100022-3 Hafnium (1000μg/mL in 2% HNO3 + 0.5% HF)

High-Purity Standards

Catalogue number: 100022-3

Version No: 3.3

Chemwatch Hazard Alert Code: 3

Safety Data Sheet according to OSHA HazCom Standard (2012) requirements

SECTION 1 IDENTIFICATION

Product Identifier

<table>
<thead>
<tr>
<th>Product name</th>
<th>100022-3 Hafnium (1000μg/mL in 2% HNO3 + 0.5% HF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Synonyms</td>
<td>1000μg/mL Hafnium in 2% HNO3 + 0.5%HF</td>
</tr>
<tr>
<td>Proper shipping name</td>
<td>Corrosive liquid, acidic, inorganic, n.o.s. (contains nitric acid and hydrofluoric acid)</td>
</tr>
<tr>
<td>Other means of identification</td>
<td>100022-3</td>
</tr>
</tbody>
</table>

Relevant use of the chemical and restrictions on use

Recommended use of the chemical and restrictions on use

Use according to manufacturer's directions.

Name, address, and telephone number of the chemical manufacturer, importer, or other responsible party

Registered company name | High-Purity Standards |
Address | PO Box 41727 SC 29423 United States |
Telephone | 843-767-7900 |
Fax | 843-767-7906 |
Website | highpuritystandards.com |
Email | Not Available |

Emergency phone number

| Association / Organisation | INFOTRAC |
| Emergency telephone numbers | 1-800-535-5053 |
| Other emergency telephone numbers | 1-352-323-3500 |

SECTION 2 HAZARD(S) IDENTIFICATION

Classification of the substance or mixture

| Classification | Acute Toxicity (Oral) Category 4, Acute Toxicity (Dermal) Category 3, Metal Corrosion Category 1, Skin Corrosion/Irritation Category 1A, Serious Eye Damage Category 1 |

Label elements

<table>
<thead>
<tr>
<th>Hazard pictogram(s)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>SIGNAL WORD</td>
<td>DANGER</td>
</tr>
</tbody>
</table>

Hazard statement(s)

| H302 | Harmful if swallowed. |
| H311 | Toxic in contact with skin. |
| H290 | May be corrosive to metals. |
| H314 | Causes severe skin burns and eye damage. |

Continued...
Precautionary statement(s) Prevention

P260 Do not breathe dust/fume/gas/mist/vapours/spray.

Precautionary statement(s) Response

P301+P330+P331 IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.

Precautionary statement(s) Storage

P405 Store locked up.

Precautionary statement(s) Disposal

P501 Dispose of contents/container in accordance with local regulations.

SECTION 3 COMPOSITION / INFORMATION ON INGREDIENTS

Mixtures

<table>
<thead>
<tr>
<th>CAS No</th>
<th>% [weight]</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>7440-58-6</td>
<td>0.1</td>
<td>hafnium</td>
</tr>
<tr>
<td>7697-37-2</td>
<td>2</td>
<td>nitric acid</td>
</tr>
<tr>
<td>7664-39-3</td>
<td>0.5</td>
<td>hydrofluoric acid</td>
</tr>
<tr>
<td>7732-18-5</td>
<td>balance</td>
<td>water</td>
</tr>
</tbody>
</table>

SECTION 4 FIRST-AID MEASURES

Description of first aid measures

Eye Contact

If this product comes in contact with the eyes:
- Immediately hold eyelids apart and flush the eye continuously with running water.
- Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids.
- Transport to hospital or doctor without delay.

Skin Contact

For thermal burns:
- Decontaminate area around burn.
- Consider the use of cold packs and topical antibiotics.

For first-degree burns (affecting top layer of skin)
- Hold burned skin under cool (not cold) running water or immerse in cool water until pain subsides.
- Use compresses if running water is not available.
- Cover with sterile non-adhesive bandage or clean cloth.
- DO NOT apply butter or ointments; this may cause infection.
- Give over-the-counter pain relievers if pain increases or swelling, redness, fever occur.

For second-degree burns (affecting top two layers of skin)
- Cool the burn by immerse in cold running water for 10-15 minutes.
- Use compresses if running water is not available.
- Do NOT apply ice as this may lower body temperature and cause further damage.
- Do NOT break blisters or apply butter or ointments; this may cause infection.
- Protect burn by cover loosely with sterile, nonstick bandage and secure in place with gauze or tape.

To prevent shock: (unless the person has a head, neck, or leg injury, or it would cause discomfort):
- Lay the person flat.
- Elevate feet about 12 inches.
- Elevate burn area above heart level, if possible.
- Cover the person with coat or blanket.
- Seek medical assistance.

For third-degree burns
- Seek immediate medical or emergency assistance.
- In the mean time:
  - Protect burn area cover loosely with sterile, nonstick bandage or, for large areas, a sheet or other material that will not leave lint in wound.
  - Separate burned toes and fingers with dry, sterile dressings.
  - Do not soak burn in water or apply ointments or butter; this may cause infection.
  - To prevent shock see above.
  - For an airway burn, do not place pillow under the person's head when the person is lying down. This can close the airway.
  - Have a person with a facial burn sit up.
  - Check pulse and breathing to monitor for shock until emergency help arrives.

If there is evidence of severe skin irritation or skin burns:
- Avoid further contact. Immediately remove contaminated clothing, including footwear.
- Flush skin under running water for 15 minutes.
- Avoiding contamination of the hands, massage calcium gluconate gel into affected areas, pay particular attention to creases in skin.
- Contact the Poisons Information Centre.
- Continue gel application for at least 15 minutes after burning sensation ceases.
### Inhalation

- If pain recurs, repeat application of calcium gluconate gel or apply every 20 minutes.
- If no gel is available, continue washing for at least 15 minutes, using soap if available. If patient is conscious, give six calcium gluconate or calcium carbonate tablets in water by mouth.
- Transport to hospital, or doctor, urgently.
- If burns or combustion products are inhaled remove from contaminated area.
- Lay patient down. Keep warm and rested.
- Prostheses such as false teeth, which may block airway, should be removed, where possible, prior to initiating first aid procedures.
- Apply artificial respiration if not breathing, preferably with a demand valve resuscitator, bag-valve mask device, or pocket mask as trained. Perform CPR if necessary.
- Transport to hospital, or doctor, without delay.
- Inhalation of vapours or aerosols (mists, fumes) may cause lung oedema.
- Corrosive substances may cause lung damage (e.g. lung oedema, fluid in the lungs).
- As this reaction may be delayed up to 24 hours after exposure, affected individuals need complete rest (preferably in semi-recumbent posture) and must be kept under medical observation even if no symptoms are (yet) manifested.
- Before any such manifestation, the administration of a spray containing a dexamethasone derivative or beclomethasone derivative may be considered.

This must definitely be left to a doctor or person authorised by him/her.

(IIISC13719)

For massive exposures:
- If dusts, vapours, aerosols, fumes or combustion products are inhaled, remove from contaminated area.
- Lay patient down. Keep warm and rested.
- Prostheses such as false teeth, which may block airway, should be removed, where possible, prior to initiating first aid procedures.
- Apply artificial respiration if not breathing, preferably with a demand valve resuscitator, bag-valve mask device, or pocket mask as trained. Perform CPR if necessary.
- If victim is conscious, give six calcium gluconate or calcium carbonate tablets in water by mouth.
- Transport to hospital, or doctor, urgently.

### Ingestion

- For advice, contact a Poisons Information Centre or a doctor at once.
- Urgent hospital treatment is likely to be needed.
- If swallowed do NOT induce vomiting.
- If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain open airway and prevent aspiration.
- Observe the patient carefully.
- Never give liquid to a person showing signs of being sleepy or with reduced awareness; i.e. becoming unconscious.
- Give water to rinse out mouth, then provide liquid slowly and as much as casualty can comfortably drink.
- Transport to hospital or doctor without delay.

**Most important symptoms and effects, both acute and delayed**

See Section 11

**Indication of any immediate medical attention and special treatment needed**

Following acute or short term repeated exposure to hydrofluoric acid:
- Subcutaneous injections of Calcium Gluconate may be necessary around the burnt area. Continued application of Calcium Gluconate Gel or subcutaneous Calcium Gluconate should then continue for 3-4 days at a frequency of 4-6 times per day, if a “burning” sensation recurs, apply more frequently.
- Systemic effects of extensive hydrofluoric acid burns include renal damage, hypocalcaemia and consequent cardiac arrhythmias. Monitor haematological, respiratory, renal, cardiac and electrolyte status at least daily. Tests should include FBE, blood gases, chest X-ray, creatinine and electrolytes, urine output, Ca ions, Mg ions and phosphate ions. Continuous ECG monitoring may be required.
- Where serum calcium is low, or clinical, or ECG signs of hypocalcaemia develop, infusions of calcium gluconate, or if less serious, oral Sandocal, should be given. Hydrocortisone 500 mg in a four to six hour infusion may help.
- Antibiotics should not be given as a routine, but only when indicated.
- Eye contact pain may be excruciating and 2-3 drops of 0.05% pentocaine hydrochloride may be instilled, followed by further irrigation.

**Biological Exposure Index - BEI**

These represent the determinants observed in specimens collected from a healthy worker exposed at the Exposure Standard (ES or TLV):

<table>
<thead>
<tr>
<th>Determinant</th>
<th>Index</th>
<th>Sampling Time</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Methaemoglobin in blood</td>
<td>1.5% of haemoglobin</td>
<td>During or end of shift</td>
<td>B, NS, SQ</td>
</tr>
</tbody>
</table>

B: Background levels occur in specimens collected from subjects NOT exposed.

NS: Non-specific determinant; Also seen after exposure to other materials.

SQ: Semi-quantitative determinant - Interpretation may be ambiguous; should be used as a screening test or confirmatory test.

For acute or short term repeated exposures to fluorides:
- Fluoride absorption from gastro-intestinal tract may be retarded by calcium salts, milk or antacids.
- Fluoride particulates or fume may be absorbed through the respiratory tract with 20-30% deposited at alveolar level.
- Peak serum levels are reached 30 mins. post-exposure; 50% appears in the urine within 24 hours.
- For acute poisoning (endotracheal intubation if inadequate tidal volume), monitor breathing and evaluate/monitor blood pressure and pulse frequently since shock may supervene with little warning. Monitor ECG immediately; watch for arrhythmias and evidence of Q-T prolongation or T-wave changes. Maintain monitor. Treat shock vigorously with isotonic saline (in 5% glucose) to restore blood volume and enhance renal excretion.
- Where evidence of hypocalcaemia or normocalcaemic tetany exists, calcium gluconate (10 ml of a 10% solution) is injected to avoid tachycardia.

**Biological Exposure Index - BEI**

These represent the determinants observed in specimens collected from a healthy worker exposed at the Exposure Standard (ES or TLV):

<table>
<thead>
<tr>
<th>Determinant</th>
<th>Index</th>
<th>Sampling Time</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluorides in urine</td>
<td>3 mg/gm creatinine</td>
<td>Prior to shift</td>
<td>B, NS</td>
</tr>
<tr>
<td></td>
<td>10mg/gm creatinine</td>
<td>End of shift</td>
<td>B, NS</td>
</tr>
</tbody>
</table>

B: Background levels occur in specimens collected from subjects NOT exposed.

NS: Non-specific determinant; also observed after exposure to other exposures.
SECTION 5 FIRE-FIGHTING MEASURES

Extinguishing media

» There is no restriction on the type of extinguisher which may be used.
» Use extinguishing media suitable for surrounding area.

Special hazards arising from the substrate or mixture

Fire Incompatibility

None known.

Special protective equipment and precautions for fire-fighters

Fire Fighting

Fire/Explosion Hazard

» Non combustible.
» May emit corrosive fumes.

SECTION 6 ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

See section 8

Environmental precautions

See section 12

Methods and material for containment and cleaning up

<table>
<thead>
<tr>
<th>Minor Spills</th>
<th>Major Spills</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drains for storage or use areas should have retention basins for pH adjustments and dilution of spills before discharge or disposal of material.</td>
<td>Clear area of personnel and move upwind.</td>
</tr>
<tr>
<td>Clean up all spills immediately.</td>
<td></td>
</tr>
</tbody>
</table>

Personal Protective Equipment advice is contained in Section 8 of the SDS.

SECTION 7 HANDLING AND STORAGE

Precautions for safe handling

Safe handling

» Avoid all personal contact, including inhalation.

Other information

» Store in original containers.

Conditions for safe storage, including any incompatibilities

Suitable container

» DO NOT use aluminium or galvanised containers
» Lined metal can, lined metal pail/ can.
For low viscosity materials
» Drums and jerricans must be of the non-removable head type.
» Material is corrosive to most metals, glass and other siliceous materials.

Storage incompatibility

» Inorganic acids are generally soluble in water with the release of hydrogen ions.
» WARNING: Avoid or control reaction with peroxides. Salts of inorganic fluoride:
» react with water forming acidic solutions.
» react with mild steel, galvanised steel / zinc producing hydrogen gas which may form an explosive mixture with air.
Hydrogen fluoride:
» reacts violently with strong oxidisers, acetic anhydride, alkalis, 2-aminoethanol, arsenic trioxide (with generation of heat), bismuthic acid, calcium oxide, chlorosulfonic acid, cyanogen fluoride, ethyleneamine, ethyleneimine, fluorine (fluorine gas reacts vigorously with a 50% hydrofluoric acid solution and may burst into flame), nitrogen trifluoride, N-phenylazopiperidine, oleum, oxygen difluoride, phosphorus pentoxide, potassium permanganate, potassium tetrafluorosilicate(2-), beta-propiolactone, propylene oxide, sodium, sodium tetrafluorosilicate, sulfuric acid, vinyl acetate
» reacts (possibly violently) with aliphatic amines, alcohols, alkanolamines, alkylene oxides, aromatic amines, amides, ammonia, ammonium hydroxide, ethylenediamine, isocyanates, metal acetylides, metal silicides, methanesulfonic acid, nitrogen compounds, organic anhydrides, oxides, silicon compounds, vinyldene fluoride
» attacks glass and siliceous materials, concrete, ceramics, metals (flammable hydrogen gas may be produced), metal alloys, some plastics, rubber coatings, leather, and most other materials with the exception of lead, platinum, polyethylene, wax.

SECTION 8 EXPOSURE CONTROLS / PERSONAL PROTECTION

Control parameters

OCCUPATIONAL EXPOSURE LIMITS (OEL)

INGREDIENT DATA

<table>
<thead>
<tr>
<th>Source</th>
<th>Ingredient</th>
<th>Material name</th>
<th>TWA</th>
<th>STEL</th>
<th>Peak</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>US OSHA Permissible Exposure Levels (PELs) - Table Z1</td>
<td>hafnium</td>
<td>Hafnium</td>
<td>0.5 mg/m³</td>
<td>Not Available</td>
<td>Not Available</td>
<td>[*Note: The REL also applies to other hafnium compounds (as Hf).]</td>
</tr>
<tr>
<td>US NIOSH Recommended Exposure Limits (RELs)</td>
<td>hafnium</td>
<td>Celtium, Elemental hafnium, Hafnium metal</td>
<td>0.5 mg/m³</td>
<td>Not Available</td>
<td>Not Available</td>
<td>Not Available</td>
</tr>
</tbody>
</table>
### US OSHA Permissible Exposure Levels (PELs) - Table Z1

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Material name</th>
<th>Original IDLH</th>
<th>Revised IDLH</th>
</tr>
</thead>
<tbody>
<tr>
<td>nitric acid</td>
<td>Nitric acid</td>
<td>5 mg/m³ / 2 ppm</td>
<td>Not Available</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 mg/m³ / 4 ppm</td>
<td>Not Available</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Not Available</td>
<td>Not Available</td>
</tr>
</tbody>
</table>

---

### US NIOSH Recommended Exposure Limits (RELs)

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Material name</th>
<th>Original IDLH</th>
<th>Revised IDLH</th>
</tr>
</thead>
<tbody>
<tr>
<td>nitric acid</td>
<td>Nitric acid, Aqua fortis, Engravers acid, Hydrogen nitrate, Red fuming nitric acid (RFNA); White fuming nitric acid (WFNA)</td>
<td>2 ppm</td>
<td>Not Available</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 mg/m³ / 2 ppm</td>
<td>Not Available</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 ppm</td>
<td>Not Available</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Not Available</td>
<td>Not Available</td>
</tr>
</tbody>
</table>

---

### US ACGIH Threshold Limit Values (TLV)

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Material name</th>
<th>Original IDLH</th>
<th>Revised IDLH</th>
</tr>
</thead>
<tbody>
<tr>
<td>nitric acid</td>
<td>Nitric acid</td>
<td>Not Available</td>
<td>Not Available</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Not Available</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Not Available</td>
<td>Not Available</td>
</tr>
</tbody>
</table>

---

### EMERGENCY LIMITS

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Material name</th>
<th>Original IDLH</th>
<th>Revised IDLH</th>
</tr>
</thead>
<tbody>
<tr>
<td>hafnium</td>
<td>Hafnium</td>
<td>1.5 mg/m³</td>
<td>17 mg/m³</td>
</tr>
<tr>
<td></td>
<td></td>
<td>99 mg/m³</td>
<td></td>
</tr>
<tr>
<td>nitric acid</td>
<td>Nitric acid</td>
<td>Not Available</td>
<td>Not Available</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Not Available</td>
<td>Not Available</td>
</tr>
<tr>
<td>hydrofluoric acid</td>
<td>Hydrogen fluoride, (Hydrofluoric acid)</td>
<td>Not Available</td>
<td>Not Available</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Not Available</td>
<td>Not Available</td>
</tr>
<tr>
<td>water</td>
<td></td>
<td>Not Available</td>
<td>Not Available</td>
</tr>
</tbody>
</table>

---

### Exposure controls

**Appropriate engineering controls**

- Engineering controls are used to remove a hazard or place a barrier between the worker and the hazard.

**Personal protection**

- Safety glasses with unperforated side shields may be used where continuous eye protection is desirable, as in laboratories; spectacles are not sufficient where complete eye protection is needed such as when handling bulk-quantities, where there is a danger of splashing, or if the material may be under pressure.

**Eye and face protection**

- Safety glasses with unperforated side shields may be used where continuous eye protection is desirable, as in laboratories; spectacles are not sufficient where complete eye protection is needed such as when handling bulk-quantities, where there is a danger of splashing, or if the material may be under pressure.

**Skin protection**

- See Hand protection below

**Hands/feet protection**

- Elbow length PVC gloves
- When handling corrosive liquids, wear trousers or overalls outside of boots, to avoid spills entering boots.

**Body protection**

- See Other protection below

**Other protection**

- Overalls.

**Thermal hazards**

- Not Available

**Respiratory protection**

- Type A Filter of sufficient capacity.

### SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

**Information on basic physical and chemical properties**

<table>
<thead>
<tr>
<th>Appearance</th>
<th>Physical state</th>
<th>Odour</th>
<th>Odour threshold</th>
<th>pH (as supplied)</th>
<th>Melting point / freezing point (°C)</th>
<th>Initial boiling point and boiling range (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>colorless</td>
<td>Liquid</td>
<td>Not Available</td>
<td>Not Available</td>
<td>&lt;2</td>
<td>Not Available</td>
<td>Not Available</td>
</tr>
</tbody>
</table>
SECTION 10 STABILITY AND REACTIVITY

Reactivity
See section 7

Chemical stability
Contact with alkaline material liberates heat

Possibility of hazardous reactions
See section 7

Conditions to avoid
See section 7

Incompatible materials
See section 7

Hazardous decomposition products
See section 5

SECTION 11 TOXICOLOGICAL INFORMATION

Information on toxicological effects

**Inhaled**
Inhalation of vapours or aerosols (mists, fumes), generated by the material during the course of normal handling, may be harmful. The material can cause respiratory irritation in some persons. Corrosive acids can cause irritation of the respiratory tract, with coughing, choking and mucous membrane damage. Acute effects of fluoride inhalation include irritation of nose and throat, coughing and chest discomfort. Acute inhalation of hydrogen fluoride (hydrofluoric acid) vapours causes severe irritation of the eye, nose and throat, delayed fever, bluing of the extremities and water in the lungs, and may cause death.

**Ingestion**
Accidental ingestion of the material may be harmful; animal experiments indicate that ingestion of less than 150 gram may be fatal or may produce serious damage to the health of the individual. Ingestion of acidic corrosives may produce burns around and in the mouth, the throat and oesophagus. Fluoride causes severe loss of calcium in the blood, with symptoms appearing several hours later including painful and rigid muscle contractions of the limbs.

**Skin Contact**
Skin contact with the material may be harmful; systemic effects may result following absorption. Skin contact with acidic corrosives may result in pain and burns; these may be deep with distinct edges and may heal slowly with the formation of scar tissue. Contact of the skin with liquid hydrofluoric acid (hydrogen fluoride) may cause severe burns, erythema, and swelling, vesiculation, and serious crusting. Fluorides are easily absorbed through the skin and cause death of soft tissue and erode bone. Open cuts, abraded or irritated skin should not be exposed to this material. Entry into the blood-stream, through, for example, cuts, abrasions or lesions, may produce systemic injury with harmful effects.

**Eye**
If applied to the eyes, this material causes severe eye damage. Direct eye contact with acid corrosives may produce pain, tears, sensitivity to light and burns. Animal testing showed that a 20% solution of hydrofluoric acid (hydrogen fluoride) in water caused immediate damage in the form of total clouding of the lens and ischaemia of the conjunctiva.

**Chronic**
Long-term exposure to respiratory irritants may result in airways disease, involving difficulty breathing and related whole-body problems. Substance accumulation, in the human body, may occur and may cause some concern following repeated or long-term occupational exposure. Repeated or prolonged exposure to acids may result in the erosion of teeth, swelling and/or ulceration of mouth lining. Extended exposure to inorganic fluorides causes fluorosis, which includes signs of joint pain and stiffness, tooth discoloration, nausea and vomiting, loss of appetite, diarrhoea or constipation, weight loss, anaemia, weakness and general unwellness. Hydrogen fluoride easily penetrates the skin and causes destruction and corrosion of the bone and underlying tissue.

<table>
<thead>
<tr>
<th>Chemical</th>
<th>TOXICITY</th>
<th>IRRITATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>100022-3 Hafnium</td>
<td>Not Available</td>
<td>Not Available</td>
</tr>
<tr>
<td>(1000μg/mL in 2% HNO3 + 0.5% HF)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chemical</th>
<th>TOXICITY</th>
<th>IRRITATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>hafnium</td>
<td>Not Available</td>
<td>Not Available</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chemical</th>
<th>TOXICITY</th>
<th>IRRITATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>nitric acid</td>
<td>Not Available</td>
<td>Not Available</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chemical</th>
<th>TOXICITY</th>
<th>IRRITATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>hydrofluoric acid</td>
<td>Inhalation (rat) LC50: 625 ppm/1hr[^2]</td>
<td>Eye (human): 50 mg - SEVERE</td>
</tr>
<tr>
<td></td>
<td>Inhalation (rat) LC50: 1276 ppm/4hr[^2]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Inhalation (rat) LC50: 319 ppm/1hr[^2]</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chemical</th>
<th>TOXICITY</th>
<th>IRRITATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>water</td>
<td>Not Available</td>
<td>Not Available</td>
</tr>
</tbody>
</table>
NITRIC ACID
For acid mists, aerosols, vapours
Test results suggest that eukaryotic cells are susceptible to genetic damage when the pH falls to about 6.5.
The material may cause severe skin irritation after prolonged or repeated exposure and may produce on contact skin redness, swelling, the production of vesicles, scaling and thickening of the skin.
Oral (?) LD₅₀: 50-500 mg/kg [Various Manufacturers]

HYDROFLUORIC ACID
(liver and kidney damage) [Manufacturer] for hydrogen fluoride (as vapour)

HAFNIUM & HYDROFLUORIC ACID & WATER
No significant acute toxicological data identified in literature search.

NITRIC ACID & HYDROFLUORIC ACID
Asthma-like symptoms may continue for months or even years after exposure to the material ends.

NITRIC ACID & HYDROFLUORIC ACID
The material may produce severe irritation to the eye causing pronounced inflammation.

NITRIC ACID & HYDROFLUORIC ACID
The material may produce respiratory tract irritation, and result in damage to the lung including reduced lung function.

Acute Toxicity ✗ Carcinogenicity 🛑
Skin Irritation/Corrosion ✓ Reproductivity 🛑
Serious Eye Damage/Irritation ✓ STOT - Single Exposure 🛑
Respiratory or Skin sensisation 🛑 STOT - Repeated Exposure 🛑
Mutagenicity 🛑 Aspiration Hazard 🛑

SECTION 12 ECOLOGICAL INFORMATION

Ecotoxicity:
The tolerance of water organisms towards pH margin and variation is diverse.
For Fluorides: Small amounts of fluoride have beneficial effects however; excessive intake over long periods may cause dental and/or skeletal fluorosis.
Prevent, by any means available, spillage from entering drains or water courses.

DO NOT discharge into sewer or waterways.

Legend: 1. Value obtained from Europe ECHA Registered Substances - Acute toxicity 2. * Value obtained from manufacturer's SDS. Unless otherwise specified data extracted from RTECS - Register of Toxic Effect of chemical Substances

<table>
<thead>
<tr>
<th>Endpoint</th>
<th>Test Duration (HR)</th>
<th>Species</th>
<th>Value</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>hafnium</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>nitric acid</td>
<td>ENDPOINT</td>
<td>Test Duration (HR)</td>
<td>Species</td>
<td>Value</td>
</tr>
<tr>
<td>NOEC</td>
<td>16</td>
<td>Crustacea</td>
<td>10-7mg/L</td>
<td>4</td>
</tr>
<tr>
<td>hydrofluoric acid</td>
<td>ENDPOINT</td>
<td>Test Duration (HR)</td>
<td>Species</td>
<td>Value</td>
</tr>
<tr>
<td>LC₅₀</td>
<td>96</td>
<td>Fish</td>
<td>5mg/L</td>
<td>2</td>
</tr>
<tr>
<td>EC₅₀</td>
<td>48</td>
<td>Crustacea</td>
<td>&lt;270mg/L</td>
<td>1</td>
</tr>
<tr>
<td>NOEC</td>
<td>504</td>
<td>Fish</td>
<td>4mg/L</td>
<td>2</td>
</tr>
<tr>
<td>water</td>
<td>ENDPOINT</td>
<td>Test Duration (HR)</td>
<td>Species</td>
<td>Value</td>
</tr>
<tr>
<td>LC₅₀</td>
<td>96</td>
<td>Fish</td>
<td>897.520mg/L</td>
<td>3</td>
</tr>
<tr>
<td>EC₅₀</td>
<td>96</td>
<td>Algae or other aquatic plants</td>
<td>876.874mg/L</td>
<td>3</td>
</tr>
</tbody>
</table>

Legend: 1. IUCLID Toxicity Data 2. Europe ECHA Registered Substances - Ecotoxicological Information - Aquatic Toxicity 3. EPIWIN Suite V3.12 (QSAR) - Aquatic Toxicity Data (Estimated) 4. US EPA, Ecotox database - Aquatic Toxicity Data 5. ECETOC Aquatic Hazard Assessment Data 6. NITE (Japan) - Bioconcentration Data 7. METI (Japan) - Bioconcentration Data 8. Vendor Data

Persistence and degradability

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Persistence: Water/Soil</th>
<th>Persistence: Air</th>
</tr>
</thead>
<tbody>
<tr>
<td>water</td>
<td>LOW</td>
<td>LOW</td>
</tr>
</tbody>
</table>

Continued...
### Bioaccumulative potential

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Bioaccumulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>water</td>
<td>LOW (LogKOW = -1.38)</td>
</tr>
</tbody>
</table>

### Mobility in soil

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Mobility</th>
</tr>
</thead>
<tbody>
<tr>
<td>water</td>
<td>LOW (KOC = 14.3)</td>
</tr>
</tbody>
</table>

### SECTION 13 DISPOSAL CONSIDERATIONS

**Waste treatment methods**

- Containers may still present a chemical hazard/danger when empty.
- Recycle wherever possible.

### SECTION 14 TRANSPORT INFORMATION

#### Labels Required

- **Marine Pollutant**: NO

#### Land transport (DOT)

- **UN number**: 3264
- **UN proper shipping name**: Corrosive liquid, acidic, inorganic, n.o.s. (contains nitric acid and hydrofluoric acid)
- **Transport hazard class(es)**
  - Class: 8
  - Subrisk: Not Applicable
- **Packing group**: II
- **Environmental hazard**: Not Applicable
- **Special precautions for user**
  - Special Label: 8
  - Special provisions: 386, B2, I82, T11, TP2, TP27

#### Air transport (ICAO-IATA / DGR)

- **UN number**: 3264
- **UN proper shipping name**: Corrosive liquid, acidic, inorganic, n.o.s. * (contains nitric acid and hydrofluoric acid)
- **Transport hazard class(es)**
  - ICAO/IATA Class: 8
  - ICAO / IATA Subrisk: Not Applicable
  - ERG Code: 8L
- **Packing group**: II
- **Environmental hazard**: Not Applicable
- **Special precautions for user**
  - Special provisions: AOA03
  - Cargo Only Packing Instructions: 865
  - Cargo Only Maximum Qty / Pack: 30 L
  - Passenger and Cargo Packing Instructions: 851
  - Passenger and Cargo Maximum Qty / Pack: 1 L
  - Passenger and Cargo Limited Quantity Packing Instructions: Y840
  - Passenger and Cargo Limited Maximum Qty / Pack: 0.5 L

#### Sea transport (IMDG-Code / GGVSee)

- **UN number**: 3264
- **UN proper shipping name**: CORROSIVE LIQUID, ACIDIC, INORGANIC, N.O.S. (contains nitric acid and hydrofluoric acid)
Product name: Y; Y

2|2

Ship Type: Not Applicable

F-A, S-B

Version No:

Chemwatch:

SECTION 15 REGULATORY INFORMATION

Transport in bulk according to Annex II of MARPOL and the IBC code

<table>
<thead>
<tr>
<th>Source</th>
<th>Product name</th>
<th>Pollution Category</th>
<th>Ship Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMO MARPOL (Annex II) - List of Noxious Liquid Substances Carried in Bulk</td>
<td>Nitric acid (70% and over)/Nitric acid (less than 70%)</td>
<td>Y; Y</td>
<td>2</td>
</tr>
</tbody>
</table>

NITRIC ACID(7697-37-2) IS FOUND ON THE FOLLOWING REGULATORY LISTS

International Air Transport Association (IATA) Dangerous Goods Regulations - Prohibited List

Passenger and Cargo Aircraft

US - California OEHHA/ARB - Acute Reference Exposure Levels and Target Organs (CRELs)

US - California Permissible Exposure Limits for Chemical Contaminants

US - Hawaii Air Contaminant Limits

US - Idaho - Limits for Air Contaminants

US - Massachusetts - Right To Know Listed Chemicals

US - Michigan Exposure Limits for Air Contaminants

US - Minnesota Permissible Exposure Limits (PELs)

US - Oregon Permissible Exposure Limits (Z-1)

US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants

NITRIC ACID(7697-37-2) IS FOUND ON THE FOLLOWING REGULATORY LISTS

International Air Transport Association (IATA) Dangerous Goods Regulations - Prohibited List

Passenger and Cargo Aircraft

US - California OEHHA/ARB - Acute Reference Exposure Levels and Target Organs (RELs)

US - California Permissible Exposure Limits - Carcinogens

US - Hawaii Air Contaminant Limits

US - Idaho - Limits for Air Contaminants

US - Massachusetts - Right To Know Listed Chemicals

US - Michigan Exposure Limits for Air Contaminants

US - Minnesota Permissible Exposure Limits (PELs)

US - Oregon Permissible Exposure Limits (Z-1)

US - Pennsylvania Hazardous Substance List

US - Rhode Island Hazardous Substance List

US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants

US - Vermont Permissible Exposure Limits Table Z-1 - Final Rule Limits for Air Contaminants

US - Vermont Permissible Exposure Limits Table Z-1 - A Transitional Limits for Air Contaminants

US - Washington Permissible Exposure Limits of air contaminants

US - Wyoming Toxic and Hazardous Substances Table Z-1 Limits for Air Contaminants

US ACGIH Threshold Limit Values (TLV)

US NIOSH Recommended Exposure Limits (RELs)

US OSHA Permissible Exposure Levels (PELs) - Table Z1

US Toxic Substances Control Act (TSCA) - Chemical Substance Inventory

HYDROFLUORIC ACID(7664-39-3) IS FOUND ON THE FOLLOWING REGULATORY LISTS

International Agency for Research on Cancer (IARC) - Agents Classified by the IARC Monographs

US - Alaska Limits for Air Contaminants

US - California OEHHA/ARB - Acute Reference Exposure Levels and Target Organs (RELs)

US - California Permissible Exposure Limits for Chemical Contaminants

US - Hawaii Air Contaminant Limits

US - Idaho - Limits for Air Contaminants

US - Massachusetts - Right To Know Listed Chemicals

US - Michigan Exposure Limits for Air Contaminants

US - Minnesota Permissible Exposure Limits (PELs)

US - Oregon Permissible Exposure Limits (Z-1)

US - Pennsylvania Hazardous Substance List

US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants

US - Vermont Permissible Exposure Limits Table Z-1 - A Final Rule Limits for Air Contaminants

US - Vermont Permissible Exposure Limits Table Z-1 - A Transitional Limits for Air Contaminants

US - Washington Permissible Exposure Limits of air contaminants

US - Wyoming Toxic and Hazardous Substances Table Z-1 Limits for Air Contaminants

US ACGIH Threshold Limit Values (TLV)

US NIOSH Recommended Exposure Limits (RELs)

US OSHA Permissible Exposure Levels (PELs) - Table Z1

US SARA Section 302 Extremely Hazardous Substances

US Toxic Substances Control Act (TSCA) - Chemical Substance Inventory

HYDROFLUORIC ACID(7664-39-3) IS FOUND ON THE FOLLOWING REGULATORY LISTS

International Agency for Research on Cancer (IARC) - Agents Classified by the IARC Monographs

US - Alaska Limits for Air Contaminants

US - California OEHHA/ARB - Acute Reference Exposure Levels and Target Organs (RELs)

US - California Permissible Exposure Limits for Chemical Contaminants

US - Hawaii Air Contaminant Limits

US - Idaho - Limits for Air Contaminants

US - Massachusetts - Right To Know Listed Chemicals

US - Michigan Exposure Limits for Air Contaminants

US - Minnesota Permissible Exposure Limits (PELs)

US - Oregon Permissible Exposure Limits (Z-1)

US - Pennsylvania Hazardous Substance List

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US OSHA Permissible Exposure Levels (PELs) - Table Z1

US SARA Section 302 Extremely Hazardous Substances

US Toxic Substances Control Act (TSCA) - Chemical Substance Inventory

WATER(7732-18-5) IS FOUND ON THE FOLLOWING REGULATORY LISTS

International Agency for Research on Cancer (IARC) - Agents Classified by the IARC Monographs

US - Alaska Limits for Air Contaminants

US - California OEHHA/ARB - Acute Reference Exposure Levels and Target Organs (RELs)

US - California Permissible Exposure Limits for Chemical Contaminants

US - Hawaii Air Contaminant Limits

US - Idaho - Limits for Air Contaminants

US - Massachusetts - Right To Know Listed Chemicals

US - Michigan Exposure Limits for Air Contaminants

US - Minnesota Permissible Exposure Limits (PELs)

US - Oregon Permissible Exposure Limits (Z-1)

US - Pennsylvania Hazardous Substance List

US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants

US - Vermont Permissible Exposure Limits Table Z-1 - A Final Rule Limits for Air Contaminants

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US OSHA Permissible Exposure Levels (PELs) - Table Z1

US SARA Section 302 Extremely Hazardous Substances

US Toxic Substances Control Act (TSCA) - Chemical Substance Inventory
Federal Regulations

Superfund Amendments and Reauthorization Act of 1986 (SARA)

<table>
<thead>
<tr>
<th>HAZARD CATEGORIES</th>
<th>Immediate (acute) health hazard</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delayed (chronic) health hazard</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Fire hazard</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Pressure hazard</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Reactivity hazard</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

US. EPA CERCLA HAZARDOUS SUBSTANCES AND REPORTABLE QUANTITIES (40 CFR 302.4)

<table>
<thead>
<tr>
<th>Name</th>
<th>Reportable Quantity in Pounds (lb)</th>
<th>Reportable Quantity in kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitric acid</td>
<td>1000</td>
<td>454</td>
</tr>
<tr>
<td>Hydrofluoric acid</td>
<td>100</td>
<td>45.4</td>
</tr>
</tbody>
</table>

State Regulations

US. CALIFORNIA PROPOSITION 65

None Reported

National Inventory Status

Australia - AICS N (hafnium)
Canada - DSL Y
Canada - NDSL N (hafnium; water; hydrofluoric acid; nitric acid)
China - IECSC N (hafnium)
Europe - EINEC / ELINCS / NLP Y
Japan - ENCS N (hafnium; hydrofluoric acid; nitric acid)
Korea - KECI Y
New Zealand - NZIoC N (hafnium)
Philippines - PICCS Y
USA - TSCA Y

Legend:

Y = All ingredients are on the inventory
N = Not determined or one or more ingredients are not on the inventory and are not exempt from listing (see specific ingredients in brackets)

SECTION 16 OTHER INFORMATION

Other information

Ingredients with multiple cas numbers

<table>
<thead>
<tr>
<th>Name</th>
<th>CAS No</th>
</tr>
</thead>
<tbody>
<tr>
<td>hydrofluoric acid</td>
<td>7664-39-3, 790596-14-4</td>
</tr>
</tbody>
</table>

Classification of the preparation and its individual components has drawn on official and authoritative sources as well as independent review by the Chemwatch Classification committee using available literature references. The SDS is a Hazard Communication tool and should be used to assist in the Risk Assessment.

Definitions and abbreviations

PC – TWA: Permissible Concentration - Time Weighted Average
PC – STEL: Permissible Concentration - Short Term Exposure Limit
IARC: International Agency for Research on Cancer
ACGIH: American Conference of Governmental Industrial Hygienists
STEL: Short Term Exposure Limit
TEEL: Temporary Emergency Exposure Limit
IDLH: Immediately Dangerous to Life or Health Concentrations
OSF: Odour Safety Factor
NOAEL: No Observed Adverse Effect Level
LOAEL: Lowest Observed Adverse Effect Level
TLV: Threshold Limit Value
LOD: Limit Of Detection
OTV: Odour Threshold Value
BCF: BioConcentration Factors
BEI: Biological Exposure Index

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