29 April 2004 **The use of vacuum lines**

The type of vacuum line currently in use in the undergraduate inorganic and organic laboratories is of a design typically encountered in organometallic research groups. It consists of a double manifold--one for the vacuum and one for the nitrogen gas. The two are connected to the rubber hose outlets by three-way taps. The vacuum is created by a mechanical pump and a liquid nitrogen "muck trap" protects this pump from the main part of the line. This trap collects most gases and liquids evaporated from your apparatus in order to prevent the organic or corrosive compounds from destroying the machinery. Liquid nitrogen, bp -196°, is used to cool the gases passing into the trap, but unfortunately, oxygen will also condense at this temperature. The liquefaction of oxygen must be avoided at all costs! Consequently, a few rules must be applied to the use of a vacuum line:

1) Never put an open piece of glassware into liquid nitrogen, e.g., a test tube, beaker, or muck trap open to the air. Reason: air contains oxygen and this will liquefy over a period of time.
2) Never use a vacuum line without cooling the muck trap in liquid nitrogen. Reason: solvents entering the oil-filled pump will lower the viscosity and reduce lubrication. There might also be a fire or toxicity hazard as the oil and solvent get hot.
3) Always watch the exit bubbler when letting nitrogen into a previously evacuated system. This will tell you if air is being drawn back into the system because the supply of nitrogen is not meeting the demand.
4) Grease all ground glass joints properly and clean with dichloromethane before regular washing. Do this each time you use a piece of apparatus to eliminate leaks and to keep the joints free from solid particles.

STEPS IN OPERATING A VACUUM LINE

Turning On:

1) Empty the muck trap into an organic waste disposal can. If in doubt, use the halogenated waste.
2) Clean and grease the trap joint. Use a Keck clip to fasten it.
3) CLOSE THE AIR LEAK. Leaving it open will allow oxygen to condense.
4) Put an empty dewar around muck trap. This allows you to fill it afterwards without spilling nitrogen over your hands.
5) Pour liquid nitrogen carefully into the dewar.
6) Within about 20 seconds of filling the dewar, turn the mechanical pump on.
7) Open the tap to the main part of the line.
8) Turn on the nitrogen gas supply gently.

Turning Off:

1) Close tap to main part of line.
2) Take liquid nitrogen dewar away from muck trap.
3) Turn off mechanical pump.
4) Open air leak.
5) Return dewar-support (but not dewar) to catch muck trap in case it falls.
6) Turn off nitrogen gas supply, or turn down to one bubble per 10 seconds if leaving an experiment under nitrogen.

If You Should Make a Mistake and Leave the Air Leak Open:

1) Close air leak.
2) Leave everything else untouched.
3) Leave the room, taking all occupants with you.
4) Call a laboratory instructor. Be careful, liquid oxygen is VERY DANGEROUS!