Section 1: IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

1.1. Product identifier

Product Code
SAC027

Product Name
Hafnium Tetrachloride

UN/ID no
1759

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

1.2. Relevant identified uses of the substance or mixture and uses advised against

Recommended Use
Chemical intermediate

Uses advised against

1.3. Details of the supplier of the safety data sheet

Manufacturer
ATI, 1000 Six PPG Place, Pittsburgh, PA 15222 USA

1.4. Emergency telephone number

Emergency Telephone
Chemtrec: +1-703-741-5970

Section 2: HAZARDS IDENTIFICATION

This material is classified per Regulation (EC) No 1272/2008.

2.1. Classification of the substance or mixture

Regulation (EC) No 1272/2008

<table>
<thead>
<tr>
<th>Skin corrosion/irritation</th>
<th>Category 1B</th>
</tr>
</thead>
<tbody>
<tr>
<td>May be corrosive to metals</td>
<td>Category 1</td>
</tr>
</tbody>
</table>

2.2. Label elements

Danger

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

Emergency Overview

Appearance  Powder  Physical state  Solid  Odour  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 corrosive resistant container

Precautionary Statements - Disposal
Dispose of contents/container to an approved waste disposal plant

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

Other Information
Harmful if swallowed

Section 3: COMPOSITION/INFORMATION ON INGREDIENTS

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

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>EC No</th>
<th>CAS No</th>
<th>Weight-%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hafnium Tetrachloride</td>
<td>236-826-5</td>
<td>13499-05-3</td>
<td>&gt;95</td>
</tr>
<tr>
<td>Zirconium Tetrachloride</td>
<td>233-058-2</td>
<td>10026-11-6</td>
<td>&lt;4</td>
</tr>
</tbody>
</table>

Section 4: FIRST AID MEASURES

4.1. Description of first aid measures
Inhalation
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Call a doctor or poison control centre 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.

4.2. 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.

4.3. Indication of any immediate medical attention and special treatment needed
Note to doctors
Treat symptomatically.

Section 5: FIREFIGHTING MEASURES

5.1. Extinguishing media

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

5.2. Special hazards arising from the substance or mixture

Non-combustible

Hazardous combustion products
Hydrogen chloride gas may cause respiratory and/or eye irritation.

5.3. Advice for firefighters

Firefighters should wear self-contained breathing apparatus and full firefighting turnout gear.

Section 6: ACCIDENTAL RELEASE MEASURES

6.1. 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.

6.2. Environmental precautions

Collect spillage to prevent release to the environment.

6.3. 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.

6.4. Reference to other sections

See Section 12: ECOLOGICAL INFORMATION.

Section 7: HANDLING AND STORAGE

7.1. 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.

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

7.2. Conditions for safe storage, including any incompatibilities
Storage Conditions

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

7.3. Specific end use(s)
Risk Management Methods (RMM)
The information required is contained in this Safety Data Sheet.

Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1. Control parameters

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>European Union</th>
<th>United Kingdom</th>
<th>France</th>
<th>Spain</th>
<th>Germany</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hafnium Tetrachloride 13499-05-3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>TWA: 0.5 mg/m³</td>
<td>-</td>
</tr>
<tr>
<td>Zirconium Tetrachloride 10026-11-6</td>
<td>-</td>
<td>TWA: 5 mg/m³</td>
<td>-</td>
<td>STEL: 10 mg/m³ TWA: 5 mg/m³</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>Italy</th>
<th>Portugal</th>
<th>Netherlands</th>
<th>Finland</th>
<th>Denmark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hafnium Tetrachloride 13499-05-3</td>
<td>-</td>
<td>TWA: 0.5 mg/m³</td>
<td>-</td>
<td>TWA: 0.5 mg/m³</td>
<td>-</td>
</tr>
<tr>
<td>Zirconium Tetrachloride 10026-11-6</td>
<td>-</td>
<td>STEL: 10 mg/m³ TWA: 5 mg/m³</td>
<td>-</td>
<td>TWA: 1 mg/m³</td>
<td>TWA: 5 mg/m³</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>Austria</th>
<th>Switzerland</th>
<th>Poland</th>
<th>Norway</th>
<th>Ireland</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hafnium Tetrachloride 13499-05-3</td>
<td>TWA: 0.5 mg/m³</td>
<td>-</td>
<td>TWA: 0.5 mg/m³</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Zirconium Tetrachloride 10026-11-6</td>
<td>TWA: 5 mg/m³</td>
<td>TWA: 5 mg/m³</td>
<td>STEL: 10 mg/m³ TWA: 5 mg/m³</td>
<td>TWA: 5 mg/m³</td>
<td>TWA: 5 mg/m³ STEL: 10 mg/m³</td>
</tr>
</tbody>
</table>

Derived No Effect Level (DNEL) No DNELs are available for this product as a whole

Predicted No Effect Concentration (PNEC) No PNECs are available for this product as a whole.

8.2. Exposure controls

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

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 contaminate concentrations. Respiratory protection must be provided in accordance with current local regulations.

Environmental exposure controls
Section 6: ACCIDENTAL RELEASE MEASURES.

Section 9: PHYSICAL AND CHEMICAL PROPERTIES

9.1. Information on basic physical and chemical properties

<table>
<thead>
<tr>
<th>Physical state</th>
<th>Solid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>Powder</td>
</tr>
<tr>
<td>Colour</td>
<td>white, orange</td>
</tr>
<tr>
<td>Odour</td>
<td>Pungent, Slight chlorine.</td>
</tr>
<tr>
<td>Odour threshold</td>
<td></td>
</tr>
</tbody>
</table>
Section 10: STABILITY AND REACTIVITY

9.2. Other information

<table>
<thead>
<tr>
<th>Property</th>
<th>Values</th>
<th>Remarks • Method</th>
</tr>
</thead>
<tbody>
<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>Vapour pressure</td>
<td>-</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Vapour 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></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>Oxidising properties</td>
<td>Not applicable</td>
<td></td>
</tr>
</tbody>
</table>

10.1. Reactivity

Reacts with water.

10.2. Chemical stability

Stable under normal conditions.

Explosion data

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

10.3. Possibility of hazardous reactions

Hazardous polymerisation

Hazardous polymerisation does not occur.

Possibility of Hazardous Reactions

Reacts with water.

10.4. Conditions to avoid

Unintentional contact with water.

10.5. Incompatible materials

Water, alcohols, phenols, and amines. Rubber, coatings, and some plastics. Reacts with metals to produce heat and corrosive gases.
10.6. Hazardous decomposition products
Reacts with water to produce hydrogen chloride gas or hydrochloric acid and heat.

**Section 11: TOXICOLOGICAL INFORMATION**

**11.1. Information on toxicological effects**

<table>
<thead>
<tr>
<th>Product Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inhalation</td>
</tr>
<tr>
<td>Eye contact</td>
</tr>
<tr>
<td>Skin Contact</td>
</tr>
<tr>
<td>Ingestion</td>
</tr>
</tbody>
</table>

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

**Sensitisation**
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.

**Section 12: ECOLOGICAL INFORMATION**

**12.1. Toxicity**
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 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>
<td>-</td>
<td>The 48 h EC50 of Hafnium dioxide to Daphnia magna 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</td>
<td>The 96h LC50 value of</td>
<td>-</td>
<td>The 48 h EC50 of</td>
</tr>
</tbody>
</table>
Zirconium tetrachloride to Chlorella vulgaris was greater than 262 mg of ZrCl4/L. 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. Zirconium tetrachloride to Daphnia magna was greater than 190 mg of ZrCl4/L.

12.2. Persistence and degradability

12.3. Bioaccumulative potential

12.4. Mobility in soil

12.5. Results of PBT and vPvB assessment

The PBT and vPvB criteria do not apply to inorganic substances.

12.6. Other adverse effects

Section 13: DISPOSAL CONSIDERATIONS

13.1. Waste treatment methods

<table>
<thead>
<tr>
<th>Waste from residues/unused products</th>
<th>Disposal should be in accordance with applicable regional, national and local laws and regulations.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contaminated packaging</td>
<td>Disposal should be in accordance with applicable regional, national and local laws and regulations.</td>
</tr>
</tbody>
</table>

Section 14: TRANSPORT INFORMATION

IMDG

<table>
<thead>
<tr>
<th>14.1 UN/ID no</th>
<th>1759</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.2 Proper shipping name</td>
<td>Corrosive solid, n.o.s. (Hafnium Tetrachloride)</td>
</tr>
<tr>
<td>14.3 Hazard Class</td>
<td>8</td>
</tr>
<tr>
<td>14.4 Packing Group</td>
<td>III</td>
</tr>
<tr>
<td>14.5 Marine pollutant</td>
<td>Not applicable</td>
</tr>
<tr>
<td>14.6 Special Provisions</td>
<td>128, IB8, IP3, T1, TP33</td>
</tr>
<tr>
<td>14.7 Transport in bulk according to Annex II of MARPOL and the IBC Code</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>

RID

<table>
<thead>
<tr>
<th>14.1 UN/ID no</th>
<th>1759</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.2 Proper shipping name</td>
<td>Corrosive solid, n.o.s. (Hafnium Tetrachloride)</td>
</tr>
<tr>
<td>14.3 Hazard Class</td>
<td>8</td>
</tr>
<tr>
<td>14.4 Packing Group</td>
<td>III</td>
</tr>
<tr>
<td>14.5 Environmental hazard</td>
<td>Not applicable</td>
</tr>
<tr>
<td>14.6 Special Provisions</td>
<td>128, IB8, IP3, T1, TP33</td>
</tr>
</tbody>
</table>

ADR

<table>
<thead>
<tr>
<th>14.1 UN/ID no</th>
<th>1759</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.2 Proper shipping name</td>
<td>Corrosive solid, n.o.s. (Hafnium Tetrachloride)</td>
</tr>
<tr>
<td>14.3 Hazard Class</td>
<td>8</td>
</tr>
<tr>
<td>14.4 Packing Group</td>
<td>III</td>
</tr>
</tbody>
</table>
14.5 Environmental hazard
Not applicable
14.6 Special Provisions
128, IB8, IP3, T1, TP33

ICAO (air)
14.1 UN/ID no 1759
14.2 Proper shipping name Corrosive solid, n.o.s. (Hafnium Tetrachloride)
14.3 Hazard Class 8
14.4 Packing Group III
14.5 Environmental hazard Not applicable
14.6 Special Provisions 128, IB8, IP3, T1, TP33

IATA
14.1 UN/ID no 1759
14.2 Proper shipping name Corrosive solid, n.o.s. (Hafnium Tetrachloride)
14.3 Hazard Class 8
14.4 Packing Group III
14.5 Environmental hazard Not applicable
14.6 Special Provisions 128, IB8, IP3, T1, TP33

Section 15: REGULATORY INFORMATION

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>French RG number</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hafnium Tetrachloride</td>
<td>13499-05-3</td>
<td>-</td>
</tr>
<tr>
<td>Zirconium Tetrachloride</td>
<td>10026-11-6</td>
<td>-</td>
</tr>
</tbody>
</table>

European Union

Take note of Directive 98/24/EC on the protection of the health and safety of workers from the risks related to chemical agents at work.

Authorisations and/or restrictions on use:
This product does not contain substances subject to authorisation (Regulation (EC) No. 1907/2006 (REACH), Annex XIV). This product does not contain substances subject to restriction (Regulation (EC) No. 1907/2006 (REACH), Annex XVII).

International Inventories

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></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

15.2. Chemical safety assessment
No chemical safety assessment has been performed for this product.

### 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.

This material safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006

**Note:**
The information provided in this Material 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 ATImetals.com