Date of Issue:
18 September 2013

SAFETY DATA SHEET

1. SUBSTANCE AND SOURCE IDENTIFICATION

Product Identifier

SRM Number: 4967A
SRM Name: Radium-226 Radioactivity Standard
Other Means of Identification: Not applicable.

Recommended Use of This Material and Restrictions of Use

This Standard Reference Material (SRM) consists of a solution of a standardized and certified quantity of radioactive radium-226 in a suitably stable and homogeneous matrix. It 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 4967A consists of approximately 5 mL of a hydrochloric acid and barium chloride solution contained in a flame-sealed borosilicate-glass ampoule. The solution contains hydrochloric acid at a mass fraction of approximately 4 %, equivalent to an amount of substance concentration (molarity) of approximately 1.0 mol/L.

Company Information

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2. HAZARDS IDENTIFICATION

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 4967A is a radioactive material, Radium-226, with a massic activity of 2482 Bq•g^{-1} in a hydrochloric acid solution. Radium-226 decays by alpha-particle emission and the progeny of radium-226 decays by alpha and beta-particle emission. During the decay process X-rays and gamma rays, with energies from 11 keV to 2.5 MeV are also emitted. Gaseous radon-222 will escape from the ampoule when it is opened.

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

Other Designations:

Hydrochloric Acid (no other designations listed)

Hazardous Component(s)	CAS Number	EC Number (EINECS)	Nominal Mass Concentration (%)
Hydrochloric Acid	7647-01-0	231-595-7	4
Radium-226		Not applicable	0.0016
Non-Hazardous Component(s)			
Water	7732-18-5	231-791-2	96

NOTE: The amount of barium chloride contained in this solution is below the reportable limits required by OSHA for SDS information: hazardous components (1 %); carcinogens (0.1 %), required by OSHA, 29 CFR 1910.1200 (g)(2)(i)(C)(1), for MSDS information. For actual concentrations of the elements see the Certificate of Analysis.

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. 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: Thermal decomposition will form 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 and Emergency Procedures and 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 2012 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:

Component: Radium-226

ALI_{inh}: 0.6 μCi See NRC 10 CFR 20 Appendix B.

ALI_{ing}: 2 μCi See NRC 10 CFR 20 Appendix B.

OSHA: See OSHA 29 CFR and NRC 10 CFR 20.
ACGIH: See International Commission on Radiological Protection guidelines

Component: Hydrochloric Acid

NIOSH (REL):	7 mg/m^3; 5 ppm (Ceiling) 50 ppm (IDLH)
ACGIH (TLV):	2 ppm (Ceiling)
OSHA (PEL):	7 mg/m^3; 5 ppm (Ceiling)

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: 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

NOTE: The physical and chemical data provided are for the pure hazardous components.

Descriptive Properties:	**Hydrochloric Acid (4 % of this SRM)**
Appearance (physical state, color, etc.):	Colorless to yellow liquid
Molecular Formula:	HCl
Molar Mass (g/mol):	36.46
Odor:	Pungent, irritating odor
Odor threshold:	Not available
pH:	<2
Evaporation rate (ether = 1):	>1
Melting point/freezing point (ºC):	–114.22
Relative Density (g/L):	1.639
Vapor Pressure (mmHg):	14 (20 ºC)
Vapor Density (air = 1):	1.268
Viscosity (cP):	Not available
Solubility(ies):	Miscible with water
Partition coefficient (n-octanol/water):	Not available
Particle Size (if relevant)	Not applicable
Thermal Stability Properties:	
Autoignition Temperature (ºC):	Not applicable
Thermal Decomposition (ºC):	Not applicable
Initial boiling point and boiling range (ºC):	–85.05 (–121.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: Not reactive per SARA 311/312 and NFPA.

Stability: X Stable _____ Unstable

Possible Hazardous Reactions: May react with evolution of heat; release toxic, corrosive, flammable or explosive gases on contact with water.

Conditions to Avoid: Heat, flames, sparks and other sources of ignition. May ignite or explode on contact with combustible materials.

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

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

Hazardous Decomposition: Thermal decomposition will produce hydrogen chloride gas.

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, severe skin corrosion, and eye damage.

Potential Health Effects (Acute, Chronic and Delayed):

Inhalation: Inhalation of hydrochloric acid 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: Hydrochloric 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: Hydrochloric 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, concentrated hydrochloric acid can cause burns to the gastrointestinal tract.

Numerical Measures of Toxicity:

Acute Toxicity: Not classified.
Hydrochloric acid, Rat, Inhalation LC50: 1562 ppm (4 h)
Hydrochloric acid, Rat, Oral LD50: 700 mg/kg

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

Serious Eye damage/ Eye irritation: This SRM contains >1 % hydrochloric 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
Hydrochloric acid is not listed in NTP, IARC or OSHA as a carcinogen.

Radiological Hazard: Ra-226
Ionizing radiation is a known carcinogen.

Reproductive Toxicity: Not classified.
Hydrochloric acid, Rat, Oral TDLo: 450 mg/kg (1 hour prior to copulation)

Specific Target Organ Toxicity, Single Exposure: Not classified.

Specific Target Organ Toxicity, Repeated Exposure: Not classified.

Aspiration Hazard: No data available.

12. ECOLOGICAL INFORMATION

Ecotoxicity Data:

Solution: Hydrochloric Acid/Radium-226
No ecotoxicity data listed.

Component: Hydrochloric Acid
Mosquitofish (*Gambusia affinis*), LC50: 282 mg/L, Static (96 h)
Shore crab (*Carcinus maenas*), LC50: 240 mg/L (48 h)

Component: Radium-226
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: UN2910, Radioactive Material Excepted Package, Class 7

Subsidiary Risk: UN1789, Hydrochloric acid, Class 8, Packing Group II Excepted Quantity E2.

15. REGULATORY INFORMATION

U.S. Regulations:

CERCLA Sections 102a/103 (40 CFR 302.4): Hydrochloric Acid, 5000 lbs; 2270 kg RQ.

SARA Title III Section 302 (40 CFR 355.30): Hydrochloric Acid, 500 lbs TPQ (gas only).

SARA Title III Section 304 (40 CFR 355.40): Hydrochloric Acid, 5000 lbs EPCRA RQ (gas only).

SARA Title III Section 313 (40 CFR 372.65):
Hydrochloric Acid: 1 % de minimis concentration (acid aerosols including mists, vapors, gas, for, and other airborne forms of any particle size).

OSHA Process Safety (29 CFR 1910.119):
Regulated for Hydrochloric Acid at higher concentrations 500 lb TQ (anhydrous).

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: Not listed.

U.S. TSCA Inventory: Hydrochloric acid is listed.

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

Canadian Regulations:
WHMIS Information: Not provided for this material.

16. OTHER INFORMATION

Issue Date: 18 September 2013

Sources: ChemAdvisor, Inc., MSDS *Hydrochloric Acid 2N*, 13 March 2013.

Hazardous Substances Data Bank, National Library of Medicine, *Hydrochloric Acid* CAS 7647-01-0, Animal Toxicity Studies, available at http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB (accessed Sep 2013).

Hazardous Substances Data Bank, National Library of Medicine, *Radium-226*, available at http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB (accessed Sep 2013).

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	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 Transportation Agency	SCBA	Self-Contained Breathing Apparatus
IDLH	Immediately Dangerous to Life and Health	SRM	Standard Reference Material
LC50	Lethal Concentration, 50 %	STEL	Short Term Exposure Level
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
NIOSH	National Institute for Occupational Safety and Health	UEL	Upper Explosive Limit
NIST	National Institute of Standards and Technology	WHMIS	Workplace Hazardous Materials Information System
n.o.s.	Not Otherwise Specified		

Disclaimer: Physical and chemical data contained in this SDS are provided only for use in assessing the hazardous nature of the 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 of Analysis.

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.