

## Hot Plates

Hot plates with hermitically sealed components and low or adjustable maximum temperatures are ideal. Recommend using solvent purification systems instead of stills. Only use for stirring if you are also heating, otherwise use a stir plate. Water baths and heating mantles are other heating options.

### Hazards

Fires have occurred in the past because of flammable materials being heated past their flash point or being left too close to hot plates. Explosions have occurred from over-heating chemical reactions, causing a rise in pressure, inadvertent heating, or a temperature-induced run-away reaction.



Figure 1—Corning Model PC-351 on a lab jack

### Discard Faulty Models

Hot plate heating element failures happen frequently in older models (prior to 1984). These hot plates utilize a solid state switching component (triac) to turn off power to the heating element. If shorted the triacs fail in the “on” position), and this failure mode could result in a **hot plate not turning off although it appears to be off**. A common causing of shorting out is liquids contacting electronics in plates without a hermetic seal. Replace damaged plates. **Models known to have problems are the Corning Models PC-351 (Figure 1), PC-35, PC400D, PC 200, PC220, PC320, PC420 and Fisher IsoTemp and Thermolyne Cimarec Model SP46925**

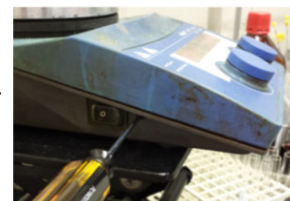


Figure 2— Adjusting STL

### Set up for safety

- **Determine the maximum temperature** your hot plate can reach. If it is well above what you need get a new plate or do not leave unattended. Some models have the ability to adjust the maximum temperature. This is often called the **Safe Temperature Limit (STL)** . The default STL setting is often > 400 C°. **Set your STL for at least 25 C° below the flash point of your materials**. A screwdriver is often needed for the adjustment. (Figure 2)
- Check there is **extra room in your containers to allow for expansion**. Submerge vessels in oil baths before heating to check there is sufficient room to prevent spilling oil on a hot surface. Oil baths should be less than half full. Reminder- Flasks in a closed system ALWAYS need a **pressure relief** mechanism. A vent via a needle in the septa is the minimum relief. Hook air sensitive reactions up to a nitrogen bubbler to regulate pressure.
- Place hot plates on **jacks** (Figure 1) with the container which needs to be heated clamped in place to ensure the heat source can be quickly removed , without trying to grab the hot materials.
- **Thermometers need to be calibrated** correctly or the reaction may be conducted at temperatures higher or lower than expected. Check **thermometers are secured in place**. Recommend using a **boss head clamp** instead of 3-prong clamp. (Figure 3) A thermometer that is not secured may fall or be knocked out over the course of the reaction, resulting in the hot plate continuing to heat past the set temperature.
- Set up in the **fume hood** to contain vapors and have the sash provide protection from any incidents.



Figure 3 Boss head clamp on right

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### Watch the stir bar or thermometer after any adjustments to verify the desired effect is achieved

- **Watch a separate thermometer and not a temperature display on the hotplate.** These digital readouts display a temperature, but are known to be very inaccurate. Only a calibrated thermometer can give you a true reading of the temperature.
- **Stir and heat knobs can look very similar.** Someone intending to turn the stirrer up may inadvertently turn the heat up instead.
- The **direction to turn knobs off is not the same for all hot plates.** For example, Brand A may turn to the left to turn off, while Brand B turns to the right. Someone used to working with Brand A may accidentally turn the temperature up instead of off when working with Brand B.
- The temperature **knob may turn “through” off to high.** Someone who thought they had turned a hot plate off may have accidentally turned it to high.

### Only leave unattended if it can “fail-safe”

- 1st verify **constant temp for 1 hr.** Then check reaction is still **has sufficient materials for 1.5 times the amount of time you expect to be away.** Do not leave unattended heat for more than 20 hrs.
- Clear the area around the hotplate so if something does go wrong the incident cannot spread. Do not leave ignitable materials such as flammable waste and squirt bottles, cardboard sample trays and any papers or wipes.
- Secure cords out of the way so they won’t be caught in cabinet doors or bumped by other working nearby
- **Post the intended temperature and your contact information**
- Empower lab members to monitor all heating elements and adjust the temp if the contact cannot be reached.

### Unplug hot plates so they cannot turn on when not in use

Always unplug hot plates when not in use. If not unplugging set the STL to zero as a 2nd “off” switch.

### Incorrect temperature common

Fires caused by incorrect temperatures on hot plates are reported by Universities several times a year. Lawrence Berkeley National Labs, Oak Ridge National Labs and others have issued safety alerts. Photo at right is from one of the UMN incidents.



Figure 3 UMN hot plate incident hot oil sprayed all over fume hood.