Working Safely in 2.674

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Mechanical Engineering
Safety Overview

- You are the person most responsible for your own safety.

So:

- Prepare – get information.
- Plan your work – before you start.
- Pay attention – while in the lab.
- If you don’t know, **ASK**.
Emergencies

- What do you do if there is an emergency?
  - Inform Instructor
  - Stay calm

- Know evacuation routes & assembly areas

<table>
<thead>
<tr>
<th>Building</th>
<th>Exterior Assembly Point A</th>
<th>Exterior Assembly Point B</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Mass Ave towards Memorial Drive - end of Building 1</td>
<td>Kresge Oval</td>
</tr>
<tr>
<td>3</td>
<td>Killian Court</td>
<td>Courtyard between 11 &amp; 13</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Interior Assembly Point A</th>
<th>Interior Assembly Point B</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Lobby 7</td>
<td>Lobby 10</td>
</tr>
<tr>
<td>3</td>
<td>Lobby 7</td>
<td>Lobby 10</td>
</tr>
</tbody>
</table>

- Are you signed up for MITAlert? [emergency.mit.net]
Potential Hazards

- What potential hazards will you be working with in the lab?
  - Chemicals (you must complete a web-based training module on General Chemical Hygiene)
  - Nano materials
  - Compressed gases
  - Physical hazards (sharp objects / high voltage)
  - Laser/UV light
Chemical Hygiene aka Working With Chemicals

- Be alert and aware
  - Conduct experiments with head firmly attached
- Know the hazards of your experiment
  - Consult SDS and use PPE
- Follow established procedures
- Wear appropriate clothing
- Properly dispose of waste materials
(Material) Safety Data Sheets (MSDS)

- SDS’s exist for all chemicals and contain information on:
  - Health, Hazard, Toxicity Data
  - Accident and Disposal Procedures
  - Storage and PPE (personal protective equipment)

- Google: “chemical name MSDS”
GHS: Globally Harmonized System

- New system for chemical Hazard Communication and labeling
- New standardized SDS format
- New pictograms
- “Signal Word”: Warning or Danger
- Hazard statements
- Hazards 1-5 with 1 as highest hazard
Acetone (M)SDS

7. HANDLING AND STORAGE
7.1 Precautions for safe handling
Avoid contact with skin and eyes. Avoid inhalation of vapour or mist. Use explosion-proof equipment. Keep away from sources of ignition - No smoking. Take measures to prevent the build up of electrostatic charge. For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities
Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resoled and kept upright to prevent leakage.

7.3 Specific end use(s)
Apart from the uses mentioned in section 1.2 no other specific uses are stipulated.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION
8.1 Control parameters

<table>
<thead>
<tr>
<th>Component</th>
<th>CAS-No.</th>
<th>Value</th>
<th>Control parameters</th>
<th>Basis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetone</td>
<td>67-64-1</td>
<td>TWA</td>
<td>500 ppm</td>
<td>USA, ACGIH Threshold Limits</td>
</tr>
</tbody>
</table>

Remarks
Eye & Upper Respiratory Tract irritation
Central Nervous System impairment
Hematologic effects
Substances for which there is a Biological Exposure Index or Indices (see BEI® section)
Not classified as a human carcinogen
STEL 750 ppm
USA, ACGIH Threshold Limits

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</tr>
</thead>
<tbody>
<tr>
<td>Acetone</td>
<td>67-64-1</td>
<td>STEL</td>
<td>1,000 ppm 2,400 mg/m³</td>
<td>USA, OSHA - TABLE Z-1 Limits for Air Contaminants - 1910.1000</td>
</tr>
</tbody>
</table>

The acetone STEL does not apply to the cellulose acetate fiber industry. It is in effect for all other sectors.

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<td>TWA</td>
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<td>USA, Occupational Exposure Limits (OSHA) - TABLE Z-1 Limits for Air Contaminants</td>
</tr>
</tbody>
</table>

The value in mg/m³ is approximated.

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<thead>
<tr>
<th>Component</th>
<th>CAS-No.</th>
<th>Parameters</th>
<th>Value</th>
<th>Biological specimen</th>
<th>Basis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetone</td>
<td>50 mg/ml</td>
<td>Urine</td>
<td></td>
<td></td>
<td>ACGIH - Biological Exposure Indices (BEI)</td>
</tr>
</tbody>
</table>

Remarks
End of shift (As soon as possible after exposure ceases)
How can you be exposed to chemicals?

- Contact with skin or eyes (absorption)
- Inhalation
- Ingestion
- Injection
Avoiding Skin Exposures: 2.674/2.675 Lab Attire

- Wear long pants
- Wear closed toe shoes
- **Avoid:**
  - Loose or torn clothing
  - Dangling jewelry or hair
  - Shorts or skirts
  - Sandals

Figure by MIT OpenCourseWare.
PPE: Personal Protective Equipment

- Head protection
- Eye and Face protection – safety glasses
  - Wear safety glasses in lab at all times
- Hearing protection
- Respiratory protection
- Arm and Hand protection – gloves
- Foot and Leg protection
- Protective clothing – lab coat
Avoiding **Inhalation** Exposure: Proper Fume Hood Use

These images have been removed due to copyright restrictions.
Proper Fume Hood Use: Material Placement

This image has been removed due to copyright restrictions. Please see https://www.purdue.edu/ehps/rem/ih/graphics/placement.jpg.
Avoiding Ingestion:

NO FOOD or DRINK ALLOWED in labs at MIT!

Note: This includes gum.
Nanoparticles are smaller than cells

- Respirable
- Ultrafine
- Nanoparticles

<table>
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<tr>
<th>Red blood cells</th>
<th>Bacteria</th>
<th>Tobacco smoke</th>
<th>Viruses</th>
</tr>
</thead>
<tbody>
<tr>
<td>10um</td>
<td>1um</td>
<td>100nm</td>
<td>10nm</td>
</tr>
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</table>

Figure by MIT OpenCourseWare.
Nanotechnology: EHS implications

- Emergent technology - uncertainty about health effects
- Studies suggest
  - Inhalation is highest risk (lung damage)
  - Nanoparticles can cross cell membranes
- But also
  - HEPA filters and fume hoods are quite effective at collecting nanoparticles

HIGH UNCERTAINTY ≠ HIGH RISK
HIGH UNCERTAINTY = HIGH PRECAUTION
Inhalation Risk: Least ⇒ Greatest

- solid material with embedded nanostructure
- solid material with nanostructure bound to surface
- liquid suspensions of nanoparticles
- free nanoparticles (dry & dispersible)
Safe handling of dry, particulate Carbon Nanotubes (CNTs)

- Sturdy glove with good integrity (e.g., nitrile)
- Work in fume hood
- CNTs removed from furnaces, reactors, or other enclosures should be put in sealed containers for transport
- Wet wipe surfaces of fume hoods or other enclosures after each use or at end of day
CNT Waste Management

The following nanomaterial/CNT waste should be collected in a plastic bag or other sealed container, labeled as hazardous waste, and placed in the lab’s Hazardous Waste Collection area:

- Pure CNTs
- Items contaminated with loose CNTs (e.g., wipes/PPE)
- Solid matrixes with CNTs that are friable or have a nanostructure loosely attached to the surface
Hazardous Waste Area
Compressed Gas Cylinders

- Pressure hazard
- May contain hazardous materials
- Safe when handled properly
- Tanks should always be secured
- Do not adjust valves or regulators without proper instruction
Cutting Safety

- Use the correct tool for the job
- ALWAYS cut AWAY from the body
- Know where your non-cutting hand is
- Use a guide
- Dispose used sharps in a sharps container

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Electrical Safety

• Insulate electrical conductors.
  • ceramic, glass, rubber

• Elevate / Shield conductors.
  • Reduce personal exposure

• Guard conductors by enclosing them.
  • Receptacle covers, boxes, & conduit

• Inspect electrical systems prior to energizing.
  • Look for: Loose or frayed wires/cords/plugs
    Missing guards or broken outlets/fixtures
  • Only specially trained workers are authorized to make electrical repairs.
  • MIT Facilities maintains building power supply and electrical distribution equipment.

• Develop safe work practices.
  • Know what circuits are closed (live!)
  • Tools/jewelry/exposed body parts make good conductors

• Housekeeping!
Laser/UV Safety

- You will use a class 3R laser.
  - 635nm at 5mW (milliwatt).
  - >5mW may damage eye, >1mW may irritate.
  - Do not stare into beam.
  - If eyes become irritated, avert your eyes.

- You will use UV lamps.
  - Unshielded UV can damage eyes and skin.
  - Don’t point UV lamps at eyes or defeat shields.
  - Cover all skin; wear protective goggles/shield.
  - Don’t remove goggles/shield to get closer look.
General Chemical Hygiene Web Training

Find “General Chemical Hygiene” in your list of required courses and click.
General Chemical Hygiene Web Training

Scroll down and click the “web-based” button to launch the course.
General Chemical Hygiene Web Training

- **You must complete Course 100 – General Chemical Hygiene by February 10, 2016 (before 1st lab)!**

- Note: The EHS list is populated by an automatic feed from MITSIS (the Registrar). Until they release their list the EHSD list will not be updated. There may be a 1 to 2 day delay for changes to appear.

- Firefox is the preferred browser for the eLearning System. Safari will also work; Chrome might...

- You will need to turn off pop-up blockers and have up-to-date versions of Flash and Java.

- For technical assistance visit [http://ehs.mit.edu/site/training](http://ehs.mit.edu/site/training)
Review of Topics Covered

- Emergency Information
- Lab Specific Chemical Hygiene
  - (M)SDS sheets, GHS system
  - PPE - safety glasses, gloves, lab coat
  - Fume hood
- Nanomaterials
- Compressed Gas Cylinders
- Cutting Safety, Electrical and Laser/UV Safety
- Training Course: complete by Feb 10 2016
Remember:

- You are the person most responsible for your own safety.

So:

- Prepare – get information.
- Plan your work – before you start.
- Pay attention – while in the lab.