Chloroform

Standard Operating Procedure

Revision Date: 05/17/22

This standard operating procedure (SOP) outlines the handling and use of chloroform. Review this document and supply the information required in order to make it specific to your laboratory. In accordance with this document, laboratories should use appropriate controls, personal protective equipment, and disposal techniques when handling chloroform.

# Description [Provide additional information as it pertains to your research protocol]

Chloroform (CAS # = 67-66-3) is a clear, colorless liquid with a pleasant, nonirritating odor that can be detected as low as 11.7 ppm (odor threshold) but more likely detected at levels of 85 to 307 ppm (well above safe exposure limits).

Synonyms include: Trichloromethane, Methane trichloride, Formyl trichloride, Trichloroform, Methenyl trichloride and Freon 20.

**Caution**: Chloroform will degrade in the presence of heat, UV light, air and certain metal catalysts resulting in the generation of phosgene, a highly toxic gas/liquid, with a characteristic odor of cut hay/grass. If exposure to phosgene is suspected, immediately notify your supervisor and seek medical attention.

**NOTE**: Stabilizers are often added to prevent oxidation and generation of hydrochloric acid and phosgene:

Common stabilizers include ethanol at concentrations of 1% and amylene (or pentene) at concentrations of 100 ppm. Amylene is often used as a stabilizer in analytical applications where pure-grade chloroform is needed; however, there is evidence that amylene is not an effective stabilizer.

Chloroform is used as an extractant solvent in manufacture of rubber, essential oils, sterols and alkaloids, guttapercha, resins, and in the recovery of fat from waste products; in chemical analysis and assays; and in photographic processing.

It is also used as a general solvent of lacquers, plastics, dyes, fats, greases, gums, oils, adhesives, and waxes, and in the rubber cleaning and dry cleaning industries.

**Useful Chloroform Links:**

* <http://www.atsdr.cdc.gov/substances/toxsubstance.asp?toxid=16>
* <http://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=52&tid=16>
* <http://www.nap.edu/openbook.php?record_id=4911&page=282>

## Process [Write the steps for using the chemical in your research protocol]

# Potential Hazards [Provide additional information as it pertains to your research protocol]

* Chloroform has been classified as a potential to probable human carcinogen, based on adequate evidence for carcinogenicity in animals. Some animal studies also show evidence of reproductive and developmental toxicity from chloroform exposure.
* Inhalation of vapors can cause headaches, drowsiness, dizziness, and nausea. At high concentrations disorientation, anesthetic effects, and unconsciousness can occur, but acute toxicity is low.
* Chloroform is an eye, skin and upper respiratory tract irritant.
* Chloroform is not combustible but exposure to fire or high temperatures may lead to formation of phosgene, hydrogen chloride (HCl) and chlorine, all highly toxic gases.
* Chloroform should be treated as a time-sensitive chemical, similar to peroxides.  Chloroform that is not stabilized has a very short shelf-life and should be purchased in small quantities. Chloroform stabilized with amylene has a shelf-life <12 months. There is evidence that ethanol, which is present at greater concentrations, is a better stabilizer; chloroform stabilized with ethanol typically has a shelf life of 5 years.
* Consult the SDS for Chloroform for additional guidance and information.
* Many manufacturers provide information on the lot manufacturer date on their website.

## Occupational Exposure Limits (OELs):

MIOSHA: **2 ppm**, **8-hour** PEL

Contact EHS for assistance in performing an exposure assessment.

# Engineering Controls [Provide additional information as it pertains to your research protocol]

Work with chloroform in a chemical fume hood. Dilute solutions (< 10%) may be used on the benchtop in small quantities (< 500 mL).

# Work Practice Controls [Provide additional information as it pertains to your research protocol]

* Date chloroform bottles when received.
* Keep containers of chloroform closed as much as possible and store away from light.
* Be aware of skin absorption as a possible route of exposure. Plan work so that minimal glove contact is expected, and purchase appropriate gloves for cleaning up small spills. (Refer to the PPE section below, for glove recommendations.)
* Use in the smallest practical quantities for the experiment being performed.
* Do **not** mix or store with acids; may form toxic gas.
* Thoroughly wash hands when finished handling.
* Chloroform that has exceeded the expiration date should be disposed of as a hazardous waste
* It may be prudent to test for a low pH as an indicator of HCl and phosgene prior to use (in the fume hood).
* The presence of phosgene can also be detected by preparing indicator strips as follows:
Strips of filter paper are dipped in 5% w/v Diphenylamine and 5% w/v Dimethylaminobenzaldehyde in an alcoholic solution (ethanol works fine) and then allowed to dry. Strips should be a very light yellow when dry, and activate to a dark yellow/orange color upon presence of phosgene.

# Personal Protective Equipment [Provide additional information as it pertains to your research protocol]

* The minimum PPE for work with chloroform is **Viton** or **PVA** (Polyvinyl Acetate) laboratory gloves, lab coat, and safety glasses (ANSI/ISEA Z87.1 approved). Keep in mind that chloroform will penetrate **nitrile** gloves in less than 2.5 minutes.
* If a splash may occur, wear chemical splash goggles and a face shield.
* Environment, Health & Safety (EHS) [Glove Compatibility](http://ehs.umich.edu/research-clinical/planning-safe-research/glove-compatibility-chart/) webpage can also be used to determine the recommended gloves.

# Transportation and Storage

* Do not store chloroform with incompatibles. Chloroform is not compatible with the following: acetone, strong bases, alkalis, chemically-active metals (such as aluminum, magnesium, sodium, or potassium), dinitrogen tetroxide, fluorine, disilane, sodium methylate, triisopropylphosphine, and solid potassium tert-butoxide.
* Transport chloroform in secondary containment, preferably a polyethylene or other non-reactive acid/solvent bottle carrier.
* Store in secondary containment.
* Avoid storing on the floor.

# Waste Disposal [Provide additional information as it pertains to your research protocol]

Because most spent, unused, and expired chemicals/materials are considered hazardous wastes, they **must** be properly disposed of. **Do not dispose of chemical wastes by dumping them down a sink, flushing in a toilet or discarding in regular trash containers, unless authorized by EHS Hazardous Materials Management (HMM)**. Contact EHS-HMM at (734) 763-4568 for waste containers, labels, manifests, waste collection and for any questions regarding proper waste disposal. Also refer to the EHS [Hazardous Waste](http://ehs.umich.edu/haz-waste/) Web page for more information.

# Training of Personnel

All personnel shall read and fully adhere to this SOP when handling chloroform.

# Certification

I have read and understand the above SOP. I agree to contact my Lab Director if I plan to modify this procedure.

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### Major Revisions (Tracking purposes only -- Do not print as part of SOP)

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| Date | Revision |
| 09-13-18 | EHS name and logo were added, updated the formatting, and revised the content under Exposure/Unintended Content (AKJ). |
| 03-04-19 | Reviewed and updated. |
| 05-17-22 | Removed section on emergency response (LGS) |

**References**

National Academies of Sciences, Engineering, and Medicine. 1995. Prudent Practices in the Laboratory: Handling and Disposal of Chemicals. Washington, DC: The National Academies Press. https://doi.org/10.17226/4911.