

**SAFETY DATA SHEET**

**1. SUBSTANCE AND SOURCE IDENTIFICATION**

**Product Identifier**

**SRM Number:** 3165  
**SRM Name:** Vanadium (V) 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 vanadium. A unit of SRM 3165 consists of five 10 mL sealed borosilicate glass ampoules of an acidified aqueous solution prepared gravimetrically to contain a known mass fraction of vanadium. The solution contains nitric acid at an amount-of-substance concentration (molarity) of approximately 1.6 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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 1-800-424-9300 (North America)  
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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 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.

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### 3. COMPOSITION AND INFORMATION ON HAZARDOUS INGREDIENTS

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**Substance:** Vanadium in nitric acid solution

**Other Designations:**

Nitric acid (aqua fortis; hydrogen nitrate; azotic acid; engraver's acid)

Vanadium nitrate [vanadium dinitrate; VO(NO<sub>3</sub>)<sub>2</sub>]

**NOTE:** Vanadium in nitric acid solution forms a solvated vanadium nitrate salt.

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

<b>Hazardous Component(s)</b>	<b>CAS Number</b>	<b>EC Number (EINECS)</b>	<b>Nominal Mass Concentration (%)</b>
Nitric acid	7697-37-2	231-714-2	10
Vanadium nitrate	not assigned	not assigned	1.8
<b>Non-Hazardous Component(s)</b>			
Water	7732-18-5	231-791-2	>88

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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. 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.

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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 and vanadium.

**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”.

**Storage:** Store and handling in accordance with all current regulations and standards. Keep separated from incompatible substances (See Section 10, “Stability and Reactivity”).

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## 8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

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### Exposure Limits

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

Vanadium nitrate:

NIOSH (REL): 1 mg/ m<sup>3</sup> (as V) TWA  
NIOSH (REL): 3 mg/ m<sup>3</sup> STEL (as V) STEL  
NIOSH (REL): 0.05 mg/ m<sup>3</sup> (as V, related to vanadium compounds, dust and fume, 15 min) Ceiling  
OSHA (PEL): 0.5 mg/ m<sup>3</sup> (V<sub>2</sub>O<sub>5</sub>, fume) Ceiling  
OSHA (PEL): 0.1 mg/ m<sup>3</sup> (V<sub>2</sub>O<sub>5</sub>, dust) 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 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.

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## 9. PHYSICAL AND CHEMICAL PROPERTIES

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**NOTE:** The physical and chemical data provided are for the pure components. No physical or chemical data are available for this solution of vanadium nitrate and nitric acid. The actual behavior of the solution may differ from the individual components.

<b>Descriptive Properties:</b>	<b>Nitric acid (10 % of this SRM)</b>	<b>Vanadium nitrate (1.8 % of this SRM)</b>
<b>Appearance (physical state, color, etc.):</b>	colorless to yellow liquid	not available
<b>Molecular Formula</b>	HNO <sub>3</sub>	VO(NO <sub>3</sub> ) <sub>2</sub>
<b>Molar Mass (g/mol)</b>	63.01	194.95
<b>Odor</b>	irritating odor	odorless
<b>Odor threshold</b>	not available	not available
<b>pH</b>	1 (1 M)	not applicable
<b>Evaporation rate</b>	not available	not applicable
<b>Melting point/freezing point</b>	-42 °C (-43 °F)	not available
<b>Relative Density (g/L) as specific gravity (water = 1):</b>	1.5027 at 25 °C	not available
<b>Vapor Pressure (mmHg)</b>	47.9 at 20 °C	not applicable
<b>Vapor Density (air = 1)</b>	3.2	not applicable
<b>Viscosity (cP)</b>	not available	not available
<b>Solubility(ies)</b>	miscible with water and ether	not available
<b>Partition coefficient (n-octanol/water)</b>	not available	not available
<b>Particle Size</b>	not applicable	not available
<b>Thermal Stability Properties</b>		
<b>Autoignition Temperature</b>	not applicable	not applicable
<b>Thermal Decomposition</b>	not applicable	not available
<b>Initial boiling point and boiling range</b>	83 °C (181 °F)	not applicable
<b>Explosive Limits, LEL (Volume %)</b>	not applicable	not applicable
<b>Explosive Limits, UEL (Volume %)</b>	not applicable	not applicable
<b>Flash Point</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:** 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 and vanadium.

**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 skin corrosion.

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

**Inhalation:** Inhalation of nitric 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. Vanadium and its compounds may cause respiratory tract irritation, irritation, allergic reactions, nausea, vomiting, diarrhea, chest pain, difficulty breathing, lung congestion, kidney damage, and liver damage.

**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. Vanadium and its compounds may cause irritation, allergic reactions, and skin disorders.

**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. Vanadium and its compounds may cause eye irritation and blurred vision.

**Ingestion:** 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)

Vanadium nitrate: No data available.

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

**Serious Eye damage/Eye irritation:** This SRM contains >1 % 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:** Not classified.

**Listed as a Carcinogen/Potential Carcinogen**   Yes  X  No

Nitric acid and vanadium nitrate are not listed by NTP, IARC or OSHA as carcinogens.

**Reproductive Toxicity:** Not classified.

Nitric acid, Rat, Oral TDLo: 21 150 mg/kg (pregnant 1 d to 21 d)

Nitric acid, Rat, Oral TDLo: 2345 mg/kg (pregnant 18 d)

**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

Nitric acid: Starfish (*Asterias rubens*) LC50 [renewal/aerated water]: 100 mg/L to 300 mg/L (48 h)

Vanadium 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.

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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. Nitric acid subject to disposal regulations: U.S. EPA 40 CFR 262, Hazardous Waste Numbers: D001, D002.

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## 14. TRANSPORTATION INFORMATION

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

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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) final RQ
- SARA Title III Section 302 (40 CFR 355.30): Nitric acid, 1000 lbs (454 kg) TPQ
- SARA Title III Section 304 (40 CFR 355.40): Nitric acid, 1000 lbs (454 kg) EPCRA RQ
- SARA Title III Section 313 (40 CFR 372.65): 1 % de minimis concentration (nitric acid);  
1 % de minimis concentration (Vanadium compounds,  
except when contained in an alloy)
- OSHA Process Safety (29 CFR 1910.119): Regulated for nitric acid at higher concentrations 500 lbs. TQ  
(≥94.5 % by weight).
- 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 is listed.

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

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

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## 16. OTHER INFORMATION

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**Issue Date:** 21 May 2014

**Sources:** ChemAdvisor, Inc., MSDS *Nitric Acid*, 07 February 2014.

ChemAdvisor, Inc., MSDS *Vanadium*, 21 March 2014.

Hazardous Substances Data Bank (HSDB), National Library of Medicine's TOXNET system, *Nitric Acid* CAS No. 7697-37-2; available at <http://toxnet.nlm.nih.gov> (accessed May 2014).

### 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 %	STOT	Specific Target Organ Toxicity
LEL	Lower Explosive Limit	TLm	Threshold Limit, median
MSDS	Material Safety Data Sheet	TLV	Threshold Limit Value
NFPA	National Fire Protection Association	TPQ	Threshold Planning Quantity
NIOSH	National Institute for Occupational Safety and Health	TSCA	Toxic Substances Control Act
NIST	National Institute of Standards and Technology	TWA	Time Weighted Average
n.o.s.	Not Otherwise Specified	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 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>.