

Product Titanium 6-Aluminium 4-Vanadium alloy powder (size: 0-45 µm).
Revision date 02/17/2017
Revision 1



Safety Data Sheet (SDS)

SECTION 1: IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Product name	Titanium 6-Aluminium 4-Vanadium alloy powder (size: 0-45 µm).
Synonyms, Trade names	Ti-6Al-4V ELI. Ti-6Al-4V Grade 5. Ti-6Al-4V Grade 23. Ti64.
Identified uses	Metal Powder for Additive Layer Manufacturer.
Supplier	Renishaw plc Brooms Road Stone Business Park Stone, Staffordshire ST15 0SH United Kingdom Tel: +44 (0) 1785 285000 (during UK office hours 09:00 to 17:00 UTC).
Contact person	msds@renishaw.com
Emergency telephone	999 / 911 or local emergency number.

SECTION 2: HAZARDS IDENTIFICATION

Appearance	Metallic powder.
Color	Grey.
Odor	Odourless.

Pictogram(s)



Signal word	Danger
Hazard statements	H228 Flammable solid.

Precautionary statements

Prevention

P210 Keep away from heat/ sparks/open flames/hot surfaces. — No smoking.
P241 Use explosion-proof electrical/ventilating/lighting/process/equipment.
P280 Wear protective gloves/ protective clothing/eye protection/face protection.

Response

P370 + P378 In case of fire: Use Class D (Dry Powder) extinguisher with spin applicators for extinction.

Contains	Not applicable
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GHS classification

Physical and chemical hazards	Flam. Sol 1- H228
Human health	Not classified
Environment	Not classified

OSHA regulatory status	This product is Hazardous under the OSHA Hazard communication Standard.
Inhalation	High dust levels may irritate the respiratory system. May cause breathing difficulties if inhaled.
Ingestion	Can cause irritation of the gastrointestinal tract.
Skin contact	Can cause mechanical irritation, abrasion or allergic skin reaction.
Eye contact	Dust can cause mechanical irritation.
Routes of exposure	No information available.
Other hazards	Explosion/fire hazards may be present when: Dust or fines are dispersed in air or powder or dusts are in contact with certain metal oxides (e.g. rust, copper oxide). Dust can irritate the eyes. High dust levels may irritate the respiratory system.

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

Name	Product identifier	GHS classification	%
Titanium	CAS-No.: 7440-32-6 EC No.: 231-142-3		60-100%
Aluminium	CAS-No.: 7429-90-5 EC No.: 231-072-3	Flam. Sol 1- H228, Water-react 2 - H261	1-10%
Vanadium	CAS-No.: 7440-62-2 EC No.: 231-171-1		1-10%

Composition comments No additional information available.

SECTION 4: FIRST AID MEASURES

Description of first aid measures

General information	Provide general first aid, rest, warmth and fresh air. As a general rule, in case of doubt or if symptoms persist, always call a doctor. Seek medical attention for all burns and eye injuries, regardless how minor they may seem. First aid personnel must be aware of own risk during rescue.
Inhalation	Remove patient to fresh air, allow to rest and keep warm. If not breathing, give artificial respiration and seek medical attention.
Ingestion	Ingestion: DO NOT induce vomiting! Rinse mouth out and then drink plenty of water. Get medical attention if discomfort occurs.
Skin contact	Remove contaminated clothing, shoes and jewelry and wash before reuse. Wash skin with soap and water for several minutes. Get medical attention if symptoms persist.
Eye contact	Eye contact: Do not rub eye. Avoid contaminating unaffected eye. Make sure to remove any contact lenses from the eyes. Rinse with a gentle stream water for at least 15 minutes. Hold eye lids open. Get medical attention if symptoms persist.

Most important symptoms and effects, both acute and delayed

General information	The severity of the symptoms described will vary dependent on the concentration and the length of exposure. Exposure to metal dusts and oxides may cause metal fume fever.
Inhalation	High dust levels may irritate the respiratory system. May cause breathing difficulties if inhaled.
Ingestion	Can cause irritation of the gastrointestinal tract.
Skin contact	Can cause mechanical irritation, abrasion or allergic skin reaction.
Eye contact	Dust can cause mechanical irritation.
Routes of exposure	No information available.

Most important symptoms and effects, both acute and delayed

Notes to the physician Treat symptomatically.

SECTION 5: FIRE-FIGHTING MEASURES

Auto ignition temperature (°C)	480.00 °C
Flammability limit - lower(%)	No information available.
Flammability limit - upper(%)	No information available.
Flash point	No information available.

Extinguishing media	Use gentle surface application of Class D extinguishing agent or dry inert granular material (e.g., sand) to cover and ring the burning material. Use ONLY Class D – Dry Powder - extinguishers with spin applicators for smother effect application. DO NOT USE water, halogenated agents, or ABC dry chemical agents. These fire extinguishing agents will react with the burning material.
Hazardous combustion products Unusual fire & explosion hazards	Decomposition of this product may yield metallic oxides. Dust clouds may be explosive. Even a minor dust cloud can explode violently. Dust accumulation on floor, ledges and beams can present a risk of ignition, flame propagation and secondary explosions. Will react with oxidizing agents or acids and alkalis, causing heating and hydrogen release - explosion risk.
Special fire fighting procedures	If possible, fight fire from protected position. Avoid breathing fire vapours. Keep up-wind to avoid fumes. Ventilate closed spaces before entering them. Do not inhale explosion / combustion gases. Avoid creation of dusts. Gently smother burning material with dry sand or other inert substance, or special powder (Class D - Dry Powder) extinguishers with spin applicator. Gently cover and ring the burning material. Avoid mixing of the extinguishing agent with the burning material. Apply extinguishing media carefully to avoid creating airborne dust. Do not disturb the material until completely cool.
Protective equipment for firefighters	Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode. Clothing for fire-fighters (including helmets, protective boots and gloves) conforming to MSHA/NIOSH standards will provide a basic level of protection for chemical incidents. (See also NFPA 1971/NFPA 1851.)

SECTION 6: ACCIDENTAL RELEASE MEASURES

Personal precautions	Read and follow manufacturer's recommendations. Do not touch or walk through spilled material. If necessary evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Wear protective clothing as described in Section 8 of this safety data sheet. Avoid inhalation of vapours and contact with skin and eyes. Provide adequate ventilation. In case of inadequate ventilation, use respiratory protection. Do not smoke, eat or drink while using this product. Eliminate all sources of ignition. Wash hands after use.
For emergency responders	Follow safe handling advice and personal protective equipment recommendations for normal use of product.
Environmental precautions	Prevent from entering sewers or the immediate environment. In case of large spill, inform local police, local authority and/or fire brigade as appropriate.
Spill clean up methods	Restrict non-essential personnel from the area. In case of spills, beware of slippery floors and surfaces. Eliminate all ignition sources. Evacuate area. Use dry cleanup procedures. Collect any spilled material immediately by vacuuming or shoveling - use non sparking tools or equipment/natural bristle brushes. Take care not to raise dust. Place in labelled, dry, water-tight containers. Seal containers for disposal (See Section 13). If using vacuum suction equipment ensure that it is suitable for use with ignitable dusts.

SECTION 7: HANDLING AND STORAGE

Handling	Ensure good dust ventilation during handling. If necessary, use local exhaust ventilation. Use non-sparking tools when opening or closing containers. Avoid sources of sparks or other sources of ignition i.e. no grinding - naked flames - smoking etc. Protect against static electricity. HEPA vacuuming is recommended to clean up any dusts that may be generated during handling and processing. Use personal protective equipment, see Section 8. Avoid generation of dust clouds. Wash hands and face thoroughly before eating, drinking or smoking. Keep powder away from open flames and other sources of ignition. Maintain a supply of "coarse" (rock-type) salt and/or "Class D" (for metal fires) fire extinguisher located near processing and storage areas.
Usage description Storage precautions	Use only according to directions. Keep locked up and out of reach of children. Avoid contact with incompatible materials, static, moisture, and flames. Keep containers tightly closed. Keep away from heat, sparks and open flame. Avoid contact with oxidising agents. Store in tightly closed original container in a cool, dry and well-ventilated place. Good housekeeping and engineering practices should be employed to prevent the generation and accumulation of dusts.
Specific end use(s)	The identified uses for this product are detailed in Section 1.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

Protective equipment



Component	STD	TWA (8 Hrs)	STEL (15mins)	Notes
Aluminium	WEL	10 inhalable aerosol mg/m ³		Inhalable.
Aluminium	WEL	4 respirable aerosol mg/m ³		Respirable.
Aluminium	NIOSH	10 (1) mg/m ³		Total dust.
Aluminium	NIOSH	5 (2) mg/m ³		Respirable fraction, pyro powders, welding fumes.
Aluminium	NIOSH	2 (3) mg/m ³		Soluble salts, alkyls.

Ingredient comments

Workplace Exposure Limits Guidance Note EH40/2005. The National Institute for Occupational Safety and Health (NIOSH).

**Process conditions
Engineering measures**

Ensure that eye flushing systems and safety showers are located close by in the work place. Provide adequate ventilation, including appropriate local extraction, to ensure that the defined occupational exposure limit is not exceeded. Use with adequate explosion-proof ventilation designed to handle metal particulates.

Respiratory equipment

A NIOSH approved dust mask or filtering facepiece is recommended in poorly ventilated areas or when permissible exposure limits may be exceeded. Respirators should be selected by and used under the direction of a trained health and safety professional following requirements found in OSHA's respirator standard (29 CFR 1910.134). If the respirator is the sole means of protection, use a full-face supplied air respirator. Change filters frequently.

Hand protection

Use suitable protective gloves if there is a risk of skin contact. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Change gloves regularly. Consult manufacturer for specific advice on material. Selection of the glove material depends on consideration of the penetration times, rates of diffusion and degradation, and concentration specific to the workplace. Where hand contact with the product may occur use gloves approved to relevant standards (e.g.US: F739). Gloves must be inspected prior to use.

Eye protection

Wear safety goggles or face shield to prevent any possibility of eye contact. Wear safety glasses with side shields (or goggles). Ensure compliance with OSHA's PPE standard (29 CFR 1910.132 and .133) for eye and face protection.

Hygiene measures

Observe normal hygiene standards. Keep container tightly closed. Immediately take off any contaminated clothing and launder before re-use. Wash hands and / or face before breaks and at the end of the shift. After work, wash the skin and apply skin cream. Do not eat, drink, or smoke while using this product.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Appearance	Metallic powder.
Color	Grey.
Odor	Odourless.
Odor threshold - lower	No information available.
Odor threshold - upper	No information available.
pH-Value, Conc. Solution	No information available.

pH-Value, Diluted solution	No information available.
Melting point	1605 - 1660 °C
Initial boiling point and boiling range	No information available.
Flash point	No information available.
Evaporation rate	No information available.
Flammability state	No information available.
Flammability limit - lower(%)	No information available.
Flammability limit - upper(%)	No information available.
Vapor pressure	No information available.
Vapor density (air=1)	No information available.
Relative density	No information available.
Bulk density	No information available.
Solubility	Insoluble.
Decomposition temperature	No information available.
Partition coefficient; n-Octanol/Water	No information available.
Auto ignition temperature (°C)	480.00 °C
Viscosity	No information available.
Explosive properties	May be explosive if dispersed into a dust cloud in air in the presence of a source of ignition. Minimum Ignition Energy (Electrostatic Spark): 4-5 mJ. Minimum Ignition Energy (Mechanical Spark): 3-4 mJ. Minimum Ignition Temperature: 710°C. Layer Ignition Temperature: >400°C. Minimum Explosive Concentration: 50g/m ³ . Limiting Oxygen for Combustion: 7%. Pmax: 6.1 bar. Kmax: 60 bar.m.s-1. St Class: 1.
Oxidizing properties	No information available.
Molecular weight	No information available.
Volatile organic compound	No information available.
Other information	These are typical values and do not constitute a specification.

SECTION 10: STABILITY AND REACTIVITY

Reactivity	Stable product under recommended storage and handling conditions.
Polymerization description	Not applicable.
Stability	Stable product under recommended storage and handling conditions.
Hazardous polymerization	Will not polymerise.
Hazardous decomposition products	Thermal decomposition or combustion may liberate hazardous/flammable gasses and nitrogen oxides.
Conditions to avoid	High temperatures, humid conditions, contact with oxidising substances, and sources of ignition.

Materials to avoid Combustible materials, acid, oxidising agents, halogenated hydrocarbons.

SECTION 11: TOXICOLOGICAL INFORMATION

Toxicological information This product is not considered carcinogenic, mutagenic or teratogenic. Eye contact has shown particulate irritation. Skin contact with titanium powders may cause physical abrasion. The toxicity of titanium has been found to be relatively inert. No scientific evidence was found of a health hazard from the inhalation of titanium powder in concentration of air that does not exceed 10 mg/m³ total dust containing less than 1% quartz. No toxicological data available for this product.

Acute toxicity (Oral LD50) No information available.
Acute toxicity (Dermal LD50) No information available.
Acute toxicity (Inhalation LC50) No information available.

Skin corrosion/Irritation

Respiratory sensitization
Skin sensitization
Reproductive toxicity: No information available.
Germ cell mutagenicity

Carcinogenicity:
Carcinogenicity No carcinogenicity data available for this product. This product is not considered carcinogenic, mutagenic, or teratogenic.

NTP - Carcinogenicity **Titanium:** Not Listed.
Aluminium powder (stabilised): Not Listed.
Vanadium: Not Listed.

OSHA - Carcinogenicity The product and its components are not listed.
IARC - Carcinogenicity **Titanium:** Not Listed.
Aluminium powder (stabilised): Not Listed.
Vanadium: Not Listed.

Specific target organ toxicity - Single exposure:
STOT - Single exposure No information available.
Specific target organ toxicity - Repeated exposure:
STOT - Repeated exposure No information available.

SECTION 12: ECOLOGICAL INFORMATION

Acute toxicity - Fish No information available.
Acute toxicity - Aquatic invertebrates No information available.
Acute toxicity - Aquatic plants No information available.
Acute toxicity - Microorganisms No information available.
Chronic toxicity - Fish No information available.
Chronic toxicity - Aquatic invertebrates No information available.
Chronic toxicity - Aquatic plants No information available.
Chronic toxicity - Microorganisms No information available.
Ecotoxicity The product components are not classified as environmentally hazardous. However, this does not exclude the possibility that large or frequent spills can have a harmful or damaging effect on the environment.

Eco toxicological information No ecological toxicity available on the overall finished product.

Degradability No information available.

Bioaccumulative potential The product does not contain any substances expected to be bioaccumulating.

Mobility No information available.

Results of PBT and vPvB assessment No information available.

Other adverse effects No information available.

SECTION 13: DISPOSAL CONSIDERATIONS

Waste management Waste product should be disposed of via a licensed operator or may be sent to a metals

reclamation facility that is able to handle fines. Contaminated packing should be disposed of according to local authority guidelines.

Disposal methods Dispose in accordance with all applicable federal, state and local laws and regulations.

SECTION 14: TRANSPORT INFORMATION

UN number

UN no. (DOT/TDG)	UN3089
UN no. (IMDG)	UN3089
UN no. (IATA)	UN3089

Proper shipping name

DOT/TDG proper shipping name	METAL POWDER, FLAMMABLE, N.O.S. (Spherical Ti-6A-4V Powder < 45 um)
IMDG proper shipping name	METAL POWDER, FLAMMABLE, N.O.S. (Spherical Ti-6A-4V Powder < 45 um)
IATA proper shipping name	METAL POWDER, FLAMMABLE N.O.S. (Spherical Ti-6A-4V Powder < 45 um)

Transport hazard class(es)

DOT/TDG class	4.1
IMDG class	4.1
IATA class	4.1

Transport labels



Packing group(s)

DOT packing group	II
IMDG packing group	II
IATA packing group	II

Special precautions for user

EMS	F-G, S-G
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Environmentally hazardous substance/Marine pollutant

ADR	No
IMDG	No
IATA	No

SECTION 15: REGULATORY INFORMATION

Approved code of practice Workplace Exposure Limits Guidance Note EH40/2005. GHS Classification in accordance with 29 CFR 1910 (OSHA HCS).

US federal regulations

SARA section 302 extremely hazardous substances tier II threshold planning quantities

The following ingredients are listed None Listed.

CERCLA/Superfund, Hazardous substances/Reportable quantities (EPA)

The following ingredients are listed None Listed.

SARA extremely hazardous substances EPCRA reportable quantities

The following ingredients are listed None Listed.

SARA 313 emission reporting

The following ingredients are listed Aluminium
Vanadium

CAA accidental release prevention

The following ingredients are listed None Listed.

OSHA highly hazardous chemicals

The following ingredients are listed None Listed.

US state regulations

California proposition 65 carcinogens and reproductive toxins

The following ingredients are listed None Listed.

California air toxics "Hot Spots" (A-I)

The following ingredients are listed None Listed.

California air toxics "Hot Spots" (A-Ii)

The following ingredients are listed None Listed.

Massachusetts "Right To Know" list

The following ingredients are listed Aluminium
Vanadium

Rhode Island "Right To Know" list

The following ingredients are listed Aluminium

Minnesota "Right To Know" list

The following ingredients are listed Aluminium

New Jersey "Right To Know" list

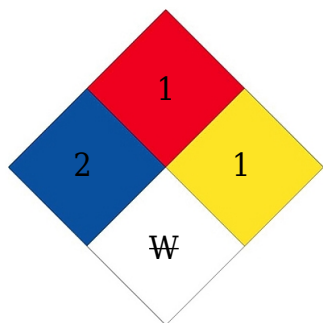
The following ingredients are listed Titanium
Vanadium

Pennsylvania "Right To Know" list

The following ingredients are listed Aluminium
Vanadium

SECTION 16: OTHER INFORMATION

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)



HAZARDOUS MATERIAL INFORMATION SYSTEM (HMIS)

Health	2
Flammability	1
Physical hazard	1
Personal protection	E

General information	No information available.
Revision comments	This is a first issue.
Revision date	02/17/2017
Revision	1

Disclaimer

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