Heating Devices

Many labs and shops use at least one type of heating device, such as ovens, hot plates, heating mantles and tapes, and oil baths. Heating materials, especially chemicals, present a number of fire and safety hazards.

GENERAL PRECAUTIONS

- Steam-heated devices are preferred whenever temperatures of 100 C or less are required.
- Ensure the supply of water for steam generation is sufficient prior to leaving a device unattended, and never leave it for an extended period of time.
- For electric heating devices, the heating element in the device must be enclosed with no exposed wiring. If a heating device becomes frayed or damaged and wires are visible, repair or discard it.
- Use a fail-safe device to control the temperature to prevent a fire or explosion if the temperature of the reaction increases too quickly.
- Always wear appropriate PPE or use hot pads when handling heated materials.

ELECTRICALLY HEATED OVENS

Specifically designed ovens, with heating elements and temperature controls on the outside, can be used to remove water or other solvents from chemical samples or to dry glassware.

- Ovens may require an exhaust system to prevent substances from escaping the oven or developing an explosive atmosphere in the oven. If the oven is not connected to an exhaust system, do not use with toxic chemicals.
- Due to the risk of explosion, do not dry glassware containing organic compounds in an unvented oven.
- After rinsing with organic solvents, rinse glassware with distilled water before placing in an oven.
- Use bimetallic strip thermometers rather than mercury thermometers. If a mercury thermometer breaks in the oven, turn off the heat and keep oven closed until completely cool before attempting cleanup. Contact EH&S for assistance and refer to the Mercury Spills Focus Sheet.

OIL, SALT AND SAND BATHS

Electrically heated baths should be used for heating over 100 C. When heating to 100 - 200 C a saturated paraffin oil can be used; use silicon oil or molten salt baths for heating up to 300 C.

- Do not spill water or volatile substances into the bath; it can splatter hot material and cause serious injuries.
- Do not generate smoke.
- Make sure oils do not overheat and burst into flames. Monitor bath temperature and keep below the flash point of the oil being used.
- Avoid leaving baths unattended; fit with thermal sensing devices to turn of electrical power if the bath overheats.
- Mix well to ensure there are no “hot spots.”
- Use a sturdy, noncombustible container and secondary containment in case of spills.
- Place directly on a stable horizontal surface or use a laboratory jack or similar device.
- Wear heat-resistant gloves when handling.
- Ensure bath materials, especially sand, are completely cooled before discarding.

HOT PLATES

- Only use newer hot plates in good working order, especially when working with flammable liquids.
- Older style hot plates can pose an electrical spark hazard from the on/off switch or the thermostat used to regulate the temperature.
- Corroded bimetallic thermostats can fuse shut and not allow the plate to be turned off. Check for corrosion before using.
- Never store volatile flammable materials near a hot plate.

HEATING MANTLES

Heating mantles enclose a heating element in a series of layers of fiberglass cloth. These are commonly used for heating round-bottom flasks and reaction vessels.

- To prevent shock hazards, ensure the fiberglass coating is not worn or broken and do not spill water or other chemicals into the mantle.
- Do not plug directly into an electrical outlet; use a variable autotransformer to control the voltage.
- Do not exceed the voltage recommended by the manufacturer; higher voltages will cause the mantle to overheat, melt the fiberglass insulation and expose the bare heating element.
- If the mantle has an outer metal case to prevent damage to the fiberglass, ground the case to protect against shock if the interior element shorts against the metal case.
- Some older equipment may have asbestos insulation. Contact EH&S to replace the insulation and dispose of the asbestos.

HEAT GUNS

Heat guns use motor-driven fans to blow air over an electrically heated filament. They are often used to dry glassware or to heat the upper part of a distillation apparatus when using materials with a high boiling point.

- Use a heat gun designed for research; it will have lower air speeds and produce higher temperatures than consumer hair dryers.
- Never use near volatile chemicals; the power switches and fan motors may produce sparks.
- Do not use an extension cord to power a heat gun due to high current draw.
- Do not obstruct or cover the air inlet grills.
- Always switch the tool off before putting it down on any surface and allow to cool before storing it.
- Do not direct the air flow toward yourself or look down the nozzle while the gun is turned on.

HOT AIR BATHS

Electrically heated air baths can be used to heat small or irregularly shaped vessels. Air baths have low heat capacity, and may need to be heated to 100 C or more above the target temperature.

- Nitrogen is preferred for reactions involving flammable materials.
- When using glass, wrap the vessel with heat resistant tape to contain the shards if it is broken.

TUBE FURNACES

Tube furnaces are often used for high-temperature reactions under pressure.

- Ensure the heating element is fully enclosed.
- When using glass, wrap the vessel with heat resistant tape to contain the shards if it is broken.
- Use care when selecting glassware, tubes and joints to ensure they can withstand the pressures involved.
- Follow safety practices for electrical safety and pressure when using vacuum systems.

MICROWAVE OVENS

Microwave heating presents several potential hazards not commonly encountered with other heating methods such as extremely rapid temperature and pressure rise, liquid superheating, arcing and microwave leakage. Microwaves designed for research have built-in safety features and operating procedures to mitigate these hazards.

- Only use microwave ovens designed for research use; domestic microwave ovens are not appropriate.
- Do not place metal inside the oven.
- Sealed containers can build up pressure resulting in container rupture.
- Never operate the oven with the door open to avoid exposure to microwaves.
- Do not use extension cords and make sure the oven is electrically grounded.

Please contact EH&S for more information about using heating devices in research.