UCIrvine
University of California, Irvine

Standard Operating Procedure (SOP)

This Standard Operating Procedure (SOP) describes basic chemical safety information for Mass Spectrometry (MS). Prior to conducting work with a mass spectrometer personnel must obtain approval from their Principal Investigator (PI) and/or Supervisor and attend the appropriate laboratory safety training. The PI must complete the Lab-Specific Use Procedures section and provide their personnel with a copy of this SOP.

Print a copy of this SOP, sign it, and insert into your Safety on Site (SOS) Binder.

Mass Spectrometry (Mass Spec)

Department:	
Date SOP was written:	
Date SOP was approved by PI/lab supervisor:	
Principal Investigator:	
Principal Investigator Signature:	
Internal Lab Safety Coordinator/Lab Manager:	
Lab Phone:	
Office Phone:	
Emergency Contact: *(Name and Phone Number)*	
Location(s) covered by this SOP: *(Building/Room Number)*	

Type of SOP: [X] Process ☐Hazardous Chemical ☐ Experiment ☐Equipment Use

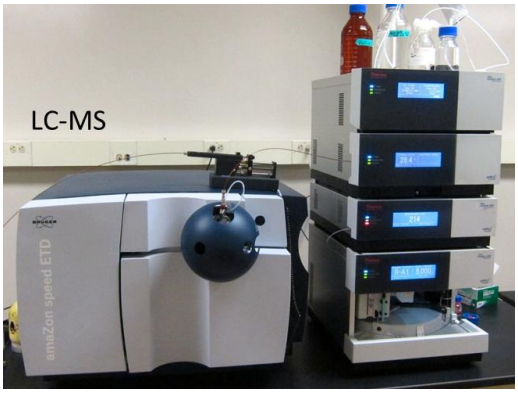
Contents

Read and review any applicable manufacturer/vendor safety information before developing the standard operating procedures and performing work.

**** NOTE: Each section needs to be complete with clear and detailed information based on the blue/italic font instruction. SOP must be approved and dated by the PI or lab supervisor.*

1. Purpose and Scope of Work/Activity:

Mass spectrometry is a powerful and versatile technique for analyzing pure chemicals or a mixture of chemicals. There are many different types of mass spectrometers including Accelerator Mass Spectrometry (AMS), Gas Chromatography-Mass Spectrometry (GC-MS), Liquid Chromatography-Mass Spectrometry (LC-MS), Inductively Coupled Plasma-Mass spectrometry (ICP-MS), Isotope Ratio Mass Spectrometry (IRMS), Ion Mobility Spectrometry-Mass Spectrometry (IMS-MS), Matrix-Assisted Laser Desorption/Ionization-Time Of Flight (MALDI-TOF), Surface-Enhanced Laser Desorption/Ionization-Time of Flight (SELDI-TOF), and Tandem MS (MS/MS). These different types of mass spectrometry have different methods of sample introduction, sample ionization, and detection. When analyzing a sample it is important to choose the proper type of mass spectrometry for the sample of interest. For example a matrix-assisted laser desorption ionization-time of flight (MALDI-TOF) is a good choice when analyzing a variety of biomolecules including peptides and carbohydrates.



Mass spectrometry poses some safety concerns, however these safety concerns are highly dependent on the type of instrument being used. Read the instrument manual and be familiar with the safety concerns of your particular model of mass spectrometer.

The information below addresses general laboratory safety concerns while operating a mass spectrometer. Modify this SOP with your laboratory's specific operational procedures with the help of the Principal Investigator and verify the SOP with EH&S approval prior to working with a mass spectrometer. Ensure that the laboratory specific procedures outlined in this SOP are followed by laboratory workers at all times. This document is not designed to substitute hands-on training and supervision by experienced laboratory personnel.

2. Responsibility and Definitions

Identify the personnel that have primary roles in the SOP and describe how their responsibilities relate to this SOP. If necessary, include contact information.

Responsibilities of the Principle Investigator

- Must provide their laboratory with a copy of this SOP, must sign this SOP, and ensure that all members of their laboratory sign and understand this SOP.
- Must ensure that their laboratory personnel have obtained the appropriate general laboratory safety training, laboratory specific training, and any refresher training.
- Must ensure that trained personnel conduct repairs and maintenance on the mass spectrometer as needed.

Responsibilities of Laboratory Personnel

- Must obtain all necessary laboratory safety training, refresher training, and laboratory specific training.
- Must read, sign, understand, and follow this SOP when using the mass spectrometer.
- Must read the safety data sheet (SDS) for any compound being analyzed by the mass spectrometer.

Definitions

- SOP: standard operating procedure
- SDS: safety data sheet
- MS and Mass spec: mass spectrometry or mass spectrometer
- GC: gas chromatography or gas chromatograph

3. Specific Hazards and Controls

3.1. Chemical Hazards

The chemical hazards will vary depending on the experiment and samples being analyzed. Read the SDS for any compound being used as a solvent or as the analyte prior to conducting an analysis with a mass spec. Take all the necessary precautions for these compounds.

List all of the specific chemicals typically used and their hazards.

Chemical/Material (Name, Cas #, other ID)	Hazards	GHS Symbol
		Health Hazard  Flame  Exclamation Mark  Gas Cyliner  Corrosion  Exploding Bomb  Flame Over Circle  Environment  Skull and Crossbones 

Example: Dichloromethane (75-09-2)	- causes skin irritation - causes serious eye irritation - may cause drowsiness or dizziness - suspected of causing cancer	

3.2. Hazards and Controls

The general hazards and controls associated with mass spectrometry are shown in the table below. The risks and hazards vary depending on the specific mass spectrometer being used. Read the instrument manual and be familiar with the safety concerns associated with your particular model of mass spectrometer.

Risks and Hazards	Controls
High temperatures • Burns	• Do not touch any part of the instrument that operates at high temperatures (e.g. oven). • If maintenance needs to be conducted, turn the instrument off and allow it to cool.
Electrical hazards and high voltage • Electrocution	• Typically, the high voltage areas are enclosed within the instrument, never remove the safety interlocks, shields, or panels. • Never touch the ionization sources. • Never take the mass spectrometer apart to conduct work on the instrument, always notify a qualified technician. • High voltages can remain within the instrument even when it is turned off.
Chemical hazards • Chemical exposure • Chemical inhalation	• Always read the SDSs, familiarize yourself with the chemical hazards, and take the necessary precautions prior to beginning work. • Always wear the appropriate PPE. • If solvent reservoirs or waste containers are used they must be air tight. Never allow solvent vapors to vent into the laboratory. • The pump and source exhaust contain traces of the chemicals that are being analyzed, therefore the exhaust fumes will have the same hazards as the chemicals being analyzed (toxic, irritant, biohazard, etc.). Vent the pump and exhaust into a fume hood when possible. • Sample preparation should be conducted within a fume hood, biosafety cabinet, or glovebox.
Laceration/Piercing hazards • Needle pricks	• Never recap needles. • Handle syringes with the necessary precautions. • Never leave uncapped syringes in the laboratory, discard used syringes without capping.
Flammable chemicals • Fire	• Remove any sources of ignition and combustible materials.
Lifting hazard • Injury	• Always obtain help when moving heavy equipment. • Before moving the instrument or any of its components, check its weight and determine a safe method of movement.
Power failure	• If there is a power failure turn off all of the equipment and gas sources.

4. Hazard Control(s)

4.1. Engineering/Ventilation Controls

A mass spectrometer does not require specific engineering or ventilation controls. When possible vent the pump and source exhaust fumes into a fume hood. The sample preparation should be done in a fume hood, biosafety cabinet, or glovebox depending on the specific hazards associated with each compound that is being used.

4.2. Administrative Controls

Documentation

- The mass spectrometry standard operating procedure (SOP) must be completed and signed by every member of the laboratory.
- Safety data sheets (SDS) for each material should be reviewed prior to use.
- Manufacturer operating manual should be reviewed prior to use.

Training

- Training must be completed prior to working in the laboratory.
- Process specific training must be completed prior to working with a mass spectrometer.
- Basic mandatory trainings include laboratory safety fundamentals, hazardous waste management, and hazardous materials incidents emergency procedures.

4.3. Personal Protective Equipment

EYE PROTECTION: ANSI Z87.1-compliant safety glasses or safety goggles if a splash hazard is present.

PROTECTIVE CLOTHING: Long pants (or equivalent) completely covering legs, closed toed shoes, and a traditional lab coat or flame resistant Nomex® lab coat when working with flammables.

HAND PROTECTION: Nitrile or neoprene gloves are typically adequate for minor splashes. Consult the SDS and/or your PI to determine whether the material or process requires alternative hand protection.

5. Location of Nearest Emergency Safety Equipment

ITEMS	LOCATION
EYEWASH/SAFETY SHOWER	
CHEMICAL SPILL KIT	
FIRST AID KIT	
FIRE EXTINGUISHER	
TELEPHONE	
FIRE ALARM MANUAL PULL STATION	
OTHERS/DETAILS:	

6. Step-by-Step Operating Procedure

Provide the steps required to perform this procedure.

For a process: *Write enough detailed description of the procedure to guide the user through the process including details of startup, normal condition operation, temporary operation condition and emergency shut-down, etc.*

Also cover enough information, such as:

1. *Chemical concentrations, gas amount*
2. *Pressure limits, temperature ranges*
3. *Flow rates*
4. *Special safety equipment is to be utilized.*
5. *Schematics or pictures for complex setups.*
6. *Highlight safety precautions put in place*
7. *What to do when an upset condition occurs*
8. *What alarms and instruments are pertinent if an upset condition occurs*
9. *If lockout/tagout is required*

Some tips:

- *Use numbers for steps and sub-steps that have to be performed in a specific sequence*
- *Use bullets for steps or items that can be performed in any order.*
- *Solicit ideas for other users.*
- *Include a flow diagram to help interpret more complex procedures.*
- *Include pictures and label different components.*

For Equipment: *Describe the step-by-step procedure for using the equipment properly. Include details for potential equipment failure if something is done improperly in the procedure. Describe how to power down the equipment at the end of use.*

BASIC OPERATING PROCEDURE

You must edit this procedure to reflect your laboratory's specific procedure. Each mass spectrometer and different type of mass spectrometer will have a different procedure, make sure to follow your research laboratory's specific procedure, this is meant to offer a general procedure for guidance and safety considerations when using a mass spectrometer.

1. Inspect the instrument to ensure that all parts are working properly.
2. Turn the instrument on.
3. Allow the instrument to warm up.
4. Prepare the sample in a fume hood, biosafety cabinet, or glovebox.
5. Ensure that the system is behaving normally and that the temperature and pressure are stable.
6. Inject your sample into the instrument.
    a. If using an auto-injection system allow the system to inject the sample.
        i. Keep hands clear of the auto-injection system when it is in operation, the needle from the injection system can cause injury.
    b. If using a manual injection, use a syringe to measure the amount of solution, then put the syringe into the injector (slowly until you feel the end, do not push it in roughly this can damage the inside of the injector) and slowly depress the syringe plunger (if you feel resistance stop), and remove the syringe.
        i. When conducting a manual injection take the necessary precautions for using sharps.
7. Once your sample run is complete, allow the instrument to go through its cleaning cycle.
8. Turn the mass spectrometer off.
9. Dispose of all waste into the appropriate hazardous waste containers.

7. Special Handling Procedures, Transport, and Storage Requirements

Describe special handling and storage requirements for hazardous chemicals/gases in the laboratory, especially for highly reactive, unstable and highly flammable materials and corrosives. Describe transport and secondary containment requirement, between the laboratories or between facilities.

8. Preventive Maintenance

Clean up and preventive maintenance is important for keeping equipment in safe working order. Any regular maintenance and/or calibration frequency for research equipment, instrumentation and/or facilities should be included here.

The preventive maintenance is dependent on the type of mass spectrometer. Please follow the manufacturer's guidelines for maintaining and cleaning your instrument.

9. Monitoring and Safety Systems

This section includes a list of all monitoring systems such as gas detectors, safety interlocks, equipment guards, fail safe control logic, etc. noted.

10. Waste Disposal/Cleanup

Dispose of any hazardous waste generated through UCI EH&S. A hazardous waste pick up can be scheduled by completing a Hazardous Waste Pick Up Form, via the internet, https://www.ehs.uci.edu/programs/enviro/ or texting hwp@uci.edu (detailed instructions can be found at https://www.ehs.uci.edu/apps/waste/Text%20a%20Chemical%20Waste%20Request.pdf or https://www.ehs.uci.edu/apps/waste/text_to_collect.jsp).

11. Emergency Response Plan

In this section describe any special procedures for spills, releases, or fires. Indicate how accidental events should be handled and by whom. List emergency contact numbers.

11.1. First Aid Procedure

If inhaled

1. Move to fresh air
2. Have victim rest in half-upright position
3. Seek medical attention immediately

In case of skin or eye contact

1. Immediately flush skin or eyes (eyewash station) with plenty of water for at least 15 minutes
2. Remove contaminated clothing and shoes
3. Get medical attention immediately

If swallowed

1. Do not induce vomiting unless directed to do so by medical personnel and never give anything by mouth to an unconscious person
2. Loosen tight clothing such as a collar, tie, belt, or waistband
3. Get medical attention immediately

11.2. Life-threatening emergencies

(Such as: fire, explosion, large-scale spill or release, compressed gas leak, valve failure, etc)

1. Evacuate the room and close the door behind you
2. Secure the room to prevent entry
3. Alert people in the area and activate the local alarm systems
4. **Call 911 – Tell the dispatcher the name of the gas or chemical.**
5. Provide local notification
6. Report to EH&S at x4-6200 within 8 hours
7. Complete online incident report at *https://www.ehs.uci.edu/apps/hr/index.jsp*

Identify the area management staff that must be contacted and include their work and home numbers. This must include the PI and may include the safety coordinator and facility manager.

11.3. In case personnel are exposed or injured

1. Remove the victim from the area if it is safe to do so
2. Follow first aid protocol as mentioned above
3. Provide safety data sheets (SDSs) for all chemicals to Emergency Medical Technician (EMT) or to the hospital
4. Report to EH&S x4-6200
5. Complete the online incident form *https://www.ehs.uci.edu/apps/hr/index.jsp* or Human Resources, Workers Compensation at x4-9152

Non-life threatening emergencies

1. Notify your supervisor or faculty staff
2. Report to EH&S x4-6200

Identify the area management staff that must be contacted and include their work and home numbers. This must include the PI and may include the safety coordinator and facility manager.

11.4. For spill & accident procedure

In the event of a small spill or release that can be cleaned by a trained local personnel follow below steps:

1. Use appropriate personal protective equipment and clean up material for chemical spilled
2. Double bag spill waste in the appropriate bags (e.g. red biohazard bags for biohazard waste), label, and schedule a chemical waste pick-up

In case of large spill or release:

1. Evacuate the spill area
2. Post someone or mark-off hazardous area with tape and warning signs
3. **Call 911** and EH&S at x4-6200 for assistance
4. Keep the fire extinguisher nearby
   Note: Fire extinguishers containing water are not suitable for flammable liquid fires

12. References

This section should include the references that were used to produce this SOP.

- Agilent. Agilent Triple Quad Mass Spectrometer (Model K6460 and K6420) Safety Guide. https://conquerscientific.com/wp-content/product-images/2019/01/Agilent-6420_-K6420-and-K6460-Triple-Quad-MS-Safety-Guide.pdf

- University of Bristol School of Chemistry. Safety in the Mass Spectrometry Facility. http://www.chm.bris.ac.uk/ms/safety.xhtml
- AB SCIEX Safety Guide TOF Systems. May 2010. Part Number: 1041490 A. https://sciex.jp/Documents/Downloads/Literature/tof-safety-guide-eng.pdf

13. Additional Notes and Attachments

In this section list any notes or attachments needed to implement this SOP.

14. Documentation of Training

- Any deviation from this SOP requires approval from PI.
- Prior to conducting any work with the equipment, designated personnel must provide training to his/her laboratory personnel specific to the hazards and procedures involved in working with this process.
- The Principal Investigator must provide his/her laboratory personnel with a copy of this SOP and a copies of any SDS provided by the manufacturer for any chemicals used.
- The Principal Investigator must ensure that his/her laboratory personnel have attended appropriate laboratory safety training or refresher training annually.

I have read and understand the content of this SOP:

Name	Signature	Identification	Date