ENVIRONMENT, HEALTH & SAFETY
UNIVERSITY OF MICHIGAN

Servicing Potentially Hazardous Exhaust Systems Guideline

Date: 10/04/19
Revision #: 03

Applies To: Employees and contractors working on potentially hazardous exhaust systems

This Guideline is issued jointly by the Department of Environment, Health & Safety (EHS) and Architecture, Engineering and Construction.

Table of Contents

Summary

The purpose of this Guideline is to prevent employee and contractor exposure to potentially hazardous materials when performing work involving contact with interior surfaces of fume hoods and other potentially hazardous exhaust systems.

Scope

This Guideline applies to all persons, including contractors, accessing the interior of potentially hazardous exhaust systems. A list of buildings with potentially hazardous exhaust points or electromagnetic fields is attached (Appendix A "Buildings with Hazardous Exhaust Points or Electromagnetic Fields").

Reference Regulations

The following document provides guidance, rules, and regulations that govern the operation of the health and safety program. When questions arise, EHS is the University authority having responsibility.

- Hazard Communication Standard (29 CFR 1910.1200)

Definitions

TERM	DEFINITIONS
Biological Safety Cabinet (BSC)	A special safety enclosure used to handle pathogenic microorganisms in a laboratory. Some can be exhausted outside or inside the facility.
Building/Departmental Contact	The person empowered by a dean, director, or department head to arrange for and coordinate maintenance and operational activities for a designated facility.
Electromagnetic Field (EMF)	In this context it is the electromagnetic radiation spectrum that is non-ionizing and limited to the RF portion of the spectrum covered by FCC guidelines and regulations (Frequencies that range from 300 kHz to 100 GHz and is the range in which the FCC sets exposure standards). That spectral range includes broadcast antennas for radio, cellular, amateur radio, microwave and satellite transmission. Antennas that do not broadcast (receiving antennas and dishes) are not sources of radiation and are not a concern. In addition, there is RF equipment that the FCC categorically excludes from routine RF assessment because they are designed, tested, certified to the FCC and built to meet RF exposure limits for members of the public. In those instances, the FCC considers installation and use of those devices as designed to be sufficient (e.g. most WiFi repeaters and some small data point-to-point dishes).
Fume Hood (Chemical Fume Hood)	A ventilated enclosed work space intended to capture, contain and exhaust fumes, vapors, and particulate matter generated inside the enclosure to outside the facility.
Environment, Health & Safety (EHS)	The University of Michigan department that works to maintain a safe and healthy environment. The Department will survey matters of environmental sanitation, occupational safety, occupational health, and radiation safety; coordinate and assist in educating faculty, staff and students on standards applicable to University-associated activities and safety efforts throughout the University; advise faculty and staff on procedures relating to

TERM	DEFINITIONS
	biosafety and biological safety cabinets; develop accident prevention programs; provide advice; render service; investigate accidents; and maintain statistics related to occupational safety and health. Refer to the EHS website for guidance and educational materials.
Perchlorates	Are vapors or condensed precipitates of perchloric acid. Vapors can condense while passing through the hood exhaust system forming perchlorates. Dried crystallized perchlorates are shock sensitive and can detonate upon contact during cleaning, modification or repair of the hood system.
Perchloric Acid	A strong acid that is a powerful oxidizing agent. Perchloric acid protocols involving cold perchloric acid can be performed in a standard chemical fume hood; however, specially designed fume hoods are required if perchloric acid is heated, or if perchloric acid is used at concentrations >72%, used frequently or in large quantities.
Perchloric Acid Fume Hood	A fume hood constructed of noncombustible materials and equipped with a water wash-down system. This system is activated to prevent the formation of perchlorates in the exhaust ducts after using the acid.
Potentially Hazardous Exhaust Systems	Any exhaust system used for chemical, radiological, or biohazardous materials. The systems include fume hoods, BSCs, exhaust snorkels, slot hoods, canopies, paint booths, etc.
Radioisotopes/Radioactive Materials	Elements with unstable nuclei that give off energy in the form of ionizing radiation through a process called nuclear decay.
Roof Safety Plans	Contain specific information regarding the equipment, fume hoods, ducted biological safety cabinets, exhaust fan locations, and cell towers on the roof of a specific facility. Roof Safety Plans are maintained by Operations Engineering and are available by computer connection to the drawing files with authorization from Operations Engineering.
Work Control Shutdown Coordinator	Coordinates and communicates critical utility and service outages to Operations and the UM campus community. Building or Departmental Contacts are strongly encouraged to send updated contact information by email to the Shutdown Coordinator at: facops-wm-shutdown@umich.edumailto:facops-wm-shutdown@umich.edu or by phone through the Operations Call Center at 647-2059.

Responsibility:

Deans, Directors and Department Heads

- Actively support this guideline within individual units.
- Designate a Building or Departmental Contact to coordinate shutdowns with Operations Work Control. Provide the Work Control Shutdown Coordinator with contact information.

- Take disciplinary action against any person determined to be out of compliance with this Guideline.
- Notify maintenance departments, contractors, and EHS of any known hazards pertaining to exhaust systems to be worked on.

Supervisors

- Review Roof Safety Plans to determine if work on a roof or in a potentially hazardous exhaust system will require a shutdown of an exhaust system.
- Determine, according to the Roof Safety Plans, exactly which fans will need to be shut down and which exhaust hoods are affected.
- Notify the Shutdown Coordinator of work requiring a shutdown and describe the impact on building occupants. Work with the Shutdown Coordinator and the Building or Departmental Contact to determine the least disruptive and most efficient shutdown schedule.
- Assure that staff is aware of this Guideline, instructed on the details of implementation, and provided with equipment and controls.
- Report all workplace accidents or injuries and complete Illness or Injury Report Form.
- Contact EHS to complete a site investigation and request technical assistance.

Employees

- Comply with this Guideline and any further safety recommendations made by your supervisor or EHS.
- Consult with your supervisor when there are questions regarding health and safety.
- Report any job related injuries or illnesses, questions on health and safety, or any unsafe or unhealthy working conditions to your supervisor.
- Contact EHS to evaluate potentially unsafe conditions.

Building and Departmental Contacts

- Work with the Operations Shutdown Coordinator, supervisors and appropriate building representatives to determine the least disruptive and most efficient shutdown schedule.
- Notify building occupants of exhaust system/fume hood shutdowns prior to occurrence by posting the designated notices on the exhaust hoods affected and contacting the affected parties via e-mail, telephone, or in person.
- Verify, on the day(s) of work, that the laboratories have complied with all shutdown requirements by conducting site visits to each of the affected locations.
- Notify the dean, director, or department head of any personnel not complying with the required shutdown procedures or restrictions.
- Remove all notification signs from fume hoods, doors, elevators, etc. once the project is completed, and notify the researchers that they can continue normal operation of their laboratory.

EHS

- Review and revise this Guideline as needed.
- Provide technical assistance and conduct safety audits when necessary.

- Provide training to UM employees required to access exhaust systems or roofs with potential hazards. Training for U-M maintenance employees is conducted as part of new employee safety orientation and periodically annual training.

Architecture & Operations Engineering (A&OE)

- Modify Roof Safety Plans to reflect changes to exhaust systems or EMF emission sources. Field verify all modifications to these systems.
- Create new Roof Safety Plans for new buildings or additions and manage tagging/signing efforts.
- Distribute and archive changes and provide prints or electronic drawings.
- Review design documents for new projects and ensure information is transferred to the Roof Safety Plan Team.

Region Maintenance

- Tag exhaust systems according to the Roof Safety Plans and Appendix B of this guideline and post warning signage on access doors to the roofs.

Work Control-Shutdown Coordinator

- Coordinate and communicate exhaust system shut downs, utility outages, and service outages to the appropriate departmental contacts impacted.
- Maintain a database of building and departmental contacts needed to effectively plan and communicate shutdowns in all buildings on campus.
- Maintain a web-based shutdown request service for use by anyone requiring access to a roof with potentially hazardous exhaust.

Departments Hiring or Coordinating Activities of Outside Contractors

- Communicate the potential hazards present when working on roofs with potential hazards. Outside contractors will be required to follow this Guideline and must be provided a copy.
- Comply with all responsibilities listed in the "Supervisors" section of this Guideline with the exception that the outside contractor shall provide any personal protective equipment necessary for the project.

Procedures

Prior to and during work on the interior of potentially hazardous exhaust systems, proper steps shall be taken per this Guideline to ensure that personnel are not exposed to chemical, biological or radiological hazards. The Shutdown Coordinator will work with the Building or Departmental Contacts to schedule the work. They will in turn, notify all impacted users of the affected exhaust system prior to any shutdown of building systems.

If users of exhaust systems do not comply with the requirements of an exhaust system shutdown, the work shall not take place until compliance is verified by the Building or Departmental Contact.

If the work requires access to a roof, adhere to the Roof Access for Buildings with Potential Roof Top Hazards guideline.

A. Pre-Job Preparation

1. Upon receipt of a work order involving the interior of a potentially hazardous exhaust system, the supervisor shall consult the Buildings with Hazardous Exhaust Points or Electromagnetic Fields list in Appendix A to determine if the work site has a potentially hazardous exhaust system. If the building is not listed, the work may proceed following normal work site safety procedures.
2. If the work site is listed as having potentially hazardous exhaust, the supervisor shall refer to the Roof Safety Plan, available through A&OE, appropriate to the facility to determine if the work will require fume hoods or other potentially hazardous exhaust systems to be shutdown. If the building does not have a Roof Safety Plan, the supervisor shall contact Operations Engineering and EHS to assist with the determination.
3. Once work within a potentially hazardous exhaust system is identified, the supervisor shall implement the following:
    - Notify the Shutdown Coordinator of any work requiring a shutdown and describe the impact on building occupants (what exhaust systems must be shutdown, when they will be shut down, and how long the shutdown will last). This is accomplished using the on-line Shutdown Request form: https://shutdown.fo.umich.edu/ShutdownRequestForm/. To submit the shutdown request via fax, send the completed form to the Operations Call Center at 763-2932.
    - The Shutdown Coordinator will work with the Supervisor and the Building or Department Contacts to determine the least disruptive and most efficient shutdown schedule.
    - The Building or Department Contact shall post a "Warning! Do Not Use This Hood" (Appendix C) sign on all affected exhaust hoods, fume hoods, and ducted BSCs. Doors to the affected laboratories, corridors, and additional locations may also be posted to increase awareness. This information shall also be communicated to the affected users via e-mail, telephone, or in person.

B. Exhaust System Site Investigation

Specific site investigations for most potentially hazardous exhaust systems are not necessary. The supervisor shall arrange with EHS to perform a site investigation under the following conditions:

1. If radioactive materials are used in the affected fume hoods or exhaust system, EHS Radiation Safety Service (RSS) shall be contacted at (734) 764-6200. If necessary, RSS will conduct a contamination survey of affected systems. After the survey has been conducted, RSS shall notify the supervisor with an email of the results and any additional precautions required.
2. For perchloric acid fume hoods, EHS Research Health and Safety shall be contacted at (734) 647-1143 to conduct a site investigation. If the inspection indicates perchlorates have formed or the presence of perchlorates is suspected, EHS shall notify the project coordinator that a firm specializing in the cleaning and repairing of perchloric acid exhaust systems will have to be hired to abate the hazard before work can progress.
3. Unusual circumstances or hazards were identified by the owner or noted by employees.

C. Required Shut down Procedures

Laboratory personnel or other users are required to adhere to the following steps to prepare for a shutdown.

- All chemicals in affected hoods must be removed, capped, or covered.
- Funnels in chemical containers are not acceptable; funnels must be removed and the containers covered or capped.
- All equipment, such as hotplates and stirrers, must be turned off.
- Clean the interior surfaces of the hood if workers will need to enter or contact the interior surfaces.
- Conducting any experiment in a shutdown fume hood, or using any ducted exhaust system that goes to the shutdown system is prohibited.

Immediately preceding the start of the scheduled work, the Building or Department Contact or designee shall inspect the impacted exhaust hoods to verify compliance. Any non-compliance shall be addressed by the Building or Department Contact and corrective action taken prior to the work proceeding. If the non-compliance cannot be corrected within a reasonable period of time, the work shall be rescheduled and the department may be billed for the wasted staff time.

If a fan shutdown is required, the supervisor and the zone maintenance supervisor for the building shall determine who will turn the fans off and back on. Work shall comply with the EHS Lock-Out/Tag-Out Guideline.

If the work will take longer than scheduled, the workers shall notify their supervisor as soon as possible. The supervisor shall notify the Shutdown Coordinator to coordinate the extended shutdown.

D. Compliance

Failure to comply with this procedure may expose laboratory personnel and maintenance personnel to hazardous materials. Non-compliance with these requirements will result in the work not being completed as planned, causing delays in research, and a report to the appropriate dean, director, or department head for possible disciplinary action.

E. Personal Protective Equipment (PPE)

Personal protective equipment shall be worn during work on all fume hoods and other potentially hazardous exhaust systems. Protective equipment shall be provided to the workers by their supervisor. The goal is to prevent skin contact with the interior surfaces of these systems. The minimum protective equipment required for all potentially hazardous exhaust systems include the following:

- Gloves – Disposable latex, vinyl or nitrile gloves shall be worn under a leather palmed glove. Additional acid or solvent resistant gloves may be required if unusual circumstances or hazards are identified. Contact EHS if you have any questions.
- Safety Glasses or Goggles – Shall be worn whenever work is taking place inside a laboratory. Glasses shall also be worn when working on exhaust duct work, dampers, and motors.

- Disposable Suit/Coveralls – Shall be worn when contact with the inside of a potentially hazardous exhaust system is likely.
- Respiratory Protection – Typically not required unless work on a potentially hazardous exhaust system involves the potential for exposure to contaminated dust and/or exposure to residual chemicals. Contact EHS for information on the appropriate respirator cartridges.
- Radiation Monitoring Dosimeters (Badges) – Dosimeters shall be issued by RSS at the discretion of the Radiation Safety Officer (RSO) or RSS health physicist.

F. Post Completion of Work

1. All locks and tags shall be removed from all locked-out/tagged-out equipment by the person that placed it.
2. All locked-out/tagged-out equipment shall be put back in operation. Proper operation of said equipment shall be verified by the maintenance mechanic.
3. Workers shall notify their supervisor upon completion of the work. The supervisor shall report the project completion to the Shutdown Coordinator and the appropriate zone maintenance supervisor. The Shutdown Coordinator will notify the Building or Department Contacts.
4. All notices and tags posted on the fume hoods, laboratory doors, entry doors, elevators, etc. shall be removed by the Building or Department Contacts.
5. The Building or Department Contact shall notify the researchers of the project completion and give the go ahead to resume normal operations of the systems.
6. When required by RSS, tools used in a potentially radioactively contaminated environment shall be surveyed for contamination by RSS personnel prior to leaving the job site. RSS personnel shall monitor site conditions during work, as per their assessment.

G. Fume Hoods Which Must Remain Operational

When the Shutdown Coordinator schedules a fume hood shutdown, the Building or Department Contact shall inform the coordinator if operation of a fume hood or exhaust system cannot be interrupted. The Shutdown Coordinator and/or building contact shall contact EHS to determine if, and under what conditions, the work on the roof can proceed.

1. These projects will not be a routine occurrence and will be investigated on a case by case basis.
2. EHS will develop a case specific written procedure for experiments allowed to continue while the work is performed on the roof top.

The Building or Department Contact shall post the procedure on each affected hood system and ensure all restrictions outlined in the procedure are relayed to the researcher and are being adhered to during the maintenance period.

If it is determined the roof top work cannot proceed with the experiment in progress, the experiment or process shall be relocated or the work shall not be performed until the experiment has been completed.

The Building or Department Contact and EHS shall conduct weekly walk-through inspections during long term projects to verify compliance with the use restrictions.

Non-compliance with the use restrictions shall result in the affected hoods being shut down completely for the duration of the project and a report provided to the appropriate dean, director, or department head for possible disciplinary action taken against the users.

H. Biological Safety Cabinets

A Biological Safety Cabinet (BSC) is designed to contain biological hazards. Repairs should only be made by trained personnel that understand the potential hazards present. U-M EHS Biological Safety technicians are trained and approved by the primary BSC manufacturers to repair, maintain, certify, and provide warranty work on BSCs. In addition, all work on BSCs must be approved by the U-M Biological Safety Officer (BSO) to prevent the potential release of a biological agent to the environment and potential exposure to personnel. When required by the BSO, trained EHS Biological Safety technicians will decontaminate the BSC in accordance with the NSF Standard before repair work can begin. After a BSC has been repaired it must be certified by persons trained in the NSF 49 BSC Certification Standard. EHS technicians are NSF 49 trained and have the specialty equipment required to conduct this certification.

Maintenance - If a repair order for a BSC is received, the supervisor shall contact EHS Biological Safety at 647-1143 regarding the repair. Facilities Maintenance is responsible for providing all utilities to the BSC including: vacuum, gas, and the wall electrical outlet. A small number of BSCs are placed beneath a canopy exhaust or connected to the building exhaust. In these cases, Facilities Maintenance maintains the exhaust system up to the BSC. Departments experiencing problems with utilities provided to a BSC should submit a completed Work Order.

Technical Support

All referenced guidelines, regulations, and other documents are available through EHS at 763-6973 or on the EHS Website

Contact the Fume Hood Roof Safety Access coordinator at (734) 647-5019 for specific information on the roof safety plans and access to drawings.

Attachments

- Appendix A Buildings with Fume Hoods
- Appendix B Rooftop Exhaust Hazard Identification
- Appendix C Warning – Do Not Use This Hood sign

ENVIRONMENT, HEALTH & SAFETY
UNIVERSITY OF MICHIGAN

Appendix A: Buildings with Hazardous Exhaust Points or Electromagnetic Fields

Date: 10/03/19

BUILDING	#
1100 North University Building	188
1210 Eisenhower Place	5079
2850 S. Industrial, Eisenhower Corp. Park West	8072
Alice Lloyd	59
Animal Research Facility	168
Art & Architecture (A&A)	432
Auto Lab Fuel Storage	5168
Auxillary Services	2501
Bagnoud Francois-Xavier Building	395
Biological Science Building (BSB)	5169
Bonisteel Interdisciplinary Research Building (BIRB)	402
Brehm Tower	5102
Briarwood 1	8076
Buhr	799
Burlington Office Center	5011
Campus Safety & Security Building (CSSB)	742
Central Campus Rec. Bldg. Bell Margaret Pool (CCRB)	226
Central Power Plant (CPP)	261
Chemistry & Dow Willard H Laboratory (08, 48, 88)	158
College of Pharmacy Building	230
Cooley Mortimer E Building	403
Dana Samuel Trask Building	189
Dental Bldg. & WK Kellogg Foundation Institute	162
Dow Herbert H Building	447
Duderstat Center	396
East Ann Arbor Ambulatory Surgery (4270 Plymouth Rd.)	5038
East Hall	166
Electrical Engineering & Computer Science Bldg. (EECS)	448
ERB 1 (IST Central Office)	435
ERB II (IST Lab wing)	436
EWRE (Engineering 1A)	414
Francis Thomas Jr Public Health (SPH II)	234
Frankel Samuel And Jean Cardiovascular Center	5109
G.G. Brown/Dow Connector	407
George Reserve - Pond Lab	N/A
Gerstacker (IST highbay)	437
Gorguze Family Laboratory (EPB)	424
Hatcher South	181
Health Services	176
Kellogg Eye Center (KEC)	324
Kraus Edward Henry Building	211
Lay Walter E Automotive Engineering Laboratory	400
Life Sciences Institute (LSI)	5036
Lorch Hall	154
Lurie Ann And Robert H Biomedical Engineering Bldg.	406
Lurie Engineering Center	397
MBNI (MHRI)	100

BUILDING	#
Medical Center Parking Structure	300
Medical Science I	190
Medical Science II	200
Michigan Memorial Phoenix Project Laboratory	404
Modern Language Building	207
Modular MRI Building	5348
Mott Hospital	312
MSRB I	223
MSRB II	213
MSRB III	229
NAME	415
NCRC Building 14	5254
NCRC Building 20	5259
NCRC Building 22	5260
NCRC Building 23	5261
NCRC Building 26	5263
NCRC Building 28	5264
NCRC Building 30	5265
NCRC Building 35	5266
NCRC Building 36	5267
NCRC Building 60	5270
NCRC Building 80	5273
NCRC Building 520	5281
NCRC Building 550	5282
Newberry Hall (Kelsey Museum)	178
North Campus Service Building #1	418
North Ingalls (300)	332
North Ingalls (400)	333
Palmer Commons	5047
Pellston Biological Station	4096
Randall Harrison M Laboratory	208
Rogel Cancer Center	301
Ruthven Museum	193
School of Education (SOE)	221
School of Music	440
Simpson Parking Structure	320
South Quad	63
Space Research	441
Taubman Biomedical Science Research Bldg. (BSRB)	5037
Taubman Health Center	317
Transportation Research Institute (UMTRI)	444
University Hospitals	316
University Hospital South	318
USB	5046
Varsity Drive Bldg.	812
Vaughan Henry Frieze Public Health Building (SPH I)	204
West Hall	167

Appendix B: Rooftop Exhaust Hazard Identification

All exhaust systems on a roof with potentially hazardous exhaust will be identified with one of four designations: **green**/**white** stripes, **red**/**white** stripes, solid **red**, or **yellow** with white stripes. A legend will be posted on all roof access points based on the descriptions below:

Green and **White** Diagonal Stripes: Safe to approach and safe to work on system at any time. No hazardous constituents exhausted. An example would be general building exhaust.

Yellow and **White** Diagonal Stripes: Generally safe to approach and work around with caution. Avoid working directly in front of the exhaust point. These exhaust systems have the potential to unexpectedly emit helium, carbon dioxide, or refrigerant gas and create a low-temperature and/or an oxygen deficient environment around the stack. Actual work on the system will require a coordinated shut down. Employees must maintain situational awareness and leave the area if gas clouds or atypical exhaust patterns emanate from the stack or exhaust grill.

Red and **White** Diagonal Stripes: Potentially hazardous exhaust system meeting minimum safety and engineering requirements. Exhaust systems meeting these requirements have sufficient exhaust stack height and velocity to eject potential hazards outside the building envelope. These systems are safe to approach and work around. Actual work on the system or over the exhaust stream will require a shutdown and compliance with this EHS Guideline.

Typically, Strobic-type fan systems will be identified as Red and **White** Diagonal Stripes. These systems meet or exceed the minimum effluent flow standards established by UPE and EHS. The minimum standard for any exhaust labeled Red/White stripes is that the physical stack height is not less than 10 feet high, the exit velocity from the stack is not less than 3,000 feet per minute (fpm), and the system is equipped with a bleed-in damper to supply make-up air. The bleed-in damper will ensure a constant stack exit velocity regardless of hood sash heights, filter loading, or anything else that would normally reduce flow from a stack.

Solid **Red**: Potentially hazardous exhaust system that must be shutdown in order to approach within 20 feet of the exhaust stack. By default, all chemical fume hoods that are NOT part of a Strobic-type system will be designated as Solid **Red** regardless of what hazardous materials are in use.

ENVIRONMENT, HEALTH & SAFETY
UNIVERSITY OF MICHIGAN

Appendix C: Do Not Use This Hood Sign

DO NOT USE THIS HOOD

THIS HOOD IS TEMPORARILY OUT OF SERVICE DUE TO SCHEDULED WORK

DATES OF SHUTDOWN

BUILDING CONTACT: Name **Phone:**

- Use of this exhaust hood is prohibited until this warning notice has been removed.
- All containers of chemicals shall be capped or covered. Leaving funnels in the containers is not acceptable. All experimental equipment shall be turned off.
- This applies even if the exhaust fan is operating: people may be working on the fume hood exhaust system.
- Use of this fume hood while it is tagged out of service may expose you and others to hazardous materials.
- *Failure to comply with the above is considered non-compliance and will be referred to your dean, director or department head for disciplinary action.*

Contact the **Work Control Shutdown Coordinator** at (734) 647-2059
Or
your **Building or Department Contact** for additional shutdown information.