

MATERIAL SAFETY DATA SHEET FOR TITANIUM METAL

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PRODUCT NAME OR NUMBER: Titanium and Titanium Alloy

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I - COMPONENT DATA

| CHEMICAL COMPONENTS | C.A.S. NUMBER | % WT. |
|---------------------|---------------|--------|
| Aluminum | 7429-80-5 | 0-8 |
| Chromium | 7440-47-3 | 0-11 |
| Columbium (Niobium) | 7440-03-1 | 0-2 |
| Iron | 7439-89-8 | 0-2 |
| Molybdenum | 7439-98-7 | 0-11.5 |
| Nickel | 7440-02-0 | 0-0.8 |
| Tantalum | 7440-25-7 | 0-1 |
| Tin | 7440-31-5 | 0-4.5 |
| Titanium | 7440-32-6 | 73-89 |
| Vanadium | 7440-62-2 | 0-13 |
| Zirconium | 7440-67-7 | 0-5 |

II - PHYSICAL DATA

BOILING POINT (°F): 5930

VAPOR PRESSURE (mmHg @ 20°C): Not applicable

VAPOR DENSITY (AIR=1): Not applicable

SOLUBILITY IN WATER: Insoluble

APPEARANCE AND ODOR: Odorless gray metallic solid. Available in ingots, mill products, castings, sponge, chips, briquettes, and other irregular shapes

SPECIFIC GRAVITY (H₂O=1): 4.5

MELTING POINT (°F): 3050

EVAPORATIVE RATE (ETHYL ETHER=1): Not applicable

III - FIRE & EXPLOSION HAZARD DATA

FLASH POINT (°F): Not applicable

METHOD USED: Not applicable

FLAMMABILITY LIMITS (%VOL): LEL:Not applicable UEL:Not applicable

AUTO-IGNITION TEMPERATURE (°F): 2200°F for metal in air; 480°F for powder in air

EXTINGUISHING MEDIA: Dry table salt or Type D fire extinguisher.

SPECIAL FIRE-FIGHTING INSTRUCTIONS: Remove uninvolved material, allow fire to burn out. Fire can be controlled by covering with dry salt or powder from Type D extinguisher. Carbon dioxide is not effective.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Dry titanium burns slowly while releasing much heat. Water applied to burning titanium may cause an explosion. Piled chips may burn vigorously.

IV - REACTIVITY DATA

STABILITY (CONDITIONS TO AVOID): Stable, avoid open flame and heat.

INCOMPATIBILITY (MATERIALS TO AVOID): Strong oxidizing or reducing agents.

HAZARDOUS DECOMPOSITION PRODUCTS: Metallic or metal oxide fumes and dust may be produced during welding, grinding or cutting operations. See Section V for further information.

HAZARDOUS POLYMERIZATION: Will not occur.

V - HEALTH HAZARD DATA

PRIMARY ROUTE(S) OF ENTRY: Inhalation, skin contact, eye contact.

EFFECTS OF EXPOSURE: No toxic effects would be expected from its inert solid form or under normal usage such as forging and heating. Prolonged, repeated exposure to fumes or dusts generated during cutting, grinding, or welding may cause adverse health effects associated with the following constituents:

INHALATION OF METAL FUMES OR DUST:

Aluminum - not generally regarded as serious industrial health hazard.

Chromium - the dusts of chromium metal are usually reported to be relatively nontoxic, although there are reports of skin ulcers, usually on hands, or a perforated nasal septum. Some insoluble chromium compounds are suspect carcinogens.

Columbium (Niobium) - no reports of human intoxication.

Iron - siderosis, no fibrosis.

Molybdenum - irritation to the nose and throat, weight loss, and digestive disturbances in animals. No industrial poisoning has been reported.

Nickel - respiratory irritation and pneumonitis. Several nickel compounds, including nickel oxide are suspect lung and nasal carcinogens.

Tantalum - no systemic effects from industrial exposure have been reported in humans.

Tin - dust of tin oxides has caused a pneumoconiosis, which is relatively benign.

Titanium – generally considered to be in the nuisance dust category.

Vanadium – irritant to the conjunctivae and respiratory tract. May lead to pulmonary involvement. Signs and symptoms of poisoning are pallor, greenish-black discoloration of the tongue, cough, conjunctivitis, pain in the chest, bronchitis, rales and rhonchi, bronchospasm, tremor of the fingers and arms, and radiographic reticulation.

Zirconium – studies of several zirconium compounds conclude that zirconium is an element of low toxicity.

Note. Some fume constituents pose more potential hazards than others, depending upon their inherent toxicity and concentration. Of special concern are chromium, vanadium, nickel and possibly titanium. It is advised that your particular operation be evaluated by a competent health professional to determine whether or not a hazard exists.

SKIN CONTACT: Dermatitis due to sensitization may occur in some individuals from exposure to chromium and nickel fumes. Columbium (niobium) has been reported to be a skin irritant.

EYE CONTACT: May cause irritation.

INGESTION: May cause irritation of the mouth and throat.

EXPOSURE LIMITS: (OSHA nuisance dust standards apply to components shown as "None")

| CHEMICAL COMPONENTS | OSHA PEL (mg/M ³) | ACGIH TLV (mg/M ³) | NTP LISTED | IARC LISTED |
|---------------------|---|--|------------|-------------|
| Aluminum | None | 5 (as welding fumes) | No | No |
| Chromium | 0.5 (soluble compounds) | 0.5 | Yes | Yes |
| Chromium (Cr + 6) | 0.1 | 0.05 | Yes | Yes |
| Columbium (Niobium) | None | None | No | No |
| Iron | 10 (as Fe ₂ O ₃ fume) | 5 | No | No |
| Molybdenum | 5 (soluble compounds) | 5 (soluble compounds) | No | No |
| Nickel | 10 | 0.1 (soluble Ni compounds) | No | Yes |
| Tantalum | 5 | 10 | No | No |
| Tin | 2 | 2 | No | No |
| Titanium | None | 10 (as TiO ₂) | No | No |
| Vanadium | 0.5 (dust) | 0.05 (as V ₂ O ₅) | No | No |
| Zirconium | 5 | 5 | No | No |

VI - EMERGENCY & FIRST-AID PROCEDURES

INHALATION: In case of overexposure, immediately move person from contaminated area to fresh air at once. Give artificial respiration if breathing has stopped, or oxygen, if necessary. Get medical attention, if necessary.

SKIN: If irritation develops, remove contaminated clothing immediately and wash contaminated skin with soap or mild detergent and water for 5 minutes. If irritation persists, seek medical attention.

EYES: In case of contact, immediately wash eyes with large amounts of water for 15 minutes, occasionally lifting the lower and upper lids. Seek medical attention if necessary.

INGESTION: Seek medical attention, if necessary.

VII - SPECIAL HANDLING INFORMATION

VENTILATION: Ventilation, as described in the *Industrial Ventilation Manual* produced by the American Conference of Governmental Industrial Hygienists, should be used to maintain concentrations of air contaminants below established air contaminant standards.

RESPIRATORY PROTECTION: A properly-fitted NIOSH-approved, dust fume respirator should be worn during welding or burning, when air contaminant levels exceed OSHA permissible exposure levels (PELs) or ACGIH threshold limit values (TLVs). Respiratory protection should be selected and used in accordance with the OSHA Respiratory Protection Standard (29 CFR 1910.134) and other applicable regulations.

PROTECTIVE CLOTHING: Use appropriate protective clothing for protection of exposed skin areas from heat, sparks, and ultraviolet radiation during forging, grinding, and welding.

EYE PROTECTION: Use face shield (8" minimum) or goggles when burning, or grinding. When welding, use a hood providing full face coverage for protection from ultraviolet radiation.

VIII - SPECIAL PRECAUTIONS

Do not allow metallic dust to accumulate. Metallic dust may present a serious fire hazard.

Titanium and titanium alloy solids are not considered combustible in the form supplied. However, subsequent machining operations require the use of cutting fluids to reduce the temperature of waste material which might ignite without coolant.

Arc and sparks generated when welding or grinding could be a source of ignition for combustible and flammable materials.

ACTION TO TAKE FOR SPILLS (USE APPROPRIATE SAFETY EQUIPMENT): Keep material separated from incompatible materials and sources of ignition.

DISPOSAL INFORMATION: Non-recyclable scrap may be land-filled in accordance with federal, state, and local regulations.

IX - ADDITIONAL INFORMATION

DOT INFORMATION

HAZARDOUS MATERIAL, PROPER SHIPPING NAME: Not applicable

HAZARD CLASS: Not applicable

UN IDENTIFICATION NUMBER: Not applicable

EPA HAZARDOUS WASTE NO.: Not applicable

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