# MAS.450 Laboratory safety guide

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## Introduction

Guidelines for not getting you, someone you know or work with, or other people hurt/damaged/killed are the same inside and outside of lab:

- know the hazards around you
- make accurate risk assessments
- know what to do if the unexpected strikes
- be careful and deliberate
- anticipate and avoid potential problems

This guide provides summary information about laser safety, chemical safety, and other related safety issues. In addition, it lists the safety equipment in the lab, as well as emergency phone numbers and contacts in case of emergency.

# Laser Safety

## introduction

Lasers are concentrated, bright lights. Direct eye exposure to the lasers we will use in class can cause temporary, or even permanent, blindness. Other lasers used in the research laboratory are more dangerous: a direct beam can cause burns or start fires, and even diverged beams or diffuse reflections can be hazardous.

## laser classification

The intensity of a laser's emission is used to classify its danger. ANSI standard Z-236.1 defines the following laser classes:

Class 1: Lasers that can't produce injury during normal operations.


Class 2a: Low power visible lasers or laser systems not intended for prolonged viewing, but that aren't hazardous under normal conditions.

Class 2: Low power visible lasers or laser systems that do not present a hazard due to "normal human aversion responses" (in other words, you're aware its a bright light so you look away fast enough). Some hazards may occur such sources are viewed for an extended period of time, much like any other bright source.

Class 3a: Medium power lasers or laser systems that normally will not be hazardous if viewed momentarily with the unshielded eye.

Class 3b: Laser or laser systems that can be hazardous if viewed directly. Hazards may include specular reflections (the beam bouncing off shiny or mirrorlike surfaces).

Class 4: Lasers of laser systems that result in hazards for diffuse or scattered reflection as well as from specular reflection or the direct beam. These lasers also pose fire and skin burn hazards.

We will use only Class 3a (IIIa) or lower lasers in class. Lasers of Class 3b and 4 are used in the research lab.

## laser hazards

Class 3a lasers pose two major hazards: **biological** and **electrical**. Biological hazards for this laser class are exclusively optical. Your eye's cornea can focus laser light onto your retina, increasing its brightness up to 100,000 times and causing retinal damage. Specular or mirror-like reflections, such as those from an optical mirror or a watch, can also cause retinal damage. Lasers are more dangerous than conventional light sources because the eye usually doesn't respond as quickly to "stop down" or force you to look away.

Class 3b and 4 lasers used in the adjacent research lab can an additional biological hazard of burns to the skin.

Lasers are usually high voltage (1kV to 10kV) gas discharge tubes. As such, they can pose an electrical hazard. The voltages and currents are enough to cause involuntary muscle contraction that can force you to maintain your contact with a charged wire should you come in contact with one.

## laser safety guidelines

- Never look down any undiverged laser beam.
- Never point a laser beam at a person.
- Avoid placing an unshielded eye near the beam axis during alignment.
- Avoid looking at specular reflections of the beam, or diverting specular reflections towards others.
- Keep the beam axis below typical standing and sitting position.
- The chairs in the lab are designed to keep you above beam height: don't sit so that your eyes are placed near the beam level.
- If you are not using a setup, or leave the room for a prolonged time, close the shutter in the beam to reduce the chance of accidental exposure.
- Terminate beams at the end of their useful paths with a beam block or stopper.

Some labs use special laser goggles to filter out the potentially dangerous laser light from the eye. However, holography requires that the beam be visible for setup and inspection of the holographic apparatus. So labs also require that you look towards a diverged (spread-out) beam. Some people may find this step uncomfortable, but a sufficiently diverged beam poses no health hazard.

# Chemical safety

## introduction

In holography, chemicals are used to process photosensitive plates and films and to adhere plates to plate holders. Some of these chemicals are flammable, others are toxic. Following lab safety guidelines for handling chemicals is extremely important. Your TA is the first person you should consult, if possible, to find out about chemical hazards or to report a potential chemical hazard.

## Chemical safety guidelines

- Lab coats, gloves, and safety glasses (eye protection) are **required** when handling chemicals.
- Do not eat or drink in lab. Avoid touching your mouth or eyes with your hands, since they may have residual chemicals on them.
- Some chemicals such as bromine, methanol, and potassium dichromate should only be handled under a fume hood because of the toxicity of their vapors.
- Check the label of all chemicals you handle, and label all chemicals you mix clearly.
- Always wash your hands after lab, even after wearing gloves.
- Never smoke in lab: it's against MIT policy and Cambridge ordinance, risks damage to the optics, and poses the risk of ignition.
- Don't let fumes of flammable chemicals such as methanol accumulate.
- Don't mix acids and bases in large quantities.
- Dispose of all chemicals as directed by your TA or signs in the lab. In general, **dump nothing** down the sink. Many chemicals can be reused.
- Confirm the contents of a waste chemical bottle before pouring anything into it.
- Soak up spills, clean up counters, and wash down the darkroom sink properly. Dispose of paper towels carefully.
- Know the location of safety equipment, including the emergency shower and eyewash station, the fire extinguisher, the first aid kit, and the telephone

(both in the darkroom and the Media Lab lobby).

- Use the shower only in extreme emergency because of the fifty gallons of water it dumps into the darkroom.
- Report any accident, no matter how slight, to your TA or other supervisor right away.

## specific chemical hazards

**Index matching fluid**

**Xylene** (pronounced "Zi-leen") is flammable and harmful if swallowed or inhaled in great concentration. The use of xylene in holographic imaging produces vapor levels well below health safety levels set by OSHA.

**Mineral oil** is essentially inert, and in pharmaceutical purity is used to treat gastric distress.

**Developers**

**Kodak D-19**, a developer developed for black and white photography, can cause minor skin irritation and is harmful if swallowed.

**Pyrogallol** is a component of several developers we will use in later labs. It is poisonous; skin contact, inhalation, and ingestion should all be avoided.

**Ascorbic acid** is also known as Vitamin C. Our ascorbic acid is not food grade, so don't eat it. It is used in several developers.

**Sodium Carbonate**, a developer component in the "Ilford" process, is harmful if swallowed and can cause eye burns and skin irritation.

**Sodium Phosphate Dibasic**, another developer component, is a minor skin and eye irritant.

**Sodium Hydroxid**e, used as a component in the "PAA" developer, is highly corrosive, causes severe skin or eye burns, and is very harmful of swallowed.

**Bleaches**

**EDTA bleach** contains EDTA, which should not come in contact with the skin, and Potassium Bromide, which is harmful if swallowed.

**Potassium dichromate** (or "dichro") **bleach** contains **potassium dichromate**, which is highly toxic, corrosive, and is a cancer-suspect. This bleach also contains **sulfuric acid**, which is corrosive and poisonous. **Avoid skin or eye contact!**

**Bromine water** consists of elemental bromine mixed with water. It is extremely dangerous, and should only be handled with thick gloves and under a fume hood. Avoid contact, including fumes! We will seldom, if ever, use bromine water in class. You may see it in the fume hood, however.

Drying agents and other chemicals

**Methanol** is used to dry plates. Avoid vapors (use only under a fume hood), and avoid skin exposure. **Isopropanol** is less dangerous but should also be treated with caution. Both are flammable.

**Glacial acetic acid**, or **stop bath**, is a skin irritant at high concentrations and has irritating vapors. Avoid inhalation.

**Triethanolamine** is a slippery, large-moleculed compound used to swell emulsion. It may be a skin irritant.

## Other safety issues

Many optical components, holographic plates, and other objects in the lab are made of glass. The edge of plates, even from the manufacturer, as sharp enough to cut you. Be careful. There are also a large number of razor blades used in lab for cutting, scraping, and prying. Handle them very carefully.

Holographic exposures are made in the dark, and chemical processing proceeds in the dark. Be familiar with the lab so that you can get around without running into things. In general, don't leave rooms completely dark unless you are exposing or processing a plate: someone entering the room from the bright hallway may not be able to see well.

For most minor medical problems, you can and should take advantage of the proximity of the Media Lab to the MIT Medical Department.

## Safety equipment

Locate and remember the locations of the following objects in the lab and darkroom:

- lab coats, safety glasses, gloves
- first aid kit
- MSDS safety sheets (chemical safety information for all the chemicals in the lab)
- telephone (darkroom, building lobby) and emergency phone number list
- eye wash station
- emergency shower

- fire extinguisher
- fume hood
- waste disposal area
- emergency chemical spill containment materials

## Phone numbers

You contact your lab TA first in case of a problem or safety issue. If your TA is unavailable, consult the list of phone numbers on the outside door of the lab (or call other numbers as previously directed by your TA). Steven Smith, the lab safety supervisor, is often in the research lab and is available to help.

Here are some of those numbers, should the up-to-date list in lab be unavailable to you:

- Holography receptionist, who can forward your calls to instructors and staff:
- Prof. Stephen Benton: 3-8145
- Steven Smith (lab safety supervisor): 3-0626
- Greg Tucker (building safety supervisor): 3-0644
- Fire and explosion: 100
- Medical emergency: 100
- Medical department: 3-4481
- Flood: 3-4948
- Campus police: 3-1212
- Physical plant: FIXIT

Be sure to identify your location:

Building **E15**
Holography lab: **E15-044**
Darkroom: **E15-044B**

Lab phone number: **3-0610**

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