand protection

- Wear nitrile butyl rubber, neoprene, or PVC glove during battery component disassembly.
- Discard contaminated work clothing after one work day.

Other skin protection

- Wear protective clothing during battery component disassembly.
- Discard contaminated work clothing after one work day.

Respiratory protection :

- None required during normal use.
- Wear NIOSH or European Standard EN 149 approved full or half face piece (with goggles) respiratory protective equipment when necessary.
- In lack of oxygen(< 19.5%), wear the supplied-air respirator or self-contained oxygen breathing apparatus.



- In case exposed to particulate material, the respiratory protective equipments as follow are recommended; facepiece filtering respirator or air-purifying respirator, high-efficiency particulate air(HEPA) filter media or respirator equipped with powered fan, filter media of use (dust, mist, fume)

8.2.3 Environmental exposure controls

Substance/mixture related measures to prevent exposure: Not available

Instruction measures to prevent exposure: Not available

Organisational measures to prevent exposure: Not available

Technical measures to prevent exposure: Not available

Section IX – PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

Appearance

Description : Solid

Color : Not available

Odor : Odorless

Odor threshold : Not available

pH : Not available

Melting point/freezing point : Not available

Initial boiling point and boiling range : Not available

Flash point : Not available

Evaporation rate : Not available

Flammability (solid, gas) : Not available

Upper/lower flammability or explosive limits : Not available

Vapor pressure : Not available

Solubility (ies) : insoluble.

Vapor density : Not available

Relative density : Not available

Partition coefficient: n-octanol/water : Not available

Auto ignition temperature : Not available

Decomposition temperature : Not available

Viscosity : Not available

Explosive properties : Not available

Oxidizing properties : Not available

Molecular weight : Not available

9.2 Other information

Not available



Section X – STABILITY AND REACTIVITY

10.1 Reactivity

- Stable at ambient temperature.

10.2 Chemical stability

- There is no hazard when the measures for handling and storage are followed.
- Stable under normal temperatures and pressures.

10.3 Possibility of hazardous reactions

- Will not occur under normal conditions.
- In case of cell damage, possible release of dangerous substances and a flammable gas mixture.
- Containers may explode when heated.
- Fire may produce irritating and/or toxic gases.
- Some liquids produce vapors that may cause dizziness or suffocation.
- Inhalation of material may be harmful.

10.4 Conditions to avoid

- Keep away from heat/sparks/open flames/hot surfaces. No smoking.
- Friction, heat, sparks or flames
- Dusts or shavings from borings, turnings, cuttings, etc.
- Do not exceed manufacturer's recommendation for charging or use battery for an application for which it was not specifically designed.
- Do not electrically short.

10.5 Incompatible materials

- Avoid contact with acids and oxidizers.
- Keep away from any possible contact with water, because of violent reaction and possible flash fire.
- Handle under inert gas. Protect from moisture.
- Combustibles, reducing agents

10.6 Hazardous decomposition products

- None under normal conditions.
- Corrosive and/or toxic fume
- Material may produce irritating and highly toxic gases from decomposition by heat and combustion during burning.
- Irritating and/or toxic gases

Section XI – TOXICOLOGICAL INFORMATION

※ This is a product that fulfills a certain function in solid state with specific shape without discharging any chemical substance in its use and has no obligation to write (M)SDS. Since this document contains the precautions for safe handling related to its materials or chemical substances consisting of this product, please note that these overall information is irrelevant to this product.

11.1 Information on toxicological effects

Acute toxicity

Oral : ATEmix = 1770 mg/kg bw

- Graphite : Rat LD₅₀ > 2,000 mg/kg (female)(OECD Guideline 401)
- Fe : Rat LD₅₀ = 98,600 mg/kg (Reduced iron, OECD TG 401)
- Copper : Rat LD₅₀ > 2,500 mg/kg (Cupric oxide; read across)(OECD TG 423, GLP)
- Dimethyl carbonate : Rat LD₅₀ > 5,000 mg/kg (male/female) (OECD Guideline 401)
- Aluminum : Rat LD₅₀ > 15,900 mg/kg (OECD TG 401)(Fumed alumina; read across)
- Polyethylene : Rat LD₅₀ > 2,000 mg/kg
- 1,3-Dioxolan-2-one : Rat LD₅₀ = 10,400 mg/kg (male) (OECD Guideline 401)
- Lithium hexafluorophosphate(1-) : Rat LD₅₀ = 50 ~ 300 mg/kg (Female)(OECD Guideline 423, GLP)
- Ethyl acetate : Rat LD₅₀ = 4,934 mg/kg
- Carbon black : Rat LD₅₀ > 8,000 mg/kg (OECD TG 401)
- Nickel; Raney nickel : Rat LD₅₀ > 9,000 mg/kg (male/female) (OECD Guideline 401, GLP)
- Lithium carbonate;Lithane : Rat LD₅₀ = 525 mg/kg

Dermal :

- Copper : Rat LD₅₀ > 2,000 mg/kg (OECD TG 402, GLP)
- Dimethyl carbonate : Rabbit LD₅₀ > 2,000 mg/kg (male/female)
- 1,3-Dioxolan-2-one : Rat LD₅₀ > 2,000 mg/kg (male/female) (OECD Guideline 402)
- Ethyl acetate : Rabbit LD₅₀ > 20,000 mg/kg (male)
- Lithium carbonate;Lithane : Rabbit LD₅₀ > 3,000 mg/kg (male/female) (OECD Guideline 402)

Inhalation :

- Graphite : Rat LD₅₀ > 2 mg/L/4hr (male/female) (OECD Guideline 403)
- Fe : Rat LC₅₀ > 100 mg/m³/6hr
- Dimethyl carbonate : Rat LD₅₀ > 5.36 mg/L/4hr (male/female) (OECD Guideline 403)
- Aluminum : Rat LC₅₀ > 0.888 mg/L/4hr (analytical) (OECD TG 403)
- 1,3-Dioxolan-2-one : Rat LC₀ = 730 mg/m³ /8hr
- Ethyl acetate : Rat LCL₀ > 6000 ppm (male/female)
- Carbon black : Rat LC₅₀ > 0.005 mg/L/4hr
- Lithium carbonate;Lithane : Rat LC₅₀ > 2 mg/L/4hr (male/female) (OECD Guideline 403)

Skin corrosion/ irritation :

- Graphite : In the skin irritation test using rabbits, the test material was not irritating. (OECD Guideline 404, GLP)
- Fe : In test on skin irritation with rabbits, skin irritations were not observed.(Read across; Fe3O4)(OECD TG 404, GLP)
- Copper : In test on skin irritation with rabbits, skin irritations were not observed. (OECD TG 404, GLP)
- Dimethyl carbonate : In the skin irritation test using rabbits, the test material was not irritating. (OECD Guideline 404)
- Aluminum : Aluminium oxide caused slight erythema in 2/12 rabbits. The observed effects do not lead to a classification. Aluminium oxide is, therefore, not considered to be a primary skin irritant.(OECD TG 404)(Read across; aluminium oxide)
- Polyethylene : No irritation was observed at the other two treated sites and no corrosive effects were noted during the study using rabbits. The primary irritation index was calculated as 0.2 and polyethylene was classified as a mild irritant.
- 1,3-Dioxolan-2-one : In the skin irritation test using rabbits, the test material was not classified. (OECD Guideline 404, GLP)
- Lithium hexafluorophosphate(1-) : In the skin irritation test using human, the test material was



corrosive. (EU Method B.40, GLP)

- Ethyl acetate : In the skin irritation test using rabbits, the test material was slightly irritating. (OECD Guideline 404)
- Carbon black : In test on skin irritation with rabbits, skin irritations were not observed. (OECD TG 404)
- Nickel; Raney nickel : Industrial nickel dust causes nickel dermatitis.
- Lithium carbonate; Lithane : In the skin irritation test using rabbits, the test material was not irritating. (OECD Guideline 404, GLP)

Serious eye damage/ irritation :

- Graphite : In the eye irritation test using rabbit, the test material was not irritating. (OECD Guideline 405, GLP)
- Fe : In test on eyes irritation with rabbits, eyes irritations were not observed.(Read across; Fe₃O₄)(OECD TG 405, GLP)
- Copper : In test on skin irritation with rabbits, skin irritations were not observed. (OECD TG 405, GLP)
- Dimethyl carbonate : In the eye irritation test using rabbit, the test material was not irritating. (GLP)
- Aluminum : An eye irritation study of the aluminium oxide was performed in rabbits. No eye irritation/ corrosion effects were observed. (Read across; aluminium oxide)
- Polyethylene : Mild irritants were observed in eye irritation test with rabbits. (Score 11.7/110)
- 1,3-Dioxolan-2-one : In the eye irritation test using rabbit, the test material was moderately irritating. (OECD Guideline 405, GLP)
- Lithium hexafluorophosphate(1-) : In the eye irritation test using fertilised brown leghorn chicken eggs, the test material was severely irritating. (GLP)
- Ethyl acetate : In the eyes irritation test using rabbits, the test material was not irritating. (OECD Guideline 405)
- Carbon black : In test on eyes irritation with rabbits, eyes irritations were not observed. (OECD TG 405)
- Lithium carbonate; Lithane : In the eye irritation test using rabbit, the test material was moderately irritating. (OECD Guideline 405, GLP)

Respiratory sensitization :

- Aluminum : Al₂O₃ was the least inflammatory material tested and led to only weak effects on the mouse lung. (Read across; Aluminium oxide)
- Carbon black : In respiratory sensitization test with mice, it did not induce respiratory sensitization.

Skin sensitization :

- Graphite : In the skin sensitization test using mice, the test material was not skin sensitization. (OECD Guideline 429, GLP)
- Fe : In the test using guinea pigs, the test substance was not considered to be a dermal sensitizer in guinea pigs.(read across; FeO, Fe₂O₃)
- Copper : In maximization test on skin sensitization with guinea pig, skin sensitization was not observed. (OECD TG 406, GLP)
- Dimethyl carbonate : In the skin sensitization test using guinea pig, this material was not skin sensitizing. (OECD Guideline 406, GLP)
- Aluminum : In test with guinea pigs, it can be concluded that aluminium oxide has no sensitisation potential under the experimental conditions. (Read across; Aluminium oxide)
- Polyethylene : No reactions were observed in skin sensitization test with guinea pigs.
- 1,3-Dioxolan-2-one : In the skin sensitization test using guinea pig, this material was not classified. (OECD Guideline 406, GLP)
- Lithium hexafluorophosphate(1-) : In the skin sensitization test using mice, the test material was not skin sensitization. (OECD Guideline 429, GLP)
- Ethyl acetate : In the skin sensitization test using guinea pig, this material was not skin sensitizing. (OECD Guideline 406)
- Carbon black : In skin sensitization test with guinea pig, it did not induce skin sensitization. (OECD TG 406, GLP)
- Nickel; Raney nickel : Nickel hypersensitivity dermatitis may be initiated by contact with nickel on the



skin.

- Lithium carbonate; Lithane : In the skin sensitization test using guinea pig, this material was not skin sensitizing. (OECD Guideline 406, GLP)

Carcinogenicity :

IARC

- Nickel : Group 2B
- Cobalt and cobalt compounds : Group 2B
- Polyethylene : Group 3
- Carbon black : Group 2B

NTP

- Nickel : R
- Iron : Present

OSHA

- Nickel : Present

ACGIH

- Nickel : A5
- Cobalt and cobalt compounds : A3
- Aluminum : A4
- Carbon black : A3

KOREA-ISHL

- Cobalt and inorganic compounds : 2
- Carbon black : 2
- Nickel : 1A

EU

- Lithium nickelate : Carc.1A
- Nickel : Carc.2

- Copper : EPA IRIS: D In carcinogenicity study with rat, tumor was not observed.

- Polyethylene : Fifty rats were implanted with polyethylene. In the polyethylene group, 23 developed tumors (two of these were unrelated to the implants).

Mutagenicity :

- Graphite : Negative reactions were observed in vitro (Bacterial Reverse Mutation Assay(OECD Guideline 471, GLP)).
- Fe : In mammalian cell gene mutation assay electrolytic iron, positive carbonyl iron exhibited a cytotoxic and mutagenic response (OECD TG 476)
- Copper : Negative reactions were observed in both in vitro(Ames test) and in vivo(DNA damage and/or repair; unscheduled DNA synthesis, micronucleus assay). (GLP)
- Dimethyl carbonate : Negative reactions were observed in both in vitro (Mammalian Chromosome Aberration Test (OECD Guideline 473, GLP)) and in vivo (Mammalian Spermatogonial Chromosome Aberration Test (OECD Guideline 483))
- Aluminum : Negative reactions were observed in vitro (mammalian cell gene mutation assay with mouse lymphoma L5178Y cells(OECD TG 476, GLP)) and in vivo (micronucleus assay with rats (OECD TG 474, GLP)). (Aluminium hydroxide, aluminium chloride, aluminum oxide; read across)
- Polyethylene : Negative reactions were observed in Ames test using Salmonella typhimurium and Escherichia coli.
- 1,3-Dioxolan-2-one : Negative reactions were observed in vitro (mammalian cell gene mutation assay (OECD Guideline 476, GLP)).
- Lithium hexafluorophosphate(1-) : Negative reactions were observed in both in vivo (Mammalian Erythrocyte Micronucleus test(OECD Guideline 474)) and in vitro (Bacterial Reverse Mutation Assay(OECD Guideline 471, GLP)).
- Ethyl acetate : Negative reactions were observed in both in vitro(Bacterial Reverse Mutation



Assay(OECD Guideline 471)) and in vivo (Mammalian Erythrocyte Micronucleus Test(OECD Guideline 474)).

- Carbon black : Negative reactions were observed in both in vitro(Bacterial gene mutation test(OECD TG 471, GLP), Chromosomal aberrations test(OECD TG 476)) and in vivo(DNA damage and/or repair test).
- Lithium carbonate;Lithane : Negative reactions were observed in vitro (Bacterial Reverse Mutation Assay(OECD Guideline 471, GLP)).

Reproductive toxicity :

- Copper : In reproductive toxicity with rats, there were no effects considered (up to 1500 ppm). (OECD TG 416, GLP)
- Aluminum : No reproduction, breeding and early post-natal developmental toxicity was observed in rats at 1000 mg/kg bw for males and females. (OECD TG 422, GLP)(Aluminium chloride; read across)
- Lithium hexafluorophosphate(1-) : In the two-generation reproductive toxicity with rats, no effects observed on reproductive toxicity. (male/female)(OECD Guideline 416, GLP)(OECD Guideline 414)(Information on major hydrolysis product of the registered substance (released rapidly on contact with water/moisture))
- Carbon black : No adverse effects on the reproductive function are expected.(OECD TG 414)

Specific target organ toxicity (single exposure) :

- Fe : If inhaled, iron is a local irritant to the lung and gastrointestinal tract.
- Copper : All animals showed expected gains in bodyweight over the study period and there were no abnormalities noted at necropsy. (OECD TG 423, GLP)
- Aluminum : In test using rats, Clinical signs of depression, laboured respiration, piloerection and hunched appearance was noted at the highest dose 15900 mg/kg. Macroscopic examination at the end of the observation period did not reveal any aluminium-related changes of the internal organs of the aluminium treated animals compared to the control group. (OECD TG 401)(Fumed alumina; read across)
- Polyethylene : No test substance-related toxic effects were observed in an acute oral toxicity study with rats.
- Lithium hexafluorophosphate(1-) : Clinical signs observed during the study period were lethargy, hunched posture, uncoordinated movements, piloerection at 300 mg/kg, hunched posture, piloerection at 50 mg/kg. The surviving animals had recovered from the symptoms by Day 3.(OECD Guideline 423, GLP)
- Carbon black : No effect on endothelins or blood pressure was observed after exposure to carbon black. There were also no effects on body temperature and activity of the animals.
- Nickel; Raney nickel : In the acute oral toxicity using rat, there were no effects on clinical signs, systemic toxicity.(OECD Guideline 401, GLP)

Specific target organ toxicity (repeat exposure) :

- Fe : Rats were exposed to metallic iron as carbonyl iron via their feed (2.5%) for 2, 4, 6, or 9 weeks. This resulted in a strong increase of non-heme iron in the liver and clear lipid peroxidation in the liver and the mucosa of the duodenum. No evidence for DNA breakage were found. What follows is the original abstract of the publication. (carbonyl iron)
- Copper : In test with rats for 92 days, there were no mortalities or signs of clinical toxicity observed in any of the test species during the duration of the study. Ophthalmoscopic examinations revealed no abnormalities at any dose level tested. At gross pathology, significant decreases in heart and kidney weight were noted in the high dose males in the thymus and kidneys of high dose females. (GLP)
- Aluminum : On occasion workers chronically exposed to aluminum-containing dusts or fumes have developed severe pulmonary reactions including fibrosis, emphysema and pneumothorax.
- Polyethylene : No significant adverse effects were observed in subchronic (90-day) oral toxicity study with rats and dogs.
- Lithium hexafluorophosphate(1-) : According to expert review of fluoride intake and effects on human health, fluoride intake in drinking water at levels close to or above 4 mg/l is associated with dental



fluorosis and perhaps also bone fluorosis and/or weakening.; Damage to dental enamel recorded: especially notable in young animals, which also showed atrophy of respiratory organs/tissues with local oedema of bronchial mucosa. Older animals showed peribronchial hyperplasia. Animals around 1 year in age showed cavity formation in their bones.(Information on major hydrolysis product of the registered substance (released rapidly on contact with water/moisture))(OECD Guideline 412)

- Carbon black : Mice were continuously fed various types of carbon black in massive quantities (10% in diet) for 12 to 18 months. This led to no detectable changes from the normal in the organs and tissues of the mice fed.

- Nickel; Raney nickel : In nickel plating industry, exposure to nickel containing vapors has been reported to be assoc with asthma.

Aspiration Hazard : Not available

Section XII – ECOLOGICAL INFORMATION

※ This is a product that fulfills a certain function in solid state with specific shape without discharging any chemical substance in its use and has no obligation to write (M)SDS. Since this document contains the precautions for safe handling related to its materials or chemical substances consisting of this product, please note that these overall information is irrelevant to this product.

12.1 Ecological toxicity

- Acute toxicity : ATEmix = 0.14 mg/l

Fish

- Graphite : 96hr-LC₅₀ (*Brachydanio rerio*) > 100 mg/L

- Fe : 96hr-LC₅₀ > 10000 mg/L (OECD TG 203, GLP)

- cobalt lithium dioxide : 96hr-LC₅₀ = 54.1 mg/L (Read across; cobalt (II) chloride hexahydrate), 34d-NOEC (*Pimephales promelas*) = 0.21 mg/L

- Aluminum : 96hr-LC₅₀ > 218.64 mg/L (GLP)(Read across; aluminium chloride hexahydrate), 28d-NOEC (*Pimephales promelas*) = 4.7 mg/L (Read across; aluminium sulphate)

- 1,3-Dioxolan-2-one : 96hr-LC₅₀ > 100 mg/L (OECD Guideline 203, GLP)

- Lithium hexafluorophosphate(1-) : 96hr-LC₅₀ = 51 ~ 193 mg/L Information on major hydrolysis product of the registered substance (released rapidly on contact with water/moisture); 21d-NOEC = 4 mg F-/L

- Ethyl acetate : 96hr-LC₅₀ = 230 mg/L

- Carbon black : 96hr-LC₀ = 1000 mg/L (OECD TG 203, GLP)

- Lithium carbonate; Lithane : 96hr-LC₅₀ = 30.3 mg/L (OECD Guideline 203, GLP), 34d-NOEC (*Danio rerio*) = 15.28 mg/L (Read across; lithium hydroxide monohydrate)(OECD Guideline 210, GLP)

Crustacean

- Graphite : 48hr-EC₅₀ (*Daphnia magna*) > 100 mg/L

- Fe : 48hr-EC₅₀ > 100 mg/L (OECD TG 202, GLP)

- cobalt lithium dioxide : 48hr-EC₅₀ = 2.618 mg/L (GLP)(Read across; cobalt (II) chloride hexahydrate), 42d-NOEC (*Neanthes arenaceodentata*) = 0.713 mg/L (ASTM Method E1562, GLP)

- Aluminum : 48hr-LC₅₀ = 0.071 mg/L (Read across; CAS 13473-90-0), 8d-NOEC (*Ceriodaphnia dubia*) = 4.9 mg/L (Read across; CAS 7784-13-6)

- 1,3-Dioxolan-2-one : 48hr-EC₅₀ > 100 mg/L (OECD Guideline 202, GLP)

- Lithium hexafluorophosphate(1-) : 48hr-LC₅₀ > 100 mg/L (OECD Guideline 202, GLP);21d-NOEC(*Daphnia magna*) = 10 mg/L (Information on major hydrolysis product of the registered substance (released rapidly on contact with water/moisture)) (OECD guideline 202, GLP)

- Ethyl acetate : 24hr-EC₅₀ = 2500 mg/L

- Carbon black : 24hr-EC₅₀ > 5600 mg/L (OECD TG 202, GLP)



- Lithium carbonate; Lithane : 48hr-EC₅₀ = 33.2 mg/L (OECD Guideline 202, GLP), 21d-NOEC (*Daphnia magna*) = 9 mg/L (Read across; lithium)(OECD Guideline 211, GLP)

Algae

- Graphite : 72hr-EC₅₀ (*Selenastrum capricornutum*) > 100 mg/L
- cobalt lithium dioxide : 96hr-EC₅₀ = 71.314 mg/L (Read across; cobalt (II) chloride hexahydrate), 96hr-NOEC (*Dunaliella tertiolecta*) = 4.672 mg/L
- Aluminum : 72hr-EC₅₀ = 0.0169 mg/L (OECD TG 201), (Read across; CAS 13473-90-0)
- 1,3-Dioxolan-2-one : 72hr-EC₅₀ > 100 mg/L (OECD Guideline 201, GLP), 72hr-NOEC(*Selenastrum capricornutum*) = 100mg/L(OECD Guideline 201, GLP)
- Lithium hexafluorophosphate(1-) : 96hr-EC₅₀ > 100 mg/L ; 96h-NOEC = 22 mg/L (OECD Guideline 201, GLP)
- Carbon black : 72hr-EC₅₀ > 10000 mg/L , 72hr-NOEC > 10,000mg/l (OECD TG 201, GLP)
- Lithium carbonate; Lithane : 72hr-EC₅₀ > 400 mg/L

12.2 Persistence and degradability

Persistence

- Graphite : Low persistency (log Kow is less than 4 estimated.) (Log Kow = 0.78)
- Aluminum : Low persistency (log Kow is less than 4 estimated.) (Log Kow = 0.33) (estimated)
- 1,3-Dioxolan-2-one : Low persistency (log Kow is less than 4 estimated.) (Log Kow = 0.11) (20 °C, pH > 5.33 - < 5.79)(EU Method A.8, GLP)
- Lithium hexafluorophosphate(1-) : Low persistency (log Kow is less than 4 estimated.) (Log Kow = 0.354) (20 °C, pH > 6.5 - < 7.5)(OECD Guideline 107, GLP)
- Ethyl acetate : Low persistency (log Kow is less than 4 estimated.) (Log Kow = 0.68)

Degradability : Not available

C. Bioaccumulative potential

Bioaccumulation

- Graphite : Bioaccumulation is expected to be low according to the BCF < 500 (BCF = 2.433)
- cobalt lithium dioxide : Bioaccumulation is expected to be low according to the BCF < 500 (BCF = 23) (Read across; 57CoCl)
- Copper : Bioaccumulation is expected to be low according to the BCF < 500 (BCF = 0.02 ~ 20)
- Dimethyl carbonate : Bioaccumulation is expected to be low according to the BCF < 500 (BCF = 3.2)
- Aluminum : Bioaccumulation is expected to be low according to the BCF < 500 (BCF = 3.162) (estimated)
- 1,3-Dioxolan-2-one : Bioaccumulation is expected to be low according to the BCF < 500 (BCF = 3.162) (estimated)
- Lithium hexafluorophosphate(1-) : Bioaccumulation is expected to be low according to the BCF < 500 (BCF < 31)
- Ethyl acetate : Bioaccumulation is expected to be low according to the BCF < 500 (BCF = 30)
- Nickel; Raney nickel : Bioaccumulation is expected to be low according to the BCF < 500 (BCF = 70)

Biodegradation

- Dimethyl carbonate : As well-biodegraded, it is expected to have low accumulation potential in living organisms (= 86% biodegradation was observed after 28 days) (OECD Guideline 301 C, GLP)
- Polyethylene : As not well-biodegraded, it is expected to have high accumulation potential in living organisms (= 0% biodegradation was observed after 28 days)
- 1,3-Dioxolan-2-one : As well-biodegraded, it is expected to have low accumulation potential in living organisms (70% ~ 80% biodegradation was observed after 10 days) (OECD Guideline 301 A, GLP)
- Lithium hexafluorophosphate(1-) : As well-biodegraded, it is expected to have low accumulation potential in living organisms (= 86% biodegradation was observed after 28 days) (OECD Guideline 301 C, GLP)
- Ethyl acetate : As well-biodegraded, it is expected to have low accumulation potential in living organisms (= 62% biodegradation was observed after 10 days)



- Carbon black : carbon black is an inorganic substance and will not biodegraded by microorganisms.

12.4 Mobility in soil

- 1,3-Dioxolan-2-one : Low potency of mobility to soil. (Koc = 3.219) (estimated)
- Ethyl acetate : Low potency of mobility to soil. (Koc = 6)
- Nickel; Raney nickel : Low potency of mobility to soil. (Koc = 2.86)

12.5 Results of PBT and vPvB assessment : Not available

12.6 Other adverse effects : Not available

Section XIII – DISPOSAL CONSIDERATION

13.1 Waste treatment methods

Product/Packaging disposal

- Consider the required attentions in accordance with waste treatment management regulation.

Waste codes / Waste designation according to LoW(2015) : 16-06-05

Waste treatment-relevant information

- Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Sewage disposal-relevant information: Not available

Other disposal recommendations: Not available

Section XIV – TRANSPORTATION INFORMATION

※ If those lithium-ion batteries are packed with or contained in an equipment, then it is the responsibility of the shipper to ensure that the consignment are packed in compliance to the latest edition of the IATA Dangerous Goods Regulations section II of either Packing Instruction 966 or 967 in order for that consignment to be declared as NOT RESTRICTED (non-hazardous/non-Dangerous). If those lithium-ion batteries are packed with or contained in an equipment, UN No. is UN3481.

14.1 UN Number : 3480

14.2 UN Proper shipping name : LITHIUM ION BATTERIES

14.3 Transport Hazard class : 9

14.4 Packing group : II

14.5 Special provisions : 188, 230, 384

14.6 Packing instructions : P903

14.7 Environmental hazards : No

14.8 Special precautions for user

in case of fire : F-A

in case of leakage : S-I

14.9 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code : Not Available

14.10 IATA Transport : PI 965-Section IB

14.11 Package labels



Section XV – REGULATORY INFORMATION

15.1 Safety, health and environmental regulation/legislation specific for the substance or mixture

EU regulations

Authorisations and/or restrictions on use:

Authorisations: Not regulated

Restrictions on use:

- Nickel : Regulated

Other EU regulations:

EU SVHC list

Foreign Regulatory Information

External information :

U.S.A management information (OSHA Regulation) : Not regulated

U.S.A management information (CERCLA Regulation) :

- Copper : 5,000 lb

- ethyl acetate : 5,000 lb

- Nickel : 100 lb

U.S.A management information (EPCRA 302 Regulation) : Not regulated

U.S.A management information (EPCRA 304 Regulation) : Not regulated

U.S.A management information (EPCRA 313 Regulation) :

- Copper : Regulated

- Aluminium : Regulated

- Nickel : Regulated

- lithium carbonate : Regulated

- Cobalt, Co : Regulated

Substance of Roterdame Protocol : Not regulated

Substance of Stockholme Protocol :

- lithium hexafluorophosphate(1-) : Regulated

Substance of Montreal Protocol : Not regulated



15.2 Chemical safety assessment :

- No chemical safety assessment has been carried out for this product by the supplier.

Section XVI – OTHER INFORMATION EU

Product safety data sheet for PA0001N0006A/PA0001N0007A/PA001N0008A prepared in accordance with Regulation (EU) 2015/830 (REACH), Annex II, and OSHA 29 CFR 1910.1200

16.1 Indication of changes

Date Updated : 01 Jan 2021

Version : Rev. 00

16.2 Abbreviations and acronyms

ACGIH = American Conference of Government Industrial Hygienists

CLP = Classification Labelling Packaging Regulation ; Regulation (EC) No 1272/2008

CAS No. = Chemical Abstracts Service number

DMEL = Derived Minimal Effect Levels

DNEL = Derived No Effect Level

EC Number = EINECS and ELINCS Number (see also EINECS and ELINCS)

EU = European Union

IARC = International Agency for Research on Cancer

ISHL = Industrial Safety & Health Law

NIOSH = National Institute for Occupational Safety & Health

NTP = National Toxicology Program

OSHA = European Agency for Safety and Health at work

PBT = Persistent, Bioaccumulative and Toxic substance

PNEC(s) = Predicted No Effect Concentration(s)

REACH = Registration, Evaluation, Authorisation and Restriction of Chemicals Regulation (EC) No 453/2010

STP = Sewage Treatment Plant

SVHC = Substances of Very High Concern

vPvB = Very Persistent and Very Bioaccumulative

UN = United Nations

MARPOL = International Convention for the Prevention of Pollution from Ships (IMO)

IBC = Intermediate Bulk Container

CERCLA = Comprehensive Environmental Response, Compensation & Liability Act (US)

EPCRA = Emergency Planning and Community Right-to-Know Act (US)

EINECS = European Inventory of Existing Commercial chemical Substances

ELINCS = European List of Notified Chemical Substances

16.3 Key literature reference and sources for data :

U.S. National library of Medicine (NLM) Hazardous Substances Data Bank (HSDB)



LookChem; <http://www.lookchem.com/>
IUCLID: <http://ecb.jrc.ec.europa.eu/IUCLID-DataSheets/7631905.pdf>
CHRIP(Cheical Risk Information Platform)
EPISUITE v4.11; <http://www.epa.gov/opt/exposure/pubs/episuitedi.html>
The Chemical Database -The Department of Chemistry at the University of Akron;
<http://ull.chemistry.uakron.edu/erd/>
ECOTOX: <http://cfpub.epa.gov/ecotox/>
International Chemical Safety Cards (ICSC): <http://www.nihs.go.jp/ICSC/>
National Chemical Information System (<http://ncis.nier.go.kr>)
Korea Dangerous Material Inventory Management System (<http://hazmat.nema.go.kr>)
REACH information on registered substances; <https://echa.europa.eu/information-on-chemicals/registered-substances>
EU CLP; <https://echa.europa.eu/information-on-chemicals/cl-inventory-database>
NIOSH Pocket Guide; <http://www.cdc.gov/niosh/npg/npgdcas.html>
IARC Monographs on the Evaluation of Carcinogenic Risks to Humans; <http://monographs.iarc.fr>
National Toxicology Program; <http://ntp.niehs.nih.gov/results/dbsearch/>
TOMES-LOLI®; <http://www.rightanswerknowledge.com/loginRA.asp>
UN Recommendations on the transport of dangerous goods 17th
American Conference of Governmental Industrial Hygienists TLVs and BEIs.

16.4 Classification and procedure used to derive the classification for mixtures according to

Regulation(EC) 1272/2008(CLP) : Not classified

16.5 Relevant H-statements : Not applicable

16.6 Training advice :

- Do not handle until all safety precautions have been read and understood.

16.7 Further information :

Data of sections 4 to 8, as well as 10 to 12, do not necessarily refer to the use and the regular handling of the product (in this sense consult package leaflet and expert information), but to release of major amounts in case of accidents and irregularities. The information describes exclusively the safety requirements for the product (s) and is based on the present level of our knowledge. This data does not constitute a warranty for the characteristics of the product(s) as defined by the legal warranty regulations. "(n.a. = not applicable; n.d. = not determined)"

The data for the hazardous ingredients were taken respectively from the last version of the sub-contractor's safety data sheet.