1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Product identifier
Product Name: Hafnium Tetrachloride

Other means of identification
Product Code: SAC027
UN/ID No.: 1759
Synonyms: Hafnium Tetrachloride: Hafnium Chloride, (Product #405)

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 Address: ATI, 1000 Six PPG Place, Pittsburgh, PA 15222 USA
Emergency telephone number: Chemtrec: 1-800-424-9300

2. HAZARDS IDENTIFICATION

Classification
This material is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

- Skin corrosion/irritation: Category 1B
- May be corrosive to metals: Category 1

Label elements

Emergency Overview

Danger

Hazard statements
May be corrosive to metals
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 SWALLOWED: Rinse mouth. Do NOT induce vomiting
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 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.
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.

Hazards not otherwise classified (HNOC)
Reacts violently with water (EUH014)

Other Information
Harmful if swallowed.

3. COMPOSITION/INFORMATION ON INGREDIENTS

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

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

4. FIRST AID MEASURES

First aid measures

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

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

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.

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

Most important symptoms and effects, both acute and delayed

Symptoms
May cause acute gastrointestinal effects if swallowed. Contact with moist skin may cause skin burns. May cause breathing difficulties if inhaled.

Indication of any immediate medical attention and special treatment needed

Note to physicians
Treat symptomatically.

5. FIRE-FIGHTING MEASURES

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.

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

Protective equipment and precautions for firefighters  
Firefighters should wear self-contained breathing apparatus and full firefighting turnout gear.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

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

Environmental precautions  Collect spillage to prevent release to the environment.

Methods and material for containment and cleaning up

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.

7. HANDLING AND STORAGE

Precautions for safe 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.

Conditions for safe storage, including any incompatibilities


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

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>ACGIH TLV</th>
<th>OSHA PEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hafnium Tetrachloride</td>
<td>TWA: 0.5 mg/m³ Hf</td>
<td></td>
</tr>
<tr>
<td>13499-05-3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zirconium Tetrachloride</td>
<td>STEL: 10 mg/m³ Zr</td>
<td>TWA: 5 mg/m³ Zr</td>
</tr>
<tr>
<td>10026-11-6</td>
<td>TWA: 5 mg/m³ Zr</td>
<td>(vacated) STEL: 10 mg/m³ Zr</td>
</tr>
</tbody>
</table>

Page 3 / 8

North America; English
Appropriate engineering controls

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

Individual protection measures, such as personal protective equipment

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.

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.

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

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic 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>Odor</td>
</tr>
<tr>
<td>Appearance</td>
<td>Powder</td>
<td>Odor threshold</td>
</tr>
<tr>
<td>Color</td>
<td>white, orange</td>
<td></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 in other solvents</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Partition coefficient</td>
<td>-</td>
<td></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>
</tbody>
</table>

Other Information

<table>
<thead>
<tr>
<th>Property</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Softening point</td>
<td>-</td>
</tr>
<tr>
<td>Molecular weight</td>
<td>320.30 of Hafnium Tetrachloride</td>
</tr>
<tr>
<td>VOC Content (%)</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Density</td>
<td>-</td>
</tr>
<tr>
<td>Bulk density</td>
<td>110-130lb/ft3</td>
</tr>
</tbody>
</table>
10. STABILITY AND REACTIVITY

Reactivity
Reacts with water

Chemical stability
Stable under normal conditions.

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.

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</td>
<td>112 mg/kg bw</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>13499-05-3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zirconium Tetrachloride</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>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.

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

Acute toxicity
Harmful if swallowed.

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.

Reproductive toxicity
Product not classified.

STOT - single exposure
Product not classified.

STOT - repeated exposure
Product not classified.
Aspiration hazard

Product not classified.

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>
</tr>
</thead>
<tbody>
<tr>
<td>Hafnium Tetrachloride</td>
<td>The 72 h EC50 of Hafnium dioxide in water to Pseudokirchneriella subcapitata was greater than the solubility limit of 0.008 mg Hf/L.</td>
<td>The 96 h LC50 of Hafnium dioxide in water to Danio rerio was greater than the solubility limit of 0.007 mg Hf/L.</td>
</tr>
<tr>
<td>13499-05-3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zirconium Tetrachloride</td>
<td>The 14 d NOEC of zirconium tetrachloride to Chlorella vulgaris was greater than 262 mg of ZrCl4/L.</td>
<td>The 96h LC50 value of zirconium tetrachloride to Oncorhynchus mykiss was greater than 51 mg ZrCl4/L and the 96 h LL50 of zirconium tetrachloride to Danio rerio was greater than 190 mg of ZrCl4/L.</td>
</tr>
<tr>
<td>10026-11-6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Other adverse effects

13. DISPOSAL CONSIDERATIONS

Waste treatment methods

Disposal of wastes

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.

14. TRANSPORT INFORMATION

DOT

<table>
<thead>
<tr>
<th>UN/ID No.</th>
<th>Proper shipping name</th>
<th>Hazard Class</th>
<th>Packing Group</th>
<th>Special Provisions</th>
<th>Emergency Response Guide Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1759</td>
<td>Corrosive solid, n.o.s. (Hafnium Tetrachloride)</td>
<td>8</td>
<td>III</td>
<td>128, IB8, IP3, T1, TP33</td>
<td>154</td>
</tr>
</tbody>
</table>

15. REGULATORY INFORMATION

International Inventories

<table>
<thead>
<tr>
<th>TSCA</th>
<th>DSL/NDSL</th>
<th>EINECS/ELINCS</th>
<th>ENCS</th>
<th>IECSC</th>
<th>KECL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complies</td>
<td>Complies</td>
<td>Complies</td>
<td>Complies</td>
<td>Not Listed</td>
<td>Complies</td>
</tr>
</tbody>
</table>
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

US Federal Regulations

SARA 313
Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product does not contain any chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372

SARA 311/312 Hazard Categories

<table>
<thead>
<tr>
<th>Hazard Category</th>
<th>Yes/No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute health hazard</td>
<td>Yes</td>
</tr>
<tr>
<td>Chronic Health Hazard</td>
<td>No</td>
</tr>
<tr>
<td>Fire hazard</td>
<td>No</td>
</tr>
<tr>
<td>Sudden release of pressure hazard</td>
<td>No</td>
</tr>
<tr>
<td>Reactive Hazard</td>
<td>No</td>
</tr>
</tbody>
</table>

CWA (Clean Water Act)
This product contains the following substances which are regulated pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42)

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>CWA - Reportable Quantities</th>
<th>CWA - Toxic Pollutants</th>
<th>CWA - Priority Pollutants</th>
<th>CWA - Hazardous Substances</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zirconium Tetrachloride 10026-11-6</td>
<td>5000 lb</td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

CERCLA
This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>Hazardous Substances RQs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zirconium Tetrachloride 10026-11-6</td>
<td>5000 lb</td>
</tr>
</tbody>
</table>

US State Regulations

California Proposition 65
This product does not contain any Proposition 65 chemicals

U.S. State Right-to-Know Regulations

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>New Jersey</th>
<th>Massachusetts</th>
<th>Pennsylvania</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zirconium Tetrachloride 10026-11-6</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

U.S. EPA Label Information
EPA Pesticide Registration Number Not applicable

16. OTHER INFORMATION
Additional information available from: Safety data sheets and labels available at ATImetals.com