



# TIMETAL HIGH TEMPERATURE TITANIUM ALLOYS

## Safety Data Sheet (SDS)

### Section 1 – Identification

**1(a) Product Identifier used on Label:** TIMETAL High Temperature Titanium Alloys

**1(b) Other means of identification:** TIMETAL 6-2-4-2, TIMETAL 17, TIMETAL 6-2-4-6, TIMETAL 679, TIMETAL 685, TIMETAL 8-1-1, TIMETAL 829, TIMETAL 834, TIMETAL 1100

**1(c) Recommended use of the chemical and restrictions on use:** Steel and alloy productions use, casting, welding, sieving, stamping, forging, extrusion, hot and cold rolling, drawing, cutting, pressing and powder processing.

**1(d) Name, address, and telephone number:**

TIMET  
100 Titanium Way  
Toronto, OH 43964

Phone number : 740-537-5616 and/or 740-537-5672

**1(e) Emergency phone number:** Chemtrec: **1-800-424-9300** (within United States) or + **703-527-3887** (outside United States)

*NOTE: Chemtrec emergency numbers should be used only in the event of chemical emergencies involving spills, leaks, fire, exposure, or in the event of an accident involving chemicals.*

### Section 2 – Hazard(s) Identification

**2(a) Classification of the chemical:** TIMETAL High Temperature Titanium Alloys are considered an article under Reach regulation (REACH REGULATION (EC) No 1907/2006) and is not subject to classification under CLP regulation (REGULATION (EC) No 1272/2008). This Safety Data Sheet is written for Titanium alloys supplied in solid form as articles. To fulfill the requirements of REACH the titanium sponge and alloying substances that are supplied into the EU or manufactured in the EU are registered separately in accordance with their obligated band deadlines.

However, TIMETAL High Temperature Titanium Alloys are not exempt as an article under OSHA's Hazard Communication Standard (29 CFR 1910.1200) due to its downstream use, thus this product is considered a mixture and a hazardous material. Therefore, the categories of Health Hazards as defined in "GLOBALLY HARMONIZED SYSTEM OF CLASSIFICATION AND LABELING OF CHEMICALS (GHS), Third revised edition ST/SG/AC.10/30/Rev. 3" United Nations, New York and Geneva, 2009 have been evaluated. Refer to Section 3, 8 and 11 for additional information.

**2(b) Signal word, hazard statement(s), symbols and precautionary statement(s):**

Hazard Symbol	Hazard Classification	Signal Word	Hazard Statement(s)
	Single Target Organ Toxicity (STOT) Repeat Exposure - 2	<b>Warning</b>	May cause damage to respiratory tract, liver and kidney through prolonged or repeated inhalation exposure.  If converted to small particles during further processing, handling, or by other means, may form combustible dust concentrations in air.
NA	Combustible Dust		

**Precautionary Statement(s):**

Prevention	Response	Storage/Disposal
Do not breathe dusts or fumes.	Get medical advice/attention if you feel unwell.	Dispose of contents in accordance with federal, state and local regulations.

**2(c) Hazards not otherwise classified:** None Known

**2(d) Unknown acute toxicity statement (mixture):** None Known

### Section 3 – Composition/Information on Ingredients

**3(a-c) Chemical name, common name (synonyms), CAS number and other identifiers, and concentration:**

Chemical Name	Alloy	CAS Number	EC Number	% weight
Titanium	All	7440-32-6	231-142-3	82-90
Aluminum	All	7429-90-5	231-072-3	2-8
Tin	TIMETAL 6-2-4-2, 17, 6-2-4-6, 679, 829, 834, 1100	7440-31-5	231-141-8	2-11
Zirconium	TIMETAL 6-2-4-2, 17, 6-2-4-6, 679, 685, 829, 834, 1100	7440-67-7	231-142-3	1-5
Molybdenum	TIMETAL 6-2-4-2, 17, 6-2-4-6, 679	7439-98-7	231-107-2	1-6
Chromium	TIMETAL 17	7440-47-3	231-157-5	0-3
Vanadium	TIMETAL 8-1-1	7440-62-2	231-171-1	0-1

EC - European Community

CAS - Chemical Abstract Service

TIMETAL 828 also has >1% of niobium. These products contain small amounts (<1%) of various chemicals in addition to those listed. These small quantities are frequently referred to as "trace" or "residual" elements that generally originate in the raw materials used. TIMETAL 6-2-4-2 and 679 contains trace amounts of silicon. TIMETAL 17 contains trace amounts of iron. TIMETAL 685, 829 and 1100 contains trace amounts of molybdenum and silicon. TIMETAL 834 contains trace amounts of niobium, molybdenum, silicon and carbon.



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**Section 4 – First-aid Measures**

**4(a) Description of necessary measures:**

- **Inhalation: TIMETAL High Temperature Titanium Alloys** as sold/shipped is not a likely form of exposure. However during further processing (welding, grinding, burning, etc.), if inhaled: Get medical advice/attention if you feel unwell.
- **Eye Contact: TIMETAL High Temperature Titanium Alloys** as sold/shipped is not a likely form of exposure. However during further processing (welding, grinding, burning, etc.), if in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue Rinsing. Get medical advice/attention if you feel unwell.
- **Skin Contact: TIMETAL High Temperature Titanium Alloys** as sold/shipped is not a likely form of exposure. However during further processing (welding, grinding, burning, etc.), Get medical advice/attention if you feel unwell.
- **Ingestion: TIMETAL High Temperature Titanium Alloys** as sold/shipped is not a likely form of exposure. However during further processing (welding, grinding, burning, etc.), if swallowed: Get medical advice/attention if you feel unwell.

**4(b) Most important symptoms/effects, acute and delayed (chronic):**

- **Inhalation: TIMETAL High Temperature Titanium Alloys** as sold/shipped is not likely to present an acute or chronic health effect.
- **Eye: TIMETAL High Temperature Titanium Alloys** as sold/shipped is not likely to present an acute or chronic health effect.
- **Skin: TIMETAL High Temperature Titanium Alloys** as sold/shipped is not likely to present an acute or chronic health effect.
- **Ingestion: TIMETAL High Temperature Titanium Alloys** as sold/shipped is not likely to present an acute or chronic health effect.

However during further processing (welding, grinding, burning, etc.) individual components may illicit an acute or chronic health effect. Refer to Section 11-Toxicological Information.

**4(c) Immediate Medical Attention and Special Treatment: None Known**

**Section 5 – Fire-fighting Measures**

**5(a) Suitable (and unsuitable) Extinguishing Media:** Not Applicable for **TIMETAL High Temperature Titanium Alloys** as sold/shipped. Use extinguishers appropriate for surrounding materials.

**5(b) Specific Hazards arising from the chemical:** Not Applicable for **TIMETAL High Temperature Titanium Alloys** as sold/shipped. When burned, toxic smoke, fume and titanium oxides may be emitted. Titanium dust, fines, turnings and small pieces may ignite more easily under favorable conditions. Finely divided dusts may be explosive. Do not use water; treat as a Class “D” fire.

**5(c) Special protective equipment and precautions for fire-fighters:** Self-contained NIOSH approved respiratory protection and full protective clothing should be worn when fumes and/or smoke from fire are present. Heat and flames cause emittance of acrid smoke and fumes. Do not release runoff from fire control methods to sewers or waterways. Firefighters should wear full face-piece self-contained breathing apparatus and chemical protective clothing with thermal protection. Direct water stream will scatter and spread flames and, therefore, should not be used.

**Section 6 - Accidental Release Measures**

**6(a) Personal Precautions, Protective Equipment and Emergency Procedures:** Not Applicable for **TIMETAL High Temperature Titanium Alloys** as sold/shipped. For spills involving finely divided particles, clean-up personnel should be protected against contact with eyes and skin. If material is in a dry state, avoid inhalation of dust.

**6(b) Methods and materials for containment and clean up:** Not Applicable for **TIMETAL High Temperature Titanium Alloys** as sold/shipped. Collect material in appropriate, labeled containers for recovery or disposal in accordance with federal, state, and local regulations. Follow applicable OSHA regulations (29 CFR 1910.120) and all other pertinent state and federal requirements.

**Section 7 - Handling and Storage**

**7(a) Precautions for safe handling:** Not Applicable for **TIMETAL High Temperature Titanium Alloys** as sold/shipped, however further processing (welding, burning, grinding, etc.) with the potential for generating high concentrations of airborne particulates should be evaluated and controlled as necessary. Do not breathe metal fumes and/or dust. Cut resistant gloves and sleeves should be worn when working with alloys.

**7(b) Conditions for safe storage, including any incompatibilities:** Store away from open flames or sparks.

**Section 8 - Exposure Controls / Personal Protection**

**8(a) Occupational Exposure Limits (OELs):** **TIMETAL High Temperature Titanium Alloys** as sold/shipped in its physical form does not present an inhalation, ingestion or contact hazard, nor would any of the following exposure data apply. However, operations such as burning, welding (high temperature), sawing, brazing, machining, grinding, etc. may produce fumes and/or particulates. The following exposure limits are offered as reference for an experienced industrial hygienist to review.

Ingredients	OSHA PEL <sup>1</sup>	ACGIH TLV <sup>2</sup>	NIOSH REL <sup>3</sup>	IDLH <sup>4</sup>
Titanium	15 mg/m <sup>3</sup> (as TiO <sub>2</sub> , total dust)	10 mg/m <sup>3</sup> (as TiO <sub>2</sub> )	LFC <sup>5</sup> (as TiO <sub>2</sub> )	5,000 mg/m <sup>3</sup> (as TiO <sub>2</sub> )
Aluminum	15 mg/m <sup>3</sup> (total dust, PNOR <sup>6</sup> ) 5.0 mg/m <sup>3</sup> (as respirable fraction, PNOR)	1.0 mg/m <sup>3</sup>	10 mg/m <sup>3</sup> (as total dust) 5.0 mg/m <sup>3</sup> (as respirable dust)	NE
Tin	2.0 mg/m <sup>3</sup> (as inorganic compounds, Sn)	2.0 mg/m <sup>3</sup> (as metal and inorganic compounds, Sn)	2.0 mg/m <sup>3</sup> (also applies to other inorganic tin compounds, as Sn except tin oxides)	100 mg/m <sup>3</sup> (as Sn)



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**Section 8 - Exposure Controls / Personal Protection (continued)**

**8(a) Occupational Exposure Limits (OELs) (continued):**

Ingredients	OSHA PEL <sup>1</sup>	ACGIH TLV <sup>2</sup>	NIOSH REL <sup>3</sup>	IDLH <sup>4</sup>
Zirconium	15 mg/m <sup>3</sup> (as total dust, PNOR) 5.0 mg/m <sup>3</sup> (as respirable fraction, PNOR)	10 mg/m <sup>3</sup> (as Mo insoluble compounds, inhalable fraction <sup>7</sup> ) 3.0 mg/m <sup>3</sup> (as Mo insoluble compounds, respirable fraction <sup>8</sup> ) 0.5 mg/m <sup>3</sup> (as Mo soluble compounds, respirable fraction)	NE	NE
Molybdenum	15 mg/m <sup>3</sup> (as total dust, PNOR) 5.0 mg/m <sup>3</sup> (as respirable fraction, PNOR)	10 mg/m <sup>3</sup> (as Mo insoluble compounds, inhalable fraction) 3.0 mg/m <sup>3</sup> (as Mo insoluble compounds, respirable fraction) 0.5 mg/m <sup>3</sup> (as Mo soluble compounds, respirable fraction)	NE	NE
Chromium	0.5 mg/m <sup>3</sup> (as Cr II & III, inorganic compounds) 1.0 mg/m <sup>3</sup> (as Cr, metal) 0.005 mg/m <sup>3</sup> (as Cr VI, inorganic compounds & certain water insoluble) "AL" 0.0025 mg/m <sup>3</sup> (as Cr VI, inorganic compounds & certain water insoluble)	0.5 mg/m <sup>3</sup> (as Cr III, inorganic compounds) 0.5 mg/m <sup>3</sup> (as Cr, metal) 0.05 mg/m <sup>3</sup> (as Cr VI, inorganic compounds) 0.01 mg/m <sup>3</sup> (as Cr VI, inorganic compounds & certain water insoluble)	0.5 mg/m <sup>3</sup> (as Cr II & III, inorganic compounds) 0.5 mg/m <sup>3</sup> (as Cr, metal) 0.001 mg/m <sup>3</sup> (as Cr VI, inorganic compounds & certain water insoluble)	250 mg/m <sup>3</sup> (as Cr II & metal) 25 mg/m <sup>3</sup> (as Cr III) 15 mg/m <sup>3</sup> (as Cr VI)
Vanadium	"C" 0.5 mg/m <sup>3</sup> (respirable dust, V <sub>2</sub> O <sub>5</sub> )	0.05 mg/m <sup>3</sup> (as inhalable fraction)	"C" 0.05 mg/m <sup>3</sup> (15 min)	35 mg/m <sup>3</sup> (as V)

NE - None Established

1. OSHA Permissible Exposure Limits (PELs) are 8-hour TWA (time-weighted average) concentrations unless otherwise noted. A (C) designation denotes a ceiling limit, which should not be exceeded during any part of the working exposure unless otherwise noted. A Peak is defined as the acceptable maximum peak for a maximum duration above the ceiling concentration for an eight-hour shift. A skin notation refers to the potential significant contribution to the overall exposure by the cutaneous route, either by contact with vapors or, of probable greater significance, by direct skin contact with the substance. A Short Term Exposure Limit (STEL) is defined as a 15-minute exposure, which should not be exceeded at any time during a workday. An Action level (AL) is used by OSHA and NIOSH to express a health or physical hazard. They indicate the level of a harmful or toxic substance/activity, which requires medical surveillance, increased industrial hygiene monitoring, or biological monitoring. Action Levels are generally set at one half of the PEL but the actual level may vary from standard to standard. The intent is to identify a level at which the vast majority of randomly sampled exposures will be below the PEL.
2. Threshold Limit Values (TLV) established by the American Conference of Governmental Industrial Hygienists (ACGIH) are 8-hour TWA concentrations unless otherwise noted. A Short Term Exposure Limit (STEL) is defined as the maximum concentration to which workers can be exposed for a short period of time (15 minutes) for only four times throughout the day with at least one hour between exposures. A "skin" notation refers to the potential significant contribution to the overall exposure by the cutaneous route, either by contact with vapors or, of probable greater significance, by direct skin contact with the substance. ACGIH-TLVs are only recommended guidelines based upon consensus agreement of the membership of the ACGIH. As such, the ACGIH TLVs are for guideline use purposes and are not legal regulatory standards for compliance purposes. The TLVs are designed for use by individuals trained in the discipline of industrial hygiene relative to the evaluation of exposure to various chemical or biological substances and physical agents that may be found in the workplace.
3. The National Institute for Occupational Safety and Health Recommended Exposure Limits (NIOSH-REL) - Compendium of Policy and Statements. NIOSH, Cincinnati, OH (1992). NIOSH is the federal agency designated to conduct research relative to occupational safety and health. As is the case with ACGIH TLVs, NIOSH RELs are for guideline purposes only and as such are not legal, regulatory limits for compliance purposes.
4. The "immediately dangerous to life or health air concentration values (IDLHs)" are used by NIOSH as part of the respirator selection criteria and were first developed in the mid-1970's by NIOSH. The Documentation for Immediately Dangerous to Life or Health Concentrations (IDLHs) is a compilation of the rationale and sources of information used by NIOSH during the original determination of 387 IDLHs and their subsequent review and revision in 1994.
5. LFC – Lowest Feasible Concentration. Refer to Section 11, Toxicological Information.
6. PNOR (Particulates Not Otherwise Regulated). All inert or nuisance dusts, whether mineral, inorganic, or organic, not listed specifically by substance name are covered by a limit which is the same as the inert or nuisance dust limit of 15 mg/m<sup>3</sup> for total dust and 5 mg/m<sup>3</sup> for the respirable fraction.
7. Inhalable fraction. The concentration of inhalable particulate for the application of this TLV is to be determined from the fraction passing a size-selector with the characteristics defined in the ACGIH 2013 TLVs<sup>®</sup> and BEIs<sup>®</sup> (Biological Exposure Indices) Appendix D, paragraph A.
8. Respirable fraction. The concentration of respirable dust for the application of this limit is to be determined from the fraction passing a size-selector with the characteristics defined in ACGIH 2013 TLVs<sup>®</sup> and BEIs<sup>®</sup> Appendix D, paragraph C.

**8(b) Appropriate Engineering Controls:** Use controls as appropriate to minimize exposure to metal fumes and dusts during handling operations. Provide general or local exhaust ventilation systems to minimize airborne concentrations. Local exhaust is necessary for use in enclosed or confined spaces. Provide sufficient general/local exhaust ventilation in pattern/volume to control inhalation exposures below current exposure limits.

**8(c) Individual Protection Measures:**

- **Respiratory Protection:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, use only a NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. Concentration in air of the various contaminants determines the extent of respiratory protection needed. Half-face, negative-pressure, air-purifying respirator equipped with P100 filter is acceptable for concentrations up to 10 times the exposure limit. Full-face, negative-pressure, air-purifying respirator equipped with P100 filter is acceptable for concentrations up to 50 times the exposure limit. Protection by air-purifying negative-pressure and powered air respirators is limited. Use a positive-pressure-demand, full-face, supplied air respirator or self-contained breathing apparatus (SCBA) for concentrations above 50 times the exposure limit. If exposure is above the IDLH (Immediately dangerous to life or health) for any of the constituents, or there is a possibility of an uncontrolled release or exposure levels are unknown, then use a positive-demand, full-face, supplied air respirator with escape bottle or SCBA.

**Warning!** Air-purifying respirators both negative-pressure, and powered-air do not protect workers in oxygen-deficient atmospheres.



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**Section 8 - Exposure Controls / Personal Protection (continued)**

**8(c) Individual Protection Measures (continued):**

- **Eyes:** Wear appropriate eye protection to prevent eye contact. For operations which result in elevating the temperature of the product to or above its melting point or result in the generation of airborne particulates, use safety glasses to prevent eye contact. Contact lenses should not be worn where industrial exposures to this material are likely. Use safety glasses or goggles as required for welding, burning, sawing, brazing, grinding or machining operations.
- **Skin:** Wear appropriate personal protective clothing to prevent skin contact. Cut resistant gloves and sleeves should be worn when working with products. For operations which result in elevating the temperature of the product to or above its melting point or result in the generation of airborne particulates, use protective clothing, and gloves to prevent skin contact. Protective gloves should be worn as required for welding, burning or handling operations. Contaminated work clothing must not be allowed out of the workplace.
- **Other protective equipment:** An eyewash fountain and deluge shower should be readily available in the work area.

**Section 9 - Physical and Chemical Properties**

- |   |  |
|---|--|
| <b>9(a) Appearance (physical state, color, etc.):</b> Solid metal | <b>9(j) Upper/lower Flammability or Explosive Limits:</b> NA |
| <b>9(b) Odor:</b> Odorless  | <b>9(k) Vapor Pressure:</b> NA                               |
| <b>9(c) Odor Threshold:</b> NA                                    | <b>9(l) Vapor Density (Air = 1):</b> NA                      |
| <b>9(d) pH:</b> NA  | <b>9(m) Relative Density:</b> 5-6 (H <sub>2</sub> O = 1)     |
| <b>9(e) Melting Point/Freezing Point:</b> >2800°F                 | <b>9(n) Solubility(ies):</b> Water Insoluble                 |
| <b>9(f) Initial Boiling Point and Boiling Range:</b> ND           | <b>9(o) Partition Coefficient n-octanol/water:</b> ND        |
| <b>9(g) Flash Point:</b> NA                                       | <b>9(p) Auto-ignition Temperature:</b> NA                    |
| <b>9(h) Evaporation Rate:</b> NA                                  | <b>9(q) Decomposition Temperature:</b> ND                    |
| <b>9(i) Flammability (solid, gas):</b> Non-flammable              | <b>9(r) Viscosity:</b> NA                                    |
- NA - Not Applicable  
ND - Not Determined for product as a whole

**Section 10 - Stability and Reactivity**

- 10(a) Reactivity:** Not Determined (ND) for product in a solid form. Do not use water on molten metal.
- 10(b) Chemical Stability:** Stable under normal storage and handling conditions.
- 10(c) Possibility of hazardous reaction:** None Known
- 10(d) Conditions to Avoid:** Storage with strong acids or calcium hypochlorite.
- 10(e) Incompatible Materials:** Molten metal may react violently with water. Contact with water or steam above 704°C also will cause a violent reaction.
- 10(f) Hazardous Decomposition Products:** Thermal oxidative decomposition of product can produce fumes containing metal oxides.

**Section 11 - Toxicological Information**

**11 Information on toxicological effects:** The following toxicity data has been determined for **TIMETAL High Temperature Titanium Alloys** when further processed using the information available for its components applied to the guidance on the preparation of an SDS under the GHS requirements of OSHA and the EU CPL:

Hazard Classification	Hazard Category		Hazard Symbols	Signal Word	Hazard Statement
	EU	OSHA			
<b>STOT following Repeated Exposure</b> (covers Categories 1 & 2)	NA*	2 <sup>j</sup>		<b>Warning</b>	May cause damage to respiratory tract, liver and kidney through prolonged or repeated inhalation exposure.

\* Not Applicable - These products are considered articles under Reach regulation (REACH REGULATION (EC) No 1907/2006) and are not subject to classification under CLP regulation (REGULATION (EC) No 1272/2008).

Toxicological data listed below are presented regardless to classification criteria. Individual hazard classification categories where the toxicological information has met or exceeded a classification criteria threshold are listed above.

- a. No LC<sub>50</sub> or LD<sub>50</sub> has been established for **TIMETAL High Temperature Titanium Alloys**. The following data has been determined for the components:
- |  |  |
|--|--|
| • <b>Titanium Dioxide:</b> LD <sub>50</sub> > 10,000 mg/kg (Oral/Rat); LC <sub>50</sub> > 6.82 mg/l (Inhalation/Rat) | • <b>Zirconium:</b> Rat LD <sub>50</sub> > 5000 mg/kg (powder)<br>Rat LD <sub>50</sub> > 9000 mg/kg (NLM Toxnet) |
| • <b>Aluminum:</b> Rat LD <sub>50</sub> > 15.9 g/kg (REACH)  | • <b>Vanadium Pentoxide:</b> LD <sub>50</sub> = 145 mg/kg (Oral/Mouse)   |
| • <b>Tin:</b> Rat LD <sub>50</sub> > 2000 mg/kg (REACH)<br>Rat (dust) LC <sub>50</sub> > 4.75 mg/L (REACH)           |  |
- b. No Skin (Dermal) Irritation data available for **TIMETAL High Temperature Titanium Alloys** as a as a mixture as a as a mixture. The following Skin (Dermal) Irritation information was found for the components:
- **Molybdenum:** May cause skin irritation.



## Section 11 - Toxicological Information (continued)

### 11 Information on toxicological effects (continued):

- c. No Eye Irritation data available for **TIMETAL High Temperature Titanium Alloys** as a mixture. The following Eye Irritation information was found for the components:
- **Vanadium Pentoxide:** Rabbit Draize - Corrosive.
- d. No Skin (Dermal) Sensitization data available for **TIMETAL High Temperature Titanium Alloys** as a mixture or its components.
- e. No Respiratory Sensitization data available for **TIMETAL High Temperature Titanium Alloys** as a mixture or its components.
- f. No Germ Cell Mutagenicity data available for **TIMETAL High Temperature Titanium Alloys** as a mixture. The following Mutagenicity and Genotoxicity information was found for the components:
- **Aluminum:** IUCLID; ATSDR have found this ingredient is not mutagenic *in vitro*; but has marginal effects *in vivo*.
- g. Carcinogenicity: IARC, NTP, and OSHA do not list **TIMETAL High Temperature Titanium Alloys** as carcinogens. The following Carcinogenicity information was found for the components:
- **Welding Fumes** - IARC Group 2B carcinogen, a mixture that is possibly carcinogenic to humans.
  - **Titanium Dioxide** - According to the experimental studies and reviewed IUCLID toxicological data, Rats (but not mice) exposed to ultrafine TiO<sub>2</sub> particles at 10 mg/m<sup>3</sup> developed lung tumors; probably results from inhibited particle clearance from lung. Titanium and titanium compounds, for the most part, have been considered virtually inert and not highly toxic to man. Titanium dioxide has recently been considered a potential occupational carcinogen based on inhalation studies on rats. Results indicated increases in bronchioloalveolar adenomas and squamous cell carcinomas. As a result, NIOSH recommends exposure to titanium dioxide be reduced to the lowest feasible concentration (LFC).
  - **Chromium (as metal and trivalent chromium compounds)** – IARC Group 3 carcinogens, not classifiable as to their human carcinogenicity.
  - **Vanadium Pentoxide:** IARC - 2B, ACGIH - Animal carcinogen A-4. 104 wk Rat inhalation carcinogenicity - some evidence of lung neoplasms in males. 104 wk Mouse inhalation carcinogenicity - clear evidence of carcinogenicity.
- h. No Toxic Reproduction data available for **TIMETAL High Temperature Titanium Alloys** as a mixture. The following Toxic Reproductive information was found for the components:
- **Vanadium Pentoxide:** Mouse 3 mo inhalation decreases in epididymal sperm motility. Rat 3 mo inhalation no effects in males increase in estrous in females (REACH and NTP).
- i. No Specific Target Organ Toxicity (STOT) following a Single Exposure data available for **TIMETAL High Temperature Titanium Alloys** as a mixture. The following STOT following a Single Exposure data was found for the components:
- **Aluminum:** Repeated exposure associated with Asthma, fibrosis in lungs and encephalopathy in humans.
  - **Vanadium Pentoxide:** Kidney, lung, and thorax cardiac rate increased.
- j. No Specific Target Organ Toxicity (STOT) following Repeated Exposure data was available for **TIMETAL High Temperature Titanium Alloys** as a whole. The following STOT following Repeated Exposure data was found for the components:
- **Titanium Dioxide:** Inflammatory lesions in rat lungs produced by 3-month exposures to either 22.3 mg/m<sup>3</sup> of ultrafine TiO<sub>2</sub>; lesions “regressed” during a 1-year period following cessation of exposure.
  - **Aluminum:** Reviews have found chronic exposure to aluminum flake has been reported to cause pneumoconiosis in workers. Repeat oral exposure to aluminum results in decrements in neurobehavioral function and development.
  - **Vanadium Pentoxide:** Rat 90 da feeding LOEL 3 mg/kg based on erythropenia, anemia in all groups. Rat 16 da inhalation LOEC = 2 mg/m<sup>3</sup> based on survival and inflammation in Lung (NTP Study). Rat 90 da inhalation NOAEC 1 mg/m<sup>3</sup> based on lung effects (NTP and REACH).

The above toxicity information was determined from available scientific sources to illustrate the prevailing posture of the scientific community. The scientific resources includes: The American Conference of Governmental Industrial Hygienist (ACGIH) Documentation of the Threshold Limit Values (TLVs) and Biological Exposure indices (BEIs) with Other Worldwide Occupational Exposure Values 2009, The International Agency for Research on Cancer (IARC), The National Toxicology Program (NTP) updated documentation, the World Health Organization (WHO) and other available resources, the International Uniform Chemical Information Database (IUCLID), European Union Risk Assessment Report (EU-RAR), Concise International Chemical Assessment Documents (CICAD), European Union Scientific Committee for Occupational Exposure Limits (EU-SCOEL), Agency for Toxic Substances and Disease Registry (ATSDR), Hazardous Substance Data Bank (HSDB), and International Programme on Chemical Safety (IPCS).

The following health hazard information is provided regardless to classification criteria and is based on the individual component(s) and potential resultant components from further processing:

#### Acute Effects:

- **Inhalation:** Excessive exposure to high concentrations of metal dust may cause irritation to the eyes, skin and mucous membranes of the upper respiratory tract. Excessive inhalation of fumes of freshly formed metal oxide particles sized below 1.5 micrometer and usually between 0.02-0.05 micrometers from many metals can produce an acute reaction known as “metal fume fever”. Symptoms consist of chills and fever (very similar to and easily confused with flu symptoms), metallic taste in the mouth, dryness and irritation of the throat followed by weakness and muscle pain. The symptoms come on in a few hours after excessive exposures and usually last from 12 to 48 hours. Long-term effects from metal fume fever have not been noted.
- **Eye:** Excessive exposure to high concentrations of metal dust may cause irritation to the eyes.
- **Skin:** Skin contact with metal dusts may cause irritation or sensitization, possibly leading to dermatitis. Skin contact with metallic fumes and dusts may cause physical abrasion.
- **Ingestion:** Ingestion of harmful amounts of this product as distributed is unlikely due to its solid insoluble form. Ingestion of metal dust may cause nausea or vomiting.

#### Acute Effects by component:

- **Titanium and titanium dioxides:** Not Reported / Not Classified
- **Aluminum and aluminum oxides:** Not Reported / Not Classified
- **Tin and tin oxides:** Not Reported / Not Classified



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### Section 11 - Toxicological Information (continued)

#### Acute Effects by component (continued):

- **Zirconium and zirconium oxides:** Zirconium *per se* has not been shown an irritant to skin and eyes but metal dust in eyes may result in a mechanical irritation. While no adverse toxicology has been reported at this time, respiration and eye contact of these dusts should be minimized by appropriate workplace measures.
- **Molybdenum and molybdenum oxides:** Molybdenum causes skin and eye irritation. Molybdenum oxide is toxic if swallowed, and causes eye irritation.
- **Chromium, chromium oxides and hexavalent chrome:** Hexavalent chrome causes damage to gastrointestinal tract, lung, severe skin burns and eye damage, serious eye damage, skin contact may cause an allergic skin reaction. Inhalation may cause allergic or asthmatic symptoms or breathing difficulties.
- **Vanadium and vanadium Pentoxide:** Vanadium oxide is fatal if swallowed or inhaled, and may be harmful in contact with skin.

#### Delayed (chronic) Effects by component:

- **Titanium and titanium dioxides:** Titanium Oxide accumulates in the lungs – and over time mostly in alveoli and macrophages. Exposure by inhalation route should be reduced to lowest levels to reduce accumulation in lungs. This accumulation is apparently responsible for carcinogenesis in rats only (no such response in mouse or hamster).
- **Aluminum and Aluminum oxides:** Chronic inhalation of finely divided powder has been reported to cause pulmonary fibrosis and emphysema. Repeated skin contact has been associated with bleeding into the tissue, delayed hypersensitivity and granulomas. Chronic exposure to aluminum flake has been reported to cause pneumoconiosis in workers. Repeat oral exposure to aluminum results in decrements in neurobehavioral function and development.
- **Tin and tin oxides:** No systemic effects have been reported from industrial exposure to tin. Occupational exposures to tin can cause a benign pneumoconiosis termed ‘stannosis’. No cases of massive fibrosis from over-exposure to tin have been reported.
- **Zirconium and zirconium oxides:** Zirconium metal dusts will accumulate in lungs on repeated dosing.
- **Molybdenum and molybdenum oxides:** Certain handling operations, such as burning and welding, may generate both insoluble molybdenum compounds (metal and molybdenum dioxide) and soluble molybdenum compounds (molybdenum trioxide). Molybdenum compounds generally exhibit a low order of toxicity with the trioxide the more toxic. However, some reports indicate that the dust of the molybdenum metal, molybdenum dioxide and molybdenum trioxide may cause eye, skin, nose and throat irritation in animals. Also has been reported to cause induction of tumors in experimental animals, suspected of causing cancer. Molybdenum oxide is suspected of causing cancer in humans.
- **Chromium, chromium oxides and hexavalent chromium:** The health hazards associated with exposure to chromium are dependent upon its oxidation state. The metal form (chromium as it exists in this product) is of very low toxicity. The hexavalent form is very toxic. Repeated or prolonged exposure to hexavalent chromium compounds may cause respiratory irritation, nosebleed, ulceration and perforation of the nasal septum. Industrial exposure to certain forms of hexavalent chromium has been related to an increased incidence of cancer. NTP (The National Toxicology Program) Fourth Annual report on Carcinogens cites “certain Chromium compounds” as human carcinogens. ACGIH has reviewed the toxicity data and concluded that chromium metal is not classifiable as a human carcinogen. Hexavalent chromium may cause genetic defects and is suspected of damaging the unborn child. Developmental toxicity in the mouse, suspected of damaging fertility or the unborn child.
- **Vanadium and Vanadium Pentoxide:** Vanadium is considered non-toxic. Excessive long term or repeated exposures to vanadium compounds, especially vanadium pentoxide, may result in chronic pulmonary changes such as emphysema or bronchitis. Vanadium pentoxide is suspected of damaging fertility or the unborn child. Vanadium pentoxide is fatal if swallowed or inhaled. It causes damage to lungs by single, repeated or prolonged exposure.

### Section 12 - Ecological Information

**12(a) Ecotoxicity (aquatic & terrestrial):** No Data Available for **TIMETAL High Temperature Titanium Alloys** as sold/shipped. However, individual components of the product when processed have been found to be toxic to the environment. Metal dusts may migrate into soil and groundwater and be ingested by wildlife.

**12(b) Persistence & Degradability:** No Data Available for **TIMETAL High Temperature Titanium Alloys** as sold/shipped or individual components.

**12(c) Bioaccumulative Potential:** No Data Available for **TIMETAL High Temperature Titanium Alloys** as sold/shipped or individual components.

**12(d) Mobility (in soil):** No data available for **TIMETAL High Temperature Titanium Alloys** as sold/shipped. However, individual components of the product have been found to be absorbed by plants from soil.

**12(e) Other adverse effects:** None Known

#### Additional Information:

**Hazard Category:** Not Reported

**Signal Word:** No Signal Word

**Hazard Symbol:** No Symbol

**Hazard Statement:** No Statement

### Section 13 - Disposal Considerations

**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.

**Please note this information is for TIMETAL High Temperature Titanium Alloys in its original form. Any alterations can void this information.**



# TIMETAL HIGH TEMPERATURE ALLOYS

## Safety Data Sheet (SDS)

### Section 14 - Transport Information

**14 (a-g) Transportation Information:**

US Department of Transportation (DOT) under 49 CFR 172.101 does not regulate **TIMETAL High Temperature Titanium Alloys** as a hazardous material. All federal, state, and local laws and regulations that apply to the transport of this type of material must be adhered to.

Shipping Name: Not Applicable (NA) Shipping Symbols: NA Hazard Class: NA UN No.: NA Packing Group: NA DOT/IMO Label: NA Special Provisions (172.102): NA	<b>Packaging Authorizations</b> a) Exceptions: NA b) Group: NA c) Authorization: NA	<b>Quantity Limitations</b> a) Passenger, Aircraft, or Railcar: NA b) Cargo Aircraft Only: NA <b>Vessel Stowage Requirements</b> a) Vessel Stowage: NA b) Other: NA DOT Reportable Quantities: NA
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International Maritime Dangerous Goods (IMDG) and the Regulations Concerning the International Carriage of Dangerous Goods by Rail (RID) classification, packaging and shipping requirements follow the US DOT Hazardous Materials Regulation.

Regulations Concerning the International Carriage of Dangerous Goods by Road (ADR): does not regulate **TIMETAL High Temperature Titanium Alloys** as a hazardous material.

Shipping Name: Not Applicable (NA) Classification Code: NA UN No.: NA Packing Group: NA ADR Label: NA Special Provisions: NA Limited Quantities: NA	<b>Packaging</b> a) Packing Instructions: NA b) Special Packing Provisions: NA c) Mixed Packing Provisions: NA	<b>Portable Tanks &amp; Bulk Containers</b> a) Instructions: NA b) Special Provisions: NA
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International Air Transport Association (IATA) does not regulate **TIMETAL High Temperature Titanium Alloys** as a hazardous material.

Shipping Name: Not Applicable (NA) Class/Division: NA Hazard Label (s): NA UN No.: NA Packing Group: NA Excepted Quantities (EQ): NA	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th colspan="2" style="text-align: center; padding: 2px;">Passenger &amp; Cargo Aircraft Limited Quantity (EQ)</th> </tr> <tr> <td style="padding: 2px;">Pkg Inst: NA</td> <td style="padding: 2px;">Pkg Inst: NA</td> </tr> <tr> <td style="padding: 2px;">Max Net Qty/Pkg: NA</td> <td style="padding: 2px;">Max Net Qty/Pkg: NA</td> </tr> </table>	Passenger & Cargo Aircraft Limited Quantity (EQ)		Pkg Inst: NA	Pkg Inst: NA	Max Net Qty/Pkg: NA	Max Net Qty/Pkg: NA	<b>Cargo Aircraft Only</b> Pkg Inst: NA  Max Net Qty/Pkg: NA	<b>Special Provisions:</b> NA  <b>ERG Code:</b> NA
Passenger & Cargo Aircraft Limited Quantity (EQ)									
Pkg Inst: NA	Pkg Inst: NA								
Max Net Qty/Pkg: NA	Max Net Qty/Pkg: NA								

Pkg Inst – Packing Instructions      Max Net Qty/Pkg – Maximum Net Quantity per Package      ERG – Emergency Response Drill Code

**Transport Dangerous Goods (TDG) Classification:** **TIMETAL High Temperature Titanium Alloys** does not have a TDG classification.

### Section 15 - Regulatory Information

**Regulatory Information:** *The following listing of regulations relating to a TIMETAL product may not be complete and should not be solely relied upon for all regulatory compliance responsibilities.*

This product, **TIMETAL Alloys**, and/or its constituents are subject to the following regulations:

**OSHA Regulations:** Air Contaminant (29 CFR 1910.1000, Table Z-1, Z-2, Z-3): The product, **TIMETAL High Temperature Titanium Alloys** as a whole is not listed. However, individual components of the product are listed: Refer to Section 8, Exposure Controls and Personal Protection.

**EPA Regulations:** The product, **TIMETAL High Temperature Titanium Alloys** is not listed as a whole. However, individual components of the product are listed:

Components	Regulations
Aluminum	SARA 313
Chromium	CERCLA, CWA, SARA 313, RCRA, SDWA

**SARA 311/312 Potential Hazard Categories:** Immediate Acute Health Hazard; Delayed Chronic Health Hazard

**Regulations Key:**

CAA CERCLA CWA RCRA SARA TSCA SDWA	Clean Air Act (42 USC Sec. 7412; 40 CFR Part 61 [As of: 8/18/06]) Comprehensive Environmental Response, Compensation and Liability Act (42 USC Secs. 9601(14), 9603(a); 40 CFR Sec. 302.4, Table 302.4, Table 302.4 and App. A) Clean Water Act (33 USC Secs. 1311; 1314(b), (c), (e), (g); 136(b), (c); 137(b), (c) [as of 8/2/06]) Resource Conservation Recovery Act (42 USC Sec. 6921; 40 CFR Part 261 App VIII) Superfund Amendments and Reauthorization Act of 1986 Title III Section 302 Extremely Hazardous Substances (42 USC Secs. 11023, 13106; 40 CFR sec. 372.65) and Section 313 Toxic Chemicals (42 USC Secs. 11023, 13106; 40 CFR Sec. 372.65 [as of 6/30/05]) Toxic Substance Control Act (15 U.S.C. s/s 2601 et seq. [1976]) Safe Drinking Water Act (42 U.S.C. s/s 300f et seq. [1974])
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**TIMETAL HIGH TEMPERATURE ALLOYS**  
Safety Data Sheet (SDS)

**Section 15 - Regulatory Information (continued)**

**EPA Regulations (continued):**

**Section 313 Supplier Notification:** The product, **TIMETAL High Temperature Titanium Alloys** contains the following toxic chemicals subject to the reporting requirements of section 313 of the Emergency Planning and Community Right-to-Know Act and 40 CFR part 372:

CAS #	Chemical Name	Percent by Weight
7429-90-5	Aluminum	8 % max
7440-47-3	Chromium	3% max

**State Regulations:** The product, **TIMETAL High Temperature Titanium Alloys** as a whole are not listed in any state regulations. However, individual components of the product are listed in various state regulations:

Pennsylvania Right to Know: Contains regulated material in the following categories:

- Hazardous Substances: Titanium, Aluminum, Tin, Molybdenum, Chromium, Vanadium and Zirconium
- Environmental Hazards: Titanium, Aluminum, Vanadium, Vanadium and Copper
- Special Hazards: Chromium

California Prop. 65: Chromium (compounds) contain elements known to the State of California to cause cancer or reproductive toxicity.

New Jersey: Contains regulated material in the following categories:

- Hazardous Substance: Titanium, Aluminum, Tin, Molybdenum, Vanadium, Chromium, Vanadium and Zirconium
- Environmental Hazards: Titanium, Chromium and Vanadium
- Special Hazards: Aluminum (dust and fume) and Chromium

Minnesota: Titanium, Tin and Molybdenum

Massachusetts: Titanium, Aluminum, Tin, Zirconium, Molybdenum, Chromium and Vanadium

**Other Regulations:**

**WHMIS Classification (Canadian):** The product, **TIMETAL High Temperature Titanium Alloys** is not listed as a whole. However individual components are listed.

Ingredients	WHMIS Classification
Molybdenum	B4, D2B
Vanadium	D3B
Tin	D2B

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the SDS contains all the information required by the Controlled Products Regulations.

**Section 16 - Other Information**

**Prepared By:** AM Health and Safety, Inc., rev by TIMET.

**Original Issue Date:** 3/1/2008

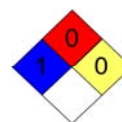
**Revised Date:** 10/03/2104

**Additional Information:**

**Hazardous Material Identification System (HMIS) Classification**

<b>Health Hazard</b>	<b>1</b>
<b>Fire Hazard</b>	<b>0</b>
<b>Physical Hazard</b>	<b>0</b>

**National Fire Protection Association (NFPA)**



HEALTH= 1, Denotes possible chronic hazard if airborne dusts or fumes are generated, irritation or minor reversible injury possible.

FIRE= 0, Materials that will not burn.

PHYSICAL HAZARD= 0, Materials that are normally stable, even under fire conditions, and will not react with water, polymerize, decompose, condense, or self-react. Non-explosives.

HEALTH = 1, Exposure could cause irritation but only minor residual injury even if no treatment is given.

FLAMMABILITY = 0, Materials that will not burn.

INSTABILITY = 0, Normally stable, even under fire exposure conditions, and are not reactive with water.

**ABBREVIATIONS/ACRONYMS:**

<b>ACGIH</b>	American Conference of Governmental Industrial Hygienists	<b>NIF</b>	No Information Found
<b>BEIs</b>	Biological Exposure Indices	<b>NIOSH</b>	National Institute for Occupational Safety and Health
<b>CAS</b>	Chemical Abstracts Service	<b>NTP</b>	National Toxicology Program
<b>CERCLA</b>	Comprehensive Environmental Response, Compensation, and Liability Act	<b>ORC</b>	Organization Resources Counselors
<b>CFR</b>	Code of Federal Regulations	<b>OSHA</b>	Occupational Safety and Health Administration
<b>CNS</b>	Central Nervous System	<b>PEL</b>	Permissible Exposure Limit
<b>GI, GIT</b>	Gastro-Intestinal, Gastro-Intestinal Tract	<b>PNOR</b>	Particulate Not Otherwise Regulated
<b>HMIS</b>	Hazardous Materials Identification System	<b>PNOC</b>	Particulate Not Otherwise Classified
<b>IARC</b>	International Agency for Research on Cancer	<b>PPE</b>	Personal Protective Equipment
<b>LC50</b>	Median Lethal Concentration	<b>ppm</b>	parts per million





**TIMETAL HIGH TEMPERATURE ALLOYS**  
Safety Data Sheet (SDS)

**Section 16 - Other Information (continued)**

**ABBREVIATIONS/ACRONYMS (continued):**

<b>LD50</b>	Median Lethal Dose	<b>RCRA</b>	Resource Conservation and Recovery Act
<b>LD<sub>Lo</sub></b>	Lowest Dose to have killed animals or humans	<b>RTECS</b>	Registry of Toxic Effects of Chemical Substances
<b>LEL</b>	Lower Explosive Limit	<b>SARA</b>	Superfund Amendment and Reauthorization Act
<b>LOEL</b>	Lowest Observed Effect Level	<b>SCBA</b>	Self-contained Breathing Apparatus
<b>LOAEC</b>	Lowest Observable Adverse Effect Concentration	<b>SDS</b>	Safety Data Sheet
<b>µg/m<sup>3</sup></b>	microgram per cubic meter of air	<b>STEL</b>	Short-term Exposure Limit
<b>mg/m<sup>3</sup></b>	milligram per cubic meter of air	<b>TLV</b>	Threshold Limit Value
<b>mppcf</b>	million particles per cubic foot	<b>TWA</b>	Time-weighted Average
<b>MSHA</b>	Mine Safety and Health Administration	<b>UEL</b>	Upper Explosive Limit
<b>NFPA</b>	National Fire Protection Association		

**Disclaimer:** Individuals handling this product should be informed of the recommended safety precautions and should have access to this information. This information relates to the specific material designed and may not be valid for such material used in combination with any other materials or in any other processes. Such information is to the best of our knowledge and belief, accurate and reliable as of the date compiled. However, no representation, warranty or guarantee is made as to its accuracy, reliability or completeness. It is the user's completeness of such information for their own particular use. We do not accept liability for any loss or damage that may occur from the use of this information nor do we offer warranty against patent infringement.

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