This Material 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 tonnage band deadlines.

Material Safety Data Sheet
TIMETAL ALLOYS - 6-4, 6-4 ELI, 230, 3-2.5, 5111

MANUFACTURER
TIMET
100 Titanium Way
Toronto, Ohio 43964
(740) 537-5616

24-Hour *Emergency* Telephone Numbers

Within the United States	*Outside the United States*
Chemtrec: 1-800-424-9300	Chemtrec: + 703-527-3887

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.

All non-emergency questions should be directed to 740-537-5672 for assistance.

Date Issued: 3/10/08, rev 1 11/25/13	**MSDS Prepared By:** **AM Health and Safety, Inc**

Section I – PRODUCT IDENTIFICATIONS

CHEMICAL NAME: Titanium containing alloying elements Al, V, Cu, Sn, and Zr	**CHEMICAL FAMILY:** Metal alloys
TRADE NAMES: TIMETAL 6-4, TIMETAL 6-4 ELI, TIMETAL 230, TIMETAL 3-2.5, TIMETAL 5111	**FORMULA:** These titanium alloys all contain titanium, aluminum and other metals. The hazardous constituents for which concentrations meet or exceed 1% are given below for each alloy.

Section II – CHEMICAL COMPOSITIONS

HAZARDOUS CONSTITUENTS FOR WHICH PELs or TLVs EXIST		ALLOYS	PERCENT	CAS NUMBER	EXPOSURE LIMITS (mg/m^3)	
					OSHA[1] PEL	ACGIH[2] TLV
Element	**PEL/ TLV Established for**					
Titanium	Titanium dioxide, as Ti	All	90-98	13463-67-7	15	10
Aluminum	Aluminum metal and oxide (total dust and respirable fraction)	TIMETAL 6-4, 6-4 ELI 3-2.5, 5111,	3-6	7429-90-5	15 - Total dust, 5 - Respirable fraction	10 - Metal dust, 5 - Welding fume
Vanadium	Vanadium pentoxide (V_2O_5) respirable dust and fume	TIMETAL 6-4, 6-4 ELI 3-2.5, 5111	2-4	1314-62-1	0.05	0.05

Section II – CHEMICAL COMPOSITIONS (continued)

HAZARDOUS CONSTITUENTS FOR WHICH PELs or TLVs EXIST		ALLOYS	PERCENT	CAS NUMBER	EXPOSURE LIMITS (mg/m^3)	
					OSHA[1] PEL	ACGIH[2] TLV
Element	**PEL/ TLV Established for**					
Copper	Copper dust and fume	TIMETAL 230	0-3	7440-50-8	0.1 (fume) 1.0 (dust)	0.2 (fume) 1 (dust)
Tin	Tin, tin oxide and inorganic compounds, except Sn H_4 as Sn	TIMETAL 5111	0-2	7440-31-5	2	2
Zirconium	Zirconium compounds as Zr	TIMETAL 5111	0-1	7440-67-7	5 PEL 10 STEL	5 TWA 10 STEL

SUMMARY: 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 6-4 ELI contains trace amounts of oxygen.

NOTE: No permissible exposure limits (PELs) or threshold limit values (TLVs) exist for these specific alloys. Values shown are applicable to component elements. Various combinations of the above components may appear in grades supplied. More specific information on a particular grade may be obtained from the specific heat certification or by contacting TIMET.

[1] OSHA Permissible Exposure Limits (PELs) are 8-hour Time-Weighted Average (TWA) concentrations unless otherwise noted.

[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 a 15-minute TWA exposure that should not be exceeded at any time during a workday, even if the 8-hour TWA is within the TLV-TWA.

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

TIMET does not consider this product, in the solid form that it is sold, to constitute a physical or health hazard. However, operations such as abrading, burning, welding, sawing, brazing, grinding, cutting, polishing, and machining that results in the creation of dust or elevated temperatures may cause eye, skin, and respiratory tract irritation.

Section III – HAZARDS IDENTIFICATION

PRIMARY ENTRY ROUTES		**TIMET does not consider this product, in the solid form that it is sold, to constitute a physical or health hazard.** However, operations such as abrading, burning, welding, sawing, brazing, grinding, cutting, polishing, and machining that results in the creation of dust or elevated temperatures may cause eye, skin, and respiratory tract irritation. Entry Routes for Dust: Inhalation, Skin, Eye NOTE: Ingestion for Copper & Vanadium
TARGET ORGANS		Target Organs for Dust - Respiratory System, Skin, Eyes, NOTE: Liver and Kidney (increased risk with Wilson's Disease) for Copper
EFFECTS OF OVEREXPOSURE	ACUTE	EYES: Dust may cause mechanical irritation. DERMAL: Dust may cause mechanical irritation. Copper and vanadium are skin irritants. INHALATION: Excessive exposure to high concentrations of dust may cause irritation to the mucous membranes of the upper respiratory tract. Excessive inhalation of fumes of freshly formed metal oxide particles sized below 1.5 microns and usually between 0.02-0.05 microns 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. Titanium dioxide may cause pulmonary fibrosis and permanent damage. Vanadium Pentoxide may cause green tongue, metallic taste, eczema, cough, fine rales, wheezing, bronchitis, and dyspnea (breathing difficulty). INGESTION: Ingestion of harmful amounts of this product as distributed is unlikely due to its solid insoluble form. Ingestion of dust may cause nausea or vomiting.

Section III – HAZARDS IDENTIFICATION (continued)		
EFFECTS OF OVEREXPOSURE (Continued)	CHRONIC	Titanium Dioxide: The signs and symptoms of chronic exposure to titanium dioxide include X-ray evidence of mild fibrosis, dyspnea, cough, and declines in pulmonary function. Aluminum: Aluminum dusts/fines are a low health risk by inhalation and should be treated as a nuisance dust. Aluminum dust is a respiratory and eye irritant. Vanadium: Excessive long term or repeated exposures to vanadium compounds, especially the pentoxide, may result in chronic pulmonary changes such as emphysema or bronchitis. Tin: No systemic effects have been reported from industrial exposure to tin. However, exposure to dust and fume of tin (oxide) is recognized to result in a benign pneumoconiosis called stannosis. No cases of massive fibrosis from over-exposure to tin have been reported. Zirconium: The signs and symptoms of chronic exposure to zirconium may include the development of pulmonary granulomas. Copper: Prolonged or repeated skin contact may cause dermatitis. May cause liver and kidney damage. May cause lung damage.
CARCINOGENIC REFERENCES		Titanium Dioxide: The International Agency for Research on Cancer (IARC) identifies Titanium Dioxide as Group 3 carcinogens, not classifiable as to their human carcinogenicity.
MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE		Chronic respiratory disease may be aggravated by exposure to dust or fumes.
Section IV – FIRST AID MEASURES		
INHALATION		If a person inhales large amounts of the dust from this material, move the exposed person to fresh air. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.
INGESTION		Seek medical if large quantities of dust as been swallowed.
SKIN		Wash dust from skin with soap and water. If irritation persists, seek medical attention.
EYES		If dust enters eyes, flush eyes with clean water. If irritation persists, seek medical attention.
NOTES TO PHYSICIAN		Individuals with Wilson's disease are more susceptible to chronic copper poisoning.

Section V – FIRE	
FLAMMABILITY RATING	Noncombustible
FIRE AND EXPLOSION HAZARD	Application of water to burning titanium can cause an explosion.
FIRE EXTINGUISHING MEDIA	Extinguish using salt of a Class D Fire extinguisher; water or carbon dioxide may prove ineffective. Avoid breathing fumes from the burning material. In case of fire in the surroundings: use appropriate extinguishing medium.
INCOMPATIBILITY (Materials to avoid)	Molten metal may react violently with water. Contact with water or steam above 704^{o}C also will cause a violent reaction.
HAZAROUS DECOMPOSITION PRODUCTS	Titanium alloys may release fumes containing titanium oxides.
HAZARDOUS POLYMERIZATION	Will not occur.
SPECIAL INFORMATION	Titanium based alloys in this form are not considered combustible. During subsequent processing (cutting, welding, grinding, etc.) the generation of dust in high concentrations may present fire and explosion hazards.

Section VI – SPILL OR LEAK PROCEDURES
Minimal problems with spills of this product will occur because of its solid form. In case of spills, shovel solids into drum or container for recycling or disposal in accordance with Federal, State and Local Regulations.

Section VII – HANDLING AND STORAGE	
HANDLING	If airborne dust is generated, use an appropriate NIOSH – or MSHA – approved respirator. Wash hands thoroughly after handling, before eating, or applying cosmetics. Wash exposed skin at the end of each shift. Do not shake clothing, rags, or other items to remove dust.
STORAGE	Store away from open flames or sparks.

Section VIII – SPECIAL PROTECTION INFORMATION	
RESPIRATORY PROTECTION	Not required under normal conditions of use or handling. For Dust or Fumes - Use appropriate NIOSH – or MSHA – approved respirators if engineering controls are infeasible or insufficient.
SKIN PROTECTION	Wear coveralls, safety shoes, etc., as needed and as appropriate to the conditions of handling and use.
EYE PROTECTION	Use safety goggles or glasses with side shields as needed, particularly during machining, grinding or any operation that may create dust.
VENTILATION	Local exhaust ventilation should be used to control exposure to airborne dust or fume whenever possible.

Section IX – PHYSICAL DATA			
FREEZING POINT:	n/a	VAPOR PRESSURE (mmHg):	n/a
MELTING POINT:	>2800^{0}F	VAPOR DENSITY (AIR=1):	n/a
BOILING POINT:	n/a	DENSITY (H_20=1):	5-6
FLASHPOINT:	n/a	SOLUBILITY IN WATER:	no
pH:	n/a	PHYSICAL STATE:	Solid
APPEARANCE AND ODOR:	Odorless solid metal	SPECIFIC GRAVITY:	n/a

Section X – REACTIVITY DATA	
STABILITY	Stable.
INCOMPATABILITY	Molten metal may react violently with water. Contact with water or steam above 704^{o}C also will cause a violent reaction.
DECOMPOSITION	Titanium alloys may release fumes containing metal oxides.

Section XI – TOXICOLOGY DATA	
INHALATION	CAS # 13463-67-7, Titanium Dioxide, Rat, lowest published toxic concentration: 250 mg/m^3/6 hour/2 year- intermittent. CAS # 7429-90-5, Aluminum, Man, lowest published toxic concentration: 4 mg/m^3/1 year- intermittent. CAS # 7440-67-7, Zirconium, Hamster, lowest published toxic concentration: 30 mg/m^3/72 week- intermittent. CAS # 1314-62-1, Vanadium, Human, lowest published toxic concentration: 346 mg/m^3.
INGESTION	CAS # 13463-67-7, Titanium Dioxide, Rat, Oral lowest published toxic dose: 60 gm/kg. CAS # 7440-50-8, Copper, Human, lowest published toxic dose: 120 µg/kg. CAS # 1314-62-1, Vanadium, Rat, lowest published toxic dose: 91 mg/kg/26 week- intermittent.
SKIN CONTACT	CAS # 13463-67-7, Titanium Dioxide, Skin, Human 300 µg/3 day- intermittent. CAS # 1314-62-1, Vanadium, Rabbit, lethal dose (50 percent kill): 50 mg/kg.
See NIOSH, *RTECS* (XR2275000), for additional toxicity data on Titanium dioxide, (BD0330000) for Aluminum, (YW2450000) for Vanadium Pentoxide, (XP7320000) for Tin, (ZH7070000) for Zirconium, (GL5325000) for Copper.	

Section XII – ECOLOGICAL DATA
No data available

Section XIII – DISPOSAL	
DISPOSAL	Scrap metal can be reclaimed for reuse.
DISPOSAL REGULATORY REQUIREMENTS	Scrap metal can be reclaimed for reuse. Follow applicable Federal, State and Local regulations.
CONTAINER CLEANING AND DISPOSAL	Follow applicable Federal, State and Local regulations. Observe safe handling precautions.

Section XIV – SHIPPING INFORMATION: DOT TRANSPORTATION DATA (49 CFR 172.101)
TIMETAL Alloys are not listed under current DOT Regulations.

Section XV – REGULATORY INFORMATION		
COMPONENTS	Titanium, Aluminum, Vanadium, Copper, Tin, Zirconium,	
TSCA	LISTED	
SUBJ. TO SEC. 313 RPT	Aluminum, Copper	
SUBJ. TO SEC. 302 RPT	N/A	
RCRA	N/A	
COMPONENT		Aluminum, Vanadium, Copper, Tin, Zirconium
SARA 311/312	Acute	Aluminum, Copper
	Chronic Health Hazard	Copper
	Fire	No
	Reactive	No
	Sudden release of Pressure	No
STATE	CAS# 7440-32-6 (Titanium) can be found on the following state right to know lists: New Jersey, Pennsylvania, Minnesota, and Massachusetts. It is also on the Canada's DSL List. CAS# 7429-90-5 (Aluminum) can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, Massachusetts. It is also on the Canada's DSL List. CAS# 7440-62-2, (Vanadium) can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, Massachusetts. It is also on the Canada's DSL List. CAS# 7440-50-8, (Copper) can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, Massachusetts It is also on the Canada's DSL List. CAS# 7440-31-5 (Tin) can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, Massachusetts. It is also on the Canada's DSL List. CAS# 7440-67-7 (Zirconium) can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Massachusetts. It is also on the Canada's DSL List.	

Section XVI – ADDITIONAL INFORMATION

Prepared By: AM Health and Safety, Inc., rev1 by TIMET

Hazard Rating Systems:

NFPA Code: 1-0-0 HMIS Code: 1*-0-0-Supplied by user PPE: See Section VIII

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 complied. 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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