SECTION 1 - IDENTIFICATION

COMPANY ADDRESS:
The Virtual Foundry, Inc
211 S Water St
Stoughton, WI 53589
USA

PRODUCT NAME: **Titanium 64-5 Filamet™**

PRODUCT USE: Manufacture of metal parts by extrusion, injection-moulding, or 3D printing.

SECTION 2 - HAZARDS IDENTIFICATION SUMMARY

(As defined by OSHA Hazard Communication Standard, 29 CFR 1910.1200)

PHYSICAL HAZARDS: Contact with product at elevated temperatures can result in thermal burns. Inhalation of dusts and vapors of melted material from this product may cause irritation of the eyes, nose, throat and respiratory system. May cause coughing or shortness of breath. Mechanical eye irritant. May cause tearing and redness. Mechanical skin irritant. Prolonged contact may cause skin abrasion, redness, itching. Irritating to the respiratory tract. Large overdoses may cause nervous system disturbances, and diarrhea. May cause nausea and vomiting. No long-term health effects are anticipated.

HAZARD STATEMENTS: Irritating to eyes and respiratory tract. Exposure may include persistent cough, shortness of breath.

OTHER HAZARDS: If small particles are generated during further processing, handling, or by other means, combustible dust concentrations in air may form.

SECTION 3 - COMPOSITION, INFORMATION OF INGREDIENTS

Base Metal	**CAS No.**	**%by Weight**
Titanium (Ti)	7440-32-6	75.0 - 90.0
Alloying Elements		
Aluminum (Al)	7429-90-5	0.0 - 10.0
Vanadium (V)	7440-62-2	0.0 - 5.0
Note: Some or all of the alloying elements listed may be present		
Chemical Name	**CAS No.**	**%by Weight**
2-Propenenitrile, polymer with 1,3-butadiene and	9003-56-9	trace

ethenylbenzene		
Binding Additive	Proprietary	trace
Polylactic Acid	9051-89-2	<20%

SECTION 4 - FIRST AID MEASURES

IF SWALLOWED: Call a poison control center or doctor immediately for treatment advice. Do not induce vomiting unless told to do so by the poison control center or consult a doctor if necessary. Seek immediate medical attention.

IF ON SKIN OR CLOTHING: Immediately flush with plenty of water for at least 15 minutes. Remove contaminated clothing. Wash skin using soap. Get medical attention if symptoms persist. Cool skin rapidly with cold water after contact with hot polymer. DO NOT attempt to remove hot polymer from skin or contaminated clothing as skin may be easily damaged. If skin irritation persists, call a physician.

IF IN EYES: Flush eyes with large volumes of water for at least 15 minutes lifting upper and lower eyelids occasionally. Consult a physician immediately.

IF INHALED: Remove from exposure to fresh air. Lay patient down. Cover with blanket. If symptoms persist, call a physician. If person is not breathing, call 911 or an ambulance, then provide medical aid.

MAIN SYMPTOMS: Redness, coughing and/or wheezing.

NOTE TO PHYSICIAN: Treat symptomatically.

SECTION 5 - FIRE FIGHTING MEASURES

FLAMMABILITY

AUTOIGNITION TEMPERATURE: 388°C

SUITABLE EXTINGUISHING MEDIA: Use dry chemical powder.

UNSUITABLE EXTINGUISHING MEDIA: Avoid high pressure media which could cause the formation of a potentially explosible dust-air mixture.

SPECIFIC HAZARDS ARISING FROM THE CHEMICAL: Flammable solid. May form explosible dust-air mixture if dispersed.

HAZARDOUS COMBUSTION PRODUCTS: Decomposition products may include the following materials: metal oxide/oxides.

EXPLOSION DATA

SENSITIVITY TO MECHANICAL IMPACT: Not sensitive.

SENSITIVITY TO STATIC DISCHARGE: No information available.

FIRE FIGHTING INSTRUCTIONS AND FIRE FIGHTING EQUIPMENT: Avoid water, halogenated

extinguishing agents. Avoid generation of dust. Cover to eliminate oxygen. Isolate burning material with ring of dry sand or Type D extinguishant. Do not disturb burning powder until completely cool. Use of ABC rated extinguishers may accelerate fire.

ADDITIONAL INFORMATION: Reacts with water, acids, and alkalis to produce hydrogen. Dust/air mixture may explode violently when ignited. High heat of fire may cause underlying concrete to fracture. Dust/Fines in contact with metal oxides (e.g. rust) may present hazard of a thermite reaction. Dust/fines in contact with water may generate hazardous quantities of flammable/explosive hydrogen gas. Avoid risk of secondary explosion by limiting accumulations of fugitive dust.

PERSONAL PROTECTIVE EQUIPMENT: Wear self-contained breathing apparatus.

SECTION 6 - ACCIDENTAL RELEASE MEASURES

PERSONAL PRECAUTIONS: No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilled material. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing dust. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

ENVIRONMENTAL PRECAUTIONS: Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

METHODS FOR CLEANING UP: No information available.

SECTION 7 - HANDLING AND STORAGE

HANDLING: Put on appropriate personal protective equipment (see Section 8). Do not ingest. Avoid contact with eyes, skin and clothing. Avoid breathing dust. May form explosible dust-air mixture if dispersed. Avoid the creation of dust when handling and avoid all possible sources of ignition (spark or flame). Prevent dust accumulation. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. Keep in the original container or an approved alternative made from a compatible material, kept tightly closed when not in use. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Electrical equipment and lighting should be protected to appropriate standards to prevent dust coming into contact with hot surfaces, sparks or other ignition sources. Use only non-sparking tools. Take precautionary measures against electrostatic discharges. To avoid fire or explosion, dissipate static electricity during transfer by grounding and bonding containers and equipment before transferring material. Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking.

STORAGE: Store in accordance with local regulations. Store in a segregated and approved area. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Eliminate all ignition sources. Separate from oxidizing materials. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabeled containers. Use appropriate containment to avoid environmental contamination. See Section 10 for incompatible materials before handling or use.

SECTION 8 - EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS

Base Metal	CAS No.	%by Weight	ACGIH TLV (Mg/M^3)	OSHA PEL (Mg/M^3)
Titanium (Ti)	7440-32-6	75.0 - 90.0	None	None
Alloying Elements				
Aluminum (Al)	7429-90-5	0.0 - 10.0	1.0 (Resp.)	10.0 (Total) 5.0 (Resp.)
Vanadium (V)	7440-62-2	0.0 - 5.0	None	None
Note: Some or all of the alloying elements listed may be present				

COMPONENT	OSHA PEL	ACIGH TLV	NIOSH IDLH
2-Propenenitrile, polymer with 1,3-butadiene and ethenylbenzene 9003-56-9	-	-	-

TLV: Threshold Limit Value over 8 hours of work.
PEL: Permissible Exposure Limit

ADDITIONAL PROTECTION: Provide eyewash station and washing facilities accessible to areas of use and handling.

ENGINEERING CONTROLS

Engineering Measures: Use only with adequate ventilation. If user operations generate dust, fumes, gas, vapor or mist, use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

EXPOSURE MONITORING

Exposure Limits: See table above.

Hygiene Measures: Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reuse. Ensure that eyewash stations and safety showers are close to the workstation location.

PERSONAL PROTECTIVE EQUIPMENT

Eye protection: Safety eyewear complying with an approved standard should be used to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: safety glasses with side-shields. If operating conditions cause high dust concentrations to be produced, use dust goggles.

Skin protection: Avoid skin contact with molten polymer. Wear appropriate protective clothing to minimize risk of injury to the skin from contact with dust or physical abrasion. Long sleeved/impervious clothing if contact is probable and skin is sensitive. Protect contact with skin when processing; while material is hot, wear insulated safety gloves; wash hands after handling. Coveralls should be made from fire resistive materials which tend to not accumulate static charges. They should be designed in such a way as to avoid accumulation of dust in cuffs, pockets, etc.

Respiratory protection: Based on the hazard and potential for exposure, select a respirator that meets the appropriate standard or certification. Respirators must be used according to a respiratory protection program to ensure proper fitting, training, and other important aspects of use.

Hand protection: While material is hot, wear insulated safety gloves; wash hands after handling.

Hygiene measures: Provide regular cleaning of equipment, work area and clothing. Handle in accordance with good industrial hygiene and safety practices. Do not eat, drink or smoke when using this product. Wash hands before breaks and immediately after handling product. Avoid contact with eyes. Do not breathe dust. Use personal protective equipment as required.

Special hazard: No information available.

Environmental Protection: Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Appearance:	Filament, Pellets
Color:	Greyish
Odor:	Slight
Odor Threshold:	No information available.
Melting/Freezing Point:	150-180°C (302- 356°F)
Boiling Point:	No information available.
Flash Point:	No information available.

Evaporation Rate:	No information available.
Flammability:	No information available.
Flammability Limits:	No information available.
Vapor Pressure:	Not applicable
Vapor Density:	Not applicable
Specific gravity:	2.7 - 3.95 (H20=1)
Relative Density:	No information available.
Water Solubility:	Negligible (<0.1%), Insoluble in cold and hot water
Percent Volatile (v/v):	0%
Chemical Stability:	No information available.
Conditions to avoid:	No information available.
Solubility in other solvents:	Insoluble
Partition Coefficient:	No information available.
Auto-Ignition Temperature:	388°C
Hazardous Decomposition Products:	No information available.
Possibility of Hazardous Reactions:	No information available.
Hazardous Polymerization:	No information available.
Decomposition Temperature:	250°C
Viscosity:	No information available.
Explosive Properties:	No information available.
Oxidizing Properties:	No information available.

Other Information:

Softening Point:	80-100°C
VOC Content (%)	negligible
Bulk Density:	0.8-1.3 g/cc (50-80 lb/ft^3)
MEC:	45-120 (g/m^3)
MIE:	4-13 (mJ)
KST:	90-300 (bar-m/sec)

MIT (layer): 650°C

SECTION 10 - STABILITY AND REACTIVITY

INCOMPATIBILITY: Water, acids, alkalis, halogenated compounds, oxidizers. Avoid contact with iron oxide (rust) and other metal oxides. See NFPA "Fire Protection Guide for Hazardous Materials" for further information.

CHEMICAL STABILITY: Stable under recommended storage conditions.

HAZARDOUS POLYMERIZATION: Will not undergo hazardous polymerization.

CONDITIONS & MATERIALS TO AVOID: Avoid keeping resin molten for excessive periods of time at elevated temperatures. Prolonged exposure will cause polymer degradation. Dust formation. Oxidizing agents/materials, Strong bases. Incompatible with strong oxidizing agents and halogens.

HAZARDOUS DECOMPOSITION PRODUCTS: Burning produces noxious and toxic fumes, Carbon monoxide (CO), Carbon Dioxide (CO_2). Exothermic reaction with water, acids, alkalis, to generate hydrogen and heat.

SECTION 11 - TOXICOLOGICAL INFORMATION

Principal routes of exposure: Skin contact.

PRODUCT INFORMATION:

Acute toxicity: None established.

Chronic toxicity: None established.

Specific effects: Inhalation of dust may cause shortness of breath, tightness of chest, a sore throat and cough. Ingestion may cause gastrointestinal irritation. Product dust may be irritating to eyes.

Long term toxicity: None established.

Mutagenic effects: None established.

Reproductive toxicity: None established.

Carcinogenic effects: This product contains one or more substances which are classified by IARC as carcinogenic to humans (Group I), probably carcinogenic to humans (Group 2A) or possibly carcinogenic to humans (Group 2B).

COMPONENT	ACGIH	IARC	NTP	OSHA
2-Propenenitrile, polymer with 1,3-butadiene and	-	Group 3	-	--

ethenylbenzene 9003-56-9				

Target organ effects: Eyes, Respiratory system.

Ingestion: May cause gastrointestinal discomfort if consumed in large amounts. Not an expected route of exposure.

Inhalation: Inhalation of dust in high concentration may cause irritation of the respiratory system.

Eye Contact: Dust contact with the eyes can lead to mechanical irritation.

Symptoms related to the physical, chemical, and toxicological characteristics: Redness. Coughing and/or wheezing.

Delayed and immediate effects and also chronic effects from short and long term exposure:

Irritation: Product dust may be irritating to eyes, skin, and respiratory system.

SECTION 12 - ECOLOGICAL INFORMATION

Toxicity:

Product/ingredient name	Result	Species	Exposure
Aluminium powder (stabilized)	Acute LC50 38000 µg/l Acute LC50 120 µg/l Fresh water Chronic NOEC 9 mg/l Fresh water	Daphnia - Daphnia magna Fish - Oncorhynchus mykiss - Embryo Aquatic plants - Ceratophyllum demersum	48 hours 96 hours 3 days
vanadium	Acute LC50 1550 µg/l Acute LC50 1.8 mg/l Fresh water Chronic NOEC 500 mg/l Marine water	Daphnia - Daphnia magna Fish - Pimephales promelas Algae - Glenodinium halli	48 hours 96 hours 72 hours

Ecotoxicity: Pellets may be eaten by wildlife and should be swept up and placed in closed containers. EC50/72h/algae > 1100 mg/L

Persistence and degradability: Not readily biodegradable.

Bioaccumulation: Not expected to bioconcentrate or bioaccumulate.

Mobility: Is not likely mobile in the environment.

Other adverse effects: This substance is not considered to be persistent, bioaccumulating nor toxic (PBT).

Ozone: Not applicable.

SECTION 13 - DISPOSAL CONSIDERATIONS

WASTE DISPOSAL METHODS: The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Care should be taken when handling emptied containers that have not been cleaned or rinsed out. Empty containers or liners may retain some product residues. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

CONTAMINATED PACKAGING: No information available.

SECTION 14 - TRANSPORT INFORMATION

DOT: Not regulated.
MEX: Not regulated.
ICAO: Not regulated.
IATA: Not regulated.
IMDG: Not regulated.
UN NUMBER: N/A.

SECTION 15 - REGULATORY INFORMATION

DOT: This product is not regulated by USDOT as a Hazardous Material (49 CFR 172.101). No UN code assigned. No placard required for transportation.
SARA (TITLE III): Under applicable definitions, this material may meet the criteria for a delayed (chronic) health hazard.
SARA (SECTION 313): Not Listed.
CALIFORNIA PROP. 65: Not Listed.
TSCA: Not Listed.
DSCL (EEC): Listed on the DSCL inventory.
RCRA HAZARDOUS WASTE NUMBER: Not Listed.

COMPONENT	SARA 313 – Threshold Values %
1,3-butadiene 106-99-0	0.1

Electrical equipment must be suitable for use in hazardous atmospheres involving Group E combustible dusts in accordance with 29CFR1910.307. Refer to the National Electrical Code (NFPA 70) for guidance in determining the type and design of equipment and installation which meets this requirement.

SARA Title III:

Section 311/312: Not listed

Section 313 Toxic Chemicals:

	Product name	CAS number	%
Form R - Reporting requirements	Aluminium powder (stabilized) vanadium	7429-90-5 7440-62-2	≤10.0 ≤5.0
Supplier notification	Aluminium powder (stabilized) vanadium	7429-90-5 7440-62-2	≤10.0 ≤5.0

CLEAN AIR ACT, TITLE VI (1990): This product does not contain, nor was it manufactured using ozone depleting chemicals.

CALIFORNIA PROPOSITION 65: This product contains the following Proposition 65 chemicals:

COMPONENT	CALIFORNIA Prop. 65
1,3-butadiene	Carcinogen Developmental Female Reproductive

Inventory Status:
TSCA (USA): Listed*
DSL (Canada): Listed*
NDSL (Canada): Not Listed
EINECS (Europe): Listed*
AICS (Australia): Listed*
ENCS (Japan): Not Identified**
IECSC (People's Republic of China): Listed*
PICCS (Philippines): Listed*
ECL (Korea): Listed*
ECN (Taiwan): Listed*

*"Listed" indicates that all components of this product comply with the inventory requirements administered by the governing country(s).
** Pure metals are not specifically identified by CAS or ENCS number.

SECTION 16 - OTHER INFORMATION, INCLUDING THE DATE OF PREPARATION OF THE LAST REVISION

LABEL REQUIREMENTS: Not expected to produce significant adverse health effects when the recommended instructions for use are followed.

NFPA HAZARD RATINGS	HEALTH	0
	FLAMMABILITY	1

	PHYSICAL HAZARD	0
	INSTABILITY	-
	4=Severe 3=Serious 2=Moderate 1=Slight 0=Minimal	

HMIS HAZARD RATINGS	HEALTH	0
	FLAMMABILITY	1
	PHYSICAL HAZARD	0
	PERSONAL PROTECTION	X
	4=Severe 3=Serious 2=Moderate 1=Slight 0=Minimal	

DISCLAIMER: The information provided in this SDS is based on available data from reliable sources and is correct to the best of The Virtual Foundry, Inc's knowledge. The Virtual Foundry, Inc makes no warranty, express or implied, regarding the accuracy of the data or the results obtained from the use of this product. Nothing herein may be construed as recommending any practice or any product in violation of any law or regulations. The user is solely responsible for determining the suitability of any material or product for a specific purpose and for adopting any appropriate safety precautions. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

REVISED DATE: December 2019