THE CITADEL
SCHOOL OF SCIENCE AND MATHEMATICS

Chemistry Department
Standard Operating Procedures

Print out the completed form and keep a readily accessible hard copy in the lab (also keeping an electronic copy is highly recommended).

Date: 12-11-2017

SOP Title: Nitric Acid

Supervisor/Principal Investigator/Instructor: Laboratory Safety Manager (Freedman)/Department Head (Bevsek)

Department/Bldg/Room#: Chemistry/Byrd Hall

Supervisor/Principal Investigator/Instructor Phone Number: 953-1067(Lab Safety Manager)/ 953-7790 (Department Head)

Section 1 – Process/Experiment

NA

Section 2 – Hazardous Chemicals

Nitric acid (see attached SDS) is an extremely corrosive acid and **strong oxidizing agent**. It may be harmful if ingested, inhaled, or absorbed through the skin. It can cause severe skin and eye burns resulting in irreversible damage. It is extremely destructive to the tissue of the mucous membranes and the upper respiratory tract.

As a strong oxidizing agent, it can cause **violent explosions** when combined with reducing agents such as organic solvents and reagents. Therefore, great care must be taken to store it separately from organic acids, flammable and combustible liquids (such as organic solvents), and organic reagents in general. Nitric acid waste must also be segregated from all other organic waste. Combination of nitric acid waste with other non-compatible waste streams is a major cause of laboratory explosions.

EXPOSURE LIMITS

OSHA has established maximum inhalation exposure limits for workers in occupational settings for over 500 chemicals. These are known as **Permissible Exposure Limits** and cannot legally be exceeded. For nitric acid the PEL is quite low:

2 ppm - 8 hour time weighted average exposure
4 ppm - 15 min. time-weighted average exposure (short-term exposure limit)
https://www.osha.gov/dsg/annotated-pels/tablez-1.html

Therefore, work with nitric acid should always be done in a fume hood, glove box, or in totally-sealed containers to keep inhalation exposures as low as possible. Contact the Laboratory Safety Manager or EH&S if you believe you are being exposed. In some instances, EH&S can do quantitative exposure monitoring. Because nitric acid is also a serious skin contact hazard, skin exposure should also be absolutely minimized.

Section 3 – Potential Hazards

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)
Oxidizing liquids (Category 3), H272
Corrosive to metals (Category 1), H290
Skin corrosion (Category 1A), H314
Serious eye damage (Category 1), H318

Signal word	Danger
Hazard statement(s)	
H272	May intensify fire; oxidizer.
H290	May be corrosive to metals.
H314	Causes severe skin burns and eye damage.
Precautionary statement(s)	
P210	Keep away from heat.
P220	Keep/Store away from clothing/ combustible materials.
P221	Take any precaution to avoid mixing with combustibles.
P234	Keep only in original container.
P264	Wash skin 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.
P304 + P340 + P310	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Immediately call a POISON CENTER/doctor.
P305 + P351 + P338 + P310	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. **Immediately call a POISON CENTER/doctor.**
P363	Wash contaminated clothing before reuse.
P370 + P378	In case of fire: Use dry sand, dry chemical or alcohol-resistant foam to extinguish.
P390	Absorb spillage to prevent material damage.
P405	Store locked up.
	Store in corrosive resistant stainless steel container with a resistant inner liner.
P501	Dispose of contents/ container to an approved waste disposal plant.

See attached SDS

Section 4 – Approvals Required

PI or designee must provide training to the laboratory personnel specific to the hazards involved in working with hazardous chemicals, work area decontamination, and emergency procedures.

The laboratory personnel should attend the trainings, review this SOP and SDS and complete the documentation of training. The trainings should be provided prior to work with hazardous chemicals and annual refresher thereafter.

PI or designee should inform EHS and the Laboratory Safety Manger if nitric acid use has exceeded PEL. The Laboratory Safety Manager and EHS will evaluate the operating procedures and advise on the handling requirements.

Section 5 – Designated Area

As/If deemed necessary, PIs or supervisors will insert any information about whether a special use-area is designated for this material. This will be laboratory specific.

Section 6 – Special Handling Procedures and Storage Requirements

Nitric acid can be only used in areas properly equipped with a certified eye wash/safety shower that can be reached within ten seconds. It is essential that all strong oxidizers be stored separately from other laboratory chemicals with which they may react. For oxidizing acids such as nitric acid this includes all organic materials. Ensure secondary containment and segregation of incompatible chemicals. Also, follow any substance-specific storage guidance provided in Safety Data Sheet (SDS) documentation.

The corrosive properties of nitric acid and its ability to produce fires or explosions by combination with combustible materials make the following considerations mandatory in the selection of a storage site:

- A relatively cool, dry environment free from extremes of temperature--humidity should be maintained.
- Store in a material that is acid-resistant; this facilitates flushing and other cleanup procedures in the event of leaks or spills.
- Store on low shelves or in "Corrosives" storage cabinets.
- **Segregate nitric acid from organic acids, and flammable and combustible liquids. This is crucial to avoid fires/explosions!**
- Segregate all acids from active metals such as sodium, potassium, magnesium, etc.
- Use bottle carriers for transporting materials when possible.
- When mixing acids and water, always add acid to water. To avoid surface boiling/spattering, **NEVER add water to acid!**
- Store mineral acids together, separate from oxidizing agents and organic materials.
- Store acetic acid and other organic acids with the combustible organic liquids.

Section 7 – Personal Protective Equipment

See the PPE information under Section II of *The Citadel Chemistry Department Chemical Hygiene Plan* regarding:

- what PPE is needed and when/where to use
- recommendations of required PPE found in the SDS
- obtaining your PPE
- glove selection criteria
- respirator use, etc.

At minimum, complete protection of the eyes and skin is essential.

Section 8 – Engineering/Ventilation Controls

For further information, see the following pages in Section II of The *Citadel Chemistry Department Chemical Hygiene Plan*:

- Fume Hood Usage SOP
- Criteria for Implementing Engineering Controls

If quantities, temperature or concentrations of use create a potential explosion hazard, then installation of blast shields around the experimental apparatus is strongly encouraged.

Section 9 – Spill and Accident Procedures/Decontamination

See directions under the "Chemical Spill Clean-Up Procedures" and "Emergency Response" sections of the CHP. Incident Report forms should already be present in all laboratories.

Student first aid cases are treated at The Citadel's Mary Bennett Murray Infirmary or a local emergency room. Employee and visitor first aid cases are treated through *CompEndium*, and *Concentra*, Dorchester Road (843-554-6737), *Concentra*, Rivers Avenue (843-735-5020) or local emergency room at the direction the Office of Human Resources (843-953-6922 or 953-5376--Benefits Manager).

DECONTAMINATION
Using proper personal protective equipment as outlined above, decontaminate equipment and bench tops using soap and water and properly dispose of all chemical and contaminated disposables as hazardous waste following the guidelines below

Section 10 – Waste Collection/Disposal

See "Chemical Waste Disposal" in Section II of *The* Citadel *Chemistry Department Chemical Hygiene Plan.*
It is crucial to avoid mixing nitric acid waste with organic waste of any kind. Nitric acid waste containers should be clearly marked as such to avoid accidental addition of any reducible materials. Failure to do this will cause a violent explosion.

Section 11 – Process Steps

NA

Section 12 – Training

- PI or designee must provide training to the laboratory personnel specific to the hazards involved in working with hazardous chemicals, work area decontamination, and emergency procedures.
- The laboratory personnel should attend the trainings, review this SOP and SDS and complete the documentation of training.
- The trainings should be provided prior to work with hazardous chemicals and annual refresher thereafter.
- Laboratory Safety Manager will keep training records

SOP Prepared by (Name and Title): Tiffany CR Freedman, Laboratory Safety Manager

SAFETY DATA SHEET

Version 3.11
Revision Date 05/23/2016
Print Date 11/29/2017

1. PRODUCT AND COMPANY IDENTIFICATION

1.1 Product identifiers

Product name : Nitric acid

Product Number : 258121
Brand : Sigma-Aldrich
Index-No. : 007-004-00-1

CAS-No. : 7697-37-2

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich
3050 Spruce Street
SAINT LOUIS MO 63103
USA

Telephone : +1 800-325-5832
Fax : +1 800-325-5052

1.4 Emergency telephone number

Emergency Phone # : +1-703-527-3887 (CHEMTREC)

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)
Oxidizing liquids (Category 3), H272
Corrosive to metals (Category 1), H290
Skin corrosion (Category 1A), H314
Serious eye damage (Category 1), H318

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram

Signal word Danger

Hazard statement(s)
H272 May intensify fire; oxidizer.
H290 May be corrosive to metals.
H314 Causes severe skin burns and eye damage.

Precautionary statement(s)
P210 Keep away from heat.
P220 Keep/Store away from clothing/ combustible materials.
P221 Take any precaution to avoid mixing with combustibles.
P234 Keep only in original container.
P264 Wash skin 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.
P304 + P340 + P310	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Immediately call a POISON CENTER/doctor.
P305 + P351 + P338 + P310	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a POISON CENTER/doctor.
P363	Wash contaminated clothing before reuse.
P370 + P378	In case of fire: Use dry sand, dry chemical or alcohol-resistant foam to extinguish.
P390	Absorb spillage to prevent material damage.
P405	Store locked up.
P406	Store in corrosive resistant stainless steel container with a resistant inner liner.
P501	Dispose of contents/ container to an approved waste disposal plant.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.2 Mixtures

Formula : HNO_3

Molecular weight : 63.01 g/mol

Hazardous components

Component		Classification	Concentration
Nitric acid			
CAS-No.	7697-37-2	Ox. Liq. 3; Met. Corr. 1; Skin Corr. 1A; Eye Dam. 1; H272, H290, H314	>= 90 - <= 100 %
EC-No.	231-714-2		
Index-No.	007-004-00-1		
Registration number	01-2119487297-23-XXXX		

For the full text of the H-Statements mentioned in this Section, see Section 16.

4. FIRST AID MEASURES

4.1 Description of first aid measures

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance.Move out of dangerous area.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact
Take off contaminated clothing and shoes immediately. Wash off with soap and plenty of water. Consult a physician.

In case of eye contact
Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.Continue rinsing eyes during transport to hospital.

If swallowed
Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed
The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed
No data available

5. FIREFIGHTING MEASURES

5.1 Extinguishing media

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture
No data available

5.3 Advice for firefighters
Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information
Use water spray to cool unopened containers.

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures
Wear respiratory protection. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas.
For personal protection see section 8.

6.2 Environmental precautions
Do not let product enter drains.

6.3 Methods and materials for containment and cleaning up
Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13).

6.4 Reference to other sections
For disposal see section 13.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling
Avoid inhalation of vapour or mist.
Keep away from sources of ignition - No smoking.Keep away from heat and sources of ignition.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities
Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.
Storage class (TRGS 510): Strongly oxidizing hazardous materials

7.3 Specific end use(s)
Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters

Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Nitric acid	7697-37-2	TWA	2.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Upper Respiratory Tract irritation Eye irritation Dental erosion		
		STEL	4.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Upper Respiratory Tract irritation Eye irritation Dental erosion		

		ST	4.000000 ppm 10.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	2.000000 ppm 5.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	2.000000 ppm 5.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		The value in mg/m3 is approximate.		
		PEL	2 ppm 5 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
		STEL	4 ppm 10 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)

Derived No Effect Level (DNEL)

Application Area	Exposure routes	Health effect	Value
Workers	Inhalation	Acute local effects	2.6 mg/m3
Workers	Inhalation	Long-term local effects	1.3 mg/m3
Consumers	Inhalation	Acute local effects	1.3 mg/m3
Consumers	Inhalation	Long-term local effects	0.65 mg/m3

8.2 Exposure controls

Appropriate engineering controls
Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Personal protective equipment

Eye/face protection
Tightly fitting safety goggles. Faceshield (8-inch minimum). Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection
Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact
Material: Fluorinated rubber
Minimum layer thickness: 0.7 mm
Break through time: 480 min
Material tested:Vitoject® (KCL 890 / Aldrich Z677698, Size M)

Splash contact
Material: Nature latex/chloroprene
Minimum layer thickness: 0.6 mm
Break through time: 120 min
Material tested:Lapren® (KCL 706 / Aldrich Z677558, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374
If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Body Protection
Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection
Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure
Do not let product enter drains.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: liquid Colour: colourless
b)	Odour	No data available
c)	Odour Threshold	No data available
d)	pH	< 1 at 20 °C (68 °F)
e)	Melting point/freezing point	No data available
f)	Initial boiling point and boiling range	100 °C (212 °F) at 1,013 hPa (760 mmHg)
g)	Flash point	No data available
h)	Evaporation rate	No data available
i)	Flammability (solid, gas)	No data available
j)	Upper/lower flammability or explosive limits	No data available
k)	Vapour pressure	11 hPa (8 mmHg) at 20 °C (68 °F)
l)	Vapour density	No data available
m)	Relative density	1.48 g/cm3
n)	Water solubility	completely soluble
o)	Partition coefficient: n-octanol/water	No data available
p)	Auto-ignition temperature	No data available
q)	Decomposition temperature	No data available
r)	Viscosity	No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	The substance or mixture is classified as oxidizing with the category 2.

9.2 Other safety information
No data available

10. STABILITY AND REACTIVITY

10.1 Reactivity
No data available

10.2 Chemical stability
Stable under recommended storage conditions.
Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions
No data available

10.4 Conditions to avoid
May discolor on exposure to air and light.

10.5 Incompatible materials
Alkali metals, Organic materials, Acetic anhydride, Acetonitrile, Alcohols, Acrylonitrile

10.6 Hazardous decomposition products
Other decomposition products - No data available
Hazardous decomposition products formed under fire conditions. - Nitrogen oxides (NOx)
In the event of fire: see section 5

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity
No data available

Inhalation: No data available

Dermal: No data available

No data available

Skin corrosion/irritation
No data available

Serious eye damage/eye irritation
No data available

Respiratory or skin sensitisation
Germ cell mutagenicity

No data available

Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

Reproductive toxicity
No data available
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

Additional Information
RTECS: Not available

Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract, eyes, and skin., Inhalation may provoke the following symptoms:, spasm, inflammation and edema of the bronchi, spasm, inflammation and edema of the larynx, pneumonitis, Symptoms and signs of poisoning are:, burning sensation, Cough, wheezing, laryngitis, Shortness of breath, Headache, Nausea, Vomiting, Pulmonary edema. Effects may be delayed., Large doses

may cause: conversion of hemoglobin to methemoglobin, producing cyanosis; marked fall in blood pressure, leading to collapse, coma, and possibly death.

Liver - Irregularities - Based on Human Evidence
Liver - Irregularities - Based on Human Evidence

12. ECOLOGICAL INFORMATION

12.1 Toxicity
No data available

12.2 Persistence and degradability
No data available

12.3 Bioaccumulative potential
No data available

12.4 Mobility in soil
No data available

12.5 Results of PBT and vPvB assessment
PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Other adverse effects

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Product
Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

Contaminated packaging
Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)
UN number: 2031 Class: 8 (5.1) Packing group: I
Proper shipping name: Nitric acid
Reportable Quantity (RQ): 1000 lbs

Poison Inhalation Hazard: No

IMDG
UN number: 2031 Class: 8 (5.1) Packing group: I EMS-No: F-A, S-Q
Proper shipping name: NITRIC ACID

IATA
UN number: 2031 Class: 8 (5.1) Packing group: I
Proper shipping name: Nitric acid
IATA Passenger: Not permitted for transport

15. REGULATORY INFORMATION

SARA 302 Components
The following components are subject to reporting levels established by SARA Title III, Section 302:

	CAS-No.	Revision Date
Nitric acid	7697-37-2	2007-07-01

SARA 313 Components
The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Nitric acid	7697-37-2	2007-07-01

SARA 311/312 Hazards
Reactivity Hazard, Acute Health Hazard, Chronic Health Hazard

Massachusetts Right To Know Components

	CAS-No.	Revision Date
Nitric acid	7697-37-2	2007-07-01

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Nitric acid	7697-37-2	2007-07-01
Water	7732-18-5	

New Jersey Right To Know Components

	CAS-No.	Revision Date
Nitric acid	7697-37-2	2007-07-01
Water	7732-18-5	

California Prop. 65 Components
This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

16. OTHER INFORMATION

Full text of H-Statements referred to under sections 2 and 3.

Eye Dam.	Serious eye damage
H272	May intensify fire; oxidizer.
H290	May be corrosive to metals.
H314	Causes severe skin burns and eye damage.
H318	Causes serious eye damage.
Met. Corr.	Corrosive to metals
Ox. Liq.	Oxidizing liquids
Skin Corr.	Skin corrosion

HMIS Rating

Health hazard:	3
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	3

NFPA Rating

Health hazard:	3
Fire Hazard:	0
Reactivity Hazard:	3
Special hazard.l:	OX

Further information

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

Preparation Information
Sigma-Aldrich Corporation
Product Safety – Americas Region
1-800-521-8956

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