Date of Issue:
30 July 2015

SAFETY DATA SHEET

1. SUBSTANCE AND SOURCE IDENTIFICATION

Product Identifier

SRM Number: 4412L
SRM Name: Molybdenum-99 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 4412L consists of 5 mL of a 3 M (18 %) nitric acid solution in which a certified quantity of radioactive Molybdenum-99 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
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Gaithersburg, Maryland 20899-2300

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1-800-424-9300 (North America)
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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.

SRM 4412L is a radioactive material, Molybdenum-99, with a massic activity of approximately 28 MBq•g $^{-1}$ in nitric acid solution. Molybdenum-99 decays by beta-particle emission to excited levels of Tc-99. During the decay process, X-rays and gamma rays with energies from 2 keV to 762 keV are also 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.

3. COMPOSITION AND INFORMATION ON HAZARDOUS INGREDIENTS

Substance: Radioactive Molybdenum-99 in 3.1 M Nitric Acid.

Other Designations:

Nitric Acid: Aqua fortis; hydronitrate; azotic acid; engraver's acid.
Molybdenum-99: Not applicable.

This SRM contains trace amounts of Na_2MoO_4. Components are listed in compliance with OSHA's 29 CFR 1910.1200; for the actual values see the NIST Certificate.

Hazardous Component(s)	CAS Number	EC Number (EINECS)	Nominal Mass Concentration (%)
Nitric Acid	7697-37-2	231-714-2	18
Molybdenum-99	Not applicable	Not applicable	0.0000002
Non-Hazardous Component(s)			
Water	7732-18-5	231-791-2	>81

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: 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.

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: 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

6. ACCIDENTAL RELEASE MEASURES

This material is radioactive. DO NOT touch spilled material. Immediately notify safety personnel of a spill.

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)

7. HANDLING AND STORAGE

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".

8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

Exposure Limits:

Molybdenum-99:

ALI_{inh}: 1000 µCi or 37 MBq. See NRC 10 CFR 20 Appendix B.
ALI_{ing}: : 1000 µCi or 37 MBq.
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^3 (2 ppm; TWA)
	10 mg/m^3 (4 ppm; STEL)
	65 mg/m^3 (25 ppm; IDLH)
ACGIH (TLV):	5 mg/m^3 (2 ppm; TWA)
	10 mg/m^3 (4 ppm; STEL)
OSHA (PEL):	5 mg/m^3 (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.

9. PHYSICAL AND CHEMICAL PROPERTIES

Descriptive Properties:	Nitric Acid
Appearance (physical state, color, etc.):	colorless to yellow liquid
Molecular Formula:	HNO_3
Molar Mass (g/mol):	63.01
Odor:	irritating odor
Odor threshold:	not available
pH:	1 (1 M)
Evaporation rate:	not available
Melting point/freezing point (ºC):	–42 (–43 ºF)
Relative Density (g/L) as specific gravity (water = 1):	1.5027 at 25 ºC
Vapor Pressure (mmHg):	47.9 at 20 ºC
Vapor Density (air = 1):	3.2
Viscosity (cP):	not available
Solubility(ies):	miscible with water and ether
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):	83 (181 ºF)
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: 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

11. TOXICOLOGICAL INFORMATION

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:
Nitric acid, Rat, Inhalation LC50: 130 mg/m^3 (4 h)

Skin Corrosion/Irritation: This SRM contains 18 % nitric acid and it is classified as Category 1B.

Serious Eye Damage/Eye Irritation: This SRM contains 18 % 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: Molybdenum-99
Ionizing radiation is a known carcinogen.

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.

12. ECOLOGICAL INFORMATION

Ecotoxicity Data:

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

Component: Molybdenum-99
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.

13. DISPOSAL CONSIDERATIONS

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.

14. TRANSPORTATION INFORMATION

U.S. DOT and IATA:

Primary Risk: UN2915, Radioactive Material, Type A Package, Hazard Class 7
Subsidiary Risk: Not applicable.

15. REGULATORY INFORMATION

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:	Yes.
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.

16. OTHER INFORMATION

Issue Date: 30 July 2015

Sources: ChemAdvisor, Inc., SDS *Nitric Acid*, 1 December 2014.

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 July 2015).

United States National Library of Medicine, Hazardous Substance Database (HSDB), *Nitric Acid*; available at http://toxnet.nlm.nih.gov/newtoxnet/hsdb.htm (accessed July 2015).

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 Transportation Agency	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; or via the Internet at http://www.nist.gov/srm.