

# Norton Group Toepler Pump Operating Instructions

## Version 3.1

### I. Startup

- 1 Take the oil diffusion pump out of line. Valves **A** and **H** should be closed but connected to dynamic vacuum.
- 2 Attach a collection device at **P** and a sample at **C, E or F**. If you wish to evacuate it, open its stopcock to the Toepler pump.
- 3 Valves **C, E, F,** and **G** should be closed (if they don't have a sample flask attached).
- 4 Valves **B, D, I, J, L** and **O** should be open (valves **K, M** and **N** should be closed from previous use).
- 5 Slowly evacuate the whole system through **A** (watch the Hg in the pump base while evacuating: **do not evacuate too fast** or the Hg bumps dangerously). Carefully open valve **M** to fill the manometer and observe that a good vacuum is established in the system using the vacuum gauge on the high vacuum line (fill the manometer slowly to the arm reaching to valve **K** so that an air pocket ain't trapped in this arm). Close valve **I**.
- 6 If you want to measure the volume of a gas sample you need to know at least the volume of the neck of your collection vessel at **P**. If you are going to use just the volume of the neck to measure the volume of your gas sample you should close its stopcock now.
- 7 With the entire system under vacuum, and after checking that the knurled knob for the compressed air valve is closed (turned all the way clockwise), turn on the rough pump and compressed air to the control box.
- 8 Turn control box toggles to white: down, yellow: up, blue: down.
- 9 Carefully open **N** (as you do this keep an eye on the Hg in the pump: if there is accidentally air in the pump the Hg will rise/shoot towards G and get caught in the check valve). Close **L**.

### II. Pump Operation

#### *Manual Control*

- 1 Turn control box toggles to white: up, yellow: up, blue: down (Hg should rise at a rate controlled by the needle valve on the control solenoid. Turn it counterclockwise to open which increases the rate of Hg flow).
- 2 Allow Hg to rise to upper chamber of the pump, then flip white toggle down. Hg should then descend to the base of the lower chamber.

**!! to return the Hg to the base of the pump at any time, flip the white toggle down !!**

#### *Auto Pump Control*

- 3 The Hg in the upper chamber should be at a level below the photocell. It may be lowered by cycling the Hg manually through a couple of cycles.
- 4 With the white toggle down and the Hg in the base of the pump, flip the blue toggle up. Now begin auto-cycling by flipping the white toggle up.
- 5 Observe the operation of the pump.
  - a . The Hg should be pumped down when it reaches the photocell control. If it doesn't reach the photocell, adjust the needle valve on the comp. air so that the Hg will rise at a faster rate. If it goes past the photocell flip the white toggle down to return the Hg to the base. You may need to adjust the photocell so that it operates correctly.
  - b. The Hg must reach the base so that fresh sample is introduced with each cycle. If it is not reaching the base and pausing a few seconds before the next cycle, increase the setting of the cycle time knob (delay time: knob turned counterclockwise, MIN = 5 seconds, knob turned clockwise, MAX = 21 seconds).
  - c. To stop cycling at any time, flip the white toggle down. The Hg will return to the base of the pump.

### **III. Sample Collection**

With the entire system under vacuum (as after step II.2 or II.5c), Hg in the base of the pump, **N** open, and toggles white: down, yellow: up, blue: down:

- 1 Close **D** and **B** and attach a sample at **C**; open **C** and evacuate the neck leading to the flask using **A**, then close **A**.
- 2 Close **J**.

- 3 Open **C** slowly. Open **B** which allows sample to enter the pump. Close **B** when the Hg in the pump base rises to a “safe stopping point” (short of the ball valve in the arm leading from the pump base to **N**).
- 4 Flip the white toggle up (be ready to flip it back).
- 5 You are now cycling the pump manually to avoid accidental tripping of the photocell when Hg splashes as the first large amounts of gas enter the upper chamber. After a couple of cycles you can begin autocycling by flipping the blue toggle up. After many cycles flip the white toggle down.

#### IV. Sample Pressure Measurement

- 1 As at the end of step I.5, **O** and **M** should be open and **I** closed on the manometer. Close **M**.
- 2 Open **K** and allow manometer and upper chamber Hg to adjust.
- 3 Very carefully crack **M** open and allow Hg to rise to the calibration tape in the upper chamber. Slight adjustments may be made by adjusting the position of stopcock **K** (if the calibration mark is overshoot adjust the manometer as in steps VI.1-4).
- 4 Read the Hg height in the manometer column and subtract 81.0 from it. This is the pressure in torr present in the 7.546 mL volume of the upper chamber + the volume of collection apparatus attached at **P** into which the sample is collected at this point. If you wish to continue pumping you must first adjust the manometer as detailed in steps VI.1-4 below.

#### V. Transfer of Sample to Collection Apparatus

There are two methods to transfer a sample from the pump to a collection vessel: using the manometer's reservoir of Hg (which is limited by a sample pressure of less than ? torr) and using the Toepler pump reservoir.

*To use the manometer reservoir:*

This procedure is a continuation of IV and assumes that the pump is in the configuration as in step IV.4.

- 1 Close **M**.
- 2 Carefully open the valve of the collection vessel at **P**.
- 3 Open **K** and allow Hg to equilibrate.

- 4 Open **M** slowly allowing Hg to rise into the upper chamber until you reach a safe stopping point.
- 5 Close the stopcock or valve of the collection device above **P**. Return Hg to the manometer reservoir (VI.1-4).

*To use the Toepler pump reservoir:*

- 1 If you have just measured the sample pressure you will need to return the manometer Hg to the manometer base (VI.1-4).
- 2 Carefully open the valve of the collection vessel at **P**.
- 3 Using Manual Control (B.2-3) of the pump raise the Hg but establish control of the Hg with the knurled knob valve to the air supply. Using this knob raise the Hg to the desired height by increasing the air pressure.
- 4 After turning off the air and closing the valve to the collection vessel, close valve **N** and then the white toggle to the off position which will evacuate the line behind valve **N**.
- 5 Slowly open valve **N** to return the Hg to the base of the pump (if this is done somewhat slowly the Hg will drain smoothly to the base, if you drain the Hg *too fast* it can cause the ball valve to seat and require multiple raising and lowering repetitions to finally drain the Hg).

## **VI. Manometer Adjustment**

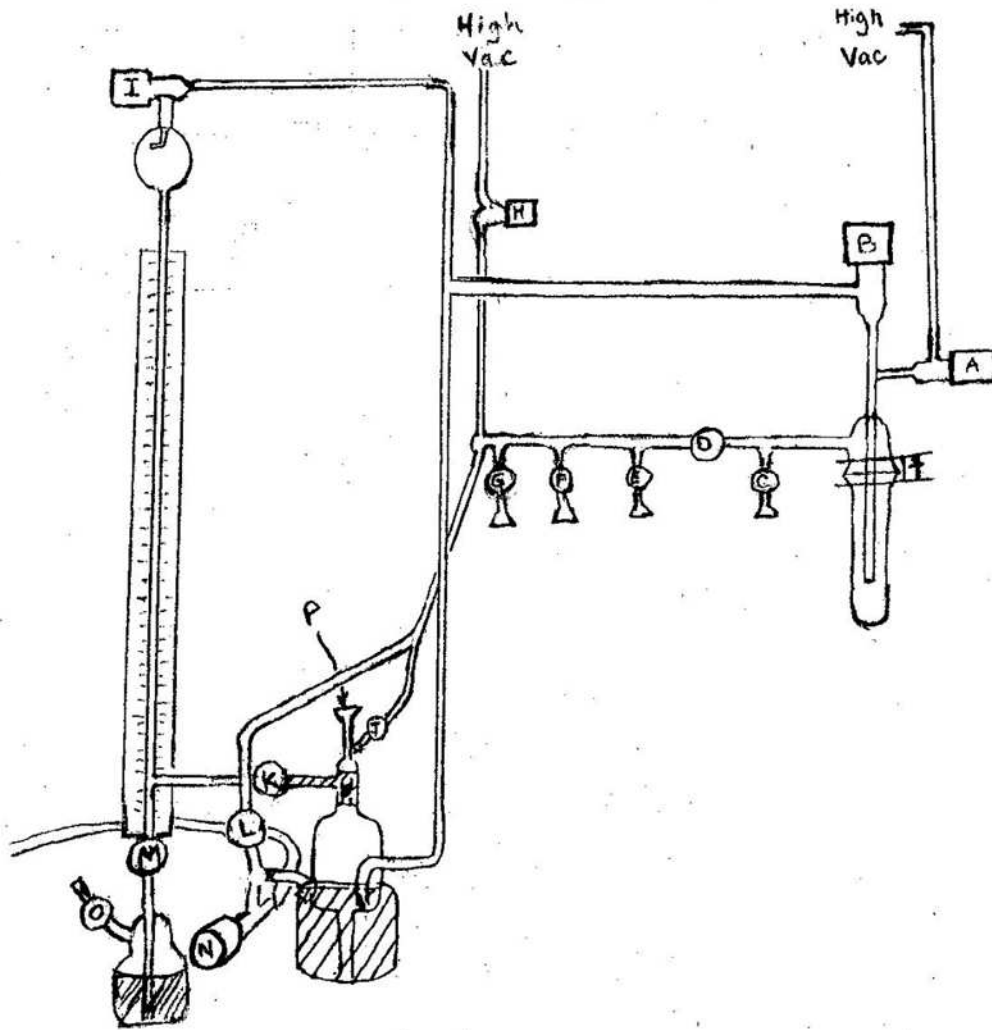
- 1 Evacuate the manometer reservoir using the vacuum available through stopcock **O**.
- 2 Open **M** to remove the desired amount of Hg.
- 3 Close **M** and **K** and then carefully open **O** to the atmosphere.
- 4 Carefully open **M** to return the manometer to dynamic air pressure.

Note: if you are going to continue pumping return to **II**.

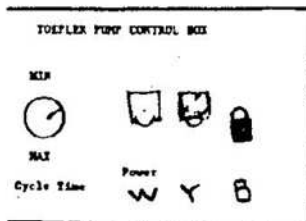
## **VII. Shutdown**

- 1 Open **B**, **D** and **I** and close **N**, then open **L** followed by a very careful opening of **J** (Hg in the pump base should not *bump* ).
- 2 Close manometer valve **M** before venting to the atmosphere.

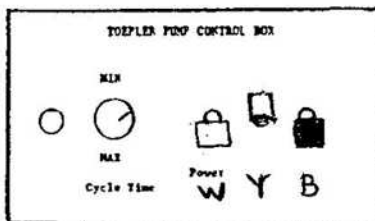
- 3 Carefully open **G** to vent the system. Remove the sample collection device completely, then open **N** to vent the rough pump and turn it off. Cover **P**.
- 4 Slowly open **M** allowing Hg to drain from manometer (drain to just above arm leading to **K**).



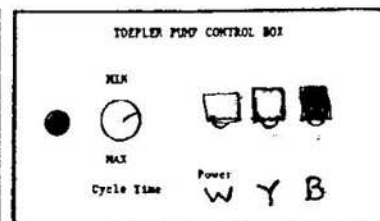
Toepler Pump Control Box Settings



A: Manual, Hg up



B: Manual, Hg down



C: Auto-control