

3.14. Glass Apparatus and Plasticware Assembly

Borosilicate glassware is recommended for all laboratory glassware except for special experiments that use ultra violet (UV) or other light sources. The only soft glass provided in the laboratory should be reagent bottles, measuring equipment, stirring rods, and tubing.

Any glass equipment to be evacuated, such as suction flasks, must be specially designed with heavy walls. Dewar flasks and large vacuum vessels should be taped or otherwise screened or contained in a metal jacket to prevent flying glass in the case of an implosion. Household Thermos bottles have thin walls and are not acceptable substitutes for laboratory Dewar flasks.

3.14.1. Preparation of Glass Tubing and Stoppers

To cut glass tubing:

If the tubing does not readily pull apart, the nick probably is too shallow or rounded. Make a fresh sharp file scratch in the same place and repeat the operation.

All glass tubing and rods, including stirring rods, should be fire polished before use. Unpolished cut glass has a razor-like edge, which not only can lacerate the skin, but will also cut into a stopper or rubber hose, making it difficult to insert the glass properly. After polishing or bending glass, allow ample time for it to cool before grasping it.

To drill a stopper:

- Use only a sharp borer one size smaller than that which will just slip over the glass tube.
- Lubricate rubber stoppers with water or glycerol.
- Bore the hole by slicing through the stopper, twisting with moderate forward pressure, grasping the stopper only with the fingers, and keeping the hand away from the back of the stopper.
- Keep the index finger of the drilling hand against the barrel of the borer and close to the stopper to stop the borer when it breaks through.
- It is preferable to drill only part way through and then finish by drilling from the opposite side. Discard a stopper if a hole is irregular or does not fit the inserted tube snugly, if it is cracked, or if it leaks.
- Corks should have been previously softened by rolling and kneading. Rubber or cork stoppers should fit into a joint so that one-third to one-half of the stopper is inserted.

When available, glassware with ground joints is preferable. Glass stoppers and joints should be clean, dry and lightly lubricated.

3.14.2. Insertion of Glass Tubes or Rods into Stoppers or Flexible Tubing

To insert glass tubes into stoppers or flexible tubing:

- Make sure the diameter of the tube or rod is compatible with the diameter of the hose or stopper.
- If not already fire polished, fire polish the end of the glass to be inserted; let it cool.
- Lubricate the glass. Water may be sufficient but glycerol is a better lubricant.
- Wear heavy gloves or wrap layers of cloth around the glass and protect the other hand by holding the hose or stopper with a layered cloth pad.
- Hold the glass rod or tube near the end to be inserted, not more than 5 cm (2 in) from the end.
- Insert the glass with a slight twisting motion, avoiding too much pressure and

torque.

- If necessary, use a cork borer as a sleeve for insertion of glass tubes.
- Substitute a piece of metal tubing for glass tubing if possible.
- Remove stuck tubes by slitting the hose or stopper with a sharp knife.

3.14.3. Apparatus Assembly

The following recommendations will help make apparatus assembly easier, safer, and avoid equipment failure during use:

- Keep your workspace free of clutter.
- Set up clean, dry apparatus, firmly clamped and well back from the edge of the lab bench or hood with due regard to the proximity of reagent bottles to burners and to other workers and their equipment. Choose sizes that can properly accommodate the operation to be performed, allowing 20% free space at the minimum.
- Use only equipment that is free from flaws such as cracks, chips, frayed wire, and obvious defects. Glassware can be examined in polarized light for stains. Even the smallest chip or crack renders glassware unusable; chipped or cracked ware should be repaired or discarded.
- A properly placed pan under a reaction vessel or container will act as a secondary containment to confine spilled liquids in the event of glass breakage.
- Addition and separatory funnels should be properly supported and oriented so that the stopcock will not be loosened by gravity. A retainer ring should be used on the stopcock plug. Glass stopcocks should be freshly lubricated. Teflon stopcocks should not need lubrication.
- Condensers must be properly supported with securely positioned clamps. The attached water hoses must be secured to the glass fittings with wire or appropriate hose clamps.
- Stirrer motors and vessels should be secured to maintain proper alignment. Magnetic stirring is preferable.
- Apparatus attached to a ring stand should be positioned so that the center of gravity of the system is over the base and not to one side. There should be adequate provision for removing burners or baths quickly. Standards bearing heavy loads should be firmly attached to the bench top. Equipment racks should be securely anchored at the top and bottom.

3.14.4. Operational Precautions

The following precautions should be considered prior to assembly and during operation of the apparatus.

- When working with flammable gases or liquids, do not allow burners or other ignition sources in the vicinity. Use appropriate traps, condensers, or scrubbers to minimize release of vapors to the environment. If a hot plate is used, ensure that the temperatures of all exposed surfaces are less than the autoignition temperature of the chemicals likely to be released and that the temperature control device and the stirring or ventilating motors do not spark.
- Only non-sparking motors or pneumatic motors should be used in chemical laboratories.
- Whenever possible, use controlled electrical heaters or steam in place of gas burners.
- Inspect power cords for chemical or physical damage by unplugging the equipment then bending the cord to look for cracks in the insulation. Be sure to check carefully

and close to the point where the power cord enters the housing.

- Apparatus, equipment, or chemical bottles must not be placed on the floor.
- Never heat a closed container. Provide a vent as part of the apparatus for chemicals that are to be heated. Prior to heating a liquid, place boiling stones in unstirred vessels (except test tubes). If a burner is to be used, distribute the heat with a ceramic-centered wire gauze. Use a thermometer with its bulb in the boiling liquid if there is the possibility of a dangerous exothermic decomposition as in some distillations. This will provide a warning and may allow time to remove the heat and apply external cooling. The setup should allow for fast removal of heat.
- Whenever hazardous gases or fumes are likely to be evolved, an appropriate gas trap should be used and the operation confined to a fume hood.
- Fume hoods are recommended for all operations in which toxic or flammable vapors are evolved as in many distillations. Most vapors have a density greater than that of air and will settle on a bench top or floor where they may diffuse to a distant burner or ignition source. These vapors will roll out over astonishingly long distances and, if flammable, an ignition can cause a flash back to the source of the vapors. Once diluted with significant amounts of air, vapors move in air essentially as air itself.
- Use a hood when working with a system under reduced pressure (which may implode). Close the sash to provide a shield. If a hood is not available, use a standing shield. Shields that can be knocked over must be stabilized with weights or fasteners. Standing shields are preferably secured near the top. Proper eye and face protection must be worn even when using the shields or hood.