Chemical Hygiene Plan
Standard Operating Procedures

Aerospace Engineering and Mechanics
University of Minnesota
19 Akerman Laboratory

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Last Updated: 6/28/96

Standard Operating Procedures
19 Akerman Laboratory

These procedures are intended to augment the *University of Minnesota Hazardous Chemical Waste Management* notebook available in the *Right-To-Know* rack on the door of 19 Akerman. That notebook contains detailed information on safety and hazardous waste handling.

Safety Training

Persons using the laboratory facilities must receive safety training prior to working with any chemicals. Contact Laboratory Safety Coordinators or Department Safety Coordinator for training information.

Material Safety Data Sheets

Prior to working with any chemical read its Material Safety Data Sheet (MSDS).

The MSDS for chemicals in 19 Akerman is available in MSDS notebook in the *Right-To-Know* rack. If you bring a new chemical into the lab, you are responsible for providing three copies of its MSDS and notifying the Laboratory Safety Coordinator so that it can be added to the Chemical Inventory for the lab. MSDS information can be obtained from three sources: the manufacturer, the Department of Environmental Health and Safety World Wide Web site at http://www.dehs.umn.edu/msds.html, or the on-line MSDS system using the instructions available in the MSDS notebook.

Miscellaneous

No food or drink allowed in the lab. Do not use lab glassware in place of cups and plates for food.

Do not block escape routes.

Do not block safety shower and eye wash station.

If you have any questions about laboratory safety or standard operating procedures, contact the Laboratory Safety Coordinators.

Statement of Compliance

All laboratory users must sign a Statement of Compliance form in order obtain laboratory privileges. Any laboratory user not complying with these rules will lose laboratory privileges.

Working with Chemicals in the Hood

Wear proper protective equipment when using chemicals.

- **Gloves:** Blue and yellow chemical gloves must be worn when using chemicals. Latex gloves are not a good protective barrier for acids and bases, latex is also dissolved by acetone. Chemical gloves are worn by many lab users, you should always handle the gloves by the cuffs when putting them on and never touch the blue surfaces with your bare hands when removing the gloves. After using chemical gloves, rinse them off in water.
- **Apron:** A splash apron is available on the fume hood. It should be worn when using corrosive chemicals to protect you and your clothes from damage.
- **Eye Wear:** Safety glasses, splash goggles, and face shields are all available in the lab. At a minimum safety glasses should be worn when dealing with chemicals.

Label all flasks, beakers and containers with the following information:

- contents,
- date purchased or started, and
- owner name.

Chemicals may be stored in a covered labeled beaker under the hood only for short time periods. Open containers may not be left in the hood unattended. Unlabeled containers with chemicals in them are unacceptable (this includes containers of water).

Label and store chemicals in cabinets below the hood. Use waste containers compatible with the waste chemicals and store waste in waste cabinet.

Chemicals must be stored in separate bins according to compatibility:

- Flammable chemicals such as alcohol and acetone must be kept in the locked flammable cabinet.
- Storage compatibility of chemicals is indicated by the chemical's DDC number. DDC numbers are listed in *Appendix 6: Chemical Waste Registry* of the *Hazardous Chemical Waste Management* notebook.
- Different chemicals may only be stored together if they have the same DDC numbers. Storage bins are labeled with DDC numbers.
- If there is no bin available for your chemical notify the Laboratory Safety Coordinator immediately.

Whenever possible, chemicals should be used under the hood. Before using the hood, ensure that it is functioning. Proper hood operation is indicated by the streamer hanging from the hood window being pulled into the hood. Notify the Laboratory Safety Coordinator immediately if the hood is not working.

Do not leave a hot plate unattended when it is in operation.

Clean all glassware and instruments after you are finished with your experiment. Leave the hood clean and uncluttered.

Rinse chemical gloves before removing and handle gloves by the cuffs only. Wash your hands thoroughly before you leave the lab.

Use common sense and never take short cuts when dealing with chemicals.

Chemical Emergencies

Do not abandon spilled chemicals:

- Follow the RESCUE, CONFINE, REPORT, SECURE, CLEANUP procedures outlined on p.17 of the *Hazardous Chemical Waste Management* notebook.
- Spill kits for acidic, caustic and solvent spills are available next to the fume hood for neutralization and containment of large spills. Follow the instructions on the spill kit container.
- Protective equipment must be worn when dealing with a spill.
- If you are unsure about the proper use of the spill kit or the quantity of spilled chemical is too large to handle with the spill kit available, notify Environmental Health and Safety or call 911.
- Notify the Laboratory Safety Coordinator when any portion of a spill kit is used.

If you are exposed to a chemical, seek medical assistance immediately:

- If you think you may have exposed yourself to a hazardous chemical, assume that you have indeed been exposed and follow emergency procedures immediately.
- Call 911 immediately.
- Notify the Lab Safety Coordinator, Department Safety Coordinator, or Principal Investigator .
- Consult the Material Safety Data Sheet on the chemical for emergency procedures.
- **Skin Contact:** Clothing should be removed immediately and the safety shower used to flush the affected area for a minimum of 15 minutes. Seek medical attention immediately.
- **Eye Contact:** The eye wash station should be used to flush the eyes for a minimum of 15 minutes. Seek medical attention immediately.
- **Inhaling Fumes:** Seek medical attention immediately.
- **Ingestion:** Each chemical requires different remedies. Seek medical attention immediately.

Waste Handling

Do not dispose of chemicals in the drain - especially heavy metals, alcohol, and organic solvents. Rinse water containing traces of Cr, Ni, Cu must be disposed of as hazardous waste.

The following is an e-mail message from the Environmental Health and Safety concerning disposal of metal particles in solution.

Date: Mon, 07 Nov 94 12:36:00 PST
From: ``Wentworth, Jon" < jwentworth@cassandra.dehs.umn.edu >
To: Wendy Grebner < Wendy@aem.umn.edu >
Subject: MWCC discharge limits

The following is a list of local discharge limitations into the Metro Disposal System (MDS). Waste pollutants containing metal concentrations in excess of the maximum limitations should be collected for disposal by the University's Chemical Waste Program or treated onsite prior to discharge.

A.	Cadmium	2 mg/L\cr
B.	Chromium total	8 mg/L\cr
C.	Copper	6 mg/L\cr
D.	Cyanide total	4 mg/L\cr
E.	Lead	1 mg/L\cr
F.	Mercury	0.1 mg/L\cr
G.	Nickel	6 mg/L\cr
H.	Zinc	8 mg/L\cr

The pH range for discharge to the MDS is limited to equal or greater than 5 and less than or equal to 10.

Waste chemicals must only be stored in the green waste cabinet.

Mixed and old chemicals can be kept in a compatible or their original bottle. When adding waste to a container, ensure that the chemicals being added are compatible with chemicals already contained in the bottle. If in doubt, start a new bottle. ***It is very dangerous to mix incompatible chemicals.***

Only yellow hazardous waste labels may be used to label waste bottles. Label waste bottle with date, chemicals added (including any suspended particles), approximate amounts, and your name.

Solid hazardous waste disposal:

- Solid hazardous waste containing hazardous chemicals of more than trace amounts must be disposed of in a plastic bag inside a metal container labeled for solid waste disposal.
- Examples of solid hazardous waste include: used paper towels, wipes, gloves, and neutralized waste after spill clean up.
- Waste bags must be labeled with contents.
- Any waste containing HF or other highly hazardous substances must be double bagged.

The Laboratory Safety Coordinators will handle disposal of labeled waste containers.

Special Precautions for Hydrofluoric Acid

Hydrofluoric Acid (HF) 48% is a particularly dangerous substance which is sometimes used in etching solutions in Lab 19. When HF is exposed to tissue, is penetrates the skin and attacks the underlying tissue and bone. Amputation may be required due to the damage done. It should be noted that HF is colorless, odorless, and does not cause pain immediately when contacting skin. You may have no warning symptoms of tissue damage until up to 24 hour after contact with HF although severe deep tissue damage may result.

The following precautions are required when working with HF:

Training:

- You must view the HF Safety video, "Preventing Exposure to Hydrofluoric Acid" (which can be borrowed from the Dept. of Environmental Health and Safety).
- You must be trained by a Lab Safety Coordinator in handling, labeling, ventilation, personal protective equipment, and emergency equipment associated with HF usage.
- Carefully read the Material Safety Data Sheet on HF before using it. Familiarize yourself with the precautions and first aid measures.

Protective Equipment:

- You must use two layers of gloves at all times when handling HF:
  - ◊ Test the chemical gloves with an air hose to ensure their are no holes prior to use. Immerse the inflated gloves in water and look for bubbles. Discard the glove if bubbles are observed.
  - ◊ Double glove - use a pair of latex gloves underneath the chemical gloves to provide an extra layer of protection.
- You must wear splash goggles, a face shield, and a splash apron with sleeves when handling with HF.
- HF may only be used in the fume hood.

Special Handling Instructions:

- HF dissolves glass, some metals (generating potentially explosive hydrogen gas, and other silicon-bearing materials (releasing toxic silicon tetrafluoride gas), therefore plastic beakers and containers must be used for solutions containing HF and HF must be used in the hood.
- The HF Hazard sign must be posted in the fume hood when HF is in use.
- Hazardous waste containing HF should be disposed of as soon as possible to minimize the risk to other laboratory users. If you produce hazardous waste containing HF, notify the Laboratory Safety Coordinator so that Hazardous Waste disposal can be arranged immediately.

Emergency Treatment:

- If you think you may have exposed yourself to HF, assume that you have indeed been exposed and follow emergency procedures immediately. First aid must be started within seconds of exposure.
- Call 911 immediately.
- Notify the Lab Safety Coordinator, Dept. Safety Coordinator, or PI .
- Remove any contaminated clothing.
- **Skin contact:** Flush the affected area with running water for at least 15 minutes.
- Burned area should be immersed in Zephiran Chloride. If immersion is not practical, towels should be soaked with Zephiran Chloride and used as compresses on the burned area. Compresses should be changed every 2 minutes for 4 to 6 hours.
- Apply Acid Aid (Magnesium Oxide) to the affected area.
- In case of **eye contact**, wash eyes with water for at least 5 minutes and seek medical attention immediately.
- If HF is **ingested or inhaled**, seek medical attention immediately.
- Seek treatment from a physician familiar with HF exposure.

Solid hazardous waste disposal:

- Any material exposed to even minute amounts of HF should be considered hazardous waste.
- Solid hazardous waste containing HF must be disposed of in two layer of plastic bags and placed inside a metal container labeled for solid waste disposal.
- Waste bags must be labeled with contents.

Metallography

[Reference: Smithells Metal Reference Book, 6th Edition, Edited by Eric A. Brandes, Butterworths, Boston, 1983, Section 10. Book located in 130C.]

Mechanical methods of polishing and grinding distort the material surface to a depth of 10 - 100 μm. When precise information about the surface of a metal is needed, EDM cutting with chemical polishing must be used. Alternatively, the disturbed layer can be removed by chemical means. A common error is to fail to completely remove the distorted metal from the deformed surface. The specimen dimensions should be measured before and after polishing to prevent this error.

Chemical polishes and etchants are used on metals to remove oxides, remove the surface layer distorted by mechanical polishing and grinding, produce a smooth surface free from strain, and preferentially attack grain boundaries. The specimen should be examined prior to polishing or etching. Subsequent etching can change the shape and color of inclusions, cracks and pits.

After the polishing or etching procedure is complete, the specimen should be rinsed in water, then alcohol, and dried with the air hose. A common mistake is to allow staining to occur with improper rinsing and drying which causes false structures to be observed. Preparation of an unfamiliar material should be checked with repeated polishing and etching to ensure that the feature observed is real.

Chemical Polishing and Etching

Chemical polishing and etching recipes are given by several references. Follow all precautionary recommendations in these recipes. Avoid using particularly hazardous chemicals such as HF if possible. General procedures should include the following steps:

- Chemical polishing and etching should be performed under the hood with the proper protective equipment - chemical gloves at a minimum.
- Clean the specimen to be polished with alcohol.
- Dry the specimen and measure its dimensions.
- Follow recipe guidelines and safety precautions for polishing and etchant mixtures.
- Often stirring is necessary during the procedure. Ensure that the stirring rod will not be damaged by the chemicals used.
- Occasionally heated mixtures are recommended. Be sure to follow all safety guidelines given in the recipe.
- Rinse specimen in water, then alcohol, and dry with air hose.
- Measure dimensions.
- If the polishing or etchant mixture can be reused, label the mixture and place it in the appropriate bin in the storage cabinet.
- If the polishing or etchant mixture cannot be reused, label the mixture as hazardous waste and place it in the appropriate bin in the waste cabinet.

- Rinse water is considered to be hazardous waste if the pH is below 5 and/or the water contains metal particles. pH test strips are available in the yellow cabinet.
- Turn off and unplug stir/hot plate if used.
- Clean all glassware and instruments after you are finished with your experiment. Leave the hood clean and uncluttered.
- Rinse chemical gloves before removing and handle gloves by the cuffs only. Wash your hands thoroughly before you leave the lab.

Electrochemical Polishing

For final polishing finishes on metals, electrochemical polishing is often used. Electrochemical polishing employs electrical currents in combination with chemicals to perform fine polishing. Hills on the surface are dissolved more rapidly than valleys. It is important to realize that corners of your sample will be preferentially dissolved during electrochemical polishing procedures.

Electrochemical polishing recipes are given by several references. It is preferable to work on voltage recommendations (accurate voltage regulation is essential). If both voltage and current density are stated but cannot be simultaneously attained, the prepared solution is probably wrong. If not, the current density should be ignored. Recipes are usually designed for temperatures in the 15 to 35 °C range. Follow all precautionary recommendations in these recipes. Avoid using particularly hazardous chemicals such as HF if possible.

General procedures should include the following steps:

- Chemical polishing and etching should be performed under the hood with the proper protective equipment - chemical gloves at a minimum.
- Clean the specimen to be polished with alcohol.
- Dry the specimen and measure its dimensions.
- Follow recipe guidelines and safety precautions for chemical mixtures and electrical values.
- Often stirring is necessary during the procedure. Ensure that the stirring rod will not be damaged by the chemicals used.
- Occasionally heated mixtures are recommended. Be sure to follow all safety guidelines given in the recipe.
- The negative terminal (black) on the power supply should be attached with an alligator clip to the metallic plate recommended as the cathode by the recipe (often copper or stainless steel).
- The positive terminal (red) on the power supply should be attached with an alligator clip or locking tweezers to the specimen.
- Before turning on the power supply, rotate the “DC Control” dial to zero and the “Vernier” dial to .1. The “Rem/Loc” toggle should be left on “Loc”.

- To turn on the power supply, first rotate the “DC” switch to “On”, then turn the very left hand switch to the “On” position, finally put the “Line” toggle in the up position. Increase the “DC” dial to the recommended voltage.
- To avoid damaging your sample, pay particular attention to the voltage levels given in the recipe and do not allow the sample to touch the cathode.
- Before removing the specimen from the polishing mixture the power supply must be turned off by turning the “DC” to zero and the “Line” toggle down.
- To avoid electrocution, the sample holder and alligator clips should not be touched while the power supply is on.
- Rinse specimen in water, then alcohol, and dry with air hose.
- Measure dimensions.
- If the polishing mixture can be reused, label the mixture and place it in the appropriate bin in the storage cabinet.
- If the polishing mixture cannot be reused, label the mixture as hazardous waste and place it in the appropriate bin in the waste cabinet.
- Rinse water is considered to be hazardous waste if the pH is below 5 and/or the water contains metal particles. pH test strips are available in the yellow cabinet.
- Turn off and unplug stir/hot plate if used.
- Turn off and unplug power supply if used.
- Clean all glassware and instruments after you are finished with your experiment. Leave the hood clean and uncluttered.
- Rinse chemical gloves before removing and handle gloves by the cuffs only. Wash your hands thoroughly before you leave the lab.

Cole-Parmer 8850 Ultrasonic Cleaner

Consult *Operating Instructions* for operation information.

Micro Cleaning Solution is the primary medium used in the Ultrasonic Cleaner. Aqueous and solvent solutions may also be used. Strong acids and powerful caustics should not be used directly in the cleaning tank. If you use them, use proper handling precautions, put them in a separated container and suspend this in the tank with enough water and soap to act as a driving medium.

The Micro Cleaning Solution Cleaning requires no special disposal treatment (see information sheet with MSDS). Other solutions must be evaluated individually to determine if they should be considered as hazardous waste if they contain solvents, acids, bases or metal particles in the solution - follow the guidelines given in the **Waste Handling** section.

Working with the Laser on the Moiré Microscope

Reference the *Moiré Microscope Lab Notebook* for operation instructions. Full training and certification is required before the Moiré Microscope may be used.

The laser on the moiré microscope is a 5mW (10mW max) HeNe Class IIIb laser. An additional 15mW max HeNe Class IIIb laser is located in the tall green cabinet. Class IIIb lasers can produce eye injury from both direct and specularly reflected beams.

PolyScience Water Bath

Consult *Operators Manual* for operation instructions.

Only de-ionized water may be used in the water bath. Two drops of Lab Algaecide may be used in the bath on an as needed basis to prevent algae growth. Water containing Lab Algaecide is considered to be hazardous waste. Alternatively, a small amount of bleach may be used in the water to prevent algea growth. Water containing a small amount of bleach is not considered to be hazardous waste.

Instron 4502 Universal Testing Machine

Consult *Instruction Manual* for operation instructions. Full training and certification is required before the Instron Testing Machine may be used.

Laboratory Safety Coordinator Duties

Laboratory Safety Coordinators are responsible for enforcing safety procedures and maintaining chemical and waste inventories.

Laboratory Safety Coordinator will ensure that the following tasks are performed in a timely manner:

- Laboratory Audit Checklist completed on a weekly basis.
- Weekly testing of the eye wash station.
- Monthly testing of the safety shower.
- Safety Procedures and Hazardous Waste Management procedures will be kept up to date (minimum of annual review).
- Periodic review (minimum of weekly) of the Chemical Inventory and MSDS inventory. Provide Department Safety Coordinator with two copies of all MSDS pages.
- Periodic review (minimum of weekly) of the contents of the waste cabinet and solid waste container. Timely disposal via the University of Minnesota Hazardous Chemical Waste Management guidelines. The following steps should be performed:
  - ◊ Ensure that waste containers are labeled with Hazardous Waste labels containing the following information: start date, fill date, contents, and owner.
  - ◊ Ship incompatible chemicals in separate boxes. Separate chemicals by DDC number.
  - ◊ Complete one shipping manifest for each box. See previous shipping manifests as examples. DDC and EPA numbers are listed in *Appendix 6: Chemical Waste Registry* of the *Hazardous Chemical Waste Management* notebook.
  - ◊ Photocopy each shipping manifest and file the copy in *the Chemical Hygiene Plan/Standard Operating Material* notebook.
  - ◊ Pack each container in a box with packing peanuts. Draw an up arrow on the outside of the box to indicate proper orientation of the box. Secure flaps with tape and attach the bottom copy of the shipping manifest to the box.
  - ◊ Mail the top two copies of the shipping manifest to the Department of Environmental Health and Safety. Attach a note asking that they call the lab before pickup to make sure someone is available to let them in.
  - ◊ Boxes waiting for pickup must be kept in the bins near the door while waiting for pickup.

Statement of Compliance
Aerospace Engineering and Mechanics
University of Minnesota
19 Akerman Laboratory

User Name _____

E-Mail Address _____

Office Location _____ Office Phone _____

Lab Location _____ Lab Phone _____

Home Phone _____

Type of Worked Expected:

_____

_____

_____

_____

Expected Chemicals Use:

_____

_____

_____

_____

Safety Training Completed:

_____

_____

_____

_____

I have read and understood the Safety Procedures and Hazardous Waste Management Plan for 19 Akerman. I agree to comply with these rules and the practices outlined in the University of Minnesota Hazardous Chemical Waste Management notebook. I agree to follow instructions provided by Safety Coordinators. I will act in a responsible manner concerning my own safety and the safety of others.

I understand that if I do not comply with these rules, I will lose my laboratory privileges.

User Name _____ Signature _____

Advisor _____ Signature _____

Aerospace Engineering and Mechanics
19 Akerman
Laboratory Users as of 6/28/96

Laboratory User	Last Training	SOC On File
Tom Shield		
Richard James		
Wendy Grebner	Lab Safety Coord.	
Pam Schumacher	Lab Safety Coord.	
Valerie Maher		
Rob Tickle		
Liyang Zhao		
Tatiana Wilensky		
Jian Li		
Qiang Guo		
Gustavo Gioia		
Kevin Hane		
Ellen Longmire		
Long Duong		
Kosti Henninghausen	6/17/96 WG	
Jahma Comby	6/17/96 WG	
Brian Jensen	6/17/96 WG	
Kim Marsh		
Don Webster		

Hydrofluoric Acid Training

The following individuals have viewed the HF Safety video, "Preventing Exposure to Hydrofluoric Acid" (from the Dept. of Environmental Health and Safety) and received training from Lab Safety Coordinator in handling, labeling, ventilation, personal protective equipment, and emergency equipment associated with HF usage.

Date	Name
4/26/96	Brian Jensen
4/26/96	Valerie Maher
4/29/96	Wendy Grebner
4/29/96	Pam Schumacher
4/29/96	John Tucker
4/29/96	Tatiana Wilensky
6/17/96	Rob Tickle

Moiré Microscope Training

Full training and certification is required before the Moiré Microscope may be used. The following individuals are authorized to use the Moiré Microscope.

Tom Shield
Wendy Grebner

Instron 4502 Universal Testing Machine Training

Full training and certification is required before the Instron Testing Machine may be used. The following individuals are authorized to use the Instron Testing Machine.

Tom Shield
Wendy Grebner
Valerie Maher

AEM Safety Committee Meetings

Date	19 Akerman Lab Safety Coordinators in Attendance
5/9/96	Wendy Grebner, Pam Schumacher
6/20/96	Wendy Grebner, Pam Schumacher