

## Safe Hand Soldering Work Practices

This guidance document is designed as a reference for safe soldering work practices at Purdue University Fort Wayne (PFW). Most soldering done at PFW is electronic hand soldering, using a soldering iron or gun and this operation is the focus of these guidelines. Soldering can also be done using a torch, but this will not be covered in this document. Use of best work practices including good ventilation provides adequate protection while hand soldering, however, it is important to request an assessment of hazards if there are any health or safety concerns.

Soldering is a group of joining processes that produce a joining of materials by using a filler metal (solder) with a temperature not exceeding 840°F (450°C). The metals being joined are heated to the soldering temperature but they do not become liquid; only the solder does. In addition to the solder and the base metals, soldering operations may involve the use of fluxes, coatings, and cleaning agents. Electronic soldering can lead to potential exposures via airborne, skin contact, and hand to mouth routes, from both the products used and the by-products of the soldering process. There are also physical hazards from heat. To ensure employee awareness of the hazards and safe work practices when soldering, this summary, has been prepared for use by workers and supervisors of soldering operations.

### Potential Hazards

**Fumes:** While “fumes” refers to volatilized solid material that has then condensed in the air, the term is used here to include other airborne products including gases and vapors that may be produced in soldering. Because soldering fume generally rises vertically, it is easy for them to enter the breathing zone of the operator unless ventilation is used. Fans or local exhaust ventilation should be used to minimize exposure to soldering fume. Those who are soldering should be aware of potential respiratory effects of exposure. These include watery and prickly eyes, runny or blocked nose, sore throat, coughing, wheezing, and breathing difficulties. Symptoms may start soon after exposure, or be delayed for several hours, so their link to the soldering activity may not be obvious. Any concern should be addressed to the supervisor/instructor.

There are three potential sources of fumes during soldering:

1. **Fumes from heated solder constituents:** Solder composition may vary but, lead and tin are primary constituents of many solders used in electronic soldering. Other metals that can be found in solders include cadmium, silver, copper, nickel, zinc, arsenic, beryllium, antimony, indium, and bismuth.
2. **Fumes and decomposition products from heating of oil, paints, or coatings present on the surfaces heated during soldering:** Materials present on surfaces being soldered, (e.g. paint or solvent residues) can produce toxic fumes, gases, and vapors during the soldering process. This may occur even when the coating is on the back of an object being soldered, not directly on the soldered surface. Oils, paints, and coatings should be removed from surfaces to be heated during soldering, to prevent volatilization of these products. Teflon materials and coatings may evolve toxic fumes when heated above 625°F (450°C). Work with Teflon materials should always be done with local exhaust ventilation systems.

3. **Fumes from fluxes:** Flux allows solder to flow more smoothly. Soldering may involve the use of flux paste or liquid, or the solder itself may have a flux core. When this flux is heated it may be volatilized to a gaseous state. Information of three types of fluxes follows.
  - a. **Rosin Fluxes-** When heated, rosin-based solder fluxes form fumes containing a variety of particulates and gas components. Exposure to these fumes can cause irritation, sensitization, or other respiratory effects. Sensitization refers to an immune response where an individual has little or no initial response to an agent but, following exposure, experiences intense reactions even at low exposure levels. Exposure to rosin pyrolysis products should be kept as low as possible, regardless of the presence of any symptoms.
  - b. **Organic Water Soluble Fluxes-** These fluxes contain organic acids (e.g. citric, lactic, benzoic, and glutamic), which may produce mild irritation to the respiratory tract.
  - c. **Inorganic Water Soluble Fluxes-** These fluxes are corrosive and contain zinc chloride, stannous chloride, hydrochloric acid and phosphoric acid dissolved in water. These can cause irritation of the nose, throat, and respiratory tract.

**Direct Contact:** Depending on the type of materials being used, contact with solder flux, flux residues, and fumes themselves can cause dermatitis, mild allergic irritation of the skin, or severe burns to the skin or eyes. Wearing long-sleeved clothing, while not required, can prevent skin contact. Good work practices should be used to prevent contact of soldering materials with the eyes.

**Indirect Contact/Ingestion:** Care should be taken to prevent exposure to soldering materials via the hand to mouth route. Hands should be washed with soap and water when taking breaks and at the completion of soldering tasks. Work areas should be kept clean and wiped with a damp paper towel. Food is not permitted in soldering work areas.

**Burns and fire:** Burns can result from touching the hot objects associated with soldering like the soldering iron or surfaces heated by the iron. Good work practices should be used to prevent contact with hot objects. While the risk of fire is minimal, care should be taken and unnecessary combustible items should be removed from soldering work areas.

### **RECOMMENDED LEAD WORK PRACTICES**

Based on standard soldering iron temperatures of 620°F-700°F, it is unlikely that lead fume will be generated during electronic soldering unless the solder is heated to extreme temperatures. Even when there is no exposure to lead fumes, there is still a need for safe work practices to prevent exposure to lead from other routes.

### **Hazard Assessment and Controls**

Since there can be several products in use during the soldering process, each operation should be evaluated for hazards. Any change in process or materials should be evaluated for potential hazards. Soldering work should be done in well-ventilated areas with fans positioned to pull air away from the operator's breathing zone when possible. In some cases, local exhaust ventilation may be necessary. Any signs or symptoms of respiratory or dermatological symptoms should be immediately reported to your supervisor/instructor. Hands should be washed with soap and water when taking breaks and at the completion of soldering tasks. Work areas should be kept clean and wiped with a damp paper towel to minimize the presence of lead dust in the work area. Food is not permitted in soldering work areas.