

**SAFETY DATA SHEET**

**1. SUBSTANCE AND SOURCE IDENTIFICATION**

**Product Identifier**

**SRM Number:** 3134  
**SRM Name:** Molybdenum (Mo) Standard Solution (Nominal HCl 10 %)  
**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 molybdenum. A unit of SRM 3134 consists of five 10 mL sealed borosilicate glass ampoules of an acidified aqueous solution prepared gravimetrically to contain a known mass fraction of molybdenum. The solution contains hydrochloric acid at a volume fraction of approximately 10 %, equivalent to an amount of substance concentration (molarity) of approximately 1.2 mol/L.

**Company Information**

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

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**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 fume, mists, vapors, spray.  
 P264 Wash hands thoroughly after handling.  
 P280 Wear protective gloves, protective clothing, eye 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.  
 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 poison center or doctor.  
 P363 Wash contaminated clothing before reuse.

P390 Absorb spillage to prevent material damage.  
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.

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### 3. COMPOSITION AND INFORMATION ON HAZARDOUS INGREDIENTS

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**Substance:** Hydrochloric Acid/Molybdenum chloride Solution

**Other Designations:**

Hydrochloric Acid (no other designations listed)

Molybdenum chloride (molybdenum (V) chloride, molybdenum pentachloride).

**NOTE:** Molybdenum in hydrochloric acid solution forms a solvated molybdenum chloride salt.

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

Hazardous Component(s)	CAS Number	EC Number (EINECS)	Nominal Mass Concentration (%)
Hydrochloric Acid	7647-01-0	231-595-7	4
Molybdenum Chloride	10241-05-1	233-575-3	2.8
<b>Non-Hazardous Component(s)</b>			
Water	7732-18-5	231-791-2	>92

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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:** 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.

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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:** 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

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## 6. ACCIDENTAL RELEASE MEASURES

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**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.

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## 7. HANDLING AND STORAGE

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**Safe Handling Precautions:** See Section 8, “Exposure Controls and Personal Protection”. Handle glass ampoules with care.

**Storage:** Store and handling in accordance with all current regulations and standards. Keep separated from incompatible substances (acids, combustible materials, halo carbons, amines, bases, oxidizing materials, metals, halogens, metal salts, metal oxides, reducing agents, peroxides, metal carbide, cyanides).

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## 8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

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### Exposure Limits:

**Component:** Hydrochloric Acid

NIOSH (REL):      7 mg/m<sup>3</sup>; 5 ppm (Ceiling)  
50 ppm (IDLH)

ACGIH (TLV):      2 ppm (Ceiling)

OSHA (PEL):      7 mg/m<sup>3</sup>; 5 ppm (Ceiling)

**Component:** Molybdenum, soluble compounds

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

ACGIH (TLV):      10 mg/m<sup>3</sup>; 4 ppm (TWA) inhalable fraction; 3 mg/m<sup>3</sup>; 2 ppm (TWA) respirable fraction

OSHA (PEL):      5 mg/m<sup>3</sup>; 2 ppm (TWA); 15 mg/m<sup>3</sup>; 10 ppm (TWA) total dust

**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.

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## 9. PHYSICAL AND CHEMICAL PROPERTIES

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**NOTE:** The physical and chemical data provided are for the pure hazardous components. No physical or chemical data are available for this solution of molybdenum chloride and hydrochloric acid.

<b>Descriptive Properties:</b>	<b>Hydrochloric Acid (4 % of this SRM)</b>	<b>Molybdenum chloride (2.8 % of this SRM)</b>
<b>Appearance (physical state, color, etc.):</b>	Colorless to yellow liquid	Black deliquescent crystalline solid
<b>Molecular Formula:</b>	HCl	Cl <sub>5</sub> Mo
<b>Molar Mass (g/mol):</b>	36.46	273.21
<b>Odor:</b>	Pungent, irritating odor	Odorless
<b>Odor threshold:</b>	Not available	Not available
<b>pH:</b>	<2	Not applicable
<b>Evaporation rate (ether = 1):</b>	>1	Not applicable
<b>Melting point/freezing point (°C):</b>	-114.22	Not available
<b>Relative Density (g/L):</b>	1.639	Not available
<b>Vapor Pressure (mmHg):</b>	14 (20 °C)	Not applicable
<b>Vapor Density (air = 1):</b>	1.268	Not available
<b>Viscosity (cP):</b>	Not available	Not available
<b>Solubility(ies):</b>	Miscible with water	Water, alcohol, ether, ammonia, mineral acids, chloroform, carbon tetrachloride
<b>Partition coefficient (n-octanol/water):</b>	Not available	Not available
<b>Particle Size (if relevant)</b>	Not applicable	Not available
<b>Thermal Stability Properties:</b>		
<b>Autoignition Temperature (°C):</b>	Not applicable	Not applicable
<b>Thermal Decomposition (°C):</b>	Not applicable	170 (338 °F)
<b>Initial boiling point and boiling range (°C):</b>	-85.05 (-121.°F)	268 (514 °F)
<b>Explosive Limits, LEL (Volume %):</b>	Not applicable	Not applicable
<b>Explosive Limits, UEL (Volume %):</b>	Not applicable	Not applicable
<b>Flash Point (°C)</b>	Not applicable	Not applicable
<b>Flammability (solid, gas):</b>	Not applicable	Not applicable

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## 10. STABILITY AND REACTIVITY

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**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

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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, 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. Acute exposure to molybdenum chloride may cause irritation of the mucous membranes. No data available for chronic exposure.

**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. Molybdenum chloride may cause irritation.

**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. Acute exposure to molybdenum chloride may cause irritation; chronic exposure may result in conjunctivitis.

**Ingestion:** If ingested, concentrated hydrochloric acid can cause burns to the gastrointestinal tract. No data available for ingestion of molybdenum chloride.

**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

Molybdenum chloride: No data available.

**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.

Molybdenum chloride: No data available.

**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.

Molybdenum chloride is not listed in NTP, IARC or OSHA as a 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.

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## 12. ECOLOGICAL INFORMATION

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**Ecotoxicity Data:**

**Component:** Hydrochloric Acid

Mosquitofish (*Gambusia affinis*), LC50: 282 mg/L, Static (96 h)

Shore crab (*Carcinus maenas*), LC50: 240 mg/L (48 h)

**Component:** Molybdenum chloride

No information available.

**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:** Dispose of waste in accordance with all applicable federal, state, and local regulations. Hydrochloric acid subject to disposal regulations: U.S. EPA 40 CFR 262, Hazardous Waste Number: D002

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### 14. TRANSPORTATION INFORMATION

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**U.S. DOT and IATA:** UN1760, Corrosive liquid, n.o.s. (contains hydrochloric acid), Hazard Class 8, Packing Group II, Excepted Quantities E2.

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### 15. REGULATORY INFORMATION

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**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:	No.
FIRE:	No.
REACTIVE:	No.
PRESSURE:	No.

**State Regulations:**

California Proposition 65: Not listed.

**U.S. TSCA Inventory:** Hydrochloric acid and molybdenum chloride are listed.

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

**Canadian Regulations:**

WHMIS Information: Not provided for this material.

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## 16. OTHER INFORMATION

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**Issue Date:** 10 February 2014

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

ChemAdvisor, Inc., MSDS *Molybdenum Pentachloride*, 13 March 2013.

ChemAdvisor, Inc., MSDS *Molybdenum*, 13 March 2013

EPA Hazardous Waste Codes for Waste Streams Commonly Generated by Small Generators, available at <http://www.epa.gov/osw/hazard/generation/sqg/handbook/insert.pdf> (accessed July 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 July 2013).

Hazardous Substances Data Bank, National Library of Medicine, *Molybdenum chloride* CAS 3251-23-8, available at <http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB> (accessed July 2013).

NIOSH Pocket Guide to Chemical Hazards, *Molybdenum (soluble compounds, as Mo)*, available at <http://www.cdc.gov/niosh/npg/npgd0434.html> (accessed July 2013).

### 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 Limit
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](mailto:srmmsds@nist.gov); or via the Internet at <http://www.nist.gov/srm>.