California Institute of Technology

Laboratory and Workplace Safety Signs

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Table of Contents

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Scope

This program applies to the design, application, and use of signs or symbols at The California Institute of Technology (Caltech) to define specific hazards of a nature such that failure to designate them may lead to accidental injury to students, employees, contractors and the public, or cause property damage.

Purpose

The purpose of this program is to provide guidance in regards to the accident prevention signs used at Caltech and to ensure that the various meanings of accident prevention signs and the hazards that they represent are conveyed effectively.

This program is also in place to comply with the following regulations and standards relating to accident prevention signs:

- Title 8, California Code of Regulations (CCR), Section 3340 – Accident Prevention Signs
- California Health and Safety Code, Section 25249.6 – Clear and Reasonable Warning, Proposition 65 Sign, Office of Environmental Health Hazard Assessment (OEHHA)
- National Fire Protection Association (NFPA) 704, Standard System for the Identification of the Hazards of Materials for Emergency Response (Fire Diamond)
- Title 10, Code of Federal Regulations (CFR), Section 20.1902 – Posting Requirements

Responsibilities

PI's, Managers, Supervisors, Safety Officer, and/or Responsible Person

- Ensure that accident prevention warning signs in respective areas are up to date, visible, and in good condition.
- Ensure that students and employees recognize and understand the meaning of accident prevention signs.

Environment, Health, and Safety

- Provide guidance on the completion and placement of required accident prevention signs.

Classification of Signs and Requirements

General Safety Signs

General safety signs are found throughout campus and shall be used where there is a need for general instructions and suggestions relative to safety measures that requires signage.

Danger Signs

Danger signs shall be used only where an immediate hazard exists. All employees are instructed that danger signs indicate immediate danger and that special precautions are necessary. Danger signs consist of the colors red, black, and white only.

Danger signs can be found in laboratories, trade shops, chemical storage areas, central plant and other areas where an immediate hazard may exist that requires signage. Examples of wording are:

- DANGER – FLAMMABLE MATERIAL, No Smoking
- DANGER – CORROSIVE LIQUIDS, Wear Protective Equipment
- DANGER – LASER RADIATION, avoid eye or skin exposure to direct or scatter radiation

Warning Signs

Warning signs shall be used to indicate a potentially hazardous situation which, if not avoided, could result in death or serious injury. All employees are instructed that warning signs indicate a potentially hazardous situation that could result in death or serious injury.

Warning signs shall be used to indicate a potentially hazardous situation which, if not avoided, could result in death or serious injury. Examples of wording for "WARNING" signs are:

- WARNING – PINCH POINT
- WARNING – This Machine Starts Automatically

Caution Signs

Caution signs shall be used only to warn against potential hazards or to caution against unsafe practices. All employees are instructed that caution signs indicate a possible hazard against which proper precaution should be taken. Standard color of the background is yellow; and the panel, black with yellow letters. Any letters used against the yellow background will be black.

Caution signs can be found throughout campus to warn against potential hazards or to caution against unsafe practices. Examples of wording for "CAUTION" signs include:

- CAUTION – NO CHEMICALS IN DRAINS, Use Chemical Waste Containers
- CAUTION – WATCH YOUR STEP
- CAUTION – Potential hazard in laboratory

Biological Hazard Signs

Biohazard warning signs are posted in areas and laboratories that contain biohazardous agents or potentially infectious materials.

The biological hazard warning sign is used to signify the actual or potential presence of a biohazard, or potentially infectious material and to identify equipment, containers, rooms, material, experimental animals, or combinations thereof, which contain, or are contaminated with, viable hazardous agents. The biohazard symbol design is fluorescent orange or orange-red color. Background color is optional as long as there is sufficient contrast for the symbol to be clearly defined. Appropriate wording may be used in association with the symbol to indicate the nature or identity of the hazard, name of individual responsible for its control, precautionary information, etc., but this information must not be superimposed on the symbol.

Radiation Warning Signs

Radiation warning signs indicate the types of exposure levels that may be present in the lab or area. Magenta or black on a yellow background are the internationally recognized colors used to signify the presence of ionizing radiation. The symbol used is called the trefoil.

Depending on the level of radiation present, the following signage may be used:

- **Caution – X-ray.** This warning sign is used to indicate use of radiation producing machine in that location.
- **Caution – Radioactive Materials.** This warning sign is used to indicate that radioactive materials are used or stored in this lab or area.
- **Caution – Radiation Area.** This warning sign is used to indicate areas where radiation levels may exist that are in excess of 5 millirem (mrem) per hour at a distance of 30 centimeters (cm) from the source of radiation or from any surface that the radiation penetrates.
- **Caution – High Radiation Area.** This warning sign is used to indicate areas where radiation levels may exist that are in excess of 100 mrem per hour at a distance of 30 cm from the source of radiation or from any surface that the radiation penetrates.
- **Radiation Warning Labels.** Use radiation warning labels to mark containers and equipment used to manipulate or store radioactive materials, contaminated items, or other sources of ionizing radiation.

Laser Hazard Signs

Laser hazard warning signs are used to indicate the actual or potential laser light hazard in the laboratory or in an area.

Danger laser radiation sign is used for class 3b and 4 lasers.

Proposition 65 Signs

Proposition 65 (Prop 65) is a California regulation that requires businesses to notify students, employees, visitors, contractors, etc. about detectable amounts of certain chemicals in the products they purchase, in their homes or workplaces, or that are released into the environment. Businesses are required to provide a "clear and reasonable" warning before knowingly and

intentionally exposing anyone to a chemical listed on the Proposition 65 list. Caltech posts Prop 65 warning signs throughout the workplace. The sign must clearly communicate that the chemical in question is known to the state to cause cancer, or birth defects or other reproductive harm.

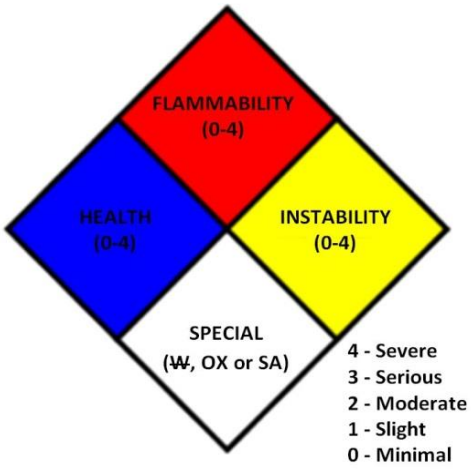
Locations

Proposition 65 signs should be posted at the entrances to buildings or areas where listed chemicals may be present.

At Caltech, Proposition 65 is present at the bottom of each of the Accident Prevention Warning Signs denoted by the following:

WARNING – THIS AREA CONTAINS A CHEMCIAL KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER OR BIRTH DEFECTS OR OTHER REPRODUCTIVE HARM

National Fire Protection Association (NFPA) 704, Standard System for the Identification of the Hazards of Materials for Emergency Response (Fire Diamond)



NFPA 704 is part of the Accident Prevention Warning Signs that are placed on the door or wall prior to entering an area where the hazards may be present. They are intended to provide emergency responders with the information they need to determine the immediate actions to be taken in an emergency.

NFPA 704 provides criteria for assessing the health, flammability, reactivity, and related hazards that are presented by short-term, acute exposure to a material under conditions of fire, spill, or similar emergencies. A number rating system of 0-4 (zero being the least hazardous and four being the most hazardous) is provided to rate health, flammability, and reactivity and symbols (i.e. W, Ox, SA) are located in the white area for special hazards. The NFPA system uses a "diamond shape" to succinctly display the type of hazards present. See **Appendix 1** for information on how chemical manufactures determine the ratings.

Caltech's Laboratory Emergency Information Signs

The following guidance should be used for the evaluation of the chemical hazard and completion of the NFPA diamond. You can find blank copies of the standard NFPA Laboratory Safety on the Environment, Health, and Safety website.

Determining Rating Number for NFPA Sign

Use the criteria below to determine the number rating required to be posted in each of the sections of the NFPA diamond.

To find the NFPA classification rating for a chemical, refer to the Safety Data Sheet (SDS), chemical label, or contact the EH&S Office for assistance. The following should be used for the evaluation of the hazard rating for a given area:

Health Hazard	Post the highest NFPA classification rating present in the area regardless of amount
Flammability Hazard	**NFPA 4**- More than 5 gallons (NFPA, Class IA) and/or any flammable gases. **NFPA 3**- 5 gallons or less (NFPA, Class IA) and/or 10 gallons or less of (Class 1B, 1C)). **NFPA 2**- 2 gallons or less (NFPA, Class IA) and/or 4 gallons or less of (Class 1B, 1C). **NFPA 1**- Less than 1 gallon (NFPA 4, Class IA) and/or 2 gallons or less of (Class 1B, 1C).
Reactivity Hazard	Post the highest NFPA classification rating present in the area regardless of amount
Special Hazards	Post the appropriate special hazard regardless of amount

Locations

Emergency Information Signs are required to be posted at the entrance to each lab where hazardous material is stored or where potential hazards exist.

Filling out the NFPA Sign

- Enter full building name and room/laboratory number on the sign.
- Enter the emergency contact information. The recommended emergency contacts for laboratories are the Principal Investigator and group Safety Officer.
- Select one of the following signs based on the materials present in your laboratory.
    - For chemicals use
    - For chemical hazards that require a rating of **4** in any of the categories on the NFPA "diamond" or that have special hazards use
    - For Biohazards and radioactive material use
    - For Biohazards use
    - For Radioactive material use
- Mark the appropriate checks for personal protective equipment required in the area.

- Mark the appropriate checks for the hazards present in the laboratory. Note: when “other” is checked, indicate specifics in the "list specifics" column such as:
    - **Water Reactive Material**
    - **Neurotoxins**
    - **Biohazards** (Indicate Biohazard classification, i.e. Minimal Hazard)
    - **Health, Flammability and/or Reactivity hazards** rated 3 or above.
- Enter the date the sign was updated on.

Posting the Sign

After completing all information on the sign:

- Install the sign on the wall by the entrance to the room or laboratory. The sign should hang at eye level.
- DO NOT INSTALL ON THE DOOR.

Appendix 1: Factors Used to Determine NFPA Ratings of Chemicals

Table 1: Degrees of Health Hazards

Degree of Hazard*	Criteria
4 — Materials that, under emergency conditions, can be lethal.	• Gases whose LC_{50} for acute inhalation toxicity is less than or equal to 1000 parts per million (ppm). • Any liquid whose saturated vapor concentration at 20°C (68°F) is equal to or greater than ten times its LC_{50} for acute inhalation toxicity, if its LC_{50} is less than or equal to 1000 ppm. • Dusts and mists whose LC_{50} for acute inhalation toxicity is less than or equal to 0.5 milligrams per liter (mg/L). • Materials whose LD_{50} for acute dermal toxicity is less than or equal to 40 milligrams per kilogram (mg/kg). • Materials whose LD_{50} for acute oral toxicity is less than or equal to 5 mg/kg.
3 — Materials that, under emergency conditions, can cause serious or permanent injury.	• Gases whose LC_{50} for acute inhalation toxicity is greater than 1000 ppm but less than or equal to 3000 ppm. • Any liquid whose saturated vapor concentration at 20°C (68°F) is equal to or greater than its LC_{50} for acute inhalation toxicity, if its LC_{50} is less than or equal to 3000 ppm and that does not meet the criteria for degree of hazard 4. • Dusts and mists whose LC_{50} for acute inhalation toxicity is greater than 0.5 mg/L but less than or equal to 2 mg/L. • Materials whose LD_{50} for acute dermal toxicity, is greater than 40 mg/kg but less than or equal to 200 mg/kg. • Materials that are corrosive to the respiratory tract. • Materials that are corrosive to the eye or cause irreversible corneal opacity. • Materials that are corrosive to skin. • Cryogenic gases that cause frostbite and irreversible tissue damage. • Compressed liquefied gases with boiling points at or below -55°C (-66.5°F) that cause frostbite and irreversible tissue damage. • Materials whose LD_{50} for acute oral toxicity, is greater than 5 mg/kg but less than or equal to 50 mg/kg.

Degree of Hazard*	Criteria
2 — Materials that, under emergency conditions, can cause temporary incapacitation or residual injury.	• Gases whose LC_{50} for acute inhalation toxicity is greater than 3000 ppm but less than or equal to 5000 ppm • Any liquid whose saturated vapor concentration at 20°C (68°F) is equal to or greater than one-fifth its LC_{50} for acute inhalation toxicity, if its LC_{50} is less than or equal to 5000 ppm and that does not meet the criteria for either degree of hazard 3 or degree of hazard 4. • Dusts and mists whose LC_{50} for acute inhalation toxicity is greater than 2 mg/L but less than or equal to 10 mg/L. • Materials whose LD_{50} for acute dermal toxicity, is greater than 200 mg/kg but less than or equal to 1000 mg/kg. • Compressed liquefied gases with boiling points between -30°C (-22°F) and -55°C (-66.5°F) that can cause severe tissue damage, depending on duration of exposure. • Materials that are respiratory irritants. • Materials that cause severe but reversible irritation to the eyes or lacrimators. • Materials that are primary skin irritants or sensitizers. • Materials whose LD_{50} for acute oral toxicity, is greater than 50 mg/kg but less than or equal to 500 mg/kg.
1 — Materials that, under emergency conditions, can cause significant irritation.	• Gases and vapors whose LC_{50} for acute inhalation toxicity is greater than 5000 ppm but less than or equal to 10,000 ppm. • Dusts and mists whose LC_{50} for acute inhalation toxicity is greater than 10 mg/L but less than or equal to 200 mg/L. • Materials whose LD_{50} for acute dermal toxicity is greater than 1000 mg/kg but less than or equal to 2000 mg/kg. • Materials that cause slight to moderate irritation to the respiratory tract, eyes, and skin. • Materials whose LD_{50} for acute oral toxicity is greater than 500 mg/kg but less than or equal to 2000 mg/kg.
0 — Materials that, under emergency conditions, would offer no hazard beyond that of ordinary combustible materials.	• Gases and vapors whose LC_{50} for acute inhalation toxicity is greater than 10,000 ppm. • Dusts and mists whose LC_{50} for acute inhalation toxicity is greater than 200 mg/L. • Materials whose LD_{50} for acute dermal toxicity is greater than 2000 mg/kg. • Materials whose LD_{50} for acute oral toxicity is greater than 2000 mg/kg. • Materials that are essentially nonirritating to the respiratory tract, eyes, and skin.
*For each degree of hazard, the criteria are listed in a priority order based upon the likelihood of	

Degree of Hazard*	Criteria
exposure.	

Table 2: Degrees of Flammability Hazards

Degree of Hazard	Criteria
4 — Materials that will rapidly or completely vaporize at atmospheric pressure and normal ambient temperature or that are readily dispersed in air and will burn readily.	• Flammable gases. • Flammable cryogenic materials. • Any liquid or gaseous material that is liquid while under pressure and has a flash point below 22.8°C (73°F) and a boiling point below 37.8°C (100°F) (i.e., Class IA liquids). • Materials that ignite spontaneously when exposed to air. • Solids containing greater than 0.5 percent by weight of a flammable or combustible solvent are rated by the closed cup flash point of the solvent.
3 — Liquids and solids that can be ignited under almost all ambient temperature conditions. Materials in this degree produce hazardous atmospheres with air under almost all ambient temperatures or, though unaffected by ambient temperatures, are readily ignited under almost all conditions.	• Liquids having a flash point below 22.8°C (73°F) and having a boiling point at or above 37.8°C (100°F) and those liquids having a flash point at or above 22.8°C (73°F) and below 37.8°C (100°F) (i.e., Class IB and Class IC liquids). • Materials that on account of their physical form or environmental conditions can form explosive mixtures with air and that are readily dispersed in air. • Flammable or combustible dusts with representative diameter less than 420 microns (40 mesh). • Materials that burn with extreme rapidity, usually by reason of self-contained oxygen (e.g., dry nitrocellulose and many organic peroxides). • Solids containing greater than 0.5 percent by weight of a flammable or combustible solvent are rated by the closed cup flash point of the solvent.
2 — Materials that must be moderately heated or exposed to relatively high ambient temperatures before ignition can occur. Materials in this degree would not under normal conditions form hazardous atmospheres with air, but under high ambient temperatures or under moderate heating could release vapor in sufficient	• Liquids having a flash point at or above 37.8°C (100°F) and below 93.4°C (200°F) (i.e., Class II and Class IIIA liquids). • Solid materials in the form of powders or coarse dusts of representative diameter between 420 microns (40 mesh) and 2 mm (10 mesh) that burn rapidly but that generally do not form explosive mixtures with air. • Solid materials in a fibrous or shredded form that burn rapidly and create flash fire hazards, such as cotton, sisal, and hemp. • Solids and semisolids that readily give off flammable vapors. • Solids containing greater than 0.5 percent by weight of a flammable or combustible solvent are rated by the closed cup flash

Degree of Hazard	Criteria
quantities to produce hazardous atmospheres with air.	point of the solvent.
1 — Materials that must be preheated before ignition can occur. Materials in this degree require considerable preheating, under all ambient temperature conditions, before ignition and combustion can occur.	• Materials that will burn in air when exposed to a temperature of 815.5°C (1500°F) for a period of 5 minutes in accordance with Annex D. • Liquids, solids, and semisolids having a flash point at or above 93.4°C (200°F) (i.e., Class IIIB liquids). • Liquids with a flash point greater than 35°C (95°F) that do not sustain combustion when tested using the *Method of Testing for Sustained Combustibility*, per 49 CFR 173, Appendix H or the UN *Recommendations on the Transport of Dangerous Goods, Model Regulations*, 11th revised edition, and the related *Manual of Tests and Criteria*, 3rd revised edition. • Liquids with a flash point greater than 35°C (95°F) in a water-miscible solution or dispersion with a water noncombustible liquid/solid content of more than 85 percent by weight. • Liquids that have no fire point when tested by ASTM D 92, *Standard Test Method for Flash and Fire Points by Cleveland Open Cup*, up to the boiling point of the liquid or up to a temperature at which the sample being tested shows an obvious physical change. • Combustible pellets with a representative diameter greater than 2 mm (10 mesh). • Most ordinary combustible materials. • Solids containing greater than 0.5 percent by weight of a flammable or combustible solvent are rated by the closed cup flash point of the solvent.
0 — Materials that will not burn under typical fire conditions, including intrinsically noncombustible materials such as concrete, stone, and sand.	• Materials that will not burn in air when exposed to a temperature of 816°C (1500°F) for a period of 5 minutes in accordance with Annex D.

Table 3: Degrees of Instability Hazards

Degree of Hazard	Criteria
4 — Materials that in themselves are readily capable of detonation or explosive decomposition or explosive reaction at normal temperatures and pressures.	• Materials that are sensitive to localized thermal or mechanical shock at normal temperatures and pressures. • Materials that have an instantaneous power density (product of heat of reaction and reaction rate) at 250°C (482°F) of 1000 W/mL or greater.
3 — Materials that in themselves are capable of detonation or explosive decomposition or explosive reaction, but that require a strong initiating source or that must be heated under confinement before initiation.	• Materials that have an instantaneous power density (product of heat of reaction and reaction rate) at 250°C (482°F) at or above 100 W/mL and below 1000 W/mL. • Materials that are sensitive to thermal or mechanical shock at elevated temperatures and pressures.
2 — Materials that readily undergo violent chemical change at elevated temperatures and pressures.	• Materials that have an instantaneous power density (product of heat of reaction and reaction rate) at 250°C (482°F) at or above 10 W/mL and below 100 W/mL.
1 — Materials that in themselves are normally stable, but that can become unstable at elevated temperatures and pressures.	• Materials that have an instantaneous power density (product of heat of reaction and reaction rate) at 250°C (482°F) at or above 0.01 W/mL and below 10 W/mL.
0 — Materials that in themselves are normally stable, even under fire conditions.	• Materials that have an instantaneous power density (product of heat of reaction and reaction rate) at 250°C (482°F) below 0.01 W/mL. • Materials that do not exhibit an exotherm at temperatures less than or equal to 500°C (932°F) when tested by differential scanning calorimetry.

- **Special Hazard**- Refer to the SDS for the NFPA symbol for each hazard category. Some of the most common symbols are the ₩ (water reactive), **OX** (oxidizer) and **SA** (simple asphyxiant gas) symbols**.**