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

Product identifier
Product Name
Hafnium and Hafnium Alloy Scrap: Borings, Clippings, Shavings, Turnings and Scalpings, Fines, Swarf

Other means of identification
Product Code
SAC044
UN/ID No.
UN3089
Synonyms
All hafnium scrap including: borings, clippings, shavings, turnings, scalpings, fines, dust, and swarf.

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

2. HAZARDS IDENTIFICATION

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

Flammable solids

Label elements

Emergency Overview

Danger

Hazard statements
Flammable solids

Appearance
Metal turnings, fines

Physical state
Solid

Odor
Odorless

Precautionary Statements - Prevention
Wear protective gloves/protective clothing/eye protection
Keep away from heat/sparks/open flames/hot surfaces. - No smoking
Ground/bond container and receiving equipment
If dust clouds can occur, use explosion-proof electrical/ventilating/lighting/equipment.

Precautionary Statements - Response
In case of fire: Use salt (NaCl) or class D dry powder for extinction.

Hazardous ingredients (HNOC)
Not applicable

Other Information
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.

3. COMPOSITION/INFORMATION ON INGREDIENTS

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>CAS No.</th>
<th>Weight-%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zirconium</td>
<td>7440-67-7</td>
<td>90- &gt;99</td>
</tr>
<tr>
<td>Hafnium</td>
<td>7440-58-6</td>
<td>0-10</td>
</tr>
<tr>
<td>Niobium (Columbium)</td>
<td>7440-03-1</td>
<td>0-4</td>
</tr>
<tr>
<td>Tin</td>
<td>7440-31-5</td>
<td>0-3</td>
</tr>
<tr>
<td>Molybdenum</td>
<td>7439-98-7</td>
<td>0-2</td>
</tr>
<tr>
<td>Chromium</td>
<td>7440-47-3</td>
<td>0-1</td>
</tr>
<tr>
<td>Iron</td>
<td>7439-89-6</td>
<td>0-1</td>
</tr>
<tr>
<td>Nickel</td>
<td>7440-02-0</td>
<td>0-0.1</td>
</tr>
</tbody>
</table>

4. FIRST AID MEASURES

First aid measures

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

Skin Contact: None under normal use conditions.

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

Ingestion: IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell.

Most important symptoms and effects, both acute and delayed

Symptoms: None anticipated.

Indication of any immediate medical attention and special treatment needed

Note to physicians: Treat symptomatically.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media
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.

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.

Explosion data
Sensitivity to Mechanical Impact None.
Sensitivity to Static Discharge May be ignited by heat, sparks or flames.

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. 170.

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.

7. HANDLING AND STORAGE

Precautions for 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.

Conditions for safe storage, including any incompatibilities

Storage Conditions Keep away from heat, sparks, flame and other sources of ignition (i.e., pilot lights, electric motors and static electricity). For long-term storage, keep sealed in argon-filled steel drums.

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

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters
### 9. PHYSICAL AND CHEMICAL PROPERTIES

<table>
<thead>
<tr>
<th>Property</th>
<th>Values</th>
<th>Remarks • Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Melting point / freezing point</td>
<td>1830-1870 °C / 3330-3400 °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></td>
</tr>
<tr>
<td>Evaporation rate</td>
<td>-</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Flammability (solid, gas)</td>
<td>-</td>
<td>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>
</tbody>
</table>

**Chemical Name**

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>ACGIH TLV</th>
<th>OSHA PEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zirconium 7440-67-7</td>
<td>STEL: 10 mg/m³ STEL: 10 mg/m³ Zr</td>
<td>TWA: 5 mg/m³ Zr (vacated) STEL: 10 mg/m³ Zr</td>
</tr>
<tr>
<td>Hafnium 7440-58-6</td>
<td>TWA: 0.5 mg/m³ TWA: 0.5 mg/m³ Hf</td>
<td>TWA: 0.5 mg/m³</td>
</tr>
<tr>
<td>Niobium (Columbium) 7440-03-1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tin 7440-31-5</td>
<td>TWA: 2 mg/m³ TWA: 2 mg/m³ Sn except Tin hydride</td>
<td>TWA: 2 mg/m³ Sn except oxides</td>
</tr>
<tr>
<td>Molybdenum 7439-98-7</td>
<td>TWA: 10 mg/m³ inhalable fraction</td>
<td>-</td>
</tr>
<tr>
<td>Iron 7439-89-6</td>
<td>TWA: 3 mg/m³ respirable fraction</td>
<td>-</td>
</tr>
<tr>
<td>Chromium 7440-47-3</td>
<td>TWA: 0.5 mg/m³</td>
<td>TWA: 1 mg/m³</td>
</tr>
<tr>
<td>Nickel 7440-02-0</td>
<td>TWA: 1.5 mg/m³ inhalable fraction</td>
<td>TWA: 1 mg/m³</td>
</tr>
</tbody>
</table>

**Appropriate engineering controls**

**Engineering Controls**

Avoid generation of uncontrolled particles.

**Individual protection measures, such as personal protective equipment**

**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.

**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.
10. STABILITY AND REACTIVITY

Reactivity
Not applicable

Chemical stability
Stable under normal conditions.

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.

11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure

Product Information

Inhalation
Product not classified.

Eye contact
Product not classified.

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

Ingestion
Product not classified.
### Chemical Name Oral LD50 Dermal LD50 Inhalation LC50

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

### Information on toxicological effects

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

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

- **Acute toxicity**: Product not classified.
- **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.

#### 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>
<th>Toxicity to microorganisms</th>
<th>Crustacea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zirconium 7440-67-7</td>
<td>14 d NOEC of zirconium dichloride oxide to Chlorella vulgaris was greater than 102.5 mg of Zr/L.</td>
<td>96 h LL50 of zirconium to Danio rerio was greater than 74.03 mg/L.</td>
<td>-</td>
<td>48 h EC50 of zirconium dioxide in water to Danio rerio was greater than 74.03 mg/L.</td>
</tr>
<tr>
<td>Hafnium 7440-58-6</td>
<td>72 h EC50 of hafnium to Pseudokirchneriella subcapitata was great than 8 ug of Hf/L (100% saturated solution).</td>
<td>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>48 h EC50 of Hafnium dioxide in water to Danio rerio was greater than the solubility limit of 0.007 mg Hf/L.</td>
</tr>
<tr>
<td>Niobium (Columbium) 7440-03-1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tin</td>
<td>72 h EC50 of tin</td>
<td>7 d LOEC of tin chloride</td>
<td>-</td>
<td>7 d LC50 of tin chloride</td>
</tr>
<tr>
<td>Chemical Name</td>
<td>RCRA - D Series Wastes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------</td>
<td>------------------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chromium 7440-47-3</td>
<td>5.0 mg/L regulatory level</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This product contains one or more substances that are listed with the State of California as a hazardous waste.

### 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.

**Chemical Name** | **RCRA - D Series Wastes**
---|---
Chromium 7440-47-3 | 5.0 mg/L regulatory level

### 14. TRANSPORT INFORMATION

**DOT**

- **Regulated**
- **UN/ID No.** UN3089
- **Proper shipping name** Metal powder, flammable, n.o.s. (Hafnium)
- **Hazard Class** 4.1
- **Packing Group** II
- **Special Provisions** IB8, IP2, IP4, T3, TP33
- **Emergency Response Guide** 170
15. REGULATORY INFORMATION

International Inventories

<table>
<thead>
<tr>
<th>Inventory</th>
<th>Complies</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSCA</td>
<td></td>
</tr>
<tr>
<td>DSL/NDSL</td>
<td></td>
</tr>
<tr>
<td>EINECS/ELINCS</td>
<td></td>
</tr>
<tr>
<td>ENCS</td>
<td></td>
</tr>
<tr>
<td>IECSC</td>
<td></td>
</tr>
<tr>
<td>KECL</td>
<td></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

US Federal Regulations

SARA 313
Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product contains a chemical or chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>CAS No.</th>
<th>Weight-%</th>
<th>SARA 313 - Threshold Values %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chromium</td>
<td>7440-47-3</td>
<td>0-1</td>
<td>1.0</td>
</tr>
<tr>
<td>Nickel</td>
<td>7440-02-0</td>
<td>0-0.1</td>
<td>0.1</td>
</tr>
</tbody>
</table>

SARA 311/312 Hazard Categories

- Acute health hazard: No
- Chronic Health Hazard: No
- Fire hazard: Yes
- Sudden release of pressure hazard: No
- Reactive Hazard: No

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>Chromium</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nickel</td>
<td>X</td>
<td>X</td>
<td></td>
<td></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>Chromium</td>
<td>5000 lb</td>
</tr>
<tr>
<td>Nickel</td>
<td>100 lb</td>
</tr>
</tbody>
</table>
US State Regulations

California Proposition 65
This product contains the Proposition 65 chemicals listed below. Proposition 65 warning label available at ATImetals.com.

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>California Proposition 65</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nickel - 7440-02-0</td>
<td>Carcinogen</td>
</tr>
</tbody>
</table>

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 7440-67-7</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Hafnium 7440-58-6</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Tin 7440-31-5</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Molybdenum 7439-98-7</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Chromium 7440-47-3</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Nickel 7440-02-0</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

<table>
<thead>
<tr>
<th>NFPA</th>
<th>Health hazards 0</th>
<th>Flammability 1</th>
<th>Instability 0</th>
<th>Physical and Chemical Properties -</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMIS</td>
<td>Health hazards 1*</td>
<td>Flammability 2</td>
<td>Physical hazards 0</td>
<td>Personal protection X</td>
</tr>
</tbody>
</table>

Chronic Hazard Star Legend  * = Chronic Health Hazard

Issue Date  28-May-2015
Revision Date  09-Aug-2019
Revision Note  SDS sections updated: 2, 4, 5, 6, 7, 9, 11, 14

Note:  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 ATImetals.com