100 22-3 Hafnium (100μg/mL in 2% HNO3 + Tr HF)

High-Purity Standards

Catalogue number: 100 22-3
Version No: 3.3

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

SECTION 1 IDENTIFICATION

Product Identifier

<table>
<thead>
<tr>
<th>Product name</th>
<th>100 22-3 Hafnium (100μg/mL in 2% HNO3 + Tr HF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Synonyms</td>
<td>100μg/mL Hafnium in 2% HNO3 + Tr 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>100 22-3</td>
</tr>
</tbody>
</table>

Recommended use of the chemical and restrictions on use

Relevant identified uses
Use according to manufacturer's directions.

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

<table>
<thead>
<tr>
<th>Registered company name</th>
<th>High-Purity Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address</td>
<td>PO Box 41727 SC 29423 United States</td>
</tr>
<tr>
<td>Telephone</td>
<td>843-767-7900</td>
</tr>
<tr>
<td>Fax</td>
<td>843-767-7906</td>
</tr>
<tr>
<td>Website</td>
<td>highpuritystandards.com</td>
</tr>
<tr>
<td>Email</td>
<td>Not Available</td>
</tr>
</tbody>
</table>

Emergency phone number

<table>
<thead>
<tr>
<th>Association / Organisation</th>
<th>INFOTRAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency telephone numbers</td>
<td>1-800-535-5053</td>
</tr>
<tr>
<td>Other emergency telephone numbers</td>
<td>1-352-323-3500</td>
</tr>
</tbody>
</table>

SECTION 2 HAZARD(S) IDENTIFICATION

Classification of the substance or mixture

| Classification                   | Acute Toxicity (Inhalation) Category 2, Metal Corrosion Category 1, Skin Corrosion/Irritation Category 1A, Serious Eye Damage Category 1 |

Label elements

Hazard pictogram(s)

<table>
<thead>
<tr>
<th>SIGNAL WORD</th>
</tr>
</thead>
<tbody>
<tr>
<td>DANGER</td>
</tr>
</tbody>
</table>

Hazard statement(s)

<table>
<thead>
<tr>
<th>Hazard code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>H330</td>
<td>Fatal if inhaled.</td>
</tr>
<tr>
<td>H290</td>
<td>May be corrosive to metals.</td>
</tr>
<tr>
<td>H314</td>
<td>Causes severe skin burns and eye damage.</td>
</tr>
</tbody>
</table>

Hazard(s) not otherwise specified
Not Applicable
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

P403+P233 Store in a well-ventilated place. Keep container tightly closed.

Precautionary statement(s) Disposal

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

SECTION 3 COMPOSITION / INFORMATION ON INGREDIENTS

Substances
See section below for composition of Mixtures

Mixtures

<table>
<thead>
<tr>
<th>CAS No</th>
<th>%[weight]</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>7440-58-6</td>
<td>0.01</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>0-0.49</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.
- Continue flushing until advised to stop by the Poisons Information Centre or a doctor, or for at least 15 minutes.
- Transport to hospital or doctor without delay.
- Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact

If skin or hair contact occurs:
- Immediately flush body and clothes with large amounts of water, using safety shower if available.
- Quickly remove all contaminated clothing, including footwear.
- Wash skin and hair with running water. Continue flushing with water until advised to stop by the Poisons Information Centre.
- Transport to hospital or doctor.

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.

Inhalation

If fumes or combustion products are inhaled remove from contaminated area.
- Lay patient person flat.
- Elevate feet about 12 inches.
- 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.
- 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.

[ICSC13719]

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
For acute or short term repeated exposures to strong acids:
Airway problems may arise from laryngeal edema and inhalation exposure. Treat with 100% oxygen initially.
Respiratory distress may require intubation or intubation is contraindicated by excessive swelling.
Intravenous lines should be established immediately in all cases where there is evidence of circulatory compromise.
Strong acids produce a coagulation necrosis characterised by formation of a coagulum (eschar) as a result of the dessicating action of the acid on proteins in specific tissues.

INGESTION:
Immediate dilution (milk or water) within 30 minutes post ingestion is recommended.
DO NOT attempt to neutralise the acid since exothermic reaction may extend the corrosive injury.
Be careful to avoid further vomit since re-exposure of the mucosa to the acid is harmful. Limit fluids to one or two glasses in an adult.
Charcoal has no place in acid management.
Some authors suggest the use of lavage within 1 hour of ingestion.

SKIN:
Skin lesions require copious saline irrigation. Treat chemical burns as thermal burns with non-adherent gauze and wrapping.
Deep second-degree burns may benefit from topical silver sulfadiazine.

EYE:
Eye injuries require retraction of the eyelids to ensure thorough irrigation of the conjuctival cul-de-sacs. Irrigation should last at least 20-30 minutes. DO NOT use neutralising agents or any other additives. Several litres of saline are required.
Cycloplegic drops, (1% cyclopentolate for short-term use or 5% homatropine for longer term use) antibiotic drops, vasoconstrictive agents or artificial tears may be indicated dependent on the severity of the injury.
Steroid eye drops should only be administered with the approval of a consulting ophthalmologist.

[Ellenhorn and Barceloux: Medical Toxicology]

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.
Not considered to be a significant fire risk.
Acids may react with metals to produce hydrogen, a highly flammable and explosive gas.
Heating may cause expansion or decomposition leading to violent rupture of containers.
May emit corrosive, poisonous fumes. May emit acid smoke.

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

Minor Spills
Drains for storage or use areas should have retention basins for pH adjustments and dilution of spills before discharge or disposal of material.
Check regularly for spills and leaks.
Clean up all spills immediately.
Avoid breathing vapours and contact with skin and eyes.
Control personal contact with the substance, by using protective equipment.
Contain and absorb spill with sand, earth, inert material or vermiculite.
3.3

100 22-3 Hafnium (100μg/mL in 2% HNO₃ + Tr HF

SECTION 7 HANDLING AND STORAGE

Precautions for safe handling

- Avoid all personal contact, including inhalation.
- Wear protective clothing when risk of exposure occurs.
- Use in a well-ventilated area.
- WARNING: To avoid violent reaction, ALWAYS add material to water and NEVER water to material.
- Avoid smoking, naked lights or ignition sources.
- Avoid contact with incompatible materials.
- When handling, DO NOT eat, drink or smoke.
- Keep containers securely sealed when not in use.
- Avoid physical damage to containers.
- Always wash hands with soap and water after handling.
- Work clothes should be laundered separately. Launder contaminated clothing before re-use.
- Use good occupational work practice.
- Observe manufacturer's storage and handling recommendations contained within this SDS.
- Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.

Other information

- Store in original containers.
- Keep containers securely sealed.
- Store in a cool, dry, well-ventilated area.
- Store away from incompatible materials and foodstuff containers.
- Protect containers against physical damage and check regularly for leaks.
- Observe manufacturer's storage and handling recommendations contained within this SDS.

Conditions for safe storage, including any incompatibilities

Suitable container

- DO NOT use aluminium or galvanised containers
- Check regularly for spills and leaks
- Lined metal can, lined metal pail/ can.
- Plastic pail.
- Polyliner drum.
- Packing as recommended by manufacturer.
- Check all containers are clearly labelled and free from leaks.
- For low viscosity materials
- Drums and jerricans must be of the non-removable head type.
- Where a can is to be used as an inner package, the can must have a screwed enclosure.
- For materials with a viscosity of at least 2680 cSt, (23 deg. C) and solids (between 15 C deg. and 40 deg C.):
- Removable head packaging;
- Cans with friction closures and
- low pressure tubes and cartridges may be used.

Where combinationpackages are used, and the inner packages are of glass, porcelain or stone ware, there must be sufficient inert cushioning material in contact with inner and outer packages unless the outer packaging is a close fitting moulded plastic box and the substances are not incompatible with the plastic.

Storage incompatibility

- Inorganic acids are generally soluble in water with the release of hydrogen ions. The resulting solutions have pHs of less than 7.0.
- Inorganic acids neutralise chemical bases (for example: amines and inorganic hydroxides) to form salts - neutralisation can generate dangerously large amounts of heat in small spaces.
- The dissolution of inorganic acids in water or the dilution of their concentrated solutions with additional water may generate significant heat.
- The addition of water to inorganic acids often generates sufficient heat in the small region of mixing to cause some of the water to boil explosively. The resulting "bumping" can spatter the acid.
- Inorganic acids react with active metals, including such structural metals as aluminium and iron, to release hydrogen, a flammable gas.
- Inorganic acids can initiate the polymerisation of certain classes of organic compounds.
- Inorganic acids react with cyanide compounds to release gaseous hydrogen cyanide.
- Inorganic acids generate flammable and/or toxic gases in contact with diisocyanates, isocyanates, mercaptans, nitriles, sulfides, and strong reducing agents. Additional gas-generating reactions occur with sulfites, nitrates, thiocyanates (to give HCN and SO₃), dithionites (SO₂), and even carbonates.
- Acids often catalyse (increase the rate of) chemical reactions.
- WARNING: Avoid or control reaction with peroxides. All transition metal peroxides should be considered as potentially explosive. For example transition metal complexes of alkyl hydroperoxides may decompose explosively.
- The pi-complexes formed between chromium(0), vanadium(0) and other transition metals (haloarene-metal complexes) and mono- or poly-fluorobenzene show extreme sensitivity to heat and are explosive.
- Avoid reaction with borohydrides or cyanoborohydrides
- Reacts with mild steel, galvanised steel / zinc producing hydrogen gas which may form an explosive mixture with air.

SECTION 8 EXPOSURE CONTROLS / PERSONAL PROTECTION

Control parameters

<table>
<thead>
<tr>
<th>OCCUPATIONAL EXPOSURE LIMITS (OEL)</th>
</tr>
</thead>
</table>

**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>
</tbody>
</table>

Continued...
<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Material name</th>
<th>TEEL-1</th>
<th>TEEL-2</th>
<th>TEEL-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>hafnium</td>
<td>Hafnium</td>
<td>1.5 mg/m³</td>
<td>17 mg/m³</td>
<td>99 mg/m³</td>
</tr>
<tr>
<td>nitric acid</td>
<td>Nitric acid</td>
<td>Not Available</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>
<td>Not Available</td>
</tr>
<tr>
<td>water</td>
<td>Not Available</td>
<td>Not Available</td>
<td>Not Available</td>
<td>Not Available</td>
</tr>
</tbody>
</table>

Exposure controls

Engineering controls are used to remove a hazard or place a barrier between the worker and the hazard. Well-designed engineering controls can be highly effective in protecting workers and will typically be independent of worker interactions to provide this high level of protection. The basic types of engineering controls are:

- Process controls which involve changing the way a job activity or process is done to reduce the risk.
- Enclosure and/or isolation of emission source which keeps a selected hazard "physically" away from the worker and ventilation that strategically "adds" and "removes" air in the work environment. Ventilation can remove or dilute an air contaminant if designed properly. The design of a ventilation system must match the particular process and chemical or contaminant in use. Employers may need to use multiple types of controls to prevent employee overexposure.

Local exhaust ventilation usually required. If risk of overexposure exists, wear approved respirator. Correct fit is essential to obtain adequate protection. Supplied-air type respirator may be required in special circumstances. Correct fit is essential to ensure adequate protection. An approved self-contained breathing apparatus (SCBA) may be required in some situations. Provide adequate ventilation in warehouse or closed storage area. Air contaminants generated in the workplace possess varying "escape" velocities which, in turn, determine the "capture velocities" of fresh circulating air required to effectively remove the contaminant.

<table>
<thead>
<tr>
<th>Type of Contaminant</th>
<th>Air Speed:</th>
</tr>
</thead>
<tbody>
<tr>
<td>solvent, vapours, degreasing etc., evaporating from tank (in still air).</td>
<td>0.25-0.5 m/s (50-100 f/min.)</td>
</tr>
<tr>
<td>aerosols, fumes from pouring operations, intermittent container filling, low speed conveyor transfers, welding, spray drift, plating acid fumes, pickling (released at low velocity into zone of active generation)</td>
<td>0.5-1 m/s (100-200 f/min.)</td>
</tr>
<tr>
<td>direct spray, spray painting in shallow booths, drum filling, conveyor loading, crusher dusts, gas discharge (active generation into zone of rapid air motion)</td>
<td>1-2.5 m/s (200-500 f/min.)</td>
</tr>
<tr>
<td>grinding, abrasive blasting, tumbling, high speed wheel generated dusts (released at high initial velocity into zone of very high rapid air motion)</td>
<td>2.5-10 m/s (500-2000 f/min.)</td>
</tr>
</tbody>
</table>

Within each range the appropriate value depends on:

<table>
<thead>
<tr>
<th>Lower end of the range</th>
<th>Upper end of the range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Room air currents minimal or favourable to capture</td>
<td>1: Disturbing room air currents</td>
</tr>
<tr>
<td>2: Contaminants of low toxicity or of nuisance value only.</td>
<td>2: Contaminants of high toxicity</td>
</tr>
<tr>
<td>3: Intermittent, low production.</td>
<td>3: High production, heavy use</td>
</tr>
<tr>
<td>4: Large hood or large air mass in motion</td>
<td>4: Small hood-local control only</td>
</tr>
</tbody>
</table>

Simple theory shows that air velocity falls rapidly with distance away from the opening of a simple extraction pipe. Velocity generally decreases with the square of distance from the extraction point (in simple cases). Therefore the air speed at the extraction point should be adjusted, accordingly, after reference to distance from the contaminating source. The air velocity at the extraction fan, for example, should be a minimum of 1-2 m/s (200-400 f/min) for extraction of solvents generated in a tank 2 meters distant from the extraction point. Other mechanical considerations, producing performance deficits within the extraction apparatus, make it essential that theoretical air velocities are multiplied by factors of 10 or more when extraction systems are installed or used.
**Personal protection**

- **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.
  - Chemical goggles, wherever there is a danger of the material coming in contact with the eyes; goggles must be properly fitted.
  - Full face shield (20 cm, 8 in minimum) may be required for supplementary but never for primary protection of eyes; these afford face protection.
  - Contact lenses may pose a special hazard; soft contact lenses may absorb and concentrate irritants. A written policy document, describing the wearing of lenses or restrictions on use, should be created for each workplace or task. This should include a review of lens absorption and adsorption for the class of chemicals in use and an account of injury experience. Medical and first-aid personnel should be trained in their removal and suitable equipment should be readily available. In the event of chemical exposure, begin eye irrigation immediately and remove contact lens as soon as practicable. Lens should be removed at the first signs of eye redness or irritation - lens should be removed in a clean environment only after workers have washed hands thoroughly. [CDC NIOSH Current Intelligence Bulletin 59], [AS/NZS 1336 or national equivalent]

**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.
- PVC Apron.
- PVC protective suit may be required if exposure severe.
- Eyewash unit.
- Ensure there is ready access to a safety shower.

**Thermal hazards**

Not Available

**Respiratory protection**

Type A Filter of sufficient capacity (AS/NZS 1716 & 1715, EN 143:2000 & 149:2001, ANSI Z88 or national equivalent)

### SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

**Information on basic physical and chemical properties**

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Appearance</strong></td>
<td>colorless</td>
</tr>
<tr>
<td><strong>Physical state</strong></td>
<td>Liquid</td>
</tr>
<tr>
<td><strong>Relative density (Water = 1)</strong></td>
<td>Not Available</td>
</tr>
<tr>
<td><strong>Odour</strong></td>
<td>Not Available</td>
</tr>
<tr>
<td><strong>Partition coefficient n-octanol / water</strong></td>
<td>Not Available</td>
</tr>
<tr>
<td><strong>Odour threshold</strong></td>
<td>Not Available</td>
</tr>
<tr>
<td><strong>Auto-ignition temperature (°C)</strong></td>
<td>Not Available</td>
</tr>
<tr>
<td><strong>pH (as supplied)</strong></td>
<td>&lt;2</td>
</tr>
<tr>
<td><strong>Decomposition temperature</strong></td>
<td>Not Available</td>
</tr>
<tr>
<td><strong>Melting point / freezing point (°C)</strong></td>
<td>Not Available</td>
</tr>
<tr>
<td><strong>Viscosity (cSt)</strong></td>
<td>Not Available</td>
</tr>
<tr>
<td><strong>Initial boiling point and boiling range (°C)</strong></td>
<td>Not Available</td>
</tr>
<tr>
<td><strong>Molecular weight (g/mol)</strong></td>
<td>Not Available</td>
</tr>
<tr>
<td><strong>Flash point (°C)</strong></td>
<td>Not Available</td>
</tr>
<tr>
<td><strong>Taste</strong></td>
<td>Not Available</td>
</tr>
<tr>
<td><strong>Evaporation rate</strong></td>
<td>Not Available</td>
</tr>
<tr>
<td><strong>Explosive properties</strong></td>
<td>Not Available</td>
</tr>
<tr>
<td><strong>Flammability</strong></td>
<td>Not Available</td>
</tr>
<tr>
<td><strong>Oxidising properties</strong></td>
<td>Not Available</td>
</tr>
<tr>
<td><strong>Upper Explosive Limit (%)</strong></td>
<td>Not Available</td>
</tr>
<tr>
<td><strong>Surface Tension (dyn/cm or mN/m)</strong></td>
<td>Not Available</td>
</tr>
<tr>
<td><strong>Lower Explosive Limit (%)</strong></td>
<td>Not Available</td>
</tr>
<tr>
<td><strong>Volatile Component (%vol)</strong></td>
<td>Not Available</td>
</tr>
<tr>
<td><strong>Vapour pressure (kPa)</strong></td>
<td>Not Available</td>
</tr>
<tr>
<td><strong>Gas group</strong></td>
<td>Not Available</td>
</tr>
<tr>
<td><strong>Solubility in water (g/L)</strong></td>
<td>Miscible</td>
</tr>
<tr>
<td><strong>pH as a solution (1%)</strong></td>
<td>Not Available</td>
</tr>
<tr>
<td><strong>Vapour density (Air = 1)</strong></td>
<td>Not Available</td>
</tr>
<tr>
<td><strong>VOC g/L</strong></td>
<td>Not Available</td>
</tr>
</tbody>
</table>

### SECTION 10 STABILITY AND REACTIVITY

**Reactivity**

- 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

The material can cause respiratory irritation in some persons. The body’s response to such irritation can cause further lung damage. Corrosive acids can cause irritation of the respiratory tract, with coughing, choking and mucous membrane damage. There may be dizziness, headache, nausea and weakness. The material has NOT been classified by EC Directives or other classification systems as “harmful by inhalation”. This is because of the lack of corroborating animal or human evidence.

Ingestion

Ingestion of acidic corrosives may produce burns around and in the mouth, the throat and oesophagus. Immediate pain and difficulties in swallowing and speaking may also be evident. The material has NOT been classified by EC Directives or other classification systems as “harmful by ingestion”. This is because of the lack of corroborating animal or human evidence.

Skin Contact

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. Skin contact is not thought to have harmful health effects (as classified under EC Directives); the material may still produce health damage following entry through wounds, lesions or abrasions. Entry into the blood-stream, through, for example, cuts, abrasions or lesions, may produce systemic injury with harmful effects. Examine the skin prior to the use of the material and ensure that any external damage is suitably protected.

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. Mild burns of the epithelia generally recover rapidly and completely.

Chronic

Repeated or prolonged exposure to acids may result in the erosion of teeth, swelling and/or ulceration of mouth lining. Irritation of airways to lung, with cough, and inflammation of lung tissue often occurs. 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.

<table>
<thead>
<tr>
<th>Substance</th>
<th>Toxicity</th>
<th>Irritation</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 22-3 Hafnium (100μg/mL in 2% HNO₃ + Tr HF)</td>
<td>Not Available</td>
<td>Not Available</td>
</tr>
<tr>
<td>Hafnium</td>
<td>Not Available</td>
<td>Not Available</td>
</tr>
<tr>
<td>Nitric acid</td>
<td>Not Available</td>
<td>Not Available</td>
</tr>
<tr>
<td>Hydrofluoric acid</td>
<td>Inhalation (rat) LC50: 625 ppm/1h[^2]</td>
<td>Not Available</td>
</tr>
<tr>
<td>Water</td>
<td>Not Available</td>
<td>Not Available</td>
</tr>
</tbody>
</table>

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

NITRIC ACID

For acid mists, aerosols, vapours

Test results suggest that eukaryotic cells are susceptible to generic damage when the pH falls to about 6.5. The material may produce respiratory tract irritation, and result in damage to the lung including reduced lung function. 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]

Nitric 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.

Acute Toxicity ✓

Skin Irritation/Corrosion ✓

Serious Eye Damage/Irritation ✓

Carcinogenicity

Reproductivity

STOT - Single Exposure

Continued...
SECTION 12 ECOLOGICAL INFORMATION

Toxicity

<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>NOEC</td>
<td>16</td>
<td>Fish</td>
<td>107mg/L</td>
<td>4</td>
</tr>
<tr>
<td>LC50</td>
<td>96</td>
<td>Fish</td>
<td>51mg/L</td>
<td>2</td>
</tr>
<tr>
<td>EC50</td>
<td>48</td>
<td>Crustacea</td>
<td>~270mg/L</td>
<td>1</td>
</tr>
<tr>
<td>EC50</td>
<td>96</td>
<td>Crustacea</td>
<td>26-48mg/L</td>
<td>2</td>
</tr>
<tr>
<td>NOEC</td>
<td>504</td>
<td>Fish</td>
<td>4mg/L</td>
<td>2</td>
</tr>
</tbody>
</table>

Ecotoxicity:
The tolerance of water organisms towards pH margin and variation is diverse. Recommended pH values for test species listed in OECD guidelines are between 6.0 and almost 9. Acute testing with fish showed 96h-LC50 at about pH 3.5. Prevent, by any means available, spillage from entering drains or water courses. DO NOT discharge into sewer or waterways.

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>

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

- Recycle wherever possible.
- Consult manufacturer for recycling options or consult local or regional waste management authority for disposal if no suitable treatment or disposal facility can be identified.
- Treat and neutralise at an approved treatment plant. Treatment should involve: Neutralisation with soda-ash or soda-lime followed by: burial in a land-fill specifically licensed to accept chemical and / or pharmaceutical wastes or Incineration in a licensed apparatus (after admixture with suitable combustible material).
- Decontaminate empty containers with 5% aqueous sodium hydroxide or soda ash, followed by water. Observe all label safeguards until containers are cleaned and destroyed.

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 | Hazard Label 8 |
| | Special provisions 386, B2, IB2, 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 A3A803 |
| | 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 Y640 |
| | 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) |
| Transport hazard class(es) | IMDG Class 8 |
| | IMDG Subrisk Not Applicable |
| Packing group | II |
| Environmental hazard | Not Applicable |
| Special precautions for user | EMS Number F-A, S-B |
| | Special precautions 274 |
| | Limited Quantities 1 L |

### 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>
Safety, health and environmental regulations / legislation specific for the substance or mixture

**HAFeNIUm(7440-58-6) IS FOUND ON THE FOLLOWING REGULATORY LISTS**

- International Agency for Research on Cancer (IARC) - Agents Classified by the IARC Monographs
- International Air Transport Association (IATA) Dangerous Goods Regulations - Prohibited List Passenger and Cargo Aircraft
- US - Alaska Limits for Air Contaminants
- US - California OEHHA/ARB - Chronic 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)

**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 - 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 - Rhode Island Hazardous Substance List
- US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants

**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
- International Air Transport Association (IATA) Dangerous Goods Regulations - Prohibited List Passenger and Cargo Aircraft
- 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 - Acceptable Maximum Peak Concentrations
- 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-A Final Rule Limits for Air Contaminants

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

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

### Federal Regulations

Superfund Amendments and Reauthorization Act of 1986 (SARA)

#### SECTION 311/312 HAZARD CATEGORIES

<table>
<thead>
<tr>
<th>Hazard Type</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate (acute) health hazard</td>
<td>Yes</td>
<td></td>
</tr>
<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>Substance</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

[Continued...]
### US. CALIFORNIA PROPOSITION 65

None Reported

<table>
<thead>
<tr>
<th>National Inventory</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia - AICS</td>
<td>N (hafnium)</td>
</tr>
<tr>
<td>Canada - DSL</td>
<td>Y</td>
</tr>
<tr>
<td>Canada - NDSL</td>
<td>N (hafnium; hydrofluoric acid; water; nitric acid)</td>
</tr>
<tr>
<td>China - IECSC</td>
<td>N (hafnium)</td>
</tr>
<tr>
<td>Europe - EINEC / ELINCS / NLP</td>
<td>Y</td>
</tr>
<tr>
<td>Japan - ENCS</td>
<td>N (hafnium; hydrofluoric acid; water; nitric acid)</td>
</tr>
<tr>
<td>Korea - KECI</td>
<td>Y</td>
</tr>
<tr>
<td>New Zealand - NZIoC</td>
<td>N (hafnium)</td>
</tr>
<tr>
<td>Philippines - PICCS</td>
<td>Y</td>
</tr>
<tr>
<td>USA - TSCA</td>
<td>Y</td>
</tr>
</tbody>
</table>

**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**

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. Many factors determine whether the reported Hazards are Risks in the workplace or other settings. Risks may be determined by reference to Exposures Scenarios. Scale of use, frequency of use and current or available engineering controls must be considered.

**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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