NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY
U.S. DEPARTMENT OF COMMERCE

Date of Issue:
18 March 2024

SAFETY DATA SHEET

1. Substance and Source Identification

Product Identifier

SRM Number: 3122
SRM Name: Hafnium (Hf) Standard Solution
Other Means of Identification: Not applicable.

Recommended Use of This Material and Restrictions of Use

This Standard Reference Material (SRM) is intended for use as a primary calibration standard for the quantitative determination of hafnium. A unit of SRM 3122 consists of 50 mL of an acidified aqueous solution prepared gravimetrically to contain a known mass fraction of hafnium in a polyethylene bottle sealed in an aluminized bag.

Company Information

National Institute of Standards and Technology
Standard Reference Materials Program
100 Bureau Drive, Stop 2300
Gaithersburg, Maryland 20899-2300

Telephone: 301-975-2200
E-mail: SRMMSDS@nist.gov
Website: https://www.nist.gov/srm

Emergency Telephone ChemTrec:
1-800-424-9300 (North America)
+1-703-527-3887 (International)

2. Hazards Identification

Classification

Physical Hazard:	Not classified.	
Health Hazard:	Skin Corrosion/Irritation	Category 1B
	Serious Eye Damage/Eye Irritation	Category 1

Label Elements

Symbol

Signal Word

DANGER

Hazard Statement(s)

H314	Causes severe skin burns and eye damage.

Precautionary Statement(s)

P260	Do not breathe fumes, mists, vapors, or spray.
P264	Wash hands thoroughly after handling.
P280	Wear protective gloves, protective clothing, and eye protection.
P301+P330+P331	If swallowed: Rinse mouth. Do NOT induce vomiting.
P303+P361+P353	If on skin (or hair): Remove immediately all contaminated clothing. Rinse skin with water.
P304+P340	If inhaled: Remove person to fresh air and keep comfortable for breathing.
P305+P351+P338	If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P310	Immediately call a doctor.
P363	Wash contaminated clothing before reuse.
P405	Store locked up.
P501	Dispose of contents and container according to local regulations.

Hazards Not Otherwise Classified: Not applicable.

Ingredients(s) with Unknown Acute Toxicity: Not applicable.

3. COMPOSITION AND INFORMATION ON HAZARDOUS INGREDIENTS

Substance: Hafnium in nitric acid solution.

Other Designations:
Nitric acid (aqua fortis; hydrogen nitrate; azotic acid; engraver's acid)
Hafnium nitrate [nitric acid, hafnium(4+) salt (4:1); hafnium tetranitrate; nitric acid, hafnium(4+) salt]

NOTE: The solution is prepared gravimetrically from high-purity hafnium metal to contain a known mass fraction of hafnium in nitric acid with trace amounts of hydrofluoric acid. Hafnium in nitric acid solution forms a solvated hafnium nitrate salt.

Components are listed in compliance with OSHA's 29 CFR 1910.1200; for the actual values see the NIST Certificate of Analysis.

Hazardous Component(s)	CAS Number	EC Number (EINECS)	Nominal Mass Concentration (%)
Nitric acid	7697-37-2	231-714-2	<20
Hafnium nitrate	15509-05-4	239-536-7	2.4
Non-Hazardous Component(s)			
Water	7732-18-5	231-791-2	>77.6

4. FIRST AID MEASURES

Description of First Aid Measures:

Inhalation: If adverse effects occur, remove to uncontaminated area. If not breathing, give artificial respiration or oxygen by qualified personnel. Seek immediate medical attention.

Skin Contact: Wash skin with soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get immediate medical attention. Thoroughly clean and dry contaminated clothing before reuse. Destroy contaminated shoes.

Eye Contact: Immediately flush eyes, including under the eyelids with copious amounts of water for at least 15 minutes. Seek immediate medical attention.

Ingestion: Contact a poison control center immediately for instructions. Do not induce vomiting. Give water to rinse out mouth. Never give liquids to a person with reduced awareness or becoming unconscious. If vomiting occurs, keep head lower than hips to prevent aspiration. If not breathing, give artificial respiration by qualified personnel. Seek immediate medical attention.

Most Important Symptoms/Effects, Acute and Delayed: Acid burns to skin, eyes, and lungs.

Indication of any immediate medical attention and special treatment needed, if necessary: If any of the above symptoms are present, seek immediate medical attention.

5. FIRE FIGHTING MEASURES

Fire and Explosion Hazards: Negligible fire hazard. See Section 9, "Physical and Chemical Properties" for flammability properties.

Extinguishing Media:
Suitable: Use extinguishing media appropriate to the surrounding fire.
Unsuitable: None listed.

Specific Hazards Arising from the Chemical: Miscellaneous decomposition products.

Special Protective Equipment and Precautions for Fire-Fighters: Avoid inhalation of material or combustion byproducts. Wear full protective clothing and NIOSH approved self-contained breathing apparatus (SCBA).

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions, Protective Equipment and Emergency Procedures: Immediately contact emergency personnel. Keep unnecessary personnel away. Use suitable protective equipment; see Section 8, "Exposure Controls and Personal Protection".

Methods and Materials for Containment and Clean up: Do not touch spilled material. Notify safety personnel of spills. Absorb with sand or other non-combustible material. Collect spilled material in appropriate container for disposal. Isolate hazard area and deny entry.

7. HANDLING AND STORAGE

Safe Handling Precautions: See Section 8, "Exposure Controls and Personal Protection".

Storage: Store and handle in accordance with all current regulations and standards. Keep separated from incompatible substances (see Section 10, "Stability and Reactivity").

8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

Exposure Limits			
Component(s)	**OSHA (PEL)**	**ACGIH (TLV)**	**NIOSH (REL)**
Nitric acid	5 mg/m^3 (2 ppm) TWA	5 mg/m^3 (2 ppm) TWA 10 mg/m^3 (4 ppm) STEL	5 mg/m^3 (2 ppm) TWA 10 mg/m^3 (4 ppm) STEL 65 mg/m^3 (25 ppm) IDLH
Hafnium nitrate (as Hf, related to Hafnium compounds)	0.5 mg/m^3 TWA	No occupational limits established.	0.5 mg/m^3 TWA 50 mg/m^3 IDLH

Engineering Controls: Provide local exhaust or process enclosure ventilation system. Ensure compliance with applicable exposure limits.

Personal Protection: In accordance with OSHA 29 CFR 1910.132, subpart I, wear appropriate Personal Protective Equipment (PPE) to minimize exposure to this material.

Respiratory Protection: If workplace conditions warrant a respirator, a respiratory protection program that meets OSHA 29CFR 1910.134 must be followed. Refer to NIOSH 42 CFR 84 for applicable certified respirators.

Eye/Face Protection: Wear splash resistant safety goggles with a face shield. An eyewash station should be readily available near areas of use.

Skin and Body Protection: Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product. Chemical-resistant gloves should be worn at all times when handling chemicals.

9. PHYSICAL AND CHEMICAL PROPERTIES

Descriptive Properties:

Appearance (physical state, color, etc.):	colorless to yellow liquid
Molecular Formula:	not applicable
Molar Mass (g/mol):	not applicable
Odor:	irritating odor
Odor threshold:	not available
pH:	acidic
Evaporation rate:	not available
Melting point/freezing point (ºC):	not available
Relative Density (g/L) as specific gravity (water = 1):	not available
Vapor Pressure (mmHg):	not available
Vapor Density (air = 1):	not available
Viscosity (cP):	not available
Solubility(ies):	miscible with water
Partition coefficient (n-octanol/water):	not available

Thermal Stability Properties:

Autoignition Temperature (ºC):	not applicable
Thermal Decomposition (ºC):	not applicable
Initial boiling point and boiling range (ºC):	not available
Explosive Limits, LEL (Volume %):	not applicable
Explosive Limits, UEL (Volume %):	not applicable
Flash Point (ºC):	not applicable
Flammability (solid, gas):	not applicable

10. STABILITY AND REACTIVITY

Reactivity: Stable at normal temperatures and pressure.

Stability: X Stable _____ Unstable

Possible Hazardous Reactions: None listed.

Conditions to Avoid: Contact with combustible or incompatible materials.

Incompatible Materials: Acids, combustible materials, halo carbons, amines, bases, oxidizing materials, metals, halogens, metal salts, metal oxides, reducing agents, peroxides, metal carbide, cyanides.

Fire/Explosion Information: See Section 5, "Fire Fighting Measures".

Hazardous Decomposition: Thermal decomposition will produce oxides of nitrogen, hydrogen fluoride, hafnium, and other miscellaneous decomposition products.

Hazardous Polymerization: _____ Will Occur X Will Not Occur

11. TOXICOLOGICAL INFORMATION

Route of Exposure: X Inhalation X Skin X Ingestion

Symptoms Related to the Physical, Chemical and Toxicological Characteristics: Acid burns to skin, eyes, and lungs.

Potential Health Effects (Acute, Chronic and Delayed):

Inhalation: Inhalation of acid fumes can damage the mucous membranes and upper respiratory tract. Short term exposure may cause irritation and inflammation of the upper respiratory tract, coughing, choking, sore throat, shortness of breath, headache, dizziness, and nausea. Long term exposure to acid fumes may cause damage to teeth, bronchial irritation, chronic cough, bronchial pneumonia, and gastrointestinal disturbances.

Skin Contact: Nitric and hydrofluoric acid can cause severe skin burns. Severity of the damage depends on the concentration and duration of exposure. Effects of acid burns may be delayed.

Eye Contact: Nitric and hydrofluoric acid can cause severe eye irritation, corneal burns, permanent eye damage, or blindness. Severity of the damage depends on the concentration and duration of exposure.

Ingestion: If ingested, nitric and hydrofluoric acid can cause severe burns and damage to the gastrointestinal tract.

Numerical Measures of Toxicity

Acute Toxicity: Not classified.

Nitric acid: Rat, Inhalation LC50: 130 mg/m^3 (4 h)
Hydrofluoric acid: Rat, Inhalation LC50: 1276 ppm (1 h); 1100 mg/m^3 (1 h)
Hafnium nitrate: no data available.

Skin Corrosion/Irritation: This SRM contains >1 % of nitric acid and hydrofluoric acid and it is classified as Category 1B.

Serious Eye Damage/Irritation: This SRM contains >1 % nitric acid and hydrofluoric acid and it is classified as Category 1.

Respiratory Sensitization: No data available.

Skin Sensitization: No data available.

Germ Cell Mutagenicity: No data available.

Carcinogenicity: Not classified.

Listed as a Carcinogen/Potential Carcinogen _____ Yes __X__ No
Nitric acid, hydrofluoric acid, and hafnium nitrate are not listed by NTP, IARC or OSHA as carcinogens/potential carcinogens.

Reproductive Toxicity: Not classified.

Nitric acid: Rat, Oral TDLo: 21 150 mg/kg (pregnant 1 d to 21 d)
Rat, Oral TDLo: 2345 mg/kg (pregnant 18 d)
Hydrofluoric acid: Rat, Inhalation TCLo: 470 µg/m^3 (4 h, pregnant 1 d to 22 d)

Specific Target Organ Toxicity, Single Exposure: No data available.

Specific Target Organ Toxicity, Repeated Exposure: No data available.

Aspiration Hazard: No data available.

12. ECOLOGICAL INFORMATION

Ecotoxicity Data

Nitric acid: Fish, hooknose or pogge (*Agonus cataphractus*) LC50: 100 mg/L to 330 mg/L (48 h)
Hydrofluoric acid: Invertebrate, water flea (Daphnia magna) EC50: 270 mg/L (48 h)
Hafnium nitrate: No data available.

Persistence and Degradability: No data available.

Bioaccumulative Potential: No data available.

Mobility in Soil: No data available.

Other Adverse effects: No data available.

13. DISPOSAL CONSIDERATIONS

Waste Disposal: Dispose of waste in accordance with all applicable federal, state, and local regulations. Subject to disposal regulations: U.S. EPA 40 CFR 262, Hazardous Waste Numbers: nitric acid (D001, D002) and hydrofluoric acid (U134).

14. TRANSPORTATION INFORMATION

U.S. DOT and IATA: UN1760, Corrosive liquid, n.o.s. (contains nitric acid and hydrofluoric acid), Hazard Class 8, Packing Group II.

15. REGULATORY INFORMATION

U.S. Regulations:

C ERCLA Sections 102a/103 (40 CFR 302.4):	Nitric acid, 1000 lbs. (454 kg) final RQ Hydrofluoric acid, 100 lbs. (45.4 kg) final RQ
SARA Title III Section 302 (40 CFR 355.30):	Nitric acid, 1000 lbs. (454 kg) TPQ Hydrofluoric acid, 100 lbs. (45.4 kg) TPQ
SARA Title III Section 304 (40 CFR 355.40):	Nitric acid, 1000 lbs. (454 kg) EPCRA RQ Hydrofluoric acid, 100 lbs. (45.4 kg) EPCRA RQ
SARA Title III Section 313 (40 CFR 372.65):	1 % de minimis concentration for nitric acid and hydrofluoric acid.
OSHA Process Safety (29 CFR 1910.119):	Regulated for nitric acid at higher concentrations 500 lbs. TQ (≥94.5 % by weight) Hydrofluoric acid, 1000 lbs. (454 kg) TQ (anhydrous)

SARA Title III Sections 311/312 Hazardous Categories (40 CFR 370.21):

ACUTE HEALTH:	Yes
CHRONIC HEALTH:	No
FIRE:	No
REACTIVE:	No
PRESSURE:	No

State Regulations: Not listed under California Proposition 65.

U.S. TSCA Inventory: Nitric acid, hydrofluoric acid, and hafnium nitrate are listed.

TSCA 12(b), Export Notification: Not listed.

Canadian Regulations: WHMIS Information is not provided for this material.

16. OTHER INFORMATION

Issue Date: 18 March 2024

Sources: ChemAdvisor, Inc., SDS *Nitric Acid*, 09 December 2015.

ChemAdvisor, Inc., SDS *Hydrofluoric Acid*, 09 December 2015.

CDC; NIOSH; *NIOSH Pocket Guide to Chemical Hazards*; Department of Health and Human Services (DHHS), Centers for Disease Control and Prevention (CDC), National Institute for Safety and Health; *Nitric Acid*, 11 April 2016; available at https://www.cdc.gov/niosh/npg/npgd0447.html (accessed Mar 2024).

Hazardous Substances Data Bank (HSDB), National Library of Medicine's PubChem system, *Nitric Acid CAS No. 7697-37-2*; available at https://pubchem.ncbi.nlm.nih.gov/ (accessed Mar 2024).

ChemID*plus* Advanced, National Library of Medicine's PubChem system, *Hafnium Nitrate CAS No. 15509-05-4*; available at https://pubchem.ncbi.nlm.nih.gov/ (accessed Mar 2024).

Key of Acronyms:

ACGIH	American Conference of Governmental Industrial Hygienists	NRC	Nuclear Regulatory Commission
ALI	Annual Limit on Intake	NTP	National Toxicology Program
CAS	Chemical Abstracts Service	OSHA	Occupational Safety and Health Administration
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act	PEL	Permissible Exposure Limit
CFR	Code of Federal Regulations	RCRA	Resource Conservation and Recovery Act
DOT	Department of Transportation	REL	Recommended Exposure Limit
EC50	Effective Concentration, 50 %	RM	Reference Material
EINECS	European Inventory of Existing Commercial Chemical Substances	RQ	Reportable Quantity
EPCRA	Emergency Planning and Community Right-to-Know Act	RTECS	Registry of Toxic Effects of Chemical Substances
IARC	International Agency for Research on Cancer	SARA	Superfund Amendments and Reauthorization Act
IATA	International Air Transport Association	SCBA	Self-Contained Breathing Apparatus
IDLH	Immediately Dangerous to Life and Health	SRM	Standard Reference Material
LC50	Lethal Concentration, 50 %	STEL	Short Term Exposure Limit
LD50	Lethal Dose, 50 %	STOT	Specific Target Organ Toxicity
LEL	Lower Explosive Limit	TLm	Threshold Limit, median
MSDS	Material Safety Data Sheet	TLV	Threshold Limit Value
NIOSH	National Institute for Occupational Safety and Health	TPQ	Threshold Planning Quantity
NIST	National Institute of Standards and Technology	TSCA	Toxic Substances Control Act
n.o.s.	Not Otherwise Specified	TWA	Time Weighted Average
		UEL	Upper Explosive Limit
		WHMIS	Workplace Hazardous Materials Information System

Disclaimer: The NIST SDS information is specific to the NIST product and is believed to be correct, based upon our current knowledge. The SDS may not necessarily be all inclusive and should be used only as a guide. NIST does not guarantee the accuracy or completeness of this information. The only official source for specific values and uncertainties is the certificate or report.

Users of this SRM should ensure that the SDS in their possession is current. This can be accomplished by contacting the SRM Program: telephone (301) 975-2200; e-mail srmmsds@nist.gov; or via the Internet at https://www.nist.gov/srm.