

## SAFETY DATA SHEET

### 1. SUBSTANCE AND SOURCE IDENTIFICATION

#### Product Identifier

**SRM Number:** 4321d  
**SRM Name:** Natural Uranium Radioactivity Standard  
**Other Means of Identification:** Not applicable.

#### Recommended Use of This Material and Restrictions of Use

This Standard Reference Material (SRM) is intended primarily for the calibration of instruments that are used to measure radioactivity and for the monitoring of radiochemical procedures. A unit of SRM 4321d consists of 5 mL of a 1.06 M (6 %) nitric acid solution in which a certified quantity of radioactive uranium-238, uranium-235, and uranium-234 is dissolved. The solution is contained in a 5 mL flame sealed borosilicate glass ampoule.

#### 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  
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 1-800-424-9300 (North America)  
 +1-703-527-3887 (International)

### 2. HAZARDS IDENTIFICATION

#### Radiological Hazard

**Warning: THIS MATERIAL SHOULD ONLY BE USED BY PERSONS QUALIFIED TO HANDLE RADIOACTIVE MATERIAL!**

This product contains licensed radioactive material and is therefore subject to the requirements of 10 CFR Part 20 (e.g., public and occupational exposure limits, waste disposal). At a minimum, the basic radiation safety principles of time, distance, and shielding, and appropriate radiation contamination control should be practiced to avoid/minimize any external and/or internal exposure. Consult with your Radiation Safety office for your facility's radiation safety requirements/precautions specific to the radionuclide(s) (including its activity and chemical/physical form) in this Radioactive SRM.

**Warning: SRM 4321d is a radioactive material, comprised of uranium-238, with a massic activity of approximately 228.93 Bq·g<sup>-1</sup> uranium-235 with a massic activity of approximately 10.54 Bq·g<sup>-1</sup> and uranium-234 with a massic activity of approximately 220.16 Bq·g<sup>-1</sup> in solution. Uranium decays by alpha-particle emission. The progeny of uranium-238, uranium-235 and uranium-234 decay by alpha- and beta- particle emission. During the decay process x-rays and gamma rays with energies from 11 keV to 2.0 MeV are emitted.**

#### Classification.

**Physical Hazard:** There are no known physical hazards associated with this material.

**Health Hazard:** Skin Corrosion/Irritation Category 1B  
 Serious Eye Damage/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:** None.

**Ingredients(s) with Unknown Acute Toxicity:** None.

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**3. COMPOSITION AND INFORMATION ON HAZARDOUS INGREDIENTS**


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**Substance:** Natural Uranium in 1.06 M Nitric Acid solution.

**Other Designations:**

**Nitric Acid:** Aqua fortis; hydronitrate; azotic acid; engraver's acid.

**Natural Uranium:** Not applicable.

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

| <b>Hazardous Component(s)</b>     | <b>CAS Number</b> | <b>EC Number<br/>(EINECS)</b> | <b>Nominal Mass Concentration<br/>(%)</b> |
|-----------------------------------|-------------------|-------------------------------|-------------------------------------------|
| Nitric Acid                       | 7697-37-2         | 231-714-2                     | 6.3                                       |
| Uranium-238                       | Not applicable    | Not applicable                | 0.000184                                  |
| Uranium-235                       | Not applicable    | Not applicable                | 0.0132                                    |
| Uranium-234                       | Not applicable    | Not applicable                | 0.0000956                                 |
| <b>Non-Hazardous Component(s)</b> |                   |                               |                                           |
| Water                             | 7732-18-5         | 231-791-2                     | >83                                       |

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**4. FIRST AID MEASURES**


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**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:** Rinse affected area with copious amounts of water followed by washing with soap and water for at least 15 minutes while removing contaminated clothing. Seek medical attention, if needed.

**Eye Contact:** Immediately flush eyes, including under the eyelids with copious amounts of water for at least 30 minutes. Seek immediate medical attention.

**Ingestion:** Contact a poison control center immediately for instructions. Wash out mouth with water, but do not induce vomiting. Seek medical aid at once, and bring the container or label.

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

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

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## 5. FIRE FIGHTING MEASURES

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**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:** Oxides of nitrogen.

**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).

**NFPA Ratings:** (0 = Minimal; 1 = Slight; 2 = Moderate; 3 = Serious; 4 = Severe)

Health = 3

Fire = 0

Reactivity = 0

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## 6. ACCIDENTAL RELEASE MEASURES

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**This material is radioactive. DO NOT touch spilled material. Immediately notify safety personnel of a spill. Use appropriate lab clean up procedure for radioactive material.**

**Personal Precautions, Protective Equipment, Methods and Materials for Containment and Clean up:**

**Radiological Emergency Procedures:**

*The following is a guide for first responders. The following actions, including remediation, should be carried out by qualified individuals. In cases where a life-threatening injury occurs concurrent with personal contamination, treat the injury first.*

Do not touch damaged packages or spilled material. Handle as a radioactive material spill. In addition to those actions described below, the guidelines in the Emergency Response Guidebook (ERG) provide more specific measures that should be followed.

**Spill and Leak Control:**

Alert and clear everyone from the area affected by the spill.

Take actions to limit the spread of contamination.

Summon aid.

**Damage to the Radioactive Source:**

Evacuate the immediate vicinity around the source.

Place a barrier at a safe distance from the source.

Identify area as a radiation hazard.

**Suggested Emergency Protective Equipment:**

Gloves

Footwear Covers

Outer layer or easily removed protective clothing (as situation requires)

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## 7. HANDLING AND STORAGE

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**Safe Handling Precautions and Storage:** This material is radioactive. Store and handle in accordance with all current regulations and standards. See NRC 10 CFR 20 or state regulations. See Section 8, “Exposure Controls and Personal Protection”.

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## 8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

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**Exposure Limits:**

**U-238:**

ALI<sub>inh</sub>: 0.04 µCi (1.48 kBq) (Bone surface) (See NRC 10 CFR 20 Appendix B)

ALI<sub>ing</sub>: 10 µCi (370 kBq) (Bone surface)

OSHA: See OSHA 29 CFR and NRC 10 CFR 20.

ACGIH: See International Commission on Radiological Protection guidelines.

**U-235:**

ALI<sub>inh</sub>: 0.04 µCi (1.48 kBq) (Bone surface) (See NRC 10 CFR 20 Appendix B)

ALI<sub>ing</sub>: 10 µCi (370 kBq) (Bone surface)

OSHA: See OSHA 29 CFR and NRC 10 CFR 20.

ACGIH: See International Commission on Radiological Protection guidelines.

**U-234:**

ALI<sub>inh</sub>: 0.04 µCi (1.48 kBq) (See NRC 10 CFR 20 Appendix B)

ALI<sub>ing</sub>: 10 µCi (370 kBq) (Bone surface)

OSHA: See OSHA 29 CFR and NRC 10 CFR 20.

ACGIH: See International Commission on Radiological Protection guidelines.

**Nitric Acid:**

NIOSH (REL): 5 mg/m<sup>3</sup> (2 ppm; TWA)  
10 mg/m<sup>3</sup> (4 ppm; STEL)

65 mg/m<sup>3</sup> (25 ppm; IDLH)

ACGIH (TLV): 5 mg/m<sup>3</sup> (2 ppm; TWA)  
10 mg/m<sup>3</sup> (4 ppm; STEL)

OSHA (PEL): 5 mg/m<sup>3</sup> (2 ppm; TWA)

**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 eye wash station should be readily available near areas of use.

**Skin and Body Protection:** Wear protective clothing to prevent contact with skin. Wear appropriate gloves.

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**9. PHYSICAL AND CHEMICAL PROPERTIES**


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**Descriptive Properties:****SRM 4321d solution**

**Appearance (physical state, color, etc.):**

Light yellow liquid

**Molecular Formula:**

Not applicable

**Molar Mass (g/mol):**

Not applicable

**Odor:**

Slightly pungent

**Odor threshold:**

<1 ppm HNO<sub>3</sub>

**pH:**

0

**Evaporation rate:**

<1

**Melting point/freezing point (°C):**

−4

**Relative Density (g/L) as specific gravity (water = 1):**

1.06 at 20 °C

**Vapor Pressure (mmHg):**

2 kPa (17 mmHg) at 20 °C (water) plus  
0.01 Pa (0.0001 mmHg) at 20 °C (HNO<sub>3</sub>)

**Vapor Density (air = 1):**

2.18 (HNO<sub>3</sub> vapor)

**Viscosity (mm<sup>2</sup>/s = centiStokes):**

~0.991 at 20 °C

**Solubility(ies):**

Soluble in water and alcohol

**Partition coefficient**

not available

**(n-octanol/water):**

**Thermal Stability Properties:**

**Autoignition Temperature (°C):**

not applicable

**Thermal Decomposition (°C):**

not applicable

**Initial boiling point and boiling range (°C):**

101

**Explosive Limits, LEL (Volume %):**

not applicable

**Explosive Limits, UEL (Volume %):**

not applicable

**Flash Point (°C):**

not applicable

**Flammability (solid, gas):**

not applicable

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**10. STABILITY AND REACTIVITY**


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**Reactivity:** Stable at normal temperatures and pressure.

**Stability:**     X     Stable     \_\_\_\_\_     Unstable

**Possible Hazardous Reactions:** None listed.

**Conditions to Avoid:** Avoid contact with combustible materials and 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:** Oxides of nitrogen.

**Hazardous Polymerization:** \_\_\_\_\_ Will Occur        X   Will Not Occur

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## 11. TOXICOLOGICAL INFORMATION

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**Route of Exposure:**      X   Inhalation        X   Skin        X   Ingestion

**Symptoms Related to the Physical, Chemical and Toxicological Characteristics:** Burning pain and severe corrosive skin damage. Permanent eye damage including blindness could result.

**Potential Health Effects (Acute, Chronic and Delayed):**

**Inhalation:** Nitric acid, if inhaled, can damage the mucous membranes and 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 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 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:** Ingestion of this material is unlikely under normal conditions of use. If ingested, nitric 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<sup>3</sup> (4 h)

**Skin Corrosion/Irritation:** This SRM contains 6 % nitric acid and it is classified as Category 1B.

**Serious Eye Damage/Eye Irritation:** This SRM contains 6 % nitric 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:** No data available.

**Listed as a Carcinogen/Potential Carcinogen**

\_\_\_\_\_ Yes        X   No  
Nitric acid is not listed by NTP, IARC or OSHA as a carcinogen.

**Radiological Hazard:** U-238, U-235 and U-234

While radionuclides have been identified as carcinogens, occupational exposure limits as prescribed by the NRC can only be exceeded with this SRM under prolonged direct exposure.

**Reproductive Toxicity:** No data available.

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

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

**Aspiration Hazard:** No data available.

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## 12. ECOLOGICAL INFORMATION

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**Ecotoxicity Data:**

**Component:** Nitric Acid

Fish: Starfish (*Asterias rubens*), LC50: 100-300 mg/L (48 h, renewal, aerated water)

**Component:** Natural Uranium

No ecotoxicity data listed.

**Persistence and Degradability:** No data available.

**Bioaccumulative Potential:** No data available.

**Mobility in Soil:** No data available.

**Other Adverse Effects:** No data available.

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### 13. DISPOSAL CONSIDERATIONS

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**Waste Disposal:** This material is radioactive. Dispose in accordance with all applicable federal, state, and local regulations for **RADIOACTIVE** materials. See NRC 10 CFR 20 subpart K.

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### 14. TRANSPORTATION INFORMATION

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**U.S. DOT and IATA:**

**Primary Risk:** Corrosive liquid, acidic, inorganic, n.o.s. (contains nitric acid), UN3264, Hazard Class 8, Packing Group II, Excepted Quantity E2.

**Subsidiary Risk:** UN2910, Radioactive Material, Excepted Package.

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### 15. REGULATORY INFORMATION

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**U.S. Regulations:**

CERCLA Sections 102a/103 (40 CFR 302.4): Nitric Acid, 1000 lbs; 454 kg RQ.

SARA Title III Section 302 (40 CFR 355.30): Nitric Acid, 1000 lbs TPQ.

SARA Title III Section 304 (40 CFR 355.40): Nitric Acid, 1000 lbs EPCRA RQ.

SARA Title III Section 313 (40 CFR 372.65): Nitric Acid, 1.0 % de minimis concentrations.

OSHA Process Safety (29 CFR 1910.119): Nitric Acid at higher concentrations 500 lbs. TQ ( $\geq 94.5\%$ ) is regulated.

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:**

California Proposition 65: No components are regulated.

**U.S. TSCA Inventory:** Nitric acid listed.

**TSCA 12(b), Export Notification:** No components are listed.

**Canadian Regulations:**

WHMIS Information: Not provided for this material.

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### 16. OTHER INFORMATION

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**Issue Date:** 27 November 2017

**Sources:** ChemAdvisor, Inc., SDS *Nitric 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*, 18 November 2010; available at <http://www.cdc.gov/niosh/npg/npgd0447.html> (accessed Nov 2017).

United States National Library of Medicine, Hazardous Substance Database (HSDB), *Nitric Acid*; available at <http://toxnet.nlm.nih.gov/newtoxnet/hsdb.htm> (accessed Nov 2017).

OSHA 29 CFR, Subpart Z, Ionizing radiation, 1910.1096.

NRC 10 CFR 20, Standards for Protection Against Radiation.

DOT 49 CFR 173, Shippers General Requirements for Shipments and Packages.

## Key of Acronyms:

|        |                                                                       |       |                                                       |
|--------|-----------------------------------------------------------------------|-------|-------------------------------------------------------|
| ACGIH  | American Conference of Governmental Industrial Hygienists             | NIOSH | National Institute for Occupational Safety and Health |
| ALI    | Annual Limit on Intake                                                | NIST  | National Institute of Standards and Technology        |
| CAS    | Chemical Abstracts Service                                            | NRC   | Nuclear Regulatory Commission                         |
| CEN    | European Committee for Standardization                                | NTP   | National Toxicology Program                           |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act | OSHA  | Occupational Safety and Health Administration         |
| CFR    | Code of Federal Regulations                                           | PEL   | Permissible Exposure Limit                            |
| CPSU   | Coal Mine Dust Personal Sample Unit                                   | 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                           |
| ISO    | International Organization for Standardization                        | STEL  | Short Term Exposure Limit                             |
| LC50   | Lethal Concentration, 50 %                                            | TDLo  | Toxic Dose Low                                        |
| LD50   | Lethal Dose, 50 %                                                     | TLV   | Threshold Limit Value                                 |
| LEL    | Lower Explosive Limit                                                 | TPQ   | Threshold Planning Quantity                           |
| MSDS   | Material Safety Data Sheet                                            | TSCA  | Toxic Substances Control Act                          |
| NFPA   | National Fire Protection Association                                  | TWA   | Time Weighted Average                                 |
| MSHA   | Mine Safety and Health Administration                                 | UEL   | Upper Explosive Limit                                 |
|        |                                                                       | WHMIS | Workplace Hazardous Materials Information System      |

**Disclaimer:** Physical and chemical data contained in this SDS are provided only for use in assessing the hazardous nature of this material. The SDS was prepared carefully, using current references; however, NIST does not certify the data in the SDS. The certified values for this material are given in the NIST Certificate.

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; fax (301) 948-3730; e-mail [srmmsds@nist.gov](mailto:srmmsds@nist.gov); or via the Internet at <http://www.nist.gov/srm>.