

SECTION 1 - IDENTIFICATION

COMPANY ADDRESS:

The Virtual Foundry, LLC
211 S Water St
Stoughton, WI 53589
USA

PRODUCT NAME: Aluminum 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
Aluminum (Al)	7429-90-5	60.0 - 99.7
Alloying Elements		
Boron (B)	7440-42-8	0.0 - 1.5
Copper (Cu)	7440-50-8	0.0 - 40.0
Chromium (Cr)	7440-47-3	0.0 - 5.0
Indium (In)	7440-74-6	0.0 - 0.10
Iron (Fe)	7439-89-6	0.0 - 17.0
Lithium (Li)	7439-93-2	0.0 - 3.0
Magnesium (Mg)	7439-95-4	0.0 - 6.0

Manganese (Mn)	7439-96-5	0.0 - 1.5
Scandium (Sc)	7440-20-2	0.0 - 4.0
Silicon (Si)	7440-21-3	0.0 - 20.0
Silver (Ag)	7440-22-4	0.0 - 0.7
Titanium (Ti)	7440-32-6	0.0 - 10.0
Vanadium (V)	7440-62-2	0.0 - 2.0
Zinc (Zn)	7440-66-6	0.0 - 10.0
Zirconium (Zr)	7440-67-7	0.0 - 2.5
Alumina (Al ₂ O ₃)	1344-28-1	0.0 - 20.0
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 ethenylbenzene	9003-56-9	trace
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:** 650°C**FLAMMABILITY LIMITS IN AIR (MEC):** 45gm/m³**MEC/MIE:** Refer to NFPA 484, Sec. A4.3.1

SUITABLE EXTINGUISHING MEDIA: Type D. Use foam, Carbon Dioxide (CO₂), dry chemical, alcohol resistant foams (preferred if available). General-purpose synthetic foams (including AFFF) or protein foams may function, but much less effectively.

UNSUITABLE EXTINGUISHING MEDIA: Do not use a solid water stream as it may scatter and spread fire.

SPECIFIC HAZARDS ARISING FROM THE CHEMICAL: Thermal decomposition can lead to release of irritating gases and vapors. Do not breathe fumes in case of fire.

HAZARDOUS COMBUSTION PRODUCTS: Carbon oxides Nitrogen oxides (NO_x) Hydrocarbons.

EXPLOSION DATA

SENSITIVITY TO MECHANICAL IMPACT: Not sensitive

SENSITIVITY TO STATIC DISCHARGE: Fine dust dispersed in air, in sufficient concentrations, and in the presence of an ignition source is a potential dust explosion hazard.

SPECIAL FIRE FIGHTING PROCEDURES: 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.

UNUSUAL FIRE AND EXPLOSION HAZARDS: 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: Ensure adequate ventilation. Standard personal protection equipment (PPE). Avoid contact with skin eyes. Avoid dust formation.

ENVIRONMENTAL PRECAUTIONS: Avoid dispersal of spilled material, runoff and contact with soil, waterways, drains, and sewers. Should not be released into the environment, may be dangerous to birds and small animals.

METHODS FOR CLEANING UP: Remove all sources of ignition. Prohibit smoking in area. Use non-sparking conductive tools to transfer spilled material to a leak-proof container. Brushes/Brooms should have natural bristles. Avoid synthetic materials. Avoid generation of dust cloud during clean-up. Vacuum or carefully scoop up spilled material and place in appropriate container for disposal. Avoid creating dusty conditions and prevent wind dispersal. Ventilate area through non-mechanical means (e.g., opening a window). Take care not to raise dust. Use non-sparking tools. Clean up using methods, which

avoid dust generation such as vacuuming (with appropriate filter to prevent airborne dust levels which exceed the TLV), wet dust mop or wet clean up. If airborne dust is generated, use an appropriate NIOSH-approved respirator.

SECTION 7 - HANDLING AND STORAGE

HANDLING: Use personal protective equipment. Workers should be protected from the possibility of contact with molten material during fabrication. Avoid contact with eyes. Low hazard for usual industrial or commercial handling. Avoid accumulations of dust. Good housekeeping practices are essential to mitigate/prevent risk of secondary explosions. Local ventilation and vacuum systems must be suitable for use with Group E explosive dusts.

STORAGE: Do not store in areas protected by automatic sprinkler systems. Do not store with oxidizing materials. Proper grounding of process equipment is essential. Use non-sparking, conductive tools. Proper bonding of containers during transfer operations is essential. All electrical equipment must be suitable for Class II, Group E locations. Avoid static build-up and discharge. Keep tightly closed in cool, dry and well-ventilated environment. Keep away from heat, sparks, and flames. Keep away from incompatible materials. Store at temperatures not exceeding 50°C.

SECTION 8 - EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS

Base Metal	CAS No.	%by Weight	ACGIH TLV (Mg/M ³)	OSHA PEL (Mg/M ³)
Aluminum (Al)	7429-90-5	60.0 - 99.7	1.0 (Resp.)	15.0 (Total) 5.0 (Resp.)
Alloying Elements				
Boron (B)	7440-42-8	0.0 - 1.5	None	None
Copper (Cu)	7440-50-8	0.0 - 40.0	1.0 (Dust) 0.2 (Fume)	1.0 (Dust) 0.2 (Fume)
Chromium (Cr)	7440-47-3	0.0 - 5.0	0.5	1.0
Iron (Fe)	7439-89-6	0.0 - 17.0	5.0 (Fume)	10.0 (Fume)
Indium (In)	7440-74-6	0.0 - 0.10	0.1 (In)	0.1 (In)
Lithium (Li)	7439-93-2	0.0 - 3.0	None	None
Magnesium (Mg)	7439-95-4	0.0 - 6.0	10.0 (Fume)	15.0 (Fume)
Manganese (Mn)	7439-96-5	0.0 - 1.5	1.0 (Fume)	5.0
Scandium (Sc)	7440-20-2	0.0 - 4.0	None	None
Silicon (Si)	7440-21-3	0.0 - 20.0	10.0 (Total) 5.0 (Resp.)	15.0 (Total) None

Silver (Ag)	7440-22-4	0.0 - 0.7	None	None
Titanium (Ti)	7440-32-6	0.0 - 10.0	None	None
Vanadium (V)	7440-62-2	0.0 - 2.0	0.05 (V2O5)	0.5 (V2O5)
Zinc (Zn)	7440-66-6	0.0 - 10.0	5.0 (Fume)	5.0 (Fume)
Zirconium (Zr)	7440-67-7	0.0 - 2.5	5.0	5.0
Alumina (Al ₂ O ₃)	1344-28-1	0.0 - 20.0	10.0	15.0
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: Apply technical measures to comply with the occupational exposure limits. Where reasonably practicable this should be achieved by the use of local exhaust ventilation and good general extraction. Provide appropriate local ventilation systems that are suitable for Class II, Group E dusts, per the National Electrical Code, NFPA 70. Provide sufficient mechanical ventilation to reduce airborne concentrations and minimize exposure. Maintain employee exposure below applicable permissible exposure limits.

Exposure Monitoring

Exposure Limits: This material can generate Particulates Not Otherwise Classifiable (PNOC). The Occupational Safety and Health Administration (OSHA) PEL/TWA for PNOC is 15mg/m³ for the respirable fraction. The American Conference of Governmental Industrial Hygienists (ACGIH) TLV/TWA for PNOC is 10 mg/m³ for inhalable particulates and 3 mg/m³ for respirable particulates.

Hygiene Measures: Avoid contact with eyes. Do not inhale dust/smoke/mist. Avoid contact with skin and eyes. Wash hands before eating.

PERSONAL PROTECTIVE EQUIPMENT:

Eye protection: Avoid eye contact. To minimize the risk of injury to eyes, always wear appropriate protective safety glasses side-shields or chemical safety goggles.

Skin protection: Avoid skin contact. Wear appropriate protective clothing to minimize risk of injury to 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: Respirator must be worn if exposed to dust. Wear respirator with dust filter. Recommended respiratory protection: N95. If concentrations exceed the exposure limits listed in Section 2, Exposure Guidelines, or irritation or other symptoms are experienced, follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard 149 approved respirator. Respiratory protection is needed if any of the exposure limits in Section 3 are exceeded. Consult an industrial hygiene professional prior to respirator selection and use. Use a positive-pressure air supplied respirator if there is any potential for an uncontrolled release, exposure levels are not known, or any other circumstances where air-purifying respirators may not provide adequate protection. **WARNING:** Air purifying respirators do not protect workers in oxygen-deficient atmospheres.

Hand protection: Wear if contact is probable and skin is sensitive.

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: Workers should be protected from the possibility of contact with molten material during fabrication.

Environmental Protection: Do not allow to enter drains or watercourses.

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Appearance:	Filament, Pellets
Color:	Grayish
Odor:	Slight
Odor Threshold:	No information available.
Melting/Freezing Point:	150-180 ° C (302- 356 ° F) / 150-180 ° C (302- 356 ° F), Tg (Glass transition temperature): 55-60 ° C (131-140 °F)
Boiling Point:	No information available
Flash Point:	349°C / 660°F
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 (H2O=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:	455°C / 388°C
Hazardous Decomposition Products:	No information available
Possibility of Hazardous Reactions:	No information available.
Hazardous Polymerization:	No information available.
Decomposition Temperature:	320°C / 250 °C
Viscosity:	No information available.
Explosive Properties:	Fine dust dispersed in air may ignite.
Oxidizing Properties:	No information available.
Other Information:	
Softening Point:	80-100°C
VOC Content (%)	negligible
Bulk Density:	0.8-1.3 gm/cc (50-80 lb/ft3)
MEC:	45-120 (gm/m3)
MIE:	4-13 (mJ)
KST:	90-300 (bar-m/sec)
MIT (layer):	650C

SECTION 10 - STABILITY AND REACTIVITY

INCOMPATIBILITY: (Materials to Avoid): 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 Occur

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 (CO²). Exothermic reaction with water, acids, alkalis, to generate hydrogen and heat.

SECTION 11 - TOXICOLOGICAL INFORMATION

Principal routes of exposure: Eye contact, Skin contact, Inhalation, Ingestion.

PRODUCT INFORMATION:

Acute toxicity: No information available.

Chronic toxicity: Aluminum dust is considered to be a nuisance particulate by OSHA. Continued exposure to concentrations above the recommended TLV may cause irritation of the eye, mucous membranes and upper respiratory tract. Inhalation of Copper, Zinc fumes may be one cause of "Metal Fume Fever". Symptoms include chills, fever, sweating, metallic taste, nausea, general weakness, muscle aches. Chronic overexposure to Manganese may cause nervous system disorders (Parkinson-type symptoms, pneumonitis).

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: No information available.

Mutagenic effects: No information available.

Reproductive toxicity: No data is available on the product itself.

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 ethenylbenzene 9003-56-9	-	Group 3	-	--

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 respiratory system.

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

Symptoms related to the physical, chemical, and toxicological characteristics:

Symptoms: 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

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: Solid or chemical waste generators must determine whether a discarded waste is classified as a hazardous waste. U.S. EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local waste regulations to ensure complete and accurate classification. Should not be released into the environment. Do not contaminate ponds, waterways or ditches with chemical or used container.

CONTAMINATED PACKAGING: Empty remaining contents. Do not re-use empty containers. Empty containers should be transported/delivered using a registered waste carrier to local recyclers for disposal.

SECTION 14 - TRANSPORT INFORMATION

DOT: Not regulated.

MEX: Not regulated.

ICAO: Not regulated.

IATA: Not regulated.

IMDG: Not regulated.

UN NUMBER: NA

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: Reactive (Sudden Release of Pressure).

Section 313 Toxic Chemicals:

- Aluminum (Fume or Dust)
- Copper (If present >1.0% de minimus)
- Manganese (If present >1.0% de minimus)
- Silver (If present >1.0% de minimus)
- Zinc (Fume or Dust) (If present)

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 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
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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, LLC's knowledge. The Virtual Foundry, LLC 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: January 2019
REFERENCE: Revised for GHS compliance