1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Product Identifier / Product Name: Titanium & Titanium Alloys

Other means of identification: 6AL/4V Grade 5 / 6AL/4V Grade 23 (ELI) / CP-Grade 4 / CP-Grade 2

Recommended Use: Titanium & Titanium Alloy product manufacture (i.e. forging, casting, welding, cutting, etc. for aerospace, medical, military, and/or commercial applications).

Recommended Restrictions: None

Distributor Information: President Titanium Co., Inc. – 243 Franklin Street – Hanson, MA 02341 U.S.A. Phn: (781) 294-0000 / Fax: (781) 293-3753 / Web: www.presidenttitanium.com

Emergency Information: CHEMTREC: 1-800-424-9300

2. HAZARDS IDENTIFICATION

Classification
This chemical is not considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Label Elements

<table>
<thead>
<tr>
<th>Appearance</th>
<th>Physical State</th>
<th>Odor</th>
</tr>
</thead>
<tbody>
<tr>
<td>various product forms</td>
<td>solid</td>
<td>odorless</td>
</tr>
</tbody>
</table>

Hazards not otherwise classified (HNOC)
Not applicable

Other Information
When product is subjected to welding, burning, melting, sawing, brazing, grinding, buffing, polishing, and/or other similar heat-generating processes, airborne particles and/or fumes may cause general irritation of the eyes, nasal, and lungs. There is also the chance of the following potentially hazardous airborne particles and/or fumes that may be generated:
- titanium dioxide an IARC Group 2B carcinogen
- vanadium pentoxide (V2O5) affects eyes, skin, respiratory system

3. COMPOSITION/INFORMATION ON INGREDIENTS

Synonyms (partial list):
6AL/4V Grade 5 Titanium, 6AL/4V ELI (Grade 23) Titanium, CP-Grade 4 Titanium, CP-Grade 2 Titanium

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>CAS No.</th>
<th>Weight-%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Titanium (Ti)</td>
<td>7440-32-6</td>
<td>88 - 100</td>
</tr>
<tr>
<td>Aluminum (AL)</td>
<td>7429-90-5</td>
<td>0 - 6.75</td>
</tr>
</tbody>
</table>
### 4. FIRST AID MEASURES

First aid measures

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Eye contact</strong></td>
<td>In the case of particles coming in contact with eyes during processing, treat as with any foreign object.</td>
</tr>
<tr>
<td><strong>Skin Contact</strong></td>
<td>In the case of skin irritation or allergic reactions see a physician.</td>
</tr>
<tr>
<td><strong>Inhalation</strong></td>
<td>If excessive amounts of smoke, fume, or particulate are inhaled during processing, remove to fresh air and consult a qualified health professional.</td>
</tr>
<tr>
<td><strong>Ingestion</strong></td>
<td>Not an expected route of exposure.</td>
</tr>
</tbody>
</table>

**Most important symptoms and effects, both acute and delayed**

- **Symptoms**: May cause allergic skin reaction.

**Indication of any immediate medical attention and special treatment needed**

- **Note to physicians**: Treat symptomatically.

### 5. FIRE-FIGHTING MEASURES

**Suitable extinguishing media**
Not flammable in the form of this product as distributed, flammable as finely divided particles or pieces resulting from processing of this product. Smother with salt (NaCl) or class D dry powder fire extinguisher.

**Unsuitable extinguishing media**
Do not spray water on burning metal as an explosion may occur. This explosive characteristic is caused by the hydrogen and steam generated by the reaction of water with the burning material.

**Specific hazards arising from the chemical**
Intense heat. Very fine, high surface area material resulting from grinding, buffing, polishing, or similar processes of this product may ignite spontaneously at room temperature. WARNING: Fine particles resulting from grinding, buffing, polishing, or similar processes of this product may form combustible dust-air mixtures. Keep particles away from all ignition sources including heat, sparks, and flame. Prevent dust accumulations to minimize combustible dust hazard.

**Hazardous combustion products**
Titanium dioxide an IARC Group 2B carcinogen, Hexavalent Chromium (Chromium VI) may cause lung, nasal, and/or sinus cancer. Vanadium pentoxide (V2O5) affects eyes, skin, respiratory system, zinc, copper, magnesium, or cadmium fumes may cause metal fume fever. Soluble molybdenum compounds such as molybdenum trioxide may cause lung irritation.

**Explosion data**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sensitivity to Mechanical Impact</strong></td>
<td>None</td>
</tr>
<tr>
<td><strong>Sensitivity to Static Discharge</strong></td>
<td>None</td>
</tr>
</tbody>
</table>

**Protective equipment and precautions for firefighters**
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH approved (or equivalent) respirator and full protective gear.

### 6. ACCIDENTAL RELEASE MEASURES
Personal precautions, protective equipment and emergency procedures

Personal precautions
Use personal protective equipment as required.

For emergency responders
Use personal protective equipment as required.

Environmental precautions
Not applicable to massive product.

Methods and material for containment and cleaning up
Methods for containment
Not applicable to massive product.

Methods for cleaning up
Not applicable to massive product.

7. HANDLING AND STORAGE

Precautions for safe handling
Advice on safe handling
Very fine, high surface area material resulting from grinding, buffing, polishing, or similar processes of this product may ignite spontaneously at room temperature. WARNING: Fine particles resulting from grinding, buffing, polishing, or similar processes of this product may form combustible dust-air mixtures. Keep particles away from all ignition sources including heat, sparks, and flame. Prevent dust accumulations to minimize combustible dust hazard.

Conditions for safe storage, including any incompatibilities
Storage Conditions
Keep chips, turnings, dust, and other small particles away from heat, sparks, flame and other sources of ignition (i.e., pilot lights, electric motors and static electricity).

Incompatible materials
Dissolves in hydrofluoric acid / Ignites in the presence of fluorine. When heated above 200°C, reacts exothermically with the following. Chlorine, bromine, halocarbons, carbon tetrachloride, carbon tetrafluoride, and freon.

8. EXPOSURE CONTROLS/PERSOANAL PROTECTION

Control parameters

Exposure Guidelines

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>ACGIH TLV</th>
<th>OSHA PEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Titanium</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7440-32-6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aluminum</td>
<td>TWA: 1 mg/m³ respirable fraction</td>
<td>TWA: 15 mg/m³ total dust TWA: 5 mg/m³ respirable fraction</td>
</tr>
<tr>
<td>7429-90-5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vanadium</td>
<td>Ceiling: 0.5 mg/m³ V2O5 respirable dust Ceiling: 0.1 mg/m³ V2O5 fume</td>
<td></td>
</tr>
<tr>
<td>7440-62-2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iron</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7439-89-6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Appropriate engineering controls

Engineering Controls
Avoid generation of uncontrolled particles.

Individual protection measures, such as personal protective equipment

Eye/face protection
When airborne particles may be present, appropriate eye protection is recommended. For example, tight-fitting goggles, foam-lined safety glasses or other protective equipment that shield the eyes from particles.

Skin and body protection
Fire/flame resistant/retardant clothing may be appropriate during hot work with the product. Wear protective gloves. Cut-resistant gloves and/or protective clothing may be appropriate when sharp surfaces are present.

Respiratory protection
When particulates/fumes/gases are generated and if exposure limits are exceeded or irritation is experienced, proper approved respiratory protection should be worn. Positive-pressure supplied air respirators may be required for high airborne contaminant concentrations. Respiratory protection must be provided in accordance with current local regulations.
9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Values</th>
<th>Remarks * Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical state</td>
<td>Solid</td>
<td></td>
</tr>
<tr>
<td>Appearance</td>
<td>Various massive product forms</td>
<td></td>
</tr>
<tr>
<td>Color</td>
<td>metallic, gray or silver</td>
<td></td>
</tr>
<tr>
<td>Odor</td>
<td>Odorless</td>
<td></td>
</tr>
<tr>
<td>Odor threshold</td>
<td>Not applicable</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Property</th>
<th>Values</th>
<th>Remarks * Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ph</td>
<td>Not applicable</td>
<td></td>
</tr>
<tr>
<td>Melting point/freezing point</td>
<td>1540-1670 °C 2800-3000 °F</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Boiling point / boiling range</td>
<td>Not applicable</td>
<td></td>
</tr>
<tr>
<td>Flash point</td>
<td>Not applicable</td>
<td></td>
</tr>
<tr>
<td>Evaporation rate</td>
<td>Not applicable</td>
<td></td>
</tr>
<tr>
<td>Flammability (solid, gas)</td>
<td>Not applicable</td>
<td></td>
</tr>
</tbody>
</table>

Flammability Limit in Air

Upper flammability limit: Not applicable
Lower flammability limit: Not applicable

Vapor pressure: Not applicable
Vapor density: Not applicable
Specific Gravity: 4.5
Water solubility: Insoluble
Solubility in other solvents: Not applicable
Partition coefficient: Not applicable
Autoignition temperature: Not applicable
Decomposition temperature: Not applicable
Kinematic viscosity: Not applicable
Dynamic viscosity: Not applicable
Explosive properties: Not applicable
Oxidizing properties: Not applicable

Other Information

Softening point: Not applicable
Molecular weight: Not applicable
VOC Content (%): Not applicable
Density: Not applicable
Bulk density: Not applicable

10. STABILITY AND REACTIVITY

Reactivity
Not applicable

Chemical stability
Stable under normal conditions.

 Possibility of Hazardous Reactions
None under normal processing.
Hazardous polymerization: Hazardous polymerization does not occur.

Conditions to avoid
Dust formation and dust accumulation.

Incompatible materials
Dissolves in hydrofluoric acid, ignites in the presence of fluorine.
When heated above 200°C, reacts exothermically with the following: chlorine, bromine, halocarbons, carbon tetrachloride, carbon tetrafluoride, and freon.
Hazardous Decomposition Products
When product is subjected to welding, burning, melting, sawing, brazing, grinding, buffing, polishing, or other similar heat-generating processes, the following potentially hazardous airborne particles and/or fumes may be generated:
- titanium dioxide an IARC Group 2B carcinogen
- Vanadium pentoxide (V2O5) affects eyes, skin, respiratory system

11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure
Product Information
- Inhalation Not an expected route of exposure for product in massive form.
- Eye contact Not an expected route of exposure for product in massive form.
- Skin Contact May cause sensitization by skin contact.
- Ingestion Not an expected route of exposure for product in massive form.

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>Oral LD50</th>
<th>Dermal LD50</th>
<th>Inhalation LC50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Titanium</td>
<td>&gt; 5000 mg/kg bw</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Aluminum</td>
<td>15,900 mg/kg bw</td>
<td>--</td>
<td>&gt; 1 mg/L</td>
</tr>
<tr>
<td>Vanadium</td>
<td>&gt; 2000 mg/kg bw</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Iron</td>
<td>98,600 mg/kg bw</td>
<td>--</td>
<td>&gt; 0.25 mg/L</td>
</tr>
</tbody>
</table>

Information on toxicological effects
Symptoms May cause sensitization by skin contact.

Delayed and immediate effects as well as chronic effects from short and long-term exposure
Acute toxicity Product not classified.
Skin corrosion/irritation Product not classified.
Serious eye damage/eye irritation Product not classified.
Sensitization May cause sensitization by skin contact.
Germ cell mutagenicity Product not classified.
Carcinogenicity Product not classified.

12. ECOLOGICAL INFORMATION

Ecoxicity
This product contains a chemical which is listed as a severe marine pollutant according to DOT

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>Algae/aquatic plants</th>
<th>Fish</th>
<th>Toxicity to microorganisms</th>
<th>Crustacea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Titanium</td>
<td>The 72 h EC50 of titanium dioxide to Pseudokirchnerella subcapitata was 61 mg of TiO2/L</td>
<td>The 96 h LC50 of titanium dioxide to Cyprinodon variegatus was greater than 10,000 mg of TiO2/L. The 96 h LC50 of titanium dioxide to Pimephales promelas was greater than 1,000 mg of TiO2/L</td>
<td>The 3 h EC50 of titanium dioxide for activated sludge were greater than 1000 mg/L</td>
<td>The 48 h EC50 of titanium dioxide to Daphnia Magna was greater than 1000 mg of TiO2/L</td>
</tr>
<tr>
<td>Aluminum</td>
<td>The 96-h EC50 values for reduction of biomass of Pseudokirchneriella subcapitata in AAP Medium at pH 6, 7, and 8 were estimated as 20.1, 5.4, and 150.6</td>
<td>The 96 h LC50 of aluminium to Oncorhynchus mykiss was 7.4 mg of Al/L at pH 6.5 and 14.6 mg of Al/L at pH 7.5</td>
<td>--</td>
<td>The 48-h LC50 for Ceriodaphnia dubia exposed to Aluminium chloride increased from 0.72 to greater than 99.6 mg/L with water hardness increasing from 25 to 200 mg/L</td>
</tr>
</tbody>
</table>
μg/L, respectively, for dissolved Al

<table>
<thead>
<tr>
<th></th>
<th>72 h EC50 of vanadium pentoxide to Desmodesmus subspicatus was 2,907 ug of V/L</th>
<th>The 96 h LC50 of vanadium pentoxide to Pimephales promelas was 1,850 ug of V/L</th>
<th>The 3 h EC50 of sodium metavanadate for activated sludge was greater than 100 mg/L</th>
<th>The 48 h EC50 of sodium vanadate to Daphnia magna was 2,661 ug of V/L</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vanadium</strong></td>
<td>7440-62-2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Iron</strong></td>
<td>7439-89-6</td>
<td>--</td>
<td>The 96 h LC50 of 50% iron oxide black in water to Danio rerio was greater than 10,000 mg/L</td>
<td>The 3 h EC50 of iron oxide for activated sludge was greater than 10,000 mg/L</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>The 48 h EC50 of iron oxide to Daphnia magna was greater than 100 mg/L</td>
</tr>
</tbody>
</table>

**Persistence and degradability**

**Bioaccumulation**

**Other adverse effects**

### 13. DISPOSAL CONSIDERATIONS

**Waste treatment methods**
- **Disposal of wastes**: Disposal should be in accordance with applicable regional, national and local laws and regulations.
- **Contaminated packaging**: None anticipated.

**Disposal**: Scrap should be recycled whenever possible. Product dusts and fumes from processing operations should also be recycled or classified by a competent environmental professional and disposed of in accordance with applicable federal, state or local regulations.

**Container Cleaning and Disposal**: This product as supplied does not possess characteristics which qualify as hazardous waste. Following processing and use, resulting titanium powders, fines and/or swarf will impact cleaning and disposal and should be evaluated by a competent environmental professional.

### 14. TRANSPORT INFORMATION

**DOT**: Not regulated

### 15. REGULATORY INFORMATION

**International Inventories**
- **TSCA**: Complies
- **DSL/NDSL**: Complies
- **EINECS/ELINCS**: Complies
- **ENCS**: Complies
- **IECSC**: Complies
- **KECL**: Complies
- **PICCS**: Complies
- **AICS**: Complies

**Legend:**
- **TSCA**: United States Toxic Substances Control Act Section 8(b) Inventory
- **DSL/NDSL**: Canadian Domestic Substances List/Non-Domestic Substances List
- **EINECS/ELINCS**: European Inventory of Existing Chemical Substances/European List of Notified Chemical Substances
- **ENCS**: Japan Existing and New Chemical Substances
- **IECSC**: China Inventory of Existing Chemical Substances
- **KECL**: Korean Existing and Evaluated Chemical Substances
- **PICCS**: Philippines Inventory of Chemicals and Chemical Substances
- **AICS**: Australian Inventory of Chemical Substances

**US Federal Regulations**
SARA 313
Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product contains no chemical or chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372:

SARA 311/312 Hazard Categories
- Acute health hazard No
- Chronic health hazard No
- Fire hazard No
- Sudden release of pressure hazard No
- Reactive hazard No

CWA (Clean Water Act)
This product does not contain any substances which are listed as regulated pollutants, pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42)

CERCLA
This material, as supplied, contains none of the substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

US State Regulations
California Proposition 65 - This product contains none of the Proposition 65 chemicals

U.S. State Right-to-Know Regulations

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>New Jersey</th>
<th>Massachusetts</th>
<th>Pennsylvania</th>
</tr>
</thead>
<tbody>
<tr>
<td>Titanium 7440-32-6</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aluminum 7429-90-5</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Vanadium 7440-62-2</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

U.S. EPA Label Information

EPA Pesticide Registration Number Not applicable

16. OTHER INFORMATION

NFPA  Health hazards – 0  Flammability – 0  Instability – 0  Physical and Chemical Properties – n/a

HMIS  Health hazards – 1*  Flammability – 0  Physical Hazards – 0  Personal Protection – X

Chronic Hazard Star Legend  * = Chronic Health Hazard

Note:
The information provided in this safety data sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.