

# Titanium and Titanium Alloys

## Safety Data Sheet

According To Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules And Regulations  
Date of Issue: 08/30/2023

Version: 1.0

### SECTION 1: IDENTIFICATION

#### 1.1. Product Identifier

**Product Form:** Mixture

**Product Name:** Titanium and Titanium Alloys

**Synonyms:** Alloy #200; Alloy #900; Alloy #STAGCG57; Alloy #342; Alloy #2SA

#### 1.2. Intended Use of the Product

**Use of the Substance/Mixture:** No use is specified.

#### 1.3. Name, Address, and Telephone of the Responsible Party

Distributor

ThyssenKrupp Materials NA, Inc.

22355 W. Eleven Mile Road

Southfield, Michigan 48034

TEL: 248-233-5681

#### 1.4. Emergency Telephone Number

**Emergency Number** : 248-233-5681

### SECTION 2: HAZARDS IDENTIFICATION

#### 2.1. Classification of the Substance or Mixture

##### GHS-US Classification

**Classification as delivered:**

Not classified

##### Classification Intended Use (Physical alteration resulting in dust, fines, and chips):

Flammable solids Category 1 H228

Self-heating substances and mixtures Category 1 H251

Substances and mixtures which in contact with water emit flammable gases Category 2 H261

Skin sensitization, Category 1 H317

Carcinogenicity Category 2 H351

Reproductive toxicity Category 2 H361

Hazardous to the aquatic environment – Acute Hazard Category 3 H402

Combustible Dust

#### 2.2. Label Elements

##### GHS-US Labeling

**Classification as delivered:**

Not classified

##### Classification Intended Use (Physical alteration resulting in dust, fines, and chips):

##### Hazard Pictograms (GHS-US)



##### Signal Word (GHS-US)

: Danger

##### Hazard Statements (GHS-US)

: May form combustible dust concentrations in air.  
H228 - Flammable solid.  
H251 - Self-heating; may catch fire.  
H261 - In contact with water releases flammable gas.  
H317 - May cause an allergic skin reaction.  
H351 - Suspected of causing cancer.  
H361 - Suspected of damaging fertility or the unborn child.  
H402 - Harmful to aquatic life.

##### Precautionary Statements (GHS-US)

: P201 - Obtain special instructions before use.  
P202 - Do not handle until all safety precautions have been read and understood.  
P210 - Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.

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P223 - Do not allow contact with water.  
P231+P232 - Handle under inert gas. Protect from moisture.  
P235+P410 - Keep cool. Protect from sunlight.  
P240 - Ground/Bond container and receiving equipment.  
P241 - Use explosion-proof electrical, ventilating, and lighting equipment.  
P261 - Avoid breathing dust, fume.  
P272 - Contaminated work clothing must not be allowed out of the workplace.  
P273 - Avoid release to the environment.  
P280 - Wear protective gloves, protective clothing, and eye protection.  
P302+P352 - If on skin: Wash with plenty of water.  
P308+P313 - If exposed or concerned: Get medical advice/attention.  
P321 - Specific treatment (see section 4 on this SDS).  
P333+P313 - If skin irritation or rash occurs: Get medical advice/attention.  
P335+P334 - Brush off loose particles from skin. Immerse in cool water/wrap in wet bandages.  
P363 - Wash contaminated clothing before reuse.  
P370+P378 - In case of fire: Use appropriate media (see section 5) to extinguish.  
P402+P404 - Store in a dry place. Store in a closed container.  
P405 - Store locked up.  
P407 - Maintain air gap between stacks/pallets.  
P420 - Store away from other materials.  
P501 - Dispose of contents/container in accordance with local, regional, national, and international regulations.

### Supplemental Information

: Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Proper grounding procedures to avoid static electricity should be followed. Prevent dust accumulation (to minimize explosion hazard). Avoid generating dust.

### 2.3. Other Hazards

This product is physiologically inert in its massive form. However, user-generated dust and/or fumes may pose a physiological hazard if inhaled or ingested. Avoid inhalation of metal dusts and fumes. May cause an influenza-like illness. Avoid skin and eye contact with dusts to prevent mechanical irritation. User-generated dust is easily ignited and difficult to extinguish. Inhalation of dusts and fumes can cause metal fume fever. Symptoms can include a metallic or sweet taste in the mouth, sweating, shivering, headache, throat irritation, fever, chills, thirstiness, muscle aches, nausea, vomiting, weakness, fatigue, and shortness of breath. Risk of thermal burns on contact with molten product. Molten material may produce fumes that are toxic or irritating.

### 2.4. Unknown Acute Toxicity (GHS-US)

No data available

## SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1. Substance

Not applicable

### 3.2. Mixture

Name	Synonyms	Product Identifier	%	GHS US classification
Titanium	Titanium powder, dry / Titanium powder / Titanium powder, wetted / Titanium sponge powders / titanium	(CAS-No.) 7440-32-6	30 – 99	Flam. Sol. 1, H228 Comb. Dust
Vanadium	Ammonium trioxovanadate / vanadium / Vanadium metal / Vanadium, elemental	(CAS-No.) 7440-62-2	0 – 13	Comb. Dust
Molybdenum	Molybdenum, metallic / molybdenum / Molybdenum, metal / Molybdenum, elemental / Molybdenum metal	(CAS-No.) 7439-98-7	0 – 11.5	Repr. 2, H361 Comb. Dust
Chromium	Chromium metal / Chromium, elemental / Chromium, metal / Chromium, metallic / Chrome, metal / Chrome	(CAS-No.) 7440-47-3	0 – 11	Comb. Dust

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Aluminum	Aluminium / Aluminium metal / Aluminium, metal / Aluminum metal / Aluminum, elemental / Aluminum, metal / C.I. 77000 / CI 77000 / Aluminium powder (stabilised) / Aluminium powder (stabilized) / Aluminium powder / Pigment Metal 1 / Aluminum powder / Aluminium metal, powder / aluminum	(CAS-No.) 7429-90-5	0 – 8	Flam. Sol. 1, H228 Water-react. 2, H261 Comb. Dust
Zirconium	Zirconium, elemental / Zirconium metal / Zirconium powder (pyrophoric) / Zirconium suspended in a flammable liquid / Zirconium powder, dry / Zirconium metallic	(CAS-No.) 7440-67-7	0 – 6	Flam. Sol. 1, H228 Comb. Dust
Tin	Tin metal / Tin, elemental / Tin, metal / TIN / tin / Organometallic tin	(CAS-No.) 7440-31-5	0 – 4.5	Comb. Dust
Iron	Iron, elemental / Direct reduced Iron / Iron, reduced / Elemental iron / IRON POWDER / iron	(CAS-No.) 7439-89-6	0 – 2	Flam. Sol. 1, H228 Self-heat. 1, H251 Comb. Dust
Niobium	niobium	(CAS-No.) 7440-03-1	0 – 2	Flam. Sol. 1, H228 Comb. Dust
Tantalum	Tantalum metal / Tantalum, elemental / Tantalum, metal / tantalum	(CAS-No.) 7440-25-7	0 – 1	Flam. Sol. 1, H228 Comb. Dust
Nickel	Nickel metal / Nickel, elemental / Nickel, metallic / Nickel, metal / C.I. 77775	(CAS-No.) 7440-02-0	0 – 0.8	Skin Sens. 1, H317 Carc. 2, H351 STOT RE 1, H372 Aquatic Acute 1, H400 Aquatic Chronic 3, H412 Comb. Dust

Full text of H-phrases: see section 16

## SECTION 4: FIRST AID MEASURES

### 4.1. Description of First-aid Measures

**First-aid Measures General:** Never give anything by mouth to an unconscious person. If you feel unwell, seek medical advice (show the label where possible). Removal of solidified material from skin, eyes, or mouth requires medical assistance. The health effects listed below are not likely to occur unless dust or fumes are generated by processing.

**First-aid Measures After Inhalation:** Remove to fresh air and keep at rest in a position comfortable for breathing. Using proper respiratory protection, move the exposed person to fresh air at once. Encourage exposed person to cough, spit out, and blow nose to remove dust. Immediately call a poison center, physician, or emergency medical service. Immediately call a POISON CENTER or doctor/physician.

**First-aid Measures After Skin Contact:** *Normal handling:* Immediately remove contaminated clothing. Wash affected area with soap and water for at least 15 minutes. If exposed or concerned: Get medical advice/attention. *For particulates and dust:* Brush off loose particles from skin. *In molten form:* Immerse in cool water/wrap in wet bandages. Cool skin rapidly with cold water after contact with molten product. Removal of solidified molten material from skin requires medical assistance. Seek medical attention for thermal burns.

**First-aid Measures After Eye Contact:** *Contact with solid product or product dusts:* Immediately rinse with water for a prolonged period (at least 15 minutes) while holding the eyelids wide open. Remove contact lenses, if present and easy to do. Continue rinsing. Obtain medical attention. *In molten form:* Removal of solidified molten material from the eyes requires medical assistance.

**First-aid Measures After Ingestion:** Rinse mouth. Do not induce vomiting. Immediately call a POISON CENTER or doctor/physician.

### 4.2. Most Important Symptoms and Effects Both Acute and Delayed

**Symptoms/Injuries:** Under normal conditions of use not expected to present a significant hazard. During processing or physical alteration, flakes or powder cause irritation of the respiratory tract, eyes, skin, and are harmful. Molten material may release toxic, and irritating fumes. The primary acute health hazard associated with this product would be the potential for exposure to fumes during metal processing operations. Suspected of damaging fertility or the unborn child. Skin sensitization. Suspected of causing cancer. Risk of thermal burns on contact with molten product.

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**Symptoms/Injuries After Inhalation:** Exposure may produce an allergic reaction. During processing, the most significant route of exposure is by the inhalation (breathing) of fumes. If fumes are inhaled, they can cause a condition commonly known as metal fume fever with symptoms which resemble influenza; Symptoms may be delayed 4-12 hours and begin with a sudden onset of thirst, and a sweet, metallic or foul taste in the mouth. Other symptoms may include upper respiratory tract irritation accompanied by coughing and a dryness of the mucous membranes, lassitude and a generalized feeling of malaise. Fever, chills, muscular pain, mild to severe headache, nausea, occasional vomiting, exaggerated mental activity, profuse sweating, excessive urination, diarrhea and prostration may also occur. . During welding, the most significant route of exposure is by the inhalation (breathing) of welding fumes. If welding fumes are inhaled, they can cause a condition commonly known as metal fume fever with symptoms which resemble influenza. Inhalation of dusts and fumes can cause metal fume fever. Symptoms can include a metallic or sweet taste in the mouth, sweating, shivering, headache, throat irritation, fever, chills, thirstiness, muscle aches, nausea, vomiting, weakness, fatigue, and shortness of breath.

**Symptoms/Injuries After Skin Contact:** Exposure may produce an allergic reaction. Dust may cause irritation in skin folds or by contact in combination with tight clothing. Mechanical damage via flying particles and chipped slag is possible. May cause an allergic skin reaction. Contact with fumes or metal powder will irritate skin. Contact with hot, molten metal will cause thermal burns.

**Symptoms/Injuries After Eye Contact:** Mechanical damage via flying particles and chipped slag is possible. During metal processing, dusts caused from physical alteration will likely cause eye irritation. Fumes from thermal decomposition or molten material will likely be irritating to the eyes. Risk of thermal burns on contact with molten product.

**Symptoms/Injuries After Ingestion:** *In massive form:* Ingestion is not considered a potential route of exposure. Ingestion of the molten product may cause severe thermal burns.

**Chronic Symptoms:** Suspected of damaging fertility or the unborn child. Suspected of causing cancer. Overexposure to metal fumes may result metal fume fever (chills, muscle aches, nausea, fever, dry throat, cough, weakness, lassitude), disturbances in smell and/or taste, and possible discoloration of skin, hair and mucous membranes; discoloration may become permanent. Inhalation of Nickel compounds has been shown in studies to provide an increased incidence of cancer of the nasal cavity, lung and possibly larynx in nickel refinery workers. Repeated inhalation of iron oxide dust can cause siderosis a benign condition. Vanadium: May cause gastrointestinal discomfort, renal damage, nervous system depression and irritation of the respiratory passages. May also cause cardiac palpitations and asthma. Molybdenum: Chronic exposure to molybdenum compounds is suspected of causing cancer. Compounds are also known to cause irritation to the skin, eyes, and respiratory tract. Chromium: Certain hexavalent chromium compounds have been demonstrated to be carcinogenic on the basis of epidemiological investigations on workers and experimental studies in animals. Increased incidences of respiratory cancer have been found in chromium (VI) workers. There is an increased incidence of lung cancer in industrial workers exposed to chromium (VI) compounds. Please refer to IARC volume 23 for a more detailed discussion. Aluminum: Inhalation of finely divided aluminum powder may cause pulmonary fibrosis. Tin: Has been shown to increase incidence of sarcoma in animal tests. Chronic exposure to tin dusts and fume may result in "stannosis", a mild form of pneumoconiosis. Tantalum: Repeated exposure to tantalum alloys may cause fibrosis, chronic rhinitis and "hard metal pneumoconiosis".

### 4.3. Indication of Any Immediate Medical Attention and Special Treatment Needed

If you feel unwell, seek medical advice (show the label where possible). If exposed or concerned, get medical advice and attention. If medical advice is needed, have product container or label at hand.

## SECTION 5: FIRE-FIGHTING MEASURES

### 5.1. Extinguishing Media

**Suitable Extinguishing Media:** As shipped: Use extinguishing media appropriate for surrounding fire. For metal fires, dry sand, graphite, or dry table salt may be used. Use class D extinguishing media on fines, dust, or molten metal. Use water spray on chips and fines.

**Unsuitable Extinguishing Media:** Use of heavy stream of water may spread fire. Do not use halogenated extinguishing agents on small chips or fines. Do not use water when molten material is involved, contact of hot product with water will result in a violent expansion as the water turns to steam causing explosion with massive force.

### 5.2. Special Hazards Arising From the Substance or Mixture

**Fire Hazard:** *In massive form:* Not flammable. Dust, chips, or ribbons can be ignited more easily, by an ignition source, by improper machining, or by spontaneous combustion if finely divided and damp. If small particles are generated during further processing, handling or by other means, may form combustible dust concentrations in air. *For particulates and dust:* Self-heating: may catch fire. Reacts readily with water to produce flammable gases which may ignite and cause a fire. Flammable solid. Combustible Dust. Small chips, turnings, dust and fines from processing may be readily ignitable. Molten material may react violently with water forming explosive or flammable reactions.

**Explosion Hazard:** Product itself is not explosive but if dust is generated, dust clouds suspended in air can be explosive. Dust explosion hazard in air. Molten material may react violently with water forming explosive or flammable reactions.

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**Reactivity:** *In massive form:* Stable at ambient temperature and under normal conditions of use. If finely divided, chips, dusts, ribbons, turnings: Reacts readily with water liberating highly flammable gases. Reacts violently with strong oxidizers. Increased risk of fire or explosion. In molten form may react violently with water.

## 5.3. Advice for Firefighters

**Precautionary Measures Fire:** Under fire conditions, hazardous fumes will be present. Exercise caution when fighting any chemical fire.

**Firefighting Instructions:** Do not breathe fumes from fires or vapours from decomposition. In case of fire: Evacuate area. Fight fire remotely due to the risk of explosion. In case of major fire and large quantities: Evacuate area. Fight fire remotely due to the risk of explosion.

**Protection During Firefighting:** Firefighters must use full bunker gear including NIOSH-approved positive-pressure self-contained breathing apparatus to protect against potential hazardous combustion and decomposition products. Do not enter fire area without proper protective equipment, including respiratory protection.

**Hazardous Combustion Products:** Metallic oxides. Metal oxides.

**Other Information:** Do not allow run-off from fire fighting to enter drains or water courses. Risk of dust explosion.

## SECTION 6: ACCIDENTAL RELEASE MEASURES

### 6.1. Personal Precautions, Protective Equipment and Emergency Procedures

**General Measures:** Remove ignition sources. Keep away from heat, hot surfaces, sparks, open flames, and other ignition sources. No smoking. Do not handle until all safety precautions have been read and understood. Do not breathe dust or fumes. Do not breathe fumes from molten product. Do not get in eyes, on skin, or on clothing. Use only non-sparking tools. Avoid generating dust. Where possible allow molten material to solidify naturally.

#### 6.1.1. For Non-Emergency Personnel

**Protective Equipment:** Use appropriate personal protective equipment (PPE).

**Emergency Procedures:** Avoid creating or spreading dust. Evacuate unnecessary personnel. Stop leak if safe to do so.

#### 6.1.2. For Emergency Personnel

**Protective Equipment:** Wear suitable protective clothing, gloves and eye/face protection. Equip cleanup crew with proper protection.

**Emergency Procedures:** Eliminate ignition sources. Evacuate unnecessary personnel, isolate, and ventilate area. Upon arrival at the scene, a first responder is expected to recognize the presence of dangerous goods, protect oneself and the public, secure the area, and call for the assistance of trained personnel as soon as conditions permit.

### 6.2. Environmental Precautions

Notify authorities if liquid enters sewers or public waters. Prevent entry to sewers and public waters. Avoid release to the environment. Avoid release of dust/fines to waterways to avoid potential bioaccumulation.

### 6.3. Methods and Materials for Containment and Cleaning Up

**For Containment:** Remove ignition sources. Use only non-sparking tools. As an immediate precautionary measure, isolate spill or leak area in all directions. Contain solid spills with appropriate barriers and prevent migration and entry into sewers or streams. Avoid generation of dust during clean-up of spills. If metal is in molten form allow to cool and collect as a solid. If metal is in solid form collect for re-melting purposes. Where possible allow molten material to solidify naturally. Recycle or dispose of in compliance with current legislation.

**Methods for Cleaning Up:** Clean up spills immediately and dispose of waste safely. For dust spills: Use explosion proof vacuum during cleanup, with appropriate filter. Do not mix with other materials. Use clean non-sparking tools to collect material and place it into loosely covered plastic containers for later disposal. Take up mechanically (sweeping, shoveling) and collect in suitable container for disposal. Vacuum clean-up is preferred. If sweeping is required use a dust suppressant. *In molten form:* Allow product to completely solidify, then scrape product from hard surface. Avoid generation of dust clouds. Place solidified product in appropriate waste container. Allow liquid material to solidify before cleaning up. Contact competent authorities after a spill.

### 6.4. Reference to Other Sections

See Section 8 for Exposure Controls and Personal Protection and Section 13 for Disposal Considerations. See Section 8 for exposure controls and personal protection and Section 13 for disposal considerations.

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## SECTION 7: HANDLING AND STORAGE

### 7.1. Precautions for Safe Handling

**Additional Hazards When Processed:** Product dust is combustible. Use care during processing to minimize generation of dust. When immersed in furnace, splashing of molten metal can occur. Molten metal and water can be an explosive combination. The risk is greatest when there is sufficient molten metal to entrap or seal off the water. Water and other forms of contamination on or contained in scrap or remelt ingot are known to have caused explosions in melting operations. While the products may have minimal surface roughness and internal voids, there remains the possibility of moisture contamination or entrapment. If confined, even a few drops of water can lead to violent explosions. All tooling and containers which come in contact with molten metal must be preheated or specially coated and rust free. Molds and ladles must be preheated or oiled prior to casting. Any surfaces that may contact molten metal (e.g. concrete) should be specially coated. Drops of molten metal in water (e.g. from plasma arc cutting), while not normally an explosion hazard, can generate enough flammable hydrogen gas to present an explosion hazard. Vigorous circulation of the water and removal of the particles minimize the hazards. During melting operations, the following minimum guidelines should be observed:

-Inspect all materials prior to furnace charging and completely remove surface contamination such as water, ice, snow, deposits of grease and oil or other surface contamination resulting from weather exposure, shipment, or storage.

-Store materials in dry, heated areas with any cracks or cavities pointed downwards.

-Preheat and dry large or heavy items such as ingot adequately before charging into a furnace containing molten metal. This is typically done by use of a drying oven or homogenizing furnace. The drying cycle should bring the internal metal temperature of the coldest item of the batch to 400 °F (204 °C) and then hold at that temperature for 6 hours. If suspected of containing moisture, product should be THOROUGHLY DRIED before being added to a molten bath. Otherwise, entrained moisture could expand explosively and spatter molten metal out of the bath. Avoid dust production. Accumulation and dispersion of dust with an ignition source can cause a combustible dust explosion. Keep dust levels to a minimum and follow applicable regulations. Risk of thermal burns on contact with molten product. May be a potential hazard under the following conditions: Small chunks, dust or fines in contact with water can generate flammable or toxic gases. These gases could present an explosion hazard in confined or poorly ventilated spaces. Finely divided metals (e.g. powders or wire) may have enough surface oxide to produce thermite reactions/explosions.

**Precautions for Safe Handling:** Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Keep away from heat, sparks, open flames, and hot surfaces. No smoking. Do not get in eyes, on skin, or on clothing. Do not breathe vapors from molten product. Do not breathe dust. Wash hands and other exposed areas with mild soap and water before eating, drinking or smoking and when leaving work. Take precautionary measures against static discharge. Use only non-sparking tools. Avoid creating or spreading dust.

**Hygiene Measures:** Wash hands and other exposed areas with mild soap and water before eating, drinking or smoking and when leaving work. Handle in accordance with good industrial hygiene and safety procedures.

### 7.2. Conditions for Safe Storage, Including Any Incompatibilities

**Technical Measures:** Comply with applicable regulations. Maintain air gap between stacks/pallets. Proper grounding procedures to avoid static electricity should be followed. Take action to prevent static discharges. Ground and bond container and receiving equipment. Use explosion-proof electrical, ventilating, and lighting equipment. Avoid creating or spreading dust. Use explosion-proof electrical, ventilating, lighting equipment.

**Storage Conditions:** Store in original container. Store in dry protected location to prevent any moisture contact. Keep away from heat and flame. Store locked up/in a secure area. Store in a cool, dry place. Keep away from moisture, extremely high or low temperatures, ignition sources, and incompatible materials. Keep container tightly closed. Store in a well-ventilated place. Keep container tightly closed. Keep in fireproof place.

**Incompatible Materials:** Corrosive substances in contact with metals may produce flammable hydrogen gas. Strong acids, strong bases, strong oxidizers. Alkalis. Mineral acids. Dust, fines, and chips: Water. When molten: water.

### 7.3. Specific End Use(s)

No use is specified.

## SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1. Control Parameters

For substances listed in section 3 that are not listed here, there are no established exposure limits from the manufacturer, supplier, importer, or the appropriate advisory agency including: ACGIH (TLV), AIHA (WEEL), NIOSH (REL), or OSHA (PEL).

Vanadium (7440-62-2)		
USA NIOSH	NIOSH REL (TWA)	1 mg/m <sup>3</sup> (Ferrovanadium dust)
USA NIOSH	NIOSH REL (STEL)	3 mg/m <sup>3</sup> (Ferrovanadium dust)
USA OSHA	OSHA PEL (Ceiling)	0.5 mg/m <sup>3</sup> (respirable dust) 0.1 mg/m <sup>3</sup> (fume)

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<b>Molybdenum (7439-98-7)</b>		
	Internal OEL Value(s)	5 mg/m <sup>3</sup> (Molybdenum (as Mo), Soluble Compounds)
<b>USA ACGIH</b>	ACGIH OEL TWA	10 mg/m <sup>3</sup> (inhalable particulate matter) 3 mg/m <sup>3</sup> (respirable particulate matter)
<b>USA NIOSH</b>	NIOSH REL (TWA)	5 mg/m <sup>3</sup> (Molybdenum (as Mo), Soluble Compounds)
<b>USA IDLH</b>	IDLH	5000 mg/m <sup>3</sup>
<b>USA OSHA</b>	OSHA PEL (TWA) [1]	5 mg/m <sup>3</sup> (Molybdenum (as Mo), Soluble Compounds) 15 mg/m <sup>3</sup> (Molybdenum (as Mo), Insoluble Compounds (Total dust))
<b>Chromium (7440-47-3)</b>		
<b>USA ACGIH</b>	ACGIH OEL TWA	0.5 mg/m <sup>3</sup> (inhalable particulate matter)
<b>USA ACGIH</b>	BEI (BLV)	0.7 µg/l Parameter: Total chromium - Medium: urine - Sampling time: end of shift at end of workweek (population based)
<b>USA NIOSH</b>	NIOSH REL (TWA)	0.5 mg/m <sup>3</sup>
<b>USA IDLH</b>	IDLH	250 mg/m <sup>3</sup>
<b>USA OSHA</b>	OSHA PEL (TWA) [1]	1 mg/m <sup>3</sup>
<b>Aluminum (7429-90-5)</b>		
<b>USA ACGIH</b>	ACGIH OEL TWA	1 mg/m <sup>3</sup> (respirable particulate matter)
<b>USA ACGIH</b>	ACGIH chemical category	Not Classifiable as a Human Carcinogen
<b>USA NIOSH</b>	NIOSH REL (TWA)	10 mg/m <sup>3</sup> (total dust) 5 mg/m <sup>3</sup> (respirable dust)
<b>USA OSHA</b>	OSHA PEL (TWA) [1]	15 mg/m <sup>3</sup> (total dust) 5 mg/m <sup>3</sup> (respirable fraction)
<b>Zirconium (7440-67-7)</b>		
<b>USA ACGIH</b>	ACGIH OEL TWA	5 mg/m <sup>3</sup>
<b>USA ACGIH</b>	ACGIH OEL STEL	10 mg/m <sup>3</sup>
<b>USA ACGIH</b>	ACGIH chemical category	Not Classifiable as a Human Carcinogen
<b>USA NIOSH</b>	NIOSH REL (TWA)	5 mg/m <sup>3</sup>
<b>USA NIOSH</b>	NIOSH REL (STEL)	10 mg/m <sup>3</sup>
<b>USA IDLH</b>	IDLH	50 mg/m <sup>3</sup>
<b>Tin (7440-31-5)</b>		
<b>USA ACGIH</b>	ACGIH OEL TWA	2 mg/m <sup>3</sup> (inhalable particulate matter)
<b>USA NIOSH</b>	NIOSH REL (TWA)	2 mg/m <sup>3</sup>
<b>USA IDLH</b>	IDLH	100 mg/m <sup>3</sup>
<b>Tantalum (7440-25-7)</b>		
<b>USA NIOSH</b>	NIOSH REL (TWA)	5 mg/m <sup>3</sup> (dust)
<b>USA NIOSH</b>	NIOSH REL (STEL)	10 mg/m <sup>3</sup> (dust)
<b>USA IDLH</b>	IDLH	2500 mg/m <sup>3</sup> (dust)
<b>USA OSHA</b>	OSHA PEL (TWA) [1]	5 mg/m <sup>3</sup>
<b>Nickel (7440-02-0)</b>		
<b>USA ACGIH</b>	ACGIH OEL TWA	1.5 mg/m <sup>3</sup> (inhalable particulate matter)
<b>USA ACGIH</b>	ACGIH chemical category	Not Suspected as a Human Carcinogen
<b>USA ACGIH</b>	BEI (BLV)	5 µg/l Parameter: Nickel - Medium: urine - Sampling time: post-shift at end of workweek (background)
<b>USA NIOSH</b>	NIOSH REL (TWA)	0.015 mg/m <sup>3</sup>
<b>USA IDLH</b>	IDLH	10 mg/m <sup>3</sup>
<b>USA OSHA</b>	OSHA PEL (TWA) [1]	1 mg/m <sup>3</sup>

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## 8.2. Exposure Controls

### Appropriate Engineering Controls

: Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure. Avoid dust production. Avoid creating or spreading dust. Ensure that dust-handling systems (such as exhaust ducts, dust collectors, vessels, and processing equipment) are designed in a manner to prevent the escape of dust into the work area (i.e, there is no leakage from the equipment). Suitable eye/body wash equipment should be available in the vicinity of any potential exposure. Ensure adequate ventilation, especially in confined areas. Ensure all national/local regulations are observed. Proper grounding procedures to avoid static electricity should be followed. Proper grounding procedures to avoid static electricity should be followed. Use explosion-proof equipment. Use local exhaust or general dilution ventilation or other suppression methods to maintain dust levels below exposure limits. Power equipment should be equipped with proper dust collection devices. It is recommended that all dust control equipment such as local exhaust ventilation and material transport systems involved in handling of this product contain explosion relief vents or an explosion suppression system or an oxygen-deficient environment.

### Personal Protective Equipment

: Safety glasses. Insufficient ventilation: wear respiratory protection. Gloves. Protective clothing. Protective goggles. Insufficient ventilation: wear respiratory protection.



### Materials for Protective Clothing

: With molten material wear thermally protective clothing. Chemically resistant materials and fabrics. Wear fire/flame resistant/retardant clothing. Thermal protection required when working with hot material.

### Hand Protection

: Wear chemically resistant protective gloves. If material is hot, wear thermally resistant protective gloves. Wear protective gloves. When needed, wear protective gloves to protect against thermal and/or mechanical hazards.

### Eye and Face Protection

: Chemical goggles or face shield. Chemical safety goggles.

### Skin and Body Protection

: Wear suitable protective clothing.

### Respiratory Protection

: Use a NIOSH-approved respirator or self-contained breathing apparatus whenever exposure may exceed established Occupational Exposure Limits. If exposure limits are exceeded or irritation is experienced, approved respiratory protection should be worn. In case of inadequate ventilation, oxygen deficient atmosphere, or where exposure levels are not known wear approved respiratory protection.

### Thermal Hazard Protection

: If material is hot, wear thermally resistant protective gloves. When working with hot material, use suitable thermally protective clothing.

### Environmental Exposure Controls

: Do not allow the product to be released into the environment.

### Consumer Exposure Controls

: Do not eat, drink or smoke during use.

### Other Information

: When using, do not eat, drink or smoke.

## SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

### 9.1. Information on Basic Physical and Chemical Properties

Physical State	: Solid
Appearance	: Metallic.
Odor	: Odorless.
Odor Threshold	: Not applicable
pH	: No data available
Evaporation Rate	: No data available
Melting Point	: 1537.8 – 1671.1 °C (2800.04 – 3039.98 °F)
Freezing Point	: No data available
Boiling Point	: No data available
Flash Point	: Not applicable
Auto-ignition Temperature	: No data available
Decomposition Temperature	: No data available
Flammability (solid, gas)	: Flammable solid (Dust, chips, fines, turnings)



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Vapor Pressure	: No data available
Relative Vapor Density at 20°C	: No data available
Relative Density	: No data available
Specific Gravity	: 4.5 (Water = 1)
Solubility	: Insoluble in water.
Partition Coefficient: N-Octanol/Water	: No data available
Viscosity	: No data available

## 9.2. Other Information

No additional information available

## SECTION 10: STABILITY AND REACTIVITY

### 10.1. Reactivity

*In massive form:* Stable at ambient temperature and under normal conditions of use. If finely divided, chips, dusts, ribbons, turnings: Reacts readily with water liberating highly flammable gases. Reacts violently with strong oxidizers. Increased risk of fire or explosion. In molten form may react violently with water.

### 10.2. Chemical Stability

*In massive form:* Stable under recommended handling and storage conditions (see section 7). *Particulates and dust:* Self-heating: may catch fire. Flammable solid. Metallic dusts may ignite or explode.

### 10.3. Possibility of Hazardous Reactions

In contact with water releases flammable gas.

### 10.4. Conditions to Avoid

Direct sunlight, extremely high or low temperatures, heat, hot surfaces, sparks, open flames, incompatible materials, and other ignition sources. Dust accumulation (to minimize explosion hazard). Dust, chips, or ribbons can be ignited more easily, by an ignition source, by improper machining, or by spontaneous combustion if finely divided and damp.

### 10.5. Incompatible Materials

Corrosive substances in contact with metals may produce flammable hydrogen gas. Strong acids, strong bases, strong oxidizers. Alkalis. Mineral acids. Dust, fines, and chips: Water. When molten: water.

### 10.6. Hazardous Decomposition Products

None expected under normal conditions of use. Thermal decomposition may produce: Metal oxides.

## SECTION 11: TOXICOLOGICAL INFORMATION

### 11.1. Information on Toxicological Effects

**Acute Toxicity (Oral):** Not classified

**Acute Toxicity (Dermal):** Not classified

**Acute Toxicity (Inhalation):** Not classified

<b>Vanadium (7440-62-2)</b>	
LD50 Oral Rat	> 2000 mg/kg
<b>Molybdenum (7439-98-7)</b>	
LD50 Oral Rat	> 2000 mg/kg
LD50 Dermal Rat	> 2000 mg/kg
LC50 Inhalation Rat	> 5.84 mg/l/4h
LC50 Inhalation Rat	> 3.92 mg/l/4h
<b>Chromium (7440-47-3)</b>	
LD50 Oral Rat	> 5000 mg/kg
LC50 Inhalation Rat	> 5.41 mg/l/4h
<b>Aluminum (7429-90-5)</b>	
LD50 Oral Rat	> 15900 mg/kg
LC50 Inhalation Rat	> 0.888 mg/l/4h
<b>Tin (7440-31-5)</b>	
LD50 Oral Rat	700 mg/kg
LD50 Dermal Rat	> 2000 mg/kg
LC50 Inhalation Rat	> 4.75 mg/l/4h
<b>Iron (7439-89-6)</b>	
LD50 Oral Rat	98.6 g/kg
<b>Niobium (7440-03-1)</b>	
LD50 Oral Rat	> 10 g/kg

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LD50 Dermal Rat	> 2000 mg/kg
LC50 Inhalation Rat	> 5.45 mg/l/4h
<b>Tantalum (7440-25-7)</b>	
LD50 Oral Rat	> 2000 mg/kg
LD50 Dermal Rat	> 2000 mg/kg
LC50 Inhalation Rat	> 5.18 mg/l/4h
<b>Nickel (7440-02-0)</b>	
LD50 Oral Rat	> 9000 mg/kg
LC50 Inhalation Rat	> 10.2 mg/l (Exposure time: 1 h)

**Skin Corrosion/Irritation:** Not classified

**Serious Eye Damage/Irritation:** Not classified

**Respiratory or Skin Sensitization:** May cause an allergic skin reaction.

**Germ Cell Mutagenicity:** Not classified

**Carcinogenicity:** Suspected of causing cancer.

<b>Chromium (7440-47-3)</b>	
IARC group	3
<b>Nickel (7440-02-0)</b>	
IARC group	2B
National Toxicology Program (NTP) Status	Reasonably anticipated to be Human Carcinogen.
OSHA Hazard Communication Carcinogen List	In OSHA Hazard Communication Carcinogen list.

**Reproductive Toxicity:** Suspected of damaging fertility or the unborn child.

**Specific Target Organ Toxicity (Single Exposure):** Not classified

**Specific Target Organ Toxicity (Repeated Exposure):** Not classified

**Aspiration Hazard:** Not classified

**Symptoms/Injuries After Inhalation:** Exposure may produce an allergic reaction. During processing, the most significant route of exposure is by the inhalation (breathing) of fumes. If fumes are inhaled, they can cause a condition commonly known as metal fume fever with symptoms which resemble influenza; Symptoms may be delayed 4-12 hours and begin with a sudden onset of thirst, and a sweet, metallic or foul taste in the mouth. Other symptoms may include upper respiratory tract irritation accompanied by coughing and a dryness of the mucous membranes, lassitude and a generalized feeling of malaise. Fever, chills, muscular pain, mild to severe headache, nausea, occasional vomiting, exaggerated mental activity, profuse sweating, excessive urination, diarrhea and prostration may also occur. . During welding, the most significant route of exposure is by the inhalation (breathing) of welding fumes. If welding fumes are inhaled, they can cause a condition commonly known as metal fume fever with symptoms which resemble influenza. Inhalation of dusts and fumes can cause metal fume fever. Symptoms can include a metallic or sweet taste in the mouth, sweating, shivering, headache, throat irritation, fever, chills, thirstiness, muscle aches, nausea, vomiting, weakness, fatigue, and shortness of breath.

**Symptoms/Injuries After Skin Contact:** Exposure may produce an allergic reaction. Dust may cause irritation in skin folds or by contact in combination with tight clothing. Mechanical damage via flying particles and chipped slag is possible. May cause an allergic skin reaction. Contact with fumes or metal powder will irritate skin. Contact with hot, molten metal will cause thermal burns.

**Symptoms/Injuries After Eye Contact:** Mechanical damage via flying particles and chipped slag is possible. During metal processing, dusts caused from physical alteration will likely cause eye irritation. Fumes from thermal decomposition or molten material will likely be irritating to the eyes. Risk of thermal burns on contact with molten product.

**Symptoms/Injuries After Ingestion:** *In massive form:* Ingestion is not considered a potential route of exposure. Ingestion of the molten product may cause severe thermal burns.

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**Chronic Symptoms:** Suspected of damaging fertility or the unborn child. Suspected of causing cancer. Overexposure to metal fumes may result metal fume fever (chills, muscle aches, nausea, fever, dry throat, cough, weakness, lassitude), disturbances in smell and/or taste, and possible discoloration of skin, hair and mucous membranes; discoloration may become permanent. Inhalation of Nickel compounds has been shown in studies to provide an increased incidence of cancer of the nasal cavity, lung and possibly larynx in nickel refinery workers. Repeated inhalation of iron oxide dust can cause siderosis a benign condition. Vanadium: May cause gastrointestinal discomfort, renal damage, nervous system depression and irritation of the respiratory passages. May also cause cardiac palpitations and asthma. Molybdenum: Chronic exposure to molybdenum compounds is suspected of causing cancer. Compounds are also known to cause irritation to the skin, eyes, and respiratory tract. Chromium: Certain hexavalent chromium compounds have been demonstrated to be carcinogenic on the basis of epidemiological investigations on workers and experimental studies in animals. Increased incidences of respiratory cancer have been found in chromium (VI) workers. There is an increased incidence of lung cancer in industrial workers exposed to chromium (VI) compounds. Please refer to IARC volume 23 for a more detailed discussion. Aluminum: Inhalation of finely divided aluminum powder may cause pulmonary fibrosis. Tin: Has been shown to increase incidence of sarcoma in animal tests. Chronic exposure to tin dusts and fume may result in "stannosis", a mild form of pneumoconiosis. Tantalum: Repeated exposure to tantalum alloys may cause fibrosis, chronic rhinitis and "hard metal pneumoconiosis".

## SECTION 12: ECOLOGICAL INFORMATION

### 12.1. Toxicity

**Ecology - General** : Harmful to aquatic life.

Molybdenum (7439-98-7)	
LC50 Fish 1	800 – 1320 mg/l
Nickel (7440-02-0)	
LC50 Fish 1	100 mg/l (Exposure time: 96 h - Species: Brachydanio rerio)
EC50 - Crustacea [1]	121.6 µg/l (Exposure time: 48h - Species: Ceriodaphnia dubia [static])
LC50 Fish 2	15.3 mg/l
EC50 - Crustacea [2]	1 mg/l (Exposure time: 48 h - Species: Daphnia magna [Static])
EC50 Other Aquatic Organisms 2	0.174 (0.174 – 0.311) mg/l (Exposure time: 96 h - Species: Pseudokirchneriella subcapitata [static])

### 12.2. Persistence and Degradability

Titanium and Titanium Alloys	
Persistence and Degradability	Not established. Inorganic product which cannot be eliminated from water by biological purification processes.

### 12.3. Bioaccumulative Potential

Titanium and Titanium Alloys	
Bioaccumulative Potential	Not established.

### 12.4. Mobility in Soil

No additional information available

### 12.5. Other Adverse Effects

**Other Information** : Avoid release to the environment.

## SECTION 13: DISPOSAL CONSIDERATIONS

### 13.1. Waste Treatment Methods

**Waste Treatment Methods:** Dispose of waste material in accordance with all local, regional, national, provincial, territorial and international regulations. Material should be recycled if possible.

**Sewage Disposal Recommendations:** Do not dispose of waste into sewer. Do not empty into drains.

**Waste Disposal Recommendations:** Dispose of contents/container in accordance with local, regional, national, and international regulations.

**Additional Information:** Handle empty containers with care because residual product is flammable. Recover or recycle if possible.

**Ecology - Waste Materials:** This material is hazardous to the aquatic environment. Keep out of sewers and waterways. Avoid release to the environment.

## SECTION 14: TRANSPORT INFORMATION

The shipping description(s) stated herein were prepared in accordance with certain assumptions at the time the SDS was authored, and can vary based on a number of variables that may or may not have been known at the time the SDS was issued.

### 14.1. In Accordance with DOT

Not regulated for transport

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## 14.2. In Accordance with IMDG

Not regulated for transport

## 14.3. In Accordance with IATA

Not regulated for transport

\*The shipping descriptions above do not apply to forms of this product that may result from further processing (such as dust, fines, and chips). Shipping classifications must be reassessed if the form of the product is altered.

## SECTION 15: REGULATORY INFORMATION

### 15.1. US Federal Regulations

Titanium and Titanium Alloys	
SARA Section 311/312 Hazard Classes	Physical hazard - Self-heating Health hazard - Reproductive toxicity Health hazard - Respiratory or skin sensitization Physical hazard - In contact with water emits flammable gas Physical hazard - Flammable (gases, aerosols, liquids, or solids) Health hazard - Carcinogenicity Physical hazard - Combustible dust
<b>Titanium (7440-32-6)</b>	
Listed on the United States TSCA (Toxic Substances Control Act) inventory - Status: Active	
<b>Vanadium (7440-62-2)</b>	
Listed on the United States TSCA (Toxic Substances Control Act) inventory - Status: Active Subject to reporting requirements of United States SARA Section 313	
SARA Section 313 - Emission Reporting	1 % (except when contained in an alloy)
<b>Molybdenum (7439-98-7)</b>	
Listed on the United States TSCA (Toxic Substances Control Act) inventory - Status: Active	
<b>Chromium (7440-47-3)</b>	
Listed on the United States TSCA (Toxic Substances Control Act) inventory - Status: Active Subject to reporting requirements of United States SARA Section 313	
CERCLA RQ	5000 lb no reporting of releases of this hazardous substance is required if the diameter of the pieces of the solid metal released is >100 µm
SARA Section 313 - Emission Reporting	1 %
<b>Aluminum (7429-90-5)</b>	
Listed on the United States TSCA (Toxic Substances Control Act) inventory - Status: Active Subject to reporting requirements of United States SARA Section 313	
SARA Section 313 - Emission Reporting	1 % (dust or fume only)
<b>Zirconium (7440-67-7)</b>	
Listed on the United States TSCA (Toxic Substances Control Act) inventory - Status: Active	
<b>Tin (7440-31-5)</b>	
Listed on the United States TSCA (Toxic Substances Control Act) inventory - Status: Active	
<b>Iron (7439-89-6)</b>	
Listed on the United States TSCA (Toxic Substances Control Act) inventory - Status: Active	
<b>Niobium (7440-03-1)</b>	
Listed on the United States TSCA (Toxic Substances Control Act) inventory - Status: Active	
<b>Tantalum (7440-25-7)</b>	
Listed on the United States TSCA (Toxic Substances Control Act) inventory - Status: Active	
<b>Nickel (7440-02-0)</b>	
Listed on the United States TSCA (Toxic Substances Control Act) inventory - Status: Active Subject to reporting requirements of United States SARA Section 313	
CERCLA RQ	100 lb (only applicable if particles are < 100 µm)
SARA Section 313 - Emission Reporting	0.1 %

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## 15.2. US State Regulations

<b>Titanium (7440-32-6)</b>
U.S. - New Jersey - Right to Know Hazardous Substance List
<b>Vanadium (7440-62-2)</b>
U.S. - New Jersey - Right to Know Hazardous Substance List
U.S. - Pennsylvania - RTK (Right to Know) List
U.S. - Massachusetts - Right To Know List
U.S. - Pennsylvania - RTK (Right to Know) - Environmental Hazard List
<b>Molybdenum (7439-98-7)</b>
U.S. - New Jersey - Right to Know Hazardous Substance List
U.S. - Pennsylvania - RTK (Right to Know) List
U.S. - Massachusetts - Right To Know List
<b>Chromium (7440-47-3)</b>
U.S. - New Jersey - Right to Know Hazardous Substance List
U.S. - Pennsylvania - RTK (Right to Know) List
U.S. - Massachusetts - Right To Know List
U.S. - Pennsylvania - RTK (Right to Know) - Special Hazardous Substances
U.S. - Pennsylvania - RTK (Right to Know) - Environmental Hazard List
<b>Aluminum (7429-90-5)</b>
U.S. - New Jersey - Right to Know Hazardous Substance List
U.S. - Pennsylvania - RTK (Right to Know) List
U.S. - Massachusetts - Right To Know List
U.S. - Pennsylvania - RTK (Right to Know) - Environmental Hazard List
<b>Zirconium (7440-67-7)</b>
U.S. - New Jersey - Right to Know Hazardous Substance List
U.S. - Pennsylvania - RTK (Right to Know) List
U.S. - Massachusetts - Right To Know List
<b>Tin (7440-31-5)</b>
U.S. - New Jersey - Right to Know Hazardous Substance List
U.S. - Pennsylvania - RTK (Right to Know) List
U.S. - Massachusetts - Right To Know List
<b>Tantalum (7440-25-7)</b>
U.S. - New Jersey - Right to Know Hazardous Substance List
U.S. - Pennsylvania - RTK (Right to Know) List
U.S. - Massachusetts - Right To Know List
<b>Nickel (7440-02-0)</b>
U.S. - New Jersey - Right to Know Hazardous Substance List
U.S. - Pennsylvania - RTK (Right to Know) List
U.S. - Massachusetts - Right To Know List
U.S. - Pennsylvania - RTK (Right to Know) - Special Hazardous Substances
U.S. - Pennsylvania - RTK (Right to Know) - Environmental Hazard List

### California Proposition 65



**WARNING:** This product can expose you to Nickel, which is known to the State of California to cause cancer. For more information go to [www.P65Warnings.ca.gov](http://www.P65Warnings.ca.gov).

Chemical Name (CAS No.)	Carcinogenicity	Developmental Toxicity	Female Reproductive Toxicity	Male Reproductive Toxicity
Nickel (7440-02-0)	X			

## SECTION 16: OTHER INFORMATION, INCLUDING DATE OF PREPARATION OR LAST REVISION

<b>Date of Preparation or Latest Revision</b>	: 08/30/2023
<b>Other Information</b>	: This document has been prepared in accordance with the SDS requirements of the OSHA Hazard Communication Standard 29 CFR 1910.1200. This document has been prepared in accordance with the SDS requirements of the OSHA Hazard Communication Standard 29 CFR 1910.1200.

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### GHS Full Text Phrases:

H228	Flammable solid
H251	Self-heating; may catch fire
H261	In contact with water releases flammable gas
H317	May cause an allergic skin reaction
H351	Suspected of causing cancer
H361	Suspected of damaging fertility or the unborn child
H372	Causes damage to organs through prolonged or repeated exposure
H400	Very toxic to aquatic life
H402	Harmful to aquatic life
H412	Harmful to aquatic life with long lasting effects

*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.*

SDS US (GHS HazCom)