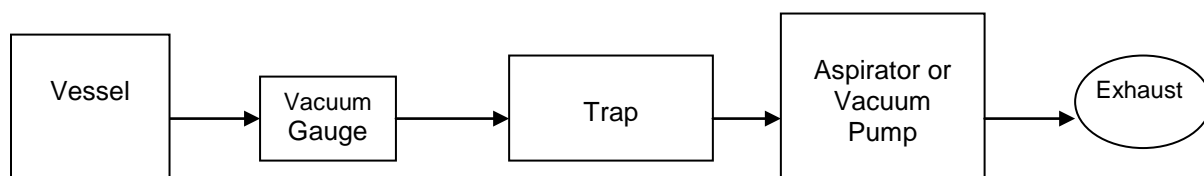


## VACUUM SYSTEM SAFETY

A vacuum system is a common piece of equipment found and used in most labs. The main components of a vacuum system include:

- Vessel or System to Which Vacuum Will be Applied
- Vacuum Gauge
- Trap
- Aspirator or Vacuum Pump
- Exhaust System



Vacuum systems require special work procedures to reduce the likelihood of the implosion of evacuated glassware that could eject flying glass and chemical. Vacuum work involving hazardous and flammable liquids must be conducted in a fume hood or glove box.

### Vessels

- Glass Vessel
  - Used in low vacuum operations
  - All work should be done behind adequate shielding
  - Check for flaws such as star cracks, scratches, and etchings each time it is used
  - Use only round bottomed or thick walled (e.g. Pyrex) evacuated reaction vessels specifically designed for operations at reduced pressure
  - Avoid using repaired glassware
  - Never evacuate thin walled, Erlenmeyer, or round-bottomed flasks larger than 1L
- Dewar Flasks
  - Used in high vacuum operations
  - Should be shielded

### Vacuum Gauges

The type of vacuum gauge to be used is determined by the pressure range to be measured. The vacuum gauge should be placed in the system close to the test vessel between the trap and vessel.

Continued on next page...

## Cold Traps

A cold trap should be fitted on the suction line when working with volatile substances in a vacuum system. This will minimize the amount of material that enters the discharge water or pump oil. The recommended cold trap coolant is a mixture of dry ice and isopropyl alcohol. Acetone or ether is not recommended, since they are volatile and flammable. Liquid nitrogen, a cryogenic, should not be used as a coolant since liquid oxygen can concentrate in the trap, inviting explosion. If a cryogenic must be used as a coolant:

- Consult with your laboratory supervisor
- Refer to Appendix H "Vacuum Transfers" of the CCE Division Chemical Safety Manual (p.85) <http://www.cce.caltech.edu/content/chemical-safety>

Additional filters may be needed to prevent release of particle matter.

## Aspirator or Vacuum Pump System

Before any operation is performed an appropriate vacuum system should be selected.

Type of Vacuum System	Distillation/ Concentration
Mechanical Vacuum Pumps or Facility Vacuum System	<ul style="list-style-type: none"><li>• Only for less-volatile substances</li><li>• Removal of final traces of solvents</li><li>• With suitable tap</li></ul>
Water Aspirator	<ul style="list-style-type: none"><li>• With suitable trap</li></ul>
Steam Aspirator	<ul style="list-style-type: none"><li>• With suitable trap</li></ul>

## Exhaust Systems

- Output of each pump must be vented to a fume hood or exhaust system. This is essential when the pump is being used to evacuate a system containing a volatile toxic or corrosive substance.

## Vacuum Work Procedures

- Wear personal protective equipment including explosion shield and face shield
- Work in a fume hood
- Select appropriate vacuum system:
  - Water aspirator if using solvents or corrosive gases
  - Install a solvent collection device and a trap with a check valve between the water aspirator and the apparatus to prevent water from being drawn back into the apparatus

When using a mechanical vacuum pump:

- Always use a cold trap to prevent liquids from being drawn into the pump
- Vent to an fume hood or exhaust system to the outside of the building
- Belt driven mechanical pumps with exposed belts must have protective guards
- Check the oil levels and change the oil routinely
- If solvents or corrosive substances are inadvertently drawn into the pump, the contaminated oil should be immediately changed and disposed of as [hazardous waste](#)
- Place a pan under the pump to catch oil drips