Standard Operating Procedure

**2,4,6-Trinitrotoluene (TNT)**

*This is an SOP template and is not complete until: 1) lab specific information is entered into the box below 2) lab specific protocol/procedure is added to the protocol/procedure section and
3) SOP has been signed and dated by the PI and relevant lab personnel.*

 Print a copy and insert into your
*Laboratory Safety Manual* and *Chemical Hygiene Plan*.
Refer to instructions for assistance.

|  |  |
| --- | --- |
| **Department:** | Click here to enter text. |
| **Date SOP was written:** | Click here to enter a date. |
| **Date SOP was approved by PI/lab supervisor:** | Click here to enter a date. |
| **Principal Investigator:** | Click here to enter text. |
| **Internal Lab Safety Coordinator/Lab Manager:** | Click here to enter text. |
| **Lab Phone:** | Click here to enter text. |
| **Office Phone:** | Click here to enter text. |
| **Emergency Contact:** | Click here to enter text. |
| *(Name and Phone Number)* |
| **Location(s) covered by this SOP:** | Click here to enter text. |
| *(Building/Room Number)* |

**Type of SOP:** [ ]  Process [x] Hazardous Chemical [ ]  Hazardous Class

**Purpose**

Trinitrotoluene (TNT) is an explosive chemical. If not stored and handled properly, this can pose a serious threat to the health and safety of laboratory personnel, emergency responders and chemical waste handlers. Hence, it is important to follow safety protocols to handle this chemical.

TNT is sometimes used as a reagent in chemical synthesis, but it is best known as a useful explosive material with convenient handling properties. The explosive yield of TNT is considered to be the standard measure of strength of bombs and other explosives. In chemistry, TNT is used to generate charge transfer salts. TNT is one of the most commonly used explosives for military and industrial applications. It is valued partly because of its insensitivity to shock and friction, which reduces the risk of accidental detonation, compared to other more sensitive high explosives such as nitroglycerin. TNT melts at 80 °C (176 °F), far below the temperature at which it will spontaneously detonate, allowing it to be poured as well as safely combined with other explosives. TNT neither absorbs nor dissolves in water, which allows it to be used effectively in wet environments. Additionally, it is stable compared to other high explosives.

In the laboratory, 2,4,6-trinitrotoluene is produced by a two-step process. A nitrating mixture of concentrated nitric and sulfuric acids is used to nitrate toluene to a mixture of mono- and di-nitrotoluene isomers, with cooling to maintain careful temperature control. The nitrated toluenes are separated, washed with dilute sodium bicarbonate to remove oxides of nitrogen, and then carefully nitrated with a mixture of fuming nitric acid and sulfuric acid. Towards the end of the nitration, the mixture is heated on a steam bath. The trinitrotoluene is separated, washed with a dilute solution of sodium sulfite and then recrystallized from alcohol.

**Physical & Chemical Properties/Definition of Chemical Group**

CAS#: 118-96-7

Class: Explosive

Molecular Formula: C6H2(NO2)3CH3

Form (physical state): N/A

Color: N/A

Boiling point: 240 C

**Potential Hazards/Toxicity**

Explosive. Reactive at high temperature or pressure. Will detonate under strong shock. Reacts with reducing agents.

**Important danger information!**

It is a common misconception that TNT and dynamite are the same, or that dynamite contains TNT. In fact, whereas TNT is a specific chemical compound, dynamite is an absorbent mixture soaked in nitroglycerin that is compressed into a cylindrical shape and wrapped in paper. Upon detonation, TNT decomposes as follows:

2 C7H5N3O6 → 3 N2 + 5 H2O + 7 CO + 7 C

2 C7H5N3O6 → 3 N2 + 5 H2 + 12 CO + 2 C

The reaction is exothermic but has a high activation energy. Because of the production of carbon, TNT explosions have a sooty appearance. Because TNT has an excess of carbon, explosive mixtures with oxygen-rich compounds can yield more energy per kilogram than TNT alone. During the 20th century, amatol, a mixture of TNT with ammonium nitrate was a widely used military explosive.

Detonation of TNT can be done using a high velocity initiator or by efficient concussion.

 **Target Organs:** Male reproductive system

**Potential Health Effects:**

 **Eye Exposure:** May cause burns

 **Skin Exposure:** Central cyanosis unresponsive to oxygen therapy is classic

 **Ingestion:** Nausea and vomiting may occur

 **Inhalation:** Dyspnea and tachypnea may occur

 **Symptoms:** irritation skin, mucous membrane; liver damage, jaundice; cyanosis; sneezing; cough, sore throat; peripheral neuropathy, muscle pain; kidney damage; cataract; sensitization dermatitis; leukocytosis (increased blood leukocytes); anemia; cardiac irregularities.

**Personal Protective Equipment (PPE)**

**Respiratory Protection**

Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Always use a NIOSH approved respirator when necessary.

Respirators should be used only under any of the following circumstances:

* As a last line of defense (i.e., after engineering and administrative controls have been exhausted).
* When Permissible Exposure Limit (PEL) has exceeded or when there is a possibility that PEL will be exceeded.
* Regulations require the use of a respirator.
* An employer requires the use of a respirator.
* There is potential for harmful exposure due to an atmospheric contaminant (in the absence of PEL)
* As PPE in the event of a chemical spill clean-up process

Lab personnel intending to use/wear a respirator mask must be trained and fit-tested by ORS and should contact occhealt@uga.edu. This is a UGA requirement described in more detail in the [UGA Respiratory Protection Plan](https://esd.uga.edu/sites/default/files/respiratoryprotection.pdf) and supported by the [Office of Research Occupational Health and Safety Program](https://research.uga.edu/ohsp/).

**Hand Protection**

Viton gloves must be worn while handling TNT.

NOTE: Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with TNT.

Refer to glove selection chart from the links below:

<http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf>

OR

<http://www.allsafetyproducts.biz/page/74172>

OR

<http://www.showabestglove.com/site/default.aspx>

OR

<http://www.mapaglove.com/>

**Eye Protection**

Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133. A face shield might be required for additional protection of the entire face.

**Skin and Body Protection**

Lab coats should be worn. Full length pants and close-toed shoes must be worn at all times by all individuals that are occupying the laboratory area.

**Hygiene Measures**

Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product.

**Engineering Controls**

Use process enclosure, local exhaust ventilation, or other engineering controls to control airborne levels below recommended exposure limits. In other words, use a fume hood.

**First Aid Procedures**

**If inhaled**

Leave the contaminated area; take deep breaths of fresh air. If symptoms develop, call a physician.

**In case of skin contact**

Flood affected skin with water while removing and isolating all contaminated clothing. Gently wash all affected skin areas thoroughly with soap and water. If symptoms such as redness or irritation develop, call a physician.

**In case of eye contact**

First check the victim for contact lenses and remove if present. Flush victim's eyes with water or normal saline solution for 20 to 30 minutes while simultaneously calling a hospital or poison control center.

**If swallowed**

Do not induce vomiting. If the victim is conscious and not convulsing, give 1 or 2 glasses of water to dilute the chemical and call a hospital.

**Special Handling and Storage Requirements**

**Handling:** TNT should be considered hazardous. Avoid direct physical contact. Use appropriate, approved safety equipment. Untrained individuals should not handle this chemical or its container. Handling should occur in a chemical fume hood. **Storage:** This high explosive should be kept well away from initiator explosives, protected from physical damage, separated from oxidizing materials, combustibles and sources of heat.

**Spill and Accident Procedure**

**Chemical Spill Dial 911**

**24-7 On-Call Response to Research, Environment, Health or Safety Concerns Dial 2-5561 from a campus phone or 706-542-5561 from a non-campus line.**

**Spill** – Follow the procedures set out in the [UGA Chemical and Laboratory Safety Manual.](http://research.uga.edu/docs/units/safety/manuals/Chemical-Laboratory-Safety-Manual.pdf)

[If there are any chemical-specific protocols for responding to a spill, insert them here or mark “none”:]

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# **Medical Emergency Dial 911**

**Life Threatening Emergency, After Hours, Weekends And Holidays** – Dial **911** or the emergency phone numbers listed at the beginning of the UGA Chemical and Laboratory Safety Manual

*Note: All incidents that result in an injury or property damage must be reported to ORS / ESD using a University Incident/Accident Report.*

**Non-Life Threatening Emergency** – Follow the instructions in the UGA Chemical and Laboratory Safety Manual.

*Note: All incidents that result in an injury or property damage must be reported to ORS / ESD using a University Incident/Accident Report.*

**Decontamination/Waste Disposal Procedure**

**For general hazardous waste disposal procedures, see Appendix H of the UGA Chemical and Laboratory Safety Manual.**

**Chemical Specific Procedures: [to be inserted or marked as “none”]**

Wearing proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of the used 2,4,6-trinitrotoluene and disposables contaminated with 2,4,6-trinitrotoluene as hazardous waste.

**Safety Data Sheet (SDS) Location**

UGA personnel can access Online SDS through a link in the upper left corner of the ESD home page (<https://esd.uga.edu>) and logging in by using their UGA email user name and password.

**Protocol/Procedure (Add lab specific Protocol/Procedure here)**

Click here to enter text.

**NOTE**

Any deviation from this SOP requires approval from PI.

**Documentation of Training** (signature of all users is required)

* Prior to conducting any work with Trinitrotoluene (TNT), designated personnel must provide training to his/her laboratory personnel specific to the hazards involved in working with this substance, work area decontamination, and emergency procedures.
* The Principal Investigator must provide his/her laboratory personnel with a copy of this SOP and access to the SDS provided by the manufacturer.
* The Principal Investigator must ensure that his/her laboratory personnel have attended appropriate laboratory safety training or refresher training within the last 12 months.

**Principal Investigator SOP Approval**

Print name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Signature\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Approval Date:

I have read and understand the content of this SOP:

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