Section 1: PRODUCT AND COMPANY IDENTIFICATION

Product identifier
Product Name: Hafnium Tetrachloride
Product Code: SAC027

Other means of identification
UN/ID No.: 1759
Synonyms: Hafnium Tetrachloride: Hafnium Chloride, (Product #405)

Registration Number(s)

Recommended use of the chemical and restrictions on use
Recommended Use: Chemical intermediate
Uses advised against

Details of the supplier of the safety data sheet
Manufacturer: ATI, 1000 Six PPG Place, Pittsburgh, PA 15222 USA
Emergency telephone number:
Emergency Telephone: Chemtrec +1 703-741-5970

Section 2: HAZARDS IDENTIFICATION

Classification of the substance or mixture
| Corrosive to metals: Category 1 |
| Skin corrosion/irritation: Category 1B |

Label elements

Emergency Overview

Signal word: Danger
Hazard statements:
H290 - May be corrosive to metals
H314 - Causes severe skin burns and eye damage

Appearance: Powder
Physical state: Solid
Odor: Pungent, Slight chlorine.

Precautionary Statements - Prevention
• Wear protective gloves/protective clothing/eye protection
• Do not breathe dust/gas/mist

Precautionary Statements - Response

• IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. • Immediately call a POISON CENTER or doctor/physician
• IF ON SKIN (or hair): • Brush off loose particles from skin. Remove/ Take off immediately all contaminated clothing. Rinse skin with water/ shower
• IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
• IF SWALLOWED: Rinse mouth. DO NOT induce vomiting
• Wash contaminated clothing before reuse
• Absorb spillage to prevent material damage

Precautionary Statements - Storage

• Store in a dry place
• Store in corrosion-resistant container

Precautionary Statements - Disposal

• Dispose of contents/container to an approved waste disposal plant

Other Information

Other hazards Harmful if swallowed
Hazards not otherwise classified (HNOC)
Reacts violently with water • (EUH014)

Section 3: COMPOSITION/INFORMATION ON INGREDIENTS

Synonyms
Hafnium Tetrachloride: Hafnium Chloride, (Product #405)

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>Weight-%</th>
<th>ENCS</th>
<th>ISHL No.</th>
<th>CAS No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hafnium Tetrachloride</td>
<td>&gt;95</td>
<td>X</td>
<td>-</td>
<td>13499-05-3</td>
</tr>
<tr>
<td>13499-05-3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zirconium Tetrachloride</td>
<td>&lt;4</td>
<td>X</td>
<td>-</td>
<td>10026-11-6</td>
</tr>
<tr>
<td>10026-11-6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Chemical Name  | Poisonous and Deleterious Substances Control Law |
-----------------|-------------------------------------------------|
Hafnium Tetrachloride 13499-05-3 | - |
Zirconium Tetrachloride 10026-11-6 | - |

Section 4: FIRST AID MEASURES

Inhalation
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Call a physician or poison control center immediately.

Skin Contact
Brush off loose particles from skin. Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.

Eye contact
Flush with water for 15 minutes. See a physician.

Ingestion
Do NOT induce vomiting. Have patient drink large quantities of water if able. Call Physician immediately for further instructions.

Symptoms
May cause acute gastrointestinal effects if swallowed. Contact with moist skin may cause skin burns. May cause breathing difficulties if inhaled.
Inhalation  
Product not classified.

Skin Contact  
Causes severe skin burns.

Eye contact  
Causes severe eye damage.

Ingestion  
Harmful if swallowed.

Note to physicians  
Treat symptomatically.

Section 5: FIRE FIGHTING MEASURES

Flammable properties  
Non-combustible.

Explosive properties  
Not applicable.

Suitable extinguishing media  
Non-combustible.

Unsuitable extinguishing media  
If a fire occurs in the area, avoid water contact with the product to prevent evolution of hazardous gases.

Specific hazards arising from the chemical  
Non-combustible.

Hazardous combustion products  
Hydrogen chloride gas may cause respiratory and/or eye 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. Follow Emergency Response Guidebook, Guide No. 154.

Environmental precautions  
Collect spillage to prevent release to the environment.

Methods for containment  
Prevent further leakage or spillage if safe to do so.

Methods for cleaning up  
Sweep or shovel material into dry containers. Avoid creating uncontrolled dust. Wash the spill location thoroughly with water. Respiratory protection may be needed. Skin and eye protection should be used during cleanup.

Section 7: HANDLING AND STORAGE

Handling  
Advice on safe handling  
Handle in accordance with good industrial hygiene and safety practice. Protect from moisture. Reacts with water. Ensure adequate ventilation, especially in confined areas. Handle under inert gas such as nitrogen or argon to maintain the integrity of the product.

Storage  
Storage Conditions  
Keep in corrosion resistant containers. Keep in properly labeled containers. Keep in a dry, cool and well-ventilated place. Protect from direct sunlight. Containers may become pressurized. Handle and open container with care.

Incompatible materials  
Water, alcohols, phenols, and amines. Rubber, coatings, and some plastics. Reacts with metals to produce heat and corrosive gases.

Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION
Exposure Guidelines

This product, as supplied, does not contain any hazardous materials with occupational exposure limits established by the region specific regulatory bodies.

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>Japan</th>
<th>ISHL Working Environmental Evaluation Standards - Administrative Control Levels</th>
<th>ACGIH TLV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hafnium Tetrachloride</td>
<td>-</td>
<td></td>
<td>TWA: 0.5 mg/m³ Hf</td>
</tr>
<tr>
<td></td>
<td>13499-05-3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zirconium Tetrachloride</td>
<td>-</td>
<td></td>
<td>STEL: 10 mg/m³ Zr</td>
</tr>
<tr>
<td></td>
<td>10026-11-6</td>
<td></td>
<td>TWA: 5 mg/m³ Zr</td>
</tr>
</tbody>
</table>

Engineering Controls

Avoid generation of uncontrolled particles. Local exhaust ventilation during processing is recommended.

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

If a risk of eye injury or irritation is present, appropriate eye protection is recommended; for example, tight-fitting goggles, foam-lined safety glasses, face shield, or other protective equipment that shields the eyes.

Skin and body protection

Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

General Hygiene Considerations

Handle in accordance with good industrial hygiene and safety practice.

Section 9: PHYSICAL AND CHEMICAL PROPERTIES

<table>
<thead>
<tr>
<th>Property</th>
<th>Values</th>
<th>Remarks • Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical state</td>
<td>Solid</td>
<td></td>
</tr>
<tr>
<td>Appearance</td>
<td>Powder</td>
<td>Odor</td>
</tr>
<tr>
<td>Color</td>
<td>white, orange</td>
<td>Odor threshold</td>
</tr>
<tr>
<td>pH</td>
<td>&lt;1</td>
<td></td>
</tr>
<tr>
<td>Melting point / freezing point</td>
<td>320 °C / 610 °F</td>
<td></td>
</tr>
<tr>
<td>Boiling point / boiling range</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Flash point</td>
<td>-</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Evaporation rate</td>
<td>-</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Flammability (solid, gas)</td>
<td>-</td>
<td>Not flammable</td>
</tr>
<tr>
<td>Flammability Limit in Air</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper flammability limit:</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Lower flammability limit:</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Vapor pressure</td>
<td>-</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Vapor density</td>
<td>-</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>2.8</td>
<td></td>
</tr>
<tr>
<td>Water solubility</td>
<td>Reacts with water, hydrolyzes</td>
<td></td>
</tr>
<tr>
<td>Solubility(ies)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Partition coefficient</td>
<td>-</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Autoignition temperature</td>
<td>-</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Decomposition temperature</td>
<td>-</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Kinematic viscosity</td>
<td>-</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Dynamic viscosity</td>
<td>-</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Explosive properties</td>
<td>Not applicable</td>
<td></td>
</tr>
<tr>
<td>Oxidizing properties</td>
<td>Not applicable</td>
<td></td>
</tr>
<tr>
<td>Softening point</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Molecular weight</td>
<td>320.30 of Hafnium Tetrachloride</td>
<td></td>
</tr>
<tr>
<td>VOC Content (%)</td>
<td>Not applicable</td>
<td></td>
</tr>
<tr>
<td>Density</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>
Bulk density 110-130lb/ft³

---

**Section 10: STABILITY AND REACTIVITY**

**Reactivity**
Reacts with water

**Stability**
Stable under normal conditions.

**Explosion data**
- Sensitivity to Mechanical Impact: None.
- Sensitivity to Static Discharge: None.

**Possibility of Hazardous Reactions**
Reacts with water

**Hazardous polymerization**
Hazardous polymerization does not occur

**Conditions to avoid**
Unintentional contact with water

**Incompatible materials**
Water, alcohols, phenols, and amines. Rubber, coatings, and some plastics. Reacts with metals to produce heat and corrosive gases.

**Hazardous Decomposition Products**
Reacts with water to produce hydrogen chloride gas or hydrochloric acid and heat.

---

**Section 11: TOXICOLOGICAL INFORMATION**

**Information on likely routes of exposure**

**Product Information**

**Inhalation**
Product not classified.

**Eye contact**
Causes severe eye damage.

**Skin Contact**
Causes severe skin burns.

**Ingestion**
Harmful if swallowed.

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>Oral LD50</th>
<th>Dermal LD50</th>
<th>Inhalation LC50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hafnium Tetrachloride 13499-05-3</td>
<td>112 mg/kg bw</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Zirconium Tetrachloride 10026-11-6</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Information on toxicological effects**

**Symptoms**
May cause skin burns. May cause severe upper respiratory irritation if inhaled. May cause acute gastrointestinal effects if swallowed. May cause burning sensation or redness in the eyes.

---

**Acute toxicity**

**Numerical measures of toxicity - Product Information**

**Numerical measures of toxicity - Component Information**

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>Oral LD50</th>
<th>Dermal LD50</th>
<th>Inhalation LC50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hafnium Tetrachloride</td>
<td>112 mg/kg bw</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Zirconium Tetrachloride - - - -

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

**Skin corrosion/irritation**
Causes severe skin burns.

**Serious eye damage/eye irritation**
Causes severe eye damage.

**Sensitization**
Product not classified.

**Germ cell mutagenicity**
Product not classified.

**Carcinogenicity**
Product not classified.

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>Japan</th>
<th>IARC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hafnium Tetrachloride</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>13499-05-3</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Zirconium Tetrachloride</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>10026-11-6</td>
<td></td>
<td>-</td>
</tr>
</tbody>
</table>

**Reproductive toxicity**
Product not classified.

**STOT - single exposure**
Product not classified.

**STOT - repeated exposure**
Product not classified.

**Target Organ Effects**
.

**Aspiration hazard**
Product not classified.

---

**Section 12: ECOLOGICAL INFORMATION**

**Ecotoxicity**
This product as shipped is not classified for aquatic toxicity.

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>Algae/aquatic plants</th>
<th>Fish</th>
<th>Toxicity to microorganisms</th>
<th>Crustacea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hafnium Tetrachloride</td>
<td>The 72 h EC50 of Hafnium dioxide in water to <em>Pseudokirchneriella subcapitata</em> was greater than the solubility limit of 0.008 mg Hf/L.</td>
<td>The 96 h LC50 of Hafnium dioxide in water to <em>Danio rerio</em> was greater than the solubility limit of 0.007 mg Hf/L.</td>
<td>-</td>
<td>The 48 h EC50 of Hafnium dioxide to <em>Daphnia magna</em> was greater than the solubility limit of 0.007 mg Hf/L.</td>
</tr>
<tr>
<td>Zirconium Tetrachloride</td>
<td>The 14 d NOEC of zirconium tetrachloride to <em>Chlorella vulgaris</em> was greater than 262 mg of ZrCl4/L.</td>
<td>The 96h LC50 value of zirconium tetrachloride to <em>Oncorhynchus mykiss</em> was greater than 51 mg ZrCl4/L and the 96 h LL50 of zirconium tetrachloride to <em>Danio rerio</em> was greater than 190 mg of ZrCl4/L.</td>
<td>-</td>
<td>The 48 h EC50 of zirconium tetrachloride to <em>Daphnia magna</em> was greater than 190 mg of ZrCl4/L.</td>
</tr>
</tbody>
</table>

**Persistence and degradability**
.

**Bioaccumulation**
.
Mobility

Other adverse effects

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>EU - Endocrine Disrupters - Candidate List</th>
<th>EU - Endocrine Disruptors - Evaluated Substances</th>
<th>Endocrine disrupting potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hafnium Tetrachloride</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Zirconium Tetrachloride</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

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
Disposal should be in accordance with applicable regional, national and local laws and regulations.

Section 14: TRANSPORT INFORMATION

UN Number 1759
Packing Group III
Proper shipping name Corrosive solid, n.o.s. (Hafnium Tetrachloride)
Hazard Class 8
Special Provisions 128, IB8, IP3, T1, TP33

IMDG
Proper shipping name Corrosive solid, n.o.s. (Hafnium Tetrachloride)
Hazard Class 8
UN/ID No. 1759
Packing Group III
Special Provisions 128, IB8, IP3, T1, TP33

ICAO (air)
UN/ID No. 1759
Proper shipping name Corrosive solid, n.o.s. (Hafnium Tetrachloride)
Hazard Class 8
Packing Group III
Special Provisions 128, IB8, IP3, T1, TP33

ADR
UN/ID No. 1759
Proper shipping name Corrosive solid, n.o.s. (Hafnium Tetrachloride)
Hazard Class 8
Packing Group III
ERG Code 154
Special Provisions 128, IB8, IP3, T1, TP33

IATA
UN/ID No. 1759
Proper shipping name Corrosive solid, n.o.s. (Hafnium Tetrachloride)
Hazard Class 8
Packing Group III
Special Provisions 128, IB8, IP3, T1, TP33

Japan
UN Number 1759
Proper shipping name Corrosive solid, n.o.s. (Hafnium Tetrachloride)
Hazard Class 8
Packing Group III
Special Provisions 128, IB8, IP3, T1, TP33

Section 15: REGULATORY INFORMATION
International Inventories

<table>
<thead>
<tr>
<th>Inventory</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSL/NDSL</td>
<td>Complies</td>
</tr>
<tr>
<td>EINECS/ELINCS</td>
<td>Complies</td>
</tr>
<tr>
<td>ENCS</td>
<td>Complies</td>
</tr>
<tr>
<td>IECSC</td>
<td>Not Listed</td>
</tr>
<tr>
<td>KECL</td>
<td>Complies</td>
</tr>
<tr>
<td>PICCS</td>
<td>Not Listed</td>
</tr>
<tr>
<td>AICS</td>
<td>Not Listed</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>Dangerous Substances</th>
<th>organic solvents</th>
<th>Harmful Substances Whose Names Are to be Indicated on the Label</th>
<th>ISHL - Prevention of Hazards Due to Specified Chemical Substances (Class 2)</th>
<th>Prevention of Lead Poisoning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hafnium Tetrachloride 13499-05-3</td>
<td>&gt;1 %</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zirconium Tetrachloride 10026-11-6</td>
<td>&gt;1 %</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>Class 2</th>
<th>Class 1</th>
<th>Poisonous and Deleterious Substances Control Law</th>
<th>Fire Service Law:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hafnium Tetrachloride 13499-05-3</td>
<td>Not applicable</td>
<td>-</td>
<td>Not applicable</td>
<td>-</td>
</tr>
<tr>
<td>Zirconium Tetrachloride 10026-11-6</td>
<td>Not applicable</td>
<td>-</td>
<td>Not applicable</td>
<td>-</td>
</tr>
</tbody>
</table>

Section 16: OTHER INFORMATION

Prepared By

Issue Date 08-Jul-2015
Revision Date 28-Feb-2020
Revision Note SDS sections updated: 2, 5, 6, 9, 11, 12, 14.

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 ATlmetals.com