SAFETY DATA SHEET

Issue Date 28-May-2015 **Revision Date** 11-Aug-2020 **Version** 5

Section 1: PRODUCT AND COMPANY IDENTIFICATION

Product identifier

Product Name Zirconium and Zirconium Alloys

Product Code SAC001

Other means of identification

Synonyms Zirconium and Zirconium Alloys: Includes the following non-powder products: Zirconium foil, Zircaloy-2, Zircaloy-4, Zr-2.5Nb, ZrNb705, Zircadyne 702, Zircadyne 704, Zircadyne 706, ASTM Grades B350-R60802, B350-B60804, B350-B60901, B352-R60812, B352-R60814, B493-R60704, B493-R60705, B493-R60706 (Product #334)

Registration Number(s)

Recommended use of the chemical and restrictions on use

Recommended Use Alloy product manufacture

Uses advised against

Details of the supplier of the safety data sheet

Manufacturer

Emergency telephone number

Section 2: HAZARDS IDENTIFICATION

Classification of the substance or mixture

Not a hazardous substance or mixture according to the Globally Harmonized System (GHS)

Label elements

Emergency Overview

Hazard statements

Appearance Various massive product forms	**Physical state** Solid	**Odor** Odorless

Precautionary Statements - Prevention

Precautionary Statements - Response

Precautionary Statements - Storage

Precautionary Statements - Disposal

Other Information

Other hazards When product is subjected to welding, burning, melting, sawing, brazing, grinding, buffing, polishing, or other similar heat-generating processes, the following potentially hazardous airborne particles and/or fumes may be generated: Hexavalent Chromium (Chromium VI) may cause lung, nasal, and/or sinus cancer. Soluble molybdenum compounds such as molybdenum trioxide may cause lung irritation.

Hazards not otherwise classified (HNOC)

• Not applicable

Section 3: COMPOSITION/INFORMATION ON INGREDIENTS

Synonyms

Zirconium and Zirconium Alloys: Includes the following non-powder products: Zirconium foil, Zircaloy-2, Zircaloy-4, Zr-2.5Nb, ZrNb705, Zircadyne 702, Zircadyne 704, Zircadyne 706, ASTM Grades B350-R60802, B350-B60804, B350-B60901, B352-R60812, B352-R60814, B493-R60704, B493-R60705, B493-R60706 (Product #334)

Chemical Name	Weight-%	ENCS	ISHL No.	CAS No.
Zirconium 7440-67-7	90-98.5	-	-	7440-67-7
Hafnium 7440-58-6	0.005-10	-	-	7440-58-6
Niobium (Columbium) 7440-03-1	0-4	-	-	7440-03-1
Tin 7440-31-5	0-3	-	-	7440-31-5
Molybdenum 7439-98-7	0-2	-	-	7439-98-7
Iron 7439-89-6	0.1-1	-	-	7439-89-6
Chromium 7440-47-3	0-1	-	-	7440-47-3
Nickel 7440-02-0	0-0.1	-	-	7440-02-0

Chemical Name	Poisonous and Deleterious Substances Control Law
Zirconium 7440-67-7	-
Hafnium 7440-58-6	-
Niobium (Columbium) 7440-03-1	-
Tin 7440-31-5	-
Molybdenum 7439-98-7	-
Iron 7439-89-6	-
Chromium 7440-47-3	-
Nickel 7440-02-0	-

Chemical Name	Class 1	Class 2
Zirconium 7440-67-7	-	-
Hafnium 7440-58-6	-	-
Niobium (Columbium) 7440-03-1	-	-
Tin 7440-31-5	-	-
Molybdenum 7439-98-7	453	-
Iron 7439-89-6	-	-
Chromium 7440-47-3	87	-
Nickel 7440-02-0	308 309	-

Section 4: FIRST AID MEASURES

Inhalation If excessive amounts of smoke, fume, or particulate are inhaled during processing, remove to fresh air and consult a qualified health professional.

Skin Contact In the case of skin irritation or allergic reactions see a physician.

Eye contact In the case of particles coming in contact with eyes during processing, treat as with any foreign object.

Ingestion Not an expected route of exposure.

Symptoms May cause allergic skin reaction.

Inhalation Not an expected route of exposure for product in massive form.

Skin Contact Nickel or Cobalt containing alloys may cause sensitization by skin contact.

Eye contact Not an expected route of exposure for product in massive form.

Ingestion Not an expected route of exposure for product in massive form.

Note to physicians Treat symptomatically.

Section 5: FIRE FIGHTING MEASURES

Flammable properties Non-flammable.

Explosive properties Not applicable.

Suitable extinguishing media Product not flammable in the form as distributed, flammable as finely divided particles or pieces resulting from processing of this product. Isolate large fires and allow to burn out. Smother small fires with salt (NaCl) or class D dry powder fire extinguisher.

Unsuitable extinguishing media Do not spray water on burning metal as an explosion may occur. This explosive characteristic is caused by the hydrogen and steam generated by the reaction of water with the burning material.

Specific hazards arising from the chemical Intense heat. Very fine, high surface area material resulting from grinding, buffing, polishing, or similar processes of this product may ignite spontaneously at room temperature. WARNING: Fine particles resulting from grinding, buffing, polishing, or similar processes of this product may form combustible dust-air mixtures. Keep particles away from all ignition sources including heat, sparks, and flame. Prevent dust accumulations to minimize combustible dust hazard. Zirconium foil, which is shipped as rolls, may ignite after unrolling if exposed to temperatures between 350-450°C, depending on foil thickness and rate of heating.

Hazardous combustion products Hexavalent Chromium (Chromium VI) may cause lung, nasal, and/or sinus cancer. Soluble molybdenum compounds such as molybdenum trioxide may cause lung irritation.

Special protective equipment for fire-fighters Firefighters should wear self-contained breathing apparatus and full firefighting turnout gear.

Section 6: ACCIDENTAL RELEASE MEASURES

Personal precautions Use personal protective equipment as required.

For emergency responders Use personal protective equipment as required.

Environmental precautions Not applicable to massive product.

Methods for containment Not applicable to massive product.

Methods for cleaning up Not applicable to massive product.

Section 7: HANDLING AND STORAGE

Handling

Advice on safe handling Very fine, high surface area material resulting from grinding, buffing, polishing, or similar processes of this product may ignite spontaneously at room temperature. WARNING: Fine particles resulting from grinding, buffing, polishing, or similar processes of this product may form combustible dust-air mixtures. Keep particles away from all ignition sources including heat, sparks, and flame. Prevent dust accumulations to minimize combustible dust hazard. Zirconium foil, which is shipped as rolls, may ignite after unrolling if exposed to temperatures between 350-450°C, depending on foil thickness and rate of heating.

Storage

Storage Conditions Keep chips, turnings, dust, and other small particles away from heat, sparks, flame and other sources of ignition (i.e., pilot lights, electric motors and static electricity).

Incompatible materials Dissolves in hydrofluoric acid. Ignites in the presence of fluorine. When heated above 200°C, reacts exothermically with the following:: chlorine, bromine, halocarbons, carbon tetrachloride, carbon tetrafluoride, and freon.

Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

Exposure Guidelines

Chemical Name	Japan	ISHL Working Environmental Evaluation Standards - Administrative Control Levels	ACGIH TLV
Zirconium 7440-67-7	-	-	STEL: 10 mg/m³ STEL: 10 mg/m³ Zr TWA: 5 mg/m³ TWA: 5 mg/m³ Zr
Hafnium 7440-58-6	-	-	TWA: 0.5 mg/m³ TWA: 0.5 mg/m³ Hf
Niobium (Columbium) 7440-03-1	-	-	-
Tin 7440-31-5	-	-	TWA: 2 mg/m³ TWA: 2 mg/m³ Sn except Tin hydride
Molybdenum 7439-98-7	-	-	TWA: 10 mg/m³ inhalable fraction TWA: 3 mg/m³ respirable fraction
Iron 7439-89-6	-	-	-
Chromium 7440-47-3	TWA: 0.5 mg/m³	-	TWA: 0.5 mg/m³
Nickel 7440-02-0	TWA: 1 mg/m³ ISHL/ACL: 0.1 mg/m³	ISHL/ACL: 0.1 mg/m³	TWA: 1.5 mg/m³ inhalable fraction

Engineering Controls Avoid generation of uncontrolled particles.

Personal Protective Equipment

Respiratory protection When particulates/fumes/gases are generated and if exposure limits are exceeded or irritation is experienced, proper approved respiratory protection should be worn. Positive-pressure supplied air respirators may be required for high airborne contaminant concentrations. Respiratory protection must be provided in accordance with current local regulations.

Eye/face protection	When airborne particles may be present, appropriate eye protection is recommended. For example, tight-fitting goggles, foam-lined safety glasses or other protective equipment that shield the eyes from particles.
Skin and body protection	Fire/flame resistant/retardant clothing may be appropriate during hot work with the product. Cut-resistant gloves and/or protective clothing may be appropriate when sharp surfaces are present.

General Hygiene Considerations Handle in accordance with good industrial hygiene and safety practice.

Section 9: PHYSICAL AND CHEMICAL PROPERTIES

Physical state	Solid		
Appearance	Various massive product forms	**Odor**	Odorless
Color	Metallic gray or silver	**Odor threshold**	Not applicable

Property	**Values**	**Remarks • Method**
pH	-	Not applicable
Melting point / freezing point	1850 °C / 3362 °F	
Boiling point / boiling range	-	
Flash point	-	
Evaporation rate	-	Not applicable
Flammability (solid, gas)	350-450 °C (Zr foil only)	Product not flammable in the form as distributed, flammable as finely divided particles or pieces resulting from processing of this product. Zirconium foil, which is shipped as rolls, may ignite after unrolling if exposed to temperatures between 350-450°C, depending on foil thickness and rate of heating
Flammability Limit in Air		
Upper flammability limit:	-	
Lower flammability limit:	-	
Vapor pressure	-	Not applicable
Vapor density	-	Not applicable
Specific Gravity	6.49	
Water solubility	Insoluble	
Solubility(ies)		
Partition coefficient	-	Not applicable
Autoignition temperature	-	Not applicable
Decomposition temperature	-	Not applicable
Kinematic viscosity	-	Not applicable
Dynamic viscosity	-	Not applicable
Explosive properties	Not applicable	
Oxidizing properties	Not applicable	
Softening point	-	
Molecular weight	-	
VOC Content (%)	Not applicable	
Density	-	
Bulk density	-	

Section 10: STABILITY AND REACTIVITY

Reactivity
Not applicable

Stability Stable under normal conditions.

Explosion data

Sensitivity to Mechanical Impact	None.
Sensitivity to Static Discharge	None.

Possibility of Hazardous Reactions None under normal processing

Hazardous polymerization Hazardous polymerization does not occur

Conditions to avoid Dust formation and dust accumulation

Incompatible materials Dissolves in hydrofluoric acid. Ignites in the presence of fluorine. When heated above 200°C, reacts exothermically with the following:: chlorine, bromine, halocarbons, carbon tetrachloride, carbon tetrafluoride, and freon

Hazardous Decomposition Products When product is subjected to welding, burning, melting, sawing, brazing, grinding, buffing, polishing, or other similar heat-generating processes, the following potentially hazardous airborne particles and/or fumes may be generated:: Soluble molybdenum compounds such as molybdenum trioxide may cause lung irritation. Hexavalent Chromium (Chromium VI) may cause lung, nasal, and/or sinus cancer.

Section 11: TOXICOLOGICAL INFORMATION

Information on likely routes of exposure

Product Information

Inhalation Not an expected route of exposure for product in massive form.

Eye contact Not an expected route of exposure for product in massive form.

Skin Contact Nickel or Cobalt containing alloys may cause sensitization by skin contact.

Ingestion Not an expected route of exposure for product in massive form.

Chemical Name	Oral LD50	Dermal LD50	Inhalation LC50
Zirconium 7440-67-7	> 5000 mg/kg bw	-	>4.3 mg/L
Hafnium 7440-58-6	> 5000 mg/kg bw	-	>4.3mg/L
Niobium (Columbium) 7440-03-1	> 10,000 mg/kg bw	> 2000 mg/kg bw	-
Tin 7440-31-5	> 2000 mg/kg bw	> 2000 mg/kg bw	> 4.75 mg/L
Molybdenum 7439-98-7	> 2000 mg/kg bw	> 2000 mg/kg bw	> 5.10 mg/L
Iron 7439-89-6	98,600 mg/kg bw	-	> 0.25 mg/L
Chromium 7440-47-3	> 3400 mg/kg bw	-	> 5.41 mg/L
Nickel 7440-02-0	> 9000 mg/kg bw	-	> 10.2 mg/L

Information on toxicological effects

Symptoms Nickel or Cobalt containing alloys may cause sensitization by skin contact.

Acute toxicity

Numerical measures of toxicity - Product Information

Numerical measures of toxicity - Component Information

Chemical Name	Oral LD50	Dermal LD50	Inhalation LC50

Zirconium	> 5000 mg/kg bw	-	>4.3 mg/L
Hafnium	> 5000 mg/kg bw	-	>4.3mg/L
Niobium (Columbium)	> 10,000 mg/kg bw	> 2000 mg/kg bw	-
Tin	> 2000 mg/kg bw	> 2000 mg/kg bw	> 4.75 mg/L
Molybdenum	> 2000 mg/kg bw	> 2000 mg/kg bw	> 5.10 mg/L
Iron	98,600 mg/kg bw	-	> 0.25 mg/L
Chromium	> 3400 mg/kg bw	-	> 5.41 mg/L
Nickel	> 9000 mg/kg bw	-	> 10.2 mg/L

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Skin corrosion/irritation Product not classified.

Serious eye damage/eye irritation Product not classified.

Sensitization Nickel or Cobalt containing alloys may cause sensitization by skin contact.

Germ cell mutagenicity Product not classified.

Carcinogenicity Product not classified.

Chemical Name	Japan	IARC
Zirconium 7440-67-7		-
Hafnium 7440-58-6		-
Niobium (Columbium) 7440-03-1		-
Tin 7440-31-5		-
Molybdenum 7439-98-7		-
Iron 7439-89-6		-
Chromium 7440-47-3		Group 3
Nickel 7440-02-0	2	Group 1 Group 2B

Reproductive toxicity Product not classified.

STOT - single exposure Product not classified.

STOT - repeated exposure Product not classified.

Aspiration hazard Product not classified.

Section 12: ECOLOGICAL INFORMATION

Ecotoxicity

This product as shipped is not classified for aquatic toxicity.

Chemical Name	Algae/aquatic plants	Fish	Toxicity to microorganisms	Crustacea
Zirconium	*The 14 d NOEC of zirconium dichloride oxide to Chlorella vulgaris was greater than 102.5 mg of Zr/L.*	*The 96 h LL50 of zirconium to Danio rerio was greater than 74.03 mg/L.*	-	*The 48 h EC50 of zirconium dioxide to Daphnia magna was greater than 74.03 mg of Zr/L.*

Hafnium	*The 72 h EC50 of hafnium to Pseudokirchneriella subcapitata was great than 8 ug of Hf/L (100% saturated solution).*	*The 96 h LC50 of Hafnium dioxide in water to Danio rerio was greater than the solubility limit of 0.007 mg Hf/L .*	-	*The 48 h EC50 of Hafnium dioxide to Daphnia magna was greater than the solubility limit of 0.007 mg Hf/L.*
Niobium (Columbium)	-	-	-	-
Tin	*The 72 h EC50 of tin chloride pentahydrate to Pseudokirchnerella subcapitata was 9,846 ug of Sn/L*	*The 7 d LOEC of tin chloride pentahydrate to Pimephales promelas was 827.9 ug of Sn/L*	-	*The 7 d LC50 of tin chloride pentahydrate to Ceriodaphnia dubia was greater than 3,200 ug of Sn/L.*
Molybdenum	*The 72 h EC50 of sodium molybdate dihydrate to Pseudokirchneriella subcapitata was 362.9 mg of Mo/L.*	*The 96 h LC50 of sodium molybdate dihydrate to Pimephales promelas was 644.2 mg/L*	The 3 h EC50 of molybdenum trioxide for activated sludge was 820 mg/L.	*The 48 h LC50 of sodium molybdate dihydrate to Ceriodaphnia dubia was 1,015 mg/L. The 48 h LC50 of sodium molybdate dihydrate to Daphnia magna was greater than 1,727.8 mg/L.*
Iron	-	*The 96 h LC50 of 50% iron oxide black in water to Danio rerio was greater than 10,000 mg/L.*	The 3 h EC50 of iron oxide for activated sludge was greater than 10,000 mg/L.	*The 48 h EC50 of iron oxide to Daphnia magna was greater than 100 mg/L.*
Chromium	-	-	-	-
Nickel	*NOEC/EC10 values range from 12.3 µg/l for Scenedesmus accuminatus to 425 µg/l for Pseudokirchneriella subcapitata.*	*The 96h LC50s values range from 0.4 mg Ni/L for Pimephales promelas to 320 mg Ni/L for Brachydanio rerio.*	The 30 min EC50 of nickel for activated sludge was 33 mg Ni/L.	*The 48h LC50s values range from 0.013 mg Ni/L for Ceriodaphnia dubia to 4970 mg Ni/L for Daphnia magna.*

Persistence and degradability

Bioaccumulation

Other adverse effects

Chemical Name	EU - Endocrine Disrupters Candidate List	EU - Endocrine Disruptors - Evaluated Substances	Endocrine disrupting potential
Zirconium	-	-	-
Hafnium	-	-	-
Niobium (Columbium)	-	-	-
Tin	-	-	-
Molybdenum	-	-	-
Iron	-	-	-
Chromium	-	-	-
Nickel	-	-	-

Section 13: DISPOSAL CONSIDERATIONS

Waste from residues/unused products Disposal should be in accordance with applicable regional, national and local laws and regulations.

Contaminated packaging None anticipated.

Section 14: TRANSPORT INFORMATION

IMDG Not regulated

ICAO (air) Not regulated

ADR Not regulated

IATA Not regulated
Japan

Section 15: REGULATORY INFORMATION

International Inventories

DSL/NDSL	Complies
EINECS/ELINCS	Complies
ENCS	Complies
IECSC	Complies
KECL	Complies
PICCS	Not Listed
AICS	Not Listed

Legend:
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List
EINECS/ELINCS - European Inventory of Existing Chemical Substances/European List of Notified Chemical Substances
ENCS - Japan Existing and New Chemical Substances
IECSC - China Inventory of Existing Chemical Substances
KECL - Korean Existing and Evaluated Chemical Substances
PICCS - Philippines Inventory of Chemicals and Chemical Substances
AICS - Australian Inventory of Chemical Substances

Chemical Name	Dangerous Substances	organic solvents	Harmful Substances Whose Names Are to be Indicated on the Label	ISHL - Prevention of Hazards Due to Specified Chemical Substances (Class 2)	Prevention of Lead Poisoning
Zirconium 7440-67-7	>1 %	Not applicable	Not applicable	-	-
Hafnium 7440-58-6	>1 %	Not applicable	Not applicable	-	-
Niobium (Columbium) 7440-03-1	Not applicable	Not applicable	Not applicable	-	-
Tin 7440-31-5	>0.1 %	Not applicable	Not applicable	-	-
Molybdenum 7439-98-7	Ignitable substance X >1 %	Not applicable	Not applicable	-	-
Iron 7439-89-6	Not applicable	Not applicable	Not applicable	-	-
Chromium 7440-47-3	>0.1 %	Not applicable	Not applicable	-	-
Nickel 7440-02-0	>0.1 %	Not applicable	X	-	-

Chemical Name	Class 2	Class 1	Poisonous and Deleterious Substances Control Law	Fire Service Law:
Zirconium 7440-67-7	-	-	Not applicable	Class 2
Hafnium	-	-	Not applicable	Class 2

7440-58-6				
Niobium (Columbium) 7440-03-1	-	-	Not applicable	Class 2
Tin 7440-31-5	-	-	Not applicable	Class 2
Molybdenum 7439-98-7	-	453	Not applicable	2
Iron 7439-89-6	-	-	Not applicable	2
Chromium 7440-47-3	-	87	Not applicable	Class 2
Nickel 7440-02-0	-	308 309	Not applicable	Class 2

Fire Service Law: -

Section 16: OTHER INFORMATION

Issue Date 28-May-2015

Revision Date 11-Aug-2020

Revision Note SDS sections updated: 4, 5, 7, 9, 12.

Key or legend to abbreviations and acronyms used in the safety data sheet

Note:
This SDS complies with the requirements of JIS Z 7250:2010 and JIS Z 7252:2009 (Japan)
The information provided in this safety data sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

End of Safety Data Sheet

Additional information available from: Safety data sheets and labels available at ATImaterials.com