_____ _____ – Identify key hazards and precautions to implement

- Handling and use of glass vessels – Learn how to prevent injury from flying glass + chemicals
- Use of vacuum systems –

Safe use of h

- Hazards and Mandatory control measures

- Estimate the maximum internal pressure of your reaction by calculation and ensure the glass vessel can withstand the pressure of the intended operation. See vessel examples in Figures 1-3. If you are unsure of the pressure rating for your glassware, consult the SFU Glass shop.
- Consult the SFU Glass shop about having your glass pressure vessels made in house.
- Consider using vessels with a safety coating (e.g., epoxy).
- Carefully check glass vessels for star cracks, scratches or etching marks before each use. Cracks can increase the likelihood of breakage or may allow chemicals to leak into the vessel. Sometimes the washing of the glassware, especially prolonged time spent in base baths, can cause microfractures on the surface of the glass. Contact the SFU Glass shop for assistance.
- Carry out pressure reactions in a fume hood, labelled with signs to indicate the contents of the reaction vessel and the explosion risk.
- Use a pressure gauge to monitor reaction pressure.
- It is recommended to use an aluminum block or beads as source of heat for pressure vessels because an explosion in a liquid heating bath would scatter hot liquid around the area.
- Wrap the vessel with tape (e.g., vinyl tape or electrical tape) and shield with a metal screen. Alternatively, wrap with tape and surround the vessel with multiple layers of loose cloth, then clamp behind a safety shield.
- Seal glass centrifuge tubes with rubber stoppers clamped in place.
- Glass tubes with high-pressure sealers should be no more than 3/4 full.
- Sealed bottles and tubes of flammable materials should be wrapped in cloth, placed behind a safety shield,

Use of vacuum systems

Various chemical manipulations require the use of a vacuum system, which can be a simple vacuum line or more complex Schlenk line (vacuum manifold). Generally, vacuum is achieved by water aspirator or mechanical pump. Adhere to the following best practices:

- Carry out vacuum procedures inside a fume hood and use an explosion shield.
- Schlenk line should be installed in a fume hood. First time users of the Schlenk line should practice without any hazardous chemicals or difficult manipulations. Refer to the Schlenk Line Survival Guide and arrange for hands on training by an experienced laboratory member.
- Do not allow water, solvents and corrosive gases to be drawn into vacuum systems. Protect pumps with cold traps and vent their exhaust into an exhaust hood. See Vacuum trapping.
- Assemble vacuum apparatus in a manner that avoids strain, particularly to the neck of the flask.
- Avoid putting pressure on a vacuum line to prevent stopcocks from popping out or glass apparatus from exploding.
- Place vacuum apparatus in such a way that the possibility of being accidentally hit is minimized.
- Schlenk lines should be cleaned once or twice a year, or whenever they get contaminated. Avoid soaking Schlenk lines with double oblique stopcocks in a base bath since the corrosive solution can slowly etch the ground glass joints and compromise the seal. For tips on cleaning, see the Schlenk Line Survival Guide

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Mechanical pump safety

- **Fire hazard** - Avoid placing vacuum pumps inside a closed cabinet to avoid overheating. Never run vacuum pumps near flammable and temperature sensitive chemicals.
- Avoid using flexible tubing to vent vacuum pumps. Check the exhaust line regularly for the presence of oil to ensure obstruction does not occur during operation.
- Do not use a vacuum pump if the oil has become contaminated with residual water, hazardous chemicals and/or flammable solvents, it may result in pump system damage. The oil needs to be removed and disposed as hazardous waste.
- **Slipping hazard** - Use secondary containment, one that can withstand the weight of the pump (e.g. a metal tray), to contain any oil leaks. Clean any spills promptly.

chemicals and

- If needed, contact the manufacturer about alternatives to glass vials, for example, silicon carbide, which is strong and chemically resistant. Note, however, that silicon carbide is not microwave transparent like glass, so the reaction will be under thermal conditions.
- Be aware of the potential kinetics of your reaction and stability of your reagents at high temperatures.
- Avoid any synthesis that poses high risk under conventional heating conditions, such as those involving compounds with azide or nitro groups.
- Ensure adequate stirring to reduce the potential for localized superheating.
- Ensure to monitor both pressure and temperature of your reaction.

High-pressure operations (e.g., steel reactor vessels, compressed gas systems)

- High-pressure operations must be performed only in approved equipment which meets requirements such as being appropriately selected for the operation, properly labeled and installed, and protected by pressure-relief and necessary control devices. Equipment requires hydrostatic testing before initial service and re-testing every five or ten years thereafter; after significant repair or modification; and if the vessel experiences overpressure or overtemperature.
- Contact